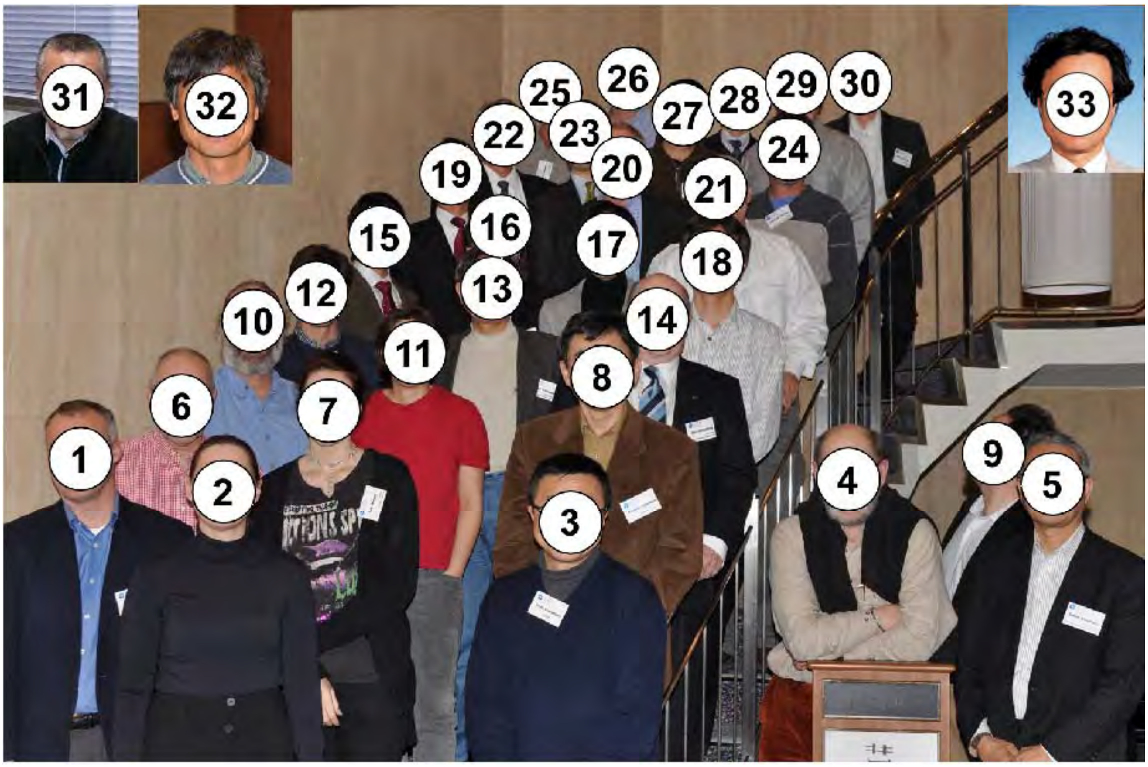
MINUTES
Tenth Meeting of the
Engineering Development Panel (EDP)
of the
Integrated Ocean Drilling Program (IODP)
January 13 – 15, 2010
Sendai, Japan

MEETING PARTICIPANTS



1. Greg MYERS, 2. Maria ASK, 3. Yoshi KAWAMURA, 4. John THOROGOOD, 5. Junzo KASAHARA, 6. Dan EVANS, 7. Sally MORGAN, 8. Kiyoshi SUYEHIRO, 9. Issa KAGAYA, 10. John TAUXE, 11. Mai-Linh DOAN, 12. Michael MALER, 13. Yoshiyasu WATANABE, 14. Jack RINGELBERG, 15. Toru IKEGAMI, 16. Hirokazu KARAZAWA, 17. Takashi NAKAGAWA, 18. Mitsua TAMURA, 19. Yoshio ISOZAKI, 20. Lothar WOHLGEMUTH, 21. Kevin GRIGAR, 22. INOOKA Hariku, 23. Yuichi SHINMOTO, 24. Gerald ITERRINO, 25. Leon HOLLOWAY, 26. Steve MIDGLEY, 27. Tang Haixiong, 28. Hiromi FUJIMOTO, 29. Mike STORMS, 30. Saneatsu SAITO, 31. Hiroshi ASANUMA, 32. Nori KYO, 33. Osam SANO.

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Executive Summary
IODP Engineering Development Panel
Tenth Meeting
January 13 - 15, 2010
Sendai, Japan

EDP Recommendations and
Consensus Statements

The EDP forwards the following consensus statements to SAS panels, IODP-MI, or other entities as appropriate.

EDP Consensus 1001-01: Approval of Agenda
The EDP approves the agenda for EDP Meeting #10.

Routing: IODP-MI
Priority: Medium

EDP Consensus 1001-02: Approval of EDP Meeting #9 Minutes
The EDP approves the minutes from EDP Meeting #9.

Routing: IODP-MI
Priority: High

EDP Consensus 1001-03: EDP Meeting #11
The EDP recommends that EDP Meeting #11 be held July 14-16, 2010 in Santa Fe, New Mexico. John Tauxe will be host of this meeting.

Routing: IODP-MI, STP, SPC
Priority: High

EDP Consensus 1001-04: EDP Meeting #12
The EDP recommends that EDP Meeting #12 be held in Grenoble, France. Proposed dates for EDP Meeting #12 are January 12-14, 2011. Mai-Linh Doan will be the host of the meeting.

Routing: IODP-MI, STP, SPC
Priority: Medium

EDP Consensus 1001-05: EDP STP Liaison
The EDP designates Yoshiyasu Watanabe as the EDP representative at the next STP meeting to be held March 17-19, 2010 in Sydney, Australia.

Routing: IODP-MI, STP
Priority: High

EDP Consensus 1001-06: EDP SPC Representative
The EDP designates Maria Ask as the EDP representative at the next SPC meeting to be held March 23-26, 2010 in Sydney, Australia.

Routing: IODP-MI, SPC
Priority: High

EDP Consensus 1001-07: EDP SSEP Liaison
The EDP designates Bill Ussler as the EDP representative at the next SSEP meeting to be held May 18-21, 2010 in Kochi, Japan.

Routing: IODP-MI, SSEP
Priority: High

EDP Action Item 1001-01: INVEST Implemental and Renewal Process
EDP recognizes the need for engineering considerations in the development of the new science plan. A working group of EDP meeting attendees (panel members, liaisons from the various SAS panels, and representatives of IOs) provided comments to be forwarded to interested parties in time for the upcoming IWG+ meeting (20-22 January 2010).

Routing: IODP-MI, SPC, IWG+, SPWC
Priority: High

EDP Consensus 1001-08: IODP-MI/EDP Communications
The EDP thanks the IODP-MI President for presenting the IODP-MI / EDP Communication Plan. EDP appreciates his support for continued engineering development in the current and future program, and the appointment of a new Operations Manager.

Routing: IODP-MI, SPC
Priority: Medium

EDP Consensus 1001-09: IODP-MI FY2011 Engineering Development Plan
The EDP endorses the IODP-MI FY11 Engineering Development Plan.

Routing: IODP-MI, SPC
Priority: High

EDP Consensus 1001-10: IODP-MI Engineering Development Proposal Process
The EDP recognizes that the disbanding of the Engineering Task Force risks weakening the IODP-MI Engineering Development Proposal Process. This could adversely affect community and industry interest in submitting new ED proposals, as well as the quality of proposals submitted to EDP. EDP requests a decision from IODP-MI if the existing Engineering Development Proposal Process will continue to be promoted. The process also needs demobilization funding and increase in advertisement for ED proposals. There is urgency in our request to enable the annual call for proposals to be met (April 15).

Routing: IODP-MI, SPC

Priority: High
Background: The structure for IODP Engineering Development (ED) Proposal Process is available on the IODP-MI website (www.iodp.org/eng-dev). This structure include an informal and confidential review (deadline March 15), call for unsolicited annual call for ED proposals on April 15, a prescreening of ED proposals by the Engineering Task Force, a review and ranking of the ED proposals by EDP at the July meeting, and endorsement of the ED plan at the January EDP meeting.

EDP Consensus 1001-11: IODP-MI Engineering Development demobilization funding
The EDP proposes that IODP-MI provide demobilization funding beyond 2013 in order to allow the completion of current and proposed ED projects that must extend beyond that date.

Routing: IODP-MI, SPC, IWG+
Priority: High
Background: EDP Consensus 1001-10: IODP-MI Engineering Development Proposal Process

EDP Consensus 1001-12: Encouraging the Submission of Engineering Development Proposals
The EDP wishes to facilitate the submission of more ED proposals. To that end, we wish to encourage advertisement of and communication pertaining to the proposal process.

Routing: IODP-MI, SPC
Priority: High
Background: EDP Consensus 1001-10: IODP-MI Engineering Development Proposal Process

EDP Consensus 1001-13: Proposal 743-Full
The EDP draft review of Proposal 743-Full is forwarded to the EDP Chair who will forward the final review to IODP-MI.

Routing: IODP-MI, SSEP
Priority: High

EDP Consensus 1001-14: Proposal 758-Full
The EDP draft review of Proposal 758-Full is forwarded to the EDP Chair who will forward the final review to IODP-MI.

Routing: IODP-MI, SSEP
Priority: High

EDP Consensus 1001-15: Scoping Studies
The EDP endorses that the IODP-MI continues with the scoping studies *Ultra-Deep Drilling Scoping Study* and *Coring Scoping Study* as presented at the meeting.

Routing: IODP-MI
Priority: Medium

EDP Consensus 1001-16: Report from the planned two IODP-related conferences on Deep Drilling at the January 2011 EDP meeting.
The EDP requests that Greg Myers report from the two planned IODP-related conferences on deep drilling, tentatively to be organized during 2010. IODP-MI is requested to forward the published meeting reports, if available, from those meetings at January 2011 EDP meeting.

Routing: IODP-MI, IOs, SPC
Priority: High

EDP Consensus 1001-17: EDP Microbiology Contamination Report
The EDP responds to the STP Consensus Statements 0802-06: Detection and Control of Contamination Issues During Riser Drilling and 0908-10: EDP Liaison and Microbiology Contamination Issues. The EDP has considered the technical aspects of the issues, and is forwarding the report "*Understanding and controlling microbiological contamination by drilling fluids during scientific drilling*" to the STP. The report will be presented at the upcoming STP meeting in Sydney, Australia, 17-19 March 2010. The EDP will forward industry contacts to STP before the upcoming STP meeting. The EDP Microbiology Contamination working group will thereafter be dismantled.

Routing: STP, IODP-MI, IOs, SPC
Priority: High

EDP Consensus Item 1001-18: At-sea Engineering Testing Time Request for SCIMPI
The EDP reviewed a written proposal and presentation concerning allocation of at-sea engineering testing time to drill one 200-m deep borehole at ODP Site 1245. The EDP encourages the proponents to do as much preliminary testing as possible prior to sea-trial with the *JOIDES Resolution*. Presuming that the planned preliminary testing progress is satisfactory, the EDP endorses the plan to deploy the SCIMPI array at the chosen test site.

Routing: IODP-MI, STP
Priority: High
Background: The proponents have targeted the Hydrate Ridge as the test area because other ongoing programs in this area will enable frequent monitoring, and a potential future connection to online monitoring of SCIMPI. The proponents estimate that the on-site operation time is ~2 days, based on past drilling experience. USIO agrees with this time estimate. The EDP acknowledges that the time estimate may be influenced by external factors such as weather conditions. There will be land- and minimal sea-tests are to be conducted in May-June 2010.

EDP Action Item 1001-02: EDP Technology Roadmap development
EDP assigns a working group consisting of Bill Ussler, Hiroshi Asanuma, Maria Ask, Mai-Linh Doan, Leon Holloway, Toru Ikegami, and Tang Haixiong to revise version 3.0 of the EDP Technology Roadmap. The EDP will examine and revise the Technology Roadmap by email and

create a document ready for formal approval at its July 2010 meeting. The approved version will be posted on the IODP-MI website after the July meeting.

Routing: IODP-MI, STP
Priority: High
Background: The EDP Technology Roadmap is a living document. This review should focus on incorporating new technology requirements, to recognize achievements, as well as reviewing the Microsoft Visio chart.

EDP Action Item 1001-03: Improving EDP Meeting Efficiency
EDP recognizes the need to improve the effectiveness of EDP meetings by facilitating logistics in three areas: EDP will distribute draft meeting minutes within one month of the meeting, distribute the meeting agenda and attached material, if available, at least one month before the meeting, and distribute draft presentation material at least one week before.

Routing: IODP-MI, SPC
Priority: Medium

EDP Consensus 1001-19: Engineering input to the new science plan
The EDP requests that a representative from SPWC present at the EDP meeting in July 2010 the status of the new science plan and explain how SPWC intends to obtain an engineering assessment of the plan.

Routing: IODP-MI, SPC, IWG+, SPWC
Priority: High
Background: ED is a key component of the renewal process for the next scientific ocean drilling program.

EDP Consensus 1001-20: Outgoing EDP member
The EDP thanks outgoing member Mitsuo Tamura for his dedicated service to the panel.

Routing: PMOs, IODP-MI
Priority: Medium

EDP Consensus 1001-21: IODP-MI personnel at the Washington DC office
The EDP thanks IODP-MI personnel at the Washington DC for their dedicated service to the panel.

Routing: PMOs, IODP-MI
Priority: Medium

Draft Minutes
IODP Engineering Development Panel
Tenth Meeting
January 13 - 15, 2010
Sendai, Japan

In these minutes, the Recommendations, Consensus Statements, and Action Items are not repeated in detail. Please refer to the Executive Summary for the full text of each, as indicated.

Wednesday, January 13, 2010

Agenda Item #1: Welcoming Remarks; Meeting Logistics, Safety (by Asanuma)

The meeting was convened in the conference room of Sendai Excel Tokyu Hotel in Sendai, Japan. The host of EDP Meeting #10, Hiroshi Asanuma, welcomed all participants and made a few opening remarks regarding meeting logistics, safety particularly regarding earthquake hazard, and call to EDP members to provide input to Agenda Item #14 (Appendix A). Maria Ask informed the meeting about the background for the absence of Bill Ussler. She thanked Asanuma for hosting the meeting at Sendai.

Agenda Item #2: Introduction, Robert's Rules (by Ask)

After a round of self-introduction by the EDP members and other meeting participants, it was noted that this is the last meeting of Mitsuo Tamura. Ask reviewed Robert's Rules of Order, the EDP Terms of Reference, and the main goals and tasks of EDP meeting #10 (Appendix B). She requested the following EDP members for taking the meeting minutes:

Mitsuo Tamura, morning minutes, Wednesday, January 13, 2010
John Tauxe, afternoon minutes, Wednesday, January 13, 2010
Mai-Linh Doan, morning minutes, Thursday, January 14, 2010
Mike Maler, afternoon minutes, Thursday, January 14, 2010
Hiroshi Asanuma, morning minutes, Friday, January 15, 2010
Yoshi Kawamura, Maria Ask, afternoon minutes, Friday, January 15, 2010

Agenda Item #3: Approval of Meeting Agenda (by Ask)

Ask reviewed the meeting agenda. A motion was made to approve the meeting agenda, and a second was provided. The Agenda was approved by consensus.

Agenda Item #4: Quorum Discussion (by Ask)

EDP consists of 14 voting members; 10 are needed to maintain a quorum. At this meeting, three members were absent (Ussler, Roy Wilkens and Sumio Sakuma). Jack Ringelberg and Hirokazu Karasawa attended as alternates for Wilkens and Sakuma, respectively. Hence, 13 voting members EDP members and alternates were present at the meeting. Ask asked if anyone would leave before the end of the 3rd day. No one planned to leave early. Hence, quorum should be maintained throughout the meeting.

Asanuma commented that the Chairman should attend the meeting and EDP members agreed on it.

Agenda Item #5: Approve Minutes from EDP Meeting #9 (by Ask)

Draft Minutes for EDP meeting #9 were posted on the EDP working area before EDP meeting #10. Tauxe suggested that the minutes should be approved after incorporating some additional editorial corrections (provided via e-mail). A motion was made to approve the EDP #9 Minutes, and a second was provided. The minutes were approved by consensus.

Agenda Item #6a: Preliminary Discussion of next 2 Meeting Locations and Times, EDP Meeting #11 – USA (by Tauxe)

Tauxe presented background information on hosting EDP Meeting #11 in Santa Fe, New Mexico, USA from on 14 to 16 July 2010 (Appendix C). He provided travel and accommodation information, local and regional attractions, and ideas for excursion on July 17, 2010. A motion was made by John Thorogood to approve the location and dates of EDP Meeting #11, and Mike Maler provided the second. The meeting location was approved by consensus.

Agenda Item #6b: Preliminary Discussion of next 2 Meeting Locations and Times, EDP Meeting #12 – France (by Doan)

Doan offered to host EDP Meeting #12 in Grenoble, France, tentatively from 12-14 January, 2010. She provided information on meeting venue (Maison Sciences de l'Europe), hotels, transportation, and potential post-meeting activities in Grenoble, France (Appendix C).

Agenda Item #7: Review Status of Previous Meeting Action Items and Recommendations (by Ask)

Ask reviewed the status of action items and recommendations from EDP Meeting #8 (Appendix E). Five out of 13 EDP recommendations were mentioned.

EDP Consensus 0907-10: *Development of an External Review Process for Engineering Development Proposals*; this process is on hold due to reorganization of IODP-MI. It is unclear what IODP-MI's role in Engineering Development will be.

EDP Consensus 0907-12: *EDP Vice-chair;* Consensus via electronic mail nominated Maria Ask as EDP Vice-chair

EDP Consensus 0907-14: *Modifications to the At-sea Engineering Testing Policy*; Modified policy is posted for public view

EDP Consensus 0907-15: *Continued IODP-MI Support of the EDP*; Plan forwarded was to be discussed in Agenda Item #13 of EDP Meeting #10

EDP Consensus 0907-16: *Request for Tool Loss Report for the MSS*; Greg Myers summarized the findings and corrective actions from this report in Agenda Item #11c of EDP Meeting #10

Agenda Item #8: SPC Report (by Kasahara)

Junzo Kasahara presented results from SPC Meeting #14 that was held in Kiel, Germany, August 25-27, 2009 (Appendix F). The main results were:

- SPC approved the engineering development plan for FY2011 (SPC Consensus 0908-04). SPC also endorsed expanding the definition of IODP-related engineering developments to include those with external funding and those developed outside the IODP framework.
- SPC received EDP consensus items EDP Consensus 0907-07, 0907-11, 0907-13, and 0907-14.
- SPC accepted EDP Consensus 0907-15 on the current support of EDP by IODP-MI and forwarded this to IODP-MI (SPC Consensus 0908-10). The SPC acknowledged the valuable role that IODP-MI provided to EDP, and wished to see a good continuity of this function during and after the relocation of offices.
- SPC has approved the five-month operational plan and contingencies for *Chikyu* with starting dates in FY2011 to be determined (SPC Consensus 0908-13). The schedule is strongly dependent on the Kuroshio Current, and as a result, five different cases have been developed (Cases 1, 2, 3, 4a, and 4b), with Cases 1 to 3 being first, second and third priority, respectively (Appendix F). More information will be requested by CDEX if the internal ranking of Cases 4a and 4b needs to be established. Cases 1 and 2 cannot be executed if the Kuroshio Current is too strong, whereas Case 3 is somewhat sensitive and Cases 4a and 4b are not sensitive to the strength of the Kuroshio Current.

  Case 1: Site NT2-01 (observatory), Site NT3-01 (riser drilling), and Site NT3-01 (riserless observatory)

  Case 2: riser drilling at Site NT3-01

  Case 3: Site NT02-01 (observatory), NT3-01 (riserless drilling of riser top hole), and Okinawa Trough Deep biosphere (Proposal 601-Full3)

  Case 4a: Site NT2-01 (observatory), Site NT3-01 (riserless observatory), and Okinawa Trough Deep Biosphere (Proposal 601-Full3)

  Case 4b: Site NT2-01 (observatory), Site NT3-01 (riserless observatory), and Mariana Convergent Margin (Proposal 505-Full5).
- SPC has approved the schedule of five expeditions of the *JOIDES Resolution* (*JR*) for late FY2010 and FY2011 (SPC Consensus 0908-15):

  • Juan de Fuca Flank Hydrogeology (Proposal 545-Full3) + Cascadia Accretionary Prism CORK (Proposal 734-APL)

  • South Pacific Gyre Microbiology (Proposal 662-Full3)

  • Louisville Seamounts (Proposal 636-Full3)

  • Superfast Spreading Crust (Proposal 552-Full5) + Costa Rica Seismogenesis Project (CRISP) Phase A (Proposal 537A-Full5). Superfast Spreading Crust drilling will be implemented first; but CRISP A will have a guaranteed operational window of ~50%

of the operational days
Mid-Atlantic Ridge Microbiology (Proposal 677-Full).

SPC commended the Working Group of Flexible Expedition Implementation (Filippelli, Ohkouchi, Peterson) to explore schemes at the proposal level and SPC level that would ensure achievements of top science objectives while allowing maximum implementation flexibility. SPC has asked the Operations Task Force (OTF) to use these guidelines in their development and scheduling of the Mediterranean Outflow (Proposal 644-Full2).

Asanuma asked for a clarification of the meaning of the term "*received*". Kawahara replied that it meant "*recorded*" where further information is required for acceptance. Further discussion was forwarded to the executive session.

Agenda Item #9: SSEP Report (by Tauxe)

Tauxe reported the outcomes from the SSEP Meeting #13 in Melbourne, Australia, November 2009 (Appendix G).

A general concern of SSEP concerns the idle time for the *JR*: Specifically, the time allowed for the ship to do commercial work can undermine perceptions of scientific integrity, and there are unknown scheduling risks of hiring out the ship. Thorogood and Holloway commented that it is important to keep the *JR* in operation, especially for maintaining the crew (contract issues). A further concern was that proposals are being submitted without the requisite background data.

Some concerns from CDEX include: (1) *Chikyu* is an industrial culture, creating challenges in continuity and team-building; (2) Core recovery has been low (35%) and of poor quality (cuttings and mush), although admittedly rotary drilling was made in heterogeneous materials and with the priority being to make hole; (3) Logging has been canceled; (4) The lack of experienced core techs results in the inability to have contingencies; and (5) The cryogenic magnetometer is down, even after repairs.

ESO reported excellent core quality from New Jersey.

Tauxe informed that of the 17 proposals submitted, 7 included engineering challenges. The recurring engineering themes include drilling into hydrothermally active areas, sampling of in-situ fluids and gases, pressure coring, core recovery (several proposals could benefit from the use of sea-bed frames, due to drilling into unstable or heterogeneous formations), borehole instrumentation, and microbial sampling and/or monitoring. At the meeting, Tauxe proposed that EDP should review five of the proposals; SSEP ended up forwarding two proposals to EDP for review (see Agenda Item #20).

Agenda Item #10: STP Report (by Saito)

Sanny Saito reported from the STP meeting in Jeju Island, Korea, on 17-19 August, 2009 (Appendix H). Six out of 20 STP items were relevant to EDP. These items are briefly summarized below:

STP Consensus 0908-01: EDP Report and White Paper and STP input. Asanuma presented the EDP White paper for the INVEST meeting at the STP meeting. STP expressed interest to collaborate and make poster presentations at the INVEST meeting; In STP Action Item 0908-26: *EDP White Paper input*, STP members were asked to review and given input to the EDP white paper and send their comments to the STP chair for synthesis.

STP Consensus 0908-03: Magnetic Susceptibility Sonde (MSS). Trevor Williams gave an update on the MSS performance during Expedition 320. STP supports efforts to replace this instrument.

STP Consensus 0908-06: Reservation of platform time for non-expedition-specific purposes. The STP supports SPC's changes to guidelines that suggest 3 platform days per 2-month expedition be automatically set aside for other purposes (e.g., APLs, engineering).

STP Consensus 0908-07: Field Testing of the Riserless Mud Recovery System (RMR). The STP fully supports the idea of field-testing of the RMR if an opportunity is presented for using an IODP vessel. When and if such testing occurs, STP would like to have the opportunity to review the results.

STP Consensus 0908-08: IODP-MI Efforts to Integrate Engineering Activities. The STP endorses the IODP-MI efforts to integrate engineering activities including SOC-, POC-, and non-IODP-funded engineering development projects.

STP Consensus 0908-10: EDP Liaison and Microbiology Contamination Issues. Yuki Morono will replace Rick Colwell as the STP liaison to the *EDP Microbiology Contamination Working Group*. The STP requests that the EDP working group consider strategies for reducing the drilling mud contamination of cores obtained using riser and non-riser drilling and in materials that are difficult to core. Considerations include the modification of mud constituents to reduce contamination or the opportunity for microbial growth to occur within the muds.

STP recognizes that the microbiology contamination issue is significant. While STP has some knowledge about tracers, it wants to know how to minimize the core contamination and microbial growth. STP requests a presentation at STP meeting #10 at Sydney in March, a written report before the STP meeting #11 in summer 2010, and that EDP identifies a contact person in the EDP WG.

Saito also reported on the status of the STP road map which is version 0.95. It consists of 46 items, of which 17 items are linked to 37 EDP technology roadmap items.

Agenda Item #11a: Operators Reports and Status of FY10 Engineering Developments (including 3rd party tools), CDEX (by Kyo and Shinmoto)

Nori Kyo updated the EDP on the status of the development of telemetry system for Long Term Borehole Monitoring System (LTBMS; Appendix I). An experimental prototype (EXP) consisting of downhole and subsea modules has been built. Four different types of tests were conducted in FY2009: component evaluation tests, system Integration test, environmental life test, and field test. The environmental test included three types of tests: system life test (10.9 months at 150°C), shock / vibration test (250 G, 2-axis), and HTHP test (16000 psi at 135°C for 1 hour). The original plan for the system life test was to run the test at 125°C for 5 years, but instead, the test was run for a shorter period at an elevated temperature (10.9 months in 150°C), since a change in the characteristics of the pulse transformer was observed beyond 130°C. Testing has revealed deformations and cracks in the printed circuit board. This problem is still being investigated. Kyo said that a system life of 5 years for the current set up can be subjected to a maximum temperature of ~100°C. The field test was made in a 1.5-m-diameter borehole to 200 m depth. The environmental life test was extended and related reports will be submitted to IODP-MI by the end of March 2010. Kyo welcomed comments from IODP-MI, Greg Myers, and EDP.

A dummy sensor test was conducted at Site C0010 during NantroSEIZE Expedition 319 in the summer of 2009. The test was conducted to investigate how much vibration occurs during deployment. The instrument string included, among other things, accelerometers to measure the shock when the tool string hits the re-entry cone. The dummy test had to be conducted under a strong current, which may have contributed to the loss of a seismometer at the base of the instrument string. Nevertheless, collected data reveal that some vibrations occur. New dummy tests will be conducted in FY2010 and FY2011. The purposes of the new tests are to obtain acceleration data in actual conditions, confirm the maximum current condition at which the sensor can be safely run, check vibration transfer insulation by the drill collars, check vortex-induced vibration (VIV) reduction in the pipe, and evaluate the size of the pipe on which the sensors are attached.

Yuichi Shinmoto reported on the development of coring tools for scientific drilling and *Chikyu* (Appendix I). He presented an overview of the Rotary Core Barrel (RCB) on *Chikyu*. The core recovery for the RCB has varied from 28 to 55% during NanTroSEIZE Stage 1. In general, the best core quality was obtained for mudstones, and the worst for sandy-gravel formations. Shinmoto proposed that improvements in the Polycrystalline Diamond Compact (PDC) bit have been made, including the “without reverse cone” type blades that can reduce core jamming, and facilitates cuttings removal. A question was asked if better recovery could be attributed to the new drill bit or to better weather conditions. Shinmoto replied that the weather conditions were similar (rather calm sea), and that the formations were similar.

Shinmoto reviewed technology developments that have been made for the Small-Diameter RCB (SD-RCB), the Turbine-Driven Coring System (TDCS), the Turbo-Corer, and Measurement - While - Coring (MWC) / Logging - While - Coring (LWC). The SD-RCB has a core bit outer diameter of 8.5 inch, and a core size of 83 mm. Improvements include better mud or Lost Circulation Material (LCM) circulation capability, an impregnated diamond core bit for hard rock formations, and new core catchers. The core quality and recovery of ultra hard rock formations is improved by allowing higher revolutions per minute and less weight on bit (WOB) of the T-MDCB. In addition, the T-MDCB uses drilling mud as the drilling fluid, and has extended high temperature capabilities. Two features have enhanced the core quality and recovery of the Turbo-Corer: First, it can be used with the wireline RCB, and second, it has directional control for vertical coring. Directional coring control with the MWC / LWC is achieved by monitoring inclination, azimuth, tool-face, etc. Properties that are being logged include formation properties such as natural gamma ray, resistivity, sonic velocity, etc. In addition, downhole temperature and pressure are measured. The data are transmitted in real-time.

Agenda Item #11b: Operators Reports and Status of FY10 Engineering Developments (including 3rd party tools), ESO (by Evans and Morgan)

Dan Evans presented a report from ESO to the EDP (Appendix J). He reported that the New Jersey MSP expedition was deemed highly successful all around. The lift boat L/B *Kayd* was used during the 79 days of Expedition 313, during which coring and logging was conducted down to a maximum depth of 757 mbsf at three sites. Drilling was very challenging, and core recovery varied from 58 to 86% for the cored intervals. A time analysis showed that the vast majority of the time was used for operations. The onshore scientific party was held in Bremen from 6 November – 4 December 2009. The cores obtained are of very good quality. The results revealed both remnants of ancient sandy beaches and continental soils, indicating large sea level changes (≤ 100 meters). The scientists have identified about ten cycles of sea level rise and fall with drastic seaward shifts of the shoreline during the interval between 14 and 35 million years ago.

The upcoming Great Barrier Reef, Australia, expedition will be using a brand-new platform: the *Greatship Maya*. Although this is a more capable platform than the originally proposed *Bluestone Topaz*, there is some concern as to its newness. Future Mission-Specific Platform (MSP) expeditions include Hawaiian Drowned Reefs, which is at OTF (ESO is initiating planning for FY11 – scoping has begun) and the New England Hydrogeology proposal is in the OTF ‘Holding Bin’ awaiting site survey (EDP input will be useful). Other proposals are under review at SSEP and two proposals will be ranked at the upcoming SPC meeting in March 2010 (672-Full3, Baltic Sea Basin Palaeoenvironment and Chicxulub).

Evans informed the EDP that the MeBo drill has been used off South America, and that a process has started to setting up a remote drilling consortium with Williams, Bremen and BGS.

Sally Morgan presented ESO borehole and core petrophysics (Appendix J) and the European Petrophysics Consortium (EPC), which is a network of universities (Leicester (lead), Montpellier and Aachen). EPC provides ESO with equipment and personnel for the planning, acquisition, processing and distribution of core petrophysical measurements and borehole petrophysical measurements on MSP expeditions.

Morgan briefly reviewed logging tools used and the outcome of logging for already competed MSP expeditions (Exp. 302, 310 and 313), together with the plans for the upcoming Expedition 325 to the Great Barrier Reef. She expressed some concern about sufficient room for the logging engineer on the rooster box platform, and that a redesign had been agreed upon. Holloway said that he had some ideas concerning this, and that ESO should contact him. Holloway also expressed concern about the proposed logging program involving six tool runs in each of ten holes, since deterioration of the borehole with multiple runs is a common problem. He recommended that the logging runs for each hole be carefully prioritized, in case the borehole becomes unusable. Logging has also identified discrepancies in drilling depth records, and a need for more accurate drilling recording procedures is identified.

Agenda Item #11c: Operators Reports and Status of FY10 Engineering Developments (including 3rd party tools), USIO (by Myers)

Greg Myers gave an engineering and operations update from the USIO (Appendix K). Organizational changes within IODP-MI include the loss of Tom Janacek and Myers. Myers has recently accepted a position as Senior Technical Expert at the Consortium for Ocean Leadership (COL), and Sean Higgins has left COL to join Columbia University. TAMU Engineering has advertised for an Engineering Supervisor (interviews have been completed), a Staff Engineer (Bob Aduddell was hired), and a Mechanical Engineer (on hold). Gerry Iturrino is now serving as the Manager of Engineering and Technical Services at LDEO, which needs to hire 1-2 additional electrical engineers. EDP welcomes Yoshi Kawamura as IODP-MI's new Operations Manager.

Myers presented a draft schedule for operations of the *JR* through the end of this IODP phase in September 2013, and a summary of recent operational achievements. On average, the ship is working only 8 months of each of the remaining 3 years. Recent operational achievements include several records: The record for Advanced Piston Corer (APC) was advanced four times during Expeditions 320, 321 and 323, from 378.2 to 458.4 mbsf. The shallowest shelf site (84.2 mbsf) was obtained during Expedition 317, during which the new record for single bit sedimentary hole was obtained (1927.5 mbsf).

Myers presented an update on USIO projects:

Rig Instrumentation System (RIS). RIS still has issues to be resolved including display of VIT and core line depth, depth measurements and WOB measurements — the plan is to address these during maintenance on the long *JR* transit following the Wilkes Land expedition to the Pacific Northwest.

Sediment temperature tools. One Sediment Temperature Tool with Pressure (SETP) was deployed using *Chikyu* for Exp. 322, but the tool was deployed only for testing. No suitable formations were found for deployment. The SETP has been returned to College Station for storage. Two Sediment Temperature Tool (SET) are currently deployed on *JR*, and two SET tools have been deployed but not used on *Chikyu*. They also have been returned to College Station for storage. In addition, one SET tool is available as a backup.

Multi-Function Telemetry Module (MFTM). The MFTM replaces the UDTM, and it has a standardized downhole telemetry interface. It can be configured to operate in Standalone LDEO Telemetry Mode, Schlumberger Mode, MDHDS Mode, or SCIMPI Mode.

Magnetic Susceptibility Sonde (MSS). The conclusions from the tool loss report were presented. The lockable flapper valve (LFV) was found to have caused the loss of the tool. Modifications to the design of the LFV have been proposed and are being evaluated. Tool replacement effort is underway. The new MSS tool has two sensors and data retrieval is integrated into SLB telemetry. Successful runs have been completed on land and at sea.

Multisensor Magnetometer Module (MMM). The MMM project is funded in the FY2010 IODP Annual Program Plan. Contract negotiations have commenced. The MMM tool shall consist of four sensors (Fluxgate and Overhauser magnetometers, accelerometer, and gyroscope) and be integrated into SLB telemetry. The paleomagnetic tool string is planned to include MSS-MMM-Gamma Ray.

Wireline Heave Compensator (WHC). New successful tests have been done with the WHC at different water depths, varying sea states, and tool loads.

Logging-While-Coring (LWC). The measurement system works well, and core recovery is good for sediments but poor for hard rocks. New fixed cutter bits were created and tested in 2007. The system awaits field trial.

Large Pipe Handling Infrastructure. A unique handling infrastructure is required to deploy 6 5/8” drillpipe with the *JR*’s horizontal pipe racking system. The main items requiring modification are the dual side door elevators. The primary benefit will be the ability to deploy large diameter, late generation logging tools. The USIO received NSF funds to begin this project in FY2010. The process of submitting a Request for Quotes (RFQ) for the proposed work should begin spring 2010.

Testing, Servicing and Calibration Facilities. TAMU has a Metrology Lab for testing and calibrating tools and sensors over a range of temperatures and pressures. The Service center at TAMU is a facility for servicing and reconditioning IODP temperature and pressure tools (i.e. SET, SETP, and Advanced Piston Corer Temperature Tool, APCT3). The Environmental Qualification Facility at LDEO comprises a 1000 ft test well, a 10 kpsi pressure vessel, a logging truck with 19,000 ft of cable, a 500 g shock machine, and a -40 to +100°C temperature chamber.

Observatory Installations. New observatory installations are planned for the Juan de Fuca Ridge, Cascadia Margin, and North Pond.

Maintenance activities are planned to occur in the pacific northwest region. Two projects are scheduled for the maintenance period to increase reliability of the RIS. First, a crown encoder will replace the draw works encoder that currently is used to measure depth. Second, the WOB is currently measured from hook load, but will be replaced by load pins. Wireline logging tools will be refurbished and the wireline logging cable will be replaced. New stainless steel tubing will be installed for the WHC hydraulic system, and the foundation for the SLB winch cab will be raised for better visibility.

Future projects that are under consideration include ½ APC corer, Powered XCB, and Drilling Sensor Sub (DSS). DSS testing has been volunteered by Schlumberger. Holloway suggested that Fugro might also have interest in its development.

The USIO is working outside traditional funding models. New funding has been obtained from the Moore Foundation (North Pond CORK development) and a proposal has been submitted to the US Department of Energy's RPSEA project (modify *JR* for RMR operation). Other potential funding agencies include governmental bodies and the oil and gas industry.

Myers discussed borehole management, and saw the RMR system as being a big part of improving borehole conditions. This could go as far as 3650 m water depth on the *JR*—deeper than riser capability on the *Chikyu*. Responding to questions by Doan and Holloway, Myers notes that the RMR cannot be combined with a Blow Out Preventer (BOP), so it would be used only for top-hole sections for now, and a riser vessel would be required to complete the hole. The dream, however, is to use *JR* for drilling complete holes.

Agenda Item #12: Introduction of IODP-MI President (by Suyehiro)

Kiyoshi Suyehiro presented the IODP-MI report (Appendix L). Suyehiro became president of IODP-MI in May 2009, and initiated the consolidation of the two IODP-MI offices to one central management office (CMO) at Tokyo University. The Sapporo Office will be closed in February 2010, and the Washington DC office was downsized to two financial officers and one contracting officer in December 2009. The Tokyo Office has been in operation since late December and is planned to be in full operation from March 2010.

Central management functions include science operations/services management, science planning support, business/administrative, education and outreach, engineering development, and data management. Suyehiro considers engineering development to be very important for the future, and a necessity for new science. Suyehiro said that that IODP-MI will be an umbrella for data management.

Suyehiro informed us that Myers left IODP-MI to COL in December 2009, and that this move resulted in the disbanding of the Engineering Task Force (ETF). Yoshihisa Kawamura started his new position as Operations Manager on January 1, 2010; he was formerly at CDEX. Suyehiro said that program-wide oversight is necessary for the new drilling program, and that IOs cooperation is key.

The IODP Lead Agencies have ordered a Second Triennium Review of IODP-MI from FY2007-2009. The committee will start in the fall of 2009 and finish in early 2010. The committee consists of distinguished members, with leadership experience in the geosciences. Most committee members are not currently involved with IODP, but they have some familiarity or prior experience with scientific drilling. The focus of the work includes evaluation of the effectiveness of the IODP science planning process, SAS functionality, and relationships between the SAS, IODP-MI and the Implementing Organizations. This work should help focus discussion for post-2013 scientific drilling.

Challenges for the CMO include delivery of IODP science, serving the IODP members, bridging to the next program. Suyehiro presented the IODP□MI values: open, ocean, uniting, inspiring, and international.

Agenda Item #13: Explanation of EDP/IODP-MI Communications (by Suyehiro)
Suyehiro opened the floor for discussion.

Holloway asked what the plans are to bring together engineering development in Japan and the US, which has been separated the last 2-3 years. He thinks that collaboration has many technology and cost saving advantages. Suyehiro said that he was open to suggestions, but agreed that IODP-MI should play a facilitating role. Myers remarked that Mike Storms actually has arranged a joint meeting between IOs this week. Holloway suggested that CDEX and USIO should have a day meeting to discuss joint projects, and Myers replied that IOs used to meet before EDP meetings, but that there currently are no big group projects. Asanuma remarked that EDP has a mandate to work for SOC projects (platform independent). He also stated that better communication between scientists and engineers is needed. Doan asked Holloway to clarify what the similarities and compatibilities are between the US and Japanese drilling capabilities. Holloway responded that while they are largely compatible, the Japanese and US have been developing tools in isolation. Joint projects are needed to increase collaboration. Suyehiro said that this would be most important to outline for the next phase of ocean drilling.

Ask said that the previous system of channeling ED proposals through the ETF to the EDP worked fairly well. She asked what the plan is for the future, after the dismantling of the ETF. Suyehiro responded that he cannot answer concretely. Ask reiterated that a structure for submitting engineering proposals is needed. Thorogood said that EDP has been underutilized and suggested that the EDP should be involved earlier in the proposal process, for example by working with the IOs earlier in the proposal chain. He also requested more effective linkage between the IOs and industry, to prevent spending time on reinventing technologies that have already been developed.

After the coffee break, Suyehiro assured the EDP that he wants to keep engineering development going, and wants to encourage consulting experts in the field. He said that this would work against the renewal of the program. Suyehiro said that he wished to keep up the work by Janacek and Myers together with EDP. He suggested that this might include an increased size of the panel, and to consult the best people in the field. Holloway argued that the function of ETF strengthened the proposals, and that this role helped to shorten the review process.

Tauxe said that the proposals that are forwarded to EDP from SSEP could be better in terms of engineering content. Science proposals are forwarded to EDP from SSEP when it is deemed that they are sufficiently mature, from a science standpoint, and then they can be submitted for engineering review. Tauxe argued that while proposals may be mature from the perspective of the science, they may or may not contain sufficient technical detail to be ready for an EDP review. He suggested that before a proposal comes to EDP, it would benefit of some independent technical and engineering review, perhaps with the assistance of the IOs. Holloway remarked that proposals used to go through operational review at ODP. Evans replied that the former system required that the proponents should include engineers and operations folks as proponents. He also said that one way to proceed may be through the mission idea, when a workshop is organized and a mission team is formed to develop a proposal. The mission team should consist of scientists, IOs, and other expertise. Thorogood remarked that a similar idea was discussed before the INVEST meeting—that IODP MI would need to constitute a centralized engineering function. He proposed that such a function is needed, rather than leaving this to the IOs. Storms said that TAMU still has the initial evaluation that Holloway mentioned, but that the problem is that TAMU only does this for proposals that have been chosen for scheduling. Storms said that this is too late in the schedule. Iterrino suggested that more than one representative from EDP may be needed at the SSEP meeting. SEEP often split up into working groups, which precluded the ability for one EDP representative to participate in the detailed discussion for all proposals that have suitable engineering content. Tauxe agreed, and remarked that he had to select sessions at the last SSEP meeting. He also said that SSEP typically reviews more proposals than the 17 reviewed at SSEP #13, and may use more breakout sessions. It would be good to include a mechanism to help EDP determine how many liaisons it should send to a given SSEP meeting, based on what is expected to be presented. Suyehiro agreed that SSEP's proposal structure could use improvement.

Agenda Item #14: INVEST Workshop Report and Discussion - Implementation and the Renewal Process

Comments were solicited from those who attended the INVEST workshop.

Suyehiro showed slides from his INVEST Renewal Process presentation (Appendix M). He stated that the new (post-2013) program will not be called IODP. Suyehiro said that the new program should remain an international science program with multiple platform capabilities. He further said that it would be an international program, and not a collaboration of country-specific programs. The International Working Group plus (IWG+) will determine the "rules of the game" and the “game plan”. Their work must be available by the end of 2011. Although we do not yet know who the US operator will be (currently TAMU) for Japan it will probably remain CDEX. The Science Plan Writing Committee (SPWC) is responsible for describing the next science plan. The SPWC consist of Christina Ravelo: Neogene Paleoclimatology, isotope geochemistry, INVEST SC; *Heiko Palike: Paleogene, Arctic, paleoclimate, INVEST SC; Rob DeConto: Paleoclimate modeling, CO_2 climate sensitivity, cryosphere evolution; *Fumio Inagaki: Deep biosphere INVEST SC; *Katrina Edwards: Microbiology INVEST SC; *Naoh Ohkouchi: Biogeochemistry, ocean chemistry LIP impacts; *Andy Fisher: Fluids, crustal evolution; *Damon Teagle: Ocean crust, Moho, fluids; Mike Bickle: Hydrothermal, CO_2 sequestration, climate-tectonic links, LIPS; *Demian Saffer: Subduction, seismology, geohazards, NanTroSEIZE; *Gilbert Camoin: Sea Level INVEST SC; Peter Barrett: Societal impacts, IPCC linkages; *Shuichi Kodaira: Seismic imaging, crustal evolution, geophysics; *Richard Arculus: Arc magmatism (*attended INVEST). Suyehiro showed the current renewal plan from 2009 to 2013, which includes IWG+ activities, funding cycles and MOUs, and involvement of the science community.

Thorogood posed a question about the time line, and if EDP will have a chance to review the process. He said EDP may miss an opportunity here. Suyehiro said that there will be an internal review of the new science plan, and encouraged EDP to read the minutes of the IWG+.

Ask asked if the new science plan will be completed before the January 2011 meeting. Suyehiro said that the science plan will be ready, and that the EDP Chair can submit a request for involvement. It was remarked that the Demian Saffer seemed to be the only member of the SPWC that had some engineering experience.

Holloway asked how and if the EDP Technical Roadmap will be incorporated into the new science plan. He said it might be useful, and should be reviewed by CDEX, USIO, and ESO. Thorogood disagreed and said that the TR is waste of effort, because it does not address a specific problem. Holloway replied that a plan is needed for development of the engineering technology.

Asanuma presented information from his Technical Session (WG 6.3) at INVEST, and many other sessions. [Note: this presentation is not incorporated in the meeting appendices]

Yoshiyasu Watanabe informed the panel that there had been many discussions about the Mohole in WG 2.3, lead by Chris Macleod [Note: this presentation is not incorporated in the meeting appendices]. The need of interaction between the scientific community and industry had been highlighted. Aspects of seafloor mapping/sampling and geological characterization, and merits of spot- and continuous coring versus cuttings had been discussed. Mohole drilling will require riser capability to at least 4500 m water depth and a borehole minimum depth of 7000 mbsf. This will require development of new high pressure and temperature drilling and logging tools. Further evaluation and development of a variety of seabed drilling platforms, including a seabed drill may be needed. Three candidate sites for Mohole were proposed: near Site 1256, off Hawaii, off Mexico where water depths and temperatures are favorable, and at Nobukazu Seamount.

Ask noted two new and challenging topics for EDP: deep mining (sea floor and subsea mining) and CO_2 sequestration.

Agenda Item #15: Feedback INVEST Technology White Paper Report (Asanuma) 15 minutes

Myers gave a summary of his INVEST presentation (Appendix N), but worried that the work EDP did for INVEST may not make it into the final INVEST report. Myers said that a major point made at INVEST was by Peter Schulteiss (former EDP member) who believed that the focus should be on improving core recovery and quality, and that better bit control is needed. A discussion about bit motion ensued, after which the idea of seabed frames was brought up. Myers and others had been told that seabed frames were not to be discussed in proposals. Tauxe asked what the politics were regarding the seabed frames. He said that while EDP thinks it is a promising technology for improving coring, obstacles to its implementation must be identified and removed. Ask suggested to move this discussion to Agenda Item #18. [Note, this discussion did not continue and was not resumed—at least the political milieu was never discussed.]

An *ad hoc* working group for the meeting was assembled in order to develop an EDP Recommendation regarding our position on INVEST and our continued involvement. This group consisted of EDP members (Asanuma, Tauxe, Thorogood), IOs (Evans/Morgan, Myers, Shinmoto), liaisons (Saito), IODP-MI (Kawamura). A letter was composed, reviewed and sent to IWG+ after the meeting (Appendix Q).

Agenda Item #16: Introduction of IODP-MI Operations Manager (by Kawamura)

Yoshi Kawamura has a background in nuclear physics. He has been working 18 years as a Schlumberger wireline field engineer and at JAMSTEC and CDEX before starting at IODP-MI on 1 January 2010 as Operation Manager. He will probably overlap the work by Janacek and Myers.

Agenda Item #17: FY10 and FY11 Engineering Development Plans (by Kawamura)

Kawamura presented the engineering plan for FY2010 and FY2011 (Appendix O). Five projects are ongoing in FY2010:

(1) Single Cable Installation for Measuring Parameters In-situ (SCIMPI): Design is underway, with USIO telemetry, preparing sea test plan (expect sea test request during this EDP meeting),

(2) Motion Decoupled Hydraulic Delivery System (MDHDS): Following extensive contract deliberations, the design is well underway – utilizing USIO telemetry,

(3) Long Term Borehole Monitoring System (LTBMS): Extended life test is nearing completion. Primary deliverables which include the specifications for the LTBMS telemetry system have been completed,

(4) Multi-Sensor Magnetometer Module (MMM): The project has not yet started, due to contractual issues, and

(5) Common Deployment System for simple observatories: Design is complete, fabrication to commence soon, utilizing USIO telemetry.

In FY2011 two projects are continuing (SCIMPI and MMM). No new SOC engineering projects are underway.

Mitsuo Tamura commented that no candidate existed for FY2011, and that fewer and fewer proposals are coming in. He requested a strategy to encourage proponents to submit new proposals. He asked what the current status was and Kawamura replied that April 15 is the deadline for proposals. He also said that he has not been updated on the proposal pressure for this year. Asanuma suggested that a scheme should be developed for sending proposals out for external review.

Agenda Item #18: EDP Final Comments on FY10 and FY11 Engineering Development Plan (by Ask)

Ask asked each member of EDP to give constructive comments and concerns for the Engineering development. The following comments were stated by EDP members:

- It is most important to increase advertisement for Engineering Development (ED) proposals. ETF and external reviewers or groups are also important.
- The engineering screening process should be more closely tied to the scientific screening process.
- It is most important to speed up ED proposal process, the ED proposals should be sent out for external review by specialists before they are forwarded to EDP for ranking.
- One way to get new proposals is to set up calls for specific subjects related to mature engineering issues in the IODP ED technology roadmap (request for proposals).
- Make combined proposals with other groups, for example ICDP.
- People need to have a formal and clear structure of the ED proposal process structure. This includes firm time lines, guidelines. Because the time before the end of this program is short, there should be guidelines for how to process an ED proposal quicker or move it to the next phase. It takes time and effort to prepare a proposal, there should be some insurance for proponents what their expectations may be.
- If the ETF is pulled out of the equation, and if EDP fills the ETF role, will there be a risk of conflict of interest? Is there another means to fill the ETF function? Can an engineering proposal come in on its own, unsolicited? There should be

demobilization funding beyond 2013. IODP MI should be able to fund projects for longer than 2 years, even at this time.

- The ETF function is very important for screening ED proposals. Is EDP qualified to review all proposals? How many ED proposals can EDP manage without ETF screening? To speed up the evaluation process, the proposal should be clearly written. We need something to ensure that all proposals are good and mature enough to be reviewed by EDP.
- We must stick with the process wehave—it is a good process. We should review SOC and non-SOC proposals. There should be an advisory panel, replicating the ETF function of prescreening proposals before they reach EDP. The persons in the group should have a wide background, which should be separate from the external review function. The external review function should be utilized to advise EDP on specific matters where EDP lacks skills.
- SSEP proposals might be subjected to a similar review path for ED as ED proposals. Endorse establishing an ETF structure again to serve as screening role and independence from the EDP. (Myers noted that the ETF was purely voluntary, details were then discussed). Have formal requests on proposals based on ED needs. *Other programs with similar engineering needs should be invited to submit ED proposals.*
- It is important to find new teams of proponents, consisting of both scientists and engineers.
- We need some scheme to accept challenging or basic studies for future IODP technologies. We need more flexibility for SOC funded ED projects, because newly suggested technologies are platform-related to some degree. We should ask guests and liaisons to provide comments.
- It is important to ensure that capture the former ED proposal structure, and modify it as wanted. It is important to inform the community about the ED proposal schedule, time lines, etc.

The floor was then opened for discussion within EDP, resulting in the following comments:

We need to attract new people to submit proposals. New proponents need help to understand IODP specific ED boundaries (hole diameter, etc). We need to have a formal place for proposals, and a formal place to foster them, and advertise them. A clear structure is needed. There must be money behind the proposal—it is not fair to proponents to advertise for input without a firm commitment. IODP-MI needs to come out with a request for proposal, giving the specific dimensions of what needs to be accomplished—more like industry does it. When reviewing SSEP proposals, EDP might find the need for requesting specific proposals for completing the proposal, e.g., call for a program manager for microbiology research program

Guests and liaisons were finally invited to present their views and suggestions:

• Technological demands from scientists are summarized in STP roadmap. There are no ST proposals. STP should use the ED proposal function in some way. What is the definition of ED development? In the STP roadmap 50% of items are shipboard measurements: cryo-magnetometer, sample preservation, microbiology, etc. If someone submits ST related proposal, STP is happy to send people to help evaluate. Collaboration between engineering and science is important; STP and EDP need to improve their interactions.

If IODP-MI wants to see transformative science enabled by new engineering, funding commitments will have to be provided to support requested proposals. This structure is more likely to be implemented in the next phase of the program because timeframes on the order of years are needed to develop proposals into projects. It would be great if this phase could be initiated now.

These comments need to be sent to the funding agencies and organizations that deal with the next program. Send these comments to IWG+, which is meeting next week.

EDP will write a consensus of the need to continue engineering development proposals within EDP including advice to IODP-MI. We will also send a letter to IODP-MI, SPC and IWG+ with our suggestions (above text), and IODP-MI may also send a copy to IWG+ including their concerns.

A group consisting of Ask (ECORD), Watanabe (Japan), and Tauxe (USA) drafted the consensus statement for Agenda Item #18. Myers provided an EDP statement from about 3 yrs ago.

COFFEE

Agenda Item #19: Review of Operations Review Task Force Recommendations (NanTroSEIZE Stage 1 and PEAT Expeditions) (by Kawamura)

Kawamura's presentation is included in Appendix P.

IODP-MI Operations Review Task Force (ORTF) conducts operational reviews of IODP Expeditions. The Task Force review is based upon confidential reports submitted by the IO and expedition co-chief scientists. These operational reviews focus on "lessons learned" and "how do we do things better in the future?" Areas of discussion include pre-expedition planning, expedition drilling operations, communications between scientists and operators, roles and responsibilities of scientists and operators, general procedures and policies (e.g., curation, communications), laboratory operations, lessons learned and defining better approaches in the future.

ORTF reviewed the operations of NanTroSEIZE Stage 1 Expeditions 314-316 and PEAT Expeditions 320 and 321 in 2009.

OTRF recommendations for NantroSEIZE include:

JAMSTEC/CDEX meet with the new drilling contractor (MantleQuest) to discuss alternate dynamic positioning practices taking into account the basic types of scientific drilling.

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).

JAMSTEC/CDEX should meet with the new drilling contractor (MantleQuest) to discuss the possibility of adding core techs to the MantleQuest crew. These personnel should be repeatedly assigned to coring expeditions for the benefit of long-term continuity and operational/science optimization.

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. No specific cause (and hence no solution) arose during this review. The Extended Coring System (XCB) on the *JR* 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).

The Operations Review Task Force heard commentary about the serious VIV responses of the drillstring that were repeatedly observed during Expeditions 314-316. 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.

Thorogood commented that hearing of the use of technicians as drillers appalled him. A brief discussion followed regarding career tracks of core technicians and the influence of experience on drilling results.

OTRF recommendations for PEAT include:

The new refined procedures of deep APC coring, drilling-over, and the use of non-magnetic core barrels are recommended, which will be a real plus of the new coring activities on the *JR*.

When wireline operations encounter difficulties, clearer communication between LDEO and logging scientists, as well as co-chiefs and operations superintendent, is required. Operational decisions should be made on the ship after timely consultation with the appropriate parties onshore (LDEO and Schlumberger), and clear procedures need to be in place.

Navigational and rig instrumentation data need to be consistently logged and archived in the science database, and be accessible post-cruise. The shipboard display of these data must be visually clear.

Robust software version control and documentation tools are needed for all systems in accordance with a detailed configuration management plan.

The velocity sensor may apply too much pressure to the core. A provision for a "manual mode" should be made.

Steve Midgley commented that their tool got stuck twice, due to lack of the necessary communication between telemetry lab and logger consol. Better communication will not be difficult to implement in the future. Navigation and rig instrumentation data need to be consistently logged. Midgley said that drilling parameters now have been added to the database. Tauxe noted that it is convenient to have all data in the same database. Midgley added that vessel motion is captured by accelerometers, and that this data will be inserted later in the database. Storms added that ship motion data is useful for seismic data acquisition.

Agenda Item #20: Technical Review of Active Drilling Proposals Forwarded from SSEP (by Watchdogs)

Two active drilling proposals were forwarded by the SSEP to the EDP for technical review. Ask requested confirmation that there was no conflict of interest amongst the watchdogs assigned by Ask. Watchdogs confirmed there was no conflict. Details of the discussion are not presented in order to maintain proposal confidentiality.

Agenda Item #22: Status and Discussion of Scoping Studies (by Kawamura)

Kawamura presented an overview (Appendix T). There are two scoping studies: Ultra-Deep Drilling and Improved Core Recovery. He did not discuss the former because it is the subject of agenda item 23. He summarized the IODP Drilling and Core Technology report provided by David Huey of SES, Inc to IODP-MI. Based on a single well analysis, Huey found no correlation between ship heave and core recovery but he recommended expanding the study to a larger population. Other recommendations included routinely collecting ship dynamic data to document conditions during coring as well as lithology. IODP-MI should also investigate non-rotary coring techniques. Myers requested that the document be placed on-line so others can see what has been tried in the past.

Kawamura presented a slide from EDP Meeting #9 with the next steps for this study. With the exception of the Huey report, all are still pending. Saito said that STP is still working on their report for EDP.

Coffee Break 1500 – 1530

Reconvene at 1530 with short discussion on agenda for the rest of the day.

Agenda Item #23: Deep Drilling Frontiers (by Thorogood/Myers)
Myers presented a brief recap of the history of this scoping study and its mandate to drill to the Moho. He proposed two workshops that will begin scoping this effort. The first workshop, tentatively scheduled for June 2010, will be funded by CDEX and ESO. The second workshop, tentatively scheduled for September or October 2010, will by funded by the Sloane Foundation to support their deep carbon cycle initiative. This will require funding from multiple sources and extensive preparation such as comprehensive engineering development and site characterization. Thorogood suggested that early planning remain flexible in order to adapt to evolving technology during a long planning process (>10 years).

At Asanuma's request, Karasawa presented the results of Geothermal Well WD-1a. This 1998 well set a world record for greatest formation temperature successfully drilled. The key technology was a combination of top drive system and powerful mud cooling units called "TDS Cooling." It kept the borehole temperature below 140°C. Citing a white paper on drilling tool technology, Asanuma observed that maximum tool operating temperatures have not improved appreciably in the past 10 years. Thus we should focus on cooling the borehole.

Action Items: Myers will deliver the report resulting from the 2010 workshops to EDP 12 in January 2011. Thorogood will represent EDP at both workshops.

Agenda Item #24: Microbiology Contamination Report Discussion (by Thorogood/Morono)
At the request of STP, EDP investigated "drilling fluids and /or techniques that are less likely to adversely impact interstitial water geochemistry, rock geochemistry, and microbiology." On behalf of Ussler (chair of the subcommittee and report author), Thorogood presented a summary of the EDP microbiology contamination report (Appendices U, V). Though the report contains a number of recommendations, the underlying message was to identify specific core contamination issues and needs before embarking on complex and expensive mitigation efforts. This message was emphasized in the presentation and suggestion that STP seek industry input, as well.

Yuki Morono (STP) observed that we know very little at this point and need to document contamination further. Tracers could be a reasonable approach. Microbiologists can identify some contaminating species. STP had reached conclusions similar to those of the EDP report. Given the latter point, discussion ensued on merits of forwarding the report to STP (per original request) or parking it until a later date. It was generally agreed that EDP should forward the report and give a brief presentation at the next STP meeting.

Asanuma moved that EDP forward the report to STP and provide a presentation at the next STP meeting. Tauxe seconded.

Action item: Thorogood will provide a copy of his presentation to Watanabe, who will present it at the next STP meeting.

Ask noted that the panel did not endorse the FY11 Engineering Development Plan nor offer a Consensus Statement for the Deep Drilling Frontiers Scoping Study. She will draft both and circulate via email for approval.

Agenda Item #21: Break-out Session - 2 groups to write Technical Reviews of Active Drilling

Watchdogs plus interested panel members work on reviews based on earlier discussion with panel members and guests.

Agenda Item #25: Preliminary Agenda for EDP Meeting #11 (Ask) 15 minutes

Ask presents a preliminary agenda of EDP#11 planned for 14 to 16 July, 2010, in Santa Fe. The EDP#12 meeting will be hosted in Europe and #13 will be in Japan. All the IOs were asked to send presentations to MI/chairs prior to the meeting. IODP-China was asked to make a presentation on their activity. Wohlgemuth will make a presentation on deep drilling technology on the KTB project. Asanuma commented that if the CC WG exists, Inooka would take the place of Tamura as a Japanese member. A status report or review of ISP will be made. For better efficiency, the next draft agenda will be available one month after EDP #10, documentation will be available one month before the meeting, and presentations will be available one week before the meeting.

Agenda Item #26: Next Meeting Location and Time (by Tauxe)

John Tauxe showed some ideas for the excursion after EDP#11 (Appendix C).

Agenda Item #27: EDP Final Comments on Scoping Studies (by Ask)

The panel members agreed to endorse IODP-MI's continuation of scoping studies. Thorogood commented that scoping studies should be continued as technologies for better core quality/recovery and downhole monitoring are progressing.

Agenda Item #28: Finalize Technical Reviews of Active Drilling Proposals Forwarded from SSEP (by Ask)

The review results will be sent to Ussler as a draft, who will forward the reviews to IODP-MI for distribution. He may change some sentences if necessary.

Agenda Item #29: Review of Ship-time Request for Engineering Testing (by Kawamura and Iterrino)

Kawamura reviewed requests/status on engineering testing on IODP platform (LWC: USIO, active heave compensator, SCIMPI, MDHMS) as well as its process. It has been also noted that all the panels have been apprised of the engineering testing time policy endorsed by EDP consensus.

Iterrino showed a plan for engineering testing of SCIMPI, which will be made at Hydrate Ridge. The proposal is to drill a 200-m borehole for SCIMPI and deploy a 7-element SCIMPI string within 3 days. Kawamura commented on the procedure to determine the schedule of the engineering testing. Panel members/observers asked questions and gave comments.

Agenda Item #30: Update on the Technology Roadmap (by Ask)

Ask suggested to organize working group to update the Technology Roadmap. The group consists of Holloway (USA), Ussler (USA, Lead), Ikegami (Japan), Doan (ECORD), Asanuma (Japan), Ask (ECORD), and Haixiong (China). IOs can input some comments. There should be a link between STP-EDP TR will be updated.

Agenda Item (unnumbered): China deepwater presentation (by Xiang)

Xiang introduced activities in Chinese IODP groups. Currently, systems have been deployed in water depths of 500 to 3000 m. Deep water drilling (>3000-m) is planned in the South China Sea and drill rigs are being built. New exploration wells are being drilled in west Africa, Hainan Island, and the South China Sea (water depth is around 1500-m). There is no news on construction of Chinese science ocean drilling vessel.

Agenda Item #31: Review Consensus Items, Recommendations, and Action Items (by Ask)

EDP started to write an executive summary of the EDP#10 meeting. Ask suggested sending documentation to the EDP members and asked for comments during lunch. The comments to IWG+ should be sent ASAP because they have a meeting from 20-22 January 2010.

Agenda Item #32: Deep Drilling Scoping Studies and Frontiers Discussion (by Ask/Asanuma/Thorogood), Executive session

Agenda Item #33: Completion of Writing Assignments (by Ask), Executive session

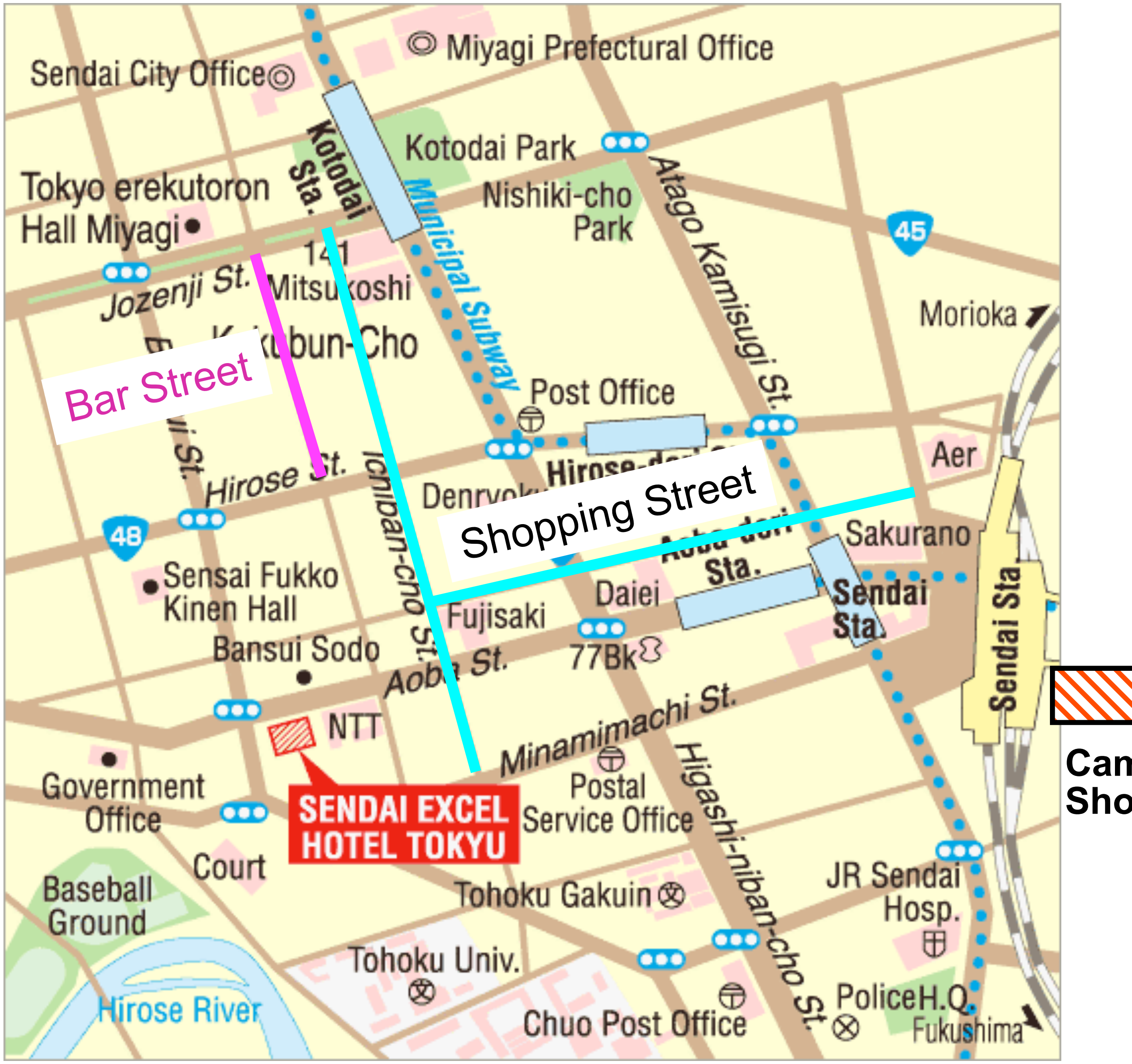
Agenda Item #34: Finalize Consensus Items and Recommendations (by Ask), Executive session

Agenda Item #35: Parting Comments (by Asanuma), Executive session

Announcement on EDP #10 meeting (13-15 Jan., 2010)

Host:
Hiroshi Asanuma, Associate Professor
Graduate School of Environmental Studies
Tohoku University
asanuma@ni2.kankyo.tohoku.ac.jp
TEL&FAX +81-22-795-7399

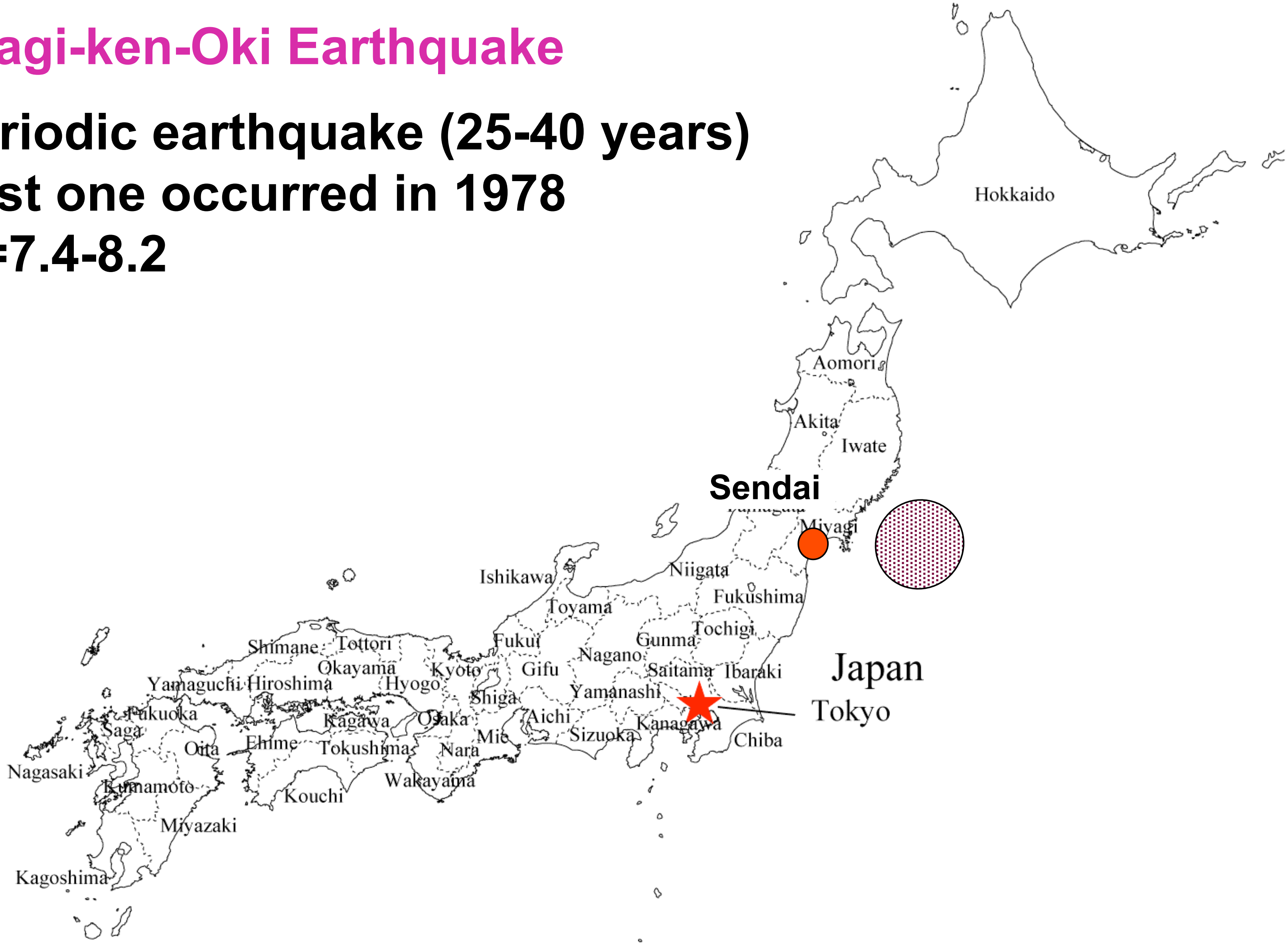
Map of downtown Sendai



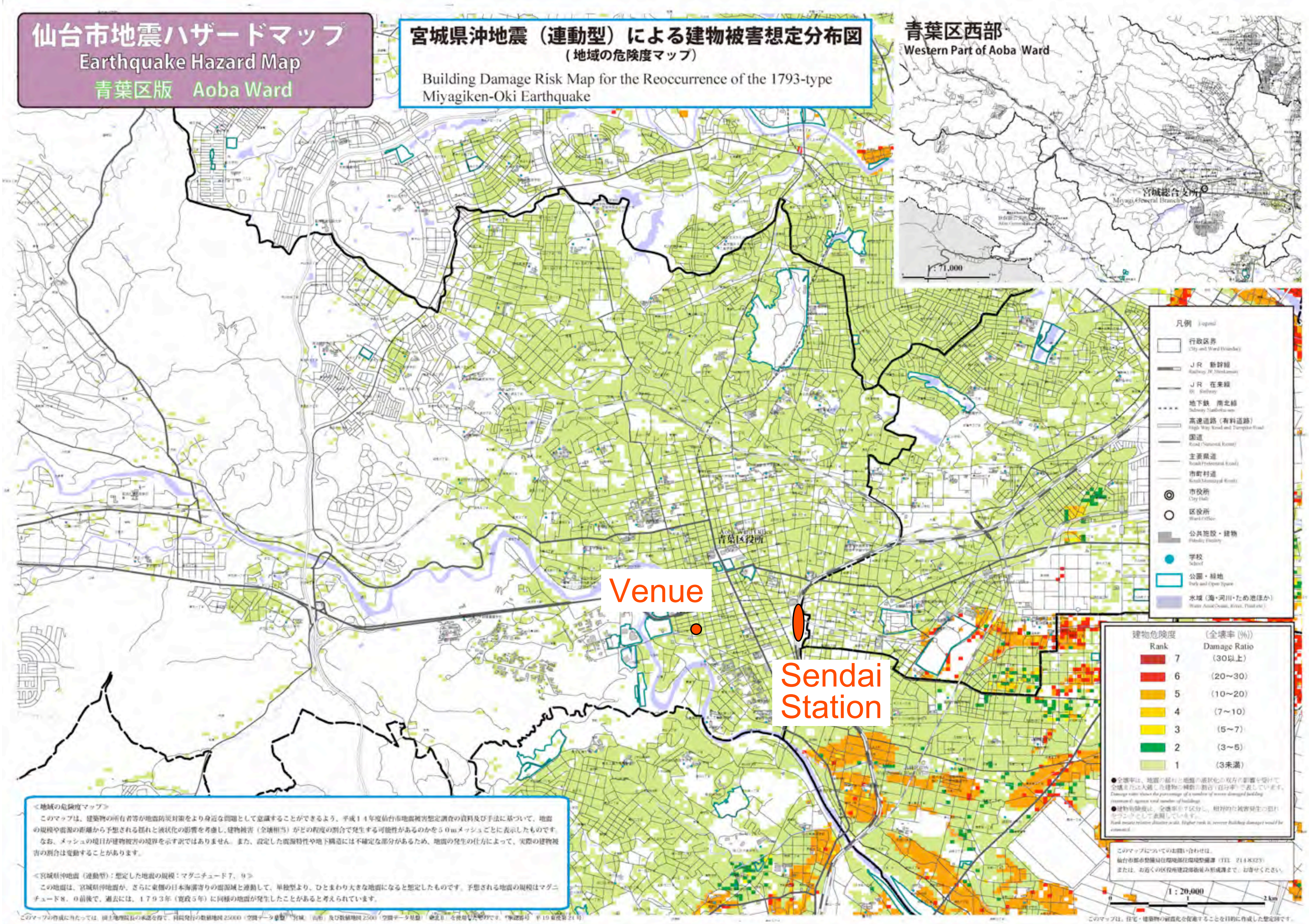
Earthquake hazard

Miyagi-ken-Oki Earthquake

Periodic earthquake (25-40 years)
Last one occurred in 1978
M=7.4-8.2



Hazard Map


仙台市地震ハザードマップ
Earthquake Hazard Map
青葉区版 Aoba Ward
宮城県沖地震（連動型）による建物被害想定分布図
（地域の危険度マップ）
Building Damage Risk Map for the Reoccurrence of the 1793-type Miyagiken-Oki Earthquake
青葉区西部
Western Part of Aoba Ward
1 : 71,000
凡例
行政区界
ＪＲ 新幹線
ＪＲ 在来線
地下鉄 南北線
高速道路（有料道路）
国道
主要県道
市町村道
市役所
区役所
公共施設・建物
学校
公園・緑地
水域（海・河川・ため池ほか）
青葉区役所
Venue
Sendai Station
建物危険度
Rank
（全壊率（%））
Damage Ratio
7 （30以上）
6 （20～30）
5 （10～20）
4 （7～10）
3 （5～7）
2 （3～5）
1 （3未満）
1 : 20,000
2 km

If it occurred…….

In the hotel

- Do not rush out from your room
- Open the door to secure an exit
- Electricity will be cut off for a while, but back-up system will start very soon
- Follow instruction from the hotel staff

Outside of the hotel

- Protect your head and keep away from dangerous objects (glass, wall, signboard)
- Try to come back the hotel on foot, or find police for their help

Events

13 (Wednesday)

*Official banquet (18:00-20:00, in this hotel)

14 (Thursday) (optional)

*Donto-Festival in Ohsaki-Hachiman Shrine
A kind on local “fire-festival” to wish health and business success of the year.
(Risk to get **LOST**)

15 (Friday) (optional)

*Shabu-shabu restaurants (by your own expense, 45USD with drink, **15 seats max**.)
One of the Japanese style to enjoy beef

16 (Sunday) (Optional)

*University tour: (Earthquake Monitoring Center, Tsunami Engineering Laboratory, Subsurface Radar Laboratory)
*Tour around Sendai (dependent on weather)

Excursion (optional)

9:30	Depart from Excel Tokyu Hotel
9:40～10:10	Subsurface Radar Laboratory
10:20～11:00	Tsunami Engineering Laboratory
11:10～11:50	Research Center for Prediction of Earthquakes and Volcanic Eruptions
12:00～12:40	Lunch
12:40～14:00	Move to Matsushima Island
14:00～15:00	Matsushima
15:00～16:00	Move to JR Sendai Station
16:10	Breakup at Tokyu Hotel

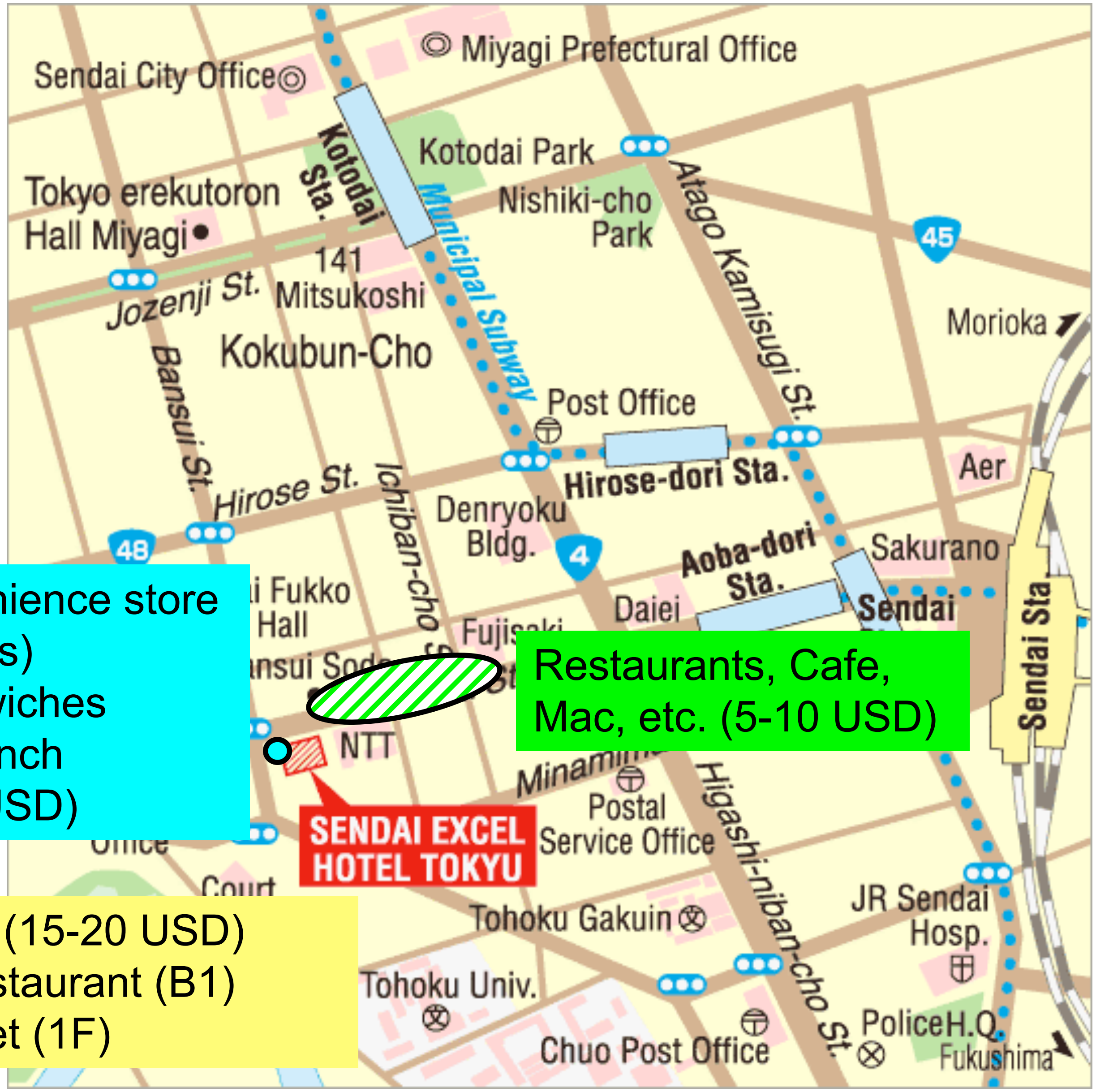
Some seats are still available. PLS contact Hiro for on-site registration.

To members of "comment at EDP#10 on outputs from INVEST" WG

- **PLS bring/send your comments on INVEST output (ED plan, strategy, implementation) by noon 14 Jan. to Hiro in any style (email, memory stick, handwriting).**
- **Simple and itemized comments are welcomed.**
- **PLS come to the meeting room by 8:00 on 15 Jan. for finalization of the comments**

WG members: Hiro Asanuma, John Tauxe, John Thorogood, Greg Myers, Sanny Saito, Yuuichi Shinmoto, Yoshi Kawamura, Sally Morgan/Dan Evans

Lunch (by your own expense)



Convenience store (Sankus)
-Sandwiches
-Box lunch
(5-10 USD)

Restaurants, Cafe, Mac, etc. (5-10 USD)

In this Hotel (15-20 USD)
-Chinese restaurant (B1)
-Lunch Buffet (1F)

Participants to “Fire-festival”, evening 14 Jan.

Leave the hotel at 18:30

○Sanny Saito, Dan Evans, Sally Morgan

○Hiro Asanuma, Mai-linh Doan, Maria Ask

○Hiromi Fujimoto, Hai Xiong Tang, T. Ikegami, Y. Watanabe

○Mitsuo Tamura, J. Kasahara, T. Nakagawa, H. Inooka

- It would be better to bring some paper to burn (no plastic) to wish your health and happiness of the year. It is believed that your writing will be improved after burning handwriting documents.
- Avoid big handbags and camera.
- You should pay attention to pickpocket.

EDP Meeting #10

January 13 – 15, 2009

Sendai, Japan

Robert’s Rules of Order

- Some basic principles and procedures apply to all decision making processes; these principles and procedures are referred to formally as 'parliamentary procedure'.
- Parliamentary procedures are the rules that help us maintain order and fairness in all decision-making processes.
- Robert's Rules of Order is one man's presentation and discussion of parliamentary procedure that has become the leading authority in most organizations today.

Robert's Rules of Order

- Each meeting follows an order of business (agenda)
- Only one main motion can be pending at a time
- Only one member can be assigned the floor at a time
- Members take turns speaking
- No member speaks twice about a motion until all members have had the opportunity to speak

Robert's Rules of Order

- Members take their seats promptly when the chair calls the meeting to order, and conversation stops
- Members raise their hands to be recognized by the chair and don't speak out of turn
- In debate, members do not 'cross talk', or talk directly to each other, when another member is speaking
- Members keep their discussion to the issues, not to personalities or other members' motives
- Members speak clearly and loudly (and slowly) so all can hear
- Members listen when others are speaking

The EDP version of Robert's Rules of Order

1. EDP generally discuss a topic at considerable length
2. Make a **motion** that will be the outcome of EDP (not by the chair)
3. Obtain a **second**
4. Open the floor for **discussion**
5. At end of discussion, make **consensus** statement.

- If the motion is called…the chair is required to get a formal in favor, opposed
- If there are concerned about an item, the chair will need to get a hand count and record that.

Robert's Rules of Order - terminology

- Ask for **modifications**
- Ask for a **motion**
- Ask for a **second**
- Ask if all in **favor**
- Ask if any **opposed**
- Ask if any **abstaining**
- Call the question

EDP Terms of Reference: General purpose

- EDP reports to the SPC (*Science Planning Committee*) and may communicate directly with IODP-MI (*IODP Management International*).
- EDP shall provide advice on matters related to he technological needs and engineering developments necessary to meet the science objectives of active IODP proposals and the IODP ISP (*Initial Science Plan*)
  - To the SPC ➔ SPPOC (*Science Planning and Policy Oversight Committee)*
  - To the IODP-MI ➔ IOs (*Implementing Organizations*)

EDP Terms of Reference: Mandate

- EDP shall identify long-term (2-5 year lead time) technological needs determined from active drilling proposals and the ISP
- EDP shall recommend priorities for ED to meet those needs for the
  - annual IODP engineering plan
  - longer term
- As requested by the Science Steering and Evaluation Panel (SSEP) or the SPC, the EDP shall review IODP drilling proposals
  - to assess IODP technological readiness to achieve the proposed objectives, and where appropriate,
  - recommend priorities for technological approaches and necessary engineering developments.

EDP Terms of Reference: Mandate

Appropriate topics shall include:

- Assessment of commercial, off-the-shelf technology to determine if it can optimally meet identified IODP technological needs or whether research and development is required.
- Appropriate modes for pursuing engineering development projects (i.e., through the IODP, universities, industry, or joint ventures).
- Performance requirements for specific technological needs.
- Procedures to develop and evaluate program contracts in support of technical design and innovation.

Schedule for taking the meeting minutes

Day 1 morning – Mitsuo Tamura (JPN)
Day 1 afternoon – John Tauxe (US)

Day 2 morning – Mai-Linh Doan (ECORD)
Day 2 afternoon – Mike Maler (US)

Day 3 morning – Hiroshi Asanuma (JPN)
Day 3 afternoon – Yoshi Kawamura (ODP-MI), Maria Ask (ECORD)

Goals / Tasks of EDP Meeting #10

1. Information about "*new*" IODP-MI: Personnel, Roles and Responsibilities
2. Determine the fate of the Engineering Development Proposal Process (new and ongoing)
3. Push forward with scoping studies
    1. deep drilling (including SPC request)
    2. drilling frontiers
4. Review SSEP Proposals
5. Review and comment the Microbiology report
6. Comment on the ship-time request.
7. Get feedback from the INVEST meeting, especially concerning the EDP TWP.
8. EDP Technology Roadmap Ver.3.0

EDP Meeting #10 Draft Agenda

January 13-15, 2010

Sendai, Japan

DAY 1: Wednesday, January 13 (8:30-17:30)

1. Welcoming Remarks; Meeting Logistics, Safety (Asanuma) 15 minutes	08:30 – 08:45
2. Introduction, Robert's Rules (Ask) 15 minutes	08:45 – 09:00
3. Approval of Meeting Agenda (Ask) 15 minutes	09:00 – 09:15
4. Quorum Discussion (Ask) 5 minutes	09:15 – 09:20
5. Approve Minutes from EDP Meeting #9 (Ask) 10 minutes	09:20 – 09:30
6. Preliminary Discussion of next 2 Meeting Locations and Times	09:30 – 09:45
a. EDP #11 – USA (Tauxe) 10 minutes b. EDP #12 – Europe (Doan) 5 minutes	
7. Review Status of Previous Meeting Action Items and Recommendations (Ask) 20 minutes	09:45 – 10:05
COFFEE	10:05 – 10:30
8. SPC Report (Kasahara) 15 minutes	10:30 – 10:45
9. SSEP Report (Tauxe) 10 minutes	10:45 – 10:55
10. STP Report (Saito) 10 minutes	10:55 – 11:05
11. Operatory Reports and Status of FY10 Engineering Developments (including 3rd party tools)	
a. CDEX – 30 minutes	11:05 – 11:35
b. ESO – 30 minutes	11:35 – 12:05
LUNCH	12:05 – 13:30
c. USIO – 60 minutes	13:30 – 14:30
12. Introduction of IODP-MI President (Suyehiro) 15 minutes	14:30 – 14:45
13. Explanation of EDP/IODP-MI Communications (Suyehiro) 25 minutes	14:45 – 15:10
COFFEE	15:10 – 15:25
14. INVEST Workshop Report and Discussion - implementation and the Renewal Process (Suyehiro/Asanuma /Watanabe/Ask) 65 minutes	15:25 – 16:45
15. Feedback INVEST Technology White Paper Report (Asanuma) 15 minutes	16:45 – 17:30

Day 2: Thursday, January 14 (8:30-17:30)

16. Introduction of IODP-MI Operations Manager (Kawamura) 15 minutes	08:30 – 08:45
17. FY10 and FY11 Engineering Development Plans (Kawamura) 15 minutes	08:45 – 09:00
18. EDP Final Comments on FY10 and FY11 Engineering Development Plan (Ask) 45 minutes	09:00 – 09:45
COFFEE	09:45 – 10:00
19. Review of Operations Review Task Force Recommendations (NanTroSEIZE Stage 1 and PEAT Expeditions) (Kawamura) 45 minutes	10:00 – 10:45
20. Technical Review of Active Drilling Proposals Forwarded from SSEP (Watchdogs) 90 minutes 743-Full - Gulf of Mexico Hydrates Holloway (lead); Ikegami; Doan 758-Full - Atlantis Massif Thorogood (lead); Tamura; Mahler	10:45 – 12:00
LUNCH	12:00 – 13:00
Continuation of 20. Technical Review of Active Drilling Proposals…	13:00 – 13:45
21. Break-out Session - 2 groups to write Technical Reviews of Active Drilling Proposals Forwarded from SSEP (all welcome) 75 minutes	13:45 – 15:00
COFFEE	15:00 – 15:30
22. Status and Discussion of Scoping Studies (Kawamura) 30 minutes	15:30 – 16:00
23. Deep Drilling Frontiers (Thorogood/Myers) 60 minutes	16:00 – 16:30
24. Microbiology Contamination Report Discussion (Thorogood/Morono) 60 minutes	16:30 – 17:30

DAY 3: Friday January, 15 (8:30 – 12:00)

25. Preliminary Agenda for EDP Meeting #11 (Ask) 15 minutes	08:30 – 08:45
26. Next Meeting Location and Time (Ask/Tauxe) 15 minutes	08:45 – 09:00
27. EDP Final Comments on Scoping Studies (Ask) 10-15 minutes This is to give EDP a chance to comment regarding scoping studies.	
28. Finalize Technical Reviews of Active Drilling Proposals Forwarded from SSEP (Ask) 60 minutes	09:00 – 10:00
COFFEE	10:00 – 10:15
29. Review of Ship-time Request for Engineering Testing (Kawamura/Itterino) 30 minutes.	10:15 – 10:45
30. Update on the Technology Roadmap (Ask) 30 minutes	10:45 – 11:15
31. Review Consensus Items, Recommendations, and Action Items (Ask) 75 minutes a. Phrasing b. Routing c. Background	11:15 – 12:00
LUNCH	12:00 – 13:15

DAY 3: Friday, January 15 (13:15–17:30)
EXECUTIVE SESSION

32. Deep Drilling Scoping Studies and Frontiers Discussion (Ask/Asanuma/Thorogood) 75 minutes	13:15 – 14:30
33. Completion of Writing Assignments (Ask) 30 minutes	14:30 – 15:30
COFFEE	15:00 – 15:30
34. Finalize Consensus Items and Recommendations (Ask) 90 minutes a. Phrasing b. Background c. Routing	15:30 – 17:15
35. Parting Comments (Asanuma) 15 minutes	17:15 – 17:30

Approval of Meeting Agenda

Goals / Tasks of EDP Meeting #10

1. Information about “*new*” IODP-MI: Roles and Responsibilities
2. Determine the fate of the Engineering Development Proposal Process (new and ongoing)
3. Push forward with scoping studies
    1. deep drilling
    2. drilling frontiers
4. Review SSEP Proposals
5. Review and comment the Microbiology report
6. Addressing the SPC request
7. Comment on the ship-time request.
8. Get feedback from the INVEST meeting, especially concerning the EDP TWP.
9. EDP Technology Roadmap Ver.3.0

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A Candidate for EDP #11: Santa Fe, New Mexico

John Tauxe

Neptune and Company

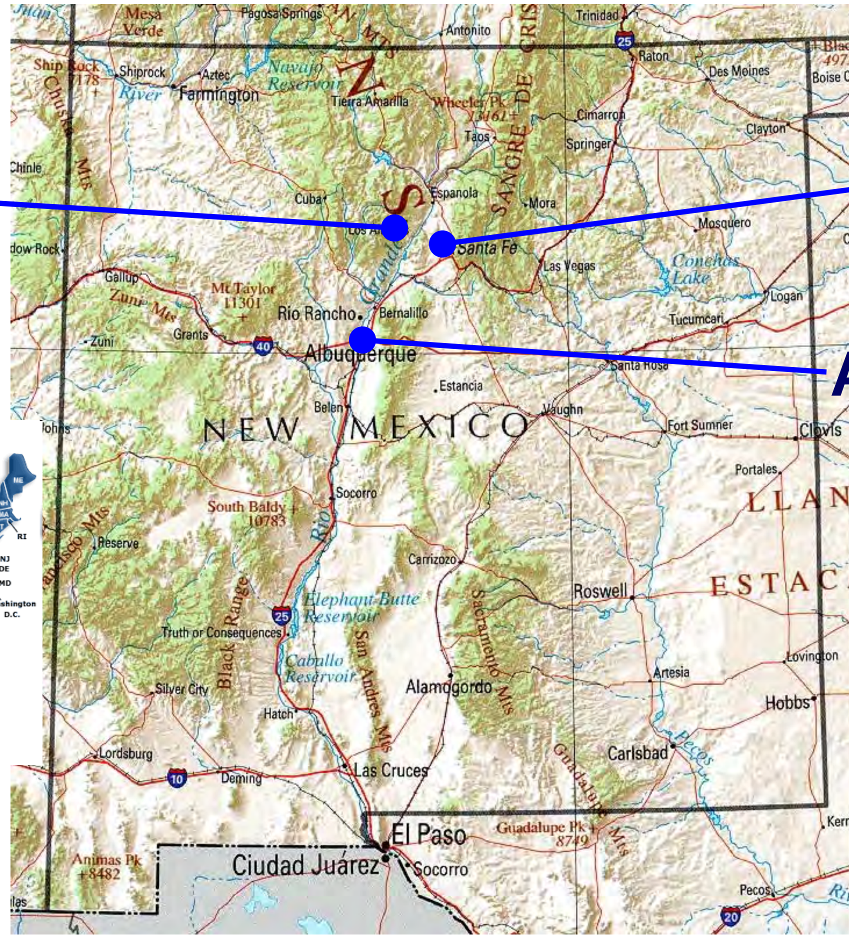
Los Alamos, NM

iodp engineering development panel

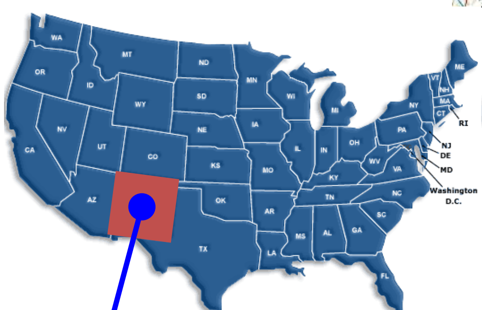
Locations in New Mexico

Los Alamos
pop. ~12,000

State Capitol
Santa Fe
pop. ~70,000



Albuquerque
pop. ~850,000



New Mexico
pop. ~2,000,000

State question:
Red or green?

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Connections to Albuquerque

By road:

Interstates 

(N-S) and 

(E-W)

Route 66 

By train:

Amtrak from Los Angeles or Chicago

By air:

Albuquerque (ABQ) from many major airports;

by United, Delta, American Continental…

Direct to Santa Fe (SAF) via LAX or DFW, for $$$

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Albuquerque to Santa Fe

By road: I-25, or "Turquoise Trail"

- rental car (1 hr 45 min drive)
- shuttle van (to hotel or nearby)

By train:

- New Mexico Rail Runner
- requires bus or taxi to train station from airport in ABQ
- requires taxi from railyard to hotel in Santa Fe

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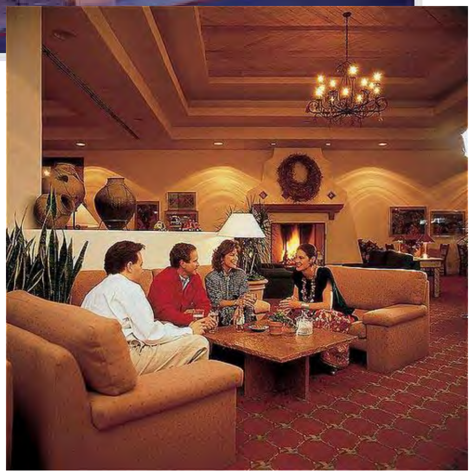
Santa Fe Accommodations

The Eldorado



La Fonda

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Santa Fe Attractions

southwestern cuisine

art

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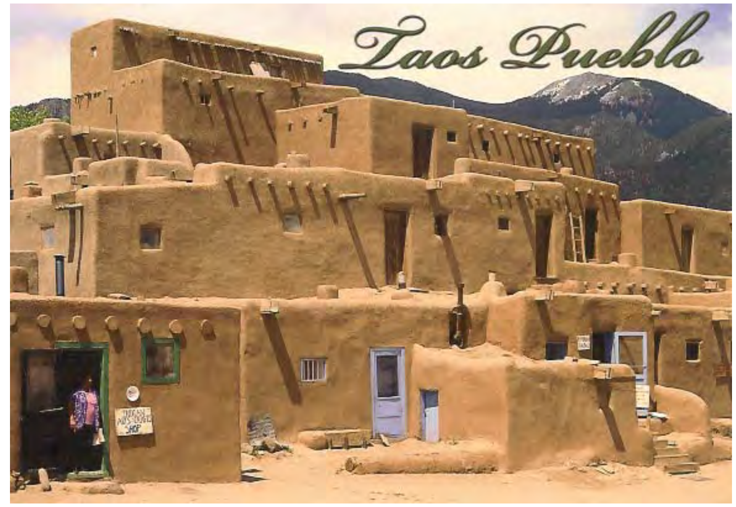
Regional Attractions



Los Alamos and the Jemez Mts.

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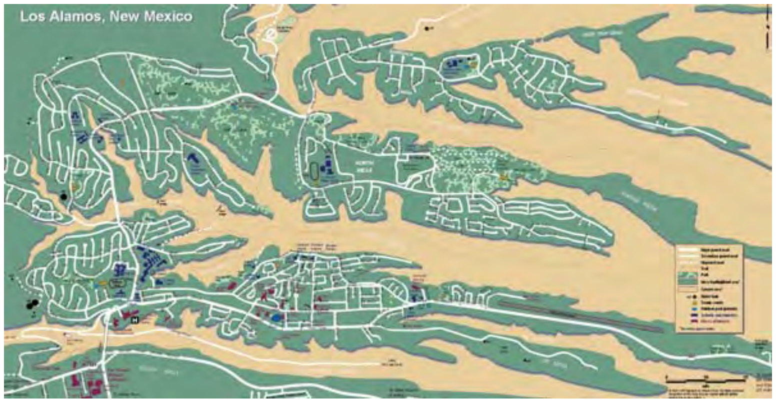
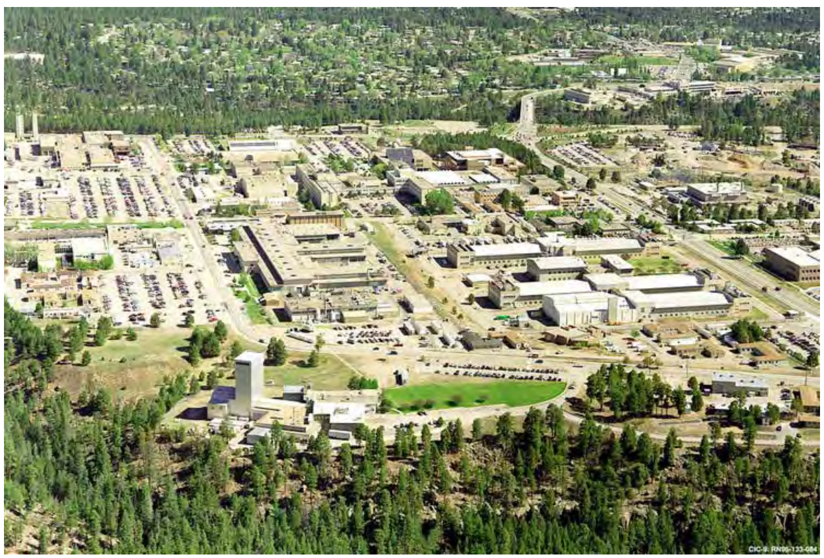
Los Alamos Attractions





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Valles Caldera National Preserve

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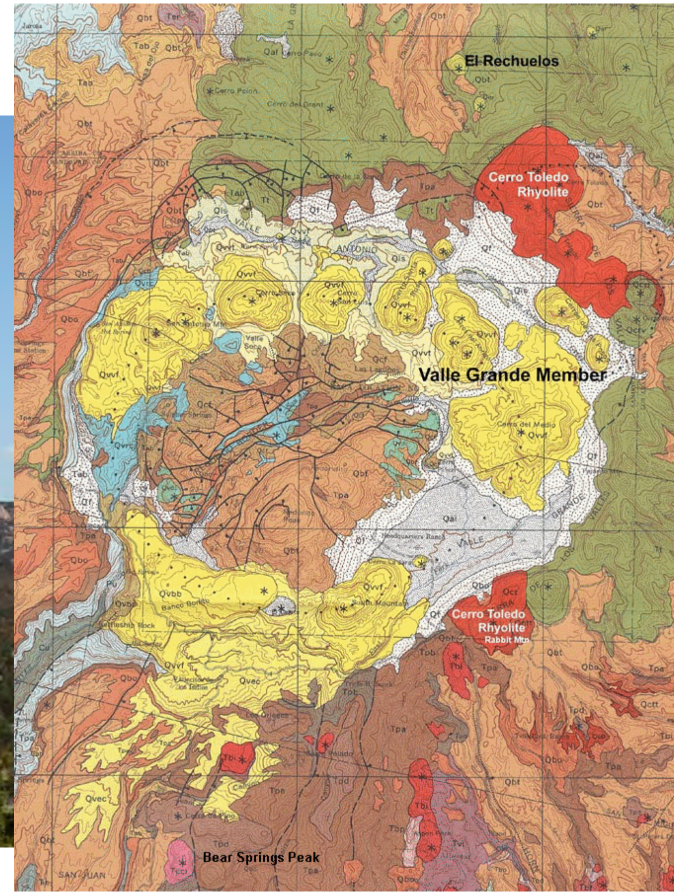
Excursion Ideas…

Geology field trip to Jemez Volcanic Complex with Fraser Goff



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Excursion Ideas…

Environmental investigations at Los Alamos National Laboratory

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Excursion Ideas…

Radioactive Waste at Los Alamos National Laboratory

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Excursion Ideas…

A visit to the famous BLACK HOLE, a surplus store in Los Alamos

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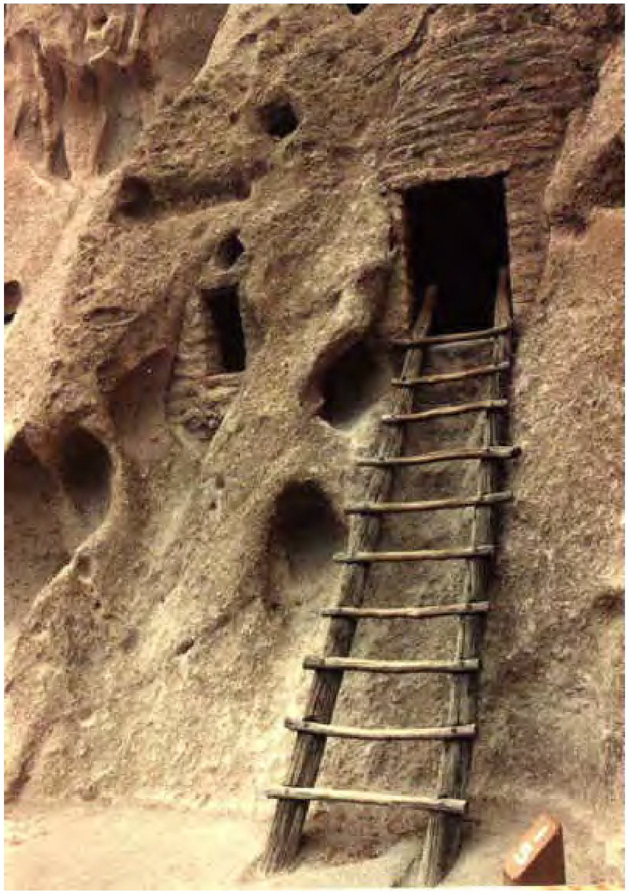
Excursion Ideas…

Field trip to Bandelier National Monument



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Excursion Ideas…

of just go for a hike…


Grenoble EDP12
January 2011

Going to Grenoble

Grenoble lies within the French Alps but is of easy access

1h05 by bus shuttle from
Lyon International Airport
(LYS with major companies: AF, BA, LH)

3h by bullet train from Paris

3 motorways

Scheduled meeting location

Maison Sciences de l'Homme

http://www.msh-alpes.prd.fr/

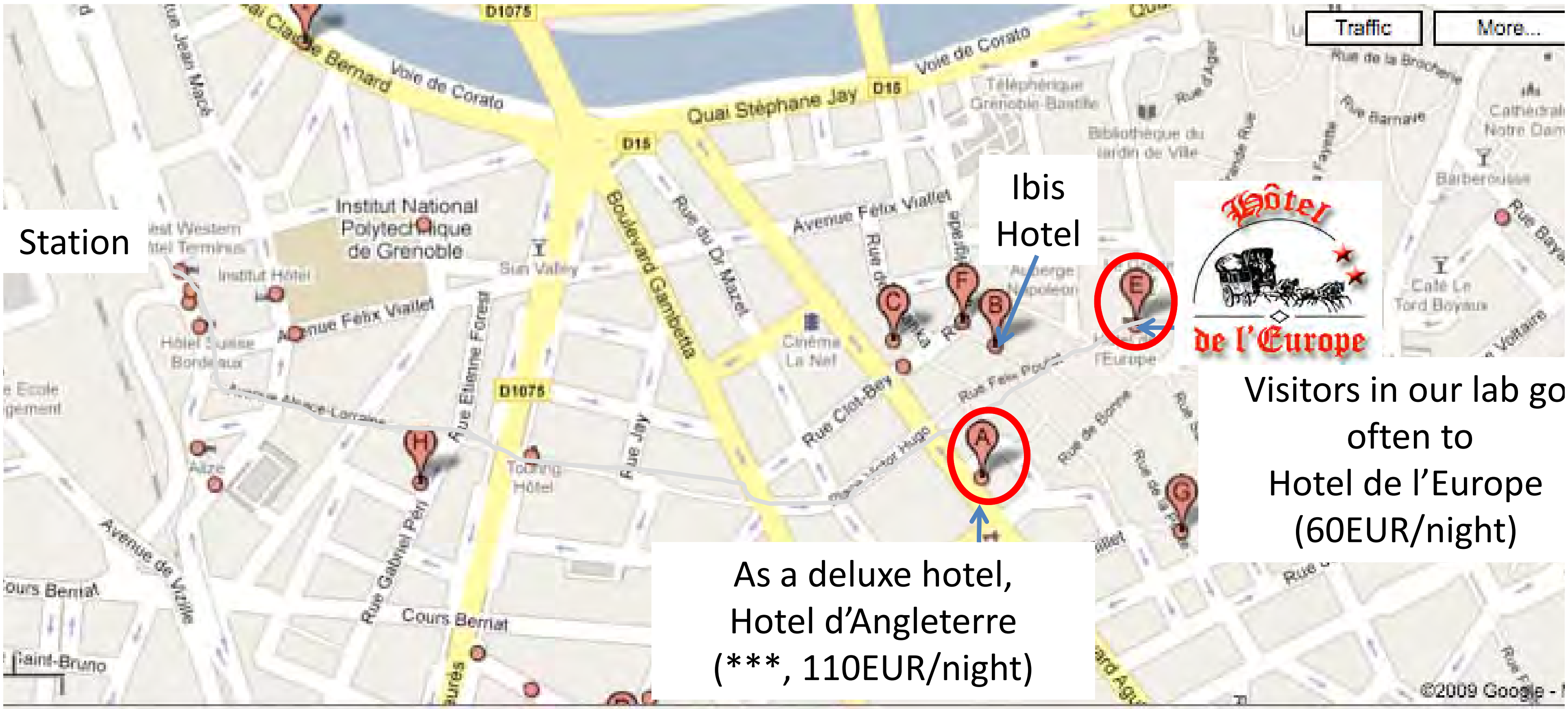
in Grenoble Campus

(some says it is the most beautiful campus in France)

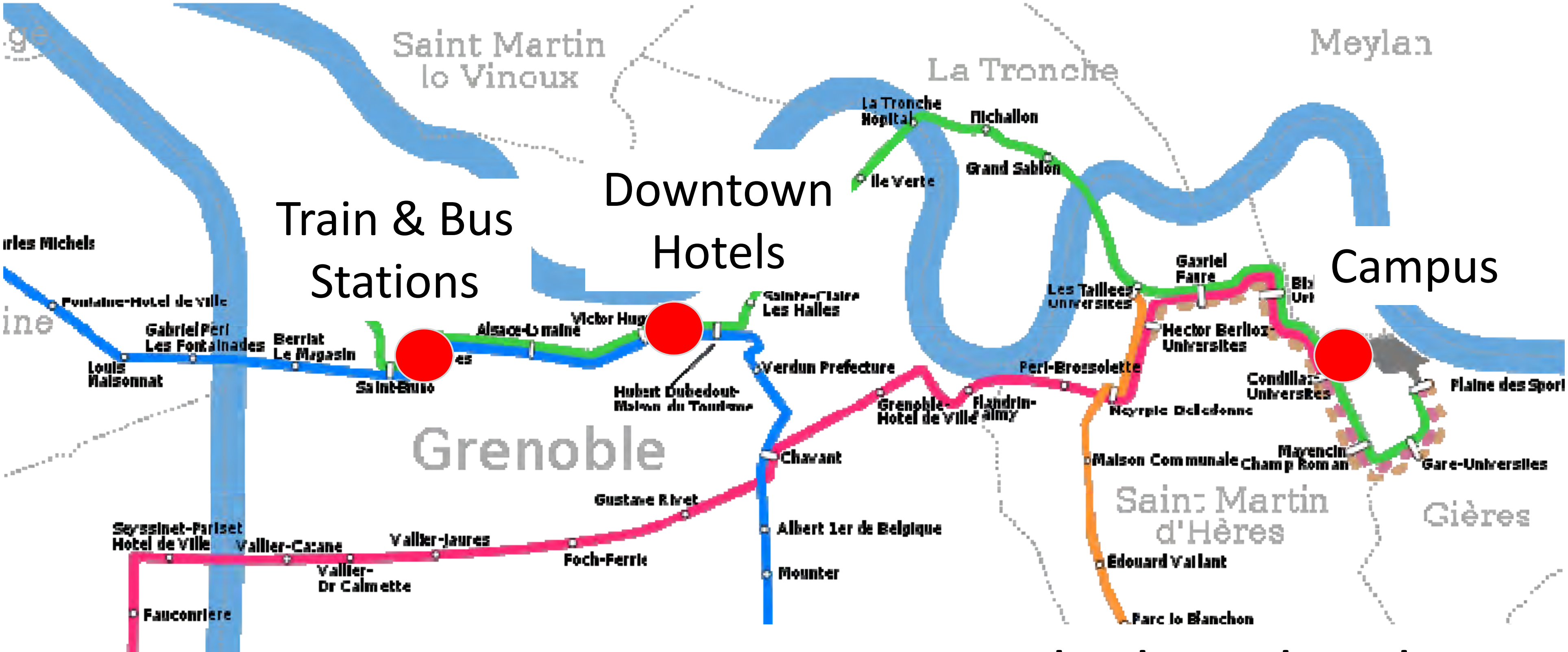
- It welcomes dozens of meetings and conferences per year
- Meeting room for 30 persons
- Facilities for videoconferencing

Downtown hotels

The proposed hotel would be Hotel de l'Europe
(http://www.**hoteleurope**.fr),
but there is a lot of choice downtown



Sites and Transportation



Transportation by bus shuttle

Easy transportation between site by modern tramway

Post-meeting activities

Scientific visits:

- ESRF Synchrotron
- ILL nuclear reactor

Touristic attractions:

- Medieval town of Annecy
- Several ski resorts around: Chamrousse , Alpes d'Huez, les Deux Alpes, …


Welcome to Grenoble!

EDP 9 Recommendations and Action Items

Item	Title	Update / Status
0907-01	Approval of Agenda	N/A
0907-02	Approval of EDP Meeting #8 Minutes	N/A
0907-03	EDP SPC Representative	N/A
0907-04	EDP STP Liaison	N/A
0907-05	EDP Meeting #10	N/A
0907-06	EDP Meeting #11	Finalized during this meeting.
0907-07	Endorsement of Field Testing of the Riserless Mud Recovery System	N/A
0907-08	EDP Review of non-Science Operating Cost proposals	N/A

EDP 9 Recommendations and Action Items

Item	Title	Update / Status
0907-09	EDP Review of non-Science Operating Cost supported projects	N/A
0907-10	Development of an External Review Process for Engineering Development Proposals	On hold due to reorganization of IODP-MI. It is unclear what IODP-MI's future role in Engineering Development will be.
0907-11	EDP Technology Roadmap version 3.0	The roadmap version 3.0 is posted on the website for public view.
0907-12	EDP Vice chairs	EDP Consensus via electronic mail nominated Maria Ask as co Vice-chair
0907-13	IODP-MI Efforts to Integrate Engineering	N/A

EDP 9 Recommendations and Action Items

Item	Title	Update / Status
0907-14	Modifications to the At-sea Engineering Testing Policy	Modified policy is posted for public view.
0907-15	Continued IODP-MI Support of the EDP	Plan forward will be discussed in Agenda Item 1 13
0907-16	Request for Tool Loss Report for the MSS	Greg Myers will summarize the findings and corrective actions from this report.
0907-17	Outgoing EDP members	N/A

IODP Science Planning Committee 14th Meeting, 25–27 August 2009 IFM-GEOMAR/Kiel University, Kiel, Germany

Junzo Kasahara
SPC Vice Chair

- **4.2.2 SPC discussion and prioritization**
- **SPC Consensus 0908-04**: The SPC approves the engineering development plan for FY2011. The SPC also endorses expanding the definition of IODP-related engineering developments to include those with external funding and those developed outside the IODP framework.

- **SPC Consensus 0908-08:** The SPC receives EDP Consensus 0907-07 on field testing of the riserless mud recovery system,
- 0907-11 on the EDP roadmap,
- 0907-13 on integrating engineering development, and
- 0907-14 on the at-sea engineering testing policy.

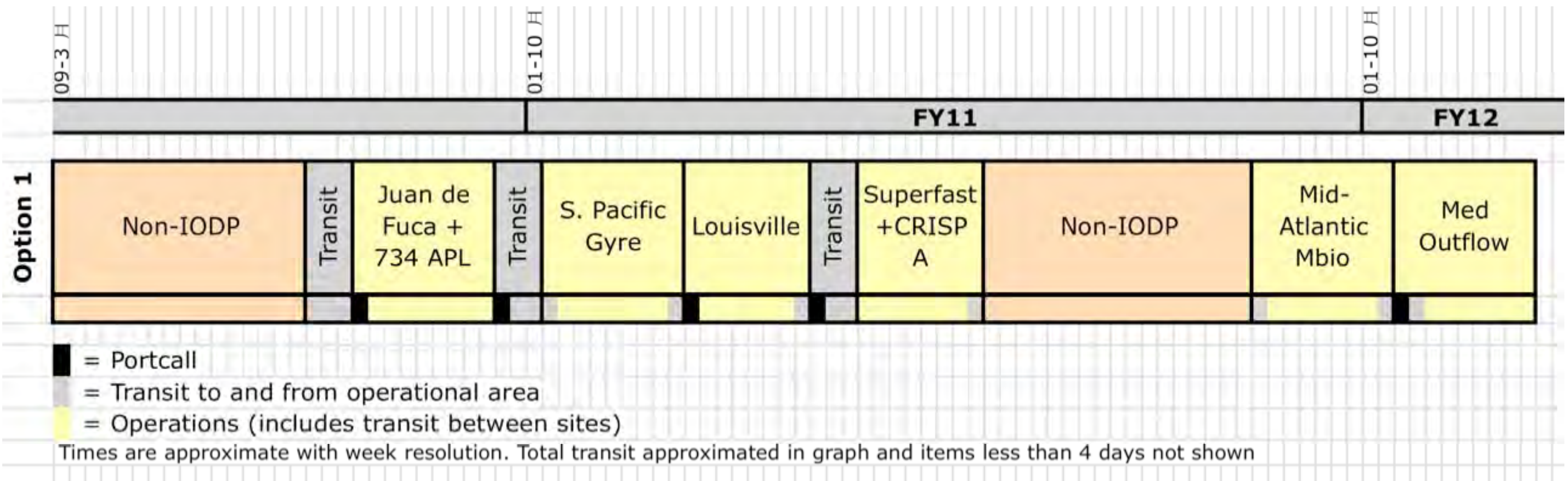
- **SPC Consensus 0908-10:** The SPC accepts EDP Consensus 0907-15 on the current support of EDP by IODP-MI and forwards it to IODP-MI. The SPC acknowledges the valuable role that IODP-MI provided to EDP, and wishes to see a good continuity of this function during and after the relocation of offices.

- **SPC Consensus 0908-12:** The SPC commends the efforts of the "Flexible Expedition Implementation" Working Group (Filippelli, Ohkouchi, Peterson) to explore schemes at the proposal level and SPC level that would ensure achievement of top science objectives while allowing maximum implementation flexibility.

- The SPC asks the Operations Task Force (OTF) to use the guidelines of the Flexible Implementation Working Group report to develop a plan that optimizes the allocation of operational days to these expeditions. Scheduling of the Mediterranean Outflow (Proposal 644-Full2) expedition is tentatively set for early FY2012 but needs to be confirmed later.

- **SPC Consensus 0908-13:** The SPC approves the following five-month operational plan and contingencies for *Chikyu*, with starting date in FY2011 to be determined.
- **Case 1** (top priority): (1) Site NT2-01 (observatory); (2) Site NT3-01 (riser drilling); and (3) Site NT3-01 (riserless observatory).
- **Case 2** (second priority): riser drilling at Site NT3-01.
- **Case 3** (third priority if the Kuroshio current is determined to be too strong for riser drilling): (1) Site NT2-01 (observatory); (2) Site NT3-01 (riserless observatory); (3) NT3-01 (non-riser drilling of riser top hole); and (4) Okinawa Trough Deep Biosphere (Proposal 601-Full3).

- If extreme Kuroshio currents prohibit Case 3, Case 4a and Case 4b are to be considered (more information needs to be provided by CDEX to determine the priority ranking between cases 4a and 4b):
- **Case 4a**: (1) Site NT2-01 (observatory); (2) Site NT3-01 (riserless observatory); and (3) Okinawa Trough Deep Biosphere (Proposal 601-Full3).
- **Case 4b**: (1) Site NT2-01 (observatory); (2) Site NT3-01 (riserless observatory); and (3) Mariana Convergent Margin (Proposal 505-Full5).


09-3 月
01-10 月
01-10 月
FY11
FY12
Option 1
Non-IODP
Transit
Juan de Fuca + 734 APL
Transit
S. Pacific Gyre
Louisville
Transit
Superfast +CRISP A
Non-IODP
Mid-Atlantic Mbio
Med Outflow
= Portcall
= Transit to and from operational area
= Operations (includes transit between sites)
Times are approximate with week resolution. Total transit approximated in graph and items less than 4 days not shown

- **SPC Consensus 0908-15:** The SPC approves the following *JOIDES Resolution* schedule for late FY2010 and FY2011: (1) Juan de Fuca Flank Hydrogeology (Proposal 545-Full3) and Cascadia Accretionary Prism CORK (Proposal 734-APL); (2) South Pacific Gyre Microbiology (Proposal 662-Full3); (3) Louisville Seamounts (Proposal 636-Full3); (4) Superfast Spreading Crust (Proposal 552-Full5) + Costa Rica Seismogenesis Project (CRISP) Phase A (Proposal 537A-Full5); and (5) Mid-Atlantic Ridge Microbiology (Proposal 677-Full).

- **SPC Consensus 0908-16:** The decision tree for the Superfast Spreading Crust (Proposal 552-Full5) + Costa Rica Seismogenesis Project (CRISP) Phase A (Proposal 537A-Full5) slot in the FY2011 *JOIDES Resolution* schedule would involve several steps, guided by the following basic premises:
- (1) Superfast would be implemented first, with the only objective being the deep hole;
- (2) CRISP A would have a guaranteed operational window (~50% of the operational days).
- If hole conditions at Superfast preclude significant advancement of objectives, operations will cease at Superfast and begin immediately at CRISP A objectives.
- If site conditions are adequate and Superfast can commence, operations will continue at Superfast, and stop without debate at a time such that ~50% of the operational days can occur at CRISP A.

- The SPC endorses the guidelines outlined in the working group report and acknowledges the need to be more pro-active in maximizing scientific outcomes for the program while retaining the primary objectives of proposals. The SPC will consider evaluating, on a case by case basis, possibilities for combining expedition objectives and/or staffing and crew, and/or for implementing flexibility in the length of expeditions.

- To aid in future scheduling considerations, the SPC asks IODP-MI to contact proponents of proposals currently residing at SPC and at OTF (but not scheduled) to prioritize their scientific objectives in light of potentially reduced implementation and operational times.

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Report to EDP from the Liaison to SSEP #13 (Melbourne, Nov 2009)

John Tauxe, EDP Liaison

Neptune and Company

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General Concerns of SSEP

(Not necessarily engineering concerns…)

- Idle time for the *JR* platform
- Allowing the ship to do commercial work can undermine perceptions of scientific integrity
- Unknown risks of hiring out the ship
- Proposals are being submitted without the requisite background data.

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Concerns from CDEX

- *Chikyu* is an industrial culture, creating challenges in continuity and team-building.
- Core recovery has been poor (35%) with terrible quality (cuttings and mush), though this was rotary drilling in heterogeneous materials, with the priority being to make hole.
- Logging was canceled.
- The lack of experienced core techs results in the inability to have contingencies.
- The cryogenic magnetometer is down, even after repairs.

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Report from ESO

- Core quality from New Jersey is reported to be excellent.

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Proposals with Engineering Interest

Of the 17 proposals submitted,

- 3 were at high latitude,
- 2 involved pressure coring,
- 2 addressed submarine landslide geohazards,
- 1 proposed rock drilling from the sea floor in a carbonate "Lost city" type hydrothermal field,
- 2 list microbiological sampling (and instrumentation) as a high priority objective,
- 1 proposes side-wall coring,
- 4 propose *in-situ* fluid and/or gas sampling, and
- 3 propose drilling into high temperatures.

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Recurring Engineering Themes

- drilling into hydrothermally active areas
- sampling of *in-situ* fluids and gases
- pressure coring
- several proposals could benefit from the use of sea-bed frames, due to drilling into unstable or heterogeneous formations
- borehole instrumentation
- microbial sampling and/or monitoring

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Specific Issue: Drilling in Submarine Landslides

- Two proposals addressed this geohazard.
- Use of the CPTu (cone penetrometer with pore pressure capability) is proposed for one. This is said to be better than traditional logging tools, which might get stuck in the unconsolidated sediments.
- Safety issue: Drilling is in an unstable area – what if drilling triggers a fresh landslide? (Not an engineering issue, *per se*.)

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Other Engineering Topics

- One proposal mentioned frozen cores, but we were not able to determine what this meant.
- Use of Schlumberger's MDT (Modular Formation Dynamics Tester) was proposed on one proposal, but requires large-diameter drill pipe.
- One shallow, near-shore site (requiring a MSP) could serve as a instrument (e.g. borehole observatory) testing ground. The EDP is encouraged to consider the utility of this.

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Proposal Forwarded to EDP: 743

Dynamics of a Transient, Fault-Controlled, Thermogenic Hydrate System at MC-118 in the Gulf of Mexico

This is an ambitious and comprehensive effort to study gas hydrates.

Main SSEP question: Is the proposed drilling feasible?

Issues:

- safety concerns with encountering shallow hazards during riserless drilling
- some pressurized coring
- *in-situ* sampling of gas, salinity, and temperature
- questions about CORK compatibility
- microbiological monitoring
- installation observatory network

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Proposal Forwarded to EDP: 758

Serpentinization, fluids and life: Biogeochemical and tectono-magmatic processes in young mafic and ultramafic seafloor

This is a study of the process of serpentinization and its implications.

SSEP questions pertain to feasibility of drilling, logging, sampling, and installing observatories.

Issues:

- continuous recovery in top 50 m is critical
- use of seabed rock drilling system with wireline coring,

  e.g. MeBo rock drill, Williamson Deep Water Automated Coring System (DWACS) or ROVDRILL 3

  assuming need for a Mission-Specific Platform
- slim-line logging and installation of observatories
- *in-situ* fluid and microbial sampling

STP Report to the EDP

Clive Neal – STP Chair,
Sanny Saito – STP Vice Chair

Outline:

- EDP-relevant items from the STP August 2009 meeting.
- Contamination issue
- STP Roadmap Updates

IODP Scientific Technology Panel (STP) 9th Meeting, 17th – 19th August 2009 Jeju Island, Korea

STP #9 Meeting August 17-19, Jeju, Korea

20 Consensus Statements:

0908-01: EDP Report and White Paper and STP input
0908-02: Preservation of Cuttings from Riser Sites
0908-03: Magnetic Susceptibility Sonde (MSS)
0908-04: Expedition QA/QC Reporting
0908-05: Approval of Expedition Measurement Plans
0908-06: Reservation of platform time for non-expedition-specific purposes
0908-07: Field Testing of the Riserless Mud Recovery System
0908-08: IODP-MI Efforts to Integrate Engineering Activities
0908-09: STP Recommendations for Routine Microbiological Sampling on IODP Expeditions
0908-10: EDP Liaison and Microbiology Contamination Issues
0908-11: JOIDES Resolution Microbiology Contamination Issues
0908-12: Depth Scale Terminology Update
0908-13: Support for the SEDIS project
0908-14: Sean Higgins
0908-15: Tom Janecek
0908-16: Peter Blum
0908-17: Youn-Soo Lee
0908-18: Rick Colwell
0908-19: Paul Johnson
0908-20: Minoru Ikehara

STP #9 Meeting August 17-19, Jeju, Korea

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0908-19: Paul Johnson
0908-20: Minoru Ikehara

6 STP Consensus Statements relevant to EDP (in **yellow**)

EDP-Relevant STP Consensus Statements (1/6)

0903-01: EDP Report and White Paper and STP input

STP thanks Dr. Asanuma for his presentation of the draft EDP white paper for the INVEST meeting. STP will comment on the document and send it back to the EDP by 21st August. STP is willing to collaborate with EDP to make poster presentations at the INVEST meeting. See STP Action Item 0908-26.

Priority: High
STP suggests this be forwarded to EDP.

STP Action Item 0908-26: EDP White Paper input.
The STP members have ben asked to review and given input to the EDP white paper and send their comments to the STP chair for synthesis.

EDP-Relevant STP Consensus Statements (2/6)

0908-03: Magnetic Susceptibility Sonde (MSS)

The STP thanks Trevor Williams for the update on the Magnetic Susceptibility Sonde performance during Expedition 320. While the loss of this instrument down hole was a significant setback, the data obtained prior to the loss demonstrated the importance of including MSS in the IODP logging tool suite and STP fully supports efforts to replace this valuable instrument.

Priority: High
STP suggests this be forwarded to EDP, IODP-MI, and the USIO-LDEO.

EDP-Relevant STP Consensus Statements (3/6)

0908-06: Reservation of platform time for non-expedition-specific purposes.

The STP supports SPC's changes to guidelines that suggest 3 platform days per 2-month expedition be automatically set aside for other purposes (e.g., APLs, engineering).

Priority: Medium
STP suggests this be forwarded to SPC, EDP, IODP-MI and the IOs.

EDP-Relevant STP Consensus Statements (4/6)

0908-07: Field Testing of the Riserless Mud Recovery System

The STP fully supports the idea of field-testing of the Riserless Mud Recovery System (RMR) if an opportunity is presented for using an IODP vessel. RMR is a very promising technique for advancing deep water, deep hole drilling technology, which is important for achieving numerous IODP scientific objectives. When and if such testing occurs, STP would like to have the opportunity to review the results.

Priority: High
STP suggests this be forwarded to IODP-MI, the IOs, and EDP

EDP-Relevant STP Consensus Statements (5/6)

0908-08: IODP-MI Efforts to Integrate Engineering Activities

The STP endorses the IODP-MI efforts to integrate engineering activities including SOC-, POC-, and non-IODP-funded engineering development projects.

Priority: High
STP suggests this be forwarded to IODP-MI, EDP, Lead-Agencies

EDP-Relevant STP Consensus Statements (6/6)

EDP Liaison and Microbiology Contamination Issues

- STP Consensus Statement 0802-06
- SPC Consensus 0803-10
- EDP Action Item 0807-06
- STP Consensus Statement 0908-10

Microbiology Contamination Issues

STP Consensus Statement 0908-10: EDP Liaison and Microbiology Contamination Issues

Yuki Morono will replace Rick Colwell as the STP liaison to the EDP Microbiology Contamination Working Group.

The STP requests that this EDP working group consider strategies for reducing the drilling mud contamination of cores obtained using riser and non-riser drilling and in materials that are difficult to core (e.g., see STP Roadmap items B1-2, B2-2 and B2-5). Considerations include the modification of mud constituents to reduce contamination or the opportunity for microbial growth to occur within the muds.

Priority: High
STP suggests this be forwarded to EDP and IODP-MI.

STP's status

- STP recognizes that this is a significant issue
- STP has some knowledge about tracers
- STP wants to know how to minimize the core contamination and microbial growth

Requests from STP

- Presentation at STP #10 at Sydney in March
- Written report before STP #11 in summer
- Identify a contact person in the WG

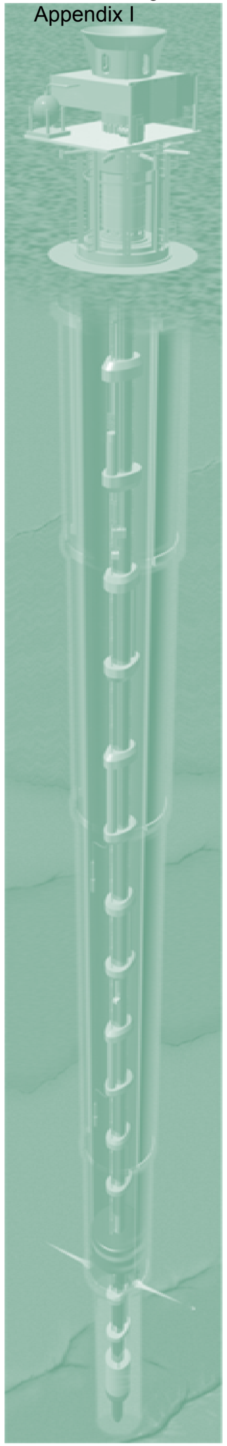
To be discussed in detail in the agenda item 22 on Day #2. Dr. Yuki Morono will attend this meeting as a Liaison of Contamination WG.

STP Roadmap updates

- Current version: 0.95
- Some updates since #9 EDP meeting
  - Revised contents and prioritization
  - Added 1 item and removed 20 items
  - 17 EDP-linked items
  - Grouping, inter-relationship, and re-numbering for 46 items
  - A set of documents including introduction, descriptions, and spread sheet.

Grouping of 46 items

- A: Shipboard/Laboratory
  - A1: Shipboard/laboratory measurements (19)
  - A2: Software/Database (3)
- B: Drilling/Coring
  - B1: Drilling technologies (4)
  - B2: Coring technologies (8)
- C: Downhole measurements
  - C1: Logging technologies (7)
  - C2: In situ measurements / fluid sampling (4)
  - C3: Long-term downhole sensors (1)
- D: Underway geophysics (3)



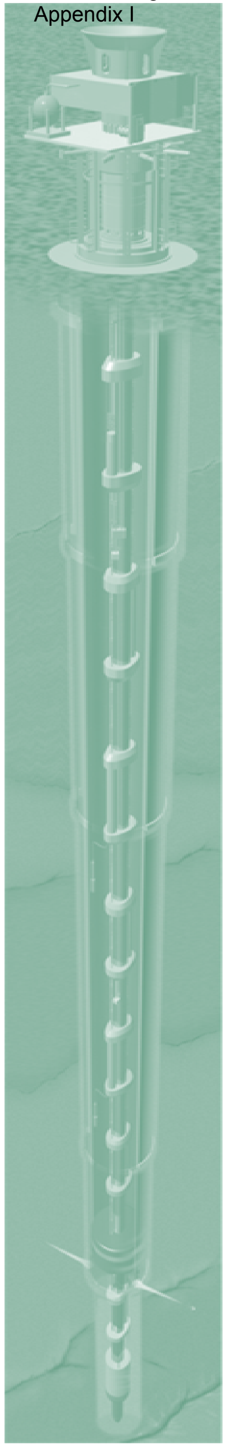
Update on Development of Telemetry System for Long Term Borehole Monitoring System

Nori KYO (kyom@jamstec.go.jp)

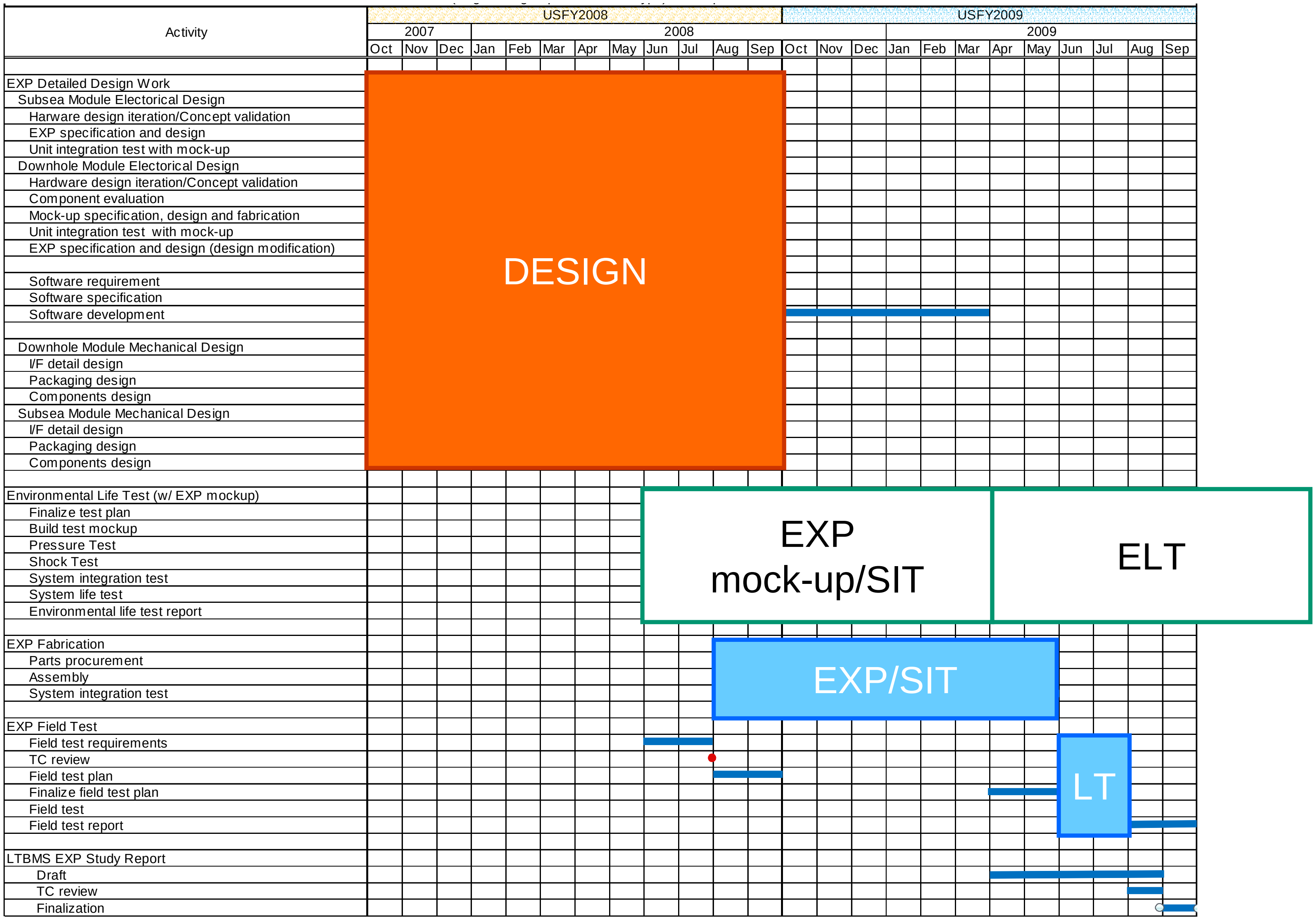
Center for **D**eep **E**arth e**X**ploration

Japan **A**gency for **M**arine-earth **S**cience and **TEC**hnology

EDP#10@Sendai, January, 2010



FY08/09 schedule



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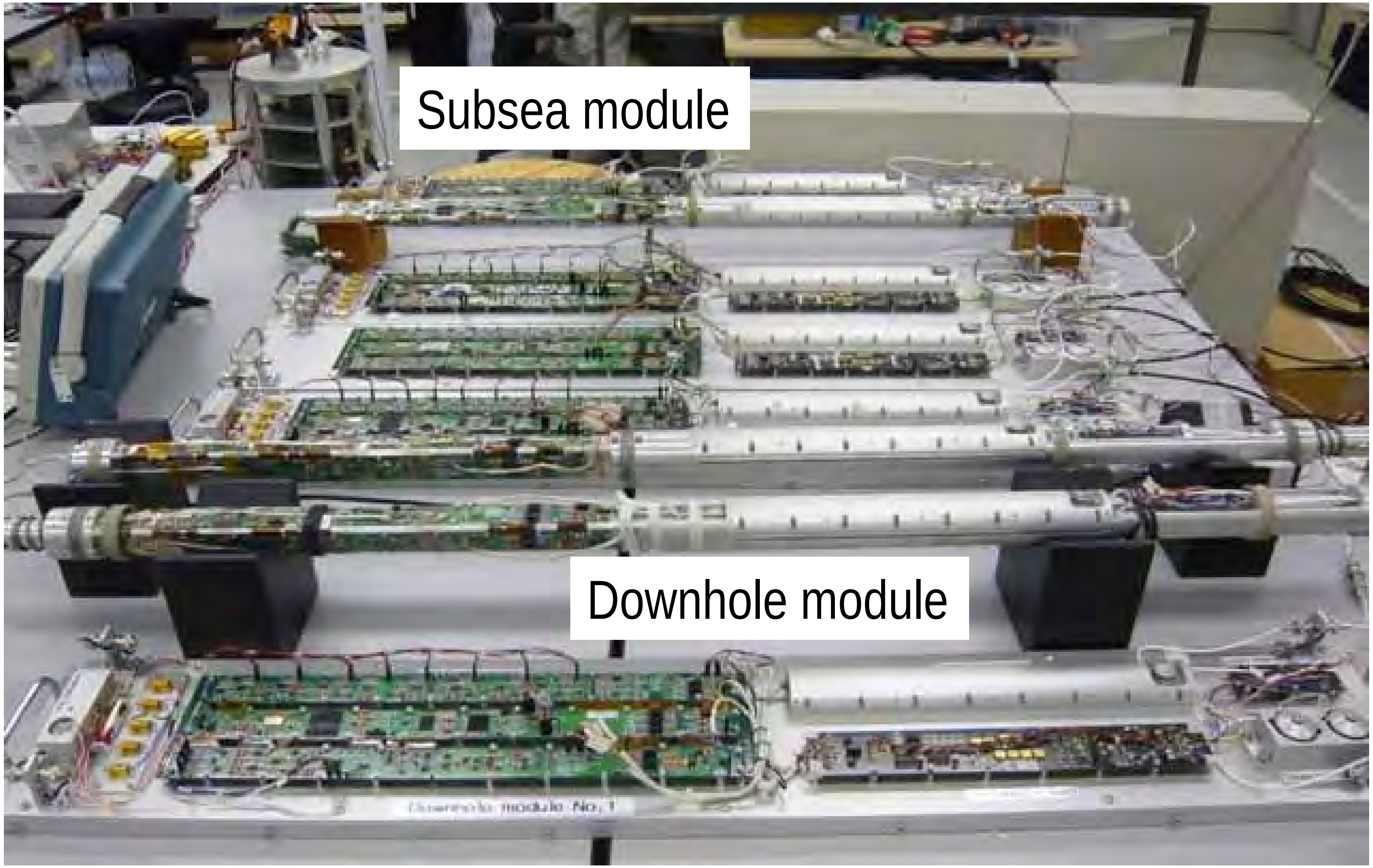
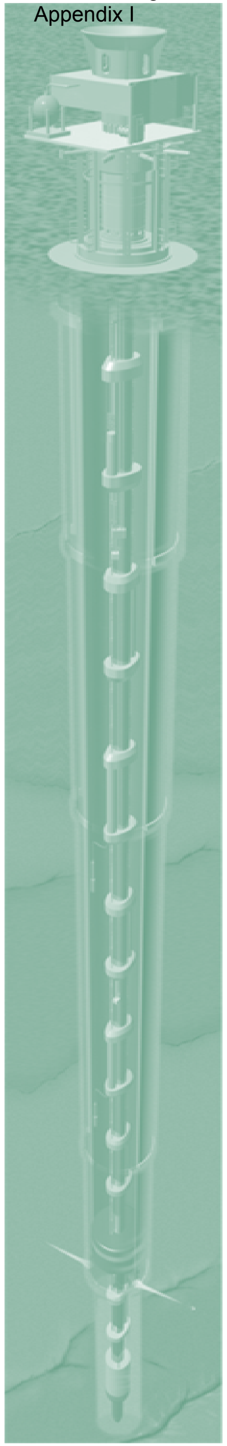
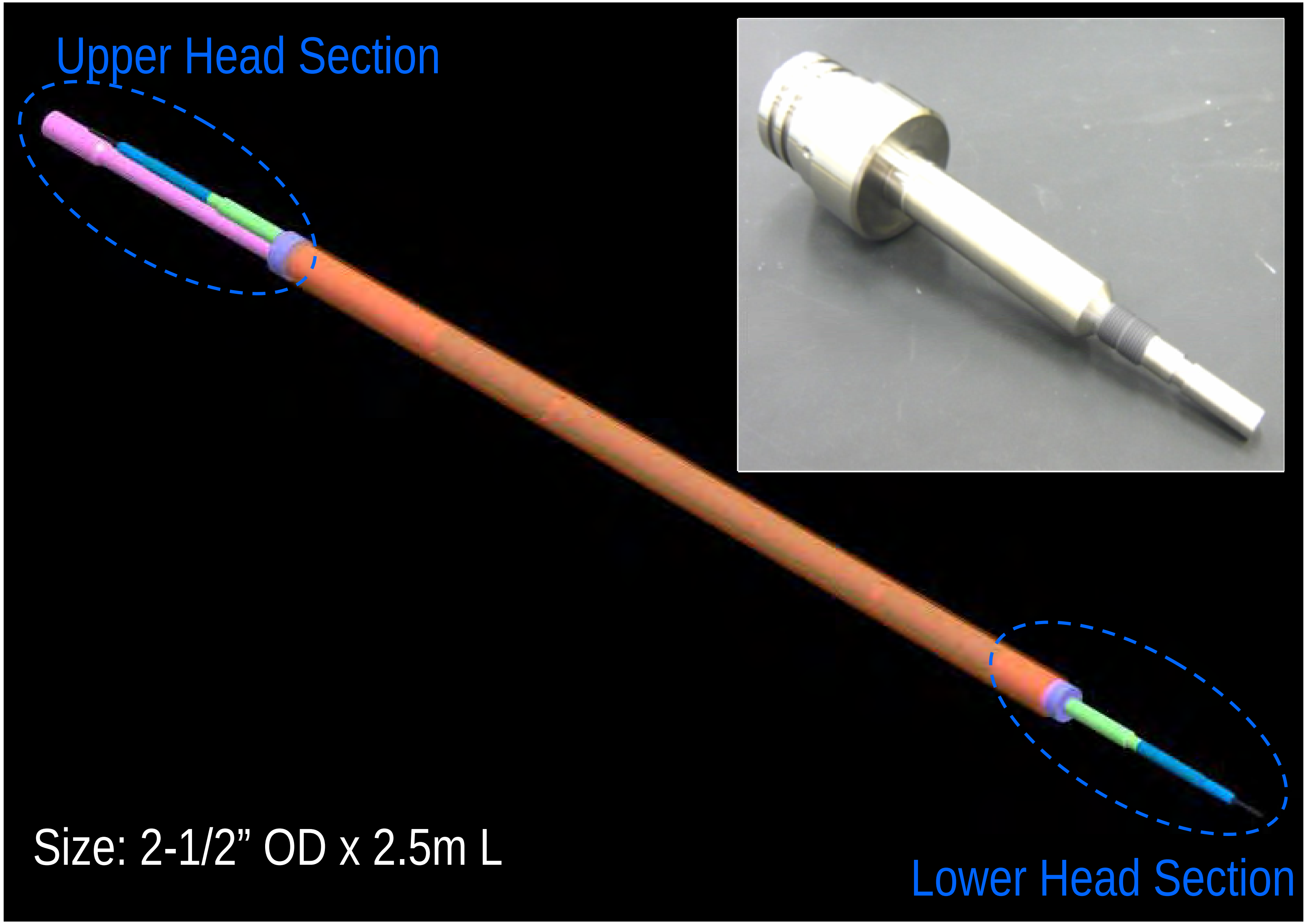
Experimental prototype (EXP)

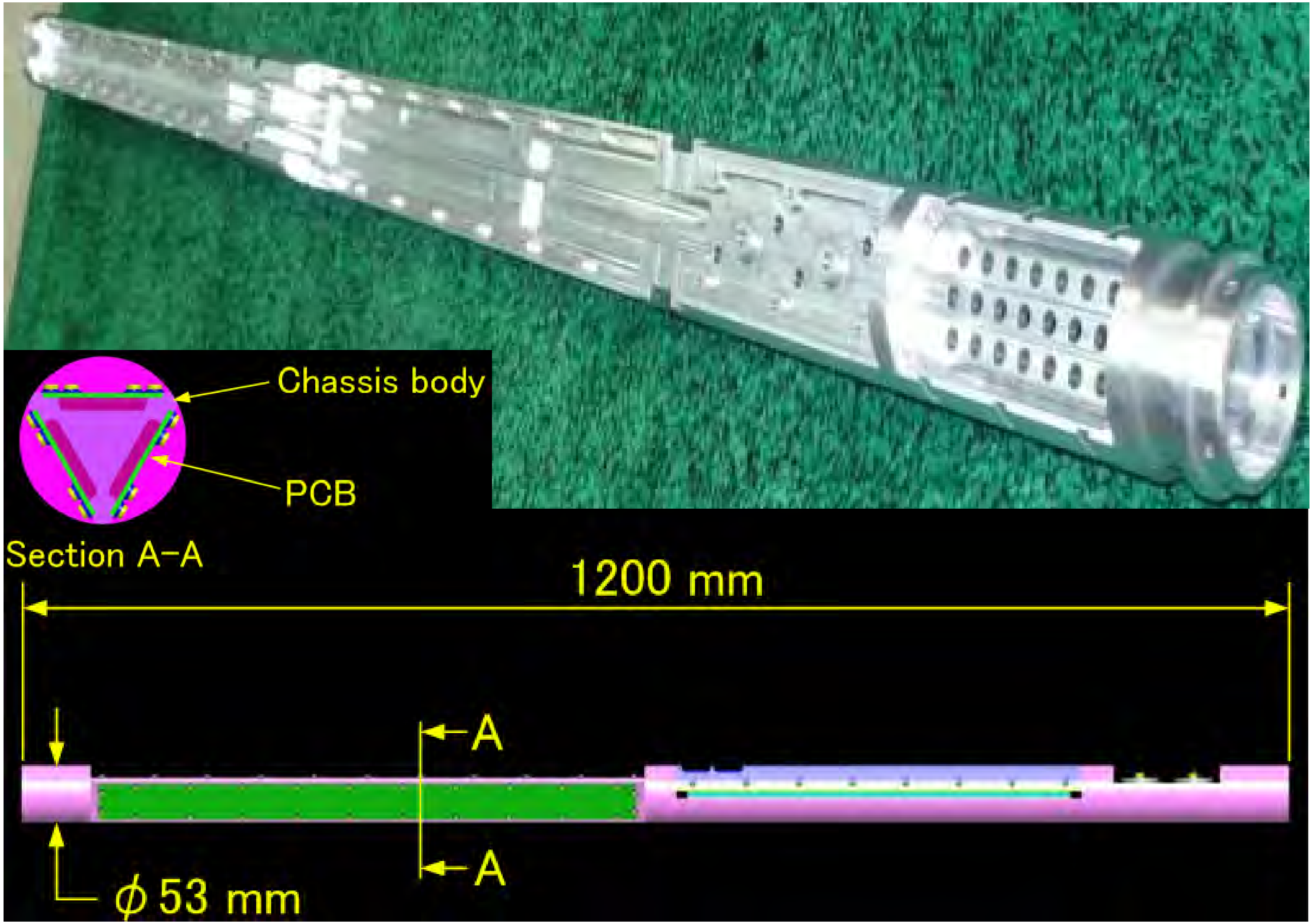




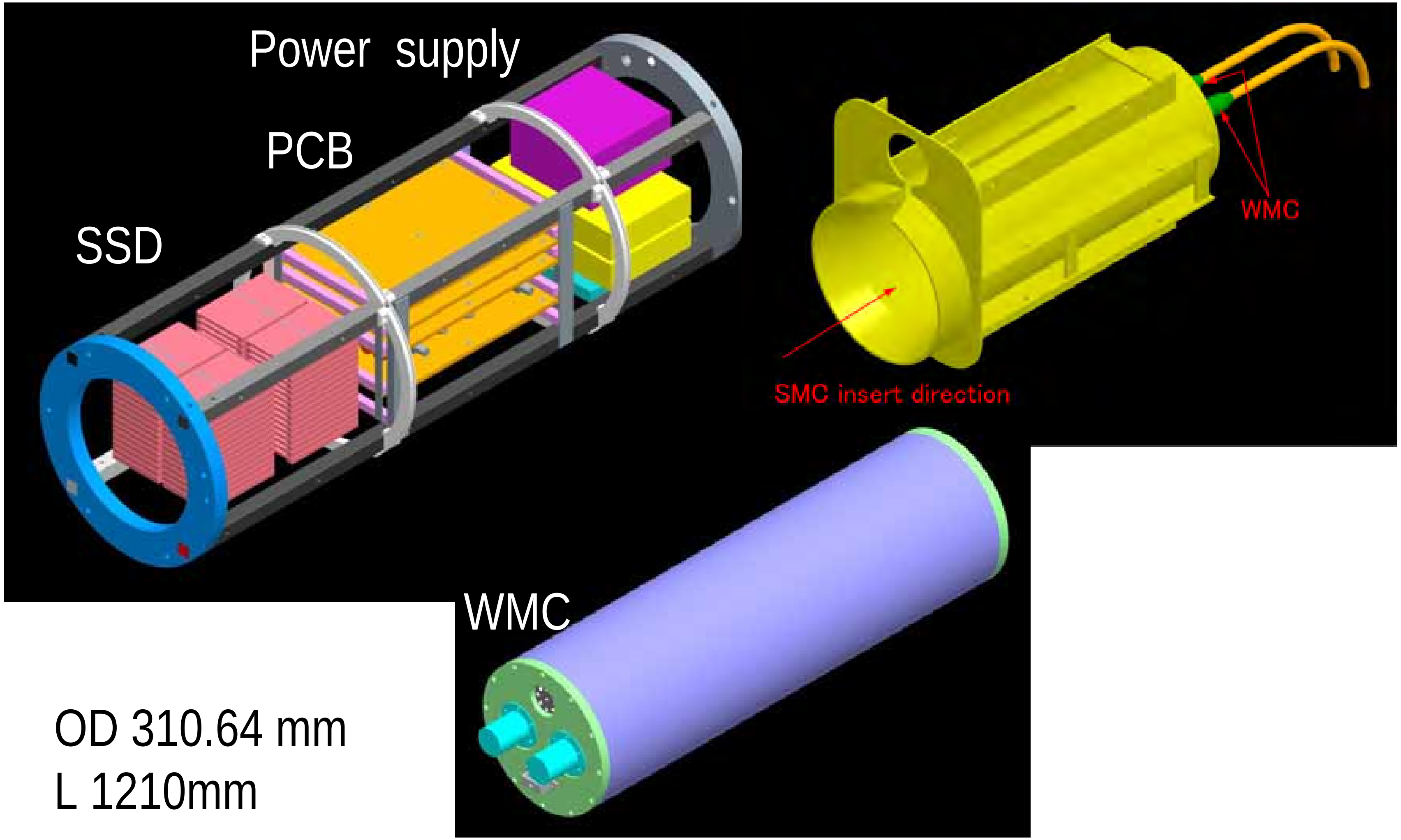
Downhole module (overall view)



Downhole module electronics

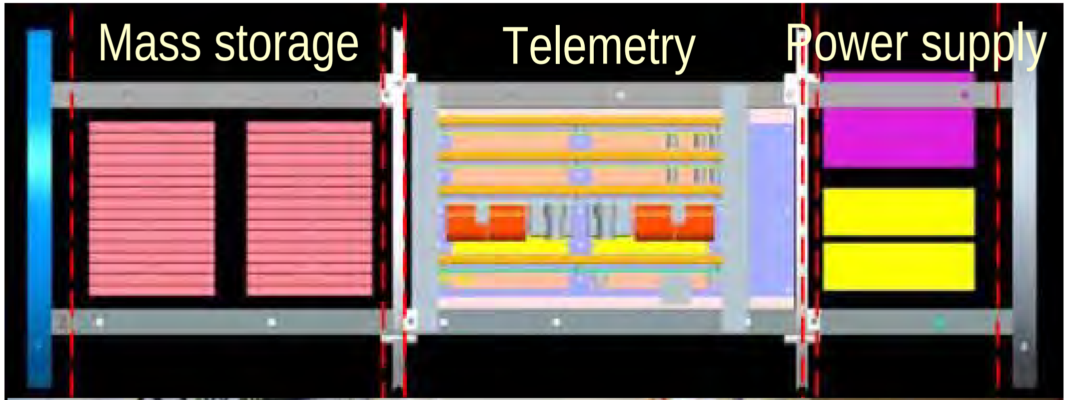


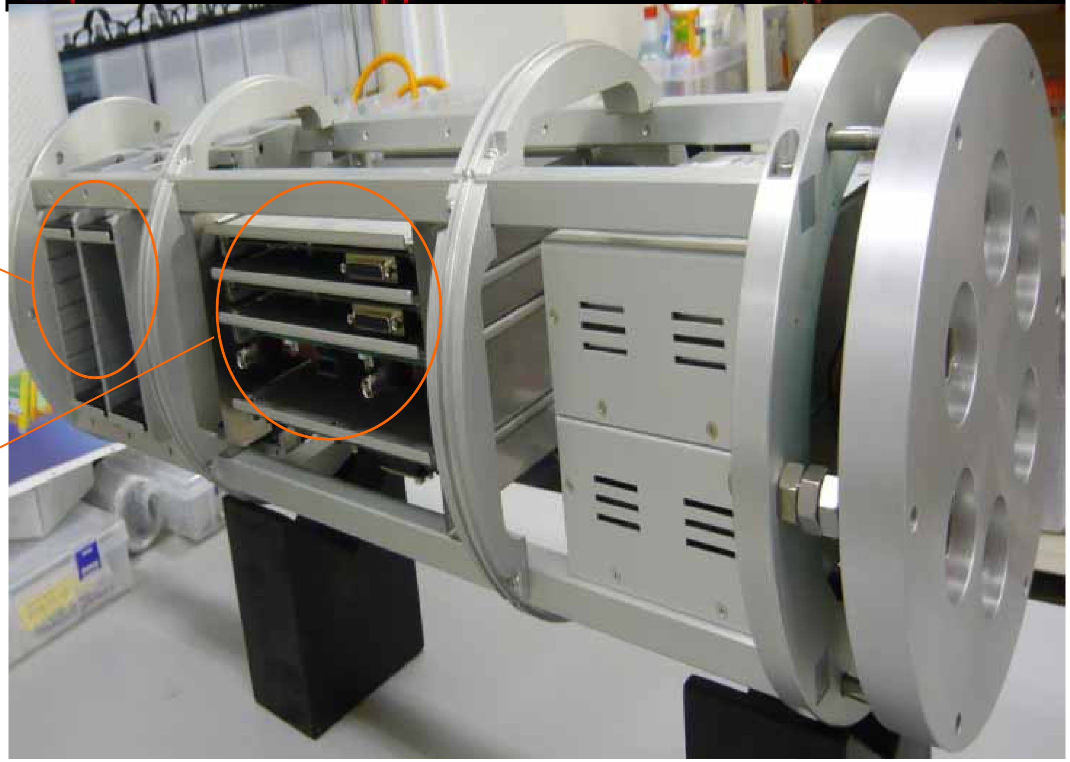
Subsea module

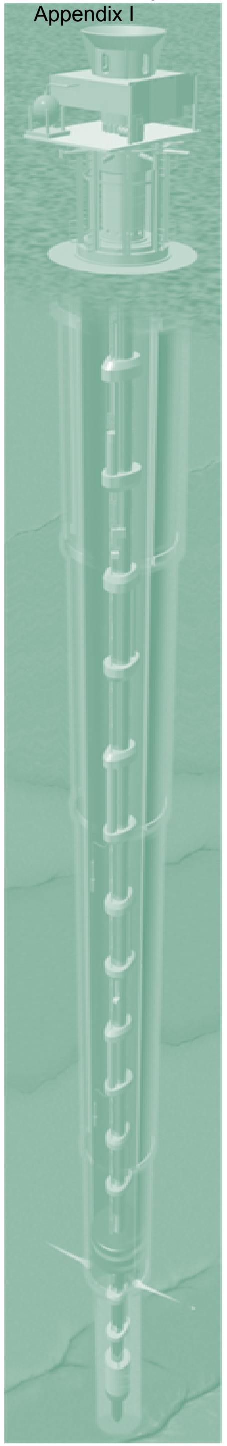


OD 310.64 mm
L 1210mm

Subsea module

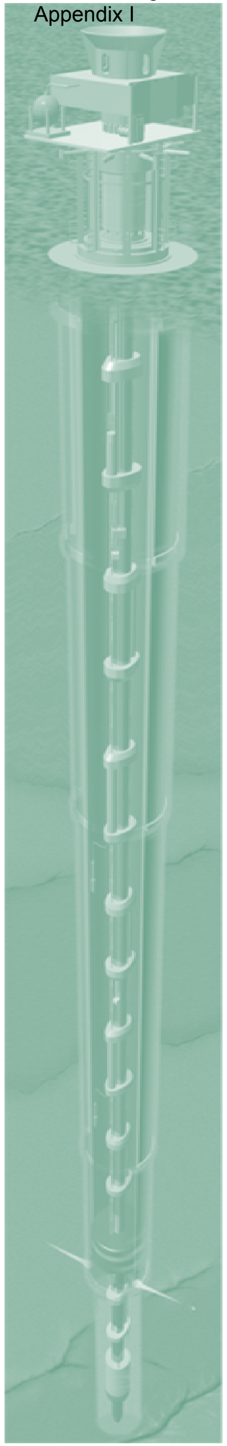




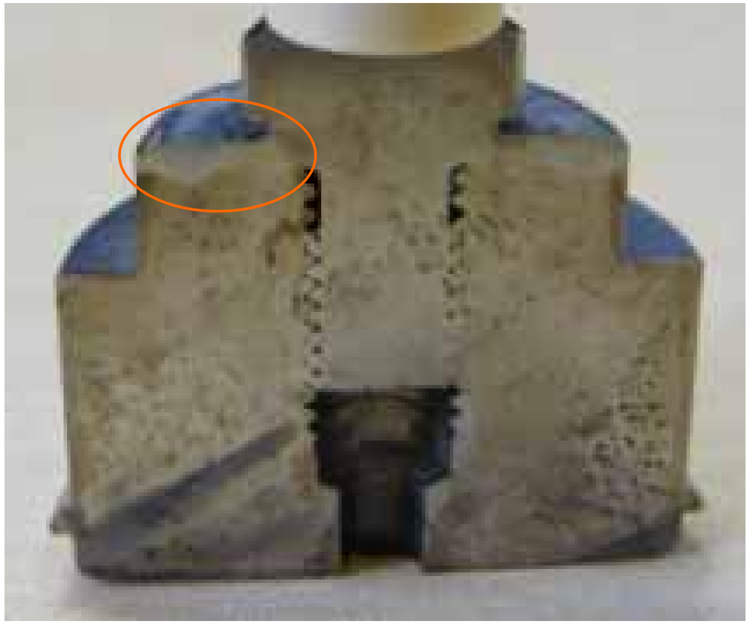


Tests in FY09

- Component evaluation test
- System Integration test
- Environmental life test
  - System life test (10.9 months in 150 °C)
  - Shock / vibration test (250 G, 2 axis)
  - HTHP test (16000 psi in 135 °C for 1 hour)
- Field test

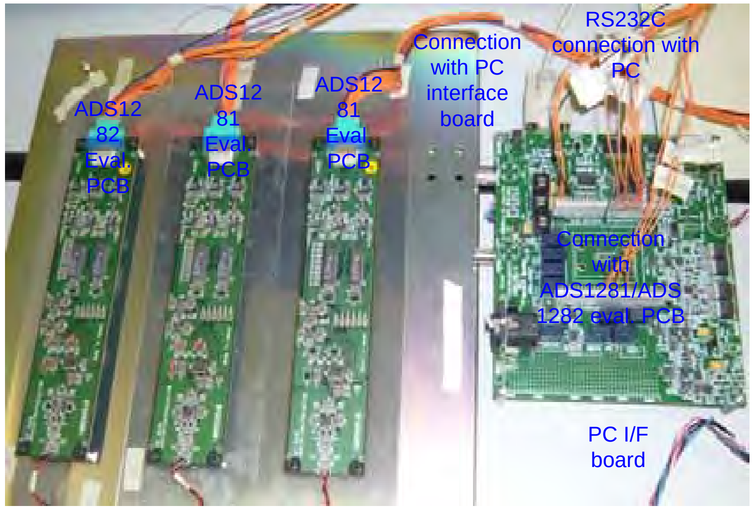


Component evaluation



Mechanical parts

- Upper and lower head welding test
- Bulkhead welding test
- Housing pressure Test



Electrical parts

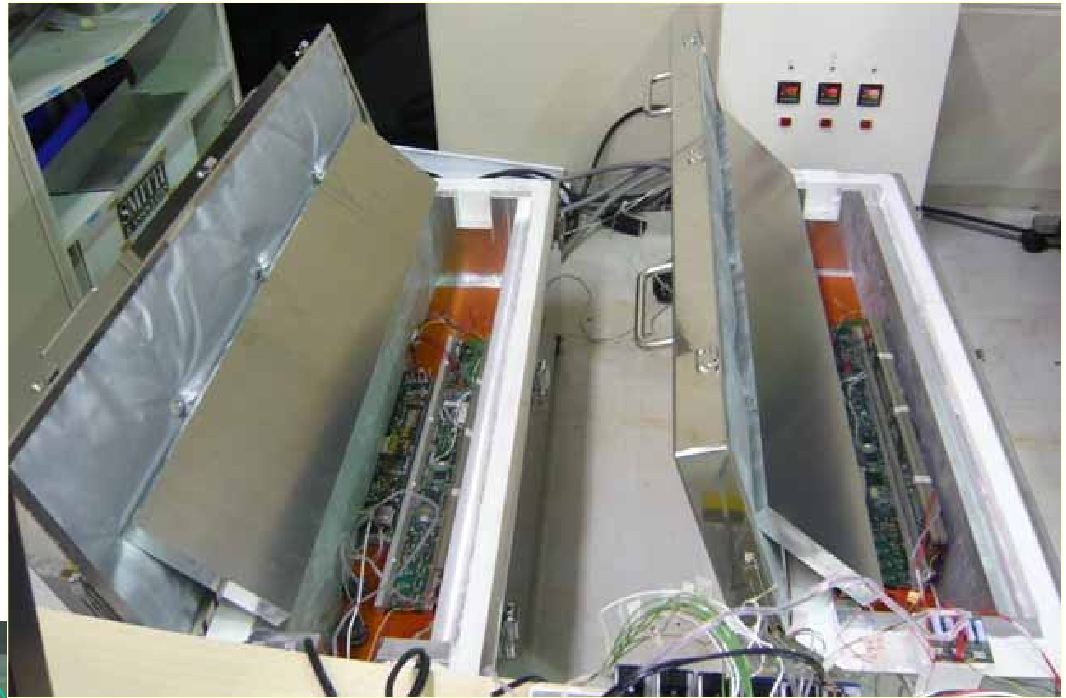
- Fast sampling ADC
- Slow sampling ADC
- Voltage reference IC
- Voltage controlled crystal oscillator
- Fault recover unit

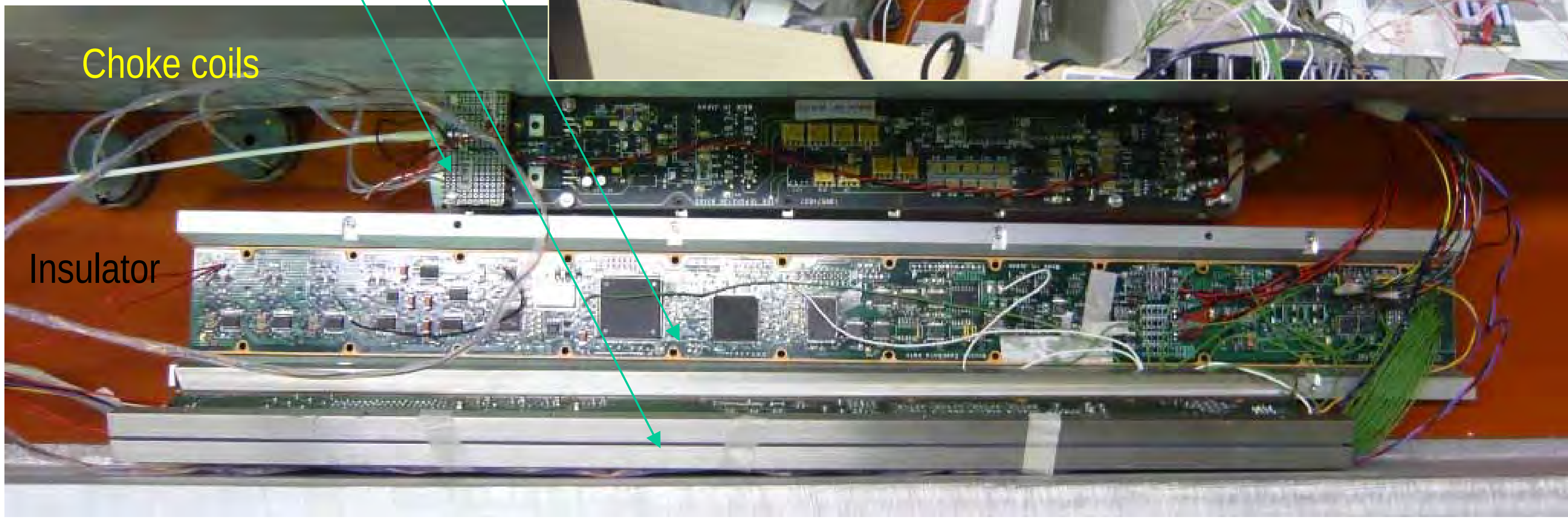
EXP mockup in oven

Telemetry main board

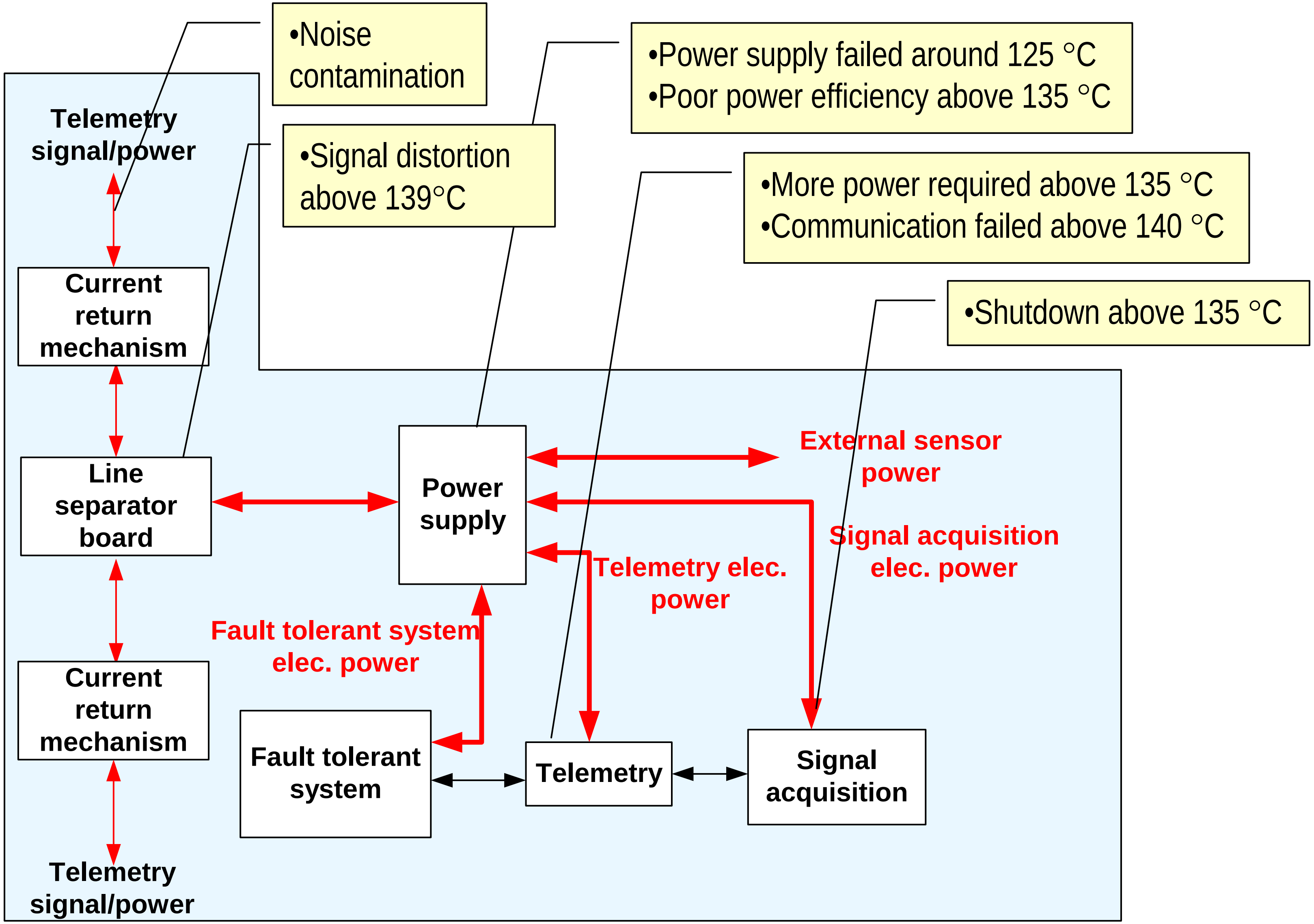
Slow ADC board

Line separator
Power supply

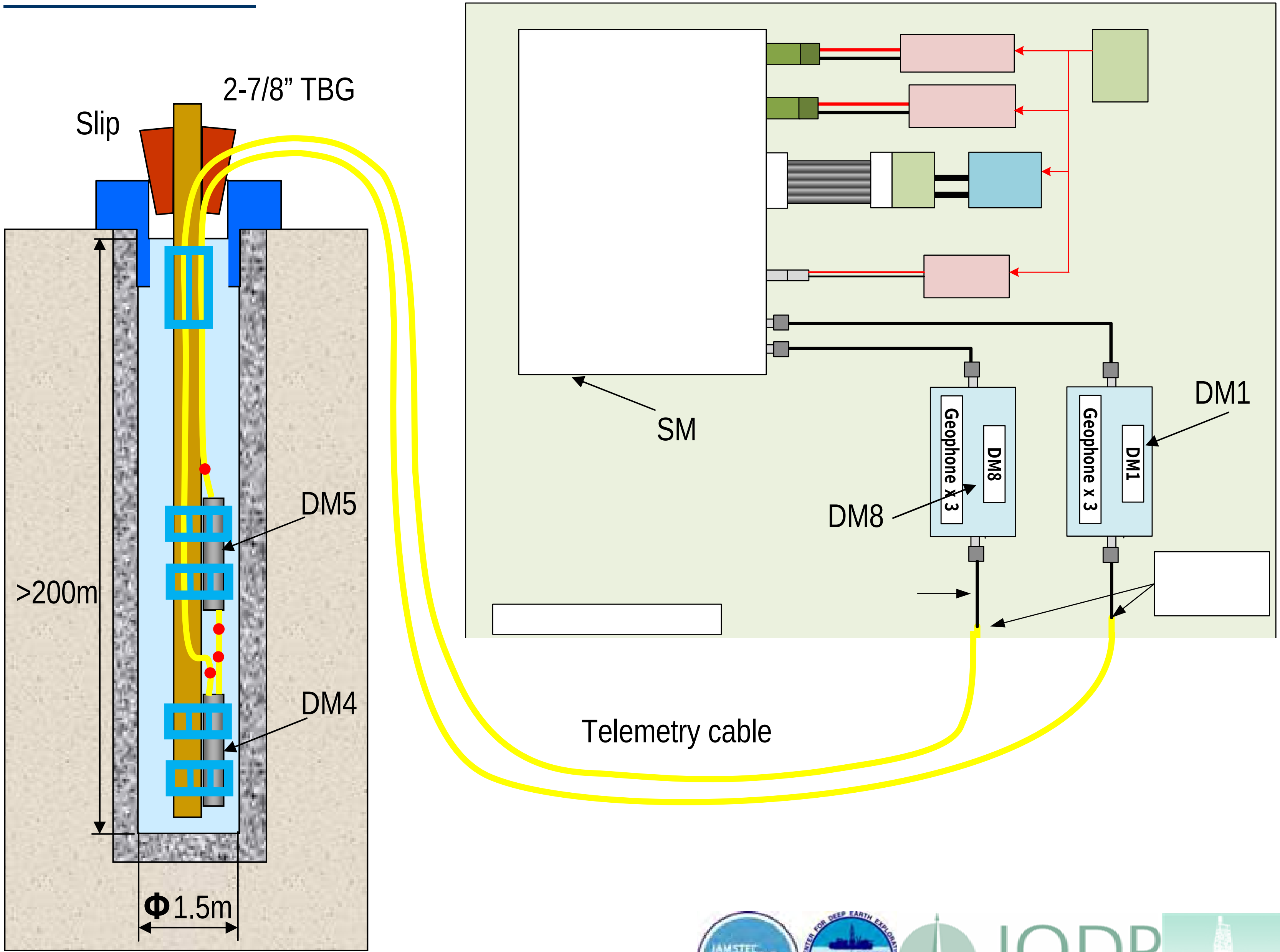




Extension of SIT with EXP mockup

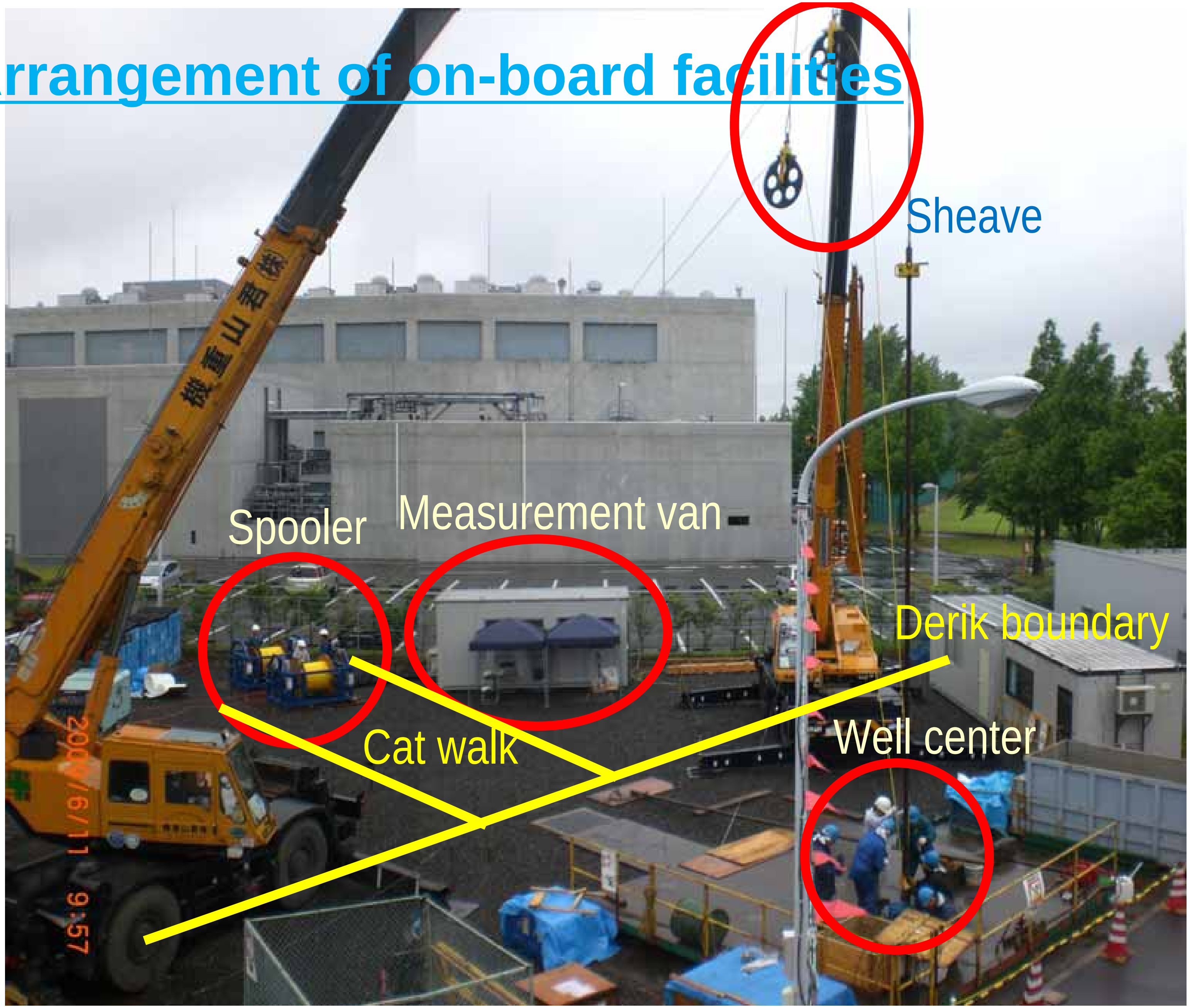


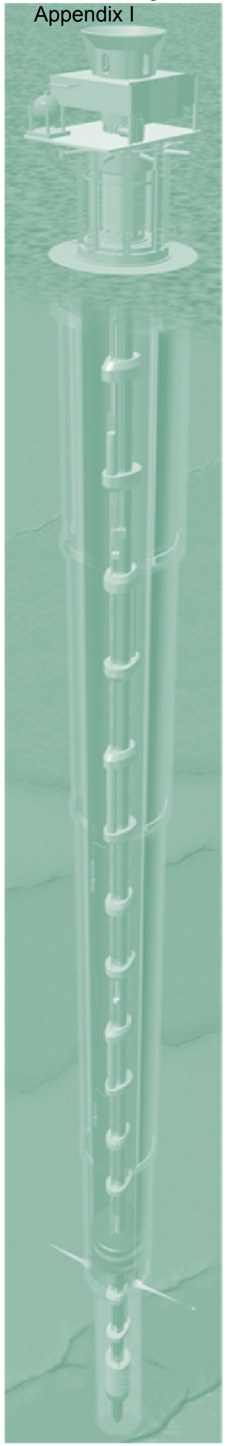
Field test



EDP#10@Sendai, January, 2010

Arrangement of on-board facilities





FY09 Deliverables

A. EXP System Integration Test Report

- A-1 EXP SYSTEM INTEGRATION TEST REPORT (EXP-mock-up)
- A-2 EXP SYSTEM INTEGRATION TEST REPORT (EXP-8 Downhole Modules)

B. Environmental Life Test Report

- B-1 TEST PLAN FOR MECHANICAL LIFE TEST OF LTBMS TELEMETRY MODULE
- B-2 EVALUATION REPORT OF MECHANICAL LIFE TEST OF TELEMETRY MODULE
- B-3 TECHNICAL DOCUMENT OF SYSTEM LIFE TEST PLAN
- B-4 EVALUATION REPORT OF SYSTEM LIFE TEST (Intermediate)
- B-5 LIFE TEST OF CERAMIC VERSION TELEMETRY UNIT (Intermediate)

C. Document on EXP Telemetry System for Field Test

- C-1 EXP DESIGN DOCUMENT OF TELEMETRY SYSTEM
- C-2 EXP DESIGN DOCUMENT OF SUBSEA MODULE ELECTRONICS
- C-3 EXP DESIGN DOCUMENT OF SUBSEA MODULE MECHANICS
- C-4 EXP DESIGN DOCUMENT OF DOWNHOLE MODULE ELECTRONICS
- C-5 EXP DESIGN DOCUMENT OF DOWNHOLE MODULE MECHANICS
- C-6 QUALITY FILE OF EXP TELEMETRY SYSTEM FOR LTBMS
- C-7 EVALUATION REPORT FOR ADS1281 AND ADS1282 (Intermediate)
- C-8 EVALUATION REPORT OF VCXO
- C-9 EVALUATION REPORT OF MOSFET RETURN RELAY
- C-10 EVALUATION REPORT OF MOSFET GATE DRIVER
- C-11 EVALUATION REPORT OF OPTICALLY ISOLATED RELAY
- C-12 EVALUATION REPORT OF CURRENT RETURN CONTROL
- C-13 TELEMETRY CABLEPROPAGATION DELAY MEASUREMENT

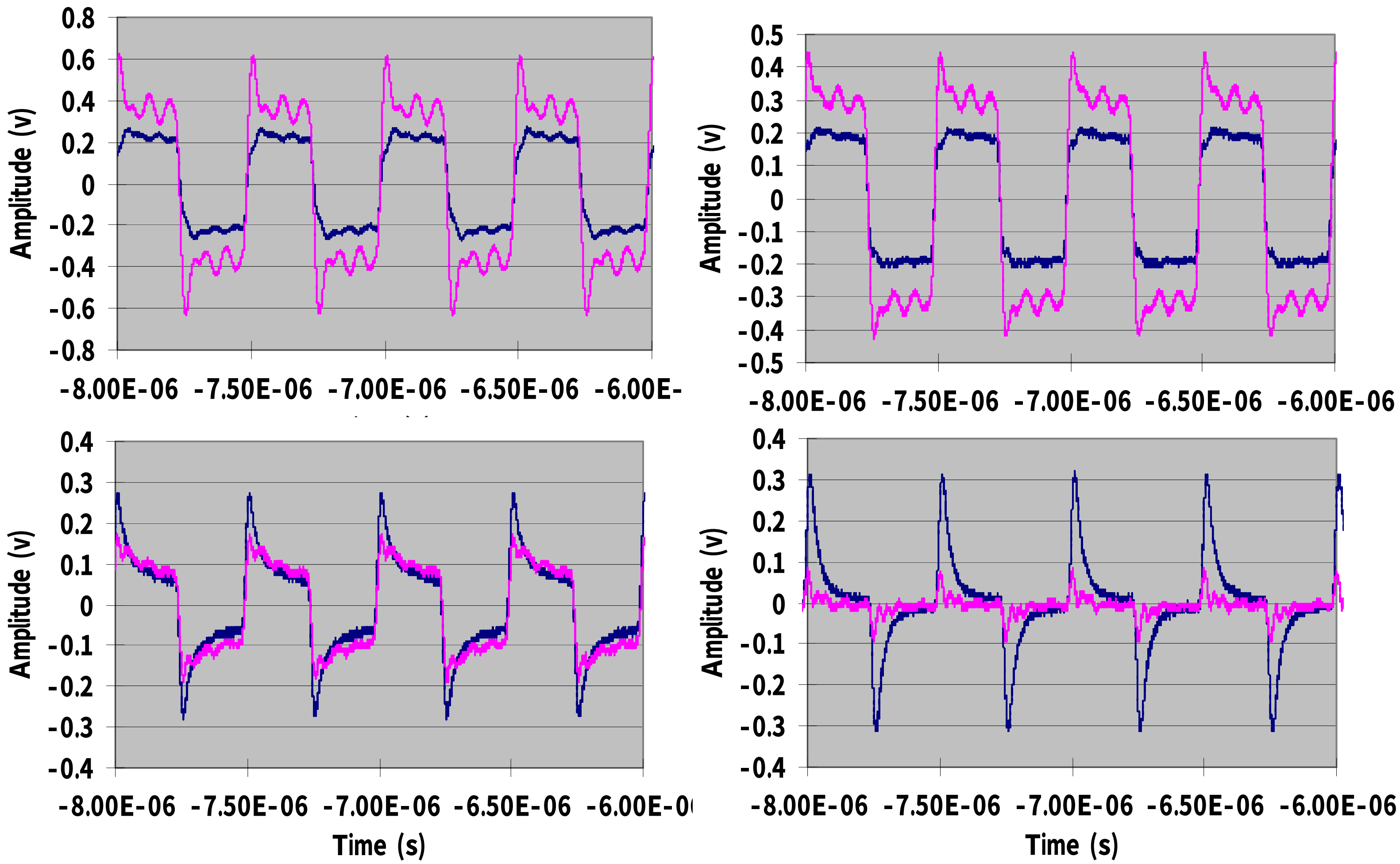
D. EXP Field Test Report

- D-1 EXP FIELD TEST REPORT OF LTBMS TELEMETRY SYSTEM

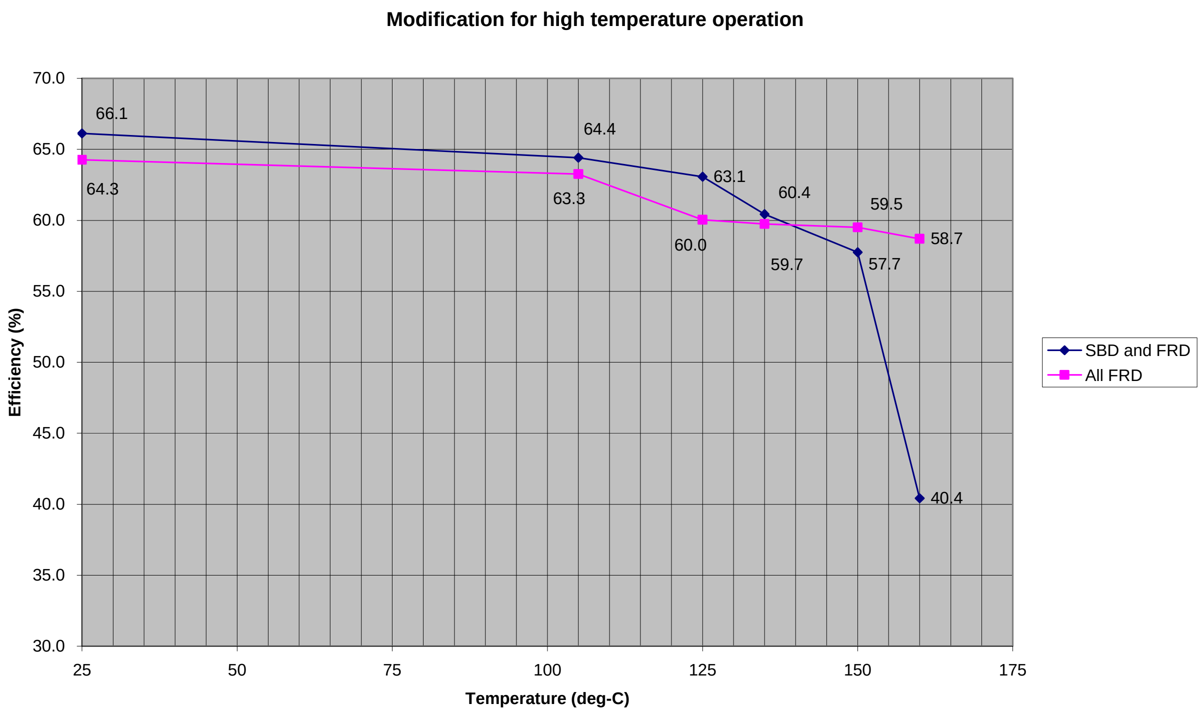
E. Action Items for Engineering Prototype (ENP)

- E-1 TECHNICAL DOCUMENT OF JUNCTION BOX FOR DOWNHOLE
- E-2 TECHNICAL DOCUMENT OF WIRING CONNECTON FOR SEABED
- E-3 COST ESTIMATION OF BATTERY MODULE
- E-4 TECHNICAL DOCUMENT FOR ENP DEVELOPMENT (Intermediate)

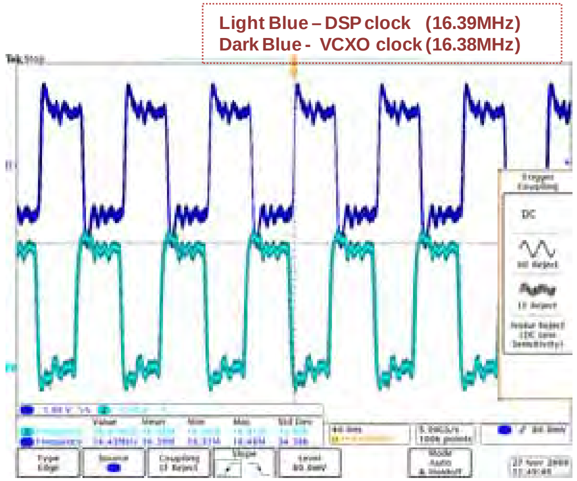
Pulse transformer

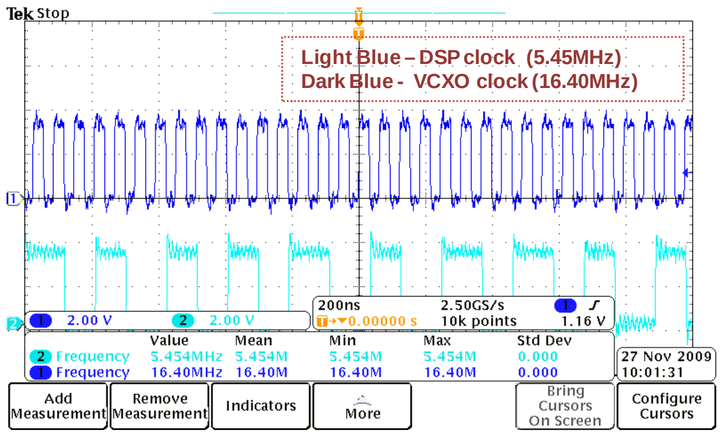


Isolated downhole power supply

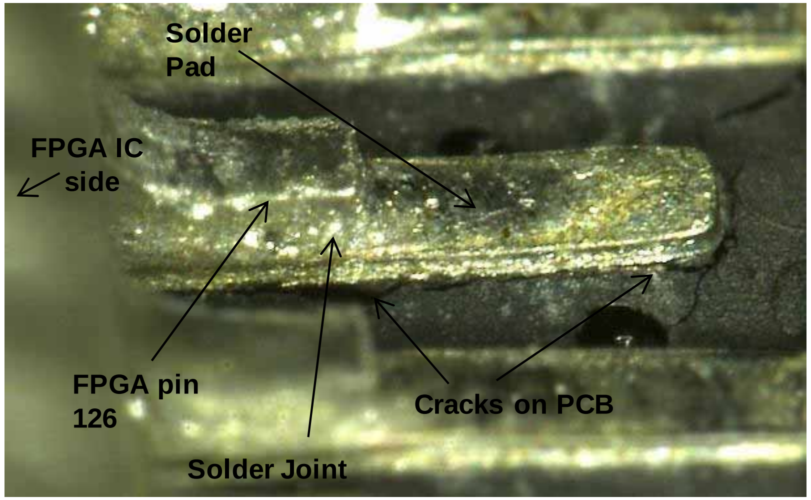


Clock signal through FPGA

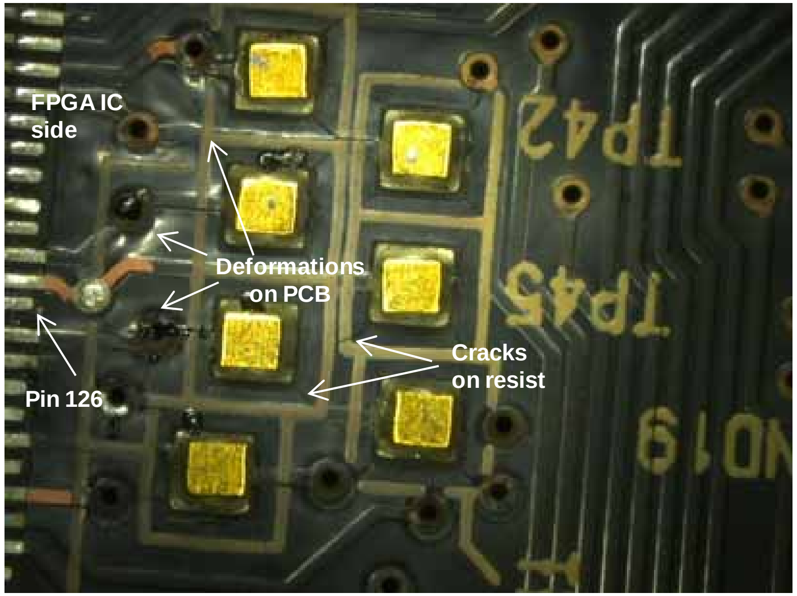


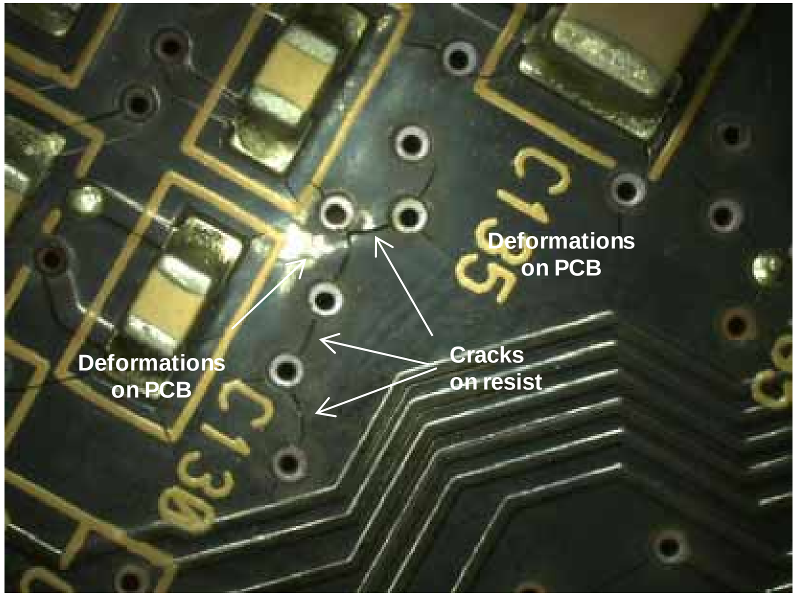


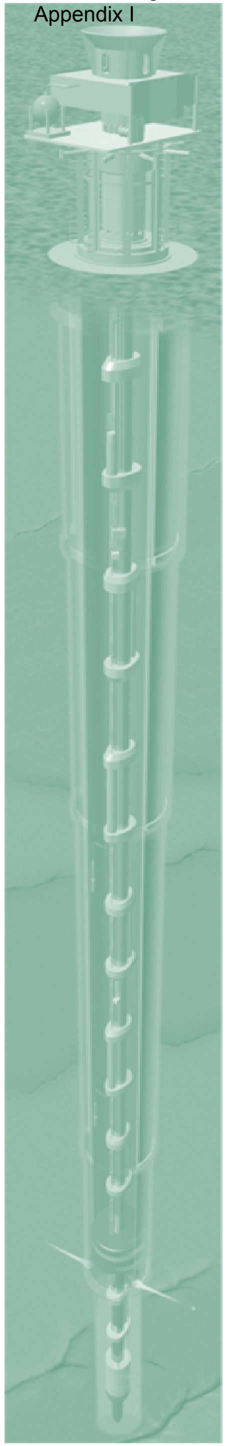
PCB problem



Temperature	Time	Time
139 °C	2868 hrs	2390 hrs
125 °C	0.9 yrs	0.73 yrs
85 °C	23.4 yrs	19.1 yrs
70 °C	96.5 yrs	78.8 yrs





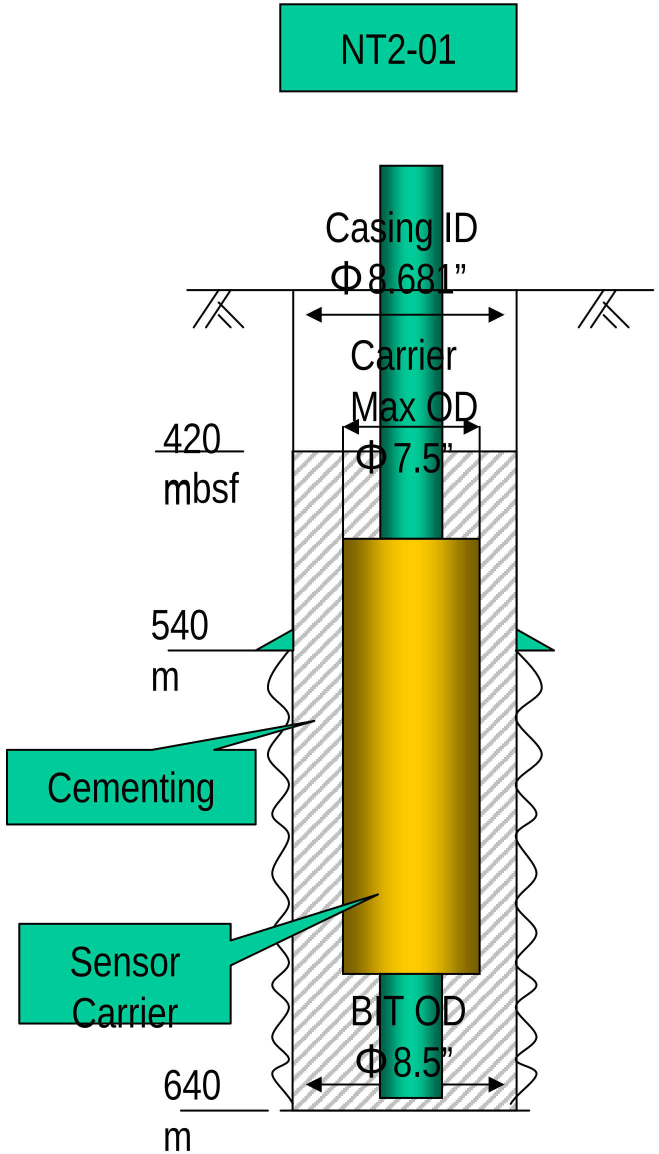


Progress report on Riserless Observatory Development

(Dummy Run Test)

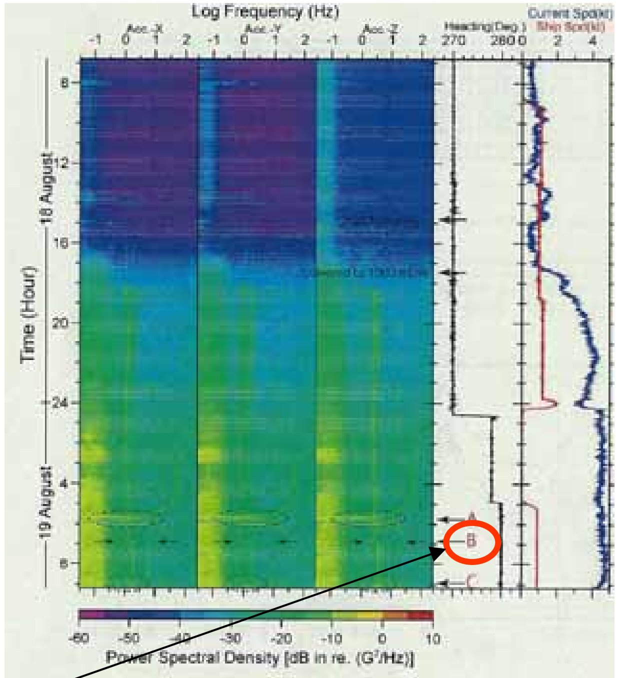
EDP#10@Sendai, January, 2010

Riserless observatory

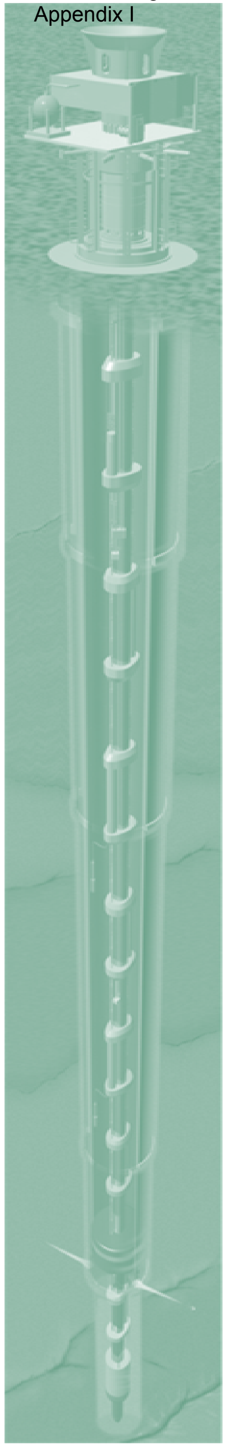


EDP#10@Sendai, January, 2010

2009 Nan-Tro Dummy Run



Lost point



Flow to deploy

Modify Cork head and J-tool

Modify Instrument Carrier

Select tubing size

2010/Mar.

Dummy Run Test

2010/Mar.

Tank Test

Numerical simulation

Until 2011/Feb.?

Make operation criteria

Until 2010/Sept.?

Sensor Acceleration Test

2011?

Check Current status at the drilled site

Judgment

2011?

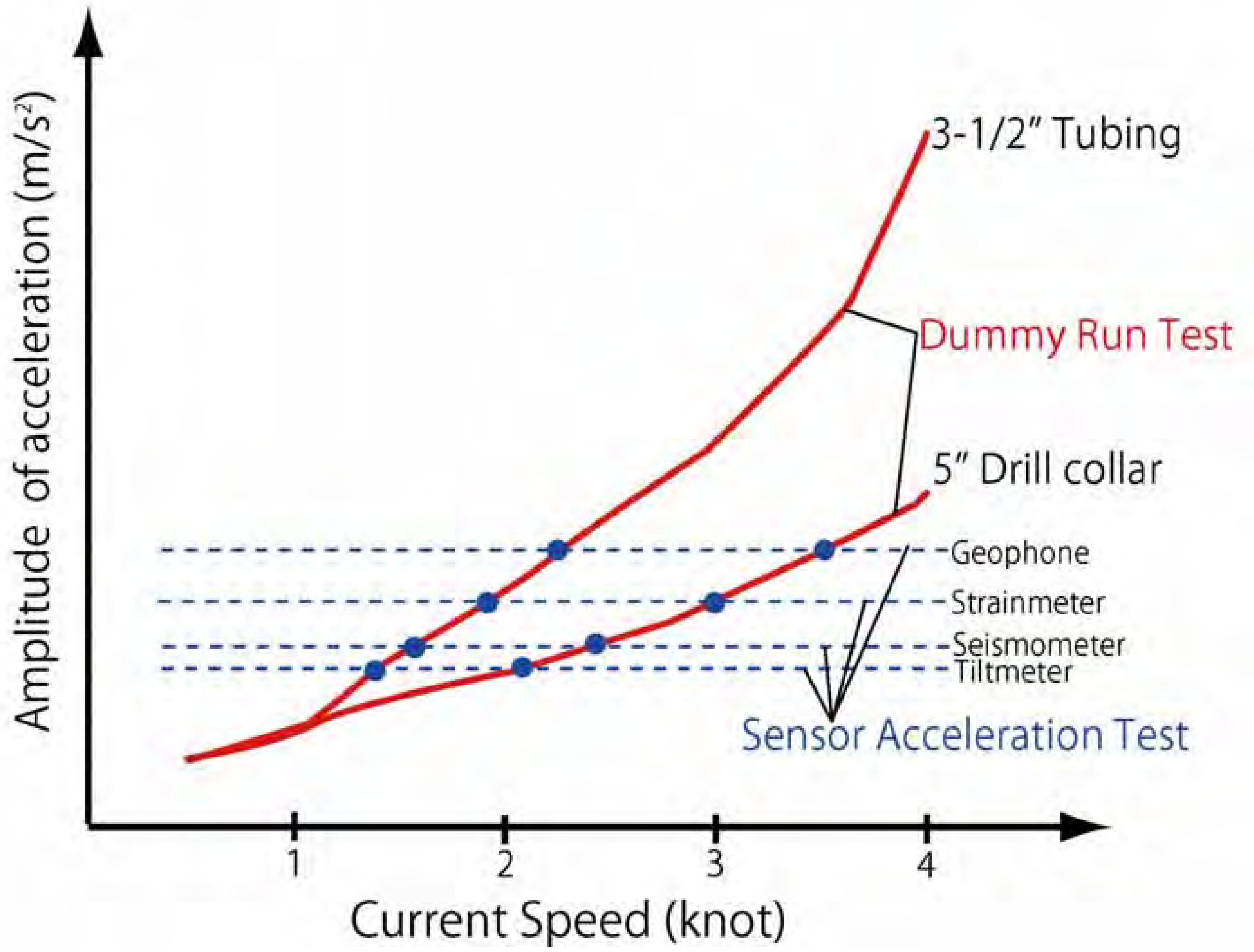
Install riserless observatory

Other operation

Purpose

(1) To obtain acceleration data in actual condition
(2) To confirm max current condition at running with sensor capability
(3) To confirm safety running condition under hi-current
(4) To check vibration transfer insulation by DC
(5) To check VIV reduction with knobby pipe
(6) To evaluate the size of the pipe on which the sensors are attached.

To determine the operation criteria



The 10th Engineering Development Panel (EDP), January 13-15, 2009, Sendai-Japan

Development of Coring Tools for Scientific Drilling on the *D/V Chikyu*

Y. Shinmoto, E. Miyazaki, K. Kato, Y. Yamazaki, J. Ishiwata, T. Miyazaki, T. Nakamura, Y. Mizuguchi and K. Wada

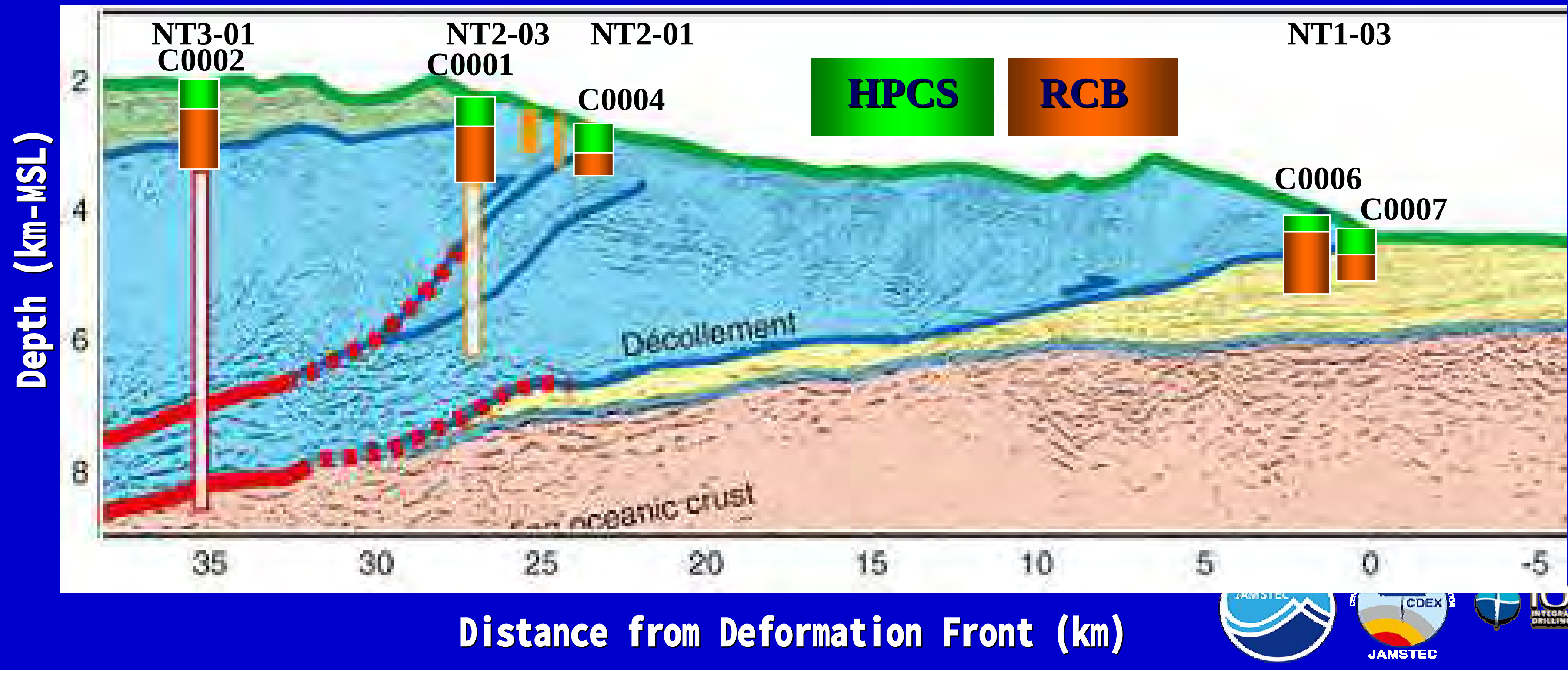
Engineering Department
CDEX, JAMSTEC

Overview of RCB Coring on the *D/V Chikyu*

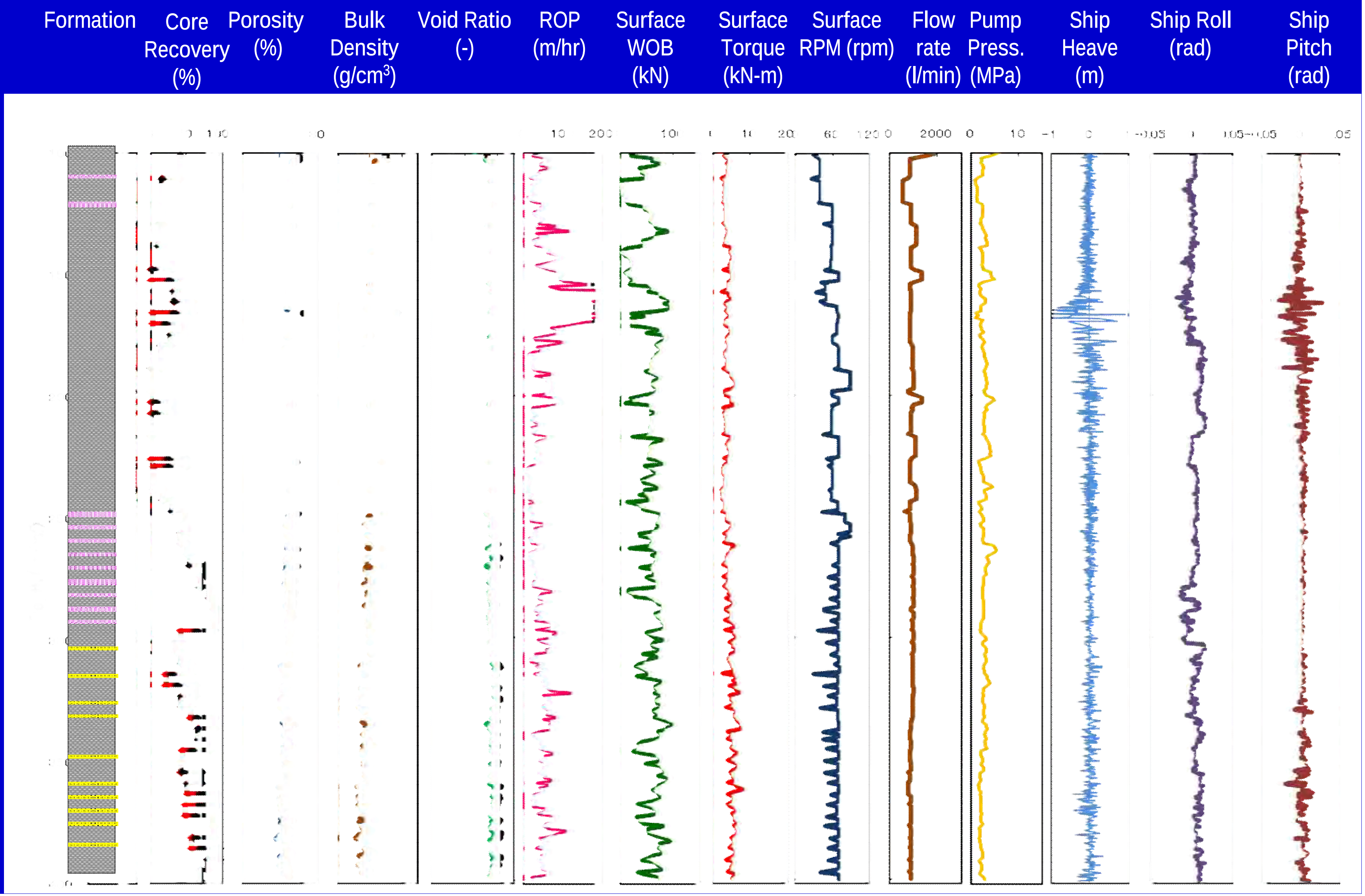
- Operational time of only 1 ~ 2 hours including drop-down and retrieval of the inner barrel.
- Runs possible even when HPCS / EPCS / ESCS systems not applicable.
- Applicable for soft (clay) to hard rock (basalt)
- All coring carried out with PDC Bit
- Core conditions (recovery, quality) varies according to Bit, Formations, Heave-motions, Fluctuations in WOB & Stick-slip

Results of NanTroSEIZE Stage 1 Riser-less Coring

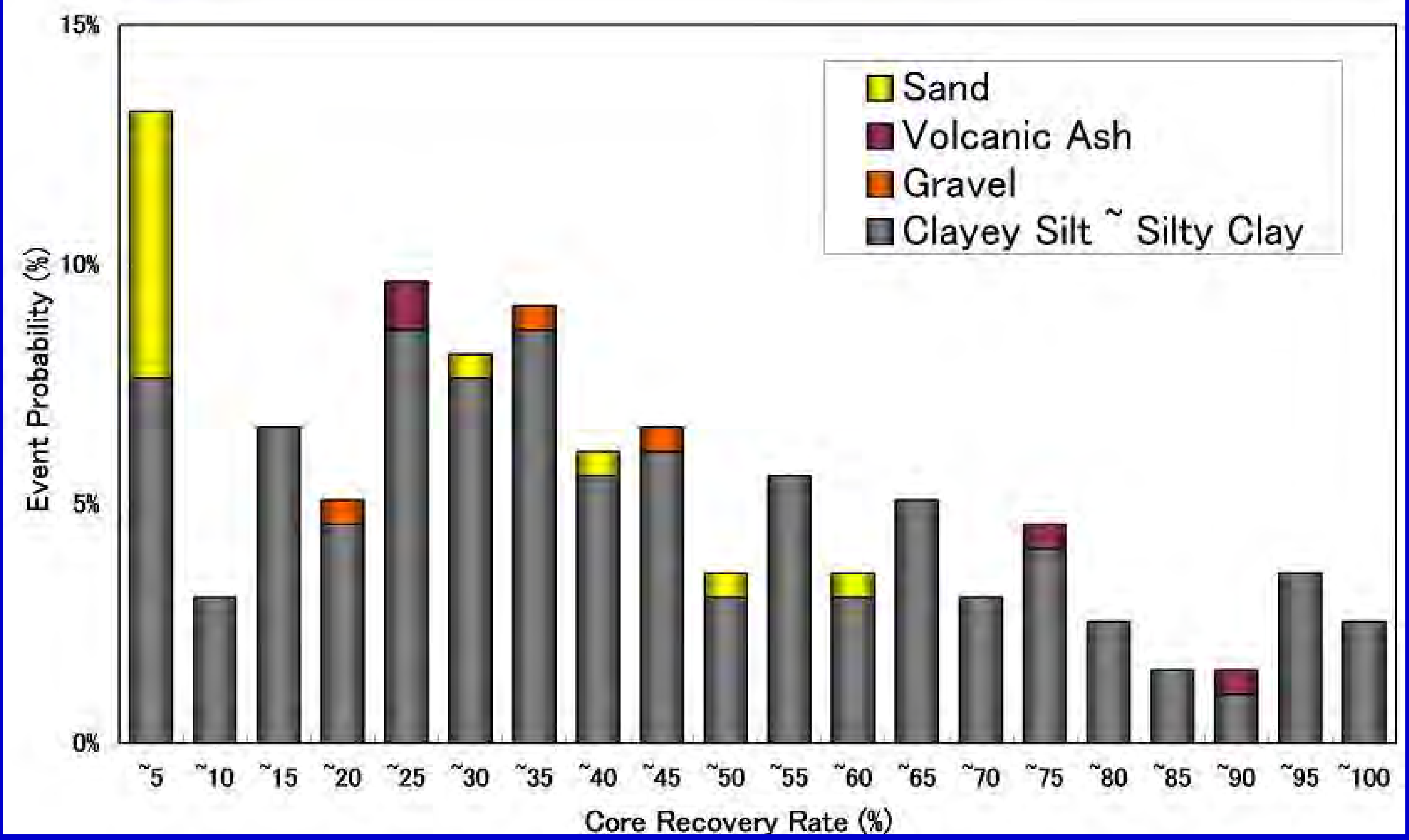
Hole	Water Depth (m)	Runs	Coring Depth (m)	Core Sample (m)	Core Recovery(%)
C0001	2187.5	26	230.0~457.8	126.3	55.4
C0002	1937.5	66	475.0~1057.0	208.4	35.8
C0004	2630.5	56	100.0~400.0	130.8	43.6
C0006	3875.5	23	395.0~603.0	88.5	42.5
C0007	4049.0	35	174.5~493.0	87.9	27.6



Coring Parameters (Hole C0004)



Core Recovery during NanTroSEIZE Stage1



RCB Core Sample Conditions in NanTroSEIZE Stage 1

Good

Bad

Sandy-Gravel

PDC Improvement (RCB)

-Prevents Core Jamming
-Prevents Core Washout
-Smooth Cuttings Removal

Reverse Cone type
Blades (8)

W/O Reverse Cone type
Optimization of Blades (5)

Improvement of Core Barrel & Bit

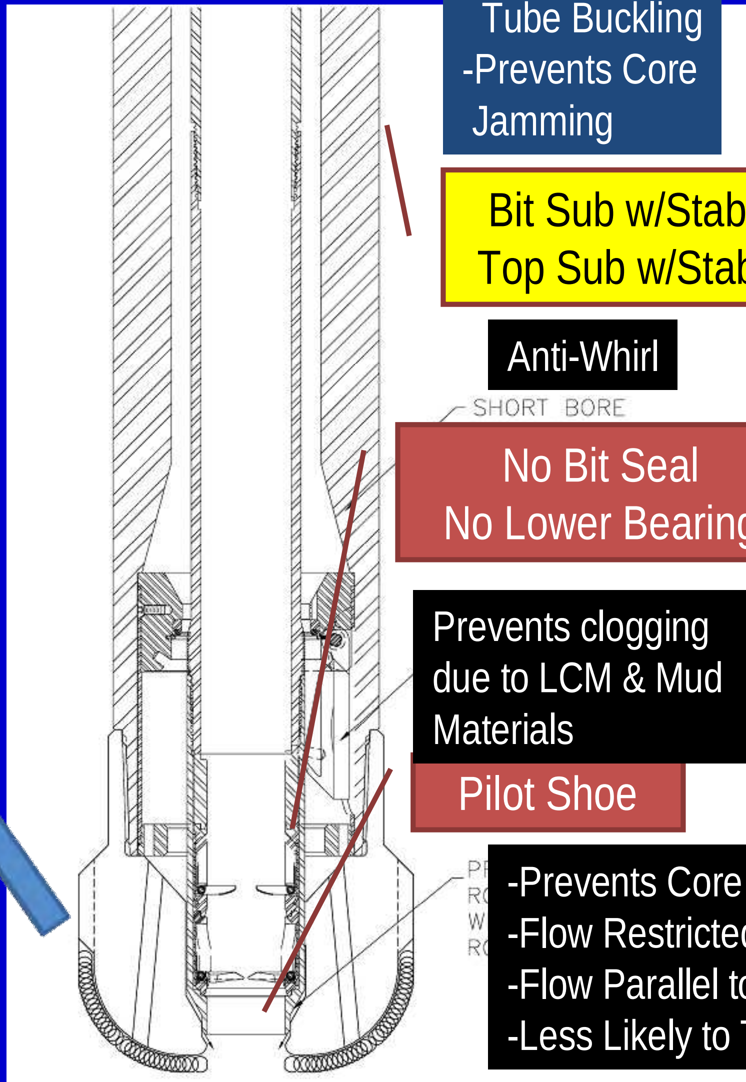
UPGRADE RCB

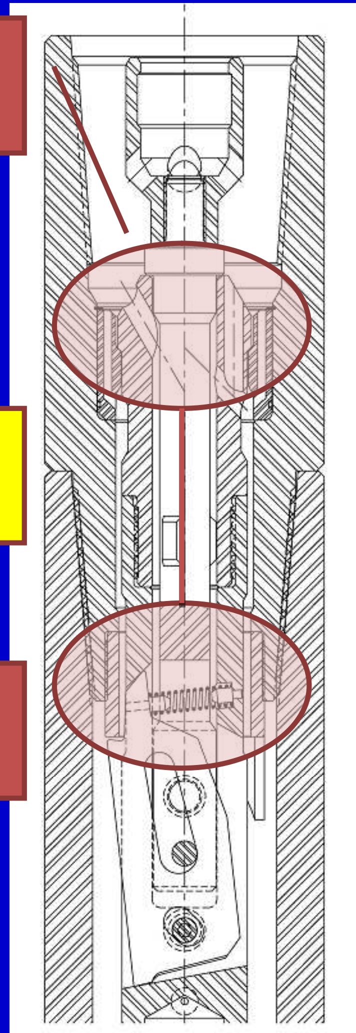
W/O Reverse Cone type
Optimization of Blades

-Prevents Core Jamming
-Prevents Core Washout
-Smooth Cuttings Removal

Drilling fluid: Mud

•**Stability *in site***





Upper Landing
Upper Latching

-Prevents Inner Tube Buckling
-Prevents Core Jamming

Bit Sub w/Stab.
Top Sub w/Stab.

Anti-Whirl

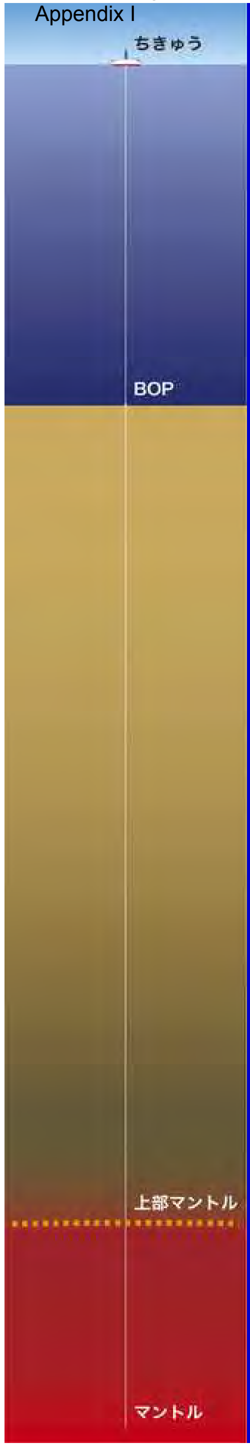
No Bit Seal
No Lower Bearing

Prevents clogging due to LCM & Mud Materials

Pilot Shoe

-Prevents Core Washout
-Flow Restricted by close fit
-Flow Parallel to Core
-Less Likely to Trap Pieces of Core

JAMSTEC

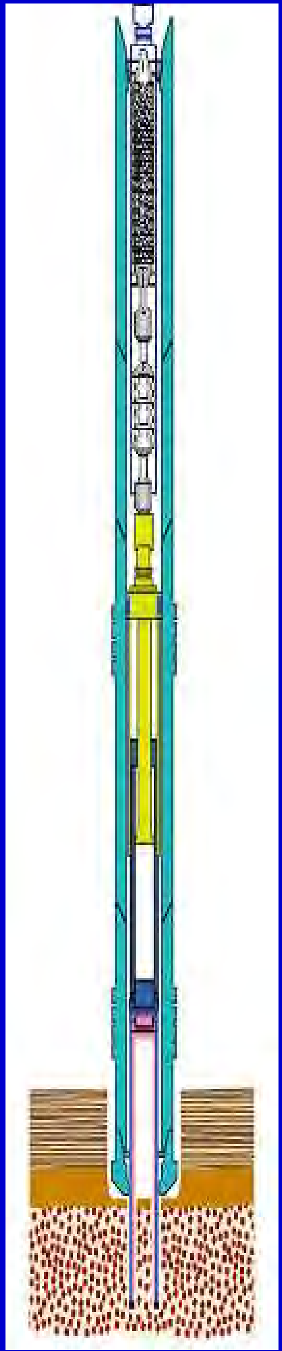


Technology Development in Deep Sea Coring

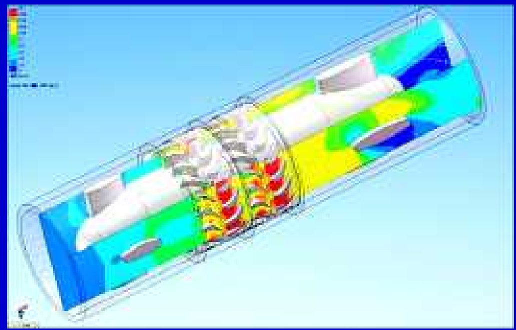
Small-Diameter RCB (SD-RCB)

- Core bit OD: 8.5 in.
- Core size (φ83 mm)
- Improvement of mud or LCM circulation capability
- Impregnated Diamond Core Bit in hard rock formations
- New Core Catchers (double core catchers) to enhance core recovery

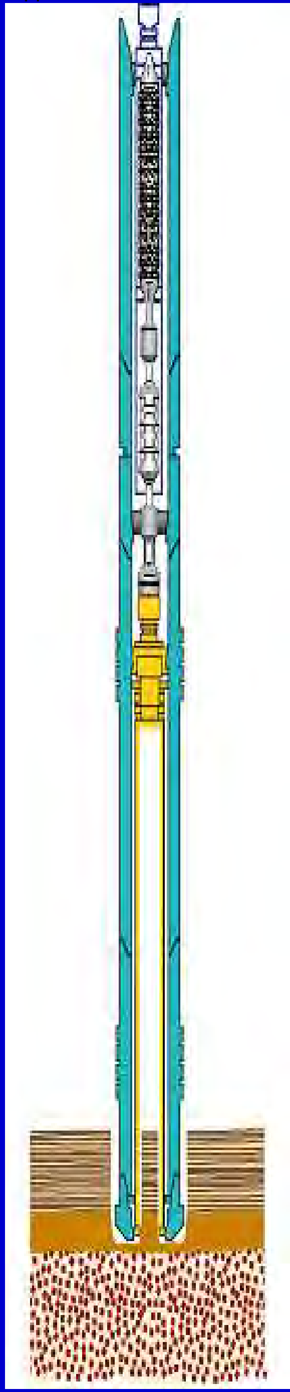
JAMSTEC CDEX IODP



Turbine-Motor Driven Core Barrel (T-MDCB)



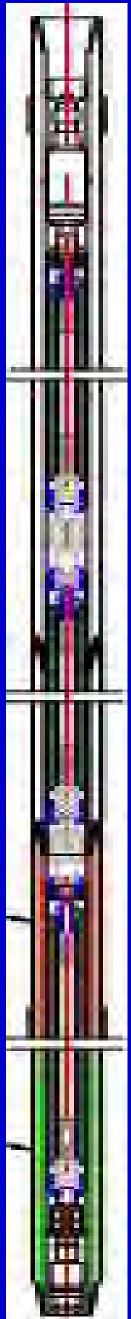
- Higher revolutions per minute and less Weight – on-Bit to enhance core quality and recovery in ultra hard rock formations
- Use of mud as the Drilling Fluid
- High Temperature capability



Turbo-Corer

- Applicable with Wireline Rotary Core Barrel
- Directional control for vertical coring
- Enhancement of core quality and recovery

Turbine Motor (1/2 Size Model)



MWC / LWC

- Directional coring control by monitoring Inclination, Azimuth, Tool-face, etc.
- Logging the formation properties such as natural Gamma-rays, Resistivity, Sonic data, etc.
- Real-time data transmission
- Monitoring of additional downhole information such as Temperature and Pressure

Website:

http://www.jamstec.go.jp/chikyu/jp/CHIKYU/index.html

The English version will be launched this April, 2010.

Thank you for your kind attention!

JAMSTEC

CENTER FOR DEEP EARTH EXPLORATION
CDEX
JAMSTEC

IODP
INTEGRATED OCEAN DRILLING PROGRAM

Engineering Development Panel

13th-15th January 2010, Sendai

ESO Report

Dan Evans
ECORD Science Operator - Science Manager

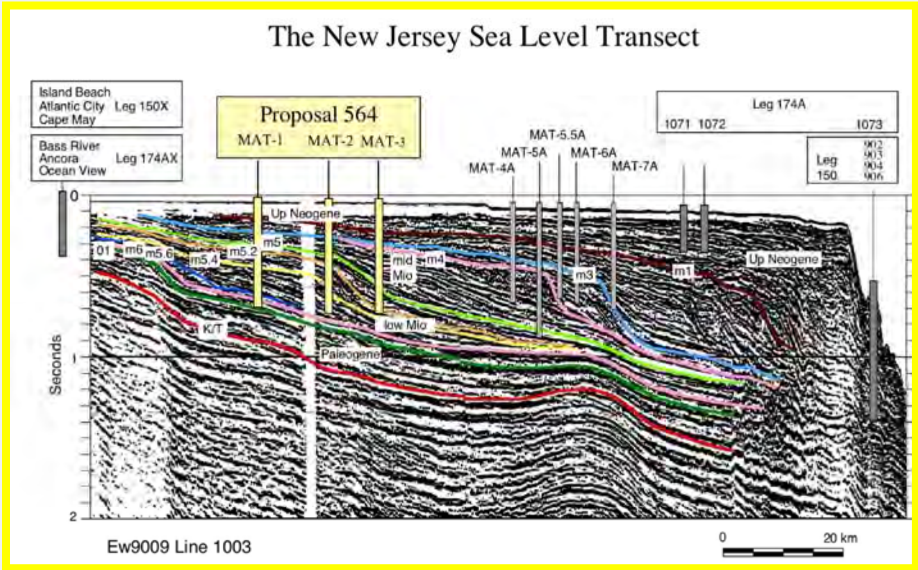
New Jersey Shallow Shelf Expedition

- The L/B *Kayd* left Louisiana in early April
- Arrived Atlantic City 22nd April ahead of schedule
- Left Atlantic City on 30th April
- Operations completed 17th July (79 days)

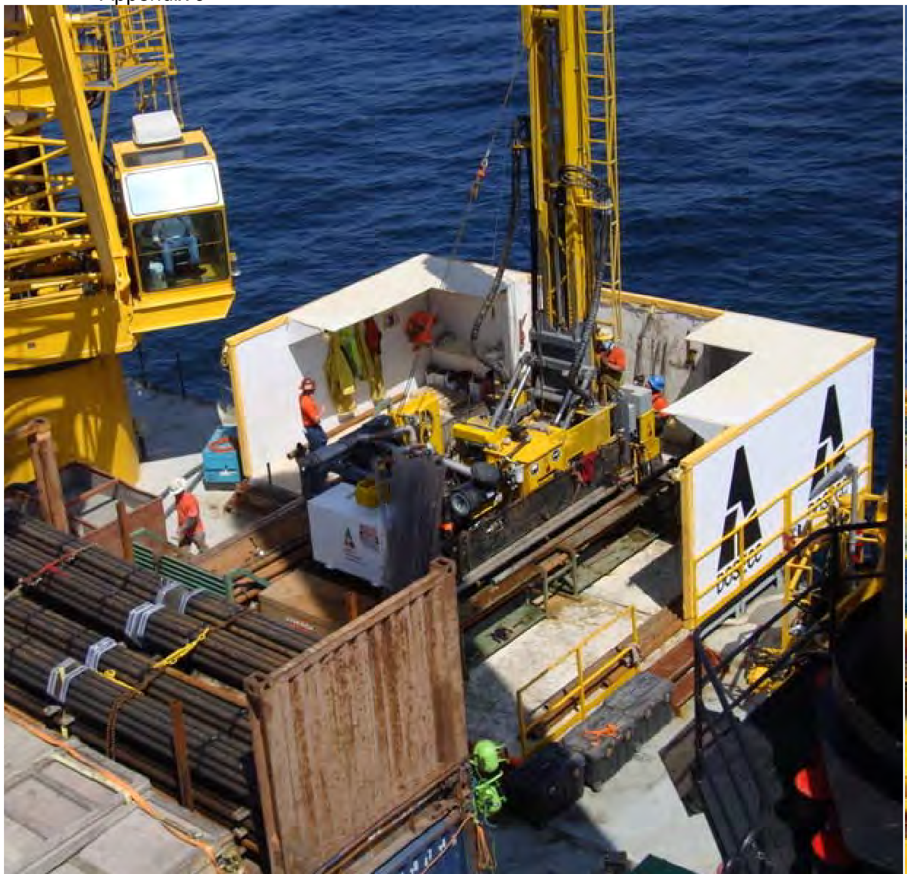
- Onshore Science Party
  at Bremen
  6th Nov – 4th Dec

NJSS objectives

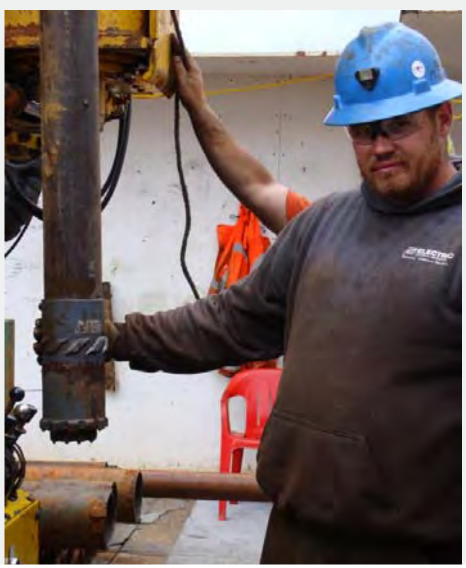
- Core and log three sites
- Maximum depth 750 mbsf
- Drilling, as expected, proved to be very challenging

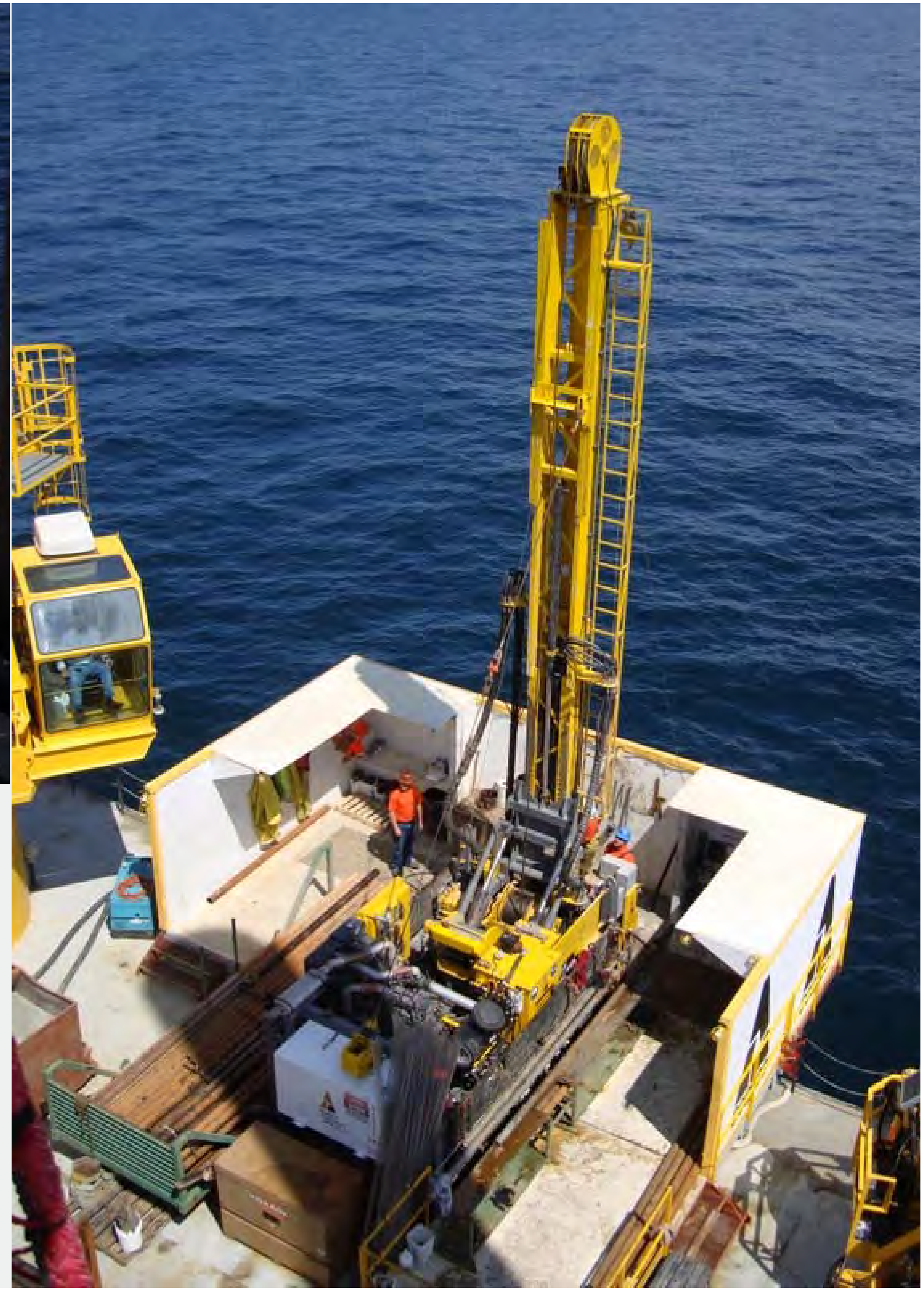



icdp
DOSECCA
ECORD
Science Operator




ECORD

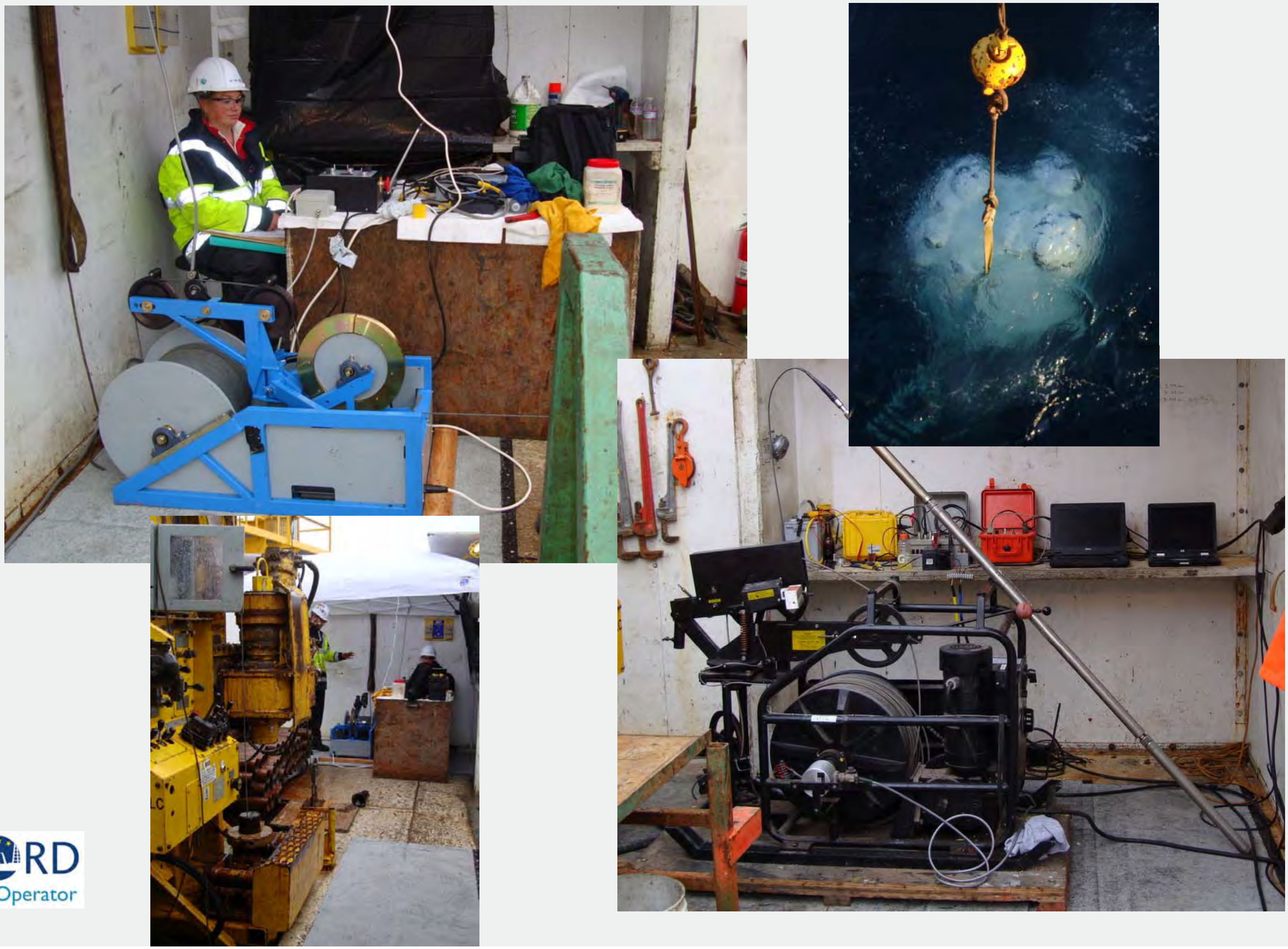




ECORD Science Operator

Wireline & VSP Logging

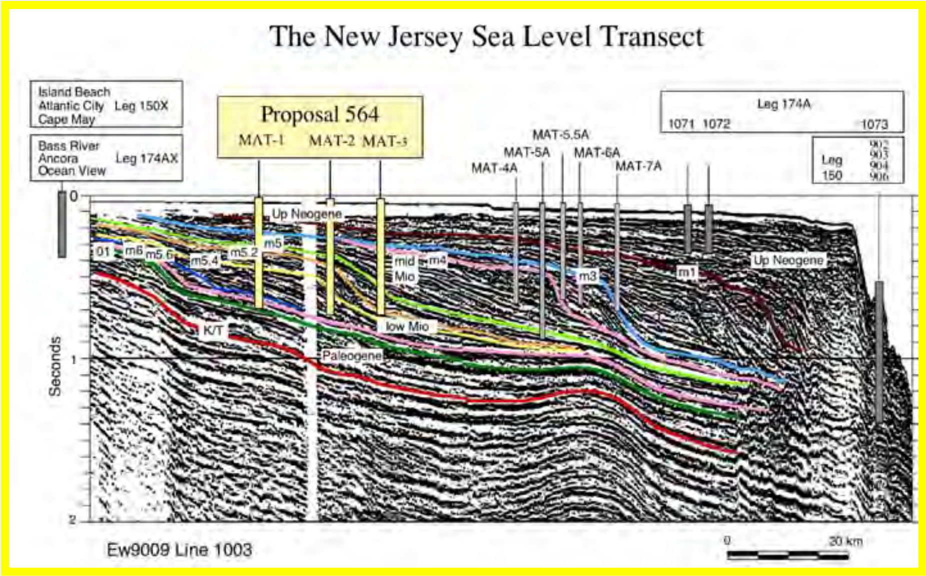
IODP INTEGRATED OCEAN DRILLING PROGRAM

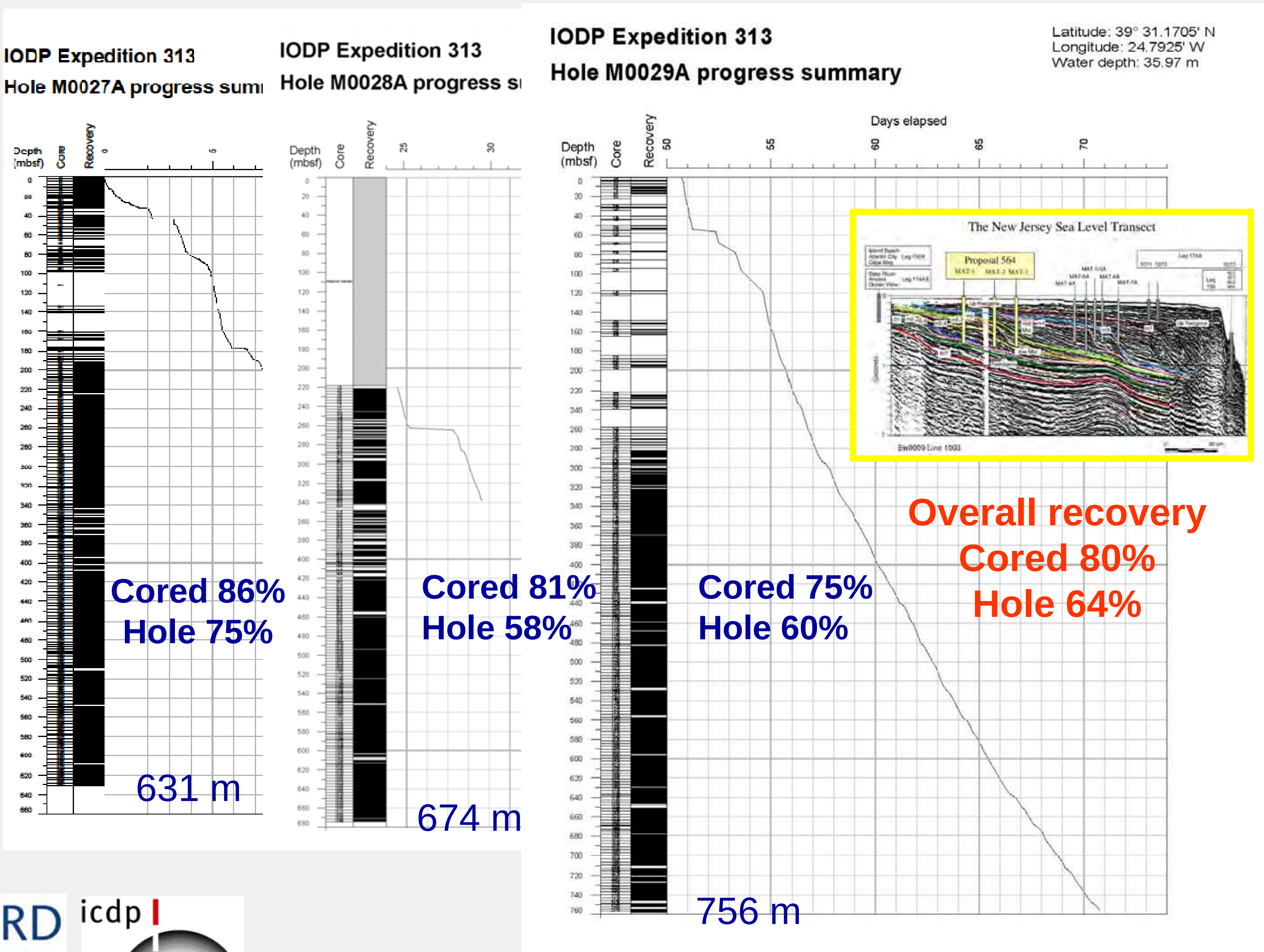


ECORD Science Operator

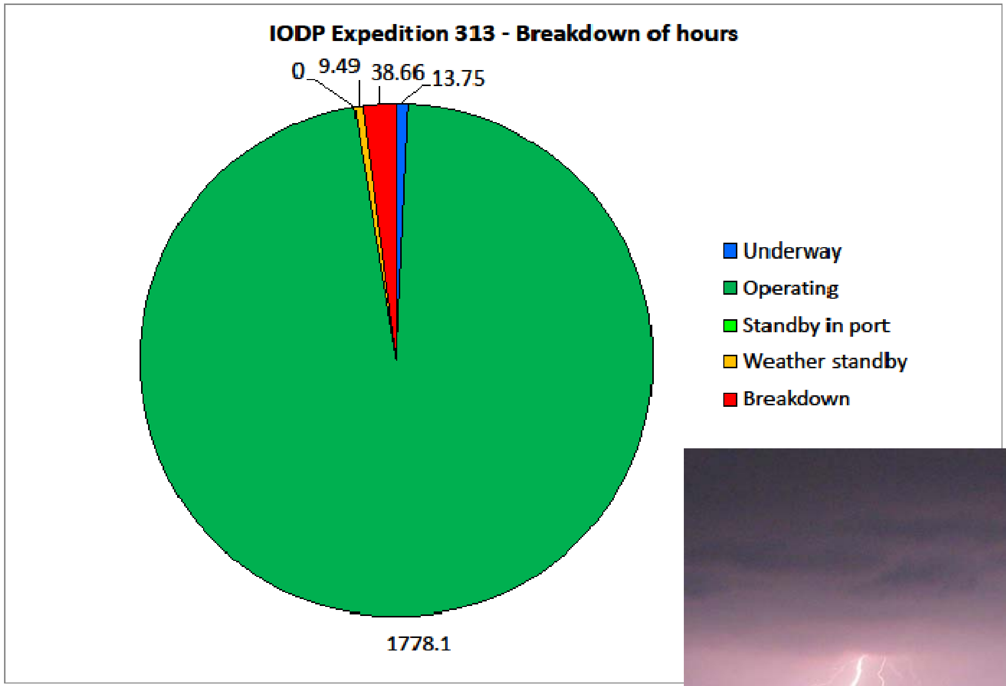
NJSS results

- Hole MAT-1A ended at 631 MBSF
  - Crossed Eocene/Oligocene boundary
- Hole MAT 2 TD’d at 674 mbsf.
  - Bottomed in lowermost Miocene sequence m6.
- MAT 3 cored to 756.65 m
  - Recovered key Miocene packages.
  - Passed through basal Miocene (m5.8).




IODP Expedition 313
Hole M0027A progress sum
Depth (mbsf)
Core
Recovery
Cored 86%
Hole 75%
631 m
IODP Expedition 313
Hole M0028A progress s
Depth (mbsf)
Core
Recovery
Cored 81%
Hole 58%
674 m
IODP Expedition 313
Hole M0029A progress summary
Latitude: 39° 31.1705' N
Longitude: 24.7925' W
Water depth: 35.97 m
Days elapsed
Depth (mbsf)
Core
Recovery
The New Jersey Sea Level Transect
Proposal 564
Cored 75%
Hole 60%
756 m
Overall recovery
Cored 80%
Hole 64%

Time analysis



NJ Onshore Science Party

- Began in Bremen on 6th November
- Completed 4th December
  - CoreWall successfully set up

ECORD Science Operator

IODP
INTEGRATED OCEAN DRILLING PROGRAM

ECORD
Science Operator


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

NJSS Press release

- Closer inspections in the Bremen laboratories have revealed both remnants of ancient sandy beaches and continental soils, indicating sea-level changes of as much as 100 metres. The scientists have identified about ten cycles of sea-level rise and fall with drastic seaward shifts of the shoreline during the interval between 14 and 35 million years ago.

NJSS Press release

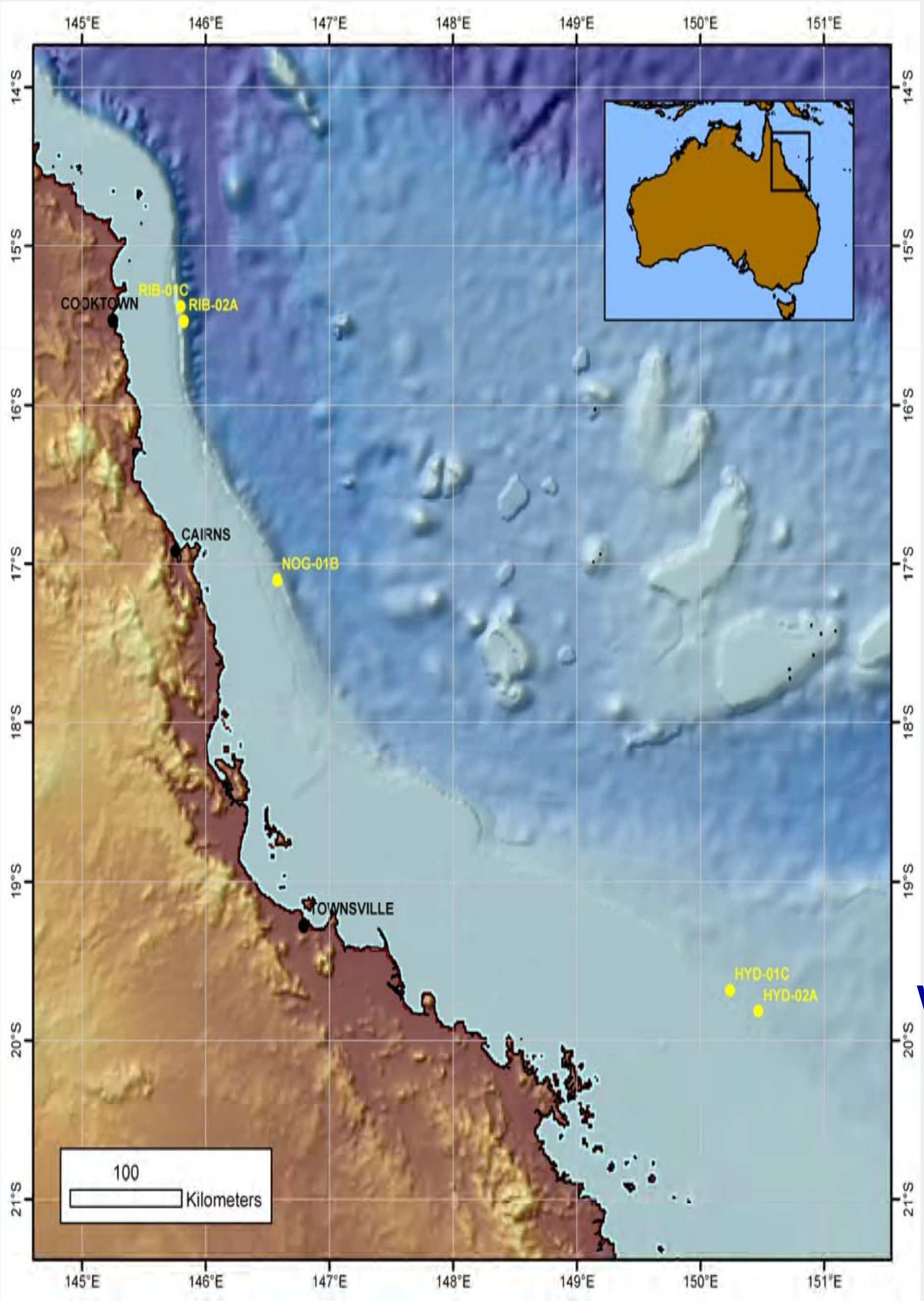
- We came across thick freshwater lenses at all three drill sites as deep as 400 metres below the sea floor ……we think that these freshwater lenses, originated more than 12,000 years ago during the last ice age, when sea-level was much lower and the New Jersey shoreline was occasionally seaward of our drill sites.

'World-class pore water dataset'

ECORD Science Operator

Display webpage

- http://www.slatev.com/index.html?bcpid=988327350&bclid=29897817001&bctid=29702765001
- **Drilling for clues about Global Warming.**
- Link to video



Great Barrier Reef Environmental Changes

#325

5 transects

38 potential sites
Water Depth 44-198 m
Wireline logging 2 holes per transect
45 days operations

Great Barrier Reef Environmental Changes Expedition

- Vessel contract signed on 11th May.
- Platform provider is 'Bluestone' based in Singapore.
  - The vessel *Bluestone Topaz* was to be mobilised in Singapore/Townsville in early October 2009.
  - ESO and Science Party join in Townsville 1st November.
  - Circa 45 day expedition.
  - Demobilise in Townsville.

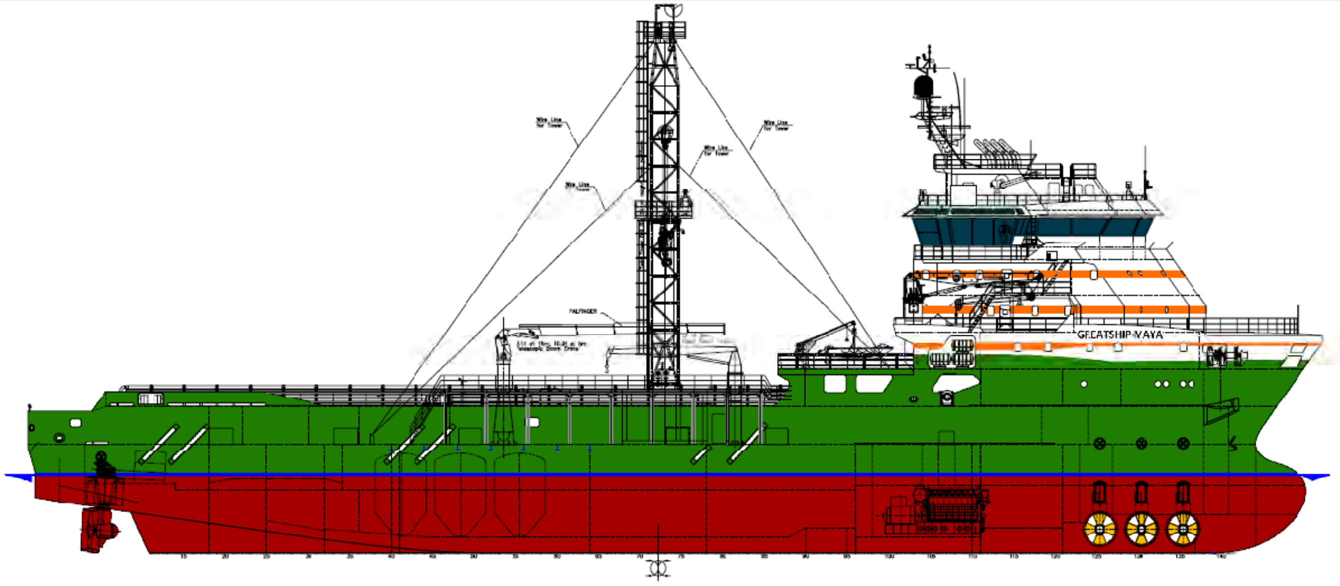
ECORD Science Operator

GBRMPA visit

- In August ESO representatives visted Bluestone in Singapore and GBRMPA in Townsville.
- Satisfactory meeting with Bluestone on outward journey.
- Meeting with GBRMPA.
  - Approved Environmental Management Plan subject to removing 2 sites and minor modifications.
  - Clarification of number of topics.
- Met briefly with Bluestone on return.
  - Advised of problems with *Bluestone Topaz.*

Bluestone changes

- Engine problems with *Bluestone Topaz* too great to repair.
- After several weeks of negotiation we have:
  - Brand new vessel – *Greatship Maya.*
  - Greater capability, better DP, more accommodation, faster.

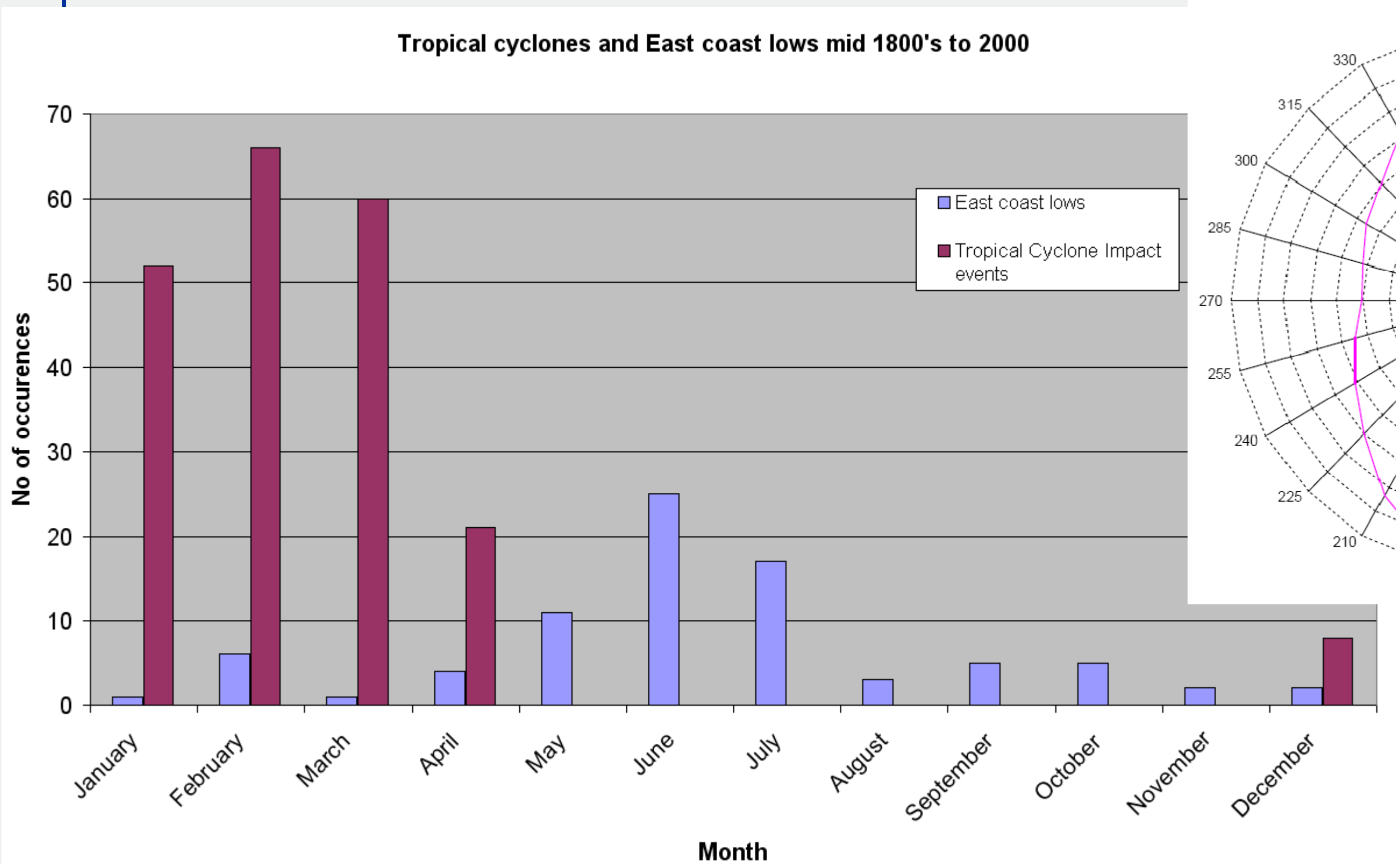


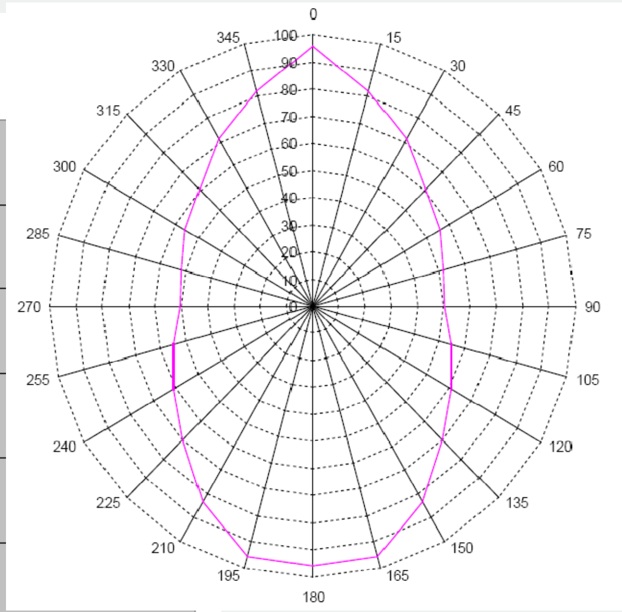
ECORD Science Operator

ECORD Science Operator

Bluestone changes

- Bluestone are taking typhoon downtime risk





Probability of <1 typhoon off Queensland during operations

Bluestone changes

- Delay in delivery to Townsville.
- Arrive end January, depart early February for c. 45 days.
- Bluestone are arranging Scientific Permit.
- We have export permit for cores.
- Science Party now complete – shortage of offshore sedimentologists.
- Onshore Science Party in Bremen 2nd July 2010.

ECORD Science Operator

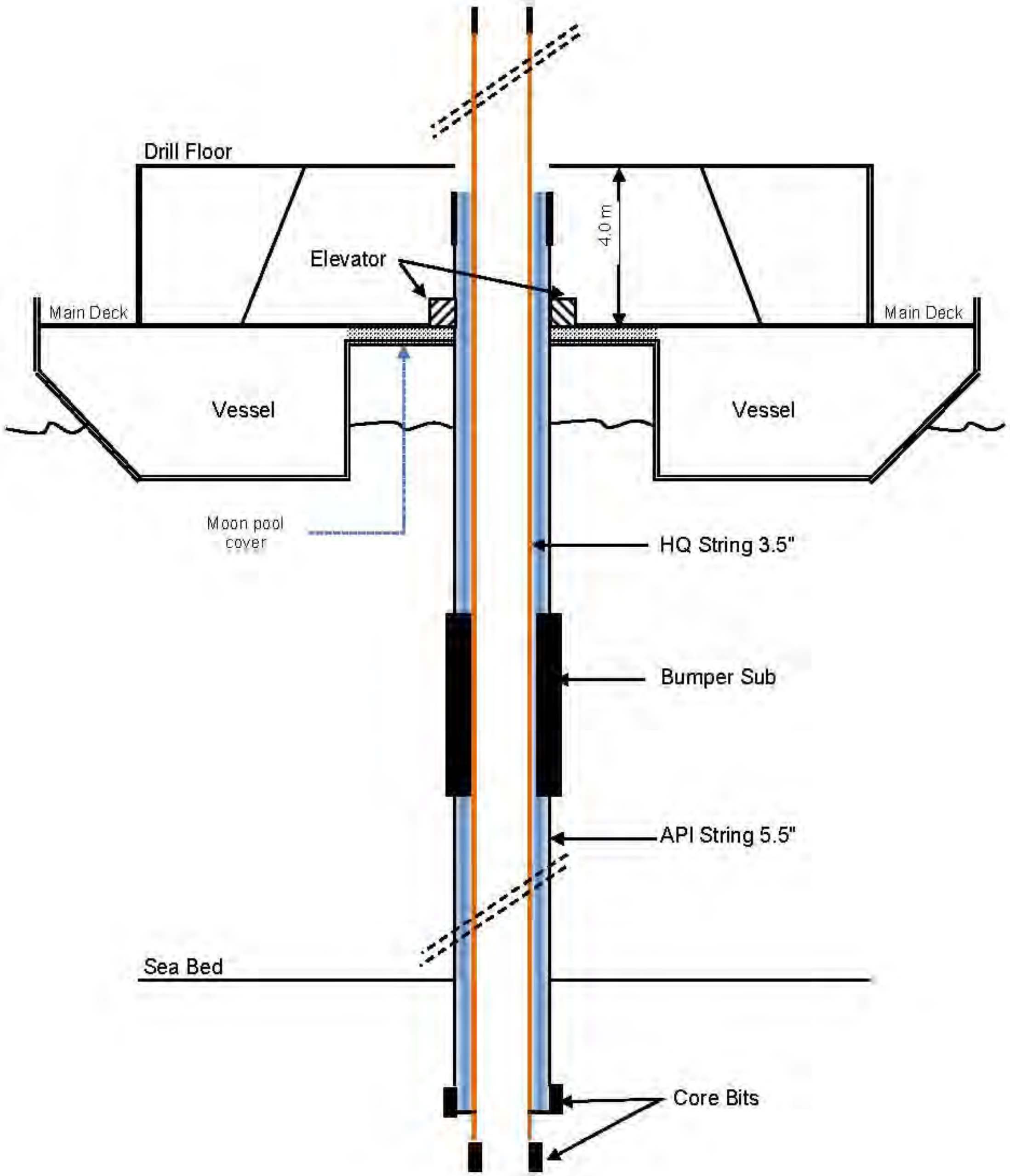


Diagram 1: Drilling/Coring System

Engineering Developments

Mebo used off S America

Setting up remote drilling consortium

ECORD Science Operator

	Status	Number	Short Title	Contact Proponent	Platform
1	Rev Full	673-Full2	Morocco Margin Mud Mound	Van Rooij	MSP+NR
2	Rev Pre	708-Pre2	Central Arctic Paleoceanography	Stein	MSP
3	New Full	735-Full	South China Sea Tectonic Evolution	Li	NR
4	New Full	743-Full	Gulf of Mexico Hydrate Dynamics	Knapp	R
5	**New Full**	754-Full	Norwegian Sea Silica Diagenesis	Davies	NR
6	**New Pre**	755-Pre	Arctic Slope Stability	Winkelmann	NR
7	**New Pre**	756-Pre	Arctic Ocean Exit Gateway	Jakobsson	NR
8	**New APL**	757-APL	South Pacific Eocene-Oligocene	Lyle	NR
9	**New Full**	758-Full	Atlantis Massif Seafloor Processes	Frueh-Green	MSP
#	**New Pre**	759-Pre	EPR Fast-Spread Crust	Haymon	NR
#	**New Pre**	760-Pre	SW Australia Margin Cretaceous Climate	Grocke	NR
#	**New Pre**	761-Pre	South Atlantic Bight Hydrogeology	Wilson	MSP
#	**New APL**	762-APL	Grizzly Bare Outcrop Microbiology	Wheat	NR
#	**New APL**	763-APL	Iberian Margin Paleoclimate	Hodell	NR
#	**New Pre**	764-Pre	TAG II Hydrothermal System	Rona	NR

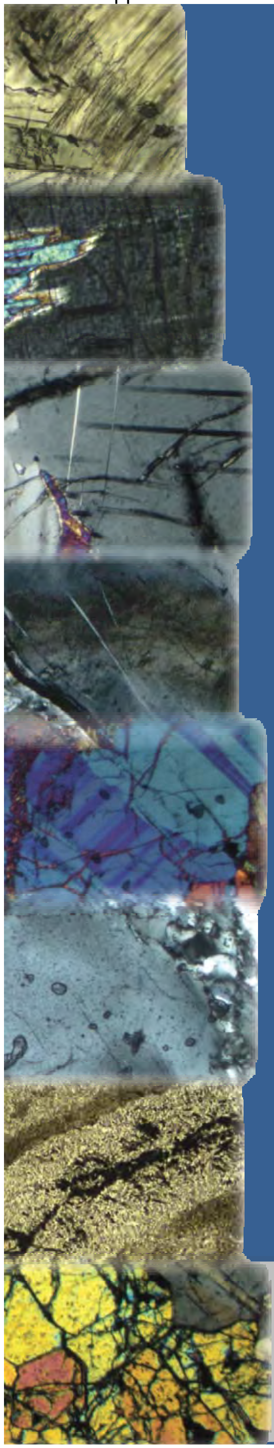
SSEPs Nov 09 - 6/17 require MSPs

Externally Reviewed

#	5 reviews	672-Full3	Baltic Sea Basin Paleoenvironment	Andren	MSP+NR
#	6 reviews	748-Full	Nice Airport Landslide	Stegmann	MSP

Future MSPs

- Hawaiian Drowned Reefs is at OTF and ESO is initiating planning for FY11 –scoping has begun
- New England Hydrogeology is highly ranked and in OTF ‘Holding Bin’ awaiting site survey
  - EDP input will be useful
- SSEPs reviewing other proposals
- Sent to SPC for ranking in March
  - 672-Full3 Baltic Sea Basin Palaeoenvironment
  - Chixculub



Integrated Ocean Drilling Program
United States Implementing Organization

Engineering and Operations Update

EDP Meeting

Sendai, Japan, 13-15 January 2010

Integrated Ocean Drilling Program
United States Implementing Organization

Outline

- Organizational Changes
- Schedule
- Project Updates
- CORK Expeditions
- Maintenance Period
- Future Projects

Organizational Changes

- Consortium for Ocean Leadership
  - Sean Higgins has left COL
  - Greg Myers is serving as Senior Technical Expert
- TAMU Engineering
  - Engineering Supervisor
    - Interviews complete
  - Mechancial Engineer
    - Bob Aduddell hired to fill the position of Staff Engineer
  - Mechanical Engineer
    - On Hold
- LDEO Engineering
  - Gerry Iturrino is now serving as the Manager of Engineering and Technical Services
  - 1-2 potential electrical engineer hires needed

Outline

- Organizational Changes
- Schedule
- Project updates
- CORK Expeditions
- Maintenance Period
- Future Projects

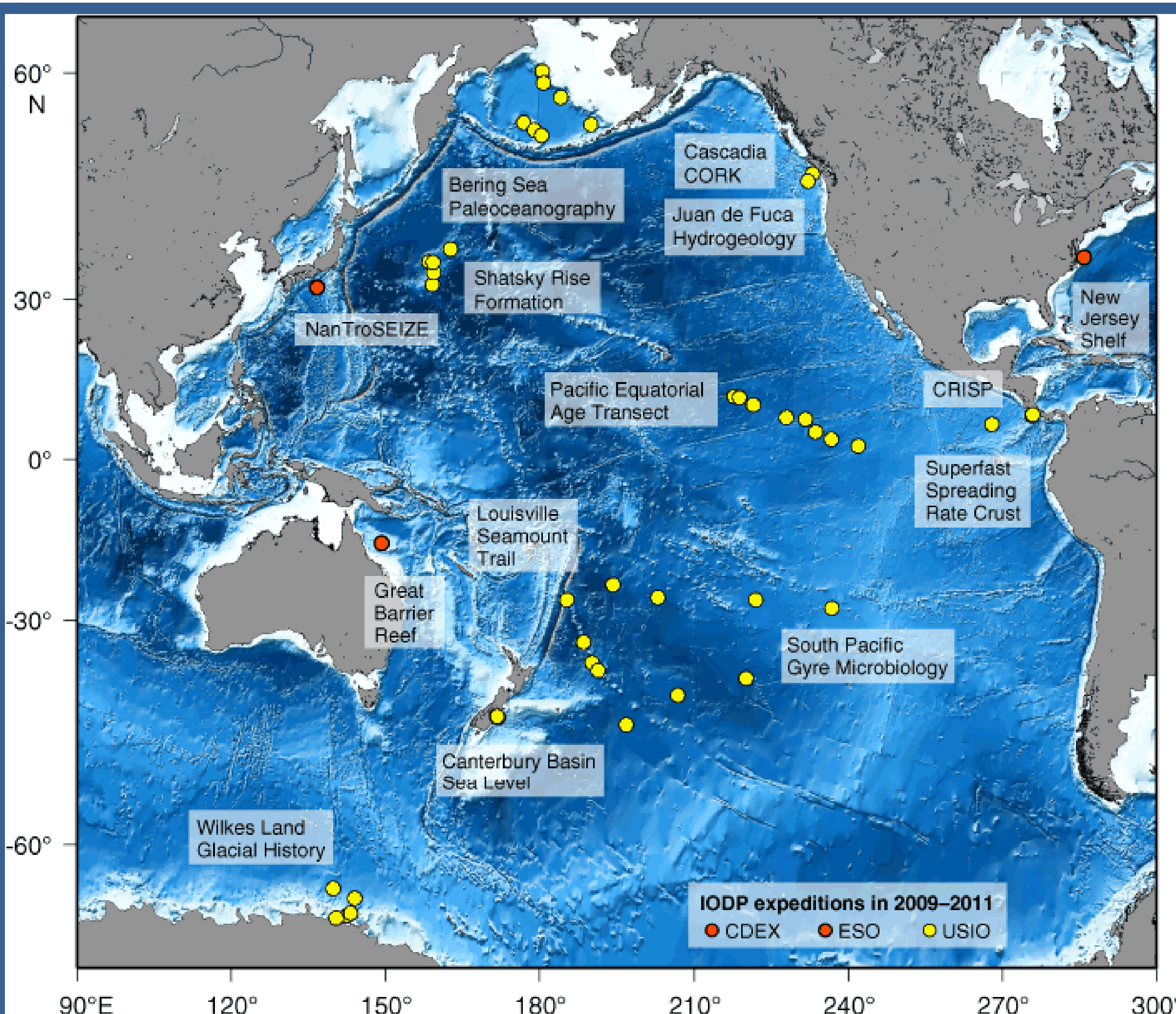
JOIDES Resolution Operations Schedule

USIO *JOIDES Resolution* Expedition Schedule

Expedition	Expedition Number	Port [7] (Origin)	Dates [1,2]	Total Days (Port/Sea)	Days at Sea (Transit[3]/ Operation[illegible])	Co-Chief Scientists	USIO Contacts[4]
Wilkes Land[5]	318	Wellington	4 January–9 March 2010	64 (5/59)	16/4[illegible]	C. Escutia H. Brinkhuis	A. Klaus* T. Williams^
Transit/Maintenance	N/A	Hobart	9 March–5 July 2010	118 (88/30)	[illegible]/A	N/A	
Juan de Fuca	3XX	TBD	5 July–4 September 2010	61 (5/56)	(2/54)	A. Fisher T. Tsuji	K. Gamage* S. Mrozewski^
Cascadia CORK/Transit[6]	3XXT	Victoria	4 September–6 October 2010	33 (5/[illegible]	(20/8)	TBD	K. Petronotis*
South Pacific Gyre	3XX	*Papeete, Tahiti*	6 October–7 December 2010	62 (2/60)	(8/52)	S. D'Hondt TBD	C. Alvarez Zarikian* H. Evans^
Louisville	3XX	Wellington	7 December 2010–6 February 2011	61 (5/56)	(8/48)	A. Koppers Y. Yamazaki	J. Geldmacher* J. Inwood^
Transit	N/A	*Auckland*	6 February–10 March 2011	[illegible]	N/A	N/A	
CRISP[8]	3XX	TBD	mid-March to mid-April	TBD	(TBD/26)	TBD TBD	
Superfast[8]	3XX	TBD	mid-April [illegible]id-May	TBD	(TBD/26)	TBD TBD	
Non-[illegible]ODP							
Mid-Atlantic Microbiology	3XX	TBD	S[illegible]mber	TBD	TBD	TBD TBD	

[1] Dates for expeditions may be adjusted pendin[illegible]P activi[illegible]
[2] The start date reflects the initial port call d[illegible]. The v[illegible] will sa[illegible] when ready.
[3] Transit total is the transit to and from p[illegible] call and do[illegible]ot include transit between sites.
[4] The USIO contact list includes both the [illegible]xpedition Proje[illegible] Manager (*), the primary contact for the expedition, and the Logging Staff Scientist (^). In addition, further expedition informati[illegible] be obtained [illegible] http://www.iodp-usio.org.
[5] Wilkes Land includes operations at Ade[illegible]ft (638 A[illegible]L)
[6] 734 APL operations; includes portcall in V[illegible] for personnel change after operations on ~17 October 2010
[7] Blue and TBD ports under investigation
[8] Superfast and CRISP implementation as mini[illegible]peditions under consideration at OTF. Port determination will impact total days.

11 December 2009

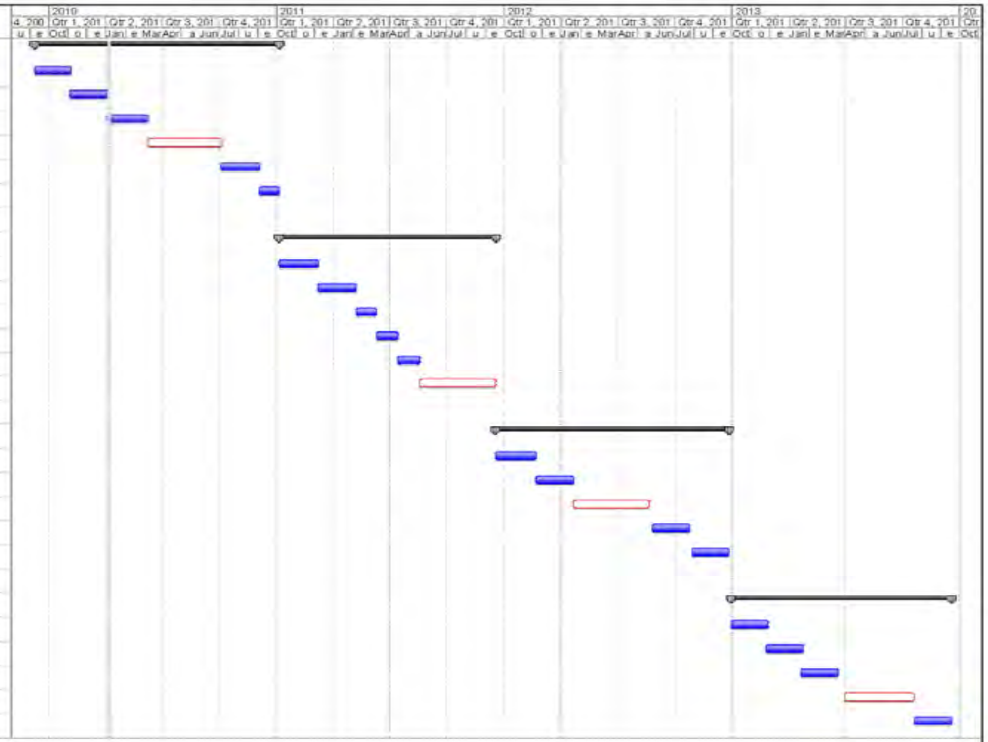

60° N
30°
0°
-30°
-60°
90°E
120°
150°
180°
210°
240°
270°
300°
Bering Sea Paleoceanography
Cascadia CORK
Juan de Fuca Hydrogeology
Shatsky Rise Formation
NanTroSEIZE
New Jersey Shelf
Pacific Equatorial Age Transect
CRISP
Superfast Spreading Rate Crust
Louisville Seamount Trail
Great Barrier Reef
South Pacific Gyre Microbiology
Canterbury Basin Sea Level
Wilkes Land Glacial History
IODP expeditions in 2009–2011
CDEX
ESO
USIO

Recent Operational Achievements

- Expeditions 320 & 321 (Pacific Equatorial Age Transect)
  - Hole 1335B set an Advanced Piston Corer (APC) record at 378.2 mbsf
  - Hole 1338B broke that APC record with 384.9 mbsf
  - Hole 1338C set a new record with 414.4 mbsf (1338 B&C were on expedition 321)
- Expedition 323 (Bearing Sea)
  - Hole 1341B set a new APC record with 458.4 mbsf (56 cores)
- Expedition 317 (Canterbury Basin)
  - Hole 1353A was the shallowest shelf site cored by JR at 84.2 mbsl
  - Hole 1352C set a record for single bit sedimentary hole at 1927.5 mbsf

Conceptual Ship Schedule through 2013

ID	Task Name	Start	Finish	Predecessors
1	**FY 2010**	**Wed 9/9/09**	**Wed 10/6/10**	
2	Shatsky	Wed 9/9/09	Fri 11/6/09	
3	Canterbury	Wed 11/4/09	Mon 1/4/10	
4	Wilkes Land	Mon 1/4/10	Tue 3/9/10	
5	Maintenance Period	Tue 3/9/10	Mon 7/5/10	
6	Juan de Fuca	Mon 7/5/10	Sat 9/4/10	
7	Cascadia CORK	Sat 9/4/10	Wed 10/6/10	
8				
9	**FY2011**	**Wed 10/6/10**	**Sun 9/18/11**	
10	South Pacific Gyre	Wed 10/6/10	Tue 12/7/10	
11	Louisville Seamount	Tue 12/7/10	Sun 2/6/11	
12	TRANSIT from Aukland to Balboa	Mon 2/7/11	Thu 3/10/11	
13	CRISP	Fri 3/11/11	Thu 4/14/11	
14	Superfast	Thu 4/14/11	Thu 5/19/11	
15	Alternative Funding ?GoM Engineering?	Thu 5/19/11	Sun 9/18/11	
16				
17	**FY2012**	**Sun 9/18/11**	**Thu 9/27/12**	
18	Mid-Atlantic Microbio	Sun 9/18/11	Tue 11/22/11	
19	Med Outflow	Tue 11/22/11	Sat 1/21/12	
20	Alternative Funding ?Gulf of Mexico Hydrat	Sat 1/21/12	Mon 5/21/12	
21	TBN operation	Sun 5/27/12	Thu 7/26/12	
22	TBN operation	Sun 7/29/12	Thu 9/27/12	
23				
24	**FY2013**	**Sun 9/30/12**	**Thu 9/19/13**	
25	TBN operation	Sun 9/30/12	Thu 11/29/12	
26	TBN operation	Sun 11/25/12	Thu 1/24/13	
27	TBN operation	Sun 1/20/13	Thu 3/21/13	
28	Alternative Funding ?Industry-Science-Eng	Sun 3/31/13	Sun 7/21/13	
29	TBN operation	Sun 7/21/13	Thu 9/19/13	



Project: Ship schedule through 2013
Date: Tue 1/5/10

Task · Split · Progress · Milestone · Summary · Project Summary · External Tasks · External Milestone · Deadline

Page 1

Integrated Ocean Drilling Program
United States Implementing Organization

Outline

- Organizational Changes
- Schedule
- Project updates
- CORK Expeditions
- Maintenance Period
- Future Projects

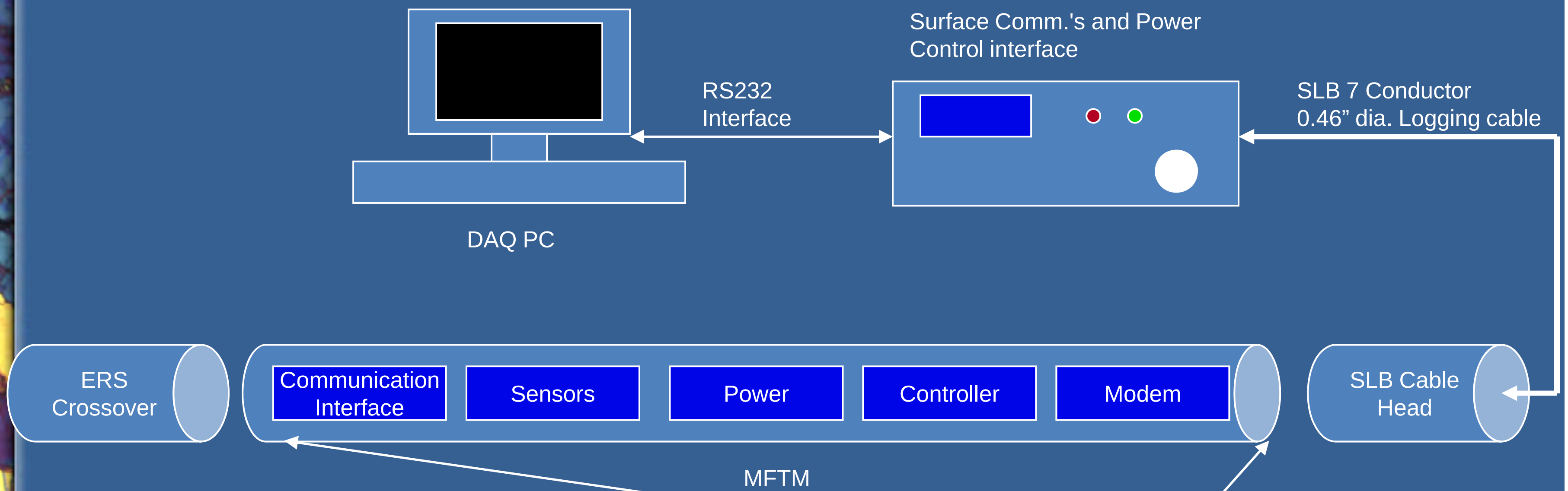
Rig Instrumentation System (RIS)

- New RIS installed during vessel conversion
  - Remaining issues
    - Display of VIT and coreline depth
      - Coreline depth displayed on JR TV system
      - Is also displayed in RIS
      - New pipe counter sensors installed in Wellington
    - Depth measurement
      - Currently using draw works encoder to measure depth
      - Plan is to install crown encoder during maintenance period
    - WOB Measurement
      - Currently using hook load as a proxy for WOB
      - Plan underway to install load pins during maintenance period

Sediment Temperature Tools

- Sediment Temperature Tool with Pressure (SETP)
  - One tool deployed to Chikyu for Exp. 322
  - Tool only deployed for testing, no suitable formations found for deployment
  - Tool returned to College Station for storage
- Sediment Temperature Tool (SET)
  - 2 tools currently deployed on JR
  - Two tools deployed on Chikyu not used, returned to College Station for storage
  - 1 tool prepared for back-up

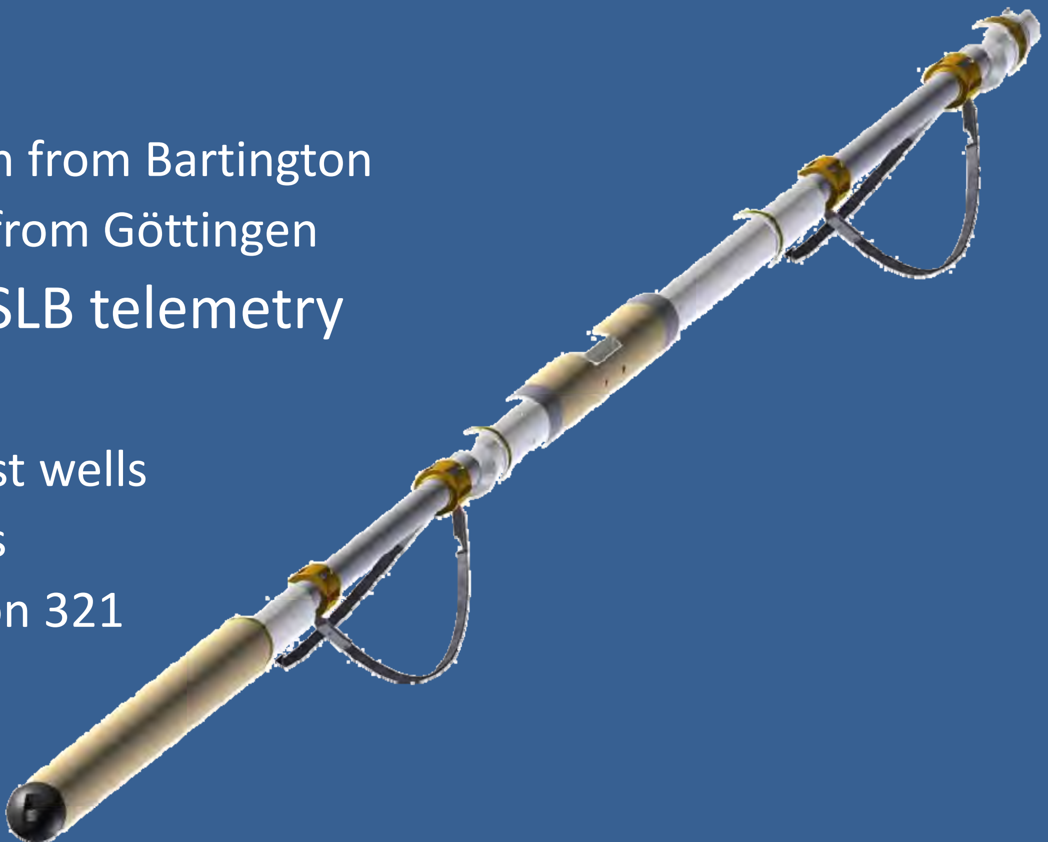
Multi-Function Telemetry Module (MFTM)



- Standardized Downhole Telemetry Interface
- Operating Configurations
  - Standalone LDEO Telemetry Mode
  - Schlumberger Mode
  - MDHDS Mode
  - SCIMPI Mode
- Replacement for UDTM

Magnetic Susceptibility Sonde (MSS)

- Tool replacement effort underway
- Tool Description
  - Two sensors
    - High-resolution from Bartington
    - Deep-reading from Göttingen
  - Integrated into SLB telemetry
  - Successful runs:
    - LDEO & SLB test wells
    - SODV sea trials
    - IODP Expedition 321

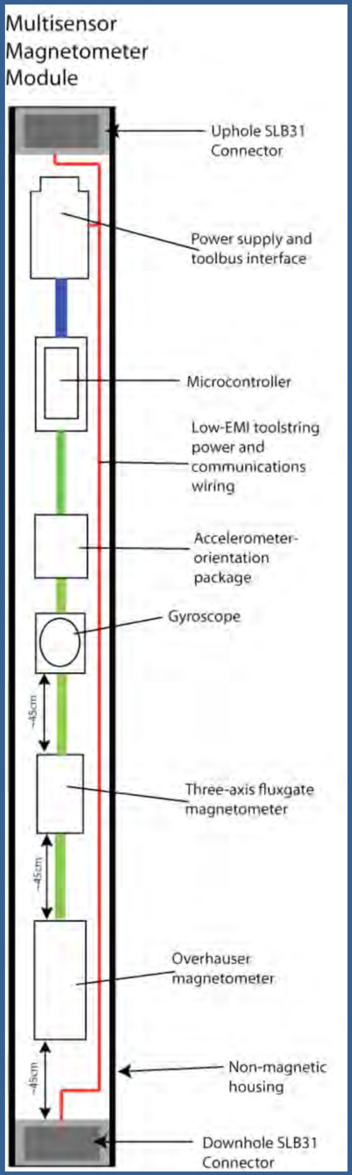


LFV Lockable Flapper Valve

•Task force created to develop a preventative measure, mitigation strategy and/or alternative valve solution to avoid LFV incidents.
•Experiments have been conducted with Schlumberger
•Several design modifications under review

Multisensor Magnetometer Module (MMM)

- Status
  - Project funded in FY2010 IODP Annual Program Plan
  - Contract negotiations are commencing
- Tool summary
  - Four sensors
    - Fluxgate magnetometer
    - Overhauser magnetometer
    - Accelerometer
    - Gyroscope
  - Integrated into SLB telemetry
  - Short Paleo-string MSS-MMM-Gamma
  - Scientific applications
    - Continuous magnetic field records in borehole
    - Calculate magnetization & polarity of rocks
    - Magnetostratigraphy both sedimentary & igneous

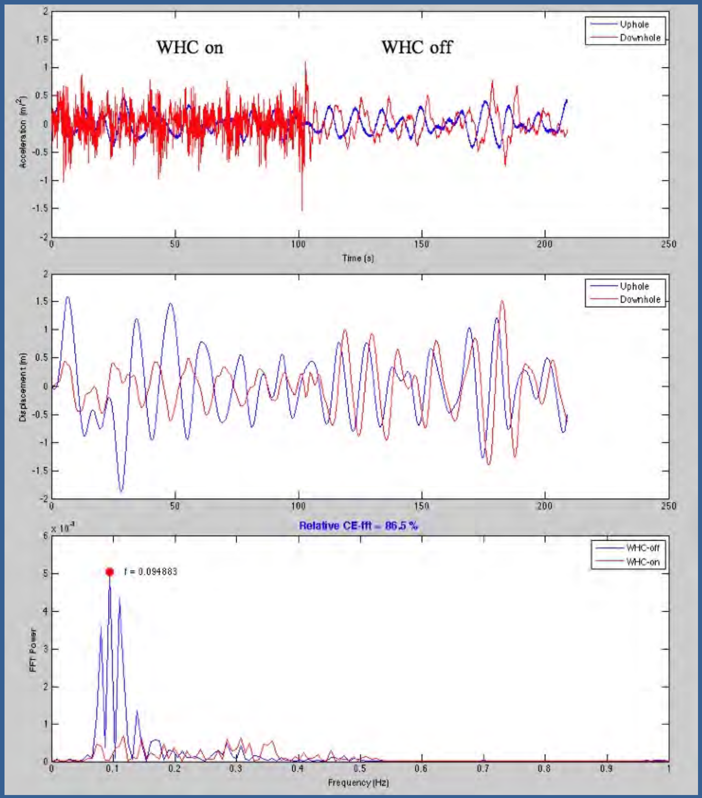


IODP Integrated Ocean Drilling Program United States Implementing Organization

Wireline Heave Compensator (WHC)

- Downhole tool motion compensation at different water depths, varying sea states, and tool loads.

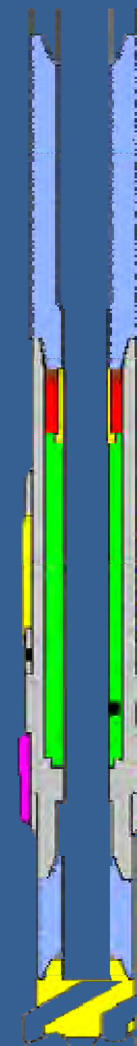
- Assessment of surface motion versus downhole tool displacement.



LWC Logging-While-Coring

Leg 204: soft sediment

Leg 209: hard rock



MDCB
core barrels
and upper
BHA

Modified
RAB-8

RCB
lower BHA
and bit

- Measurement system working well
- Core recovery in hard rocks problematic
- New fixed cutter bits were created and tested in 2007
- System awaiting field trial

Large Pipe Handling Infrastructure

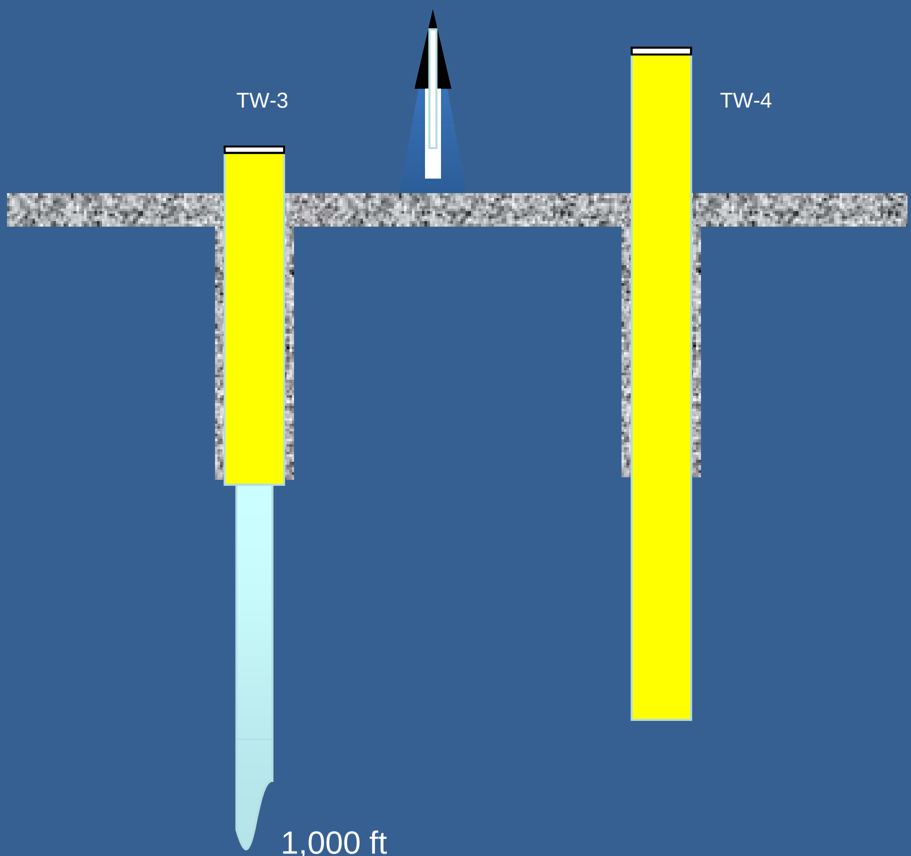
- In order to deploy 6 5/8" drillpipe with the *JOIDES Resolution's* horizontal pipe racking system, unique handling infrastructure is required.
- The main items requiring modification are the dual side door elevators. Depending on the final design of the elevators, other handling equipment such as the lifting bails, elevator handler, elevator stool, pipe transfer skate system, etc, could also require modifications.
- The primary benefit will be the ability to deploy large diameter, late generation logging tools (see poster)
- Discussions are underway with potential subcontractors for providing advice and assistance to the USIO during the vendor selection, design, and installation of the modified systems
- There are no plans for modifying any coring tools onboard the *JOIDES Resolution* to provide larger diameter cores
- The USIO received NSF funds to begin this project in FY2010
- The process of submitting a Request for Quotes (RFQ) for the proposed work should begin spring 2010.

Testing, Servicing and Calibration Facilities

- Metrology Lab at Texas A&M
  - Two temperature baths to cover range of temperatures needed for deployment
  - Dead weight tester for calibration of pressure transducers
- Service center at Texas A&M
  - Facility for servicing and re-conditioning IODP temperature and pressure tools
  - Three SET tools prepared for shipping and deployment
  - One SETP tool prepared for shipping and deployment
  - Advanced Piston Corer Temperature Tool (APCT3) tools prepared for shipping and deployment

LDEO Test Well Facilities

Testwell-3
Total Depth is 1000'
Hole diameter is 6.25" from 20' to total depth
20' of 8" diameter surface casing
Static water level is at 316 ft below surface



Testwell-4
Total depth 61'
Hole diameter is 10.2" from 14' to total depth
14' of 14.25" diameter surface casing
Pressure Vessel
- 40' depth
- 6.56" ID
- 10,000 psi
- G/O 7 conductor through wiring

Environmental Qualification Facility

- 1000 ft test well
- 10 kpsi pressure vessel (40 ft x 6.5 inch OD)
- Logging truck with 19,000 ft of cable
- 500 g shock machine
- **-40ºC to +100ºC** temperature chamber

Outline

- Organizational Changes
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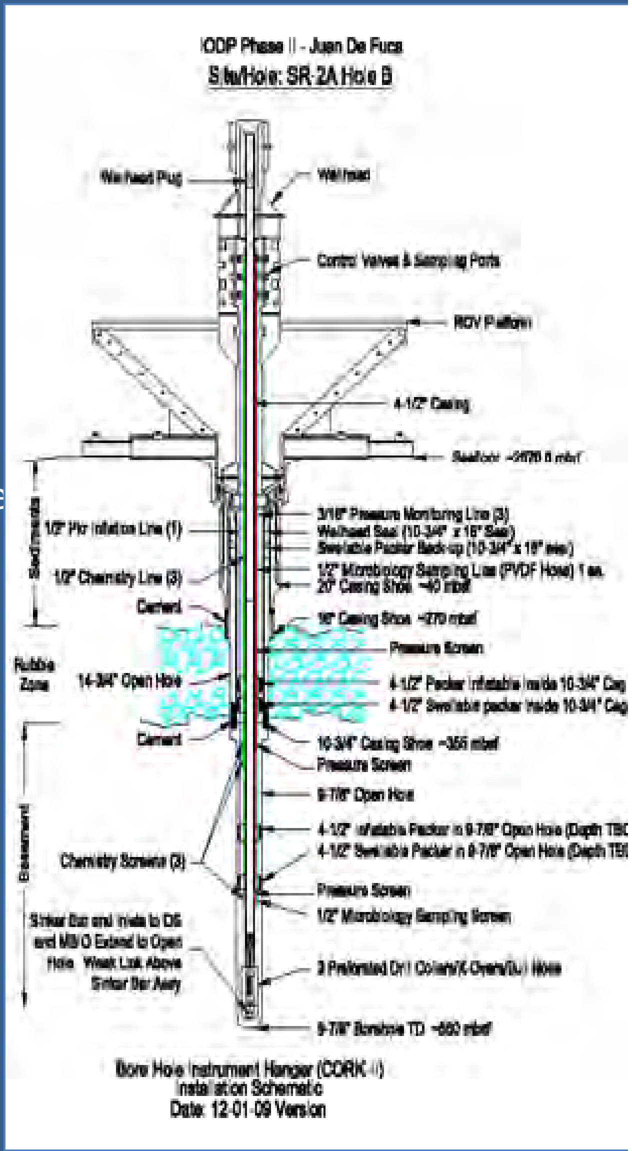
Observatory Installations

Juan de Fuca II

- CORK-II
  - Two new CORK deployments
  - One CORK replacement
  - CORK design by Tom Pettigrew
- Umbilical
  - Three umbilicals
    - Umbilical #1 – S.S. ½” Inflation line, S.S. ¼”x2 pressure lines.
    - Umbilical #2 – Three ½” S.S. chemistry lines
    - Umbilical #3 – One Tefzel line for micro-bio sampling
- Installation Hardware
  - Packers
    - Inflatable packers will be backed up by swellable packers
- Coatings
  - All hardware below lower packer coated for micro-bio sampling



Observatory Installations: continued

- Cascadia:
  - Scheduled to immediately follow Juan de Fuca – II
  - CORK Deployment
    - Planning meeting with PI's scheduled for 22 January
- North Pond
  - Scheduled for September 2011
  - CORK Deployments
    - Two new CORK installations
    - One CORK replacement
  - Casing
    - Casing below packers to be fiberglass
  - Packers
    - All packers to be inflatable. Composition of Swellable packers leach into formation.
  - Umbilicals
    - Umbilical #1 – One ½" Inflation line, four ¼" pressure lines. All SST.
    - Umbilical #2 – Three ½" SST chemistry lines
    - Umbilical #3 – four Tefzel line for micro-bio sampling Possibility of 4 micro-bio umbilicals
    - Checking into feasibility of using this many reels in the moon pool area

Outline

- Organizational Changes
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- Future Projects

Maintenance Period

- Location of maintenance activities will be Northwest Pacific region
- Two projects scheduled for maintenance period to increase reliability of RIS
  - Depth measurement
    - Currently using draw works encoder to measure depth
    - Plan is to install crown encoder during maintenance period
  - WOB Measurement
    - Currently using Hook Load
    - Plan is to install load pins during maintenance period
- Refurbish wireline logging tools
  - All tools returned to Schlumberger Offshore District in Texas
- Replace the wireline logging cable
- Install new stainless steel tubing for the WHC hydraulic system
- Raise the foundation for the SLB winch cab for better visibility

Outline

- Organizational Changes
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Future Projects under consideration

- ½ APC Corer:
  - Design and develop an APC tool to take ½ cores
    - Advantages
      - Very low cost development
      - Decrease in bending core barrels
      - Increase APC deployment depths
    - Initial design completed
    - Review, fabrication and testing required
- Powered XCB
  - Design XCB system powered by mud motor
    - Possibility of increasing quantity and quality of XCB cores
- Drilling Sensor Sub (DSS) - complete project after hiatus
  - Bench test tools
  - Land test both subs in drilling environment and in pressure well
  - When satisfied tools are performing properly – test with Retrievable memory module (RMM) tools

Working outside of traditional funding models

- North Pond CORK development funded by the Moore Foundation
- A three year proposal has been submitted to the US Department of Energy's RPSEA project to modify the JOIDES Resolution to conduct Riserless Mud Recovery Operations for a field test in the Gulf of Mexico.
- We are working with other potential funding agencies to conduct non-IODP funded operations.

IODP-MI Report

Kiyoshi Suyehiro
IODP-MI

EDP Sendai Jan 2010

Tokyo Office

Etchujima Campus

- Tokyo University of Marine Science and Technology (TUMSAT) Etchujima campus
  - http://www.kaiyodai.ac.jp/English/

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Tokyo Office

- Main Office Function
  - SAS support: from Sapporo + DC to **Tokyo**
- All CMO Functions with cost-saving for IODP
- Timeline
  - Washington DC Office downsize: Dec 2009
  - Tokyo Office Operation from late December
  - Sapporo Office closure: mid February, 2010
  - Normal operation: March, 2010

IODP-MI
INTEGRATED OCEAN DRILLING PROGRAM
MANAGEMENT INTERNATIONAL

Central management functions

- Science operations/Services management
- Science planning support
- Business/Administrative

- Education and outreach
- Engineering development
- Data management

IODP-MI
INTEGRATED OCEAN DRILLING PROGRAM
MANAGEMENT INTERNATIONAL

IODP-MI status and outlook

- Greg Myers moved to Ocean Leadership in December 2009.
- Engineering TF disbanded in Dec 2009.
- Yoshihisa Kawamura on board IODP-MI as Operations Manager on January 1, 2010.
- **Program-wide oversight** is necessary. IOs cooperation is key.
- Post-IODP engineering development.

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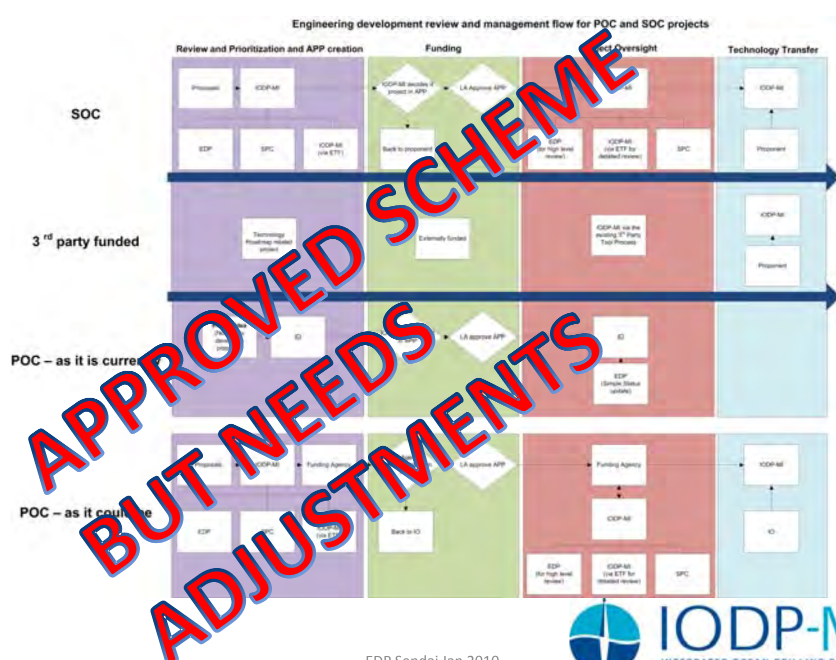

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Second Triennium Rev Com

- The IODP Lead Agencies have asked for the Second Review of IODP-MI (FY07-09).
- *Guideline*: Start in the fall of 09 and complete in early 10. Consist of 7-8 distinguished members, with leadership experience in the Geosciences. Nearly all of the Review committee members are expected not to be currently involved with IODP, but to have some familiarity or prior experience with scientific drilling.
- *Focus*: Effectiveness of the IODP science planning process, SAS functionality, relationships between the SAS, IODP-MI and the Implementing Organizations. Specifically, the effectiveness of the evaluation and ranking of IODP proposals in terms of addressing IODP scientific goals.
- **Effectiveness of the SAS service panels in aiding the technical capabilities and functionalities of the Implementing Organizations.**
- Place the analysis of SAS activities within the context of current financial, legal, logistical, technical, and operational realities, and should help focus discussion for post-2013 scientific drilling.
- Committee: Ian MacGregor (Chair), Sir Geoffrey Allen, Keir Becker, Toshitsugu Fujii, Geoff Garrett, Hodaka Kawahata, Dennis Kent

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CMO Challenges

- Delivery of IODP science
- Serving the IODP Members
- Bridging to the next program
- IODP-MI Values
  – Open
  – Ocean
  – Uniting
  – Inspiring
  – International

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Renewal Process

- International science program with multiple-platform capabilities.
- International WG+ to reset the architecture and principles (rules of the game).
- Science Plan Writing Committee (SPWC) is responsible for describing the next program plan. New, transformative and exciting science and realistic implementation plan (game plan).

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IWG +

- http://www.iodp.org/iodp-council/

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Timelines	2009							2010												2011												2012												2013											
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
IWG+ Meetings and Reports																																																								
IWG+ Meetings	#1			#1b				#2					#3						#4					#5						#6					#7																	
Set up Drafting Group	X																																																						
Complete input to the INVEST meeting		X																																																					
U.S. National Research Council (NRC) committee organized to evaluate the accomplishements of IODP in the last 40 years			X																																																				
INVEST Meeting				X																																																			
Post INVEST PR					X																																																		
Science Plan Working Group Approval						X																																																	
Meet with BoG at AGU							X																																																
Second Triennium Review of IODP Program							X																																																
Triennium Report complete (1st Quarter)											X																																												
NRC committee evaluates New Science Plan																X																																							
IWG+ Position Papers - first draft and final																								X																															
Models for program architecture							X																X																															
Contributions; money flow; etc.							X																X																															
SAS structure							X																X																															
Program management/CMO/Ios							X																X																															
Implementation plan							X																X																															
Funding Cycles and MOUs																																																								
Completion of documents for US National Science Board																														X																									
Presentation to the US National Science Board																																			X																				
Korea renews for 2011-2020																				X																																			
NZ bid for further funding																									X																														
Germany starts to seek approval																															X																																								End of current program		
Australia starts a new 5-year funding cycle																																X																							
New MOUs written																																		X	X																					
Japan needs to sign MOU																																					X																		
Science Community																																																								
INVEST Meeting				X																																																			
Science Plan WG established					X																																																		
Science Plan WG reports to SASEC								X																																															
New Science Plan Outline/Draft													X																																										
Internal review of New Science Plan																X																																							
External review of New Science Plan																				X																																			
Completion of New Science Plan																							X																																
Interim science structure to review proposals																																X																							
Science Plan Implementing Community (IOs+MEXT+NSF+ECORD)																																																								
Pick up Science Seeds for the first 5 years															X																																								
Five-year implementation plan with technology roadmap (Draft)																				X																																			
Technical Review of Implementation plan																					X																																		
Completion of 5-year implementation plan																							X																																
Implementing Organizations																																																								
IOs needs to start 2014 plans for new program																																X																							
New schedule for drilling post-2013																																X																							

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Science Plan Writing Committee

- **SASEC Consensus 11_12_09: SASEC recommends to the IWG+ that the following slate of candidates be invited to participate in the Science Plan Writing Committee tasked with writing a Science Plan for a future ocean drilling program.**
- **Recommended SPWC:** ***Christina Ravelo**: Neogene Paleoclimatology, isotope geochemistry, INVEST SC; ***Heiko Palike:** Paleogene, Arctic, paleoclimate, INVEST SC; **Rob DeConto**: Paleoclimate modeling, CO2 climate sensitivity, cryosphere evolution; ***Fumio Inagaki**: Deep biosphere INVEST SC; ***Katrina Edwards**: Microbiology INVEST SC; ***Naoh Ohkouchi**: Biogeochemistry, ocean chemistry LIP impacts; ***Andy Fisher**: Fluids, crustal evolution; ***Damon Teagle**: Ocean crust, Moho, fluids; **Mike Bickle:** Hydrothermal, CO2 sequestration, climate-tectonic links, LIPS; ***Demian Saffer**: Subduction, seismology, geohazards, NanTroSEIZE; ***Gilbert Camoin**: Sea Level INVEST SC; **Peter Barrett**: Societal impacts, IPCC linkages; ***Shuichi Kodaira**: Seismic imaging, crustal evolution, geophysics; ***Richard Arculus**: Arc magmatism (*attended INVEST)

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Towards renewal

- Good science
- Good engineering
- Good management
- Competitive
- General and global support

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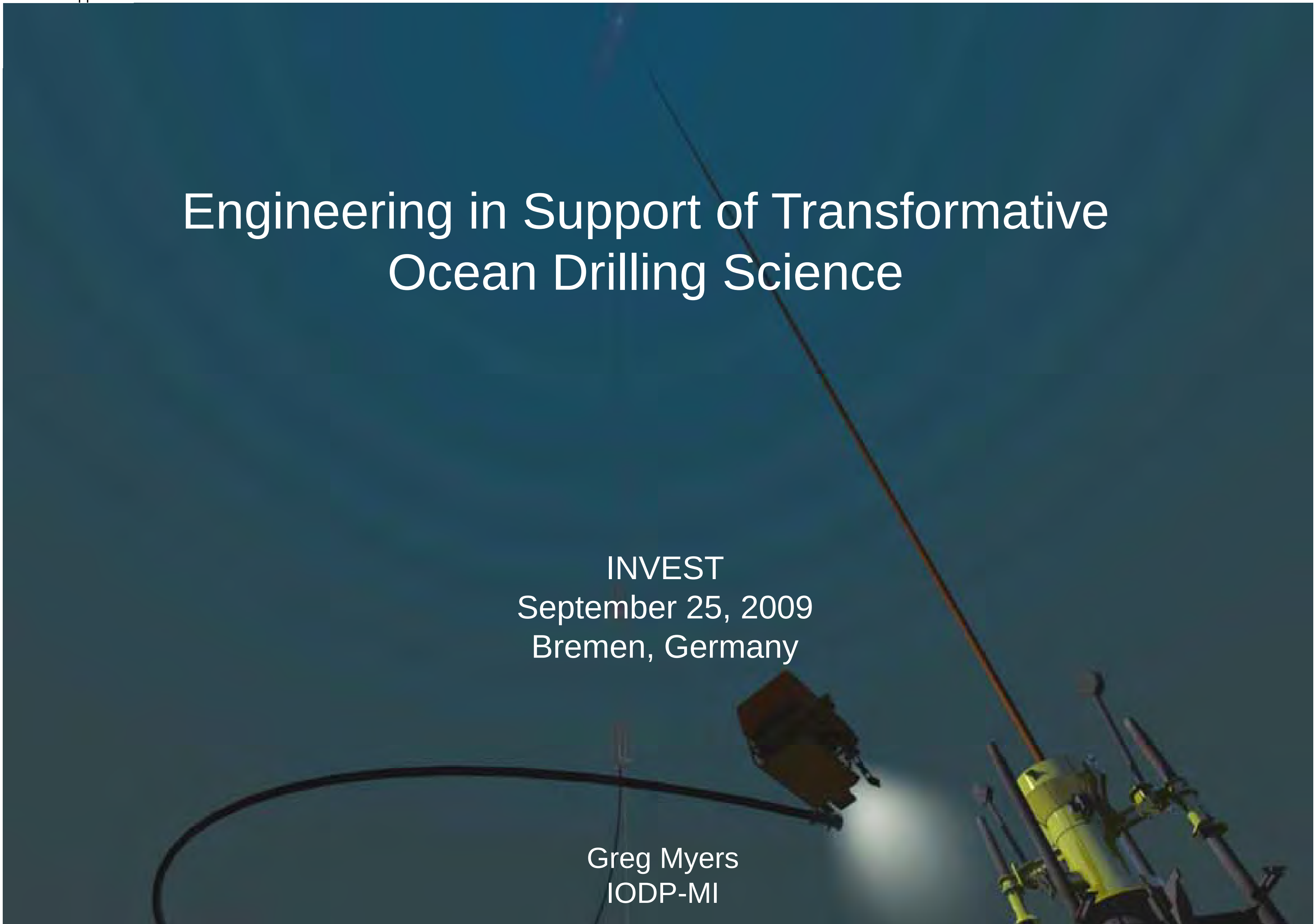
IODP-MI
INTEGRATED OCEAN DRILLING PROGRAM
MANAGEMENT INTERNATIONAL



Engineering in Support of Transformative Ocean Drilling Science

INVEST
September 25, 2009
Bremen, Germany

Greg Myers
IODP-MI

Outline

- Overview
- Where do technology gaps exist
- Solutions and explanations
- Next steps

Celebrate our technological successes …and build upon them

- Mission specific platforms
- Chikyu and riser drilling
- JOIDES Resolution and drillship conversion
- Observatories
- In-situ sampling of gabbros, hydrates, microbiological communities, overpressured sediments, any many more unique materials

Primary areas of need
(aka technology gaps)

1. Enable improvement of the quantity and quality of acquired core in deepwater and in medium to hard lithology
2. Enable acquisition of “sampling challenged” material (microbio, deep crust, upper section crustal rocks, upper mantle, high temperature)
3. Borehole management techniques

EDP White Paper

Key Technological Challenges for the Next Phase of Scientific Ocean Drilling

- **Improving Core Recovery and Quality** – improving borehole stability, core quality and quantity
- **Addressing Geohazards** – enabling the study of underlying geologic and geodynamic processes
- **Microbiology in the Marine Subsurface Environment** – advancing sampling and study of deep-dwelling microorganisms
- **Drilling to the Moho and Other Complex Drilling Projects** – reaching the Mohorovičic discontinuity and deep ocean-crust targets
- **Virtual Staffing** – developing shore-based operation centers to support complex drilling projects

Core Quantity and Quality

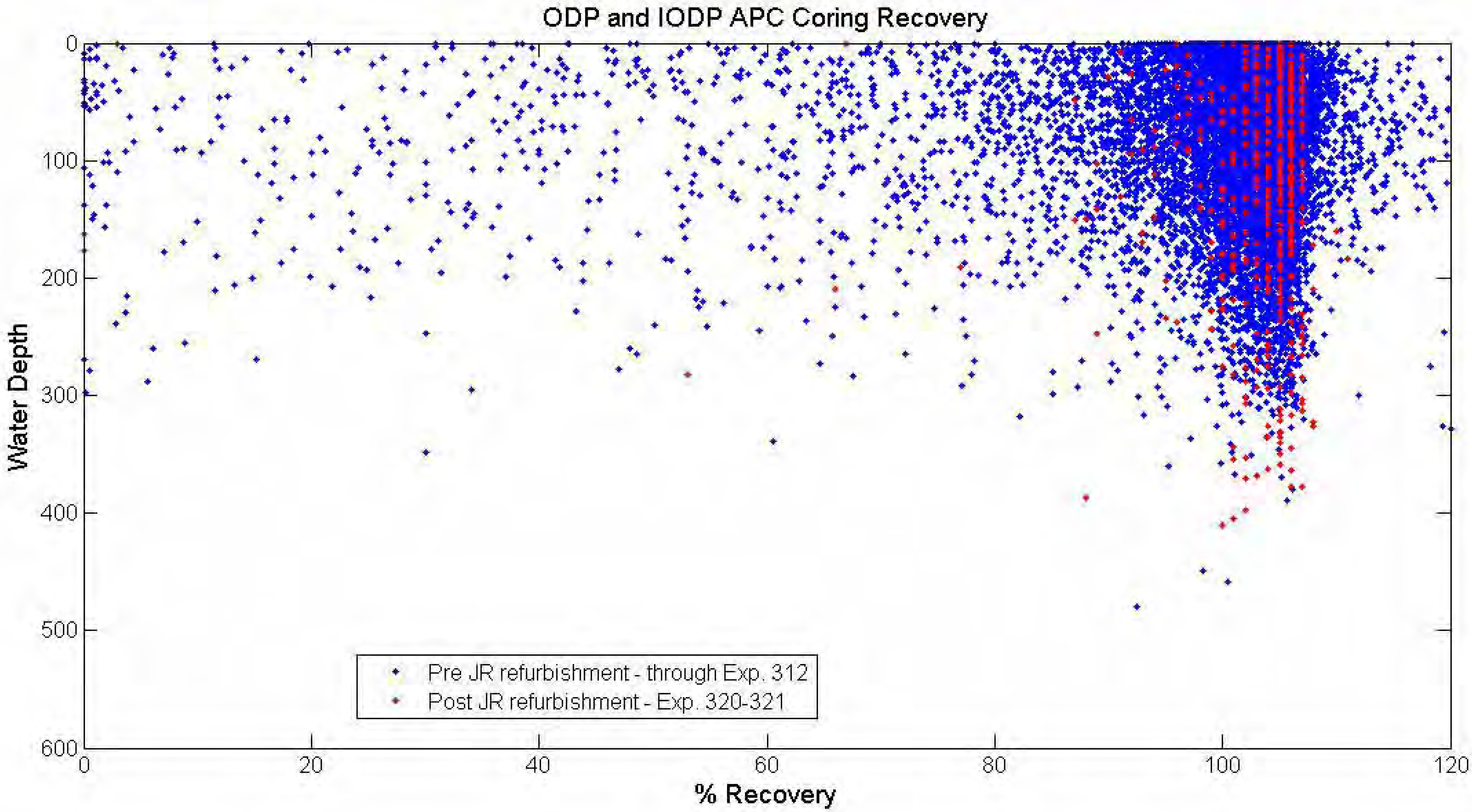


Table T1. Hole summary, Expedition 315.

Hole	Location	Water depth (mbsl)	Number of cores	Drilled depth (m)	Interval cored (m)	Recovered (m)	Recovery (%)	Comments
C0001E	33°14.3442′N, 136°42.6924′E	2198.0	13 HPCS	118.10	118.10	112.67	95.4	Lost inner core barrel in hole
C0001F	33°14.3437′N, 136°42.7067′E	2197.0	19 HPCS, 2 ESCS	248.83	140.80	137.50	97.7	
C0001G	33°14.3237′N, 136°42.6933′E	2196.5	NA	74.50	NA	NA	NA	ROV cable tangled around drill pipe
C0001H	33°14.3233′N, 136°42.6840′E	2197.0	26 RCB	590.50	228.60	126.30	[illegible]	ole caving
C0001I	33°14.2030′N, 136°42.4330′E	2198.5	NA	520.00	NA	NA	NA	Hole caving
Site C0001 totals:			32 HPCS, 2 ESCS, 26 RCB	1551.93	487.50	376.47	77.2	
C0002B	33°17.9928′N, 136°38.2029′E	1937.5	66 RCB	1057.00	582.00	208.30	[illegible]	
C0002C	33°18.0026′N, 136°38.1869′E	1936.6	2 HPCS	13.77	13.80	13.77	99.8	
C0002D	33°18.0075′N, 136°38.1910′E	1937.1	16 HPCS, 2 ESCS	204.00	204.00	161.90	79.4	
Site C0002 totals:			18 HPCS, 2 ESCS, 66 RCB	1274.77	799.80	383.97	48.0	

[illegible]	[illegible]	56.0612'W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1256D-F1	6°44.1631'N	91° 56.0612'W	Fishing run 1 (9 inch fishing magnet with 2 junk bask			[illegible]			23.75	1.0
1256D-F2	6°44.1631'N	91° 56.0612'W	Fishing run 2 (9-1/2 inch fishing mill with 2 junk bask			[illegible]			28.00	1.2
1256D-F3	6°44.1631'N	91° 56.0612'W	Fishing run 3 (9-1/2 inch fishing mill with 1 junk bask			[illegible]			28.50	1.2
1256D-F4	6°44.1631'N	91° 56.0612'W	Fishing run 4 (9 inch fishing magnet with 2 junk bask			[illegible]			22.05	0.9
1256D-6	6°44.1631'N	91° 56.0612'W	8	25.80	1.39	[illegible]	.00	25.80	85.70	3.6
1256D-7	6°44.1631'N	91° 56.0612'W	12	46.00	10.68	[illegible]	.00	46.00	96.00	4.0
1256D-8	6°44.1631'N	91° 56.0612'W	13	62.50	18.49	[illegible]	.00	62.50	99.50	4.1

Solutions for improving core quantity and quality

- Drill bit motion compensation
- Operational techniques using real-time drilling parameter feedback
- Other coring/sampling systems
- Continuous use of engineered drilling fluid

Acquisition of “sampling challenged” material

- Microbiological samples in all hole depths and water depths
- Young crust, upper section rocks
- Deep earth samples in water depths beyond 2,500m
- In regions where overpressures or other shallow hazards exist
- In high temperature environments

Needed downhole equipment

<u>Drilling and Coring</u>

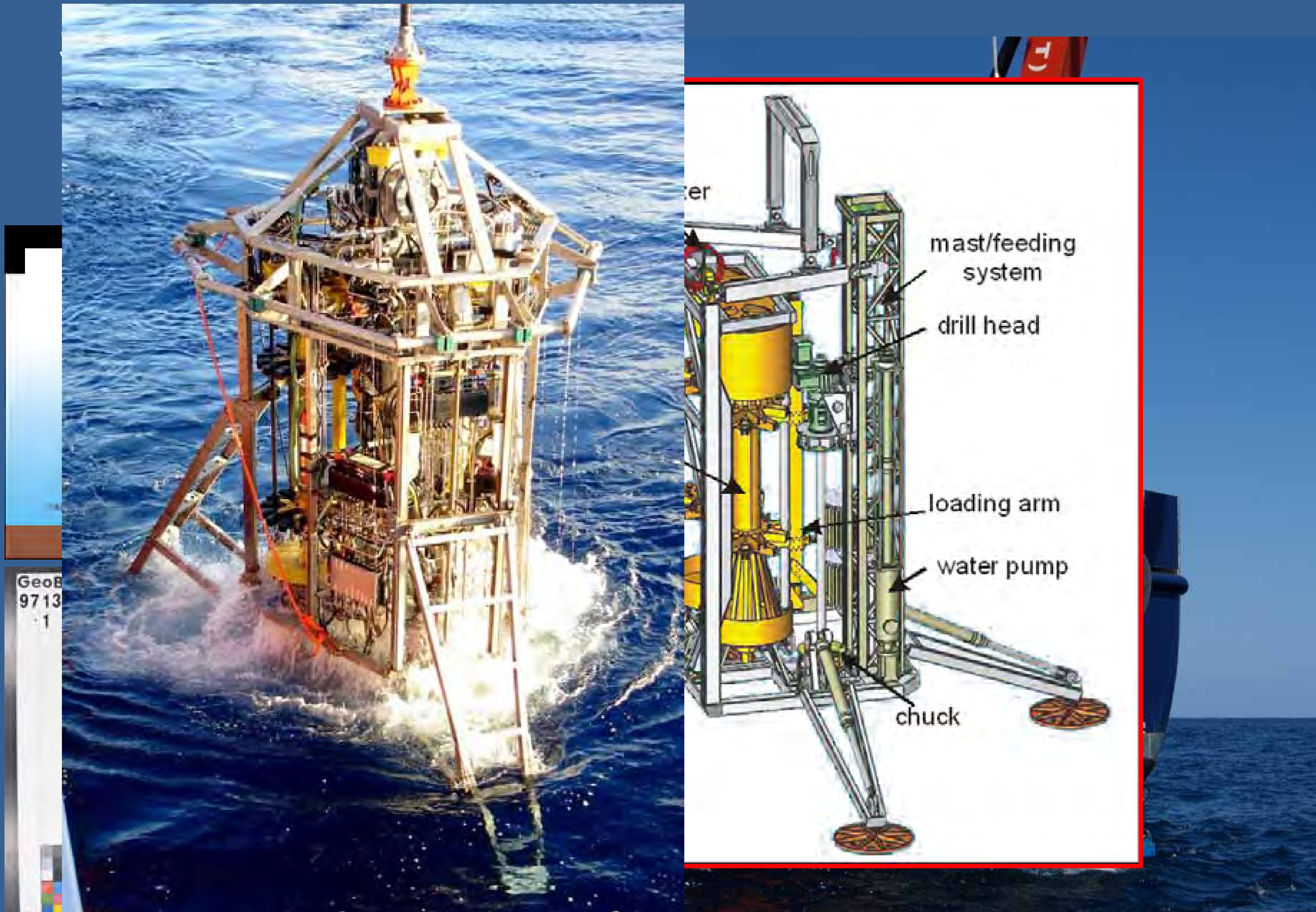
- Instrumented drill collars
- Microbio core barrels
- Transition zone corers
- High temperature mud and equipment

<u>Logging</u>

- Emerging drill collar fluid sampling and seismic measurements
- Latest generation wireline tools deployable from all platforms
- Fluid samplers, sidewall corers, geochemistry, magnetic resonance

Heresy or Programmatic Evolution

- Subsea drilling systems
  - Use for shallow hole site characterization
  - Especially useful for upper 100m of young crust
- Punch and go exploration
  - Drill, recovery all cuttings, wireline log, spot core or sidewall core
  - Lower cost, drill deeper
  - Latest generation logging tools needed
- Systematic partnering with other entities engaged in ocean research and drilling
  - Other science programs
  - Oil and gas industry



Source: Tim Freudenthal – MARUM and David Smith - BGS

Heresy or Programmatic Evolution

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  - Use for shallow hole site characterization
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  - Other science programs
  - Oil and gas industry

Borehole Management

- Managing the borehole means:
  - Remove cuttings
  - Provide lithostatic and pore pressure compensation
  - Develop mud cake on borehole wall to provide additional stability
  - Mitigate fluid inflows and outflows
  - Limiting excess pumping rates

- Historically, seawater with occasional mud sweeps has been utilized, thus the deepest IODP hole is just over 2,111m deep

- Engineered mud must be circulated continuously as part of a comprehensive plan to drill and core effectively

Techniques for borehole management

- Existing
  - Riser Drilling- complete mud circulation solution with blow out prevention
  - Riserless drilling - pump and dump
- Emerging
  - Riserless Mud Recovery - mud circulation without blowout prevention

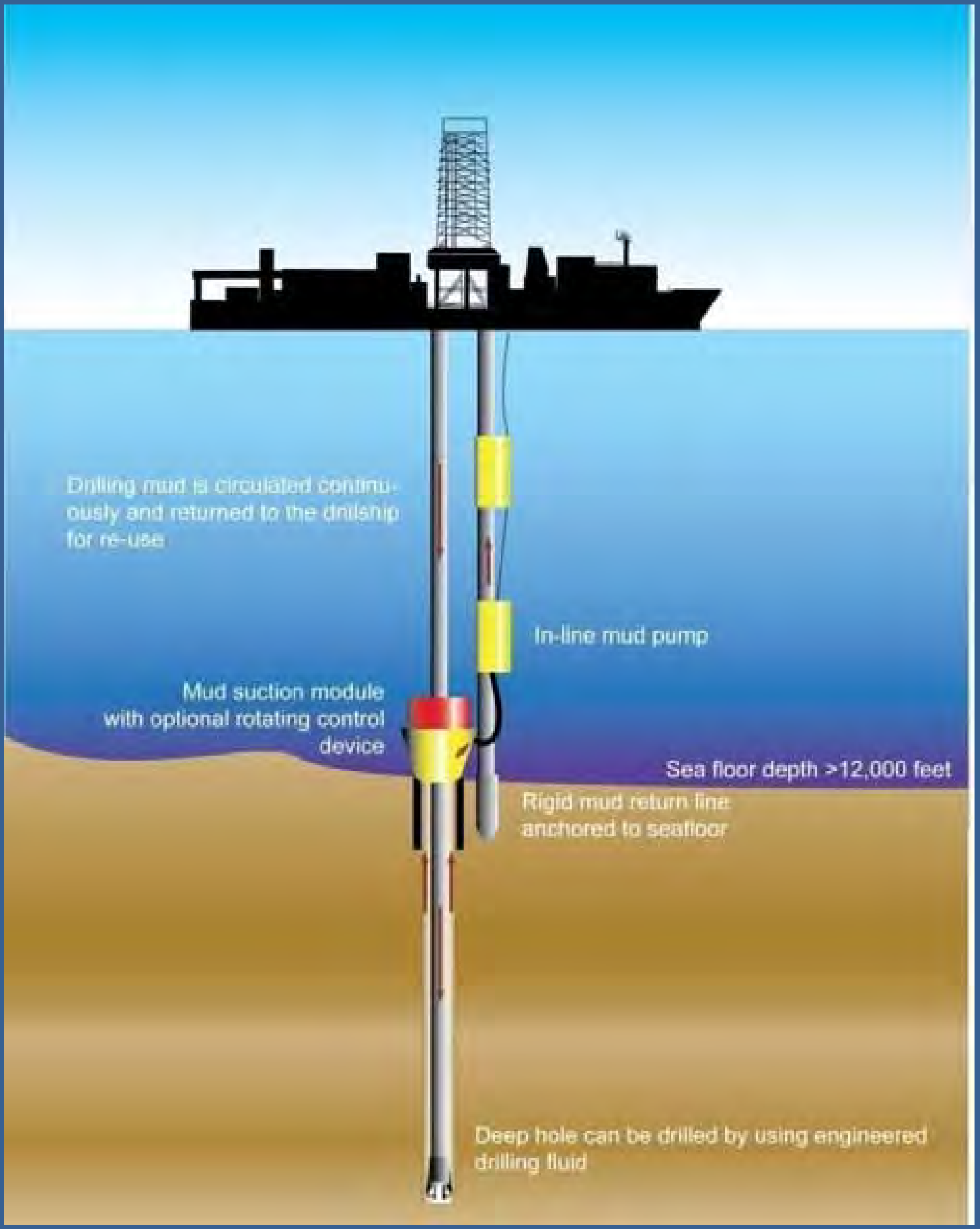
Low Cost Dual Gradient Drilling Project

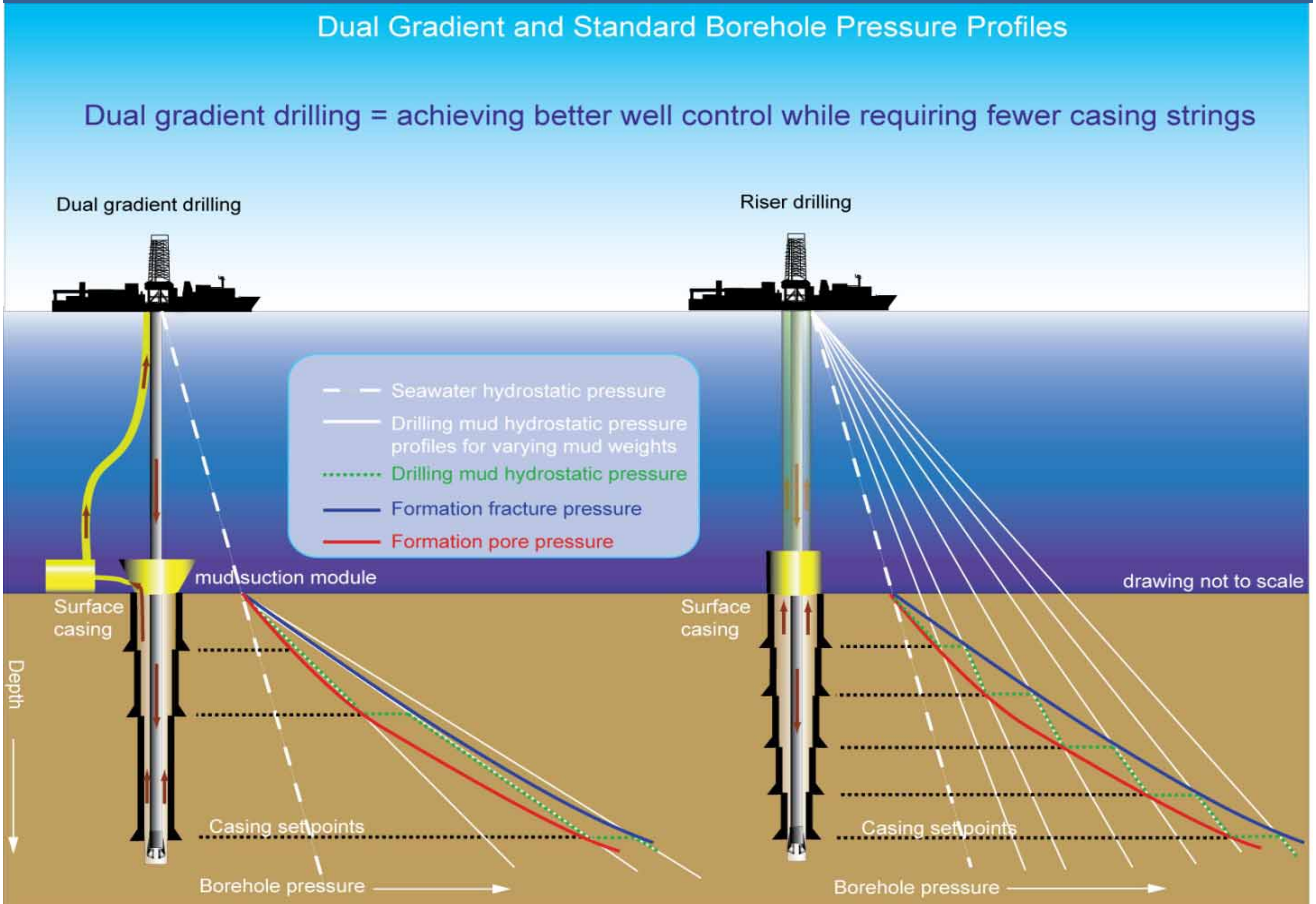
The industry funded project to identify the requirements for deploying AGR Drilling Services' Riserless Mud Recovery system on a drillship such as the *JOIDES Resolution*.

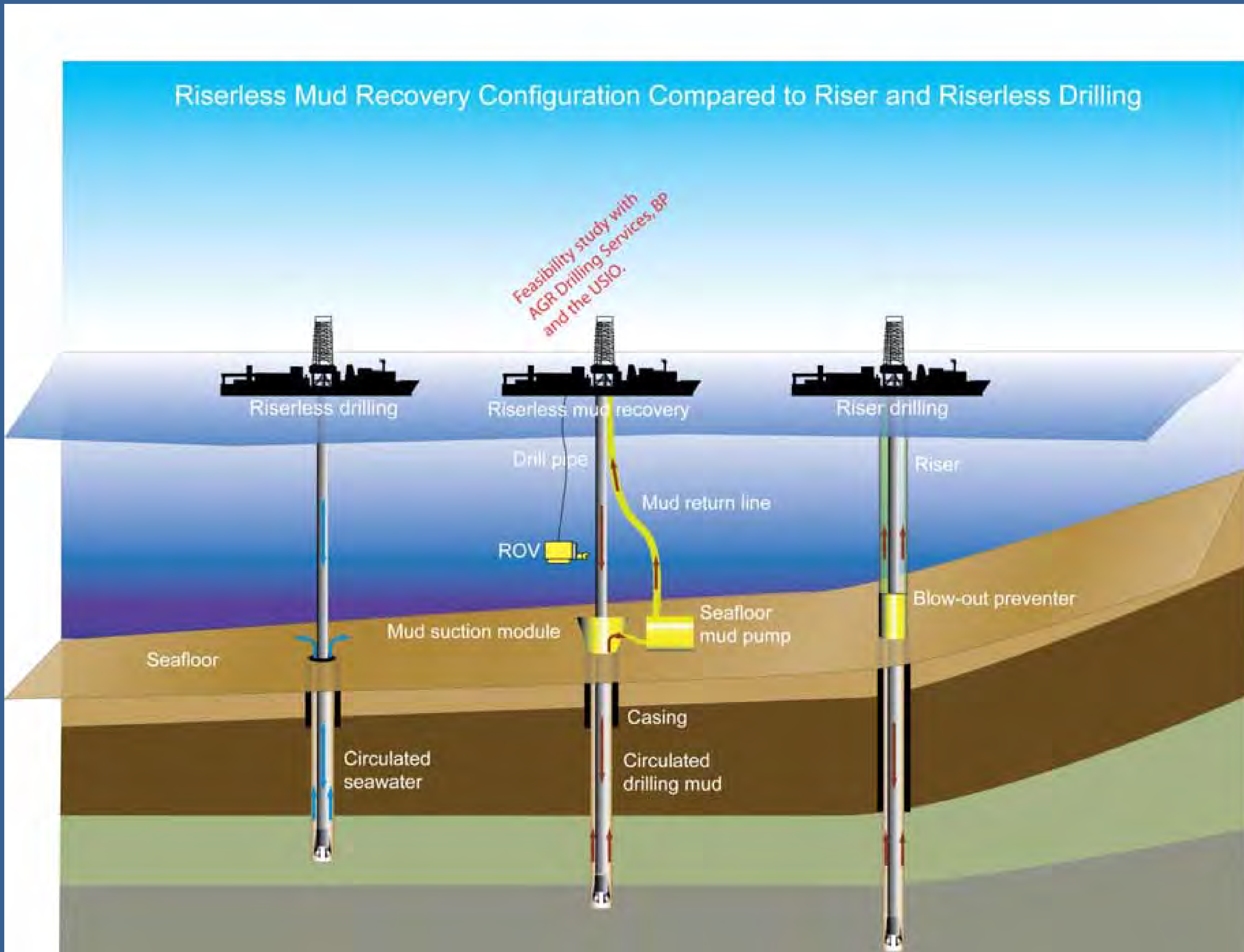
This enabling technology benefits the IODP science community by providing environmentally friendly drilling access to areas previously not drillable by IODP, this includes deep crustal and overpressure sites.

This technology is directly applicable to Chikyu, *JOIDES Resolution* and MSPs.

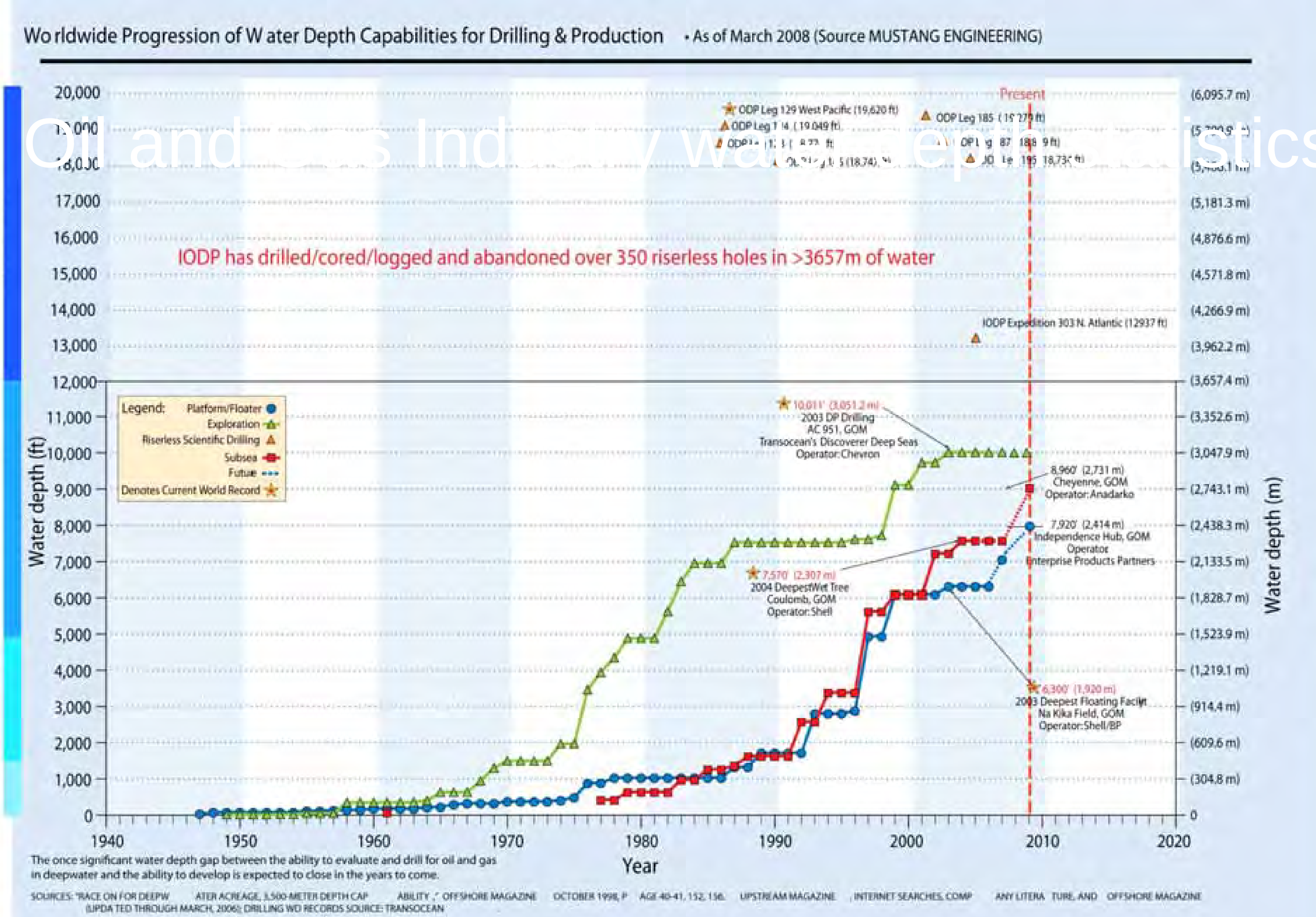
Funds provided by the DeepStar Consortium




Dual Gradient and Standard Borehole Pressure Profiles
Dual gradient drilling = achieving better well control while requiring fewer casing strings
Dual gradient drilling
Riser drilling
Seawater hydrostatic pressure
Drilling mud hydrostatic pressure profiles for varying mud weights
Drilling mud hydrostatic pressure
Formation fracture pressure
Formation pore pressure
mud suction module
drawing not to scale
Surface casing
Surface casing
Depth
Casing set points
Casing set points
Borehole pressure
Borehole pressure


Riserless Mud Recovery Configuration Compared to Riser and Riserless Drilling
Feasibility study with AGR Drilling Services, BP and the USIO.
Riserless drilling
Riserless mud recovery
Riser drilling
Drill pipe
Mud return line
Riser
ROV
Blow-out preventer
Seafloor mud pump
Mud suction module
Seafloor
Casing
Circulated seawater
Circulated drilling mud

Oil and Gas Industry Water Depth Statistics



Deepwater Inline Pump Module

Timeline

- 2009 - Feasibility project – completed by IODP-MI
  - Demonstrated RMR feasibility for IODP to 3,650 m (on paper)
  - Funded by DeepStar Industry Consortium
- 2011-2012 Field Trial from an IODP platform in <3,650 m of water
  - Must be preceded by procurement of funding and completion of engineering, vessel modifications and operations simulation
  - Funded partially by DeepStar, RPSEA, major Industry operator/s, cost sharing by AGR and IODP operators
- 2013-2014 Field trial in water depth >3,650 m
  - Must be preceded by procurement of funding and completion of engineering, vessel modifications and operations simulation
- 2015 – Ultra-deephole in hyper-deepwater capability could be ready

RMR platform suitability

- <100 m of water - MSP
- 100 to 2,750 m of water – *JOIDES Resolution*
- 2,750 to >3,650 m of water – *CHIKYU*

- Primary factors:
  - Lifting capacity
  - Derrick capability (single vs dual derrick)
  - Bulk material and tubular storage
  - Deck space

To realize these goals…

- An engineering paradigm shift is needed if we are to achieve these goals as an integrated program
  - We have extremely high expectations for the technical panels, yet we cannot continue to rely so heavily on volunteer based engineering. We must bolster our engineering resources
  - Centralized engineering must be able to solicit proposals rather than passively receive them as we do now

In Summary

- IODP has been hugely successful
- Three primary areas need improvement if new science is to be achieved
- Internal and external solutions are emerging
- The next phase of the program will require a significant and even more coordinated engineering effort

POSTERS!

POSTERS!

POSTERS!

FY 2010 Projects

- SCIMPI – Design underway, utilizing USIO telemetry, preparing sea test plans (expect sea test request this EDP meeting)
- MDHDS –Following extensive contract deliberations, the design is well underway – utilizing USIO telemetry
- LTBMS – Extended life test nearing completion. Primary deliverables which include the specifications for the LTBMS telemetry system have been completed.
- MMM – Project not started, awaiting contract initiation
- Common Deployment System for simple observatories– Design complete, fabrication to commence soon, utilizing USIO telemetry

FY2011 Engineering Proposals Received by IODP-MI

Three proposals were submitted to IODP-MI and forwarded to EDP for review and grouping. Two proposals out of the three are not within IODP-MI funding purview.

SOC Proposal

1. EDP-2011-01A : Wireline Hydraulic Testing and Imaging Tool 2 stars

Non-SOC Proposals

2. EDP-2011-02A : Development of CFRP riser pipe for 4000m deep waters 4 stars
(Carbon Fiber Reinforced Plastic Riser)

3. EDP-2011-01B : Replacement of the Magnetic Susceptibility Sonde N/A

No proposals are selected for moving forward into the draft FY2011 engineering plan

5 stars: Extraordinary proposal.
(ED impacts multiple aspects of the ISP and/or Tech Roadmap. Exceptional cost/benefit ratio: very high probability of success.)
4 stars: Very good
(Impacts the ISP and/or Tech Roadmap: good cost/benefit, high probability of success)
3 stars: Good
(Impacts the ISP and/or Tech Roadmap: acceptable cost/benefit, acceptable probability of success.)
2 stars: Could be strengthened
(Can impact ISP: contains deficiencies in organization, and/or poor cost/benefit, and/or poor probability of success.)
1 star: Not Acceptable
(It does not impact the ISP or contains deficiencies in organization, and/or poor cost/benefit, and/or poor probability of success.)

FY2011 Draft Engineering Plan

- Continuing Projects
  - Simple Observatory Initiative
    - Complete SCIMPI fabrication and sea testing
  - Multi-sensor Magnetometer Tool (MMM)
    - Year two (of three)
    - Fabrication and calibration
- No new SOC engineering projects in FY2011

Engineering Development Panel
IODP-MI Report

Sendai, Japan
January 13 - 15, 2010

Yoshi Kawamura
IODP-MI

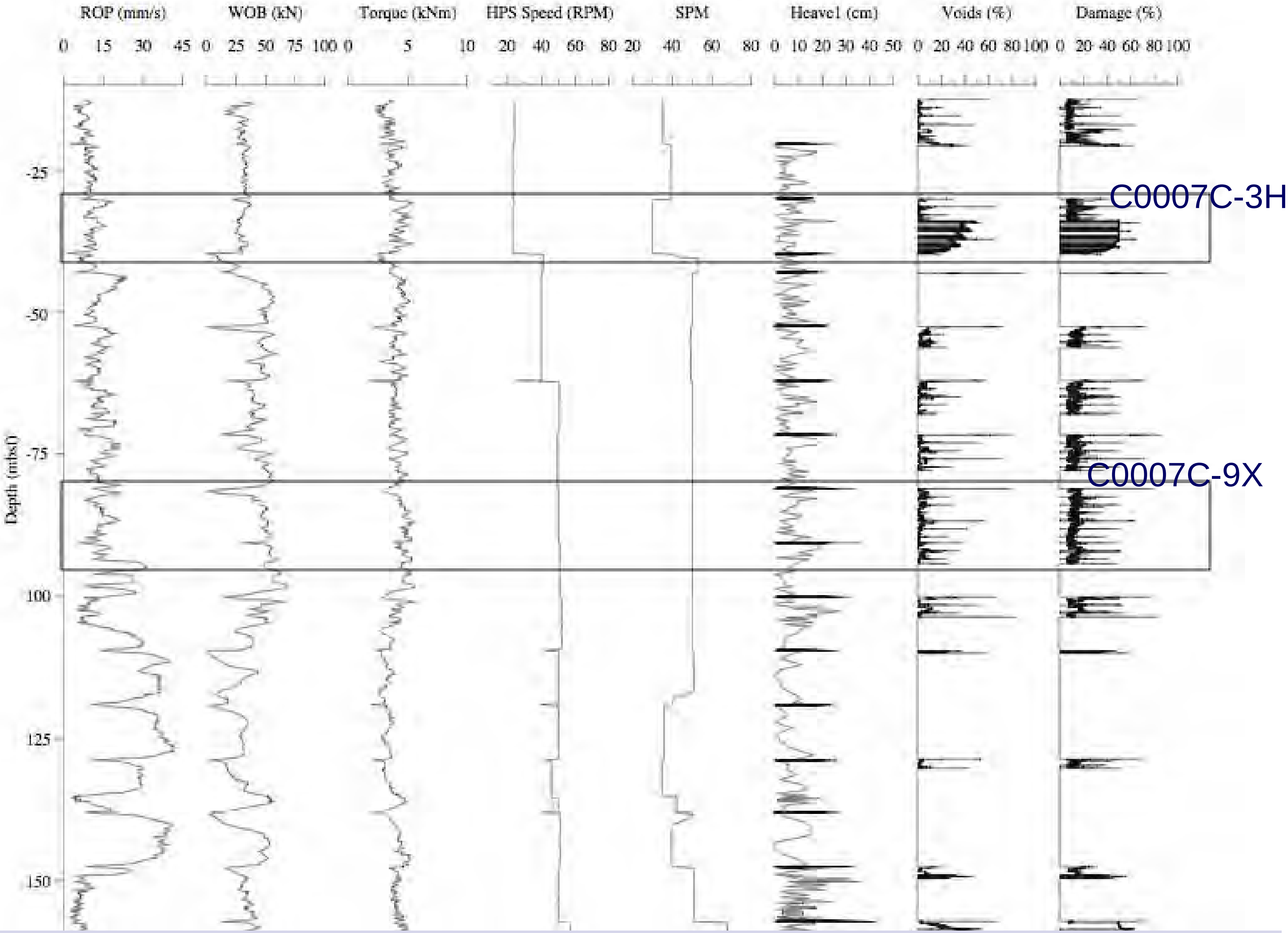
INTEGRATED OCEAN DRILLING PROGRAM
MANAGEMENT INTERNATIONAL

EDP Scoping Studies

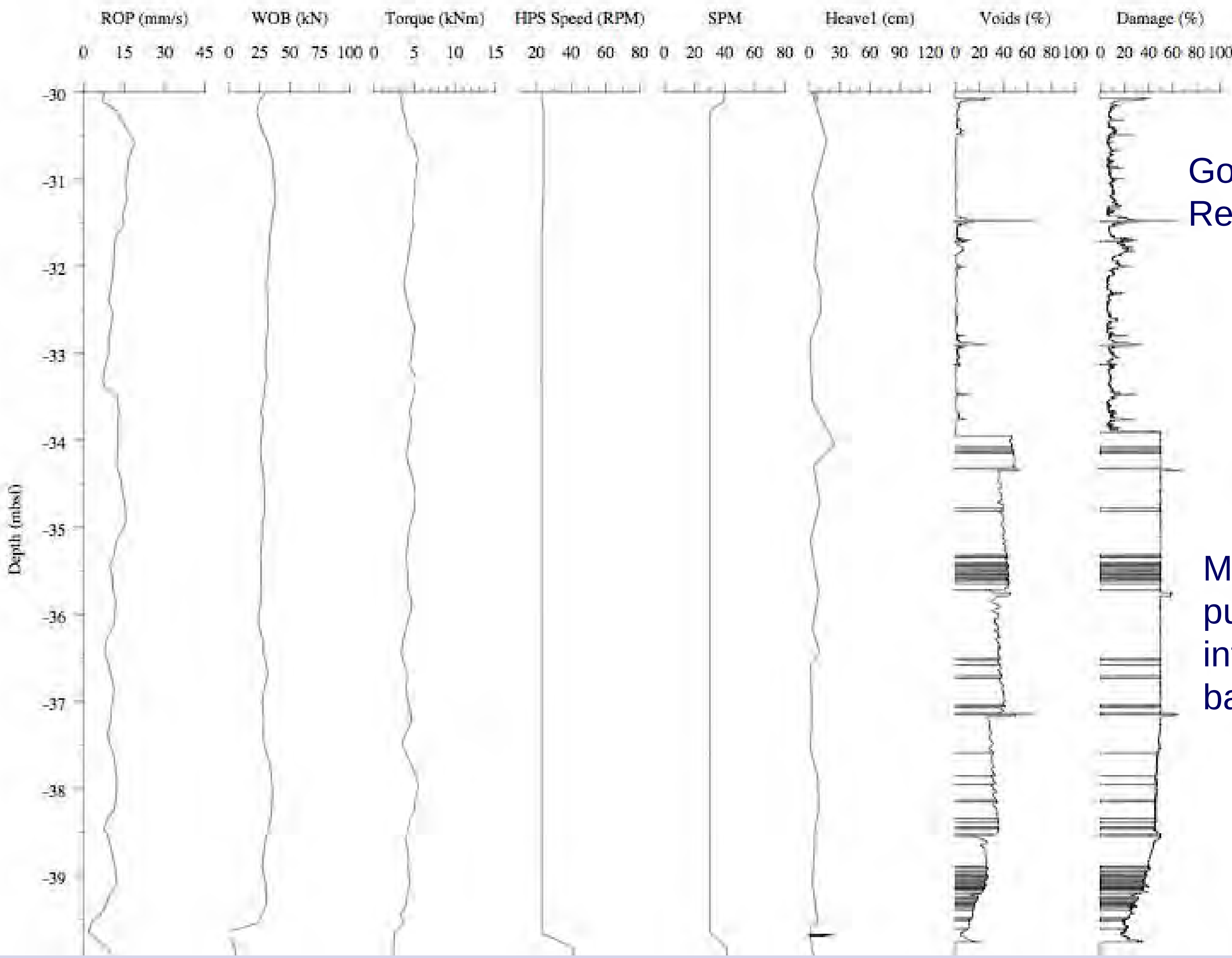
- Ultra Deepwater Drilling Scoping Study
  - IODP-MI sponsored Mantle-Sampling Workshop, September 2010
  - More discussion on next agenda item
- Coring Scoping Study
  - In depth look at NanTroSEIZE Exp. 316 data
  - Comprehensive report indentifying past and present drilling and coring technologies both within and outside of scientific ocean drilling

Analysis of Selected Cores from IODP Expedition 316

- Comparison of core quality and recovery to operational and environmental parameters.
  - WOB, ROP, RPM, Torque, vessel heave, core recovery, core damage percent and core void percentage (from CT scans)
  - Initial Plots of chosen parameters vs. depth for entire boreholes and for select cores
  - Crossplots of core quality, recovery and drilling/vessel parameters


ROP (mm/s)
0 15 30 45
WOB (kN)
0 25 50 75 100
Torque (kNm)
0 5 10
HPS Speed (RPM)
20 40 60 80
SPM
20 40 60 80
Heave1 (cm)
0 10 20 30 40 50
Voids (%)
0 20 40 60 80 100
Damage (%)
0 20 40 60 80 100
Depth (mbsf)
-25
-50
-75
100
125
150
C0007C-3H
C0007C-9X

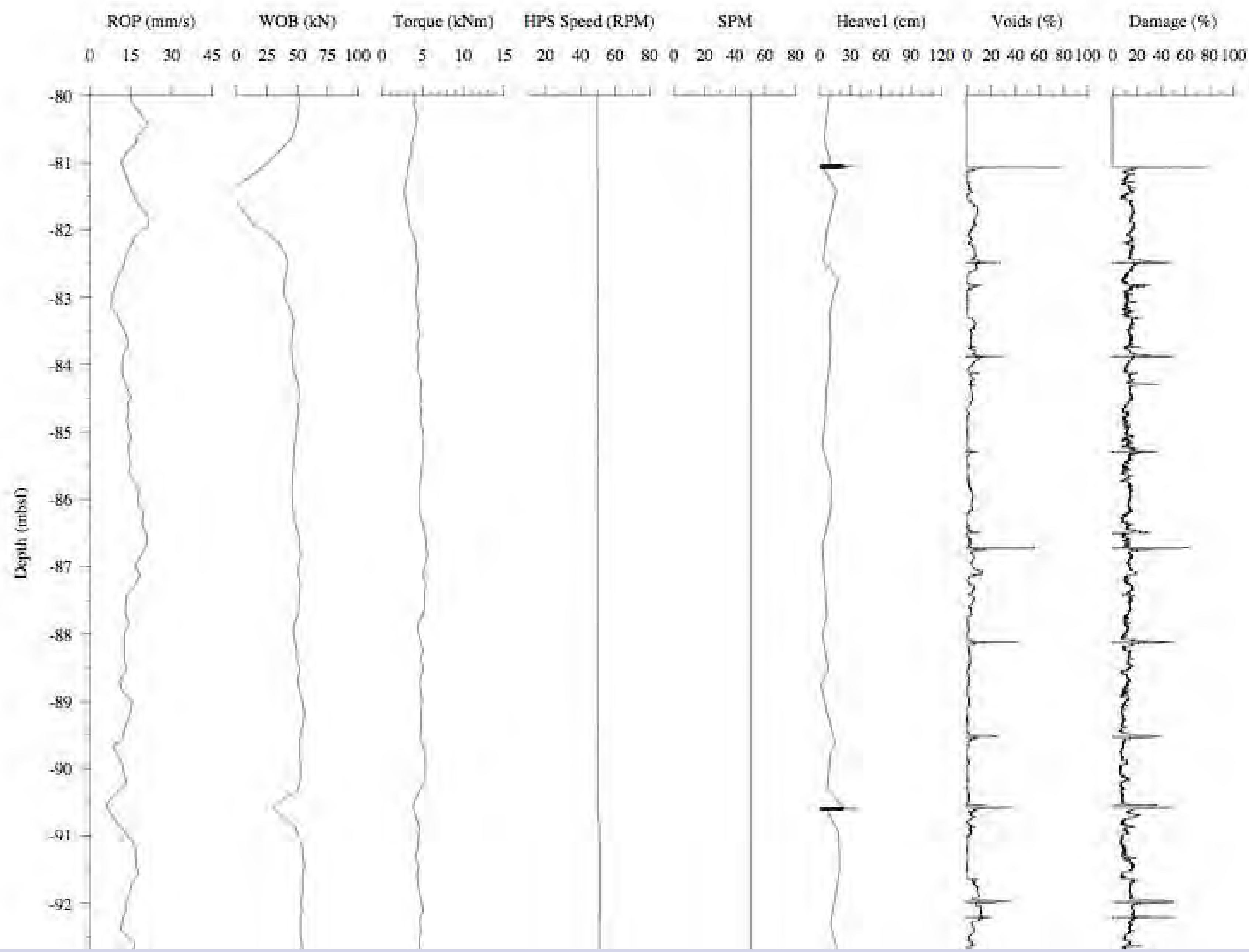
C0007C-3H



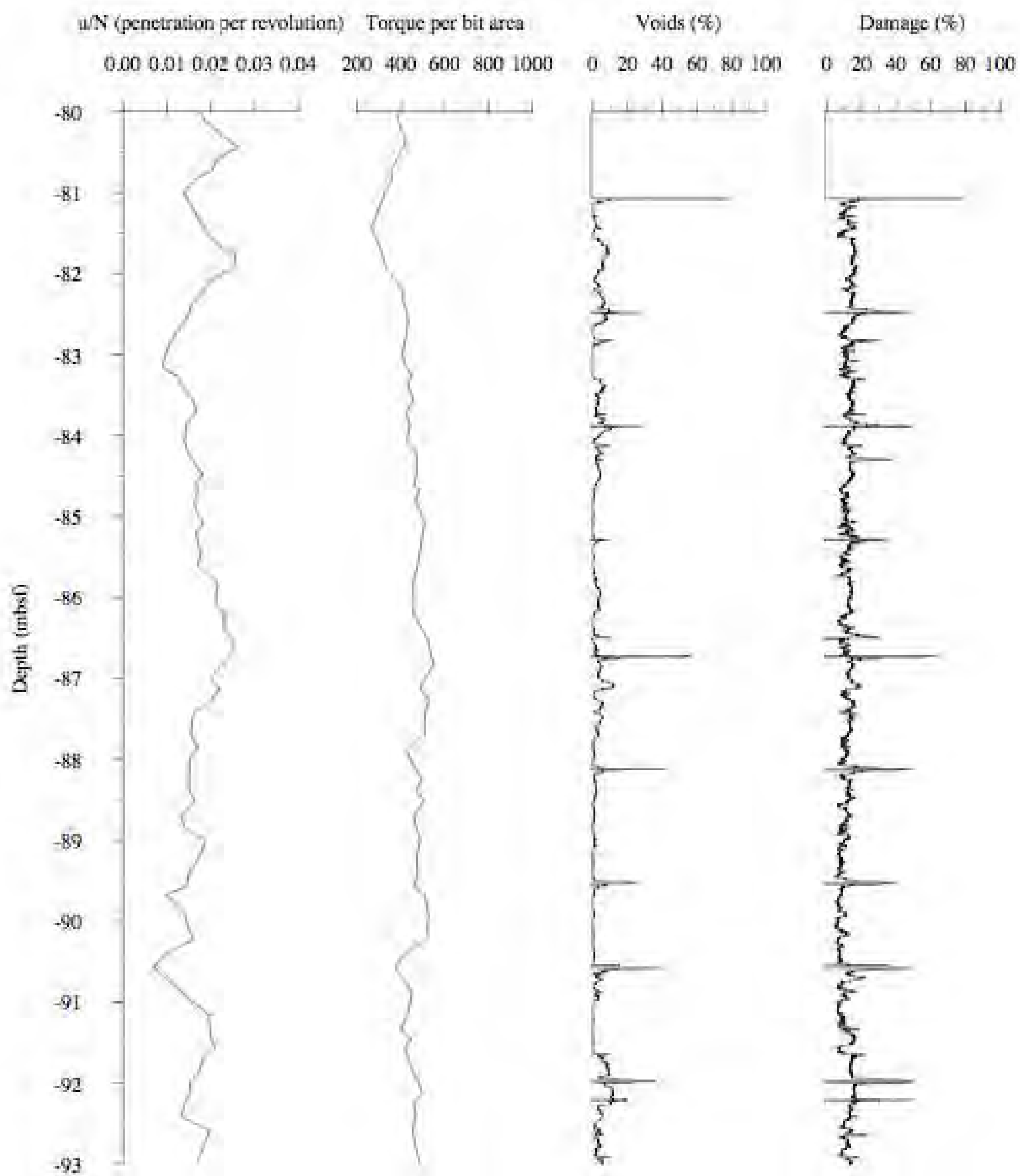
Good Recovery

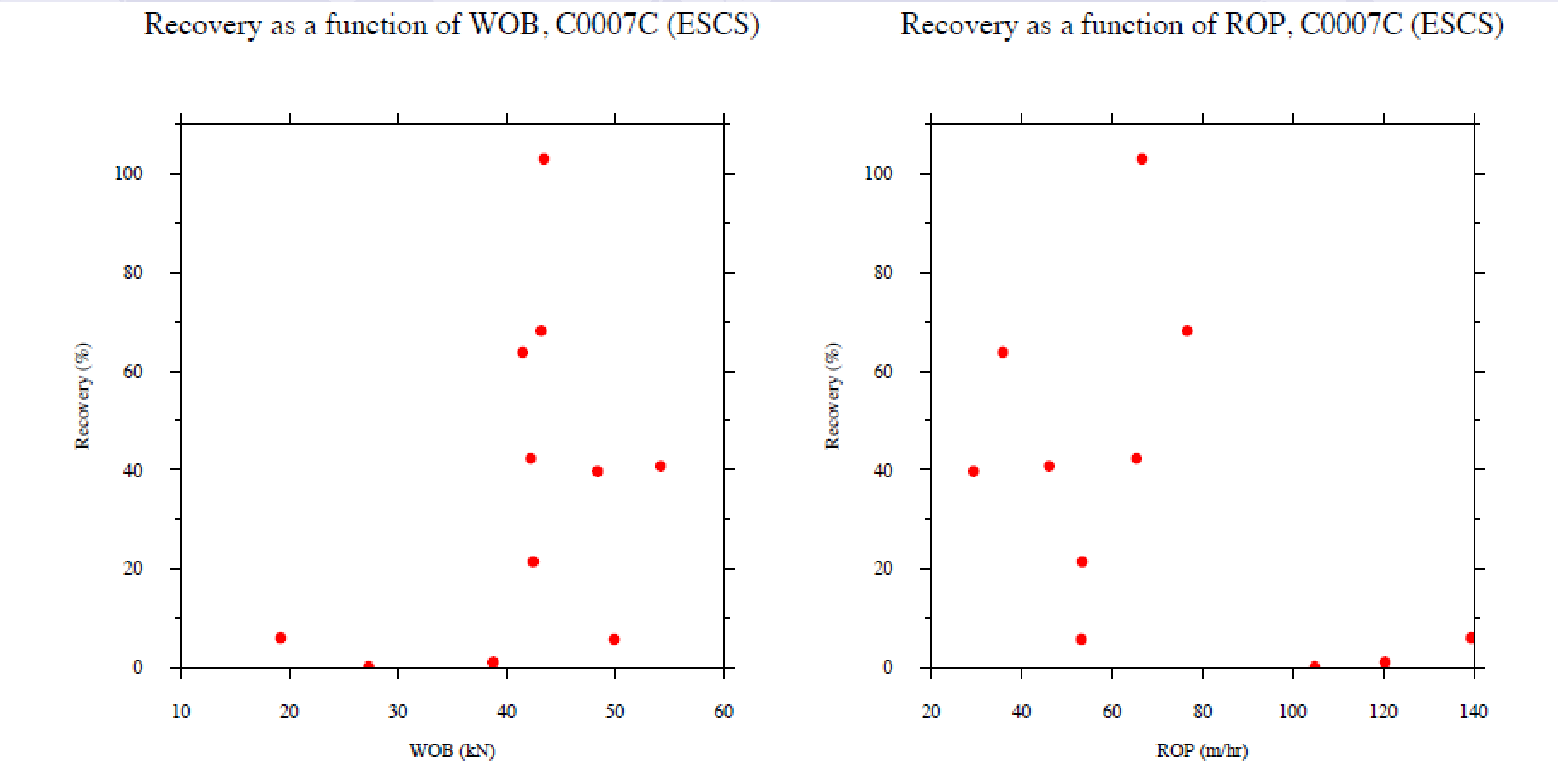
Material pulled into core barrel

C0007C-9X

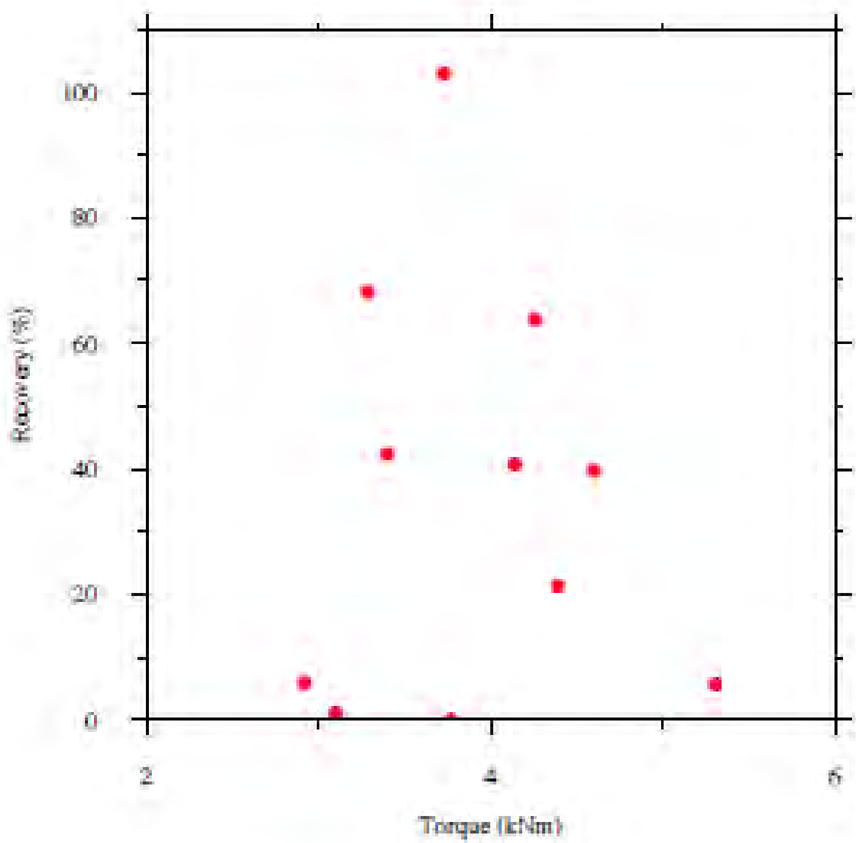

ROP (mm/s)
0 15 30 45
WOB (kN)
0 25 50 75 100
Torque (kNm)
0 5 10 15
HPS Speed (RPM)
20 40 60 80
SPM
0 20 40 60 80
Heave1 (cm)
0 30 60 90 120
Voids (%)
0 20 40 60 80 100
Damage (%)
0 20 40 60 80 100
Depth (mbsl)
-80
-81
-82
-83
-84
-85
-86
-87
-88
-89
-90
-91
-92

C0007C-9X

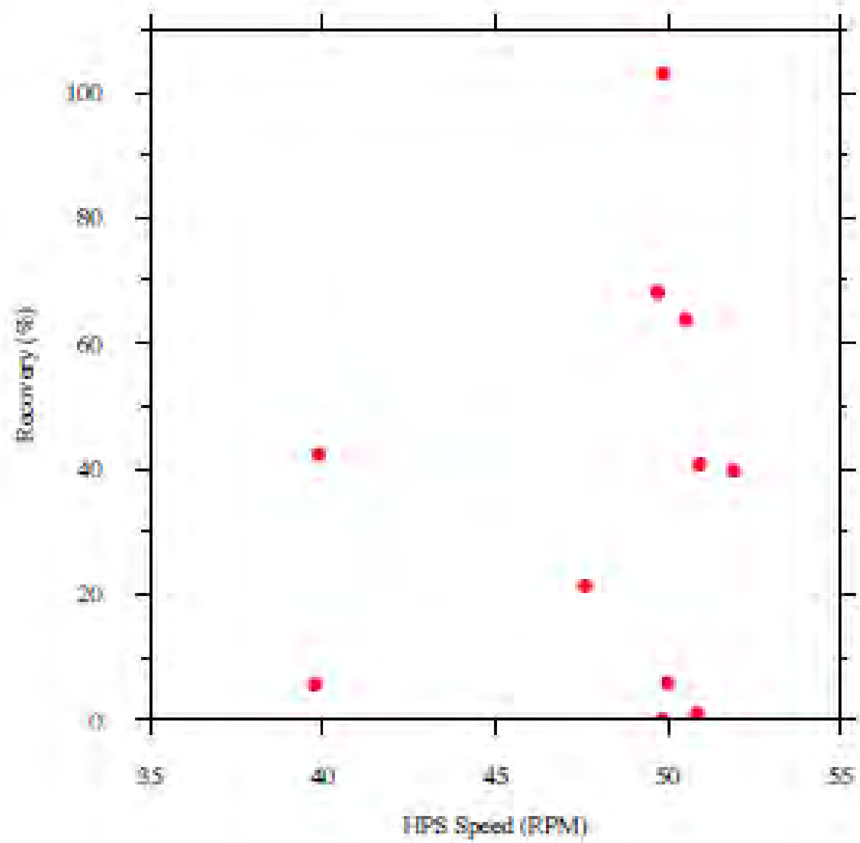

u/N (penetration per revolution)
0.00 0.01 0.02 0.03 0.04
Torque per bit area
200 400 600 800 1000
Voids (%)
0 20 40 60 80 100
Damage (%)
0 20 40 60 80 100
Depth (mbsl)
-80
-81
-82
-83
-84
-85
-86
-87
-88
-89
-90
-91
-92
-93

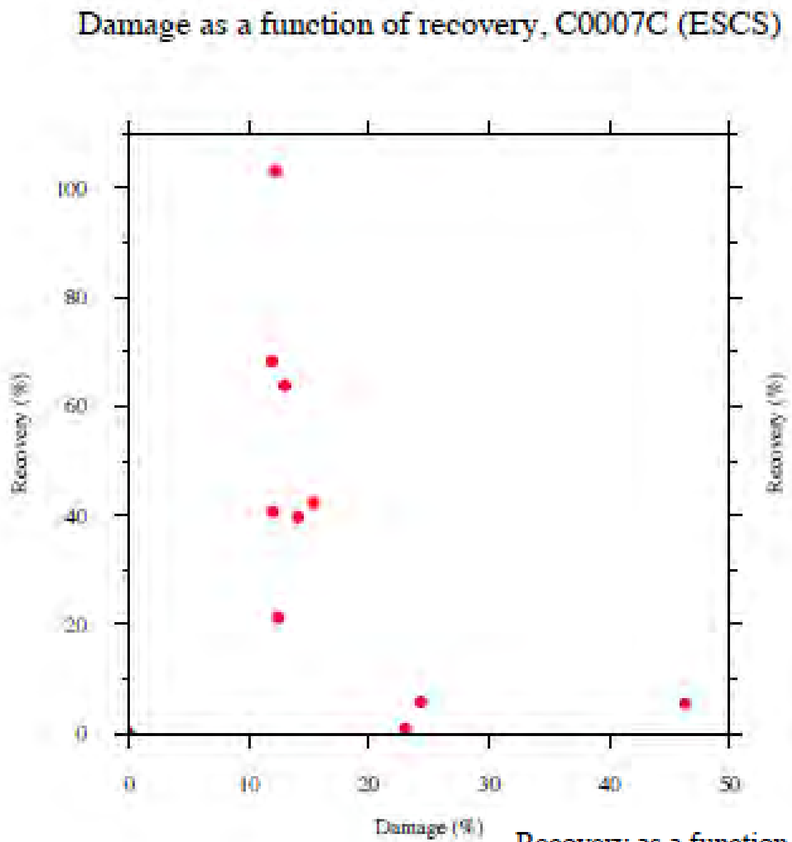

Recovery as a function of WOB, C0007C (ESCS)
Recovery (%)
100
80
60
40
20
0
10
20
30
40
50
60
WOB (kN)
Recovery as a function of ROP, C0007C (ESCS)
Recovery (%)
100
80
60
40
20
0
20
40
60
80
100
120
140
ROP (m/hr)

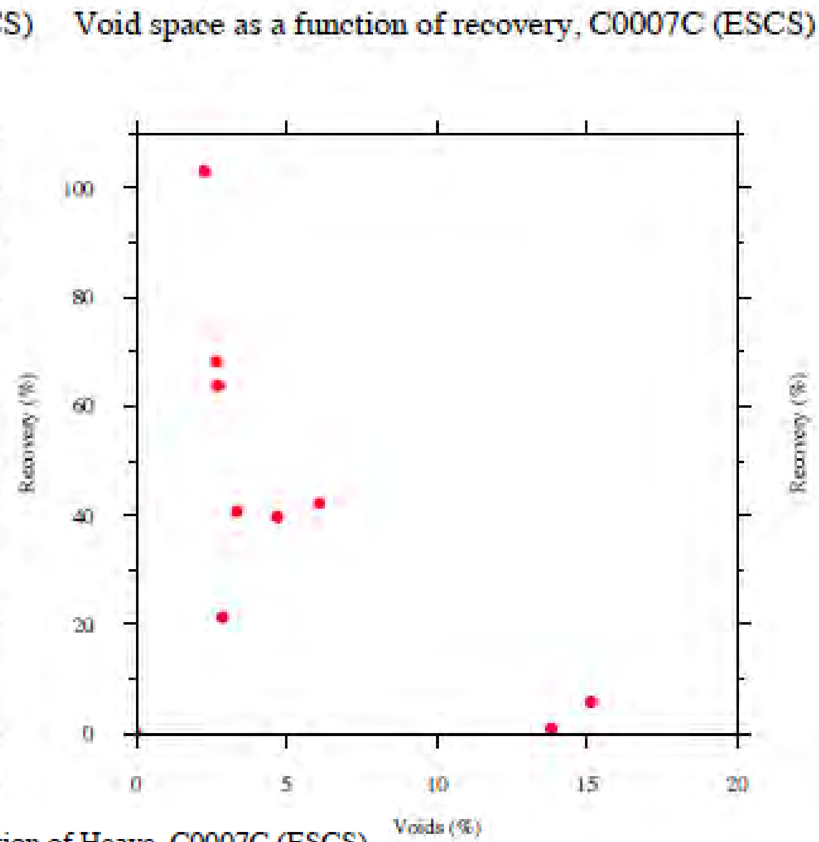
Recovery as a function of Torque, C0007C (ESCS)

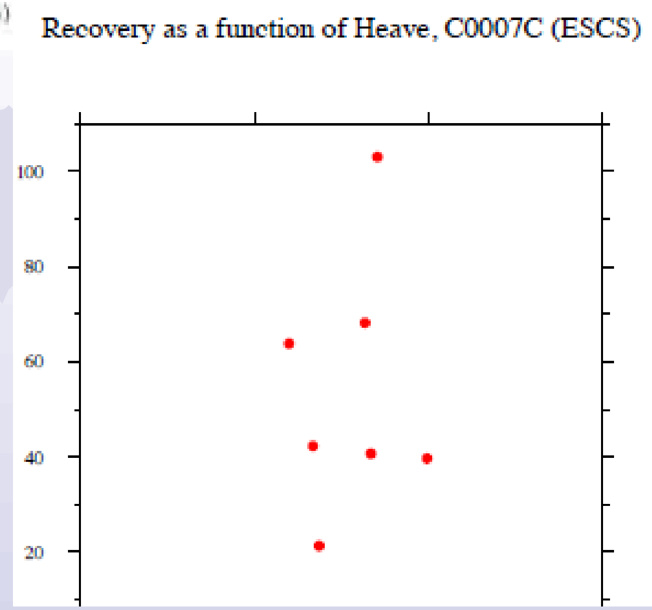


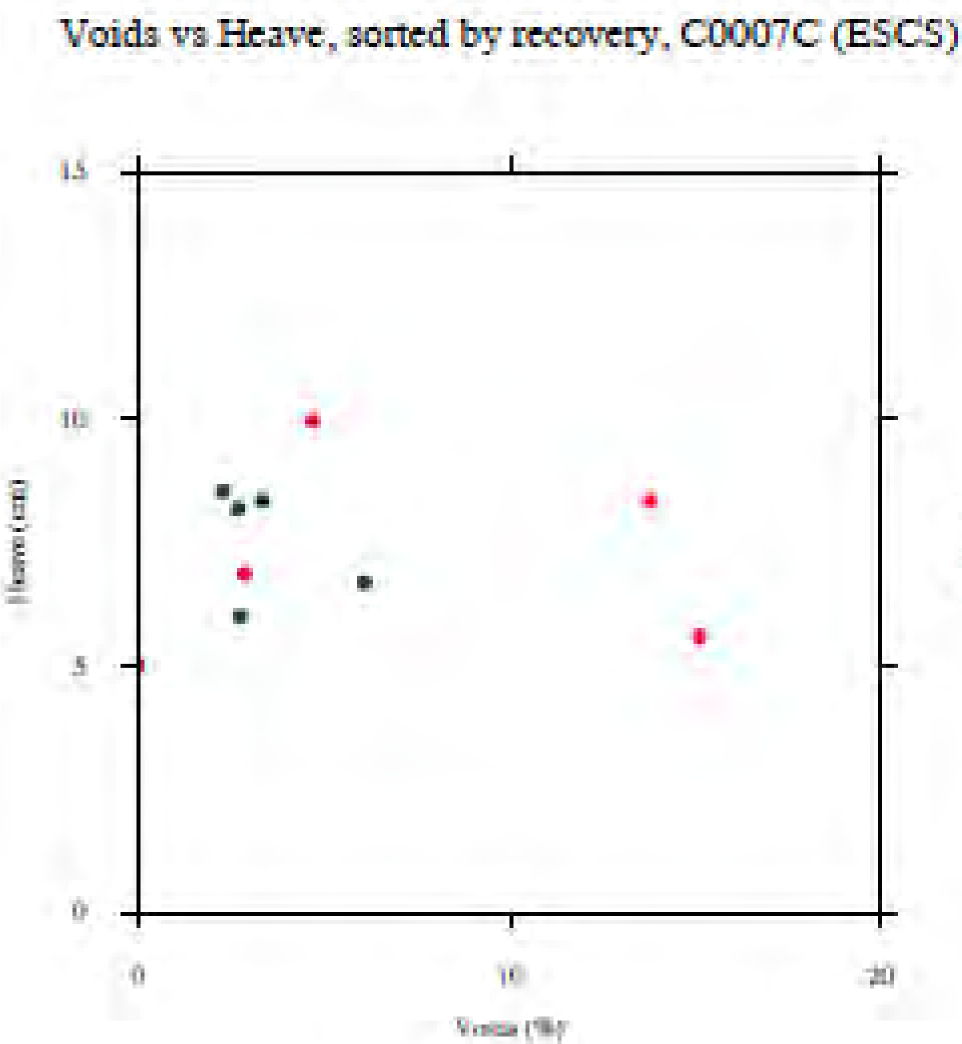
Recovery as a function of bit RPM, C0007C (ESCS)

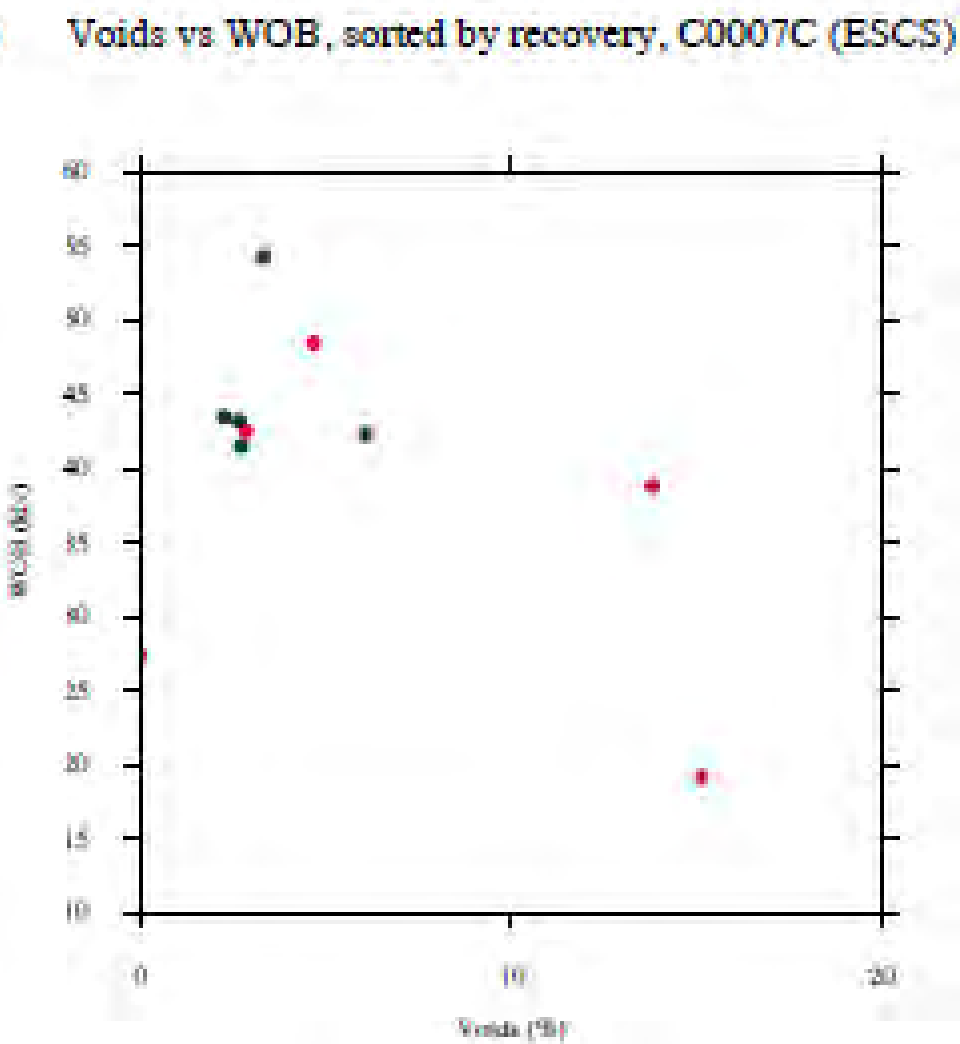



Damage as a function of recovery, C0007C (ESCS)
Recovery (%)
Damage (%)
0
10
20
30
40
50
0
20
40
60
80
100


Void space as a function of recovery, C0007C (ESCS)
Recovery (%)
Voids (%)
0
5
10
15
20
0
20
40
60
80
100
Recovery (%)


Recovery as a function of Heave, C0007C (ESCS)
100
80
60
40
20





Crossplots of drilling parameters, heave, and quality paramters for ESCS cores from Hole C00007C. Recover y > 40%(green), Recovery < 40% (red)

Conclusions

- Little, in any, correlation between drilling parameters, vessel heave, core recovery and core quality

Recommendations

- Expand the study over a much larger population of cores collected in more widely varying conditions.
- Upcoming drilling legs collect heave, roll, pitch and yaw data at the same time intervals as the drilling parameter data.
- Compile lithological data from cored material and compare to the drilling data and core quality (note: this was supposed to be done as part of this study)

Recommendations Continued…

- More accurate correlation of core quality to drilling environment may be possilbe with the ability to measure actual core material passing through the core catcher – behavior of core material as it enters the barrel throat may be a limiting factor on recovery.
- Development of non-rotary coring in lithified materials using vibration or hammer drilling techniques may hold the best promise for increase core recovery and quality.

IODP Drilling and Coring Technology

Excellent detailed record of past and present:

- Drilling Vessels
- Wireline Retrievable Coring Tools
- Coring Tool Ancillaries
- Other Coring Systems
- Downhole Samplers / Measuring Tools, Probes
- Sandline and Sinker Bar Systems
- Drill Strings

IODP Drilling and Coring Technology continued….

- BHAs and components
- Core bits, drill bits
- Shipboard Systems for enhanced coring/logging/sampling
- Re-entry Systems and Components
- Seafloor Systems, Casing
- Enhancements for Logging
- DSDP, ODP, and IODP Technology Bone Yard

IODP Drilling and Coring Technology

- Any additions to the report?
- Efforts to keep this document current?
- Document needs to be posted online in a user-friendly way. How would it be most useful and more visable?
- Additional comments?

Next Steps…

IODP-MI Specific Next Steps

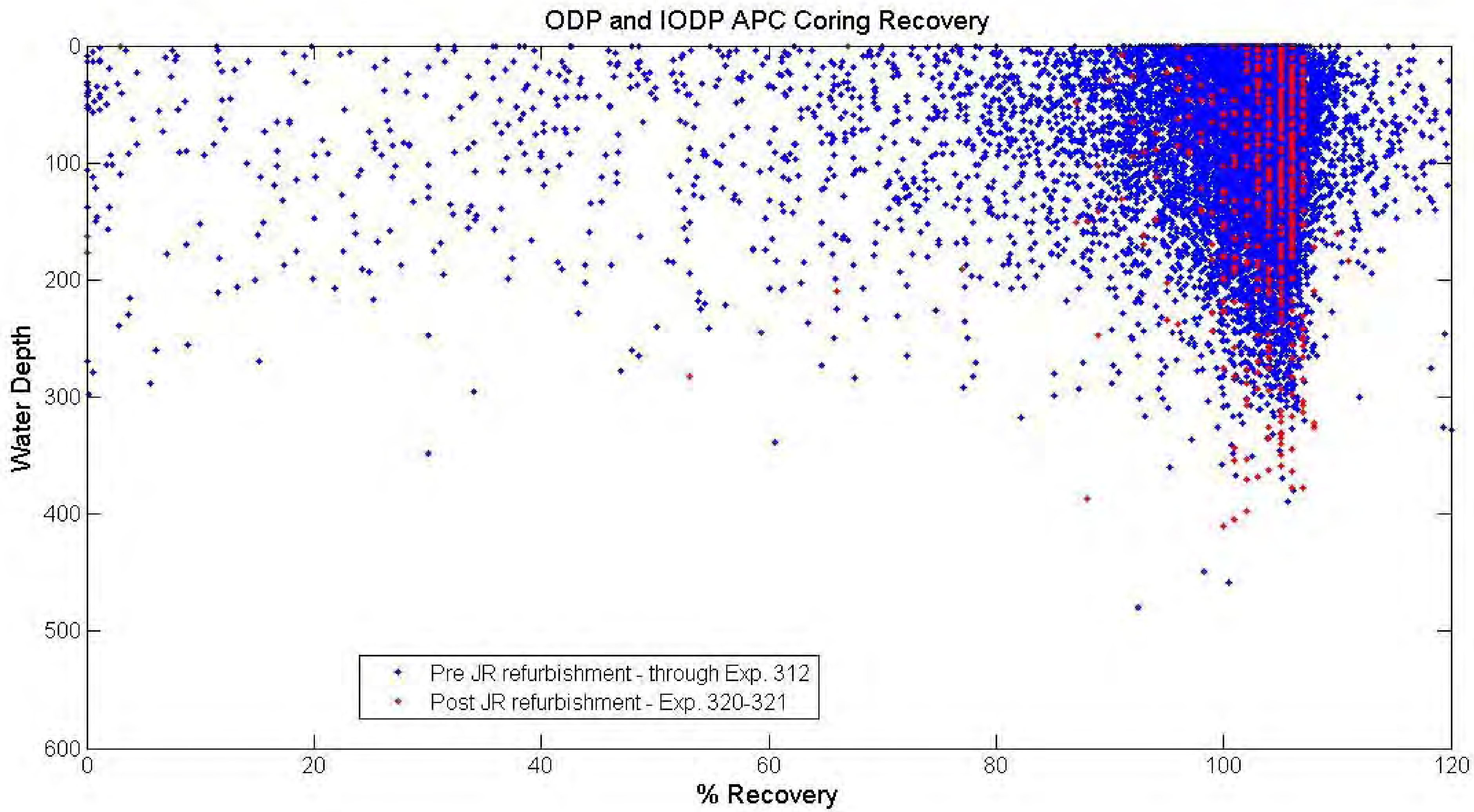
- Create a package (available to public) for archiving what has been done including:
  - IODP-MI data analysis
  - NanTroSEIZE data analysis
    - Contracted Study on C0007
    - *Incorporate CDEX work, still in progress
  - IODP Drilling and Coring Technology Report
- Any new data analysis? Track stats as program continues such as (next slide)?:

Next Steps…

From the last meeting:

- Integrated downhole coring systems: Build on coring performance study to develop a platform-independent map of downhole coring applications showing how the different systems relate to each other and where future developments are required to overcome quantified performance shortfalls. (Leon, John Thorogood, John Tauxe, Maria, Lothar, Bill, Kevin, Nori, Sumio, David)
  - Use coring study as starting point
  - Contractor should be familiar with IODP needs and tools
    - John Thorogood will help locate key personnel to help
    - Marshall Pardee (sp) could also be useful to help, he was involved in ICDP projects
    - Lothar will contact European experts (Bernd W.)
    - Alister Skinner would be very helpful
  - Complete coring study first, then move on to integrated surface drilling systems.

First look at Pre/Post JR Refurbishment



EDP Feedback on Path Forward

Operations Review Task Force (ORTF)

IODP-MI Operations Review Task Force conducts operational reviews of IODP Expeditions. The Task Force review is based upon confidential reports submitted by the IO and expedition co-chief scientists. These operational reviews focus on "lessons learned" and "how do we do things better in the future?" Areas of discussion include pre-expedition planning, expedition drilling operations, communications between scientists and operators, roles and responsibilities of scientists and operators, general procedures and policies (e.g., curation, communications), laboratory operations, etc.

2009 ORTF Meetings

- NanTroSEIZE Stage 1 - January 8-9, 2009
  - Expedition 314, LWD Transect
  - Expedition 315, Megasplay Riser Pilot
  - Expedition 316, Shallow Megasplay and Frontal Thrusts
- Pacific Equatorial Age Transect (PEAT) – December 4-5, 2009
  - Expeditions 320 and 321

NanTroSEIZE Stage 1

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:

- riser drilling in regions of possible overpressured hydrocarbons, shallow water,
- riser drilling in regions of possible overpressured hydrocarbons, deep water,
- riser drilling in geologic regions with no pressured hydrocarbons and
- riserless, open hole drilling

NanTroSEIZE Stage 1

Recommendation ORTF314-316_06 continued…

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:

- GPS only
- GPS with backup, low cost, disposable seafloor beacons launched from the ship.

NanTroSEIZE Stage 1

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).

NanTroSEIZE Stage 1

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 longterm 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*

NanTroSEIZE Stage 1

Recommendation ORTF314-316_08 continued…

- *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 subcontractors, 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

NanTroSEIZE Stage 1

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.

NanTroSEIZE Stage 1

Task Force Response to ECSC core recovery

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 ecognized 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).

NanTroSEIZE Stage 1

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. 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.

NanTroSEIZE Stage 1

Task Force Response to VIV 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.

NanTroSEIZE Stage 1

Additional drilling issues from Stage 1 operations, not identified in ORTF but identified in Japanese National Technology Group.

- appropriateness of drill bit choice, drilling speed, etc.
- the active heave compensation system – not tested

Pacific Equatorial Age Transect

Recommendation ORTF 320-321_05: *The new refined procedures of deep APC coring, drilling-over, and the use of non-magnetic core barrels are commended, and a real plus of the new coring activities on the JR.*

Pacific Equatorial Age Transect

Recommendation ORTF 320-321_07: When wireline operations encounter difficulties, clearer communication between LDEO and logging scientists as well as co-chiefs and operations superintendent is required. Operational decisions should be made on the ship after timely consultation with the appropriate parties onshore (LDEO and Schlumberger), and clear procedures need to be in place.

Pacific Equatorial Age Transect

Recommendation ORTF 320-321_08:

Navigational and rig instrumentation data need to be consistently logged and archived in the science data base, and be accessible post-cruise. The shipboard display of these data must be visually clear.

Pacific Equatorial Age Transect

Recommendation ORTF 320-321_09: Robust software versioning and documentation tools are needed for all systems in accordance with a detailed configuration management plan.

Pacific Equatorial Age Transect

Recommendation ORTF 320-321_19: *The velocity sensor may apply too much pressure to the core. A provision for a "manual mode" should be made.*

MEMORANDUM

To: IODP-MI, SPC, IWG+, SPWC

From: Attendees of Engineering Development Panel Meeting #10

Date: 15 January 2010, Sendai, Japan

RE: Engineering Development and the New Science Plan

Engineering aspects of the Integrated Ocean Drilling Program (IODP) New Ventures in Exploring Scientific Targets (INVEST) 2009 meeting were presented and discussed at the Engineering Development Panel (EDP) Meeting #10 in Sendai, Japan (13 to 15 January, 2010.)

A working group at the EDP meeting was formed to cover as wide range of representation present at the meeting as possible. We have summarized the comments from the panel members and attending liaisons from the various Science Advisory Structure (SAS) panels and implementing organizations (IOs) below. The working group consists of Hiroshi Asanuma (EDP member, Japan), John Tauxe (EDP member, USA), John Thorogood (EDP member, ECORD), Greg Myers (IO liaison, USIO/COL), Yuuichi Shinmoto (IO liaison, CDEX), Dan Evans (IO liaison, ESO), Sanseatsu Saito (STP liaison), and Yoshi Kawamura (IODP-MI Operations Manager). The EDP supports the comments of the working group.

Members of the EDP believe that the realization of many goals of the new science plan can be achieved only with new technologies, and that consultation with the EDP and engineering professionals is critical. Detailed comments on each technology are not provided here, since this is meant to capture ideas at a high level. The EDP meeting agreed upon the following action item:

EDP Action Item 1001-01: INVEST Implemental and Renewal Process
EDP recognizes the need for engineering considerations in the development of the new science plan. A working group of EDP meeting attendees (panel members, liaisons from the various SAS panels, and representatives of IOs) provided comments to be forwarded to interested parties in time for the upcoming IWG+ meeting (20-22 January 2010).

Routing: IODP-MI, SPC, IWG+, SPWC

Priority: High

Comments from the Working Group

- EDP very much appreciates the inclusion of engineering development in the INVEST workshop. We wish to assure our continued and expanded participation in IODP-MI activities, supporting efforts to promote the science being done to a new level.
- The INVEST meeting represented a very strong start for defining some of the technology needs for scientific ocean drilling beyond 2013. The white papers, poster sessions, workgroups and speakers addressed these needs, yet the time allotted during the INVEST meeting was not sufficient to fully assimilate the details. These details are critical for the creation of the new science plan tied to technological reality. The EDP technological white paper submitted to the INVEST meeting contains a vision for future engineering that will support new and innovative science. The EDP now asks that the writers of the new science plan incorporate the EDP suggestions for engineering into the new science plan. We are concerned that without proper attention to large scale engineering restructuring efforts, a new science plan will not be sufficiently transformative or implementable.
- The EDP must have a formal role in the writing of the new science plan. Our specific responsibility is to identify gaps between scientific goals and feasibility with current platforms. EDP should prepare a written "Gap Analysis" as an integral part of the new plan, providing guidance on costs and timescales needed to achieve these goals.
- The products of technological sessions in INVEST are reasonable, because they reflect demands expressed in the scientific sessions and white papers. Review of the INVEST output and participation in drafting the next SP by EDP is essential to examine the feasibility of science plans and to identify targets in the next phase of technology development. A strategy for continuing communication among scientists, engineers and drilling operators to achieve a common understanding of ocean drilling technologies and their limitations is required.
- INVEST covered broad fields of technological development. During the preparation of the new science plan, the EDP should consider engineering priorities based on strong connections between science targets and core items identified in the engineering road map. Principal science targets requiring engineering developments include drilling to the Mohorovičić Discontinutiy (Moho), addressing geohazards, and further paleoenvironmental and microbiological research.
- The ocean drilling community is approaching a crossroads. After decades of

supporting drilling holes around the globe, funding agencies may be looking for something new and transformative. The EDP recognizes many ways in which the science community can be provided with better data, samples, and engineering techniques that will open up new possibilities. In order to realize a new level of achievement in marine geoscience, engineering development will need to be employed more effectively. The current science being performed has been done for awhile, and can continue, though funding and interest seem to be waning. More interesting work awaits, and can only be realized with support from the engineering community.

- EDP should be more involved in scientific proposal screening, and highly recommends to scientific proponents that they involve engineering expertise to assist in proposal development. This participation should advance the status of their proposals, and will make it easier for EDP to provide positive feedback. The current state of affairs has the engineer reviewers often at a loss to respond, as the proposals commonly do not provide sufficient detail to be evaluated.

- EDP must communicate that realization of the new science plan will likely involve complex projects requiring new technologies. These efforts will require organizational structures and skill sets that cannot be accommodated within the existing IO resourcing. Thus project- and mission-specific teams will need to be established. Further, long term activities may justify the creation of a central engineering organization as envisaged in the EDP white paper. Whichever route is eventually chosen, the ISP should recognize the limitations of existing structures in the face of the demands of future science.

- EDP may identify major gaps in technology required to underpin the science and should act as a facilitator to assist in the structuring of Requests for Proposals (RFPs) for research or technology development programs, (e.g. microbial contamination research.)

- A current constraint inherent in the proposal process is the inability to discuss or propose platform-specific issues. This precludes the submission of certain types of potentially valuable proposals, and therefore engineering developments. For example, some approaches to mitigating microbiological contamination involve the use and treatment of drilling muds, which are inherently platform-dependent. EDP recommends that the ED proposal process allow for platform-specific developments.

Technological Drivers for Future IODP Science

Progressing from ***application-specific*** *to* ***systematic*** *technological development*

Contributed by the IODP Engineering Development Panel

Abstract

Since its inception with the Deep Sea Drilling Project (DSDP) scientific ocean drilling has always had a technology development component. Technology development has been critical for advancing ocean drilling and scientific progress would not have occurred without it. Resolution of the simpler technical problems have progressed satisfactorily through an application-specific process, however the more difficult and complex problems that limit achieving many of the scientific objectives of the Initial Science Plan (ISP) and active IODP drilling proposals remain unresolved and will require a more comprehensive and systematic effort. This White Paper highlights key technological/scientific goals identified by the Engineering Development Panel (EDP)—Improving Core Recovery and Quality; Addressing Geohazards; Microbiology in the Marine Subsurface Environment; Drilling to the Moho and Other Complex Drilling Projects; and Virtual Staffing—that are derived from the EDP Technology Roadmap v. 3.0 (http://www.iodp.org/eng-dev), the ISP, and active drilling proposals; and reinforced by the Science and Technology Panel (STP) Roadmap (v. 0.93). They offer the greatest promise for transforming scientific ocean drilling. In order to accomplish some of these goals, large-scale engineering developments will be necessary to deliver the transformational science needed by any drilling program beyond 2013.

The Role of the EDP

The EDP lies within the Science Advisory Structure (SAS) of the IODP and is one of the key bodies charged with providing guidance on the development of engineering technologies for scientific ocean drilling. The EDP identifies long-term technological needs determined from active IODP proposals and the ISP, and recommends priorities for engineering developments to meet those needs, both for the annual IODP-MI engineering plan and on a longer term.

The EDP has been focusing on technological issues in support of scientific drilling objectives since its formation in September 2005, and has many recommendations to make to the scientific community in order to promote our understanding of the Earth. While much of the engineering development work in the past has been application-specific in nature, the EDP recognizes the need for a more systematic approach to engineering development, encouraging greater efficiency and improved methods, and delivering better quality of the science.

Key Technological Challenges for the Next Phase of Scientific Ocean Drilling

- **Improving Core Recovery and Quality** – improving borehole stability, core quality and quantity
- **Addressing Geohazards** – enabling the study of underlying geologic and geodynamic processes
- **Microbiology in the Marine Subsurface Environment** – advancing sampling and study of deep-dwelling microorganisms
- **Drilling to the Moho and Other Complex Drilling Projects** – reaching the Mohorovičic discontinuity and deep ocean-crust targets
- **Virtual Staffing** – developing shore-based operation centers to support complex drilling projects

Each of these technological challenges are examined below:

GOAL: Improving Core Recovery and Quality

CHALLENGES

Core recovery has been a significant problem in many drilling environments, including active fault zones, volcanic rubble in Mid-ocean ridge (MOR) settings, unconsolidated coarse material or zones of strong rheological contrast (e.g., chert-shale interbeds), igneous rocks (hard rock), gas hydrates, and gassy sediments (e.g., extruding cores on deck). Significantly higher core recovery of comparable lithologies typically occurs at land-based drill sites because the drill string is not subjected to the effects of ocean currents and vessel heave. These motions make accurate control of coring parameters almost impossible with the result that core recovery and quality are much worse that would normally be expected in an onshore context.

SOLUTIONS

Studies undertaken by IODP-MI suggest that core quality deteriorates with increasing rock hardness or brittleness. Industrial experience suggests that accurate control of the downhole drilling parameters, such as weight on bit and torsional stability of the drillstring, are critical determinants of core quality.

Isolating downhole conditions from the external environment by regulating feed and torsion through a seabed coring frame offers the prospect of dramatically improved core recovery and the ability to use a variety of new and "state of practice" sampling/coring tools as well as *in situ* testing devices (see the EDP and STP Technology Roadmaps for specific technologies and details). The addition of seabed frame technology is critical for aiding future scientific ocean drilling in achieving elusive science objectives and may create new scientific opportunities and targets. As early as 1998, the scientific community identified the need for a "seabed frame" to meet the IODP scientific goals with the new IODP non-riser vessel (CDC, 2000). The May 2004 Autonomous Downhole Tools Workshop participants re-affirmed this need (http://www.oceanleadership.org/programs-and-partnerships/usssp/workshops/past-workshops/usssp-past-workshops-2004/workshop-on-autonomous-downhole-tools-in-the-integrated-ocean-drilling/).

A recommended development pathway to deliver a step change in core recovery would be:

1. Review capabilities of existing deployment systems (vertical motion reduction systems such as vessel heave compensators) for utilizing seabed frames and installing/servicing borehole observatories;
2. Model and calibrate vertical motion reduction systems integrated with a seabed frame;
3. Specify a seabed frame for controlling bit feed, rotation, and ability for *in situ* testing experiments and stabilizing tools used for *in situ* measurements; and
4. Integrate coring and data acquisition systems for a common bottom-hole assembly (BHA).

A development of this nature will require a coordinated and focused effort. It will not happen as the result of application-specific developments by industry or academia. IODP-MI should create an engineering development organization charged with defining the options and producing a firm estimate of time and cost to implement these systems and then, if the Lead Agencies approve, oversee the resulting development program. This proposed engineering development organization would also be responsible for the long-term planning of complex drilling projects, such as a possible effort to reach the Moho, discussed further below.

STATE OF PRACTICE

Seabed drilling systems are already being pioneered by the geotechnical community (e.g., RovDrill and DWACS), and by certain European (e.g., Marum MeBo and BGS Rockdrill) scientific activities. Current depth capabilities of these seabed corers are on the order of 100 to 150 meters. This type of technology in conjunction with new 'state of practice' ship heave compensation equipment should therefore be evaluated for application to the task of deep water and possibly 1-2 km deep borehole coring operations.

Seabed frame technology has been developed within the marine geotechnical industry over the past ~30 years. It provides stability to the drill bit for improved deployment of *in situ* tests, and hydraulics at the seafloor that may be used in conjunction with a seafloor-mounted swivel system to advance the borehole with a controlled feed rate to enable improved weight on bit control. This capability, possibly supported with a deep-water ROV or acoustically activated clamping and pull-down systems, would expand the non-riser drilling capability to meet scientific objectives that require the need for:

1. Recovery of sand on continental margins and deep-water fan systems;
2. Recovery of corals in shallow water environments;
3. Recovery of young or zero age crust;
4. Deployment of *in situ* tools for the measurement of pore pressure, resistivity, and temperature as well as gamma ray density, acoustic velocity and other "wireline" logging measurements in the upper 100 mbsf and in unstable borehole formations;
5. Deployment of specialty tools for the measurement of *in situ* stress (e.g., packers) pressure core samplers, and a variety of "off the shelf" geotechnical tools (e.g., penetrometers); and
6. Recovery of contacts between hard and soft layers (e.g., limestone/chert sequences, contacts between lava flows, soil horizons between lava flows).

Standard geotechnical seabed frames (i.e., without the more sophisticated swivel/hydraulic advancement control), use a set of hydraulic jaws to clamp the drill string eliminating motion at the bit. This operation provides more reaction for the passive heave compensator to work against and in a more efficient operating range to enhance recovery, and to allowing tools such as the motor driven core barrel (MDCB) to be used more effectively, to enable routine spudding of hard rock holes, as well as to improve core recovery using pressure core sampling (PCS) type tools (Figure 1). A further enhancement and one that will result in a step change in technology will be to utilize a more technically-advanced seabed frame that incorporates a hydraulic feed and swivel system to control weight on bit (WOB) from the seafloor, rather than from a heaving ship.

We also note that improving core recovery and core quality is a top priority of the Science Technology Panel (STP) Roadmap, which reinforces its critical importance to scientific ocean drilling. In addition, we emphasize the need for an integrated planning and development approach to acquire and implement drill bit stabilization technology. Ultimately, an integrated system, when coupled with high quality rig and drill string instrumentation, will enable the full suite of present and future downhole tools to work far more effectively in the full range of materials to be cored and tested (Figure 1).

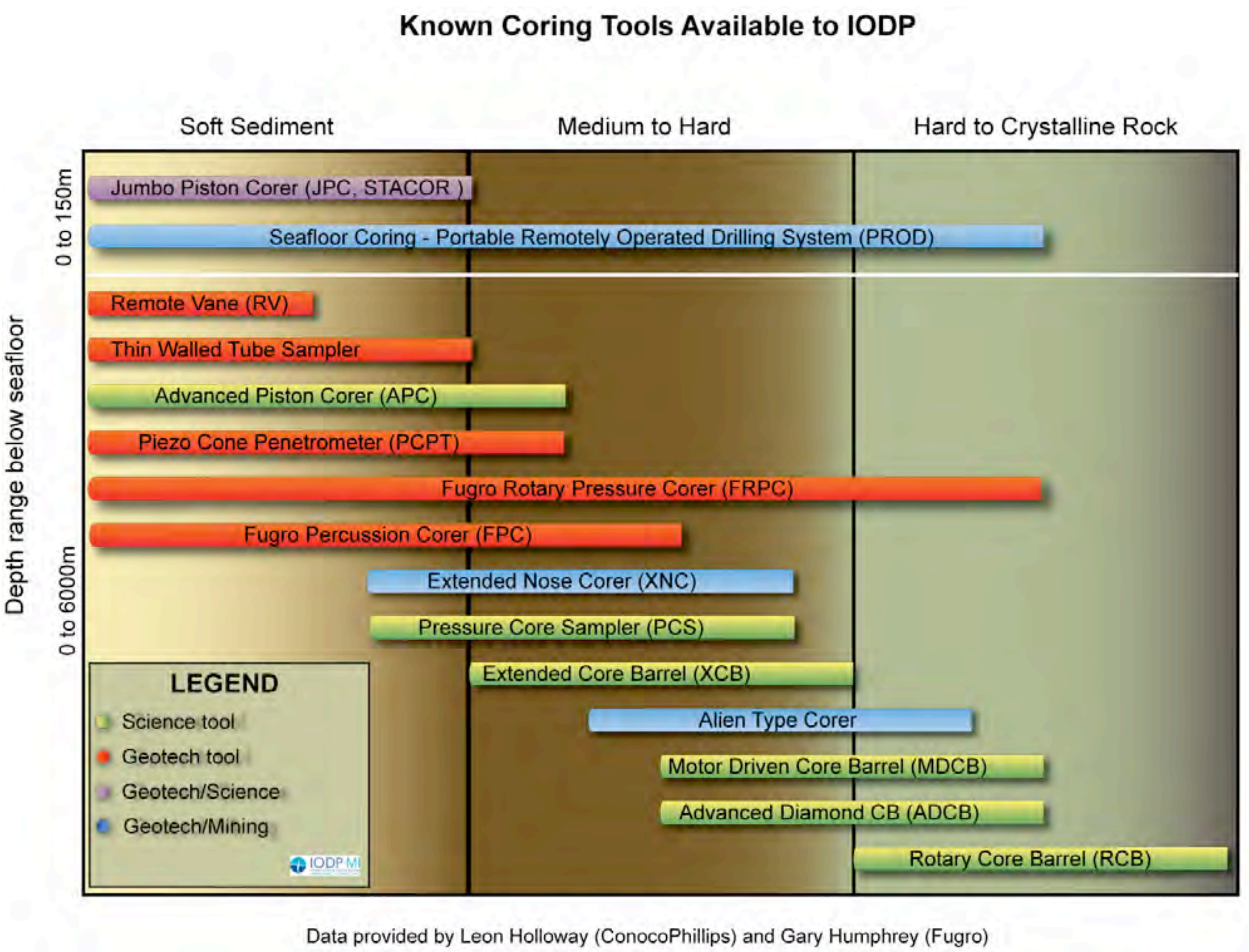


Figure 1: Illustration of known coring technologies available to the IODP and their suitability for various sediment types.

GOAL: Addressing Geohazards

CHALLENGES

The governing processes and recurrence intervals of geohazards are still poorly understood. Data obtained through scientific drilling, coring, logging, *in situ* measurements, and post-drilling borehole observatories provide unique information on potentially geohazardous processes because oceanic sediments preserve evidence of past geohazards (e.g., earthquakes, landslides, volcanic eruptions/collapses, and bolide impacts). The *in situ* conditions of these sediments also provide key information on their state before, during and after a catastrophic event, which may help predict imminent (sub-) seafloor deformation.

SOLUTIONS

Incorporation and/or modification of existing technologies, and new innovations are needed for better data collection of oceanic geohazard processes. Improved drill bit stabilization is critical for increasing core recovery, improving core quality, and for conducting some types of *in situ* measurements. In addition, capability for directional drilling is needed. For shallow sub-bottom depths, thin-walled geotechnical samplers are needed to collect high-quality undisturbed cores for subsequent laboratory measurements. For greater sub-bottom depths, the drilling systems need to be upgraded and/or developed [e.g., rotary core barrel (RCB) and diamond coring systems (DCS, ADCB); Figure 1]. New developments for borehole measurements include characterization of the seafloor (e.g., cone penetrometers), pore pressure and *in situ* stress measurements [e.g., hydraulic fracturing (HF), hydraulic tests on pre-existing fractures (HTPF)], improved logging while drilling (LWD)/monitoring while drilling (MWD) capabilities and further development of logging while coring (LWC). A critical requirement of successful long-term monitoring systems is improved reliability and redundancy of components in systems for high temperature and pressure, and corrosive environments, including cables, connectors, data systems, telemetry, and power systems.

STATE OF PRACTICE

The IODP recently hosted a workshop addressing oceanic geohazards (Morgan et al., 2009). One of the tasks of this workshop was to evaluate, list, and document tools and technologies available for geohazards studies.

The Advanced Piston Corer (APC) is the standard tool for sampiong soft sediments. It penetrates 9.5 meters and is composed of thick-walled material incorporating a blunt nosed cutting shoe. The net result is that the core taken is highly deformed.

The passive heave compensation system on the *JOIDES Resolution* was recently refurbished while in dry dock during 2009. The state of practice for drill string stabilization is discussed above.

Current thin-walled geotechnical sampling tools exist in industry and could be implemented on IODP vessels if a standard type seabed frame were available to immobilize drill bit motion. Piezocone penetrometer (PCPT), remote vane (RV) tools, and a host of other industry available tools from the geotechnical community could be implemented on IODP vessels if a seabed frame were available.

Numerous methods for measurement of borehole stress exist which include geophysical logging, and *in situ* and core testing. Methods used routinely in the oil and gas industry include geophysical logging, leak-off tests and laboratory testing of intact cores. However, most methods only probe parts of the stress tensor. Multiple measurements thus provide the best characterization of the stress tensor and pressure.

GOAL: Microbiology in the Marine Subsurface Environment

CHALLENGES

The sub-surface biosphere has captured the curiosity and interest of the scientific community within the last decade, and what we are learning is revolutionizing how we view the seafloor and what is below it. There is a critical need to obtain uncontaminated sediment and microbial samples that preserve an intact microbial community at *in situ* pressure, temperature, and fluid chemistry. Integral to the sample recovery process is the capability of transferring the samples to laboratory apparatus without further compromising the integrity or contaminating the samples. There is a further need to better integrate the geochemical measurements of the core with microbiology (e.g., interstitial water sampling and analysis with microbiological sampling). This issue is also highlighted in the STP Technology Roadmap.

SOLUTIONS

A system is required to prevent core contamination by fluids (*in situ* formation fluids and circulated drilling fluids) during coring, as the core is advanced up into the inner core barrel. Systems are also needed for *in situ* incubation for properly identifying and describing community composition and function, and for understanding the physiology and nutrient requirements of these organisms. In most cases, recovery of microbiological samples at *in situ* conditions is desired, however some samples could be returned to the surface after completion of an incubation experiment. Long-term monitoring of microbial community composition and associated geochemical and thermal changes may be needed to meet some scientific objectives.

STATE OF THE PRACTICE

Land-based technologies should be thoroughly investigated to determine if there are concepts and approaches that can be used for offshore applications. The ODP and IODP have experimented with novel contamination tracers (fluorescent beads and perfluorocarbon - PFT) with some success. However, the IODP currently has no systems for preventing contamination of microbiological sample during coring, or for incubating them *in situ,* although there are independently-funded projects developing down-hole incubation systems.

The EDP has established a Microbiology Contamination Working Group that is addressing issues associated with minimizing or eliminating the physiological effects of drilling fluid contamination on *in situ* microbiological incubations and core sampling. Drilling fluids and muds used on all IODP vessels are complex mixtures of materials optimized to meet operational and engineering requirements for drilling. Determining the physiological effects of each specific component on microbes is a difficult bio-assay problem, primarily because most of the microbes found in deep-sea sediments cannot be cultured at the present time. What complicates assessment even more is that some formulations or components of drilling fluids and muds are proprietary. At this point, viewing mud components as classes of compounds is most expedient. For example, the use of chemically-reduced constituents that are bio-active, such as magnetite, should be replaced by a physiologically inert substance that meets the same performance requirements for the drilling mud. Investigating and reformulating drilling muds to minimize their effects on microbe physiology is a complex and potentially expensive endeavor. In the near-term, determining whether contamination has occurred would be more expedient.

GOAL: Drilling to the Moho and Other Complex Drilling Projects

<u>*CHALLENGES*</u>

Exploration of the oceanic crust down to the Mohorovičic discontinuity, as well as other complex deep ocean-crust drilling projects will require a higher level of engineering planning and development, including organization and planning/strategy (pilot hole, long-term project management, on-the-project technological developments) of the project, site characterization, vessel capacity, borehole management, as well as downhole equipment development than has hitherto not been the norm in the IODP.

<u>*SOLUTIONS*</u>

In comparison with the planning and lead-time for executing a typical 2-month ODP/IODP expedition and the experience gained with land-based ultra-deep drilling (e.g., the KTB and Kola Peninsula SG-3 boreholes), the planning process alone for initiating a Moho drilling project will be on the order of ten years. A dedicated project office will be required to manage such an ambitious goal. This project office should be set up under the auspices of IODP-MI to plan, coordinate and oversee the large-scale engineering developments necessary to execute ultra-deep drilling. It should be managed in the same manner as an industrial project of comparable scale, with all associated project management practices such as goal setting, organization structure, stage-gating, planning, scheduling, risk management and cost control. Global experts from other ultra-deep borehole projects should be consulted and retained as needed.

Time and resources must be allocated to conduct full site characterization of the nature of the ocean crust that will be drilled and the *in situ* state of effective stress, as well as the atmospheric and oceanographic environments to enable selection of an optimal site. Based on the experience gained during several deep-drilling projects (Kola SG-3 and the KTB) the exact knowledge of the stress field and borehole stability are of critical importance for the success of the project. Improved methods for measuring the state of stress must be developed. All equipment, tools and sensors must be adopted for high temperatures and pressures, and for highly corrosive environments. Required advances in drilling technology include developments in drillstring and casing handling [e.g., risers may be constructed from advanced materials, and/or “riserless mud recovery” (RMR™) systems may be implemented], next generation mud motors, cutting removal and high-temperature mud programs, and adequate safety considerations (e.g., blow-out preventer for hydrocarbon occurrence). Data collection should be as redundant as possible, by multiple data collection methods (e.g., LWD, MWD, LWC, cuttings analyses, logging and long-term monitoring) and robust data transfer from downhole sensors, and real-time transmissions to shore-based science and engineering collaborators, IODP-MI, and members of the SAS.

STATE OF PRACTICE

IODP-MI is currently executing a scoping study on ultra-deep boreholes at the request of the EDP to determine the present state of practice for ultra-deep drilling technologies.

Temperature and pressure ratings of all downhole tools are significant issues if the tools are to be deployed in a mud-filled borehole that exceeds 175 °C. The oil and gas and the geothermal industries have been drilling wells with borehole temperatures up to 250 ^{o}C and many downhole tools have been developed to work in these environments for short duration deployments. Limited tools are available for working at higher temperatures. Figure 1 lists coring tools known to be available to the IODP. Most of these would need to be modified for use at high temperatures and pressures, which would represent a significant engineering effort and cost.

There are two approaches to ultra-deep drilling: (1) riser drilling and a relatively new technology termed (2) "riserless mud recovery" (RMR™). Ongoing activities are increasing the depth capacity of the riser ship *Chikyu*, including systems for high-temperature and high-pressure conditions under deep sea floor, and development of carbon fiber reinforced plastic riser pipe. IODP-MI is working with the DeepStar Consortium to develop the ultra-deepwater RMR™ system in collaboration with its industry partner AGR Drilling Services. RMR™ can potentially be deployed on any IODP drilling platform.

ENGINEERING DEVELOPMENT AND OPERATIONS PLANNING

In the light of the future requirement for complex drilling projects and oversight of significant technological developments such as seabed frames, enabling technologies required for future scientific drilling programs will not be delivered through the existing informal arrangements that exist between EDP and IODP-MI. A drilling program of such scale will require a much more formal and structured approach to ensure success within the time-scales required.

It is recommended that a full-time engineering organization be set up under the auspices of IODP-MI to plan, coordinate and oversee the engineering developments necessary to deliver the transformational science associated with the scientific drilling beyond 2013. The organization should consist of two sections, technology development and operational planning.

The technology team, consisting of specialists in subsea engineering, drilling systems and downhole tools, would be responsible for solving the problems associated with drillstring stabilization, next generation coring systems, and ultra-deep water technologies.

The operations team, consisting of experienced well engineers and operations engineers, would be responsible for planning the introduction of the new technologies and also undertaking the long-range conceptual planning and budgeting for frontier exploration projects such as the 21st Century Mohole and other complex deep ocean-crust targets.

Based on current practice in the oil and gas industry, it is envisaged that such a organization would consist of approximately 12-20 people who would manage an annual external budget on the order of 4 to 5 million USD that supports meeting scientific drilling objectives requiring long lead-time planning and development. It should consist of established industry professionals and be located in close proximity to one of the major oil and gas industry centers in either the USA or Europe.

In addition to pursuing the long-term goals, recent experience with technology issues that have come before the EDP indicate that such a group would be well-placed to undertake technology scoping studies, reviews of specific technologies of value across all operators and provide specialist well engineering input to complex drilling projects. It is expected that with sufficient resources the complex problems associated with ultra-deep drilling (deep water, high temperatures and pressures) can be resolved and that drilling to the Moho will become possible.

GOAL: Virtual staffing

CHALLENGES

The anticipated increase in complexity of coring systems and the technological sophistication of instrumentation and analysis during the next phase of scientific drilling will require a larger ship-board crew comprising more professional engineers and technicians than in previous drilling programs. There is parallel need for sufficiently large science parties to take part in complex drilling projects, and to maximize the scientific output of the data collected. The challenge is to optimize the staffing of scientists, technicians and engineers considering the limited space available on the drilling vessels and mission specific platforms (MSPs).

SOLUTIONS

The rapid evolution of global communications and networking technologies offers a potential solution for integrating shore-based scientists and engineers with shipboard operations. Substantial operational benefits will be gained from the development and implementation of shore-based real time operations support centers. Such centers could allow more flexible staffing of scientist, technicians and engineers, and maintain a 24/7 presence on-shore for consultation and guidance. Each expedition should evaluate the Minimum Measurements Recommendation with their science plan to coordinate how to achieve the science with the appropriate ship-based crew supported by the virtual staff.

STATE OF PRACTICE

The practice of virtual science parties is well-established in the ESO MSP missions. Remote operations centers are well-established in the oil and gas industry and they have demonstrated benefits in cost-reduction and mission flexibility.

The EDP Technology Roadmap

Much of the above information has been extracted from the EDP Technology Roadmap, which is a long term vision (3-5 years) of priorities in engineering development that are vital to achieve the science goals of the IODP and future scientific ocean drilling programs. It is an evolving document that undergoes review annually at the summer meeting of the EDP. The roadmap is based primarily on the scientific goals of the IODP as enunciated in the Initial Science Plan and active IODP proposals, and outlines and examines the engineering development needs for achieving these initiatives.

More information

EDP and Roster of Members – http://www.iodp.org/edp

Technical Roadmap and Engineering Development Proposal Submission – http://www.iodp.org/eng-dev

Seafloor Drills/Rock Corers

EDP 10 - Jan 13-15, 2010

G. L. Holloway

Two Different Types of Seafloor Drills

- Umbilical assist (deployment and power)
- ROV assist (hydraulics and power)

Two Different Types of Drilling Concepts

- Conventional rod over rod technique (BGS, MeBo, PROD)
- Wire line type technique (ROVDrill 3, DWACS)

Companies or Research Organizations who offer Seafloor Drills

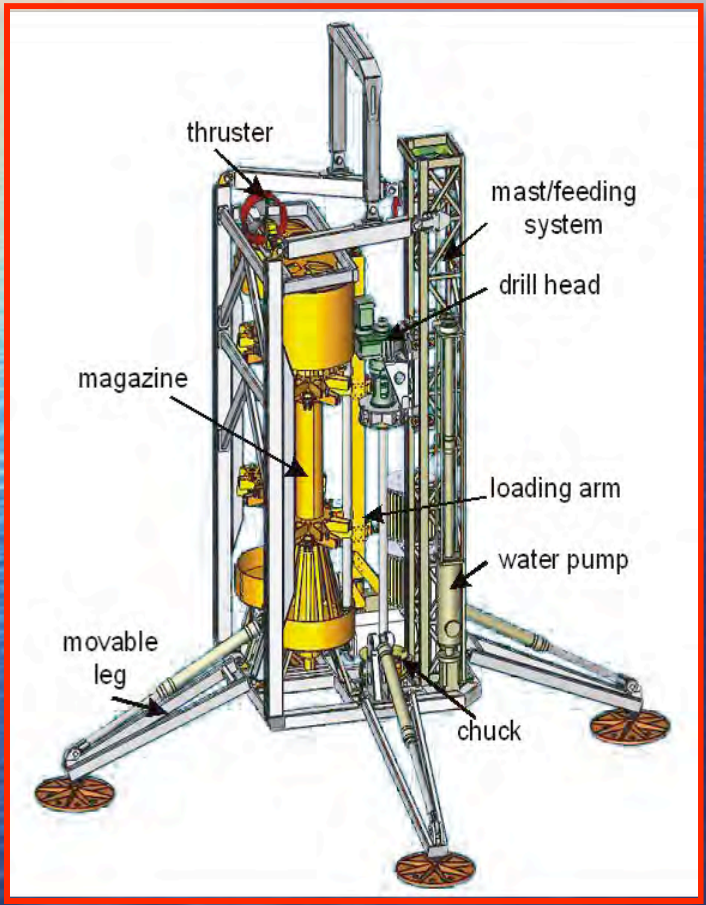
- BGS – rock corer
- Univ. of Bremen -MEBO
- Benthic Geotech – PROD
- Seafloor Geoservices Inc.– ROVDrill
- Williamson & Associates – DWACS
- Nichiyu Giken Kogyo - BMS Drill

General Capabilities w/ New Generation of Seabed Corers

- ~1000 to 3000m water depth
- Diamond coring/Sediment sampling to ~ 100/150mbsf
- In situ testing ~ 80 to 200m
- Designed for geotechnical or shallow science programs
- Deployment much faster than conventional single joint drill rig
- ROV version allows drill to be abandoned on seafloor incase weather or mechanical problems develop

BGS Seafloor Drill

MEBO Seafloor Drill



Seafloor Schematic

Deployment Mode

PROD1

Launch & recovery system (LARS) provided if A-frame is not available to offer move options with vessels of opportunity

On-deck w/ sediment footing

Deployment in hard rock mode w/ LARS

PROD1 Capabilities

- Controlled sea-bed landing
- No seabed surcharge or disturbance at borehole location
- Precise borehole depth measurement
- High quality sampling & in situ testing from seabed
- Monotonic and cyclic in situ testing capabilities
- Operation on slopes up to 20 degrees
- Ball Cone, VST and methane sniffer available

PROD2

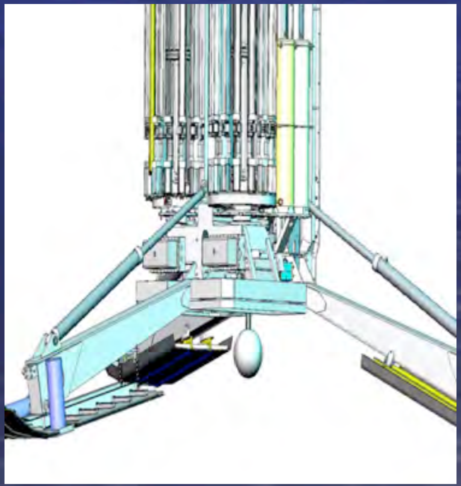
(Awaiting Sea trials)

- Operating water depth increased to 3,000m
- Piston sample diameter increased to 75mm
- Rotary core diameter increased to 72mm
- Incorporates 8 years operational experience with PROD1 (newer electronics).

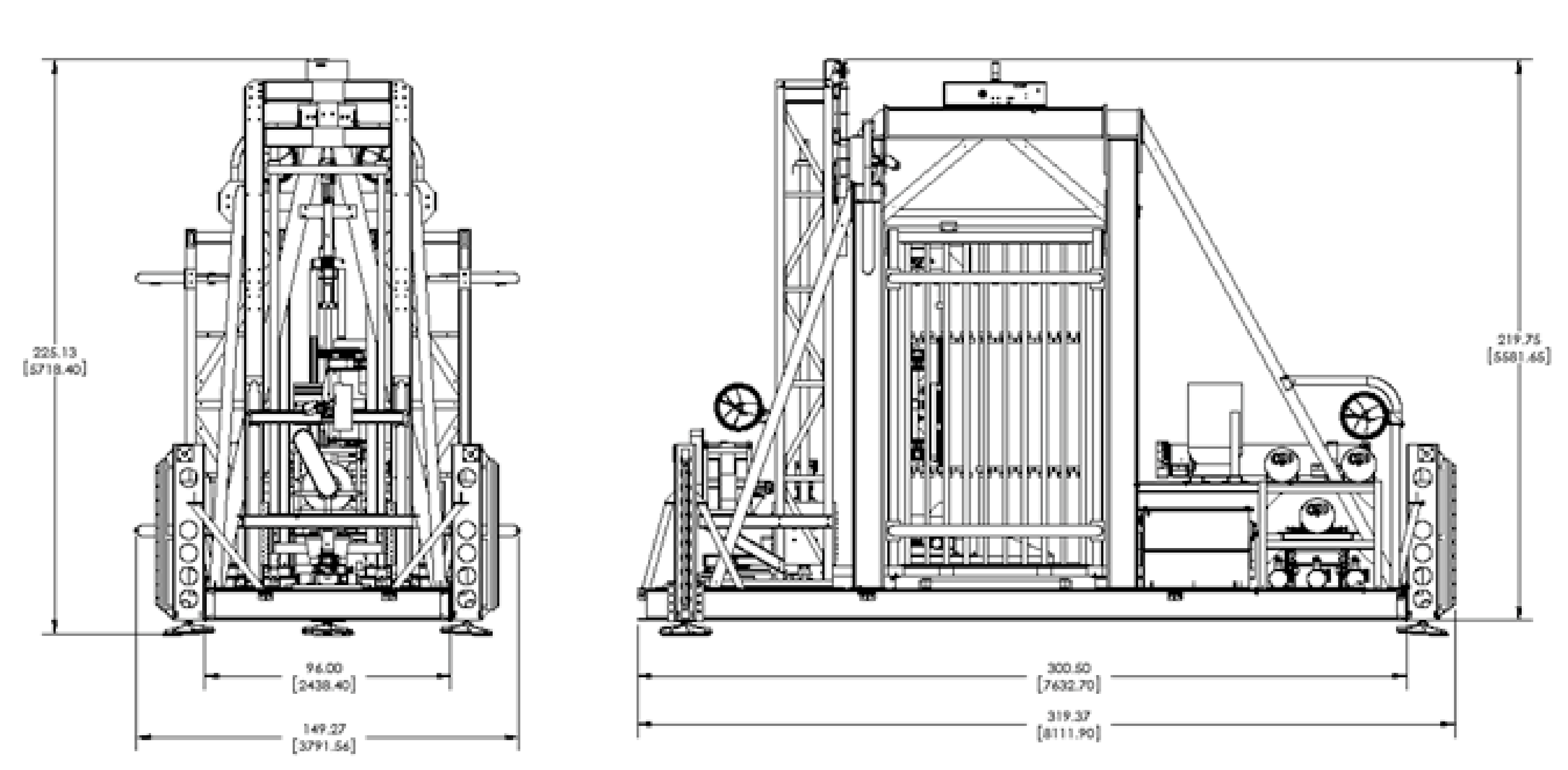
PROD Pipeline Engineering Tools

Variable Rate & Large Scale Simulation Tools

- VPST and LPST being developed for deployment from PROD
- VPST: torque is measured on a rotating sphere, pushed into the seabed, to assess pipeline friction
- LPST: load, penetration & penetration rate are measured as the sphere is pushed into the seabed, to assist in assessing installation & longer term pipeline/riser embedment



Williamson DWACS

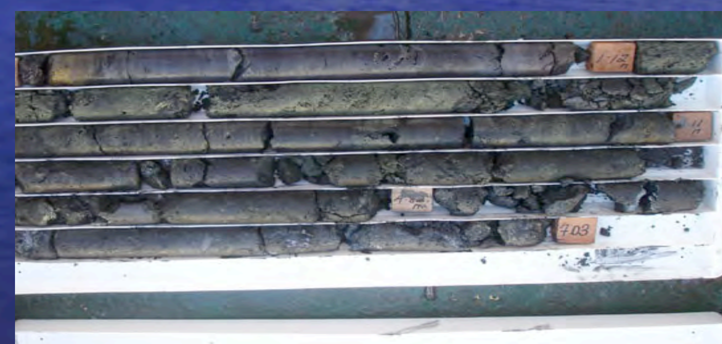


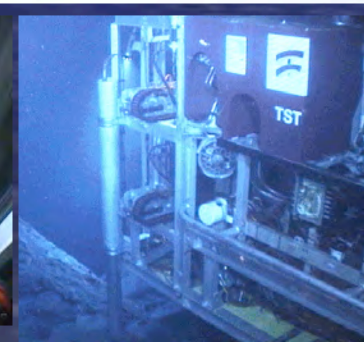
Williamson DWACS

- Deep water, Automated, Wire-line drill
- Capable of drilling/recovering 150 meter core
- Operational water depth up to 3000 meters
- Robotic wire-line drilling system
- Suite of different tools available

ROVDrill 1 & 2

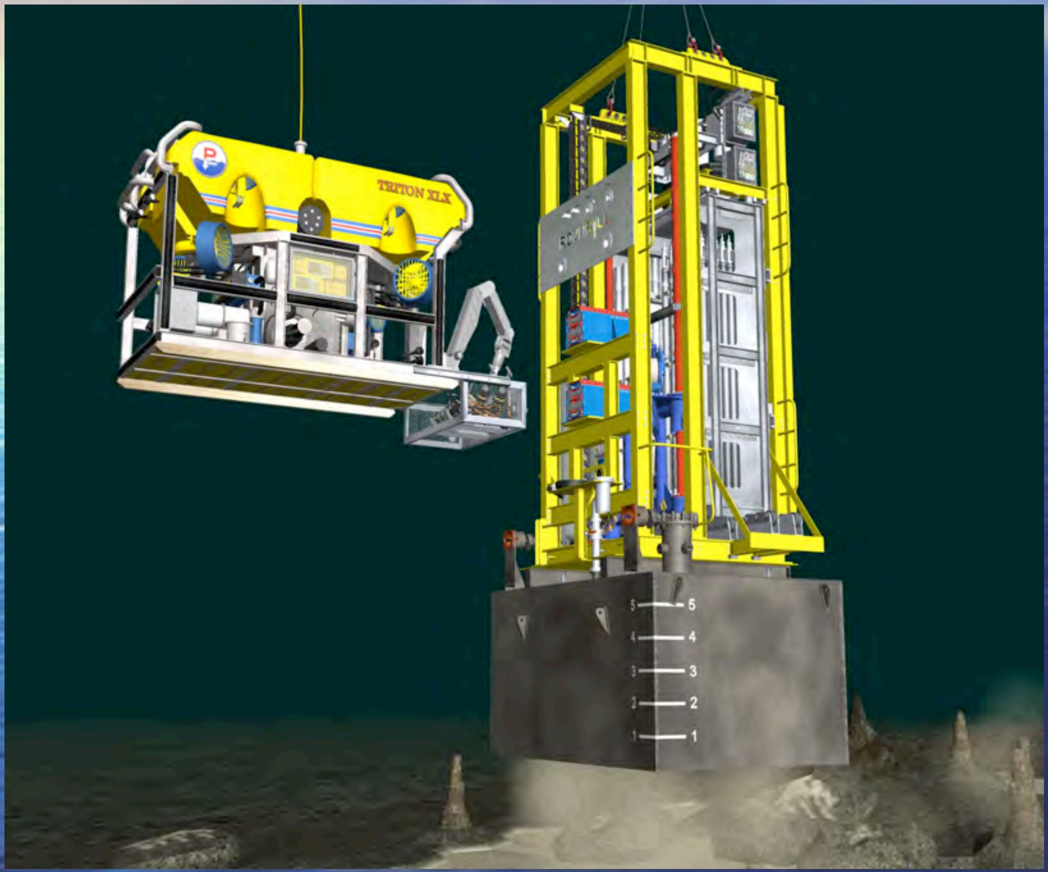
(shallow 18m coring depth capability – designed for Solwara mineral exploration-offshore New Britian)





ROV mounted on a drill sled

ROV Drill 3 w/ mud skirt
(new generation of seafloor drill)



- Independently lowered w/ steel wire
- ROV operates zip pumps to install mud skirt into soil
- ROV releases deployment wire from drill
- ROV plugs into drill to supply power
- Operation of drill via surface control unit

ROVDrill3 Capabilities

- Remotely operated seafloor geotechnical drilling, sampling and in-situ testing rig.
- Evolution of previous field - proven systems.
- Electrical and Hydraulic power provided by free-swimming work-class ROV via wet-mate hot stab interfaces.
- Modular design with interchangeable foundation assemblies for all types of seabed terrains and gradients up to 30º from horizontal
- Suitable for shallow or deepwater geotechnical site investigation campaigns worldwide.

ROVDrill 3 Specifications

- Can operate from any locally available ROV equipped vessel of opportunity (limited by depth of available ROV)
- Works in all seabed environments (soft sediment to hard rock)
- Provides rotary drilling with wireline push-sampling and CPT as standard tools.
- Maximum sampling depth >200m (continuous CPT)
- Provides sample diameters up to 3” (76.2mm), OD
- Builds upon experience from ROVDrills 1 & 2.

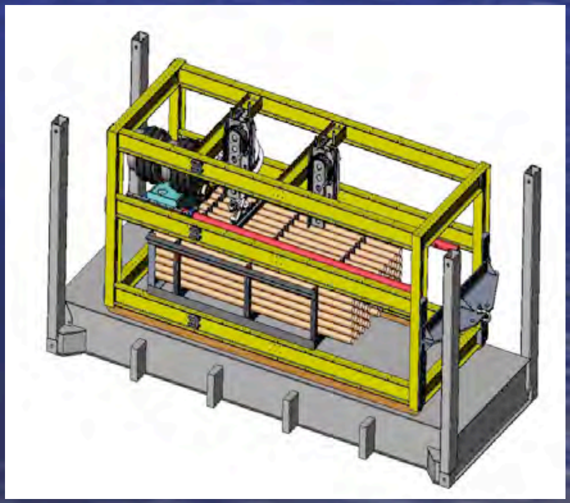
ROVDRILL & Vessel Requirements

- **100-150 HP Work class ROV Spread**
  - -Subsea hydraulic power: 18 gpm at 3000 psig from the ROV auxiliary pump
  - Subsea electrical power: Single phase power 5 amps at 120V
  - Access to single mode fiber or twisted shield pair in the ROV umbilical
  - Access to the ROV's telemetry system for data transfer

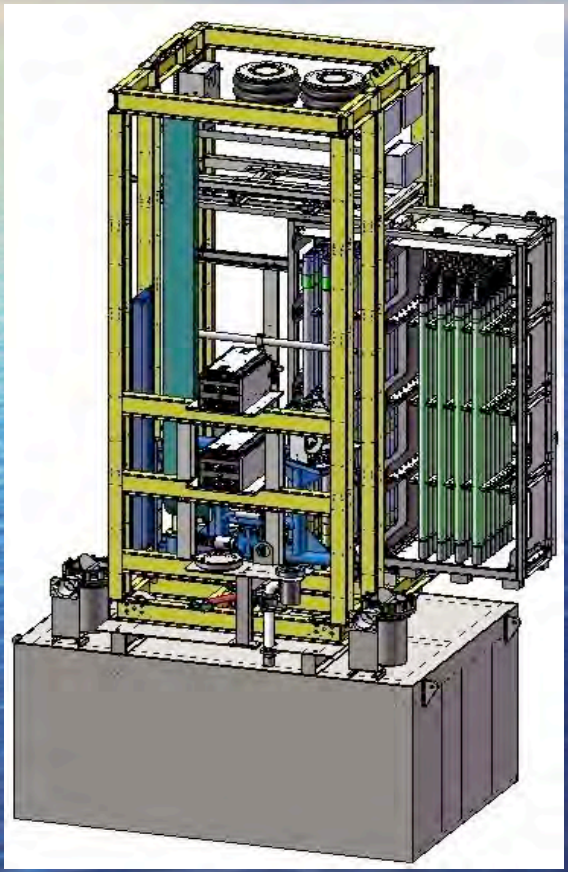
- **Fast deployment winch: 30-35m/min. or faster**

- **Deck crane w/ nominal 50t SWL capacity**

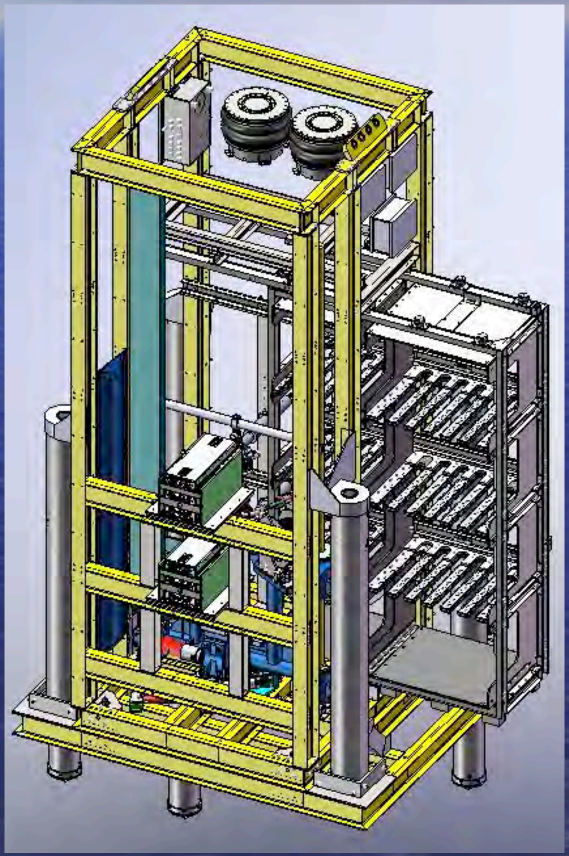
- **Modest deck space of 500 square feet to accommodate**
  - Drilling module on flat rack footprint 20ft x 8ft (160 sf)
  - Skirted mud mat footprint 11.5ft x 8.5ft (100 sf)
  - Soils Test Lab footprint 20ft x 8ft (160 sf)
  - Spares container foot print 20ft x 8ft (160sf)



ROVDrill3 Deployment Modes



Deployed w/ mud skirt



Deployed w/ hard rock legs

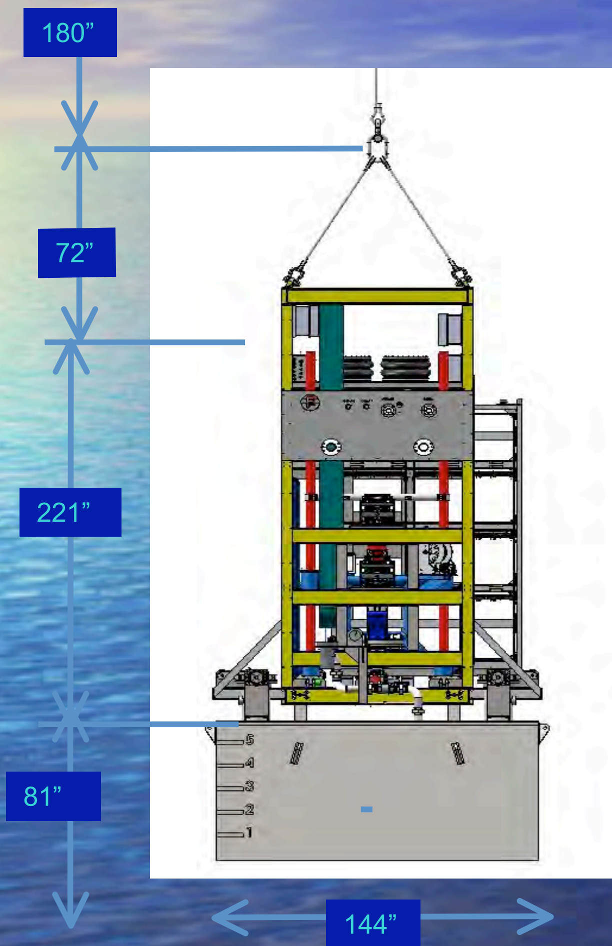
ROVDrill3 Land Test

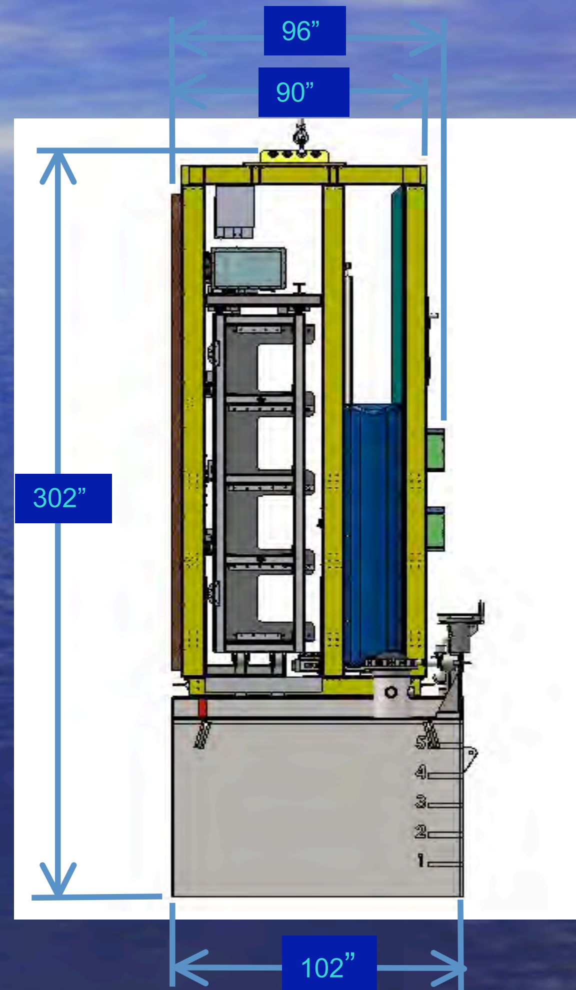
(completed summer 2009)

Control Console

ROVDrill w/o base

General ROVDRILL 3 Dimensions





Rovdrill 3 – Assembled Dimensions,
(NOT Shipped in this configuration)

Summary

- Seafloor corers can be mobilized to port of call anywhere in the world via airfreight or cargo vessel
- Deployed from smaller vessels of opportunity
- Provides initial information to develop deeper science drilling programs
- Multiple deployments allow good sites to be located for future deep drilling program
- Allows drill ships to concentrate on coring below 100m and not waste time attempting to spud /core from bare rock locations but to set casing first and then begin coring w/ better WOB control

Deep Drilling Scoping Study

EDP Recommendation 0801-16: Drilling to the Moho

The EDP recognizes SPC's interest in understanding the technological challenges associated with a future Moho drilling project (in reference to SPC Consensus 0708-30) and is initiating discussions about this problem.

- SPC requested that EDP, IODP- MI and the IO's conduct scoping for deep drilling related to Moho.
- This effort has been awaiting coordination and resources.
- IODP-MI, CDEX, the USIO have just started working together to propose two separate workshops this summer and fall, one funded within IODP, the other funded by the Sloan Foundation. The workshops will focus on the science, technology and planning required to drill 6-7 Km deep holes in water depths greater than 4,000m. Should the workshops move forward, an EDP representative with deephole, instrustry experience will be invited. Please see Kiyoshi Suyehiro, Yoshio Isozaki, and Greg Myers for more details.

21st Century Mohole – from Previous meetings

1. What
   - Review the technology options and possible evolutionary pathways to achieve the capability to deliver the ultra-deepwater ultra-deep scientific drilling capability. The limits to present riser technology, potential for mud-lift systems or remote seabed applications must be considered.
2. When
   - Work is occurring now on ultra-deepwater, deephole drilling through the DeepStar contract
3. How
   - IODP-MI to work with EDP members to generate possible well plan and report to SPC
   - Capitalize on existing works. Utilize non-confidential items of DeepStar project to scope out this project.
   - Use Moho Workshop document (2006)
   - Use Ultra-Deepwater Oil and Gas Technology Workshop Report (2005)

IODP
Integrated Ocean Drilling Program
United States Implementing Organization

Microbiology Contamination Report

Ussler / Thorogood

January 14, 2010

- **STP Consensus Statement 0802-06: Detection and Control of Contamination Issues During Riser Drilling**

- STP proposes that multiple contamination tests using PFT (PerFluorocarbon Tracer), and fortuitous or additional inorganic tracers (e.g., barium, lithium bromide, potassium bromide) be used during riser coring. Sampling of drilling mud should be scheduled so that microbial communities in this medium can be compared to those in the samples.

  Also, ***STP asks EDP to investigate drilling fluids and /or techniques that are less likely to adversely impact interstitial water geochemistry, rock geochemistry, and microbiology***.

  The best test way to initiate this may be to have an appropriate presentation to EDP by Rick Colwell (STP member).

Masui Report Conclusions

- Results clearly suggest current mud formulations allow growth of bacteria.
- Mud tank provides microbial enrichment environment with rapid composition changes during a circulation cycle
- Fresh muds and pH of 11 or greater may reduce contamination effect
- Post operation analysis suggested several contaminants from deep seafloor sediments
- Contamination may critically affect analysis of deep microbiological habitats and geochemical analyses
- Critical to avoid contamination during riser drilling:
  - Prevent growth in mud tank
  - How to process cores for accurate analysis
  - Recognise and use contaminants as tracers
  - Core sample storage to avoid chemical & biological alterations

Masui, N., Morono, Y., and Inagaki, F., 2008. Microbiologcial assessment of circulation mud flulids during the first operation of riser drilling by the deep-earth research vessel Chikyu, Geomicrobiology Journal 25:274-282

Issue: The findings of Masui et al. (2008) raised concerns about the impact of drilling fluids on core collected during riser drilling.

Without executing experiments designed to measure core contamination during riser drilling from *Chikyu*, the amount of core contamination, the effect of lithology and the impact of the type of coring system are unknown.

Recommendation #1 – A pre-emptive approach to mitigating core contamination by conducting a series of experiments designed to evaluate and quantify core contamination by drilling fluids as early as possible during riser drilling from the *Chikyu*.

Issue: Can new formulations and handling of drilling fluids resolve contamination issues?

Recommendation #2 – The options are potentially expensive and difficult to evaluate and execute. We do not recommend pursuing any aggressively until specific core contamination issues and needs are identified. There are no simple solutions.

- –Evaluate present compositions of drilling fluids
- –Conduct bioassays to determine bio-active components
- –Find appropriate substitutes that are bio-inactive
- –Replace compounds that inhibit PCR reactions or lethal
- –Purify additives that contain exotic DNA or viable organisms
- –Recondition mud during circulation on deck
- –Reformulate the drilling fluid
- –Oil-based or synthetic muds

Issue: Are existing tracers of contamination suitable and are there other options?

Recommendation #3 – **Reduce routine PFT use** because of background contamination issues in the laboratory and find suitable substitutes so that PFT is not compromised when it is necessary for critical intervals or drilling legs.

Recommendation #4 – **Refine positive release strategies** for verifying tracer release. A false negative is an expensive error when considering the amount of time and expense that goes into microbiological analyses and incubations.

Recommendation #5 – **Develop microbial tracer strategies.** Spike the drilling fluids with well-characterized genome-sequenced microbes.

Issue: Are there new drilling/coring strategies that could be developed?

Recommendation #6 – **Conduct a scoping study that evaluates pressure gradients within wellbores** for non-riser, riser, and dual gradient drilling. Develop strategies for better managing pressure gradients to reduce overpressures that would force drilling fluids into core samples.

Recommendation #7 – **Implement a carefully planned mud program that will maintain pressure balance** in the borehole so that the risks of contamination by infiltration and through induced fractures are reduced.

Recommendation #8 – **Implement large diameter drill pipe** and coring systems, either on a case-by-case basis or permanently on post-2013 drilling platform(s).

Recommendation #9 – **Explore depth-extended over-drilling methods or other transitional coring strategies** to replace XCB/ESCS coring systems, such as the DCB or MDCB. This is an important opportunity to gain more understanding/sampling of deep-biosphere sediment-hosted microbial communities below depths attainable by APC. Transition corers and coring improvements will have a larger benefit to the drilling program, not just the microbiology and geochemical component.

Recommendation #10 – **Equip a shipboard laboratory van dedicated for microbiological contamination monitoring**. Control access and contamination from general lab areas.

Recommendation #11 – A dedicated and concerted effort to investigate contamination effects and to sample the deep biosphere is necessary. Systematically collect data over multiple drilling legs and platforms to define the core contamination problem. Mitigation methods used are going to depend on mission objectives.

The EDP advocates a systematic analysis and planning approach, including risk assessment, to address the problem of core contamination.

Additional Thoughts (JLT)

- Advice from Industry?
- Complex problem, requires:
  - Clear goals
  - Leadership and delivery organisation
  - Should be costed and funded
  - Defined and managed as a project
  - Multi-year schedule
  - Uncertain outcomes requiring flexibility

Understanding and Controlling Microbiological Contamination by Drilling Fluids During Scientific Drilling

This report is in response to the following Consensus Statement forwarded from the STP:

STP Consensus Statement 0802-06: Detection and Control of Contamination Issues During Riser Drilling

STP proposes that multiple contamination tests using PFT (PerFluorocarbon Tracer), and fortuitous or additional inorganic tracers (e.g., barium, lithium bromide, potassium bromide) be used during riser coring. Sampling of drilling mud should be scheduled so that microbial communities in this medium can be compared to those in the samples. Also, STP asks EDP to investigate drilling fluids and/or techniques that are less likely to adversely impact interstitial water geochemistry, rock geochemistry, and microbiology. The best test way to initiate this may be to have an appropriate presentation to EDP by Rick Colwell (STP member).

Background

Drilling fluids contain high levels of active microbial cells and high concentrations of heavy mineral salts (e.g., barium) that are potential contaminants of microbiology and geochemistry, respectively. Growth of microbes in drilling fluids was observed during the training cruise of Chikyu (Inagaki et al. unpublished). The microbes utilize xanthan gum, a common drilling mud additive. Also, drilling fluids are highly alkaline and contain high concentrations of specific heavy mineral salts (such as $BaSO_4$, LiBr). Thus, these drilling fluids may affect both the core microbiology and the inorganic geochemistry (e.g., pH, specific cation and anion concentrations, etc.) of interstitial water and also trace element geochemistry of igneous rock core (e.g., lithium isotopic composition).

Introduction

The EDP has considered this request forwarded by the STP and provides as a major part of this report an analysis of options and a series of recommendations that address not only the immediate concern about microbial and geochemical contamination of cores, but the broader needs of the scientific ocean drilling community to obtain higher quality (i.e., uncontaminated and undisturbed) core.

Assumptions and Framework for this Analysis

While developing this report, a number of assumptions were made concerning the framework for the core contamination issue raised by the STP:

1. We assume that the drilling muds will be water-based and that no petroleum-derived hydrocarbons are in the mud formulation.
2. The recommendations made in this report are also applicable to collecting uncontaminated sedimentary pore fluids, gases, and targeted lithologies (e.g., gas hydrates). Understanding the subsurface biosphere requires a multi-target approach.
3. A long-term objective of the drilling program is to improve core quality and recovery. Resolving methods for ensuring minimal core contamination and disturbance will substantially improve the scientific value of recovered core. In addition, it is more likely that progress will be made with these needs if there is a broad base of drilling community support.
4. The analysis and recommendations of this report should be relevant to more than just the *Chikyu*, but to all mud-based drilling/coring legs and platforms (e.g., JOIDES Resolution, mission specific platforms, etc).
5. Future drilling for microbial objectives is going to require significant pre-planning for an expedition.

Background

The pioneering study of Masui et al. (2008) made the following observations by comparing drilling mud before and after riser drilling for a duration of approximately 6 days. No core was recovered.

1. There was a 2-fold increase in cell-like fluorogenic particles. This was interpreted as indicating an increase in cell abundance from either contamination by deep marine sediments or the growth of microbes in the drilling fluid.
2. Incubation of drilling mud before and after the 6-day drilling showed no growth of bacterial colonies on plates inoculated with pre-drilling mud, but a number of colonies grew on plates inoculated with post-drilling mud. All the colony isolates were affiliated with the *Halomonas* genus, a common salt/alkali-tolerant terrestrial microorganism. These results suggested that the *Halomonas* came from buried terrestrial soils at depth and thrived in the drilling mud.
3. Culture-independent methods indicated that the pre-drilling mud was contaminated by the bacterium *Xanthomonas*, which is utilized for the manufacturing of xanthan gum, a minor constituent of the mud formulation used for the drilling.
4. Remarkably, culture-independent methods provided evidence for a large variety of deep-biosphere-related bacteria and archaea, despite the contamination by large amounts of exotic DNA from the *Halomonas* and *Xanthomonas*. Thus, despite the contamination, something was learned about the subsurface biosphere.

The findings of Masui et al. (2008) have clearly raised concern about what the impact of drilling fluids might be on core collected during riser drilling. Without actually executing experiments designed to measure core contamination during riser drilling from *Chikyu*, the amount of core contamination, the effect of lithology and the impact of the type of coring system are unknown.

Recommendation #1 – We recommend a pre-emptive approach to mitigating core contamination by conducting a series of experiments designed to evaluate and quantify core contamination by drilling fluids as early as possible during any upcoming expeditions that will utilize a marine drilling riser or other mud return systems.

An Analysis of Options

A variety of approaches may be attempted to mitigate contamination by drilling fluids. However, not knowing the severity of the core contamination problem and its dependence on lithology and type of coring system, the EDP is unable to recommend a specific course of action.

1. New formulations and handling of drilling fluids
    a. Evaluate present compositions of drilling fluids that may be used on IODP vessels. Some components may be inert, and could be used to evaluate the degree of contamination and penetration depth into cores (finely-milled barite, for example).
    b. Conduct bioassays to determine which components of drilling fluid are bio-active. There is an enormous array of micro-organisms whose metabolism is unknown, thus it is a very difficult task to implement a tractable bioassay program.
    c. Find appropriate substitutes that are bio-inactive (using a bio-inactive steroisomeric compound might be one approach, such as L-sugars which are produced on an industrial scale).
    d. Replace compounds that inhibit PCR reactions or are obviously lethal to micro-organisms.
    e. Purify additives that contain exotic DNA or viable organisms – work with manufacturers and supply chain to ensure that contaminants are not introduced.
    f. Recondition mud during circulation on deck – ozonation is a potential means for eliminating growth of microorgansisms like *Halomonas*.
    g. Reformulate the drilling fluid – an expensive and very difficult process considering the complexity of contemporary drilling fluids and the risk on the rig floor of poor mud performance.
    h. Oil-based or synthetic muds – higher temperatures will require a shift from water-based to oil/synthetic muds. This introduces an entirely new set of problems from the contamination standpoint, both in core and the environment. Synthetic fluids are presently banned in the North Sea.

Recommendation #2 – The options listed above (1a to 1g) are potentially expensive and difficult to evaluate and execute. We do not recommend pursuing any of these options aggressively until specific core contamination issues and needs have been identified. There are no simple solutions.

2. Mechanical protection
    a. Various strategies have been proposed to protect sediment cores during collection and their ascent to the surface. Primarily these involve dispensing a coating or gel during passage of the core into the core barrel. The mechanical configuration of the drill bits and coring systems presently in use do not provide full protection of the core during collection before coating. The coating material may potentially be a contaminant of the core, and would have to be formulated accordingly.

3. Tracers - Various chemical and physical tracer methodologies have been tested and developed during the ODP.
    a. Smith et al. (2000a, 2000b) have concluded based on perfluorocarbon tracer (PFT) and fluorescent microsphere tracers (mimic micro-organisms) that APC and RCB coring as implemented on the JOIDES Resolution is suitable for microbiological studies of the deep biosphere (small deltaP). Successful delivery of the tracer has to be confirmed as pointed out by Smith et al. (2000a, 2000b) and this should be part of the tracer protocol.
    b. Lever et al. (2008) have demonstrated low degrees of contamination of non-riser cores – both in basalt (RCB) and in sediments (APC) using PFT. These results and those of Smith et al. (2000a, 2000b) imply that if pressure gradients within the borehole and pump pressures can be managed, then forced intrusion of drilling fluids into the pore spaces, and natural and opened fractures of hard rocks will be minimized.
    c. The Subsurface Life Task Force (IOPD Microbiology Working Group Report, 2003) recognized that overuse of PFT in the shipboard laboratories increases the background and reduces the utility of PFT as a tracer. This is a long-term issue, and development of alternatives to PFT is recommended.
    d. Masui et al. (2008) state that it will be difficult to run tracer experiments using compounds like PFT on *Chikyu* because of technical difficulties with the volume and high flow of the mud pumping system.
    e. Fluorescent microspheres might be better suited for hard rock contamination tracing according to the IOPD Microbiology Working Group Report (2003).
    f. The STP implies in their consensus statement above that constituents of drilling fluids such as barium (barite?) and lithium bromide may be used as fortuitous tracers to evaluate core contamination. We assume ‘barium’ is referring to barite, a common constituent of drilling fluids used to increase density (weight of the mud).
    g. Barite is one of the least soluble inorganic compounds known and is difficult to dissolve for geochemical studies of seawater strontium and sulfur isotope records (e.g., Paytan et al., 1998; Mearon et al., 2003). Use of barite in drilling fluids in sedimentary sections that would be studied for paleooceanographic purposes and documenting changes in seawater strontium and sulfate sulfur isotopes is highly undesirable.

h. As pointed out in the STP consensus statement, the use of lithium salts in drilling fluids would pose a serious problem for studies of lithium isotopes in ocean crust. Lithium salts are to be avoided for these drilling targets.

Recommendation #3 – Reduce routine PFT use because of background contamination issues in the laboratory and find suitable substitutes so that PFT is not compromised when it is necessary for critical intervals or drilling legs.

Recommendation #4 – Refine positive release strategies for verifying tracer release. A false negative is an expensive error when considering the amount of time and expense that goes into microbiological analyses and incubations.

Recommendation #5 – Develop microbial tracer strategies. Spike the drilling fluids with well-characterized genome-sequenced microbes. Masui et al. (2008) clearly showed that *Halomonas* grew at an acceptable rate for use as a microbial tracer in the mud tanks When running microbial tracers in the drilling fluids, it will be important to have a positive control, such as doing a time-series sampling of an undisturbed tank of drilling fluid. It appears that the presence of the *Halomonas* DNA did not have appreciable inhibition of the PCR reactions used to amplify the rare deep-biosphere organisms detected in the study, thus purposeful introduction of a microbial tracer may not affect the methods used to investigate the microbial community.

4. New drilling/coring strategies
   a. Riser drilling creates an elevated borehole pressure gradient that may fracture rock or force drilling fluids into surrounding sediments.
   b. Dual gradient drilling has a significant advantage compared to riser drilling because the pressure head is reduced to hydrostatic pressure at the seafloor. It is less likely that the borehole pressure gradient will exceed the local strength of the rocks or sediments. "Wellbore pressure gradients can be maintained between the window of formation pore pressure and the formation fracture pressure, thereby avoiding wellbore instability" (Myers, 2009).
   c. Drill with large diameter pipe and run larger coring systems. The cores will yield more material and the central portion of the core should be less contaminated. Larger amounts of material per unit depth will allow higher vertical resolution of sampling of the deep biosphere, fluid geochemistry, etc. (IOPD Microbiology Working Group Report, 2003).
   d. Improve and/or extend over-drilling methods like APC coring. It has been shown that APC coring has the least amount of core contamination and highest quality, although there are core disturbance issues even with APC coring.
   e. Pressure management to reduce drilling fluid infiltration of core. Based on qualitative descriptions the pressure increase during non-riser drilling and coring at the bottom of the borehole is 'small'. This increased pressure is caused by friction through drilling hardware. In contrast, during mud-based drilling/coring the pressure may rise to the fracture pressure of the

lithology, causing immediate infiltration of the drilling mud into surrounding sediments and ahead of the bit.

f. Develop transitional coring systems and a replacement for the XCB coring system. Smith et al. (2000a, 2000b) point out the inferior core quality for microbiological studies that is collected with the XCB coring system on the JOIDES Resolution. *Chikyu* has a similar system (Extended Shoe Coring System – ESCS) to the XCB.
g. Renewed development and use of the DCB. The DCB has been used once, producing a clean and uncontaminated sample (IMWGR, 2003).
h. Testing and possibly renewed development of a MDCB. MDCB systems have not been tested with respect to core contamination issues (IMWGR, 2003).

Recommendation #6 – Conduct a scoping study that evaluates pressure gradients within wellbores for non-riser, riser, and dual gradient drilling. Develop strategies for better managing pressure gradients to reduce overpressures that would force drilling fluids into core samples.

Recommendation #7 – Implement a carefully planned mud program that will maintain pressure balance in the borehole so that the risks of contamination by infiltration and through induced fractures are reduced.

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EDP Microbiology Contamination Working Group

Bill Ussler, chair
Leon Holloway
John Thorogood
Matsui Tamura
Rick Colwell (STP liaison)

Risk Matrix (to be developed)

Technical; organizational; financial (create matrix with 'status quo' and compare with increased or decreased risk)

Evaluate risk
Risk mitigation
Best practices
Mitigation

Mitigation strategies depend on the lithology, fracture state, state of stress, rock mechanics; plus the drilling/coring/sampling objectives.