Interim Technology Advice Panel (iTAP)
Meeting Minutes, February 21-22, 2003
Vrije Universiteit, Amsterdam

Introduction & Reports

Following a welcome and introductions, modifications were made to the agenda to accommodate participants' schedules. Reports on the Chikyu (by Takagawa), non-riser platform plans (by Allan), and MSP platform operations (by Skinner) were presented.
Highlights from these reports included the following:

- the Chikyu drilling units will be installed in July, the sea trial for the ship part is scheduled for March 2003, a training cruise is scheduled to start in Q4 of 2005, and operations will begin in Q4 of 2006
- the US National Science Board approved FY2003-2007 ODP program plan, including phase-out, and the RFP for a US System Integration Contractor for the non-riser vessel will be released soon.
- MSP operations will be conducted by BGS in IODP. BGS are currently planning the highest ranked MSP programs (Arctic Drilling).

Cross-platform Technical Issues

Four cross-platform technology issues were proposed for discussion:

1. standardization of drill pipe diameter
2. standardization of coring tools
3. logging tools
4. logging while drilling (LWD) for detection of hydrocarbons

Of these, the drill pipe diameters and logging tools were discussed. The coring tool discussion was deferred until iTAP's joint meeting with iSCIMP and LWD was tabled until the next meeting because of time constraints.

Drill pipe diameter

Dave Huey introduced the topic by presenting the history of the selection of 5" drill pipe in ODP for standardizing on non-riser ships drill pipe at 6-5/8" in IODP (refer to Appendix A). Following a thorough discussion, iTAP prepared a list of the pros and cons for recommending standard pipe diameter.

The pros identified are:

- Potential for larger tools - new & existing
- Stronger/better fishing tools (internal)
- Faster wireline trips and less swabbing
- Higher torque
- Choose now & spend a lot less later
- Easier to apply internal metallic coatings
- Tapered drill string
- Higher annular velocity
- Lower pressure drop

The cons identified are:

- Higher initial cost (pipe, tools, racker)
- Higher storage volume needed
- Pipe may have to be engineered because of corrosion and tensile strength
- Higher pipe weight limitation to larger rigs
- Lower pipe trip speed
- Vortex-induced vibrations (VIV) may be an issue and should be assessed

The panel decided that more information is required for making an informed recommendation. Therefore, the panel made an interim recommendation, as follows:

2003-01. iTAP recommends [that iPC recommends] that the Ocean Drilling Program, through its prime contractor [JOI], subcontract a technical evaluation of the technical, operational, and scientific benefits (e.g. core quality, core volume, tool deployment) and costs of outfitting the JR- replacement to be able to handle up to 6 - 5/8" drillpipe. iTAP will provide the technical workstatement to ODP.

Following the meeting, iTAP members Frank Schuh and Dave Huey prepared a proposed work statement and recommended source.

Logging tools
iTAP discussed the issue of the use of standardized logging tools across all platforms. New technology (e.g. smart drill pipe with data transmission rates of about 2 million bits/sec is available and large advances in memory tools) available from the oil industry is an important aspect to consider in this discussion. Logging is also part of the iSCIMP mandate and members of that panel have begun similar discussions. Because of the strong interest by iTAP in adapting as much of the new technology as possible into IODP operations, the panel agreed that the most prudent approach was to ask a subcommittee of the both panels to discuss and make a recommendation on this topic for discussion at the next meetings of both full panels. iTAP agreed on the following consensus:

Considering the rapidly changing technology and the re-structuring of the logging industry that includes many more supply companies and technologies such as "smart pipe" and memory tools, a review of these technologies and their applications to IODP is essential. A subcommittee of iTAP and iSCIMP will review these technologies and develop a series of options for the acquisition of these data in IODP. These options will be reviewed jointly by iSCIMP and iTAP. Members: Buecker (+ two other iSCIMP members), Kamata, Arai, Gearhart (guest), Becker (guest).

Borehole Stability and Temperature
Vincent Maury summarized temperature and stress-related change from "passive" drilling to "active" drilling. Boreholes fail in shear under a number of rupture modes, including another along existing fractures. Temperature effects (heating and cooling) change the state of stress around boreholes as they are drilled; the bottom of the hole is cooled (more stable) while the upper part is heated (less stable) which can affect borehole stability. Some failure modes observed in ODP cannot be easily explained, and therefore remedies are difficult to prescribe. A borehole simulator (model) is needed to predict temperature and stress during drilling. For planning boreholes in IODP, it is important to back analyze past drilling incidents. Following this informative presentation, iTAP discussed the issue of stability and agreed that analysis of the ODP history is important for reducing borehole stability problems in IODP.

2003-02. iTAP recommends that a hole problem risk mitigation plan be developed for every scheduled program. The plan should include near-real time analyses during the drilling program that uses real-time drilling parameters. These parameters should also be captured into the IODP data base to be used to improve future drilling plans.

2003-03. iTAP recommends that [iPC recommends] that the Ocean Drilling Program incorporate an evaluation of the termination of each borehole as part of the ongoing legacy documentation of the ODP. iTAP will define the scope of this evaluation so that the information can be used to prepare for the technical challenges in IODP.

Complex Drilling Programs (CDPs)

Ted Moore introduced the topic of CDPs to iTAP. He explained that riser drilling projects may be many months long, therefore multiple legs more than one platform may be needed. Therefore there is a need for assistance in the detailed planning of these projects. This introduction was followed by presentations from the two lead proponents of the existing CDPs that are in review in IODP, Harold Tobin [Nantroseize] and Roland von Huene [CRISP]. These proponents attended iTAP to get advice from the panel on technical issues that they could subsequently use for planning purposes. Their presentations to iTAP were valuable because they provided real examples for iTAP to discuss the approaches and needs for planning these types of expeditions in IODP.

The technical issues of Nantroseize are as follows:

- The ultimate drilling target is the seismogenic zone of eastern Japan to ca. 6 km below seafloor in 3 km of water.
- Work has already been done in riserless drilling mode in DSDP and ODP.
- The program will also need to install observatories that will measure parameters within deep and intermediate depth zones.
- The proponents are currently planning the program in three phases:
    1. Drilling to sample the accretionary prism to study the sediment input into the subduction zone.
    2. Drilling to and through splay faults.
    3. Drilling to and through the seismogenic zone.
- LWD/MWD at elevated temperature will be needed [[temperature estimates are > 100^{o}C].
- Downhole testing includes stress, pore pressure, velocity, fluid sampling, and long term monitoring of some of these parameters.
- Overpressures are likely present.
- Fractured sedimentary rocks will be encountered.
- The Kuroshio Current is a concern because of VIV.

The technical issues of CRISP [Costa Rica] are as follows:

- Similar conditions and science targets as Nankai, with the exception that the target seismogenic zone is at 5 km below seafloor in 500 m of water.
- There are no known current problems in the area.
- The anticipated rock-types that would be encountered are not well known.

iTAP discussed the CDPs in terms of two separate aspects: (1) the best approach for IODP to plan and implement these types of programs; and (2) advice to the proponent groups.

IODP approach for undertaking CDPs

John Thorogood led the discussion by first presenting industry's approach for planning and implementing deep water exploration programs. Others attending the meeting from the oil industry (e.g., Harry Doust~~,~~ Yoshi Kawamura) agreed that this approach is broadly used and accepted among major companies in the oil patch. John led the discussion and iTAP agreed that the integration of a structured project management approach into IODP is essential. The approach that industry follows is one that incorporates several formal, distinct steps that flow from one to another after formal review (gates) at each step. These steps are: appraise > select > define > execute > operate. In the ODP system, because of the simplicity with a single-purpose platform, the middle 3 steps were skipped.

Therefore, the panel recommended the following:

2003-04. iTAP recommends the formation of an IODP Working Group that will develop a project based management planning system. The system will be similar to those used by the petroleum exploration industry. It will conform to the management structure of IODP

and considers the need for efficient passage of proposals from proposed project scientific review to execution and completion of the drilling project. This Project Management Working Group would be charged with developing the project management system by June 2003.

Membership of this group would include: iTAP, iILP, industry project manager(s), iSSEPs, iPC and/or Science Planning Committee, and an OPCOM working group representative.

Advice to proponents
The panel discussed the technical issues for both Nantroseize and CRISP. The general view form iTAP is that the proponents should focus on the science objectives, rather than work on the technical needs. Although challenging, the technology for tackling these programs is available and the most crucial issue is the need to begin project planning to meet these challenges. With this in mind, the panel discussed and agreed on the following recommendation:

2003-05. iTAP recommends the formation of a Detailed Planning Group (aka Project Scoping Group) to begin the scoping process for Complex Drilling Programs that are currently planned to address seismogenic zone objectives, as an interim measure. The scoping process includes project description (based on the existing proposals in the system), risk analyses, preliminary cost estimates, and project planning.

This group would have the following membership:

- proponent representative(s)
- CDEX representative
- project management advisor
- risk identification specialist
- well engineer

The panel also provided the following **advice to proponent groups** who are planning challenging programs:

- Begin developing list of specifications (e.g., measurements and coring/sample requirements that need to be made (depth, location, resolution, temperature and dynamic range, measurement life)) and collaborate on development of this list - also complete iSCIMP's new cover sheet measurement list
- Select sites based on science objectives
- Please do not identify the type of drilling vessel or drilling methods
- Provide proposals early to the DPG
- Where appropriate, develop technical/operational options based on the science objectives

<u>Joint Panel Meeting</u>
The iTAP and iILP co-chairs presented each of their mandates and their approaches for meeting these mandates to the joint panels. Following this introduction, the panels were presented with a quick overview of Nantroseize to open a discussion on CDPs. The joint panels agreed with the project planning approach presented by John Thorogood (recommendation 2003-04).

Christian Bueker presented a report on iSCIMP/iTAP liaison and joint meetings. His report included the following:

- 2nd meeting of iSCIMP was in Calgary Dec 2002
- recommended there be a database operator – comprehensive database
- recommended there be an ad hoc database working group established immediately
- recommended that SAS include an OPCOM to identify the appropriate platform for the drilling projects and to schedule the 3 platforms

- recommended continued investigation of standardization of drillpipe size since there are potential benefits from doing so
- recommended continued development of anti-contamination drilling (anti-contamination of sample)
- recommended that the link with the iSSEPs be formalized
- joint meeting with iTAP to be in July 2003

An open discussion followed and the panels agreed that it will be important to define how best to extract technical needs from proposals for both iSCIMP and iTAP. Two approaches were suggested: passive, where technology needs are identified in submitted proposals, and active, where we look down the road and develop new technology based on what we see independent of submitted proposals. It may be important to engage both approaches and that the passive approach needs to be carefully done to ensure that there is no influence on the evaluation of proposals, while at the same time, there needs to be an open dialog with proponents to make them aware of the available technology. It was also agreed that continued discussions on standardization are important.

iILP and iTAP liaison needs were discussed and it was agreed that each panel meeting will have 1-2 representatives from the other panel. The representatives will be determined on a meeting by meeting basis depending on logistics and who is most appropriate and available to attend.

A question arose regarding how new technological developments from industry can be brought back to IODP: iTAP or iILP function? It was agreed that this could happen through both panels to ensure continued exchange of ideas between science and industry

<u>Discussion of Technical Challenges</u>
iTAP began the discussions of the technical challenges within IODP that are based on the proposed research set out in the Initial Science Plan. This discussion is the beginning of the process whereby the panel will identify and make recommendations on the highest priority technology development needs and the best approach to achieve these.

Climate history

- improved sampling tools are needed
- methods for reducing the number of holes required to achieve a continuous stratigraphic section are needed
- improved sampling for hard/soft sequences is essential

Gas hydrates

- IODP challenges include sampling at in situ conditions of pressure and temperature
- Tools for sampling at in situ conditions for pressure have seen successful in ODP and JAPEX
- Maintaining temperature conditions remains a challenge, but was found not to be an important requirement for the Nankai drilling by JAPEX – more work is required to maintain sample temperature

Hydrogeology
In ODP, a PPG was formed on this topic. The PPG identified technologies needed for successfully addressing hydrogeological science goals that include:

- expanded/improved packer
- shipboard low flow pumps
- better downhole water sampling
- enhance fluid recovery from pressure core samplers
- improved temperature tools
- new apparatus for measuring electrical conductivity on board

Zero-age crust
A lack of sediment cover at spreading centers creates a situation that seriously restricts our ability to initiate a borehole. In ODP, a special guidebase was designed to pilot the bit – so initiating a hole is no longer a challenge. However, below the surface, the basalt is brittle and highly unstable, and porous. The drilling situation is analogous to trying to drill into a pile of broken glass. The hammer drill system has some the potential for shallow penetration, but deeper penetration remains a challenge.

iTAP plans to continue discussion of these challenges at the next meeting.

Next meeting [confirmed after the meeting closed]: July 14-16 2003, Graduate School of Oceanography, University of Rhode Island.

<u>iTAP Members</u>
Yusei Arai (Japan)
Dave Huey (US)
Masahiro Kamata (Japan)
Yoshihiro Masuda (Japan; Co-chair)
Vincent Maury (France)
Kate Moran (US; Co-chair)
Frank Schuh (US)
Alister Skinner (UK)
Axel Sperber (Germany)
Sigmund Stokka (Norway)
Brian Taylor (Canada)

<u>iTAP Liaisons</u>
Christian Buecker (iSCIMP)
Shinichi Takagawa (JAMSTEC)
Yoshiro Kawamura (CDEX)
Ted Moore (iPC)
Jimmy Kinoshita (iPC)
Jeff Schuffert (iSAS Office)

<u>ITAP Guests</u>
iILP Members
Keir Becker (ODP SCICOM Chair)
Robert Bruce (iPPSP)
Steve Bohlen (JOI)
Luke Matthews (JOI)
Harold Tobin (IODP proponent)
Roland von Huene (IODP proponent)
John Thorogood (BP/IADC/SPE)
Jeroen Kenter (Meeting Host)
Jamie Allan (NSF)
Marvin Gearhart (IADC/SPE)
Jack Germaine (MIT)
Brett Chandler (Grant Prideco)

APPENDIX A

Commentary: The Argument for 6-5/8-inch Drillpipe as the Standard for IODP

----- DRAFT ----- Submitted to iTAP Panel **----- DRAFT -----**

Amsterdam Meeting, Feb. 21, 2003

D. P. Huey, iTAP Member

INTRODUCTION

During the Deep Sea Drilling Project and the Ocean Drilling Program the drillstrings used for all drilling and coring operations were based on 5-inch (and 5-1/2-inch) S-135/140 drillpipe with a nominal 4-inch diameter thru-bore. This selection was based on state-of-the-art drillpipe and metallurgical development conducted for Project Mohole in the early 1960's. In the intervening 40-50 years oilfield tubular development has progressed, drillpipe metallurgy has been advanced, commercial drillpipe production capabilities have been expanded, and improved drillpipe rotary shouldered connections have been designed and proven.

In many deepwater and deep hole drilling applications worldwide 6-5/8-inch drillpipe has been selected and proved to be superior to 5-inch/5-1/2-inch strings when large inside bores or high tensile capacities are important. The larger 6-5/8-inch pipe has been selected by Japex for use with deepwater pressure coring operations, and by Russian designers for their revolutionary aluminum drillstring, through which the novel coring tools from *Aquatic* can be deployed.

Now is the time for IODP to consider selection of 6-5/8-inch drillpipe as the "standard" drillstring for future deepwater scientific drilling as well as for the American riserless drillship (yet to be selected). Whether or not the European Multi-Platform program could benefit from 6-5/8-inch drillpipe is not clear. It would likely depend on the specific platform selected for any given operation. In some cases, when using smaller drilling platforms, even 5-inch pipe may be too large to handle.

6-5/8-inch DRILLPIPE TECHNOLOGY

For scientific drilling, coring, sampling, and logging operations the largest pass-thru diameter that is practical is preferred to enable the use of larger diameter coring tools (and, therefore, larger diameter cores), more types of coring tools (custom and commercially available), and larger diameter logging tools. The following facts support the selection of 6-5/8-inch drillpipe to best accomplish those objectives:

- 6-5/8-inch drillpipe is used in today's large-scale drillpipe as 5 or 5-1/2-inch pipe.
- With conventional API rotary-shouldered connections (e.g., API 6-5/8 IF) 6-5/8-inch pipe can have pass-thru diameters (in the pin connection) of 5.75-inches, or more.
- Newer-design, double shouldered, high-torque connections have been designed for 6-5/8-inch drill pipe that offer potentially larger I.D. bores, greater fatigue life, and less O.D. upset.
- Commercially available 6-5/8-inch drill pipe can be purchased made with 150 and 160 ksi yield strength material. (As compared to S-135 and S-140 in DSDP and ODP drillstrings)
- The oil industry equipment suppliers already fully support 6-5/8-inch drillpipe as a standard with ancillary equipment (elevators, tong jaws, handling tools, etc).
- There is no fundamental difference in maximum practical drillstring length for 5-inch, 5-1/2-inch, or 6-5/8-inch drillpipe. Maximum length strings can be designed by "tapering", i.e. for 6-5/8-inch pipe the upper 10-15% of the string might have a thicker wall than the lower section of the string.
- 6-5/8-inch drill pipe would be easier to coat internally with spray-on, anti-corrosion coating (Zn-based, or other metallic anti-corrosion systems).
- A proposed 6-5/8-inch drillstring has already been designed for the *Chikyu*, although not initially selected as the initial drillstring for OD21.
- The Japex 6-5/8-inch drillstring will (very likely) be adapted for use aboard the *JOIDES Resolution* for coring operations conducted by JNOC offshore Japan early in 2004 as part of the Japanese MH21program. The necessary conversions to the *JOIDES Resolution* pipe racker system have already been preliminarily designed.

SCIENTIFIC BENEFITS TO IODP with 6-5/8-inch DRILLPIPE

- <u>Larger cores possible using wireline-retrievable coring tools</u>.

  Figure 1 illustrates one possible set of dimensions for standard wireline cores if a 6-5/8-inch drillstring is used with a 5.75-inch minimum pass-thru diameter at the pin connections. The core diameter shown is based on reasonable up-scaling of the standard ODP coring tools. These numbers are conservative estimates – even larger cores may be possible.

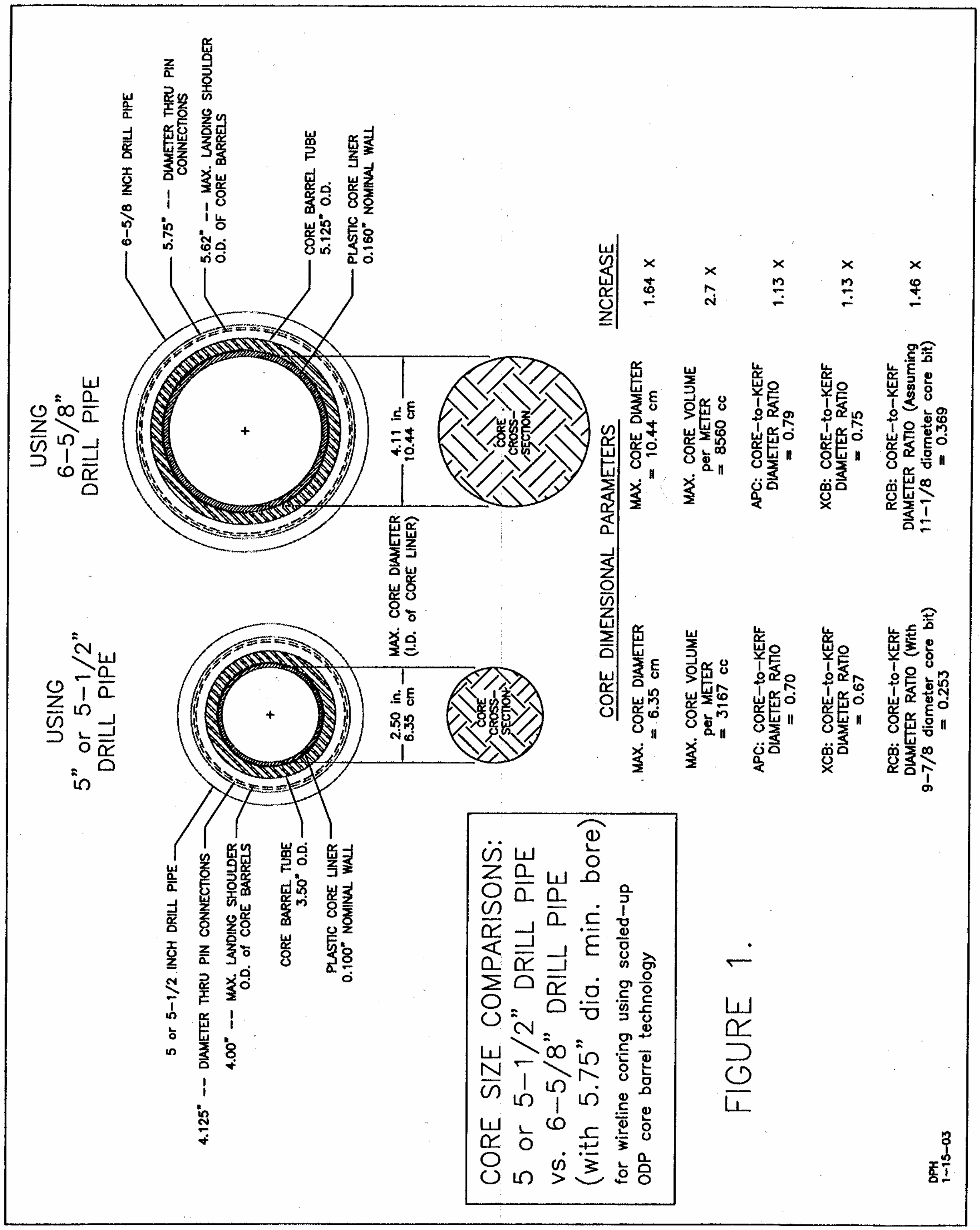
USING 5" or 5-1/2" DRILL PIPE
USING 6-5/8" DRILL PIPE
5 or 5-1/2 INCH DRILL PIPE
4.125" -- DIAMETER THRU PIN CONNECTIONS
4.00" -- MAX. LANDING SHOULDER O.D. of CORE BARRELS
CORE BARREL TUBE 3.50" O.D.
PLASTIC CORE LINER 0.100" NOMINAL WALL
6-5/8 INCH DRILL PIPE
5.75" -- DIAMETER THRU PIN CONNECTIONS
5.62" -- MAX. LANDING SHOULDER O.D. OF CORE BARRELS
CORE BARREL TUBE 5.125" O.D.
PLASTIC CORE LINER 0.160" NOMINAL WALL
2.50 in. 6.35 cm
MAX. CORE DIAMETER (I.D. of CORE LINER)
4.11 in. 10.44 cm
CORE CROSS-SECTION
CORE DIMENSIONAL PARAMETERS
INCREASE
MAX. CORE DIAMETER = 6.35 cm
MAX. CORE DIAMETER = 10.44 cm
1.64 X
MAX. CORE VOLUME per METER = 3167 cc
MAX. CORE VOLUME per METER = 8560 cc
2.7 X
APC: CORE-to-KERF DIAMETER RATIO = 0.70
APC: CORE-to-KERF DIAMETER RATIO = 0.79
1.13 X
XCB: CORE-to-KERF DIAMETER RATIO = 0.67
XCB: CORE-to-KERF DIAMETER RATIO = 0.75
1.13 X
RCB: CORE-to-KERF DIAMETER RATIO (With 9-7/8 diameter core bit) = 0.253
RCB: CORE-to-KERF DIAMETER RATIO (Assuming 11-1/8 diameter core bit) = 0.369
1.46 X
CORE SIZE COMPARISONS:
5 or 5-1/2" DRILL PIPE
vs. 6-5/8" DRILL PIPE
(with 5.75" dia. min. bore)
for wireline coring using scaled-up
ODP core barrel technology
DPH
1-15-03

FIGURE 1.

- More types of wireline-retrievable coring tools already in existence could be used.

  Both the Japex/Aumann pressure-temperature controlled coring tool and the Russian *Aquatic* suite of novel coring tools were designed to be used with 6-5/8-inch drillpipe.

  - Wireline coring tools of the future will have a larger diameter design envelope

  Important coring tool features are virtually always controlled by the annular space available between the desired core O.D. and the minimum pass-thru I.D. of the drillstring. Increased annular space inherent to 6-5/8-inch pipe would mean more room for: larger ball valves, more reliable and stronger core catchers, electronics and motor-operators for downhole core barrel functions, stronger core barrel threaded connections (leading to less broken core barrels, higher overpull allowances, less core barrel wear and tear).

  - Larger diameter logging tools can be used (both commercially available and custom-designed)

  - Larger diameter downhole instruments can be deployed

  Larger instruments can be set in boreholes by thru-the-pipe deployment methods without requiring seafloor structures and re-entry operations. This is both significantly faster and more foolproof than operations requiring re-entry into a borehole in deep water.

  - Larger and stronger wireline-deployed fishing tools can be used

  High-investment boreholes or jammed BHAs can often be saved when junked with lost core barrel or logging tool parts by thru-the-pipe fishing techniques, saving significant ship operations time. Larger diameter fishing tools are stronger and more versatile.

  - Existing coring and logging tools from ODP could still be used with a 6-5/8-inch drillstring

  Not only would the existing ODP coring tools and commonly used logging tools be compatible with a 6-5/8-inch drillstring, but they would be easier to deploy and retrieve at high speeds with less swabbing problems.

  - Borehole diameters during coring operations would not necessarily have to be any larger than current ODP standards.

  ODP coring with APC, XCB, PCS and MDCB coring tools already use an 11-7/16-inch diameter core bit when roller cones bits are used. A 6-5/8-inch drillstring would have connections with an O.D. of only about 8.5 to 8.75 inches. Use of PDC cutting structures in ODP or IODP coring operations allow for smaller core bits with diameters determined by BHA (drill collar) diameters, not core barrel diameters.

  - Downhole motors with thru-bores for wireline coring might be feasible

  Positive displacement mud motors with holes through the rotor section large enough for the passage of ODP standard wireline coring tools was never achieved during ODP despite engineering development efforts to design one. With 6-5/8-inch drillpipe this concept might prove practical opening up the possibilities of high-speed diamond drilling/coring, directional drilling, etc.

TECHNOLOGICAL, SCIENTIFIC, ECONOMIC and "POLITICAL" CHALLENGES

- DRILLING SYSTEM UPGRADE REQUIREMENTS
  Both the *Chikyu* and the soon-to-be-designated American riserless drillship would require certain drilling system upgrades to accommodate 9000-10,000m drillstrings of 6-5/8-inch drillpipe. For *Chikyu* these upgrades would be either redesigns, or retrofits, depending on the current progress of outfitting on the Japanese ship. For the new American ship the upgrades would simply be enhanced specifications for the ship conversion to riserless scientific drilling duties. The following upgrade requirements would be necessary:
  - → Drillstring design specifications. The specifications of the 6-5/8-inch drillstring itself would have to be design-optimized for IODP standard operations, including connections (type, bending strength, fatigue resistance, and maximum pass-thru diameter at the pin), tubular wall thicknesses, pipe material, string tapering (if necessary), total drillstring strength, overpull capacity optimization, maximum depth determination, etc. Drillpipe bending through the upper flex joint on the *Chikyu* would have to be examined and a flex joint chosen to minimize bending stresses during riser operations.
  - → Rig hoisting system. The hoisting system of the rig would have to be upgraded to handle the increased weight of the larger diameter drillstring. 6-5/8-inch drillpipe is about 25-35% heavier per foot than 5-inch or 5-1/2-inch pipe. More total load capacity would be required for derrick, drawworks, top drive, drillstring heave compensator, traveling block line, etc.
  - → Top drive redesign. The top drive for the 6-5/8-inch drillstring would need to be enlarged (most likely in custom design) to provide a nominal 6-inch pass-thru diameter from the oil saver to the drill stem and saver sub.
  - → Drill pipe racker system. The pipe racker would have to be enlarged to have capacity for the required length of 6-5/8-inch drillpipe.
  - → Drill pipe handling tools. Larger elevators, lift subs, slips, tongs, and other pipe handling tools would have to be acquired to operate with the 6-5/8-inch pipe.
  - → New "Knobby" drilling joints for fatigue resistance would have to be designed and fabricated
  - → Guidehorn radius. The bending radius of the guidehorn under the dill floor on the *Chikyu* and American drillship would have to be optimized for 6-5/8-inch drillpipe and its connections. It is possible that the guidehorn already designed for the *Chikyu* (larger radius than the *JOIDES Resolution* guidehorn) would prove to be suitable for 6-5/8-inch drillpipe deployed to 9000-10,000m, but the bending strength question would have to be re-examined.
  - → Ancillary drillstring elements. A full set of drillstring secondary components mated to the 6-5/8-inch drillstring would have to be designed and supplied to both drillships, including: pup joints, crossover subs, bumper subs, drilling jars, drill collars, etc.

- SCIENCE SYSTEM UPGRADE REQUIREMENTS
  - → Core Liners. Larger diameter cores require larger diameter core liners, larger D-tubes or other core storage devices, and larger core handling and cutting systems. More core storage space onboard the ships might be necessary. It might not be feasible to man-handle full length cores from rig floor to core

receiving stations, so core liner hoisting and transport systems on the ship might have to be added or upgraded.

→ Core lab upgrades. Core liner diameter is inherent in the design of many core lab instruments and tools including: cryogenic magnetometer, gamma ray porosity evaluator, and other instruments that measure core properties while still in a whole or split liner. Less significant modifications would be required to photo tables, core sampling devices, core splitters, etc.

- ECONOMIC INCREASE REQUIREMENTS
  - → A drillstring design optimization engineering effort will be required to set specifications of 6-5/8-inch drillstrings for the American drillship.
  - → The cost of 6-5/8-inch drillpipe is greater than 5-inch or 5-1/2-inch drillpipe approximately in proportion to its increased weight per foot (about 30-40% more expensive).
  - → Larger capacity hoisting equipment (derrick, drawworks, top drive, heave compensator, etc) will be more expensive than similar components designed for 5-inch drillstring service.
  - → Retrofit requirements to *Chikyu* (if any) to accommodate 6-5/8-inch drillpipe will have a cost impact.

- CHALLENGES

  This is essentially the only time in the foreseeable future of international scientific ocean drilling when it will be possible to incorporate these improvements to the drillstring specifications and achieve the benefits of larger cores, larger tools, etc.

  If the *Chikyu* remains designed for 5-inch and 5-1/2-inch drillpipe and the new American drillship is specified for the same drillstring, and both ships begin scientific operations with that standard, the chances of a future retrofit to larger diameter drillpipe are extremely slim for reasons of cost, program disruption, and plain old organizational inertia. It is probably now or never in our lifetimes.

  iTAP may be the only entity extant within the IODP hierarchy that can orchestrate the change of drillstring standard size.