Science and Technology "*Chikyu*" Expeditions

ECORD Industry Liaison Panel Meeting

Edinburgh, Scotland

11-12 June 2014

Nobu Eguchi

Japan Agency for Marine-Earth Science and Technology
Center for Deep Earth Exploration

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JAMSTEC Headquarters and Branches

Mutsu Institute for Oceanography

Tokyo Office

Yokohama Institute for Earth Sciences

Global Oceanographic Data Center

Kochi Core Center

Yokosuka Headquarters

Established in 1971

JAMSTEC Mission
Vision for the next 15 years

An Integrated Understanding
and Prediction of
Global Environmental Changes

An Advanced Understanding
of the Earth's Interior, and
Mitigation of Earthquake and
Tsunami Disasters

Fundamental Research and Development about Oceans

Improvement of the level of Marine Science and Technology

**An Integrated Understanding of
the Ocean, Earth, and Life**

A Comprehensive Study of
the Evolution of Life
and
the History of the Earth

A New Approach to
Resources Research
include
Biological

JAMSTEC Executives, Personnel and Budget

Executives

President

Dr. Asahiko Taira

Auditor

Mr. Yasushi Taya

Dr. Yuko Maeda

Executive Director

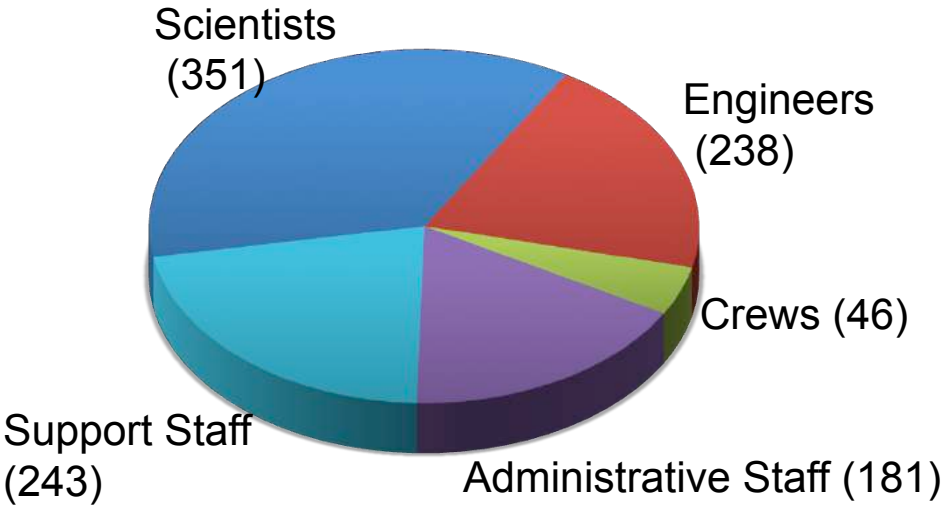
Dr. Yoshihisa Shirayama

Dr. Hitoshi Hotta

Mr. Hisashi Dobashi

Personnel

Total：1,059 employees



As of April 1, 2014

FY14 Budget

Total Budget: ¥38.0B （$380M) ($1= ¥ 100)

(national treasury disbursement ： ¥ 34.2B ($342M)

JAMSTEC Outline

Japan Agency for Marine-Earth Science and Technology

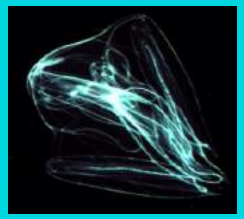
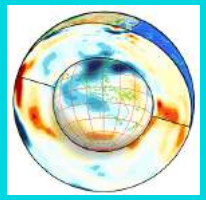
Kochi Institute for Core Sample Research	Mutsu Institute for Oceanography	Yokohama Institute for Earth Sciences	Headquarters
			

We contribute to integrated understanding of the Earth's system with the world's top-class facilities.

Research Sector

Basic Research Area

Strategic Research and Development Area


Research Support Departments

- **Kochi Institute for Core Sample Research (KOCHI)**
- **Mutsu Institute for Oceanography (MIO)**

Development and Operation Sector

Manned Submersible

Three Latest AUVs

Deep-sea Drilling Vessel

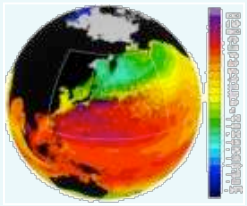
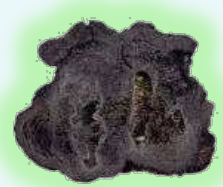
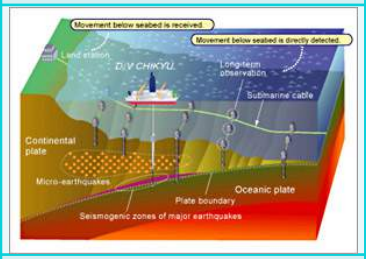
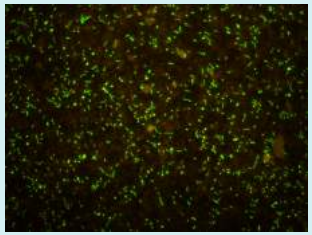
Earth Simulator

JAMSTEC

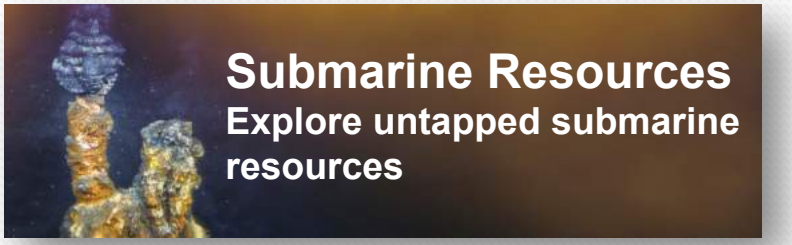
Basic Research Area

- Dept. of Coupled Ocean-Atmosphere-Land Processes Research
- Dept. of Environmental Geochemical Cycle Research
- Dept. of Integrated Climate Change Projection Research
- Dept. of Seamless Environmental Prediction Research
- Dept. of Deep Earth Structure and Dynamics Research
- Dept. of Solid Earth Geochemistry
- Dept. of Marine Biodiversity Research
- Dept. of Subsurface Geobiological Analysis and Research
- Dept. of Biogeochemistry
- Dept. of Mathematical Science and Advanced Technology
- Laboratory of Ocean-Earth Life Evolution Research

Strategic R&D Area

R&D Center for Global Change		R&D Center for Submarine Resources	
R&D Center for Ocean Drilling Science		Application Laboratory	
R&D Center for Earthquake and Tsunami		Project Team for Risk Information on Climate Change	
R&D Center for Marine Biosciences		Project Team for Analyses of Changes in East Japan Marine Ecosystems	

Focused R&D Areas 2014-2018



Submarine Resources
Explore untapped submarine resources

Ocean drilling science
Understand the Earth from beneath the seabed

Ocean and Global Climate Change
Detect signals of global environmental change

Synthetic information science
Predict the Earth's future by simulations

Seismogenic Zone
Contribute to disaster mitigation

Construction of research base
Be the ocean pioneer

Marine Bioscience
Quest for the origin of life on Earth

Vessels

GT: Gross tonnage

R/V *NATSUSIMA*

GT 1,739 t

Various observations with ROV

R/V *KAIYO*

GT 3,350 t

SWATH-type vessel
with large workspace

R/V *HAKUHOMARU*

GT 3,991 t

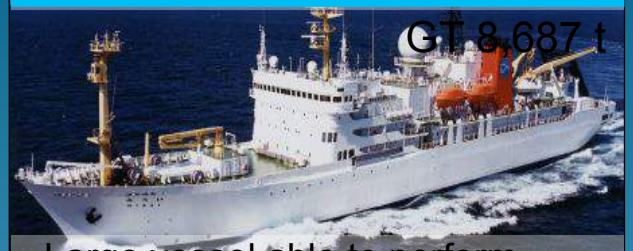
Multipurpose research vessel
with long-term cruise

R/V *YOKOSUKA*

GT 4,439 t

Support vessel for
"SHINKAI6500"

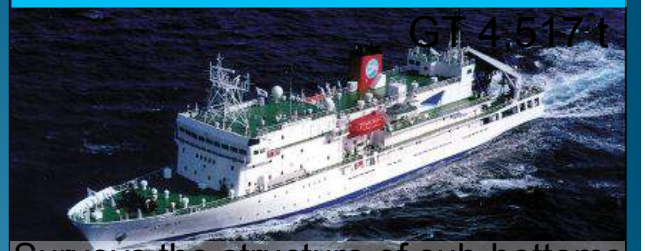
R/V *MIRAI*



GT 8,687 t

Large vessel able to perform
observation over wide areas

R/V *KAIREI*



GT 4,517 t

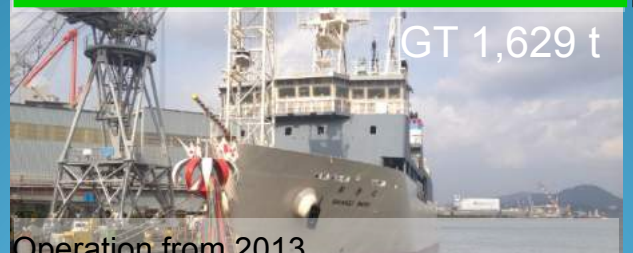
Surveys the structure of sub-bottoms
mainly with MCS

D/V *CHIKYU*

GT 56,752 t

Drilling vessel with world-class
scientific drilling capacity

R/V *SHINSEIMARU*



GT 1,629 t

Operation from 2013
Multipurpose R/V focusing on
the survey off the coast of Tohoku region

R/V (under planning)

GT 5,000 t
(approx.)

Planned to be operated from 2016
Aims to survey for submarine resources

Manned/Unmanned Underwater Vehicles

Deep Submergence Vehicle **Shinkai6500**

World-class manned submersible

Shinkai2000（Retired）

Japan's first full-fledged manned submersible for deep-sea research

AUV URASHIMA

Large AUV capable of long-distance dives

AUV YUMEIRUKA

High-performance motion control advanced acoustic observatory

AUV JINBEI

High cruising capability
Equipped with chemical sensors

AUV OTOHIME

Working AUV equipped with manipulators

ROV HYPER-DOLPHIN

Operation with high-sensitivity camera and manipulators

ROV KAIKO 7000 II

Capable of diving up to a maximum depth of 7,000 m

ROV under construction

ROV for heavy-duty work
To be launched in 2013

CDEX New Organization Chart

(after April 1st., 2014)

Director General
(Kuramoto)

Senior Adviser
(Yamao)
For Operation

Senior Adviser
(Kobayashi)
For HSE and Contract

Planning & Coordination Dpt.
(Kikuta)

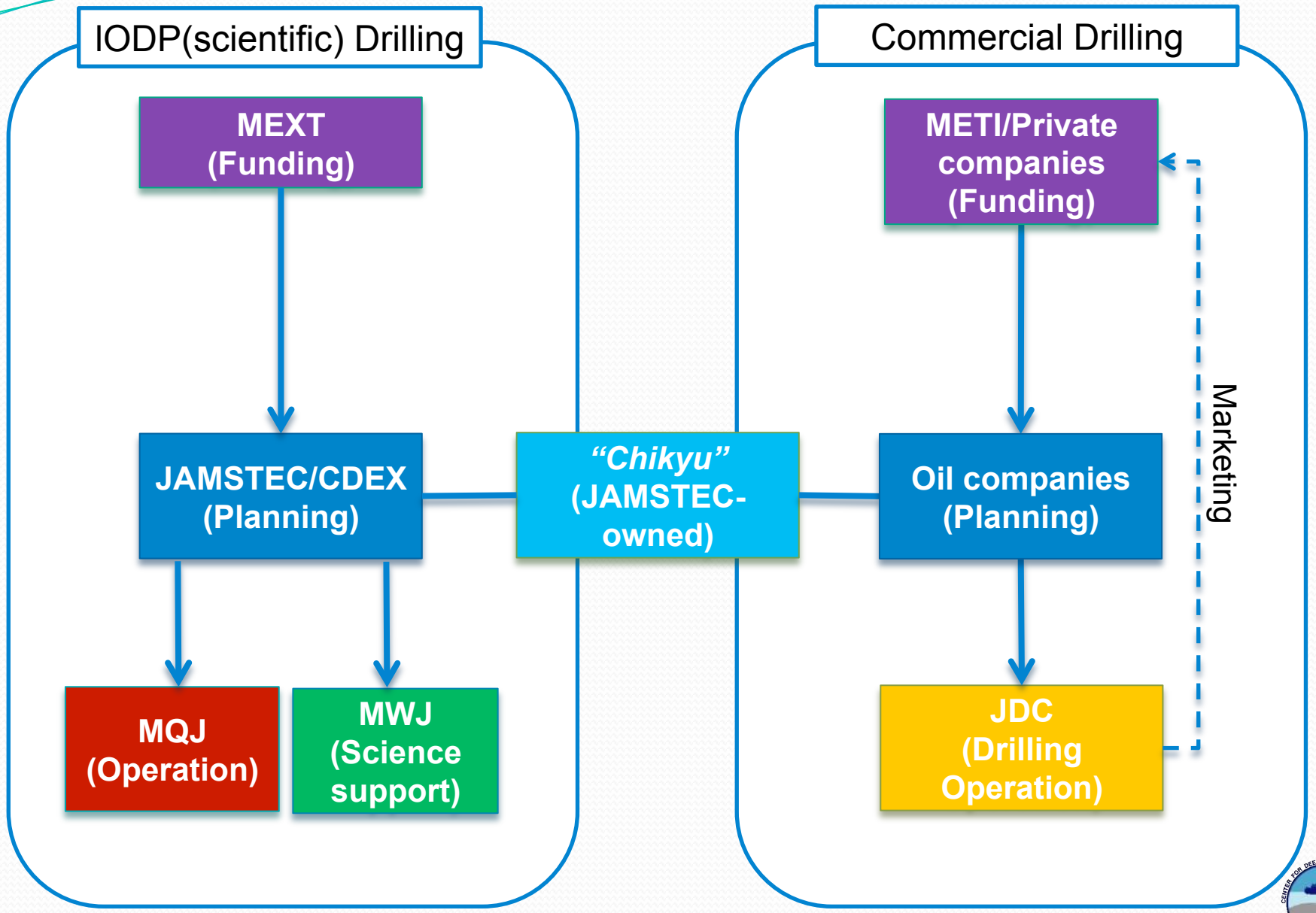
Science Services Dpt.
(Eguchi)

Engineering Dpt.
(Kyo)

Operation Dpt.
(Sawada)

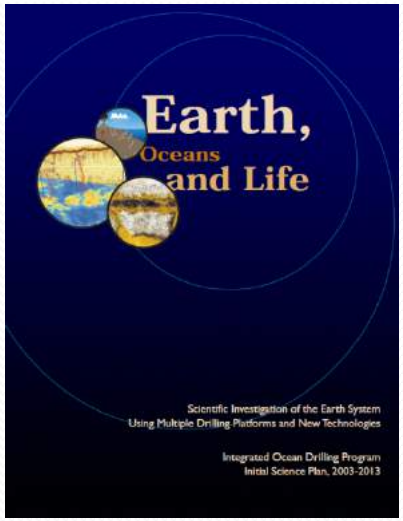
HSE G.

"Chikyu" operation structure

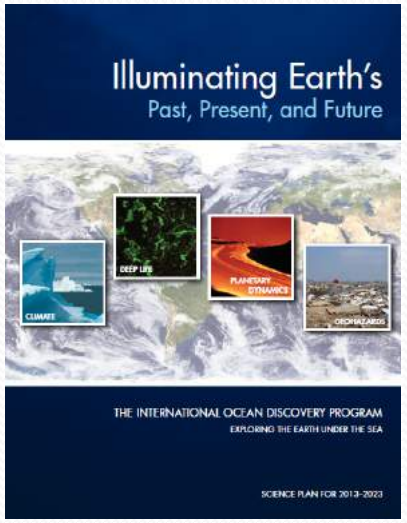


IODP Science Plans

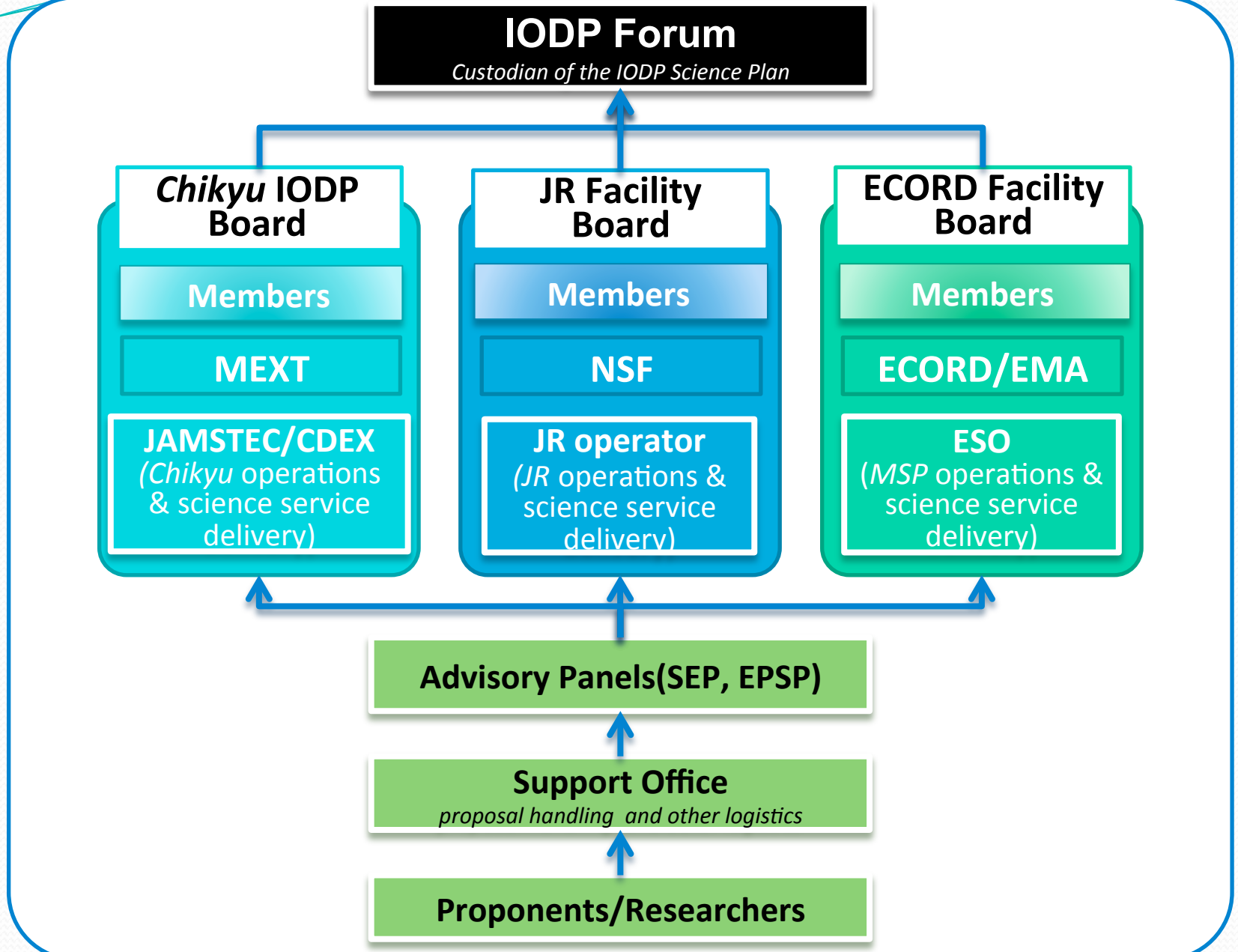
- **IODP: Integrated Ocean Drilling Program**
  - FY2003 – 2013 (2004 – 2013)
  - Initial Science Plan: “Earth, Oceans and Life”
    - Scientific Investigation of the Earth System Using Multiple Drilling Platforms and New Technologies



- **IODP: International Ocean Discovery Program**
  - FY2013 – 2023 (2014 – 2023)
  - Science Plan: “Illuminating Earth’s Past, Present and Future”
    - Exploring the Earth under the Sea



IODP Framework



Facts & FAQ

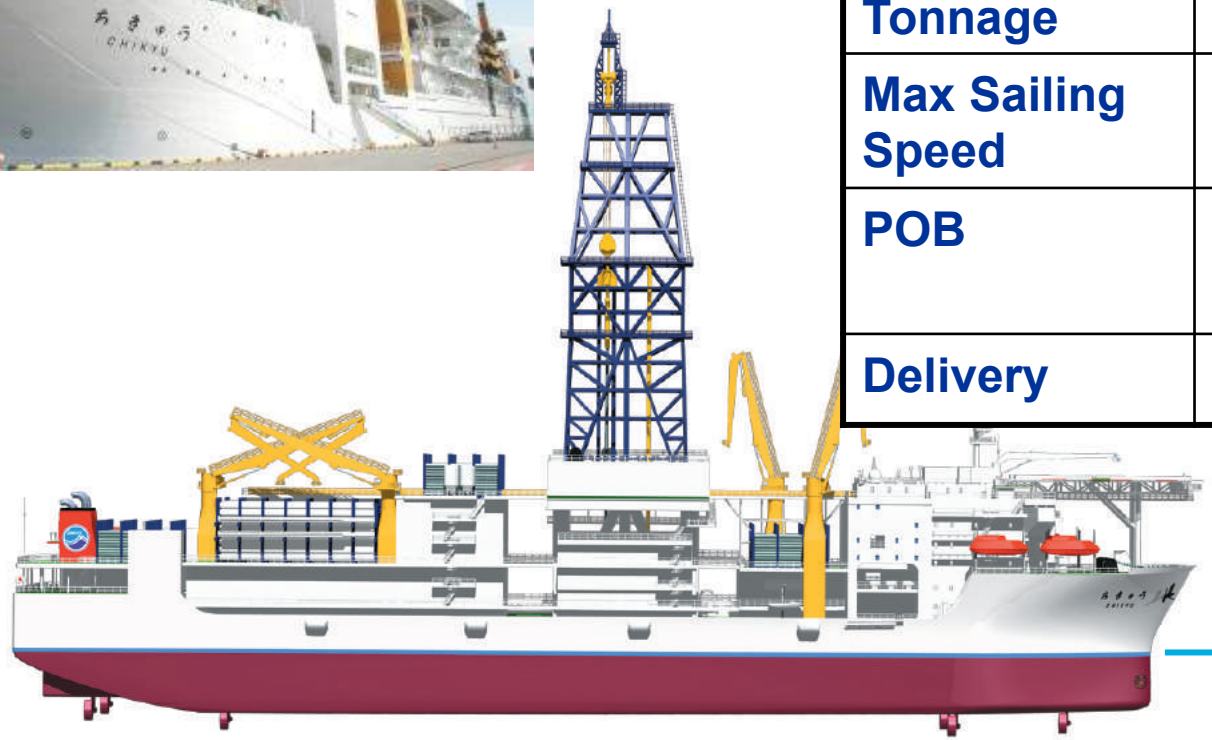
- **Chikyu** funding situation for **IODP**:
  - **MEXT** provides 80MUSD/year
  - In new **IODP**, **Chikyu program** member contribution
    - Regular member: 1MUSD/year (EOCRD is a member)
    - Partnership member: 300K/year (ANZIC)
    - Project member: over 10MUSD/project
  - **CPP** (Complementally Project Proposal): 70% of total operation cost

Facts & FAQ cont.

- **Chikyu** Cost:
  - For **IODP** & Research operation:
    - Transition: mobilization/demobilization: 300KUSD/day
    - Riser Drilling operation: 600~650KUSD/day (include planning & all services)
    - Riserless Drilling operation: 400KUSD/day (include planning & all services)
  - For **Commercial Operation** (Oil & Gus Business):
    - Marketing price: charter cost (500K/day include company profit)

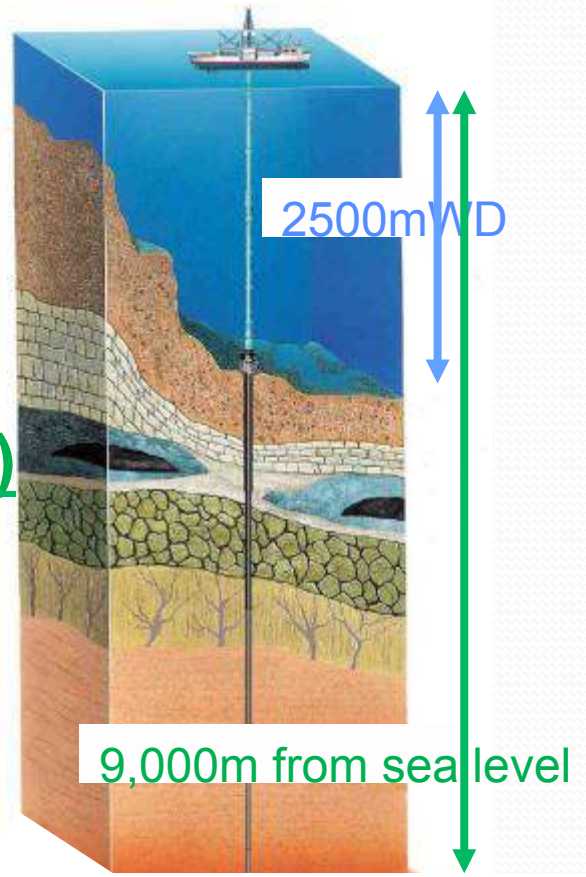
Scientific Drilling Vessel *"Chikyu"*
5th Generation Drill Ship

Length	210 m
Width	38 m
Draft	9.2 m
Height	121 m
Tonnage	57,000 t
Max Sailing Speed	10 knots
POB	200 persons (50 Science Berth)
Delivery	29th July 2005

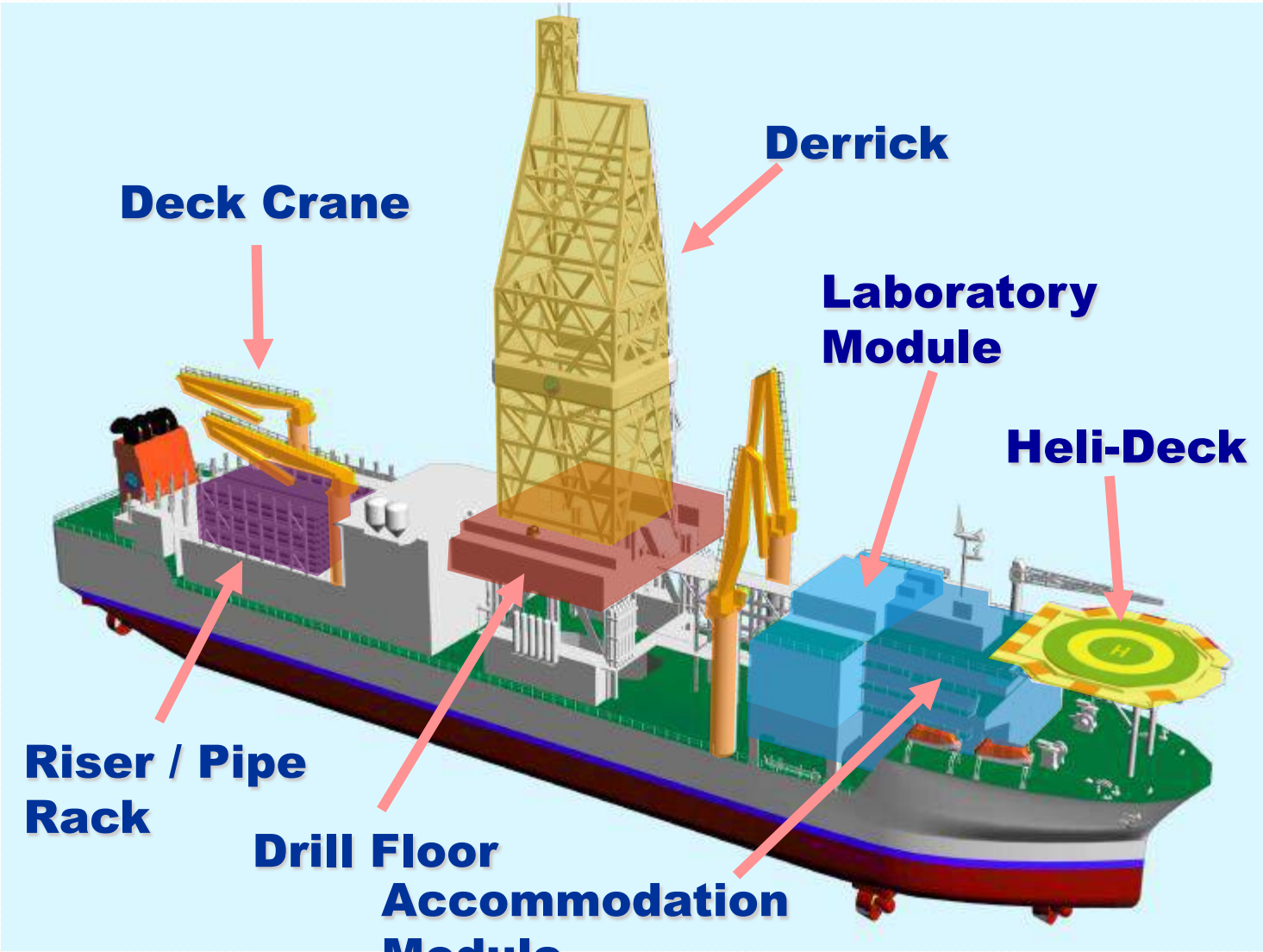


Present Drilling Capability

- **Water Depth (Riser Operation)**
  - Riser Drilling Max Water Depth (2500mWD)
    - Deepest Riser Drilling:
      - Kenya 2200mWD
- **Total Depth (WD + Penetration Depth)**
  - Max depth 9,000m from sea level
    - Deepest Riserless Drilling:
      - JFAST Expedition / 6897.5mWD (TD 7780.81mBRT)



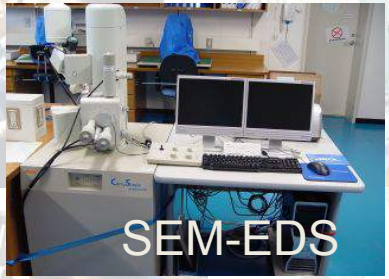
General Arrangement



Lab Highlights

High performance facilities and staffs

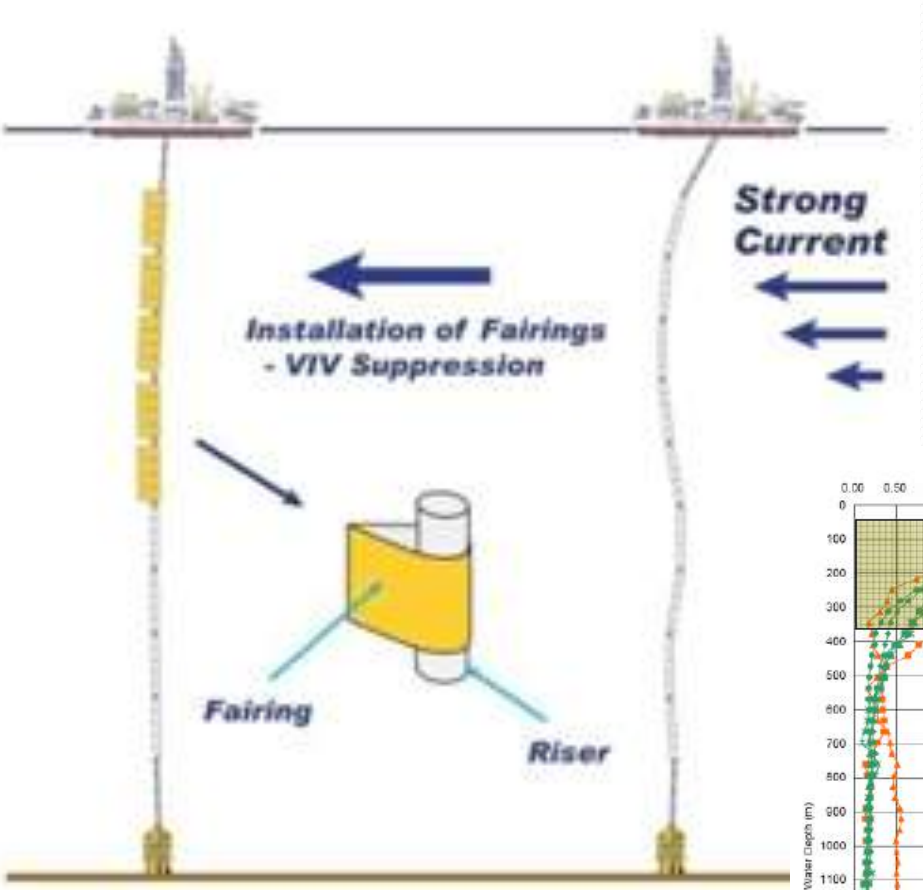
- Physical properties: 12 (X-ray CT, etc)
- Paleomagnetics: 3 (SQUID, etc)
- Petrology/Paleontology: 8 (SEM-EDS)
- Geochemistry: 12 (ICP-MS, etc)

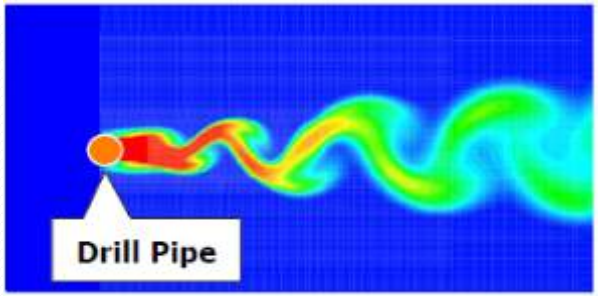


Additional Container labs

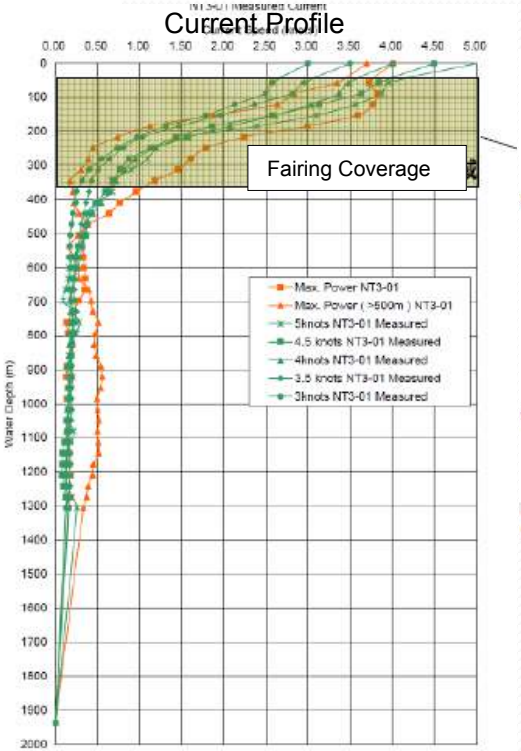
- Iso-van: controlled microbiology lab
- Mud-gas monitoring Lab

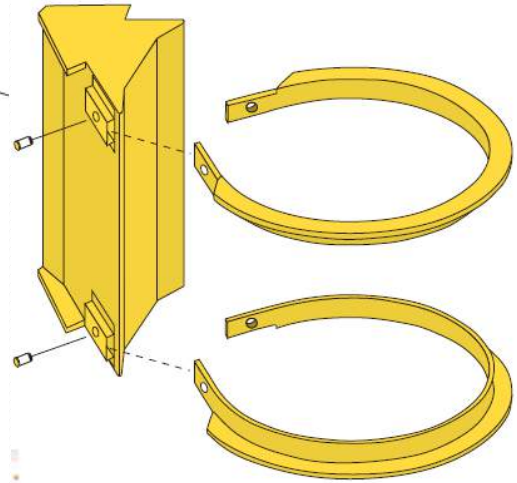
Riser Fairing





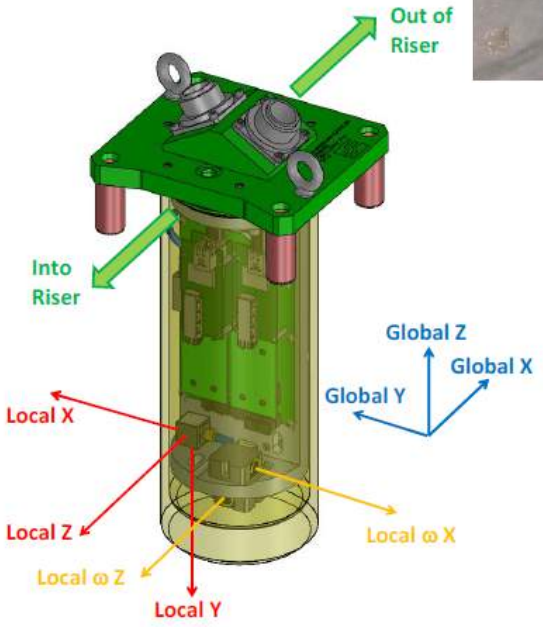
Current Profile

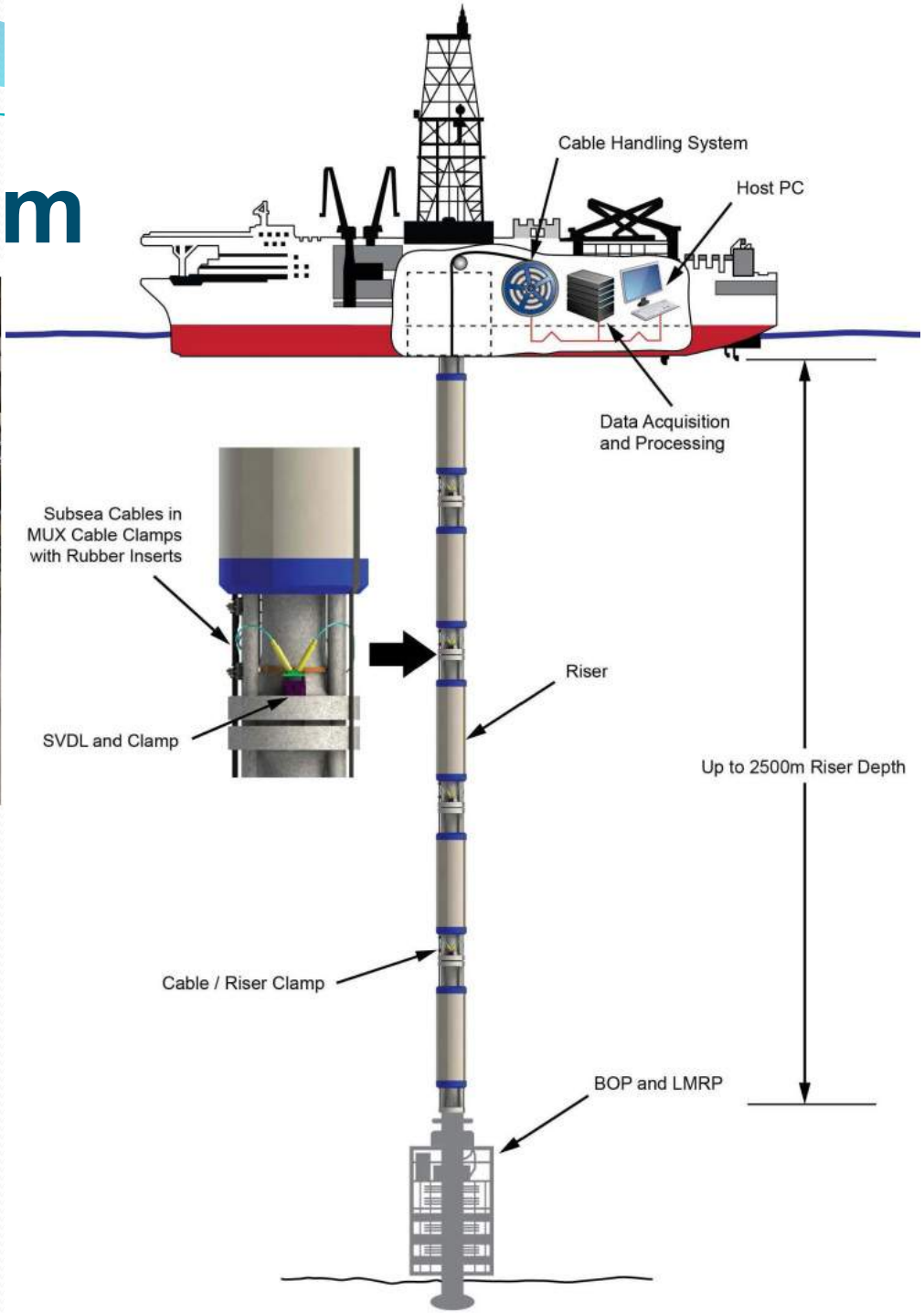




CDEX
JAMSTEC

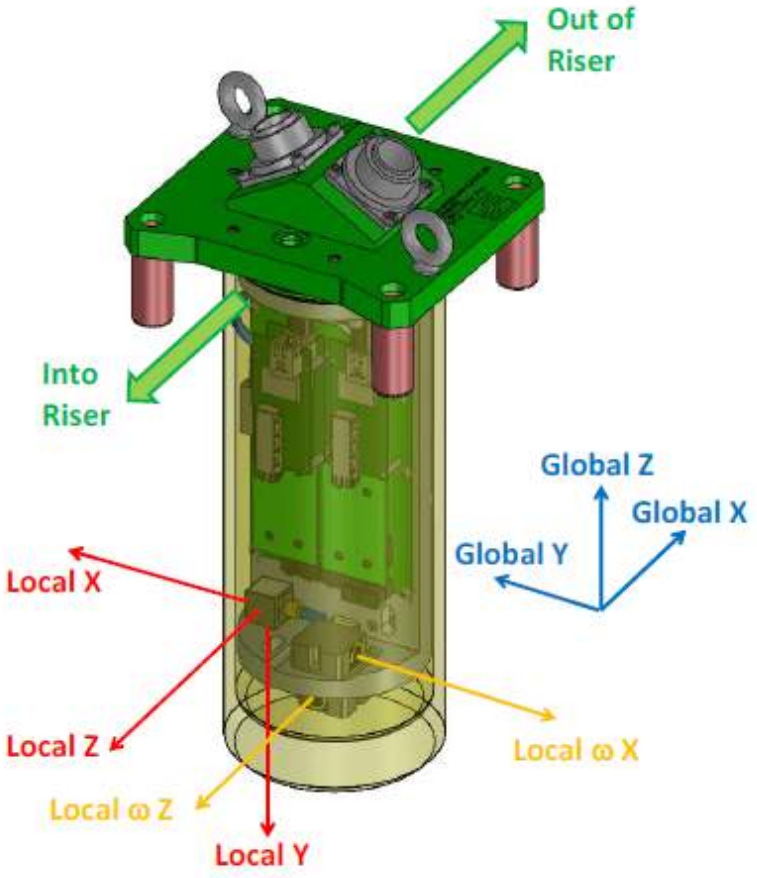
Riser Fatigue Monitoring System





Riser Fatigue Monitoring System

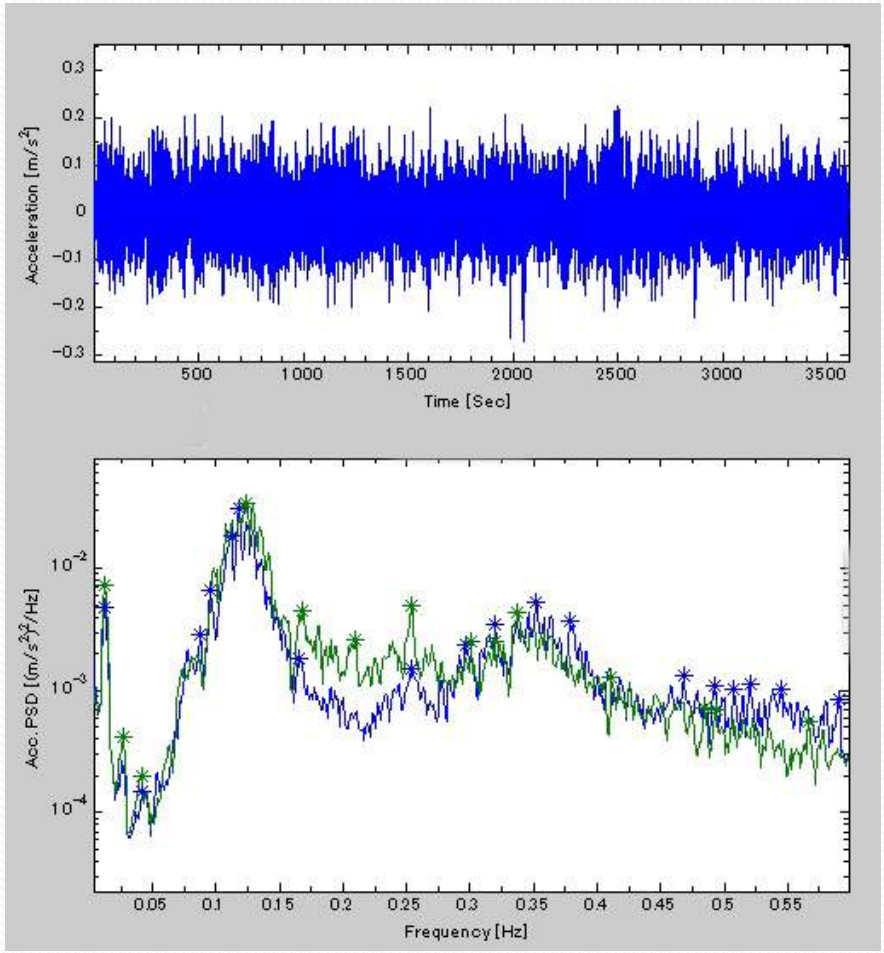
Specification	Value
Number of measurement modules (SVDL: Subsea Vibration Data Logger)	7 sets (possible to increase modules)
Deployment Depth	2,500 meters (possible to extend to 4,000 m)
SVDL Accelerometer range	± 2.0 g (triaxial)
SVDL Accelerometer resolution	350 µg
SVDL Angular Rate Sensor range	± 16 degrees/sec
SVDL Angular Rate Resolution	0.0038 degrees/sec (5 Hz bandwidth)

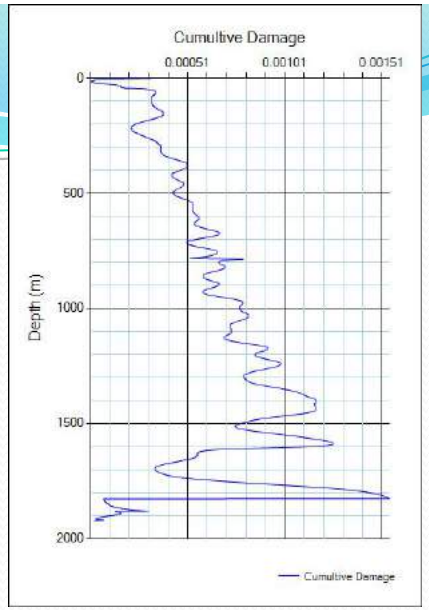


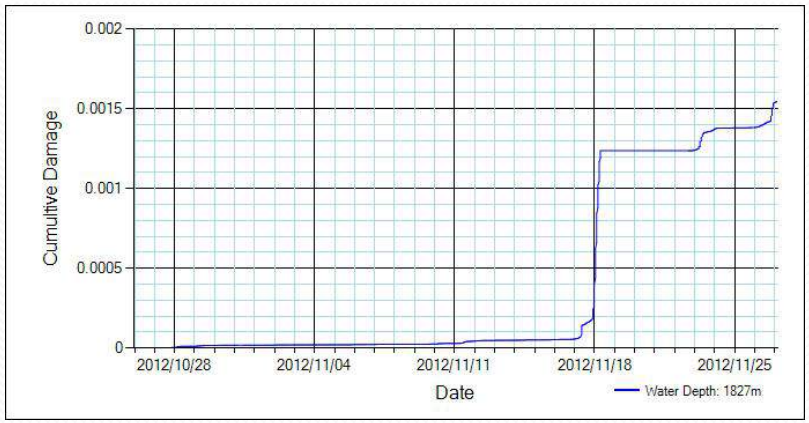
Riser Fatigue Monitoring System

Riser Fatigue Monitoring System

High Current Studies Results

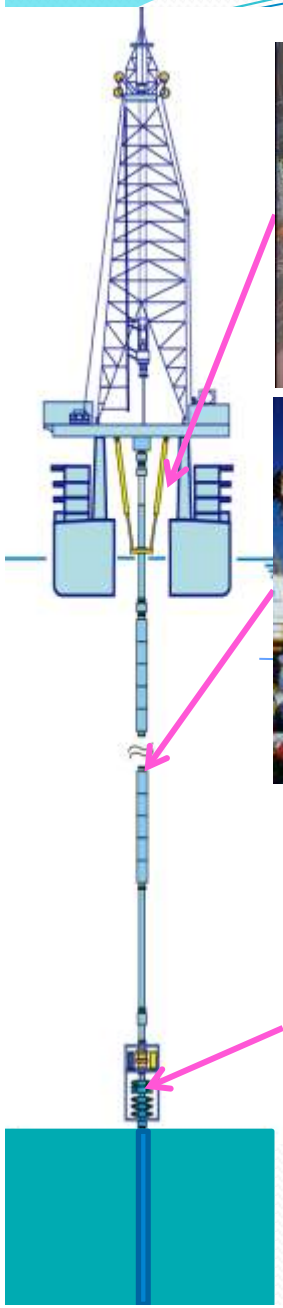






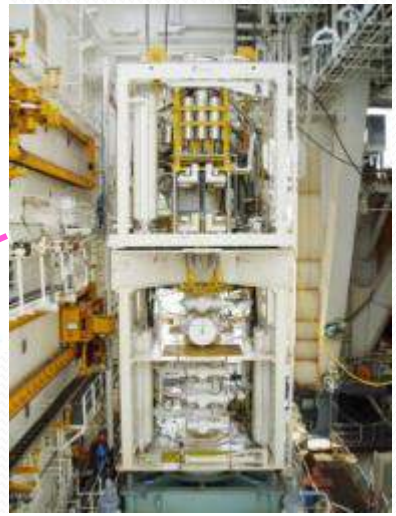
- Suppress VIV at high Kuroshio current (with fairing)
- Cumulative Damage <0.0015

Subsea Equipment



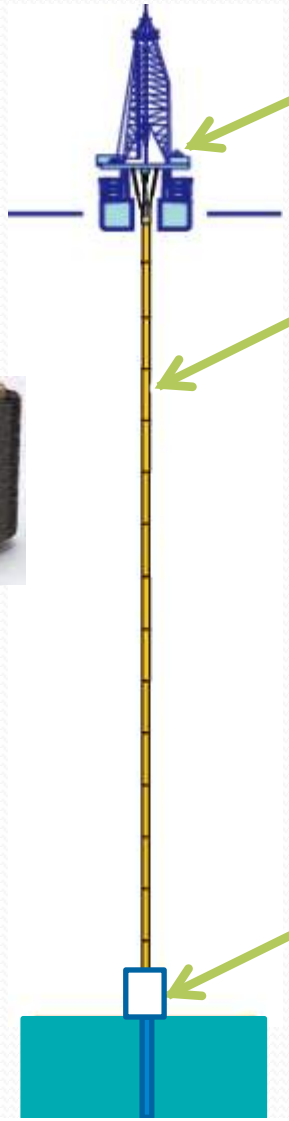
Riser Tensioner

Riser



Blow Out Preventer
BOP

4,000m Class Riser System



Vessel Modification
(Considering Riser storage and stability)

New Material Riser

- *Carbon Fiber*
- *Aluminum Alloy*
- *Titanium Alloy*
- *Combination (steel + new material)*

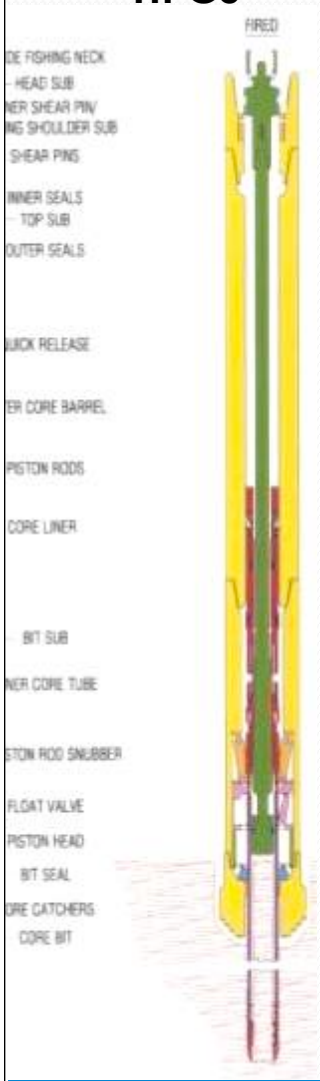
Compact BOP

Chikyu Existing Coring System (61mm core / wireline retrieval through DP)

11-7/16”Bit / Interchangeable

Very Soft - Soft

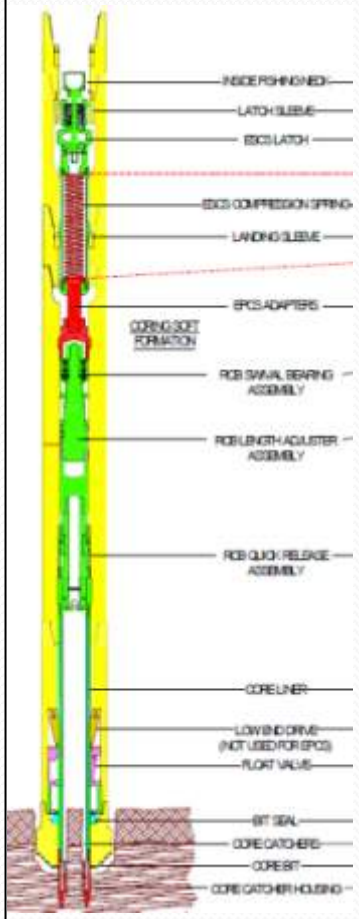
HPCS



Hydraulic Piston Coring System

Soft - Moderate

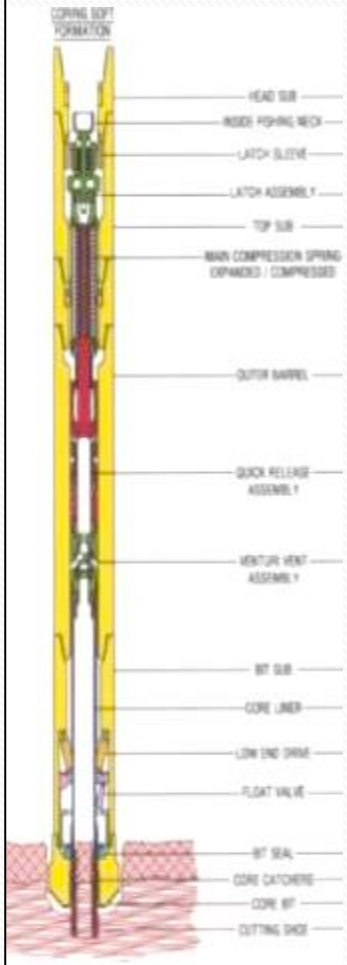
EPCS



Extended Punch Coring System

Moderate

ESCS



Extended Shoe Coring System

Soft - Hard

Hybrid PCS

51mm Core

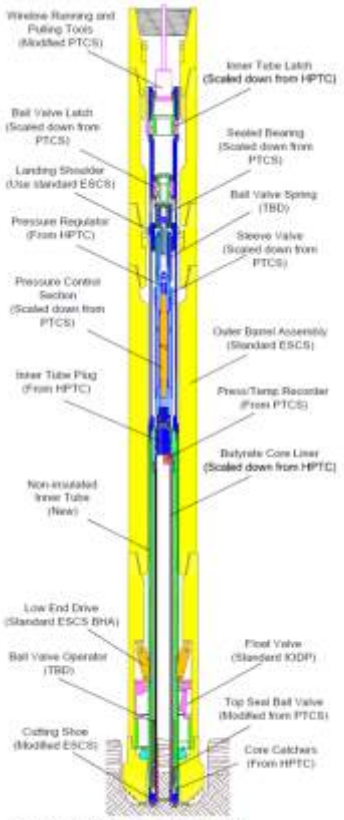


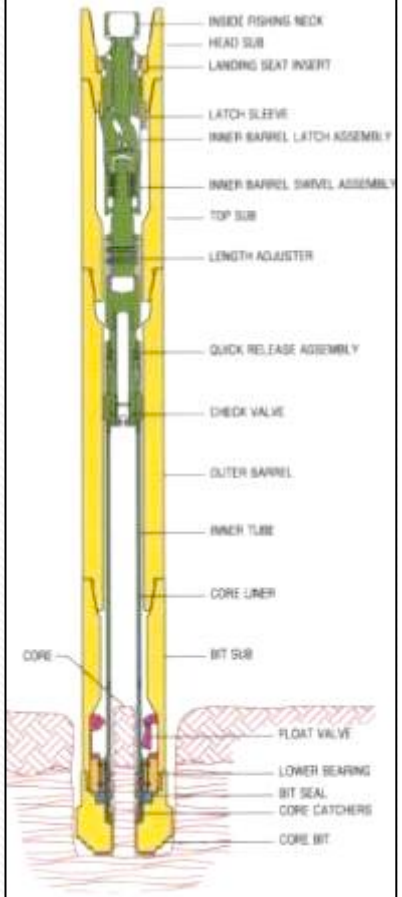
Figure 11, Proposed Hybrid PCS

Hybrid Pressure Coring System

10-5/8”Bit

Moderate - Hard

RCB

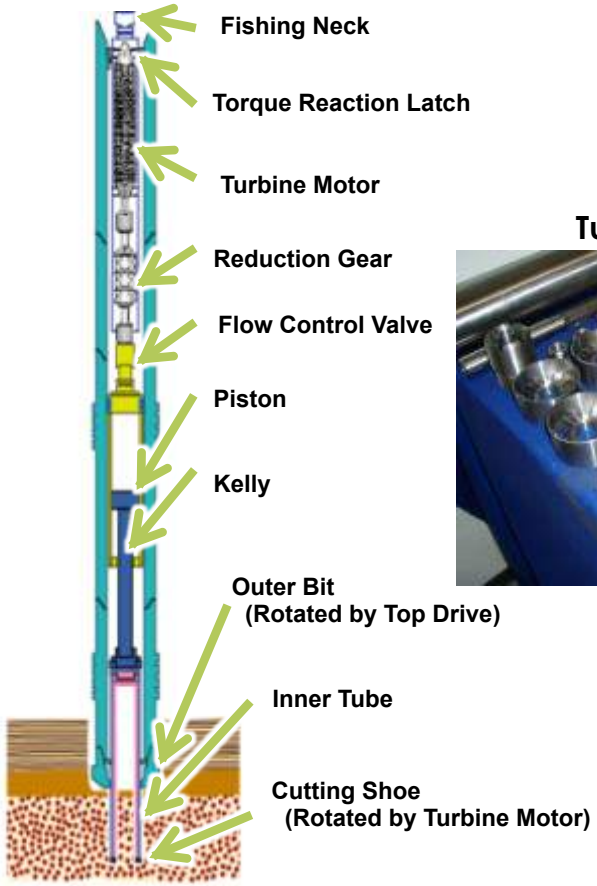


Rotary Core Barrel

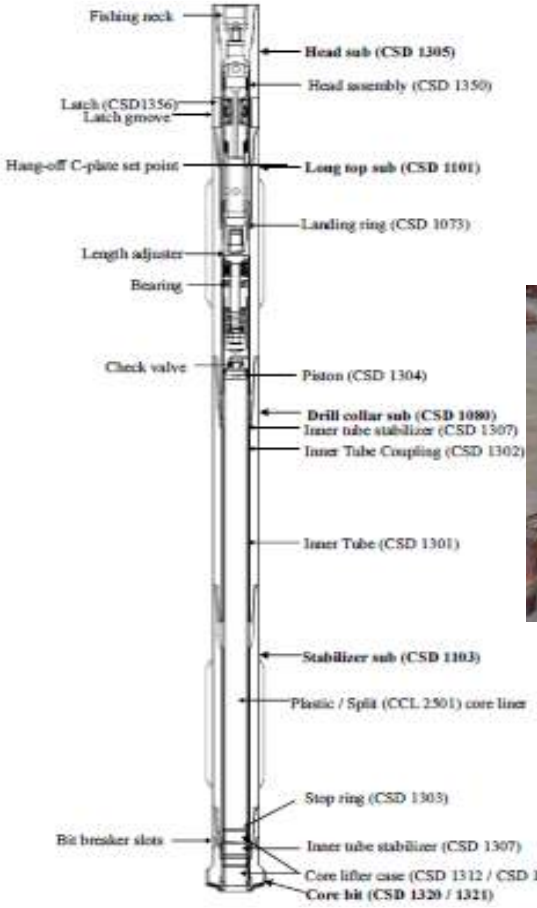
New Coring System

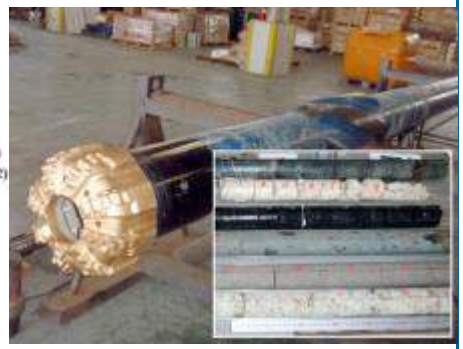
- **Turbine Driven Coring System (TDCS)**
  - Trial in 2013
  - Compatible with HPCS/ESCS Core Barrel
  - High RPM Cutting Shoe: 1200rpm
  - Hydraulic extending shoe

- **Small Diameter RCB (SD-RCB)**
  - Trial in 2013
  - 2nd Generation RCB
  - Slim Hole: 10-5/8" bit → 8-1/2" bit
  - High Durability: 21kNm → 42kNm
  - Large Core: 61mm → 75mm

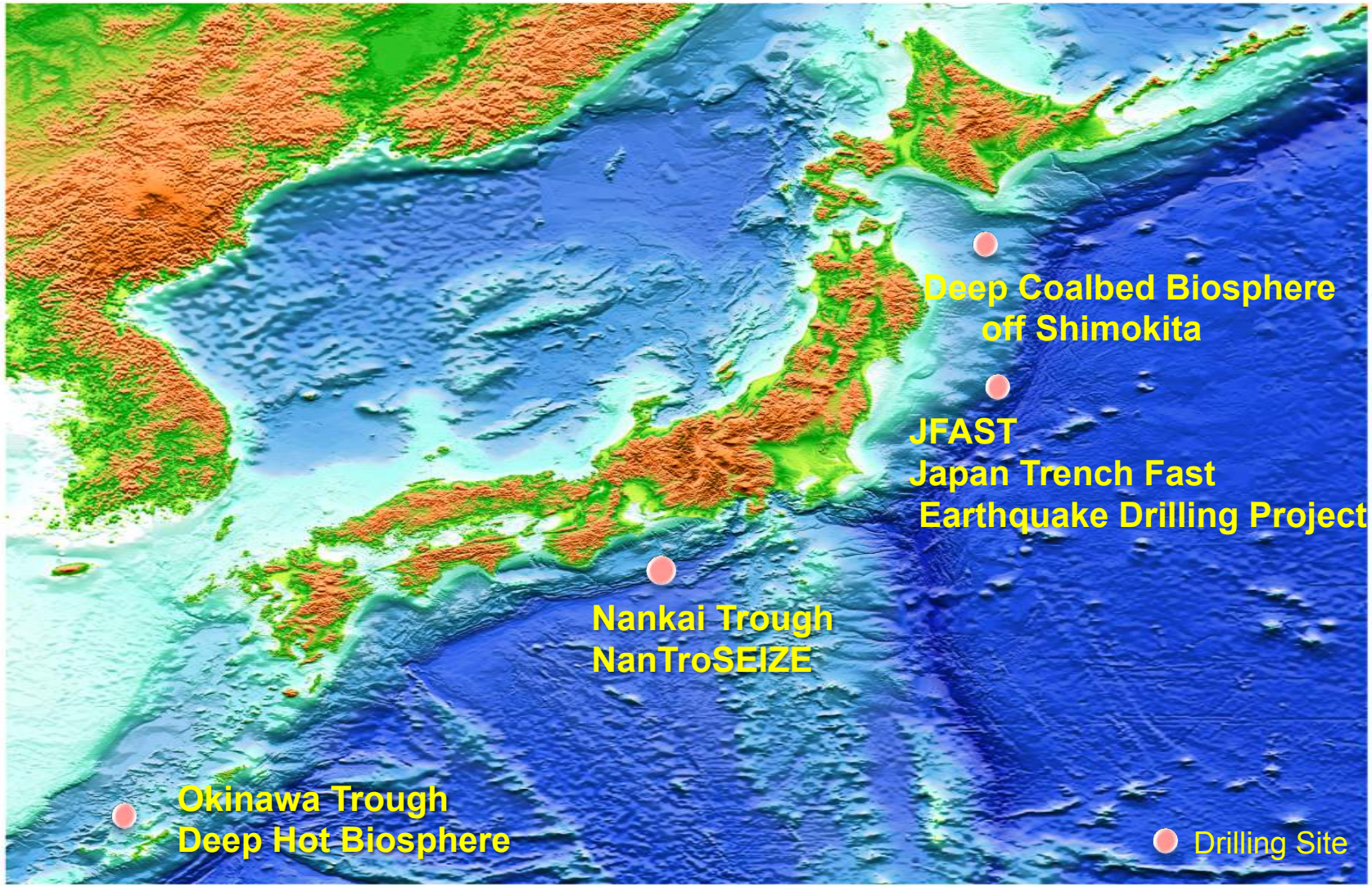


Turbine Motor





"*Chikyu*" IODP Scientific Expeditions Key Results (2007-2013)

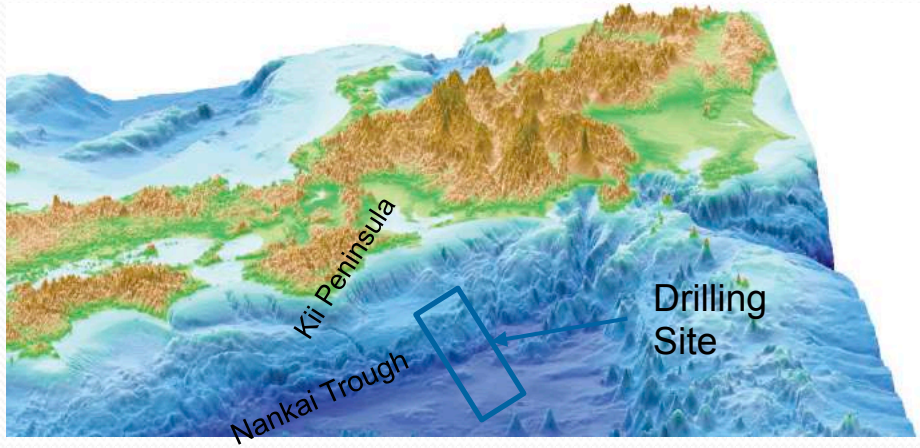


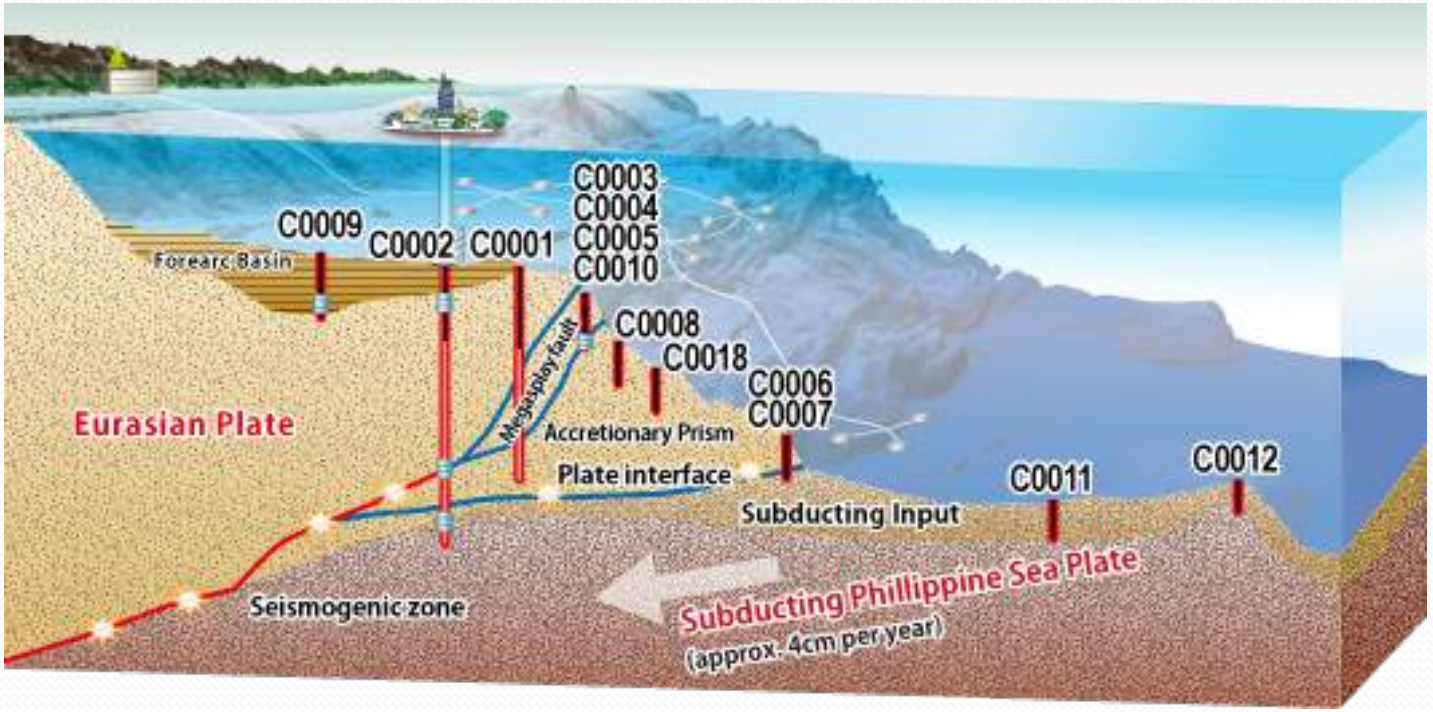
JAMSTEC

NanTroSEIZE

The Nankai Trough Seismogenic Zone Experiment

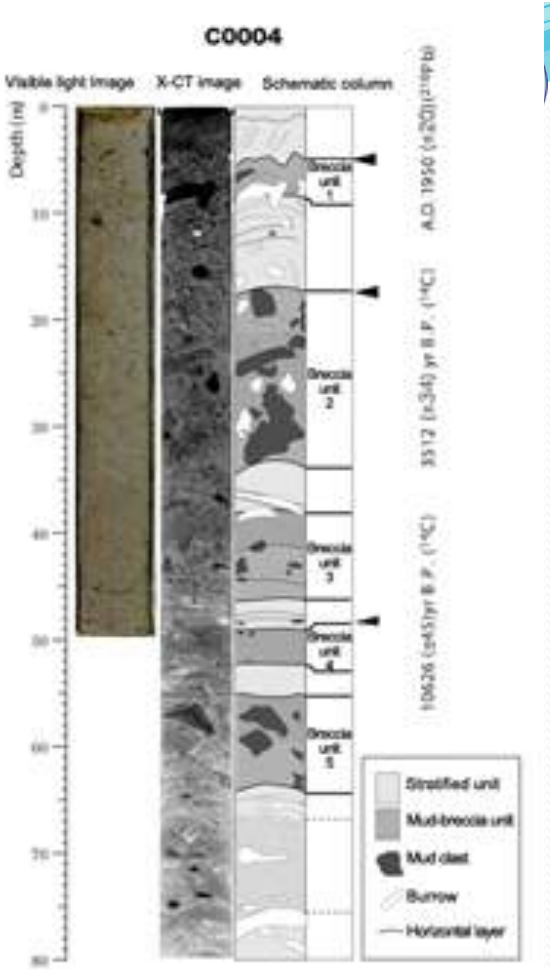
- **Research Objectives**
  Investigate the mechanism of earthquake occurring at Subduction Zone
- **Drilling Site**
  Nankai Trough, Off Kii Peninsula, Japan

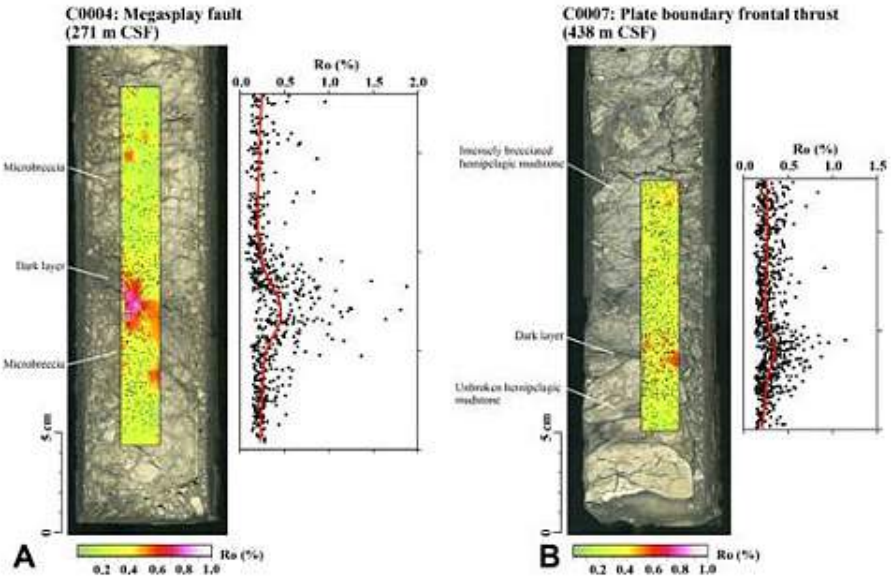


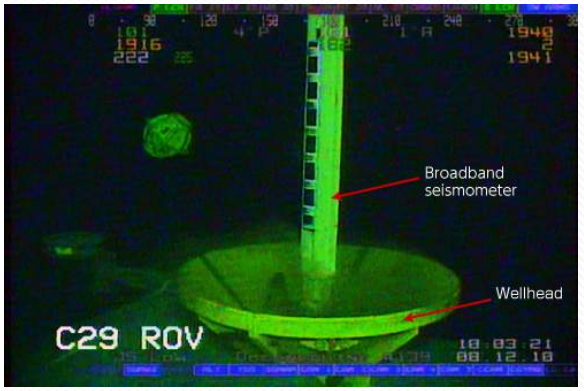


NanTroSEIZE

- **Achievements and Findings**
  - “Big picture” of the Nankai Trough
  - Origin and evolution of a splay fault
  - Mud brecciation due to the past great earthquake
  - Evidence of Tsunami generating seismic rupture
  - Successful riserless observatory (LTBMS)







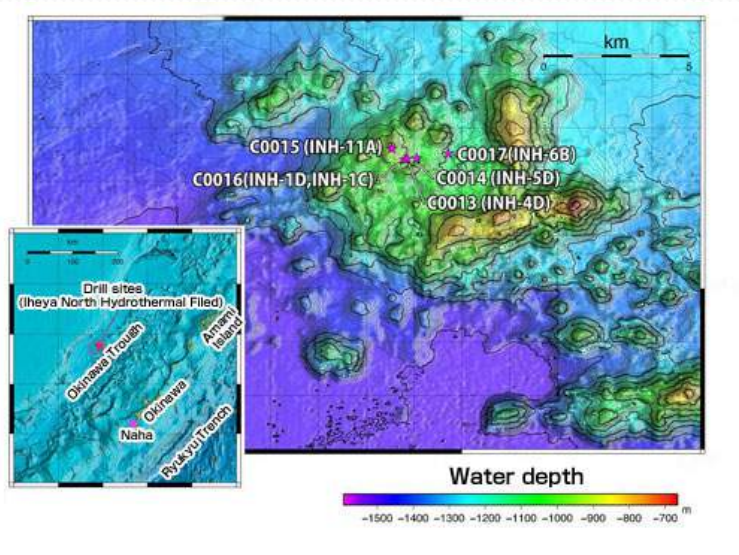
Deep Hot Biosphere

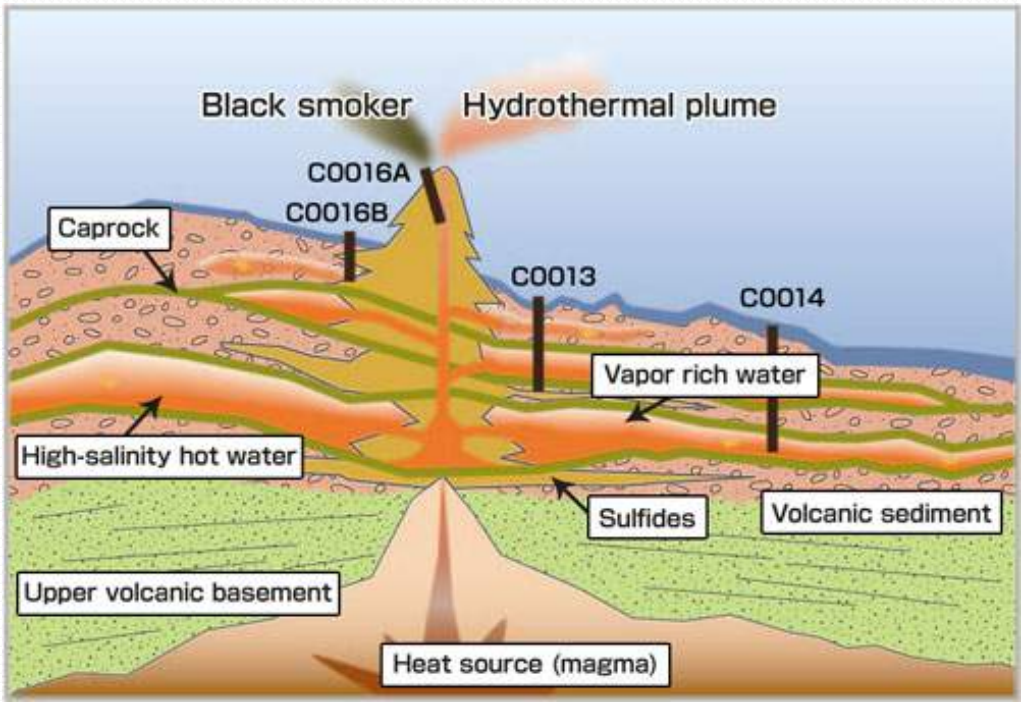
- **Research Objectives**

  Prove the existence of microbial communities, their biomass and ecosystem roles and functions

- **Drilling Site**

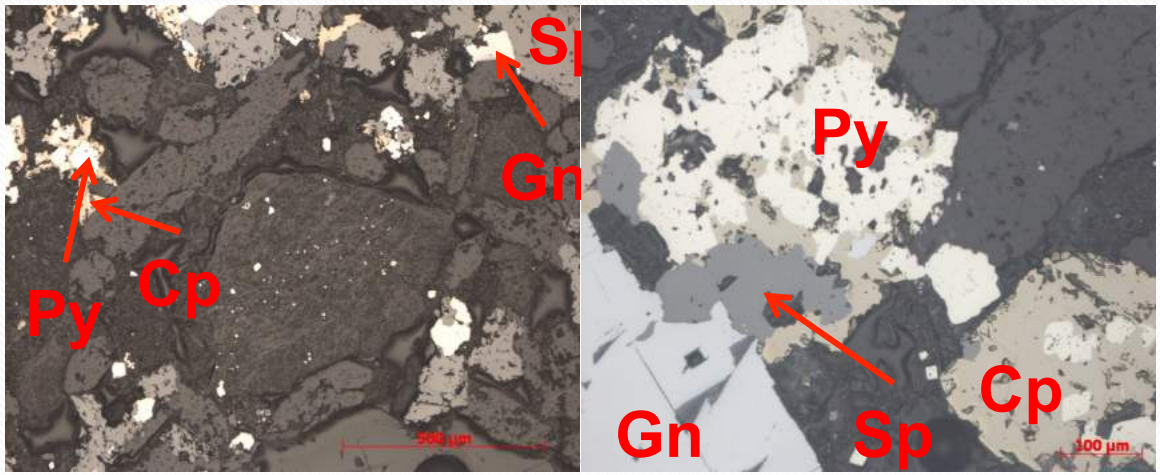
  Okinawa Trough, Iheya North hydrothermal field, Japan





Deep Hot Biosphere

- **Achievements and Findings**
  - Subseafloor hydrothermal alteration, fluid flow, and reservoirs within the defined hydrogeologic structure
  - Stratification of hydrothermal fluid by subseafloor phase separation and segregation

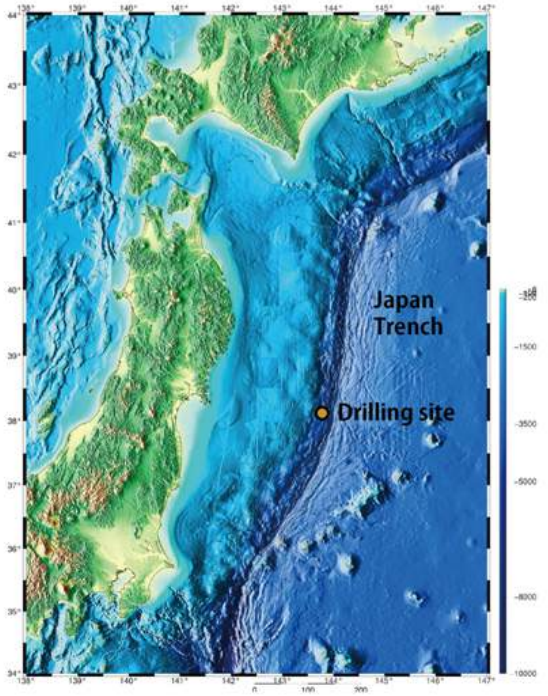


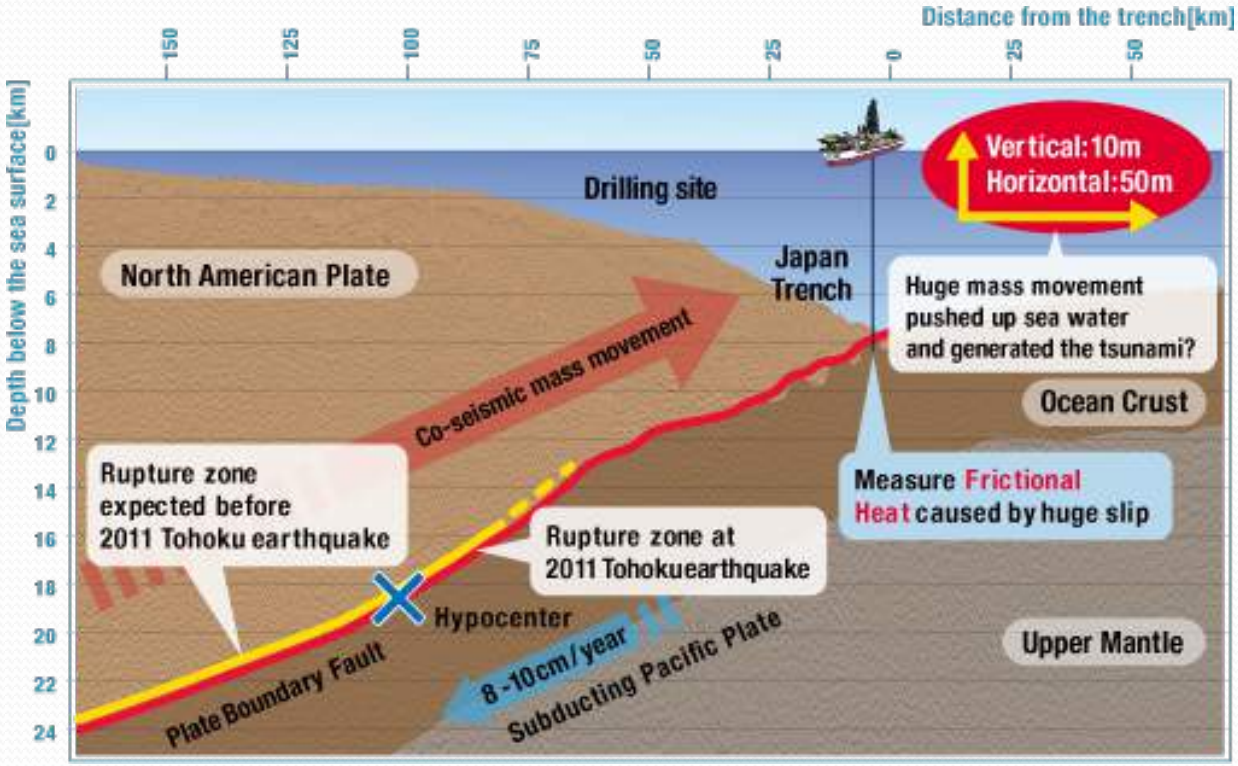
JFAST

Japan Trench Fast Earthquake Drilling Project

- **Research Objectives**
  Analyze the frictional properties of the plate boundary fault at 2011 Tohoku earthquake

- **Drilling Site**
  Off Ojika Peninsula, Japan

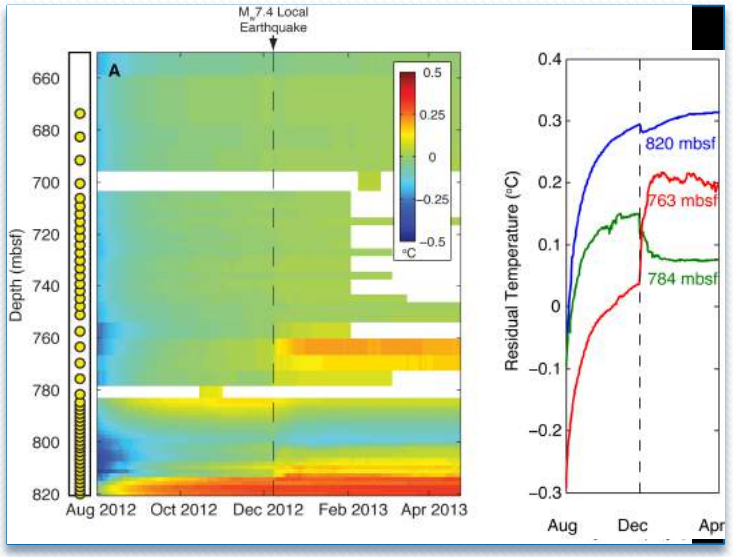




JFAST

Japan Trench Fast Earthquake Drilling Project

- **Achievements and Findings**
  - Identified fault zones at two intervals
  - Highly sheared clay samples from plate boundary décollement (evidence of slip)
  - 55 temperature sensors (MTL) installed across the two fault targets and retrieved after 9 months, and the data successfully acquired



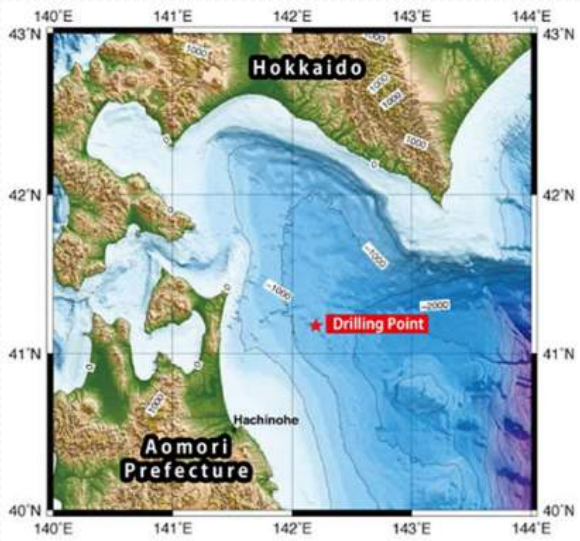
Deep Coalbed Biosphere off Shimokita

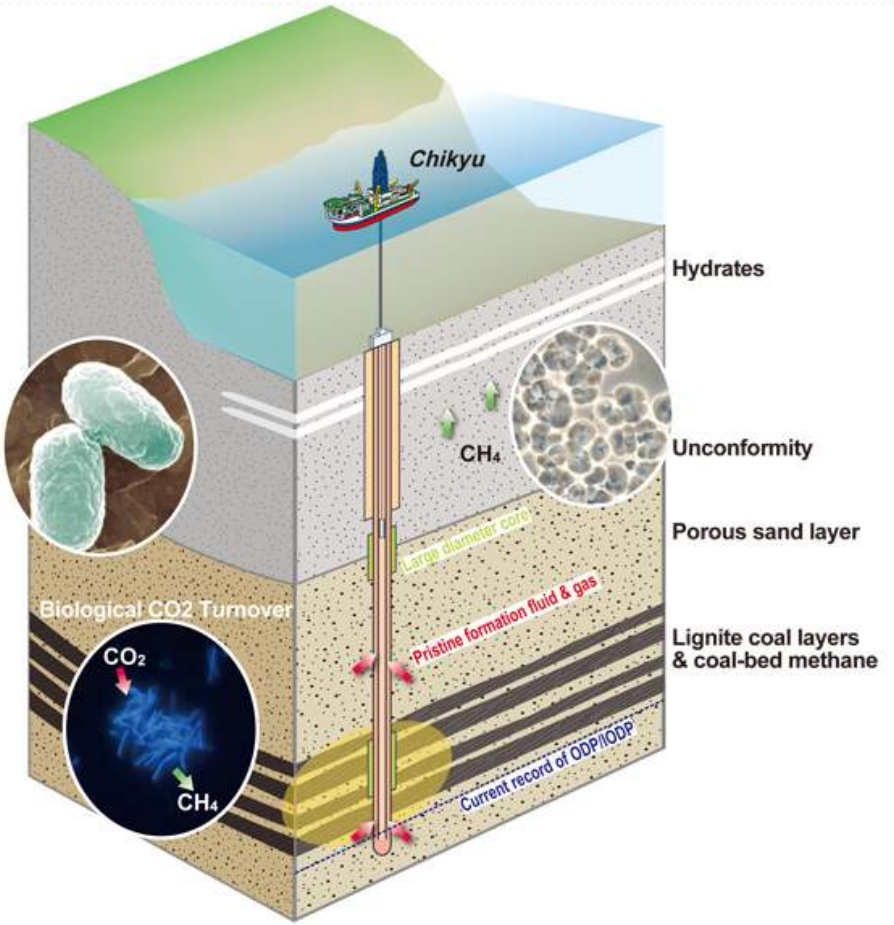
- **Research Objectives**

  Clarify deep underground biological activity, an important role in the system of carbon cycling below the sea floor.

- **Drilling Site**

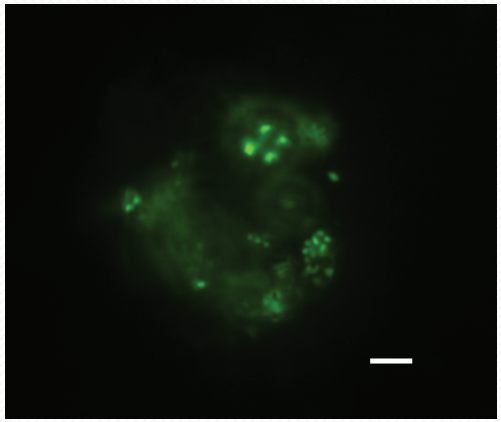
  Off Hachinohe, Japan

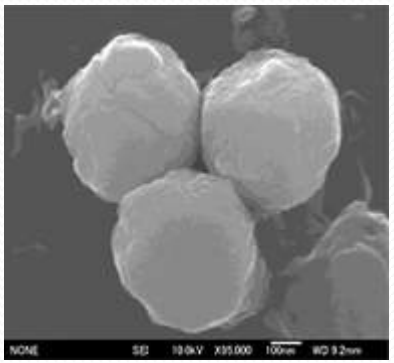


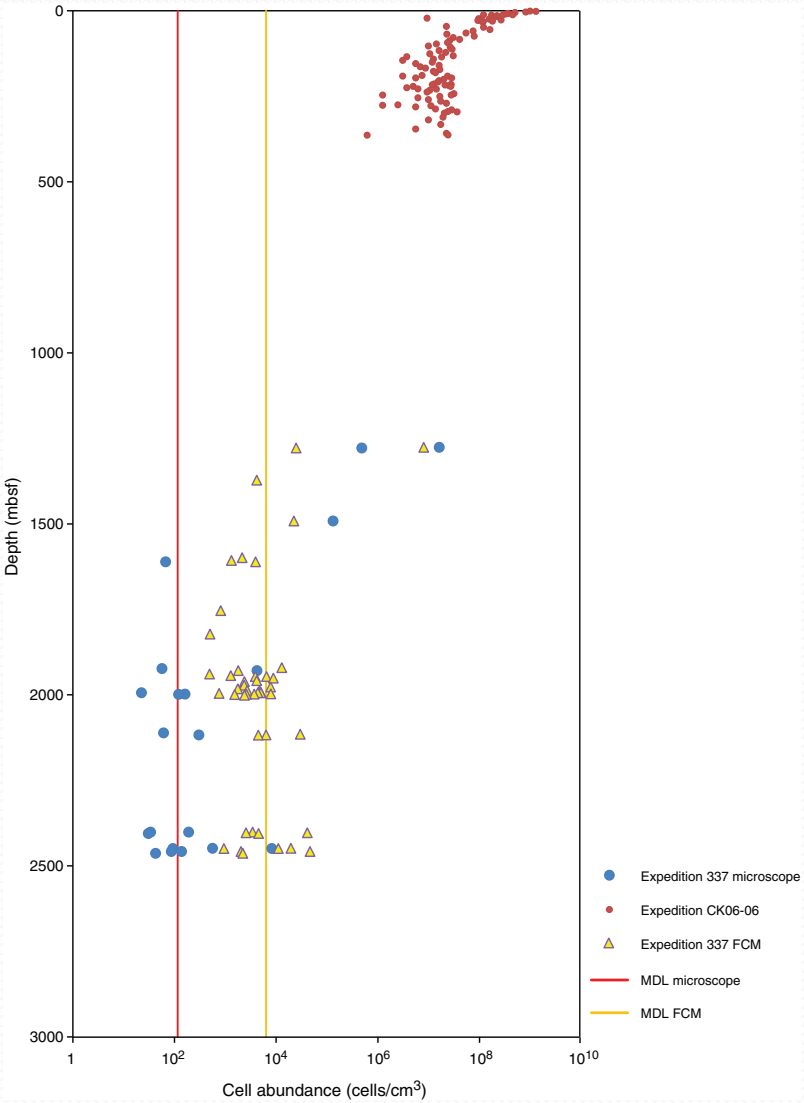


Deep Coalbed Biosphere off Shimokita

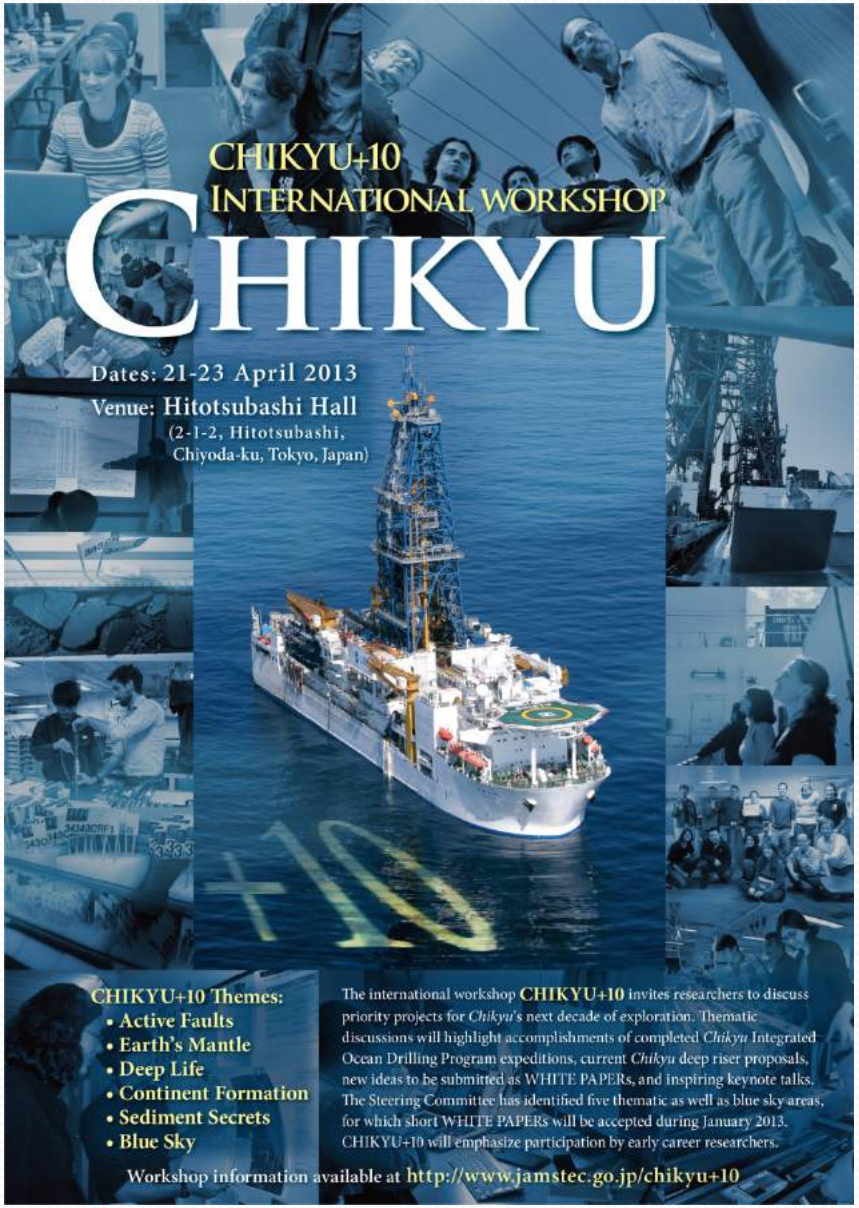
- **Achievements and Findings**
  - Evidence for deep subseafloor microbial activity associated with coalbeds
  - Interactions between a deep coalbed hydrocarbon system and subseafloor life.







CHIKYU +10 International WS



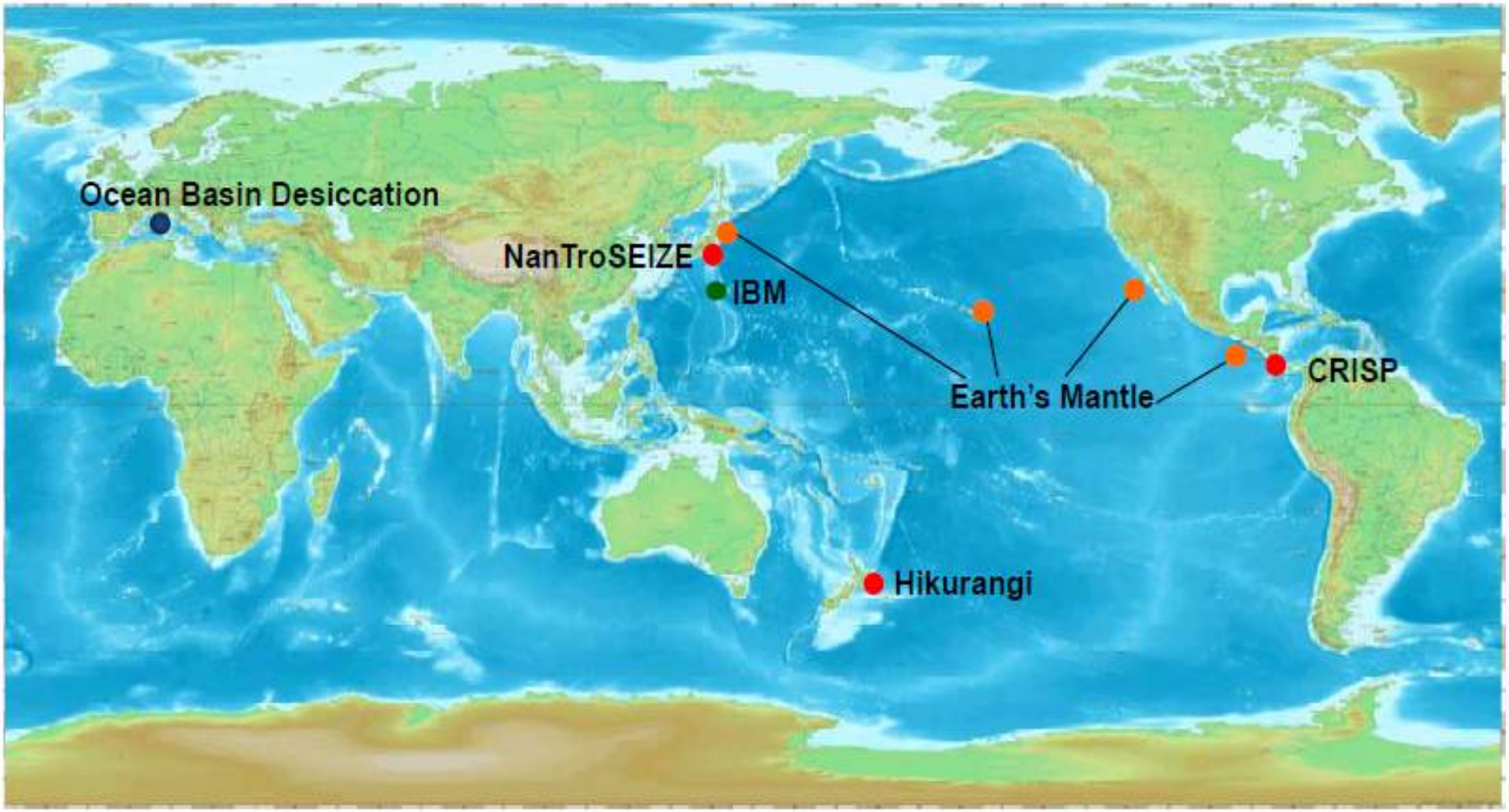
Objective:
To discuss priority projects for *Chikyu*'s next decade of exploration in the below 5 themes;

1. Active Faults
2. Earth's Mantle
3. Deep Life
4. Continent Formation
5. Sediment Secrets

CHIKYU +10 International WS cont.

- **Flagship Projects:**
  - **The Dynamic Fault Behavior**
    - Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE)
    - Costa Rica Seismogenesis Project (CRISP)
    - Slow Slip at the Hikurangi Margin
  - **The Ocean Crust and Earth's Mantle**
    - Drilling to Earth's Mantle (M2M)
    - Life Cycle of the Oceanic Lithosphere
  - **The Deep Life and Hydrothermal System**
    - Habitable Zone
  - **The Continent Formation**
    - Island arc Origin: Izu-Bonin-Mariana (IBM)
  - **The Sediment Secrets**
    - **Ocean Basin Desiccation**

Proposed Sites Map



Projects Overview

	NanTroSEIZE	CRISP	Hikurangi	Earth's Mantle	Oceanic Lithosphere	Habitable Zone	IBM	Ocean Basin Desiccation
Theme	Dynamic Fault	Dynamic Fault	Dynamic Fault	Earth's Mantle	Earth's Mantle	Deep Life	Continent Formation	Sediment Secrets
Location (LA, LO)	33.3°N 136.6°E	9.5°N 84°W	38.73°S 178.61°E	• Cocos Plate • Hawaii • Baja California	• Cocos Plate • Japan Trench		32.4°N 140.4°E	41.76°N 5°E
Water Depth (m)	2,000	500	1,000	~4,000	>4,000		1,800	>2,500
Drilling Depth (mbsf)	~5,000	~5,000	>5,000	>6,000	~6,000		~5,500	~6,000
Technical Challenge	• Deformed over-press. sediments • High current • Typhoon • Observatory	• Deformed over-press. sediments • Observatory	• Deformed over-press. sediments • Observatory.	• Hard rock: Lava Dikes Gabbro Mantle • BHT 150-250°C • Observatory	• Hard rock • Fault zone	• BHT >300°C	• Hard rock: Andesitic Tonalite Diorite • BHT 150-175°C • Observatory	• Salt formation • Over-press.

JAMSTEC

Sponsoring / Project Support

- **Opportunities?**
  - **Donations**
  - **In-kind Contribution**
  - **Sponsoring**
    - JAMSTEC/CDEX
    - *Chikyu*
    - Project
  - **Partnership**
  - **Research Collaborations (e.g., Horizon 2020)**
  - **Industry operation in the area?**
  - **Others**

"Chikyu"

Scientific Drilling Vessel 5th Generation Drill Ship

OWNER and BUILDER	
Owner	JAMSTEC
Built Year	2005
Builder	MHI/MES
MAIN DIMENTIONS	
Length overall	210.0 m
Breadth overall	38.0 m
Depth	16.2 m
Operational draft	9.2 m
Gross Tonnage	56,752 tons
Helicopter deck	Capable for EH101
DESIGN CRITERIA	
Cruising speed	11.45 knots with 5 thrusters
Max. operating water depth	2,500m
Max. drill string length	10,000m

ClassNK
• NS* : Mobile Offshore Drilling Unit • DPS Class B • Ice Strengthening Class IB • MNS* : (M0)

COMPLEMENT	
Max.	200 persons
STORAGE CAPACITIES (actual)	
Fuel oil	9,006 m³
Drill water	2,554 m³
Potable water	369 m³
Active mud	408 m³
Reserve mud	1,445 m³
Bulk mud	696 m³
Bulk cement	464 m³
VARIABLE LOAD	
Variable load	25,500 tons

POWER EQUIP.	MODEL/SPEC	MANUFACTURER
Main generator	〈12ADD30V〉×6 • 5,270 kW (7,064 HP) x 720 rpm	Mitsui
	• 5,000 kW (6,250 kVA), AC 6.6 kV, 60 Hz, 3 phase	Nishishiba
Aux generator	〈6ADD30V〉×2 • 2,640 kW (3,539 HP) x 720 rpm	Mitsui
	• 2,500 kW (3,125 kVA), AC 6.6 kV, 60 Hz, 3 phase	Nishishiba
Emergency generator	〈S12A2-MPTA〉×1 • 560 kW (700 kVA), AC 450 V, 60 Hz, 3 phase	Mitsubishi
MATERIAL HANDLING EQUIP.	**MODEL/SPEC**	**MANUFACTURER**
Deck crane	〈Elect.-Hyd. Knuckle Boom Crane C3426KE-45/15x35-1.33〉×2 • Capacity 45 ton	NOV
	〈Elect.-Hyd. Knuckle Boom Crane C3932KE-85/20x42-1.33〉×2 • Capacity 85 ton	NOV
BOP crane	• SWL 200 ton ×2	NOV

DRILLING EQUIP.	MODEL/SPEC	MANUFACTURER
Derrick	〈Dual Well Type Bolted Dynamic Derrick〉 • 21.95 m (72ft) L x 18.29 m (60ft) W x 70.10 m (230ft) H • Well center spacing 9.75 m (32") • Max. static hook load 1,250 ton	Bailey
Crown Mounted Heave Compensator	〈CMC1000-25 with AHC〉 • Hook load capacity: 518 ton (1,140 kips) • Crown Block capacity: hook load 1,250 ton • Stroke 7.62 m (25 ft)	NOV
Traveling Block	〈HTB1380〉×8 • 1981 mm (78") dia. • Capacity 1,250 ton	NOV
Drilling Control System (DCIS)	〈Cyberbase Control System〉	NOV
Drawworks	〈EH-V-5000〉 • Hoisting capacity 1,250 ton • Drum Size: 1,448 mm (57") dia. x 3,683 mm (145") length 〈GE 752RB1 Marine Shunt Wound Drilling Motor〉×4 • 4 x 930 kW, Total 5,000 HP	NOV
Drill Lines	〈6 x 26 WS IWRC〉 • Max. 3,048 m (10,000 ft) - 54 mm (2-1/8") • B.L. 2,277 kN (223 ton)	TESAC

DRILLING EQUIP. (cont'd)	MODEL/SPEC	MANUFACTURER
Rotary table	〈RST 60-1/2〉 (Main well) • Static capacity 1,250 ton 〈RST 49-1/2〉 (Aux. hole) • Static capacity 750 ton	NOV
Power Swivel	〈HPS 1000 2E AC〉×2 • 858 kW (1,150 HP) GEB AC Eex eII • Max. 260 rpm • Hoisting capacity 1,000 s.ton	NOV
Tensioner system	〈N-Line Direct Cylinder Tensioner〉×6 • Tensioner Cylinder 363 ton (800 kips) • Stroke 52ft	NOV

CDEX
JAMSTEC

BULK and MUD SYSTEMS	MODEL/SPEC	MANUFACTURER
Bulk handling system	• Barite 4,400～5,000 lbs/min. (120～218 ton/h) • Cement 3,850～4,000 lbs/min. (105～109 ton/h)	Halliburton
Mud mixing and storage system	〈Mud Mixing System〉	NOV (Procon)
	〈Active Mud Tank, Vertical Cylindrical Tank〉 • 85 m³×6	Henmi
	〈Mud Agitator, MA-25〉 • 25 HP 3.63 m Shaft, 2 x 1.02 m (40") Impeller Blade Speed 58 rpm, TOR 68.6 sec.	Brandt
	〈Reserve Mud Tank, Vertical Cylindrical Tank〉 • 212.5 m³×8	Henmi
Mud supply system	〈Mud pump,14-P-220〉×3	NOV
Mud solid control system	〈Gumbo separator, 6 ft Single Cartridge Gumbo Scalper〉×2	Brandt
	〈Shale shaker, VSM300 Elliptical Cascade Shaker〉×6	Rigtech
	〈Degasser, Magna-Vac Model 1500〉×2	Burgess
	〈Desander, 3-12 D-Sander〉×2	MiSWACO
	〈Mud clearner, 8T4/ALS II D-Silter/Adjustable Linear Shaker〉×2	MiSWACO
	〈Centrifuge, RT HeviJet 362〉×3	HILLER

WELL CONTROL Cont'd	MODEL/SPEC	MANUFACTURER
BOP Stack	〈18-3/4" 15M Stack, with Vetco Gray SHD Wellhead Connector, Pods & Shaffer Dual Annular〉 • 5,232 mm (206") L x 5,918 mm (233") W x 14,513 mm (571.38") OAH 〈LMRP〉 • Lower Flex Joint, Oilstates 18-3/4", 1,588 ton (3,500 kips) Working Tension, +/- 10° • Dual Annular, Shaffer Spherical BOP x 2, 18-3/4" 10K 〈Lower Stack〉 • Cameron Double Ram, 18-3/4" 15K TL • Cameron Triple Ram, 18-3/4" 15K TL	Cameron
BOP control system	• Mux Control System	Axon
Diverter system	〈KFDS/CSO〉 • 21"bore, 35 bar (500 psi) WP	Vetco Gray
Riser System	• Main tube 〈LoadKing 4.0〉 19.5"ID x 90 ft, 1,814 ton (4,000 kips) • Choke/Kill 〈ASTM A-519 Gr.4130〉×2 6.25"OD/4.25"ID, 103.4 MPa (15,000 psi) • Booster 〈ASTM A-519 Gr.4130〉 5"OD/4"ID, 51.7 MPa (7,500 psi) • Hydraulic 〈UNS S31803〉 3.625"OD/3"ID, 34.5 MPa (5,000 psi)	Cameron

WELL CONTROL Cont'd	MODEL/SPEC	MANUFACTURER
Choke and Kill System	〈Choke/Kill Manifold〉 • 3-1/16" 15,000 psi (Hyd. and Manual Choke) • 4-1/16" 5,000 psi (Hyd. and Manual Choke)	Cameron
	〈Mud Gas Separator〉 • 1.829 m (6ft) dia. x 14.191 m OAH • 566 Mm3/day (20 mmcf/day) = 6.55 Nm3/s	MisWACO

PIPE HANDLING	MODEL/SPEC	MANUFACTURER
Pipe Racking System	〈Hydra Racker IV, Hydraulic Trolley Column with 3 Arms〉 • Hoisting Capacity: Main Arm 12.5/6.75/4 ton @ 2.7/3.6/3.9 m reach	NOV
	〈Fingerboard / Bellyboard〉 • 84 x 13-3/8"CSG + 324 x 6-5/8"DP + 20 x 8"DC + 20 x 9-3/4"DC	
	〈Racking Winch for Fingerboard / Bellyboard〉 • 1T Utility Winch, SWL: 10 kN	NOV (Bryne Mekanikk)
Drill Floor Pipe Handling Equipment	〈Hyd. Roughneck HRN-166〉 • Pipe Range: 3-1/2" to 9-3/4 〈KT14000/25000 casset type tong〉 • Range 4-1/2"～25"	NOV
	〈Hydraulic Manipulator Arm〉 • Pipe Sizes: 3-1/2" to 60" (Range of heads required)	Patriot
	〈Pipe Transfer System (Hyd. Operated Catwalk Machine)〉 • 3-1/2" to 30" pipe, SWL 20 ton	NOV
	〈Riser Transfer System (Hyd. Operated Catwalk Machine)〉 • 90 ft Riser & Slip Joint, SWL 45 ton	NOV
Elevators	〈Dual Elevator System〉 • Load capacity: 750 s. ton • Pipe Dia. Range: 2-3/8" to 9-5/8"	Blohm+Voss DES

DRILL STRING EQUIP.	MODEL/SPEC	MANUFACTURER
Drill Pipe	〈5" Drill Pipe〉 • 5"OD, S-140, 19.5lbs, 5-1/2"FH DSTJ, R-2 〈5-1/2" Drill Pipe〉 • 5-1/2"OD, S-140, 24.7lbs, 5-1/2"FH DSTJ • 5-1/2"OD x 0.506"t, S-150, 5-3/4"FH DSTJ, R-2 〈6-5/8" Drill Pipe〉 • 6-5/8"OD, Z-140, 47.06lbs, 6-5/8"FH, R-2 (Scientific project use)	NKK Grant
CORING EQUIP.	**MODEL/SPEC**	**MANUFACTURER**
Coreline Winch	〈Dual Drum, Chain drive Elect. Winch〉 • Capacity 19 mm (3/4") Wire Rope x 10,000 m (33,000ft)	NOV
Core Line	• 19 mm (3/4") 6 x WS(36) OF (Omega Filler) IWRC x 10,000 m, B.L. 309 kN (31.5 ton) • 19 mm (3/4") 4 x F(40) G/S (Single Rope) x 10,000 m, B.L. 301 kN (30.7 ton)	TESAC
Core Carrier	〈Hydraulic on Fwd Catwalk〉 • 200 mmW x abt. 24 mL • Traveling Load/Length/Speed 0.5 kN/17.95 m/0～60 m/min.	Nishiatsu Engineering