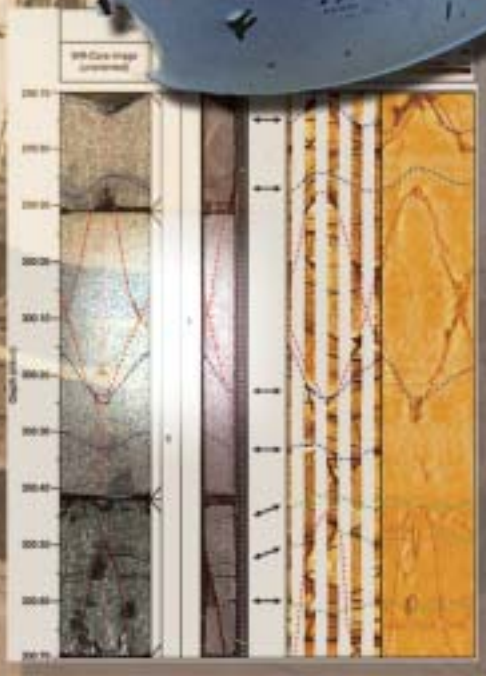
地球発見

CHIKYU HAKKEN

Earth Discovery



Volume 1
Spring,2005

Deep Science

Journey to the Center of the Earth

Since the days of the Egyptians, human beings have dreamed of journeys into the Earth. Underworld journeys have been the stuff of myth and fantasy. In Jules Verne's thrilling novel *A Journey to the Center of the Earth*, Professor Lidenbrock and his nephew Axel explore a mysterious, beautiful subterranean world by descending into an arctic volcano. This classic tale of adventure has ignited the imaginations of countless readers, explorers and scientists. Verne is considered the father of science fiction, and his theme is becoming science fact today.

Edouard Riou illustration from *A Journey to the Center of the Earth* by Jules Verne.

Edo era illustration of Namazu, the catfish that causes earthquakes.

Japanese lore has long associated the depths of the ocean with earthquakes. According to legend, catfish behave violently before the ground shakes. In Japanese myth, a giant catfish called Namazu keeps the islands of the archipelago afloat on its back. Whenever it would flip, earthquakes would occur, and its thrashing was only kept in check by the protective deity Kashima, who controlled the reviled troublemaker with a magic stone. The connection between the unknown deeps, the earth's behavior, and the lives and livelihood of humans has fascinated and absorbed storytellers, mythmakers, explorers and investigators for centuries.

Under the auspices of the Integrated Ocean Drilling Program, Japanese and other researchers are preparing to probe the inside of the Earth and reach unprecedented depths through undersea drilling in their quest to understand the unseen forces that shape our planet and its history – everything from changes in the Earth's climate to the movements of continents.

This drilling effort will produce cores – cylindrical samples of seabed deposits and rock that yield a wealth of information about the Earth when analyzed with advanced scientific instruments. The sediments deposited on the ocean floor are not unlike tape recorders of the Earth's history, providing glimpses of past climate, plate motions, catastrophic events such as volcanic eruptions and asteroid impacts, and even human activities that leave telltale chemical traces, such as advanced metallurgy or industrial activity.

Japan's main vehicle in this endeavor is the new riser drilling ship *D/V CHIKYU*, operated by the Japan Agency for Marine-Earth Science and Technology. This massive research platform is outfitted with powerful drilling tools and the latest laboratory equipment to bring scientists to new plateaus of geoscience knowledge from plate tectonics to paleomagnetism to the origin of life itself.

The need to understand the Earth's power, mechanisms and history is all the more critical in the wake of the cataclysmic tsunami disaster that struck South and Southeast Asia in December 2004. *D/V CHIKYU* presents one of the best means to learn more about our globe's hidden threats to human societies.

IODP: Inner Space Exploration

The Integrated Ocean Drilling Program is a long-term international effort on a grand scale to unravel the mysteries of the Earth's structure and history by analyzing marine sediments and rocks. The project was launched in October 2003 and the main participants are Japan, the United States and the European Union. Scientists will be following three main areas of investigation: the deep biosphere and sub seafloor ecosystems, environmental change, processes and effects, and solid earth cycles and geodynamics.

Over the past 40 years, scientist from more than 20 countries have produced intriguing results from research on ocean floor sediments and rocks that have appeared in prestigious journals such as Science and Nature. The IODP will build upon the legacies of the early drilling voyages of the Cuss I in 1961, the Deep Sea Drilling Project of 1968-1983, which helped prove the theory of plate tectonics, and the Ocean Drilling Program (ODP) of 1983-2003, which contributed significantly to our knowledge of short- and long-term climate change. These endeavors revolutionized our view of Earth history and global processes through ocean basin exploration. When fully operational in 2007, the IODP will be a larger program than its precursors with an annual budget of about $160 million, three times that of the ODP. It will introduce state-of-the-art ships and shore facilities, exploration of formerly inaccessible areas, faster research with new technologies and enhanced international scientific cooperation.

Science will set the goals of the IODP through a proposal review process. An international advisory committee drafted a 110-page Initial Science Plan (ISP) titled "Earth, Oceans and Life" for the project which sets forth its three research areas. It set forth the IODP's vision as to better comprehend the nature of the quake-generating zone under convergent continental margins, the nature of the microbial ecosystem that inhabits the sub seafloor, and gas hydrates, the tremendous frozen carbon reservoir lying under continental margins. Blue-ribbon review committee members praised the ISP and stated that "the scientific importance, technical feasibility and societal benefits of the ISP make it of exceptional importance and timeliness…the benefits of the program described in the ISP far outweigh the costs and the uncertainties." The IODP will focus on regions and processes of the Earth that were previously inaccessible or poorly understood.

Scientists participating in the IODP will make use of three drilling platforms to accomplish the goals of the Science Plan: JAMSTEC's *D/V CHIKYU*, which will use riser technology to drill to unprecedented seabed depths, a non-riser vessel provided by the United States that will be similar to the *D/V JOIDES Resolution*, a 143-meter-long drillship used in the ODP, and mission-specific platforms contributed by European countries that will be able to operate in ice-covered oceans, shallow-water zones and areas inaccessible to the *D/V CHIKYU* and *D/V JOIDES Resolution* or its successor.

The central management organization of the IODP is IODP Management International, Inc. (IODP-MI), a nonprofit U.S. corporation. It receives advice from the international IODP Science Advisory Structure, processes requests from the international scientific ocean drilling community and produces annual drilling plans in consultation with the program's Implementing Organizations in the United States, Japan and European Union countries. The IODP-MI has offices in Washington, D.C., and Sapporo, Japan. (Please see page 11 for a descriptive diagram of the IODP structure)

JAMSTEC: Exploring the Globe


JAMSTEC HQ, Yokosuka JAPAN

The Japan Agency for Marine-Earth Science and Technology was established in 1971 as the Japan Marine Science and Technology Center under Japanese government. JAMSTEC was reorganized on July 1, 2004 as an independent administrative institution with expanded scope and operations. JAMSTEC's overall mission is to better understand our planet and our relationship to it.

JAMSTEC consists of its headquarters in Yokosuka, the Yokohama Institute for Earth Sciences and the Mutsu Institute for Oceanography in Mutsu City, Aomori Prefecture, as well as US offices in Washington, DC and Seattle. JAMSTEC operates and maintains a wide array of ocean-going research vessels, submersibles, remotely operated vehicles, and research facilities including the Earth Simulator supercomputer as part of its ongoing mission.

Research initiatives and directions are aimed at understanding changes in the global environment, mitigating damage from earthquakes, tsunami, typhoon, and other natural hazards, and investigating marine geology and geophysics from the perspective of both pure research and technological development. Specific initiatives include observational and modeling research on global change (FRCGC and IORGC), investigations of the dynamics of the Earth's interior and Earth history (CDEX and IFREE), research in marine ecosystems and extremophiles (XBR), marine technology development (MARITEC), and computer simulation and modeling development across all of the above disciplines (ESC).

CDEX: Spearheading New Scientific Initiatives

JAMSTEC's Center for Deep Earth Exploration is the leading entity running the riser drilling vessel *D/V CHIKYU*, Japan's main tool in the IODP effort. CDEX's mission is to contribute to the accomplishment of the scientific goals of the international program through safe, effective and efficient operation of the *D/V CHIKYU*; to carry out technical developments for scientific drilling vessel management, drilling operations, and down hole measurement; and to support efforts to usher in new scientific fields of enquiry in geo- and bioscience through these activities. The logo of CDEX depicts one of the main goals of its work: the *D/V CHIKYU* drilling into the Earth's mantle, which accounts for over 80% of the Earth's mass.

D/V CHIKYU at Koyagi Shipyard, Nagasaki

Headquartered at the Yokohama Institute for Earth Sciences, CDEX is led by a director-general and consists of 13 groups under four main departments: Planning and Coordination, Operations, Technology, and Science and Planning. It employs about 70 scientists, technicians, managers, administrators and support staff who come from Japan and other countries, (Please see page 11 for a diagram of the CDEX organization.)

The main operations of CDEX are centered around the *D/V CHIKYU*. These consist of formulating drilling programs and annual operations for the *D/V CHIKYU* in consultation with the Central Management Organization of the IODP. *D/V CHIKYU* operations are based on these annual plans, and CDEX contracts operations jobs with companies commissioned to perform work on the drillship. CDEX also carries out site and drilling hazard surveys at candidate drilling sites, performs shallow seismic surveys, bathymetry and ocean current surveys needed for well planning. In addition, CDEX supports activities related to scientific research both onshore and offshore such as managing scientific data and dispatching scientists, conducts health, safety and environmental management for *D/V CHIKYU*-related activities and engages in outreach work to inform members of the scientific community, mass media and the public about the IODP and projects involving the *D/V CHIKYU*.

The People Behind the Science

Why is Japan taking a leading role in the IODP? "We live on the area where the Earth's activity is most vigorous – earthquakes, volcanic eruptions, crustal movements," says CDEX Director-General Asahiko Taira. "Japan is situated on these active planet processes and 30 million people actually live on one of the most dangerous or active places on the Earth. We all feel that our mission is to understand these deep Earth processes. We also felt the capabilities of the *JOIDES Resolution* were not enough in order to do that."

Aside from learning about crustal dynamics, drilling the seafloor will teach us about our world itself, says Taira, because the ocean is like a museum. "In the Abyssal Plain, disturbance by animals is very superficial," says Taira, whose research specialty is sedimentation, tectonics and paleo-oceanography. "Therefore the area is preserved as a sort of document. You have a very well preserved sedimentary layer which sometimes goes down to 200 million years ago. To us, it's exciting that the last 200 million years saw the Earth's climate change from a greenhouse to an icehouse, and we have the two sets of climatic behavior condensed in the record. The greenhouse world is probably a model for the future of the Earth if we emit too much CO_2, and global warming takes place."

Aside from helping to clarify important questions about the Earth's long-term climatic conditions, CDEX's *D/V CHIKYU* expeditions will be breaking new ground under the ocean, both literally and figuratively. "This is an area we don't know much about – how the ocean floor is altered, what are the chemical changes taking place, the water circulation system and its effect on earthquake and magmatic processes at the subduction zone," says Taira. "So this is a totally

brand new area. We have only drilled the upper 2 km, but the ocean crust is 6-7 km thick. Nobody knows its exact composition."

Taira, whose interest in geology grew out of his passion for collecting fossils as a youth around Sendai in northern Japan, has explored the deep himself, diving to depths of 5 km in submersibles over active sedimentation areas around the Nankai Trough. "It is like an alien world," he recalls. "The deep-sea floor is very, very active in many aspects. There are lots of animals, lots of garbage, even 200 km from the Japanese coast and at 4 km deep, we can see piles of plastic supermarket bags in a deep-sea canyon. The marine snow is enormous, but it contains light-emitting plant bacteria, so there were flashes of light when the submarine hit it."

Taira says CDEX's quest in operating the *D/V CHIKYU* will also touch on one of the profoundest questions humanity has ever contemplated: the origin of life on Earth. "Fifty years after the ocean drilling projects of the 1960s, the time is ripe, opportunities are available and technologies are advanced and this is the time we should go to the mantle," he says. "One of the main purposes of doing that is finding deep bacteria within the ocean crust and upper mantle. We believe there has to be life there. It's the same mission as searching for life on Mars."

Ultramafic rocks such as peridotite in the mantle produce compounds essential for life when they react with water. Says Taira: "We believe that kind of system still exists, particularly in areas like Indian Ocean, where the mantle is close to where it can react with seawater. This is a system which we believe created early life. There may be a change that we can catch the origin of life still taking place today."

"It's the same mission as searching for life on Mars."

Asahiko Taira
Director-General of CDEX

"The difficulty is how can we achieve good science?"

Shin'ichi Kuramoto
Science Service & Information Services Group Leader

The logistical and technical challenges of this unexplored frontier of our planet are being met by people such as Shin'ichi Kuramoto, Science Service & Information Services Group Leader in CDEX's Science and Planning Department. "The difficulty is how can we achieve good science?" says Kuramoto, who joined CDEX because it is representing Japan in the country's first international leadership role in a new scientific field. Kuramoto will help manage about 30 scientists and 20 support staff will work on the *D/V CHIKYU* and is tackling technical problems as well as how to maintain shipboard morale during the long expeditions and drilling interruptions.

Kuramoto also keeps the broader science and societal benefits in mind when working on the *D/V CHIKYU* project, such as undersea activity that can cause devastating earthquakes and tsunamis. "We can estimate how frequently marine sliding or earthquakes occur from learning the history of the Earth through geophysical technologies, but we still don't know when they will occur in the future," he says. "We take cores to better understand the mechanisms involved. Also, the boreholes can be used for future real-time, continuous monitoring systems of strain, tilting, and pressure and temperature changes. That will be a great advantage in giving us a few days' or hours' warning before something happens. Current warning systems in Japan only warn us 10 minutes before a large earthquake strikes. But we need real-time data from the exact point."

D/V CHIKYU sea trial in December, 2004

D/V CHIKYU: A beauty of a laboratory on a beast of a drillship

The deep sea riser drilling vessel *D/V CHIKYU*, meaning "Earth," is Japan's main vehicle in the IODP quest to unlock the secrets of the world beneath our feet. It is both the world's first dedicated science ship and the most advanced scientific drilling instrument ever. With the launch of the *D/V CHIKYU*, the science community's dream of drilling down to the Earth's mantle will finally be realized. Operated by CDEX, the *D/V CHIKYU*'s mission is to achieve the goal of going deeper than previous ocean drilling efforts and to usher in a new era in the earth and life sciences by harnessing the power of advanced technology.

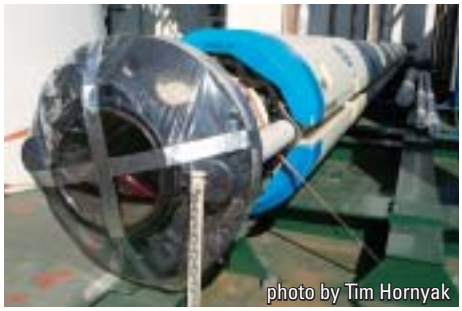
The *D/V CHIKYU* is the most powerful ocean drilling tool in the world. Using the riser drilling system deployed in the oil industry, which involves deploying a protective casing around the drill pipe and borehole, the *D/V CHIKYU* can drill 7 kilometers beneath the ocean floor, penetrating the Earth's crust and reaching the mantle. This will be far beyond the record depth of 2,111 meters set by the ODP. Drilling at the maximum water depth of 2.5 km, the *D/V CHIKYU* will wield a total drill pipe length of an astounding 9.5 km – 25 times the height of New York's Empire State Building.

The *D/V CHIKYU*'s budget was approved by the Japanese government in 2000 and construction began in 2001. She was launched in January 2002 at the Tamano Shipyard of Mitsui Engineering & Shipbuilding Co. in Tamano, Okayama Prefecture, after which rigging of the hull section began. She was moved in 2003 to the Koyagi Shipyard of the main contractor Mitsubishi Heavy Industries Ltd. in Nagasaki for fitting of the drilling section, including the derrick, which was lowered into place by Japan' largest floating crane. She is to begin official sea trials in 2005 after final outfitting and tests are completed in 2005.

"Since *D/V CHIKYU*'s drill string is about 10 km long, drilling efficiency is very important," says Yoshimasa Tamura, Director of CDEX's Technology Department. "To improve drilling efficiency, we need a tall derrick. The *D/V CHIKYU*'s derrick is the world's tallest, including the oil community. We also need a large ship to support it. Harmonizing all the complex onboard systems was a challenge."

Drilling derrick

Top drive assembly



Riser apparatus

Dynamic positioning system

Equipment on the drill floor

D/V CHIKYU's power plant

Aside from its drilling capabilities, the *D/V CHIKYU* can stupefy the visitor by her sheer size and heavy industrial might. At 210 meters long, about three-quarters the length of the Titanic, and with a gross tonnage of 57,500 tons, she appears to be at once a floating white city, drilling platform, assembly line and heliport. Her 70-meter derrick was built in Europe and shipped via the Suez Canal, and once combined with the compensator and drill floor mount, soars into the sky a total of 116 meters above the waterline. Massive cranes swivel slowly over the decks bringing drilling pipes into position in the drilling apparatus. The *D/V CHIKYU* can accommodate 150 people on four-week rotations, crew changes are accomplished by helicopters carrying up to 30 passengers that land on the massive helipad installed at the bow of the ship. Even ocean scientists are impressed.

"It's a monster," says Shin'ichi Kuramoto, who as a student sailed on the riserless drillship *D/V JOIDES Resolution* operated by the United States. "When I first saw it, I thought, 'It's so big – can we really operate this thing?'"

Notes Tamura: "It's surprising that the science community is using such a large ship, which are usually used for industrial needs dictated by economical efficiency. But this is very similar to aeronautical projects using rockets, like a space program."

"It's surprising that the science community is using such a large ship"

Yoshimasa Tamura
Director of Technology Department

Inside the vessel is the most sophisticated laboratory on the seas, boasting an X-ray CT scanner and other instruments for non-destructive core analysis, as well as a microorganism lab and paleomagnetic lab. The stability of the vessel also allows the use of more sensitive equipment than in the past.

"The science is always fun on expeditions and scientists want all sorts of samples," says Kazushi "Kuro" Kuroki, Chief of Science Support at CDEX, who has been installing the numerous pieces of lab equipment on the *D/V CHIKYU*. "My job is to help science and give the scientists good data." Another important task for shipboard technicians is safely handling the chemicals stored in the ship's labs, learning firefighting skills and how to troubleshoot when service personnel are unavailable.

"My job is to help science and give the scientists good data."

Kazushi "Kuro" Kuroki
Chief of Science Support

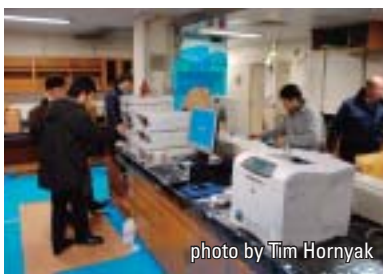
The technology that the *D/V CHIKYU* brings to bear for its main job incorporates some of the latest advances in ocean drilling and piloting. The riser drilling system is the key to direct sampling of the Earth's mantle, and the *D/V CHIKYU* is the first scientific research project to make use of this oil industry know-how.

"We want to provide good samples for scientists, that's the challenge of drilling with the *D/V CHIKYU*," says CDEX Director of Operations Department Hajime Saga, a former exploration chief with Japan Petroleum Exploration Co. (JAPEX). "We will apply sophisticated oil industry drilling operations to scientific purposes. In the future, we can reach these very deep scientific targets using the riser drilling system. So we can provide many deep samples for scientists."

To do this, large-diameter riser pipes connect the *D/V CHIKYU* to the wellhead on the ocean floor and guide the drill pipe into the well. A 380-ton blow out preventer (BOP) about the size of a six-story office building sits over the borehole, acting as a vital shield protecting the vessel from unexpected eruptions of gas, oil and other fluids from the drilling shaft with a 15,000 pounds-per-square-inch pressure-control system. Artificial drilling fluid called "mud" is circulated from the *D/V CHIKYU* by high-pressure pumps down into the drill pipes and up again through the riser pipes along with drill cuttings. Nine-meter core samples are cut by the drill bit, captured in core barrels, brought up by the wireline retrieval winch system and then sectioned into 1.5 meter tubes for shipboard analysis.

For successful riser drilling kilometers beneath the seabed, the *D/V CHIKYU* is

Biology lab



Geochemistry lab

kept in place directly above the drill hole by its dynamic positioning system, or DPS, specially modified in Japan for use on *D/V CHIKYU*. The ship receives GPS data from satellites and DPS computers automatically correct for tidal, wind and wave effects on position by firing six 360-degree-azimuth thrusters under the hull. It can keep the vessel within a 15-meter radius zone. The system was tested during a sea trial when the *D/V CHIKYU* was struck by a typhoon with winds of up to 30 meters per second and 8-meter waves. The vessel can continue drilling in surface currents up to 3-4 knots, windspeeds of up to 23 meters per second, and wave heights of up to 4.5 meters; however, large-scale deep ocean currents pose significant challenges. Eight compact diesel engines are needed for positioning control, along with 6,600-volt power generators – equipment in a class similar to but many times more powerful than the system used for Japan's Shinkansen bullet train lines.

"In the future, we can reach these very deep scientific targets using the riser drilling system"

Hajime Saga
Director of Operations Department

Saga notes that oceanic hazards are only part of the risks in drilling that are very difficult to detect beforehand. "Shallow hazards include shallow gas, methane hydrate and shallow water flow – these are very fast currents underground." Deeper hazards include geopressured gas, hydrocarbons, pressured water and geological faults. "Stuck pipes and tool loss are routine," he adds.

Onboard X-Ray CT scanning lab

Core lab

Center for Advanced Marine Core Research: Slicing, Dicing and Cooling Cores

The mission of the Center for Advanced Marine Core Research (CMCR) is to analyze marine cores using a multidisciplinary approach to understand changes in the Earth's environment and to assess potential resources in deep sea sediments. This initiative began in April 2000 as a university research facility under the name Marine Core Research Center. In April 2003, the Center was reorganized as a national research facility, was renamed and moved to the Monobe Campus of Kochi University in Kochi Prefecture on Shikoku Island. The CMCR, which is affiliated with CDEX in carrying out Japan's commitments in the IODP, will serve as a marine core repository for deep sea sediments, and will be the only place in Japan where a comprehensive suite of analyses can be conducted. The CMCR has three main roles: to be the main facility for analyzing core materials in Japan, to act as a core repository and analytical facility for the IODP, and to become the most advanced center for marine biosphere and geosphere sciences in the world. About 25 scientists, researchers and students from Japan and abroad work at the CMCR led by a director, deputy director and professors.

The CMCR building at Kochi University features a state-of-the-art multidisciplinary geoscience laboratory and core repository facilities. These allow for more sophisticated measurements than with the equipment aboard the *D/V CHIKYU*.

Kochi Core Center's main building

Sediment core in its core tube

"We want to be able to provide the same analytical environment as the ship," says Staff Scientist and geologist Kan Aoike, who has been setting up the facility's tools. "Also, Kochi is an onshore training and basic experiment facility for marine technicians. When the international operations begin, half of our marine technicians will be at sea and the other will work in Kochi. This kind of mirroring system is very important to maintain and improve technicians' skill levels, know-how in analyses as well as maintenance and data quality."

"Kochi is an onshore training and basic experiment facility for marine technicians"

Kan Aoike
Staff Scientist

The primary core analysis tools available for researchers are an X-ray CT and Multi-Sensor Core Logger lab, a paleo and rock magnetism lab, and a sampling room. These provide scientists with knowledge of the internal structure of cores and other physical properties. Detailed analyses can be performed in the physical property and sedimentology lab, the inorganic chemistry lab, the organic chemistry labs, the microscope and imaging room and the X-Ray Diffractometry, X-Ray Fluorescence and Scanning Electron Microscope lab. These facilities allow researchers to analyze microplankton remains in sediments, the crystal structures of sediments and rocks and the chemical, mineralogical, and biological fingerprints of the paleoenvironment. Other facilities include an Inductively Coupled Plasma Mass Spectrometer lab and microbiology lab. After cores are analyzed and measured, they will be stored in the CMCR's four core storage rooms, which can hold 2,000 square meters of cores, approximately 10 years' production, or nearly 80 km of core samples. These rooms are continuously monitored to avoid fluctuations in heat and humidity to keep the cores in good condition. A deep freezer will hold microbiological samples to fend off oxidation and chemical breakdown. Scientific data obtained from core analysis both at CMCR and on the *D/V CHIKYU* will be stored in a new onshore and offshore database system; they will be made public after a one-year moratorium

"Sediment cores are like tape recorders"

Kazuho Fujine
Curator

"My job is to be an achivist, conservator and educator," says Curator Kazuho Fujine. "Sediment cores are like tape recorders, but some scientific information can break down in long-term storage. Scientific measurement results such as biomarkers, called proxies, are a kind of language of the core sample. Scientists can reconstruct environmental change using proxies."

April 2005: Setting Sail for Scientific Discovery

After more than a decade of planning, coordination with the international community, consultations with scientists, technicians, officials from industry and government the dream of a Japanese scientific drill ship is coming true.

Final installations and calibrations on *D/V CHIKYU* will be completed in the spring and summer of 2005, and she will undergo sea trials, equipment tests, and crew training mission during this year. The first drilling mission, a drilling test expedition will begin in early 2006 off the coast of Hokkaido in the Shimokita Region. The CMCR will then come on line during that period, and will be ready to receive cores from the drilling expedition slated to begin in 2007.

When these systems are on line, Japan will have arrived at the forefront of Ocean Drilling.

Article contributed by Tim Hornyak, Science Correspondent

D/V CHIKYU Construction

2001

April 25

Keel laid for *D/V CHIKYU* at Tamano Shipyard, Okayama Prefecture

June 21

Cutting and bending of steel plate and beams for hull and superstructure

June 16

Fitting out of engines, propulsion, navigation equipment and computers

May 16

April 16

Interiors, wiring, and piping—installation ongoing

2003

April 22

Beginning of first sea trial

May 20

Sea trial of propulsion systems

June 7

Sea trial of positioning and navigation systems, transit to Koyagi Shipyard, Nagasaki Prefecture

November 27

Laboratories and deck controls and equipment installed

September 24

Drilling derrick assembled and installed

2004

January 16

Deck equipment and safety equipment installed

April 10

Blow out preventer installed

History

September 6

Double hull assembled

September 22

Lower decks assembled, thrusters and mounts installed

October 2

Decks and hull completed

October 5

Moonpool sections assembled

January 18 **2002**

Launching ceremony

December 13

Laboratories and quarters assembled, interiors and wiring installed

July 2

D/V CHIKYU at Koyagi Shipyard for installation of drilling and deck equipment

July 24

Moonpool construction and installation complete

August 6

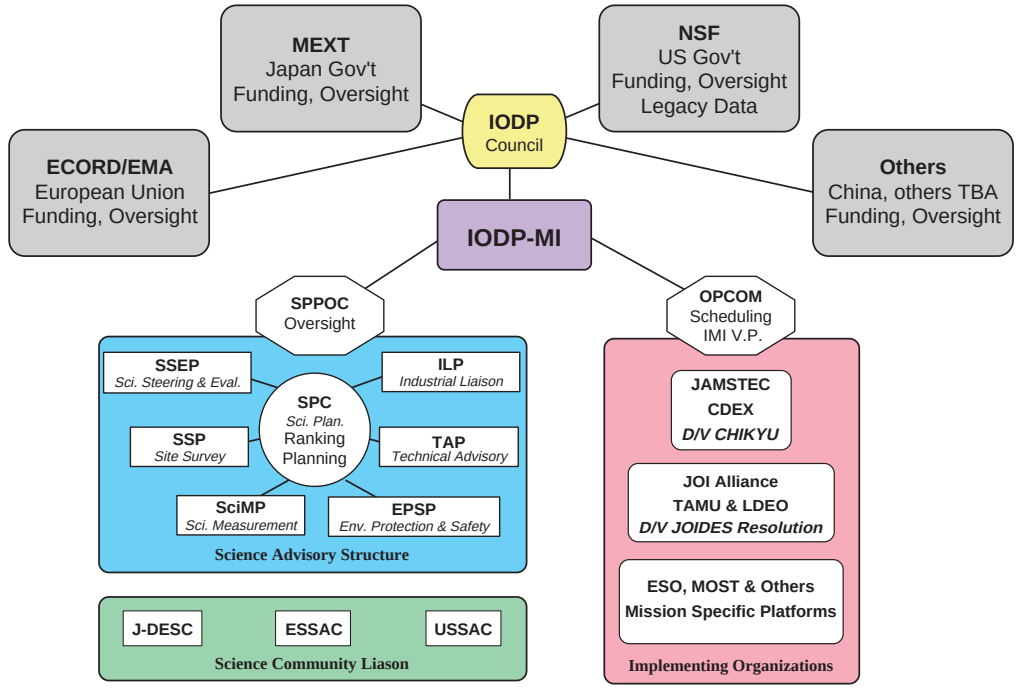
Drill floor module, winches and deck cranes installed

December 3

Second sea trial begins

Organization Structure

IODP



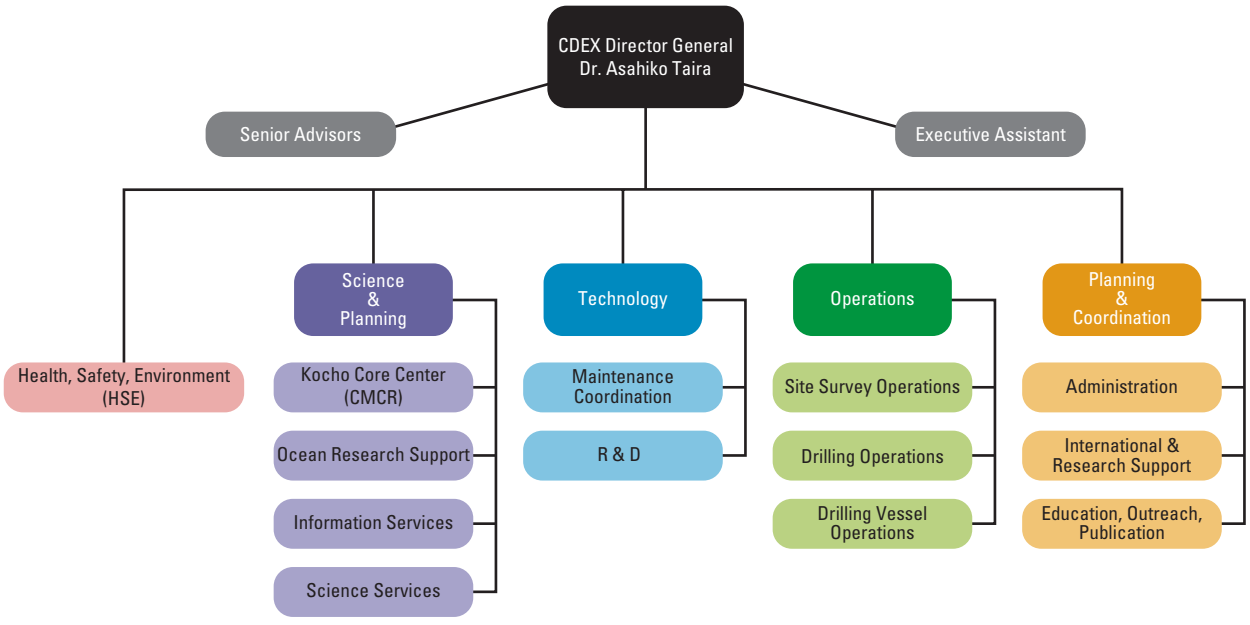
IODP – Integrated Ocean Drilling Program
IODP-MI – Integrated Ocean Drilling Program Management International
MEXT – Ministry of Education, Culture, Sports, Science and Technology
ECORD – European Consortium for Ocean Research Drilling
EMA – ECORD Managing Agency
MOST – Ministry of Science and Technology
NSF – National Science Foundation

SPPOC – Science Planning and Policy Oversight Committee
OPCOM – Operations Committee

J-DESC – Japan Drilling Earth Science Consortium
ESSAC – ECORD Science Support and Advisory Committee
USSAC – U.S. Science Advisory Committee

JAMSTEC – Japan Agency for Marine-Earth Science and Technology
CDEX – Center for Deep Earth eXploration
ESO – ECORD Science Operator
JOI – Joint Oceanographic Institutions

CDEX



CDEX has moved and grown

In July 2004 the OD21 Program Office and the Center for Deep Earth Exploration were combined to form an expanded Center for Deep Earth Exploration, one of department of JAMSTEC. The OD21 Program Office was an arm of JAMSTEC until July 2004, and was responsible for the construction of the CHIKYU and development of associated technologies, setup of the CHIKYU operational structure, and arrangement of domestic/international supporting structures.

The expanded CDEX group moved to new offices at the Yokohama Institute for Earth Sciences on November 22, 2004.

The office's new address is:

Center for Deep Earth Exploration (CDEX)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Yokohama Institute for Earth Sciences
3173-25 Showa-machi, Kanazawa-ku
Yokohama, Kanagawa 236-0001 JAPAN
PHONE: +81-45-778-5643
FAX: +81-45-778-5948
E-mail: cdex@jamstec.go.jp

Access information about the new location of CDEX at:

http://www.jamstec.go.jp/jamstec-e/access/yokohama/index.html

CDEX Public Relations Activities

The primary objectives of CDEX are to operate *D/V CHIKYU* to achieve science goals, and to inform/communicate the current status, results, and discoveries to a wide range of audiences, including researchers, technicians, administrators, educators and the public. The CDEX PR group bears responsibility for providing a bridge between CDEX and the outside world.

Based on this principle, we have conducted several promotion activities through 2004 to early 2005, including the IODP campaign at universities and schools, exhibitions at museums, and promotion and exhibition at international scientific conferences.

Our main communication tool is our web site, which has become the primary venue for timely, comprehensive, interactive, and international public relations. We are planning for a renewal of the CDEX web site: it will soon be the main window into the operations and activities of the *D/V CHIKYU*, the Kochi Core Center, and CDEX activities as the Japanese Implementing Organization of IODP. This site will be opened to the public on or around late March 2005. News, press releases, activity updates, and event information will appear on this site, and will be continuously updated.

Web address: http://www.jamstec.go.jp/jamstec-e/odinfo/index.html

2004

April 26
China officially joined IODP

April 16 – 17
The First IODP University & Museum Campaign (Kyushu)

May 9 – 13
Joint Meeting of Earth and Planetary Science (Makuhari)

May 15
Open House at the JAMSTEC Yokosuka Headquarters

May 30 – June 15
The Second IODP University & Museum Campaign (Tochigi)

July 5 – 9
1st Asia Oceania Geoscience Society (Singapore)

July 31 - August 1
Youngsters' Science Festival

August 10 – 15
Summer Vacation Science Square
(National Science Museum, Tokyo, Japan)

August 16 – 20
Western Pacific Geophysics Meeting (Honolulu, USA)

August 22
Kanto Gakuin University: Fureai Festival 2004

September 18 –20
Geological Society of Japan (Chiba)

October 16 – 17
The 3rd IODP University & Museum Campaign
(Yamagata)

October 30 – November 7
The 4th IODP University & Museum Campaign (Osaka)

November 9 – 12
OCEANS'04 / TECHNO-OCEAN'04 (OTO'04)

November 15 – 17
Coordinating Committee for Geoscience
Programmes in East and Southeast Asia:(CCOP)(Tsukuba)

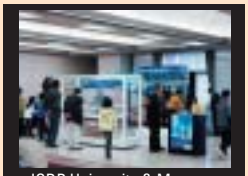
November 18
The signing ceremony of Memorandum of Understanding between the IODP-MI and the JAMSTEC concerning the IODP

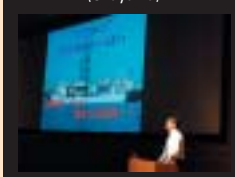
December 4 – 11
The 4th IODP University & Museum Campaign (Okayama)

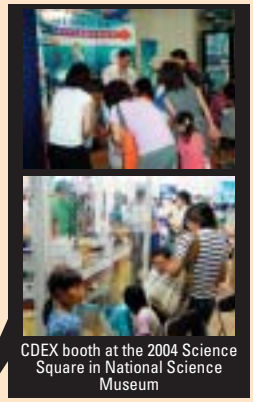
December 13 – 17
AGU Fall Meeting (San Francisco, USA)

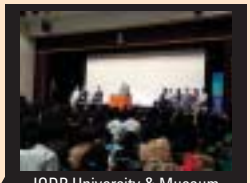

CDEX presented a booth promoting IODP at the AOGS in July, 2004


CDEX booth at the meeting of the Geological Society of Japan at Chiba University, September 18-20, 2004.


IODP University & Museum campaign at the RSK media com (Okayama)


IODP University & Museum campaign at the Okayama University of Science


CDEX booth at the 2004 Science Square in National Science Museum


IODP University & Museum campaign at the Kishiwada High School in Osaka


2004 AGU Fall meeting

Booths and presentations at recent scientific conferences

CDEX presented exhibitions and promotional booths at several international and domestic scientific conferences in 2004, often in collaboration with IODP-MI. In early May 2004, the Japan Earth Planetary Science Joint Meeting, one of the largest Japanese earth science conferences, was held in Makuhari, Chiba Pref. Every year, researchers, instructors, and students studying the geo-sciences gather from all over Japan, and almost 1,000 participants attend the meeting. In 2005, this meeting will be held from May 22 to 26 in Makuhari, Chiba. You can find the information at : **http://www.epsu.jp/jmoo2005/index_e.html**

CDEX presented a promotional booth at the 1st annual Asia Oceania Geoscience Society meeting in Singapore from July 5-9, 2004. Many Asian researchers, mainly from India, Taiwan and Indonesia, attended and participated in a lively exchange of opinions and information. The 2nd AOGS will be held in Singapore next year.

The 2004 American Geophysical Union (AGU) Fall meeting covers topics in all areas of geophysical sciences and this year it was held in San Francisco. IODP exhibited a booth in cooperation with CDEX.

IODP
INTEGRATED OCEAN DRILLING PROGRAM

IODP-MI booth at AGU, December 2004 in San Francisco. Chikyu model in front of the booth

IODP University & Museum Campaign in 2004

To promote IODP and *D/V CHIKYU* to students and the general public, the IODP University & Museum Campaign was held in 5 areas all around Japan. This campaign consisted of 3 parts:

1) Lectures held in universities for graduate and undergraduate students given to advertise IODP and educate regarding the program and the life and activities of onboard researchers,
2) Lectures to the general public in museums,
3) The exhibition of posters and other educational materials in universities and museums.

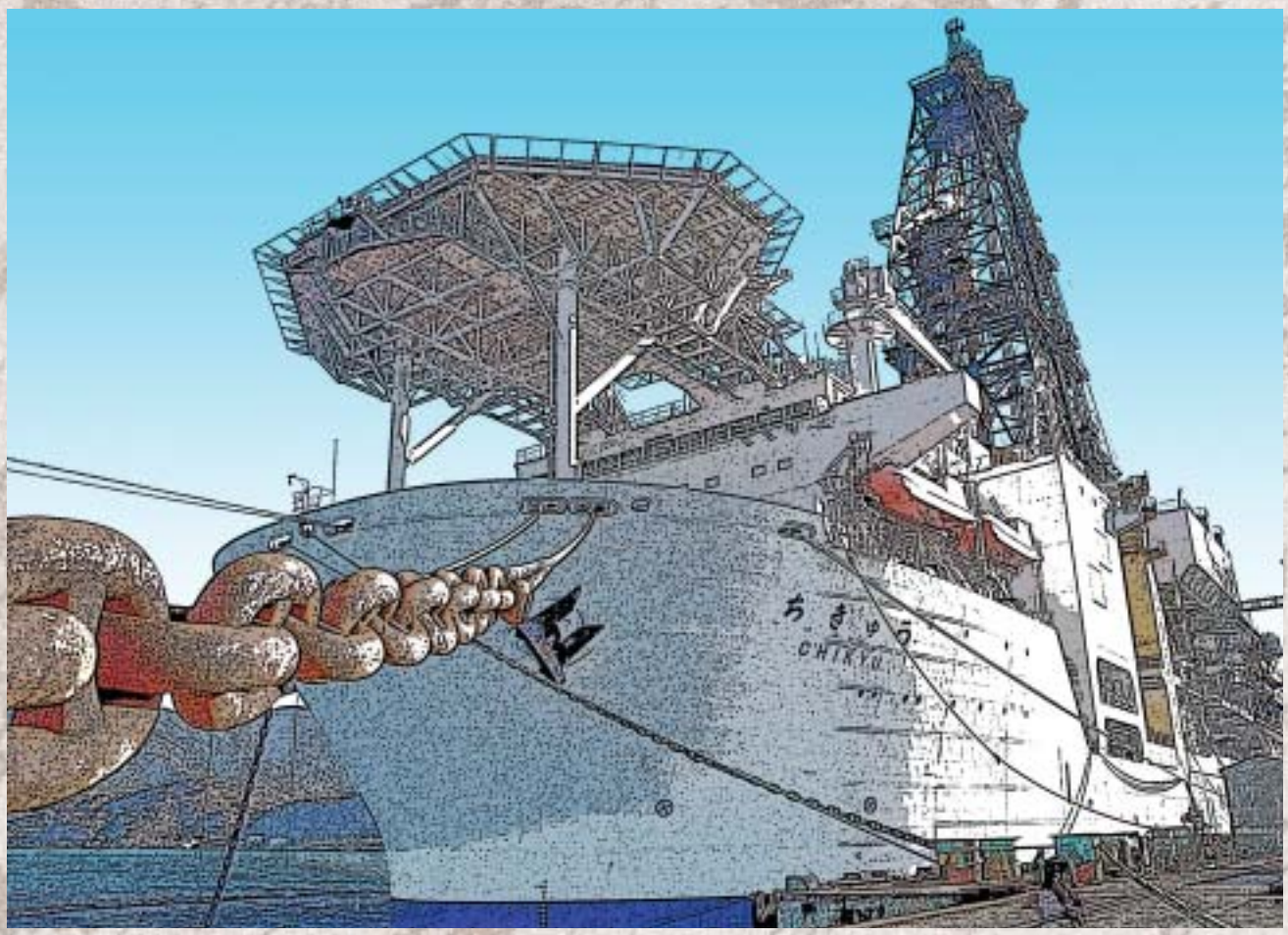
These lectures addressed the mission and structure of IODP, the scientific goal in Japan, the administrative system, how to write a proposal to get on board *D/V CHIKYU* as a researcher, and the work of marine technician, scientist, researcher. We are considering how we should perform more effective campaign and we continue to improve this campaign. This campaign will continue in 2005.

- 16-17 April: Kyusyu University / Kitakyusyu Museum of Natural History & Human History, Japan
- 30-31 May: Utsunomiya University/ Tochigi Prefectural Museum
- 31 July -1 August : The Faculty of Science, Shinshu University, Matsumoto
- 10-15 August: National Science Museum, Tokyo, Japan
- 16-17 October, 2004, Yamagata University / Yamagata Museum of Science and Industry
- 30-31 October: Kishiwada Senior High School / Osaka Museum of Natural History and Industry
- 4-5 December: Okayama University of Science / Kurashiki Museum of Natural History / RSK media com
- 10-11 February, 2005 University of the Ryukyus / Okinawa Churaumi Aquarium

About the CDEX logo

The CDEX logo is designed to give an impression of the mantle, which the deep sea drilling vessel *D/V CHIKYU* will attempt to reach. The colors gradually change from the deep sky blue of the surface gradually moving through the color scale to invoke the sea, sedimentary layers, the earth's crust, and finally, the mantle. The earth's crust as it is depicted here shows a subduction zone, a primary focus of research at CDEX.

CENTER FOR DEEP EARTH EXPLORATION
CDEX
JAMSTEC



CHIKYU HAKKEN — Earth Discovery —

IODP JAPAN Implementing Organization Report

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- World map from SANDWELL, 1997 made using GMT
- Seismic data from CDEX Nankai Trough experiment
- Core image and data from ODP Leg 206, Initial Report