



**Università di Trieste**  
**Corso di Laurea in Geologia**

**Anno accademico 2018 - 2019**

**Geologia Marina**

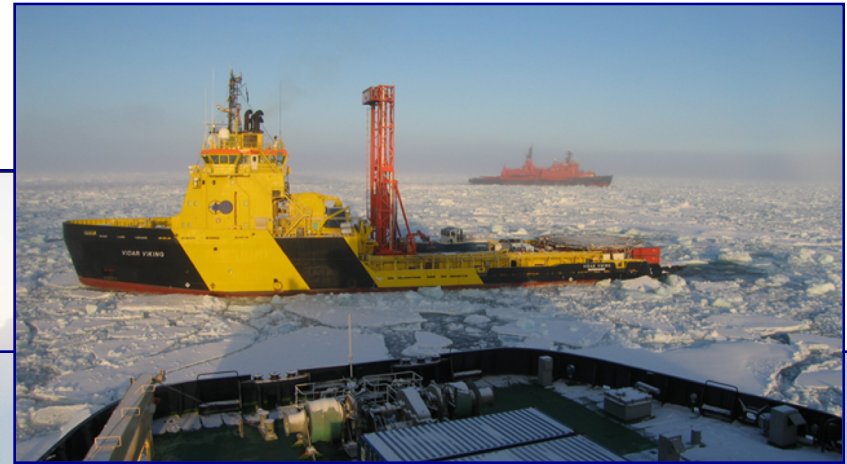
Parte II

**Modulo 2.4** Perforazione Oceanica

Docente

**Angelo Camerlenghi**

# Scientific ocean drilling is one of Earth sciences' longest running and most successful international collaborations.





# The International Ocean Discovery Program (IODP)

## Exploring the Earth Under the Sea

is an international marine research collaboration that explores Earth's history and dynamics using ocean-going research platforms to recover data recorded in seafloor sediments and rocks and to monitor subseafloor environments

<http://www.iodp.org>



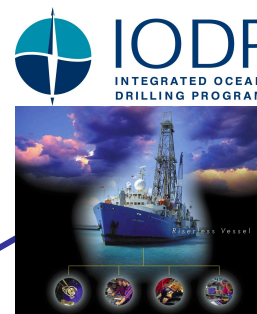
**MOHOLE**  
1958-1966



**Deep Sea Drilling Project (DSDP)**  
1968-1983



**Ocean Drilling Program (ODP)**  
1985-2003



**Integrated Ocean Drilling Program (IODP)**  
2003- 2013

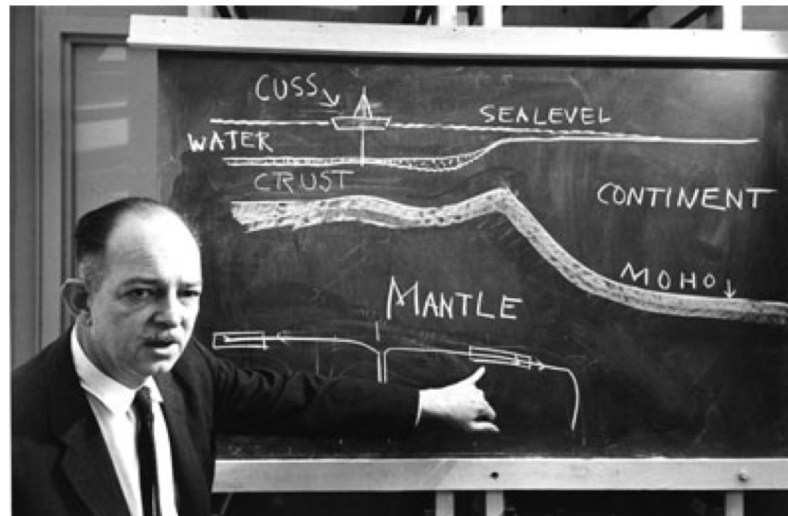


**October 2013**

**International Ocean Discovery Program (IODP)**

*End in*  
**October 2023**

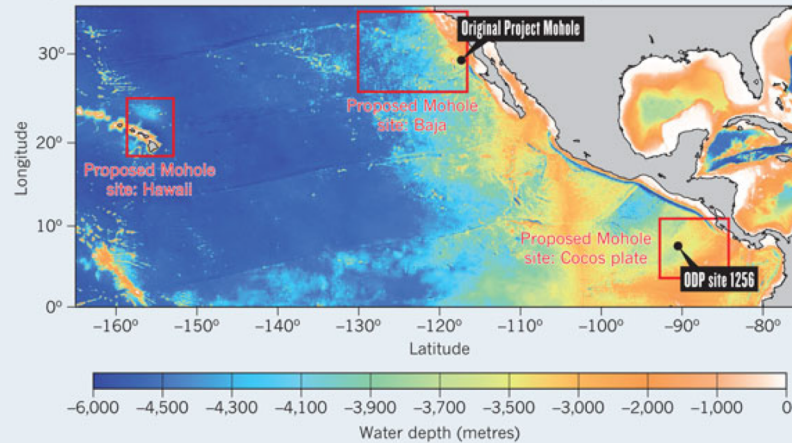
In 1961 scientific drilling took root as a feasible technology to study Earth's subseafloor geology. **Project Mohole**, a concept developed by the American Miscellaneous Society with funding from the National Science Foundation, considered the feasibility of **drilling through the Mohorovičić seismic discontinuity**



Harry Hess, a founding father of the theory of plate tectonics, explains Project Mohole  
Damon Teagle and Benoît Ildefonse, *Nature*, 2011.

### DRILLING SITES

Three areas are under consideration for drilling into the mantle. One includes the original Project Mohole drilling site. Another includes a site (ODP site 1256) where scientists will drill this year into the lower crust.

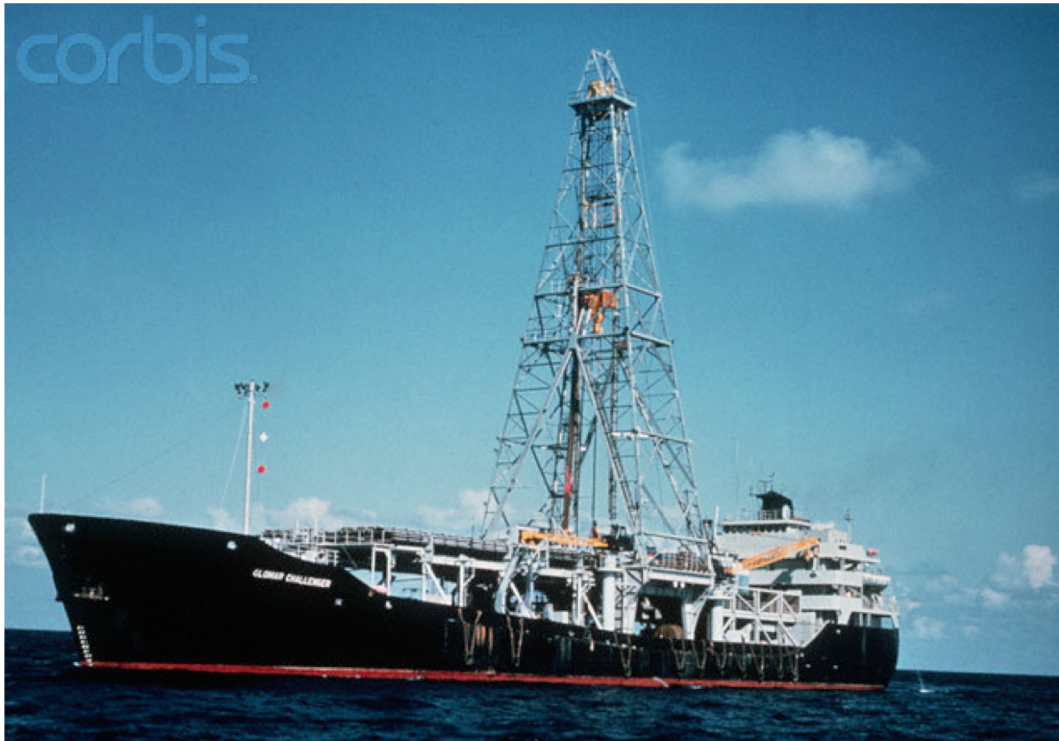


*Drill ship CUSS 1*



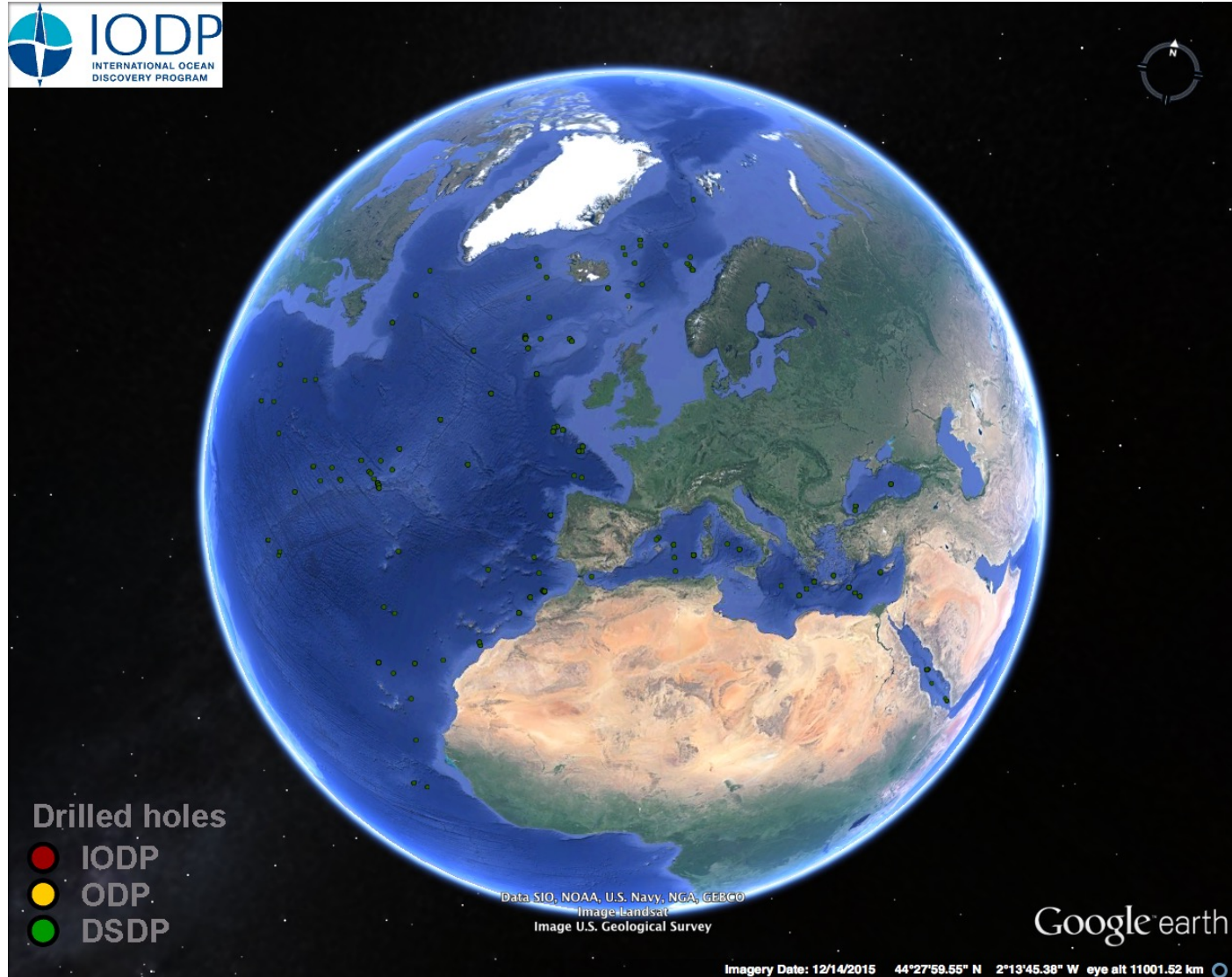
Five holes were drilled off the coast of **Guadalupe Island, Mexico**, the deepest to 601 ft (183 m) below the sea floor in 11,700 ft (3,600 m) of water. This was unprecedented: not in the hole's depth but because of the depth of the ocean and because it was drilled from an untethered platform. Also, the core sample proved to be valuable; penetrating through Miocene-age sediments for the first time to reveal the lowest 13 m (44 ft) consisting of basalt.

The next phase of scientific ocean drilling, the **Deep Sea Drilling Project (DSDP)**, began in 1966 using the Drilling Vessel *Glomar Challenger*. This pioneer vessel for DSDP conducted drilling and coring operations in the Atlantic, Pacific and Indian oceans as well as the Mediterranean and Red Seas. The *Glomar Challenger* also advanced the technology of deep-ocean drilling.





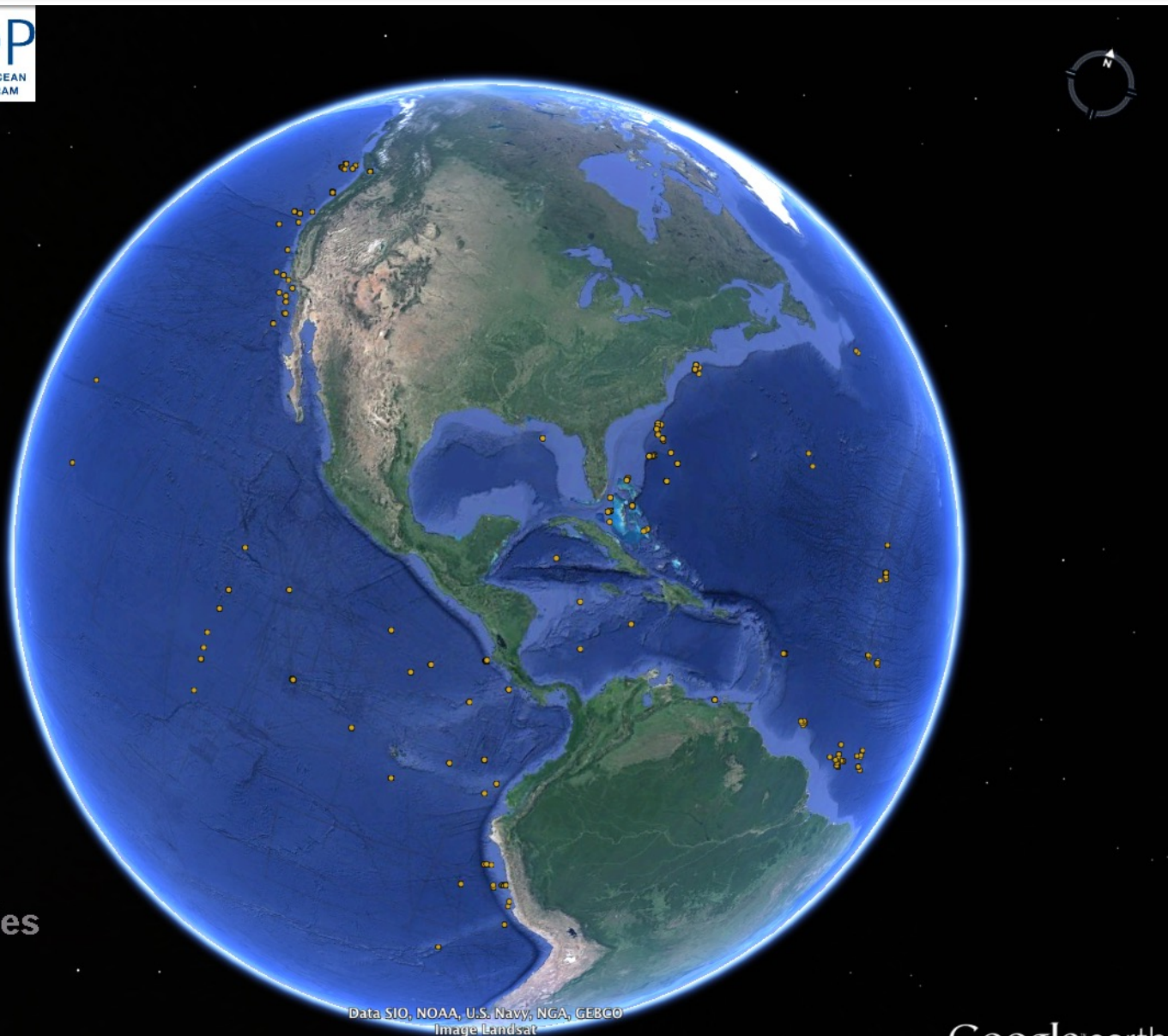
## DSDP drillsites in the Mediterranean and North Atlantic



In 1985, *JOIDES Resolution* replaced the *Glomar Challenger* at the start of a new program, the **Ocean Drilling Program (ODP)**. ODP was truly an international cooperative effort to explore and study the composition and structure of the Earth's subseafloors. The *JOIDES Resolution* conducted 110 expeditions for ODP at 2000 drill holes located throughout the world's ocean basins.







**Drilled holes**

- IODP
- ODP
- DSDP

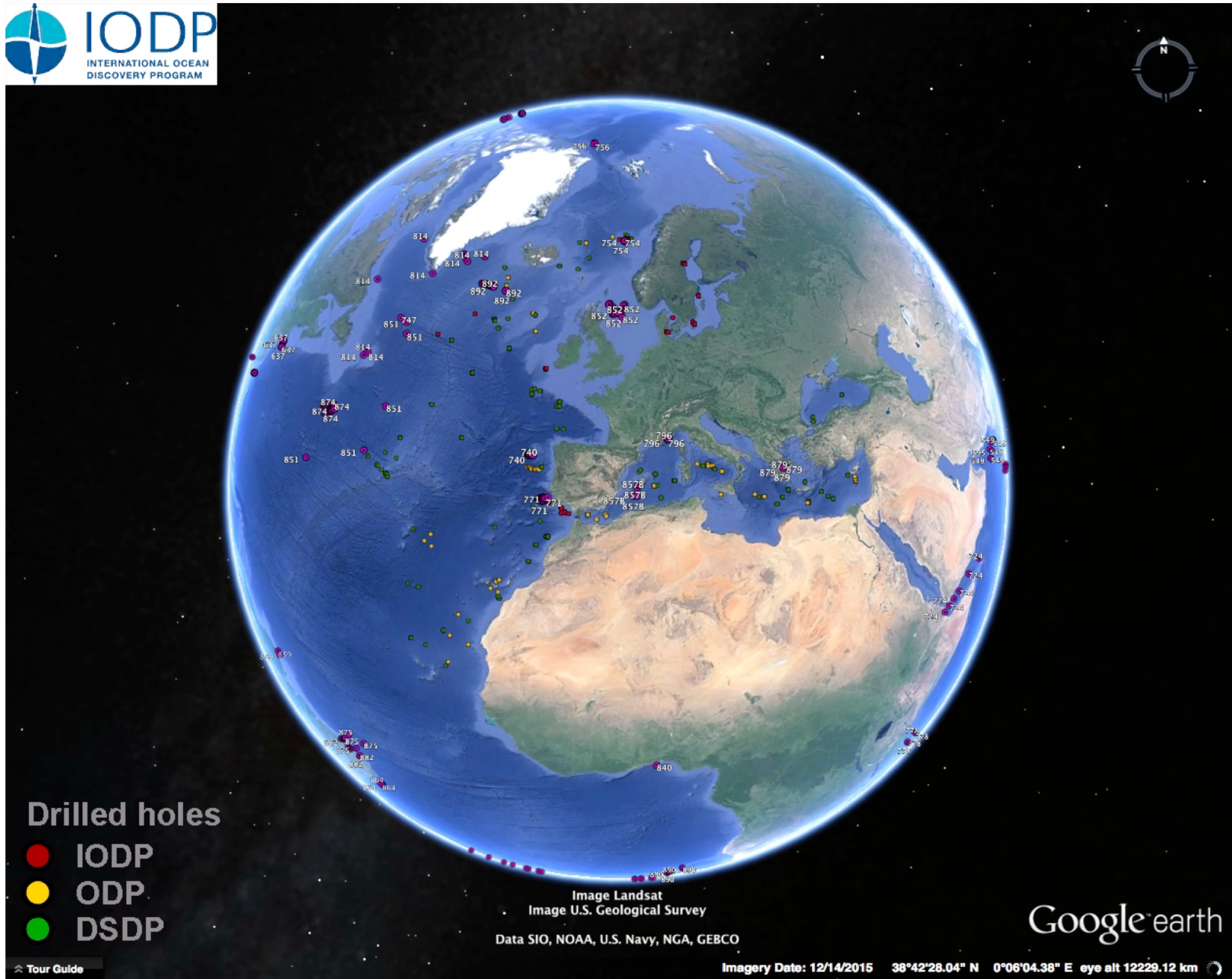
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image Landsat

Google earth

The **Integrated Ocean Drilling Program (IODP 2003-2013)** built upon the international partnerships and scientific success of the DSDP and ODP by employing multiple drilling platforms financed by the contributions from 26 participating nations. These platforms - a refurbished *JOIDES Resolution*, the new marine-riser equipped Japanese Deep Sea Drilling Vessel *Chikyu*, and specialized Mission-Specific-Platforms - were used to reach new areas of the global subsurface during 52 expeditions.





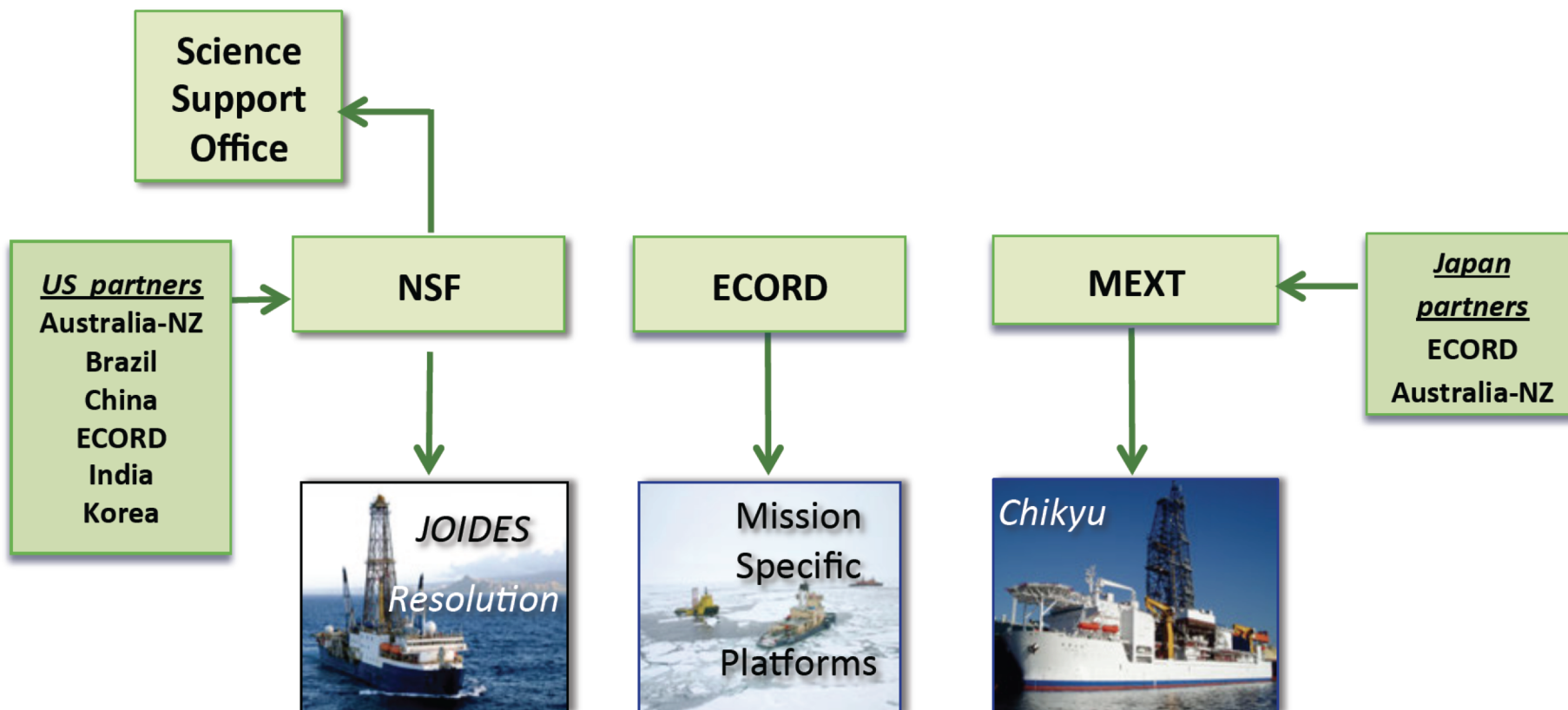


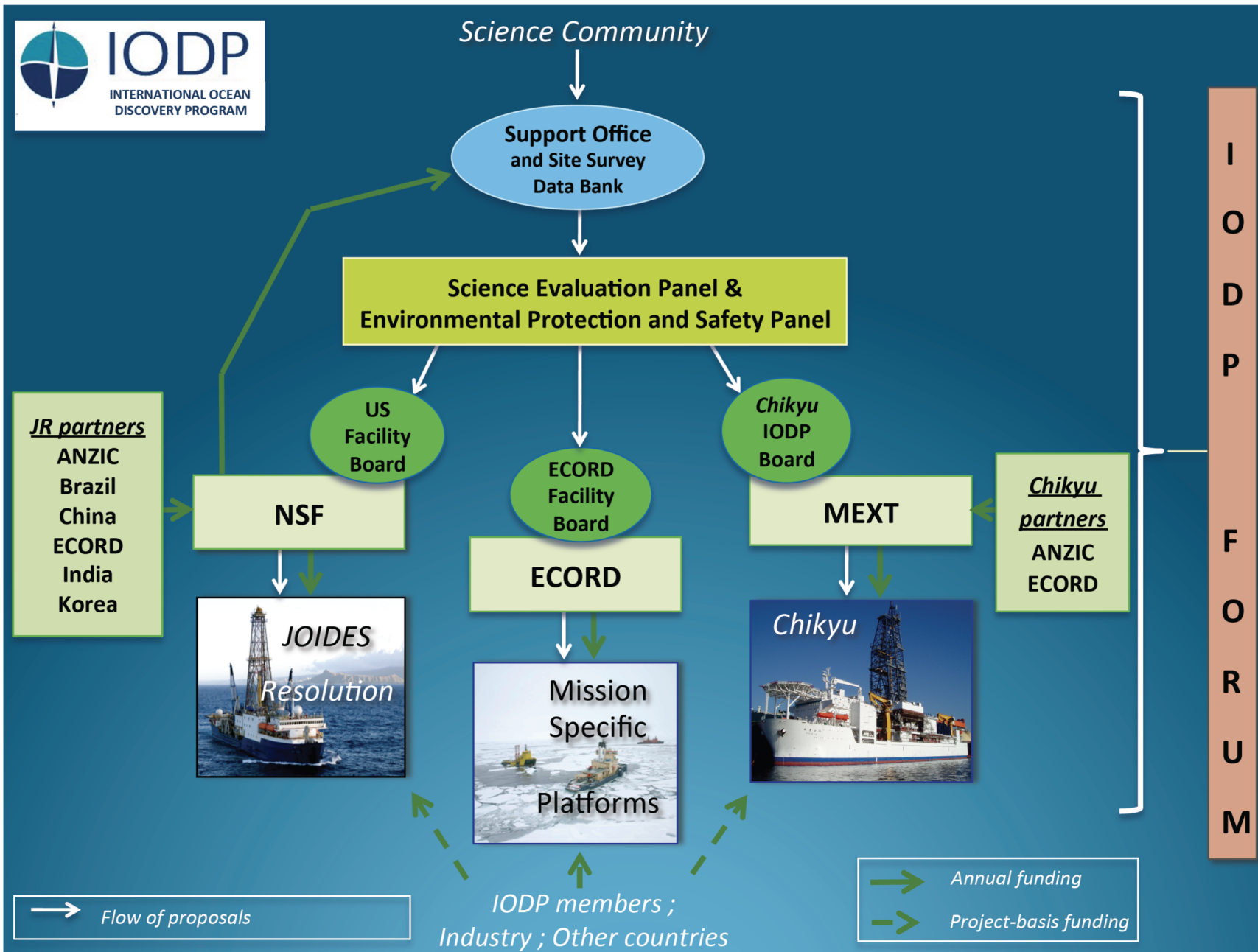
# Fundamental principles of IODP

- ***science driven project***
- ***science plan :***
  - **Climate and Ocean Change:** Reading the Past, Informing the Future
  - **Biosphere Frontiers:** Deep Life, Biodiversity, and Environmental Forcing of Ecosystems
  - **Earth Connections:** Deep Processes and Their Impact on Earth's Surface Environment
  - **Earth in Motion:** Processes and Hazards on Human Time Scales
  - Education AND OUTREACH
- ***multiple platform approach to drilling***

# IODP Funding Model

- Each platform operated independently by respective country or consortia
- Science Support Office funded by NSF









## HOW MUCH DOES IT COST? Example from end of IODP phase

<b>NSF and MEXT</b>	Total program costs (75 M USD / anno) Platform operation costs Science operation costs
<b>ECORD</b>	7 M USD / year (2003-2006) 16.8 M USD (2006)
<b>MOST</b>	5.5 M USD 2003-2008 (1.0 - 1.5 M USD / year)

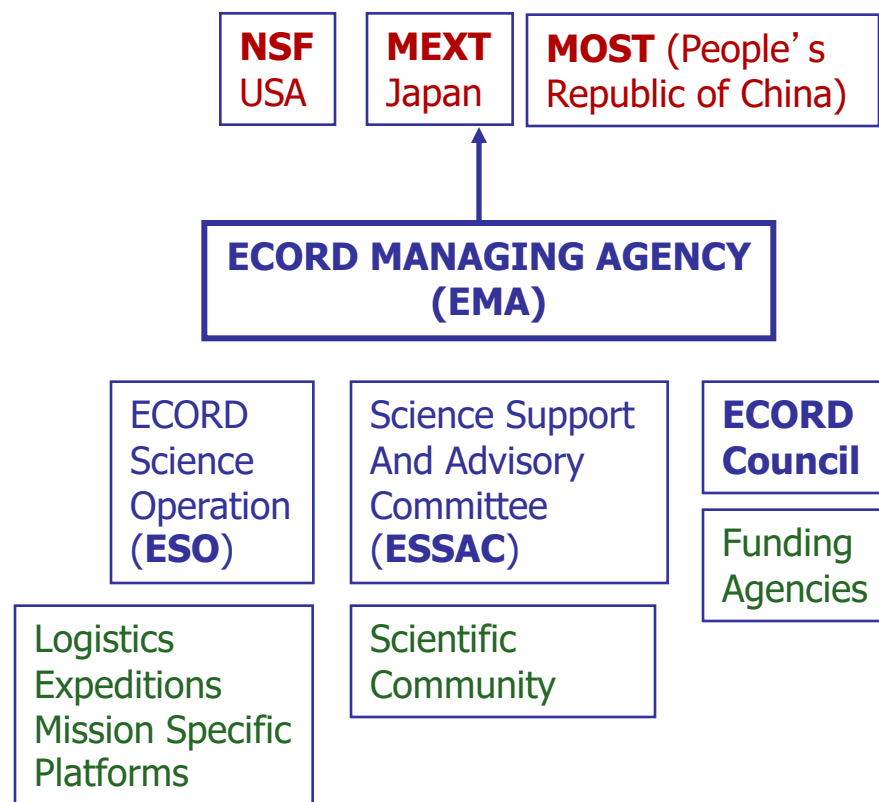
## ECORD

(European Consortium for Ocean research Drilling).



### 16 European nations + Canada

Austria	Italy
Belgium	The Netherlands
Canada	Norway
Denmark	Portugal
Finland	United Kingdom
France	Spain
Germany	Sweden
Ireland	Switzerland
Iceland	



**Prevision 2005: ECORD 12.5 Million USD, ~ 17 % of IODP**

## ECORD Science Operation (**ESO**)

**ESO** is a consortium of European scientific institutions created to manage the operations of the **Mission Specific Platforms-MSP** on behalf of ECORD in the framework of the [Integrated Ocean Drilling Program-IODP](#).

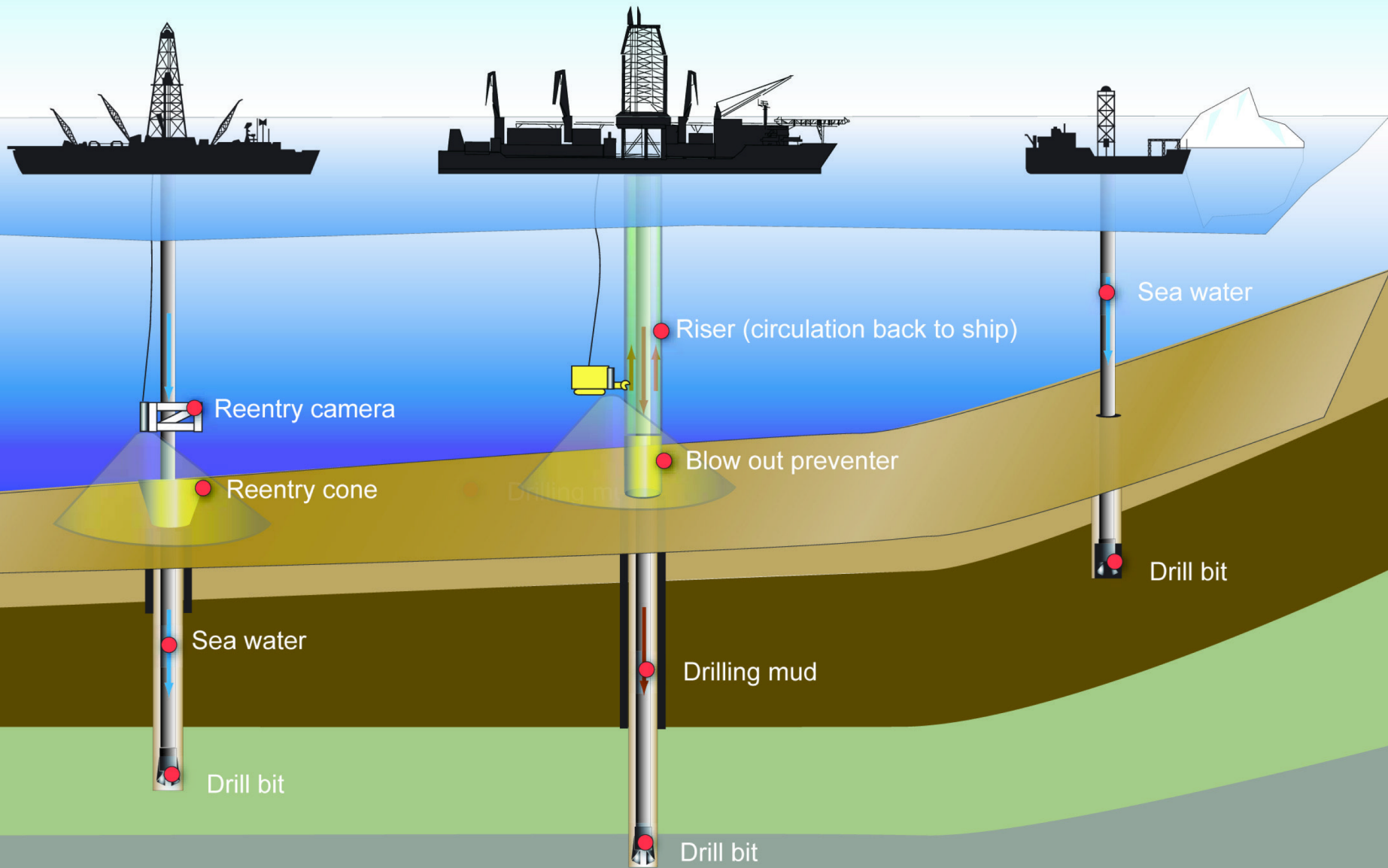
**ESO** is composed by:

- The [British Geological Survey - BGS](#), (co-ordinator) responsible of the overall management, under contract with EMA as indicated by the ECORD Council;
- The [University of Bremen](#), sub-contracted by BGS to manage the core repository and the data management with the WDC-MARE/PANGAEA ([IODP-MSP data portal](#)). GFZ Potsdam contributes with by supporting ESO with the Drilling Information System (DIS)for offshore data acquisition;
- The [European Petrophysical Consortium](#), sub-contracted by BGS to manage the Wireline Logging operations and petrophysical activities. The Consortium is composed by:
  - University of Leicester (co-ordinator), U.K,
  - the Université de Montpellier 2, France,
  - RWTH Aachen, Germany and Vrije Universiteit of Amsterdam, Netherlands.

# Riserless Drilling

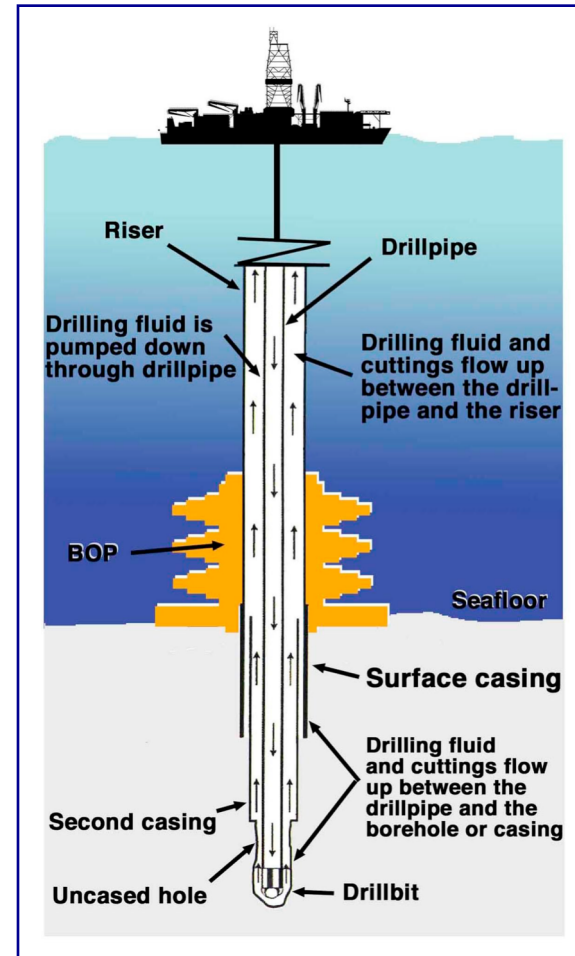
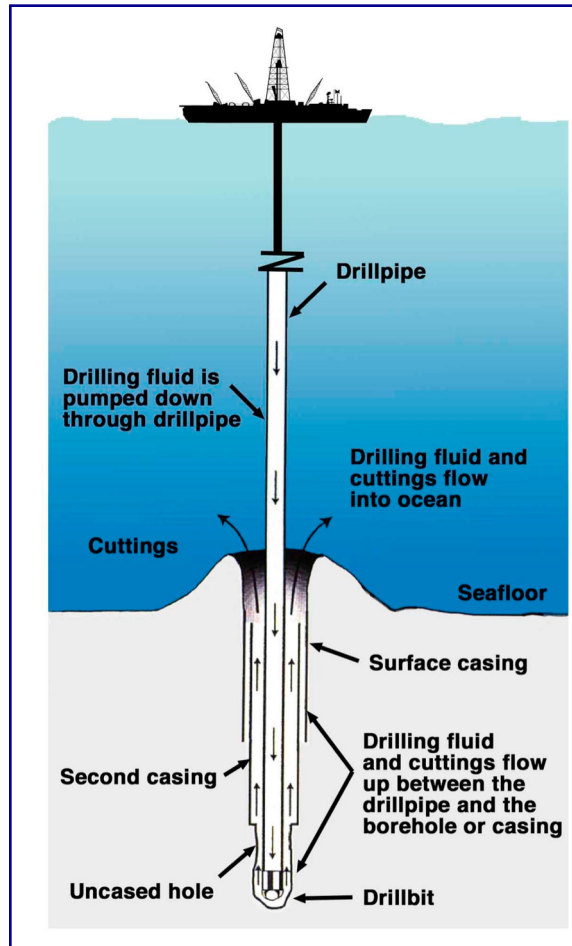
# Riser Drilling

# Mission-Specific



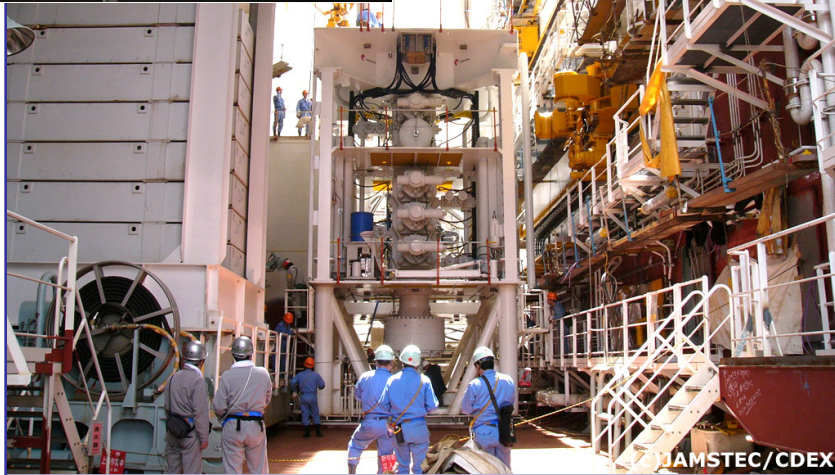
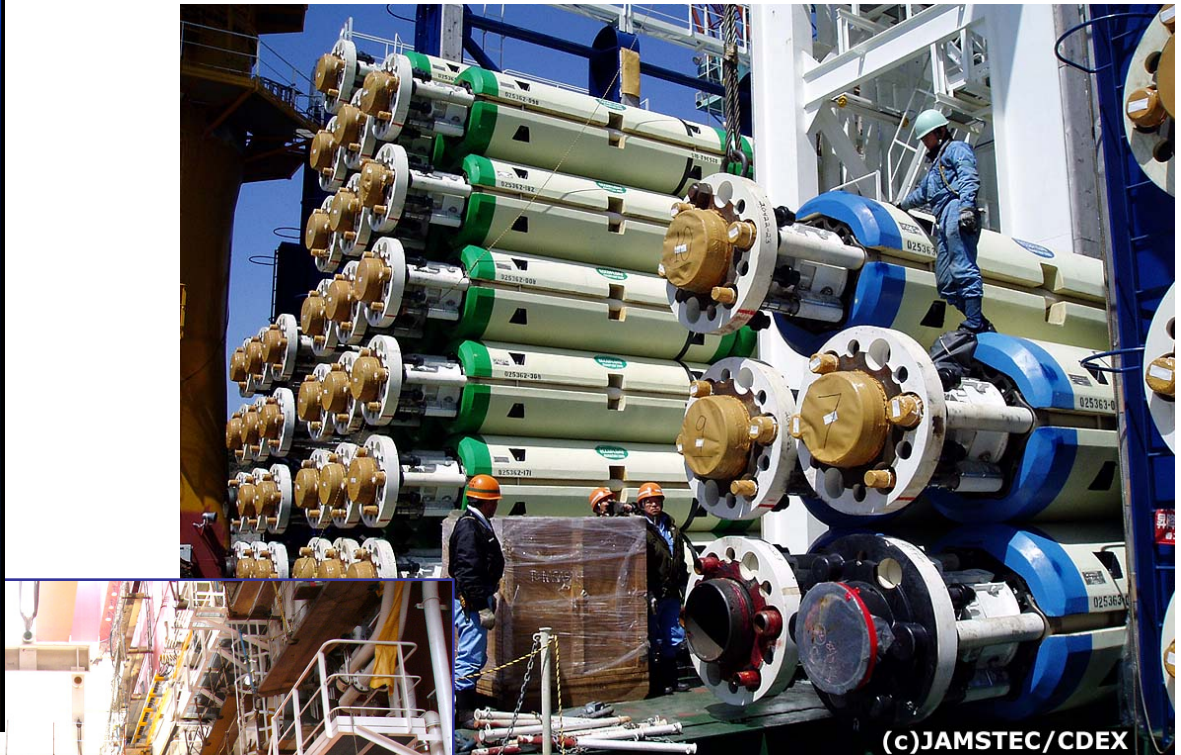
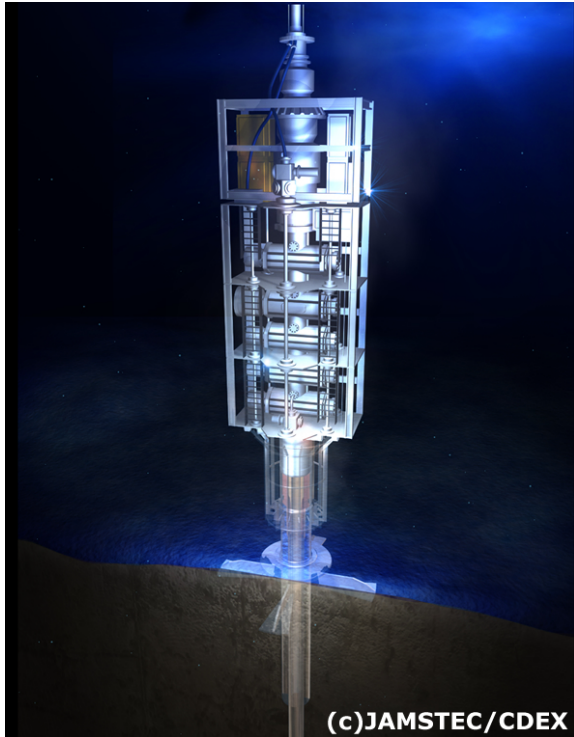


## THE 'RISER' DRILLING SYSTEM





<https://www.youtube.com/watch?v=yuu0QcnOVbo>



# CORE ON DECK

[http://www.youtube.com/watch?feature=player\\_embedded&v=wC9IDPvvze0](http://www.youtube.com/watch?feature=player_embedded&v=wC9IDPvvze0)

[http://www.iodp.org/images/stories/swf/jamstec\\_english\\_1\\_deepsea\\_drilling.swf](http://www.iodp.org/images/stories/swf/jamstec_english_1_deepsea_drilling.swf)

[http://www.iodp.org/images/stories/swf/jamstec\\_english\\_2\\_rotary\\_drilling.swf](http://www.iodp.org/images/stories/swf/jamstec_english_2_rotary_drilling.swf)

[http://www.iodp.org/images/stories/swf/jamstec\\_english\\_3\\_riser\\_system.swf](http://www.iodp.org/images/stories/swf/jamstec_english_3_riser_system.swf)

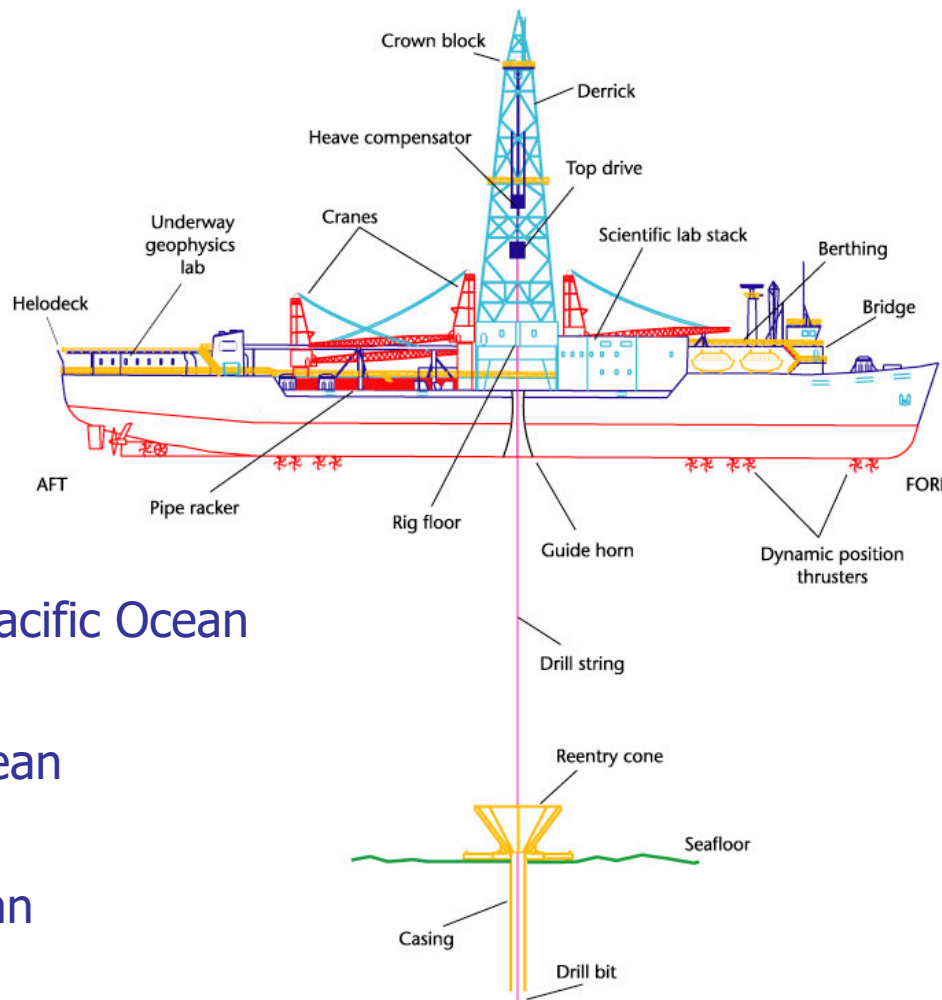
[http://www.iodp.org/images/stories/swf/4core\\_procedure\\_eng.swf](http://www.iodp.org/images/stories/swf/4core_procedure_eng.swf)

<http://www.iodp.org/core-analyzing-process/2/>



# ***JOIDES Resolution Riserless Drillship***

<b>Length</b>	<b>143 m</b>
<b>Width</b>	<b>21 m</b>
<b>Height of the rig</b>	<b>61.5 m</b>
<b>Crew</b>	<b>111 people</b>
<b>Drilling pipes</b>	<b>9 km</b>



**Deepest hole penetrated:**  
2,111 m Leg 148, Hole 504B, E Pacific Ocean

**Shallowest water depth:**  
37.51 m, Leg 143, NW Pacific Ocean

**Greatest water depth:**  
5,980 m, Leg 129, W Pacific Ocean

**Minimum water depth** according to specifications: 75 m







# Site Surveys



# Dynamic Positioning

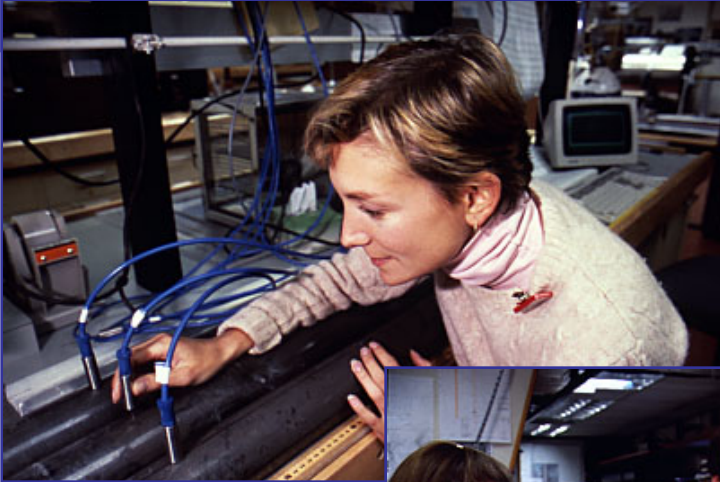


# Drilling



# Hole Re-entry





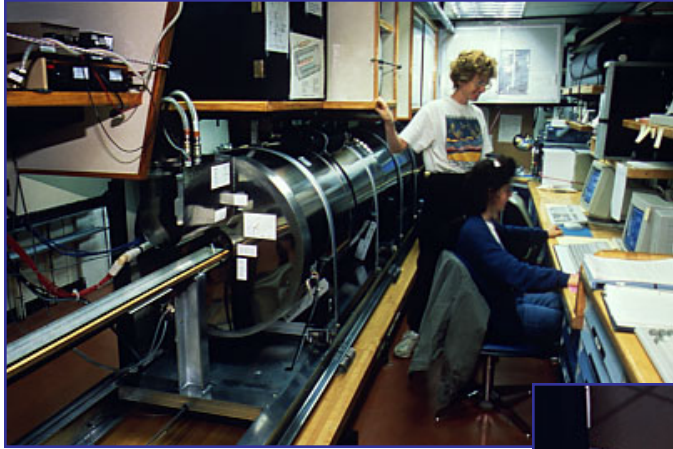
**Core  
Handling**



**Core Logging**



## Geomagnetic logging



## Microbiology



## Micropaleontology



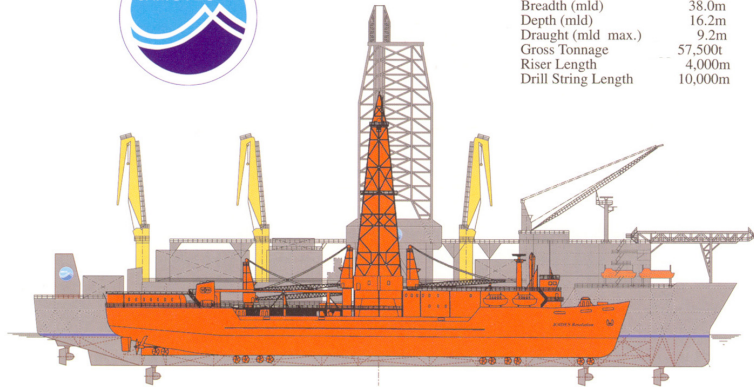
## Geochemistry



## Downhole Logging



# Chikyu Riser Drillship



## Principal Particulars

Length Overall	210.0m
Length Bpp	192.0m
Breadth (mld)	38.0m
Depth (mld)	16.2m
Draught (mld max.)	9.2m
Gross Tonnage	57,500t
Riser Length	4,000m
Drill String Length	10,000m

## JAPAN (MEXT)

Japan invests in the new deep sea riser drilling vessel Chikyu. The vessel will then be offered to IODP as drilling platform.



# *Chikyu* Riser Drillship



<b>Length</b>	<b>210 m</b>
<b>Width</b>	<b>38 m</b>
<b>Draft</b>	<b>9.2 m</b>
<b>Weight</b>	<b>57000 Ton</b>
<b>Crew</b>	<b>150 people</b>
<b>Pipes</b>	<b>10 km</b>
<b>Riser length</b>	<b>4 km</b>



The ship is built and operated by **JAMSTEC**, The Japan Agency for Marine-Earth Science and Technology