Università di Trieste
Corso di Laurea in Geologia

Anno accademico 2026 - 2027

Geologia Marina

Parte II

Modulo 2.1 Misure oceanografiche e perforazione dei fondali oceanici

Docente
Laura De Santis

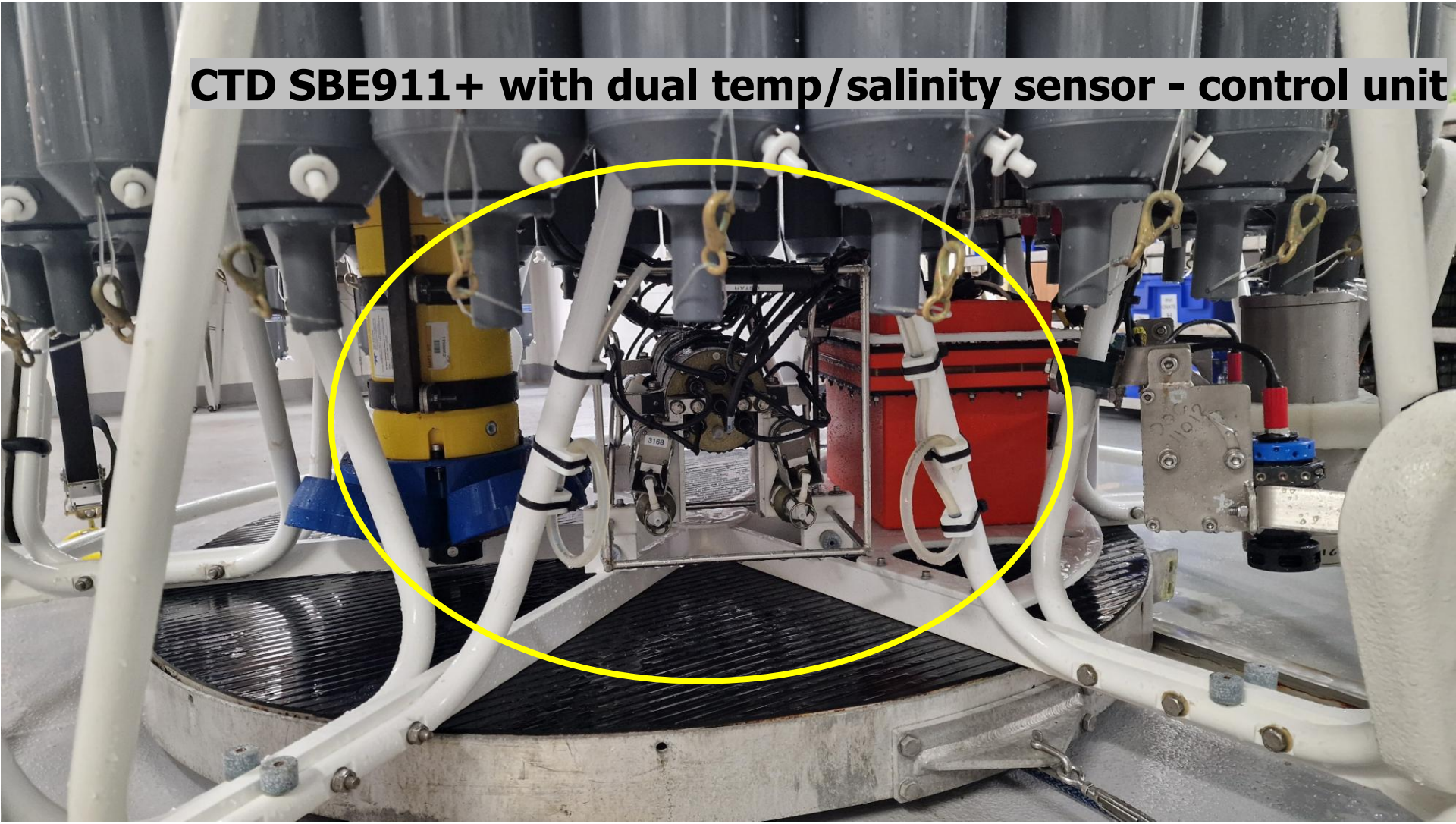


Photo by L. De Santis

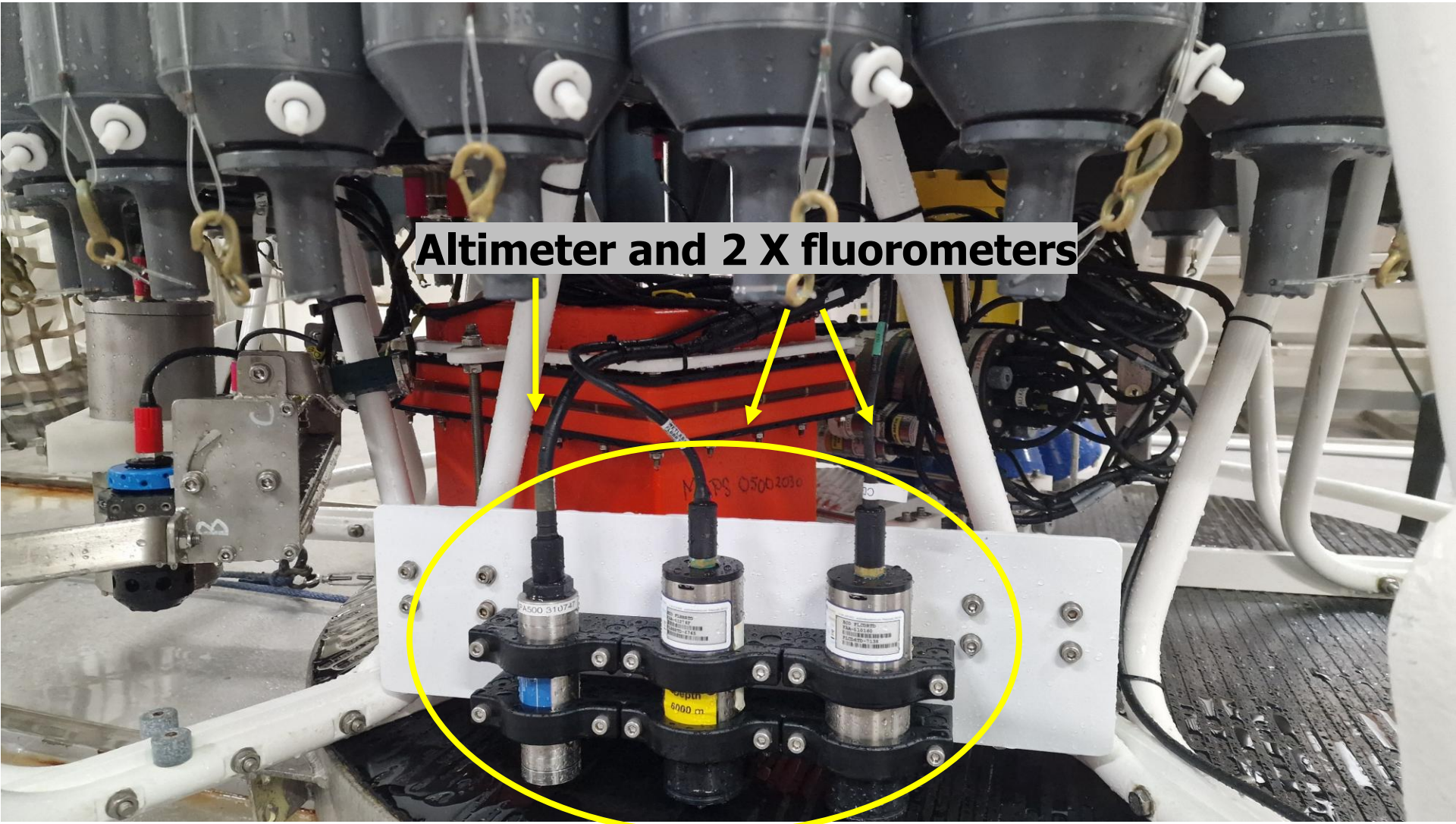


Photo by L. De Santis

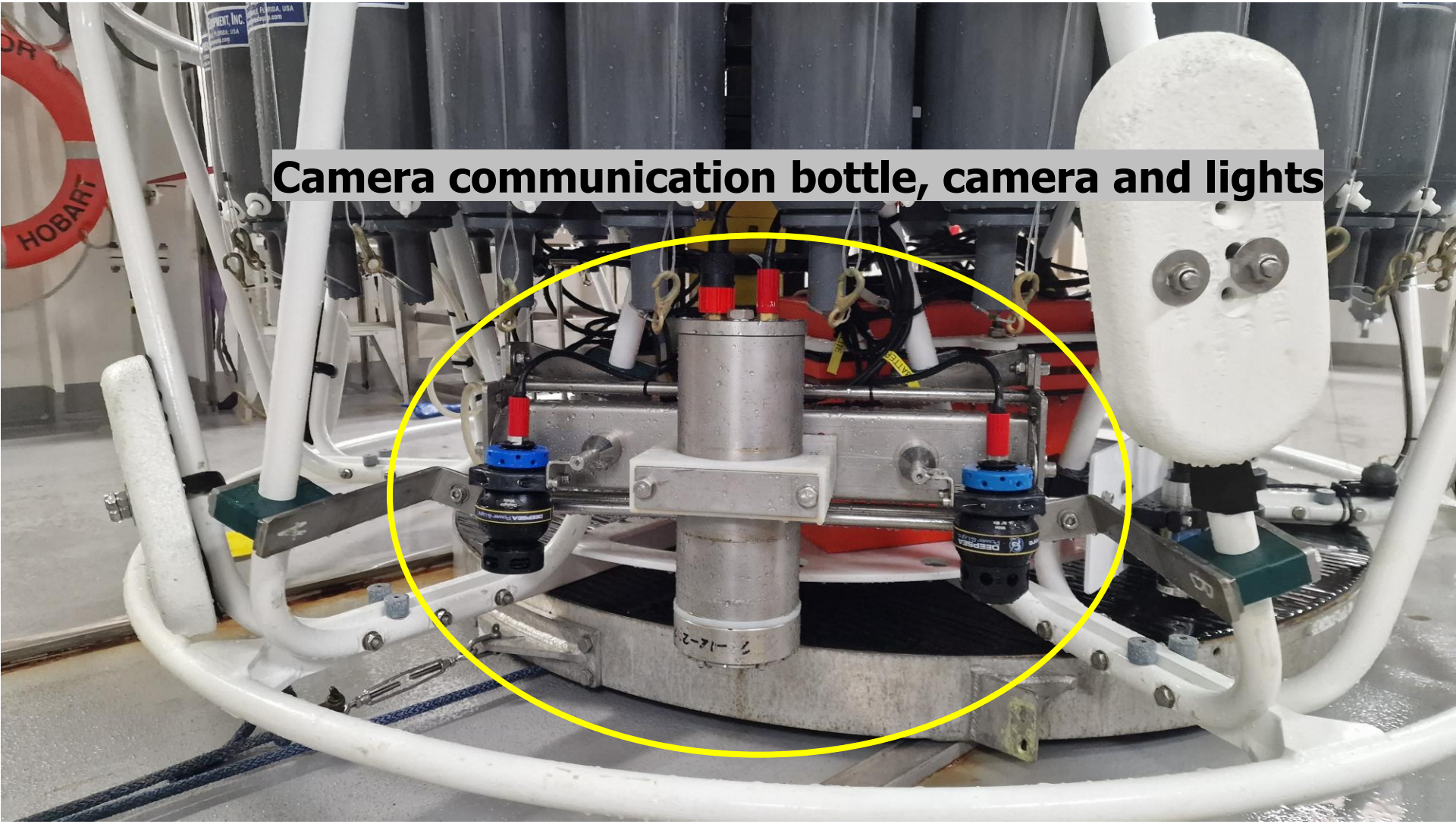
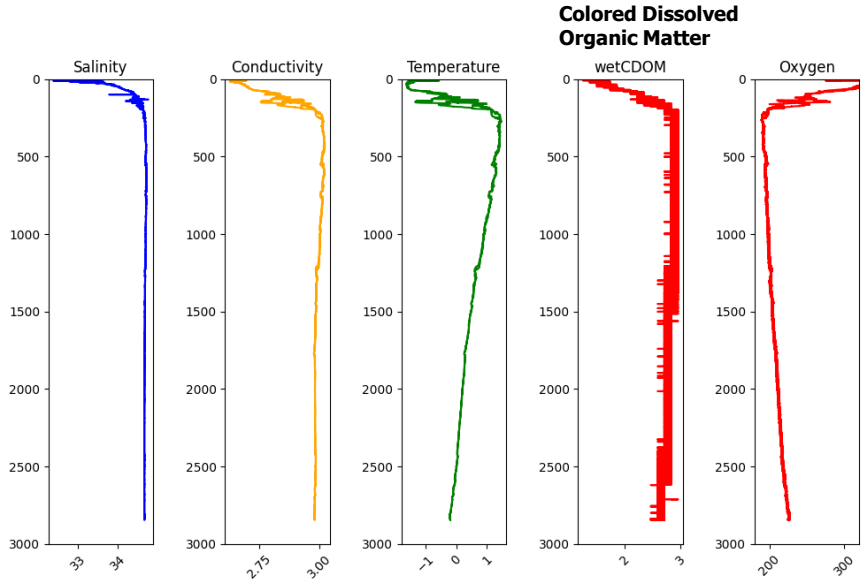


Photo by L. De Santis

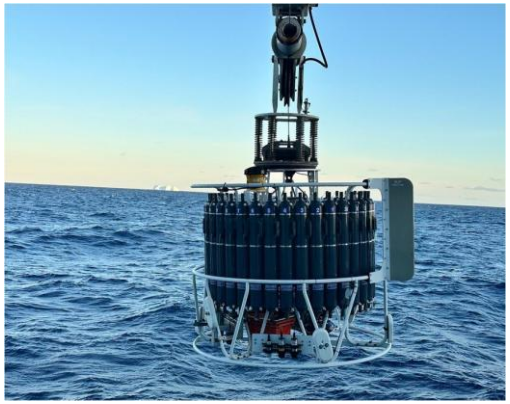
Samples collected for:

- Microbial communities
- Phytoplankton communities
- eDNA
- Particulate Organic Carbon (POC), biogenic Silica (bSi)
- Phytoplankton
- Biomarkers



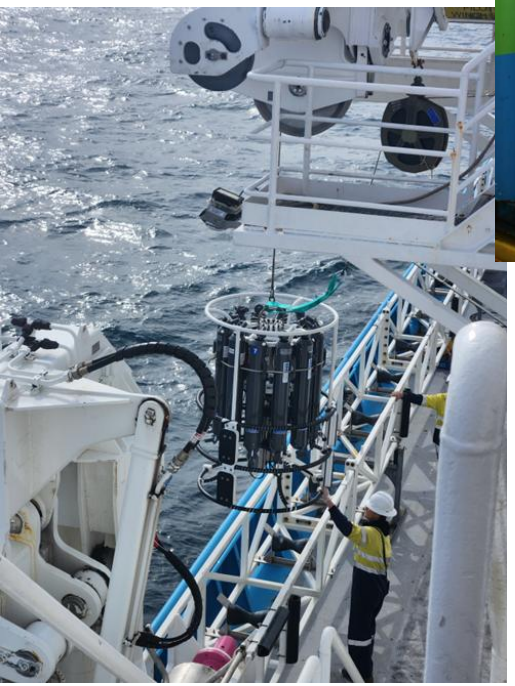
< 1000 m, collected at: surface, below the surface, **deep chlorophyll maximum** (**DCM**), below the DCM, 500 m, bottom (6 samples)

> 1000 m, collected at: 1000 m, 1500 m, 2000 m, 2500 m, 3000 m, bottom (12 samples)



University of Southampton







Samples for analysis of:

Nutrients

Trace Metals

Isotopic analyses



For seafloor biology, largest under-sampled region of continental shelf around Antarctica

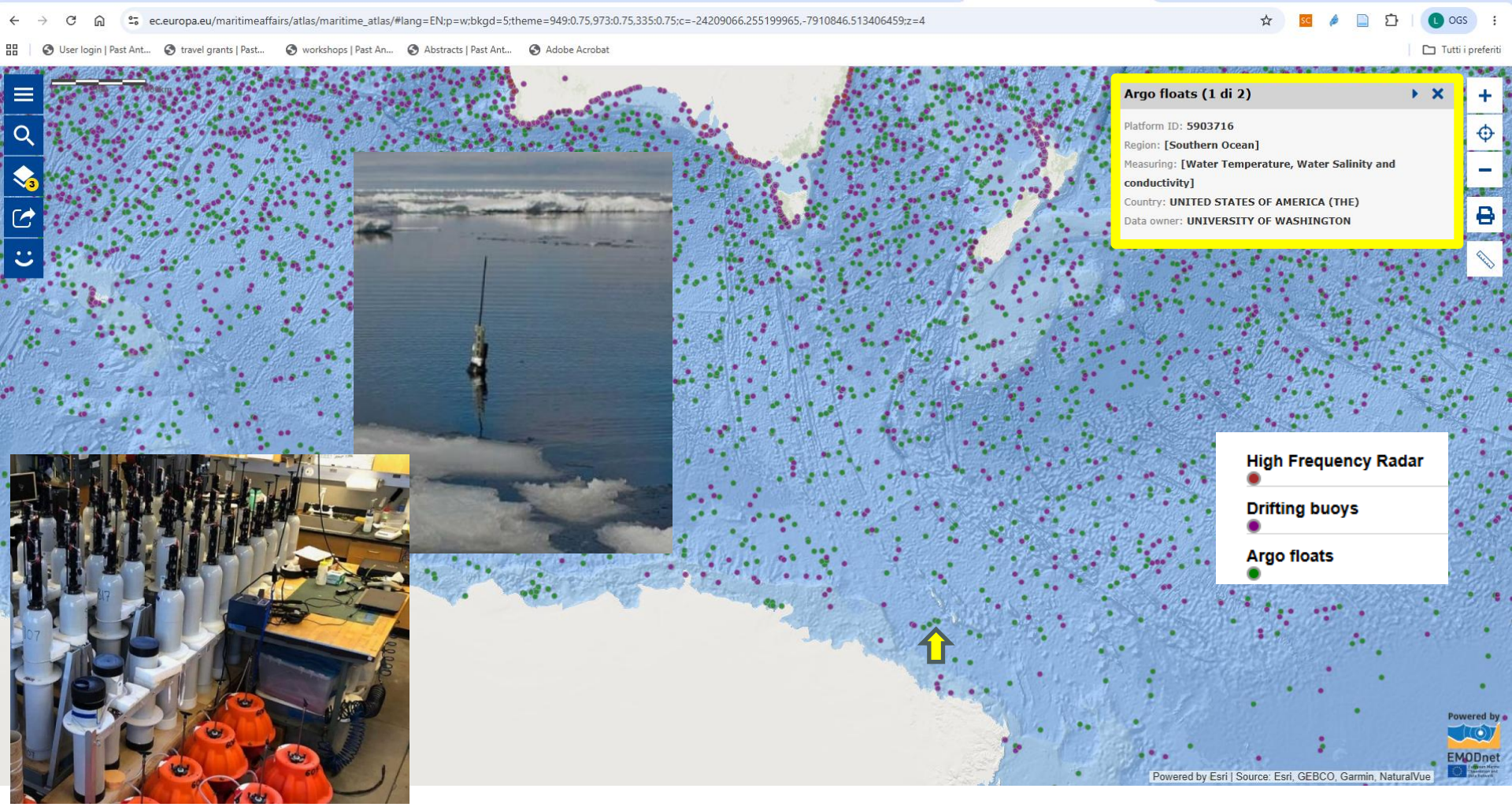
Diversity, connectivity and biogeographic history

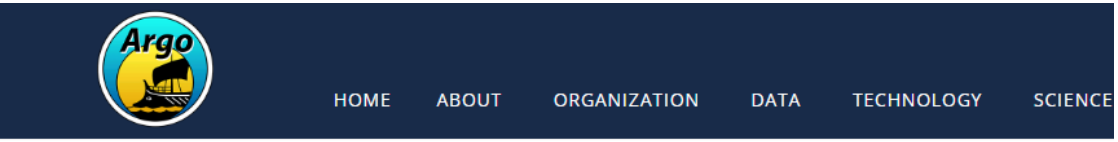
Conservation

Ice sheet history

Understanding of the forces that have shaped the evolution of life in the Southern Ocean

UNIVERSITY of TASMANIA | IMAS


ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/#lang=EN;p=w;bkgd=5;theme=949:0.75,973:0.75,335:0.75;c=-24209066.255199965,-7910846.513406459;z=4
User login | Past Ant...
travel grants | Past...
workshops | Past An...
Abstracts | Past Ant...
Adobe Acrobat
Tutti i preferiti
Argo floats (1 di 2)
Platform ID: 5903716
Region: [Southern Ocean]
Measuring: [Water Temperature, Water Salinity and conductivity]
Country: UNITED STATES OF AMERICA (THE)
Data owner: UNIVERSITY OF WASHINGTON
High Frequency Radar
Drifting buoys
Argo floats
Powered by EMODnet
Powered by Esri | Source: Esri, GEBCO, Garmin, NaturalVue



Links

Global Argo Centers and Programs | Argo Regional Centers | National Programs and Float Sites | Argo Tools | International Programs related to Argo

Global Argo Centers and Programs

- Coriolis GDAC http://www.coriolis.eu.org/Observing-the-Ocean/ARGO
- US GODAE GDAC https://usgodae.org/argo/argo.html
- OceanOPS https://www.ocean-ops.org/board
- Argo Data Management Team http://www.argodatamgt.org
- Biogeochemical Argo http://biogeochemical-argo.org/index.php

Argo Regional Centers

- Pacific Argo Regional Center (PARC) http://apdrc.soest.hawaii.edu/argo
- Indian Argo Regional Center (IARC) https://incois.gov.in/argo/ARDCenter.jsp
- Atlantic Argo Regional Center (NA-ARC) http://www.argodatamgt.org/Argo-regional-Centers/North-Atlantic-ARC
- Southern Ocean Argo Regional Center (SO-ARC) http://www.ukargo.net/southern_ocean_argo_regional_centre
- MedArgo Regional Center (MedArgo ARC) https://argo.ogs.it/medargo/

Country	Lab	Link
Australia	CSIRO/BoM	http://imos.org.au/facilities/argofloats
Canada	Marine Environmental Data Service (MEDS)	http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html
Chile	Chile Argo	http://omz.udec.cl/
China	China Argo Real-Time Data Center	www.argo.org.cn
Europe	EuroArgo	http://www.euro-argo.eu/
	MEDARGO	https://argo.ogs.it/medargo/
	MyOcean	http://marine.copernicus.eu/
France	Coriolis site	http://www.coriolis.eu.org/Observing-the-Ocean/ARGO
	Ifremer	https://www.ifremer.fr/en
Germany	German Argo	https://www.bsh.de/DE/THEMEN/Beobachtungssysteme/ARGO/argo_no
Greece	Greek Argo	http://www.greekargo.gr/
Italy	Argo-Italy	https://argo.ogs.it/#/
India	Indian Argo INCOIS	www.incois.gov.in/Incois/argo/argo_home.jsp
Japan	Japan Argo JAMSTEC	https://www.jamstec.go.jp/J-ARGO/e/
	Japan Argo JMA	http://ds.data.jma.go.jp/gmd/argo/data/index.html
Korea	KIOST	https://oceanclimate.kr/kiost_argo/
	KMA/NIMS	http://argo.nims.go.kr/
Netherlands	Dutch Argo	
Norway	NorArgo	https://norargo.no/
Poland	Polish Argo	http://www.iopan.gda.pl/hydrodynamics/po/Argo/argo.html
Russia	Russian Argo FERHRI	rus.ferhri.ru/argo/index.htm
Spain	Argo Espana	http://www.argoespana.es/
UK	British Oceanographic Data Centre The Met Office National Oceanography Centre, Southampton Plymouth Marine Laboratory	http://www.ukargo.net/
USA	US Argo data center AOML	www.aoml.noaa.gov/phod/argo/index.php
	NOAA/PMEL floats	floats.pmel.noaa.gov
	Scripps Institution of Oceanography floats	sio-argo.ucsd.edu
	W.H.O.I. floats	https://www2.whoi.edu/site/argo/
	University of Washington floats	runt.ocean.washington.edu

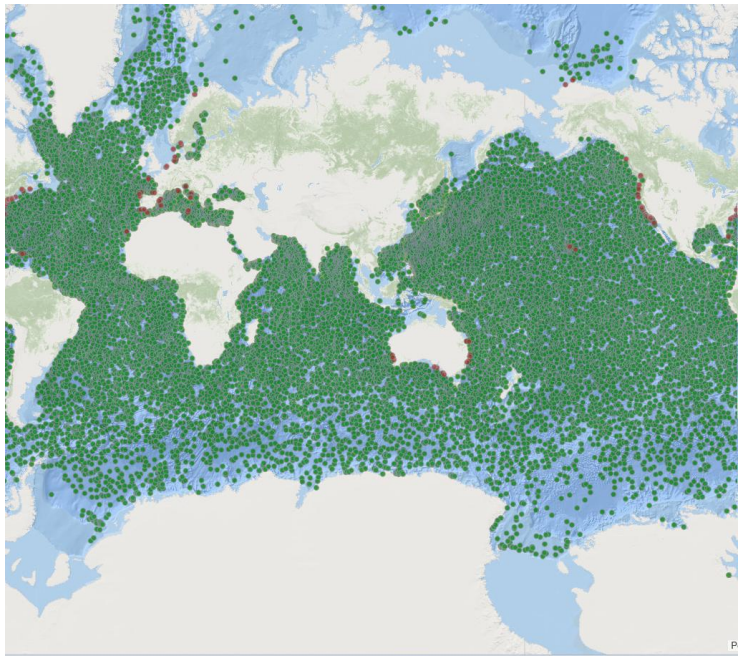
European Commission

Search Search

European Marine Observation and Data Network (EMODnet)

About | Data Services | Use & Impact | Themes | Community | Atlas of the Seas | News & Events | FAQ Downloads

Home > News > Map of the week – Argo floats

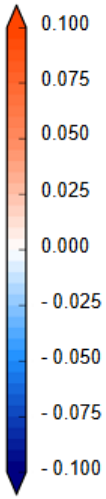


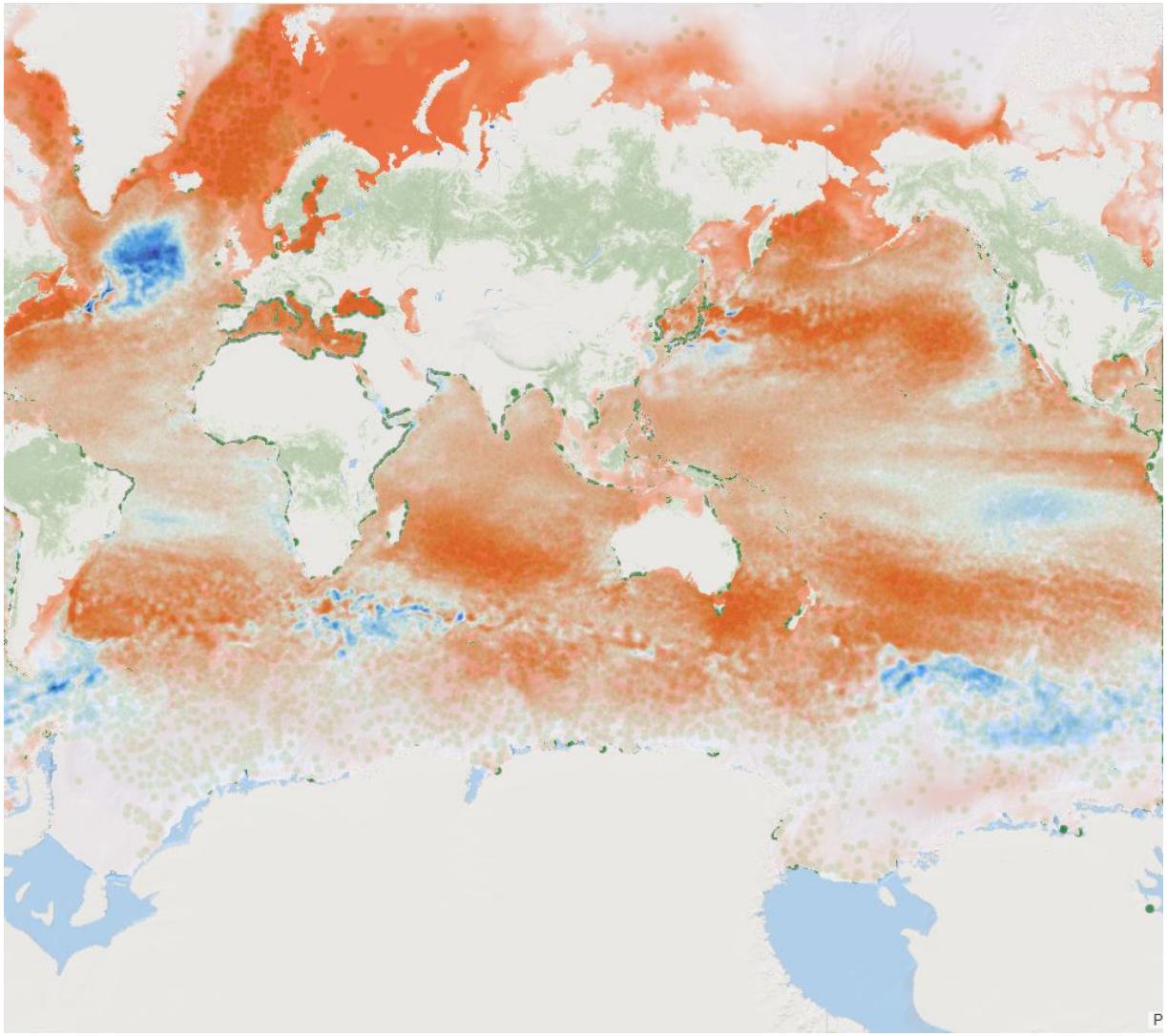
is the European Union's in situ marine data service, managed by the European Commission (EC) Directorate-General Maritime Affairs and Fisheries (EC DG MARE) and funded by the European Maritime Fisheries and Aquaculture Fund. Established in 2009, EMODnet plays a pivotal role as a trusted source of *in situ* marine environmental and human activities data and data products, serving a diverse user base across various sectors.

Global sea surface temperature regional trend

Year: 1993-2018

Unit: degree Celsius (°C) per year





Powered by EMODnet

La rompighiaccio italiana Laura Bassi

- Anno di costruzione 1995
- Equipaggio 22
- Ricercatori 48
- Lunghezza 80 m
- Larghezza 17
- Icebreaker ICE 05
- Dislocamento 5455
- Potenza installata 5100 kW (7315 Hp)
- Posizionamento dinamico DP2, gru da 50 t
- Ponte di volo per elicotteri Super Puma
- Costi mensili:
  - in operazioni >650.000 €
  - in stand by >400.000 €



OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

- two multibeam echosounders for shallow and deep water surveys;
- a sub bottom profiling system for the study of the subsoil up to few tens of meters;
- an acoustic doppler current profiler;
- a fishing echosounder to locate and map the biomass.
- As for the decks equipment, a CTD winch and a streamer winch will be installed in the B-Deck sheltered area, and a Coring winch installed on the starboard side of A-Deck, to perform gravity and piston corings.

IL NOME LAURA BASSI

Suggerimento del On. Prof. Giuseppe Valditara

Capo Dipartimento per la Formazione Superiore e la Ricerca presso il MIUR

Laura Maria Caterina Bassi Veratti,
più nota come Laura Bassi (Bologna, 29 ottobre 1711 – Bologna, 20 febbraio 1778), è stata una fisica e accademica italiana.



Fu la seconda donna laureata d'Italia dopo la veneziana Elena Lucrezia Cornaro, la prima a intraprendere una carriera accademica e scientifica e la prima al mondo a ottenere una cattedra universitaria.

- Le è dedicato un cratere su Venere
- A Bologna le è dedicato un Liceo linguistico ed una via della città
- In Austria le sono dedicati il Quality Engineering Centre of Expertise presso l'Univ. di Innsbruck ed il Centre of Visual Analytics Science and Technology presso l'Università Tecnica di Vienna
- A Sant'Antimo (NA) le è dedicato un liceo statale
- Le è stato dedicato un asteroide (15742 Laura Bassi)

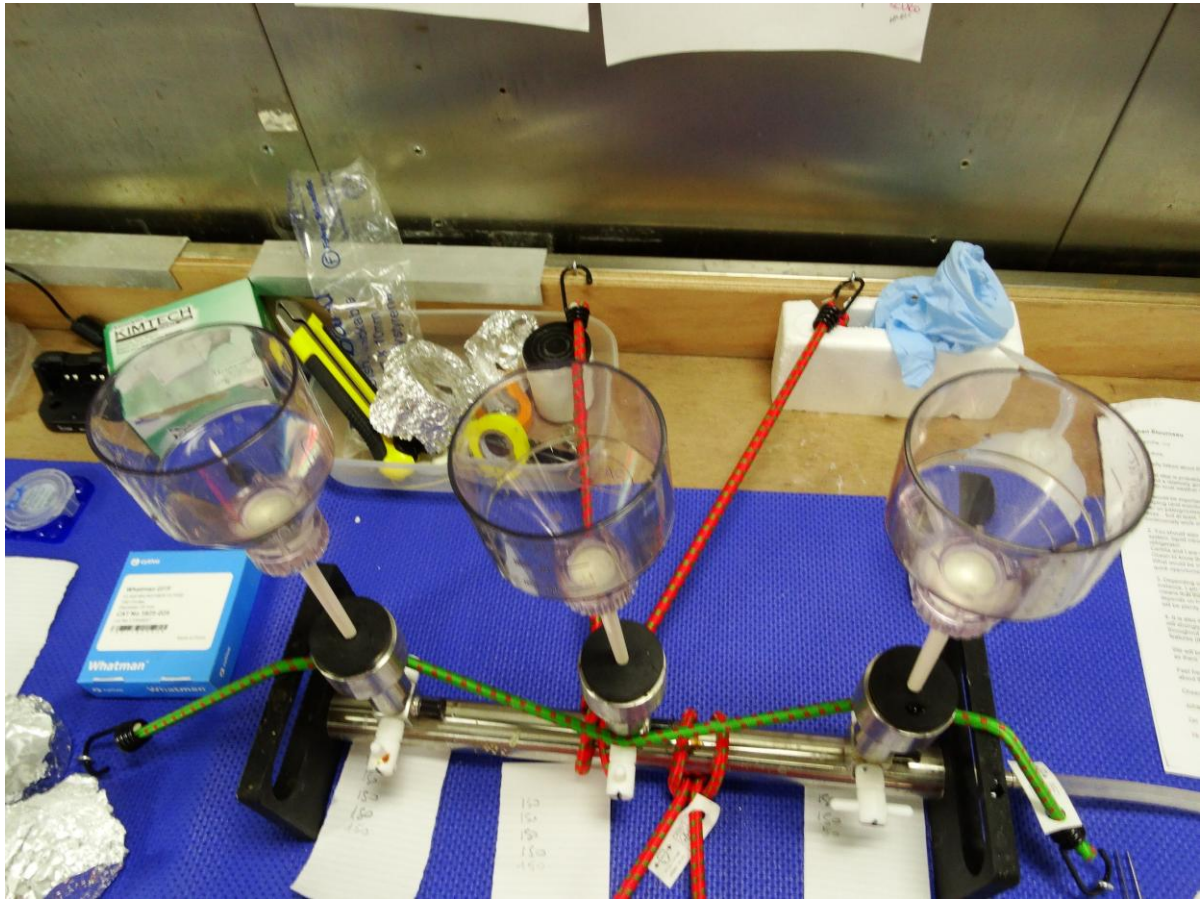


Photo L. De Santis

Expendable Bathythermograph (XBT)

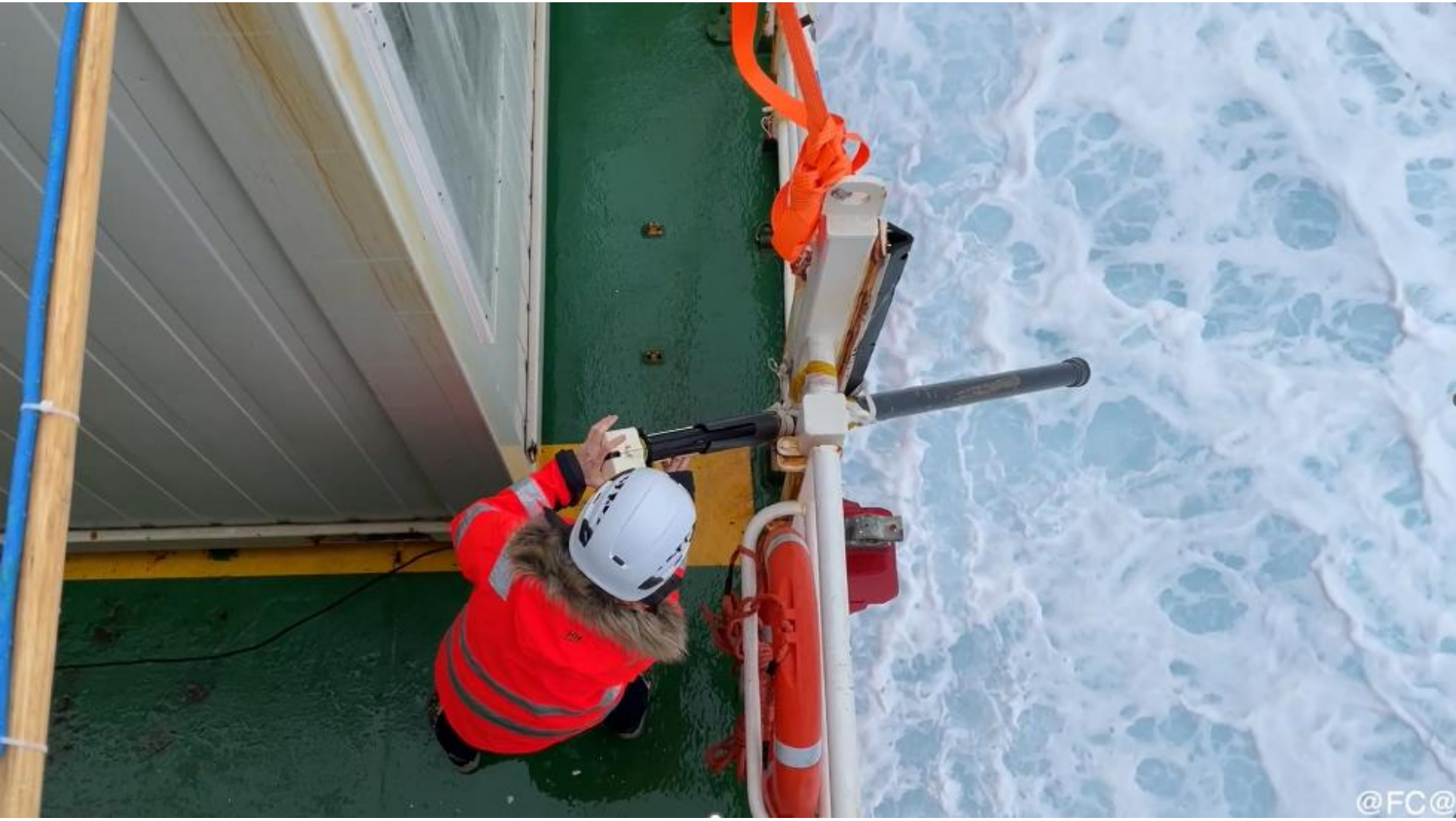
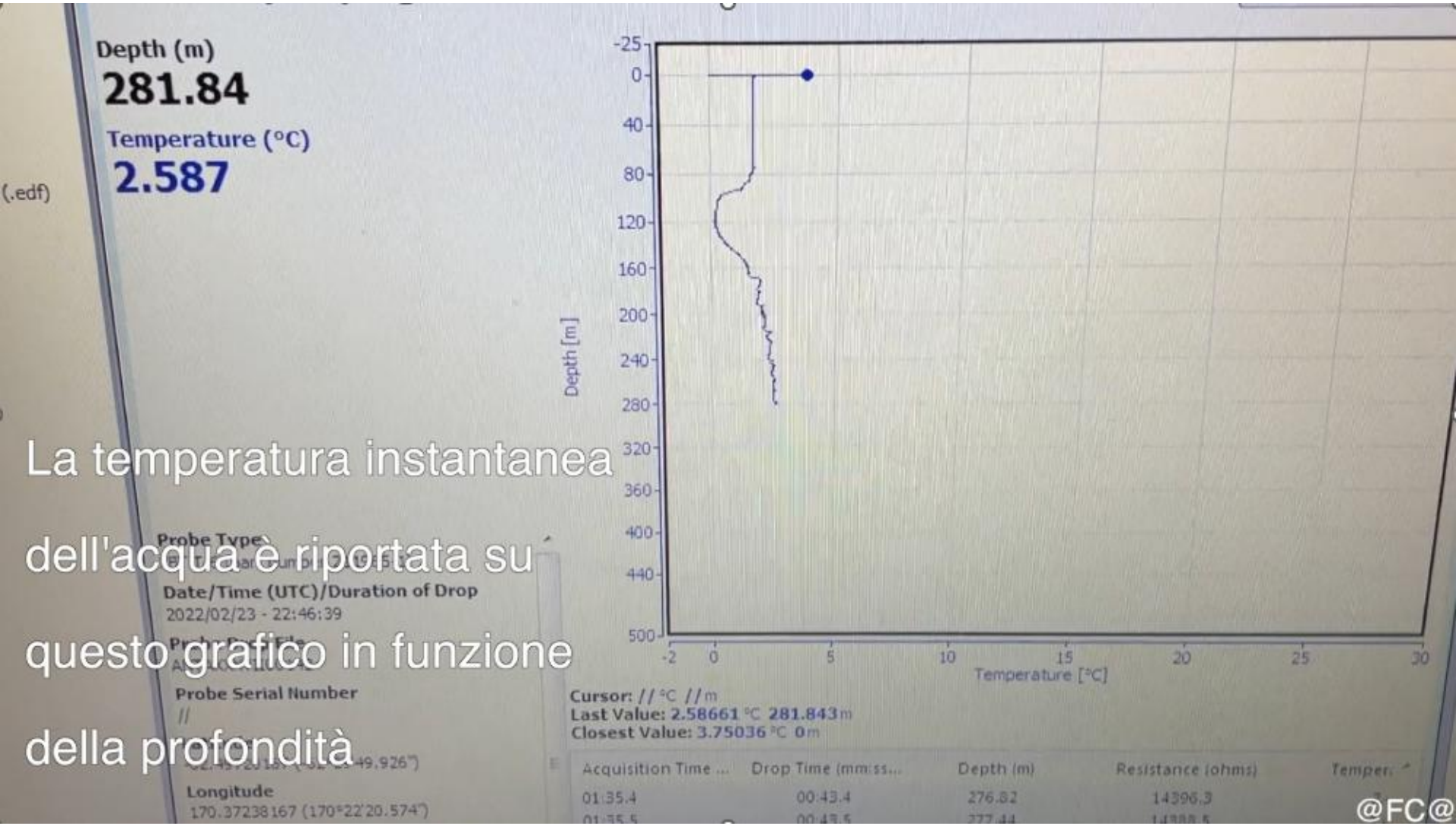


Photo F. Colleoni



La temperatura instantanea dell'acqua è riportata su questo grafico in funzione della profondità

Photo F. Colleoni

Filtering the upper 4 meters of sea water





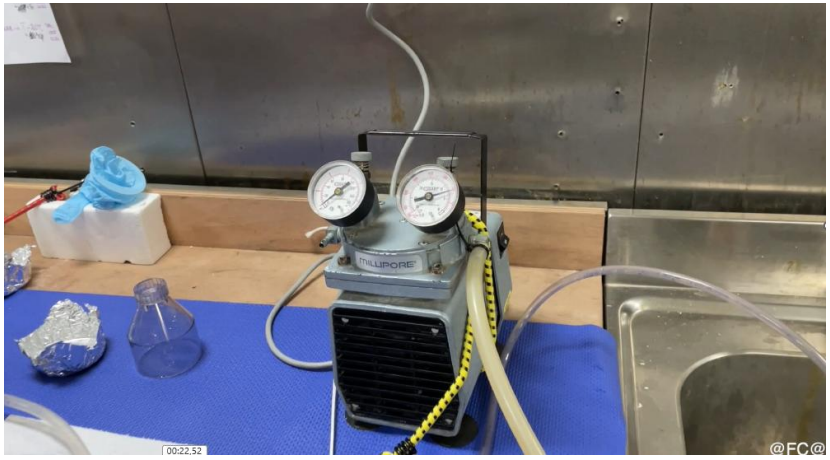
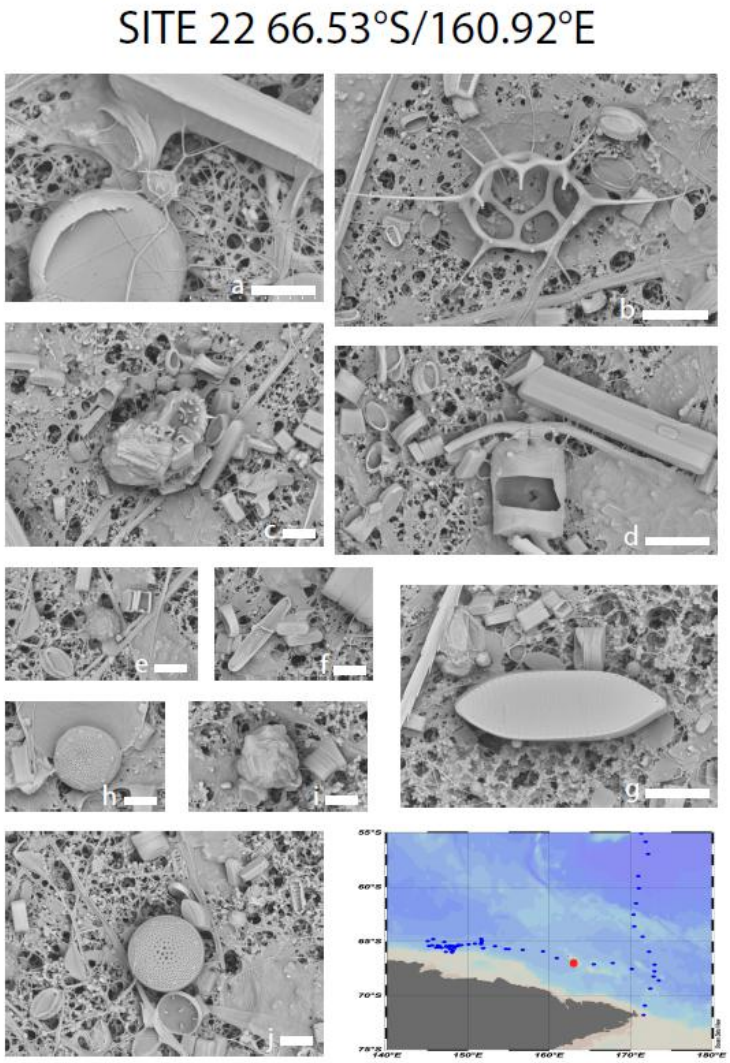




Photo F. Colleoni



a. *Triparma laevis subsp. pinnatilobata* and *Fragilariopsis curta.*
b. *Stephanocha speculum.*
c. *Fragilariopsis* sp and *Polarella glacialis* cluster.
d. *Chaetoceros convolutus* and *Fragilariopsis curta.*
e. Unidentied Cyst.
f. *Fragilariopsis cylindrus*.
g. *Fragilariopsis rhombica.*
h. Unidentied centric.
i. *Fragilariopsis* pellete.
j. *Shionodiscus gracilis.*

a, c, e-f, h-j, i-j= 5µm,
b, d, g= 10µm

Courtesy of Amy Leventer

- In this kind of conditions from the ship we can collect: acoustic data (multibeam, topas, adcp, EK80, although a little noisy and the ship's speed will likely vary) and underway surface water and CTDs
- we cannot collect sediment cores because the ship cannot stay on site, while CTD is feasible because the ship can shift, going in circle a little around its position because the CTD doesn't touch the sea bed
- It cannot collect multichannel seismic data

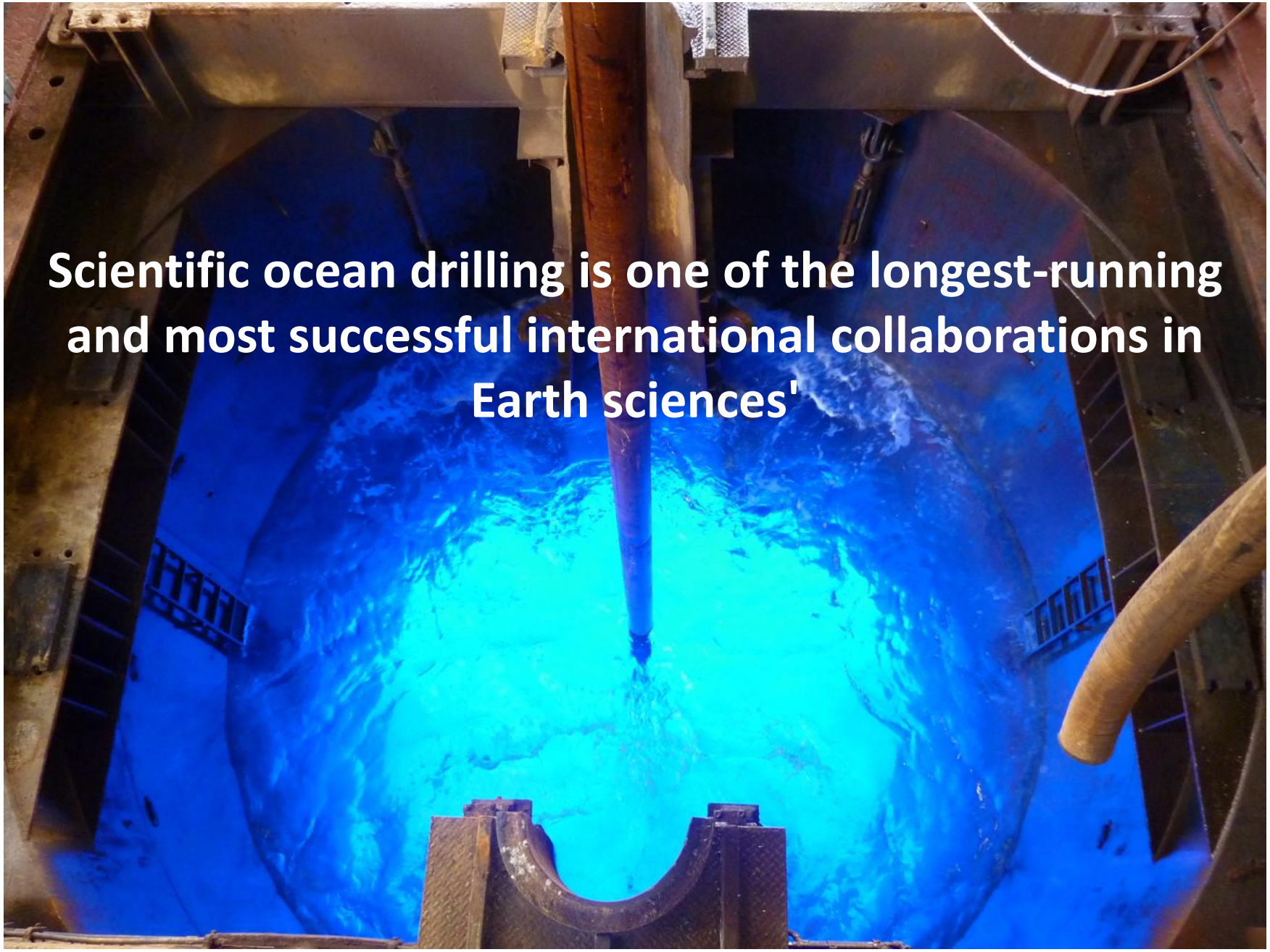


Photo F. Colleoni

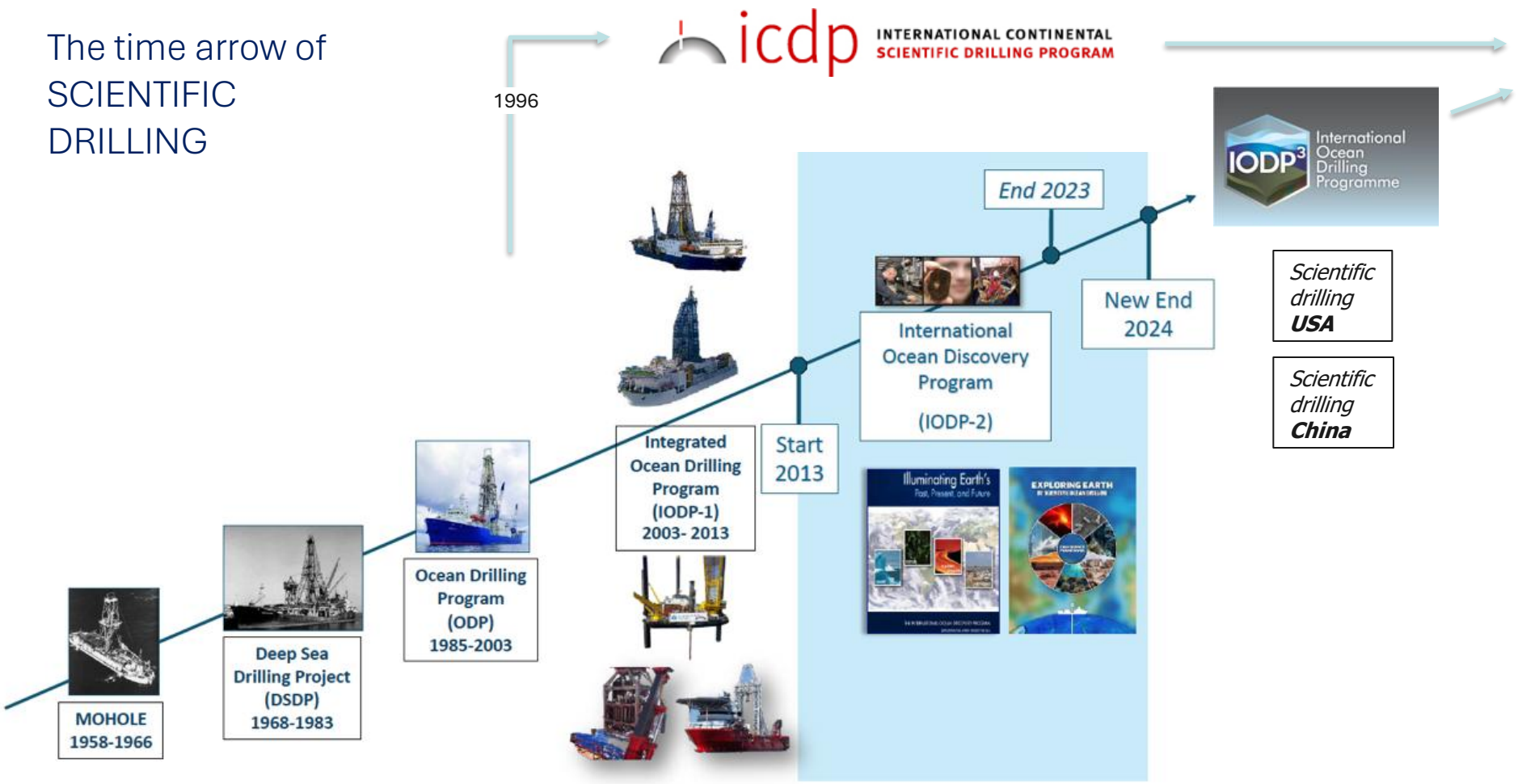
In this kind of conditions the Bassi can possibly but very unlikely collect: acoustic data (multibeam, topas, adcp, EK80) and surface water (underway sampling). But the data will be very noisy and the speed will vary
The Bassi cannot collect sediment cores, CTD or multichannel seismic data



Photo F. Colleoni

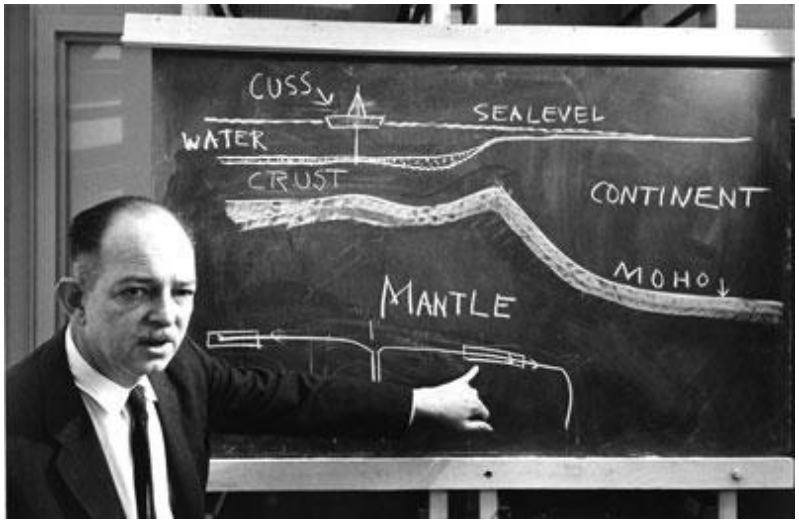

Scientific ocean drilling is one of the longest-running and most successful international collaborations in Earth sciences'

The time arrow of SCIENTIFIC DRILLING

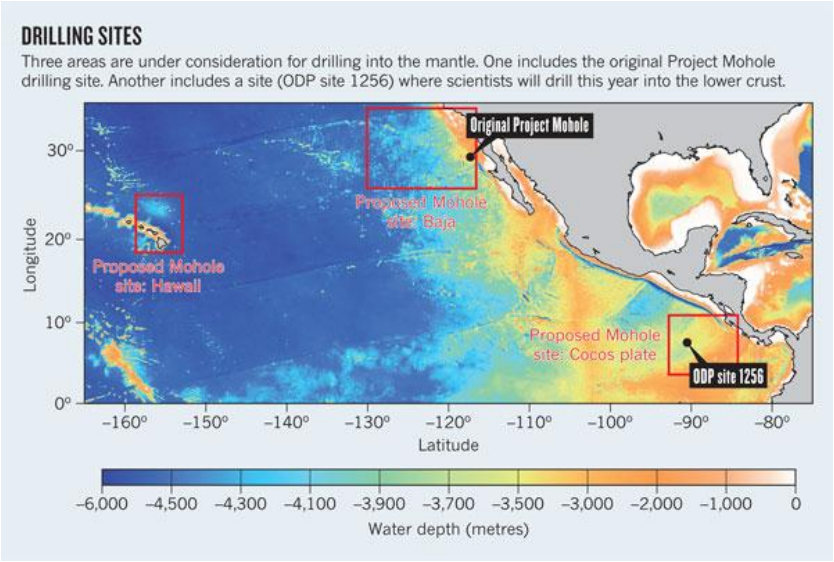


The International Ocean Discovery Program (IODP)
is an international marine research collaboration that explores Earth's history and dynamics using ocean-going research platforms to recover data recorded in seafloor sediments and rocks and to monitor subseafloor environments
http://www.iodp.org

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.





Drill ship CUSS 1

Project Mohole



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.



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.



144 meters long
21 meters wide
Derrick 66 m tall and can support 0.5 million kg of weight
Can drill to water depth of 8 km
12 computer controlled thrusters

IODP Exp 374 (2018) personnell
31 scientists
- 12 women (40%)
- 4 Students (10%)
- 9 Early career scientists (30%)

22 technical support staff (8 are women 36%)

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

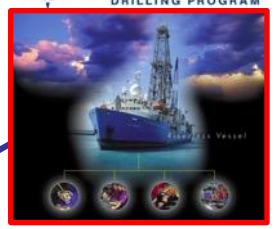
http://www.iodp.org

End in October 2023



October 2013

International Ocean Discovery Program (IODP)



Integrated Ocean Drilling Program (IODP) 2003- 2013



Ocean Drilling Program (ODP) 1985-2003



Deep Sea Drilling Project (DSDP) 1968-1983



MOHOLE 1958-1966

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 Vessl *Chikyu,* and specialized Mission-Specific-Platforms - were used to reach new areas of the global subsurface during 52 expeditions.



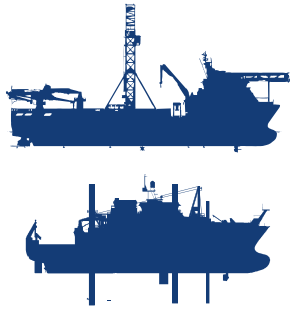




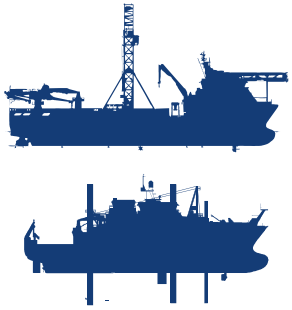



IODP
INTERNATIONAL OCEAN DISCOVERY PROGRAM
Drilled holes
IODP
ODP
DSDP

2003- 2024 IODP-1 and IODP-2

IODP Platform Providers	NSF	文部科学省 MEXT	ECORD EUROPEAN CONSORTIUM FOR OCEAN RESEARCH DRILLING
Platform	 JOIDES Resolution	 Chikyu	 Any suitable vessel
	Credit: William Crawford / IODP	Credit: JAMSTEC / IODP	
IODP Platform Operators	JOIDES Resolution Science Operator	JAMSTEC	ECORD Science Operator
	IODP Management International (IODP-MI)	Japan Agency for Marine-Earth Science and Technology	

After September 30 2024

	International Program	US Program	China Program
IODP Platform Providers	MEXT; ECORD European Consortium for Ocean Research Drilling	NSF	
Platform	 Chikyu Credit: JAMSTEC / IODP	 Any suitable vessel	 JOIDES Resolution Credit: William Crawford / IODP	 D/V Meng Xiang (梦想号)
IODP Platform Operators	JAMSTEC Japan Agency for Marine-Earth Science and Technology	ECORD Science Operator	



Core Members (Ship Operators)

ECORD European Consortium for Ocean Research Drilling

JAMSTEC MarE3

Associate Members (Cash/IKC)

Australia & New Zealand Consortium

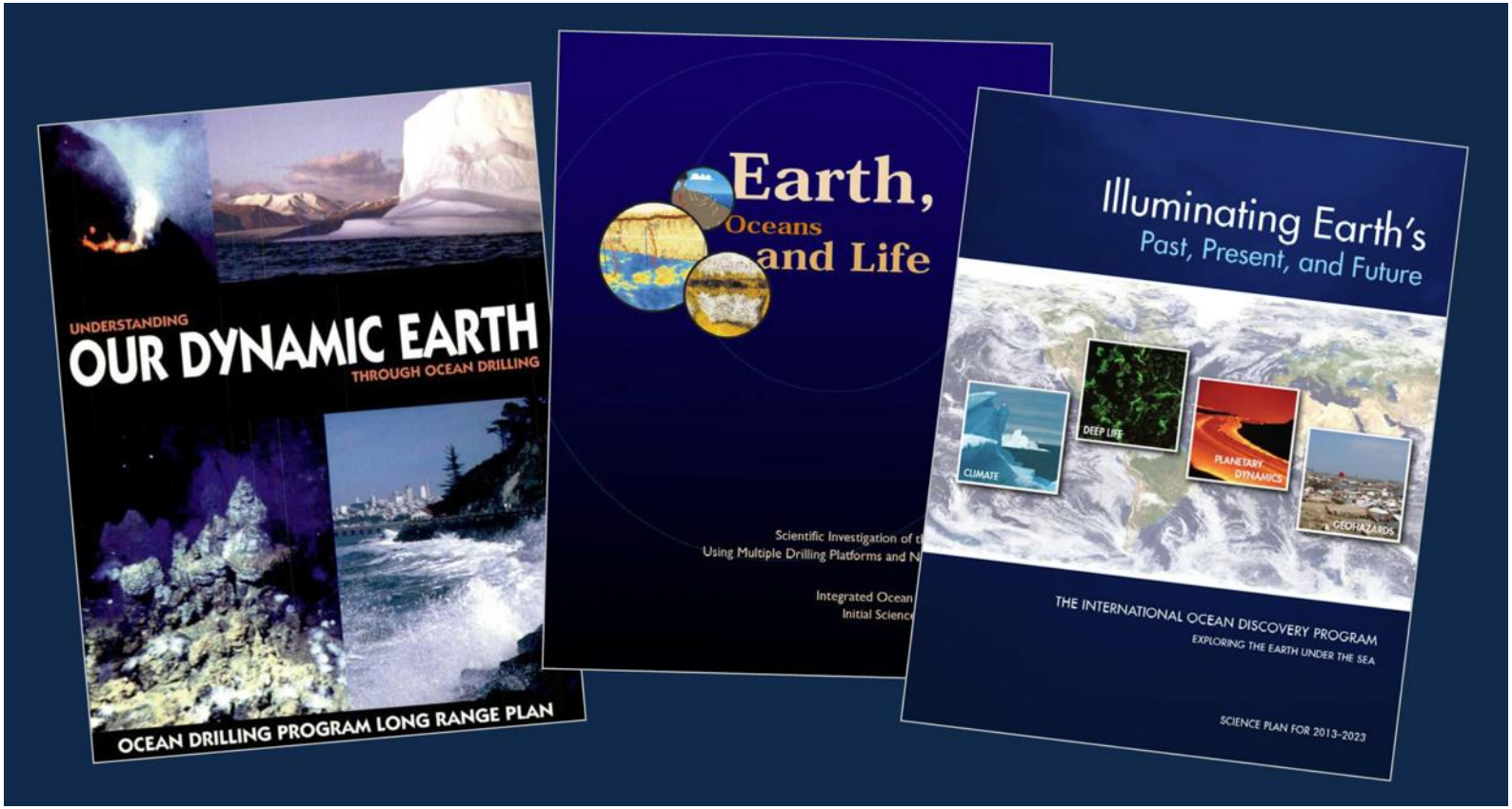
NCPOR ESSO

IODP
India
others

Temporary Members

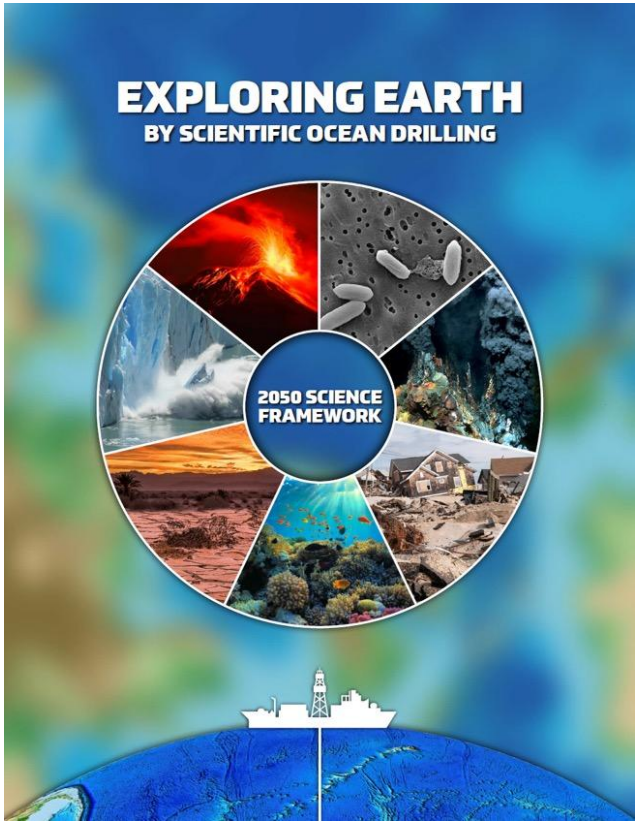
Fundamental principles of IODP

- **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**


UNDERSTANDING
OUR DYNAMIC EARTH
THROUGH OCEAN DRILLING
OCEAN DRILLING PROGRAM LONG RANGE PLAN
Earth,
Oceans
and Life
Illuminating Earth's
Past, Present, and Future
CLIMATE
DEEP LIFE
PLANETARY DYNAMICS
GEOHAZARDS
THE INTERNATIONAL OCEAN DISCOVERY PROGRAM
EXPLORING THE EARTH UNDER THE SEA
SCIENCE PLAN FOR 2013–2023

https://www.iodp.org/2050-science-framework

2020 – 2050



Anthony Koppers Co-lead Editor,
(Chair Science Framework Working Group)

Rosalind Coggon Co-lead Editor

and the Science Framework Authors and Reviewers

representing the international scientific ocean drilling community

STRATEGIC OBJECTIVES

The *Strategic Objectives* comprise broad Earth science research areas that form the foundation of scientific ocean drilling through 2050. Each objective focuses on understanding the interconnections within the Earth system.

Habitability and Life on Earth. Defining the conditions for, and the role of, life in the marine realm.

The Oceanic Life Cycle of Tectonic Plates. Investigating the genesis, aging, motion, and destruction of oceanic plates.

Earth's Climate System. Unraveling ice sheet history, sea level changes, and ocean-atmosphere interactions.

Feedbacks in the Earth System. Constraining the processes that regulate or destabilize the Earth system.

Tipping Points in Earth's History. Using Earth's geological past to illuminate future environmental change.

Global Cycles of Energy and Matter. Determining the role, mechanisms, and magnitude of Earth system cycles.

Natural Hazards Impacting Society. Understanding natural hazards in the marine environment.

ENABLING ELEMENTS

Enabling Elements advance the aims of scientific ocean drilling through numerous and varied broader impacts and outreach initiatives, partnerships and collaborations with organizations that have complementary goals, technology development, and big data analytics.

FLAGSHIP INITIATIVES

The *Flagship Initiatives* comprise long-term, multidisciplinary research endeavors that aim to test scientific paradigms and hypotheses that inform issues of particular relevance or interest to society. They typically combine research goals from multiple Strategic Objectives. Their implementation will be shaped by proposals from the scientific community that develop coordinated strategies that include long-term planning, technology development, and innovative applications of existing and new scientific ocean drilling data products.

Ground Truthing Future Climate Change. By collecting the robust data required for reconstructing global climate evolution over extended geologic time periods, scientific ocean drilling will provide information that is critical for improving climate model performance.

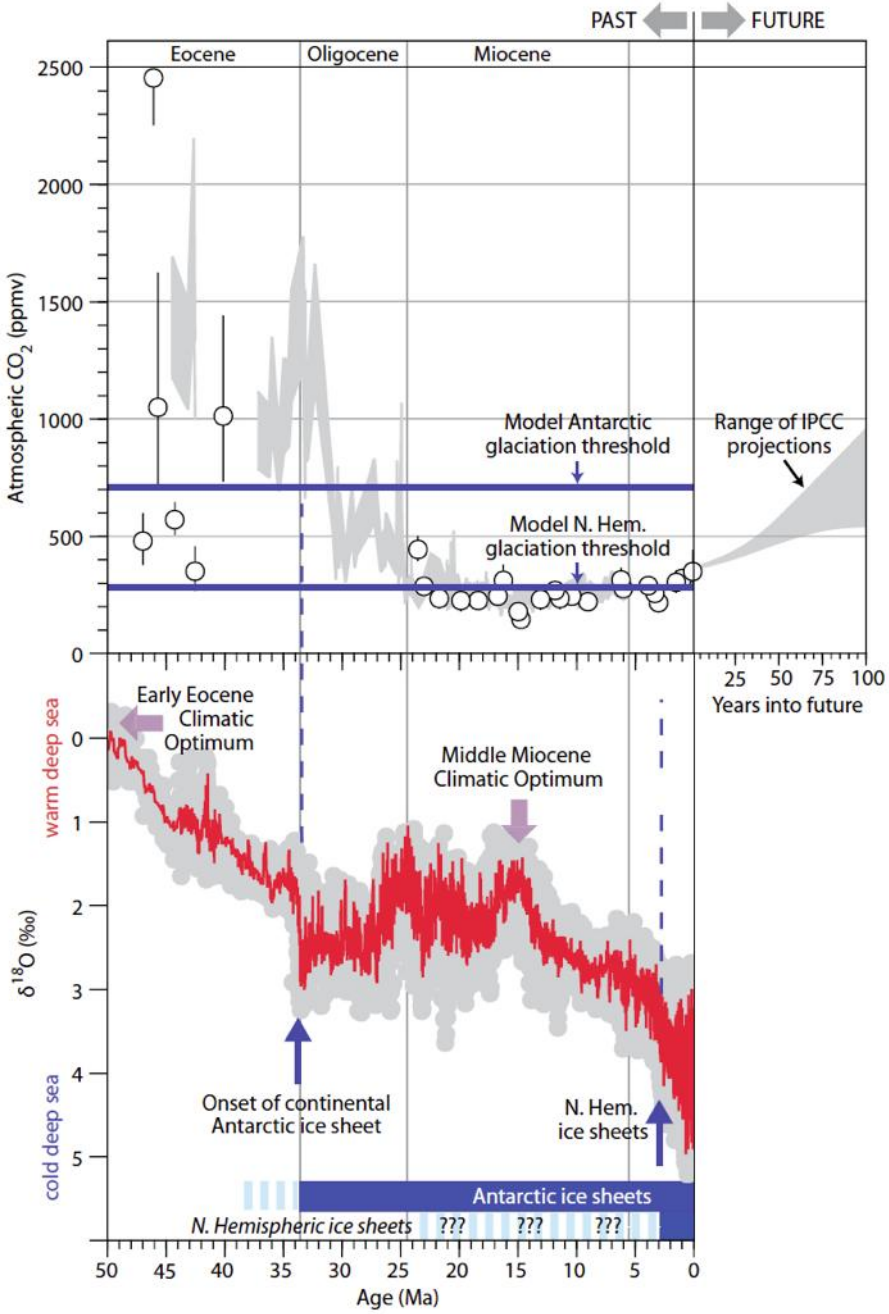
Probing the Deep Earth. By penetrating deep within oceanic crust, scientific ocean drilling will lead to a better understanding of Earth's formation and evolution and the connections between tectonics, earthquake and volcanic hazards, climate, and our planet's habitability.

Assessing Earthquake and Tsunami Hazards. By acquiring samples and deploying instruments in offshore and nearshore fault zones, scientific ocean drilling will enable more reliable assessments of the risks posed by major earthquakes and tsunamis and will facilitate improved hazard preparedness and response.

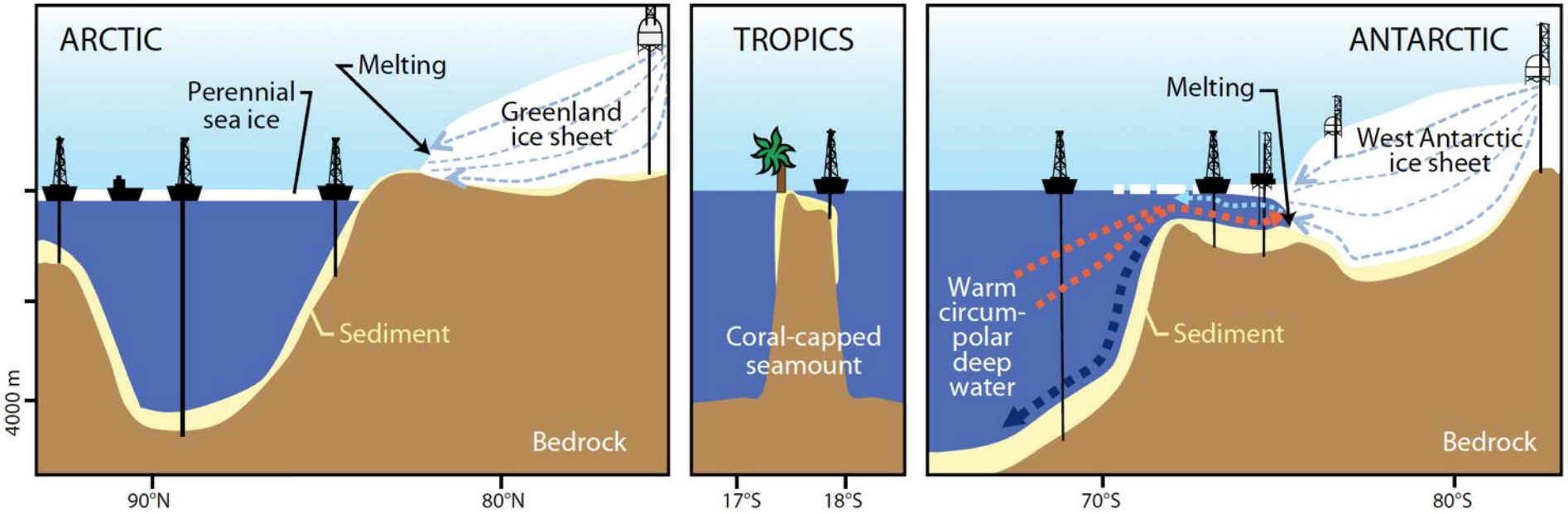
Diagnosing Ocean Health. By retrieving sedimentary records that preserve key information about past responses of biological activity to natural cycles and catastrophic events, scientific ocean drilling will enable a more informed assessment of the expected rates, duration, and magnitudes of future ocean health deterioration.

Exploring Life and Its Origins. Scientific ocean drilling and monitoring in borehole observatories will advance research into the distribution and limits of deep microbial life, novel microbes and their biotechnological applications, the emergence and evolution of life on Earth, and the possibility of life on other worlds.

Climate and Ocean Change: Reading the Past, Informing the Future

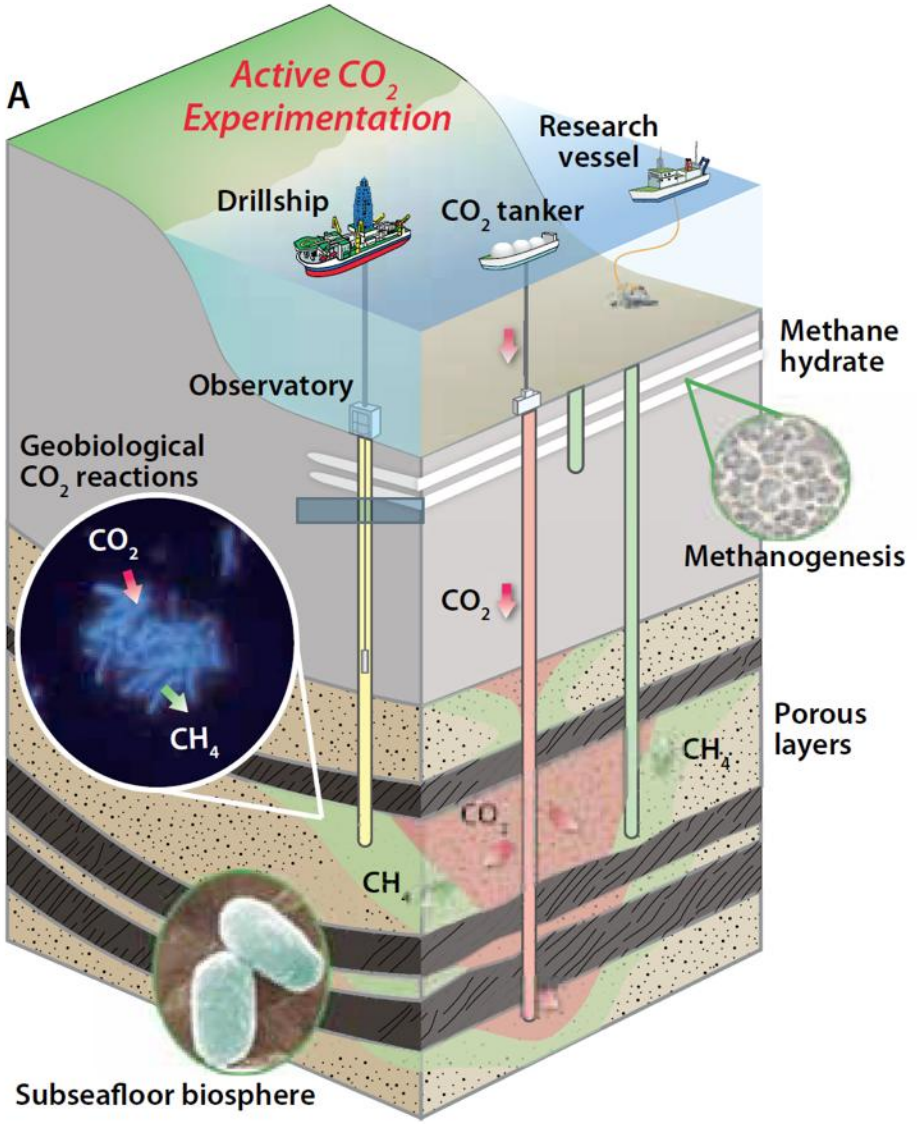


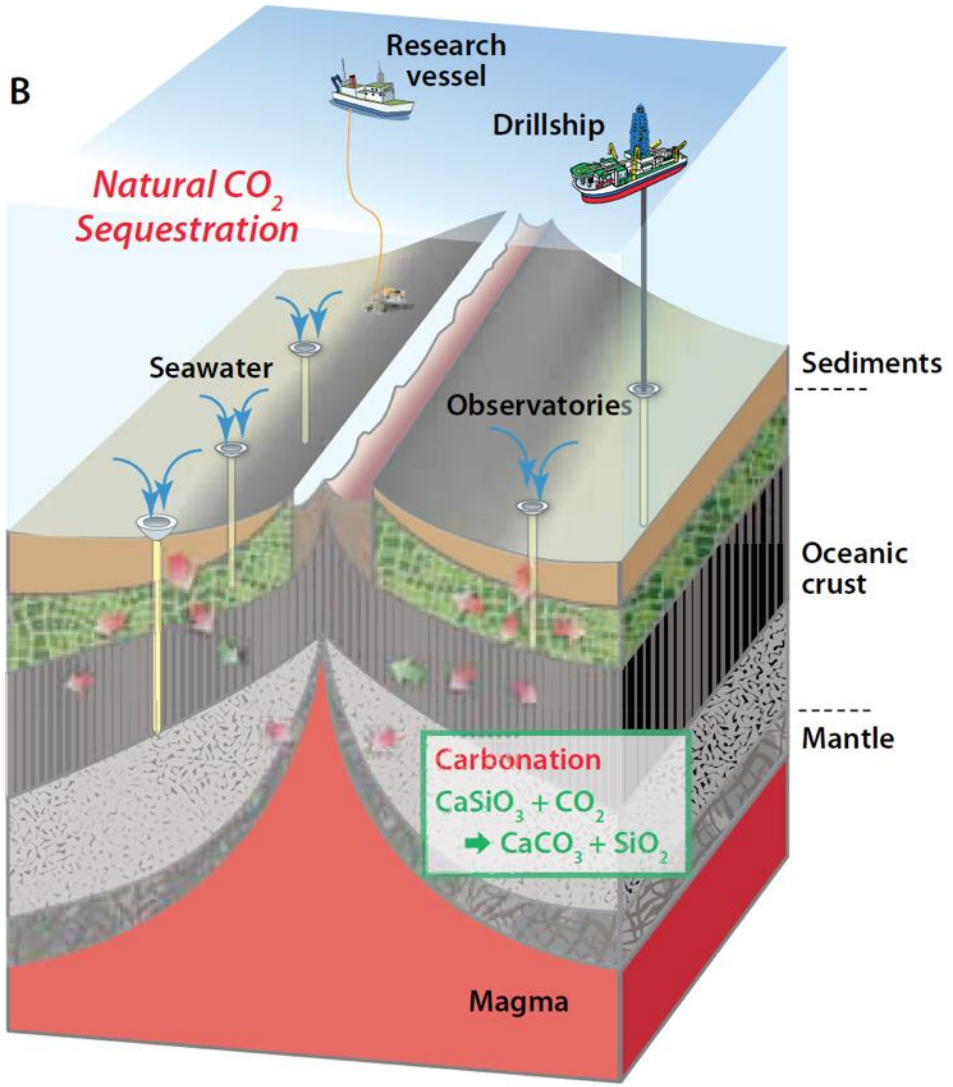
Climate and Ocean Change: Reading the Past, Informing the Future



Elements of this figure were adapted from Schoof (2010)

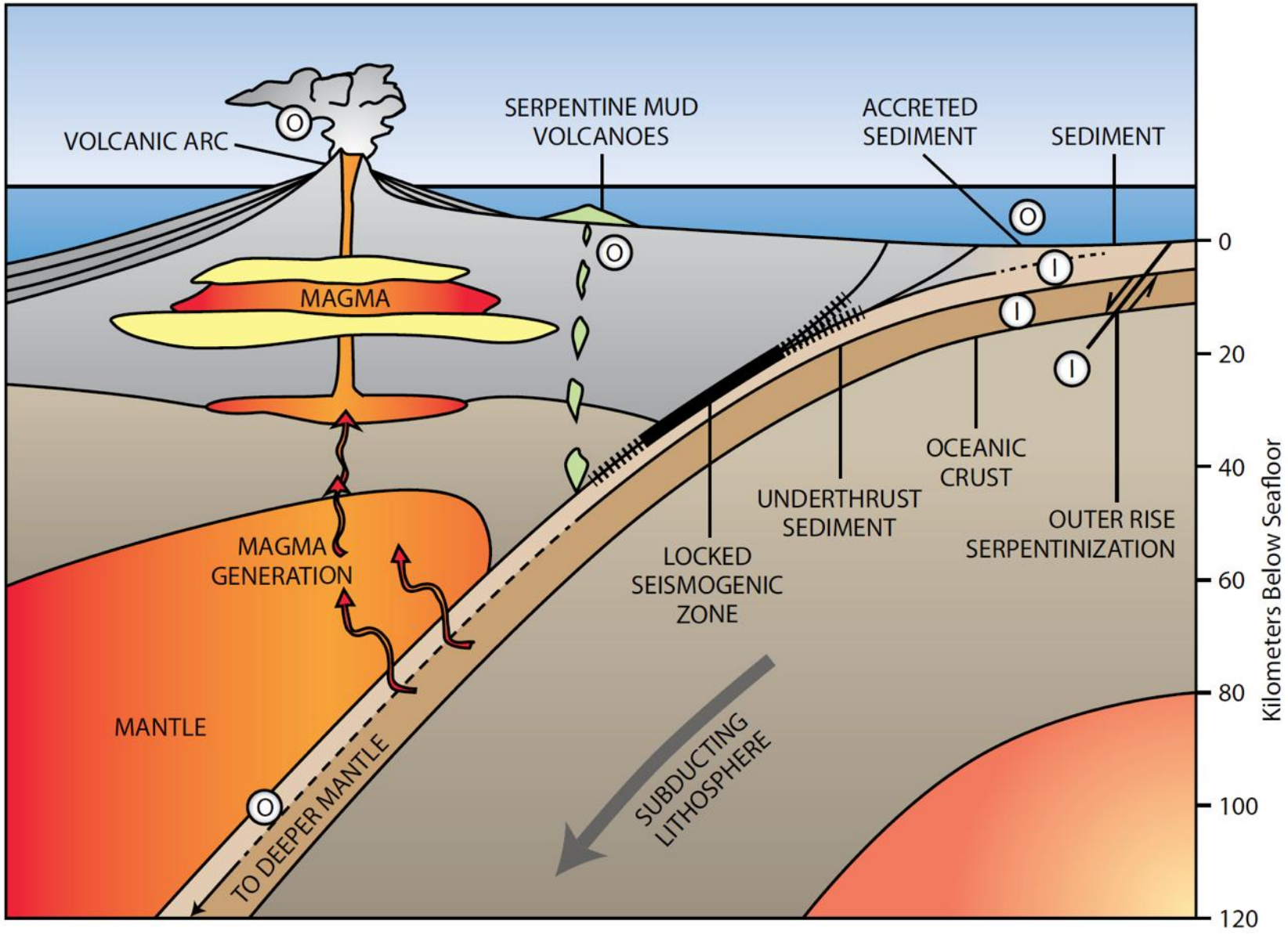
Biosphere Frontiers: Deep Life, Biodiversity, and Environmental Forcing of Ecosystems



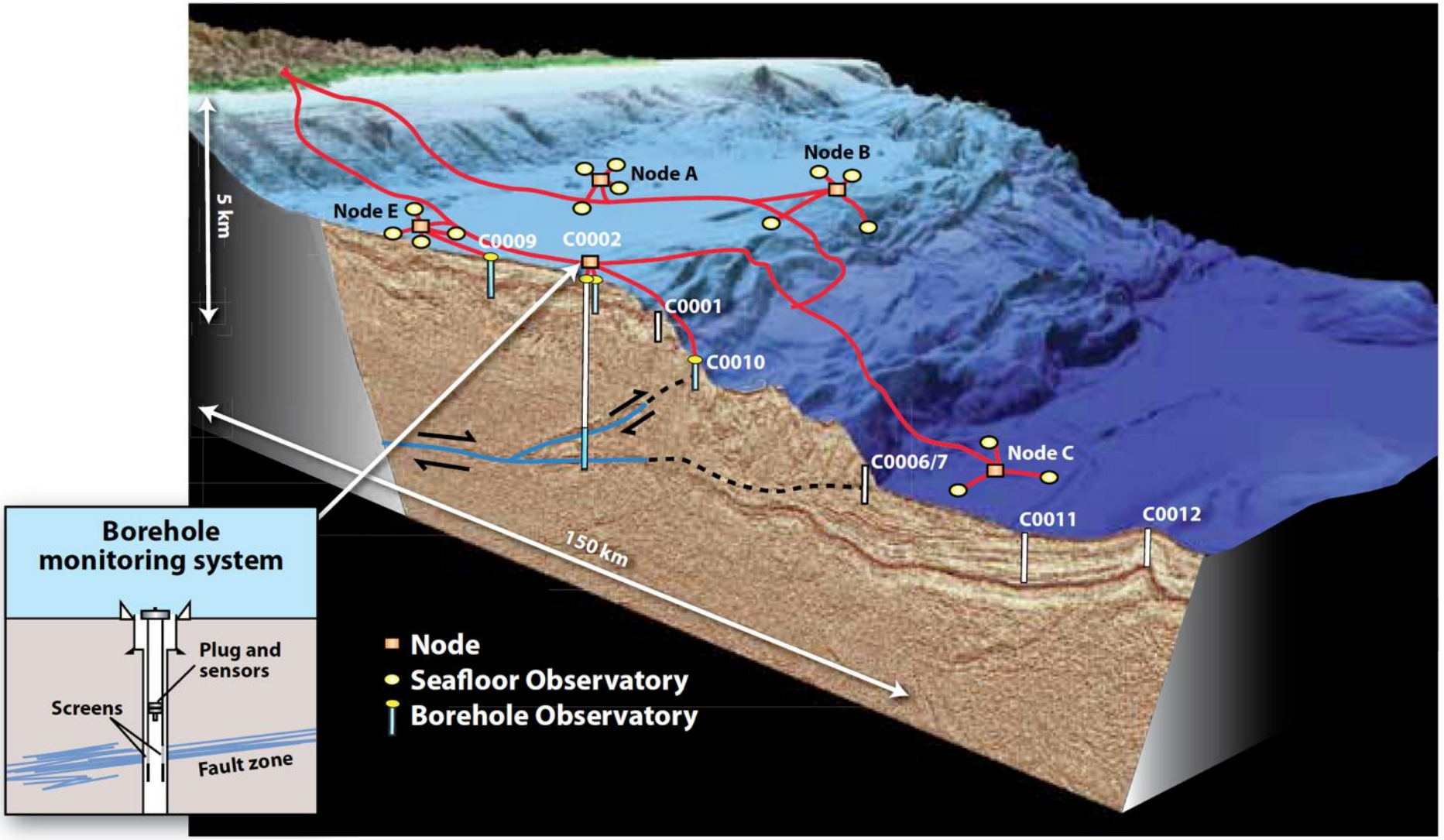


F. Inagaki, JAMSTEC

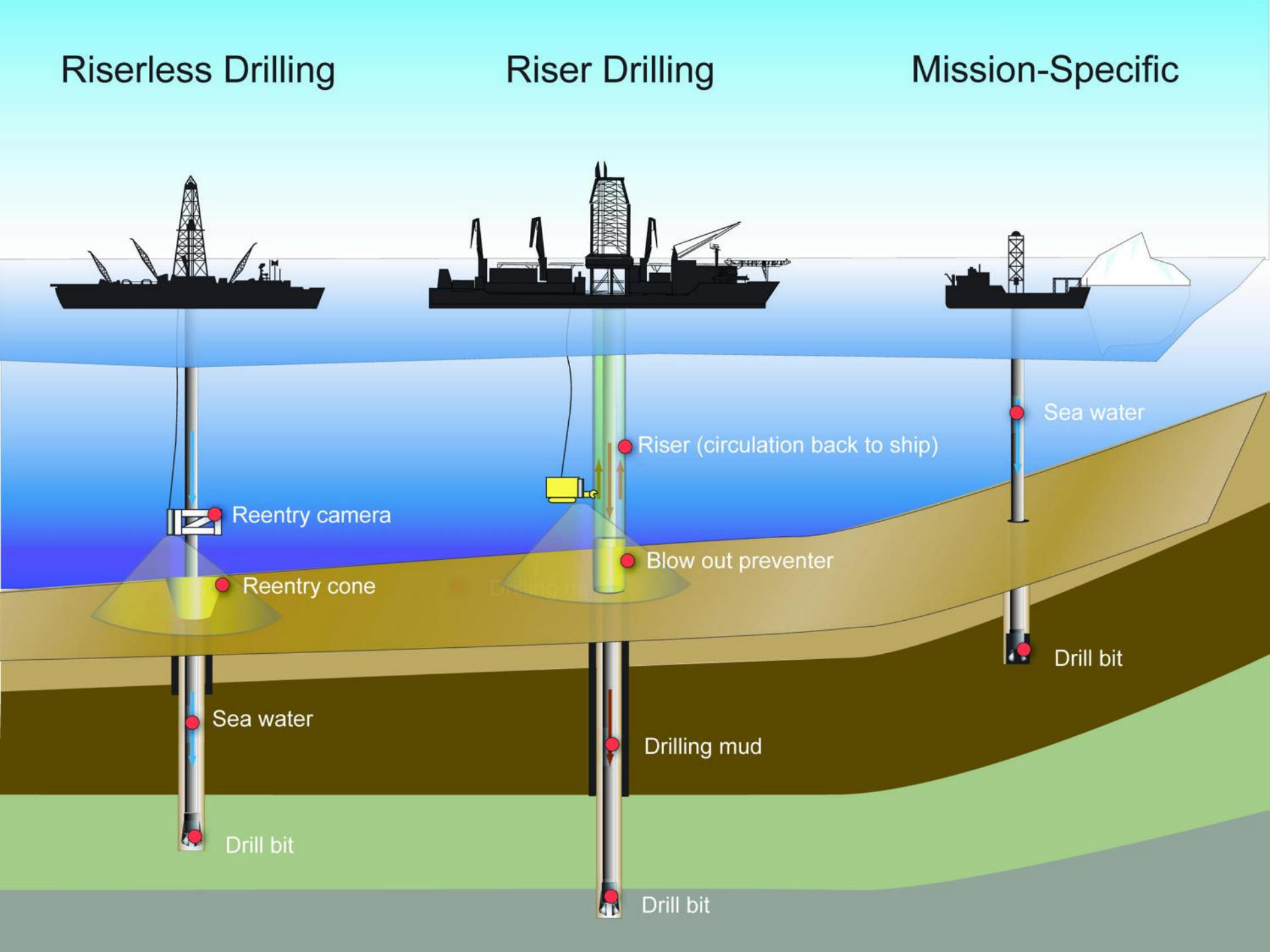
Earth Connections: Deep Processes and Their Impact on Earth's Surface Environment



Earth in Motion: Processes and Hazards on Human Time Scales



Inset from Expedition 319 Scientists (2010)


Riserless Drilling
Riser Drilling
Mission-Specific
Reentry camera
Reentry cone
Sea water
Drill bit
Riser (circulation back to ship)
Blow out preventer
Drilling mud
Drill bit
Sea water
Drill bit



Ross Sea 2006: OGS Explora

Photo L. De Santis



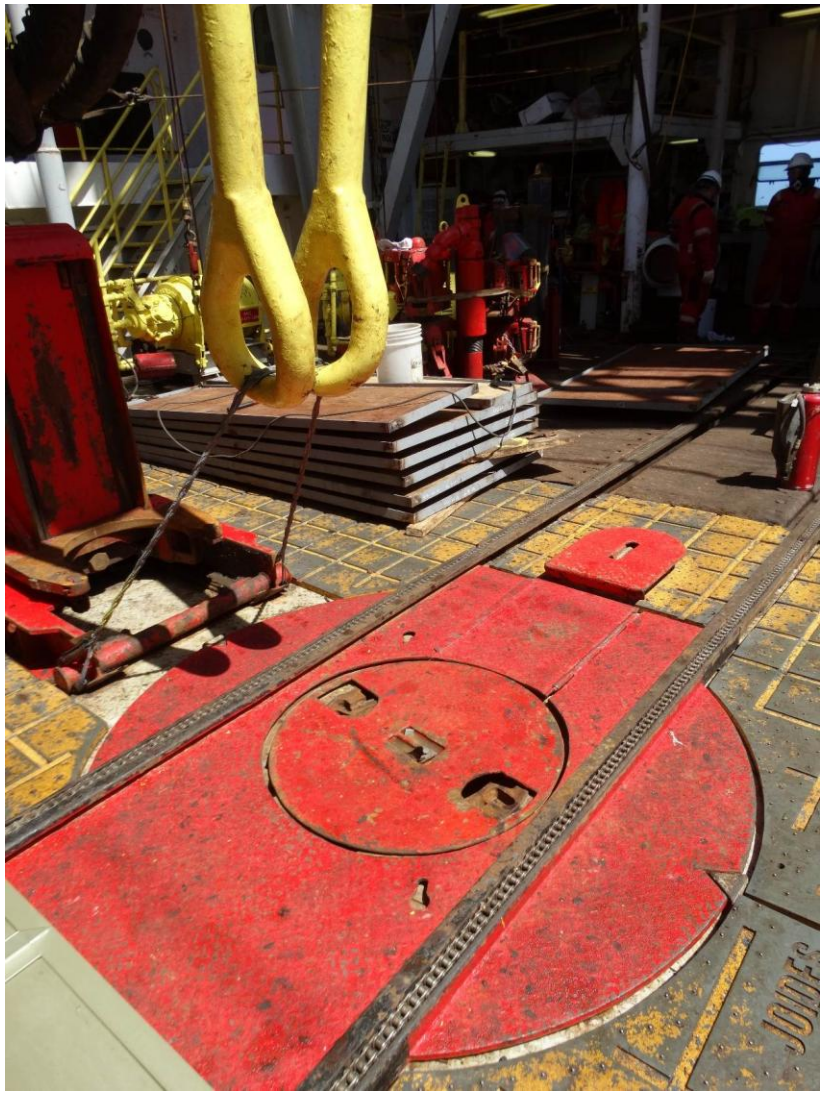
Ross Sea 2018: NB Palmer

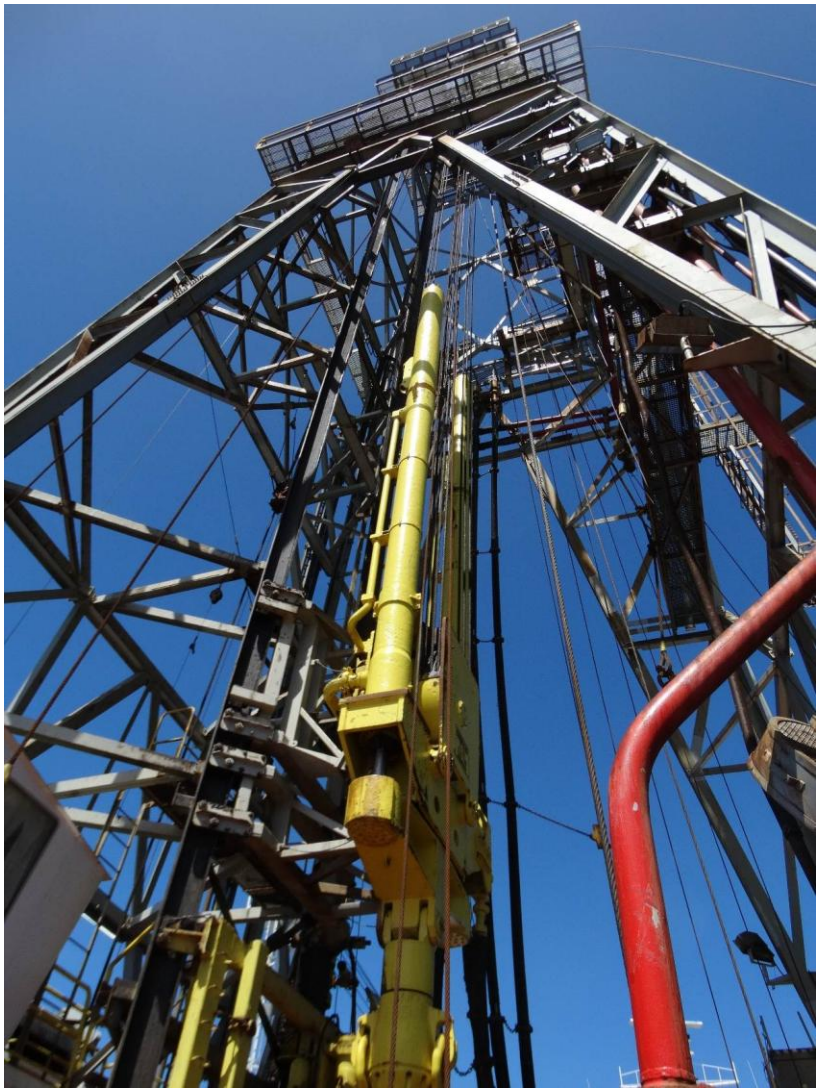
Ross Sea 2018: Joides Resolution



Photo R. Dunbar

Ross Sea 2018: Joides Resolution





IODP
INTERNATIONAL OCEAN DISCOVERY PROGRAM

Photo L. De Santis







Photo L. De Santis

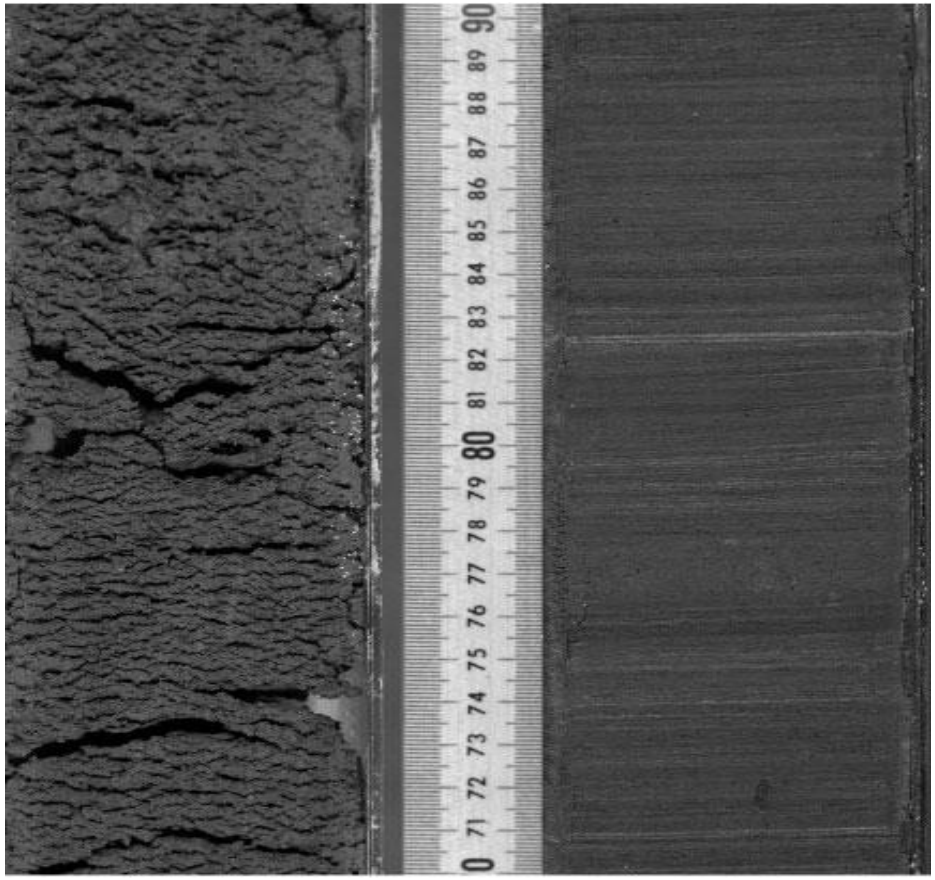








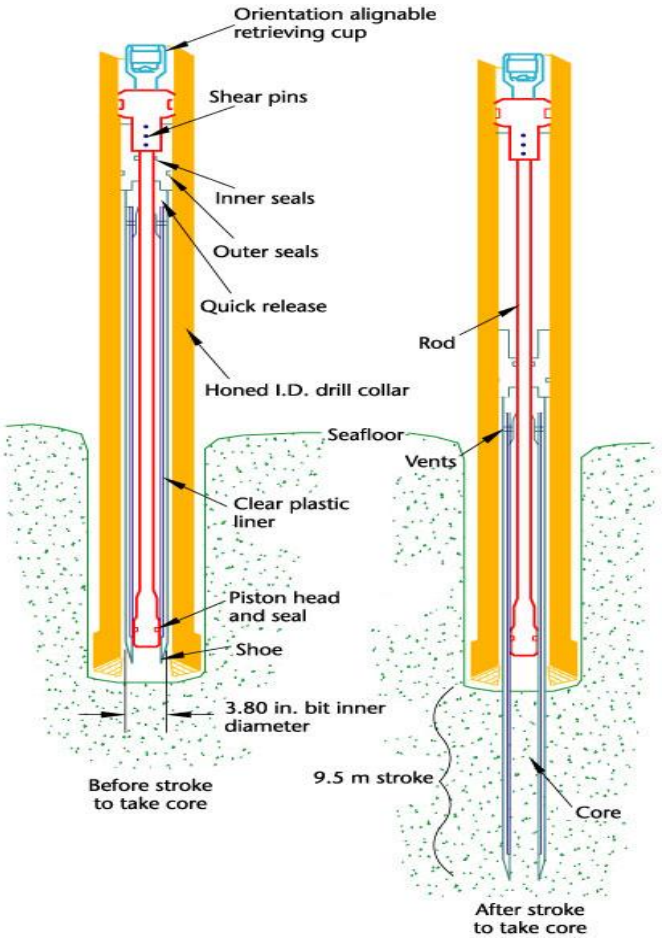
Photo L. De Santis



Rotary cores vs. Piston cores

- Drill over technique
- Deepest APC ~490m
- Better quality

APC Coring



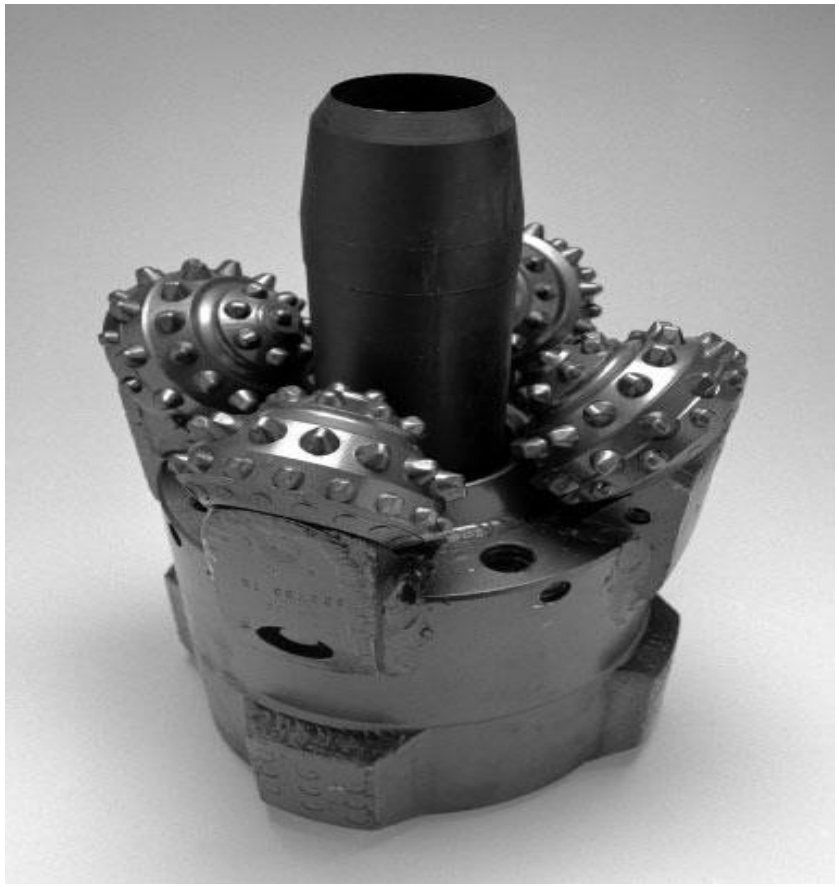
The Advanced Piston Corer (APC) is crucial for high-resolution climate and paleoceanographic studies.

The APC is a hydraulically actuated piston corer designed to recover relatively undisturbed continuous 9.5 m long oriented core samples from very soft to firm sediments.

Another tool that is now available is the ½ APC.

½ APC Coring System

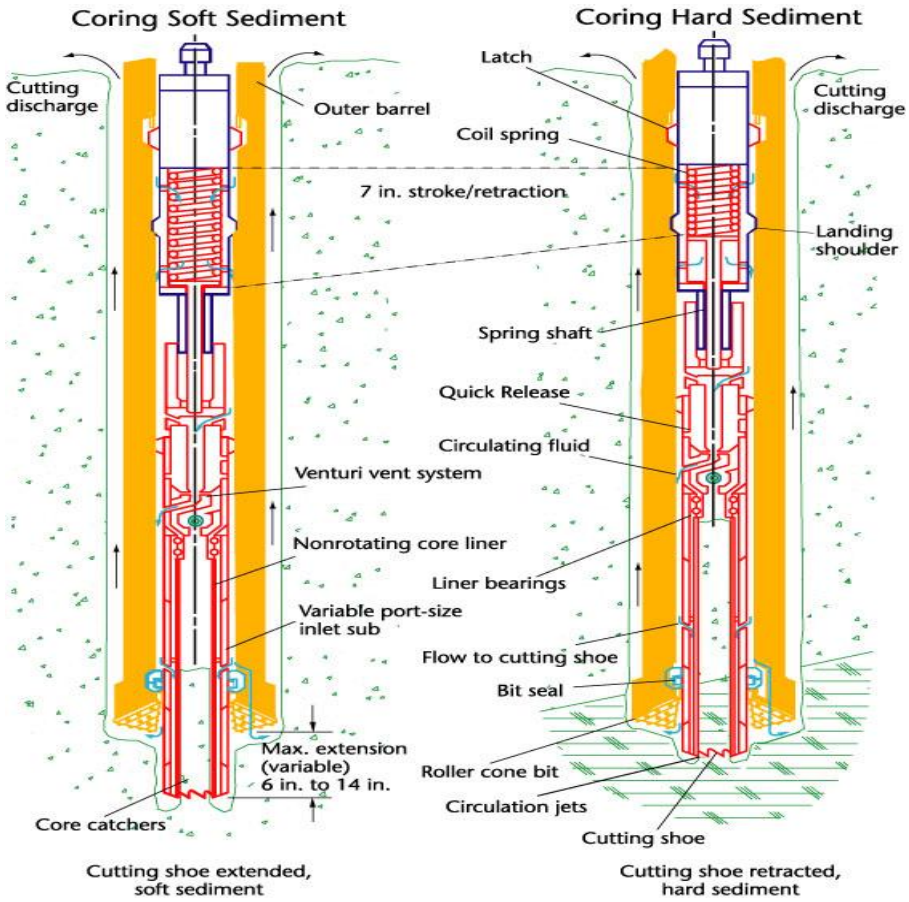
- Recovers 4.7 meter cores
- Can be used for extending core depths with improved core quality.
- Can be used to piston core through difficult sections.
- Results in fewer liner deformations.
- Takes longer than the full length APC coring system because of doubling wireline trips.
- Drill over time is eliminated or drastically reduced.
- Is completely compatible with the APC/XCB system.



Advanced piston core/ Extended Core Barrel APC / XCB Bit

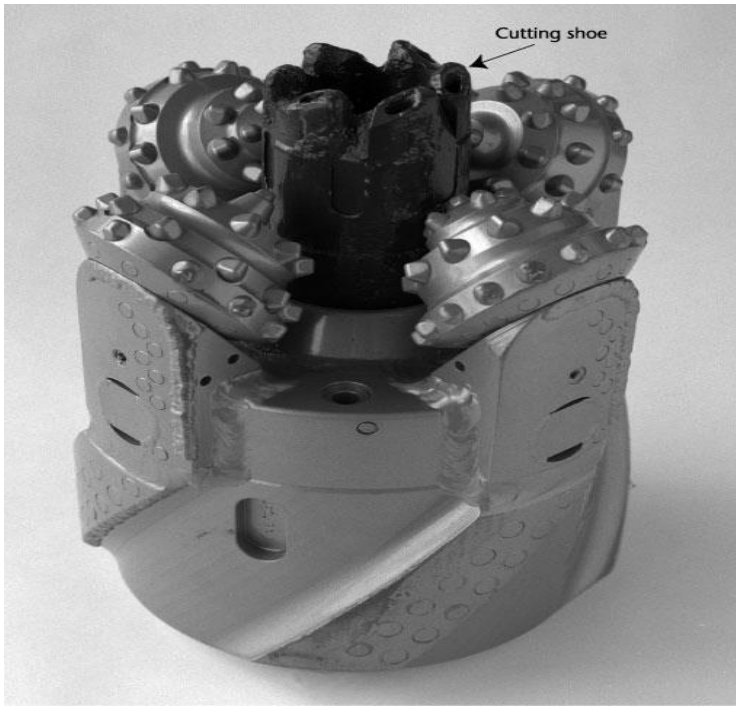
- 4 Roller cones
- APC cutting shoe shown
- Tungsten Carbide inserts.
- Drills or Cores 11 7/16” Dia. Hole.
- APC Core Dia. = 2.6” or 66 mm.
- XCB Core Dia. =2.3” or 58.4mm
- Max core length 9.84 m
- APC Record 490.4 mbsf

XCB



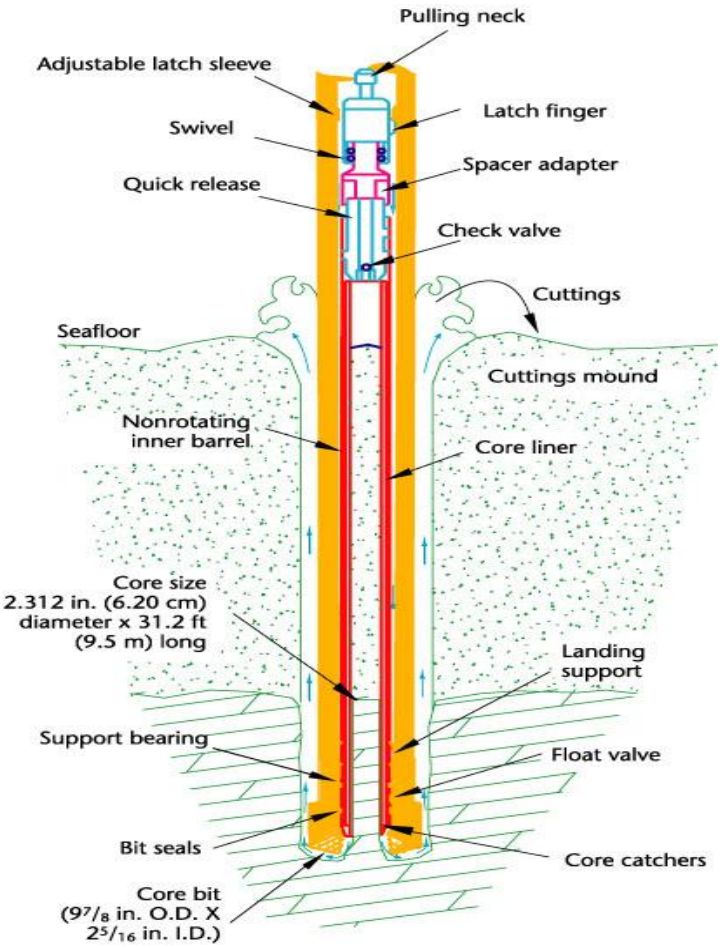
The XCB shoe extends 6 to 14 in. ahead of the bit in very soft formations and retracts ~7 in. (inside the main bit) as weight on bit exceeds about 12,000 lb (collapsing a coil spring).

APC / XCB Drilling Bit





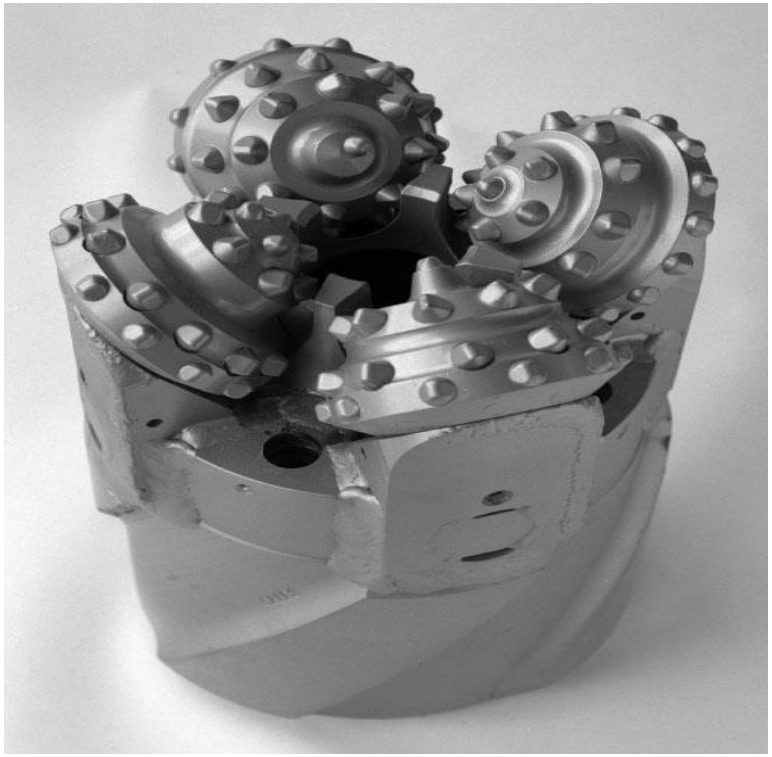
RCB Drilling Bit



RCB Coring

The Rotary Core Barrel (RCB) is a rotary coring system designed to recover core samples from firm to hard sediments and igneous basement.

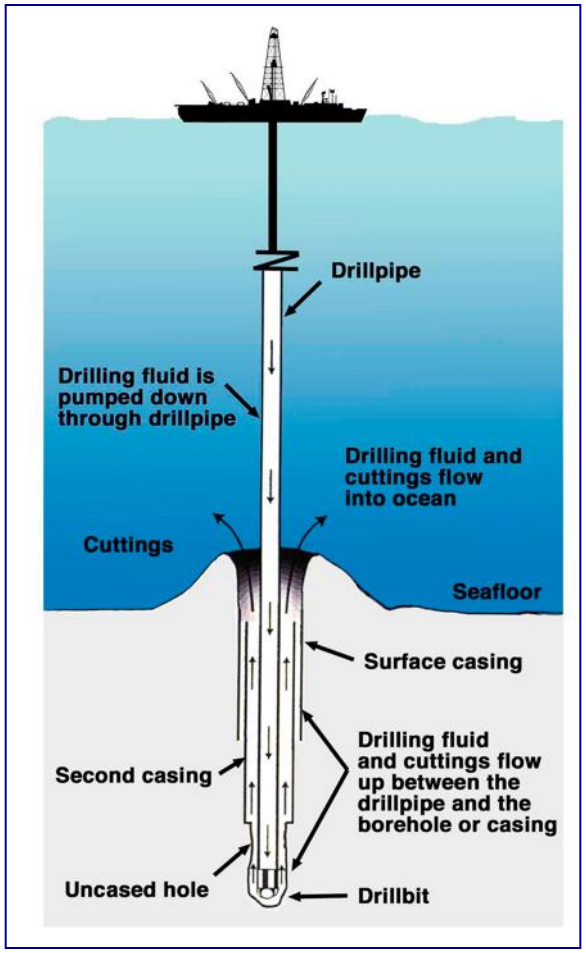
The RCB is crucial for oceanic crustal hard rock studies.

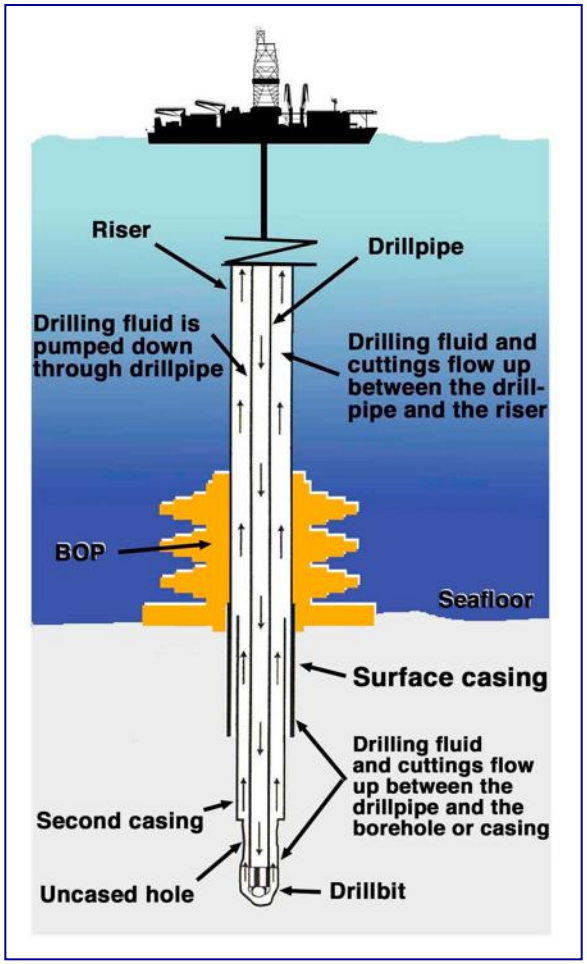


RCB Bit

- Drills or cores 9 7/8” dia. Hole
- Carbide inserts
- Uses compression (weight) to cut new hole.
- Sealed Bearings for long life
- Typical life is 40-60 hours depending on formation
- Tooth structure changes depending on formation
- Core diameter is 2.312” (58.7mm)

THE 'RISER' DRILLING SYSTEM

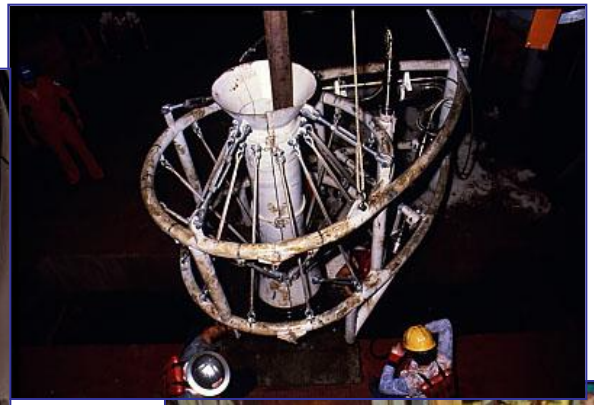




https://www.youtube.com/watch?v=a9hiUyt3DHY&t=5s

Site Surveys





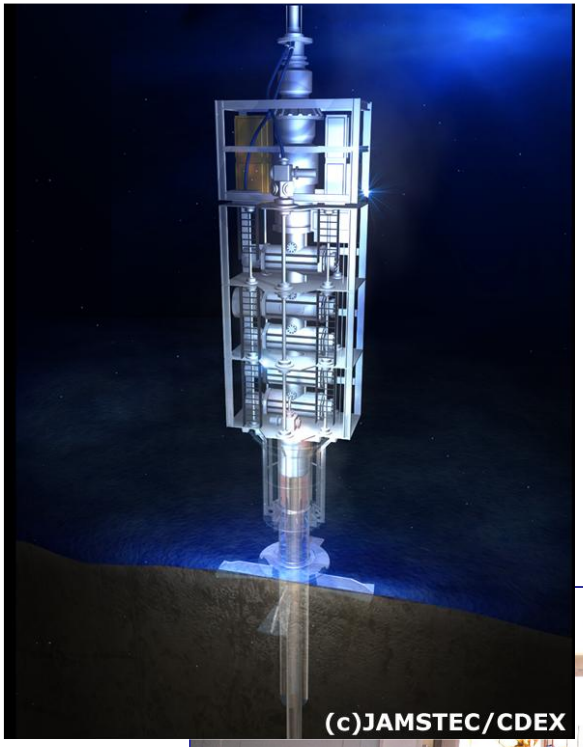
Dynamic Positioning

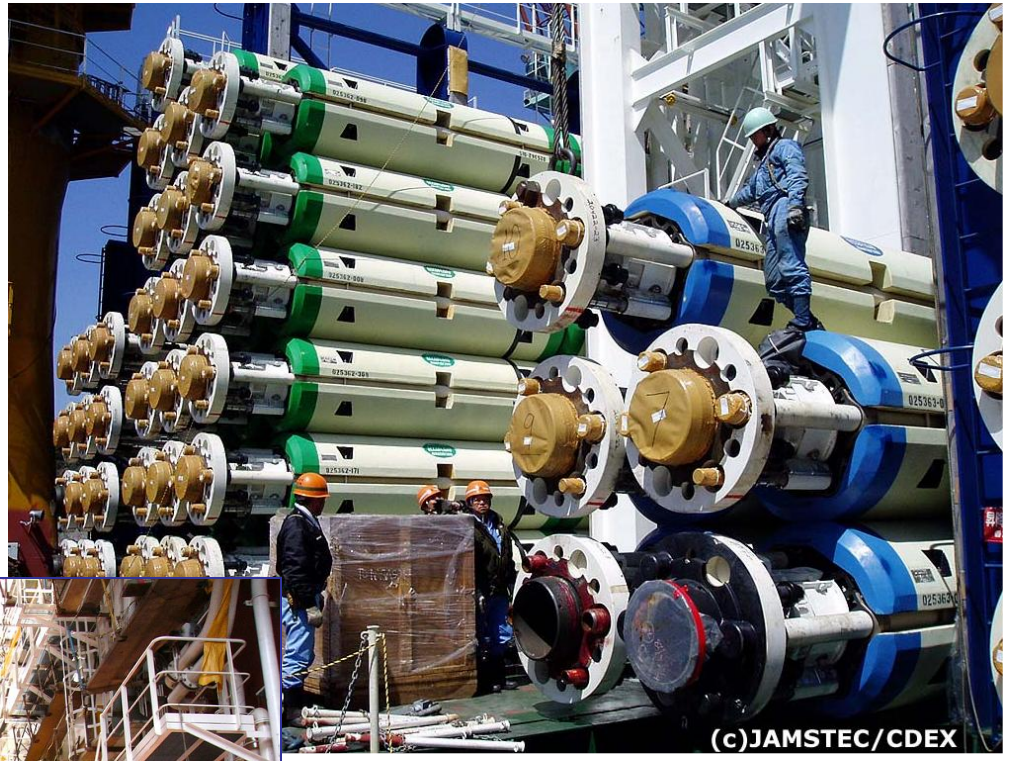


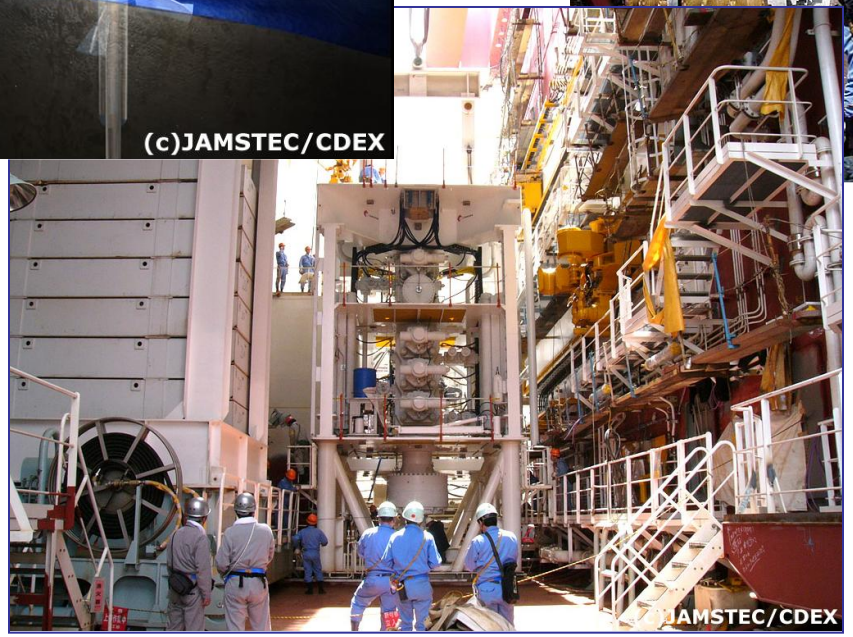
Drilling



Hole Re-entry







Measuring residual friction and the heat dissipation generated by large-scale fault movement to understand the dynamics of mega-earthquakes and the tsunamis that follow

CORE ON DECK

http://www.youtube.com/watch?feature=player_embedded&v=wC9lDPvvze0

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_3_riser_system.swf

http://www.iodp.org/images/stories/swf/4core_procedure_eng.swf

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

Chikyu drilling vessel: https: https://www.youtube.com/watch?v=bqmuwHQGo1k&t=9s

Chikyu riser drilling: https://www.youtube.com/watch?v=2B8VcQhvkPQ

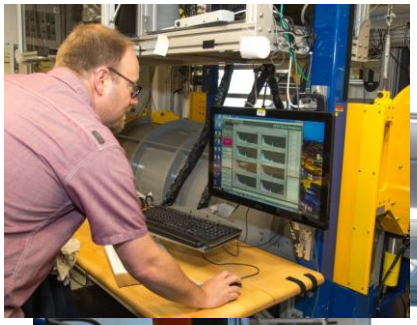
Scientific Deep Sea Drilling and Coring Technology: https://www.youtube.com/watch?v=Wb79oZ4usyo

Coring minute 7.24

Coring operations: https://joidesresolution.org/what-is-coring-anyway/



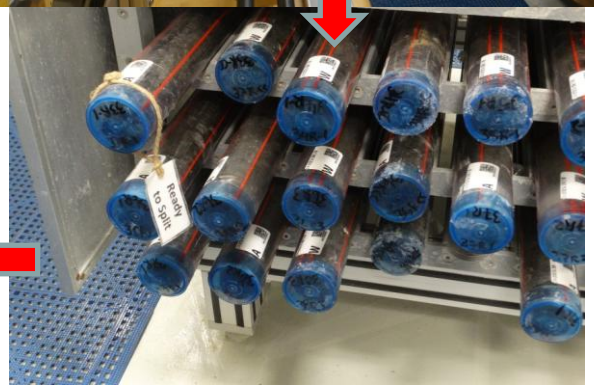




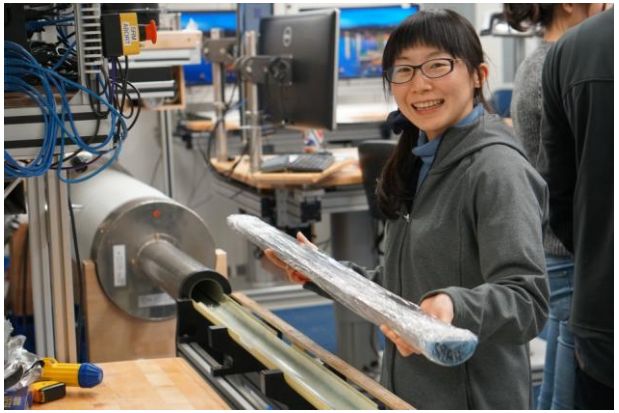







Ready to Split





Magnetic susceptibility is a measure of the degree to which a material can be magnetized by an external magnetic field. sensitive to
the concentration of ferromagnetic minerals (e.g., magnetite, pyrite, and a few other iron oxides)



GRA density is an estimate of bulk density based on the attenuation of a gamma ray beam. Emitted gamma rays are scattered by electrons in the formation.
The degree of scattering is related to the material bulk density

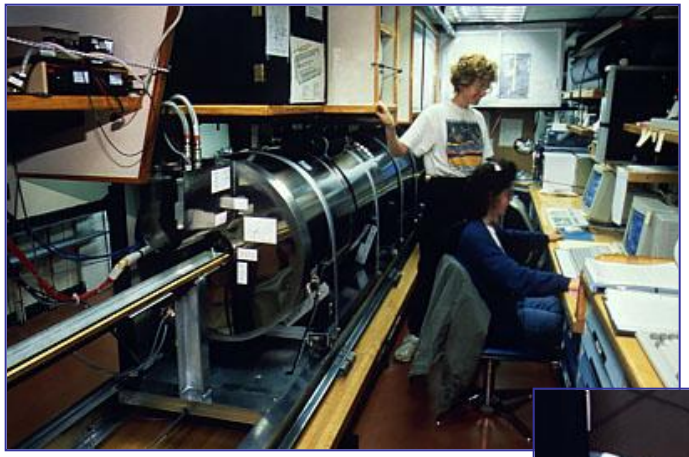




natural remanent magnetization (NRM) of archive-half core sections before and after alternating field (AF) demagnetization.



Geomagnetic logging

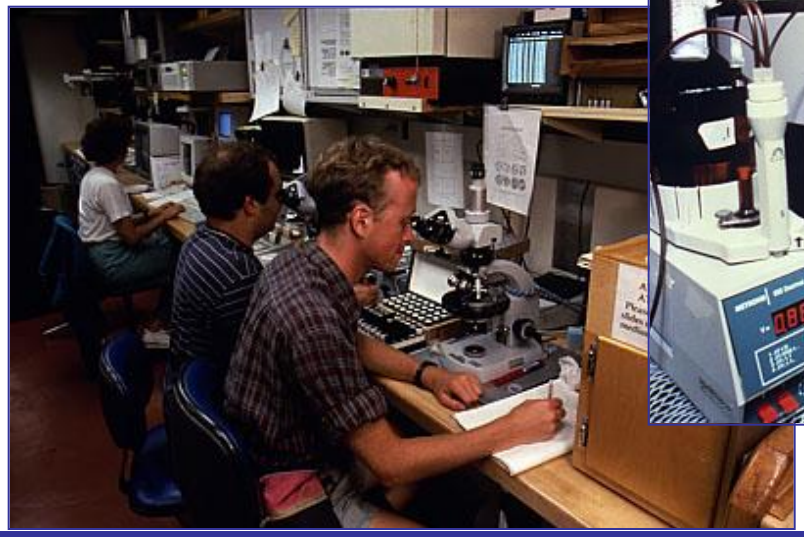


Microbiology



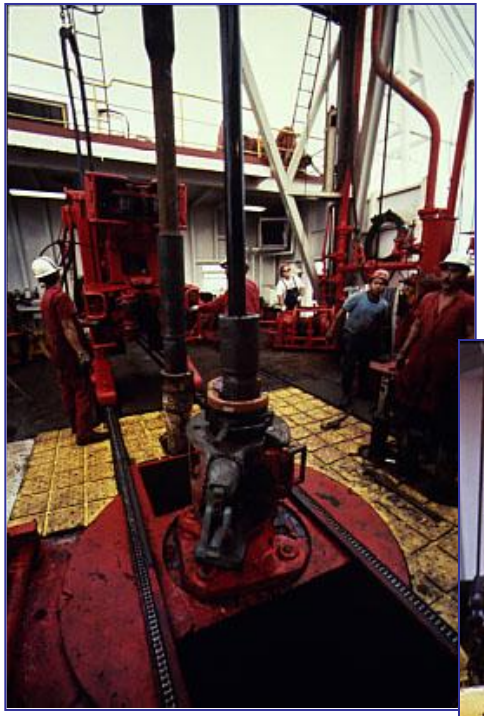


Micropaleontology



Geochemistry







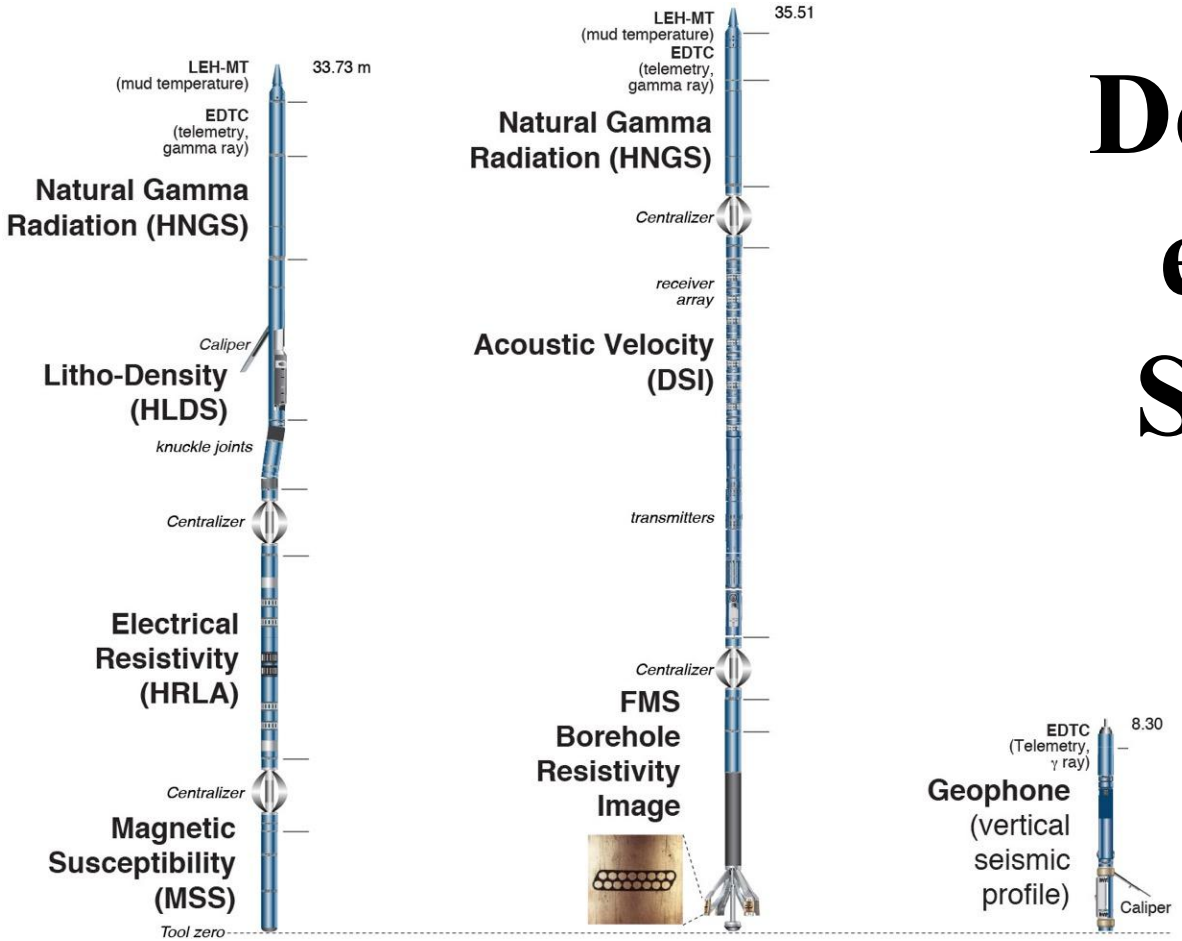


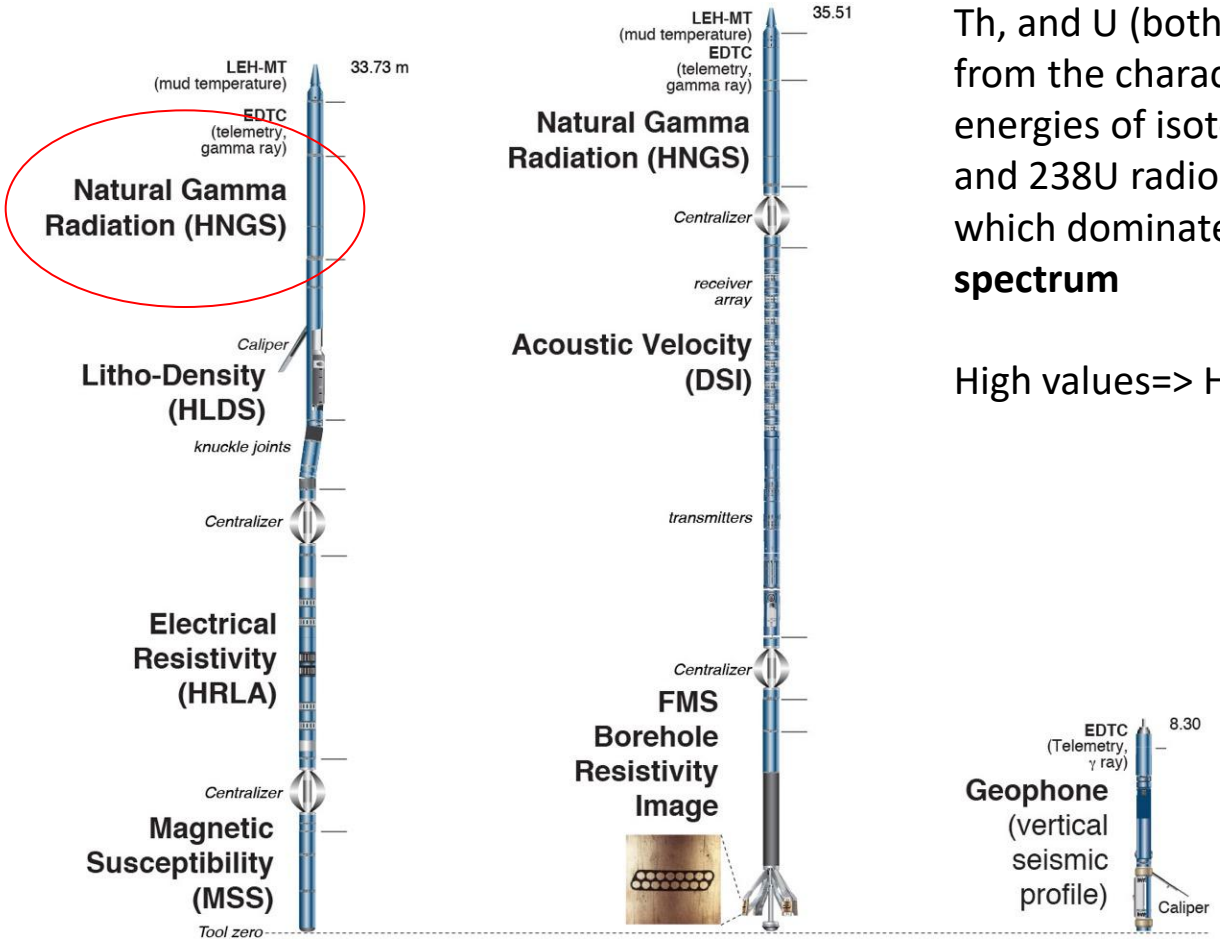
Downhole Logging

(APC), Advanced piston core. (HLAPC) Half advanced piston core. (XCB), extended barrel. (RCB) rotary core barrel (non magnetic)

Hole	Water depth (m)	Drilled sediment thickess (DSF)/Type of core/recovery %	LOGS	NOTE
U1521	562	411.50 m RCB 63%	triple combo: natural gamma radiation, density, porosity, resistivity, magnetic susceptibility, and borehole diameter total depth of 649 m (WSF). FMS-sonic, sonic velocity, and resistivity images of the borehole wall . vertical seismic profile (VSP)	A total of 132.75 h (5.5 days)
U1522	558	701.8 m RCB 40%	triple combo (no radioactive source), Versatile Seismic Imager (VSI), and Formation MicroScanner (FMS).	A total of 149.25 h (6.2 days)
U1523A **U1523B** **U1523C** **Hole U1523D** **Hole U1523E**	828 828 828 828 828	41.57 m APC 91%. 87.99 m HLAPC 59%. 3.16 m XCB 5% 0.9 m RCB 0.5%	(hole D) tool strings: a modified triple combo and the Formation MicroScanner (FMS). The Dipole Sonic Imager (DSI). Hostile Environment Litho-Density Sonde (HLDS) was run without the source for measurement of borehole diameter with the caliper	A total of 147.5 h (6.15 days)
U1524A	2394	270.3 m APC (284.17 m tot A+B APC 102%) 0.43 m HLAPC 108% 5.51 m XCB 19%	No logs	Total time 117.25 h (4.9 days). we were forced to terminate operations due to a mechanical breakdown of the port stern tube shaft.
U1524B	2394	APC (Mudline core for high resolution interstitial water and microbiologyl)		
U1524C	2394	260.5 m (drilled without coring) 19.2 m RCB 11%		
U1525	1776	63.23 m APC 103% 52.64 m HLAPC 92% 42.83 m XCB 45%	No logs	A total of 51.25 h (2.1 days) was spent on Hole U1525

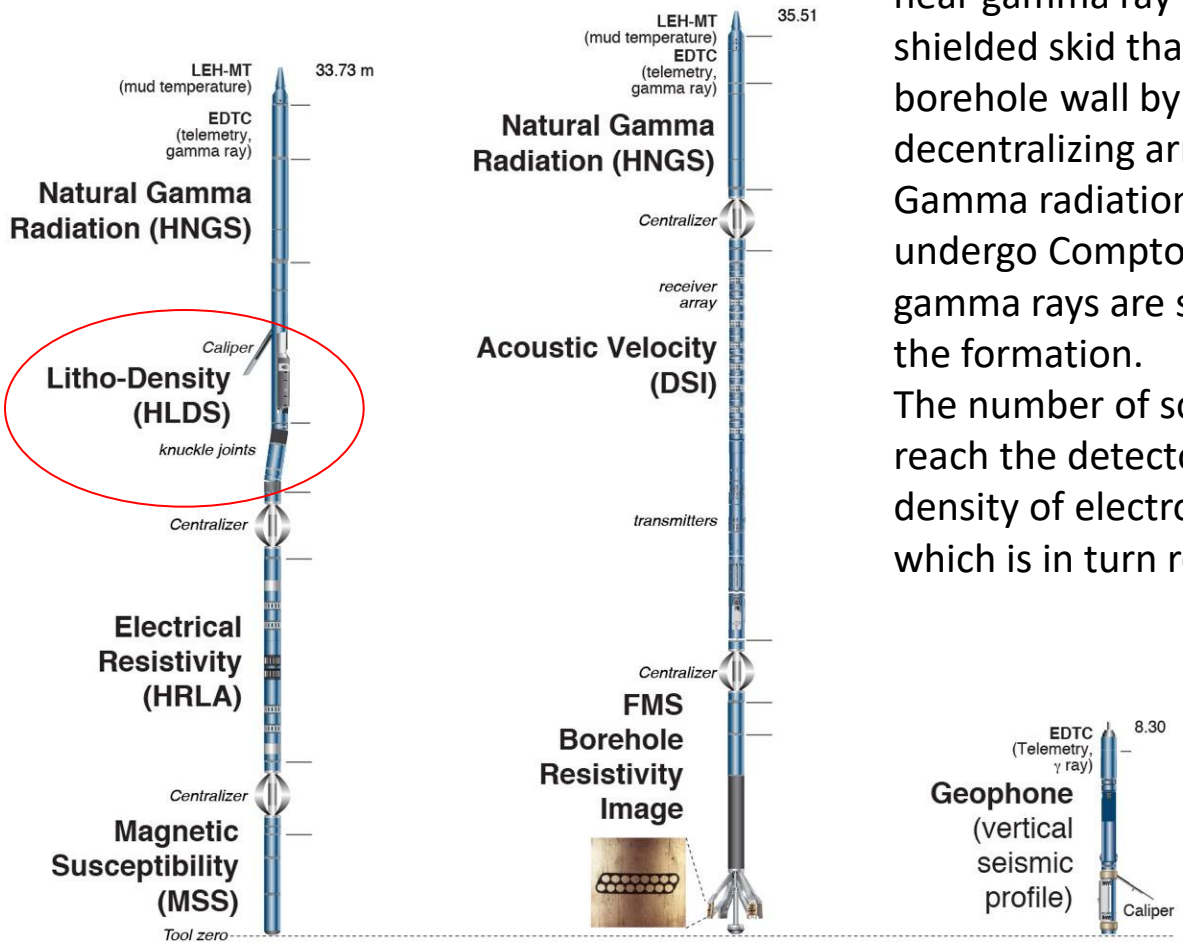
Downhole Tool Strings





Natural Gamma ray: determines concentrations of K (in weight percent), Th, and U (both in parts per million) from the characteristic gamma ray energies of isotopes in the 40K, 232Th, and 238U radioactive decay series, which dominate the **natural radiation spectrum**

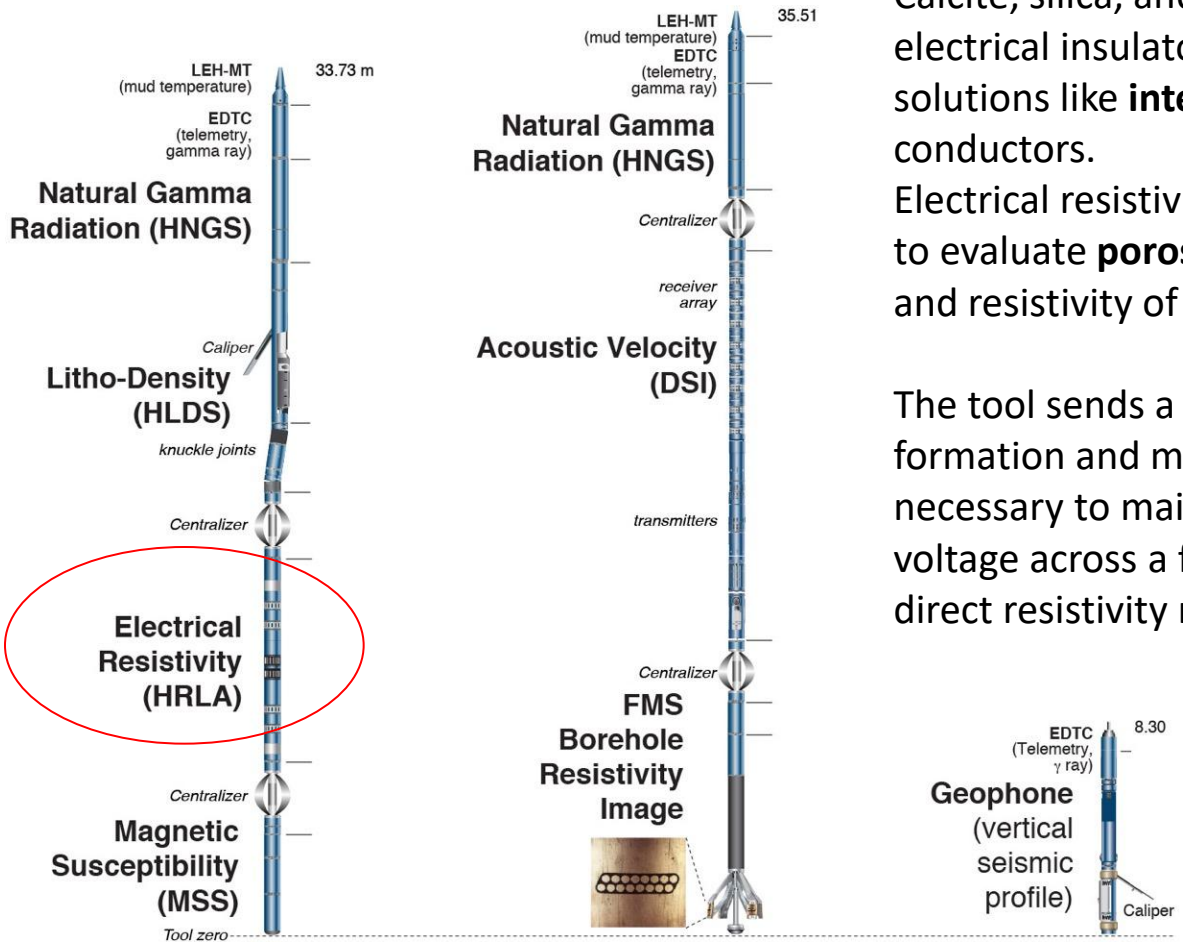
High values=> High terrigenous material



The HLDS contains a cesium (137Cs) gamma ray **source** (662 keV) and far and near gamma ray **detectors** mounted on a shielded skid that is pressed against the borehole wall by a hydraulically activated decentralizing arm.

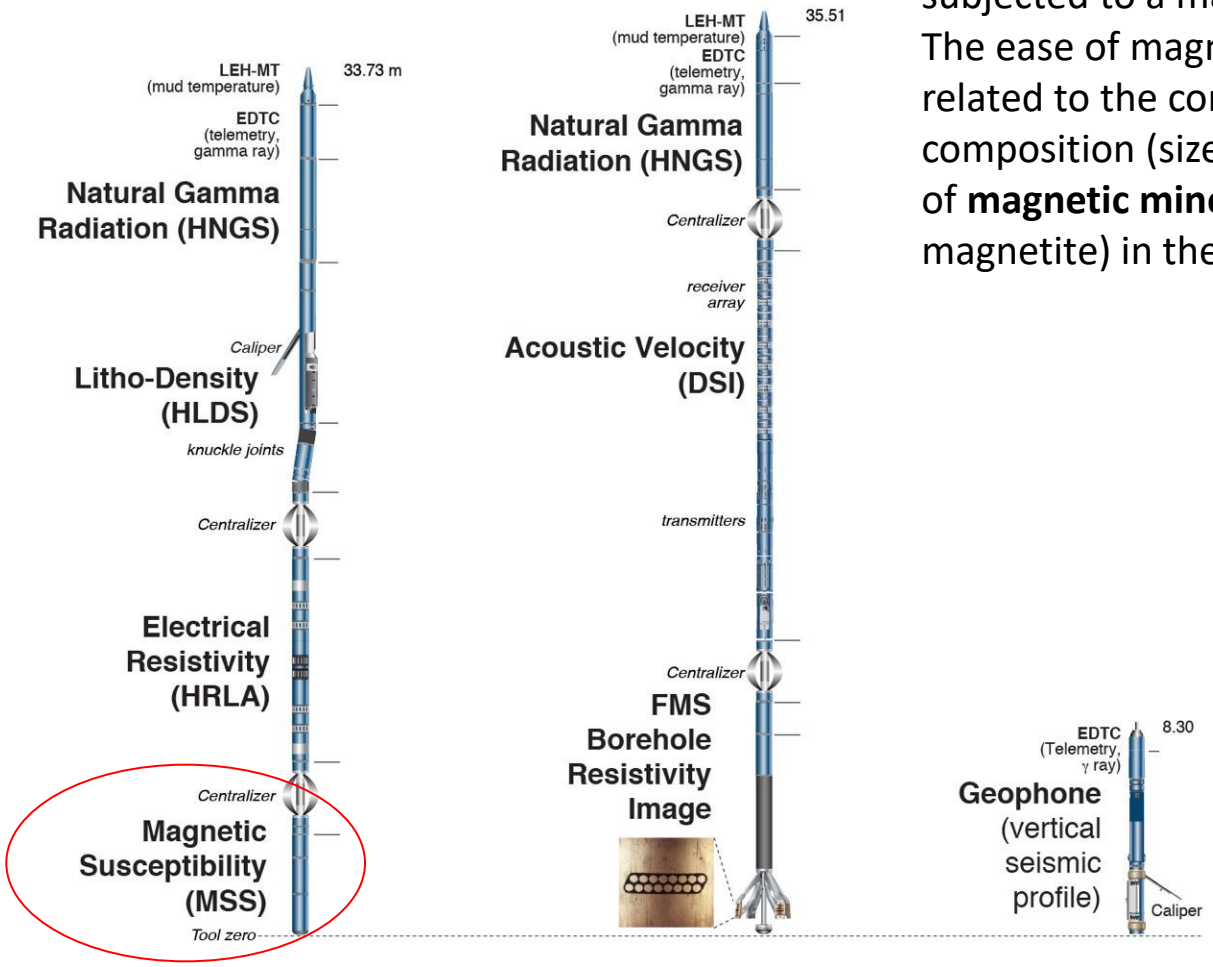
Gamma radiation emitted by the source undergo Compton scattering, in which gamma rays are scattered by electrons in the formation.

The number of scattered gamma rays that reach the detectors is proportional to the density of electrons in the formation, which is in turn related to **bulk density**.

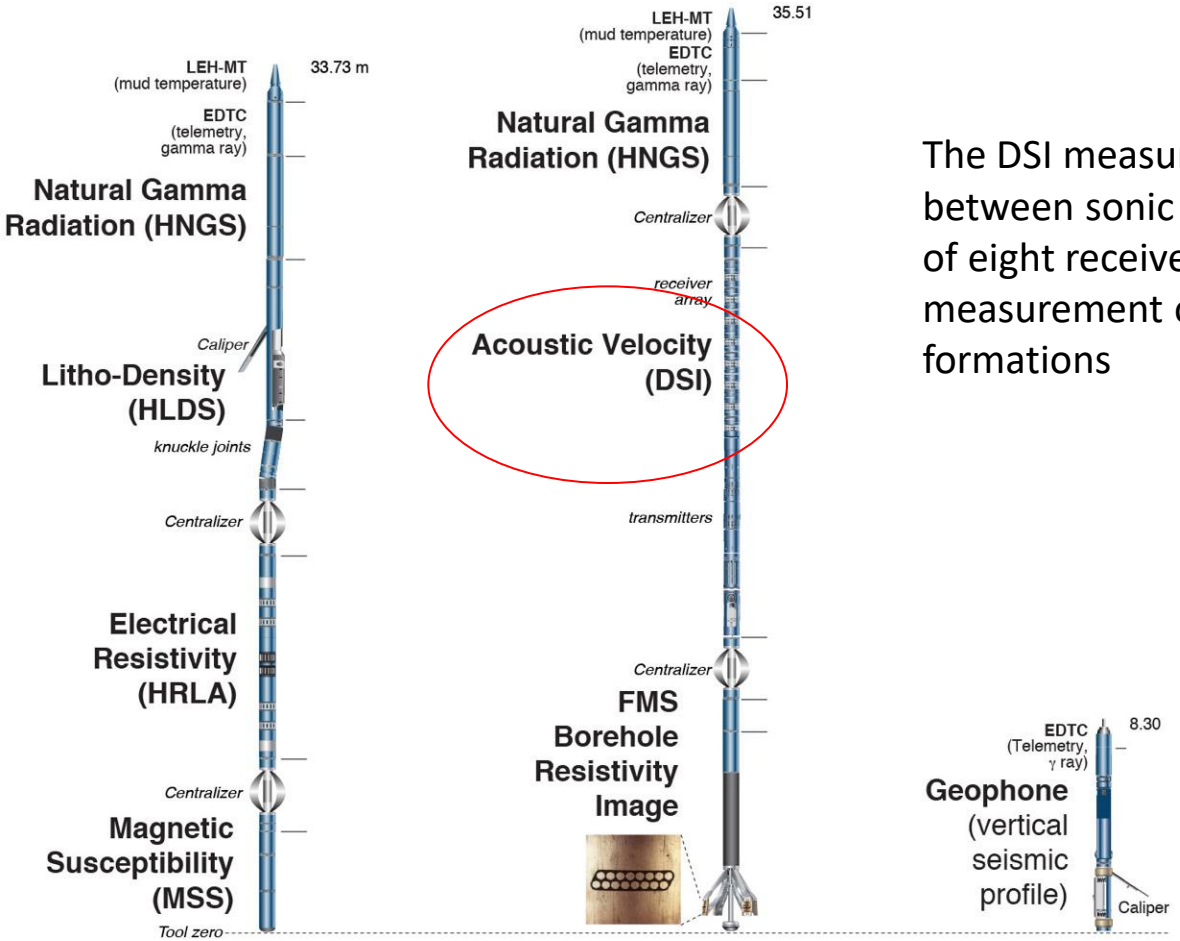


Different materials have different electrical conductivities.
Calcite, silica, and hydrocarbons are electrical insulators, whereas ionic solutions like **interstitial water** are conductors.
Electrical resistivity can therefore be used to evaluate **porosity** for a given salinity and resistivity of interstitial water.

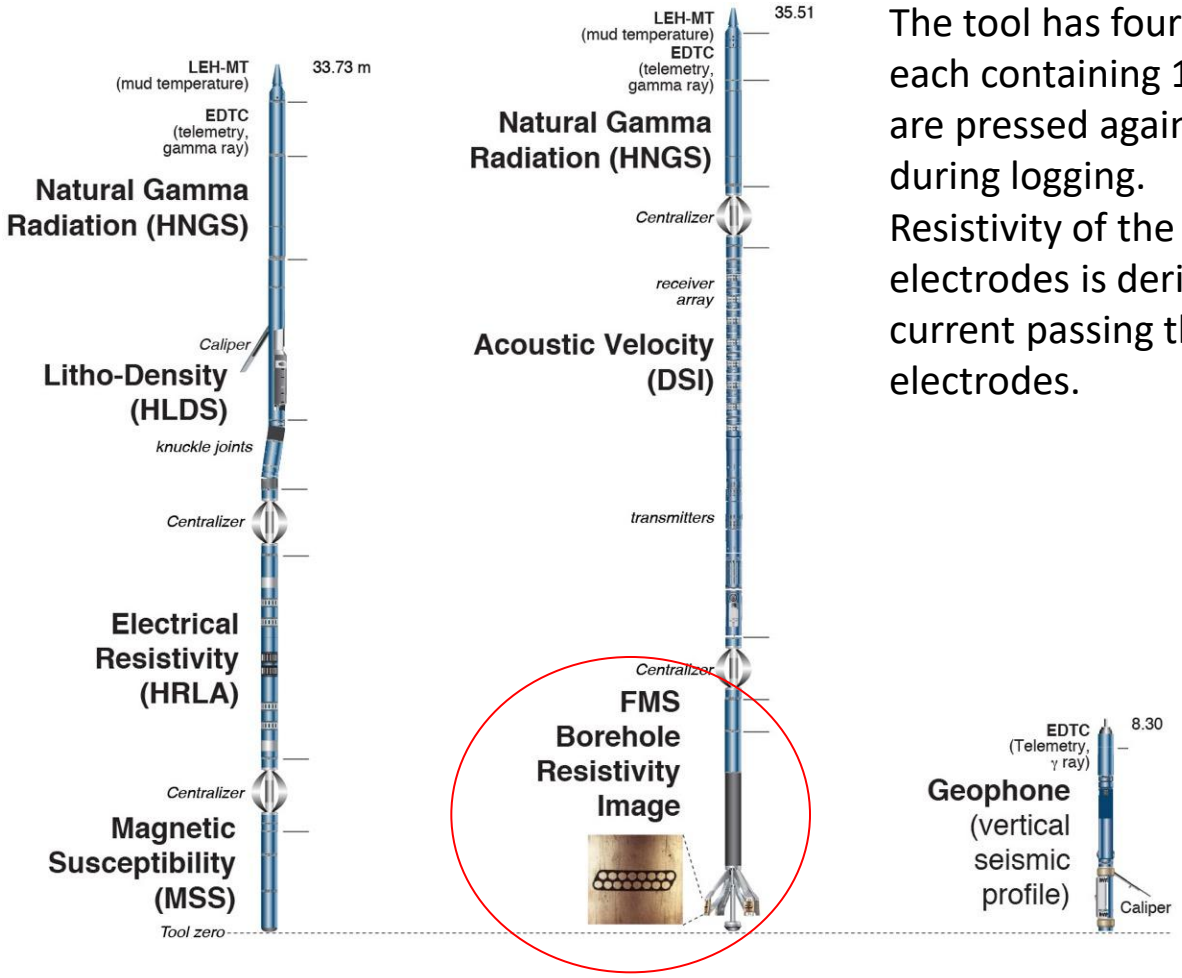
The tool sends a focused current into the formation and measures the intensity necessary to maintain a constant drop in voltage across a fixed interval, providing direct resistivity measurements



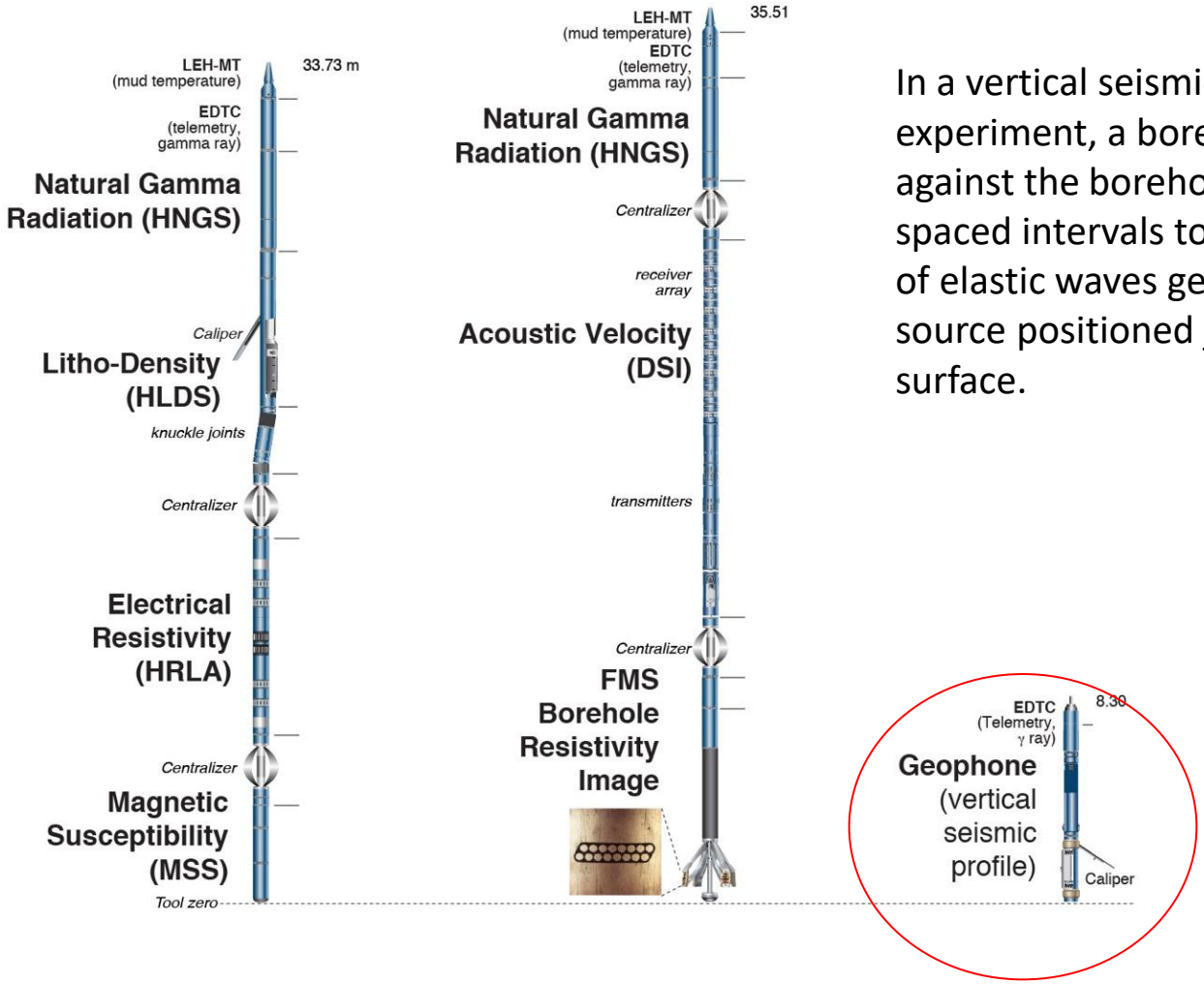
Coil sensor that measures the ease with which formations are magnetized when subjected to a magnetic field.
The ease of magnetization is ultimately related to the concentration and composition (size, shape, and mineralogy) of **magnetic minerals** (principally magnetite) in the formation.



The DSI measures the transit times between sonic transmitters and an array of eight receivers providing a direct measurement of sound velocity through formations



The FMS provides high-resolution electrical resistivity–based images of borehole walls. The tool has four orthogonal arms and pads, each containing 16 button electrodes that are pressed against the borehole wall during logging.
Resistivity of the formation at the button electrodes is derived from the intensity of current passing through the button electrodes.



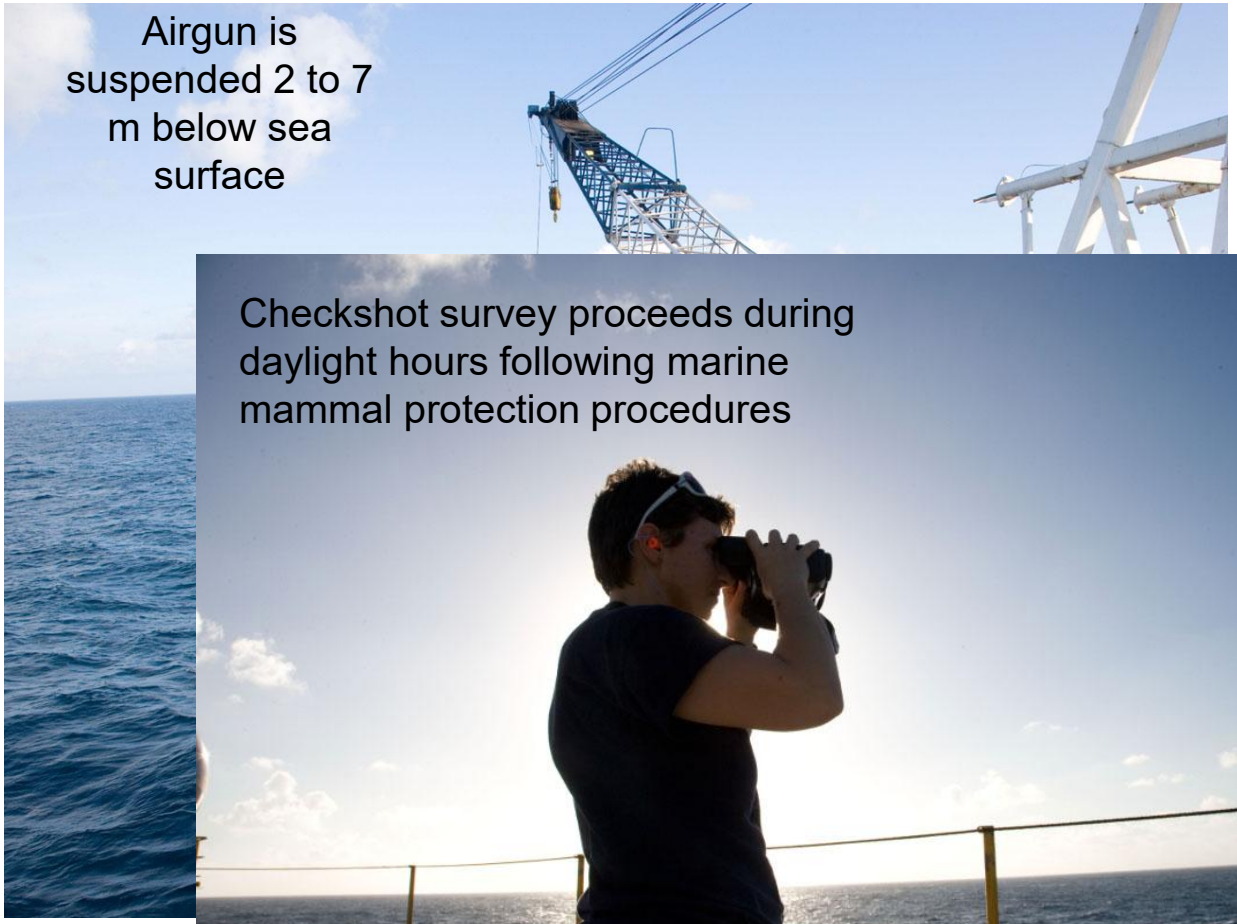
In a vertical seismic profile (VSP) experiment, a borehole VSI is anchored against the borehole wall at regularly spaced intervals to record the full waveform of elastic waves generated by a seismic source positioned just below the sea surface.

Wireline downhole logging overview

Airgun seismic source for VSP

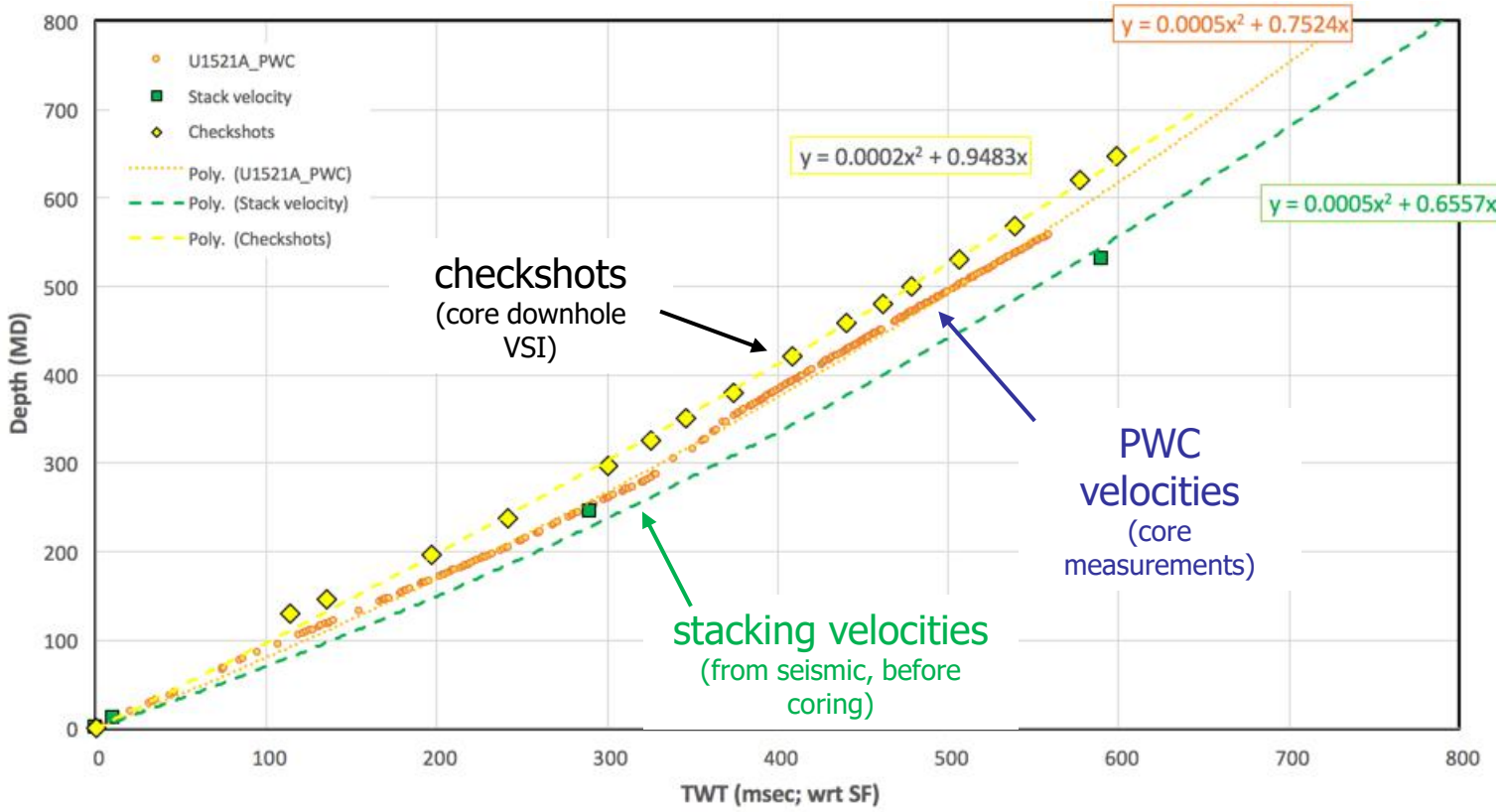


two 250-in^3 Sercel G guns in a parallel “cluster” 1 m apart
The source was positioned on the port side of the JOIDES Resolution at ~7–9 mbsl with a horizontal borehole offset of ~47 m.

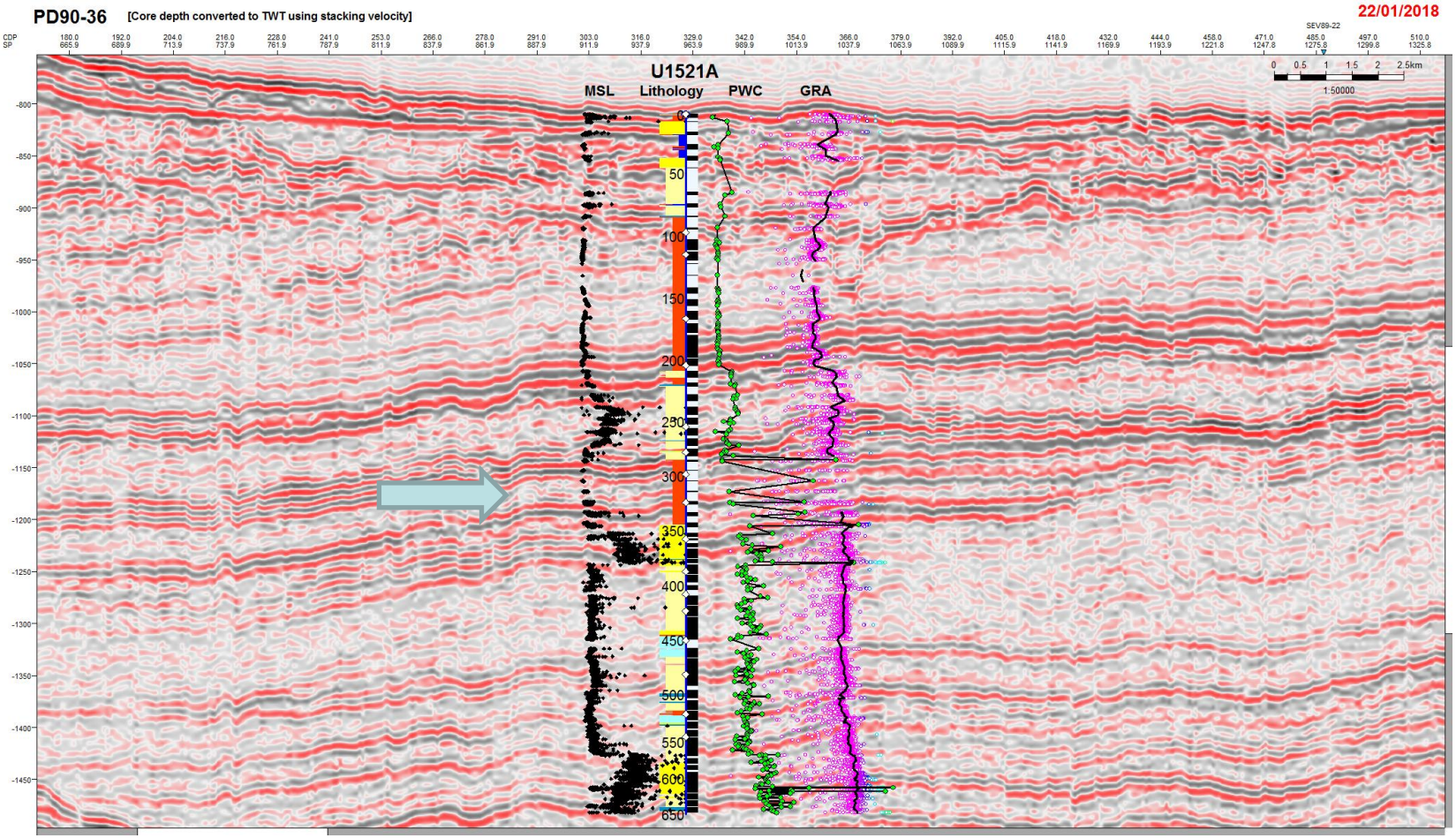

Airgun is suspended 2 to 7 m below sea surface

Checkshot survey proceeds during daylight hours following marine mammal protection procedures

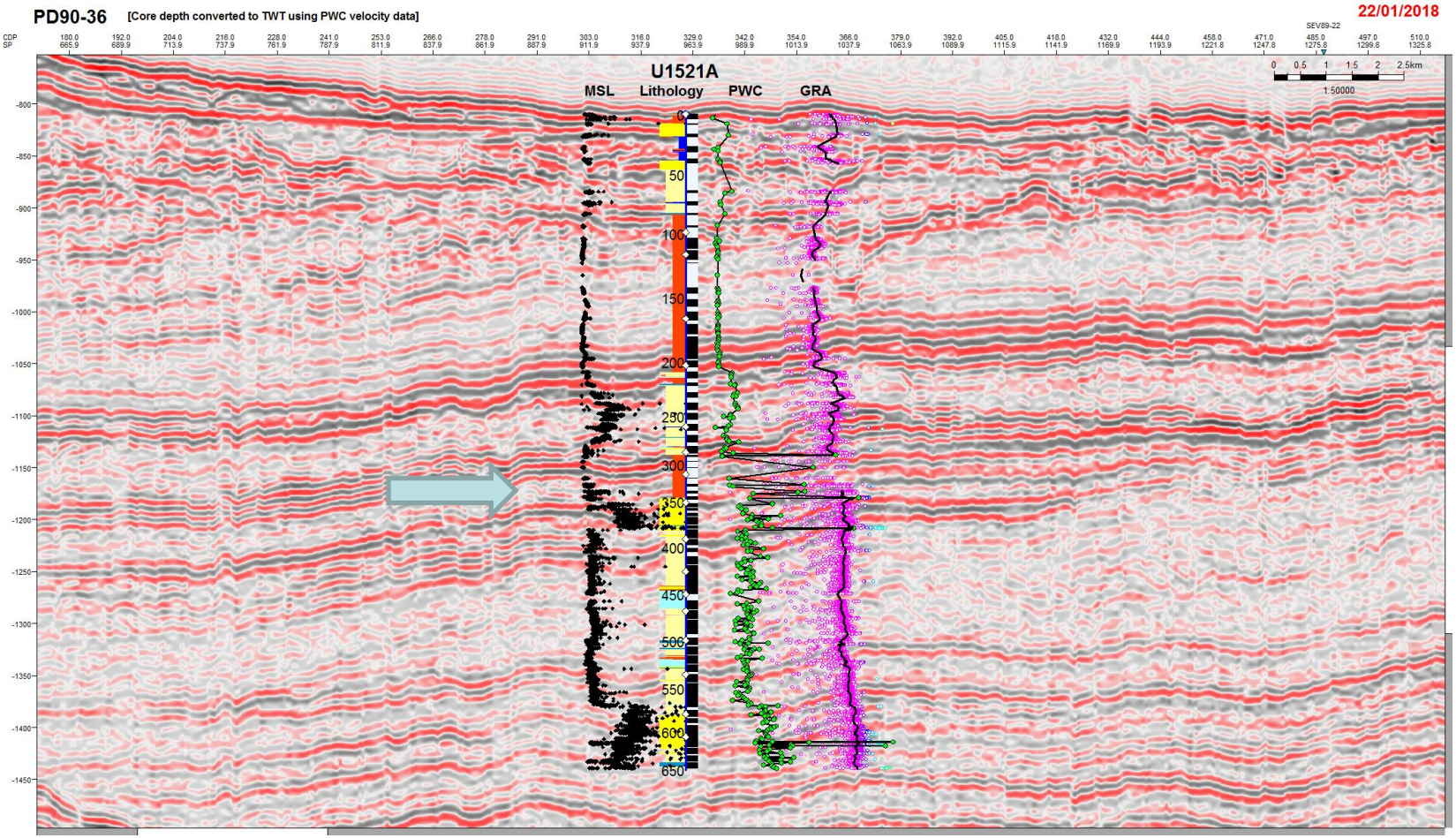
Time-depth relationship (TDR) models



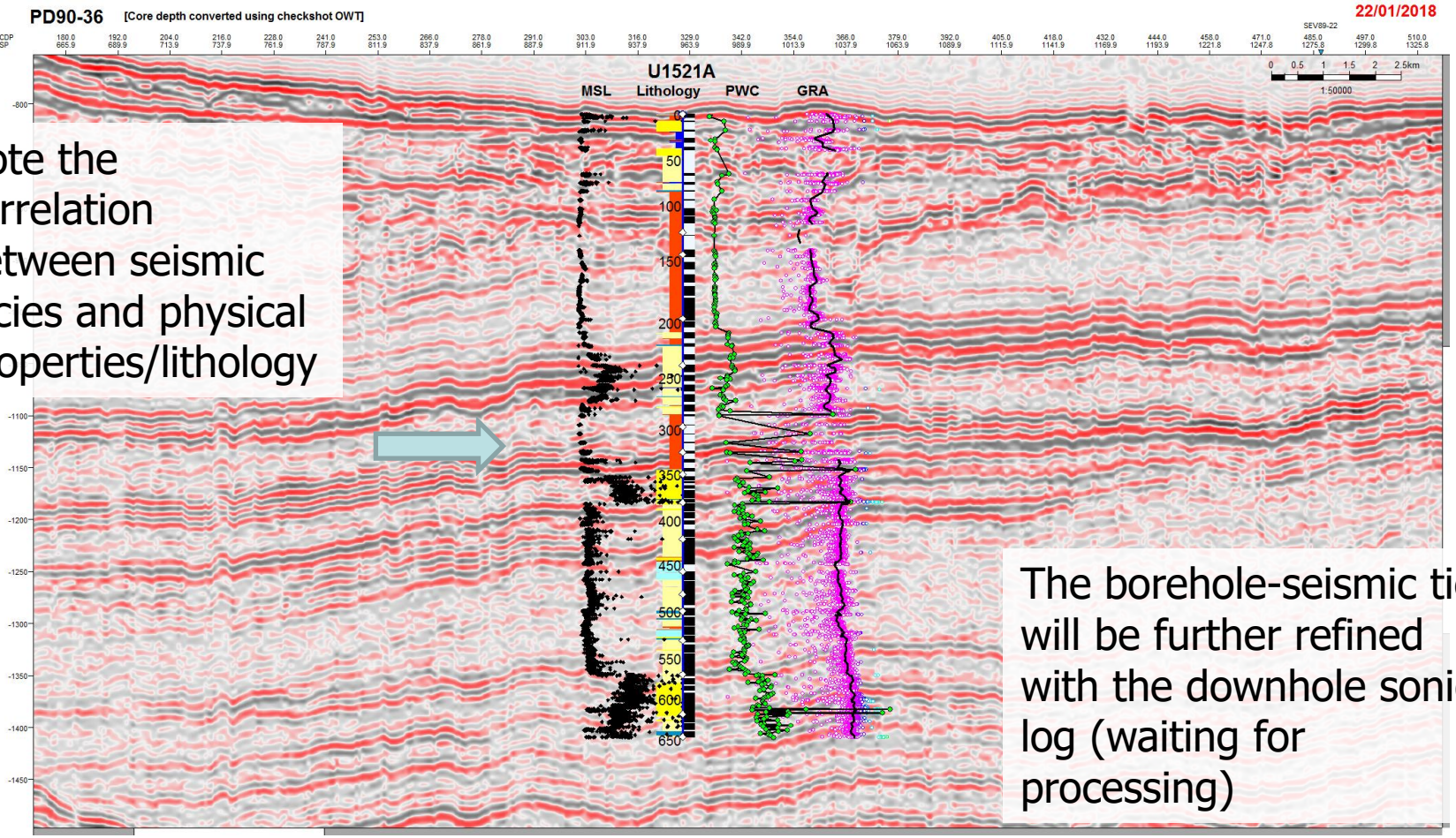
Borehole-seismic tie with stacking velocity



Borehole-seismic tie with PWC (core measurements)



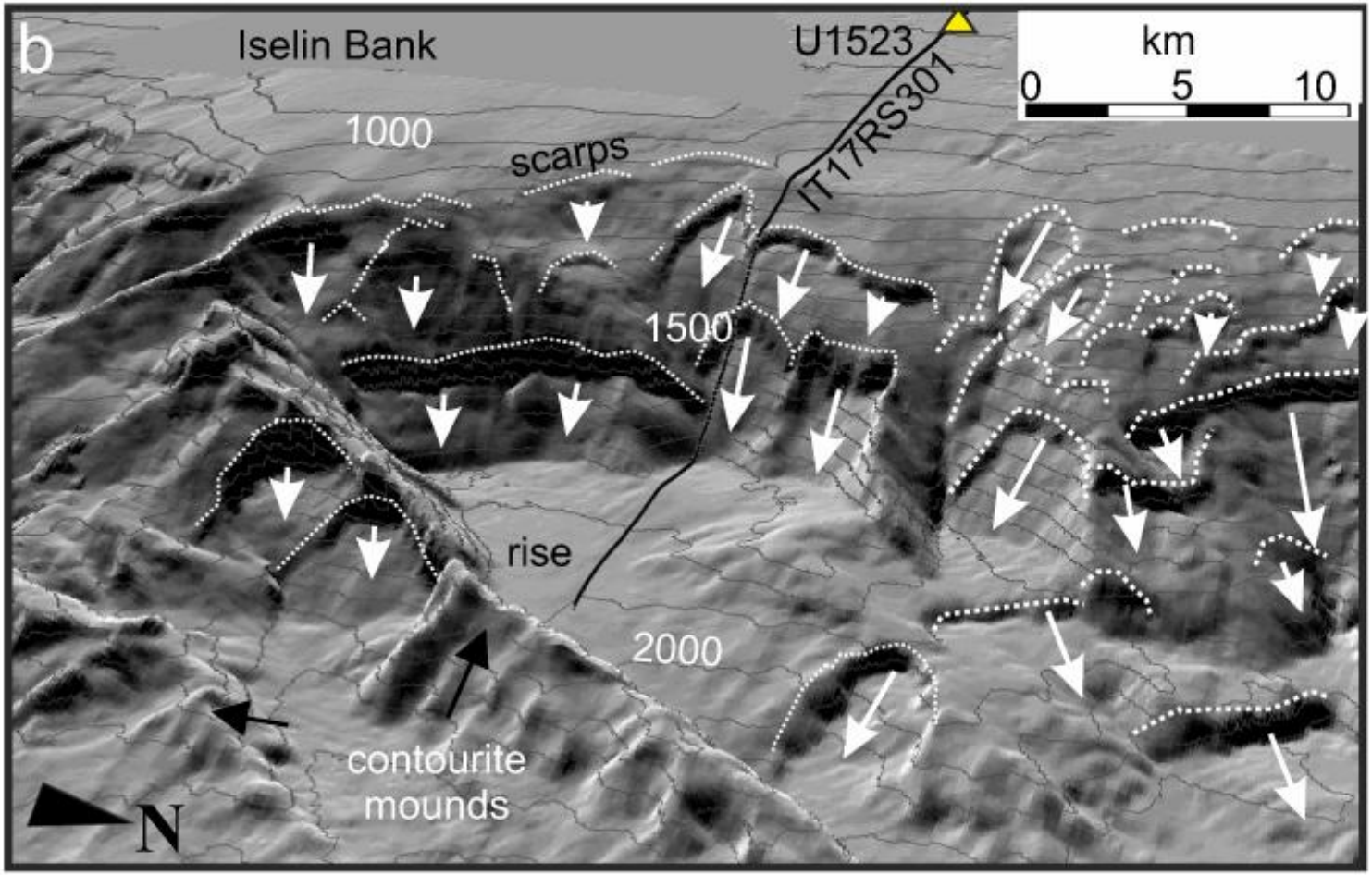
Borehole-seismic tie with VSI checkshots

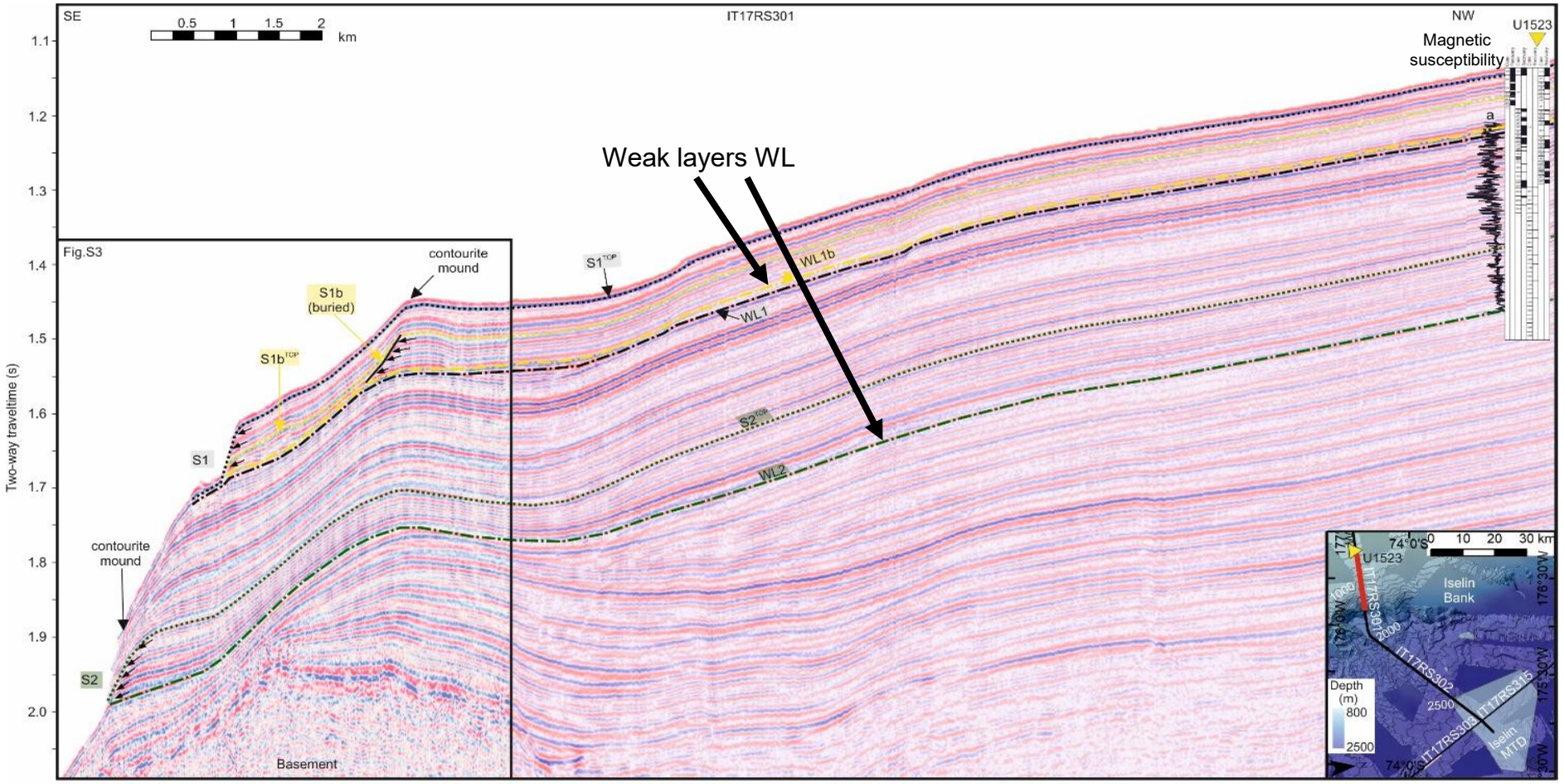


Note the correlation between seismic facies and physical properties/lithology

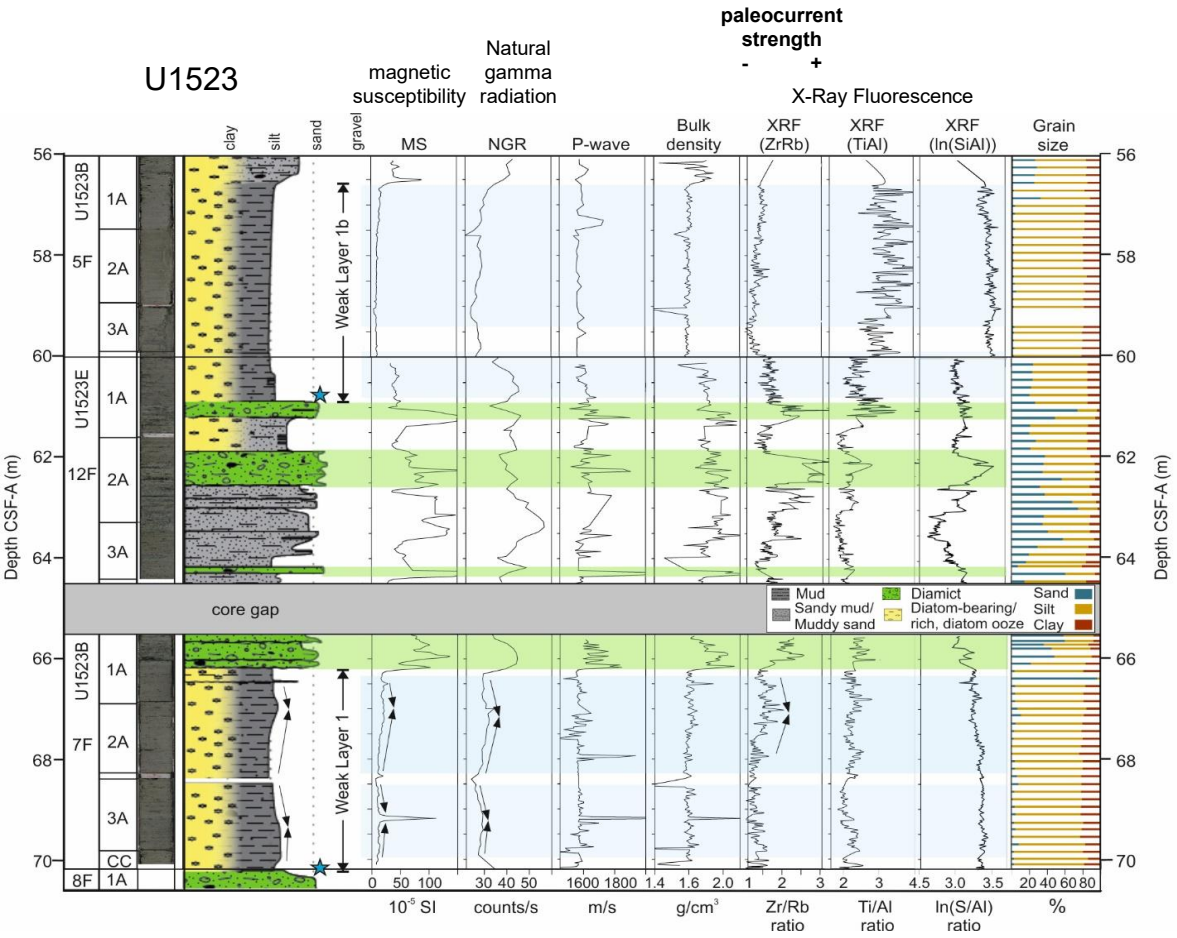
The borehole-seismic tie will be further refined with the downhole sonic log (waiting for processing)

multiple submarine landslide scarps and headwalls >100m high, >6000 km2, average slope gradients: ~6.5°).




SE
NW
IT17RS301
0.5 1 1.5 2 km
U1523
Magnetic susceptibility
a
Weak layers WL
WL1b
WL1
WL2
S1 TOP
S2 TOP
S1b (buried)
S1b TOP
S1
S2
contourite mound
contourite mound
Fig.S3
Basement
Two-way traveltime (s)
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
74°0'S
U1523
Iselin Bank
IT17RS301
IT17RS302
IT17RS305
IT17RS303
Iselin MTD
Depth (m)
800
2500
0 10 20 30 km
178°30'W
175°30'W

Packages of interbedded Miocene to Pliocene-age diatom oozes and glaciomarine diamicts



nature communications

Article

https://doi.org/10.1038/s41467-023-38240-y

Climate-controlled submarine landslides on the Antarctic continental margin

Received: 25 June 2022
Accepted: 21 April 2023
Published online: 18 May 2023
Check for updates

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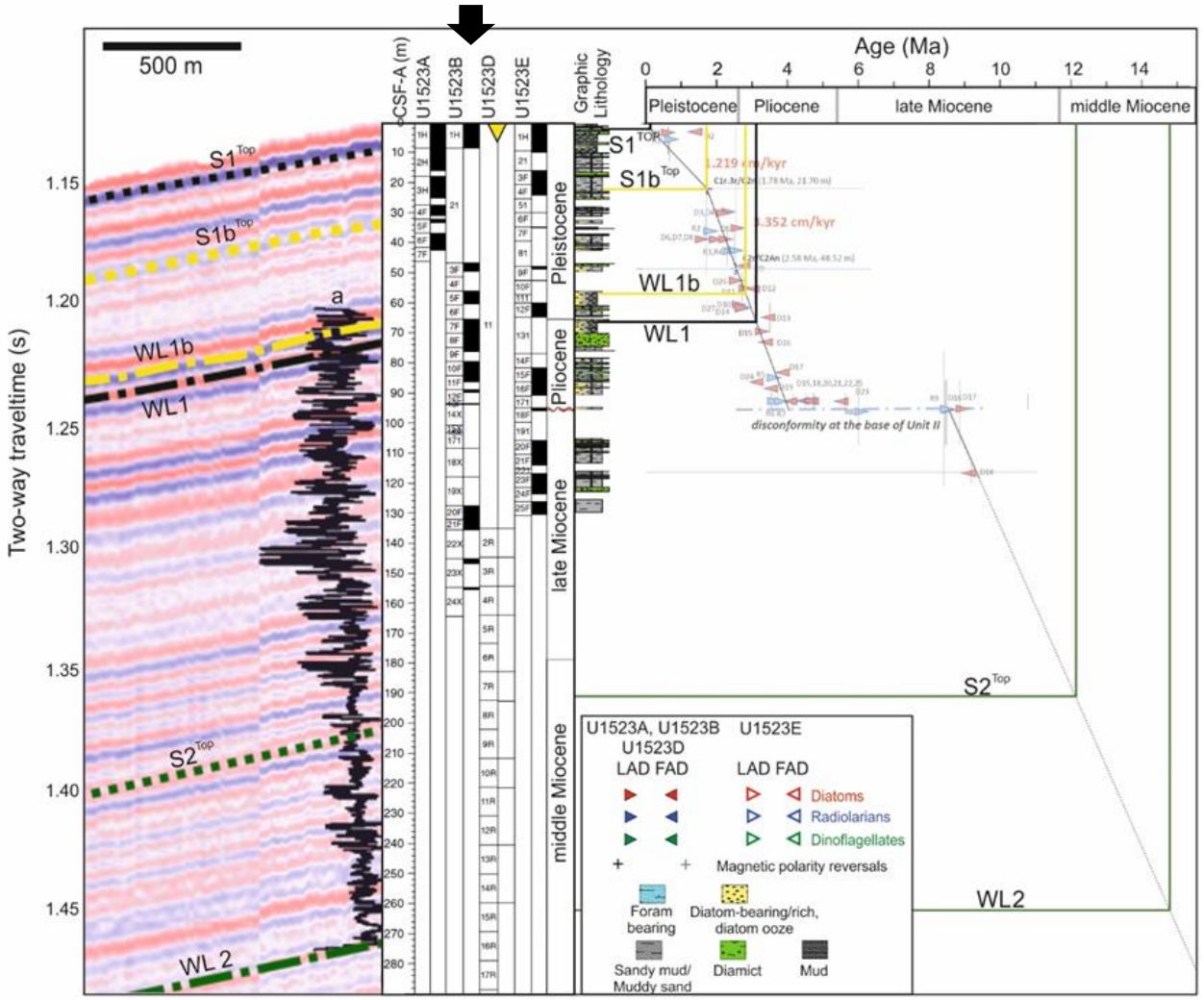


Deciphering Antarctic continental slope processes: new insights through ocean drilling

Jenny A. Gales (University of Plymouth,UK)

ECORD distinguished lecture 2024

Sediment recovered (black)
No sediment recovered (white)



WL1b: ~ 2.82Ma
(age range 2.93–2.82 Ma)

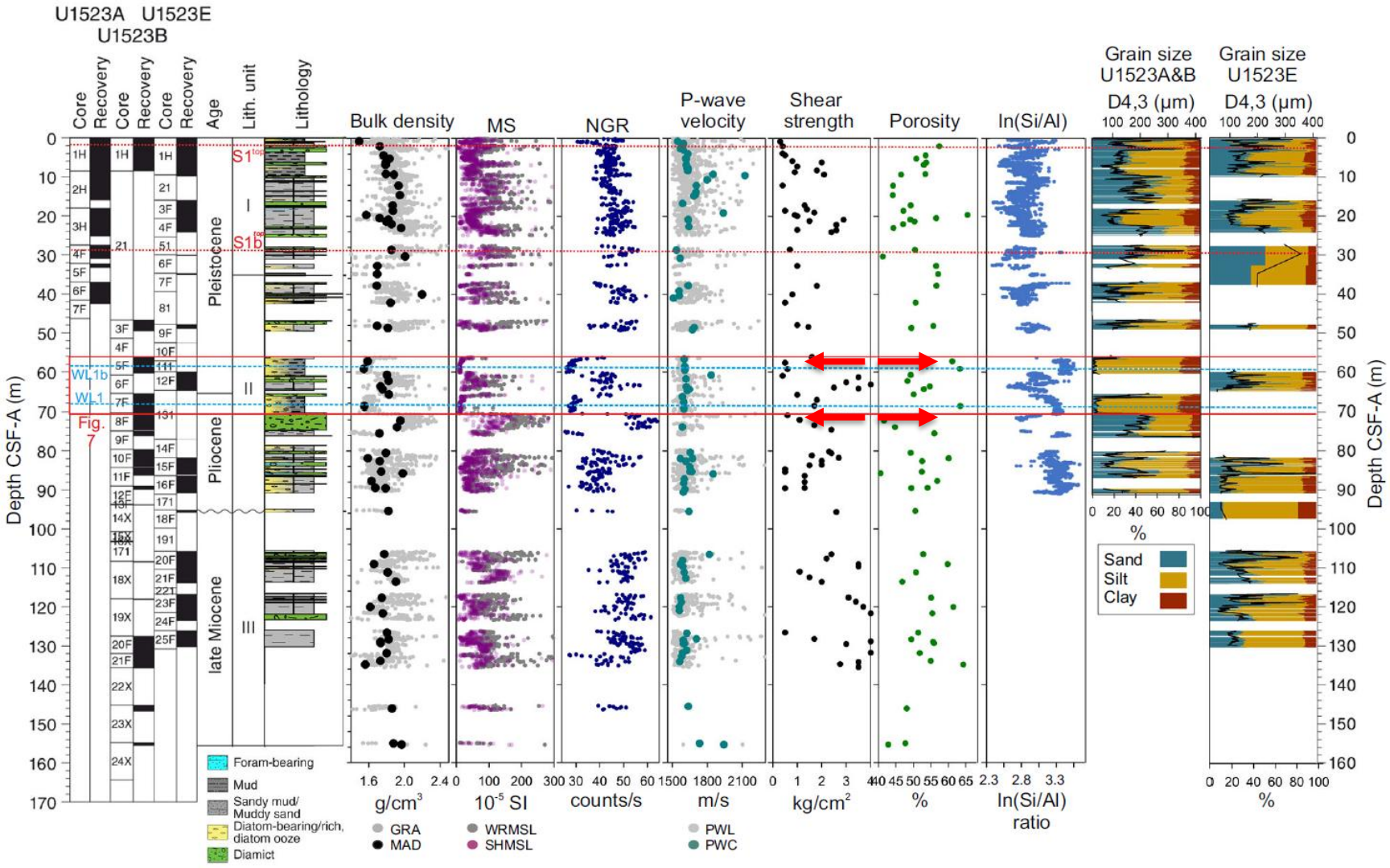
WL1: ~ 3.07Ma
(age range 3.21–3.07Ma)
mPWP (3.264–3.025Ma, +2–4 °C)

WL2: ~14.8Ma (end of MCO)

diatoms and fine-grained siliciclastic sediments (diatom oozes and diatom-rich muds) correspond to regional weak layers

Deposited during prolonged intervals of warmer-than-present climates

Very poor sediment recovery in the deeper part of the hole
=> only downhole logging


U1523A U1523E
U1523B
Core
Recovery
Age
Lith. unit
Lithology
Bulk density
MS
NGR
P-wave velocity
Shear strength
Porosity
ln(Si/Al)
Grain size U1523A&B
D4,3 (µm)
Grain size U1523E
D4,3 (µm)
Depth CSF-A (m)
S1top
S1btop
WL1b
WL1
Fig. 7
Pleistocene
Pliocene
late Miocene
I
II
III
Foram-bearing
Mud
Sandy mud/ Muddy sand
Diatom-bearing/rich, diatom ooze
Diamict
g/cm3
GRA
MAD
10-5 SI
WRMSL
SHMSL
counts/s
m/s
PWL
PWC
kg/cm2
%
ln(Si/Al) ratio
Sand
Silt
Clay

WL2 is located at ~267 mbsf and its physical properties are only available from downhole-log data due to extremely low core recovery below ~155 mbsf

Formation Micro Scanner (FMS) resistivity

