

Università di Trieste
LAUREA MAGISTRALE IN GEOSCIENZE
Curriculum Geofisico
Curriculum Geologico Ambientale

Anno accademico 2020 – 2021

Geologia Marina

Parte II

Modulo 2.3

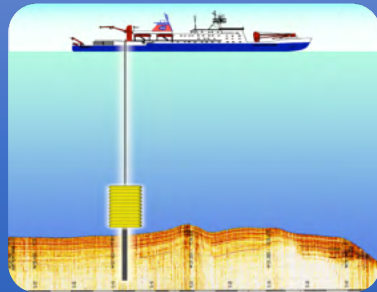
**Metodi diretti: Sondaggi superficiali ed
analisi dei sedimenti**

Relatore

Dr. Renata G. Lucchi

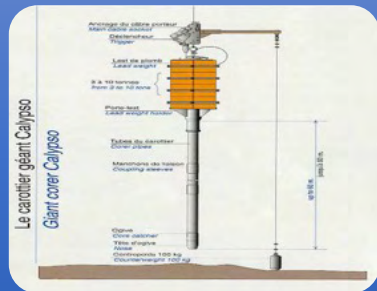
rglucchi@ogs.trieste.it

BOTTOM SAMPLING SYSTEMS



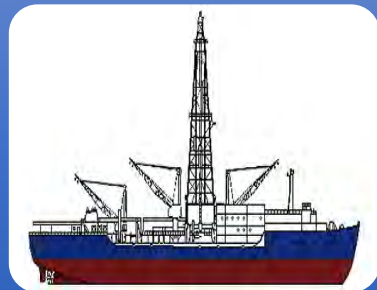
Gravity corer

- classic gravity corer (Emery and Dietz, 1941; Hvorslev and Stetson, 1946)
- box corer
- kastenlot corer
- multi-corer



Piston corer

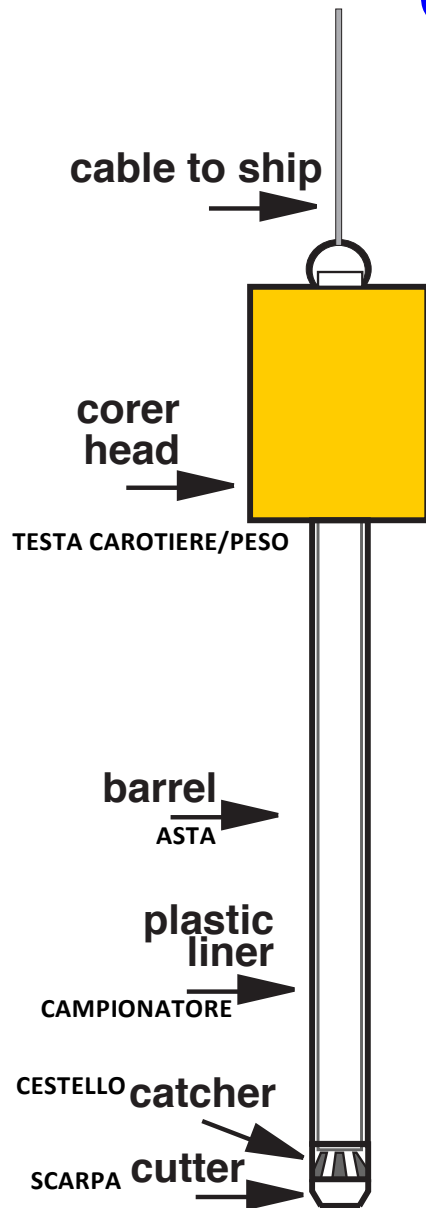
- classic piston corer (Kullenberg, 1947; 1955)
- long piston corer
 - Calypso piston corer (e.g. R/V Marion Dufresne, G.O. Sars)
 - Jumbo piston corer (e.g. R/V Araon)



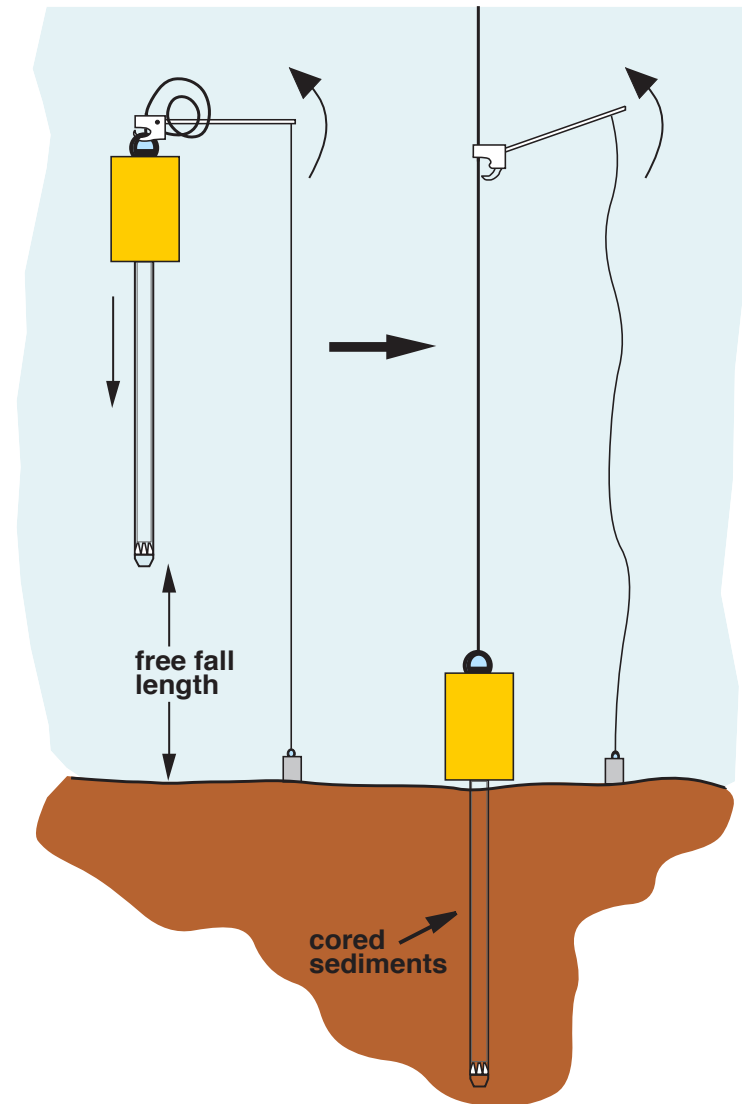
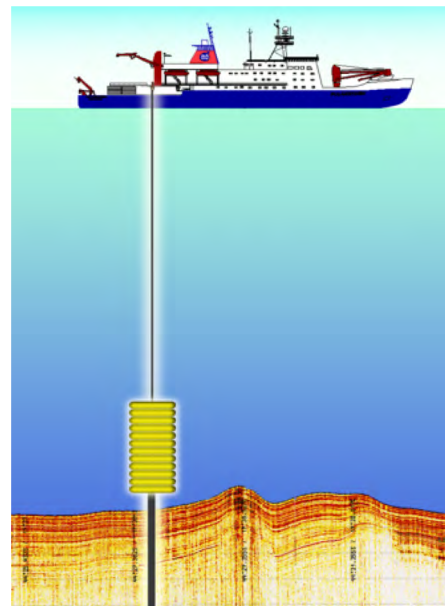
Drilling systems

- ocean floor drilling systems (e.g. IODP-drilling vessels & semi-automated MeBo system)
- ice drilling systems (e.g. EPICA-European Project for Ice Coring in Antarctica & NorthGRIP- North Greenland Ice Core Project)

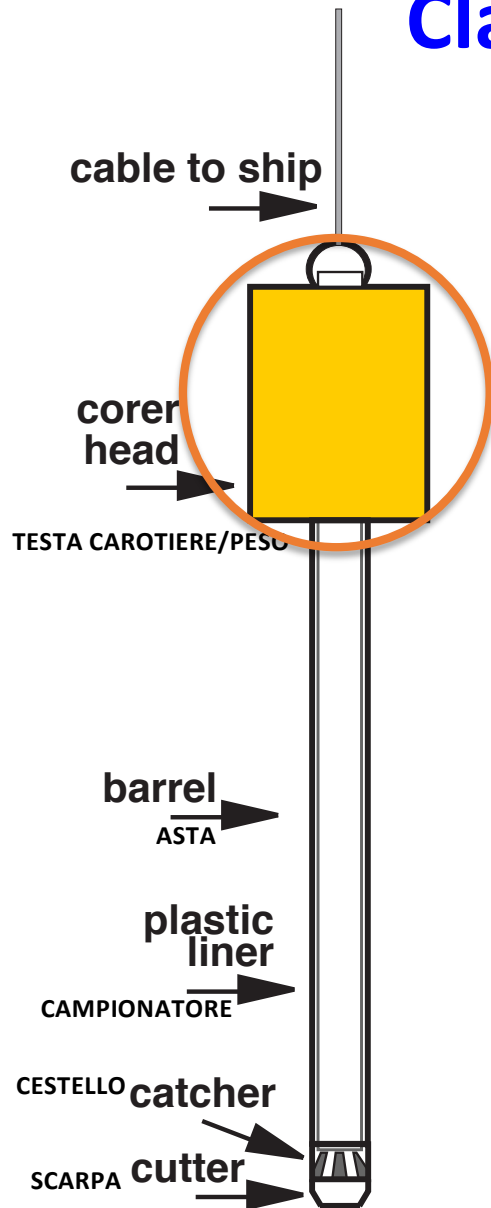
Classic gravity core system (Emery and Dietz, 1941)



It is the simplest coring device in which the weight of the coring equipment is used to force the barrel into the sea bottom. This system can work with or without a triggering system (sistema di sgancio)

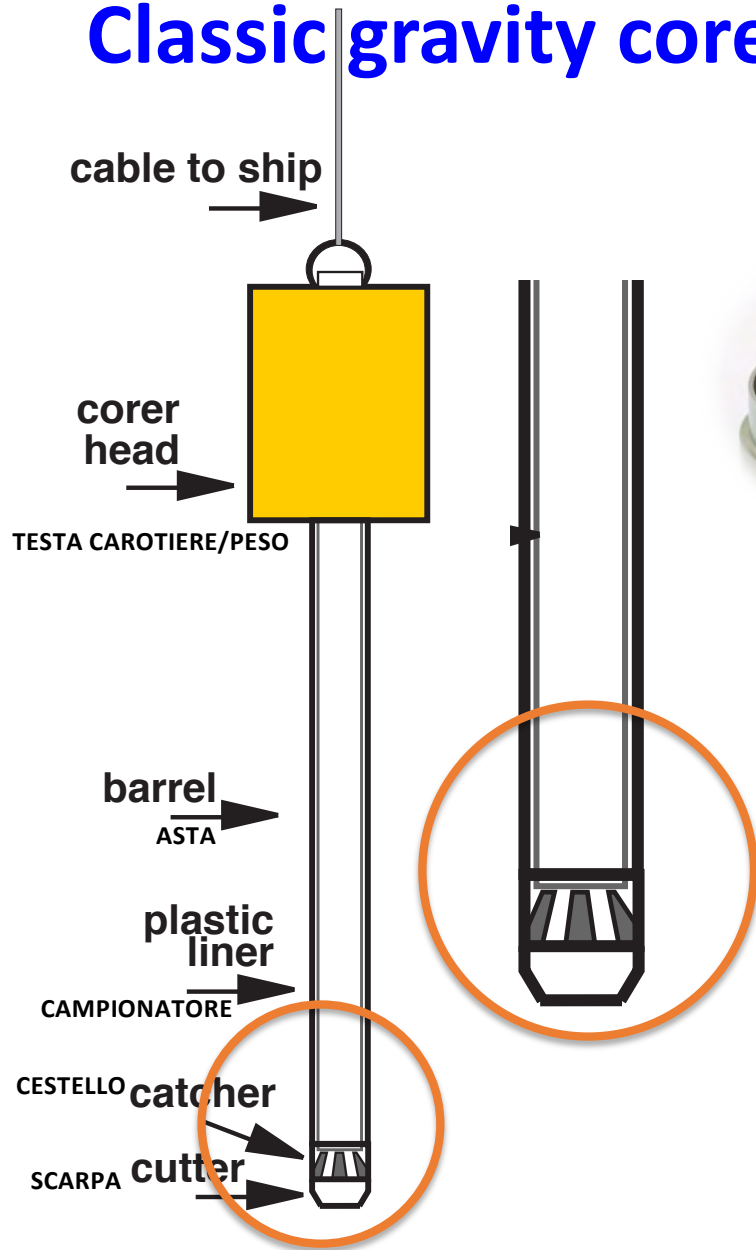


Classic gravity core system: corer head



weight 600-800 kg
6000 kg

Classic gravity core system: core catcher and cutter



core catcher
(cestello)



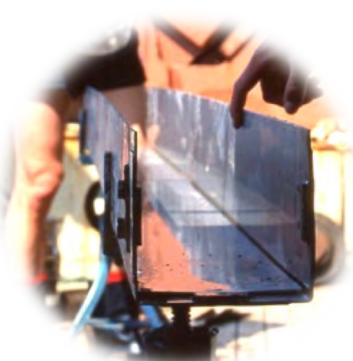
core cutter
(scarpa)



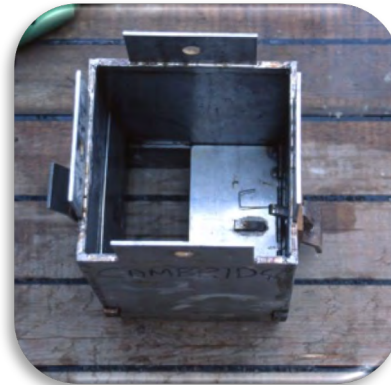
core cutter
and catcher

Additional gravity core systems: **Kastenlot corer**

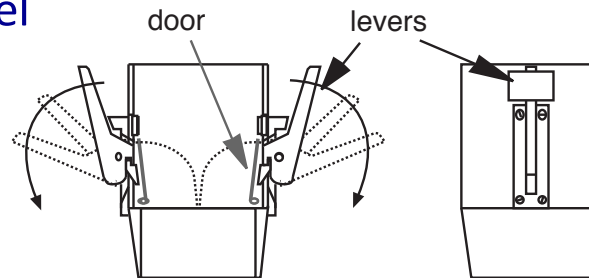
The kastenlot (kastens) corer was originally designed by Kögler (1963) it was improved and modified by Zangger and McCave (1990). The barrel, of variable lengths, is square in section (15x15 cm) and it contains a base plate that can be raised to reveal a new cleaned core surface



Square section
of barrel



Core cutter and catcher



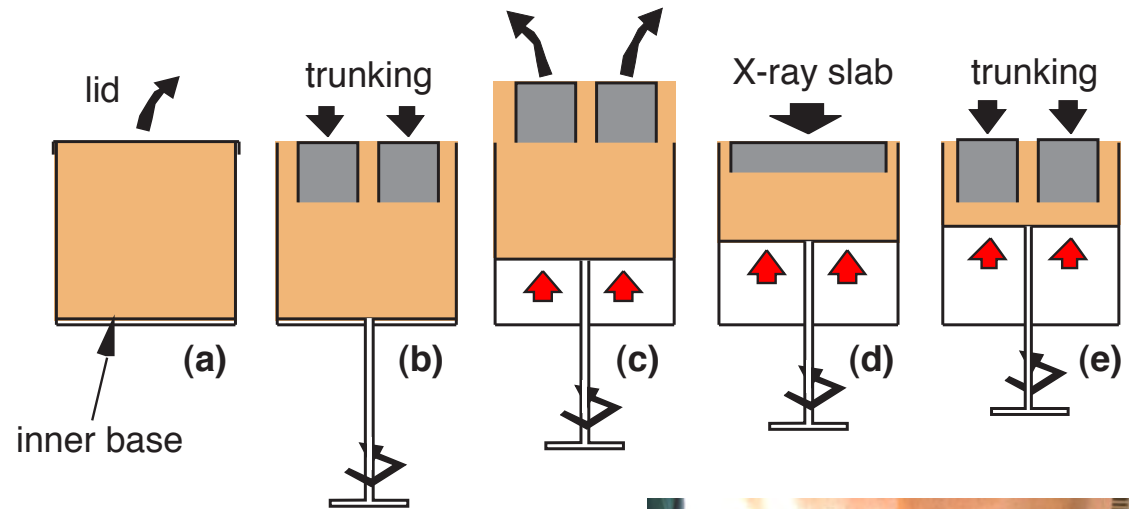
Head of
kastens
corer



The core catcher has a shutter-like closure consisting of two square doors held under tension and blocked in a retracted position by two levers located on the outside. During the corer pullout, the pressure of the surrounding sediments pushes down the two levers closing the doors.

Sampling of Kastens cores

- (a) removal of the barrel lid to reveal the core surface;
- (b) two PVC trunkings are pushed into the sediments
- (c) the inner base is moved upward to expose the trunkings that are cut at the base and removed from the main core using a cheese wire;
- (d) sampling with x-ray slabs, and a further set of trunkings (e). Each time the sediments are lifted upward and withdrawn with a cheese wire



Additional gravity core systems: **BOX-corer**

Designed for minimum disturbance of the sediment surface, ideal for coarse/stiff sea floor sediments, it allows the recovery of bottom waters.



lateral surface



coral sampling

sampling of
glacigenic
sediments

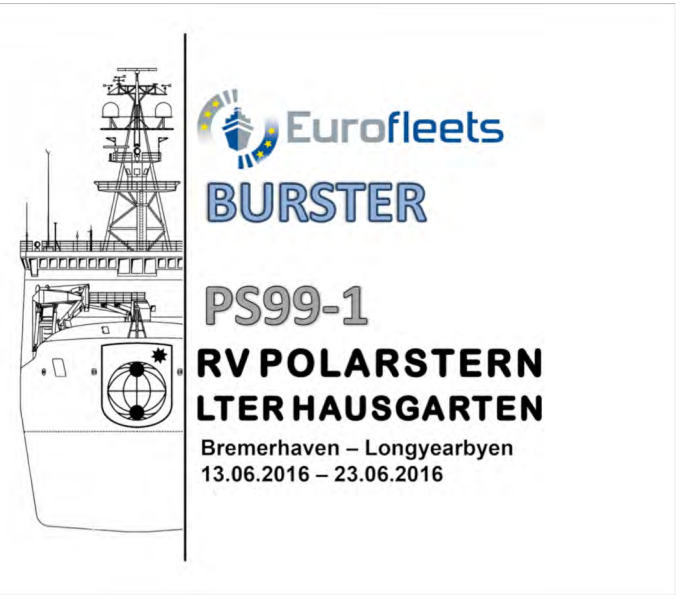
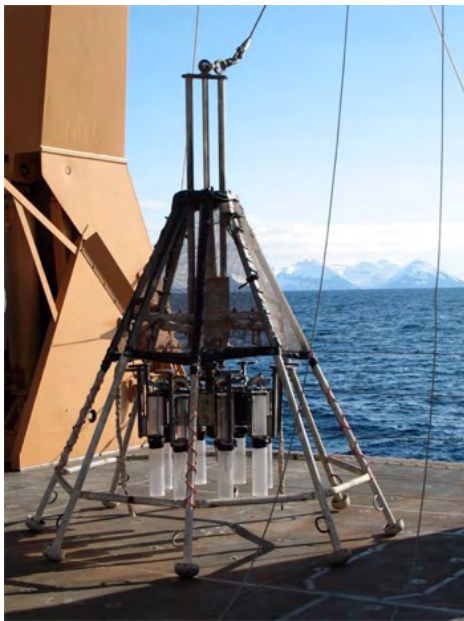


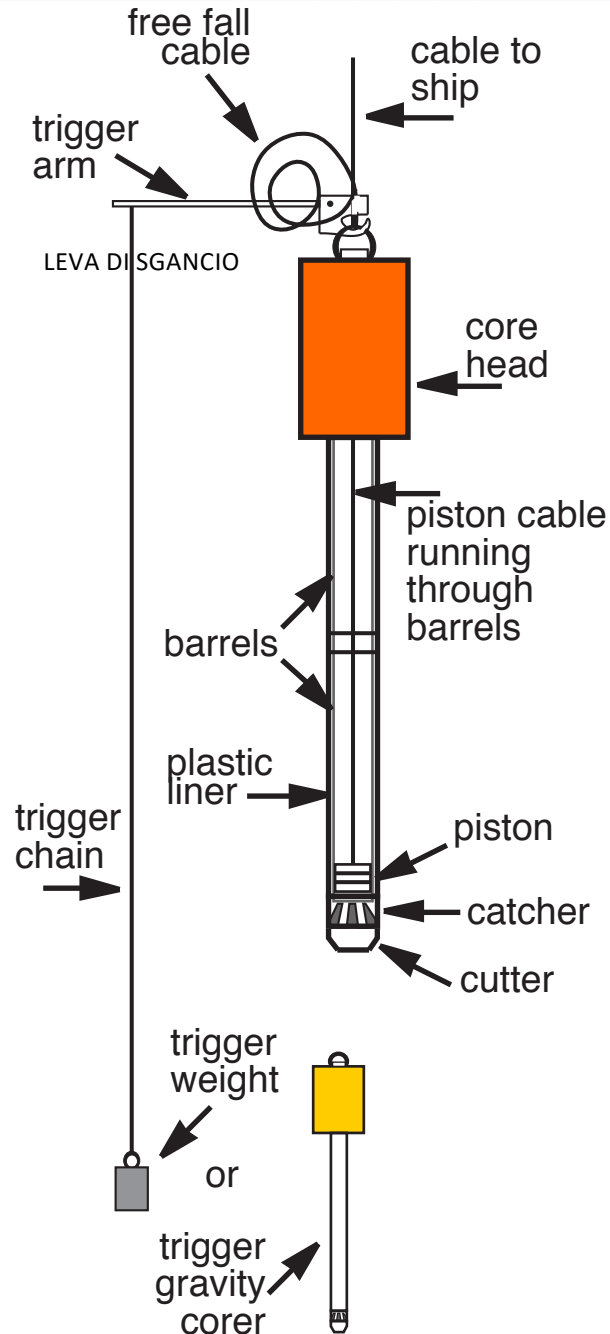
Box core sampling



Additional gravity core systems: **Multi-corer**

Especially designed for the sampling of sea bottom sediments-water interface, it permits to recover low disturbance sediment. Ideal for geochemical and biological sediment and water analysis.

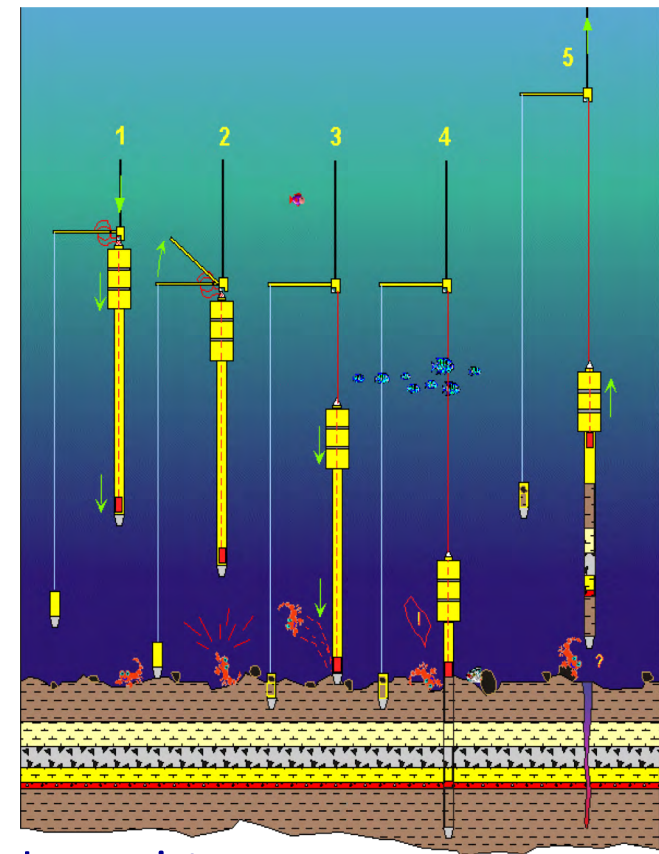




Kullenberg piston corer system

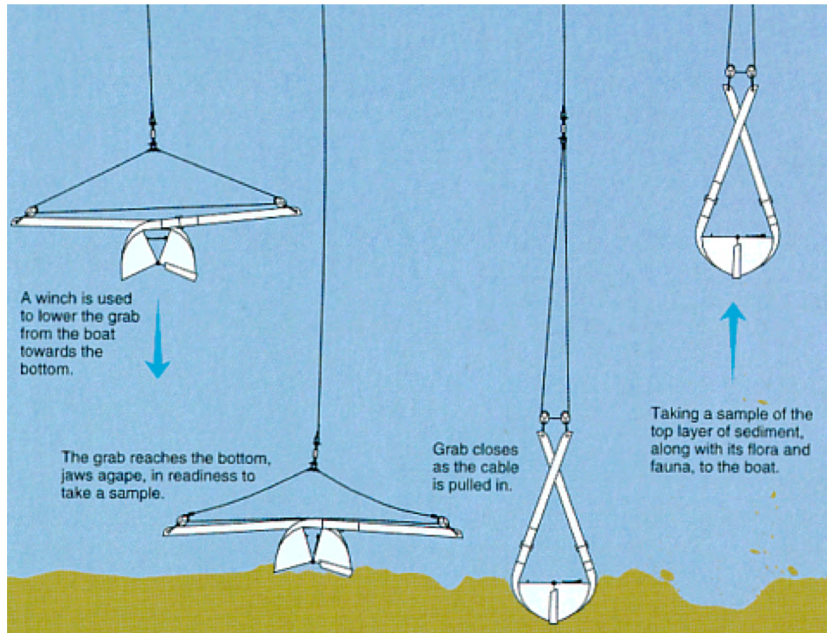
Standard assemblage for piston coring. The core barrel penetration is maximised by the action of a piston located in the lower barrel (or into the lower plastic liner if present) that helps to overcome the friction between sediments and the coring tube by generating Vacuum behind the cutter. The sediment cores obtained are less compacted and distorted than gravity cores. This system is always used coupled with a trigger mechanism.

Specifications	Kullenberg piston corer	Long piston corer
headweight	600 kg	6000 kg
barrel length	6 m	13 m
barrel inner diameter	65 mm	140 mm
barrel thickness	5 mm	5 mm
plastic liner outer diameter	63 mm	113 mm
plastic liner thickness	3 mm	5 mm
maximum cable length	5000 m	10000 m
cable diameter	12 mm	30 mm
freefall	4-5 m	1.5 m

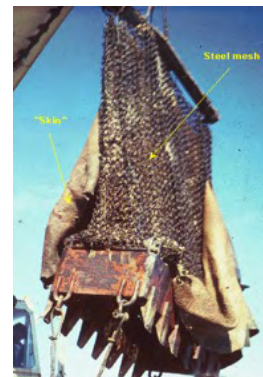
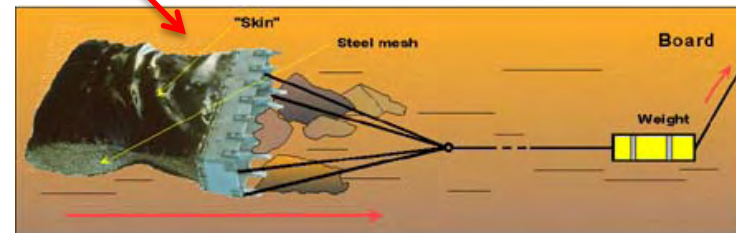
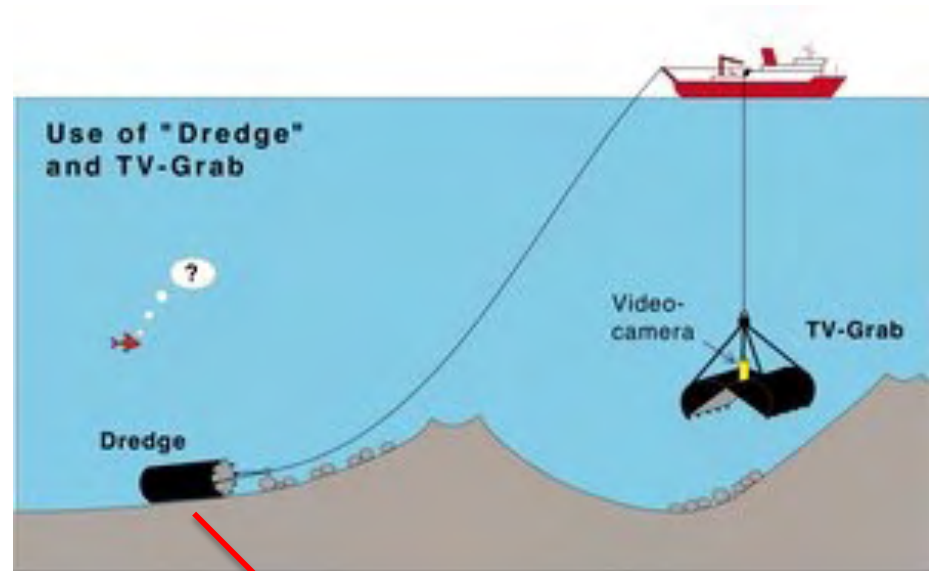


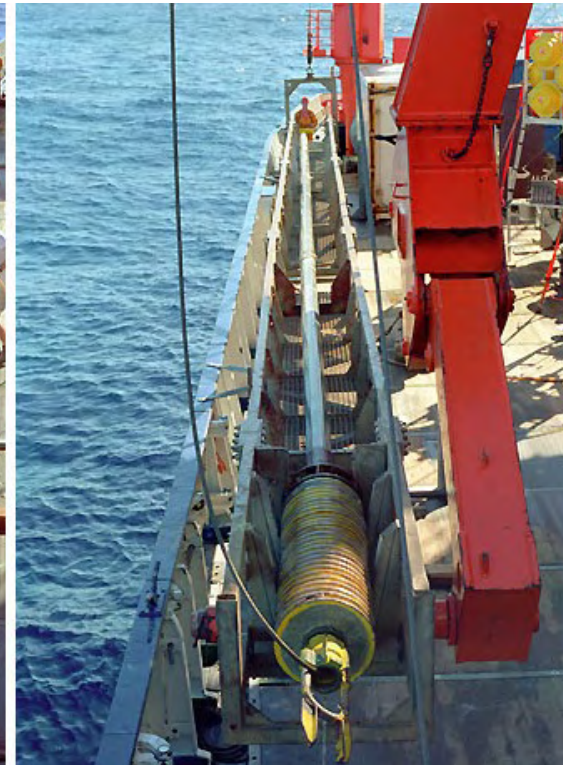
Long piston corers:
Claypsso, Jumbo etc.

Grab (benna)



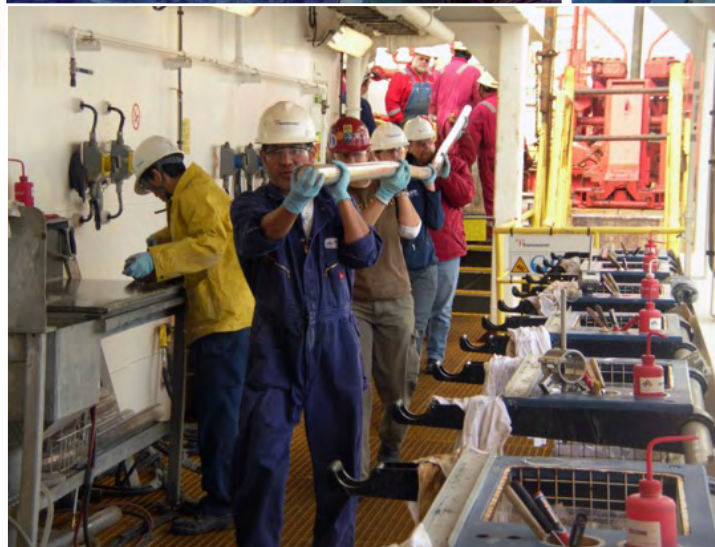
Dredge (draga)





Fotos: Volker Diekamp, Marum

CORE ON
DECK!



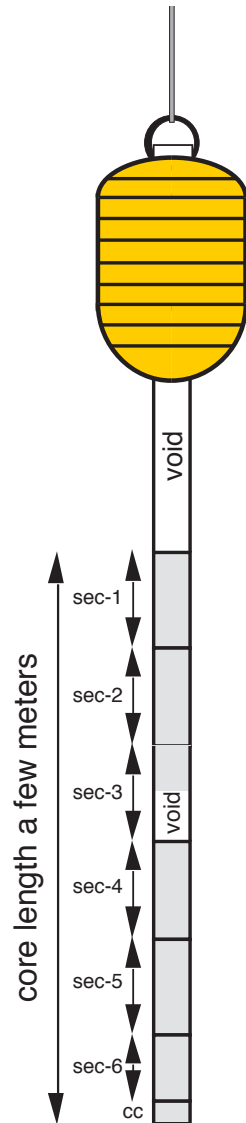


CUT INTO SECTIONS

The plastic liner is extracted from the
brrrel and cut into sections 1-1.5 m-long



SECTIONS' LABELING



The sections are numbered consecutively from bottom to top of the core or *vice versa* depending on the total length of the core.

Short cores are numbered consecutively from top to bottom.

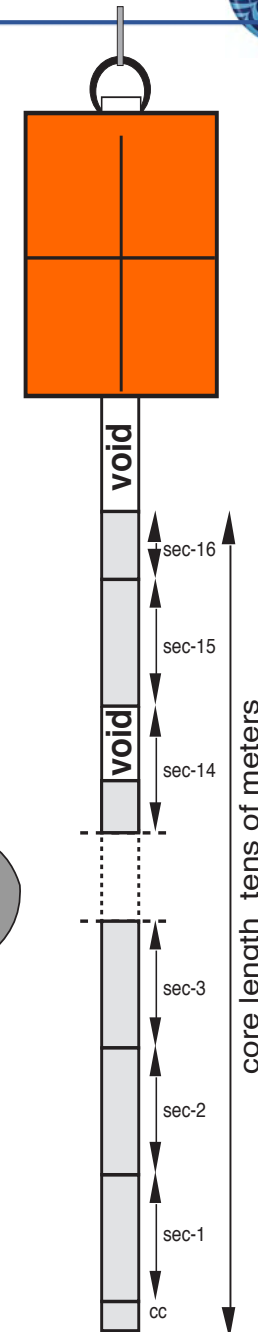
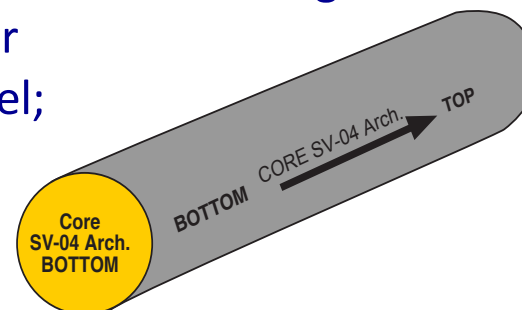
Long cores are numbered consecutively on removal from the barrel from bottom to top of core.

Each section is labeled with a code indicating

- » name of the project and/or
- » name of the research vessel;
- » core number;
- » section number
- » stratigraphic orientation

(top-bottom, arrow)

!!!! The arrow ALWAYS indicates the TOP !!!!!



CORE OPENING AND SEDIMENTS ANALYSIS

The plastic liner of each section is cut longitudinally. The plastic liner is cut by means of an electric saw/microvibro saw, while the sediments are cut using a “cheese wire”.

The two splitted half-sections are labeled as **working section** and **archive section** and will undergo a different analytical process:

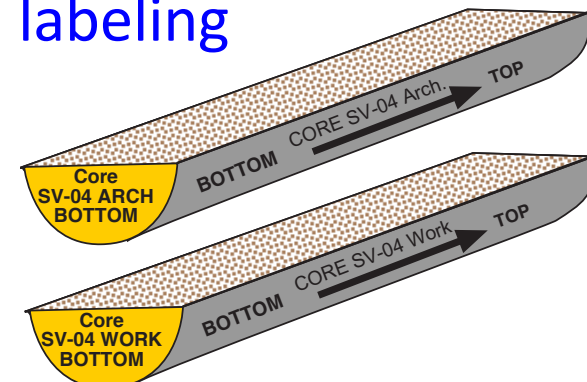
ARCHIVE SECTIONS: not destructive analyses

- X-radiographs
- multi-sensor core logger
- XRF core-scan
- photographs

WORKING SECTIONS: visual logging and sub-sampling



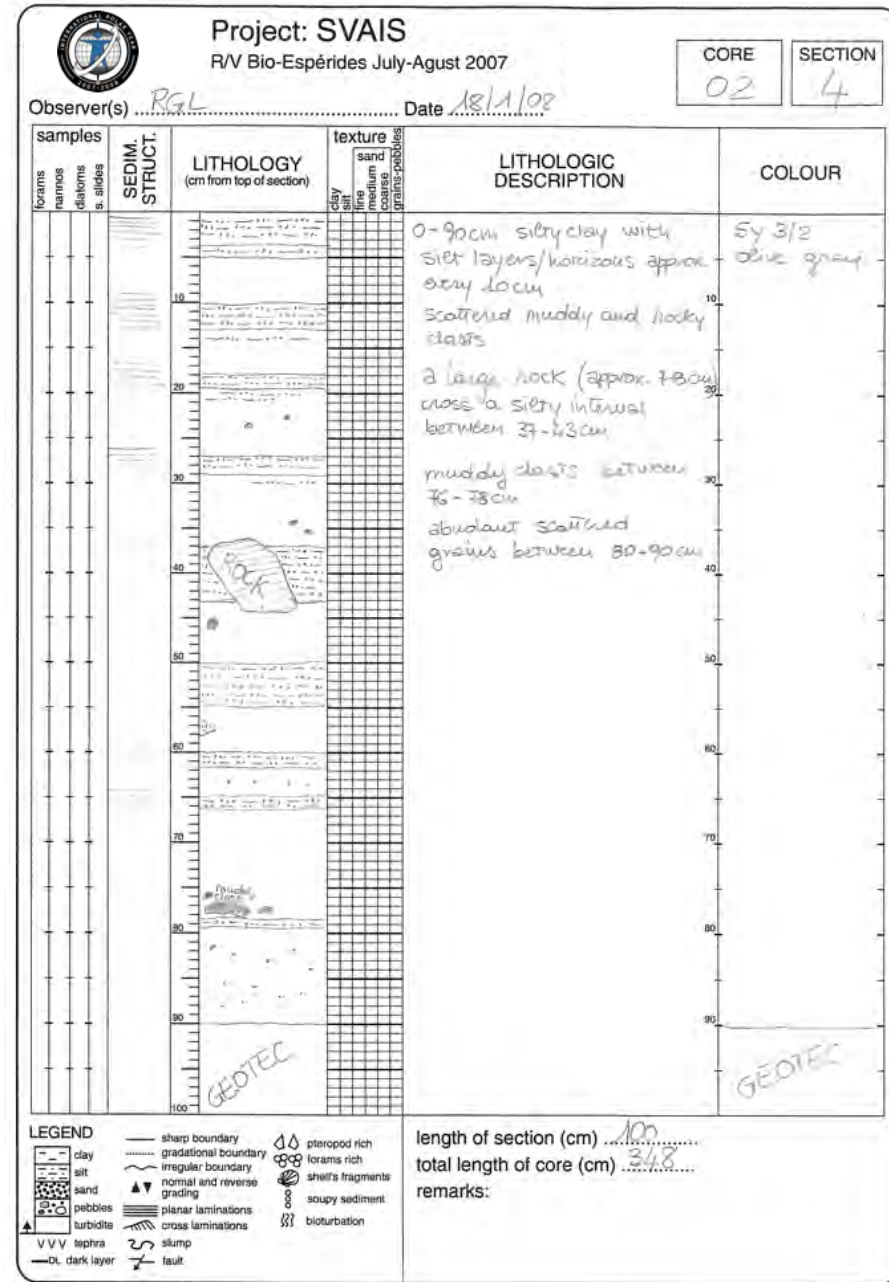
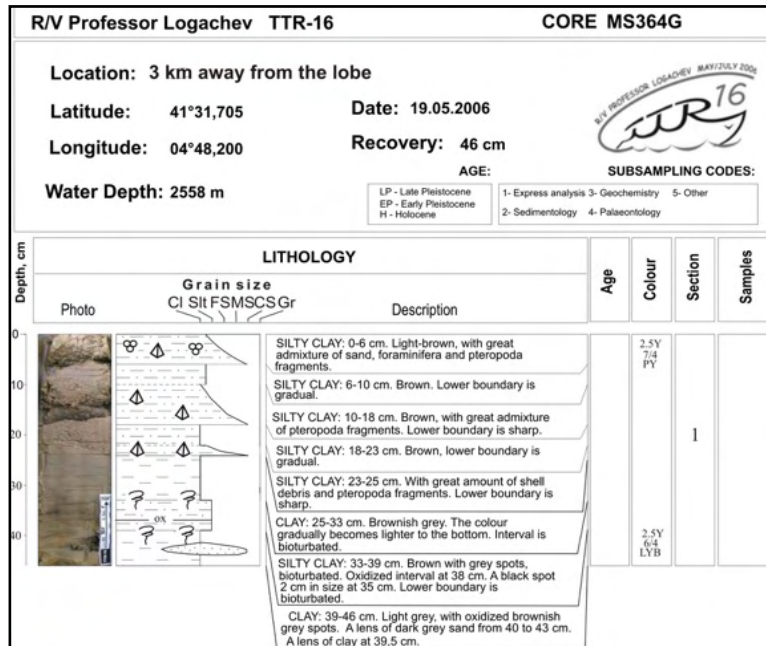
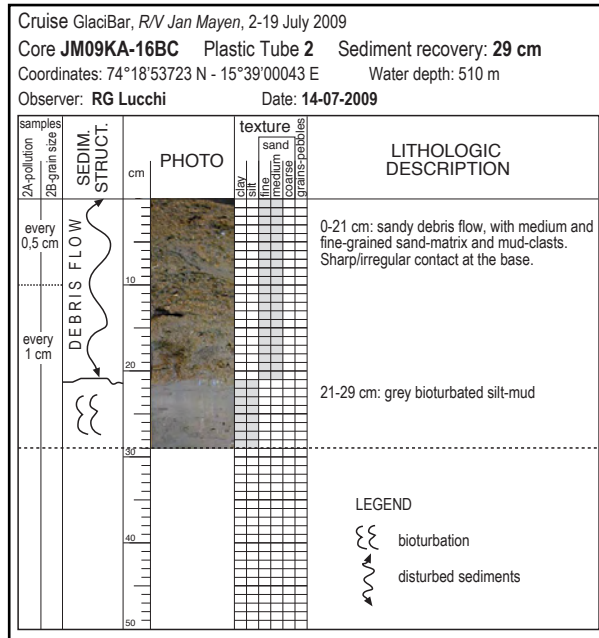
Half-sections' labeling





CORE DESCRIPTION





Visual core description 2nd step sediment composition

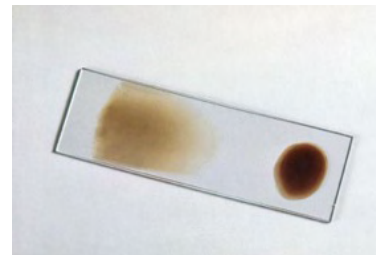
Mud composition - Smear slides

(view <https://www.youtube.com/watch?v=2sDejrpwxD4&feature=youtu.be>)

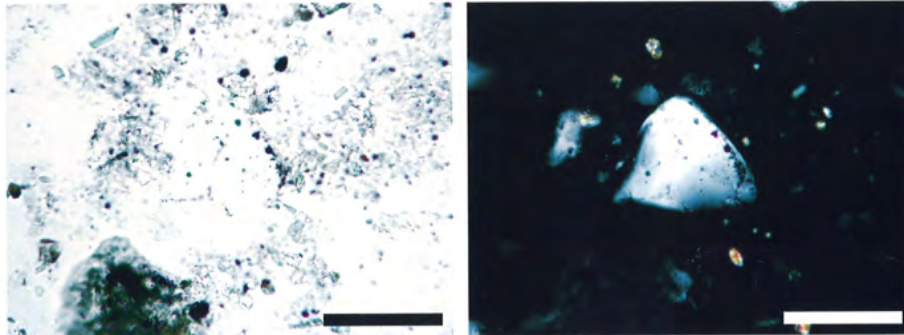
- A smear slide is a thin layer of unconsolidated sediment embedded on a glass slide for petrographic microscopic examination;
- Smear slides are a useful tool to quickly assess the **compositional content** of clay-silty sediment samples;
- Smear slides are a powerful method for rapidly evaluating tiny quantities of sediment (mineralogy, components, form, size) as the basis for **sediment classification**, and for ascertaining the presence of microfossils.



Foto: IODP Exp. 307

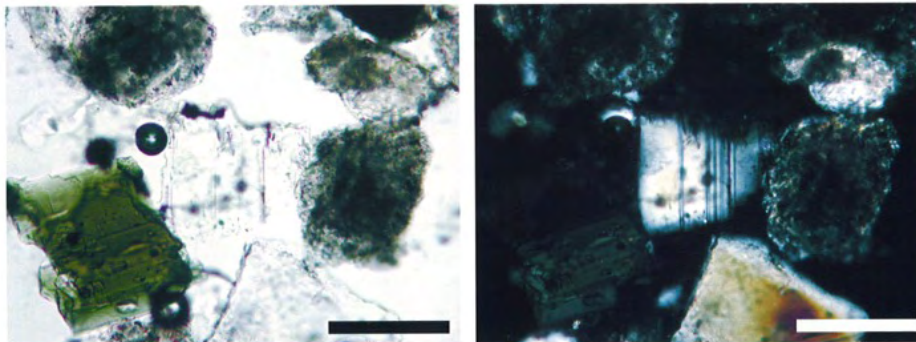


Quarz

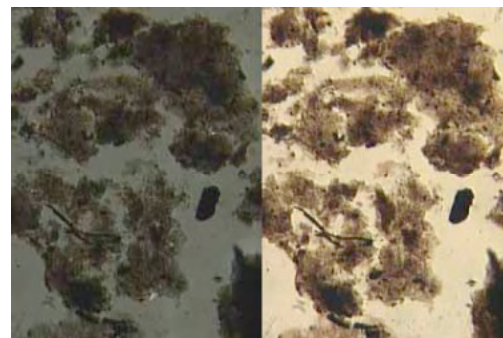


IODP Exp .320

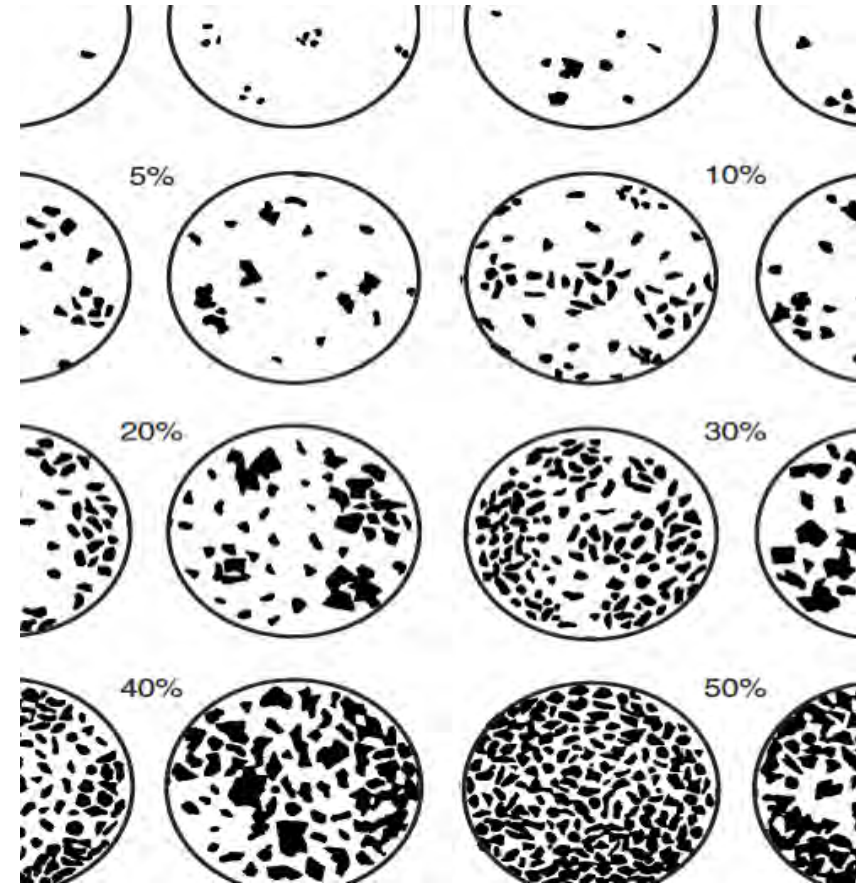
Plagioclase



Clay fraction

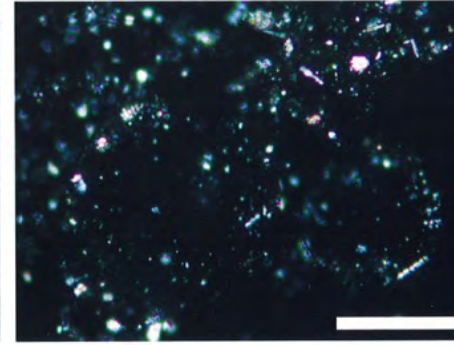
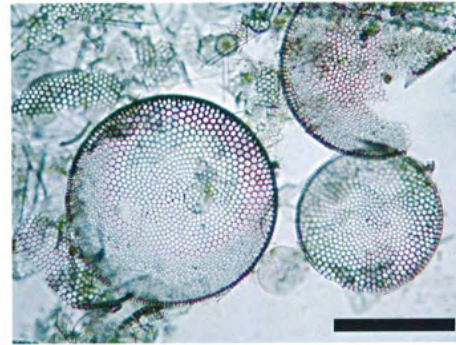


Composition/Quantification



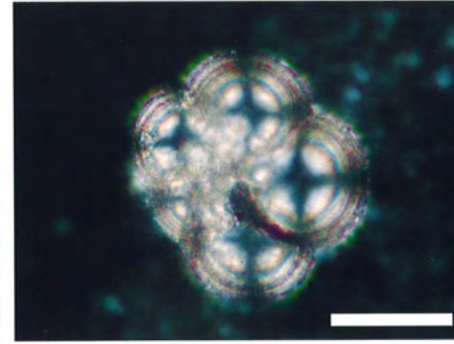
Rothwell R.G., 1988. Minerals and mineraloids in marine sediments. An Optical Identification Guide. Elsevier Science Publishers, 279 pp

Diatoms



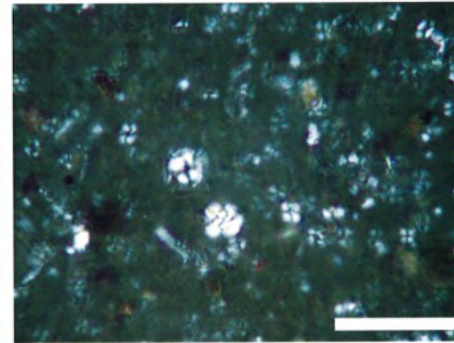
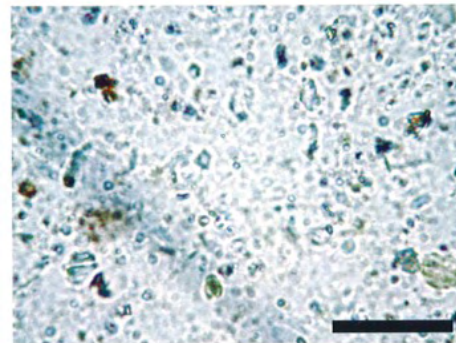
オホーツク海・中心部, 水深 1107m, XP98, PC1, Sec.1, 20cm
200倍, スケールは横 100 μ m

Foraminifera



太平洋・熊野トラフ, 水深 2190m, KT02-1, KK2PC
400倍, スケールは横 50 μ m

Calcareous nannoplankton

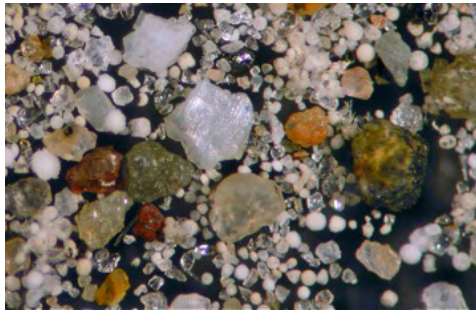


東地中海・キプロス沖, ODP Leg160, 967D, 1H, Sec.1, 0-5cm
1000倍, スケールは横 20 μ m

Sand composition

- wet sievings at 63 microns are used to investigate the composition of sediment coarse fraction, the grains form and roundness, in order to define the sediment provenance. The sand fraction is also used for biostratigraphic purposes.

**Ice Rafted Debris
(Antarctica)**



**Beach sands
(Menorca-Spain)**



**Glacigenic
sediments
(Arctic)**



**Tephra
(volcanic glass)
(Tyrrhenian)**



SEDIMENT SAMPLE DESCRIPTION

Project:

lat. N long. E water depth (m)
core section cm cm from core top

sediment type lithology
colour remarks

DESCRIPTION OF RESIDUE

textural characteristics

sorting very good good
moderately
poor very poor
sphericity high
low
angularity very angular angular
sub-angular/rounded
rounded well rounded

remarks

residue composition

(AA=very abundant; A=abundant; O=occurring; R=rare; RR=very rare)

terrigenous components: predominant not predominant

quartz calcite K-feldspar gypsum glauconite
mica pyrite dark minerals volcanic glass micronodules
rock fragments others

bioclastic components: predominant not predominant

benthic forams planktonic forams pteropods bryozoa
echinoid spines sponge spicules ostracods corals
bivalves gastropods corals algae
radiolarians diatoms spores fish teeth
plant debris coccoliths discoasters organic matter
micrascidites of tunicates others

Foraminifera: list of the most characteristic taxa

<i>G. bulloides</i>	<i>G. tenellus</i>	<i>H. siphonifera</i>	<i>G. coriacaensis</i>
<i>G. trilobus</i>	<i>N. egeri duttertrei</i>	<i>G. quinqueloba</i>	<i>G. inflata</i>
<i>N. pachyderma</i>	<i>G. ruber</i>	<i>G. scitula</i>	<i>O. univversa</i>
<i>G. gomitulus</i>	<i>G. sacculifer</i>	<i>G. glutinata</i>	<i>G. truncatulin. exc.</i>
<i>G. conglobatus</i>	<i>G. quadrilobatus</i>	<i>H. pelagica</i>	<i>G. digit./preadigit.</i>
<i>S. ionica</i>	others		

AGE
ZONE
FACIES
REMARKS

SMEAR SLIDES DESCRIPTION

Project:

lat. N long. E water depth (m)
core section cm cm from core top

sediment type lithology
colour remarks

DESCRIPTION OF SMEAR SLIDES

Calcareous nannofossil: list of the most characteristic taxa and their abundance

(AA=very abundant; A=abundant; O=occurring; R=rare; RR=very rare)

<i>E. huxleyi</i>	<i>G. oceanica</i>	<i>G. caribbeanica</i>	<i>small Gephyrocapsa</i>
<i>H. carteri</i>	<i>C. leptoporosa</i>	<i>S. pulchra</i>	<i>S. histrica</i>
<i>C. pelagicus</i>	<i>S. recurvata</i>	<i>P. scutellum</i>	<i>O. antillarum</i>
<i>R. clavigera</i>	<i>R. stylifer</i>	<i>S. fossilis</i>	<i>B. bigelowi</i>
<i>U. tenuis</i>	<i>C. jonesii</i>	<i>T. saxeae</i>	<i>C. rugosus</i>
<i>C. cristatus</i>	<i>P. multipora</i>	<i>P. lacunosa</i>	<i>C. macintyreii</i>
<i>D. broweri</i>	<i>H. sellii</i>	<i>Discoaster sp.</i>	

others

Sediment composition

(AA=very abundant; A=abundant; O=occurring; R=rare; RR=very rare)

terrigenous component: predominant not predominant

quartz calcite K-feldspar gypsum glauconite
mica dark minerals pyrite volcanic glass micronodules
dolomite aragonite Fe oxides zeolite plagioclase
rock fragments clay minerals
others

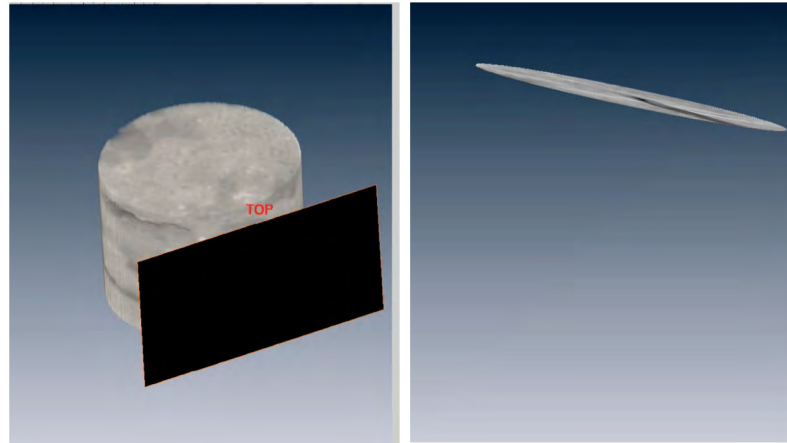
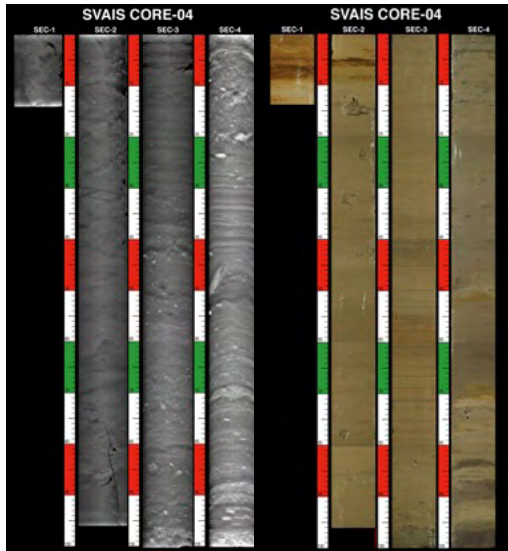
bioclastic component: predominant not predominant

benthic forams planktonic forams pteropods bryozoa
echinoid spines sponge spicules ostracods corals
bivalves gastropods corals algae
radiolarians diatoms spores fish teeth
plant debris coccoliths discoasters fish remain
shell fragments silicoflagellates organic matter
others

AGE
ZONE
FACIES
REMARKS



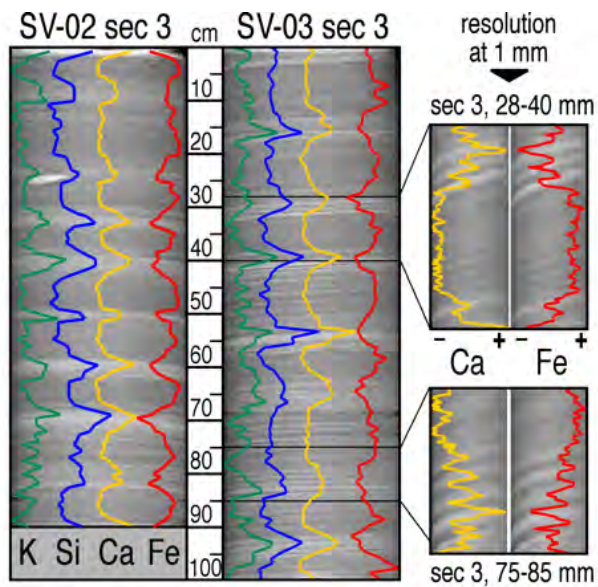
SEDIMENT CORE SCAN ANALYSES



X-Ray tomography
ENI-E&P Division

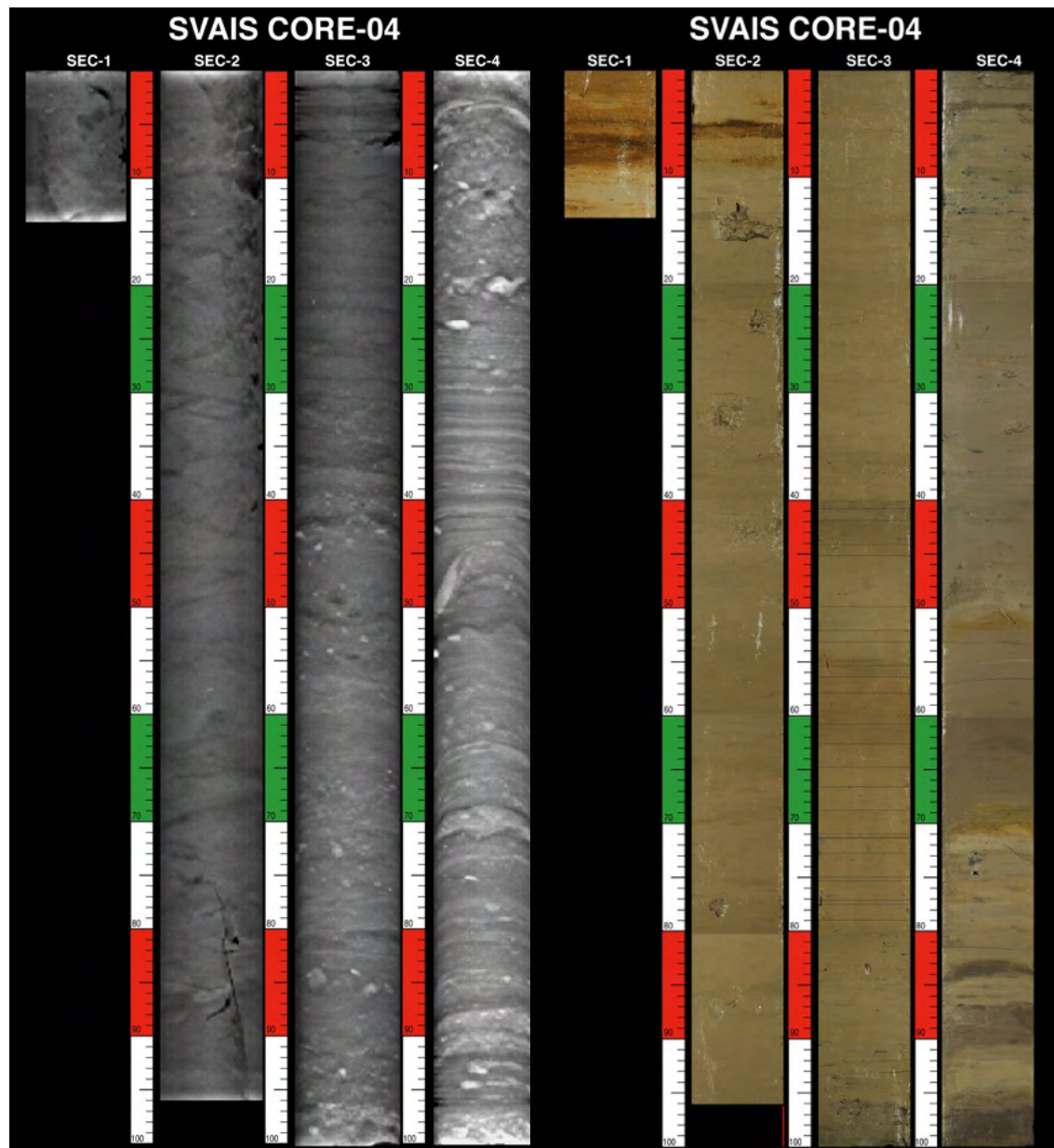


Multi-sensor core logger
ICM Barcelona



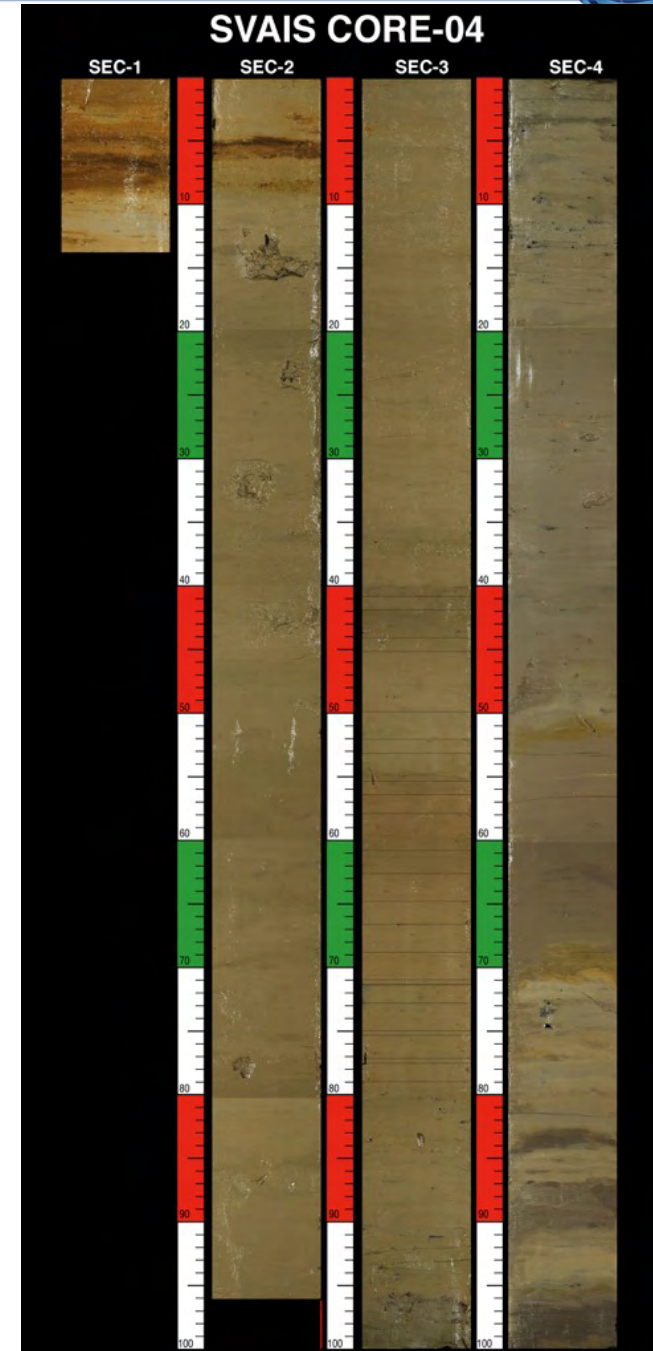
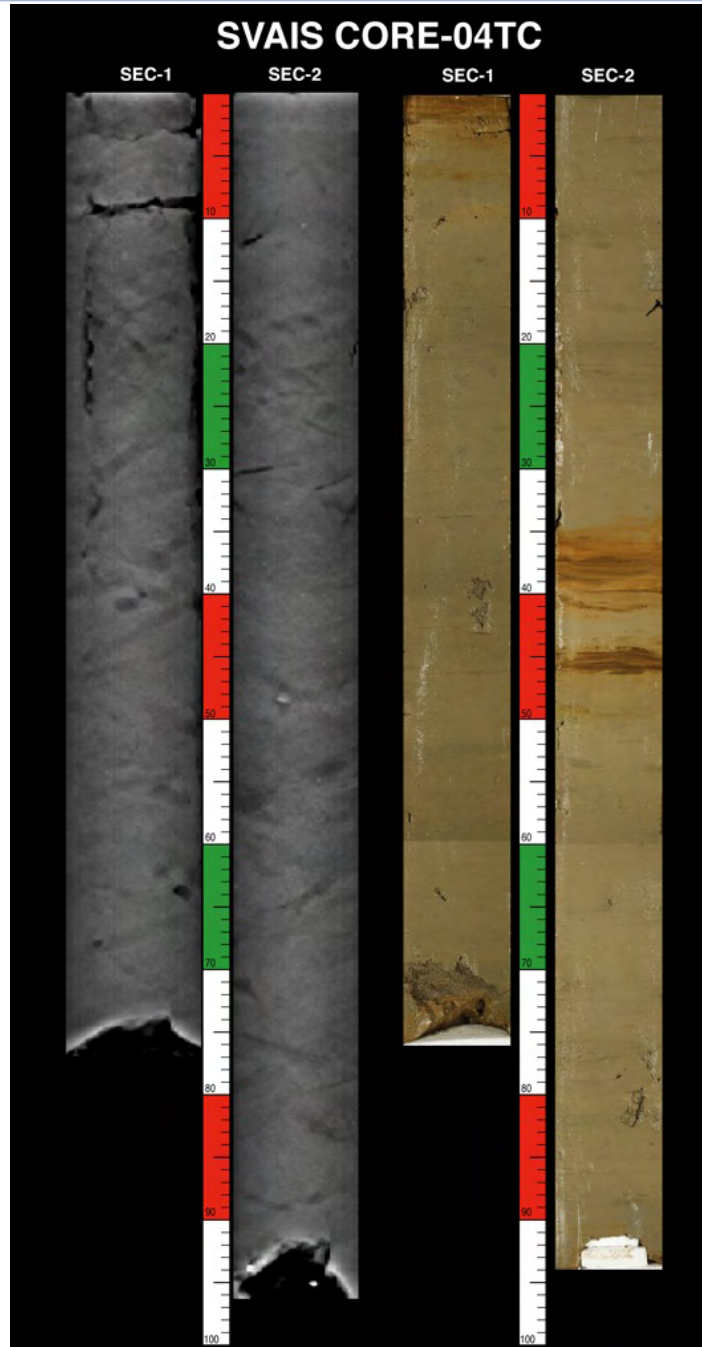
XRF core scan
MARUM
Bremen

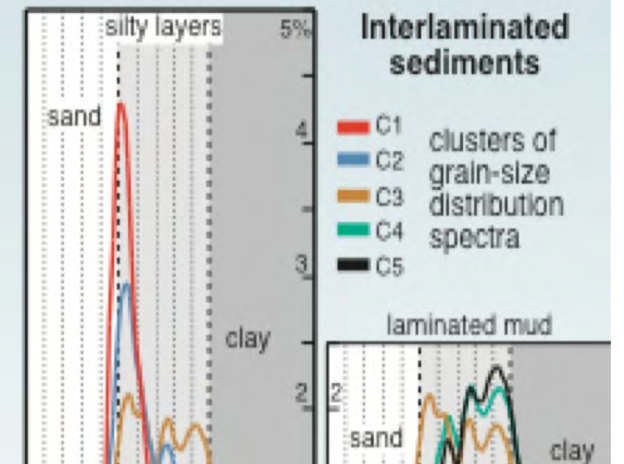
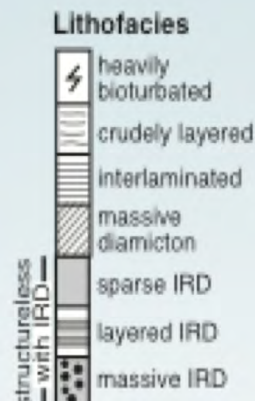
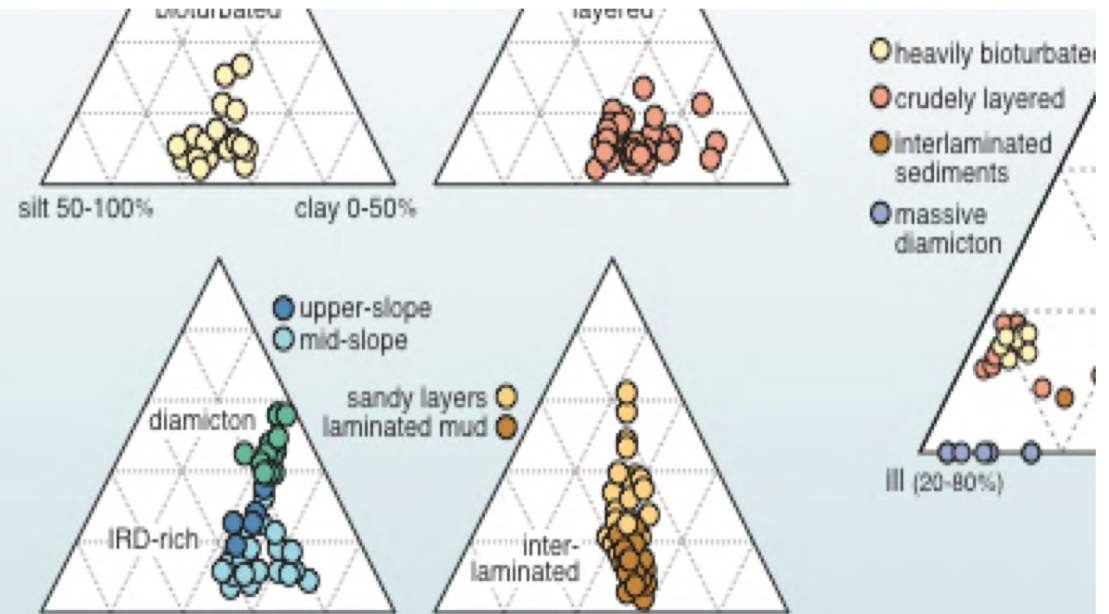
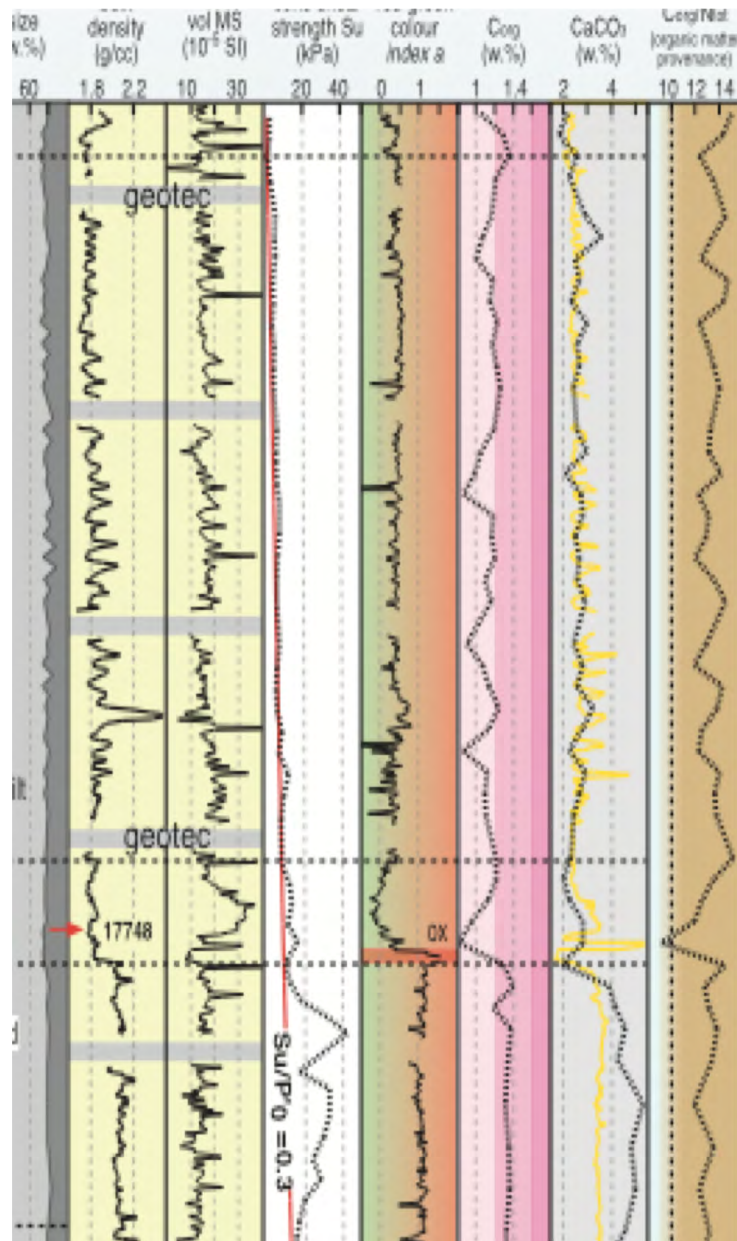
X-RAY



SEDIMENT
SURFACE

CORING DISTURBANCE







CORE REPOSITORY 4°C