CRUISE REPORT

AMARYLLIS-AMAGAS II cruise

Paramaribo (Suriname) – Recife (Brazil)

MD241 – VT180

12 June 2023 - 3 July 2023

Research Vessel *Marion Dufresne*

Chief scientists

Aline GOVIN (LSCE) & Cristiano M. CHIESSI (USP)

To refer to the AMARYLLIS-AMAGAS II cruise

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We also acknowledge the Brazilian Navy and the Brazilian National Council for Scientific and Technological Development (CNPq) for granting access to collect and investigate the material taken in Brazilian jurisdictional waters during the AMARYLLIS-AMAGAS II cruise.

MD241 AMARYLLIS-AMAGAS II crew and scientific team!

Credit: Anaïs Duhayon Photography

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1 Introduction

1.1 Description and objectives of AMARYLLIS-AMAGAS

Programmatic context

The AMARYLLIS-AMAGAS cruise resulted from merging two complementary, international and multidisciplinary scientific research projects, namely **AMARYLLIS** ("*From Amazon deep-sea sediments to natural climate variability and slope instability processes*") and **AMAGAS** ("*Degassing of the Amazon deep-sea fan: depth distribution and activity of seafloor fluid vents*").

These two projects rely on the close collaboration of dozens of scientists working in universities and public research institutes in France (9 research institutes), Brazil (7 universities), Germany (2 universities) and Sweden (1 university).

The cruise took place in two legs on board the French Research Vessel (R/V) *Marion Dufresne* for a total duration of 49 days, 27 days for leg 1 and 22 days for leg 2. It started in Bridgetown (Barbados) on 16 May 2023, called at Paramaribo (Suriname) on June 11-12 2023 for the change of legs, and ended in Recife (Brazil) on 3 July 2023.

Legs 1 and 2 of the AMARYLLIS-AMAGAS cruise are also called **AMARYLLIS-AMAGAS I** and **AMARYLLIS-AMAGAS II**. Either term is used in this cruise report.

Scientific objectives

The AMARYLLIS-AMAGAS cruise aims to **better establish the major but uncertain role played by the Amazon region in the Earth's global climate system**. Its role as a terrestrial carbon sink depends on processes that are still poorly constrained: the intensity and distribution of continental precipitation, the fertilization of soils by Saharan dust and the potential instability of gas hydrates formed in the accumulation zone of sediments transported by the Amazon River (hereafter referred to as the "Amazon cone").

Given these uncertainties, the cruise has 4 main scientific objectives:

(1) to reconstruct the past climatic history of the Amazon and northeastern Brazil, in terms of regional variability and mechanisms controlling precipitation and vegetation, on various time scales of over the last million years (ranging from anthropogenic to millennial and orbital);

(2) to assess the contribution of Saharan dust deposited in this region in the present-day and over the last million years, in particular its role as a fertilizer for the Amazon rainforest;

(3) to examine the relationship between gas hydrates and large-scale submarine landslides in the upper Amazon cone, by assessing fluid circulation and the physical properties of the sediments;

(4) to assess the extent of gas outflows into the ocean at the scale of the Amazon cone as a whole.

Strategy

The AMARYLLIS-AMAGAS cruise investigated two geographical areas located off French Guiana, northern and northeastern Brazil: the **Amazon (AM)** area and the **NE Brazil (NE)** area (Figure 1).

Four main approaches have been applied to meet the scientific objectives of the AMARYLLIS-AMAGAS cruise:

(i) Core sampling of sedimentary sequences at 16 stations: 14 on the northern and northeastern margin of Brazil and 2 on the margin of French Guiana (Figure 1);

(ii) In situ measurements of the temperature of surface sediments (< 20 m) at 5 stations located in areas where gas hydrates are present in the Amazon cone;

(iii) Acoustic imagery (water column, seabed, upper sediments) along 7 transects defined in a wide area surrounding the Amazon cone (Figure 1);

(iv) Observation of the atmospheric column and collection of modern atmospheric dust.

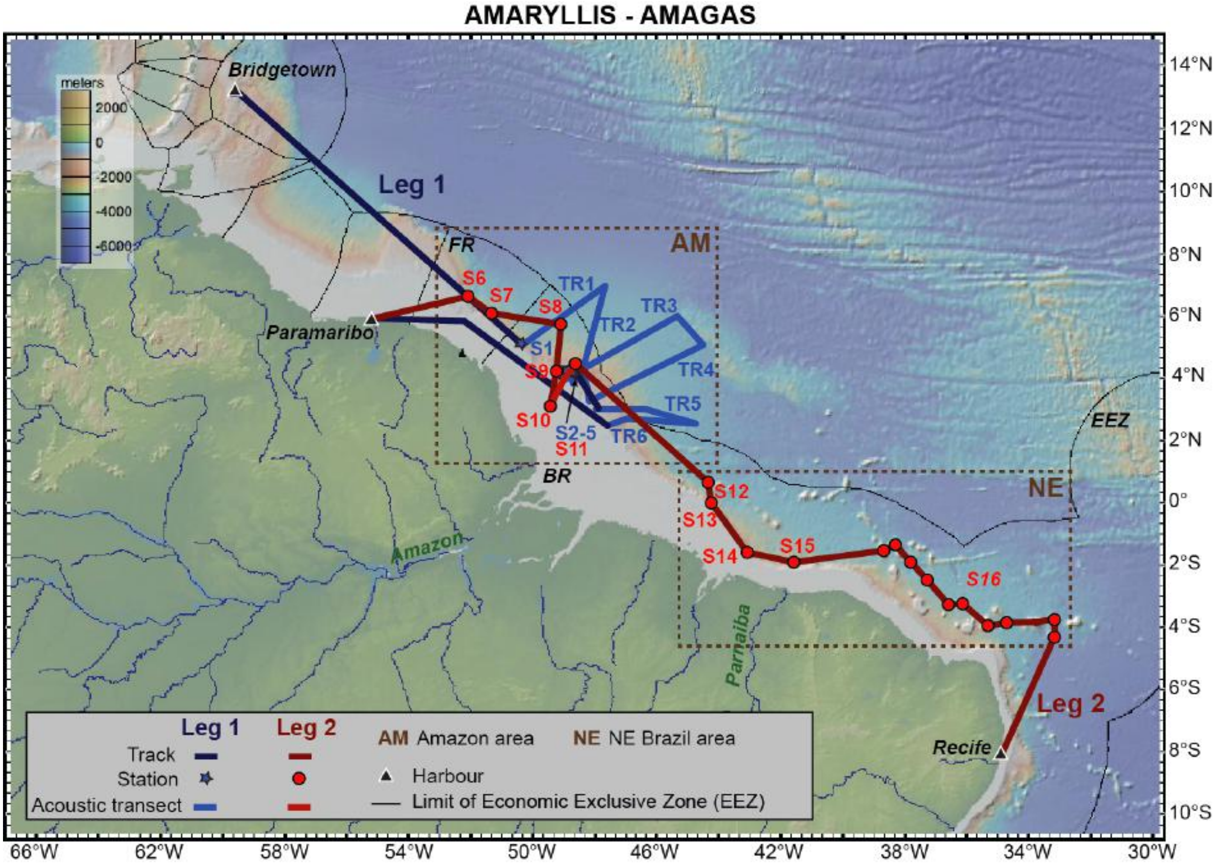


Figure 1: Cruise track of AMARYLLIS-AMAGAS I and II as shown in the original cruise proposal (see Figure 28, page 49, for the performed track of AMARYLLIS-AMAGAS II).

1.2 Overview of AMARYLLIS-AMAGAS II operations

The AMARYLLIS-AMAGAS II cruise mainly aimed to retrieve long and high-quality sedimentary sequences from the two geographical areas located along the French Guiana, northern and northeastern Brazilian margins: the Amazon area (AM) and the NE Brazil (NE) area.

The specific scientific objectives of AMARYLLIS-AMAGAS II are twofold:

(1) to document, with unprecedented resolution, the variability and drivers of tropical South American paleoclimate on complementary time scales (anthropogenic, millennial-scale, orbital) of the last few million years;

(2) to investigate the modern and past long-range North African dust transport by documenting the modern and Quaternary variability of Saharan dust supplied to the Amazon region and its impact on past Amazon climate and ecosystem.

AMARYLLIS-AMAGAS II originally included the investigation of 11 stations (S6 to S16), located along the French Guiana (S6-S7) and Brazilian (S8-S16) margins (Figure 1). Operations originally included (Table 1):

- coring of sedimentary sequences, using the multi-corer, the square-section Casq corer and giant-piston Calypso corer, at all 11 stations S6 to S16 (with the exception that no Calypso was originally planned at S16);
- measurement of heat flow in the sediments of stations S9 and S11;
- deployment of the small CTD-probe (attached to the Casq core-head) and of the small 1.7 L Niskin bottle (attached to the Calypso core-head) at all 11 stations S6 to S16;
- deployment of the large CTD-rosette at 3 stations: S8, S10 and S13;
- continuous collection of modern dust samples;
- continuous measurement of water stable isotopes in surface waters;
- continuous measurement of fluorescence in surface waters.

However, the occurrence of unforeseen events led us to revise some operations of AMARYLLIS-AMAGAS II. Table 1 provides an overview of which operations effectively took place, compared to the original planning of aboard activities.

The investigation of station S8, which is located within a 150 km-wide band along the French-Brazilian border (Figure 1) in the so-called Brazilian “frontier zone”, had to be cancelled, because a specific authorization required from the Brazilian National Defense Council (CDN) by the Brazilian National Council for Scientific and Technological Development (CNPq) was not granted on time. Due to the cancellation of S8, we decided to deploy the CTD-rosette at station S7 instead of S8, in order to maintain the collection of water samples from the Amazon (AM) area.

Towards the end of leg 1, the ship made an unforeseen stop to disembark a technical operator in Cayenne (French Guiana). As a consequence, the distribution of planned operations between legs 1 and 2 has been revised. In short, the heat flow measurements planned at stations S9 and S11, the Calypso core planned at S9 and the acoustic transect TR7 (Figure 1), have been shifted from leg 2 to leg 1 (Table 1). Instead, the acoustic transects TR5 and TR6 (Figure 1), which remained to be done during leg 1 when the unforeseen stop in Cayenne occurred, have been performed during leg 2 (Table 1).

We encountered severe difficulties in the first deployment of the CTD-rosette at station S7. After solving several error and communication issues between the deck unit and the CTD-rosette, we failed to successfully establish the communication between the deck unit and the water sampler of the rosette. After intensive testing, we identified the source of the communication issue with the water sampler. It resulted from failures within the motor pilon of the rosette, likely because of corrosion, which appeared following the long storage on the ship of an insufficiently rinsed CTD-rosette. Therefore, the CTD-rosette as a whole could not be used during AMARYLLIS-AMAGAS II cruise (Table 1). We decided to deploy the CTD in “palanquée” mode (section 2.3) at stations S10, S11, S13 and S16 (Table 1).

Station S13 has been the least successful station of AMARYLLIS-AMAGAS II. The unfortunate inversion of two digits in the latitude value of S13 in the submitted cruise proposal and the constraint imposed by the Brazilian Navy’s authorization to core within a 2.5 nm-radius circle around given coordinates have prevented us from coring at the originally planned site. When surveying the authorized area, we found a localized site with about 25 m of undisturbed sediments. However, the Casq core deployed at this alternative S13 site did not penetrate sufficiently: only the core catcher has been sampled. Given these difficulties, no Calypso core has been deployed at this location. Because of a strong North Brazil Current (up to 3 knots), the deployment of the relatively light muti-corer failed and has been cancelled. Finally, the CTD deployment in “palanquée” mode at S13 collected few water samples, because of difficulties to trigger the closure system of the bottles at correct water depths due to the strong flow of the North Brazilian Current.

Two seamounts (SM4 and SM6) with water-depths around 1900 m have been investigated at station S16 in order to find the most suitable site for past Saharan dust investigations. SM4 did not present any appropriate coring site, while two locations have been identified on SM6. One Casq core (MD23-3676Q) has been collected in the most central site of SM6 at a water depth of 1804 m. One Casq core (MD23-3677Q) and one Calypso core (MD23-3678) have been collected in the northernmost site of SM6, at a water depth of 1988 m. Because of a strong North Brazil Current (up to 2 knots), the deployment of the relatively light multi-corer failed and has been cancelled. As for S13, the CTD deployment in “palanquée” mode collected few water samples, because of difficulties to trigger the closure system of the bottles at correct water depths due to the strong flow of the North Brazilian Current.

Table 1: Comparison of originally planned and effectively performed operations during AMARYLLIS-AMAGAS II. (The differences between the originally planned and effectively performed operations are indicated in bold italic in the right-hand column.)

Stations	**Operations originally planned for AMARYLLIS-AMAGAS II**	**Operations effectively performed during AMARYLLIS-AMAGAS II**
S6 ~2500 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin
S7 ~2500 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin CTD-rosette sampling: ***failed***
S8 ~3300 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin CTD-rosette sampling	***Cancelled***
S9 ~700 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin Heat flow measurement	Multicores Casq core with CTD probe ***Done during leg 1*** ***Done during leg 1***
S10 ~70 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin CTD-rosette sampling	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin ***CTD in "palanquée" mode: 1 cast***
TR7	*Acoustic imagery between S10 and S11*	***Done during leg 1***
S11 ~1700 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin *Heat flow measurement*	Multicores Casq core with CTD probe ***CTD in "palanquée" mode: cast 1*** Calypso core with 1.7 L Niskin ***CTD in "palanquée" mode: cast 2*** ***Done during leg 1***
TR5 **TR6**	*Acoustic imagery planned for leg 1*	***Done during leg 2***
S12 ~2350 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin
S13 ~1800 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin CTD-rosette sampling	Multicores: ***failed*** Casq core with CTD probe: ~***sediment only in the core catcher*** ***Cancelled*** ***CTD in "palanquée" mode: cast 1*** ***CTD in "palanquée" mode: cast 2***
S14 ~1400 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin
S15 ~2200 m	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin	Multicores Casq core with CTD probe Calypso core with 1.7 L Niskin Calypso core with 1.7 L Niskin
S16 ~2000 m	Multicores Casq core with CTD probe	Multicores: ***failed*** Casq core with CTD probe ***Casq core at 2nd location*** ***Calypso core with 1.7 L Niskin***

		CTD in "palanquée" mode: cast 1 ***CTD in "palanquée" mode: cast 2***
Continuously	Sampling of modern mineral dust	Sampling of modern mineral dust (with the exception of the Brazilian frontier zone)
	Measurement of water stable isotopes in surface waters	Measurement of water stable isotopes in surface waters (with the exception of the Brazilian frontier zone)
	Measurement of fluorescence in surface waters	Measurement of fluorescence in surface waters (with the exception of the Brazilian frontier zone)

In summary, 27 sediment cores have been collected at 9 stations during AMARYLLIS-AMAGAS II cruise for a total of 442 m of sediment: 8 multicores, 10 Casq cores and 9 Calypso cores. Despite coring conditions that were often complicated by the high speed of the surface portion of the North Brazil Current, we achieved a very satisfactory recovery rate for Calypso, CasQ and multi-tube cores at the stations where coring operations were carried out. The mean recovery rate is on average higher than 85 % (94 % for multicores, 74 % for Casq cores and 95 % for Calypso cores).

Three Calypso cores have bent (at S6, S7 and S15), but sediments seem to show limited disturbance in these cores. These bent cores reflect the difficulty, despite the existence of thick sedimentary sequences, to penetrate the sediments of this region, enriched in terrigenous input. The CTD has been deployed at four stations, in one or two casts, in "palanquée" mode with a maximum of 7 bottles directly attached to the steel cable.

Overall, AMARYLLIS-AMAGAS II has been a great success in terms of number and quality of collected sediment cores. However, **the collection of water samples using the CTD-rosette has been extremely difficult throughout the cruise**, despite the unvaluable help of all crew members.

Physical properties measurements (magnetic susceptibility, porosity, density, P-wave velocity) were performed on board using the Genavir's Geotek core logger. Photography and sedimentological description of open core sections, as well as complementary measurements performed at the sediment surface (reflectance, elemental composition, optically-stimulated luminescence) provided key information to establish preliminary age models and plan the sampling that will be performed on land.

Finally, AMARYLLIS-AMAGAS II cruise was also the opportunity to prepare outreach material directed towards schools (primary, mid and high schools) and a wider audience. A webpage (https://amaryllis.ipsl.fr) was developed in order to share the day-to-day operations during the cruise with the French-speaking public and schools on land. In parallel, a series of videos (https://agencia.fapesp.br/diario-de-bordo) was produced to inform the Portuguese-speaking public about the aims and outcomes of the cruise.

1.3 List of cruise participants

1.3.1 Chief scientists

Table 2: AMARYLLIS-AMAGAS II chief scientists

Name	First Name	Institute	Country	Status
Govin	Aline	LSCE	France	Researcher
Chiessi	Cristiano	USP	Brazil	Professor

LSCE: Laboratoire des Sciences du Climat et de l'Environnement
USP: University of São Paulo

1.3.2 Scientific and technical team

Table 3: List of the scientific and technical team of AMARYLLIS-AMAGAS II

Name	First Name	Institute	Country	Status
Abot	Louise	LOCEAN	France	PhD student
Akabane	Thomas	USP	Brazil	PhD student
Albuquerque	Ana Luiza	UFF	Brazil	Professor
Amancio	Luiza	USP	Brazil	PhD student
Andrzejewski	Léna	GEOPS	France	Msc student
Anquetil	Christelle	METIS	France	Engineer
Ayache	Mohamed	LSCE	France	Post-doc
Ayres Neto	Arthur	UFF	Brazil	Professor
Barathieu	Héloïse	EPOC	France	PhD student
Belem	Andre	UFF	Brazil	Professor
Bertassoli	Dailson	USP	Brazil	Assistant professor
Bouloubassi	Ioanna	LOCEAN	France	Researcher
Campos	Marília	UNICAMP	Brazil	Post-doc
Chacon	Ana Beatriz	UFF	Brazil	Undergraduate student
Chompré	Patrick	Independent	France	Journalist
Dano	Alexandre	Géoazur	France	Engineer
Dewilde	Fabien	IUEM	France	Engineer
Duhayon	Anais	Independent	France	Photographer
Freitas Costa	Luiza	UFF	Brazil	Undergraduate student
Gomes da Silva	Bruno	UFF	Brazil	Undergraduate student
Grigolato	Júlia	USP	Brazil	MSc student
Haut-Labourdette	Marie	LSCE	France	PhD student
Hervé	Gwenaël	LSCE	France	Researcher

Isguder	Gulay	LSCE	France	Assistant Engineer
Jacob	Jérémy	LSCE	France	Researcher
Karsenti	Alice	GEOPS	France	PhD student
Leblanc	Maxime	LSCE	France	Post-doc
Lecomte	Manon	EPOC	France	Undergraduate student
Lessa	Douglas	UFF	Brazil	Post-doc
Lourenço	Antonio	LOCEAN	France	Engineer
Magalhães	Renê	USP	Brazil	PhD student
Mendes	Vinícius	UNIFESP	Brazil	Professor
Michel	Elisabeth	LSCE	France	Researcher
Morichetta	Alessandro	LSCE	France	Engineer
Moura	Elton Alisson	FAPESP	Brazil	Press officer
Nascimento	Rodrigo	UFF	Brazil	Post-doc
Praeg	Daniel	Géoazur	France	Researcher
Prinet	Lison	GEOPS	France	Undergraduate student
Richard	Patricia	LSCE	France	Assistant Engineer
Rodrigues	Fernanda	USP	Brazil	Post-doc
Rossignol	Linda	EPOC	France	Engineer
Rouyer	Louis	METIS	France	PhD student
Sepulchre	Pierre	LSCE	France	Researcher
Skonieczny	Charlotte	GEOPS	France	Lecturer
Soares	Maria Julia	UFF	Brazil	Undergraduate student
Stevenard	Nathan	LSCE	France	PhD student
Thil	François	LSCE	France	Engineer
Tomazella	Mariana	USP	Brazil	PhD student
Van Toer	Aurélie	LSCE	France	Engineer
Vazquez Riveiros	Natalia	Geo-Ocean	France	Researcher
Venancio	Igor	UFF	Brazil	Assistant professor
Waelbroeck	Claire	LOCEAN	France	Researcher
Wandres	Camille	LSCE	France	Engineer
Goas	Erwan	GENAVIR	France	Technical operator
Laville Saint Martin	Sébastien	GENAVIR	France	OPEXO Electronician
Le Viavant	Nicolas	GENAVIR	France	Technical operator
Morvan	Laurence	GENAVIR	France	Technical operator
Quinquis	Renaud	GENAVIR	France	Electronician

Ragu	Olivier	GENAVIR	France	Coring operator
Réaud	Yvan	GENAVIR	France	Chief coring operator
Sustersic	Mélanie	LDAS	France	Medical doctor

EPOC: Environnements, Paléoenvironnements Océaniques et Continentaux
FAPESP: São Paulo Research Foundation
GENAVIR: Gestion des navires de recherche
GEOPS: Géosciences Paris Saclay
IUEM: Institut Universitaire Européen de la Mer
LOCEAN: Laboratoire d'Océanographie et du Climat, Expérimentations et Approches Numériques
LSCE: Laboratoire des Sciences du Climat et de l'Environnement
METIS: Milieux environnementaux, transferts et interactions dans les hydrosystèmes et les sols
UFF: Fluminense Federal University
UNICAMP: University of Campinas
UNIFESP: Federal University of São Paulo
USP: University of São Paulo

1.3.3 Maritime crew members

Table 4: List of AMARYLLIS-AMAGAS II maritime crew members

Name	**First Name**	**Institute**	**Country**	**Status**
Souffre	Charles	LDAS	France	Captain
Perier	Charles	LDAS	France	2nd captain
Le Gars	Maël	LDAS	France	Lieutenant
Razafindrafahatra	Toavina	LDAS	Madagascar	Lieutenant
Randimbimananjara	Harizafy Henintsoa	LDAS	Madagascar	Lieutenant
Drouet	Enora	LDAS	France	Lieutenant
Marie	Laurent	LDAS	France	Chief mechanic
Desroys	Alexandre	LDAS	France	2nd mechanic
Berroncle	Vincent	LDAS	France	3rd mechanic
Bonvoisin	Pierre-Baptiste	LDAS	France	Electronics engineer
Bezara	Ludovic	LDAS	Madagascar	Electronics chief
Randriananja	Ialy	LDAS	Madagascar	Electric engineer
Rafanoharana	Rodolphe	LDAS	Madagascar	Bosco 1
Razafimanjakasoa	Jean Nonnat	LDAS	Madagascar	Bosco 2
Rasolomanampitoana	Rakotoarimanana	LDAS	Madagascar	Bosco 3
Dano Raherihaja	Julien	LDAS	Madagascar	Sailor 1
Randriamalala	Dina Harilala	LDAS	Madagascar	Sailor 2
Andriamandimby	Raymond Langelo	LDAS	Madagascar	Sailor 3

Baba Cardia	Sulleman	LDAS	Madagascar	Sailor 4
Samboson	Roland Fréderic	LDAS	Madagascar	Sailor 5
Razakarivony	Sylvain	LDAS	Madagascar	Sailor 6
Chow	Emilien	LDAS	Madagascar	Sailor 7
Naitra	Eddit Angelot	LDAS	Madagascar	Sailor 8
Andriantsalama	Jimmy Honore	LDAS	Madagascar	Sailor 9
Albert	Marius Michael	LDAS	Madagascar	Sailor 10
Botou	Richard	LDAS	Madagascar	Sailor 11
Kreutzer Ramangafitia	Lalasoa Roméo	LDAS	Madagascar	Sailor 12
Velo	Thierry	LDAS	Madagascar	Storekeeper
Rafanoharana	Jean Luc	LDAS	Madagascar	Worker 1
Randremalala	Eric Stephan	LDAS	Madagascar	Worker 2
Rasolonirina	Tsarasidy Prosper	LDAS	Madagascar	Worker 3
Remy	Indriamasy	LDAS	Madagascar	Worker 4
Solondraza	Sylvain	LDAS	Madagascar	Worker 5
Rakotonindrina	Roger	LDAS	Madagascar	Chief cook
Andrianarijesy	Tanteliarisoa Jerry Samuel	LDAS	Madagascar	2nd cook
Diallo	Amadou	LDAS	Madagascar	2nd cook
Rakotobearson	Ratisbonne Tantely	LDAS	Madagascar	Assistant cook
Rakotonandrasana	Andrianjafinarivo Patrick	LDAS	Madagascar	Assistant cook
STEPHANO	Dany Maurice	LDAS	Madagascar	Barman
RAJHONSON	Jimmy Arnaud	LDAS	Madagascar	Waiter
BAKO	Bruno Patrick	LDAS	Madagascar	Waiter
MAHATANA	Kenny Marcel	LDAS	Madagascar	Waiter
RAHARIJAONA	Maminiaina Raveloarisson	LDAS	Madagascar	Waiter

LDAS: Louis Dreyfus Armateurs

2 EQUIPMENT & METHODS

2.1 Geoacoustic systems

Underwater geoacoustics is a technique that uses the emission of sound pulses by acoustic geophysical equipment to geologically and geotechnically characterize the seafloor. Sea water is a strong attenuator of electromagnetic waves. For this reason, the light has an extremely limited range, making sea water completely dark beneath 200 m depth. This factor prevents direct seabed investigation methods from being viable in practice.

However, the ocean is an excellent medium for the propagation of sound. Marine geophysical methods take advantage of this ability of the ocean to investigate, through the emission and reception of acoustic pulses, the surface and subsurface geology of the seabed. The used equipment can essentially be classified as active sonars. These instruments emit an acoustic signal with a known shape that, upon encountering a surface, is reflected back to the emitting source. For each method (bathymetry, side scan sonar and seismic), there is a huge diversity of devices available on the market. The main difference between them is in the frequency range of the emitted pulse.

2.1.1 EM710 shallow-water multi-beam echo sounder

The shallow-water echo sounder Kongsberg EM710 MK2 was installed on board the oceanographic research vessel Marion Dufresne in 2015, during her mid-life upgrade. The antennas were placed on the gondola also accommodating the deep-water multibeam echo-sounder antennas, the sub-bottom profiler antennas, the Simrad fishing echo-sounder antennas and the current profiler antennas. The active elements of the transducers are based upon composite ceramics, leading to increased bandwidth (60 kHz, indeed a very large bandwidth in this frequency range).

The EM710 MK2 echo sounder uses transmitted frequencies from 40 to 100 kHz. The range of depths on which this sounder can operate is 3 to 2800 m. In shallow water, two cross-track swaths are simultaneously created in order to generate a data redundancy (as if two multi beam echo -sounders were simultaneously used). These swaths are separated by the use of digital active filters. Thus, measurement gaps are avoided. These two swaths are separated (along the ship-track axis) from each other by an angle dynamically calculated by the echo sounder. The large antenna 3 dB attenuation level (at transmission) and beam forming at reception allow images to be built and measure bathymetry at 71° to starboard and 71° to portside. Therefore, across track coverage (swath width) can be up to 5.8 times water depth. This sounder was qualified by SHOM to hydrographic norms IHO-S44, which standards are widely met, in October 2015 (IHO-S44, order 1a).

The along track beam width is equal to 0.5°, while the receive beam width is equal to 1°. The number of created soundings for one measurement in dual-swath mode is 800. During this cruise, the beam spacing was set to equidistant. The maximum swath coverage can be limited by the operator in angle without reducing the number of beams. The maximum ping rate in shallow water can be up to 30 Hz. The large transmitted beamwidth leads to a very impressive depth resolution, equal to 1 cm. A combination of phase bottom detection (for higher beamforming angles) and amplitude bottom detection (for smaller beamforming angles) is used, in order to provide soundings with the best possible accuracy.

Reflectivity data can also be extracted from the two separated frequency swaths. A mosaic is created, geographically representing sea bottom level in the studied area. This mosaic is fed by the two sets of backscattered signals.

2.1.2 EM122 deep-water multi-beam echo sounder

The R/V Marion Dufresne also hosts a deep-water multi-beam echo sounder from the same series (Kongsberg Em122 1°x1°).

The deep-water echo sounder Kongsberg EM122 was also installed on board the R/V Marion Dufresne in 2015, during her mid-life upgrade. The antennas were placed on the gondola. The transmitting antenna, placed alongside the ship, has a length of 7.8 m. The receiving antenna, placed cross-tracked, has a length of 7.2 m.

The EM122 is designed to perform seabed mapping to full ocean depth. It is the latest model in a series of deep-sea multi-beam echo sounders started with the EM12 in 1990 and followed by the EM121 and the EM120.

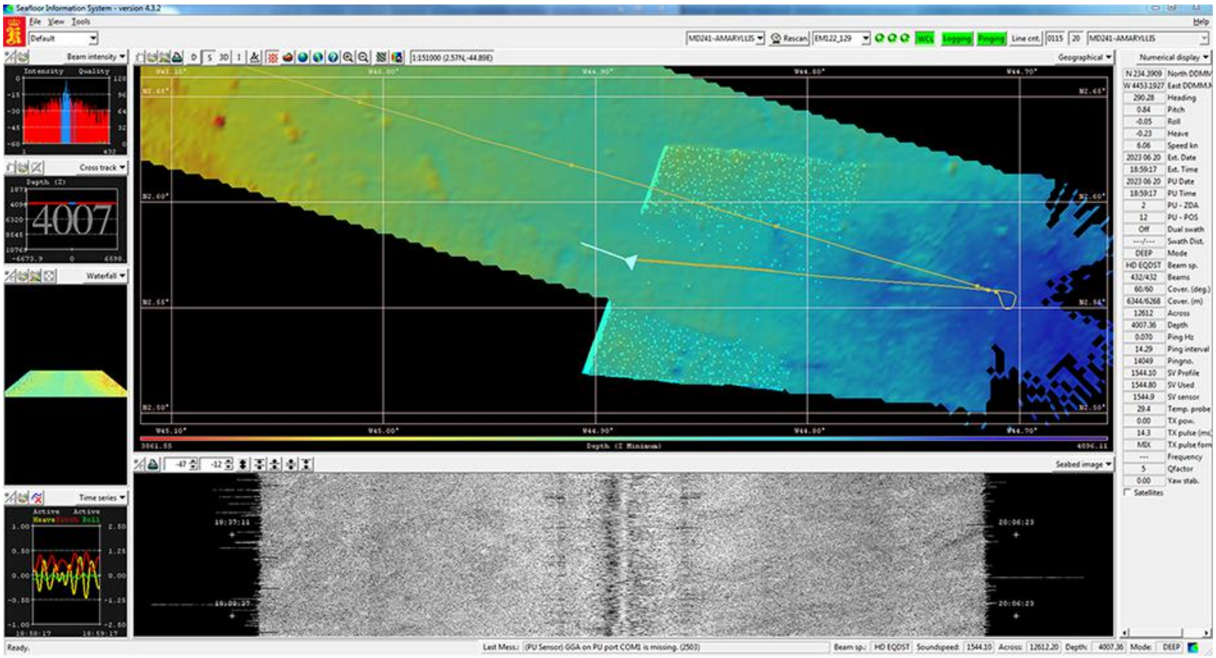


Figure 2: Example of geographical view with Seafloor Information System during AMARYLLIS-AMAGAS II cruise (here during TR6). The ship's track (top large panel) and the backscattered data (bottom large panel) can be seen on the image.

Compared with the EM120, the EM122 has up to four times the resolution in terms of sounding density through inclusion of multi-ping capability and more than twice the number of detections per swath. The achievable swath width of the EM122 is in the order of 30 kilometers. This is obtained by using long FM-CW signals which gains about 15 dB in signal to noise ratio, compared to CW pulses.

The EM122 was qualified by SHOM to hydrographic norms IHO-S44 (order 2). An accuracy better than 0.2 % of depth in deep waters is readily achievable with the EM122.

The nominal sonar frequency is 12 kHz, with an angular coverage sector of up to 150° and 864 soundings per ping. Achievable swath width on a flat bottom will normally be up to six times the water depth. However, during this cruise, the angular sector was limited to 130° (65° on both sides). The sounding spacing was set to equidistant (equi-angle is also available).

The ping rate is mainly limited by the roundtrip travel time in the water, up to a ping rate of 5 Hz. EM710 and EM122 use Seafloor Information System (SIS) for real time display. This user interface can show different kinds of displays (Figure 2).

2.1.3 SBP120 sub-bottom profiler

Sub-bottom profiling (SBP) systems are a special kind of sonar. They trigger an acoustic pulse which travels down through the water column and into the seabed. By recording the reflected returns of this pulse, it is possible to identify and characterize layers of sediment under the seafloor. They use relative low frequency emission (1-10 kHZ) and are able to separate layers less than 1 meter thick, making it ideal to high-resolution investigation of the sub-seabed geology.

The new Kongsberg SBP120 sub-bottom profiler was installed during R/V *Marion Dufresne* mid-life upgrade in 2015. The antennas are arranged according to a Mills cross configuration. The transmitting antenna (whose length is equal to 7.45 m) is made of 96 individual transducers. The wideband receiving antenna is the same as the EM122 system. SBP120 is able to create reflectivity slices of the sub-bottom sea floor as a function of the geographical position of the ship. The central frequency used for this system is 4.5 KHz. As for the “bathymetry and imaging” mode, the transmitted wave is linearly frequency modulated. The corresponding correlation gain is equal to 22 dB. The large transmitted bandwidth (4 KHz) achieves a small spatial resolution (0.19 m).

The beam forming from many signals received on each sensor provides a very narrow antenna diagram (high directivity), during transmission (3°) and reception (3°). This beam formation also achieves a high acoustic signal level. The high resolution can be degraded to 6° and even to 12°. This can be useful when the sediment layers are not horizontal and when the geological structures at the bottom of the sea are complex. Furthermore, the vertical received beam can sometimes be oriented perpendicular to the seabed slope.

Up to 11 beams are created on reception (the central beam is vertical), separated from each other by 3°. This diversity provides an opportunity to record good quality profiles when the across-track slope is steep.

SBP120 has a very high level of transmitted signal, which leads to acoustic deep penetration inside the sediment. During this cruise, a maximum penetration of about 150 m depth was achieved at 700 m water-depth, at a rare location of the cruise where the sediment package was particularly thick (Figure 3).

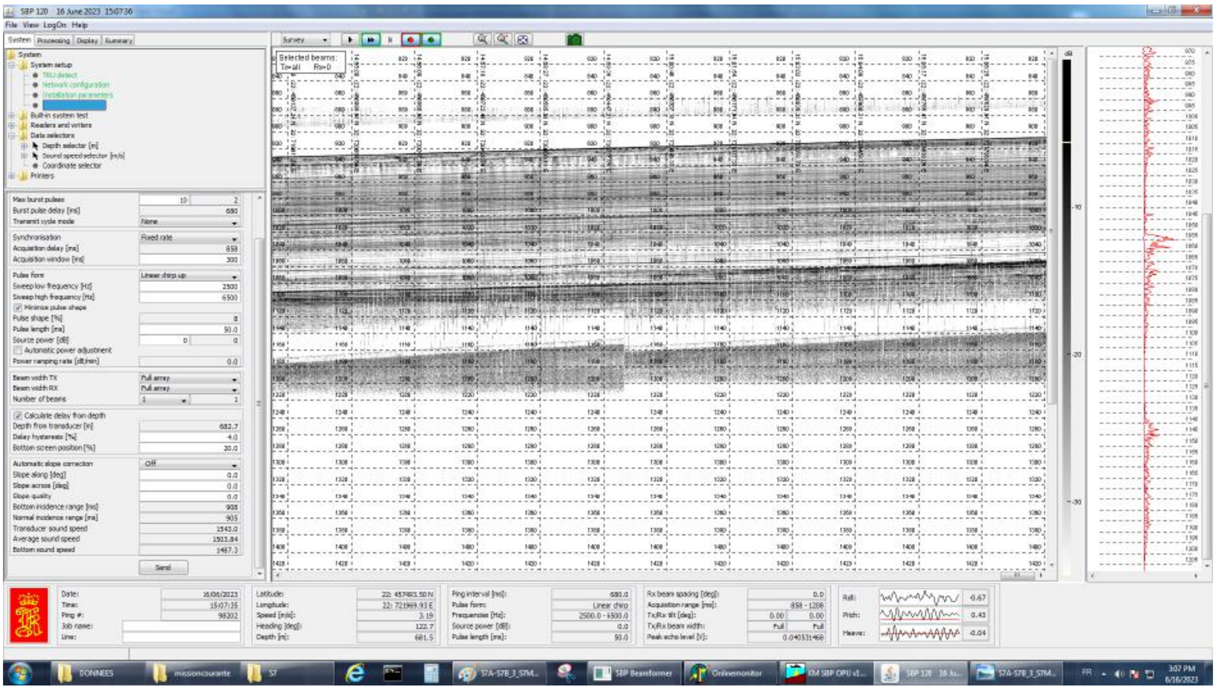


Figure 3: Example of sediment profile obtained during AMARYLLIS-AMAGAS II cruise (here at station S9).

2.1.4 Frequency test experiment with the sub-bottom profiler at stations

The pulse recorded by the sub-bottom profiler is the result of the interaction between the geological layers of the seabed and the emitted pulse. As each layer has particular physical properties, as a result of specific grain size, mineralogy, density, water, content, organic matter content, compaction, presence of bioturbation, etc., when the pulse reaches the interfaces between these layers part of the energy will be reflected, and part will be transmitted back to the surface. This will continue until the energy is attenuated, so that it is no longer able to be recorded. However, if different pulses are emitted, the same geological profile will give different returns.

The objective of this frequency test experiment is to investigate the different SBP responses for the same geology by changing the pulses characteristics and to measure the effect in resolution, signal penetration and attenuation.

The experiment consists in recording a series of SBP traces while the ship is holding position at a coring station. In the first part of the experiment, the emitted signals have the same central frequency (4.5 kHz) but different bandwidths (Table 5).

Table 5: Characteristics of part 1 of the frequency test experiment: same central frequency, varying bandwidth.

Pulse	Central Frequency	Bandwidth
2.5 - 6.5 kHZ	4.5 kHz	4 kHz
3.0 - 6.0 kHZ	4.5 kHz	3 Khz
3.5 - 5.5 kHZ	4.5 kHz	2 kHz
4.0 - 5.0 kHZ	4.5 kHz	1 kHz

The second part of the experiment uses signals with the same bandwidth (2 kHz) but changing the central frequency (Table 6).

Table 6: Characteristics of part 2 of the frequency test experiment: same bandwidth, varying the central frequency.

Pulse	Central Frequency	Bandwidth
2.5 - 4.5 kHZ	3.5 kHz	2 kHz
3.0 - 5.0 kHZ	4 kHz	2 kHz
3.5 - 5.5 kHZ	4.5 KkHz	2 kHz
4.0 - 6.0 kHZ	5 kHz	2 kHz
4.5 - 6.5 kHZ	5.5 kHz	2 kHz
3.5 - 4.5 kHz	4 kHz	1 kHz
4.5 - 5.5 kHz	5 kHz	1 kHz

The third part of the experiment is to generate synthetic seismogram using the P-wave velocity (Vp) and density profiles obtained by scanning the cores with the Multi Sensor Core Logger, with a synthetic pulse with the same characteristics as the used during the data acquisition. The Vp and density values allow to calculate the acoustic impedance profile, which, in turn, gives the reflectivity profile of the core.

By comparing the synthetic data with the real data, it will be possible to recognize the effects of the different types of sediments in the acoustic properties of the emitted signal, and develop inversion algorithms that will allow the remote recognition of seabed sediments with less coring efforts. In addition, the results of this experiment will give more precise information to decide which type of coring devices can be used at a specific location, according to the objectives of the operation.

2.2 Procedure for collecting sediment samples

2.2.1 Calypso giant piston corer

The Calypso giant piston corer, developed by IPEV and operated on board Marion Dufresne, can be fitted with a tube up to 70 m in length. The corer is deployed with a textile cable, virtually weightless in water, and extremely stiff, which significantly enhances the traction security margin and weight lifting capacity of the winch.

The principle of a Calypso coring operation is described in Figure 4 and Figure 5.

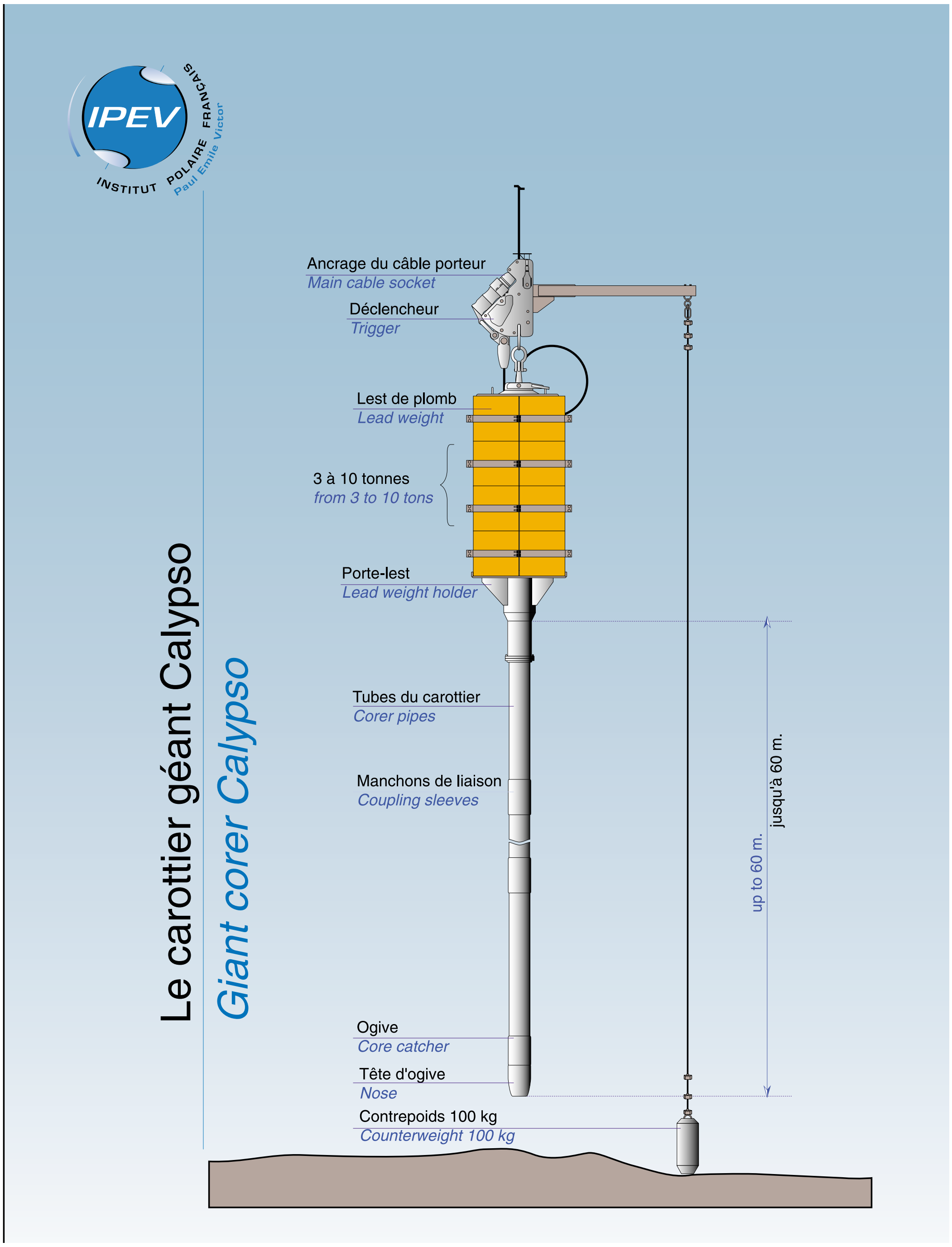


Figure 4: Giant piston corer Calypso.

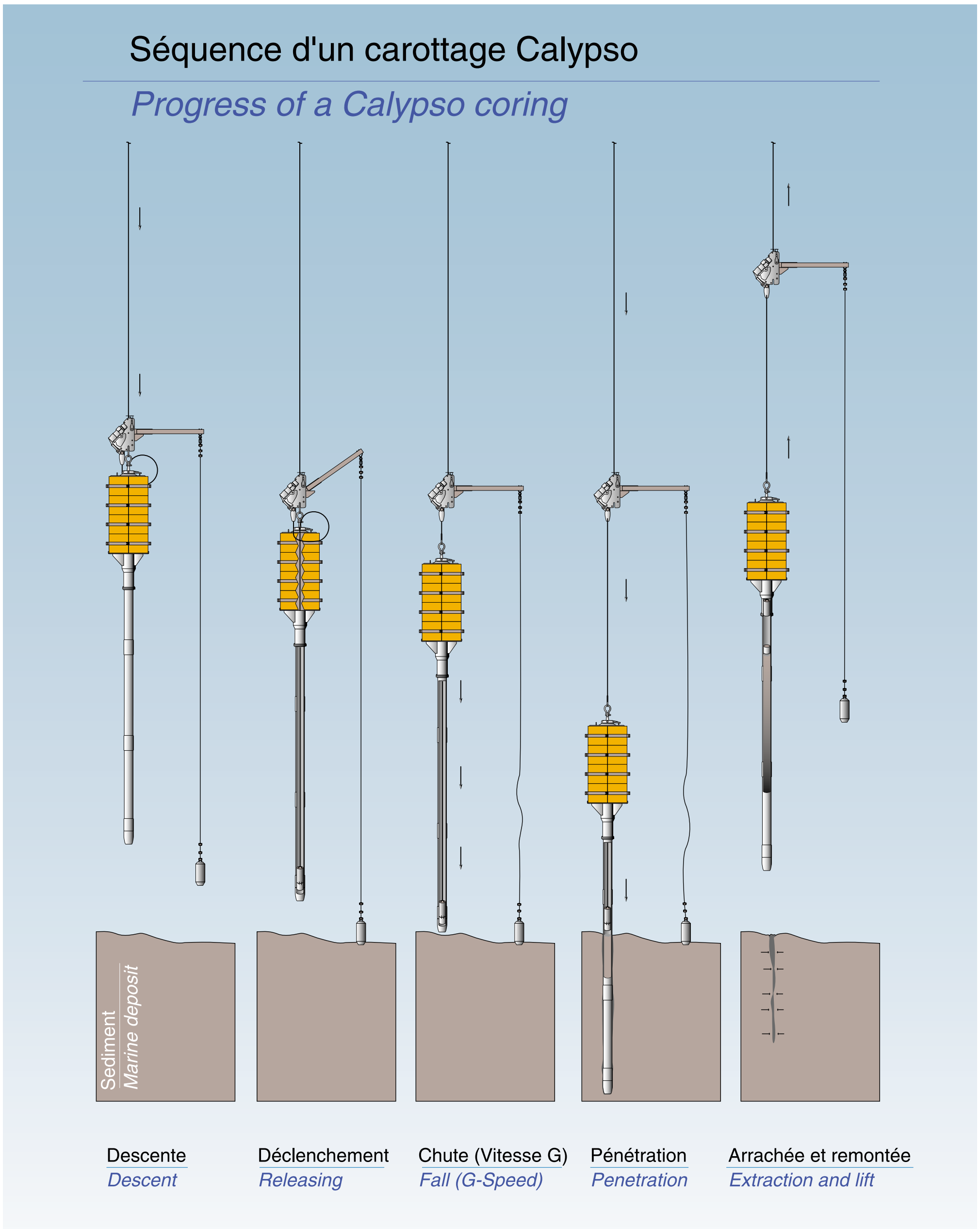


Figure 5: Sequence of a Calypso coring operation.

Temperature and salinity vertical profiles are measured by a small CTD probe (see section 2.3.2) installed on the Calypso or Casq core-head (Figure 6). Bottom waters can also be collected just before triggering with a 1.7 L Niskin bottle fitted onto the Calypso corer (Figure 6) (see section 2.3.2).

2.2.2 CINEMA software used during Calypso coring

The systematic use of the CINEMA V3.1 software and associated loggers, developed through an IFREMER-IPEV-INSU collaboration, has led to the high quality of the cores taken since the Marion Dufresne refit in 2015.

Prior to coring operations, the settings of the corer (free fall height, loop length) are estimated using the Cinema model that calculates the elastic rebound of the coring cable, and hence the free fall height, according to the site specificities (Figure 9).

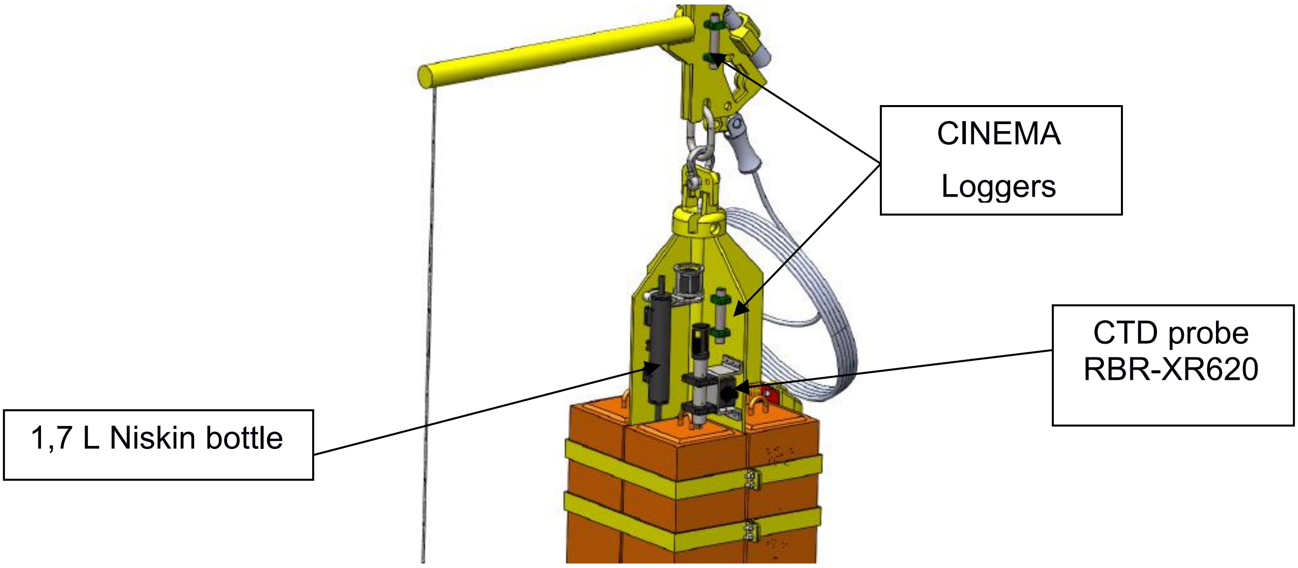


Figure 6: Sketch of the Calypso core-head showing the position of CINEMA loggers (pressure and accelerator sensors), Niskin bottle and CTD probe.

Pressure and acceleration sensors (CINEMA loggers) are attached to the corer. One set of sensors is attached on the core-head and another set on the trigger arm (Figure 6).

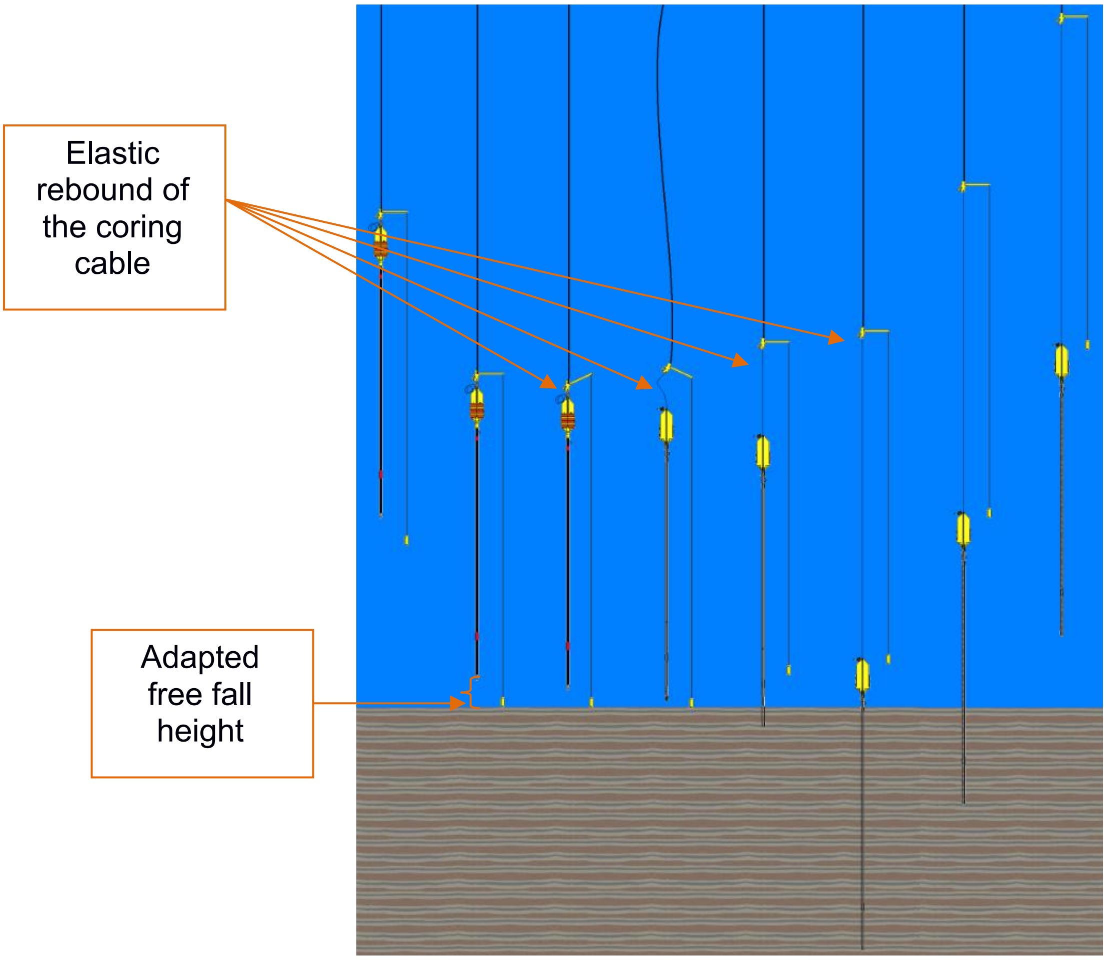


Figure 7: Schematic coring process illustrating the elastic rebound of the coring cable.

After coring, loggers data are downloaded and analyzed in the CINEMA software that builds the so-called kinematics curves, where the piston action can be seen (Figure 8).

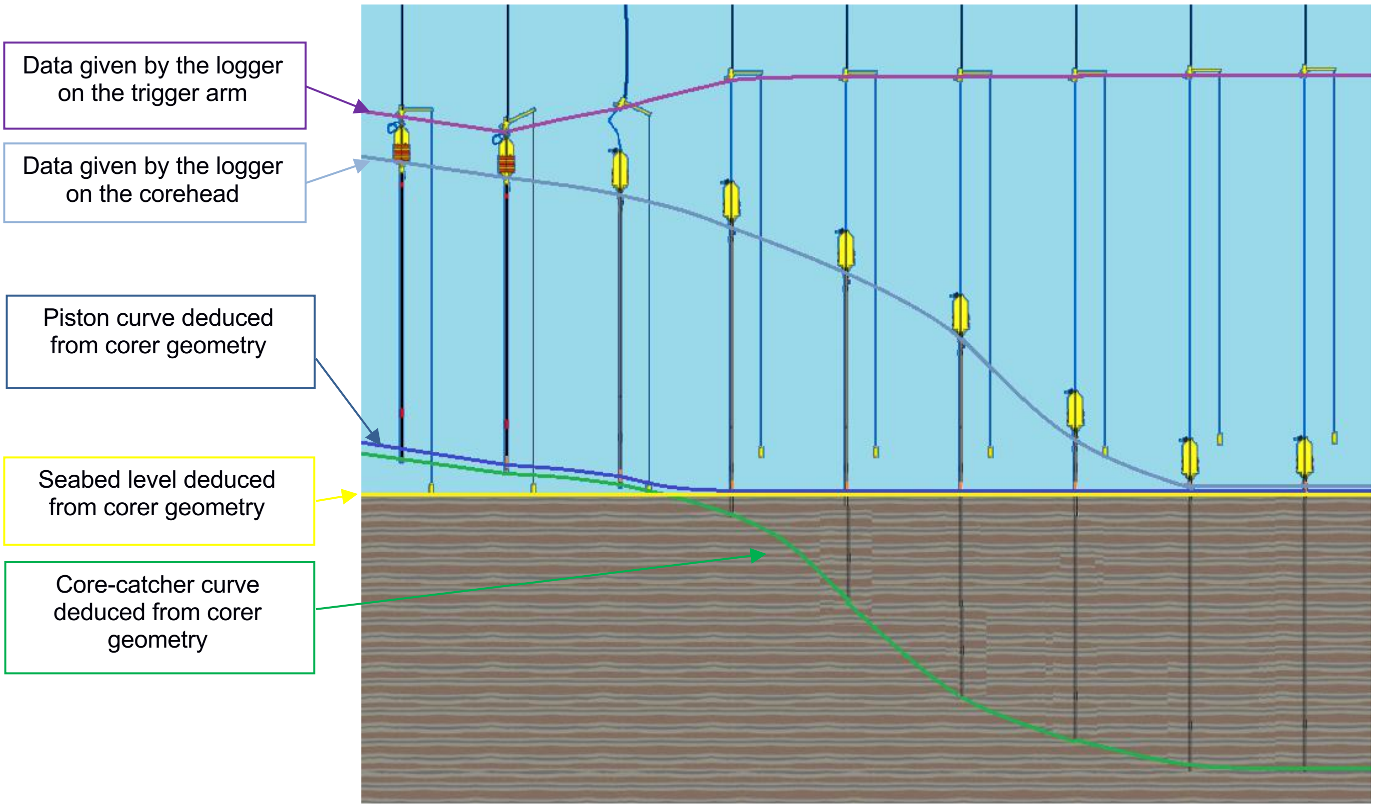


Figure 8: Examples of kinematics curves obtained from pressure and acceleration sensors during the Calypso coring process.

From the piston behavior, the model deduces the positions of layers in the core, and compares them to their in-situ position (see layer correction graphs for each Calypso core, e.g. Figure 80, page 133)

2.2.3 CAlypso SQuare cores (Casq)

The CAlypso SQuare (Casq, Figure 9) coring system combines the core-head of the Calypso system with a large square core section (25 * 25 cm). Cores retrieved with this system reach lengths up to twelve meters and collect a huge amount of sediment. These cores contain a nearly undisturbed core top with very little sediment missing. In addition, the large surface of the opened core allows improved studies of structures and textures.

Figure 9: Casq, Calypso Square core.

2.2.4 Multi-corer

The multi-corer on board R/V *Marion Dufresne* is a customized KC multi-corer (Figure 10). The corer is equipped with 4 tubes, each with an internal diameter of 90 mm and a length of 60 cm. The sample tubes are transparent with a sleeve for a quick-change system.

Figure 10: Customized multi-corer used on board Marion Dufresne.

While the multi corer is lowered into the sea, there is a full flow through the sample tubes in order to obtain an undisturbed sample. The top of each sample tube has a spring-loaded lid, which is in open position during sampling.

Once the frame is stabilized on the seafloor, an acoustic signal releases the 4 cores, which penetrate into the sediment under the action of weights (Figure 11). After penetrating the sedimentary sequence, a lid placed on top of each tube closes and the resulting vacuum holds the sample until the bottom of each tube is closed by a guillotine-like system.

Further information on the multi-corer can be found on KC's home page at: http://www.kc-denmark.dk/

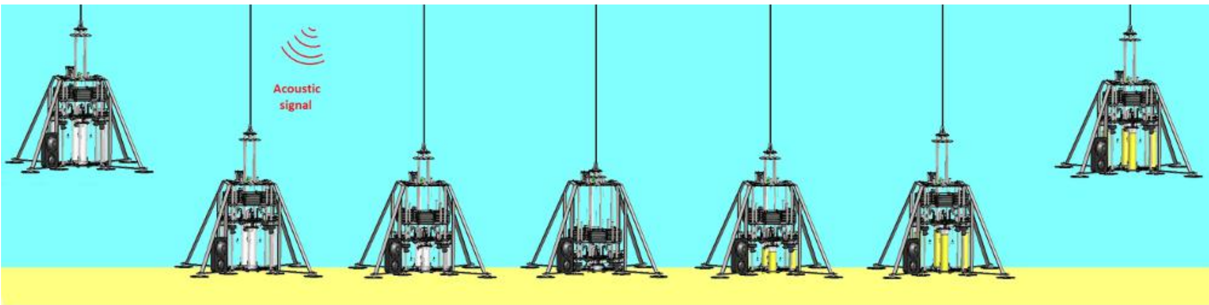


Figure 11: Coring sequence with the multi-corer.

2.3 Procedure for collecting water samples

2.3.1 CTD-rosette water sampling instrument

The CTD-rosette has two functions. First, the CTD unit allows the in-situ measurement of Conductivity, Temperature, and Depth. The CTD often has additional channels to allow data collection from other sensors, such as fluorometry and oxygen. Second, the rosette unit is a series of Niskin bottles that are closed at specific depths. The water from that depth is then brought to the surface for analysis.

Conductivity

Higher salinity (saltier) water is related to the electrical conduction in water. Conductivity is measured and can be converted to salinity using known formulas.

Temperature

Temperature is recorded in degrees Celsius. Temperatures generally decrease with depth.

Depth

Depth is measured as a pressure increase within a fluid-filled diaphragm. Each 10 meters increase in depth is approximately equivalent to 1 atmosphere of pressure.

Fluorometry

When the chemical chlorophyll A is hit with a specific wavelength of light, it fluoresces, or glows. This emitted light is detected and recorded. The amount of this detected light is a direct measurement of the amount of phytoplankton in the water.

As the CTD-rosette traverses the water column, the above-mentioned variables are measured in situ and values displayed via a direct link from the instrument to a shipboard computer. The rosette holds 24 water sampling bottles.

The CTD-rosette used during AMARYLLIS-AMAGAS II is the CNRS DT-INSU SEA BIRD SBE 911Plus System, equipped with a 24 x12 L bottles carousel water sampler (SBE32). The data acquisition rate is 24 scans/s, the typical cable vertical speed is 1 m/s. Bottles are closed during upward profiles.

Figure 12: Classical deployment of the CTD-rosette.

Figure 13: CTD deployment in "palanquée mode".

Due to unresolved communication errors between the deck unit and water sampler of the rosette (potentially due to a deficient motor pilon linked to corrosion), we did not succeed, during AMARYLLIS-AMAGAS II, in deploying the CTD-rosette in the classical way (Figure 12). Instead, we deployed the CTD probe in the degraded "palanquée" mode (Figure 13). In this mode of deployment, the frame of CTD sensors is directly attached to the steel electromechanical cable (Figure 13). A 100 kg weight is attached below the frame of CTD sensors. A maximum of 7 Niskin bottles (12 L each) are directly attached to the steel electromechanical cable at the expected sampling depths, using a mounting system adapted to the diameter of the steel electromechanical cable (10 mm). The closure of bottles is triggered by a series of messengers (weights) sliding along the steel electromechanical cable. When the first messenger released from the ship reaches the uppermost bottle, it triggers its closure and liberates a second messenger, which then slides down to trigger the closure of the next Niskin bottle. These steps are repeated until the last bottle is triggered.

The CTD deployment in "palanquée" mode is more complicated and time-consuming to operate than the classical deployment. One CTD cast at around 2000 m lasted around 3-4 hours in "palanquée" mode against 1.5 hours for the classical deployment. The triggering of bottles in "palanquée" mode is also more hazardous. It happened for most CTD casts that one bottle did not trigger, with immediate consequences on the closure of bottles located below the untriggered bottle along the cable. In this situation, we triggered again the closure of bottles, with the consequence that bottles did not close at the initially chosen water depths.

The CTD deployment in "palanquée" mode was also complicated during AMARYLLIS-AMAGAS II by the strong flow of the North Brazil Current, which regularly reached velocities up to 2-3 knots in the upper 100 meters. In this situation, the first bottles were attached during dynamical positioning of the ship at the station. When the angle made by the electromechanical cable became too high because of the surface current carrying away the CTD frame, the ship sailed into controlled drift. The ship and CTD frame then drifted together. Bottles were more easily attached to the almost vertical steel electromechanical cable. However, one had to check that both the ship and CTD frame remained during one CTD cast within the authorized perimeter for scientific activities (i.e. within the 2.5 nm-radius circle around given station coordinates). In case of two CTD deployments at the same station, the ship moved back to its original position between each CTD cast.

2.3.2 CTD probe and Niskin bottle on sediment core-heads

A CTD probe is fastened on the core-head, and logs pressure, temperature, conductivity and fluorometry during the entire downward and upward operation through the water column. The CTD probe is from RBR Limited, labeled XR620. Its data can be read with the Ruskin Software available on the company's website. The probe can be deployed on the Calypso or Casq core-heads (Figure 6), but also on the multi-corer.

A 1.7 L Niskin bottle is also fastened on the core-head of Calypso cores (Figure 6). Its closing system has been modified on board to be triggered when the core-head triggers. Consequently, the 1.7 L water sample is taken just above the seafloor. Its water depth can be calculated in this way:

Water depth of the Niskin sample = Site Depth - Free fall height - Pipe length – 1.5 meter

2.3.3 Types of collected discrete water samples

Different types of water samples have been collected for specific measurements during AMARYLLIS-AMAGAS II:

- In parallel to direct measurements of water stable isotopes performed on board (section 2.7.2, page 42), water samples have been taken from the CTD-palanquée Niskin bottles and the 1.7 L Calypso Niskin bottle for **on land δ^{18}O and δ^{13}C measurements at LOCEAN** (C. Waelbroeck, Paris, France). NB: 50 µL of $HgCl_2$ have been added in water samples taken for δ^{13}C measurements.
- Water samples have been taken from the CTD-palanquée Niskin bottles and the 1.7 L Calypso Niskin bottle for **on land Δ^{14}C measurements at LSCE** (F. Thil, Gif sur Yvette, France). NB: 1000 µL of $HgCl_2$ have been added in water samples taken for Δ^{14}C measurements.
- Water samples have been taken from the CTD-palanquée Niskin bottles exclusively for **on land analysis of nutrients** at IMAGO (UAR 191, IRD Brest).
- Water samples have been taken from the CTD-palanquée Niskin bottles exclusively for the **onboard analysis of fluorescence** (section 2.7.3, page 43).
- Water samples have been taken from the CTD-palanquée Niskin bottles exclusively for **on land measurements of polycyclic aromatic hydrocarbon (PAH) and trace elements at MARBEC** (M. Couapel, Sète, France).
- Water samples have been taken from the CTD-palanquée Niskin bottles exclusively for **on land δ^{18}O measurements at MARBEC** (M. Couapel, Sète, France).

2.4 Procedure for collecting modern mineral dust samples

Two systems operated in parallel and continuously (with the exception of the Brazilian frontier zone) in order to sample mineral dust during the two legs of the AMARYLLIS-AMAGAS cruise: a high-volume pumping system (*Enerfluid HO HSING RB30* pump; flow rate of around 75 m^3/h) and a low-volume pumping (*KNF N816KN.29 DC-B* pump; flow rate of approximately 14 l/min).

These two pumps, connected to an electrical box, were located in the "aerosol room", at the front of the ship, under the “weather mast” (Figure 14).

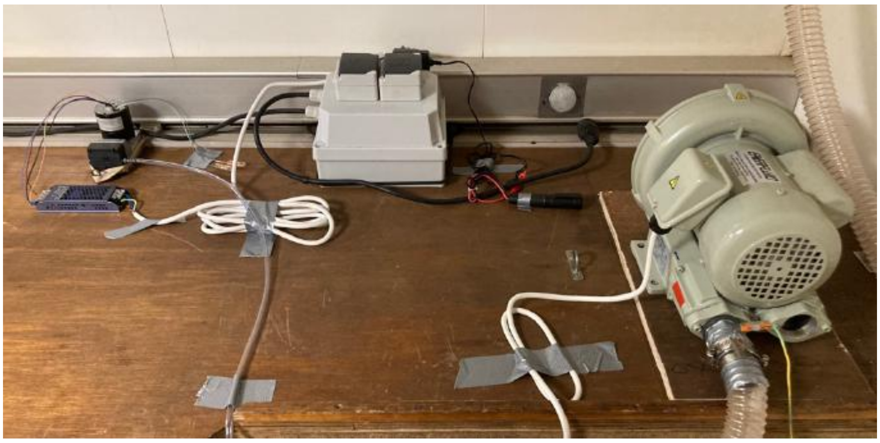


Figure 14: Electrical box installation and overview of the system in the aerosol room.

Each of the two pumps was connected by pipe to a sampling head installed on the railings of the weather mast (Figure 15).

The sampling head associated with the high-volume pump is rectangular. It allows to install a Whatman™ 41 filter paper measuring 20.3 x 25.4 cm. The small head is protected from the rain by a rigid pipe and can hold a circular Whatman™ Nucleopore™ (Track-Etch Membrane) filter with a diameter of 47 mm (porosity of 0.4 µm).

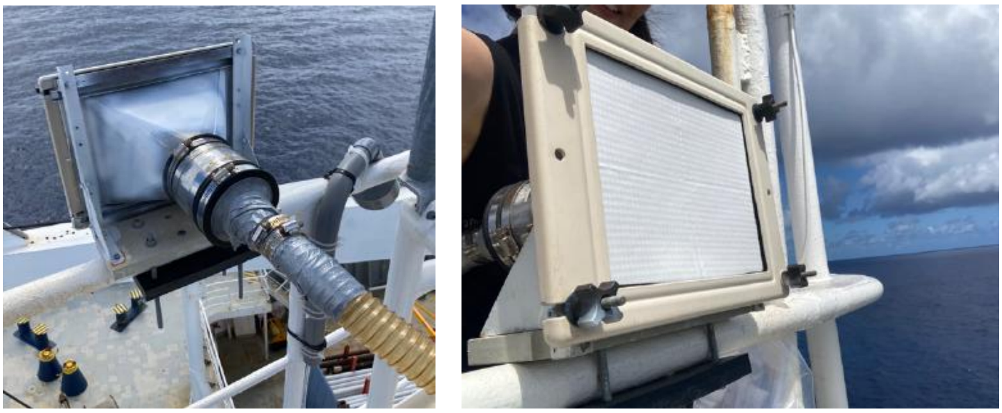


Figure 15: Installation of the two sampling heads on the railings of the weather mast.

Pumping takes place continuously. The filters were changed daily. However, when the weather did not allow it or when few amounts of aerosols were detected, the change of filter was done every two days. In addition, a wind vane was connected to the low-volume pumping system in order to stop it when the wind came from astern in order to avoid a potential contamination by particles emitted by the ship's funnels (Figure 16).

Figure 16: Vane connected to the low volume pumping system.

These “measurements-stop” phases are recorded by a data logger (Figure 17) in order to be able to later recalculate the precise duration of the pumping periods and estimate fluxes. Once collected, the filters are referenced and stored in the thermostatically controlled laboratory (Figure 18).

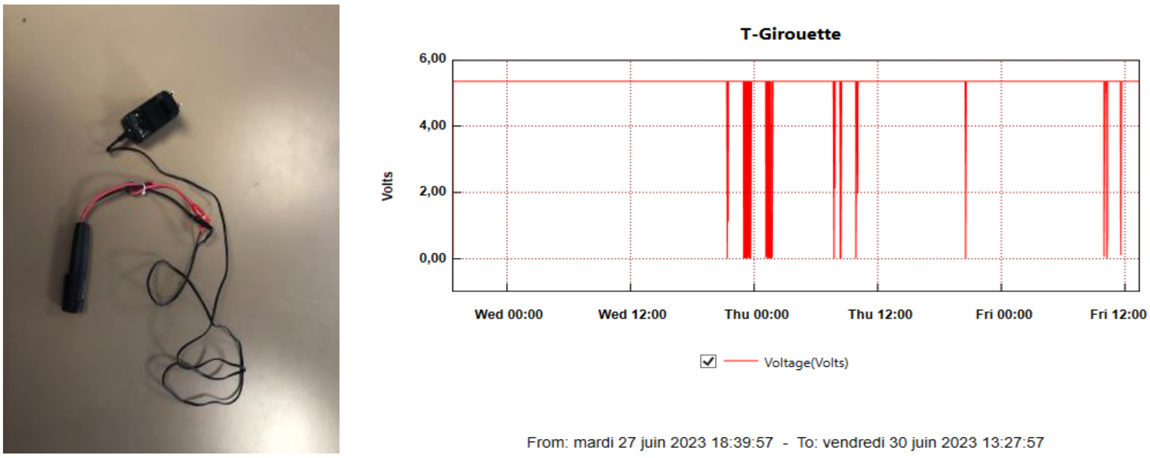


Figure 17: System for recording pump shutdown phases and example of measurements.

Figure 18: Packaging of filters in the thermostated room.

2.5 Processing Calypso, Casq cores and multicores on board

2.5.1 Calypso cores

When the core is secured on the deck of the ship, the core catcher is unscrewed. The sediment contained in the Calypso core catcher is collected with 3 cut syringes, which are labeled with the core name and the term “core catcher”.

With the help of the crew, the liner is removed from the metallic pipe and the height to which the liner is filled with sediment is determined. A broom stick is used to measure where the “free” piston is located within the liner. The top of the sediment is then inferred accounting for the length of the piston and styrofoam. The reference line along the core must be facing upwards before the core is labelled and then cut into 1.5 m sections. A pipe cutter is used to cut the liner at the top of the sediment. As the sediment is likely to be water-rich, the first labelled endcap for the top (0 cm) of the core must be ready. The length of the core is measured and noted on the description template.

After the surface of the liner has been well cleaned and dried, a mark is drawn every 1.5 m. This mark denotes the section limits, and is a guideline for cutting the liner. Each 1.5 m section is labelled on both sides with:

- the core’s number
- section number in roman numbers (I is the first one at the top of the core)
- A for “Archive” or W for “Work” (circled), (W corresponds to the water side of the whole core when placed on deck)
- T x (= Top x cm) and B y (= Bottom y cm).

The labels should be written far enough away from the section limits so that they are not covered by the caps or the tape. Figure 19 illustrates the labelling.

Caps are secured at each section end with heavy duty tape.

Each section is split into two halves, the working and archive halves, with the cut made along the reference line, the archive half on top. After splitting the liner, each cap is cut along the diameter line using a vibrating saw. The sediment from the two halves is separated by passing a fishing line between the two halves of the liner. The archive half of the cores that will be stored in France is packed immediately, while the archive half of the cores that will be stored in Brazil is sampled with a u-channel and packed. The sediment surface of the working half is carefully cleaned with a spatula. The working half is first sent to the sedimentological lab for photographs and sediment description. It is then covered with a plastic film for spectrophotometry (reflectance), X-ray fluorescence (XRF) and optically-stimulated luminescence (OSL) measurements. It is then sent to the Multi-Sensor Core Logger (MSCL) container for geophysical measurements, and finally packed.

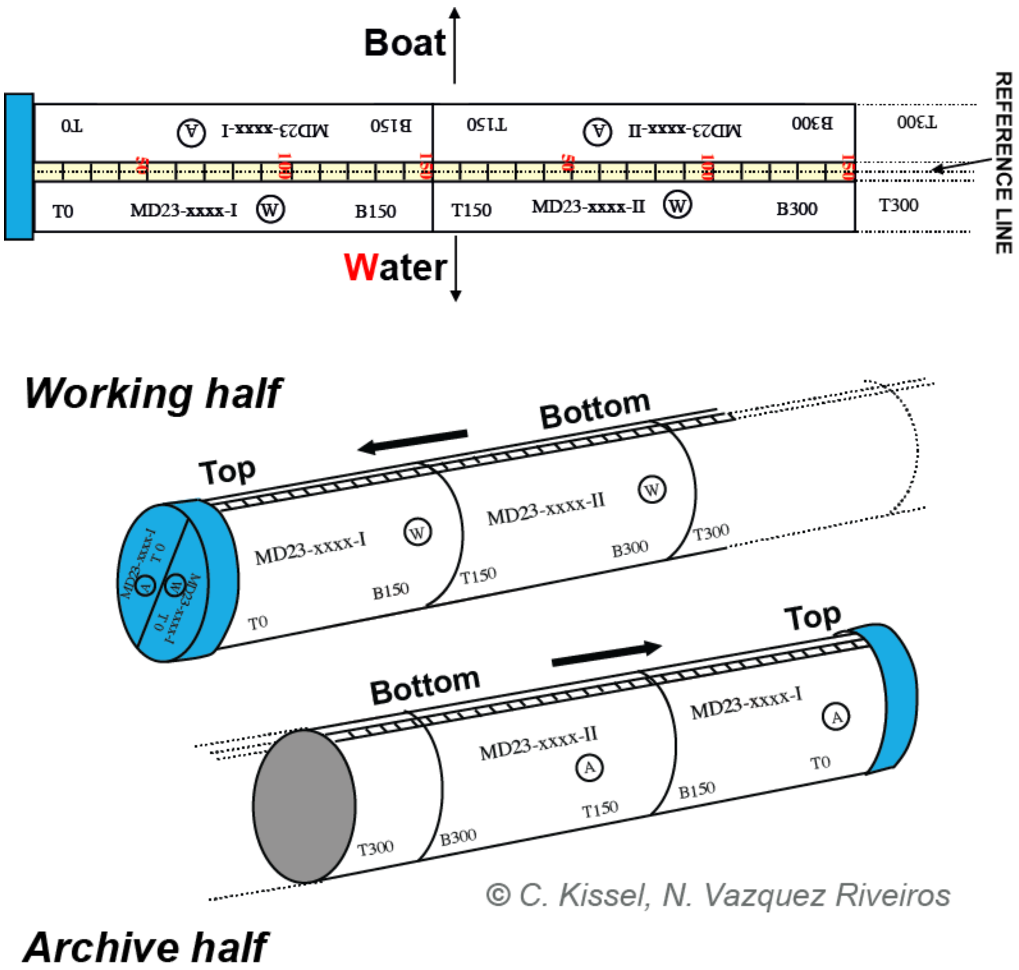


Figure 19: Sketch of the labelling of Calypso cores.

The packing consists in covering the section with plastic film, then inserting the section into a long plastic slipcase to be taped at both ends. The section is then placed inside a rectangular case called D-tube. The D-tubes are labelled with the core name, section number, in the same way as the core itself (Figure 13). In addition, T x cm and B y cm is written on the rectangular case and on each cap as appropriate (Figure 20). The section is inserted so that the top of the core is at the T end of the D-tube and the bottom of the section is at the B end. Both archive and working halves are stored facing upwards in refrigerated containers.

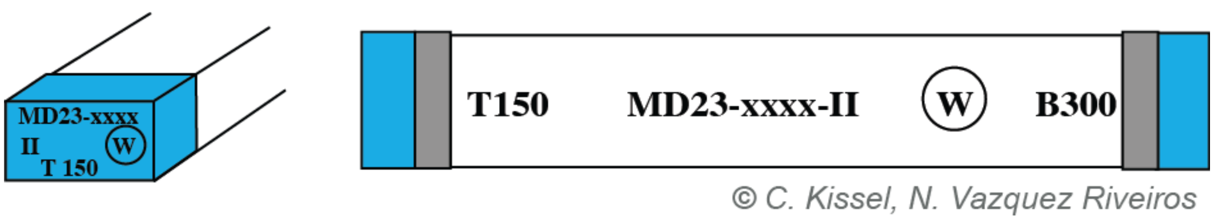


Figure 20: Labelling of the rectangular D-tubes before they are stored in one of the refrigerated containers.

2.5.2 Casq cores

The lid of the corer is unbolted by the crew. The surface of the sediment is cleaned and flattened. The length of the core is measured and noted on the description form.

Rectangular cases (called “goulottes”), previously cut on one side are pushed into the sediments, two or three rows at a time (Figure 21). The first sampling layer of the Casq contains two rows of large 12-cm wide “goulottes” labelled as A and B (Figure 21). The second Casq sampling layer contains two rows of narrow 6-cm wide “goulottes” labelled as C and D, separated by two lines of u-channels taken in the central part of the core (Figure 21). The third Casq sampling layer contains three rows of narrow 6-cm wide “goulottes” labelled as E, F and G (Figure 21). Rows A, B, C, D, E, F and u-channels are taken for scientific investigations, while row G is dedicated to public outreach.

Within each Casq sampling layer, the first section of one row (e.g. A for the first sampling layer) is usually 150 cm long, while the first section of the other row (e.g. B for the first sampling layer) is only 100 cm (Figure 21). With this section limits, sediment cuts in both sets are shifted one from another, which ensures a continuous sampling of the Casq core occurs, with no sediment loss at section’s transitions.

Each collected Casq section is labelled with:

- the core number + Q (for Casq);
- the section number + A, B or C… depending on the row;
- T x cm and B y cm.

After the rows of “goulottes” are pushed into the sediment for a given Casq sampling layer, the corer is rotated 90° sideways. A mark is made every 50 cm on the metallic frame of the corer to keep a record of the length for the next rows of “goulottes”. A fishing line is passed under each “goulotte” to cut the sediment, and each rectangular “goulotte” is removed from the core.

Rows A and B are immediately packed and stored. The u-channels are immediately packed and stored. The narrow 6-cm wide row C is then sent to photography, sediment description, spectrophotometry, XRF, OSL and MSCL measurements, and then packed. Other rows D, E, F and G are also packed and stored.

The packing of Casq sections consists in covering each section with plastic film and placing a lid on top. The entire rectangular case is then placed into a long plastic slipcase and the caps (also labelled) are placed at each side and taped.

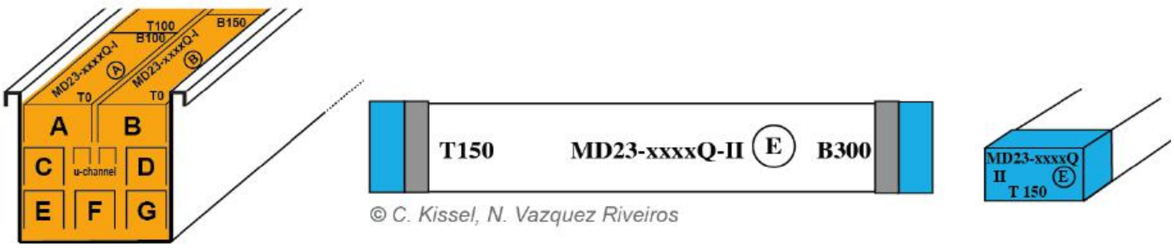


Figure 21: Sampling and labeling scheme of the Casq cores.

2.5.3 Multi-cores

Once the multi-corer is on deck, the overlying water of one of the tubes is sampled for on-board fluorescence analysis and on land PAH and trace element analyses (section 2.3.3). After that, the tubes are labelled as A (meant for analyses on foraminifera), B (meant for analyses on inorganic geochemistry), C (meant for analyses on organic geochemistry) and D (meant for analyses on pollen), from the longest to the shortest sedimentary sequence. The four tubes are transported to the lab and sampled every 1 cm with the help of extruders. Samples are accommodated in labelled plastic Petri-dishes with lid and taped with electric tape. The labels include:

- core number + MC (for multi-core);
- letter of the tube (A-D);
- sample depth range in cm (e.g., "29-30" for the sample collected between 29 and 30 cm core depth).

All petri-dishes from a same tube are placed in labelled bags (core number + MC and the letter of the tube) and stored at 4°C.

The upper 10 cm of tube A (meant for analyses on foraminifera), however, were sampled differently. These samples were placed in labelled 400 ml plastic jars with lid containing 250 ml of a solution of Bengal Rose and ethanol (2 g of Rose Bengal in 1 L of ethanol 70%). After putting the sediment sample into the solution, the jar is closed and shaken to mix the sediment and the solution. Labelling of the plastic jars follows the same scheme adopted for the Petri-dishes. Jars were also stored a 4°C.

2.6 On board measurements on Calypso and Casq cores

2.6.1 Photography of split open core sections

High-resolution digital photos of each core section were obtained with a Leaf Aptus-II 12 digital back equipped with a CCD sensor (53.7 * 40.3 mm) of 10320*7752 pixels. The back is mounted on a Phaseone Mamiya 645 AFD case III equipped with an 80 mm Phaseone camera lens. Lighting consisted on two Bowens Quad X heads.

Each section is photographed in one shot to obtain a 9430*850 pixels photograph (pixel size ~ 150 µm * 150 µm). For each core, figures grouping 15 sections are produced (e.g., Figure 34).

2.6.2 Visual core description

The visual core description was carried out on board on the working halves of Calypso cores and one of the narrow rows of Casq cores. The core description serves to summarize the most important sediment features, in particular to identify sediment structures, such as unconformities, discontinuities, turbidites and bioturbation.

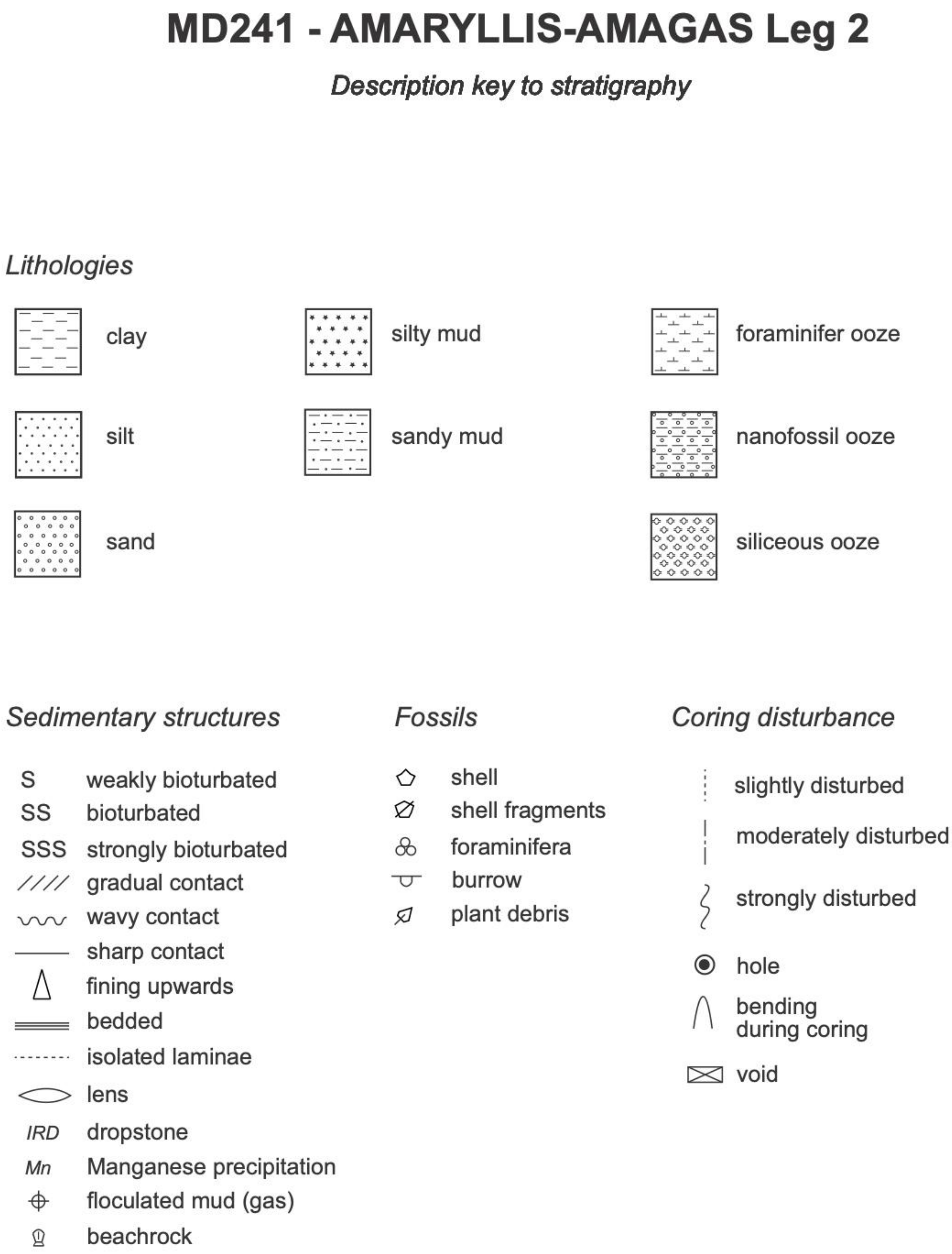


Figure 22: Sediment description legend used during AMARYLLIS-AMAGAS II.

Each visual core description is complemented by the on-board measurements of physical properties (i.e. density, spectrophotometry, magnetic susceptibility) and geochemical analyses (X-ray fluorescence and optically-stimulated luminescence).

2.6.3 The Multi Sensor Core Logger (MSCL) for geophysical properties

During AMARYLLIS-AMAGAS II, we used the Multiple Sections – Split Cores – Core Pusher – Short Belt version owned by GENAVIR. This enables a number of geophysical measurements to be made on horizontally split sediment cores encased in cylindrical plastic core liners as well as a scan of the sediment. This system is designed to be operated under computer control using two softwares, one for the geophysical parameters and one for the scan camera. Unfortunately, a scan camera mounted on the MSCL core logger was not available during the cruise.

The sensors of the Multi Sensor Core Logger include:

Ultrasonic Transducers to measure the velocity of compressional waves in the core.

- A Gamma Ray Source and Detector for measuring the attenuation of gamma rays through the core (providing density/porosity values).
- A Magnetic Susceptibility Sensor to determine the amount of magnetically susceptible material present in the sediments.
- Core Diameter: The diameter of the core is measured using a pair of displacement transducers connected to the spring-loaded compressional wave transducers. This enables the calculation of compressional wave velocity and density (from the gamma ray attenuation measurements) allowing for changes in core diameter.
- Temperature: A platinum resistance thermometer (PRT) is included. The data is logged and can be used to correct for temperature changes that may occur during the logging process. It should be used particularly to make corrections to the P-wave velocity.

The method and sensor calibration are described below.

- Gamma density

A gamma ray source and detector are mounted across the core on a sensor stand that aligns them with the centre of the core. A narrow beam of gamma rays (5 mm diameter) is emitted from a Cs-137 source with energies principally of 0.662 Mev. These gamma rays pass through the core and are detected on the other side. The small Cs capsule is securely housed inside a 150 mm diameter lead filled casing. The gamma ray detector comprises a scintillator and integral photo multiplier tube. The tube also contains the internal voltage supply and electronics to window the primary gamma rays. Pulses from the detector unit are sent continuously to a counter board in the main electronics rack. The count period and count rate are determined through the software control and internal microprocessor.

The basic equation used for calculating bulk density is:

$$\rho = (1/\mu * d) * \ln (I_0/I)$$

where: ρ = sediment bulk density

μ = the Compton attenuation coefficient

d = the sediment thickness

I_0 = the gamma source intensity

I = the measured intensity through the sample

Beam spreading attenuation through the liner or the effect of water has a significantly different attenuation coefficient for sediment minerals. Calibration of the system using both the liner in which the core is contained and the fluid which the sediment contains is essential. For example, when using a split core, the calibration should be done with pieces of aluminium of varying thickness surrounded completely by water in a sealed liner. Gamma counts should be taken through the calibration sample for different aluminium thickness and plotted as a graph of average ρ*d versus ln I, where ln I is the natural log of the measured intensity counts per second and ρ*d is the average density * thickness of the aluminium and water.

The resulting graph may deviate from the theoretical straight line because of the factors cited above. To accommodate this, the following second order polynomial equation can be fitted to the graph:

$Y = AX^2 + BX + C$, where $X = \rho * d$ and $y = \ln I$

During AMARYLLIS-AMAGAS II: A = 0.0048, B = -0.1235 and C = 10.1528

The counting time for gamma attenuation is 10 seconds.

Porosity can be calculated directly from sediment density providing that the following parameters are known or can be assumed:

1) the sediment is fully saturated

2) mineral grain density (MGD) = 2.75

3) fluid density (WD) = 1.026

The fractional porosity is then given by: $FP = (MGD - \rho) / (MGD - WD)$

- <u>Pwave Velocity System</u>

Oil filled Acoustic Rolling Contact transducers are used. The active element is a piezo-electric crystal. The upper P-wave Velocity Transducer (PWT) is lowered and raised by the motor. When logging split cores, the upper PWT is lowered onto the split core surface to take a measurement and raised prior to the core moving to the next increment along the track. A short P-wave pulse is produced at the transmitter. This pulse propagates through the core and is detected by the receiver. Pulse timing circuitry is used to measure the travel time of the pulse with a resolution of 50 ns. After calibration, the P-wave velocity can be calculated with a resolution of approximately 1.5 m/s. The accuracy of the measurements largely depends on variations in sediment or liner thickness. For horizontally split cores, it is necessary for the upper PWT to be lowered onto the split surface for each measurement increment. To avoid any contamination along the core in soft sediments, the split surface is covered with a layer of thin plastic film. A few drops of water spread along the surface of this film will provide acoustic contact, if necessary.

- <u>Core Thickness Measurements</u>

The core thickness corresponds to the distance between the active faces of the two PWT. It is measured by mounting a rectilinear displacement transducer on each of the PWT mountings. Each displacement transducer precisely follows the movement of each PWT. In practice the core thickness is measured with reference to a known thickness and the deviation from that reference is recorded.

- Magnetic Susceptibility

The Bartington point sensor is mounted in such a way that no magnetic or metallic component comes close to the sensor. An oscillator circuit in the sensor produces a low intensity alternating magnetic field. Any material with magnetic susceptibility in the near vicinity of the sensor will cause a change in the oscillator's frequency. The electronics convert this pulsed frequency information into magnetic susceptibility values. This system is calibrated absolutely. A calibration sample is provided, only to check the long-term consistency of the calibration.

During AMARYLLIS-AMAGAS II, magnetic susceptibility, P-wave velocity and gamma density have been measured on split half-sections of Calypso cores. The u-shape of Casq sections prevents an accurate measurement of P-wave velocity and gamma density on Casq sections. Thus, only magnetic susceptibility could be measured here on all Casq core sections.

2.6.4 Spectrophotometry

The reflectance of sediments was determined on each Casq and Calypso core section at 1 cm resolution using a portable Konica Minolta CM-700d spectrophotometer equipped with a MAV aperture of 8 mm diameter. After zero and white calibration, data was acquired on split half-sections covered with a thin plastic film by manually displacing the spectrophotometer by 1 cm steps from top to bottom. Data from each section was recovered using the SpectraMagic NX software and comprised bulk measurements every 10 nm from 360 to 740 nm and calculated parameters: L*(D65), a*(D65), b*(D65), C*(D65), L99(D65), A99(D65), B99(D65), C99(D65), H99(D65). L* is the lightness variable ranging from 0% to 100%, a* is the green (negative) to red (positive) variable and b* is the blue (negative) to yellow (positive) variable (Debret et al., 2011). Results acquired on each section were saved as a .mes file. They were also copied into an Excel file (one file per core, one sheet per section), with section depth indicated for each measurement.

2.6.5 X-ray fluorescence (XRF) spectrometry

Measurements of X-ray fluorescence (XRF) spectrometry were made on every Casq (section C) and Calypso cores at 4 cm resolution using an Olympus DELTA Handheld XRF Analyzer Model DPO-2000-XX. Before analysis, the exposed sediment surface was covered with plastic film to avoid damaging the detector during the readings. The scanner was then manually positioned on a stand that allows measurements to be done with the detection window in direct contact with the plastic film. Scans were performed using Beam 3 (30 s at 15 keV) in the Soil mode configuration. Calibration checks were performed using a 316-alloy standard following operational procedures required by the manufacturer. Daily tests using a NIST certified reference material (NIST 2710a) were used to check for drifts in the scanner performance. The results were exported daily, with raw files saved as .csv. Those results were then compiled in an excel file (one file per core) with sections and core depth indicated for each measurement.

2.6.6 Optically-Stimulated Luminescence (OSL) sensitivity

The Optically Stimulated Luminescence (OSL) sensitivity was measured exclusively in Calypso cores MD23-3653, MD23-3656, MD23-3664, MD23-3667, MD23-3671, MD23-3674, and MD23-3678. These measurements were conducted under subdued lighting, within a dark tent illuminated by red LED lights. Initially, a thin layer of sediments (less than 1 mm) was delicately removed from the section's surface to eliminate any sediments previously exposed to light. Subsequently, half-sections were covered with a thin plastic film. The luminescence measurements were performed using a luminescence scanner that is being developed at the Federal University of São Paulo, in 5 and 10 cm resolution. Both blue (B) and infra-red (IR) LEDs were used to stimulate the samples for 40 s per each light type. A photomultiplier was utilized to measure the emitted photons. The software employed is also under development, and enables control of the movements of the scanner and measurement settings.

Optically Stimulated Luminescence using blue light stimulation (BOSL) signal expresses the ratio between the sum of the first second over the sum of the entire curve. BOSL was determined by quantifying the proportion of the signal corresponding to the initial one-second segment of the decay curve acquired through blue light stimulation. Luminescence sensitivity has been successfully utilized as a tracer for the source of quartz grains, and in marine sediment cores of northeastern Brazil, it has been employed as a precipitation proxy.

2.7 On board measurements on water samples

2.7.1 Thermosalinograph

The SBE21 Thermosalinograph (Figure 23), manufactured by Sea-Bird Scientific, is a device used to measure and record seawater temperature and salinity. The instrument operates by passing seawater through a temperature sensor and a conductivity cell to calculate temperature and salinity values and stores measurements with timestamps for analysis.

Figure 23: SBE21 Thermosalinograph installed in the lab 5033 on the R/V Marion Dufresne*.*

The procedure to merge the data from SBE21 S/N 2116432-2500 installed in the lab 5033 in the R/V Marion Dufresne during AMARILLYS-AMAGAS II cruise with

SHIPNAV data is explained here. A small Python script was used to resample the SHPNAV data (Latitude, Longitude, time) and the SBE21 data (conductivity, temperature, and salinity) into 10-second intervals using median values. The purpose was to align the data since the navigation recording rate is approximately 1 second, while the SBE21 records every 6 seconds. No additional data filtering was applied. The resulting dataset was saved as a text file and integrated into Ocean Data View (ODV) following the GOSUD (Global Ocean Surface Underway Data) standard.

2.7.2 Water stable isotope measurements (PICARRO)

Water isotopic composition ($^{18}O/^{16}O$ and D/H ratios, expressed as $\delta^{18}O$ and δD, in per mil) was measured shipboard using Cavity Ring Down Spectroscopy (CRDS) [Picarro L2120] coupled to a Continuous Water Sampling module (CWS, Picarro) which converts the sea water input flow into water vapor (Figure 24).

The CRDS system was set to sample surface water from the Marion Dufresne's underway seawater system (collected under the hull, at ~ 5.5 m depth). The system was installed downstream of the thermosalinograph, in order to make sure that the measured sea water isotopes can be consistently related to the Salinity and Temperature data provided by the thermosalinograph. The system produces measurements every 6 seconds.

Drift-monitoring is achieved by measuring mineral water used as a home standard, for 20 min every 5 h. To do so, 1 L foil bag were filled with mineral water and used for 5 days in a row. Discrete samples were collected at the beginning and end of each foil bag in order to check that its isotopic value remains constant during its entire use.

Additionally, discrete sea water samples were collected from the same sea water intake as the that of the thermosalinograph, as well as from Niskin bottles and surface water buckets. All discrete samples will be analyzed by CRDS on land in the LOCEAN research institute (Paris, France) where different home standards bracketing the sample's isotopic values will be used to determine their value in the VSMOW scale. This way, the continuous shipboard measurements will be normalized to the VSMOW scale.

The underway data normalized to the VSMOW scale will be merged with the Marion Dufresne's underway data (salinity, temperature, GPS position) once the lab-based reference measurements are complete.

Figure 24: Installation of CRDS system onboard the Marion Dufresne. Components of the instrument are: (1) flow from underway seawater supply into filtering system, (2) double filtering system with primary filters of 25 µm and secondary filters of 2 µm allowing for filter change without interruption of the flow, (3) reservoir of flowing filtered sea water from which sea water is pumped into the continuous water sampling module (CWS) yielding stable input water pressure, (4) exit of the flowing filtered sea water reservoir, (5) home standard foil bag, (6) CWS, (7) Picarro CRDS analyzer L2120i, (8) vacuum pump, (9) user interface.

2.7.3 Fluorescence measurements (Trilogy)

Fluorescence is widely used in ocean studies for assessing phytoplankton biomass and productivity, estimating photosynthetic efficiency, and monitoring various compounds in water. Additionally, fluorescence enables the investigation of organic matter dynamics, offering insights into carbon cycling. By leveraging fluorescence properties in conjunction with water mass characterization, valuable insights can be obtained regarding the functioning and changes of marine ecosystems, ultimately allowing for the assessment of the ocean's role in the Earth's climate system.

Fluorescence in surface (continuous flow) and discrete depths (bottle samples from CTD casts in “palanquée” mode) was measured during AMARILLYS-AMAGAS II, using a benchtop Fluorometer, model Trilogy (Turner Designs) equipped with (1) a turbidity (IR) module, (2) CDOM/FDOM (UV) module, (3) a Chlorophyll in-vivo Module, and (4) a RWT/PE Green module.

Discrete samples were collected from the continuous flow system installed in the lab 5503 onboard R/V Marion Dufresne, with seawater intake at 6 m depth and flow rate averaging 62 L/min. The flow rate was monitored during the whole campaign and archived with the ship’s position and Temperature/Salinity sensor SBE 21 SeaCAT Thermosalinograph.

Fluorescence was also digitally measured in CTD casts using a Wetlabs ECO-FI fluorometer attached to the SBE 911plus CTD and a Seapoint Auto ranging fluorometer attached to a RBR XR-620 in Casq-Probe profiling. Although the fluorimeters described above have different optical characteristics, especially those used in CTD casts, the A/D data was converted to RFU (Relative Fluorescence Units) to enable comparison, assuming deep conditions below 1000 m as zero fluorescence, and in the case of Trilogy, using filtered seawater as blank.

2.8 Processing of CTD data

This section describes the deployment settings and processing procedure of the CTD profiling from AMARYLLIS-AMAGAS II based on two types of profiling: (1) Casq CTD, conducted using an RBR XR-620 mounted on the Casq core-head, and (2) SBE CTD, a Seabird 911plus model with two sets of CTO (Conductivity, Temperature, and Oxygen) and a Wet Labs ECO/AFL fluorometer. Table 7 summarizes the output of data from the 2 CTDs for comparison. After processing, removal of bad scans, and application of filters to eliminate noise and spikes, the data was merged into a single dataset using Ocean Data View software (ODV version 5.6.2) for graphical profile generation and interpretation.

Table 7: Comparative output configuration for Casq (RBR CTD) and SBE CTD data. Data marked in bold is used for ODV import.

Casq (RBR CTD)	Seabird 911+ CTD	Comment
Cruise		Metadata
Station		Metadata
Type		Metadata
	Scan Count	
yyyy-mm-ddThh:mm:ss.sss		
	Julian Days	
Longitude [degrees_east]		Metadata
Latitude [degrees_north]		Metadata
Bot. Depth [m]		Metadata
Depth [m]	**Depth [salt water, m]**	
Cond [mS/cm]	Conductivity [mS/cm]	Primary sensor
Temp [Degrees_C]	**Temperature [ITS-90, deg C]**	Primary sensor
Pres [deciBars]	**Pressure, Digiquartz [db]**	Primary sensor
FIC-a [ug/l]	**Fluorescence WET Labs ECO-AFL/FL [mg/m3]**	
	AD Voltage 2	despiking
Salin [PSU]	**Salinity, Pratical [PSU]**	
	Oxygen, SBE 43 [ml/l]	Primary sensor
	Oxygen, SBE 43 [% saturation]	Primary sensor
SpecCond [uS/cm]	Specific Conductance [uS/cm]	Primary sensor
DensAnom [n/a]		
SoS (UN) [m/s]		

	Conductivity, 2 [mS/cm]	Secondary sensor
	Temperature, 2 [ITS-90, deg C]	Secondary sensor
	Salinity, Practical 2 [PSU]	Secondary sensor
	Oxygen, SBE 43 2 [ml/l]	Secondary sensor
	Oxygen, SBE 43 2 [% saturation]	Secondary sensor

2.8.1 Sampling depth in case of CTD “palanquée” deployments

The difficulty in CTD “palanquée” deployment lies in determining the exact depth of each bottle, as even in calm sea conditions, deep currents introduce an angle to the cable, causing the bottles to be positioned incorrectly (Figure 25). Only the cable lengths were provided to the winch and deck operator for positioning each bottle. This procedure was carried out with the CTD operating and profiling. A Python script identifies these stop-go intervals and accurately calculates the delta-Z (the distance between each bottle) in the water column, subsequently generating a BTL file that contains the 1-meter moving average over the bottle depth.

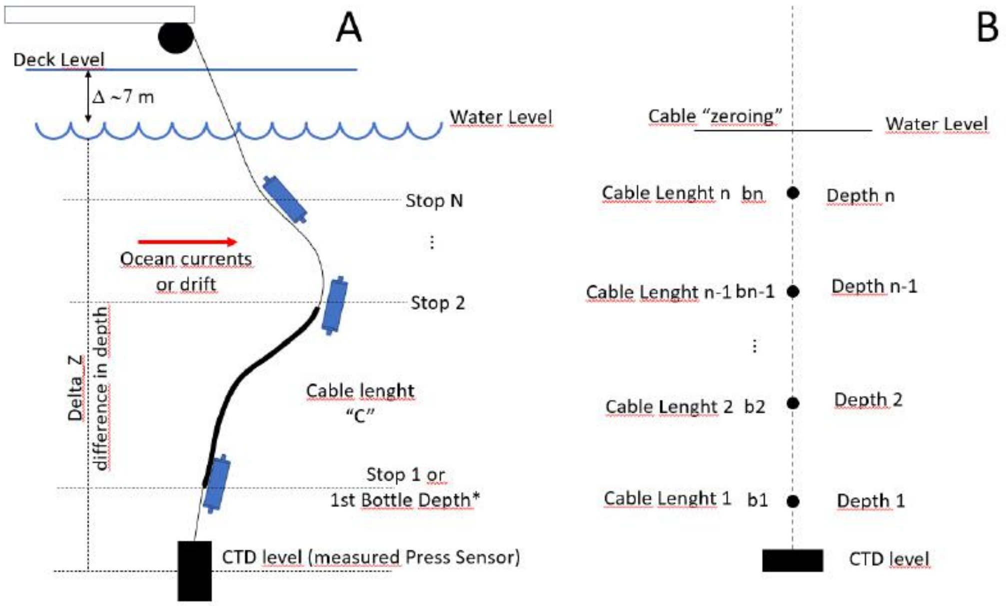


Figure 25: Deployment scheme of the CTD with Niskin bottles attached to the cable. Note that despite controlling the cable length, the actual sampling depths are determined by various factors such as cable tension, drift due to currents, etc. (A). For the deployment operations, only the cable length and the association with each bottle were communicated to the deck operator (B). Please refer to the text for further details.

Although using bottles directly attached to the cable (“palanquée” mode) is a safe procedure, some details interfered with the correct use of the bottles, as listed here:

- Station S10: shallow station, no problems detected.
- Station S11: divided in two casts with only 7 bottles per cast.
- Station S13: strong drifting prevented the trigger of bottle 5, which misfired at surface, triggering other bottles in a different depth as planned. The BTL file was manually corrected.

- Station S16: very strong drifting with a cable angle that prevented the positioning of the bottles. After switching the ship's position into controlled drift, the shallow cast was performed with the closure of 5 bottles at expected depths. Two bottles misfired in the second (and deepest) cast. The BTL file was manually corrected.

2.8.2 Processing CTD data obtained with "palanquée" deployments

The processing methods described here are based on the SIO-CalCOFi protocol, currently recommended by the Ocean Best Practices group and also used by IFREMER. Essentially, the data processing protocol follows the Seabird's settings for the 911+ v2 CTD unit and deck unity using Seasoft V2.4.0, as per Seabird's technical references with no further correction. Due to a technical issue with the Water Sampler (SBE 32 Pylon), the carousel was used for bottle collection, and the collection workflow has been modified to the classical method of bottles attached to the cable ("palanquée") positioned at predetermined depths and triggered using a messenger. As a result, the standard processing steps for the bottle file (.ROS and .BTL) have been omitted. A separate file containing depths and data for each bottle was constructed based on the analysis of CTD stop-go "stations" during the descent, compared to the cable positions and control of cable length in the water. The data for each bottle was then calculated as the 1-meter moving average over the downcast during the bottle firing process, while the CTD remained at the final depth.

The CTD temperatures obtained are processed by Seasoft without additional corrections applied (Table 8). CTD salinities are verified and compared with Casq-Probes using a salinity standard variogram for depths between 2000 and 2500 meters (in deep stations), where the profile is nearly vertical and displacements are typically very small (<0.001). The oxygen data from the CTD SBE43 were recorded without major corrections, and a "time-lag" analysis may be necessary to calibrate the sensor's response and to set the corrected value for the SBE Align data processing procedure (Table 8, seq. 4). Fluorometer data requires more in-depth analysis due to spikes in the signal. Therefore, voltage data was also recorded along with the quantitative measurements.

IMPORTANT NOTE: No further corrections were made to the profiles, but due to a significant signal drift in all sensors, caution is recommended when using unfiltered data.

To allow future data users to employ different strategies, it was decided to add self-explanatory suffixes to each file name for each processing step. For example, Cell Thermal Mass correction step added _thermal in the output filename, and so on (Figure 25). Most data processing configuration parameters follow the well-known processing standard, focusing only on superficial cleaning, as most CTD data users prefer to use their own programs for applying moving averages, despiking, and aligning sensors.

And finally, the data was exported in ASCII format (ASCII OUT routine in the SBE Data Processing software) and subsequently grouped into 1 m depth moving averages using a python script for insertion into the campaign's ODV database.

Table 8: CTD data processing workflow using standard SBEDataProcessing-Win32 software provided by Seabird.

Seq.	Operation	Observations
1	Data Conversion: To match CON or XMLCON files accordingly	Note: Latitude and Longitude added manually in .hdr and .hex
2	Window Filter: To smooth profiles & reduce spikes (median filter: 9)	Check voltage spikes in Fluorescence
3	Filter: Filter B = 0.15 on Pressure only	
4	Align CTD: Oxygen sensors only (4 seconds).	** **Need to be verified**
5	Cell Thermal Mass: Default settings	
6	ASCII Out: desired variables selected (see table 1 for AMARILLYS cruise specific selection to match CASQ CTD with SBE CTD profiles)	** **Caution**: check output HDR for errors. DatCNV overwrites the existing .hdr files with new .hdr from embedded information
7	Stop-Go check: verification of fired bottle depths	** manually using a python script
8	Loop: clean profile with minimum velocity (fixed=0.25 m/s) and remove surface soak between (5 and 20 m depth)	** Note: a new output in ASCII out is created (with original station name and "_Clean" suffix)

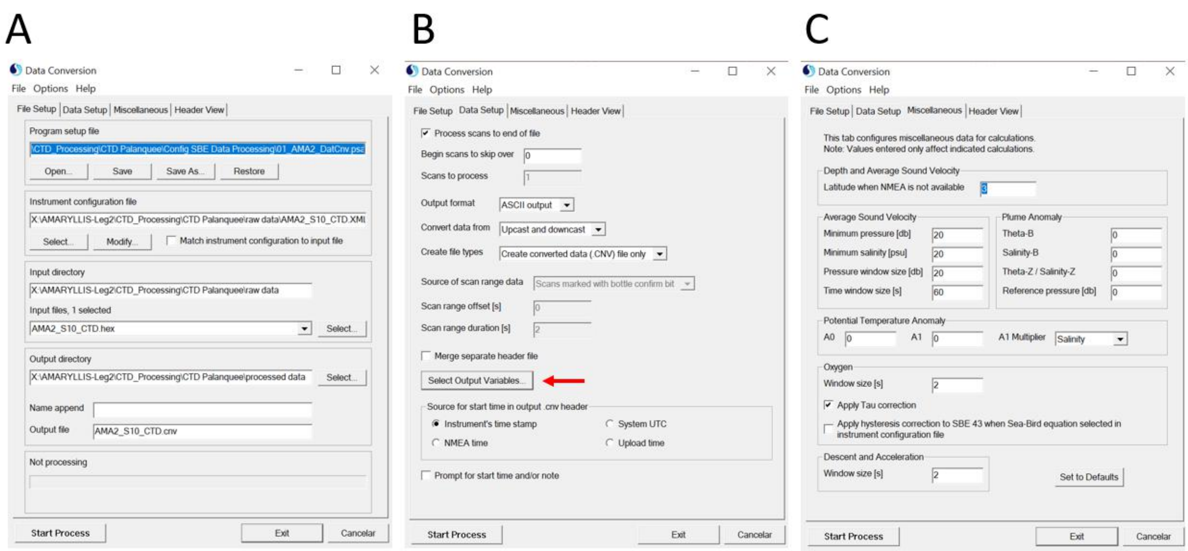


Figure 26: Selected Options used in Data Conversion for the SBE CTD. Note (A) the structure of files in the CTD Processing folder, (B) the converted data for upcast and downcast together using instrument timestamp, and (C) the configuration of window size and miscellaneous data for processing. The red arrow indicates the option to configure selected variables for output.

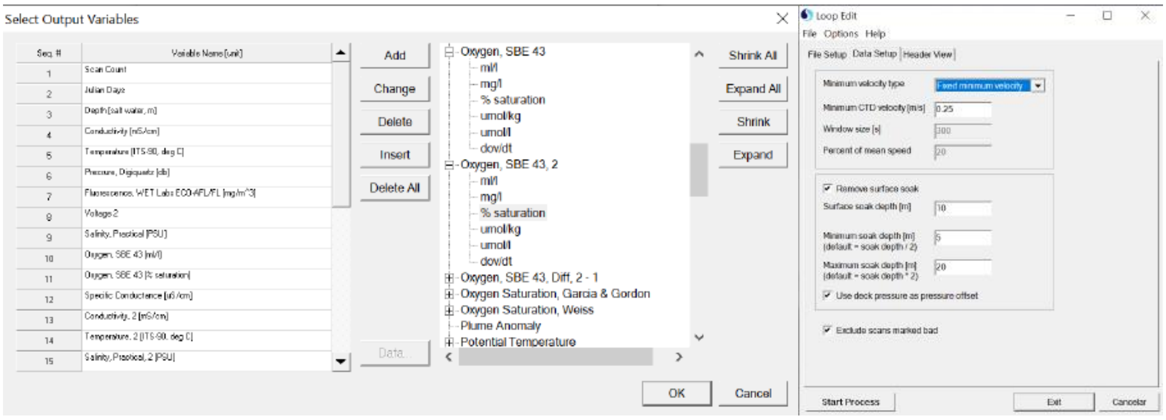


Figure 27: Selected output variables, to match RBR CTD and SBE CTD casts, according to Table 8 and configuration of Loop (step 8 in Table 8), to clean the profile.

2.8.3 Processing and filtering of data obtained with the Casq CTD probe

The RBR XR-620 CTD is an oceanographic measuring instrument used for collecting conductivity, temperature, and pressure data at various depths in the water column and employs a combination of sensors to measure these variables with high resolution and accuracy. The XR-620 used on board is equipped with an additional fluorescence sensor to chlorophyll.

The XR-620 is referred here to as the Casq-Probe, installed on the Casq core-head for profiling during Casq coring. It is important to note that due to the geometry of the Casq and its position, spikes in the signal are expected in the profile, as the Casq disrupts the stable layers during its turbulent descent. Additionally, the upcast is expected to be significantly different from the downcast for the same reason (turbulence), and the descent and ascent speed can interfere with fine-scale stratification patterns that cannot be observed. The data is automatically converted using the instrument's internal calibration and exported into an Excel table. The table is manually adjusted for position (latitude and longitude) and metadata (cruise, station, type) for direct import into ODV. The data processing for cleaning and despiking involves replacing outliers with a 3-meter moving window (over depth), and bad scans are marked with NaN. Cutting off the data when the probe is not in the water is done manually. The final Excel file is then converted to a csv file to import in ODV. The fluorometer of the Casq-Probe sensor exhibited a significant number of spikes. To remove them, a despiking technique based on a 3-meter moving window over the depth data was employed. A Python script was developed for this purpose.

2.8.4 CTD data visualization with Ocean Data View (ODV)

All cleaned and depth-resolved measurements (Casq-Probe and SBE CTD) condensed with a 1 m moving average resolution were imported into Ocean Data View (ODV) following the developed protocol (Schlitzer et al., 2018).

3 CRUISE DESCRIPTION

3.1 Station map

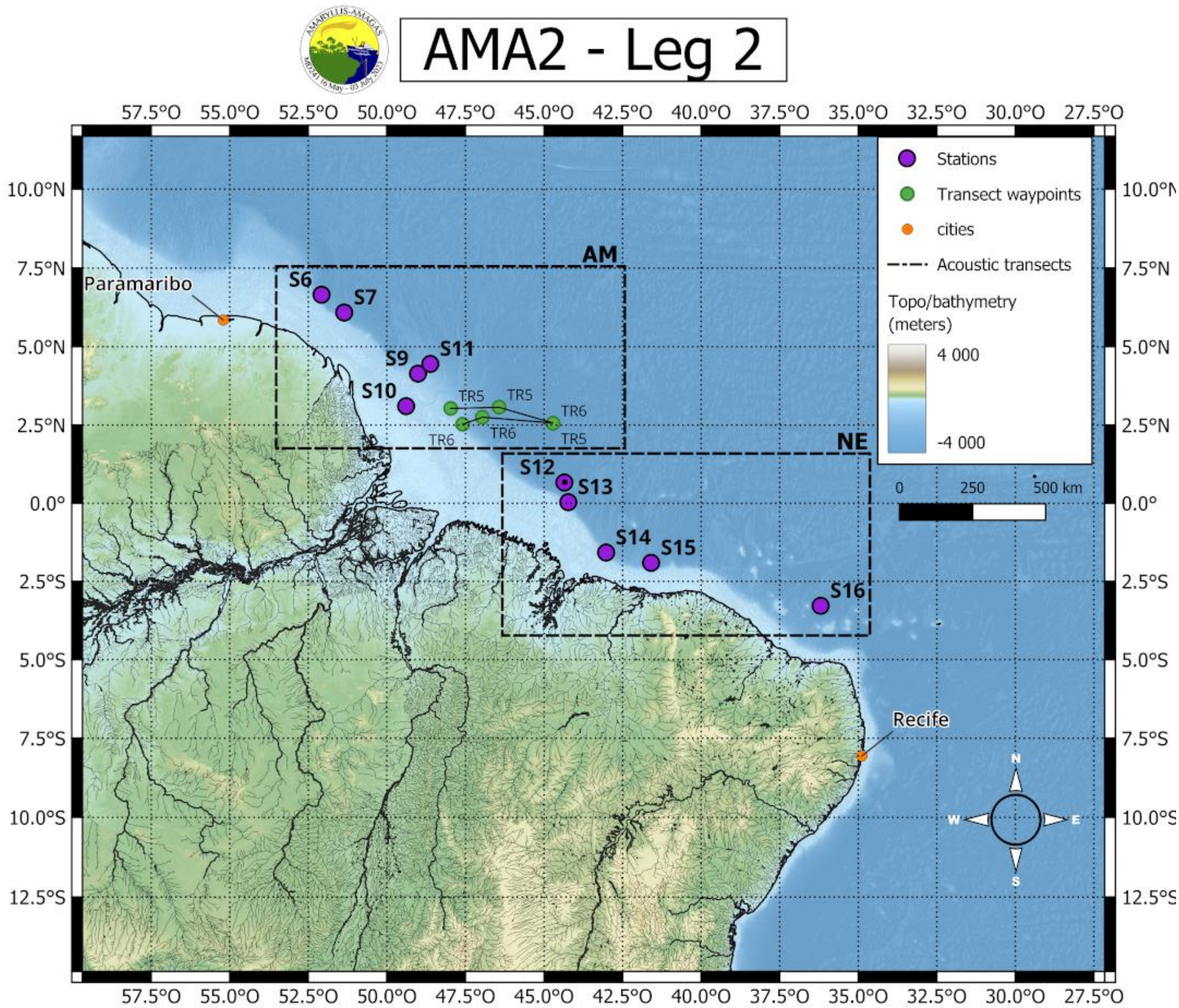


Figure 28: Stations and transects investigated during AMARYLLIS-AMAGAS II. “AM” refers to the Amazon region, and “NE” refers to the NE Brazil region.

3.2 Summary tables

Table 9: Summary table of MD241 AMARYLLIS-AMAGAS II sediment cores. "u-ch" refers to u-channels and "MUC" to multi-core. In this table, coordinates refer to the location of cores provided by the Posidonia ultra-short baseline acoustic positioning system fixed to coring devices.

Station	Device	Core	Latitude	Longitude	Water depth (m)	Core length (m)	Storage at LSCE	Storage at USP
S6	MUC	MD23-3651MC	6°39.373 N	52°04.735 W	2518	0.35	B, C	A, D
S6	Casq	MD23-3652Q	6°39.388 N	52°04.760 W	2518	10.49	A, C, E, u-ch	B, D, F, G
S6	Calypso	MD23-3653	6°39.363 N	52°04.745 W	2518	50.37	u-ch	W, A
S7	MUC	MD23-3654MC	6°05.431 N	51°21.541 W	2278	0.29	B, C	A, D
S7	Casq	MD23-3655Q	6°05.445 N	51°21.569 W	2278	8.62	A, C, E, G, u-ch	B, D, F
S7	Calypso	MD23-3656	6°05.432 N	51°21.560 W	2278	42.24	W, A	
S9	MUC	MD23-3657MC	4°08.600 N	49°00.595 W	695	0.40	B, C	A, D
S9	Casq	MD23-3658Q	4°08.612 N	49°00.576 W	695	9.35	A, C, E, G, u-ch	B, D, F
S10	MUC	MD23-3659MC	3°06.279 N	49°23.276 W	70	0.53	B, C	A, D
S10	Casq	MD23-3660Q	3°06.278 N	49°23.277 W	70	11.14	A, C, E, u-ch	B, D, F, G
S10	Calypso	MD23-3661	3°06.281 N	49°23.277 W	70	23.42	u-ch	W, A
S11	MUC	MD23-3662MC	4°27.215 N	48°37.050 W	1696	0.40	B, C	A, D
S11	Casq	MD23-3663Q	4°27.175 N	48°37.285 W	1696	9.30	A, C, E, u-ch	B, D, F, G
S11	Calypso	MD23-3664	4°27.176 N	48°37.287 W	1696	33.67	u-ch	W, A
S12	MUC	MD23-3665MC	0°39.720 N	44°21.115 W	2343	0.38	B, C	A, D
S12	Casq	MD23-3666Q	0°39.719 N	44°21.106 W	2343	9.4	A, C, E, G, u-ch	B, D, F
S12	Calypso	MD23-3667	0°39.719 N	44°21.116 W	2343	32.4	W, A	
S13	Casq	MD23-3668Q	0°02.019 N	44°13.647 W	1797	0		
S14	MUC	MD23-3669MC	1°34.752 S	43°1.421 W	1365	0.38	B, C	A, D
S14	Casq	MD23-3670Q	1°34.747 S	43°1.452 W	1365	10.49	A, C, E, G, u-ch	B, D, F
S14	Calypso	MD23-3671	1°34.748 S	43°1.452 W	1365	41.88	W, A	
S15	MUC	MD23-3672MC	1°54.501 S	41°35.478 W	2241	0.23	B, C	A, D
S15	Casq	MD23-3673Q	1°54.487 S	41°35.524 W	2241	8.50	A, C, E, u-ch	B, D, F, G
S15	Calypso	MD23-3674	1°54.486 S	41°35.526 W	2241	42.76	u-ch	W, A
S15	Calypso	MD23-3675	1°54.485 S	41°35.520 W	2241	51.33	W, A, u-ch	
S16	Casq	MD23-3676Q	3°16.841 S	36°11.824 W	1804	8.76	A, C, E	B, D, F
S16	Casq	MD23-3677Q	3°14.355 S	36°11.876 W	1988	11.30	A, C, E, G u-ch	B, D, F
S16	Calypso	MD23-3678	3°14.356 S	36°11.874 W	1988	23.72	W, A	

Table 10: Summary table of CTD deployments in "palanquée" mode during MD241 AMARYLLIS-AMAGAS II.

Station	CTD name	Latitude	Longitude	Water depth (m)	Comments	Samples taken for
S10	AMA2-S10-CTD	3°06.272 N	49°23.268 W	70		Water stable isotopes $\Delta^{14}C$ Fluorescence PAH & Trace metals
S11	AMA2-S11-CTD-1	4°27,175 N	48°37,285 W	1700	Upper 0-1700 m layer only	
S11	AMA2-S11-CTD-2	4°27.217 N	48°37.261 W	1695		
S13	AMA2-S13-CTD-1	0°02.587 N	44°10.766 W	700	Upper 0-700 m layer only	
S13	AMA2-S13-CTD-2	0°02.135 N	44°10.607 W	2206		
S16	AMA2-S16-CTD-1	3°17.955 S	36°11.140 W	500	Upper 0-500 m layer only	
S16	AMA2-S16-CTD-2	3°17.801 S	36°11.397 W	1450	Upper 0-1450 m layer only	

Table 11: Summary table of acoustic transects during MD241 AMARYLLIS-AMAGAS II.

Transects	Way points	Latitude	Longitude	Water depth (m)	Comments
TR5	TR5_SoL	3°01.955 N	47°58.015 W	437	**Acoustic acquisition** water column bathymetry seafloor
TR5	TR5_MP1	3°04.390 N	46°25.660 W	3087	
TR5	TR5_EoL	2°33.450 N	44°42.632 W	4061	
TR6	TR6_SoL	2°33.450 N	44°42.632 W	4061	
TR6	TR6_MP1	2°45.062 N	46°57.741 W	2220	
TR6	TR6_EoL	2°31.501 N	47°35.339 W	400	

NB: Methodological details on the acoustic acquisition during transects TR5 and TR6 are given in the cruise report of AMARYLLIS-AMAGAS I (https://doi.org/10.17600/18003361).

3.3 Time log table

Table 12: Summary table of MD241 AMARYLLIS-AMAGAS II daily activities. In this table, coordinates refer to the ship's location and may slightly differ to the ones given in Table 9.

Date [UTC]	Station/ transect	Time [UTC]	Lat. [N]	Long. [W]	WD [m]	Operations description
13/06/2023		02:00				**Departure from Paramaribo, Suriname**
13/06/2023	S6	02:00				Beginning of transit
		20:37				Beginning of survey
		23:55				**Arrival at station S6**
14/06/2023		00:10	6°39.387	52°04.768	2518	At station S6 (MUC)
		00:10				Beginning of operations
		03:57				Triggering
		04:48				**Core MD23-3651MC on deck**
						Recovery: 35 cm
		05:00	6°39.381	52°04.739	2518	At station S6 (Casq)
		05:00				Beginning of operations
		06:53				Ground touched
		08:28				**Core MD23-3652Q on deck**
						Recovery: 10.49 m
		09:30	6°39.362	52°04.746	2519	At station S6 (Calypso)
		09:30				Beginning of operations
		13:09				Triggering
		15:50				**Core MD23-3653 on deck**
						Recovery: 50.37 m
		17:20				**Departure from station S6**
14/06/2023	S7	17:20				Beginning of transit
		23:12				Beginning of survey
15/06/2023		04:36				**Arrival at station S7**
		04:36	6°05.404	51°21.586	2278	At station S7 (MUC)
		06:23				Beginning of operations
		07:33				Triggering
		08:31				**Core MD23-3654MC on deck**
						Recovery: 29 cm
		08:31	6°05.410	51°21.564	2281	At station S7 (Casq)
		08:45				Beginning of operations

		10:55				Ground touched
		12:37				**Core MD23-3655Q on deck**
						Recovery: 8.62 m
		13:30	6°05.431	51°21.560	2278	At station S7 (Calypso)
		13:45				Beginning of operations
		17:07				Triggering
		19:00				**Core MD23-3656 on deck**
						Recovery: 42.24 m
16/06/2023		00:40				**Departure from station S7**
16/06/2023	S9	00:40				Beginning of transit
		14:46				Beginning of survey
		15:43				**Arrival at station S9**
		15:43	4°08.626	49°00.590	695	At station S9 (MUC)
		15:47				Beginning of operations
		16:19				Triggering
		16:40				**Core MD23-3657MC on deck**
						Recovery: 40 cm
		17:15	4°08.612	49°00.577	695	At station S9 (Casq)
		17:15				Beginning of operations
		18:19				Ground touched
		19:20				**Core MD23-3658Q on deck**
						Recovery: 9.35 m
		19:25				**Departure from station S9**
16/06/2023	S10	19:25				Beginning of transit
17/06/2023		03:36				Beginning of survey
		10:50				**Arrival at station S10**
		10:50	3°06.278	49°23.274	77	At station S10 (MUC)
		11:05				Beginning of operations
		11:25				Triggering
		11:45				**Core MD23-3659MC on deck**
						Recovery: 50 cm
		11:45	3°06.281	49°23.277	77	At station S10 (Casq)
		11:45				Beginning of operations
		12:34				Ground touched
		13:20				**Core MD23-3660Q on deck**

						Recovery: 11.14 m
		13:45 13:45 15:26 16:15	3°06.281	49°23.269	77	At station S10 (Calypso) Beginning of operations Triggering **Core MD23-3661 on deck** Recovery: 23.42 m
		16:15 17:50 18:27 18:55	3°06.272	49°23.268	77	At station S10 (CTD) AMA2-S10-CTD-1 in water AMA2-S10-CTD-1 on bottom **AMA2-S10-CTD-1 out of water** Recovery: 5 samples
		19:00				**Departure from station S10**
17/06/2023	S11	19:00 06:44 07:52				Beggining of transit Beginning of survey **Arrival at station S11**
18/06/2023	S11	07:52 08:00 09:09 09:57	4°27.218	48°37.263	1701	At station S11 (MUC) Beginning of operations Triggering **Core MD23-3662MC on deck** Recovery: 41 cm
18/06/2023	S11	10:05 10:05 11:21 12:35	4°27.218	48°37.261	1696	At station S11 (Casq) Beginning of operations Ground touched **Core MD23-3663Q on deck** Recovery: 9.30 m
18/06/2023	S11	13:10 13:48 14:56 15:40	4°27.218	48°37.2615	1696	At station S11 (CTD) AMA2-S11-CTD-1 in water AMA2-S11-CTD-1 on bottom **AMA2-S11-CTD-1 out of water** Recovery: 6 samples
18/06/2023	S11	15:50 15:50 17:52 19:10	4°27.217	48°37.261	1696	At station S11 (Calypso) Beginning of operations Triggering **Core MD23-3664 on deck** Recovery: 33.64 m
18/06/2023	S11	19:10 20:12 22:05	4°27.217	48°37.261	1695	At station S11 (CTD) AMA2-S11-CTD-2 in water AMA2-S11-CTD-2 on bottom

		23:30				**AMA2-S11-CTD-2 out of water**
						Recovery: 7 samples
		23:40				**Departure from station S11**
18/06/2023	TR5 and TR6	23:40				Beginning of transit
19/06/2023		07:45	3°01.955	47°58.015	437	Start of line TR5 (SoL)
		22:58	3°04.390	46°25.660	3087	Mid-point of line TR5 (MP1)
20/06/2023		16:59	2°33.450	44°42.632	4061	End of line TR5 (EoL)
		17:20	2°33.450	44°42.632	4061	Start of line TR6 (SoL)
21/06/2023		15:10	2°45.062	46°57.741	2220	Mid-point of line TR6 (MP1)
		23:00	2°31.501	47°35.339	400	End of line TR6 (EoL)
21/06/2023	S12	23:00				Beginning of transit
22/06/2023		17:01				Beginning of survey
		20:00				**Arrival at station S12**
		20:00	0°39.720	44°21.106	2343	At station S12 (MUC)
		20:00				Beginning of operations
		21:15				Triggering
		22:10				**Core MD23-3665MC on deck**
						Recovery: 40 cm
		22:10	0°39.719	44°21.107	2343	At station S12 (Casq)
		22:10				Beginning of operations
		23:39				Ground touched
23/06/2023		01:05				**Core MD23-3666Q on deck**
						Recovery: 9.40 m
		01:35	0°39.716	44°21.074	2343	At station S12 (Calypso)
		01:35				Beginning of operations
		04:43				Triggering
		06:04				**Core MD23-3667 on deck**
						Recovery: 32.40 m
		06:20				**Departure from station S12**
23/06/2023	S13	06:20				Beginning of transit
		11:18				Beginning of survey
		15:02				**Arrival at station 13**
		15:02	0°02.019	44°13.646	1797	At station S13 (Casq)
		15:30				Beginning of operations
		17:01				Ground touched
		18:25				**Core MD23-3668Q on deck**
						Recovery: 0 m
		20:30	0°02.613	44°10.762	2217	At station S13 (CTD)
		21:00				AMA2-S13-CTD-1 in water

		22:01				AMA2-S13-CTD-1 on bottom
		23:18				**AMA2-S13-CTD-1 out of water**
						Recovery: 7 samples
		23:45	0°02.136	44°10.607	2200	At station S13 (CTD)
		23:51				AMA2-S13-CTD-2 in water
24/06/2023		00:43				AMA2-S13-CTD-2 on bottom
		02:10				**AMA2-S13-CTD-2 out of water**
						Recovery: 1 sample
		02:19				**Departure from station S13**
24/06/2023	S14	02:19				Beginning of transit
		12:35				Beginning of survey
		15:01				**Arrival at station S14**
		15:01	-1°34.739	43°01.404	1361	At station S14 (MUC)
		15:01				Beginning of operations
		15:50				Triggering
		16:20				**Core MD23-3669MC on deck**
						Recovery: 36 cm
		16:20	-1°34.742	43°01.403	1361	At station S14 (Casq)
		16:20				Beginning of operations
		17:31				Ground touched
		18:30				**Core MD23-3670Q on deck**
						Recovery: 10.49 m
		18:30	-1°34.748	43°01.403	1361	At station S14 (Calypso)
		18:50				Beginning of operations
		21:05				Triggering
		22:40				**Core MD23-3671 on deck**
						Recovery: 41.88 m
		22:45				**Departure from station S14**
24/06/2023	S15	23:57				Beginning of transit
25/06/2023		05:56				Beginning of survey
		08:39				**Arrival at station S15**
		08:39	-1°54.107	41°35.374	2241	At station S15 (MUC)
		08:39				Beginning of operations
		09:40				Triggering
		10:28				**Core MD23-3672MC on deck**
						Recovery: 20 cm

		10:28 10:28 11:48 13:00	- 1°54.499	41°35.477	2241	At station S15 (Casq) Beginning of operations Ground touched **Core MD23-3673Q on deck** Recovery:8.50 m
		13:00 13:30 15:44 17:00	- 1°54.498	41°35.480	2241	At station S15 (Calypso) Beginning of operations Triggering **Core MD23-3674 on deck** Recovery: 42.76 m
		17:00 17:00 20:27 23:06	- 1°54.489	41°35.475	2241	At station S15 (Calypso) Beginning of operations Triggering **Core MD23-3675 on deck** Recovery: 51.30 m
		23:30				**Departure from station S15**
25/06/2023	S16	23:30				Beginning of transit
26/06/2023		22:47				Beginning of survey
27/06/2023		14:35				**Arrival at station S16**
		14:40 14:40 16:22 17:25	- 3°16.856	36°11.760	1804	At station S16 (Casq) Beginning of operations Ground touched **Core MD23-3676Q on deck** Recovery: 8.76 m
		17:46 17:46 18:47 20:25	- 3°14.369	36°11.805	1988	At station S16 (Casq) Beginning of operations Ground touched **Core MD23-3677Q on deck** Recovery: 11.30 m
		20:25 22:00 23:47	- 3°14.377	36°11.809	1988	At station S16 (Calypso) Beginning of operations Triggering
28/06/2023		01:09				**Core MD23-3678 on deck** Recovery: 23.72 m
		02:45 02:55 04:25 05:40	- 3°17.956	36°11.140	2119	At station S16 (CTD) AMA2-S16-CTD-1 in water AMA2-S16-CTD-1 on bottom **AMA2-S16-CTD-1 out of water**

						Recovery: 5 samples
		05:50	-3°17.801	36°11.505	2031	At station S16 (CTD)
		05:57				AMA2-S16-CTD-2 in water
		07:27				AMA2-S16-CTD-2 on bottom
		09:08				**AMA2-S16-CTD-2 out of water**
						Recovery: 3 samples
		12:54				Beginning of transit
		21:49				Beginning of survey
29/06/2023		01:53				Beginning of transit
		06:40				Beginning of survey
		10:42				Beginning of transit
		22:07				Beginning of survey
30/06/2023		02:28				Beginning of transit
		06:32				Beginning of survey
		10:33				**Departure from station S16**
30/06/2023		10:33				Beginning of transit
01/07/2023		18:45				**Arrival in Recife, Brazil**

3.4 Collected sediment and water samples at all stations

3.4.1 Station S6

3.4.1.1 Station S6 information

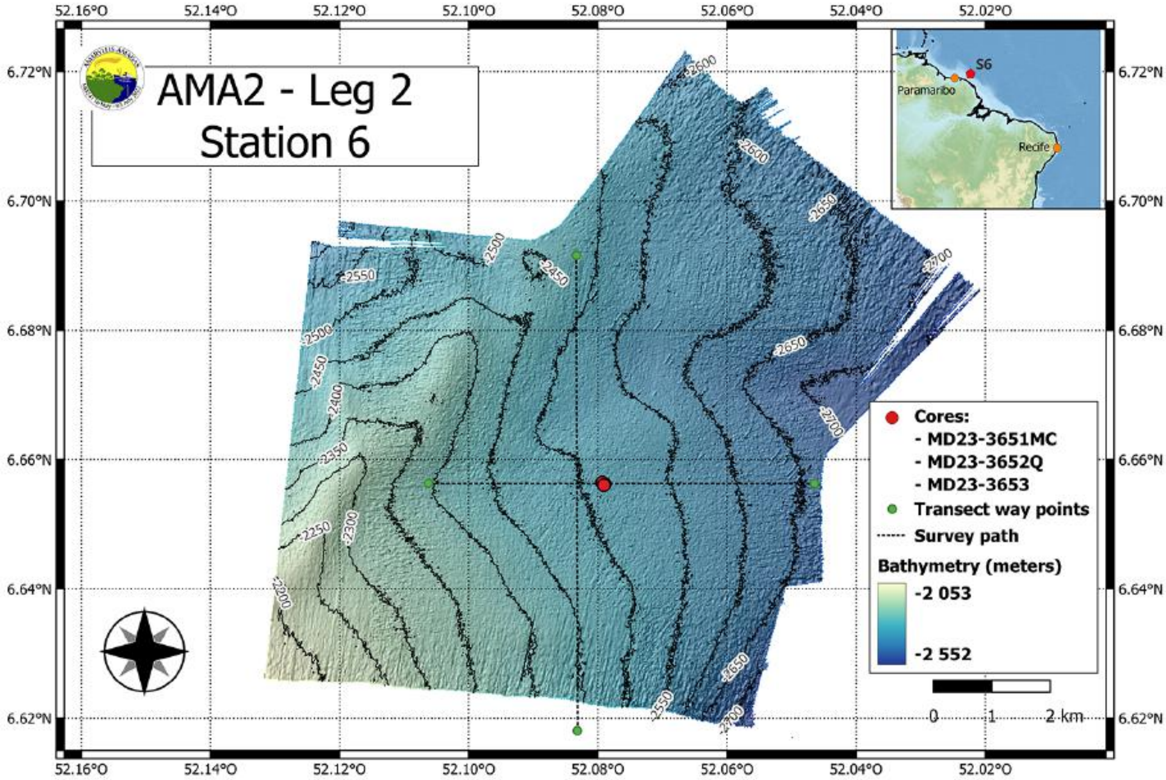


Figure 29: Bathymetric map at station S6.

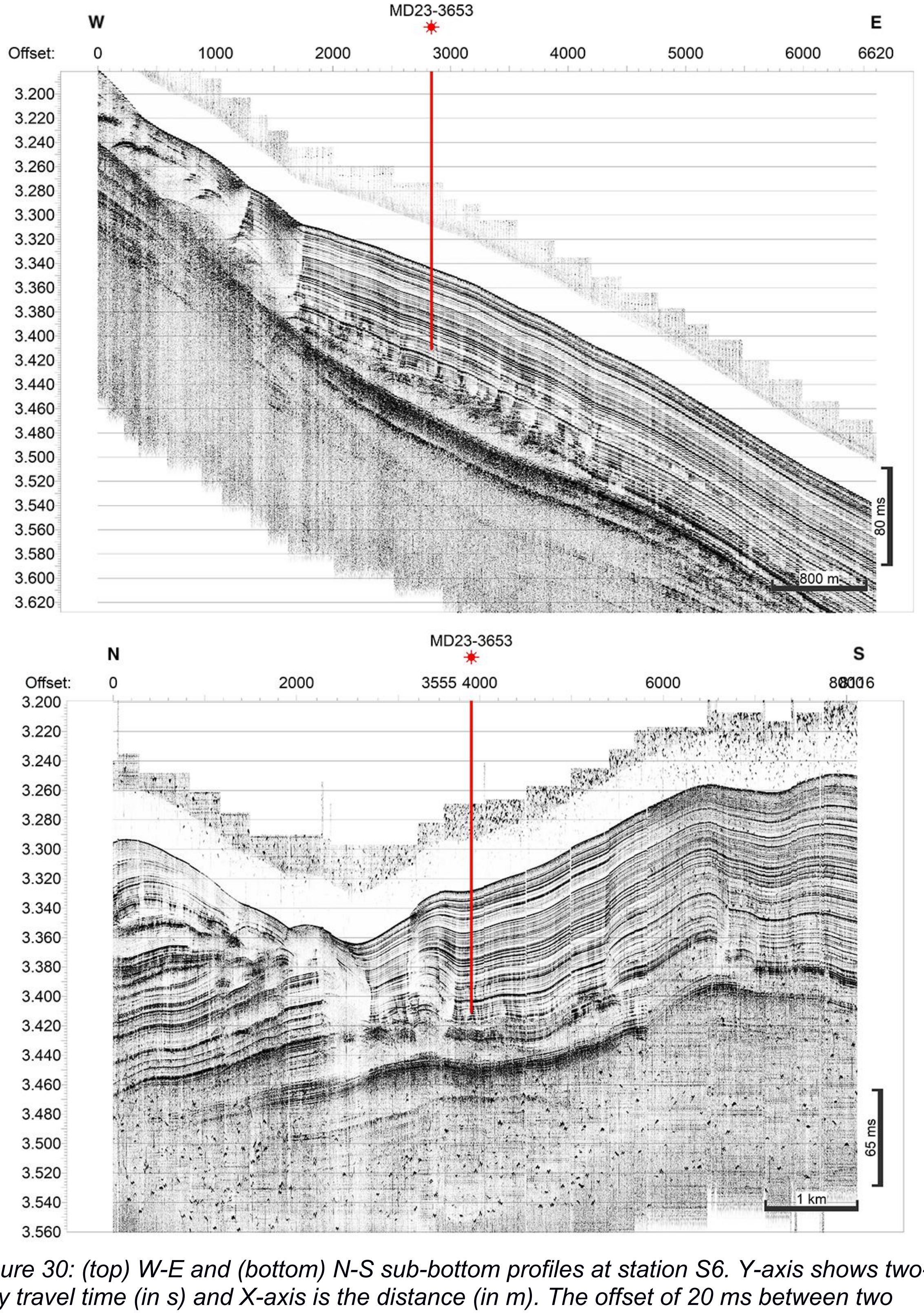


Figure 30: (top) W-E and (bottom) N-S sub-bottom profiles at station S6. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

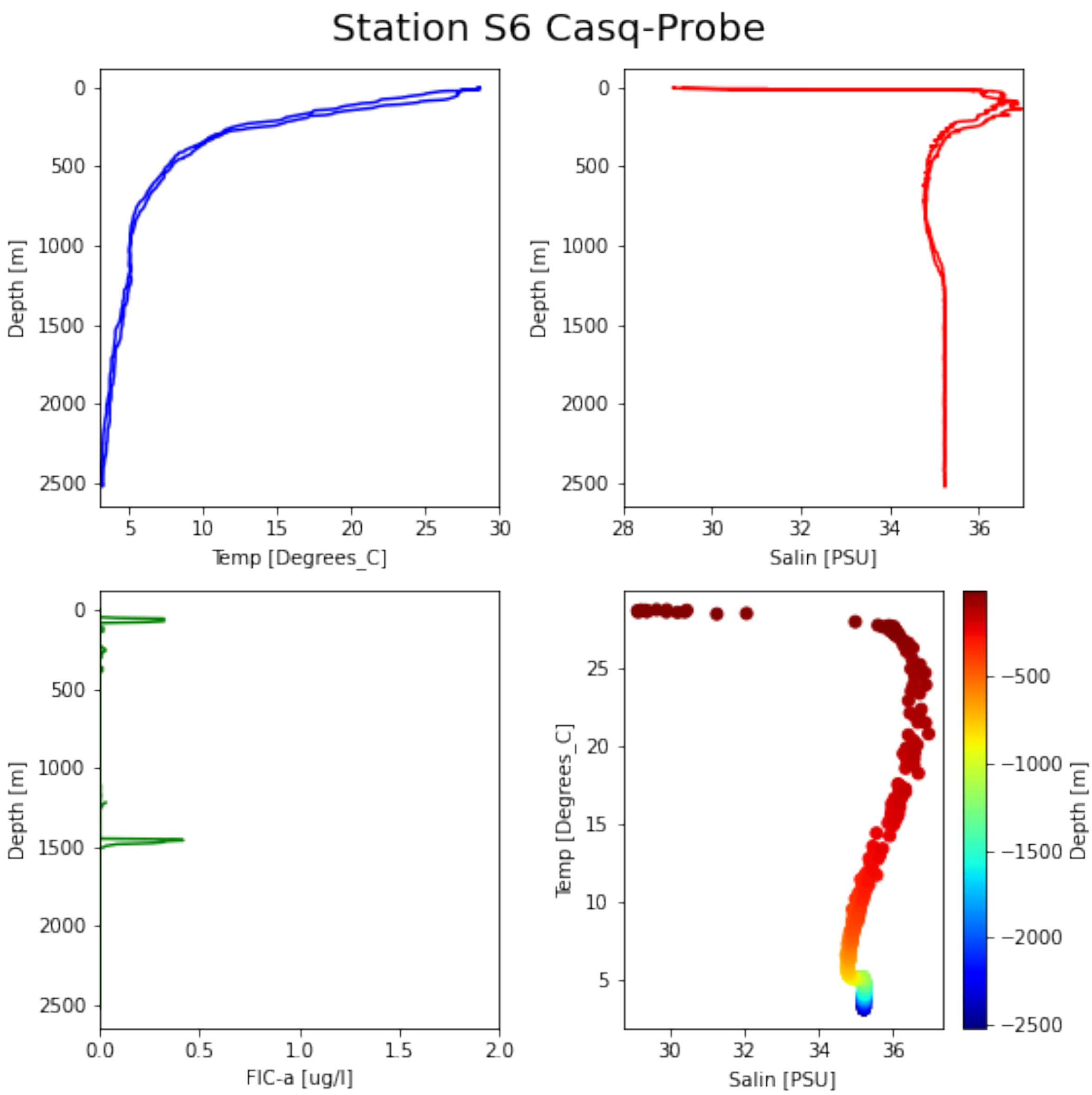


Figure 31: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S6.

3.4.1.2 Multicore MD23-3651MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **14/06/2023**
Core MD23 - 3651MC	*Station* ***S6***	*Operator* **All shifts**
Comments *Andre BELEM took supernatant water above core D* *Sample 15-16 cm (core D): part of it felt on the ground and we recovered the surface (not in contact with the soil)* *Sample 30-31 and 31-32 (core D): they may be mixed*		

Core	**Core length (cm)**	**Purpose of core** (forams, extra, or archive)	**Core subsampling?** *(example for type: 1-cm slice)*	**Temp. of supernatant water (°C)**	**Sampling of supernatant water?**	**Rose-Bengal?**	**Remarks**
A	33 cm	**FORAMS**	**yes** / ~~no~~ **operator:** all shifts together **type:** 1-cm slice		~~yes~~ / no	**yes** / no	*Rose Bengal in first 10 cm*
B	33 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** all shifts together **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
C	34.5 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** all shifts together **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
D	32 cm	**POLLEN**	**yes** / ~~no~~ **operator:** all shifts together **type:** 1-cm slice		**yes** / ~~no~~	~~yes~~ / **no**	

Figure 32: Coring information of multi-core MD23-3651MC.

3.4.1.3 Casq core MD23-3652Q

Cruise Name

MD241-AMA2-Leg2

Date : **14/06/2023**

station N° : **S6**

Weather information

Wind speed: **17,7 knots**
Wind direction: 91,00 °
Sea : 0 m

Core (N°) :

MD23-3652Q

Core Length:

10,49 m

Position (posidonia)

Latitude : 06 ° 39,608 N

Longitude : 52 ° 4,815 W

Corer (type) : CASQ

total weight (air) : t

total weight (water) : **surface** **6,5 t**
extraction **7,1 t**

TUNINGS :

Tubes (length) : **12,00 m**

Résultats CINEMA

Measured Parameters :

multibeam water depth	**2518**	m
released cable length :	2 500	m
Extraction/total *(tons)* :	12,24	t
extraction/differential *(tons)* :		t

TIME (GMT)

On station :	23:55 GMT
Beginning of operation :	05:00 GMT
Triggering :	06:53 GMT
End of operation :	09:30 GMT
Duration of operation :	4.5h

INSTRUMENTATION
Other OPERATIONS on site

MUC CTD-Rosette

Small CTD **Small Niskin**

Other **Calypso**

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Two bags with coretop sediment and one bag with core catcher sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 850	850 – 1000	### – 1049
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII	A-VIII

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 900	900 – 1049	
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII	

2nd level: 2 small boxes C and D + 2 u-channels

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 900	900 – 1048	
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII	

0 – 150	150 – 250	250 – 400	400 – 550	550 – 700	700 – 850	850 – 1000	### – 1050
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII	D-VIII

0 – 150	150 – 301	301 – 452	452 – 602,5	602,5 – 753	753 – 905	905 – 1048	
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VII	

0 – 100	100 – 250	250 – 401	401 – 552	552 – 702,5	702,5 – 853	853 – 1003	### – 1050
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII	u-ch B-VIII

3rd level: 2 small boxes E, F and G

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 900	900 – 1047	
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII	

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 850	850 – 1000	### – 1049
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	F-VIII

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 900	900 – 1049	
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII	

Figure 33: Coring information of Casq core MD23-3652Q. Numbers in red indicate depths that differ from the typical Casq section limits.

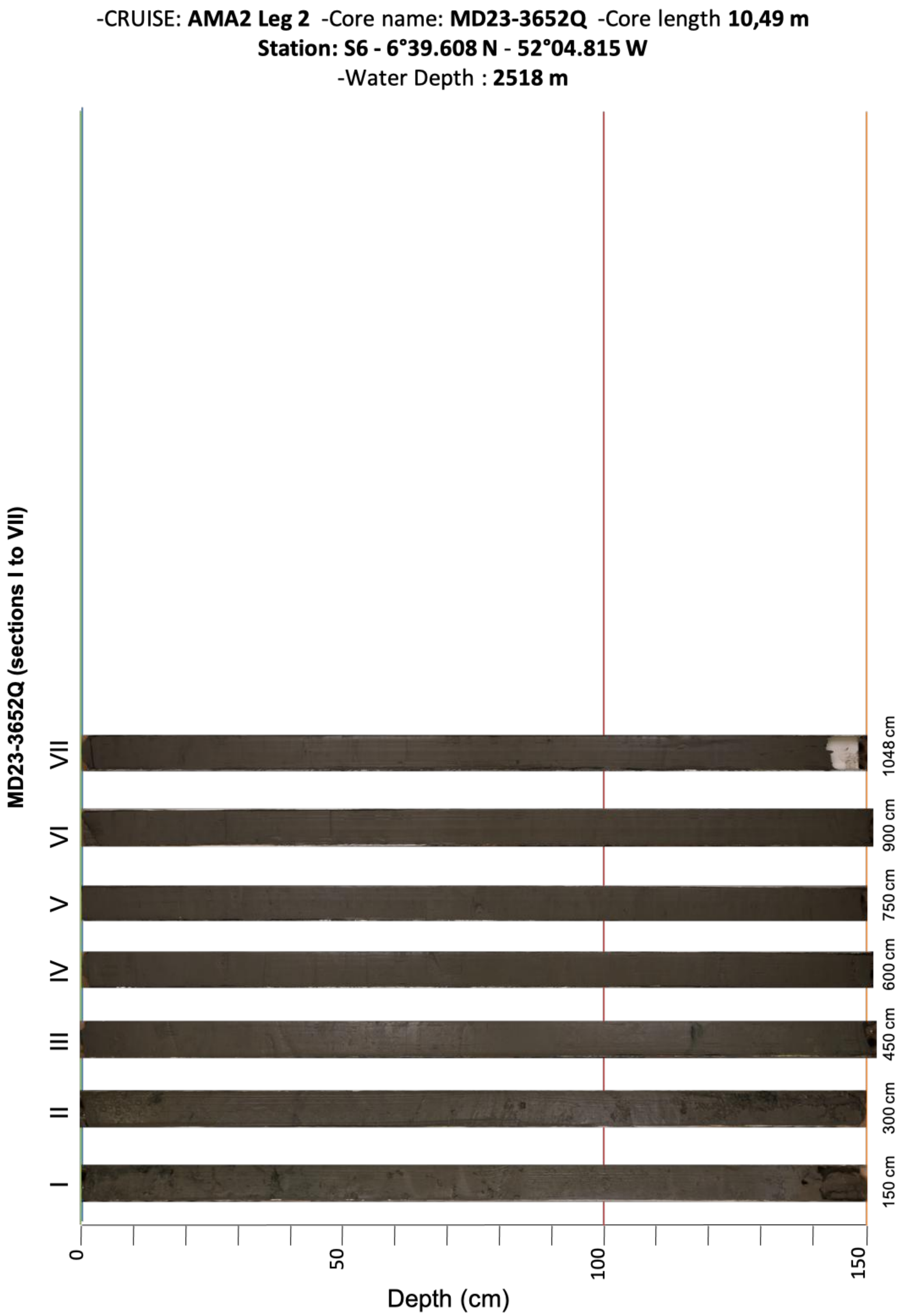
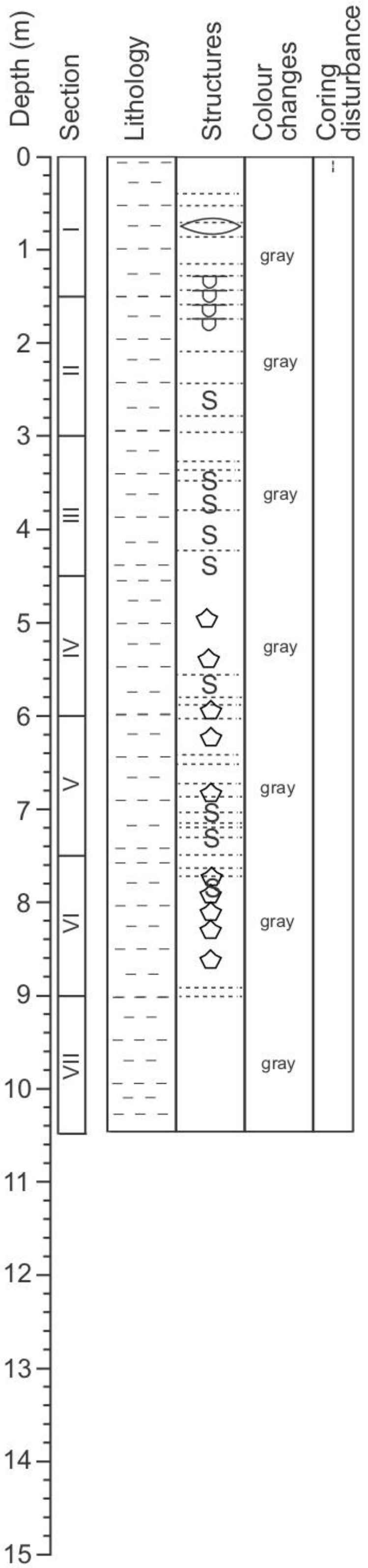


Figure 34: Pictures of Casq core MD23-3652Q.

MD241-AMA2-Leg2	MD23-3652Q	Position: 6°39,608 N 52°04,815 W
Station S6	Sediment description (1/1)	Water-depth: 2.518 m Core length: 10.50 m



Comments

Homogeneous gray mud with moderate bioturbation, dark marks (manganese nodules?) or isolated laminae and shells fragments throughtout the core sections.

0-7 cm: coring sampling disturbance

72-73cm: lighter-gray mud-laminae

130-180cm: burrow (biological hard tube)

Figure 35: Sediment description of Casq core MD23-3652Q.

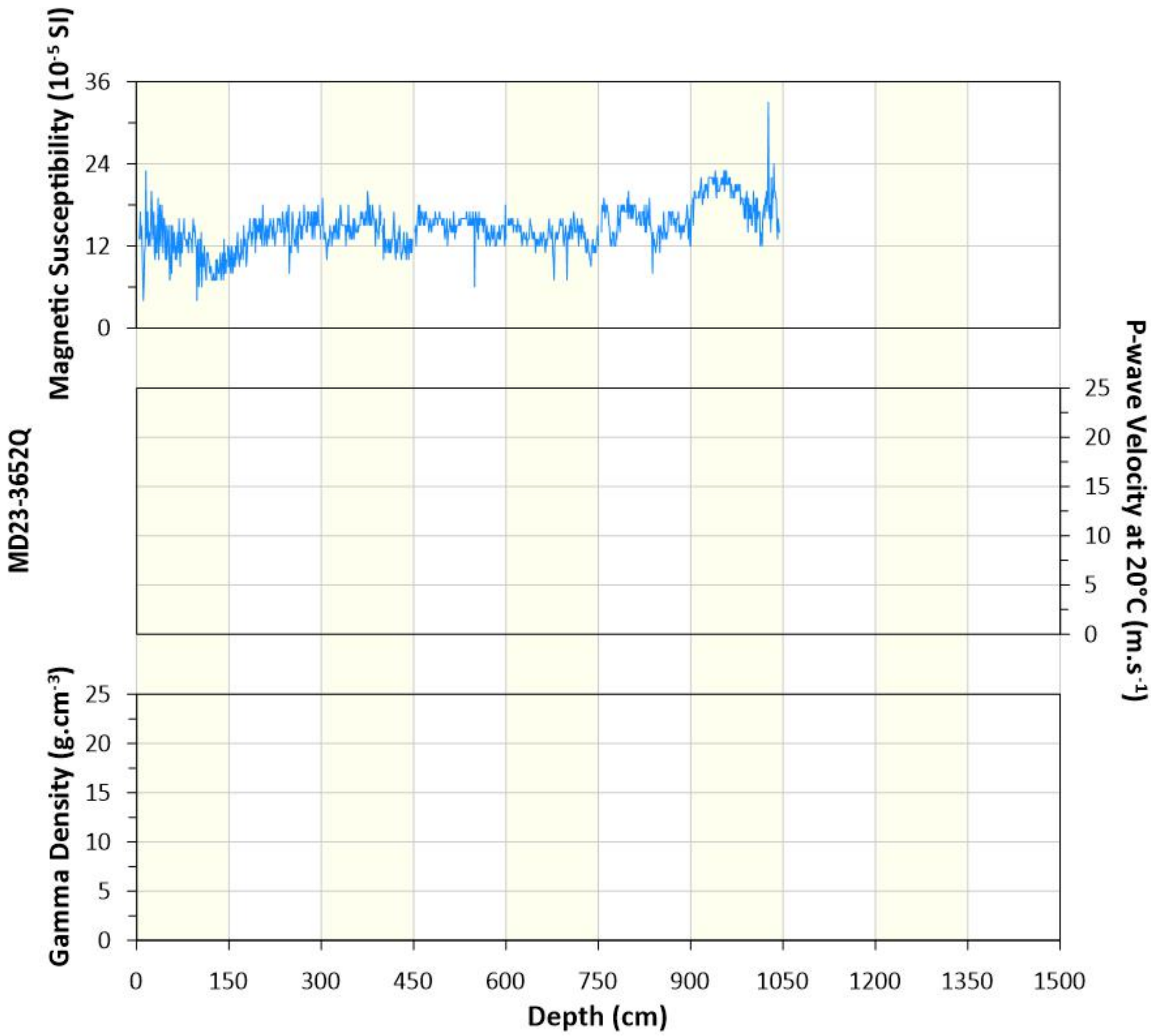


Figure 36: Physical properties of Casq core MD23-3652Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

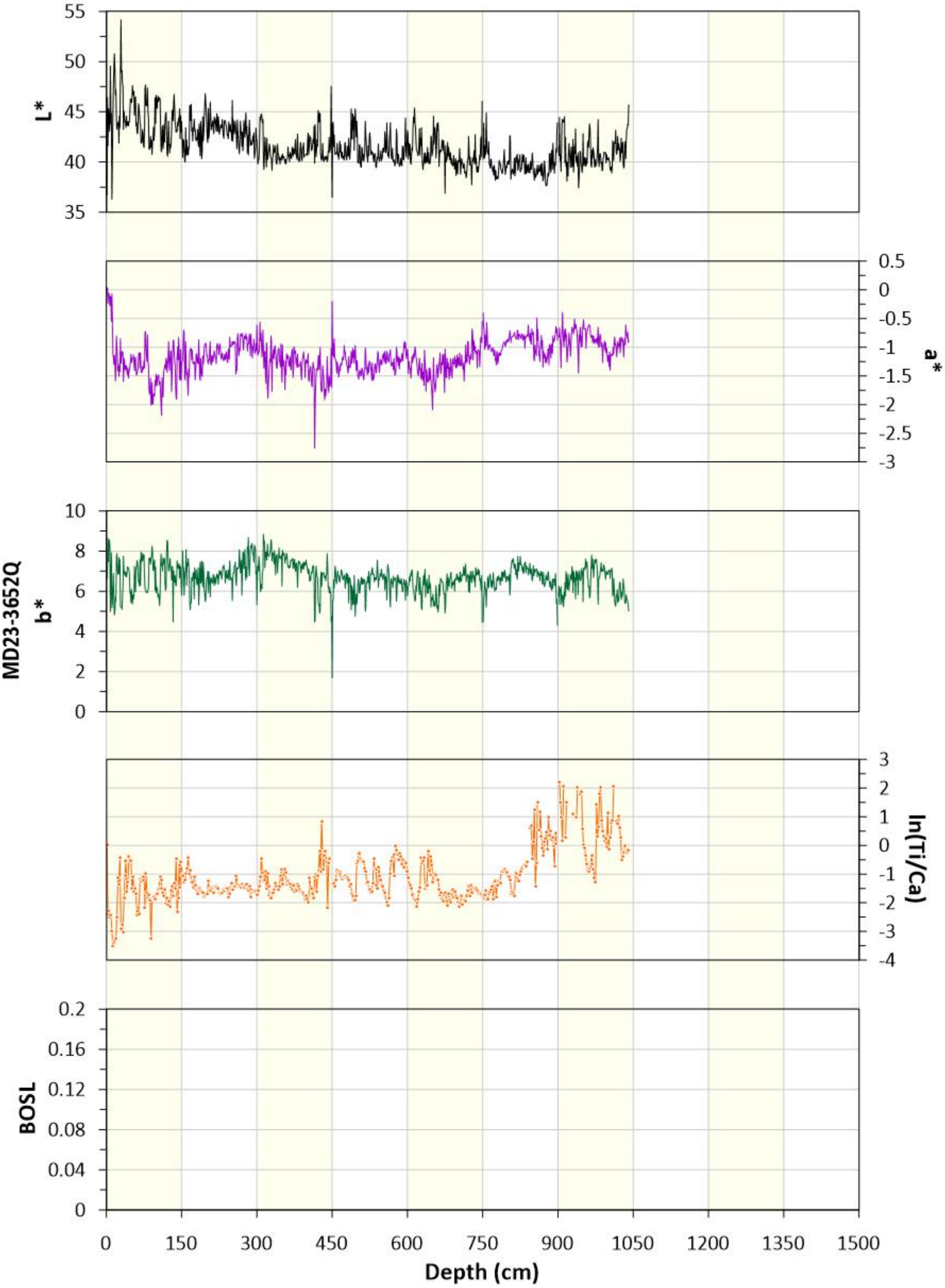


Figure 37: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3652Q. BOSL was not analyzed in Casq cores.*

3.4.1.4 Calypso core MD23-3653

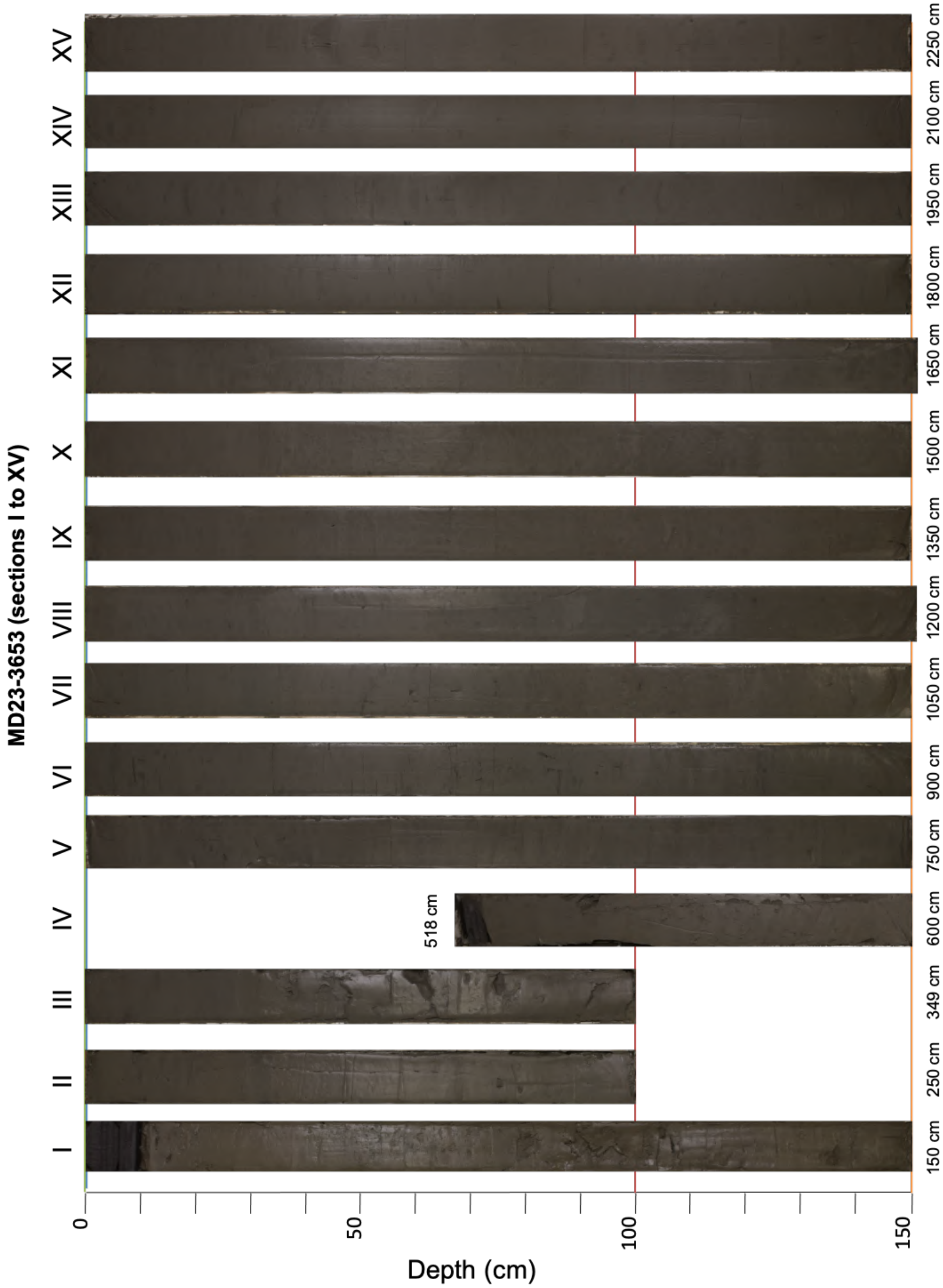
Cruise Name **MD241-AMA2-Leg2**	Date : **14/06/2023** station N° : **S6**	Weather information Wind speed: **19 knots** Wind direction: 73.00 ° Sea : ~1 m
Core (N°) : **MD23-3653**	**Core Length:** **50.37 m**	**Position (posidonia)** Latitude : **06 ° 39.363 N** Longitude : **52 ° 4.745 W**
Corer (type) : Calypso total weight (air) : t total weight (water) : **surface 6.8 t** **after extraction 7.6 t**	**TUNINGS :** Tubes (length) : **54.67 m** Cables : Free fall : **3.70 m** theoritical elastic rebound **5.93 m** loop length **9.38 m** counterweight cable length m (3m50 lest)	**Résultats CINEMA** thickness sediment sampled m thickness sediment cored m
Measured Parameters : multibeam water depth **1 519 m** released cable length : m Extraction/total *(tons)* : **16.52 t**	**TIME (GMT)** On station : **23:55 GMT** Beginning of operation : **09:30 GMT** Triggering : **13:09 GMT** End of operation : **17:20 GMT** Duration of operation : **8 hours**	**INSTRUMENTATION** **Other OPERATIONS on site** MUC CTD-Rosette Small CTD Small Niskin: full of sediment no water recovered Other : CASQ NB: bent, pipe broken

Description : One bag with coretop sediment and one bag with core catcher syringues
Sampling for Martine Couapel
U-channels taken on the archive half.
Incidents : core bent at ~ 4m, pipe broken. Part of it cut to release the liner with the sediment. 169cm of sediment lost.

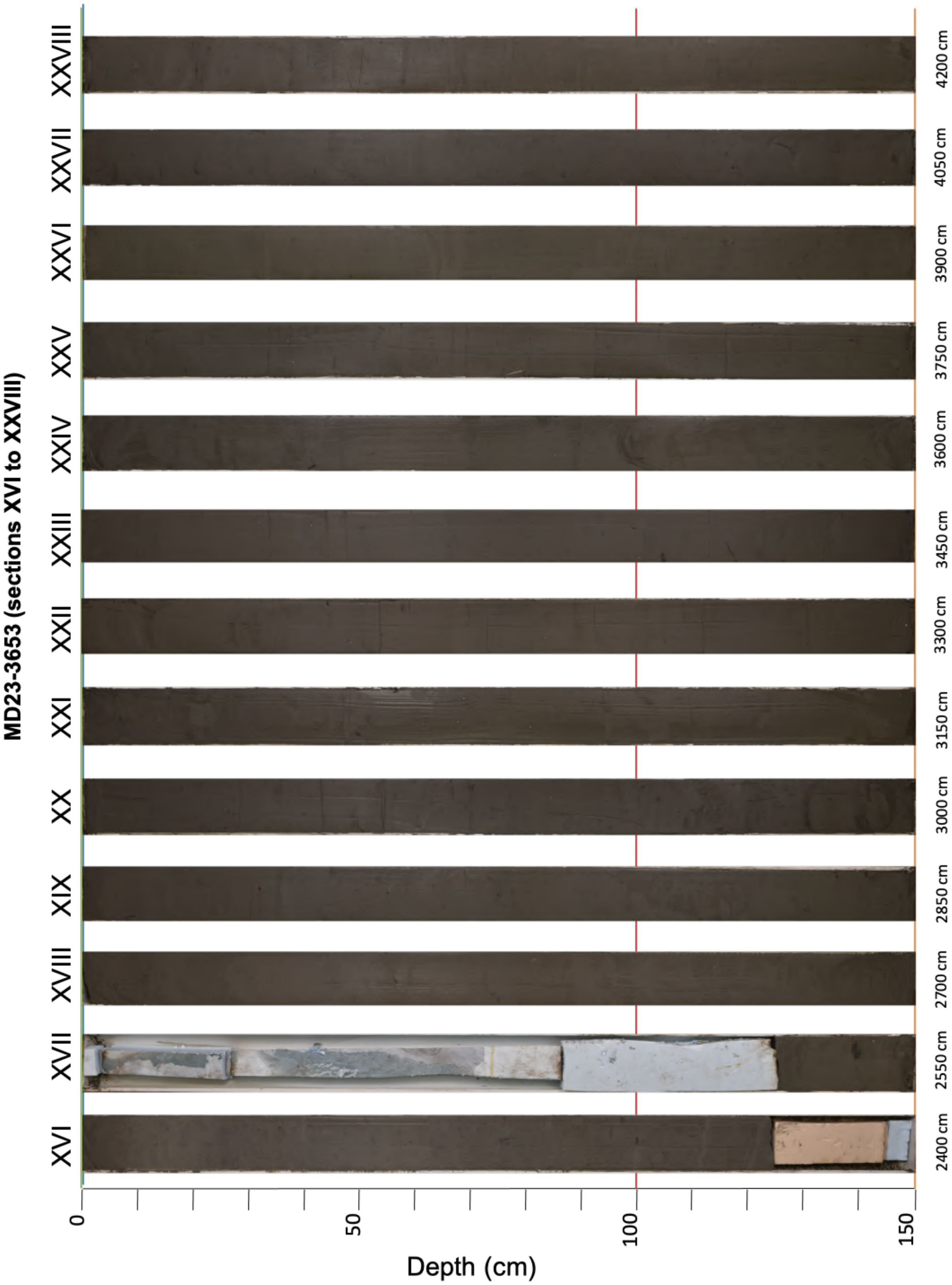
0	150	250	349 518	600	750	900 1050
I	II	III	IV	V	VI	VII
1050	1200	1350	1500	1650	1800	1950 2100
VIII	IX	X	XI	XII	XIII	XIV
2100	2250	2400	2550	2700	2850	3000 3150
XV	XVI	XVII	XVIII	XIX	XX	XXI
3150	3300	3450	3600	3750	3900	4050 4200
XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII
4200	4350	4500	4650	4800	4950 5038	
XXIX	XXX	XXXI	XXXII	XXXIII	XXXIV	

Figure 38: Coring information of Calypso core MD23-3653. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3653** -Core length **50.37 m**
Station: S6 -Latitude: **6°39.363 N**-Longitude: **52°04.745 W**
-Water Depth : **2518 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3653** -Core length **50.37 m**
Station: S6 -Latitude: **6°39.363 N**-Longitude: **52°04.745 W**
-Water Depth : **2518 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3653** -Core length **50.37 m**
Station: S6 -Latitude: **6°39.363 N**-Longitude: **52°04.745 W**
-Water Depth : **2518 m**

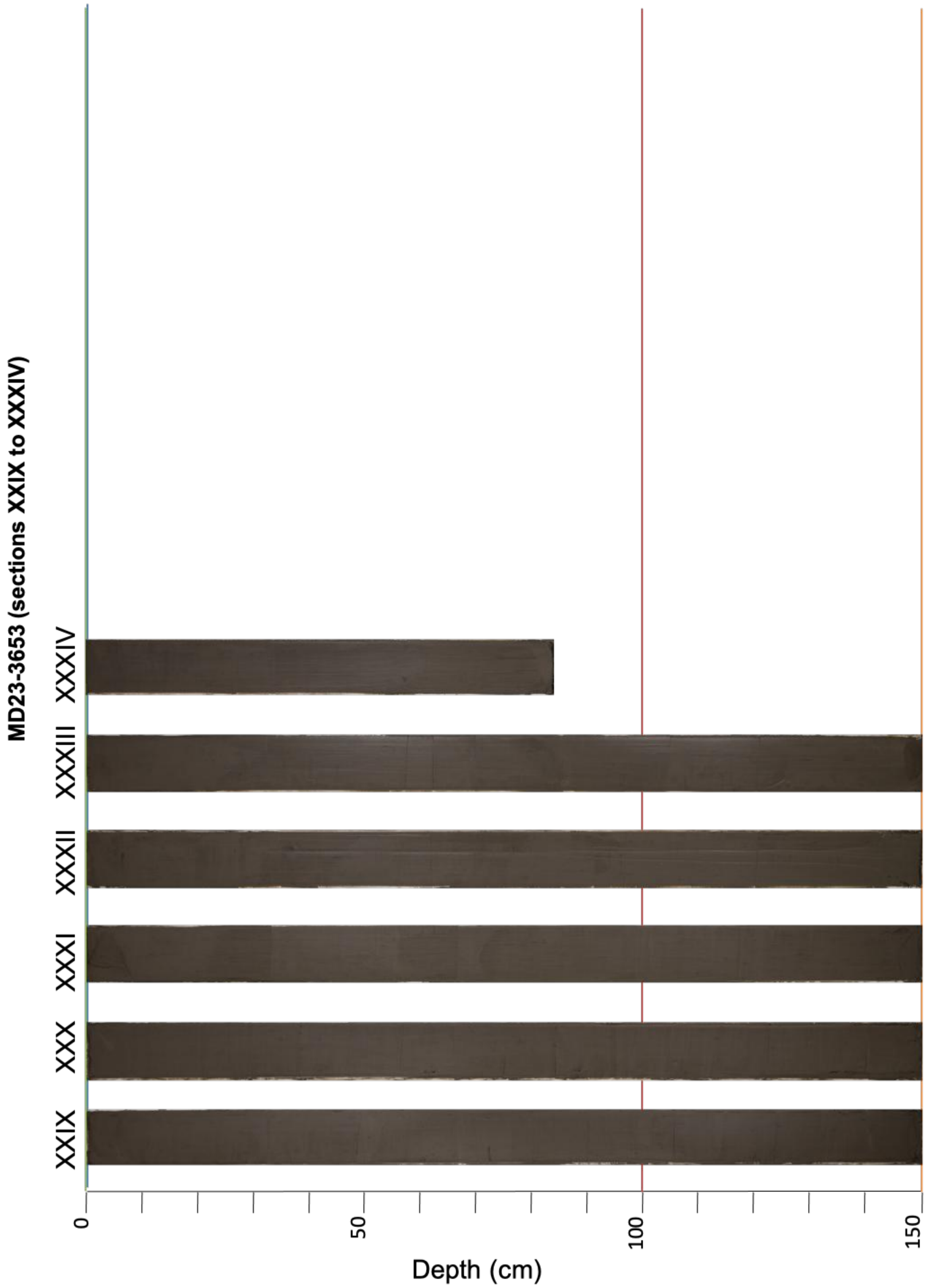
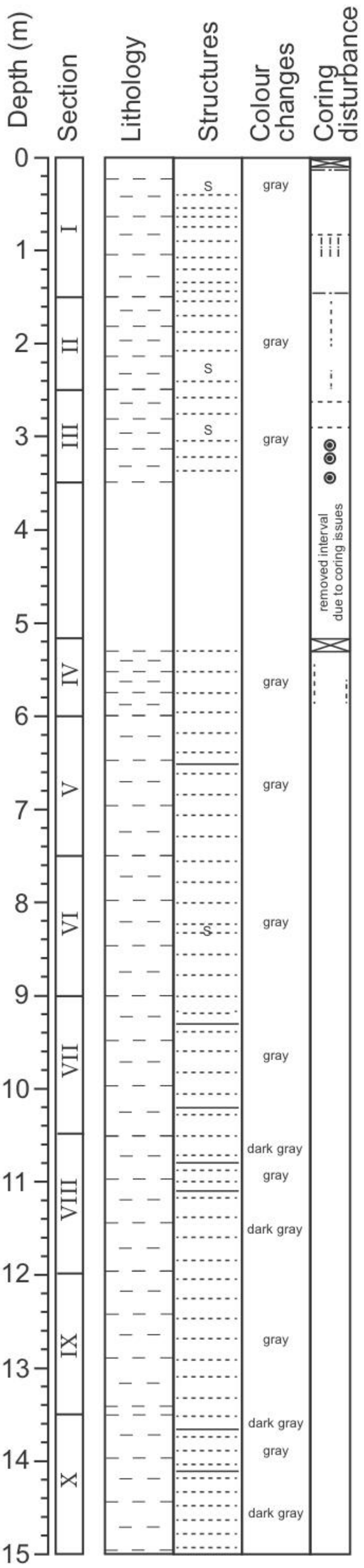


Figure 39: Pictures of Calypso core MD23-3653.

MD241-AMA2-Leg2	**MD23-3653**	Position: 6°39.363 N 52°04.745 W
Station S6	**Sediment description (1/4)**	Water-depth: 2518 m Core length: 50.37 m



Comments

Homogeneous gray mud with darker marks ou laminae throughout the core sections

Coring and/or splitting disturbances mostly in the first 3 sections

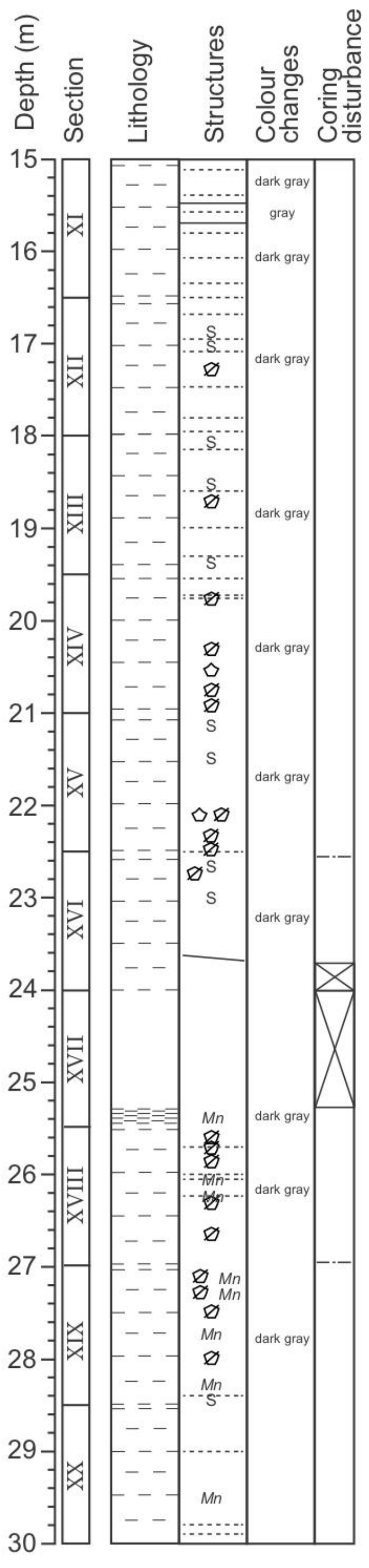
Darker marks or darker layers throughout the core sections

Removed interval due to coring issues between 349 - 518 cm

0-10 cm: void

518-523 cm: void

MD241-AMA2-Leg2	**MD23-3653**	Position: 6°39.363 N 52°04.745 W
Station S6	**Sediment description (2/4)**	Water-depth: 2518 m Core length: 50.37 m



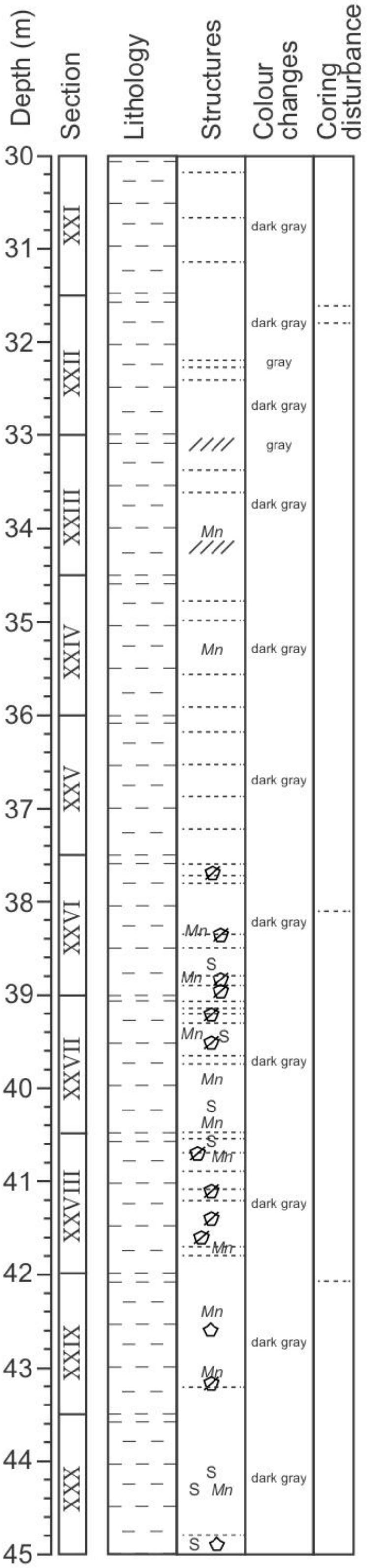
Comments

Homogeneous gray mud with darker marks ou laminae throughout the core sections

Darker marks or darker layers throughout the core sections

2375-2525 cm: void

MD241-AMA-Leg2	**MD23-3653**	Position:6°39.363 N 52°04.745 W
Station S6	**Sediment description (3/4)**	Water-depth: 2518 m Core length: 50.37 m



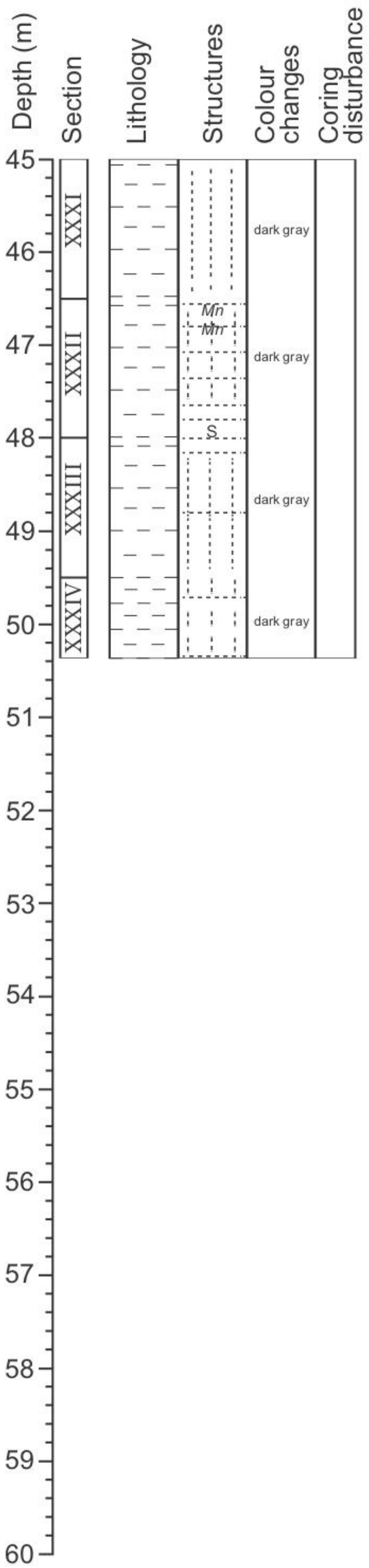
Comments

Homogeneous gray mud with darker marks ou laminae throughout the core sections

Darker marks or darker layers throughout the core sections

Few coring disturbances

MD241-AMA2-Leg2	**MD23-3653**	Position:6°39.363 N 52°04.745 W Water-depth: 2518 m
Station S6	**Sediment description (4/4)**	Core length: 50.37 m

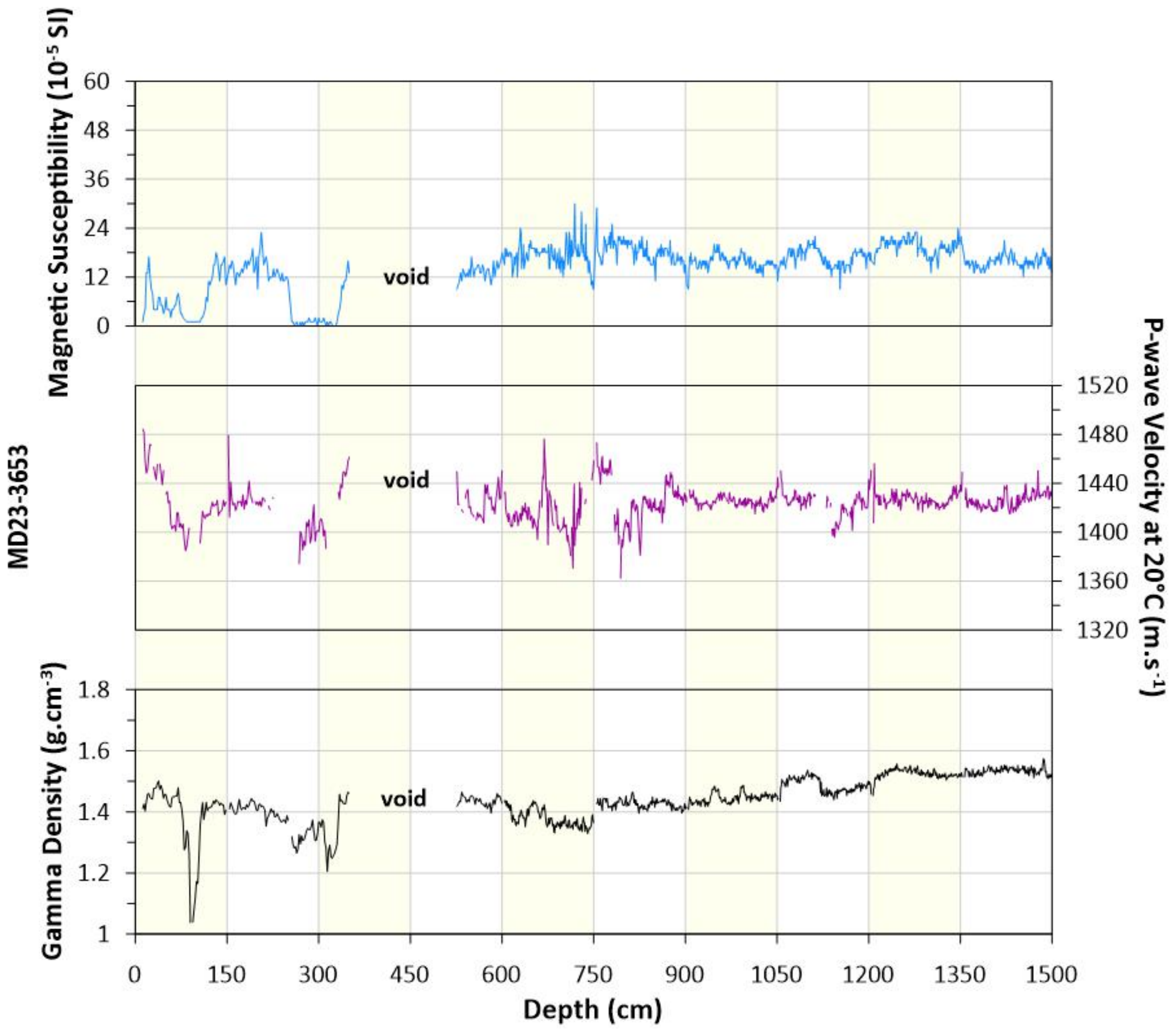


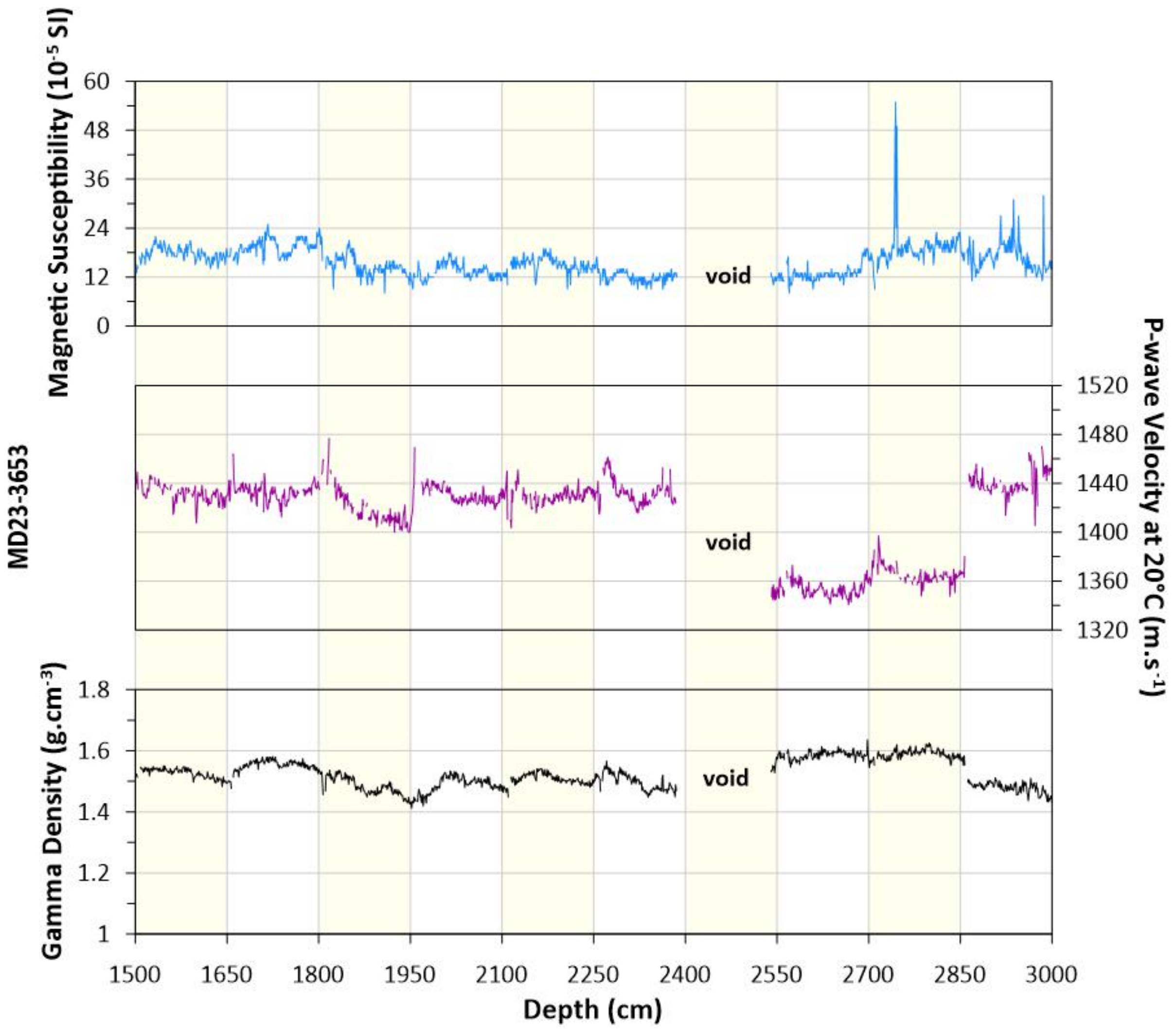
Comments

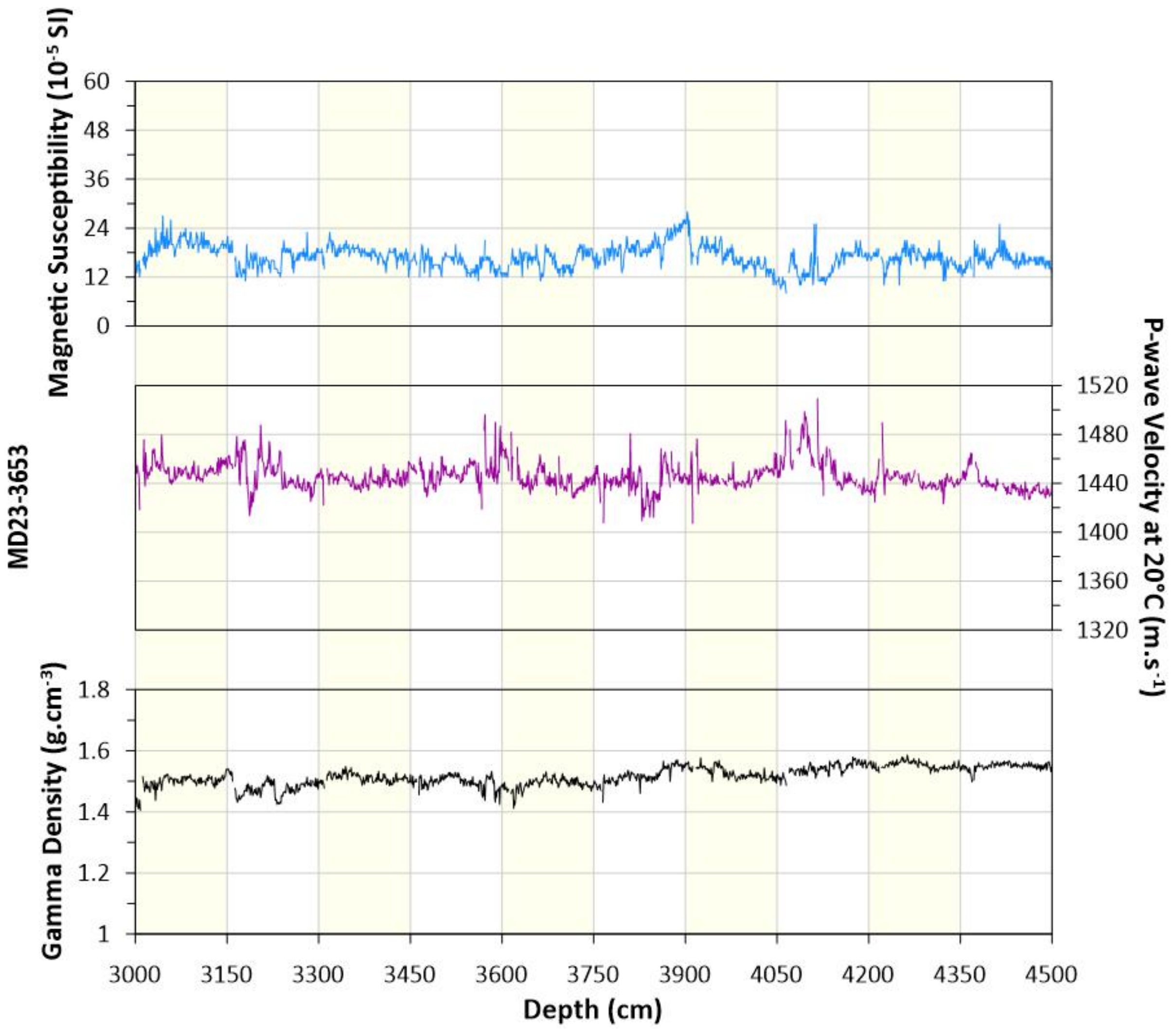
Homogeneous gray mud with darker marks ou laminae throughout the core sections

Darker marks, darker layers or darker meridional lines, throughout the core sections

Figure 40: Sediment description of Calypso core MD23-3653.


MD23-3653
Magnetic Susceptibility (10-5 SI)
60
48
36
24
12
0
void
P-wave Velocity at 20°C (m.s-1)
1520
1480
1440
1400
1360
1320
Gamma Density (g.cm-3)
1.8
1.6
1.4
1.2
1
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)


Magnetic Susceptibility (10^{-5} SI)
60
48
36
24
12
0
void
MD23-3653
P-wave Velocity at 20°C ($m.s^{-1}$)
1520
1480
1440
1400
1360
1320
void
Gamma Density ($g.cm^{-3}$)
1.8
1.6
1.4
1.2
1
void
1500 1650 1800 1950 2100 2250 2400 2550 2700 2850 3000
Depth (cm)


Magnetic Susceptibility (10^{-5} SI)
60
48
36
24
12
0
MD23-3653
P-wave Velocity at 20°C ($m.s^{-1}$)
1520
1480
1440
1400
1360
1320
Gamma Density ($g.cm^{-3}$)
1.8
1.6
1.4
1.2
1
3000
3150
3300
3450
3600
3750
3900
4050
4200
4350
4500
Depth (cm)

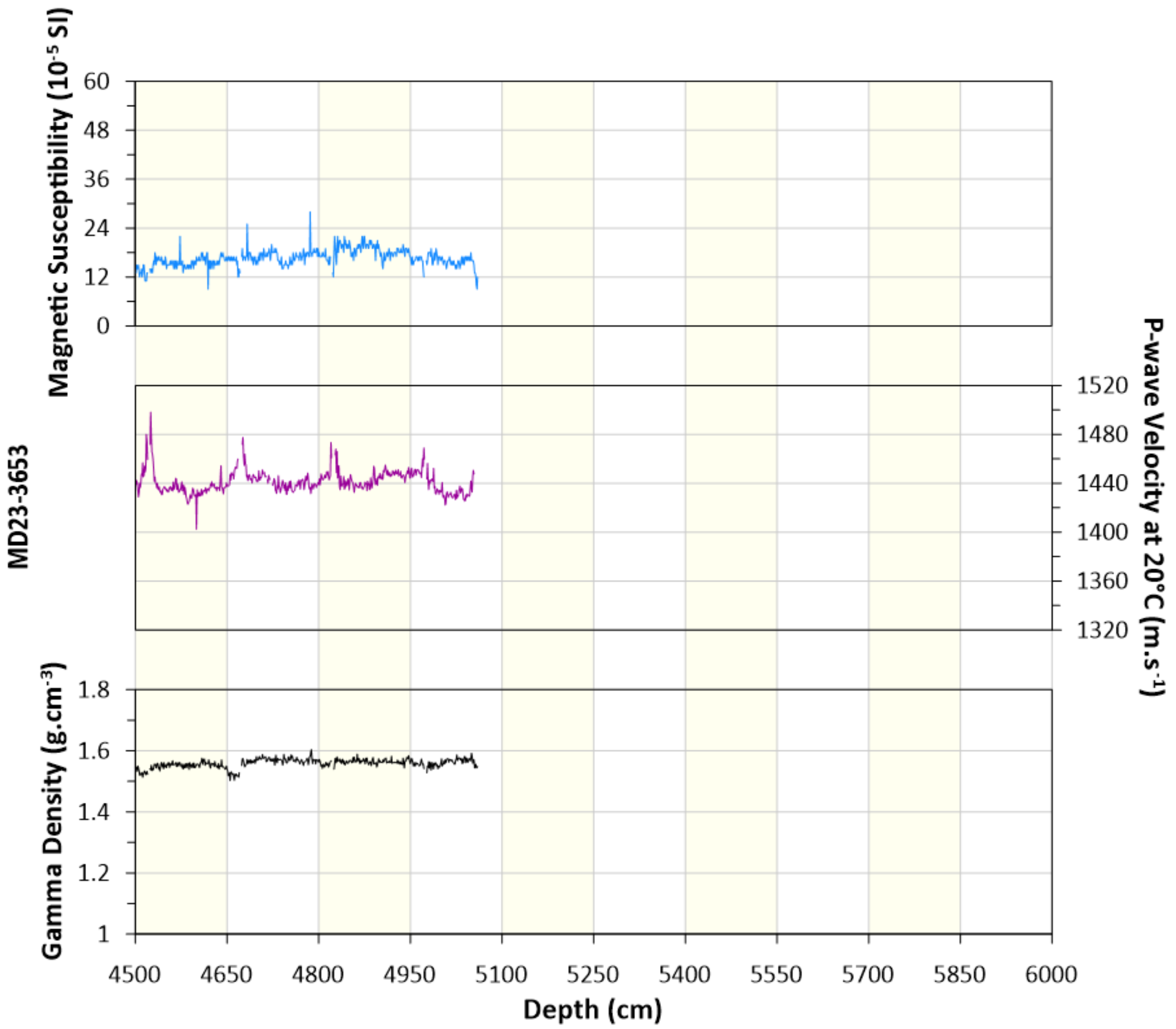
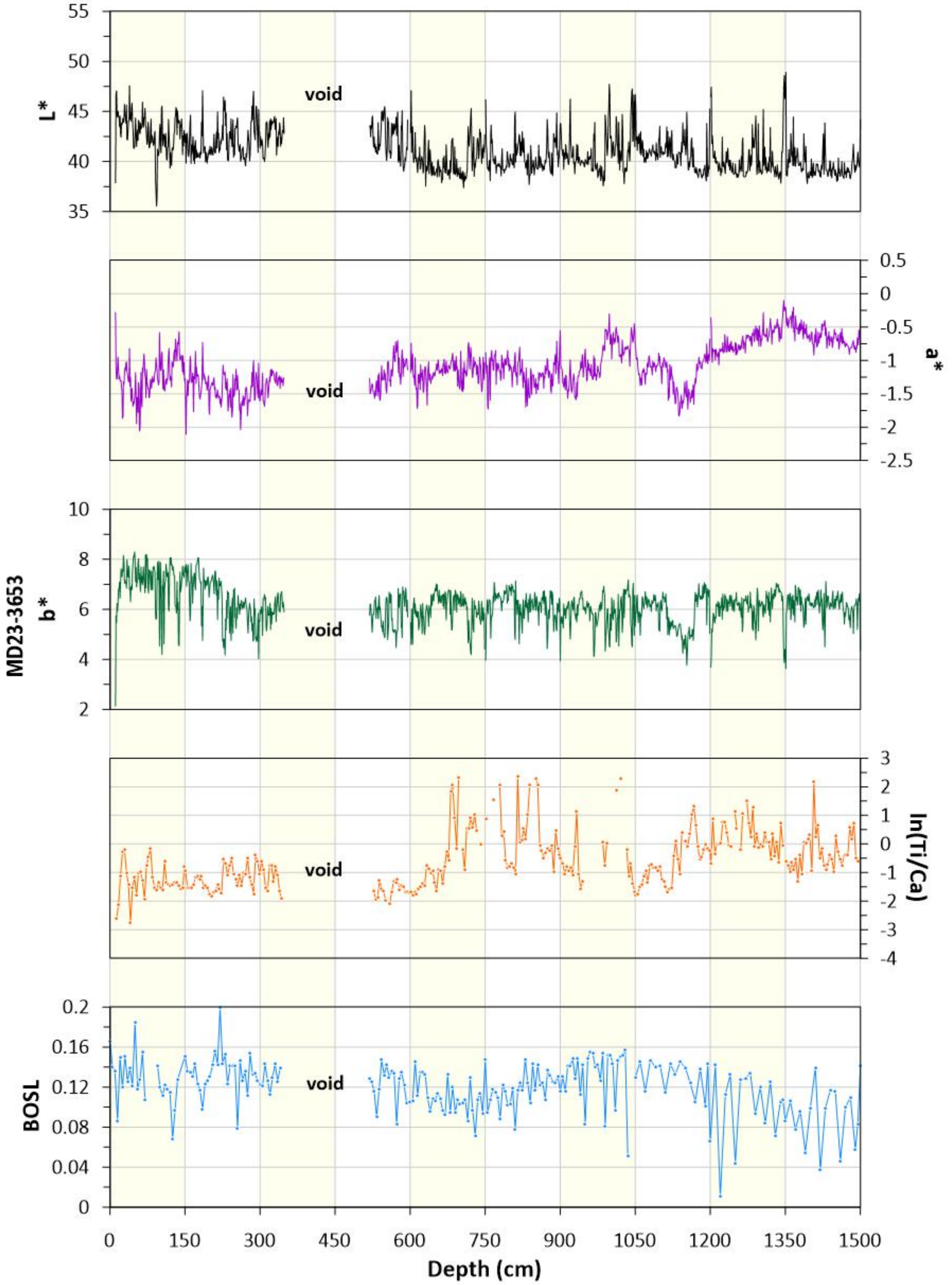
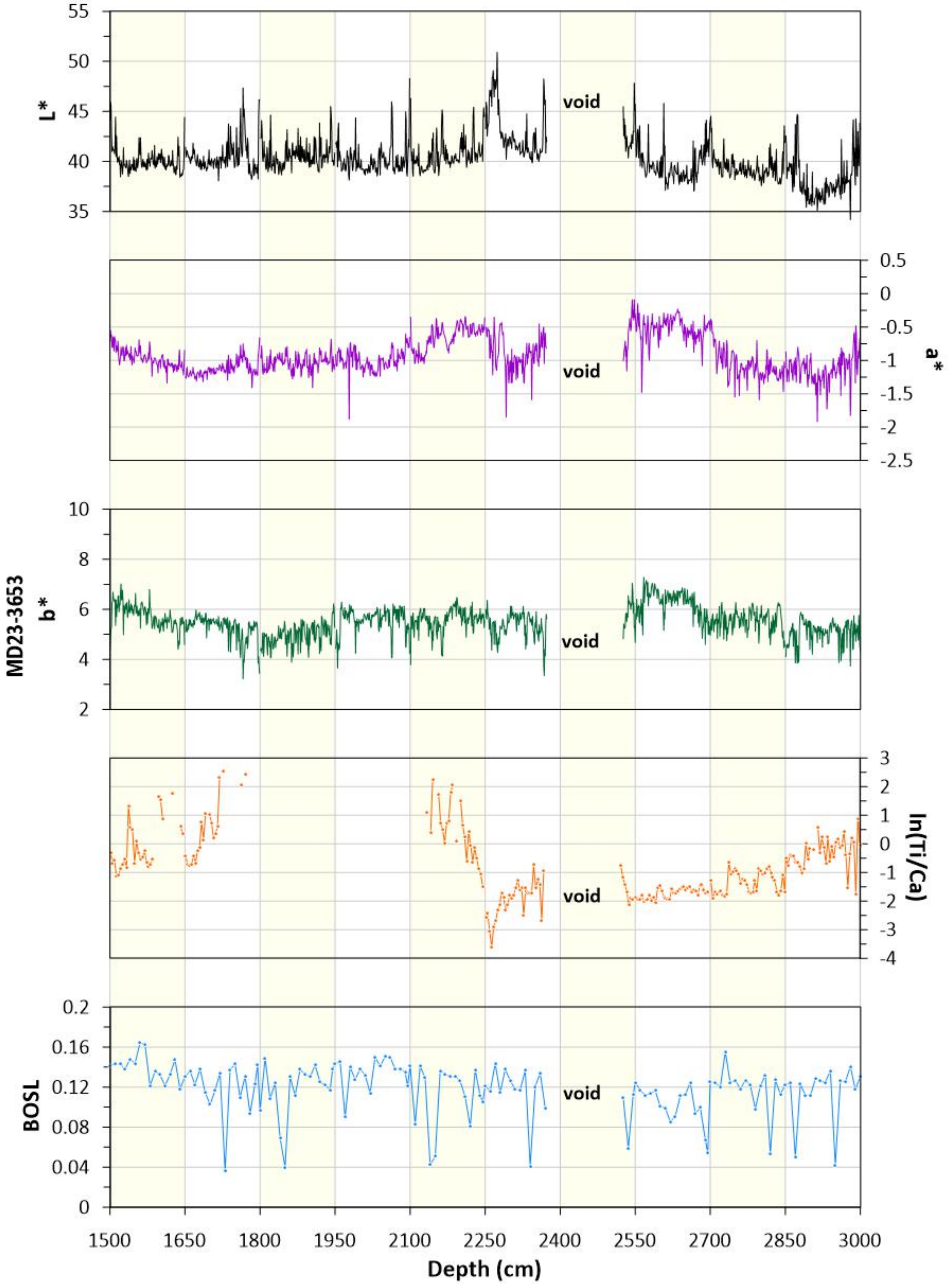
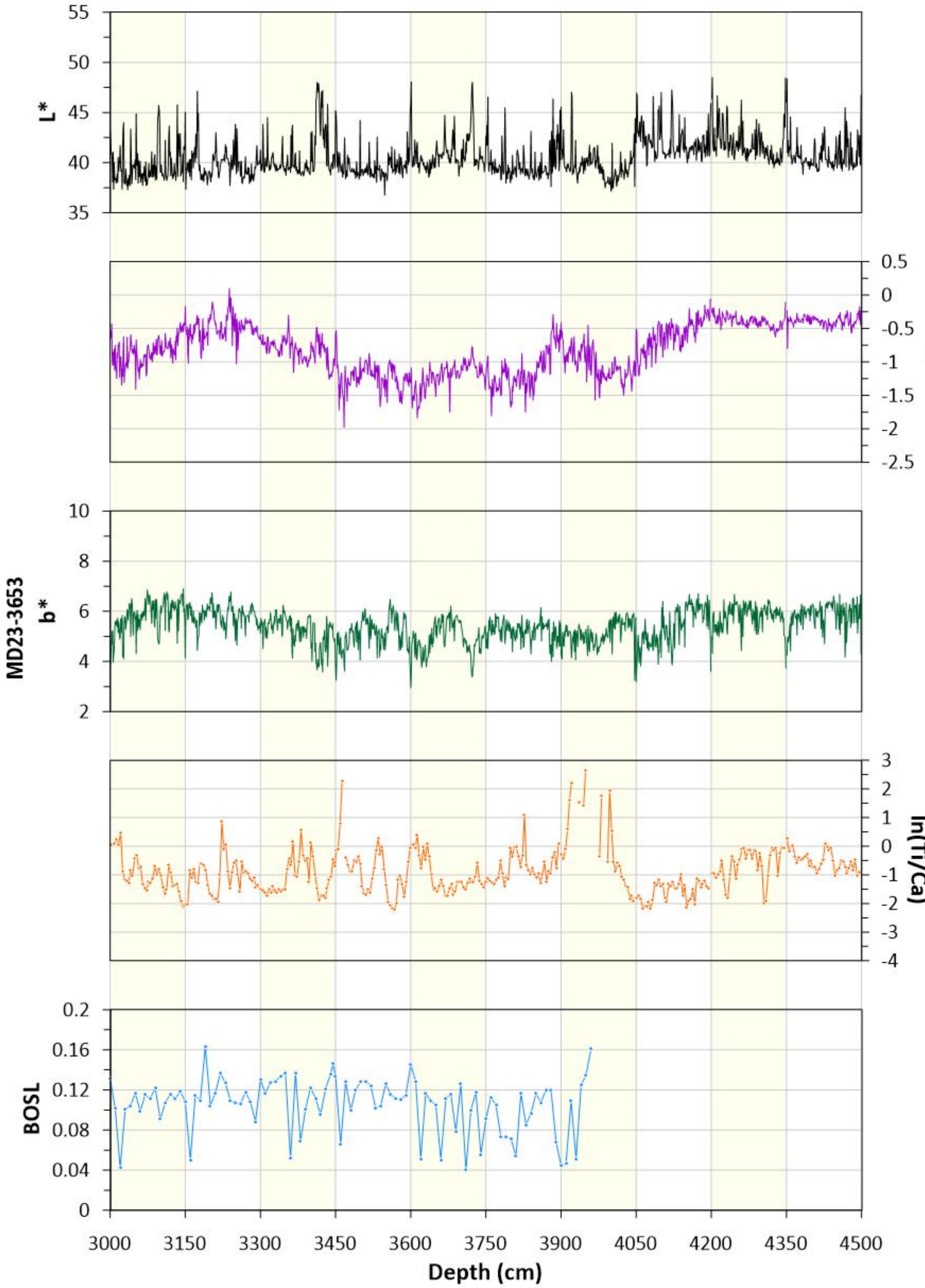


Figure 41: Physical properties of Calypso core MD23-3653.



MD23-3653
L*
55
50
45
40
35
void
a*
0.5
0
-0.5
-1
-1.5
-2
-2.5
b*
10
8
6
4
2
ln(Ti/Ca)
3
2
1
0
-1
-2
-3
-4
BOSL
0.2
0.16
0.12
0.08
0.04
0
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)


L*
a*
MD23-3653
b*
ln(Ti/Ca)
BOSL
void
Depth (cm)


L*
a*
MD23-3653
b*
ln(Ti/Ca)
BOSL
Depth (cm)

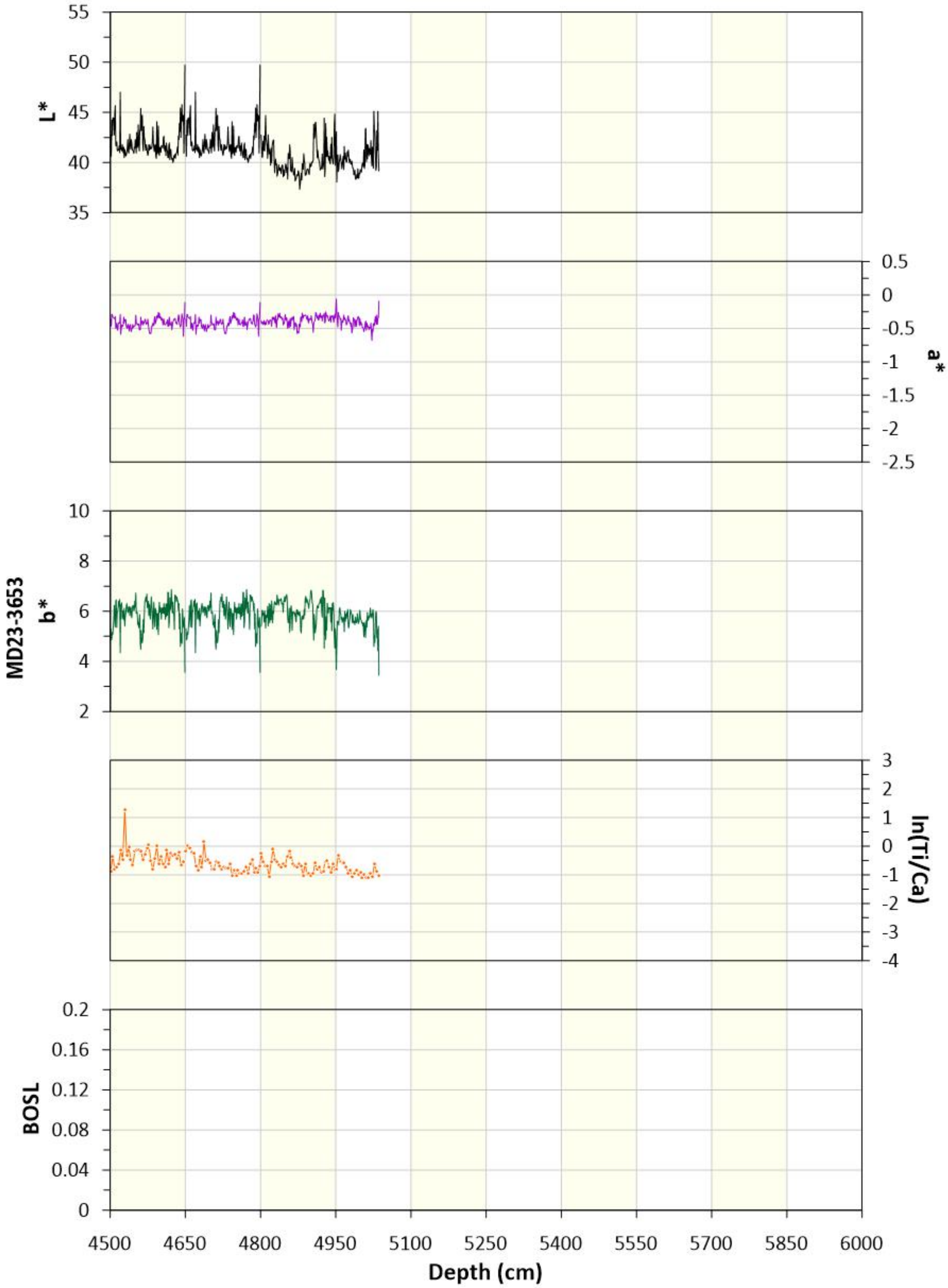


Figure 42: Spectrophotometry (L, a*, b*), X-ray Fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3653. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record. BOSL was not analyzed below ca. 4000 cm core depth.*

Because core MD23-3653 has been bent, there is no figure comparing the recovered sediment thickness to the in-situ sediment layers computed by the CINEMA software for this Calypso core. Despite the bent pipe, the sediment of core MD23-3653 seems to show little disturbance.

3.4.1 Station S7

3.4.1.1 Station S7 information

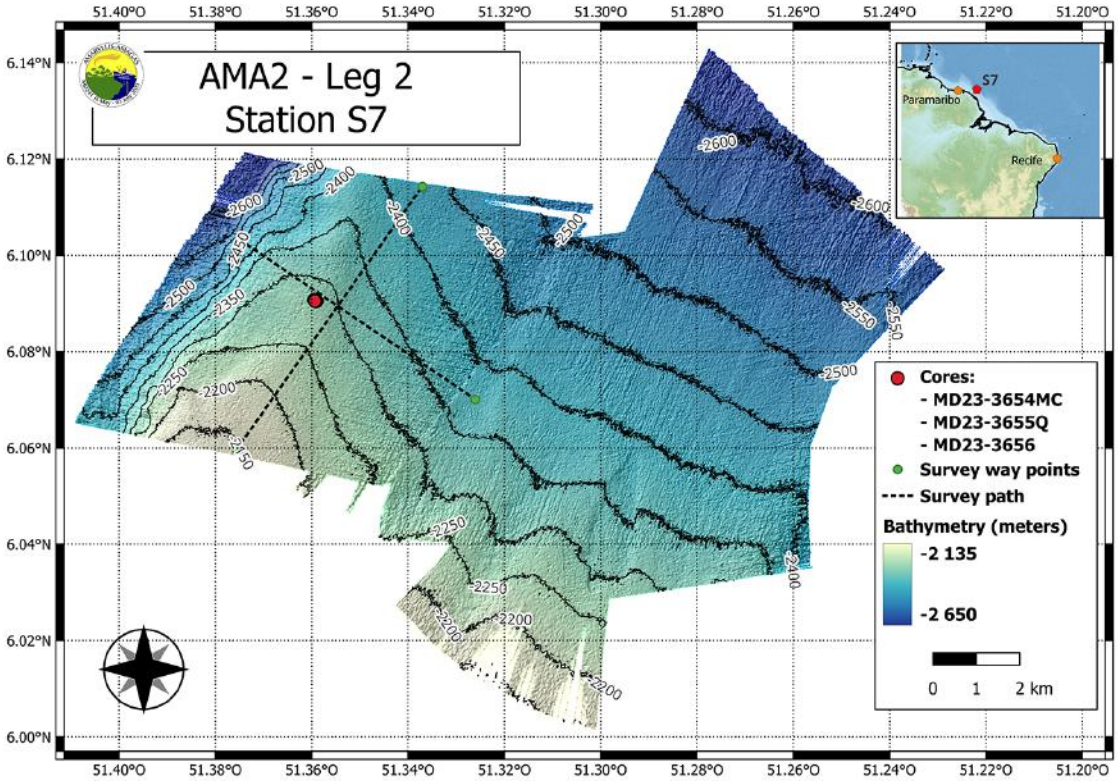


Figure 43: Bathymetric map at station S7.

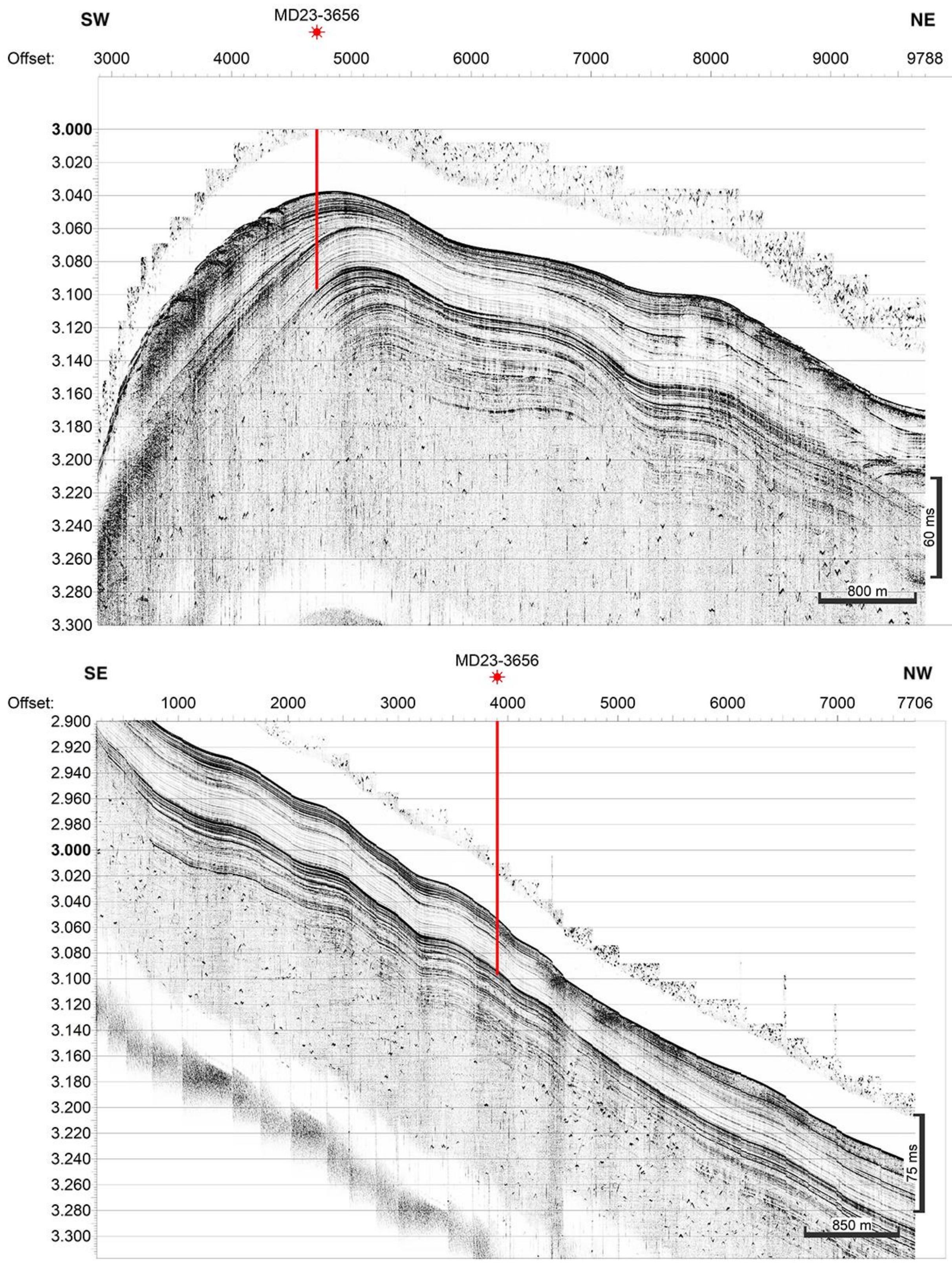


Figure 44: (top) SW-NE and (bottom) SE-NW subbottom profiles at station S7. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

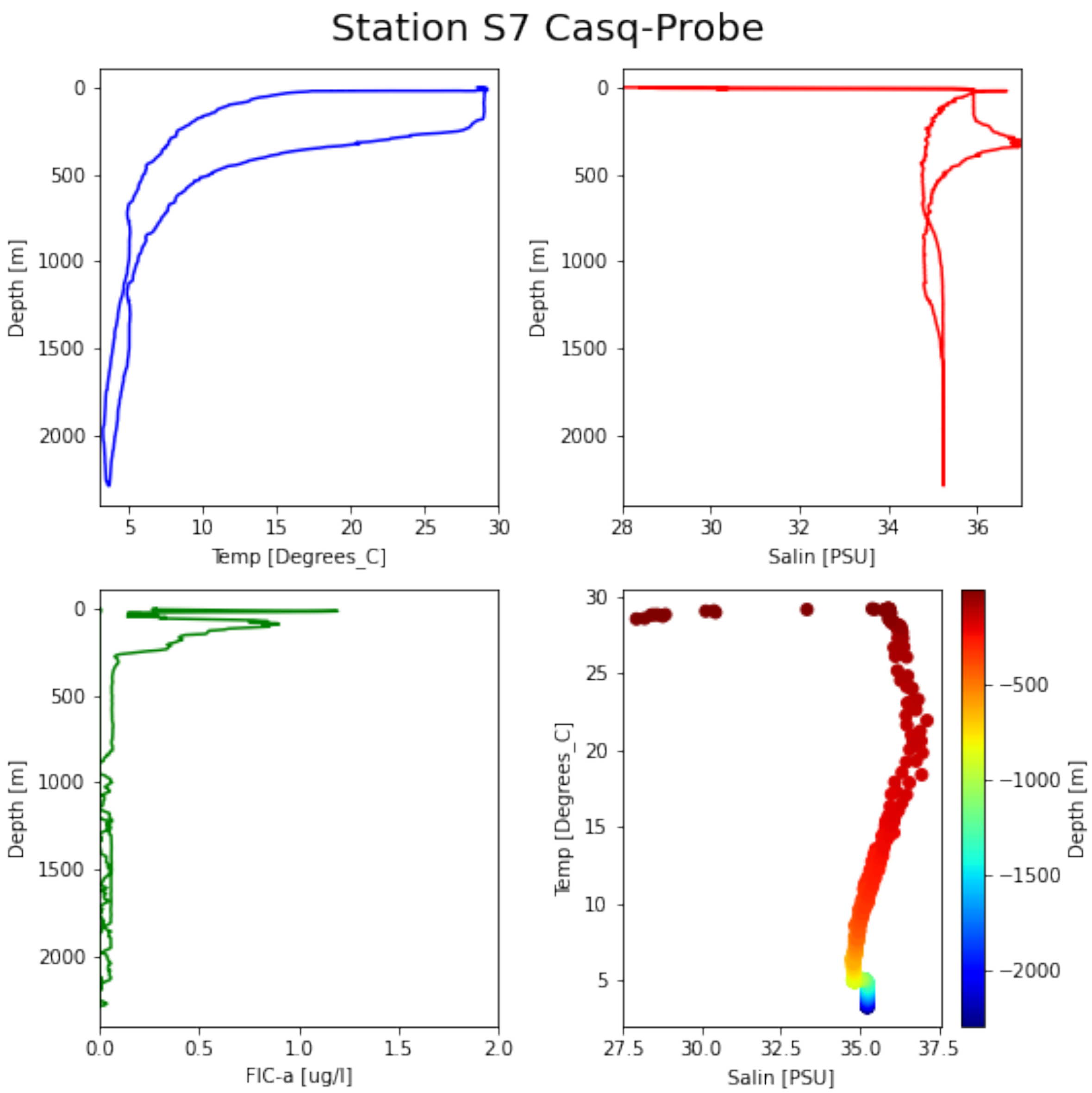


Figure 45: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S7.

3.4.1.2 Multicore MD23-3654MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **15/06/2023**
Core MD23 - 3654MC	*Station* ***S7***	*Operator* **4-8 ; 8-12**

Comments

Andre BELEM took supernatant water above one of the core

17 cm depth (core A) Bioturbated sandy sediment changes to sandy mud

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? (example for type: 1-cm slice)	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	27 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 4-8 **type:** 1-cm slice		yes / no	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	27 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
C	26 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	*Found a worm (~3 cm) between 15 and 20 cm depth*
D	24.5 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	

Figure 46: Coring information of multicore MD23-3654MC

3.4.1.3 Casq core MD23-3655Q

Cruise Name
MD241-AMA2-Leg2

Date : **15/06/2023**
station N° : **S7**

Weather information
Wind speed: **11 knots**
Wind direction: 71,00 °
Sea : 1 m

Core (N°) :
MD23-3655Q

Core Length:
8,62 m

Position (posidonia)
Latitude : 06 ° 5.445 N
Longitude : 51 ° 21.569 W

Corer (type) : **CASQ**
total weight (air) : t
total weight (water) : **surface** **6,3 t**
extraction **7,2 t**

TUNINGS :
Tubes (length) : **12,00 m**
Cables :
Free fall : **m**
theoritical elastic rebound **m**
loop length **m**
counterweight cable length **m** (3m50 lest)

Résultats CINEMA
thickness sediment sampled
thickness sediment cored **m**

Measured Parameters :
multibeam water depth **2278** m
released cable length : m
Extraction/total *(tons)* : **9,70** t
extraction/differential *(tons)* : t

TIME (GMT)
On station : **04:36 GMT**
Beginning of operation : **08:45 GMT**
Triggering : **10:55 GMT**
End of operation : **13:30 GMT**
Duration of operation : **4h15**

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other **Calypso**

Description : Descriptions and MSCL on line C
One bag with core top sediment and another with core catcher sediment
Sampling for Martine Couapel
Incidents :

1st level: two large boxes A and B.

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 855	
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII	

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 859		
B-I	B-II	B-III	B-IV	B-V	B-VI		

2nd level: 2 small boxes C and D + 2 u-channels

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 857		
C-I	C-II	C-III	C-IV	C-V	C-VI		

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 857	
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII	

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 857		
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI		

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 857	
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII	

3rd level: 2 s,qll boxes E, F qnd G

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 862		
E-I	E-II	E-III	E-IV	E-V	E-VI		

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 852	
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 862		
G-I	G-II	G-III	G-IV	G-V	G-VI		

Figure 47: Coring information of Casq core MD23-3655Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3655Q** -Core length **8,62 m**
Station: S7 -Latitude: **6°05.445 N**-Longitude: **51°21.569 W**
-Water Depth : **2278 m**

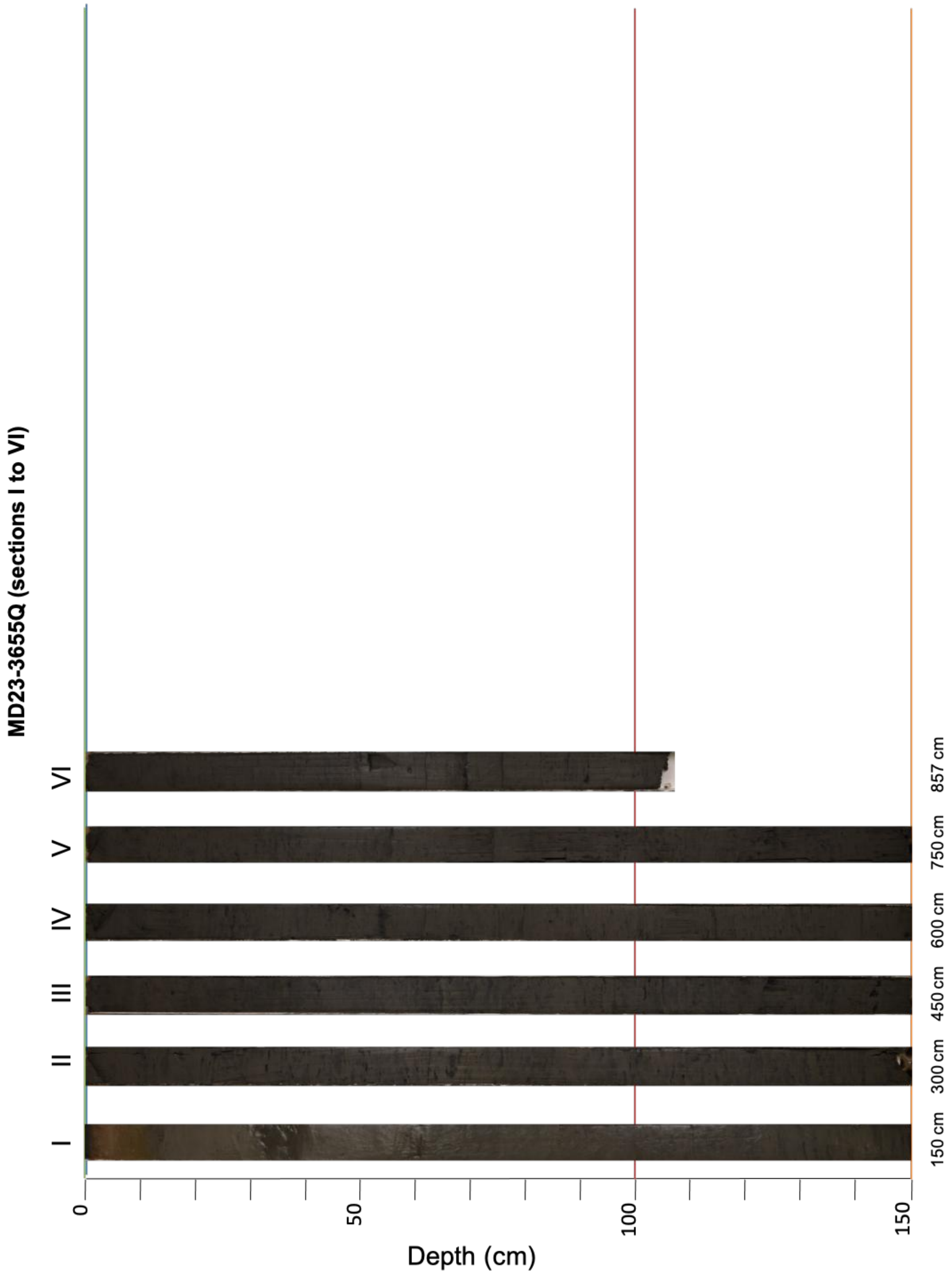
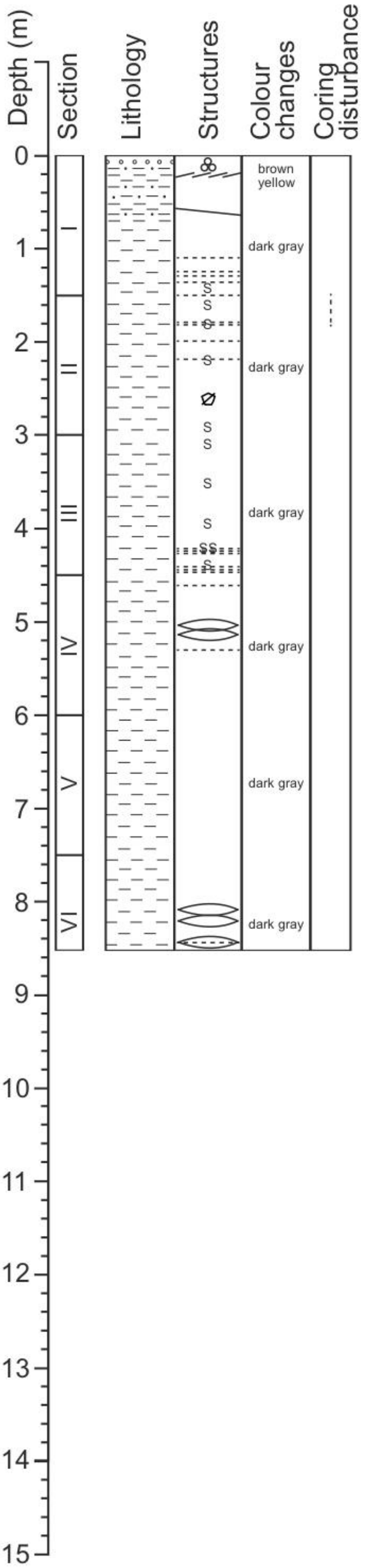


Figure 48: Pictures of Casq core MD23-3655Q.

MD241-AMA2-Leg2	MD23-3655Q	Position: 6°05.410'N 51°21.564'W
Station S7	Sediment description (1/1)	Water-depth: 2278 m Core length: 8.62 m



Comments

Homogeneous gray mud with darker marks or laminea throughout the core sections
First 60 cm high content of sand
Darker marks or laminea (manganese ?)

Contents :
- Rare shells or fragments shells from the first 2 sections (foraminifera ?)
- Some weakly bioturbations from the first 3 sections
- Some holes and lines coring distrubances from section II

Contacts :
- Gradational 16 cm
- Obliquous sharp 58-60 cm

End of the core : 857 cm

Figure 49: Sediment description of Casq core MD23-3655Q

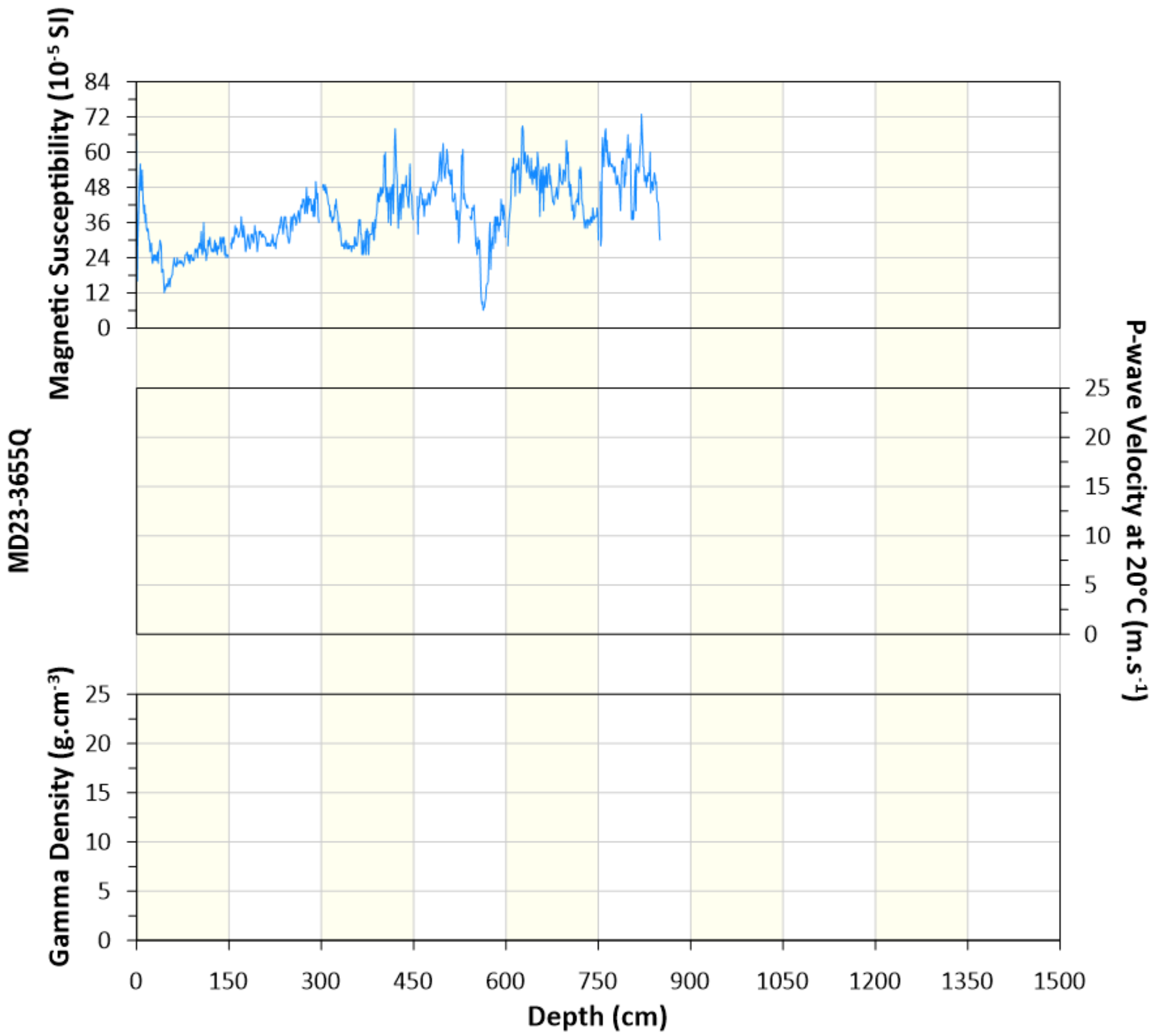


Figure 50: Physical properties of Casq core MD23-3655Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

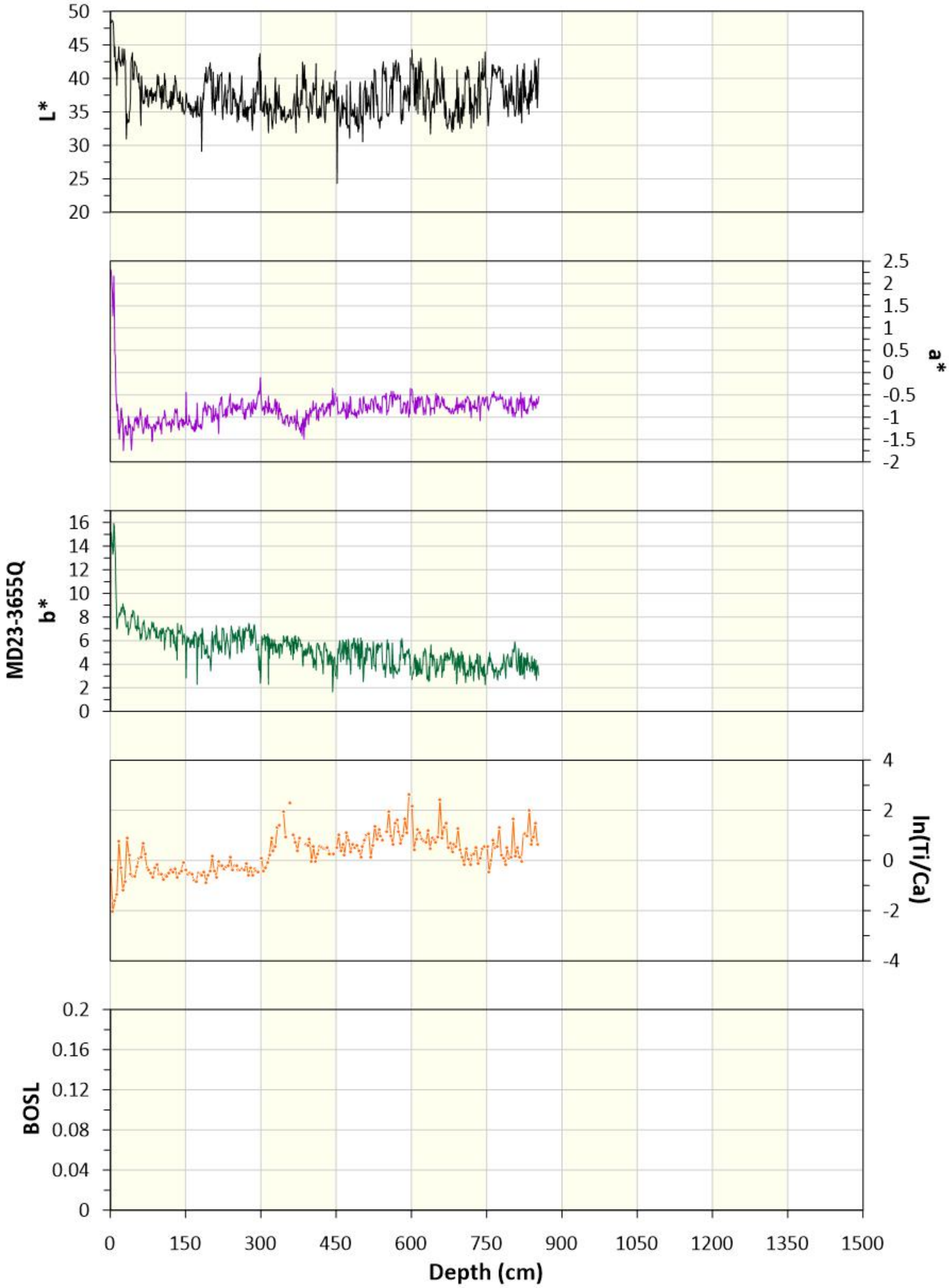


Figure 51: Spectrophotometry (L, a*, b*), X-ray Fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3655Q*

3.4.1.4 Calypso core MD23-3656

Cruise Name MD241-AMA2-Leg2	Date : 15/06/2023 station N° : S7	Weather information Wind speed: 12,2 knots Wind direction: 99,00 ° Sea : m
Core (N°) : MD23-3656	**Core Length:** 42,2 m	**Position (posidonia)** Latitude : 6°5.432 N Longitude : 51°21.560 W
Corer (type) : Calypso total weight (air) : t total weight (water) : surface 7,2 t bottom t	**TUNINGS :** Tubes (length) : 46,25 m Cables : Free fall : 1,50 m theoritical elastic rebound 5,80 m loop length 5,54 m counterweight cable length m (3m50 last)	**Résultats CINEMA** thickness sediment sampled m thickness sediment cored m
Measured Parameters : multibeam water depth 2 278 m released cable length : m Extraction/total *(tons)* : 16,39 t	**TIME (GMT)** On station : 08:38 GMT Beginning of operation : 13:45 GMT Triggering : 17:07 GMT End of operation : 21:00 GMT Duration of operation : 7h15	**INSTRUMENTATION Other OPERATIONS on site** MUC CTD-Rosette Small CTD Small Niskin Other : CASQ

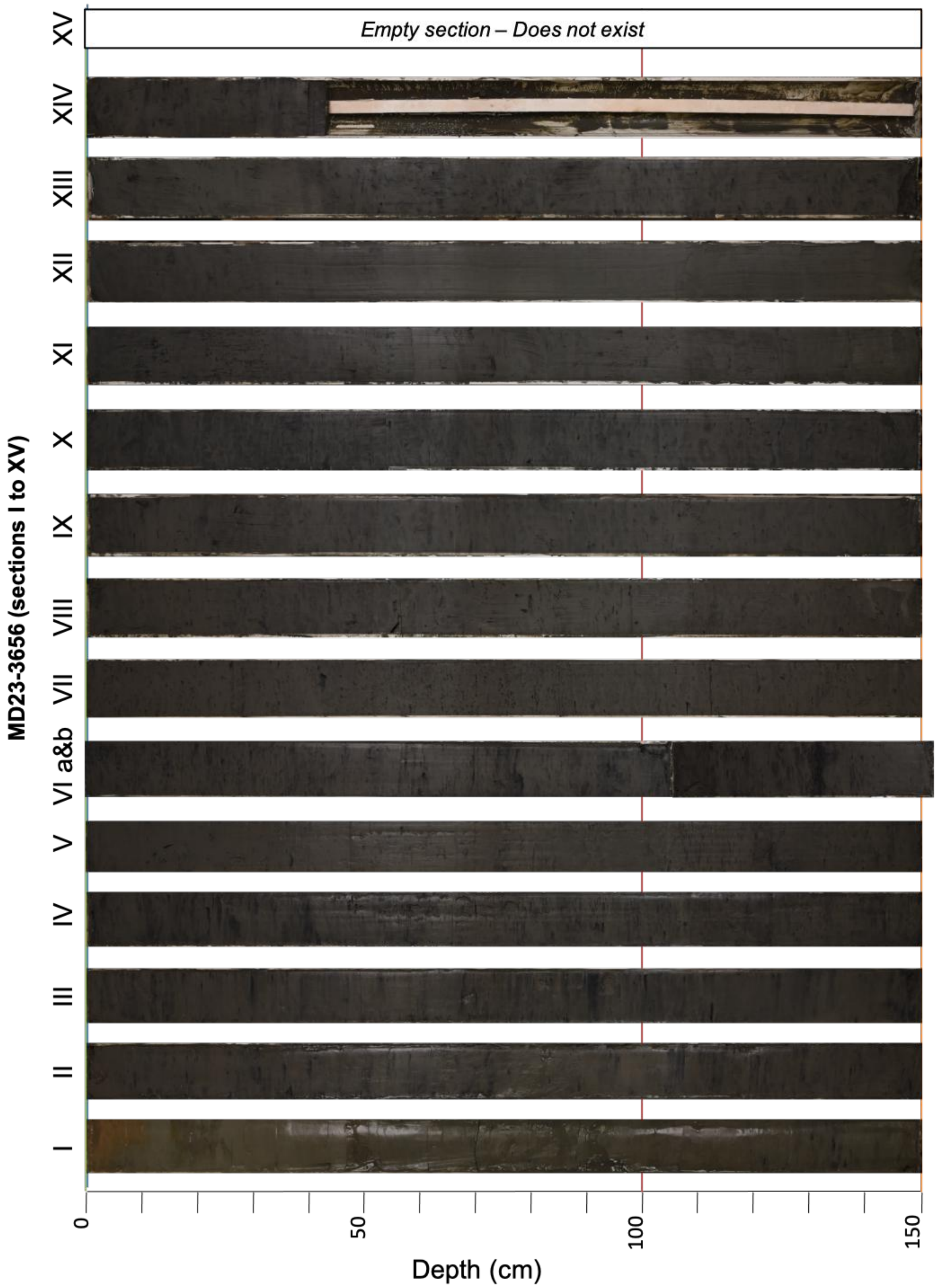
Description : coretop sed in a bag. Three syringes of core catcher in another bag.

Incidents : top of the pipe slightly bent. Core cut in two for extraction from the pipe: 8.54 m + 33.70 m = 42.24 m. Section XV and part of section XIV full of water and emptied at

Section	Top (cm)	Bottom (cm)
I	0	150
II	150	300
III	300	450
IV	450	600
V	600	750
VIa	750	854
VIb	854	900
VII	900	1050
VIII	1050	1200
IX	1200	1350
X	1350	1500
XI	1500	1650
XII	1650	1800
XIII	1800	1950
XIV	1950	2100
XV - empty	2100	2250
XVI	2250	2400
XVII	2400	2550
XVIII	2550	2700
XIX	2700	2850
XX	2850	3000
XXI	3000	3150
XXII	3150	3300
XXIII	3300	3450
XXIV	3450	3600
XXV	3600	3750
XXVI	3750	3900
XXVII	3900	4050
XXVIII	4050	4150
XXIX	4150	4224

Figure 52: Coring information of Calypso core MD23-3656. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3656** -Core length **42,24 m**
Station: S7 -Latitude: **6°05.432 N**-Longitude: **51°21.560 W**
-Water Depth : **2278 m**



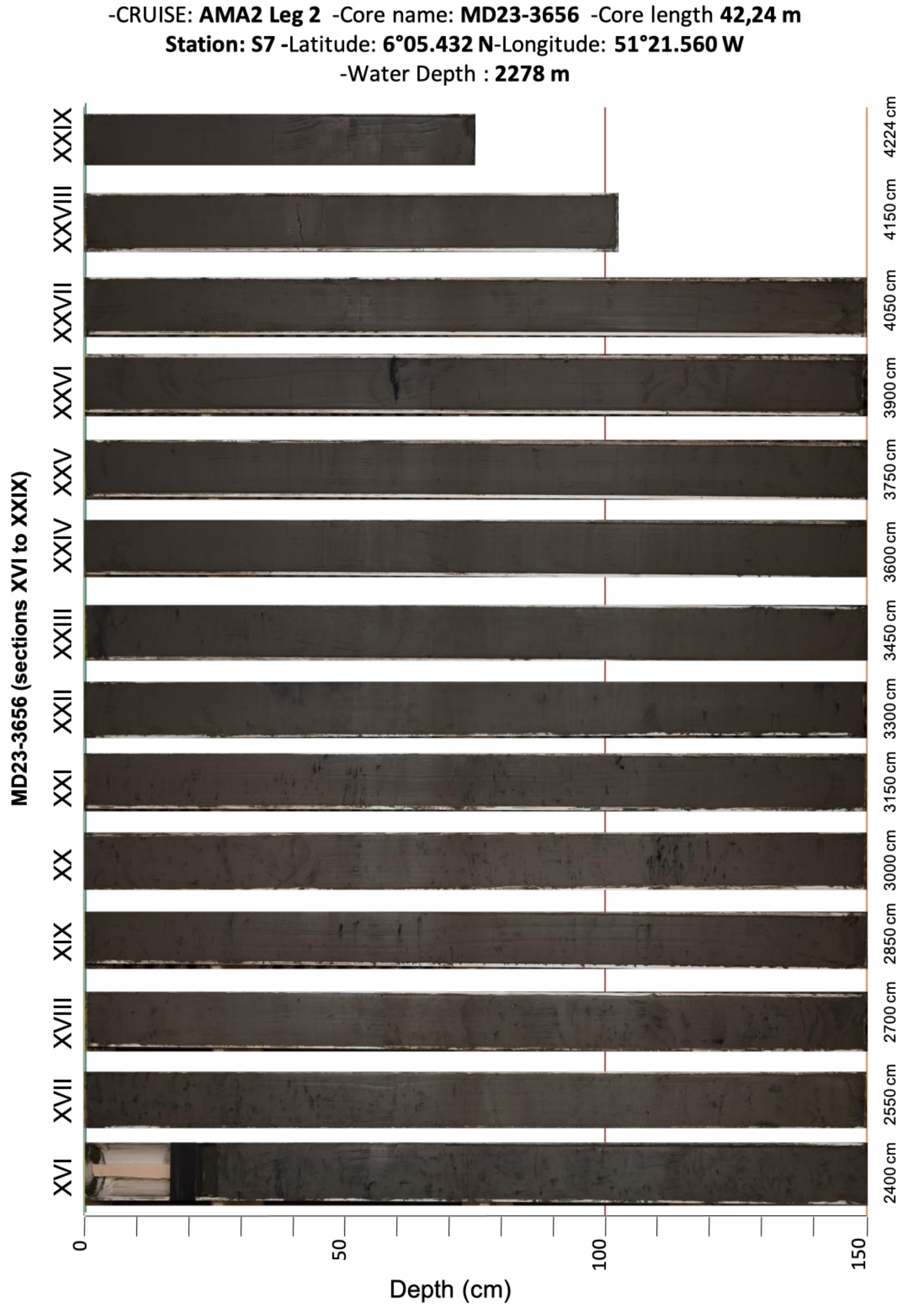
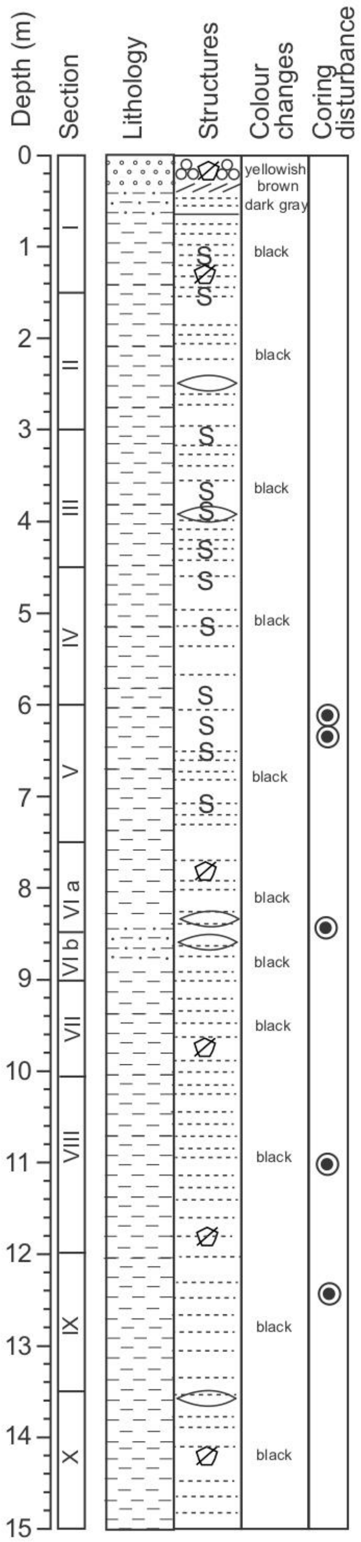


Figure 53: Pictures of Calypso core MD23-3656.

MD241-AMA2-Leg2 Station S7	MD23-3656 Sediment description (1/3)	Position: 06°05.431'N 51°21.560'W Water-depth: 2.278 m Core length: 42.24 m



Comments

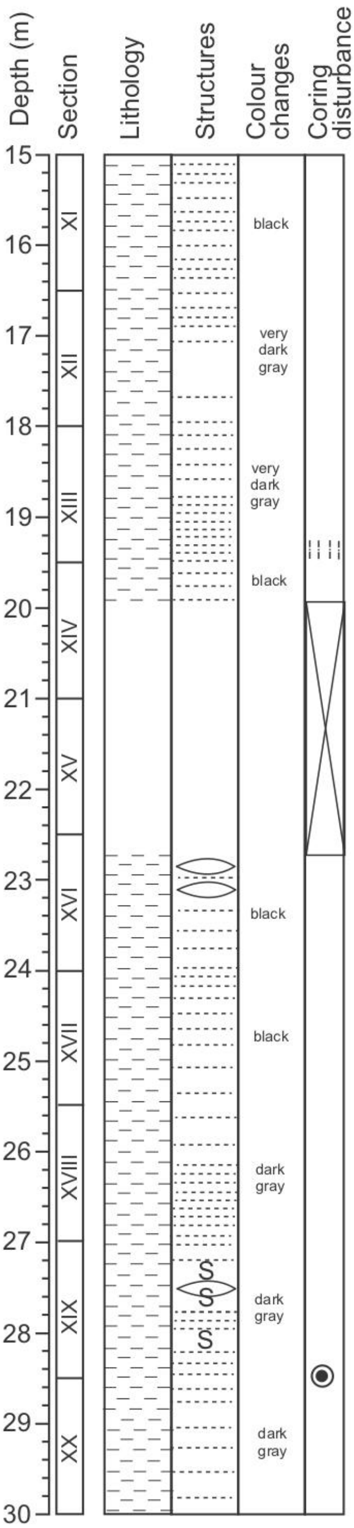
General Aspect:
Homogenous dark mud with black spots (manganese nodules?), moderate bioturbation, shell fragments and lens of darker material.

0-26cm: Heterogenous yellowish brown sandy layer with shell fragments and forams(??)

26cm: Gradational contact

26-1500cm: Homogenous black mud with plenty of black spots (manganese precipitation?), sparse lens of darker mud and shell fragments, moderate bioturbation. Occasional holes (sampling disturbance or bioturbation?)

MD241-AMA2-Leg2	MD23-3656	Position: 06°05.431'N 51°21.560'W
Station S7	Sediment description (2/3)	Water-depth: 2.278 m Core length: 42.24 m



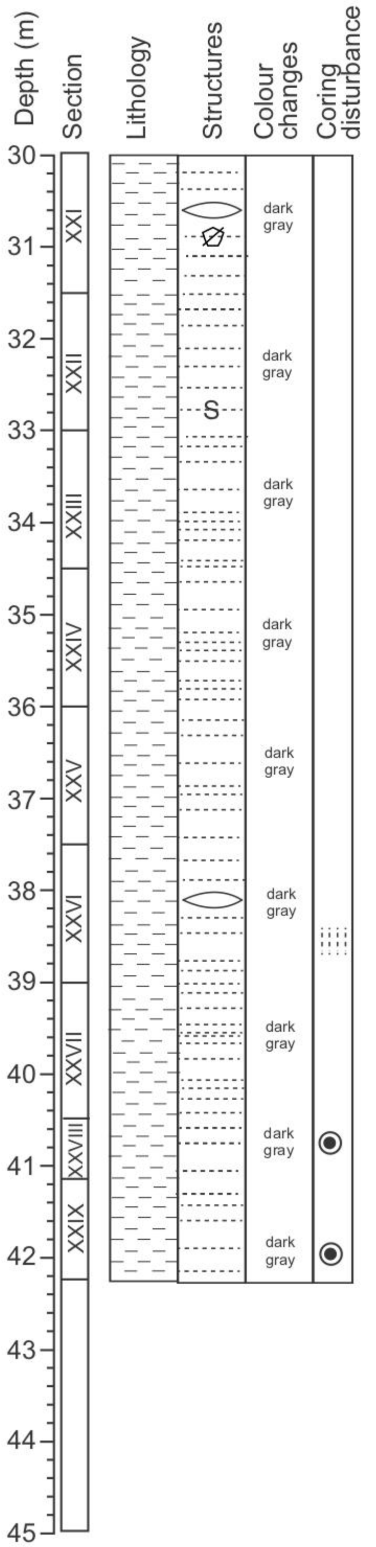
Comments

General Aspect:
Homogenous dark mud with black spots (manganese nodules?), few bioturbation and sparse lens of darker material.

1947-1950cm: Moderate core sampling disturbance

1990-2275cm: Void

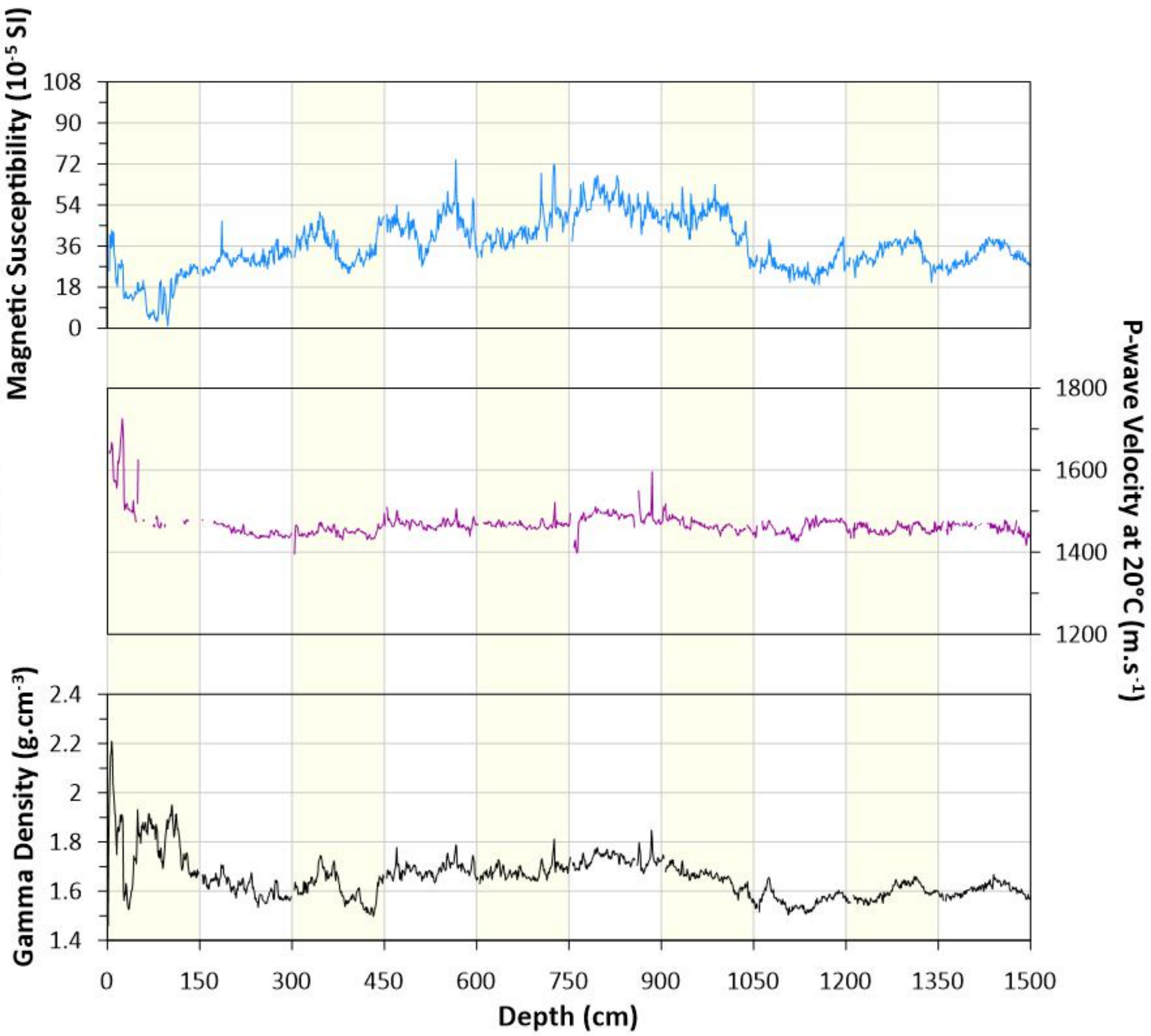
MD241-AMA-Leg2	MD23-363656	Position: 06°05.431'N 51°21.560'W
Station S7	Sediment description (3/3)	Water-depth: 2.278 m Core length: 42.24 m

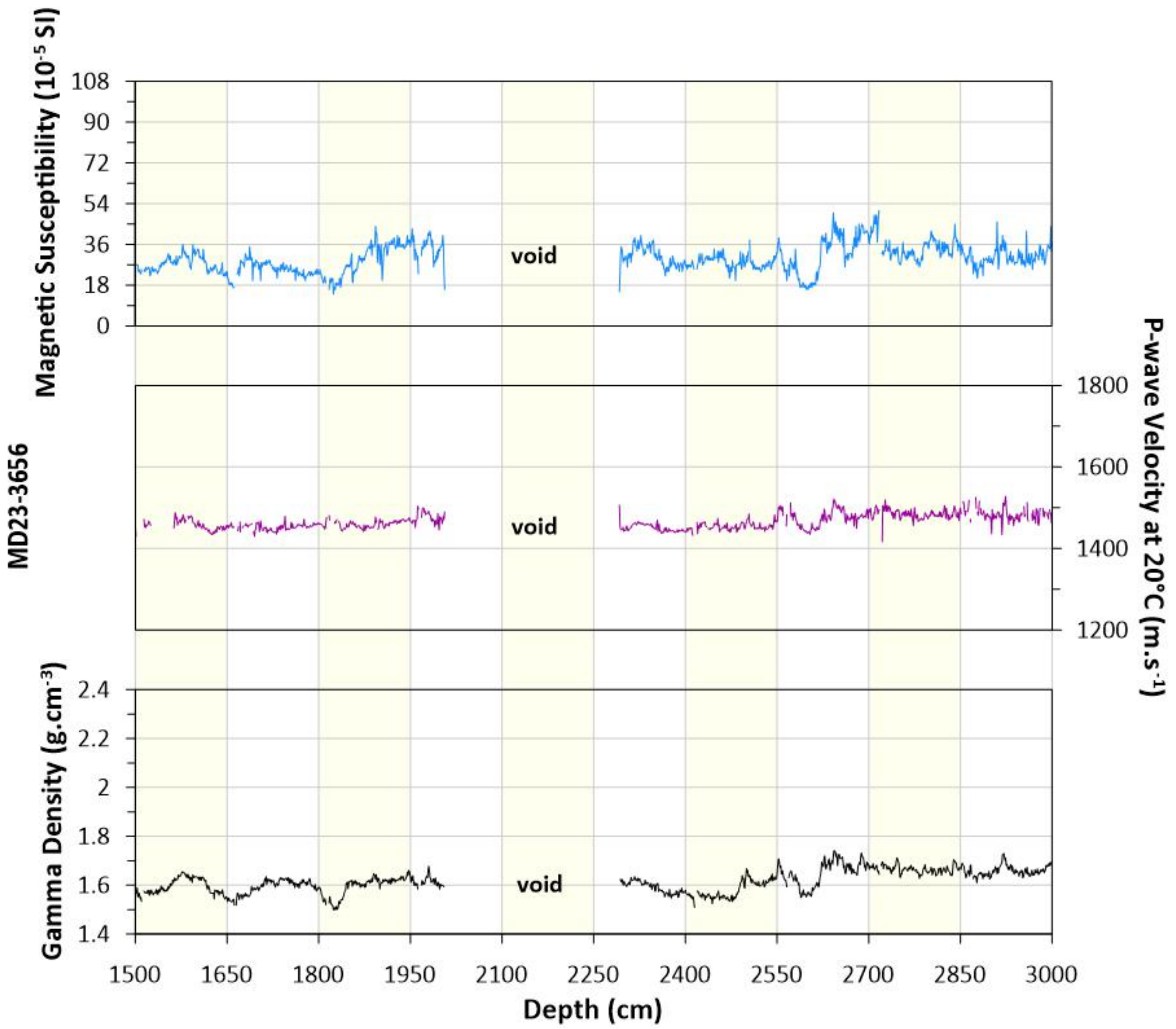


Comments

General Aspect:
Homogenous dark mud with black spots (manganese nodules?), few bioturbation, shell fragments and lens of darker material.

Figure 54: Sediment description of Calypso core MD23-3656.


Magnetic Susceptibility (10-5 SI)
108
90
72
54
36
18
0
MD23-3656
P-wave Velocity at 20°C (m.s-1)
1800
1600
1400
1200
Gamma Density (g.cm-3)
2.4
2.2
2
1.8
1.6
1.4
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)


Magnetic Susceptibility (10^{-5} SI)
108
90
72
54
36
18
0
void
MD23-3656
P-wave Velocity at 20°C (m.s^{-1})
1800
1600
1400
1200
void
Gamma Density (g.cm^{-3})
2.4
2.2
2
1.8
1.6
1.4
void
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

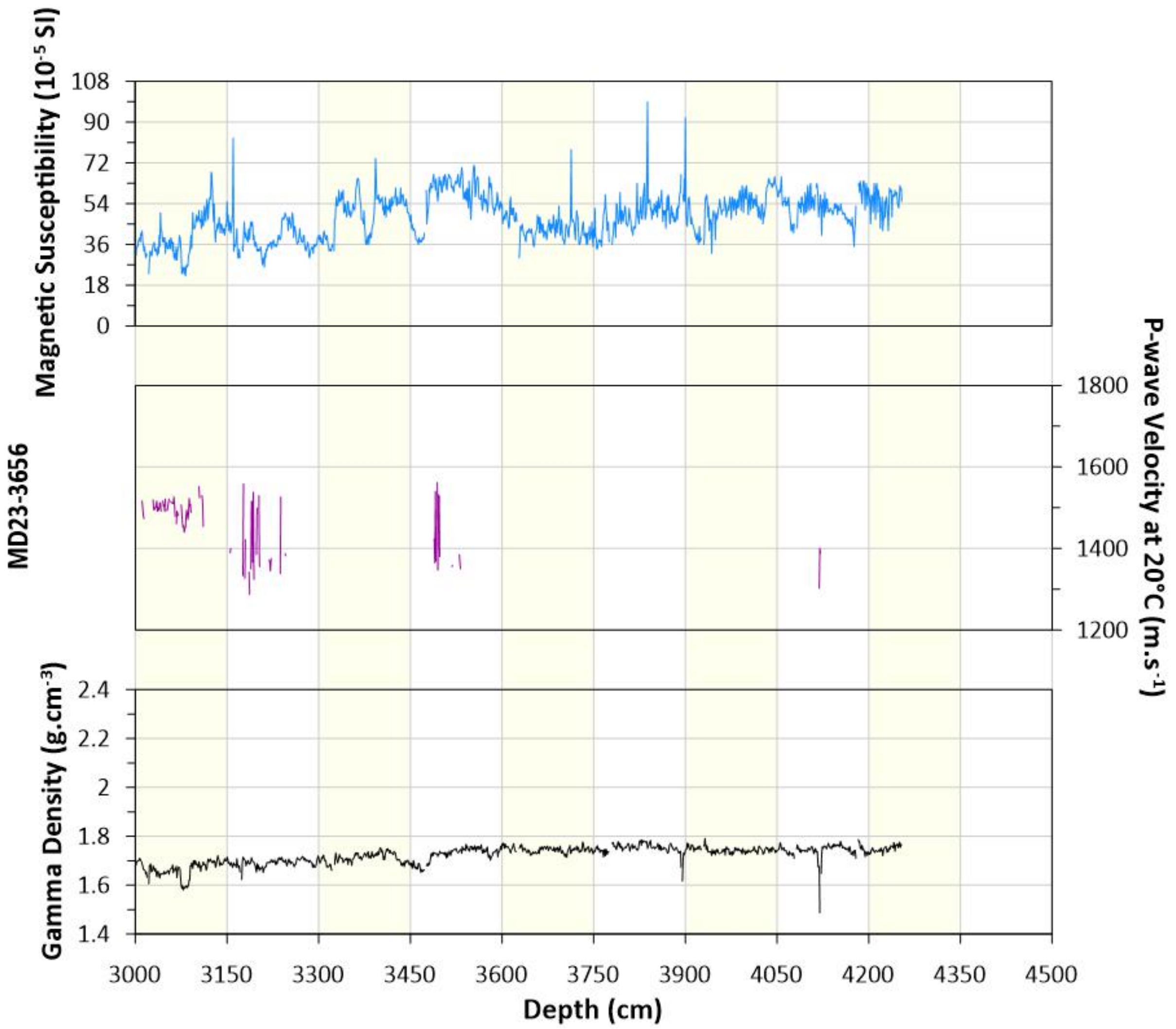
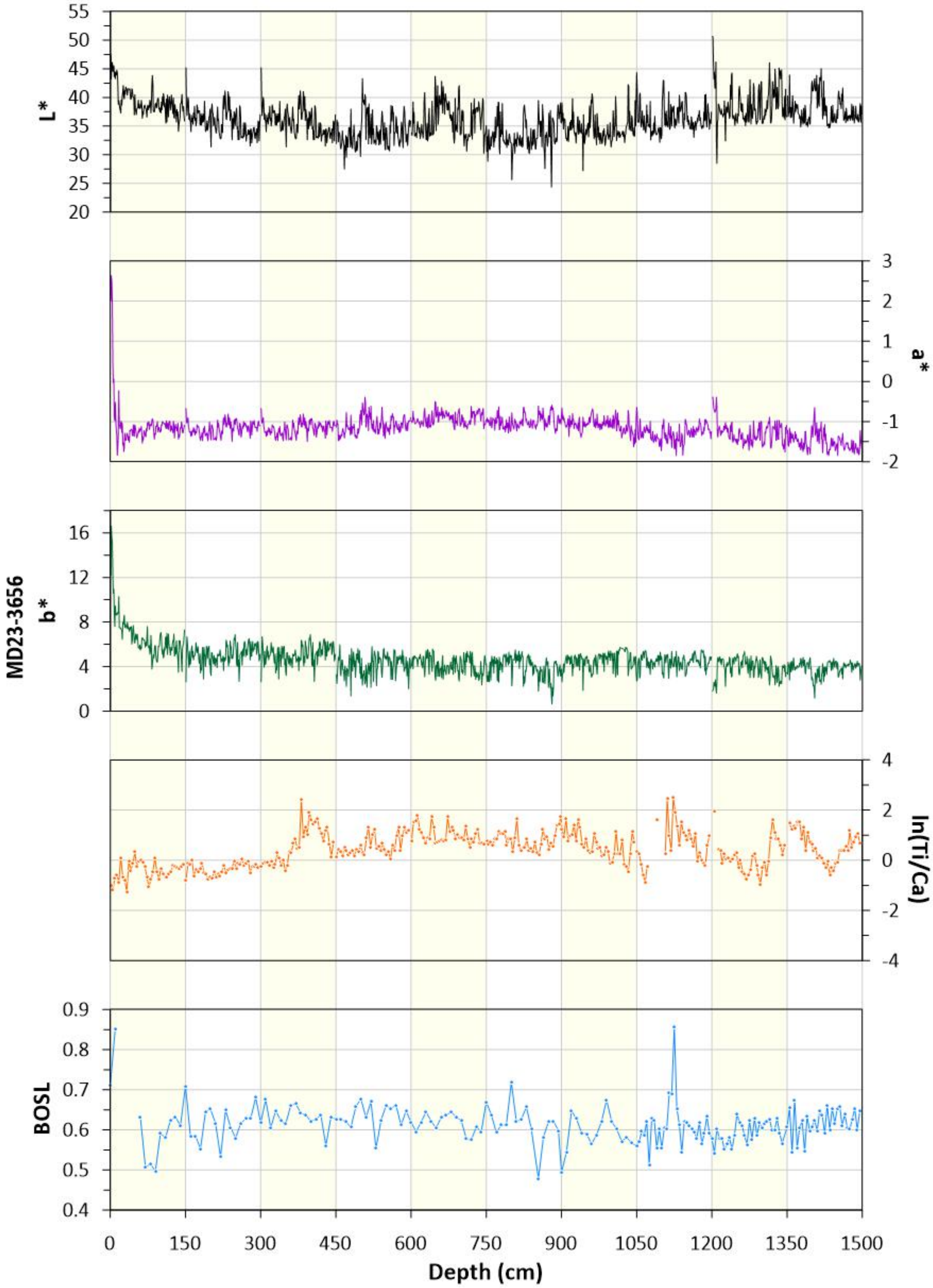
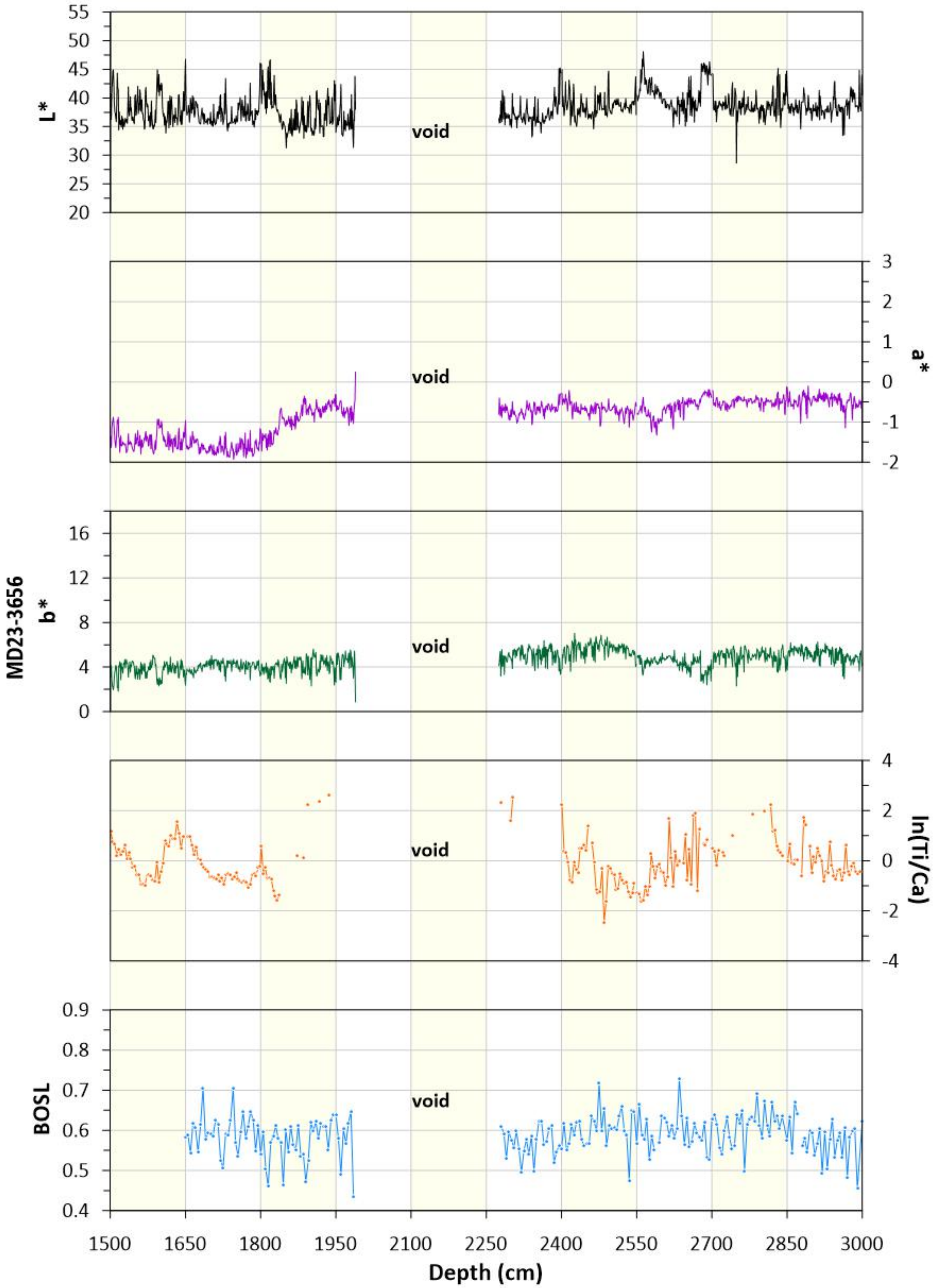


Figure 55: Physical properties of Calypso core MD23-3656. The quality of P-wave velocity measurements is reduced in lower core sections, explaining the absence of plotted data.


L*
a*
MD23-3656
b*
ln(Ti/Ca)
BOSL
Depth (cm)


L*
void
a*
void
MD23-3656
b*
void
ln(Ti/Ca)
void
BOSL
void
Depth (cm)

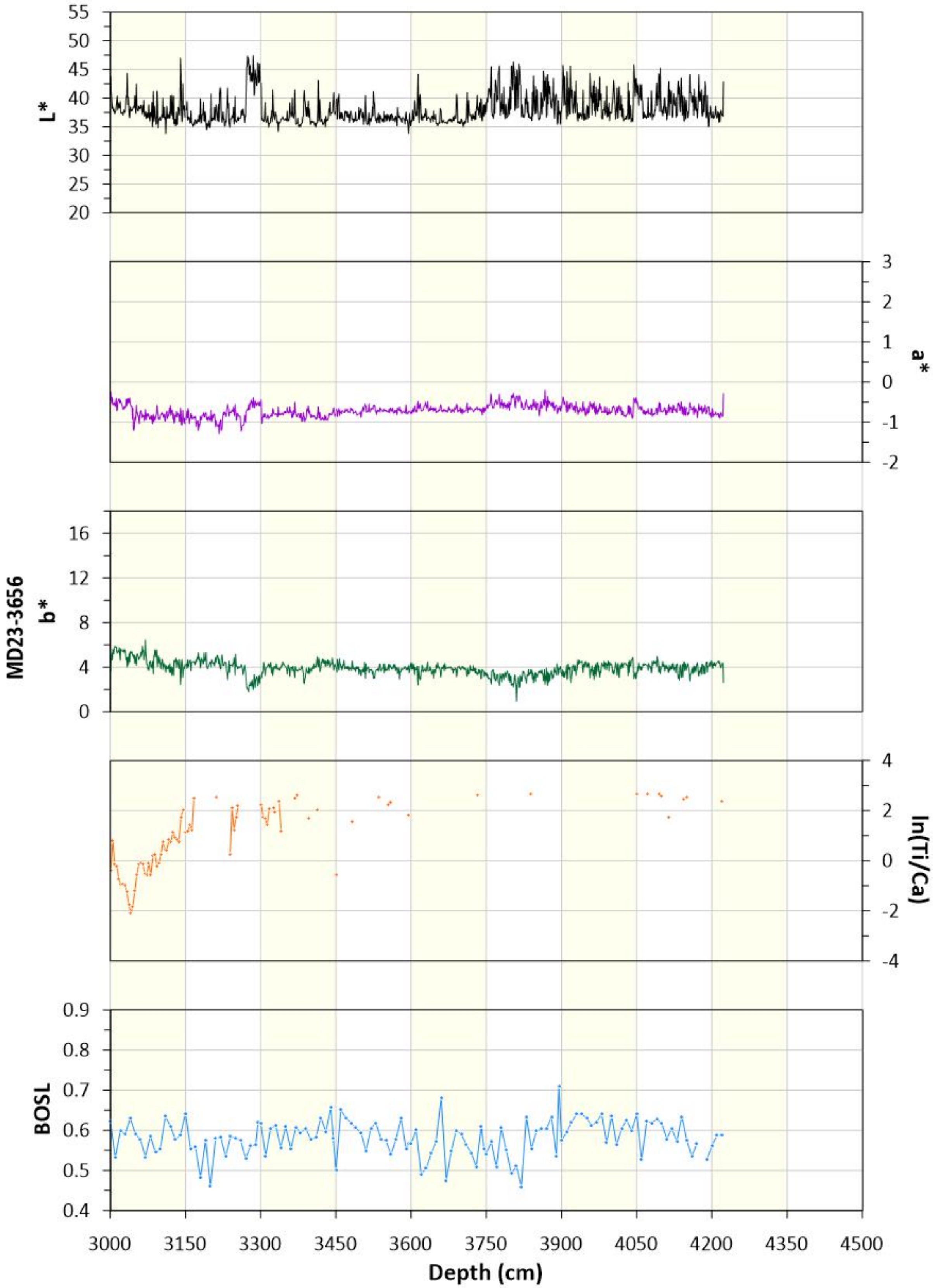


Figure 56: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3656. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

Because core MD23-3656 has been bent, there is no figure comparing the recovered sediment thickness to the in-situ sediment layers computed by the CINEMA software for this Calypso core. Despite the bent pipe, the sediment of core MD23-3656 seems to show little disturbance.

3.4.2 Station S8

Station S8 has been cancelled by lack of specific Brazilian authorization (see section 1.2, page 9).

3.4.3 Station S9

3.4.3.1 Station S9 information

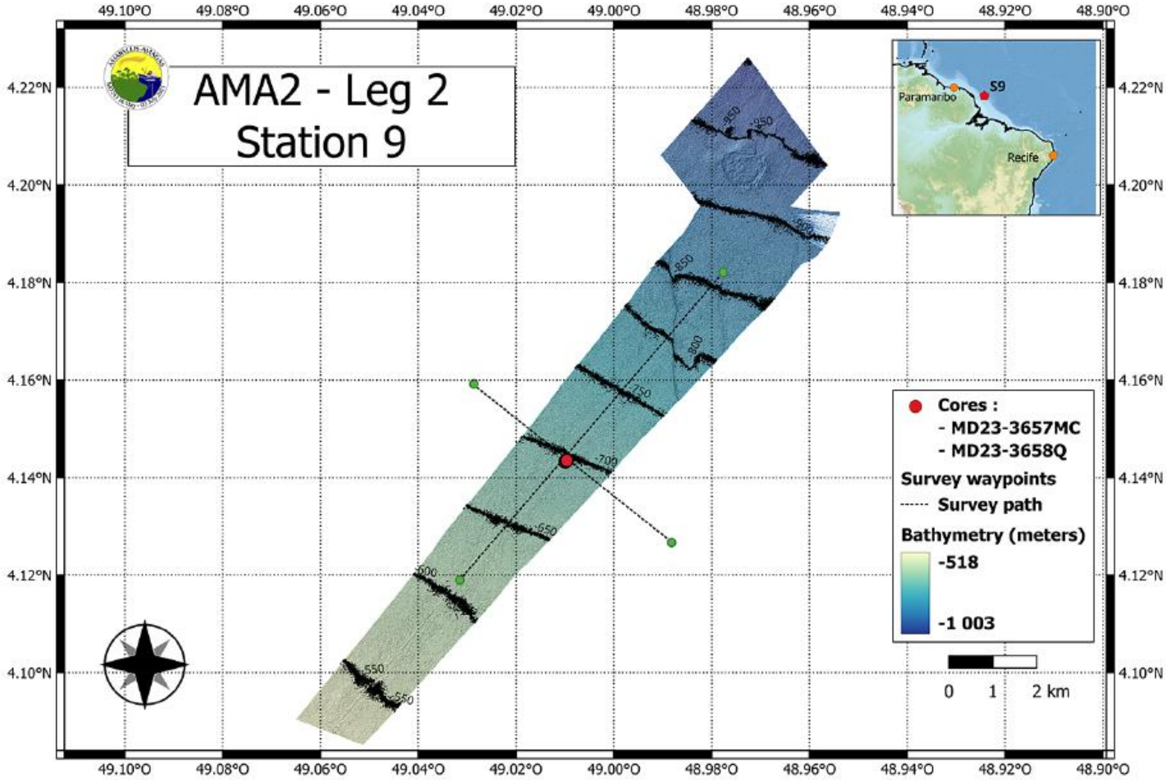


Figure 57: Bathymetric map at station S9.

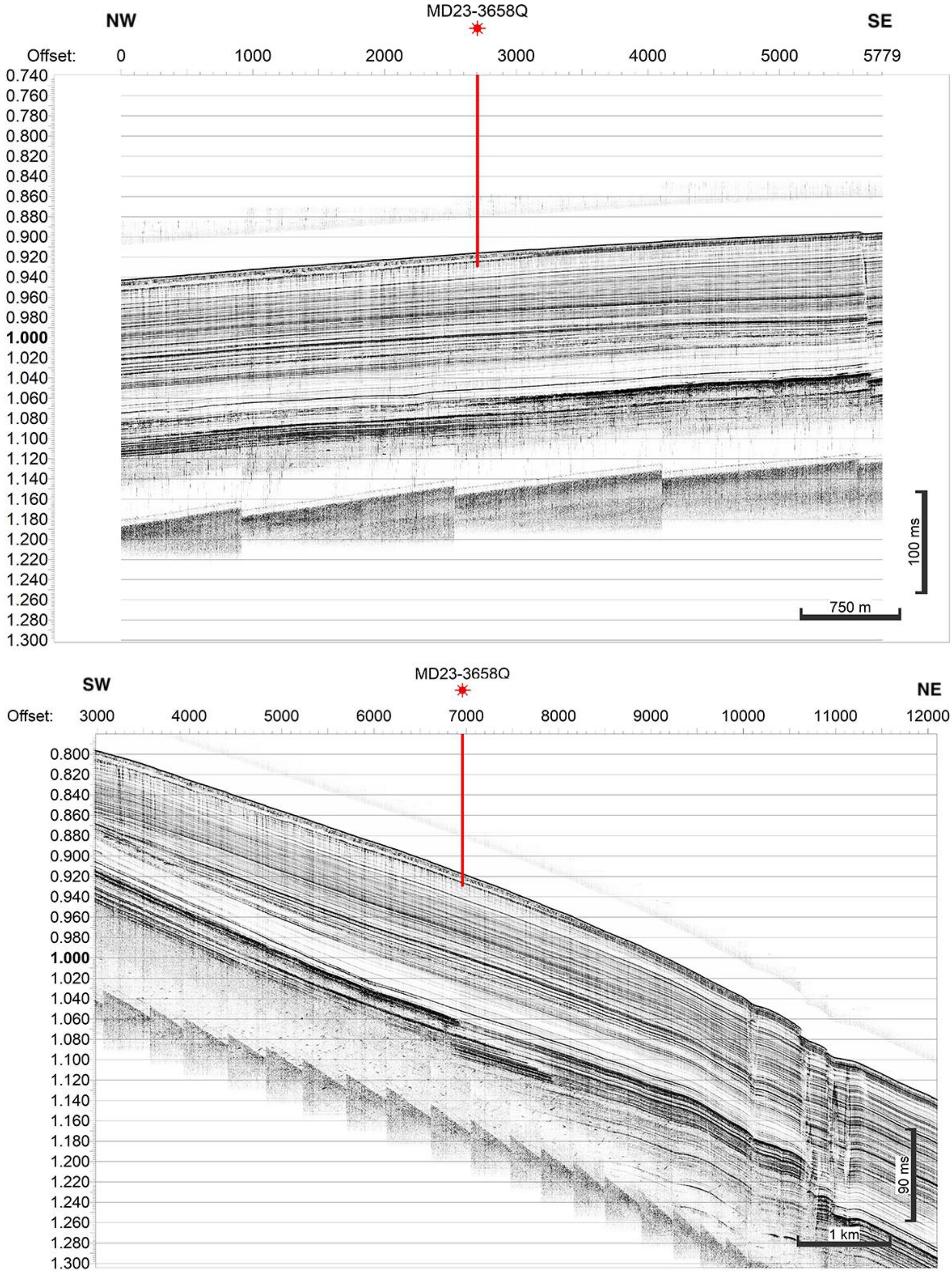


Figure 58: (top) NW-SE and (bottom) SW-NE subbottom profiles at station S9. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

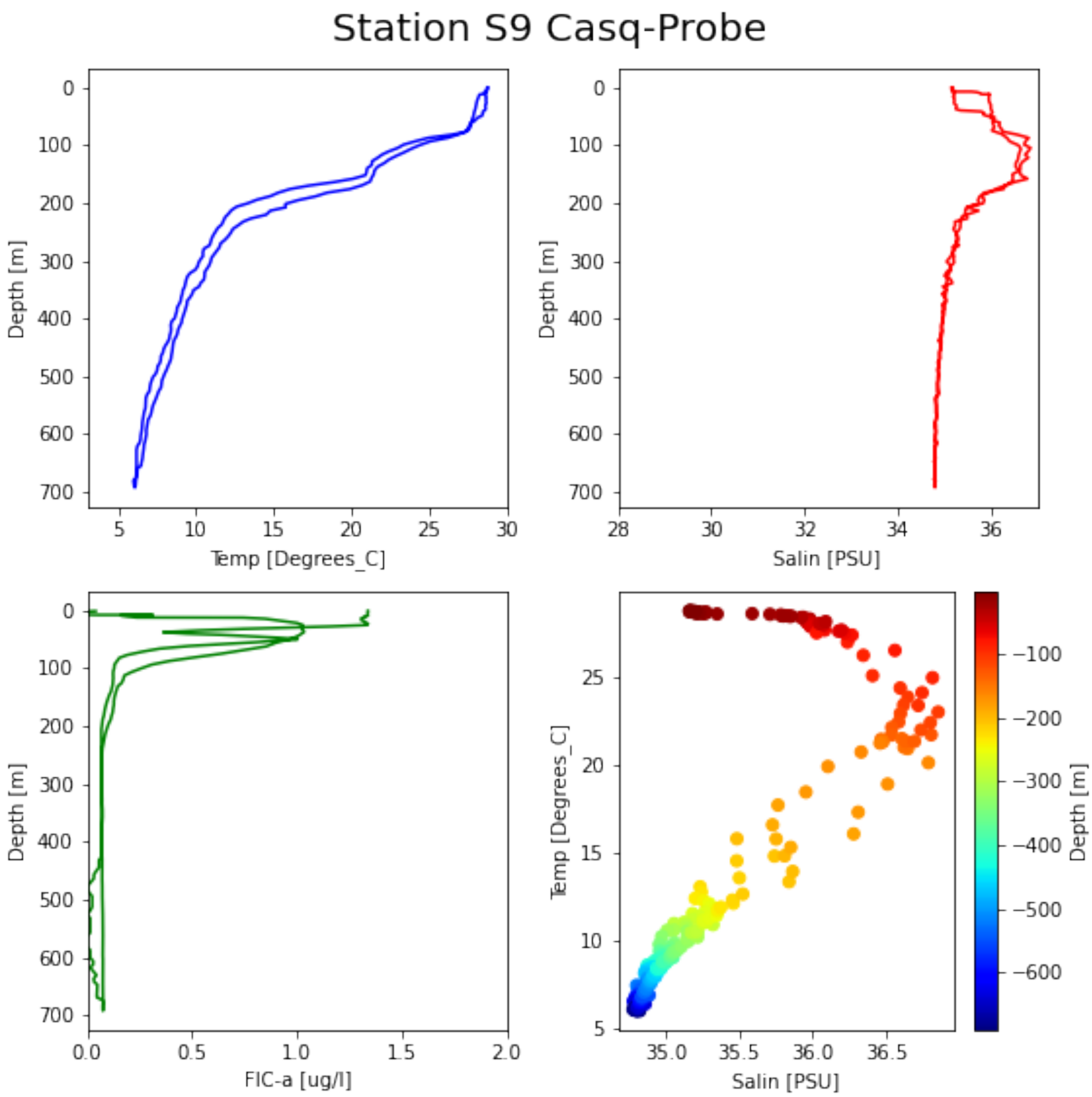


Figure 59: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S9.

3.4.3.2 Multicore MD23-3657MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **16/06/2023**
Core MD23 - 3657MC	*Station* ***S9***	*Operator* **4-8 ; 8-12 ; 0-4**
Comments *Andre BELEM took supernatant water above core A* *Elisabeth MICHEL took supernatant water above core B*		

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? (example for type: 1-cm slice)	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	38.5 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ~~no~~	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	38.5 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		**yes** / ~~no~~	~~yes~~ / **no**	
C	40 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
D	37 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 4-8 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	*Sample 16-17 has bivalves*

Figure 60: Coring information of multi-core MD23-3657MC.

3.4.3.3 Casq core MD23-3658Q

Cruise Name

MD241-AMA2-Leg2

Date : **16/06/2023**

station N° : **S9**

Weather information

Wind speed: **3.6 knots**
Wind direction: ##### °
Sea : m

Core (N°) :

MD23-3658Q

Core Length:

9.35 m

Position (posidonia)

Latitude : **04 ° 8.612 N**
Longitude : **49 ° 0.576 W**

Corer (type) : CASQ

total weight (air) : t

total weight (water) : **surface** **6.3 t**
extraction **7.2 t**

TUNINGS :

Tubes (length) : **12.00 m**

Cables :
Free fall : m
theoritical elastic rebound m
loop length m
counterweight cable length m (3m50 lest)

Résultats CINEMA

thickness sediment sampled

thickness sediment cored m

Measured Parameters :

multibeam water depth **695** m

released cable length : m

Extraction/total *(tons)* : **13.00** t

extraction/differential *(tons)* : t

TIME (GMT)

On station : **15:43 GMT**

Beginning of operation : **17:15 GMT**

Triggering : **18:19 GMT**

End of operation : **19:20 GMT**

Duration of operation : 2h

INSTRUMENTATION
Other OPERATIONS on site

MUC CTD-Rosette

Small CTD Small Niskin

Other : **Calypso taken during leg 1**

Description : Descriptions and MSCL on line C
Two bags with core top sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0–100	100–250	250–400	400–550	550–700	700–850	850–935
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII

0–150	150–300	300–450	450–600	600–750	750–850	850–935
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII

2nd level: 2 small boxes C and D + 2 u-channels

0–150	150–300	300–450	450–600	600–750	750–850	850–935
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–935
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII

0–150	150–300	300–450	450–600	600–750	750–850	850–935
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–935
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII

3rd level: 2 small boxes E, F and G

0–150	150–300	300–450	450–600	600–750	750–850	850–936
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–936
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII

0–150	150–300	300–450	450–600	600–750	750–850	850–936
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII

Figure 61: Coring information of Casq core MD23-3658Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3658Q** -Core length **9.35 m**
Station: S9 -Latitude: **4°08.612 N**-Longitude: **49°00.576 W**
-Water Depth : **695 m**

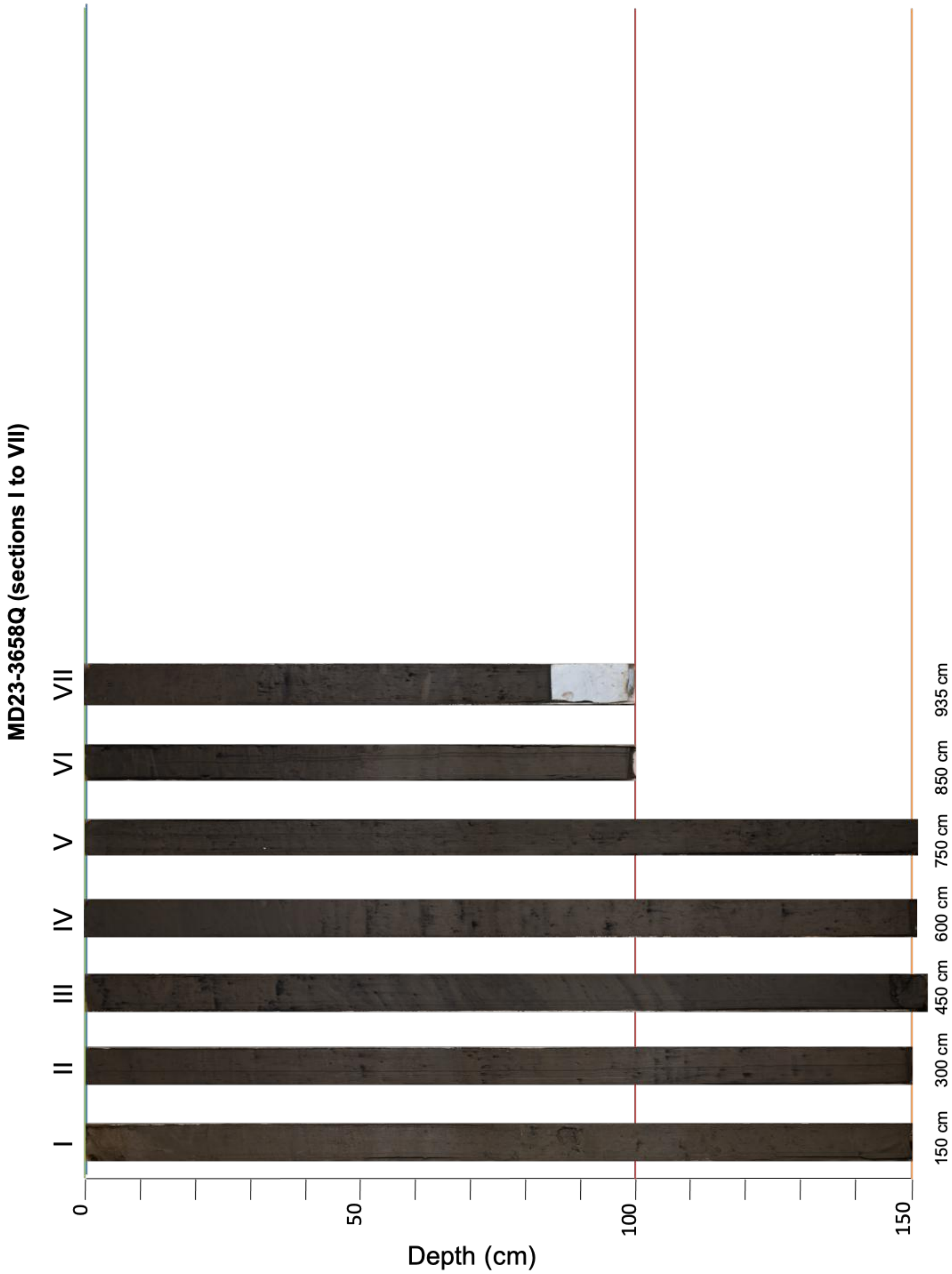
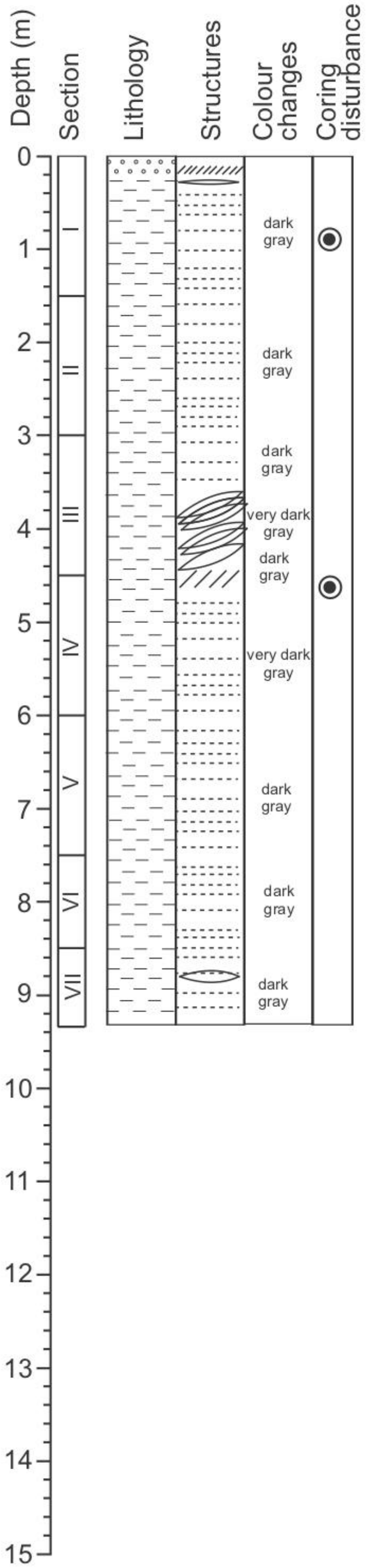


Figure 62: Pictures of Casq core MD23-3658Q.

MD241-AMA2-Leg2	MD23-3658Q	Position: 04°08.612'N 49°00.576'W Water-depth: 695 m
Station S9	Sediment description (1/1)	Core length: 9.35 m



Comments

Homogenous dark gray mud with balck spots with some very dark gray centimetric lens.

0-4cm: fine sand
20cm: fine sandy layer

350-430cm: obliquos centimetric mud darker lens

Figure 63: Sediment description of Casq core MD23-3658Q.

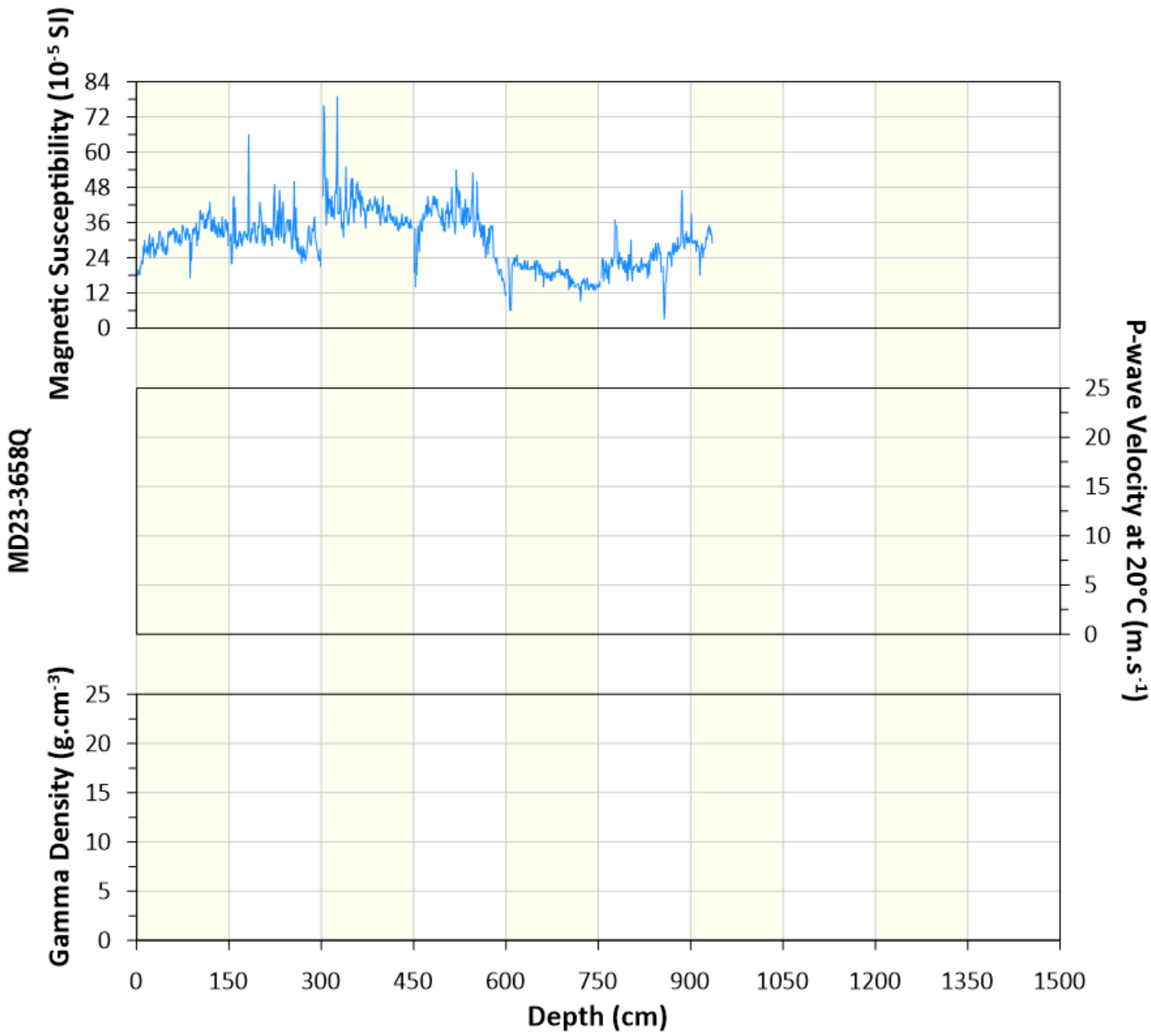


Figure 64: Physical properties of Casq core MD23-3658Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

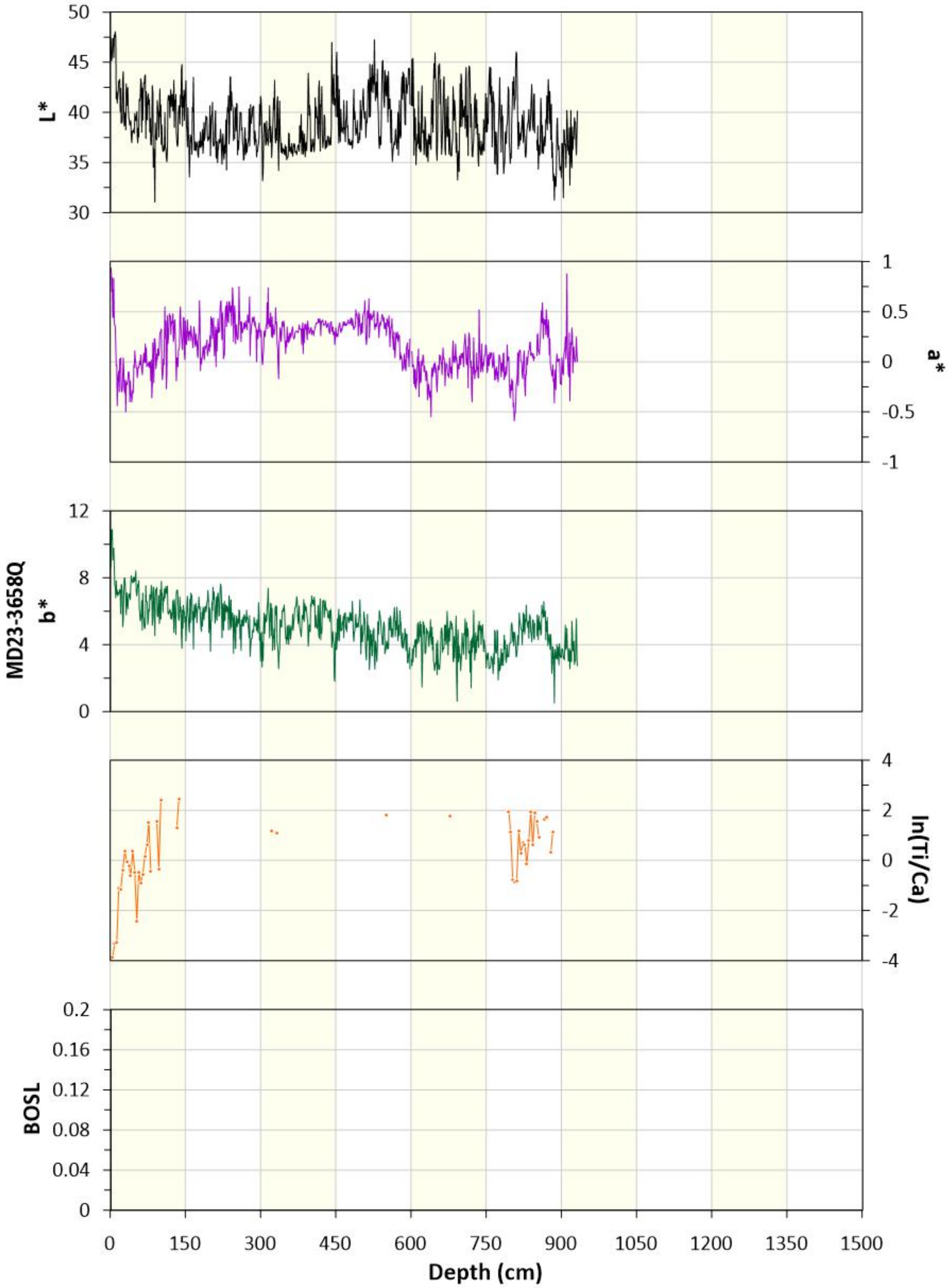


Figure 65: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3658Q. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

The Calypso core at station S9 has been collected during leg 1 (see section 1.2, page 9 and Table 1, page 11).

3.4.4 Station S10

3.4.4.1 Station S10 information

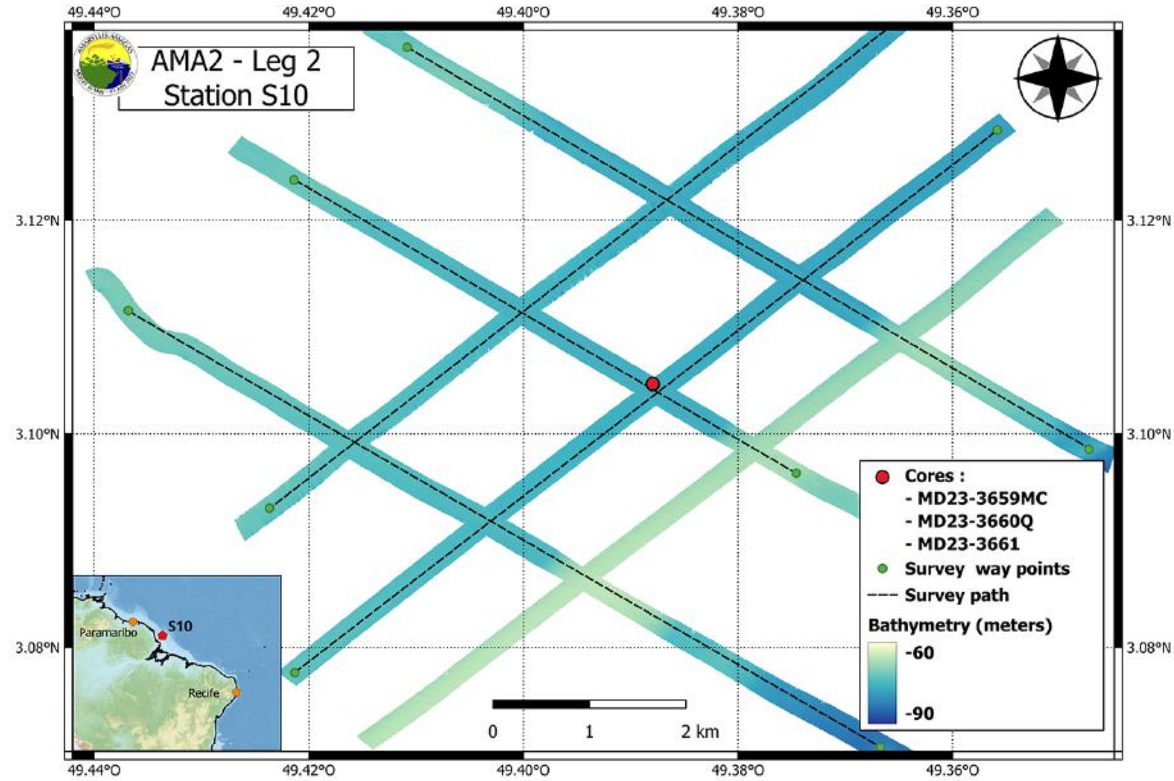
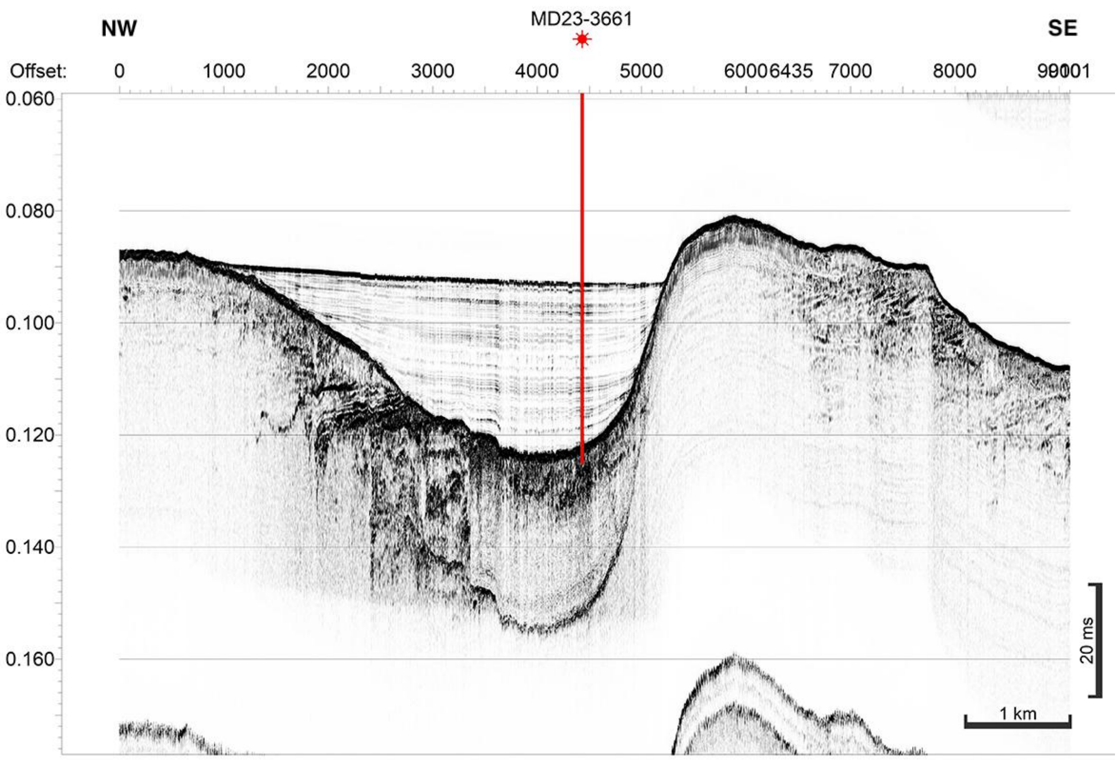


Figure 66: Bathymetric map at station S10.



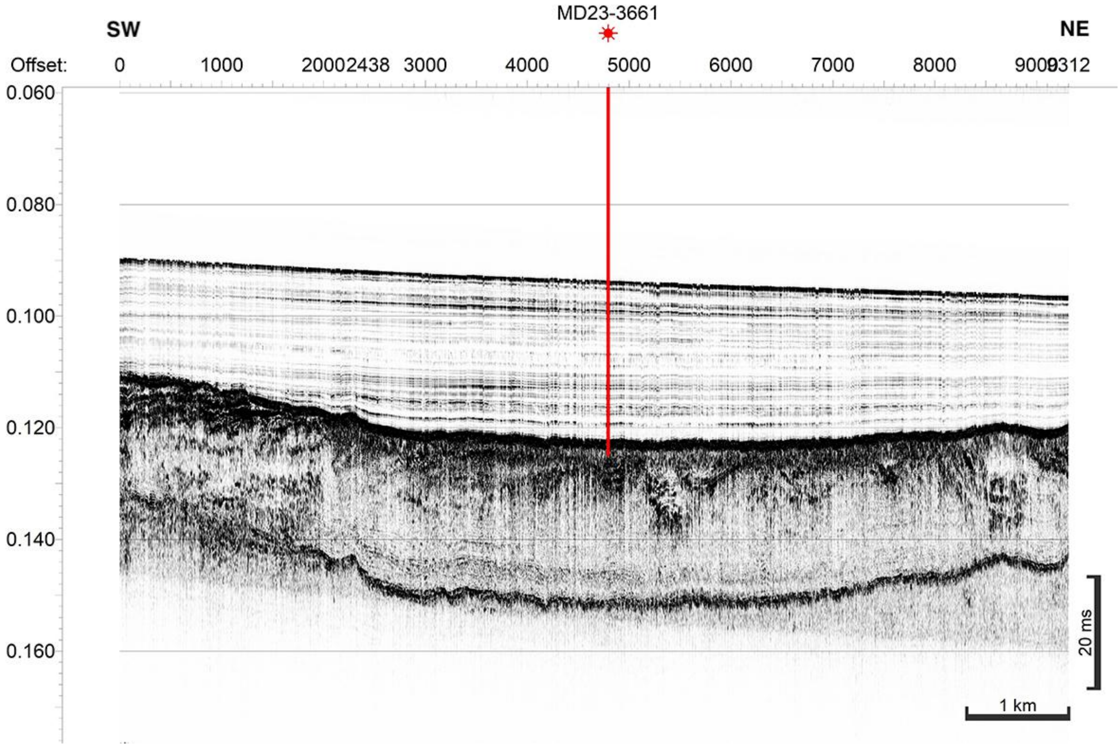


Figure 67: (top) NW-SE and (bottom) SW-NE subbottom profiles at station S10. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

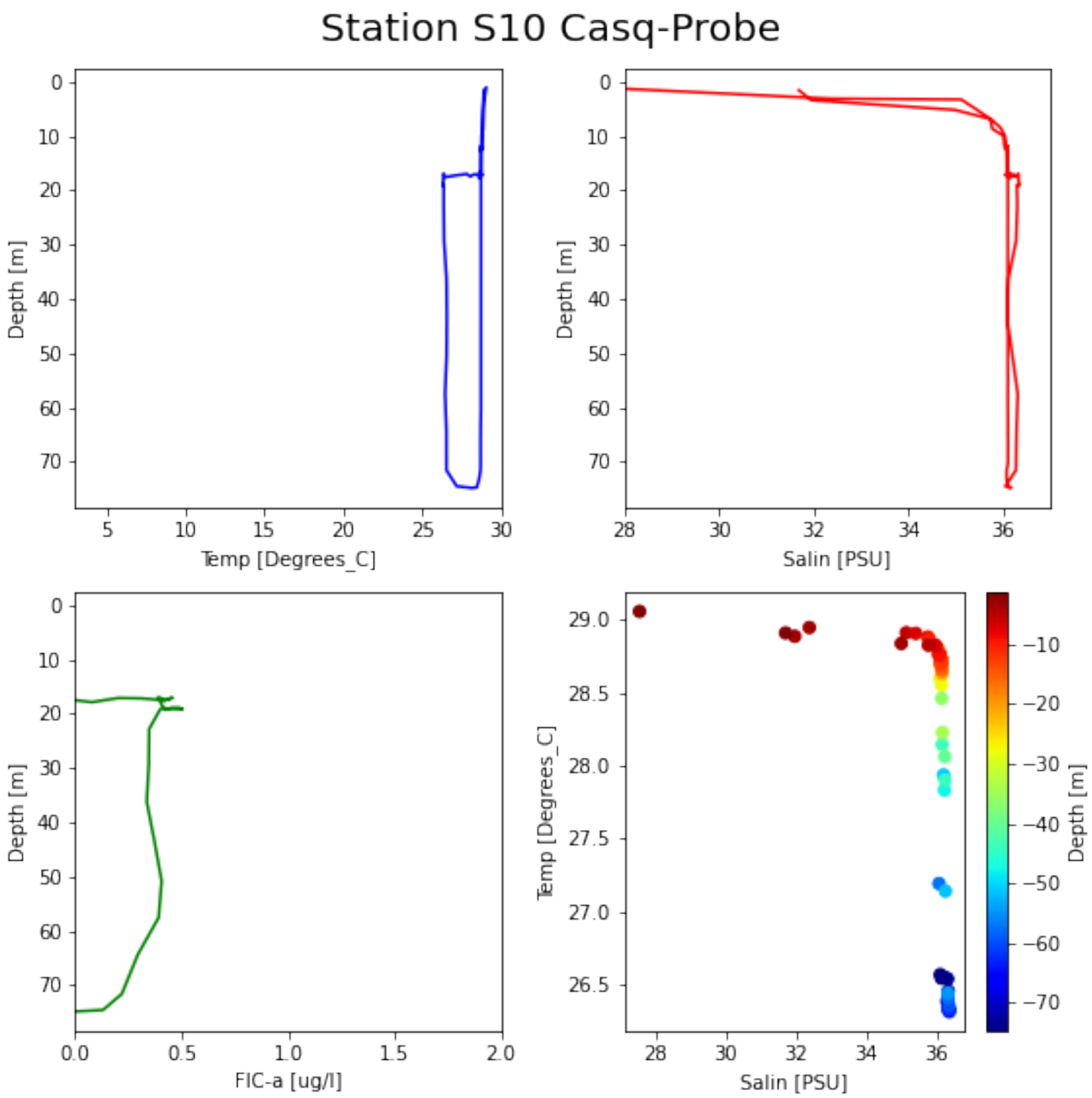


Figure 68: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S10.

3.4.4.2 Multicore MD23-3659MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **17/06/2023**
Core MD23 - 3659MC	*Station* ***S10***	*Operator* **8-12 ; 0-4**
Comments *Loss of 46-47 and 47-48 cm of core B.*		

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? *(example for type: 1-cm slice)*	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	53 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ~~no~~	**yes** / ~~no~~	*Rose Bengal in first 10 cm* *4 to 6 cm bioturbated ?* *Worm at 5-6 cm depth*
B	46 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ***no***	~~yes~~ / **no**	*Loss of the last 2 cm*
C	47.5 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
D	48 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	

Figure 69: Coring information of multi-core MD23-3659MC.

3.4.4.3 Casq core MD23-3660Q

Cruise Name
MD241-AMA2-Leg2

Date : **17/06/2023**
station N° : **S10**

Weather information
Wind speed: **8 knots**
Wind direction: 75,00 °
Sea : <1 m

Core (N°) :
MD23-3660Q

Core Length:
11,14 m

Position (posidonia)
Latitude : **03 ° 6,278 N**
Longitude : **49 ° 23,277 W**

Corer (type) : **CASQ**
total weight (air) : t
total weight (water) : **surface** **6,3 t**
extraction **7,1 t**

TUNINGS :
Tubes (length) : **12,00 m**

Résultats CINEMA

Measured Parameters :

multibeam water depth	**70 m**
released cable length :	**2 500 m**
Extraction/total *(tons)* :	**12,24 t**
extraction/differential *(tons)* :	**t**

TIME (GMT)

On station :	**10:50 GMT**
Beginning of operation :	**11:45 GMT**
Triggering :	**12:34 GMT**
End of operation :	**13:25 GMT**
Duration of operation :	**1h45**

INSTRUMENTATION
Other OPERATIONS on site
MUC **CTD-Rosette**
Small CTD **Small Niskin**
Other **Calypso**

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Bag with core catcher sediment
Sampling for Martine Couapel
Incidents : Top 0-12 cm of sediments in plastic bag, because it was too liquid. 0cm start right after (photo taken)

1st level: two large boxes A and B.

0–150	150–300	300–450	450–600	600–750	750–900	900–1050	###–1114
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII	A-VIII

0–100	100–250	250–400	400–550	550–700	700–850	850–1000	###–1114
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII	B-VIII

2nd level: 2 small boxes C and D + 2 u-channels

0–150	150–300	300–450	450–600	600–750	750–900	900–1050	###–1114
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII	C-VIII

0–100	100–250	250–400	400–550	550–700	700–850	850–1000	###–1117
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII	D-VIII

0–150	150–300	300–450	450–600	600–750	750–900	900–1050	###–1117
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VI	

0–100	100–250	250–400	400–550	550–700	700–850	850–1000	###–1117
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VI	u-ch B-VII

3rd level: 2 small boxes E, F and G

0–150	150–300	300–450	450–600	600–750	750–900	900–1050	###–1117
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII	E-VIII

0–100	100–250	250–400	400–550	550–700	700–850	850–1000	###–1117
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	F-VIII

0–150	150–300	300–450	450–600	600–750	750–900	900–1050	###–1117
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII	G-VIII

Figure 70: Coring information of Casq core MD23-3660Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3660Q** -Core length **11.14m**
Station: S10 -Latitude: **3°06.278 N**-Longitude: **49°23.277 W**
-Water Depth : **70 m**

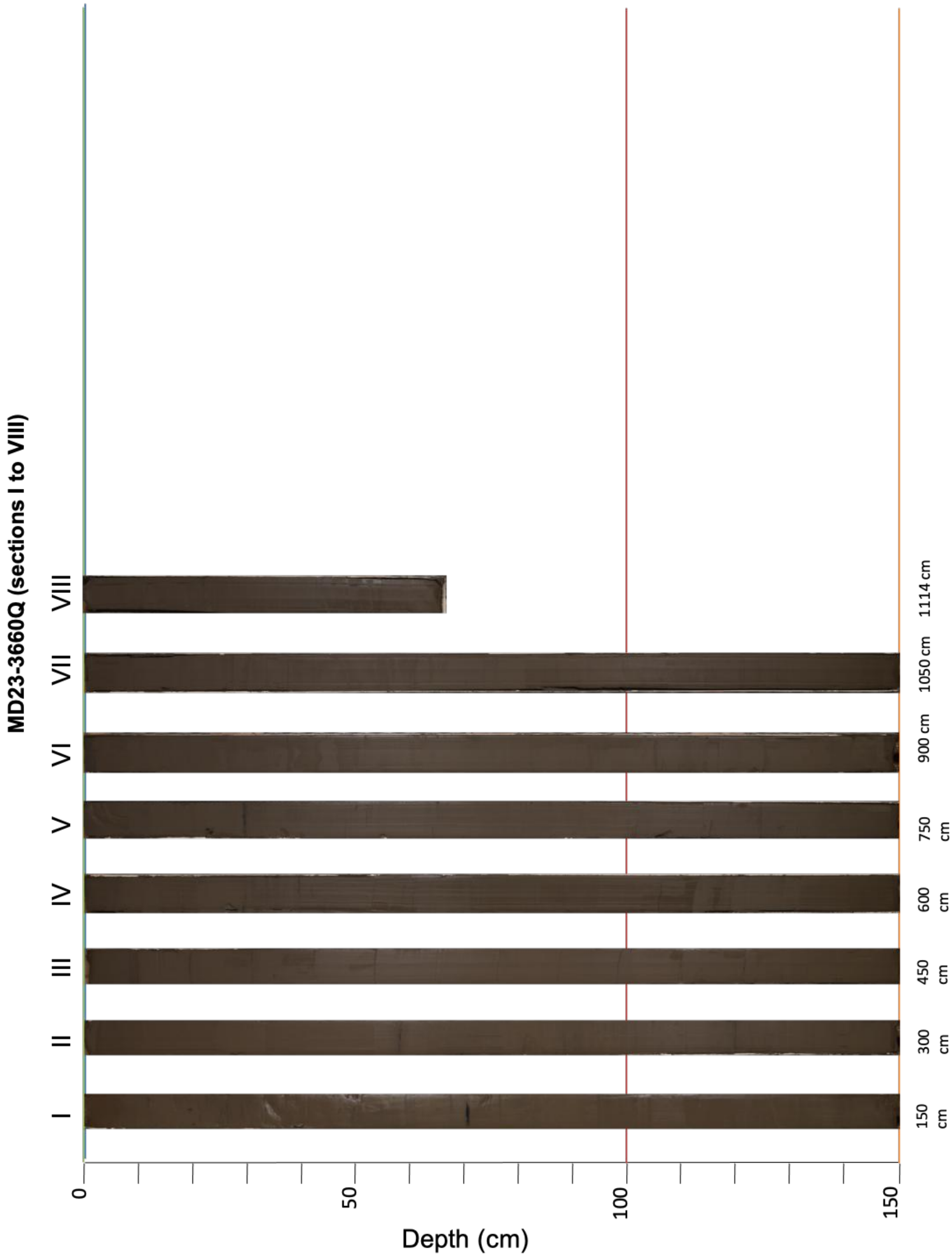
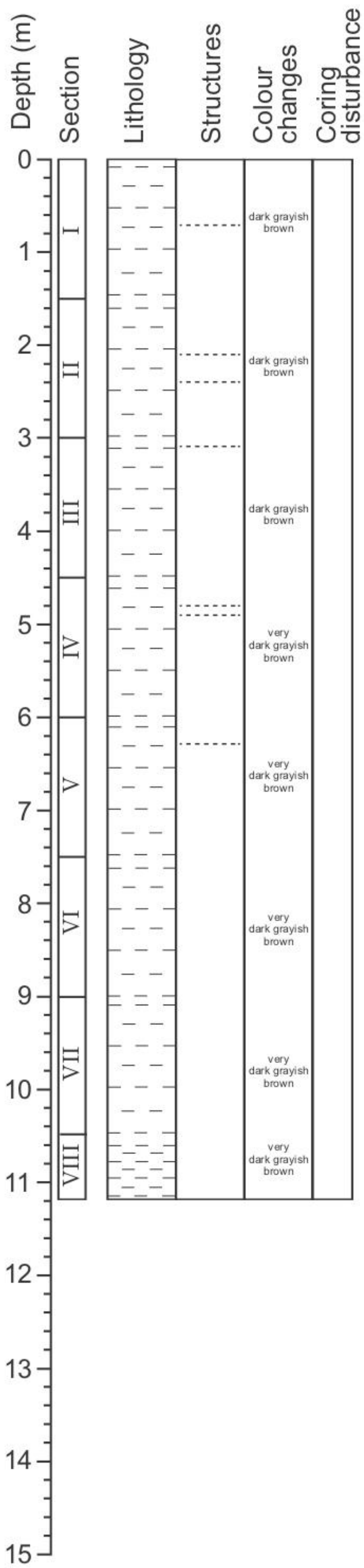


Figure 71: Pictures of Casq core MD23-3660Q.

MD241-AMA2-Leg2	**MD23-3660Q**	Position: 3°06,278 N 49°23,277 W
Station S10	**Sediment description (1/1)**	Water-depth: 70 m Core length: 11,14 m



Comments

Homogeneous dark grayish brown or very dark grayish brown with darker marks ou laminae in some parts of the core

Figure 72: Sediment description of Casq core MD23-3660Q.

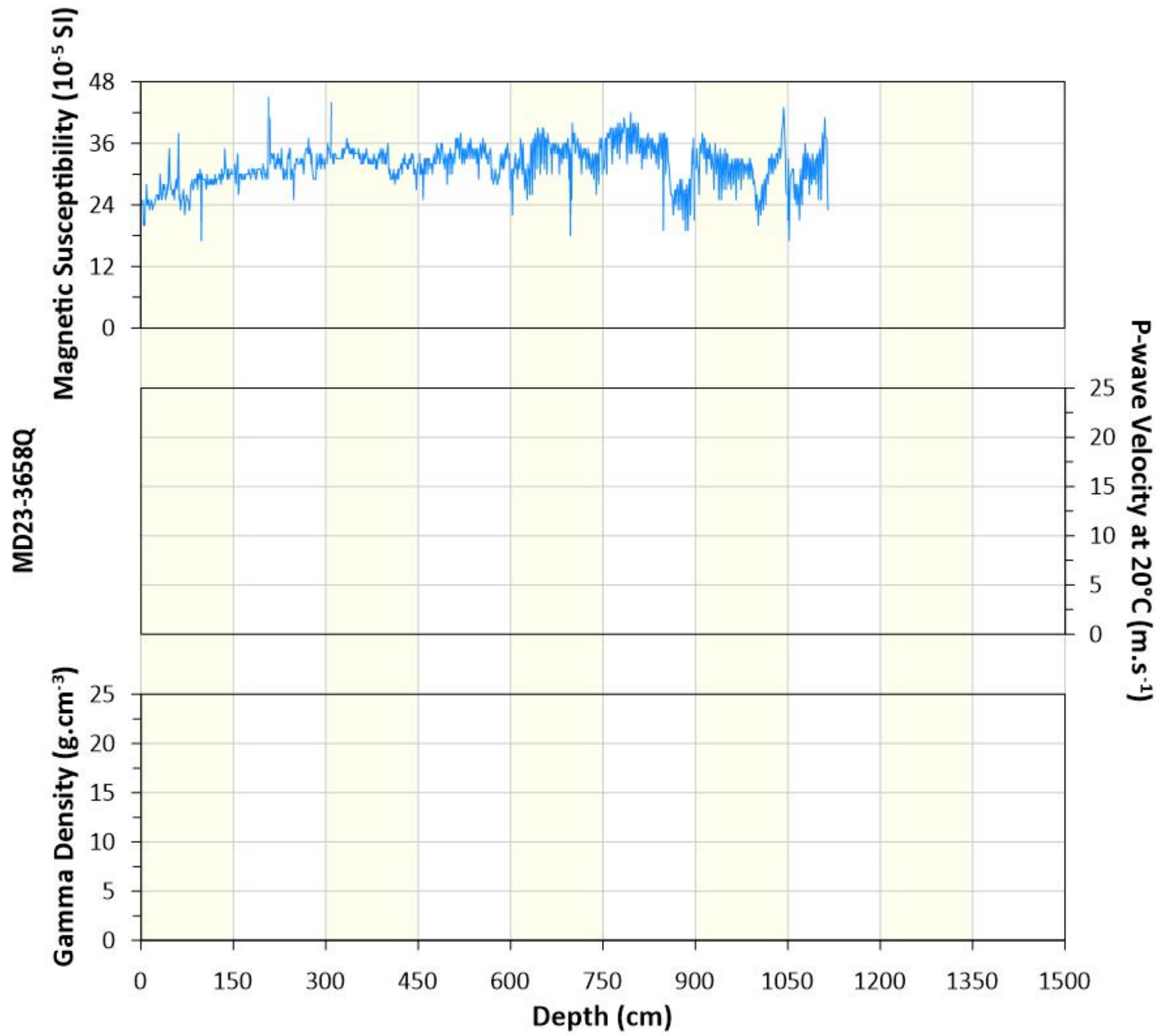


Figure 73: Physical properties of Casq core MD23-3660Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

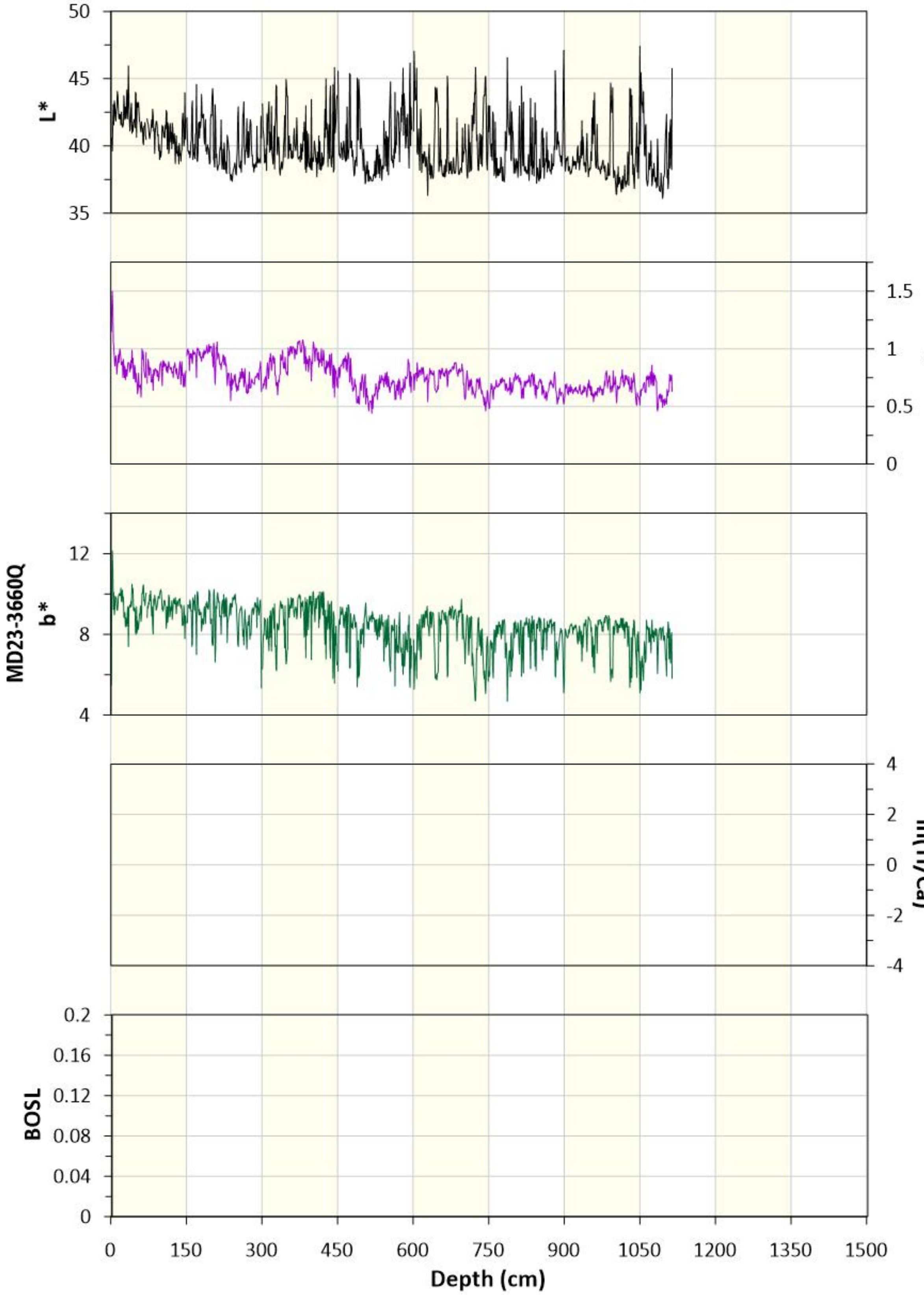


Figure 74: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3660Q.*

3.4.4.4 Calypso core MD23-3661

Cruise Name **MD241-AMA2-Leg2**	Date : **17/06/2023** station N° : **S10**	Weather information Wind speed: **7,5 knots** Wind direction: 45,00 ° Sea : <1 m
Core (N°) : **MD23-3661**	**Core Length:** **23,43 m**	**Position (posidonia)** **Latitude : 3°6.281 N** **Longitude : 49°23.277 W**
Corer (type) : **Calypso** total weight (air) : t total weight (water) : **surface 6,2 t** **bottom 6,8 t**	**TUNINGS :** **Tubes** (length) : **24,75 m** **Cables :** Free fall : **1,50 m** theoritical elastic rebound **0,16 m** loop length **1,60 m** counterweight cable length **m** (3m50 lost)	**Résultats CINEMA** thickness sediment sampled **m** thickness sediment cored **m**
Measured Parameters : **multibeam water depth** **70 m** **released cable length :** **49,2 m** Extraction/total *(tons)* : **13,01 t**	**TIME (GMT)** On station : **10:50 GMT** Beginning of operation : **13:45 GMT** **Triggering :** **15:26 GMT** End of operation : **17:30 GMT** **Duration of operation :** **3h45**	**INSTRUMENTATION** **Other OPERATIONS on site** **MUC** **CTD-Rosette Palanquée** **Small CTD** **Small Niskin** Other : **CASQ**

Description : Three syringes of core catcher in one bag.
U-channels taken on the archive half.

Incidents : Between 13-81 cm, sediment was put by hand inside the u-channel. SXV: section too sandy/rocky to take u-channel. Big beachrock on bag.
S.XVI: very sandy with small rocks - no uchannel taken but potentially possible

0	*150*	*300*	*450*	*600*	*750*	*900*	*1050*
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**

1050	*1200*	*1350*	*1500*	*1650*	*1800*	*1950*	*2100*
	VIII	**IX**	**X**	**XI**	**XII**	**XIII**	**XIV**

2100	*2250*	*2343*					
	XV	**XVI**					

Figure 75: Coring information of Calypso core MD23-3661. Numbers in red indicate depths that differ from the typical Calypso section limits.

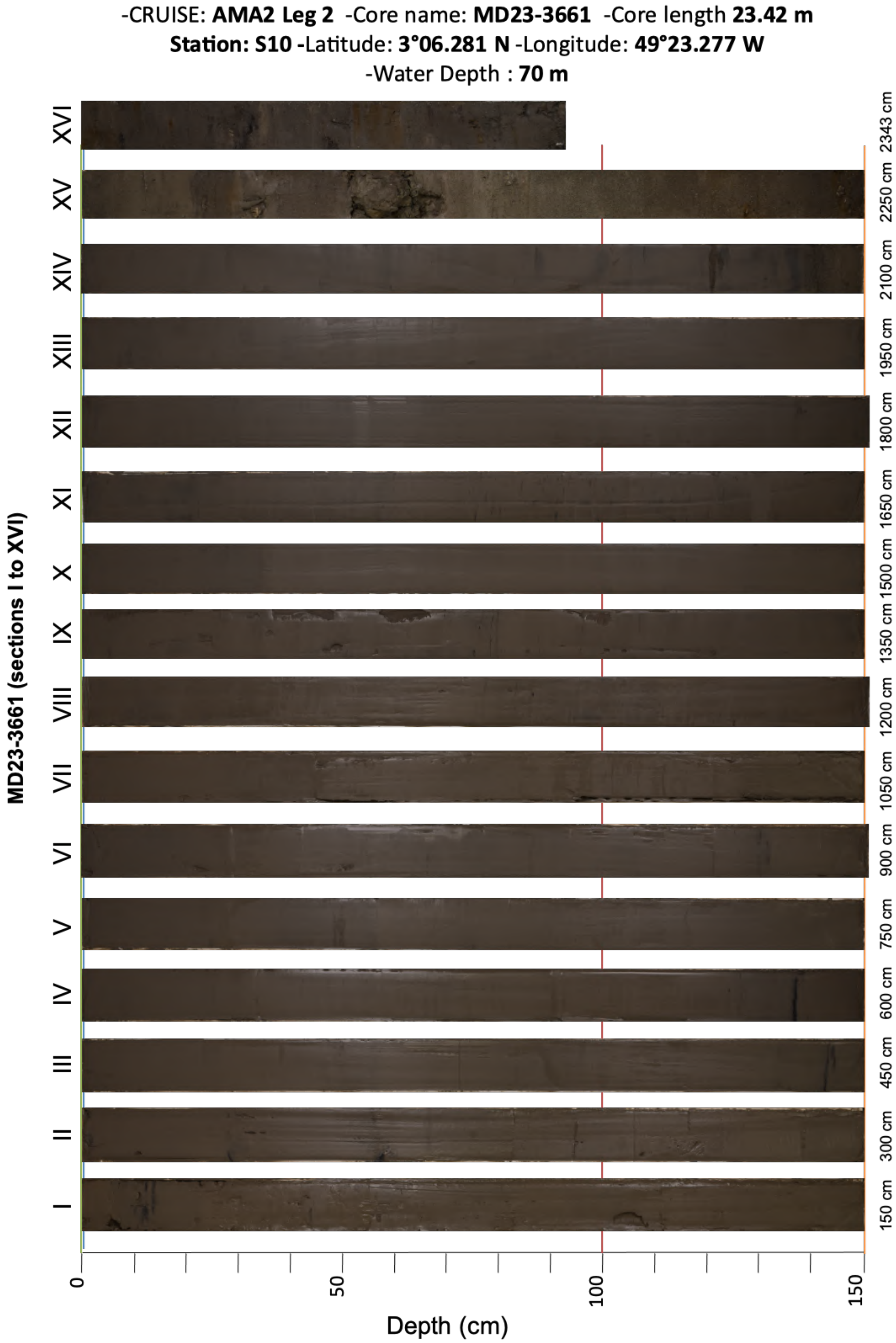
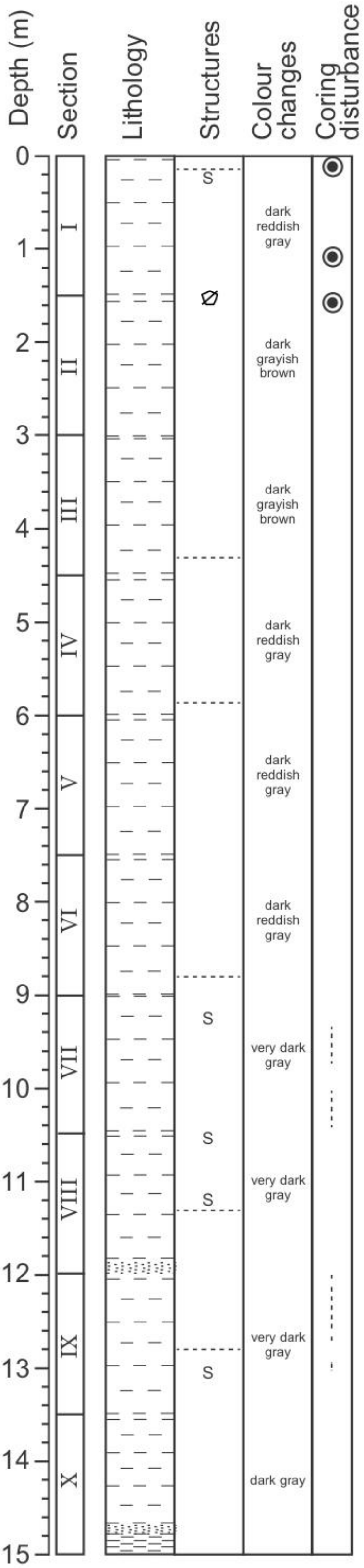


Figure 76: Pictures of Calypso core MD23-3661.

MD241-AMA2-Leg2	**MD23-3661**	Position: 3°06,281 N 49°23,277 W
Station S10	**Sediment description (1/2)**	Water-depth: 70 m Core length: 23.42 m

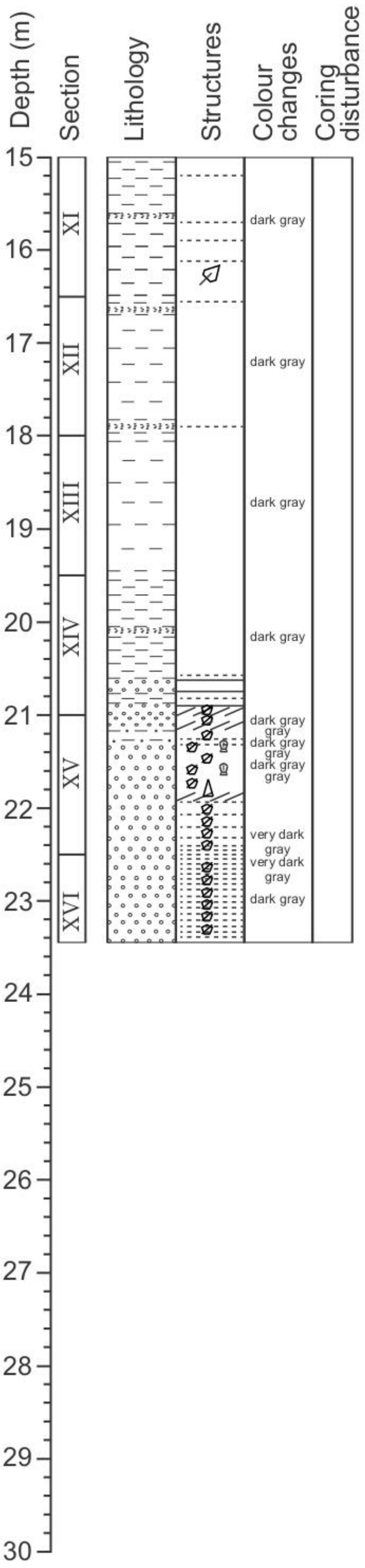


Comments

Very homogeneous soft mud for the first sections, and very homogeneous dark grayish brown or dark reddish gray or dark gray mud for the other sections

Black spots or layers in some parts of the core

MD241-AMA2-Leg2	**MD23-3661**	Position: 3°06,281 N 49°23,277 W
Station S10	**Sediment description (2/2)**	Water-depth: 70 m Core length: 23.42 m



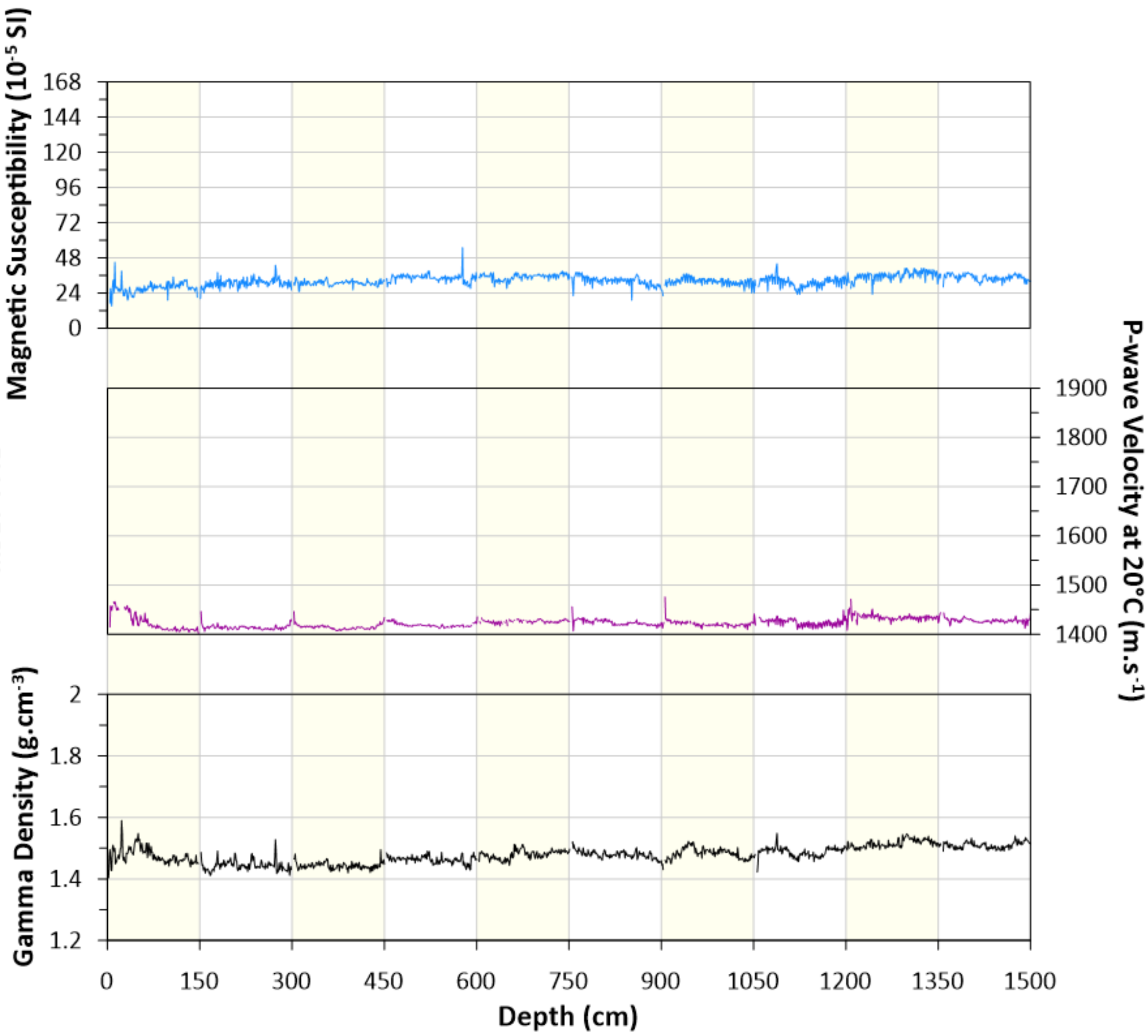
Comments

Very homogeneous soft mud for the first sections, and very homogeneous dark grayish brown or dark reddish gray or dark gray mud for the other sections

Black spots or layers in some parts of the core

Last sections with sand, presence of beachrocks, shell fragments, several brownish marks or layers, and other marks or layers with different colors (black, olive gray)

Figure 77: Sediment description of Calypso core MD23-3661.


Magnetic Susceptibility (10-5 SI)
168
144
120
96
72
48
24
0
MD23-3661
P-wave Velocity at 20°C (m.s-1)
1900
1800
1700
1600
1500
1400
Gamma Density (g.cm-3)
2
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)

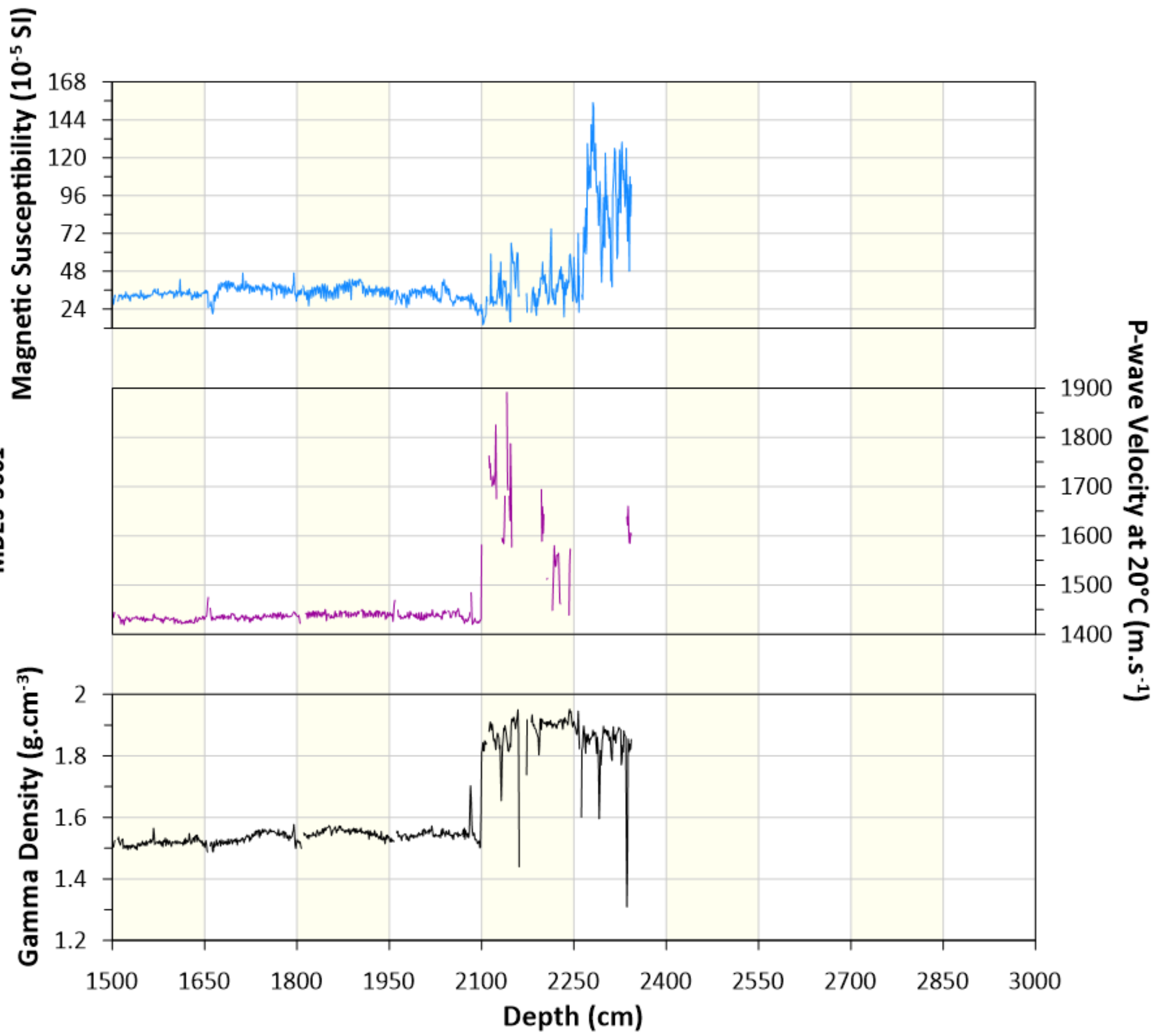
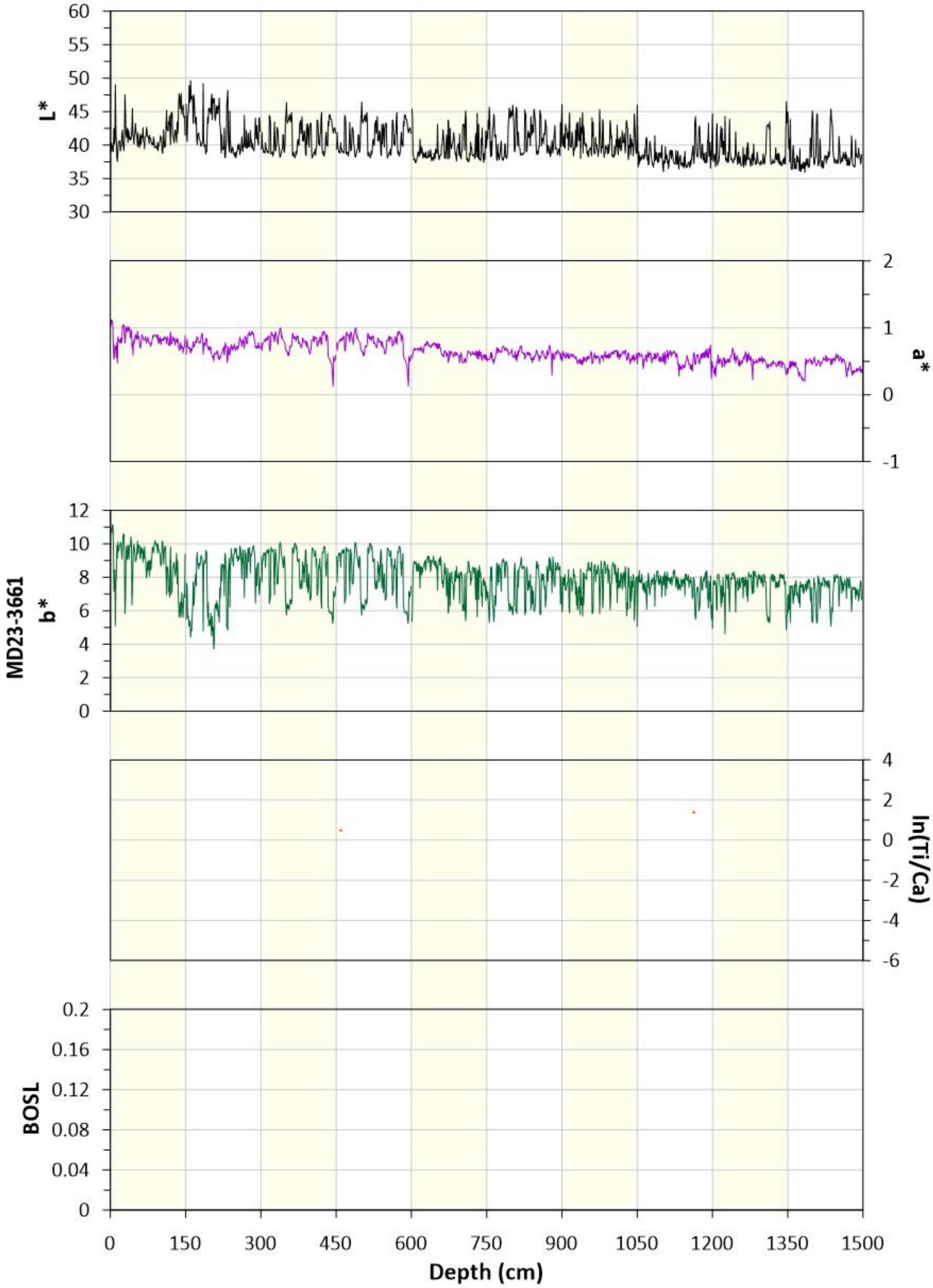


Figure 78: Physical properties of Calypso core MD23-3661. The quality of P-wave velocity measurements is reduced in lower core sections, explaining the absence of plotted data.


L*
a*
MD23-3661
b*
ln(Ti/Ca)
BOSL
Depth (cm)

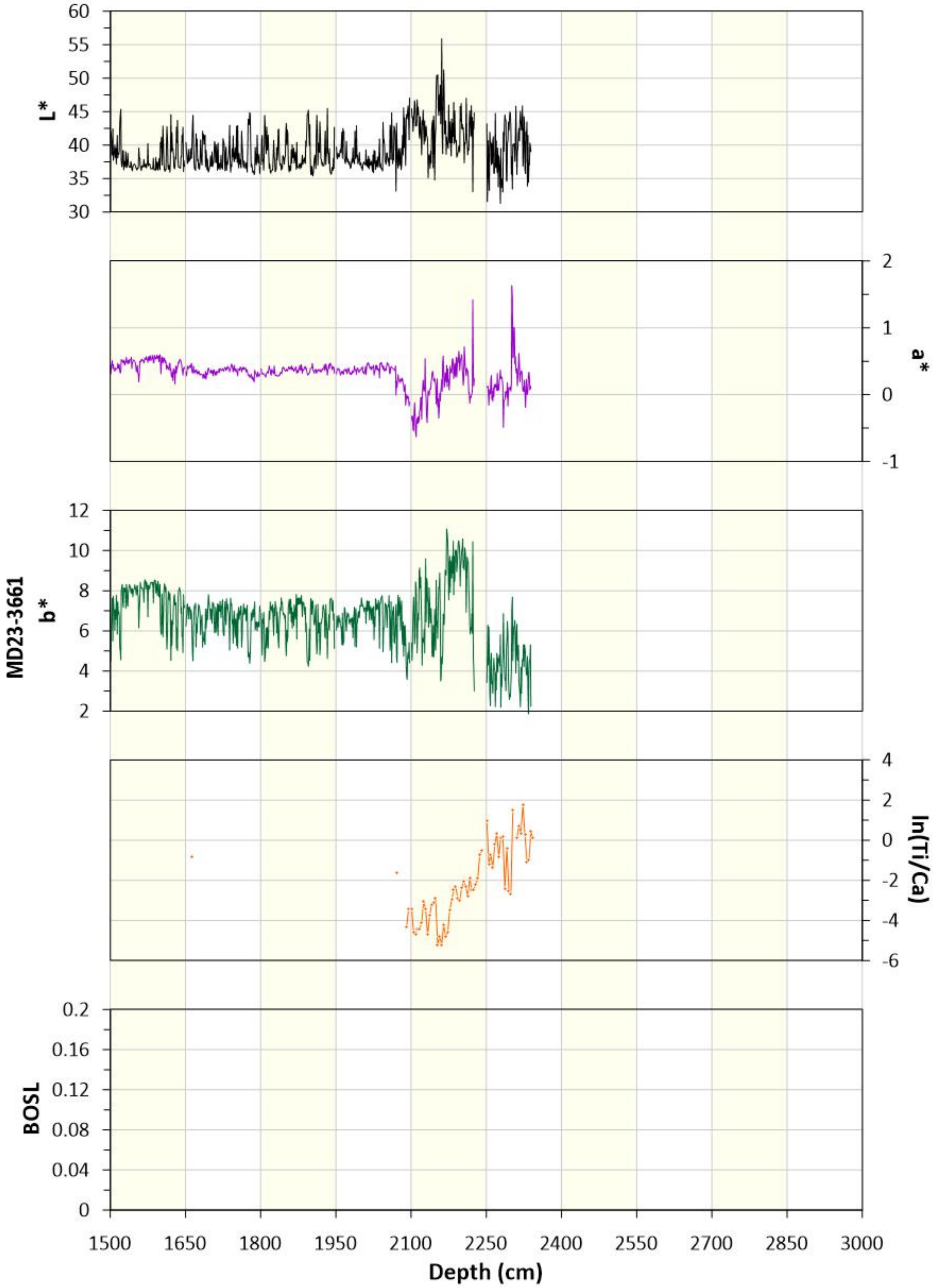


Figure 79: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3661. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

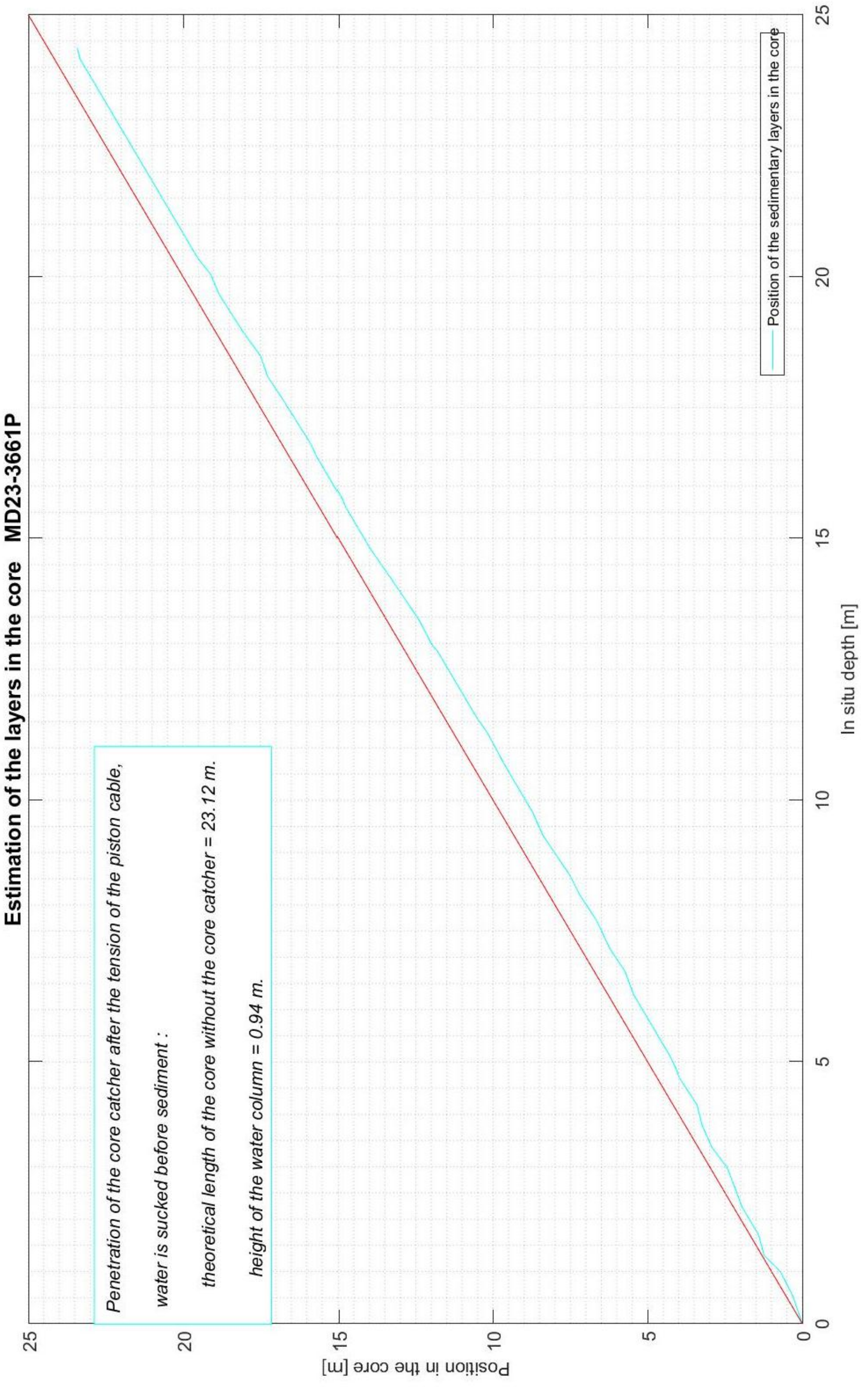


Figure 80: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3661.

Core MD23-3661 shows evidence for sediment undersampling between 0 and 6 m, and normal sampling between 6 m and the core's bottom depth.

3.4.4.5 Data of CTD-rosette ("palanquée") AMA2-S10-CTD

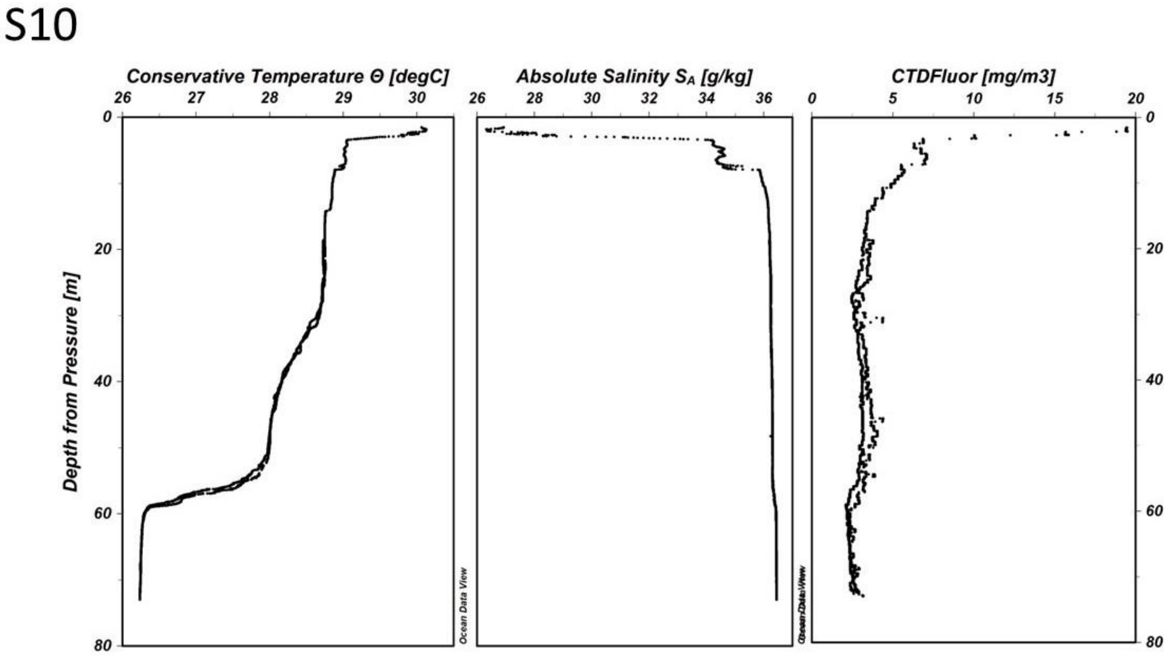


Figure 81: Temperature, salinity and fluorescence vertical profiles obtained by the CTD probe operated in "palanquée" mode at station S10.

Table 13: Collected water samples during CTD "palanquée" cast at station S10. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	14	23	5	9	2	CTD
Water depth (m) cable length	5	15	30	45	65	?
Water depth (m) pressure sensor	5	14.9	30	45	65	
δ^{18}O LOCEAN (20 mL)	X	X	X	X	X	
δ^{13}C LOCEAN (25 mL)	X	X	X	X	X	
$HgCl_2$ (µL) added in δ^{13}C bottle	50	50	50	50	50	
Δ^{14}C (250 mL)	X	X	X	X	X	
$HgCl_2$ (µL) added in Δ^{14}C bottle	1000	1000	1000	1000	1000	
Nutrients (30 mL)	X	X		X	X	
Fluorescence (0-200 m)						
PAH & trace elements MARBEC (60 mL)	X	X		X	X	
Water stable isotopes MARBEC (30 mL)	X	X		X	X	
Comments			Bottle leaked		Bottle leaked	

3.4.5 Station S11

3.4.5.1 Station S11 information

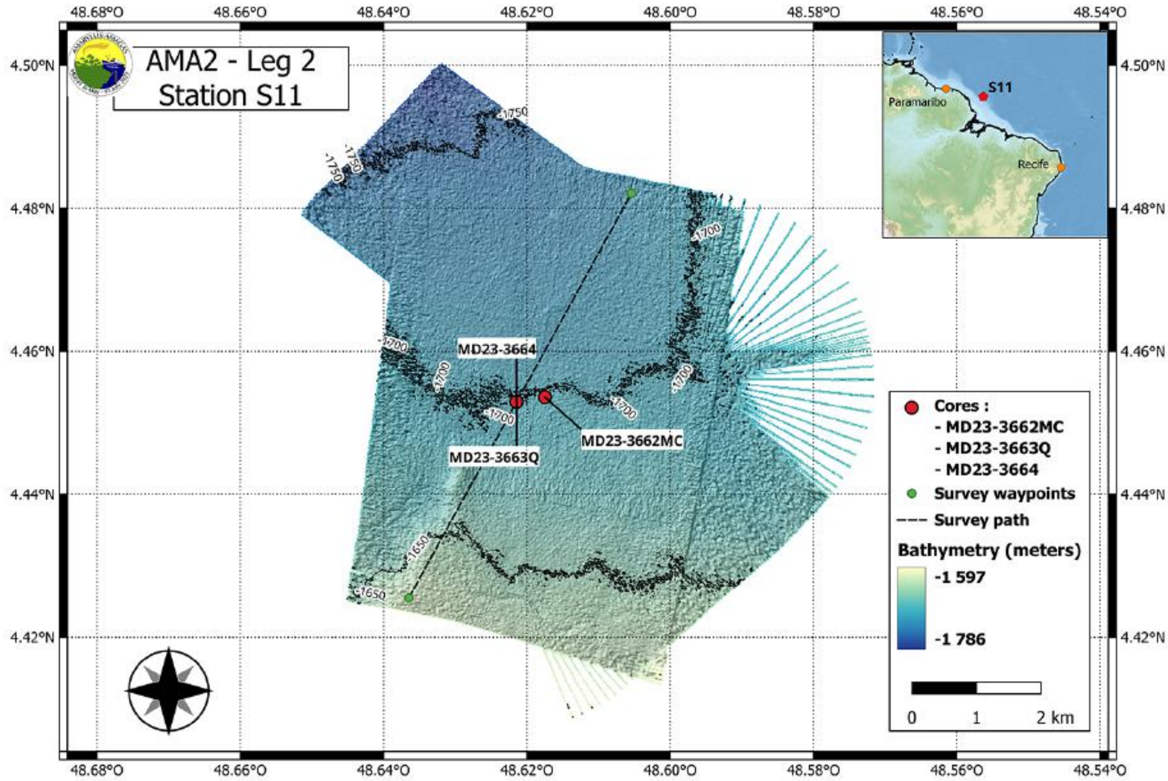


Figure 82: Bathymetric map at station S11. Note that the lighter multi-corer (~300 kg) compared to heavier Casq and Calypso corer (~6500 kg) drifted away with the strong flow of the North Brazil Current, explaining the slightly aside location of multi-core MD23-3662MC.

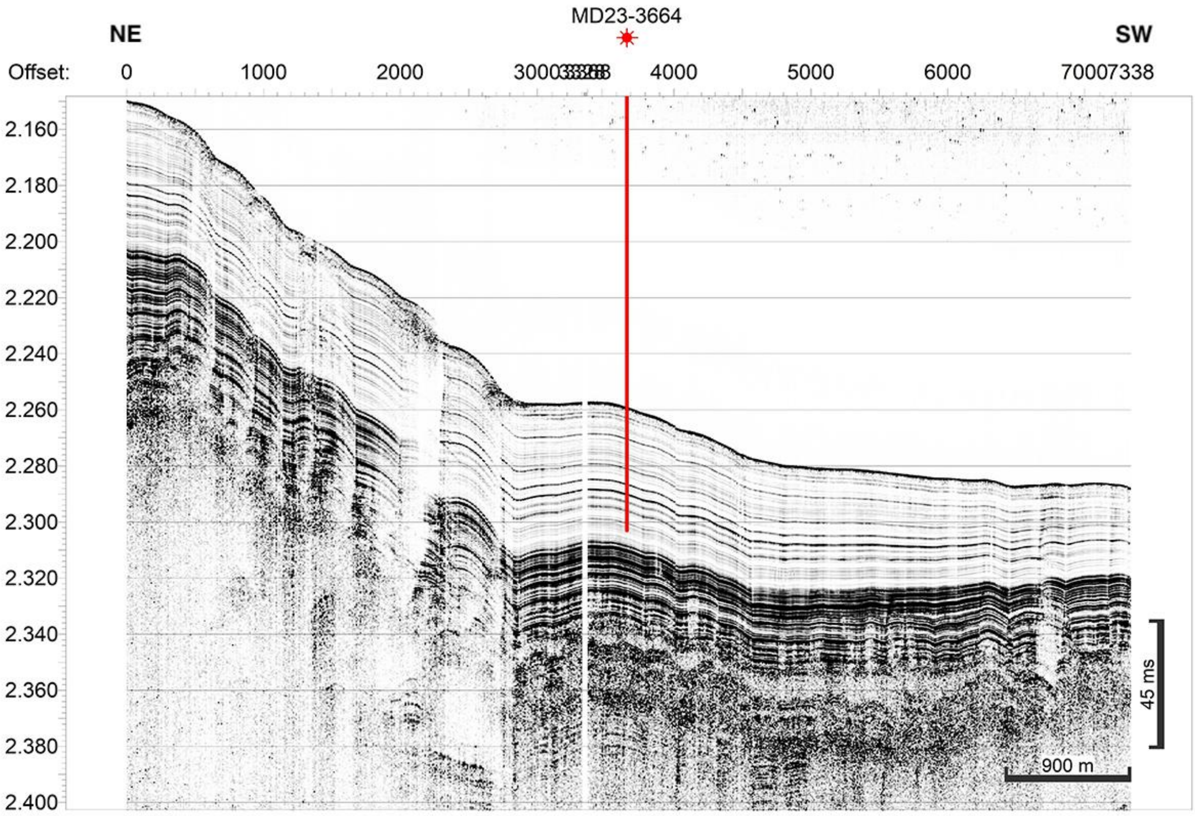


Figure 83: NE-SW subbottom profile at station S11. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

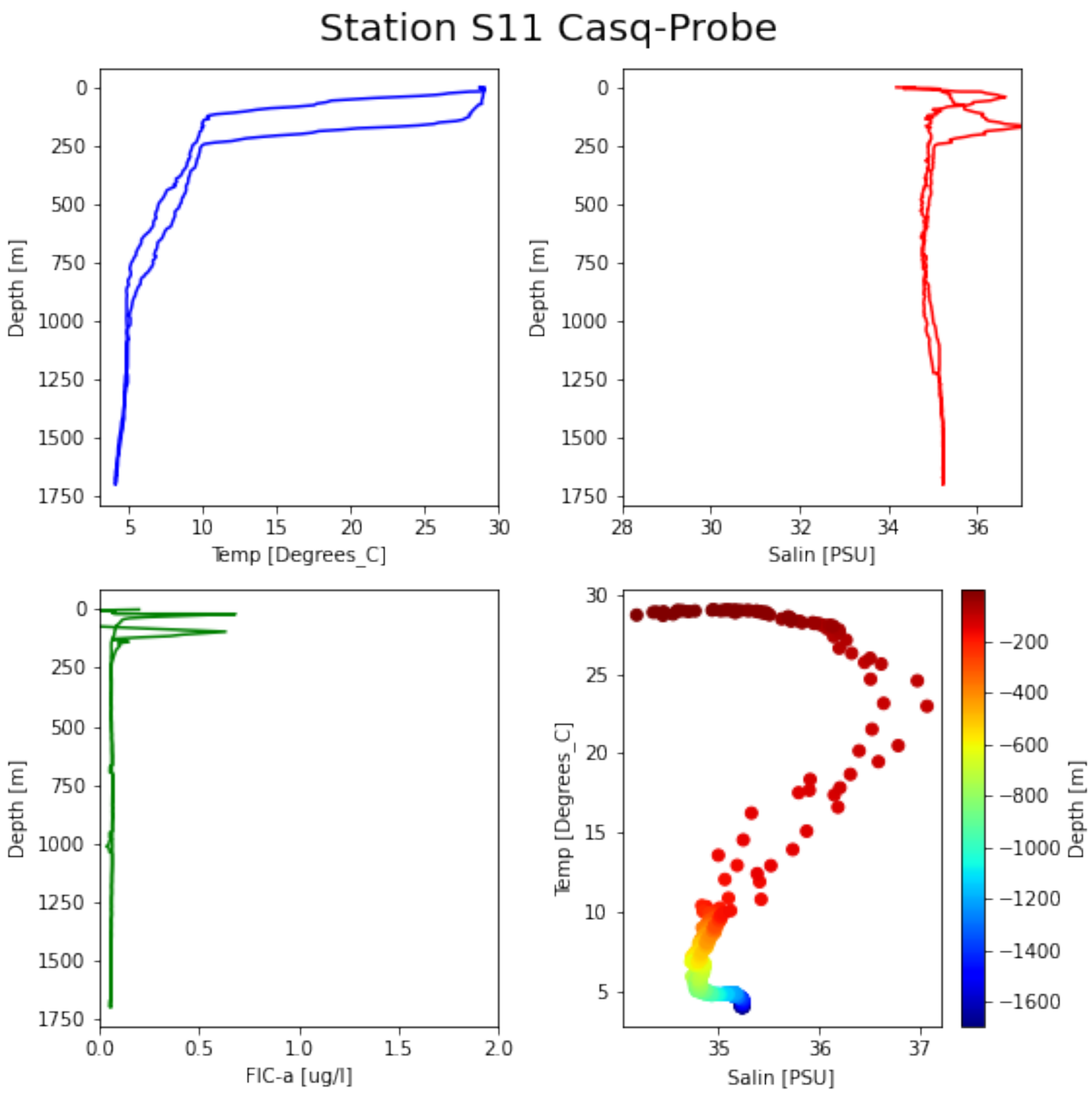


Figure 84: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S11.

3.4.5.2 Multicore MD23-3662MC

Multicore INFORMATION	*Expedition* MD241 AMARYLLIS-AMAGAS Leg 2	*Date* 18/06/2023
Core MD23 - 3662MC	*Station* **S11**	*Operator* 4-8 ; 8-12 ; 0-4

Comments

Andre BELEM took supernatant water above core A, B and C
Elisabeth MICHEL took supernatant water above core C

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? *(example for type: 1-cm slice)*	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	43 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ~~no~~	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	43 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ***no***	~~yes~~ / **no**	
C	41.5 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		**yes** / ~~no~~	~~yes~~ / **no**	
D	42 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 8-12 ?? **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	

Figure 85: Coring information of multi-core MD23-3662MC.

3.4.5.3 Casq core MD23-3663Q

Cruise Name
MD241-AMA2-Leg2

Date : **18/06/2023**
station N° : **S11**

Weather information
Wind speed: **9 knots**
Wind direction: 64,00 °
Sea : <1 m

Core (N°) :
MD23-3663Q

Core Length:
9,36 m

Position (posidonia)
Latitude : **04 ° 27,175 N**
Longitude : **48 ° 37,285 W**

Corer (type) : CASQ
total weight (air) : 7,0 t
total weight (water) : surface 6,4 t
full 6,8 t

TUNINGS :
Tubes (length) : 12,00 m

Résultats CINEMA

Measured Parameters :
multibeam water depth 1696 m
released cable length : m
Extraction/total *(tons)* : 10,90 t
extraction/differential *(tons)* : t

TIME (GMT)
On station : 07:52 GMT
Beginning of operation : 10:05 GMT
Triggering : 11:21 GMT
End of operation : 13:10 GMT
Duration of operation : 3h15

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other Calypso

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Bag with core top sediment and bag with core catcher sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0–150	150–300	300–450	450–600	600–750	750–850	850–939	
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII	
0–100	100–250	250–400	400–550	550–700	700–850	850–939	
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII	

2nd level: 2 small boxes C and D + 2 u-channels

0–150	150–300	300–450	450–600	600–750	750–900	900–936	
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII	
0–100	100–250	250–400	400–550	550–700	700–850	850–934	
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII	
0–150	150–300	300–450	450–600	600–750	750–850	850–934	
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VII	
0–100	100–250	250–400	400–550	550–700	700–850	850–934	
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII	

3rd level: 2 small boxes E, F and G

0–150	150–300	300–450	450–600	600–750	750–850	850–937	
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII	
0–100	100–250	250–400	400–550	550–700	700–800	800–934	
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	
0–150	150–300	300–450	450–600	600–750	750–850	850–934	
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII	

Figure 86: Coring information of Casq core MD23-3663Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name **MD23-3663Q** -Core length **9,30 m**
Station: S11 -Latitude: **4° 27.175 N** -Longitude: **48° 37.285 W** –
Water Depth :**1696 m**

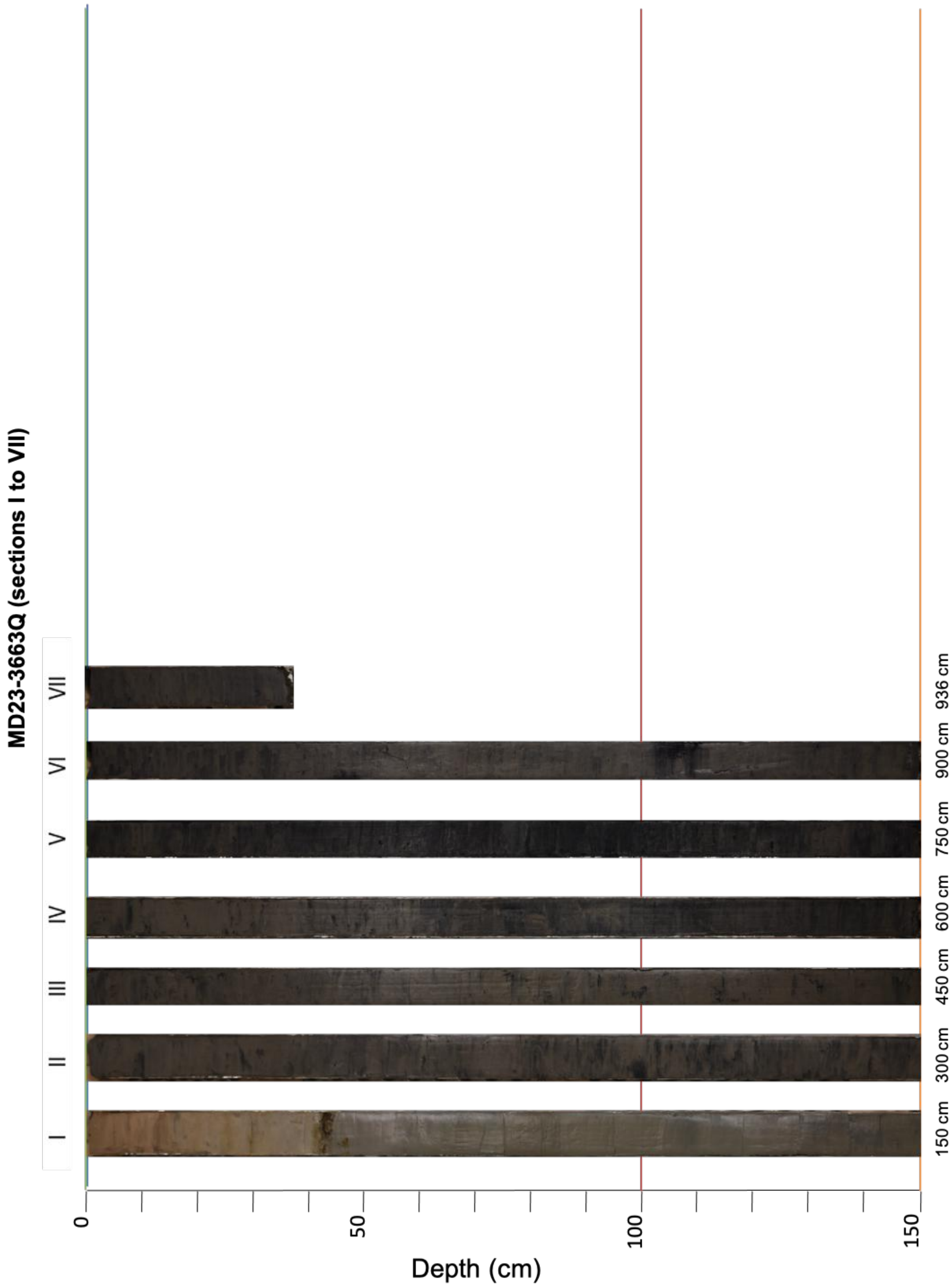
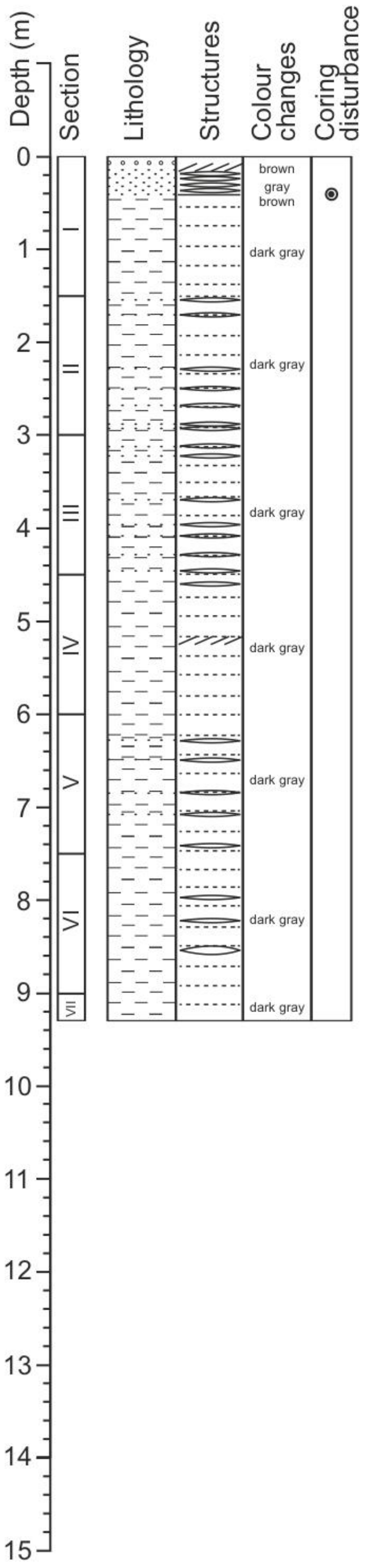


Figure 87: Pictures of Casq core MD23-3663Q.

MD241-AMA2-Leg2	MD23-3663Q	Position: 4°27.175'N 48°37.285'W
Station S11	Sediment description (1/1)	Water-depth: 1696 m Core length: 9.30 m



Comments

Homogeneous drak gray mud with darker marks or laminea silted throughout the core sections
First 40 cm high content of sand and silt mix colored between gray brown and pluricentimetric light olive brown layers (16-18, 21-23, 25-28 and 36-39.5 cm)
Darker marks or laminea (manganese ?)

Contents :
- Hole coring distrubance from section I

Contacts :
- Gradational 12 and 510 cm
- Sharp 39 cm

End of the core : 936 cm

Figure 88: Sediment description of Casq core MD23-3663Q.

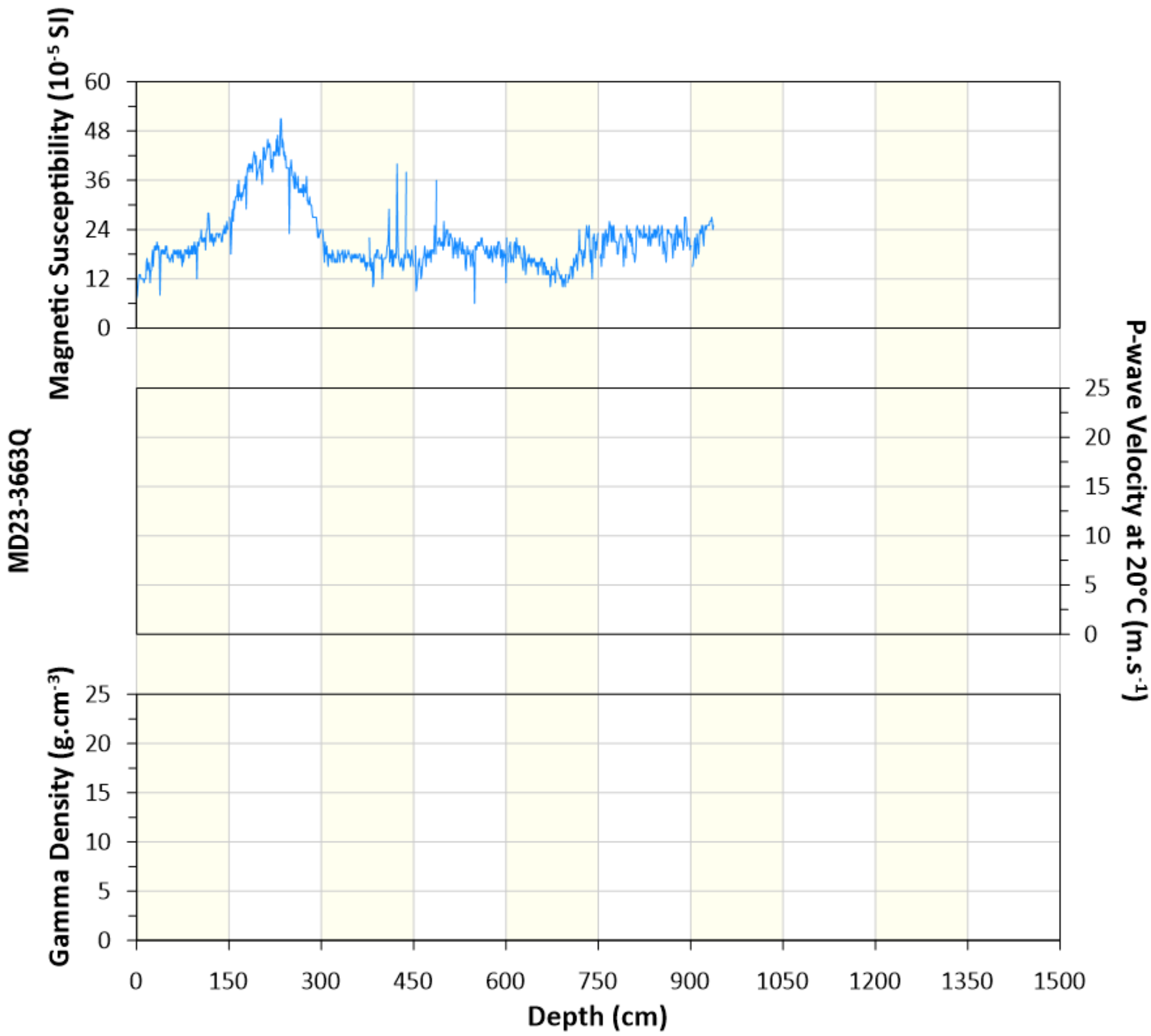


Figure 89: Physical properties of Casq core MD23-3663Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

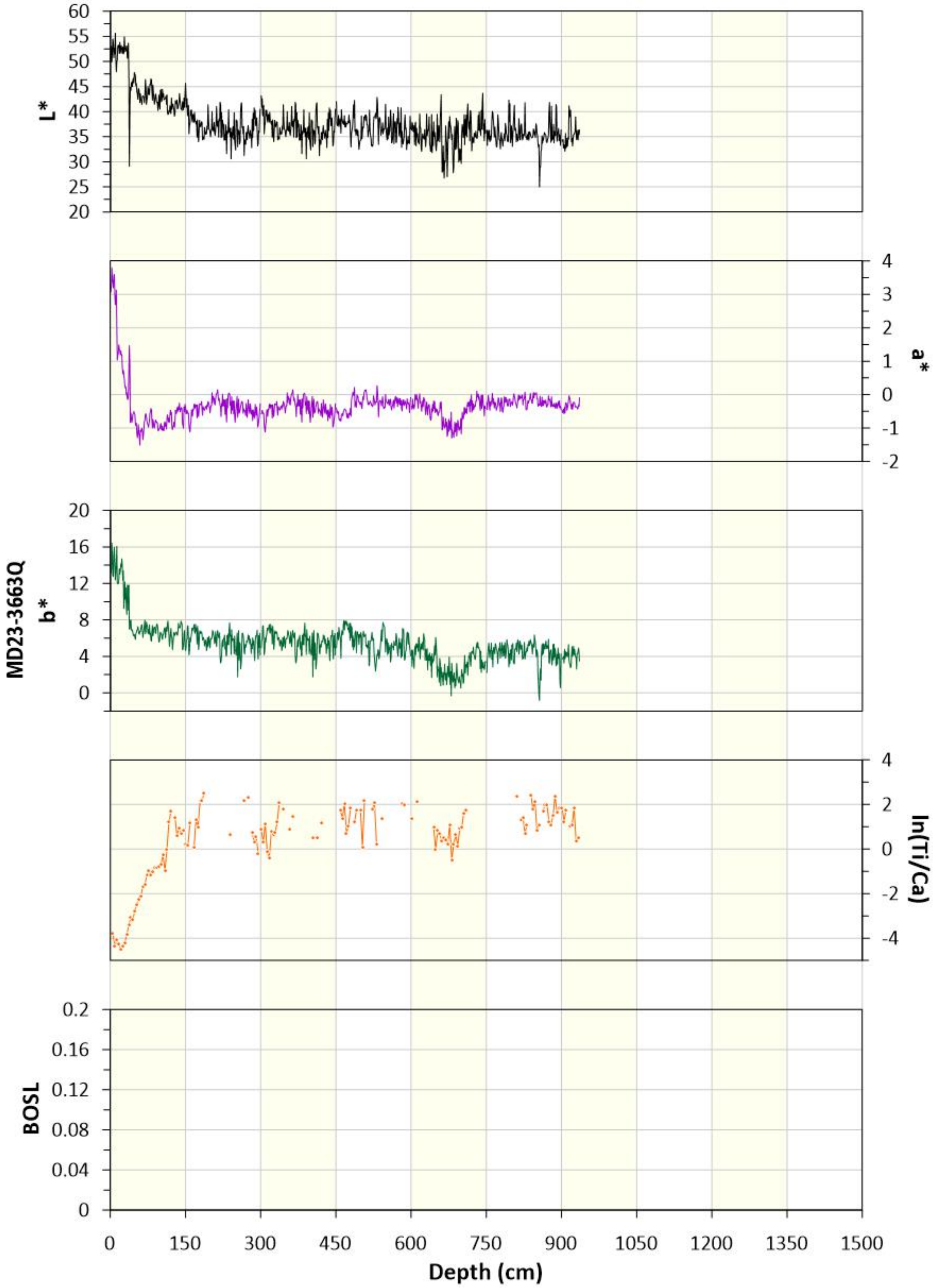


Figure 90: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3663Q. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

3.4.5.4 Calypso core MD23-3664

Cruise Name MD241-AMA2-Leg2	Date : 18/06/2023 station N° : S11	Weather information Wind speed: 9.5 knots Wind direction: 41.00 ° Sea : ~0 m
Core (N°) : MD23-3664	**Core Length:** 33.67 m	**Position (posidonia)** Latitude : 04 ° 27.176 N Longitude : 48 ° 37.287 W
Corer (type) : Calypso total weight (air) : 7.1 t total weight (water) : surface 6.4 t; bottom 7.2 t	**TUNINGS :** Tubes (length) : 34.45 m Cables : Free fall : 2.00 m theoritical elastic rebound 4.27 m loop length 6.10 m counterweight cable length m (3m50lest)	**Résultats CINEMA** thickness sediment sampled m thickness sediment cored m
Measured Parameters : multibeam water depth 1 696 m released cable length : 1 659.0 m Extraction/total *(tons)* : 13.69 t	**TIME (GMT)** On station : 07:52 GMT Beginning of operation : 15:50 GMT Triggering : 17:52 GMT End of operation : 19:10 GMT Duration of operation : 3h20	**INSTRUMENTATION Other OPERATIONS on site** MUC; CTD-Rosette palanquée Small CTD; Small Niskin Other : CASQ

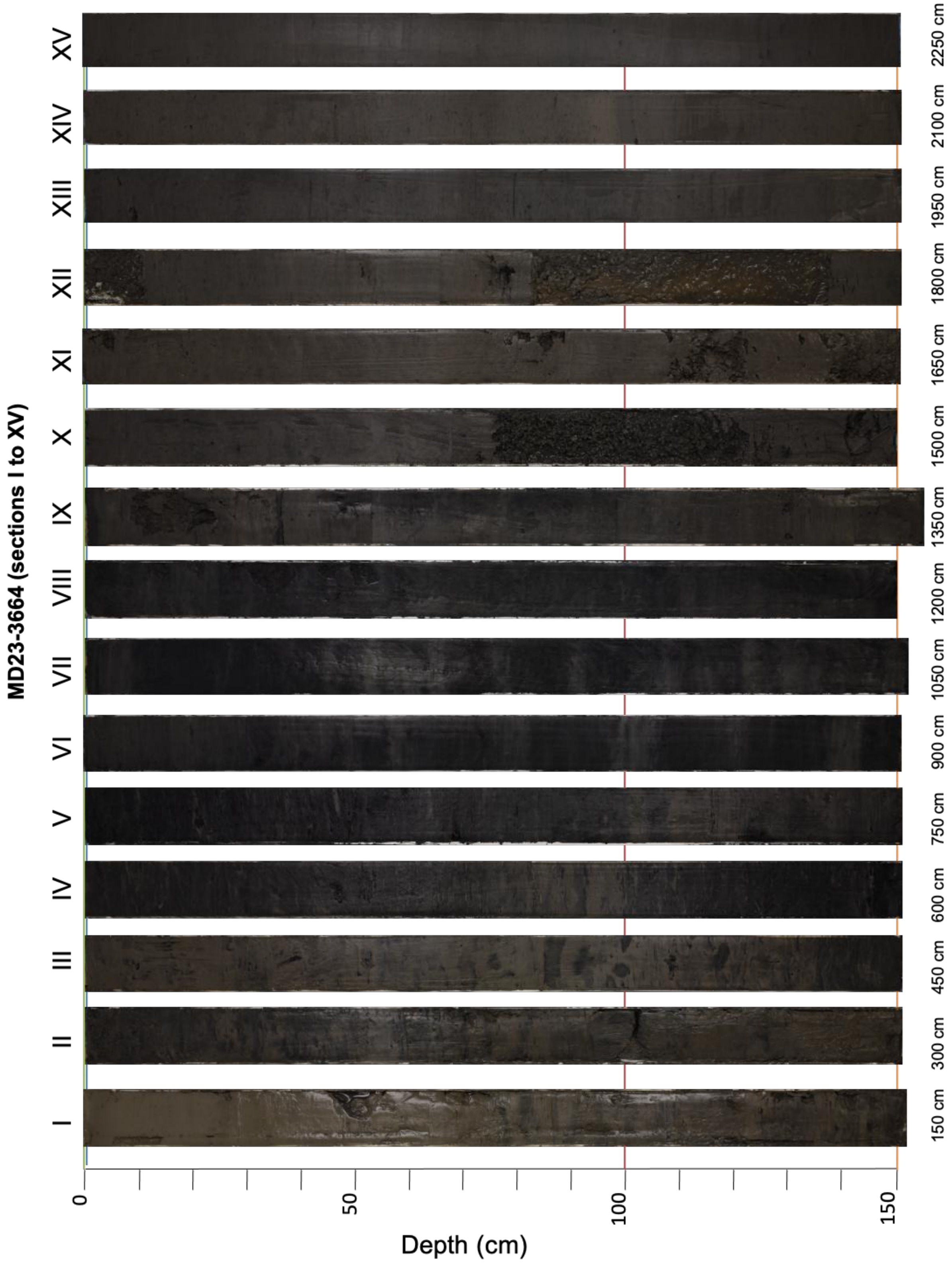
Description : Three syringes of core catcher in one bag.
U-channels taken on the archive half.

Incidents : SI: 3cm lost and put in petri dish.
SII, III, IV and V: holes in section due to gaz
SIX: sediment missing in uchannel at the top (overflow)
SX: sediment lost when cutting liner, recovered in bag.

0	150	300	450	600	750	900	1050
I	II	III	IV	V	VI	VII	
1050	1200	1350	1500	1650	1800	1950	2100
VIII	IX	X	XI	XII	XIII	XIV	
2100	2250	2400	2550	2700	2850	3000	3150
XV	XVI	XVII	XVIII	XIX	XX	XXI	
3150	3300	3367					
XXII	XXIII						

Figure 91: Coring information of Calypso core MD23-3664. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3664** -Core length **33.67 m**
Station: S11 -Latitude: **4°27.176 N** -Longitude: **48°37.287 W**
-Water Depth : **1696 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3664** -Core length **33.67 m**
Station: S11 -Latitude: **4°27.176 N** -Longitude: **48°37.287 W**
-Water Depth : **1696 m**

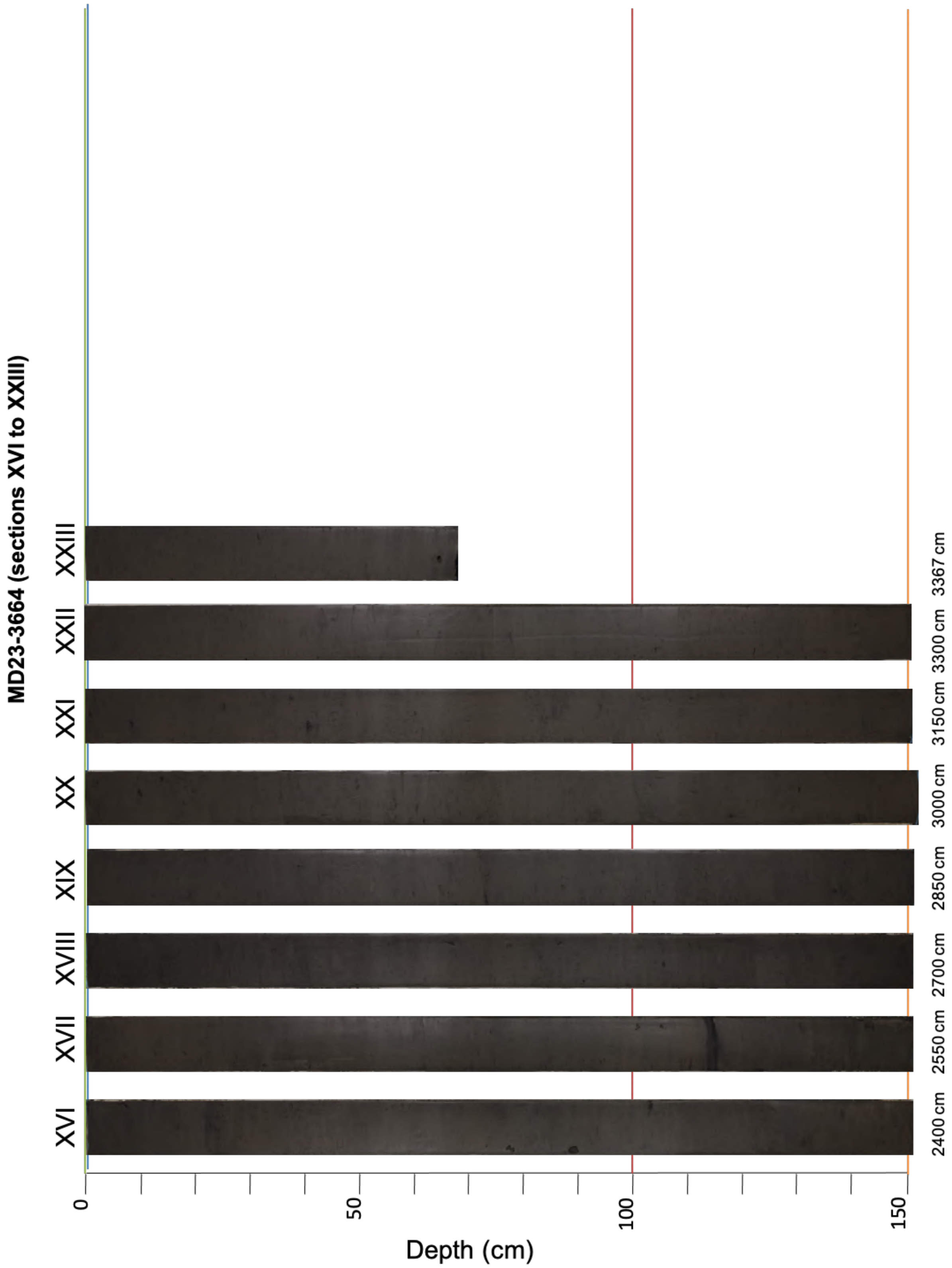
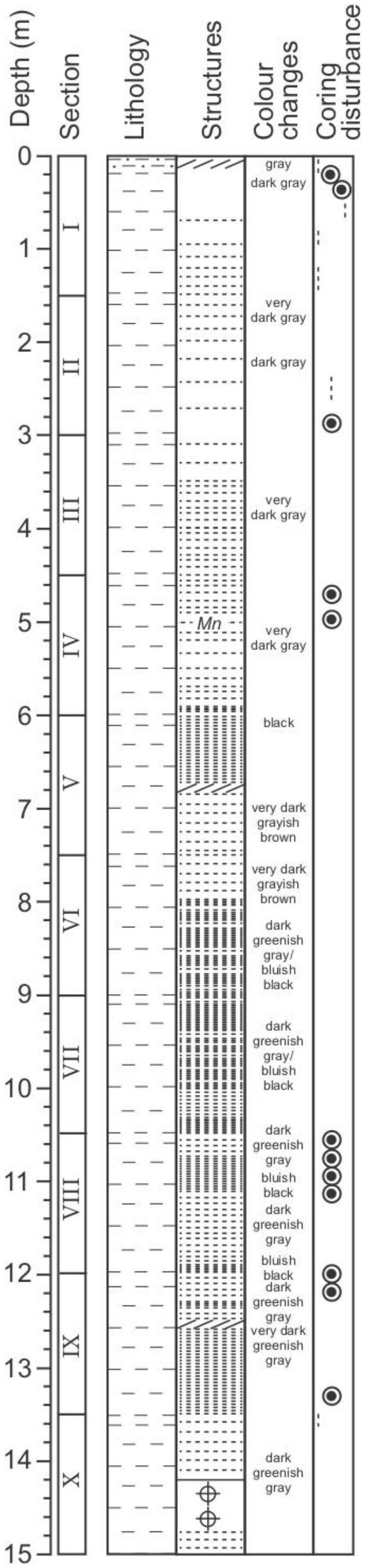


Figure 92: Pictures of Calypso core MD23-3664.

MD241-AMA2-Leg2	**MD23-3664**	Position: 4°27.176 N 48°37.287 W
Station S11	**Sediment description (1/3)**	Water-depth: 1696 m Core length: 33.67 m



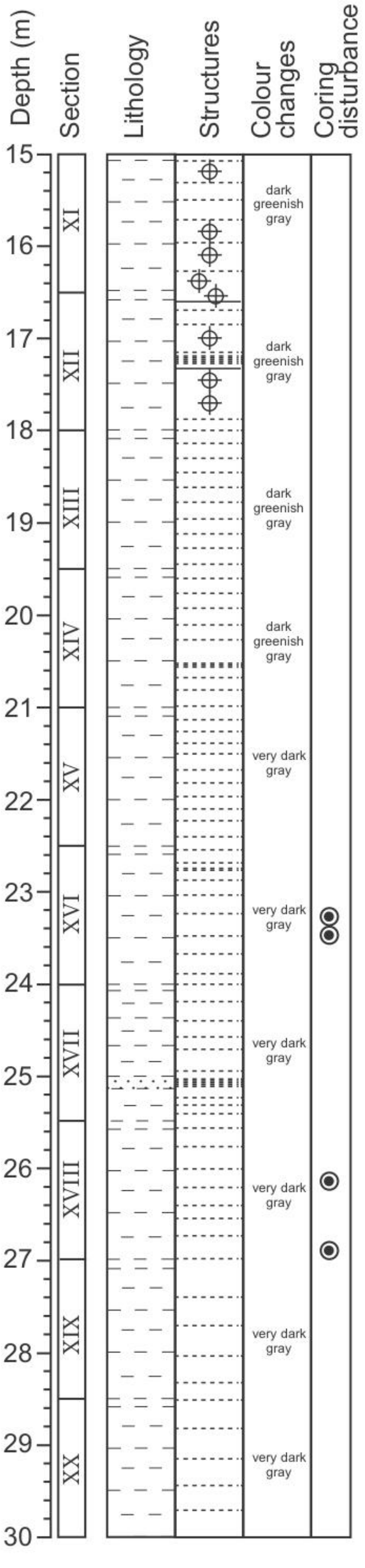
Comments

Homogeneous dark to very dark grayish mud with black marks (or layers) throughout the entire core

Presence of floculated mud in some sections of the core which can be an indication of gas release

Some coring disturbances in some sections

MD241-AMA2-Leg2	**MD23-3664**	Position: 4°27.176 N 48°37.287 W
Station S11	**Sediment description (2/3)**	Water-depth: 1696 m Core length: 33.67 m



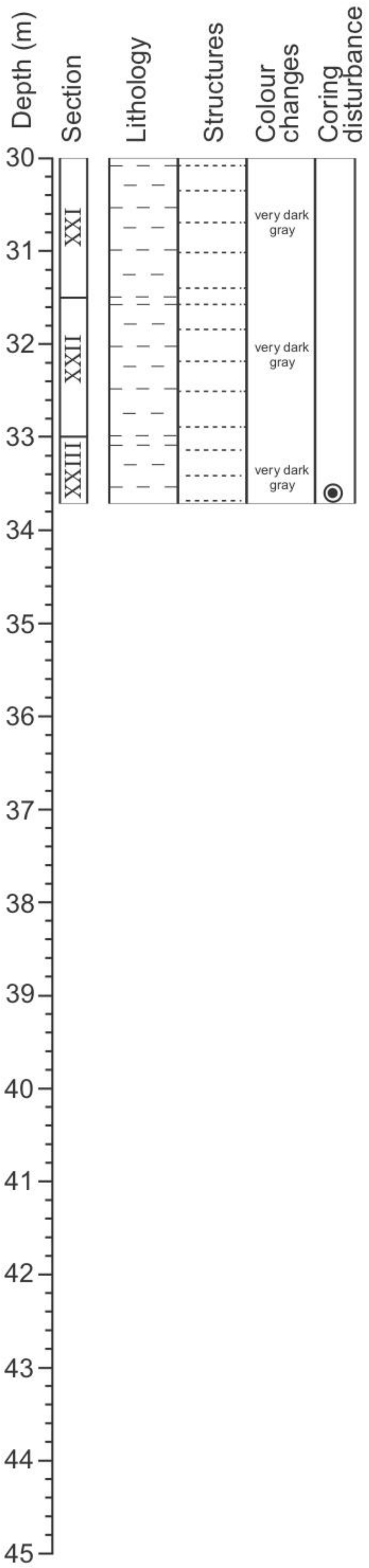
Comments

Homogeneous dark to very dark grayish mud with black marks (or layers) throughout the entire core

Presence of floculated mud in some sections of the core which can be an indication of gas release

Some coring disturbances in some sections

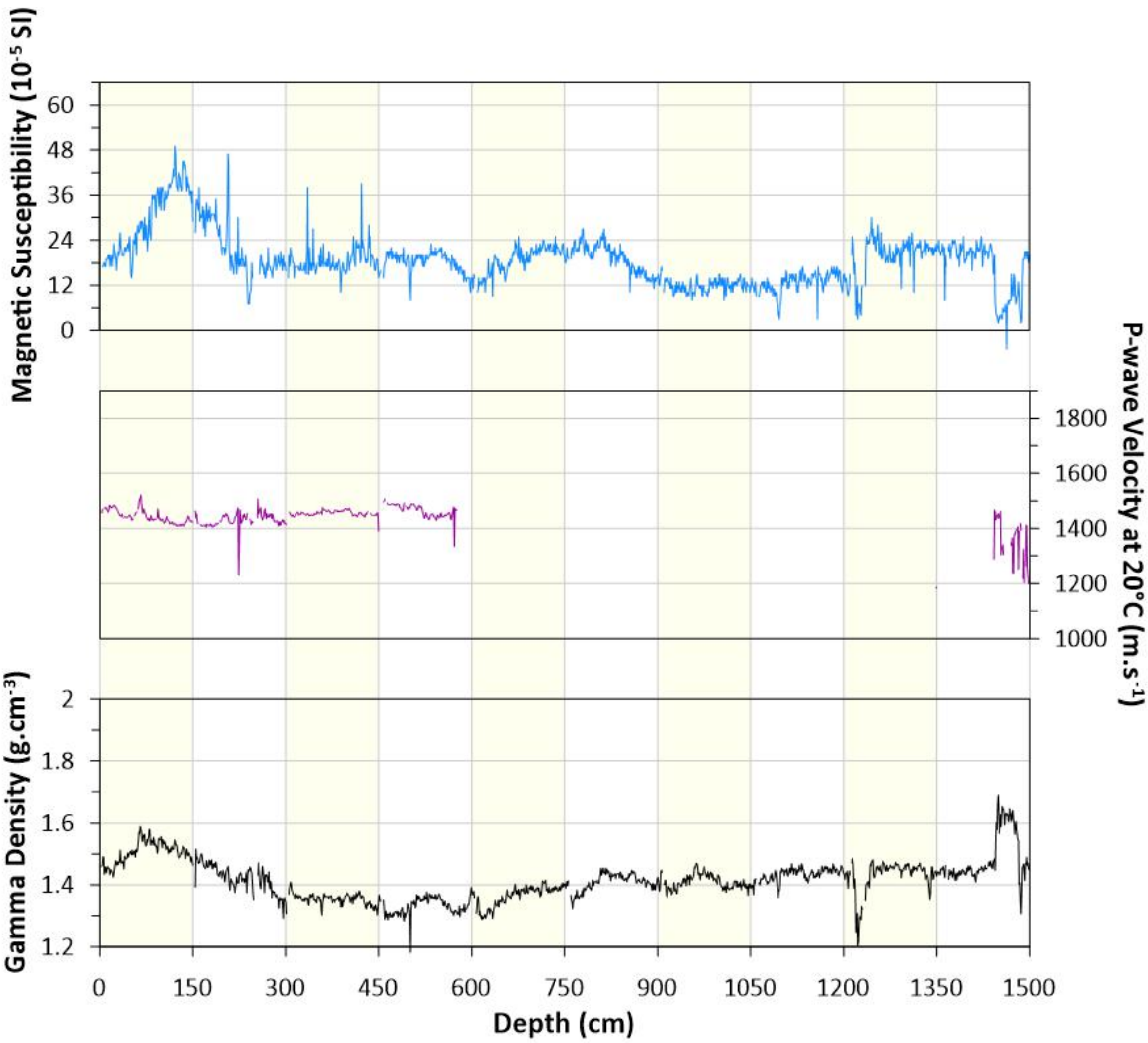
MD241-AMA-Leg2	**MD23-3664**	Position: 4°27.176 N 48°37.287 W
Station S11	**Sediment description (3/3)**	Water-depth: 1696 m Core length: 33.67 m



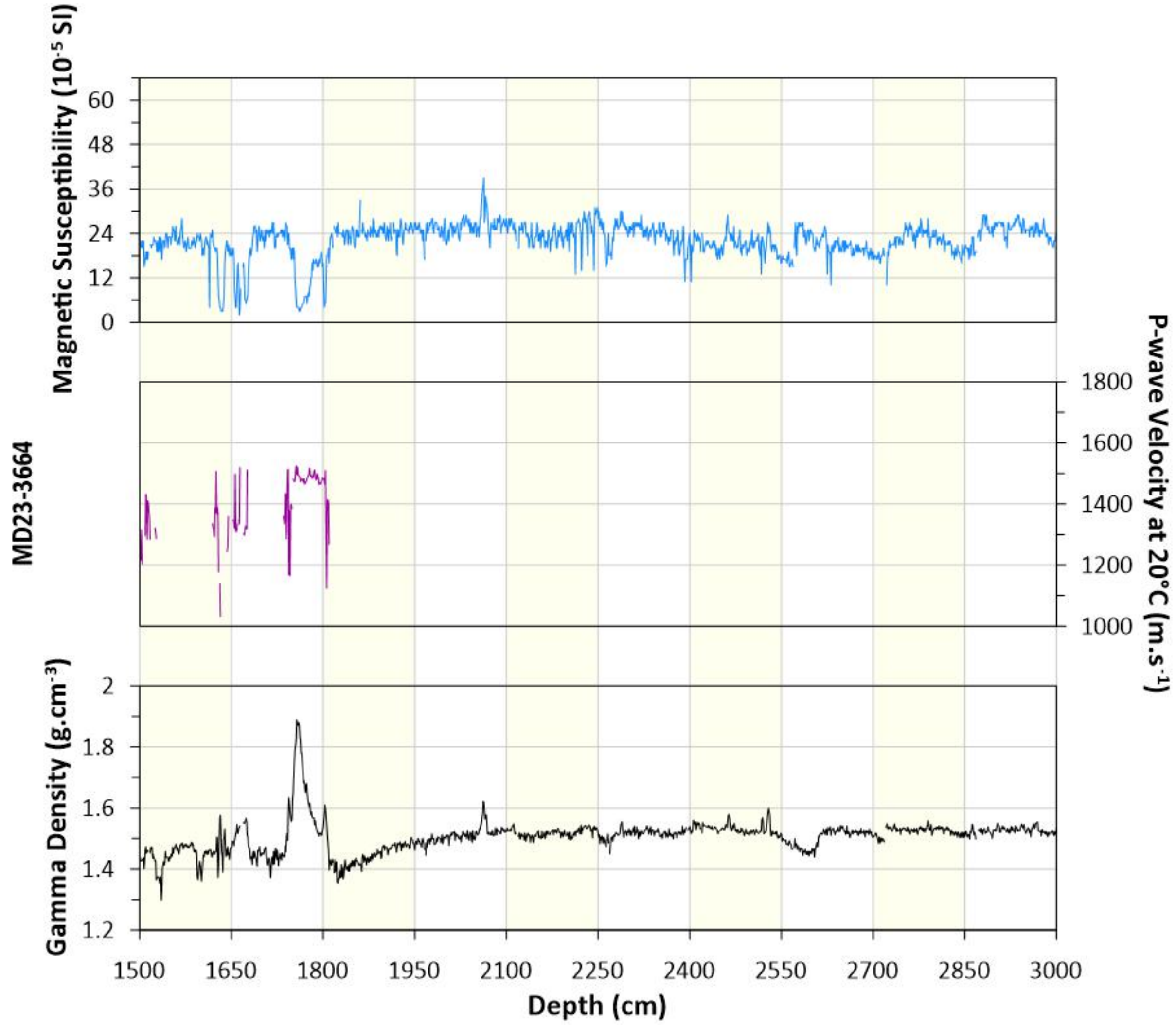
Comments

Homogeneous dark to very dark grayish mud with black marks (or layers) throughout the entire core

Figure 93: Sediment description of Calypso core MD23-3664.



Magnetic Susceptibility (10⁻⁵ SI)
60
48
36
24
12
0
MD23-3664
P-wave Velocity at 20°C (m.s⁻¹)
1800
1600
1400
1200
1000
Gamma Density (g.cm⁻³)
2
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)


Magnetic Susceptibility (10^{-5} SI)
60
48
36
24
12
0
MD23-3664
P-wave Velocity at 20°C ($m.s^{-1}$)
1800
1600
1400
1200
1000
Gamma Density ($g.cm^{-3}$)
2
1.8
1.6
1.4
1.2
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

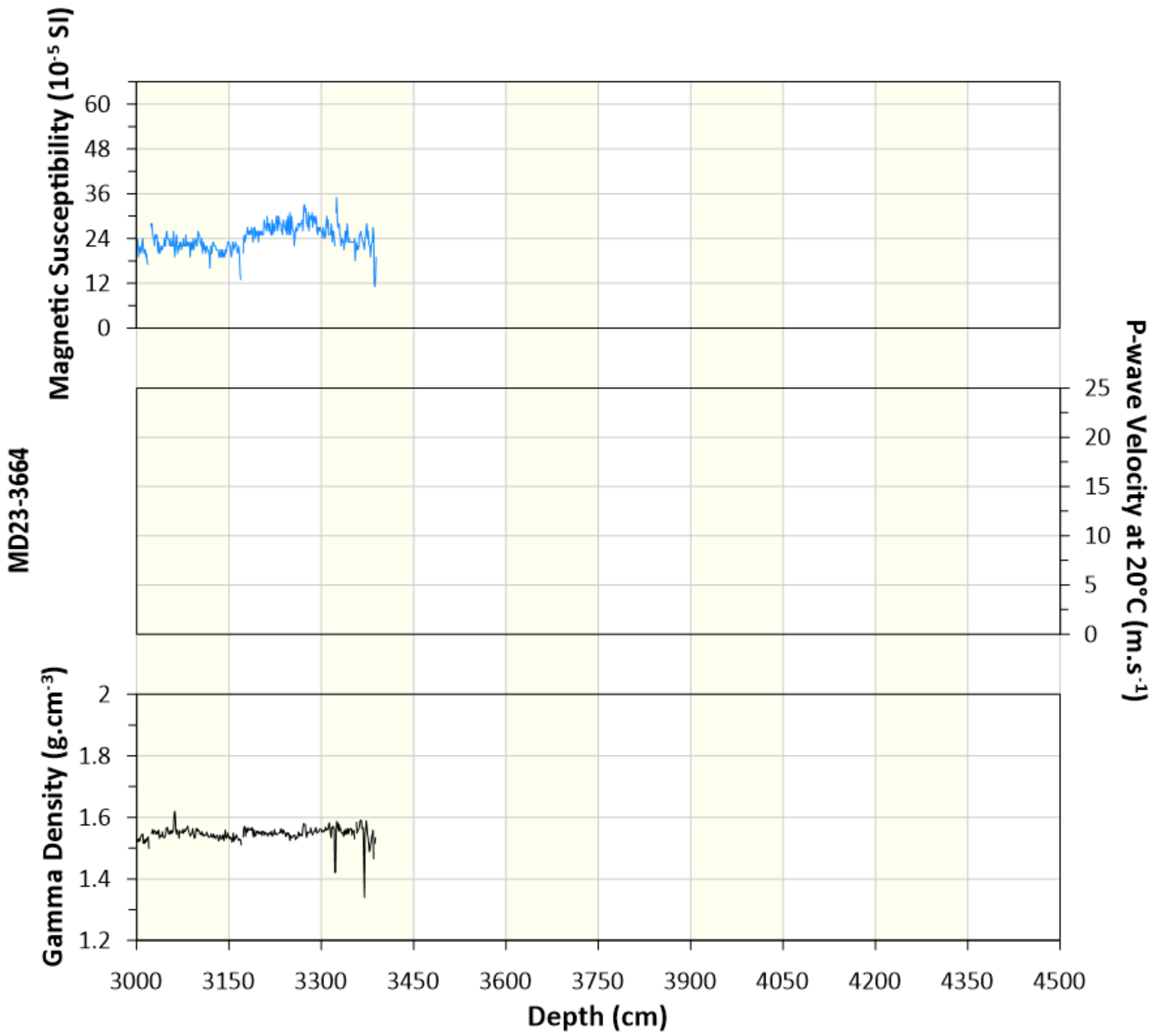
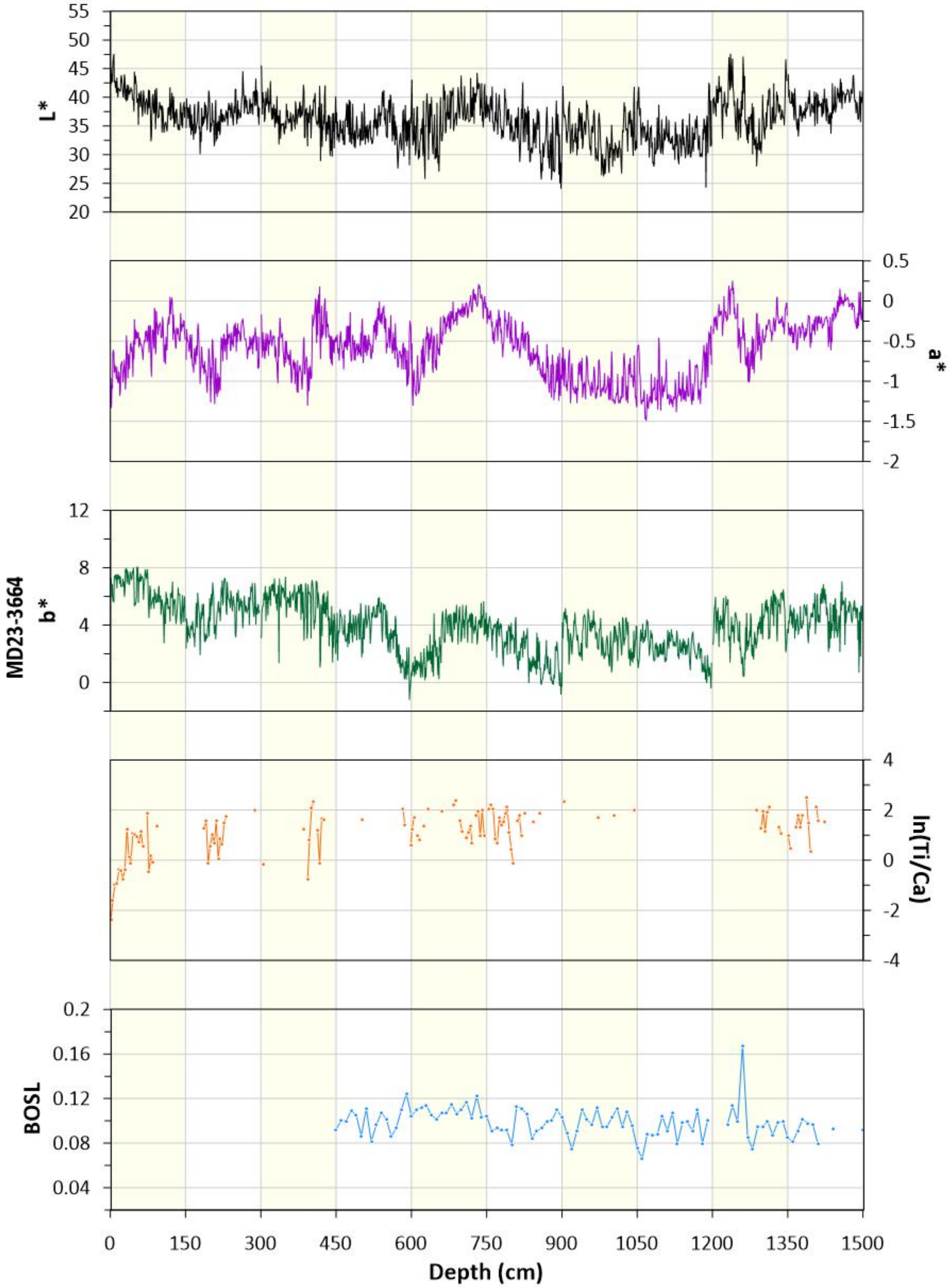
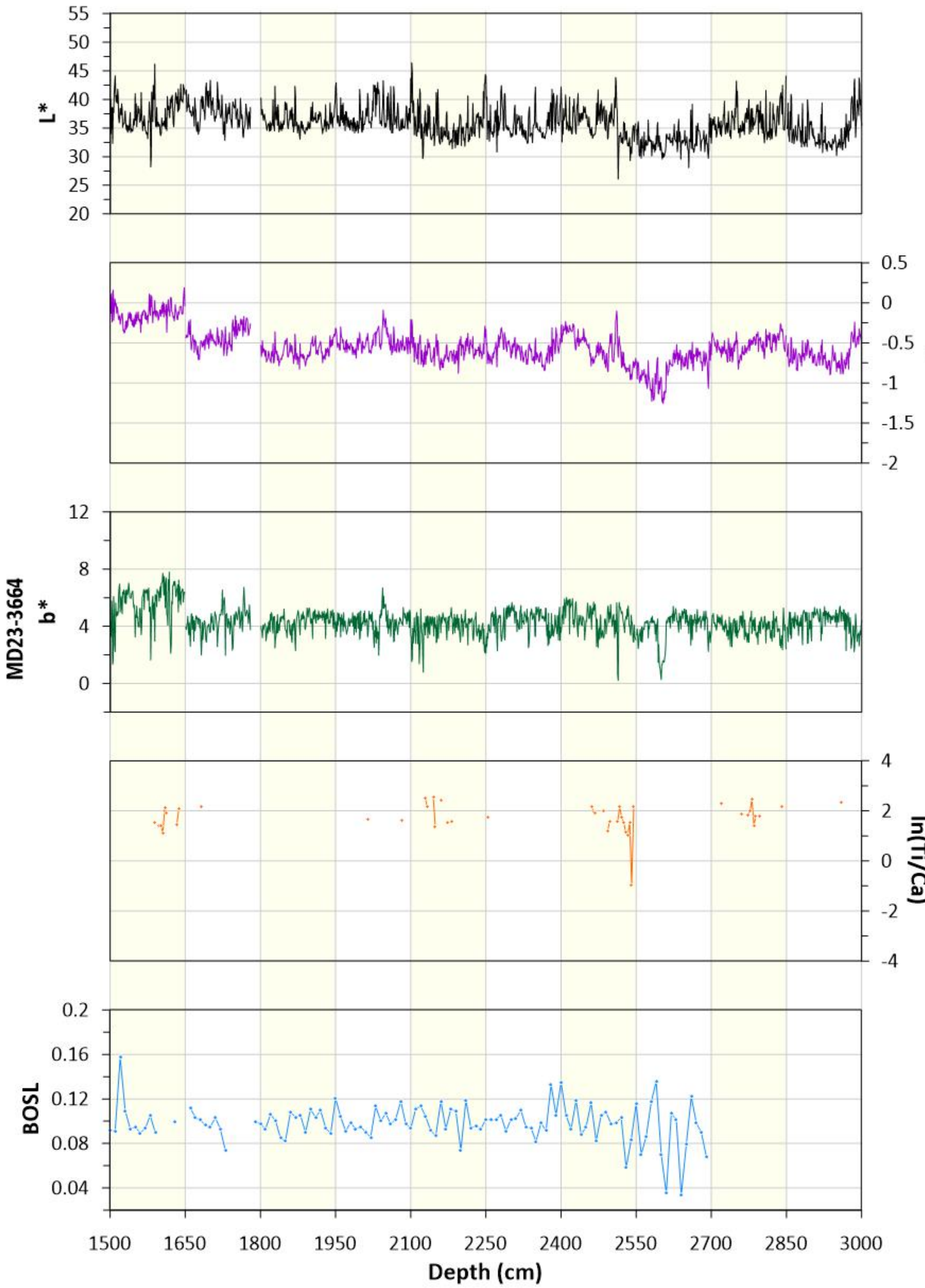


Figure 94: Physical properties of Calypso core MD23-3664. The quality of P-wave velocity measurements is reduced in lower core sections, explaining the absence of plotted data.


L*
a*
MD23-3664
b*
ln(Ti/Ca)
BOSL
Depth (cm)



55
50
45
40
35
30
25
20
L*
0.5
0
-0.5
-1
-1.5
-2
a*
12
8
4
0
MD23-3664
b*
4
2
0
-2
-4
ln(Ti/Ca)
0.2
0.16
0.12
0.08
0.04
BOSL
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

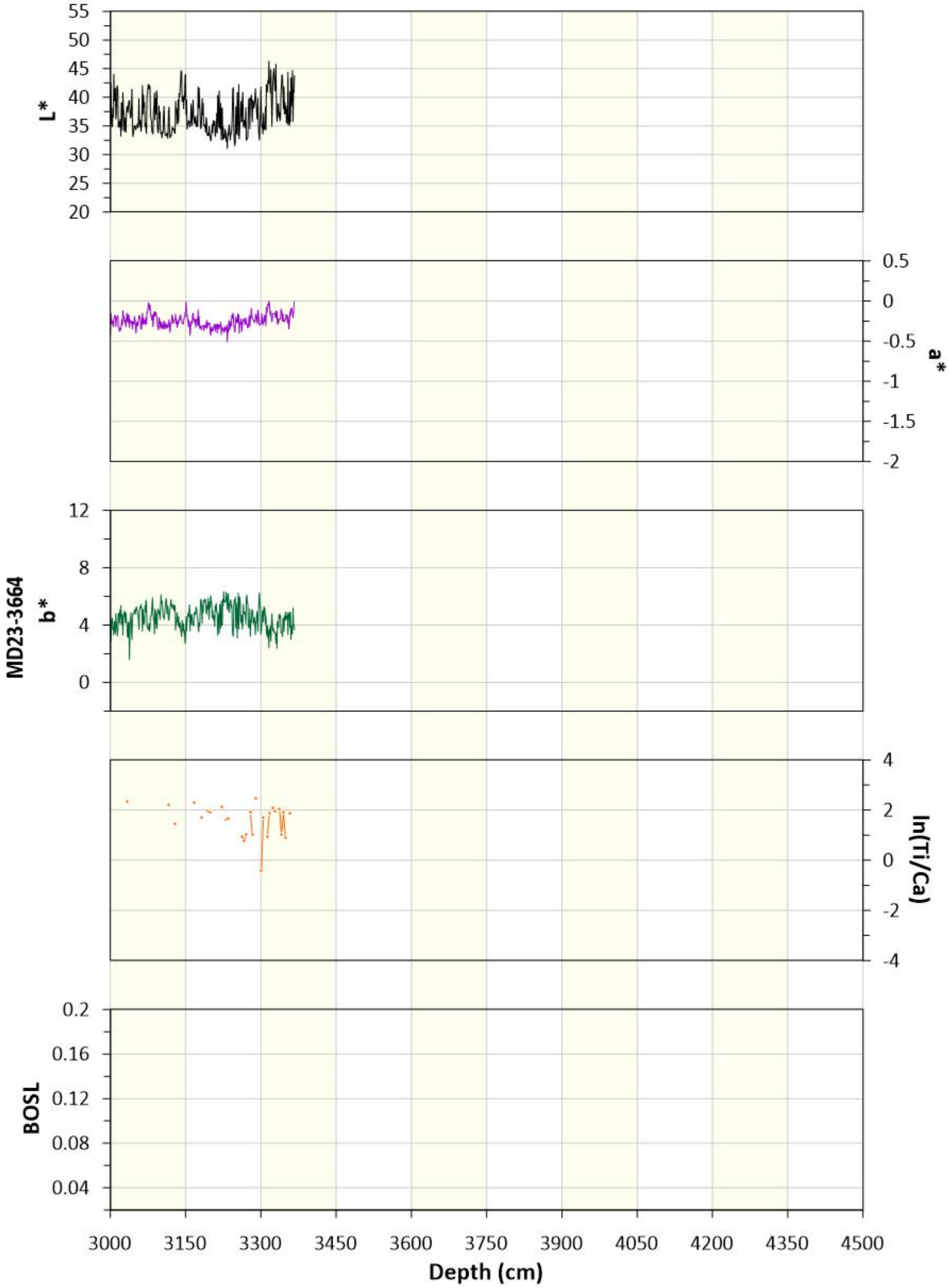


Figure 95: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3664. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

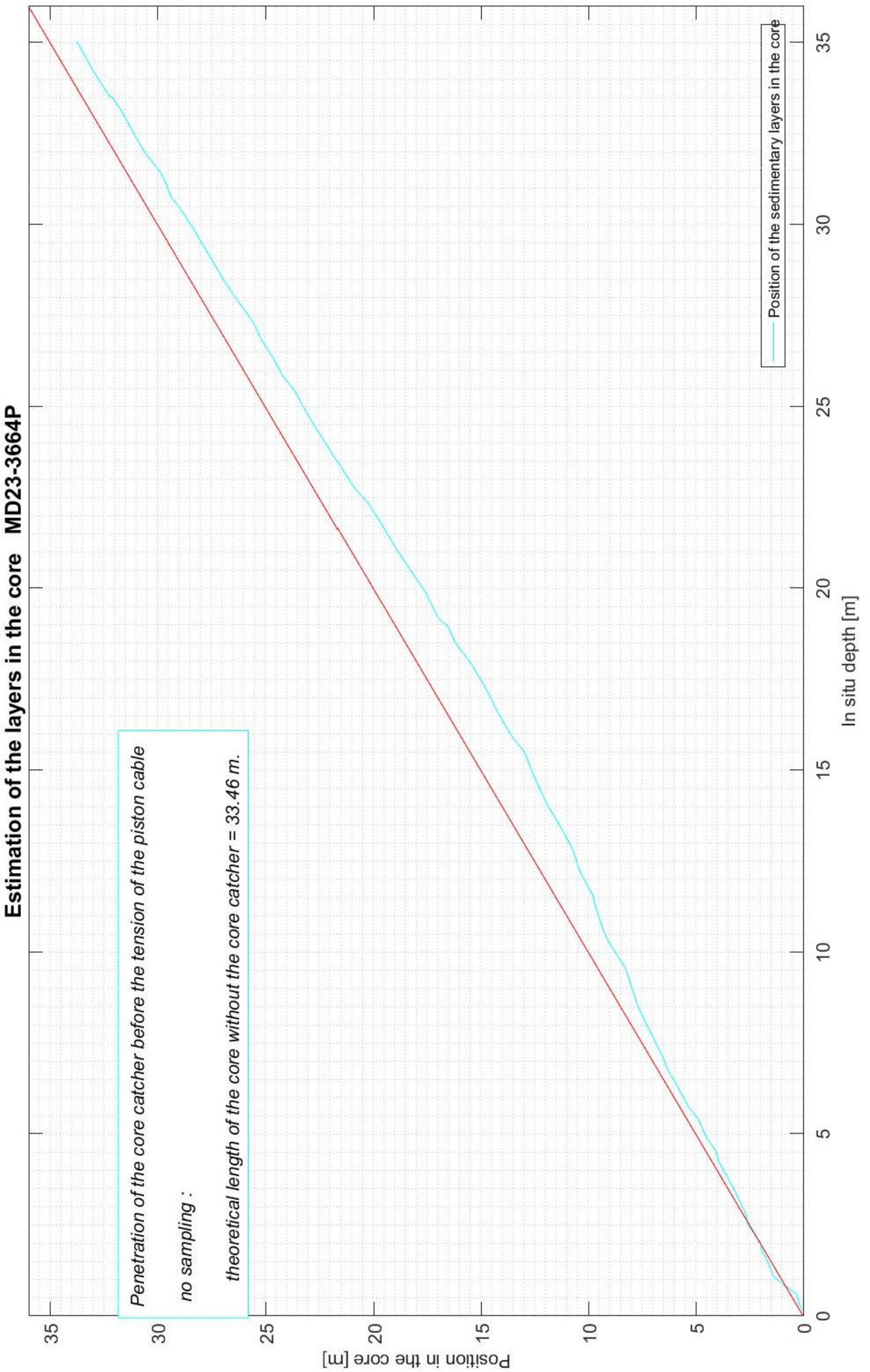


Figure 96: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3664.

Core MD23-3664 shows evidence for sediment undersampling between 0 and ~12 m and normal sampling between ~12 m and the core's bottom depth.

3.4.5.5 Data of CTD-rosette ("palanquée mode") AMA2-S11-CTD

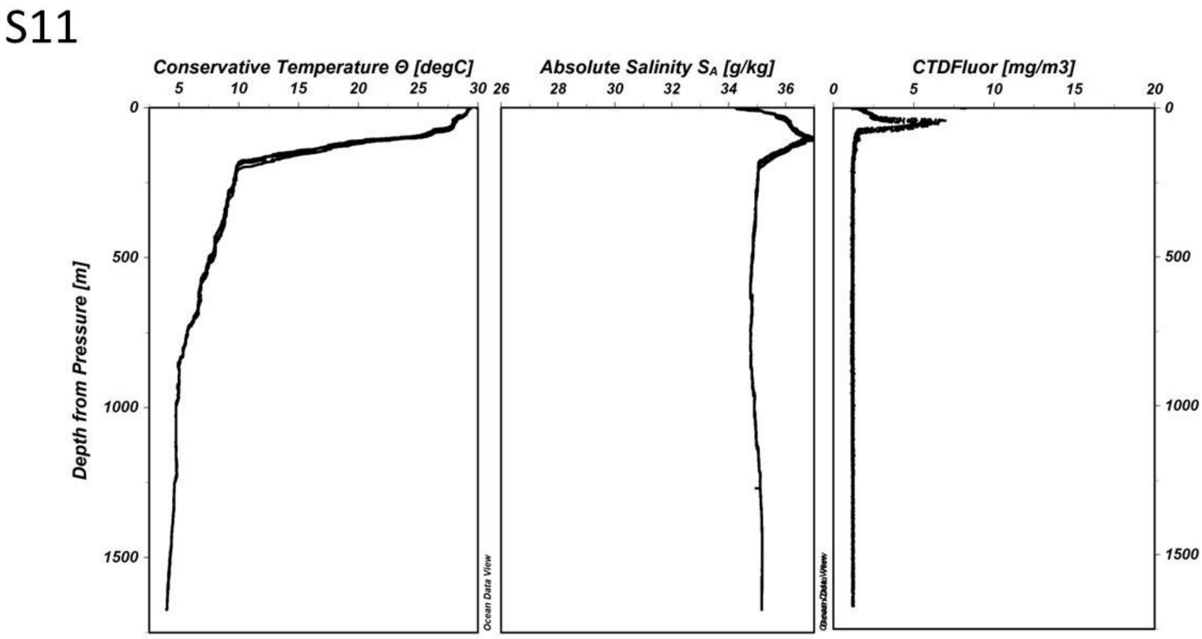


Figure 97: Temperature, salinity and fluorescence vertical profiles obtained by the CTD probe operated in "palanquée" mode at station S11.

Table 14: Collected water samples during CTD "palanquée" cast 1 at station S11. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	1	2	3	4	5	6	7	CTD
Water depth (m) cable length	5	20	50	80	100	200	450	
Water depth (m) pressure sensor	5.0	28.4	58.4	88.7	109.2	209.5	459.0	700
$\delta^{18}O$ LOCEAN (20 mL)	X	X	X	X	X	X	X	
$\delta^{13}C$ LOCEAN (25 mL)	X	X	X	X	X	X	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle	50	50	50	50	50	50	50	
$\Delta^{14}C$ (250 mL)	X	X	X	X		X	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle	1000	1000	1000	1000		1000	1000	
Nutrients (30 mL)	X	X	X	X	X	X	X	
Fluorescence (0-200 m)								
PAH & trace elements MARBEC (60 mL)	X		X			X	X	
Water stable isotopes MARBEC (30 mL)	X							
Comments					upper cap not closed			

Table 15: Collected water samples during CTD "palanquée" cast 2 at station S11. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	7	6	5	4	3	2	1	CTD
Water depth (m) cable length	100	700	850	1000	1250	1500	1675	
Water depth (m) pressure sensor	167.9	268.6	868.8	1018.4	1168.7	1417.2	1666.8	1680
$\delta^{18}O$ LOCEAN (20 mL)	X	X	X	X	X	X	X	
$\delta^{13}C$ LOCEAN (25 mL)	X	X	X	X	X	X	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle	50	50	50	50	50	50	50	
$\Delta^{14}C$ (250 mL)	X	X	X	X	X	X	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle	1000	1000	1000	1000	1000	1000	1000	
Nutrients (30 mL)	X	X		X		X		
Fluorescence (0-200 m)								
PAH & trace elements MARBEC (60 mL)	X		X				X	
Water stable isotopes MARBEC (30 mL)								
Comments					upper cap not closed			

3.4.6 Station S12

3.4.6.1 Station S12 information

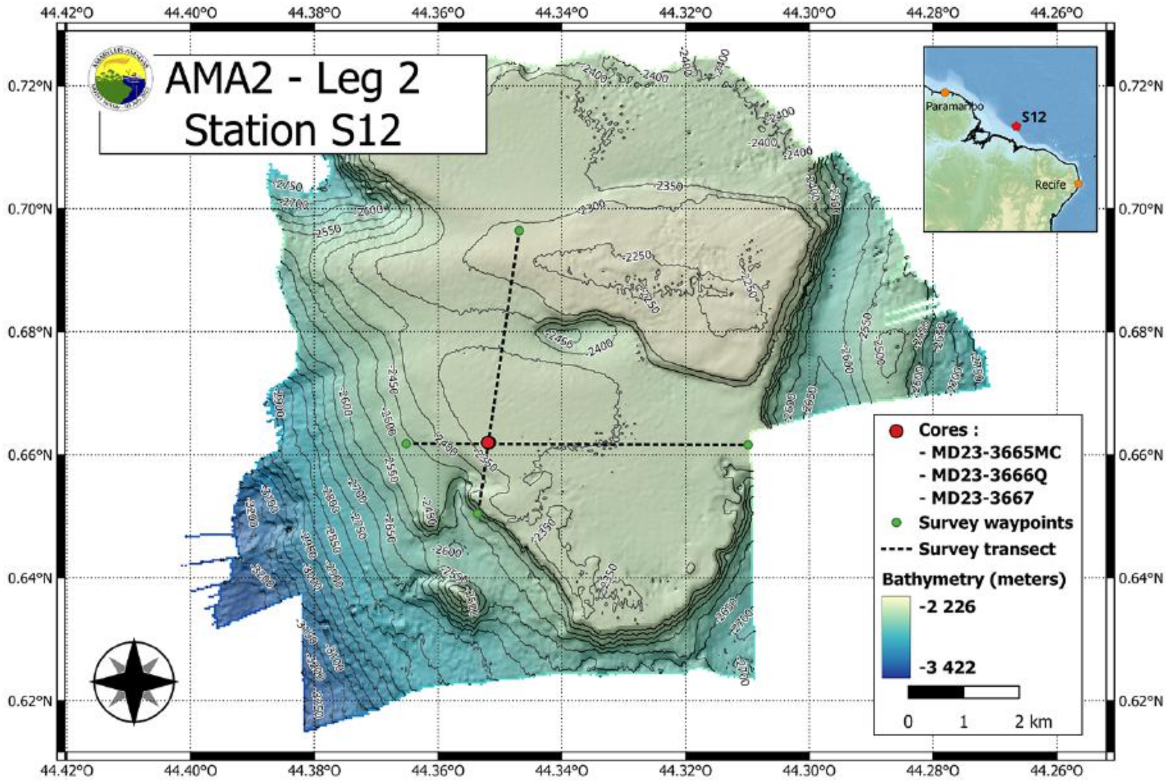


Figure 98: Bathymetric map at station S12.

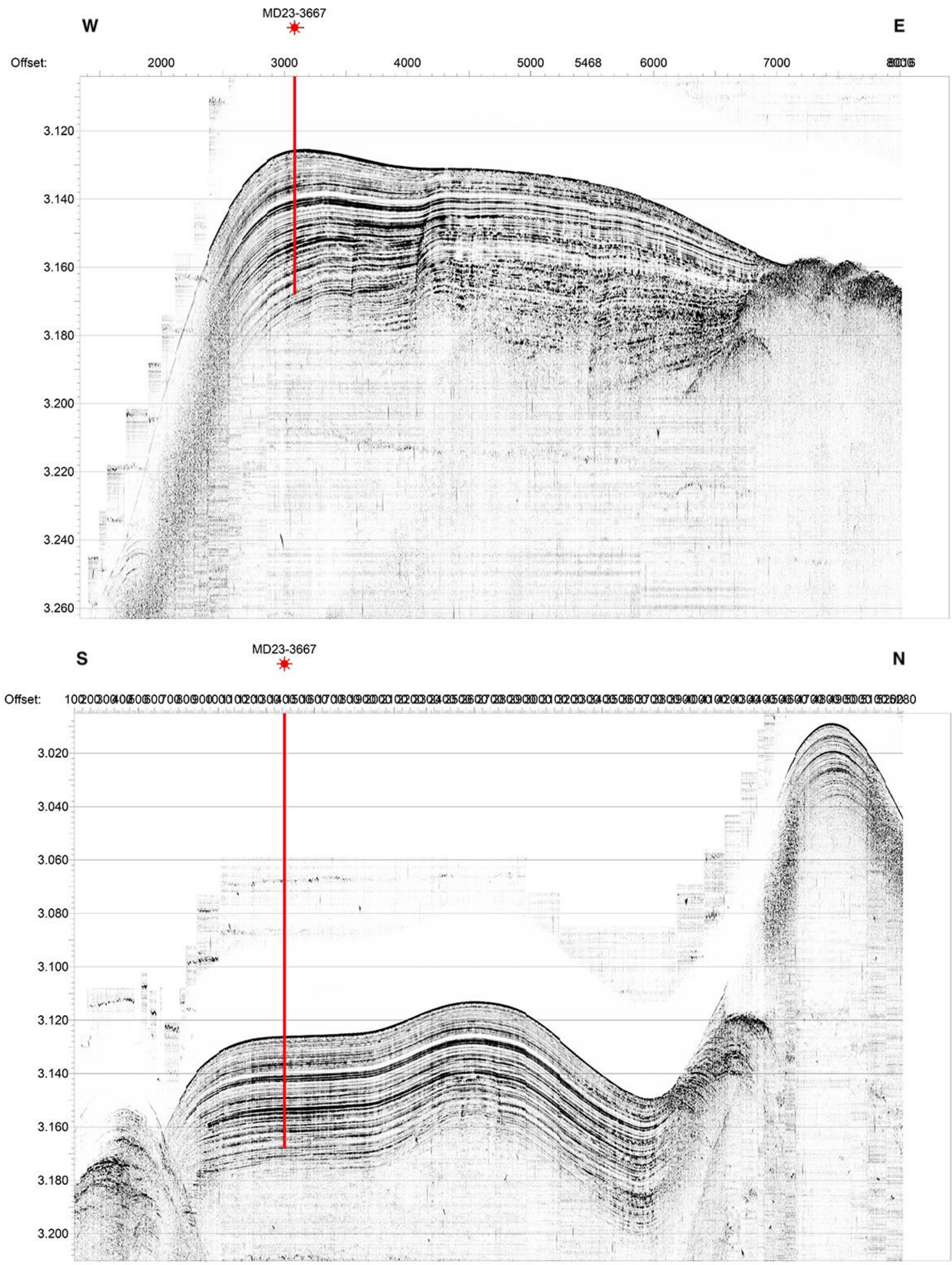


Figure 99: (top) W-E and (bottom) S-N subbottom profiles at station S12. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

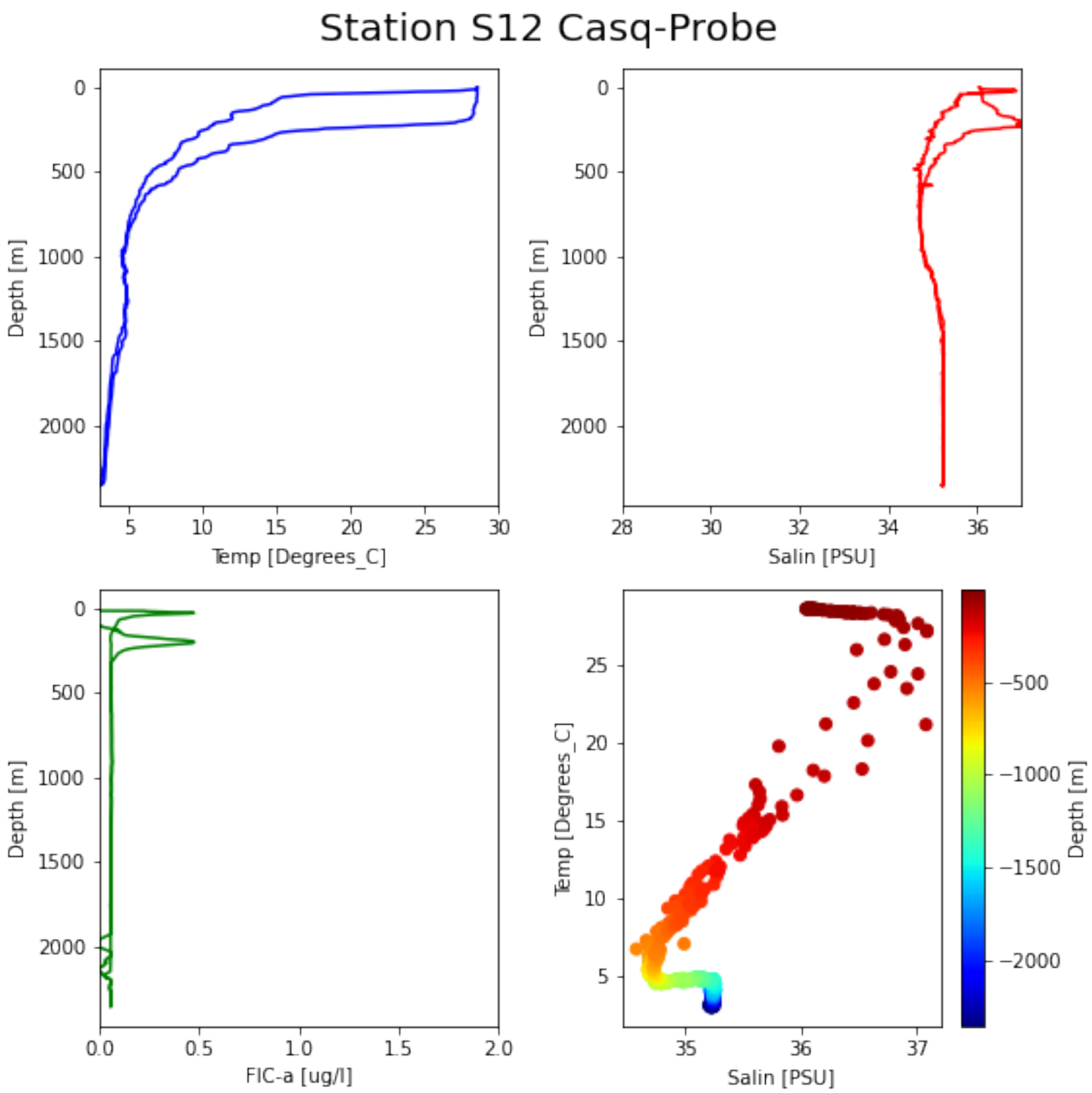


Figure 100: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S12.

3.4.6.2 Multicore MD23-3665MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **22/06/2023**
Core MD23 – 3665 MC	*Station* ***S12***	*Operator* **4-8 ; 8-12 ; 0-4**
Comments *Elisabeth MICHEL took supernatant water above core A*		

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? *(example for type: 1-cm slice)*	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	37 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ~~no~~	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	38 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		**yes** / ~~no~~	~~yes~~ / **no**	
C	37 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		yes / **no**	yes / **no**	
D	37 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 8-12 ?? **type:** 1-cm slice		yes / **no**	yes / **no**	

Figure 101: Coring information of multi-core MD23-3665MC.

3.4.6.3 Casq core MD23-3666Q

Cruise Name

MD241-AMA2-Leg2

Date : **22/06/2023**

station N° : **S12**

Weather information

Wind speed: **21 knots**
Wind direction: ##### °
Sea : ~1 m

Core (N°) :

MD23-3666Q

Core Length:

9.40 m

Position (posidonia)

Latitude : **00 ° 39.719 N**

Longitude : **44 ° 21.106 W**

Corer (type) : CASQ

total weight (air) : t

total weight (water) : surface 6.3 t, bottom 7.0 t

TUNINGS :

Tubes (length) : 12.00 m

Résultats CINEMA

Measured Parameters :

multibeam water depth	**2343**	m
released cable length :	2 328	m
Extraction/total *(tons)* :	11.50	t
extraction/differential *(tons)* :		t

TIME (GMT)

On station :	20:00 GMT
Beginning of operation :	22:10 GMT
Triggering :	23:39 GMT
End of operation :	01:35 GMT
Duration of operation :	3h30

INSTRUMENTATION
Other OPERATIONS on site

MUC CTD-Rosette

Small CTD Small Niskin

Other : Calypso

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Two bags with core top sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0–150	150–300	300–450	450–600	600–750	750–850	850–940
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–940
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII

2nd level: 2 small boxes C and D + 2 u-channels between them

0–150	150–300	300–450	450–600	600–750	750–900	900–940
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–940
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII

0–150	150–300	300–450	450–600	600–750	750–900	900–940
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–940
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII

3rd level: 3 small boxes E, F and G

0–150	150–300	300–450	450–600	600–750	750–850	850–940
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII

0–100	100–250	250–400	400–550	550–700	700–850	850–940
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII

0–150	150–300	300–450	450–600	600–750	750–900	900–940
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII

Figure 102: Coring information of Casq core MD23-3666Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name **MD23-3666Q** -Core length **9.4 m**
Station: S12 -Latitude: **0° 39.719 N** -Longitude: **44° 21.106 W** –
Water Depth :**2343 m**

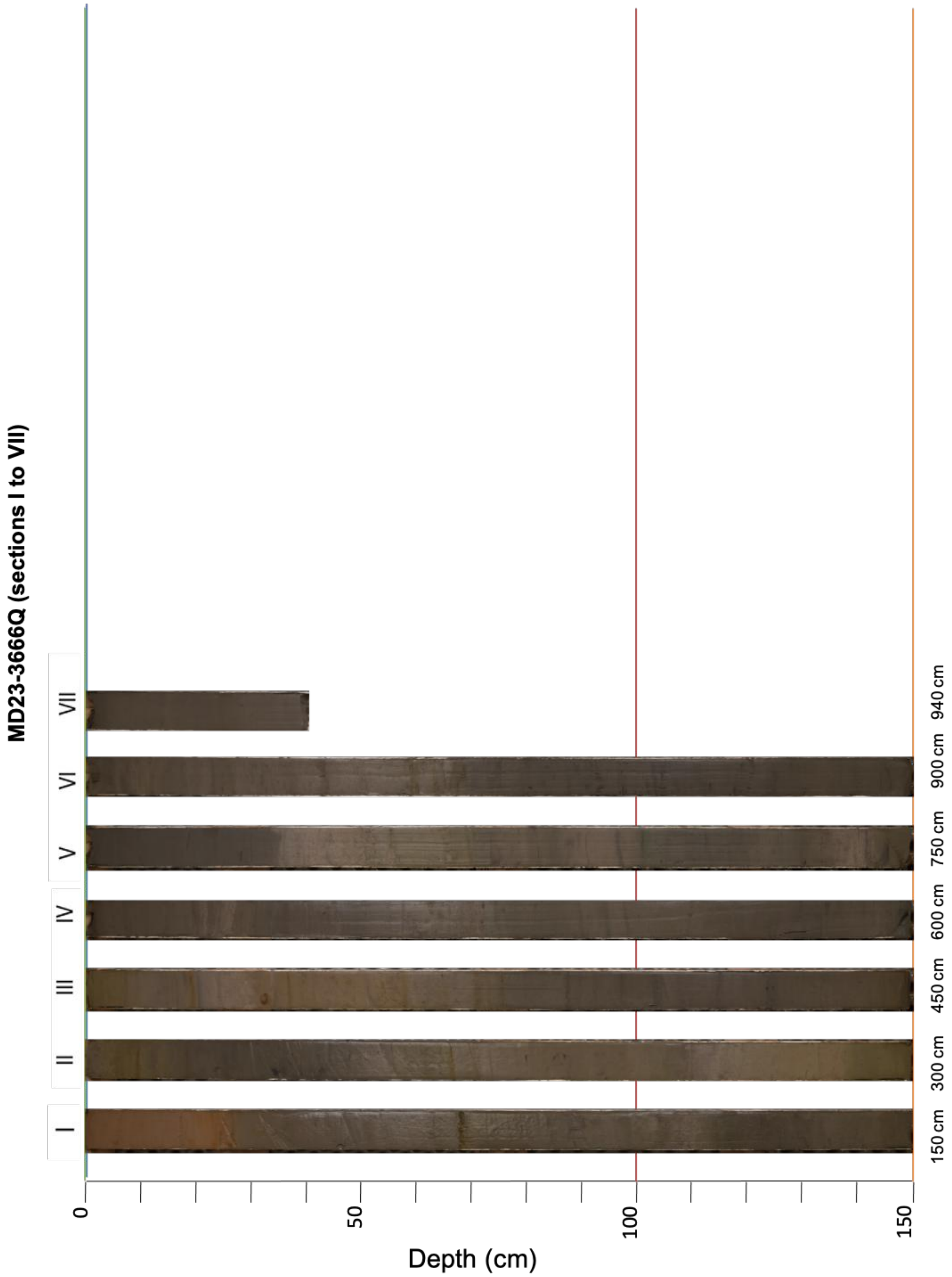
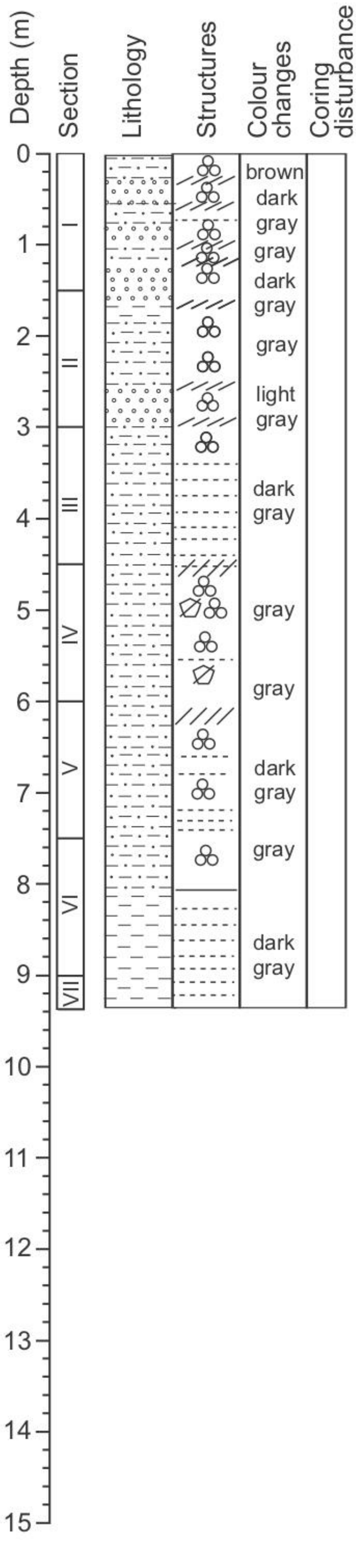


Figure 103: Pictures of Casq core MD23-3666Q.

MD241-AMA2-Leg2 Station S12	MD23-3666Q Sediment description (1/1)	Position: 0°39.719'N 44°21.106'W Water-depth: 2343 m Core length: 9.40 m



Comments

Heterogenous sandy-mud sequence, with intervals of carbonatic sandy-mud layers (forams?) intercalated by more silte-clay mud. Most of changes are in a gradational contacts.

0-30cm: Sandy-mud with brownish collor

Figure 104: Sediment description of Casq core MD23-3666Q

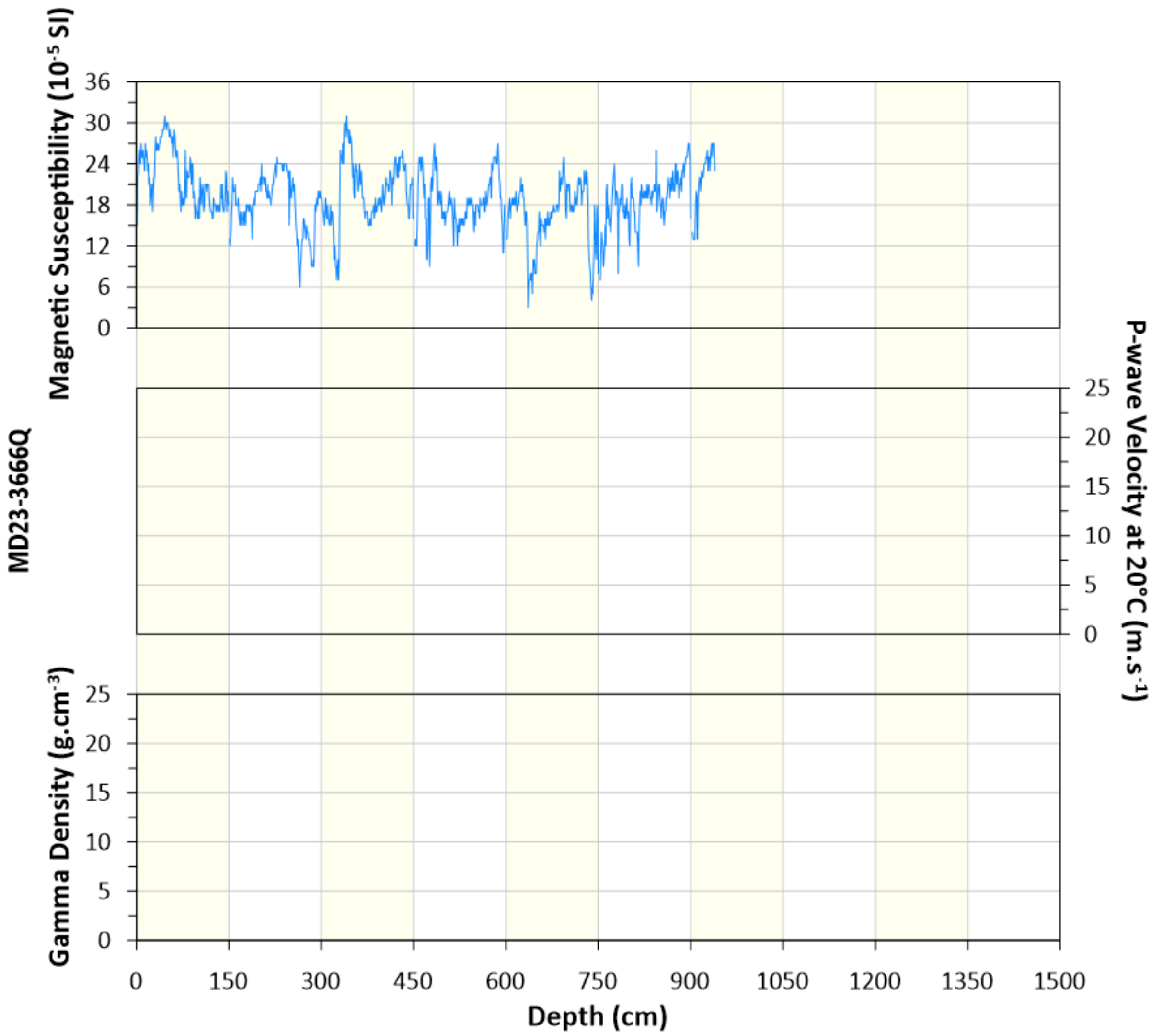


Figure 105: Physical properties of Casq core MD23-3666Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

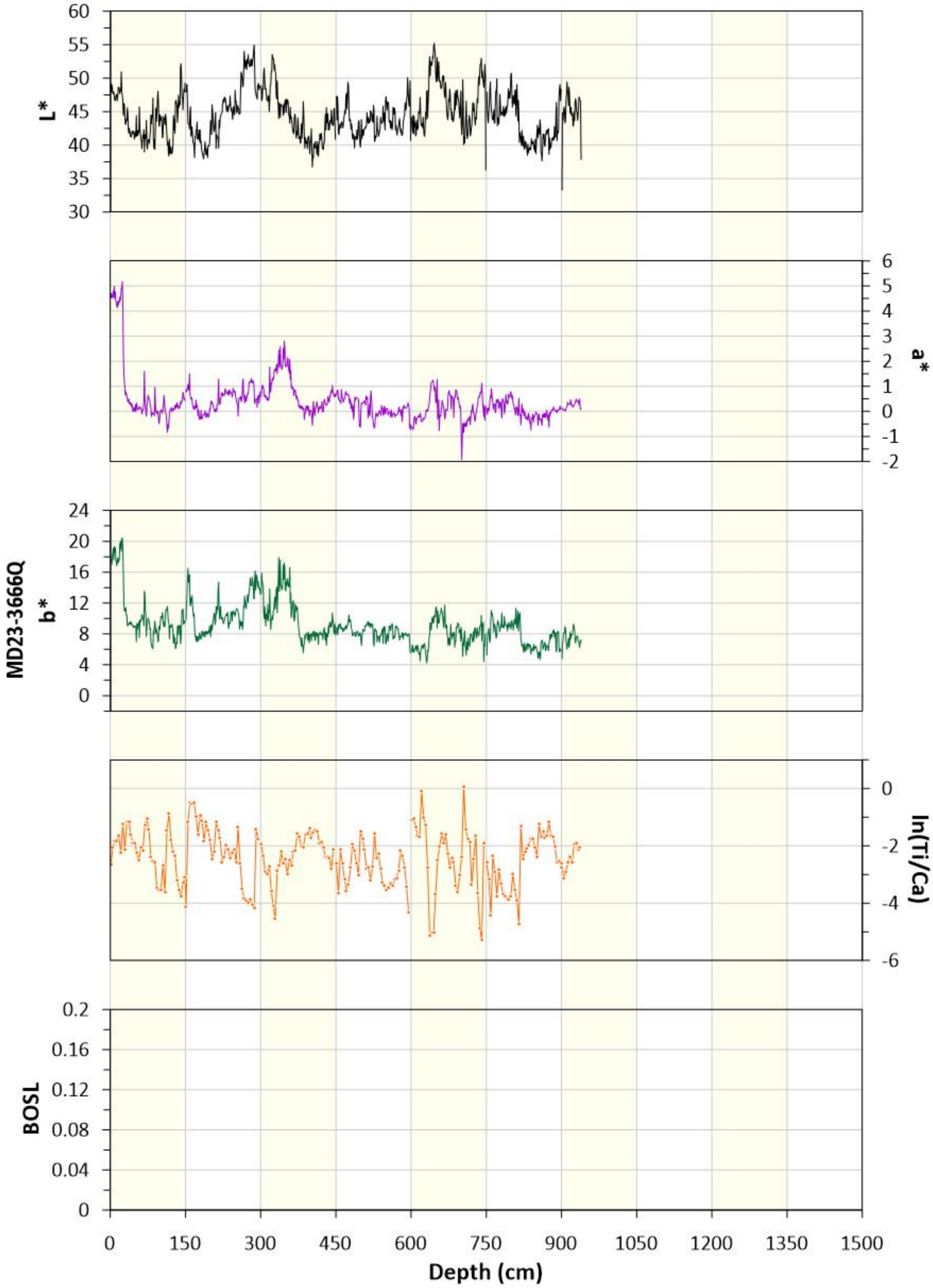


Figure 106: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3666Q. BOSL was not analyzed in Casq cores.*

3.4.6.4 Calypso core MD23-3667

Cruise Name

MD241-AMA2-Leg2

Date : 23/06/2023
station N° : S12

Weather information
Wind speed: 20 knots
Wind direction: 101.00 °
Sea : ~0 m

Core (N°) :

MD23-3667

Core Length:

32.4 m

Position (posidonia)
Latitude : 00 ° 39.719 N
Longitude : 44 ° 21.116 W

Corer (type) : Calypso
total weight (air) : t
total weight (water) : surface 6.0 t
bottom 7.6 t

TUNINGS :
Tubes (length) : 34.45 m
Cables :
Free fall : 2.00 m
theoritical elastic rebound 5.85 m
loop length 6.86 m
counterweight cable length m (3m50 lest)

Résultats CINEMA
thickness sediment sampled m
thickness sediment cored m

Measured Parameters :
multibeam water depth 2 343 m
released cable length : m
Extraction/total *(tons)* : 11.30 t

TIME (GMT)
On station : 20:00 GMT
Beginning of operation : 01:35 GMT
Triggering : 04:43 GMT
End of operation : 06:20 GMT
Duration of operation : 4h45

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other : CASQ

Description : Three syringes of core catcher in one bag.

Incidents : Sediment on top of the weight, niskin bottle didn't close because of sediment in bottom trap
S. III: liner broken & scotched to hold the sediment (some sed. lost), mostly on the A half. Liner pieces inside the section, mixed with the sediment.
S. XIII: liquid sediment lost when opening the section (hole in the sediment now)

0	150	250	400	550	700	850 – 1000
I	II	III - liner broken	IV	V	VI	VII

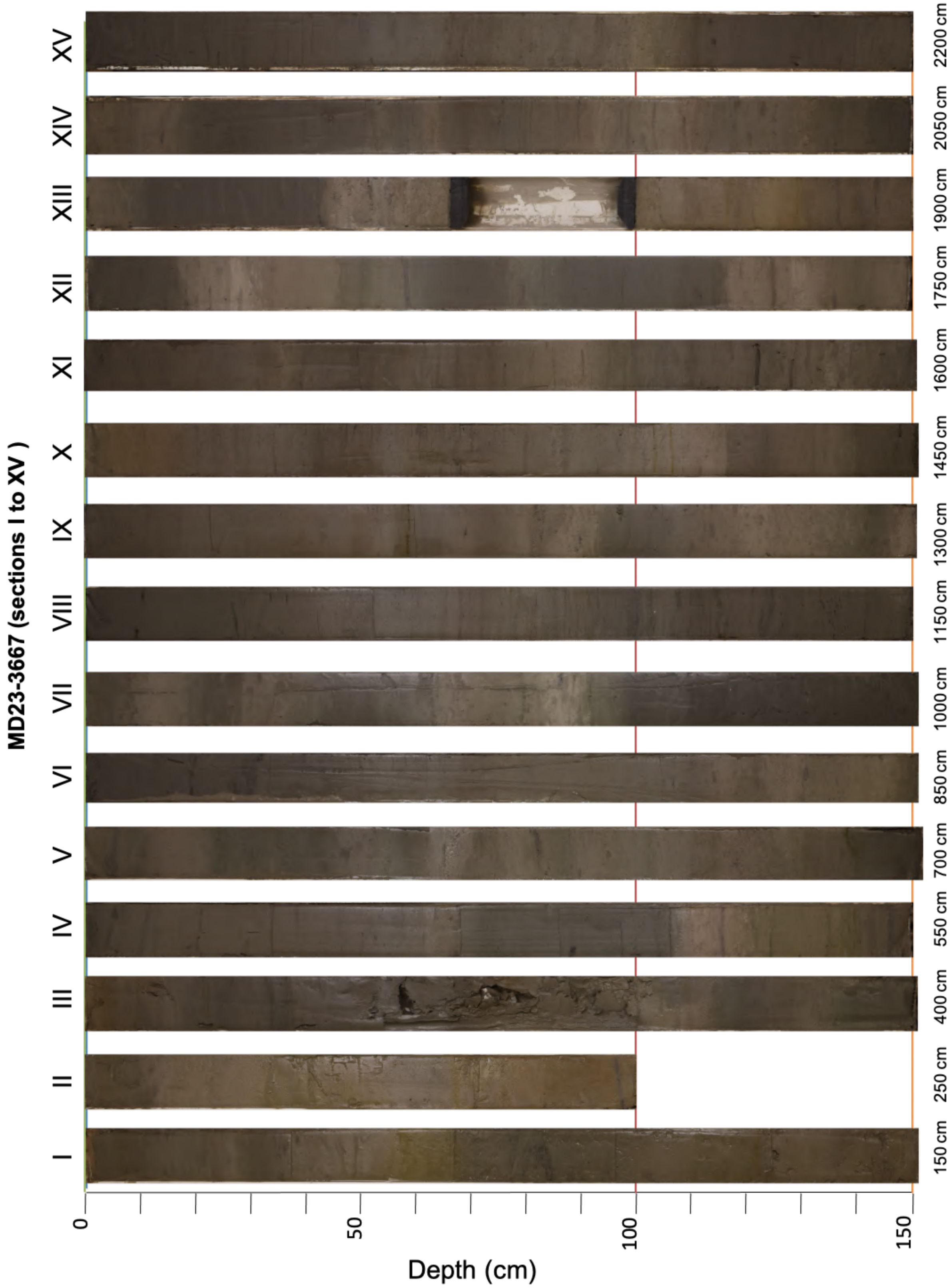
1000	1150	1300	1450	1600	1750	1900 – 2050
VIII	IX	X	XI	XII	XIII	XIV

2050	2200	2350	2500	2650	2800	2950 – 3100
XV	XVI	XVII	XVIII	XIX	XX	XXI

3100 – 3240						
XXII						

Figure 107: Coring information of Calypso core MD23-3667. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3667** -Core length : **32.4 m**
Station: S12 -Latitude: **0°39.719 N** -Longitude: **44°21.116 W**
-Water Depth : **2343 m**



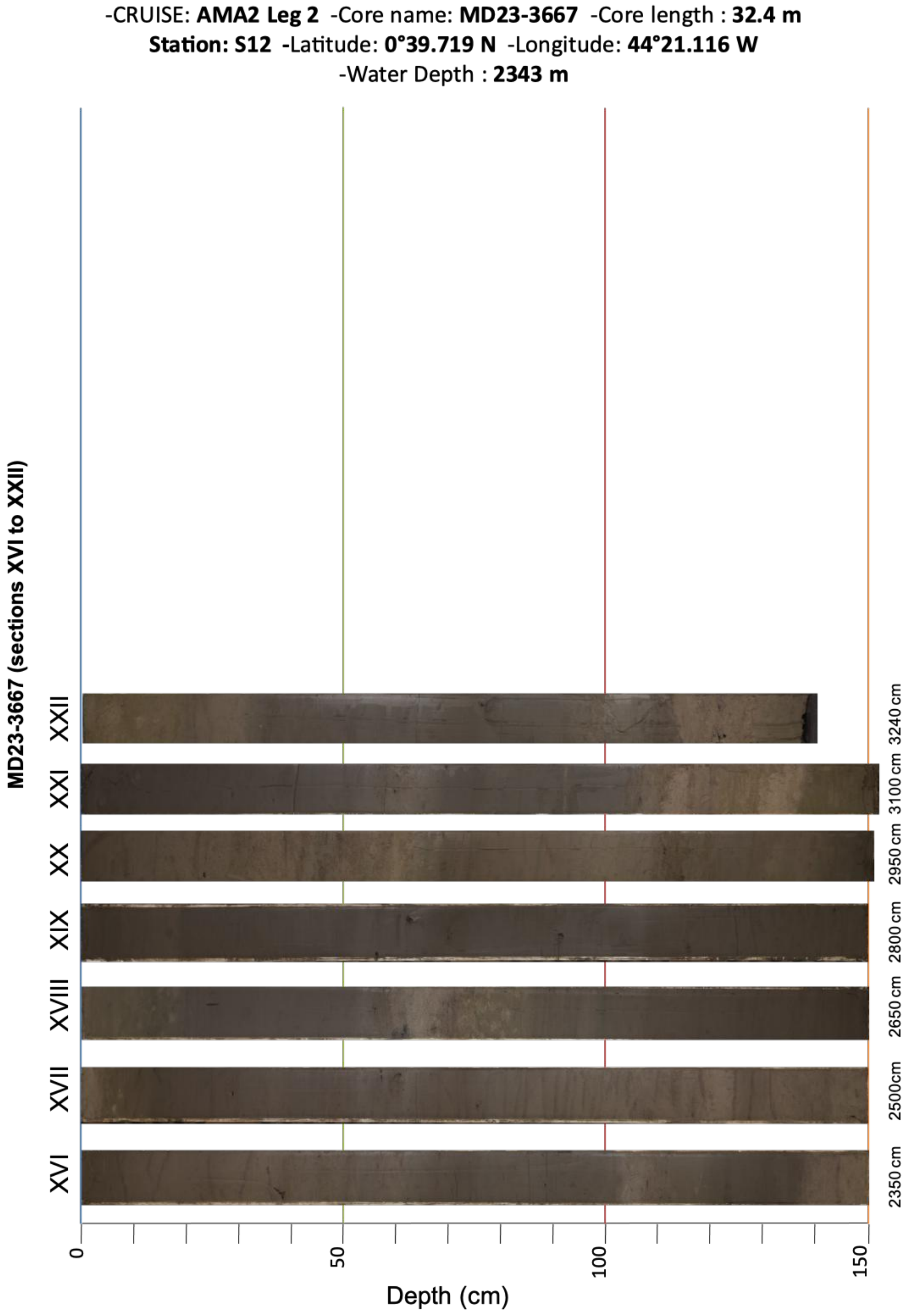
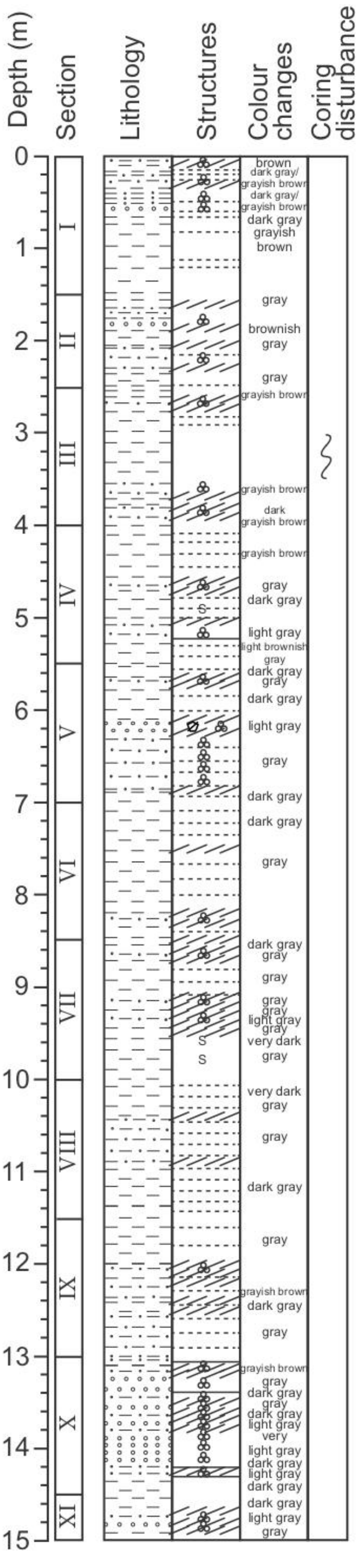


Figure 108: Pictures of Calypso core MD23-3667.

MD241-AMA2-Leg2	**MD23-3667**	Position: 0°39.719 N 44°21.116 W
Station S12	**Sediment description (1/3)**	Water-depth: 2343 m Core length: 32.4 m

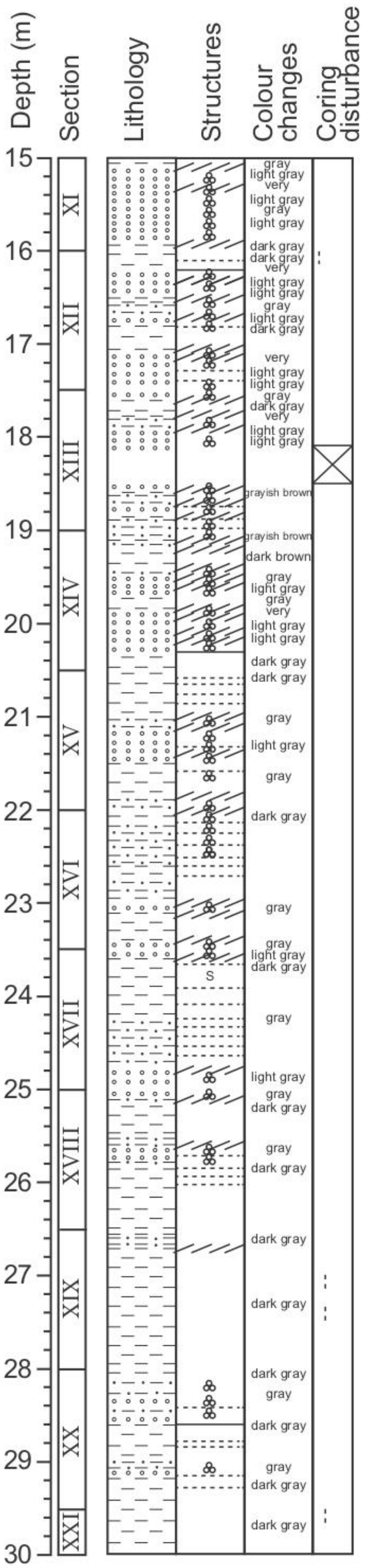


Comments

Heterogenous sandy-mud sequence, with intervals of carbonatic sandy-mud layers (forams?) intercalated by more silt-clay mud. Most of changes are in a gradational contacts.

Strong coring disturbance in section III

MD241-AMA2-Leg2	**MD23-3667**	Position: 0°39.719 N 44°21.116 W
Station S12	**Sediment description (2/3)**	Water-depth: 2343 m Core length: 32.4 m

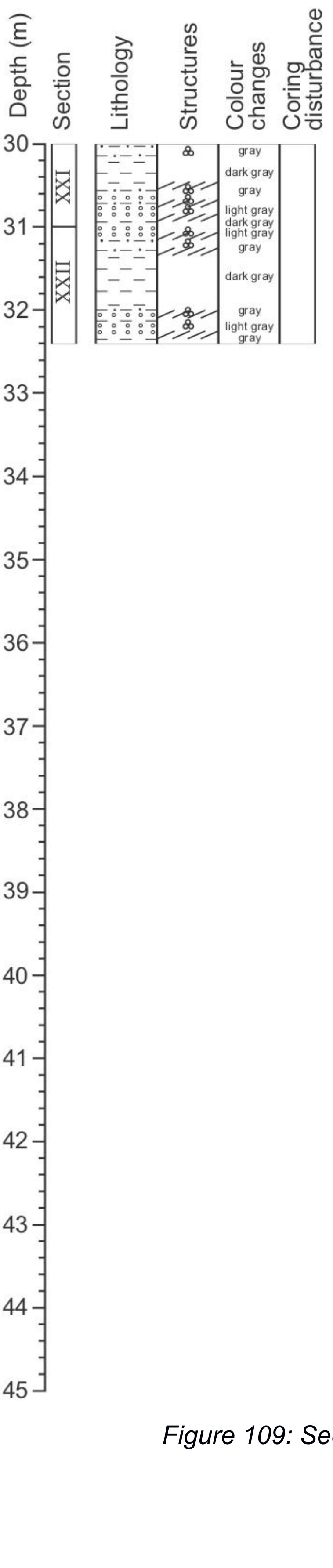


Comments

Heterogenous sandy-mud sequence, with intervals of carbonatic sandy-mud layers (forams?) intercalated by more silt-clay mud. Most of changes are in a gradational contacts.

Void in section XIII

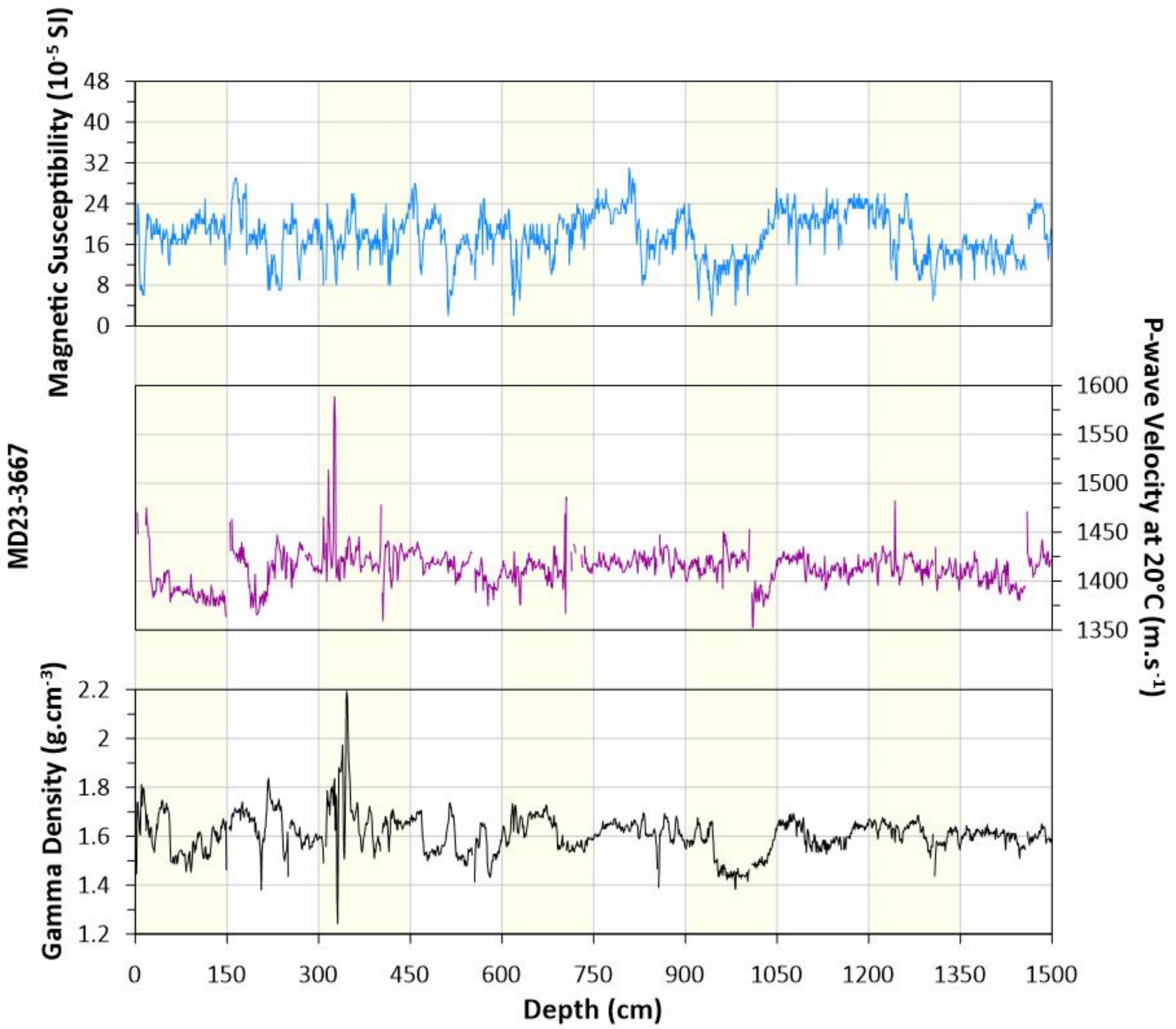
MD241-AMA-Leg2	**MD23-3667**	Position: 0°39.719 N 44°21.116 W
Station S12	**Sediment description (3/3)**	Water-depth: 2343 m Core length: 32.4 m

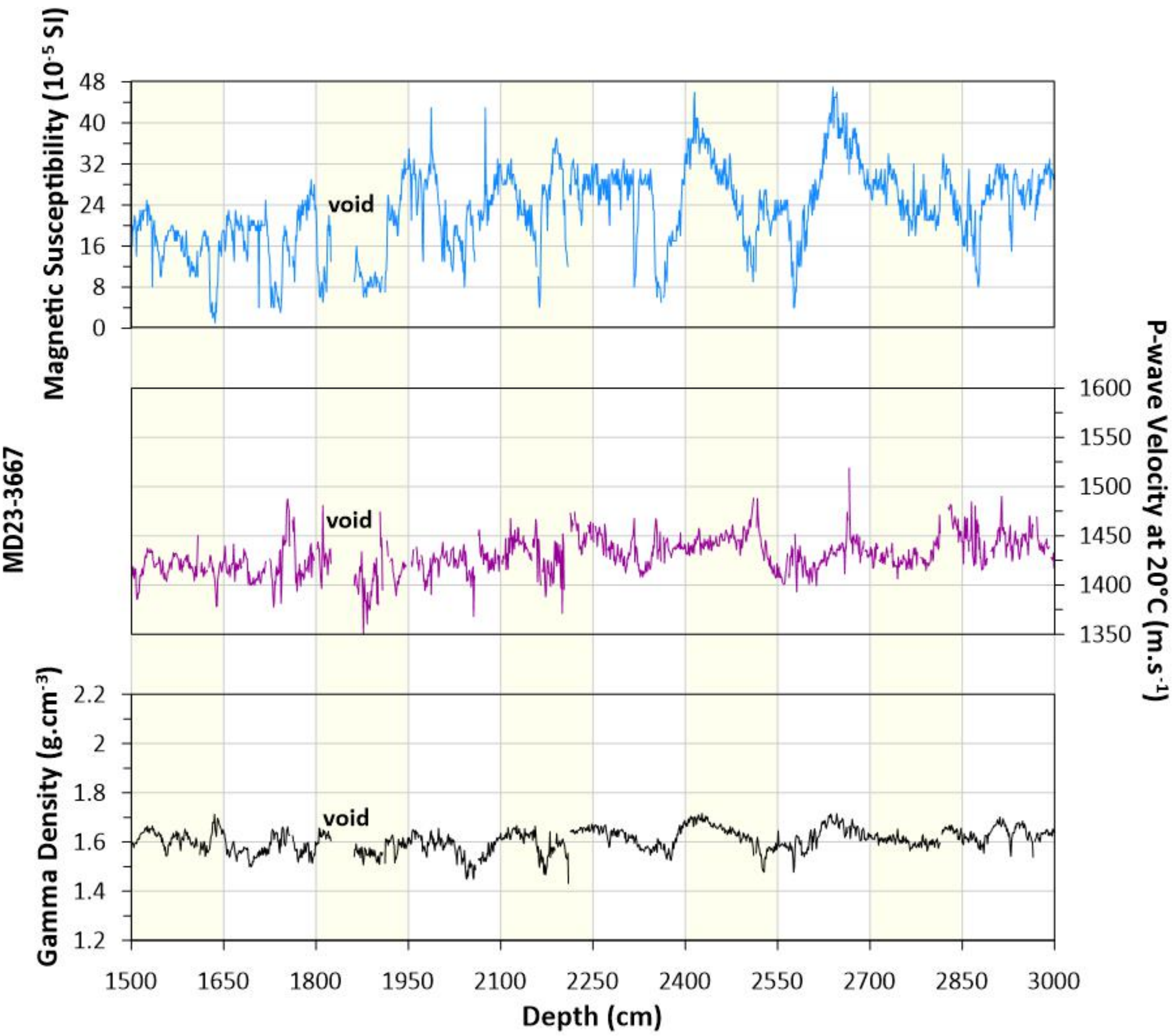


Comments

Heterogenous sandy-mud sequence, with intervals of carbonatic sandy-mud layers (forams?) intercalated by more silt-clay mud. Most of changes are in a gradational contacts.

Figure 109: Sediment description of Calypso core MD23-3667.


Magnetic Susceptibility (10-5 SI)
48
40
32
24
16
8
0
MD23-3667
P-wave Velocity at 20°C (m.s-1)
1600
1550
1500
1450
1400
1350
Gamma Density (g.cm-3)
2.2
2
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)



MD23-3667
Magnetic Susceptibility (10^{-5} SI)
48
40
32
24
16
8
0
void
P-wave Velocity at 20°C ($m.s^{-1}$)
1600
1550
1500
1450
1400
1350
void
Gamma Density ($g.cm^{-3}$)
2.2
2
1.8
1.6
1.4
1.2
void
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

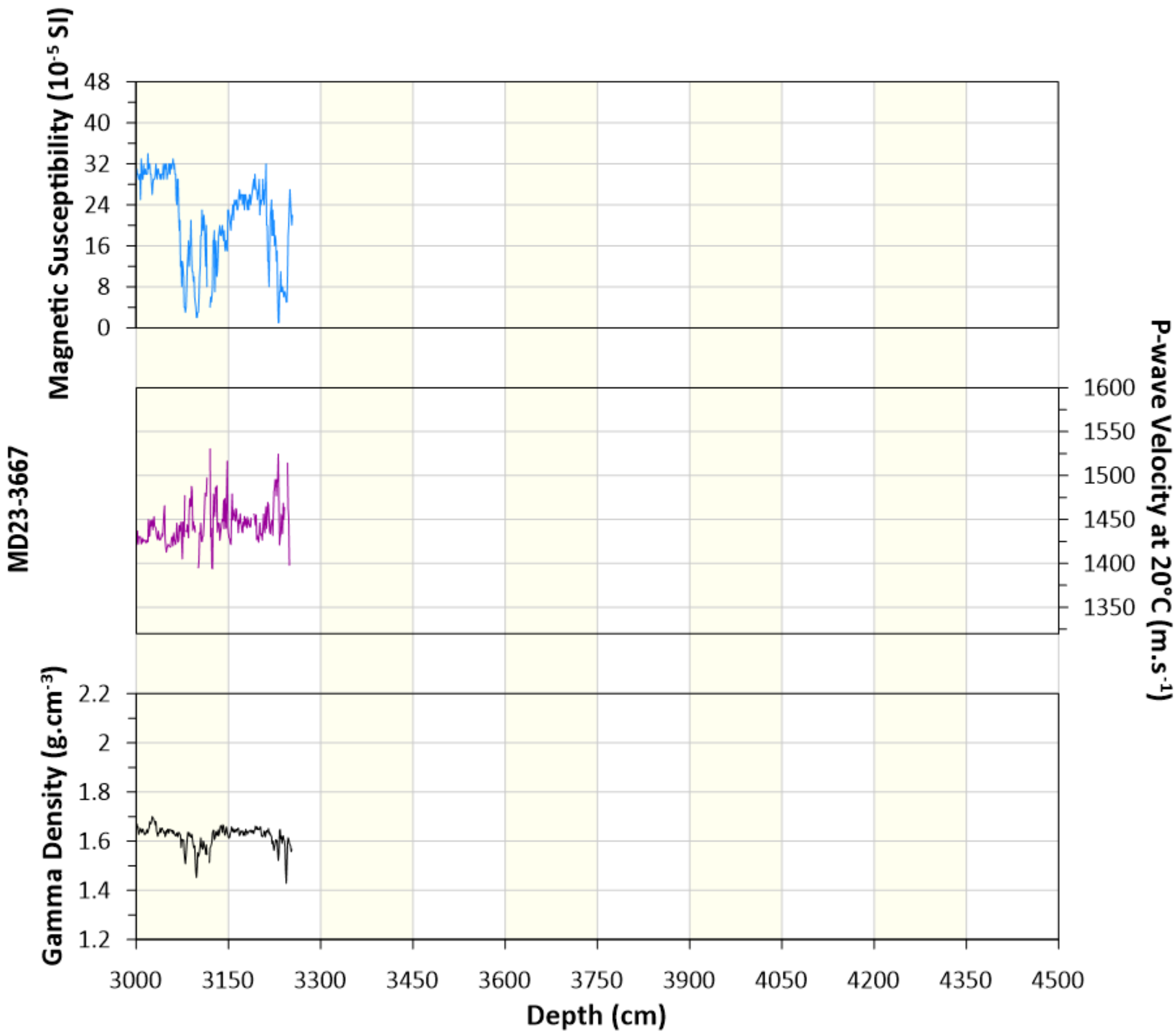
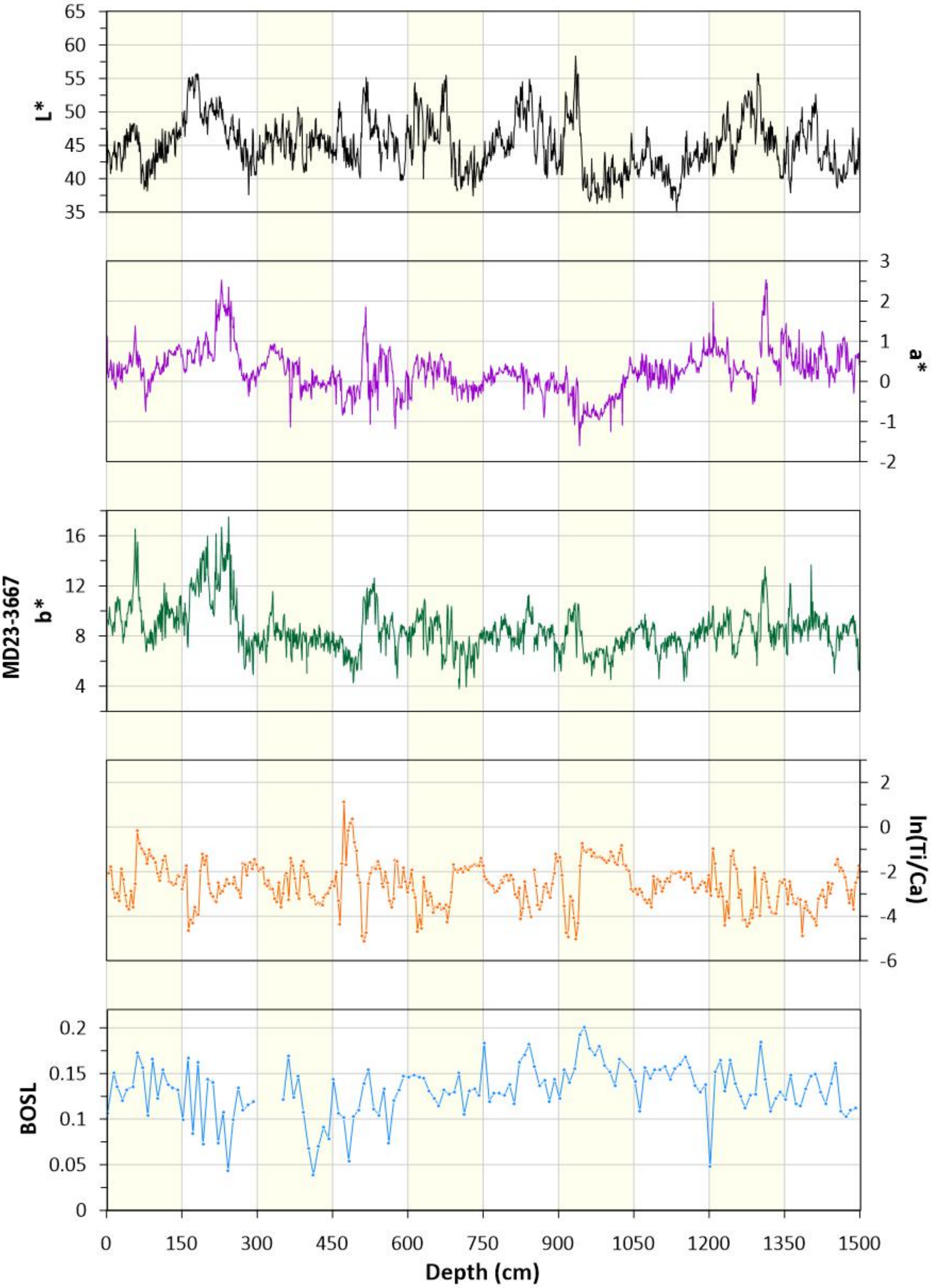
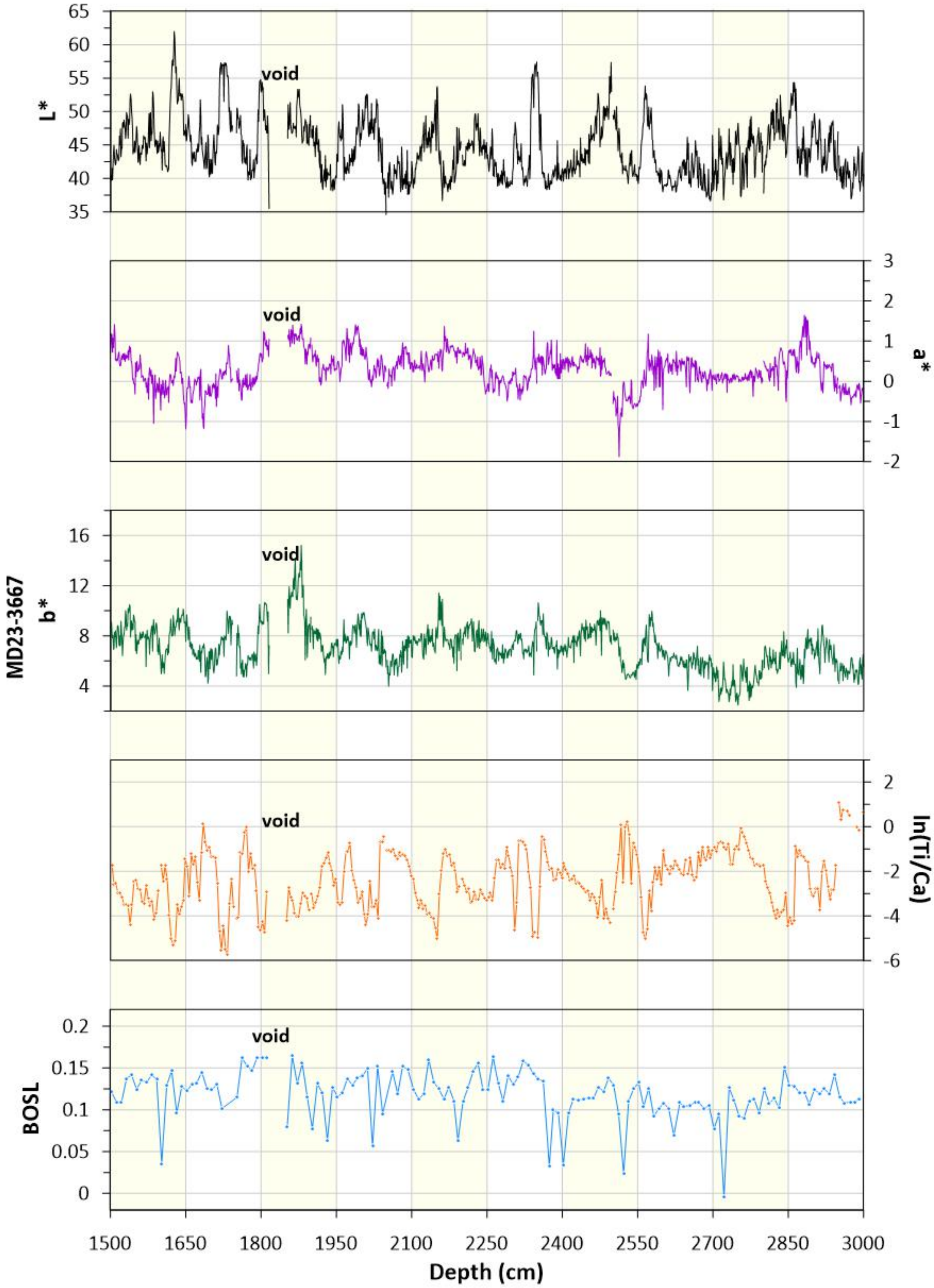


Figure 110: Physical properties of Calypso core MD23-3667.



L*
a*
MD23-3667
b*
ln(Ti/Ca)
BOSL
Depth (cm)


L*
void
a*
MD23-3667
b*
ln(Ti/Ca)
BOSL
Depth (cm)
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000

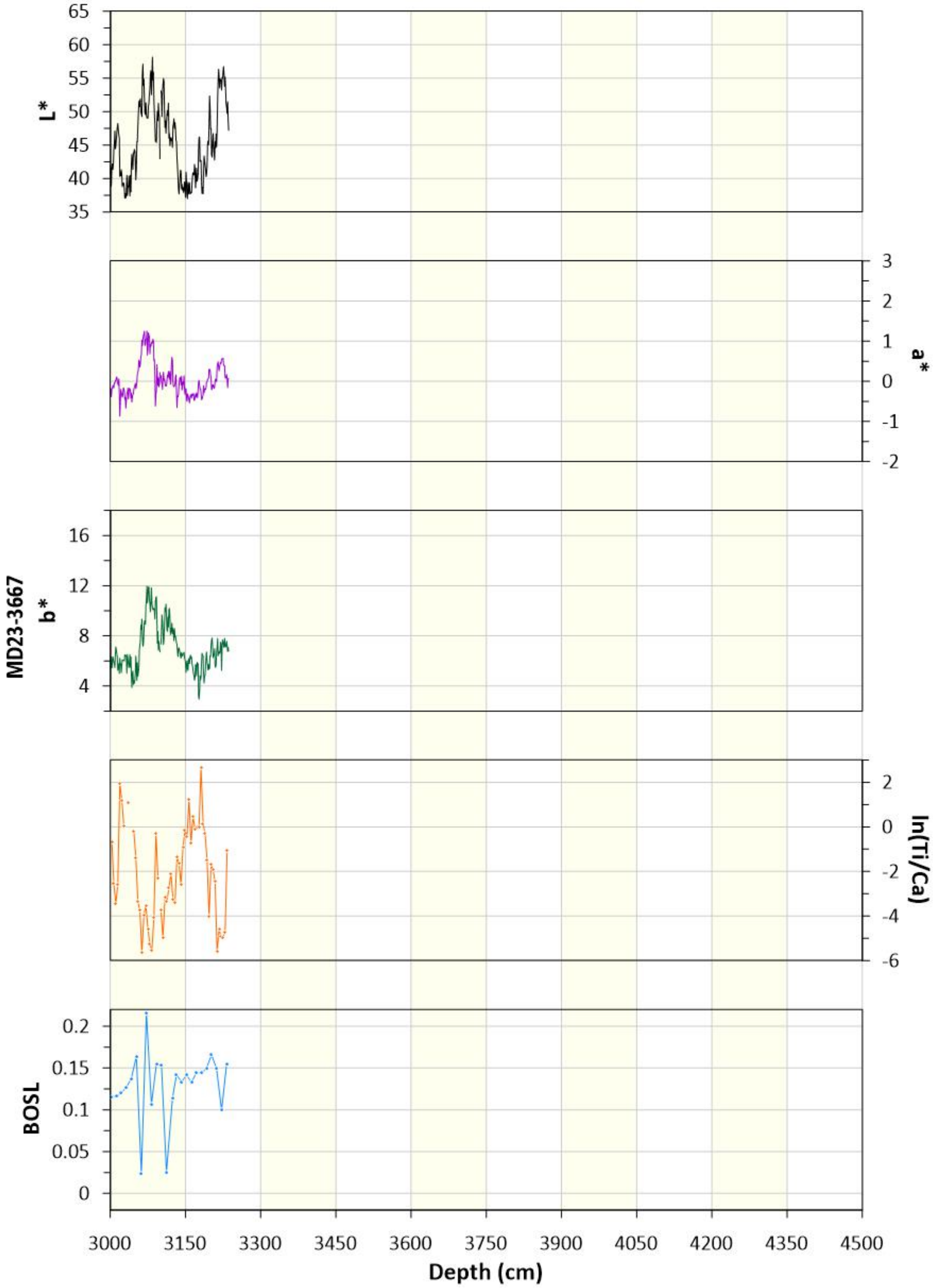


Figure 111: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3667.*

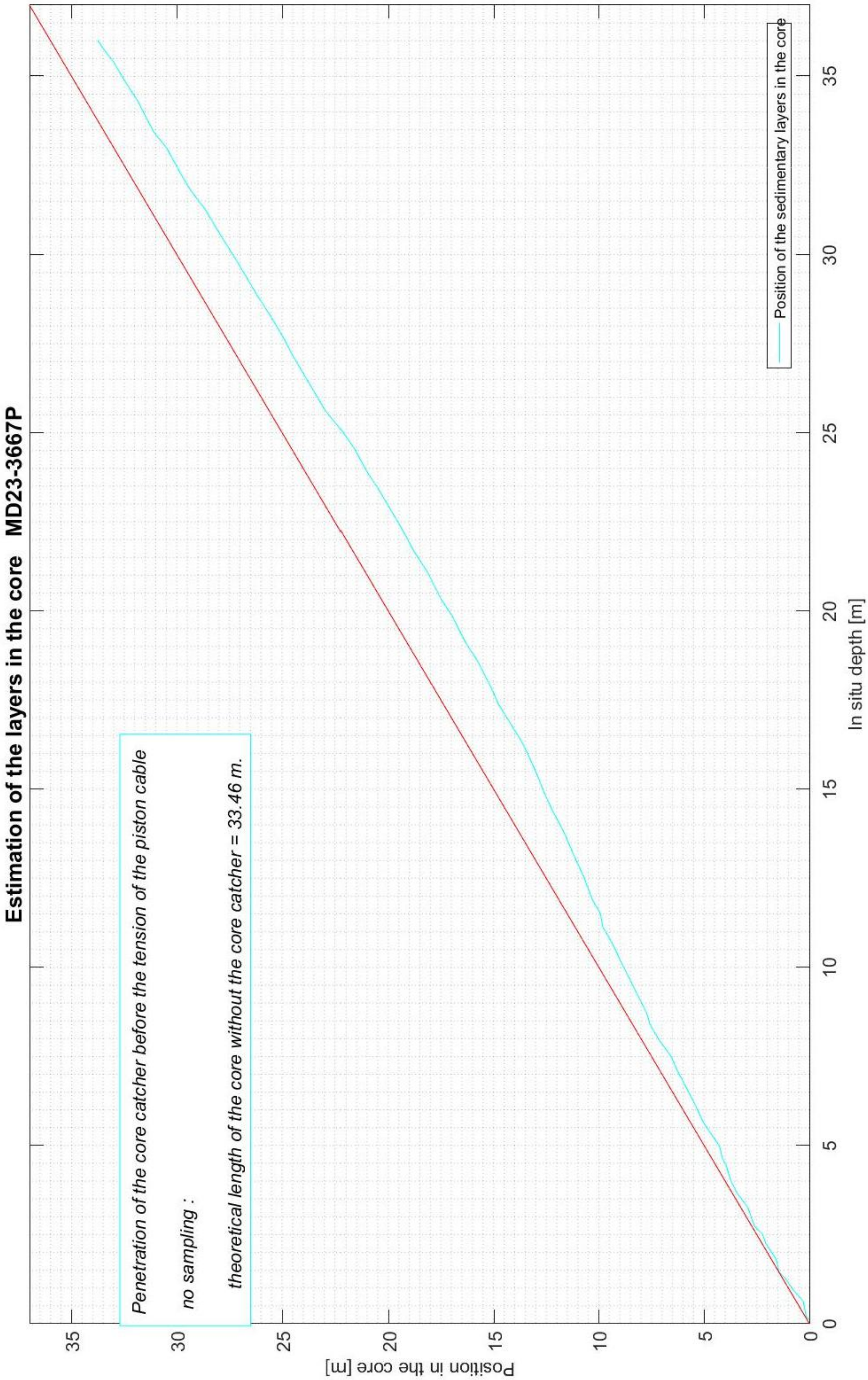


Figure 112: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3667.

Core MD23-3667 shows evidence for sediment undersampling between 0 and ~13 m and normal sampling between ~13 m and the core's bottom depth.

3.4.7 Station S13

3.4.7.1 Station S13 information

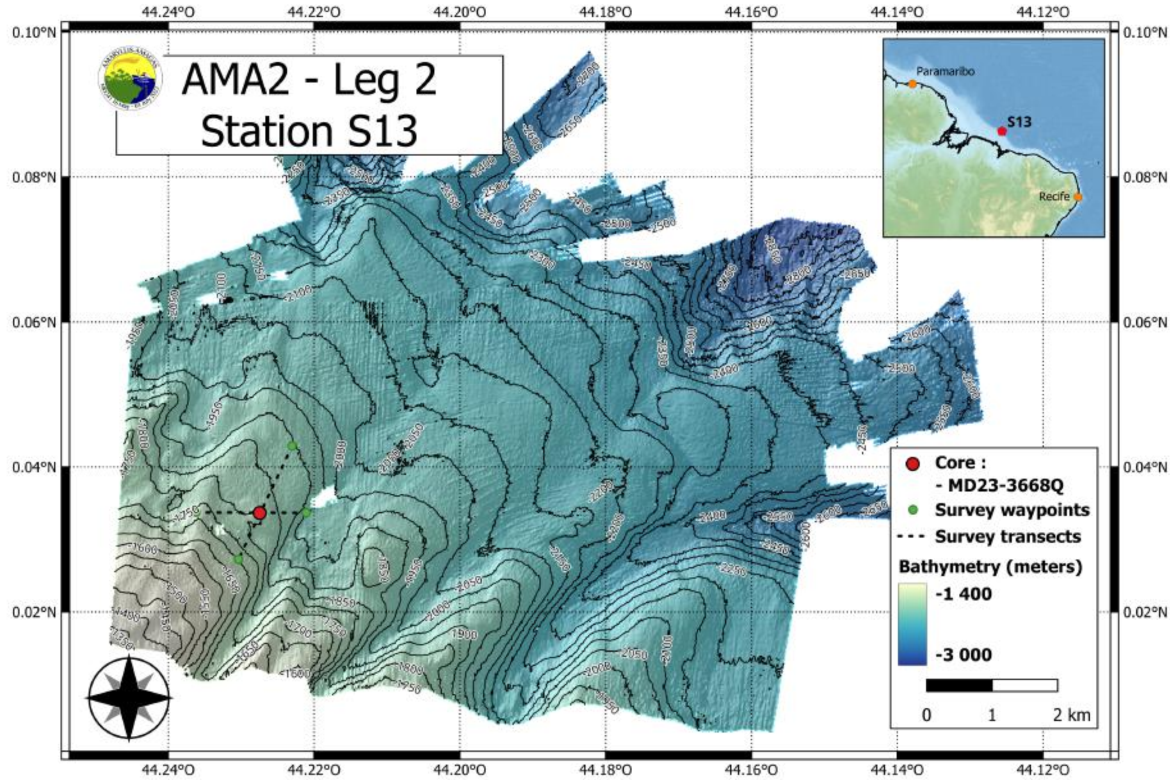
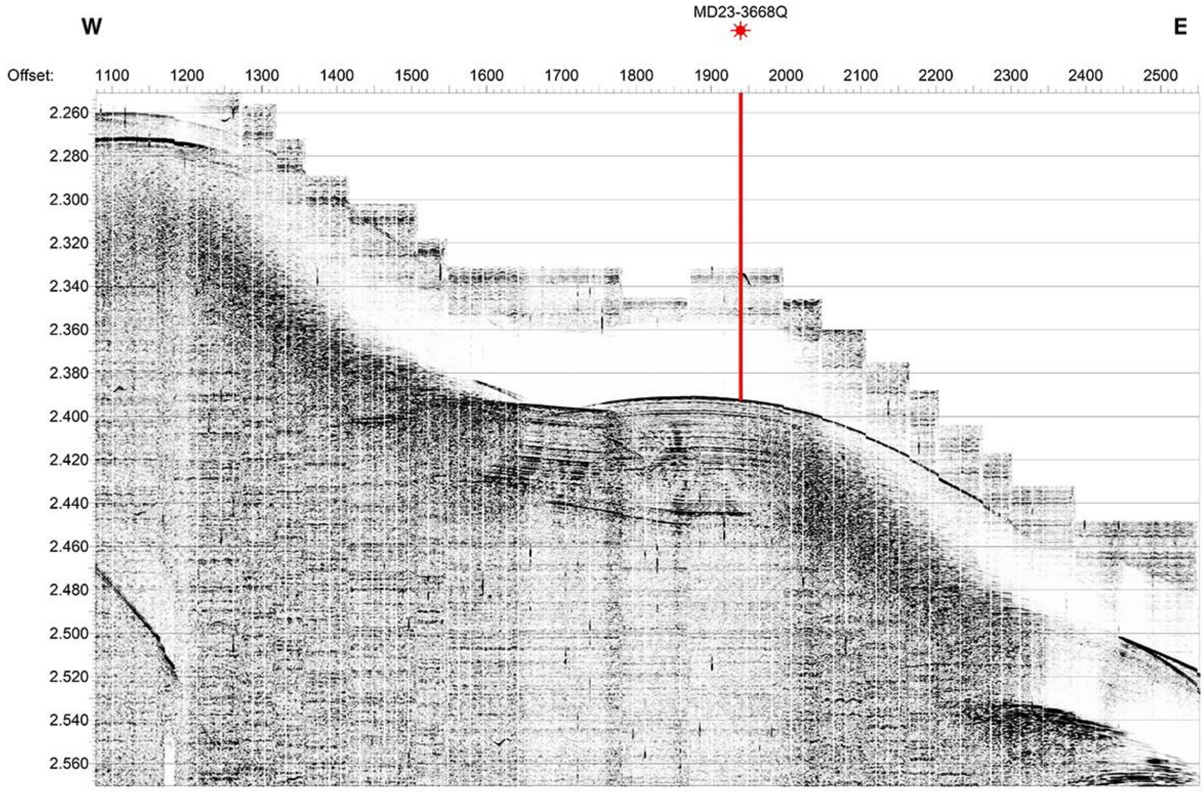


Figure 113: Bathymetric map at station S13.



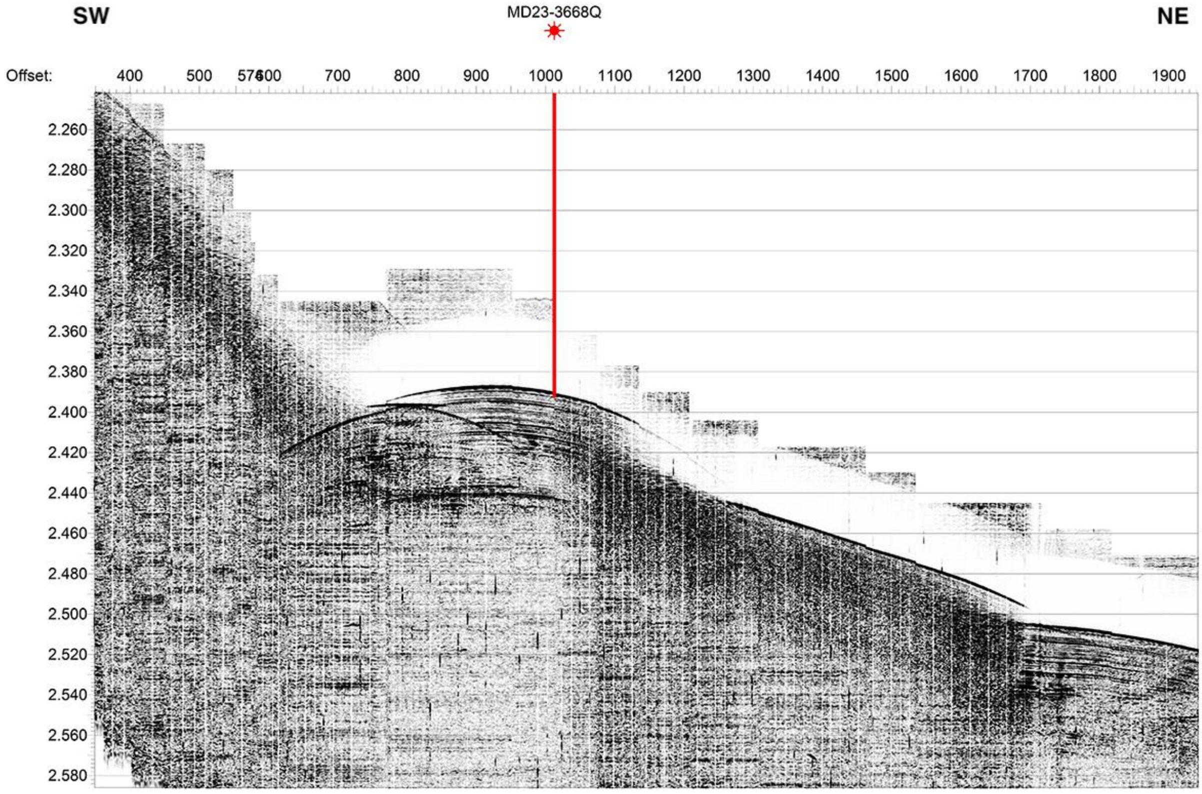


Figure 114: (top) W-E and (bottom) SW-NE subbottom profiles at station S13. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

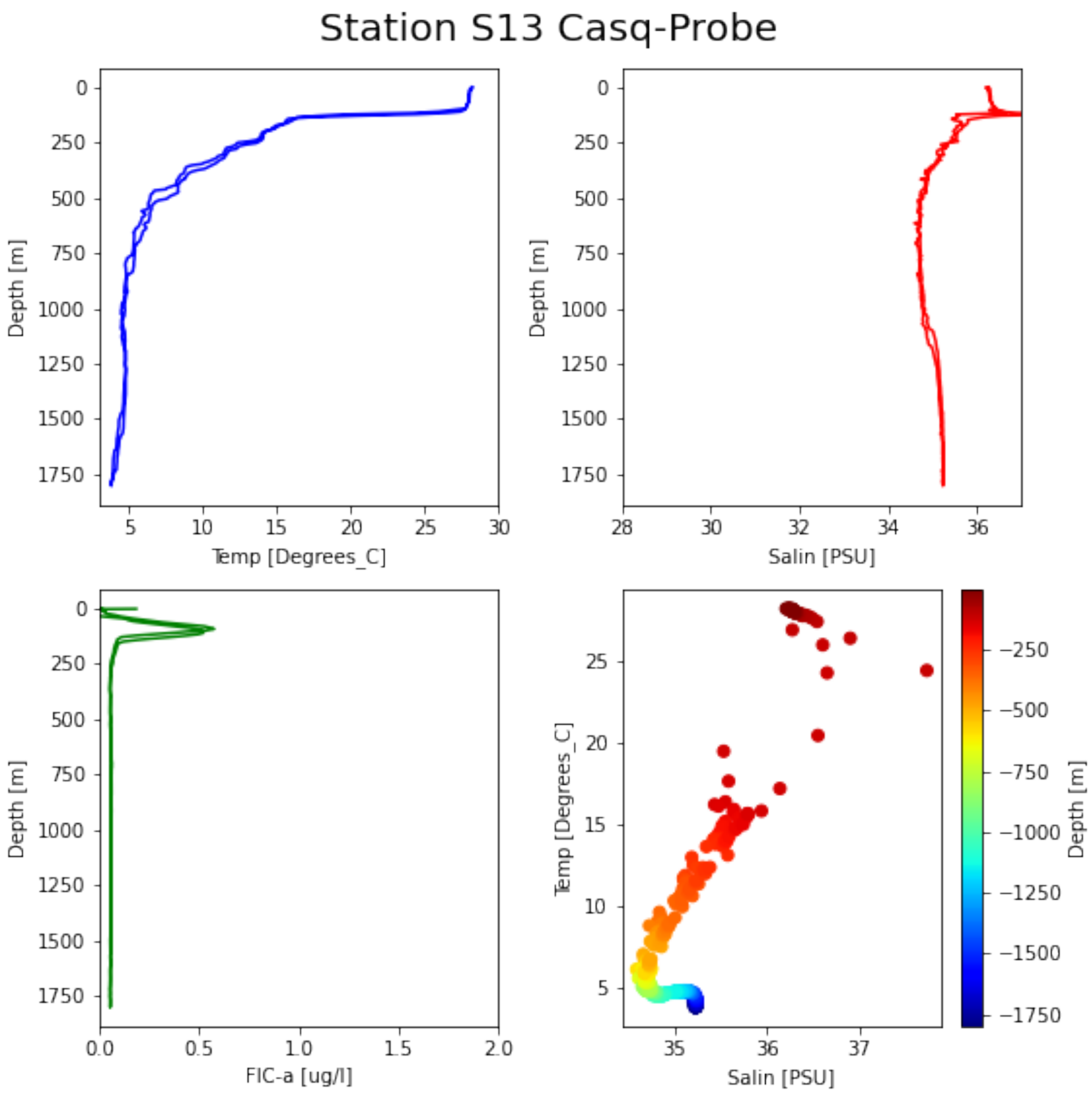


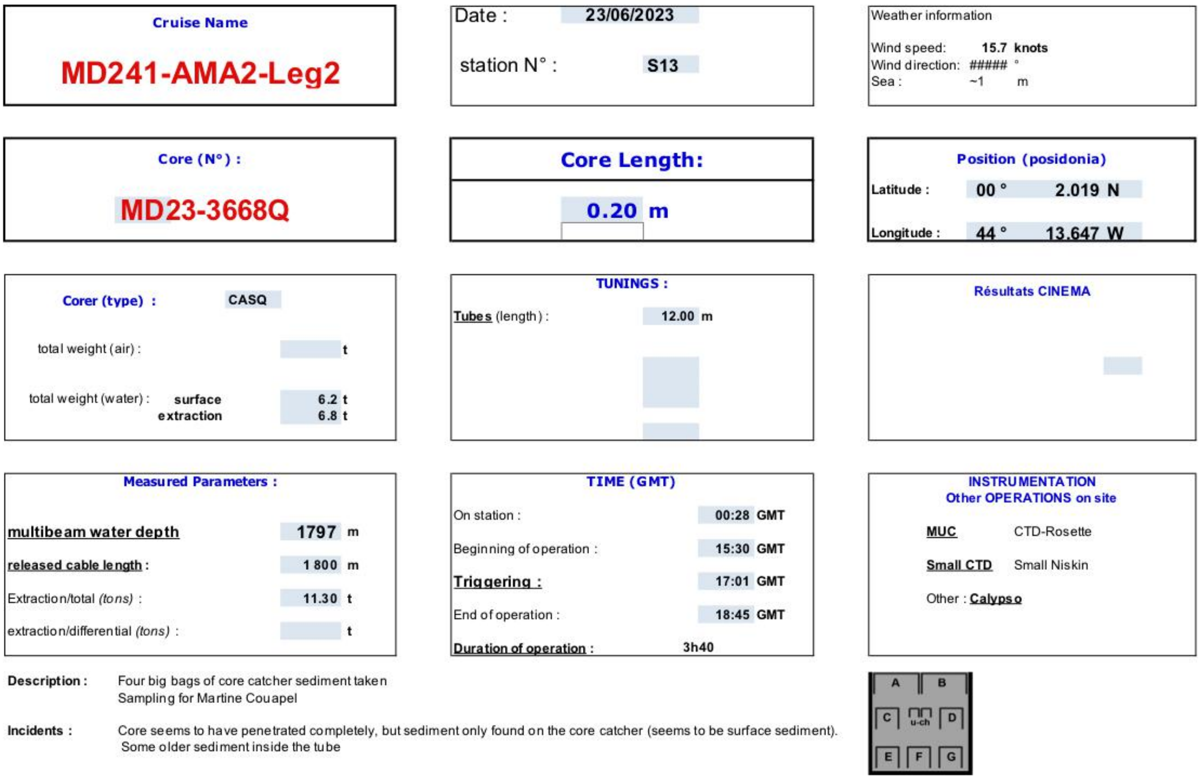
Figure 115: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S13.

Because of the strong North Brazilian surface current, the deployment of the multi-corer failed and was cancelled at station S13.

The Casq core MD23-3668Q came back almost empty on deck. Only the core catcher has been sampled. No measurement has been done on this core.

Given the lack of sediment recovery in the Casq core, no Calypso core was deployed at station S13.

3.4.7.2 Casq core MD23-3668Q



Cruise Name
MD241-AMA2-Leg2

Date : **23/06/2023**
station N° : **S13**

Weather information
Wind speed: **15.7 knots**
Wind direction: ##### °
Sea : ~1 m

Core (N°) :
MD23-3668Q

Core Length:
0.20 m

Position (posidonia)
Latitude : **00 ° 2.019 N**
Longitude : **44 ° 13.647 W**

Corer (type) : **CASQ**
total weight (air) : t
total weight (water) : **surface** **6.2 t**
extraction **6.8 t**

TUNINGS :
Tubes (length) : **12.00 m**

Résultats CINEMA

Measured Parameters :

multibeam water depth	**1797**	m
released cable length :	**1 800**	m
Extraction/total *(tons)* :	**11.30**	t
extraction/differential *(tons)* :		t

TIME (GMT)

On station :	**00:28 GMT**
Beginning of operation :	**15:30 GMT**
Triggering :	**17:01 GMT**
End of operation :	**18:45 GMT**
Duration of operation :	**3h40**

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other : **Calypso**

Description : Four big bags of core catcher sediment taken
Sampling for Martine Couapel

Incidents : Core seems to have penetrated completely, but sediment only found on the core catcher (seems to be surface sediment).
Some older sediment inside the tube

Figure 116: Coring information of Casq core MD23-3668Q. Numbers in red indicate depths that differ from the typical Casq section limits.

The Casq core MD23-3668Q came back almost empty on deck. Only the core catcher has been sampled.

3.4.7.3 Data of CTD-rosette ("palanquée mode") AMA2-S13-CTD

S13

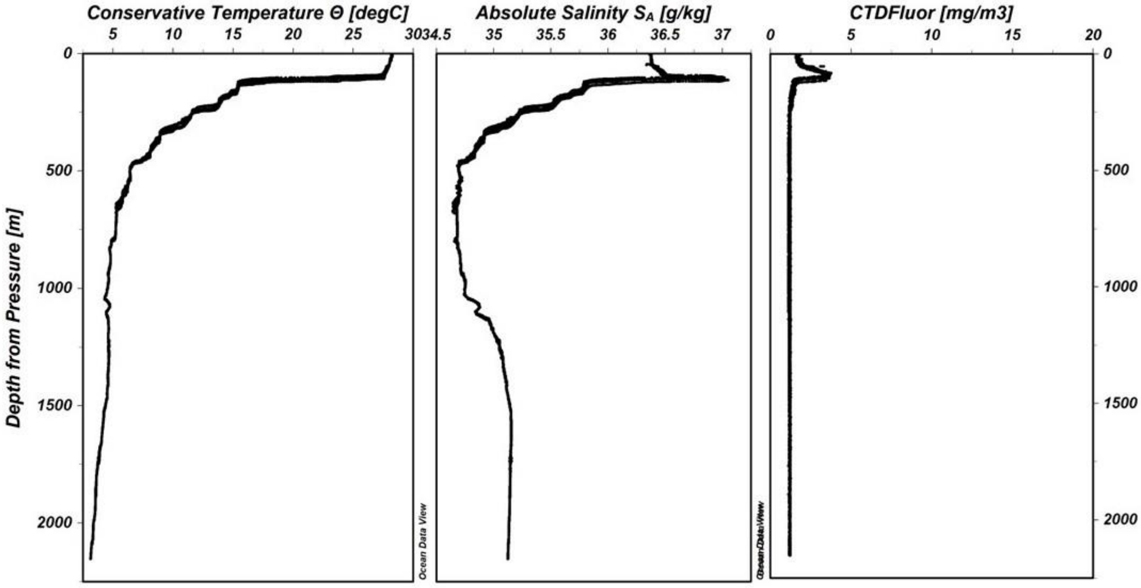


Figure 117: Temperature, salinity and fluorescence vertical profiles obtained by the CTD probe operated in "palanquée" mode at station S13.

Table 16: Collected water samples during CTD "palanquée" cast 1 at station S13. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	7	6	5	4	3	2	1	CTD
Water depth (m) cable length	5	30	80	100	150	350	450	
Water depth (m) pressure sensor	5.0	22.9		18.3	72.0	263.9	366.6	700
$\delta^{18}O$ LOCEAN (20 mL)	X	X		X	X	X	X	
$\delta^{13}C$ LOCEAN (25 mL)	X	X		X	X	X	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle	50	50		50	50	50	50	
$\Delta^{14}C$ (250 mL)	X	X		X	X	X	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle	1000	1000		1000	1000	1000	1000	
Nutrients (30 mL)	X	X	X	X	X	X	X	
Fluorescence (0-200 m)								
PAH & trace elements MARBEC (60 mL)	X				X			
Water stable isotopes MARBEC (30 mL)	X				X			
Comments			bottle not closed	triggered when 3rd bottle at the surface -> ~13 m cable length	triggered when 3rd bottle at the surface -> ~63 m cable length	triggered when 3rd bottle at the surface -> ~263 m cable length	triggered when 3rd bottle at the surface -> ~363 m cable length	

Table 17: Collected water samples during CTD "palanquée" cast 2 at station S13. "X" indicates a sample has been taken in the corresponding bottle for the written purpose. Cast 2 at station S13 aimed at collecting one deep water sample at 2150 m water-depth.

Number of Niskin bottle	7	CTD
Water depth (m) cable length	2150	
Water depth (m) pressure sensor	2150.1	2152
$\delta^{18}O$ LOCEAN (20 mL)	X	
$\delta^{13}C$ LOCEAN (25 mL)	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle	50	
$\Delta^{14}C$ (250 mL)	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle	1000	
Nutrients (30 mL)		
Fluorescence (0-200 m)		
PAH & trace elements MARBEC (60 mL)	X	
Water stable isotopes MARBEC (30 mL)	X	
Comments		

3.4.8 Station S14

3.4.8.1 Station S14 information

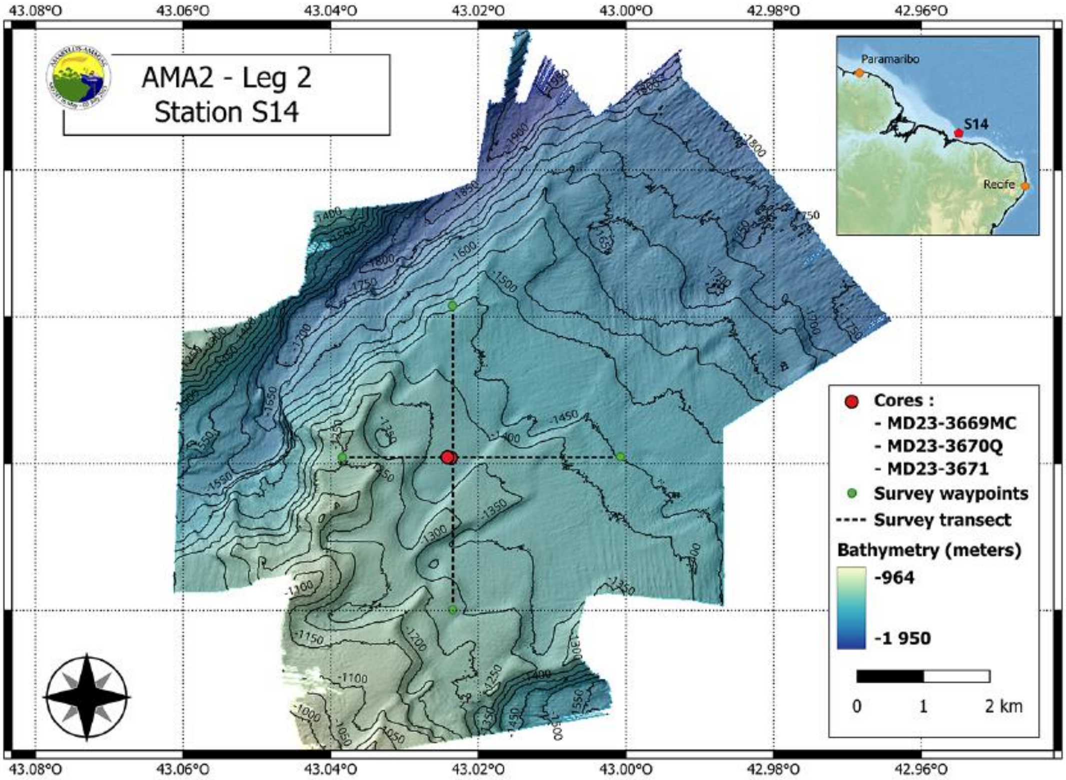
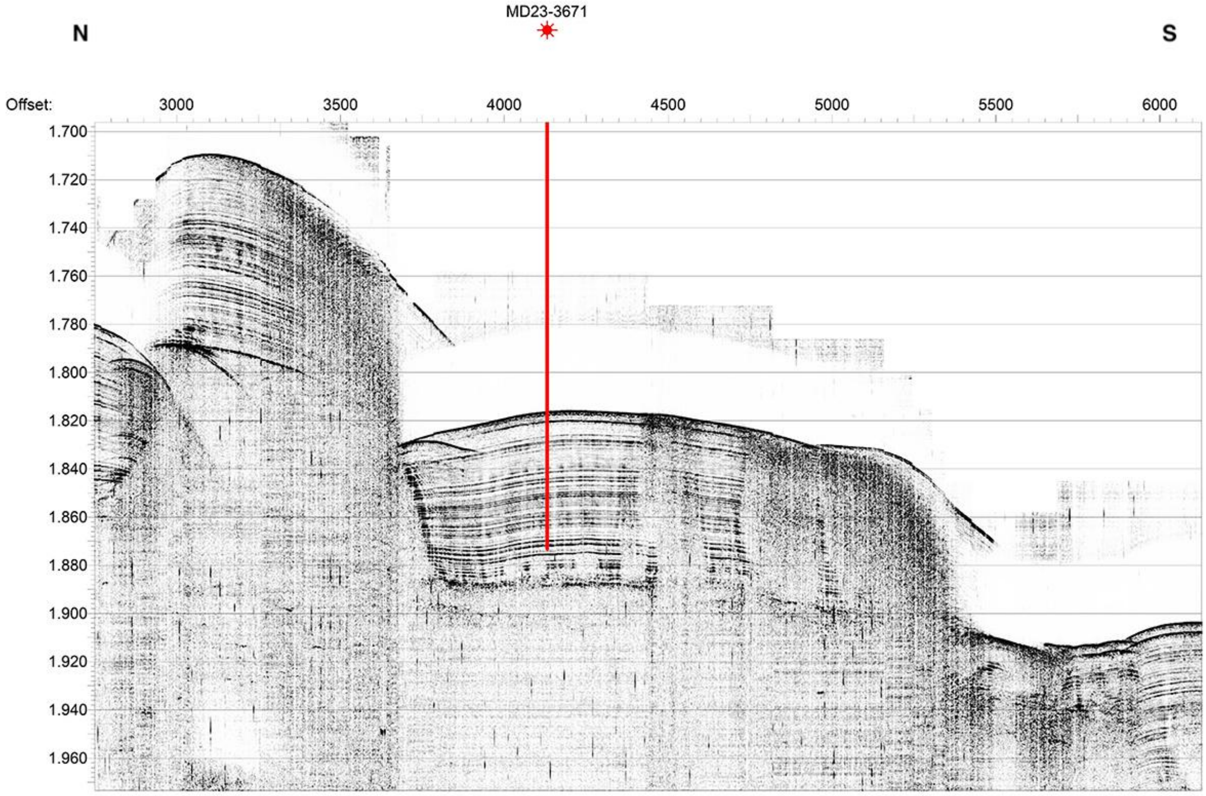


Figure 118: Bathymetric map at station S14.



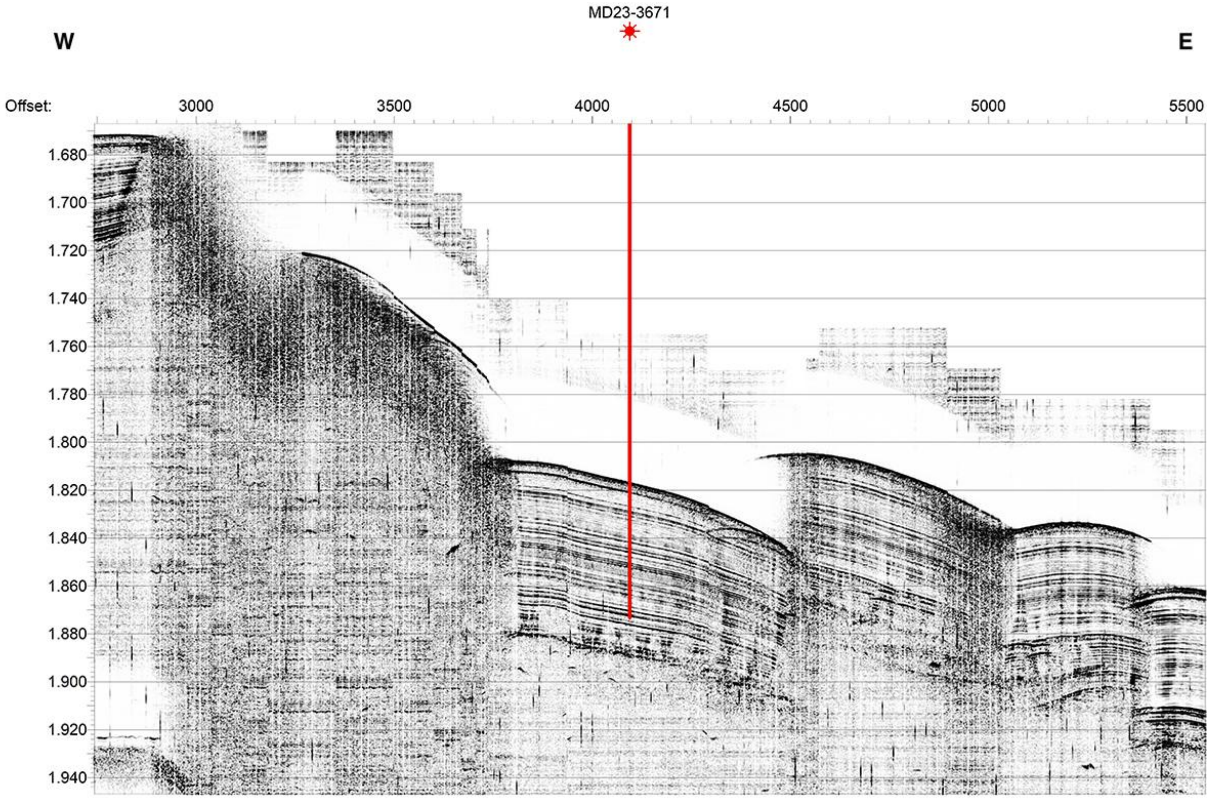


Figure 119: (top) N-S and (bottom) W-E sub-bottom profiles at station S14. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

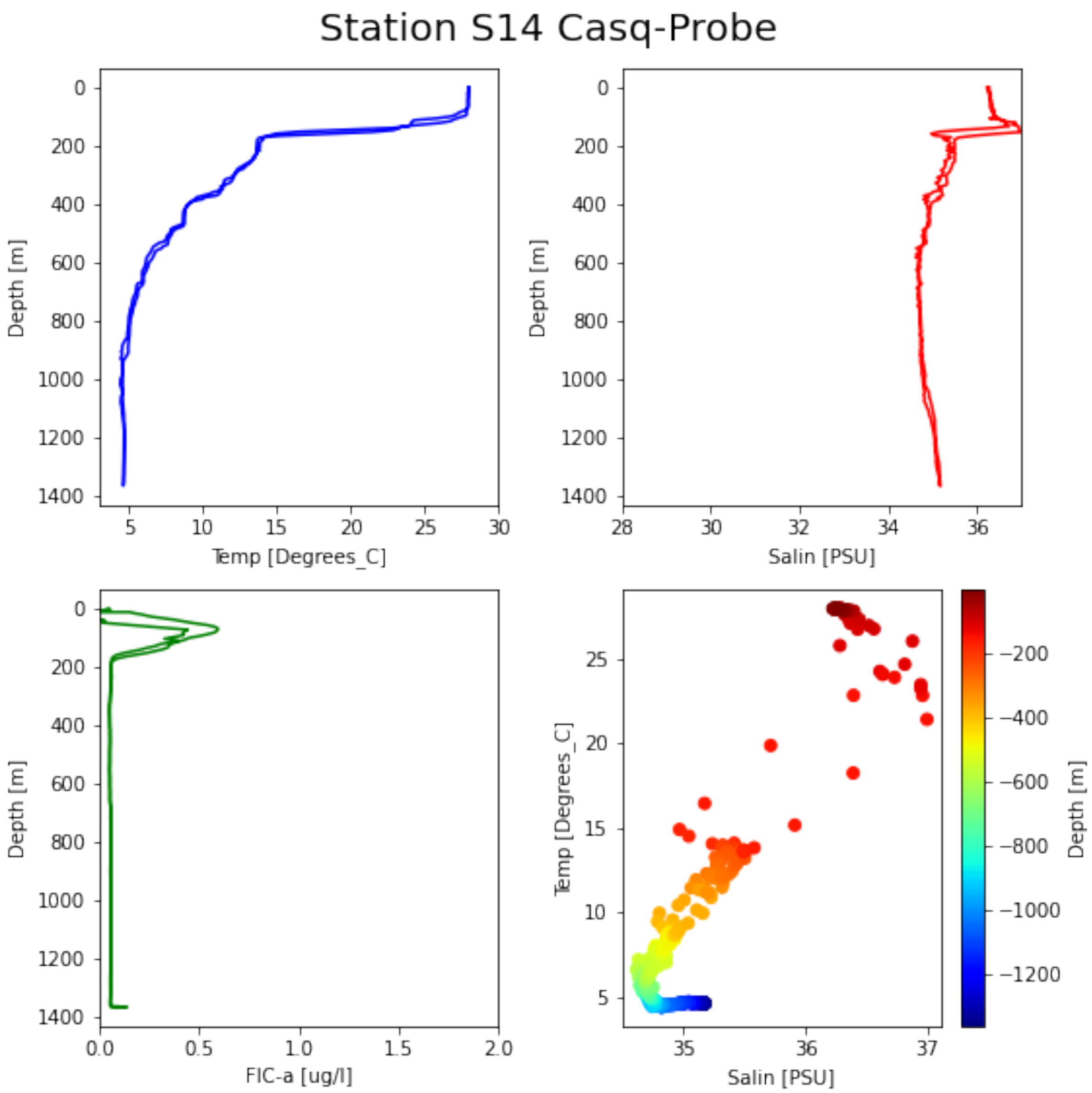


Figure 120 Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S14.

3.4.8.2 Multicore MD23-3669MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **24/06/2023**
Core MD23 – 3669 MC	*Station* ***S14***	*Operator* **0-4**
Comments *Supernatant water sampled above core D (Elisabeth and Claire)*		

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? (example for type: 1-cm slice)	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	37 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		~~yes~~ / **no**	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	36.5 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		**yes** / ***no***	~~yes~~ / **no**	
C	36.5 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
D	37 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 0-4 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	*Worm at 5-6 cm*

Figure 121: Coring information of multicore MD23-3669MC.

3.4.8.3 Casq core MD23-3670Q

Cruise Name

MD241-AMA2-Leg2

Date : 24/06/2023

station N° : S14

Weather information

Wind speed: 0,2 knots
Wind direction: ##### °
Sea : ~1 m

Core (N°) :

MD23-3670Q

Core Length:

10,49 m

Position (posidonia)

Latitude : 01 ° 34,747 S

Longitude : 43 ° 1,452 W

Corer (type) : CASQ

total weight (air) : t

total weight (water) : surface 6,4 t
extraction 7,1 t

TUNINGS :

Tubes (length) : 12,00 m

Résultats CINEMA

Measured Parameters :

multibeam water depth	1357	m
released cable length :		m
Extraction/total *(tons)* :	11,80	t
extraction/differential *(tons)* :		t

TIME (GMT)

On station :	15:01 GMT
Beginning of operation :	16:20 GMT
Triggering :	17:31 GMT
End of operation :	18:50 GMT
Duration of operation :	2h30

INSTRUMENTATION
Other OPERATIONS on site

MUC CTD-Rosette

Small CTD Small Niskin

Other Calypso

Description : Descriptions, photo, XRF, spectro and MSCL on line C
One bag with core catcher sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0 100	100 250	250 400	400 550	550 700	700 850	850 1000	1000 1049
A-I	A-II	A-III	A-IV	A-V	A-VI	A-VII	A-VIII

0 150	150 300	300 450	450 600	600 750	750 900	900 1049	
B-I	B-II	B-III	B-IV	B-V	B-VI	B-VII	

2nd level: 2 small boxes C and D + 2 u-channels between them

0 150	150 300	300 450	450 600	600 750	750 900	900 1049	
C-I	C-II	C-III	C-IV	C-V	C-VI	C-VII	

0 100	100 250	250 400	400 550	550 700	700 850	850 1000	1000 1049
D-I	D-II	D-III	D-IV	D-V	D-VI	D-VII	D-VIII

0 150	150 300	300 450	450 600	600 750	750 900	900 1049	
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI	u-channel A-VII	

0 100	100 250	250 400	400 550	550 700	700 850	850 1000	1000 1049
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI	u-channel B-VII	u-ch B-VIII

3rd level: 3 small boxes E, F and G

0 150	150 300	300 450	450 600	600 750	750 900	900 1049	
E-I	E-II	E-III	E-IV	E-V	E-VI	E-VII	

0 100	100 250	250 400	400 550	550 700	700 850	850 1000	1000 1049
F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	F-VIII

0 150	150 300	300 450	450 600	600 750	750 900	900 1049	
G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII	

Figure 122: Coring information of Casq core MD23-3670Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3670Q** -Core length **10.49 m**
Station: S14 -Latitude: 1 °34.747 S -Longitude: 43 °1.452 W
-Water Depth : **1365 m**

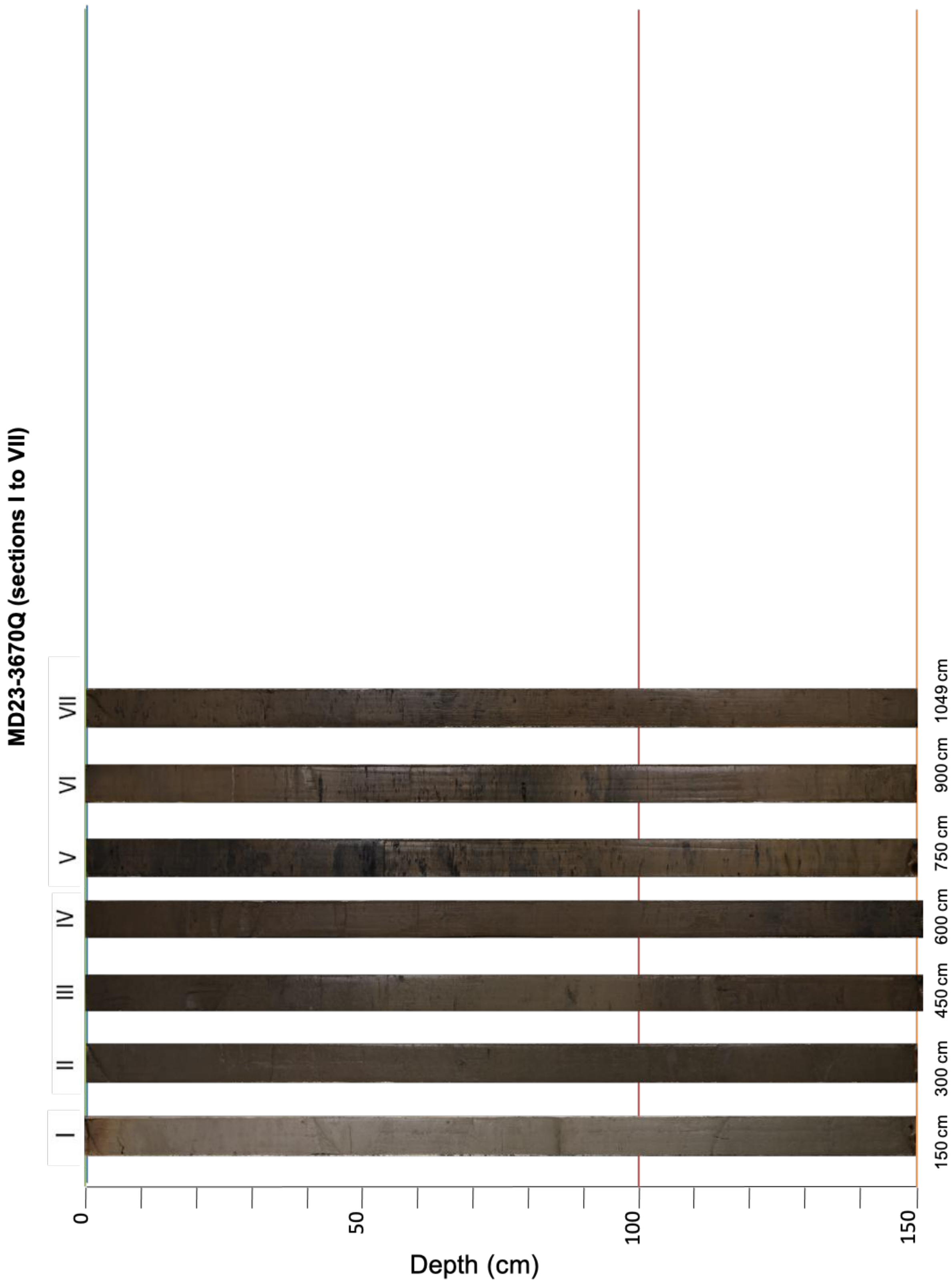
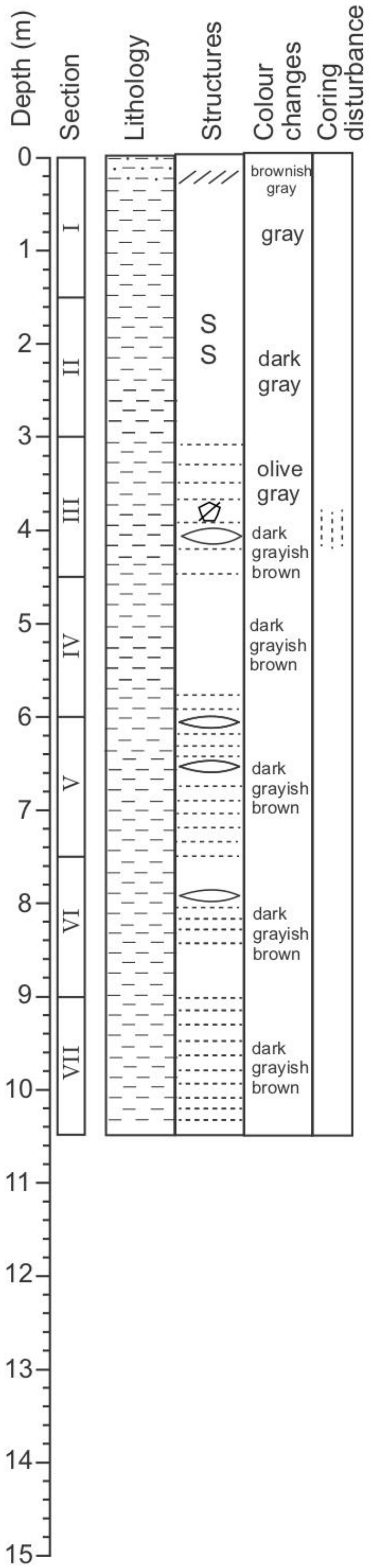


Figure 123: Pictures of Casq core MD23-3670Q

MD241-AMA2-Leg2	**MD23-3670Q**	Position: 1°34.747'S 43°01.452'W
Station S14	**Sediment description (1/1)**	Water-depth: 1365 m Core length: 10.49 m



Comments

Homogenous grayish mud with darker lens/layers, black spots (manganese precipitation?), shell fragmens and bioturbation signals.

0-8cm: light brownish sandy-mud

Figure 124: Sediment description of Casq core MD23-3670Q.

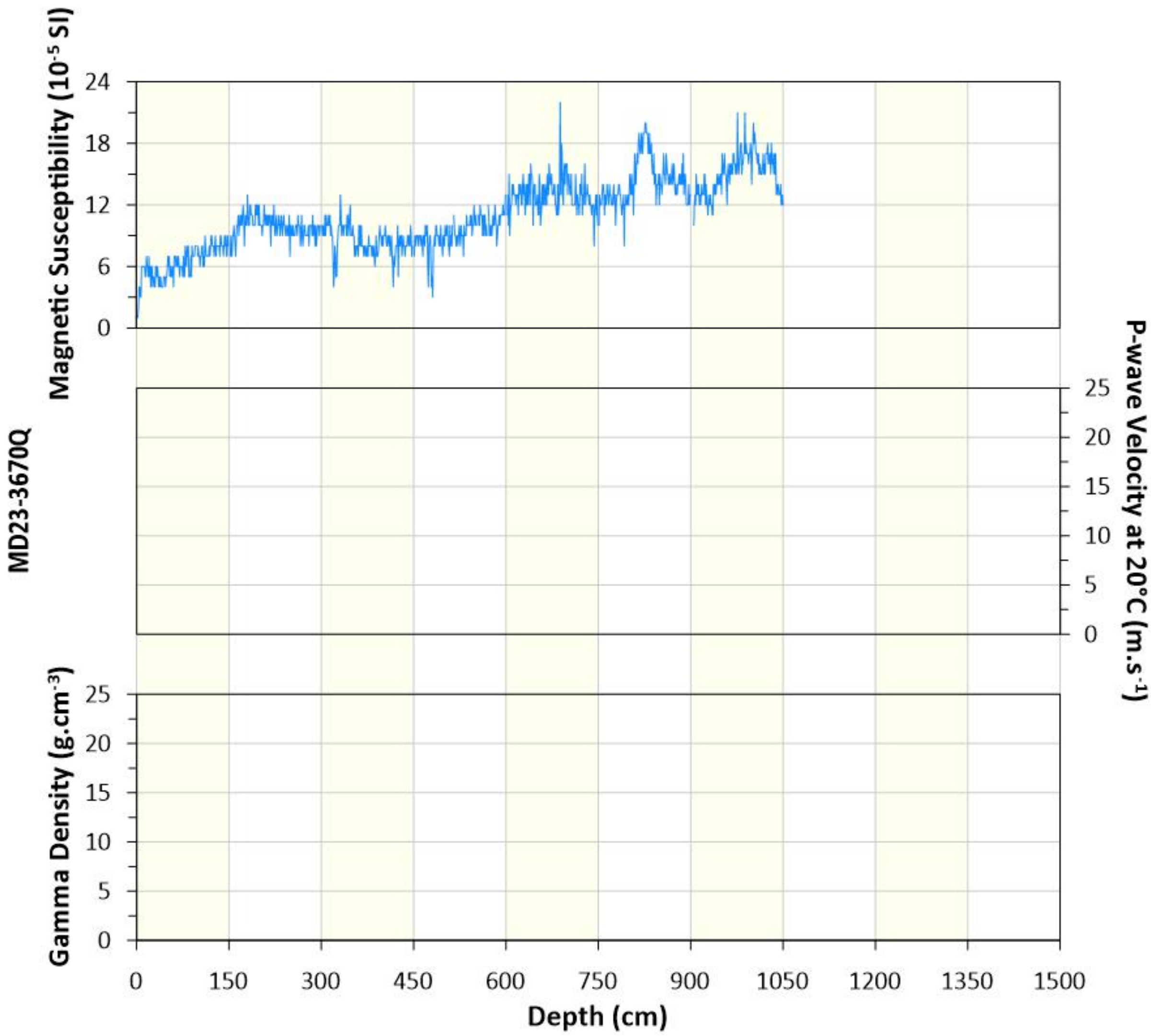


Figure 125: Physical properties of Casq core MD23-3670Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

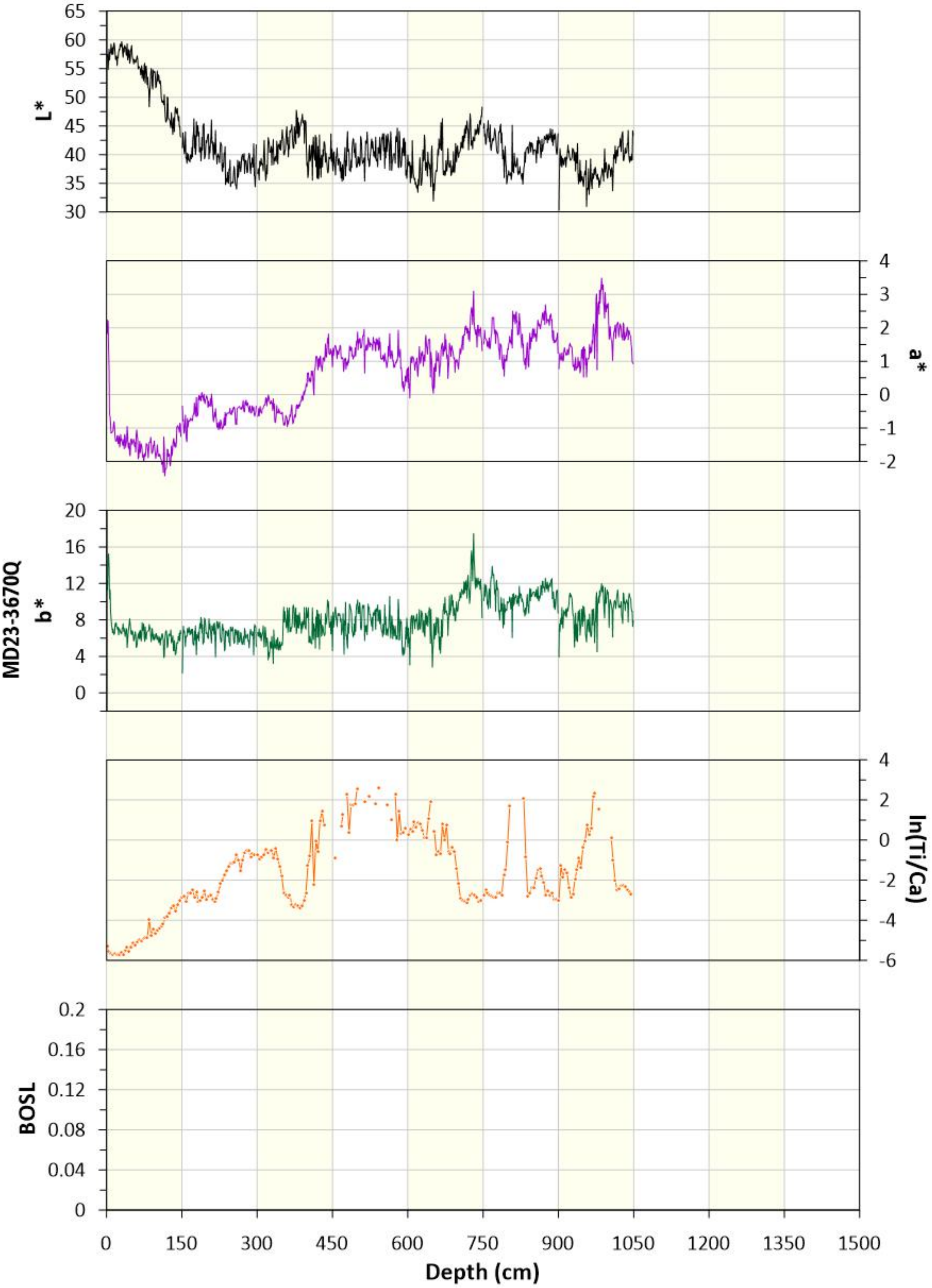


Figure 126: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3670Q. Low Ca content in this core leads to a slightly discontinuous ln(Ti/Ca) record. BOSL was not analyzed in Casq cores.*

3.4.8.4 Calypso core MD23-3671

Cruise Name
MD241-AMA2-Leg2

Date : **24/06/2023**
station N° : **S14**

Weather information
Wind speed: **18 knots**
Wind direction: 106 °
Sea : ~1.5 m

Core (N°) :
MD23-3671

Core Length:
41,9 m

Position (posidonia)
Latitude : **01 ° 34.748 S**
Longitude : **43 ° 1.452 W**

Corer (type) : **Calypso**
total weight (air) : t
total weight (water) : **surface** **6,6 t**
bottom **t**

TUNINGS :
Tubes (length) : **43,73 m**
Cables :
Free fall : **2,00 m**
theoritical elastic rebound **3,61 m**
loop length **5,37 m**
counterweight cable length **m** (3m50 feet)

Résultats CINEMA
thickness sediment sampled **m**
thickness sediment cored **m**

Measured Parameters :
multibeam water depth **1 357 m**
released cable length : **m**
Extraction/total *(tons)* : **14,40 t**

TIME (GMT)
On station : **15:01 GMT**
Beginning of operation : **18:50 GMT**
Triggering : **21:05 GMT**
End of operation : **22:50 GMT**
Duration of operation : **4h**

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD **Small Niskin**
Other : **CASQ**

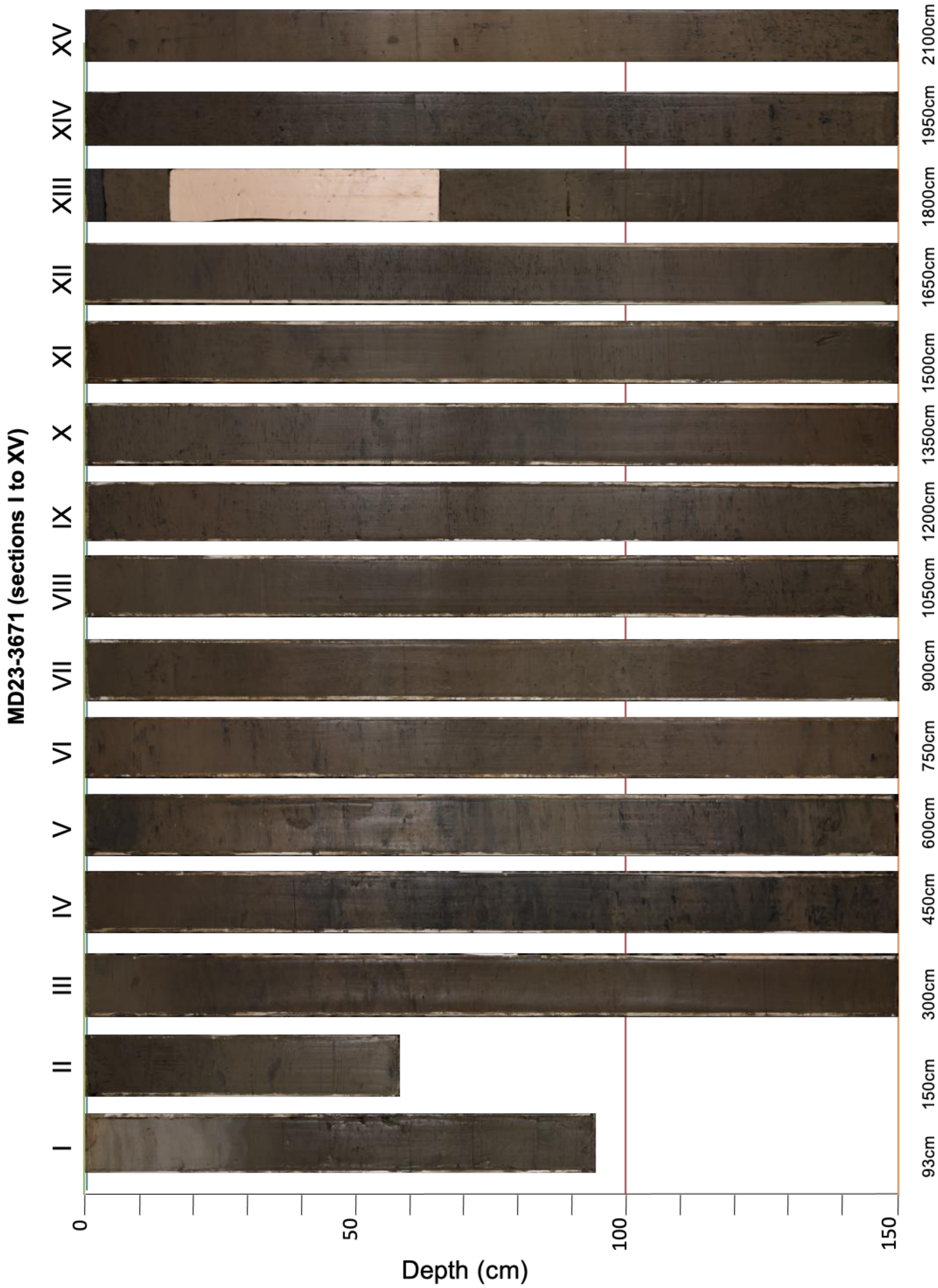
Description : Three syringes of core catcher in one bag.

Incidents :

0 – 93	*93 – 150*	*150*	*300*	*450*	*600*	*750 – 900*
I	**II**	**III**	**IV**	**V**	**VI**	**VII**
900	*1050*	*1200*	*1350*	*1500*	*1650*	*1800 – 1950*
VIII	**IX**	**X**	**XI**	**XII**	**XIII**	**XIV**
1950	*2100*	*2250*	*2400*	*2550*	*2700*	*2850 – 3000*
XV	**XVI**	**XVII**	**XVIII**	**XIX**	**XX**	**XXI**
3000	*3150*	*3300*	*3450*	*3600*	*3750*	*3900 – 4050*
XXII	**XXIII**	**XXIV**	**XXV**	**XXVI**	**XXVII**	**XXVIII**
4050 – 4188						
XXIX						

Figure 127: Coring information of Calypso core MD23-3671. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3671** -Core length **41.88 m**
Station: S14 -Latitude: 1°34.748 S -Longitude: 43 °1.452 W
-Water Depth : **1 365 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3671** -Core length **41.88 m**
Station: S14 -Latitude: 1°34.748 S -Longitude: 43 °1.452 W
-Water Depth : **1 365 m**

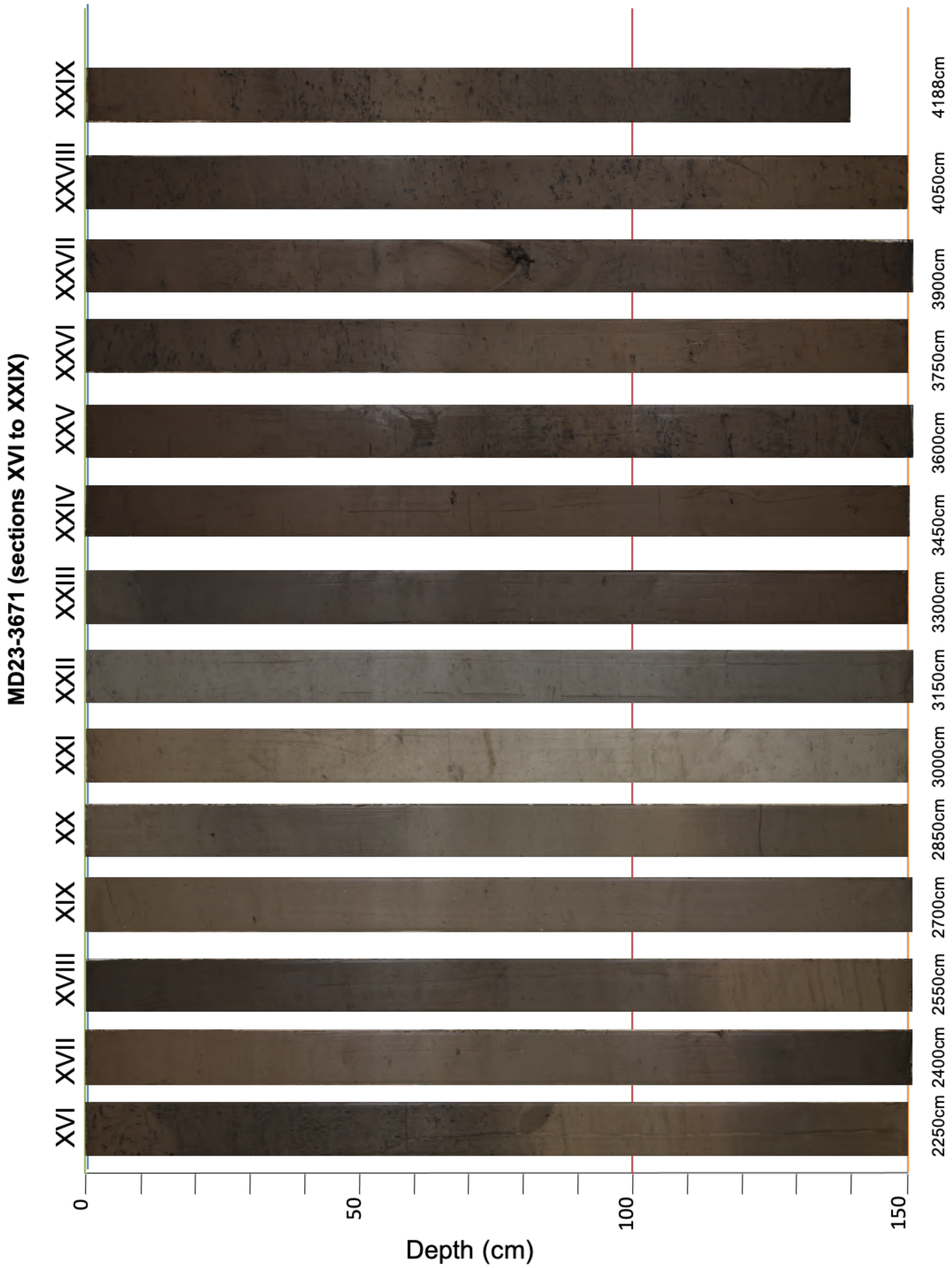
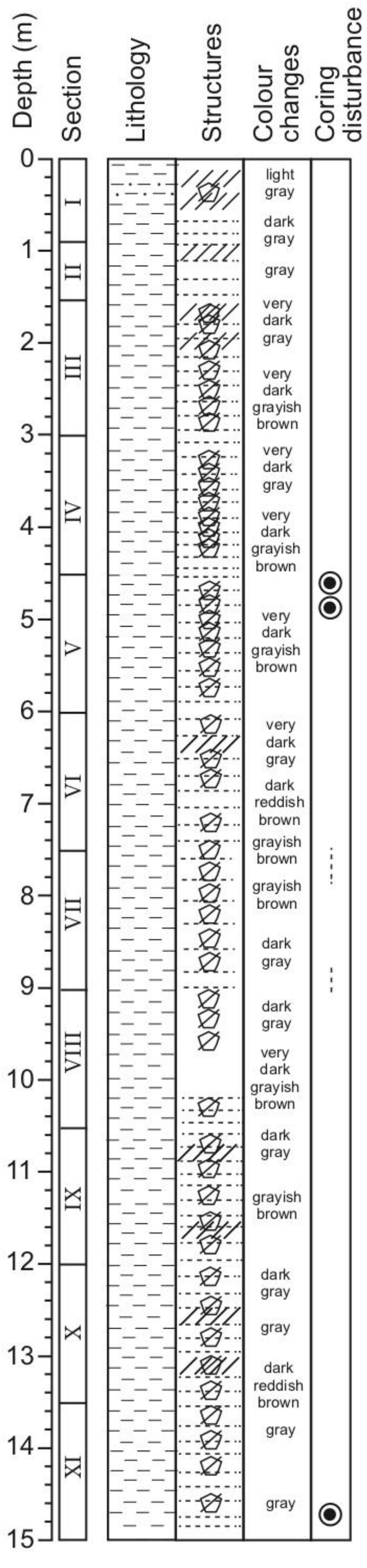


Figure 128: Pictures of Calypso core MD23-3671.

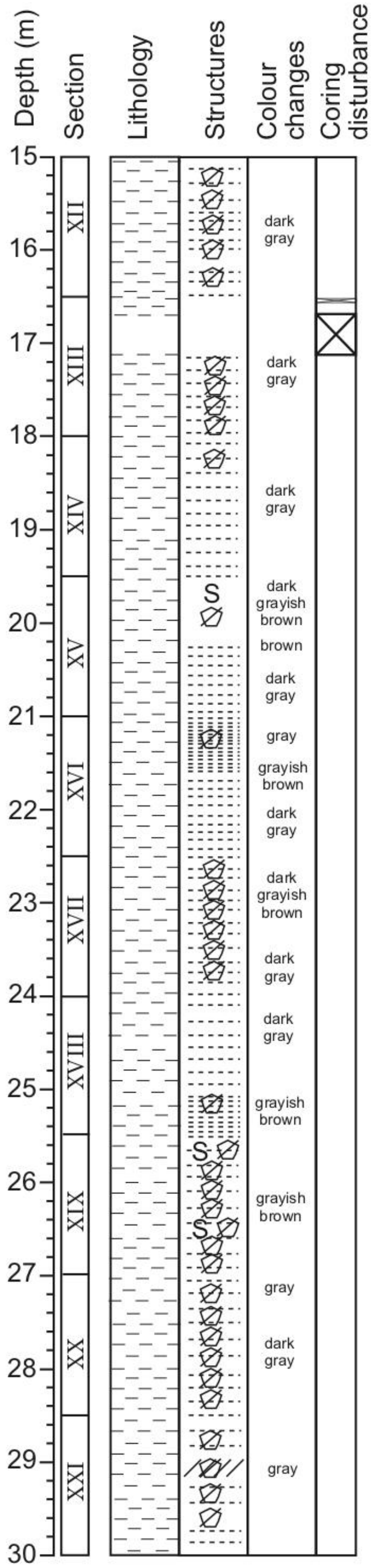
MD241-AMA2-Leg2	**MD23-3671**	Position: 1°34.748'S 43°01.452'W
Station S14	**Sediment description (1/3)**	Water-depth: 1365 m Core length: 41.88 m



Comments

Homogeneous grayish mud with plenty of shells fragments and black spots (manganese precipitation?) along the core.

MD241-AMA2-Leg2	**MD23-3671**	Position: 1°34.748'S 43°01.452'W
Station S14	**Sediment description (2/3)**	Water-depth: 1365 m Core length: 41.88 m



Comments

Homogeneous grayish mud with plenty of shells fragments and black spots (manganese precipitation?) along the core.

1650-1653cm: void
1665-1716cm: void

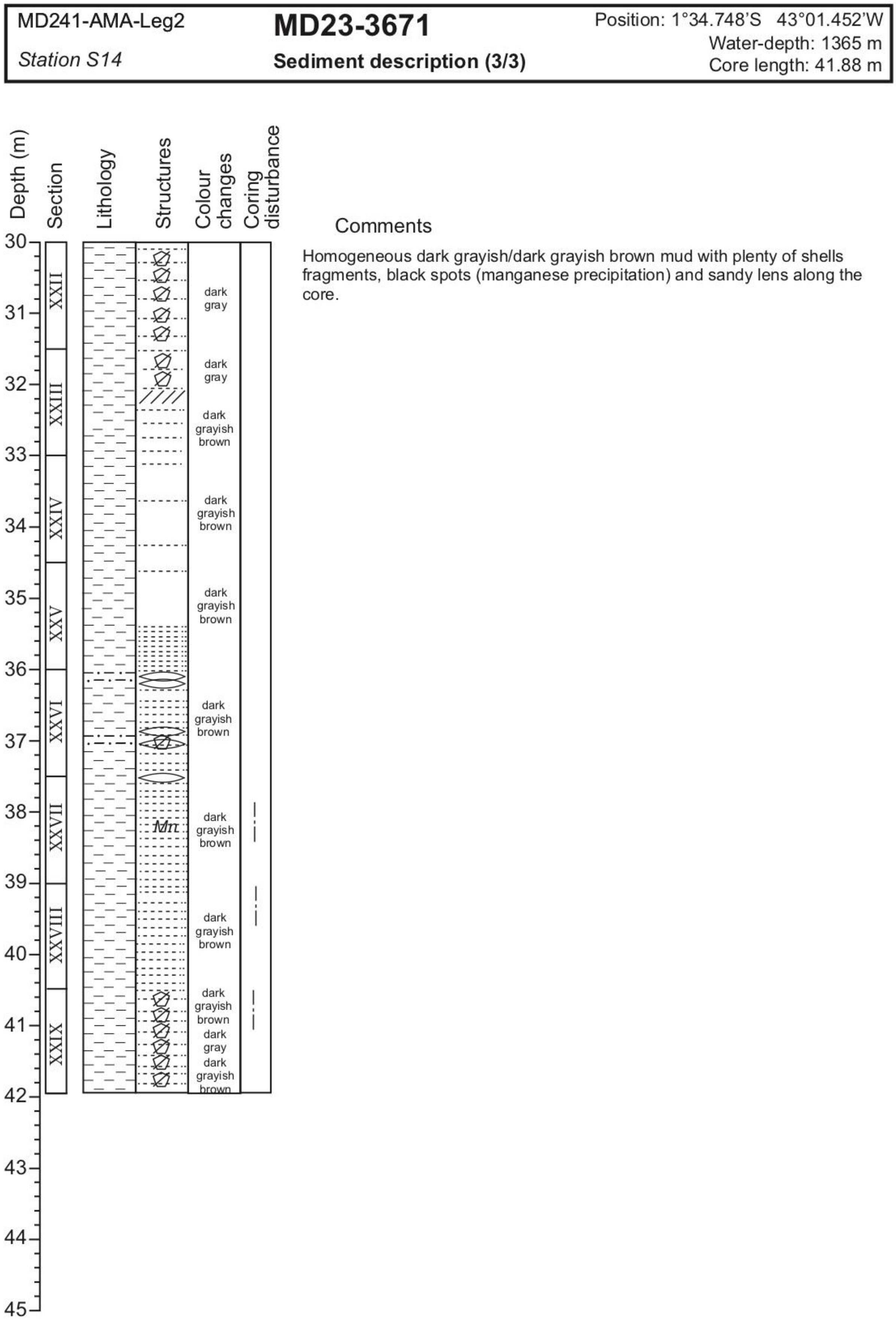
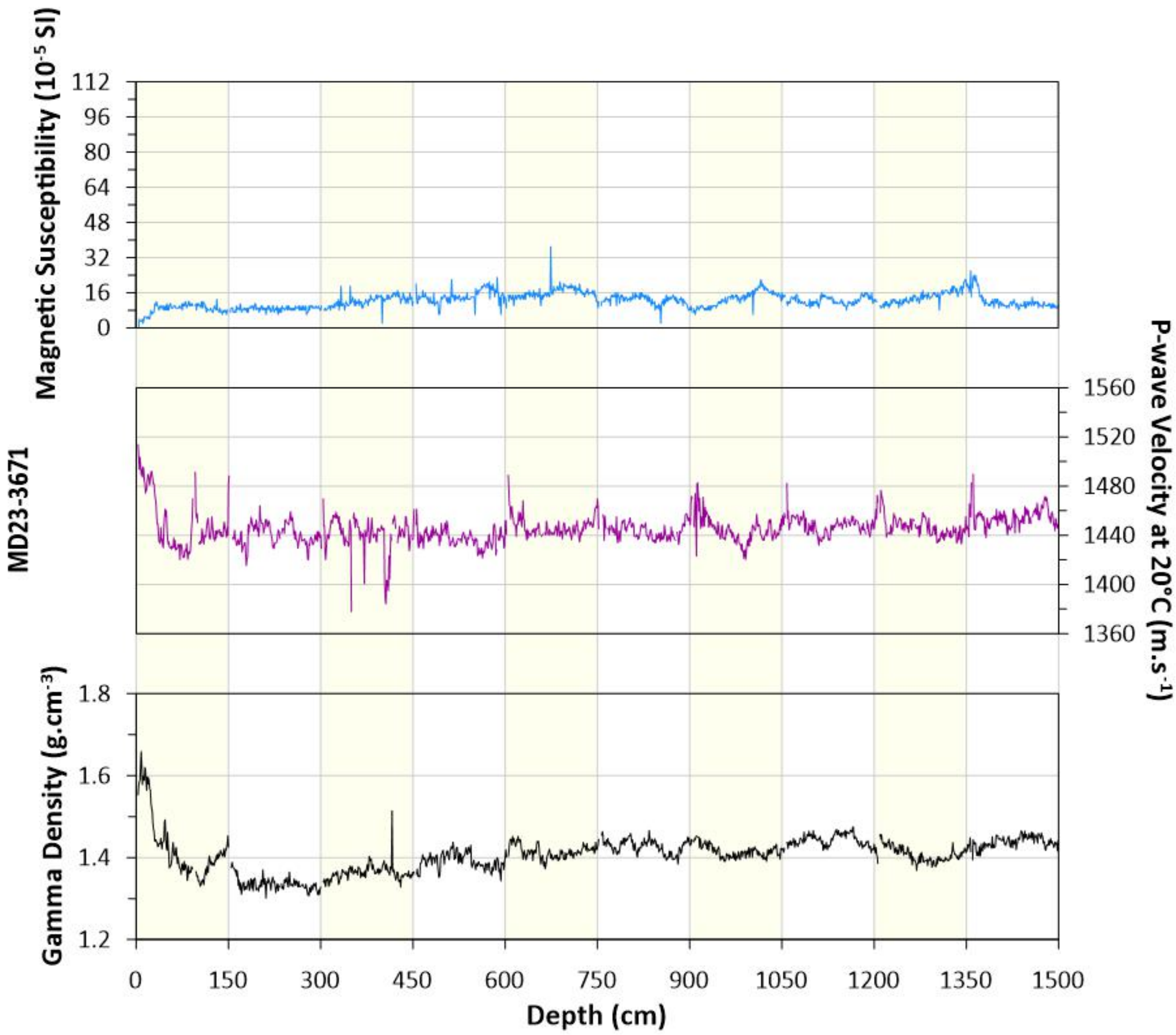
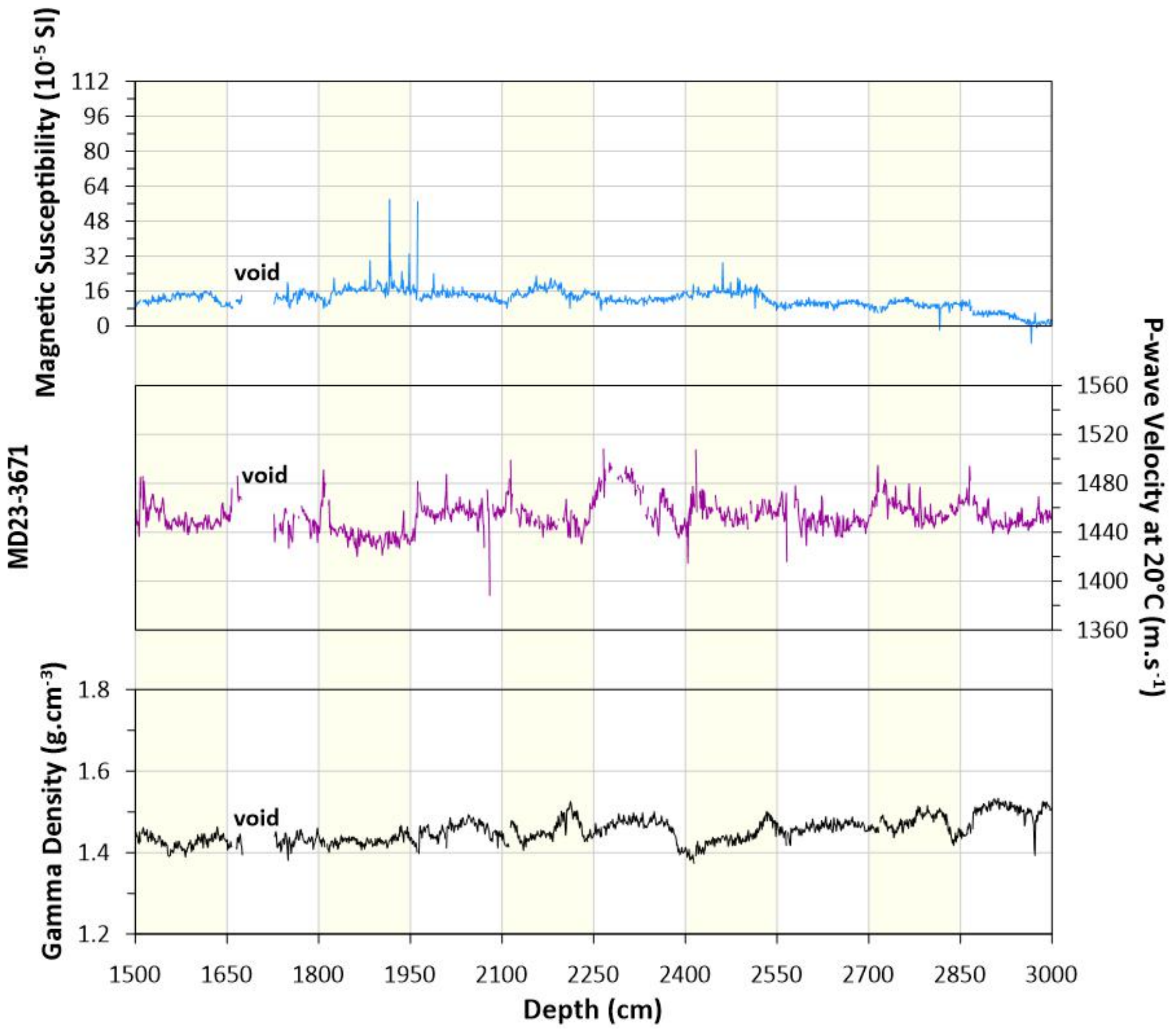


Figure 129: Sediment description of Calypso core MD23-3671.


Magnetic Susceptibility (10-5 SI)
112
96
80
64
48
32
16
0
MD23-3671
P-wave Velocity at 20°C (m.s-1)
1560
1520
1480
1440
1400
1360
Gamma Density (g.cm-3)
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)



MD23-3671
Magnetic Susceptibility (10-5 SI)
112
96
80
64
48
32
16
0
void
P-wave Velocity at 20°C (m.s-1)
1560
1520
1480
1440
1400
1360
void
Gamma Density (g.cm-3)
1.8
1.6
1.4
1.2
void
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

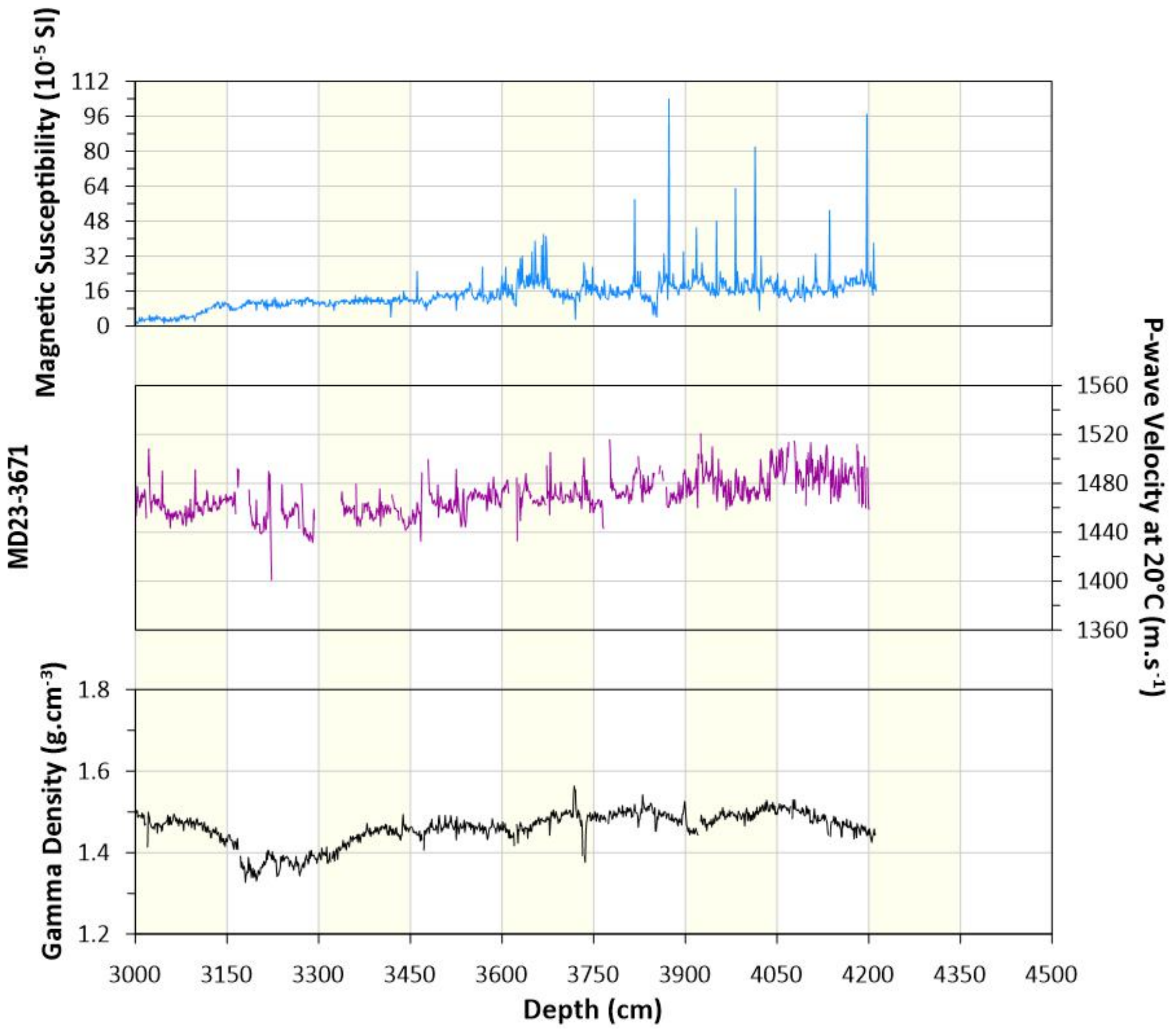
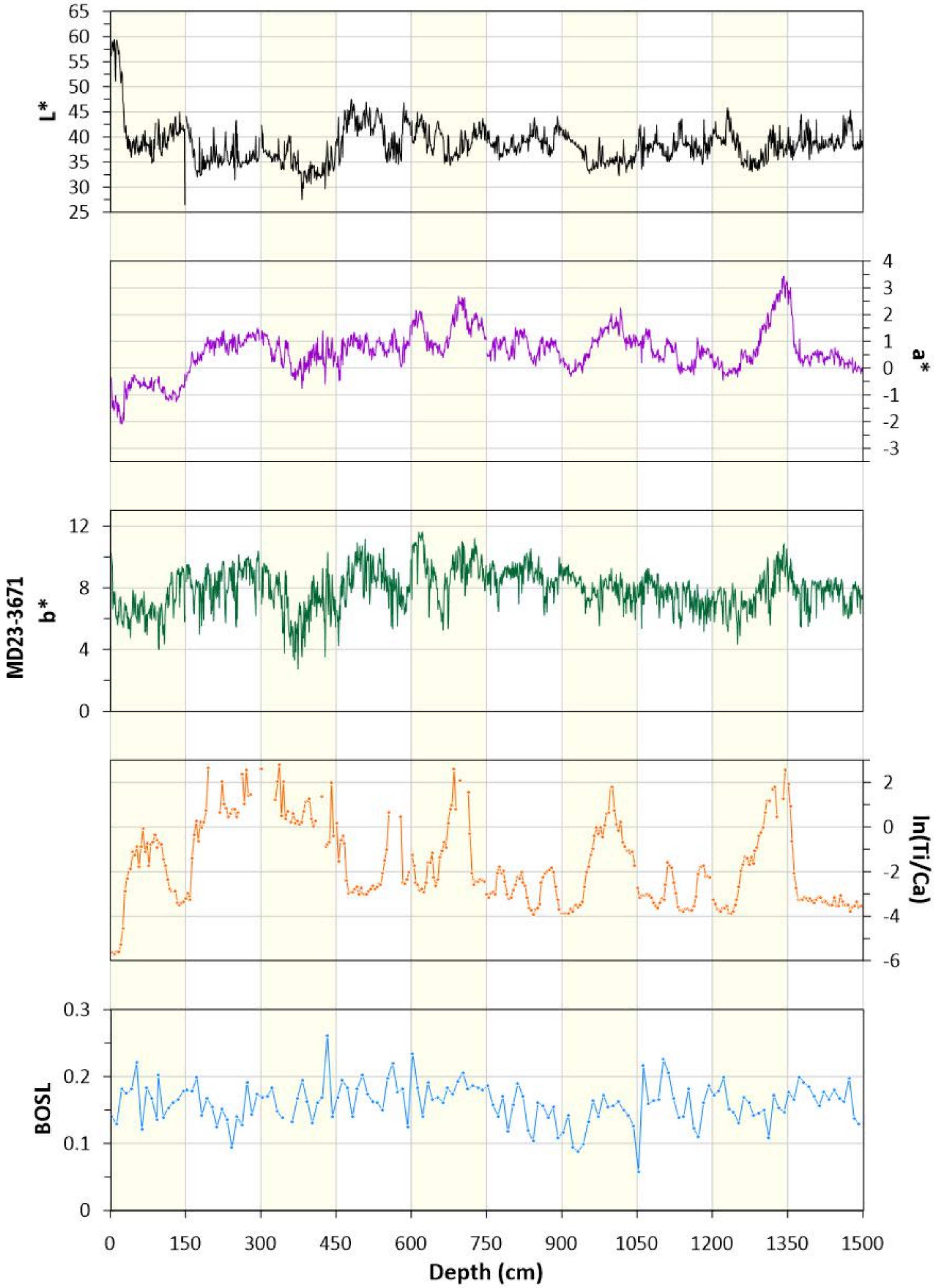
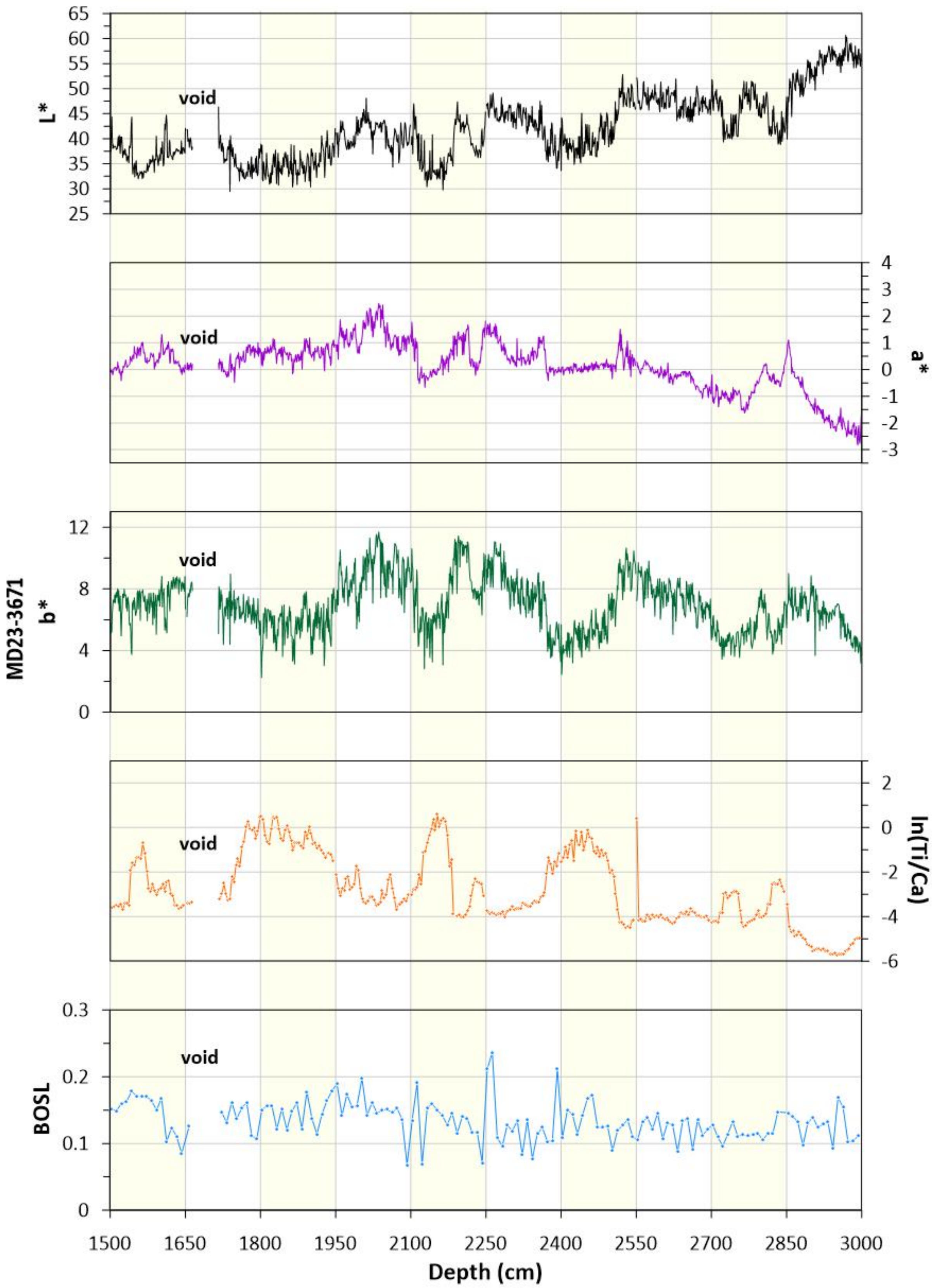


Figure 130: Physical properties of Calypso core MD23-3671.


L*
a*
MD23-3671
b*
ln(Ti/Ca)
BOSL
Depth (cm)



L*
65
60
55
50
45
40
35
30
25
void
a*
4
3
2
1
0
-1
-2
-3
MD23-3671
b*
12
8
4
0
ln(Ti/Ca)
2
0
-2
-4
-6
BOSL
0.3
0.2
0.1
0
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

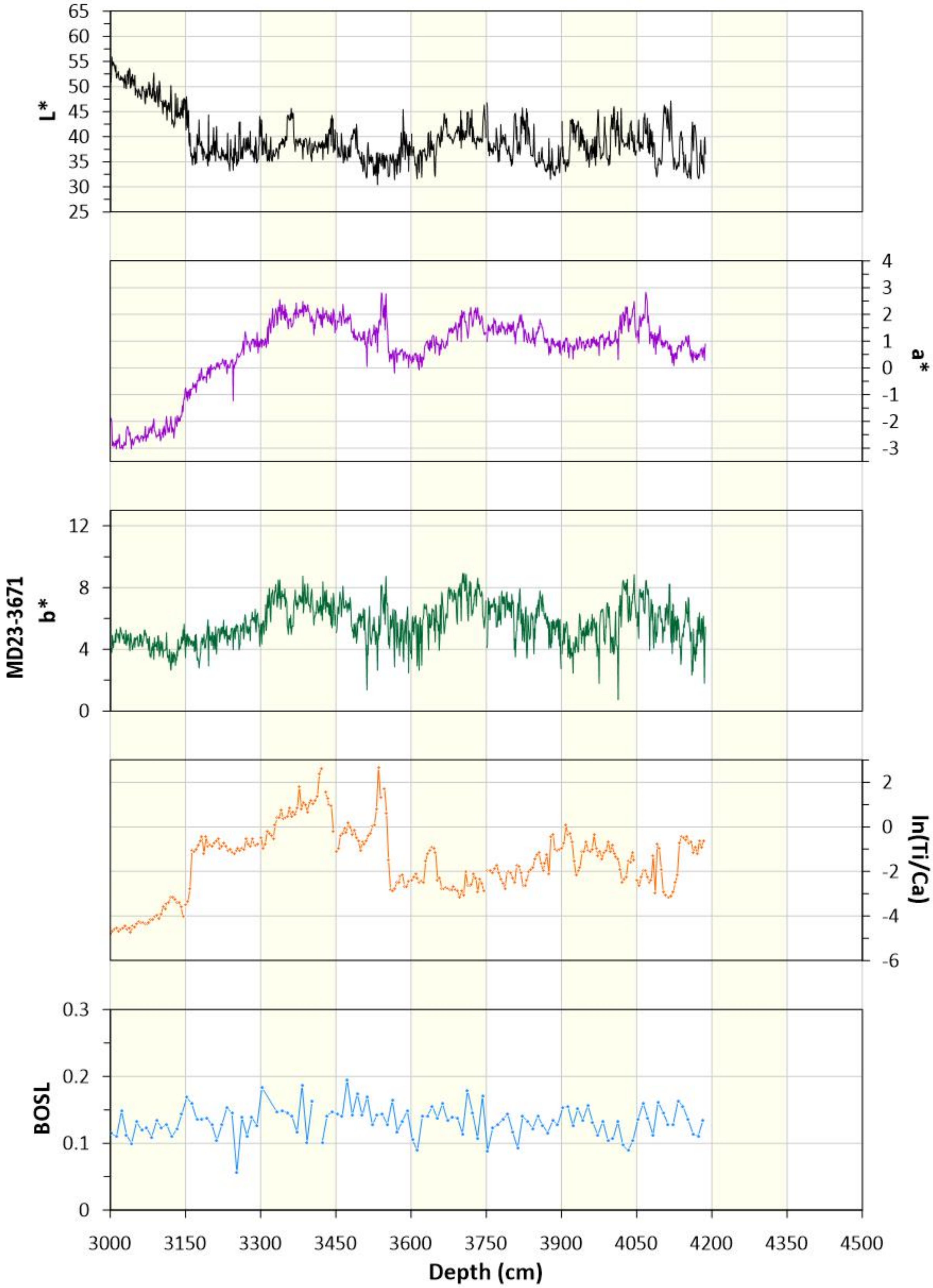


Figure 131: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3671. Low Ca content in this core leads to a slightly discontinuous ln(Ti/Ca) record.*

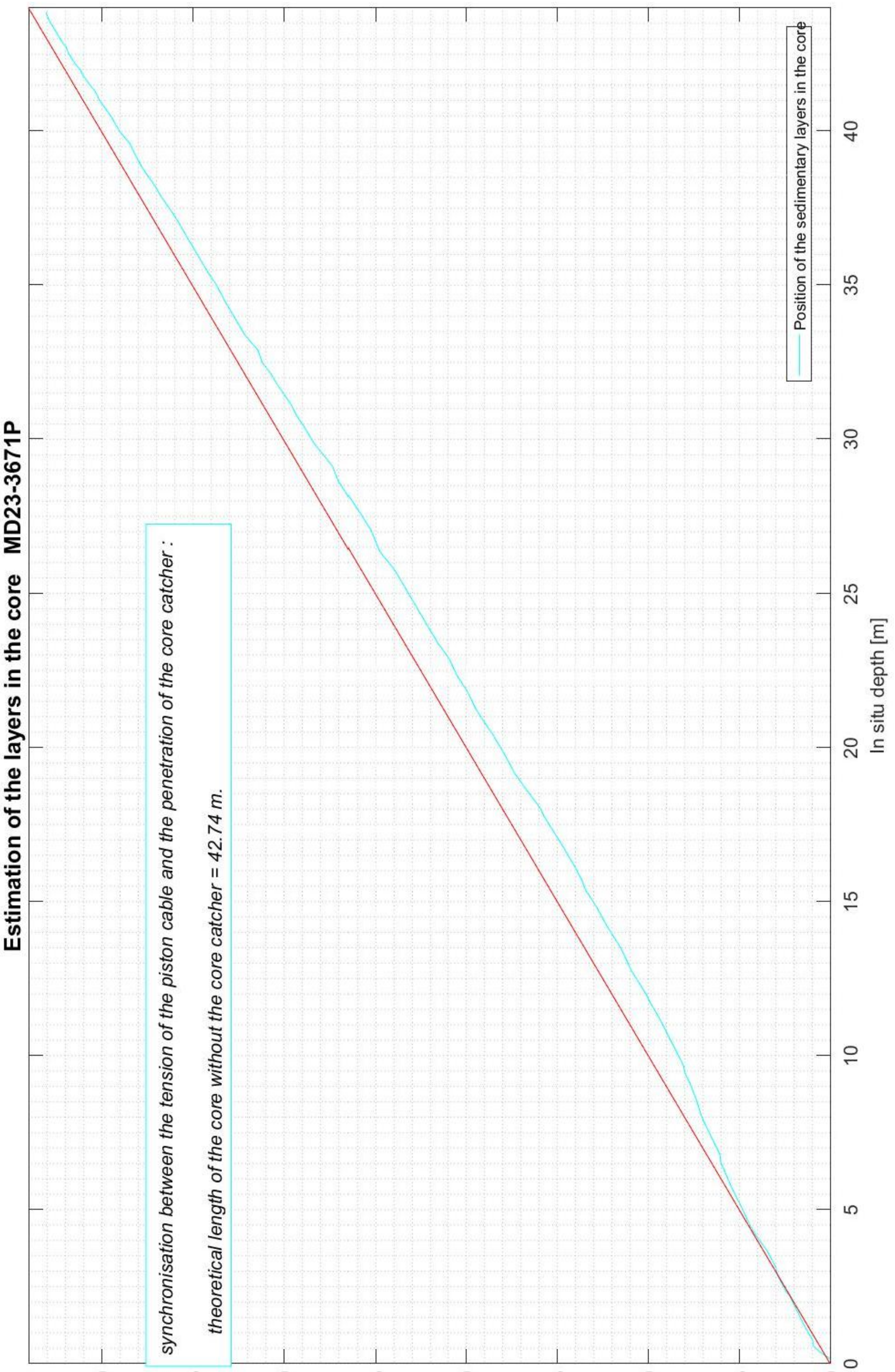


Figure 132: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3671

Core MD23-3671 shows evidence for sediment normal sampling between 0 and 5 m, undersampling between 5 and 20 m and normal sampling between 20 m and the core's bottom depth.

3.4.9 Station S15

3.4.9.1 Station S15 information

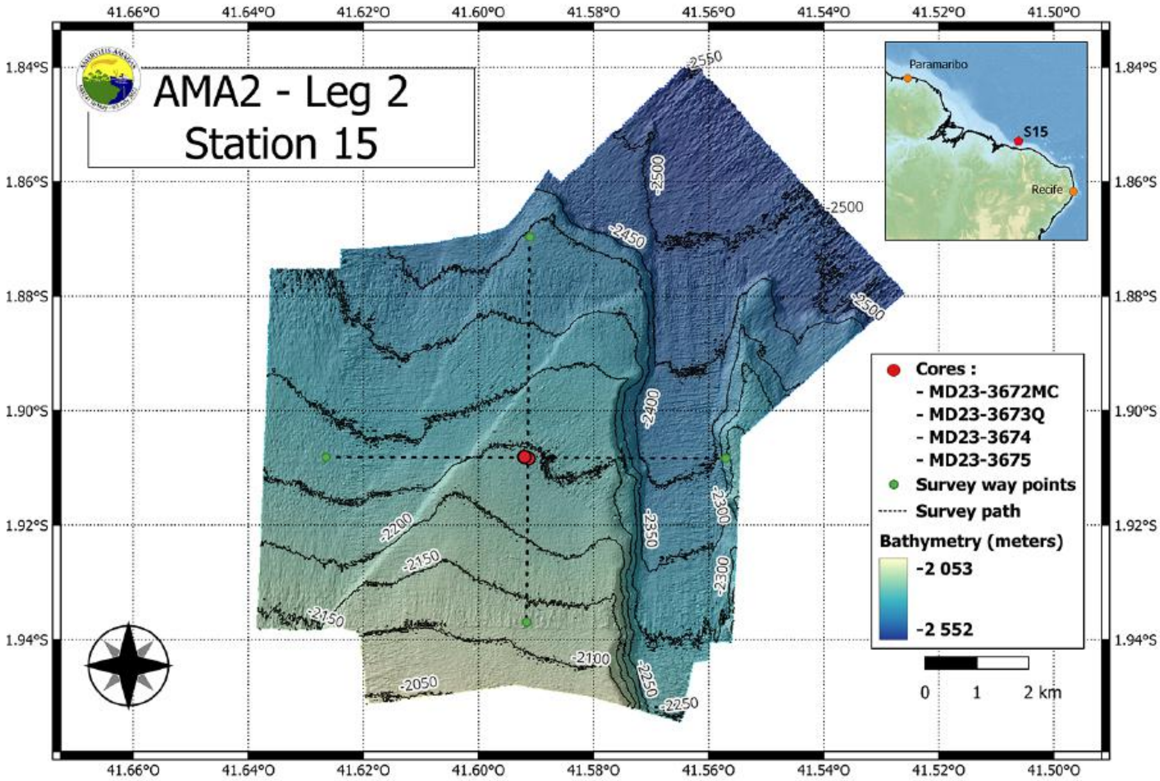


Figure 133: Bathymetric map at station S15.

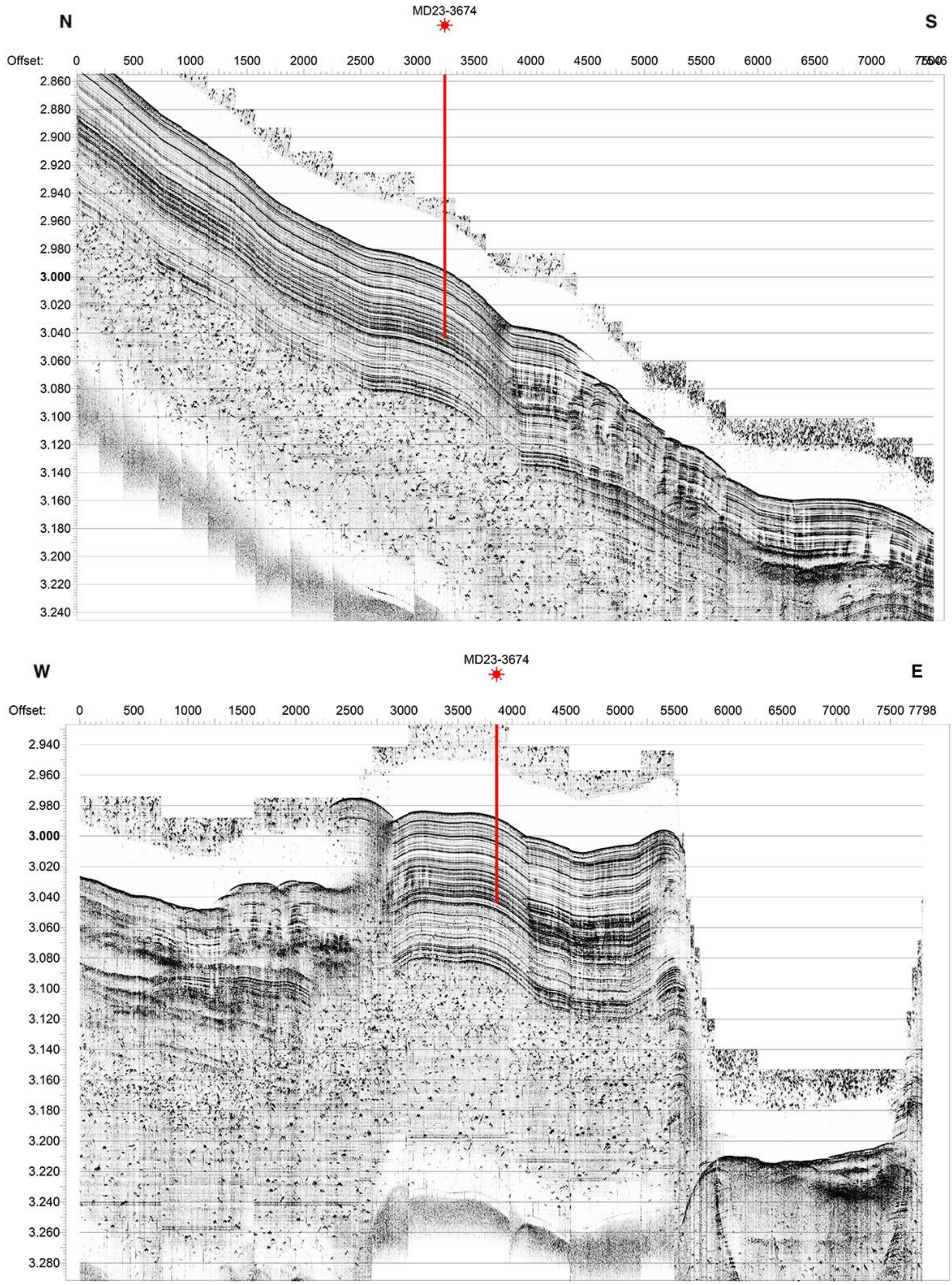


Figure 134: (top) N-S and (bottom) W-E sub-bottom profiles at station S15. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

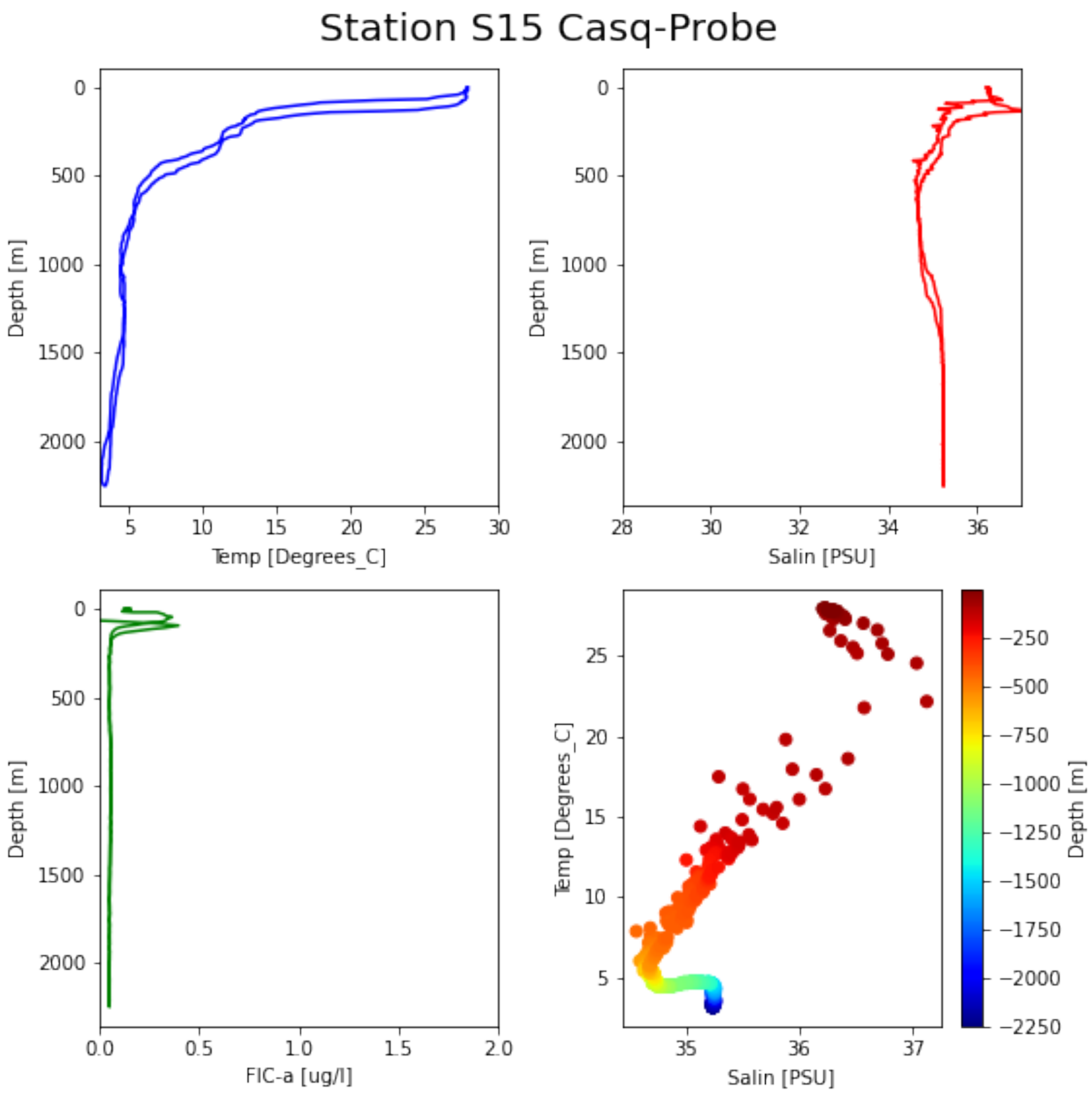


Figure 135: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S15.

3.4.9.2 Multicore MD23-3672MC

Multicore INFORMATION	*Expedition* **MD241 AMARYLLIS-AMAGAS Leg 2**	*Date* **25/06/2023**
Core MD23 – 3672 MC	*Station* ***S15***	*Operator* **8-12**
Comments *Supernatant water sampled above core A (Elisabeth)*		

Core	Core length (cm)	Purpose of core (forams, extra, or archive)	Core subsampling? (*example for type: 1-cm slice*)	Temp. of supernatant water (°C)	Sampling of supernatant water?	Rose-Bengal?	Remarks
A	21 cm	**FORAMS**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		**yes** / ~~no~~	**yes** / ~~no~~	*Rose Bengal in first 10 cm*
B	20 cm	**INORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / ***no***	~~yes~~ / **no**	
C	21 cm	**ORGANIC**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	
D	19 cm	**POLLEN**	**yes** / ~~no~~ **operator:** 8-12 **type:** 1-cm slice		~~yes~~ / **no**	~~yes~~ / **no**	

Figure 136: Coring information of multicore MD23-3672MC.

3.4.9.3 Casq core MD23-3673Q

Cruise Name
MD241-AMA2-Leg2

Date : **25/06/2023**
station N° : **S15**

Weather information
Wind speed: **18 knots**
Wind direction: ##### °
Sea : ~1 m

Core (N°) :
MD23-3673Q

Core Length:
8.50 m

Position (posidonia)
Latitude : **01 ° 54.487 S**
Longitude : **41 ° 35.524 W**

Corer (type) : CASQ
total weight (air) : t
total weight (water) : surface 6.2 t
extraction 6.9 t

TUNINGS :
Tubes (length) : 12.00 m

Résultats CINEMA

Measured Parameters :
multibeam water depth 2241 m
released cable length : m
Extraction/total *(tons)* : 11.20 t
extraction/differential *(tons)* : t

TIME (GMT)
On station : 08:39 GMT
Beginning of operation : 10:28 GMT
Triggering : 11:48 GMT
End of operation : 13:30 GMT
Duration of operation : 3h30

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other : Calypso

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Two bags with core catcher sediment
Sampling for Martine Couapel

Incidents :

1st level: two large boxes A and B.

0–150	150–300	300–450	450–600	600–750	750–840		
A-I	A-II	A-III	A-IV	A-V	A-VI		

0–100	100–250	250–400	400–550	550–700	700–840		
B-I	B-II	B-III	B-IV	B-V	B-VI		

2nd level: 2 small boxes C and D + 2 u-channels between them

0–150	150–300	300–450	450–600	600–750	750–840		
C-I	C-II	C-III	C-IV	C-V	C-VI		

0–100	100–250	250–400	400–550	550–700	700–840		
D-I	D-II	D-III	D-IV	D-V	D-VI		

0–150	150–300	300–450	450–600	600–750	750–840		
u-channel A-I	u-channel A-II	u-channel A-III	u-channel A-IV	u-channel A-V	u-channel A-VI		

0–100	100–250	250–400	400–550	550–700	700–840		
u-channel B-I	u-channel B-II	u-channel B-III	u-channel B-IV	u-channel B-V	u-channel B-VI		

3rd level: 3 small boxes E, F and G

0–100	100–250	250–400	400–550	550–700	700–850		
E-I	E-II	E-III	E-IV	E-V	E-VI		

0–150	150–300	300–450	450–600	600–750	750–850		
F-I	F-II	F-III	F-IV	F-V	F-VI		

0–100	100–250	250–400	400–550	550–700	700–850		
G-I	G-II	G-III	G-IV	G-V	G-VI		

Figure 137: Coring information of Casq core MD23-3673Q. Numbers in red indicate depths that differ from the typical Casq section limits.

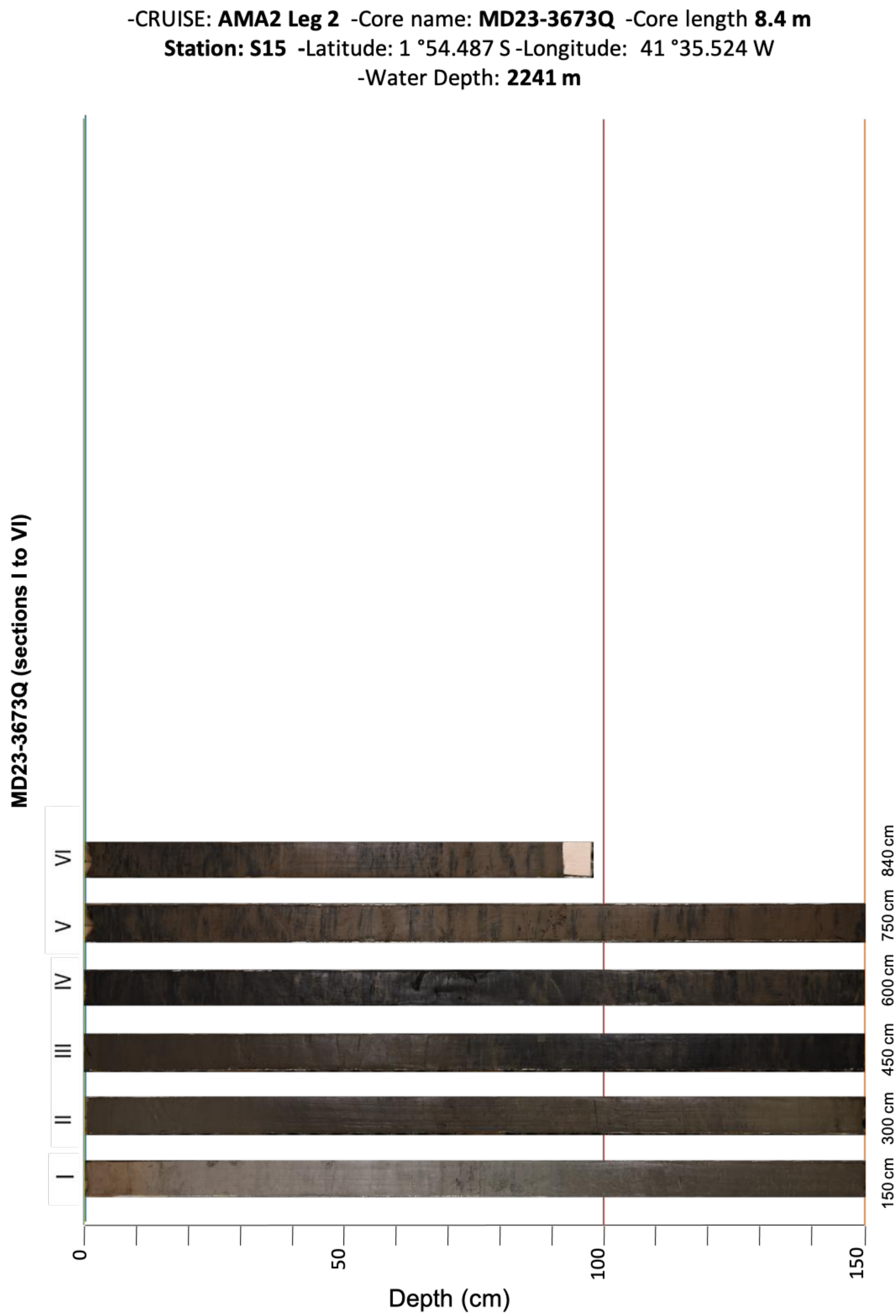
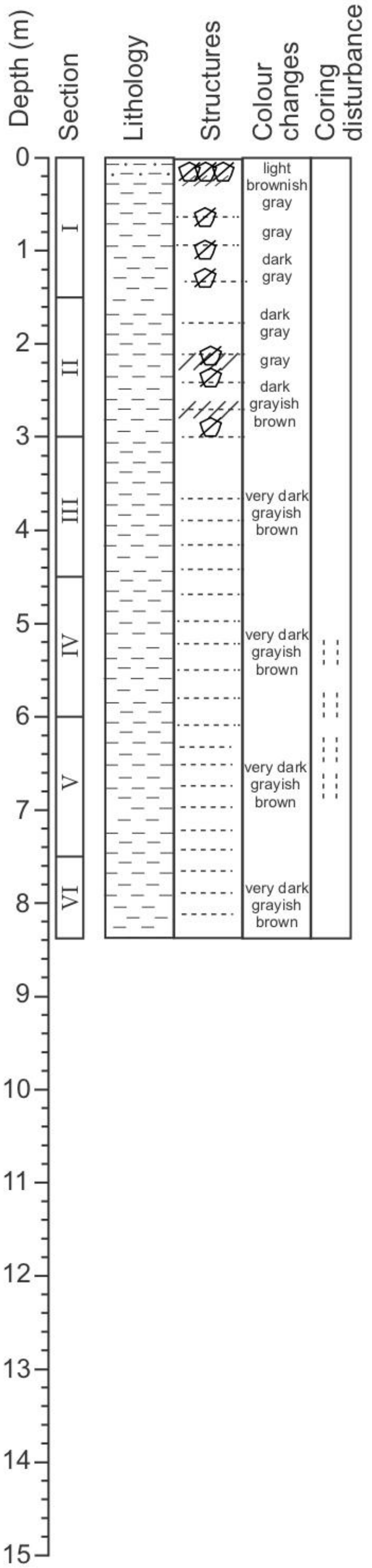


Figure 138: Pictures of Casq core MD23-3673Q.

MD241-AMA2-Leg2	**MD23-3673Q**	Position: 1°54.487'S 41°35.524'W
Station S15	**Sediment description (1/1)**	Water-depth: 2241 m Core length: 8.50 m



Comments

Homogenous gray mud with dark marks all along the core, and shell fragments in the upper part.

0-20 cm: sandy-mud with shell fragments.

Figure 139: Sediment description of Casq core MD23-3673Q.

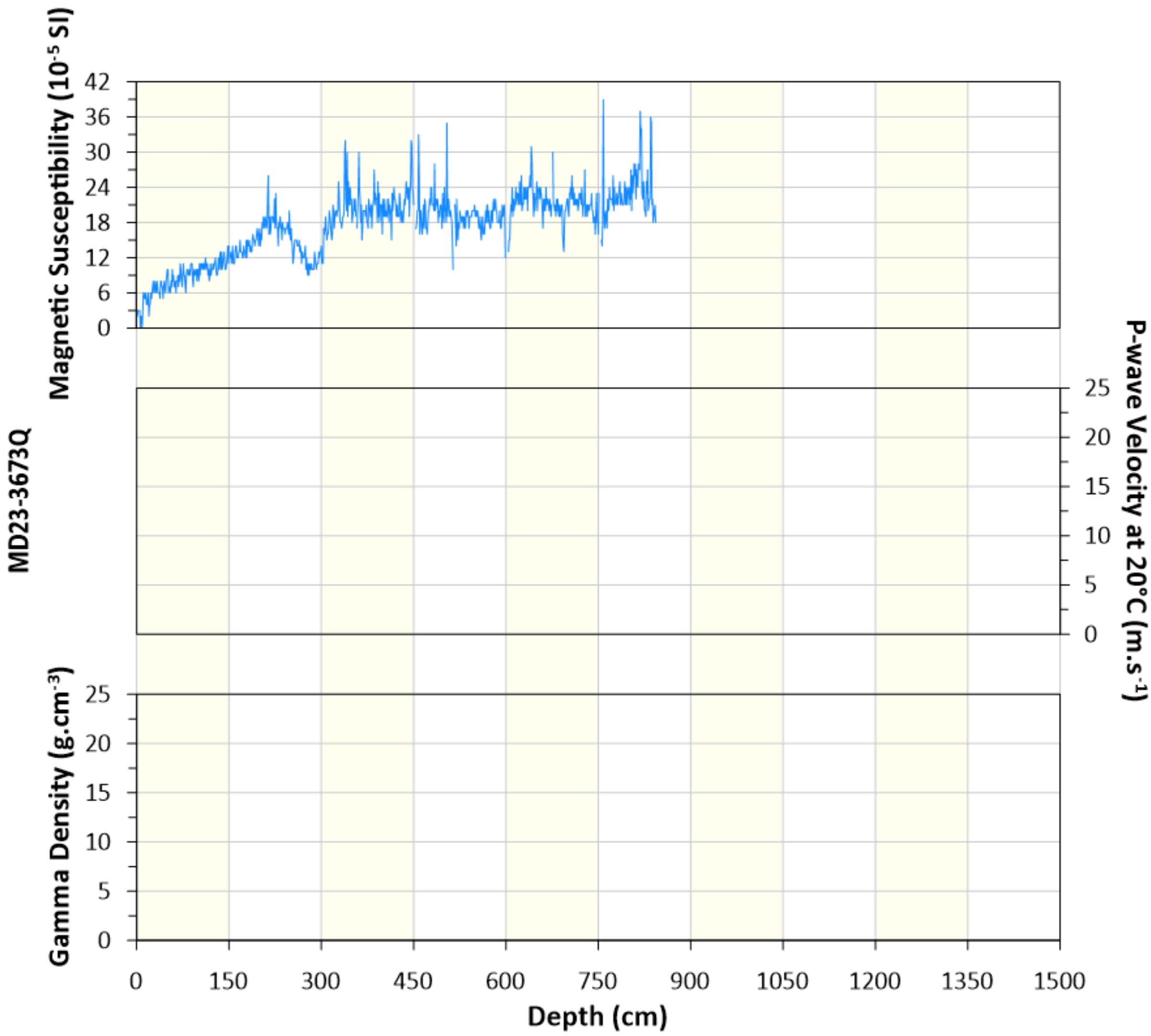


Figure 140: Physical properties of Casq core MD23-3673Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

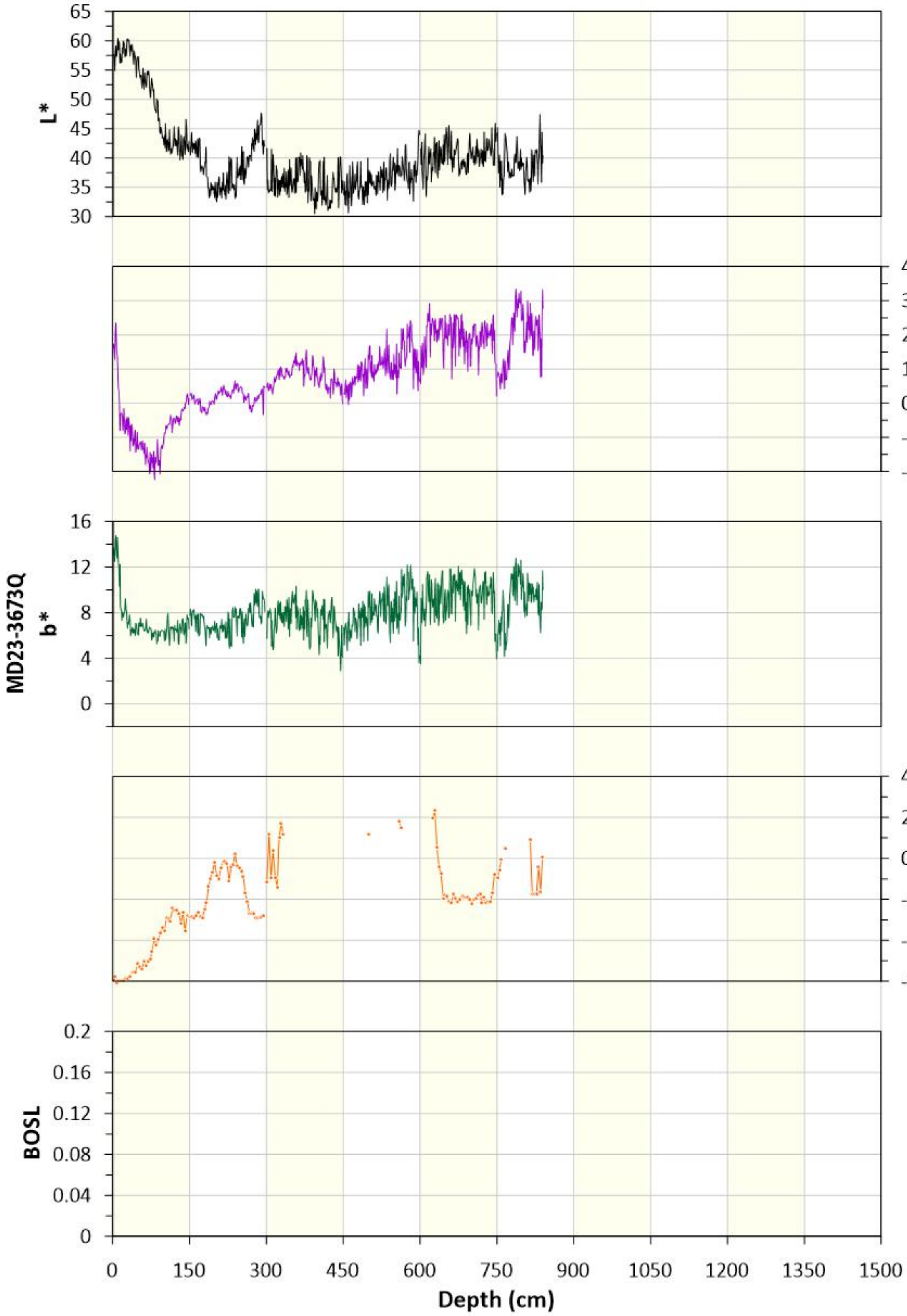


Figure 141: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3673Q. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record. BOSL was not analyzed in Casq cores.*

3.4.9.4 Calypso core MD23-3674

Cruise Name **MD241-AMA2-Leg2**	Date : **25/06/2023** station N° : **S15**	Weather information Wind speed: **21 knots** Wind direction: 116.00 ° Sea : ~1 m
Core (N°) : **MD23-3674**	**Core Length:** **42.76 m**	**Position (posidonia)** Latitude : **01 ° 54.486 S** Longitude : **41 ° 35.526 W**
Corer (type) : Calypso total weight (air) : t total weight (water) : **surface** 6.6 t **bottom** 7.3 t	**TUNINGS :** Tubes (length) : **43,73 m** **Cables :** Free fall : **2.00 m** theoritical elastic rebound **5.83 m** loop length **6.74 m** counterweight cable length m (3m50 lest)	**Résultats CINEMA** thickness sediment sampled m thickness sediment cored m
Measured Parameters : **multibeam water depth** 2 241 m **released cable length :** m Extraction/total *(tons)* : 13.40 t	**TIME (GMT)** On station : **08:39 GMT** Beginning of operation : **13:30 GMT** **Triggering :** **15:44 GMT** End of operation : **17:00 GMT** **Duration of operation :** **3h30**	**INSTRUMENTATION** **Other OPERATIONS on site** **MUC** CTD-Rosette **Small CTD** **Small Niskin** Other : **CASQ**

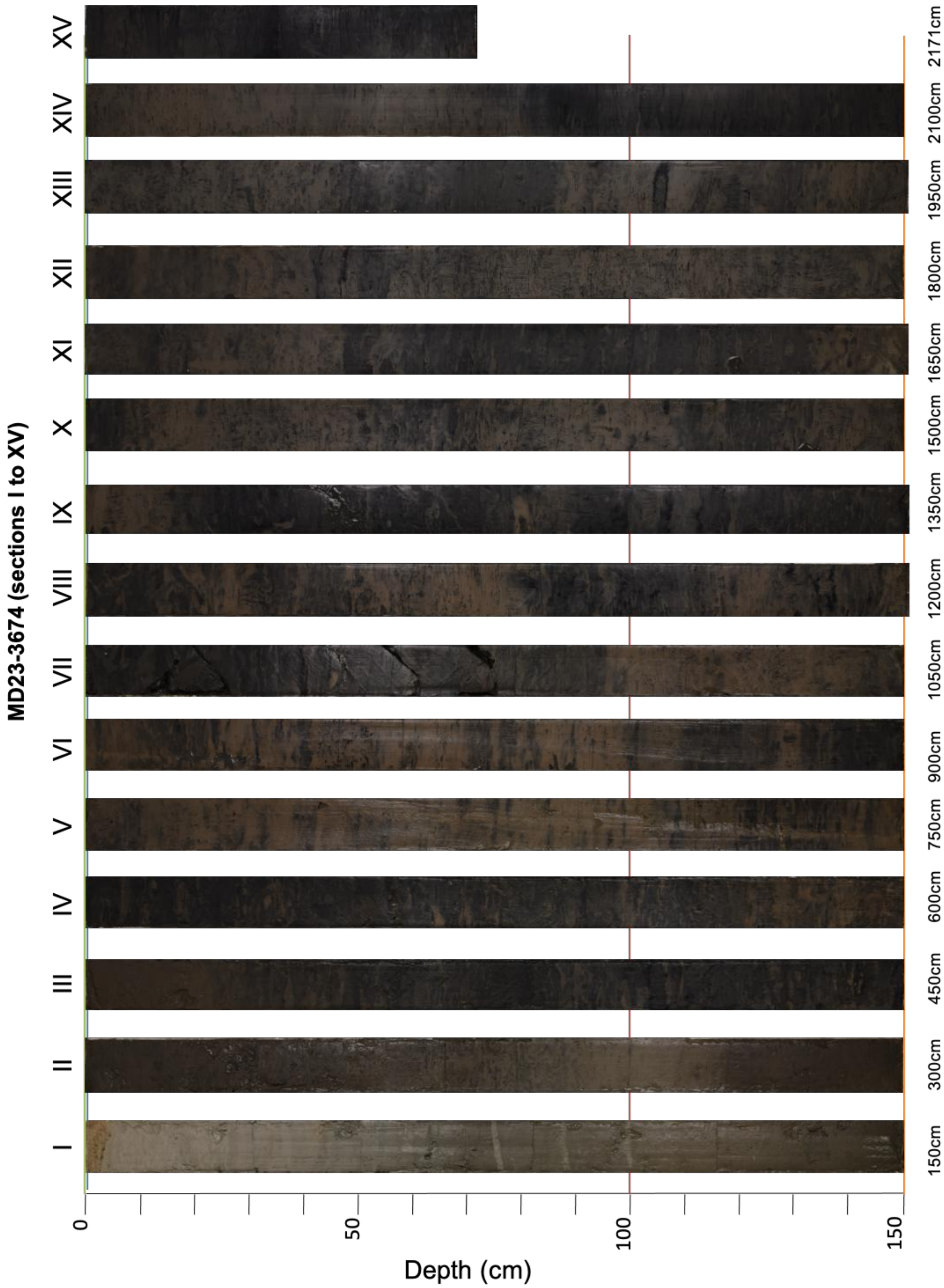
Description : Three syringes of core catcher in a bag.
Counterweight cable length=tube's length + free fall + 2.87 m

Incidents : S. IV: u-channel: 40/50 last cm perturbed, inserted by hand.
S. V: u-channel taken in the top of the section (lower part was cracked)
S. IX: u-channel: nodule at 118-120 cm on a bag
S.XXI: sediment in the top cap put on a bag due to expansion. S. XXII: idem

0–150	150–300	300–450	450–600	600–750	750–900	900–1050
I	**II**	**III**	**IV**	**V**	**VI**	**VII**
1050–1200	1200–1350	1350–1500	1500–1650	1650–1800	1800–1950	1950–2100
VIII	**IX**	**X**	**XI**	**XII**	**XIII**	**XIV**
2100–2171	2171–2250	2250–2400	2400–2550	2550–2700	2700–2850	2850–3000
XV	**XVI**	**XVII**	**XVIII**	**XIX**	**XX**	**XXI**
3000–3150	3150–3300	3300–3450	3450–3600	3600–3750	3750–3900	3900–4050
XXII	**XXIII**	**XXIV**	**XXV**	**XXVI**	**XXVII**	**XXVIII**
4050–4200	4200–4276					
XXIX	**XXX**					

Figure 142: Coring information of Calypso core MD23-3674. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3674** -Core length **42.76 m**
Station: S15 -Latitude: 1°54.486 S -Longitude: 41°35.526 W
-Water Depth : **2241 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3674** -Core length **42.76 m**
Station: S15 -Latitude: 1°54.486 S -Longitude: 41°35.526 W
-Water Depth : **2241 m**

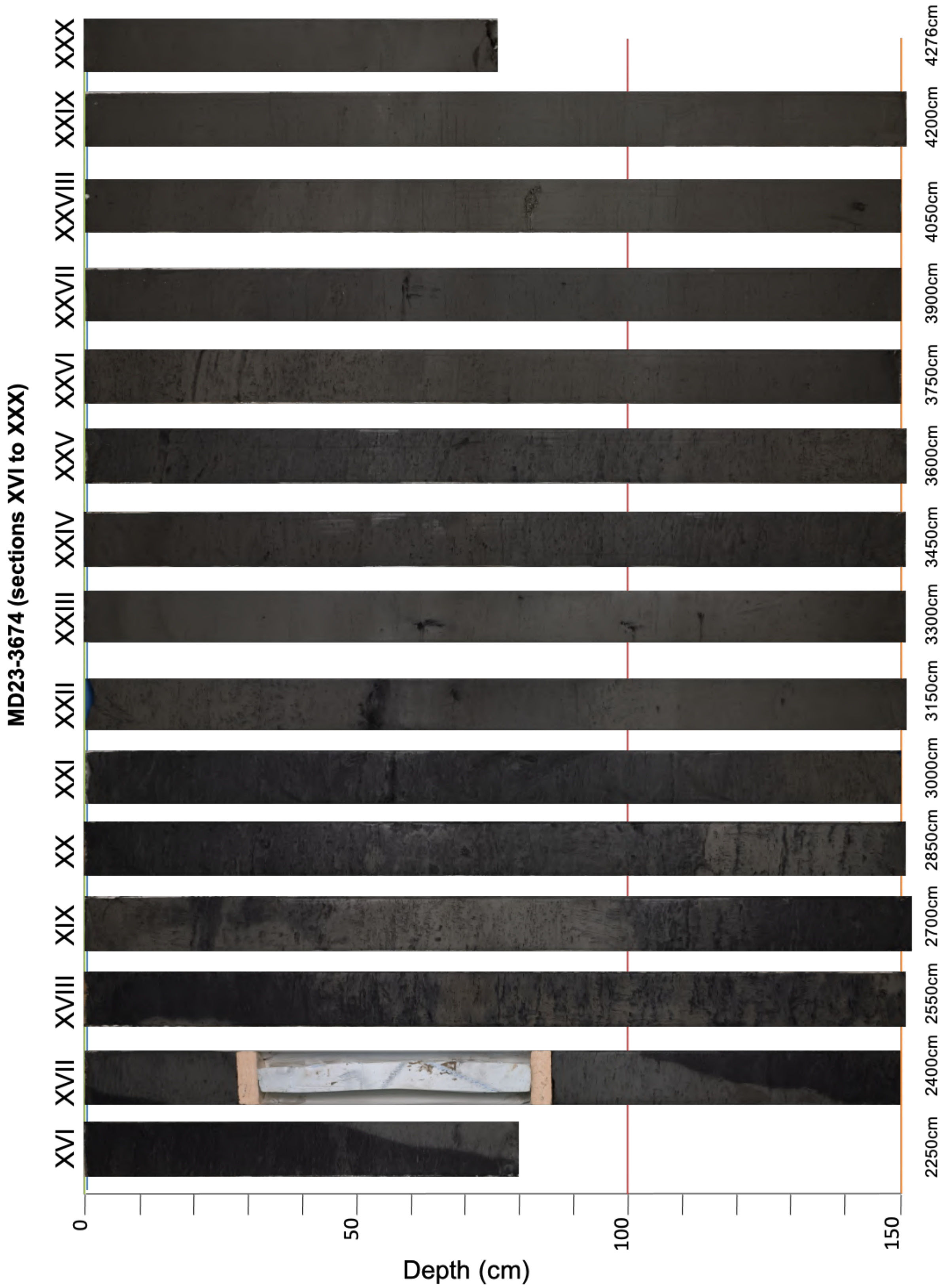
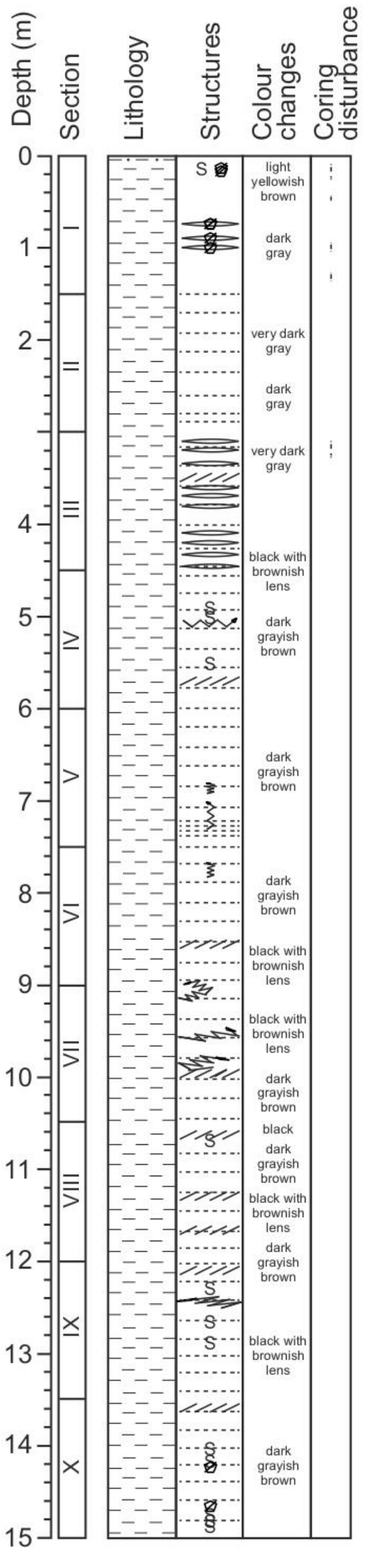


Figure 143: Pictures of Calypso core MD23-3674.

MD241-AMA2-Leg2	MD23-3674	Position: 1°54.486'S 41°35.526'W
Station S15	Sediment description (1/3)	Water-depth: 2241 m Core length: 42.76 m



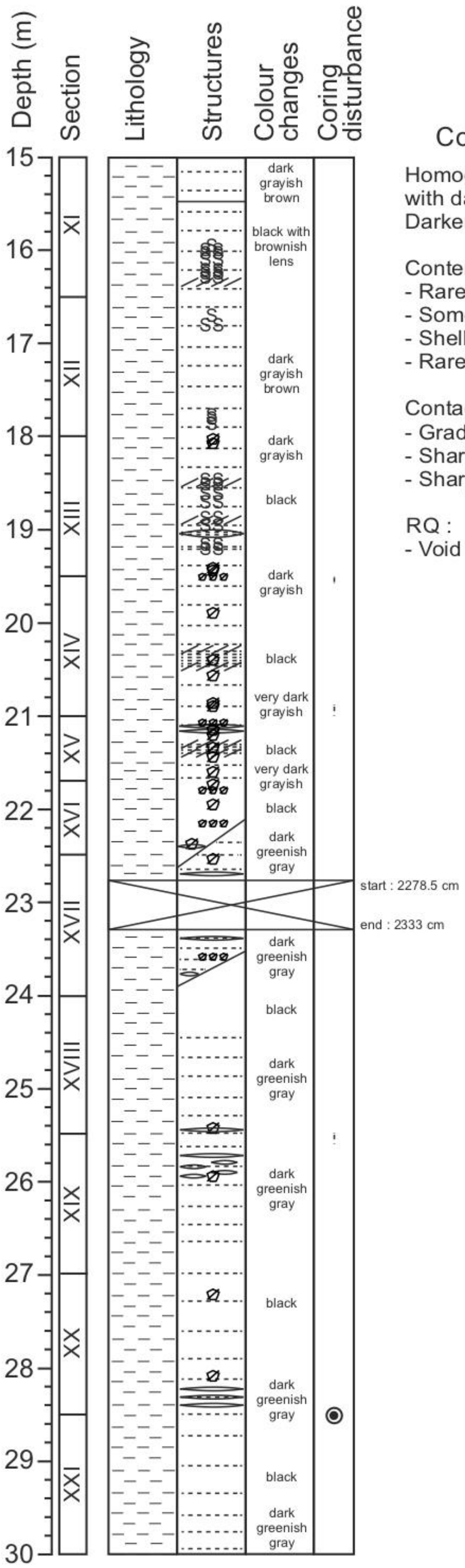
Comments

Homogeneous dark grayish/brown - black mud with brownish lens alternance with darker marks, dots or laminea
First 4 cm high content of sand
Darker marks or laminea (manganese ?)

Contents :
- Rare slightly disturbances
- Some bioturbations
- Shell fragments
- Wet mud cracks (gaz)

Contacts :
- Gradational

MD241-AMA2-Leg2	MD23-3674	Position: 1°54.486'S 41°35.526'W
Station S15	Sediment description (2/3)	Water-depth: 2241 m Core length: 42.76 m



Comments

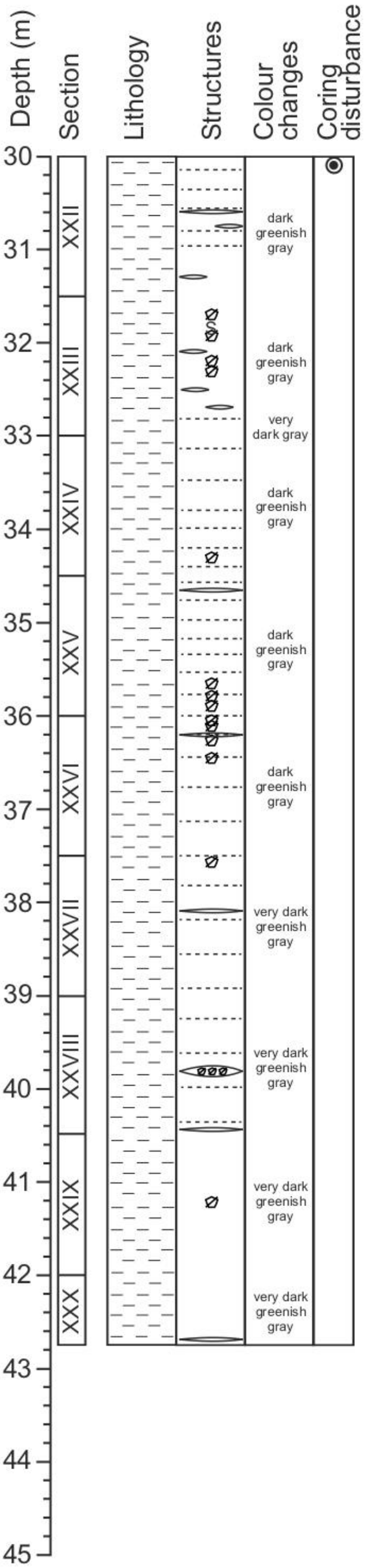
Homogeneous dark grayish/greenish - black mud alternance
with darker marks, dots or laminea
Darker marks or laminea (manganese ?)

Contents :
- Rare slightly disturbances
- Some bioturbations
- Shell fragments
- Rare hole coring distrubances

Contacts :
- Gradational
- Sharp planar
- Sharp planar obliquous

RQ :
- Void between 2278.5 and 2333 cm

MD241-AMA2-Leg2	MD23-3674	Position: 1°54.486'S 41°35.526'W
Station S15	Sediment description (3/3)	Water-depth: 2241 m Core length: 42.76 m



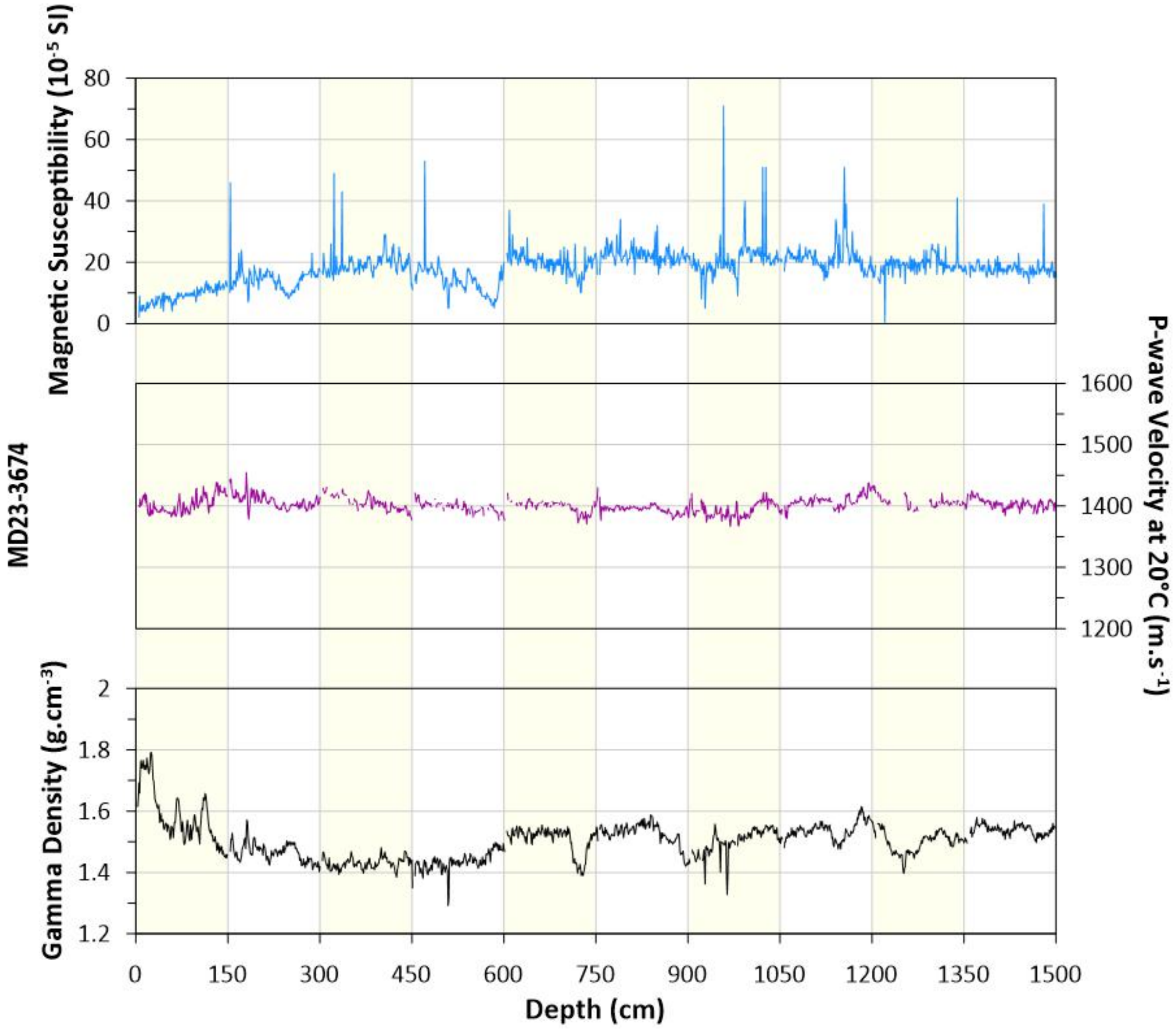
Comments

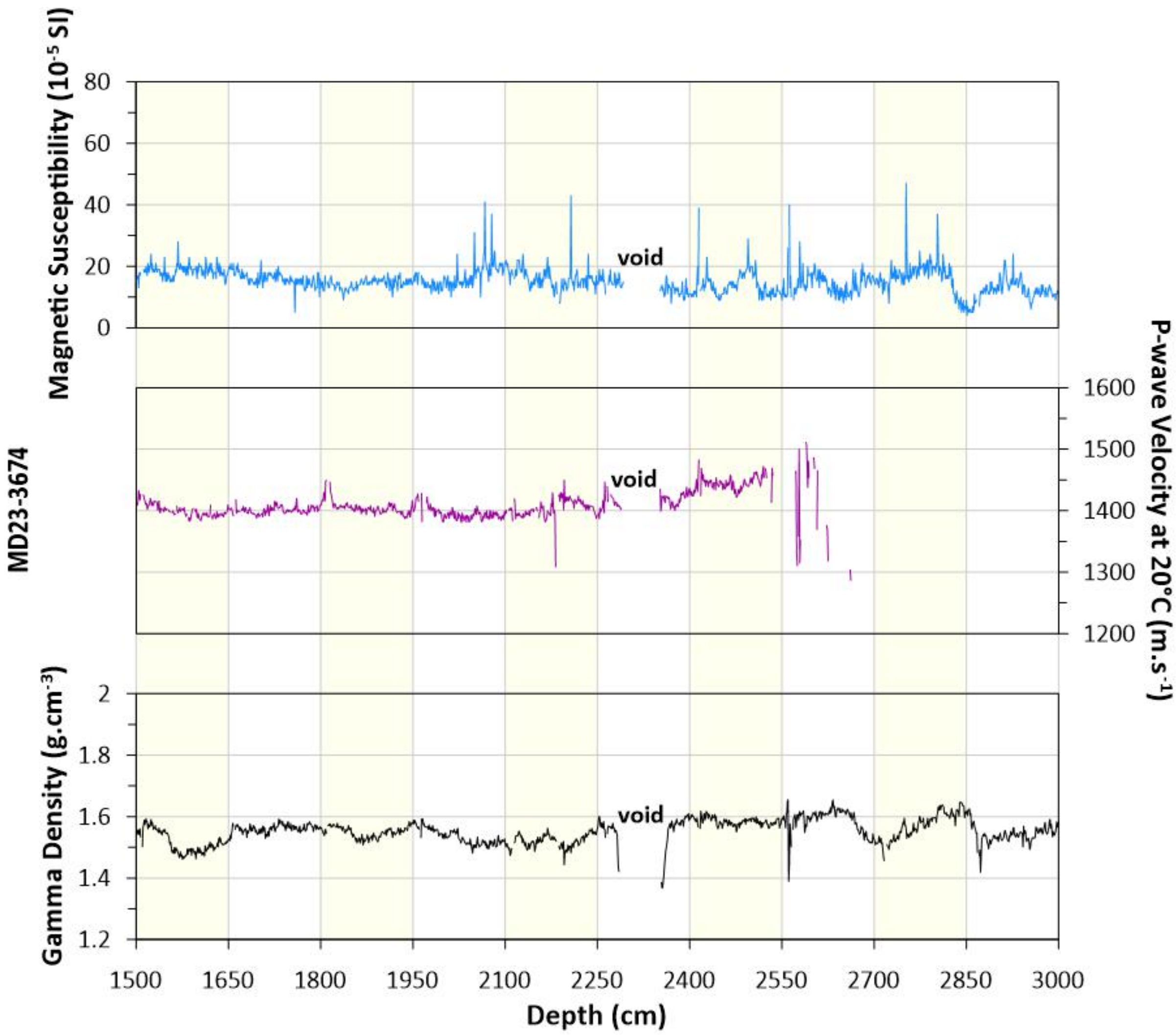
Homogeneous very dark to dark greenish gray mud
with darker marks, dots or laminea
Darker marks or laminea (manganese ?)

Contents :
- Rare bioturbations
- Shell fragments
- Rare hole coring distrubances

End of the core : 4276 cm

Figure 144: Sediment description of Calypso core MD23-3674.


Magnetic Susceptibility (10^{-5} SI)
80
60
40
20
0
MD23-3674
P-wave Velocity at 20°C (m.s^{-1})
1600
1500
1400
1300
1200
Gamma Density (g.cm^{-3})
2
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)



Magnetic Susceptibility (10^{-5} SI)
80
60
40
20
0
void
MD23-3674
P-wave Velocity at 20°C ($m.s^{-1}$)
1600
1500
1400
1300
1200
void
Gamma Density ($g.cm^{-3}$)
2
1.8
1.6
1.4
1.2
void
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

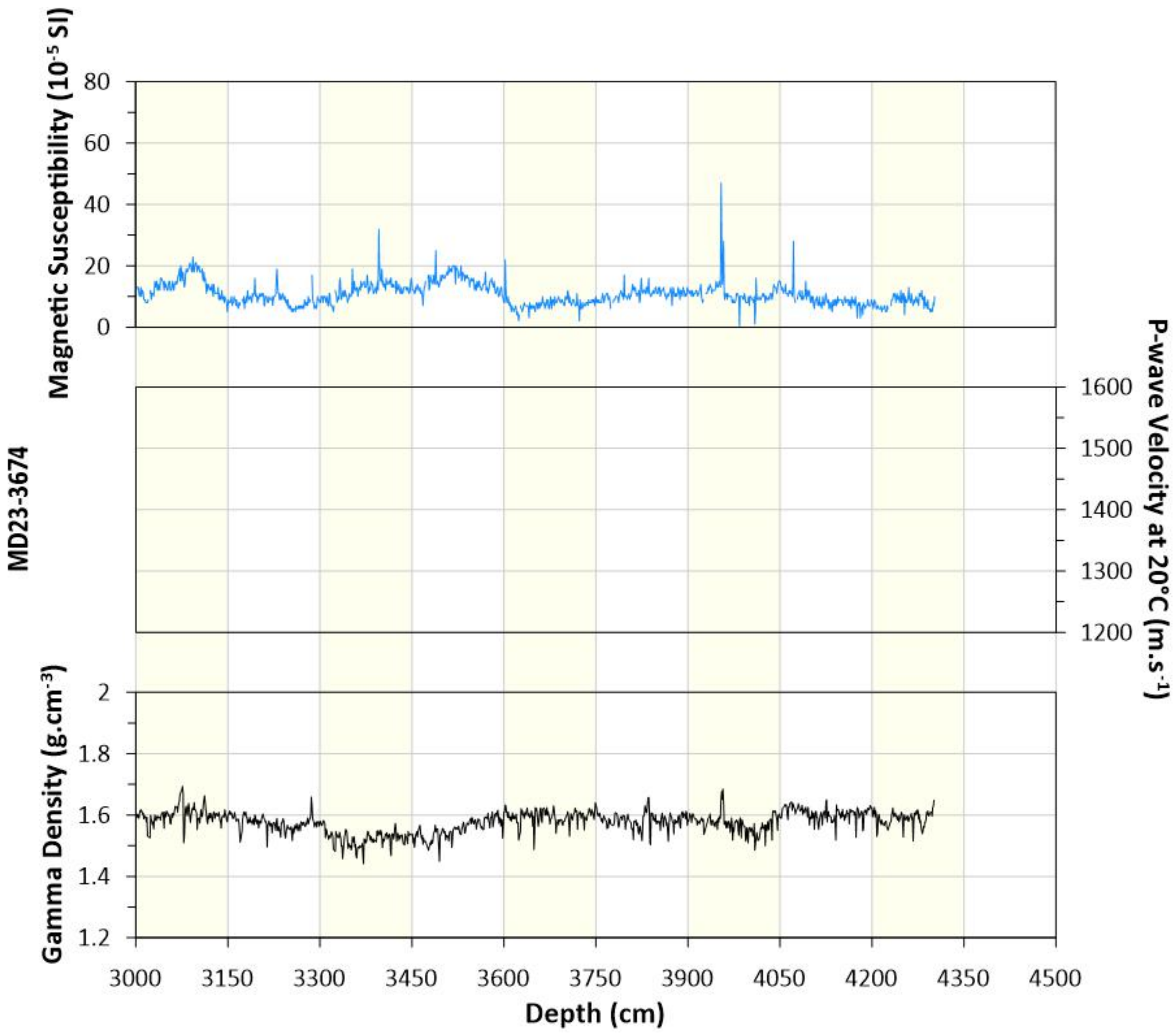
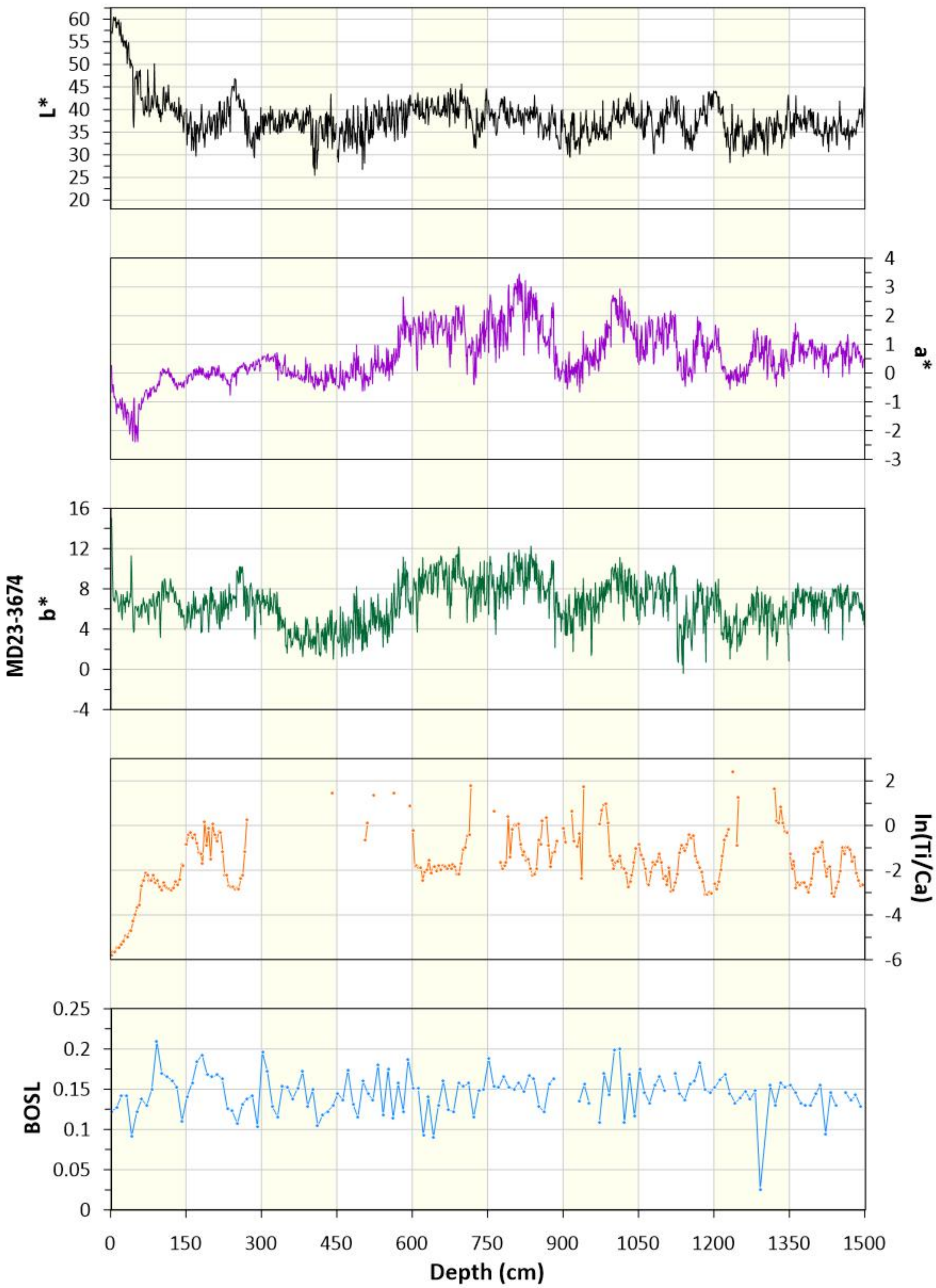
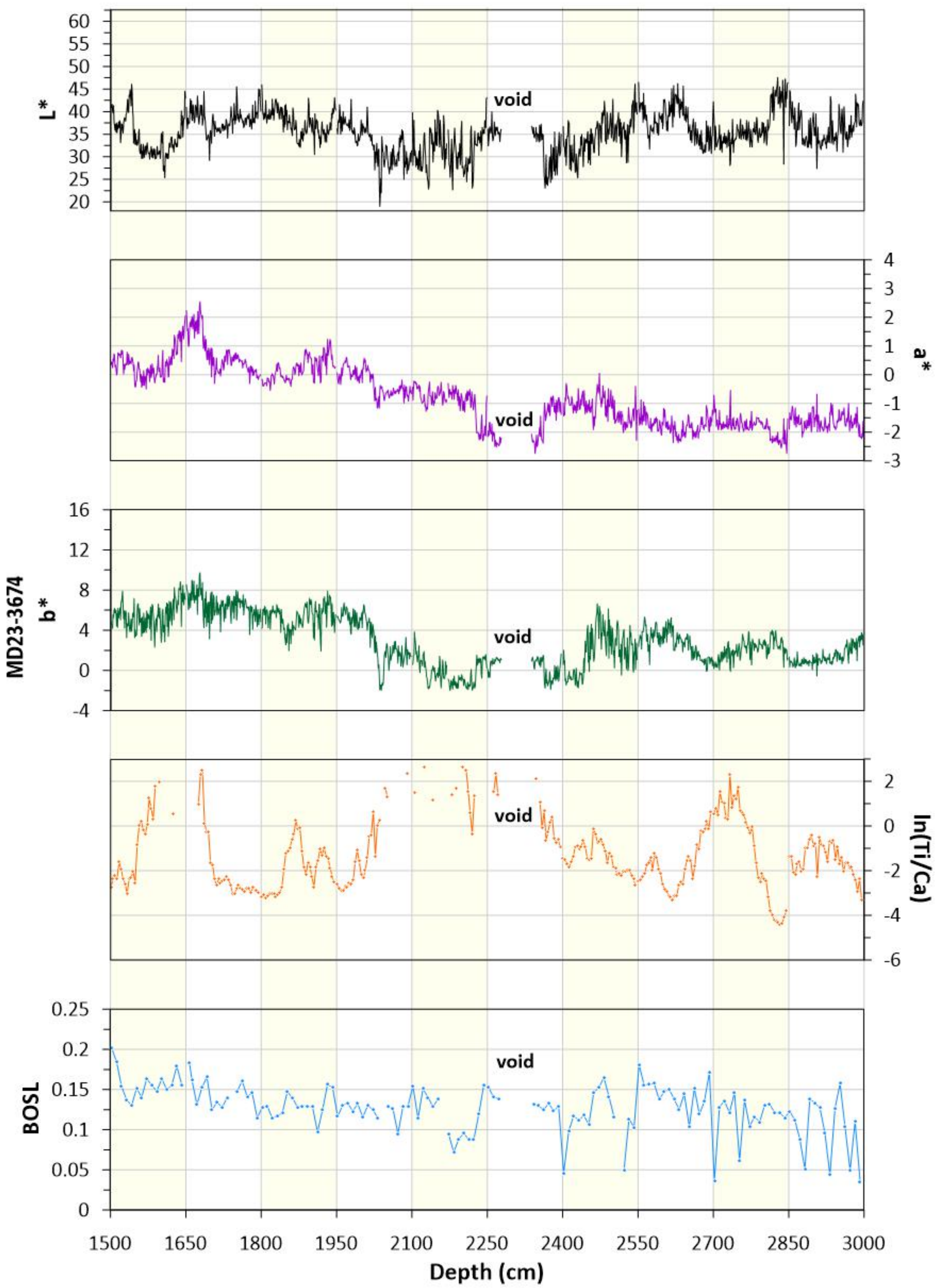


Figure 145: Physical properties of Calypso core MD23-3674. The quality of P-wave velocity measurements is reduced in lower core sections, explaining the absence of plotted data.


L*
60
55
50
45
40
35
30
25
20
a*
4
3
2
1
0
-1
-2
-3
MD23-3674
b*
16
12
8
4
0
-4
ln(Ti/Ca)
2
0
-2
-4
-6
BOSL
0.25
0.2
0.15
0.1
0.05
0
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)



L*
60
55
50
45
40
35
30
25
20
void
a*
4
3
2
1
0
-1
-2
-3
MD23-3674
b*
16
12
8
4
0
-4
ln(Ti/Ca)
2
0
-2
-4
-6
BOSL
0.25
0.2
0.15
0.1
0.05
0
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

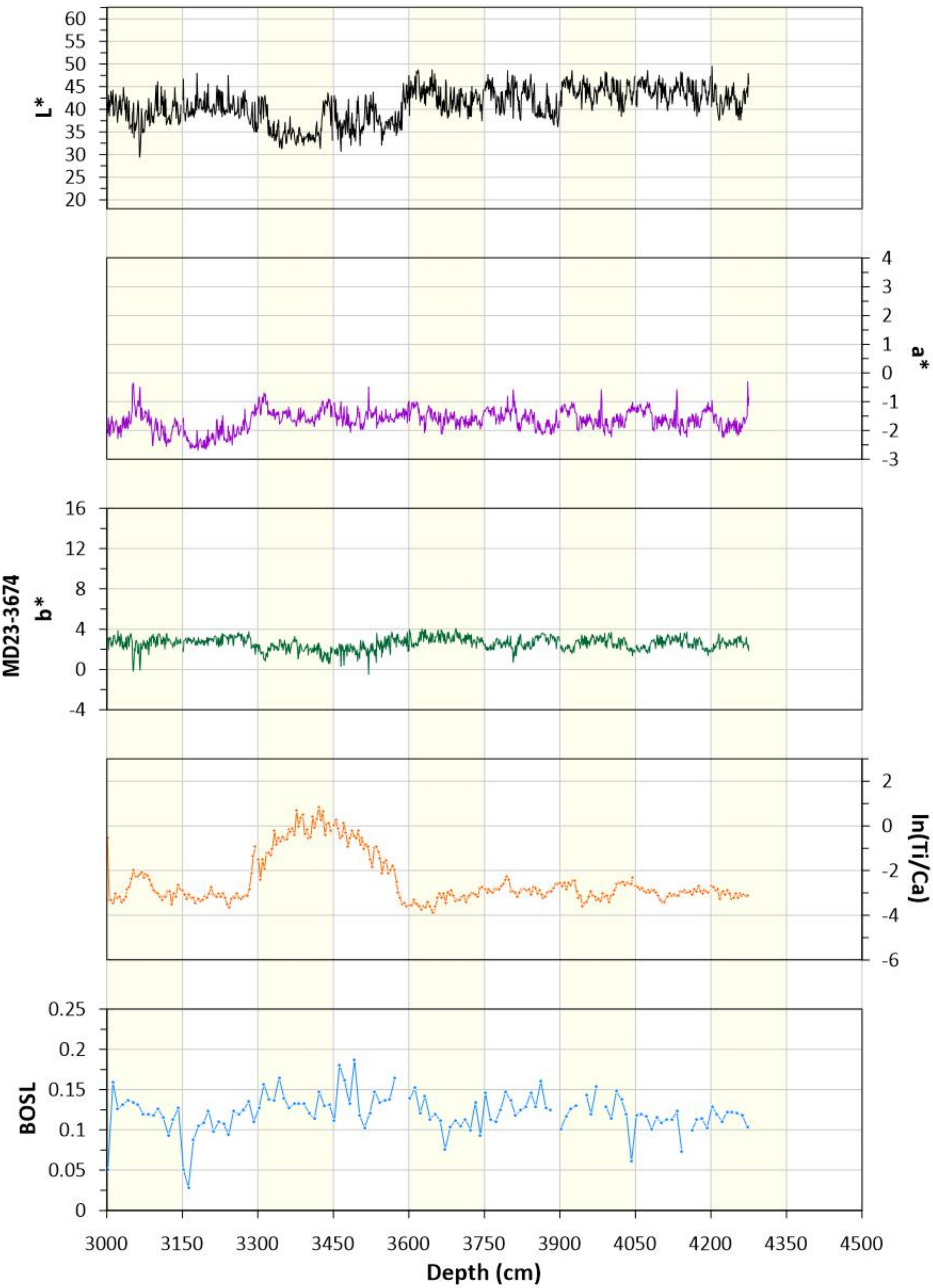


Figure 146: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3674. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record.*

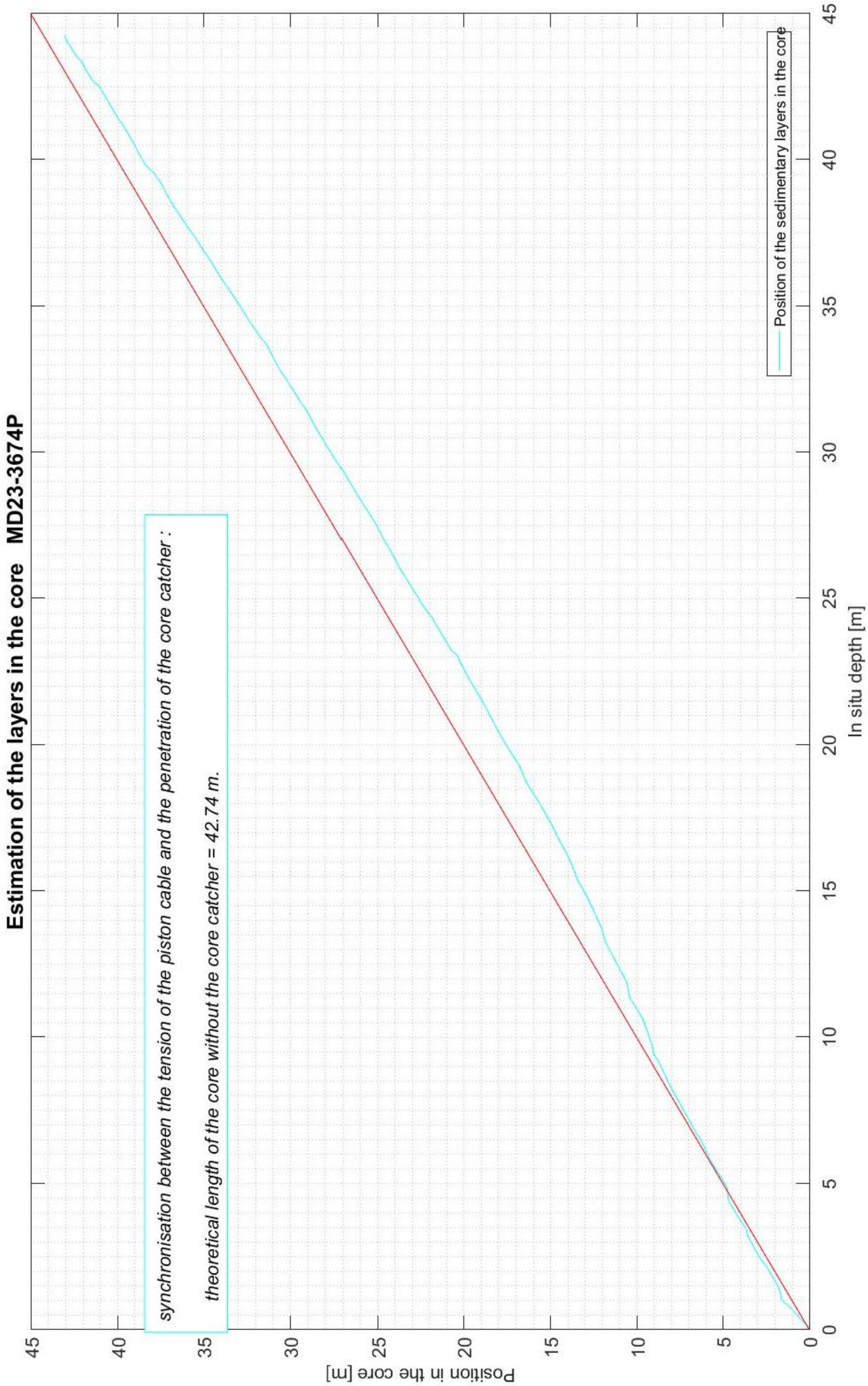


Figure 147: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3674.

Core MD23-3674 shows evidence for sediment normal sampling between 0 and 9 m, undersampling between 9 and 17 m and normal sampling between 17 m and the core's bottom depth.

3.4.9.5 Calypso core MD23-3675

Cruise Name

MD241-AMA2-Leg2

Date : **25/06/2023**
station N° : **S15**

Weather information
Wind speed: **16,3 knots**
Wind direction: 83,00 °
Sea : ~1 m

Core (N°) :

MD23-3675

Core Length:

51,33 m

Position (posidonia)
Latitude : **01 ° 54,485 S**
Longitude : **41 ° 35,52 W**

Corer (type) : **Calypso**
total weight (air) : t
total weight (water) : **surface** **6,8 t**
bottom **7,8 t**

TUNINGS :
Tubes (length) : **54,07 m**
Cables :
Free fall : **2,60 m**
theoritical elastic rebound **6,08 m**
loop length **8,10 m**
counterweight cable length m (3m50 test)

Résultats CINEMA
thickness sediment sampled m
thickness sediment cored m

Measured Parameters :
multibeam water depth **2 241 m**
released cable length : m
Extraction/total *(tons)* : **15,13 t**

TIME (GMT)
On station : **08:39 GMT**
Beginning of operation : **17:00 GMT**
Triggering : **20:27 GMT**
End of operation : **23:30 GMT**
Duration of operation : **6h30**

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD **Small Niskin**
Other : **CASQ**

Description : Three syringes of core catcher in a bag.
Core cut in three sections when removing from the metal tube: 0-843 cm, 843-2205 cm, 2205-5135 cm

Incidents : S. Via: sed. fell from the tube and put on a bag
S. XVII: emptied (water inside) when cutting the sections
S. XXVI: bottom of the section: 5 cm of sediment (in stratigraphic order) expanded and was recovered between two round cups
S. XXX: quite some water coming out when cutting the sections

0	150	300	450	600	750	843 843	900
I	II	III	IV	V	VIa	VIb	VII

1050

1050	1200	1350	1500	1650	1800	1950
VIII	IX	X	XI	XII	XIII	XIV

2100

2100	2205 2205	2250	2400	2550	2700	2850	3000
XVa	XVb	XVI	XVII - empty	XVIII	XIX	XX	XXI

3150

3150	3300	3450	3600	3750	3900	4050
XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII

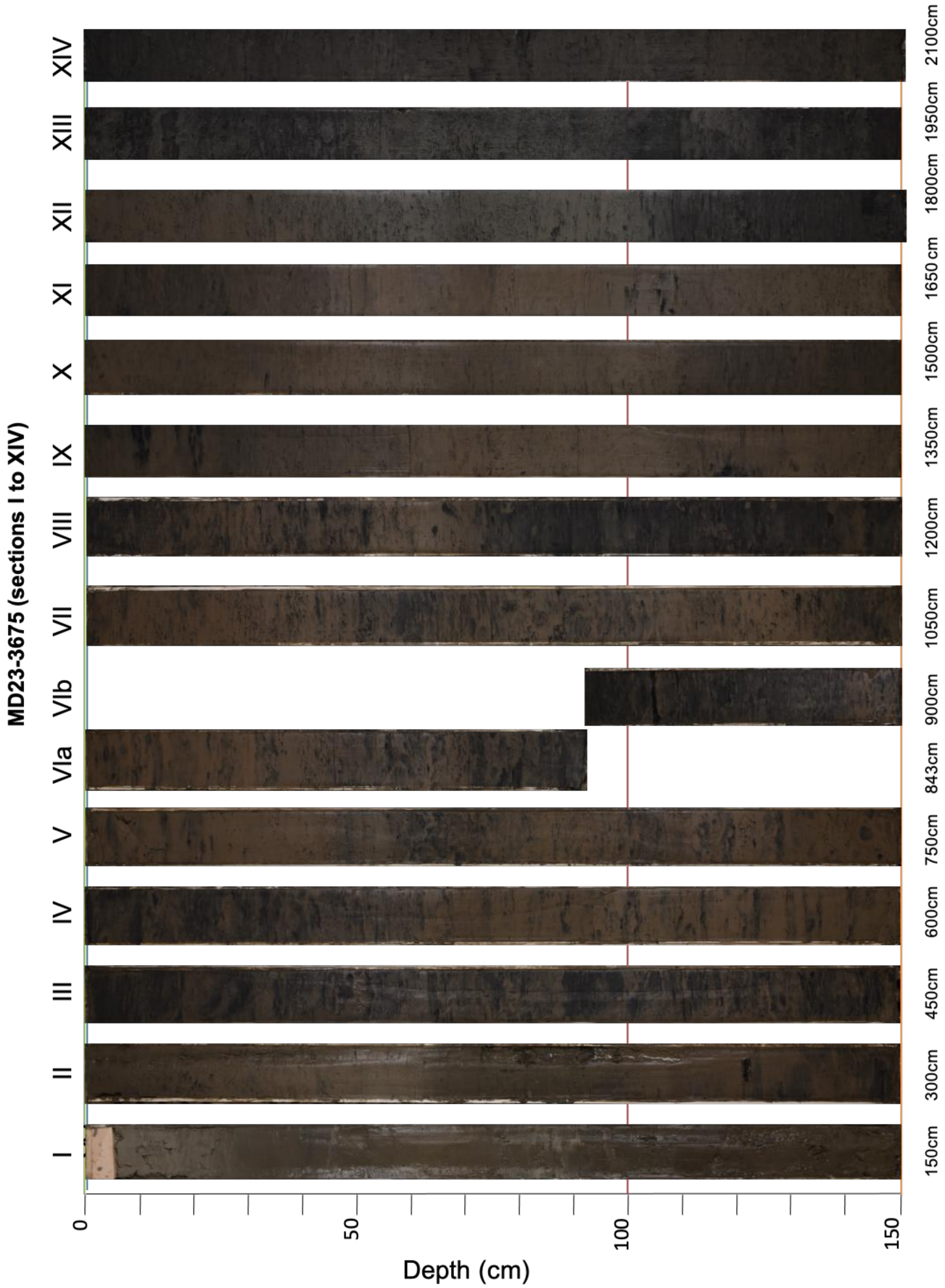
4200

4200	4350	4500	4650	4800	4950	5050 5050
XXIX	XXX	XXXI	XXXII	XXXIII	XXXIV	XXXV

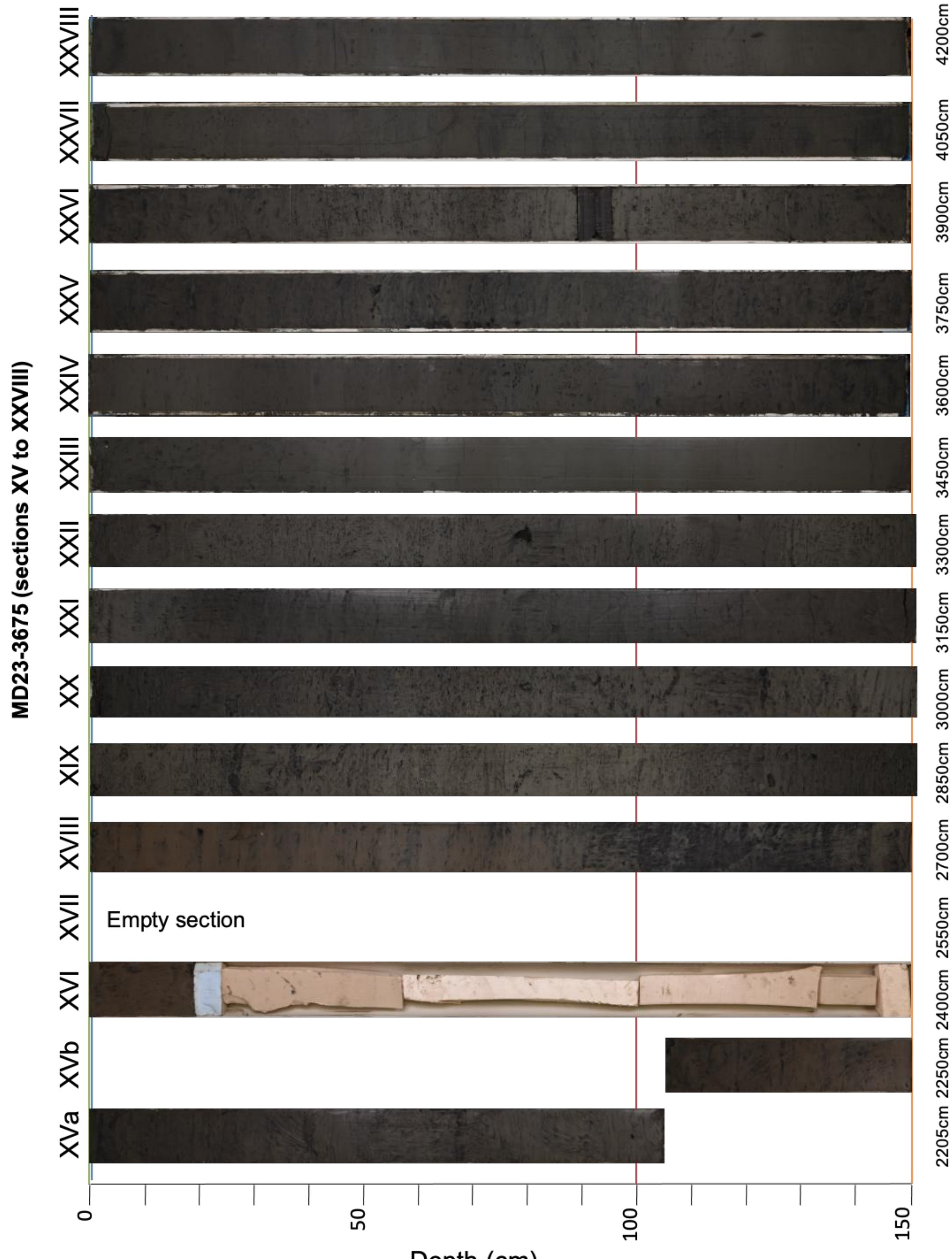
5135

Figure 148: Coring information of Calypso core MD23-3675. Numbers in red indicate depths that differ from the typical Calypso section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3675** -Core length **51.33 m**
Station: S15 -Latitude: **1°54.485 S** -Longitude: **41°35.520 W**
-Water Depth : **2241 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3675** -Core length **51.33 m**
Station: S15 -Latitude: **1°54.485 S** -Longitude: **41°35.520 W**
-Water Depth : **2241 m**



-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3675** -Core length **51.33 m**
Station: S15 -Latitude: **1°54.485 S** -Longitude: **41°35.520 W**
-Water Depth : **2241 m**

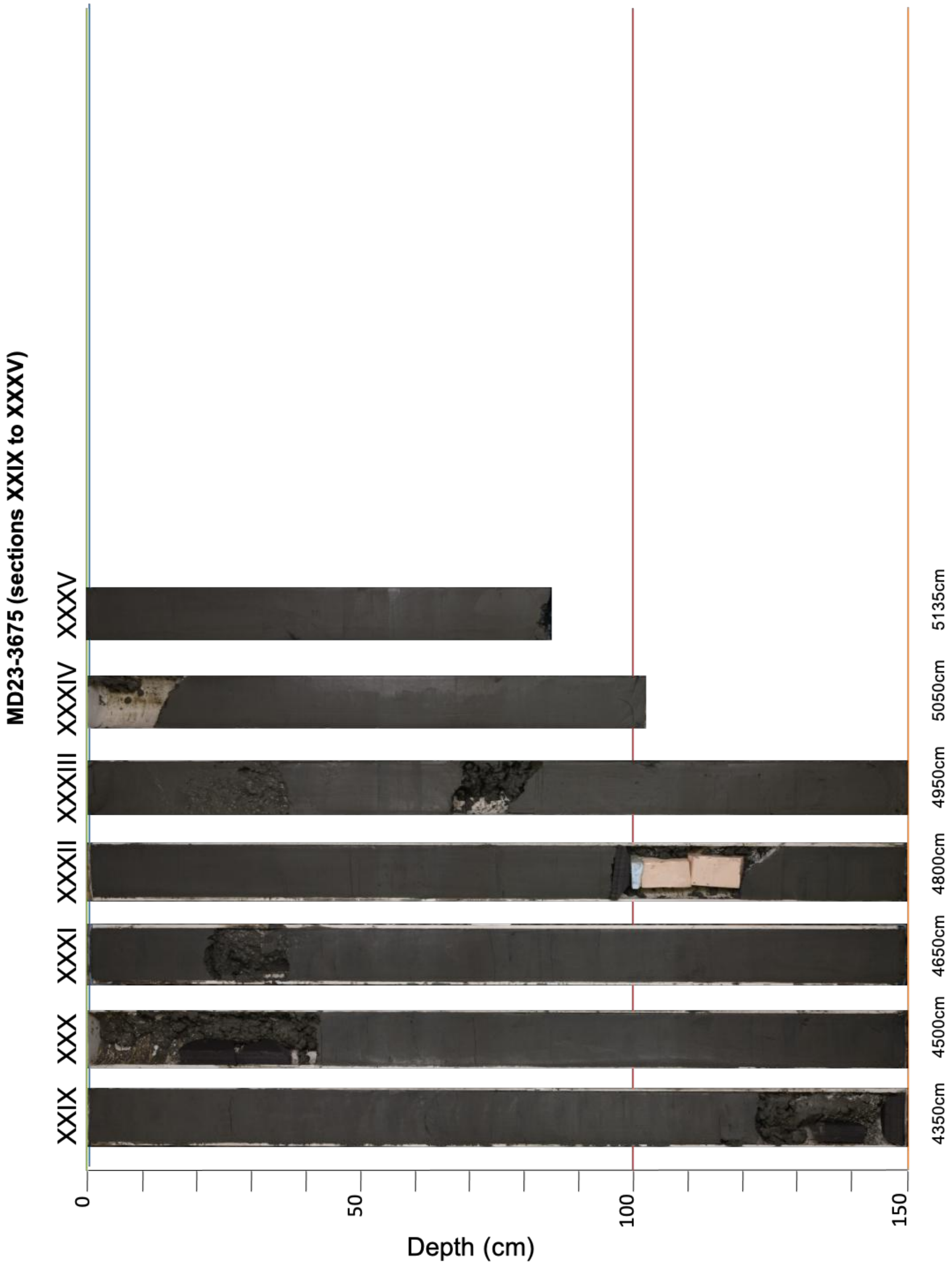
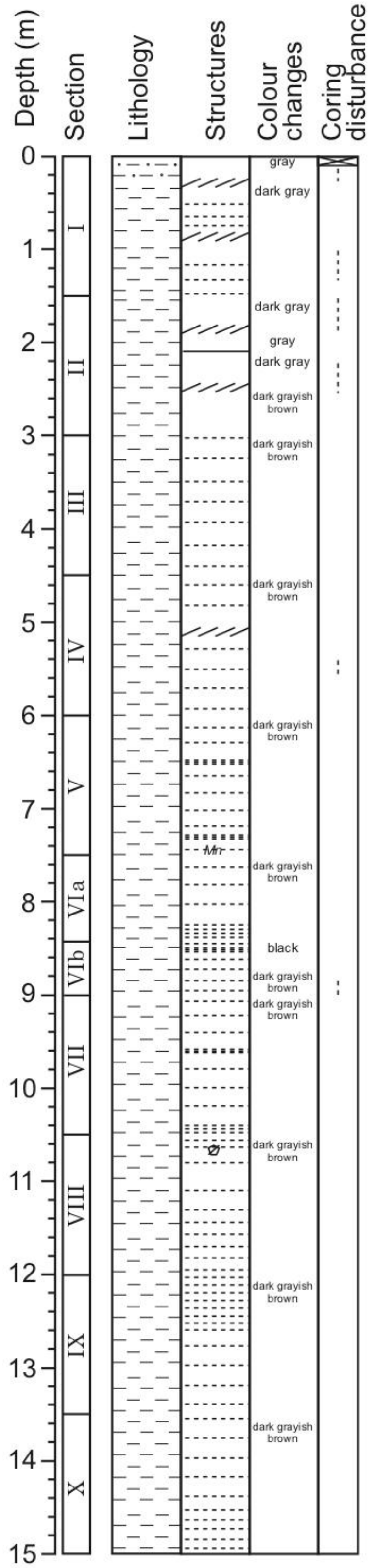


Figure 149: Pictures of Calypso core MD23-3675.

MD241-AMA2-Leg2	**MD23-3675**	Position: 1°54.485 S 41°35.520 W
Station S15	**Sediment description (1/4)**	Water-depth: 2241 m Core length: 51.33 m

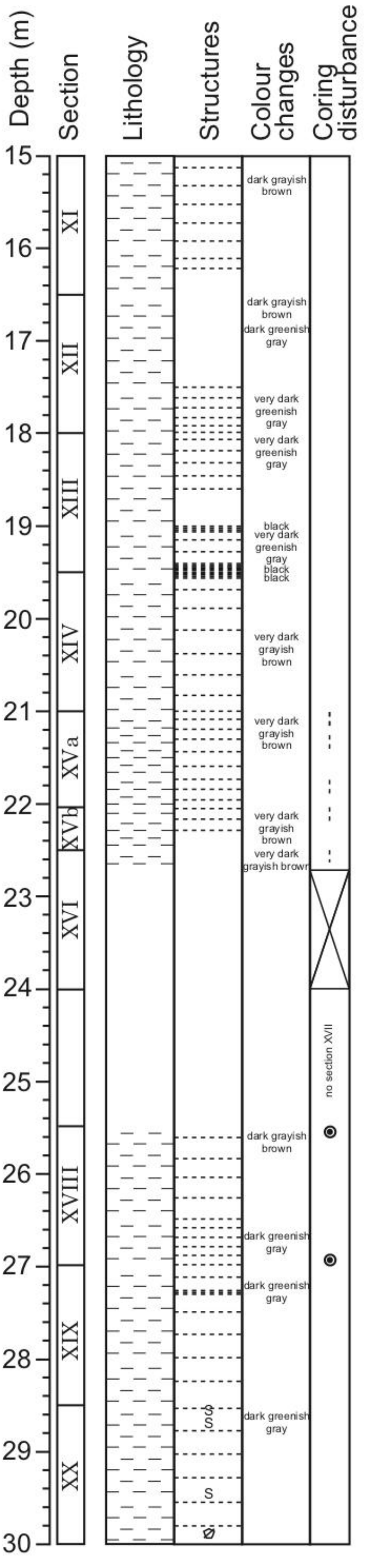


Comments

Homogeneous dark gray or dark grayish brown mud with black marks or dots along the sections

0-5 cm: void

MD241-AMA2-Leg2 *Station S15*	**MD23-3675** **Sediment description (2/4)**	Position: 1°54.485 S 41°35.520 W Water-depth: 2241 m Core length: 51.33 m



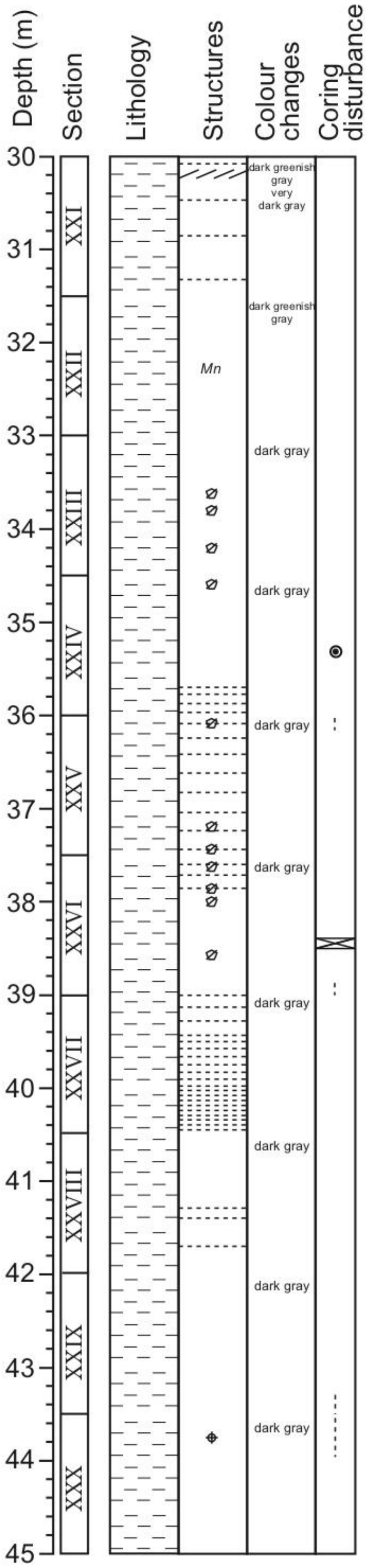
Comments

Homogeneous dark grayish brown or dark greenish gray mud with black marks or dots along the sections

2270-2400 cm: void

There is no section XVII

MD241-AMA-Leg2	**MD23-3675**	Position: 1°54.485 S 41°35.520 W
Station S15	**Sediment description (3/4)**	Water-depth: 2241 m Core length: 51.33 m



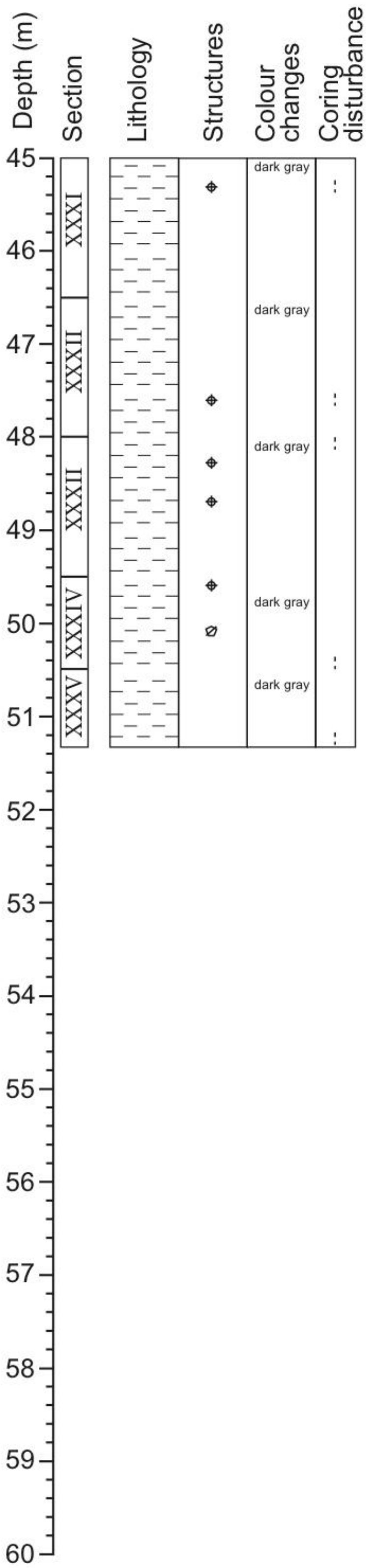
Comments

Homogeneous dark greenish gray or dark gray mud with black marks or dots along the sections

3840-3846 cm: void

Sediment disturbance due to gas release in the last section

MD241-AMA2-Leg2	**MD23-3675**	Position: 1°54.485 S 41°35.520 W
Station S15	**Sediment description (4/4)**	Water-depth: 2241 m Core length: 51.33 m

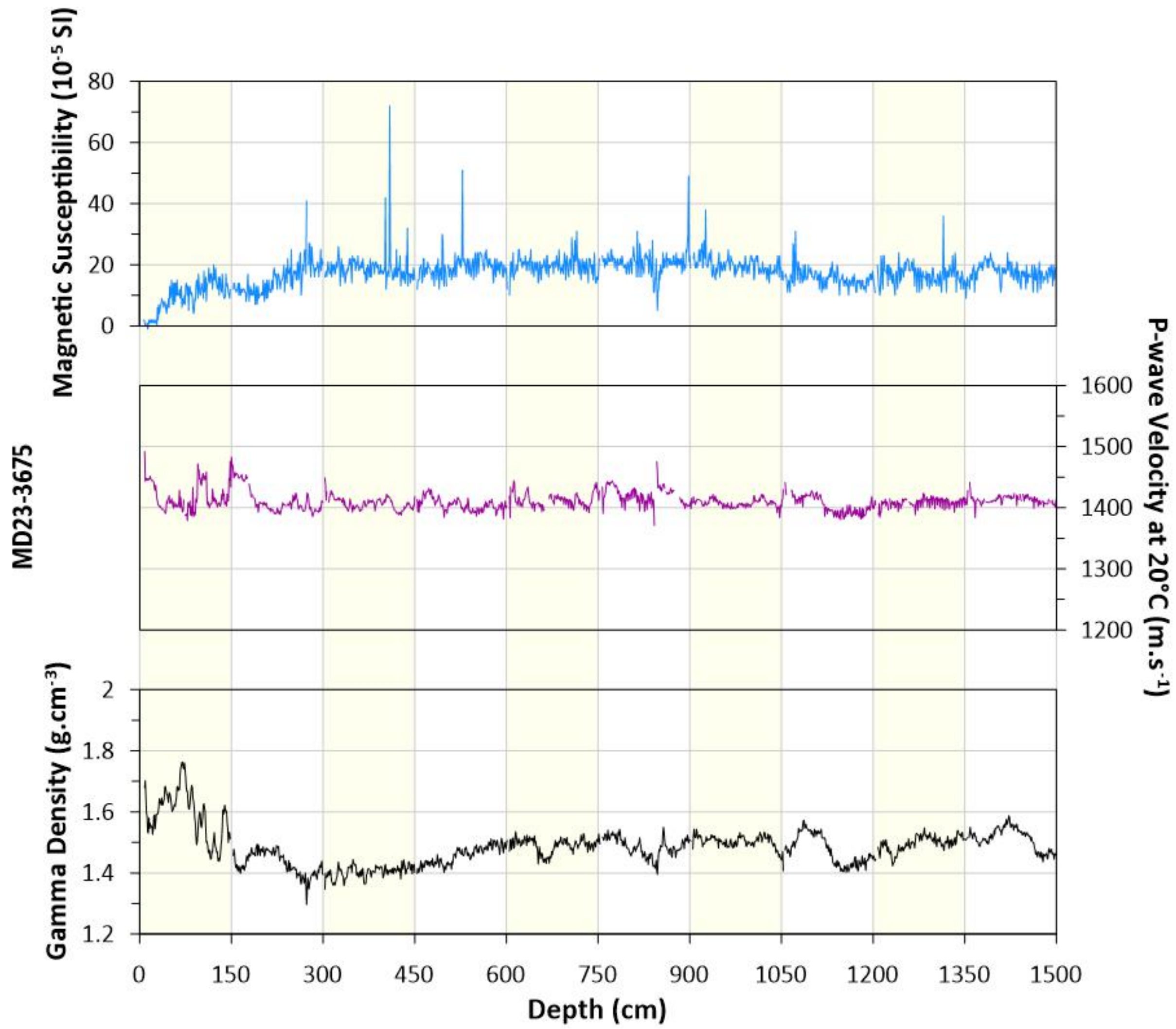


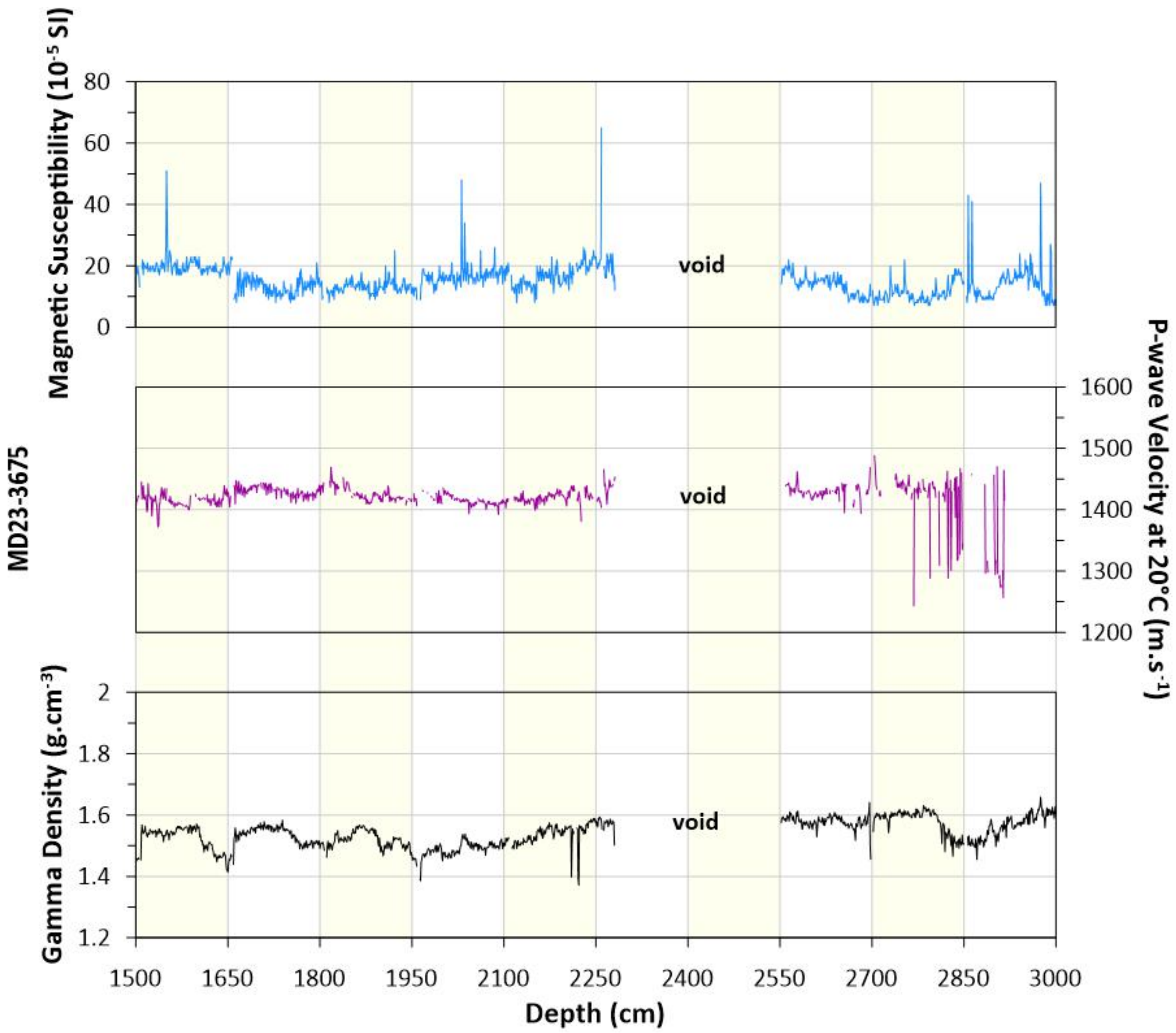
Comments

Homogeneous dark gray mud with black marks or dots along the sections

Sediment disturbance due to gas release in the sections

Figure 150: Sediment description of Calypso core MD23-3675.


Magnetic Susceptibility (10^{-5} SI)
80
60
40
20
0
MD23-3675
P-wave Velocity at 20°C ($m.s^{-1}$)
1600
1500
1400
1300
1200
Gamma Density ($g.cm^{-3}$)
2
1.8
1.6
1.4
1.2
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)



MD23-3675
Magnetic Susceptibility (10-5 SI)
80
60
40
20
0
void
P-wave Velocity at 20°C (m.s-1)
1600
1500
1400
1300
1200
void
Gamma Density (g.cm-3)
2
1.8
1.6
1.4
1.2
void
1500
1650
1800
1950
2100
2250
2400
2550
2700
2850
3000
Depth (cm)

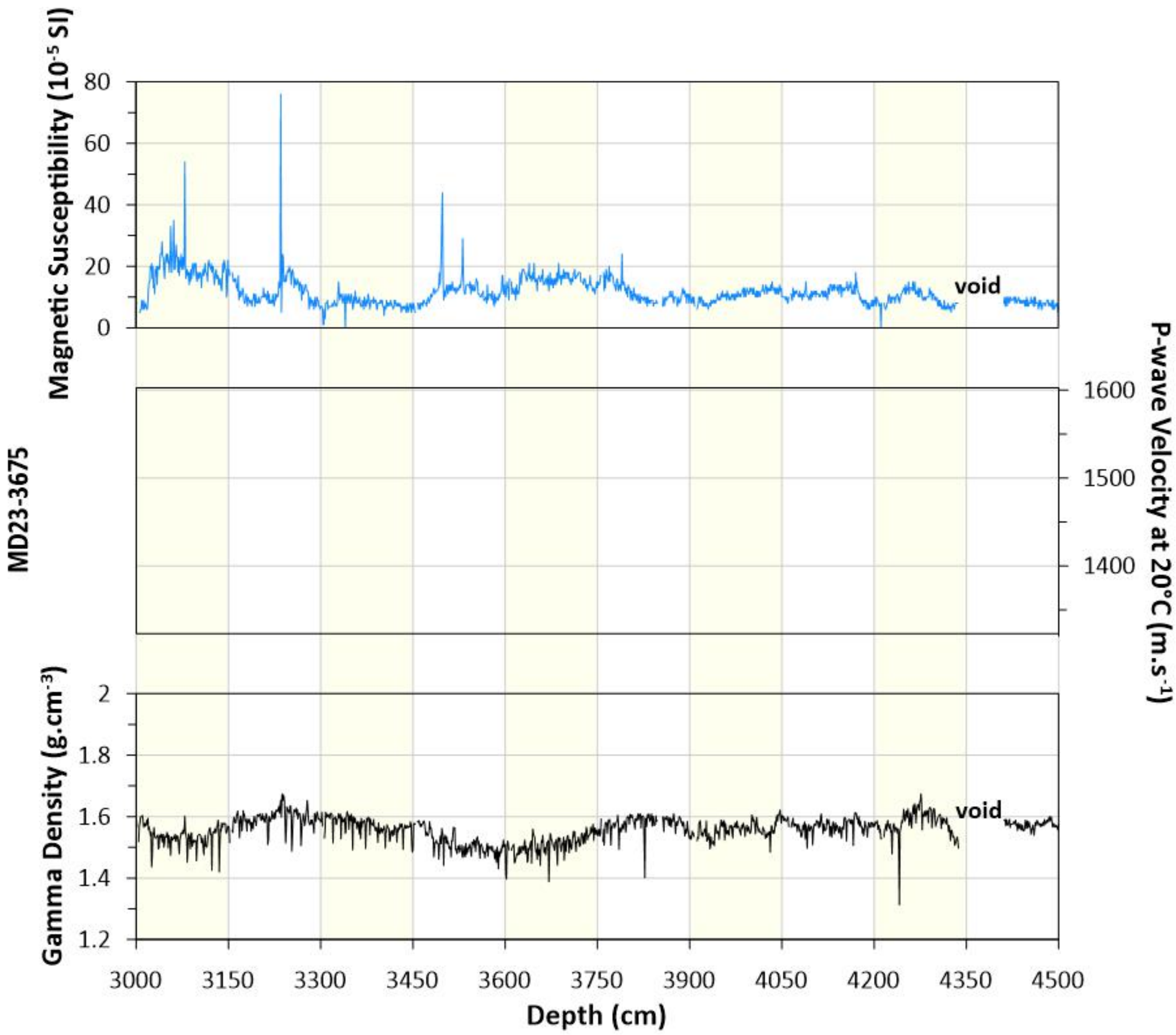
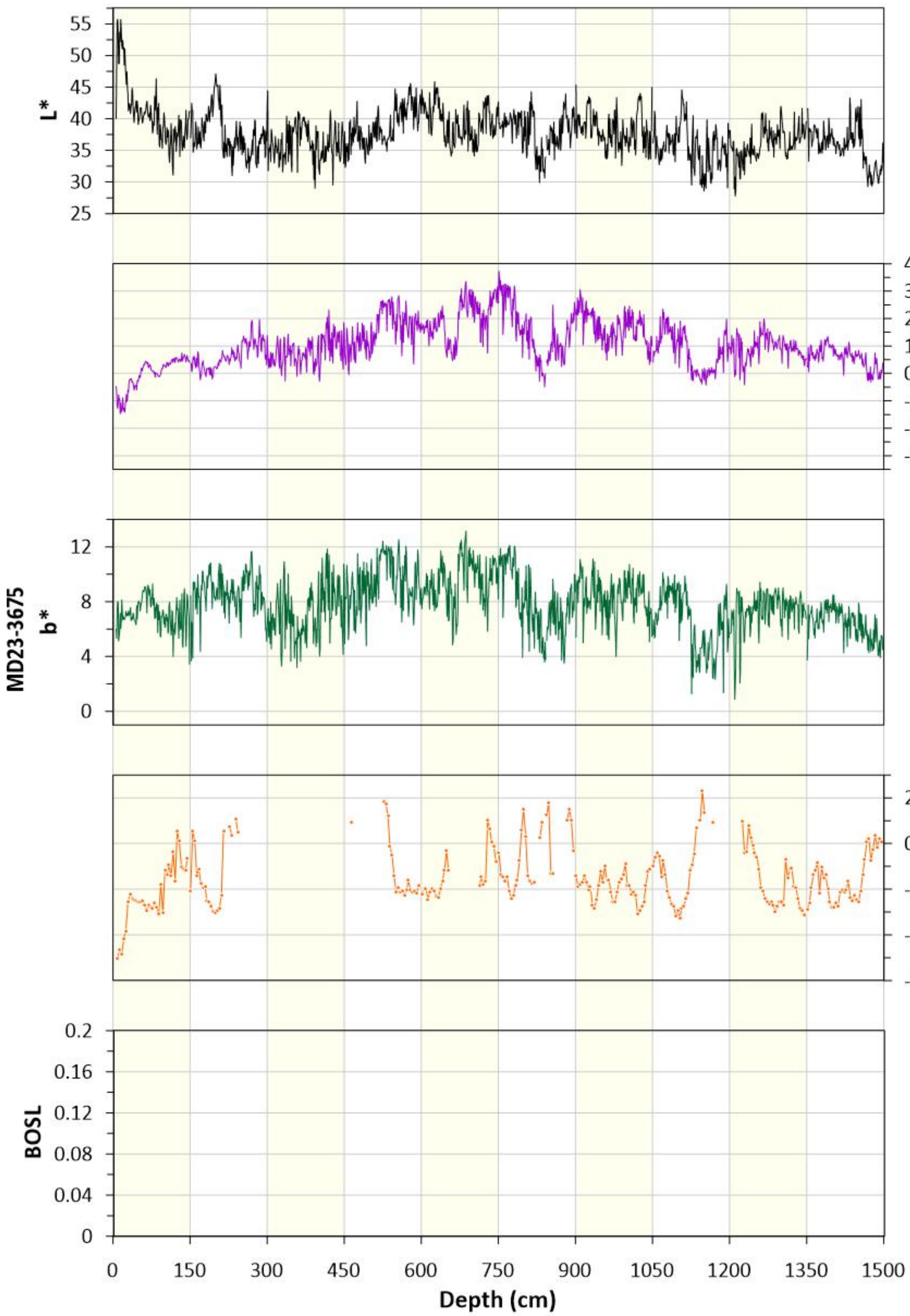
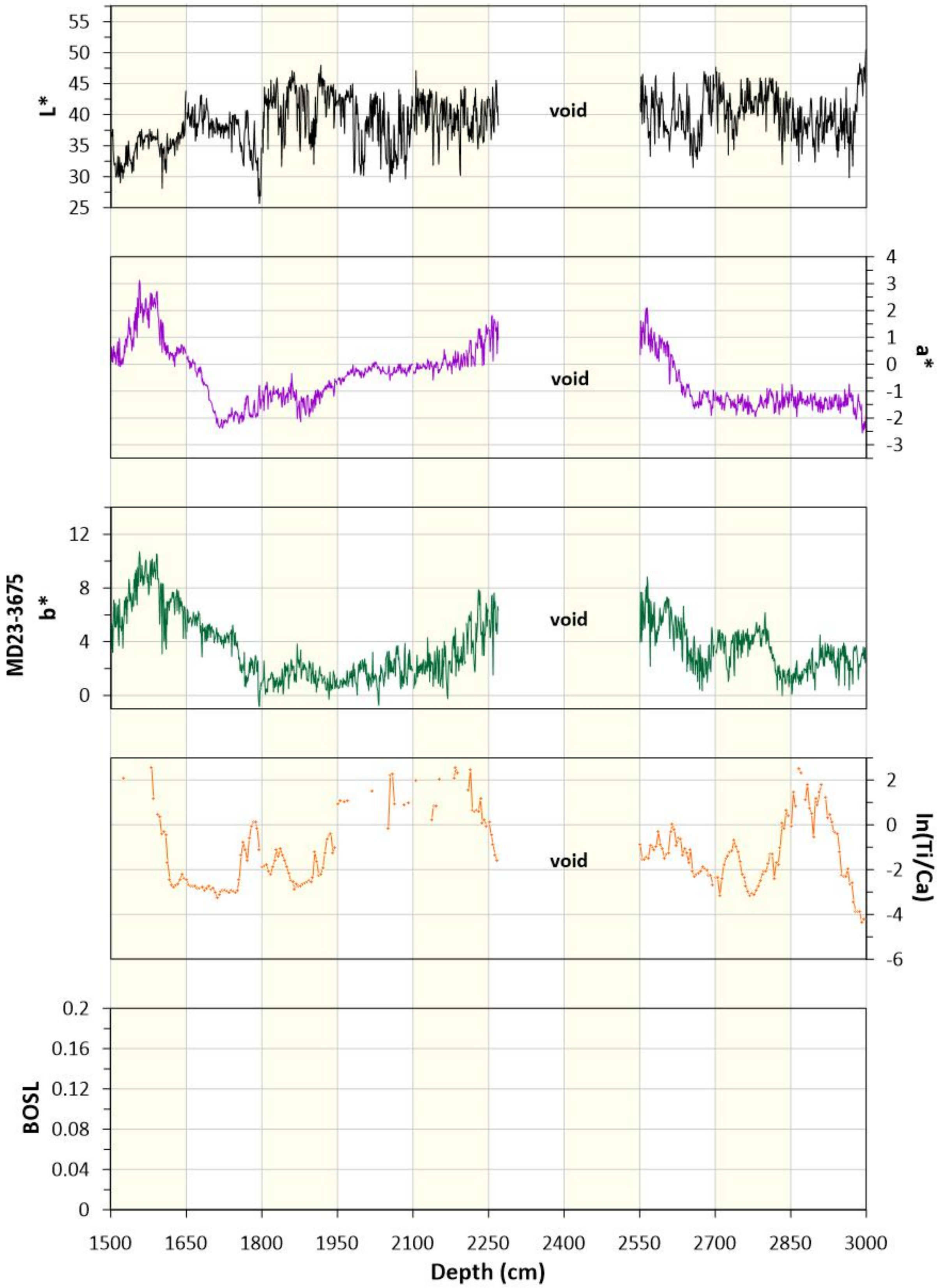
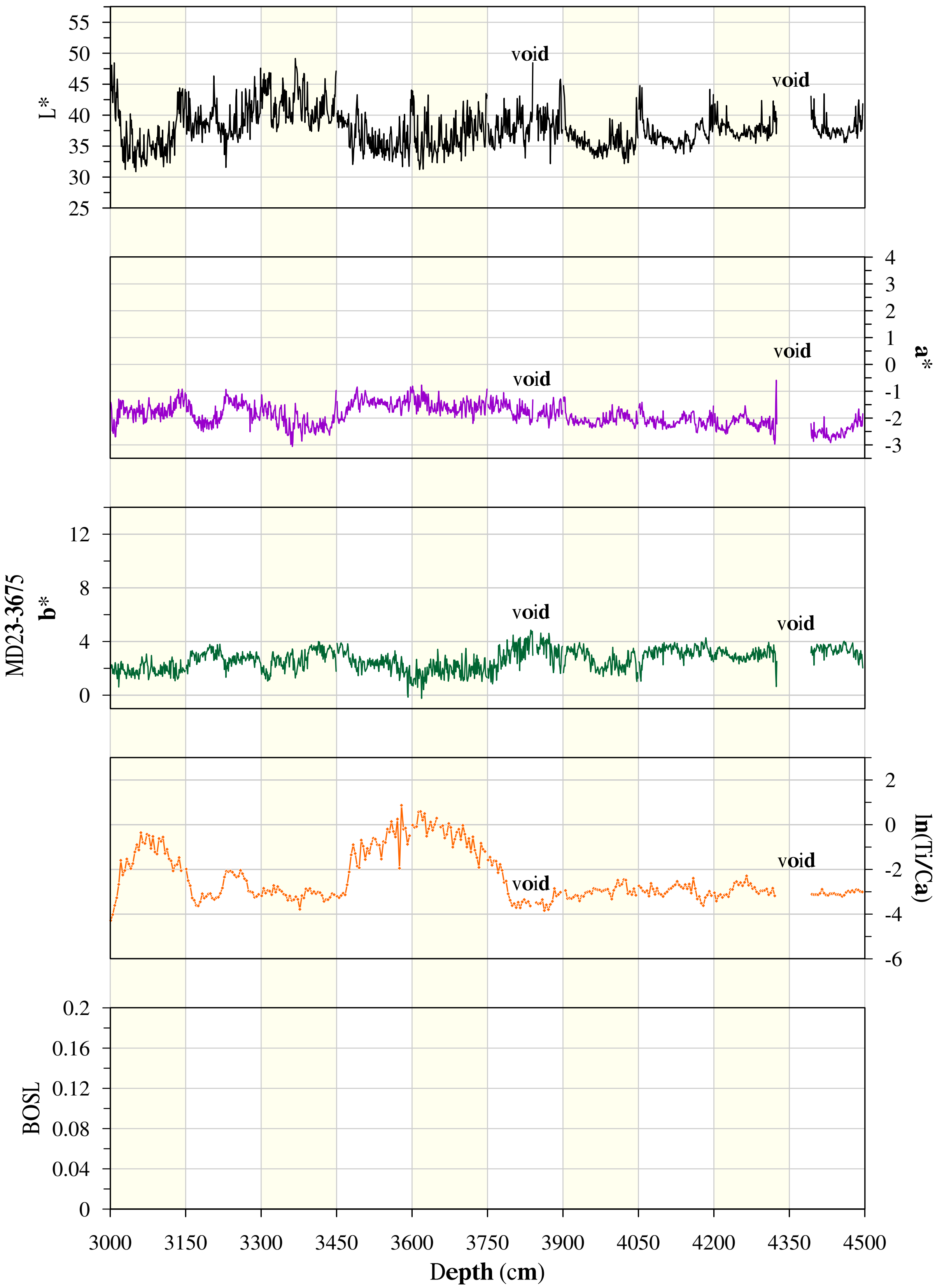


Figure 151: Physical properties of Calypso core MD23-3675. The quality of P-wave velocity measurements is reduced in lower core sections, explaining the absence of plotted data.


L*
55
50
45
40
35
30
25
a*
4
3
2
1
0
-1
-2
-3
MD23-3675
b*
12
8
4
0
ln(Ti/Ca)
2
0
-2
-4
-6
BOSL
0.2
0.16
0.12
0.08
0.04
0
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)


L*
void
a*
void
MD23-3675
b*
void
ln(Ti/Ca)
void
BOSL
Depth (cm)



L*
55
50
45
40
35
30
25
void
void
a*
4
3
2
1
0
-1
-2
-3
void
void
MD23-3675
b*
12
8
4
0
void
void
ln(Ti/Ca)
2
0
-2
-4
-6
void
void
BOSL
0.2
0.16
0.12
0.08
0.04
0
3000
3150
3300
3450
3600
3750
3900
4050
4200
4350
4500
Depth (cm)

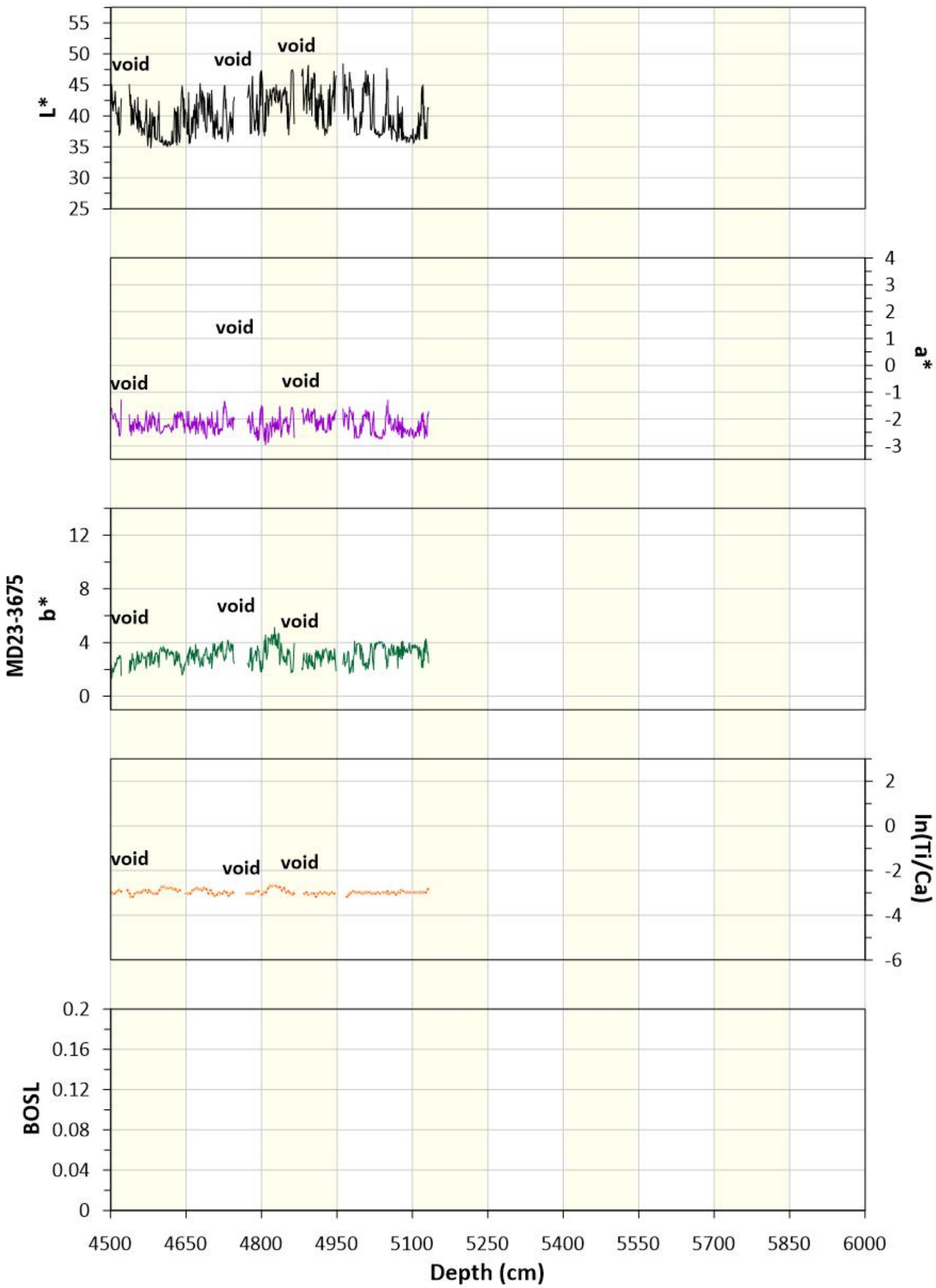


Figure 152: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3675. Low Ca content in this core leads to a discontinuous ln(Ti/Ca) record. BOSL was not analyzed in this Calypso core.*

Because core MD23-3675 has been bent, there is no figure comparing the recovered sediment thickness to the in-situ sediment layers computed by the CINEMA software for this Calypso core. Despite the bent pipe, the sediment of core MD23-3675 seems to show little disturbance.

3.4.10 Station S16

3.4.10.1 Station S16 information

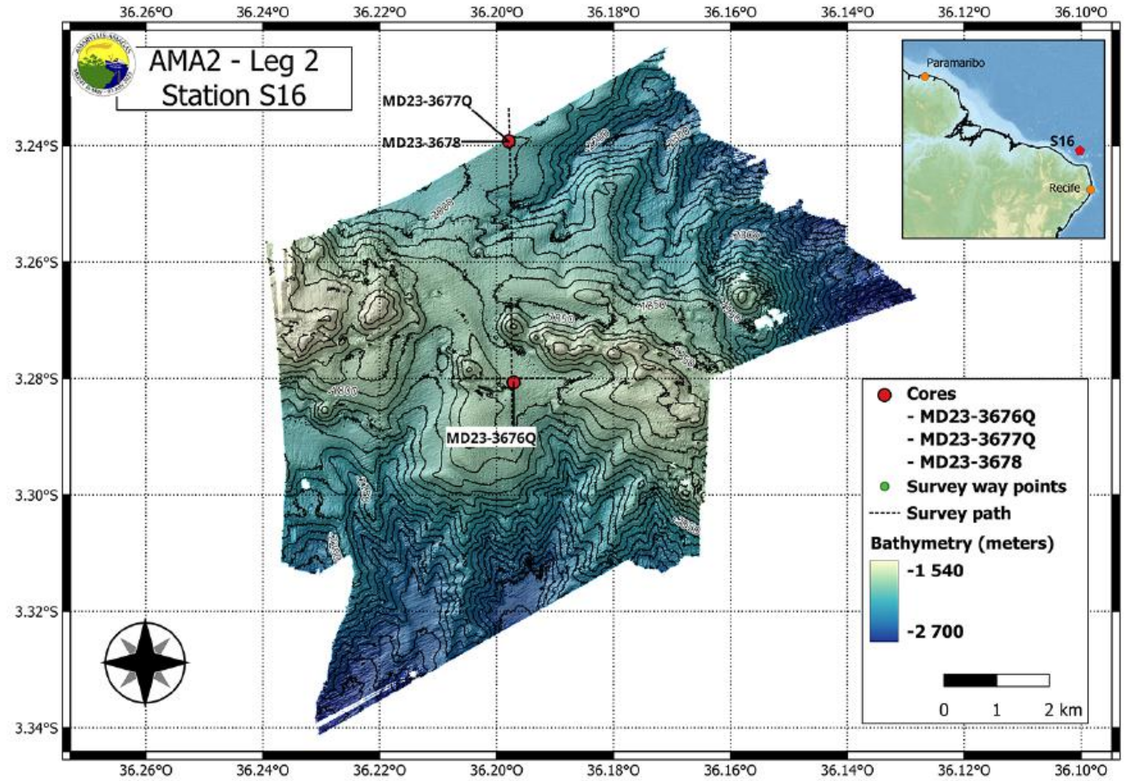
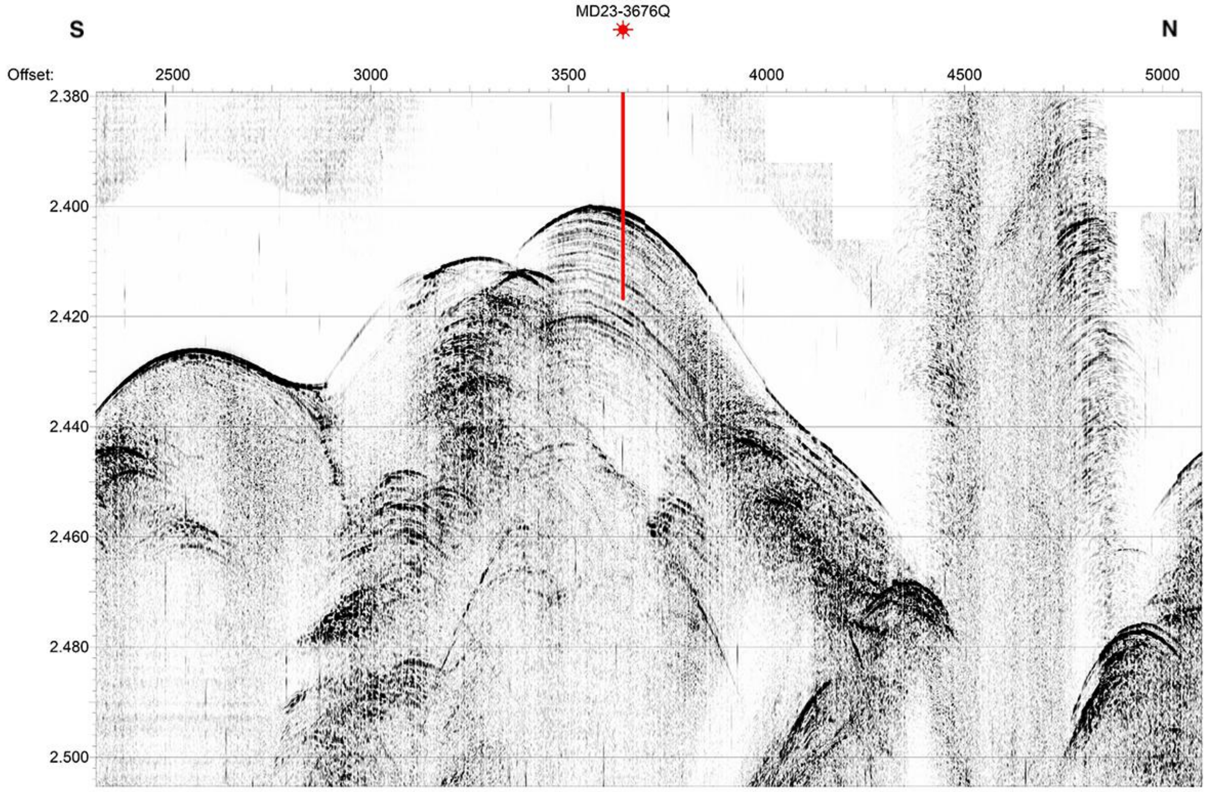


Figure 153: Bathymetric map at station S16.



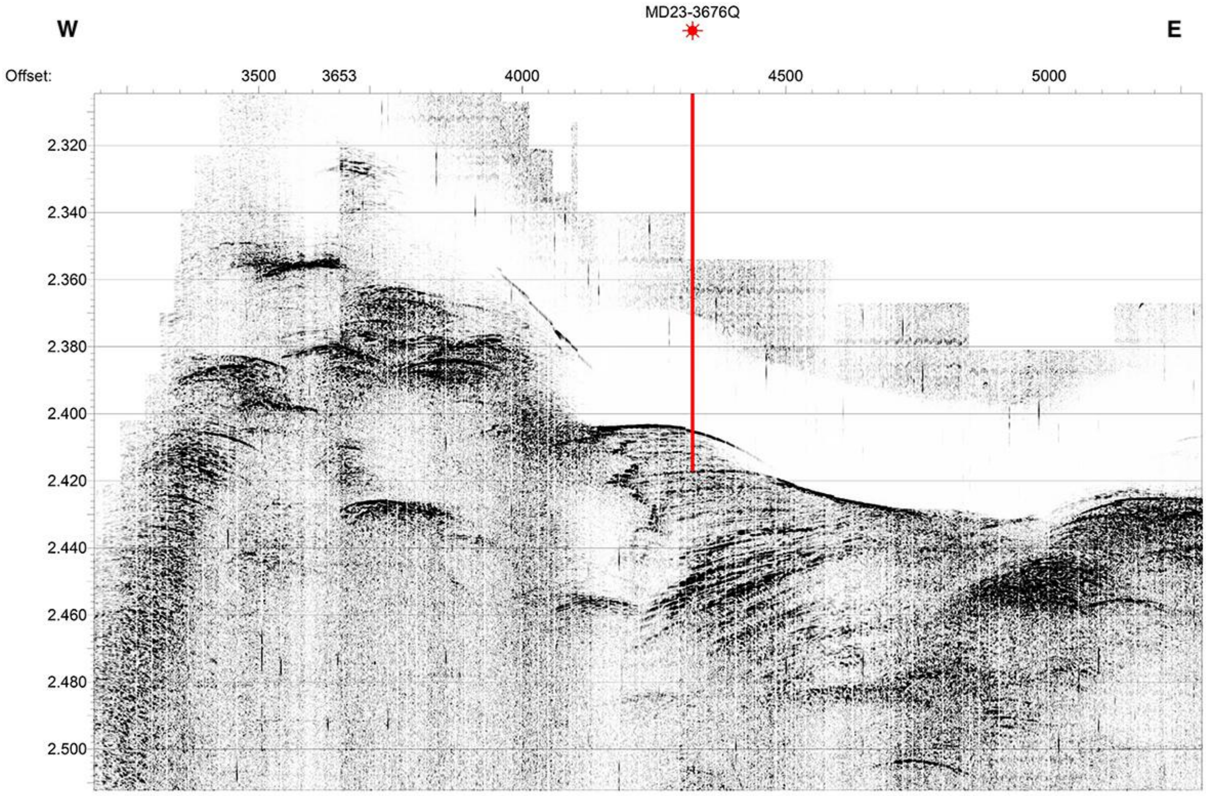


Figure 154: (top) S-N and (bottom) W-E sub-bottom profiles at the location of core MD23-3676Q at station S16. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

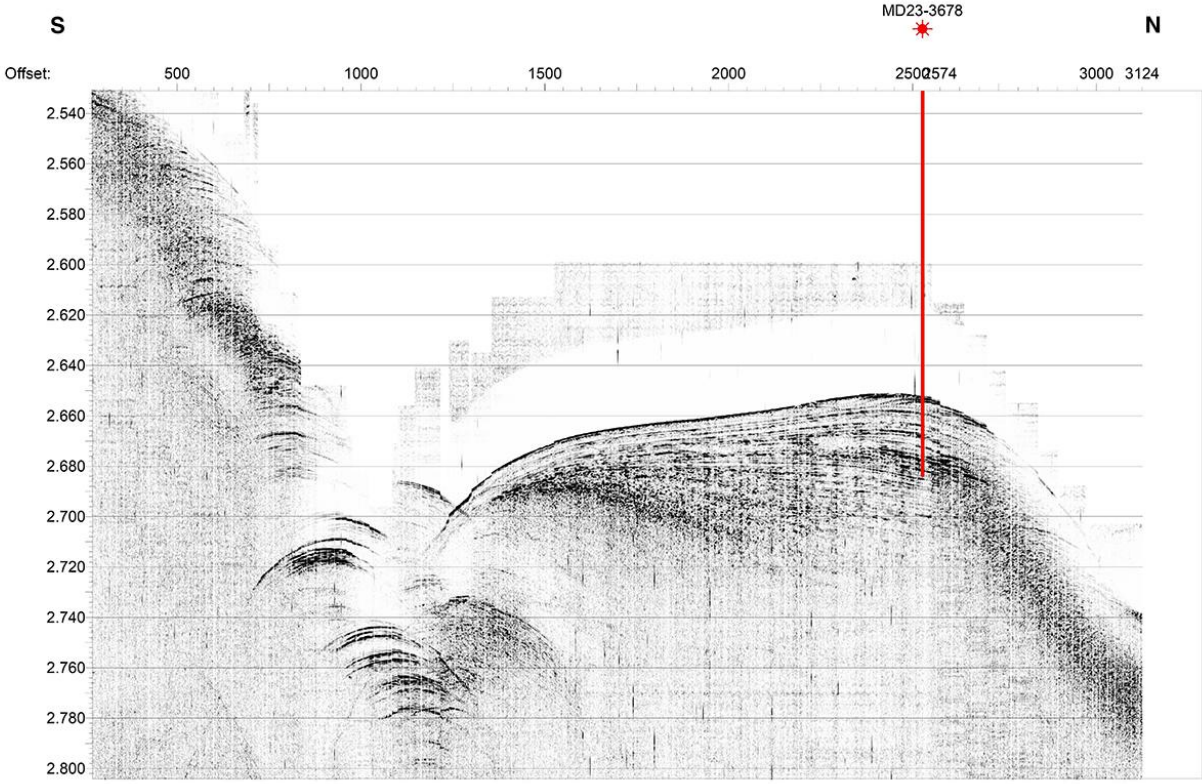


Figure 155: S-N sub-bottom profile at the location of cores MD23-3677Q and MD23-3678 at station S16. Y-axis shows two-way travel time (in s) and X-axis is the distance (in m). The offset of 20 ms between two horizontal lines roughly corresponds to 15 m.

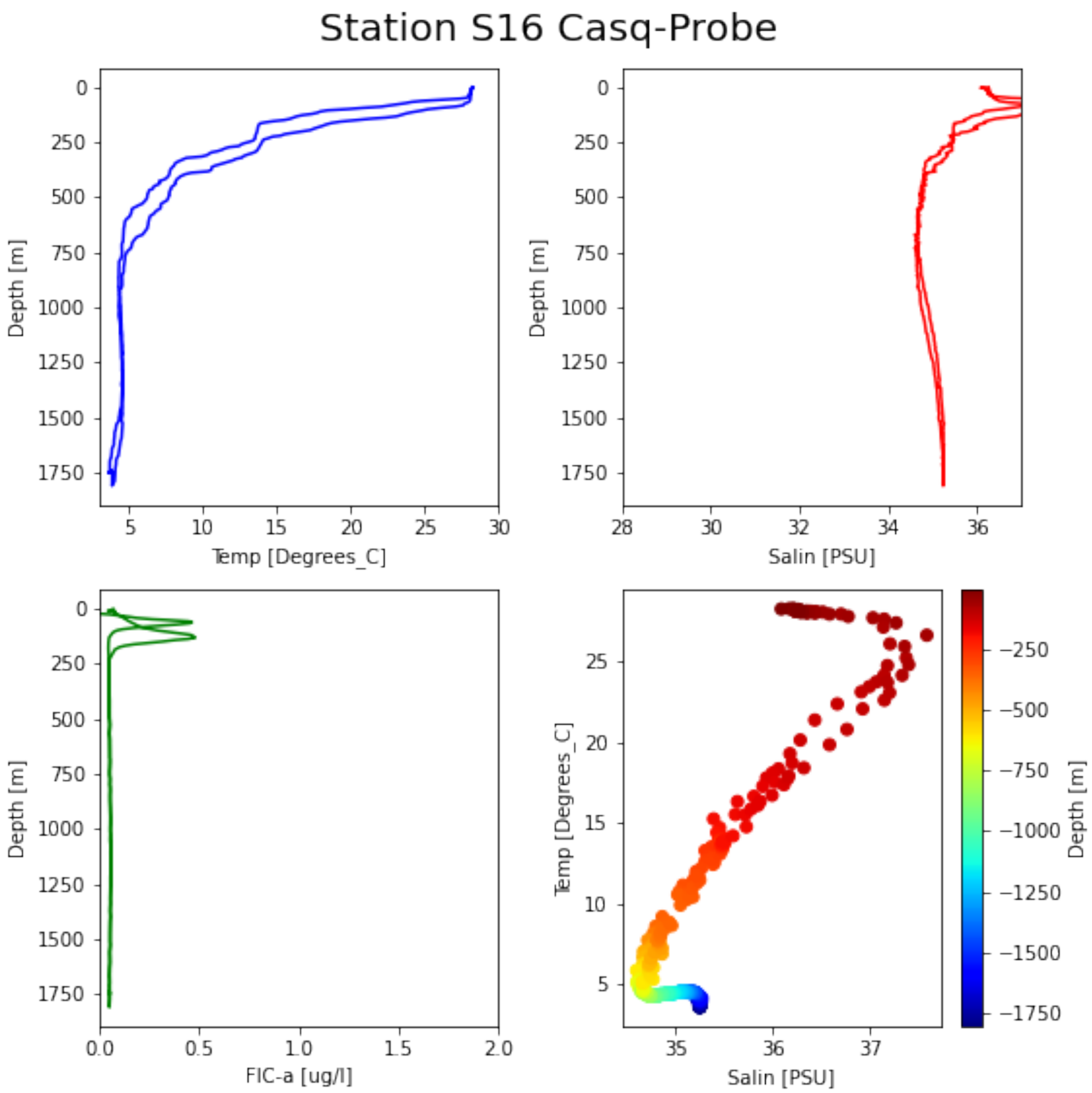


Figure 156: Temperature, salinity and fluorescence vertical profiles, as well as corresponding temperature-salinity diagram, from data obtained by the Casq core-head CTD probe deployed at station S16, at the central location of core MD23-3676Q.

3.4.10.2 Casq core MD23-3676Q

Cruise Name

MD241-AMA2-Leg2

Date : **27/06/2023**

station N° : **S16 (SM6-MD)**

Weather information

Wind speed: **14 knots**
Wind direction: ##### °
Sea : ~1 m

Core (N°) :

MD23-3676Q

Core Length:

8.76 m

Position (posidonia)

Latitude : **03 ° 16.841 S**

Longitude : **36 ° 11.824 W**

Corer (type) : **CASQ**

total weight (air) : t

total weight (water) : **surface** **6.2 t**
extraction **6.8 t**

TUNINGS :

Tubes (length) : **12.00 m**

Résultats CINEMA

Measured Parameters :

multibeam water depth	**1804**	m
released cable length :		m
Extraction/total *(tons)* :	**10.05**	t
extraction/differential *(tons)* :		t

TIME (GMT)

On station :	**14:40 GMT**
Beginning of operation :	**14:40 GMT**
Triggering :	**16:22 GMT**
End of operation :	**17:25 GMT**
Duration of operation :	**2h45**

INSTRUMENTATION
Other OPERATIONS on site

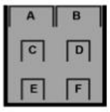
MUC CTD-Rosette

Small CTD **Small Niskin**

Other :

Description : Descriptions, photo, XRF, spectro and MSCL on line C. No u-channel, no G-line taken
Two bags with core catcher sediment
Sampling for Martine Couapel?

Incidents : Complicated sampling because sediment was very sandy (foram sand) and not cohesive.
We made a plate with the top of a d-tube to help recovering the sediment after passing the fishing line, but the first cm of each line may have been mixed/dragged.
Also, this method promoted compaction of the sections, but the high water content made that they recover the 150 cm lenght quickly.
Also, sediment was likely lost between each section.



1st level: two large boxes A and B.

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 878		
A-I	**A-II**	**A-III**	**A-IV**	**A-V**	**A-VI**		

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 850	850 – 878	
B-I	**B-II**	**B-III**	**B-IV**	**B-V**	**B-VI**	**B-VII**	

2nd level: 2 small boxes C and D

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 878	
C-I	**C-II**	**C-III**	**C-IV**	**C-V**	**C-VI**	**C-VII**	

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 878		
D-I	**D-II**	**D-III**	**D-IV**	**D-V**	**D-VI**		

3rd level: 2 small boxes E and F

0 – 150	150 – 300	300 – 450	450 – 600	600 – 750	750 – 878		
E-I	**E-II**	**E-III**	**E-IV**	**E-V**	**E-VI**		

0 – 100	100 – 250	250 – 400	400 – 550	550 – 700	700 – 800	800 – 878	
F-I	**F-II**	**F-III**	**F-IV**	**F-V**	**F-VI**	**F-VII**	

Figure 157: Coring information of Casq core MD23-3676Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3676Q** -Core length : **8.76 m**
Station: S16 -Latitude: 03 °16.841 S -Longitude: 36 °11.824 W
-Water Depth : **1804 m**

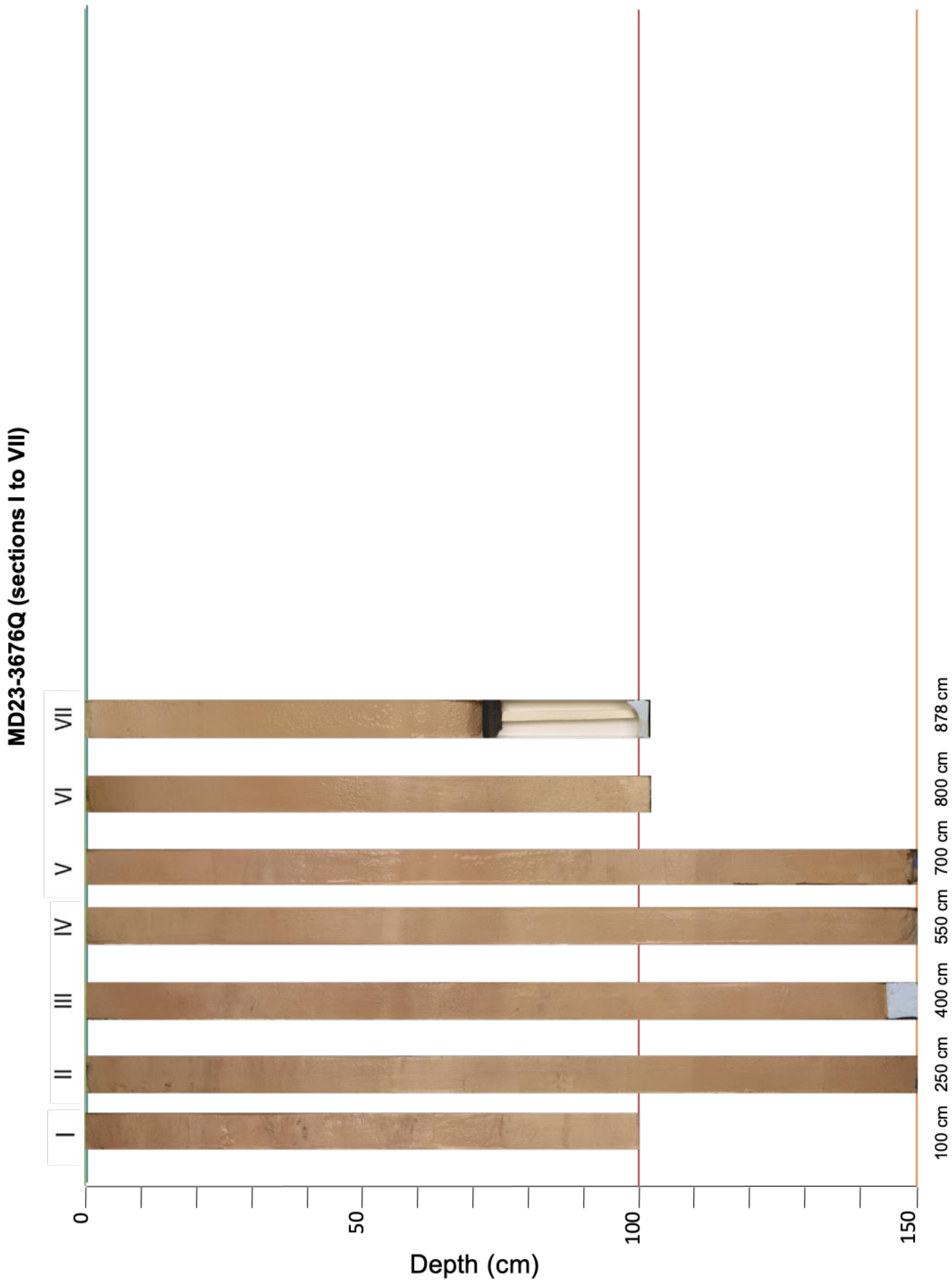


Figure 158: Pictures of Casq core MD23-3676Q.

MD241-AMA2-Leg2	**MD23-3676Q**	Position: 03°16.856'S 36°11.760'W
Station S16 (SM6-MD)	**Sediment description (1/1)**	Water-depth: 1804 m Core length: 8.76 m

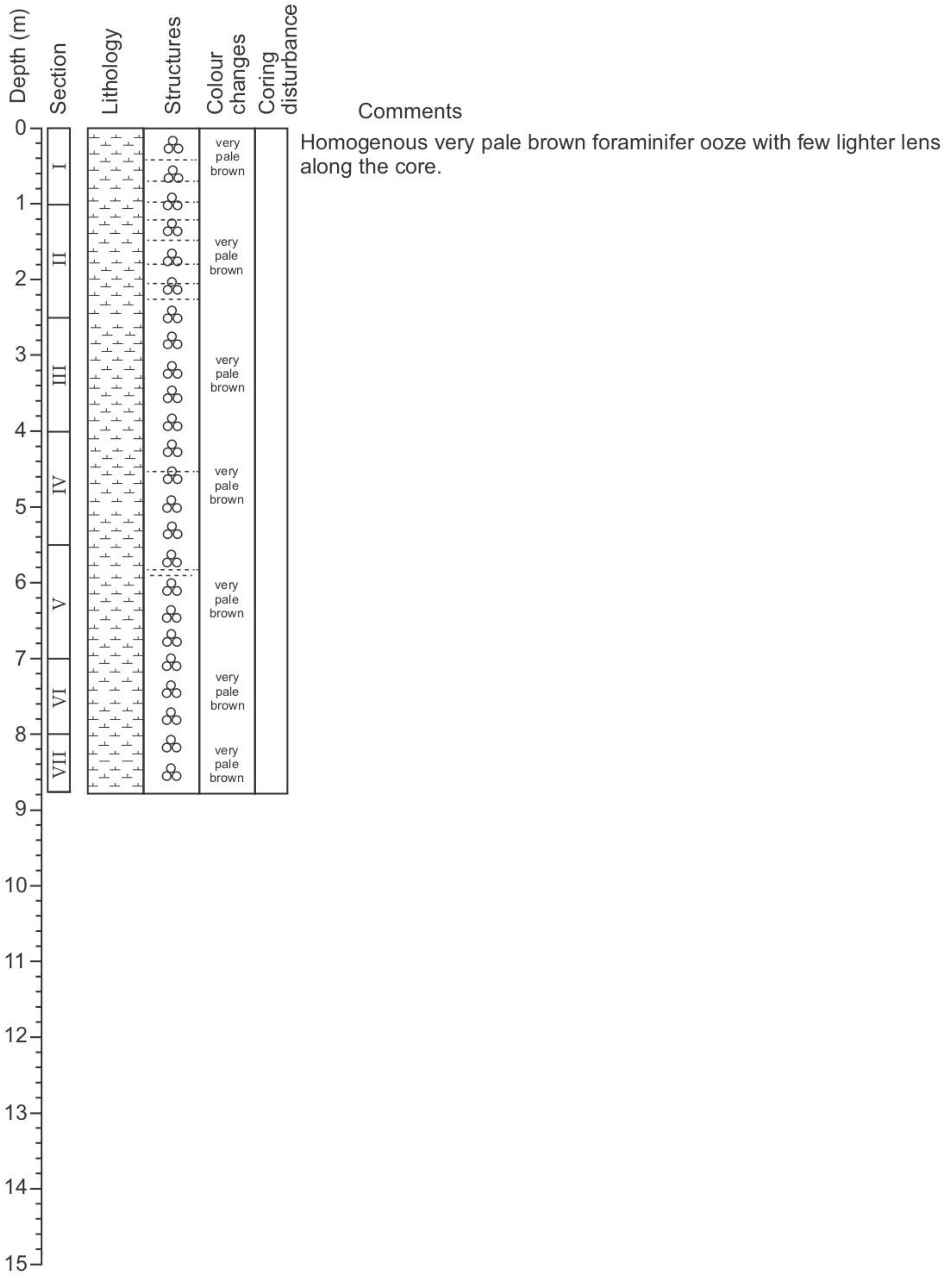


Figure 159: Sediment description of Casq core MD23-3766Q.

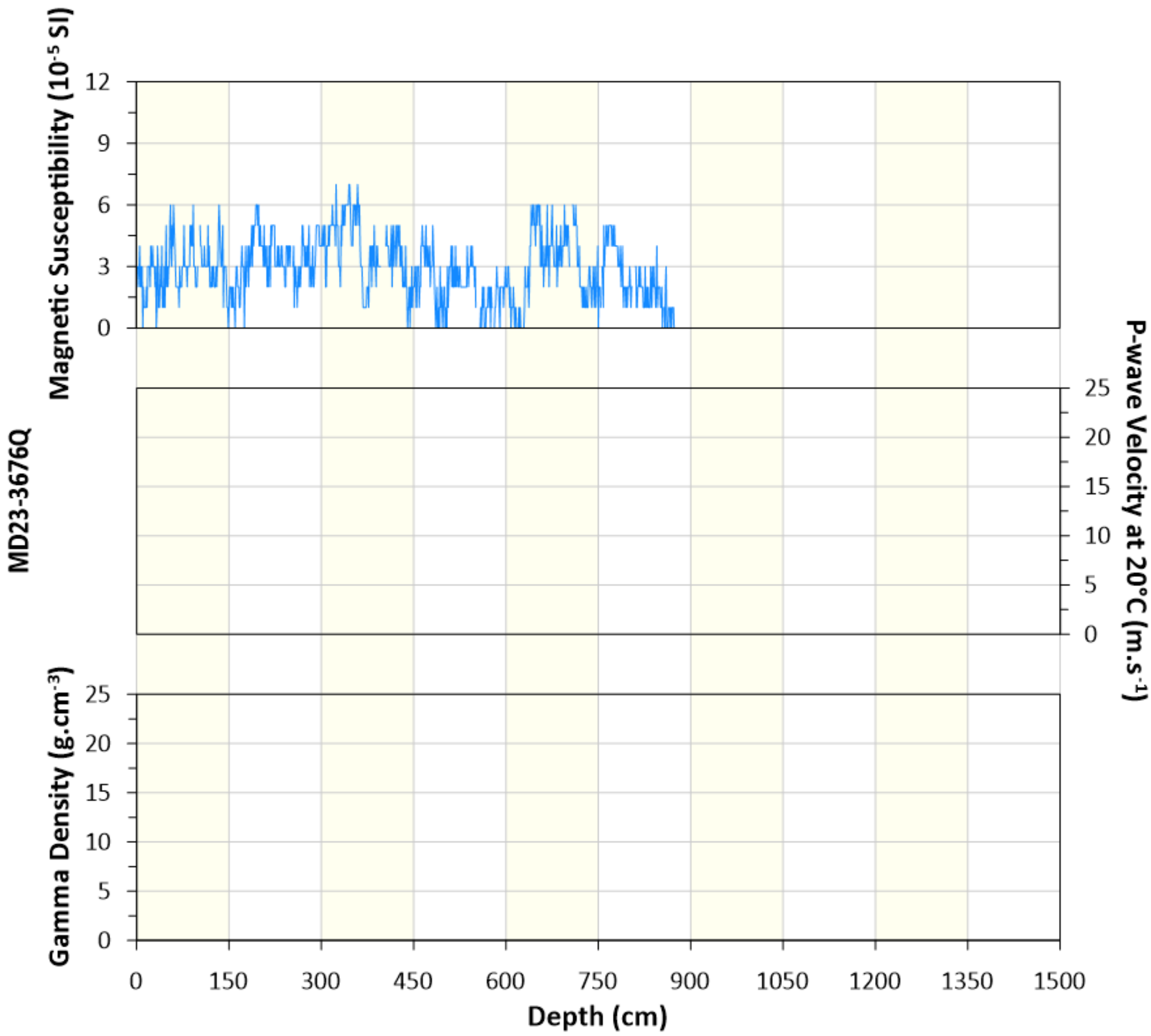


Figure 160: Physical properties of Casq core MD23-3676Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

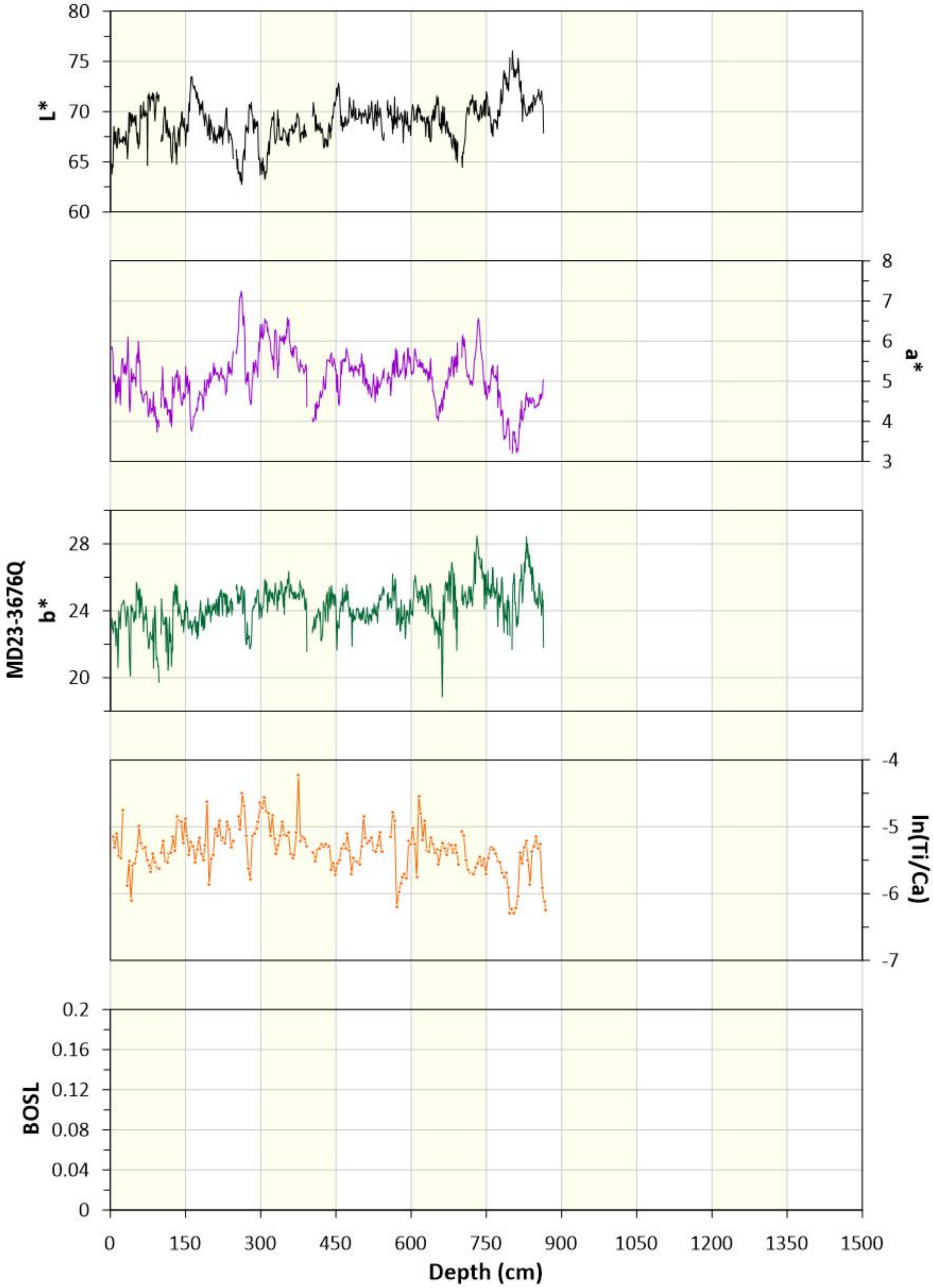


Figure 161: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3676Q. BOSL was not analyzed in Casq cores.*

3.4.10.3 Casq core MD23-3677Q

Cruise Name **MD241-AMA2-Leg2**	Date : 27/06/2023 station N° : S16 (SM6-MD-N)	Weather information Wind speed: 13.8 knots Wind direction: 127 ° Sea : ~1 m
Core (N°) : **MD23-3677Q**	**Core Length:** **11.30 m**	**Position (posidonia)** Latitude : 03 ° 14.355 S Longitude : 36 ° 11.876 W
Corer (type) : CASQ total weight (air) : t total weight (water) : surface 6.2 t extraction 7.0 t	**TUNINGS :** Tubes (length) : 12.00 m	**Résultats CINEMA**
Measured Parameters : **multibeam water depth** 1988 m **released cable length** : m Extraction/total *(tons)* : 10.30 t extraction/differential *(tons)* : t	**TIME (GMT)** On station : 17:46 GMT Beginning of operation : 17:25 GMT **Triggering :** 18:47 GMT End of operation : 20:45 GMT **Duration of operation :** 3h20	**INSTRUMENTATION** **Other OPERATIONS on site** MUC CTD-Rosette Small CTD Small Niskin Other : Calypso

Description : Descriptions, photo, XRF, spectro and MSCL on line C
Two bags with core catcher sediment
Sampling for Martine Coupapel

Incidents : S. VII-A: sediment missing when lifting from the CASQ. ??

1st level: two large boxes A and B.

0 150	*150 300*	*300 450*	*450 600*	*600 750*	*750 900*	*900 1050*	*### 1130*
A-I	**A-II**	**A-III**	**A-IV**	**A-V**	**A-VI**	**A-VII**	**A-VIII**
0 100	*100 250*	*250 400*	*400 550*	*550 700*	*700 850*	*850 1000*	*### 1130*
B-I	**B-II**	**B-III**	**B-IV**	**B-V**	**B-VI**	**B-VII**	**B-VIII**

2nd level: 2 small boxes C and D + 2 u-channels between them

0 150	*150 300*	*300 450*	*450 600*	*600 750*	*750 900*	*900 1050*	*### 1130*
C-I	**C-II**	**C-III**	**C-IV**	**C-V**	**C-VI**	**C-VII**	**C-VIII**
0 100	*100 250*	*250 400*	*400 550*	*550 700*	*700 850*	*850 1000*	*### 1130*
D-I	**D-II**	**D-III**	**D-IV**	**D-V**	**D-VI**	**D-VII**	**D-VIII**
0 150	*150 300*	*300 450*	*450 600*	*600 750*	*750 900*	*900 1050*	*### 1130*
u-channel A-I	**u-channel A-II**	**u-channel A-III**	**u-channel A-IV**	**u-channel A-V**	**u-channel A-VI**	**u-channel A-VII**	**u-ch A-VIII**
0 100	*100 250*	*250 400*	*400 550*	*550 700*	*700 850*	*850 1000*	*### 1130*
u-channel B-I	**u-channel B-II**	**u-channel B-III**	**u-channel B-IV**	**u-channel B-V**	**u-channel B-VI**	**u-channel B-VII**	**u-ch B-VIII**

3rd level: 3 small boxes E, F and G

0 100	*100 250*	*250 400*	*400 550*	*550 700*	*700 850*	*850 1000*	*### 1133*
E-I	**E-II**	**E-III**	**E-IV**	**E-V**	**E-VI**	**E-VII**	**E-VIII**
0 150	*150 300*	*300 450*	*450 600*	*600 750*	*750 900*	*900 1050*	*### 1133*
F-I	**F-II**	**F-III**	**F-IV**	**F-V**	**F-VI**	**F-VII**	**F-VIII**
0 100	*100 250*	*250 400*	*400 550*	*550 700*	*700 850*	*850 1000*	*### 1133*
G-I	**G-II**	**G-III**	**G-IV**	**G-V**	**G-VI**	**G-VII**	**G-VIII**

Figure 162: Coring information of Casq core MD23-3677Q. Numbers in red indicate depths that differ from the typical Casq section limits.

-CRUISE: **AMA2 Leg 2** -Core name: **MD23-3677Q** -Core length **11.30m**
Station: S16 -Latitude: 3°14.355 S -Longitude: 36°11.876 W
-Water Depth : 1988**m**

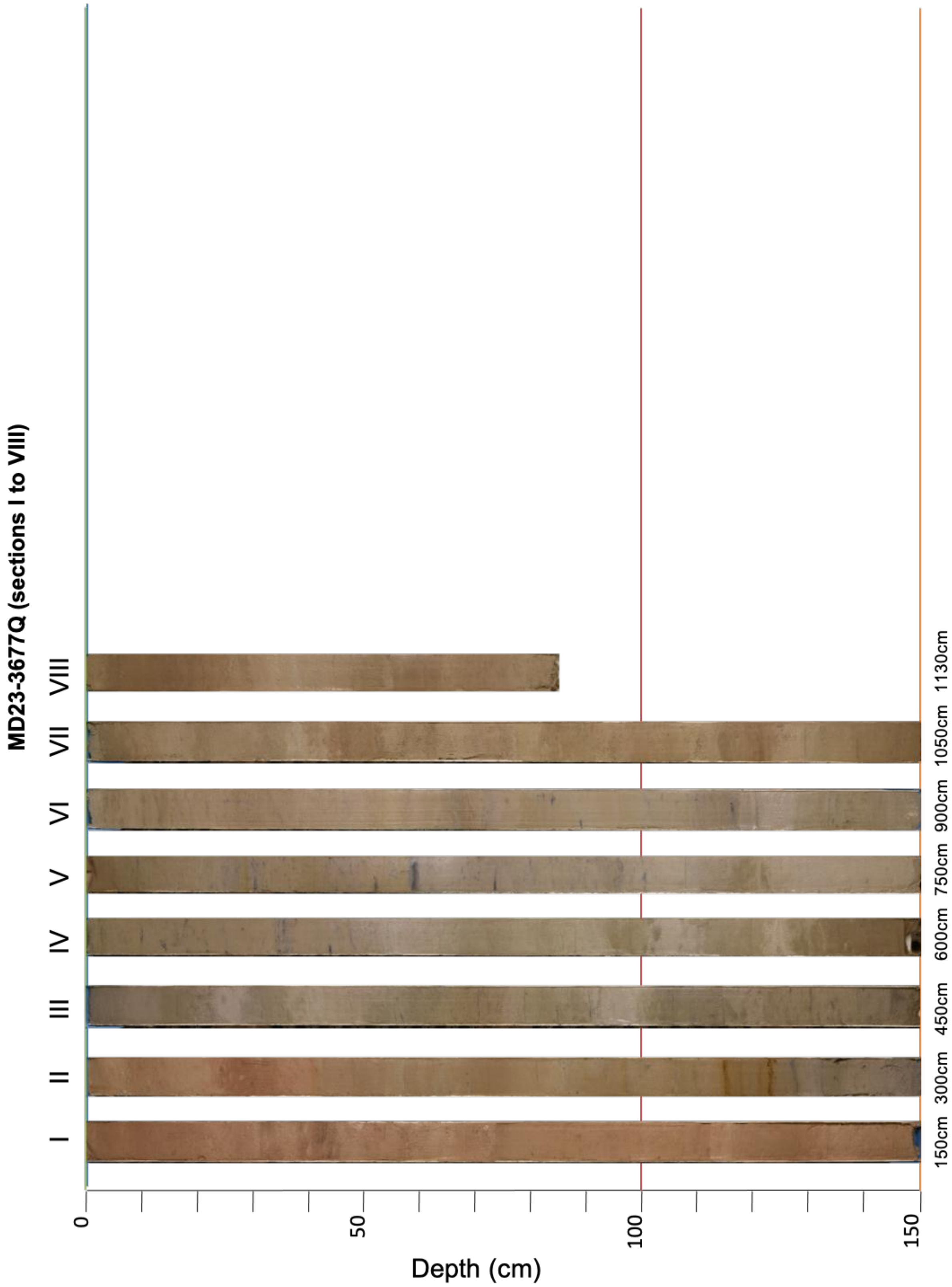
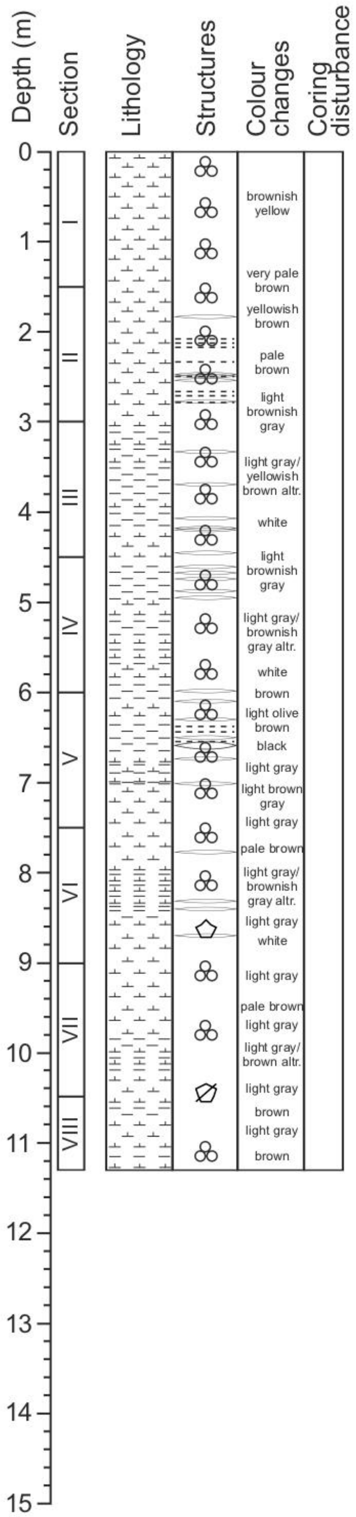


Figure 163: Pictures of Casq core MD23-3677Q.

MD241-AMA2-Leg2	MD23-3677Q	Position: 3°14.355'S 36°11.876'W
Station S16	Sediment description (1/1)	Water-depth: 1998 m Core length: 11.30 m



Comments

Grayish/brown carbonate foraminiferal general aspect with many alternances between white/light gray carbonate foraminiferal ooze and light brownish/brown « muddy foraminiferal » areas with some colored or darker isolated laminea all along the core

RQ :
- Rare or no foraminifera in muddy areas
- altr. = color alternance beteween ooze and muddy areas

Contents :
- Lot of foraminifera (= ooze)
- Rare shell and shell fragments
- Some darker marks, dots or laminea
- Some colored isolated laminea
  - [200-240 cm] x4 light brownish gray laminea
  - [240-280 cm] x4 yellowish brown laminea
  - [630-660 cm] x3 olive yellow laminea

Contacts :
- Gradational contacts between ooze and muddy areas and between change of color

End of the core : 1330 cm

Figure 164: Sediment description of Casq core MD23-3677Q.

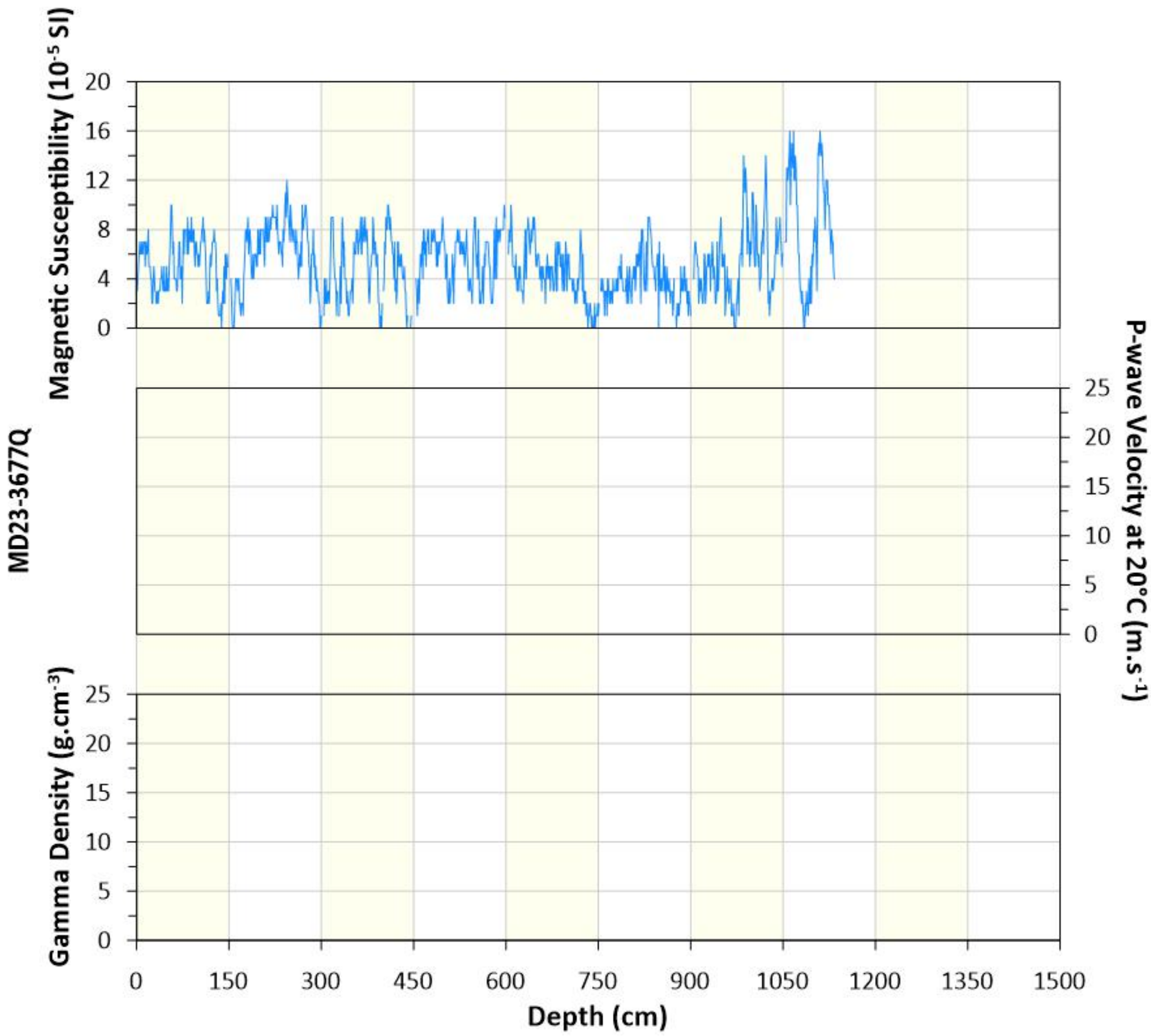


Figure 165: Physical properties of Casq core MD23-3677Q. P-wave velocity and gamma density cannot be estimated in Casq sections.

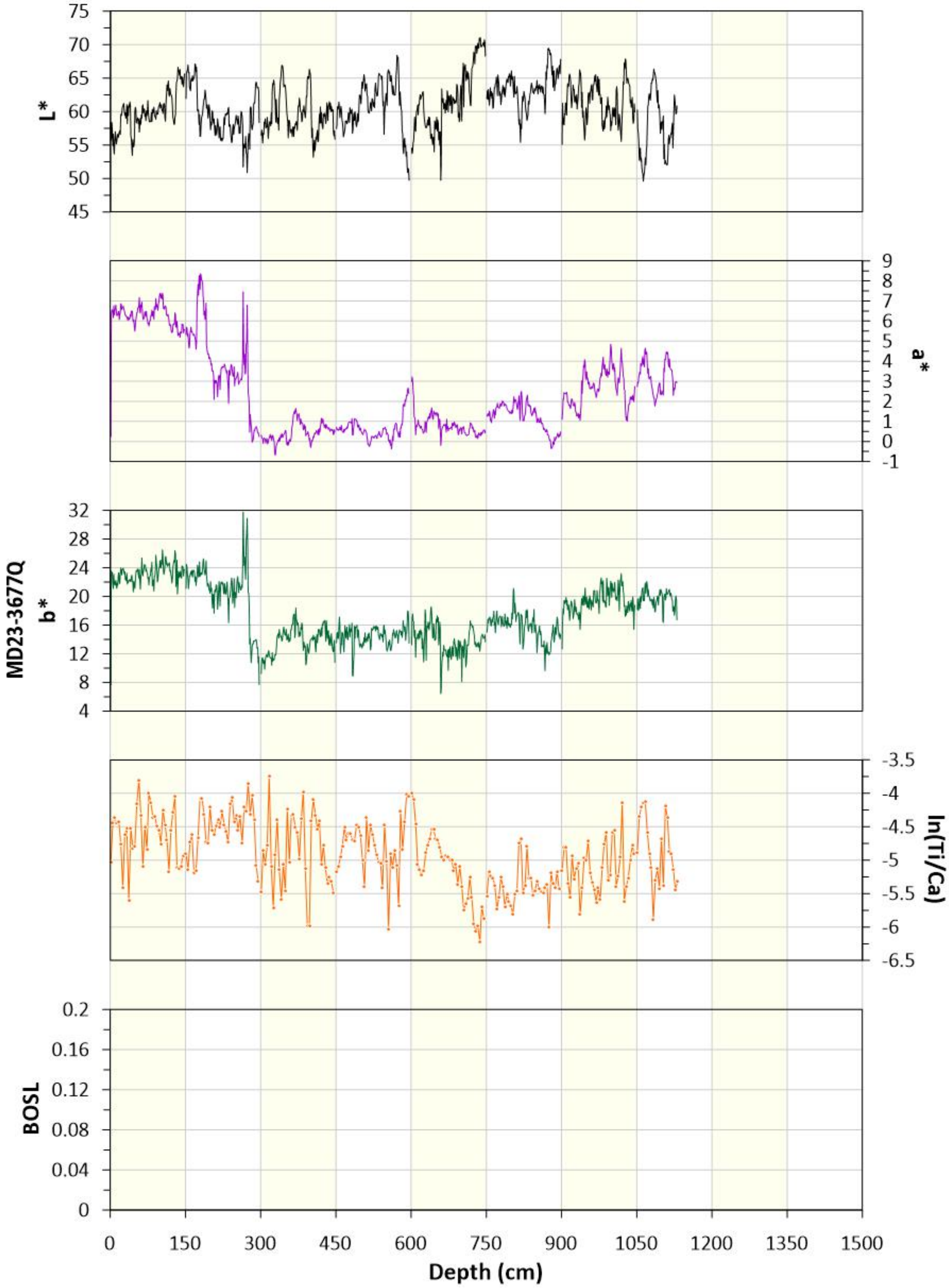


Figure 166: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Casq core MD23-3677Q. BOSL was not analyzed in Casq cores.*

3.4.10.4 Calypso core MD23-3678

Cruise Name
MD241-AMA2-Leg2

Date : **27/06/2023**
station N° : **S16 (SM6MD-N)**

Weather information
Wind speed: **16,7 knots**
Wind direction: 151,00 °
Sea : ~1 m

Core (N°) :
MD23-3678

Core Length:
23,7 m

Position (posidonia)
Latitude : **03 ° 14,356 S**
Longitude : **36 ° 11,874 W**

Corer (type) : Calypso
total weight (air) : t
total weight (water) : surface 6,3 t
bottom 7,1 t

TUNINGS :
Tubes (length) : 24,78 m
Cables :
Free fall : 2,00 m
theoritical elastic rebound 4,79 m
loop length 6,20 m
counterweight cable length m (3m50 lost)

Résultats CINEMA
thickness sediment sampled m
thickness sediment cored m

Measured Parameters :
multibeam water depth 1 988 m
released cable length : m
Extraction/total *(tons)* : 10,30 t

TIME (GMT)
On station : 17:46 GMT
Beginning of operation : 22:00 GMT
Triggering : 23:47 GMT
End of operation : GMT
Duration of operation :

INSTRUMENTATION
Other OPERATIONS on site
MUC CTD-Rosette
Small CTD Small Niskin
Other : CASQ

Description : Three syringes of core catcher in a bag.

Incidents :

0	150	300	450	600	750	900 – 1050
I	II	III	IV	V	VI	VII

1050	1200	1350	1500	1650	1800	1950 – 2100
VIII	IX	X	XI	XII	XIII	XIV

2100	2250	2372				
XV	XVI					

Figure 167: Coring information of Calypso core MD23-3678; Numbers in red indicate depths that differ from the typical Calypso section limits.

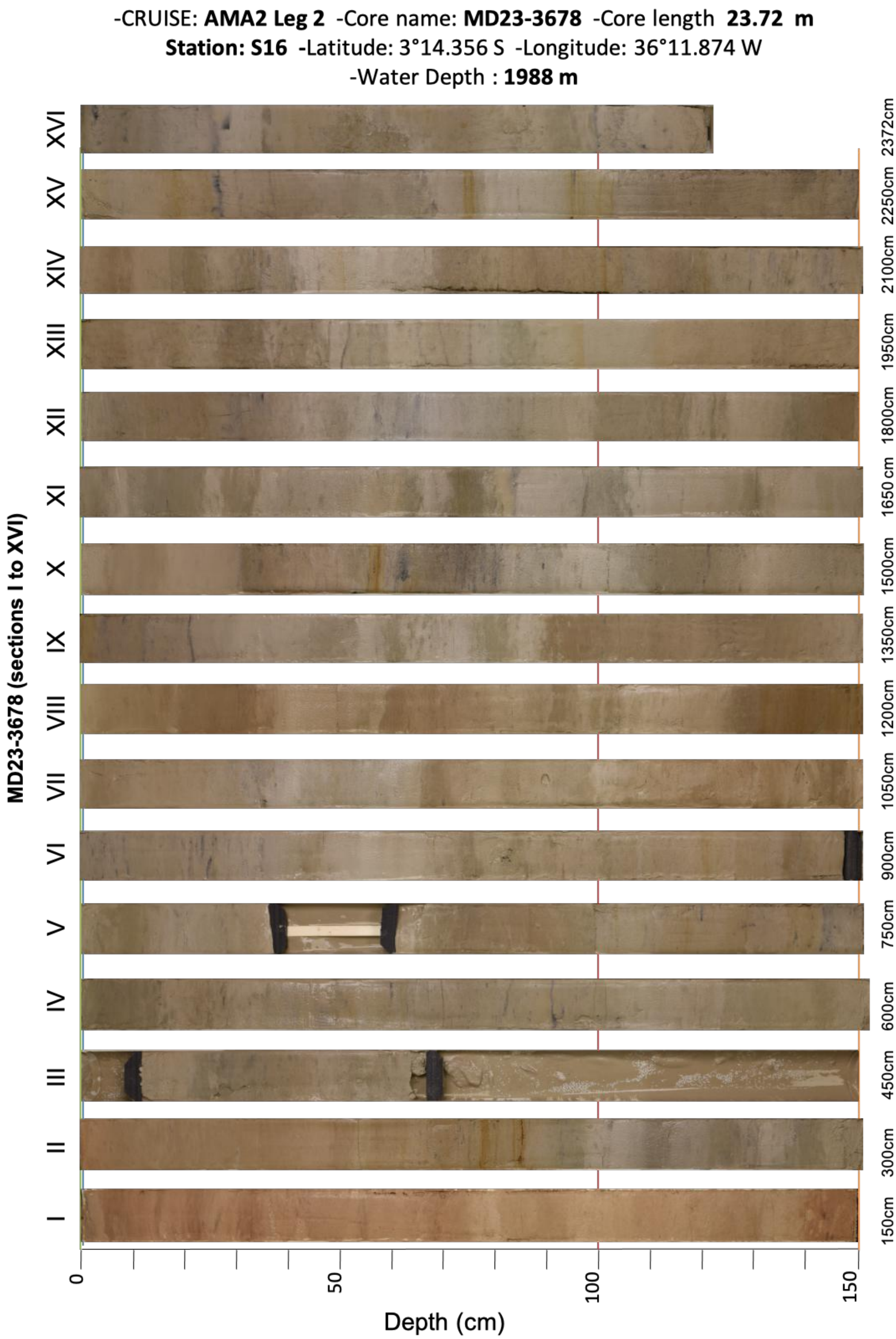
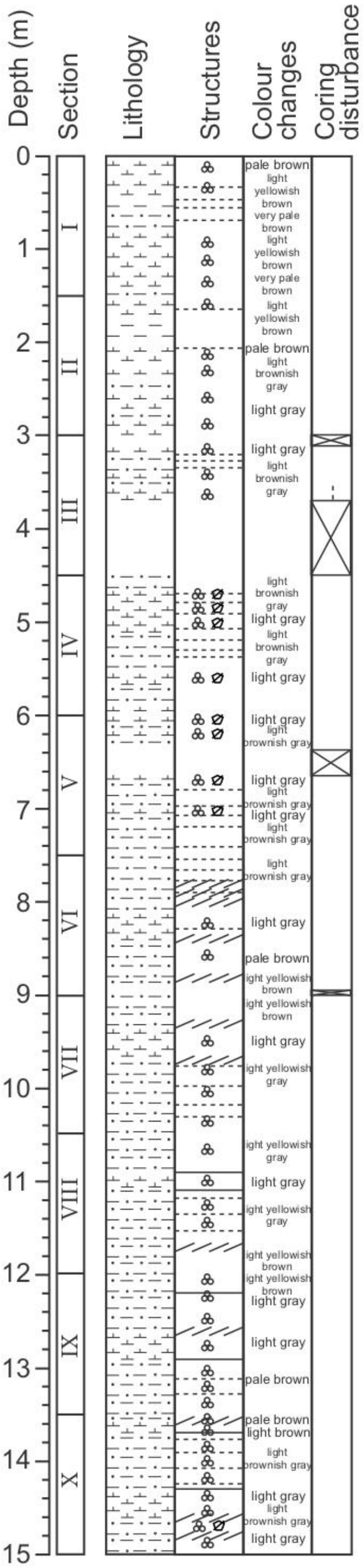


Figure 168: Pictures of Calypso core MD23-3678.

MD241-AMA2-Leg2	**MD23-3678**	Position: 3°14.356 S 36°11.874 W
Station S16	**Sediment description (1/2)**	Water-depth: 1988 m Core length: 23.72 m

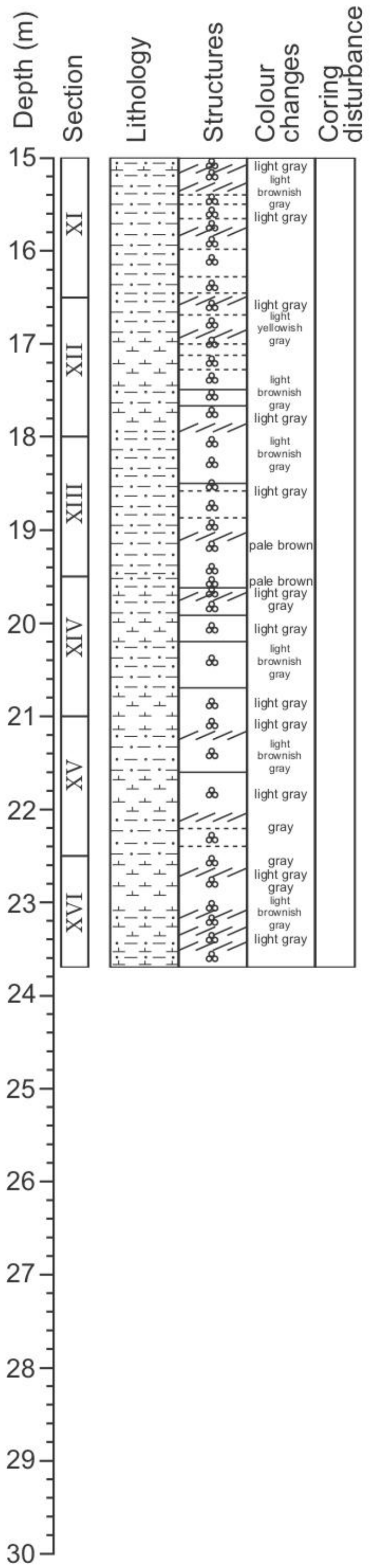


Comments

Sediment with foraminiferal ooze or sandy mud with foraminifera, many alternances in color from light gray to light brownish gray, some darker marks or layers along the sections.

300-312 cm: void
367-450 cm: void
896-900 cm: void

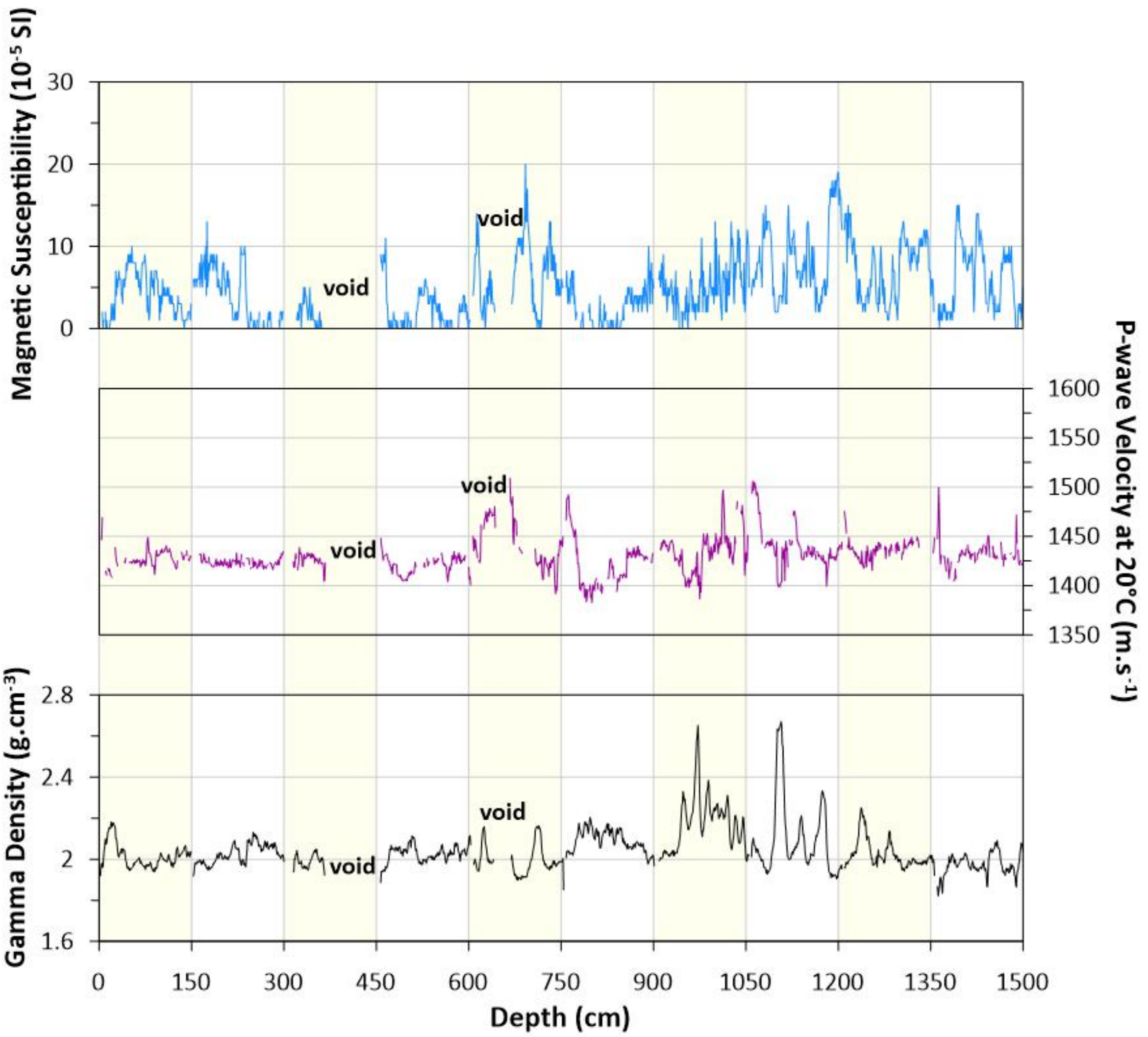
MD241-AMA2-Leg2	**MD23-3678**	Position: 3°14.356 S 36°11.874 W
Station S16	**Sediment description (2/2)**	Water-depth: 1988 m Core length: 23.72 m



Comments

Sediment with foraminiferal ooze or sandy mud with foraminifera, many alternances in color from light gray to light brownish gray, some darker marks or layers along the sections.

Figure 169: Sediment description of Calypso core MD23-3678.


Magnetic Susceptibility (10^{-5} SI)
30
20
10
0
void
void
MD23-3678
P-wave Velocity at 20°C ($m.s^{-1}$)
1600
1550
1500
1450
1400
1350
void
void
Gamma Density ($g.cm^{-3}$)
2.8
2.4
2
1.6
void
void
0
150
300
450
600
750
900
1050
1200
1350
1500
Depth (cm)

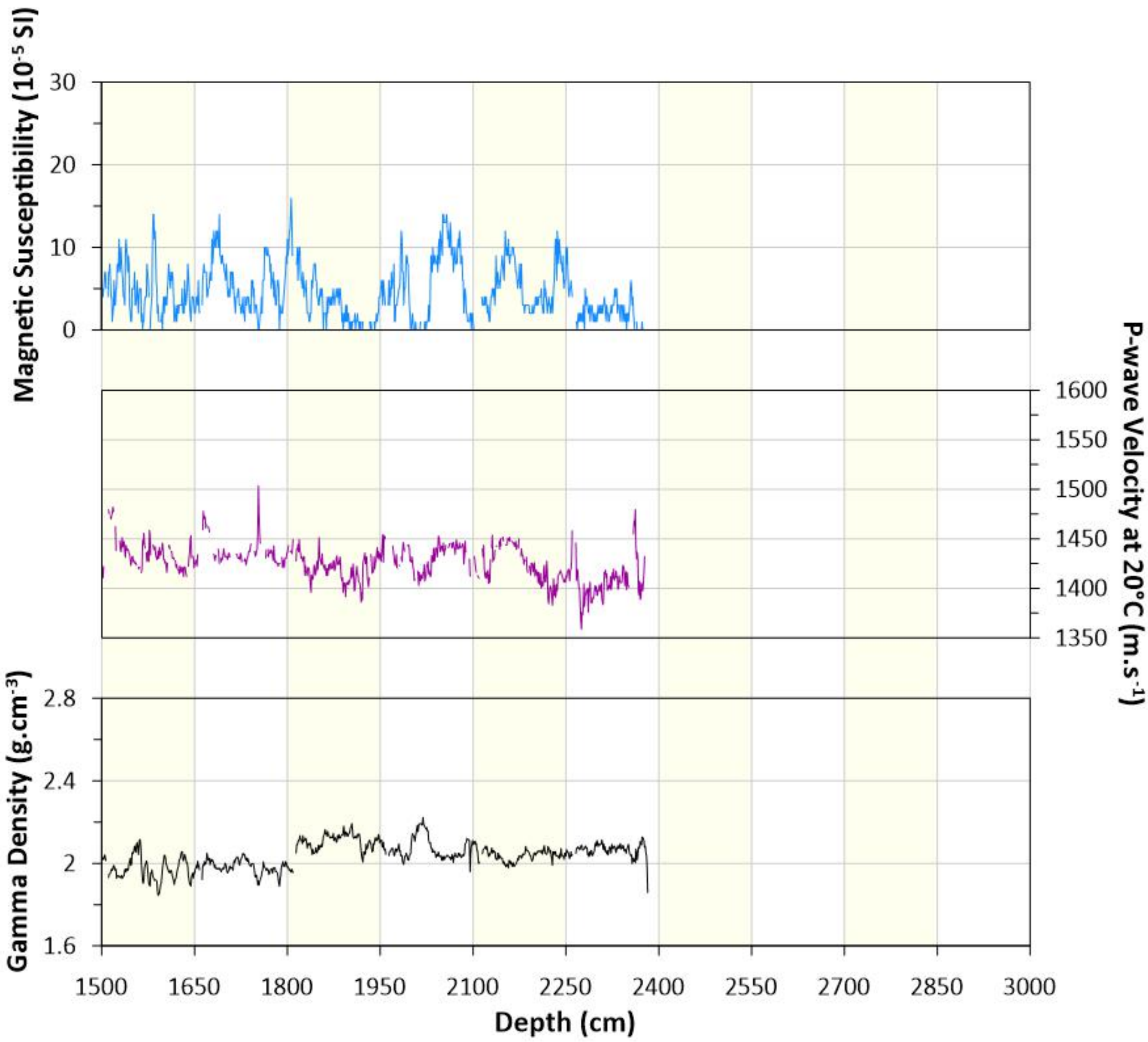
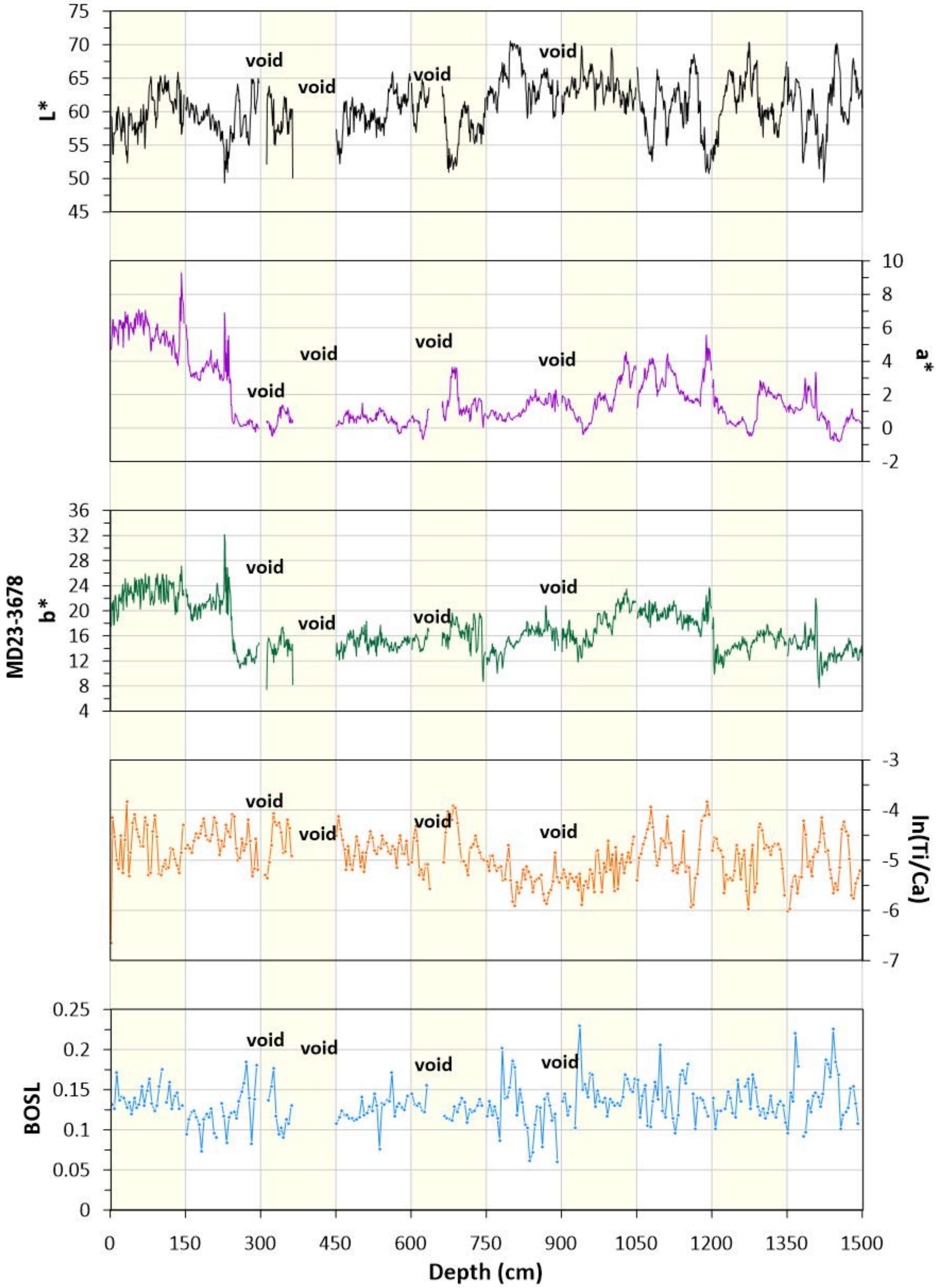


Figure 170: Physical properties of Calypso core MD23-3678.



L*
a*
MD23-3678
b*
ln(Ti/Ca)
BOSL
void
Depth (cm)

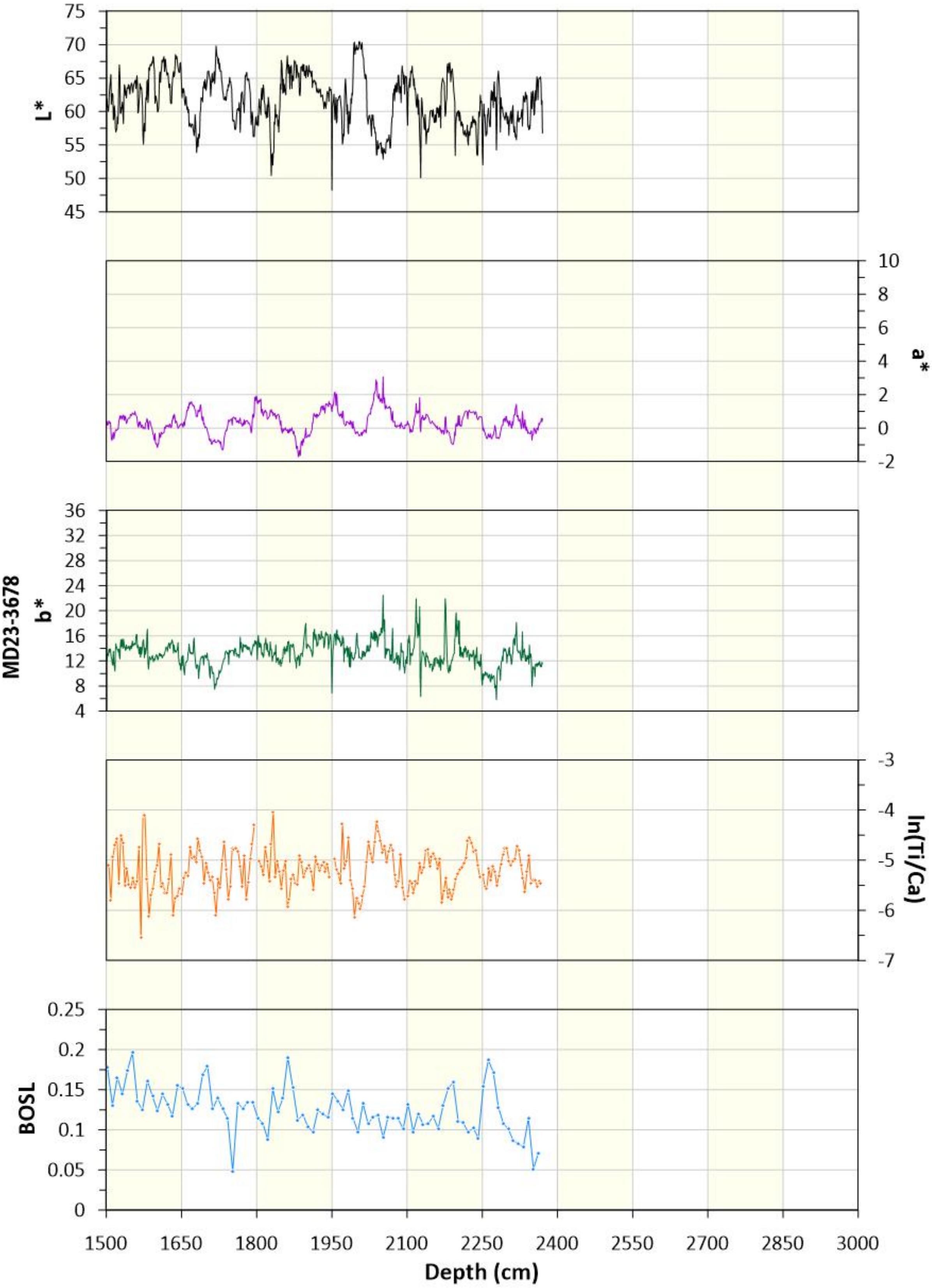


Figure 171: Spectrophotometry (L, a*, b*), X-ray fluorescence (ln(Ti/Ca)) and optically-stimulated luminescence sensitivity (BOSL) data of Calypso core MD23-3678.*

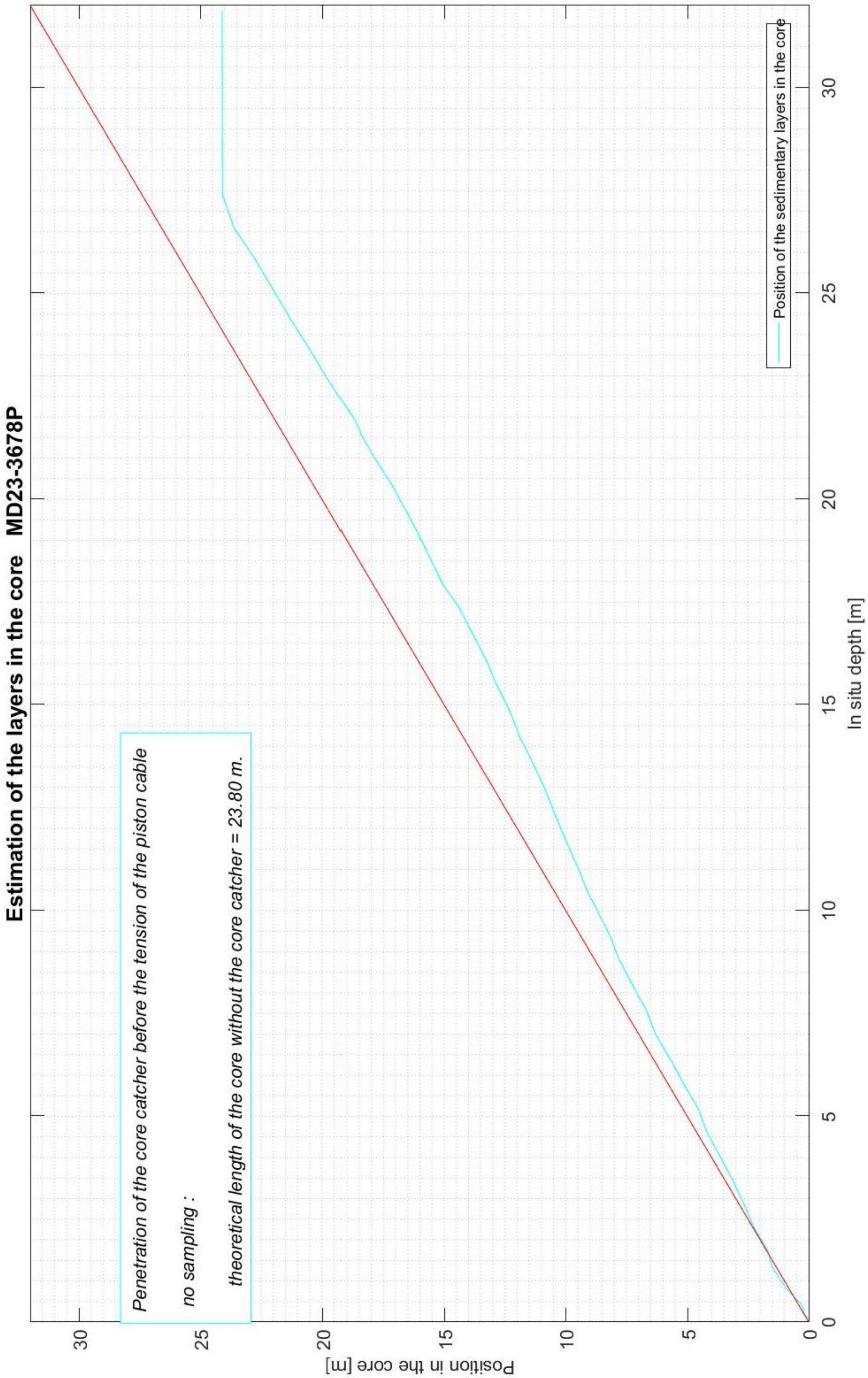


Figure 172: Recovered sediment thickness versus in situ sediment layers, computed by the CINEMA software for core MD23-3678.

Core MD23-3678 shows evidence for sediment undersampling between 4 and the core's bottom depth.

3.4.10.5 Data of CTD-rosette ("palanquée mode") AMA2-S16-CTD

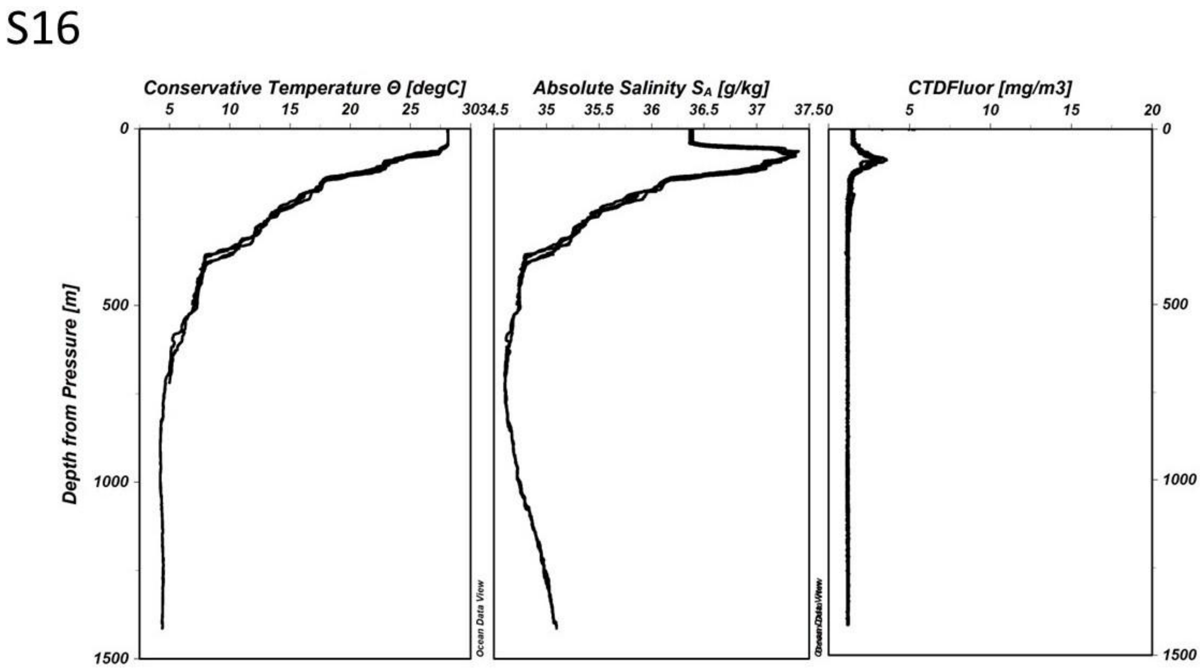


Figure 173: Temperature, salinity and fluorescence vertical profiles obtained by the CTD probe operated in "palanquée" mode at station S16.

Table 18: Collected water samples during CTD "palanquée" cast 1 at station S16. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	5	4	3	2	1	CTD
Water depth (m) cable length	20	60	90	200	300	
Water depth (m) pressure sensor	41.2	59.8	87.6	196.5	298.4	500
$\delta^{18}O$ LOCEAN (20 mL)	X	X	X	X	X	
$\delta^{13}C$ LOCEAN (25 mL)	X	X	X	X	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle	50	50	50	50	50	
$\Delta^{14}C$ (250 mL)	X	X	X	X	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle	1000	1000	1000	1000	1000	
Nutrients (30 mL)						
Fluorescence (0-200 m)						
PAH & trace elements MARBEC (60 mL)		X	X	X		
Water stable isotopes MARBEC (30 mL)		X	X	X		
Comments						

Table 19: Collected water samples during CTD "palanquée" cast 2 at station S16. "X" indicates a sample has been taken in the corresponding bottle for the written purpose.

Number of Niskin bottle	6	3	2	1	CTD
Water depth (m) cable length		100	400	700	
Water depth (m) pressure sensor	310.2	97.6	293	698.4	1450
$\delta^{18}O$ LOCEAN (20 mL)		X	X	X	
$\delta^{13}C$ LOCEAN (25 mL)		X	X	X	
$HgCl_2$ (µL) added in $\delta^{13}C$ bottle		50	50	50	
$\Delta^{14}C$ (250 mL)		X	X	X	
$HgCl_2$ (µL) added in $\Delta^{14}C$ bottle		1000	1000	1000	
Nutrients (30 mL)					
Fluorescence (0-200 m)					
PAH & trace elements MARBEC (60 mL)				X	
Water stable isotopes MARBEC (30 mL)				X	
Comments			planned at 600 m but did not close at 600 m		

3.5 Surface-water properties along the cruise track

The data standard used in the Ocean Data View database is the modified Global Ocean Surface Underway Data (GOSUD), specifically tailored to include only the TSG variables: constant intake depth (6 m), sea surface salinity [PSS-78], and sea surface temperature [degrees Celsius]. The metadata standard for GOSUD has been retained. The resulting underway data is showed in Figure 174.

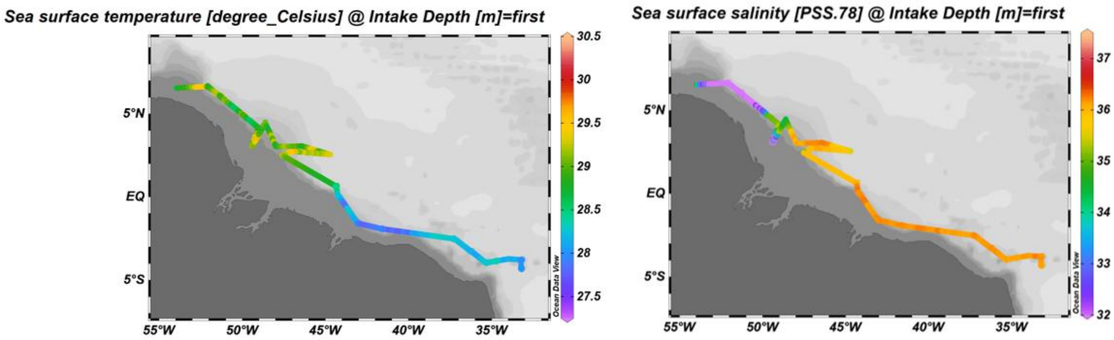


Figure 174: Surface underway Thermosalinograph data (temperature and salinity) along the cruise track of AMARYLLIS-AMAGAS II.

3.6 Comparison of Casq-probe CTD and “palanquée” CTD data

Figure 175 shows the combined data from Casq-Probe and SBE “palanquée” CTD, for all stations during AMARYLLIS-AMAGAS II. To validate the salinity data, we used the layer below 1700 meters of depth, sampled by both Casq-Probe systems (RBR XR-620) and SBE CTD (SBE 911plus), where stability of salinity values is expected (almost vertical line). A difference of 0.256 g/Kg (absolute salinity) is observed between the two sensors (Figure 175), a difference that cannot be explained solely by the equipment discrepancy, suggesting some calibration condition. The SBE 911plus exhibited salinities [PSS-78] between 34.990 and 34.995, corresponding to temperatures [ITS-90] of 4.06 and 3.30, respectively, between 1700 and 2100 m, in accordance with observations (Silva et al., 2010) in the northwest portion of the same study region as her. These salinity values correspond to UNADW and MNADW (UNADW T=4.28 S=35.0 and MNADW T=3.43 S=34.97, "U": Upper and "M": Middle North Atlantic Deep Water). The suggestion is that the Casq-Probe data should be interpreted with caution. Another factor to be observed is that due to the descent rate, the measurements appear to be significantly disturbed along the water column.

In terms of fluorescence (Figure 176), although the two instruments are fundamentally different, both exhibited the same pattern with a deepening and decrease in fluorescence signal in the southernmost stations. In all stations, the peak fluorescence was confined to the mixed layer shallower than 100 m. In the northwest portion of the study region, the fluorescence peak was between 10 and 30 meters, and in the southeast portion between 50 and 80 meters deep. The fluorescence data still need to be further processed to remove spikes and the internal sensor variation using the zero-signal layer.

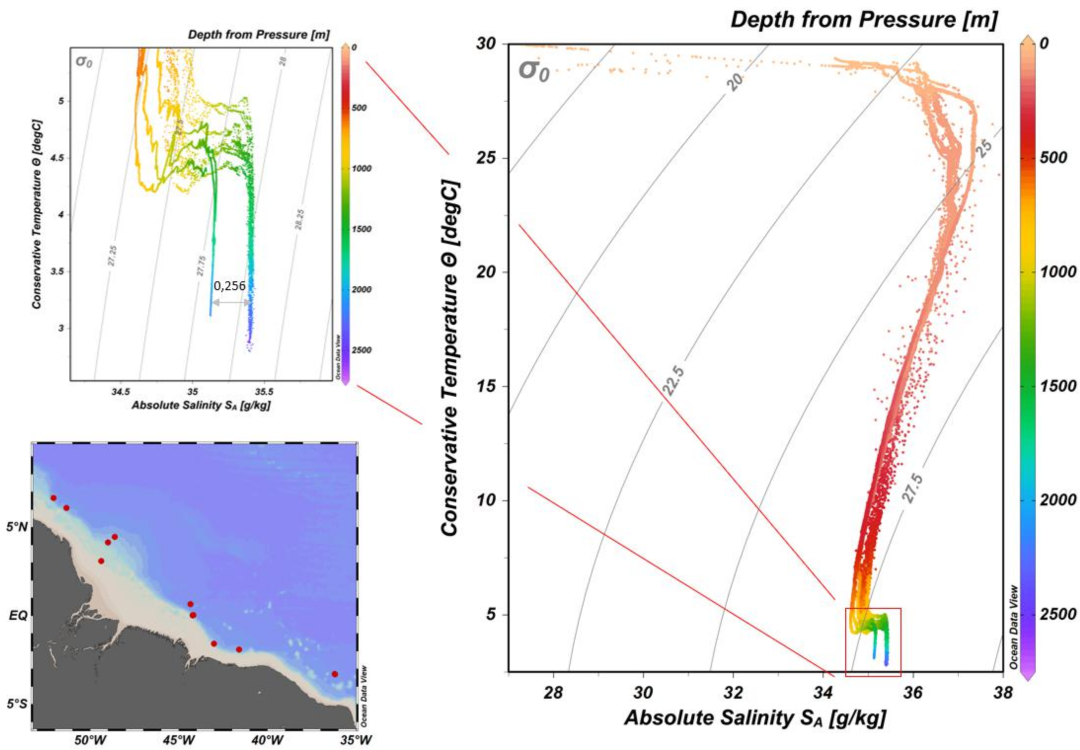


Figure 175: Temperature – Salinity diagrams of all Casq-Probe and SBE “palanquée” CTD casts (right panel) with a zoom on the deepest part of the casts (upper left panel). The map shows the geographical positions of CTD deployments (bottom left panel).

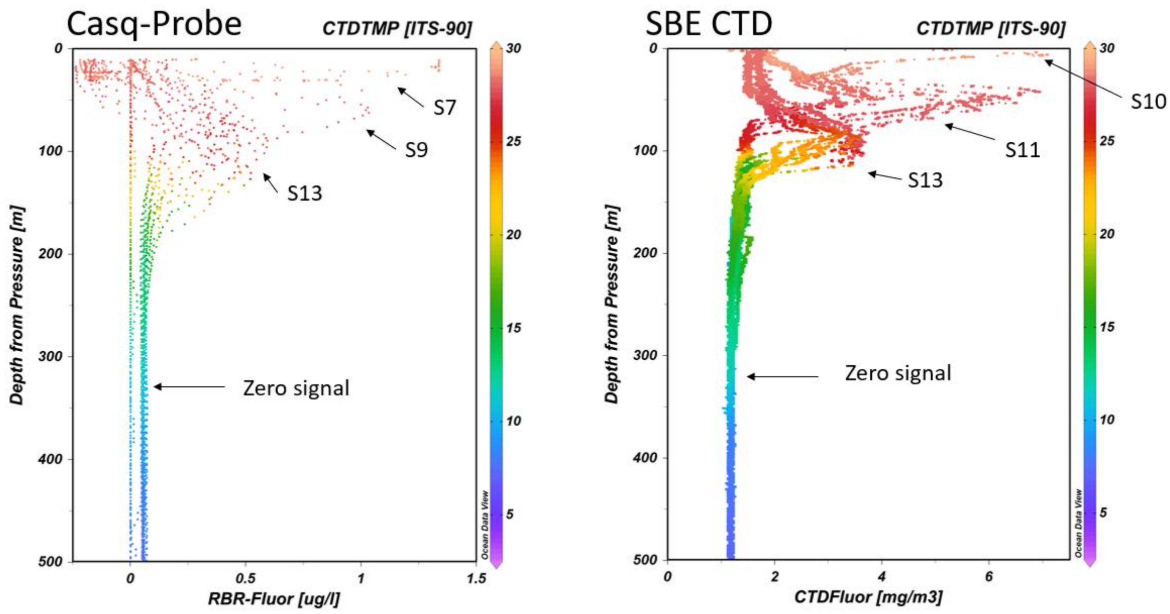


Figure 176: Fluorescence signal from Casq-Probe (RBR XR-620) and SBE “palanquée” CTD (Wet Labs ECO). Note the zero-signal (uncalibrated) layer in both sensors.

3.7 Collected discrete water samples

3.7.1 Collected discrete water samples from 1.7 L Calypso Niskin bottle

The 1.7 L Niskin bottle was attached to the Calypso core-head at all stations where a Calypso core has been deployed.

However, for some reasons, the Niskin bottle could not always be sampled or sample's measurements will have to be interpreted with caution:

- Station S6: the Niskin bottle was covered with sediment. It must have touched the seafloor when the core's pipes bent.
- Station S8: not investigated by lack of appropriate Brazilian authorization.
- Station S9: no Calypso deployed at this station during leg 2.
- Station S12: the Niskin bottle did not trigger and came back open on deck.
- Station S13: no Calypso deployed at this station (empty Casq).

Water samples collected from the 1.7 L Calypso Niskin bottle are given in Table 20.

Table 20: Collected water samples from the 1.7 L Niskin bottle attached to the Calypso core-head

Station	**S6**	**S7**	**S10**	**S11**	**S14**	**S15**	**S16**
Latitude	6°39.363 N	6°05.432 N	3°06.281 N	4°27.176 N	1°34.748 S	1°54.486 S	3°14.356 S
Longitude	52°04.745 W	51°21.560 W	49°23.277 W	48°37.287 W	43°1.452 W	41°35.526 W	36°11.874 W
Calypso	MD23-3653	MD23-3656	MD23-3661	MD23-3664	MD23-3671	MD23-3674	MD23-3678
Water depth m	2518	2278	70	1696	1365	2241	1988
Core length m	54.67	46.25	24.75	34.45	43.73	43.73	24.78
Free fall m	3.7	1.5	1.5	2	2	2	2
Niskin depth m	2459.13	2229.75	43.25	1659.05	1318.77	2194.77	1960.72
$\delta^{18}O$ LOCEAN (20 mL)		X	X	X	X	X	X
$\delta^{13}C$ LOCEAN (25 mL)		X	X	X	X	X	X
$HgCl_2$ (µL)		50	50	50	50	50	50
$\Delta^{14}C$ (250 ml)	X	X	X	X	X	X	X
$HgCl_2$ (µL)	1000	1000	1000	1000	1000	1000	1000
Nutrients (30 mL)							
Fluorescence (0-200 m)							
PAH + trace elements MARBEC (60 mL)							
Water stable isotopes MARBEC (30 mL)							

3.7.2 Collected discrete water samples for fluorescence

A total of 15 discrete samples were taken during ship cruising (points T1 to T15 in Figure 177) from the seawater continuous flow system and measured directly in the fluorometer using the 4 modules described in section 2.7.3.

The same procedure was performed in Casq CTD-probe stations (S6, S7, S9, S11, S12, S14, S15 and S16). Discrete samples collected in stations S10 and S13 from CTD casts in "palanquée mode" (bottles with sampling depth < 300 m) were also analyzed. The raw fluorescence was stored in the equipment and later transferred to a file table, to be corrected and calibrated in laboratory. No water samples nor any physical samples were stored.

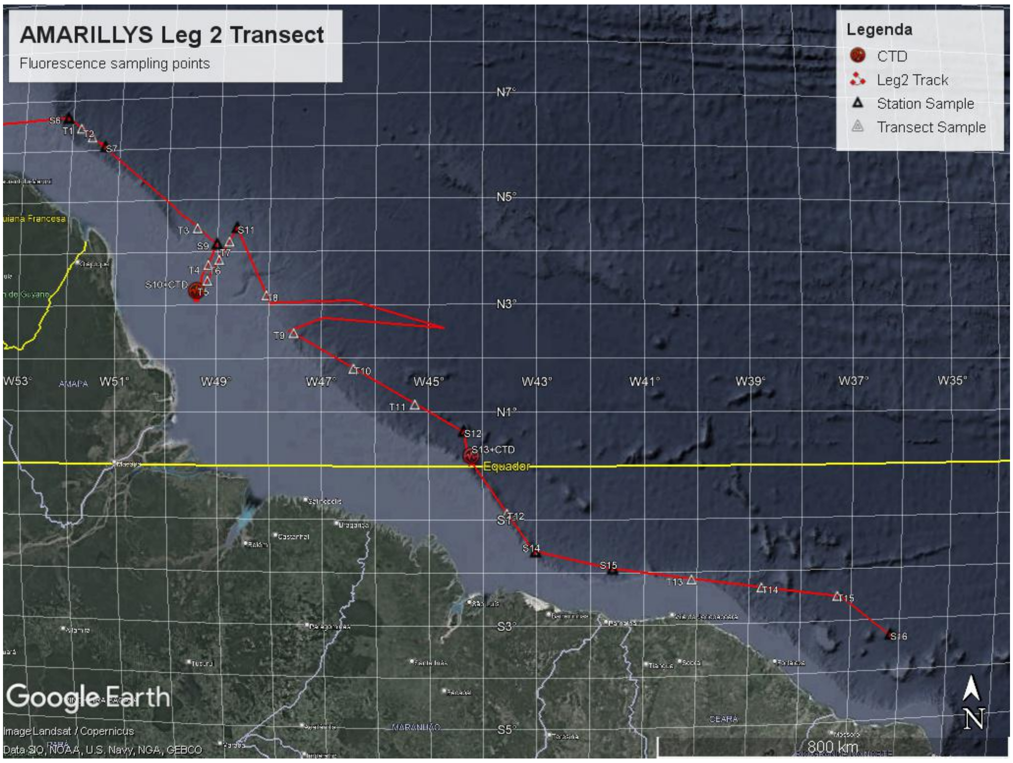


Figure 177: Ship track of AMARYLLIS-AMAGAS II with discrete sampling positions for fluorescence measurements.

3.8 Collected modern mineral dust samples

A total of 41 low-volume filters (Table 21) and 40 high-volume filters (Table 22) were collected between May 16 and June 30 2023 from Bridgetown (Barbados) to Recife (Brazil).

Table 21: Summary table of the filters collected by the low-volume pumping system during the AMARYLLIS-AMAGAS I and II cruises.

Low Volume	Beginning of pumping				End of pumping			
Sample Name	**Date**	**Time**	**Latitude**	**Longitude**	**Date**	**Time**	**Latitude**	**Longitude**
AMA-LV-019	16/05/2023	12:27 UTC	13°06.102N	059°37.861W	17/05/2023	19:19 UTC	13°06.102N	059°37.861W
AMA-LV-020	17/05/2023	19:19 UTC	13°06.102N	059°37.861W	18/05/2023	20:05 UTC	09°46.254N	055°49.760W
AMA-LV-021	18/05/2023	20:05 UTC	09°46.254N	055°49.760W	19/05/2023	19:26 UTC	06°23.788N	051°58.553W
AMA-LV-022	19/05/2023	19:26 UTC	06°23.788N	051°58.553W	20/05/2023	18:33 UTC	05°37.007N	051°04.077W
AMA-LV-023	20/05/2023	18:33 UTC	05°37.007N	051°04.077W	21/05/2023	18:43 UTC	05°36.993N	051°03.955W
AMA-LV-024	21/05/2023	18:43 UTC	05°36.993N	051°03.955W	22/05/2023	19:04 UTC	06°00.405N	050°36.389W
AMA-LV-025	22/05/2023	19:04 UTC	06°00.405N	050°36.389W	23/05/2023	19:05 UTC	06°52.381N	047°44.262W
AMA-LV-026	23/05/2023	19:05 UTC	06°52.381N	047°44.262W	24/05/2023	19:14 UTC	04°33.457N	048°19.008W
AMA-LV-027	24/05/2023	19:14 UTC	04°33.457N	048°19.008W	25/05/2023	18:46 UTC	04°20.386N	048°50.094W
AMA-LV-028	25/05/2023	18:46 UTC	04°20.386N	048°50.094W	27/05/2023	19:09 UTC	04°20.173N	048°49.737W
AMA-LV-029	27/05/2023	19:09 UTC	04°20.173N	048°49.737W	29/05/2023	19:39 UTC	05°27.559N	046°21.523W
AMA-LV-030	29/05/2023	19:39 UTC	05°27.559N	046°21.523W	30/05/2023	19:14 UTC	05°01.192N	044°51.345W
AMA-LV-031	30/05/2023	19:14 UTC	05°01.192N	044°51.345W	31/05/2023	19:18 UTC	03°55.483N	046°52.896W
AMA-LV-032	31/05/2023	19:18 UTC	03°55.483N	046°52.896W	02/06/2023	19:03 UTC	04°17.277N	048°43.800W
AMA-LV-033	02/06/2023	19:03 UTC	04°17.277N	048°43.800W	05/06/2023	19:25 UTC	04°14.890N	049°02.177W
AMA-LV-034	05/06/2023	19:25 UTC	04°14.890N	049°02.177W	06/06/2023	19:17 UTC	05°00.027°N	051°27.372W
AMA-LV-035	06/06/2023	19:17 UTC	05°00.027°N	051°27.372W	07/06/2023	18:48 UTC	04°08.594N	049°00.613W
AMA-LV-036	07/06/2023	18:48 UTC	04°08.594N	049°00.613W	08/06/2023	19:22 UTC	03°34.799N	049°10.511W
AMA-LV-037	08/06/2023	19:22 UTC	03°34.799N	049°10.511W	09/06/2023	21:11 UTC	05°59.665N	052°55.791W
AMA-LV-038	09/06/2023	21:11 UTC	05°59.665N	052°55.791W	12/06/2023	17:41 UTC	05°48.604N	055°09.970W
AMA-LV-039	12/06/2023	17:41 UTC	05°48.604N	055°09.970W	13/06/2023	17:47 UTC	06°37.571N	052°40.896W
AMA-LV-040	13/06/2023	17:47 UTC	06°37.571N	052°40.896W	14/06/2023	15:29 UTC	06°39.627N	052°04.599W
AMA-LV-041	14/06/2023	15:29 UTC	06°39.627N	052°04.599W	15/06/2023	18:20 UTC	06°06.620N	051°21.881W
AMA-LV-042	15/06/2023	18:20 UTC	06°06.620N	051°21.881W	16/06/2023	18:51 UTC	04°08.610N	049°00.586W
AMA-LV-043	16/06/2023	18:51 UTC	04°08.610N	049°00.586W	17/06/2023	18:43 UTC	03°06.281N	049°23.273W
AMA-LV-044	17/06/2023	18:43 UTC	03°06.281N	049°23.273W	19/06/2023	19:16 UTC	03°03.808N	046°48.367W
AMA-LV-045	19/06/2023	19:16 UTC	03°03.808N	046°48.367W	21/06/2023	16:08 UTC	02°43.098N	047°02.940W
AMA-LV-046	21/06/2023	16:08 UTC	02°43.098N	047°02.940W	23/06/2023	17:24 UTC	00°02.024N	044°13.654W
AMA-LV-047	23/06/2023	17:24 UTC	00°02.024N	044°W13.654W	25/06/2023	18:07 UTC	01°54.490S	041°35.485W
AMA-LV-048	25/06/2023	18:07 UTC	01°54.490S	041°35.485W	27/06/2023	18/02 UTC	03°14.365S	036°11.814W
AMA-LV-049	27/06/2023	18/02 UTC	03°14.365S	036°11.814W	30/06/2023	11:19 UTC	04°21.702S	033°16.728W

Table 22: Summary table of the filters collected by the high-volume pumping system during the AMARYLLIS-AMAGAS I and II cruises.

High Volume	Beginning of pumping				End of pumping			
Sample Name	**Date**	**Time**	**Latitude**	**Longitude**	**Date**	**Time**	**Latitude**	**Longitude**
AMA-HV-016	16/05/2023	12:27 UTC	13°06.102N	059°37.861W	17/05/2023	19:19 UTC	13°06.102N	059°37.861W
AMA-HV-017	17/05/2023	19:19 UTC	13°06.102N	059°37.861W	18/05/2023	20:05 UTC	09°46.254N	055°49.760W
AMA-HV-018	18/05/2023	20:05 UTC	09°46.254N	055°49.760W	19/05/2023	19:26 UTC	06°23.788N	051°58.553W
AMA-HV-019	19/05/2023	19:26 UTC	06°23.788N	051°58.553W	20/05/2023	18:33 UTC	05°37.007N	051°04.077W
AMA-HV-020	20/05/2023	18:33 UTC	05°37.007N	051°04.077W	21/05/2023	18:43 UTC	05°36.993N	051°03.955W
AMA-HV-021	21/05/2023	18:43 UTC	05°36.993N	051°03.955W	22/05/2023	19:04 UTC	06°00.405N	050°36.389W
AMA-HV-022	22/05/2023	19:04 UTC	06°00.405N	050°36.389W	23/05/2023	19:05 UTC	06°52.381N	047°44.262W
AMA-HV-023	23/05/2023	19:05 UTC	06°52.381N	047°44.262W	24/05/2023	19:14 UTC	04°33.457N	048°19.008W
AMA-HV-024	24/05/2023	19:14 UTC	04°33.457N	048°19.008W	25/05/2023	18:46 UTC	04°20.386N	048°50.094W
AMA-HV-025	25/05/2023	18:46 UTC	04°20.386N	048°50.094W	27/05/2023	19:09 UTC	04°20.173N	048°49.737W
AMA-HV-026	27/05/2023	19:09 UTC	04°20.173N	048°49.737W	29/05/2023	19:39 UTC	05°27.559N	046°21.523W
AMA-HV-027	29/05/2023	19:39 UTC	05°27.559N	046°21.523W	30/05/2023	19:14 UTC	05°01.192N	044°51.345W
AMA-HV-028	30/05/2023	19:14 UTC	05°01.192N	044°51.345W	31/05/2023	19:18 UTC	03°55.483N	046°52.896W
AMA-HV-029	31/05/2023	19:18 UTC	03°55.483N	046°52.896W	02/06/2023	19:03 UTC	04°17.277N	048°43.800W
AMA-HV-030	02/06/2023	19:03 UTC	04°17.277N	048°43.800W	05/06/2023	19:25 UTC	04°14.890N	049°02.177W
AMA-HV-031	05/06/2023	19:25 UTC	04°14.890N	049°02.177W	06/06/2023	19:17 UTC	05°00.027N	051°27.372W
AMA-HV-032	06/06/2023	19:17 UTC	05°00.027°N	051°27.372W	07/06/2023	18:48 UTC	04°08.594N	049°00.613W
AMA-HV-033	07/06/2023	18:48 UTC	04°08.594N	049°00.613W	08/06/2023	19:22 UTC	03°34.799N	049°10.511W
AMA-HV-034	08/06/2023	19:22 UTC	03°34.799N	049°10.511W	09/06/2023	21:11 UTC	05°59.665N	052°55.791W
AMA-HV-035	09/06/2023	21:11 UTC	05°59.665N	052°55.791W	12/06/2023	17:41 UTC	05°48.604N	055°09.970W
AMA-HV-036	12/06/2023	17:41 UTC	05°48.604N	055°09.970W	14/06/2023	15:29 UTC	06°39.627N	052°04.599W
AMA-HV-037	14/06/2023	15:29 UTC	06°39.627N	052°04.599W	15/06/2023	18:20 UTC	06°06.620N	051°21.881W
AMA-HV-038	15/06/2023	18:20 UTC	06°06.620N	051°21.881W	16/06/2023	18:51 UTC	04°08.610N	049°00.586W
AMA-HV-039	16/06/2023	18:51 UTC	04°08.610N	049°00.586W	17/06/2023	18:43 UTC	03°06.281N	049°23.273W
AMA-HV-040	17/06/2023	18:43 UTC	03°06.281N	049°23.273W	19/06/2023	19:16 UTC	03°03.808N	046°48.367W
AMA-HV-041	19/06/2023	19:16 UTC	03°03.808N	046°48.367W	21/06/2023	16:08 UTC	02°43.098N	047°02.940W
AMA-HV-042	21/06/2023	16:08 UTC	02°43.098N	047°02.940W	23/06/2023	17:24 UTC	00°02.024N	044°13.654W
AMA-HV-043	23/06/2023	17:24 UTC	00°02.024N	044°W13.654W	25/06/2023	18:07 UTC	01°54.490S	041°35.485W
AMA-HV-044	25/06/2023	18:07 UTC	01°54.490S	041°35.485W	27/06/2023	18/02 UTC	03°14.365S	036°11.814W
AMA-HV-045	27/06/2023	18/02 UTC	03°14.365S	036°11.814W	30/06/2023	11:19 UTC	04°21.702S	033°16.728W

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