CRUISE REPORT

MONOPOL Cruise
MD 191/ MONOPOL
on board R/V “Marion Dufresne”
from 23/05/2012 to 15/06/2012
Singapore -Singapore

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1. SCIENTIFIC OBJECTIVES AND RATIONALE

The northern tropical Indian Ocean and the surrounding lands are the location of a strong monsoon system, which has a profound impact on the socio-economy of one of the most densely populated areas of the world. Climate modeling and forecasting are notoriously difficult because the Indian Monsoon is a particularly complex system, potentially affected by a large array of periodic to semi-periodic forcings, regional to global in extent, with timescales ranging from interanual changes (El Niño-Southern Oscillation-ENSO) to (10^4-10^5yr) orbital modulation of solar insolation. Climatic and oceanographic instrumental records are too short to provide a clear understanding of the natural (*pre-anthropic*) variability of the Indian Monsoon system. Thus, the various processes invoked to explain Indian Monsoon variability at different timescales remain largely unconstrained, preventing reliable assessments of monsoon vulnerability to future changes, such as those linked to mankind-activity.

Long marine sequences, deposited at high sedimentation rates, make it possible to study the sensitivity of the Indian Monsoon to forcings at decadal to millennial timescales, or to study its response to instantaneous, catastrophic events (i.e. Toba eruption, 74 kyr ago). A substantial amount of sedimentary records have already been studied in the Arabian Sea and the western tropical Indian Ocean to reconstruct the dynamics of summer wind monsoon and its effects on surface currents and subsurface Ekman pumping. However, only a few studies were devoted so far to study past changes in the Indian Ocean hydrological cycle. Several key issues have not been satisfactorily addressed, such as: 1/ the impact of ENSO-like variability on Indian Monsoon precipitations and its evolution along the Holocene, under different insolation conditions, or 2/ the links between monsoon precipitations and high-latitude rapid climatic variability during glacials (Dansgaard-Oeschger oscillations, Heinrich Events), or interglacials (i.e. the 8.2 ka event). At the longer timescale the response of the Indian Monsoon to orbital forcing has been generally considered a relative simple "precession story". Recent studies suggest otherwise, and conclude that wind and precipitations changes are regionally or locally controlled by a complex combination of precession and obliquity forcing, which affects the Intertropical Convergence Zone structure and endeavour. At those orbital timescales, the existence of periods of anomalously strong wet monsoon episodes, which cannot be explained by a simple response to insolation forcing further suggests that we may still underestimate important aspects of Indian monsoon variability.
Compared to the large amount of cores retrieved and studied over the years in the Arabian Sea by numerous, international oceanographic institutes, only a few sedimentary records have been gathered from the Bay of Bengal. Yet, it is in the Bay of Bengal that past changes in monsoon precipitation should have had the largest impact on oceanographic conditions because of the massive discharge of two major fluvial systems : the Irrawaddy and the Salween (to the East) and the Ganges-Brahmapoutra (to the North). Those large monsoon-related fluvial discharges result, today, in the striking low salinity (32-34 psu) of surface waters from the Bay of Bengal, and maintain a strong latitudinal salinity gradient between the Bay of Bengal and the Arabian Sea, making the Maldives another highly sensitive area to changes monsoon precipitation budget.

In addition - and in close relationship to monsoon history- the Himalaya shows of the world's highest physical and chemical erosion rates and is obviously, therefore, a key area to study and try to quantify the relationships between erosion and climate. Sediments of the Bay of Bengal and the Andaman Sea, which are fed by the Ganges/Brahmaputra and Irrawaddy Rivers, provide an exceptional record of erosion changes in the Himalayan ranges, at various

timescales, in response to Indian Monsoon and sea level variations. This in turn is related to paleoclimatic and paleoenvironmental changes affecting SW Asia.

On the basis of the scientific rational summarized above, and with the financial support provided by ANR MONOPOL project, we organized the MONOPOL cruise on board the R/V Marion Dufresne from May 23 to June 15 2012 (Singapore-Singapore). The two main objectives of this MONOPOL cruise were:

To retrieve and analyze expanded marine sedimentary sections from the Bay of Bengal and the Maldives area using the CASQ and CALYPSO corer in order (i) to reconstruct Indian Monsoon sensitivity to forcings at different timescales (multi-decadal to orbital), and under different boundary conditions (insolation forcing, ice extension, atmospheric CO2 content), with a special emphasis on monsoon precipitations and discharges of the two main river systems entering the Bay of Bengal (Ganges Brahmaputra Rivers system and Irrawaddy River); and (ii) to reconstruct the alteration and erosional history of the Himalaya ranges at these timescales in order to establish their relationship to changes in the intensity of the Indian monsoon rainfall and sea level variations.

To gather fresh plankton material (zooplankton from multi-net operations, and nannoplancton from water samples), water samples (CTD/rosette) and surface sediments (multi-corer) in order to provide material for geochemical and biological proxy studies and calibration.

2. CRUISE SUMMARY

2.1 MAIN HIGHLIGHTS

2.1.1 Cancelation of Maldives objectives

In the initial cruise project, submitted to the French Oceanographic Fleet Evaluation Committee, the cruise track was set to depart from Male (Maldives) and to end up in Colombo (Sri Lanka), in order to limit long steaming tracks. During the final set up of R/V *Marion Dufresne* cruise calendar, the MONOPOL cruise was integrated along with other cruises (CIRCEA, PTOLEMEE) and the MONOPOL port calls were modified accordingly, with a boarding port call in Singapore and a final port call in La Reunion Island (this final port call was later changed to Singapore because of the CIRCEA cruise shifting from "before" to "after" MONOPOL). With these port calls, the total length of MONOPOL track was increased from ~ 3000 nautic miles, to about ~ 5000 nm.

The steaming time was estimated using an average vessel speed of ~ 13.5 knots. However, very early in the cruise, because of meteorological conditions (monsoon wind around 20-30 knots, rough sea) and the impossibility to navigate with the three electric generators (due to a technical problem), we realized that such an average ship speed (13.5 knots) would be nearly impossible to maintain during the whole cruise, especially during the long steaming track (> 1200 nm) towards the Maldives Islands, for which wind and sea would have been against us. A more realistic vessel speed under these conditions would be below 10 knots, meaning that we could waste large amounts of time compared to our original plans during long distance steaming.

In addition, results from the first site (MONO1), which resulted in a bent CALYPSO core, showed us that the sedimentary cover in the Bay of Bengal was complex and coring operations would require that we devote as much time as needed in site surveying (3.5 kHz, multi-beam bathymetry) in order to secure our key coring operations.

Thus, in order to save precious time for our main objectives, we decided to cancel the Maldives sites and focus on the Bay of Bengal objectives.

2.1.2 Sites studied during MONOPOL cruise (see table 1)

The ship sailed from Singapore on May 23 and returned in Singapore on June 15, 2012. During the cruise, operations took place at 12 sites in the Bay of Bengal, along a S-N transect.

Site MONO 1 (7°58.8N - 89°24.1E ; 3600m of water depth) was selected based on an E-W Parasound profile from SONNE cruise 125 along 8°N. This profile showed two potential coring sites : (i) a small topographic high (about ~ 50-60m above the seafloor), that could be covered with hemipelagic sediments ; and (ii) the surrounding, seafloor area with an apparently regular sedimentary draping (according to some short cores from the eastern part of the Bay of Bengal, the channel/levee systems were not active during at least the last three climatic cycles). The topographic high could not be cored because it is the location of a NOAA meteorological buoy since 2011, and the international rules guarantee a 5 nm clearance zone around this buoy.

Thus, it is only the second potential location that was cored with a ~ 35m CALYPSO corer. It bent at about 19m, presumably in reaching fine, compacted turbidite layers corresponding to the time the channel/levee systems were active in this area. The 23m-long sedimentary section is disturbed in the upper part (piece of broken liner found in the first section). The

CTD/Rosette functioned correctly. The *in situ* pump was attached below the rosette. The pumping at 3390m during 4 hours failed. We later discovered the filter was improperly mounted. The multi-net functioned correctly. The MC failed (empty).

Sites MONO2 (11°46.10N- 88°38.78E ; 3175m) and MONO3 (14°47.16N - 89°05.72 E ; 2806 m) are located north of MONO1, along a S-N transect. They were selected to provide water, plankton and surface sediment material for the study of modern processes and the calibration of bio and geochemical proxies used in paleo-reconstructions. At these two sites, no CASQ or CALYPSO coring was attempted. We only deployed the multi-net plankton tow, the CTD/rosette, an *in situ* pump (2985 and 2090 m, respectively) and the MC. All the operations worked well, except the MC, which provided empty or partially filled tubes. The best sedimentary records were obtained during a second try of MC at MONO3 (two tubes nearly filled). But in general, the poor recovery and the presence of turbid water above the sediment suggest that the MC may fall partially on the side at the seafloor (problem of stability likely due to its small base and high height).

Site MONO4 (17°10.94N - 89°28.92E ; 2368m) was selected based on 3.5kHz profile obtained on board the R/V *Marion Dufresne* while heading towards SONNE cruise 115KL location. The site MONO4 makes it possible to continue the S-N transect further to the North for proxy calibrations. As far as sedimentary cover is concerned, according to short (~10m) sedimentary records available from this area (i.e. SONNE 115KL, MD77-180, further to the North), the area is covered by hemipelagic sediments spanning at least the last climatic cycle. Our interests in coring at MONO4 were to provide long sections for multi-cycle studies, and to get sediment covers with high-enough sedimentation rates allowing the study of rapid glacial changes (i.e. sediment pulses) in connection with high-latitude variability. Coring (CASQ and CALYPSO) operations worked well. The Multi-net deployment, as well as the CTD/Rosette and *in situ* pumping at 1000m (the shallowest depth of the whole S-N transect) worked well. As for the previous sites, the MC did not provide very good sediment sections.

Site MONO5 (18°18.62N - 89°34.26E) was selected to provide the northernmost possible site for our S-N transect, at the very limit of the Indian and Birman ZEE, still in international waters. But the site was too close from the Indian ZEE and only a shallow CTD/rosette operation was conducted at Site MONO5.

Site MONO6 (18°02.84N - 89°22.96E ; 2145m). After having moved South from MONO5 location, a deep-CTD/rosette was performed at MONO6, as well as a multi-net operation. The MC was deployed but came empty. We suspect material at the seafloor could be very coarse (sandy turbidite) since the 3.5kHz profile showed a very dark, pronounced surface reflector.

Site MONO7 (18°01.67N - 89°32.08E; 2140m) was selected after a night-long survey with the 3.5kHz, in order to get the best possible sedimentary section in this location, which is the closest we could get to the platform and the Ganges Delta while still being in international waters. At this site, sediment cover was sampled using three devices : the MC (3 tubes with sediments), the 12m-long CASQ and the CALYPSO corer. A 35m long CALYPSO was first tried. It penetrated well and a ~ 59m long CALYPSO was attempted, but the corer bent. Yet, 54.02 m of sediment were recovered.

Site MONO8 (16°30.02N - 87°47.92E ; 2560m). Site located nearby Site 118KL from SONNE expedition 125, in the levee of the active channel/Levees system, in the middle of the Bay of Bengal (about 25nm from Indian ZEE). This was our first attempt to core a presumably Holocene levee with very high sedimentation rates.

Site MONO9 (16°14.54N – 87°54.70E; 2610 m) Site located in the levee with a few strong 3.5 kHz reflectors. CASQ core revealed numerous silty layers (turbidites), from 1-2 cm up to 20 cm thick. This stiff layers probably explained the relatively short penetration of the 9m-long CASQ (only about 6 m of penetration). Decision was taken to abort CALYPSO coring operation. CTD/Rosette and plankton tow operations were conducted at site MONO9.

Site MONO10 (16°00.01N – 87°52.38E; 2660 m). Site located in the distal levee, about 2km from the channel. The 3.5 kHz profile suggested about 100m of soft, sedimentary cover (no strong reflector). Coring showed fine sediments (clay with only a few, cm-thick silty layers). About 8.50 of sediment were recovered using CASQ corer. First CALYPSO coring operation failed (loss of the corer). Another operation succeeded, making it possible to retrieve 31.40 m of fine-grained sediments.

Site MONO11 (8°17.77N – 89°23.10E; 3530m). We returned to this location which had been crossed in the first transect when heading to the North of the Bay. The 3.5kHz profile had suggested higher sedimentation rates (thickening of the sedimentary sequence, clearly observed due to the well defined acoustic reflectors). A 34.7m-long CALYPSO core made it possible to retrieve 31.72m of sediment.

Site MONO11 (7°08.17N – 89°48.19E; 3532 m). This site was designed to our reference, southernmost site, towards the exit of the Bay of Bengal. Unfortunately, the corer bent and was empty at recovery. No time was left for attempting another coring at that site and we decided to head towards Singapore, our final port call destination.

Site	CALYPSO	CASQ	Multi-corer	CTD/Rosette	In situ pump	Multi-net
MONO0	MD12-3409					
MONO1	MD12-3410	-	MD191-MD-MONO1	+	+	+
MONO2	-	-	MD191-MC-MONO2	+	+	+
MONO3	-	-	MD191-MC-MONO3 I	+	+	+
			MD191-MC-MONO3 II			
MONO4	MD12-3412	MD12-3411CQ	MD191-MC-MONO4	+	+	+
MONO5	-	-	-	+	-	-
MONO6	-	-	MD191-MC-MONO6	+	-	+
MONO7	MD12-3414	MD12-3413CQ	MD191-MC-MONO7	-	-	-
	MD12-3415					
MONO8	MD12-3417	MD12-3416CQ	MD191-MC-MONO8	-	-	-
		MD12-3418CQ				
MONO9	-	MD12-3419CQ	MD191-MC-MONO9	+	-	+
MONO10	MD12-3421	MD12-3420CQ	-	-	-	-
MONO8bis	*MD12-3422*	-		-	-	-
MONO11	MD12-3423	-	-	-	+	-
MONO12	-	-	-	-	-	-

Table 1: site and operation summary – MONOPOL/MD191

2.2 SUMMARY OF SAMPLING OPERATIONS

Fourteen cores were retrieved (CASQ and CALYPSO), to which was added one "test" core, retrieved on the Ninety East Ridge, during the transit of R/V Marion Dufresne towards Singapore, prior to the MONOPOL cruise (*CALYPSO core MD12-3409; 1°06.07S-89°16.12E; 2429m of water depth; sediment recovered: 23.7m*). The Multi-Net was deployed at 6 sites, water samples were obtained at 7 sites and surface sediments were obtained at 9 sites with the multi-corer.

- **CASQ and CALYPSO coring (tables 2 and 3):** cruise operations made it possible to recover sediment at 7 sites (+ one test site cored during transit towards Singapor, prior to MONOPOL cruise -> MONO 0). The Niskin bottle set on the corer weight made it possible to sample deep water at these sites. Until about ~ 2500m, optimization of CALYPSO corer settings (~ 3m of free fall, long piston cable loop to cancel out elastic rebound problems of the Kevlar cable) made it possible to recover good quality, sediment sections. At deeper depths, such a compensation of elastic rebound is not possible and future improvements of core quality will require the acquisition of a new, stiffer (less elastic) cable. The purchase of such a cable is planned and will be supported by the ClimCor Equipex. The use of CINEMA made it possible to fully comprehend to which extent the deepest cores were oversampled. The use of the CASQ corer made it possible to get a non-disturbed upper sedimentary, which could be spliced with the CALYPSO section.

Site	CALYPSO	Latitude	Longitude	Depth (m)	tube (m)	sediment (m)
MONO 0	MD12-3409	1°06,07' S	89°16,12' E	2429	29,4	23,7
MONO 1	MD12-3410	7°58,95N	089°24,01 E	3571	34,4	22
MONO 4	MD12-3412	17°10,94'N	89°29,91'E	2367	35	32,23
MONO 7	MD12-3414	18°01,67'N	89°32,08'E	2140	35	33,37
MONO 7	MD12-3415	18°01,66'N	89°32,09'E	2140	59,3	54,02
MONO 8	MD12-3417	16°30,03'N	87°47,82'E	2556	41,8	39,77
MONO 10	MD12-3421	15°59,96'N	87°52,53'E	2656	35,1	31,4
MONO 8 bis	MD12-3422	16°30,18'N	87°47,87'E	2560	52	29,9
MONO 11	MD12-3423	8°17.64'N	89°22.94E	3530	34,7	31,7

Table 2: Calypso coring – MONOPOL/MD191

Site	CASQ	Latitude	Longitude	Depth (m)	tube (m)	sediment (m)
MONO 4	MD12-3411-CQ	17°10.94'N	89°28.92'E	2354	12	9,2
MONO 7	MD12-3413-CQ	18°01.67'N	89°32.08'E	2140	12	9,42
MONO 8	MD12-3416-CQ	16°30.25'N	87°47.80'E	2554	12	6,98
MONO 8	MD12-3418-CQ	16°30.27'N	87°47.92'E	2557	9	8,52
MONO 9	MD12-3419-CQ	16°14.63'N	87°54.67'E	2608	9	8,36
MONO 10	MD12-3420-CQ	16°00.10'N	87°52.38'E	2660	12	8,52

Table 3: CASQ coring – MONOPOL/MD191

- **Multi-net (table 4):** The multi-net provided by CEREGE worked well, allowing the sampling of foraminifers from the surface to ~ 400m of water depth. It was used at 6 stations.

Site	Deployement	Latitude	Longitude	Deepest depth (m)	Shallowest depth (m)
MONO 1	1	7°58.83' N	89°24.05' E	408-180	60-0
MONO 1	2	7°58.82'N	89°24.35'E	100-80	20-0
MONO 2	1	11°45.95'	88°38.88' E	405-180	60-0
MONO 2	2	11°45.94'	88°38.88' E	105-80	20-0
MONO 3	1	14°47.18'	89°05.60' E	400-176	60-20
MONO 3	2	14°47.17'	89°05.58' E	101-80	20-0
MONO 4	1	17°10.94' N	89°28.92' E	400-180	60-0
MONO 4	2	17°10.94' N	89°28.92' E	103-81	20-0
MONO 6	1	18°02.83'N	89°22.89'E	400-180	60-0
MONO 6	2	18°02.83'N	89°22.89'E	100-80	20-0
MONO 9	1	16°14.4'N	87°54.6'E	400-180	40-0
MONO 9	2	16°14.4'N	87°54.6'E	100-80	20-0

Table 4: Multinet operations – MONOPOL/MD191

- **CTD/Rosette (table 5):** CTD and rosette of IPEV were deployed and worked well during the whole cruise.

Site	Nb CTD op	Latitude	Longitude	Nb of bottles	Shallowest depth (m)	Deepest depth (m)
MONO 1	1	7°58.8' N	89°24.1' E	24	13	3572
MONO 2	1	11°46.11' N	88°38.77' E	22	21	3148
MONO 3	1	14°47.16' N	89°05.72' E	24	5	2782
MONO 4	2	17°13.25' N	89°28.47' E	22	5	2329
MONO 5	1	18°18.62'N	89°34.26'E	12	5	180
MONO 6	1	18°02.84'N	89°22.96'E	24	5	2128
MONO9	1	16°14.57'N	87°54.69'E	24	5	2592

Table 5: CTD operations – MONOPOL/MD191

- **In situ water filtering (Table 6):** The *in situ* pump provided by INSU worked well during the cruise, making it possible to filter large amounts of water (up to 1300l) at depth varying from ~3500m to 1000m. Because each pumping operation is long (~ about 4h) and because only one pump was on board, the S-N transect is also a depth transect, with the deeper pumping taking place at the southernmost site (MONO1) and the shallowest pumping (~1000m) taking place at one of the northernmost site.

Site	Latitude	Longitude	Pumping depth	Pumping duration (h)	Filtered volume (l)
MONO 1	7°58.8' N	89°24.1' E	3419 m	4	0
MONO 2	11°46.11	88°38.77' E	3000 m	4	553
MONO 3	14°47.16	89°05.72' E	2100 m	4	1331
MONO 4	7°13.25' N	89°28.47' E	1000 m	4	512
MONO 11	8°17.77N	89°23.10E	3100 m	4	1010

Table 6: In situ water filtering – MONOPOL/MD191

- **Multi-corer (interface coring; Table 7)** : The biggest failure during the cruise was the difficulties to retrieve samples with the KC multi-corer at deep depths. An other model of MC had been used during two previous cruises (AMOCINT and RETRO1) and worked well. The new model was purchased for the cruise as part of a joint effort between IPEV and the laboratories associated in MONOPOL. This new model, more compact, but also taller, was delivered in Singapore just before boarding for MONOPOL. This did not leave time for some preliminary testing. During the cruise, the successive attempts (site MONO1 to MONO5) were unsatisfactory, with potential problems of triggering and stability on the seafloor. Tubes were either empty, or partially filled with clearly disturbed sediments and showed muddy overlying water. Improvements and modifications have been attempted during the cruise (i.e. removal of the hydraulic damping system, adding of extra weight to improve penetration, building of a large basal frame to improve stability. With these improvements, multi-coring operations were successful at two sites (MONO9 and MONO10), at about 2500-2700m of water depth. However, the multicorer never worked correctly at deeper depths. During our way back to Singapore, we decided to come back on several sites (MONO3, 2 and 1) in order to get nicer MC, but our attempts were not successful (3 times, the MC triggered in water).

Site	Name	Latitude	Longitude	Depth (m)	Nb of tubes filled	Notes
MONO 1	MC12-MONO1	7°59.09′ N	89°24.09′ E	3600 m	None	All tubes were empty
MONO 2	MC12 -MONO2	11°46.07′ N	88°38.77′ E	3175 m	3	Longest section recovered 14cm; disturbed?
MONO 3	MC12-MONO3-I	14°47.14′ N	89°05.57′ E	2795 m	1	Only one tube filled. Sediment lost on deck.
MONO 3	MC12-MONO3-II	14°47.14′ N	89°05.59′ E	2798 m	2	Longest section recovered 27cm; disturbed?
MONO 4	MC12-MONO4	17°10.95′ N	89°28.93′ E	2368 m	4	Longest section recovered 28cm; disturbed?
MONO 6	MC12-MONO6	18°02.85′ N	89°22.98′ E	2140 m	none	Very sandy material. Turbidites? No recovery
MONO 7	MC12-MONO7	18°01.67'N	89°32.08'E	2140 m	3	Disturbed ?
MONO 8	MC12-MONO8	16°30.29'N	87°47.92'E	2557 m	4	Tubes filled. Clear water on top.
MONO 9	MC12-MONO9	16°14.63'N	87°54.66'E	2608 m	4	Tubes filled. Clear water on top. "Magnifique"

Table 7: Multi-coring operations – MONOPOL/MD191

2.3 CRUISE LOG

Date (TU)	Time (TU)	Latitude (N)	Longitude (E)	Site	Depth	Events	Duration of operations (incl. settings of tools)	Data/samples obtained
23/05/12	12:00			**SINGAPOUR**		Departure from Singapour. Beginning of MONOPOL.		
						Heading to the Bay of Bengale		
26/05/12	17:27	7°50.10	89°38.41			Leaving ZEE. Starting 3.5 kHz acquisition		
						Because of sea and wind conditions, steaming speed only about ~10 knots		
						whereas 13.5 knots was used to evaluate the whole cruise track duration		
	22:40					After short survey; station MONO1		
	23:41					Lateral propeler problem... About 2h30 to fix the problem.	02:30	
27/05/12	01:21	7°58.8	89°24.1	**MONO 1**	3600m	**At station MONO 1**		
	01:29					**Start CTD/rosette with 3h of in situ pumping at 3390m**		
	07:53					CTD/Rosette/ISP on board. ISP did not work	06:32	CTD/rosette/ISP MONO1
	08:10	7°58.83	89°24.05			**Start multinet (2 operations)**		
	09:30					Multinet on board	01:37	Multi-net MONO1
	10:00					**Start MC operation**		
	11:20	7°58.95	89°24.01			MC on the seafloor		
	12:28					MC on board. EMPTY! (did not trigger)	02:58	*Empty Multi-core*
	15:28					**Start CALYPSO descent (35m)**		
	16:53	7°58.95	89°24.01			Triggering		
	19:36					Core on deck. Bent.	07:08	**MD12-3410**
	19:50					**Leave MONO1. Steaming to "WP3"**		
28/05/12	14:40	11°45	88°40			*Pass across WP3 position. Close to an non-active chanel.*		
						Start short survey with bathy+3.5kHz -> select site south of WP3	02:18	
	16:58	11°46.10	88°38.78	**MONO 2**	3175m	**At station MONO 2**		
	17:10					**Start CTD with 4h of in situ pumping at 2985m**		
	23:50					CTD/Rosette/ISP on board.	06:40	CTD/rosette/ISP MONO2
29/05/12	00:19	11°46.07	88°38.80			**Start MC operation**		
	01:21	11°46.07	88°38.79			MC on the seafloor		
	02:25					MC on board. Partially and unevenly filled.	02:35	MD12-MC-MONO2
	02:50					**Start multinet (2 operations; 400m and 120m)**		
	04:14					Multinet on board	01:49	Multi-net MONO2
	04:20					**Leave MONO2. Steaming to next station with 3.5kHz**		

29/05/12	18:54	14°47.16	89°05.72	**MONO 3**	2806m	**At station MONO 3**		
	19:15					**Start CTD with 4h of in situ pumping at 2090m**		CTD/rosette/ISP MONO3
30/05/12	01:23					CTD/Rosette/ISP on board.	06:07	
	01:53					**Start MC operation**		
	02:45	14°47.19	89°05.58			MC on the seafloor		
	03:50					MC on board. Nearly empty	02:27	MD12-MC-MONO3
	04:16					**Start again MC operation**		
	05:10	14°47.19	89°05.59			MC on the seafloor		
	06:05					MC on board. Two tubes nearly filled	02:15	MD12-MC-MONO3bis
	06:35					**Start multinet (2 operations)**		
	07:35					Multinet on board	01:30	Multi-net MONO3
	07:42					**Leave MONO3. Steaming to next station with 3.5kHz**		
						Survey. Pass across position of SONNE core 115KL.		
						Better site seen while steaming. Return for site MONO 4		
30/05/12	20:34	17°10.94	89°28.92	**MONO 4**	2368m	**At station MONO 4**		
	20:38					**Start multinet (2 operations)**		
	22:45					On board (longer than usual because security not release on first try..)	02:07	Multi-net MONO4
31/05/12	00:12					**Start CASQ operation**		
	00:45					winch problem. CASQ stopped at 1327m		
	02:41					Resume CASQ operation		
	03:03	17°10.93	89°28.92			CASQ penetration		
	05:30					CASQ on board (slow ascent, "truncanage" problems)	06:45	**MD12-3411-CQ**
	07:00					**Start MC operation**		
	07:36	17°10.93	89°28.93			MC on the seafloor		
	08:15					MC on board	02:45	MD12-MC-MONO4
	10:31					**Start CALYPSO operation (35m)**		
	11:29	17°10.94	89°28.91			Triggering		
	13:23					Core on deck.	05:08	**MD12-3412**
	13:42	17°10.41	89°28.74			Move ~0.5 miles to avoid sediment plume for water sampling		
	14:18					**Start CTD/rosette operation (180m only)**		
	14:41					CTD/rosette on board	01:18	shallow CTD/rosette MONO4
	14:45					Move ~5 miles to the N (avoid sediment plume in deep water sampling)		
	15:21	17°13.25	89°28.47	**MONO 4b**		**At station MONO 4b**		
	15:53					**Start CTD/rosette/ISP (pumping at 1000m)**		
	23:30					CTD/rosette/ISP on board	08:49	deep CTD/rosette/ISP MONO4
	23:58					**Leave MONO4. Steaming to next station with 3.5kHz**		
						S-N and W-E survey with 3.5kHz in the small area between		
						Indian ZEE (to the west-NW) and Birman ZEE (to the East-NE)		

01/06/12	06:23	18°18.62	89°34.26	**MONO 5**		**At station MONO 5** **CTD/Rosette operation (180m only)**		Shallow CTD/rosette MONO5
	10:00	18°02.84	89°22.96	**MONO 6**	2145m	**At station MONO 6**		
	10:11					**Start CTD/rosette operation**		
	11:45					CTD/rosette on board	01:45	deep CTD/rosette MONO6
	12:10	18°02.83	89°22.97			**Start multinet (2 operations; 400m and 120m)**		
	13:09					Multinet on board	01:24	Multi-net MONO6
	13:30					**Start MC operation**		
	14:13	18°02.83	89°22.98			MC on the seafloor		
	15:00					MC on board. Empty. Sand?	01:51	*Empty Multi-Core*
	15:15					**Leave MONO6**		
						Night-long survey to find a better location for coring		
02/06/12	02:20	18°01.67	89°32.08	**MONO 7**	2140m	**At station MONO 7**		
						Problem with winch electric board -> 30mn to fix		
	02:50					**Start MC operation** (numerous stops during descent. Winch problems)		
	04:07	18°01.67	89°32.08			MC on the seafloor		
	04:50					MC on board. 3 tubes with sediment.	02:30	MD12-MC-MONO7
	06:05					**Start CASQ operation**		
	06:41	18°01.67	89°32.08			CASQ penetration		
						Winch stopped during pulling out. Problem.		
	07:49					CASQ on board	02:59	**MD12-3413-CQ**
	10:19					**Start CALYPSO operation (35m)**		
	11:12	18°01.67	89°32.08			Core triggering		
	12:23					Core on deck	04:34	**MD12-3414**
	18:49					**Start CALYPSO operation (59.3m)**		
	19:42	18°01.66	89°32.09			Core triggering		
						Manœuvre winch heats up. Boarding stopped several times.		
	23:15					Core on Deck (bent)		
						Stay on station during hasardous handling and cutting operations of bent pipe...		
03/06/12	03:23					**Leave MONO 7**	14:59	**MD12-3415**
03/06/12	03:45							
						Heading towards next station. Near SONNE core 118KL *on the active levee/channel system*		
03/06/12	21:37	16°28.00	88°00			*Start survey; E-W transect across chanel/levee system*		

04/06/12	02:00	16°30.02	87°47.92	**MONO 8 (1)**	2560m	**At station MONO 8**		
	02:37					**Start CASQ operation (12m)**		
						during descent, winch stopped to consolidate cable		
	03:30	16°30.25	87°47.80			CASQ penetration		
	04:45					CASQ on board (top ~ 3m stretched out and mixed; leaking buoy->top was not maintained)	02:45	**MD12-3416-CQ**
	08:59					**Start CALYPSO operation (41.8m)**		
	10:00	16°30.03	87°47.82			Core triggering		
	11:43					Core on deck		**MD12-3417**
	13:20					Problem with Dynamic Positionning System...		
						Stop CASQ operations		
						Leave site to perform a long survey of the levee/chanel area		
						until DP fixed and makes it possible to keep station properly		
05/06/12	05:30			**MONO 8 (2)**		**Back to MONO 8 station**		
						Problem DP not solved. Site abandonned once again.		
						Continue survey to the South	31:00	
						DP fixed. Heading back to MONO 8		
05/06/12	19:45	16°30.29	87°43.92	**MONO 8 (3)**	2560m	**back at station MONO 8**		
	19:57					**Start MC operation**		
	20:56					MC on the seafloor		
	21:56					MC on deck. Empty. Piece of rope blocked the triggering		*MC empty*
	22:41					**Restart MC operation**		
	23:46	16°30.27	87°47.92			MC on the seafloor		
06/06/12	00:39					MC on deck. Tubes filled with sediment !!	04:43	MD12-MC-MONO8
	01:15					**Start CASQ operation**		
	02:16	16°30.27	87°47.92			CASQ penetration		
	03:45					CASQ on deck	03:06	**MD12-3418-CQ**
	04:15					**Leave station MONO 8**		
	06:08	16°14.54	87°54.70	**MONO 9**	2610m	**At station MONO 9 (site selected for dynema tests / CALYPSO)**		
	06:33					Start CTD/rosette operation		
	08:30					CTD/rosette on deck	02:22	shallow CTD/rosette MONO9
	09:00					**Start plankton towing near surface**		
	09:35					End plankton towing	01:05	Surface plankton net
	10:58					**Start Multi-core operation**		
	11:48					MC on the seafloor (stop for truncaning during ascent)		
	12:48					MC on deck. Superb !!!!	03:13	MD12-MC-MONO9
	13:49					**Start CASQ operation (9m)**		
	14:39	16°14.63	87°54.67			CASQ penetration		
	16:00					CASQ on deck	03:12	**MD12-3419-CQ**
						Sediment shows numerous stiff layers (turbidites)		
						-> not suited for CALYPSO tests...		
	16:45					**Leave station MONO 9**		

	19:45	16°00.10	87°52.38	**MONO 10**	2650m	**At Station MONO 10**		
	20:46					**Start CASQ operation**		
	21:45	16°00.10	87°52.37			CASQ penetration		
	23:50					CASQ on deck	04:05	**MD12-3420-CQ**
						Homogeneous sediments. Only a few, thin, coarser layers		
						Seems OK for CALYPSO tests		
07/06/12	02:45					**Start CALYPSO operation, 42m (with Dynema piston cable)**		
	03:50					CALYPSO at the bottom... without triggering?		
						(in fact, probably triggered during final descent)		
						Try landing corer several times		
						Corer lost during ascent to surface....		
	07:25					**Start CALYPSO operation (35.10m)**		
	08:34	15°59.96	87°52.53			Corer triggering		
	10:45					Core on deck	03:20	**MD12-3421**
						Penetration not good enough to attempt ~50m core		
	11:01					**Leave MONO10 to return (once more) to MONO8**		
	13:56	16°30.20	87°47.87	**MONO 8 (4)**	2560m	**At station MONO 8**		
	15:52					**Start CALYPSO operation (52m)**		
	17:11	16°30.18	87°47.87			Corer triggering		
	~ 19:30					Core on Deck		
						Leave site MONO 8 to return to MONO 3 (for MC operation)	05:30	**MD12-3422**
08/06/12	07:09	14°46.9	89°05.8	**MONO 3 (2)**	2807m	**Back at station MONO 3 to try to get a good MC**		
						Problem with MC tube. Too long! Shuters do not close.		
						Tubes cut.		
	08:11					**Start MC operation**		*empty MC*
	09:08	14°46.9	89°05.7			MC on the seafloor		
	10:04					MC on deck. Tubes empty !! Retry...		
	10:37					**Re-try MC operation**		
	10:42					Tension pulse. Triggered on water? MC pulled back to surface. OK		
	10:43					**Re-try MC operation**		
	11:41	14°46.88	89°05.75			MC on the seafloor		
	12:39					MC on deck. Tubes empty !!!		*empty MC*
	12:45					**Decide to stop replicate operations and leave for MONO 2**	05:30	

09/06/12	05:42	11°46.01	88°38.94	**MONO 2 (2)**	3178m	**Back at station MONO 2 to try to get a good MC**		
	05:56					**Start MC operation**		
	09:00					MC on deck. Empty.		
	09:14					**Re-try MC operation**		
	11:32					MC on deck... EMPTY again !! Argh.....	05:50	*empty MC*
	11:40					Decide to abandon MC operations and leave Site		
						Steaming to "fan-like" site, seen during S-N transect between		
						MONO1 and MONO2, at begining of cruise		
						Apparently, sediment cover expands (about x2) at this location		
10/06/12	06:45	8°17.77	89°23.10	**MONO 11**	3530m	**At Station MONO 11**		
	07:35					**Start CALYPSO operation**		
	08:25					Stopped. Rubber protection on winch is replaced		
	10:00					Resume descent (whole fixing operation took ~1:30)		
	10:34	8°17.77	89°23.09			Corer triggering		
	12:20					Corer along deck. Handling chain breaks... Core lost....	05:35	*Corer lost*
						to give time to prepare another ~32m corer		
						we start in situ pumping operation here		
						(instead of going back to nearby MONO 1, where it should have been done)		
	13:00					**Start ISP lowering to depth of 3000m**		
						ISP pumping. 4 hours		
	19:00					Pump on deck	06:00	
	20:20					**Start CALYPSO operation**		
	21:47	08°17.64	89°22.94			Corer triggering		
11/06/12	00:00					Core on deck. We leave the MONO 11 site		**MD12-3423**
						Heading to northern part of NinetyEast Ridge		
						for low sed rate sediment cover		
						Survey NNW-SSE during 3:30 (from 5:00 to 8:30)		
						Decide to return to location crossed early in the survey.		
	11:15	7°08.17	89°48.19	**MONO 12**		**At station MONO 12**		
	11:57					Start CALYPSO operation (32m)		
	13:01	7°08.17	89°48.19			Corer triggering		
	16:00					Core on deck	04:45	*Calypso empty*
						Severely bent.. And no sediment (ogive lost !!)		
						Probably thick Toba Ash layer at ~2m below surface.		
						No need to do CASQ. It would not allow to recover long enough time interval		
						Leave MONO 12		
						End of MONOPOL cruise		
						Back to SINGAPOUR		

3. METHODS AND IN BOARD DATA

2.1 PISTON CORING

Based on the water depth and the length and weight of the corer, the CALYPSO set ups (loop length, free fall height) were carefully optimized in order to avoid as much as possible sediment oversampling and deformation due to elastic rebound. Sedimentary recovery was very good in shallower sites (above ~ 2500m), but oversampling due to elastic rebound could not be avoided at deeper sites. Surface sediment and core catchers were sampled. On several sites, U-channels were sampled in the inner part of the ½ sections, or 1cm thick slabs (for X-ray photography (SCOPIX) and X-ray fluorescence analyses).

2.2 LONG GRAVITY CORING (CASQ)

The IPEV CASQ corer, with its 25x25cm section, makes it possible to recover large quantities of undisturbed sediment, with a good preservation of surface sediments. Most of the times, the 12m-long CASQ was used during the MONOPOL cruise, except when the 12m-long one was still being sampled from a previous CASQ operation. All the CASQ were sampled using 2cm-, 6cm- and 12cm- U channels. At a few sites, the large U-channels were sub-sampled with the 1cm-thick slabs.

2.3 MULTICORING

The biggest failure during the cruise was the difficulties to retrieve samples with the KC multi-corer at deep depths. Another model of MC had been used during two previous cruises (AMOCINT and RETRO1) and worked well. The new model was purchased for the cruise as part of a joint effort between IPEV and the laboratories associated in MONOPOL. This new model, more compact, but also taller, was delivered in Singapore just before boarding for MONOPOL. This did not leave time for some preliminary testing. During the cruise, the successive attempts (site MONO1 to MONO5) were unsatisfactory, with potential problems of triggering and stability on the seafloor. Tubes were either empty, or partially filled with clearly disturbed sediments and showed muddy overlying water. Improvements and modifications have been attempted during the cruise (i.e. removal of the hydraulic damping system, adding of extra weight to improve penetration, building of a large basal frame to improve stability. With these improvements, multi-coring operations were successful at two sites (MONO9 and MONO10), at about 2500-2700m of water depth. However, the multicorer never worked correctly at deeper depths.

2.5 PLANKTON NET HAULS

Samples were collected at different depths with the multinet over a 150-µm sieve.

2.6 CTD

Water was sampled at various depths through the water column. Criteria for depth selection were based on the temperature gradient. A 24 bottles rosette was used with 12-18 L Niskin bottles. A CTD seabird was coupled to the rosette and included temperature, conductivity and dissolved oxygen sensors as well as a transmitter and other logistics equipment.

2.7 SHIPBOARD DATA

2.7.1 Multibeam bathymetry and sub-bottom profiling

The multibeam deep-water echosounder Thomson Seafalcon 11 was installed on board “Marion-Dufresne” in 1995. Since then, it has become an essential instrument that is extensively used for cartography (bathymetry and imagery) and sediment profiling. It runs on two operating modes: the “bathymetry and imaging” mode and the “sub-bottom profiler”

mode. Both modes can be run simultaneously, but only at low speeds (less than 4 knots).

Bathymetry and imagery

In this operating mode, the echo sounder uses transmitted frequencies around a 12 KHz carrier. The range of depths on which this mode can operate is 80 to 11000 meters. Five cross-track swaths are simultaneously created in order to generate a data redundancy (as if five multibeam echosounders were simultaneously used). These swaths are separated by the use of active digital filters. Thus, measurement gaps are avoided. These five swaths are separated (along the boat-track axis) from each other by a 1.4 degree angle. The central swath is vertical. The large antenna 3 dB attenuation level (at transmission) and beam forming at reception allow images to be built and measure bathymetry at 120 degrees from the track axis of the boat (60 degrees to starboard and 60 degrees to portside). For bathymetry, the resolution across-track depends upon the measured depth H. The length across-track of a resolution cell is typically equal to H/100. The number of created soundings for one measurement is typically equal to 2000 (400 per swath).

The imaging system uses the reflectivity extracted from the five separated frequency swaths. A mosaic is created, geographically representing sea bottom level in the studied area. This mosaic is fed by the five sets of backscattered signal. The huge number of data for each swath (18.000) and their redundancy allow a large geographic coverage and the relative increase of the signal-to-noise ratio.

Sub-bottom profiler

The Seafalcon 11 echo sounder also includes a sub-bottom profiler. This system is able to create reflectivity slices of the sub-bottom sea floor as a function of the geographical position of the boat. The central frequency used for this system is equal to 3.75 KHz. As for the “bathymetry and imaging” mode, the transmitted wave is linearly frequency modulated. The corresponding correlation gain is equal to 23 db. The large transmitted bandwidth (1.6 KHz) achieves a small spatial resolution (0.31 meters).

As described above, beam forming from many signals received on each sensor provides a very narrow antenna diagram (high directivity), during emission (4.8 degrees) and reception (5.8 degrees). This beam formation also achieves a high acoustic signal level.

Five beams are created on reception (the central beam is vertical), separated from each other by 5 degrees. This diversity provides an opportunity to record good quality profiles when the across-track slope is steep. Typically, 100 meters penetrations are achieved for a 4000 meters depth.

Post-processing

The post-processing of bathymetry and imaging data is carried out with the “Caraibes” software, developed by I.F.R.E.M.E.R. This program enables:

The creation of geographical digital data grids for bathymetry. Contour extraction, “spline” curves filtering and bi-dimensional digital filtering are examples of tools that can be used to remove any possible artifact. Three-D representations are possible.

The creation of reflectivity mosaics for images. Filtering and contrast enhancement can then be applied. A version for real time display is also installed aboard “ Marion Dufresne”.

To view sub-bottom profiles, the IFRTP has also developed a Unix-based software that uses gmt and is freely available to interested scientific teams.

2.7.2 MSCL

The Geotek Multi-Sensor-Core-Logger is a floor mounted split core logging system that measures P-Wave Velocity and Gamma Density vertically through split cores. It features a moving vertical slide onto which is mounted the upper P-Wave transducer (PWT). The split core version enables geophysical measurements to be made on split sediment cores encased in cylindrical plastic core liners. Core sections (with plastic end caps sometimes for liquid sediments) up to 150 cm long and from 50 to 100 mm diameter can be used. The system is designed to be operated under computer control. The sampling interval chosen is 2 cm.

Sensors

Ultrasonic Transducers to measure the velocity of compressional waves through the core.
A Gamma Ray Source and Detector for measuring the attenuation of gamma rays through the core, providing density and porosity values.
A Magnetic Susceptibility Sensor to determine the amount of magnetically susceptible material present in the sediment.
A secondary measurement sensor enables measurements to be corrected for changes in core diameter. The core diameter is measured with a pair of displacement transducers connected to the spring loaded compressional wave transducers. This enables the compressional wave velocity and density to be calculated, and allows additionally for changes in core diameter.

Method and sensor calibration

Gamma density

A gamma ray source and detector are mounted across the core on a sensor stand that aligns them with the center 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 photons 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: $\Delta = (1/\alpha * d) * \ln (I_0/I)$, *where:*
Δ = sediment bulk density
d = sediment thickness
α = Compton attenuation coefficient
I_0 = gamma source intensity
I = 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 aluminum of varying thickness surrounded completely by water in a sealed liner. Gamma counts should be taken through the calibration sample for different aluminum thickness and plotted as a graph of average $\rangle$ *d versus ln I, where ln I is the natural log of the measured intensity counts per second and Δ *d is the average density * thickness of the aluminum 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 = AXX + BX +C, where X = $\rangle$ *d and y = ln I

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-⟩)/(MGD-WD)

Pwave Velocity System
The upper PWT is raised or lowered 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 (oil filled Acoustic Rolling Contact transducers are used. The active element is a piezo-electric crystal). 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, it is normal to cover the split surface 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.
The P Wave velocity of the pulse through the sediments inside the core liner is given by:
V= X / TT, where X is the sediment thickness and TT the pulse travel time in the sediment.
The measured total travel time in the sediment is: TOT = TT + PTO, where PTO is the P Wave Travel time Offset representing all additional time delays (PTO includes the pulse travel time through the liner and the faces of the transducers, the delay caused by picking a point on the wave form which is about one cycle after the onset, as well as a small electronic delay in the system circuitry).
To determine PTO, distilled water is put in a short length of liner of the type being logged and placed between the P wave transducers as if logging a normal core. The upper transducer is inserted just beneath the water surface and the following values are recorded:
T = water temperature
D = distance between the transducers faces
W = liner thickness
TOT = total travel time recorded
The velocity V of distilled water at the given temperature T is found from a standard reference source.
PTO is then given by the following equation: PTO = TOT – (D-W)/V
Sediment velocity can be processed with salinity, temperature and depth corrections. Geotek use an empirically formula to apply a factor to the measured P Wave velocity. The acoustic impedance, which is the product of the P Wave velocity and density, can also be obtained.

Core Thickness Measurements
Core thickness corresponds to the distance between the active faces of the two PWT. It is measured by mounting a rectilinear displacement transducer (DT) on each of the PWT mountings. Each DT 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
To calibrate the DT, we needed two round calibration bars of know diameter (with a difference of about 20 mm). The smaller one is placed between the transducers and the zero is adjusted. The larger piece is then inserted and the span is adjusted to obtain the difference in diameter.

Magnetic Susceptibility

The Bartington pointer sensor has been used during the MONOPOL cruise. 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.

Sedimentology

The lithology, bed color (Munsell Color Chart), sedimentary structures and drilling disturbances were routinely described in each core.

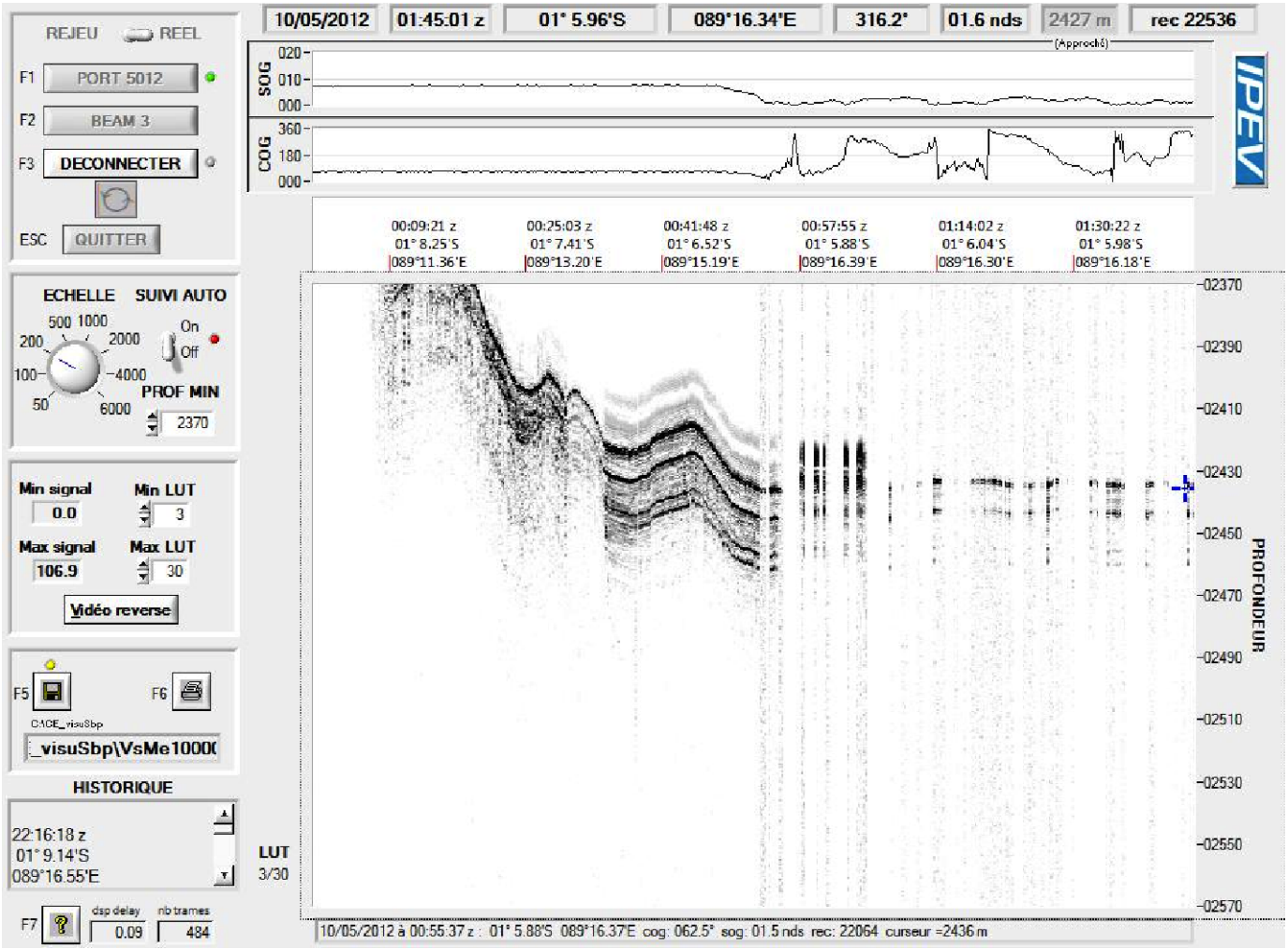
MD191 – MONOPOL	Station: MONO 0

STATION SUMMARY

Date and time approaching site: 10/5/2012 – 1:30 (TU)
Date and time ending station activity: 10/5/2012 – 6:30 (TU)
Latitude: 1°06.07’ S **Longitude**: 89°16.12’ E **Water depth (m)**: 2429
Short area description: At the North of Ridge 90° East.

Activity on station		**Core identification**
Calypso corer	Yes	**MD12-3409**
Casq	No	
Multi-corer	No	
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	No	
Plankton net	No	

Figure: 3.5 kHz profile across station MONO 0.



MD191 – MONOPOL	Station: MONO 0

CALYPSO CORING OPERATION: MD12-3409

Coring site information	*Latitude (°N):*	***1°06.07' S***
	Longitude (°E):	***89°16.12' E***
	Water depth (m):	***2429***
Calypso corer settings	*Core length (m):*	***29.42***
	Empty weight in water (t):	***6.5***
	Free fall (m):	***3.1***
	Length piston cable (m):	***45***
Coring operation	*Time corer starts descent:*	***2:35***
	Time triggering:	***4:02***
	Length cable (m):	***2399***
	Maximum tension (t)	***11***
	Time corer on deck:	***5:30***
Result coring operation	*Total weight in water (t)*	***7.59***
	Length of sediment (m)	***23.70***

General observations / incidents: *No figure for tensiometer record and CINEMA reconstructions for core MD12-3409.*

Yvan Réaud's comments:

Carotte réalisée avant la mission Monopole sur le transit VT-Rama 122, sur la ride du 90ème méridien. L'opération s'est bien passée, tout le matériel fonctionne. La carotte n'a pas pénétrée complètement, environ 5 mètres sont restés hors du sédiment. L'échantillon mesure 23.70 mètres.
Il n'y avait pas d'accéléromètres sur cette opération « test », mais les réglages sont optimaux, et promettent une récupération très fidèle du sédiment in situ. Le sédiment est très blanc, très « dur ».
Réalisée avec des manchons à vis, premier essai, concluant.

MD191 – MONOPOL	Station: MONO 0

SECTIONS INFORMATIONS OF CALYPSO MD12-3409

MONOPOL
-MD191

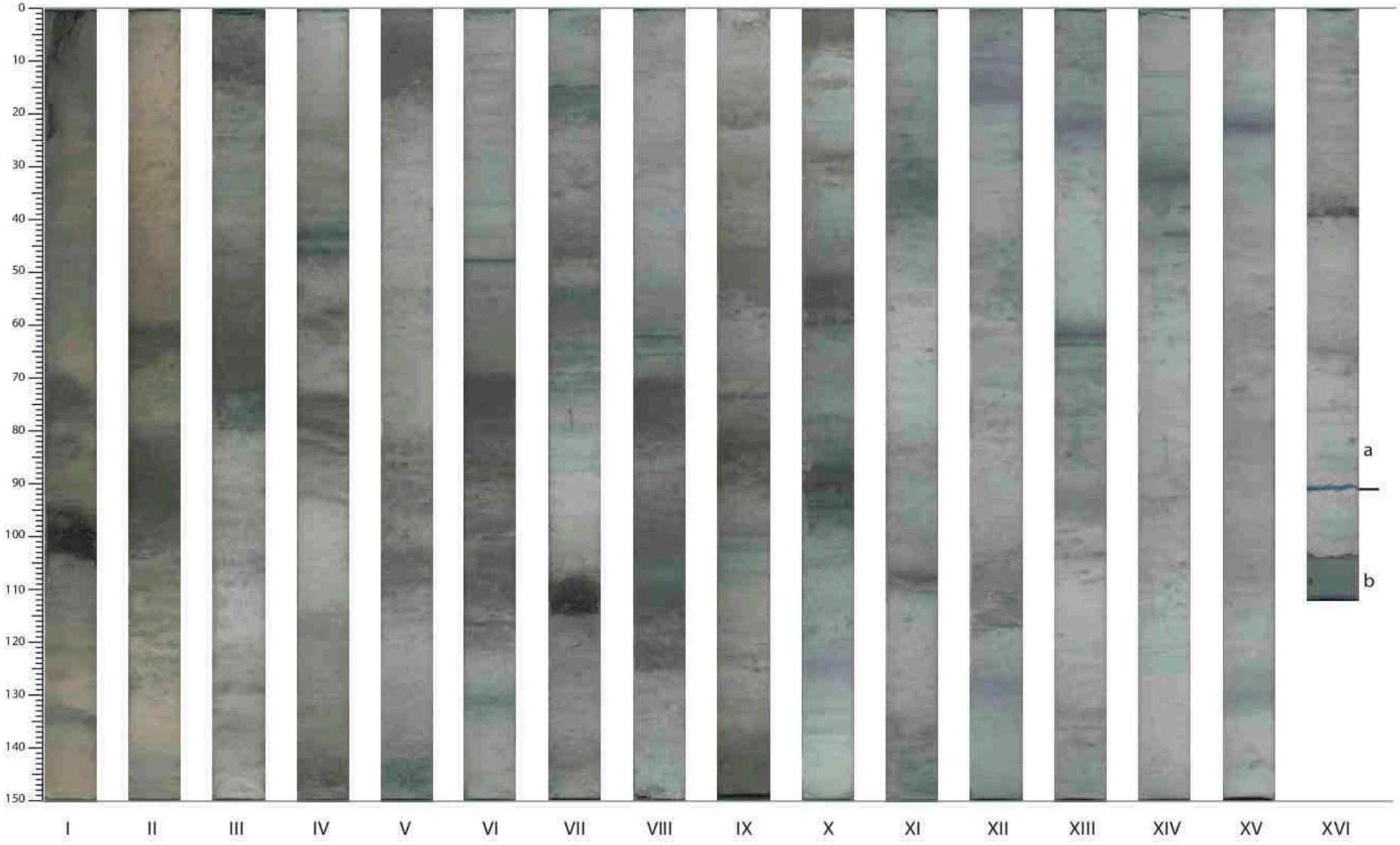
Core MD12-3409

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	150.1	Hole: 96-105
II	150	300	150.5	
III	300	450	151.9	
IV	450	600	150.2	
V	600	750	150.2	
VI	750	900	150.9	
VII	900	1050	151.2	Hole: 1009-1020
VIII	1050	1200	150.7	
IX	1200	1350	150.5	
X	1350	1500	149.5	
XI	1500	1650	150.1	
XII	1650	1800	150.8	
XIII	1800	1950	150.1	
XIV	1950	2100	150.6	
XV	2100	2250	151.0	
XVI	2250	2363	123.2	Sections a and b + hole of 10 cm

MD191 – MONOPOL	Station: MONO 0

PICTURES OF CALYPSO MD12-3409

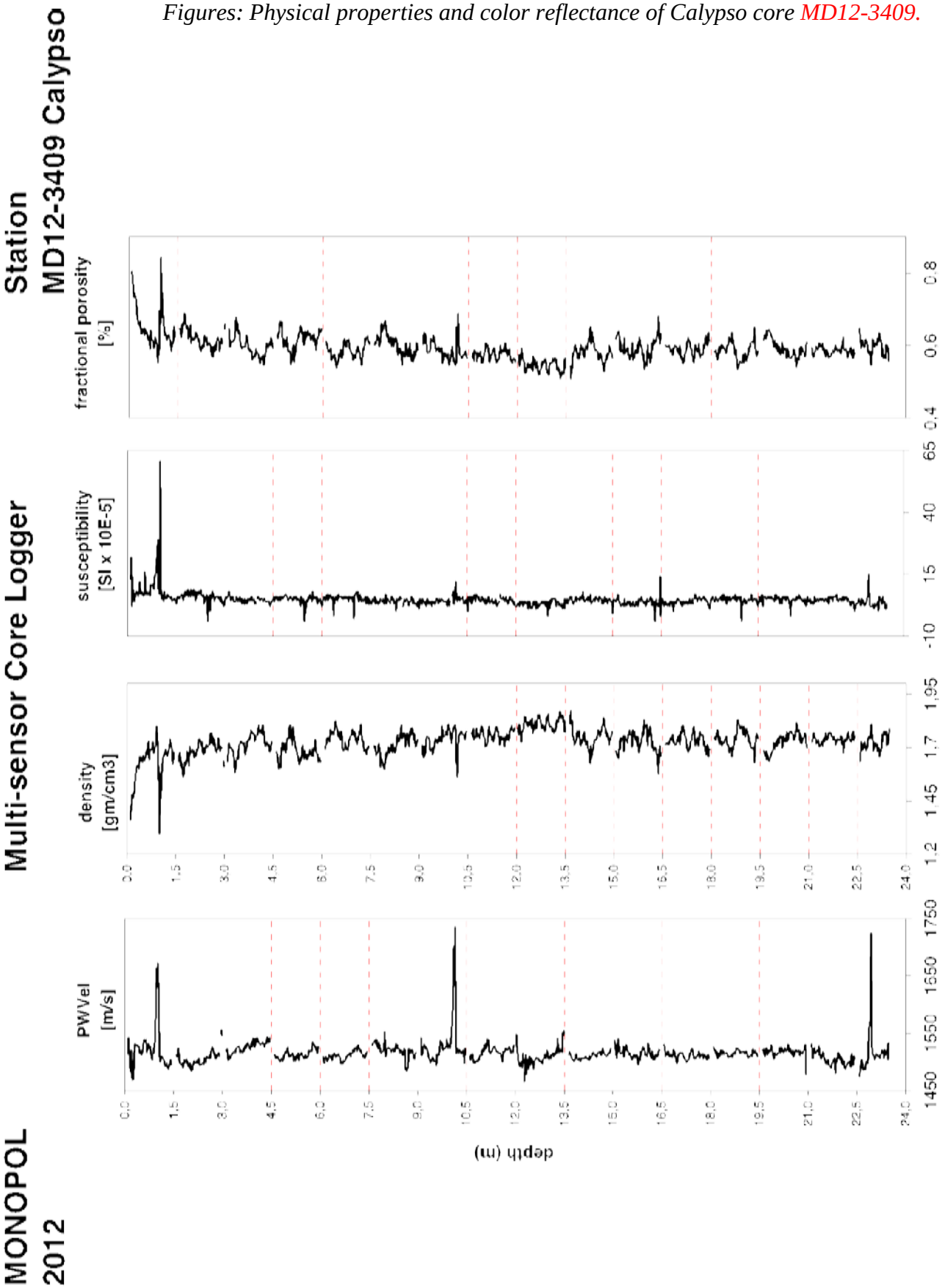
MONOPOL MD 191 - MD12-3409



MD191 – MONOPOL	Station: MONO 0

PHYSICAL PROPERTIES OF CALYPSO MD12-3409

Figures: Physical properties and color reflectance of Calypso core MD12-3409.

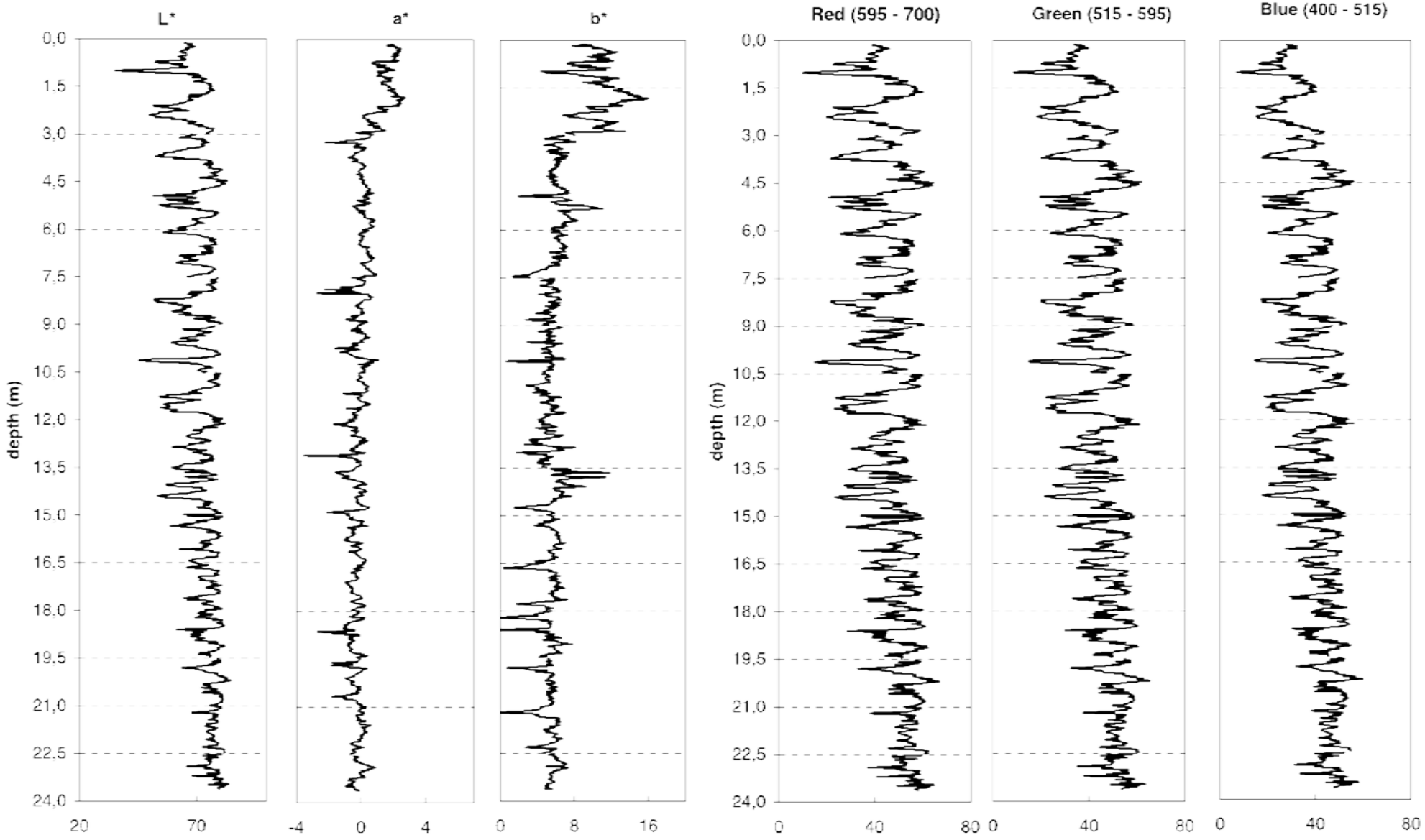


MONOPOL
2012

COLOUR REFLECTANCE

Station
MD12-3409

Spectrophotometer

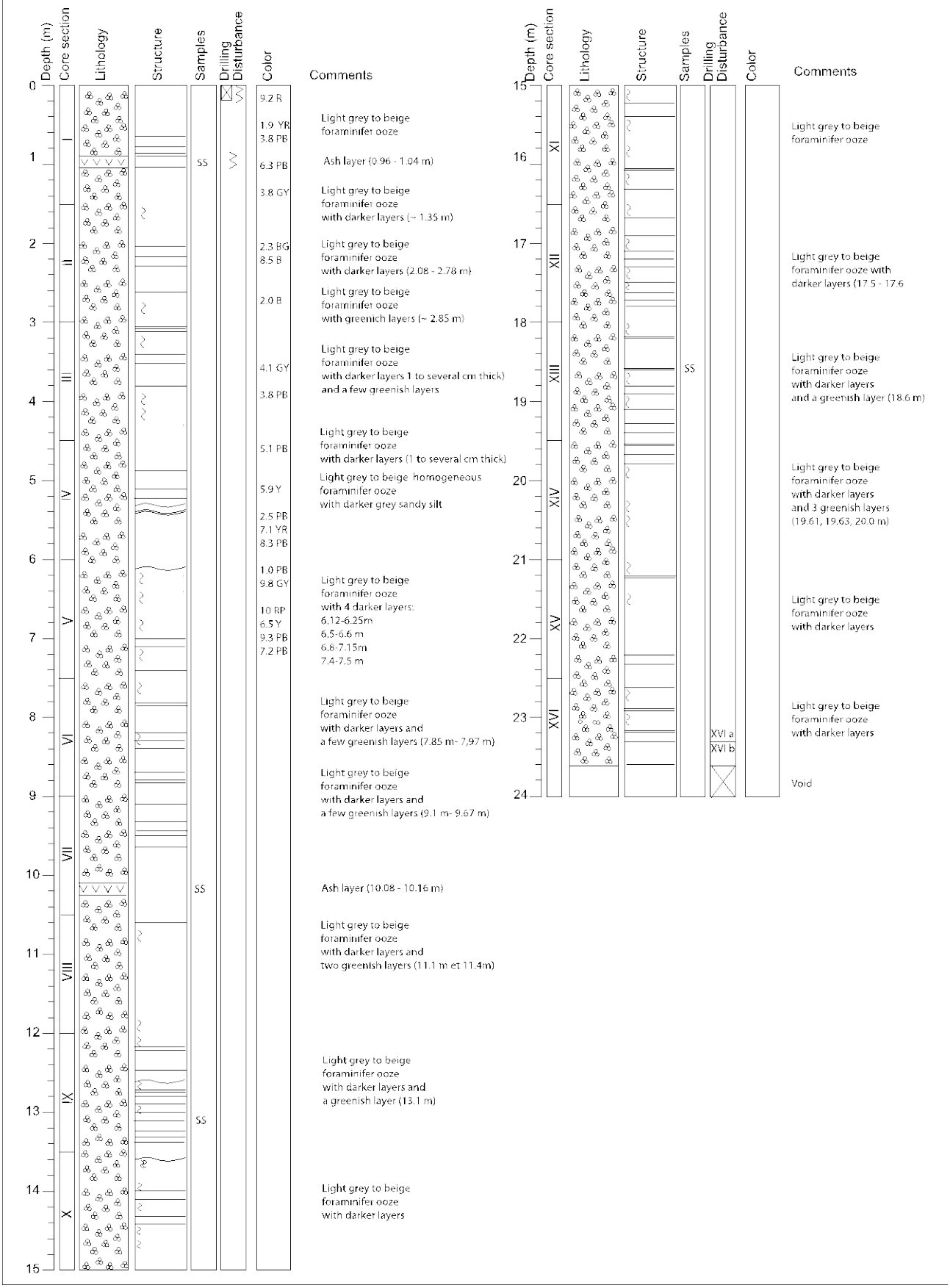


MD191 – MONOPOL	Station: MONO 0

SEDIMENTOLOGY OF CALYPSO MD12-3409

MD191-MONOPOL | Sediment Description | Station MONO 0

Observer: MMBV-EM-SDA | Core MD12-3409 | Water depth (m): 2429



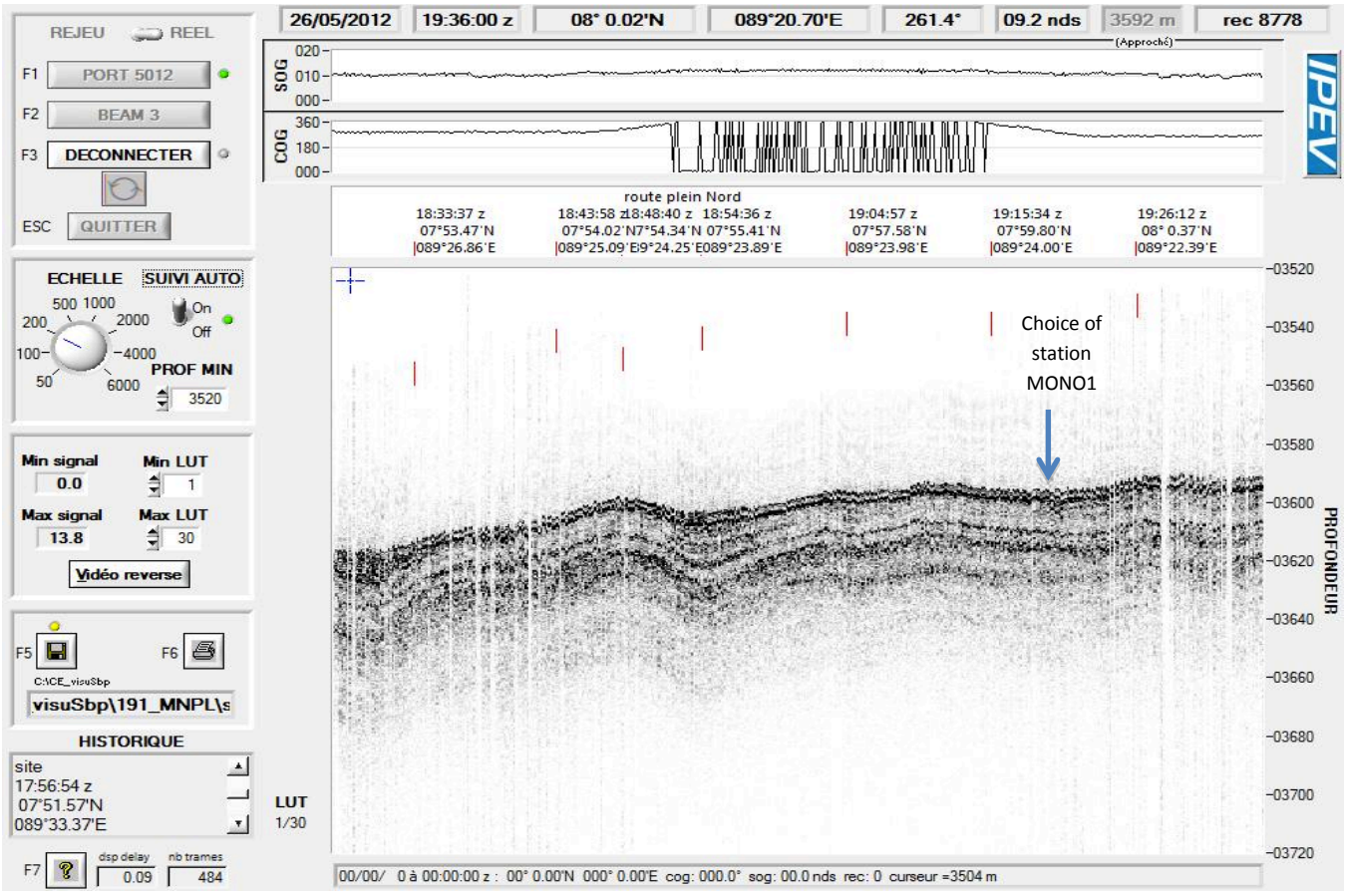
MD191 – MONOPOL	Station: MONO 1

STATION SUMMARY

Date and time approaching site: 26/5/2012 – 22:40 (TU)
Date and time ending station activity: 27/5/2012 – 19:50 (TU)
Latitude: 7°58.95N **Longitude**: 89°24.01E **Water depth (m)**: 3590
Short area description:
South eastern part of the Bay of Bengal. Easternmost end of parasound profile 8°N from SONNE cruise 125. Paleo channel/levee system draped by pelagic cover.

Activity on station		**Core identification**
Calypso corer	Yes	**MD12-3410**
Casq	No	
Multi-corer	Yes	**MD191-MD-MONO1**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	Yes	
Plankton net	Yes	

Figure: 3.5 kHz profile : choice of station MONO1 during the Survey.



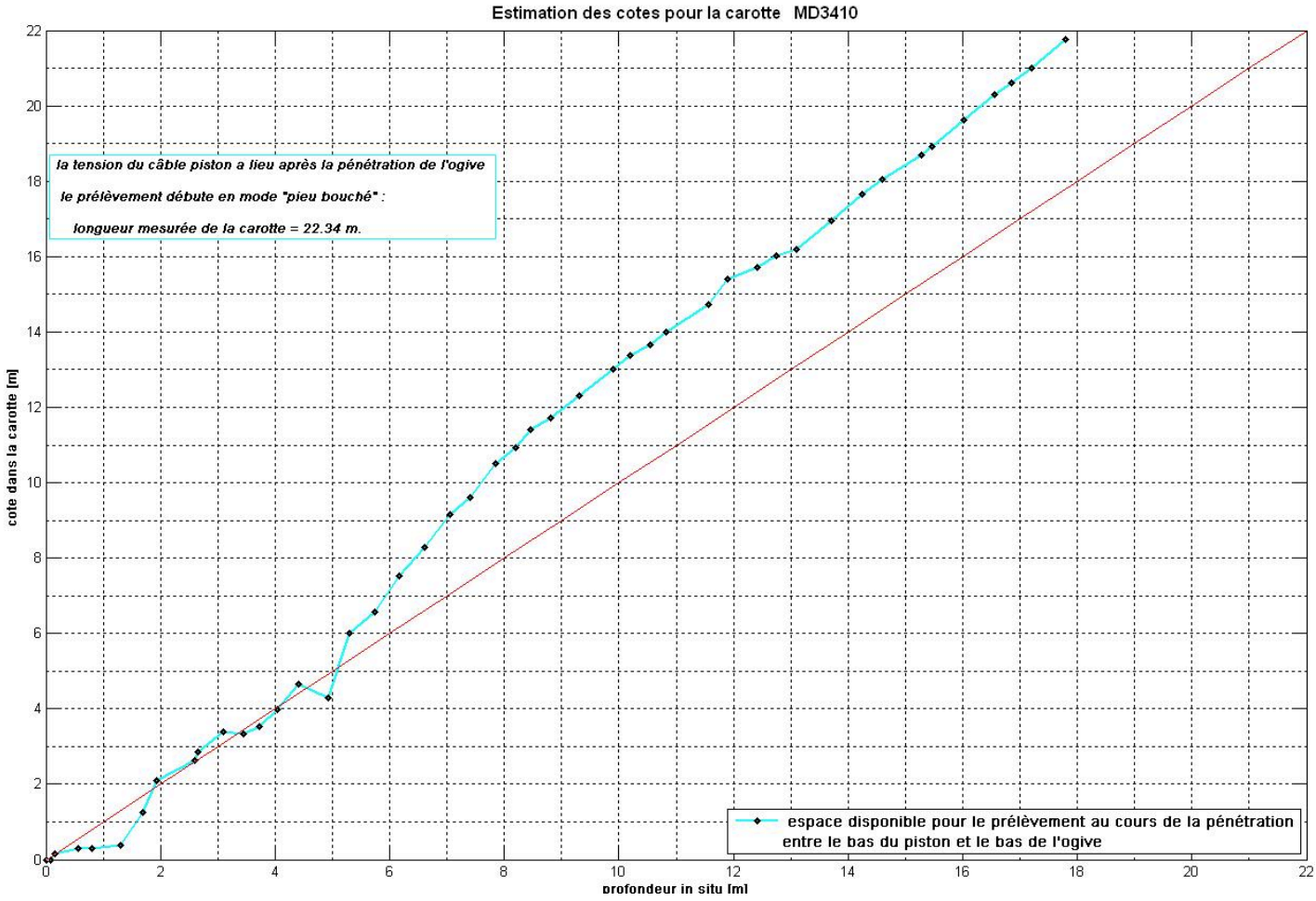
MD191 – MONOPOL	Station: MONO 1

CALYPSO CORING OPERATION: MD12-3410

Coring site information	*Latitude (°N):*	***07°58.95 N***
	Longitude (°E):	***089°24.01 E***
	Water depth (m):	***3571***
Calypso corer settings	*Core length (m):*	***34.40***
	Empty weight in water (t):	***7.15***
	Free fall (m):	***3***
	Length piston cable (m):	***44.9***
Coring operation	*Time corer starts descent:*	***15:28 TU***
	Time triggering:	***16:52 TU***
	Length cable (m):	***3564***
	Maximum tension (t)	***17.71***
	Time corer on deck:	***19:36 TU***
Result coring operation	*Total weight in water (t)*	***7.46***
	Length of sediment (m)	***22***

General observations / incidents: *Penetration 19m -> corer bent. Piston forced its way up, slicing or exploding the liner over several intervals, around the top.*

Figure: Core level versus in situ depth, CINEMA reconstructions for core MD12-3410.



MD191 – MONOPOL	Station: MONO 1

MULTI-CORER OPERATION: MD191-MC-MONO1

Coring site information	*Latitude (°N):*	***7°59.09' N***
	Longitude (°E):	***89°24.09' E***
	Water depth (m):	***3600***
Coring operation	*Time multi corer starts descent:*	***10:00***
	Time at bottom:	***11:20***
	Time corer on deck:	***12:28***
Length of sediments (cm)	*Tube 1*	***-***
	Tube 2	***-***
	Tube 3	***-***
	Tube 4	***-***

General observations / incidents: No triggering => nothing collected : empty tubes!

MULTI-NET OPERATION

		First deployement	***Second deployement***
Coring site information	*Latitude (°N):*	***7°58.83' N***	***7°58.82'N***
	Longitude (°E):	***89°24.05' E***	***89°24.35'E***
Coring operation	*Time start operation:*	***8:10***	***9:10***
	Time net on deck:	***8:44***	***9:26***
Depth of multinet collection (m)	*Collector 1*	***408-180***	***100-80***
	Collector 2	***180-100***	***80-60***
	Collector 3	***100-80***	***60-40***
	Collector 4	***80-60***	***40-20***
	Collector 5	***60-0***	***20-0***

MD191 – MONOPOL	Station: MONO 1

CTD/ROSETTE/ISP OPERATION

CTD/Rosette site information	*Latitude (°N):*	***7°58.8' N***
	Longitude (°E):	***89°24.1' E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***1:40 GMT***
	Time on bottom:	***6:13 GMT***
	Time on deck:	***7:33 GMT***
Depth of Water sampling	*Bottle 1*	***3572***
	Bottle 2	***3420***
	Bottle 3	***3416***
	Bottle 4	***3001***
	Bottle 5	***2999***
	Bottle 6	***2500***
	Bottle 7	***2499***
	Bottle 8	***2001***
	Bottle 9	***1998***
	Bottle 10	***1600***
	Bottle 11	***1251***
	Bottle 12	***1249***
	Bottle 13	***1000***
	Bottle 14	***800***
	Bottle 15	***600***
	Bottle 16	***399***
	Bottle 17	***200***
	Bottle 18	***197***
	Bottle 19	***160***
	Bottle 20	***120***
	Bottle 21	***90***
	Bottle 22	***59***
	Bottle 23	***30***
	Bottle 24	***13***

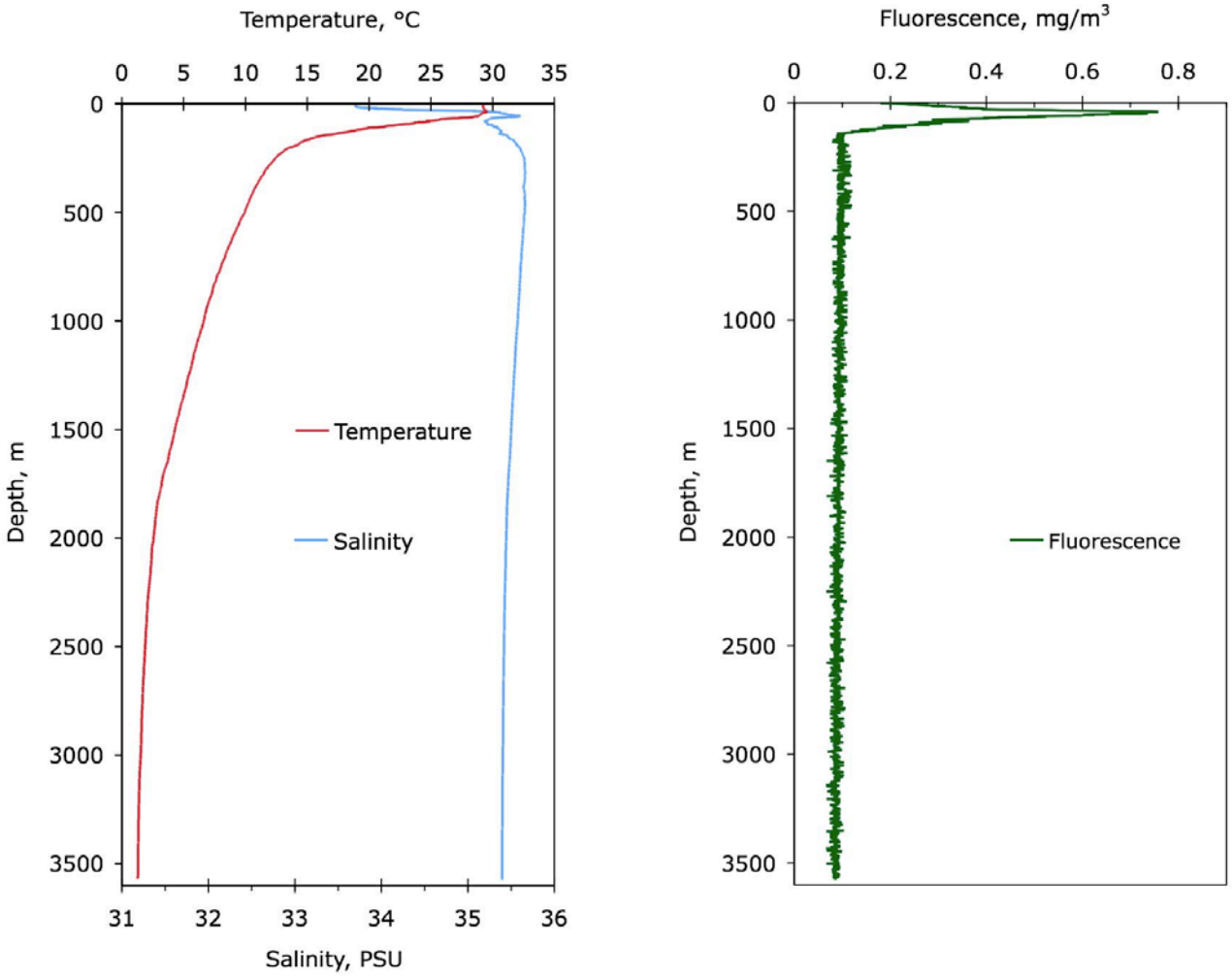
In-Situ Pumping (ISP)

Water depth of pumping (m)	3419
Filtered volume (L)	0
Filter	Nucleopore 0.4 um

General observations / incidents: *ISP didn't work (filter problem: protection liner despite of the filter itself!)*

MD191 – MONOPOL	Station: MONO 1

CTD PROFILES



Figures: Temperature, salinity and fluorescence profiles at site MONO 1.

MD191 – MONOPOL	Station: MONO 1

SECTIONS INFORMATIONS OF CALYPSO MD12-3410

MONOPOL
-MD191

Core MD12-3410

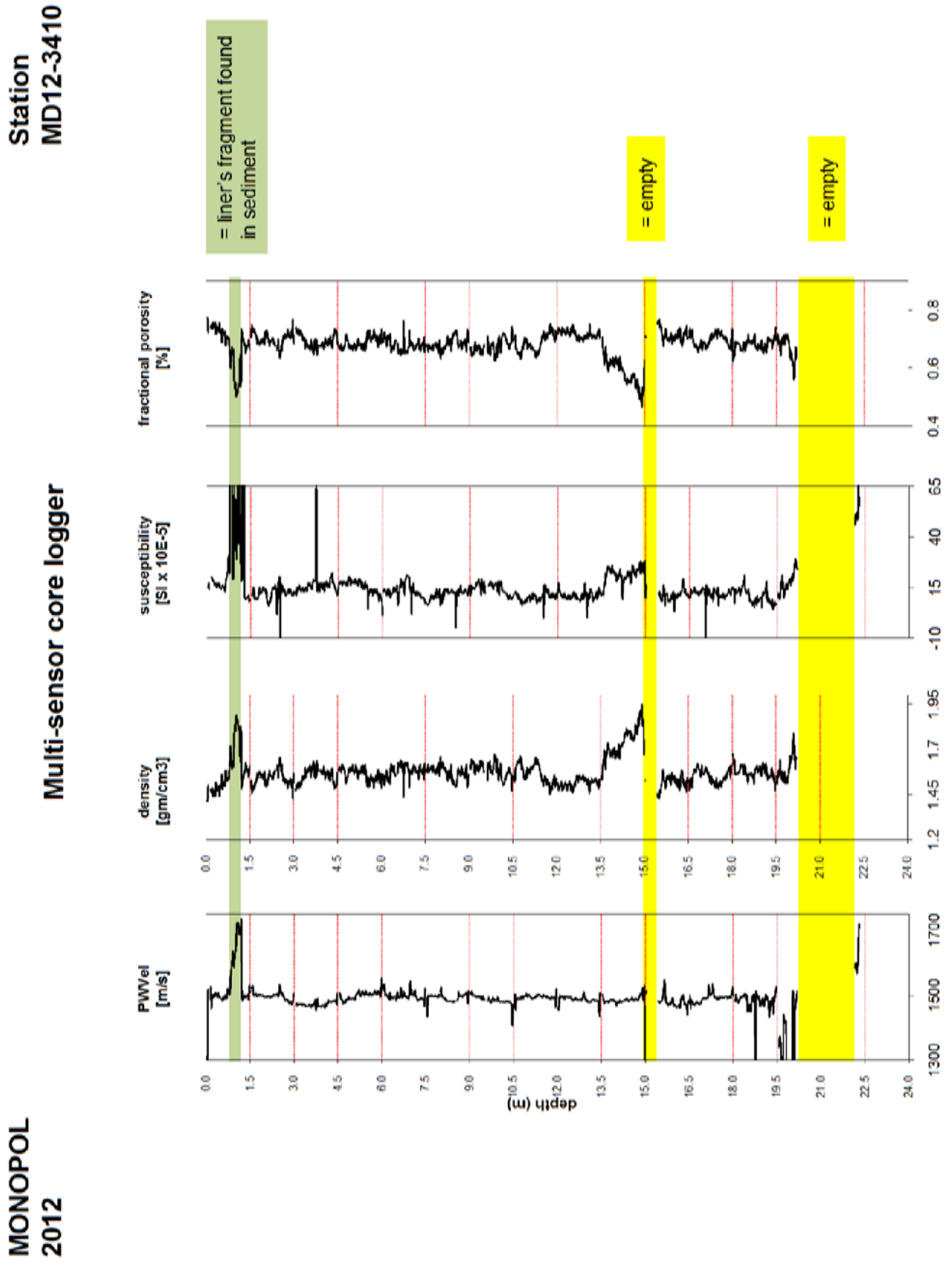
Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
Ia+Ib	0	150	151.2	2 pieces: 0-10 and 10-150; pieces of liner at 80-95.
II	150	300	150.4	
III	300	450	150.4	
IV	450	600	150	
V	600	750	150.2	
VI	750	900	150.4	
VII	900	1050	150.7	Polystyren: 951-962
VIII	1050	1200	150.2	
IX	1200	1350	150.1	
X	1350	1500	150.7	
XI	1500	1650	150.3	Polystyren: 1507-1543
XII	1650	1800	150.6	
XIII	1800	1950	150.4	
XIV	1950	2100	150.3	Polystyren: 2022-2100
XV	2100	2234	134	Polystyren: 2100-2204

MD191 – MONOPOL	Station: MONO 1

PICTURES OF CALYPSO MD12-3410

MD191 – MONOPOL	Station: MONO 1

PHYSICAL PROPERTIES OF CALYPSO MD12-3410



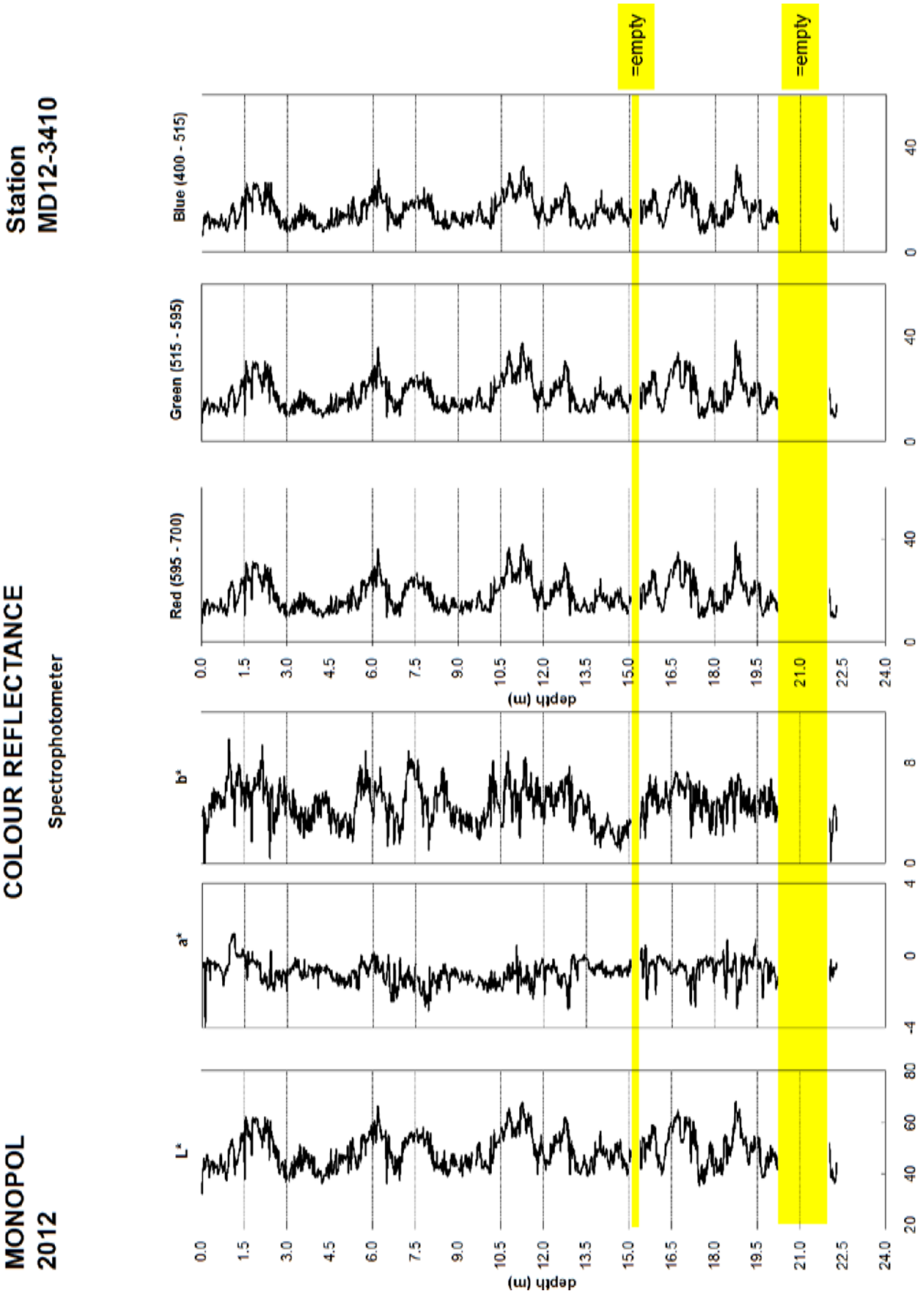


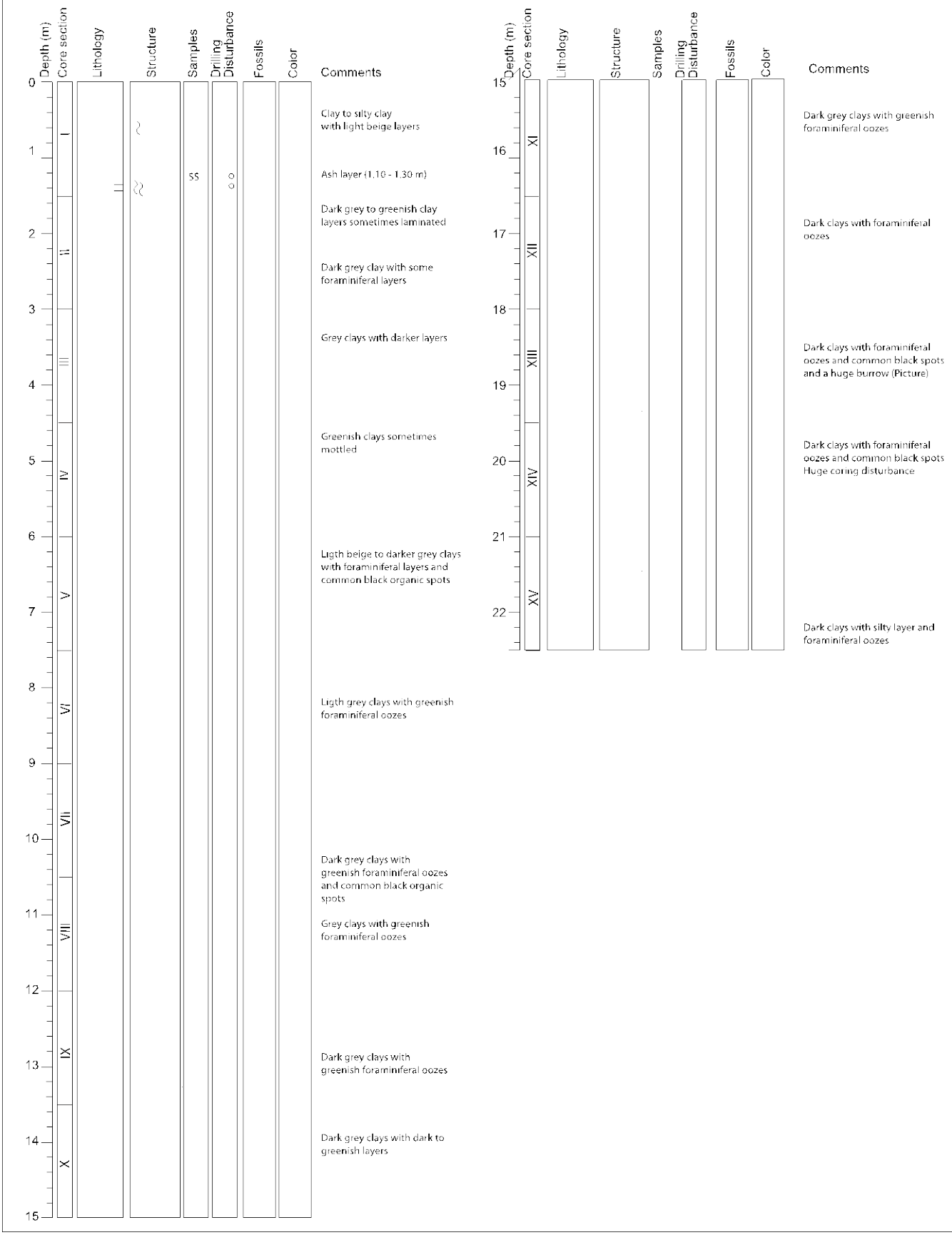
Figure: Physical properties and color reflectance of Calypso core MD12-3410.

MD191 – MONOPOL	Station: MONO 1

SEDIMENTOLOGY OF CALYPSO MD12-3410

MD191-MONOPOL | Sediment Description | Station MONO 1

Observer: MMBV-EM-SDA | Core MD12-3410 | Water depth (m): 3577



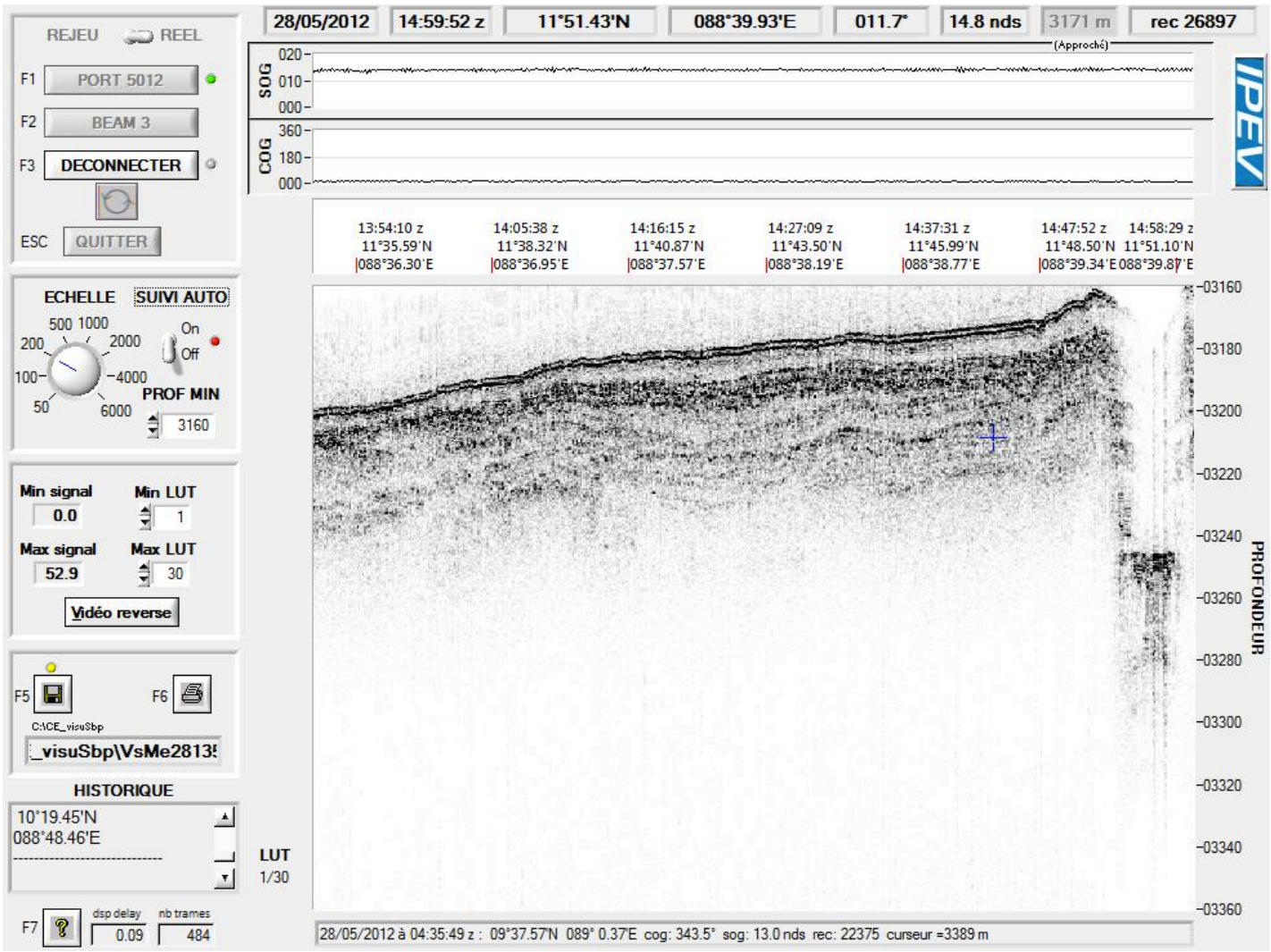
MD191 – MONOPOL	Station: MONO 2

STATION SUMMARY

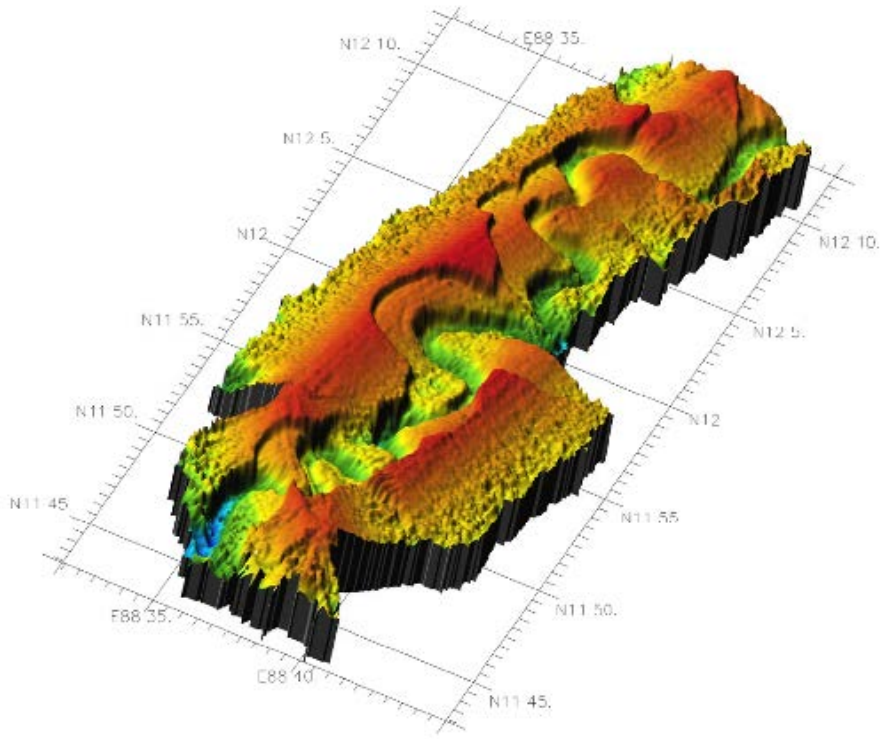
Date and time approaching site: 28/5/2012 – 14:40 (TU)
Date and time ending station activity: 29/5/2012 – 4:20 (TU)
Latitude: 11°46.10’ N **Longitude**: 88°38.78’ E **Water depth (m)**: 3175
Short area description:
Eastern part of the Bay of Bengal. Multiple canyons with meanderings.

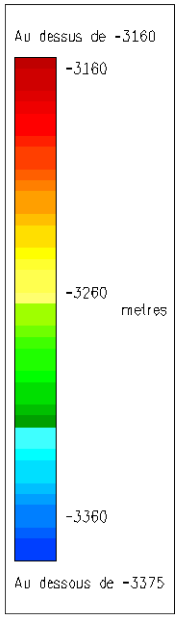
Activity on station		**Core identification**
Calypso corer	No	
Casq	No	
Multi-corer	Yes	**MD191-MC-MONO2**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	Yes	
Plankton net	Yes	

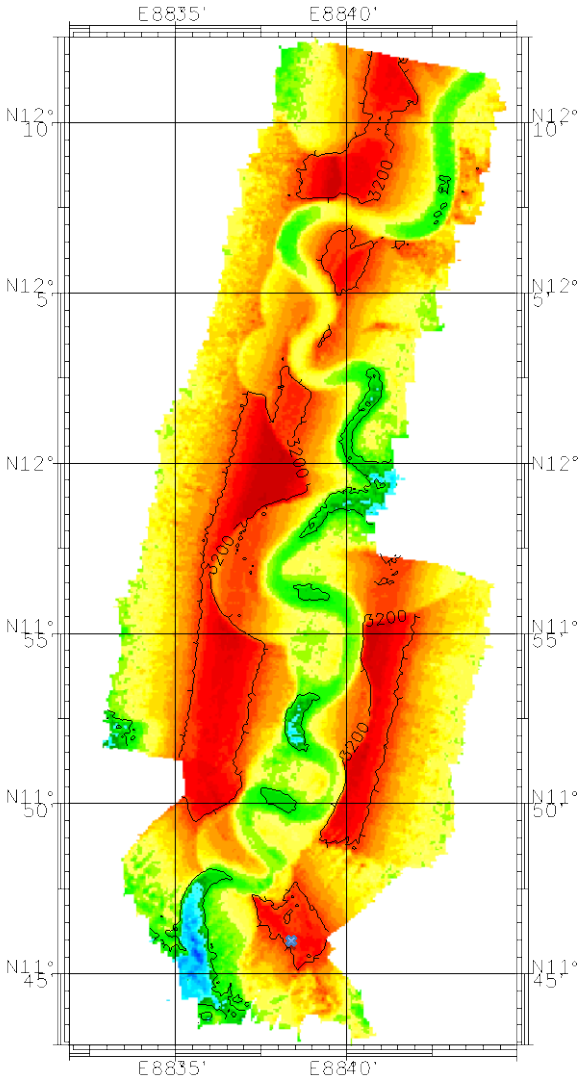
Figure: 3.5 kHz profile across station MONO 2.



Figures: Numerical model of bathymetry (same color scale), and site 2 location.







MD191 – MONOPOL	Station: MONO 2

MULTI-CORER OPERATION: MD191-MC-MONO2

Coring site information	*Latitude (°N):*	***11°46.07' N***
	Longitude (°E):	***88°38.77' E***
	Water depth (m):	***3175***
Coring operation	*Time multi corer starts descent:*	***23:19***
	Time at bottom:	***1:21***
	Time corer on deck:	***2:25***
Length of sediments (cm)	*Tube 1*	***9***
	Tube 2	***14***
	Tube 3	***7***
	Tube 4	***-***

General observations / incidents:

MULTI-NET OPERATION

		First deployement	***Second deployement***
Coring site information	*Latitude (°N):*	***11°45.95' N***	***11°45.94' N***
	Longitude (°E):	***88°38.88' E***	***88°38.88' E***
Coring operation	*Time start operation:*	***2:50***	***3:53***
	Time net on deck:	***3:45***	***4:14***
Depth of multinet collection (m)	*Collector 1*	***405-180***	***105-80***
	Collector 2	***180-100***	***80-60***
	Collector 3	***100-80***	***60-40***
	Collector 4	***80-60***	***40-20***
	Collector 5	***60-0***	***20-0***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 2

CTD/ROSETTE/ISP OPERATION

CTD/Rosette site information	*Latitude (°N):*	***11°46.11' N***
	Longitude (°E):	***88°38.77' E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***17:16***
	Time on bottom:	***18:40 - 22:40***
	Time on deck:	***23:50***
Depth of Water sampling	*Bottle 1*	***3148***
	Bottle 2	***3102***
	Bottle 3	***3001***
	Bottle 4	***3001***
	Bottle 5	***2700***
	Bottle 6	***2400***
	Bottle 7	***2100***
	Bottle 8	***1900***
	Bottle 9	*-*
	Bottle 10	***1299***
	Bottle 11	***1107***
	Bottle 12	***900***
	Bottle 13	*-*
	Bottle 14	***500***
	Bottle 15	***400***
	Bottle 16	***300***
	Bottle 17	***200***
	Bottle 18	***160***
	Bottle 19	***120***
	Bottle 20	***90***
	Bottle 21	***67***
	Bottle 22	***45***
	Bottle 23	***21***
	Bottle 24	*-*

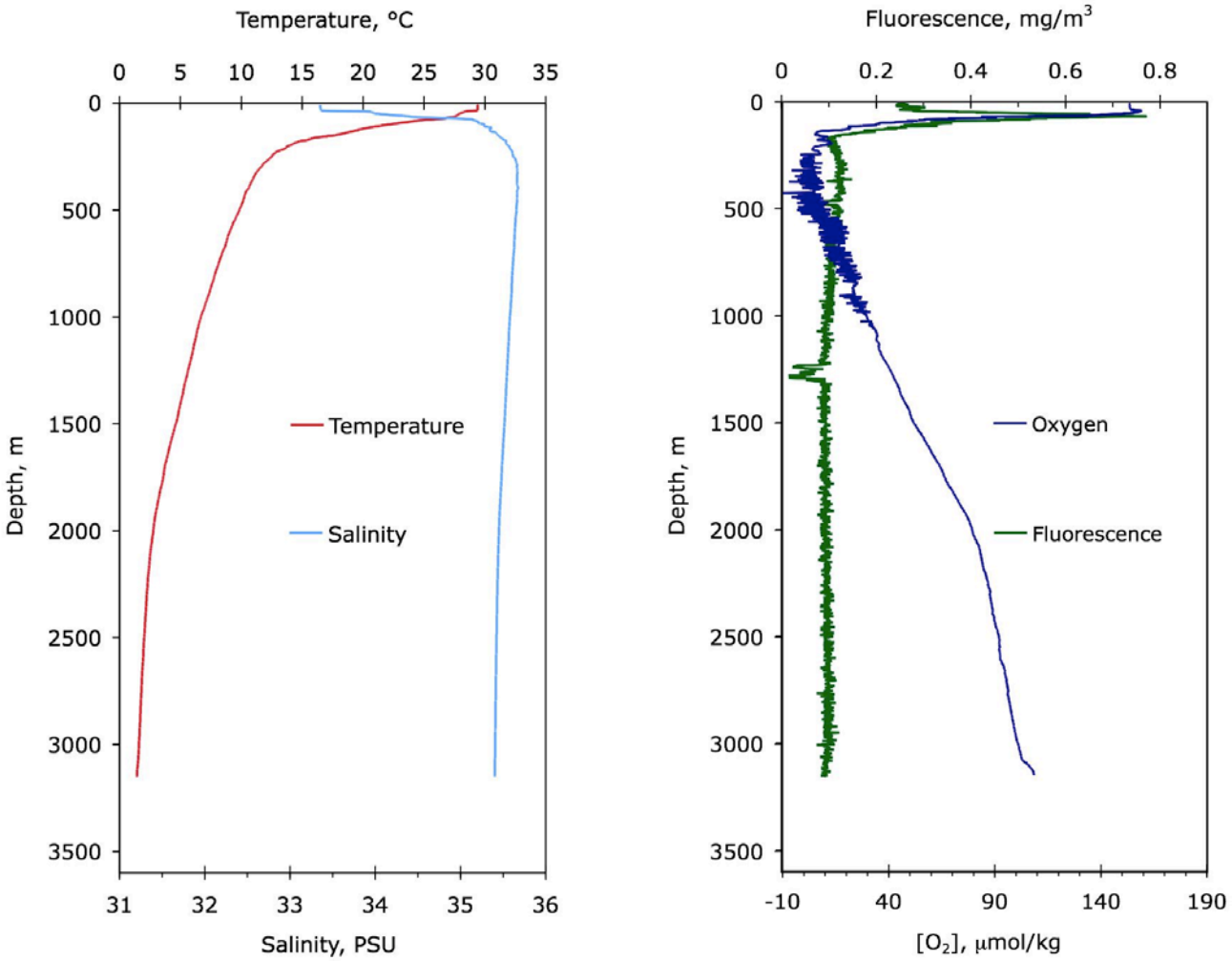
In-Situ Pumping (ISP)

Water depth of pumping (m)	3000
Filtered volume (L)	553
Filter	Nucleopore 0.4 um

General observations / incidents:

MD191 – MONOPOL	Station: MONO 2

CTD PROFILES



Figures: Temperature, salinity, fluorescence and dissolved oxygen profiles at site MONO 2.

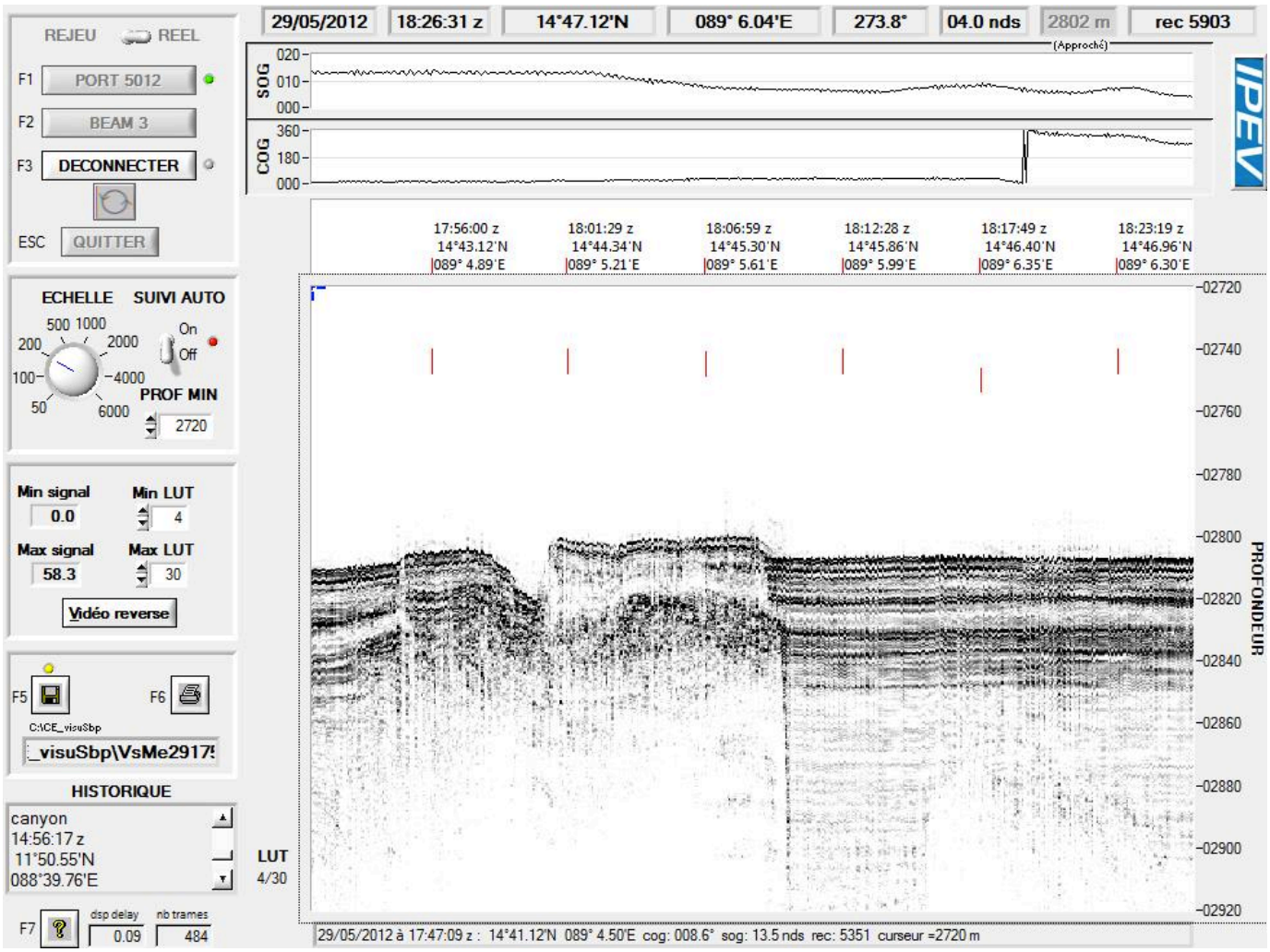
MD191 – MONOPOL	Station: MONO 3

STATION SUMMARY

Date and time approaching site: 29/5/2012 – 18:26 (TU)
Date and time ending station activity: 30/5/2012 – 7:42 (TU)
Latitude: 14°47.086' N **Longitude**: 89°05.537' E **Water depth (m)**: 2806
Short area description:
Northern part of the Bay of Bengal.

Activity on station		**Core identification**
Calypso corer	No	
Casq	No	
Multi-corer	Yes	**MD191-MC-MONO3- II**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	Yes	
Plankton net	Yes	

Figure: 3.5 kHz profile across station MONO 3, while arriving at site.



MD191 – MONOPOL	Station: MONO 3

MULTI-CORER OPERATION: MD191-MC-MONO3-I

Coring site information	*Latitude (°N):*	***14°47.14' N***
	Longitude (°E):	***89°05.57' E***
	Water depth (m):	***2795***
Coring operation	*Time multi corer starts descent:*	***1:53***
	Time at bottom:	***2:45***
	Time corer on deck:	***3:50***
Length of sediments (cm)	*Tube 1*	***-***
	Tube 2	***-***
	Tube 3	***-***
	Tube 4	***-***

General observations / incidents: *3 tubes empty and one filled, but lost on deck.*

MULTI-CORER OPERATION: MD191-MC-MONO3-II

Coring site information	*Latitude (°N):*	***14°47.14' N***
	Longitude (°E):	***89°05.59' E***
	Water depth (m):	***2798***
Coring operation	*Time multi corer starts descent:*	***4:16***
	Time at bottom:	***5:10***
	Time corer on deck:	***6:05***
Length of sediments (cm)	*Tube 1*	***27***
	Tube 2	***11***
	Tube 3	***-***
	Tube 4	***-***

General observations / incidents: *=>Scotch tape put to close the holes and block any leaking.*

MULTI-NET OPERATION

		First deployement	***Second deployement***
Coring site information	*Latitude (°N):*	***14°47.18' N***	***14°47.17' N***
	Longitude (°E):	***89°05.60' E***	***89°05.58' E***
Coring operation	*Time start operation:*	***6:35***	***7:22***
	Time net on deck:	***7:05***	***7:33***
Depth of multinet collection (m)	*Collector 1*	***400-176***	***101-80***
	Collector 2	***176-100***	***80-60***
	Collector 3	***100-80***	***60-40***
	Collector 4	***80-60***	***40-20***
	Collector 5	***60-20***	***20-0***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 3

CTD/ROSETTE/ISP OPERATION

CTD/Rosette site information	*Latitude (°N):*	***14°47.16' N***
	Longitude (°E):	***89°05.72' E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***19:15***
	Time on bottom:	***20:30***
	Time on deck:	***1:23***
Depth of Water sampling	*Bottle 1*	***2782***
	Bottle 2	***2700***
	Bottle 3	***2600***
	Bottle 4	***2400***
	Bottle 5	***2100***
	Bottle 6	***2100***
	Bottle 7	***1800***
	Bottle 8	***1500***
	Bottle 9	***1300***
	Bottle 10	***1100***
	Bottle 11	***895***
	Bottle 12	***700***
	Bottle 13	***601***
	Bottle 14	***500***
	Bottle 15	***401***
	Bottle 16	***300***
	Bottle 17	***200***
	Bottle 18	***160***
	Bottle 19	***120***
	Bottle 20	***90***
	Bottle 21	***68***
	Bottle 22	***45***
	Bottle 23	***20***
	Bottle 24	***5***

In-Situ Pumping (ISP)

Water depth of pumping (m)	2100
Filtered volume (L)	1331
Filter	Nucleopore 0.4 um

General observations / incidents:

MD191 – MONOPOL	Station: MONO 3

CTD PROFILES

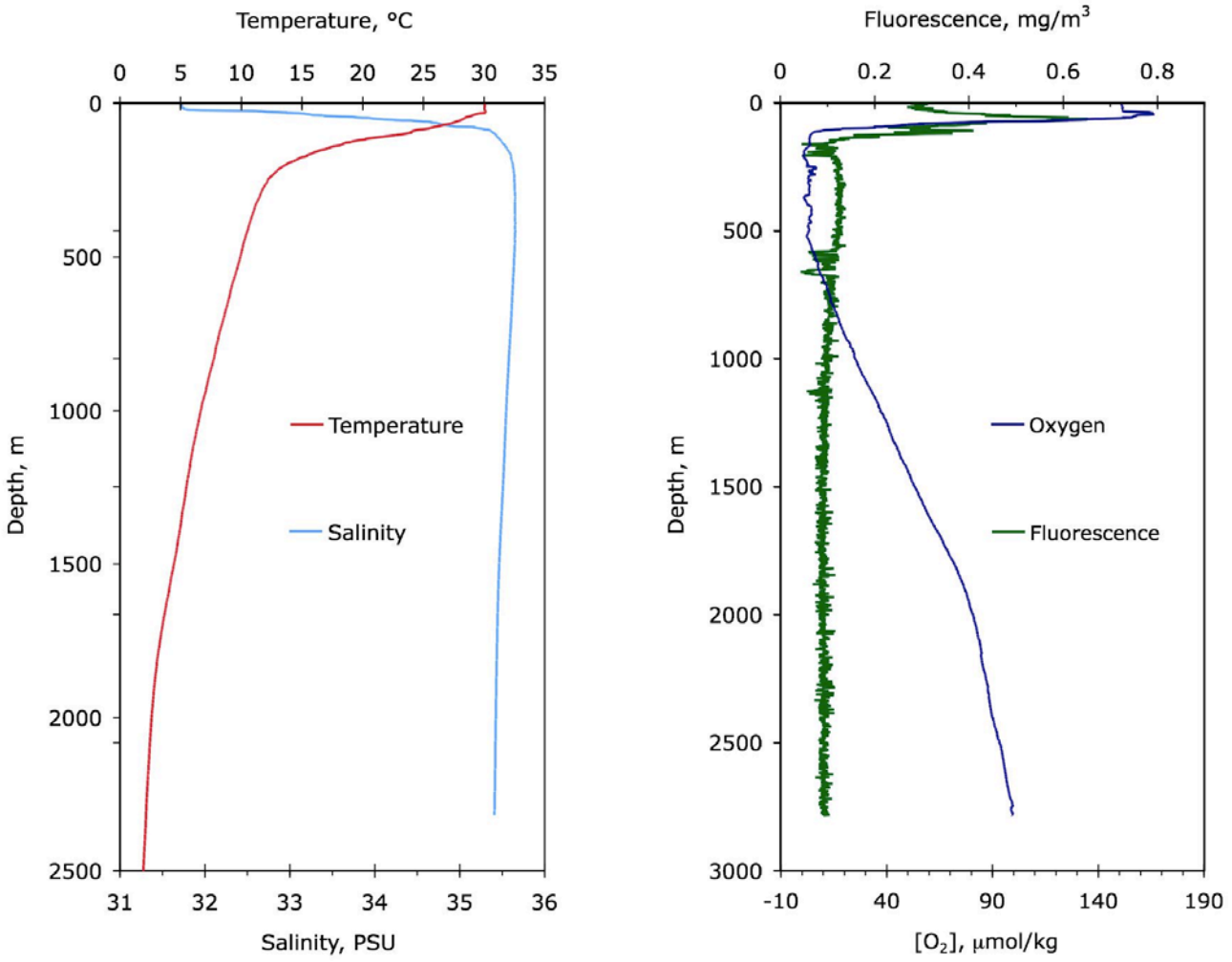


Figure: Temperature, salinity, conductivity, fluorescence and dissolved oxygen profiles at site MONO 3.

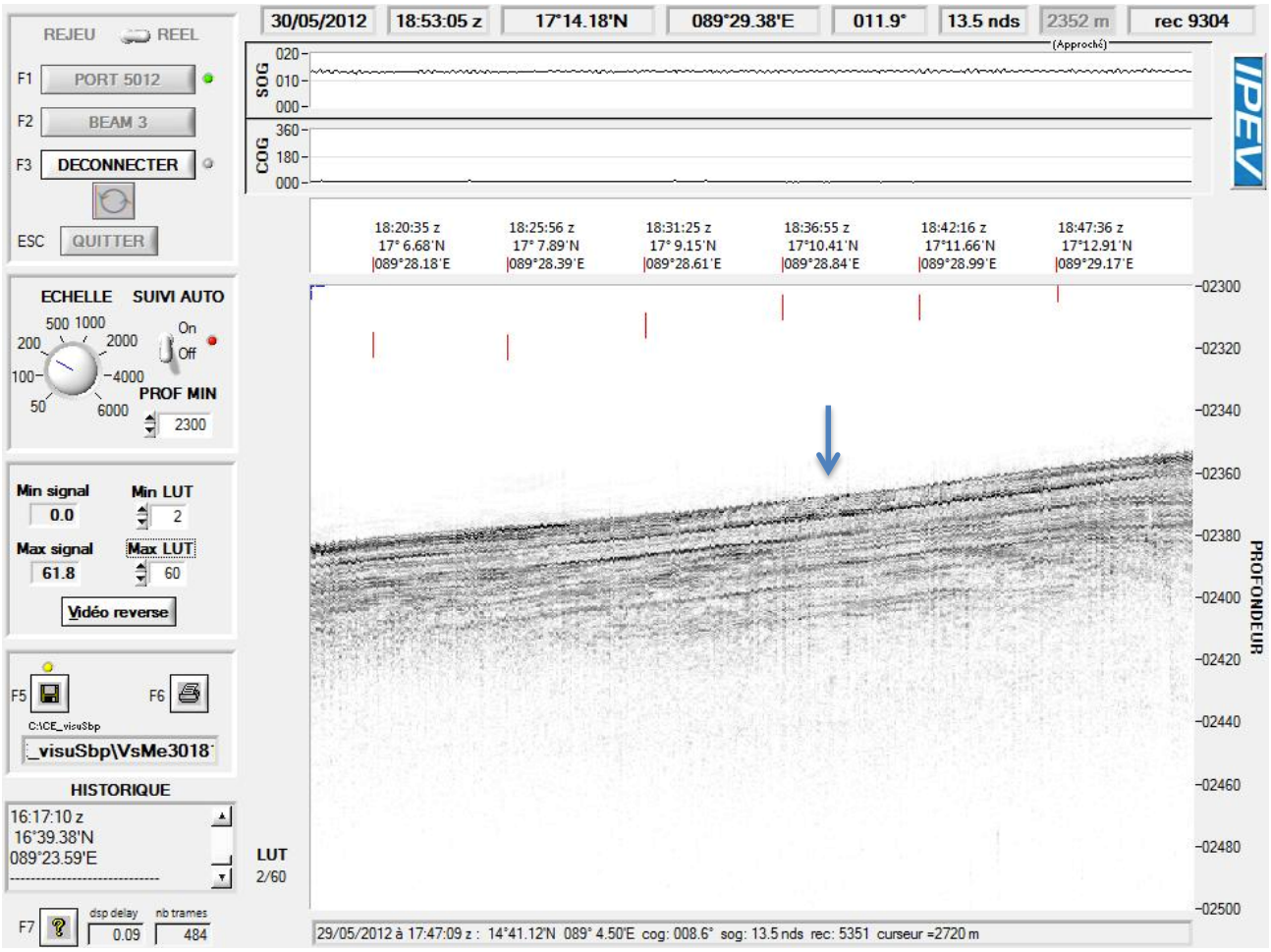
MD191 – MONOPOL	Station: MONO 4

STATION SUMMARY

Date and time approaching site: 30/5/2012 – 20:34 (TU)
Date and time ending station activity: 31/5/2012 – 23:58 (TU)
Latitude: 17°10.94'N **Longitude**: 89°28.92'E **Water depth (m)**: 2368
Short area description:
Northern part of the Bay of Bengal.

Activity on station		**Core identification**
Calypso corer	Yes	**MD12-3412**
Casq	Yes	**MD12-3411 CQ**
Multi-corer	Yes	**MD191-MC-MONO4**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	Yes	
Plankton net	Yes	

Figure: 3.5 kHz profile across station MONO 4.

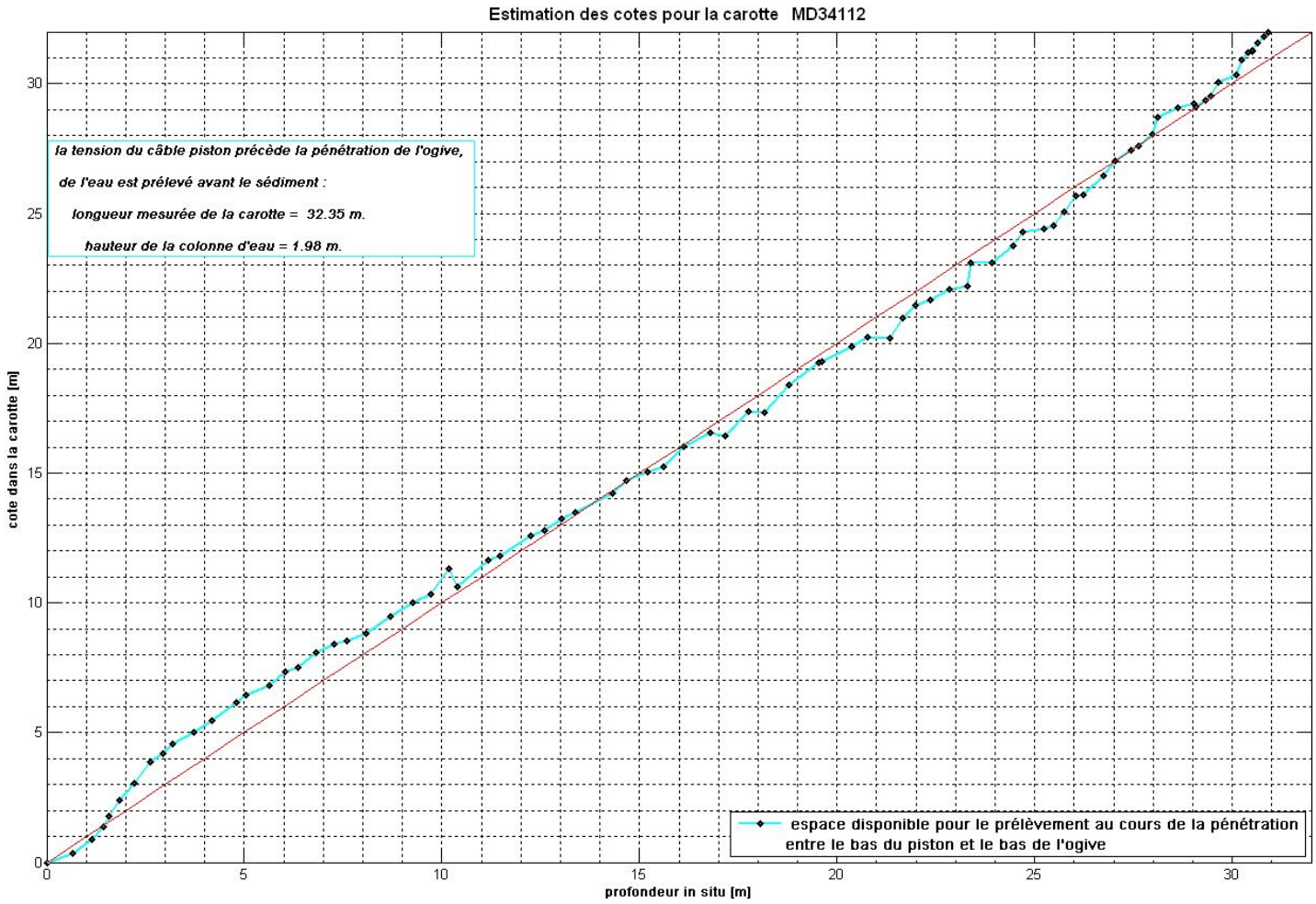


MD191 – MONOPOL	Station: MONO 4

CALYPSO CORING OPERATION: MD12-3412

Coring site information	*Latitude (°N):*	***17°10.94'N***
	Longitude (°E):	***89°29.91'E***
	Water depth (m):	***2367***
Calypso corer settings	*Core length (m):*	***35***
	Empty weight in water (t):	***7.26***
	Free fall (m):	***2.75***
	Length piston cable (m):	***47.15***
Coring operation	*Time corer starts descent:*	***10:31***
	Time triggering:	***11:29***
	Length cable (m):	***2333***
	Maximum tension (t)	***13.9***
	Time corer on deck:	***13:23***
Result coring operation	*Total weight in water (t)*	***7.57***
	Length of sediment (m)	***32.23***

Figure: Core level versus in situ sediment depth, CINEMA reconstructions for core MD12-3412.



MD191 – MONOPOL	Station: MONO 4

CASQ CORING OPERATION: MD12-3411-CQ

Coring site information	*Latitude (°N):*	***17°10.94'N***
	Longitude (°E):	***89°28.92'E***
	Water depth (m):	***2354***
Casq corer settings	*Core length (m):*	***12***
	Empty weight in water (t):	***6.7***
Coring operation	*Time corer starts descent:*	***0:12***
	Time on bottom:	***3:03***
	Maximum tension (t)	***12***
	Time corer on deck:	***5:30***
Result coring operation	*Total weight in water (t)*	***7.3***
	Length of sediment (m)	***9.20***

General observations / incidents: *Winch problem from, two hours (0:45-2:41, with CASQ hanging at 1327 m of water depth). No incidence on coring. Then problem with cable at recovery (truncanage).*

MULTI-CORER OPERATION: MD191-MC-MONO4

Coring site information	*Latitude (°N):*	***17°10.95' N***
	Longitude (°E):	***89°28.93' E***
	Water depth (m):	***2368***
Coring operation	*Time multi corer starts descent:*	***7:00***
	Time at bottom:	***7:34***
	Time corer on deck:	***8:15***
Length of sediments (cm)	*Tube 1*	***28***
	Tube 2	***23***
	Tube 3	***28***
	Tube 4	***26***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 4

CTD/ROSETTE (shallow) OPERATION

CTD/Rosette site information	*Latitude (°N):*	***17°13.25' N***
	Longitude (°E):	***89°28.47' E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***15:53***
	Time on bottom:	
	Time on deck:	***23:30***
Depth of Water sampling	*Bottle 1*	***2329***
	Bottle 2	***2301***
	Bottle 3	***2299***
	Bottle 4	***1900***
	Bottle 5	***1899***
	Bottle 6	***1501***
	Bottle 7	***1499***
	Bottle 8	***1000***
	Bottle 9	***-***
	Bottle 10	***998***
	Bottle 11	***750***
	Bottle 12	***749***
	Bottle 13	***-***
	Bottle 14	***501***
	Bottle 15	***500***
	Bottle 16	***300***
	Bottle 17	***200***
	Bottle 18	***199***
	Bottle 19	***150***
	Bottle 20	***99***
	Bottle 21	***98***
	Bottle 22	***50***
	Bottle 23	***49***
	Bottle 24	***5***

MD191 – MONOPOL	Station: MONO 4-b

CTD/ROSETTE/ISP OPERATION

CTD/Rosette site information	*Latitude (°N):*	***17°13.25' N***
	Longitude (°E):	***89°28.47' E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***15:53***
	Time on bottom:	
	Time on deck:	***23:30***
Depth of Water sampling	*Bottle 1*	***2329***
	Bottle 2	***2301***
	Bottle 3	***2299***
	Bottle 4	***1900***
	Bottle 5	***1899***
	Bottle 6	***1501***
	Bottle 7	***1499***
	Bottle 8	***1000***
	Bottle 9	*-*
	Bottle 10	***998***
	Bottle 11	***750***
	Bottle 12	***749***
	Bottle 13	*-*
	Bottle 14	***501***
	Bottle 15	***500***
	Bottle 16	***300***
	Bottle 17	***200***
	Bottle 18	***199***
	Bottle 19	***150***
	Bottle 20	***99***
	Bottle 21	***98***
	Bottle 22	***50***
	Bottle 23	***49***
	Bottle 24	***5***

In-Situ Pumping (ISP)

Water depth of pumping (m)	1000
Filtered volume (L)	512
Filter	Nucleopore 0.4 um

General observations / incidents:

MULTI-NET OPERATION

		First deployement	***Second deployement***
Coring site information	*Latitude (°N):*	***17°10.94' N***	***17°10.94' N***
	Longitude (°E):	***89°28.92' E***	***89°28.92' E***
Coring operation	*Time start operation:*	***21:35***	***22:24***
	Time net on deck:	***22:20***	***22:45***
Depth of multinet collection (m)	*Collector 1*	***400-180***	***103-81***
	Collector 2	***180-100***	***81-60***
	Collector 3	***100-80***	***60-40***
	Collector 4	***80-60***	***40-20***
	Collector 5	***60-0***	***20-0***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 4

CTD PROFILES (shallow)

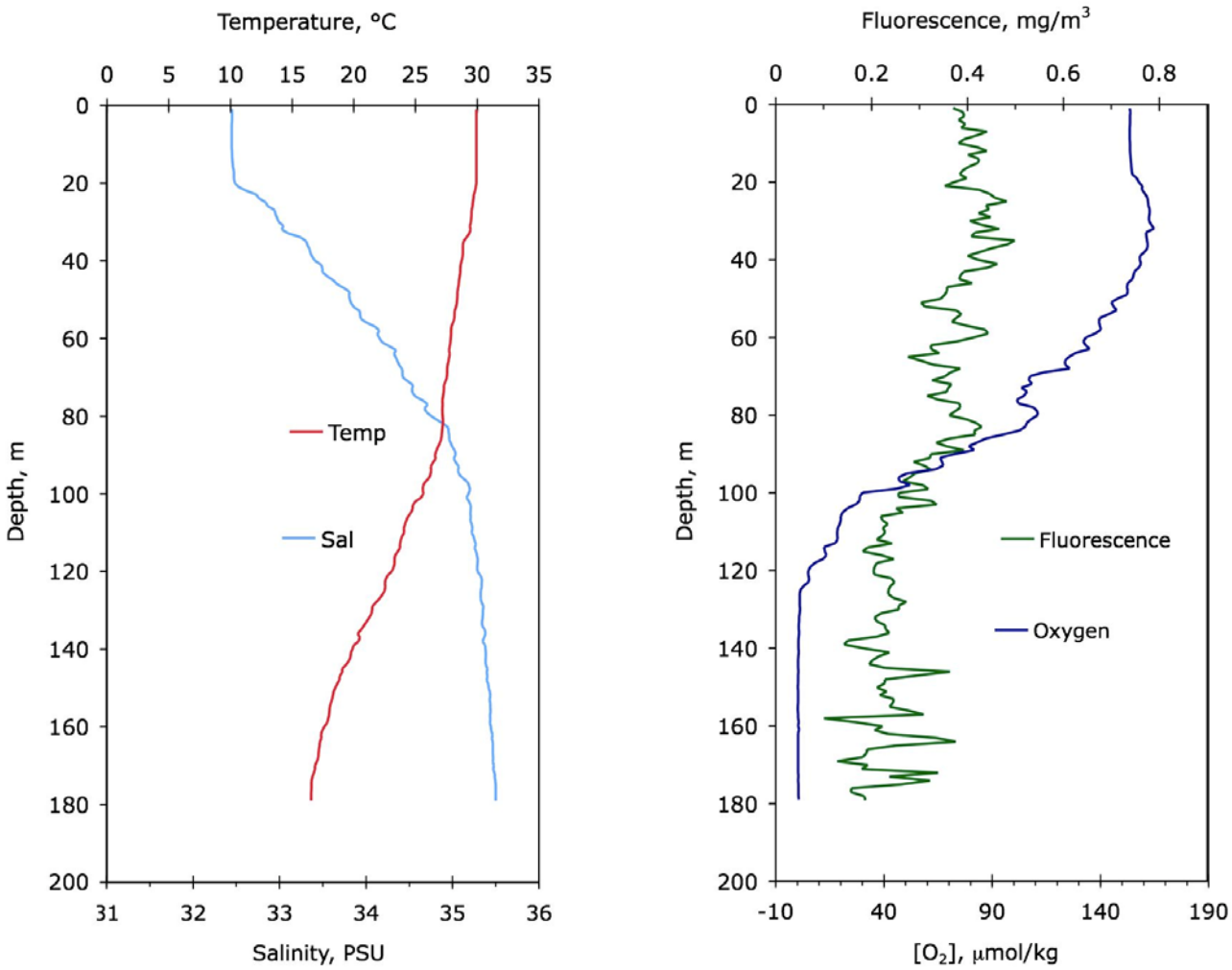


Figure: Temperature, salinity, fluorescence and dissolved oxygen profiles at site MONO 4.

MD191 – MONOPOL	Station: MONO 4-b

CTD PROFILES

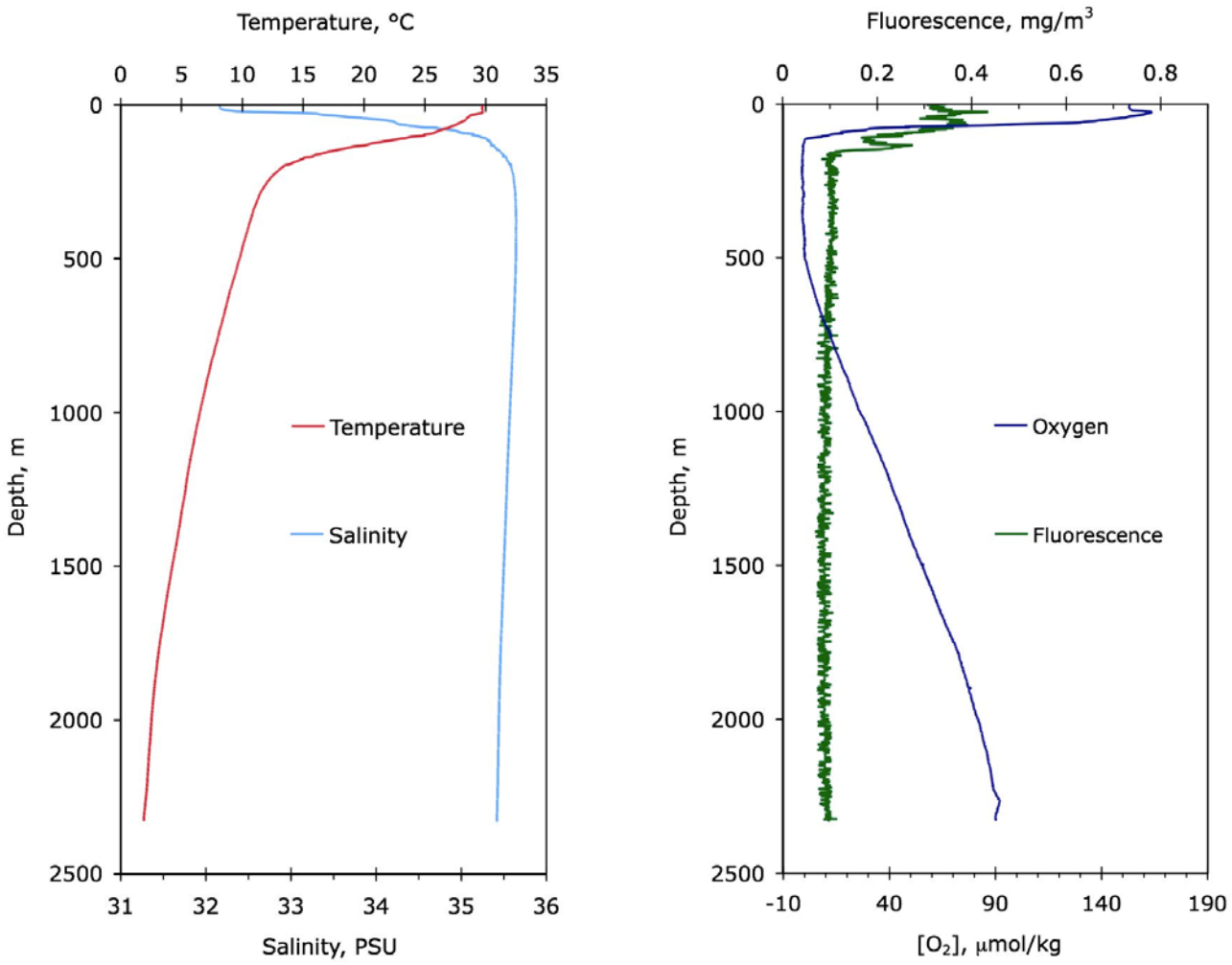


Figure: Temperature, salinity, fluorescence and dissolved oxygen profiles at site MONO 4-b.

MD191 – MONOPOL	Station: MONO 4

SECTIONS INFORMATIONS OF CALYPSO MD12-3412

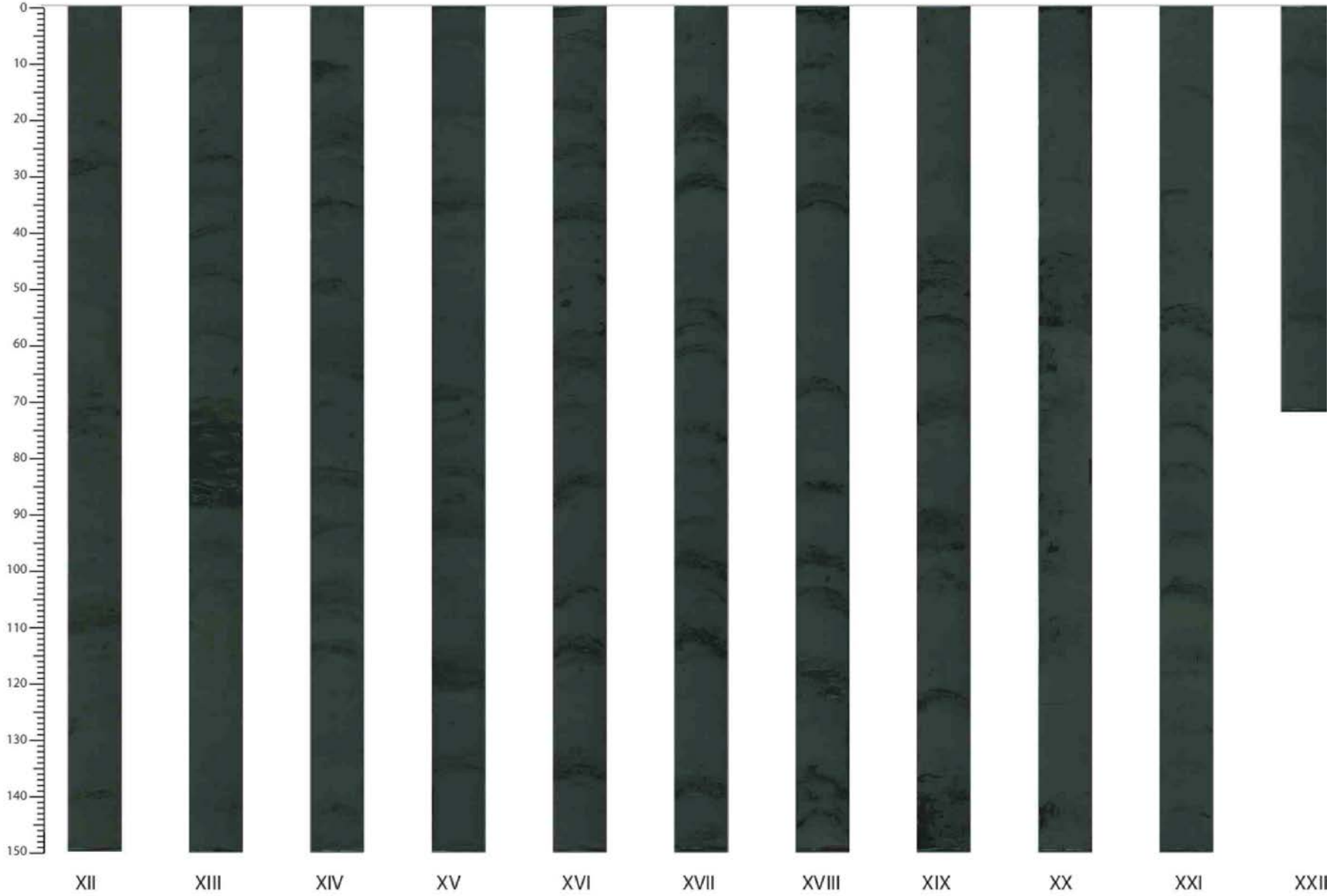
MONOPOL
-MD191

Core MD12-3412

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	149.6	
II	150	300	150.8	
III	300	450	150.1	
IV	450	600	150.4	
V	600	750	150	
VI	750	900	150.8	
VII	900	1050	150.3	
VIII	1050	1200	150.4	
IX	1200	1350	150.5	
X	1350	1500	150.4	Polystyren: 1401-1490
XI	1500	1650	150.2	
XII	1650	1800	150.4	
XIII	1800	1950	150	
XIV	1950	2100	149.1	
XV	2100	2250	151.9	
XVI	2250	2400	151.7	
XVII	2400	2550	152.2	
XVIII	2550	2700	152.2	
XIX	2700	3850	150.8	
XX	2850	3000	150.5	
XXI	3000	3150	150.9	
XXII	3150	3221	71.9	

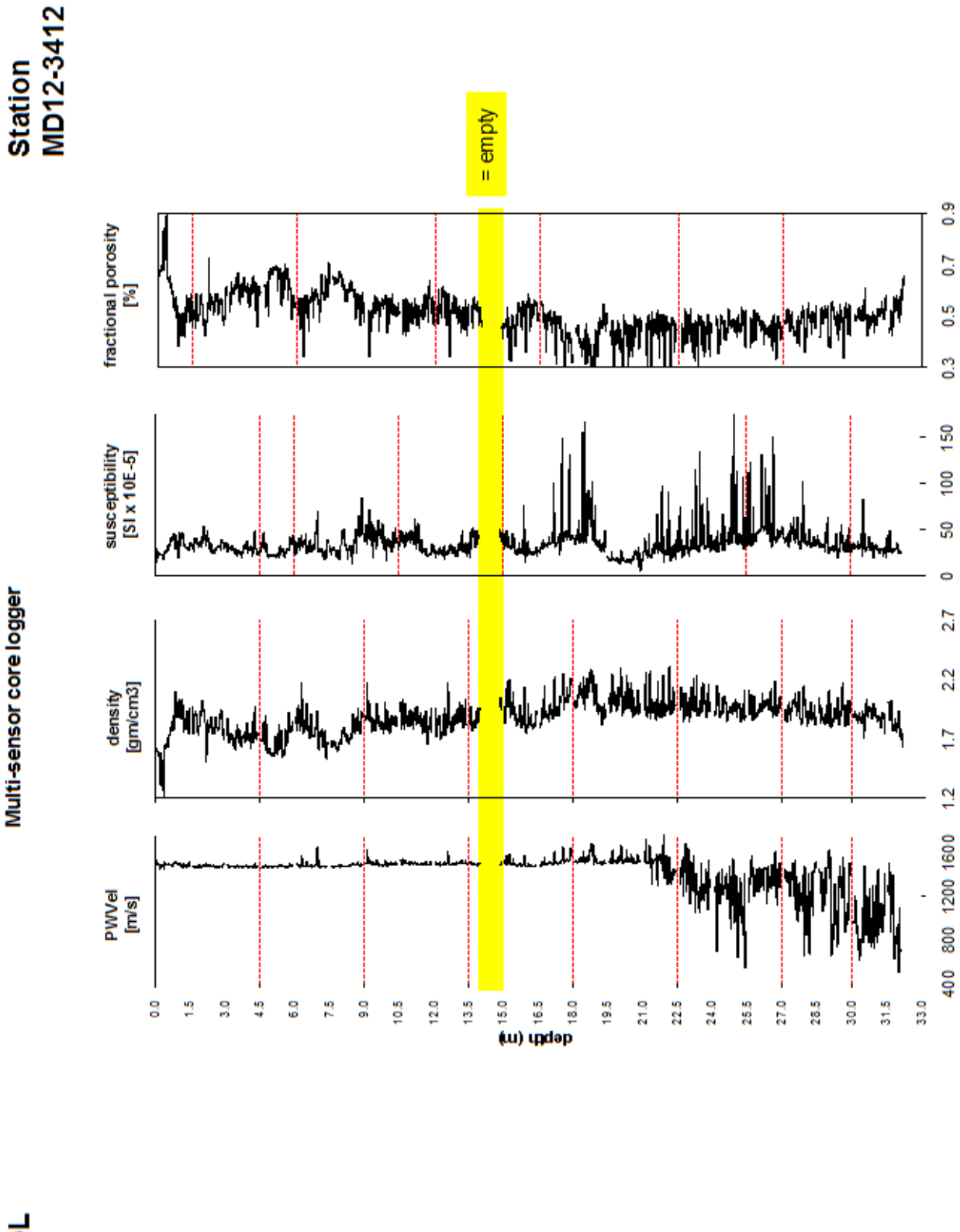
MD191 – MONOPOL	Station: MONO 4

PICTURES OF CALYPSO MD12-3412


0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
XII
XIII
XIV
XV
XVI
XVII
XVIII
XIX
XX
XXI
XXII

MD191 – MONOPOL	Station: MONO 4

PHYSICAL PROPERTIES OF CALYPSO MD12-3412



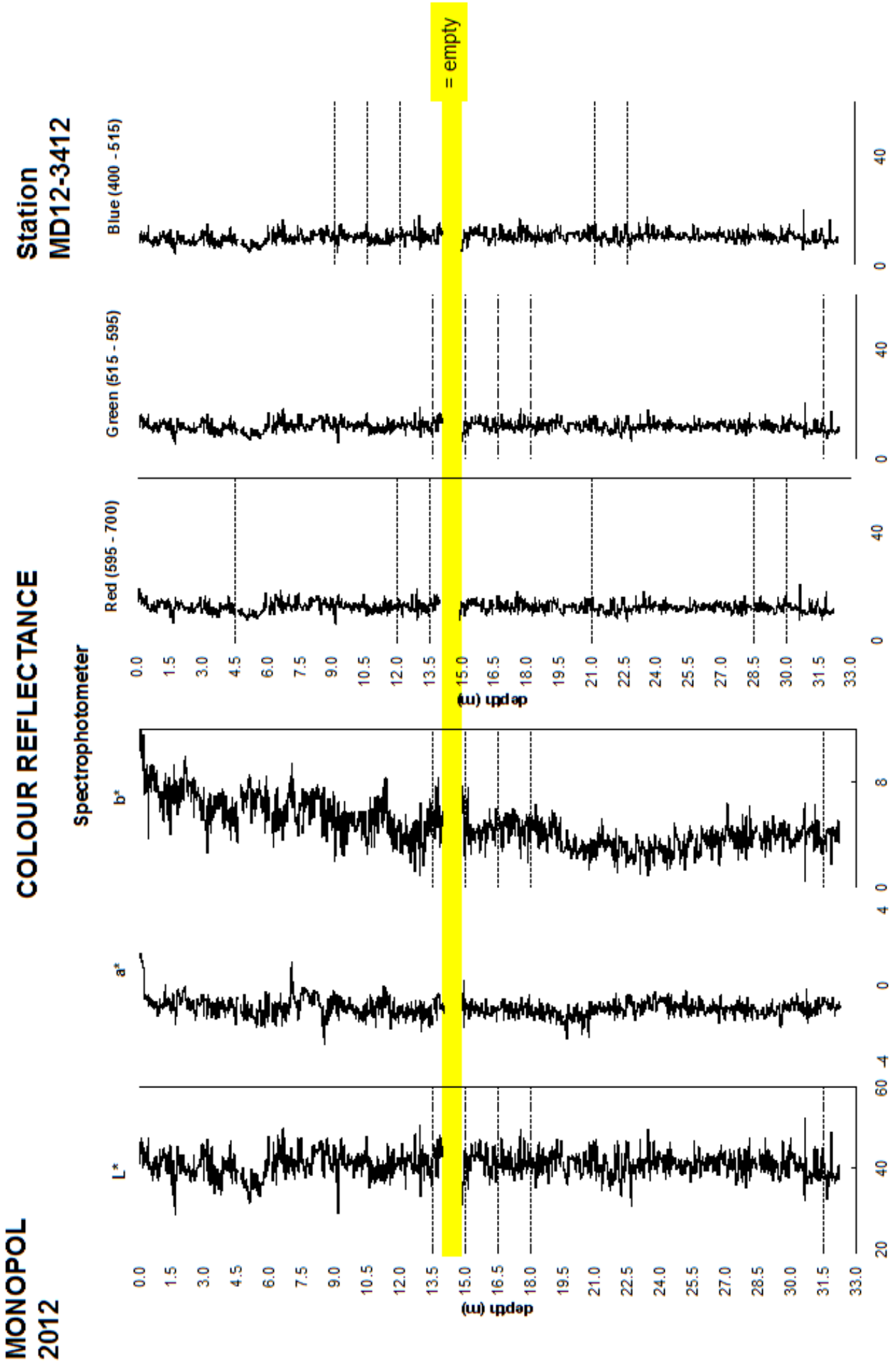


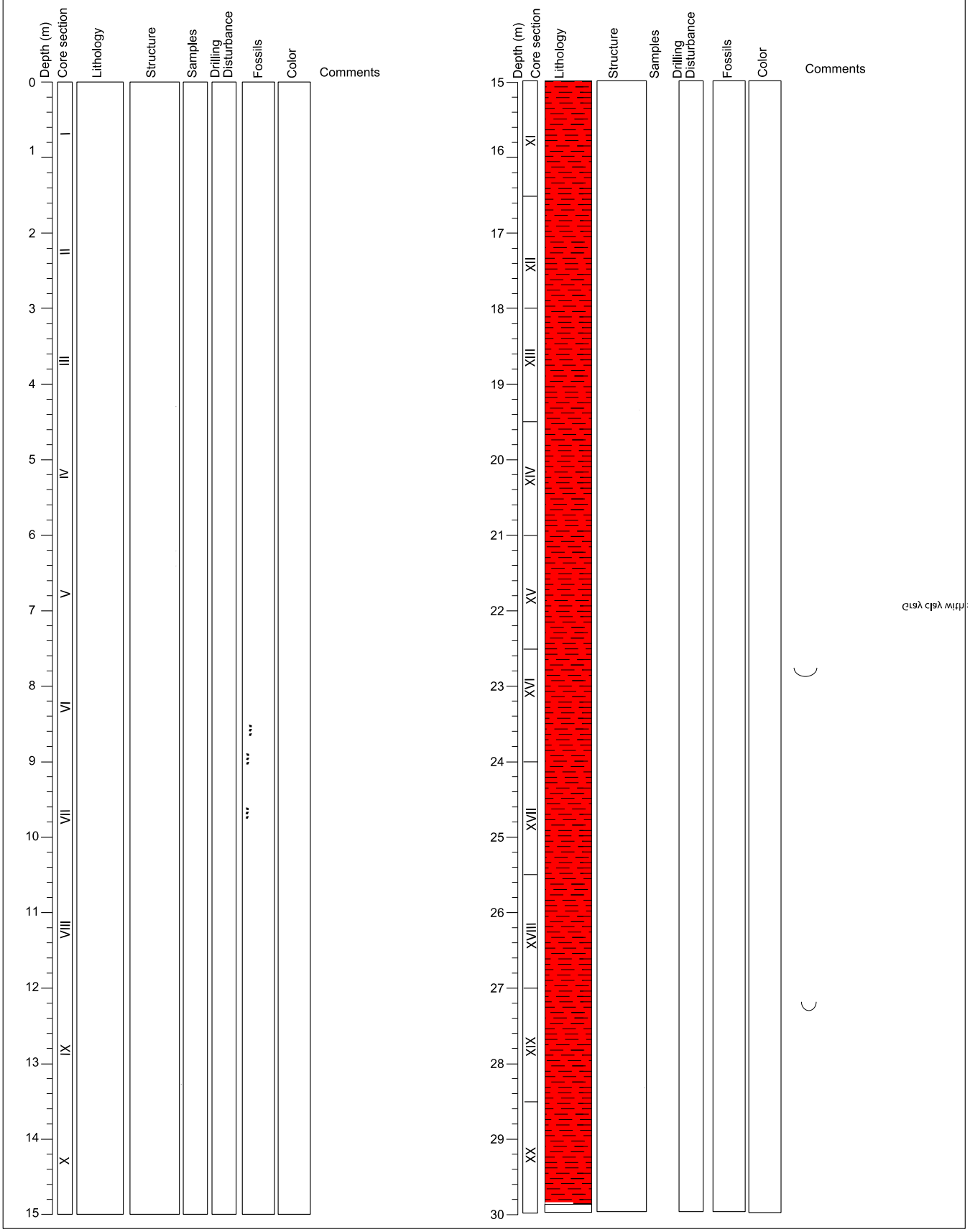
Figure: Physical properties and color reflectance of Calypso core MD12-3412.

MD191 – MONOPOL	Station: MONO 4

SEDIMENTOLOGY OF CALYPSO MD12-3412

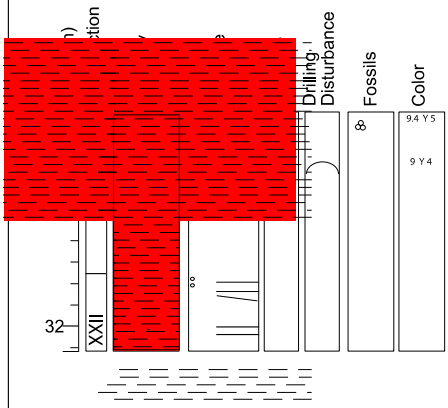
MD191-MONOPOL | Sediment Description | Station MONO 4

Observer: MMBV-EM-SDA | Core MD12-3412 | Water depth (m): 2367



MD191-MONOPOL | Sediment Description | Station MONO 4

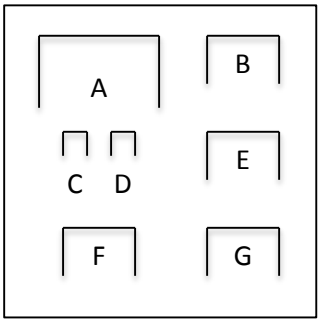
Observer: MMBV-EM-SDA | Core MD12-3412 | Water depth (m): 2367



MD191 – MONOPOL	Station: MONO 4

SECTIONS INFORMATIONS OF CASQ MD12-3411-CQ

Number of layers (2 or 3): 2
Sketch of the core section, defining the location of liners A, B, C, D, E:



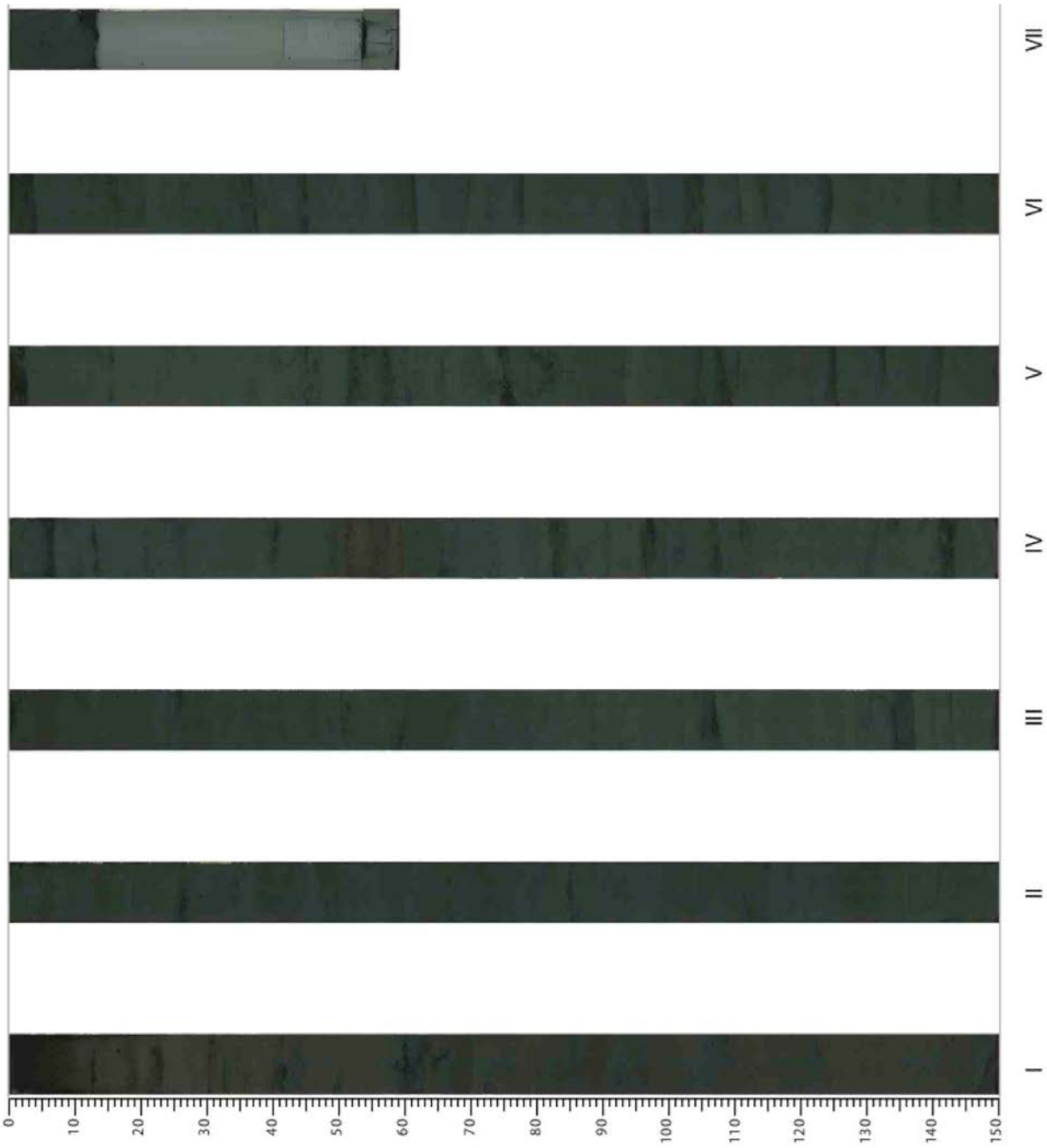
Liner A : large size (12 cm)
Liners B, E, F, G : medium size (6 cm)
Liners C, D : small U-channels

MD12-3411-CQ

Section	Theorical	Real length (cm)
I	0-150	150.2
II	150-300	150.1
III	300-450	150.1
IV	450-600	150.3
V	600-750	150
VI	750-900	150
VII	900-913	13
VIII		
IX		

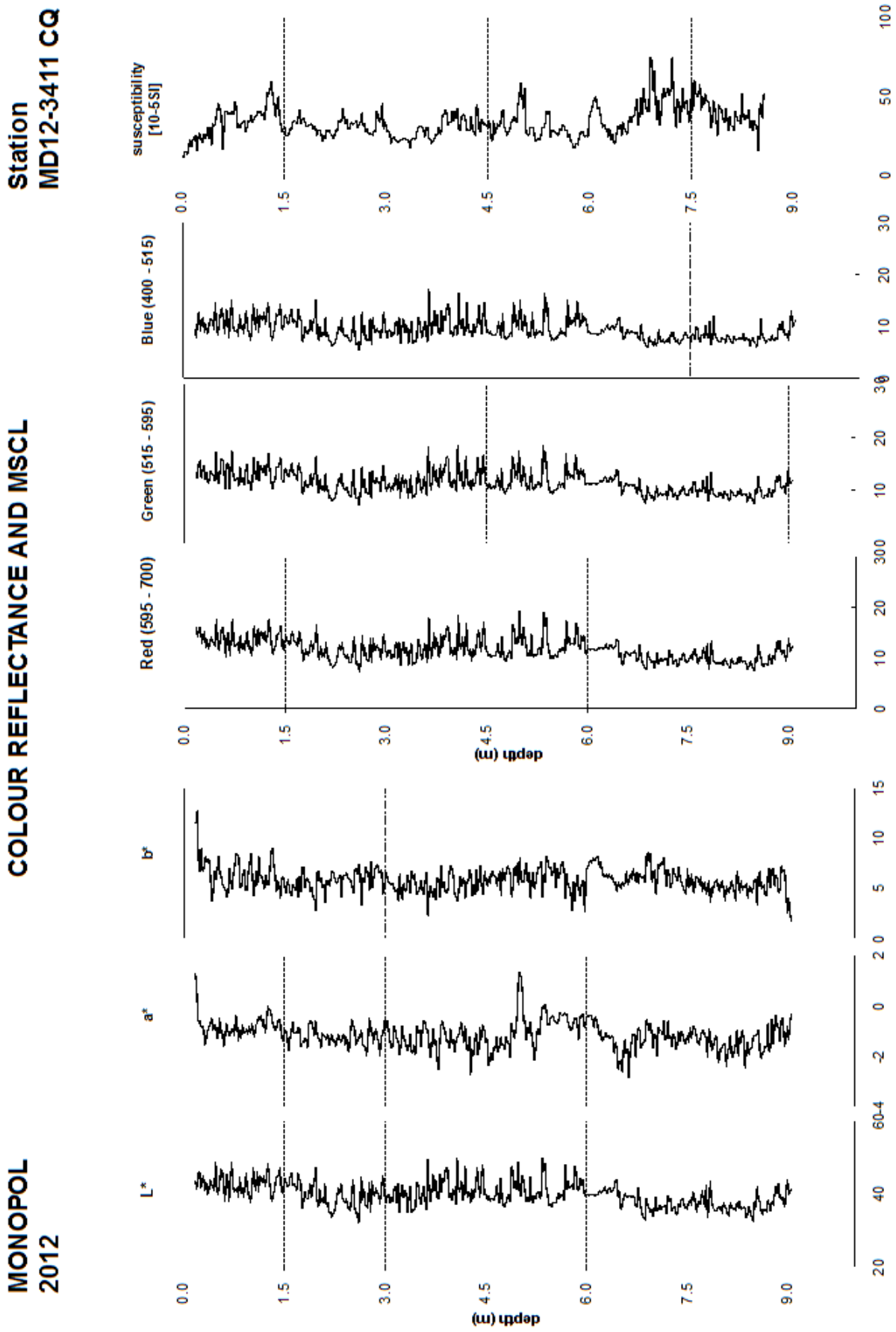
MD191 – MONOPOL	Station: MONO 4

PICTURES OF CASQ MD12-3411-CQ



MD191 – MONOPOL	Station: MONO 4

PHYSICAL PROPERTIES OF CASQ MD12-3411-CQ



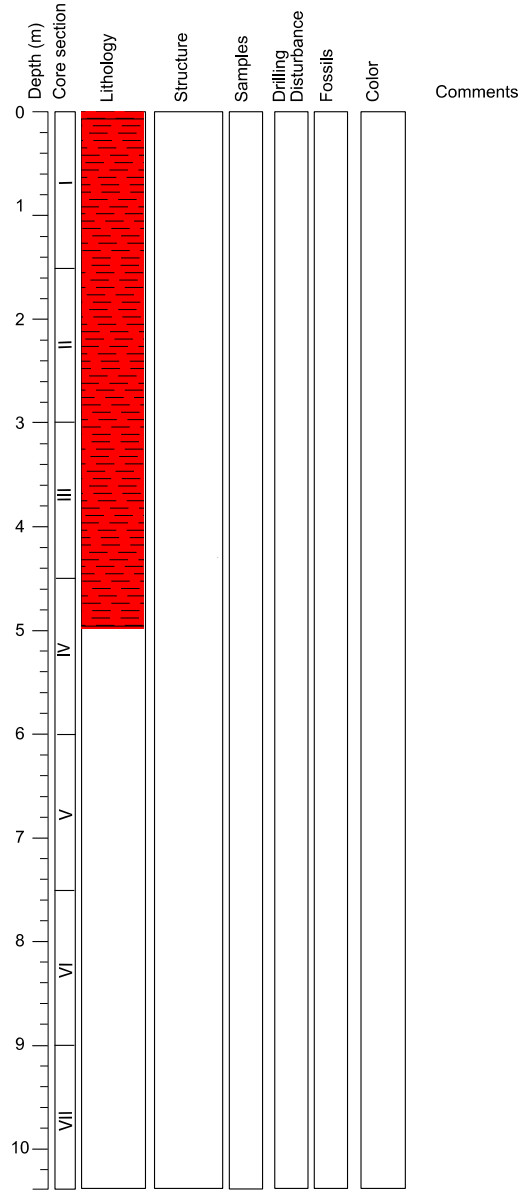
MD191 – MONOPOL	Station: MONO 4

SEDIMENTOLOGY OF CASQ CORE MD12-3411-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

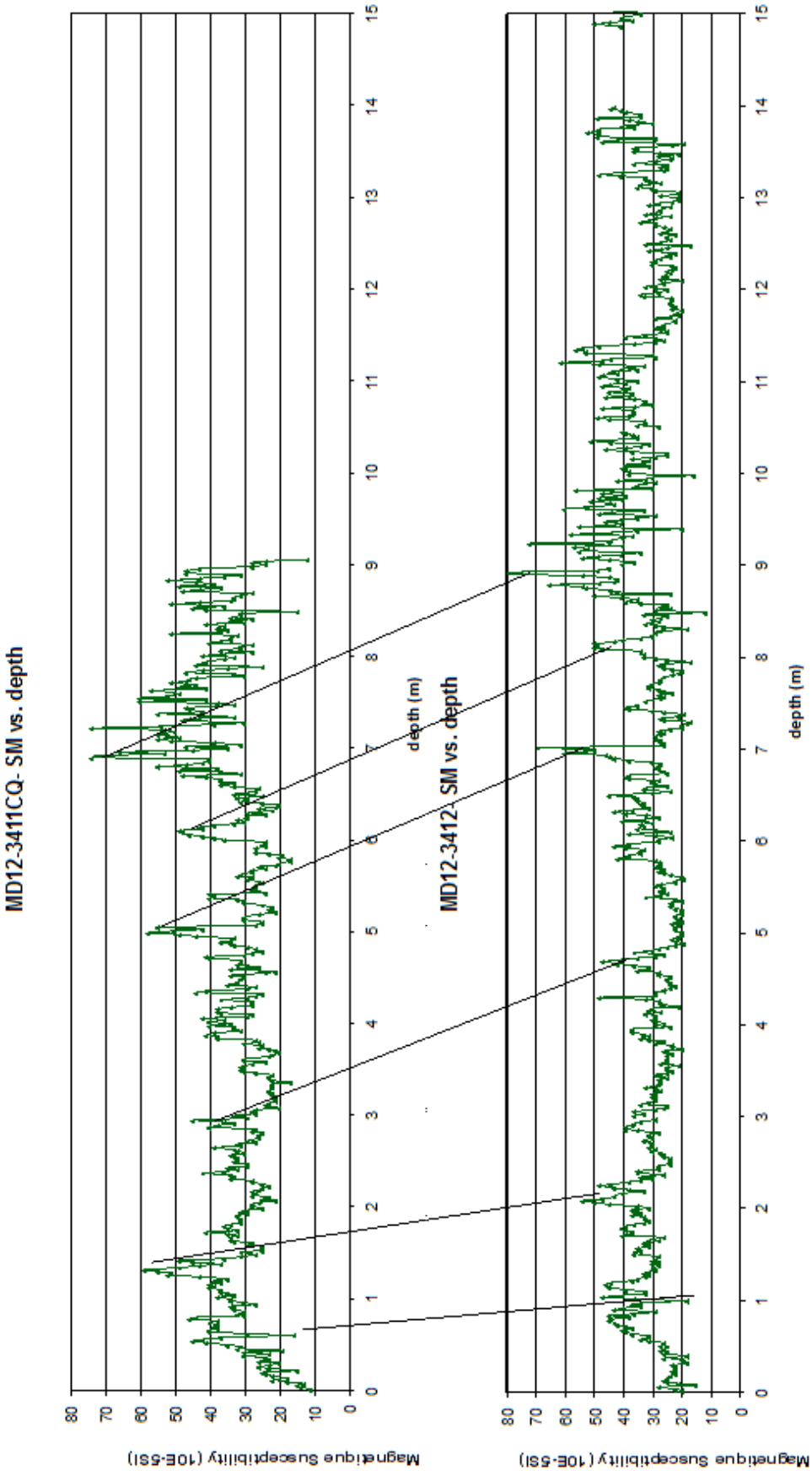
Sediment Description
Core MD12-3411 CQ

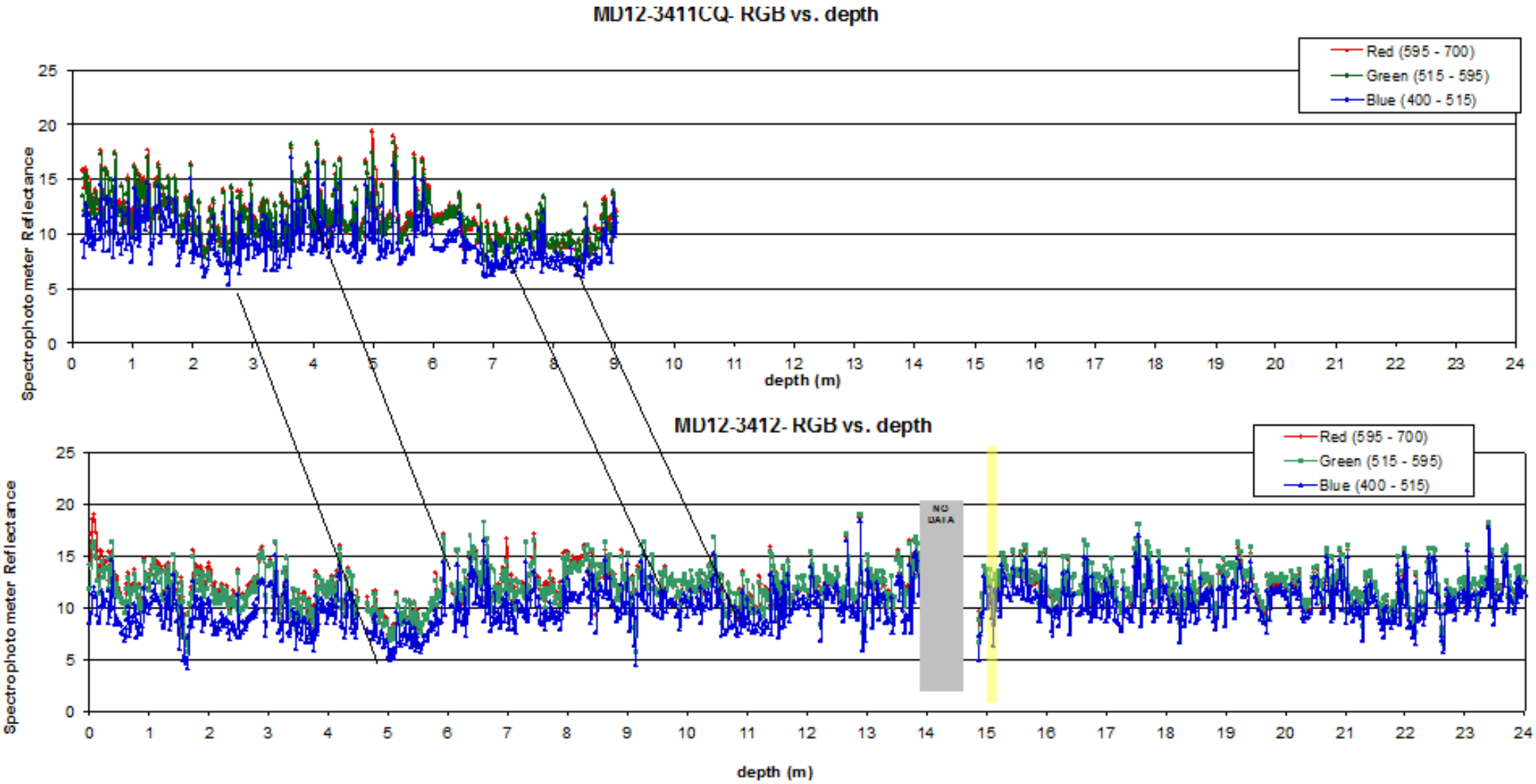
Station MONO 4
Water depth (m): 2367



MD191 – MONOPOL	Station: MONO 4

COMPARISON CASQ MD12-3411-CQ vs CALYPSO MD12-3412




MD12-3411CQ- RGB vs. depth
Red (595 - 700)
Green (515 - 595)
Blue (400 - 515)
Spectrophoto meter Reflectance
depth (m)
MD12-3412- RGB vs. depth
NO DATA
Red (595 - 700)
Green (515 - 595)
Blue (400 - 515)
Spectrophoto meter Reflectance
depth (m)

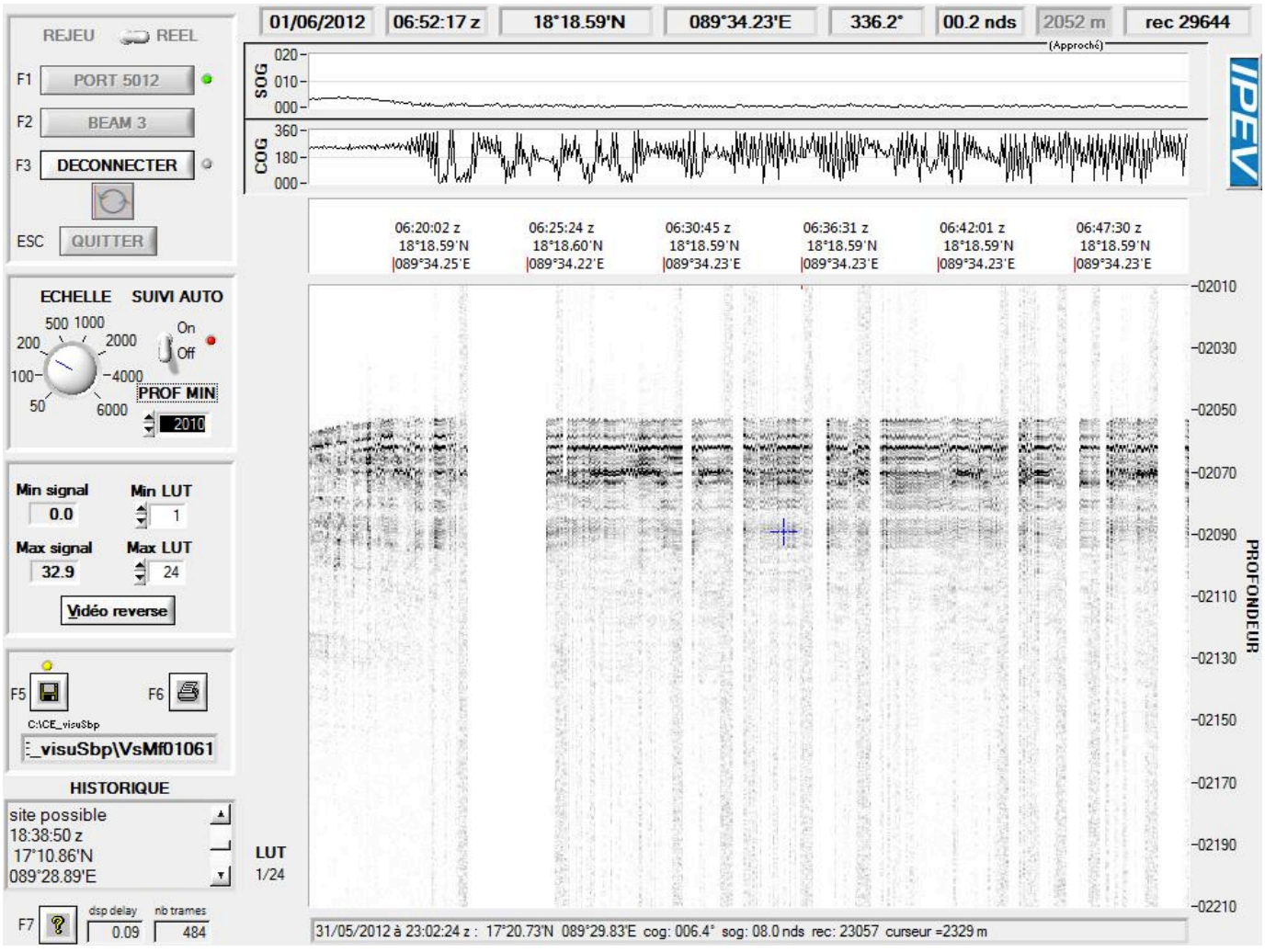
MD191 – MONOPOL	Station: MONO 5

STATION SUMMARY

Date and time approaching site: 1/6/2012 – 6:23 (TU)
Date and time ending station activity: 1/6/2012 – 8:00 (TU)
Latitude: 18°18.62'N **Longitude**: 89°34.26'E **Water depth (m)**: ?
Short area description:
Northern part of the Bay of Bengal.

Activity on station		**Core identification**
Calypso corer	No	
Casq	No	
Multi-corer	No	
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	No	
Plankton net	No	

Figure: 3.5 kHz profile across station MONO 5.



MD191 – MONOPOL	Station: MONO 5

CTD/ROSETTE (shallow) OPERATION

CTD/Rosette site information	*Latitude (°N):*	***18°18.62'N***
	Longitude (°E):	***89°34.26'E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***6:23***
	Time on bottom:	
	Time on deck:	
Depth of Water sampling	*Bottle 1*	***-***
	Bottle 2	***180***
	Bottle 3	***-***
	Bottle 4	***160***
	Bottle 5	***-***
	Bottle 6	***150***
	Bottle 7	***-***
	Bottle 8	***120***
	Bottle 9	***-***
	Bottle 10	***90***
	Bottle 11	***-***
	Bottle 12	***70***
	Bottle 13	***-***
	Bottle 14	***50***
	Bottle 15	***-***
	Bottle 16	***40***
	Bottle 17	***-***
	Bottle 18	***30***
	Bottle 19	***-***
	Bottle 20	***20***
	Bottle 21	***-***
	Bottle 22	***10***
	Bottle 23	***-***
	Bottle 24	***5***

General observations / incidents: *Bengladesh coastgard plane => warning about our position on the limit of ZEE.*

MD191 – MONOPOL	Station: MONO 5

CTD PROFILES

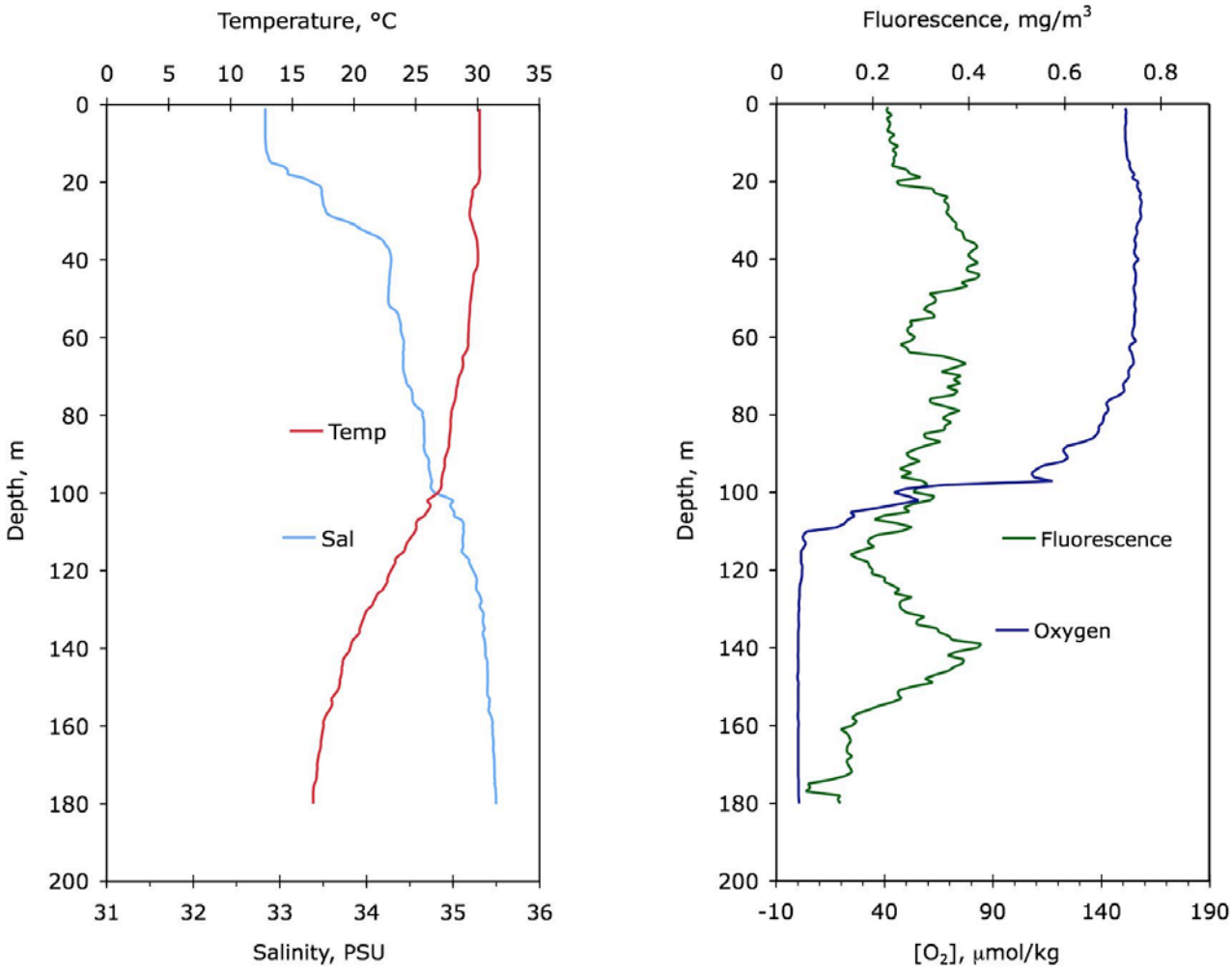


Figure: Temperature, salinity, fluorescence and dissolved oxygen profiles at site MONO 5.

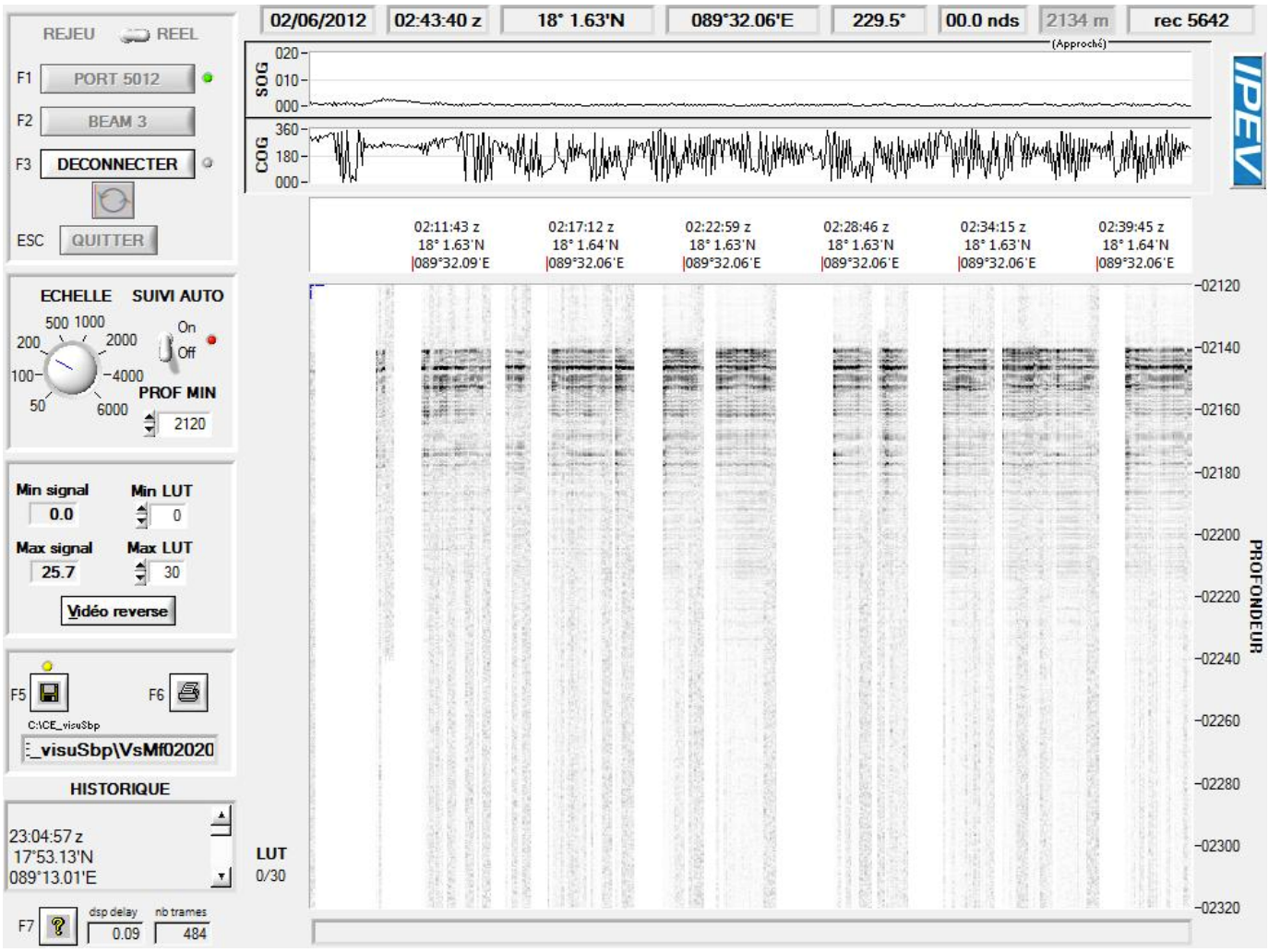
MD191 – MONOPOL	Station: MONO 7

STATION SUMMARY

Date and time approaching site: 2/6/2012 – 2:20 (TU)
Date and time ending station activity: 3/6/2012 – 3:23 (TU)
Latitude: 18°01.67'N **Longitude**: 89°32.08'E **Water depth (m)**: 2140
Short area description:
Northern part of the Bay of Bengal.

Activity on station		**Core identification**
Calypso corer	Yes	**MD12-3414/15**
Casq	Yes	**MD12-3413-CQ**
Multi-corer	Yes	**MD191-MC-MONO7**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	No	
Plankton net	No	

Figure: 3.5 kHz profile across station MONO 7.



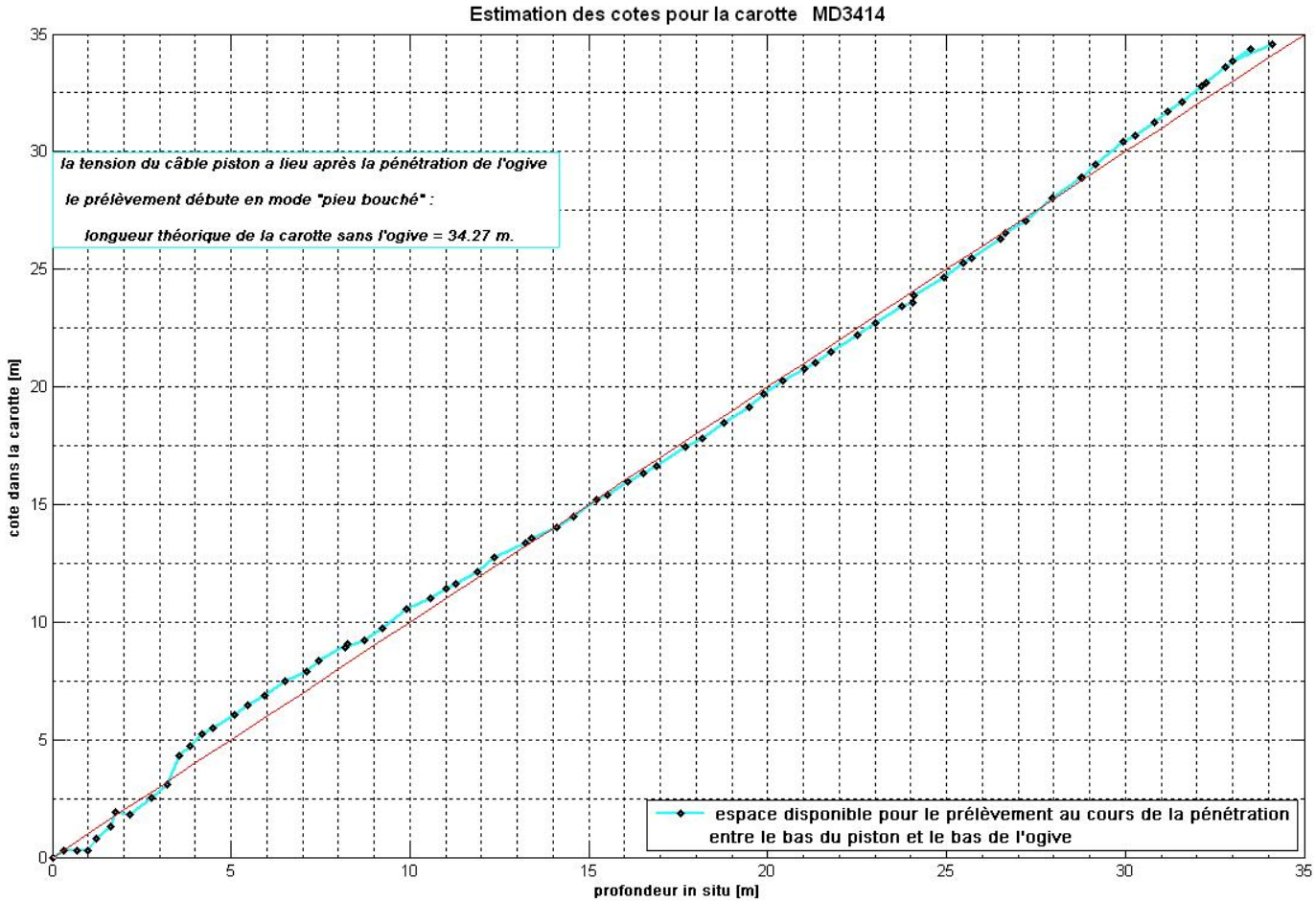
MD191 – MONOPOL	Station: MONO 7

CALYPSO CORING OPERATION: MD12-3414

Coring site information	*Latitude (°N):*	***18°01.67'N***
	Longitude (°E):	***89°32.09'E***
	Water depth (m):	***2140***
Calypso corer settings	*Core length (m):*	***35.10***
	Empty weight in water (t):	***7.28***
	Free fall (m):	***2.5***
	Length piston cable (m):	***46.38***
Coring operation	*Time corer starts descent:*	***10:23***
	Time triggering:	***11:12***
	Length cable (m):	***2107***
	Maximum tension (t)	***13.65***
	Time corer on deck:	***12:15***
Result coring operation	*Total weight in water (t)*	***7.51***
	Length of sediment (m)	***33.37***

General observations / incidents: -

Figure: Core level versus in situ sediment depth, CINEMA reconstructions for core MD12-3414.



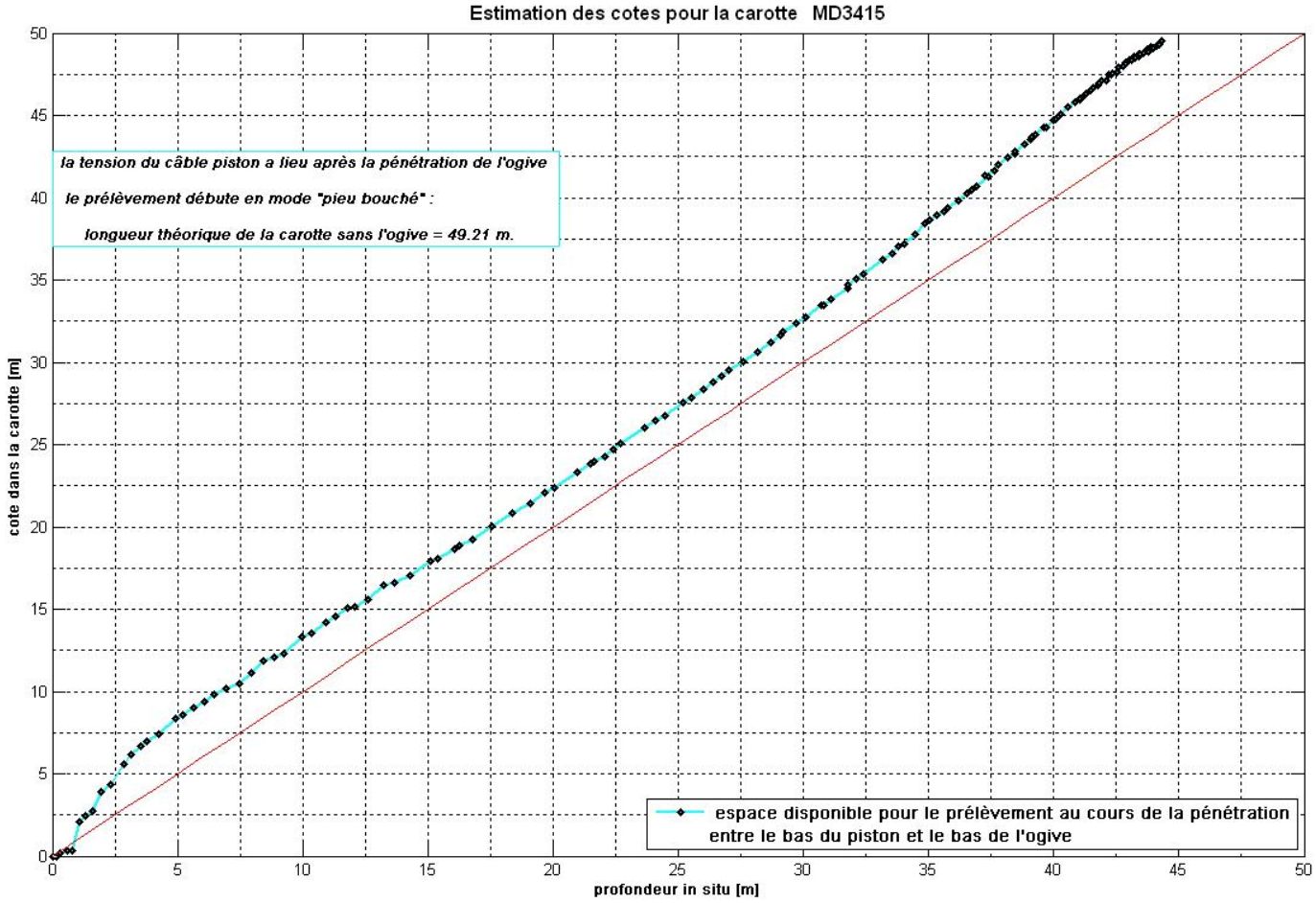
MD191 – MONOPOL	Station: MONO 7

CALYPSO CORING OPERATION: MD12-3415

Coring site information	*Latitude (°N):*	***18°01.68'N***
	Longitude (°E):	***89°32.09'E***
	Water depth (m):	***2138***
Calypso corer settings	*Core length (m):*	***59.3***
	Empty weight in water (t):	***8.10***
	Free fall (m):	***2.55***
	Length piston cable (m):	***71.31***
Coring operation	*Time corer starts descent:*	***18:48***
	Time triggering:	***19:42***
	Length cable (m):	***2078***
	Maximum tension (t)	***16.9***
	Time corer on deck:	***00:30***
Result coring operation	*Total weight in water (t)*	***8.45***
	Length of sediment (m)	***54.02***

General observations / incidents: *Corer nicely bent !!.*

Figure: Core level versus in situ sediment depth, CINEMA reconstructions for core MD12-3415.



MD191 – MONOPOL	Station: MONO 7

CASQ CORING OPERATION: MD12-3413-CQ

Coring site information	*Latitude (°N):*	***18°01.67' N***
	Longitude (°E):	***89°32.08' E***
	Water depth (m):	***2154***
Casq corer settings	*Core length (m):*	***12***
	Empty weight in water (t):	***7.26***
Coring operation	*Time corer starts descent:*	***6:00***
	Time on bottom:	***6:41***
	Maximum tension (t)	***13.9***
	Time corer on deck:	***7:45***
Result coring operation	*Total weight in water (t)*	***7.88***
	Length of sediment (m)	***9.42***

General observations / incidents:

MULTI-CORER OPERATION: MD191-MC-MONO7

Coring site information	*Latitude (°N):*	***18°01.67' N***
	Longitude (°E):	***89°32.08' E***
	Water depth (m):	***2140***
Coring operation	*Time multi corer starts descent:*	***2:50***
	Time at bottom:	***4:07***
	Time corer on deck:	***4:50***
Length of sediments (cm)	*Tube 1*	***39***
	Tube 2	***21***
	Tube 3	***-***
	Tube 4	***27***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 7

SECTIONS INFORMATIONS OF CALYPSO MD12-3414

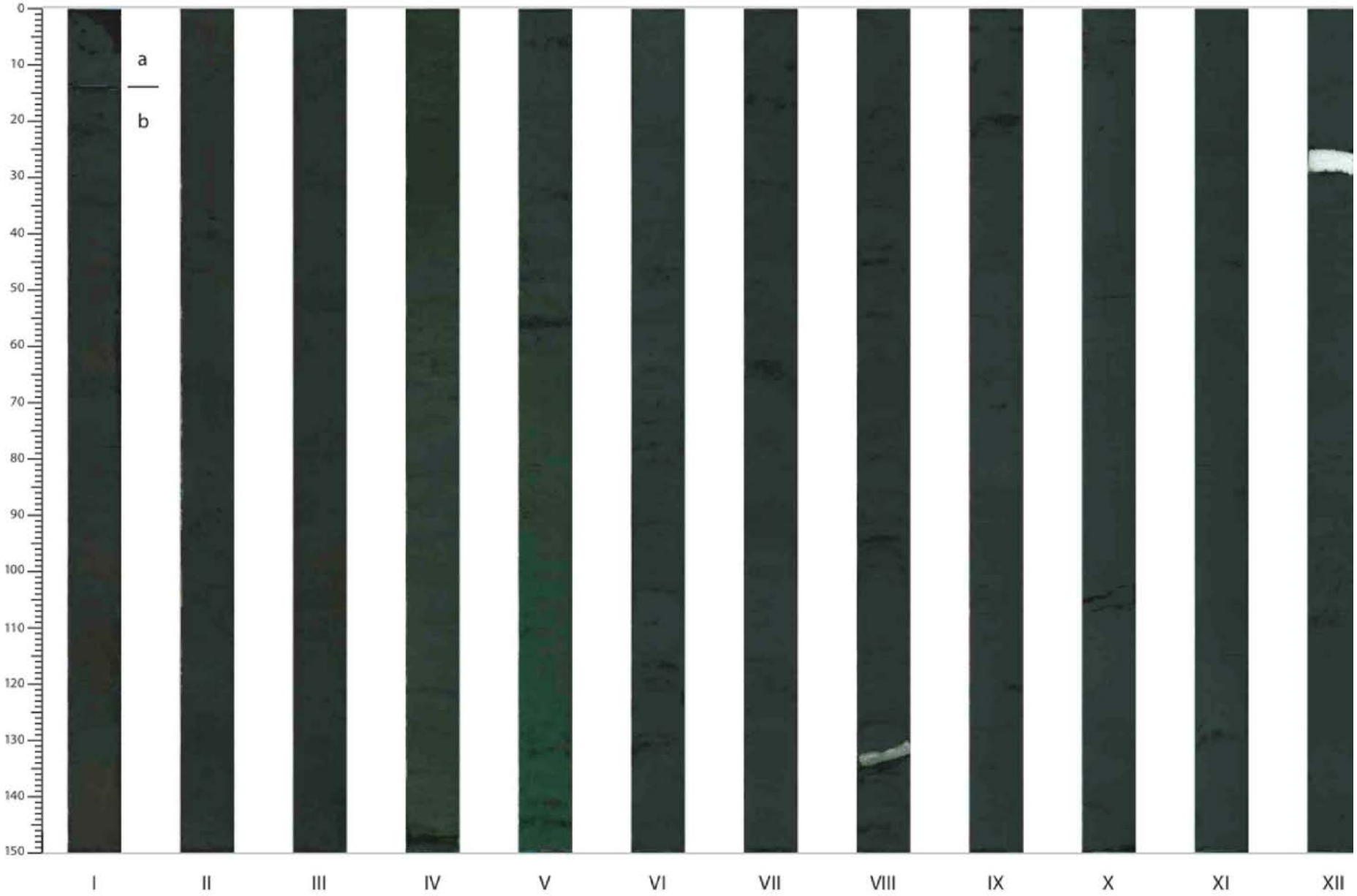
MONOPOL
-MD191

Core MD12-3414

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
Ia+b	0	150	151.7	2 parts: Ia (0-12) and Ib (12-150)
II	150	300	150.1	
III	300	450	150.5	447-450: Toba Ash layer => susceptibility and spectrophotometer didn't touch this layer
IV	450	600	150.6	
V	600	750	150.4	
VI	750	900	150.4	
VII	900	1050	151.2	
VIII	1050	1200	151.5	Polystyren: 1183-1185
IX	1200	1350	154	
X	1350	1500	154.3	
XI	1500	1650	150.7	
XII	1650	1800	150.4	Polystyren: 1675-1679
XIII	1800	1950	150.1	
XIV	1950	2100	150.2	Polystyren: 2009-2012; 2032-234; 2037-2039
XV	2100	2250	150	
XVI	2250	2400	151.9	
XVII	2400	2550	151.2	
XVIII	2550	2700	150.6	
XIX	2700	2850	150.5	
XX	2850	3000	150.3	
XXI	3000	3150	150.3	
XXII	3150	3300	150	
XXIII	3300	3337	37	

MD191 – MONOPOL	Station: MONO 7

PICTURES OF CALYPSO MD12-3414


0
10
20
30
40
50
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70
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90
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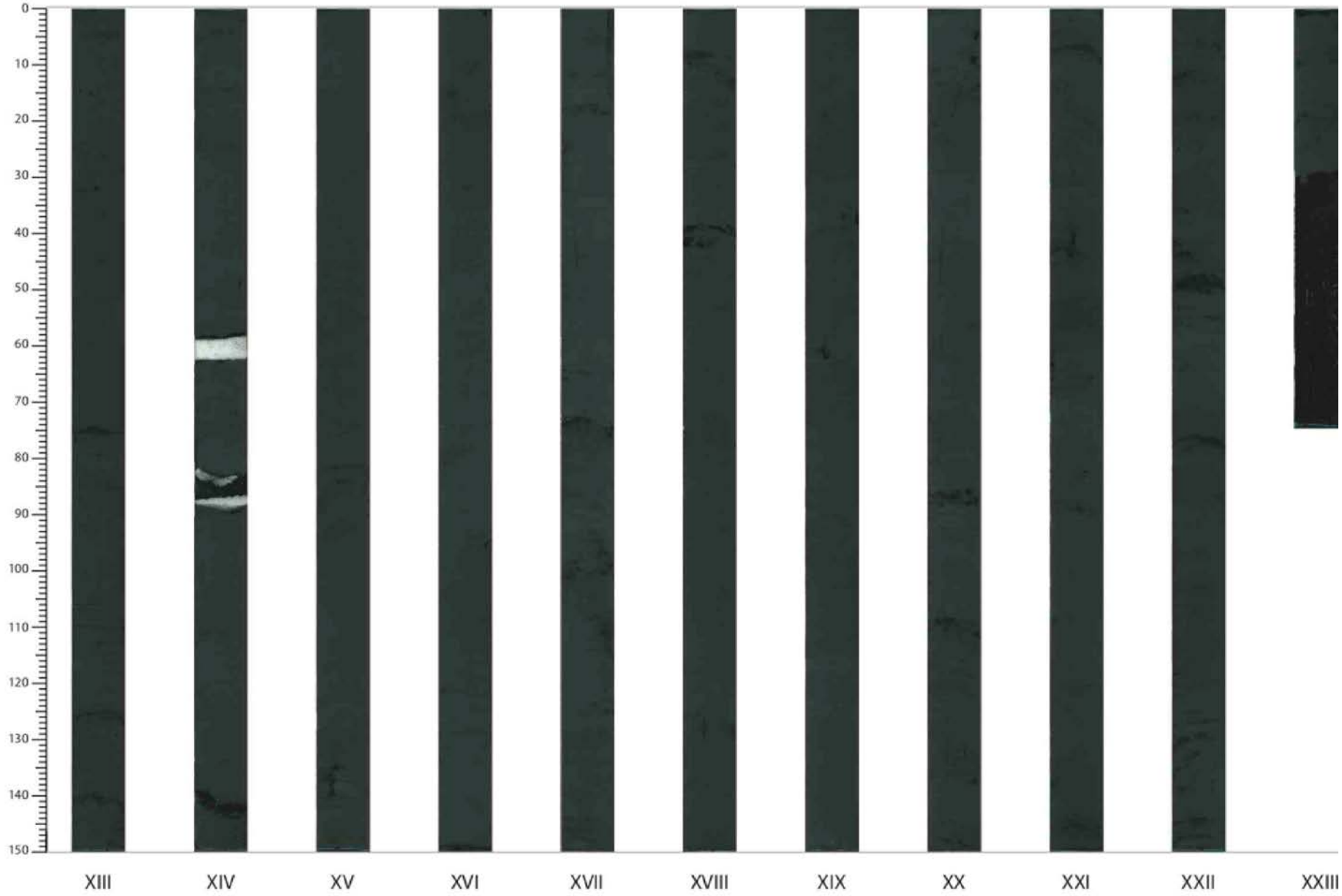
110
120
130
140
150
a
b
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII


0
10
20
30
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70
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90
100
110
120
130
140
150
XIII
XIV
XV
XVI
XVII
XVIII
XIX
XX
XXI
XXII
XXIII

MD191 – MONOPOL	Station: MONO 7

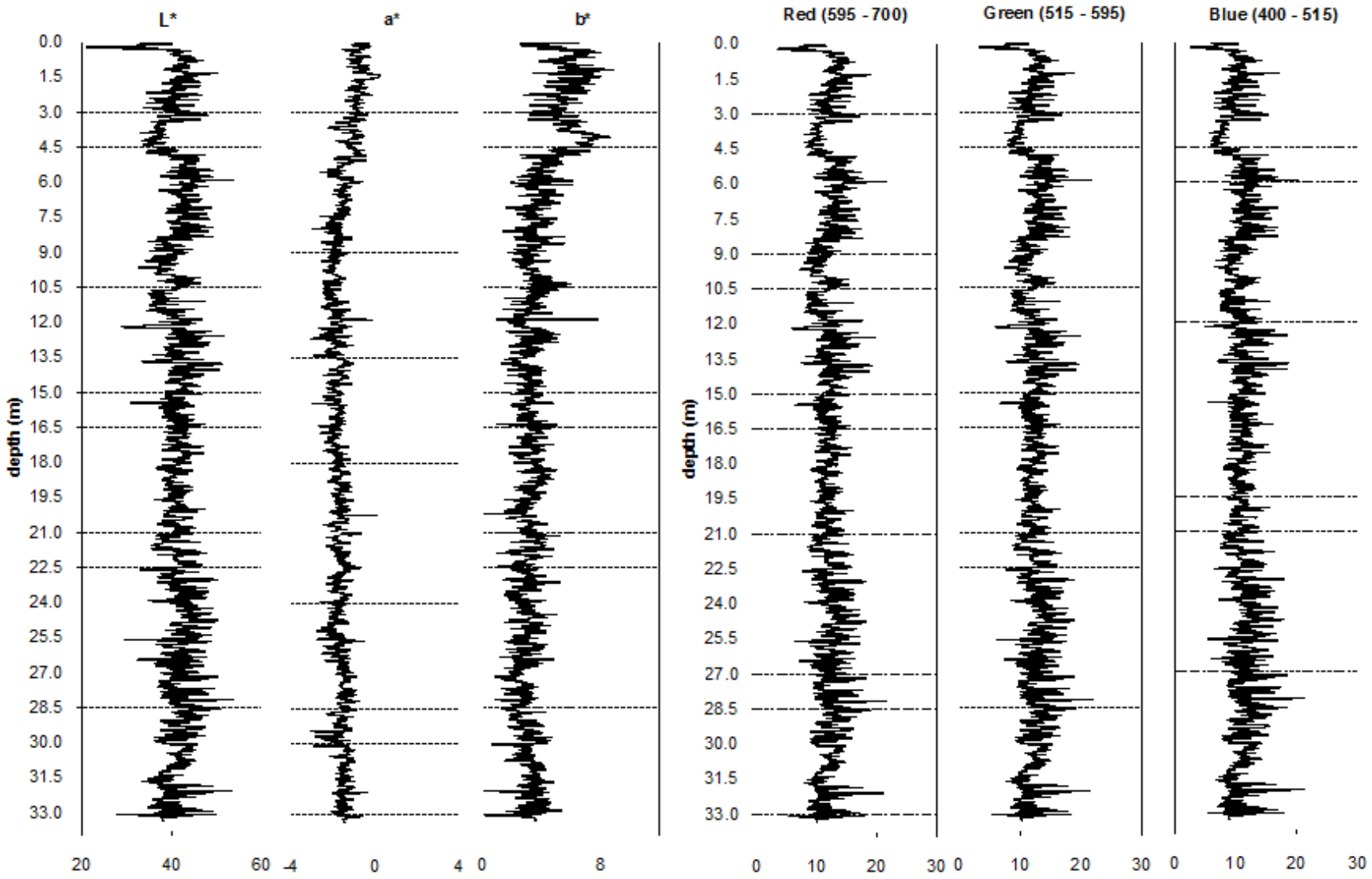
PHYSICAL PROPERTIES OF CALYPSO MD12-3414

MONOPOL
2012

COLOUR REFLECTANCE

Spectrophotometer

Station
MD12-3414



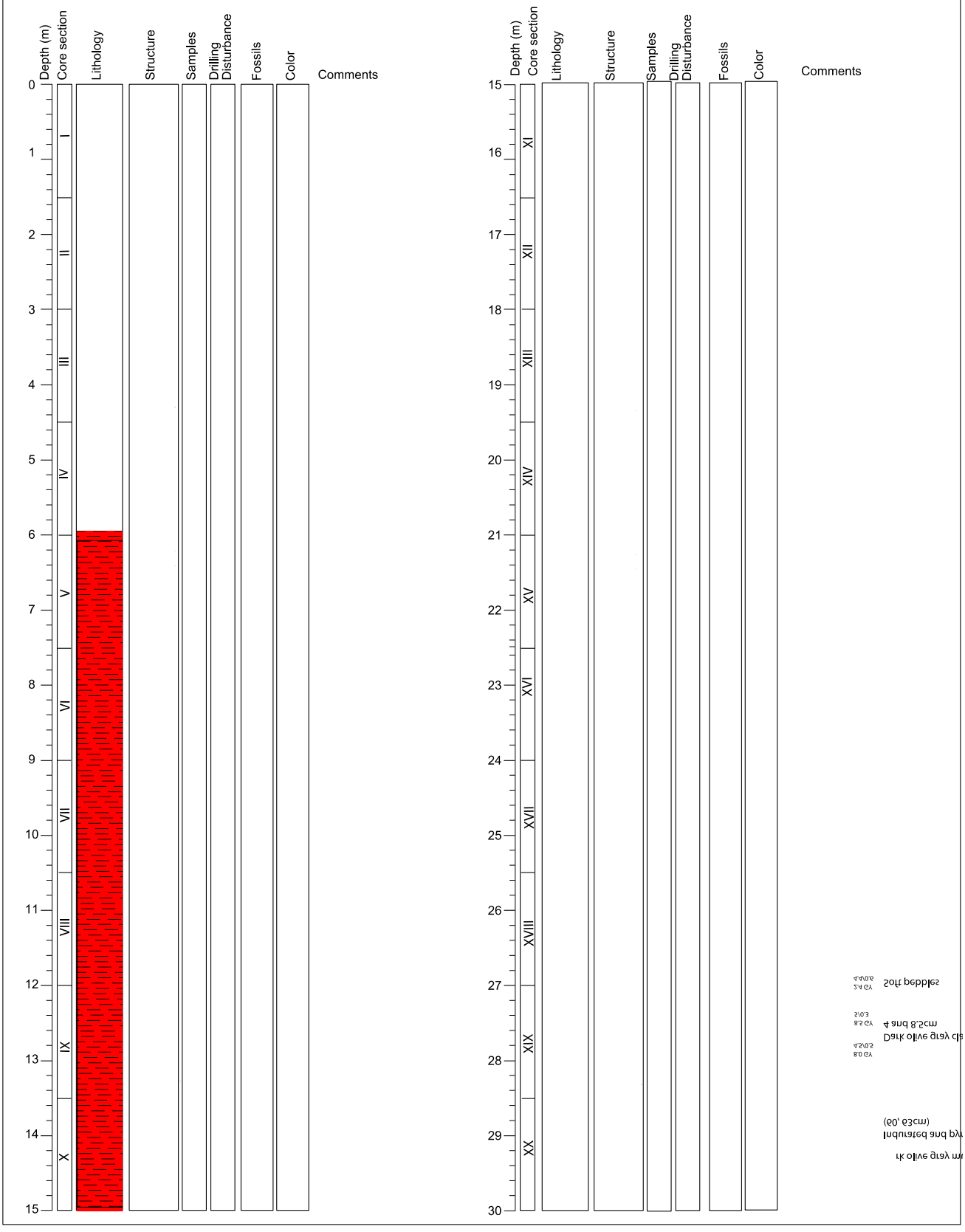
MD191 – MONOPOL	Station: MONO 7

SEDIMENTOLOGY OF CALYPSO MD12-3414

MD191-MONOPOL
Observer: MMBV-EM-SDA

Sediment Description
Core MD12-3414

Station MONO 7
Water depth (m): 2140



MD191-MONOPOL

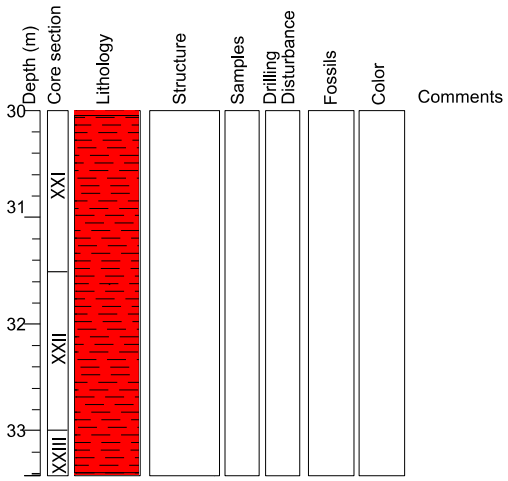
Observer: MMBV-EM-SDA

Sediment Description

Core MD12-3414

Station MONO 7

Water depth (m): 2106 ?



MD191 – MONOPOL	Station: MONO 7

SECTIONS INFORMATIONS OF CALYPSO MD12-3415

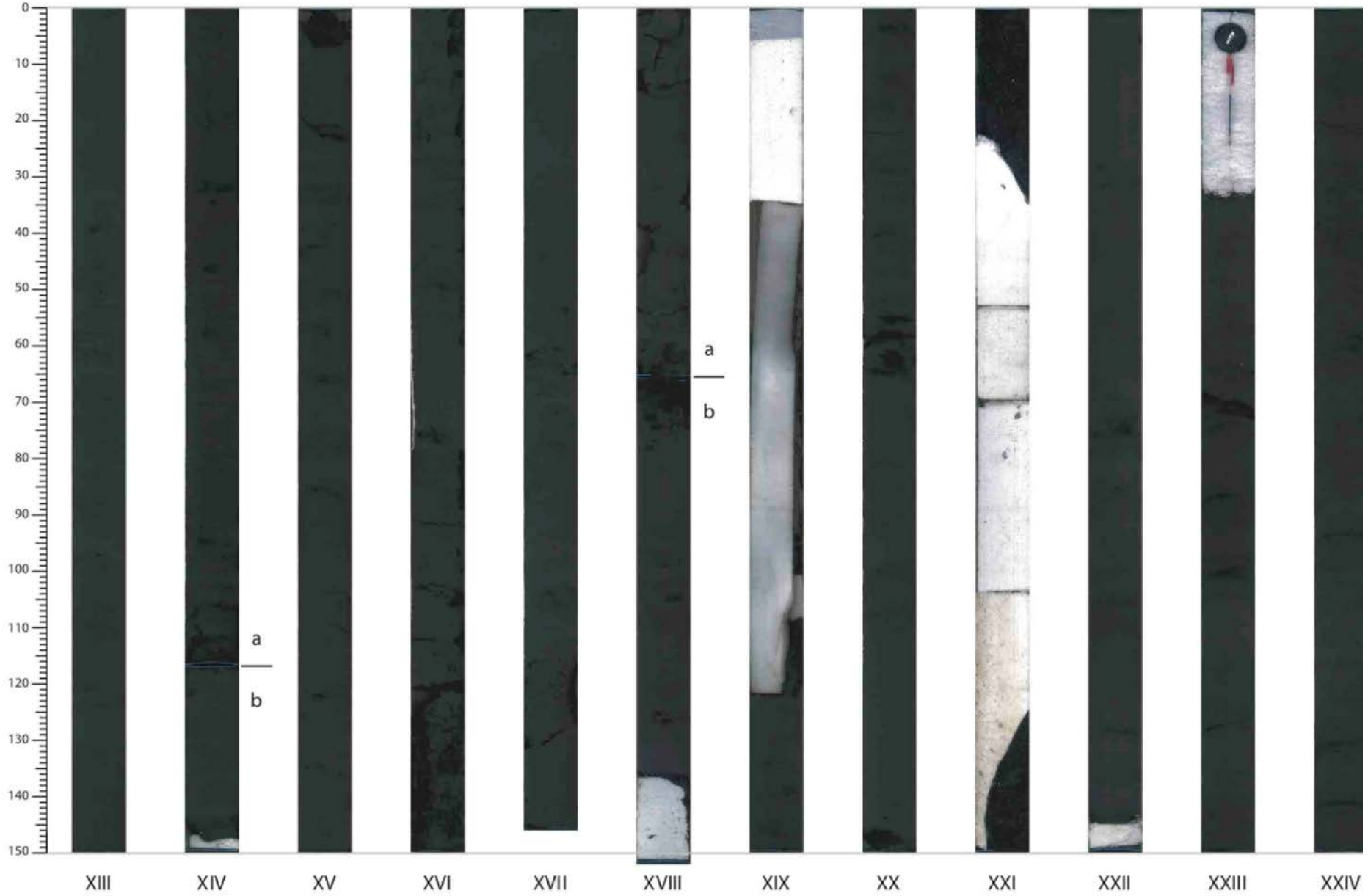
MONOPOL
191

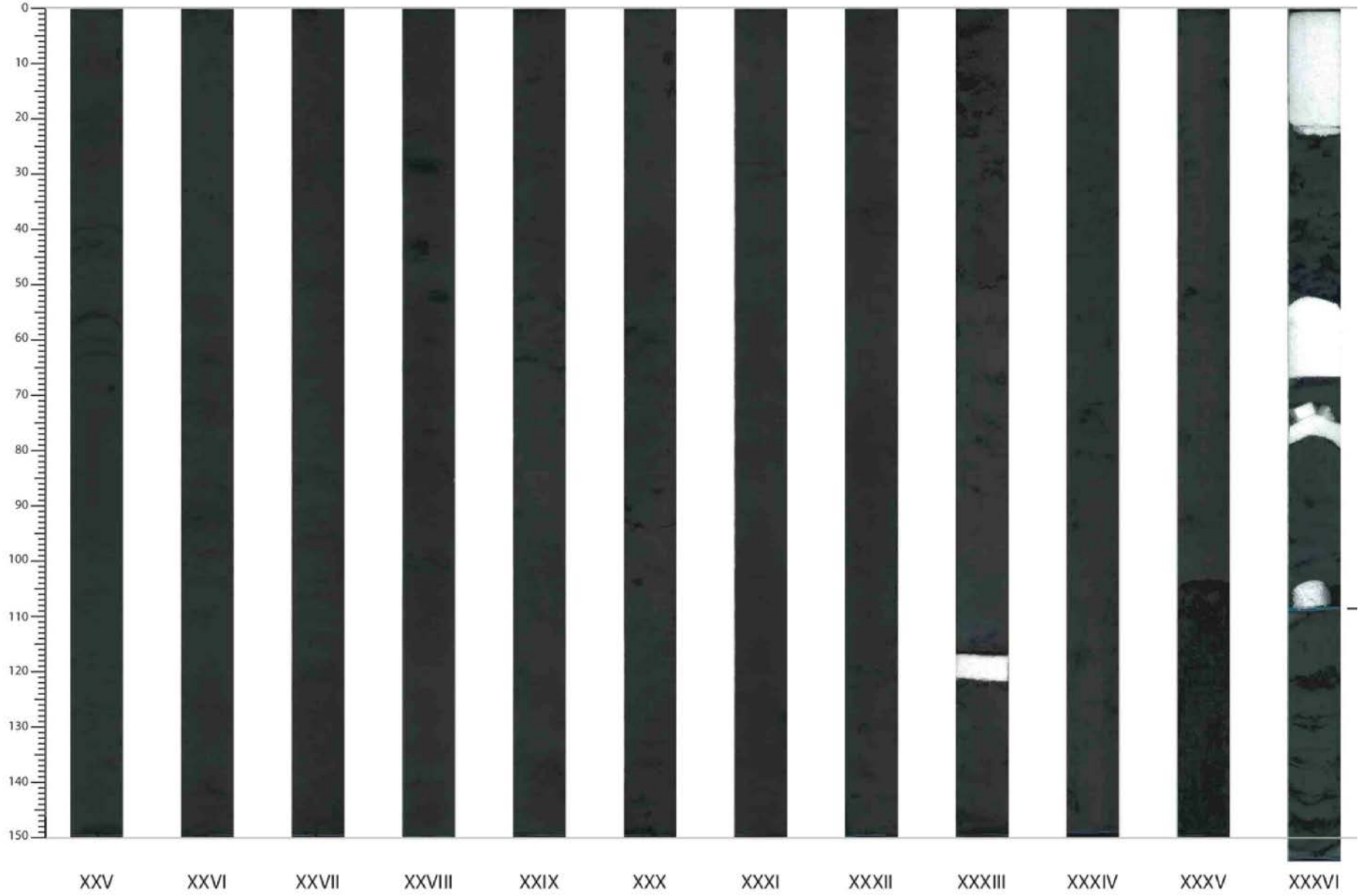
Core MD12-3415

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	149.1	
II	150	300	150.1	
III	300	450	150.8	
IV	450	600	150.2	
V	600	750	150.2	
VI	750	900	150	
VII	900	1050	149.6	
VIII	1050	1200	150.2	
IXa+b	1200	1350	149.9	2 parts : IXa (1200-1307) and IXb (1307-1350). Warning: photo (only) on IXa A (and not W).
X	1350	1500	150.3	
XI	1500	1650	149.9	
XII	1650	1800	150.3	
XIII	1800	1950	150	
XIVa+b	1950	2100	149.7	2 parts: XIVa (1950-2067) and XIVb (2067-2100). Sediment cracks:2056-2067.
XV	2100	2250	150	Empty: 2100-2107
XVI	2250	2400	150.1	Not completely full: 2370-2400
XVII	2400	2550	145.5	
XVIIIa+b	2550	2700	151.8	2 parts: XVIIIa (2548-2612) and XVIIIb (2612-2700)
XIX	2700	2850	151.2	Polystyren: 2700-2822
XX	2850	3000	149.9	Empty: 2996-3000; Hole: 2913; Crack: 2908
XXI	3000	3150	150.3	Polystyren: 3023-3135
XXII	3150	3300	150.4	Polystyren: 3298-3300
XXIII	3300	3450	149.7	Polystyren: 3300-3334 ; Crack:3369-3371
XXIV	3450	3600	150.3	
XXV	3600	3750	149.9	
XXVI	3750	3900	150.3	
XXVII	3900	4050	150.1	
XXVIII	4050	4200	150	
XXIX	4200	4350	150.4	
XXX	4350	4500	149	
XXXI	4500	4650	150.4	
XXXII	4650	4800	150.2	
XXXIII	4800	4950	150.2	Polystyren: 4917-4921
XXXIV	4950	5100	150.9	
XXXV	5100	5250	149.9	
XXXVI a+b	5250	5400	153.3	2 parts: XXXVIa (5250-5358) and XXXVIb (5358-5402). Polystyren:5250-5272; 5302-5317; 5321-5329; 5352-5358

MD191 – MONOPOL	Station: MONO 7

PICTURES OF CALYPSO MD12-3415


0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
a
b
a
b
XIII
XIV
XV
XVI
XVII
XVIII
XIX
XX
XXI
XXII
XXIII
XXIV


0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
XXV
XXVI
XXVII
XXVIII
XXIX
XXX
XXXI
XXXII
XXXIII
XXXIV
XXXV
XXXVI

MD191 – MONOPOL	Station: MONO 7

PHYSICAL PROPERTIES OF CALYPSO MD12-3415

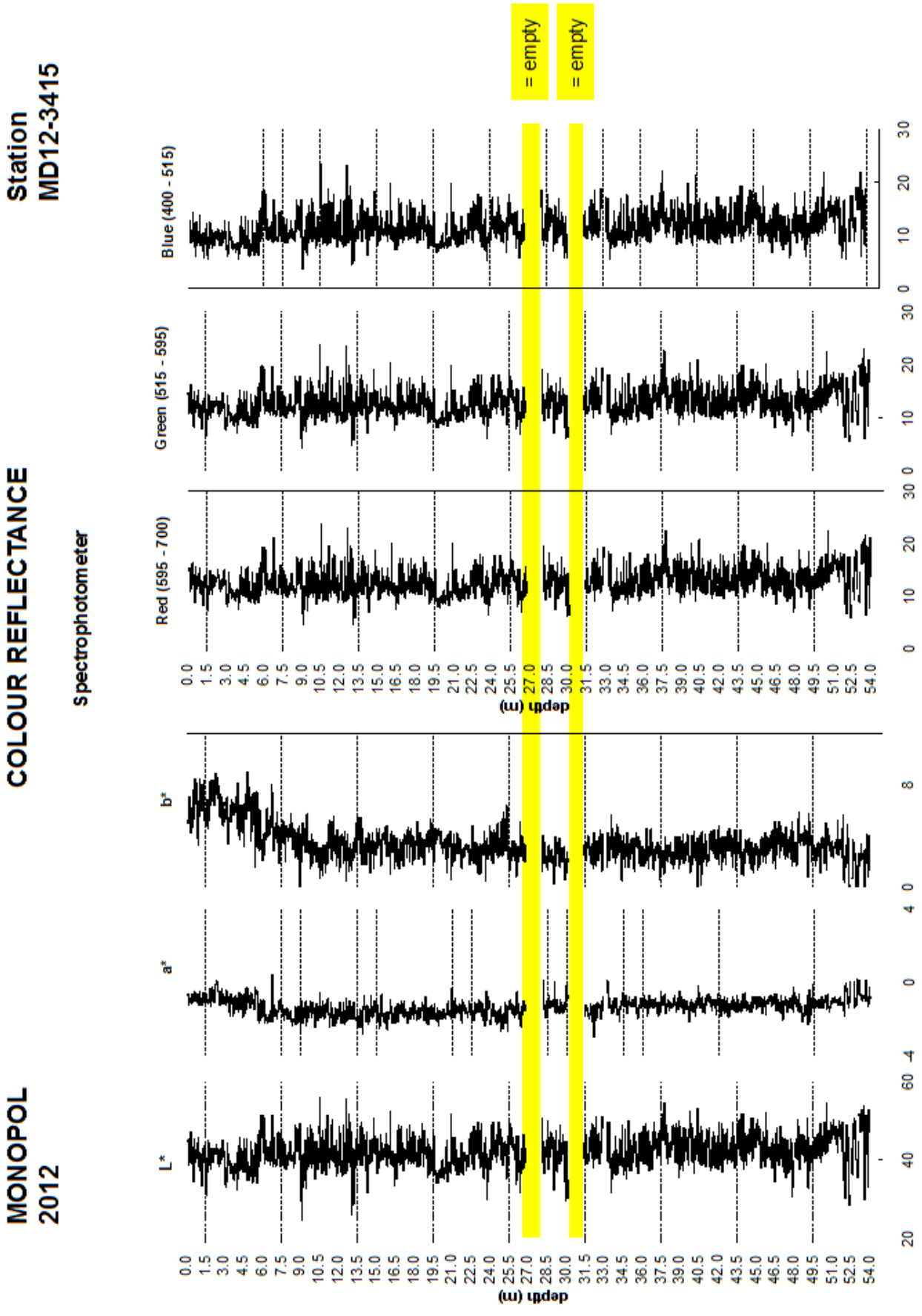
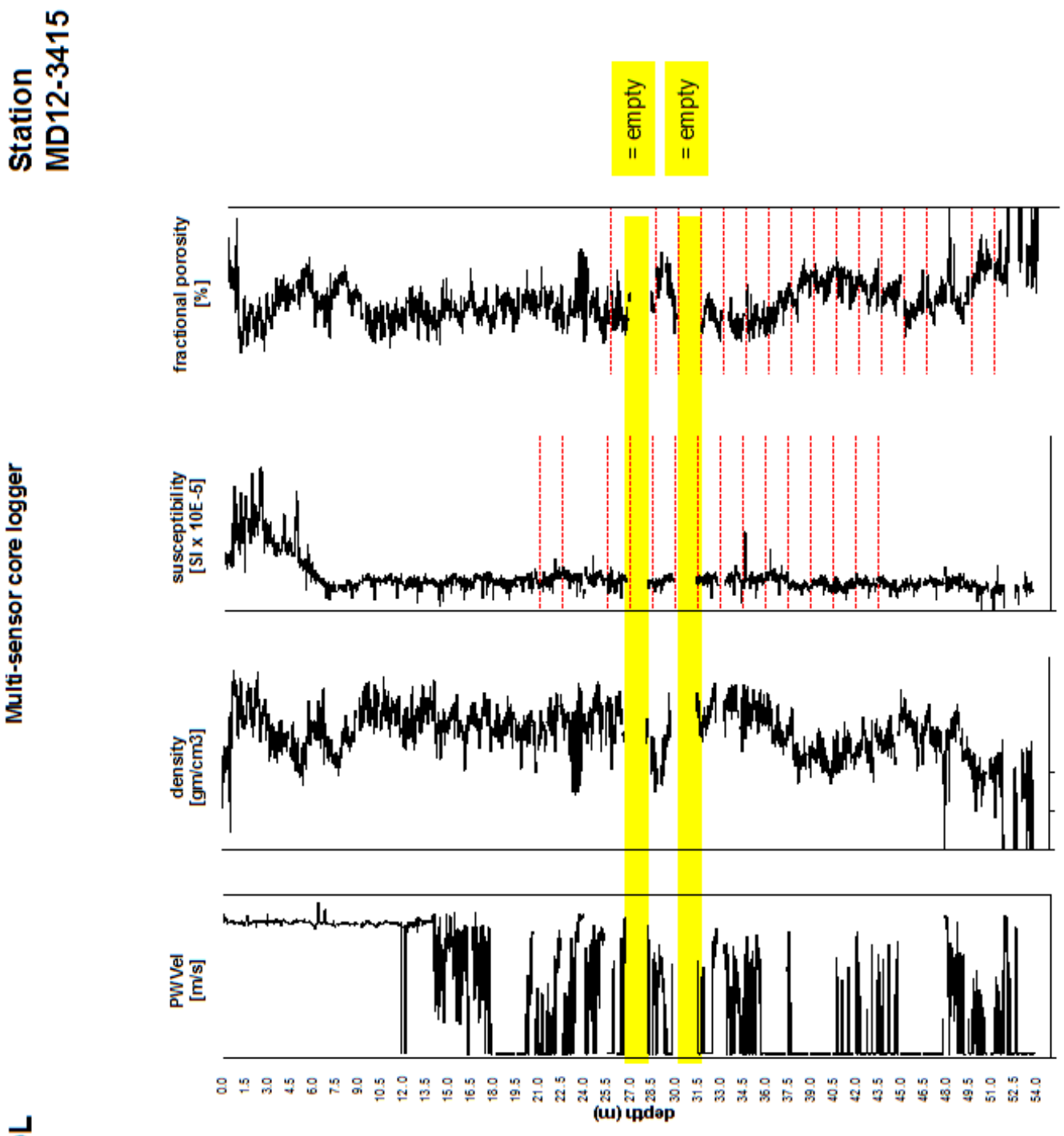


Figure: Physical properties and color reflectance of Calypso core MD12-3415.



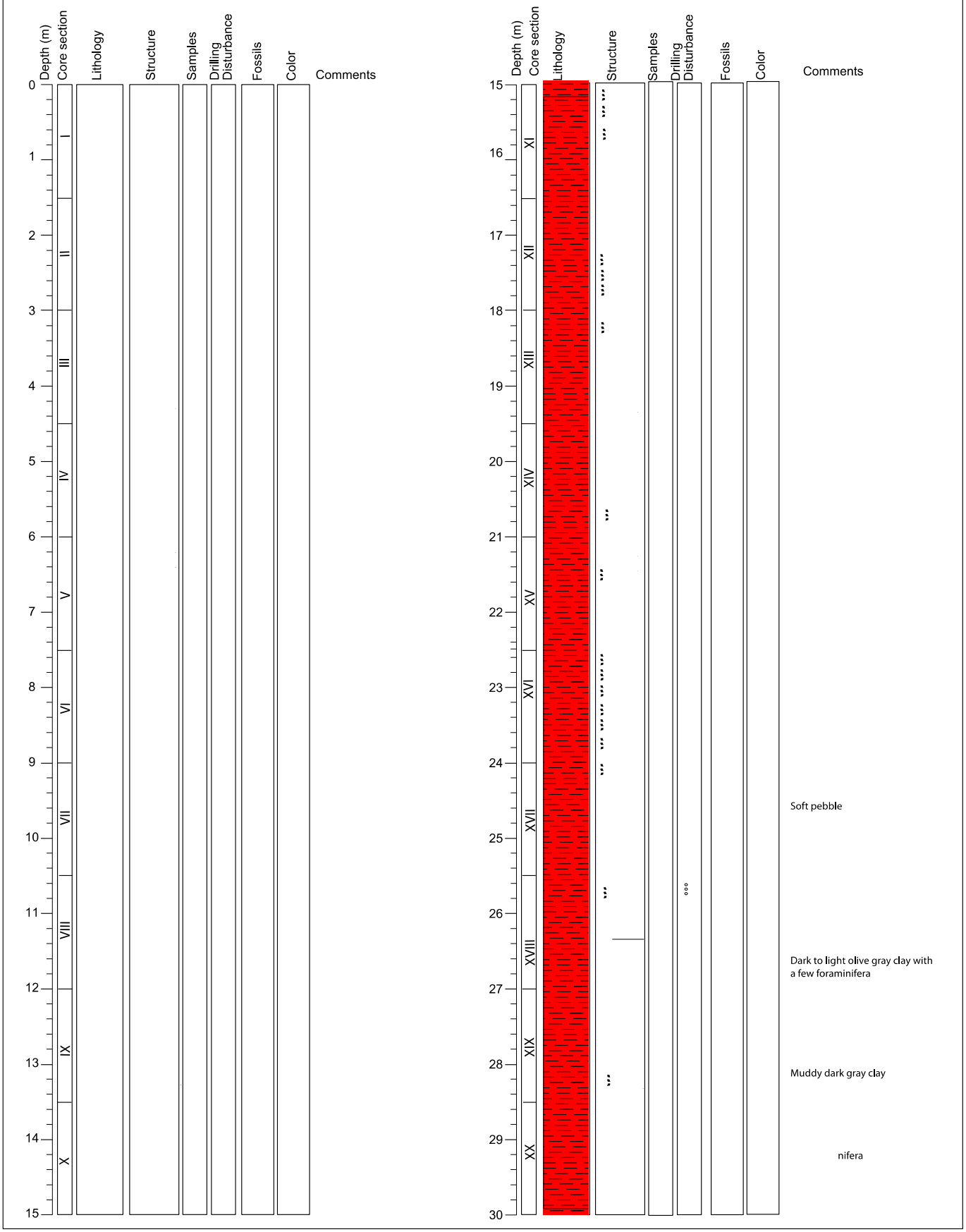
MD191 – MONOPOL	Station: MONO 7

SEDIMENTOLOGY OF CALYPSO MD12-3415

MD191-MONOPOL
Observer: MMBV-EM-SDA

Sediment Description
Core MD12-3415

Station MONO 7
Water depth (m): 2140



MD191-MONOPOL

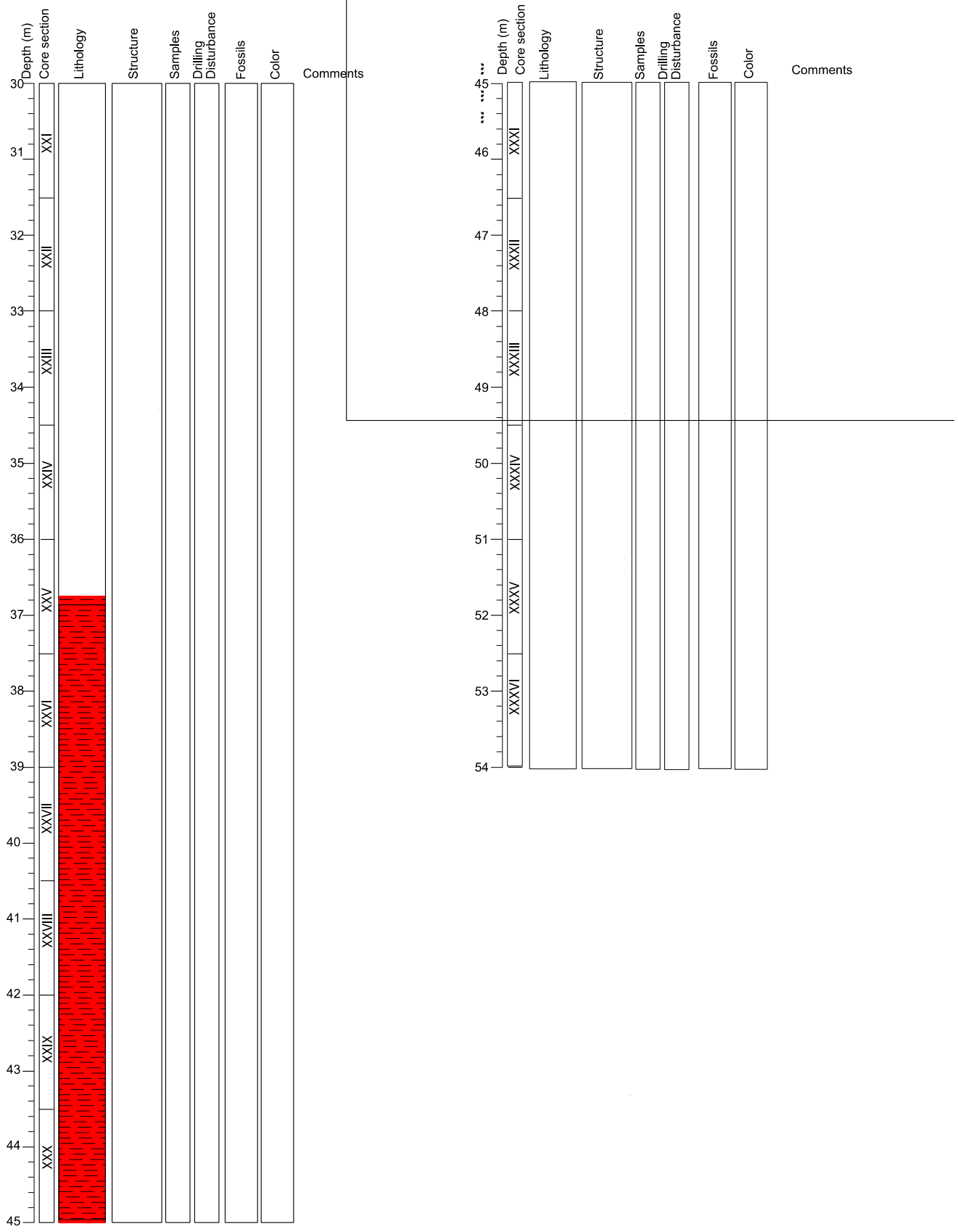
Observer: MMBV-EM-SDA

Sediment Description

Core MD12-3415

Station MONO 7

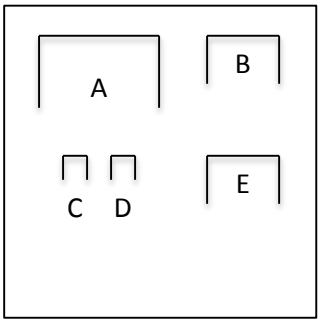
Water depth (m): 2140



MD191 – MONOPOL	Station: MONO 7

SECTIONS INFORMATIONS OF CASQ MD12-3413-CQ

Number of layers (2 or 3):
Sketch of the core section, defining the location of liners A, B, C, D, E, F:



Liner A : large size (12 cm)
Liners B, E : medium size (6 cm)
Liners C, D : small U-channels

MD12-3413-CQ

Section	Theorical	Real length (cm)
I	0-150	150
II	150-300	150
III	300-450	150.2
IV	450-600	150.4
V	600-750	150.6
VI	750-900	150.9
VII	900-942	42
VIII		
IX		

MD191 – MONOPOL	Station: MONO 7

PICTURES OF CASQ MD12-3413-CQ

PHYSICAL PROPERTIES OF CASQ MD12-3413-CQ

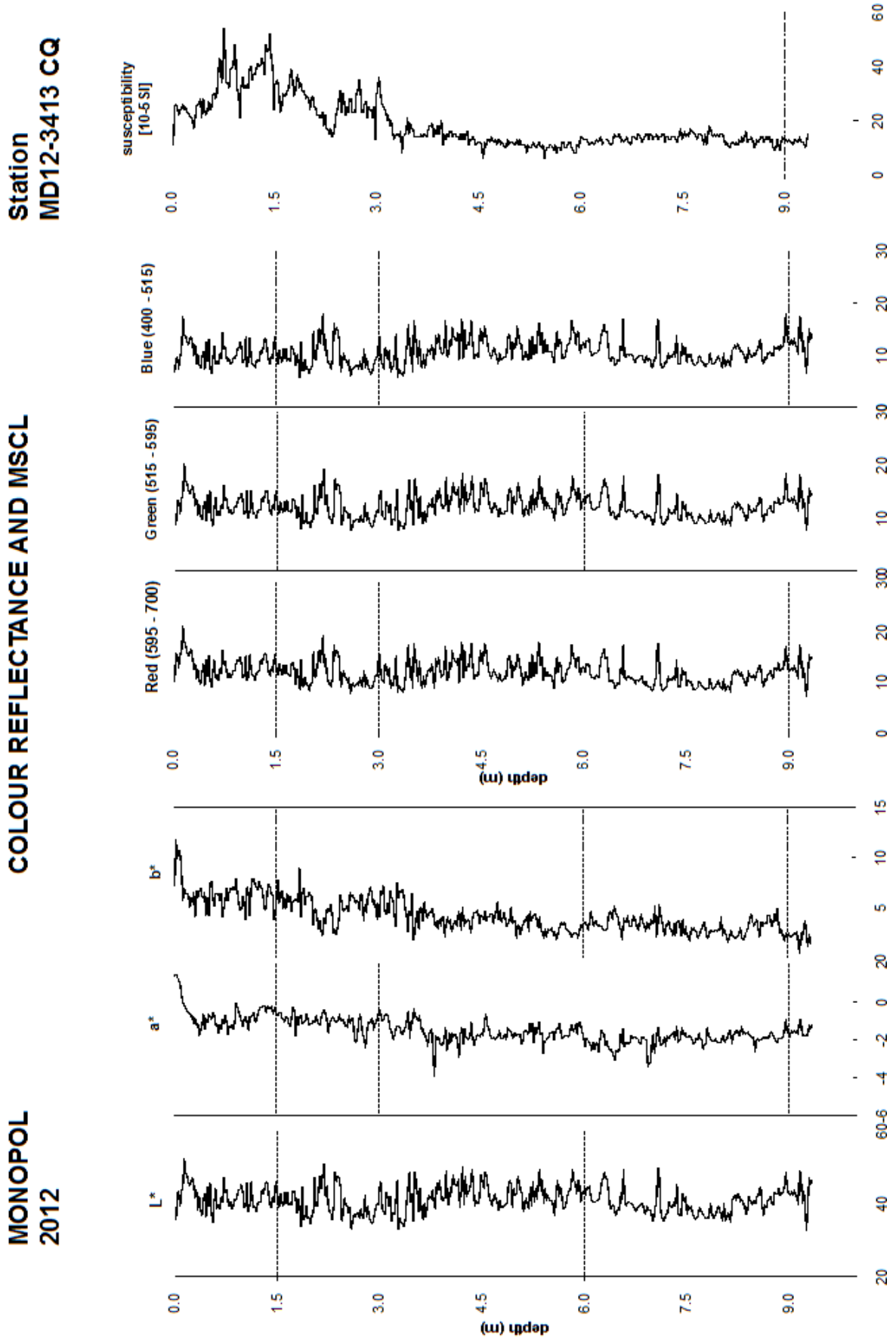


Figure: Magnetic susceptibility and color reflectance of CaSq core MD12-3413-CQ.

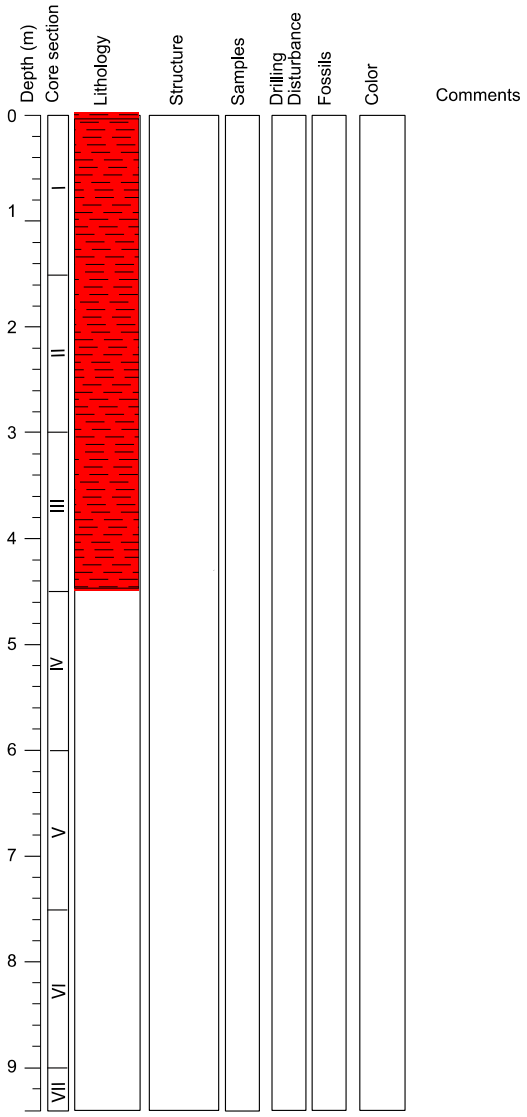
MD191 – MONOPOL	Station: MONO 7

SEDIMENTOLOGY OF CASQ CORE MD12-3413-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

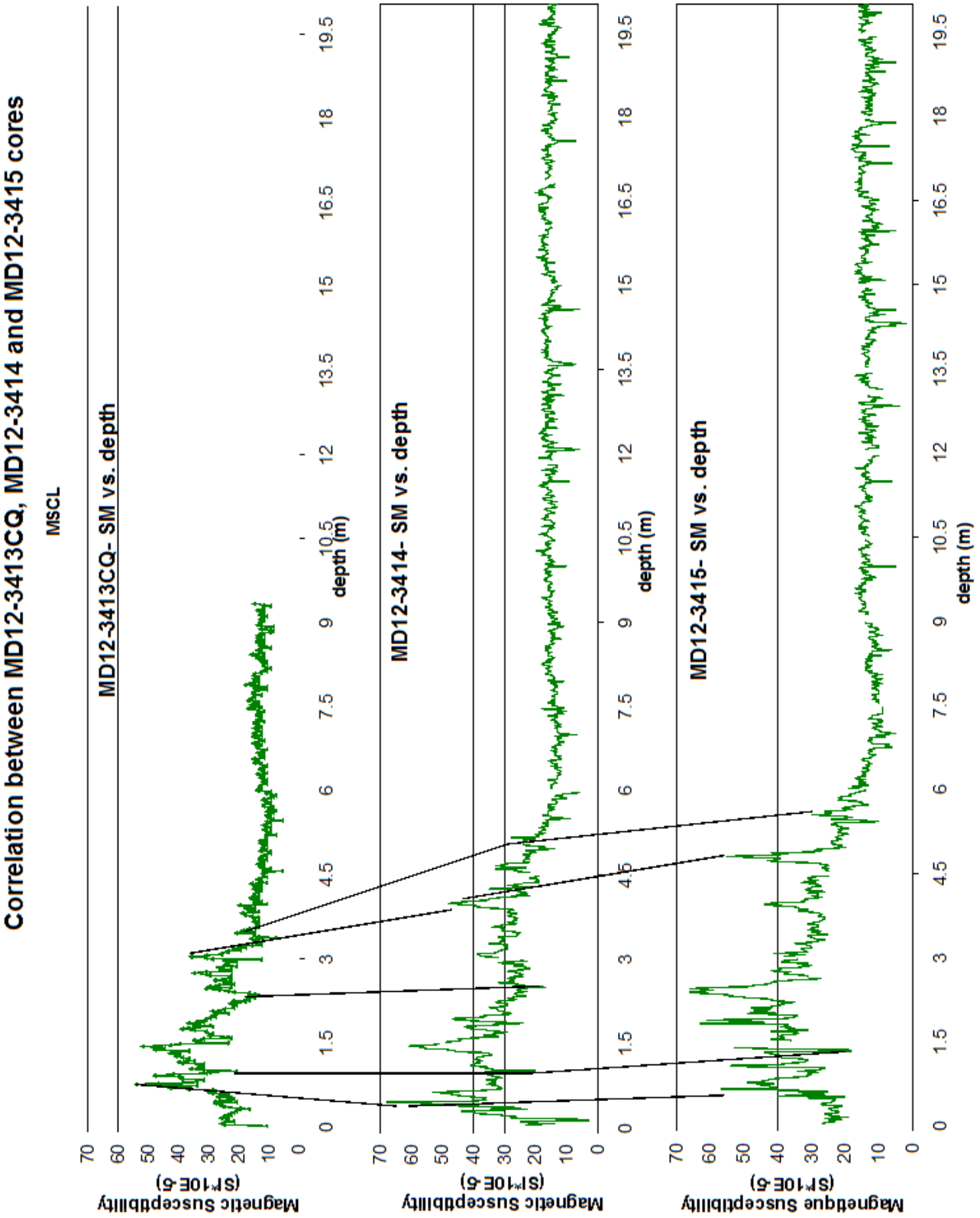
Sediment Description
Core MD12-3413 CQ

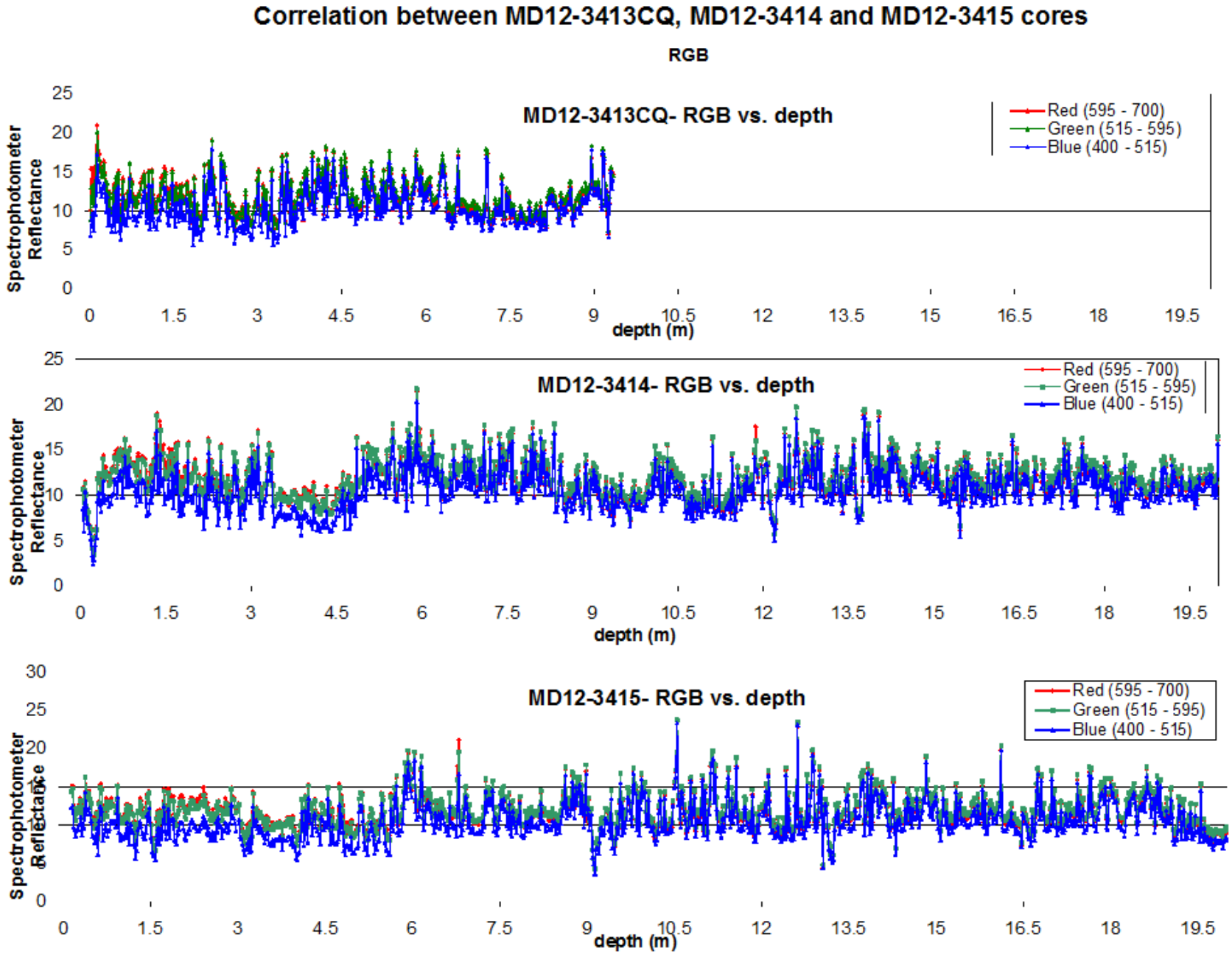
Station MONO 7
Water depth (m): 2140



MD191 – MONOPOL	Station: MONO 7

COMPARISON CASQ MD12-3413-CQ vs CALYPSO MD12-3414/15




Correlation between MD12-3413CQ, MD12-3414 and MD12-3415 cores
RGB
MD12-3413CQ- RGB vs. depth
MD12-3414- RGB vs. depth
MD12-3415- RGB vs. depth
Red (595 - 700)
Green (515 - 595)
Blue (400 - 515)
Spectrophotometer Reflectance
depth (m)
0
1.5
3
4.5
6
7.5
9
10.5
12
13.5
15
16.5
18
19.5
0
5
10
15
20
25
30

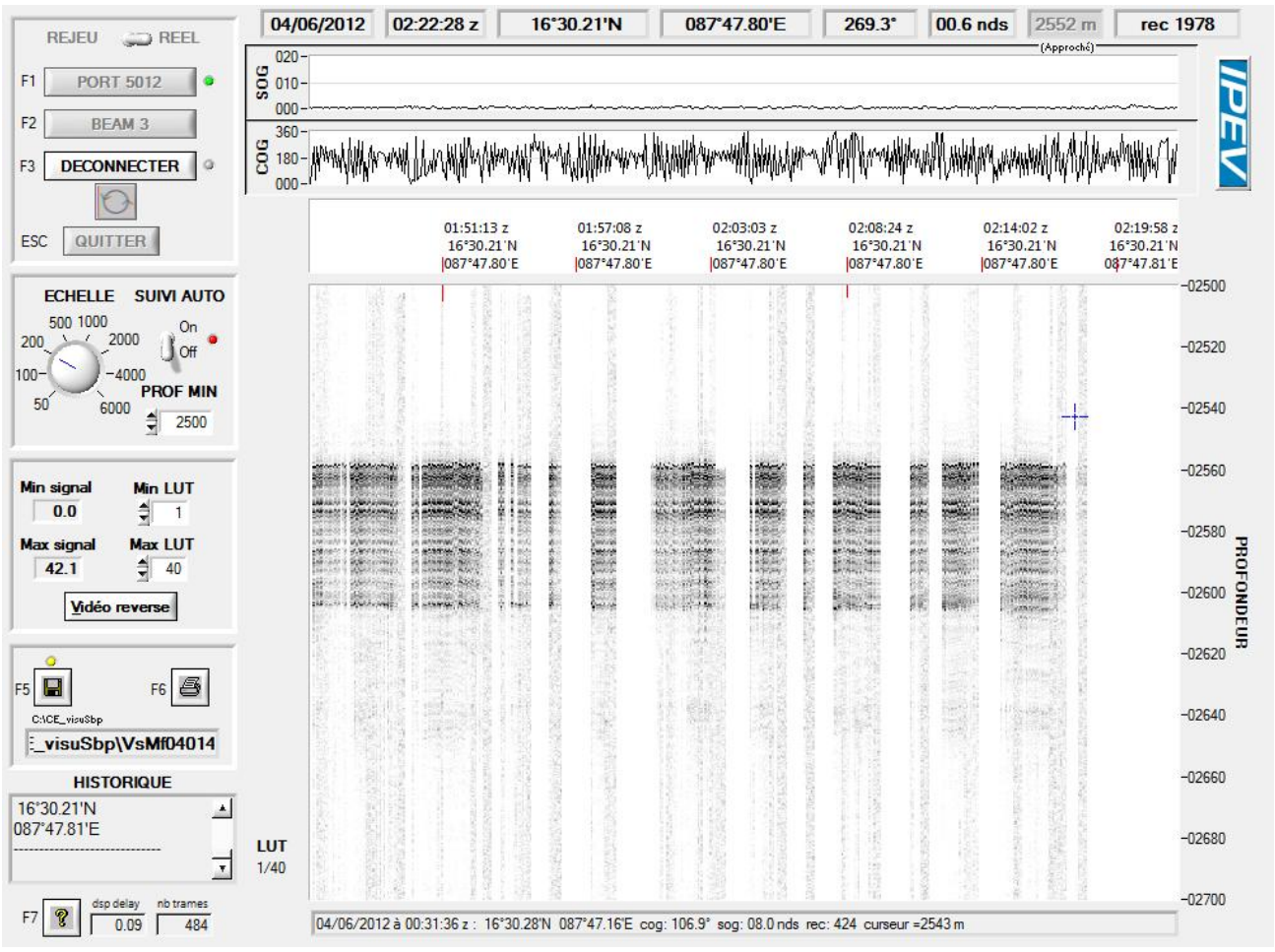
MD191 – MONOPOL	Station: MONO 8

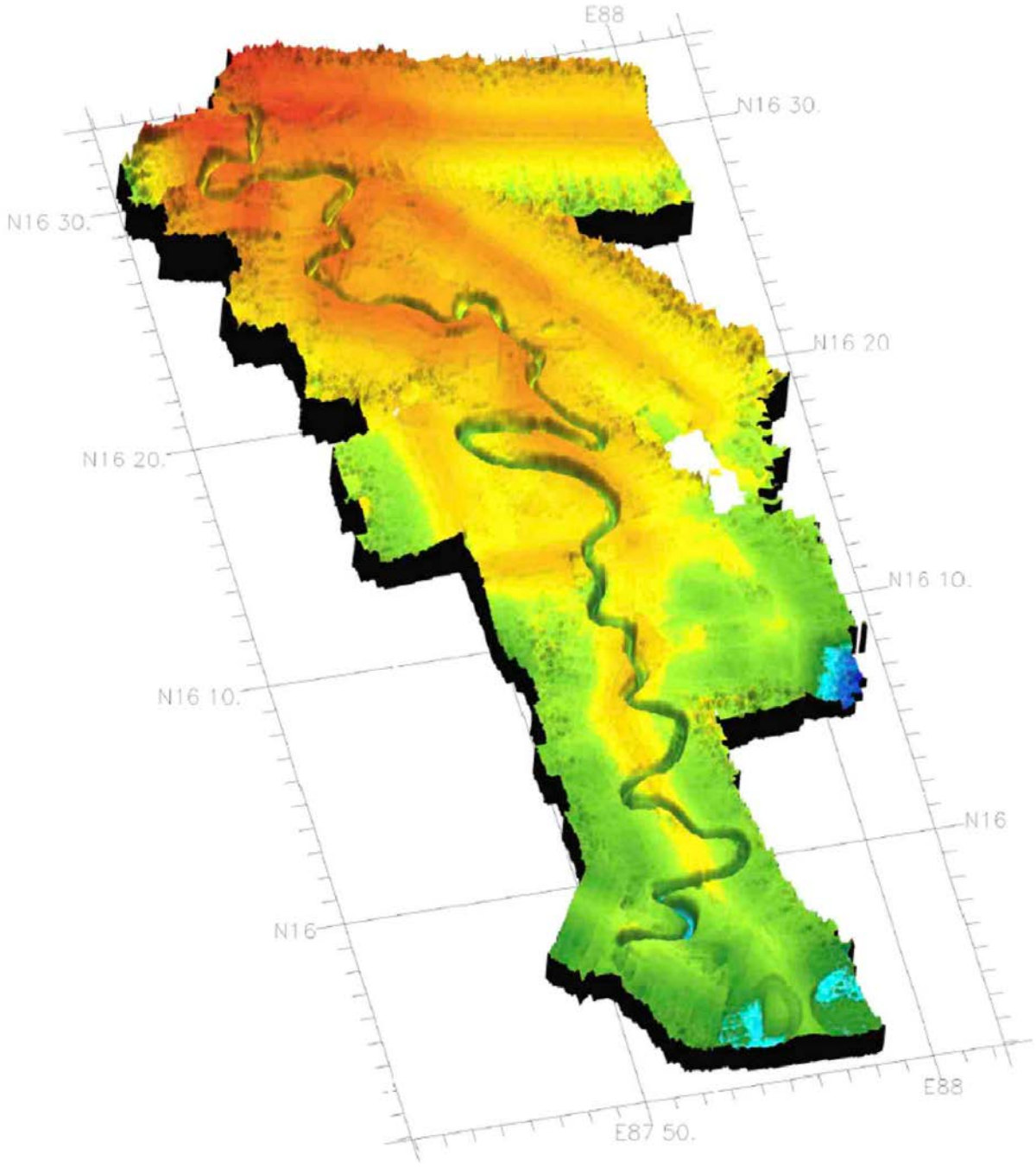
STATION SUMMARY

Date and time approaching site: 4/6/2012 – 3:19 (TU)
Date and time ending station activity:27/5/2012 – 19:50 (TU)
Latitude:16°30.25N **Longitude**: 87°47.80E **Water depth (m)**: 2560
Short area description: Close to site of core SONNE 118KL (10m). Active channel system with thick Holocene levees.

Activity on station		**Core identification**
Calypso corer	Yes (2)	**MD12-3417& MD12-3422**
Casq	Yes (2)	**MD12-3416CQ& MD12-3418CQ**
Multi-corer	Yes	**MD191-MC-MONO8**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	No	
Plankton net	No	

Figure: 3.5 kHz profile across station MONO 8 while arriving on site.




E88
N16 30.
N16 30.
N16 20
N16 20.
N16 10.
N16 10.
N16
N16
E88
E87 50.

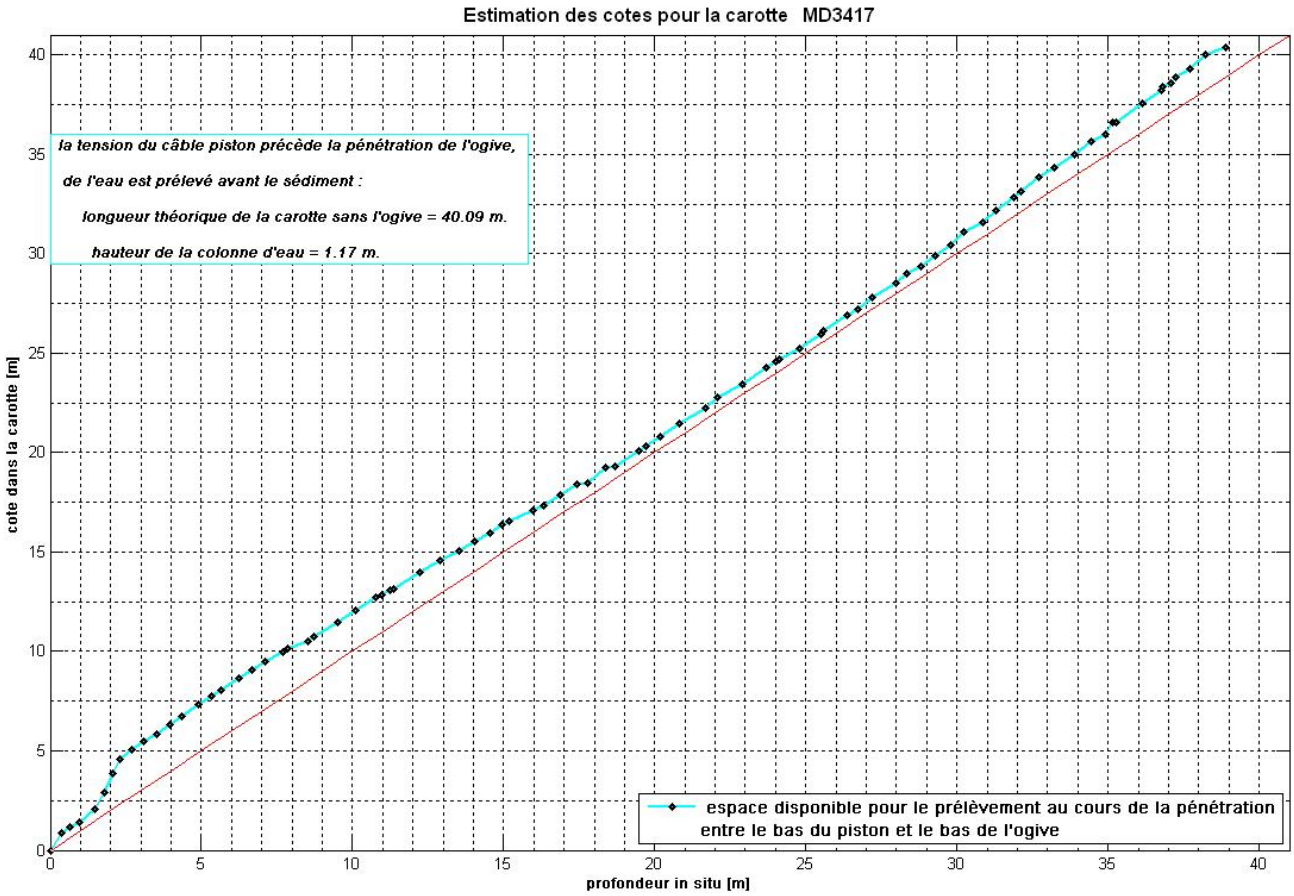
MD191 – MONOPOL	Station: MONO 8

CALYPSO CORING OPERATION: MD12-3417

Coring site information	*Latitude (°N):*	***16°30.03N***
	Longitude (°E):	***87°47.82E***
	Water depth (m):	***2564***
Calypso corer settings	*Core length (m):*	***41.8***
	Empty weight in water (t):	***7.40***
	Free fall (m):	***3***
	Length piston cable (m):	***54.39***
Coring operation	*Time corer starts descent:*	***8:59TU***
	Time triggering:	***10:00 TU***
	Length cable (m):	***2514***
	Maximum tension (t)	***11.7***
	Time corer on deck:	***11:10 TU***
Result coring operation	*Total weight in water (t)*	***7.73***
	Length of sediment (m)	***39.77***

General observations / incidents:

Figure: Core levels versus in situ sediment depth, CINEMA reconstructions for core MD12-3417.



MD191 – MONOPOL	Station: MONO 8

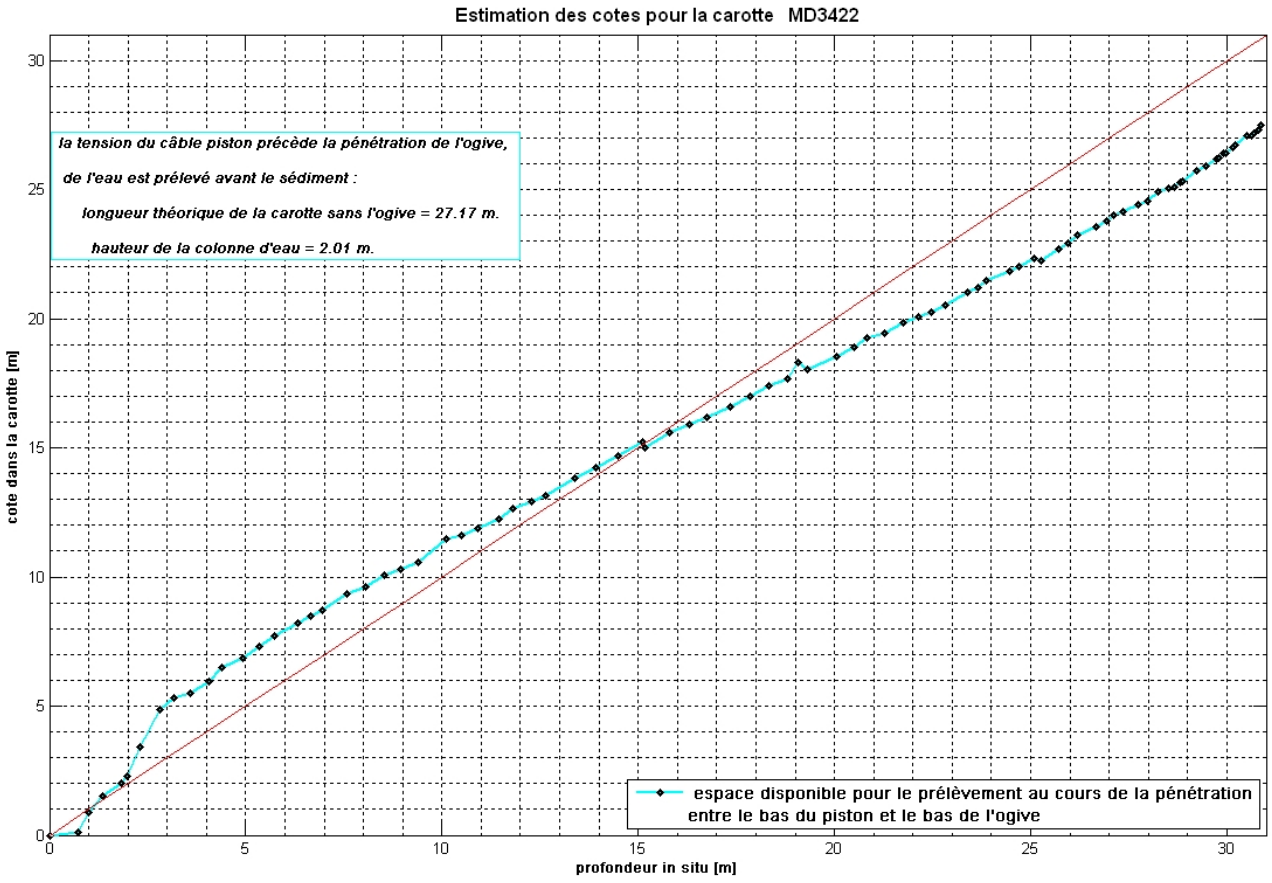
CALYPSO CORING OPERATION: MD12-3422

Coring site information	*Latitude (°N):*	***16°30.20N***
	Longitude (°E):	***87°47.87E***
	Water depth (m):	***2558***
Calypso corer settings	*Core length (m):*	***52***
	Empty weight in water (t):	***8***
	Free fall (m):	***3***
	Length piston cable (m):	***64.85***
Coring operation	*Time corer starts descent:*	***15:52 TU***
	Time triggering:	***17:11 TU***
	Length cable (m):	***2508***
	Maximum tension (t)	***14.5***
	Time corer on deck:	***18:15 TU***
Result coring operation	*Total weight in water (t)*	***8.25***
	Length of sediment (m)	***29.90***

General observations / incidents:

Corer bent.

Figure: Core levels versus in situ sediment depth, CINEMA reconstructions for core MD12-3422.



MD191 – MONOPOL	Station: MONO 8

CASQ CORING OPERATION: MD12-3416-CQ

Coring site information	*Latitude (°N):*	***16°30.25N***
	Longitude (°E):	***87°47.80E***
	Water depth (m):	***2564***
Casq corer settings	*Core length (m):*	***12***
	Empty weight in water (t):	***7.32***
Coring operation	*Time corer starts descent:*	***2:37 TU***
	Time on bottom:	***3:19 TU***
	Maximum tension (t)	***12.5***
	Time corer on deck:	***4:25 TU***
Result coring operation	*Total weight in water (t)*	***7.90***
	Length of sediment (m)	***6.98***

General observations / incidents:

The inflating buoy supposed to maintain top sediment in place before putting the corer to horizontal was punched, with a large hole -> deflated. Top sediment moved…

MD191 – MONOPOL	Station: MONO 8

CASQ CORING OPERATION: MD12-3418-CQ

Coring site information	*Latitude (°N):*	***16°30.27N***
	Longitude (°E):	***87°47.92E***
	Water depth (m):	***2557***
Casq corer settings	*Core length (m):*	***12***
	Empty weight in water (t):	***7.30***
Coring operation	*Time corer starts descent:*	***1:15 TU***
	Time on bottom:	***2:16 TU***
	Maximum tension (t)	***14.2***
	Time corer on deck:	***3:15 TU***
Result coring operation	*Total weight in water (t)*	***7.90***
	Length of sediment (m)	***8.52***

General observations / incidents:

MULTI-CORER OPERATION: MD191-MC-MONO8

Coring site information	*Latitude (°N):*	***16°30.28N***
	Longitude (°E):	***87°47.92E***
	Water depth (m):	***2549***
Coring operation	*Time multi corer starts descent:*	***22:41 TU***
	Time at bottom:	***23:46 TU***
	Time corer on deck:	***0:39 TU***
Length of sediments (cm)	*Tube 1*	***32***
	Tube 2	***29***
	Tube 3	***52***
	Tube 4	***~52***

General observations / incidents:

First Multicore operation did not work. Tubes smeared with sediment, but empty nonetheless. Corer penetrated but could not close at recovery. A piece of rope blocked the closing system.
Second MC workd OK. Interstitial water could be sampled.

From this station, the frame of the MC was made heavier in order to increase its stability.
Quality of operations seemed to increase (at least for stations not too deep)

MD191 – MONOPOL	Station: MONO 8

SECTIONS INFORMATIONS OF CALYPSO MD12-3417

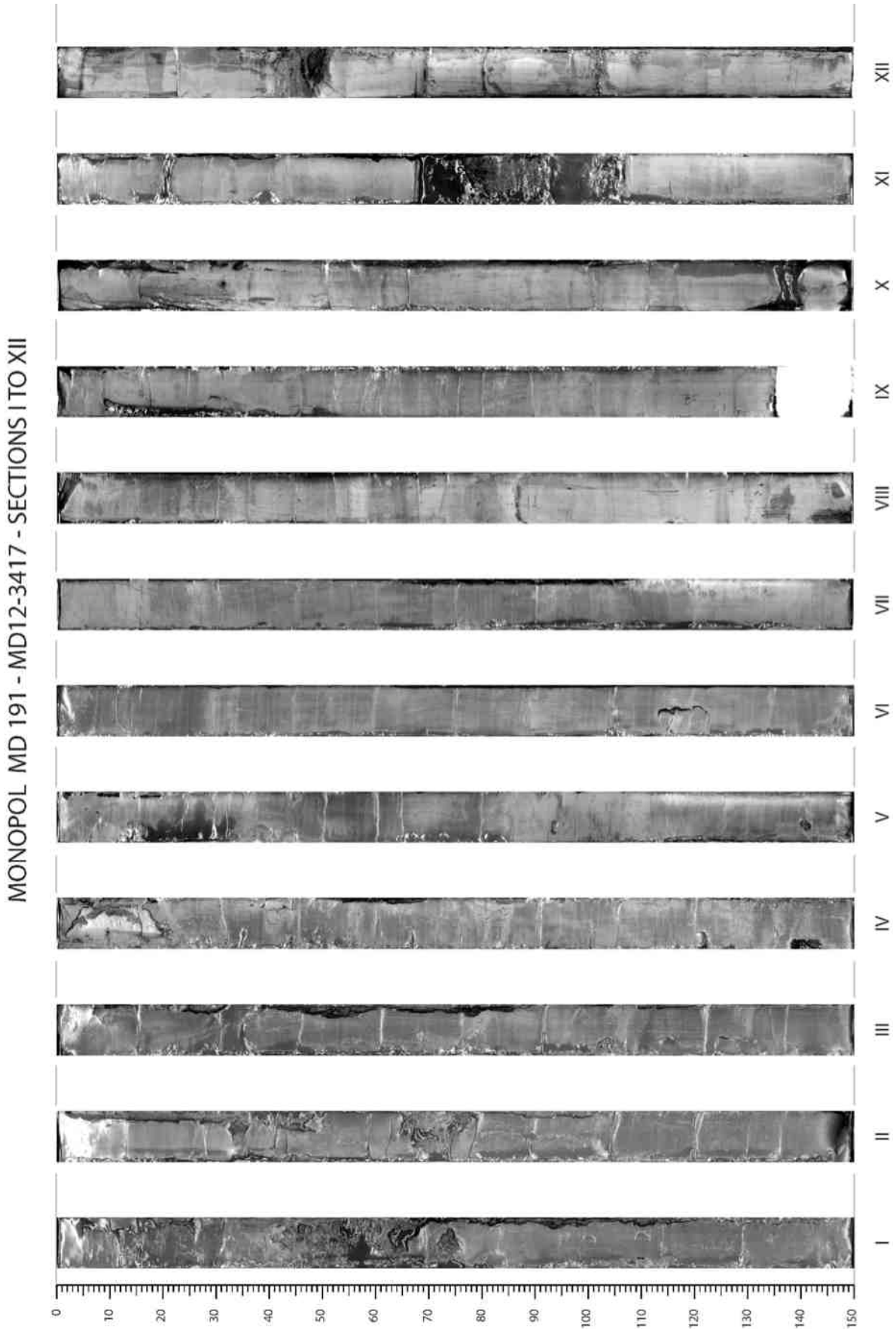
MONOPOL
-MD191

Core MD12-3417

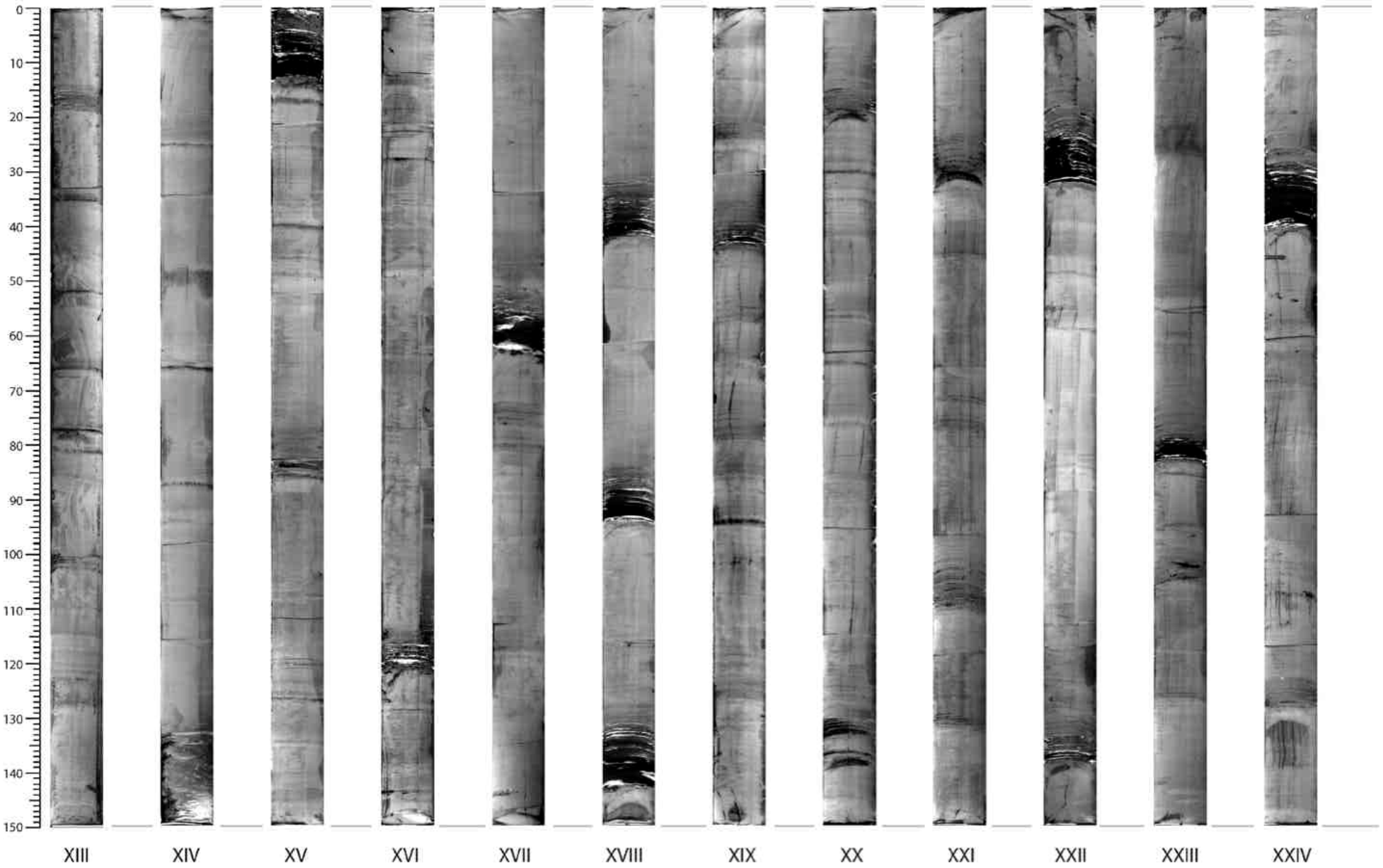
Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	149.9	
II	150	300	151.9	
III	300	450	151.3	
IV	450	600	150.6	
V	600	750	150.4	
VI	750	900	150.7	864 – 872 :small holes
VII	900	1050	151	
VIII	1050	1200	150.4	
IX	1200	1350	150.4	Polystyren : 1335 - 1350
X	1350	1500	149.9	
XI	1500	1650	150.7	
XII	1650	1800	150.4	
XIII	1800	1950	150.2	
XIV	1950	2100	151.4	
XV	2100	2250	150.7	
XVI	2250	2400	151.2	
XVII	2400	2550	150.5	
XVIII	2550	2700	150.3	
XIX	2700	2850	150.4	
XX	2850	3000	150.9	
XXI	3000	3150	150.4	
XXII	3150	3300	150.9	
XXIII	3300	3450	150.6	
XXIV	3450	3600	150.6	
XXV	3600	3750	150.1	
XXVI	3750	3900	150.7	
XXVII	3900	3977	77.6	

MD191 – MONOPOL	Station: MONO 8

PICTURES OF CALYPSO MD12-3417



MONOPOL MD 191 - MD12-3417 - SECTIONS XIII TO XXIV



MONOPOL MD 191 - MD12-3417 - SECTIONS XXV TO XXVII

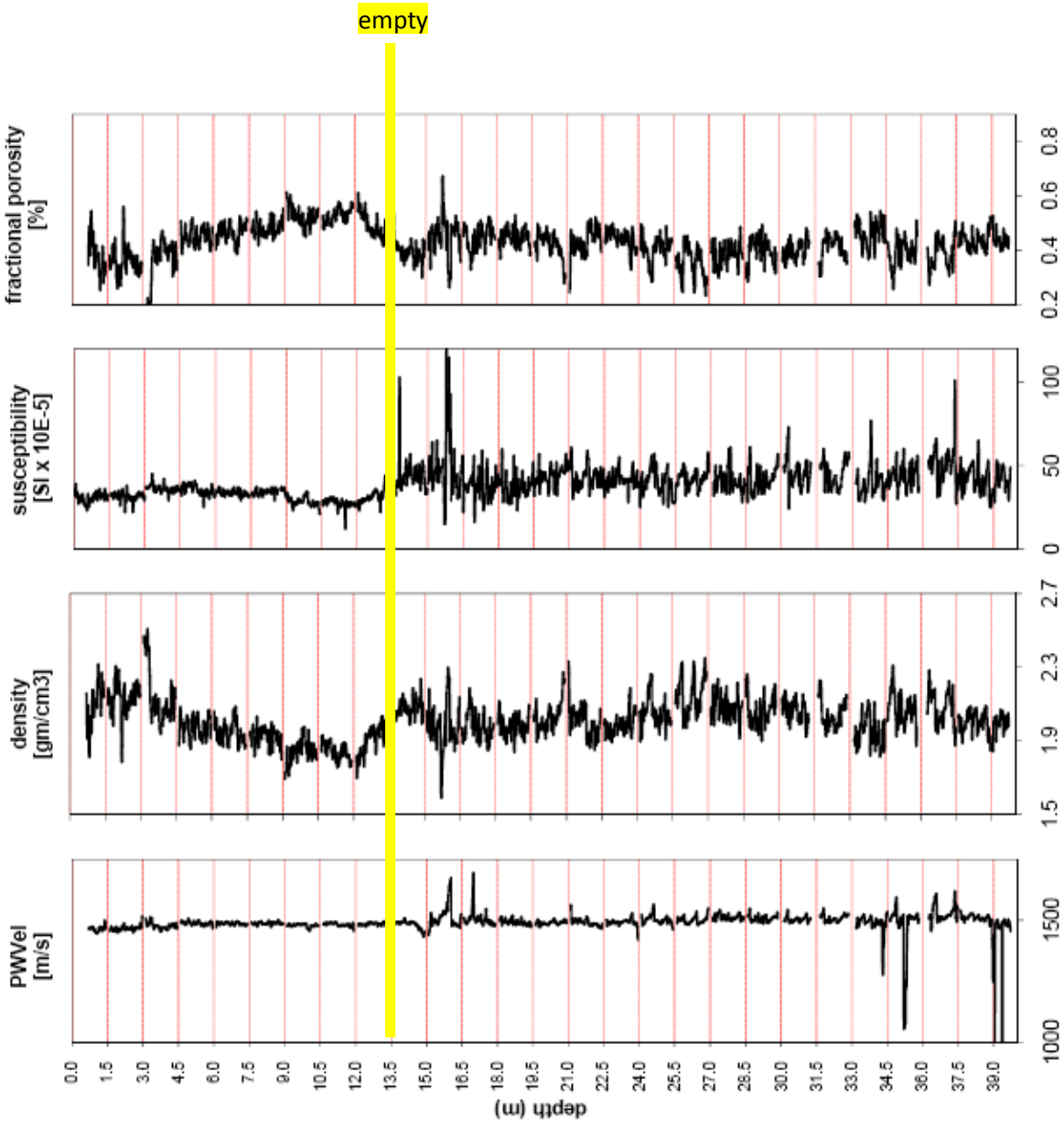
MD191 – MONOPOL	Station: MONO 8

PHYSICAL PROPERTIES OF CALYPSO MD12-3417

Station
MD12-3417

Multi-sensor core logger

MONOPOL
2012



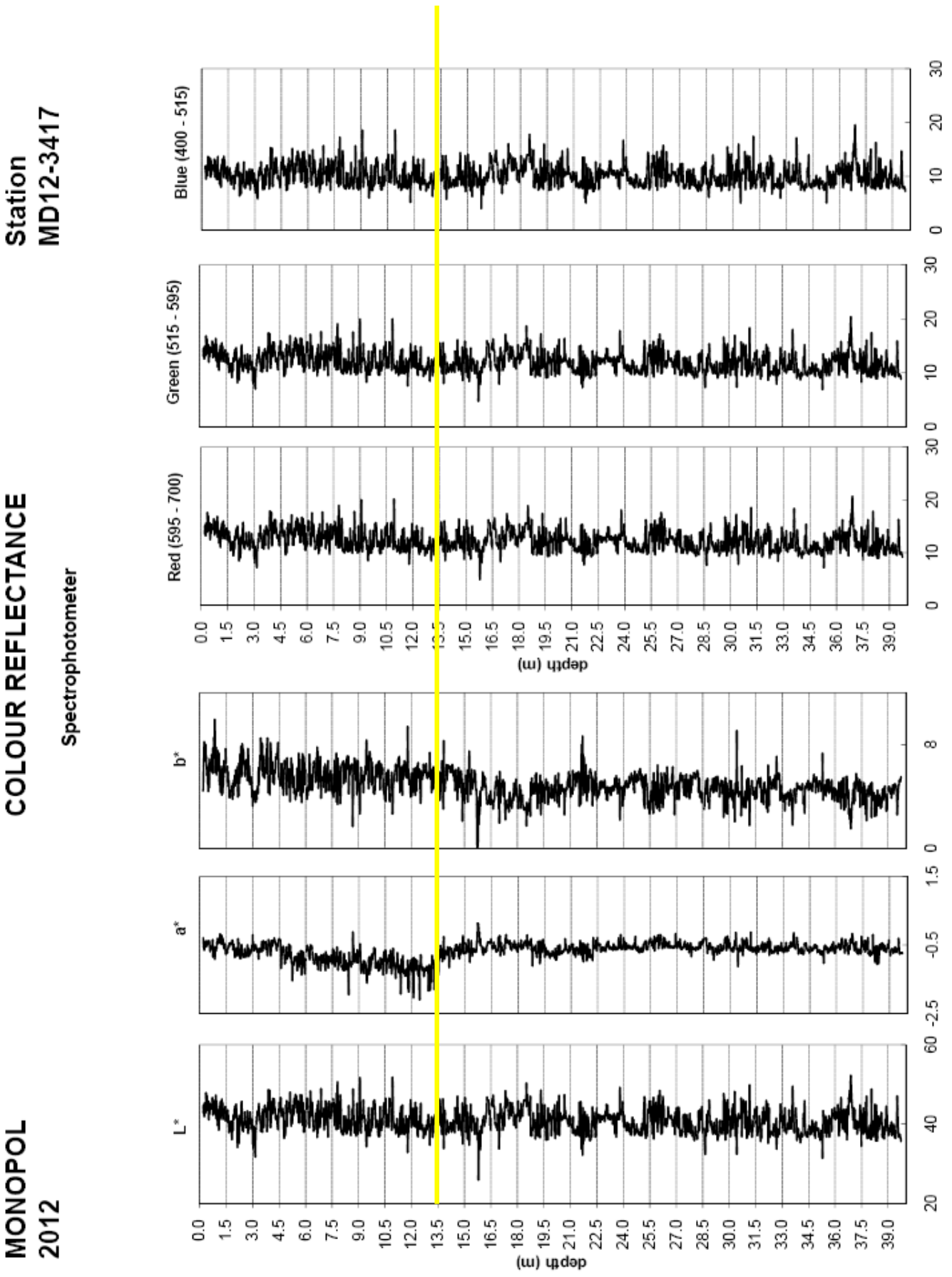
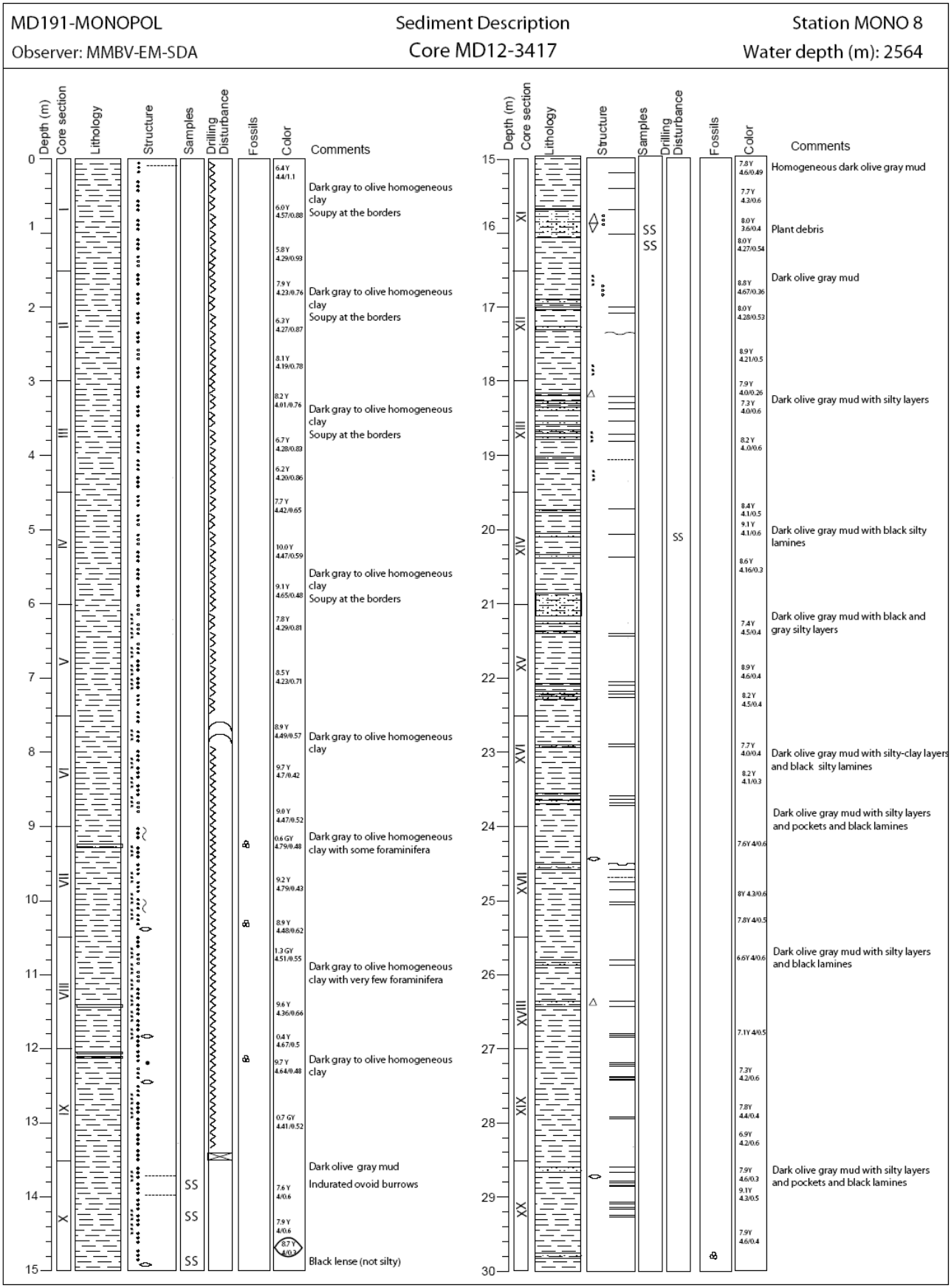


Figure: Physical properties and color reflectance of Calypso core MD12-3417

MD191 – MONOPOL	Station: MONO 8

SEDIMENTOLOGY OF CALYPSO MD12-3417



MD191-MONOPOL

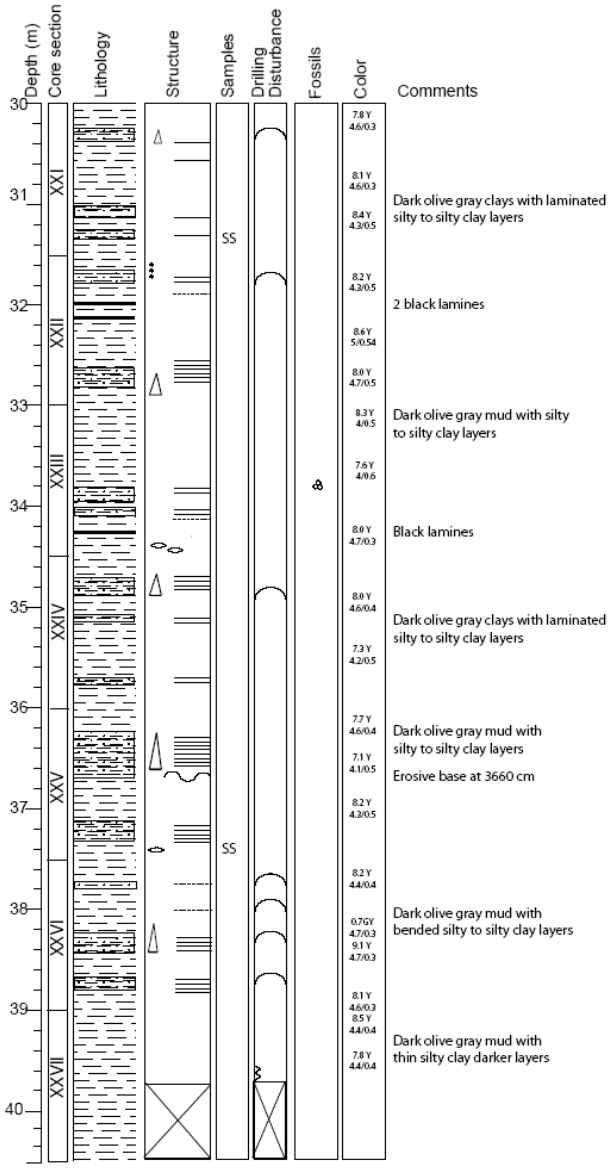
Observer: MMBV-EM-SDA

Sediment Description

Core MD12-3417

Station MONO 8

Water depth (m): 2564



MD191 – MONOPOL	Station: MONO 8

SECTIONS INFORMATIONS OF CALYPSO MD12-3422

MONOPOL
-MD191

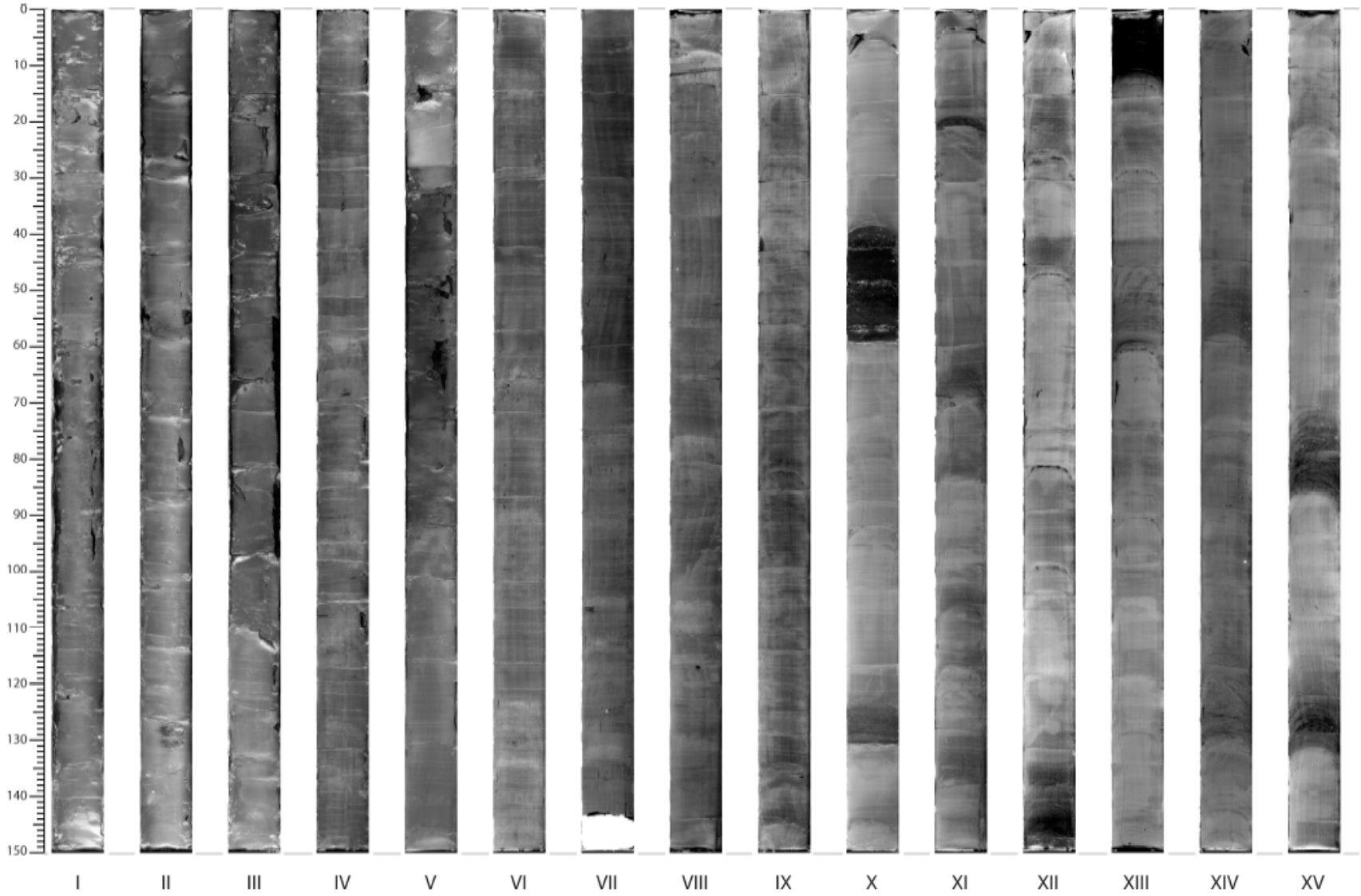
Core MD12-3422

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	150.7	
II	150	300	151.1	
III	300	450	149.9	
IV	450	600	151	
V	600	750	150.6	
VI	750	900	150.2	
VII	900	1050	150.8	1044-1051: polystyren
VIII	1050	1200	148.9	
IX	1200	1350	150.3	
X	1350	1500	150.2	
XI	1500	1650	150.7	
XII	1650	1800	150.5	
XIII	1800	1950	150.9	
XIV	1950	2100	150.4	
XV	2100	2250	150.4	
XVI	2250	2400	150.4	
XVII	2400	2550	150.4	MSCL didn’ttouch : 2518 - 2550
XVIII	2550	2700	150	2677-2686 and 2695-2700: polystyren (don’ttouchsince 2640)
XIX	2700	2850	150.9	
XX	2850	3000	133.2	Section XX + calib afterwards

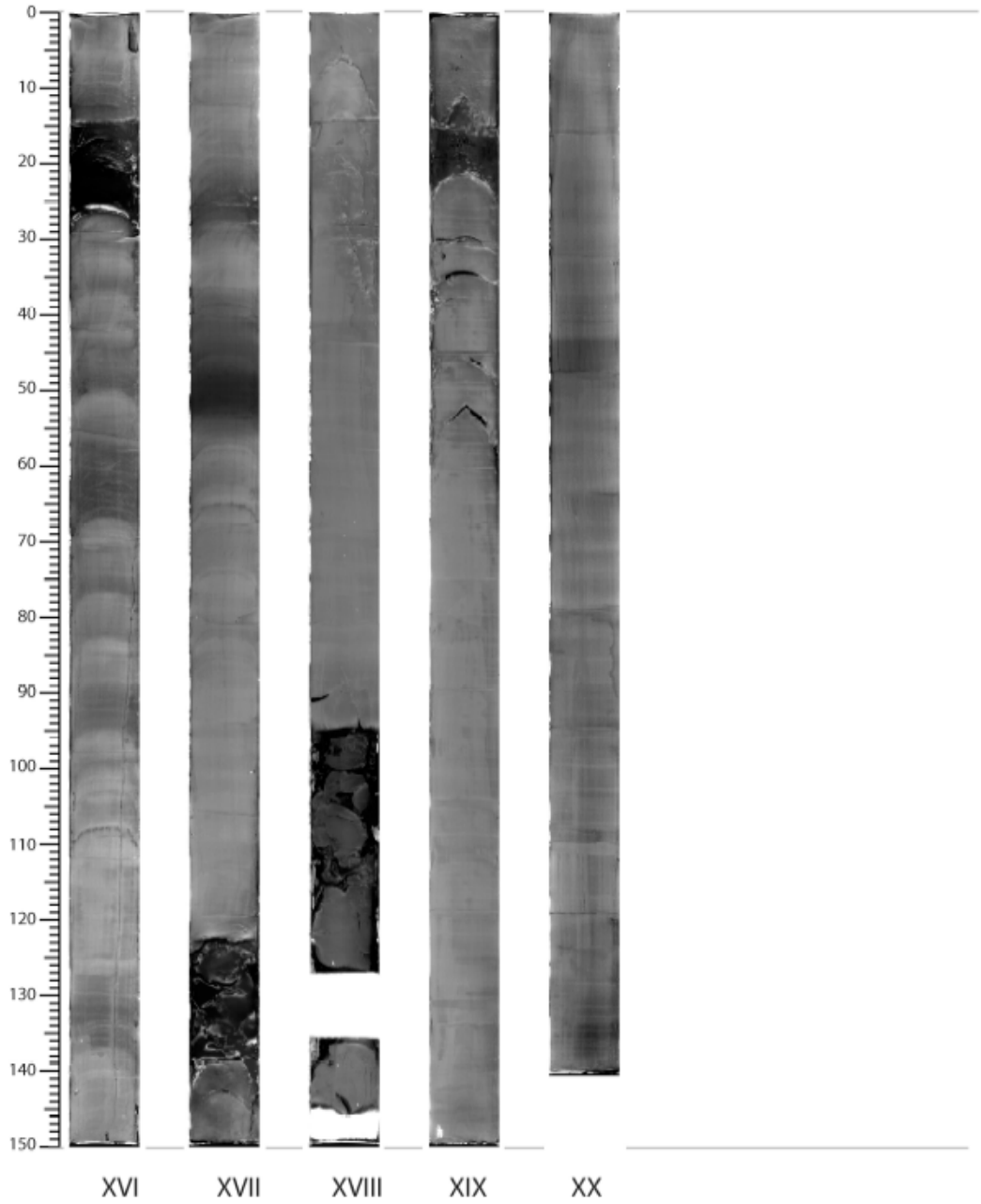
MD191 – MONOPOL	Station: MONO 8

PICTURES OF CALYPSO MD12-3422

MONOPOL MD 191 - MD12-3422



MONOPOL MD 191 - MD12-3422



MD191 – MONOPOL	Station: MONO 8

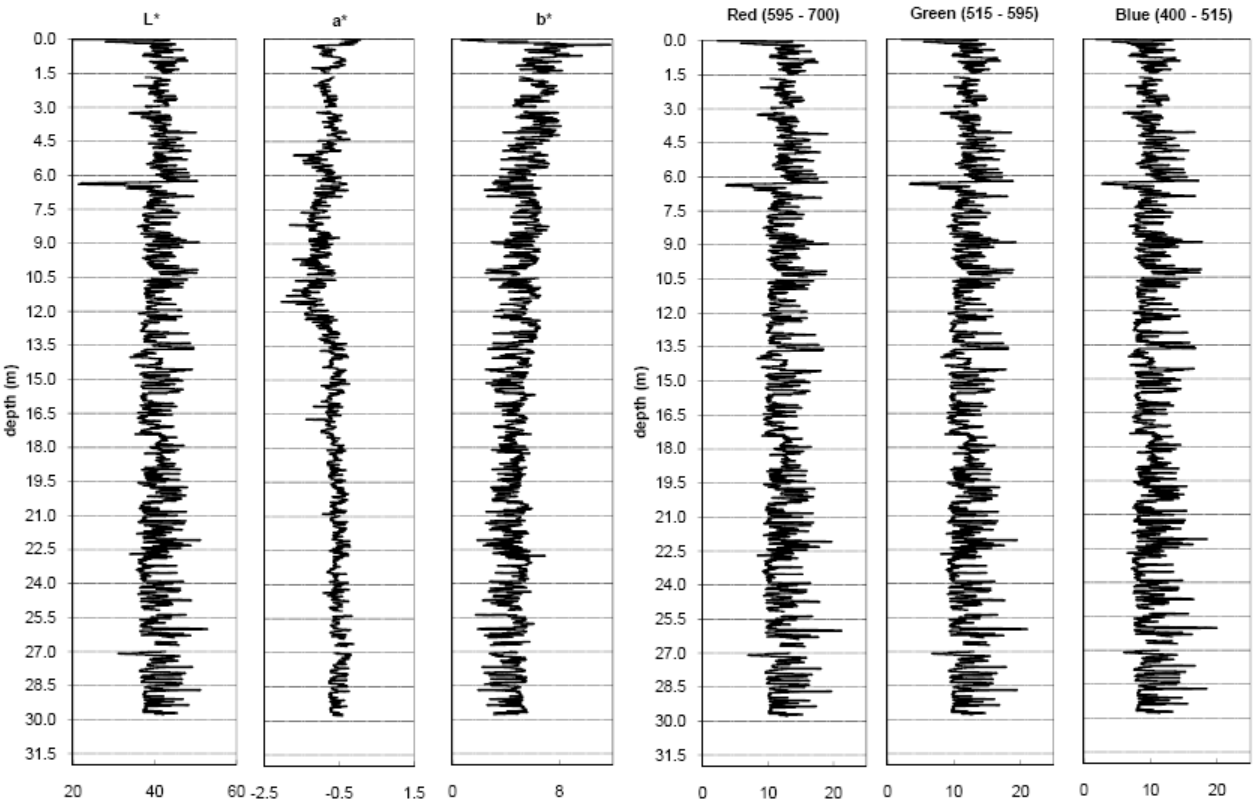
PHYSICAL PROPERTIES OF CALYPSO MD12-3422

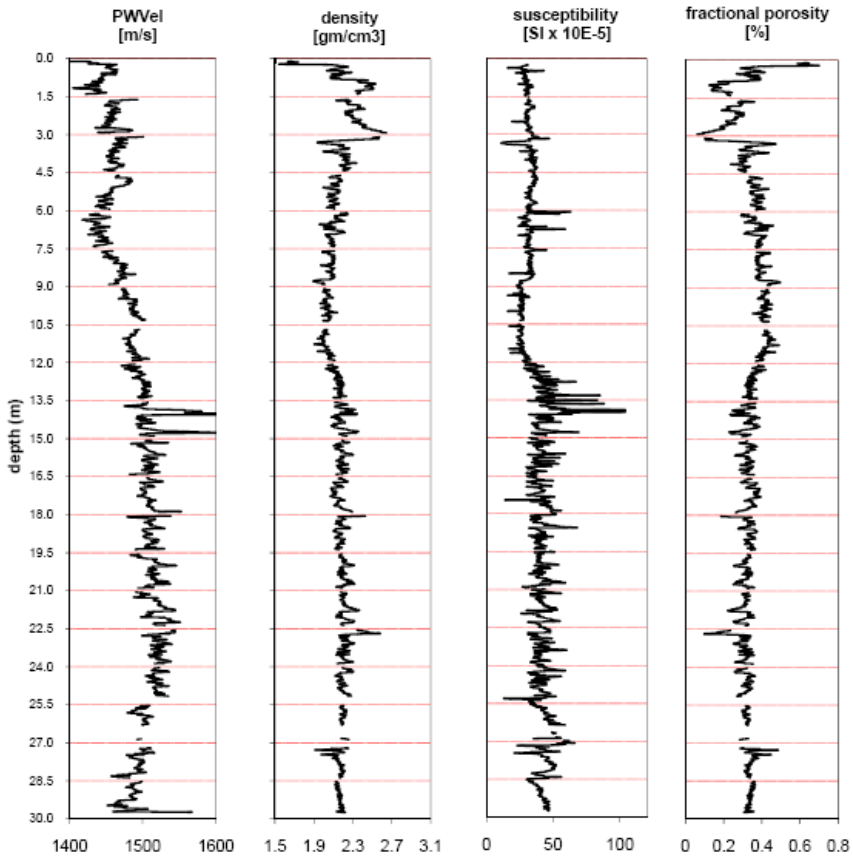
MONOPOL
2012

COLOUR REFLECTANCE

Spectrophotometer

Station
MD12-3422





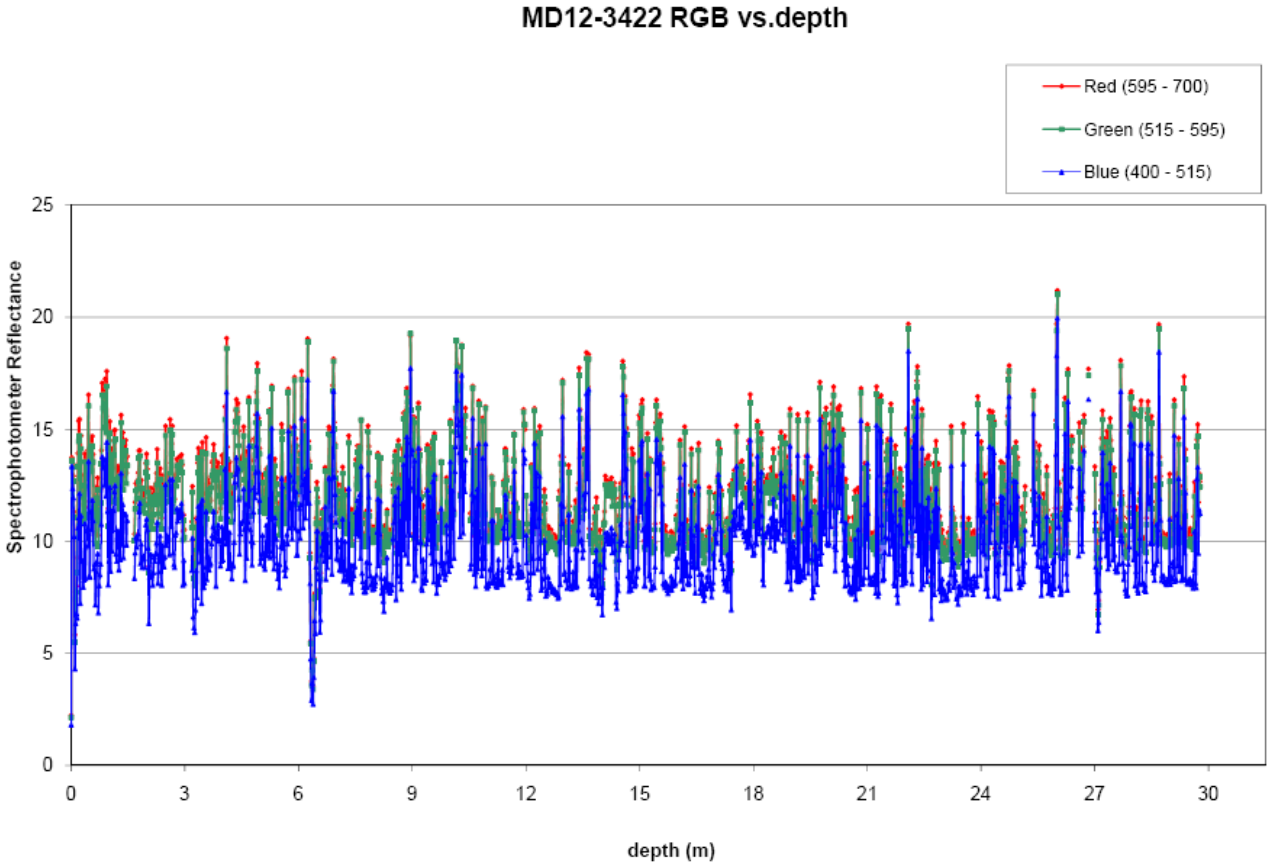
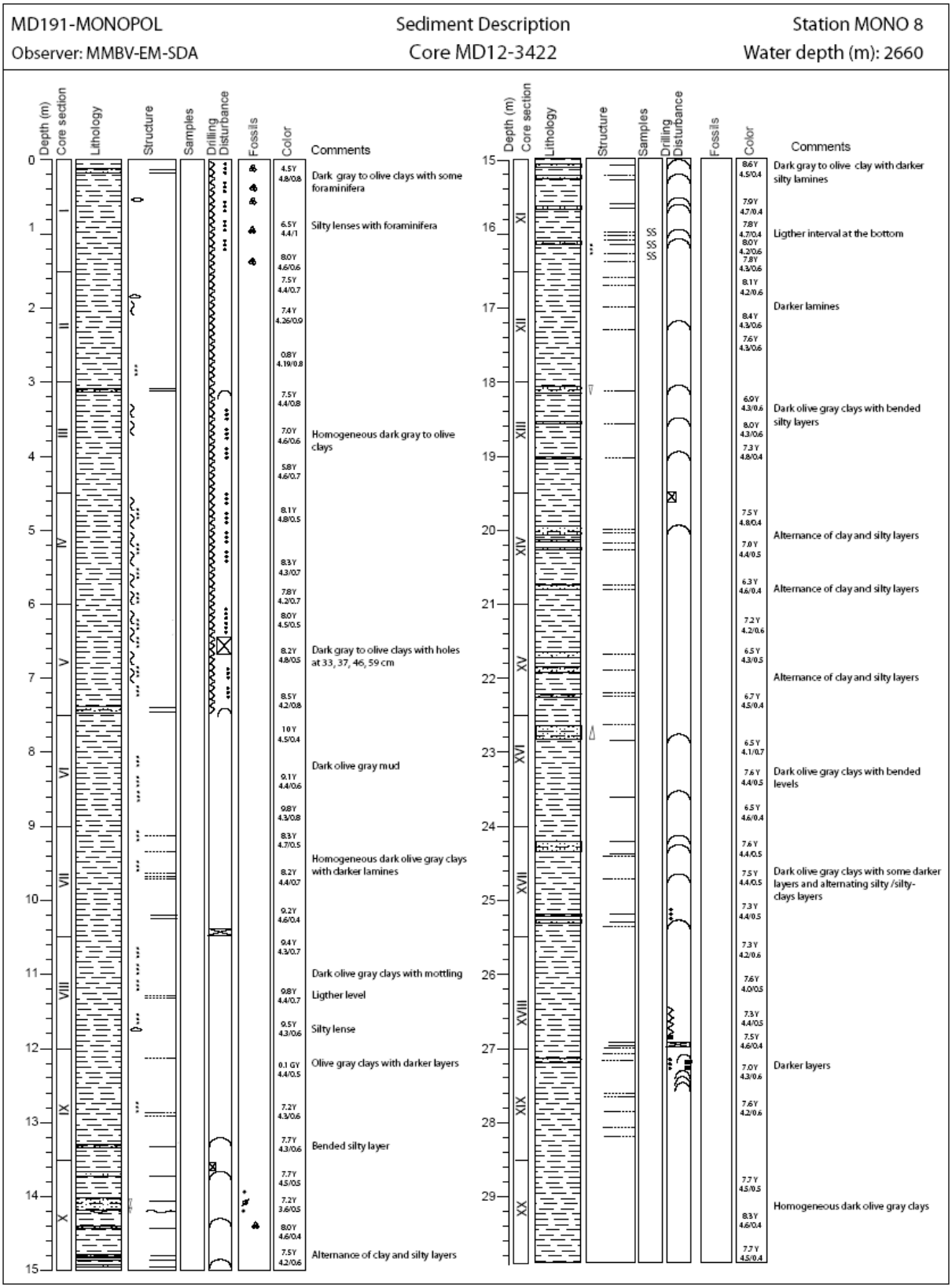


Figure: Physical properties and color reflectance of Calypso core MD12-3422

MD191 – MONOPOL	Station: MONO 8

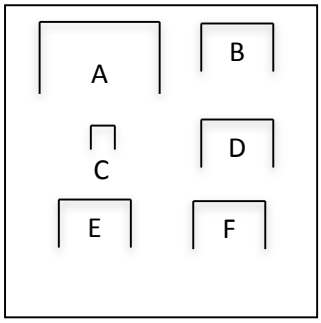
SEDIMENTOLOGY OF CALYPSO CORE MD12-3422



MD191 – MONOPOL	Station: MONO 8

SECTIONS INFORMATIONS OF CASQ MD12-3416-CQ

Number of layers (2 or 3):
Sketch of the core section, defining the location of liners A, B, C, D, E, F:



Liner A : large size (12 cm)
Liners B, D, E, F : medium size (6 cm)
Liners C : small U-channels

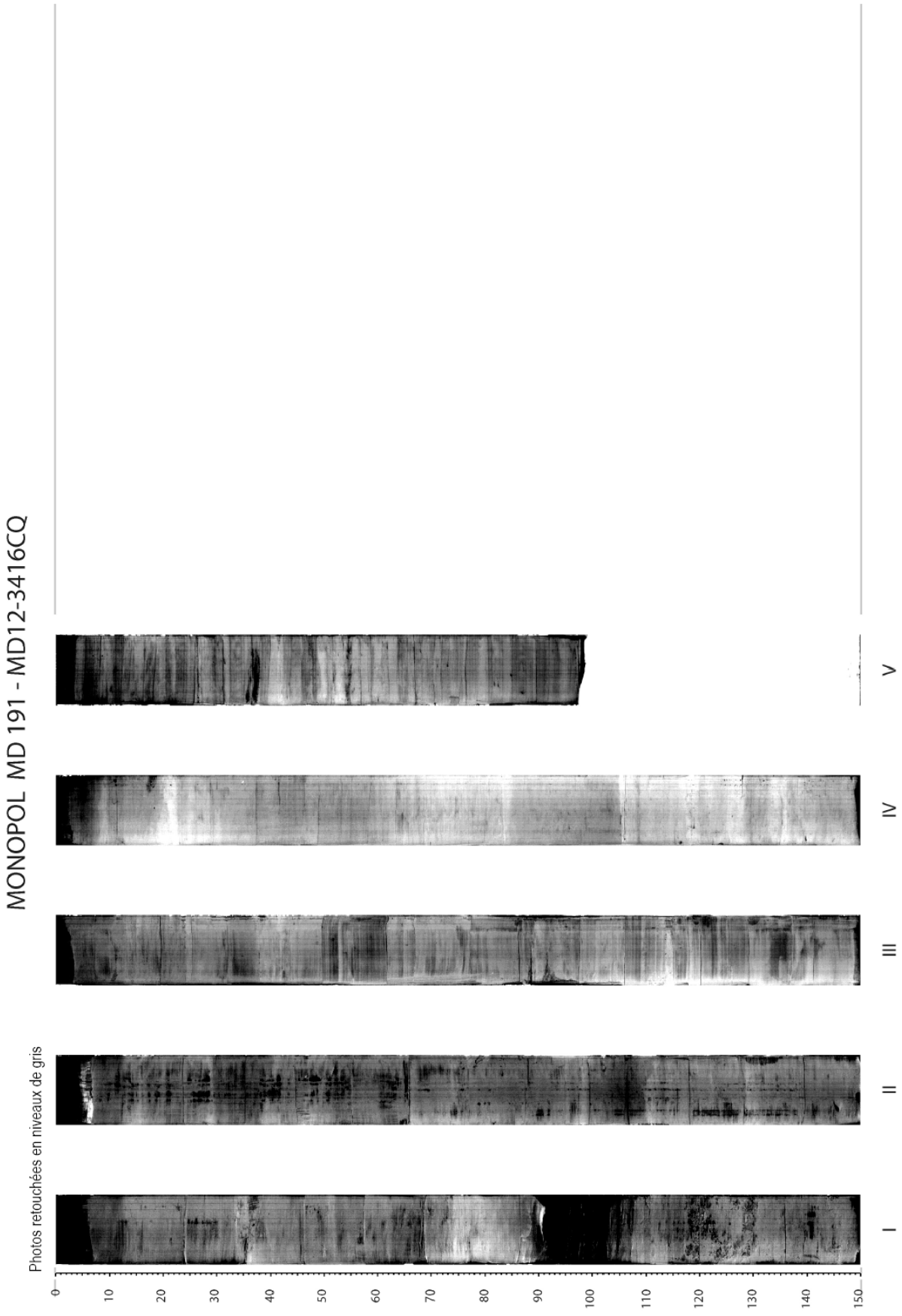
SECTIONS INFORMATIONS OF CASQ MD12-3416 CQ

Core MD12-3416 CQ — MONOPOL -MD191

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
Ia+Ib	0	150	149	-
II	150	300	149.5	-
III	300	450	149.8	-
IV	450	600	149.9	-
V	600	698	149.7	-

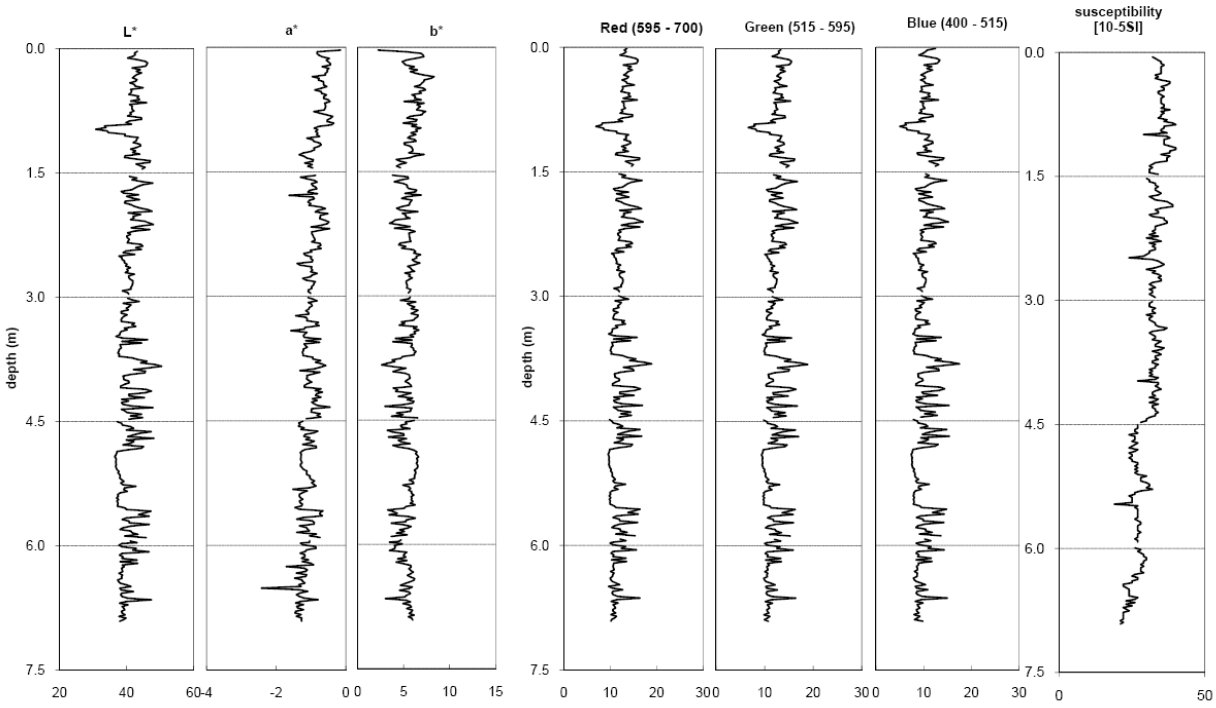
MD191 – MONOPOL	Station: MONO 8

PICTURES OF CASQ MD12-3416-CQ



MD191 – MONOPOL	Station: MONO 8

PHYSICAL PROPERTIES OF CASQ MD12-3416 -CQ



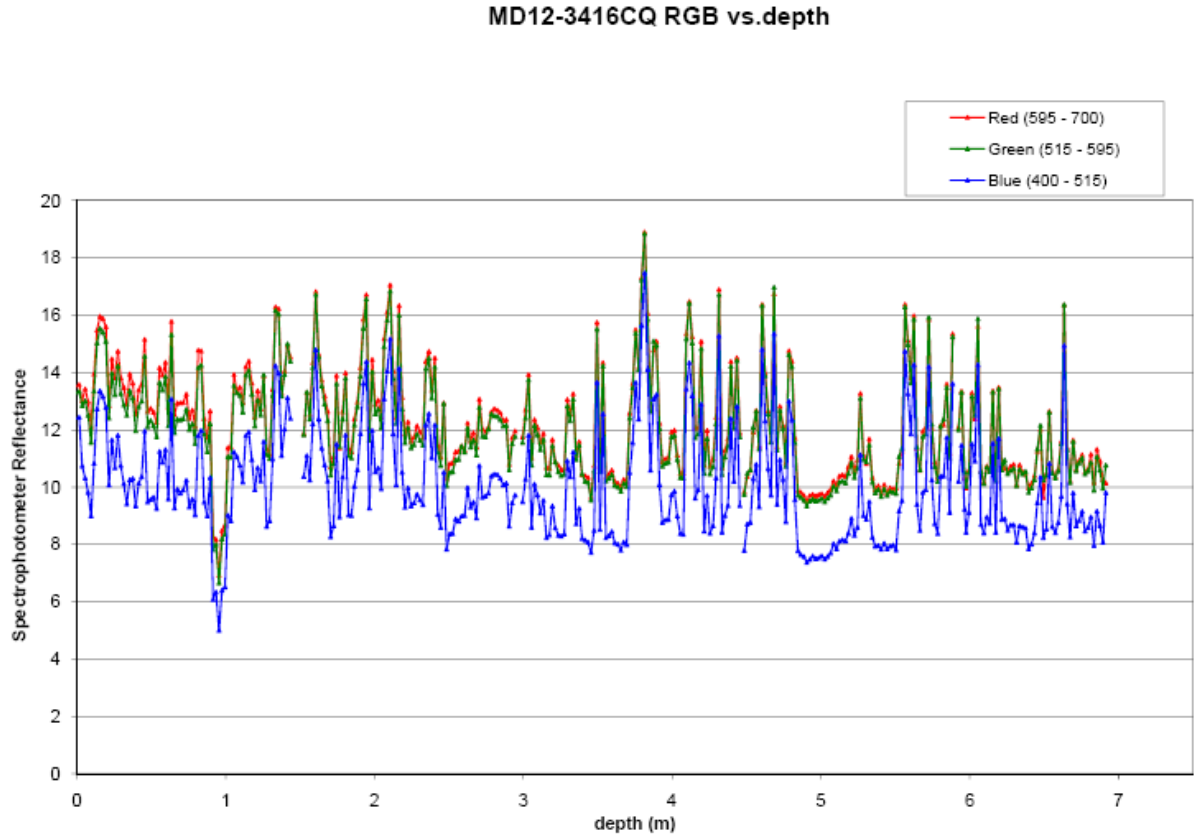


Figure: Color reflectance and physical properties of CASQ core MD12-3416 CQ

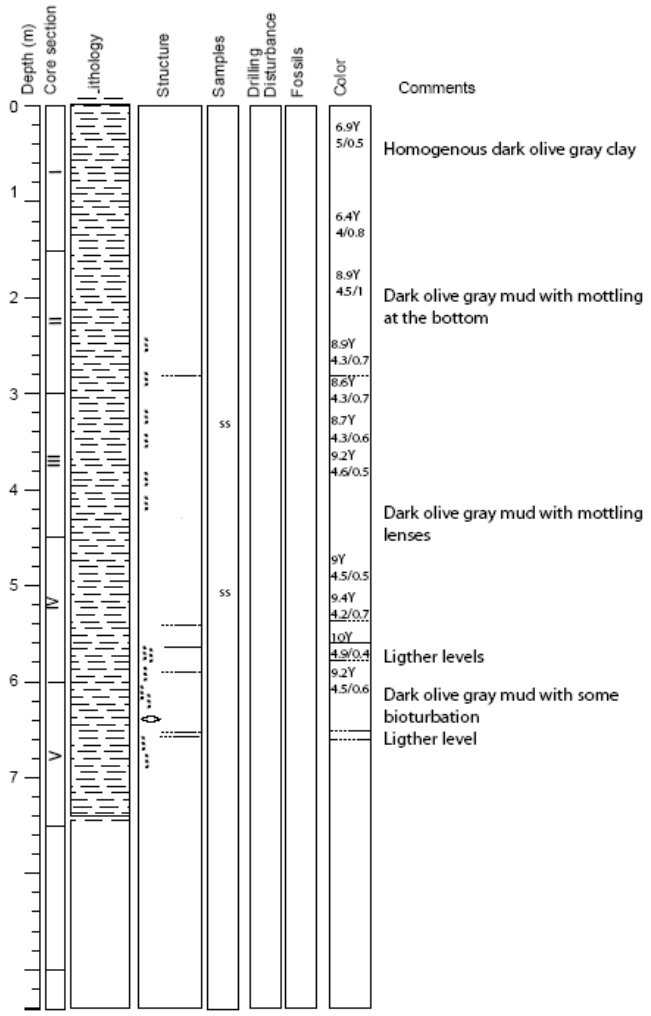
MD191 – MONOPOL	Station: MONO 8

SEDIMENTOLOGY OF CASQ CORE MD12-3416-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

Sediment Description
Core MD12-3416 CQ

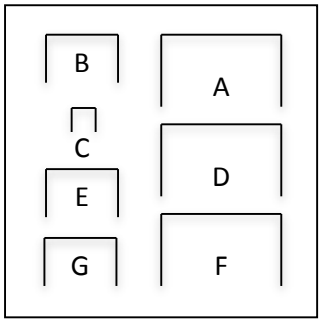
Station MONO 8
Water depth (m): 2554



MD191 – MONOPOL	Station: MONO 8

SECTIONS INFORMATIONS OF CASQ MD12-3418-CQ

Number of layers (2 or 3):
Sketch of the core section, defining the location of liners A, B, C, D, E, F, G:



Liner A, D, F : large size
Liners B, E, G : medium size
Liners C : small U-channel

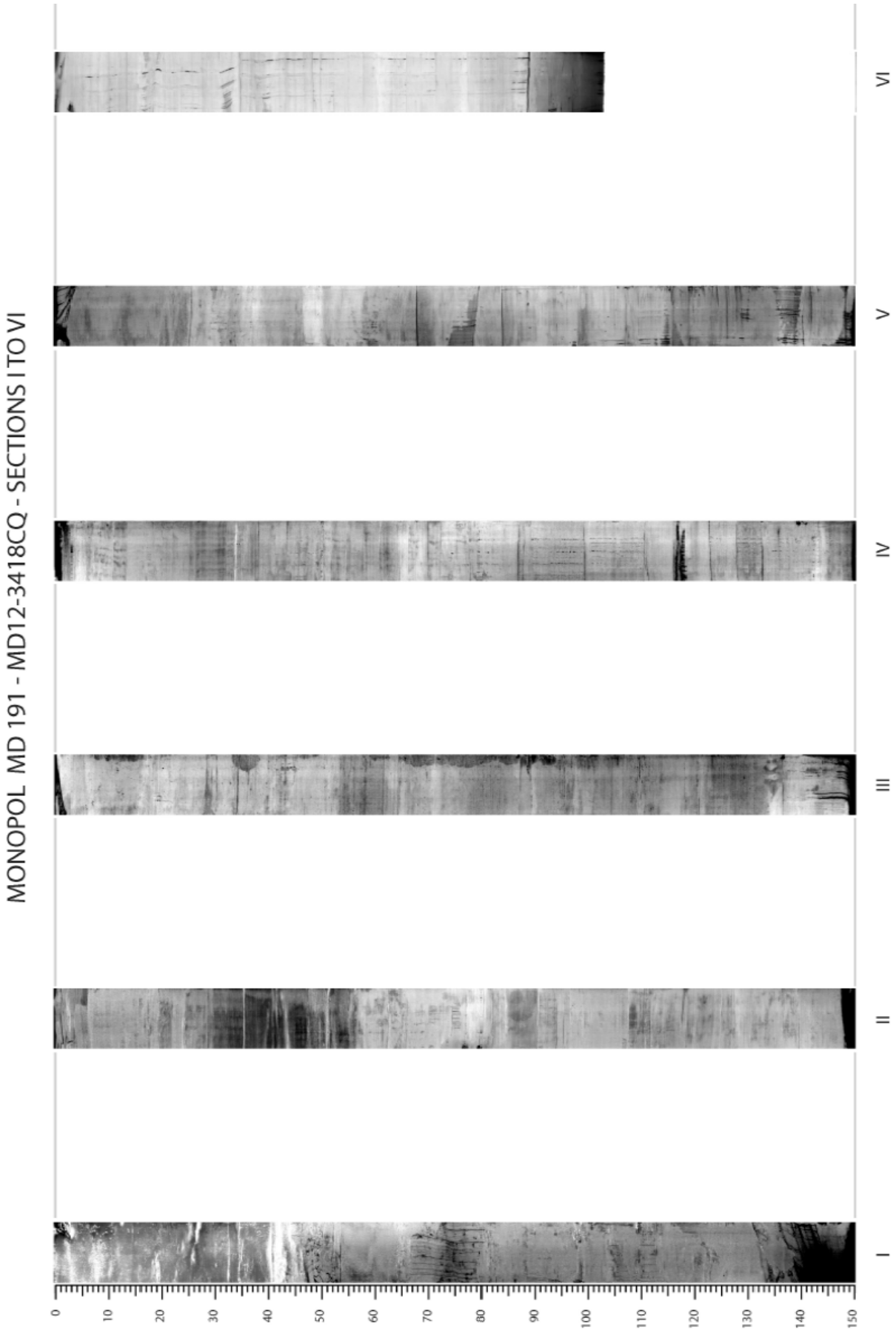
SECTIONS INFORMATIONS OF CASQ MD12-3418 CQ

Core MD12-3418 CQ — MONOPOL -MD191

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
Ia+Ib	0	150	149.2	-
II	150	300	149.2	-
III	300	450	149.4	-
IV	450	600	149.4	-
V	600	750	149.6	-
VI	750	852	149.1	-

MD191 – MONOPOL	Station: MONO 8

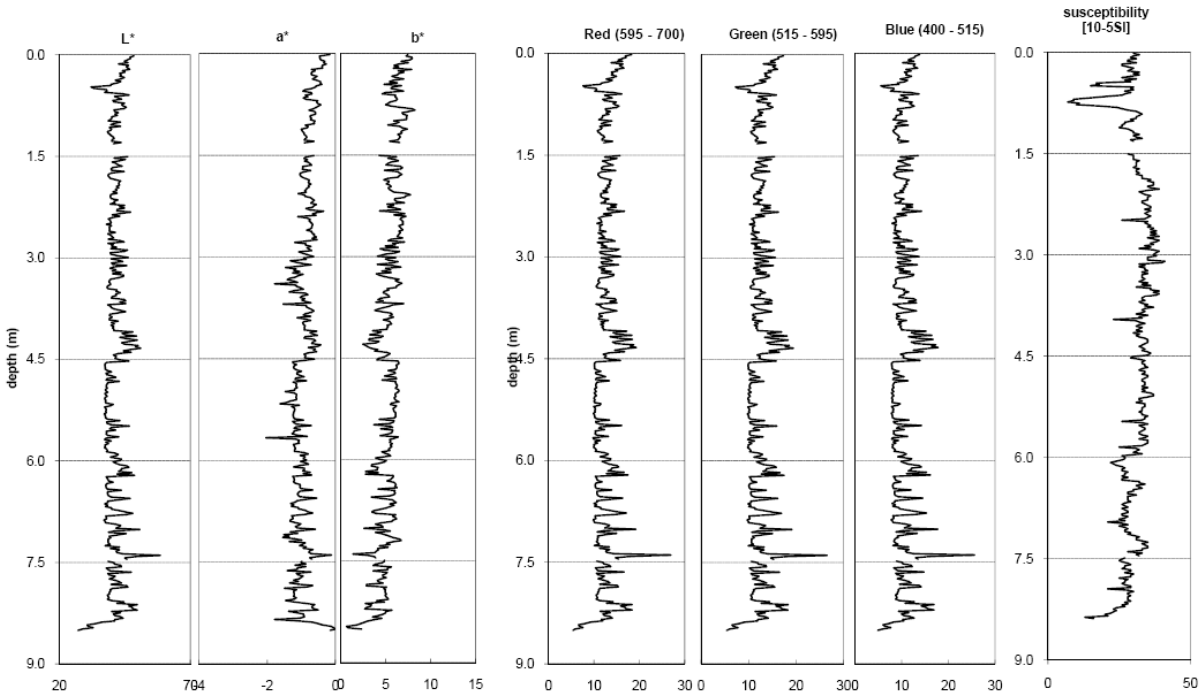
PICTURES OF CASQ MD12-3418-CQ



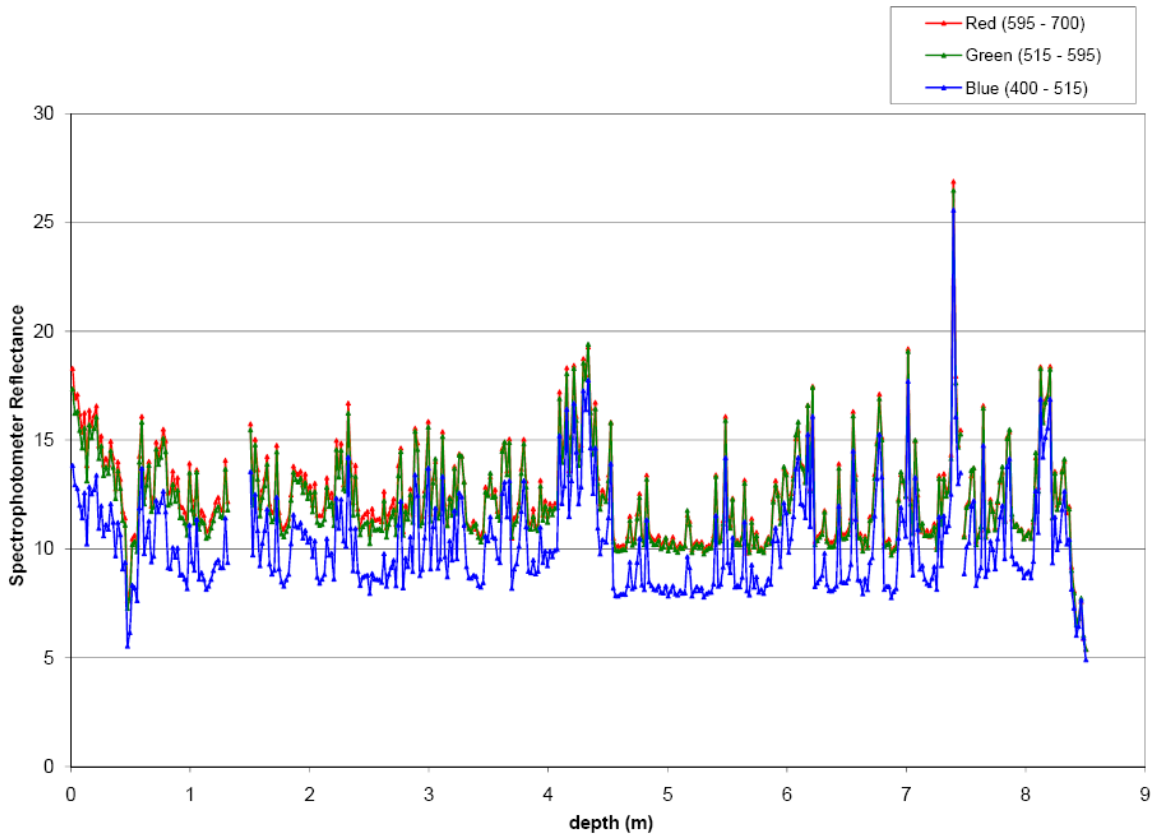
MD191 – MONOPOL	Station: MONO 8

PHYSICAL PROPERTIES OF CASQ MD12-3418 -CQ

MONOPOL 2012 **COLOUR REFLECTANCE AND MSCL** **Station MD12-3418CQ**



MD12-3418CQ RGB vs.depth



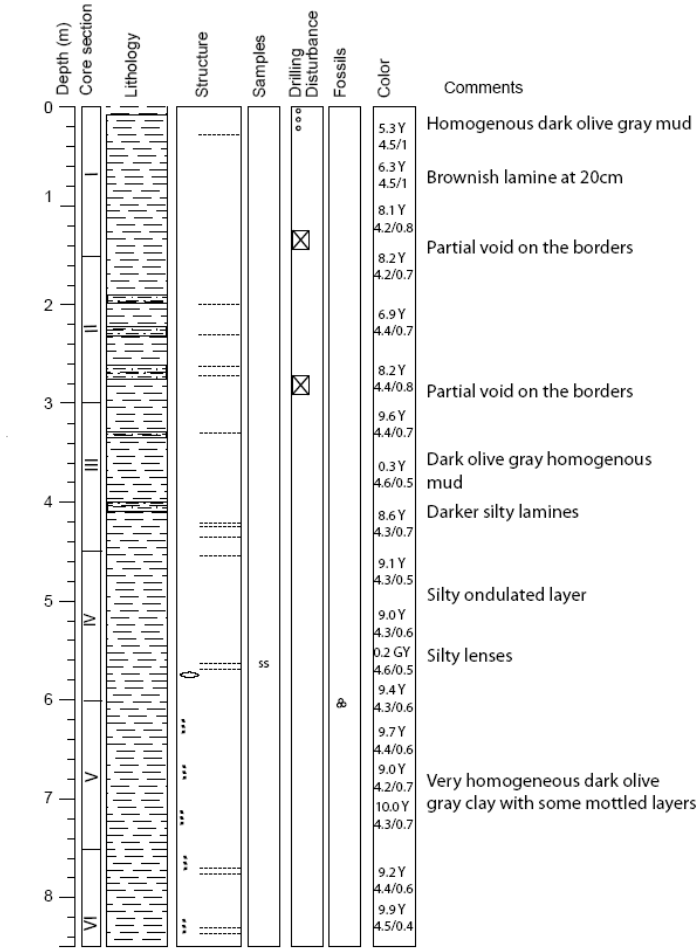
MD191 – MONOPOL	Station: MONO 8

SEDIMENTOLOGY OF CASQ CORE MD12-3418-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

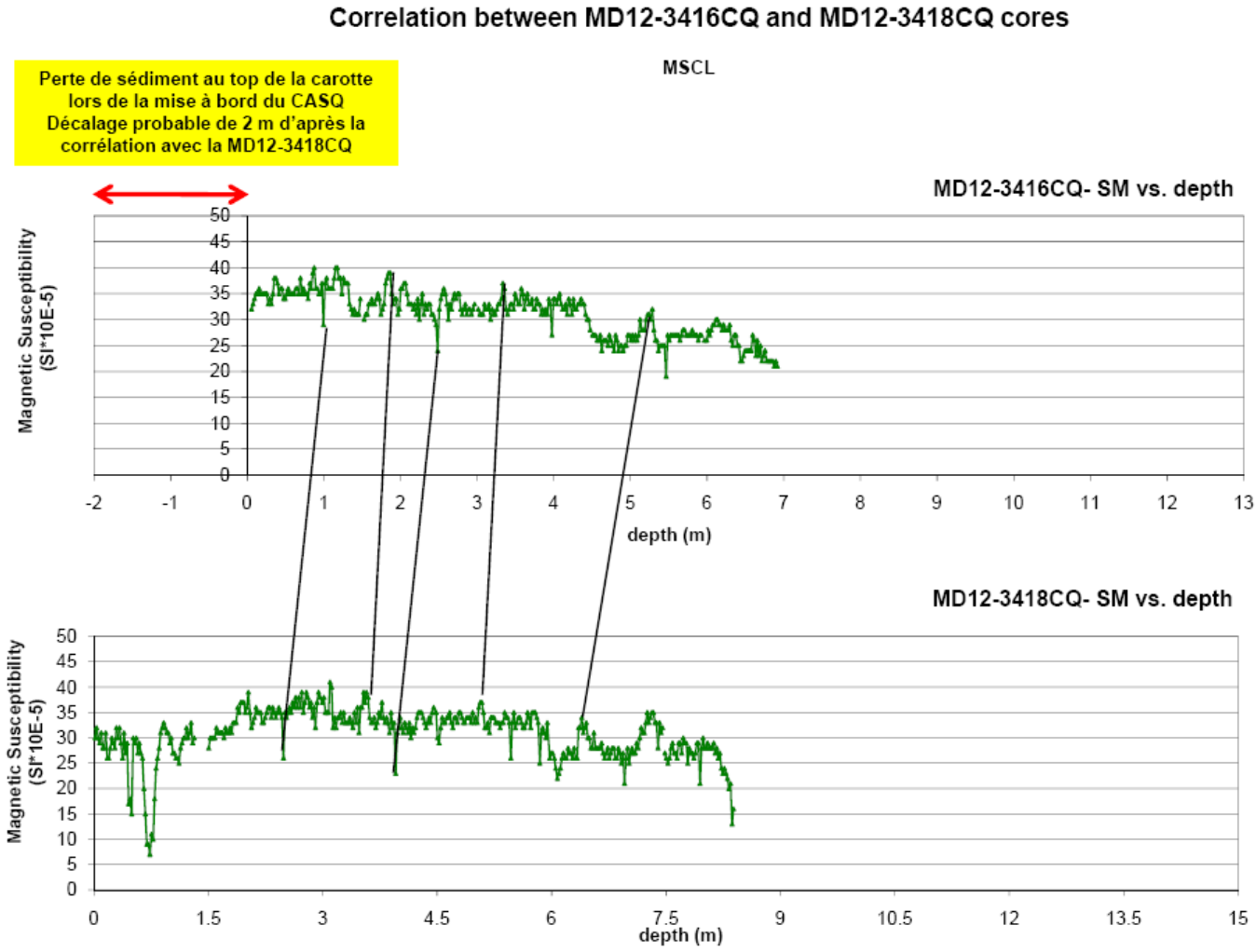
Sediment Description
Core MD12-3418 CQ

Station MONO 8
Water depth (m): 2547



MD191 – MONOPOL	Station: MONO 8

COMPARISON OF CASQ CORE MD12-3416-CQ and MD12-3418-CQ

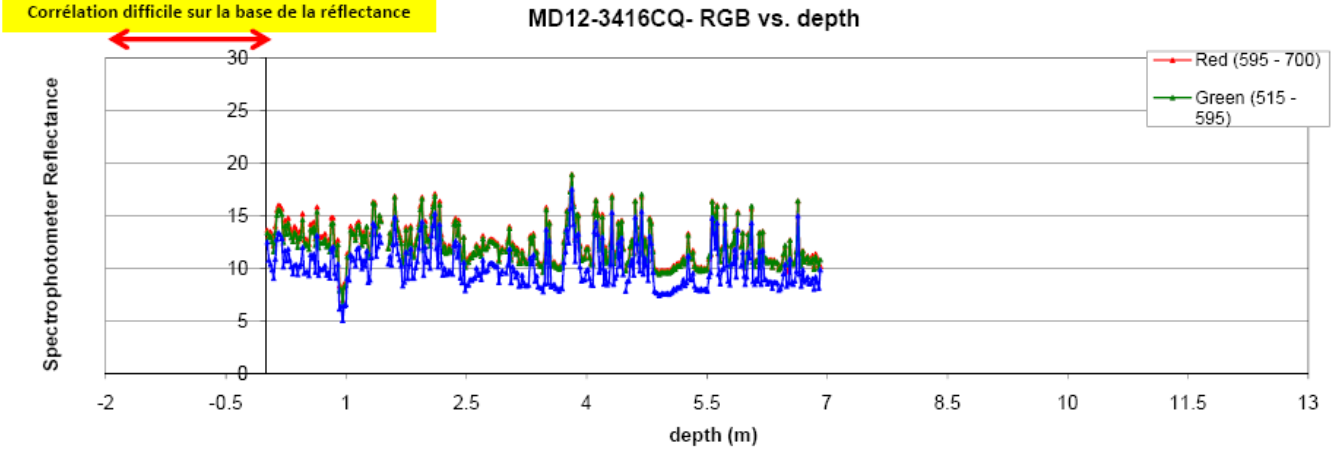


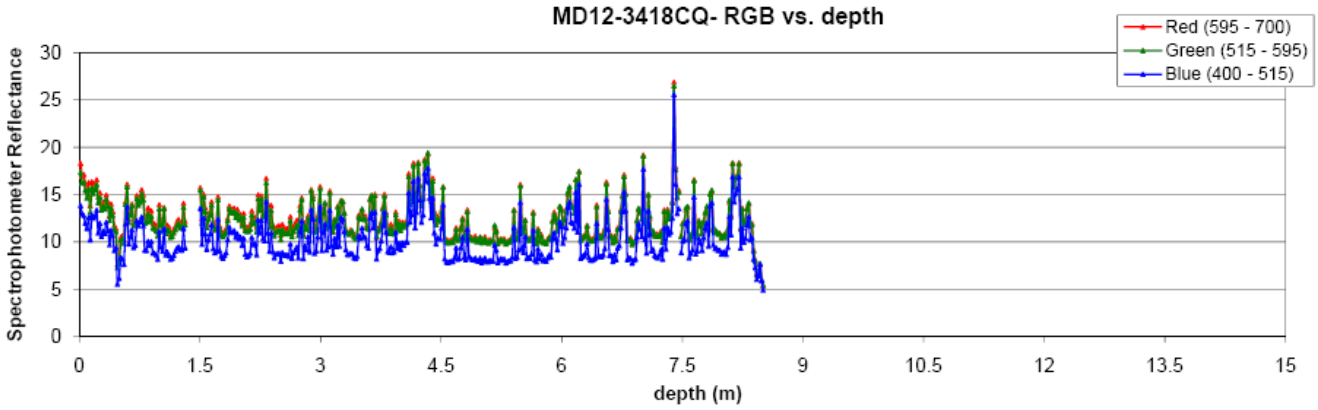
MD191 – MONOPOL	Station: MONO 8

Correlation between MD12-3416CQ and MD12-3418CQ cores

RGB

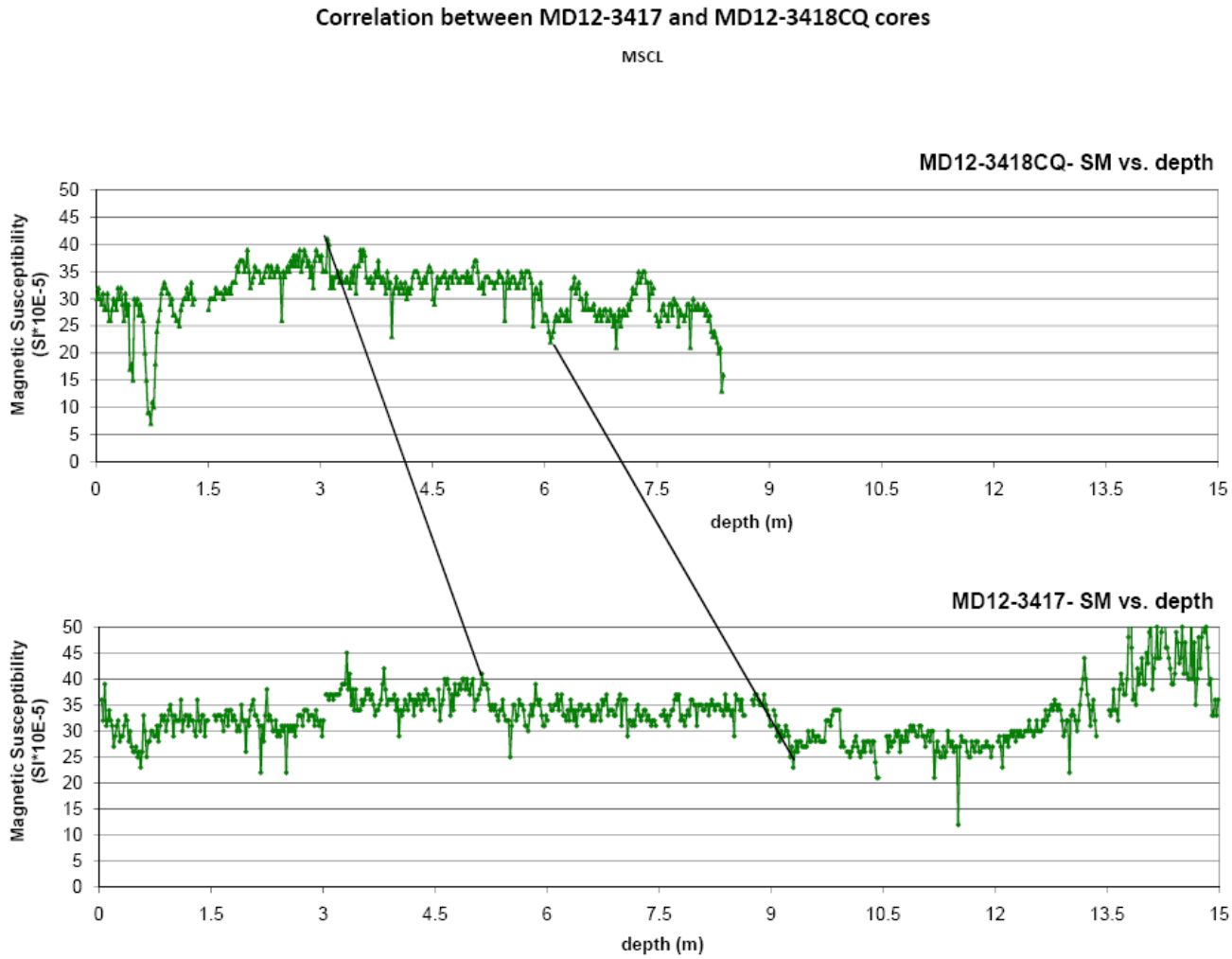
Perte de sédiment au top de la carotte lors de la mise à bord du CASQ
Décalage probable de 2 m d'après la corrélation avec la MD12-3418CQ
Corrélation difficile sur la base de la réflectance





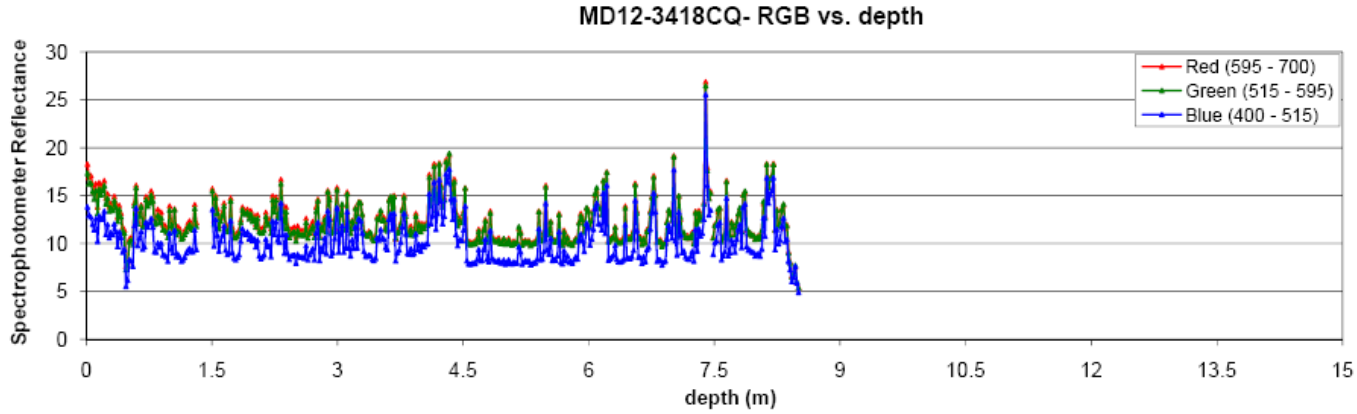
MD191 – MONOPOL	Station: MONO 8

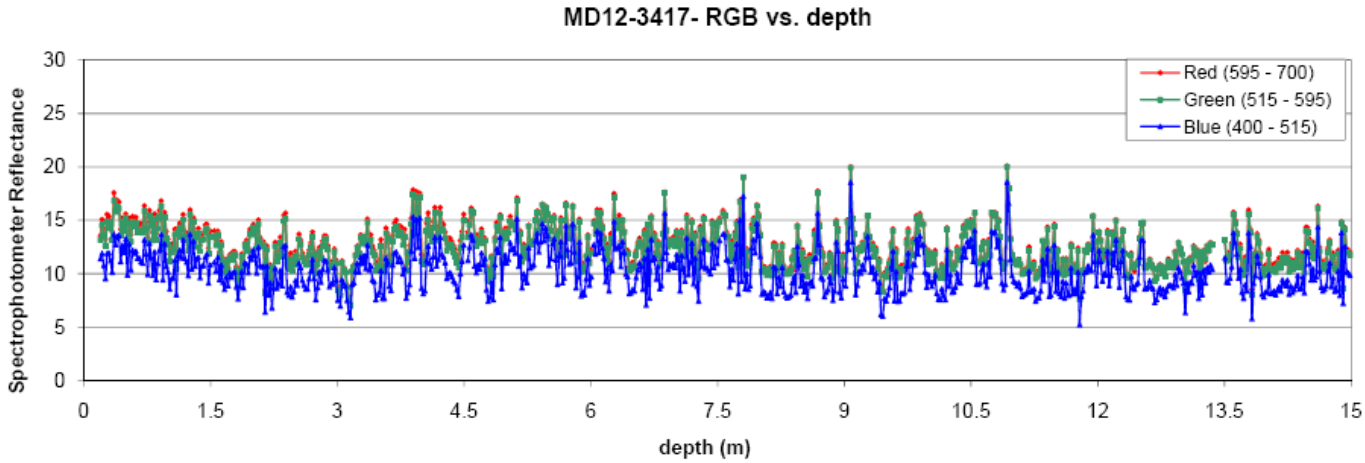
COMPARISON OF CASQ CORE MD12-3416-CQ and CALYPSO CORE MD12-3417



Correlation between MD12-3417 and MD12-3418CQ cores

RGB





MD191 – MONOPOL	Station: MONO 9

STATION SUMMARY

Date and time approaching site: 6/6/2012 –6:08 (TU)
Date and time ending station activity:6:6/2012 – 16:35 (TU)
Latitude:16°14.54N **Longitude**: 87°54.70E **Water depth (m)**: 2610
Short area description: Sedimentary levee with a few strong 3.5 kHz reflectors. CASQ core revealed numerous silty layers (turbidites), from 1-2 cm up to 20 cm thick. This stiff layers probably explained the relatively short penetration of the CASQ (only about 6m). Decision to abort CALYPSO coring operations..

Activity on station		**Core identification**
Calypso corer	No	
Casq	Yes	**MD12-3419-CQ**
Multi-corer	Yes	**MD191-MC-MONO9**
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	Yes	
Deep In situ pump	No	
Plankton net	Yes	

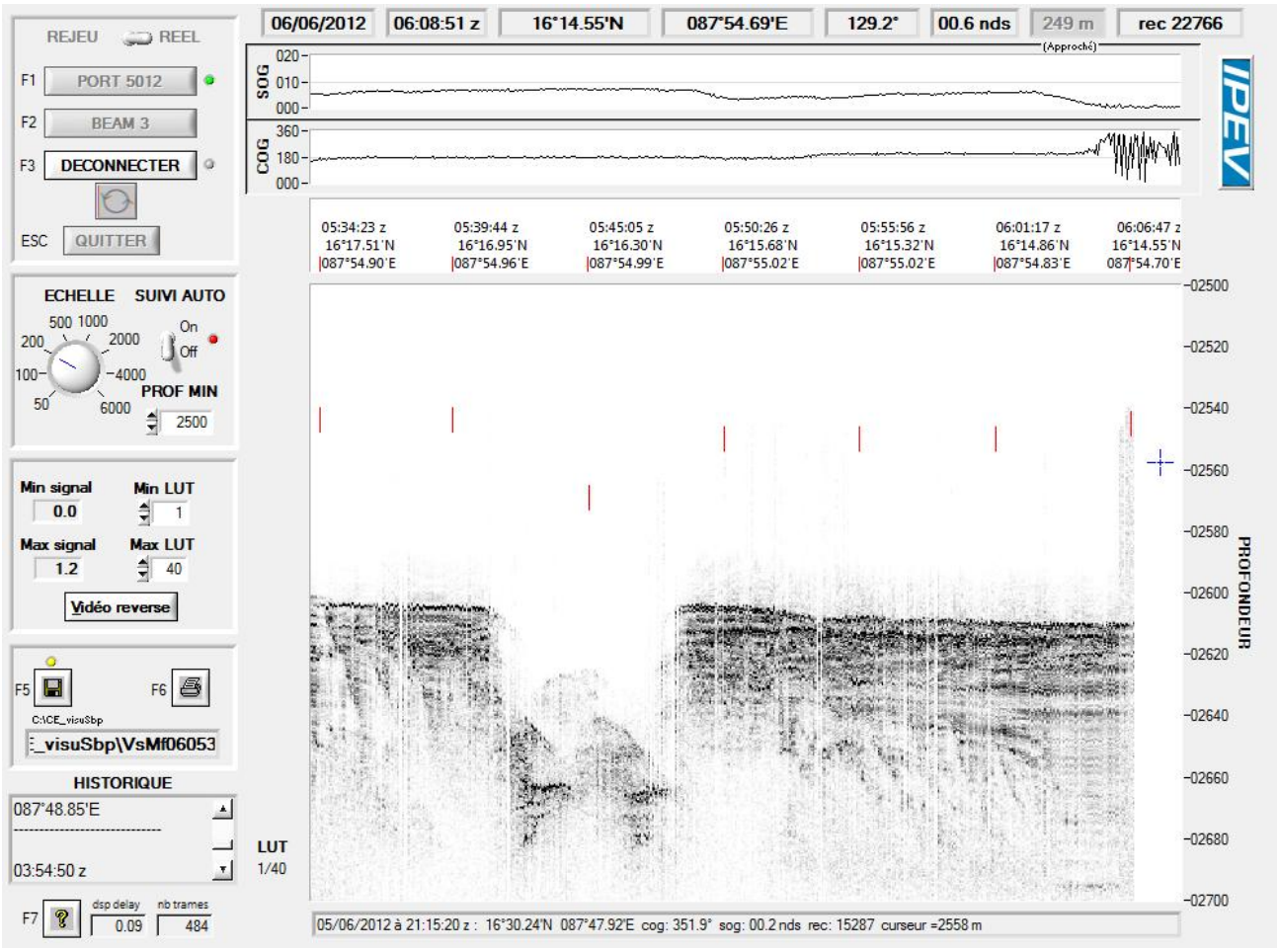


Figure: 3.5 kHz profile across station MONO 9 while arriving on site.

MD191 – MONOPOL	Station: MONO 9

CASQ CORING OPERATION: MD12-3419-CQ

Coring site information	*Latitude (°N):*	***16°14.63N***
	Longitude (°E):	***87°54.67E***
	Water depth (m):	***2614***
Casq corer settings	*Core length (m):*	***9***
	Empty weight in water (t):	***6.83***
Coring operation	*Time corer starts descent:*	***13:49 TU***
	Time on bottom:	***14:39 TU***
	Maximum tension (t)	***11.2***
	Time corer on deck:	***16:00TU***
Result coring operation	*Total weight in water (t)*	***7.25***
	Length of sediment (m)	***8.36***

General observations / incidents:

Several layers very stiff (turbidites ?), including a first layer (15-20cm thick) around 3m downcore.
The 9m-long CASQ only penetrated 6m, which suggests that a hard layer at the base may have bloc the penetration (or the too large number of small turbidites that the CASQ encompassed). This sediment is not good for long coring. Not good for testing the CALYPSO with the new cable (and cable storage system). This site is abandonned. We go further south.

MULTI-CORER OPERATION: MD191-MC-MONO9

Coring site information	*Latitude (°N):*	***16°14.63N***
	Longitude (°E):	***87°54.66E***
	Water depth (m):	***2608***
Coring operation	*Time multi corer starts descent:*	***10:58 TU***
	Time at bottom:	***11:48 TU***
	Time corer on deck:	***12:48 TU***
Length of sediments (cm)	*Tube 1*	***42***
	Tube 2	***44***
	Tube 3	***42***
	Tube 4	***~42***

General observations / incidents:

4 tubes full of sediment. Very nice !

Intersitial water sample succesfully as well as surface water.

For the first time the 4 tubes were filled with the same amount of sediment.

MD191 – MONOPOL	Station:MONO 9

CTD/ROSETTE/ISP OPERATION

CTD/Rosette site information	*Latitude (°N):*	***16°14.57'N***
	Longitude (°E):	***87°54.69'E***
CTD/Rosette operation	*Time CTD/rosette starts descent:*	***6:33 TU***
	Time on bottom:	***?***
	Time on deck:	***8:30 TU***
Depth of Water sampling	*Bottle 1*	***2592***
	Bottle 2	***2592***
	Bottle 3	***2572***
	Bottle 4	***2500***
	Bottle 5	***2200***
	Bottle 6	***1500***
	Bottle 7	***1500***
	Bottle 8	***900***
	Bottle 9	***-***
	Bottle 10	***500***
	Bottle 11	***300***
	Bottle 12	***180***
	Bottle 13	***-***
	Bottle 14	***160***
	Bottle 15	***140***
	Bottle 16	***110***
	Bottle 17	***90***
	Bottle 18	***70***
	Bottle 19	***50***
	Bottle 20	***40***
	Bottle 21	***30***
	Bottle 22	***20***
	Bottle 23	***10***
	Bottle 24	***5***

MULTI-NET OPERATION

		First deployement	***Second deployement***
Coring site information	*Latitude (°N):*	***16.24° N***	***16.24° N***
	Longitude (°E):	***87.91° E***	***87.91° E***
Coring operation	*Time start operation:*	***9:24***	***10:03***
	Time net on deck:	***9:41***	***10:10***
Depth of multinet collection (m)	*Collector 1*	***400-180***	***100-80***
	Collector 2	***180-80***	***80-60***
	Collector 3	***80-60***	***60-40***
	Collector 4	***60-40***	***40-20***
	Collector 5	***40-0***	***20-0***

General observations / incidents:

MD191 – MONOPOL	Station: MONO 9

CTD PROFILES

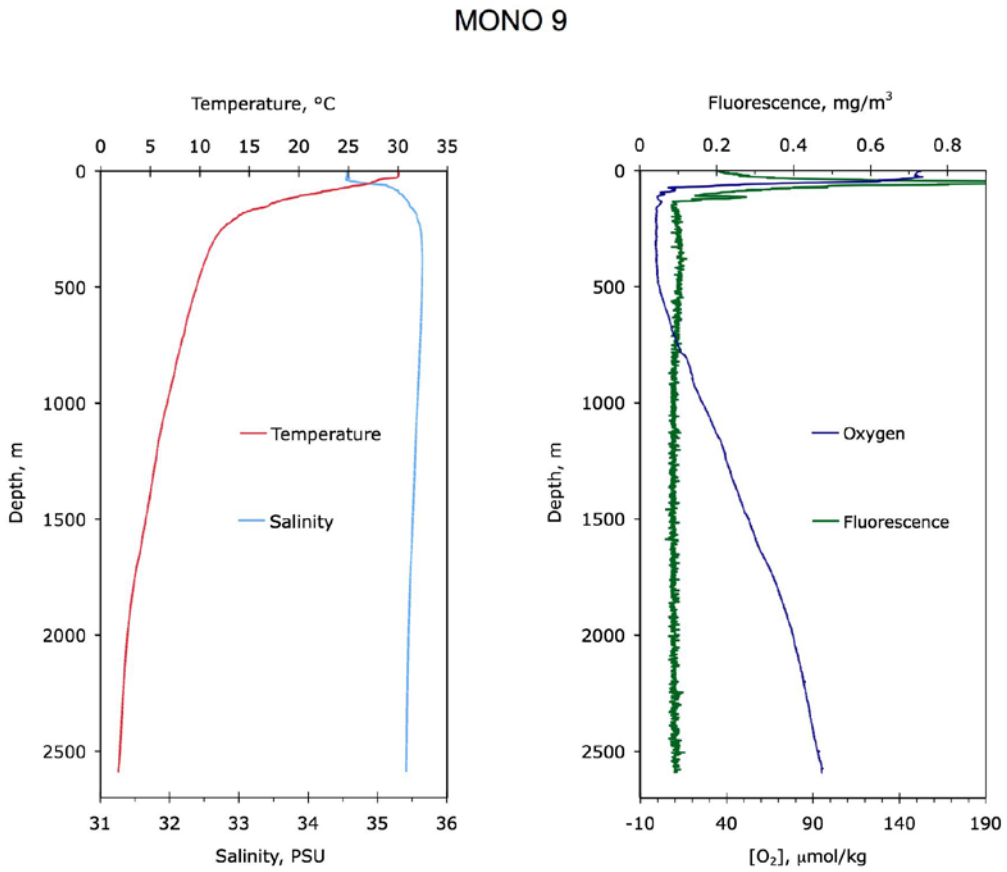
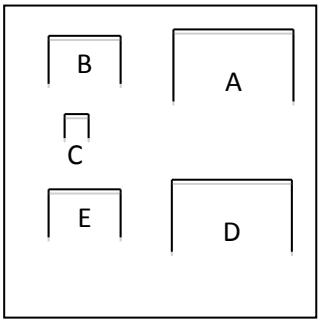


Figure: Temperature, salinity, fluorescence and dissolved oxygen profiles at site MONO 9.

MD191 – MONOPOL	Station: MONO 9

SECTIONS INFORMATIONS OF CASQ MD12-3419-CQ

Number of layers (2 or 3):
Sketch of the core section, defining the location of liners A, B, C, D, E :



Liner A, D : large size
Liners B, E : medium size
Liners C : small U-channel

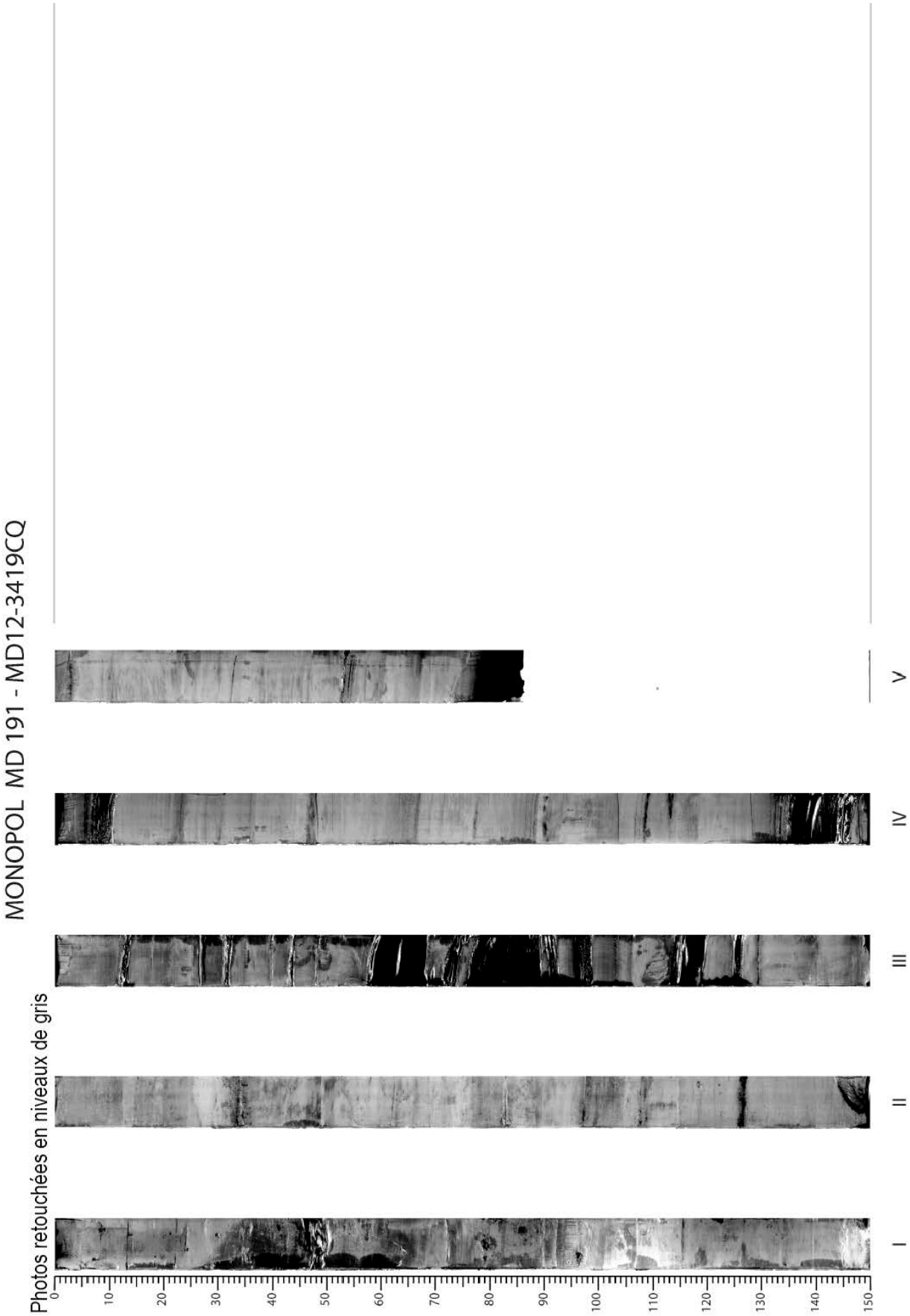
SECTIONS INFORMATIONS OF CASQ MD12-3419 CQ

Core MD12-3419 CQ — MONOPOL -MD191

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	148.9	-
II	150	300	149.3	-
III	300	450	150.3	-
IV	450	600	150.6	-
V	600	750	149.1	-
VI	750	836	??	-

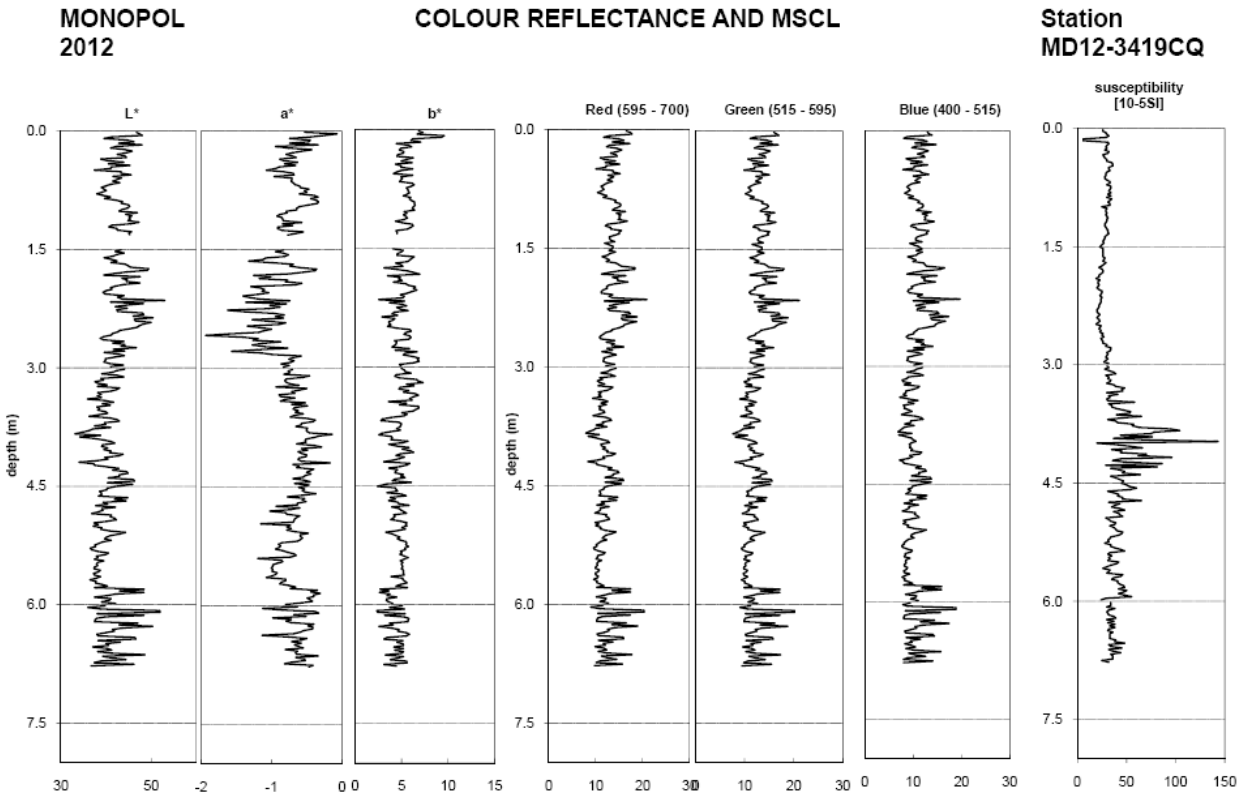
MD191 – MONOPOL	Station: MONO 9

PICTURES OF CASQ MD12-3419-CQ



MD191 – MONOPOL	Station: MONO 9

PHYSICAL PROPERTIES OF CASQ MD12-3419 -CQ



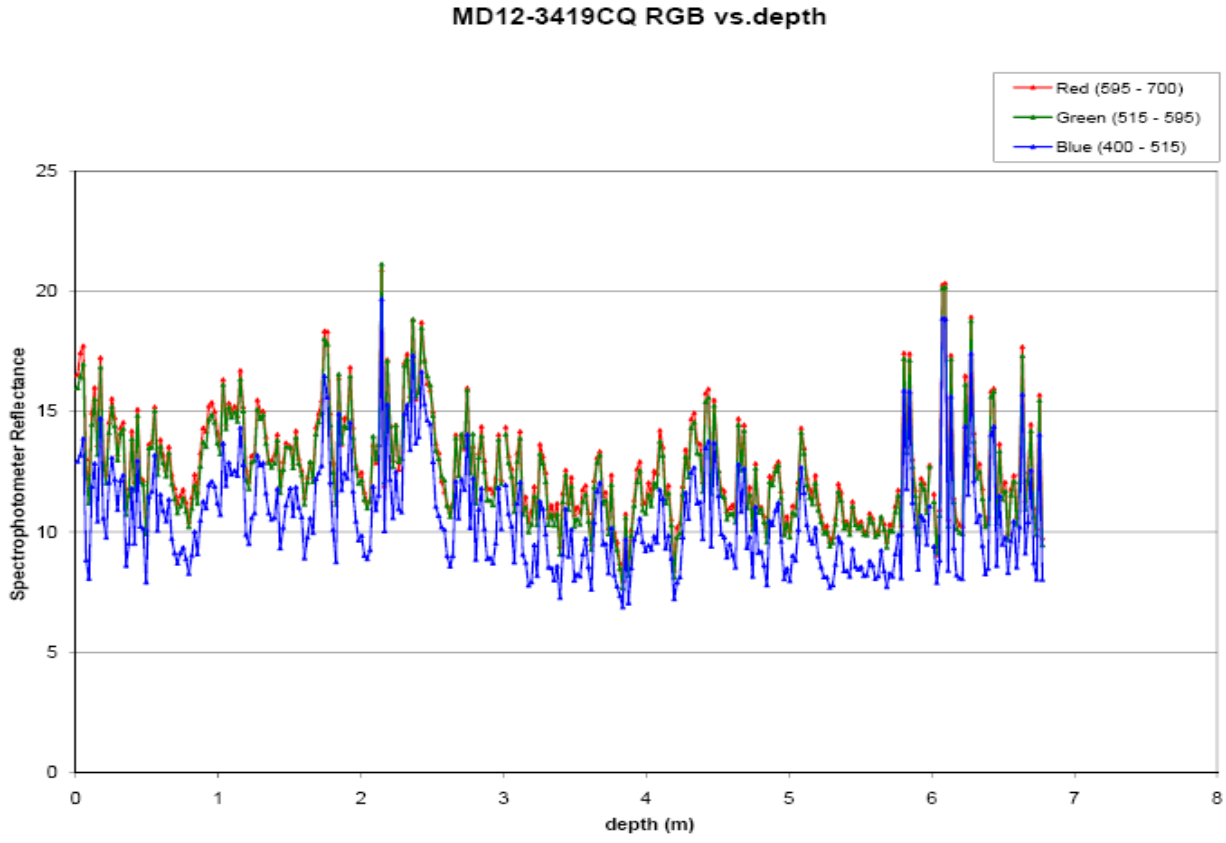


Figure: Color reflectance and physical properties of CASQ core MD12-3419 CQ

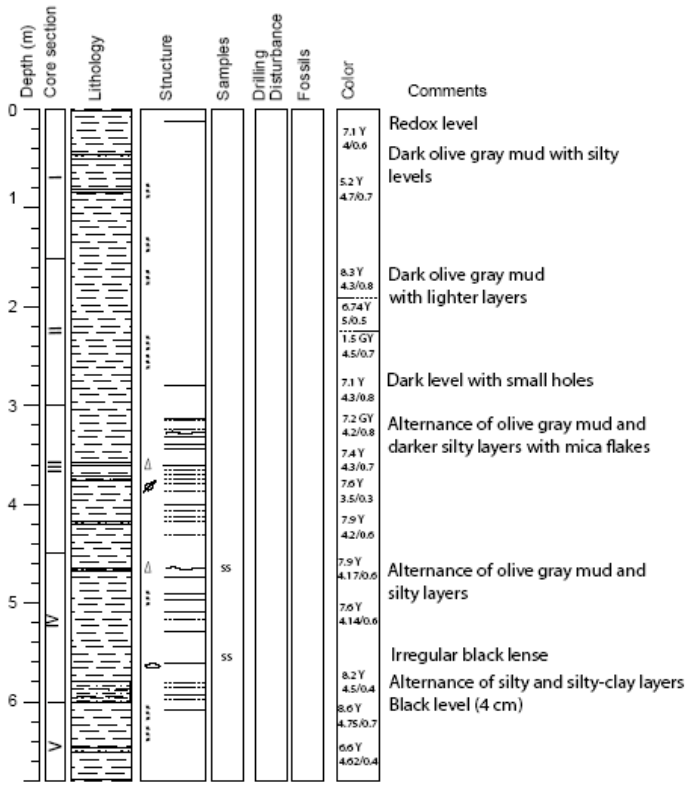
MD191 – MONOPOL	Station: MONO 9

SEDIMENTOLOGY OF CASQ CORE MD12-3419-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

Sediment Description
Core MD12-3419 CQ

Station MONO 9
Water depth (m): 2608



MD191 – MONOPOL	Station: MONO 10

STATION SUMMARY

Date and time approaching site: 6/6/2012 –19:45 (TU)
Date and time ending station activity:
Latitude: 16°00.10N **Longitude**: 87°52.38E **Water depth (m)**: 2660
Short area description: Site located in the distal levee, about 2km from the channel. The 3.5 kHz profile suggested about 100m of soft, sedimentary cover (no strong reflector). Coring showed fine sediments (clay with only a few, cm-thick silty layers).

Activity on station		**Core identification**
Calypso corer	Yes (2)	**Calypso lost& MD12-3421**
Casq	Yes	**MD12-3420-CQ**
Multi-corer	No	
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	No	
Plankton net	No	

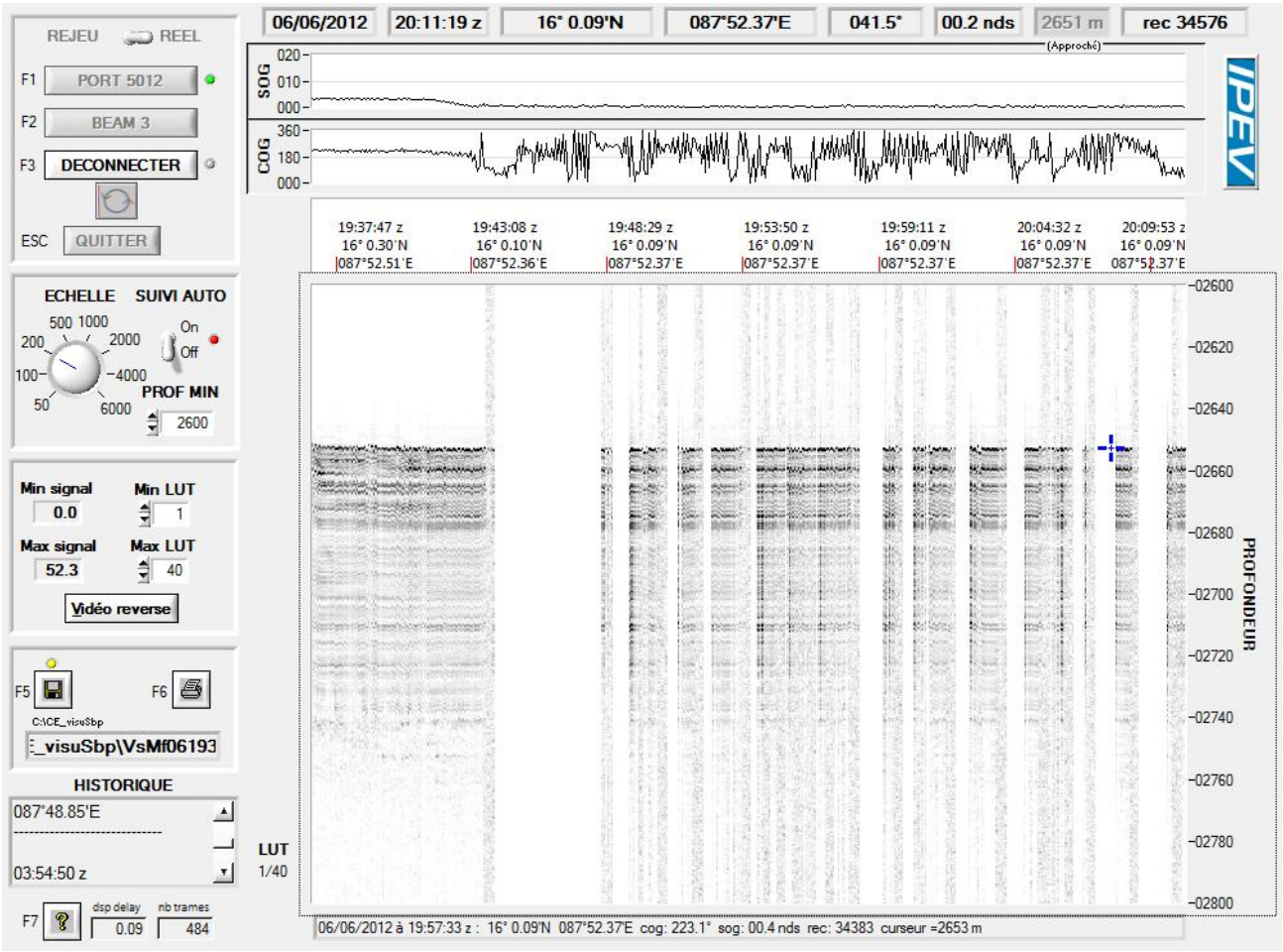


Figure: 3.5 kHz profile across station MONO 10.

MD191 – MONOPOL	Station: MONO 10

CASQ CORING OPERATION: MD12-3420-CQ

Coring site information	*Latitude (°N):*	***16°00.10N***
	Longitude (°E):	***87°52.37E***
	Water depth (m):	***2662***
Casq corer settings	*Core length (m):*	***12***
	Empty weight in water (t):	***7.09***
Coring operation	*Time corer starts descent:*	***20:46 TU***
	Time on bottom:	***21:45 TU***
	Maximum tension (t)	***14.1***
	Time corer on deck:	***23:50TU***
Result coring operation	*Total weight in water (t)*	***7.62***
	Length of sediment (m)	***8.52***

General observations / incidents:

Homogeneous sediment, without silt layers. Several black layers, could be associated to large amount of organic matter.

Decide sediment is OK for CALYPSO testing.

MD191 – MONOPOL	Station: MONO 10

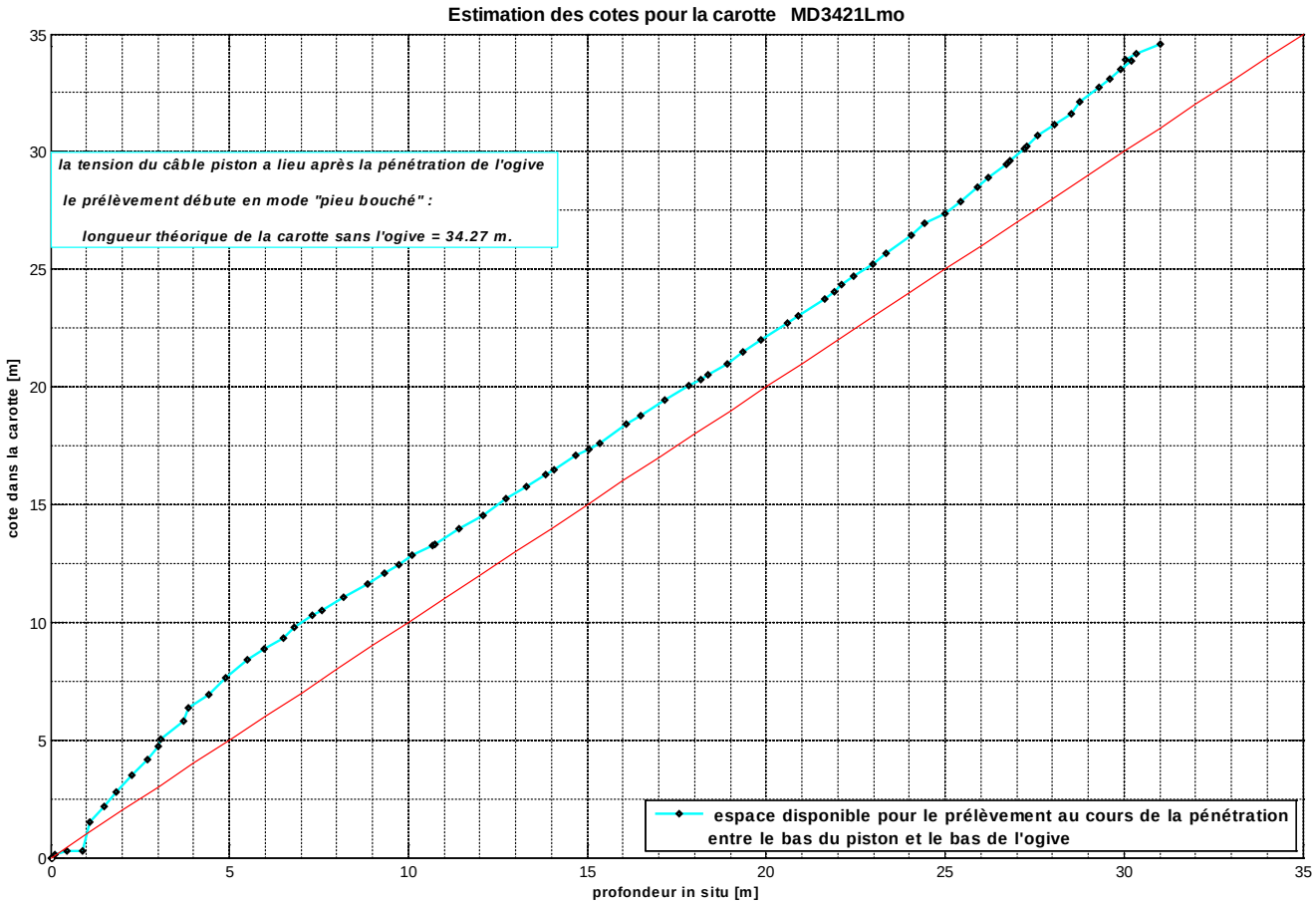
CALYPSO CORING OPERATION: MD12-3421

Coring site information	*Latitude (°N):*	***15°59.96N***
	Longitude (°E):	***87°52.53E***
	Water depth (m):	***2620***
Calypso corer settings	*Core length (m):*	***35.10***
	Empty weight in water (t):	***7.13***
	Free fall (m):	***3***
	Length piston cable (m):	***47.57***
Coring operation	*Time corer starts descent:*	***7:02TU***
	Time triggering:	***8:34 TU***
	Length cable (m):	***2589***
	Maximum tension (t)	***13.6***
	Time corer on deck:	***9:45***
Result coring operation	*Total weight in water (t)*	***7.62***
	Length of sediment (m)	***31.40***

General observations / incidents:

Moved slightly to the South to avoid re-coring where a first core has been lost. Corer penetrated well. Piston went up to the top. Optimal setting of the corer. No need to go longer (or it would require putting some more weight on top).

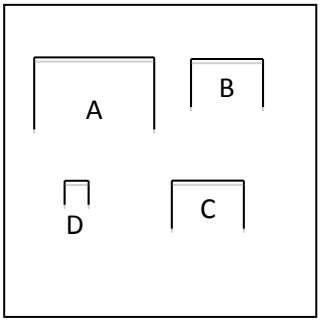
Figure: Core levels versus in situ sediment depth, CINEMA reconstructions for core MD12-3421.



MD191 – MONOPOL	Station: MONO 10

SECTIONS INFORMATIONS OF CASQ MD12-3420-CQ

Number of layers (2 or 3):
Sketch of the core section, defining the location of liners A, B, C, D :



Liner A : large size (12 cm)
Liners B, C : medium size (6 cm)
Liners D : small U-channel (pris de 3.96 à la base pour J-P Valet)

SECTIONS INFORMATIONS OF CASQ MD12-3420 CQ

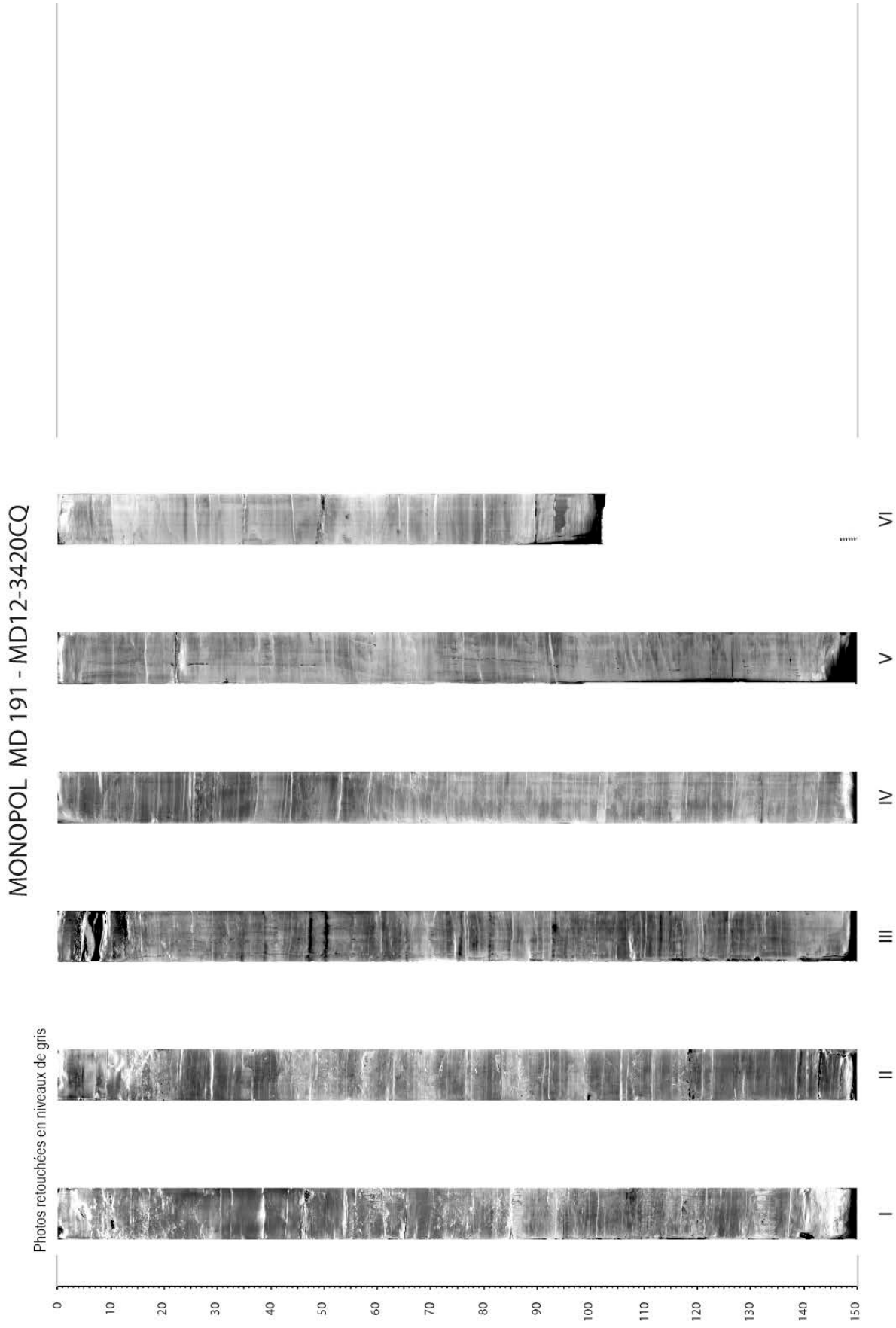
Core MD12-3420 CQ

MONOPOL -MD191

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	149.2	
II	150	300	149.6	
III	300	450	149.6	
IV	450	600	149.7	
V	600	750	149.6	
VI	750	851	149.4	Photo dans section 150cm, mais 101cm de sédiment

MD191 – MONOPOL	Station: MONO 10

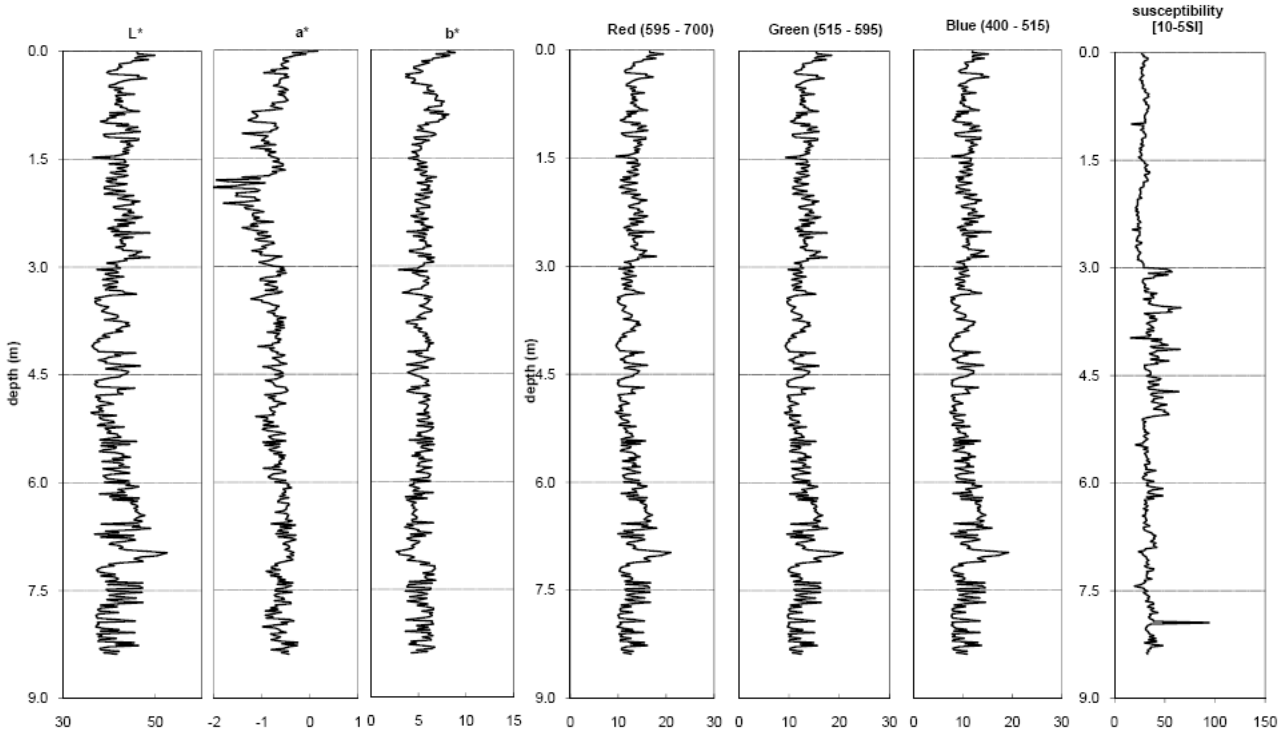
PICTURES OF CASQ MD12-3420-CQ



MD191 – MONOPOL	Station: MONO 10

PHYSICAL PROPERTIES OF CASQ MD12-3420 -CQ

MONOPOL 2012 | **COLOUR REFLECTANCE AND MSCL** | **Station MD12-3420CQ**



MD12-3420CQ RGB vs.depth

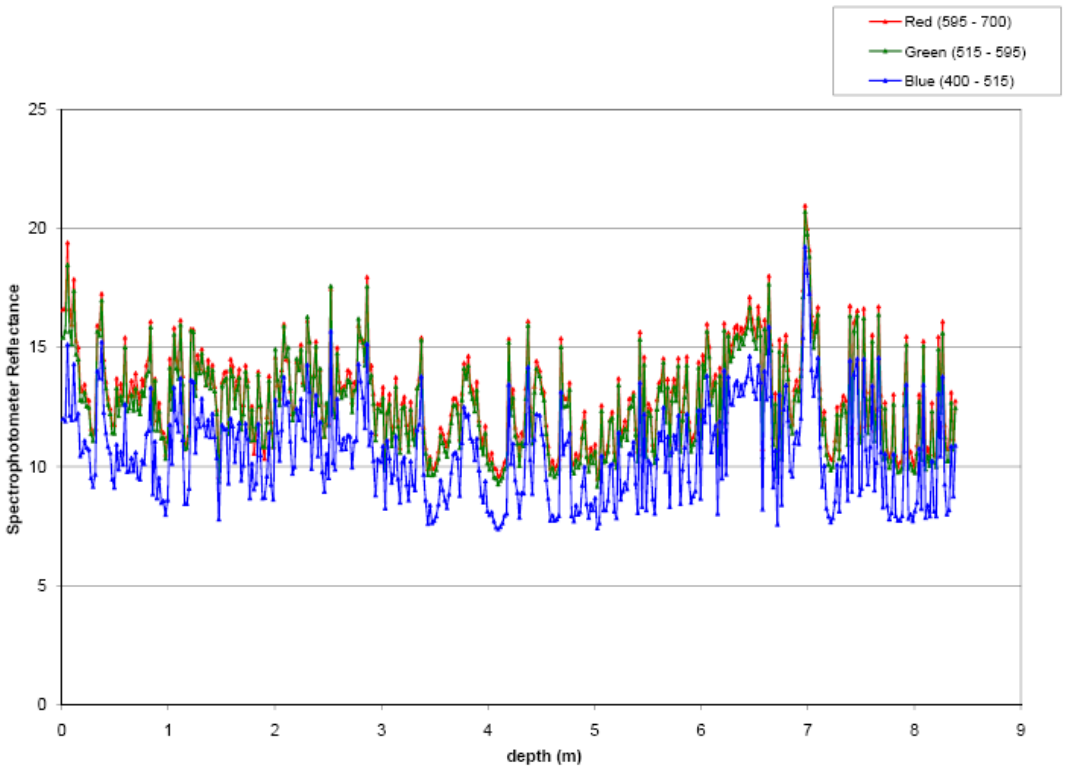


Figure: Color reflectance and physical properties of CASQ core MD12-3420 CQ

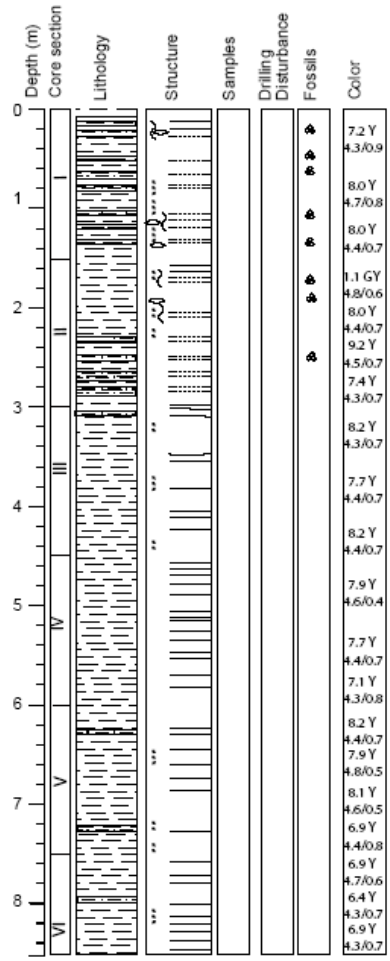
MD191 – MONOPOL	Station: MONO 10

SEDIMENTOLOGY OF CASQ CORE MD12-3420-CQ

MD191-MONOPOL
Observer: MMBV-EM-SDA

Sediment Description
Core MD12-3420 CQ

Station MONO 10
Water depth (m): 2660



Comments

Dark gray to olive clays with silty layers

Ligth gray layers (clays?) between 62-70, 84-90, 96-100, 115-128 cm

Thin alternation of dark gray and black silty layers

Dark gray to olive clays with two darker silty layers at the top and thin (<1cm-thick) dark clay layers (around 38, 47, 50, 65, 75, 81, 90 95, 110, 113, 122, 133 cm)

Dark olive gray to olive clays with darker layers (8, 16, 20, 31, 38, 48, 52, 57, 58, 63, 73, 80, 85, 118, 127, 142 cm)

Dark gray to olive clays with some silty layers and dark clay layers (around 25, 27, 41, 62, 69, 93 cm)

MD191 – MONOPOL	Station: MONO 10

SECTIONS INFORMATIONS OF CALYPSO MD12-3421

MONOPOL
-MD191

Core MD12-3421

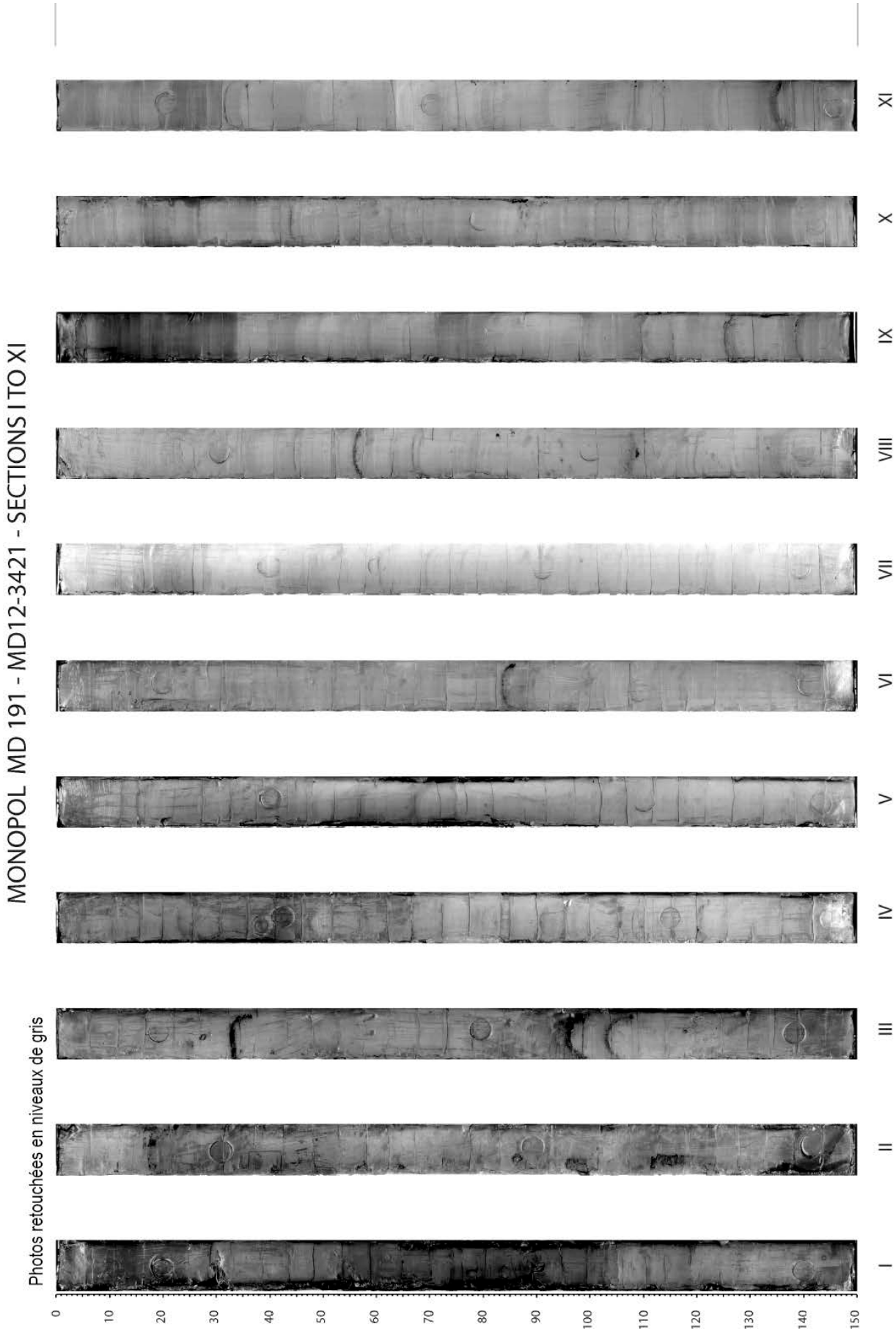
Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	150.9	-
II	150	300	150.8	-
III	300	450	150.4	-
IV	450	600	150.5	-
V	600	750	150.1	-
VI	750	900	150.1	-
VII	900	1050	150.5	-
VIII	1050	1200	151	-
IX	1200	1350	150.7	-
X	1350	1500	150.4	-
XI	1500	1650	150.6	-
XII	1650	1800	150.7	-
XIII	1800	1950	151	-
XIV	1950	2100	151.1	-
XV	2100	2250	150.8	-
XVI	2250	2400	150.3	-
XVII	2400	2550	150.6	-
XVIII	2550	2700	150	-
XIX	2700	2850	150.4	-
XX	2850	3000	149.8	-
XXI	3000	3150	141	Polystyren: 95-105

General observations / incidents:

Photo had to be re-calibrated.

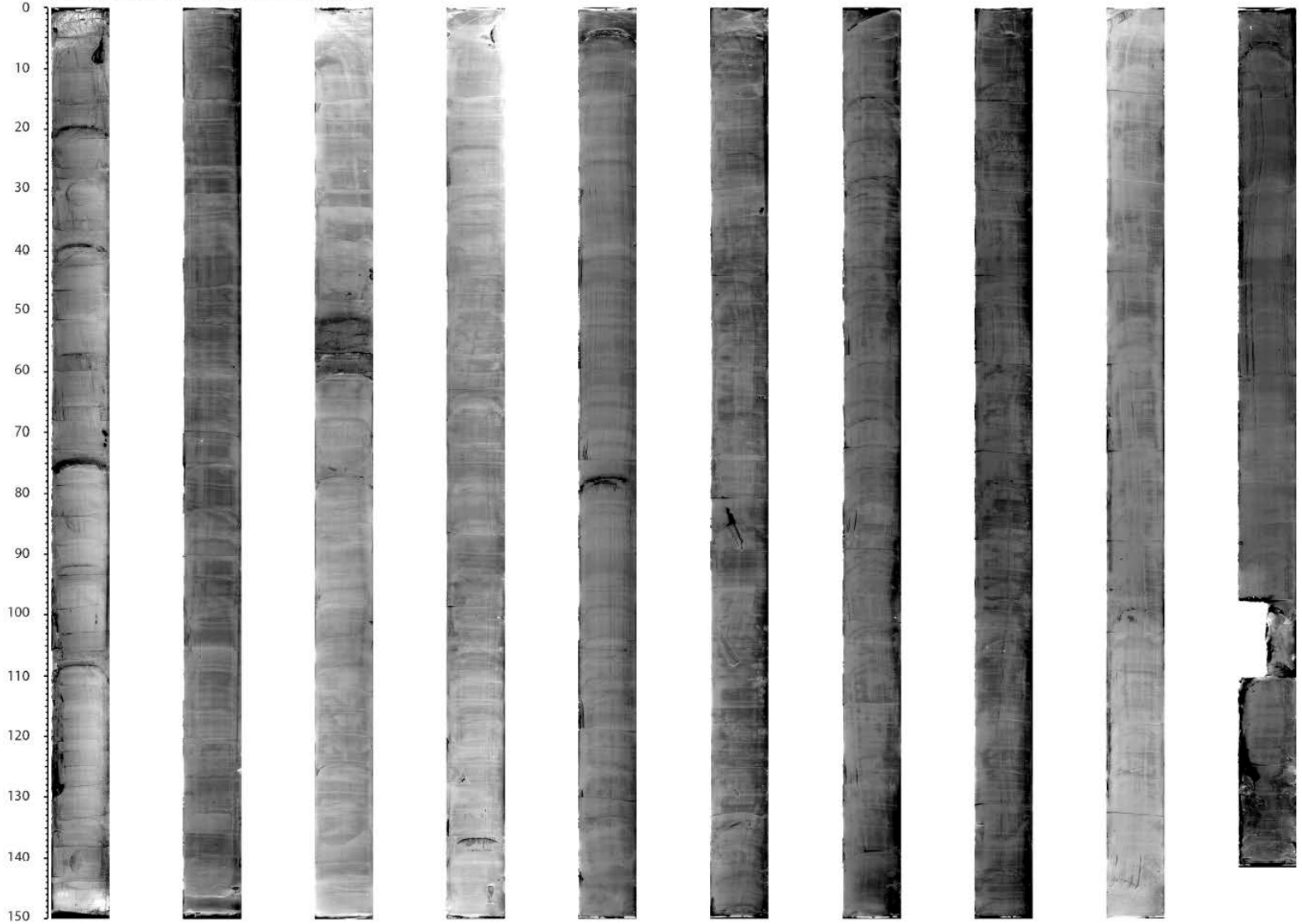
MD191 – MONOPOL	Station: MONO 10

PICTURES OF CALYPSO MD12-3421



MONOPOL MD 191 - MD12-3421 - SECTIONS XII TO XXI

Photos retouchées en niveaux de gris

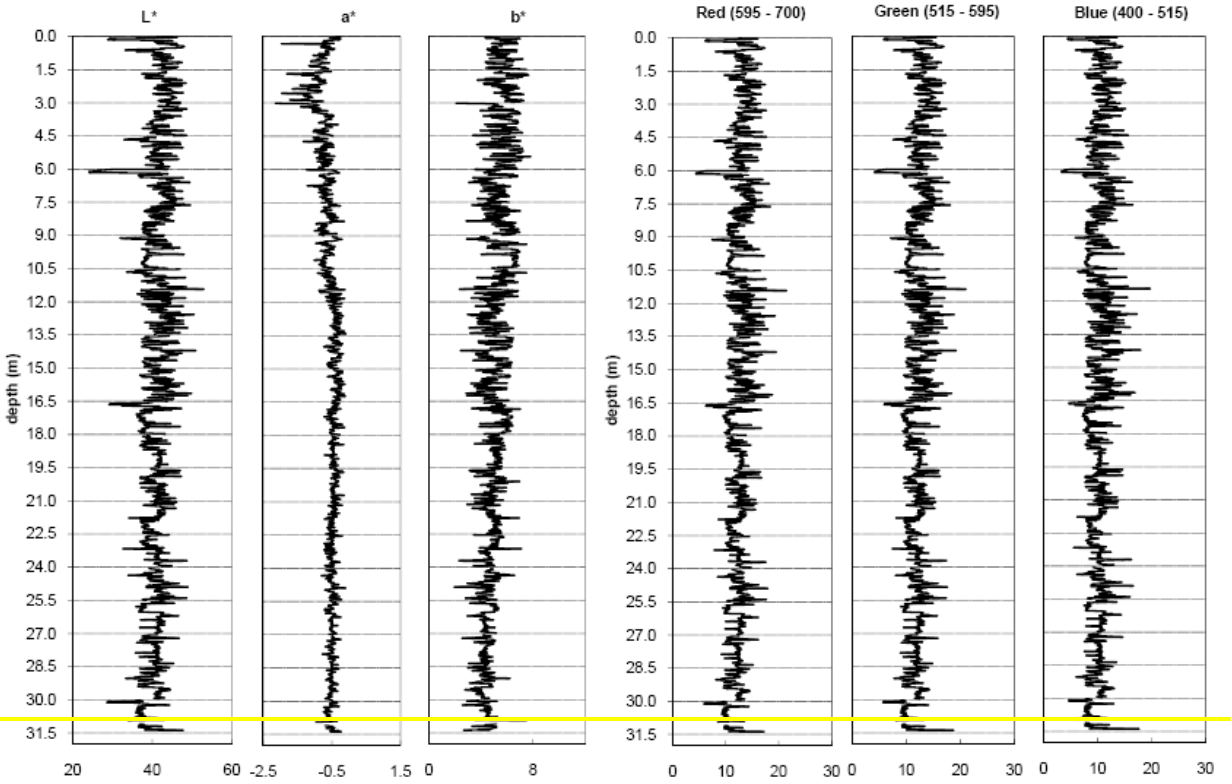


MD191 – MONOPOL	Station: MONO 10

PHYSICAL PROPERTIES OF CALYPSO MD12-3421

MONOPOL 2012 **COLOUR REFLECTANCE** **Station MD12-3421**

Spectrophotometer

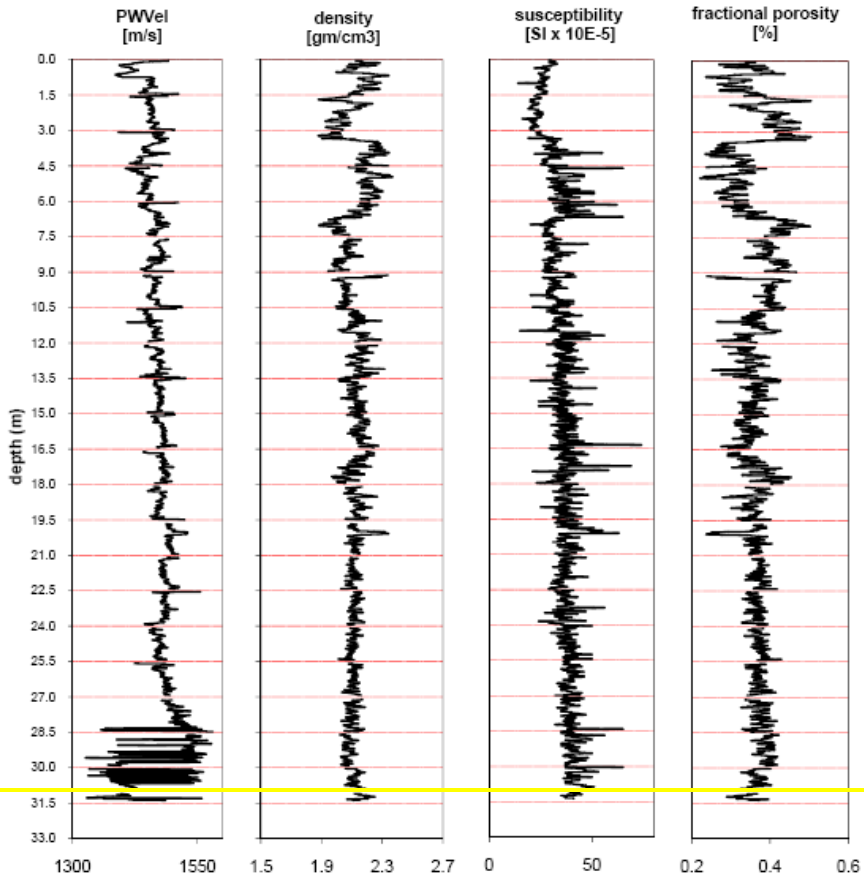


hole in sediment

MONOPOL 2012

Multi-sensor core logger

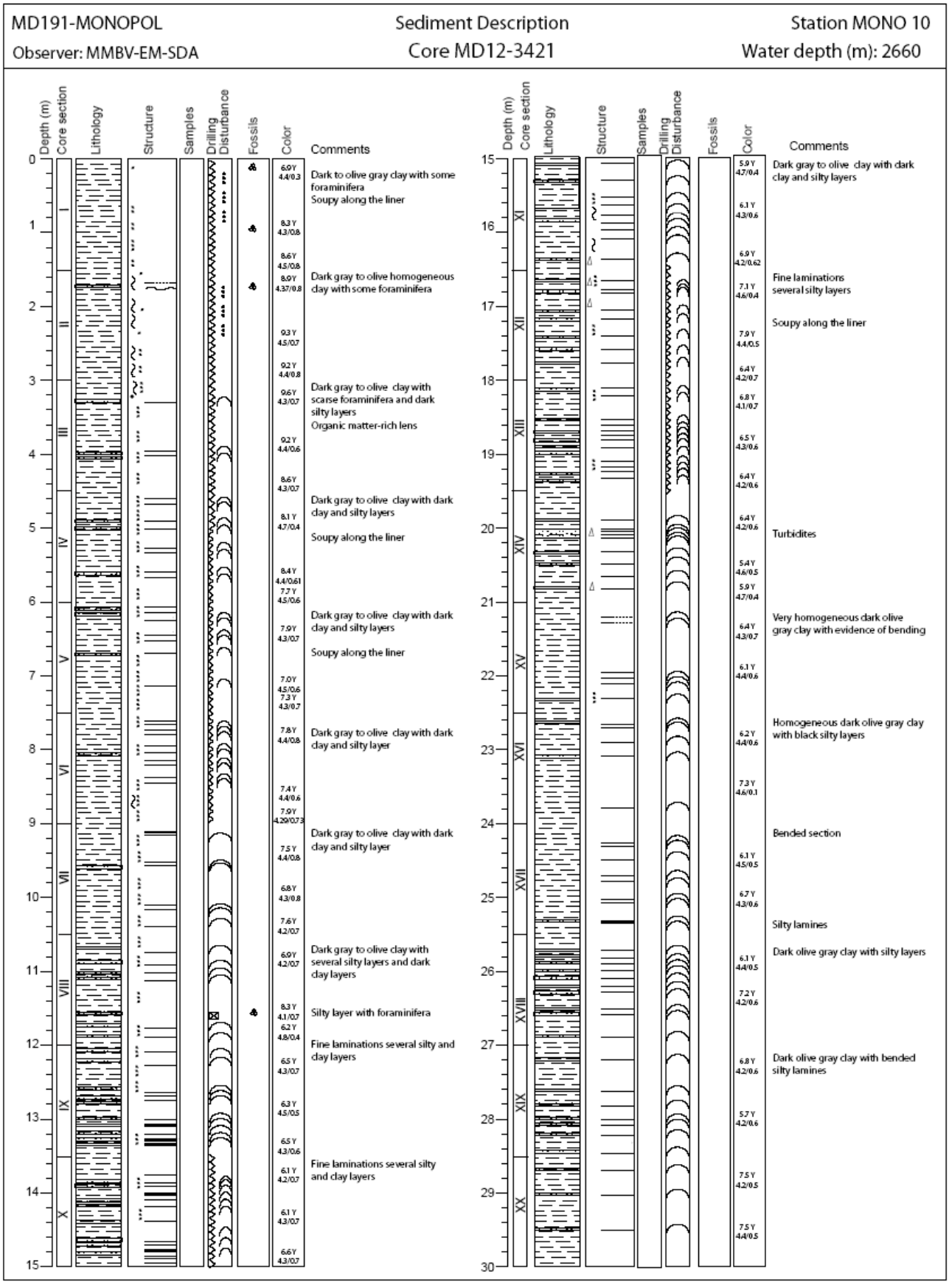
Station MD12-3421



hole in sediment

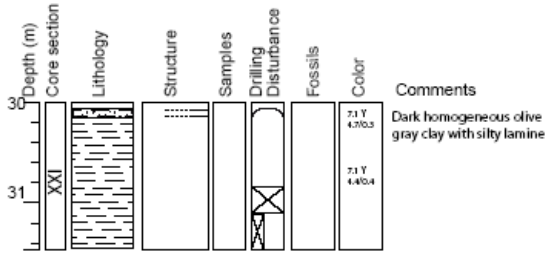
MD191 – MONOPOL	Station: MONO 10

SEDIMENTOLOGY OF CALYPSO MD12-3421



MD191-MONOPOL | Sediment Description | Station MONO 10

Observer: MMBV-EM-SDA | Core MD12-3421 | Water depth (m): 2660



MD191 – MONOPOL	Station: MONO 11

STATION SUMMARY

Date and time approaching site: 10/6/2012 –6:45 (TU)
Date and time ending station activity:
Latitude: 8°17.77N **Longitude**: 89°23.10E **Water depth (m)**: 3530
Short area description:"Fan-like" site, seen during S-N transect between MONO1 and MONO2, at beginning of cruise. Apparently, sediment cover expands (about x2) at this location.

Activity on station		**Core identification**
Calypso corer	Yes (2)	**Calypso lost & MD12-3423**
Casq	No	
Multi-corer	No	
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	Yes	
Plankton net	No	

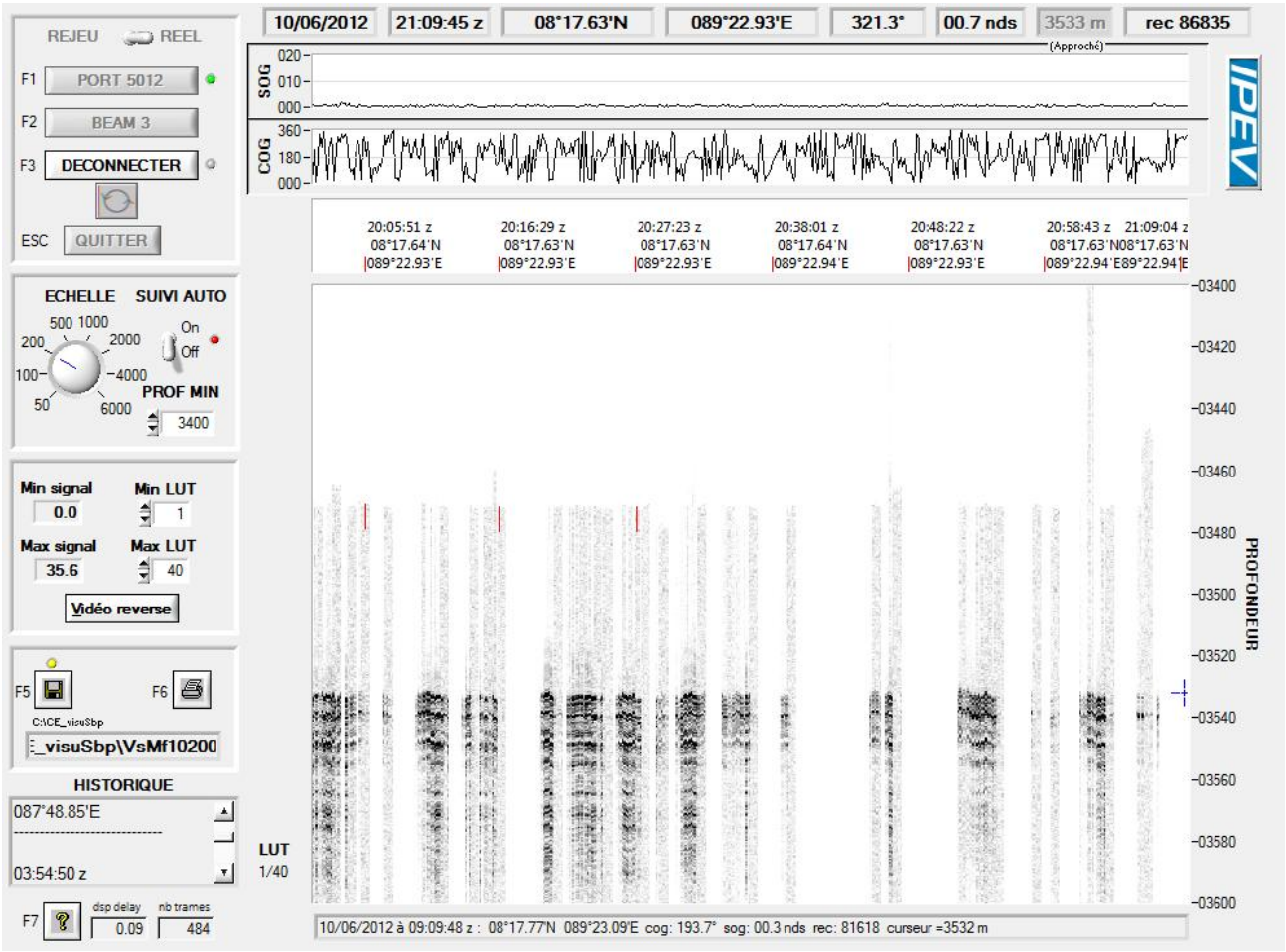


Figure: 3.5 kHz profile across station MONO 11.

MD191 – MONOPOL	Station:MONO 11

Deep ISP OPERATION

In-Situ Pumping (ISP)

Water depth of pumping (m)	3000
Filtered volume (L)	1010
Filter	Nucleopore 0.4 um

General observations / incidents:

MD191 – MONOPOL	Station: MONO 11

CALYPSO CORING OPERATION: MD12-3423

Coring site information	*Latitude (°N):*	***8°17.64***
	Longitude (°E):	***89°22.94***
	Water depth (m):	***3530***
Calypso corer settings	*Core length (m):*	***34.7***
	Empty weight in water (t):	***7.29***
	Free fall (m):	***3***
	Length piston cable (m):	***47.30***
Coring operation	*Time corer starts descent:*	***20:20***
	Time triggering:	***21:47***
	Length cable (m):	***3483***
	Maximum tension (t)	***12.95***
	Time corer on deck:	***00:00***
Result coring operation	*Total weight in water (t)*	***7.74***
	Length of sediment (m)	***31.72***

General observations / incidents:

First Calypso lost: handling chain broke.

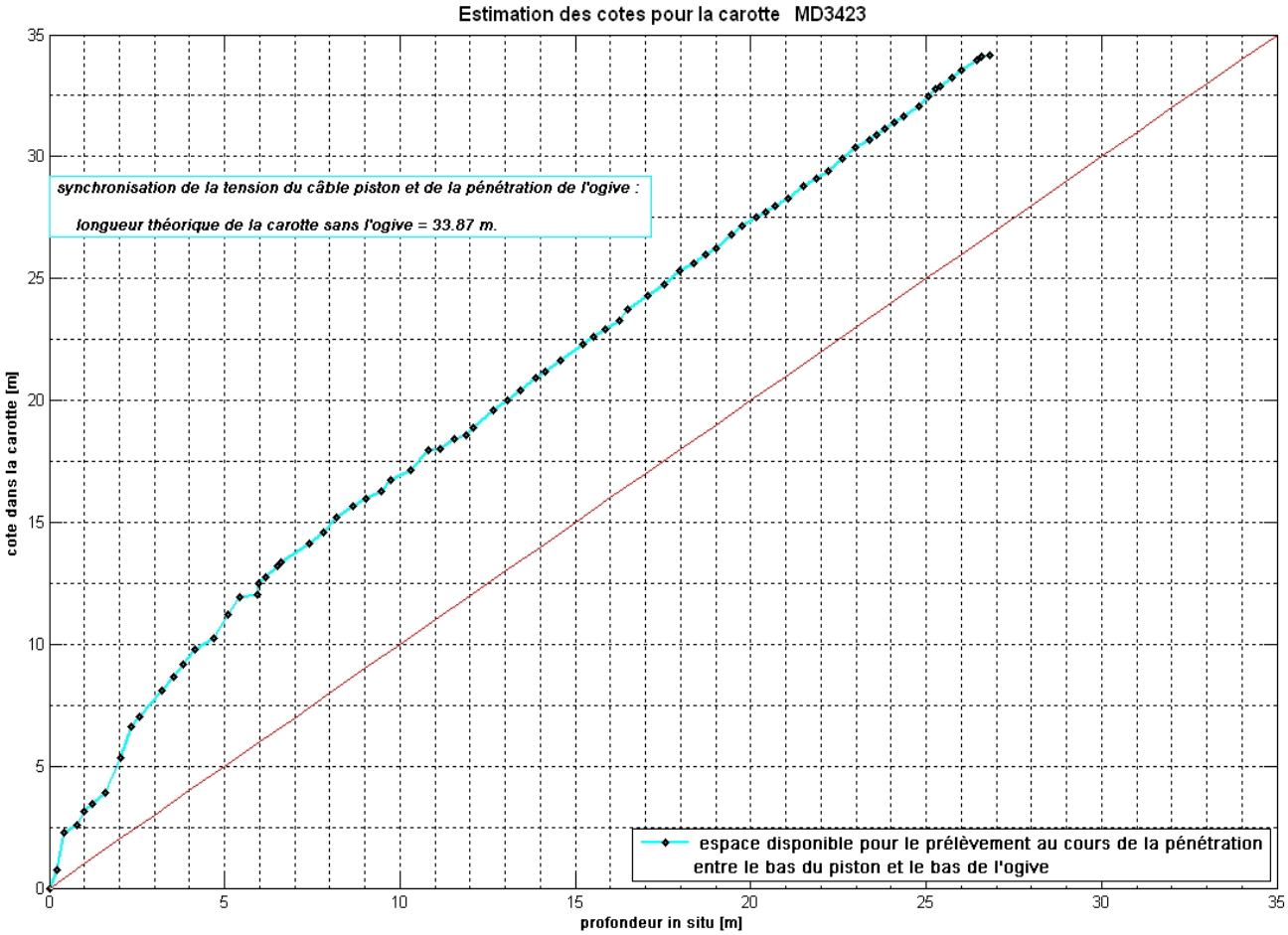


Figure: Core level versus in situ sediment depth, CINEMA reconstructions for core MD12-3423.

MD191 – MONOPOL	Station: MONO 11

SECTIONS INFORMATIONS OF CALYPSO MD12-3423

MONOPOL
-MD191

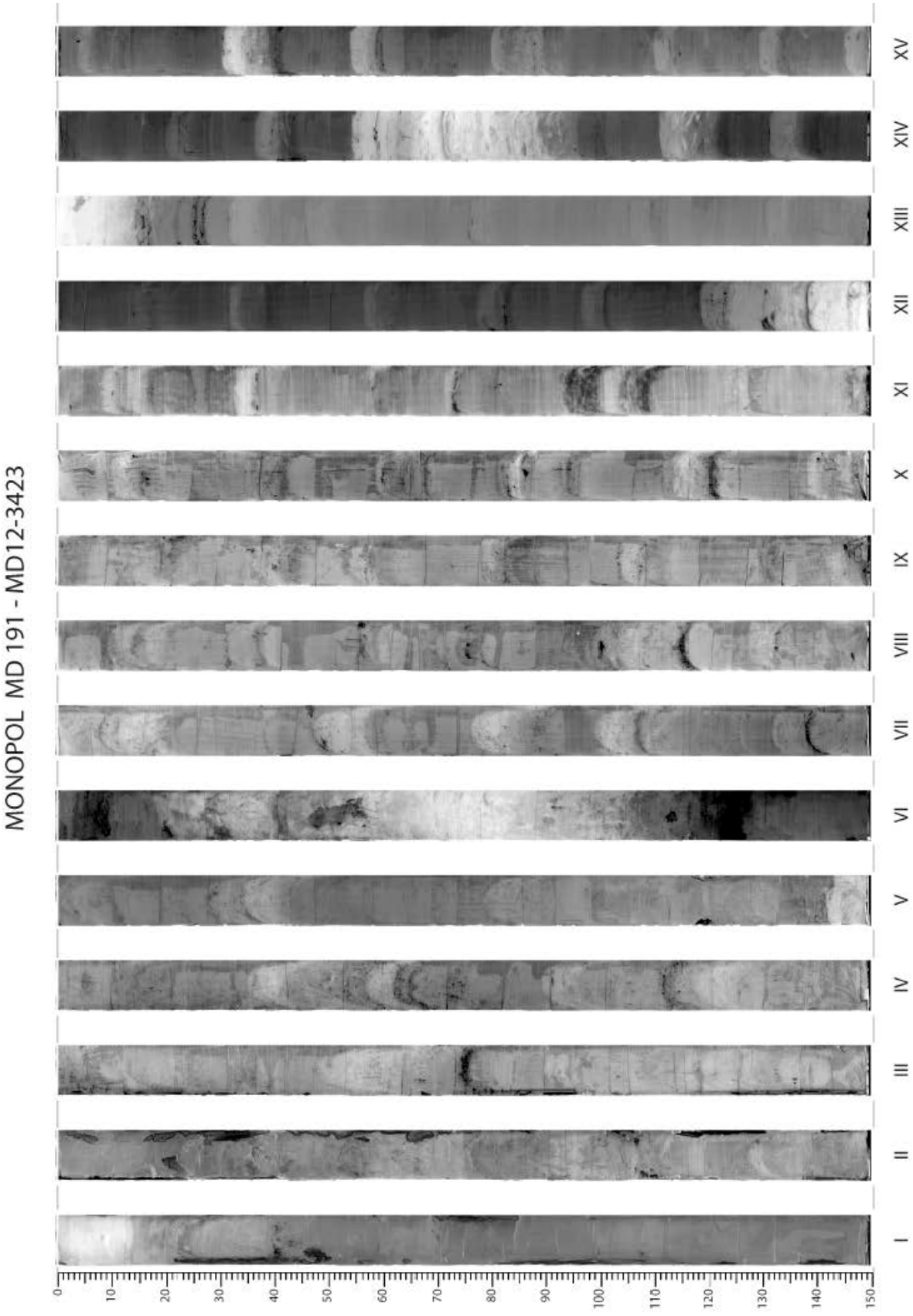
Core MD12-3423

Section	Top depth (cm)	Bottom depth (cm)	Real length of section (cm)	Observations
I	0	150	149.7	-
II	150	300	150.2	-
III	300	450	150.5	-
IV	450	600	150.6	-
V	600	750	150.1	-
VI	750	900	150.7	-
VII	900	1050	149.9	-
VIII	1050	1200	150.7	-
IX	1200	1350	150.1	-
X	1350	1500	150.3	-
XI	1500	1650	150.2	-
XII	1650	1800	150.6	-
XIII	1800	1950	150.2	-
XIV	1950	2100	150.6	-
XV	2100	2250	151.1	-
XVI	2250	2400	150.4	Volcanic stone : 22.77cm
XVII	2400	2550	150.1	-
XVIII	2550	2700	150.5	-
XIX	2700	2850	150.3	-
XX	2850	3000	150	-
XXI	3000	3150	150.6	3147-3150: empty
XXII	3000	3172	21.4	

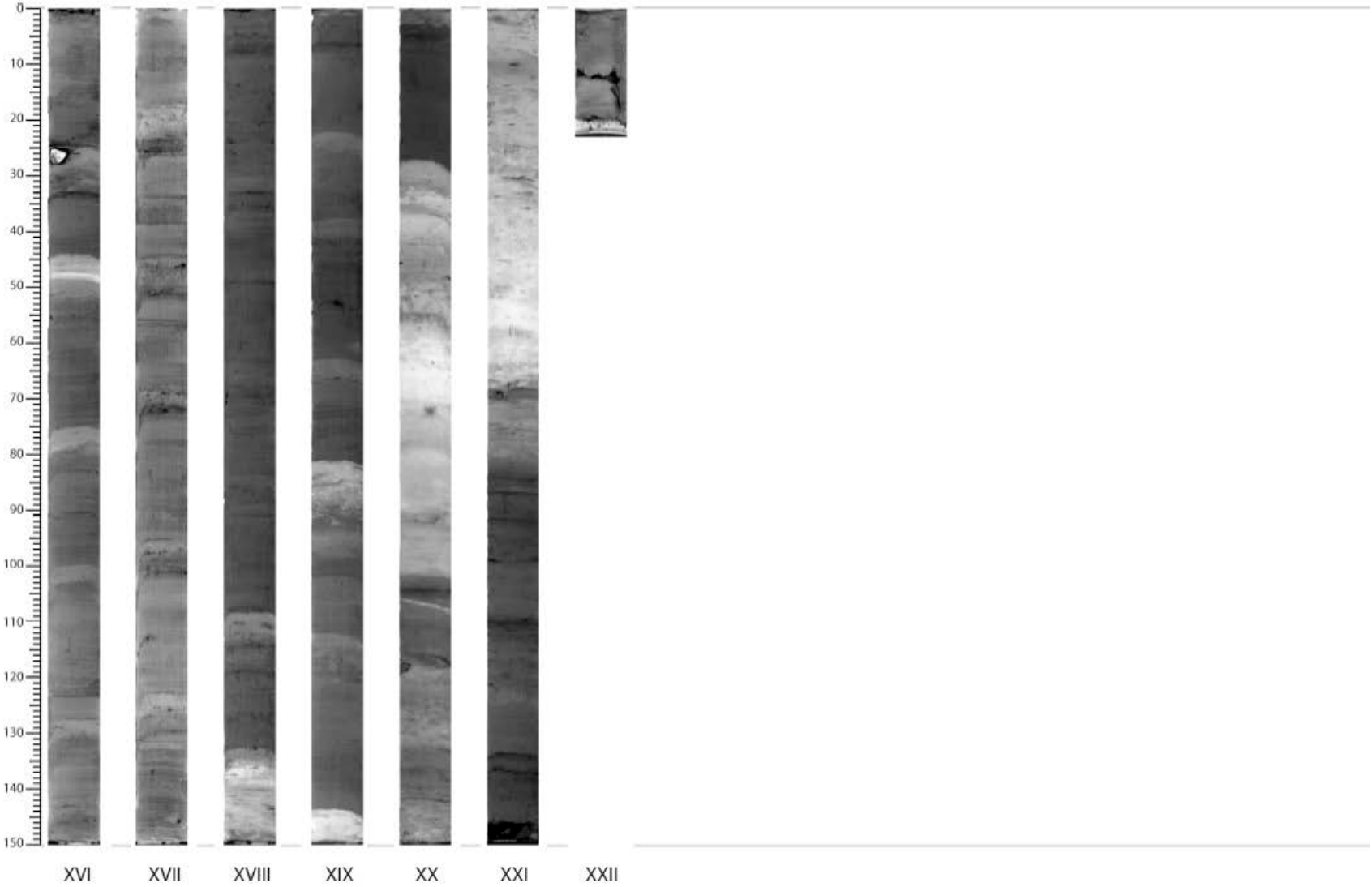
General observations / incidents:

MD191 – MONOPOL	Station: MONO 11

PICTURES OF CALYPSO MD12-3423



MONOPOL MD 191 - MD12-3423

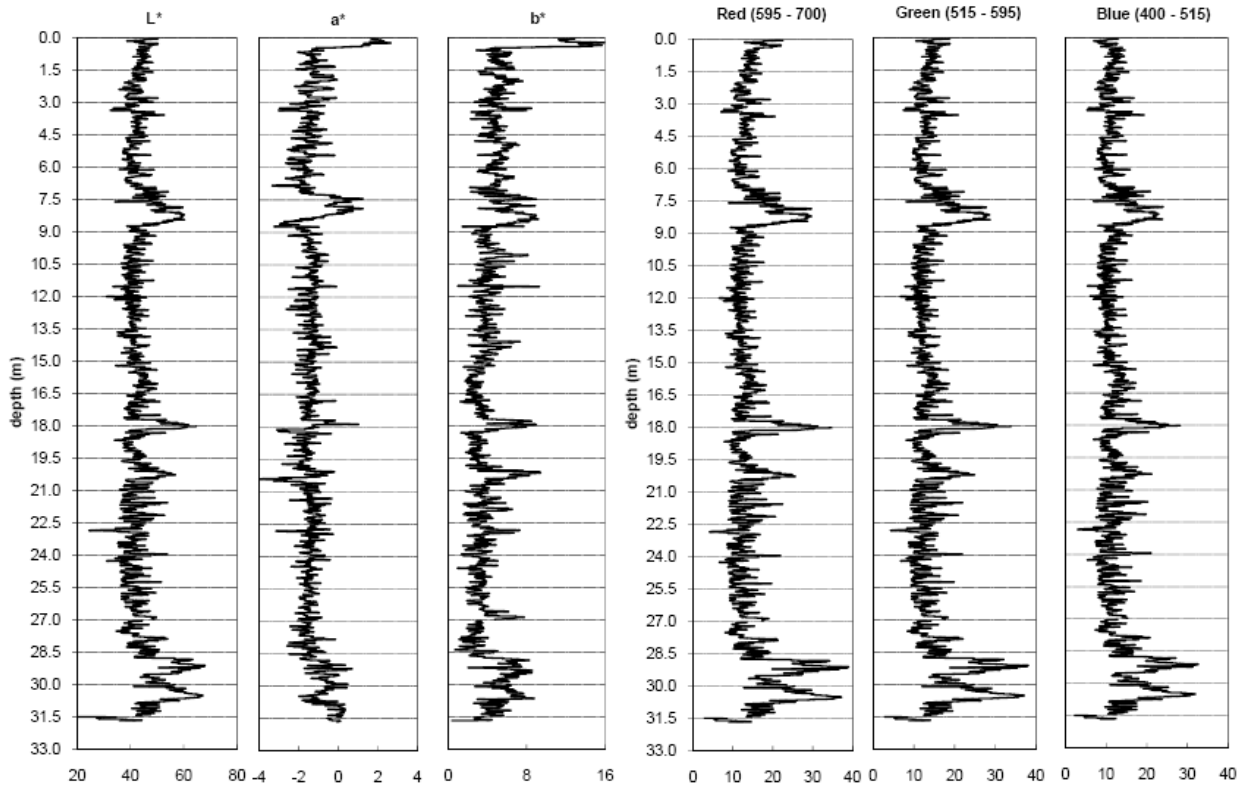


MD191 – MONOPOL	Station: MONO 11

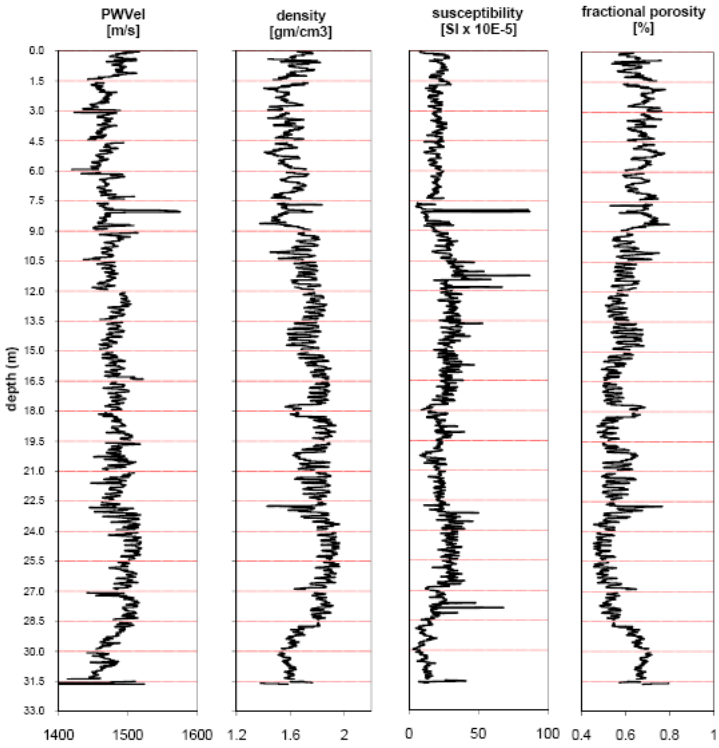
PHYSICAL PROPERTIES OF CALYPSO MD12-3423

MONOPOL 2012 **COLOUR REFLECTANCE** **Station MD12-3423**

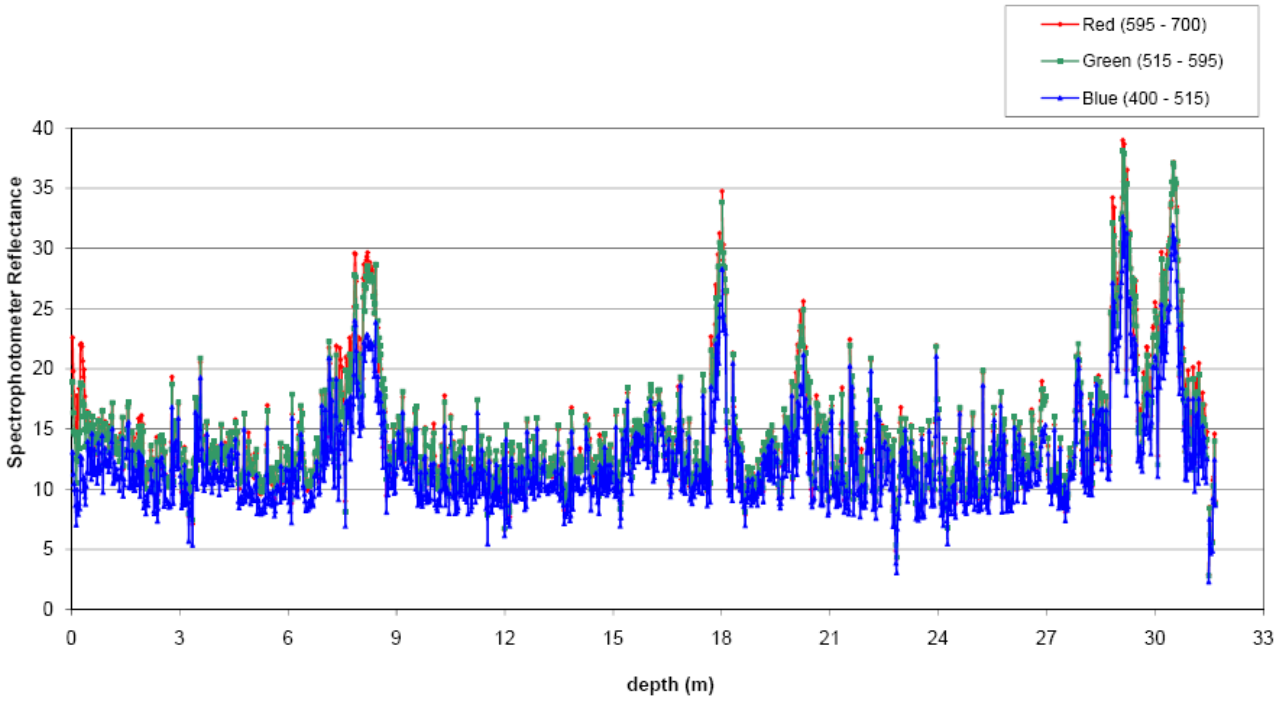
Spectrophotometer



MONOPOL 2012 Multi-sensor core logger **Station MD12-3423**

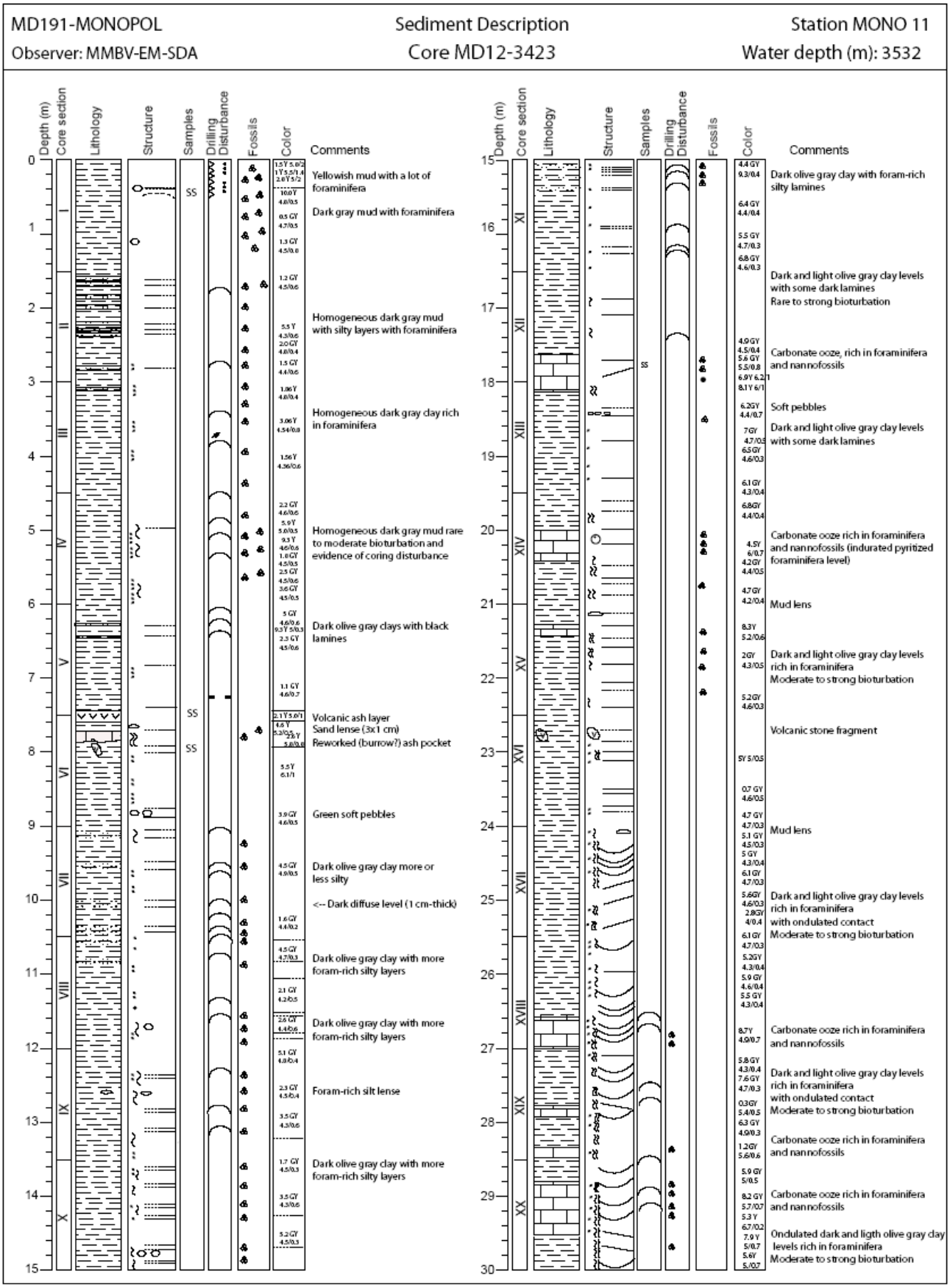


MD12-3423 RGB vs.depth



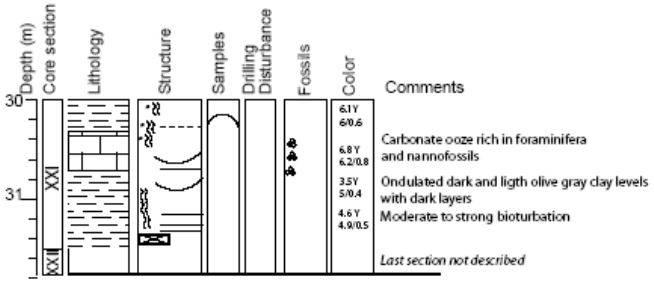
MD191 – MONOPOL	Station: MONO 11

SEDIMENTOLOGY OF CALYPSO MD12-3423



MD191-MONOPOL | Sediment Description | Station MONO 11

Observer: MMBV-EM-SDA | Core MD12-3423 | Water depth (m): 3532



Legend for Core Description

Lithology


Clay


Sand


Fossiliferous ooze


Silty clay


Sandy clay


Foraminifer ooze


Silt


Ash layers


Ash spot

Contacts

Sharp contact

Transitionnal contact


Undulating contact


Erosional contact

Bioturbation


Slight bioturbation


Heavy bioturbation

Structures


Planar lamination


Mottling


small gas hole


Fining-upward


Fault


Soft sediment deformation


Coarsening-upward


Soft pebble / isolated pebble or granule


Convolute bedding

Sand lens or pocket

Fossils


Plant debris/ wood fragment

Organic rich spot


Foraminifer

Coring disturbance


Disturbed


Fractured


Soupy


Void

Vertical structure due to degazing


Bend

Authigenics/diagenesis


Pyrite concretion

Samples

SS Smear slide

MD191 – MONOPOL	Station: MONO 12

STATION SUMMARY

Date and time approaching site: 11/6/2012 –11:15 (TU)
Date and time ending station activity:
Latitude: 7°08.17N **Longitude**: 89°48.19E **Water depth (m)**: 3532
Short area description: Site located towards the northernmost part of the Ninetyeast Ridge end. This site was designed to be our reference, southernmost site, at the exit of the Bay of Bengal. Unfortunately, the corer bent and was empty at recovery. No time was left for attempting another coring at that site and we decided to head towards Singapour (final port destination).

Activity on station		**Core identification**
Calypso corer	Yes	**Corer badly bent. Empty**
Casq	No	
Multi-corer	No	
Temp/Salinity/Fluorometry on coring device	No	
CTD / Water sampling (rosette)	No	
Deep In situ pump	No	
Plankton net	No	

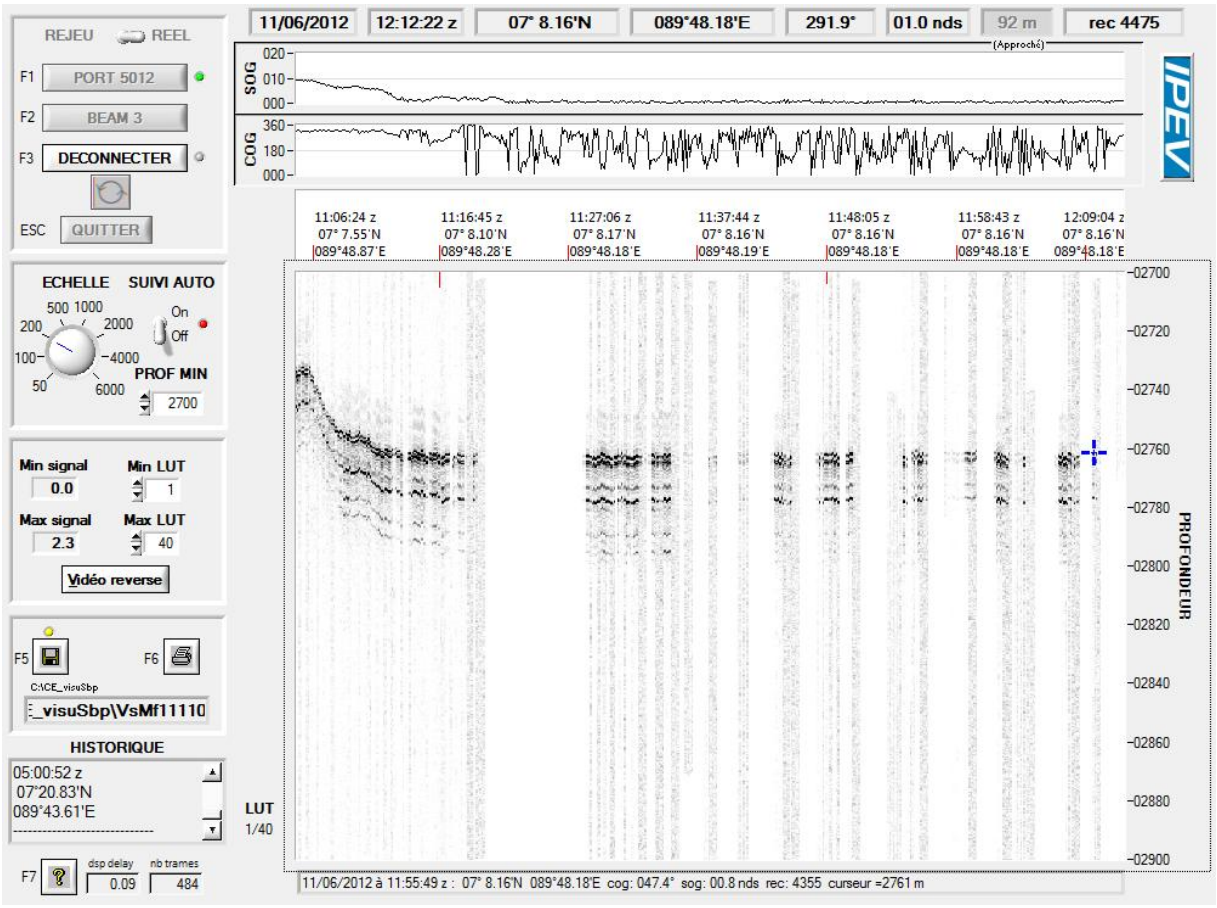


Figure: 3.5 kHz profile across station MONO 12 while arriving on site.

MD191 – MONOPOL	Station: MONO 12

CALYPSO CORING OPERATION:

Coring site information	*Latitude (°N):*	***7°08.18'***
	Longitude (°E):	***89°48.19'***
	Water depth (m):	***2760***
Calypso corer settings	*Core length (m):*	***34.70***
	Empty weight in water (t):	***7.29***
	Free fall (m):	***3***
	Length piston cable (m):	***47.19***
Coring operation	*Time corer starts descent:*	***11:56***
	Time triggering:	***13:00***
	Length cable (m):	***2715***
	Maximum tension (t)	***10.60***
	Time corer on deck:	***14:30***
Result coring operation	*Total weight in water (t)*	***7.39***
	Length of sediment (m)	***0***

General observations / incidents:

Corer severely bent, and empty.

MD191 – MONOPOL	Station: MONO 12

PICTURES OF CALYPSO