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No. 246

Hebbeln, D., T. Jennerjahn, M. Mohtadi, H. Andruleit, A. Baumgart,
M. Birkicht, C. Chiessi, A. Damar, B. Donner, N. Fadly, M. Gröning,
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O. Romero, G. Ruhland, J. Scholten, J. Smit, C. Spliethoff, S. Steinke,
R. Thomas, C. Wienberg, D. Yurnaldi

**REPORT AND PRELIMINARY RESULTS OF RV SONNE CRUISE SO-184,
PABESIA, DURBAN (SOUTH AFRICA) - CILACAP (INDONESIA) - DARWIN
(AUSTRALIA), JULY 8TH - SEPTEMBER 13TH, 2005**



The "Berichte aus dem Fachbereich Geowissenschaften" are produced at irregular intervals by the Department of Geosciences, Bremen University.

They serve for the publication of experimental works, Ph.D.-theses and scientific contributions made by members of the department.

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Hebbeln, D. and cruise participants

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Cruise Report

PABESIA

RV SONNE Cruise SO-184



Durban (08.07.2005) -
Cilacap (30./31.07.2005) -
Cilacap (21./22.08.2005) -
Darwin (13.09.2005)

D. Hebbeln, T. Jennerjahn, M. Mohtadi, H. Andruleit, A. Baumgart, M. Birkicht, C. Chiessi, A. Damar, B. Donner, N. Fadly, M. Gröning, W.S. Hantoro, C. Hayn, U.R. Kadarwati, K. Kamija, T.L. Kepel, N. Krück, F. Lamy, J. Langer, H.A. Mai, T. Mehring, B. Meyer-Schack, G. Mollenhauer, O. Morisse, A. Müller, A.K. Permana, W.S. Pranowo, D.A.S. Ranawijaya, O. Romero, G. Ruhland, J. Scholten, J. Smit, C. Spliethoff, S. Steinke, R. Thomas, C. Wienberg, D. Yurnaldi

CRUISE REPORT SO-184

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1 Participants

The first leg of SO-184 from Durban (South Africa) to Cilacap (Indonesia) was only transit. There were no scientists onboard and no scientific work has been carried out. The scientific program started with Leg 2 of SO-184.

Scientific Party SO-184, Leg 2

July 30 – August 21, 2005

Cilacap – Cilacap

Name	Discipline	Institute
Hebbeln, Dierk, Dr. (chief scientist)	Marine Geology	GeoB
Baumgart, Anne	Biogeochemistry	ZMT
Birkicht, Matthias	Biogeochemistry	ZMT
Chiessi, Cristiano	Marine Geology	GeoBv
Hantoro, Wahyu S., Dr.	Paleoclimate	LIPI
Kepel, Terry L.	Marine Biology	DKP
Krück, Nils	Biogeochemistry	ZMT
Lamy, Frank, Dr.	Marine Geology	GeoB
Langer, Jens	Marine Geology	GeoB
Mai, Hoang Anh	Marine Geology	GeoB
Fadly, Nur	Marine Biology	USK
Mehring, Tjark	Marine Geophysics	GeoB
Meyer-Schack, Birgit	Marine Geology	GeoB
Mohtadi, Mahyar, Dr.	Marine Geology	GeoB
Mollenhauer, Gesine, Dr.	Marine Geology	GeoB
Permana, Asep K.	Sedimentology	GRDC
Pranowo, Widodo S.	Oceanography	DKP
Ranawijaya, Duddy A.S.	Paleoclimate	MGI
Romero, Oscar, Dr.	Marine Geology	GeoB
Smit, Jan, Dr.	Marine Geology	VUA
Steinke, Stephan, Dr.	Marine Geology	GeoB
Thomas, Rüdiger	Marine Geology	IGK
Yurnaldi, Dida	Sedimentology	GRDC
Kamija, Kramaharja	Indonesian Observer	IN

Crew list SO-184, Leg 2

July 30 – August 21, 2005

Cilacap – Cilacap

Name	Rank
Meyer, Oliver	Master
Aden, Niels	Ch. Mate
Linnenbecker, Matthias	1 st Mate
Gollenbeck, Boris	2 nd Mate
Bräutigam, Tim Oliver	Surgeon
Guzman, Werner	Ch. Eng.
Buschhoff, Jens	2 nd Eng.
Grund, Helmuth	2 nd Eng.
Ulbricht, Martin	Electrician
Angermann, Rudolf	Ch. Electron
Großmann, Matthias	Sys.-Man.
Zeitz, Holger	Motorman
Blohm, Volker	Motorman
Golabowski, Daniel	Motorman
Tiemann, Frank	Ch. Cook
Kornaga, Ryszard	2 nd Cook
Slota, Werner	Ch. Steward
Derda, Artur	2 nd Steward
Jahns, Winfried	Boatswain
Vor, Hans-Jürgen	A.B.
Bierstedt, Torsten	A.B.
Tauscher, Jan	A.B.
Kraft, Jürgen	A.B.
Tessnow, Norman	A.B.
Müller, Gerhard	A.B.
Fricke, Ingo	A.B.
Förster, Tino	Trainee

Scientific Party SO-184, Leg 3

August 22 – September 13, 2005

Cilacap – Darwin

Name	Discipline	Institute
Jennerjahn, Tim, Dr. (chief scientist)	Biogeochemistry	ZMT
Andruleit, Harald, Dr.	Micropaleontology	BGR
Baumgart, Anne	Biogeochemistry	ZMT
Birkicht, Matthias	Biogeochemistry	ZMT
Damar, Ario, Dr.	Marine Ecology	IPB
Donner, Barbara, Dr.	Marine Geology	GeoB
Gröning, Max	Marine Geology	GeoB
Hayn, Christina	Marine Geology	GeoB
Kadarwati, Utami R.	Sedimentology	DKP
Krück, Nils	Marine Geology	ZMT
Mehring, Tjark	Marine Geophysics	GeoB
Mohtadi, Mahyar, Dr.	Marine Geology	GeoB
Morisse, Ole	Biogeochemistry	ZMT
Ruhland, Götz	Marine Geology	GeoB
Scholten, Jurian	Marine Geology	VUA
Spliethoff, Charlotte	Marine Geology	VUA
Thomas, Rüdiger	Marine Geology	IGK
Wienberg, Claudia, Dr.	Marine Geology	GeoB
Kamija, Kramaharja	Indonesian Observer	IN

Crew list SO-184, Leg 3

August 22 – September 13, 2005

Cilacap – Darwin

Name	Rank
Meyer, Oliver	Master
Aden, Niels	Ch. Mate
Linnenbecker, Matthias	1 st Mate
Gollenbeck, Boris	2 nd Mate
Bräutigam, Tim Oliver	Surgeon
Guzman, Werner	Ch. Eng.
Buschhoff, Jens	2 nd Eng.
Grund, Helmuth	2 nd Eng.
Stepputtis, Hans-Jürgen	Electrician
Angermann, Rudolf	Ch. Electron
Großmann, Matthias	Sys.-Man.
Zeitz, Holger	Motorman
Blohm, Volker	Deck Fitter
Sebastian, Frank	Motorman
Tiemann, Frank	Ch. Cook
Kornaga, Ryszard	2 nd Cook
Slotta, Werner	Ch. Steward
Derda, Artur	2 nd Steward
Jahns, Winfried	Boatswain
Vor, Hans-Jürgen	A.B.
Bierstedt, Torsten	A.B.
Tauscher, Jan	A.B.
Kraft, Jürgen	A.B.
Müller, Gerhard	A.B.
Fricke, Ingo	A.B.
Förster, Tino	Trainee

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ZMT

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Fahrenheitstraße 6
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IGK

Institut für Geowissenschaften
Universität Kiel
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24118 Kiel
Germany

GFZ

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Telegraphenberg
14473 Potsdam
Germany

BGR

Bundesanstalt für Geowissenschaften und
Rohstoffe
Stilleweg 2
30655 Hannover
Germany

LIPI

Research Center for Geotechnology
Indonesian Institute of Sciences
Jl. Sangkuriang
Bandung 40135
Indonesia

MGI

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Jl. Junjuran 236
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GRDC

Geol. Research and Development Centre
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Indonesia

USK

Dept. of Marine Sciences
Univ. of Syiah Kuala
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Direktorat Jenderal Strategi Pertahanan,
Departemen Pertahanan RI
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DKP

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Non-Living Resources
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Jakarta 12770
Indonesia

IPB

Centre for Coastal & Marine Resources
Studies
Fac. Of Fisheries & Marine Sciences
Bogor Agricultural University
Kampus IPB Darmaga
Bogor 16680
Indonesia

VUA

Faculty of Earth and Life Sciences
Vrije Universiteit
de Boelelaan 1085
1081HV Amsterdam
The Netherlands



Fig. 1.1: Scientific party of leg SO-184/2.



Fig. 1.2: Scientific party of leg SO-184/3.

2 Research Program

PABESIA is a research project centred around a ~10 week expedition with the German research vessel SONNE conducted in summer 2005 starting from Durban (South Africa) and ending in Darwin (Australia), with two additional intermediate stops in Cilacap (Indonesia). While the first leg was only for transit, the research program was carried out during the second and third leg along the Indonesian islands of Sumatra, Java and Savu. The cruise was organised by the Department of Geosciences (GeoB) and the Center for Tropical Marine Ecology (ZMT), both located at the University of Bremen, Germany, and is funded by the German Ministry for Education and Research (BMBF). The cruise and the subsequent sample analysis and data interpretation are a cooperation mainly between German and Indonesian scientists. This research project contributes to Cluster 5 “Marine Geology and Biogeochemistry” of the joint Indonesian-German SPICE program (Science for the Protection of Indonesian Coastal Ecosystems).

Overview

The tropical Indian Ocean is characterized by warm sea surface temperatures (SST) in the east, slightly colder SSTs in the west and weak westerly winds. In contrast to this, the tropical Pacific and Atlantic Oceans display a reverse pattern, in which the equatorial regions are marked by easterly winds and by increasing SSTs from east to west. At irregular intervals of two to seven years in the Pacific Ocean, this pattern is reversed during El Niño-Southern Oscillation (ENSO) events resulting in conditions very similar to those in the Indian Ocean.

A similar dipole mode has also been described for the tropical Indian Ocean (Saji et al., 1999). In contrast to the normal situation, these dipole mode events are characterized by comparatively low SSTs off Indonesia and high SSTs in the western Indian Ocean, similar to the normal pattern of the tropical Pacific and Atlantic Oceans. At the same time, precipitation over the western Indian Ocean and over tropical East Africa increases significantly, while Indonesia is hit by severe droughts, and normally west to east blowing summer winds weaken or even reverse.

By looking at a time series record of the difference of these SST anomalies from the western and eastern tropical Indian Ocean it becomes clear that during the last 40 years six such events occurred, which were not related to the Pacific ENSO events (Saji et al., 1999; Webster et al., 1999). All these dipole mode events began with cold SST anomalies off Java, which increased by moving to the northwest in the area off Sumatra (Saji et al., 1999). The observed SST anomalies can be rather big, as e.g. in 1997/1998, when off Sumatra the temperatures at the sea surface were 2°C and in 80 m water depth even 10°C colder than normal (Anderson, 1999). These SST anomalies are seen as the trigger for the following effects finally resulting in the precipitation anomalies in East Africa (Saji et al., 1999; Webster et al., 1999). These authors suggest that the dipole mode in the Indian Ocean depends on internal dynamics of the ocean-atmosphere system in this region with significant effects on climate variability on seasonal to interannual time scales.

The above-mentioned investigations, all based on the evaluation of satellite data, agree in the conclusion that the area off Java and Sumatra plays a key role for this dipole mode and thus, for the ocean-atmosphere system in the Indian Ocean. However, data based on field studies from this coastal upwelling region (Java Upwelling System; Wyrtki, 1962) are scarce. Investigations of the present-day functioning of this upwelling area off the Indonesian coast as well as of its development over the past ~50,000 years are the major goals of the PABESIA research project.

During this expedition, the documentation of the Indonesian upwelling system (upwelling, production, sedimentation, land-ocean interaction) in the sediment in response to the prevailing environmental conditions will be investigated by combined studies in the water column and at the sea floor. Another focal point will be the development of this key region under changing climatologic (glacial/interglacial changes, Holocene climatic optimum etc.) and geographic (land-water distribution in the Indonesian Archipelago) boundary conditions. The resulting reconstruction of the history of this upwelling region, ideally with a temporal resolution on a decadal scale, could later be provided as the base for modelling of the ocean-atmosphere system of the Indian Ocean under glacial and Holocene boundary conditions.

During the last 50,000 years, the Indonesian region experienced distinct variations of these boundary conditions. Besides the global climate change from glacial conditions to the present-day interglacial setting, which additionally was overlain by a number of high-frequent climate oscillations, especially the geographic and oceanographic boundary conditions changed drastically. The shallow Sunda shelf north of Java and Sumatra is one of the most extensive shelf areas of the world. Large parts of this area were dry land under the low sea level conditions of the last glacial maximum. These large-scale variations in the land-ocean distribution had distinct impacts on the monsoon circulation and thus, on the regional (and global?) climate (Wang et al., 1999). The glacial lowering of the sea level also resulted in a dramatic reduction of the Indo-Pacific throughflow (Wang, 1999), which today takes place in the eastern part of the Indonesian Archipelago as an integral part of the global thermohaline circulation (Indo-Pacific Gateway). Based on this, at least on glacial/interglacial time scales major changes of the paleoceanographic boundary conditions for the Indonesian upwelling system can be expected.

Aiming to investigate the (paleo)environmental conditions in the upwelling areas along the Indonesian continental slope off Java, Sumatra, and Sumba, the German R/V SONNE sailed for a six week expedition in Indonesian waters. The working area is located between 3°N and 97°E off Sumatra to 11°S and 211°E off Java and Sumba. In order to answer the questions raised above, the water column in the study area will be analysed for its physical state, its nutrient content, its plankton communities, and the biogeochemical characteristics of sinking and suspended particles accompanied by investigations of biogeochemical fluxes across the sediment-water interface. In addition, sedimentological, micropaleontological and isotopic studies will be performed on the sediments in order to relate their composition to the present-day environmental setting and to reconstruct the regional paleoenvironmental conditions.

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3 Narrative of the Cruise

(D. Hebbeln, T. Jennerjahn)

Between July 8 and July 30 RV SONNE made the transit from Durban in South Africa to Cilacap in Indonesia. During this first leg (SO-184/1) there were no scientists onboard and no scientific work has been carried out. This leg solely served as a transfer leg to bring RV SONNE (Fig. 3.1) from its last working area in the Mozambique Channel (SO-183) to the working area of SO-184 off Indonesia (Fig. 3.2.)



Fig. 3.1: RV SONNE during SO-184/2 in the Mentawai Basin.

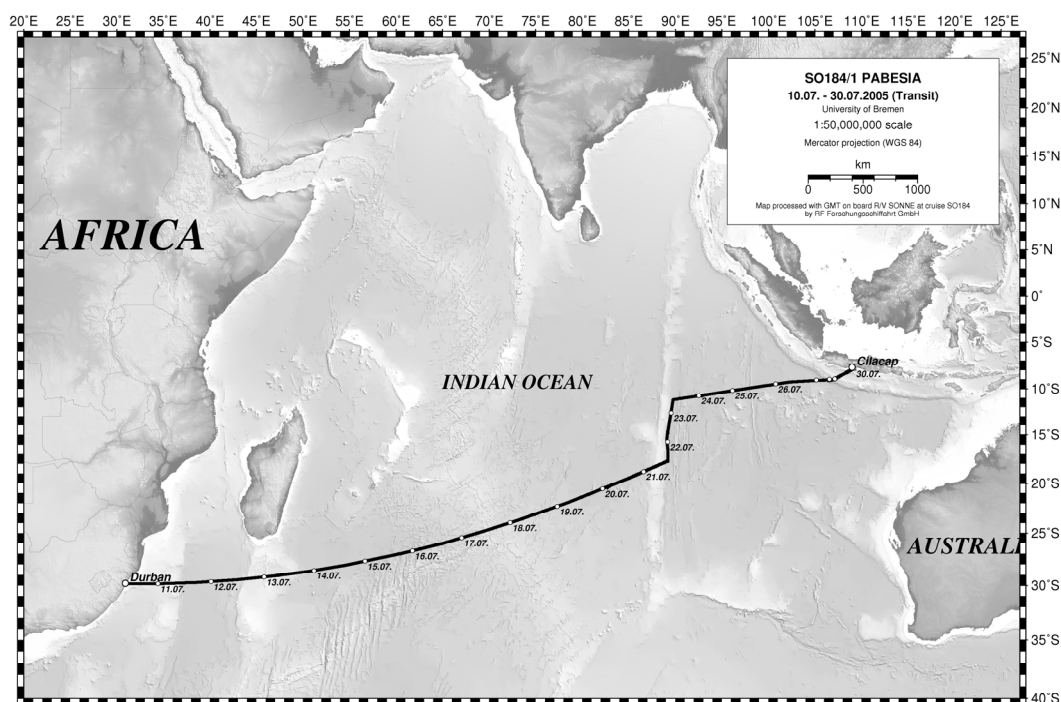


Fig. 3.2: Cruise plot for SO-184/1.

On July 30, 2005, 24 scientists of 6 nationalities working in 3 countries embarked on R/V SONNE in the port of Cilacap, Indonesia, to prepare their equipment for the PABESIA expedition, the 184th cruise of R/V SONNE (SO-184). The next day was spent with unloading the scientific equipment that was sent from Bremen in three containers and with the installations of the equipment in the onboard laboratories. On August 1 at 10 a.m. R/V SONNE left Cilacap heading westward to the first major working area off the west coast of Sumatra. Just off Cilacap RV SONNE was hit by a significant swell reminding the newly embarked

scientists that they were at sea. However, in the following day the condition of the sea and of those having been attacked by sea sickness improved.

Regular station work commenced on August 3 at 4 p.m. with a CTD and Multinet station, followed by a detailed PARASOUND and Multibeam survey over the intended working area to the southwest of the small island Mega. The sampling program on most stations comprised casts with the CTD/Rosette, the Multinet with a mobile CTD, the Multicorer and the Gravity corer. During the next day, the first day with geological sampling, the scientists had to struggle with a number of problems, technical as well as natural, culminating in a 6 m Gravity corer that fully penetrated into the sediment but enigmatically yielded no core recovery at all. Station work ended close to midnight and RV SONNE steamed to the northwest to the next working area.

The transit lasted almost the entire day of August 5 and everybody could enjoy the marvelous weather and sea conditions. In the evening the second PARASOUND and Multibeam survey began closely to the northern end of the island of Siberut, one of the Mentawai Islands. The survey yielded three promising sediment sampling sites, roughly at 1000 m, at 2000 m, and at 3000 m, thus providing a good depth transect. Sediment sampling resulted in good surface sediment coverage using the Multicorer and two short and one somewhat longer sediment cores from the shallow and the deep site. The intermediate site was impossible to sample as there was probably a very hard layer very close to the sediment surface hampering the penetration of the sampling gears. Finally, also a complete CTD and water sample transect has been obtained.

The transit to the next working area was highlighted by the passage of the equator. Based on the night's hydroacoustic survey 4 stations ranging from 1100 m to 2500 m water depth have been sampled in the northernmost working area at the seaward continental slope north of Nias Island at $\sim 1^{\circ}30'N$. Again, the sediment sampling with the Gravity corer proved to be difficult. Despite good penetration of the cores the recovery was often low or the core barrel was even empty. Station work in this area ended in the afternoon of August 9 and RV SONNE headed south again. The next passage of the equator envisaging, all ship's complement and scientists gathered in the evening for a joint barbecue at the working deck to celebrate the mid-point of the cruise, the passage of the equator and several birthdays (with three of the scientists having had their birthday at the same day).

In the morning of August 10, RV SONNE passed through Selat Siberut and entered the Mentawai fore-arc basin between the Mentawai Islands and Sumatra. Whereas the upper slope around this up to 1800 m deep basin is gently dipping towards the inner basin and marked by thick sediment packages, the lower slopes are rather steep and characterized by a rugged topography. Under perfect weather conditions the northern part of this basin has been intensively sampled between August 10 and 12, yielding core recoveries mainly ranging between 6 m and 8 m. Also the Multicorer showed high average recoveries often exceeding 40 cm. Finally, also the CTD/Rosette and Multinet sampling were extraordinarily successful.

On August 13 and 14 at $\sim 1^{\circ}30'S$ a transect perpendicular to the basin axis has been surveyed and sampled. At its northwestern end and close to Sumatra, a fantastic view on the chain of volcanoes along southwestern Sumatra was revealed with some of them apparently smoking. At the same time in the laboratory several layers of volcanic ash occurring in the sediment cores were described, thereby highlighting the close relationship between the onshore volcanic activity and the offshore sedimentation.

On its way south RV SONNE sampled two stations to the east of Mega Island that form a shoreward prolongation of the very first transect sampled on the seaward slope to the west of this island. Also along this southern margin of the Mentawai Basin mostly thick sediment packages are the dominant sub-seafloor feature, although at the slopes still some very steep

sections occur. Consequently, the coring recovery was pretty good. As this area was not protected by any islands from the open ocean a slight swell hit RV SONNE again after several days of almost lake-like conditions. Nevertheless, the weather conditions were still perfect.

The next working area in the northern Bengkulu Basin was reached on August 16. The first station on this transect was located as close to the coast that cellular phones got network connection and parts of the deck turned immediately to a busy calling shop. The good site conditions found in the Mentawai Basin also prevailed in the Bengkulu Basin, although the very flat central part of the latter basin revealed a different hydroacoustic character implying much “harder”, possibly turbidite-rich sediments. The night from August 16 to 17 was marked by heavy rains and continuous lightning, which both fortunately stopped shortly after the first station began on August 17. The attempt to sample a small knoll-type elevation in the western part of the Bengkulu Basin yielded the first “banana” (i.e. a bent core tube) of the cruise. Still, two meters of sediment could be recovered that consisted of a thick, rather coarse grained layer underlain by a stiff clay section.

The following day the outer continental margin was visited again and sampled at two sites. In contrast to the experience made in this region during the first days of the cruise, the first retrieved sediment core yielded a recovery of more than 6 m. Unfortunately, the second attempt resulted in an another “banana”. During this day, Aug. 18, the weather conditions deteriorated and a strong swell reduced the transit speed of RV SONNE considerably. Thus, the transit to last working area of SO-184/2, off the Sunda Strait, took longer than expected. Since also the final transit to Cilacap was supposed to take longer, the sampling program for the Sunda Strait area shrank to almost pure geological sampling. Nevertheless, two successful stations could be sampled. Close to midnight on Friday, August 19, the station work of cruise SO-184/2 was finished at the 43rd station. From there on RV SONNE sailed straightaway to Cilacap, where this cruise ended in the morning of August 21.

At a total of 43 stations covering 35 different localities (as some stations have been occupied twice) 32 CTD/Rosette, 24 Multinet, 34 Multicorer and 42 Gravity corer deployments have been carried out, the latter yielding a total accumulated core length of 195 m.

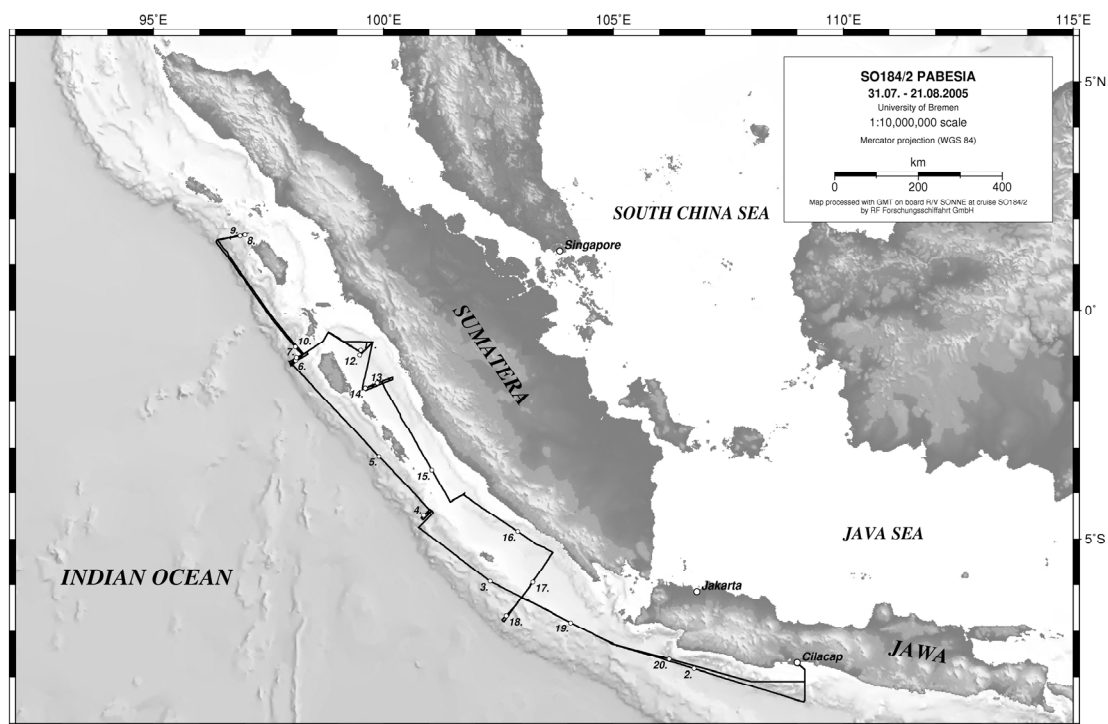


Fig. 2.2: Cruise plot for SO-184/2.

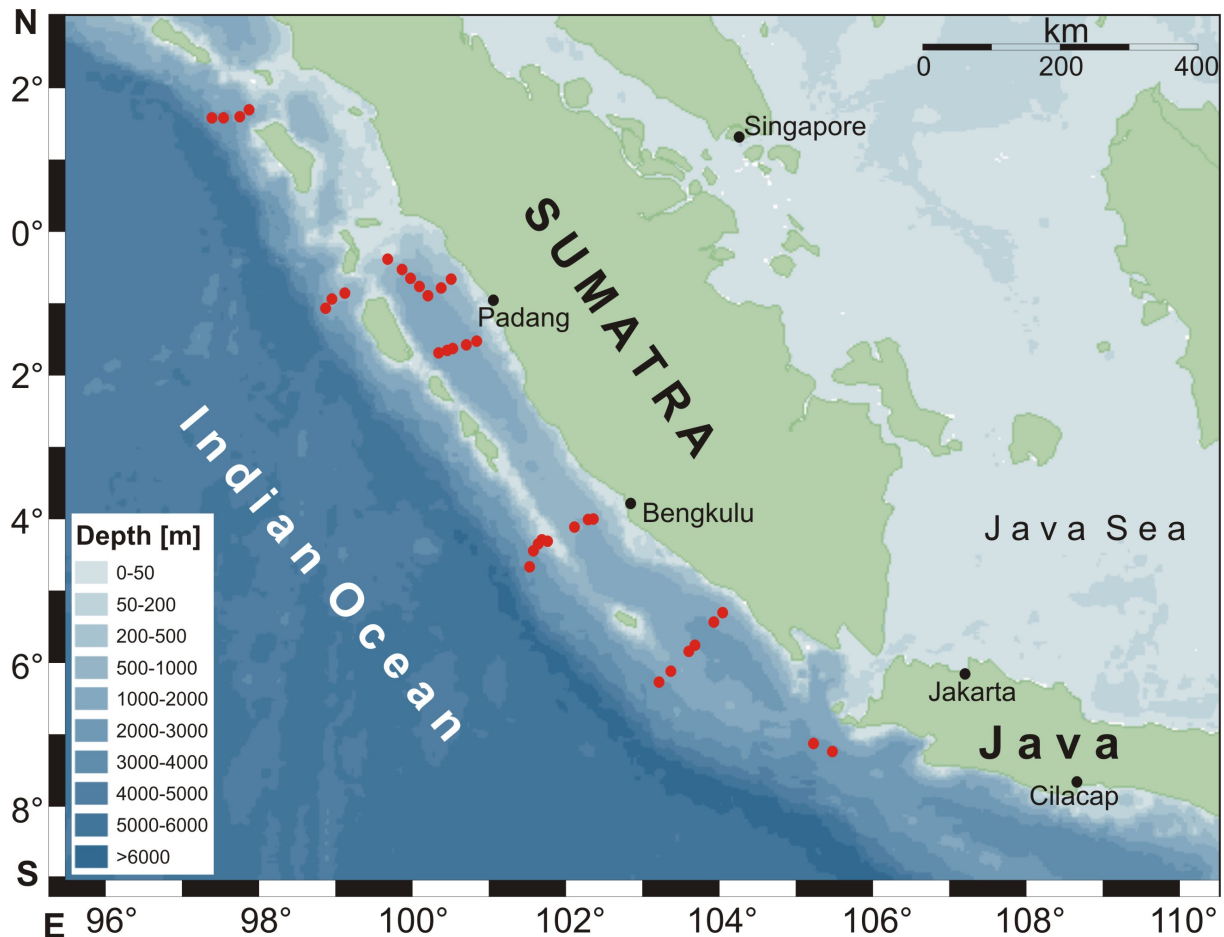


Fig. 2.3: Stations occupied during SO-184/2.

For the third leg of SO-184 17 scientists disembarked and 13 scientists embarked on the vessel in Cilacap on August 21. Three ZMT students performing field work for their diploma thesis in the nearby Segara Anakan lagoon (SPICE Custer 2 project on mangrove ecology) were offered the opportunity to visit the research vessel in the morning. In the afternoon a delegation of high-ranked officials including the Mayor of the city of Cilacap and the Rector of the Jenderal Soedirman University of Purwokerto visited the vessel. The chief scientists and Captain Meyer introduced the vessel and the research program within the frame of SPICE to the visitors. Intensive discussions on the research program and a tour of the vessel made it a successful event highly appreciated by the group of visitors. Unfortunately, one of the newly embarked scientists had to leave the vessel for health reasons and could not participate in leg 3 of cruise SO-184.

RV SONNE left Cilacap in the morning of August 22. Work at sea began almost immediately off Cilacap in the deep fore-arc basin with station GeoB 10044 in 3340 m water depth. Multinet and CTD/Rosette casts were followed by a Multicorer and Gravity corer of 6 m length all of which successfully collected data and samples. Good weather conditions facilitated station work along the transect off Cilacap in the next days. Following hydro-acoustic surveys with PARASOUND two sites were selected for sampling on the northern flank and the bottom of the fore-arc basin. Stations GeoB 10044 and 10045 yielded almost full 6 m long Gravity cores on August 22 and 23. In addition, all other instruments operated successfully except for the Multicorer which at time did not release. On August 24, two stations were selected on the southern flank of the fore-arc basin after intensive PARASOUND

survey in 2604 m and in 1780 m water depth. On August 25 a sediment trap system deployed by the Center for Tropical Marine Ecology was successfully recovered from 3000 m water depth. Although having been deployed almost 3 years ago, batteries of the release unit responded immediately. Excellent work of crew and scientists allowed recovery of the whole system within less than two hours leaving time for another full station GeoB 10048 approx. 1 nm off the sediment trap station which completed the Cilacap transect.

In the following days RV SONNE then sampled along a N-S transect off Yogyakarta. In contrast to the scientists' expectations sediment sampling was difficult in the area. A large-scale bathymetric map promised low-gradient areas in water depths less than 2000 m, but PARASOUND and Multibeam surveys revealed the opposite: steep flanks and few undisturbed sediment layers in the fore-arc basin. While the Multicorer did not release prevalently, the Gravity corer reliably supplied the scientists with sediment cores. Coarse-grained sediment at station GeoB 10051 in 2388 m water depth reduced penetration depth of the corer and resulted in a core of 224 cm length. Nonetheless, at the next station a sediment core of 470 cm length was obtained.

On August 29, RV SONNE moved on eastward to sample a third transect almost perpendicular to the coast off SE Java. Again, bathymetry of the ridge defining the western edge of the Lombok Basin located almost in the center of the upwelling made it a promising area with respect to water and sediment sampling. CTD casts and water and plankton sampling were perfect in the area. However, sediment sampling became a tedious task because of sediment properties and failure of instruments. Steep flanks of the ridge, a rugged topography and strong reflectors seen in the PARASOUND record, complicated finding suitable core locations. Moreover, the Multicorer failed at stations GeoB 10053 to GeoB 10057. While station GeoB 10054 yielded a core of 8,46 m length the Gravity corer failed at stations GeoB 10056 and GeoB 10057 on the southern flank of the fore-arc basin where the tubes were bent and empty, respectively, due to stiff and coarse sediments. After repairing the Multicorer, the missing surface sediments from that transect were collected at stations GeoB 10058 (at GeoB 10054) and GeoB 10059 (at GeoB 10053). Successful coring at station GeoB 10061 completed this transect on September 2.

On the way to the eastern slope of the Lombok Basin a deep water station was sampled in the Java Trench at 5851 m water depth. Serving as a reference open ocean station, only water and plankton were sampled. CTD data immediately revealed the different physicochemical properties of the water column in our southernmost station so far compared to the previous ones. Sampling was then continued on the eastern slope of the Lombok Basin on September 4. For this area seismic profiles of the Dutch *Snellius-II* expedition promised well-stratified and thick sediment layers in water depths <2500 m. Indeed, core recoveries were in the range between 7 and almost 10 m in the area. CTD casts and water and plankton sampling worked as perfect as always with the exception of station GeoB 10064 where the water samplers could not be released due to a broken cable connection. Following were a number of stations upslope yielding sediment cores of up to 9.85 m length. On September 6, station GeoB 10067 completed this transect with stations nicely covering the slope from 2495 m to 1137 m water depth.

RV SONNE then moved eastward to the Savu Basin through Selat Sumba, the narrow passage between the islands of Sumbawa and Flores to the north and Sumba to the south. In the following two days the continental slope of the western Savu Basin and the southern passage to the open ocean were sampled. Unlike the previous days, PARASOUND and Multibeam surveys revealed a rugged topography of the seafloor and only few locations with well-stratified sediments. Nevertheless, stations GeoB 10068 and GeoB 10069 yielded cores of 8.17 m and 9.62 m length, respectively. On September 8, RV SONNE sailed almost exactly along one transect of the Dutch *Snellius-II* expedition which promised thick and undisturbed

sediment strata. However, unexpectedly the PARASOUND survey did not confirm the previous findings. Thus only one station southeast of Sumba could be sampled, which yielded a short core with stiff, lithified and probably very old sediment.

In the night of September 8 to 9, RV SONNE left the Indonesian continental margin. On September 10, a so-called 'carbonate mound' structure was sampled on the way to Darwin, Australia, the final destination of the cruise. It was described as a reef-like carbonate structure at about 165 m water depth. However, PARASOUND survey during the night and a video survey with the towed OFOS revealed it to be a dome-like structure with its top in 20 m water depth. It was sampled three times with the TV Grab and a final gravity core of 5 m length obtained at station GeoB 10072. In the morning of September 12, RV SONNE reached the port of Darwin, the final destination of the PABESIA cruise SO-184.

During leg 3 of SO-184 a total of 30 stations were sampled, one of which was for sediment trap recovery only and three others that were sampled twice. At these stations 42 CTD/Rosette, 19 Multinet, 20 Plankton net, 31 Multicorer, 28 Gravity corer, 2 OFOS and 3 TV Grab deployments have been carried out and one sediment trap system has been successfully recovered. The gravity cores yielded an accumulated total of 162 m sediment core length.

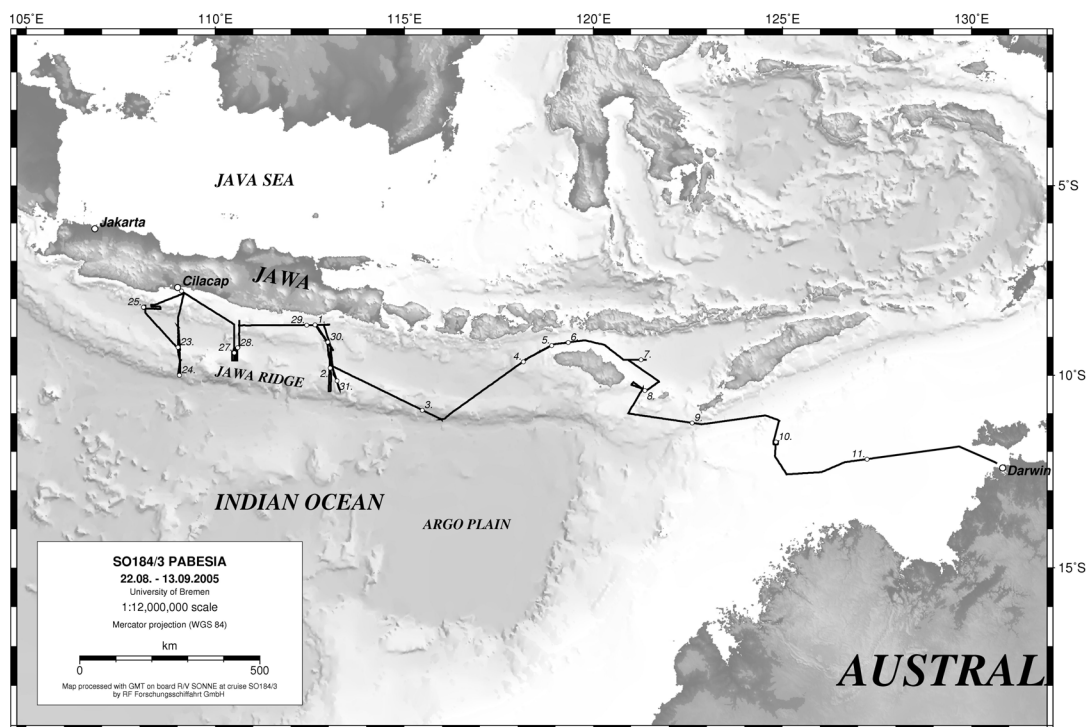


Fig. 2.4: Cruise plot for SO-184/3.

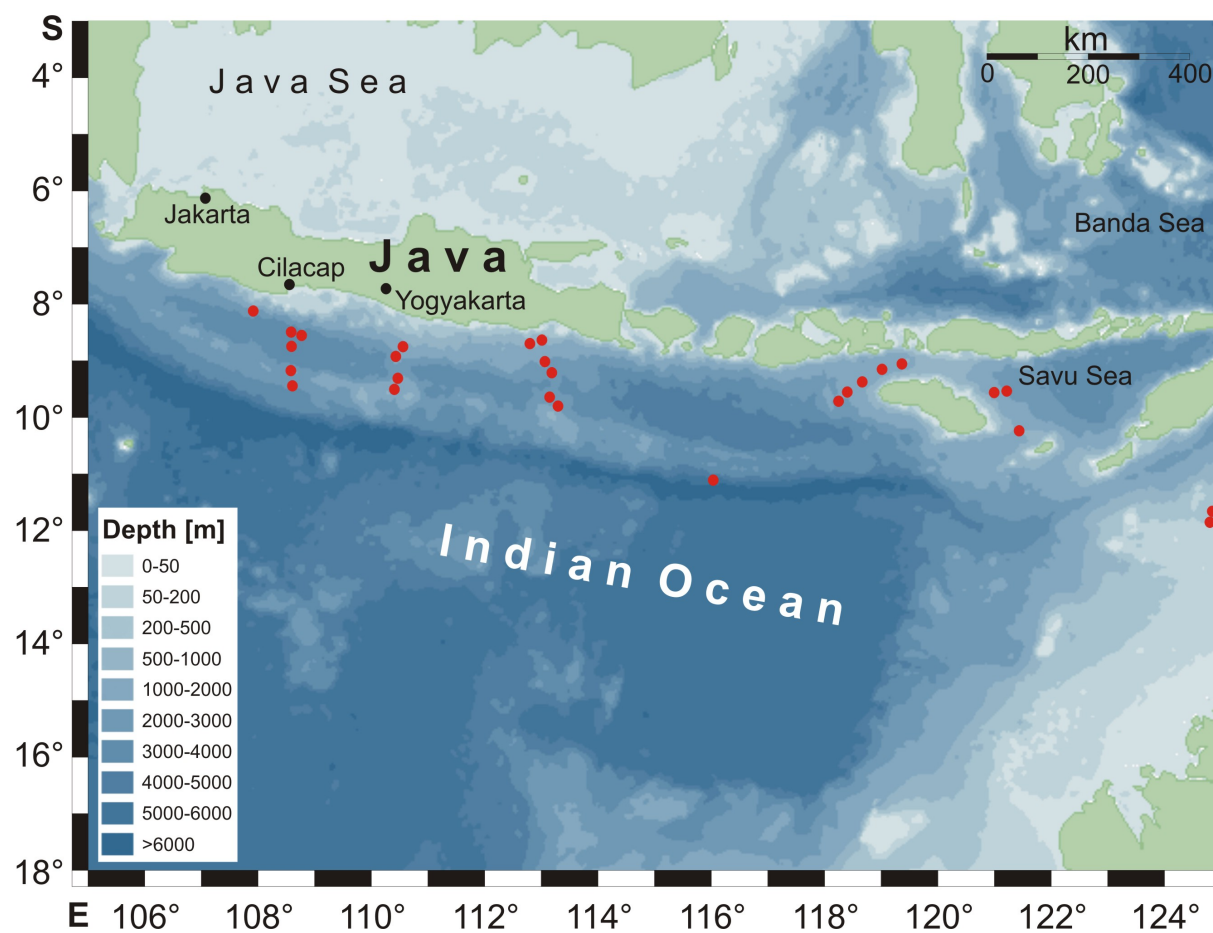


Fig. 2.5: Stations occupied during SO-184/3.

4 Underway Geophysics: PARASOUND and SIMRAD EM 120

(T. Mehring)

4.1 Introduction

The hydroacoustic systems of R/V SONNE were continuously operated during cruise SO-184/2 and SO-184/3. The multibeam echo sounder system SIMRAD EM 120 and the sediment echo sounder PARASOUND were used to collect hydroacoustic data from along the outer Sumatra continental margin and between the Mentawai Islands and Sumatra in the Leg SO-184/2, and off southern Java and in the Lombok and Savu Basins in the Leg SO-184/3. The SIMRAD EM 120 system provides topographic information at a width of six times the water depth. The PARASOUND sediment echo sounder uses frequencies around 4 kHz, which allow signal penetration into the sea floor between 10 and 100 m depending on sediment composition and grain size. These systems were run routinely with the help of most shipboard scientists in two to four hour shifts.

4.2 Instruments

4.2.1 PARASOUND

There is a KRUPP ATLAS PARASOUND system installed on RV SONNE, which operates in concert with the SIMRAD EM120. The PARASOUND system is a low-frequency sediment echo sounder. The transducer and receiver units are permanently installed in the ship's hull. It makes use of the parametric effect, which produces additional frequencies through non-linear acoustic interaction of finite amplitude waves. If two sound waves of similar frequencies for example 18 kHz and 22 kHz are emitted simultaneously, a signal of the difference-frequency, here 4 kHz, is generated for sufficiently high primary amplitudes. The new component is travelling within the emission cone of the original high frequency waves, which are limited to an angle of only 4° for the equipment used. Therefore, the footprint size of 7% of the water depth is much smaller than for conventional systems and both vertical and lateral resolutions are significantly improved.

The hull-mounted transducer array has 128 elements on an area of $\sim 1 \text{ m}^2$. It requires up to 70 kW of electric power due to the low degree of efficiency of the parametric effect. In two electronic cabinets, beam forming, signal generation and the separation of primary (18, 22 kHz) and secondary frequencies (4 kHz) is carried out. With the third electronic cabinet in the echosounder control room the system was operating on a 24-hour watch schedule.

Since the two-way travel time in the deep sea is long compared to the length of the reception window of up to 266 ms, the PARASOUND System sends out a burst of pulses at 400 ms intervals, until the first echo returns. The coverage of this discontinuous mode depends on the water depth and produces non-equidistant shot distances between bursts.

The main tasks of the operators are system control and the adjustment of the upper limit of the reception window. Because of the limited penetration of the echosounder signal into the sediment, only a small depth window close to the sea floor is recorded.

In addition to the analogue recording features with the b/w DESO 25 device, the PARASOUND System was equipped with the digital data acquisition system ParaDigMA, which was developed at the University of Bremen (Spieß, 1993). The data were stored using the standard, industry-compatible SEG-Y-format. The PC allows the buffering, transfer, and storage of the digital seismograms at very high repetition rates. From the emitted series of pulses, usually the pulse could be digitised and stored, resulting in recording intervals of 800 ms within a pulse sequence. The seismograms were sampled at a frequency of 40 kHz, with a

registration length of 266 ms for a depth window of ~200 m. An online processing was carried out during the acquisition of the data. For all profiles, PARASOUND sections were plotted with a vertical scale of several hundred meters. Most of the changes in window depth could thereby be eliminated. From these plots a first impression of variations in sea floor morphology, sediment coverage and sedimentation patterns along the ships track could be gained. In addition, the data were normalised to a constant value much smaller than the maximum average amplitude to amplify in particular deeper and weaker reflections. The main aim of using the PARASOUND system was the selection of appropriate sites for sediment sampling.

4.2.2 SIMRAD EM 120

The SIMRAD EM 120 multibeam echo sounder is permanently installed in the ships hull and is developed for bathymetric mapping of the full ocean depths. The working frequency is 12 kHz and the maximum beam angle is 150°, thus the coverage of the ocean floor is variable depending on the water depth. The SIMRAD EM 120 system used 191 beams per ping as narrow as 1°. The transmitted beam fan is split in several individual sectors with independent active steering according to vessel roll, pitch and yaw. The frequency coded from these sectors is 11.25 to 12.75 kHz transmitted sequentially at each ping.

For the navigation on board is the GPS/DGPS- System Trimble installed. If the GPS/DPS System does not work, the fallback GPS System from Ashtec Glonass-GPS starts working. Both systems are based on WGS84. The permanent running GPS-system was controlled by the nautical-officers and by the system operator. The ship's movement is corrected by the installed movement sensor SIMRAD -MRU5. To account for regional changes in sound velocity in the water column SIMRAD EM 120 needs a frequently updated sound velocity profile through the water column, which is taken at different stations with a CTD or a sound velocity probe.

Pulse length and range sampling rate are variable with depth for best resolution. The ping rate is only limited by the round trip travel time in the water up to 5 Hz. On RV SONNE, the beam width is 2° and is available for the receiving array. The resulting array lengths are between 2 and 8 m. On cruise SO-184, a total beam width of 130° (2* 65°) was used. The resulting coverage ratio corresponds to six times the water depth.

Together with the PARASOUND system, the SIMRAD EM 120 system was running 24 hours and controlled by the scientists doing 2 to 4 hour watches. Post processing has only been made for those profiles where also sediment sampling has been carried out. The data are processed with the NEPTUNE software from SIMRAD, which needed a position control, depth control and statistic data cleaning. During the cruise SO-184, the ship's system operator used the GMT software for digital bathymetric modelling and map generation.

4.3 First results

Besides getting information about the structure of the sea floor sediments, the main purpose of using the PARASOUND system was to find appropriate sites for sediment sampling. During site survey profiling, the ship usually sailed with 6 knots. Along the outer continental margin off Sumatra that has been surveyed in four transects, the slope was often too steep to get a good reflection from the bottom, especially between ~ 1200 m and 2000 m water depth and thus, too steep to find well-suited sites for sediment sampling. At the upper slope (<1200 m depth) and at the lower slope (>2000 m depth) the morphology is somewhat more gentle and some good sampling sites have been found. At approximately 2200 m water depth, there was an

obvious shift from the very steep part of the slope to a gentle dipping plain interrupted by several up to 1000 m high accretionary ridges stretching parallel to the margin (Fig. 4.1).

In the fore-arc basin between Sumatra and the Mentawai Islands, the hydroacoustic character of the sediments was quite different although the morphology of this area has some similarities to the outer continental margin. This holds especially true for the sequence of a gentle upper slope (< ~1000 m depth), a very steep mid-slope (~ 1000 m to 1400 m depth) followed by a gentle lower slope and an almost flat basin floor (~ 1750 m depth) (Fig. 4.2). In the gentle or even flat parts, the penetration of the sound waves into the sediment was on average 50 m and more.



Fig. 4.1: Bathymetric map from the outer continental slope SW of Mega Island, showing the typical steep middle slope above a gentler dipping zone below 2000 m water depth marked by slope parallel accretionary ridges.

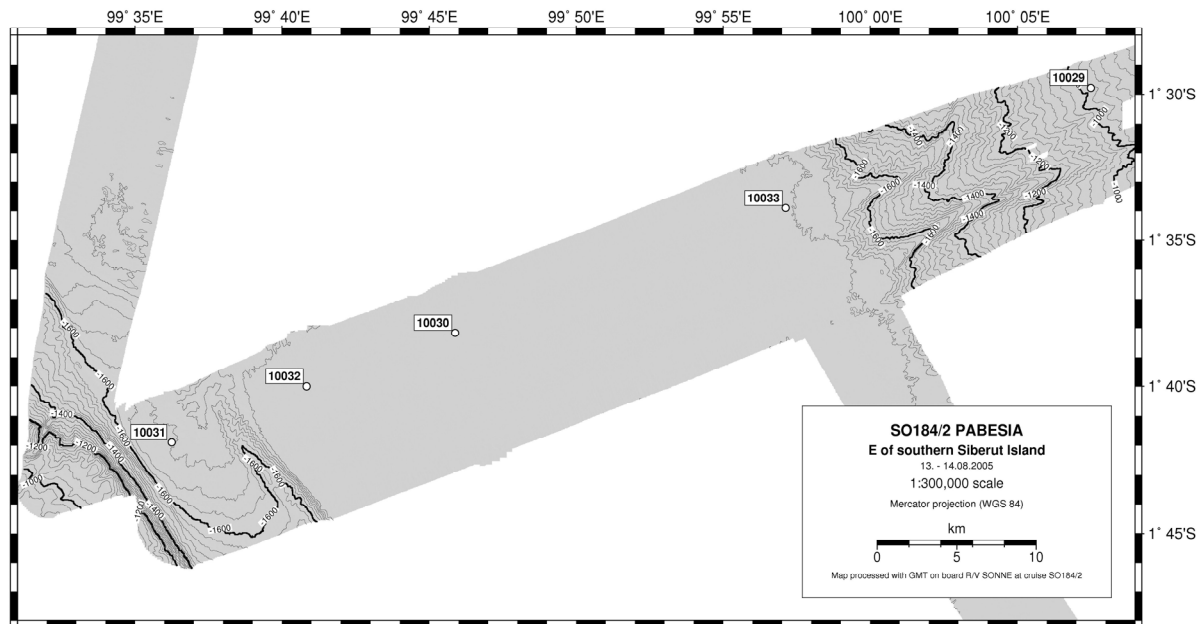


Fig. 4.2: Bathymetric map from the central Mentawai Basin E of southern Siberut Island showing the typical steep middle slope and the almost flat basin floor.

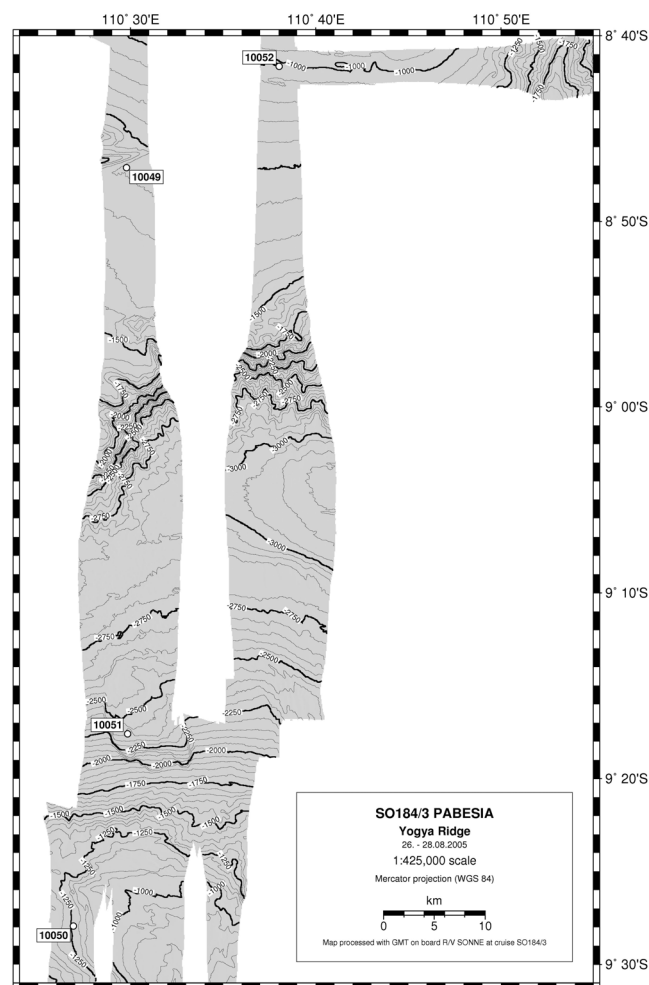


Fig. 4.3: Bathymetric map from the Yogya Ridge south of Java showing a steep northern slope and a rather gentle dipping southern slope of the fore-arc basin.

The morphology of the fore-arc basins south of Java was similar as for the fore-arc basins west of Sumatra. The northern, shoreward slopes of the basins were characterized by a rather gentle dipping upper (<1500 m depth) and lower (>2750 m depth) slope, and a very steep middle slope (1500 – 2750 m depth, Fig. 4.3). Except for the Western Lombok Basin, the basin floor (>3000 m) was typically flat. The southern, seaward slopes of the fore-arc basins were rather gentle dipping compared to the northern slopes. However, although the sediment accumulation is expectedly much lower in the southern slope of the basin compared to the near-continent northern slope, the partial lack of sediments in the southern slope implies strong currents or tectonic activities leading to sediment removal at least at the Yogya Ridge.

Four examples from the PARASOUND records are given in Figs. 4.4 to 4.7. The first one shows the western slope of the Bengkulu Basin (Fig. 4.4). Within the basin, there was a good penetration into horizontally layered sediments, whereas the slope was quite steep with no clear indications of any sediment structures. The second example from the Mentawai Basin (Fig. 4.5) shows a steep slope above a very flat basin floor. Here, the slope was partly too steep to allow for a reasonable PARASOUND record.

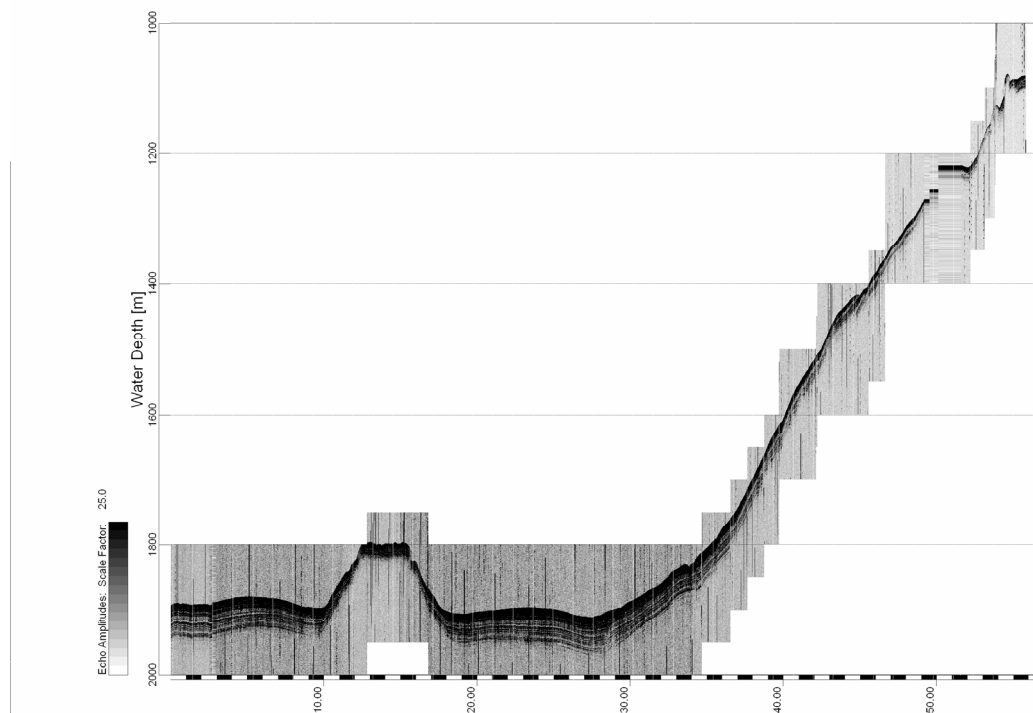


Fig.4.4: PARASOUND profile from the western slope of the Bengkulu Basin.

The third profile shows the continental slope south of Cilacap (Fig. 4.6). Thicker sediment suites can be seen in the basin, whereas the slope is apparently too steep for sediment accumulation. The fourth profile from the Western Lombok Basin is less steep and shows a better sediment accumulation than in the other profiles (Fig. 4.7). However, the structure of the deep basin here is in contrast to the other transects rather rugged.

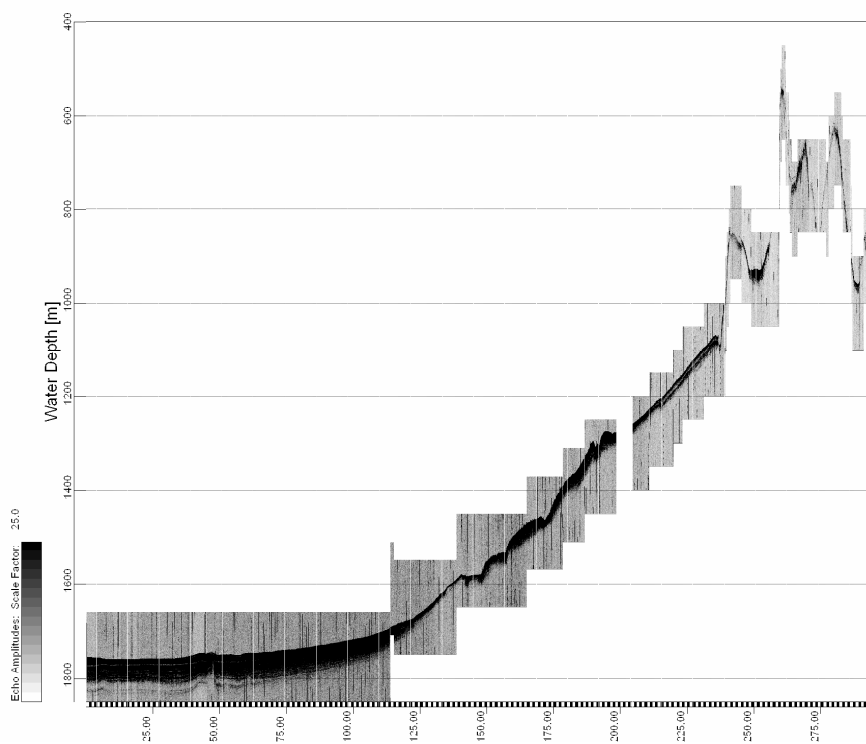


Fig.4.5: PARASOUND profile from the eastern slope of the Mentawai Basin.

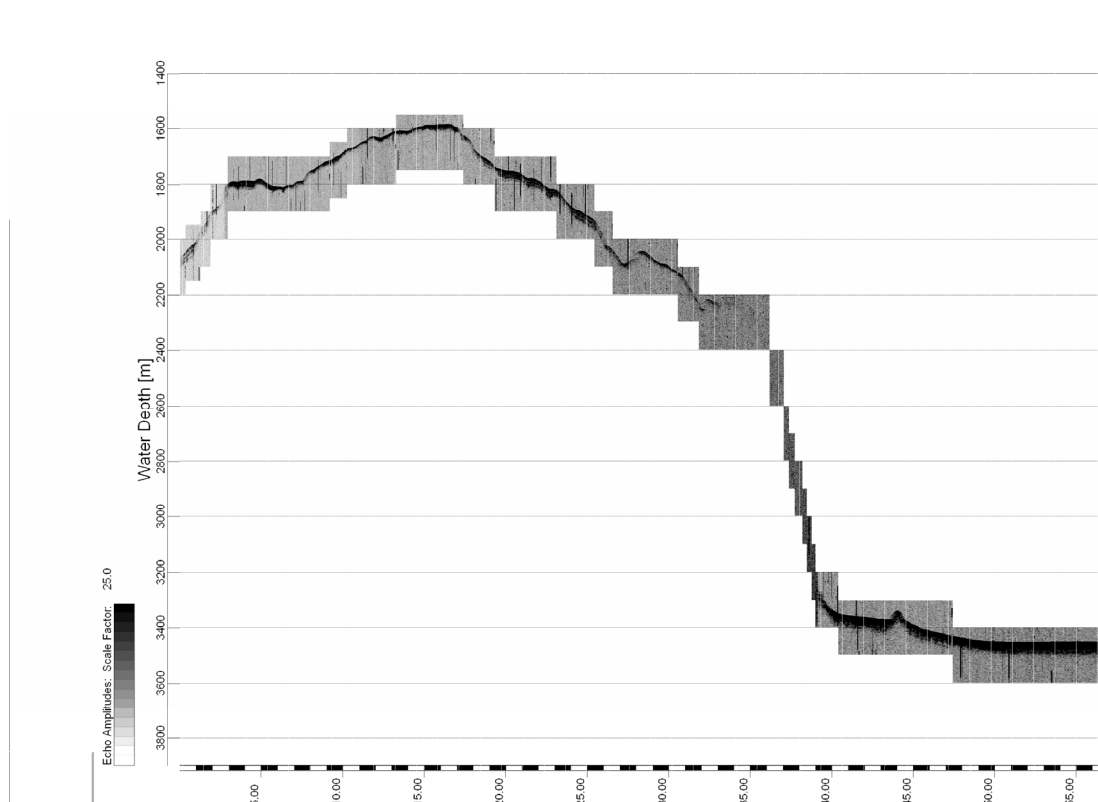


Fig.4.6: PARASOUND profile from the continental slope south of Cilacap.

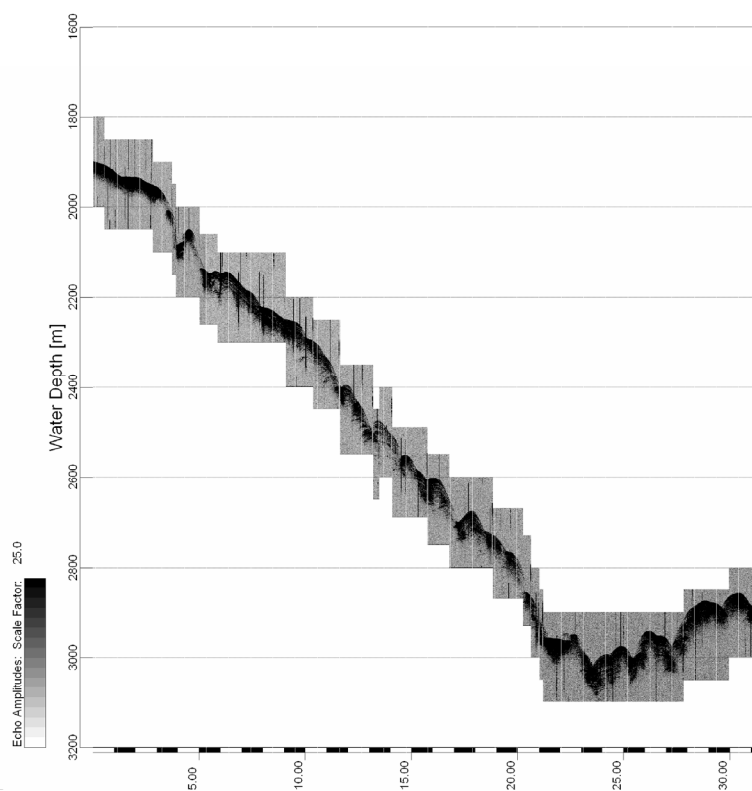


Fig.4.7: PARASOUND profile from the Western Lombok Basin.

5 CTD Profiling and Water sampling

(H. Andruleit, A. Baumgart, M. Birkicht, A. Damar, T. Kepel, N. Krück, W.S. Pranowo, R. Thomas)

5.1 Introduction

Results of recent investigations indicate that the upwelling regions in the Indian Ocean off Java and Sumatra play a key role for the dipole mode explaining major part of the variability in oceanography and climate of the Indian Ocean (see chapter 2). Most of the findings are based on satellite data and data on the physicochemical properties and the biogeochemistry of the water column are scarce. However, knowledge on the oceanographic, biological and biogeochemical processes is mandatory to understand the functioning of the upwelling system, which in turn is necessary for the reconstruction of paleoenvironmental conditions. For this purpose, physicochemical properties of the water column have been measured with a CTD and water samples have been obtained with a rosette water sample in discrete intervals of the water column.

5.2 Instruments

5.2.1 CTD and rosette water sampler

A Seabird SBE911 CTD was used to obtain data on the physicochemical properties of the water column. Besides conductivity, temperature and pressure the SBE911 measured dissolved oxygen (self-regenerative Clark-sensor with Teflon membrane). Water sampling was performed with a rosette water sample equipped with 24 Niskin bottles (10-liter volume each). One (leg 2) or two (leg 3) CTD casts were conducted at each station. During SO-184/3, the upper 150 m of the water column were sampled in high resolution for plankton first. Afterwards, as performed during SO-184/2, the CTD was lowered to the sea floor and the entire water column was sampled at discrete intervals.

First, samples for dissolved oxygen were taken with a silicon tube into 60.00 ml Winkler-bottles. At all depth levels (usually between 8 and 12) single samples for dissolved oxygen were analysed directly on board. Aliquots of 6 l from water samples were filtered through GF/F filters to determine TDM and the stable isotopes of dissolved nitrogen (ammonia, nitrate) in the water. These water samples were treated with 5 ml/l 37% HCl. 2 l of water were filtered through Nuclepore membrane filters for the determination of biogenic opal (silica) according to a slightly modified procedure of Mortlock and Froelich (1975). The spectrophotometrical nutrient analysis (NH_4^+ , NO_2^- , NO_3^- , o-PO_4^{3-} , Si(OH)_4) was carried out immediately after collection in 100 ml PE-bottles according to a modified manual procedure of Grasshoff (1999) for small sample amounts. Water samples for the determination of dissolved organic carbon were obtained by filtering the water over disposable 0.45 μm syringe filters into pre-combusted glass ampoules. After acidification to pH 2, ampoules were sealed and stored frozen.

5.2.2 Seabird SBE19 CTD with attenuation sensor

To obtain data on light transmission an additional CTD was lowered together with the Multinet. The self-contained Seabird SBE19 CTD is equipped with an attenuation sensor. The attenuation is representing the turbidity measured with a 670 nm light beam on 0.25 m and a photomultiplier. The depth-sensor [db] had an offset of 44 m.

5.2.3 Analytical methods

Dissolved oxygen in the water column was determined by an automated Winkler titration. The analysis was performed by an automated titrator (Titroline alpha), which is controlled by a redox electrode and a color agent (starch solution), on a self constructed titration board for ship cruises according to the WOCE protocol. A single-beam filter photometer SQ300 from Merck with 1 cm and 5 cm cuvettes was taken for photometrical analysis. Phosphate and silicate were measured at 820 nm, ammonia at 620 nm and nitrate/nitrite at 540 nm. A SFM25 Spectrofluorimeter (KONTRON) was taken for the determination of Chlorophyll-a. The measurement was done with 1 cm cuvettes at 435 nm excitation wavelength and at 667 nm emission wavelength.

To get an idea of phytoplankton composition, seawater samples from 40 m depth were measured before and after filtration through a 25 μm plankton net: the higher the ratio, the higher the content of picoplankton. The more the ratio approaches to 1, the more siliceous algae will be present, which do not pass the 25 μm plankton net. Siliceous algae are usually found in high nutrient areas, particularly where upwelling occurs.

5.3 Shipboard results

5.3.1 CTD

First results of Leg SO-184/2 show only slight variations in the physical parameters of all stations. A scatter plot of temperature and salinity showed an astonishingly overlay of the single profiles. The water column at all stations was stratified and divided into a mixed layer with higher temperature and lower density, which reached down to 50 to 90 m (Fig. 5.1). Underneath that depth, density rose according to decreasing temperature and increasing salinity.

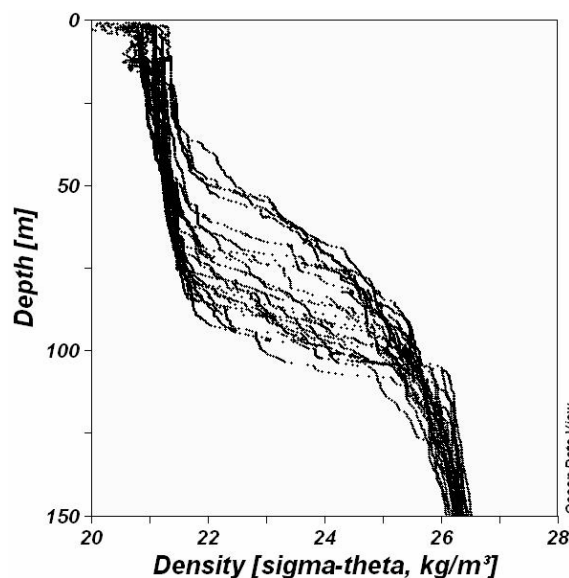


Fig. 5.1: Density profile of the stations occupied during SO-184/2.

Nevertheless, two groups of stations differed from the rest in the vertical profiles of temperature and salinity. At the stations northwest of Nias Island and northwest of Siberut

Island the salinity below the mixed layer (250 m and 1500 m) was significantly higher than at the other stations. This has been observed at stations GeoB 10011, -12, -13, -18, -19, -20 (Fig. 5.2).

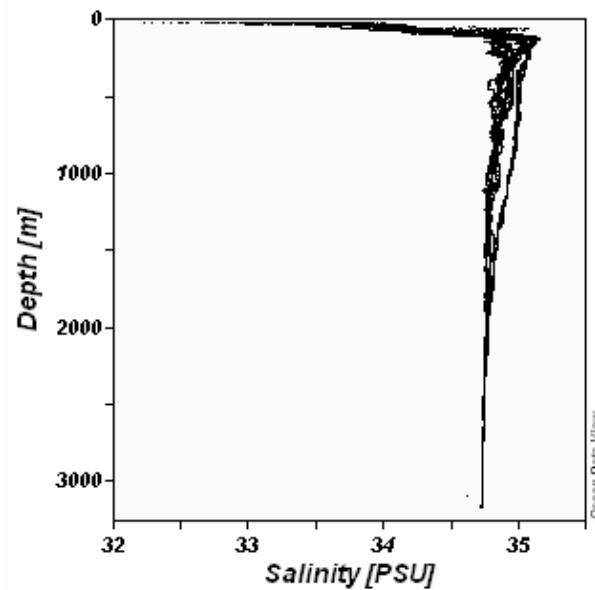


Fig. 5.2: Distribution of salinity at the stations occupied during SO-184/2. The right part of the profile between 250 and 1500 m represents the stations GeoB 10011, -12, -13, -18, -19, -20.

At the stations in the Sumatra fore-arc basin deeper than 1200 m (GeoB 10023, -24, -30, -31) the temperature below 1150 m was constantly around 6°C, whereas it continuously decreased at the remaining stations outside the Mentawai Basin (

Fig. 5.3).

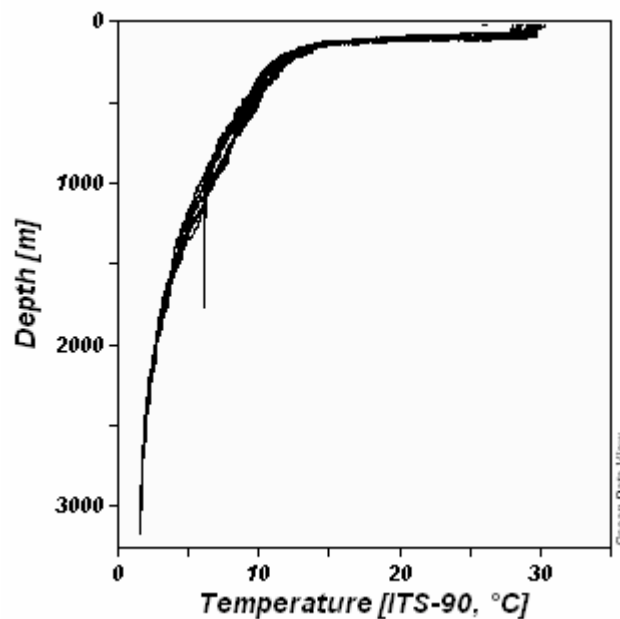


Fig. 5.3: Distribution of temperature at the occupied stations during SO-184/2. The distinct temperature below 1200m of GeoB 10023, -24, -30, -31 can be seen in the vertical profile at 6°C.

As the vertical profiles of the stations are quite similar, the horizontal distribution of salinity and temperature shows a merely constant picture as well. This is shown in a NW-SE transect of the Mentawai Basin (Fig. 5.4). In the upper 200 m of the water column, the pycnocline rises from ca. 80 m at the northeastern station GeoB 10022 to ca. 70 m at the deeper station GeoB 10024.

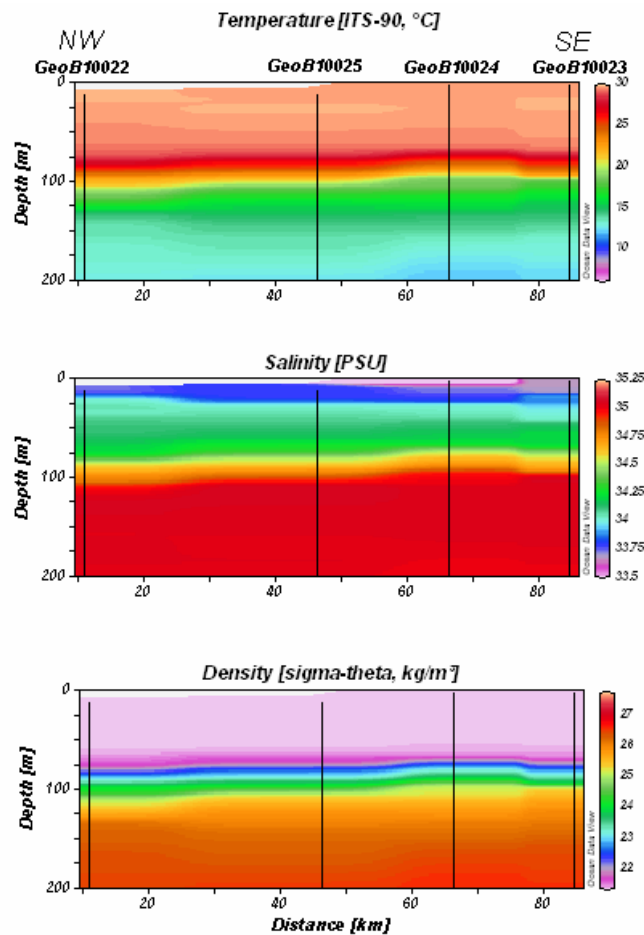


Fig. 5.4: Vertical distribution of temperature, salinity and density along a NW-SE transect through the Mentawai Basin.

The different salinity profiles in the deep water between 1.68°N; 96.51°E and 1.19°S; 98.26°E as well as the distribution of temperature between 0.77°S; 99.27°E and 1.7°S; 99.77°E may indicate an influence of lateral advection of intermediate water with higher salinity.

The distribution of temperature and salinity in a T/S-chart shows a clear difference between the stations occupied during legs SO-184/2 and SO-184/3 (Fig. 5.5). A separation into two different water bodies can be observed at depths above 200 m, which corresponds to the point at 10°C, where the profiles diverge according to salinity.

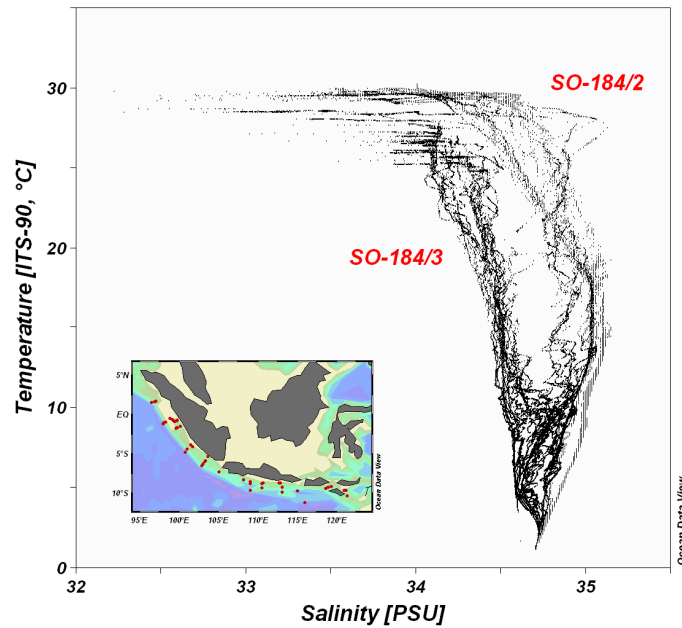


Fig. 5.5: T/S-chart of stations occupied during SO-184/2 and SO-184/3.

In contrast to stations sampled during the second leg, the stratification is less pronounced in the areas sampled during the third leg (Fig. 5.6). The horizontal pattern of density distribution may indicate upwelling around the stations in the western Lombok Basin. The highest density is found at GeoB 10053 (Fig. 5.7).

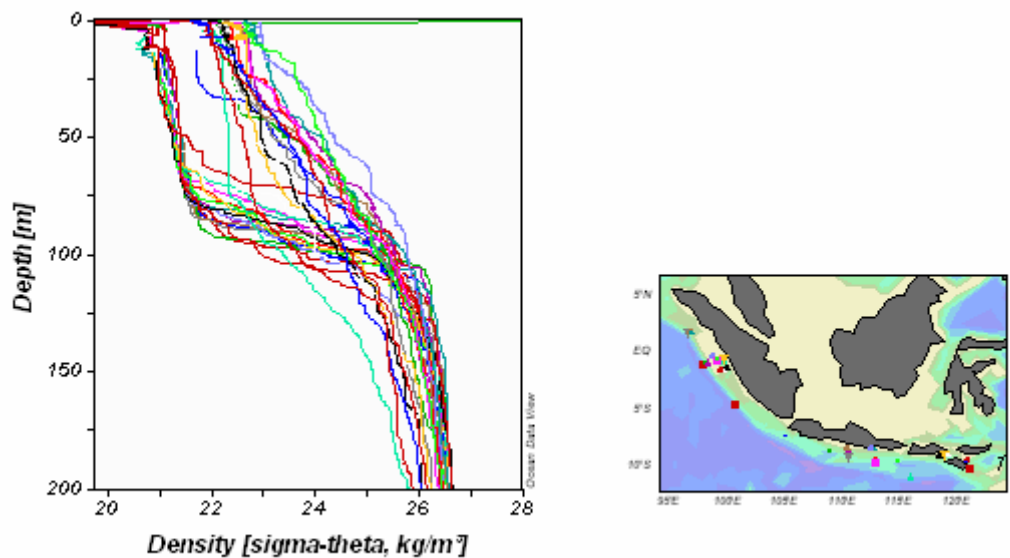


Fig. 5.6: Distribution of density in the upper 200m of the water column of the stations occupied during SO-184/2 and SO-184/3.

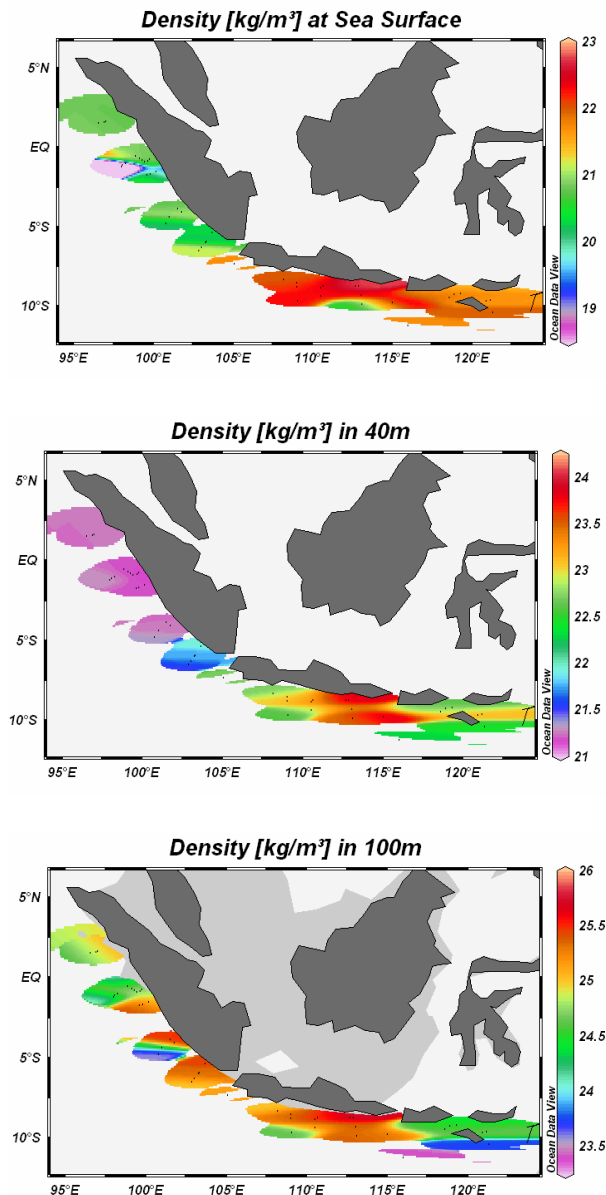


Fig. 5.7: Horizontal distribution of density at the surface, in 40 m and 100 m water depth.

5.3.2 Dissolved oxygen, nutrients and chlorophyll-a

A significant reproducibility of replicate measurements at the first stations (3 replicates gave an error of ± 0.05 ml/l O_2) allowed using single samples throughout the rest of the cruise. Unfortunately, there was a slight mismatch from time to time between Winkler-titration according to the WOCE protocol and the oxygen sensor of the CTD. Despite constantly higher values, the O_2 -sensor measurements sometimes showed differences between the absolute concentrations for the up- and downcast within one station. The problem could be due to time response or a poisoned electrode because of H_2S in the deeper layers detected olfactory. Generally the trend of Winkler and CTD determined oxygen concentrations is similar and we used the downcast profile for further interpretations.

Usually the surface layer was (super)saturated with oxygen while deeper layers were low in oxygen. At eight stations mostly off Sumatra, however, high oxygen contents were found in deeper layers. The high oxygen content of water near Sunda Strait may have been caused by surface water inflow from the Java Sea.

Profiles of physicochemical properties of the water column as well as oxygen and nutrient profiles display significant differences in the areas covered during legs 2 and 3 of cruise SO-184. There is hardly any indication of upwelling off Sumatra. Temperature and salinity peaks off Sunda Strait indicate inflow from the Java Sea. Low sea surface temperature (SST), high density and high concentrations of nitrate and silicate indicate upwelling off Java and in the Lombok Basin.

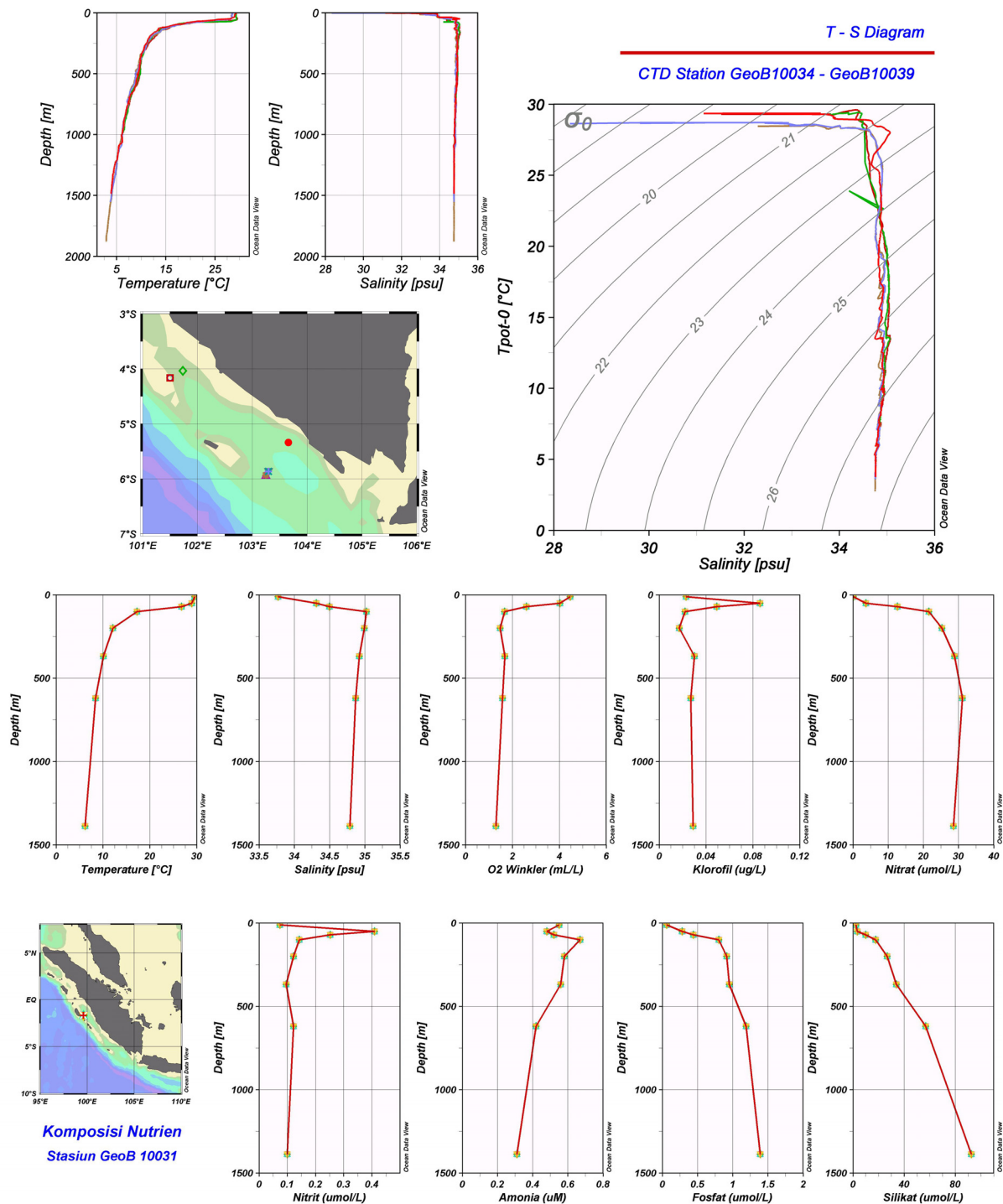


Fig. 5.8: Physicochemical parameters and nutrient concentrations at Station GeoB 10031 off Sumatra.

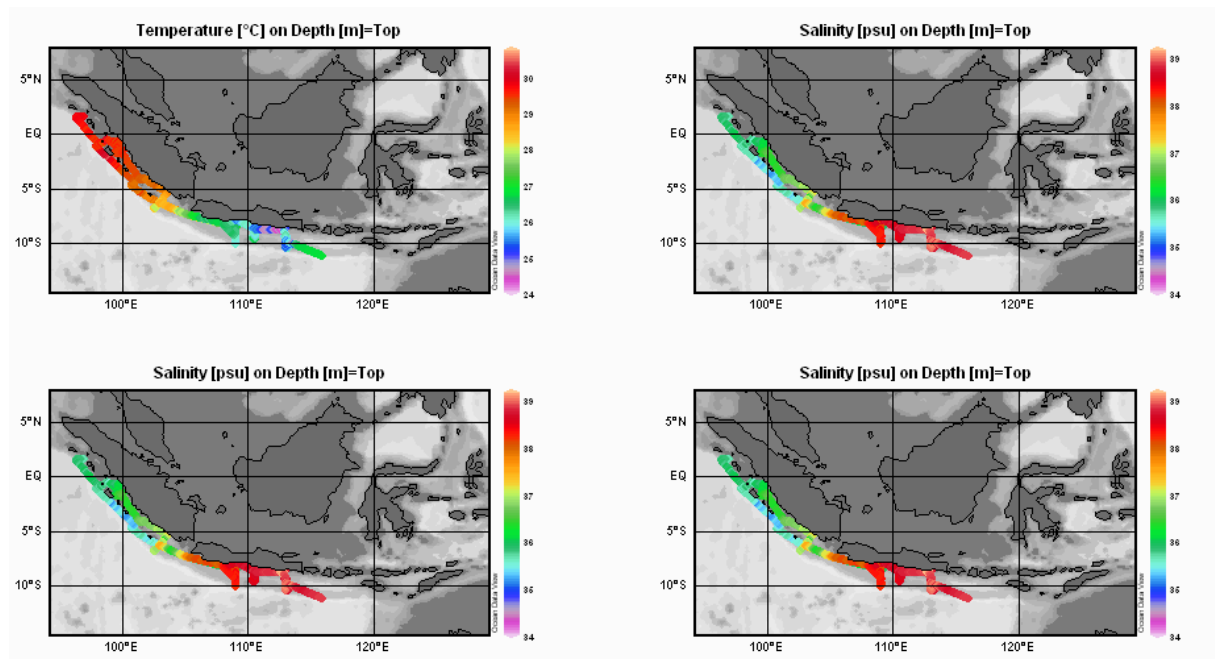


Fig. 5.9: Lower SST's and higher densities indicate upwelling southeast of Java.

Chlorophyll-a concentrations were generally low off Sumatra and western Java with a maximum between 25 m and 50 m water depth. The chlorophyll-a maximum corresponds well with maximum nitrite concentrations. This may be due to high concentrations of bacteria, e.g. cyanobacteria. The chlorophyll-a concentration was higher off eastern Java and in the Lombok Basin corresponding to the above-mentioned high concentrations of nitrate that indicates upwelling. Generally, concentrations close to $1 \text{ mg chlorophyll-a m}^{-3}$ indicate high primary production.

Table 5.1: Nutrient, oxygen and chlorophyll-a concentrations in water determined during SO-184.

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10003	3145	34.73	1.6	4.036	0.000	19.43	0.157	0.53	1.551	37.316
10003	2254	34.75	2.3	3.436	0.000	31.02	0.087	1.00	1.604	25.421
10003	1486	34.81	4.2	2.149	0.000	30.15	0.009	0.48	1.780	29.368
10003	1091	34.78	5.5	2.128	0.000	32.00	0.065	0.38	1.762	18.768
10003	793	34.87	7.2	1.755	0.000	31.48	0.078	0.41	1.753	30.316
10003	299	34.90	10.7	1.547	0.000	27.22	0.065	0.21	1.295	15.042
10003	150	35.02	14.0	1.667	0.000	28.76	0.078	0.35	1.101	11.147
10003	93	34.95	28.2	4.132	0.350	1.33	0.348	0.33	0.150	2.053
10003	72	34.23	29.2	-	0.220	0.09	0.000	0.89	0.018	0.989
10003	52	34.20	29.2	4.605	0.200	0.08	0.000	0.27	0.079	0.958
10003	20	34.00	29.1	4.503	0.200	0.11	0.000	0.37	0.000	1.105
10003	6	33.87	29.1	4.500	0.350	0.12	0.000	0.25	0.000	1.168
10007	587	34.92	8.9	1.400	0.130	31.98	0.013	0.52	1.216	48.263
10007	300	34.95	10.7	1.684	0.180	27.80	0.004	1.23	1.022	28.368
10007	199	35.03	12.3	1.599	0.220	26.59	0.004	0.30	0.916	23.947
10007	122	35.03	15.1	1.404	0.250	24.96	0.083	0.46	0.899	20.789
10007	101	34.88	20.4	2.257	0.250	17.54	0.083	0.34	0.678	13.000
10007	91	34.78	24.9	2.835	0.430	10.35	0.113	0.31	0.458	8.653
10007	86	34.71	28.0	3.449	0.350	5.00	0.226	0.34	0.238	5.084
10007	63	34.51	29.4	4.357	0.450	0.07	0.043	0.35	0.044	1.884
10007	42	34.10	29.2	4.424	0.360	0.08	0.000	0.32	0.018	1.747
10007	22	33.82	29.2	4.538	0.310	0.14	0.157	0.52	0.035	2.126
10007	5	33.61	29.2	4.520	0.360	0.10	0.117	0.37	0.044	2.337
10011	3019	34.73	1.6	3.832	0.551	28.96	0.030	-	2.581	128.211
10011	2225	34.76	2.4	3.164	0.455	29.50	0.148	-	2.714	120.474
10011	794	34.97	7.7	1.275	0.183	31.39	0.213	-	2.775	68.789
10011	248	35.05	11.9	1.747	0.251	23.74	0.148	-	1.947	19.811
10011	103	35.02	15.8	1.767	0.254	21.89	0.061	-	1.797	8.568
10011	89	34.75	25.8	2.881	0.414	11.02	0.161	-	0.890	2.053
10011	64	34.41	29.4	4.223	0.607	1.72	0.243	0.08	0.194	2.295
10011	20	34.06	29.6	4.382	0.630	0.50	0.126	0.21	0.115	1.316
10012	2087	34.77	2.8	2.891	0.416	27.91	0.035	0.27	2.907	116.211
10012	1486	34.83	4.4	2.398	0.345	31.13	0.104	0.25	3.163	104.526
10012	843	34.96	7.6	1.189	0.171	30.96	0.030	0.30	3.057	70.053
10012	192	35.08	12.5	1.936	0.278	22.85	0.091	0.25	2.035	22.053
10012	119	35.09	14.2	1.568	0.225	19.07	0.104	0.21	1.885	21.474
10012	95	34.83	23.4	2.606	0.375	13.35	0.170	0.26	1.137	10.474
10012	80	34.56	28.9	3.923	0.564	2.67	0.326	0.00	0.308	2.768
10012	59	34.38	29.4	4.201	0.604	0.27	0.291	0.17	0.185	1.747
10012	30	34.14	29.5	4.359	0.627	0.18	0.083	0.26	0.115	2.095
10012	10	33.99	29.6	4.385	0.630	0.10	0.139	0.19	0.079	0.674
10013	917	34.94	7.1	1.458	0.210	30.00	0.026	0.43	1.189	74.105
10013	447	34.99	9.9	1.555	0.224	27.78	0.065	0.30	0.996	37.105
10013	179	35.08	12.7	1.464	0.210	23.09	0.057	0.39	0.916	22.263
10013	140	35.09	13.5	1.479	0.213	22.70	0.074	0.61	0.811	20.789
10013	99	35.02	16.9	1.945	0.280	20.13	0.139	0.29	0.749	17.947
10013	75	34.38	28.8	3.923	0.564	0.58	0.313	0.44	0.159	3.095

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10013	49	34.31	29.5	4.228	0.608	0.17	0.135	0.29	0.079	1.926
10013	20	34.06	29.6	4.292	0.617	0.12	0.091	0.30	0.044	2.189
10018	2552	34.74	2.0	3.685	0.530	25.26	0.074	1.01	0.952	123.053
10018	1979	34.78	2.8	3.197	0.459	28.83	0.000	0.31	1.559	113.263
10018	1240	34.88	5.3	1.967	0.283	28.57	0.165	0.25	0.907	90.895
10018	794	34.97	7.9	1.304	0.187	30.80	0.109	0.24	1.648	57.789
10018	348	35.03	10.9	1.585	0.228	28.24	0.191	0.31	1.542	30.421
10018	153	35.09	13.2	1.526	0.219	25.07	0.191	0.29	1.145	23.000
10018	99	35.06	17.8	1.687	0.243	21.89	0.578	0.36	1.004	17.947
10018	84	34.65	27.9	2.977	0.428	10.72	0.496	0.28	1.427	8.368
10018	45	34.37	29.7	4.432	0.637	0.18	0.109	0.26	0.009	1.737
10018	30	34.07	29.8	4.456	0.641	0.13	0.078	0.25	0.000	2.011
10019	1431	34.83	4.3	2.257	0.324	28.17	0.030	2.41	1.604	10.526
10019	992	34.93	6.6	1.488	0.214	31.78	0.043	0.12	1.674	9.779
10019	696	34.99	8.4	1.214	0.175	32.43	0.048	0.37	1.621	4.589
10019	248	35.06	11.8	1.587	0.228	27.26	0.078	0.02	1.216	2.937
10019	124	35.09	14.3	1.589	0.228	24.09	0.087	0.29	1.242	38.368
10019	99	35.08	18.7	1.873	0.269	21.87	0.113	0.07	1.048	44.211
10019	85	34.57	29.0	3.793	0.545	4.72	0.300	0.21	0.282	9.000
10019	60	34.51	29.6	4.357	0.626	0.09	0.074	0.30	0.088	5.053
10019	35	34.17	29.7	4.422	0.636	0.11	0.061	0.32	0.088	6.947
10019	10	33.79	29.9	4.467	0.642	0.08	0.083	0.27	0.009	4.579
10020	1136	34.90	6.1	1.602	0.230	32.00	0.017	1.90	1.172	21.842
10020	698	34.99	8.3	1.194	0.172	29.83	0.000	0.16	1.145	21.211
10020	251	35.05	11.8	1.690	0.243	25.17	0.074	0.25	0.802	10.368
10020	127	35.08	13.6	1.677	0.241	25.09	0.057	0.20	0.590	7.379
10020	102	35.07	17.6	1.878	0.270	21.59	0.083	0.21	0.714	6.579
10020	83	34.67	24.9	2.928	0.421	12.43	0.196	0.35	0.441	5.526
10020	43	34.33	29.7	4.571	0.657	0.07	0.130	0.96	0.035	0.695
10020	13	33.84	30.0	4.457	0.641	0.00	0.074	0.33	0.018	0.800
10022	686	34.86	7.9	1.359	0.195	31.28	0.026	0.23	2.529	64.947
10022	599	34.88	8.6	1.208	0.174	30.48	0.048	0.18	2.414	46.842
10022	300	34.93	10.5	1.320	0.190	28.98	0.052	0.19	2.062	16.526
10022	201	34.99	12.3	1.545	0.222	26.93	0.043	0.13	1.833	13.737
10022	126	35.00	16.9	1.602	0.230	24.35	0.065	0.18	1.665	11.737
10022	87	34.46	26.5	2.870	0.412	9.35	0.165	0.20	0.634	5.368
10022	42	34.10	29.4	4.285	0.616	0.13	0.057	0.22	0.123	1.337
10022	12	33.74	29.7	4.446	0.639	0.11	0.074	0.18	0.053	1.516
10023	1536	34.79	6.1	1.258	0.181	28.78	0.078	0.17	2.291	30.579
10023	1215	34.79	6.2	1.263	0.182	31.91	0.061	0.32	2.229	36.421
10023	794	34.83	7.0	1.255	0.180	31.00	0.074	0.17	2.159	42.316
10023	298	34.93	10.4	1.287	0.185	27.26	0.074	0.29	1.727	17.579
10023	129	35.02	14.4	1.441	0.207	23.80	0.070	0.38	1.454	12.684
10023	99	35.05	16.8	2.213	0.318	22.41	0.074	0.28	1.374	8.895
10023	69	34.44	27.8	3.342	0.480	6.09	0.226	0.27	0.247	2.105
10023	40	34.06	29.6	4.353	0.626	0.12	0.052	0.43	0.097	6.789
10023	9	33.72	29.6	4.426	0.636	0.10	0.096	4.90	0.079	9.211
10024	1358	34.79	6.1	0.980	0.141	29.46	0.422	0.33	2.555	30.000

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10024	992	34.80	6.5	1.260	0.181	28.78	0.191	0.22	2.599	35.842
10024	497	34.89	9.2	1.426	0.205	27.48	0.152	0.19	2.282	36.158
10024	224	34.97	11.4	1.353	0.195	24.61	0.100	0.19	1.938	21.474
10024	124	35.01	15.6	1.821	0.262	20.48	0.096	0.25	1.692	13.263
10024	99	35.01	18.1	1.723	0.248	18.74	0.087	0.19	1.656	13.158
10024	80	34.64	23.8	2.206	0.317	13.33	0.122	0.17	0.952	8.158
10024	70	34.42	27.8	3.236	0.465	6.59	0.196	0.21	0.564	3.726
10024	30	34.03	29.6	4.322	0.621	0.14	0.091	0.18	0.185	1.695
10024	10	33.76	29.6	4.445	0.639	0.12	0.113	0.20	0.264	1.842
10025	1130	34.79	6.3	1.166	0.168	30.43	0.078	5.86	1.789	33.105
10025	698	34.86	7.9	1.255	0.180	28.72	0.239	0.28	1.665	28.526
10025	226	34.97	11.5	1.648	0.237	23.67	0.083	0.19	4.405	15.421
10025	127	35.03	15.5	1.874	0.269	23.28	0.078	0.25	1.233	12.263
10025	82	34.55	25.6	2.753	0.396	10.65	0.213	0.34	0.573	4.526
10025	66	34.28	28.8	3.695	0.531	3.83	0.343	0.21	0.264	2.000
10025	42	34.09	29.5	4.271	0.614	0.18	0.087	0.23	0.070	1.516
10025	12	33.78	29.6	4.555	0.655	0.14	0.083	0.81	0.044	1.937
10028	505	34.89	9.2	1.182	0.170	30.33	0.065	1.06	1.815	17.053
10028	300	34.93	10.3	1.360	0.195	30.13	0.065	0.25	1.736	28.579
10028	174	35.01	12.7	1.561	0.224	26.17	0.061	0.23	1.480	11.211
10028	124	35.02	15.8	1.372	0.197	22.30	0.030	0.21	1.366	18.000
10028	79	34.43	26.3	3.158	0.454	7.93	0.183	0.24	0.520	6.211
10028	65	34.35	28.3	3.528	0.507	4.46	0.209	0.22	0.326	3.053
10028	40	34.05	29.5	4.164	0.599	0.32	0.157	0.19	0.088	1.758
10028	11	33.69	29.8	4.406	0.633	0.12	0.052	0.25	0.018	2.726
10029	949	34.81	6.6	1.178	0.169	26.28	0.087	0.33	3.128	21.000
10029	927	34.81	6.6	1.359	0.195	28.70	0.083	0.26	2.987	24.947
10029	797	34.83	7.0	1.284	0.185	27.20	0.083	0.46	2.784	18.737
10029	450	34.90	9.5	1.197	0.172	26.91	0.043	0.28	2.573	9.474
10029	249	34.96	11.0	1.548	0.223	24.15	0.074	0.31	2.229	14.368
10029	186	34.98	11.8	1.551	0.223	22.63	0.083	0.16	2.097	10.053
10029	81	34.56	24.6	2.059	0.296	14.20	0.143	0.31	1.128	6.158
10029	66	34.23	29.1	3.825	0.550	1.59	0.378	0.21	0.229	1.105
10029	37	33.98	29.7	4.368	0.628	0.11	0.035	0.21	0.079	1.379
10029	12	33.74	29.6	4.482	0.644	0.13	0.083	0.16	0.070	2.368
10030	1741	34.78	6.1	1.181	0.170	29.28	0.009	0.18	1.727	97.474
10030	1245	34.79	6.2	1.448	0.208	29.37	0.057	2.19	1.410	91.579
10030	796	34.82	6.9	1.264	0.182	32.76	0.057	0.33	1.304	78.158
10030	500	34.90	9.4	1.272	0.183	29.70	0.083	0.22	1.101	44.474
10030	401	34.92	10.0	1.372	0.197	26.91	0.078	0.62	1.101	36.158
10030	201	34.99	11.9	1.369	0.197	21.33	0.048	0.24	0.987	27.842
10030	92	34.88	20.0	1.554	0.223	17.83	0.100	0.20	0.758	15.474
10030	73	34.48	26.7	3.354	0.482	6.09	0.239	1.98	0.194	4.316
10030	63	34.39	28.6	3.716	0.534	4.20	0.265	0.36	0.106	3.453
10030	13	33.74	29.5	4.597	0.661	0.17	0.078	0.22	0.035	2.442
10031	1387	34.79	6.2	1.168	0.168	28.57	0.100	0.31	1.392	92.579
10031	619	34.87	8.4	1.455	0.209	31.13	0.122	0.42	1.189	56.842
10031	368	34.92	10.1	1.561	0.224	28.85	0.096	0.56	0.952	34.000

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10031	199	34.99	12.1	1.357	0.195	25.28	0.122	0.58	0.916	26.632
10031	99	35.02	17.2	1.550	0.223	21.57	0.143	0.67	0.802	17.684
10031	69	34.50	26.8	2.494	0.359	12.65	0.252	0.52	0.441	10.000
10031	49	34.31	28.9	3.938	0.566	3.65	0.409	0.48	0.282	3.421
10031	10	33.77	29.5	4.389	0.631	0.12	0.074	0.55	0.062	2.421
10034	975	34.80	6.2	1.877	0.270	32.74	0.065	0.15	1.295	82.211
10034	847	34.83	6.9	1.371	0.197	30.98	0.074	0.32	1.322	74.684
10034	624	34.87	8.5	1.385	0.199	31.48	0.057	0.83	1.198	53.211
10034	399	34.93	10.0	1.491	0.214	27.63	0.052	0.37	1.075	34.053
10034	250	34.95	11.5	1.555	0.224	25.54	0.061	0.26	0.934	27.474
10034	112	35.03	16.4	1.380	0.198	19.65	0.057	0.24	0.855	20.158
10034	77	34.93	20.5	1.899	0.273	16.89	0.078	0.28	0.670	13.895
10034	67	34.54	27.6	3.126	0.449	7.39	0.183	0.34	0.317	5.947
10034	42	34.23	29.5	4.342	0.624	0.10	0.061	0.26	0.062	2.000
10034	12	33.82	29.3	4.557	0.655	0.04	0.052	0.45	0.053	2.084
10035	1478	34.81	6.4	1.593	0.229	31.80	0.122	5.44	1.656	79.26
10035	1175	34.81	6.6	1.455	0.209	28.11	0.078	1.08	1.586	77.74
10035	797	34.86	8.4	1.704	0.245	27.00	0.078	0.66	1.489	53.84
10035	499	34.94	9.7	1.480	0.213	26.70	0.078	0.77	1.498	35.95
10035	201	34.95	11.2	1.773	0.255	26.04	0.061	0.98	1.921	29.21
10035	97	34.99	16.2	1.389	0.200	21.72	0.126	0.49	1.066	20.47
10035	67	34.87	21.0	2.057	0.296	16.09	0.109	0.53	0.767	13.05
10035	52	34.46	28.4	3.688	0.530	3.98	0.278	0.51	0.194	3.32
10035	42	34.18	29.3	4.257	0.612	0.13	0.065	0.54	0.123	2.23
10035	12	33.81	29.3	4.540	0.653	0.05	0.030	0.25	0.079	2.08
10036	1478	34.76	3.9	2.736	0.393	25.98	0.052	0.31	2.943	52.84
10036	1175	34.76	5.2	1.874	0.269	28.87	0.009	6.24	3.084	62.00
10036	797	34.81	6.9	1.579	0.227	31.46	0.030	1.36	3.110	47.05
10036	499	34.91	9.3	1.371	0.197	26.63	0.013	6.30	2.502	31.47
10036	201	34.89	11.6	1.675	0.241	24.35	0.004	0.66	2.070	24.95
10036	97	34.89	16.6	1.668	0.240	20.93	0.026	0.26	1.524	14.89
10036	67	34.85	21.4	2.253	0.324	13.87	0.004	0.25	1.233	7.73
10036	52	34.66	25.9	2.923	0.420	8.46	0.148	0.24	0.784	5.94
10036	42	34.89	28.4	4.146	0.596	0.48	0.074	0.10	0.256	2.26
10036	12	33.89	29.2	4.531	0.651	0.13	0.065	0.31	0.079	1.72
10038	1888	34.75	2.9	3.004	0.432	29.93	0.091	0.35	2.062	45.11
10038	1407	34.76	4.3	2.457	0.353	30.87	0.100	0.93	2.026	46.63
10038	748	34.85	7.3	1.089	0.157	31.20	0.052	0.37	2.053	44.74
10038	602	34.83	8.1	1.274	0.183	30.96	0.065	0.29	2.044	22.47
10038	402	34.83	9.5	1.560	0.224	31.33	0.061	0.53	1.700	17.42
10038	188	34.88	12.2	1.577	0.227	26.30	0.065	0.29	1.498	14.68
10038	103	34.87	16.5	1.570	0.226	20.76	0.065	0.29	1.348	11.99
10038	63	34.88	25.0	2.802	0.403	10.57	0.157	0.31	0.608	5.56
10038	53	34.42	28.2	3.655	0.525	3.91	0.330	0.28	0.282	1.33
10038	13	33.49	28.5	4.513	0.649	0.14	0.091	0.25	0.106	1.17
10039	1777	34.75	3.0	2.713	0.390	31.72	0.030	0.24	1.894	69.42
10039	1096	34.82	5.9	1.557	0.224	32.22	0.022	0.22	1.648	57.63
10039	798	34.84	7.0	1.563	0.225	29.76	0.070	0.23	1.480	51.00

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10039	598	34.85	8.3	1.288	0.185	29.00	0.070	0.34	1.454	39.68
10039	102	34.93	16.1	1.754	0.252	20.20	0.057	0.41	0.855	15.95
10039	67	34.80	22.5	2.421	0.348	12.48	0.109	0.27	0.608	7.79
10039	56	34.88	24.9	2.906	0.418	0.04	0.148	0.29	0.485	6.39
10039	12	33.52	28.6	4.515	0.649	0.05	0.122	0.25	0.044	1.69
10040	2573	34.74	2.0	3.628	0.522	30.63	0.091	0.35	1.656	80.11
10040	1794	34.76	3.1	2.793	0.401	26.78	0.091	2.90	1.753	85.05
10040	1047	34.78	5.7	1.944	0.279	30.28	0.078	3.90	1.815	74.42
10040	669	34.83	7.8	1.281	0.184	30.17	0.083	0.14	1.736	52.89
10040	251	34.90	11.3	1.556	0.224	24.78	0.061	0.92	1.330	21.16
10040	112	34.89	16.2	1.667	0.240	22.67	0.100	0.34	1.101	17.84
10040	77	34.80	21.8	2.246	0.323	13.59	0.126	0.36	0.749	11.74
10040	62	34.80	25.7	2.722	0.391	10.41	0.157	0.34	0.485	7.82
10040	42	33.89	27.9	4.497	0.646	0.16	0.078	0.36	0.106	1.38
10040	13	33.50	28.0	4.567	0.657	0.22	0.070	0.42	0.044	1.61
10041	1514	34.78	4.0	2.312	0.332	30.89	0.030	3.40	0.599	73.16
10041	1095	34.83	5.8	1.755	0.252	28.52	0.035	0.44	0.716	45.11
10041	597	34.85	8.2	1.557	0.224	28.20	0.048	0.77	0.752	25.74
10041	280	34.90	10.8	1.439	0.207	26.41	0.048	0.61	0.611	19.00
10041	111	34.86	15.8	1.667	0.240	19.52	0.035	0.25	0.364	9.00
10041	71	34.83	22.9	2.419	0.348	13.26	0.109	0.37	0.282	5.68
10041	51	34.08	27.9	4.334	0.623	0.68	0.135	0.37	0.223	1.95
10041	9	33.91	28.5	4.514	0.649	0.23	0.048	0.31	0.141	1.27
10043	2146	34.74	2.4	3.386	0.487	11.61	0.057	0.41	1.524	48.47
10043	1635	34.76	3.5	2.605	0.374	10.96	0.052	0.42	1.568	81.47
10043	1190	34.68	4.7	2.042	0.293	12.65	0.083	0.38	1.692	64.26
10043	993	34.66	5.4	1.948	0.280	10.22	0.083	0.43	1.551	44.74
10043	497	34.84	8.8	1.376	0.198	9.65	0.087	0.45	1.463	32.16
10043	44	34.80	24.8	3.193	0.459	7.39	0.200	0.36	0.449	7.16
10043	31	34.77	26.4	3.285	0.472	5.52	0.552	0.36	0.326	3.20
10043	10	33.97	27.7	4.628	0.665	0.12	0.096	0.43	0.070	1.18
10044	3321	34.72	1.8	3.761	0.541	25.11	0.030	0.67	1.727	57.00
10044	2177	34.73	2.4	3.349	0.481	26.61	0.065	0.49	1.586	77.11
10044	995	34.69	5.6	1.869	0.269	28.13	0.109	0.65	1.700	44.47
10044	792	34.73	7.0	1.602	0.230	24.39	0.078	7.90	1.727	35.84
10044	702	34.65	6.7	1.860	0.267	26.46	0.057	0.53	1.656	52.95
10044	251	34.80	10.5	1.806	0.260	25.67	0.091	0.47	1.357	28.79
10044	153	34.56	12.8	2.059	0.296	22.37	0.083	0.63	1.128	23.63
10044	103	34.51	15.4	2.617	0.376	16.39	0.078	0.59	0.934	14.16
10044	74	34.44	20.1	2.815	0.405	12.30	0.139	0.71	0.705	13.74
10044	64	34.43	20.9	2.648	0.381	13.26	0.157	0.57	0.661	6.57
10044	54	34.37	22.8	3.089	0.444	10.63	0.274	0.68	0.511	7.36
10044	44	34.43	23.8	3.292	0.473	8.35	0.378	0.47	0.502	6.63
10044	34	34.27	25.3	3.958	0.569	5.35	0.404	1.93	0.308	3.45
10044	25	34.22	26.6	4.796	0.689	0.30	0.078	1.14	0.106	0.79
10044	10	34.21	26.6	4.779	0.687	0.25	0.065	1.00	0.062	1.01
10045	3540	34.72	1.8	3.582	0.515	19.67	0.039	0.29	1.163	67.32

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [µM]	NO ₂ [µM]	NH ₄ [µM]	PO ₄ [µM]	Si [µM]
10045	2296	34.73	2.2	3.452	0.496	34.52	0.039	0.37	1.172	40.32
10045	1110	34.67	4.7	1.905	0.274	29.13	0.043	0.65	1.278	41.16
10045	703	34.71	7.0	1.479	0.213	26.15	0.057	0.41	1.322	23.68
10045	452	34.81	9.1	1.363	0.196	25.48	0.048	0.39	1.295	14.21
10045	155	34.57	13.0	2.233	0.321	18.41	0.052	0.34	1.189	10.00
10045	104	34.51	15.3	2.620	0.377	17.70	0.070	0.43	0.846	16.11
10045	90	34.48	16.7	2.627	0.378	15.09	0.078	0.32	0.617	9.05
10045	53	34.41	24.1	3.842	0.552	5.83	0.387	0.43	0.264	6.00
10045	47	34.40	26.3	4.821	0.693	2.22	0.091	0.41	0.106	1.02
10045	30	34.32	26.4	4.791	0.689	0.81	0.074	0.31	0.044	1.33
10045	15	34.26	26.5	4.726	0.679	0.81	0.070	0.33	0.070	1.33
10046	2575	34.73	1.9	3.662	0.526	22.98	0.030	0.46	1.850	63.26
10046	1980	34.73	2.5	3.200	0.460	27.09	0.022	0.19	1.850	79.16
10046	994	34.63	5.0	2.039	0.293	30.04	0.022	0.11	1.956	62.42
10046	499	34.74	8.1	1.481	0.213	25.57	0.048	0.28	1.850	48.16
10046	302	34.63	9.7	2.541	0.365	18.80	0.061	0.21	1.004	19.58
10046	141	34.52	15.5	2.622	0.377	16.04	0.057	0.27	1.013	19.26
10046	78	34.45	21.0	3.085	0.444	11.17	0.100	0.05	0.634	13.38
10046	63	34.39	22.7	3.100	0.446	9.89	0.096	0.16	0.546	8.85
10046	48	34.26	24.4	3.750	0.539	6.98	0.113	0.26	0.264	5.61
10046	23	34.24	25.9	4.811	0.691	0.27	0.100	0.07	0.009	1.55
10046	14	34.24	25.9	4.810	0.691	0.20	0.070	0.20	0.009	1.36
10048	2998	34.72	1.8	3.594	0.517	22.07	0.083	0.22	2.670	48.89
10048	2489	34.73	2.0	3.563	0.512	25.61	0.061	0.24	2.634	71.63
10048	1693	34.75	3.1	2.823	0.406	26.85	0.043	0.24	2.740	69.58
10048	794	34.76	6.8	1.579	0.227	28.57	0.061	0.30	2.775	21.21
10048	553	34.77	8.2	1.553	0.223	30.04	0.043	0.23	2.599	25.53
10048	326	34.82	10.1	1.557	0.224	26.02	0.052	0.25	2.203	15.21
10048	231	34.72	10.6	1.875	0.270	24.35	0.057	0.25	2.115	18.32
10048	131	34.54	13.5	2.433	0.350	20.83	0.039	0.26	1.709	17.84
10048	66	34.44	22.2	2.816	0.405	11.26	0.148	0.30	0.934	10.89
10048	47	34.33	24.6	3.651	0.525	6.11	0.465	0.31	0.511	5.02
10048	22	34.21	26.6	4.719	0.678	0.10	0.026	0.26	0.088	1.76
10048	8	34.21	26.8	4.808	0.691	0.11	0.048	0.33	0.062	1.31
10049	1266	34.64	4.3	2.325	0.334	27.43	0.061	3.07	1.225	14.61
10049	1076	34.64	5.0	2.125	0.305	29.67	0.087	1.79	1.225	14.12
10049	794	34.71	6.6	1.750	0.252	28.65	0.083	1.83	1.225	9.68
10049	368	34.80	9.5	1.566	0.225	26.20	0.048	1.61	1.031	6.64
10049	298	34.73	9.9	1.821	0.262	25.67	0.096	0.64	1.004	6.74
10049	199	34.61	11.1	2.063	0.297	20.70	0.100	1.24	0.934	6.24
10049	101	34.51	15.2	2.595	0.373	17.04	0.113	0.48	0.661	5.05
10049	56	34.41	19.7	3.066	0.441	11.70	0.178	1.87	0.441	3.16
10049	41	34.34	23.4	3.821	0.549	5.93	0.630	2.16	0.247	1.97
10049	7	34.47	25.6	4.875	0.701	0.18	0.087	1.35	0.070	0.46
10051	2369	34.7291	2.082	3.495	0.502	28	0.017	1.33	1.871	26
10051	1396	34.7016	3.818	2.486	0.357	30	0.004	0.42	1.886	30.79
10051	997	34.6318	5.075	2.123	0.305	28	0.052	0.65	1.829	23.53
10051	798	34.6392	6.131	1.874	0.269	27	0.039	0.36	1.843	22.74

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10051	451	34.7579	9.084	1.639	0.236	27	0.048	0.45	1.714	11.53
10051	375	34.7124	9.447	1.739	0.250	25	0.057	0.61	1.743	10.40
10051	251	34.6455	10.58	2.031	0.292	24	0.065	0.50	1.486	9.54
10051	152	34.5384	13.72	2.516	0.362	19	0.030	0.45	1.286	9.84
10051	83	34.4041	20.67	3.078	0.442	12	0.161	0.25	0.786	4.57
10051	68	34.3497	22.46	3.357	0.483	9	0.174	0.33	0.543	2.22
10051	43	34.0605	24.21	3.521	0.506	7	0.435	0.41	0.514	2.84
10051	13	34.1493	25.86	4.756	0.684	1	0.148	0.39	0.186	0.95
10052	975	34.6621	5.6	2.025	0.291	30	0.052	2.37	2.000	91.63
10052	846	34.6813	6.312	1.915	0.275	30	0.039	0.52	2.000	81.89
10052	497	34.7857	8.703	1.556	0.224	28	0.030	0.55	1.829	50.21
10052	298	34.7505	9.869	1.833	0.263	28	0.048	0.63	1.557	40.84
10052	268	34.7337	10.17	1.801	0.259	28	0.065	0.78	1.629	39.95
10052	120	34.5052	14.43	2.592	0.373	21	0.065	0.72	1.171	30.11
10052	99	34.5234	15.6	2.605	0.374	20	0.043	0.49	1.186	26.84
10052	80	34.4596	17.53	2.853	0.410	17	0.122	0.57	0.829	22.68
10052	59	34.3933	20.6	3.045	0.438	12	0.235	0.55	0.886	15.89
10052	40	34.3235	23.04	3.427	0.493	9	1.030	0.35	0.314	11.26
10052	20	34.4146	25.44	4.838	0.695	2	0.157	0.45	0.100	2.35
10052	4	34.3914	25.78	4.921	0.707	1	0.122	0.37	0.143	2.04
10053	1351	34.6499	4.205	2.328	0.335	29	0.043	0.54	2.371	92.73
10053	996	34.6286	5.278	2.093	0.301	28	0.030	0.62	2.171	81.95
10053	547	34.7427	8.393	1.552	0.223	29	0.048	0.46	2.186	47.73
10053	348	34.7693	9.408	1.552	0.223	28	0.057	0.55	2.057	37.00
10053	175	34.6172	11.38	2.121	0.305	23	0.070	0.42	1.557	34.64
10053	92	34.505	13.58	2.499	0.359	19	0.083	0.36	1.471	28.27
10053	77	34.4742	15.68	2.757	0.396	17	0.074	0.35	1.300	22.91
10053	43	34.3891	20.54	2.962	0.426	12	0.057	0.42	0.643	14.86
10053	23	34.3237	23.08	3.232	0.465	10	0.474	0.45	0.657	9.82
10053	7	34.379	25.13	4.662	0.670	2	0.278	0.54	0.329	3.45
10054	1052	34.6386	5.54	2.124	0.305	29	0.126	0.39	2.014	78.23
10054	696	34.7059	7.459	1.632	0.235	29	0.143	0.41	1.814	56.86
10054	350	34.7699	9.528	1.556	0.224	28	0.148	0.46	1.643	36.86
10054	284	34.759	9.944	1.578	0.227	27	0.161	0.42	1.529	34.45
10054	161	34.612	11.25	2.115	0.304	24	0.165	0.67	1.471	33.36
10054	71	34.4954	17.2	2.680	0.385	18	0.183	0.46	1.057	22.00
10054	62	34.5075	18.4	-	-	16	0.213	0.47	1.000	17.68
10054	43	34.3723	21.36	-	-	13	0.226	0.38	0.600	13.27
10054	32	34.3452	22.03	3.137	0.451	11	0.291	0.31	0.571	11.32
10054	22	34.3723	23.7	3.346	0.481	9	0.661	0.36	0.486	9.27
10054	7	34.314	25.1	4.638	0.667	3	0.313	0.32	0.186	3.27
10055	2576	34.7249	1.928	3.544	0.509	28	0.026	0.75	1.557	106.14
10055	1995	34.7251	2.552	3.128	0.450	29	0.017	0.50	1.557	100.73
10055	1296	34.6618	4.105	2.358	0.339	30	0.017	0.47	1.686	92.50
10055	1049	34.6143	4.641	2.137	0.307	28	0.043	0.44	1.700	87.64
10055	700	34.6793	6.862	1.709	0.246	30	0.030	0.51	1.714	63.68
10055	521	34.7246	7.982	1.612	0.232	28	0.052	0.57	1.757	50.32
10055	401	34.7243	8.929	1.723	0.248	27	0.039	0.37	1.657	40.77

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10055	103	34.5182	14.37	2.552	0.367	19	0.048	0.45	1.100	25.55
10055	53	34.381	20.86	2.942	0.423	13	0.122	0.36	0.771	13.82
10055	44	34.3839	21.84	3.030	0.436	11	0.257	0.36	0.700	10.86
10055	24	34.2396	25.47	3.981	0.572	5	0.509	0.42	0.371	5.95
10055	10	34.2639	26.04	4.927	0.708	1	0.078	0.43	0.171	1.36
10057	1594	34.6999	3.278	2.732	0.393	27	0.017	0.63	1.486	97.45
10057	1196	34.6333	4.274	2.287	0.329	29	0.013	0.42	1.400	91.14
10057	748	34.6224	6.218	1.817	0.261	29	0.043	0.47	1.429	70.23
10057	579	34.6608	7.307	1.700	0.244	28	0.004	0.63	1.486	57.73
10057	400	34.7104	8.877	1.607	0.231	28	0.035	0.43	1.443	42.82
10057	250	34.5876	10.17	2.191	0.315	24	0.057	0.42	1.357	38.00
10057	101	34.4776	15.06	2.676	0.385	17	0.078	0.49	1.100	24.73
10057	72	34.475	18.94	2.599	0.374	13	0.143	0.38	0.714	17.36
10057	52	34.432	21.98	2.846	0.409	12	0.409	0.47	0.714	13.27
10057	42	34.4142	23.23	3.246	0.467	8	0.496	0.41	0.357	7.91
10057	23	34.3039	25.25	4.737	0.681	2	0.170	0.55	0.271	3.14
10057	8	34.3069	25.69	4.809	0.691	2	0.083	0.37	0.029	2.73
10061	2146	34.7257	2.273	3.357	0.482	27	0.035	1.66	1.329	104.64
10061	1496	34.6817	3.619	2.580	0.371	28	0.004	0.84	1.286	95.55
10061	897	34.6096	5.412	2.028	0.291	30	0.030	6.80	1.014	79.55
10061	588	34.6566	7.608	1.725	0.248	27	0.030	0.57	1.300	55.32
10061	399	34.7298	9.099	1.634	0.235	26	0.078	0.67	1.300	39.86
10061	251	34.5548	9.989	2.202	0.316	23	0.043	0.58	0.857	39.41
10061	100	34.4957	15.84	2.595	0.373	18	0.070	0.64	0.643	23.59
10061	91	34.4819	16.88	2.683	0.386	16	0.074	0.68	0.543	20.73
10061	62	34.4599	19.22	2.676	0.385	14	0.143	0.67	0.486	16.91
10061	42	34.3781	21.3	3.557	0.511	10	0.235	0.69	0.471	12.32
10061	23	34.3821	22.52	3.923	0.564	7	0.165	0.71	0.043	9.18
10061	7	34.3272	24.24	4.484	0.645	4	0.122	0.82	0.214	6.23
10062	5844	34.7085	1.324	4.595	0.660	28	0.065	1.44	2.014	106.09
10062	3001	34.7194	1.621	3.900	0.561	31	0.065	0.56	1.914	105.86
10062	1503	34.6749	3.508	2.591	0.372	33	0.057	0.45	2.200	96.00
10062	707	34.5946	6.495	1.956	0.281	32	0.074	0.48	1.914	68.50
10062	608	34.6143	7.318	2.011	0.289	29	0.048	0.46	1.643	58.77
10062	484	34.6208	8.208	2.009	0.289	29	0.043	0.48	2.057	50.27
10062	380	34.5768	9.411	2.137	0.307	24	0.074	0.47	1.757	42.91
10062	160	34.5513	16.05	2.676	0.385	17	0.074	0.40	1.271	22.82
10062	111	34.3998	22.5	2.854	0.410	13	0.100	0.39	0.800	12.50
10062	86	34.3109	26.32	3.921	0.564	5	0.261	0.45	0.300	4.91
10062	51	34.2518	26.61	4.664	0.670	2	0.083	0.42	0.029	2.82
10062	17	34.2402	26.9	4.670	0.671	1	0.100	0.40	0.014	1.05
10063	2470	34.7233	2.015	3.511	0.505	27	0.070	0.17	1.543	107.95
10063	1993	34.7176	2.531	3.207	0.461	28	0.065	1.16	1.643	102.91
10063	1246	34.6274	4.104	2.375	0.341	28	0.057	0.79	1.600	92.77
10063	548	34.6579	7.921	1.713	0.246	25	0.074	0.58	1.771	53.09
10063	229	34.516	11.38	2.464	0.354	21	0.065	0.49	1.300	34.23
10063	151	34.4915	13.97	2.671	0.384	18	0.078	1.00	1.086	26.91
10063	63	34.199	21.75	3.247	0.467	11	0.196	0.70	0.600	13.77

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10063	43	34.1586	22.77	3.704	0.532	9	0.522	1.03	0.514	11.36
10063	24	34.1294	24.74	4.280	0.615	5	0.465	0.84	0.243	6.36
10063	9	34.1572	25.87	4.931	0.709	1	0.030	0.71	0.100	1.73
10064	0				0.359	-	-	-	-	-
10065	1269	34.6216	4.279	2.366	0.340	25	0.065	0.57	2.057	89.95
10065	787	34.6107	6.005	1.982	0.285	27	0.030	0.85	1.886	70.05
10065	500	34.6329	7.759	1.897	0.273	27	0.039	1.01	1.671	52.50
10065	350	34.6248	9.139	1.928	0.277	26	0.043	0.69	1.557	40.77
10065	200	34.5099	11.79	2.565	0.369	20	0.065	0.67	1.371	31.27
10065	101	34.3893	17.45	3.118	0.448	13	0.074	0.74	0.886	19.27
10065	81	34.3149	20.94	3.606	0.518	8	0.257	0.87	0.671	13.36
10065	42	34.2049	25.01	4.371	0.628	3	0.191	1.08	0.200	5.32
10065	22	34.2037	25.32	4.523	0.650	3	0.135	0.90	0.129	4.36
10065	7	34.1772	25.49	4.469	0.642	3	0.165	0.79	0.100	4.18
10066	1599	34.6842	3.288	2.847	0.409	27	0.048	1.30	1.457	96.77
10066	1242	34.6222	4.25	2.368	0.340	29	0.013	1.39	1.457	89.18
10066	733	34.6213	6.466	1.971	0.283	28	0.061	10.59	1.314	67.00
10066	469	34.5829	8.215	2.190	0.315	28	0.039	1.90	1.243	50.27
10066	399	34.5768	8.614	2.259	0.325	25	0.065	1.95	1.371	45.05
10066	250	34.5254	10.97	2.457	0.353	21	0.039	1.47	1.200	35.64
10066	200	34.5022	12.69	2.673	0.384	18	0.065	1.30	1.114	30.05
10066	111	34.4105	16.6	3.017	0.434	15	0.078	1.26	0.914	21.00
10066	61	34.2253	23.08	3.777	0.543	8	0.470	1.26	0.586	10.68
10066	42	34.1678	24.24	3.771	0.542	6	0.661	1.45	0.471	7.59
10066	22	34.1799	25.47	4.531	0.651	3	0.196	1.53	0.400	4.23
10066	8	34.1728	26.41	4.933	0.709	1	0.083	1.79	0.300	1.41
10067	1113	34.6073	4.789	2.283	0.328	28	0.030	0.91	1.757	85.73
10067	846	34.5993	5.812	2.052	0.295	27	0.030	1.05	1.314	73.41
10067	647	34.6304	6.858	1.807	0.260	29	0.030	0.92	1.143	59.14
10067	597	34.6209	6.974	1.893	0.272	28	0.043	1.15	1.586	58.86
10067	448	34.5988	8.233	2.008	0.289	23	0.052	1.05	1.543	49.86
10067	200	34.5025	12.77	2.552	0.367	20	0.057	1.29	1.014	29.32
10067	101	34.2468	21.71	3.576	0.514	10	0.200	1.11	0.643	12.45
10067	67	34.1269	25.15	4.171	0.600	5	0.274	1.18	0.314	5.09
10067	57	34.1231	25.52	4.331	0.623	3	0.296	1.20	2.286	3.95
10067	42	34.1167	25.62	4.436	0.638	3	0.243	1.09	0.157	3.59
10067	22	34.1219	26.11	4.640	0.667	1	0.122	1.06	0.114	2.27
10067	7	34.1334	26.61	4.809	0.691	1	0.048	1.04	0.243	1.64
10068	1996	34.6078	3.439	2.283	0.328	29	0.078	3.59	1.886	111.64
10068	1502	34.6042	3.619	2.282	0.328	29	0.057	2.23	1.957	105.73
10068	1152	34.6011	4.144	2.484	0.357	28	0.087	2.02	1.814	94.64
10068	801	34.5824	5.934	2.086	0.300	28	0.096	2.34	1.843	71.95
10068	551	34.5825	7.444	2.079	0.299	28	0.074	2.75	1.543	57.59
10068	380	34.5523	8.669	2.181	0.314	27	0.100	2.42	1.929	47.73
10068	200	34.475	12.06	2.746	0.395	22	0.100	1.96	1.271	30.41
10068	101	34.3893	19.26	3.209	0.461	12	0.113	1.62	0.671	14.59
10068	72	34.305	20.91	3.402	0.489	10	0.109	1.65	0.614	11.55
10068	42	34.16	24.09	3.877	0.557	6	0.670	1.59	0.457	7.68

Table 5.1 (continued):

Station GeoB	Water depth [m]	Salinity [psu]	T [°C]	Dissolved oxygen Winkler [ml/l]	in situ Chlorophyll [mg m ⁻³]	NO ₃ +NO ₂ [μM]	NO ₂ [μM]	NH ₄ [μM]	PO ₄ [μM]	Si [μM]
10068	22	34.097	25.93	4.713	0.678	1	0.139	1.81	0.157	2.73
10068	7	34.1358	27.42	4.707	0.677	1	0.030	1.79	0.043	1.86
10069	1239	34.6019	3.847	2.278	0.327	28	0.022	5.68	0.857	95.77
10069	801	34.5846	5.475	2.117	0.304	27	0.035	3.02	1.014	74.50
10069	380	34.5638	8.341	2.150	0.309	26	0.061	3.12	0.743	48.32
10069	251	34.495	10.97	2.565	0.369	20	0.052	2.18	0.800	34.18
10069	211	34.5107	12.77	2.571	0.370	19	0.083	2.26	0.657	29.77
10069	101	34.391	19.54	3.219	0.463	11	0.091	2.25	0.443	13.82
10069	76	34.3117	21.51	3.511	0.505	9	0.104	2.30	0.329	10.50
10069	42	34.1054	24.32	3.871	0.556	6	0.357	2.07	0.314	8.00
10069	22	34.0784	25.64	4.804	0.691	2	0.226	2.13	0.214	3.86
10069	7	34.1497	27.18	4.754	0.683	1	0.087	2.10	0.257	1.41
10070	1487	34.6522	3.619	2.532	0.364	26	0.078	11.53	3.129	39.18
10070	1199	34.6118	4.304	2.442	0.351	28	0.035	3.99	3.000	35.41
10070	798	34.5826	5.832	2.069	0.297	27	0.035	2.48	2.900	29.36
10070	471	34.5679	8.091	2.064	0.297	24	0.052	2.43	2.686	20.50
10070	279	34.5227	11.35	2.533	0.364	21	0.070	2.90	2.143	14.32
10070	201	34.5014	13.23	2.645	0.380	17	0.048	4.96	1.814	11.05
10070	149	34.483	15.8	2.828	0.407	13	0.022	2.90	1.429	8.03
10070	109	34.2858	20.02	3.100	0.446	11	0.087	2.77	1.057	5.92
10070	49	34.2072	25.41	4.030	0.579	4	0.578	2.18	0.386	1.82
10070	40	34.1027	25.61	4.139	0.595	4	0.539	2.16	0.329	1.64
10070	21	34.1181	26.67	4.882	0.702	0	0.026	2.27	0.114	0.48
10070	5	34.141	27.18	4.769	0.685	0	0.057	2.75	0.014	0.42

5.3.3 Living coccolithophores from water samples

Coccolithophores are a major group of marine, unicellular phytoplankton. There are, however, only limited studies available that deal with the biogeographic occurrence of living coccolithophores in the world oceans and even less, which focus on upwelling areas. This investigation was done to study the spatial and seasonal occurrence of coccolithophores in the Java upwelling area in order to improve their use as proxies for paleoenvironmental studies.

The focus of research was laid on the horizontal and vertical sampling of the surface waters of the eastern Indian Ocean off Java during SO-184/3. At a total of 21 stations, water samples were taken at several depth intervals with the rosette sampler according to previous CTD profiling (Table. 5.2). It was aimed to sample the mixed surface water layer, above, at, and below the thermocline and at the bottom of the photic zone. The water (1 to 5 l) from each depth was filtered without further treatment through filters of 0.45 μm pore width using a vacuum pump (200 mbar) and afterwards dried at 50°C for some hours. Numbers of coccolithophores will be counted in a scanning electron microscope and calculated as cells per liter seawater.

Table 5.2: Samples of living coccolithophores taken during SO-184/3.

Station	Date	Sample depths (m)						stored at
GeoB 10044-2	22.08.2005	5	20	30	50	70	100	BGR
GeoB 10045-2	23.08.2005	5	25	55	80	110	140	BGR
GeoB 10046-2	24.08.2005	0	20	50	80	100	120	BGR
GeoB 10048-2	25.08.2005	5	20	40	65	80	130	BGR
GeoB 10049-2	26.08.2005	5	20	40	65	80	100	BGR
GeoB 10051-2	27.08.2005	5	20	40	60	80	100	BGR
GeoB 10052-2	28.08.2005	5	20	40	65	80	100	BGR
GeoB 10053-2	29.08.2005	5	20	30	40	60	80	BGR
GeoB 10054-1	29.08.2005	5	20	30	40	60	80	BGR
GeoB 10055-2	29.08.2005	5	20	30	50	70	100	BGR
GeoB 10057-2	31.08.2005	5	20	30	50	70	100	BGR
GeoB 10061-2	02.09.2005	5	10	20	40	70	100	BGR
GeoB 10062-2	03.09.2005	5	30	70	90	120	150	BGR
GeoB 10063-2	04.09.2005	5	20	40	60	80	110	BGR
GeoB 10064-2	04.09.2005	5	15	25	40	60	90	BGR
GeoB 10065-2	05.09.2005	5	20	35	60	80	100	BGR
GeoB 10066-2	05.09.2005	5	20	40	60	80	110	BGR
GeoB 10067-2	06.09.2005	5	20	40	60	80	100	BGR
GeoB 10068-4	07.09.2005	5	15	30	60	80	100	BGR
GeoB 10069-5	07.09.2005	5	20	40	60	80	100	BGR
GeoB 10070-5	08.09.2005	5	25	50	70	100	135	BGR

6 Plankton Sampling with the Multinet (64 μm) and the Plankton Net (25 μm)

(H. Andruleit, C. Chiessi, A. Damar, M. Mohtadi, G. Mollenhauer)

6.1 Introduction

The main objective of planktonic observation in the R/V Sonne cruise SO-184 is to investigate the plankton species, abundance distribution and especially the assemblage of planktonic foraminifera in the surface waters of the investigated area. Planktonic investigation during the R/V Sonne cruise SO-184 was conducted by means of a multiple closing net (Multinet) and a Plankton net. The Multinet was used during legs 2 and 3, while the Plankton net was used only during leg 3.

The Multinet with a mesh size of 64 μm was used in order to take samples of marine plankton bigger than 64 μm , i.e. macroplankton. Meanwhile, the Plankton net with a 25 μm mesh size was mainly used in order to get phytoplankton samples. The multiple closing net (Multinet) has been used on 43 stations and the Plankton net on 21 stations during R/V Sonne cruise SO-184. Together with the CTD measurements and with the water sample analysis the Multinet samples allow a more comprehensive characterization of the upper part of the water column.

6.2 Instruments

6.2.1 Multinet

The Multinet used during this cruise was the equipment assembled by Hydro-Bios, Kiel, Germany, made up of five individual 64 μm nets, that can be remotely controlled opened consecutively thus allowing the sampling of five different levels within the water column. The Multinet with an opening of 0.25 m^2 was lowered to 500 m water depth with 0.5 m/s and pulled up with 0.2 m/s. At selected levels heaving was stopped to open the next net. The levels of the water column sampled during this cruise (see exceptions below) are given in Tab. 6.1.

Table 6.1: Depth intervals and filtered water volumes sampled with the Multinet.

Net	From (m)	To (m)	Volume of water filtered (10 ³ l)
1	500	200	75
2	200	100	25
3	100	50	12,5
4	50	25	6,25
5	25	0	6,25

During leg SO-184/2 (Cilacap – Cilacap), the levels of the water column sampled in the stations GeoB 10022-1 (net 1: 500-200 m, net 2: 200-100 m, net 3: 100-50 m, net 4: 50-0 m) and GeoB 10028-1 (net 1: 480-200 m, net 2: 200-100 m, net 3: 100-50 m, net 4: 50-25 m, net 5: 25-0 m) slightly diverge from the standard due to a technical problem on the equipment in

the former station and to the shallow depth of the station in the later case. Meanwhile, during the leg 3, the whole samples were taken from the interval depths as given in Tab. 6.1.

The samples have been poisoned with 1 ml saturated HgCl_2 solution and stored at 4°C (exception made to the samples collected on the stations GeoB 10029-1 to GeoB 10031-1 and station GeoB 10033-1, poisoned with 0,25 ml of Formalin and to be stored in Bandung). A brief overview of all stations sampled with the Multinet and the cities where the samples are stored is given in Tab. 6.2.

Table 6.2 Samples collected with the Multinet during cruise SO-184.

Station	Levels of the water column sampled (m)					City of storage
	Net 1	Net 2	Net 3	Net 4	Net 5	
GeoB 10003-3	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10007-2	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10011-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10018-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10019-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10020-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10022-1	500-200	200-100	100-50	50-0	-	Bremen
GeoB 10024-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10025-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10026-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10027-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10028-1	480-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10029-1	500-200	200-100	100-50	50-25	25-0	Bandung
GeoB 10030-1	500-200	200-100	100-50	50-25	25-0	Bandung
GeoB 10031-1	500-200	200-100	100-50	50-25	25-0	Bandung
GeoB 10033-1	500-200	200-100	100-50	50-25	25-0	Bandung
GeoB 10034-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10035-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10036-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10038-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10039-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10040-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10044-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10045-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10046-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10048-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10049-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10051-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10052-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10053-1	500-200	200-100	100-50	50-25	25-0	Bremen

Table 6.2 (continued):

Station	Levels of the water column sampled (m)					City of storage
	Net 1	Net 2	Net 3	Net 4	Net 5	
GeoB 10055-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10057-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10061-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10062-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10063-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10064-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10065-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10066-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10067-1	500-200	200-100	100-50	50-25	25-0	Bremen
GeoB 10070-1	500-200	200-100	100-50	50-25	25-0	Bremen

6.2.2 Plankton Net

The Plankton Net used in this cruise was assembled by Bogor Agricultural University Workshop, Indonesia. It has a 25 μm mesh size for taking phytoplankton samples. Unlike to the Multinet, the plankton Net has only 1 net, with the opening mouth of 0.07 m^2 . On each station, the plankton net was lowered down to the depth of 60 m, for then it was heaved with 0.2 m/s up to the surface, with a total of 4,240 liters of filtered water. Besides vertical towing technique, the Plankton Net was also used on board to filter 10 liters of sea water taken from 3 different depths, i.e. the depth of oxygen maxima, the thermocline and at the sea surface, which were previously taken by a Rosette water sampler. The collected samples were preserved by lugol's solution and brought to the main laboratory in IPB-Bogor, Indonesia, for further laboratory analysis. Phytoplankton samples collected with Plankton Net during the cruise SO-184/3 are listed in Table 6.3.

Table 6.3: Phytoplankton samples collected with Plankton net during the cruise SO-184/3.

Station	Depth of vertical towing (m)	The water depth used by on board phytoplankton filtration (m)			Place of Storage
GeoB 10044-2	-	40	30	5	Bogor
GeoB 10045-4	60	100	50	5	Bogor
GeoB 10046-4	60	80	50	5	Bogor
GeoB 10047*	No plankton net sampling				
GeoB 10048-4	60	65	40	5	Bogor
GeoB 10049-4	60	65	40	5	Bogor
GeoB 10050*	No plankton net sampling				
GeoB 10051-4	60	68	40	5	Bogor
GeoB 10052-4	60	70	40	5	Bogor
GeoB 10053-4	60	90	30	5	Bogor
GeoB 10054-3	60	35	20	5	Bogor
GeoB 10055-4	-	50	25	5	Bogor
GeoB 10056*	No plankton net sampling				

Table 6.3 (continued):

Station	Depth of vertical towing (m)	The water depth used by on board phytoplankton filtration (m)			Place of Storage
GeoB 10057-4	60	55	20	5	Bogor
GeoB 10058*	No plankton net sampling				
GeoB 10059*	No plankton net sampling				
GeoB 10060*	No plankton net sampling				
GeoB 10061-8	60	50	20	5	Bogor
GeoB 10062-4	60	110	70	5	Bogor
GeoB 10063-4	60	70	20	5	Bogor
GeoB 10064-4	60	70	20	5	Bogor
GeoB 10065-4	60	70	20	5	Bogor
GeoB 10066-4	60	100	30	5	Bogor
GeoB 10067-4	60	95	50	5	Bogor
GeoB 10068-4	60	50	20	5	Bogor
GeoB 10069-7	60	65	30	5	Bogor
GeoB 10070-4	60	50	20	5	Bogor

Notes : * = only core sampling stations

6.3. Shipboard results

Samples taken with the Multinet will be analyzed in Bremen. Meanwhile, some of samples taken with the Plankton Net were roughly analyzed on board by using a light microscope. The samples analysed on board were from the stations GeoB 10052, GeoB 10054, GeoB 10062, and GeoB 10064. The brief results from phytoplankton species identification are listed in the Table 6.4.

Table 6.4: Brief results of phytoplankton species composition from 4 stations.

No.	Species	Group
1.	<i>Rhizosolenia spec.</i>	Diatoms
2.	<i>Rhizosolenia imbricata</i>	Diatoms
3.	<i>Rhizosolenia indica</i>	Diatoms
4.	<i>Navicula spec.</i>	Diatoms
5.	<i>Coscinodiscus spec.</i>	Diatoms
6.	<i>Lauderia spec.</i>	Diatoms
7.	<i>Eucampia spec.</i>	Diatoms
8.	<i>Eucampia zoodiacus</i>	Diatoms
9.	<i>Fragilaria spec.</i>	Diatoms
10.	<i>Thalassionema spec.</i>	Diatoms
11.	<i>Pseudonitzschia spec.</i>	Diatoms
12.	<i>Achnantes spec.</i>	Diatoms
13.	<i>Thalassiosira</i>	Diatoms
14.	<i>Bacillaria spec.</i>	Diatoms
15.	Small flagellates	Flagellates
16.	Chlorophyceae	Chlorophyceae

In general, like other tropical oceanic waters, phytoplankton composition and abundance in the stations observed during this cruise were relatively low. It was obviously seen from the samples collected right away after both towing and on board filtration, which show a clear water sample indicating low phytoplankton content. This is supported by the on board results of nutrient and chlorophyll-a analysis, which also show low values (see Chapter 5). However, as previously expected, it seems that a slight different in phytoplankton abundance occurs in

the Western Lombok Basin showing a relatively higher phytoplankton abundance than in the other stations. This might be related to the upwelling, which brings more nutrients up to the surface layer enabling better conditions for phytoplankton development. More complete and detail results on plankton investigation will be delivered after thorough laboratory analysis that will be conducted in Bremen and Bogor.

7 Sediment Sampling

(B. Donner, M. Gröning, W.S. Hantoro, C. Hayn, U.R. Kadarwati, F. Lamy, J. Langer, B. Meyer-Schack, H.A. Mai, M. Mohtadi, G. Mollenhauer, A.K. Permana, D.A.S. Ranawijaya, O.E. Romero, G. Ruhland, J. Scholten, J. Smit, C. Spliethoff, S. Steinke, C. Wienberg, D. Yurnaldi)

7.1 Introduction

Sediments from the Indonesian continental margin were sampled at a total of 72 stations on transects between Nias Island and Sumba Island along the coast of Sumatra, off southern Java, off Sumba, and off western Australia in the Vulcan Graben, Timor Sea. For the marine geological studies, the Multicorer (MUC) and the Gravity corer with tubes of 6 m (SL 6), 9 m (SL 9) and 12 m (SL 12) have been used for retrieving surface sediments and longer sediment cores, respectively.

7.2 Multicorer: sampling and sub-sampling

The main tool for sampling undisturbed surface sediments and the overlying bottom water was the Multicorer (MUC, GeoB) equipped with six large (10 cm diameter) and four smaller (6 cm diameter) plastic tubes of 60 cm length. Cores were mostly sampled as follows:

- 2 large tubes cut into 1 cm-thick slices for foraminiferal investigations with the upper 10 cm samples stained with rose Bengal (GeoB);
- 1 large tube cut into 1 cm-thick slices for organic carbon (TOC) geochemistry (GeoB);
- 1 large tube cut into 1 cm-thick slices for biomarker studies (GeoB);
- 1 large tube for macrofauna investigations, cut into 2 cm-thick slices (MGI);
- 1 large tube for pore water analyses (ZMT);
- 1 small tube cut into 1 cm-thick slices for studies on diatoms (GeoB);
- 1 small tube for volcanology studies (LIPI);
- 1 small tube cut into 2 cm-thick slices for grain size analyses (GeoB); and
- 1 small tube cut into 1cm-thick slices as an archive tube (GeoB).

The Multicorer was employed 64 times (for detailed stations and sampling information see Table 7.1). Except at 25 stations where the Multicorer did not release due to technical problems, the core recovery was good with 30 to 45 cm length of sediment. Almost at all stations where the Multicorer released, all tubes fully collected. Additionally, 30 ml-bottom water samples for stable carbon and oxygen isotopes analyses were taken at GeoB 10010-1 through GeoB 10036-3.

Table 7.1: Multicorer sampling during R/V SONNE Cruise SO-184.

GeoB No.	Latitude	Longitude	Water depth [m]	Recovery
<u>Working area 1: SW of Mega Island</u>				
10004-1	4° 23.00' S	101° 3.17' E	450	not released
10004-2	4° 23.01' S	101° 3.14' E	450	not released
10005-1	4° 27.45' S	100° 53.82' E	2568	not released
<u>Working area 2: NW of Siberut Island</u>				
10008-1	0° 57.26' S	98° 15.61' E	936	not released
10009-1	1° 3.76' S	98° 3.23' E	2102	not released

Table 7.1 (continued):

GeoB No.	Latitude	Longitude	Water depth [m]	Recovery
<u>Working area 3: NW of Nias Island</u>				
10010-1	1° 10.69' S	97° 58.89' E	2937	6/6 4/4
10014-1	1° 40.71' N	96° 58.86' E	1158	6/6 4/4
10015-1	1° 37.95' N	96° 53.17' E	1464	6/6 4/4
10016-2	1° 35.79' N	96° 39.62' E	1900	6/6 4/4
10017-1	1° 34.34' N	96° 30.95' E	2578	not released
<u>Working area 4: NE of Siberut Island, Mentawai fore-arc basin, northern part</u>				
10022-3	0° 29.88' S	98° 51.05' E	704	not released
10022-6	0° 30.00' S	98° 51.00' E	706	6/6 4/4
10023-3	0° 51.48' S	99° 24.47' E	1555	6/6 4/4
10024-3	0° 46.09' S	99° 16.09' E	1381	6/6 4/4
10025-3	0° 40.46' S	99° 7.39' E	1149	6/6 4/4
10026-2	0° 56.64' S	99° 31.28' E	1641	6/6 4/4
10027-3	0° 48.53' S	99° 39.18' E	875	6/6 4/4
10028-4	0° 41.80' S	99° 45.78' E	522	6/6 4/4
<u>Working area 5: E of Siberut Island, Mentawai fore-arc basin, middle part</u>				
10029-3	1° 29.75' S	100° 7.58' E	974	6/6 4/4
10031-3	1° 41.93' S	99° 36.19' E	1671	6/6 4/4
10032-1	1° 40.00' S	99° 40.83' E	1758	6/6 4/4
10033-3	1° 33.80' S	99° 57.13' E	1756	6/6 4/4
<u>Working area 6: E of Mega Island, Mentawai fore-arc basin, southern part</u>				
10034-3	4° 9.89' S	101° 29.94' E	995	6/6 4/4
10035-4	4° 2.23' S	101° 44,03' E	997	not released
<u>Working area 7: Bengkulu fore-arc basin and adjacent continental slope</u>				
10036-3	5° 20.33' S	103° 39.43' E	1502	6/6 4/4
10037-2	5° 28.83' S	103° 33.56' E	2016	not released
10038-3	5° 56.23' S	103° 14.78' E	1891	6/6 4/4
10039-3	5° 52.10' S	103° 17.65' E	1799	6/6 4/4
10040-3	6° 28.57' S	102° 51.56' E	2605	6/6 4/4
10041-3	6° 16.44' S	103° 0.51' E	1540	6/6 4/4
<u>Working area 8: Sunda Strait</u>				
10042-2	7° 6.79' S	104° 38.57' E	2457	3/6 4/4
10043-2	7° 18.53' S	105° 3.50' E	2170	1/6 4/4
<u>Working area 9: South of Cilacap</u>				
10044-3	8°29,98' S	109°01,00' E	3346	6/6 4/4
10045-6	8°44,59' S	109°01,24' E	3564	not released
10046-5	9°36,24' S	109°03,82' E	2603	not released
10047-1	9°18,41' S	109°01,01' E	1780	6/6 4/4
10048-5	8°15,18' S	108°08,83' E	3031	not released
10048-6	8°15,18' S	108°08,80' E	3026	not released
<u>Working area 10: Yogya Ridge</u>				
10049-5	8°47,08' S	110°29,80' E	1288	6/6 4/4
10050-1	9°27,90' S	110°26,95' E	1221	6/6 4/4
10051-5	9°17,54' S	110°29,94' E	2388	not released
10052-6	8°41,70' S	110°38,00' E	999	not released
10052-7	8°41,69' S	110°37,99' E	999	released but empty

Table 7.1 (continued):

GeoB No.	Latitude	Longitude	Water depth [m]	Recovery
<u>Working area 11: Western Lombok Basin</u>				
10053-6	8°40,56' S	112°52,33' E	1373	not released
10054-5	8°40,92' S	112°40,08' E	1080	not released
10055-5	9°14,89' S	113°03,10' E	2596	not released
10056-2	9°06,78' S	112°57,55' E	1861	not released
10058-1 (10054-5)	8°40,98' S	112°38,34' E	1103	6/6 4/4
10059-1 (10053-6)	8°40,57' S	112°52,34' E	1372	6/6 4/4
10060-1 (10055-5)	9°14,88' S	113°03,07' E	2597	not released
10061-5	9°43,74' S	113°01,44' E	2170	6/6 4/4
<u>Working area 12: Eastern Lombok Basin</u>				
10063-5	9°38,72' S	118°08,96' E	2495	6/6 4/4
10064-5	9°32,32' S	118°18,18' E	2035	6/6 4/4
10065-6	9°13,40' S	118°53,59' E	1289	over top
10065-8	9°13,40' S	118°53,54' E	1288	over top
10065-9	9°13,48' S	118°53,49' E	1284	2/6 4/4
10066-5	9°23,59' S	118°34,58' E	1632	not released
10066-6	9°23,60' S	118°34,53' E	1632	6/6 4/4
10067-5	9°08,96' S	119°17,41' E	1136	6/6 4/4
<u>Working area 13: Savu Basin</u>				
10068-2	9°35,74' S	120°08,91' E	2002	6/6 4/4
10069-2	9°35,67' S	120°55,00' E	1249	0/6 2/4
10069-4	9°35,75' S	120°54,97' E	1249	6/6 4/4
10070-6	10°21,62' S	121°18,17' E	1513	released

7.3 Gravity corer

7.3.1 Sediment sampling

In order to recover deeper sediment sequences, a Gravity corer with pipe lengths of alternatively 6, 9 or 12 m and a weight of 1.2 tons was used at 33 stations. Before using the Gravity corer, the liners were marked lengthwise with a straight line in order to retain the orientation of the core for later paleomagnetic analyses. Once on board, the sediment core was cut into 1 m sections, closed with caps on both ends and labelled according to a standard scheme (Fig. 7.1).

In total, 69 cores were retrieved with recoveries between 25 and 993 cm (Table 7.2). Altogether, some 195 m of sediment cores were recovered with the Gravity corer during R/V SONNE Cruise 184/2 and 162 m during R/V SONNE Cruise 184/3.

Inscription:

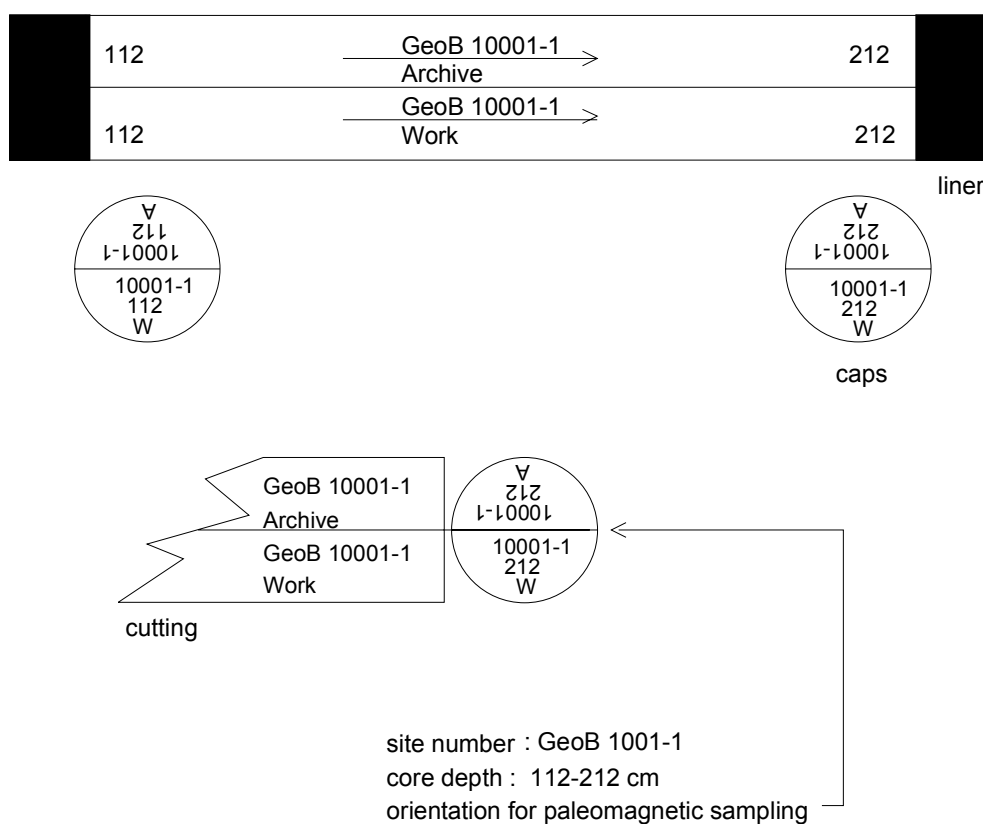


Fig. 7.1: Scheme of the inscription of gravity core segments.

All cores recovered in the equatorial Indian Ocean, off Indonesia, were cut into an *archive* and a *work* half. The *archive* half was used for core description, smear slide sampling, core photography, and color scanning. The *work* half was sampled on board with two series of 10 ml-syringes for geochemical and faunal studies, both at 5 cm intervals, starting at 3 cm depth. In some cores, an additional sample series was taken for the Indonesian participants. These samples and a number of duplicate cores (Table 7.2) will be used by scientists from the Indonesian Institutes LIPI and MGI. The remaining sample material was shipped to the University of Bremen. The core from the Vulcan Graben, Timor Sea was not opened. It will be opened, sampled and analyzed at the University of Bremen.

Table 7.2: List of gravity cores retrieved during R/V SONNE Cruise SO-184.

GeoB No.	Latitude	Longitude	Water depth (m)	Sediment recovery (cm)	Remarks
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Working area 1: SW of Mega Island

10005-2	04°27.44 S	100°53.78 E	2571	-	No recovery
10005-3	04°27.44 S	100°53.78 E	2571	282	
10006-1	04°33.02 S	100°49.90 E	2800	161	

Working area 2: NW of Siberut Island

10008-2	00°57.26 S	98°15.61 E	935	112	stored in Indonesia
10008-3	00°57.26 S	98°15.61 E	935	165	
10009-2	01°03.78 S	98°03.21 E	2104	25	Not sampled
10010-2	01°10.65 S	97°58.94 E	2954	424	

Working area 3: NW of Nias Island

10014-2	01°40.80 N	96°58.90 E	1155	72	Not sampled
10014-3	01°40.80 N	96°58.90 E	1155	476	
10015-2	01°38.00 N	96°53.18 E	1466	472	
10016-1	01°35.78 N	96°39.62 E	1900	-	No recovery
10017-2	01°34.34 N	96°30.95 E	2578	-	No recovery
10020-3	01°40.80 N	96°58.90 E	1155	473	Same as 10014, Indonesia
10021-1	01°35.35 N	96°39.66 E	1851	417	stored in Indonesia
10021-2	01°35.64 N	96°39.66 E	1905	284	

Working area 4: NE of Siberut Island, Mentawai fore-arc basin; northern part

10022-4	00°29.94 S	98°51.00 E	704	522	stored in Indonesia
10022-5	00°30.00 S	98°51.00 E	709	613	
10023-4	00°51.44 S	99°24.49 E	1557	589	
10024-4	00°46.09 S	99°16.04 E	1381	617	
10025-4	00°40.49 S	99°07.39 E	1148	652	
10026-3	00°56.65 S	99°31.28 E	1639	812	stored in Indonesia
10026-4	00°56.65 S	99°31.28 E	1639	665	
10027-4	00°48.53 S	99°39.20 E	876	530	
10028-5	00°41.77 S	99°45.77 E	521	433	

Working area 5: E of Siberut Island, Mentawai fore-arc basin; middle part

10029-4	01° 29.67 S	100° 07.68 E	962	772	stored in Indonesia
10031-4	01° 41.92 S	99° 36.21 E	1668	572	
10032-2	01° 39.98 S	99° 40.83 E	1763	805	
10033-2	01° 33.78 S	99° 57.11 E	1746	650	
10033-4	01° 33.79 S	99° 57.16 E	1754	825	

Working area 6: E of Mega Island, Mentawai fore-arc basin; southern part

10034-4	04° 09.93 S	101° 29.93 E	996	993	stored in Indonesia
10035-3	04° 02.23 S	101° 44.03 E	997	531	
10035-5	04° 02.25 S	101° 44.03 E	996	660	

Table 7.2 (continued):

GeoB No.	Latitude	Longitude	Water depth (m)	Sediment recovery (cm)	Remarks
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Working area 7: Bengkulu fore-arc basin and adjacent continental slope

10036-4	05° 20.36 S	103° 39.30 E	1509	601	stored in Indonesia
10037-1	05° 28.84 S	103° 33.56 E	2021	595	
10037-3	05° 28.82 S	103° 33.56 E	2016	622	
10038-4	05° 56.25 S	103° 14.76 E	1819	901	Bended tube
10039-4	05° 52.08 S	103° 17.66 E	1799	195	
10040-4	06° 28.52 S	102° 51.46 E	2605	673	

Working area 8: Sunda Strait

10042-4	07°06.81'S	104° 38.58'E	2454	540	stored in Indonesia not opened
10043-1	07°18.57'S	105° 03.45'E	2166		
10043-3	07°18.55'S	105° 03.53'E	2171	390	

Working area 9: South of Cilacap

10044-4	8°30,00' S	109°01,00' E	3341	548	
10045-5	8°44,64' S	109°01,27' E	3562	502	
10046-6	9°36,23' S	109°03,81' E	2602	566	
10047-2	9°18,46' S	109°00,99' E	1781	565	

Working area 10: Yogya Ridge

10049-6	8°47,09'	110°29,79'	1289 m	507 cm	stored in Indonesia
10050-2	9°27,90'	110°26,96'	1221 m	378 cm	
10051-6	9°17,54'	110°29,94'	2388 m	224 cm	
10052-5	8°41,68'	110°37,99'	1003 m	370 cm	
10052-8	8°41,68'	110°37,99'	1001 m	487 cm	

Working area 11: Western Lombok Basin

10053-5	8°40,57'	112°52,31'	1375 m	600 cm	over top
10053-7	8°40,56'	112°52,33'	1372 m	760 cm	Bended tube tube empty stored in Indonesia
10054-4	8°40,90'	112°40,10'	1076 m	846 cm	
10055-6	9°14,96'	113°03,10'	2601 m	625 cm	
10056-1	9°06,72'	112°57,56'	1859 m	-	
10057-5	9°49,26'	113°06,41'	1616 m	-	
10061-6	9°43,77'	113°01,41'	2169 m	491 cm	
10061-7	9°43,75'	113°01,47'	2168 m	517 cm	

Working area 12: Eastern Lombok Basin

10063-6	9°38,71'	118°08,96'	2495 m	948 cm	stored in Indonesia
10064-6	9°32,32'	118°18,16'	2036 m	729 cm	
10065-5	9°13,37'	118°53,57'	1290 m	920 cm	
10065-7	9°13,39'	118°53,58'	1296 m	985 cm	
10066-7	9°23,56'	118°34,53'	1635 m	658 cm	
10067-6	9°08,92'	119°17,39'	1137 m	806 cm	

Working area 13: Savu Basin

10068-3	9°35,72'	121°08,90'	2007 m	817 cm	stored in Indonesia
10069-1	9°35,72'	120°55,02'	1250 m	732 cm	
10069-3	9°35,73'	120°55,05'	1250 m	962 cm	
10070-5	10°21,63'	121°18,16'	1504 m	170 cm	not sampled

Table 7.2 (continued):

GeoB No.	Latitude	Longitude	Water depth (m)	Sediment recovery (cm)	Remarks
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Working area 13: Savu Basin

10066-7	9°23,56'	118°34,53'	1635 m	658 cm	
10067-6	9°08,92'	119°17,39'	1137 m	806 cm	

Working area 14: Vulcan Graben, Timor Sea

10072-1	11°43,52'	124°52,13'	303m	518 cm	not opened
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7.3.2 Core description and color-scanning

The core description summarizes the most important results of the analysis of each sediment core following procedures applied during ODP/IODP cruises (e.g., Mix et al., 2003). All cores, including those for the Indonesian participants were opened, described, and digitally photographed.

In the Figures 7.2 to 7.62, the first column displays the digital photographs of each core. The lithological data, indicated in the "Lithology" column, are based on visual analysis of the core and are supplemented by information from smear slide analyses. In order to quickly assess the compositional content of sediments collected during SO-184, smear slides were prepared for most of the gravity cores. Preparation of a smear slide followed standard procedures (mainly that used by the Ocean Drilling Program). We took a cover glass and placed a few drops of distilled water in its center. Afterward we collected a tiny fraction of the sample from the archive half with the flat end of the toothpick, and mixed it into the water on the cover glass, spread the wet sediment with the flat end of the toothpick until it formed a thin translucent coat across the entire cover glass, and then placed the cover glass (with the sediment smear up) on the surface of the hot plate to dry. A few drops of mounting medium were placed in the center of the slide with the glass rod, and set it on the surface of the hot plate to warm. Finally, the smear slide was returned to the hot plate for 3-5 minutes to allow it to cure. Smear slides were primarily taken from the major lithologies of each core but only selected minor lithologies such as volcanic ash layer and turbidites have been microscopically described. Smear slides were examined using a light microscope at about 125x - 1250x magnification with cross-polarised and transmitted light.

The sediment classification largely follows ODP/IODP convention. Lithological names consist of a principal name based on composition, degree of lithification, and/or texture as determined from visual description and smear slide observations. For a mixture of components, the principal name is preceded by major modifiers (in order of increasing abundance) that refer to components making up >25% of the sediment. Minor components that represent between 10% and 25% of the sediment precede the principal name and the hyphenated term "-bearing", in order of increasing abundance. For example, an unconsolidated sediment containing 45% nannofossils, 30% clay minerals, 10% foraminifers, and 5% quartz would be described as foraminifera-bearing clayey nannofossil ooze.

In the structure column the intensity of bioturbation together with individual or special features (turbidites, volcanic ash layers, plant debris, shell fragments, etc.) is shown. The hue and chroma attributes of color were determined by comparison with the Munsell soil color charts and are given in the color column in the Munsell notation.

A GretagMacbethTM *Spectrolino* spectrophotometer was used to measure percent reflectance values of sediment color at 36 wavelength channels over the visible light range (380-730 nm). The digital reflectance data of the spectrophotometer readings were routinely obtained from the surface (measured in 1 cm steps) of the archive half. The *Spectrolino* is equipped with a measuring aperture with folding mechanism allowing an exact positioning on the split core and is connected to a portable computer. The data are directly displayed within the software package Excel and can be controlled simultaneously. The color measurements of each core - representative wavelengths of 400, 550, and 700 nm, and the red/blue ratio (700 nm/450 nm) are shown together with the visual core description for each core. The reflectance of individual wavelengths is often significantly affected by the presence of minor amounts of oxyhydroxides or sulfides. To isolate these effects, we used the red/blue ratio to add additional information to the spectral data shown together with the core description for each core (Figs. 7.2 to 7.62).

7.3.3 Shipboard results

Cores were examined from 14 working areas along the Indonesian continental margin off Sumatra (including the Mentawai Basin), off Java, off Sumba, and from the continental shelf of Australia, Vulcan Graben, Timor Sea. For each working area (Tab. 7.2), a short characterisation of the types of sediments found in the gravity cores is summarised below. More details are shown in the individual core description figures.

Working area 1: SW of Mega Island

Only two, comparatively short sediment cores (282 and 161 cm) were recovered from the lower continental slope at water depths of ~2600 and 2800 m seaward of Mega Island that forms an uplifted part of the accretionary wedge off Sumatra. Both cores are characterized by homogenous nannofossil oozes, often foraminifera, diatom, and clay-bearing. No turbidites or ash layers have been observed. A large pumice fragment was found in core GeoB 10006-1.

Working area 2: SW of Siberut Island

Three very short (25 to 165 cm) and one longer (424 cm) core were recovered on the continental slope seaward of Siberut Island. The short cores are from the upper continental slope and display foraminifera-bearing nannofossil oozes with a single thin ash layer close to the top and occasional wood fragments. The longer core retrieved from the lower slope and reveals volcanic ash-bearing nannofossil oozes as the major lithology. However, thin, mostly less than 1 cm thick, coarse layers are ubiquitous throughout the core. They were typified as volcanic ash layers that are partly redeposited ("ash turbidites").

Working area 3: SW of Nias Island

Six sediment cores were successfully recovered from three sites within this northernmost working area off Sumatra (again seaward of the islands) reaching core lengths of ca. 450 cm at each station. The sites form a depth transect between ~1150 and ~2600 m across the middle continental slope. All sediments are characterized by rather homogenous nannofossil oozes, often foraminifera, clay, and/or volcanic glass-bearing, suggesting undisturbed hemipelagic sedimentation. Volcanic ash layers ranging in color from white/greyish to blackish are found at all sites. They are mostly thin (less than 0.5 cm) except for a thicker ash close to the base of core GeoB 10014-3. Thin sandy layers probably representing distal turbidites are rarely found within the recovered sequences.

Working area 4: NE of Siberut Island (Mentawai fore-arc Basin; northern part)

A number of longer sediment cores with core lengths ranging from 433 cm to 812 cm were recovered from the northernmost Mentawai Basin at water depths between ~500 m and ~1600 m. As expected from the setting within a basin, comparatively close to the coast of Sumatra, undisturbed hemipelagic sequences were difficult to obtain. Most sediment cores are characterized by background sedimentation of nannofossil ooze (generally low foraminifera content) with downcore increasing clay content (clay-bearing to clayey). Particularly in the lower 2-3 m of each core, we observed frequent intercalations of sandy turbidites, often characterized by abundant pteropod shell debris and volcanic ash layers. An exception is core GeoB 10025-4 with primarily undisturbed hemipelagic sediments and a few ash layers. Core GeoB 10024-4 displays abundant coarse layers with up to gravel-sized components and abundant plant/wood debris.

Working area 5: SE of Siberut Island (Mentawai fore-arc Basin; middle part)

We recovered five comparatively long sediment cores at four stations, primarily from the deeper part of the basin. Only the comparatively shallow-water core GeoB 10029-4 and the uppermost ~6 m of GeoB 10032-2 are dominated by fine-grained foraminifera-bearing

nannofossil oozes with only a few ash layers and very thin sandy layers that may represent distal turbidites. The other coring sites from the deep basin are substantially influenced by sediment redeposition. Core GeoB 10033-4 shows, for instance, very abundant sandy intervals alternating with foraminifera-bearing nannofossil ooze representing the background sedimentation. The sandy intervals partly show clear fining-upward, whereas further downcore a number of inversely graded, coarsening-upward sequences have been observed. Ash layers appear to be less common in this working area, and are for example absent in core GeoB 10032-2.

Working area 6: E of Mega Island (Mentawai fore-arc Basin; southern part)

This working area is the landward prolongation of working area 1. Three cores ranging from 540 to 993 cm length were recovered at two sites (with similar water depths of ~1000 m) from both sides of the basin. Sediments in all cores are dominated by rather homogenous, strongly bioturbated oozes primarily composed of foraminifera and nannofossils. The core from the seaward side of the basin (GeoB 10034-4) contains a number of thin turbidites, is generally rich in pteropod shell debris, and displays a prominent light ash layer at ~8 m core depth. The two cores from the Sumatra slope are free of turbidites and only one bioturbated purple ash layer has been observed.

Working area 7: Bengkulu fore-arc Basin and adjacent continental slope

Six sediment cores at five sites have been recovered in this working area. Core GeoB 10036-4, located on the Sumatra slope at ~1500 m depth, reveals a homogenous sequence of foraminifera and partly diatom-bearing nannofossil oozes with only a few thin sandy layers or patches, partly containing volcanic ash. Below a thick ash layer at 430 cm core depth, an abrupt color change occurs and sediments are stiff and consist of nannofossil ooze. Both cores from site GeoB 10037, close to the deepest area of the basin, contain more frequent thin sandy layers, otherwise are dominated by homogenous clay-bearing nannofossil ooze with increasing downcore diatom content (partly nannofossil-diatom ooze). Cores GeoB 10038-4 (901 cm long) and the short core GeoB 10039-4 (190 cm) from the continental slope outside the Bengkulu basin contain a few more sandy intervals on up to dm-scale. The major lithology is, however, diatom and foraminifera-bearing nannofossil ooze. Finally, core GeoB 10040-4 (673 cm) for the lower continental slope primarily displays a well-bedded intercalation of more or less “sandy” nannofossil diatom ooze, probably largely redeposited and/or affected by winnowing.

Working area 8: Sunda Strait

Three cores from two sites were taken from the continental slope off the entrance of the Sunda Strait at ~2200 and 2500 m water depth. Core GeoB 10042-1 contains homogenous sediments primarily composed of diatoms and nannofossils with minor amounts of foraminifera. We observed two ash layers, one close to the top (possibly originating from the recent Krakatau eruption) and a second at 470 cm core depth. The sequence is free of turbidites. The upper half of core GeoB 10043-3 displays a very similar sequence (including the ash layer close to the top). Sediments become, however, sandier below a distinct “ash turbidite” with a clear erosional base. Another thick sandy turbidite is located near the base of this core.

Working area 9: South of Cilacap (south of Java)

Four cores from four sites were taken from the basin floor and the southern slope of the fore-arc basin south of Java between ~1780 and 3560 m water depth. Cores GeoB 10044-4 and GeoB 10045-5 were retrieved from the basin floor containing sediments primarily composed of nannofossils with minor amounts of planktic foraminifera, both showing a variety of changes in the sediment color downcore. Whereas GeoB 10044-4 displays two thin ash layers

between 385 and 405 cm core depth, the nearby core GeoB 10045-5 is free of ash layers with several distal turbidites of 1 to 4 cm between 190 and 370 cm core depth. Cores GeoB 10046-6 and GeoB 10047-2 were taken from the southern, seaside slope and are of the same length (565 cm) and the same lithology (nannofossil ooze). The deeper core GeoB 10046-6, however, contains more bioturbation, shell fragments and tiny turbidite layers than the shallower core GeoB 10047-2. Only one ash layer could be observed in each of the cores, at ~530 cm (GeoB 10046-6) and at ~410 cm (GeoB 10047-2).

Working area 10: Yogya Ridge (south of Java)

Five cores from four sites were recovered from the Yogya Ridge, which separates the Lombok Basin in the east from the Java Basin in the west. Cores GeoB 10049-6, GeoB 10052-5 and GeoB 10052-8 were retrieved from the upper continental slope of Java at 1290 and 1000 m water depth, respectively. They contain slightly bioturbated, homogenous sediments of nannofossil- to foram-bearing nannofossil ooze. GeoB 10049-6 displays a 1 cm thin ash layer at ~200 cm, and a 12 cm thick ash layer between 376 and 388 cm core depth. Cores GeoB 10050-2 and GeoB 10051-6 were retrieved from the upper and lower part of the southern, seaside slope. The relatively short cores (~380 and 220 cm length) were taken on top of morphological highs containing homogenous nannofossil ooze sediments probably reflecting the open ocean environment. A five cm thick ash layer could be observed at ~340 cm core depth in GeoB 10050-2.

Working area 11: Western Lombok Basin

Eight cores from 6 sites were retrieved along this N-S transect in the western Lombok Basin. However, only five of them contained undisturbed marine sediments (see Tab. 7.2). The relatively long cores GeoB 10053-7 (~760 cm) and GeoB 10054-4 (~840 cm) from the upper part of the continental slope contain clay-bearing and clayey nannofossil ooze to nannofossil ooze sediments with a strong H₂S smell. Between 625 and 635 cm core depth, a 10 cm thick ash layer could be observed in GeoB 10054-4. The sediments of the core GeoB 10055-6 from the basin floor at 2600 m water depth are characterized by several thin volcanic glass ooze to volcanic glass-bearing nannofossil ooze intercepting the background sedimentation of organic-rich diatom nannofossil ooze. The same features can be observed in the cores GeoB 10061-6 and GeoB 10061-7 from the lower part of the southern, seaside slope.

Working area 12: Eastern Lombok Basin

Six cores from five sites were taken in a SW-NE transect from the lower continental slope at ~2500 m water depth (GeoB 10063-6) to the upper continental slope at ~1140 m water depth (GeoB 10067-6) in the eastern part of the Lombok Basin, west of Sumba Island. All cores were relatively long (650-990 cm) with a strong H₂S smell typical for such organic-rich sediments. In addition, the amount of ash layers in these homogenous, nannofossil ooze sediments were comparatively low (0-1 in each core), and the color of the sediments remain more or less constant throughout the cores.

Working area 13: Savu Basin

Three cores from two sites were recovered at ~2000 m water depth on the lower part (GeoB 10068-2) and at 1250 m water depth on the upper part (GeoB 10069-1, GeoB 10069-3) of the western slope of the Savu Basin. The relatively long cores (730 to 960 cm) are characterized by strongly homogenous, silica-bearing nannofossil ooze sediments. One additional, short core (GeoB 10070-5, ~170 cm length) was retrieved from the middle slope in the SW part of the Save Basin. However, this core was not samples due to the topography and the PARASOUND profile of the site indicating older structures penetrating the younger sediments. This finding was additionally supported by the stiff to medium lithified clayey sediments.

Working area 14: Vulcan Graben

One core was taken from the Vulcan Graben, Timor Sea at ~330 m water depth. The core was not opened onboard.

Legend SO-184

Lithology

one major component

calcareous



foraminifera ooze



nannofossil ooze

siliceous

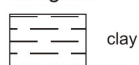


siliceous ooze



diatom ooze

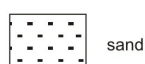
terrigenous



clay



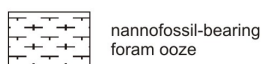
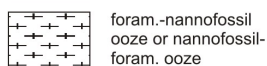
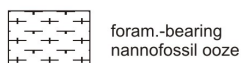
silt



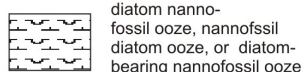
sand

mixtures

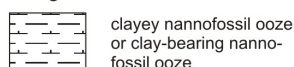
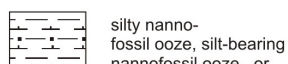
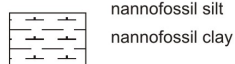
calcareous

nannofossil-bearing
foram oozeforam.-nannofossil
ooze or nannofossil-
foram. oozeforam.-bearing
nannofossil ooze

siliceous

diatom nanno-
fossil ooze, nannofossil
diatom ooze, or diatom-
bearing nannofossil ooze

terrigenous/volcanic

clayey nannofossil ooze
or clay-bearing nanno-
fossil oozesilty nanno-
fossil ooze, silt-bearing
nannofossil ooze, or
nannofossil silt

nannofossil clay

volcanic ash-bearing
nannofossil ooze

Structures



weakly bedded



bedded/laminated

mm
cm
dm
dimension of
bedding

scoured bedding



bioturbated (<30% of sediment)



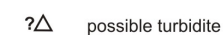
bioturbated (<30-60% of sediment)



bioturbated (>60% of sediment)



turbidite



possible turbidite



erosiv contact

Fossils



shells



shell fragments



plant/wood fragments

Others



volcanic ash layer



pumice fragment

Color

Munsell value

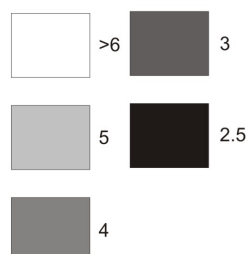


Fig. 7.2: Legend for the following core descriptions.

GeoB 10005-3

Date: 04.08.05 Pos: 04°27.44'S 100°53.78'E
 Water Depth: 2570 m Core Length: 282 cm

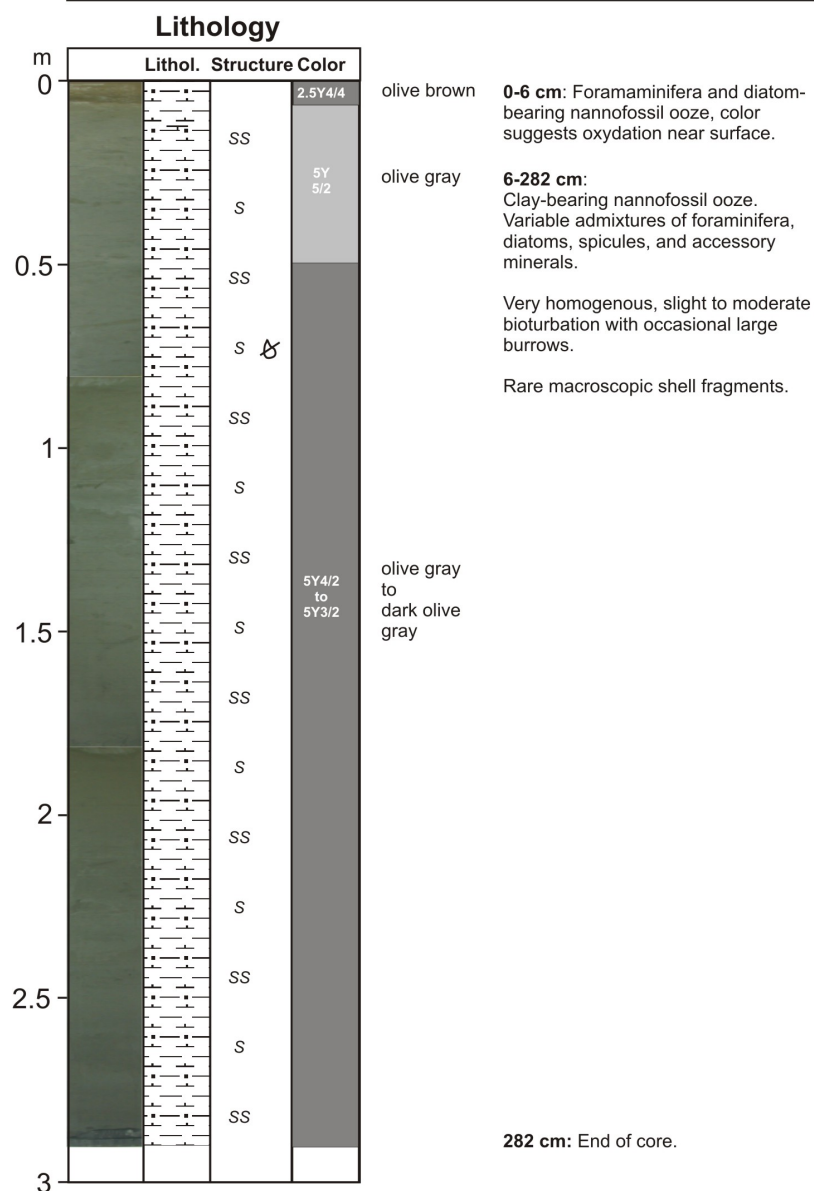


Fig. 7.3: Core description for core GeoB 10005-3.

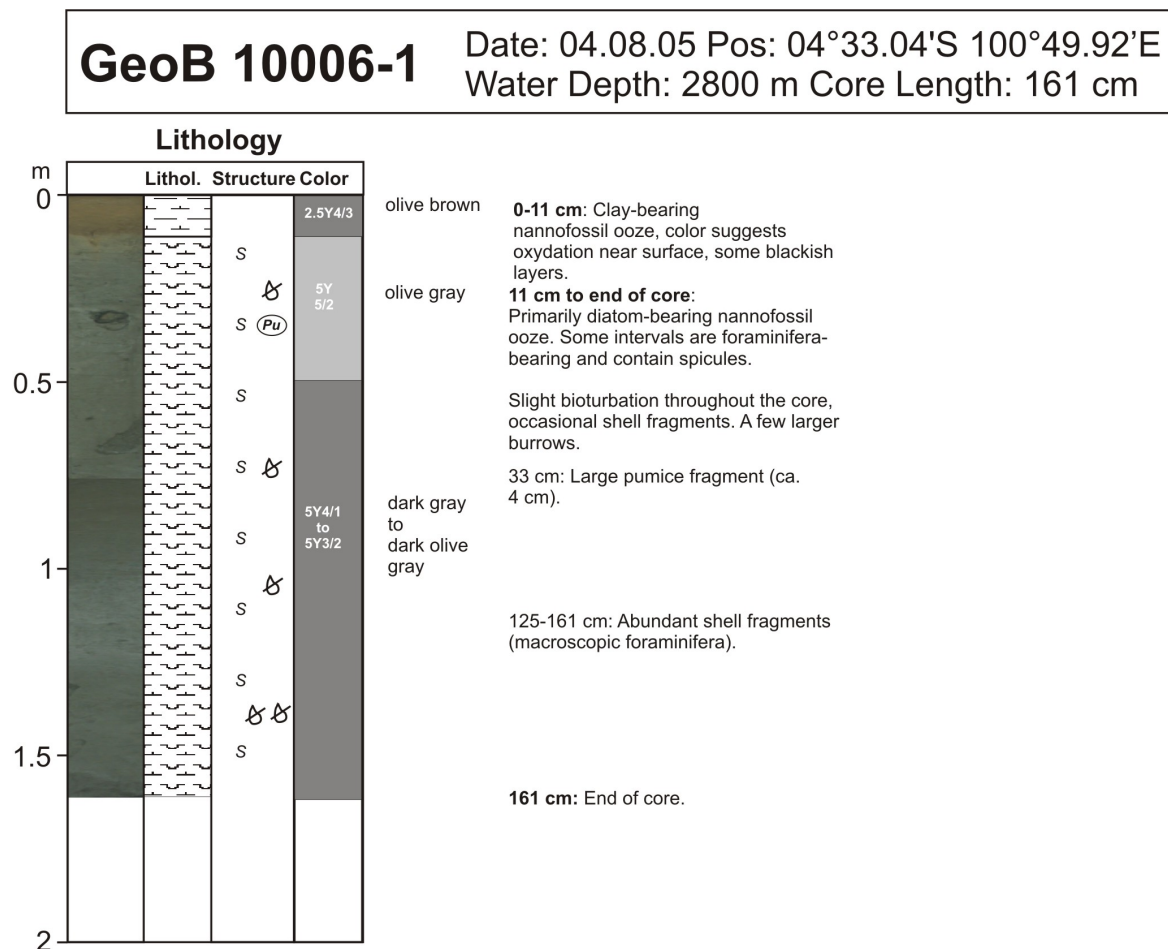


Fig. 7.4: Core description for core GeoB 10006-1.

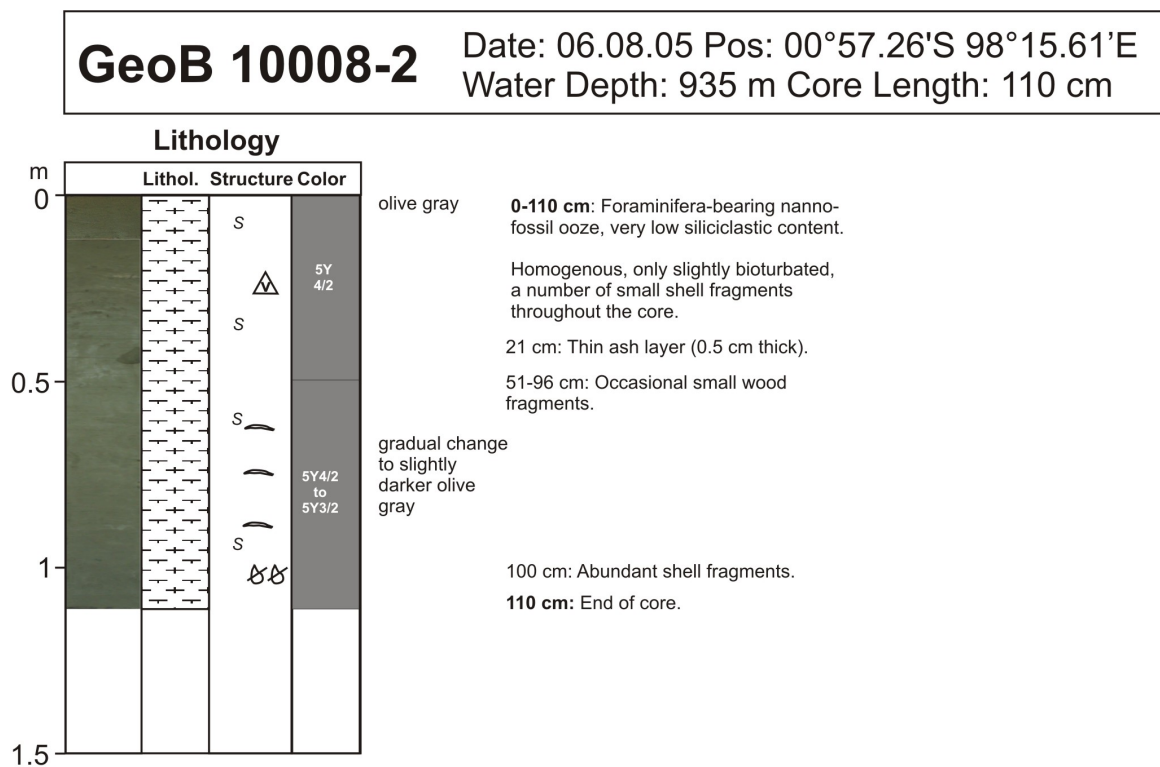


Fig. 7.5: Core description for core GeoB 10008-2.

GeoB 10008-3

Date: 06.08.05 Pos: 00°57.26'S 98°15.61'E
 Water Depth: 935 m Core Length: 165 cm

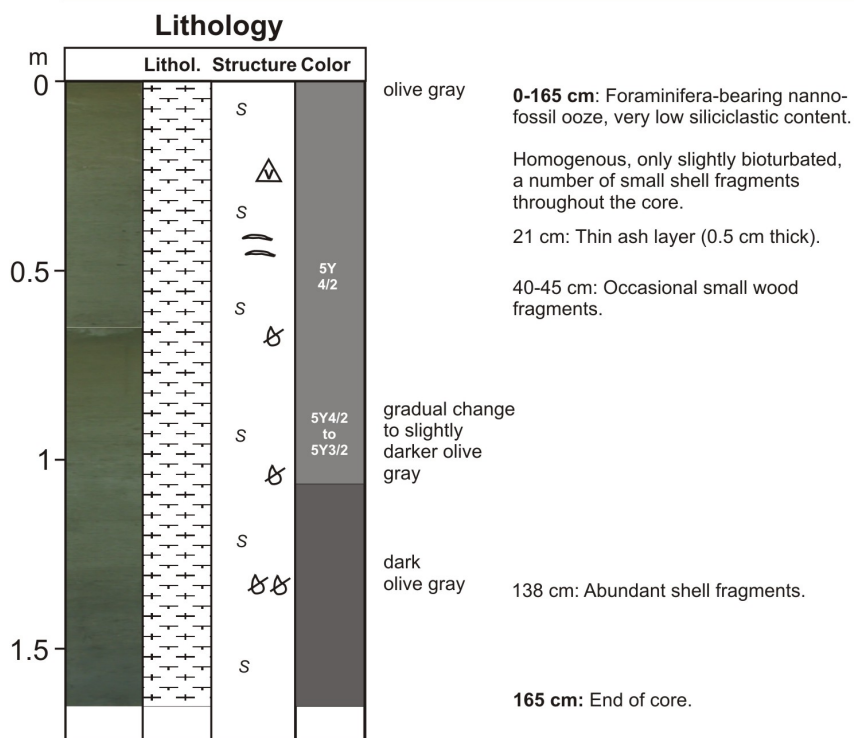


Fig. 7.6: Core description for core GeoB 10008-3.

GeoB 10009-2

Date: 06.08.05 Pos: 01°03.78'S 98°03.21'E
 Water Depth: 2100 m Core Length: 25 cm

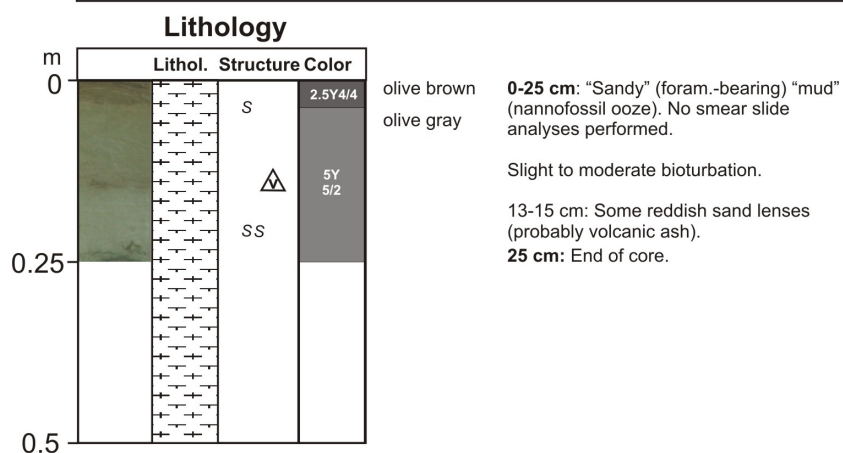


Fig. 7.7: Core description for core GeoB 10009-2.

GeoB 10010-2

Date: 06.08.05 Pos: 01°10.78'S 97°58.97'E
 Water Depth: 2953 m Core Length: 424 cm

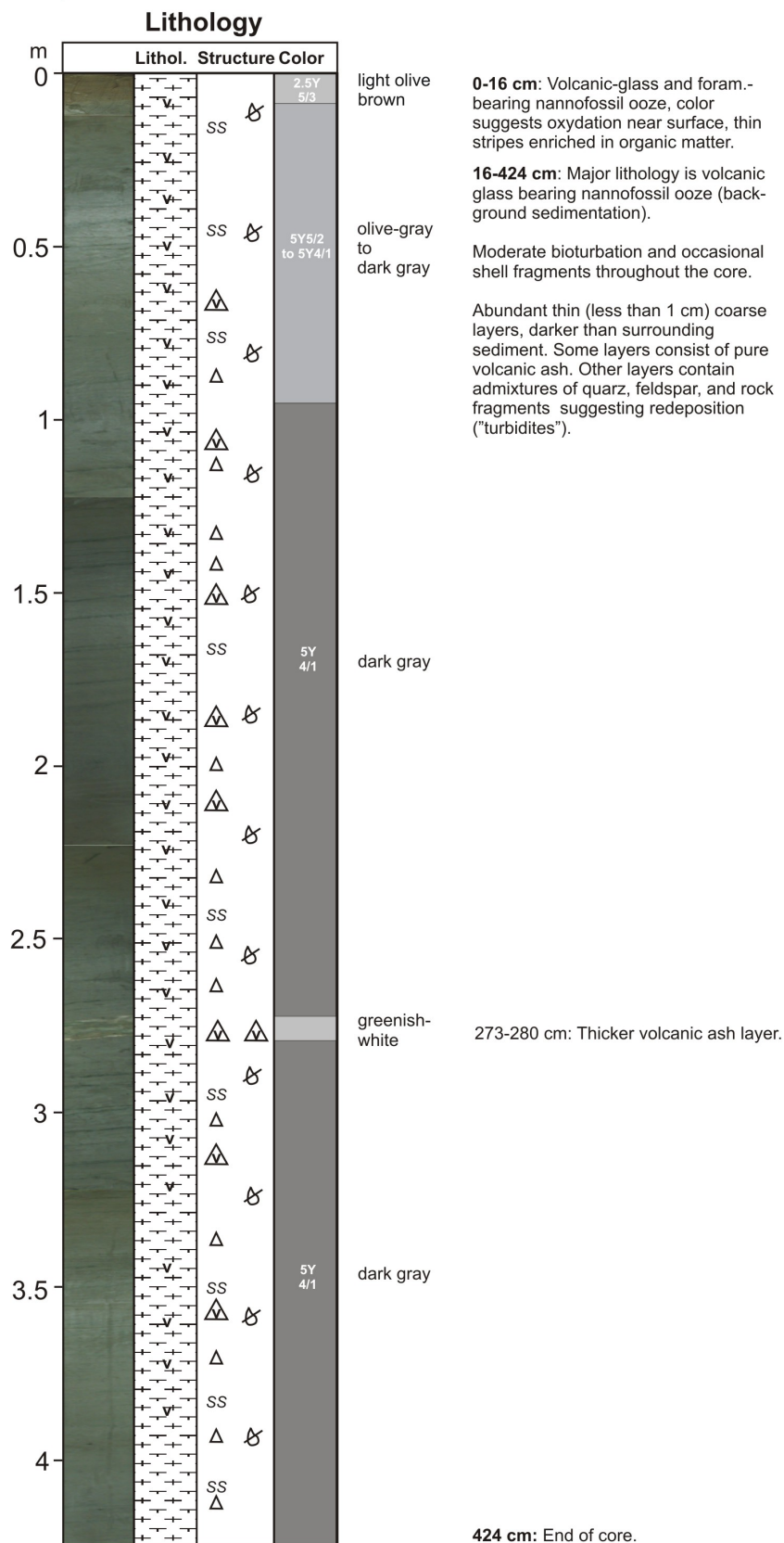


Fig. 7.8: Core description for core GeoB 10010-2.

GeoB 10014-2

Date: 08.08.05 Pos: 01°40.80'N 96°58.90'E
 Water Depth: 1159 m Core Length: 65 cm

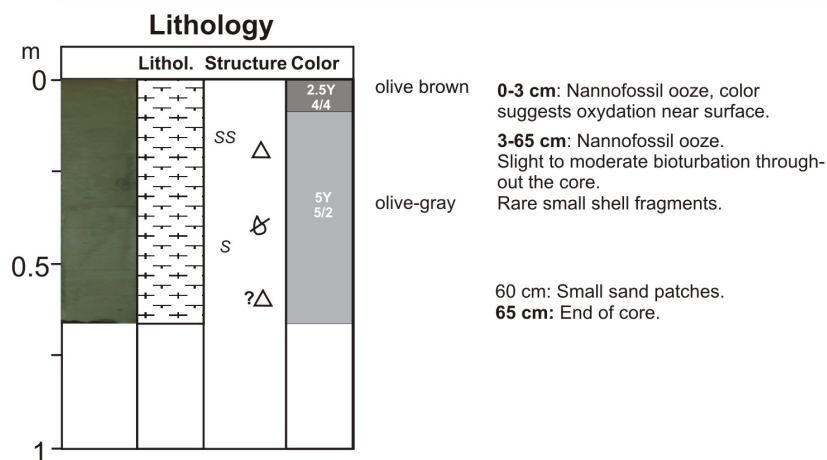


Fig. 7.9: Core description for core GeoB 10014-2.

GeoB 10014-3

Date: 08.08.05 Pos: 01°40.80'N 96°58.90'E
 Water Depth: 1159 m Core Length: 476 cm

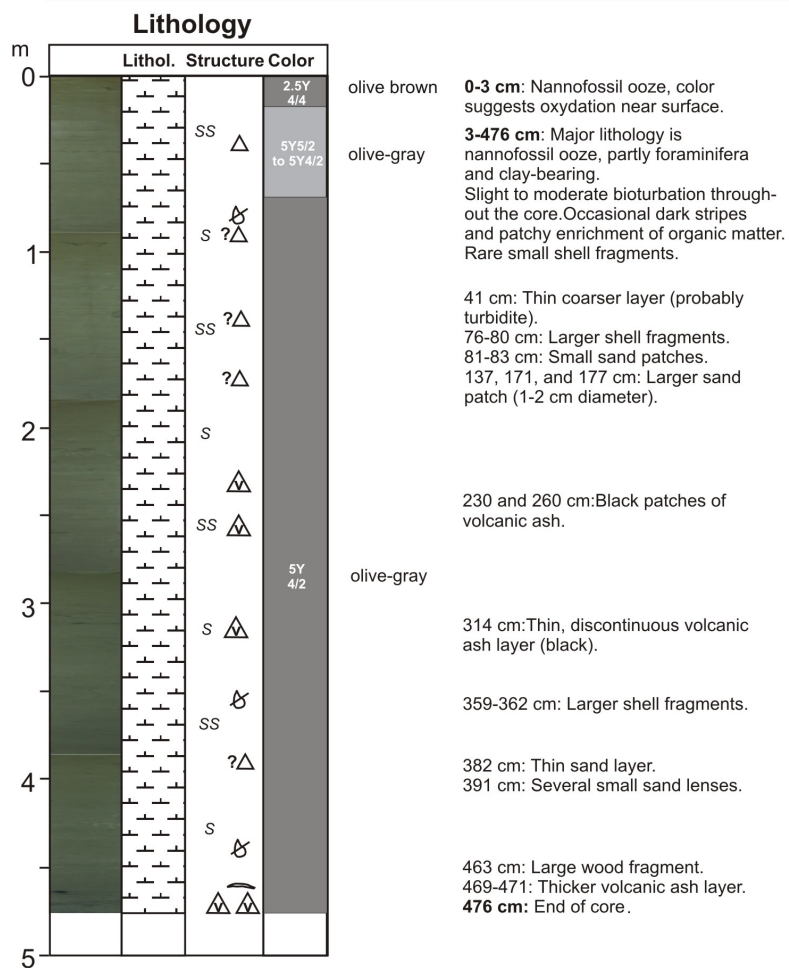


Fig. 7.10: Core description for core GeoB 10014-3.

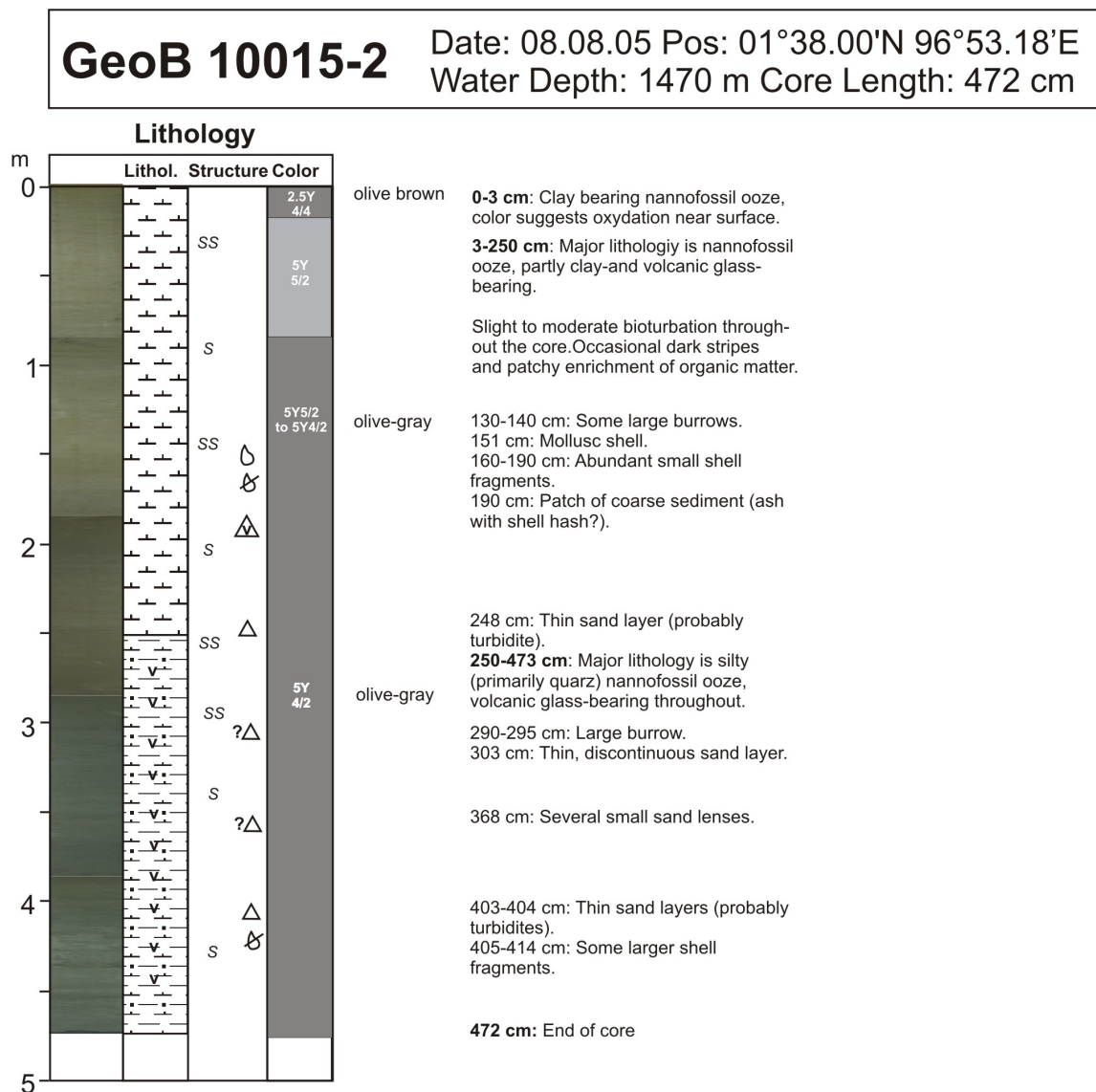


Fig. 7.11: Core description for core GeoB 10015-2.

GeoB 10020-3

Date: 09.08.05 Pos: 01°40.80'N 96°58.90'E
 Water Depth: 1159 m Core Length: 464 cm

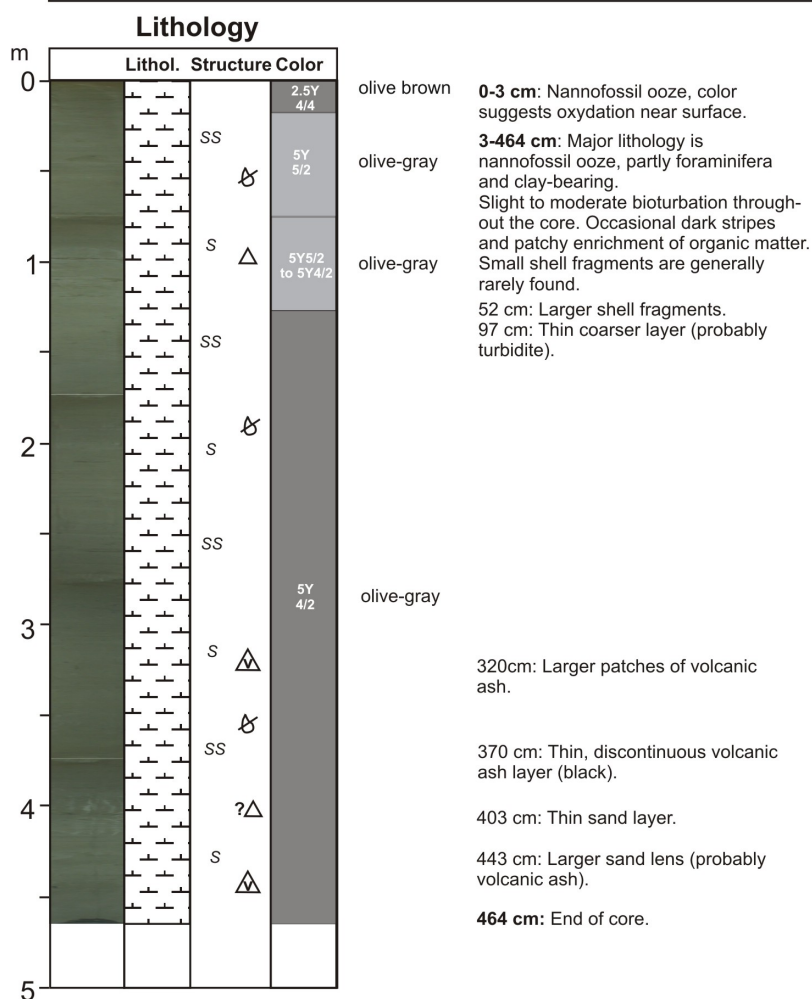


Fig. 7.12: Core description for core GeoB 10020-3.

GeoB 10021-1

Date: 09.08.05 Pos: 01°35.35'N 96°39.66'E
Water Depth: 1851 m Core Length: 417 cm

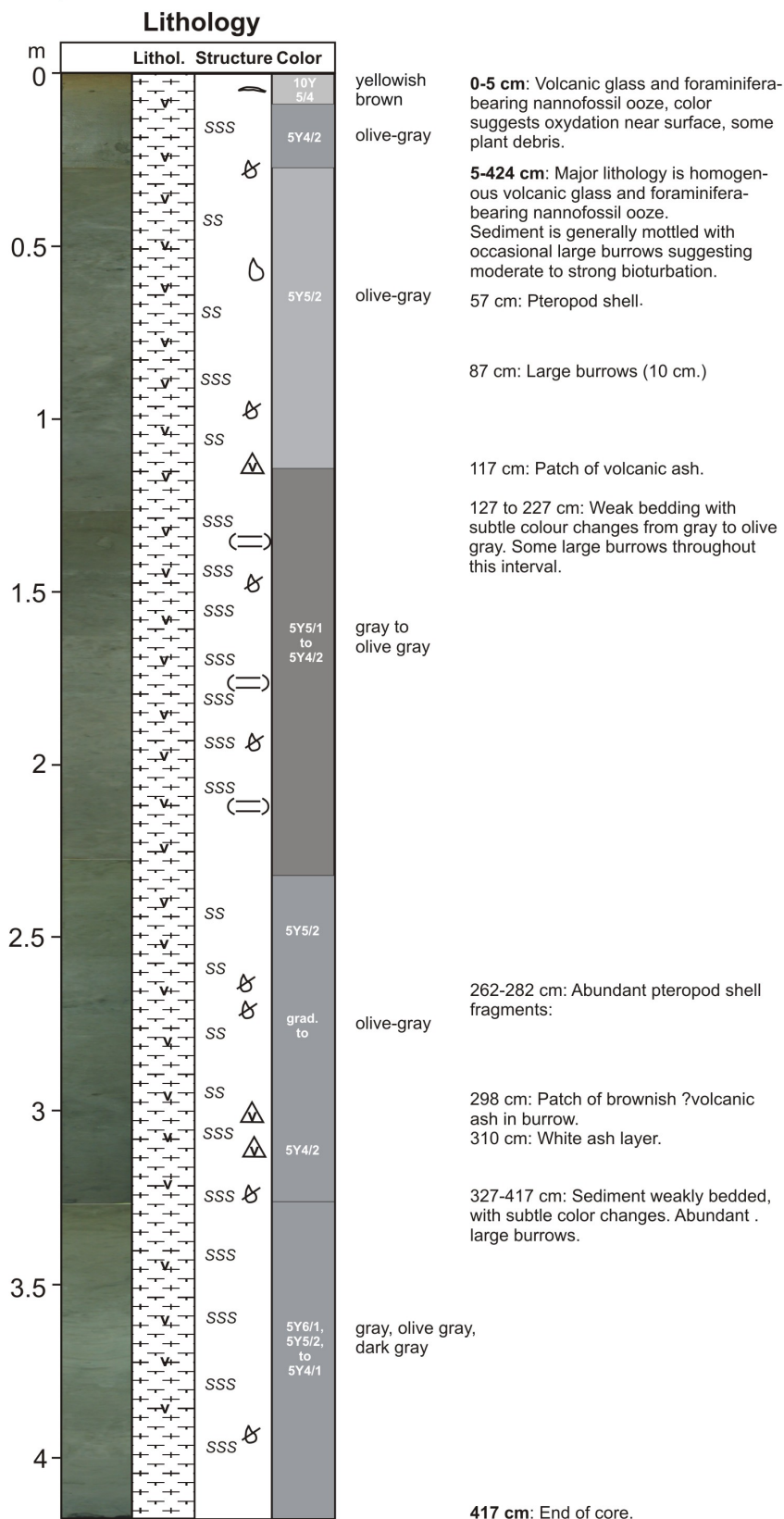


Fig. 7.13: Core description for core GeoB 10021-1.

GeoB 10021-2

Date: 09.08.05 Pos: 01°35.63'N 96°39.66'E
 Water Depth: 1905 m Core Length: 417 cm

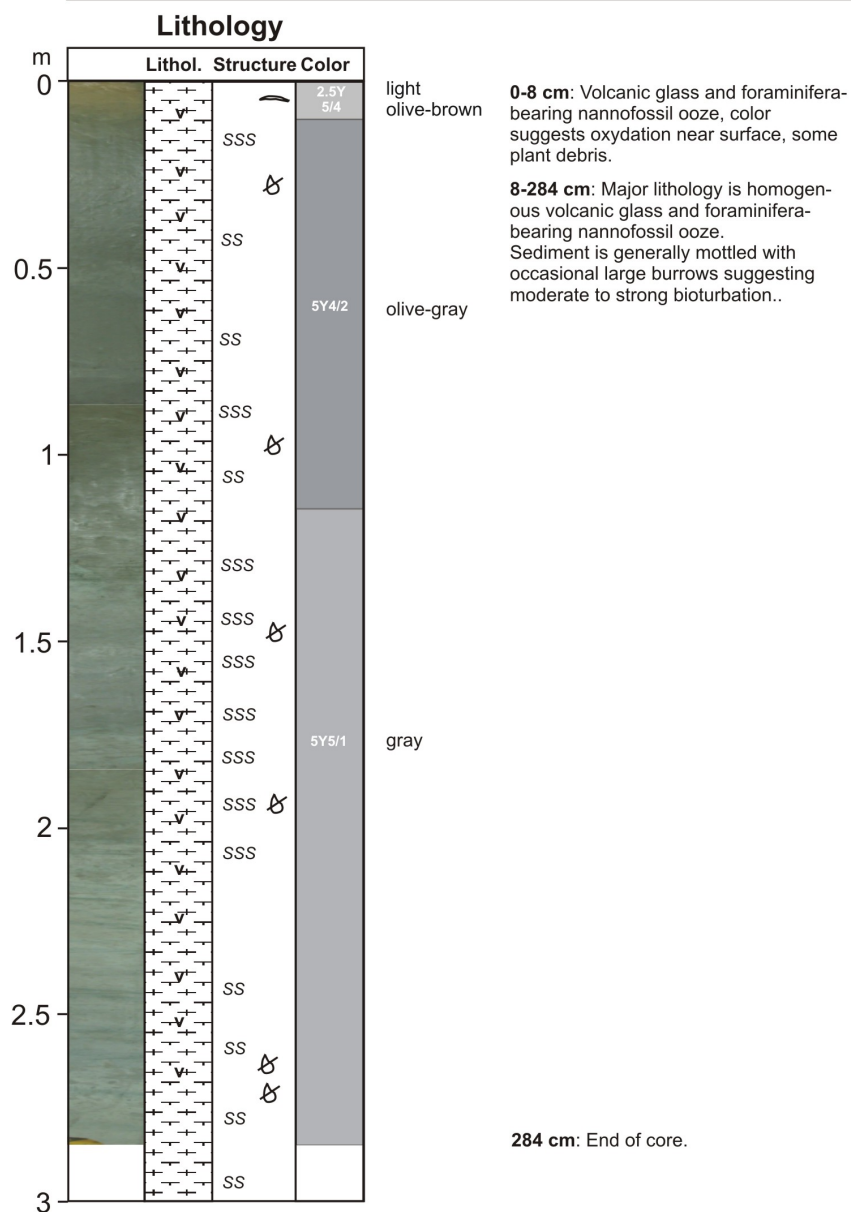


Fig. 7.14: Core description for core GeoB 10021-2.

GeoB 10022-4

Date: 10.08.05 Pos: 00°30.00'S 98°51.00'E
 Water Depth: 709 m Core Length: 508 cm

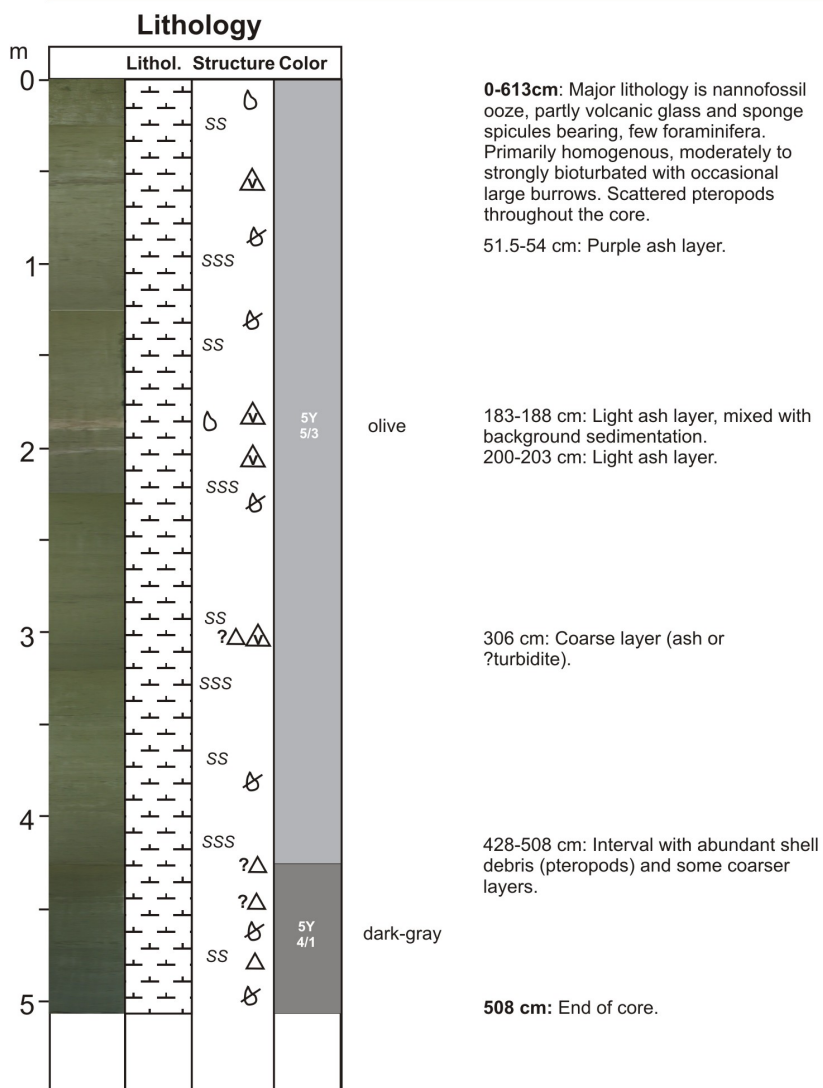


Fig. 7.15: Core description for core GeoB 10022-4.

GeoB 10022-5

Date: 10.08.05 Pos: 00°30.00'S 98°51.00'E
 Water Depth: 709 m Core Length: 613 cm

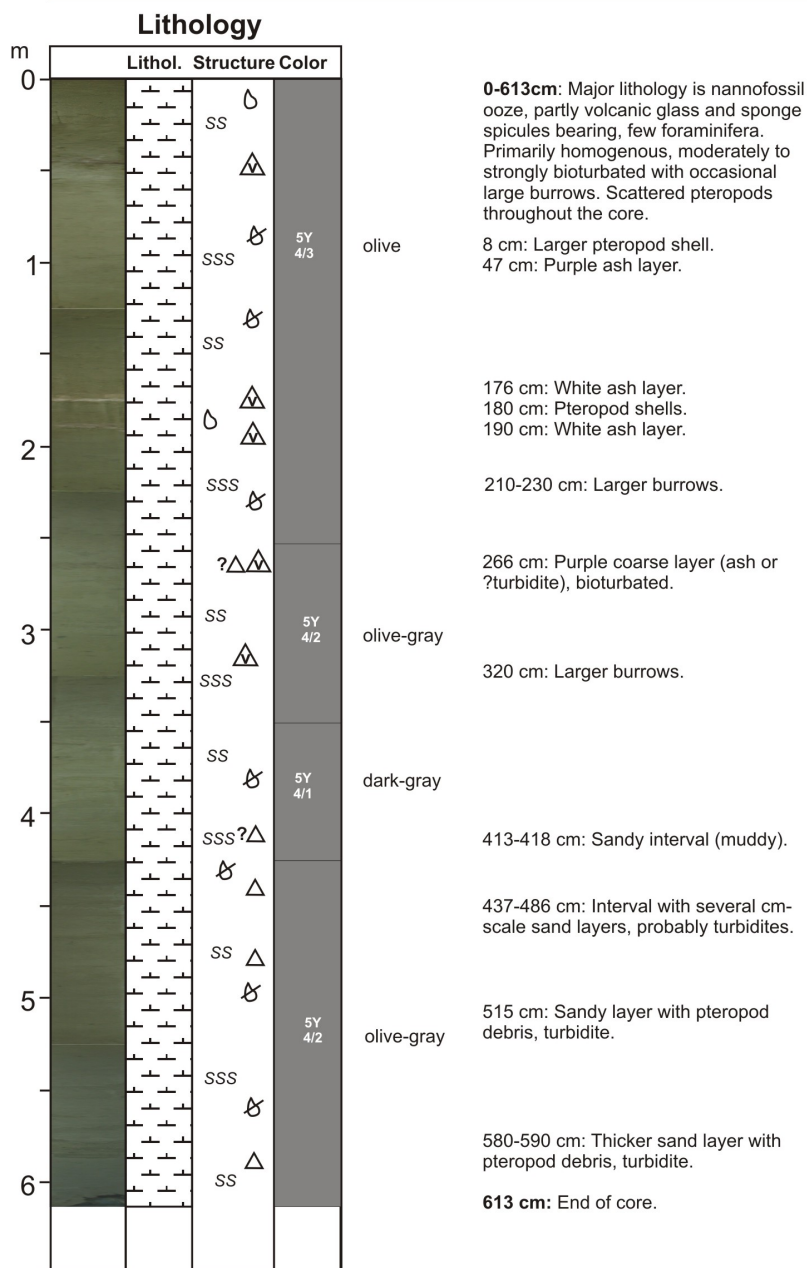


Fig. 7.16: Core description for core GeoB 10022-5.

GeoB 10023-4

Date: 11.08.05 Pos: 00°51.44'S 99°24.49'E
 Water Depth: 1557 m Core Length: 589 cm

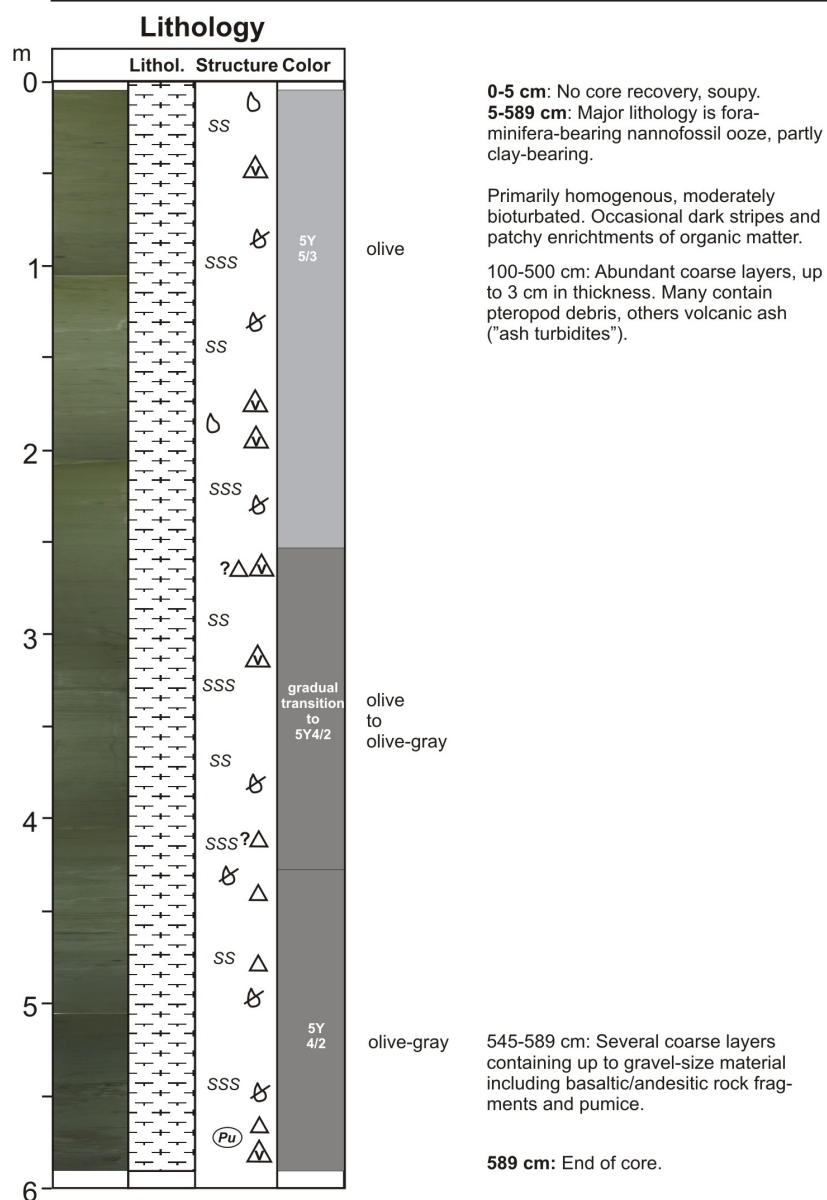


Fig. 7.17: Core description for core GeoB 10023-4.

GeoB 10024-4

Date: 11.08.05 Pos: 00°46.09'S 99°16.04'E
 Water Depth: 1381 m Core Length: 617 cm

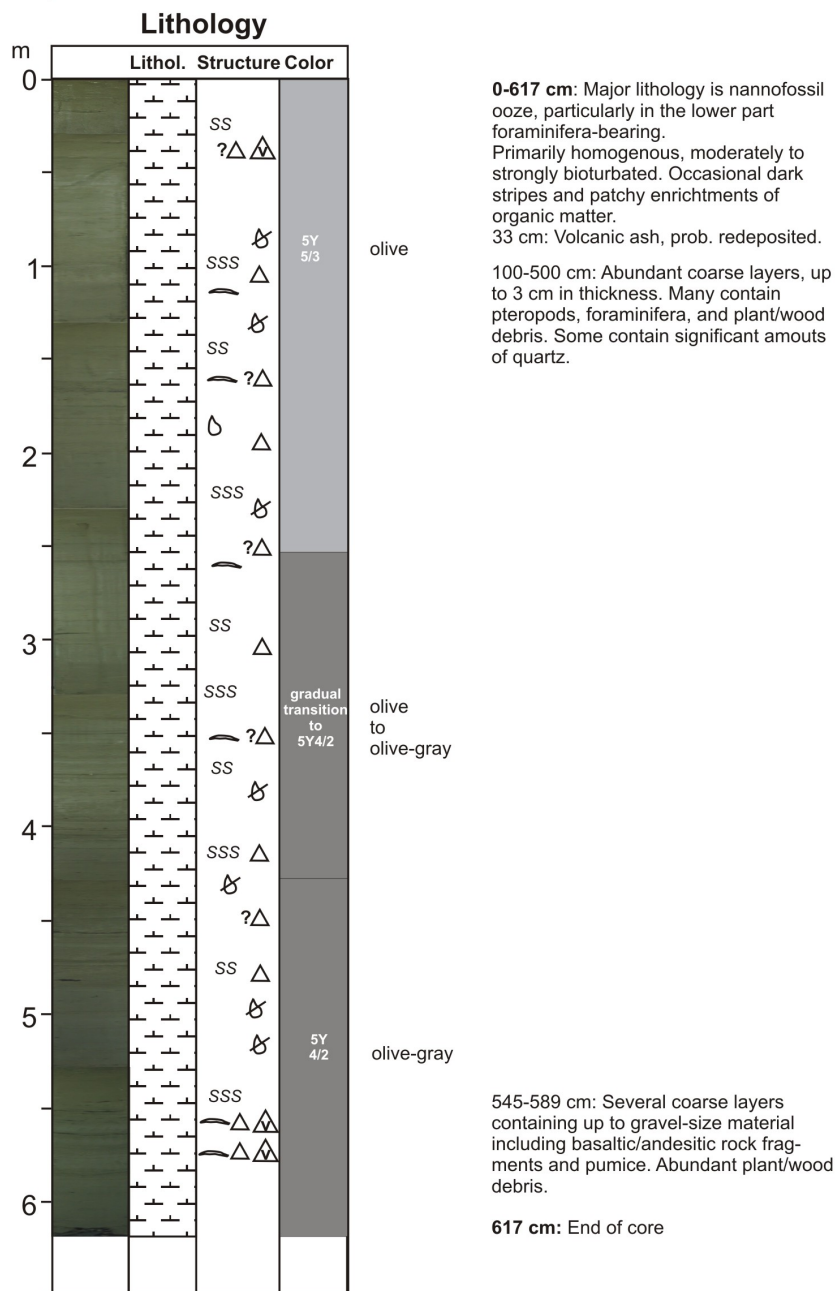


Fig. 7.18: Core description for core GeoB 10024-4.

GeoB 10025-4

Date: 11.08.05 Pos: 00°40.49'S 99°07.39'E
 Water Depth: 1148 m Core Length: 650 cm

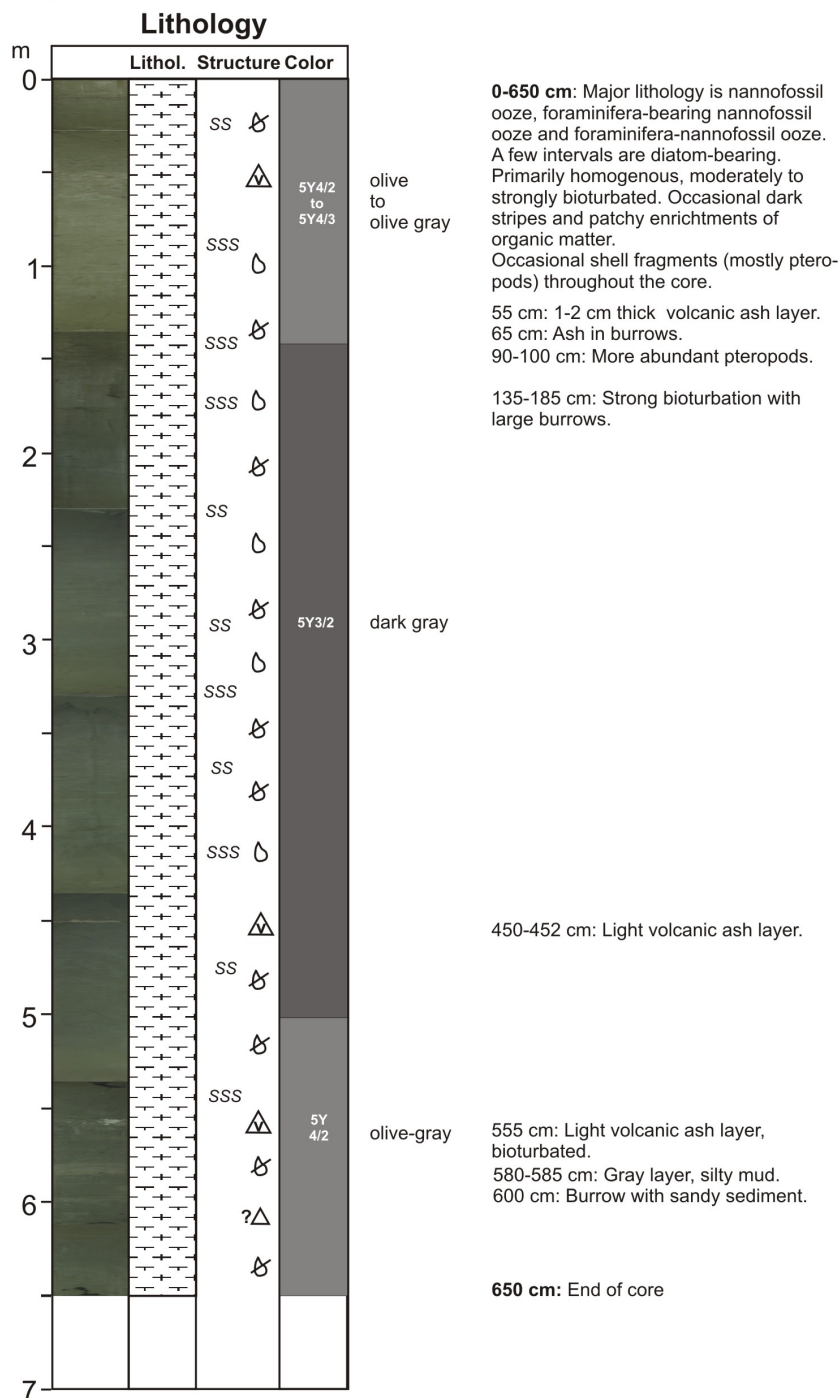


Fig. 7.19: Core description for core GeoB 10025-4.

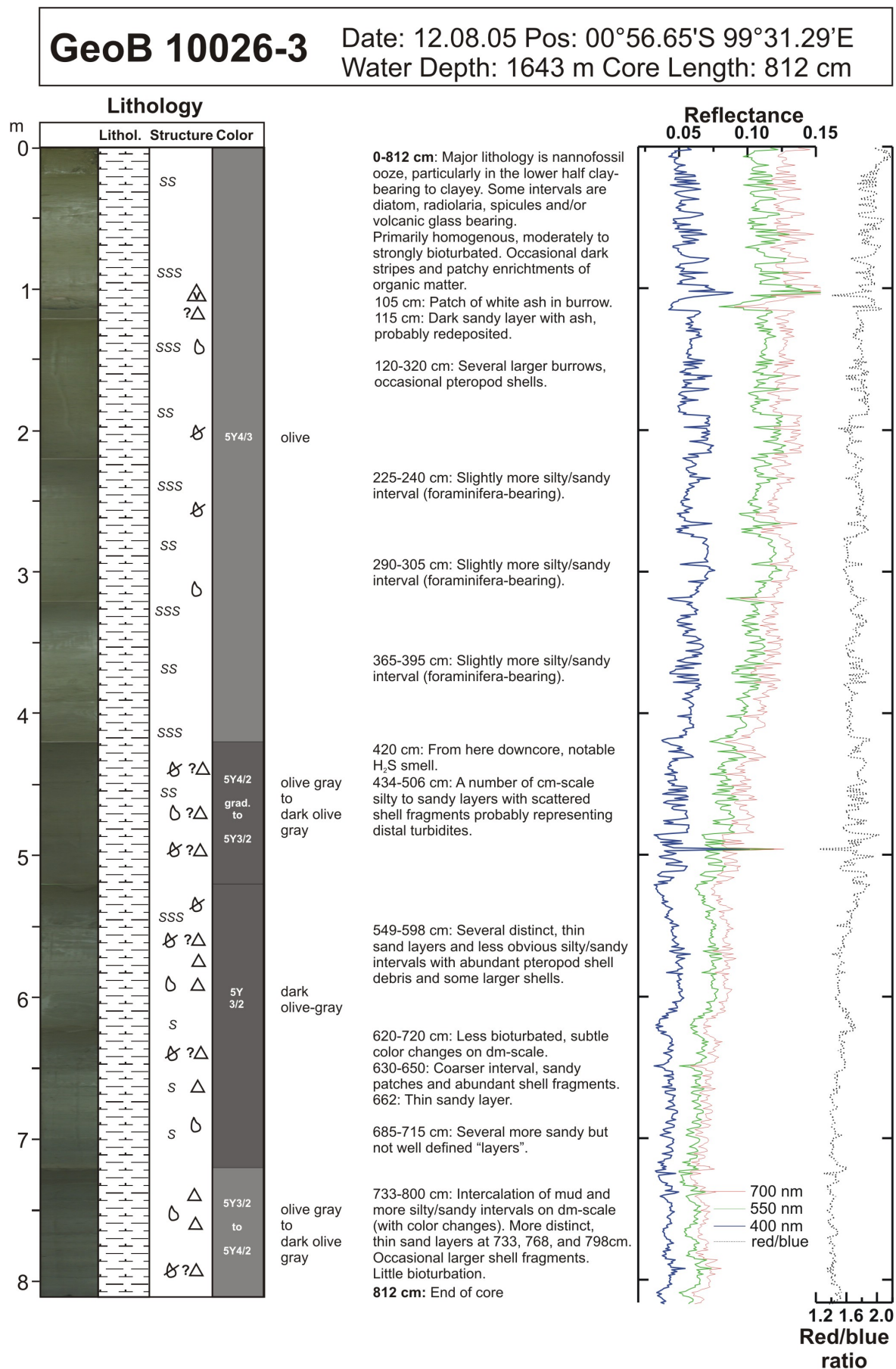


Fig. 7.20: Core description for core GeoB 10026-3.

GeoB 10026-4

Date: 12.08.05 Pos: 00°56.63'S 99°31.28'E
 Water Depth: 1638 m Core Length: 665 cm

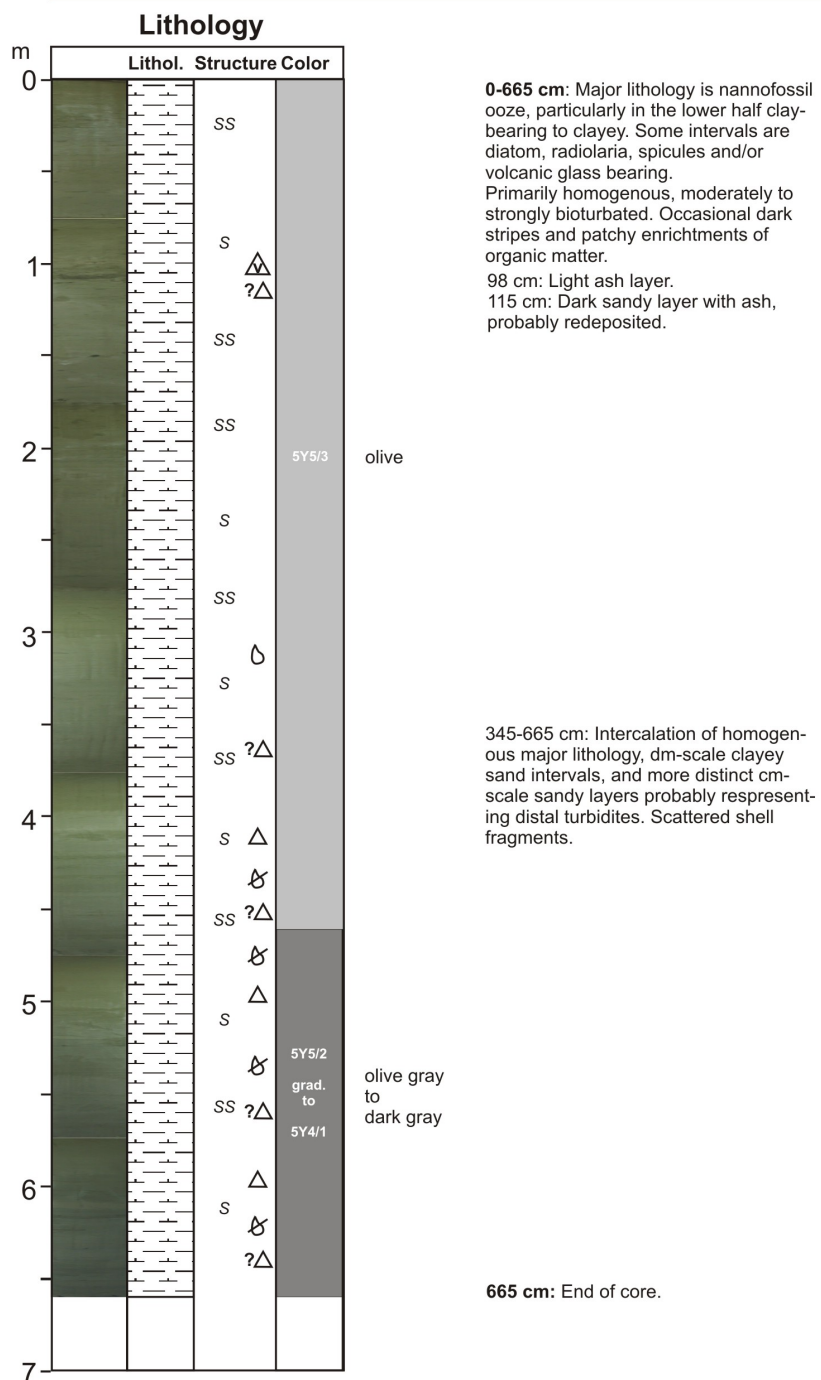


Fig. 7.21: Core description for core GeoB 10026-4.

GeoB 10027-4

Date: 12.08.05 Pos: 00°48.54'S 99°39.17'E
 Water Depth: 874 m Core Length: 530 cm

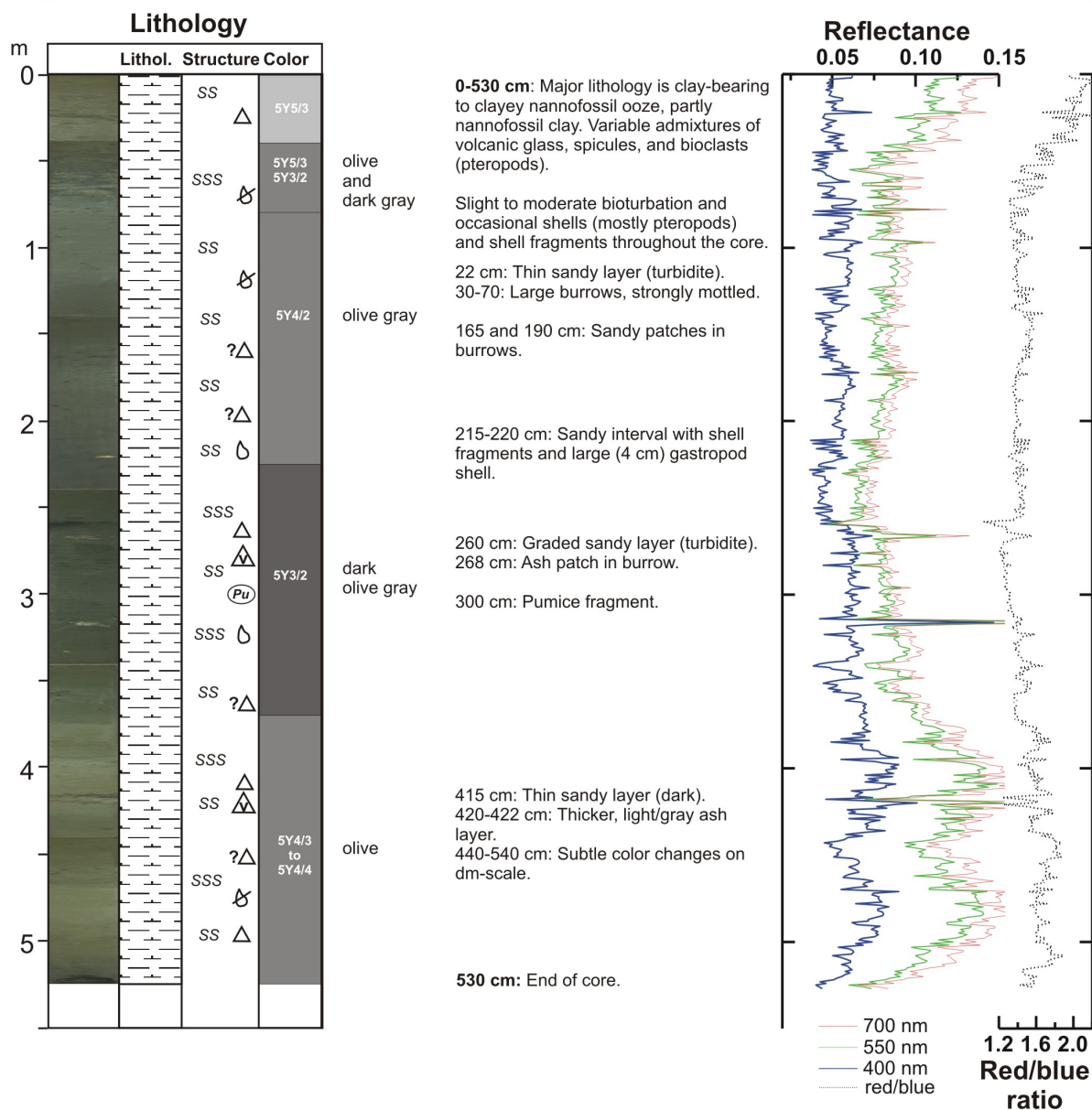


Fig. 7.22: Core description for core GeoB 10027-4.

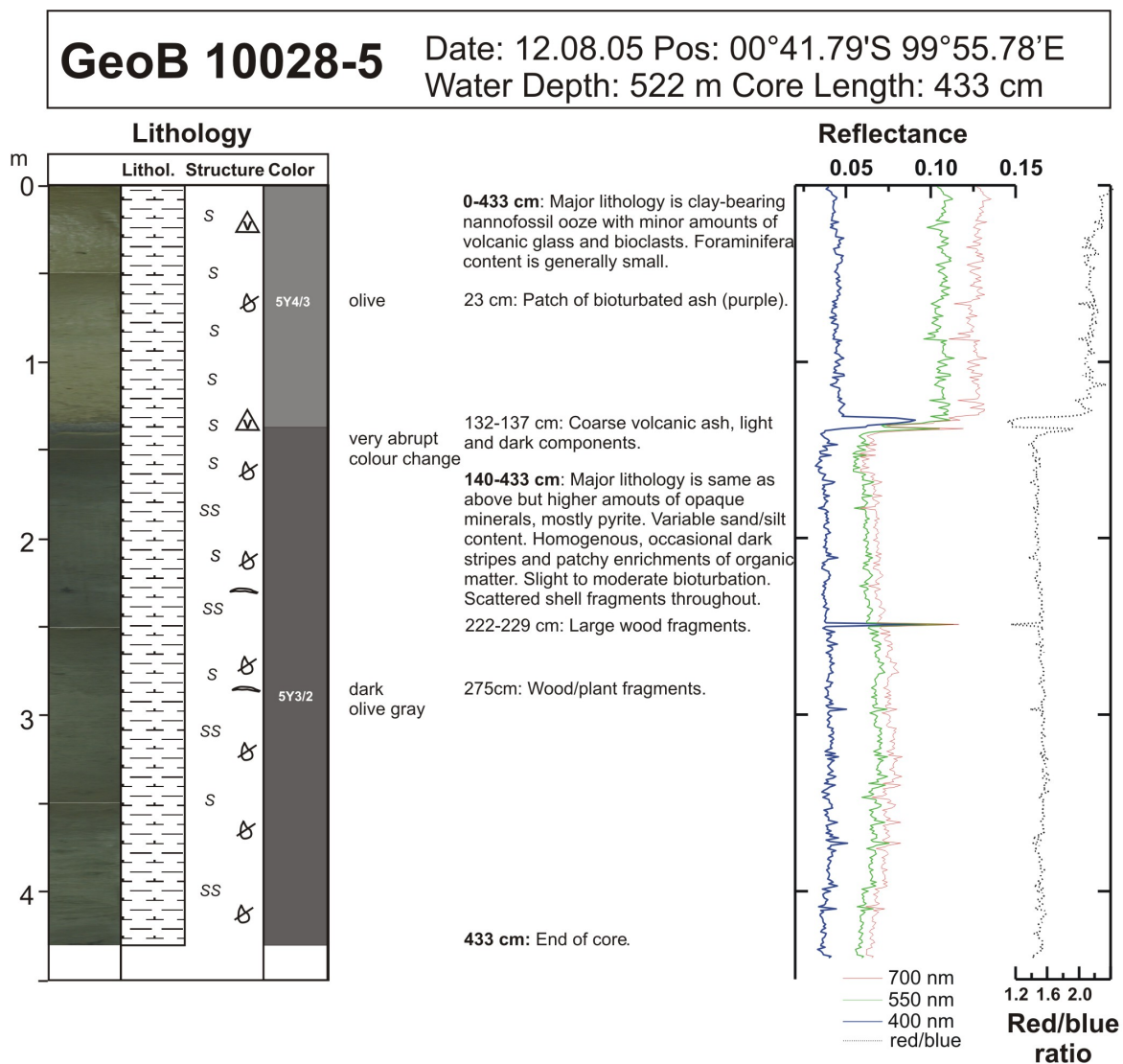


Fig. 7.23: Core description for core GeoB 10028-5.

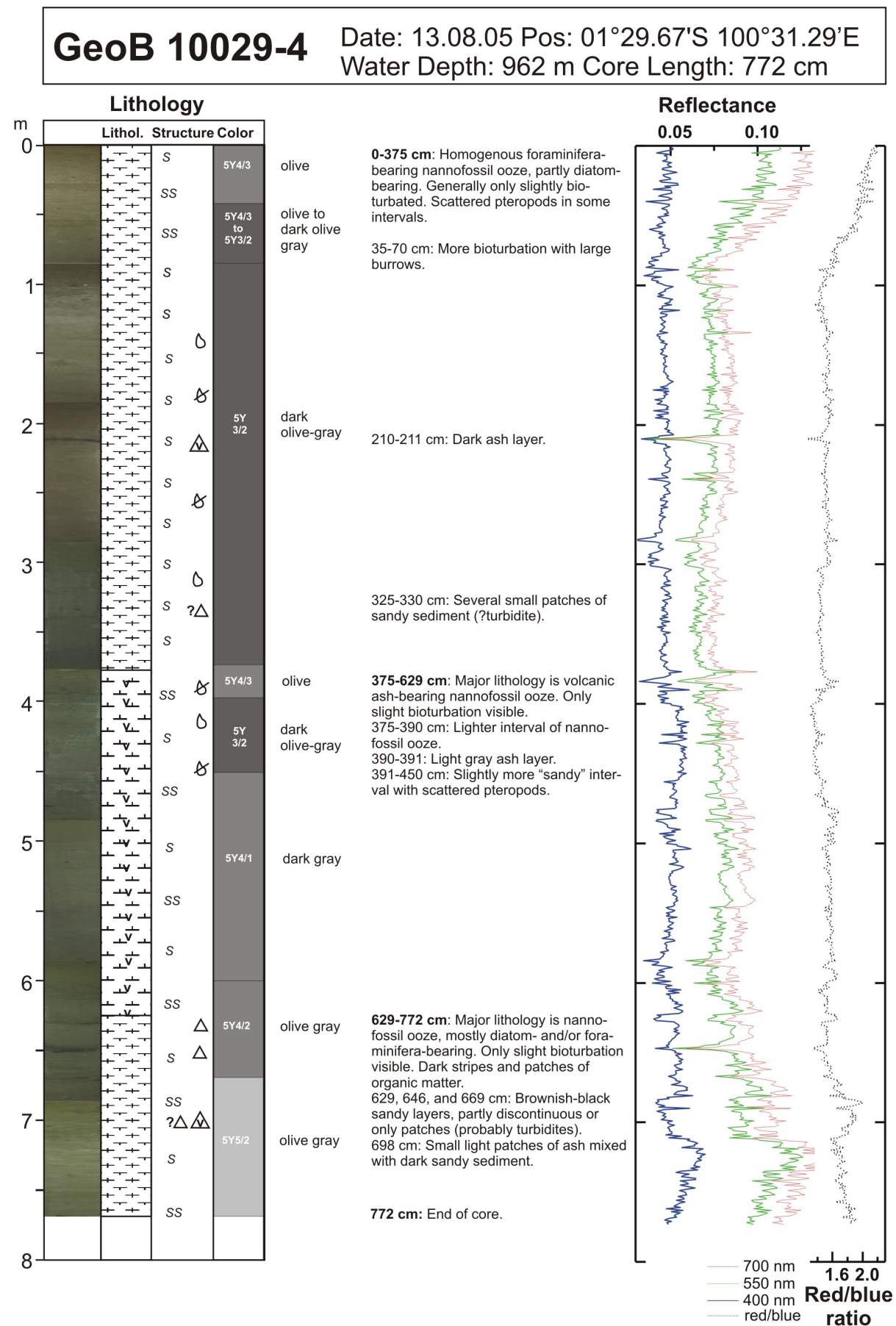


Fig. 7.24: Core description for core GeoB 10029-4.

GeoB 10031-4

Date: 14.08.05 Pos: 01°41.92'S 99°36.21'E
 Water Depth: 1668 m Core Length: 572 cm

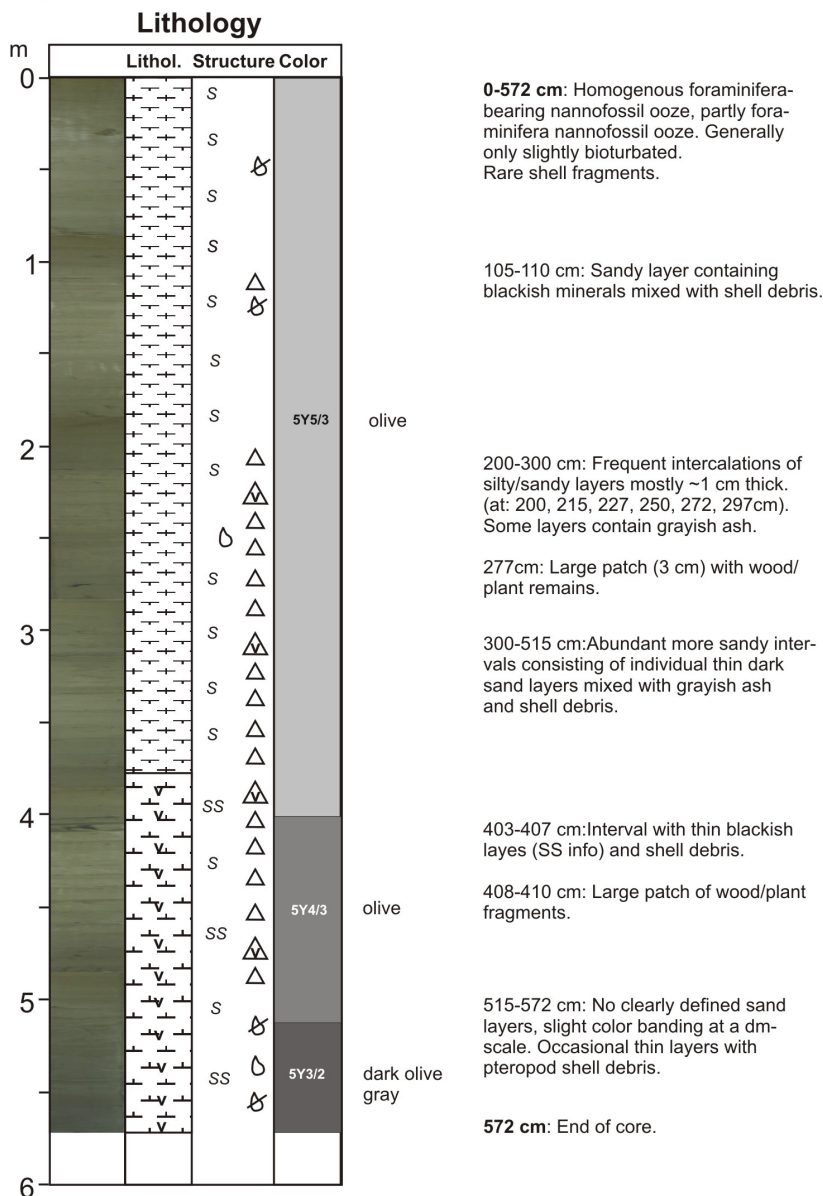


Fig. 7.25: Core description for core GeoB 10031-4.

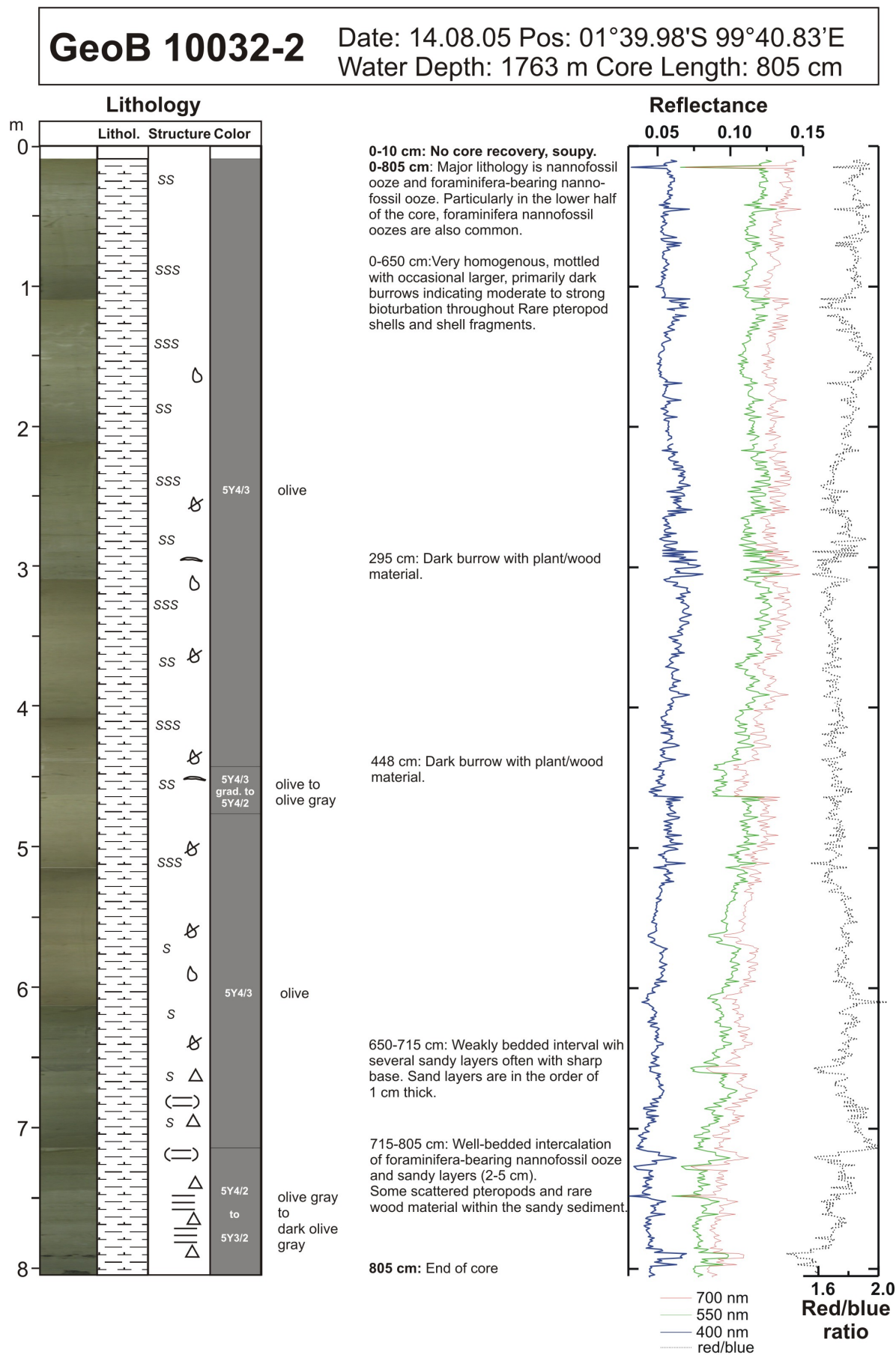


Fig. 7.26: Core description for core GeoB 10032-2.

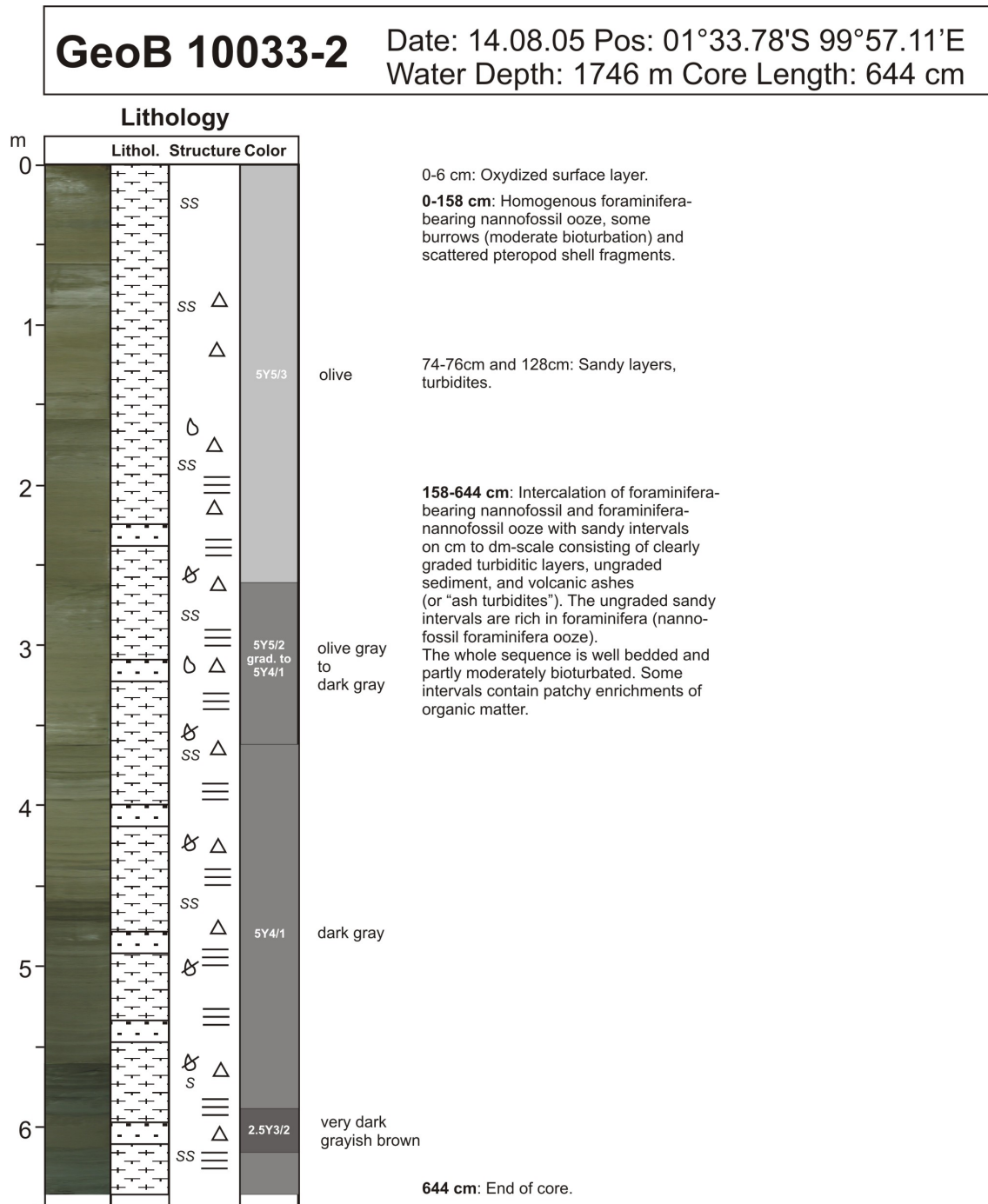


Fig. 7.27: Core description for core GeoB 10033-2.

GeoB 10033-4

Date: 14.08.05 Pos: 01°33.79'S 99°57.16'E
Water Depth: 1754 m Core Length: 825 cm

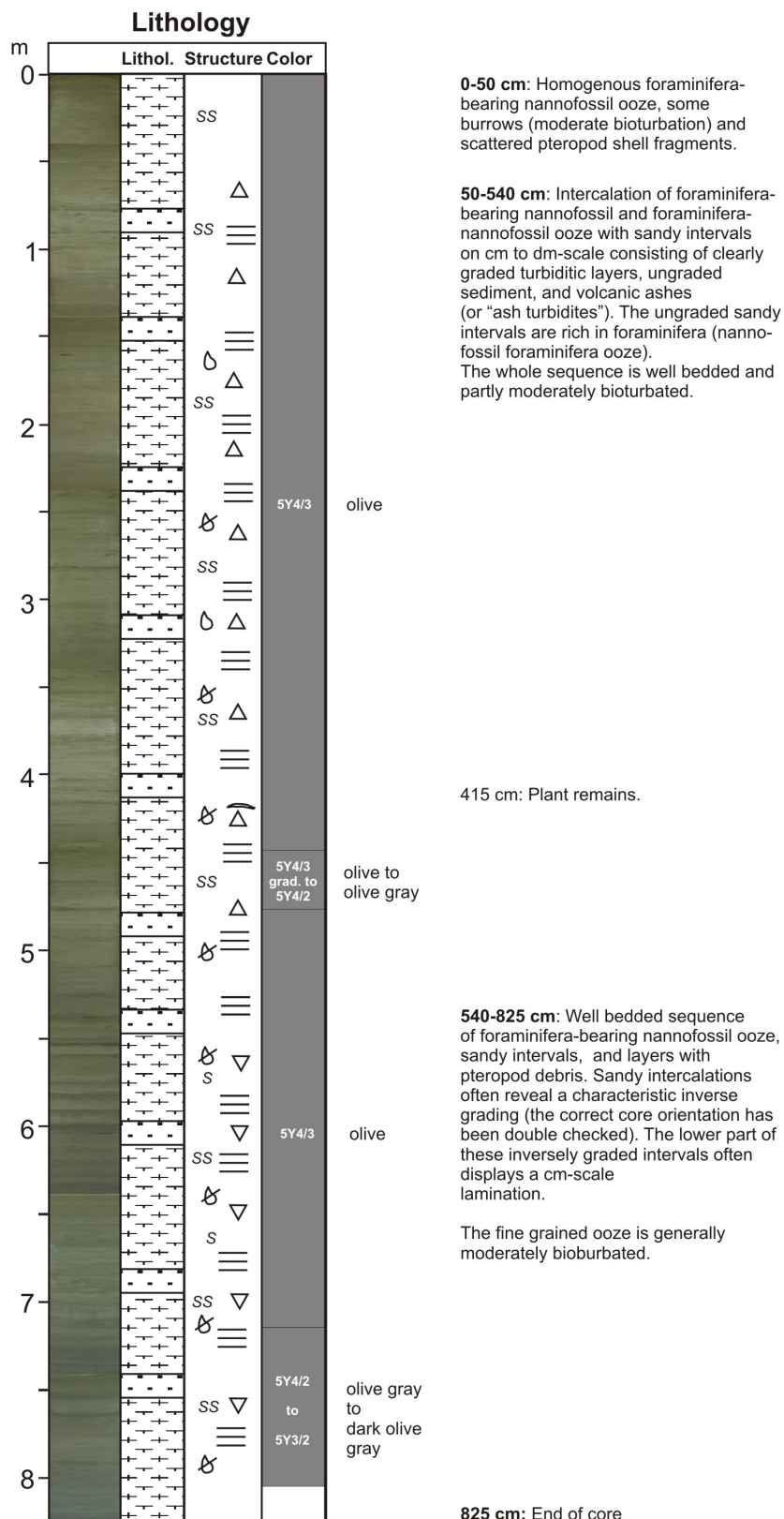


Fig. 7.28: Core description for core GeoB 10033-4.

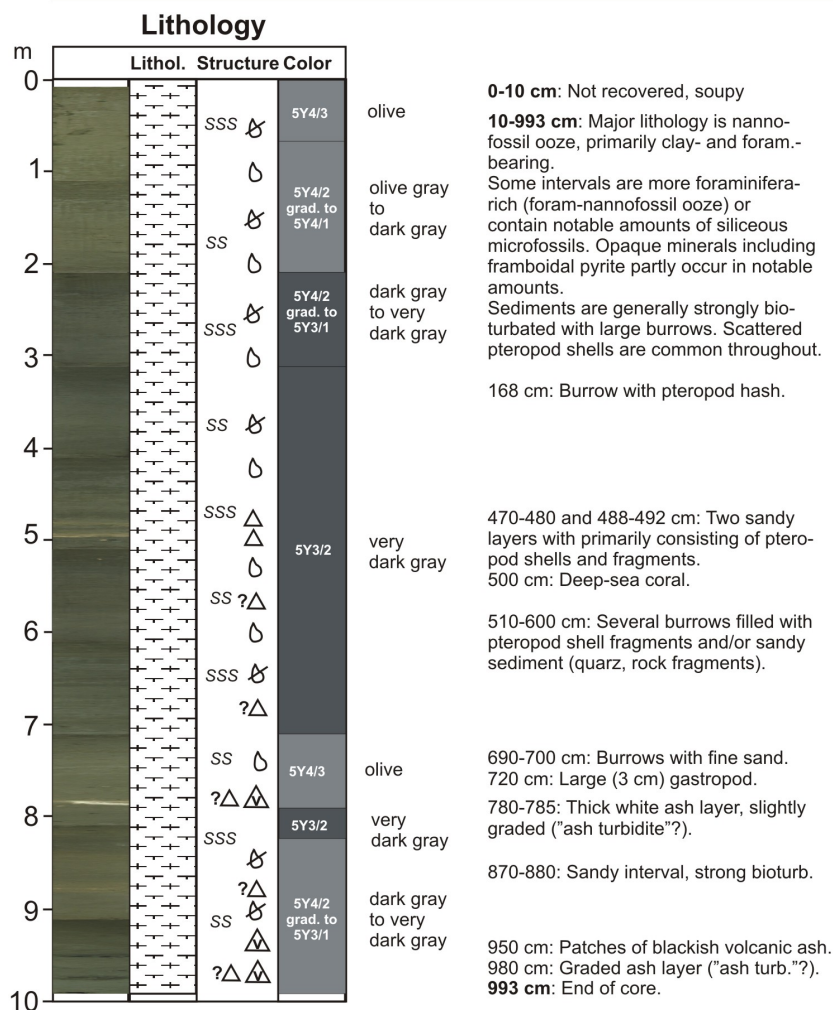
GeoB 10034-4Date: 15.08.05 Pos: 04°09.93'S 101°29.93'E
Water Depth: 996 m Core Length: 993 cm

Fig. 7.29: Core description for core GeoB 10034-4.

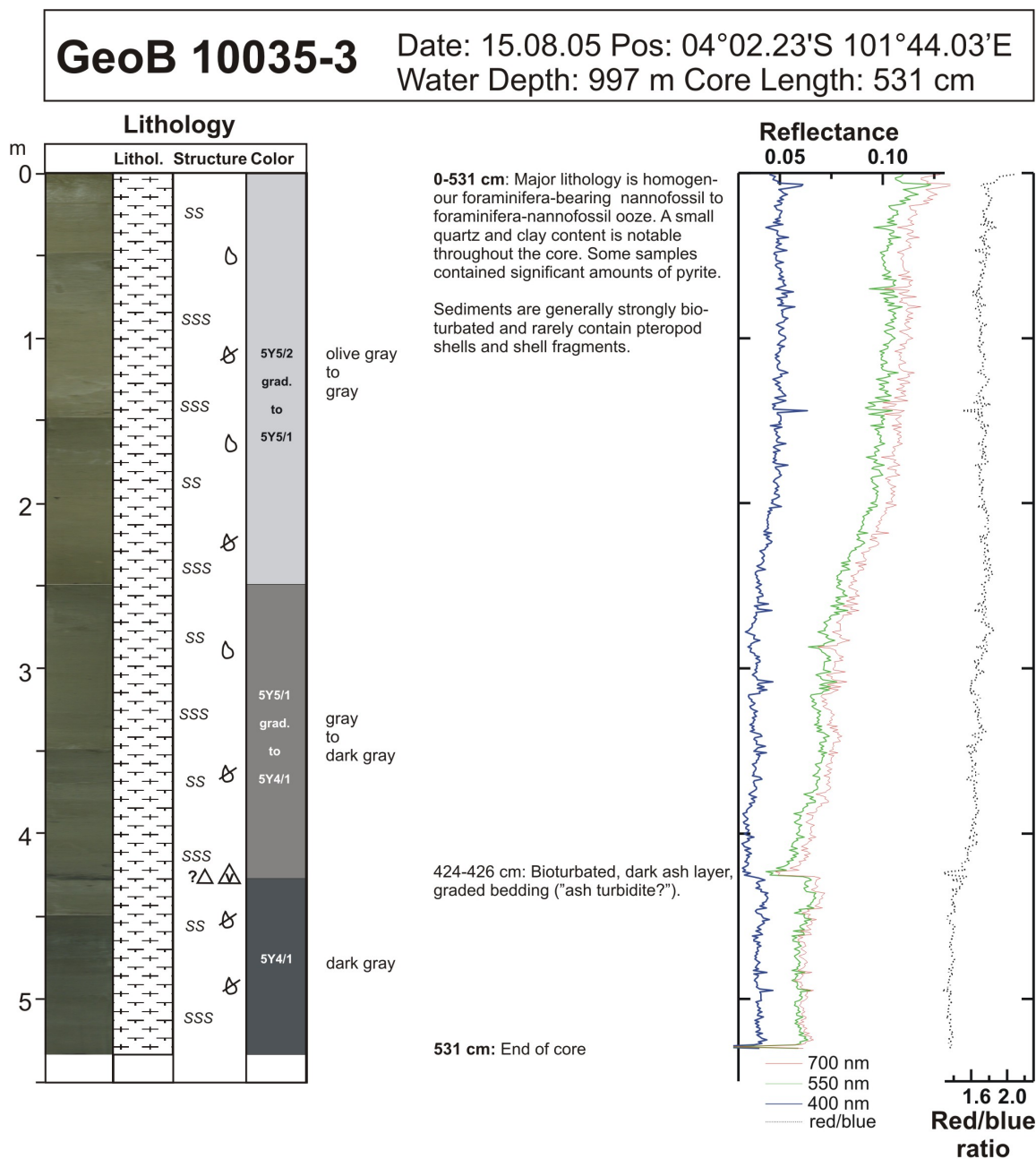


Fig. 7.30: Core description for core GeoB 10035-3.

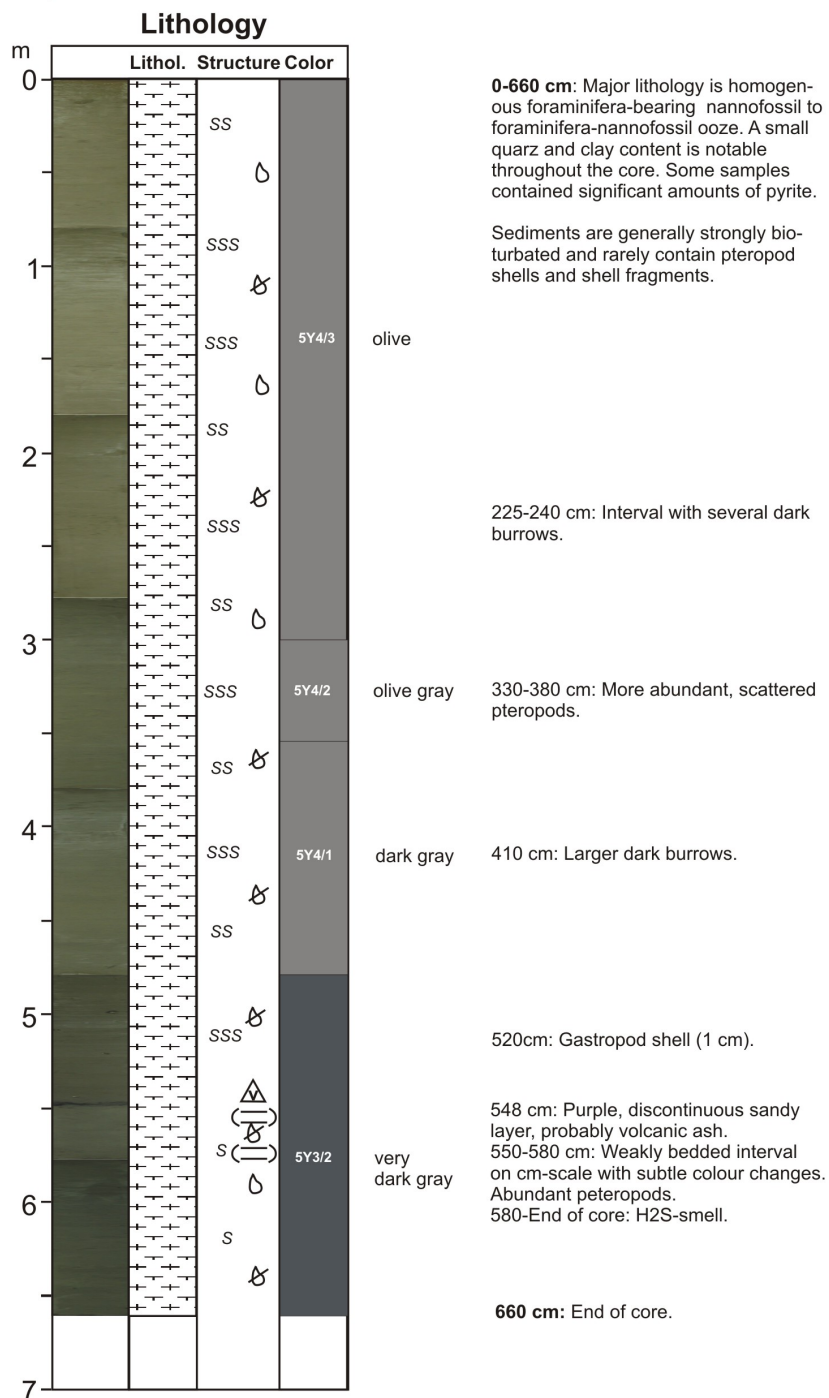
GeoB 10035-5Date: 15.08.05 Pos: 04°02.25'S 101°44.03'E
Water Depth: 996 m Core Length: 660 cm

Fig. 7.31: Core description for core GeoB 10035-5.

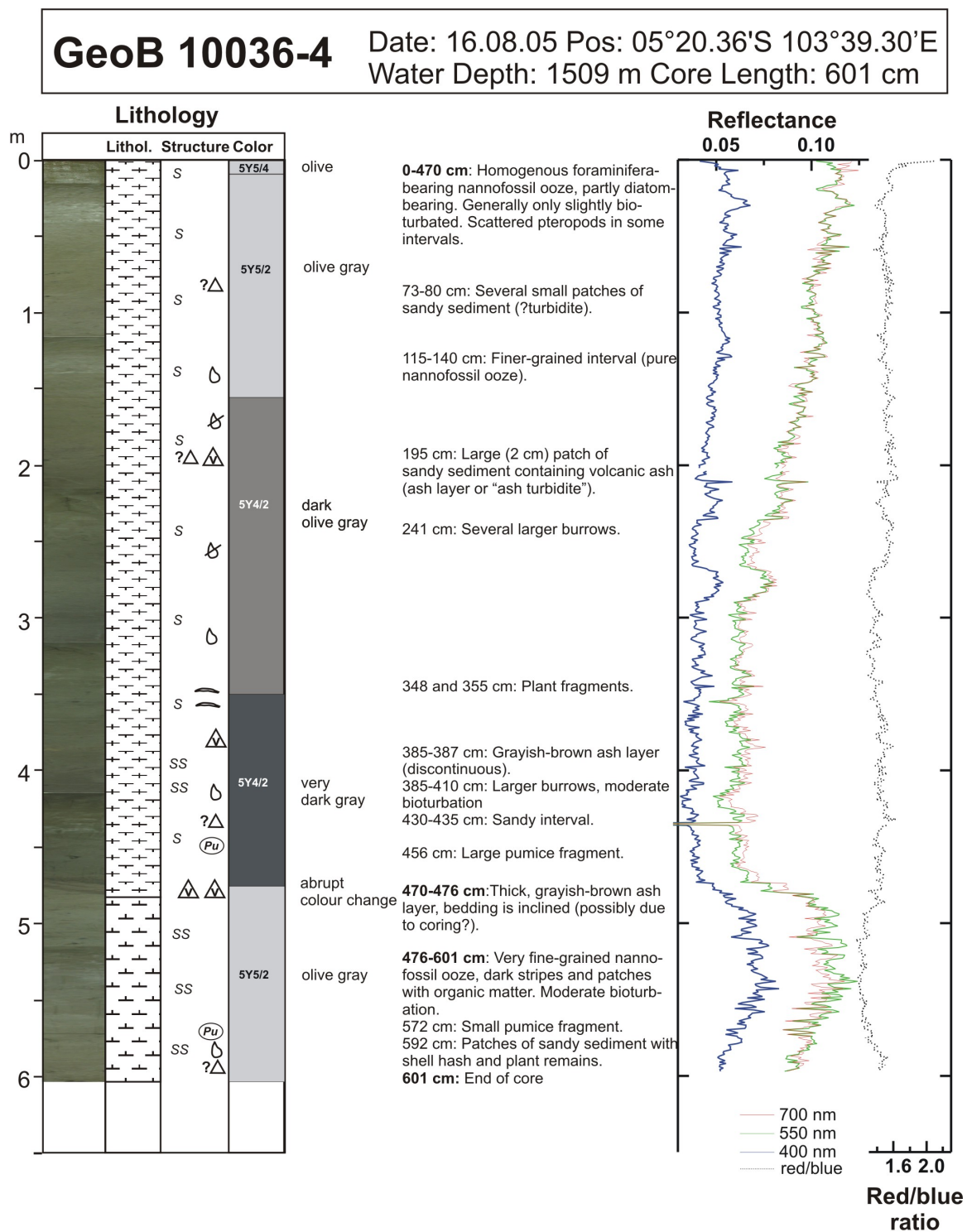


Fig. 7.32: Core description for core GeoB 10036-4.

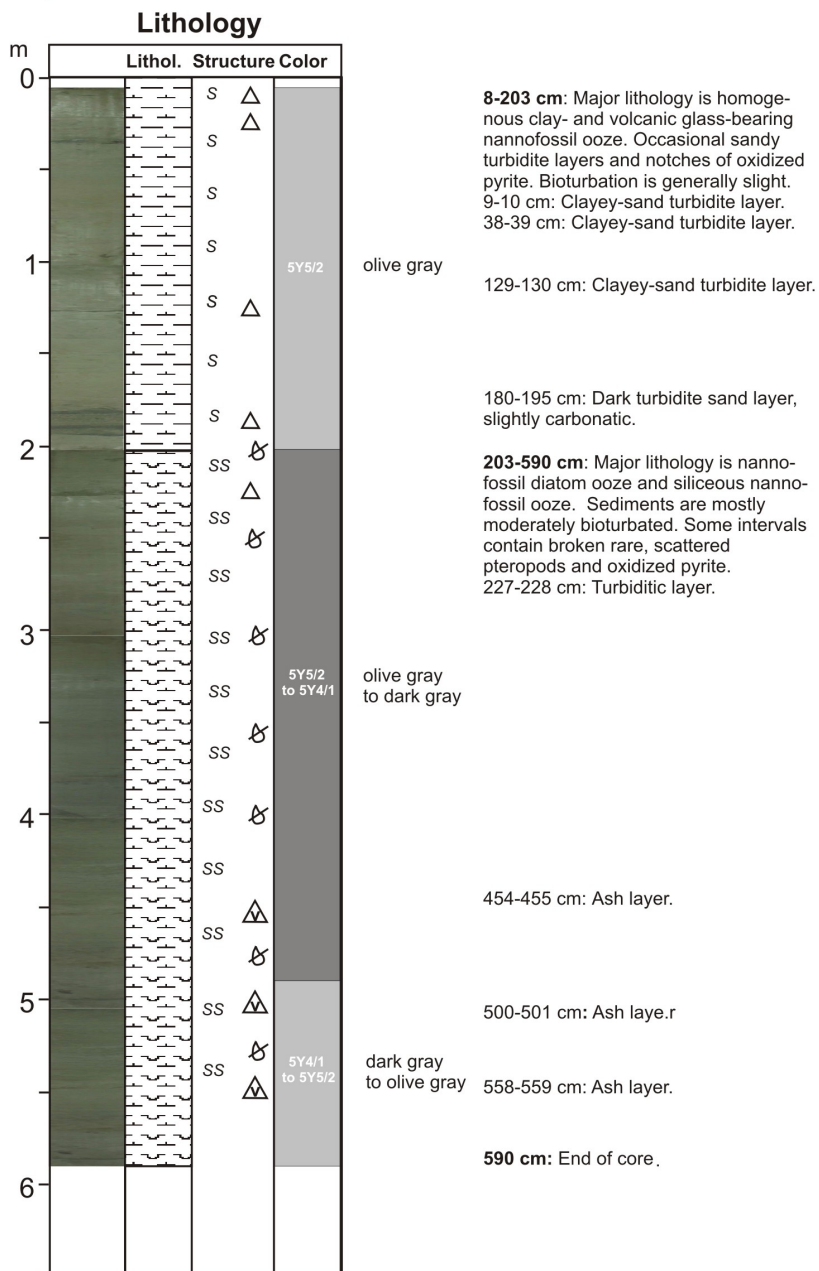
GeoB 10037-1Date: 16.08.05 Pos: 05°28.84'S 103°33.56'E
Water Depth: 2016 m Core Length: 590 cm

Fig. 7.33: Core description for core GeoB 10037-1.

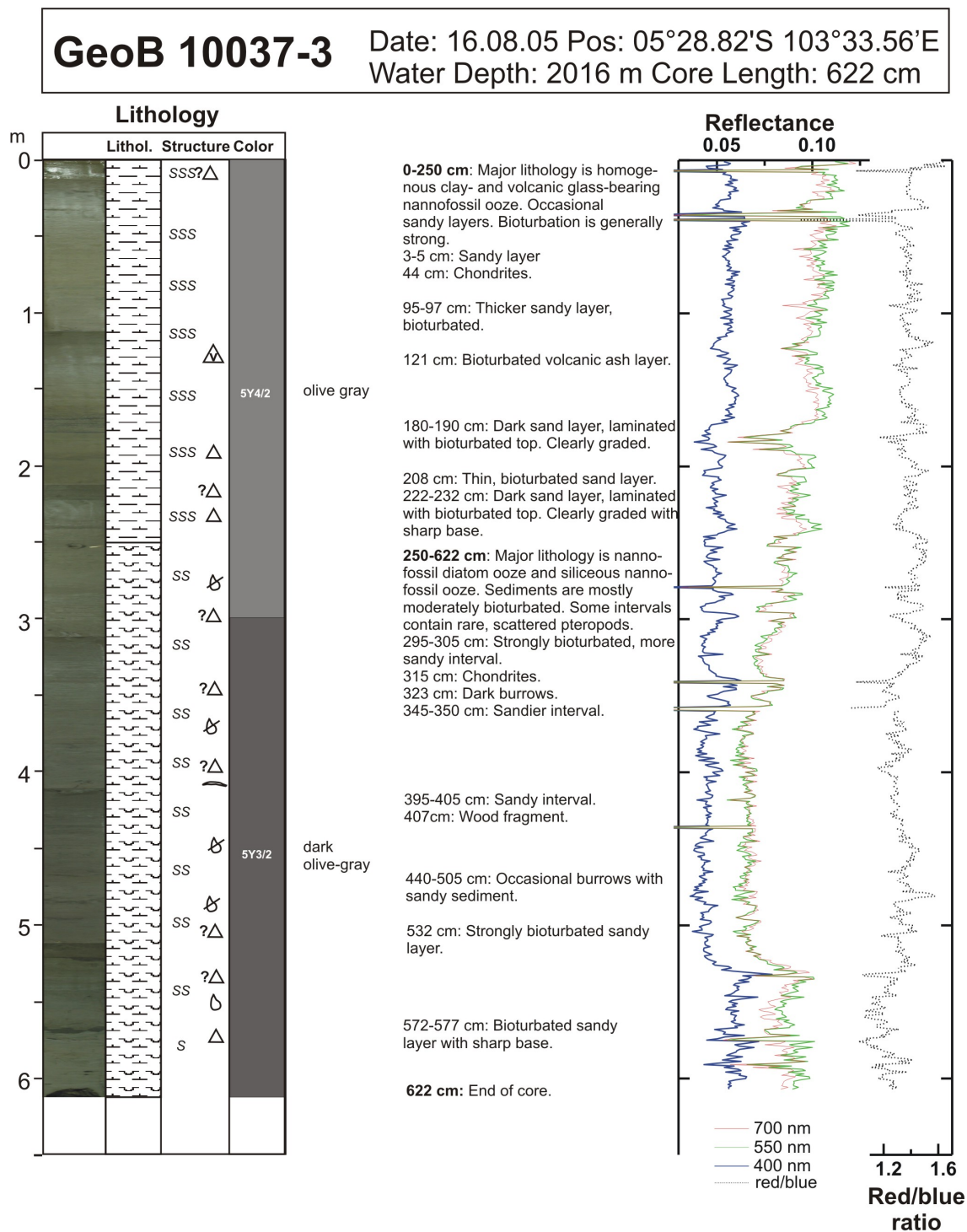


Fig. 7.34: Core description for core GeoB 10037-3.

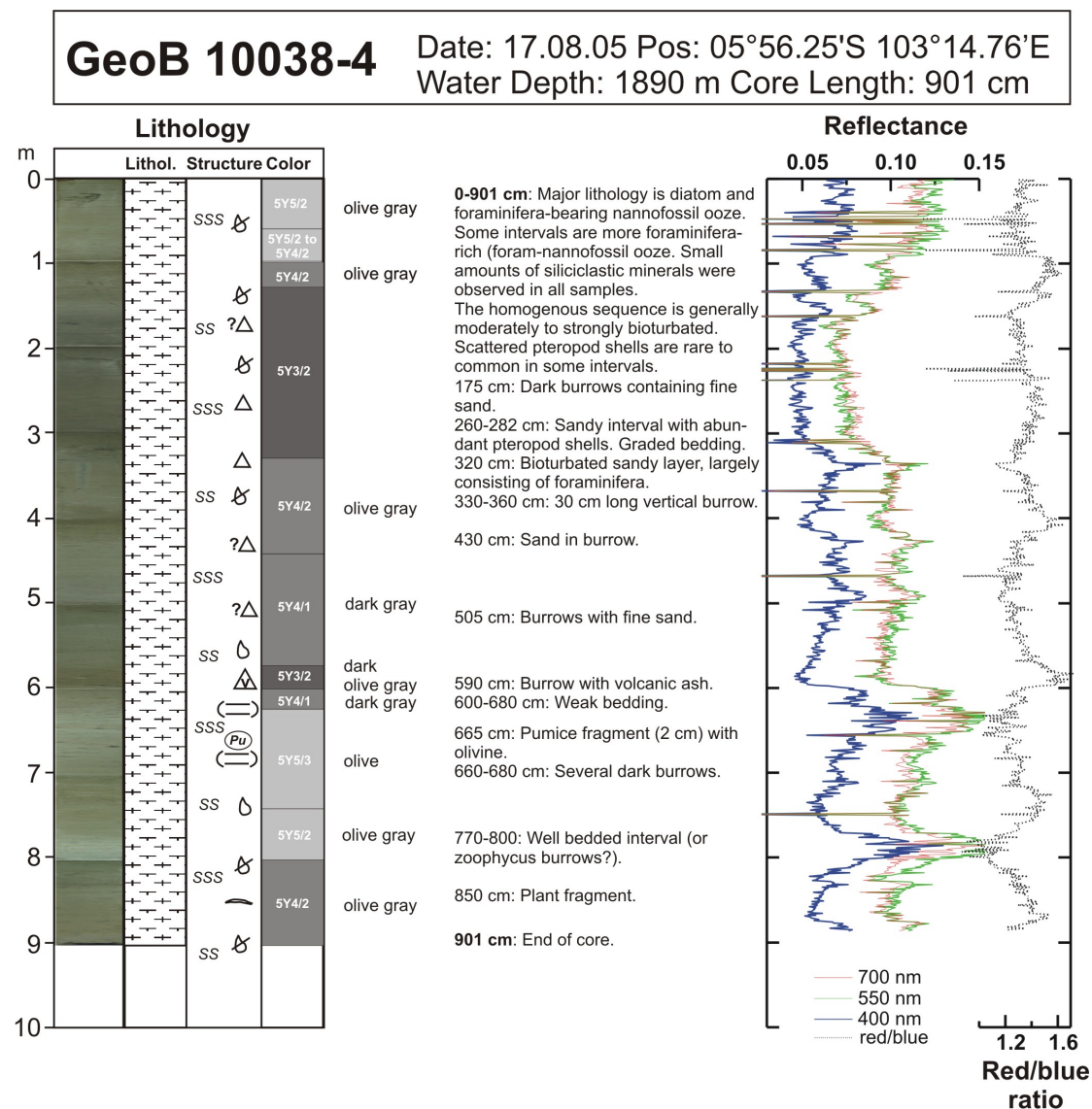


Fig. 7.35: Core description for core GeoB 10038-4.

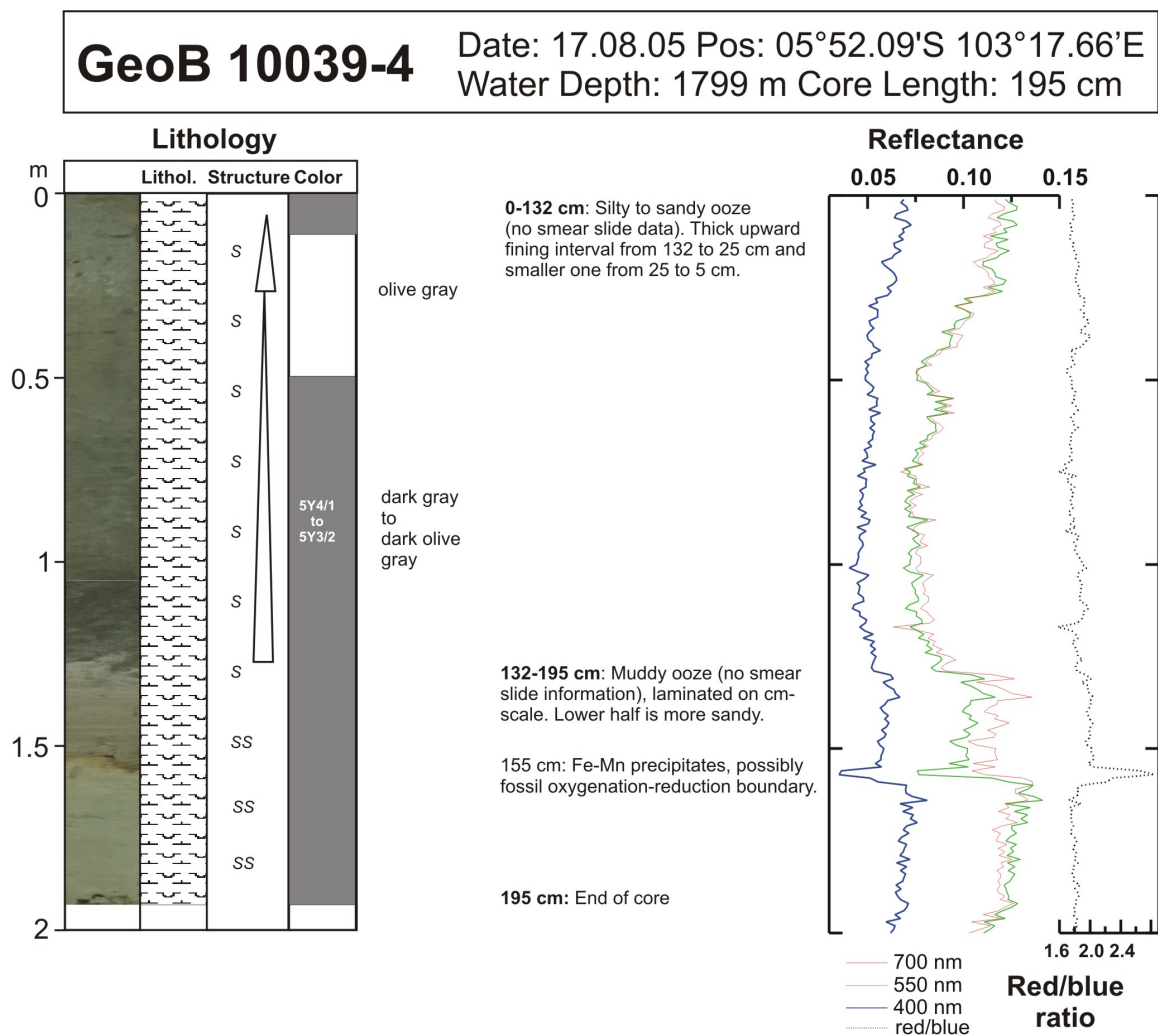


Fig. 7.36: Core description for core GeoB 10039-4.

GeoB 10040-4

Date: 18.08.05 Pos: 06°28.52'S 102°51.46'E
 Water Depth: 2605 m Core Length: 673 cm

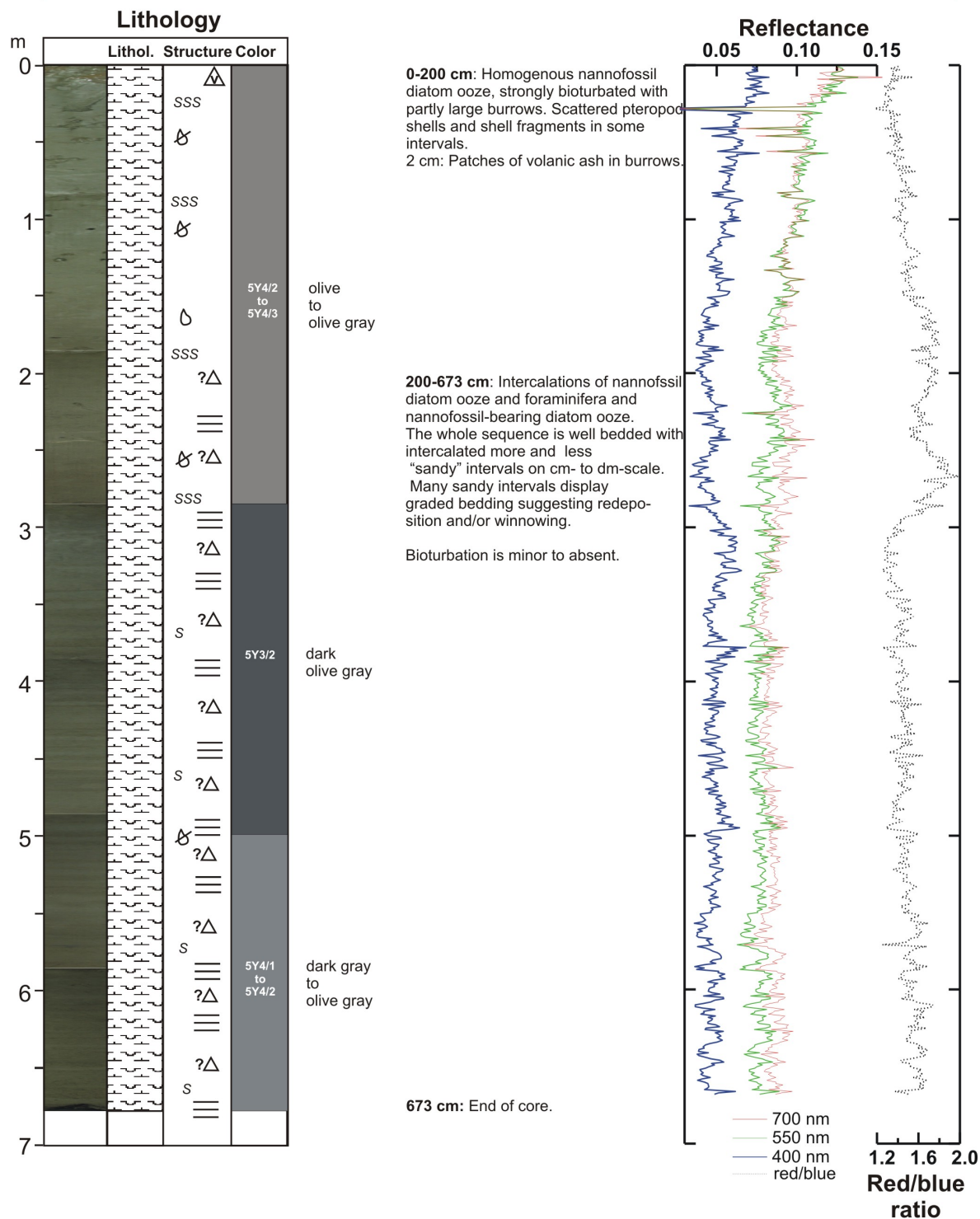


Fig. 7.37: Core description for core GeoB 10040-4.

GeoB 10042-1

Date: 19.08.05 Pos: 07°06.81'S 104°38.58'E
 Water Depth: 2454 m Core Length: 540 cm

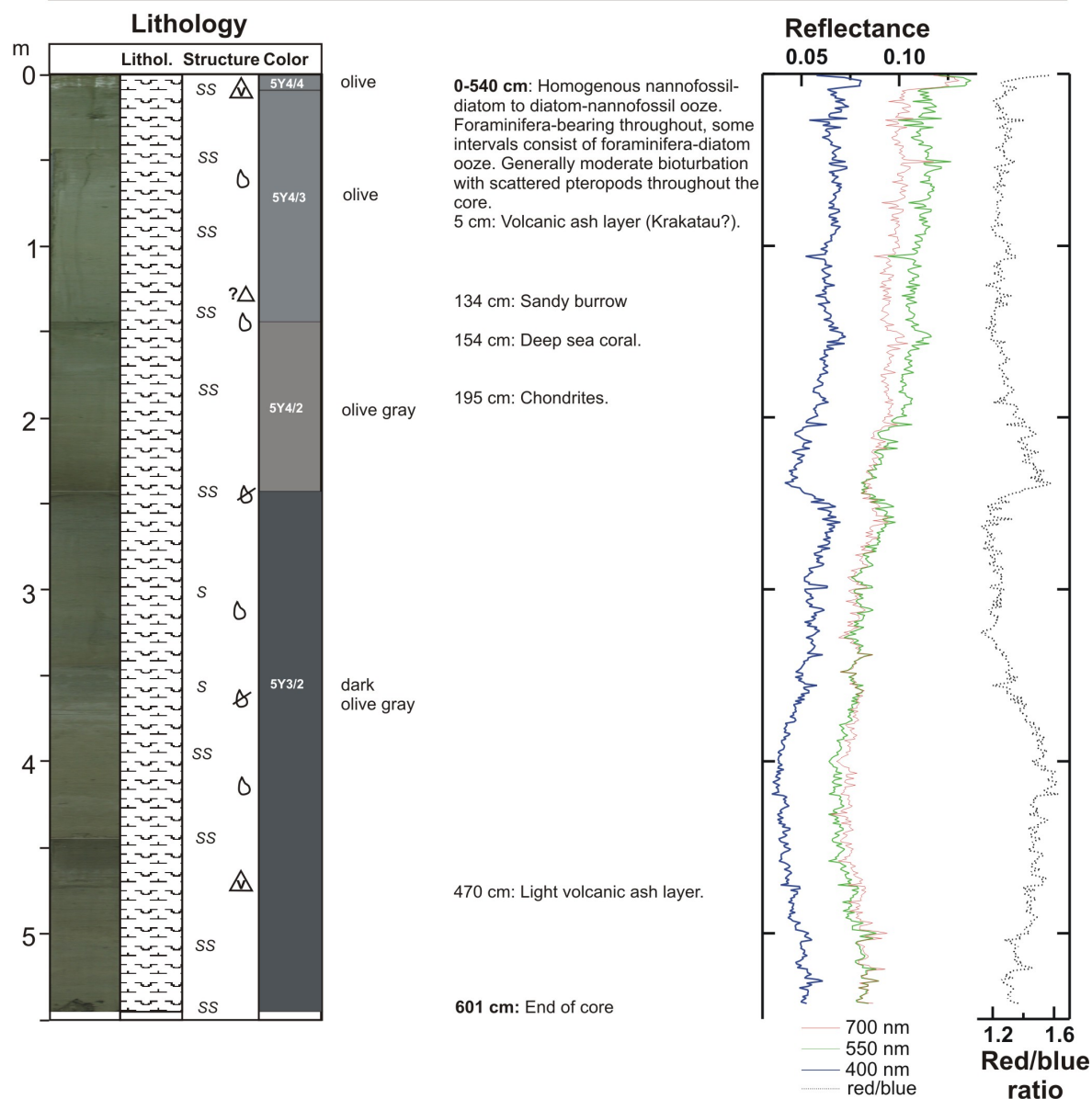


Fig. 7.38: Core description for core GeoB 10042-1.

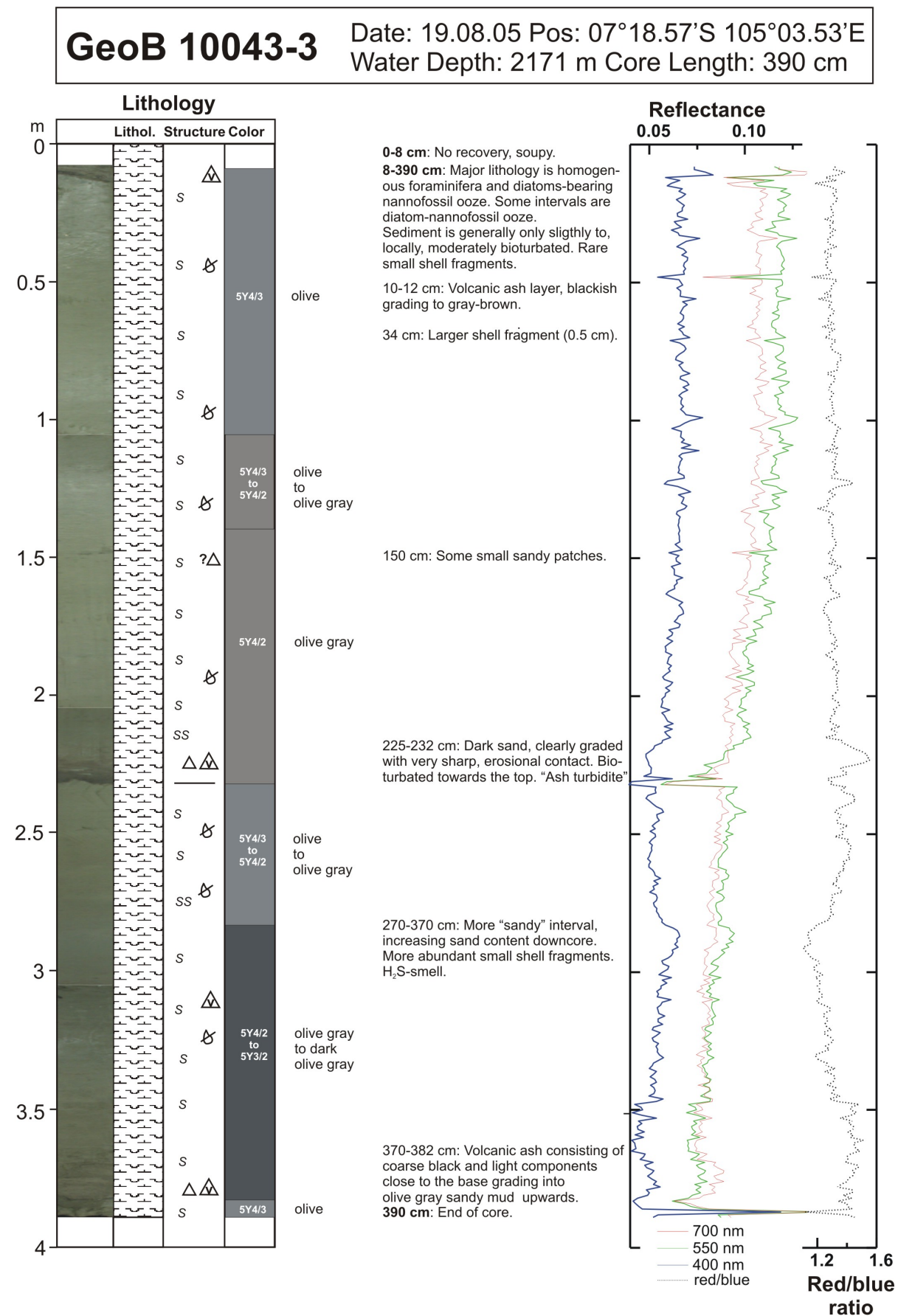


Fig. 7.39: Core description for core GeoB 10043-3.

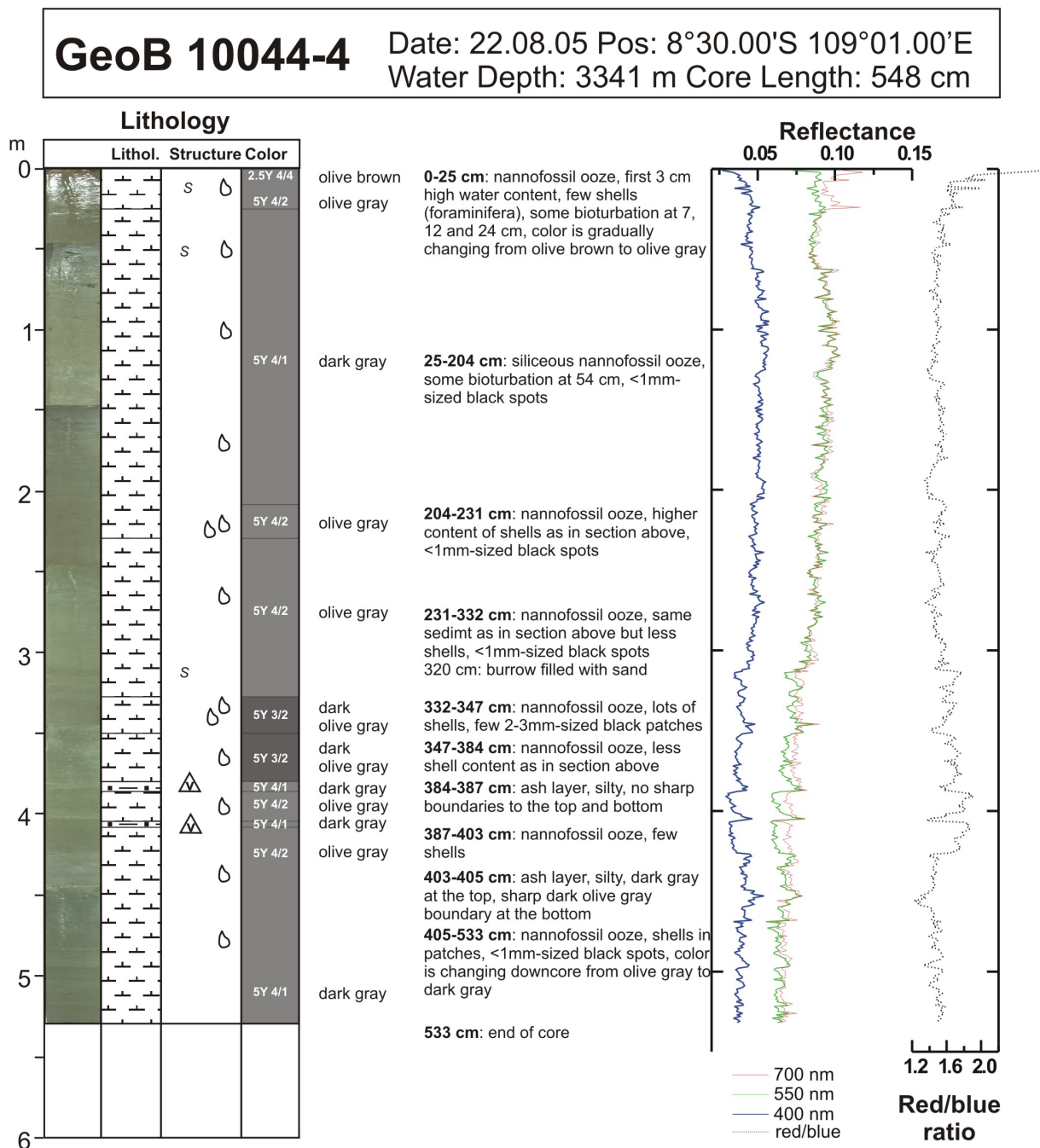


Fig. 7.40: Core description for core GeoB 10044-4.

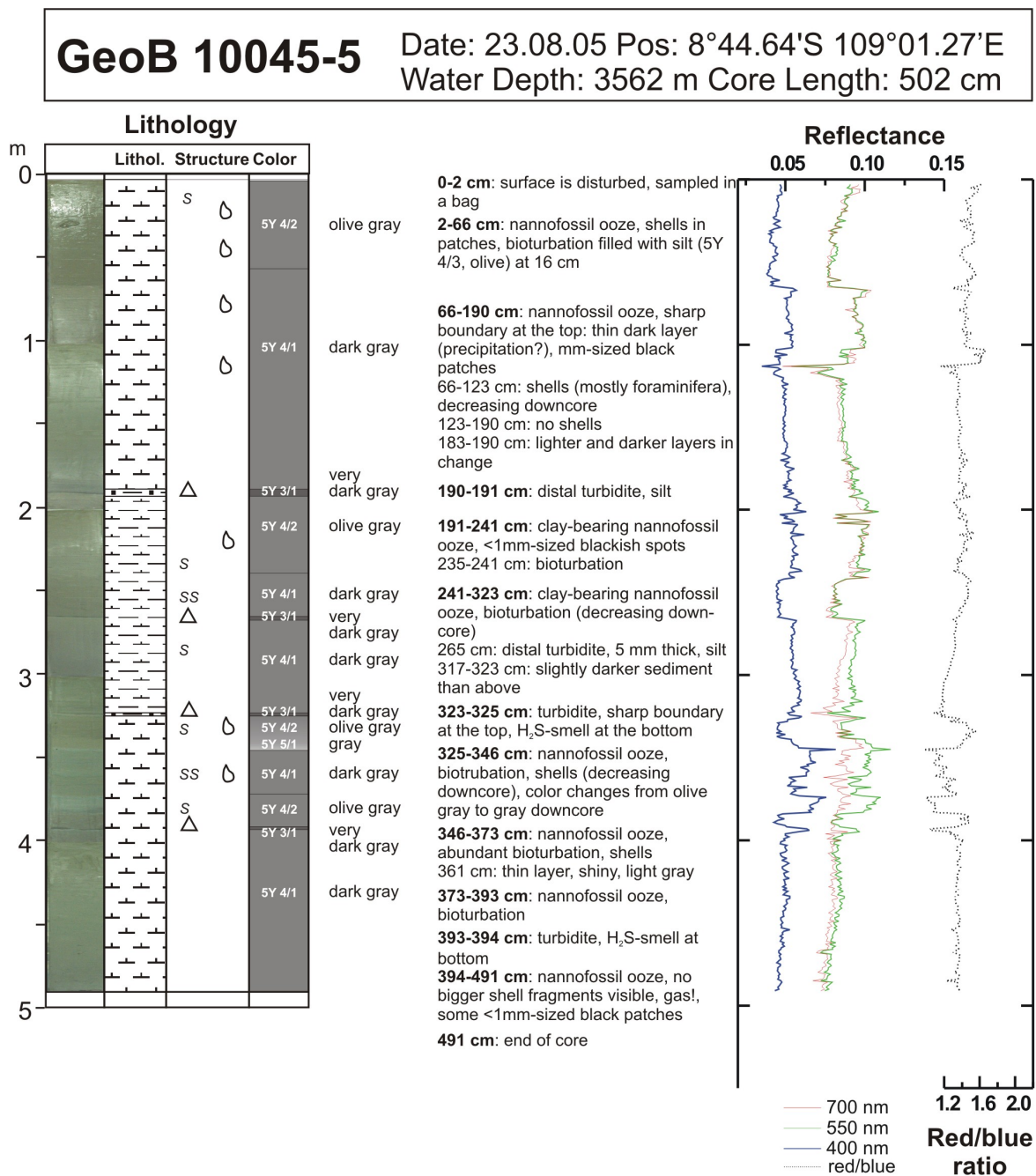


Fig. 7.41: Core description for core GeoB 10045-5.

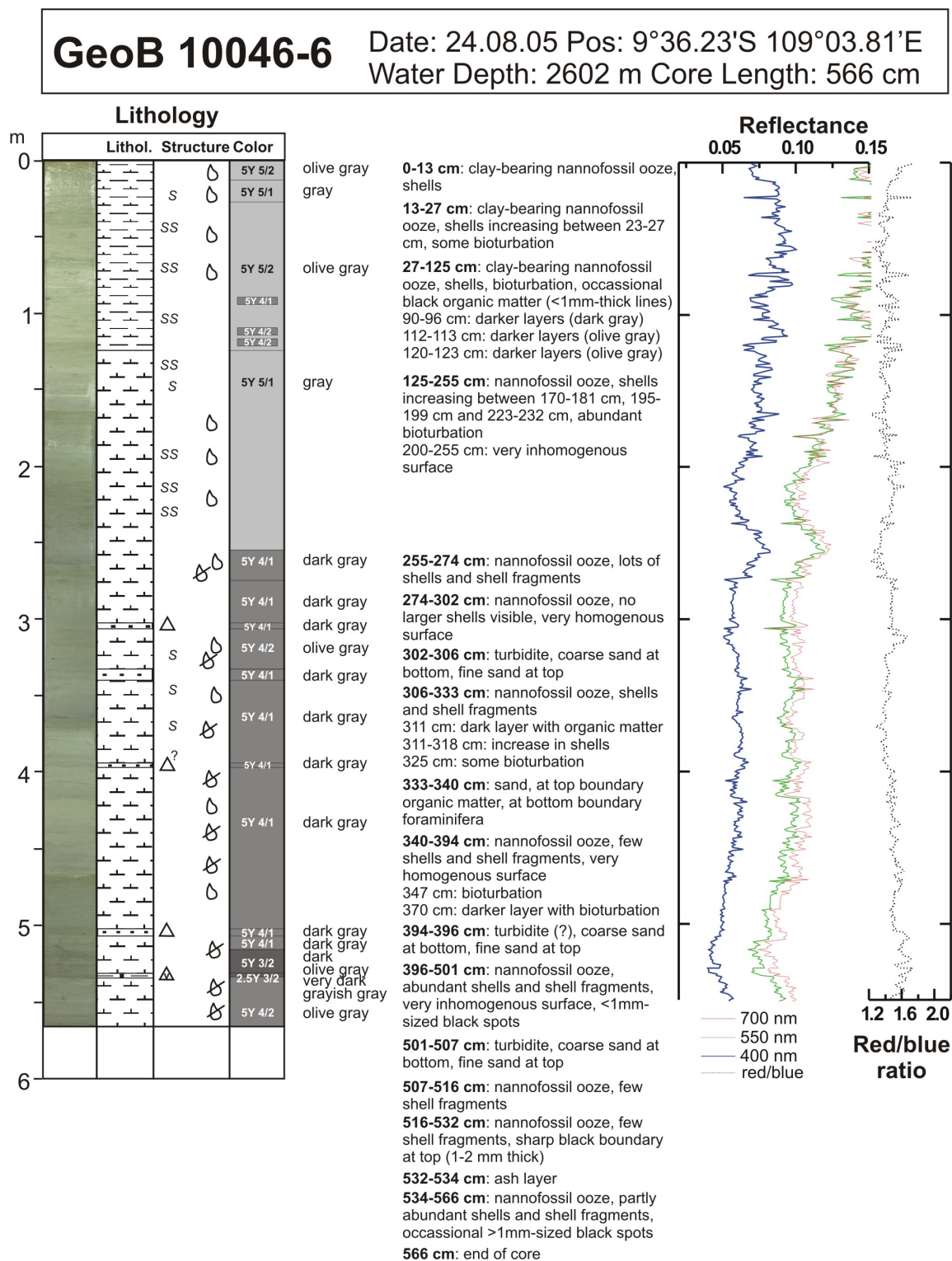


Fig. 7.42: Core description for core GeoB 10046-6.

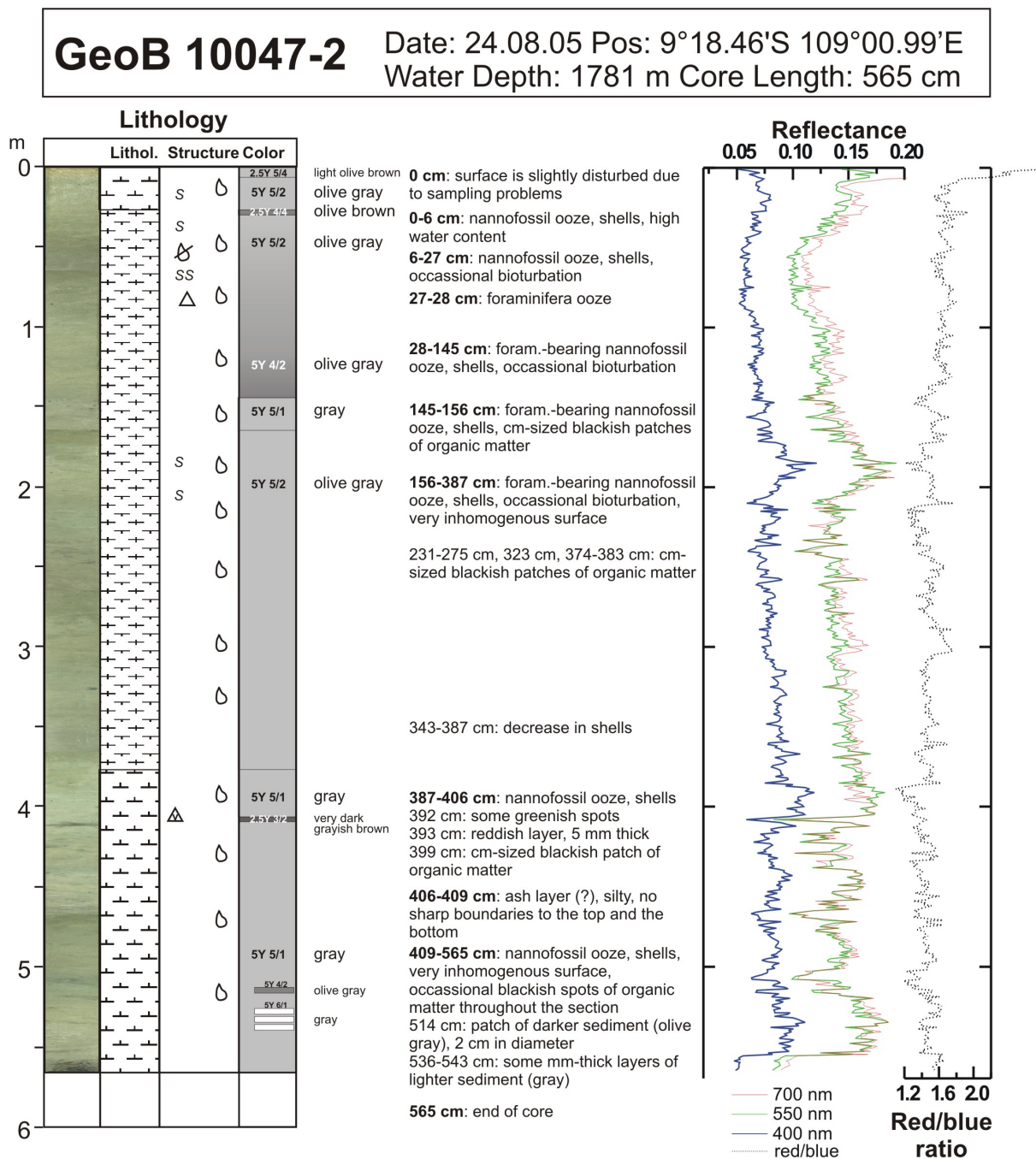


Fig. 7.43: Core description for core GeoB 10047-2.

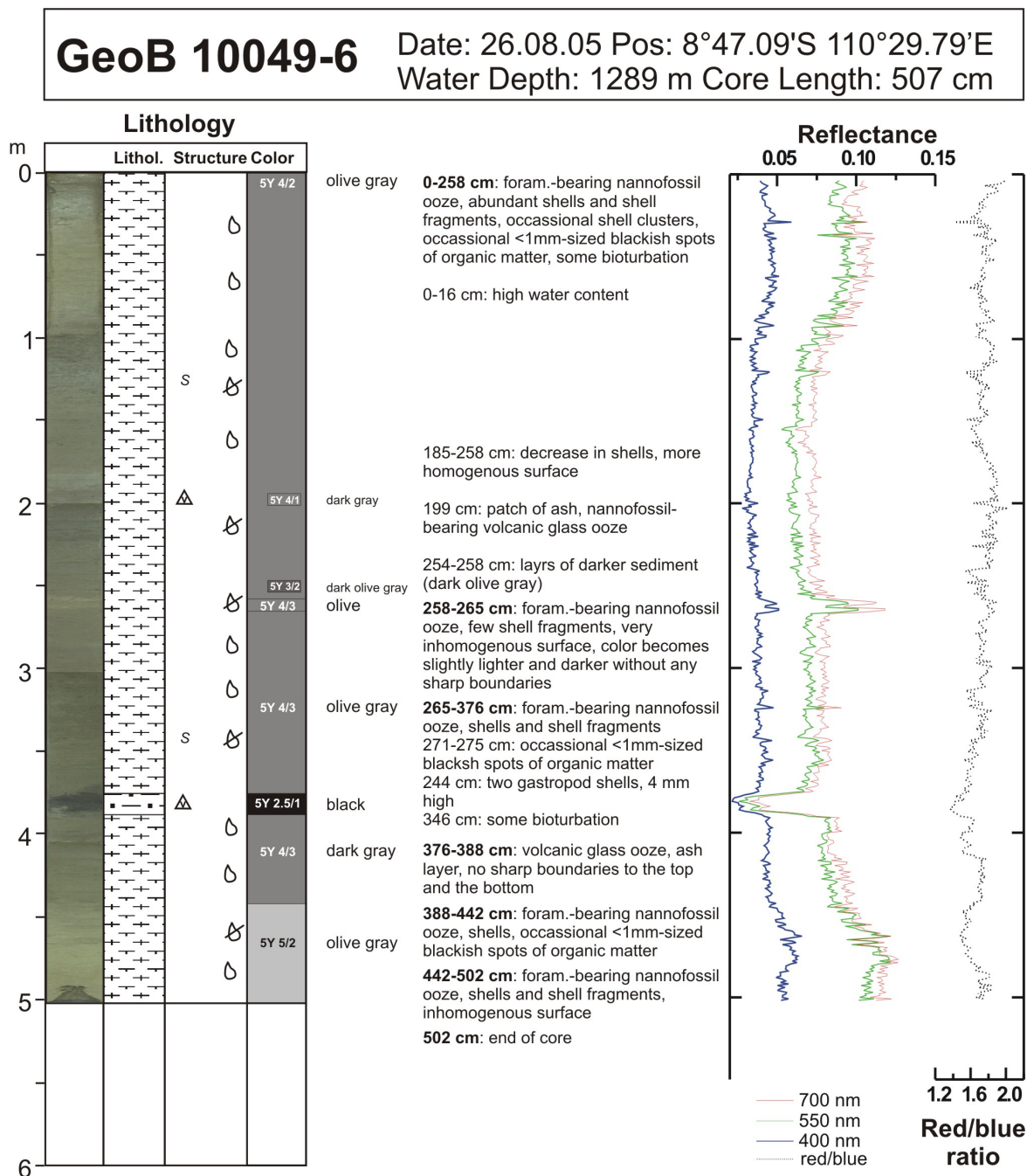


Fig. 7.44: Core description for core GeoB 10049-6.

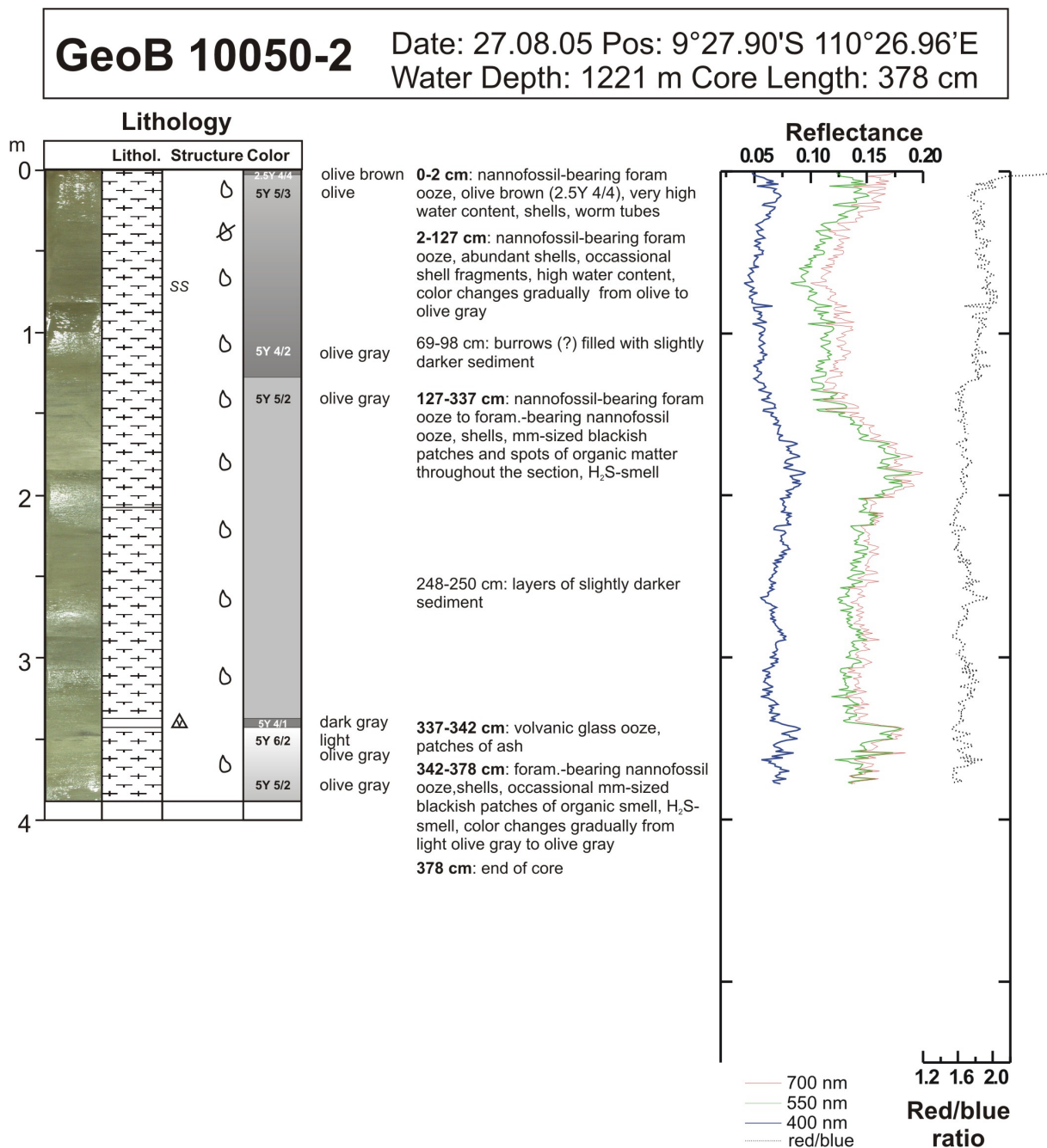


Fig. 7.45: Core description for core GeoB 10050-2.

GeoB 10051-6

Date: 27.08.05 Pos: 9°17.54'S 110°29.94'E
 Water Depth: 2388 m Core Length: 224 cm

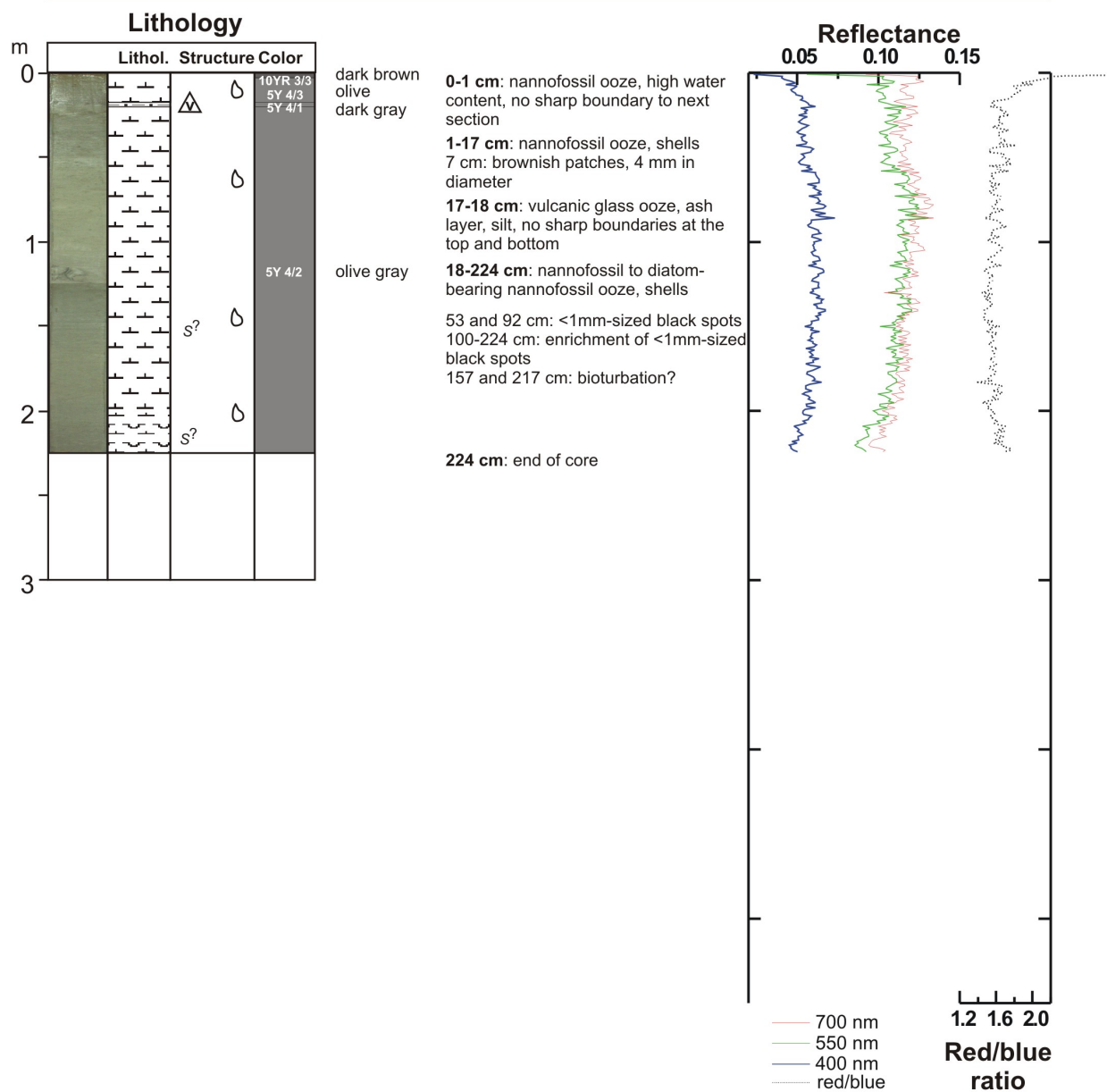


Fig. 7.46: Core description for core GeoB 10051-6.

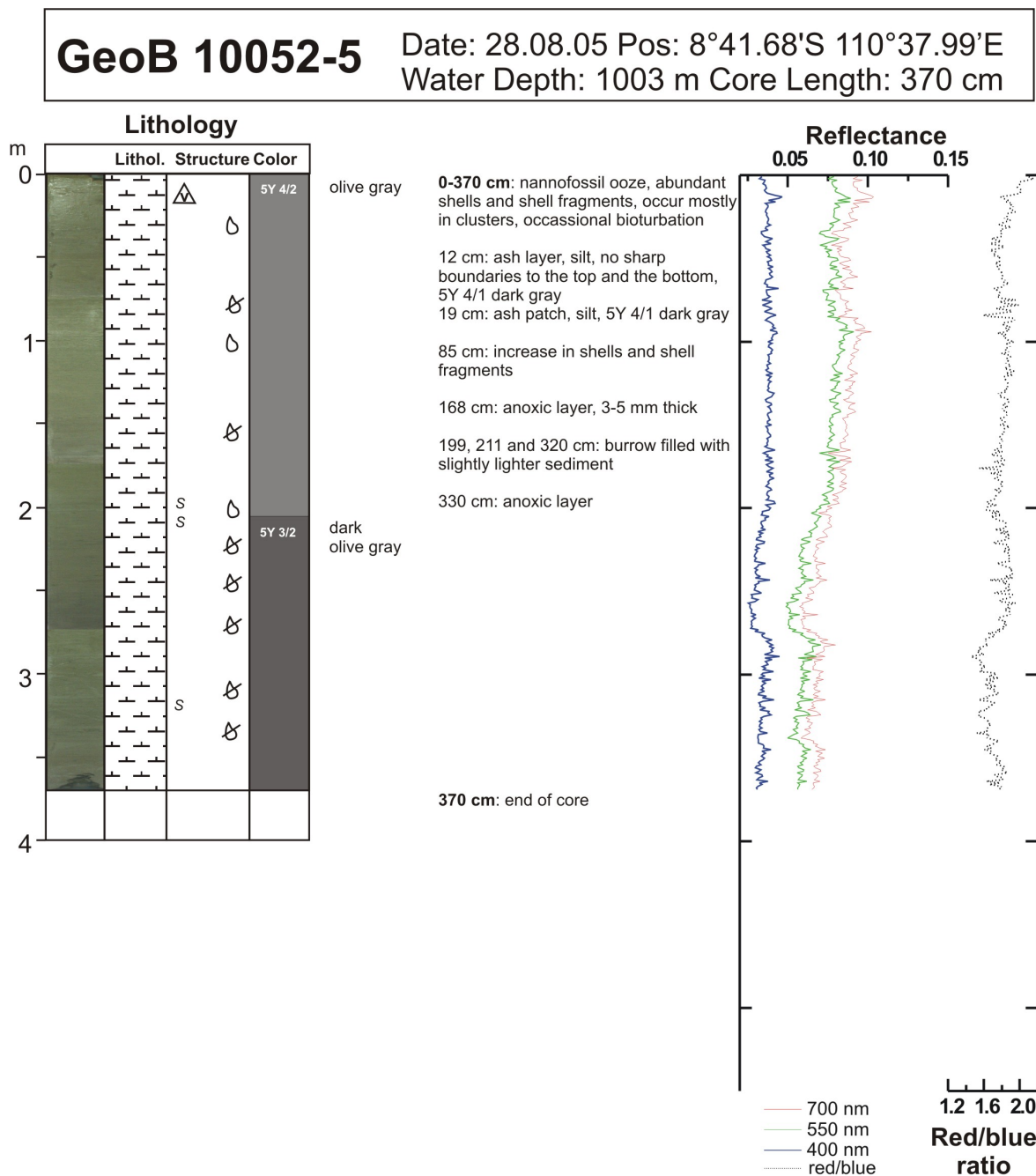


Fig. 7.47: Core description for core GeoB 10052-5.

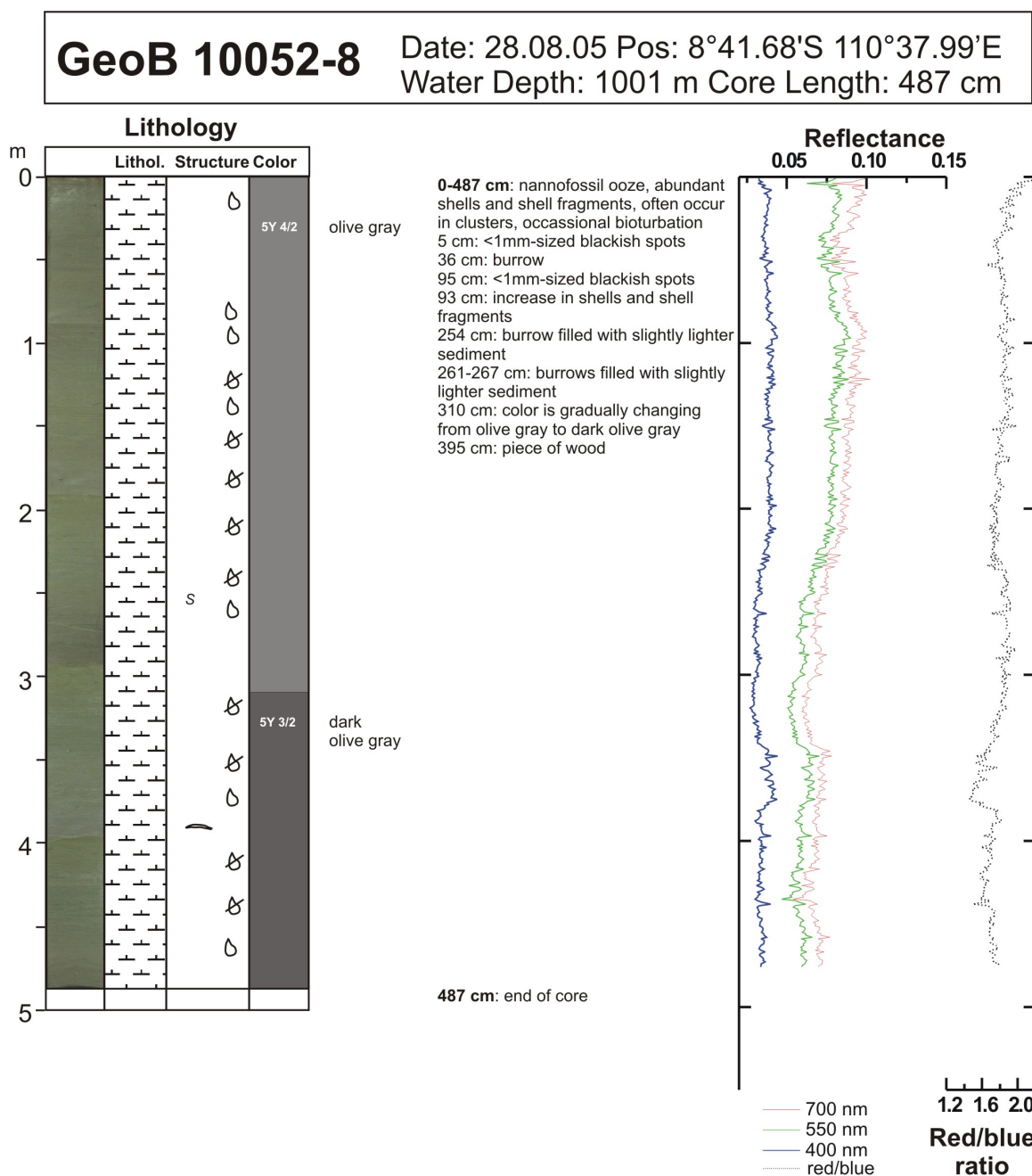


Fig. 7.48: Core description for core GeoB 10052-8.

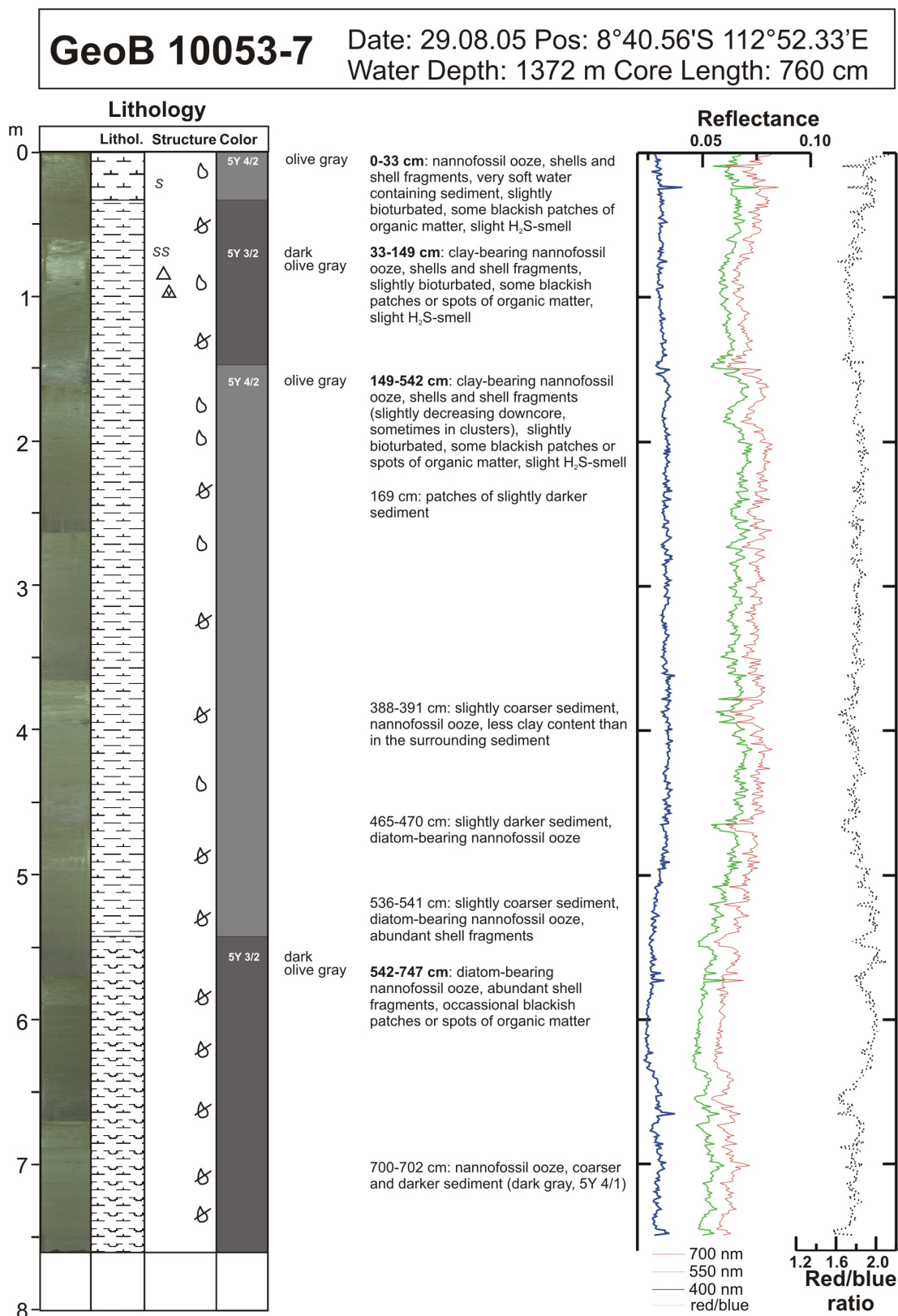


Fig. 7.49: Core description for core GeoB 10053-7.

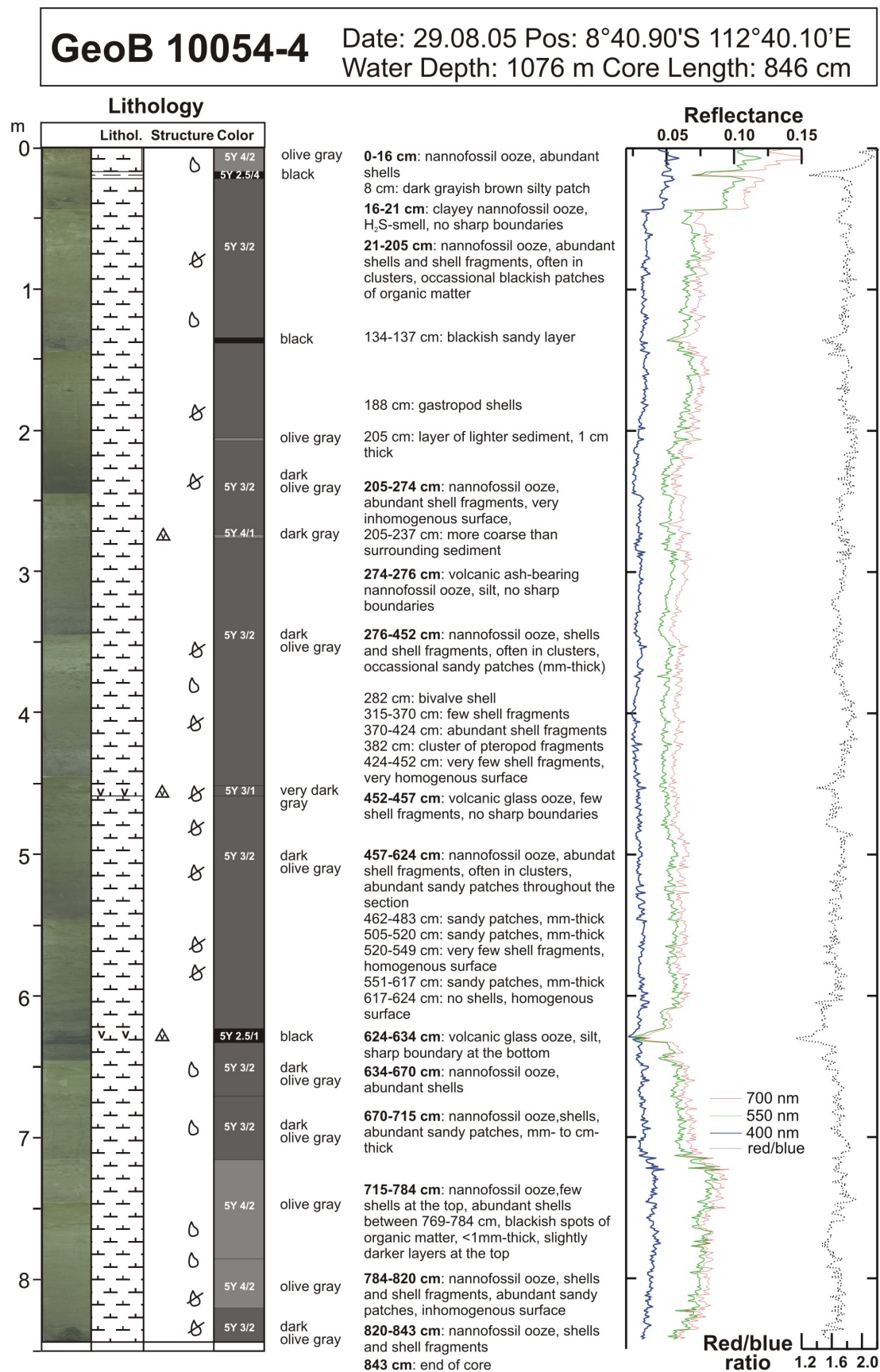


Fig. 7.50: Core description for core GeoB 10054-4.

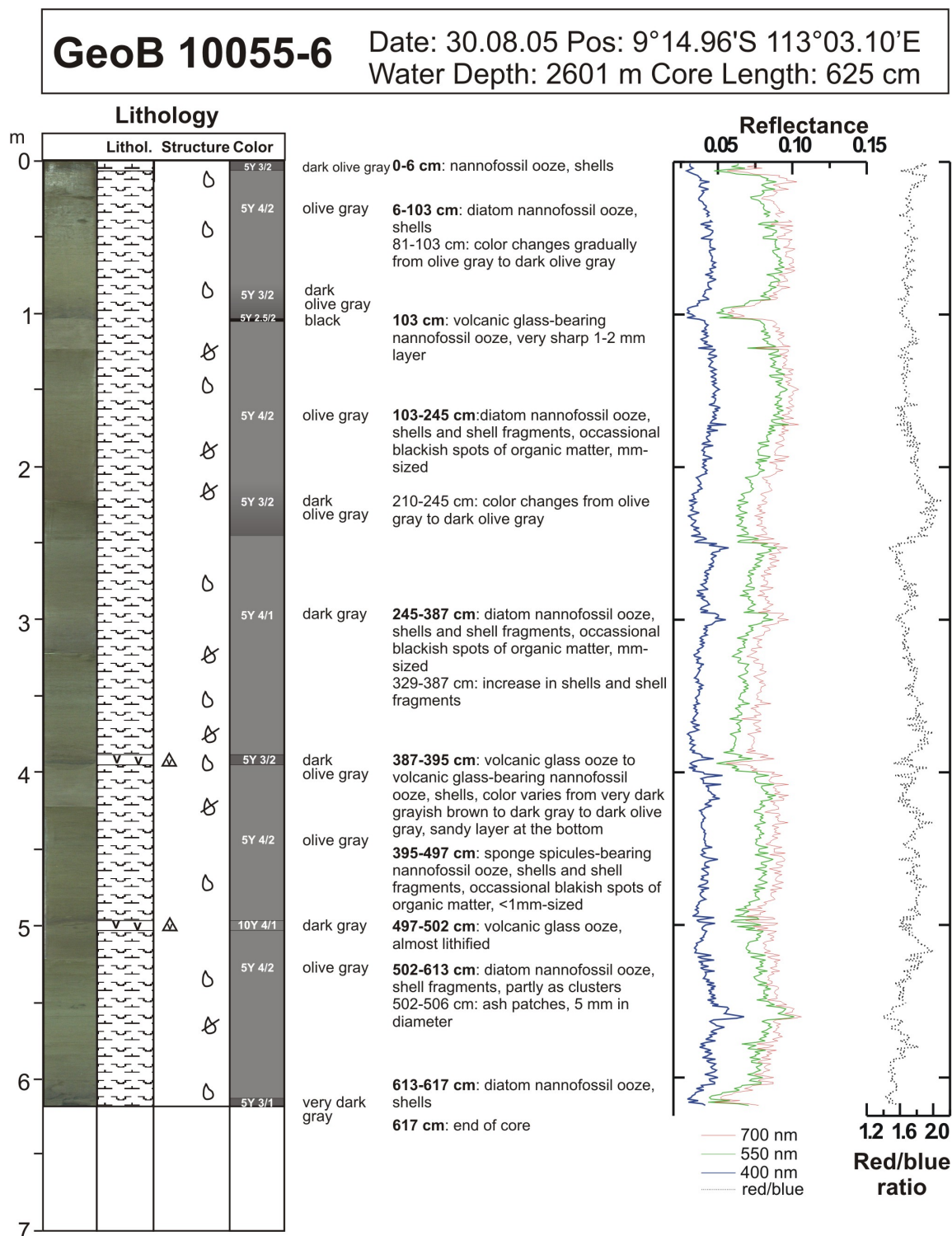


Fig. 7.51: Core description for core GeoB 10055-6.

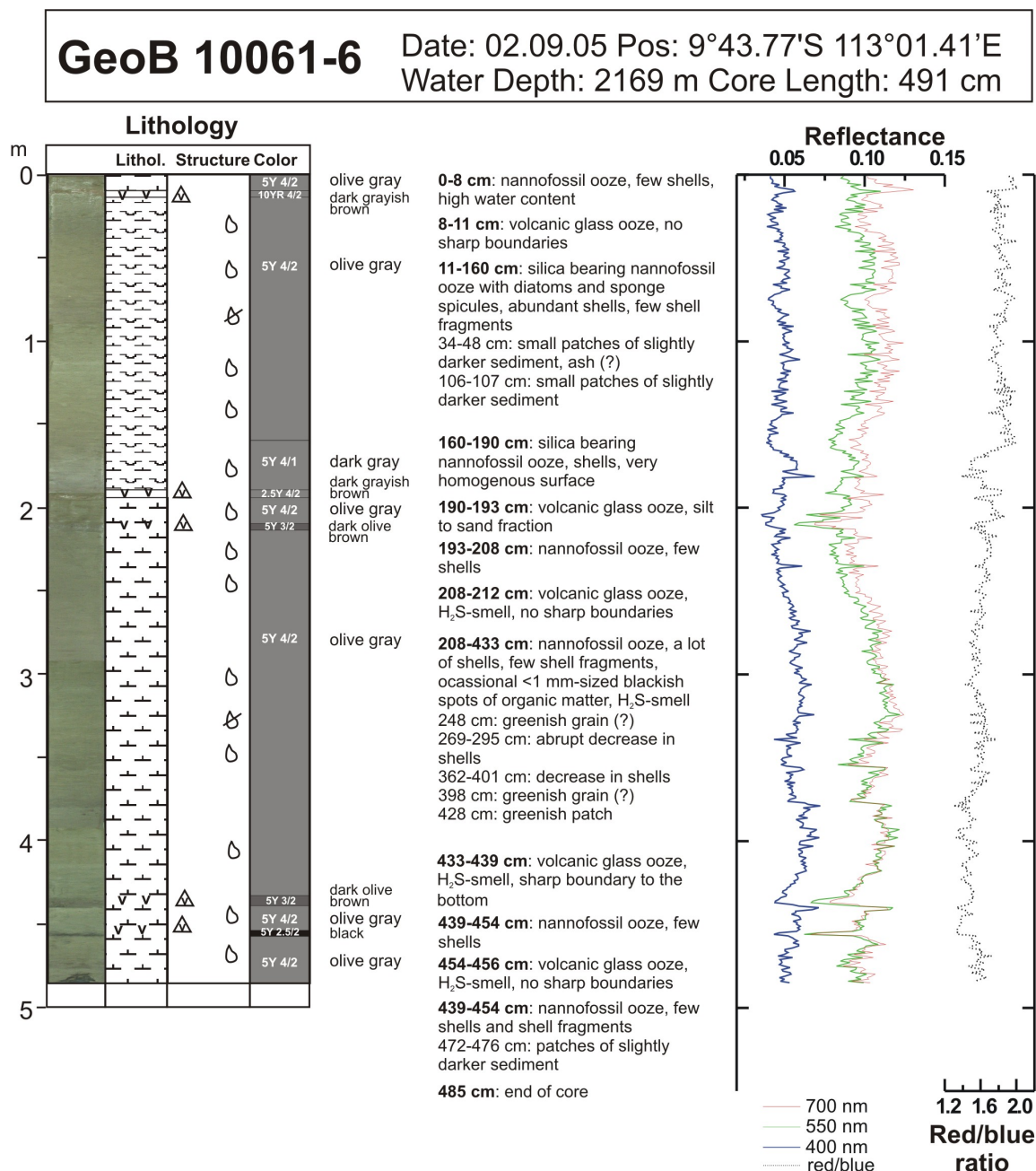


Fig. 7.52: Core description for core GeoB 10061-6.

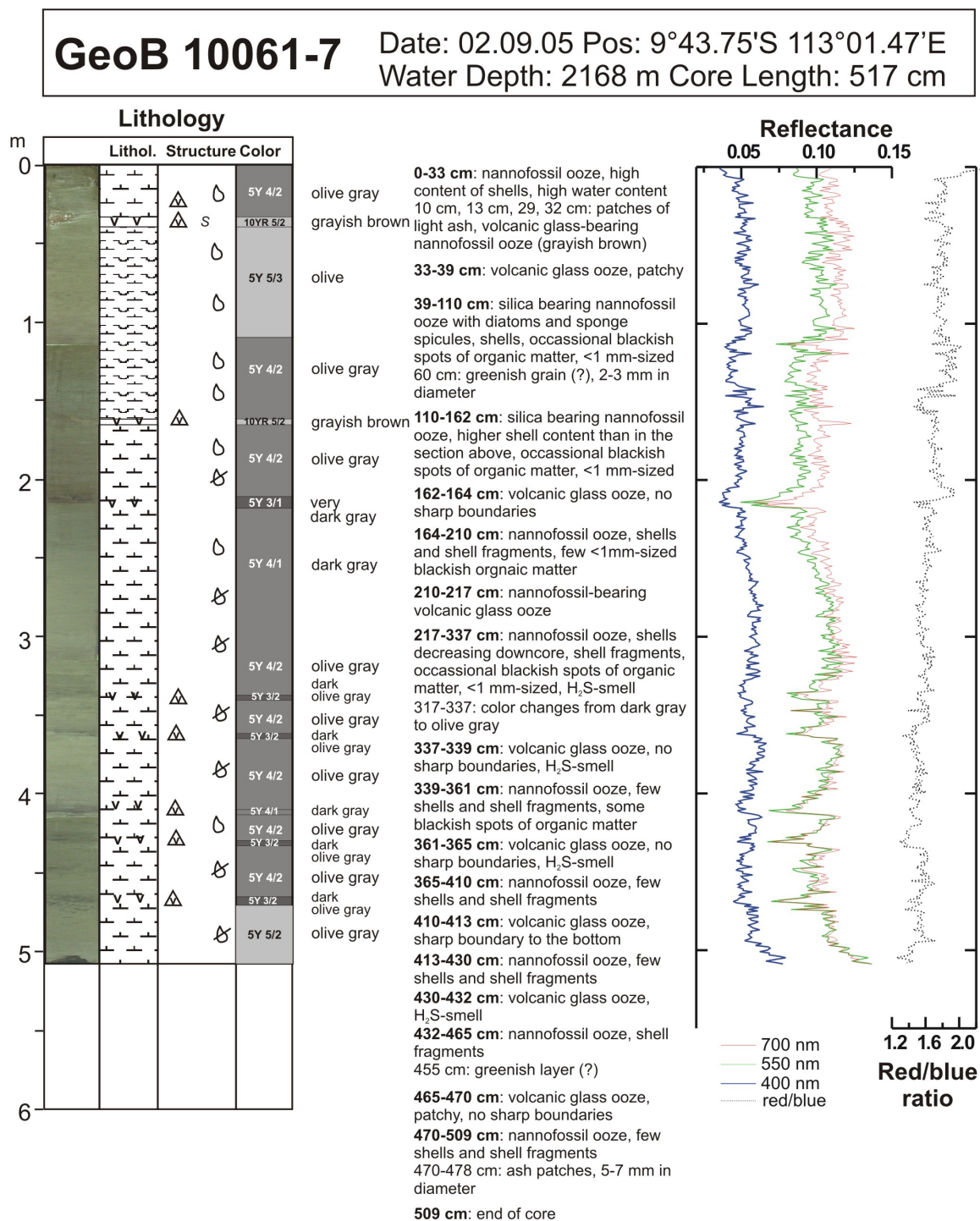


Fig. 7.53: Core description for core GeoB 10061-7.

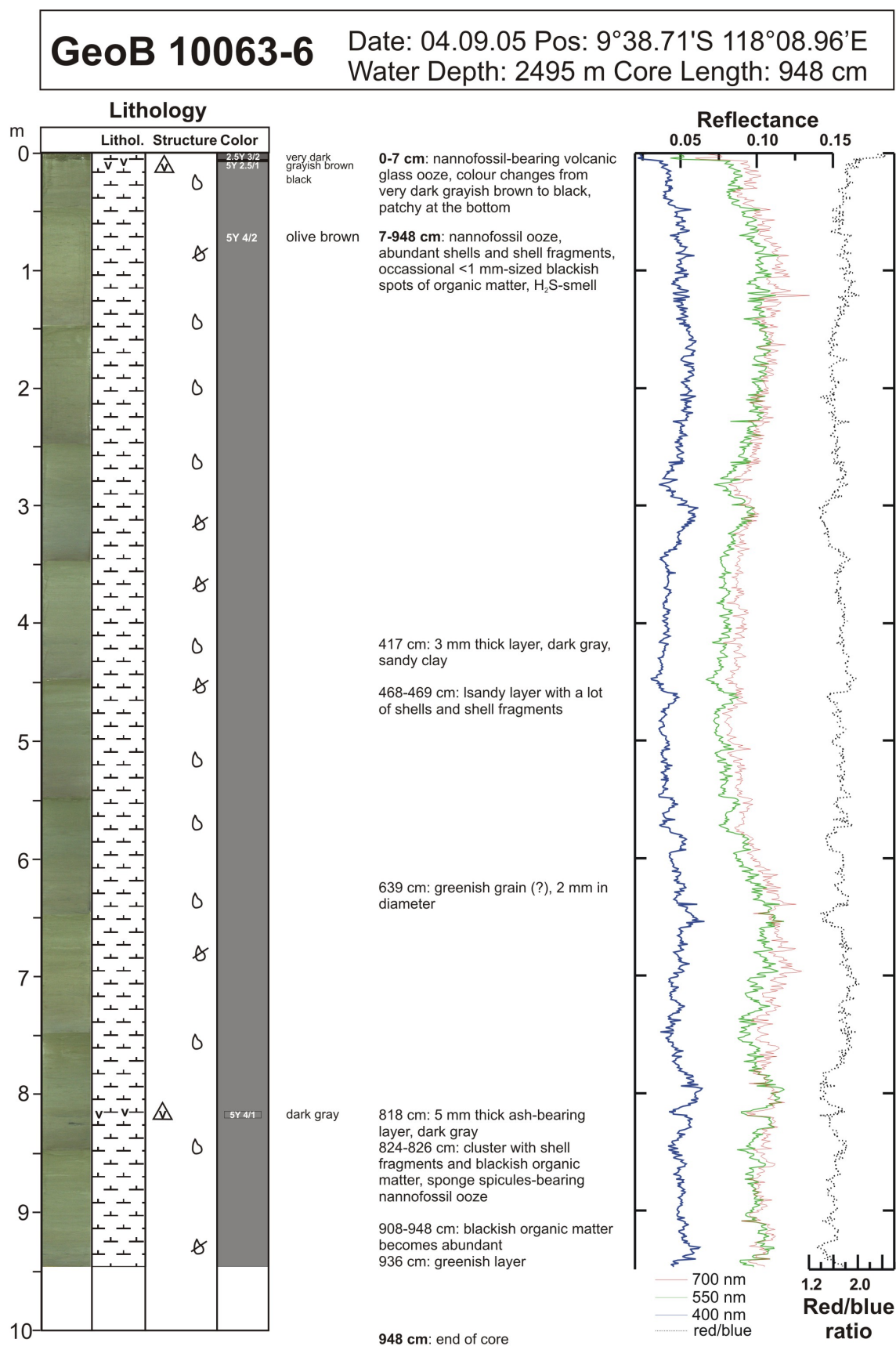


Fig. 7.54: Core description for core GeoB 10063-6.

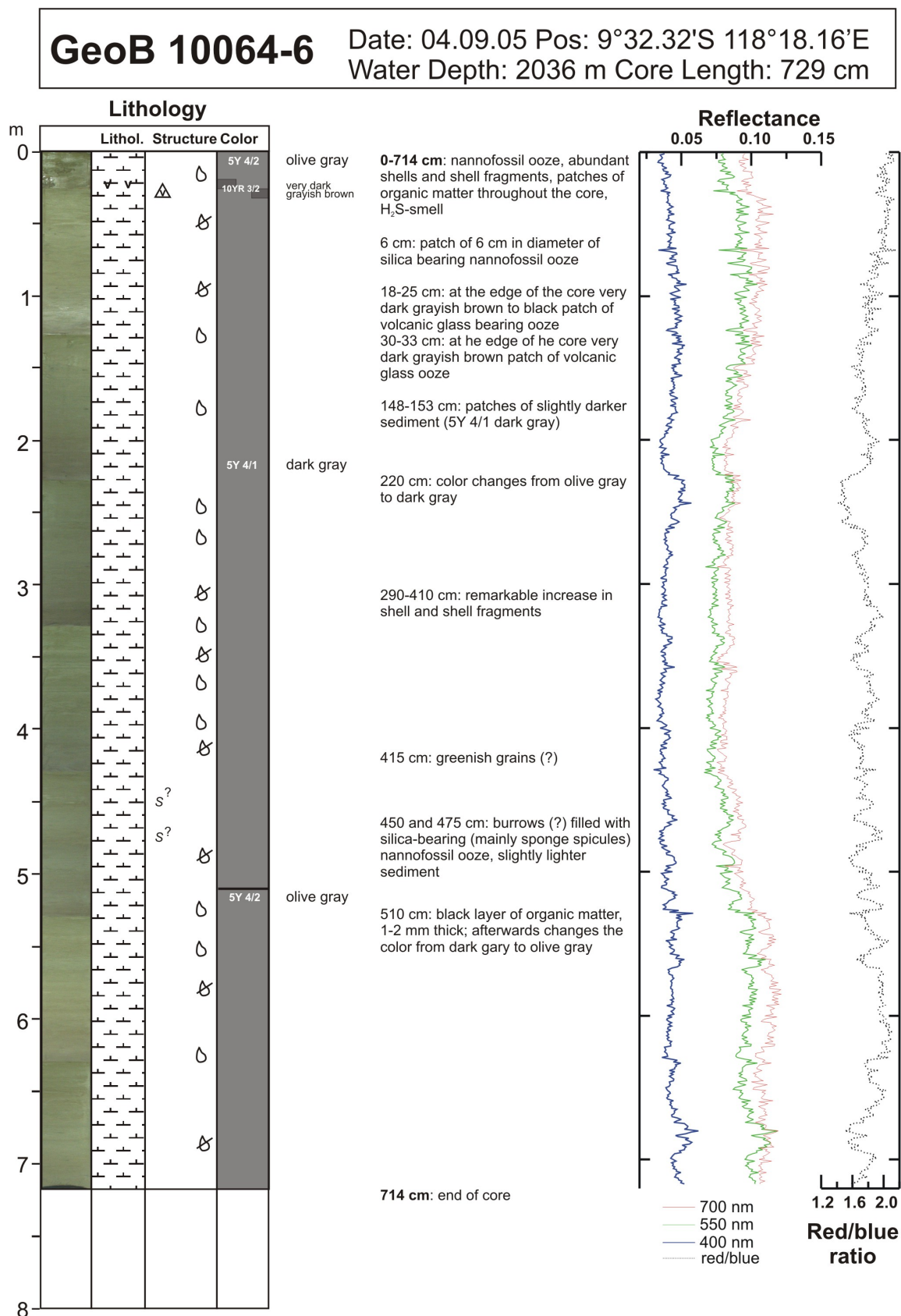


Fig. 7.55: Core description for core GeoB 10064-6.

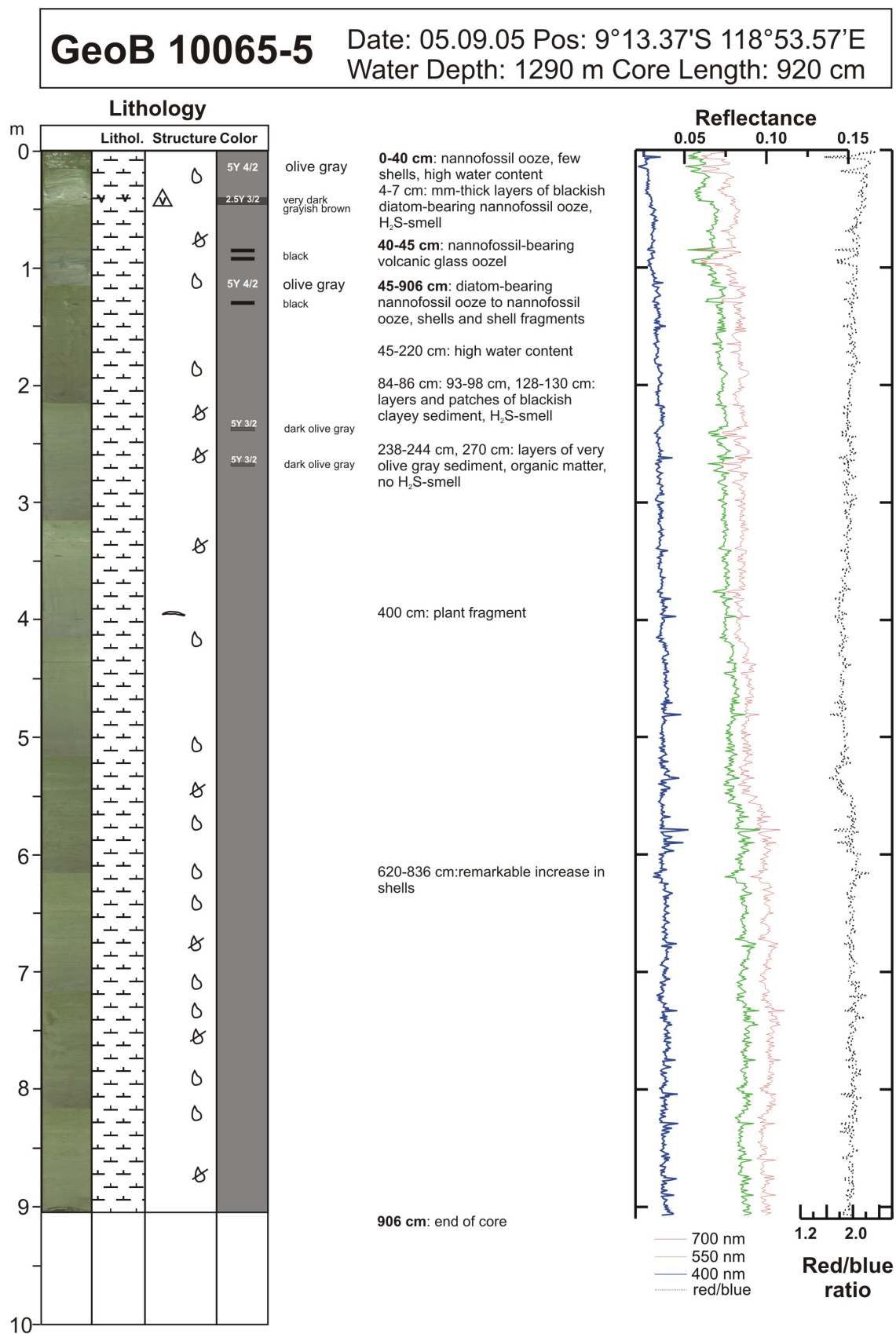


Fig. 7.56: Core description for core GeoB 10065-5.

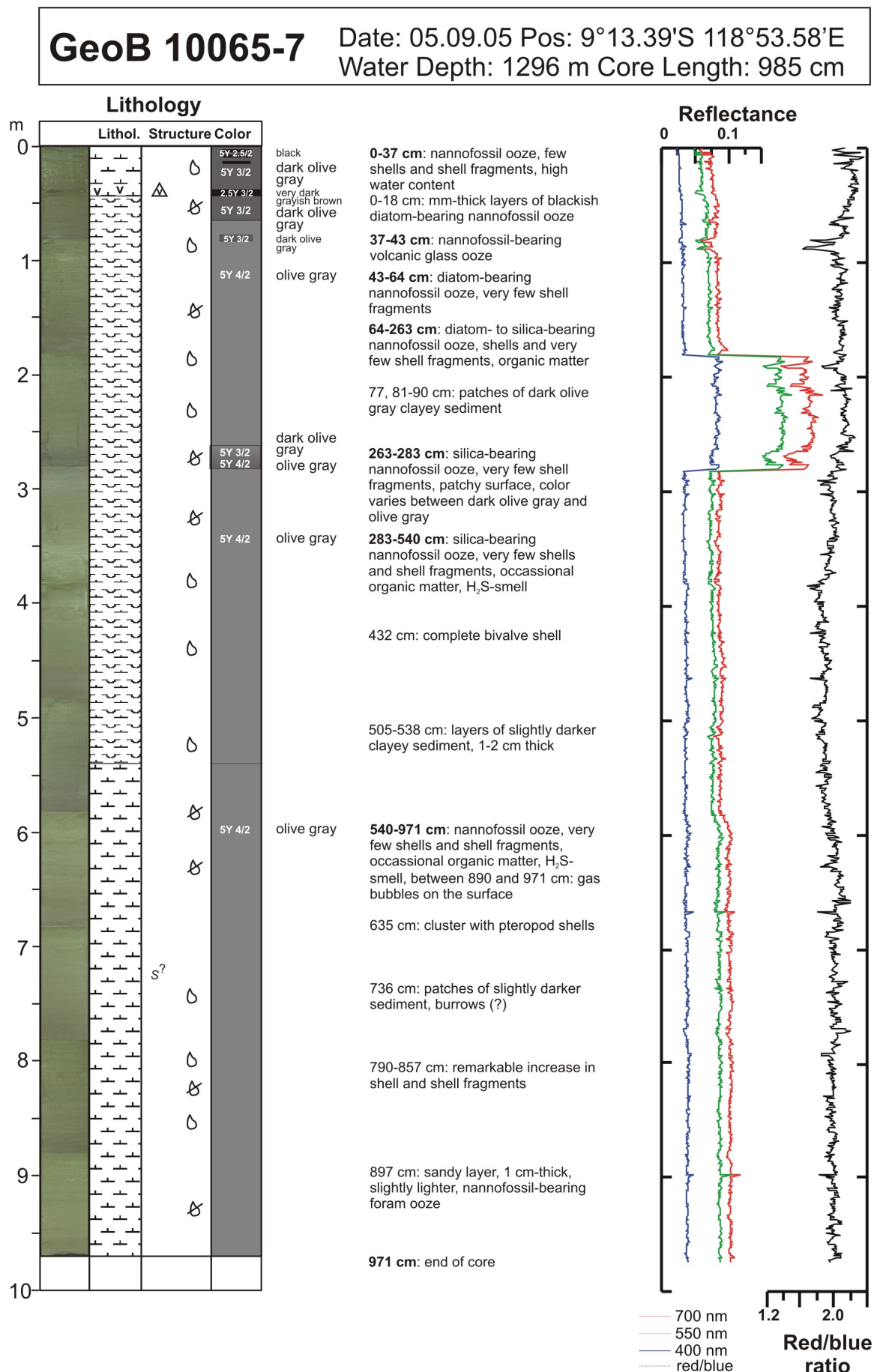


Fig. 7.57: Core description for core GeoB 10065-7.

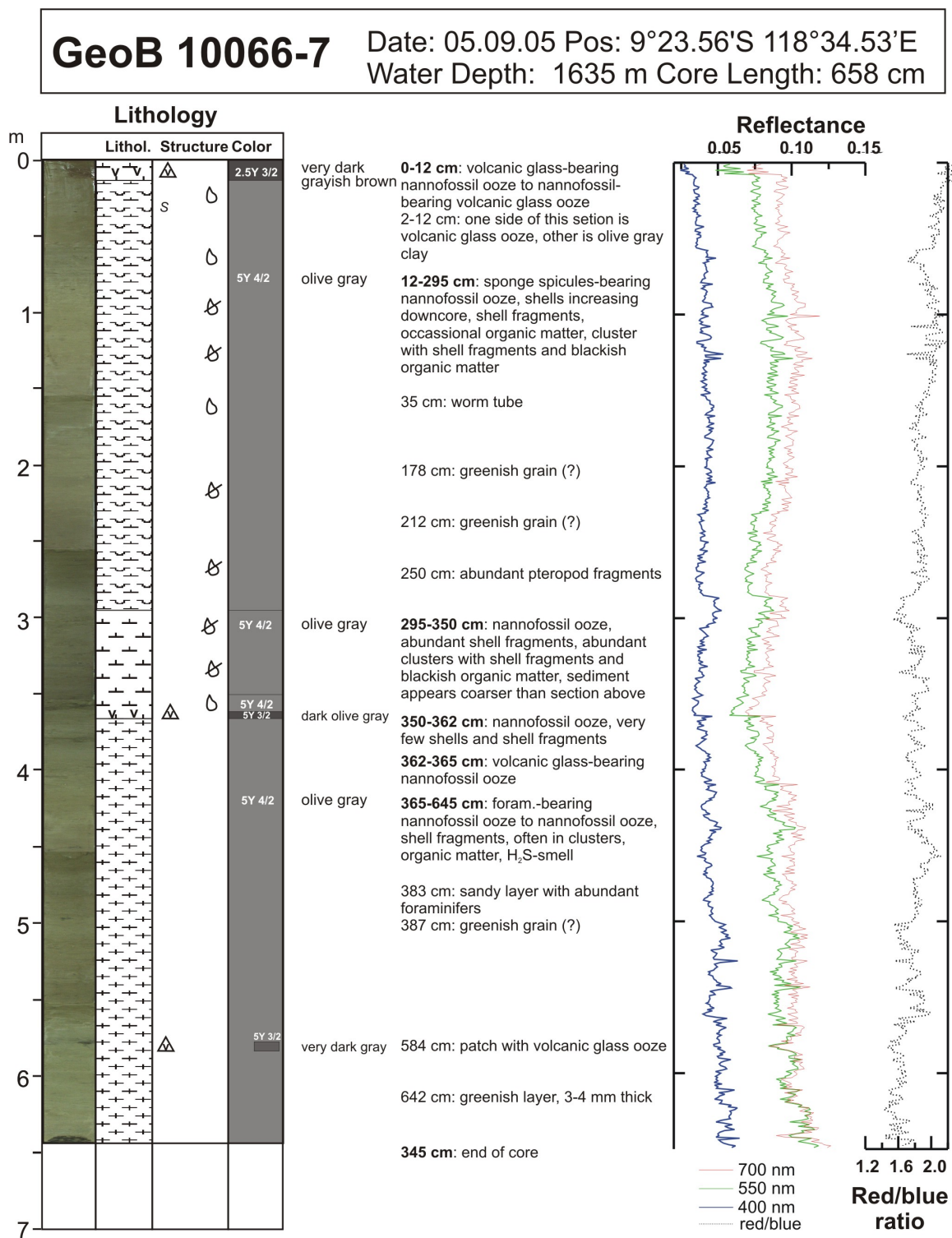


Fig. 7.58: Core description for core GeoB 10066-7.

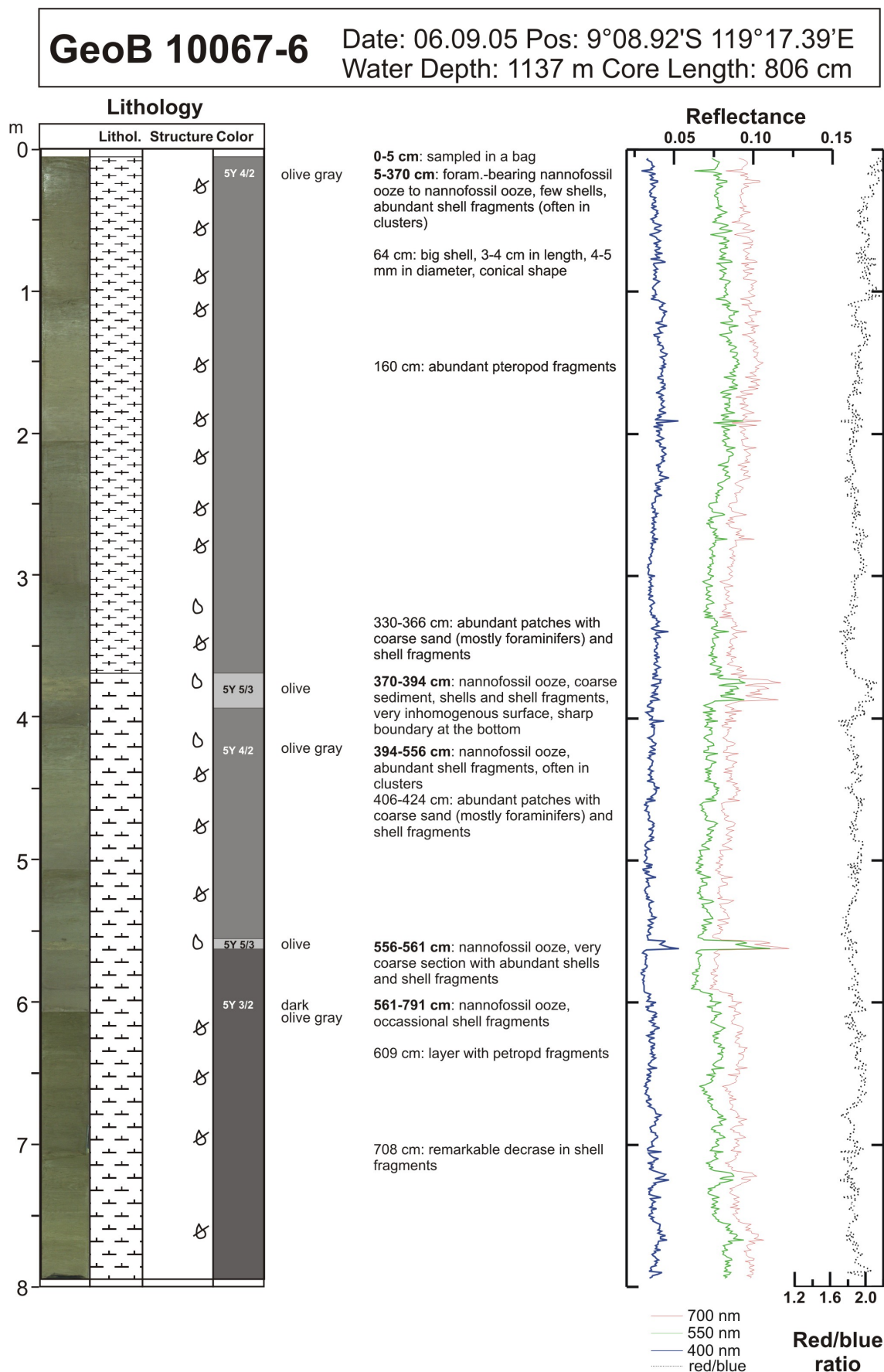


Fig. 7.59: Core description for core GeoB 10067-6.

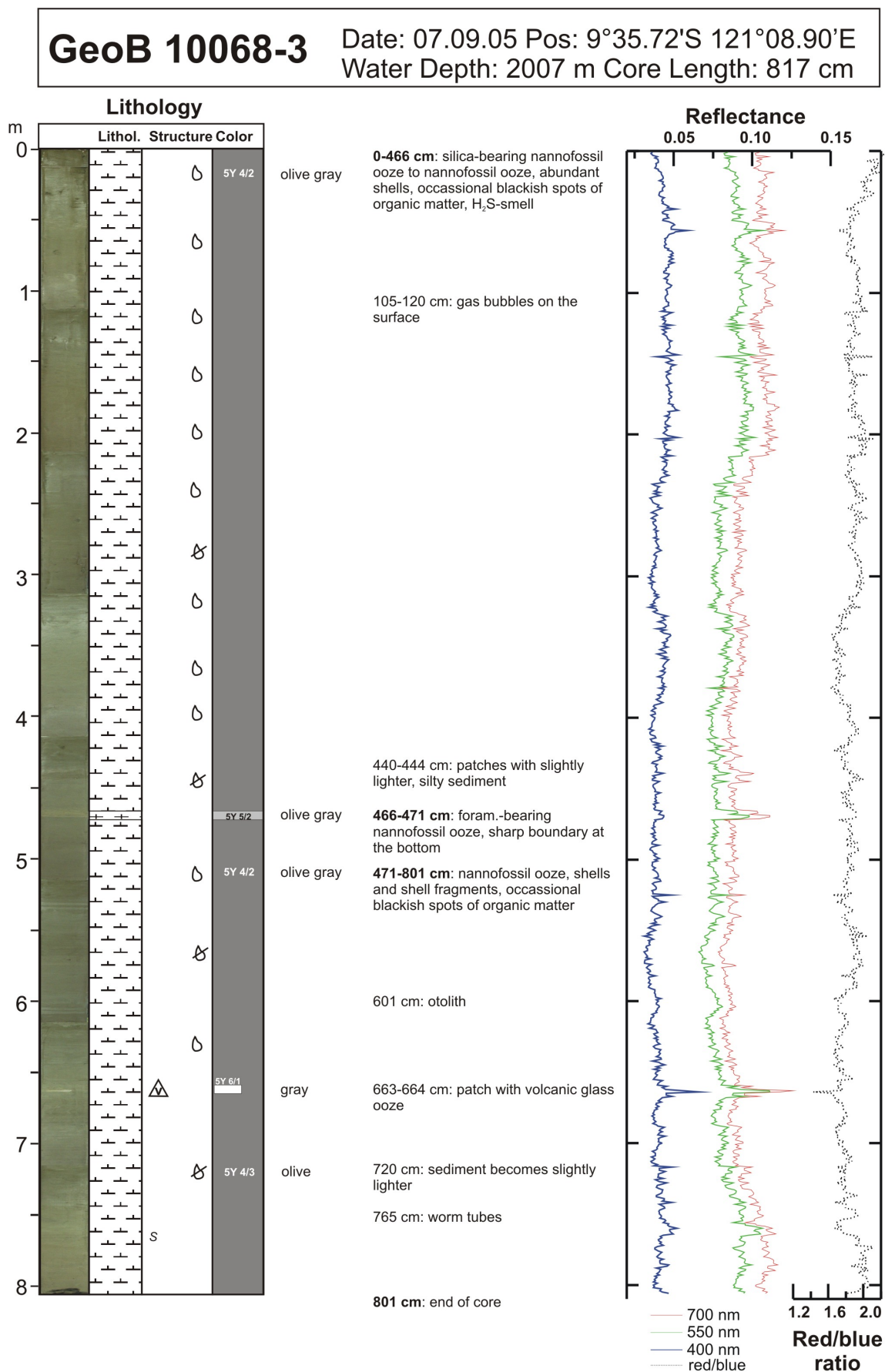


Fig. 7.60: Core description for core GeoB 10068-3.

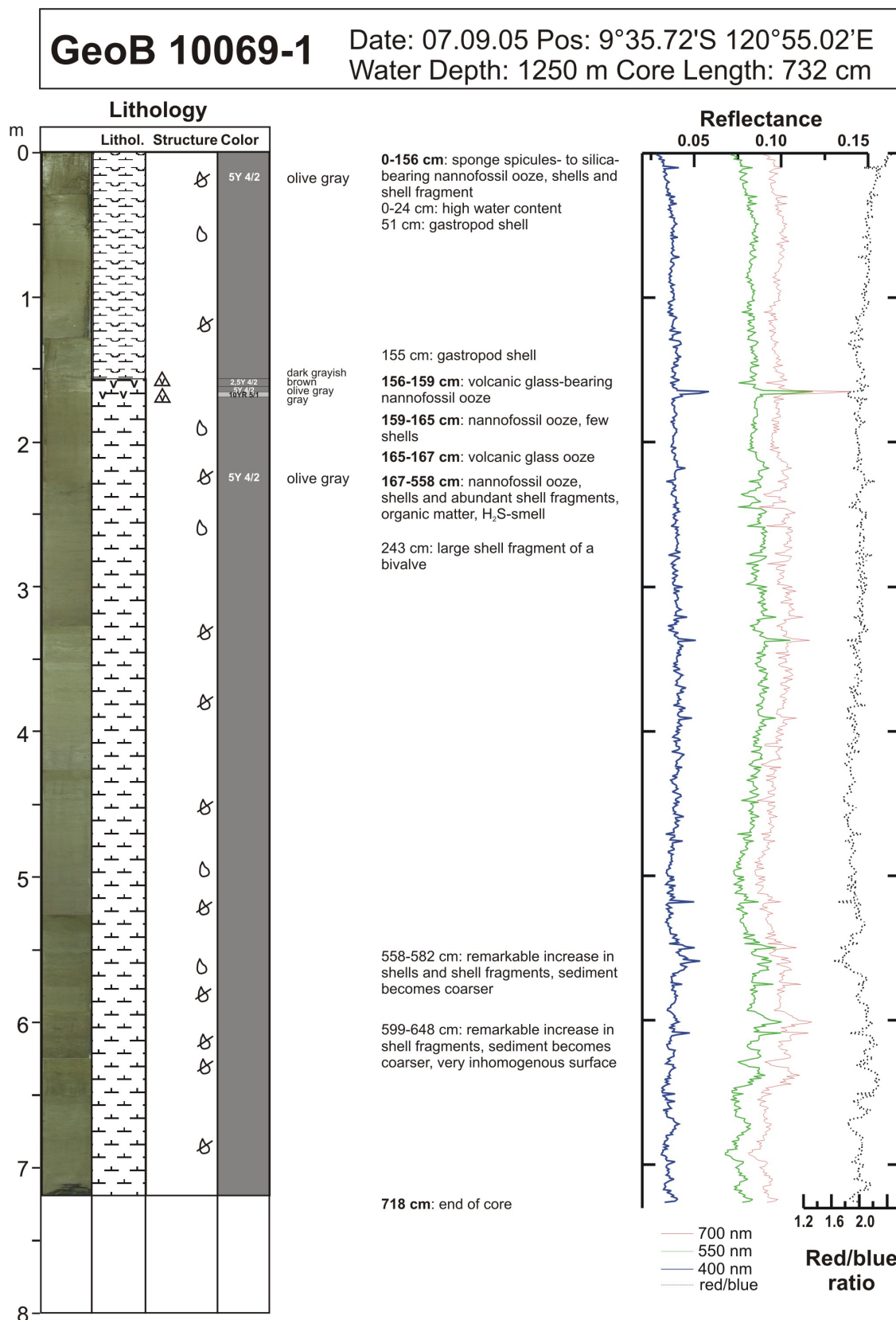


Fig. 7.61: Core description for core GeoB 10069-1.

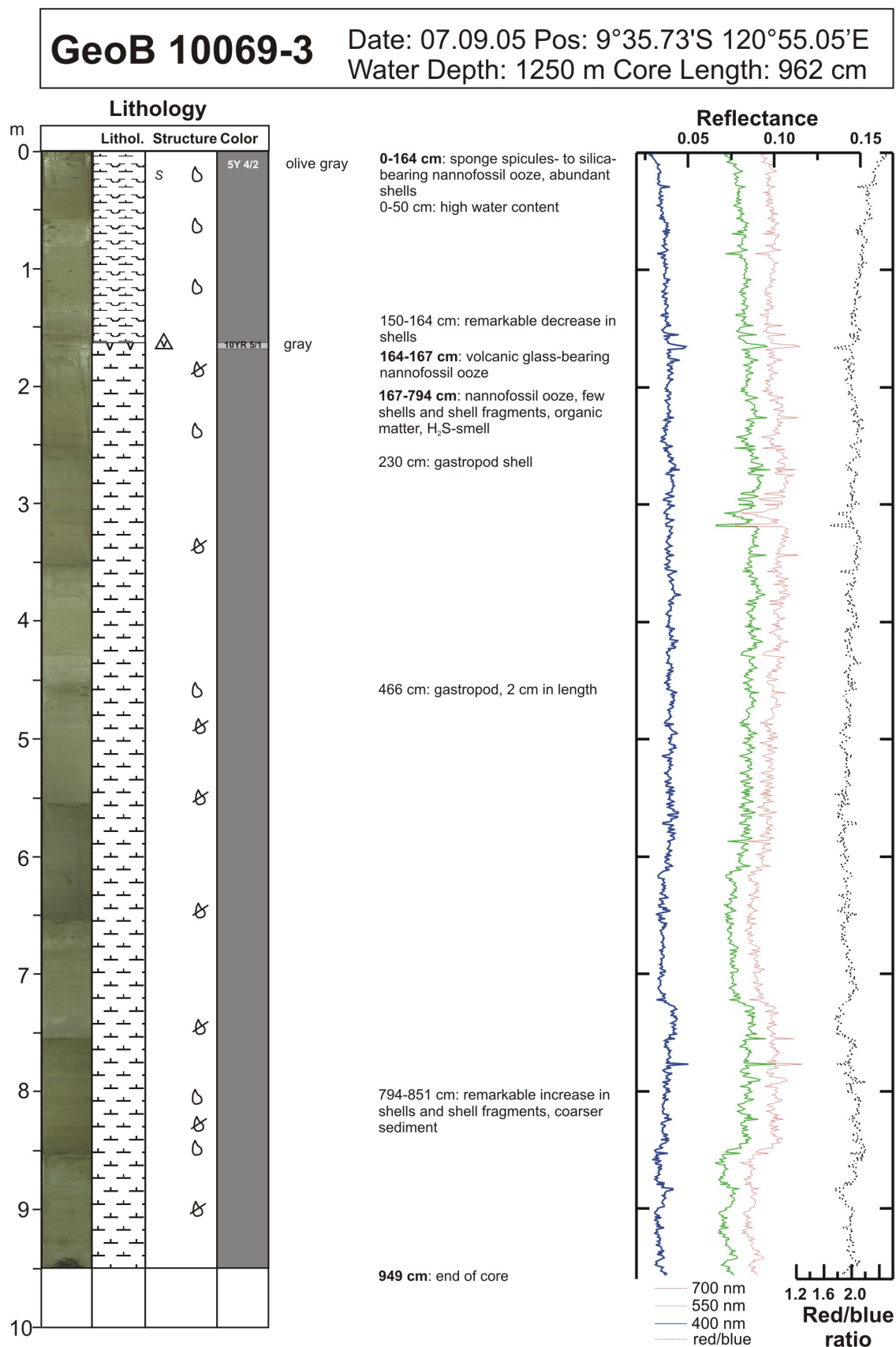


Fig. 7.62: Core description for core GeoB 10069-3.

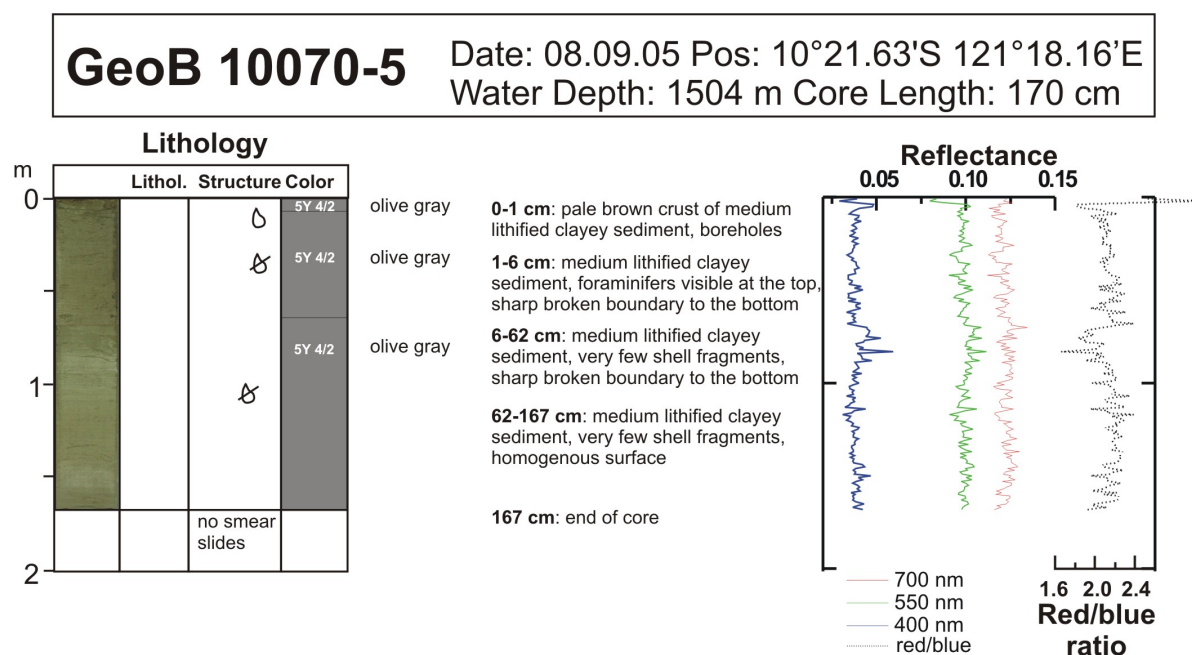


Fig. 7.63: Core description for core GeoB 10070-5.

8. Carbonate Structure Sampling

(B. Donner, C. Hayn, T. Jennerjahn, C. Wienberg)

8.1 Introduction

In the Vulcan Sub-basin off north-west Australia (Timor Sea), groups of mound structures on the seabed have been located on reflection seismic data, suspected to be modern carbonate knolls or bioherms. The total number of mounds or knolls in this region is presently unknown, furthermore little is known about their development, structure and ecosystem. One example of these knoll features is the so-called “Pee Shoal” (11°45' S / 124°50' E). The Pee Shoal is a flat-topped structure, which is made up of reef material and carbonates. It is about 1100 m wide at its base and has a height of ~155 m. To obtain a better understanding of the shape and structure of the Pee Shoal as well as the reef community living on this knoll two surveys with a deep-towed camera sled Ocean Seafloor Observation System (OFOS) were made, furthermore the knoll was sampled with a TV-guided grab sampler (TVG) and a Gravity corer (6 m pipe).

8.2 Ocean Floor Observation System (OFOS)

The OFOS system on board RV SONNE is a sophisticated deep-towed camera sled (Fig. 8.1) that has been adapted to satisfy a wide range of scientific requirements. OFOS is equipped with the following instruments: two video cameras (color camera: Deep Sea Power and Light, black and white camera: Photosea), a stereo still camera (Photosea), various xenon and halogen lights (Deep Sea power and Light), CTD (Seabird), a compass, pitch and roll sensor, and a SIMRAD SSBL (super short baseline) responder. The sled is towed behind the ship at a speed of 0.5-0.8 knots (kn).



Fig. 8.1: OFOS video sled on deck RV Sonne.

The distance of about 1.5 m to the seafloor is manually adjusted by the winch operator. To aid the winch operator in assessing the distance to the seafloor, a weight on a 2 m rope is attached to the bottom of the sled. Two laser pointers can be used to scale the video image and the still camera images. The two laser pointers are parallel and 20 cm apart, while a third one points downward at an oblique angle providing an estimate of the absolute distance to the seafloor. The still camera is loaded with a slide film (Kodak Ektachrome 100) with a maximum of 800 shots. Images were taken manually by the OFOS observers – optionally images can be taken

at regular time intervals. Date and time (UTC) information is superimposed on the black and white and color video signals from the two OFOS cameras. The video streams were recorded on two analog VHS video recorders, in addition the black and white stream was digitized online and recorded to DVD. Ships position data, SSBL position data, OFOS CTD data and an online protocol written by the OFOS observers are recorded in the DVS database system of the ship. After a complete OFOS deployment, all relevant data were downloaded and stored in a database referenced in UTC time.

8.3 TV-guided grab sampler (TVG)

The TVG provides a means of collecting large volumes of surface sediments from the seafloor, which has proved useful especially for collecting large rock samples or gas hydrates embedded in sediment (Fig. 8.2). The TVG is equipped with black and white and color video cameras looking downwards through the open lids of the grab. Positioning is provided by an SSBL responder, connected to a fibre-optic cable 50 m above the tool. Once a sampling target has been identified, the tool is set down on the sediment surface and hydraulically closed. The energy for closing the grab is provided by deep-sea batteries which allow for about 3-5 closings, depending on the length of the operation, as the lights are also powered by the same batteries.

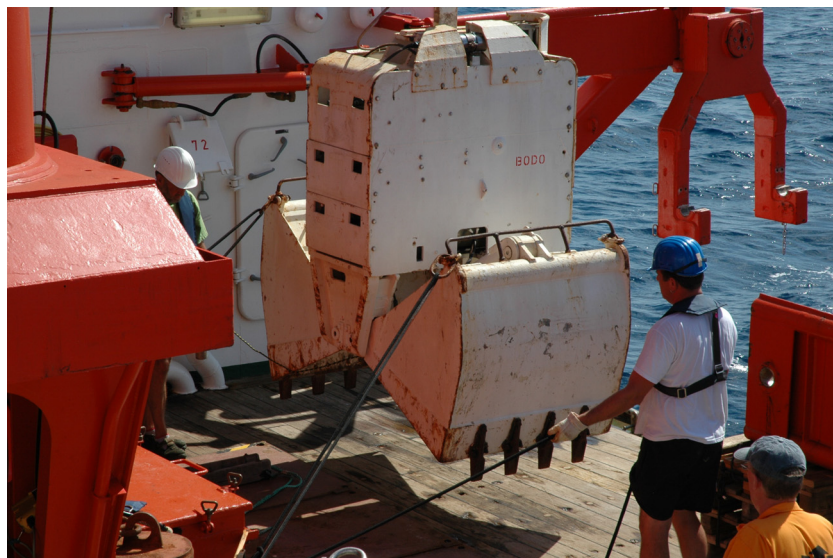


Fig. 8.2: TV-guided sediment grab on deck RV Sonne.

8.4 Shipboard results

8.4.1 OFOS survey

The video observations during the two OFOS tracks (GeoB 10071-1, GeoB 10071-2; Table 8.1) revealed that the eastern flank is very steep and not gently rising as described in former publications. It is therefore a real knoll structure. The Pee Shoal is build up by hard carbonates, which are partly covered by dead broken corals at the flank. On the flat-topped summit, which is located in a water depth of ~20 m, various species of alive very colorful (blue, red, orange) and large (up to 50 cm in height and diameter) sponges appear. Between these sponges, large fragments of dead corals are abundant. To the sides of the summit (~40 m water depth) the coral fragments are replaced by white coarse material, ranging from sand- to gravel-fraction, made up of shell fragments of various organisms (rhodoliths, algae, *Halimeda*, bivalves, gastropods, large foraminifera, etc.). In a water depth of ~ 200 m, current

ripples could be found on a platform at the eastern flank of the Pee Shoal. Moreover, living animals as fish, starfish, worms, crabs and echinoids were observed.

Table 8.1: OFOS tracks during RV Sonne cruise SO-184.

Station-No.	date		time (UTC)	latitude	longitude	water depth (m)	direction	Pee Shoal area
GeoB 10071-1	10/09/05	Start	00:30	11°44,90' S	124°50,02' E	315	N to S	eastern flank
		End	03:04	11°45,73' S	124°50,01' E	242		
GeoB 10071-2	10/09/05	Start	03:34	11°45,12' S	124°49,84' E	23	NNE to SSW	summit
		End	05:19	11°45,83' S	124°49,60' E	88		

8.4.2 TVG sampling

Three samples with the TVG were taken. Two on the summit (GeoB 10071-3, GeoB 10071-4) and one at the upper part of the southern flank (GeoB 10071-5; Tab. 8.2). The samples reveal a huge diversity of dead fragments of organisms such as corals, *Halimeda*, rhodoliths, sponges and living organisms such as sponges, crabs, worms and fish (Fig. 8.3). Furthermore, huge carbonate hardgrounds are found. Some larger fragments were sampled, washed and cooled and two bags of the coarse sandy material were sampled for each TVG sample for further analysis at the Department of Geology, University of Bremen.

Table 8.2: TVG sampling during RV Sonne cruise SO-184.

Station-No.	date	time (UTC)	latitude	longitude	water depth (m)
GeoB 10071-3	10/09/05	06:19	11°45,50' S	124°49,70' E	21
GeoB 10071-4	10/09/05	07:02	11°45,60' S	124°49,67' E	21
GeoB 10071-5	10/09/05	07:44	11°45,77' S	124°49,60' E	33



Fig. 8.3: Photographs of the TVG samples GeoB 10071-3, GeoB 10071-4 and GeoB 10071-5.

9 Sediment Trap Recovery

(M. Birkicht, M. Gröning, T. Jennerjahn, T. Mehring, O. Morisse, G. Ruhland)

9.1 Introduction

The Java – Sumatra upwelling appears to play a key role for the 'Indian Ocean dipole', a major control of Indian Ocean climate variability nowadays and possibly also in the recent geological past (Saji et al., 1999; Webster et al., 1999). Understanding the present-day functioning of this upwelling area is an important prerequisite for the reconstruction of paleoenvironmental conditions over the past ~50,000 years. However, field-based studies of the regional biogeochemistry and oceanography are scarce. Time-series fluxes of settling particles may provide clues on the seasonal variability of productivity and the transfer of carbon and nutrients from the surface to the deep ocean. For this purpose a mooring system consisting of two sediment traps and two current meters had been deployed in the Indian Ocean off Java to collect settling particles and data on current direction and velocity between November 17, 2002, and December 4, 2003.

9.2 Mooring system

The mooring deployed at a depth of 3000 m consisted of two sediment traps which collected settling particles in water depths of 1923 m and 2460 m, respectively. The upper cylindrical trap (type HYDROBIOS Mod. 440 120) collected particles in 12 cups at intervals of 31 days while the deeper cone-shaped trap (type MCLANE MARK VII) collected settling particles in 21 cups at intervals of 17 days. The system was also equipped with two MORS current meters which were placed below the traps. These collected data on current direction and velocity. A BENTHOS acoustic release (Mod. 865A) connected the approx. 1000 m long mooring system to the anchor weight. BENTHOS glass spheres and a BILLINGS topfloat provided the necessary buoyancy to keep the system upright in the water column and to transfer it to the surface after release from the anchor weight. The trap cups were initially filled with ambient seawater and poisoned with HgCl_2 to avoid decomposition of the collected particles.

9.3 Recovery protocol

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY, INDONESIA
ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: SO-184/3 (PABESIA)

Date: 25.08.2005

Mooring System Information

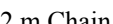
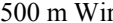
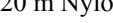
Mooring- I.D.: JAM-3

Anchor Drop:

8°16.04' S
108°08.96'E

Deployment: 27.11.2002

Recovery: 25.08.2005

		Mooring Description		Remarks	Deployment Time out	Recovery on Deck
m.a.b.	m.b.s.					
1114	1886		(1) Billing Topfloat		19:30	(UTC) 02:08
			2 m Chain			
			(11) 17' Glass Balls			02:10
			2 m Chain			
			20 m Nylon/Rope			
			2 m Chain			
			HB Sediment Trap Mod. 444 120		19:45	02:12
1077	1923		2 m Chain			
1073	1927		MORS Current Meter		19:55	02:16
			500 m Wire Rope			02:32
			(3) Triple Floats G6600-3		20:05	02:33
			20 m Nylon Rope			
			2 m Chain			
540	2460		Mark VII Sediment Trap Cups label "S"		20:15	02:37
			2 m Chain			
536	2464		MORS Current Meter			02:41
			500 m Wire Rope			
			(4) 17' Glass Balls		21:20	02:57
			1 m Chain			
34	2966		Benthos Release			02:58
			1 m Chain			
			20 m Nylon Rope			
0	3000		Anchor		21:40	

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY, INDONESIA
ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: BJ IV 2002 (JIGIE)
SO-184/3 (PABESIA)

DEPLOYMENT DATE: 27.11.02
RECOVERY DATE: 25.08.05

MOORING SYSTEM INFORMATION

Mooring I.D. **JAM-3**

	Deployment	Recovery
Captain	A. WawangAWAN.G	Oliver Meyer
Chief Scientist	Ir. Bambang Herunadi	Tim Jennerjahn
Chief mate	Nunung Suhartono	Nils-Arne Aden
Mooring Master	Tim Rixen/ Moh. Djakfar	Götz Ruhland, Ole Morisse
Recorder	Marion Kohn	Tim Jennerjahn
Scientific Hands	Ikhsan B Wahyono , Handoko Manoto , Adi Slamet Riyadi , Herie Purwanto Norman Ali , Tatang Sutardi, Rosul Tjahyono, Kuncoro, Ole Morisse, Sascha Klöpper	Matthias Birkicht, Max Gröning, Tjark Mehring
Crew Hands	Moch.Soleh, Seger Mulyono, M.Mustofa	Winfried Jahns, Torsten Bierstedt, Jan Tauscher, Hans-Jürgen Vor
Weather Condition	Overcast	Sunny, calm sea

Water Depth	3010 m
Release Model	Benthos 865 A, S/N 649, 13V
Enable Code	1A
Release Code	1B
RX Freq.	12.00 Khz
TX Freq.	10.00 Khz
Mooring Top, Description	Billing Topfloat G6600
Radio Frequency	Ch 68, 156.425 MHz
Strobe Flash	St 400 A, S/N G03-020
Release Armed (Time)	21:00 Morisse, Rixen
Mooring Position	08° 16.04' S 108° 08.96' E

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ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: SO-184/3 (PABESIA)

RECOVERY DATE: 25.08.05

SEDIMENT TRAP SYSTEM INFORMATION

Sediment trap I.D.	# JAM-3 shallow
Mooring I.D.	JAM-3
# of traps on mooring, depth	2, 1923 m, 2460 m
Trap depth	1923 m
Trap type	Hydro-Bios 444 120
Cup type, number	Nalgene, 250 ml, 1-13
Type of cup water	Seawater (1800 m)
Poison, amount	HgCl ₂ , 3,33 g/l
NaCl, amount	No.
Cups proper number	O.K.
Cups proper position	O.K.
Cups proper direction	O.K.
Deployed on cup number	open hole
Recovery on cup number	Open hole

Battery Voltage Check

	External
Deployment	9.2 V
Recovery	8.6 V

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY, INDONESIA
ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: SO-184/3 (PABESIA)

RECOVERY DATE: 25.08.05

SEDIMENT TRAP SYSTEM INFORMATION

Schedule	JAM-3 shallow	Retrieval
Bottle 1 = 11/27/2002 23:59, 744:00		
Bottle 2 = 12/28/2002 23:59, 744:00		
Bottle 3 = 01/28/2003 23:59, 744:00		
Bottle 4 = 02/28/2003 23:59, 744:00		
Bottle 5 = 03/31/2003 23:59, 744:00		
Bottle 6 = 05/01/2003 23:59, 744:00		
Bottle 7 = 06/01/2003 23:59, 744:00		
Bottle 8 = 07/02/2003 23:59, 744:00		
Bottle 9 = 08/02/2003 23:59, 744:00		
Bottle 10 = 09/02/2003 23:59, 744:00		
Bottle 11 = 10/03/2003 23:59, 744:00		
Bottle 12 = 11/03/2003 23:59, 744:00		

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY, INDONESIA
ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: SO-184 (PABESIA)

RECOVERY DATE: 25.08.05

SEDIMENT TRAP SYSTEM INFORMATION

Sediment trap I.D.	# JAM-3 deep
Mooring I.D.	JAM-3
# of traps on mooring, depth	2, 1923 m, 2460 m
Trap depth	2460 m
Frame no.	
Rotor no.	10237
Timer no.	1376
Cup type, number	Nalgene, 250 ml, 1-21
Type of cup water	Seawater (1800 m)
Poison, amount	HgCl ₂ , 3,33 g/l
NaCl, amount	No.
Cups proper number	O.K.
Cups proper position	O.K.
Cups proper direction	O.K.
Deployed on cup number	open hole
Recovery on cup number	Open hole

Battery Voltage Check

	External	Internal
Test	22.1 V	9,3 V
Deployment	22.7 V	8,2 V
Recovery	20.2 V	8.7 V

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY, INDONESIA
ZENTRUM FÜR MARINE TROPENÖKOLOGIE, GERMANY

CRUISE NO: SO-184/3 (PABESIA)

RECOVERY DATE: 25.08.05

SEDIMENT TRAP SYSTEM INFORMATION

Schedule

JAM-3 deep

Retrieval

-----VERIFICATION-----

Event	01	of	22	=	11/17/02	23:59:00
Event	02	of	22	=	12/14/02	23:59:00
Event	03	of	22	=	12/31/02	23:59:00
Event	04	of	22	=	01/17/03	23:59:00
Event	05	of	22	=	02/03/03	23:59:00
Event	06	of	22	=	02/20/03	23:59:00
Event	07	of	22	=	03/09/03	23:59:00
Event	08	of	22	=	03/26/03	23:59:00
Event	09	of	22	=	04/17/03	23:59:00
Event	10	of	22	=	04/29/03	23:59:00
Event	11	of	22	=	05/16/03	23:59:00
Event	12	of	22	=	06/02/03	23:59:00
Event	13	of	22	=	06/19/03	23:59:00
Event	14	of	22	=	07/06/03	23:59:00
Event	15	of	22	=	07/23/03	23:59:00
Event	16	of	22	=	08/09/03	23:59:00
Event	17	of	22	=	08/26/03	23:59:00
Event	18	of	22	=	09/12/03	23:59:00
Event	19	of	22	=	09/29/03	23:59:00
Event	20	of	22	=	10/16/03	23:59:00
Event	21	of	22	=	11/02/03	23:59:00
Event	22	of	22	=	11/13/03	23:59:00

Clock reads 11/27/02 21:35:29

System is ready. Remove communication cable & deploy.

9.4 Shipboard results

The mooring system was recovered in a fast and efficient manner on August 25 in the morning. Despite being deployed at 3000 m water depth for nearly three years the acoustic release responded immediately after enabling and released properly on the first attempt. Both traps were recovered on open hole and have collected particles. The sample cups were removed from the traps and stored cool immediately after recovery. From visual inspection of the cups it appears that the upper trap collected less material than the lower one despite a longer collection interval (Fig. 9.1). However, the much smaller collection area of the cylindrical-shaped upper trap when compared to the lower cone-shaped trap has to be taken into account. Although both traps were recovered on open hole the visual inspection of the samples indicates that the lower trap did not work properly in the second half of the sampling period (Fig. 9.2). Cups 1 to 12 display a pattern of collected particles which appears to be normal while cups 13 and 14 are completely filled and the following cups are almost empty. Unfortunately, the MORS current meter attached to the upper trap in 1923 m was totally damaged.



Fig. 9.1: Cups 1-12 of the upper trap of mooring JAM-3.



Fig. 9.2: Cups 1-21 of the lower trap of mooring JAM-3.

10 Acknowledgements

The scientific parties onboard R/V SONNE during the two scientific legs of the PABESIA expedition (SO-184) gratefully acknowledge the friendly co-operation and efficient technical assistance of Captain Meyer and his crew, which all together contributed significantly to the success of this expedition.

Thanks are also due to the German Research Ministry (BMBF), which funded this cruise within the project “PABESIA – Rekonstruktion der Paläoumweltbedingungen im Bereich des südlichen Indonesischen Archipels”.

11 Station List

SO-184/Leg 2

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10001-1	01.08.05	08:55	8° 32,26' S	109° 8,55' E	3119	CTD/Ros		max. depth: 46 m winch problems
10002-1	01.08.05	11:27	8° 30,68' S	109° 1,33' E	3362	CTD/Ros		max. depth: 190 m winch problems
10002-1	01.08.05	12:22	8° 30,75' S	109° 1,29' E	3364	CTD/Ros		max. depth: 2009 m
10003-1	03.08.05	10:31	4° 45,04' S	100° 46,41' E	3171	CTD/Ros		max. depth: 3153 m
10003-2	03.08.05	13:00	4° 45,09' S	100° 46,09' E	3174	CTD/Ros		max. depth: 100 m
10003-3	03.08.05	13:38	4° 45,08' S	100° 46,04' E	3176	MN	5/5	max. depth: 500 m
	03.08.05	14:35	4° 45,08' S	100° 45,95' E	3224	EM / PS	start	hydroacoustic survey
	03.08.05	19:21	4° 24,72' S	101° 4,96' E	425	EM / PS	turn	hydroacoustic survey
	03.08.05	19:50	4° 22,83' S	101° 2,84' E	460	EM / PS	turn	hydroacoustic survey
	03.08.05	22:44	4° 34,44' S	100° 51,42' E	2752	EM / PS	turn	hydroacoustic survey
	03.08.05	23:12	4° 32,41' S	100° 49,34' E	2849	EM / PS	turn	hydroacoustic survey
	04.08.05	01:38	4° 21,40' S	100° 59,68' E	682	EM / PS	turn	hydroacoustic survey
	04.08.05	02:28	4° 23,01' S	101° 3,17' E	449	EM / PS	end	hydroacoustic survey
10004-1	04.08.05	02:47	4° 23,00' S	101° 3,17' E	450	MUC	not released	
10004-2	04.08.05	03:23	4° 23,01' S	101° 3,14' E	450	MUC	not released	
10005-1	04.08.05	05:43	4° 27,45' S	100° 53,82' E	2568	MUC	not released	
10005-2	04.08.05	07:32	4° 27,47' S	100° 53,86' E	2569	GC 6M	empty core	
10005-3	04.08.05	09:22	4° 27,44' S	100° 53,91' E	2570	GC 6M	282 cm	
10006-1	04.08.05	11:53	4° 33,05' S	100° 49,92' E	2800	GC 6M	161 cm	
10007-1	04.08.05	14:36	4° 21,27' S	100° 59,75' E	609	CTD/Ros		max. depth: 594 m
10007-2	04.08.05	15:30	4° 21,26' S	100° 59,78' E	598	MN	5/5	max. depth: 500 m
	05.08.05	13:31	1° 6,88' S	97° 57,01' E	3036	EM / PS	start	hydroacoustic survey
	05.08.05	17:58	0° 55,02' S	98° 20,08' E	841	EM / PS	turn	hydroacoustic survey
	05.08.05	18:30	0° 57,73' S	98° 21,28' E	799	EM / PS	turn	hydroacoustic survey
	05.08.05	22:46	1° 9,74' S	97° 58,41' E	2981	EM / PS	turn	hydroacoustic survey
	05.08.05	23:19	1° 12,20' S	98° 0,31' E	3076	EM / PS	end	hydroacoustic survey
10008-1	06.08.05	01:48	0° 57,26' S	98° 15,61' E	936	MUC	not released	
10008-2	06.08.05	02:38	0° 57,26' S	98° 15,61' E	935	GC 6M	112 cm	stored in Bandung
10008-3	06.08.05	03:38	0° 57,26' S	98° 15,53' E	934	GC 6M	165 cm	
10008-4	06.08.05	04:29	0° 57,29' S	98° 15,59' E	934	MUC	6/6 4/4	
10009-1	06.08.05	07:09	1° 3,76' S	98° 3,23' E	2102	MUC	not released	
10009-2	06.08.05	08:35	1° 3,78' S	98° 3,21' E	2100	GC 6M	25 cm	
10010-1	06.08.05	11:14	1° 10,69' S	97° 58,89' E	2937	MUC	6/6 4/4	
10010-2	06.08.05	13:13	1° 10,80' S	97° 58,94' E	2963	GC 6M	424 cm	

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10011-1	06.08.05	15:01	1° 11,43' S	97° 59,13' E	3030	MN	5/5	max. depth: 500 m
10011-2	06.08.05	16:33	1° 11,44' S	97° 59,05' E	3038	CTD/Ros		max. depth: 2637 m winch problems
10011-3	06.08.05	19:49	1° 11,39' S	97° 58,94' E	3047	CTD/Ros		max. depth: 3024 m
10012-1	06.08.05	22:51	1° 3,73' S	98° 3,27' E	2108	CTD/Ros		max. depth: 2096 m
10013-1	07.08.05	01:25	0° 57,29' S	98° 15,59' E	936	CTD/Ros		max. depth: 927 m
	07.08.05	17:50	1° 32,86' N	96° 23,04' E	3004	EM / PS	start	hydroacoustic survey
	07.08.05	23:56	1° 39,01' N	96° 59,02' E	1212	EM / PS	turn	hydroacoustic survey
	08.08.05	00:20	1° 40,99' N	96° 58,80' E	1156	EM / PS	turn	hydroacoustic survey
	08.08.05	00:41	1° 40,63' N	96° 56,90' E	1299	EM / PS	end	hydroacoustic survey
10014-1	08.08.05	01:30	1° 40,71' N	96° 58,86' E	1158	MUC	6/6 4/4	
10014-2	08.08.05	02:35	1° 40,80' N	96° 58,87' E	1155	GC 6M	72 cm	
10014-3	08.08.05	03:41	1° 40,80' N	96° 58,90' E	1159	GC 6M	476 cm	
10015-1	08.08.05	05:35	1° 37,95' N	96° 53,17' E	1464	MUC	6/6 4/4	
10015-2	08.08.05	06:42	1° 38,00' N	96° 53,18' E	1470	GC 6M	472 cm	
10016-1	08.08.05	09:00	1° 35,78' N	96° 39,63' E	1906	GC 6M	empty core	
10016-2	08.08.05	10:36	1° 35,79' N	96° 39,62' E	1900	MUC	6/6 4/4	
10017-1	08.08.05	13:12	1° 34,34' N	96° 30,95' E	2578	MUC	not released	
10017-2	08.08.05	14:52	1° 34,31' N	96° 30,98' E	2574	GC 6M	empty core	
100018-1	08.08.05	16:33	1° 34,22' N	96° 30,73' E	2577	MN/CTD	5/5	max. depth: 500 m
100018-2	08.08.05	18:14	1° 34,09' N	96° 30,76' E	2574	CTD/Ros		max. depth: 2570 m
10019-1	08.08.05	21:48	1° 37,93' N	96° 53,11' E	1465	MN/CTD	5/5	max. depth: 500 m
10019-2	08.08.05	23:24	1° 37,81' N	96° 53,05' E	1464	CTD/Ros		max. depth: 1458 m
10020-1	09.08.05	01:09	1° 40,69' N	96° 58,77' E	1160	MN/CTD	5/5	max. depth: 500 m
10020-2	09.08.05	02:40	1° 40,79' N	96° 58,78' E	1159	CTD/Ros		max. depth: 1150 m
10020-3	09.08.05	03:36	1° 40,93' N	96° 58,81' E	1159	GC 9M	473 cm	stored in Bandung (GeoB 10014-3)
10021-1	09.08.05	06:25	1° 35,36' N	96° 39,64' E	1851	GC 6M	417 cm	(GeoB 10016)
10021-2	09.08.05	07:57	1° 35,63' N	96° 39,66' E	1906	GC 6M	284 cm	stored in Bandung
	10.08.05	05:48	0° 28,05' S	98° 48,03' E	580	EM / PS	start	hydroacoustic survey
	10.08.05	08:40	0° 36,56' S	99° 2,79' E	897	EM / PS	end	hydroacoustic survey
10022-1	10.08.05	10:13	0° 30,08' S	98° 50,98' E	707	MN/CTD	4/5	max. depth: 500 m
10022-2	10.08.05	11:25	0° 29,94' S	98° 50,95' E	704	CTD/Ros		max. depth: 697 m
10022-3	10.08.05	12:09	0° 29,88' S	98° 51,05' E	704	MUC	not released	
10022-4	10.08.05	12:48	0° 29,95' S	98° 51,00' E	705	GC 9M	522 cm	stored in Bandung
10022-5	10.08.05	13:57	0° 30,00' S	98° 51,00' E	710	GC 9M	613 cm	
10022-6	10.08.05	14:50	0° 30,00' S	98° 51,00' E	706	MUC	6/6 4/4	
10022-7	10.08.05	15:41	0° 30,19' S	98° 51,01' E	712	CTD/Ros		max. depth: 250 m

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
	10.08.05	16:00	0° 30,16' S	98° 50,88' E	712	EM / PS	start	hydroacoustic survey
	10.08.05	23:44	0° 55,19' S	99° 30,50' E	1635	EM / PS	end	hydroacoustic survey
10023-1	11.08.05	00:57	0° 51,42' S	99° 24,44' E	1557	MN/CTD	5/5	max. depth: 500 m
10023-2	11.08.05	02:32	0° 51,47' S	99° 24,44' E	1554	CTD/Ros		max. depth: 1551 m
10023-3	11.08.05	03:56	0° 51,48' S	99° 24,47' E	1555	MUC	6/6 4/4	
10023-4	11.08.05	05:09	0° 51,44' S	99° 24,49' E	1555	GC 9M	589 cm	
10024-1	11.08.05	07:10	0° 46,14' S	99° 16,12' E	1384	MN/CTD	5/5	max. depth: 500 m
10024-2	11.08.05	08:35	0° 46,00' S	99° 16,19' E	1375	CTD/Ros		max. depth: 1373 m
10024-3	11.08.05	09:46	0° 46,09' S	99° 16,09' E	1381	MUC	6/6 4/4	
10024-4	11.08.05	10:44	0° 46,09' S	99° 16,04' E	1379	GC 9M	617 cm	
10025-1	11.08.05	12:33	0° 40,50' S	99° 7,39' E	1148	MN/CTD	5/5	max. depth: 500 m
10025-2	11.08.05	13:59	0° 40,45' S	99° 7,41' E	1161	CTD/Ros		max. depth: 1145 m
10025-3	11.08.05	15:06	0° 40,46' S	99° 7,39' E	1149	MUC	6/6 4/4	
10025-4	11.08.05	16:07	0° 40,49' S	99° 7,39' E	1156	GC 9M	652 cm	
	11.08.05	19:54	0° 41,18' S	99° 46,45' E	497	EM / PS	start	hydroacoustic survey
	12.08.05	00:13	0° 59,96' S	99° 27,99' E	1650	EM / PS	end	hydroacoustic survey
10026-1	12.08.05	01:20	0° 56,65' S	99° 31,28' E	1639	MN/CTD	5/5	max. depth: 500 m
10026-2	12.08.05	02:55	0° 56,64' S	99° 31,28' E	1641	MUC	6/6 4/4	max. depth: 1637 m
10026-3	12.08.05	04:04	0° 56,63' S	99° 31,28' E	1640	GC 9M	812 cm	
10026-4	12.08.05	05:40	0° 56,64' S	99° 31,28' E	1638	GC 9M	665 cm	stored in Bandung
10027-1	12.08.05	07:43	0° 48,53' S	99° 39,20' E	876	MN/CTD	5/5	max. depth: 500 m
10027-2	12.08.05	08:58	0° 48,55' S	99° 39,16' E	874	CTD/Ros		max. depth: 867 m
10027-3	12.08.05	09:41	0° 48,53' S	99° 39,18' E	875	MUC	6/6 4/4	
10027-4	12.08.05	10:25	0° 48,54' S	99° 39,17' E	875	GC 12M	530 cm	
10028-1	12.08.05	11:58	0° 41,77' S	99° 45,77' E	521	MN/CTD	5/5	max. depth: 480 m
10028-2	12.08.05	13:13	0° 41,80' S	99° 45,83' E	520	CTD/Ros		max. depth: 470 m
10028-3	12.08.05	13:43	0° 41,82' S	99° 45,79' E	522	CTD/Ros		max. depth: 466 m
10028-4	12.08.05	14:28	0° 41,80' S	99° 45,78' E	522	MUC	6/6 4/4	
10028-5	12.08.05	15:08	0° 41,79' S	99° 45,78' E	522	GC 12M	433 cm	
	12.08.05	20:31	1° 43,50' S	99° 32,09' E	971	EM / PS	start	hydroacoustic survey
	13.08.05	03:28	1° 28,02' S	100° 11,82' E	742	EM / PS	end	hydroacoustic survey
10029-1	13.08.05	05:39	1° 29,77' S	100° 7,50' E	974	MN/CTD	5/5	max. depth: 500 m
10029-2	13.08.05	07:01	1° 29,71' S	100° 7,61' E	970	CTD/Ros		max. depth: 962 m
10029-3	13.08.05	08:30	1° 29,75' S	100° 7,58' E	974	MUC	6/6 4/4	
10029-4	13.08.05	09:15	1° 29,67' S	100° 7,68' E	964	GC 12M	772 cm	
10030-1	13.08.05	14:32	1° 38,16' S	99° 45,88' E	1767	MN/CTD	5/5	max. depth: 500 m
10030-2	13.08.05	16:03	1° 38,16' S	99° 45,89' E	1766	CTD/Ros		max. depth: 1757 m
10031-1	13.08.05	20:04	1° 41,88' S	99° 36,24' E	1673	MN/CTD	5/5	max. depth: 500 m
10031-2	13.08.05	21:44	1° 41,89' S	99° 36,11' E	1670	CTD/Ros		max. depth: 1661 m
10031-3	13.08.05	23:12	1° 41,93' S	99° 36,19' E	1671	MUC	6/6 4/4	
10031-4	14.08.05	00:21	1° 41,92' S	99° 36,21' E	1669	GC 12M	572 cm	

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10032-1	14.08.05	02:13	1° 40,00' S	99° 40,83' E	1758	MUC	6/6 4/4	
10032-2	14.08.05	03:35	1° 39,99' S	99° 40,83' E	1762	GC 12M	815 cm	
10033-1	14.08.05	07:03	1° 33,89' S	99° 57,12' E	1754	MN	5/5	max. depth: 500 m
10033-2	14.08.05	08:26	1° 33,79' S	99° 57,11' E	1752	GC 12M	650 cm	stored in Bandung
10033-3	14.08.05	09:42	1° 33,80' S	99° 57,13' E	1756	MUC	6/6 4/4	overpenetration
10033-4	14.08.05	10:55	1° 33,79' S	99° 57,16' E	1756	GC 12M	827 cm	
10033-5	14.08.05	12:08	1° 33,79' S	99° 57,14' E	1755	MUC	6/6 4/4	
	15.08.05	04:16	4° 11,49' S	101° 26,98' E	857	EM / PS	start	hydroacoustic survey
	15.08.05	05:05	4° 9,30' S	101° 31,08' E	1023	EM / PS	end	hydroacoustic survey
10034-1	15.08.05	05:45	4° 9,91' S	101° 29,91' E	992	MN/CTD	5/5	max. depth: 500 m
10034-2	15.08.05	07:00	4° 9,89' S	101° 29,94' E	997	CTD/Ros		max. depth: 989 m
10034-3	15.08.05	07:57	4° 9,89' S	101° 29,94' E	995	MUC	6/6 4/4	
10034-4	15.08.05	08:45	4° 9,92' S	101° 29,93' E	996	GC 12M	993 cm	
10035-1	15.08.05	11:49	4° 2,18' S	101° 43,99' E	997	MN/CTD	5/5	max. depth: 500 m
10035-2	15.08.05	13:08	4° 2,25' S	101° 44,04' E	997	CTD/Ros		max. depth: 989 m
10035-3	15.08.05	14:06	4° 2,23' S	101° 44,03' E	996	GC 12M	550 cm	stored in Bandung
10035-4	15.08.05	15:06	4° 2,23' S	101° 44,03' E	997	MUC	not released	
10035-5	15.08.05	16:00	4° 2,24' S	101° 44,04' E	998	GC 12M	670 cm	
	16.08.05	04:32	5° 18,02' S	103° 41,03' E	1311	EM / PS	start	hydroacoustic survey
	16.08.05	05:08	5° 20,73' S	103° 39,13' E	1527	EM / PS	end	hydroacoustic survey
10036-1	16.08.05	05:46	5° 20,26' S	103° 39,40' E	1498	MN/CTD	5/5	max. depth: 500 m
10036-2	16.08.05	07:14	5° 20,32' S	103° 39,42' E	1506	CTD/Ros		max. depth: 1493 m
10036-3	16.08.05	08:33	5° 20,33' S	103° 39,43' E	1502	MUC	6/6 4/4	
10036-4	16.08.05	09:35	5° 20,35' S	103° 39,31' E	1510	GC 12M	615 cm	
	16.08.05	10:03	5° 20,36' S	103° 39,36' E	1509	EM / PS	start	hydroacoustic survey
	16.08.05	12:08	5° 30,04' S	103° 32,72' E	2091	EM / PS	end	hydroacoustic survey
10037-1	16.08.05	12:55	5° 28,84' S	103° 33,56' E	2017	GC 12M		
10037-2	16.08.05	14:29	5° 28,83' S	103° 33,56' E	2016	MUC	not released	
10037-3	16.08.05	15:53	5° 28,82' S	103° 33,57' E	2019	GC 12M		
	16.08.05	16:32	5° 28,81' S	103° 33,61' E	2021	EM / PS	start	hydroacoustic survey
	16.08.05	23:20	6° 0,94' S	103° 11,57' E	1788	EM / PS	end	hydroacoustic survey
10038-1	17.08.05	00:22	5° 56,19' S	103° 14,72' E	1887	MN/CTD	5/5	max. depth: 500 m
10038-2	17.08.05	01:55	5° 56,25' S	103° 14,80' E	1893	CTD/Ros		max. depth: 1885 m
10038-3	17.08.05	03:34	5° 56,23' S	103° 14,78' E	1891	MUC	6/6 4/4	
10038-4	17.08.05	04:53	5° 56,25' S	103° 14,76' E	1891	GC 12M		
10039-1	17.08.05	06:37	5° 52,02' S	103° 17,64' E	1797	MN/CTD	5/5	max. depth: 500 m
10039-2	17.08.05	08:20	5° 52,10' S	103° 17,65' E	1800	CTD/Ros		max. depth: 1795 m
10039-3	17.08.05	09:49	5° 52,10' S	103° 17,65' E	1799	MUC	6/6 4/4	
10039-4	17.08.05	11:02	5° 52,09' S	103° 17,66' E	1799	GC 12M		tube bent, "banana"
	17.08.05	13:07	6° 1,03' S	103° 11,97' E	1805	EM / PS	start	hydroacoustic survey
	17.08.05	23:00	6° 47,60' S	102° 37,37' E	3329	EM / PS	end	hydroacoustic survey

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10040-1	18.08.05	01:59	6° 28,49' S	102° 51,39' E	2602	MN/CTD	5/5	max. depth: 500 m
10040-2	18.08.05	03:46	6° 28,57' S	102° 51,44' E	2599	CTD/Ros		max. depth: 2593 m
10040-3	18.08.05	06:02	6° 28,57' S	102° 51,56' E	2605	MUC	6/6 4/4	
10040-4	18.08.05	07:46	6° 28,57' S	102° 51,53' E	2605	GC 9M		
10041-1	18.08.05	10:53	6° 16,42' S	103° 0,45' E	1540	MN/CTD	5/5	max. depth: 500 m
10041-2	18.08.05	12:18	6° 16,44' S	103° 0,46' E	1541	CTD		max. depth: 1532 m
10041-3	18.08.05	13:40	6° 16,44' S	103° 0,51' E	1540	MUC	6/6 4/4	
10041-4	18.08.05	14:54	6° 16,42' S	103° 0,49' E	1539	GC 9M		tube bent, "banana"
10042-1	19.08.05	04:41	7° 6,81' S	104° 38,55' E	2460	GC 6M		
10042-2	19.08.05	06:42	7° 6,79' S	104° 38,57' E	2457	MUC	3/6 4/4	
10043-1	19.08.05	11:03	7° 18,57' S	105° 3,45' E	2173	GC 6M		
10043-2	19.08.05	12:34	7° 18,53' S	105° 3,50' E	2170	MUC	1/6 4/4	
10043-4	19.08.05	14:04	7° 18,55' S	105° 3,52' E	2172	GC 6M		
10043-4	19.08.05	15:42	7° 18,57' S	105° 3,71' E	2170	CTD		max. depth: 2161 m

SO-184/Leg 3

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10044-1	22.08.05	08:12	8° 30,01' S	109° 0,90' E	3358	MN/CTD		max. depth: 500 m
10044-2	22.08.05	09:35	8° 29,95' S	109° 0,86' E	3364	CTD/Ros		max. depth 3323 m
10044-3	22.08.05	12:09	8° 29,99' S	109° 0,98' E	3346	MUC	6/6 4/4	
10044-4	22.08.05	14:43	8° 29,99' S	109° 0,98' E	3356	GC 6M	548 cm	max. depth: 2161 m
	22.08.05	16:14	8° 29,96' S	109° 0,95' E	3353	EM / PS	start	hydroacoustic survey
	23.08.05	00:48	9° 21,38' S	109° 0,98' E	1704	EM / PS	end	hydroacoustic survey
10045-1	23.08.05	04:27	8° 44,59' S	109° 1,19' E	3571	MN/CTD		max. depth 500 m
10045-2	23.08.05	06:00	8° 44,58' S	109° 1,22' E	3576	CTD/Ros		max. depth 150 m
10045-3	23.08.05	06:34	8° 44,59' S	109° 1,25' E	3566	CTD/Ros		max. depth 3562 m
10045-4	23.08.05	09:15	8° 44,56' S	109° 1,21' E	3572	PN		max. depth 60 m
10045-5	23.08.05	09:30	8° 44,49' S	109° 1,01' E	3565	GC 6M	502 cm	
10045-6	23.08.05	11:22	8° 44,62' S	109° 1,24' E	3565	MUC	0/6 0/4	not released
	23.08.05	17:14	9° 19,91' S	109° 2,95' E	1749	EM / PS	start	hydroacoustic survey
	23.08.05	20:31	9° 40,00' S	109° 3,99' E	2841	EM / PS	turn	hydroacoustic survey
	23.08.05	23:48	9° 59,93' S	109° 4,00' E	4644	EM / PS	turn	hydroacoustic survey
	24.08.05	00:14	10° 0,27' S	109° 1,04' E	4856	EM / PS	end	hydroacoustic survey
10046-1	24.08.05	02:30	9° 36,26' S	109° 3,77' E	2604	MN/CTD		max. depth 500 m
10046-2	24.08.05	03:46	9° 36,26' S	109° 3,41' E	2602	CTD/Ros		max. depth 150 m
10046-3	24.08.05	04:19	9° 36,27' S	109° 3,53' E	2603	CTD/Ros		max. depth 2593 m
10046-4	24.08.05	06:26	9° 36,23' S	109° 3,73' E	2602	PN		max. depth 60 m
10046-5	24.08.05	07:00	9° 36,29' S	109° 3,82' E	2603	MUC	0/6 0/4	not released
10046-6	24.08.05	09:04	9° 36,24' S	109° 3,82' E	2603	GC 6M	566 cm	
10047-1	24.08.05	12:20	9° 18,53' S	109° 0,98' E	1780	MUC	6/6 4/4	
10047-2	24.08.05	13:59	9° 18,45' S	109° 0,99' E	1780	GC 6M	565 cm	

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
	24.08.05	21:04	8° 22,03' S	108° 9,01' E	3448	EM / PS	start	hydroacoustic survey
	24.08.05	23:04	8° 10,09' S	108° 8,94' E	2242	EM / PS	turn	hydroacoustic survey
	24.08.05	23:32	8° 10,05' S	108° 6,04' E	2473	EM / PS	turn	hydroacoustic survey
	25.08.05	00:30	8° 15,66' S	108° 5,94' E	3017	EM / PS	end	hydroacoustic survey
JAM-3	25.08.05	01:08	8° 16,12' S	108° 8,52' E	3160	ST		Sediment trap recovery
10048-1	25.08.05	03:01	8° 15,30' S	108° 8,84' E	3060	MN/CTD		max. depth 500 m
10048-2	25.08.05	04:34	8° 15,17' S	108° 8,81' E	3029	CTD/Ros		max. depth 150 m
10048-3	25.08.05	05:08	8° 15,18' S	108° 8,81' E	3029	CTD/Ros		max. depth 3019 m
10048-4	25.08.05	07:12	8° 15,18' S	108° 8,79' E	3030	PN		max. depth 60 m
10048-5	25.08.05	07:28	8° 15,15' S	108° 8,81' E	3033	MUC	0/6 0/4	not released
10048-6	25.08.05	09:57	8° 15,17' S	108° 8,80' E	3025	MUC	0/6 0/4	not released
	25.08.05	14:00	8° 15,19' S	108° 8,77' E	3034	EM / PS	start	hydroacoustic survey
	25.08.05	16:32	8° 15,04' S	108° 32,72' E	1756	EM / PS	turn	hydroacoustic survey
	25.08.05	16:45	8° 12,21' S	108° 32,53' E	1821	EM / PS	turn	hydroacoustic survey
	25.08.05	17:55	8° 11,69' S	108° 17,76' E	2824	EM / PS	turn	hydroacoustic survey
	25.08.05	18:10	8° 9,15' S	108° 17,91' E	2460	EM / PS	turn	hydroacoustic survey
	25.08.05	18:43	8° 9,12' S	108° 23,98' E	1098	EM / PS	turn	hydroacoustic survey
	25.08.05	21:50	7° 57,28' S	108° 54,09' E	100	EM / PS	turn	hydroacoustic survey
	26.08.05	09:58	8° 40,05' S	110° 29,96' E	997	EM / PS	turn	hydroacoustic survey
	26.08.05	11:42	8° 50,55' S	110° 29,93' E	1359	EM / PS	end	hydroacoustic survey
10049-1	26.08.05	12:11	8° 47,11' S	110° 29,77' E	1291	MN/CTD		max. depth 500 m
10049-2	26.08.05	13:31	8° 47,08' S	110° 29,78' E	1288	CTD/Ros		max. depth 150 m
10049-3	26.08.05	14:02	8° 47,08' S	110° 29,80' E	1288	CTD/Ros		max. depth 1283 m
10049-4	26.08.05	15:00	8° 47,08' S	110° 29,79' E	1289	PN		max. depth 60 m
10049-5	26.08.05	15:29	8° 47,08' S	110° 29,80' E	1289	MUC	6/6 4/4	
10049-6	26.08.05	16:44	8° 47,07' S	110° 29,78' E	1288	GC 6M	507 cm	
	26.08.05	17:34	8° 47,10' S	110° 29,77' E	1289	EM / PS	start	hydroacoustic survey
	27.08.05	02:05	9° 37,08' S	110° 29,92' E	791	EM / PS	turn	hydroacoustic survey
	27.08.05	02:27	9° 36,97' S	110° 27,12' E	1134	EM / PS	turn	hydroacoustic survey
	27.08.05	04:59	9° 21,72' S	110° 26,72' E	1591	EM / PS	end	hydroacoustic survey
10050-1	26.08.05	15:29	8° 47,08' S	110° 29,80' E	1289	MUC	6/6 4/4	
10050-2	26.08.05	16:44	8° 47,07' S	110° 29,78' E	1288	GC 6M	378 cm	
10051-1	27.08.05	08:42	9° 17,59' S	110° 29,83' E	2391	MN/CTD		max. depth 500 m
10051-2	27.08.05	10:04	9° 17,65' S	110° 29,88' E	2390	CTD/Ros		max. depth 150 m
10051-3	27.08.05	10:33	9° 17,62' S	110° 29,85' E	2394	CTD/Ros		max. depth 2387 m
10051-4	27.08.05	12:28	9° 17,54' S	110° 29,95' E	2389	PN		max. depth 60 m
10051-5	27.08.05	12:52	9° 17,50' S	110° 29,87' E	2389	MUC	0/6 0/4	not released
10051-6	27.08.05	14:51	9° 17,56' S	110° 29,94' E	2394	GC 6M	224 cm	

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
	27.08.05	16:02	9° 17,56' S	110° 29,90' E	2394	EM / PS	start	hydroacoustic survey
	27.08.05	16:16	9° 17,13' S	110° 29,12' E	2475	EM / PS	turn	hydroacoustic survey
	27.08.05	16:51	9° 17,05' S	110° 31,98' E	2401	EM / PS	turn	hydroacoustic survey
	27.08.05	20:12	9° 36,95' S	110° 32,07' E	655	EM / PS	turn	hydroacoustic survey
	27.08.05	20:41	9° 36,85' S	110° 34,97' E	574	EM / PS	turn	hydroacoustic survey
	27.08.05	23:53	9° 17,09' S	110° 35,03' E	2185	EM / PS	turn	hydroacoustic survey
	28.08.05	00:26	9° 16,99' S	110° 38,04' E	2231	EM / PS	turn	hydroacoustic survey
	28.08.05	07:36	8° 33,13' S	110° 38,03' E	537	EM / PS	end	hydroacoustic survey
10052-1	28.08.05	08:28	8° 41,63' S	110° 38,02' E	1000	MN/CTD		max. depth 500 m
10052-2	28.08.05	09:43	8° 41,39' S	110° 37,97' E	1008	CTD/Ros		max. depth 150 m
10052-3	28.08.05	10:15	8° 41,52' S	110° 37,92' E	1001	CTD/Ros		max. depth 990 m
10052-4	28.08.05	11:17	8° 41,69' S	110° 38,04' E	1002	PN		max. depth 60 m
10052-5	28.08.05	11:36	8° 41,62' S	110° 37,92' E	1001	GC 6M	370 cm	stored in Bandung
10052-6	28.08.05	12:23	8° 41,68' S	110° 38,00' E	1002	MUC	0/6 0/4	not released
10052-7	28.08.05	13:22	8° 41,68' S	110° 38,02' E	1000	MUC	0/6 0/4	empty
10052-8	28.08.05	14:18	8° 41,68' S	110° 38,00' E	1001	GC 6M	487 cm	
	29.08.05	00:57	8° 41,07' S	112° 36,05' E	1128	EM / PS	start	hydroacoustic survey
	29.08.05	05:14	8° 40,40' S	113° 2,38' E	1020	EM / PS	end	hydroacoustic survey
10053-1	29.08.05	06:07	8° 40,59' S	112° 52,30' E	1378	MN/CTD		max. depth 500 m
10053-2	29.08.05	07:28	8° 40,51' S	112° 52,38' E	1369	CTD/Ros		max. depth 150 m
10053-3	29.08.05	08:32	8° 40,53' S	112° 52,30' E	1372	CTD/Ros		max. depth 1365 m
10053-4	29.08.05	09:38	8° 40,61' S	112° 52,32' E	1379	PN		max. depth 60 m
10053-5	29.08.05	09:56	8° 40,60' S	112° 52,32' E	1375	GC 6M	>600 cm	over top
10053-6	29.08.05	10:47	8° 40,56' S	112° 52,28' E	1374	MUC	0/6 0/4	not released
10053-7	29.08.05	12:03	8° 40,59' S	112° 52,35' E	1375	GC 9M	760 cm	
10054-1	29.08.05	14:56	8° 40,87' S	112° 40,07' E	1069	CTD/Ros		max. depth 150 m
10054-2	29.08.05	15:29	8° 40,88' S	112° 40,08' E	1075	CTD/Ros		max. depth 1069 m
10054-3	29.08.05	16:22	8° 40,88' S	112° 40,09' E	1073	PN		max. depth 60 m
10054-4	29.08.05	16:44	8° 40,87' S	112° 40,10' E	1075	GC 9M	846 cm	
10054-5	29.08.05	17:32	8° 40,91' S	112° 40,04' E	1078	MUC	0/6 0/4	not released
	29.08.05	18:33	8° 40,92' S	112° 40,07' E	1080	EM / PS	start	hydroacoustic survey
	30.08.05	02:50	9° 21,67' S	113° 7,58' E	2880	EM / PS	end	hydroacoustic survey
10055-1	30.08.05	03:36	9° 14,88' S	113° 3,02' E	2615	MN/CTD		max. depth 500 m
10055-2	30.08.05	04:45	9° 14,90' S	113° 3,04' E	2604	CTD/Ros		max. depth 150 m
10055-3	30.08.05	05:13	9° 14,95' S	113° 3,06' E	2602	CTD/Ros		max. depth 2596 m
10055-4	30.08.05	07:08	9° 14,89' S	113° 3,08' E	2598	PN		max. depth 60 m
10055-5	30.08.05	07:21	9° 14,87' S	113° 3,07' E	2600	MUC	0/6 0/4	not released
10055-6	30.08.05	09:26	9° 14,91' S	113° 3,11' E	2599	GC 9M	625 cm	
10056-1	30.08.05	11:50	9° 6,70' S	112° 57,51' E	1857	GC 9M	-	tube bent, "banana"
10056-2	30.08.05	13:13	9° 6,80' S	112° 57,57' E	1863	MUC	0/6 0/4	not released
	30.08.05	17:20	9° 30,09' S	113° 0,02' E	3086	EM / PS	start	hydroacoustic survey
	31.08.05	02:27	10° 22,93' S	113° 17,67' E	1279	EM / PS	end	hydroacoustic survey

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10057-1	31.08.05	05:34	9° 49,29' S	113° 6,40' E	1615	MN/CTD		max. depth 500 m
10057-2	31.08.05	06:45	9° 49,31' S	113° 6,39' E	1613	CTD/Ros		max. depth 150 m
10057-3	31.08.05	07:11	9° 49,28' S	113° 6,37' E	1618	CTD/Ros		max. depth 1609 m
10057-4	31.08.05	08:27	9° 49,24' S	113° 6,42' E	1617	PN		max. depth 60 m
10057-5	31.08.05	08:42	9° 49,24' S	113° 6,40' E	1616	GC 6M	-	tube empty
10058-1	31.08.05	23:01	8° 41,03' S	112° 38,25' E	1113	MUC	6/6 4/4	
10059-1	01.09.05	01:38	8° 40,69' S	112° 52,08' E	1370	MUC	6/6 4/4	
10060-1	01.09.05	06:20	9° 14,88' S	113° 3,09' E	2595	MUC	0/6 0/4	not released
	01.09.05	10:59	9° 39,96' S	113° 1,59' E	2431	EM / PS	start	hydroacoustic survey
	01.09.05	18:08	10° 24,97' S	113° 0,02' E	2057	EM / PS	turn	hydroacoustic survey
	01.09.05	18:41	10° 24,92' S	113° 3,06' E	2371	EM / PS	turn	hydroacoustic survey
	01.09.05	23:15	9° 57,33' S	113° 4,07' E	1268	EM / PS	end	hydroacoustic survey
10061-1	02.09.05	00:30	9° 43,73' S	113° 1,42' E	2174	MN/CTD		max. depth 500 m
10061-2	02.09.05	01:43	9° 43,72' S	113° 1,38' E	2175	CTD/Ros		max. depth 150 m
10061-3	02.09.05	02:09	9° 43,72' S	113° 1,42' E	2173	CTD/Ros		max. depth 2165 m
10061-4	-	-	-	-	-	-	-	Not performed
10061-5	02.09.05	03:41	9° 43,75' S	113° 1,45' E	2170	MUC	6/6 4/4	
10061-6	02.09.05	05:40	9° 43,77' S	113° 1,43' E	2170	GC 6M	491 cm	stored in Bandung
10061-7	02.09.05	06:54	9° 43,76' S	113° 1,44' E	2169	GC 6M	517 cm	
10061-8	02.09.05	08:00	9° 43,74' S	113° 1,46' E	2167	PN		max. depth 60 m
10062-1	03.09.05	03:11	11° 9,98' S	115° 59,95' E	5851	MN/CTD		max. depth 500 m
10062-2	03.09.05	04:20	11° 9,79' S	115° 59,62' E	5872	CTD/Ros		max. depth 150 m
10062-3	03.09.05	04:49	11° 9,77' S	115° 59,52' E	5871	CTD/Ros		max. depth 5861 m
10062-4	03.09.05	08:45	11° 9,40' S	115° 58,73' E	5861	PN		max. depth 60 m
	03.09.05	21:39	9° 45,02' S	117° 59,96' E	2127	EM / PS	start	hydroacoustic survey
	04.09.05	00:04	9° 36,51' S	118° 12,18' E	2290	EM / PS	end	hydroacoustic survey
10063-1	04.09.05	00:31	9° 38,74' S	118° 8,92' E	2498	MN/CTD		max. depth 500 m
10063-2	04.09.05	01:43	9° 38,90' S	118° 8,78' E	2497	CTD/Ros		max. depth 150 m
10063-3	04.09.05	02:11	9° 38,87' S	118° 8,84' E	2499	CTD/Ros		max. depth 2488 m
10063-4	04.09.05	03:52	9° 38,75' S	118° 8,92' E	2494	PN		max. depth 60 m
10063-5	04.09.05	04:13	9° 38,76' S	118° 9,00' E	2501	MUC	6/6 4/4	
10063-6	04.09.05	06:32	9° 38,75' S	118° 9,00' E	2494	GC 12M	948 cm	
	04.09.05	08:14	9° 36,45' S	118° 12,26' E	2282	EM / PS	start	hydroacoustic survey
	04.09.05	09:20	9° 32,53' S	118° 17,89' E	2028	EM / PS	end	hydroacoustic survey
10064-1	04.09.05	09:26	9° 32,32' S	118° 18,24' E	2033	MN/CTD		max. depth 500 m
10064-2	04.09.05	10:41	9° 32,31' S	118° 18,45' E	2043	CTD/Ros		max. depth 150 m
10064-3	04.09.05	11:14	9° 32,27' S	118° 18,14' E	2033	CTD/Ros		max. depth 2025 m
10064-4	04.09.05	12:52	9° 32,35' S	118° 18,09' E	2034	PN		max. depth 60 m
10064-5	04.09.05	13:12	9° 32,36' S	118° 18,03' E	2033	MUC	6/6 4/4	
10064-6	04.09.05	15:03	9° 32,32' S	118° 18,16' E	2036	GC 12M	729 cm	
	04.09.05	16:07	9° 32,33' S	118° 18,15' E	2036	EM / PS	start	hydroacoustic survey
	04.09.05	23:30	9° 11,41' S	118° 57,30' E	1260	EM / PS	end	hydroacoustic survey

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10065-1	05.09.05	00:06	9° 13,36' S	118° 53,65' E	1286	MN/CTD		max. depth 500 m
10065-2	05.09.05	01:18	9° 13,36' S	118° 53,56' E	1291	CTD/Ros		max. depth 150 m
10065-3	05.09.05	01:47	9° 13,35' S	118° 53,54' E	1293	CTD/Ros		max. depth 1284 m
10065-4	05.09.05	02:45	9° 13,36' S	118° 53,57' E	1289	PN		max. depth 60 m
10065-5	05.09.05	03:06	9° 13,39' S	118° 53,53' E	1291	GC 12M	920 cm	stored in Bandung
10065-6	05.09.05	03:52	9° 13,37' S	118° 53,61' E	1294	MUC	6/6 4/4	over top
10065-7	05.09.05	05:11	9° 13,42' S	118° 53,61' E	1292	GC 12M	985 cm	
10065-8	05.09.05	05:59	9° 13,39' S	118° 53,57' E	1296	MUC	6/6 4/4	over top
10065-9	05.09.05	07:18	9° 13,41' S	118° 53,55' E	1284	MUC	2/6 4/4	
10066-1	05.09.05	10:16	9° 23,63' S	118° 34,49' E	1630	MN/CTD		max. depth 500 m
10066-2	05.09.05	11:43	9° 23,46' S	118° 34,71' E	1637	CTD/Ros		max. depth 150 m
10066-3	05.09.05	12:12	9° 23,56' S	118° 34,67' E	1630	CTD/Ros		max. depth 1616 m
10066-4	05.09.05	13:22	9° 23,69' S	118° 34,63' E	1624	PN		max. depth 60 m
10066-5	05.09.05	13:45	9° 23,61' S	118° 34,54' E	1631	MUC	0/6 0/4	not released
10066-6	05.09.05	15:16	9° 23,61' S	118° 34,54' E	1632	MUC	6/6 4/4	
10066-7	05.09.05	16:53	9° 23,56' S	118° 34,56' E	1633	GC 12M	658 cm	
	05.09.05	20:12	9° 11,54' S	118° 57,17' E	1257	EM / PS	start	hydroacoustic survey
	06.09.05	00:09	9° 8,40' S	119° 20,69' E	1170	EM / PS	end	hydroacoustic survey
10067-1	06.09.05	00:35	9° 8,95' S	119° 17,38' E	1136	MN/CTD		max. depth 500 m
10067-2	06.09.05	01:54	9° 8,93' S	119° 17,49' E	1135	CTD/Ros		max. depth 150 m
10067-3	06.09.05	02:21	9° 8,99' S	119° 17,42' E	1135	CTD/Ros		max. depth 1128 m
10067-4	06.09.05	03:20	9° 8,90' S	119° 17,45' E	1137	PN		max. depth 60 m
10067-5	06.09.05	03:41	9° 8,94' S	119° 17,43' E	1136	MUC	6/6 4/4	not released
10067-6	06.09.05	04:53	9° 8,94' S	119° 17,42' E	1136	GC 12M	806 cm	
	06.09.05	11:06	9° 12,80' S	120° 18,42' E	894	EM / PS	start	hydroacoustic survey
	06.09.05	17:25	9° 35,89' S	120° 48,34' E	890	EM / PS	turn	hydroacoustic survey
	06.09.05	23:18	9° 35,72' S	121° 24,52' E	2482	EM / PS	end	hydroacoustic survey
10068-1	07.09.05	00:35	9° 35,72' S	121° 9,09' E	2011	MN/CTD		max. depth 500 m
10068-2	07.09.05	01:00	9° 35,73' S	121° 9,13' E	2010	MUC	6/6 4/4	
10068-3	07.09.05	02:49	9° 35,72' S	121° 8,89' E	2008	GC 12M	817 cm	
10068-4	07.09.05	03:58	9° 35,73' S	121° 9,18' E	2015	PN		max. depth 60 m
10068-5	07.09.05	04:52	9° 35,69' S	121° 9,18' E	2013	CTD/Ros		max. depth 150 m
10068-6	07.09.05	04:52	9° 35,69' S	121° 9,18' E	2013	CTD/Ros		max. depth 2004 m
10069-1	07.09.05	08:06	9° 35,73' S	120° 55,08' E	1253	GC 12M	732 cm	stored in Bandung
10069-2	07.09.05	08:57	9° 35,72' S	120° 55,00' E	1249	MUC	0/6 2/4	
10069-3	07.09.05	10:14	9° 35,69' S	120° 55,02' E	1250	GC 12M	962 cm	
10069-4	07.09.05	11:02	9° 35,70' S	120° 54,95' E	1249	MUC	6/6 4/4	
10069-5	07.09.05	12:24	9° 35,89' S	120° 55,24' E	1268	CTD/Ros		max. depth 150 m
10069-6	07.09.05	12:53	9° 35,87' S	120° 55,17' E	1264	CTD/Ros		max. depth 1248 m
10069-7	07.09.05	13:49	9° 35,90' S	120° 55,17' E	1270	PN		max. depth 60 m
	07.09.05	19:26	10° 10,09' S	121° 44,94' E	1334	EM / PS	start	hydroacoustic survey
	07.09.05	23:38	10° 25,17' S	121° 23,25' E	1217	EM / PS	turn	hydroacoustic survey
	08.09.05	03:33	10° 11,13' S	121° 3,60' E	491	EM / PS	turn	hydroacoustic survey
	08.09.05	04:24	10° 14,88' S	120° 59,87' E	375	EM / PS	end	hydroacoustic survey

GeoB No.	Date	UTC	Latitude	Longitude	Depth [m]	Gear	Recovery	Remarks
10070-1	08.09.05	06:12	10° 21,52' S	121° 18,15' E	1509	MN/CTD		max. depth 500 m
10070-2	08.09.05	07:34	10° 21,53' S	121° 18,15' E	1508	CTD/Ros		max. depth 150 m
10070-3	08.09.05	08:02	10° 21,55' S	121° 18,14' E	1507	CTD/Ros		max. depth 1497 m
10070-4	08.09.05	09:13	10° 21,60' S	121° 18,23' E	1512	PN		max. depth 60 m
10070-5	08.09.05	09:33	10° 21,58' S	121° 18,13' E	1508	GC 6M	170 cm	
10070-6	08.09.05	10:29	10° 21,64' S	121° 18,13' E	1502	MUC	6/6 4/4	almost empty
	09.09.05	15:13	11° 43,51' S	124° 46,01' E	360	EM / PS	start	hydroacoustic survey
	09.09.05	16:07	11° 48,51' S	124° 46,09' E	254	EM / PS	turn	hydroacoustic survey
	09.09.05	16:15	11° 48,51' S	124° 46,84' E	247	EM / PS	turn	hydroacoustic survey
	09.09.05	17:02	11° 43,59' S	124° 47,01' E	354	EM / PS	turn	hydroacoustic survey
	09.09.05	17:12	11° 43,56' S	124° 47,95' E	347	EM / PS	turn	hydroacoustic survey
	09.09.05	18:01	11° 48,47' S	124° 48,03' E	246	EM / PS	turn	hydroacoustic survey
	09.09.05	18:12	11° 48,40' S	124° 49,02' E	246	EM / PS	turn	hydroacoustic survey
	09.09.05	19:01	11° 43,49' S	124° 49,05' E	342	EM / PS	turn	hydroacoustic survey
	09.09.05	19:10	11° 43,52' S	124° 49,98' E	323	EM / PS	turn	hydroacoustic survey
	09.09.05	20:01	11° 48,48' S	124° 50,10' E	247	EM / PS	turn	hydroacoustic survey
	09.09.05	20:09	11° 48,51' S	124° 50,98' E	235	EM / PS	turn	hydroacoustic survey
	09.09.05	20:59	11° 43,59' S	124° 51,04' E	312	EM / PS	turn	hydroacoustic survey
	09.09.05	21:09	11° 43,45' S	124° 51,90' E	307	EM / PS	turn	hydroacoustic survey
	09.09.05	22:02	11° 48,45' S	124° 51,97' E	222	EM / PS	turn	hydroacoustic survey
	09.09.05	22:12	11° 48,49' S	124° 52,87' E	213	EM / PS	turn	hydroacoustic survey
	09.09.05	23:03	11° 43,51' S	124° 53,01' E	293	EM / PS	end	hydroacoustic survey
10071-1	10.09.05	00:07	11° 44,92' S	124° 50,01' E	305	OFOS		
10071-2	10.09.05	03:33	11° 45,11' S	124° 49,83' E	24	OFOS		
10071-3	10.09.05	06:07	11° 45,47' S	124° 49,71' E	22	TVG		
10071-4	10.09.05	06:46	11° 45,57' S	124° 49,67' E	20	TVG		
10071-5	10.09.05	07:36	11° 45,78' S	124° 49,61' E	31	TVG		
10072-1	10.09.05	08:27	11° 43,52' S	124° 52,14' E	303	GC 6M	518 cm	
	10.09.05	09:23	11° 43,50' S	124° 49,59' E	329	EM / PS	start	hydroacoustic survey
	10.09.05	10:14	11° 48,55' S	124° 49,47' E	246	EM / PS	end	hydroacoustic survey

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