SONNE -Berichte

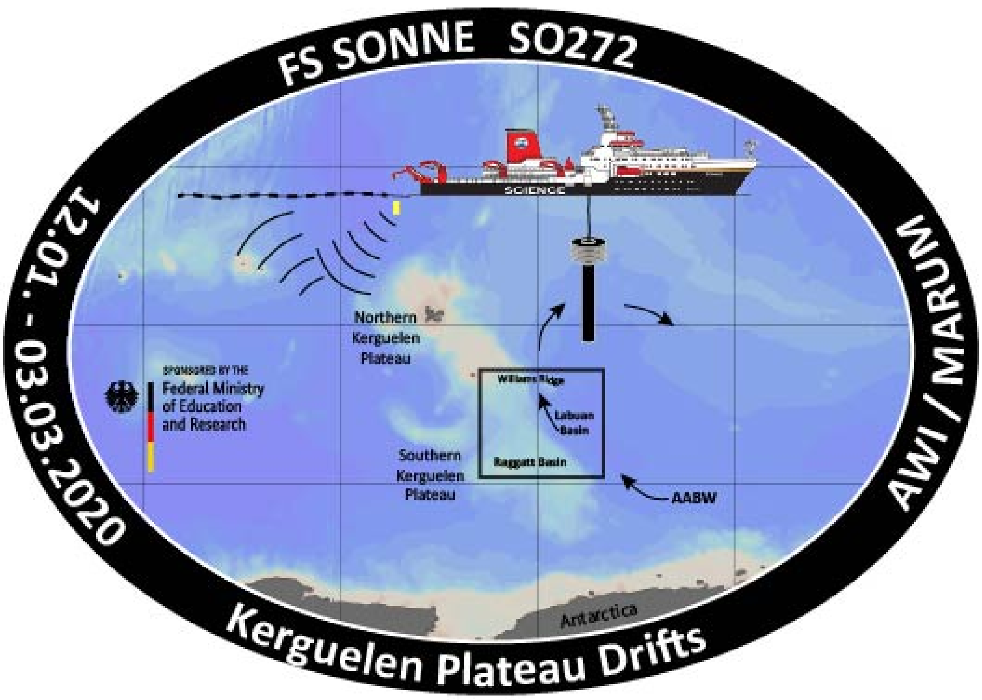
Kerguelen Plateau Drift Deposits: outstanding high-resolution chronicle of Cenozoic climatic and oceanographic changes in the southern Indian Ocean

Cruise No. SO272

Jan 11 – March 4, 2020

Port Louis (Mauritius) – Cape Town (South Africa)

Kerguelen Plateau Drifts



Dr Gabriele Uenzelmann-Neben[1] (Chief Scientist)

Dr. Thomas Westerhold[2]

[1]Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung

[2]MARUM

2020

Table of Contents

1 Cruise Summary

1.1 Summary in English

Cruise Leg SO272 with RV SONNE, leaving Port Louis, Mauritius, on January 11 2020, returning to Cape Town, South Africa, on March 4 2020, comprised seismic reflection studies and geological sampling of the Kerguelen Plateau in the southern part of the Indian Ocean. The Kerguelen Plateau rises up 2000 m above the surrounding seafloor and hence forms an obstacle for the flow of the Antarctic Circumpolar Current (ACC) and the Antarctic Bottomwater (AABW). The ACC is strongly deviated in its flow towards the north. A branch of the AABW flows northwards along the eastern flank of the plateau thereby shaping sediment drifts. A detailed study and analysis of the structure of the Labuan Basin and the central Kerguelen Plateau via seismic data and a correlation with results from DSP Leg 120 Sites 748, 750, and 751 was needed to supply information on the Cretaceous and Tertiary development of the AABW and its influence on the path of the Antarctic Circumpolar Current, This in turn will allow conclusions on the development of the East Antarctic Ice Sheet. Seismic profiles were gathered, which capture the structure of the Labuan Basin and the Kerguelen Plateau to basement and image sediment drifts. In total ~4000 km of high resolution seismic reflection data were recorded. Bathymetric and Parasound data were recorded parallel to the seismic profiling.

To complement the seismic studies and provide ages of the outcropping sediment geological samples were retrieved at 11 locations using a gravity corer and multi-corer. Both datasets will form the base for an IODP proposal.

1.2 Zusammenfassung

Der Fahrtabschnitt SO272 vom 11. Januar 2020 Post Louis, Mauritius, bis 4. März 2020 Kapstadt, Südafrika, mit FS SONNE bestand aus reflexionsseismischen und geologischen Untersuchungen des Kerguelen Plateaus im südlichen indischen Ozean. Das Kerguelen Plateau erhebt sich bis auf 1500 m Wassertiefe und formt so eine Barriere für den Antarktischen Zirkumpolarstrom (ACC) und das Antarktische Bodenwasser (AABW). Der ACC wird in einem Pfad deutlich nach Norden abgelenkt. Ein Zweig des ABBW wird an der Ostflanke des Kerguelen Plateaus nach Norden geführt und formt dort Sedimentdrifts. Eine detaillierte Erfassung und Analyse der Struktur des

Labuan Beckens und des Kerguelen Plateaus mittels seismischer Methoden und ein Anschluß an bestehende ODP Bohrungen (ODP Leg 120) wurde benötigt, um Informationen über die spätkretazische und tertiäre Entwicklung des Labua Beckens und des Kerguelen Plateaus und seinen Einfluß auf die Entwicklung der Pfade des Antarktischen Zirkumpolarstroms und des AABW zu erhalten. Das reflexionsseismische Programm während der Expedition SO272 wurde derart gestaltet, dass die Struktur des Labuan Beckens und des Kerguelen Plateaus bis zum Basement sowie mögliche Sedimentdrifts erfasst wurden. Es wurden insgesamt ~4000 km an hochauflösenden reflexionsseismischen Daten aufgenommen. Parallel zu den seismischen Profilarbeiten wurden bathymetrische und Parasound Messungen durchgeführt.

Ergänzt wurden die seismischen Messungen durch eine geologische Beprobung mittels Schwerelot und Multi-Corer. Auf diese Weise werden Information zum Alter der anstehenden sediment bereitgestellt. Beide Datensätze formen die Basis für einen IODP Bohrantrag.

Fig. 1.1 Scientific team of cruise SO272

2 Participants

2.1 Principal Investigators

Name	Institution
Uenzelmann-Neben, Gabriele, Dr.	AWI
Westerhold, Thomas, Dr.	MARUM

2.2 Scientific Party

Name	Discipline	Institution
Uenzelmann-Neben, Gabriele, Dr	Seismics / Chief Scientist	AWI
Eggers, Thorsten	Seismics	AWI
Pfeiffer, Adalbert	Seismics	AWI
Daub, Pascal	Seismics	AWI
Eisermann, Hannes	Seismics	AWI
Geils, Jonah	Seismics	AWI
Najjarifarizhendi, Banafsheh	Seismics	AWI
Nielsen, Ricarda, Dr.	Seismics	AWI
Schneider, Matthias	Seismics	AWI
Westerhold, Thomas, Dr.	Geology	MARUM
Krauss, Florian	Geology	MARUM
Petersen, Ann-Katrin	Geology	MARUM
Abbott, April	Geology	MACQUARIE
Duggan, Brian	Geology	USC
Dreutter, Simon	Bathymetry	AWI
Hehemann, Laura	Bathymetry	AWI
Werner, Ellen	Bathymetry	AWI
Repenning, Katharina	Parasound	AWI
Andreas, Pascal	Parasound	AWI
Warnke, Fynn	Parasound	AWI
Peters, Ingrid	MMO	OSC
Lazar, Laura	MMO	OSC
Sievers, Oliver	Weather	DWD

2.3 Participating Institutions

AWI	Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung
DWD	Deutscher Wetterdienst
MACQUARIE	Macquairie University, Sydney
MARUM	Universität Bremen
OSC	Ocean Science Consulting Ltd

USC University of South Carolina

3 Research Program

(G. Uenzelmann-Neben[1], T. Westerhold[2])
[1]AWI
[2]MARUM

3.1 Aims of the cruise

Located in a key region in the southern Indian Ocean the complex topography of the Kerguelen Plateau, one of the world's largest Large Igneous Provinces, has a strong influence on pathways of water masses within the Antarctic Circumpolar Current (ACC) and the Antarctic Bottom Water (AABW). Topographic highs like the Williams Ridge at the Kerguelen Plateau reduce the flow of water masses leading to the deposition of thick sediment packages. Gaps and narrow passages in contrast lead to increase in current velocity and thus erosion and non-deposition. In the Cenozoic era significant modifications in pathways and intensity of those water masses have been caused by the tectonic development of the Kerguelen Plateau as well as the opening of the Tasman Gateway, the Drake Passage and major global climatic changes. In the Kerguelen Plateau region all of these changes are explicitly well documented in the formation of sedimentary structures, e.g. sediment drifts, supposedly at very high resolution.

The overarching objectives of the cruise to the Kerguelen Plateau were twofold: 1) to study variations in flow paths and intensities of deep and bottom water masses in response to tectonic movements and climate variability; this is the major focus of the cruise, and 2) to collect critical pre-site survey data for the preparation of an IODP drilling proposal.

Objective 1: Variations in pathways and intensities of deep and bottom water masses

The tectonic development of the KP during the late Cretaceous and Cenozoic has led to significant modifications in the flow paths of deep and bottom water masses that can be reconstructed studying sediment drifts in great detail. Opening, widening and deepening of the Tasman gateway and the Drake Passage have had a significant effect on flow paths of AABW and the ACC in particular. Development and modifications in the ACC itself primarily influenced the location of the oceanographic frontal system around Antarctica relocating sedimentary depocentres. The seismic data collected allow the identification and mapping of these depocentres, and to reconstruct changes in water mass pathways and intensities through time. Major focus in the analysis of the data will be on the climate dynamics and tectonic development in the Eocene to Oligocene when climate shifted from greenhouse to icehouse conditions. Seismic mapping of the above mentioned depocentres will provide unique insight into effects of tectonic movements and modifications in climate during that time. Our detailed study will focus on the Eocene opening of the Tasman Gateway, the Oligocene opening of the Drake Passage, the late Eocene ephemeral glaciations, and the Eocene-Oligocene Transition. As a second focus, the seismic survey in the Labuan Basin (LB) provides unprecedented information on variations in water mass flows and movements in the Antarctic frontal system from the Mid-Miocene Climatic Optimum, the late Miocene cooling, and Pliocene warming. Especially this latter interval is of high significance because it might provide new views on the dynamics of both the East and West Antarctic Ice Sheets on ocean circulation when atmospheric pCO_2 was as high as today (~ 400 ppm).

The following hypotheses are to be tested:

Hypothesis 1: Tectonic movements were the major factors controlling the pathway of AABW/DWBC during the Cenozoic, while the intensity of the ACC was mainly influenced by modifications in climate.

Hypothesis 2: While colder bottom water activity can be observed east of the Tasman gateway already in the early Paleogene, warm water masses, and hence no bottom water, prevailed west of the gateway in the southern Indian Ocean prior to the Eocene-Oligocene boundary.

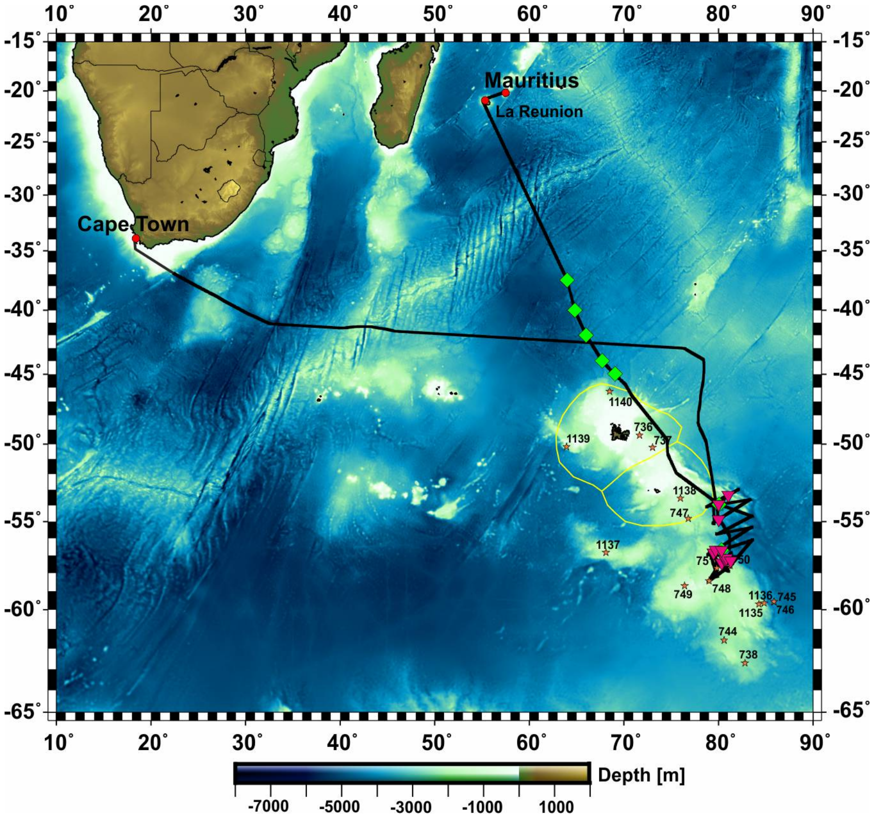


Fig. 3.1 Track chart of R/V SONNE Cruise SO272. Bathymetry from Smith and Sandwell (1997). The green diamonds show the locations of deployed ARGO floats, and the purple inverted triangles show the locations of geological sampling carried out during the cruise. Orange stars show the locations of ODP drill sites on the Kerguelen Plateau.

To test those hypotheses we collected a grid of 18 seismic profiles (1ms sample rate, 500 Hz max frequency, 80 Hz dominant frequency≅ 9 m vertical resolution) and a set of 11 sediment cores carefully selected during the cruise on the eastern KP between the CKP and Williams Ridge (WR) (Fig. 3.1). This area is perfectly suitable for the objectives of this study because topographic highs like the KP and Williams Ridge reduce the speed of deep water masses flowing within the ACC and the AABW causing the deposition of large sediment piles (see Fig. 5.3). The structure (geometry, internal unconformities, reflection characteristics) of these sediment drifts represent an extraordinary archive documenting modifications in the flow paths as well as intensity variations of the water masses in great detail. The new high-resolution seismic lines will enable the detection and detailed imaging of sediment drifts shaped by AABW and the DWBC in the LB and east of WR and by the ACC in the gap between the CKP and SKP (Fig. 5.3). Sediment drifts located in the LB and the gap between the CKP and SKP are particularly important targets because they should be sensitive recorders of past relocations of the powerful SACCF retroflection (Dezileau et al., 2000; Fukamachi et al., 2010; Mazaud et al., 2010; Sokolov and Rintoul, 2009). The seismic lines further cross ODP Leg 120 Sites 748, 750, and 751. Those sites recovered sedimentary rocks going back towards the Cretaceous (Schlich and Wise Jr, 1992; Wise et al., 1992), were used for dating regional seismic reflections (Fritsch et al., 1992; Munschy et al., 1992), and will thus allow to correlate the acquired seismic data with geological information (lithology, sediment composition, grain sizes, etc) and to develop age-depth models. Combined this will enable a palaeoceanographic interpretation of the seismic reflection data as required to address the objectives of this project. Recovery of sediment cores located off the ODP sites are required to characterize the sediment composition and dating of outcropping sediment layers to facilitate and support the interpretation of seismic profiles.

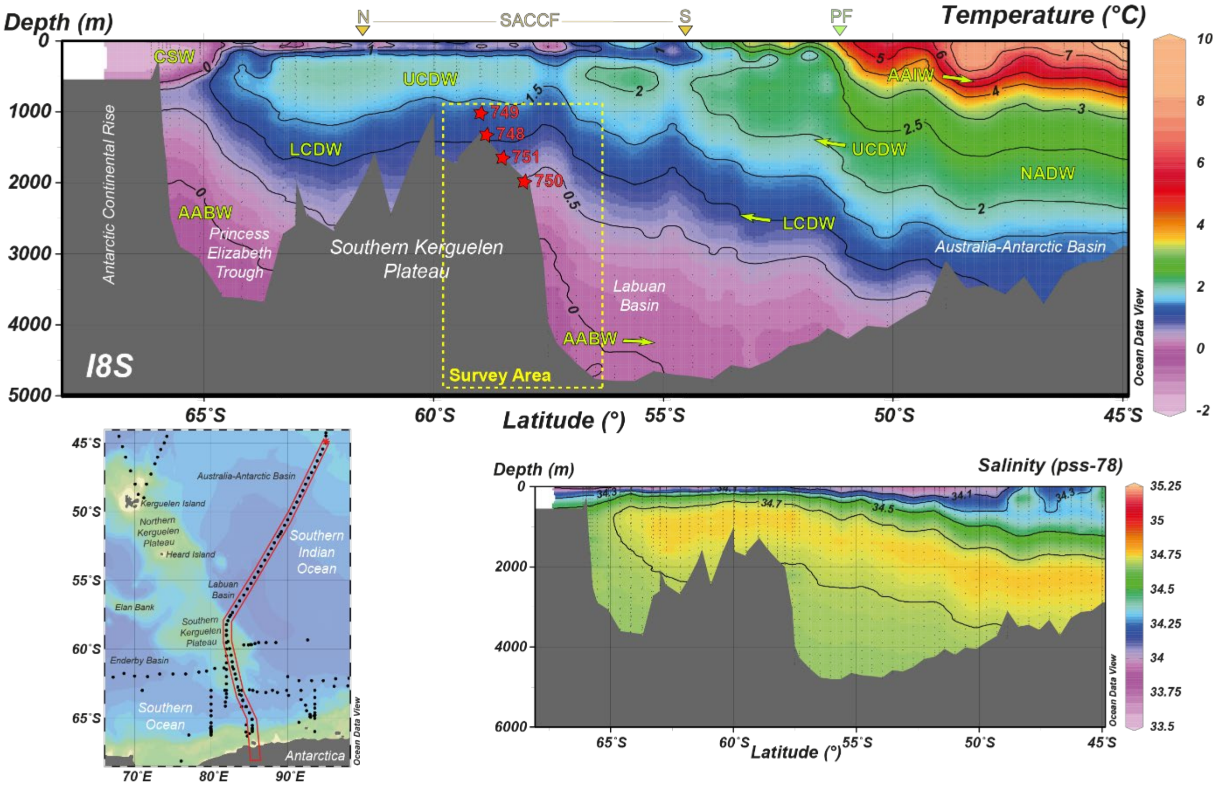


Fig. 3.2 South to North bathymetric, Temperature and Salinity transect and surface frontal boundaries across the southern Indian Ocean and Southern Ocean over the SKP with location of previous ODP drill sites. The seismic and geological survey area will cover the Labuan Basin and northern SKP currently bathed in AABW and LCDW. Profile drawn using Ocean Data View (Schlitzer, 2013).

Objective 2: Pre-site survey for an IODP proposal

Supported by the proposed seismic survey and geological sampling of the surface deposits we plan to write an IODP drilling proposal to recover the drift deposits in the Ragatt Basin on the northern SKP and in the Labuan Basin.

Carbonate rich sediments from the SKP are ideal to monitor changes in geochemical properties driven by climate throughout the Cenozoic at high resolution. The SKP is a key area to document the evolution of the Antarctic cryosphere, the ACC and the surface frontal system in the southern Indian Ocean. Previous drill cores provided low resolution and spotty windows into Cenozoic climate history of the region. Based on the information to be collected in the proposed survey a much more focused expedition could be planned to retrieve stratigraphic complete successions. In combination with the results from previous drilling at the Tasman Gateway (Leg 189), Wilkes Land (Exp. 318), and IODP 862-Pre proposal (PI Westerhold, Bohaty et al.) to drill in the subantarctic South Atlantic Ocean on the eastern Falkland Plateau (Maurice Ewing Bank and Georgia Basin), the planned IODP drilling proposal for the SKP will focus on climate change, biotic shifts, and deep-sea chemistry during the Paleogene in important southern Indian Ocean sectors, testing the following hypotheses:

Hypothesis 1: the magnitude of temperature change across transient warming events in the Paleogene is driving the response of high-latitude plankton groups.

Hypothesis 2: southern high latitude cooling causing changes in deep and bottom water circulation preceded the major onset of Antarctic Peninsula glaciation at the Eocene-Oligocene Transition.

Hypothesis 3: opening of the Drake Passage and Tasman Gateway paced the development of the Antarctic Circumpolar Current (ACC), AABW and DWBC.

Hypothesis 4: changes in high-latitude and global climate during the Cenozoic are coupled to variations in the ACC circulation.

The seismic grid and the sediment cores collected during cruise SO272 will help to characterise lithology and age of layers outcropping at the flanks of the drift deposits. We have collect a set of seismic profiles covering the locations of ODP Leg 120 Sites 748, 750 and 751 and allowing the choice of appropriate sites for an IODP proposal in the Ragatt and Labuan basins (Fig. 3.1). Parasound, providing detailed seismostratigraphic information about the upper 100-200 m of the sedimentary column, and multibeam bathymetric data have also been collected to fulfil the site survey guidelines of IODP's Science Evaluation Panel. We envision IODP drilling at KP and the Labuan Basin in a way to retrieve complete carbonate rich key records spanning Paleogene to Neogene time and to drill across important structural changes in the drift deposits for highly precise age determination. Synthesis of the here proposed seismics data and future IODP drilling would unfold the detailed history of southern high latitude climate development over the last 66 million years.

3.2 Agenda of the Cruise

The main objectives of cruise SO272 were the collection of high resolution seismic reflection data to identify sedimentary structures shaped by deep and bottom water masses and to sample outcropping sequences by geological sampling. To prepare for the cruise an environmental impact assessment was carried out by LGL Ltd. This EIA comprised an evaluation of all noise sources during the cruise: the seismic sources, the vessel itself, Parasound, and the multibeam system EM 122. Noise predictions have been undertaken for the proposed geophysical survey for the Kerguelen Plateau waters and applied to the latest published international thresholds (NMFS, 2016 and 2018a). The results indicated that none of the applicable injury thresholds would be breached outwith approximately 150 m from the operation. Animals may be within around 800 m of the source. A mitigation zone of 2000 m was found to be appropriate to control the risks from underwater noise with a shut-down distance of 500 m. The mitigation protocol has been designed to apply to distances of this magnitude in order to reduce the risk of injury to marine mammals to negligible levels. Furthermore, below mitigation measure were suggested:

- Deploying a marine mammal observer;
- Maintain a 3000 m mitigation zone;
- Avoiding starting piling at night or in poor visibility (unless further mitigation such as PAM is provided);

- Searching for animals in the mitigation zone for a minimum of 60 minutes before starting, to allow for deep-diving species to surface;
- Waiting for 30 minutes after the last observation of mammals in the mitigation zone;
- Apply a 30-minute soft start to the seismic airgun, e.g., by increasing from one gun up to four;
- Repeat the process if there is a break of over 10 minutes;
- If line changes are expected to take longer than 40 minutes, firing is to be terminated at the end of the survey line and the mitigation process repeated; and
- Report the activity and any observations using the standard format.

Additionally, an application for an environmental permit were handed in to the authorities of Australia. Upon review of our Environmental Impact Assessment, the Australian Department of Environment and Energy considered that the proposed action would not involve the killing, injuring, taking, trading, keeping or moving of any member of a listed threatened, migratory or marine species. Therefore no other permit for the proposed activity was required in addition to the permit for cetaceans under Subdivision 3 of Part 13 of the EPBC Act. The cetacean permit was issued.

We hired two independent Marine Mammal Observers from OSC to watch out for marine mammals prior and during seismic profiling. Their report can be found in chapter 5.4. Our streamer system has also included a Passive Acoustic Monitoring (PAM) system, Quiet Sea™ by Sercel. This supported the MMOs and allowed line changes during night.

4 Narrative of the Cruise

(G. Uenzelmann-Neben[1])
[1]AWI

The final preparations for cruise SO272 were carried out on board RV SONNE. 21 scientists embarked in Port Louis on January 11. Unfortunately, the unloading of the containers could only commence for the Geology containers. One of the seismic containers was delayed. This contained the working clothes, thus the set-up of the seismic equipment had to wait. RV SONNE left port on January 14 at appr. 18:00 LT to head to La Reunion, where the delayed container was supposed to be landed. We arrived in La Reunion on January 15 and carried out a safety manoeuvre. The freight vessel with our container arrived on January 16 but the port of La Reunion was on strike for the period January 16 to 17. We could load the container on January 17 but only leave port on January 18 00:30 LT already being six days behind schedule. Set-up of the seismic equipment thus began on January 18 and continued during transit to the working area.

On January 18 at 18:35 UTC the recording of EM 122 and Parasound commenced. During our transit we deployed six ARGO floats for Dr. C. Hanstein from CSIRO, Australia. The first was deployed on January 22 at 1:48 UTC. We arrived in the working area, the Labuan Basin on January 26 at ~12:00 UCT. The first geostation GeoB24001 was carried out with a gravity core and a multi-corer as well as a Sound Velocity Profiler (SVP). A second geostation followed. Seismic profiling commenced on January 27 at 4:45 UTC. We continued seismic profiling across the Labuan Basin and the central Kerguelen Plateau until February 13, 22:22 UTC, when the seismic equipment was retrieved. A set of eight geological sampling stations across the central Kerguelen Plateau followed. Seismic profiling recommenced on February 15, 20:12, and two additional profiles were collected. The seismic work ended on February 16, 23:40 followed by another geological station. The scientific programme came to an end on February 17, 5:51, when we set course for Cape Town.

The transit to Cape Town took 15 days, which was mainly due to the fact that we had to sail against the prevailing west winds and the east-setting current system within the ACC. Due to the bad weather we could not collect a bathymetric profile, which had kindly been requested by T. Thovhogi from the Petroleum Agency South Africa.

On March 3rd, 9:00 we came into the port of Cape Town. The scientists disembarked on March 4th.

5 Preliminary Results

5.1 Seismic Reflection Profiling

(G. Uenzelmann-Neben[1], T. Eggers[1], A. Pfeiffer[1], P. Daub[1], H. Eisermann[1], J. Geils[1], B. Najjarifarizhendi[1], R. Nielsen[1], M. Schneider[1])
[1]AWI

The application of seismic methods was one of the primary operational objectives of SO272 in order to obtain information on the structure and sedimentary distribution in the area of the Kerguelen Plateau. We used a standard multi-channel seismic reflection technique to image the outline and reflectivity characteristics of the sedimentary layers and the structure of the sub-sedimentary basement and lower crust by recording the returning near-vertical wave field. Figure 5.1 illustrates the principles of this technique.

5.1.1 Seismic Equipment

(T. Eggers[1], A. Pfeiffer[1])
[1]AWI

5.1.1.1 Seismic Sources, Activation and Timing

We used a cluster of 4 GI-guns to resolve the sedimentary layers. A single GI-Gun™ is made up of two independent air guns within the same body. The first air gun ("Generator") produces the primary pulse, while the second air gun ("Injector") is used to control the oscillation of the bubble produced by the "Generator". We used the "Generator" with a volume of 0.72 liters (45 in^3) and fired the "Injector" (1.68 liters = 105 in^3) with a delay of 33 ms. This leads to an almost bubble-free signal. The guns were towed 20 m behind the vessel in 2 m depth and fired every 25 m (~10 s shot interval).

The activation of the airguns occurs through a gun controller (Teledyne BigShot™). The controller provides the power necessary to activate the valves of the guns. With an optional feedback signal from extra hydrophones, the controller is capable of synchronizing the activation of each gun automatically. This ensures that the complete gun array fires at the same time. The gun controller itself waits for the fire order (TTL signal) of the navigation system.

Seismic data acquisition requires a very precise timing system, because seismic sources and recordings systems must be synchronised. All the systems are synchronised through a dedicated GPS clock with an accuracy of 1µs.

5.1.1.2 Navigation and Triggering

For planning the lines and performing the line shooting, we are using a separate navigation system (Sercel SeaPro Nav™). From ship side, we get NMEA strings for the ship position, heading, water depth and speed through water. Depending on the actual plan, the navigation system calculates the next shot point as defined by the shot parameters (shot distance, time or a combination of both) and generates the fire order for the air guns. After each successfully performed shot, the navigation system generates a navigation header file and transfers it to the acquisition system. This file uses the SEAL™ acquisition system to generate the final SEGD file for this shot point.

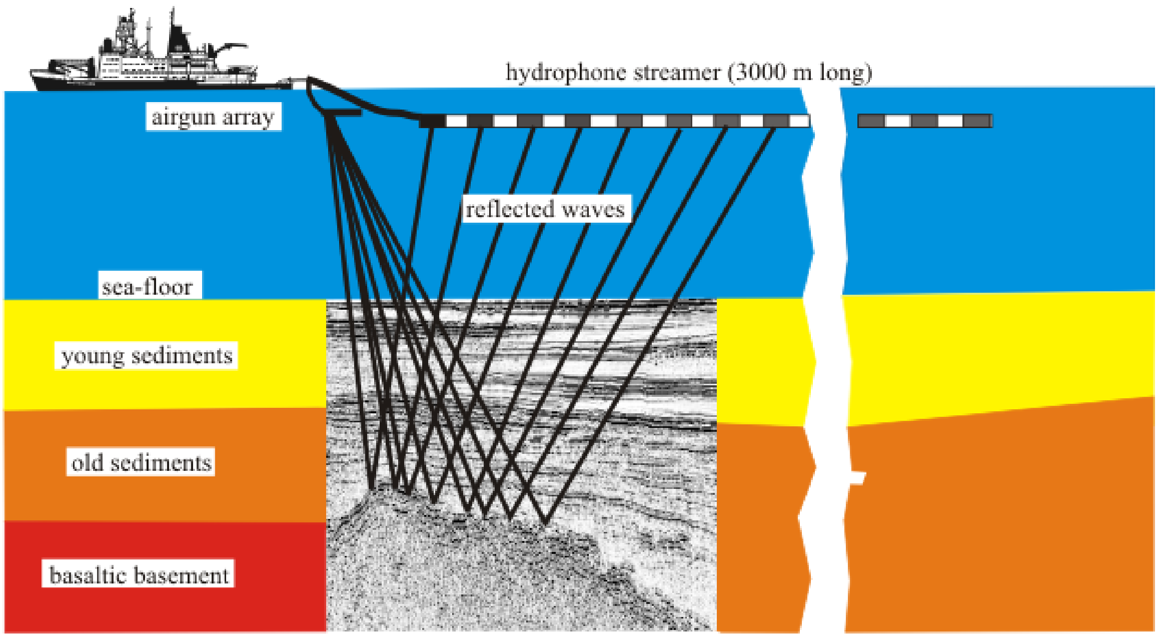


Fig. 5.1 Principle of marine seismic reflection surveying.

5.1.1.3 Multi-Channel Reflection Recording System

For multi-channel reflection data acquisition, a complete digital seismic streamer and recording system was used. The system consists of a large capacity, fully integrated, high resolution marine seismic data acquisition system (Sercel SEAL™) (Fig. 5.2). The streamer is a 240-channel hydrophone array, composed of 20 active sections with 12 channels each. Each channels consists of 8 hydrophones placed in an array. The spacing of each hydrophone array is 12.5 m (Table 5.1).

The streamer is coupled to the on-board recording system via a fiber-optic tow leader and a deck lead. The data collected by the hydrophone array is firstly converted from an analogue signal to digital via a Field Digitizing Unit (FDU2F). The data is available as a 24-Bit word with a sample rate of 1, 2 or 4 ms and then routed through a Line Acquisition Unit Marine (LAUM). After filtering and compressing the data, the LAUM sends them to the on-board equipment. The LAUM also supplies power for the FDU2F, and they are located after every 5 active sections. The interface to the on-board equipment is the Deck Cable Crossing Unit (DCXU). It has a build-in high-voltage power supply for powering all the streamer modules and acts as a LAUM for first 60 channels.

The main software is installed on a server running Linux Operating System mounted with the other components in a mobile rack. It manages the flow of acquired data from the streamer and auxiliary channels. It also manages processing of the data and export to various peripherals (FC-

AL tape drives, NFS disks, plotters, QC tools). Communications and synchronization with the navigation system are ensured via Ethernet links or a T0 signal. Communications with DCXU-428s are ensured via Ethernet links too, therefore the server can manage a virtually unlimited number of DCXU-428s (streamers). The system and all parameters for acquisition are displayed and controlled on a separate client pc with a graphical user interface (GUI).

The acquisition runs in continuous mode and the final SEGD file for a shot point will be generated according to the navigation header file, received from the navigation system. The final SEGD file is stored on the server and exported simultaneously to two Network Attached Storage (NAS) with a capacity of 5 TB each. The actual SEGD for the last shot point is also available for the QC-Software running on a separate client. With this software, it is possible to have a first look on the data for quality control.

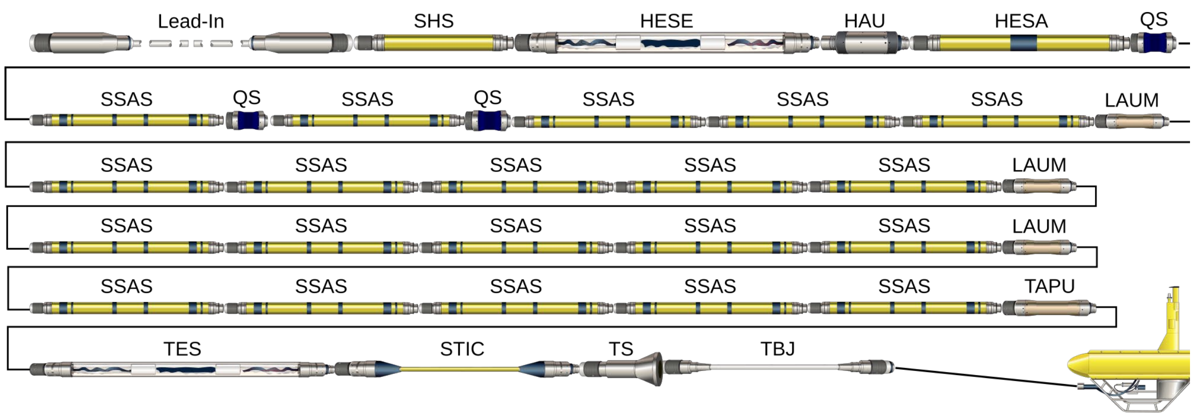


Fig. 5.2 Setup of the seismic data acquisition.

5.1.1.4 Depth Control and Positioning

With depth control units, called birds, we can control the depth of the streamer cable during operation. We use Model 5010/5011 DigiBIRD™ and CompassBIRD™ II from ION, controlled by Digicourse™ software, for this purpose. Nominal depth of the streamer cable in calm weather conditions is 10m. The depth can be changed during operation by setting new target depths for each bird through the controller software.The actual depth and heading (only Model 5011 DigiBIRD™ and CompassBIRD™ II) of each bird is available for the navigation system and will be stored for every shotpoint.

5.1.1.5 Passive Acoustic Monitoring (PAM)

We use QuietSea™ from Sercel for passive acoustic monitoring. The system can detect vocalizations emitted by marine mammals. These signals are of two types: whistles and click trains. The whistles are particular vocalizations emitted to communicate between marine mammals in the same group or are parts of a song call emitted by specific baleen whale males.

The clicks are impulsive signals (from approximately ten microseconds to few milliseconds) and so cover a great bandwidth. The bandwidth covered by clicks can be highly variable depending on the species.

The system uses the seismic data (using the SEAL™ interface) to detect vocalizations in the seismic bandwidth (from 10 Hz to 200 Hz with usual seismic sampling frequency of 2ms). It also uses dedicated streamer modules and auxiliary modules to detect localizations in the [200 Hz-96 kHz] bandwidth.

Table 5.1 Specification of SENTINEL™ active section, 12.5m spacing

Field Digitizing Units (FDUs).	
Arrangement	One per receiver point (2 channels)
Functions	A/D conversion, data digitizing, and tests
FDUs per active section	6 (2 per location)
Spacing	50m
Hydrophones	
Standard model	Sercel Flexible Hydrophone (SFH)
Nominal capacitance	32.5 nF ± 10% @ 20º C
Nominal sensitivity	–192.9 dB ref to 1 V/µPa ± 1.5 dB (22.65 V/bar) @ 20º C
Hydrophone Array	
Cut off frequency	2 Hz
Groups per section	12
Hydrophones per group	8
Group capacitance (nominal)	260 nF ± 10% @ 20° C
Group sensitivity	–194.1 dB ref to 1 V/µPa ± 1.0 dB (19.7 V/bar) @20° C

The data were recorded with the following parameters (also Appendix B):

Table 5.2 Brief description of seismic recording parameters.

Profile Name	*Active Length*	*Lead-in*	*Record Length*	*Sample Rate*
AWI-20200001	3000 m	145 m	9 s	1 ms
AWI-20200002	3000 m	145 m	9 s	1 ms
AWI-20200003	3000 m	145 m	9 s	1 ms
AWI-20200004	3000 m	145 m	9 s	1 ms
AWI-20200005	3000 m	145 m	9 s	1 ms
AWI-20200006	3000 m	145 m	9 s	1 ms
AWI-20200007	3000 m	145 m	9.5 s	1 ms
AWI-20200008	3000 m	145 m	9.5 s	1 ms
AWI-20200009	3000 m	145 m	9.5 s	1 ms
AWI-20200010	3000 m	145 m	9.5 s	1 ms
AWI-20200011	3000 m	145 m	9.5 s	1 ms
AWI-20200012	3000 m	145 m	9.5 s	1 ms
AWI-20200013	3000 m	145 m	9.5 s	1 ms
AWI-20200014	3000 m	145 m	9.5 s	1 ms
AWI-20200015	3000 m	145 m	9.5 s	1 ms
AWI-20200016	3000 m	145 m	9.5 s	1 ms
AWI-20200017	3000 m	145 m	9.5 s	1 ms
AWI-20200018	3000 m	145 m	9.5 s	1 ms

5.1.2 First Results

(G. Uenzelmann-Neben[1])
[1]AWI

The seismic grid was set up to image the structure of both basement and sedimentary rocks in the Labuan Basin between the northern Kerguelen Plateau and William's Ridge as well as on the central Kerguelen Plateau and at its eastern flank. We collected a set of lines in the Labuan Basin followed by a few transects southward onto the central plateau. This allowed a direct correlation with results from ODP Leg 120 Sites 748, 750, and 751 (Fig. 5.3) (Schlich and Wise Jr, 1992). In total, 18 seismic profiles were gathered across the Labuan Basin and Kerguelen Plateau (Fig. 5.3).

About 1.3 Tb of raw data were gathered. Due to this large amount the data were only converted into the internal format of our processing system Echos™, the shot-CDP geometry was defined, and the data were sorted. Afterwards, constant offset plots were created for quality control. The remaining processing steps will be carried by the PhD student funded through the project after our return to Bremerhaven.

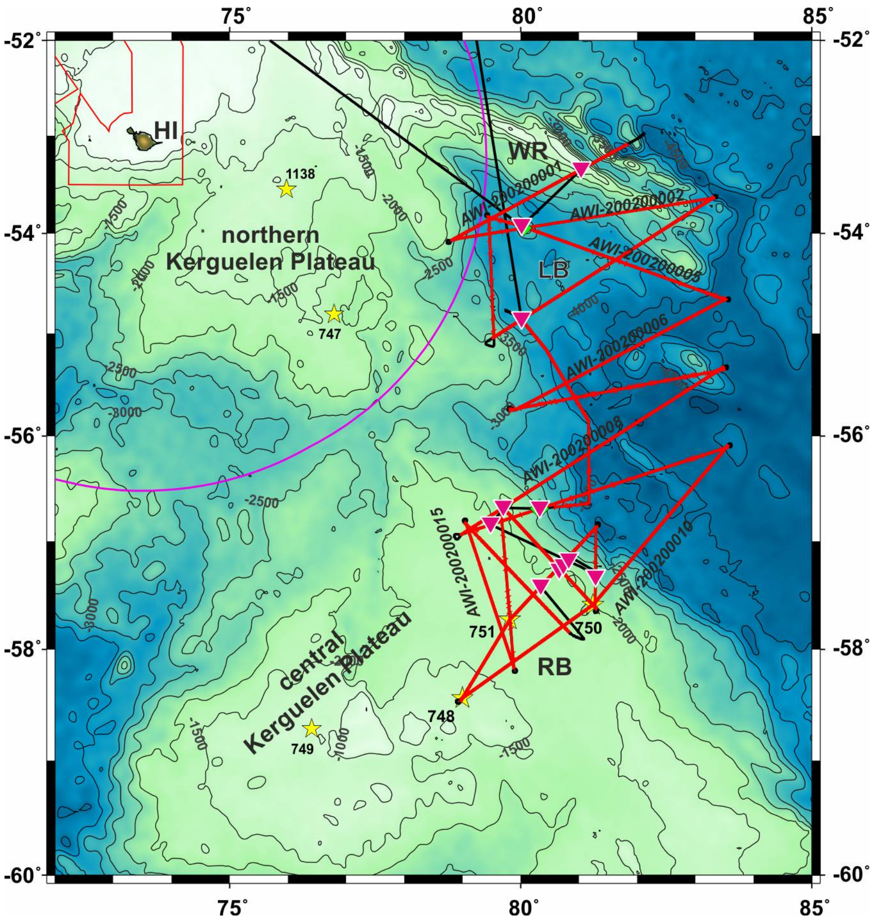


Fig. 5.3 Bathymetric map of the Kerguelen Plateau showing the locations of the collected seismic profiles (red lines) and of the geological stations (purple inverted triangles). Also shown are the locations of ODP Leg 120 Sites 748, 750, and 751 (yellow stars). The magenta lines show the boundaries of the Australian EEZ. HI= Heard Island, LB= Labuan Basin, RB= Ragatt Basin, WR= Willima's Ridge.

The seismic data are of excellent quality. Although using only small sources (four GI-guns with a total volume of 9.6 l) the seismic signals have penetrated up to 3 s TWT (~3 km) of the sedimentary column and at a few places even show intra-basement reflections. We initially collected a few lines crossing the Labuan Basin from the northern Kerguelen Plateau to the

William's Ridge and then worked our way southward. On the central Kerguelen Plateau we collected a grid of seismic lines, where we also crossed the locations of ODP Leg 120 Sites 748, 750, and 751 and which will also form the base for an IODP proposal (Fig. 5.3).

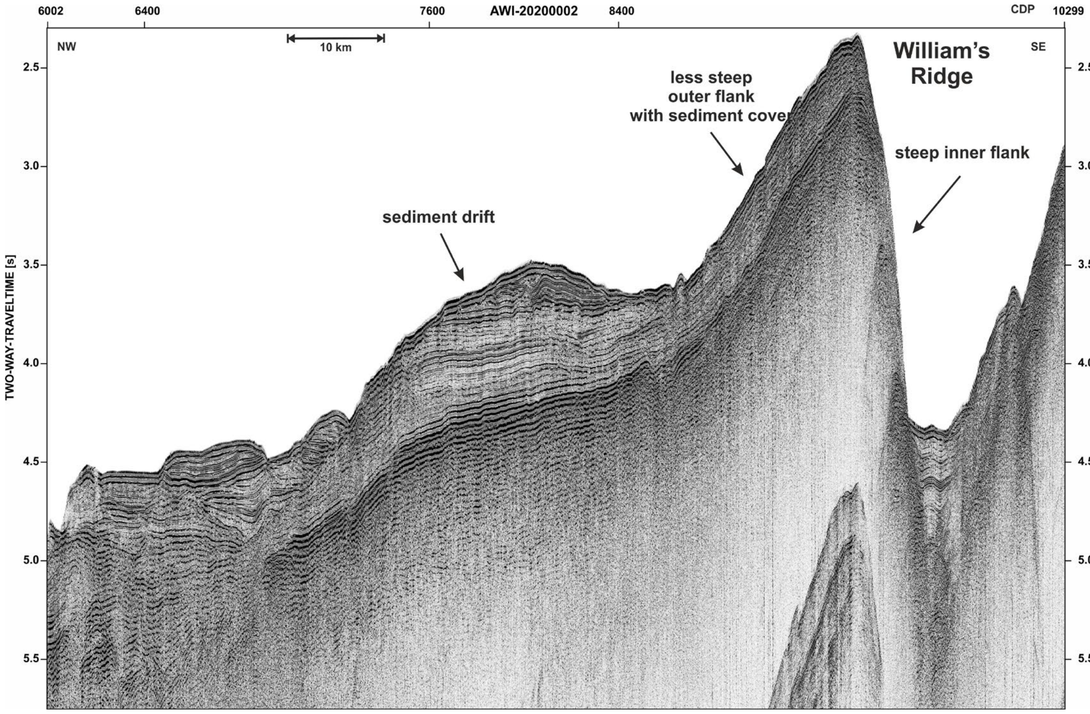


Fig. 5.4 Part of seismic line AWI-20200002 showing the western flank of the William's Ridge. Notice the steep inner flank while the outer flank is less steep. There, a significant sediment cover can be observed, and a sediment drift is formed.

The William's Ridge was imaged as a very rough basement feature, which is formed of at least two parallel elements showing both horizontal and vertical tectonic movement. The inside flanks of the elements are extremely steep, while the outside flanks are less steeply inclined. Towards the Labuan Basin, the ridge flank shows a significant cover with sediments, which are shaped into sediment drifts (Fig. 5.4). Sediment drift development can be observed all over the Labuan Basin. Several basement ridges appear to guide bottom water leading to the formation of moats and sediment drifts (Fig. 5.5).

Working southwards we continued imaging the sedimentary features in the Labuan Basin. There, basement is very rough and forms several highs, which partly rise above the seafloor and form seamounts and ridges. Magmatism appears to have occurred syn-sedimenatry since the sedimentary sequences are disturbed. Furthermore, the basement topography appears to have guided the flow of bottom water as moats and sediment drifts can be identified in their vicinity. The seismic data further show a number of unconformities and erosional surfaces.

The central Kerguelen Plateau is also characterised by strong erosion. An erosional surface encircles an up to 400 ms TWT (~400 m) thick sequence, which via a link to ODP Leg 120 Site 748 could be dated as the Eocene-Oligocene boundary (Fig. 5.6) (Coffin et al., 1990; Shipboard Scientific Party, 1989). The basement on the central Kerguelen Plateau is characterised by several highs with depressions in between. Those depressions are filled with early Cretaceous sediment. Late Cretaceous and Paleogene sediment show disturbance due to tectonic movements.

Summarising, the dataset is of excellent quality and images both tectonic structures as well as current controlled sedimentary features. Several lines of interpretation ranging from tectonomagmatic activity of the plateau as well as reactivation within the Labuan Basin to activity and relocation of pathways of deep water masses are possible. This will provide further information about the development of this important part of the Southern Ocean, where the tectonic development has had strong implications for the pathways of water masses and thus the development of the climate.

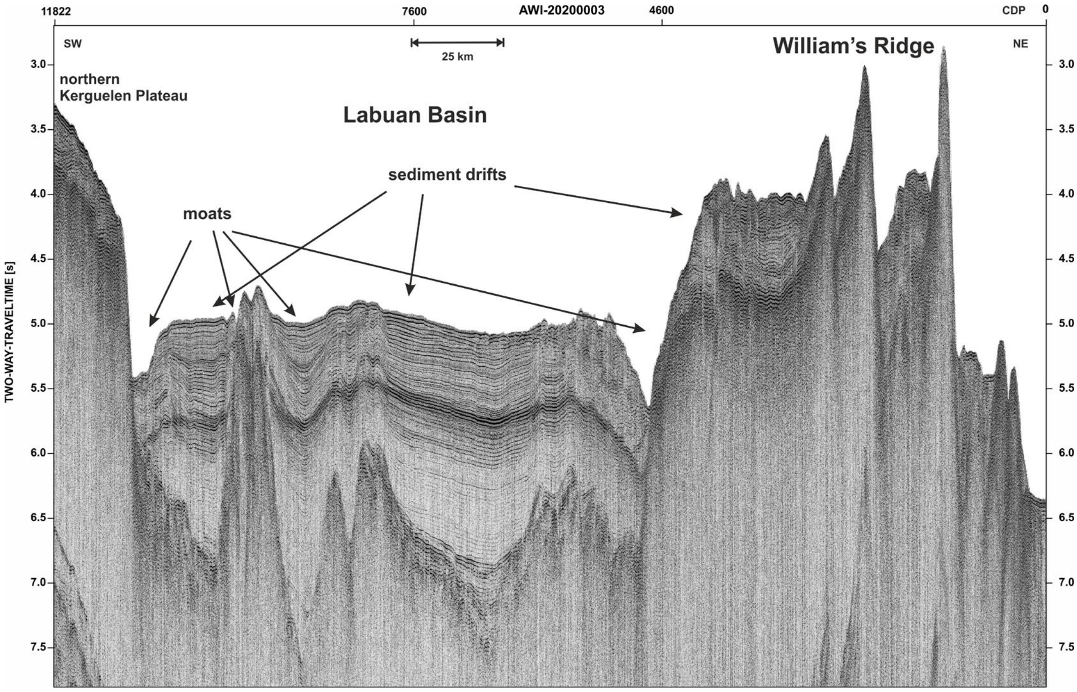


Fig. 5.5 Seismic line AWI-20200003 across the Labuan Basin showing sediment drifts and moats.

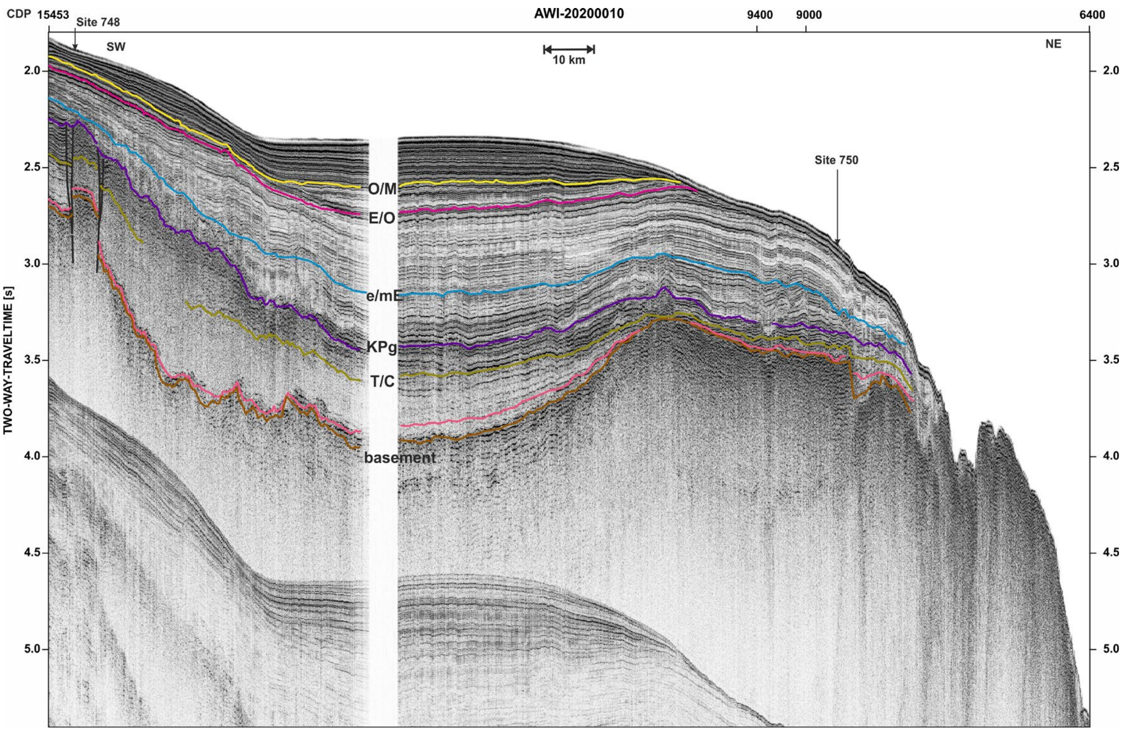


Fig. 5.6 Seismic line AWI-20200010 across the Kerguelen Plateau with a first tie to ODP Leg 120 Sites 748 and 750. e/mE= early-middle Eocene boundary, E/O= Eocene-Oligocene boundary, O/M= Oligocene-Miocene Boundary, KPg= Cretaceous-Paleogene boundary, T/C= Turonian/Campanian

5.2 Sediment Sampling

(T. Westerhold[1], A. Abbott[2], B. Duggan[3], F. Krauss[1], A.-K. Petersen[1])

[1]MARUM
[2]Macquarie
[3]USC

5.2.1 Gravity Corer

Longer sediment sequences were obtained by a gravity corer with a pipe length of 6 and 12 m, respectively, and a weight of 1.5 tons. Once on board, the sediment core was cut into 1 m sections, closed with caps on both ends and labelled. In total, 11 cores were retrieved with recoveries between 0 cm and 979 cm (Table 5.3, Fig. 5.7). Altogether ~31 m of sediment was recovered with the gravity corer during R/V SONNE Cruise SO272.

All of the gravity cores were cut into an archive and a work half. The archive half was used for core description and core imaging. The work half was sampled with syringes for Rare Earth Element (REE, Abbott/Duggan) analysis, for biostratigraphy investigations (Diatoms, Calcareous Nannofossils), and pilot foraminifera screening as well as samples with cubes for paleomagnetic studies. Core halves and samples, except the REE samples, were stored at +4°C and shipped to the GeoB core repository at MARUM.

Table 5.3 List of gravity cores retrieved during R/V SONNE expedition SO272. Geographical coordinates and water depths refer to "on ground" in Appendix C.

GeoB#	Gear	Latitude (S)	Longitude (E)	Water Depth (m)	Recovery (cm)	Notes
24001-1	12m	53°55.546’	80°00.957’	3132	979	sediment at bomb head
24002-1	6m	53°20.991’	81°02.127’	1143	0	empty, rock chips in core catcher
24003-1	12m	57°25.348’	80°20.568’	1924	322	both 6m pipes bend
24004-1	6m	57°14.333’	80°39.604’	2033	60	empty, sand recovered from CC
24005-1	6m	57°11.870’	80°43.847’	2153	108	rock in CC
24006-1	6m	57°08.640’	80°49.417’	2369	176	gravel in CC
24007-1	6m	57°18.240’	81°17.009’	2444	165	
24008-1	6m	56°50.661’	79°28.979’	1854	170	pipe bend
24009-1	6m	56°41.151’	79°41.872’	1939	275	
24010-1	6m	56°41.564’	80°19.603’	2699	112	
24011-1	12m	54°51.826’	80°00.822’	3625	748	

The core descriptions (Appendix E) summarize the most important results of the analysis of each sediment core following procedures applied during ODP/IODP expeditions. All cores were opened, described, and image scanned. Longitudinal split open core sections were imaged using the SmartCIS 1600LS line scanning system of the MARUM GeoB Core Repository (www.marum.de/en/Infrastructure/GeoBsmartCIS-1600-Line-Scanner.html). Split surfaces of each section was freshly scraped immediately prior to imaging in order to capture the ephemeral nature of sedimentary features as some features oxidize within minutes. All images were acquired at a standard resolution of 500 dpi. In order to retain the relative variability in sediment lightness throughout the expedition camera aperture was fixed at f/11. All sections were scanned using two light sources in order to achieve best lighting situations and reduce potential shadow effects of rough surfaces. A white calibration of the system was done on daily basis using a standardized white tile. Absolute color reproduction of the line scan images is ensured through the automatic application of a IT8.7/2-target referenced ICC-profile built-in the steering software of the line scanner. Section images were directly saved to the curatical database system ExpeditionDIS as jpeg files. Output also included a tab-delimited text file with red, green, blue, lightness (%) values as well as red/blue ratios in 1 mm down-core resolution for each section. Individual core sections were assembled to a single core image using the MARUM macro package for IGOR Pro (Wavemetrics). From the image red, green, blue, lightness (%) and red/blue ratio were extracted, despiked (outlier removal, data from endcap and gaps removed), smoothed and plotted in the core description barrel sheets.

The core descriptions (Appendix E) summarize the most important results of the analysis of each sediment core following procedures applied during ODP/IODP expeditions. All cores were opened, described, and image scanned. Longitudinal split open core sections were imaged using the SmartCIS 1600LS line scanning system of the MARUM GeoB Core Repository (www.marum.de/en/Infrastructure/GeoBsmartCIS-1600-Line-Scanner.html). Split surfaces of each section was freshly scraped immediately prior to imaging in order to capture the ephemeral nature of sedimentary features as some features oxidize within minutes. All images were acquired at a standard resolution of 500dpi. In order to retain the relative variability in sediment lightness throughout the expedition camera aperture was fixed at f/11. All sections were scanned using two light sources in order to achieve best lighting situations and reduce potential shadow effects of rough surfaces. A white calibration of the system was done on daily basis using a standardized white tile. Absolute color reproduction of the line scan images is ensured through the automatic application of a IT8.7/2-target referenced ICC-profile built-in the steering software of the line scanner. Section images were directly saved to the curatical database system ExpeditionDIS as jpeg files. Output also included a tab-delimited text file with red, green, blue, lightness (%) values as well as red/blue ratios in 1 mm down-core resolution for each section. Individual core sections were assembled to a single core image using the MARUM macro package for IGOR Pro (Wavemetrics). From the image red, green, blue, lightness (%) and red/blue ratio were extracted, despiked (outlier removal, data from endcap and gaps removed), smoothed and plotted in the core description barrel sheets.

In the core descriptions the lithological data are based on visual analysis of the core and supplemented by information from binocular and smear slide analyses. Visual descriptions of the representative sediment types, their colors according to the Munsell soil color chart as well as sedimentary structures and unique features, following the ODP conventions (Graham and Mazzullo, 1988). Lithological data are primarily based on the investigation of smear slides taken from selected horizons. Smear slides were prepared using Norland Optical Adhesive 61 as mounting medium (refractory index of 1.56), dried with UV light for 15 minutes. Slides were studied at up to 400x magnification on an Olympus BH-2 petrological microscope along two perpendicular profiles through the central area of the cover slip. Sediment classification followed the ODP terminology. Lithological names consist of a principal name based on composition, degree of lithification, and/or texture as determined from visual description and microscopic observations. In addition, the intensity of bioturbation together with specific features are indicated.

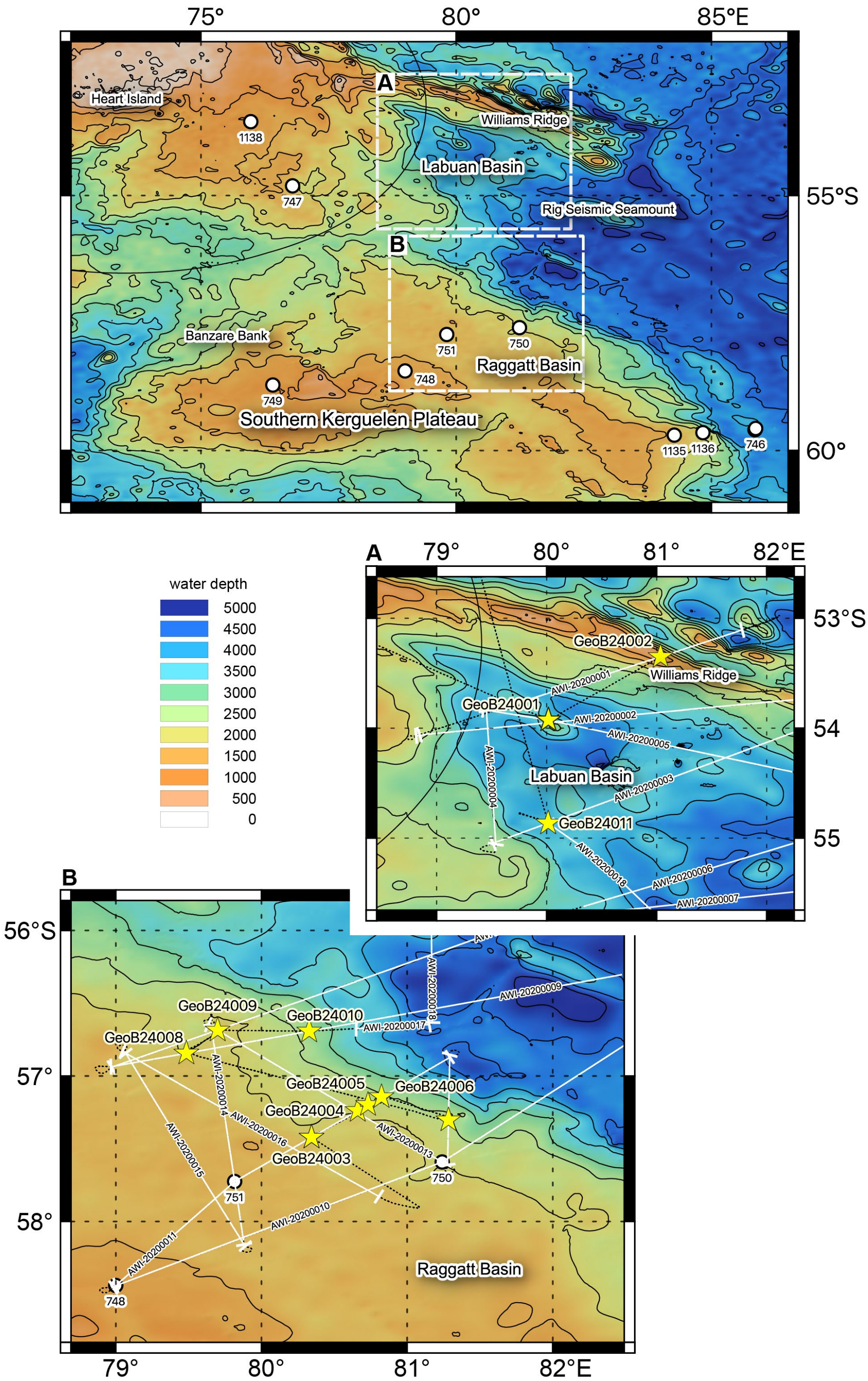


Fig. 5.7 Bathymetry map of the study area with the GeoB stations indicated by yellow stars in the Labuan (A) and Raggatt Basin (B).

5.2.2 Multi Corer

The main tool for the sampling of undisturbed surface sediments was the multi corer (MUC) equipped with 12 plastic tubes of 60 cm length and 10 cm diameter. During the expedition SO272, 6 MUC have been deployed (Table 5.4) and recovered up to 29 cm of undisturbed surface sediment.

Multi-corer tubes were distributed and processed as follows:

- 3 tubes cut into 1 cm thick slices for archive (MARUM); two of the tubes were stained with Bengal Rose from 0-7cm and packed in Kautex bottles, the other samples packed in Petri dishes (overlying not sampled).
- 3 tubes were transferred into plastic-liners as bulk sample (MARUM).
- 6 tubes were used to extract pore water samples (Macquarie & USC).

Table 5.4 Multi-corer sampling during R/V SONNE expedition SO272. Geographical coordinates and water depths refer to "on ground" in Appendix C.

GeoB#	Latitude (S)	Longitude (E)	Water Depth (m)	Max. Recovery (cm)	Notes
24001-2	53°55.544'	80°00.954'	3124	29	All tubes filled, SVP attached
24002-2	53°20.992'	81°02.126'	1142	0	MUC stopped at 1100m, SVP attached
24003-2	57°25.354'	80°20.580'	1905	15	All tubes filled, SVP attached
24004-2	57°14.329'	80°39.606'	2035	10	6 tubes filled, 6 empty
24008-2	56°50.660'	79°28.986'	1859	15	11 tubes filled, one lost
24009-2	56°41.153'	79°41.869'	1943	5	one tube filled, 11 empty

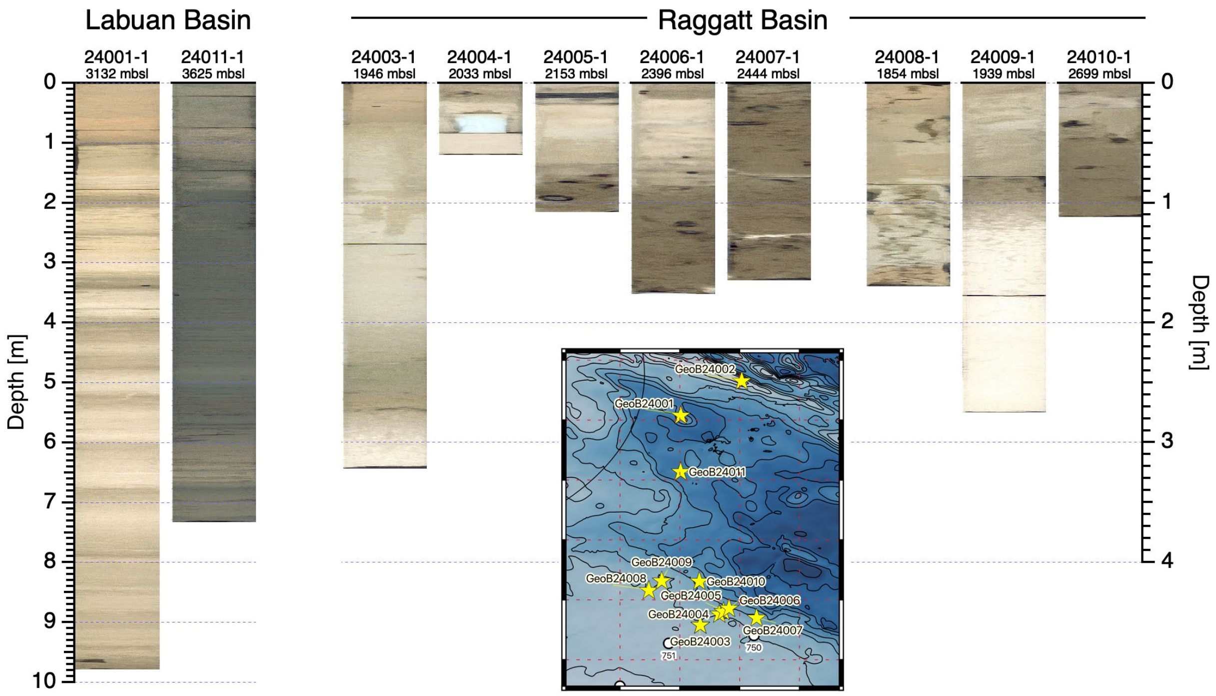


Fig. 5.8 Core image overview of all retrieved gravity cores from SO272 in the Labuan and Raggatt Basin.

5.1.3 Shipboard Results

Working Area Labuan Basin

Stations GeoB 24001 and 24002

First, in the Labuan Basin one MUC and two gravity cores were deployed at 1143 and 3132 m water depth (Figs. 5.7 and 5.8). The sediment recovered at station GeoB24001-1 (Fig. E.1) is mainly diatom ooze with drop stones and rhythmic changes in reflectance. Overall, the sediment is moderately bioturbated and contains foraminifera in increasing abundance downcore. At station 24002-1 the gravity corer did not penetrate the sea floor, only a few rock chips have been recovered in the core catcher pointing to exposure of basement rock.

Stations GeoB 24011

After the last seismic line of the cruise, AWI-20200018, one last gravity core was deployed in the Labuan Basin at 3625 m water depth, GeoB24011-1. A MUC deployment was planned but canceled due to too high swells for safe operations of the gear. The core retrieved 748 cm of olive grey diatom ooze.

Working Area Raggatt Basin

Stations GeoB 24003 to 24010

In the second working area, the Raggatt Basin, four MUC and eight gravity cores were deployed between 1854 to 2699 m water depth (Figs. 5.7 and 5.8). Recovery of sediment was between 60 and 322 cm. Decreased recovery for gravity cores was anticipated, compared to the Labuan Basin. Major objective of the cores in Raggatt Basin was to penetrate through the upper undifferentiated layer of surface sediment and probe the below much older outcropping sediment. Dating of the oldest part of the cores will help to determine the age of prominent reflectors in subbottom-profiler data and seismic profiles shore based.

The 322 cm of sediment recovered at station GeoB24003-1 is mainly radiolarian diatom ooze with drop-stones in the upper 270 cm. Below foraminifer-bearing nannofossil ooze of unknown age appears. The sediment is moderately to strongly bioturbated with massive burrows in the first meter. Both coring pipes of the 12m gear were bent due to the stiff nannofossil ooze at the base. Recovery at station GeoB24004-1 was only ~60 cm of radiolarian diatom ooze with foraminifer sand at the base. Once the core was on deck most of the sediment washed out due to the drainage of the overlying water. At GeoB24005-1 108 cm of foram ooze and clay with drop-stones was recovered. The top of the cores was very sandy and disturbed by the coring process. In the core catcher a thick black drop-stone was retrieved. GeoB24006-1 penetrated 176 cm of foram ooze at the top followed by silt-bearing clay towards the bottom. Gravel stones were found in the core catcher. Similarly, GeoB24007-1 retrieved only 165 cm of clay and drop-stones. At GeoB24008-1 the pipe was bent and brought up 170 cm of diatom ooze with drop-stones. This core was disturbed during coring and washed out later during retrieval in the lower section. A beautiful transition from overlying biosiliceous ooze into nannofossil ooze of unknown age was cored at GeoB24009-1, a 275cm long core. Last, GeoB24010-1 was retrieved from the Raggatt Basin with 112 cm of siliceous clay with drop-stones and manganese nodules.

5.3 Hydroacoustics

(S. Dreutter[1], K. Repenning[1], P. Andreas[1], L. Hehemann[1], F. Warnke[1], E. Werner[1])
[1]AWI

5.3.1 Scientific Objectives

Accurate knowledge of the seafloor topography, hence high-resolution bathymetry data, is key information necessary to understand many marine processes. It is of particular importance for the interpretation of scientific data in a spatial context. Bathymetry, or geomorphology, is a basic parameter for understanding the general geological setting of an area and geological processes such as erosion, sediment transport and deposition. Even information on tectonic processes can be inferred from bathymetry. Supplementing the bathymetric data, high-resolution sub-bottom profiler data of the top 10s of meters below the seabed provides information on the sediments at the seafloor and on the lateral extension of sediment successions. This can be used to study depositional environments on larger scales in terms of space and time, of which the uppermost sediments may also be sampled.

While world bathymetric maps give the impression of a detailed knowledge of worldwide seafloor topography, most of the world's ocean floor remains unmapped by hydroacoustic systems. Remote locations like the SO272 key research area are prime examples of this fact. In these areas, bathymetry is modelled from satellite altimetry with a corresponding low resolution. Satellite-altimetry derived bathymetry therefore lacks the necessary resolution to resolve small- to meso-scale geomorphological features (e.g., sediment waves, glaciogenic features and small seamounts). Ship-borne multibeam data provides bathymetry information in a resolution that is sufficient to resolve those features.

Using parametric sediment echosounders it is possible to image shallow subsurface structures and sedimentary patterns, which is of great importance in selecting appropriate sites for coring and, additionally, provide high-resolution cross-sections of the uppermost subsurface in order to supplement multichannel seismic data. In sediment echosounder data, the identification of, for example, stratified sedimentary layers, mass transport deposits, drift deposits, outcropping or subcropping strata, or shallow gas accumulations is possible. It can additionally be used for characterization of acoustic facies types and sedimentary processes derived by their imaged deposits. In SO272 research areas, depositional structures caused by bottom current activity are of special interest and were imaged at different locations.

5.3.1 Bathymetry

The main task of the bathymetry group was to operate the multibeam echosounder (MBES) Kongsberg EM122, including calibration and correction of the data for environmental circumstances (sound velocity, systematic errors in bottom detection, etc.), post processing and cleaning of the data, as well as data management for on-site map creation. The MBES was operated constantly throughout the cruise for underway surveying, as far as research permits allowed.

5.3.1.1 Technical description

During the SO272 cruise, the bathymetric surveys were conducted with the MBES Kongsberg EM122. The EM122 is a deep water system for continuous mapping with the full ocean depth potential (20 – 11.000 m). It operates on a frequency of around 12 kHz ranging from 10.5 to 13.5 kHz within the eight different transmit sectors. On *RV* SONNE, the EM122 transducer arrays are arranged in a hull-mounted Mills cross configuration of 16 m (transmit unit) by 8 m (receive unit) to achieve an angular beam accuracy of 0.5° by 1°. The combined motion, position, and time data comes from a Kongsberg MRU 5+ and a Kongsberg Seapath 320 system and the signal goes directly into the processing unit (PU) of the MBES to perform real-time motion compensation in Pitch, Roll and Yaw in the range of +/-10°. With a combination of phase and amplitude detection algorithms the PU computes the water depth from the returning backscatter signal.

5.3.1.2 Data acquisition and processing

Data acquisition was carried out throughout the entire cruise, starting the 18th of January 2020 at 18:30 UTC just outside the French EEZ (La Réunion) and ending on the 29th of February at 16:30 UTC before entering South African EEZ. Acquisition was only paused while crossing the French EEZ (Kerguelen Island).

Where possible, cruise tracks were planned parallel to existing bathymetric data. Due to the deep regime in the SO272 research area, the swath opening was limited to 120° (60° to both sides) to achieve a balance between coverage and ping rate and to avoid bad outer beam soundings at higher slant ranges.

For data acquisition, the Kongsberg SIS (Seafloor Information System) software was used. It pre-processes and logs the collected data, applies all corrections and defined filters, and finally displays the resulting depths on a geographical display. The recorded data was stored in 60 min blocks in the Kongsberg *.all format. Subsequent post-processing was performed using Caris HIPS and SIPS. For generating maps, the data were exported to Quantum GIS in the GeoTIFF raster format.

The data editing revealed an overall good data quality of the EM122. During transit we encountered some false bottom detections distributed over the covered area, but no technical defect could be identified that would explain this kind of artifacts. Hence, they might be connected to rough seas, higher vessel speed or poor sound velocity correction (SVC, see below). During the cruise we did three reboots of the EM122, two in order to improve the false bottom issue, and one due to a crash of SIS and the acquisition PC. Additionally, the BIST test of the EM122 failed on the TX Channels test because of low impedance on the transmitter elements, but this can be explained by the low water temperature in the Kerguelen region and was not a real technical defect. All in all the EM122 performed very satisfactory and ran stable for almost the entire trip.

5.3.1.3 Sound velocity profiles

For best survey results with correct depths, sound velocity profiles (SVP) were fed into the EM122 regularly to correct the water sound velocity in the different depths. This is essential, as the acoustic signal travels down the water column from the transducer to the seafloor and back to the surface through several different layers of water masses with each a different sound velocity. The sound velocity is influenced by density and compressibility, both depending on pressure, temperature and salinity. Wrong or outdated sound velocity profiles lead to refraction errors, false range measurements and overall reduced data quality.

During the transit with no time to stop for SVP stations, synthetic World Ocean Atlas 13 (WOA13) profiles were extracted with the SoundSpeedManager software and directly transmitted to SIS. In the main research area, a Valeport SVP probe was connected to the Mulicorer from the Geology team to acquire measured SVPs for improved correction. A total of five SVP stations were conducted in the area which was just about sufficient, since the SV was very stable during the time at the Kerguelen Plateau. During transit, more drastic changes in the water SV could be observed in the WOA13 profiles, hence, a higher number of roughly four profiles per day was extracted and applied to the data. Figure 5.9 shows the applied (measured) SVPs during the bathymetry data acquisition in the main research area.

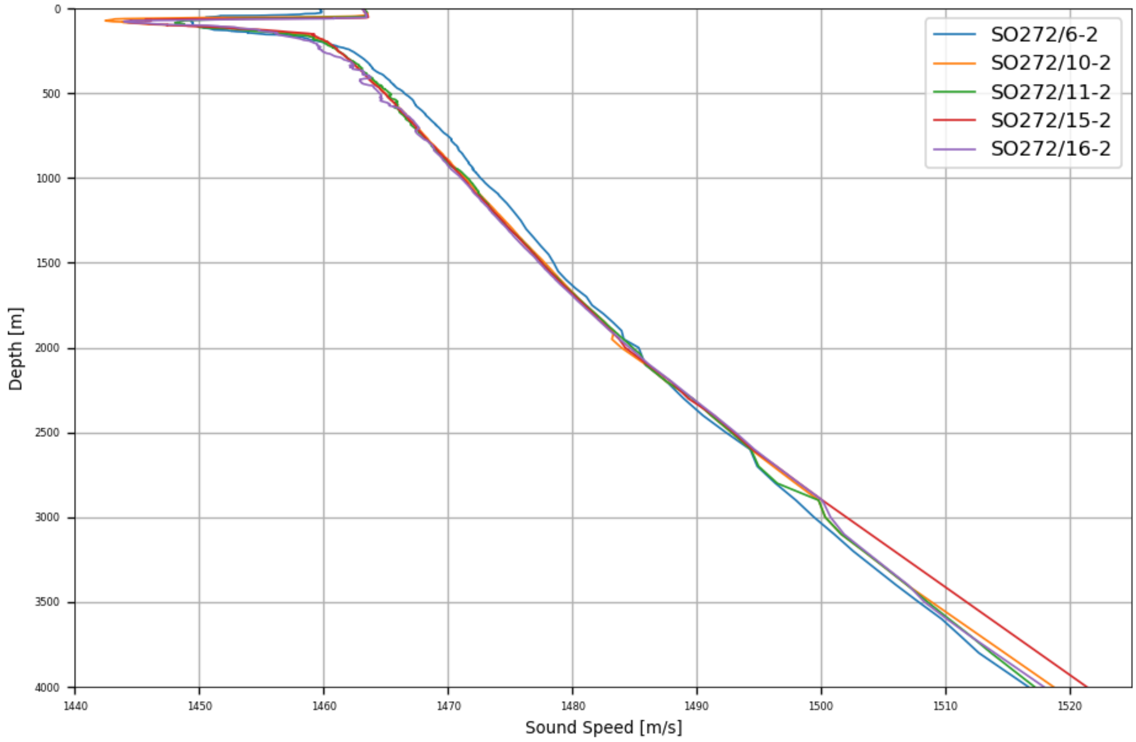


Fig. 5.9 Measured SVPs in the SO272 research area.

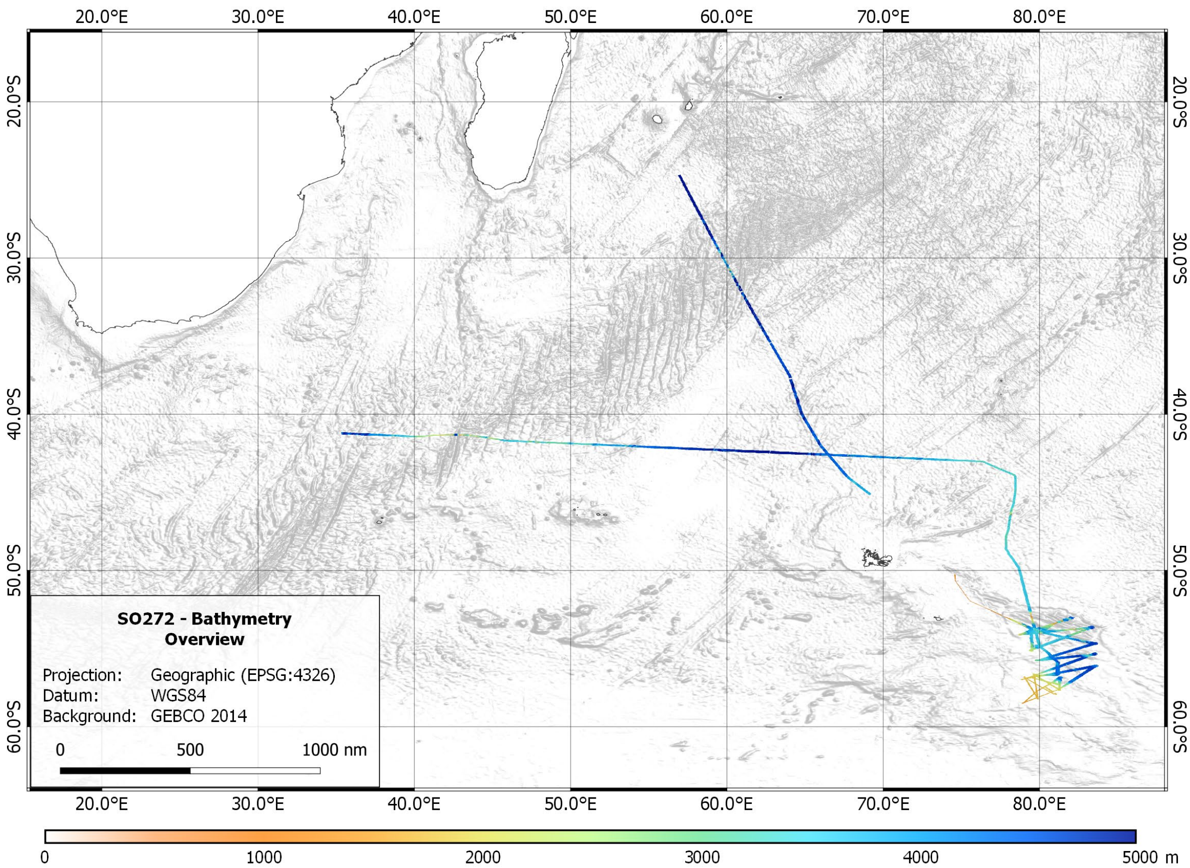


Fig. 5.10 Bathymetry collected during SO272 (including transit).

5.3.1.4 Bathymetry preliminary results

Throughout the cruise, a continuous recording of data was achieved, except for small data gaps due to the mentioned system/software errors and shutdowns, as well as the EEZs without research permits. By the end of the cruise, all EM122 data was processed and cleaned. During 42 days of survey, a track length of 11098 nm (20554 km) was surveyed. The raw data volume of the EM122 is 46 GB with 948 separate files. The water depths ranged between a minimum of 344 m to a maximum of 6249 m. Figure 5.10 shows an overview on the overall collected bathymetry data and Figure 5.11 the bathymetry in the main research area on the Kerguelen Plateau.

5.3.1.5 Data management

Bathymetric data collected during SO272 will be stored in the PANGAEA data repository at the AWI. Furthermore, the data will be provided to mapping projects and included in global bathymetry compilations such as GEBCO (General Bathymetric Chart of the Ocean). Bathymetric data will also be provided to the Nippon Foundation – GEBCO Seabed 2030 Project.

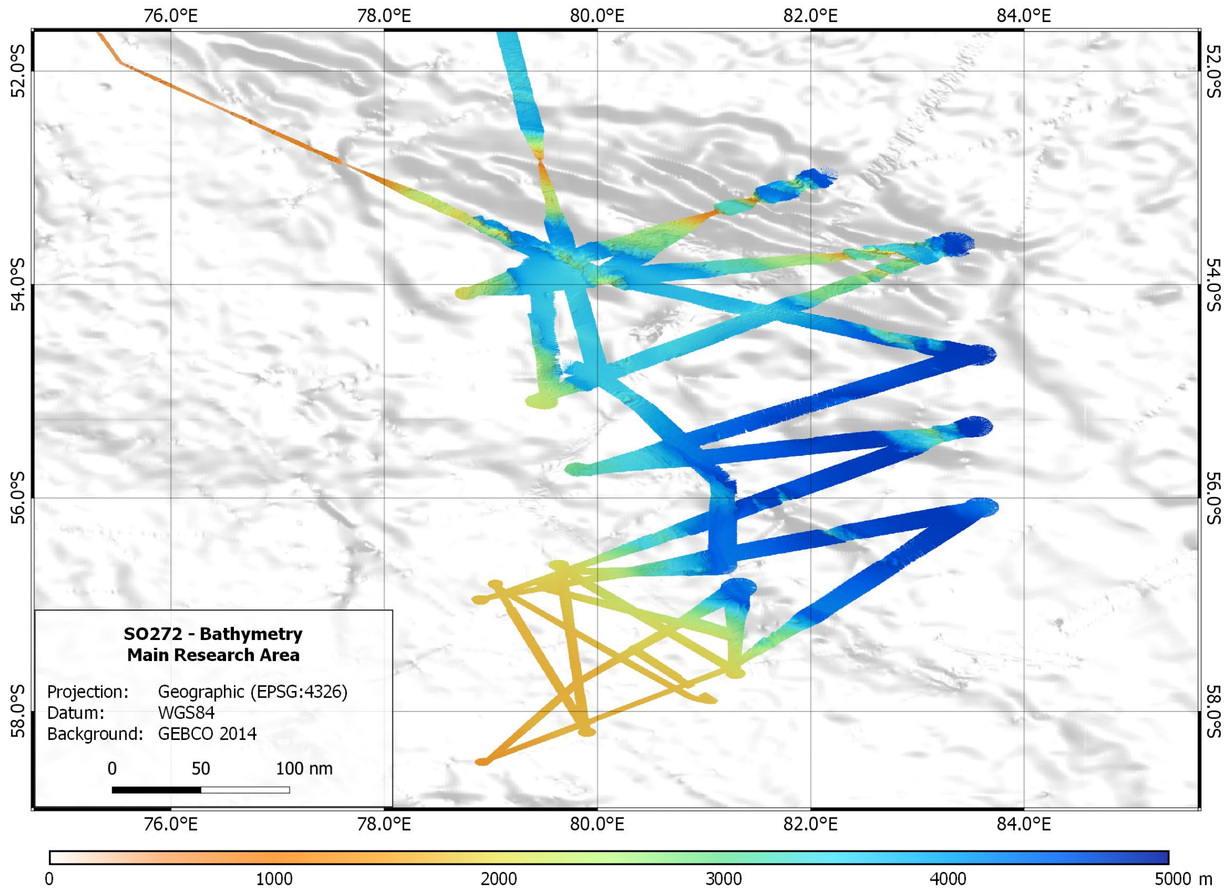


Fig. 5.11 Bathymetry collected in the SO272 main research area.

5.3.2 Sediment Echosounding

5.3.2.1 Technical description

The PARASOUND DS3 (P70) system is a hull-mounted parametric echosounder by TELEDYNE RESON GmbH (previously ATLAS HYDROGRAPHIC). The transducer transmits signals with 70 kW transmission power to enable a maximum penetration depth of about 200 m in soft sediments. The system uses the parametric effect to transmit a Secondary Low Frequency

(SLF) in the range of 0.5 to 6 kHz and a Secondary High Frequency (SHF) in the range of 36.5 to approx. 40 kHz. Both signals are generated by emitting two high frequency signals of 18 to 33 kHz. For the PARASOUND system onboard RV SONNE, the Primary High Frequency was set to 19.5 kHz to avoid acoustic interference with the simultaneously operating EM122 multibeam echosounder. The second PHF can vary between 18.5 and 33 kHz. During SO272, a SLF of 4 kHz and a rectangular pulse shape with a pulse length of 0.5 ms and 2 periods per pulse were chosen to provide a good relation between signal penetration and vertical resolution. The SLF signal travels within the narrow 19.5 kHz beam of about 4.5° aperture angle, which is much narrower than e.g. the 30° angle of a 4 kHz signal when emitted directly from the same transducer. Therefore, a higher lateral resolution can be achieved, and imaging of small-scale structures on the seafloor is superior to conventional systems.

HYDROMAP CONTROL (version 2.8.5) was used to initialize and setup the transmission parameter, while PARASTORE (version 3.4.4.9) was used for visualization and storage of PHF and SLF signals. Both PHF and SLF data were acquired over the full profile and stored as ASD files. SLF data (window size of 800 ms) were additionally stored in the more common PS3 format (Carrier Frequency mode & geographic coordinates) and regularly converted to SEG-Y format using the custom-designed program PS32SGY v1.6.3 (by H. Keil, University of Bremen). During the process, the data was resampled by factor 2, filtered with a broad bandpass filter (2 to 6 kHz) and the envelope of the seismic traces calculated. The SEG-Y file were subsequently imported to the seismic interpretation software IHS KINGDOM 2017.0 for better visualization and core location planning.

5.3.2.2 Data acquisition

The PARASOUND echosounder has been running starting on 18th of January 2020 17:51 UTC. Acquisition was stopped on 29th of February at 09:17 UTC. During this time period three software failures occurred, which could be dealt with by restarts. After this reboot, data acquisition continued on 19th of February 2020 at 09:18 UTC. Switching PARASOUND from sounding to standby was necessary while passing the French EEZ beginning on the 24th of January 2020 at 02:35 UTC. The EEZ was passed on January 25th 2020 at 09:41 UTC. Except for station work, the PARASOUND system was operated in quasi-equidistant mode, where signals are transmitted at equal intervals independent of whether the previously transmitted signal was already received again. Consequently, multiple signals can be present in the water column that allows for a better lateral coverage and, thus, resolution. Pinging mode was changed to single pulse during station work to reduce data amount. For the same reason, wait time was adjusted from 0 to 600 seconds. Seafloor detection was either based on the Controlled PARASOUND PHF or provided by the EM122.

5.3.2.3 Parasound preliminary results

During the survey, three different acoustic facies could be identified, which can be divided based on their acoustic characteristics and distinct locations around the research area Kerguelen Plateau.

One structure which could be identified are sediment drifts. Figure 5.12 shows a sediment drift body of large extent. The general signal penetration is around 200 m. On the western side converging reflectors (trace 5500 to 6500) are visible adjacent to a moat which are indications for bottom current activity. The sediment package is horizontally layered, as indicated by parallel reflections, and undisturbed on the western side. Interior parts of the sedimentary sequences display that disturbing factors have been present in the past as parallel to subparallel reflectors seem to be disrupted (trace 1000 to 2500). Moreover, parts on the eastern side show chaotic reflections with no clear layering to acoustic transparency. This is an indicator for mass movement deposits potentially originating from shallower depths associated with outcropping basement. On top of these structures however, stratified sediment has deposited again.

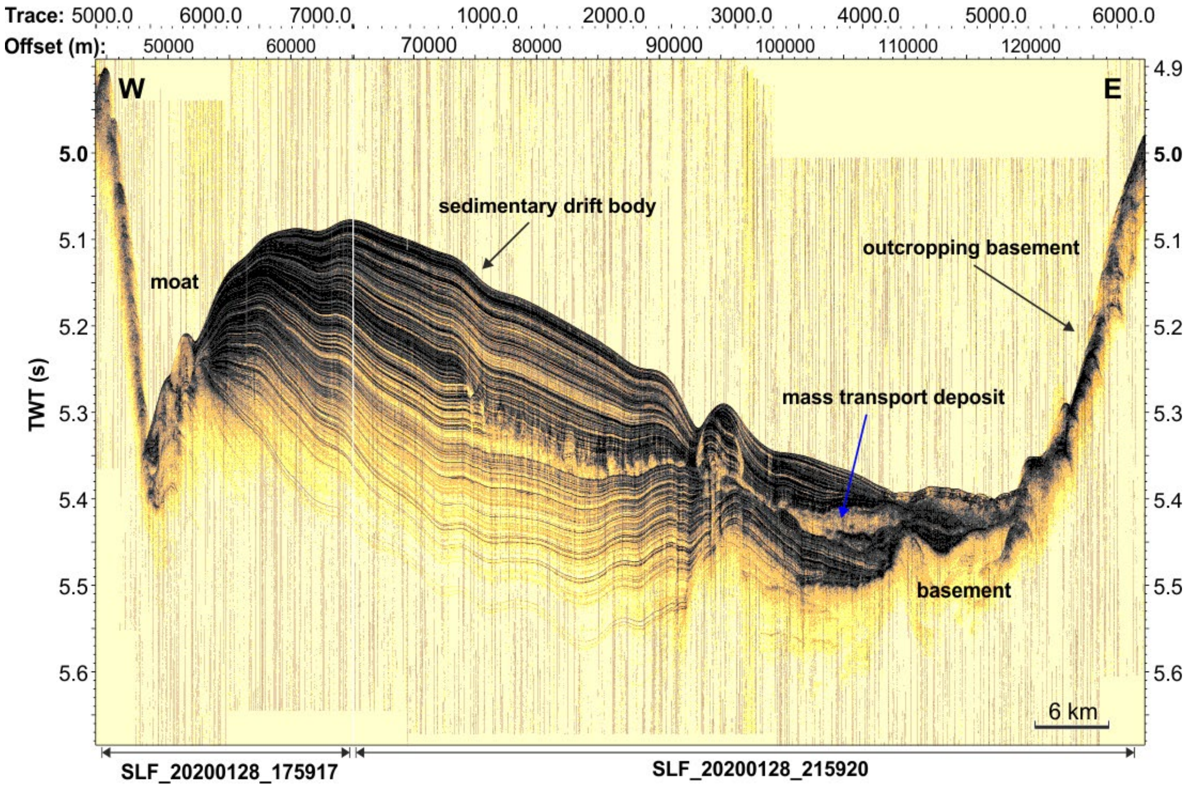


Fig. 5.12 Parasound profile SLF 20200128 175917 and SLF 20200128 215920 showing an elongated sedimentary drift body and a mass transport deposit adjacent to outcropping basement.

Another structure can be observed within the sedimentary sequences in the Labuan Basin southeast of the northern Kerguelen Plateau (Figure 5.13). This facies type is characterised by deep penetration of the acoustic signal showing horizontally layered, parallel reflectors following the topography. Around 150 m of sediments are displayed. In the southwestern part of the basin (trace 6500 to 4500), reflectors are overlapping and, thus, terminating on outcropping basement.

Moreover, wave-like sedimentary structures were found. Figure 5.14 shows that these sediment waves are characterised by variable layer thicknesses between sub-parallel reflections and two distinct formation stages separated by truncation surfaces. The older structure is more continuous and well-marked as the formation process seems to cease with time. Since there are no signs of vertical disruptions or displacements, the origin of these respective waves do not seem to be of tectonic nature but instead consequence of bottom current activity.

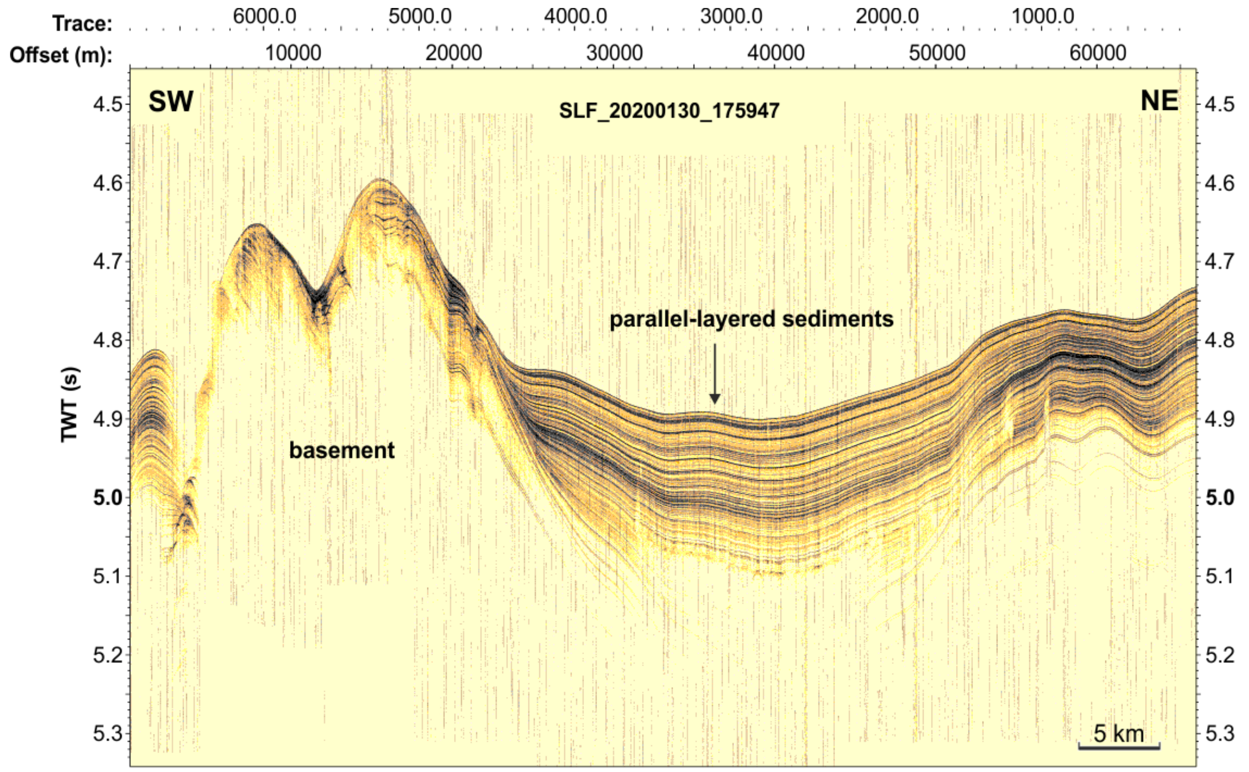


Fig. 5.13 Parasound profile SLF 20200130 175947 showing a parallel layered sediment succession, onlapping on outcropping basement in the SW.

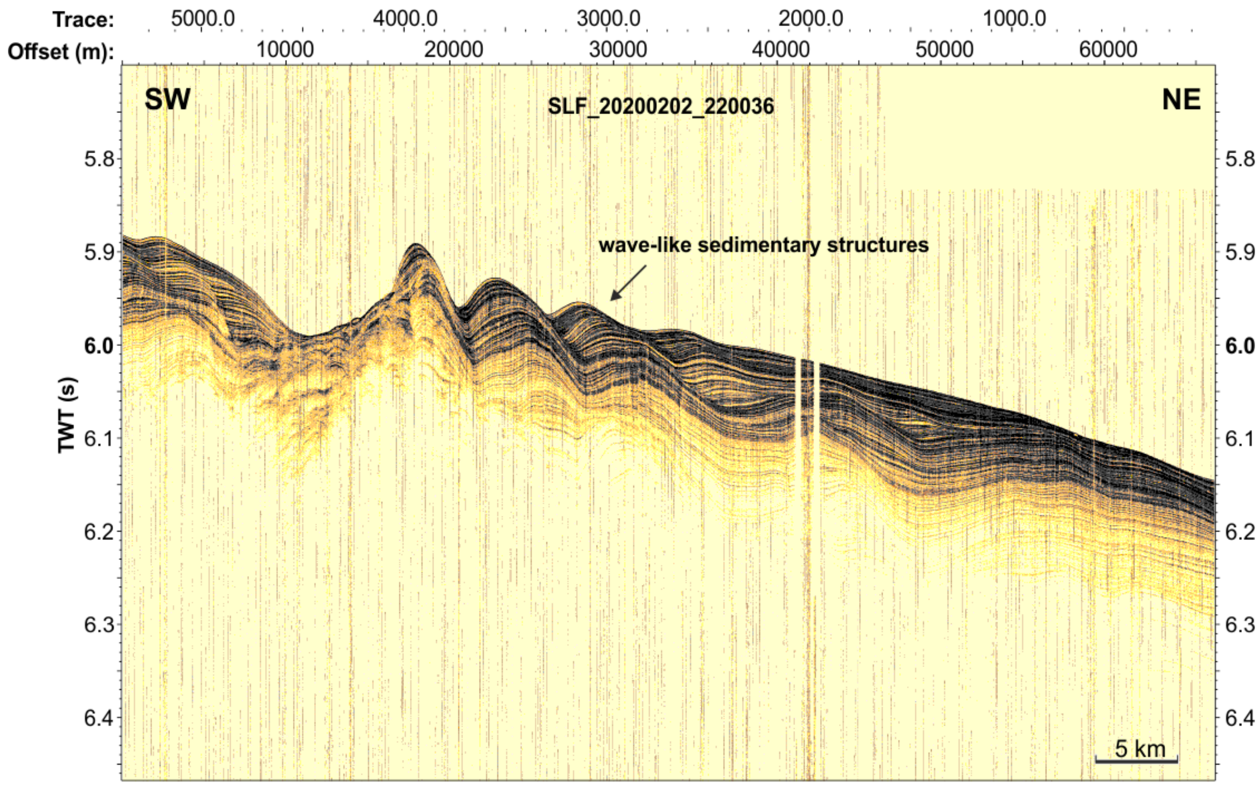


Fig. 5.14 Parasound profile SLF 20200202 220036 showing sediment waves.

5.3.2.4 Data management

Sediment echosounder data collected during SO272 will be stored in the PANGAEA data repository at the AWI.

5.4 Marine Mammal Observations

(I. Peters[1], L. Lazar[1])
[1]OSC

5.4.1 Introduction

All whales, dolphins and porpoises (cetaceans) in Australian waters are protected under the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*. Marine mammals, particularly cetaceans are acoustically-reliant animals and use sound for prey detection, predator avoidance, navigation and communication. Marine mammals produce sounds covering frequencies from only a few Hertz (Hz) to 200 kiloHertz (kHz). These range from low frequency (10–200 Hz) baleen whale (mysticete) moans, thumps and knocks, to the narrow-band high-frequency (NBHF) clicks of some toothed whales, dolphins and porpoises (odontocetes) which can reach up to 200 kHz. Correspondingly, marine mammals as a group are able to hear sounds covering frequency from only a few Hz to over 160 kHz. Consequently, sound generated from seismic surveys has the potential to cause injury or disturbance to marine mammals. The sound from acoustic seismic sources is primarily concentrated in the 10–200 Hz frequency bandwidth. The EPBC Act Policy Statement 2.1 *Interaction between offshore seismic exploration and whales: industry guidelines* make provision to reduce injury and disturbance to species that may be more sensitive in this frequency range i.e. baleen whales and larger toothed whales.

Marine mammal mitigation measures were applied during the scientific expedition from Research Vessel (RV) SONNE in adherence to cetacean permit: 2019 – 0007 from the Department of Environment and Energy, Australia and its accompanying documents to minimise risk of disturbance and injury to marine mammals. Marine Mammal Observers (MMOs) monitored a mitigation zone for the presence of all marine mammals, specifically ‘whales’, defined by Australian guidelines to include all baleen whales as well as larger toothed whales i.e. sperm, beaked, killer, false killer and pilot whales and exclude all other dolphins and porpoises. Ocean Science Consulting Limited (OSC) was contracted to supply two trained, qualified, and experienced MMOs, namely Ingrid Peters and Laura Lazar, for the duration of the project. Owing to the extended hours of daylight during summer in the Southern Ocean (approximately 22:30 to 15:00 Universal Time Coordinated, UTC), the dedicated MMOs were assisted by four scientists from the geology team aboard the vessel. These assistants were trained in observation techniques by the dedicated MMOs, to ensure the presence of two observers on watch at all times, apart from designated breaks, with at least one observer being one of the experienced dedicated MMOs. Opportunistic watches were conducted by one or more MMOs during transit outside of Australian waters in good weather conditions. Marine mammals, observed outside of dedicated visual watches, were recorded as opportunistic sightings.

Observations were conducted predominantly from the observation deck (22 m above mean sea level) and occasionally (during very bad weather conditions) from the bridge (20 m above mean sea level). Environmental conditions, including wind direction, wind speed, Beaufort sea state, swell, visibility, glare and precipitation, were recorded as prevailing sea and environmental conditions affect the ability to detect marine mammals. MMOs continued with visual observations throughout all weather conditions during all daylight hours. Observations were conducted with the naked eye and using binoculars (7x50), searching for visual cues, indicating the presence of marine mammals (e.g. splashes, feeding birds, dark or reflective shapes, etc). Specific marine mammal species cannot always be identified, due to distance from the vessel, brevity of the sighting, and/or similarity of many species to one another. In these situations, identification was narrowed down as far as taxonomically possible, including photographs which will be re-analysed at a later date to narrow down identification further.

In addition to observations by MMOs, acoustic monitoring was conducted by the seismic crew, as stipulated in the project Environmental Impact Assessment (EIA), to allow seismic operations to continue during periods of poor visibility including hours of darkness (see Section 5.1.1.5). Prior to operations, all seismic crew received some training as PAM Operators (PAMOs) for this project, consisting of an MMO presentation and a guidebook on the QuietSea PAM system. Acoustic watches were conducted throughout all seismic operations. MMOs maintained close communication with the seismic crew, including the PAMO, during daylight hours to provide guidance on mitigation. During hours of darkness, the PAMO was responsible for following the mitigation measures independently, as instructed by the MMOs.

Prior to activation of the seismic source, MMOs and PAMO monitored a 3,000-m observation zone for marine mammals for a minimum of 60 minutes. Following completion of the initial monitoring period, a soft-start commenced over a 30-minute period, commencing with one active airgun of 150 in^3, activating an additional airgun every 10 minutes until full power was reached with four activated airguns totalling 600 in^3. During line changes that lasted less than 40 minutes, a single airgun remained active for up to 29 minutes, before a short 10-minute 'mini' soft-start was conducted. In the event that a line change was expected to last longer than 40 minutes (e.g. for equipment maintenance) or for any breaks in seismic activity lasting longer than 10 minutes, a full pre-operation observation period and soft-start was conducted. MMOs continued with observations throughout line changes and gear repairs during daylight hours.

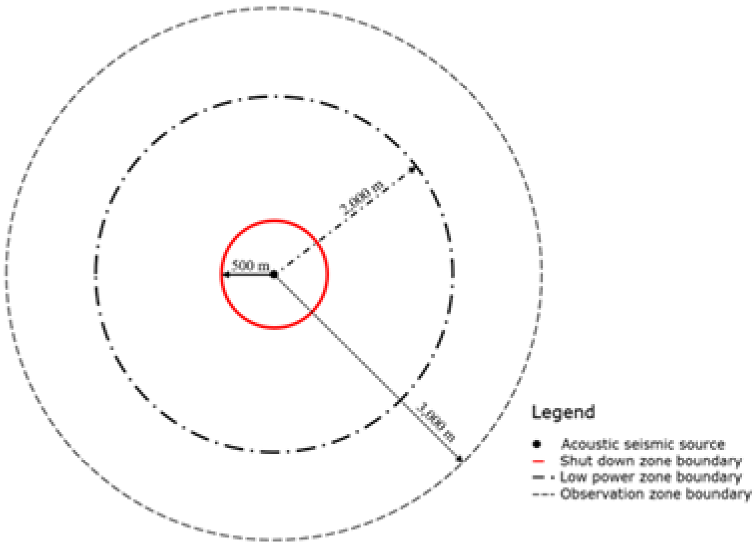


Fig. 5.15 Schematic of operational zones during seismic operations centred around the acoustic source ( ). — boundary of shut down zone; —· boundary of low power zone; --- boundary of observation zone monitored by MMOs. Source OSC (2020).

If whales were detected within the observation zone, the animals were tracked; however, no mitigation measures were taken until the animal approached the 2,000-m low power zone. When an animal entered the low power zone the seismic source was reduced to minimum, in this case powered down to a single active airgun (150 in^3). This occurred even when airguns were previously firing at full power. If an animal entered the 500-m shut-down zone, the seismic source was shut down completely. A soft-start (ramp-up) of the acoustic source commenced once the animal left the low power zone or 30 minutes from time of the last sighting within this zone, in order to allow the animal to depart the area. On occasions when the seismic source had been powered down or shut down already (e.g. in the case of a line change) soft-start was delayed until same sighting conditions apply as above.

5.4.2 Results

MMO during visual watch. © Laura Lazar.

Overall, 308 hours and 30 minutes of visual marine mammal monitoring was conducted on 22 days from 25th January to 16th February 2020 in Australian waters and in the area of seismic operations, on average 15 hours 25 minutes per day. In total, 18 seismic lines including 12 line changes were monitored continuously during daylight hours. The seismic source was at full power for 371 hours and 33 minutes, powered down to minimum pressure for 9 hours and 12 minutes and at soft-start for 8 hours and 39 minutes. Additional opportunistic watches were conducted on 10 days during transit (outside of Australian waters) and on 1 day between seismic operation when the source was not active.

MMOs observed a total of 141 cetaceans (127 adults and at least 14 calves) on 24 occasions, during the dedicated observation period (Table 1) on 12 individual days in water depths between 700–4700 m. A total of 20 sightings were 'whales', with at least 3 identified species (3 sightings of fin whales, *Balaenoptera physalus*; 1 sei whale, *Balaenoptera borealis*; and 3 pods of long-finned pilot whales with 10 calves**,** *Globicephala melas*) plus 1 sighting of unidentified pilot whales (*Globicephala* sp.); and 12 sightings of unidentified baleen whales (*Balaenoptera* spp.), including 2 possible calves or juveniles. Additionally, 4 sightings of dolphins were recorded (4 pods of hourglass dolphins with ca. 90 individuals in total, *Lagenorhynchus cruciger*), which did not require any mitigation efforts.

Fig. 5.16 Examples of marine mammal sightings observed during dedicated MMO watches. Unidentified baleen whale with blow still visible (Balaenoptera sp., left), fin whale (Balaenoptera physalus, middle) and hourglass dolphin (Lagenorhynchus cruciger, right). © Laura Lazar.

The average sighting duration was 20 minutes; however, many whales were only visible for a few blows at distance. The longest sighting (#13, fin whale, on 04/02/2020) lasted 2 hours and 52 minutes with 21 re-sightings. Animal behaviour was most often defined as 'swimming' with consistent directionality (71%), followed by 'milling', characterised by low speeds and variable directionality, (21%). On one occasion, pilot whales were observed rising head-first out the water in a vertical position, known as 'spy hopping'.

Twelve of these sightings warranted active mitigation, consequently the acoustic source was shut down on four occasions, powered down to minimum five times and soft-start delayed three times.

Table 5. 5 Overview of cetacean sightings during dedicated marine mammal observations. [+]Defined as duration from first to last sighting; [°]Initially identified as dolphins thus no mitigation action was taken, later identified through photos. BW = Baleen Whale; DW = Delphinid 'Whale'; UnID = Unidentified; PD = Power-Down, SD = Shut-Down.

#	Date	Detection mode	Type of cetacean	Common name	Distance(s) to source (m)	Total number	Sighting duration (hh:mm)[+]	Mitigation
1	25/01/2020	Visual	BW	Fin whale	No source	1	00:01	No action
2	25/01/2020	Visual	Dolphin	Hourglass dolphin	No source	16	00:01	No action
3	28/01/2020	Visual	DW	UnID pilot whale[°]	800–4700	9	00:10	No action
4	28/01/2020	Visual	Dolphin	Hourglass dolphin	380	7	00:01	No action
5	28/01/2020	Visual	BW	UnID BW	2500–4000	1	00:25	No action
6	28/01/2020	Visual	Dolphin	Hourglass dolphin	115	2	00:01	No action
7	29/01/2020	Acoustic	BW	UnID BW	1400	1	00:01	Delayed SS
8	31/01/2020	Visual	DW	Pilot whale - Long-finned	80–200	20	00:14	Delayed SS
9	31/01/2020	Acoustic	BW	UnID BW	2100	1	00:01	No action
10	31/01/2020	Acoustic	BW	UnID BW	1600	1	00:01	PD
11	01/02/2020	Visual	BW	Sei whale	1000–4100	1	00:37	PD
12	04/02/2020	Visual	BW	UnID BW	800–2900	1	00:15	PD
13	04/02/2020	Visual	BW	Fin whale	450–3400	1	02:52	SD
14	05/02/2020	Visual	DW	Pilot whale - Long-finned	80–2900	30	00:20	SD
15	08/02/2020	Visual	DW	Pilot whale - Long-finned	160–2400	30	00:41	SD
16	09/02/2020	Visual	Dolphin	Hourglass dolphin	150	7	00:01	No action
17	09/02/2020	Visual	BW	UnID BW	1500–2500	2	00:10	PD
18	09/02/2020	Visual	BW	UnID BW	1400–3400	3	00:44	PD
19	10/02/2020	Visual	BW	UnID BW	3100	1	00:01	No action
20	10/02/2020	Visual	BW	UnID BW	2900	1	00:01	No action
21	10/02/2020	Visual	BW	UnID BW	4500	1	00:01	No action
22	11/02/2020	Acoustic	BW	UnID BW	800–1400	1	00:32	Delayed SS
23	12/02/2020	Visual	BW	UnID BW	150–1100	1	00:23	SD
24	10/02/2020	Visual	BW	Fin whale	2500–4500	2	00:27	No action

Additionally, 23 sightings of 56 individual cetaceans were recorded by either the dedicated MMOs during opportunistic watches or by other crew members. While the majority (14) of these sightings were unidentifiable large (probably baleen) whales, a few additional species were observed in the following sightings: 3 Antarctic minke whales (*Balaenoptera bonaerensis)*, 1 dwarf minke whale (*Balaenoptera acutorostrata 'unnamed subspecies'*), 1 humpback whale (*Megaptera novaeangliae)*, 1 sighting of 3 southern bottlenose whales (*Hyperoodon planifrons)*, as well as 2 sightings of fin whales (3 individuals in total), 1 pod (*ca*. 15 individuals) of hourglass dolphins and 1 sei whale. An additional sighting of 6–8 unidentified dolphins was recorded by crew members, but photo quality was too poor for identification.

Weather conditions were variable during the survey, with Beaufort sea states mainly between force 3–6 (84% of the time), with occasional periods of high Beaufort sea states of 7–8 (12%). The prevailing wind strength recorded during periods of MMO visual watch was Beaufort wind force of 6–7 (20–30 knots, 47%). Wind direction was variable throughout MMO effort, but predominantly from the west (33%) and northwest (32%). Visibility was predominantly good (>5 km, 63%), and swell medium (2–4 m, 68%). Observations were hampered 32% of the time by a combination of environmental factors (poor visibility, high sea state, high wind and bad glare). Sighting conditions for visual detection are considered ‘good’ to ‘moderate’ when there are not many white caps visible (sea state 4 or below), combined with a low swell (<2 m), and moderate visibility (>3 km). Any other combination of factors is designated as ‘poor’ for sighting marine mammals, but MMOs continued watches throughout all weather conditions.

The dedicated MMOs wish to thank the geology and seismic teams for their assistance in monitoring the observation zone as well as the crew of the RV SONNE and all parties involved with this project.

5.5 ARGO Floats

(A. Abbott[1])
[1]Macquarie

Seven Argo floats were deployed over the course of voyage SO272 (Table 1) in January and February 2020. Argo floats are part of an integrated global observation strategy, with about 800 floats deployed globally each year since 2000. Each float has an estimated lifetime of 4 to 5 years, with between 3000 and 4000 active floats at any given time providing in total around 100,000 temperature, salinity, and velocity measurements per year. This data will provide a quantitative description of the upper ocean variability including information about heat and freshwater storage and transport over scales of months to decades as well as enhance the value of the Jason satellite altimeter dataset. All data is publically available from Global Data Assembly Centers in near real-time.

Table 5.6 Details on deployed ARGO floats

Hull #	Latitude	Longitude	Date & Time	Waterdepth
1061	37°29.947’S	063°59.983’E	22-01-2020; 01:48 UTC	4658 m
1079	39°59.770’S	064°48.444’E	22-01-2020; 17:48 UTC	4691 m
1054	41°59.783’S	066°00.374’E	23-01-2020; 06:18 UTC	5344 m
1080	43°59.635’S	067°42.888’E	23-01-2020; 18:46 UTC	4288 m
8847	45°00.016’S	069°00.085’E	24-01-2020; 01:40 UTC	3755 m
8830	53°55.641’S	080°01.197’E	26-01-2020; 17:57 UTC	3128 m
8846	56°41.560’S	080°19.429’E	15-02-2020; 18:15 UTC	2692 m

Argo floats were deployed over the port side of the stern deck following the standard 'cardboard box' deployment method (image below). Specifically, the protective plastic was removed from the float release mechanism as the ship was positioning to be facing into the wind. Once the ship speed was reduced, a float was hoisted using the provided harness (left) and lowered until the release mechanism was in contact with the sea surface (center). Within 30 to 60 seconds, the water release was activated and the harness released from the cardboard box (right). The float was then able to sink out of the open box. All seven release mechanisms fired properly and no additional action was necessary.

Argo floats were supplied to SO272 by the Australian Commonwealth Scientific and Industrial Research Organisation. All floats were confirmed to be successfully transmitting data after deployment.

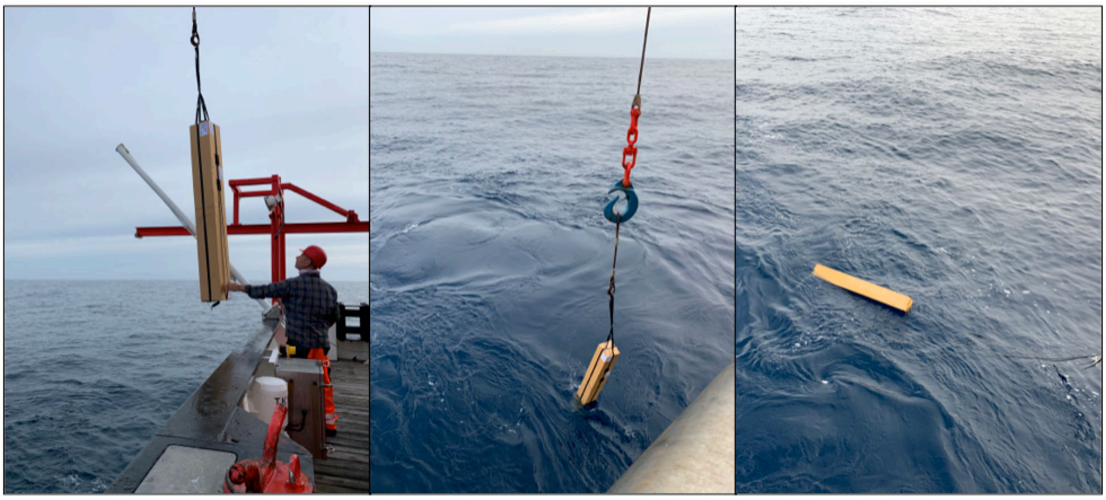


Fig. 5.17 Deployment of the ARGO Flotas.

6 Ship's Meteorological Station

(O. Sievers[1])
[1]DWD

On 14-Jan-2020 expedition SO272 started in Port Louis (Mauritius) with a delay of 2 days, heading to an unplanned further stop in the port of La Reunion, about 140 km west, for some days. Weather was fine during the idle time: the fresh easterly trade wind was hardly to notice in the lee of the islands, maximum temperatures rose to 30 to 32°C, and the nights remained warm with about 26°C. On the other hand, even heave rain showers occurred regularly.

Just in time for the departure in the early hours of January 18th the synoptic situation started to change. Corresponding to a gale low that already had passed the Kerguelen Islands on their south towards the east, a trough expanded towards South Africa, supported by a secondary low on about S45. This system swung east, pushing the subtropical high east as well. On the front of the trough the wind backed north to northwest slowly, being fresh at first and getting stronger. Sea state was dominated by a 2-meter swell coming from the east. On January 20th RV SONNE crossed the trough, marked by some hours with heavy rain and, finally, a sharp backing of the wind to southwesterly directions while increasing from 6 Bft to 7 to 8 Bft. Temperature dropped from 25 to 17°C, the supporting secondary low moved off southeast via the Kerguelen Islands.

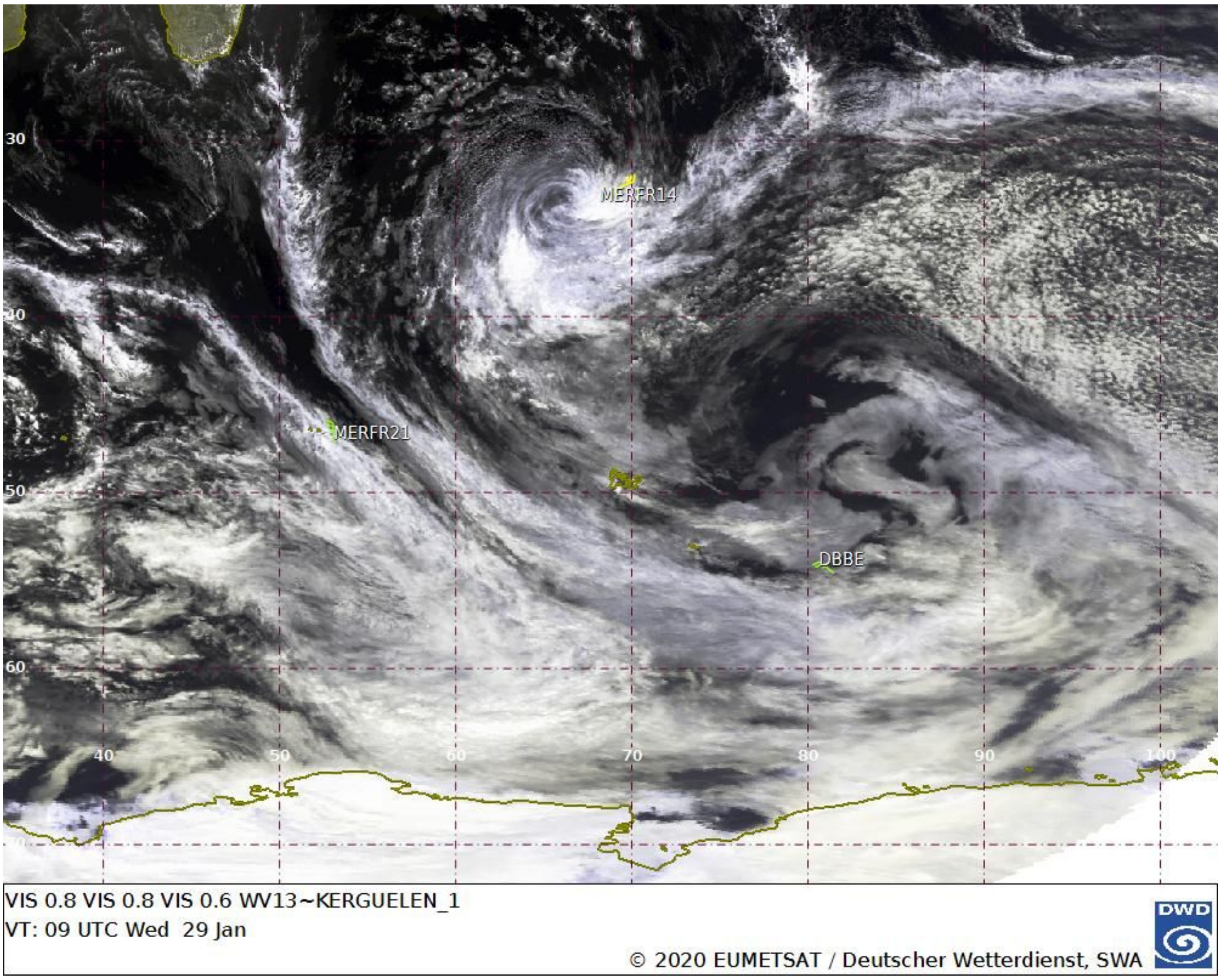


Fig. 6.1 Satellite image (composite of several VIS-channels of MET-10) of the former tropical storm DIANE, moving south near E065 (Jan 29, 2020; 0900 UTC).

Shortly behind the trough a southwesterly swell of 4 meters height became dominant, which was generated at the southern and southeastern flank of the Atlantic subtropical high that protruded into the area south of Africa with more than 1030 hPa until that time. Another strong low was located southwest of the sailing area and moved off over the Kerguelen Islands until January 23rd, causing strong to near gale winds from Northwest to West until then. Between this low and the mentioned high, sea state could increase to 5 to 6 meters until the morning hours of January 23rd, remaining at this height until in the afternoon pressure gradient and therefore wind and wave height dropped significantly.

On January 25th, after one day with weak and variable winds and a westerly swell below 2 meters, RV SONNE joined the border area of a new east moving low while she was passing the Kerguelen Islands on their northeast. This low crossed the vessel almost central next day. As a consequence winds became strong again, winds veered almost completely from West (Jan 25th) to Southwest (Jan 27th). Due to the fast variations, sea state remained at about 2 meters at first.

Behind the low moving off, the subtropical high could move into the area close northeast of the Kerguelen Islands, intensifying to more than 1035 hPa while becoming stationary and blocking any lows from passing to the east for the next days. An east swinging ridge caused a strong southwesterly wind on Jan 27th which forced the sea to increase to 3 to 4 meters. Behind the ridge, RV SONNE stayed on the southwesterly flank of the subtropical high in a mainly moderate to fresh, slowly increasing northwesterly flow until the end of the month.

The blocking was suspended by the (former) tropical storm DIANE that moved south on the westerly side of the high during the last days of January (Fig. 6.1) and passed the research area, almost dissolved, on Jan 31st on the western side. The subtropical high could be pushed east far enough to allow a trough swinging east across the working area on February 1st. An embedded secondary low, passing the area in the northeast, caused temporarily winds of gale force with strong gale gusts on its rear on Feb 2nd.

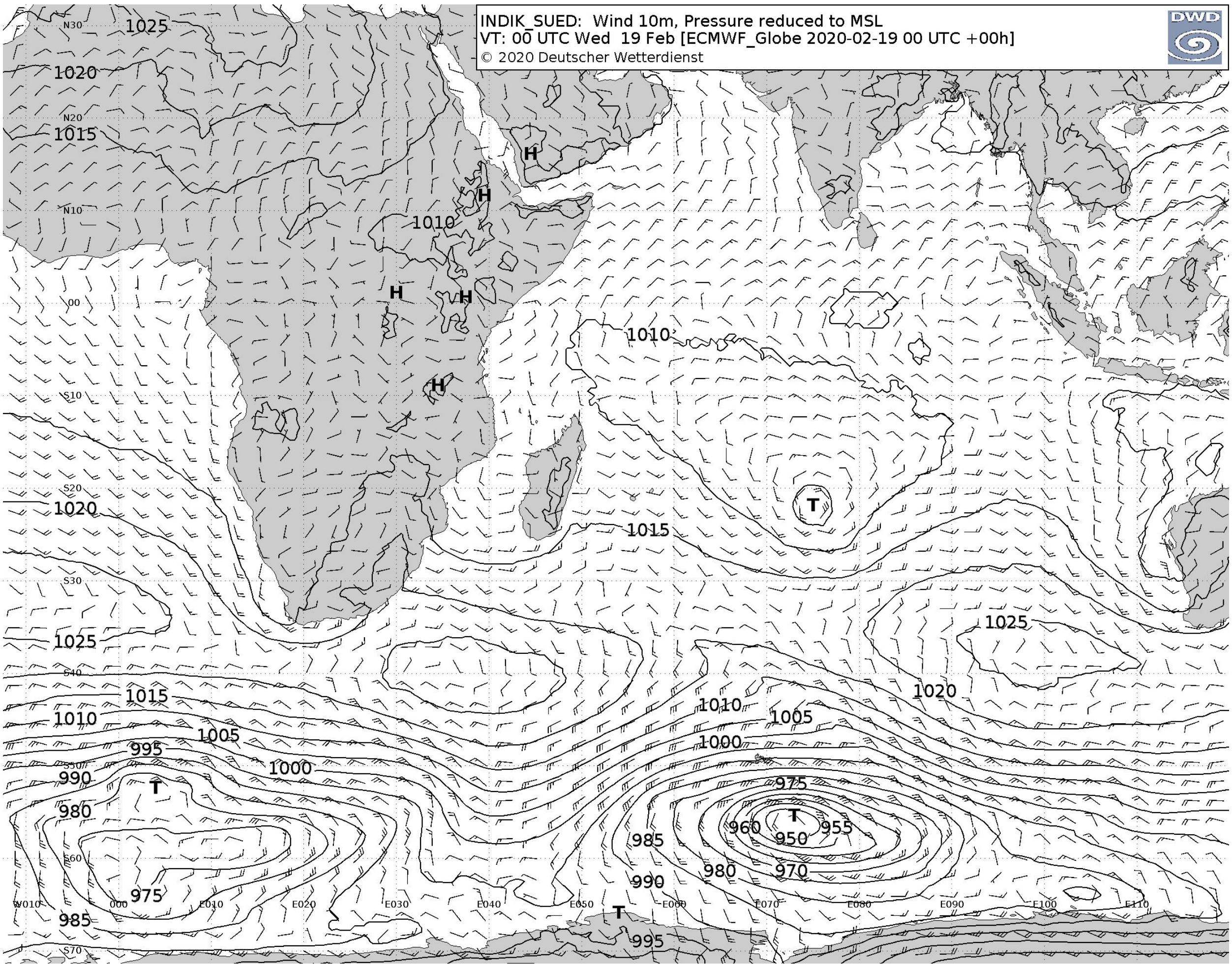


Fig. 6.2 Initial state of MSLP forecast of ECMWF forecast model (result of assimilation run), model run time Feb 19th, 2020, 0000 UTC.

Afterward, the subtropical high backed down slightly north, and south of S60 east moving low pressure systems occurred repeatedly. As a consequence, an almost stable westerly situation with mainly fresh to strong winds established, keeping dominant until mid of month. The significant wave height was in the frame of 3 to 4 meters usually. Interruptions of the situation were caused by a low passing the area close in the north on Feb 5th, causing the wind to become variable; another low passing close to the south on Feb 8th with the swell raising to about 6 meters on the rear, followed by weak low pressure activity in the very working area, letting the winds become much weaker until Feb 12th. On Feb 16th, an east swinging trough followed by low pressure development immediate south of the working area caused westerly winds in strong gale force again. Sea state increased to about 5 meters already in front of the trough.

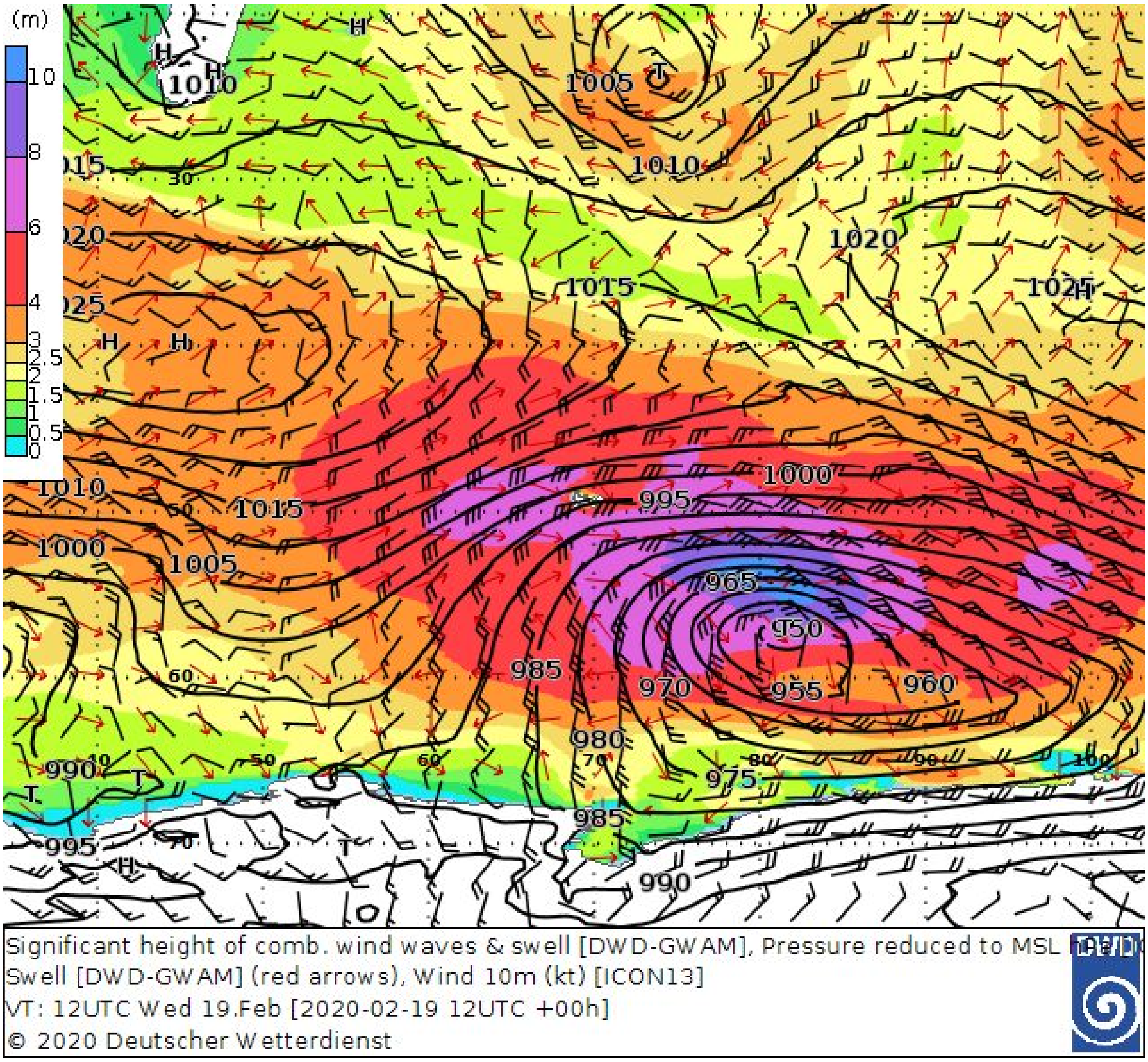


Fig. 6.3 Initial state of SWH forecast of DWD wave model (result of assimilation run), model run time Feb 19th, 2020, 1200 UTC.

Within a few hours, a beforehand harmless low southwest of the working area intensified rapidly to hurricane force, crossing the previous working area on Feb 19th (Fig. 6.2). At the location of the last core the significant wave height raised to more than 10 meters at about noon (as given by the results of the assimilation run of the DWD wave model, Fig. 6.3). As RV SONNE started to draw aside on Feb 17th already, mean wind in the sailing area hardly exceed Bft 8 to 9, however with whole gale gusts (Bft 10) on Feb 18th. Significant wave height raised to 5 to 6 meters, forcing the ship to slow down for several hours to weather the storm.

The remaining track towards Cape Town was located on the southern side of the subtropical high at first. On the rear, a northwesterly wind with near gale force (Bft 7) and gale gusts occurred for a longer time. East swinging sharp troughs caused gale or strong gale conditions on Feb 23rd, Feb 25th and Feb 27th, resp., with the SWH raising above 5 meters every time. Especially the first of these troughs caused the wind to exceed Bft 9 over several hours with violent storm gusts. Between the troughs, situation could calm down significantly at a time.

Behind the last trough the subtropical high on the Atlantic gained more influence as of Feb 27th. It expanded east into the Indian Ocean; on its front the southwesterly wind was mainly strong to near gale on Feb 27th and 28th, causing the sea to raise to 4 to 5 meters once again. As of Feb 29th, the situation became much calmer for the remaining days while passing the eastern side of the high and on the northern side towards Cape Town.

6.1 Methods

Observation data, model output and synoptic charts were available for the weather forecasts and consulting during the SO272 expedition. Most of these were specially tailored to the specific areas of transit and research.

These included, for example:

- Wind and sea state data from the DWD global model ICON/GWAM up to 174 hours forecast period in 3 hour time steps with a horizontal resolution of 0.5° for the forecast system MetMaster

- Wind and sea state data from the ECMWF global model with 120 to 240 hours forecast period in 3 to 6 hour time steps for horizontal resolutions of 0.5° and 1.5°, resp., for the forecast system MetMaster

- NINJO-Batch products from the ICON and ECMWF model for humidity, pressure and temperatures at different heights, wind and mean sea level pressure, as well as for cloud cover in three cloud levels up to 78 hours or 168 hours forecast period

- Forecast charts of wind at different heights of the global models ICON, ECMWF and GFS up to 168 hours forecast period

- Charts with comparison of the global models ICON, ECMWF and GFS up to 168 hours

- Meteograms from the ICON and ECMWF model for research area

- Synoptic weather reports and radiosonde data (TEMPS) of relevant coastal states as well as ship and buoy reports from surrounding sea areas and adjacent countries

- Satellite images of satellites „MET-8“ (IODC mission) and “MET-11” in infrared and visible spectral channels (available every 3 hours via email or every 15 minutes via sftp), prepared with Ninjo-Batch, specially prepared by the German Weather Service Hamburg WV13 for single channels and colour composites

The ship's own internet also allowed access to other relevant weather pages, such as the weather forecasts from:

- ECMWF Ensemble Meteograms

- ECMWF charts e.g. for the significant sea state

- Satellite viewer at EUMETSAT.int

- Various other weather providers if it was necessary (e.g. Weather services of South Africa, Australia, Mauritius or Meteo France / La Reunion)

Two presentations and sea weather forecast in German and English (for the ships- and expedition leadership) were prepared daily, based on these information. These contained, among other things, a detailed description of the weather situation and detailed information about wind, sea state, weather, and visibility conditions to be expected on the track during the next 3 days. Weather briefing of chief scientist took place not on a regular base but whenever decisions about further plans needed to be done. In addition, weather situation and weather development was presented and explained for the ship's command and scientific leaders every Monday and Friday morning on the bridge. Furthermore, the officer on duty was informed about current weather forecast during the morning hours, and about possible changes in the afternoon, if necessary.

The forecasts were made available to all cruise participants and crew by publishing presentations and sea weather forecasts in the scientists folder on ships server, and (as hard copy) on bulletin board. In addition, further information such as current satellite images, analysis maps and information on current typhoons was provided. Additional information and consulting was provided to all interested parties in response to enquiries about weather events.

6.2 Abbreviations

MetMaster	system for routing
ICON Model	ICOsahedral Nonhydrostatic
GWAM	Global WAve Model German Modell
ECMWF	European Centre for Medium-range Weather Forecasting
GFS	Global Forecast System Modell NOAA (National Oceanic and Atmospheric Administration US)
NINJO	meteorological work station
NINJO-BATCH	system for creation of meteorological graphics
SWH	Significant Wave Height
Bft	Beaufort

7 Station List SO272

(G. Uenzelmann-Neben[1])

[1]AWI

7.1 Overall Station List

See Appendix A

7.2 Profile Station List

See Appendix B

7.3 Sample Station List

See Appendices C and D

8 Data and Sample Storage and Availability

The seismic data collected during cruise SO272 will form the base for a PhD project. This project will comprise the processing of the seismic data as well as the interpretation of the seismic, Parasound and multi-beam data to answer the questions raised under 3.1. The geological samples form the base for a Post-Doc project.

The meta data for this cruise will be made publicly available immediately after the cruise. The raw and processed seismic data will be archived on the dedicated data server at AWI. Bathymetry and Parasound data as well as ADCP will be archived in PANGAEA.

Table 8.1 Overview of data availability

Type	Database	Available	Free Access	Contact
raw data ADCP	PANGAEA	Feb 2021	Feb 2022	gabriele.uenzelmann-neben@awi.de
multibeam	PANGAEA, BSH	Feb 2024	Feb 2025	gabriele.uenzelmann-neben@awi.de
Parasound	PANGAEA, BSH	Feb 2024	Feb 2025	gabriele.uenzelmann-neben@awi.de
seismic	AWI data archive	Feb 2024	Feb 2025	gabriele.uenzelmann-neben@awi.de
geology	PANGAEA, MARUM	Feb 2024	Feb 2025	Thomas.westerhold@marum.de

9 Acknowledgements

We like to thank Captain Oliver Meyer, his officers and crew of RV SONNE for their professional and enthusiastic engagement and service to the scientific programme of this leg. This cruise Leg SO272 and the project Kerguelen Plateau Drifts are primarily funded by the German Federal Ministry of Education and Research (BMBF) under Project Number 03G0272A/B. Additional funding has been provided by the Alfred-Wegener-Institut and MARUM as well as Macquarie University and the University of South Carolina. We gratefully acknowledge all this support.

10 References

Coffin, M.F., Munchy, M., Colwell, J.B., Schlich, R., Davies, H.L., Li, Z.-G., 1990. Seismic stratigraphy of the Raggatt Basin, southern Kerguelen Plateau: Tectonic and paleoceanographic implications. Geological Society of America Bulletin 102, 563-579.

Dezileau, L., Bareille, G., Reyss, J.L., Lemoine, F., 2000. Evidence for strong sediment redistribution by bottom currents along the southeast Indian ridge. Deep Sea Research Part I: Oceanographic Research Papers 47, 1899-1936.

Fritsch, B., Schlich, R., Munschy, M., Fezga, F., Coffin, M.F., 1992. Evolution of the Southern Kerguelen Plateau deduced from seismic stratigraphic studies and drilling at Sites 748 and 750, in: Wise Jr, S.W., Schlich, R., et al. (Eds.), Proceedings of the Ocean Drilling Program, Scientific Results. Ocean Drilling Program, pp. 895-906.

Fukamachi, Y., Rintoul, S.R., Church, J.A., Aoki, S., Sokolov, S., Rosenberg, M.A., Wakatsuchi, M., 2010. Strong export of Antarctic Bottom Water east of the Kerguelen plateau. Nature Geosci 3, 327-331.

Graham, G., Mazzullo, 1988. Handbook for shipboard sedimentologists. ODP Technical Note No. 8, 67.

Mazaud, A., Michel, E., Dewilde, F., Turon, J.L., 2010. Variations of the Antarctic Circumpolar Current intensity during the past 500 ka. Geochem. Geophys. Geosyst. 11, Q08007.

Munschy, M., Fritsch, B., Schlich, R., Fezga, F., Rotstein, Y., Coffin, M.F., 1992. Structure and Evolution of the Central Kerguelen Plateau deduced from Seismic Stratigraphic studies and drilling at Site747, in: Wise Jr, S.W., Schlich, R., et al. (Eds.), Proceedings of the Ocean Drilling Program, Scientific Results. Ocean Drilling Program, pp. 881-893.

Schlich, R., Wise Jr, S.W., 1992. The geologic and tectonic evolution of the Kerguelen Plateau: An introduction to the scientific results of Leg 120, in: Wise Jr, S.W., Schlich, R., et al. (Eds.), Proceedings of the Ocean Drilling Program, Scientific Results. Ocean Drilling Program, pp. 5-30.

Schlitzer, R., 2013. Ocean Data View. Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven.

Shipboard Scientific Party, 1989. Site 748, in: Schlich, R., Wise, S.W., et al. (Eds.), Proceedings of the Ocean Drilling Program, Initial Reports. Ocean Drilling Program, pp. 157-235.

Smith, W.H.S., Sandwell, D.T., 1997. Global Sea Floor Topography from Satellite Altimetry and Ship Depth Soundings. Science 277, 1956-1962.

Sokolov, S., Rintoul, S.R., 2009. Circumpolar structure and distribution of the Antarctic Circumpolar Current fronts: 1. Mean circumpolar paths. J. Geophys. Res. 114.

Wise, S.W., Jr., Schlich, R., et al., 1992. Proc. ODP, Sci. Results, 120: College Station, TX (Ocean Drilling Program).

Appendices

Appendix A Stationbook So272

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_1-1	2020/01/22 01:41:39	Float	station start	ARGO Float 1061	started	115.8	0.1	4657.8300	37° 30.000' S	064° 00.028' E	315.5	15.3
SO272_1-1	22/01/2020 01:46:39	Float	in the water		started	356.9	0.5	4670.7700	37° 29.995' S	064° 00.032' E	313.8	15.0
SO272_1-1	22/01/2020 01:50:14	Float	station end		started	311.9	2.7	4660.6400	37° 29.924' S	063° 59.957' E	314.8	14.7
SO272_2-1	22/01/2020 17:44:57	Float	station start	ARGO Float 1079	started	296.1	2.1	4690.7400	39° 59.770' S	064° 48.444' E	265.1	11.5
SO272_2-1	22/01/2020 17:45:52	Float	in the water		started	297.4	1.5	4694.7300	39° 59.759' S	064° 48.413' E	263.3	13.8
SO272_2-1	22/01/2020 17:50:50	Float	station end		started	269.1	5.7	4727.4800	39° 59.714' S	064° 48.078' E	272.2	10.0
SO272_3-1	23/01/2020 06:18:14	Float	station start	ARGO Float 1054	started	240.9	2.6	5343.7900	41° 59.782' S	066° 00.379' E	255.6	12.2
SO272_3-1	23/01/2020 06:19:41	Float	in the water		started	247.3	2.1	5657.7700	41° 59.802' S	066° 00.317' E	273.0	9.7
SO272_3-1	23/01/2020 06:22:06	Float	station end		started	246.3	4.7	4466.5200	41° 59.864' S	066° 00.170' E	244.8	11.4
SO272_4-1	23/01/2020 18:46:09	Float	station start	ARGO Float 1080	started	261.1	2.8	4287.8900	43° 59.634' S	067° 42.893' E	345.8	9.1
SO272_4-1	23/01/2020 18:47:35	Float	in the water		started	258.3	2.2	4293.0100	43° 59.648' S	067° 42.817' E	347.7	7.6
SO272_4-1	23/01/2020 18:49:48	Float	station end		started	263.4	3.6	4291.3700	43° 59.662' S	067° 42.687' E	343.0	8.2

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_5-1	24/01/2020 01:37:53	Float	station start	ARGO Float 8847	started	132.2	5.8	3778.6400	44° 59.898' S	068° 59.892' E	270.7	4.8
SO272_5-1	24/01/2020 01:41:27	Float	in the water		started	136.0	3.2	3754.4500	45° 00.056' S	069° 00.151' E	279.0	3.0
SO272_5-1	24/01/2020 01:43:52	Float	station end		started	144.7	4.2	3731.1100	45° 00.158' S	069° 00.285' E	284.5	4.7
SO272_6-1	26/01/2020 12:20:33	Gravity Corer	station start	GeoB 24001	started	114.4	0.3	3133.2300	53° 55.554' S	080° 00.988' E	100.0	8.8
SO272_6-1	26/01/2020 12:28:11	Gravity Corer	in the water	GC 12m	started	301.8	0.1	3135.3300	53° 55.547' S	080° 00.953' E	104.9	9.2
SO272_6-1	26/01/2020 13:27:31	Gravity Corer	max depth/on ground	Boko, maxSL: 3158m	started	112.3	0.1	3131.7000	53° 55.546' S	080° 00.957' E	103.5	11.0
SO272_6-1	26/01/2020 13:28:42	Gravity Corer	hoisting	maxSZ: 71,1kN	started	116.8	0.1	3126.7700	53° 55.546' S	080° 00.957' E	108.7	11.0
SO272_6-1	26/01/2020 14:33:29	Gravity Corer	on deck		started	94.6	0.1	3121.9900	53° 55.540' S	080° 00.957' E	105.7	12.9
SO272_6-1	26/01/2020 14:37:23	Gravity Corer	station end		started	323.6	0.1	3128.5300	53° 55.543' S	080° 00.957' E	111.0	12.9
SO272_6-2	26/01/2020 14:38:26	Multi Corer	station start	GeoB 24001	started	276.9	0.1	3134.1700	53° 55.541' S	080° 00.956' E	113.6	13.5
SO272_6-2	26/01/2020 14:44:59	Multi Corer	in the water	MUC + SVP	started	164.3	0.2	3130.8400	53° 55.551' S	080° 00.953' E	100.9	9.9
SO272_6-2	26/01/2020 16:04:30	Multi Corer	max depth/on ground	BOKO, SLmax: 3150m	started	320.6	0.1	3123.6100	53° 55.544' S	080° 00.954' E	117.6	10.1

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_6-2	26/01/2020 16:06:45	Multi Corer	hoisting	SZmax: 39,1kN	started	352.7	0.1	3131.4400	53° 55.541' S	080° 00.953' E	122.6	13.4
SO272_6-2	26/01/2020 17:47:16	Multi Corer	on deck		started	241.1	0.2	3128.2900	53° 55.555' S	080° 00.947' E	119.4	10.1
SO272_6-2	26/01/2020 17:49:20	Multi Corer	station end		started	68.7	0.1	3122.9800	53° 55.553' S	080° 00.950' E	120.0	10.7
SO272_7-1	26/01/2020 17:56:46	Float	station start	ARGO Float 8830	started	121.4	2.4	3123.9800	53° 55.627' S	080° 01.158' E	128.8	11.5
SO272_7-1	26/01/2020 17:57:47	Float	in the water		started	123.6	2.6	3116.1100	53° 55.649' S	080° 01.220' E	128.3	12.3
SO272_7-1	26/01/2020 18:00:32	Float	station end		started	125.7	6.9	3207.8500	53° 55.771' S	080° 01.494' E	121.1	12.6
SO272_8-1	26/01/2020 22:36:28	Gravity Corer	station start	GeoB 24002	started	62.8	0.4	1144.2400	53° 21.003' S	081° 02.078' E	157.9	11.5
SO272_8-1	26/01/2020 22:41:22	Gravity Corer	in the water	GC 6m	started	79.6	0.4	1147.6800	53° 20.996' S	081° 02.101' E	163.6	10.9
SO272_8-1	26/01/2020 23:05:36	Gravity Corer	max depth/on ground	SLmax: 1175m	started	339.7	0.1	1142.0700	53° 20.991' S	081° 02.127' E	161.5	10.7
SO272_8-1	26/01/2020 23:06:26	Gravity Corer	hoisting	SZmax: 29,2kN	started	307.2	0.2	1143.3600	53° 20.990' S	081° 02.123' E	168.1	10.7
SO272_8-1	26/01/2020 23:35:32	Gravity Corer	on deck		started	174.8	0.2	1141.7700	53° 20.988' S	081° 02.136' E	173.5	10.0
SO272_8-2	26/01/2020 23:38:12	Multi Corer	station start	GeoB 24002	started	167.4	0.1	1140.9700	53° 20.991' S	081° 02.132' E	167.6	10.4
SO272_8-2	26/01/2020 23:47:35	Multi Corer	in the water	MUC + SVP ohne Probennahme	started	174.5	0.1	1142.2000	53° 20.992' S	081° 02.132' E	173.9	7.7
SO272_8-2	27/01/2020 00:13:05	Multi Corer	max depth/on ground	auf Tiefe, maxSL: 1100m	started	138.1	0.2	1142.7000	53° 20.992' S	081° 02.126' E	173.0	9.1

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_8-2	27/01/2020 00:38:37	Multi Corer	on deck		started	160.8	0.1	1142.9600	53° 20.990' S	081° 02.122' E	178.6	9.6
SO272_8-2	27/01/2020 00:40:44	Multi Corer	station end		started	326.4	0.2	1143.0400	53° 20.989' S	081° 02.120' E	180.4	9.4
SO272_9-1	27/01/2020 04:42:25	Seismic Towed Receiver	station start		started	239.5	2.8	4548.1900	52° 59.270' S	082° 06.356' E	192.5	11.2
SO272_9-1	27/01/2020 04:45:03	Seismic Towed Receiver	information	Kopfboje zu Wasser	started	245.9	1.8	4545.8800	52° 59.307' S	082° 06.214' E	195.3	11.6
SO272_9-1	27/01/2020 04:53:26	Seismic Towed Receiver	information	1. Bird zu Wasser	started	244.7	2.3	4546.1700	52° 59.506' S	082° 05.706' E	189.9	16.9
SO272_9-1	27/01/2020 05:01:16	Seismic Towed Receiver	information	2. Bird zu Wasser	started	236.8	3.2	4560.7500	52° 59.681' S	082° 05.121' E	187.2	11.3
SO272_9-1	27/01/2020 05:09:24	Seismic Towed Receiver	information	3. Bird zu Wasser	started	234.7	3.1	4566.3700	52° 59.916' S	082° 04.528' E	182.9	8.5
SO272_9-1	27/01/2020 05:18:31	Seismic Towed Receiver	information	4. Bird zu Wasser	started	228.5	3.0	4559.9600	53° 00.200' S	082° 03.899' E	190.3	9.0
SO272_9-1	27/01/2020 05:27:46	Seismic Towed Receiver	information	5. Bird zu Wasser	started	232.3	3.1	4555.8800	53° 00.481' S	082° 03.271' E	201.2	10.0
SO272_9-1	27/01/2020 05:37:07	Seismic Towed Receiver	information	6. Bird zu Wasser	started	235.5	3.1	4553.8500	53° 00.755' S	082° 02.619' E	201.1	9.3
SO272_9-1	27/01/2020 05:46:38	Seismic Towed Receiver	information	7. Bird zu Wasser	started	234.9	3.4	4552.9800	53° 01.075' S	082° 01.928' E	213.5	8.7

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	27/01/2020 05:56:51	Seismic Towed Receiver	information	8. Bird zu Wasser	started	230.8	3.2	4318.6300	53° 01.407' S	082° 01.215' E	213.8	8.3
SO272_9-1	27/01/2020 06:07:22	Seismic Towed Receiver	information	9. Bird zu Wasser	started	234.6	3.7	3952.2500	53° 01.779' S	082° 00.396' E	208.7	11.4
SO272_9-1	27/01/2020 06:18:41	Seismic Towed Receiver	information	10. Bird zu Wasser	started	237.8	3.4	3775.5900	53° 02.099' S	081° 59.428' E	208.0	11.9
SO272_9-1	27/01/2020 06:29:29	Seismic Towed Receiver	information	Beginn Einbau von Modulen und einem Segment	started	241.0	3.5	3874.7200	53° 02.391' S	081° 58.524' E	212.6	11.8
SO272_9-1	27/01/2020 06:36:47	Seismic Towed Receiver	information	11. Bird zu Wasser	started	237.8	4.2	3829.6200	53° 02.634' S	081° 57.828' E	206.8	11.0
SO272_9-1	27/01/2020 06:49:26	Seismic Towed Receiver	information	12. Bird zu Wasser	started	238.6	3.8	3446.5600	53° 02.977' S	081° 56.770' E	213.1	12.9
SO272_9-1	27/01/2020 07:08:58	Seismic Towed Receiver	information	13. (letzter) Bird zu Wasser	started	248.1	4.1	3194.5000	53° 03.597' S	081° 54.942' E	215.1	11.5
SO272_9-1	27/01/2020 07:20:08	Seismic Towed Receiver	information	Streamer voll ausgesteckt	started	239.9	2.7	3110.9000	53° 03.923' S	081° 53.934' E	218.5	10.9
SO272_9-1	27/01/2020 07:28:13	Seismic Towed Receiver	information	Beginn Aussetzen Stb.Airgun-Array	started	246.8	3.3	2903.5800	53° 04.139' S	081° 53.289' E	221.7	11.0
SO272_9-1	27/01/2020 07:46:57	Seismic Towed Receiver	information	Stb.Airgun-Array ausgesteckt	started	240.7	4.3	2893.3600	53° 04.671' S	081° 51.683' E	220.1	12.0

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	27/01/2020 08:04:14	Seismic Towed Receiver	information	Airgun schießt	started	238.6	5.0	3360.6500	53° 05.320' S	081° 49.687' E	212.5	12.2
SO272_9-1	27/01/2020 08:31:43	Seismic Towed Receiver	profile start	AWI-20200001, rwK: 241°, FüG: 5kn, d: 121sm	started	236.9	4.1	3957.8200	53° 06.332' S	081° 46.617' E	203.9	15.3
SO272_9-1	28/01/2020 08:33:40	Seismic Towed Receiver	profile end		started	241.3	5.1	2362.6900	54° 03.504' S	078° 50.725' E	333.8	12.6
SO272_9-1	28/01/2020 08:46:49	Seismic Towed Receiver	information	Beginn Drehung	started	225.6	5.0	2225.1400	54° 04.046' S	078° 49.105' E	323.3	12.8
SO272_9-1	28/01/2020 09:25:16	Seismic Towed Receiver	information	Airguns full power	started	276.2	5.1	2113.8500	54° 06.225' S	078° 45.535' E	317.2	12.8
SO272_9-1	28/01/2020 10:21:27	Seismic Towed Receiver	profile start	AWI-20200002, rwK: 081°, FüG: 5kn, d: 161sm	started	82.2	5.1	2217.8000	54° 04.127' S	078° 48.788' E	309.5	10.2
SO272_9-1	29/01/2020 18:38:42	Seismic Towed Receiver	profile end	1nm weiter fahren, dann Beginn Drehung	started	80.0	5.2	4656.1400	53° 38.480' S	083° 17.935' E	301.9	10.3
SO272_9-1	29/01/2020 18:49:05	Seismic Towed Receiver	information	Beginn Drehung	started	81.1	5.2	4666.1500	53° 38.343' S	083° 19.371' E	286.2	13.9
SO272_9-1	29/01/2020 19:22:44	Seismic Towed Receiver	information	mini start up um 30 Min. verschoben, da Wal gehört wurde	started	317.5	4.9	4699.4600	53° 37.024' S	083° 21.899' E	281.4	13.9

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	29/01/2020 19:49:01	Seismic Towed Receiver	information	full ramp up gestartet	started	212.9	4.8	4673.9800	53° 37.578' S	083° 18.938' E	302.4	12.3
SO272_9-1	29/01/2020 19:51:16	Seismic Towed Receiver	profile start	AWI-20200003, rwK: 213°, d: 1nm, FüG 5kn	started	213.8	4.8	4907.5900	53° 37.729' S	083° 18.782' E	302.6	13.2
SO272_9-1	29/01/2020 20:02:52	Seismic Towed Receiver	alter course	rwK: 238°, d: 156sm, FüG: 5kn	started	229.5	4.6	4551.5600	53° 38.503' S	083° 17.866' E	293.9	15.1
SO272_9-1	29/01/2020 20:20:09	Seismic Towed Receiver	information	Airguns full power	started	237.6	4.9	4631.3900	53° 39.270' S	083° 15.859' E	296.4	13.3
SO272_9-1	31/01/2020 03:32:56	Seismic Towed Receiver	profile end		started	237.0	4.9	2371.0300	55° 02.818' S	079° 30.753' E	10.0	14.1
SO272_9-1	31/01/2020 03:44:58	Seismic Towed Receiver	on deck	Airguns an Deck	started	238.4	3.9	2347.1800	55° 03.232' S	079° 29.656' E	8.2	13.9
SO272_9-1	31/01/2020 04:25:33	Seismic Towed Receiver	information	Beginn Drehung	started	239.4	5.0	2329.4200	55° 04.994' S	079° 24.783' E	12.5	14.5
SO272_9-1	31/01/2020 06:19:19	Seismic Towed Receiver	information	Beginn Aussetzen der Airgun-Array	started	353.3	3.2	2363.8600	55° 04.647' S	079° 32.352' E	14.0	13.7
SO272_9-1	31/01/2020 06:25:04	Seismic Towed Receiver	information	Airgun-Array zu Wasser	started	1.8	3.5	2355.6800	55° 04.370' S	079° 32.325' E	22.8	14.3
SO272_9-1	31/01/2020 06:37:52	Seismic Towed Receiver	profile start	AWI-20200004	started	358.3	4.9	2371.2800	55° 03.329' S	079° 32.290' E	15.2	16.4

Station	**Date / Time UTC**	**Device**	**Action**	**Comment (Action)**	**Expedition Status**	**Course**	**Speed (kn)**	**Depth (m)**	**Latitude**	**Longitude**	**Wind Dir**	**Wind Speed (m/s)**
SO272_9-1	31/01/2020 06:43:36	Seismic Towed Receiver	information	Beginn Softstart	started	358.5	4.9	2383.1300	55° 02.860' S	079° 32.267' E	10.9	15.5
SO272_9-1	31/01/2020 07:14:39	Seismic Towed Receiver	information	Airguns full power	started	1.2	5.1	2481.0800	55° 00.386' S	079° 32.084' E	7.1	15.6
SO272_9-1	31/01/2020 12:33:09	Seismic Towed Receiver	information	Airguns auf Low Power	started	354.5	5.7	3739.7200	54° 35.098' S	079° 30.282' E	318.2	12.7
SO272_9-1	31/01/2020 13:07:17	Seismic Towed Receiver	information	Airguns auf Full Power	started	358.5	5.5	3843.8900	54° 32.262' S	079° 30.084' E	326.6	13.3
SO272_9-1	31/01/2020 21:26:57	Seismic Towed Receiver	profile end		started	356.4	5.5	3821.5600	53° 50.166' S	079° 27.158' E	280.3	10.1
SO272_9-1	31/01/2020 21:39:05	Seismic Towed Receiver	information	Beginn Drehung, Airguns auf low power	started	357.7	5.1	3833.2900	53° 49.144' S	079° 27.084' E	274.4	8.7
SO272_9-1	31/01/2020 22:20:11	Seismic Towed Receiver	information	Airguns auf full power	started	183.9	5.1	3880.1500	53° 48.758' S	079° 23.592' E	293.1	10.4
SO272_9-1	31/01/2020 22:40:01	Seismic Towed Receiver	profile start	AWI-20200005, rwK: 105°, FüG: 5kn	started	104.7	5.0	3829.9200	53° 49.841' S	079° 25.337' E	302.2	6.2
SO272_9-1	01/02/2020 03:04:04	Seismic Towed Receiver	alter course	rwk: 110°, d: 130sm	started	110.4	5.1	3133.9200	53° 55.557' S	080° 01.040' E	276.8	7.9
SO272_9-1	01/02/2020 07:04:28	Seismic Towed Receiver	information	Airguns auf Low Power	started	108.1	5.0	3769.9500	54° 02.345' S	080° 32.908' E	274.6	4.0

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	01/02/2020 08:04:24	Seismic Towed Receiver	information	Airguns auf Full Power	started	111.1	4.8	3745.6100	54° 04.039' S	080° 40.867' E	250.8	5.6
SO272_9-1	02/02/2020 05:08:25	Seismic Towed Receiver	profile end	AWI-20200005 Ende	started	111.7	5.4	4729.2900	54° 39.764' S	083° 30.279' E	261.5	10.8
SO272_9-1	02/02/2020 05:17:36	Seismic Towed Receiver	information	Beginn Drehung	started	109.7	5.0	4735.9800	54° 40.029' S	083° 31.527' E	276.2	7.0
SO272_9-1	02/02/2020 05:22:20	Seismic Towed Receiver	information	Airguns schießen nur noch mit einer Kanone	started	128.8	5.0	4738.3900	54° 40.219' S	083° 32.123' E	280.2	13.7
SO272_9-1	02/02/2020 05:50:42	Seismic Towed Receiver	information	Beginn Soft-Start	started	24.8	4.8	4740.4200	54° 40.127' S	083° 35.293' E	263.6	12.0
SO272_9-1	02/02/2020 06:00:29	Seismic Towed Receiver	information	Airguns Full Power	started	339.7	4.9	4738.0300	54° 39.391' S	083° 35.376' E	272.8	12.1
SO272_9-1	02/02/2020 06:29:29	Seismic Towed Receiver	profile start	AWI-20200006 Start, rwK: 242°, d: 139nm, FüG 5kn	started	243.2	5.4	4733.3200	54° 39.271' S	083° 31.769' E	277.9	12.0
SO272_9-1	03/02/2020 10:16:40	Seismic Towed Receiver	profile end		started	249.7	5.1	3180.2000	55° 43.995' S	079° 57.664' E	329.6	12.6
SO272_9-1	03/02/2020 10:29:09	Seismic Towed Receiver	information	Beginn Drehung	started	232.1	4.9	3215.7500	55° 44.489' S	079° 56.084' E	319.5	15.5
SO272_9-1	03/02/2020 10:31:41	Seismic Towed Receiver	information	Airguns aus	started	231.8	5.3	3236.0000	55° 44.612' S	079° 55.790' E	328.3	12.8

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	03/02/2020 10:40:10	Seismic Towed Receiver	information	Beginn Bergung Airguns	started	266.8	4.8	3213.4000	55° 44.875' S	079° 54.659' E	323.8	10.2
SO272_9-1	03/02/2020 10:49:57	Seismic Towed Receiver	on deck	Airguns zur Wartung an Deck	started	303.9	3.0	3200.7700	55° 44.731' S	079° 53.668' E	319.1	10.4
SO272_9-1	03/02/2020 12:03:53	Seismic Towed Receiver	information	Airguns zu Wasser	started	150.8	2.6	3042.2000	55° 44.845' S	079° 47.155' E	296.5	11.9
SO272_9-1	03/02/2020 12:13:55	Seismic Towed Receiver	information	Beg. Soft-Start	started	91.4	4.8	3030.1800	55° 45.072' S	079° 48.374' E	299.0	11.2
SO272_9-1	03/02/2020 12:46:00	Seismic Towed Receiver	information	Airguns auf Full Power	started	79.4	4.9	3182.0300	55° 44.523' S	079° 52.939' E	296.3	8.1
SO272_9-1	03/02/2020 12:46:18	Seismic Towed Receiver	profile start	AWI-202000007, rwk: 078°, d: 125sm	started	77.9	5.1	3187.3300	55° 44.518' S	079° 52.983' E	303.8	8.9
SO272_9-1	04/02/2020 04:14:06	Seismic Towed Receiver	information	Beginn Soft-Start	started	78.4	5.0	4660.3800	55° 30.180' S	082° 07.002' E	291.3	10.5
SO272_9-1	04/02/2020 04:20:25	Seismic Towed Receiver	information	Airguns wieder off, wegen Wal-Sichtung	started	80.0	4.9	4662.9200	55° 30.078' S	082° 07.913' E	292.4	9.1
SO272_9-1	04/02/2020 05:58:27	Seismic Towed Receiver	information	Beginn Soft-Start	started	79.8	4.8	4959.8400	55° 28.572' S	082° 22.012' E	286.4	9.5
SO272_9-1	04/02/2020 06:26:59	Seismic Towed Receiver	information	Airguns auf Full-Power	started	76.2	5.1	4747.4800	55° 28.135' S	082° 26.097' E	277.3	8.8

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	04/02/2020 13:54:32	Seismic Towed Receiver	profile end		started	81.1	4.9	4771.2200	55° 21.220' S	083° 30.416' E	295.3	9.6
SO272_9-1	04/02/2020 14:05:06	Seismic Towed Receiver	information	Beg. Drehung, Airguns auf Low Power	started	78.2	5.0	4753.7000	55° 21.045' S	083° 31.924' E	293.4	11.8
SO272_9-1	04/02/2020 14:38:25	Seismic Towed Receiver	information	Airguns auf Full Power	started	282.6	4.5	4744.8400	55° 19.067' S	083° 32.020' E	291.0	11.6
SO272_9-1	04/02/2020 14:47:22	Seismic Towed Receiver	profile start	AWI-202000008, rwk: 237°, d: 180sm	started	236.3	4.9	4740.3400	55° 19.165' S	083° 30.763' E	306.6	11.7
SO272_9-1	05/02/2020 00:51:09	Seismic Towed Receiver	information	Airguns aus, Walsichtung	started	238.3	5.1	4923.1200	55° 46.261' S	082° 16.264' E	306.0	10.7
SO272_9-1	05/02/2020 01:13:22	Seismic Towed Receiver	information	Beg. soft start	started	238.0	5.0	4676.7800	55° 47.249' S	082° 13.501' E	293.3	9.4
SO272_9-1	05/02/2020 01:34:10	Seismic Towed Receiver	information	Airguns auf Full Power	started	236.9	4.7	4673.2400	55° 48.176' S	082° 10.931' E	316.2	10.2
SO272_9-1	06/02/2020 03:02:53	Seismic Towed Receiver	profile end		started	217.5	4.3	1754.5200	56° 56.546' S	078° 58.088' E	198.6	9.4
SO272_9-1	06/02/2020 03:15:42	Seismic Towed Receiver	information	Airguns an Deck	started	214.6	4.3	1755.4300	56° 57.172' S	078° 57.312' E	209.5	9.7

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	06/02/2020 05:19:00	Seismic Towed Receiver	profile start	rwK: 072°, d: 160nm, FüG: 5,0kn, Airguns noch an Deck wegen Reparatur	started	85.9	4.1	1754.7500	56° 56.200' S	078° 57.901' E	204.0	12.9
SO272_9-1	06/02/2020 05:53:49	Seismic Towed Receiver	information	Beginn aussetzen Airgun-Array	started	70.6	4.2	1775.9000	56° 55.509' S	079° 01.955' E	206.1	13.5
SO272_9-1	06/02/2020 06:00:33	Seismic Towed Receiver	information	Airgun-Array zu Wasser uns ausgesteckt	started	73.8	3.7	1773.7700	56° 55.375' S	079° 02.736' E	218.9	12.9
SO272_9-1	06/02/2020 06:12:22	Seismic Towed Receiver	information	Beginn Soft-Start	started	71.9	5.1	1769.4600	56° 55.070' S	079° 04.326' E	216.9	13.9
SO272_9-1	06/02/2020 06:41:06	Seismic Towed Receiver	information	Airguns auf Full-Power	started	72.9	4.9	1765.8600	56° 54.331' S	079° 08.486' E	213.3	13.1
SO272_9-1	07/02/2020 13:36:40	Seismic Towed Receiver	profile end		started	83.2	4.9	4610.5400	56° 06.390' S	083° 33.681' E	324.6	5.9
SO272_9-1	07/02/2020 13:48:42	Seismic Towed Receiver	alter course	Beg. Drehung über Bb, Airguns auf Low Power	started	88.2	5.1	4356.3800	56° 06.375' S	083° 35.443' E	296.7	5.3
SO272_9-1	07/02/2020 14:15:30	Seismic Towed Receiver	information	Airguns auf Full Power	started	325.8	4.6	4261.7400	56° 04.792' S	083° 36.900' E	299.7	7.6

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	07/02/2020 14:53:22	Seismic Towed Receiver	profile start	Beg. Profil AWI-202000010, rwk: 220°, d: 118sm	started	212.7	5.0	4371.9000	56° 05.899' S	083° 32.980' E	324.3	12.0
SO272_9-1	08/02/2020 14:27:52	Seismic Towed Receiver	alter course	rwk: 234°, d: 88sm	started	229.5	5.2	2024.0600	57° 35.509' S	081° 14.398' E	167.3	17.0
SO272_9-1	09/02/2020 00:00:08	Seismic Towed Receiver	information	Airguns aus, Walsichtung	started	236.4	5.1	1667.0300	58° 03.100' S	080° 01.953' E	205.7	8.0
SO272_9-1	09/02/2020 01:11:16	Seismic Towed Receiver	information	Airguns auf Full Power	started	230.5	5.0	1669.0800	58° 06.527' S	079° 52.883' E	180.4	6.8
SO272_9-1	09/02/2020 08:06:31	Seismic Towed Receiver	profile end		started	227.1	4.9	1294.9600	58° 26.469' S	078° 59.873' E	281.7	8.5
SO272_9-1	09/02/2020 08:18:41	Seismic Towed Receiver	information	Beginn Drehung	started	246.3	5.1	1275.7500	58° 27.122' S	078° 58.413' E	262.6	9.4
SO272_9-1	09/02/2020 08:22:21	Seismic Towed Receiver	information	Airgun auf low power	started	260.6	4.8	1269.3400	58° 27.206' S	078° 57.859' E	256.1	7.2
SO272_9-1	09/02/2020 08:49:25	Seismic Towed Receiver	information	Airguns soft start	started	217.7	5.0	1253.8300	58° 27.809' S	078° 53.779' E	278.3	10.1
SO272_9-1	09/02/2020 08:59:13	Seismic Towed Receiver	information	Airguns auf full power	started	170.5	5.1	1251.4200	58° 28.586' S	078° 53.401' E	281.2	10.1
SO272_9-1	09/02/2020 09:51:08	Seismic Towed Receiver	profile start	Profil AWI-202000011, rwk: 031°, d: 51sm	started	32.9	5.1	1273.3600	58° 27.335' S	078° 58.879' E	260.3	8.9

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	09/02/2020 13:53:44	Seismic Towed Receiver	information	Walsichtung, Airguns auf Low Power	started	32.2	5.0	1576.9200	58° 10.108' S	079° 18.674' E	237.3	5.0
SO272_9-1	09/02/2020 14:20:41	Seismic Towed Receiver	information	Airguns auf Full Power	started	28.9	5.0	1621.7600	58° 08.195' S	079° 20.878' E	286.7	4.5
SO272_9-1	09/02/2020 20:06:25	Seismic Towed Receiver	alter course	rwK: 043°, d: 72sm	started	35.8	5.1	1631.7800	57° 43.590' S	079° 48.859' E	314.4	4.8
SO272_9-1	09/02/2020 23:35:36	Seismic Towed Receiver	information	Walsichtung, Airguns auf Low Power	started	44.7	4.9	1753.1300	57° 30.895' S	080° 10.962' E	8.6	5.1
SO272_9-1	10/02/2020 00:17:12	Seismic Towed Receiver	information	Airguns auf Full Power	started	45.3	5.0	1826.6100	57° 28.366' S	080° 15.346' E	18.5	6.5
SO272_9-1	10/02/2020 10:12:02	Seismic Towed Receiver	profile end		started	43.8	5.0	4342.1100	56° 52.209' S	081° 17.568' E	263.1	5.9
SO272_9-1	10/02/2020 10:23:14	Seismic Towed Receiver	information	Beginn Drehung	started	64.3	5.1	4372.5500	56° 51.568' S	081° 18.800' E	268.5	4.2
SO272_9-1	10/02/2020 10:25:56	Seismic Towed Receiver	information	Airguns auf low power	started	75.8	5.0	4377.5000	56° 51.491' S	081° 19.187' E	287.2	6.9
SO272_9-1	10/02/2020 11:01:43	Seismic Towed Receiver	information	Airguns auf full power	started	294.3	5.1	4404.7300	56° 49.559' S	081° 20.211' E	265.1	6.6
SO272_9-1	10/02/2020 11:36:06	Seismic Towed Receiver	profile start	Profil AWI-202000012, rwk: 181°, d: 46sm	started	177.8	4.9	4345.5100	56° 51.253' S	081° 17.532' E	288.0	6.6

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	10/02/2020 20:43:57	Seismic Towed Receiver	profile end		started	180.7	5.0	2029.6600	57° 36.798' S	081° 16.643' E	285.9	7.7
SO272_9-1	10/02/2020 20:56:32	Seismic Towed Receiver	information	Beginn Drehung	started	200.7	5.0	2007.4100	57° 37.842' S	081° 16.522' E	300.1	9.3
SO272_9-1	10/02/2020 20:56:53	Seismic Towed Receiver	information	Airguns auf low power	started	206.7	5.0	2009.6300	57° 37.869' S	081° 16.503' E	289.3	10.4
SO272_9-1	10/02/2020 21:37:46	Seismic Towed Receiver	information	Airguns auf full power	started	60.0	5.0	1986.1200	57° 39.649' S	081° 18.685' E	272.6	6.5
SO272_9-1	10/02/2020 22:08:48	Seismic Towed Receiver	profile start	Profil AWI-202000013, rwk: 317°, d: 3sm	started	315.0	4.9	2028.2700	57° 37.545' S	081° 17.938' E	254.5	5.8
SO272_9-1	10/02/2020 22:42:27	Seismic Towed Receiver	alter course	rwK: 317°, d: 75sm	started	320.9	5.0	2022.6800	57° 35.518' S	081° 14.391' E	246.2	7.1
SO272_9-1	11/02/2020 14:11:28	Seismic Towed Receiver	profile end		started	298.2	4.8	1978.1600	56° 38.911' S	079° 37.933' E	242.1	13.5
SO272_9-1	11/02/2020 14:12:56	Seismic Towed Receiver	alter course	Beg. Drehung, Airguns auf Low Power	started	293.2	4.6	1976.1800	56° 38.859' S	079° 37.745' E	243.3	13.7
SO272_9-1	11/02/2020 15:32:03	Seismic Towed Receiver	profile start	AWI-202000014, rwk: 175°, d: 65sm	started	182.9	5.5	1969.1200	56° 39.277' S	079° 39.269' E	257.3	11.3
SO272_9-1	11/02/2020 15:53:31	Seismic Towed Receiver	information	Airguns auf Full-Power	started	178.3	5.1	1945.0800	56° 41.085' S	079° 39.482' E	259.5	12.7

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	12/02/2020 09:42:19	Seismic Towed Receiver	profile end		started	175.5	5.0	1678.4000	58° 09.572' S	079° 52.776' E	319.0	7.0
SO272_9-1	12/02/2020 09:54:17	Seismic Towed Receiver	information	Beginn Drehung	started	189.1	5.0	1683.7800	58° 10.556' S	079° 52.860' E	313.7	6.0
SO272_9-1	12/02/2020 09:55:07	Seismic Towed Receiver	information	Airguns auf low power	started	197.8	5.0	1700.3900	58° 10.623' S	079° 52.832' E	308.0	7.2
SO272_9-1	12/02/2020 10:34:31	Seismic Towed Receiver	information	Airguns auf full power	started	66.1	4.9	1681.7800	58° 12.526' S	079° 54.875' E	312.3	7.5
SO272_9-1	12/02/2020 11:14:21	Seismic Towed Receiver	profile start	AWI-202000015, rwk: 342°, d: 86sm	started	333.5	5.2	1681.7500	58° 10.185' S	079° 53.246' E	324.1	7.5
SO272_9-1	12/02/2020 13:41:25	Seismic Towed Receiver	information	wal gesichtet; airguns shut off	started	340.9	4.9	1647.0600	57° 58.618' S	079° 45.914' E	349.7	9.0
SO272_9-1	12/02/2020 14:30:46	Seismic Towed Receiver	information	Beg. Soft Start	started	339.7	5.1	1635.8800	57° 54.742' S	079° 43.478' E	348.4	9.3
SO272_9-1	12/02/2020 15:01:00	Seismic Towed Receiver	information	Airguns auf Full Power	started	339.7	5.2	1639.4100	57° 52.341' S	079° 41.982' E	350.8	9.0
SO272_9-1	13/02/2020 04:02:20	Seismic Towed Receiver	profile end		started	339.4	4.9	1767.2100	56° 50.618' S	079° 03.985' E	256.9	15.9
SO272_9-1	13/02/2020 04:09:32	Seismic Towed Receiver	alter course	Airguns auf Low Power	started	344.5	4.8	1769.9100	56° 50.053' S	079° 03.666' E	259.1	16.1

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	13/02/2020 04:43:54	Seismic Towed Receiver	information	Beginn Soft-Start	started	301.8	4.0	1781.6900	56° 47.510' S	079° 03.615' E	259.0	12.5
SO272_9-1	13/02/2020 04:54:10	Seismic Towed Receiver	information	Airguns auf Full-Power	started	258.3	4.7	1779.1100	56° 47.375' S	079° 02.136' E	253.0	10.5
SO272_9-1	13/02/2020 05:33:23	Seismic Towed Receiver	profile start	rwK: 136°, d: 83nm, FüG: 5,0kn	started	136.1	5.1	1770.8600	56° 49.886' S	079° 02.710' E	275.2	13.2
SO272_9-1	13/02/2020 22:09:23	Seismic Towed Receiver	profile end		started	135.6	5.0	1746.9000	57° 49.781' S	080° 48.407' E	226.7	8.6
SO272_9-1	13/02/2020 22:28:01	Seismic Towed Receiver	information	Beginn Bergung Airguns	started	135.5	4.1	1743.9100	57° 50.839' S	080° 50.353' E	204.0	7.1
SO272_9-1	13/02/2020 22:36:55	Seismic Towed Receiver	on deck	Airguns	started	135.8	4.4	1752.0600	57° 51.291' S	080° 51.160' E	218.4	5.7
SO272_9-1	13/02/2020 22:38:55	Seismic Towed Receiver	information	Beginn Bergung Streamer	started	136.1	4.1	1747.1400	57° 51.393' S	080° 51.345' E	214.9	5.8
SO272_9-1	13/02/2020 22:45:08	Seismic Towed Receiver	on deck	1. Bird an Deck	started	121.0	3.4	1747.5600	57° 51.622' S	080° 51.897' E	208.6	5.6
SO272_9-1	13/02/2020 22:50:44	Seismic Towed Receiver	on deck	2. Bird an Deck	started	126.7	3.7	1746.4800	57° 51.782' S	080° 52.430' E	220.7	5.1
SO272_9-1	13/02/2020 22:54:50	Seismic Towed Receiver	on deck	3. Bird an Deck	started	133.7	3.6	1756.0600	57° 51.941' S	080° 52.768' E	212.6	6.1
SO272_9-1	13/02/2020 23:00:21	Seismic Towed Receiver	on deck	4. Bird an Deck	started	123.6	4.0	1750.0400	57° 52.163' S	080° 53.294' E	211.3	5.4

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_9-1	13/02/2020 23:09:10	Seismic Towed Receiver	on deck	5. Bird an Deck	started	117.6	3.8	1754.7800	57° 52.455' S	080° 54.203' E	227.7	8.2
SO272_9-1	13/02/2020 23:18:18	Seismic Towed Receiver	on deck	6. Bird an Deck	started	115.9	3.6	1751.7100	57° 52.700' S	080° 55.139' E	223.5	9.2
SO272_9-1	13/02/2020 23:27:51	Seismic Towed Receiver	on deck	7. Bird an Deck	started	114.7	3.8	1755.8400	57° 52.959' S	080° 56.164' E	233.7	8.0
SO272_9-1	13/02/2020 23:38:50	Seismic Towed Receiver	on deck	8. Bird an Deck	started	114.9	3.6	1758.9900	57° 53.233' S	080° 57.347' E	227.2	9.1
SO272_9-1	13/02/2020 23:49:02	Seismic Towed Receiver	on deck	9. Bird an Deck	started	113.1	3.8	1761.4800	57° 53.478' S	080° 58.444' E	230.7	8.9
SO272_9-1	14/02/2020 00:00:12	Seismic Towed Receiver	on deck	10. Bird an Deck	started	110.4	3.7	1771.3000	57° 53.727' S	080° 59.646' E	223.4	9.0
SO272_9-1	14/02/2020 00:09:30	Seismic Towed Receiver	on deck	11. Bird an Deck	started	110.2	3.7	1768.2300	57° 53.932' S	081° 00.645' E	232.0	10.1
SO272_9-1	14/02/2020 00:19:34	Seismic Towed Receiver	on deck	12. Bird an Deck	started	111.4	3.8	1770.6700	57° 54.141' S	081° 01.740' E	239.0	11.4
SO272_9-1	14/02/2020 00:32:23	Seismic Towed Receiver	on deck	14. Bird an Deck	started	102.2	3.6	1774.1500	57° 54.366' S	081° 03.137' E	240.3	12.1
SO272_9-1	14/02/2020 00:40:23	Seismic Towed Receiver	on deck	Endboye an Deck	started	103.3	3.8	1771.3300	57° 54.478' S	081° 04.046' E	235.9	11.2
SO272_9-1	14/02/2020 00:43:55	Seismic Towed Receiver	station end		started	83.2	5.3	1776.8600	57° 54.508' S	081° 04.536' E	224.3	10.4

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_10-1	14/02/2020 04:14:52	Gravity Corer	station start	GeoB24003, GC-12m	started	142.5	0.3	1902.9300	57° 25.347' S	080° 20.584' E	232.6	9.3
SO272_10-1	14/02/2020 04:21:37	Gravity Corer	in the water	FW2/SPW2	started	232.6	0.2	1907.0900	57° 25.353' S	080° 20.574' E	242.3	10.5
SO272_10-1	14/02/2020 04:58:54	Gravity Corer	max depth/on ground	Boko, SLmax: 1924m	started	18.6	0.1	1946.1100	57° 25.348' S	080° 20.568' E	244.5	10.4
SO272_10-1	14/02/2020 04:59:38	Gravity Corer	hoisting	Beginn hieven, SZmax: 45,4kN	started	138.1	0.4	1945.5000	57° 25.349' S	080° 20.571' E	248.7	11.4
SO272_10-1	14/02/2020 05:43:06	Gravity Corer	on deck		started	48.7	0.3	1946.4700	57° 25.352' S	080° 20.574' E	241.5	12.0
SO272_10-1	14/02/2020 05:44:47	Gravity Corer	station end		started	359.8	0.1	1945.9500	57° 25.352' S	080° 20.569' E	232.7	11.3
SO272_10-2	14/02/2020 05:49:09	Multi Corer	station start	MUC + SVP	started	342.7	0.2	1945.5400	57° 25.345' S	080° 20.571' E	236.3	12.1
SO272_10-2	14/02/2020 05:50:46	Multi Corer	in the water	FW2/SPW2	started	201.0	0.1	1903.9600	57° 25.343' S	080° 20.572' E	239.1	12.1
SO272_10-2	14/02/2020 06:36:53	Multi Corer	max depth/on ground	BOKO, SLmax: 1920m	started	59.8	0.1	1904.5300	57° 25.354' S	080° 20.580' E	234.4	11.7
SO272_10-2	14/02/2020 06:39:05	Multi Corer	hoisting	Beginn hieven, SZmax: 26,7kN	started	267.3	0.1	1903.6500	57° 25.353' S	080° 20.582' E	238.6	11.4
SO272_10-2	14/02/2020 07:44:04	Multi Corer	on deck		started	248.5	0.1	1902.9400	57° 25.355' S	080° 20.573' E	242.2	10.1
SO272_10-2	14/02/2020 07:45:28	Multi Corer	station end		started	95.1	0.2	1903.7100	57° 25.356' S	080° 20.576' E	247.3	12.7

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_11-1	14/02/2020 09:15:27	Gravity Corer	station start	GeoB24004, GC-6m	started	41.5	0.3	2037.0900	57° 14.274' S	080° 39.669' E	232.7	11.0
SO272_11-1	14/02/2020 09:22:52	Gravity Corer	in the water		started	251.9	0.3	2034.2300	57° 14.303' S	080° 39.642' E	241.9	10.5
SO272_11-1	14/02/2020 09:59:41	Gravity Corer	max depth/on ground	SLmax: 2080m	started	277.1	0.2	2032.8100	57° 14.333' S	080° 39.604' E	255.7	10.2
SO272_11-1	14/02/2020 10:01:50	Gravity Corer	hoisting	SZmax: 44,3kN	started	352.6	0.2	2035.0400	57° 14.331' S	080° 39.605' E	248.3	9.7
SO272_11-1	14/02/2020 10:46:10	Gravity Corer	on deck		started	5.2	0.2	2079.4700	57° 14.318' S	080° 39.604' E	226.4	13.0
SO272_11-1	14/02/2020 10:46:41	Gravity Corer	station end		started	32.4	0.2	2079.4000	57° 14.318' S	080° 39.602' E	224.7	12.9
SO272_11-2	14/02/2020 10:48:31	Multi Corer	station start	GeoB24004, MUC+SVP	started	201.7	0.2	2078.8600	57° 14.320' S	080° 39.599' E	236.0	14.2
SO272_11-2	14/02/2020 10:52:36	Multi Corer	in the water		started	175.3	0.0	2078.4000	57° 14.319' S	080° 39.607' E	233.5	13.2
SO272_11-2	14/02/2020 11:41:10	Multi Corer	max depth/on ground	SLmax: 2056m	started	25.5	0.1	2034.7800	57° 14.329' S	080° 39.606' E	229.6	13.0
SO272_11-2	14/02/2020 11:42:52	Multi Corer	hoisting	SZmax: 35,3kN	started	357.3	0.2	2032.5200	57° 14.328' S	080° 39.599' E	233.3	12.3
SO272_11-2	14/02/2020 12:48:34	Multi Corer	on deck		started	17.7	0.2	2031.8500	57° 14.321' S	080° 39.608' E	233.1	11.9
SO272_11-2	14/02/2020 12:50:20	Multi Corer	station end		started	180.3	0.1	2032.3600	57° 14.322' S	080° 39.606' E	239.0	13.6
SO272_12-1	14/02/2020 13:22:46	Gravity Corer	station start	GeoB24005	started	245.9	0.5	2155.9700	57° 11.895' S	080° 43.864' E	235.7	12.7
SO272_12-1	14/02/2020 13:26:25	Gravity Corer	in the water	GC 6m	started	359.3	0.3	2152.5900	57° 11.889' S	080° 43.861' E	231.3	13.1

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_12-1	14/02/2020 14:06:44	Gravity Corer	max depth/on ground	Boko, maxSL: 2188m	started	31.6	0.1	2152.9000	57° 11.870' S	080° 43.847' E	239.3	16.5
SO272_12-1	14/02/2020 14:07:39	Gravity Corer	hoisting	Beg. hieven, maxSZ: 50,9kN	started	27.7	0.2	2153.1200	57° 11.869' S	080° 43.852' E	231.4	15.1
SO272_12-1	14/02/2020 14:54:46	Gravity Corer	on deck		started	217.2	0.1	2153.4200	57° 11.874' S	080° 43.846' E	243.8	16.8
SO272_12-1	14/02/2020 14:57:47	Gravity Corer	station end		started	93.6	0.3	2153.7100	57° 11.875' S	080° 43.861' E	229.3	12.3
SO272_13-1	14/02/2020 15:35:10	Gravity Corer	station start	GeoB24006	started	285.1	0.3	2394.6300	57° 08.678' S	080° 49.444' E	238.1	13.6
SO272_13-1	14/02/2020 15:41:20	Gravity Corer	in the water	GC 6m	started	1.2	0.3	2397.7500	57° 08.659' S	080° 49.438' E	238.1	13.9
SO272_13-1	14/02/2020 16:25:45	Gravity Corer	max depth/on ground	BOKO, SLmax: 2428m	started	232.7	0.1	2396.0600	57° 08.640' S	080° 49.417' E	247.8	12.9
SO272_13-1	14/02/2020 16:26:16	Gravity Corer	hoisting	SZmax: 56,3kN	started	271.6	0.3	2394.2900	57° 08.640' S	080° 49.414' E	245.5	13.8
SO272_13-1	14/02/2020 17:21:55	Gravity Corer	on deck		started	282.7	0.2	2395.1000	57° 08.634' S	080° 49.419' E	225.4	16.8
SO272_13-1	14/02/2020 17:23:22	Gravity Corer	station end		started	191.8	0.3	2396.8600	57° 08.636' S	080° 49.421' E	237.3	14.6
SO272_14-1	14/02/2020 19:34:35	Gravity Corer	station start	GeoB24007, GC-6m	started	274.2	0.8	2444.1900	57° 18.243' S	081° 17.006' E	214.5	12.5
SO272_14-1	14/02/2020 19:41:12	Gravity Corer	in the water	FW2/SPW2	started	90.4	0.3	2441.9700	57° 18.244' S	081° 17.013' E	232.8	15.8
SO272_14-1	14/02/2020 20:23:29	Gravity Corer	max depth/on ground	SLmax: 2478m	started	236.5	0.2	2444.2500	57° 18.240' S	081° 17.009' E	240.2	15.8

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_14-1	14/02/2020 20:23:50	Gravity Corer	hoisting	SZmax: 52,3kN	started	180.4	0.4	2439.6300	57° 18.240' S	081° 17.011' E	236.7	16.4
SO272_14-1	14/02/2020 21:19:18	Gravity Corer	on deck		started	284.7	0.6	2440.1200	57° 18.245' S	081° 17.002' E	243.0	12.2
SO272_14-1	14/02/2020 21:46:51	Gravity Corer	station end		started	82.4	0.7	2442.3600	57° 18.239' S	081° 17.004' E	245.4	15.3
SO272_15-1	15/02/2020 05:27:55	Gravity Corer	station start	GeoB24008, GC-6m	started	62.5	0.4	1858.0600	56° 50.657' S	079° 28.989' E	278.7	7.7
SO272_15-1	15/02/2020 05:30:37	Gravity Corer	in the water	FW2/SPW2	started	82.0	0.2	1856.5300	56° 50.657' S	079° 28.988' E	275.1	8.9
SO272_15-1	15/02/2020 06:07:04	Gravity Corer	max depth/on ground	BOKO, SLmax: 1882m	started	115.0	0.2	1854.1900	56° 50.661' S	079° 28.979' E	271.1	9.4
SO272_15-1	15/02/2020 06:08:03	Gravity Corer	hoisting	SZmax: 45,3kN	started	65.0	0.2	1857.9100	56° 50.662' S	079° 28.980' E	271.7	7.9
SO272_15-1	15/02/2020 06:49:26	Gravity Corer	on deck		started	252.1	0.3	1857.4900	56° 50.663' S	079° 28.979' E	271.7	6.3
SO272_15-1	15/02/2020 06:51:35	Gravity Corer	station end		started	7.6	0.4	1857.5400	56° 50.659' S	079° 28.980' E	266.1	6.8
SO272_15-2	15/02/2020 07:16:11	Multi Corer	station start	GeoB24008, MUC + SVP	started	351.9	0.0	1872.5900	56° 50.652' S	079° 28.991' E	267.2	8.3
SO272_15-2	15/02/2020 07:17:49	Multi Corer	in the water	FW2/SPW2	started	246.7	0.4	1900.9600	56° 50.653' S	079° 28.992' E	267.4	6.2
SO272_15-2	15/02/2020 07:59:55	Multi Corer	max depth/on ground	BOKO, SLmax: 1878m	started	48.3	0.2	1858.5900	56° 50.660' S	079° 28.986' E	283.4	7.6
SO272_15-2	15/02/2020 08:04:35	Multi Corer	hoisting	SZmax: 34,6kN	started	51.6	0.1	1854.8600	56° 50.658' S	079° 28.985' E	272.9	6.4
SO272_15-2	15/02/2020 09:09:20	Multi Corer	on deck		started	9.6	0.2	1857.9700	56° 50.665' S	079° 28.985' E	317.3	7.7

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_15-2	15/02/2020 09:11:06	Multi Corer	station end		started	135.1	0.2	1858.1700	56° 50.662' S	079° 28.983' E	314.6	9.4
SO272_16-1	15/02/2020 10:41:42	Gravity Corer	station start	GeoB24009, GC-6m	started	6.0	0.3	1939.5700	56° 41.189' S	079° 41.820' E	350.3	7.4
SO272_16-1	15/02/2020 10:46:22	Gravity Corer	in the water		started	14.5	0.4	1940.2800	56° 41.174' S	079° 41.839' E	341.1	9.3
SO272_16-1	15/02/2020 11:21:31	Gravity Corer	max depth/on ground	SLmax: 1971m	started	147.5	0.2	1938.7300	56° 41.151' S	079° 41.872' E	333.8	9.5
SO272_16-1	15/02/2020 11:22:39	Gravity Corer	hoisting	SZmax: 63,8kN	started	168.9	0.2	1940.9300	56° 41.154' S	079° 41.868' E	338.6	9.3
SO272_16-1	15/02/2020 12:06:32	Gravity Corer	on deck		started	177.0	0.2	1942.4500	56° 41.148' S	079° 41.869' E	352.8	8.1
SO272_16-1	15/02/2020 12:08:31	Gravity Corer	station end		started	182.7	0.1	1939.5800	56° 41.148' S	079° 41.871' E	4.0	9.2
SO272_16-2	15/02/2020 12:09:56	Multi Corer	station start	GeoB24009, MUC + SVP	started	344.4	0.1	1942.2000	56° 41.148' S	079° 41.873' E	356.8	8.0
SO272_16-2	15/02/2020 12:11:32	Multi Corer	in the water		started	287.8	0.1	1941.7600	56° 41.149' S	079° 41.872' E	5.7	8.5
SO272_16-2	15/02/2020 12:55:52	Multi Corer	max depth/on ground	Boko, maxSL: 1966m	started	149.4	0.3	1942.5500	56° 41.153' S	079° 41.869' E	351.2	7.0
SO272_16-2	15/02/2020 12:57:07	Multi Corer	hoisting	Beg. hieven, maxSZ: 26,0kN	started	153.2	0.3	1943.1600	56° 41.155' S	079° 41.872' E	357.0	9.9
SO272_16-2	15/02/2020 14:02:28	Multi Corer	on deck		started	300.0	0.1	1945.1000	56° 41.147' S	079° 41.869' E	18.1	8.7
SO272_16-2	15/02/2020 14:03:53	Multi Corer	station end		started	344.7	0.3	1942.9800	56° 41.146' S	079° 41.868' E	19.6	9.3
SO272_17-1	15/02/2020 16:11:51	Gravity Corer	station start	GeoB24010, GC- 6m	started	319.3	0.3	2702.0000	56° 41.570' S	080° 19.609' E	359.3	10.4

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_17-1	15/02/2020 16:19:18	Gravity Corer	in the water	FW2/SPW2	started	200.1	0.1	2700.3900	56° 41.560' S	080° 19.604' E	0.3	8.9
SO272_17-1	15/02/2020 17:08:08	Gravity Corer	max depth/on ground	BOKO, SLmax: 2733m	started	265.2	0.1	2698.8900	56° 41.564' S	080° 19.603' E	347.7	7.6
SO272_17-1	15/02/2020 17:09:15	Gravity Corer	hoisting	Beginn hieven, SZmax: 56,4kN	started	218.2	0.3	2698.2300	56° 41.565' S	080° 19.602' E	344.8	7.2
SO272_17-1	15/02/2020 18:05:59	Gravity Corer	on deck		started	292.0	0.2	2698.7800	56° 41.563' S	080° 19.603' E	335.4	9.6
SO272_17-1	15/02/2020 18:07:18	Gravity Corer	station end		started	139.9	0.1	2701.1100	56° 41.564' S	080° 19.600' E	341.0	8.0
SO272_17-2	15/02/2020 18:09:34	Float	station start	ARGO-Float # 8846	started	112.7	0.1	2698.8300	56° 41.566' S	080° 19.595' E	342.7	8.7
SO272_17-2	15/02/2020 18:13:40	Float	in the water		started	294.0	2.1	2696.3800	56° 41.572' S	080° 19.508' E	346.2	9.4
SO272_17-2	15/02/2020 18:13:40	Float	station end		started	294.0	2.1	2696.3800	56° 41.572' S	080° 19.508' E	346.2	9.4
SO272_18-1	15/02/2020 18:20:41	Seismic Towed Receiver	station start		started	82.5	4.2	2716.7100	56° 41.392' S	080° 19.823' E	321.1	9.6
SO272_18-1	15/02/2020 18:22:26	Seismic Towed Receiver	information	Endboje zu Wasser	started	86.4	3.7	2726.3400	56° 41.377' S	080° 20.028' E	316.4	8.3
SO272_18-1	15/02/2020 18:29:56	Seismic Towed Receiver	information	Bird # 01 zu Wasser	started	86.8	3.9	2766.9400	56° 41.337' S	080° 20.835' E	326.2	7.9
SO272_18-1	15/02/2020 18:36:37	Seismic Towed Receiver	information	Bird # 02 zu Wasser	started	85.9	3.8	2830.2300	56° 41.308' S	080° 21.645' E	323.2	8.2

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_18-1	15/02/2020 18:43:30	Seismic Towed Receiver	information	Bird # 03 zu Wasser	started	86.6	3.6	2875.0800	56° 41.277' S	080° 22.399' E	316.9	9.7
SO272_18-1	15/02/2020 18:50:26	Seismic Towed Receiver	information	Bird # 04 zu Wasser	started	89.6	4.9	2924.6100	56° 41.252' S	080° 23.291' E	323.0	9.1
SO272_18-1	15/02/2020 18:57:16	Seismic Towed Receiver	information	Bird # 05 zu Wasser	started	88.9	4.9	2997.8100	56° 41.255' S	080° 24.332' E	321.0	8.7
SO272_18-1	15/02/2020 19:04:28	Seismic Towed Receiver	information	Bird # 06 zu Wasser	started	82.5	3.7	3070.5900	56° 41.231' S	080° 25.262' E	316.3	8.7
SO272_18-1	15/02/2020 19:11:53	Seismic Towed Receiver	information	Bird # 07 zu Wasser	started	85.1	4.8	3099.4200	56° 41.186' S	080° 26.209' E	319.6	8.4
SO272_18-1	15/02/2020 19:19:48	Seismic Towed Receiver	information	Bird # 08 zu Wasser	started	83.4	4.3	3106.1700	56° 41.131' S	080° 27.301' E	321.0	8.6
SO272_18-1	15/02/2020 19:27:51	Seismic Towed Receiver	information	Bird # 09 zu Wasser	started	86.7	4.2	3145.3200	56° 41.077' S	080° 28.355' E	318.4	7.6
SO272_18-1	15/02/2020 19:36:30	Seismic Towed Receiver	information	Bird # 10 zu Wasser	started	82.8	4.3	3185.1000	56° 41.018' S	080° 29.457' E	325.9	8.2
SO272_18-1	15/02/2020 19:45:43	Seismic Towed Receiver	information	Bird # 11 zu Wasser	started	84.5	4.2	3138.3500	56° 40.952' S	080° 30.631' E	329.9	8.5
SO272_18-1	15/02/2020 19:50:22	Seismic Towed Receiver	information	Bird # 12 zu Wasser	started	85.0	4.2	3200.4500	56° 40.922' S	080° 31.218' E	327.7	7.9
SO272_18-1	15/02/2020 19:54:35	Seismic Towed Receiver	information	Bird # 13 zu Wasser	started	84.9	4.0	3259.4500	56° 40.890' S	080° 31.741' E	324.9	8.0

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_18-1	15/02/2020 20:02:06	Seismic Towed Receiver	information	Streamer komplett zu Wasser	started	83.9	4.3	3253.9100	56° 40.841' S	080° 32.699' E	332.0	8.6
SO272_18-1	15/02/2020 20:06:51	Seismic Towed Receiver	information	Airguns zu Wasser	started	84.7	4.2	3256.8300	56° 40.805' S	080° 33.302' E	324.3	7.9
SO272_18-1	15/02/2020 20:12:54	Seismic Towed Receiver	information	Airguns soft start	started	83.4	5.0	3303.2500	56° 40.763' S	080° 34.189' E	323.4	9.4
SO272_18-1	15/02/2020 20:43:48	Seismic Towed Receiver	information	Airguns auf full power	started	83.7	4.8	3427.6800	56° 40.502' S	080° 38.828' E	335.0	7.9
SO272_18-1	15/02/2020 20:45:00	Seismic Towed Receiver	profile start	AWI-20200017, rwK: 084°, d: 17sm	started	83.0	4.8	3431.8100	56° 40.492' S	080° 39.008' E	334.8	8.4
SO272_18-1	16/02/2020 00:04:40	Seismic Towed Receiver	profile end		started	75.6	4.9	4411.0700	56° 38.829' S	081° 09.079' E	295.1	7.6
SO272_18-1	16/02/2020 00:05:40	Seismic Towed Receiver	alter course	Beg. drehen über Bb	started	73.2	4.9	4405.0700	56° 38.809' S	081° 09.222' E	278.2	5.6
SO272_18-1	16/02/2020 00:19:07	Seismic Towed Receiver	profile start	AWI-20200018, rwk: 000°d: 47sm	started	2.8	4.9	4384.9300	56° 37.975' S	081° 10.334' E	293.8	7.8
SO272_18-1	16/02/2020 09:40:01	Seismic Towed Receiver	alter course	rwK: 329°, d: 48sm	started	348.7	4.0	4629.8300	55° 51.441' S	081° 09.890' E	257.1	19.2
SO272_18-1	16/02/2020 18:58:05	Seismic Towed Receiver	alter course	auf rwK: 321°, d: 23nm	started	325.3	5.3	3763.9100	55° 09.891' S	080° 26.466' E	271.8	17.2

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_18-1	16/02/2020 23:26:53	Seismic Towed Receiver	profile end		started	326.5	5.1	3622.7600	54° 51.912' S	080° 00.951' E	285.0	18.9
SO272_18-1	16/02/2020 23:42:02	Seismic Towed Receiver	information	Airguns aus	started	318.2	4.8	3628.6200	54° 50.854' S	079° 59.606' E	294.7	15.1
SO272_18-1	16/02/2020 23:46:21	Seismic Towed Receiver	information	Beginn Bergung Airguns	started	311.8	3.4	3613.4000	54° 50.628' S	079° 59.253' E	290.6	13.4
SO272_18-1	16/02/2020 23:56:15	Seismic Towed Receiver	on deck	Airguns an Deck	started	300.7	3.6	3617.0000	54° 50.304' S	079° 58.294' E	295.4	12.4
SO272_18-1	17/02/2020 00:04:03	Seismic Towed Receiver	information	Beg. hieven Streamer	started	302.2	3.7	3605.7500	54° 50.063' S	079° 57.509' E	294.6	14.3
SO272_18-1	17/02/2020 00:09:25	Seismic Towed Receiver	information	1. Bird an Deck	started	299.5	4.3	3600.1000	54° 49.911' S	079° 57.021' E	294.9	12.7
SO272_18-1	17/02/2020 00:15:57	Seismic Towed Receiver	information	2. Bird an Deck	started	294.7	3.6	3603.7100	54° 49.732' S	079° 56.400' E	297.7	13.2
SO272_18-1	17/02/2020 00:22:28	Seismic Towed Receiver	information	3. Bird an Deck	started	295.1	3.8	3609.1200	54° 49.548' S	079° 55.800' E	302.4	12.0
SO272_18-1	17/02/2020 00:35:15	Seismic Towed Receiver	information	4. Bird an Deck	started	293.4	4.0	3624.5600	54° 49.162' S	079° 54.595' E	313.8	13.0
SO272_18-1	17/02/2020 00:48:25	Seismic Towed Receiver	information	5. Bird an Deck	started	300.7	3.9	3638.2400	54° 48.766' S	079° 53.269' E	319.4	10.4
SO272_18-1	17/02/2020 01:00:47	Seismic Towed Receiver	information	6. Bird an Deck	started	297.2	3.6	3650.9600	54° 48.416' S	079° 52.116' E	307.1	13.6

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_18-1	17/02/2020 01:11:31	Seismic Towed Receiver	information	7. Bird an Deck	started	295.8	3.8	3657.7300	54° 48.150' S	079° 51.124' E	316.8	12.7
SO272_18-1	17/02/2020 01:22:32	Seismic Towed Receiver	information	8. Bird an Deck	started	300.8	3.8	3655.6800	54° 47.851' S	079° 50.022' E	326.6	14.1
SO272_18-1	17/02/2020 01:33:00	Seismic Towed Receiver	information	9. Bird an Deck	started	293.1	4.0	3661.2900	54° 47.573' S	079° 48.983' E	325.4	12.0
SO272_18-1	17/02/2020 01:42:07	Seismic Towed Receiver	information	10. Bird an Deck	started	296.0	4.1	3683.3800	54° 47.358' S	079° 48.070' E	331.5	14.9
SO272_18-1	17/02/2020 01:50:56	Seismic Towed Receiver	information	11. Bird an Deck	started	299.3	3.4	3755.8200	54° 47.155' S	079° 47.190' E	324.7	13.8
SO272_18-1	17/02/2020 01:59:44	Seismic Towed Receiver	information	12. Bird an Deck	started	296.5	3.7	3807.9400	54° 46.934' S	079° 46.320' E	337.1	13.3
SO272_18-1	17/02/2020 02:03:06	Seismic Towed Receiver	information	13. Bird an Deck	started	287.4	4.0	3830.5800	54° 46.873' S	079° 45.993' E	328.7	15.8
SO272_18-1	17/02/2020 02:10:21	Seismic Towed Receiver	information	Endboje an Deck	started	293.7	3.1	3853.4500	54° 46.705' S	079° 45.280' E	331.6	15.3
SO272_18-1	17/02/2020 02:17:20	Seismic Towed Receiver	station end		started	315.2	5.3	3821.2700	54° 46.489' S	079° 44.615' E	326.0	12.8
SO272_19-1	17/02/2020 03:28:30	Gravity Corer	station start	GeoB24011	started	269.0	0.6	3626.3000	54° 51.850' S	080° 00.796' E	323.8	13.2
SO272_19-1	17/02/2020 03:33:24	Gravity Corer	in the water	GC 12m	started	275.5	0.2	3619.8300	54° 51.847' S	080° 00.822' E	332.1	11.9

Station	Date / Time UTC	Device	Action	Comment (Action)	Expedition Status	Course	Speed (kn)	Depth (m)	Latitude	Longitude	Wind Dir	Wind Speed (m/s)
SO272_19-1	17/02/2020 04:38:44	Gravity Corer	max depth/on ground	BOKO, SLmax: 3657m	started	334.2	0.4	3623.9600	54° 51.826' S	080° 00.822' E	301.5	12.6
SO272_19-1	17/02/2020 04:39:06	Gravity Corer	hoisting	Beginn hieven, SZmax: 91,9kN	started	315.4	0.4	3624.7300	54° 51.825' S	080° 00.819' E	301.5	10.6
SO272_19-1	17/02/2020 05:51:13	Gravity Corer	on deck		started	105.0	0.2	3614.1200	54° 51.822' S	080° 00.829' E	264.9	12.1
SO272_19-1	17/02/2020 05:53:18	Gravity Corer	station end		started	150.7	0.3	3623.8900	54° 51.825' S	080° 00.833' E	274.4	12.5

Appendix B Seismic Profile Summary

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE	FFIDs, # of SHOT	RECORD LENGTH (s)	SAMP. RATE (ms)	SHOT INTERVAL (m)	PROFILE LENGTH (nm)	STREAMER	GI-GUN ARRAY		COMMENT
												Set-up	Total volume	
20200001	start end	27.01.20 28.01.20	08:00:55 08:46:27	-53.08591 -54.06653	81.834983 78.819852	163- 9256	9	1	25	123	SEAL428	4 GI-guns, true GI mode (45+105 in^3), 33 ms delay	4 * 2.4 l	Start of ramp-up 8:00, full power 8:30
20200002	start end	28.01.20 29.01.20	10:12:30 18:51:00	-54.070017 -53.639154	78.791250 83.326615	9258- 21345	9	1	25	163	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 33 ms delay	4 * 2.4 l	
20200003	start end	29.01.20 31.01.20	19:48:00 03:33:00	-53.624952 -55.046632	83.3172396 79.5131076	21400- 33142	9	1	25	159	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 33 ms delay	4 * 2.4 l	#22203 GI-gun 4 broken, only 3 GI-guns
20200004	start end	31.01.20 31.01.20	06:43:00 21:39:59	-55.048507 -53.818698	79.5381510 79.4517708	33143- 38580	9	1	25	73	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 33 ms delay	3 * 2.4 l	
20200005	start end	31.01.20 01.02.20	20:14:15 05:21:00	-53.831007 -54.669023	79.4219792 83.5317448	38791- 50144	9	1	25	153	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 33 ms delay	3 * 2.4 l	GeoB24001 #40403, 3:03
20200006	start end	02.02.20 03.02.20	06:31:00 10:29:57	-54.655517 -55.741454	83.526337 79.934609	50430- 60756	9	1	25	140	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 33 ms delay	3 * 2.4 l	
20200007	start end	03.02.20 04.02.20	12:11:00 13:55:00	-55.750903 -55.353872	79.79920134 83.5081944	60757- 70276	9.5	1	25	129 (116)	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 33 ms delay	4 (3) * 2.4 l	#63564 GI-gun2 breaks down #65868 - #65949 Whale LP zone #66270 Wahle LP zone #66330 - #66689 Whale break #66725 – 67327 Whale break

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE	FFIDs, # of SHOT	RECORD LENGTH (s)	SAMP. RATE (ms)	SHOT INTERVAL (m)	PROFILE LENGTH (nm)	STREAMER	GI-GUN ARRAY		COMMENT
												Set-up	Total volume	
20200008	start end	04.02.20 06.02.20	14:57:00 03:02:00	-55.326901 -56.941393	83.493151 78.9690797	70489- 83796	9.5	1	25	180 (178)	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	#74109 - #74258 Whale break
20200009	start end	06.02.20 07.02.20	06:11:02 13:37:00	-56.9185856 -56.1066623	79.0683507 83.5609375	83797- 95312	9.5	1	25	155	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	4 * 2.4 l	Pressure set to 170 bar
20200010	start end	07.02.20 09.02.20	14:41:00 08:19:10	-56.082773 -58.451853	83.5627517 78.9738108	95546- 110923	9.5	1	25	208	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	4 * 2.4 l	#104330 (shot 8785, CDP 8859) ODP Site 750 #110843 (shot 9298, CDP 9373) ODP Site 748
20200011	start end	09.02.20 10.02.20	09:37:00 10:24:27	-58.471615 -56.859336	78.9627604 81.3146788	111209- 120383	9.5	1	25	124	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	4 * 2.4 l	#111370 (shot 162, CDP 174) ODP Site 748 #115091 (shot 3883, CDP 3937) ODP Site 751 # 112791 - #112823 Whale LP #116372 - #116531 Whale LP #113596 Break down of GI-gun 2
20200012	start end	10.02.20 10.02.20	11:34:52 20:56:41	-56.851849 -57.630004	81.29191840 81.2755642	120651- 124119	9.5	1	25	47	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE	FFIDs, # of SHOT	RECORD LENGTH (s)	SAMP. RATE (ms)	SHOT INTERVAL (m)	PROFILE LENGTH (nm)	STREAMER	GI-GUN ARRAY		COMMENT
												Set-up	Total volume	
20200013	start end	10.02.20 11.02.20	22:01:00 14:12:00	-57.633602 -56.648199	81.31247396 79.63247396	124350- 130330	9.5	1	25	81	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	#124608 (shot 259, CDP 305) ODP Site 750 #129472 (shot 5123, CDP 5163) crossing AWI-20200009 #130253 (shot 5904, CDP 5918) crossing AWI-20200008
20200014	start end	11.02.20 12.02.20	15:36:00 09:54:57	-56.659849 -58.175898	79.6544097 79.8808420	130473- 137245	9.5	1	25	91	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	#135237 (shot 4765, CDP 4808) ODP Site 751 #136989 (shot 6517, CDP 6561) crossing AWI-20200010
20200015	start end	12.02.20 13.03.19	11:11:58 04:14:00	-58.173034 -56.828308	79.8921094 79.0601129	137518- 143830	9.5	1	25	85	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	#137584 (shot 67, CDP 58) crossing AWI-20200014 #137748 (shot 231, CDP 257) crossing AWI-20200010 #139063 (shot 1564, CDP 1602) crossing AWI-20200011
														#143429 (shot 5912, CDP 5958) crossing AWI-20200009

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE	FFIDs, # of SHOT	RECORD LENGTH (s)	SAMP. RATE (ms)	SHOT INTERVAL (m)	PROFILE LENGTH (nm)	STREAMER	GI-GUN ARRAY		COMMENT
												Set-up	Total volume	
														#143505 (shot 5988, CDP 5988) crossing AWI-20200008 #138411 - #138731 Whale break
20200016	start end	13.02.20 13.02.20	05:55:00 22:22:40	-56.824010 -57.842274	79.0300260 80.8296875	144083- 150359	9.5	1	25	85	SEAL 428	3 GI-guns, true GI mode (45+105 in^3), 30 ms delay	3 * 2.4 l	#146570 (shot 2488, CDP 2483) crossing AWI-20200014 #150035 (shot 5953, CDP 5951) crossing AWI-20200010
20200017	start end	15.02.20 16.02.20	20:12:41 00:05:57	-56.679748 -56.647235	80.56819444 81.1529514	150360- 151802	9.5	1	25	19	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	4 * 2.4 l	
20200018	start end	16.02.20 16.02.20	00:12:30 23:40:26	-56.6424609 -54.8498481	81.1663281 79.9969444	151803- 160587	9.5	1	25	119	SEAL 428	4 GI-guns, true GI mode (45+105 in^3), 30 ms delay	4 * 2.4 l	#152153 (shot 351, CDP 351) crossing AWI-20200009 #153799 (shot 1997, CDP 1999) crossing AWI-20200008 #156395 (shot 4593, CDP 4626) crossing AWI-20200007 #157119 (shot 5317, CDP 5363) crosiing AWI-20200006

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE	FFIDs, # of SHOT	RECORD LENGTH (s)	SAMP. RATE (ms)	SHOT INTERVAL (m)	PROFILE LENGTH (nm)	STREAMER	GI-GUN ARRAY		COMMENT
												Set-up	Total volume	
														#160486 (shot 8684,CDP 8792 crossing AWI-20200003 (GeoB24011)
Total length =										2134 nm				

Appendix C GeoB Stations

GeoB-Nr.	Ship Station	Area	Gear	Date Time UTC	Latitude	Longitude	Depth (m)	Note	Remarks	Curated length
GeoB 24001-1	SO272_6-1	Labuan Basin	Gravity Corer 12m	26.01.20 12:20	53° 55.554' S	080° 00.988' E	3133	station start		
GeoB 24001-1	SO272_6-1	Labuan Basin	Gravity Corer 12m	26.01.20 13:27	53° 55.546' S	080° 00.957' E	3132	max depth/on ground	recovery 9.79 m	9.79
GeoB 24001-1	SO272_6-1	Labuan Basin	Gravity Corer 12m	26.01.20 14:37	53° 55.543' S	080° 00.957' E	3129	station end	Sediment at bomb head	
GeoB 24001-2	SO272_6-2	Labuan Basin	Multi Corer; SVP	26.01.20 14:38	53° 55.541' S	080° 00.956' E	3134	station start		
GeoB 24001-2	SO272_6-2	Labuan Basin	Multi Corer; SVP	26.01.20 16:04	53° 55.544' S	080° 00.954' E	3124	max depth/on ground	all 12 tubes filled ~28cm;	0.29
GeoB 24001-2	SO272_6-2	Labuan Basin	Multi Corer; SVP	26.01.20 17:49	53° 55.553' S	080° 00.950' E	3123	station end	6 tubes GeoB, 6 tubes Abbott/Duggan	
GeoB 24002-1	SO272_8-1	Wiliams Ridge	Gravity Corer 6m	14.02.20 04:14	53° 21.003' S	081° 02.078' E	1144	station start		
GeoB 24002-1	SO272_8-1	Wiliams Ridge	Gravity Corer 6m	14.02.20 04:14	53° 20.991' S	081° 02.127' E	1142	max depth/on ground	recovery 0 m	0.00
GeoB 24002-1	SO272_8-1	Wiliams Ridge	Gravity Corer 6m	14.02.20 04:14	53° 20.988' S	081° 02.136' E	1142	on deck	gear empty, only few rock chips in core catcher	
GeoB 24002-2	SO272_8-2	Wiliams Ridge	Multi Corer; SVP	26.01.20 23:38	53° 20.991' S	081° 02.132' E	1141	station start	MUC not to ground, only for SVP meaurements deployed	-
GeoB 24002-2	SO272_8-2	Wiliams Ridge	Multi Corer; SVP	27.01.20 00:13	53° 20.992' S	081° 02.126' E	1143	max depth/on ground	-	
GeoB 24002-2	SO272_8-2	Wiliams Ridge	Multi Corer; SVP	27.01.20 00:40	53° 20.989' S	081° 02.120' E	1143	station end		
GeoB24003-1	SO272_10-1	Raggatt Basin	Gravity Corer 6m	14.02.20 04:14	57° 25.347' S	080° 20.584' E	1903	station start		
GeoB24003-1	SO272_10-1	Raggatt Basin	Gravity Corer 6m	14.02.20 04:58	57° 25.348' S	080° 20.568' E	1946	max depth/on ground	recovery 3.37 m	3.22
GeoB24003-1	SO272_10-1	Raggatt Basin	Gravity Corer 6m	14.02.20 05:44	57° 25.352' S	080° 20.569' E	1946	station end	both 6m pipes bend	
GeoB24003-2	SO272_10-2	Raggatt Basin	Multi Corer; SVP	14.02.20 05:49	57° 25.345' S	080° 20.571' E	1946	station start		
GeoB24003-2	SO272_10-2	Raggatt Basin	Multi Corer; SVP	14.02.20 06:36	57° 25.354' S	080° 20.580' E	1905	max depth/on ground	all 12 tubes filled ~15cm;	0.15
GeoB24003-2	SO272_10-2	Raggatt Basin	Multi Corer; SVP	14.02.20 07:45	57° 25.356' S	080° 20.576' E	1904	station end	6 tubes GeoB, 6 tubes Abbott/Duggan	
GeoB24004-1	SO272_11-1	Raggatt Basin	Gravity Corer	14.02.20 09:15	57° 14.274' S	080° 39.669' E	2037	station start		
GeoB24004-1	SO272_11-1	Raggatt Basin	Gravity Corer	14.02.20 09:59	57° 14.333' S	080° 39.604' E	2033	max depth/on ground		0.60
GeoB24004-1	SO272_11-1	Raggatt Basin	Gravity Corer	14.02.20 10:46	57° 14.318' S	080° 39.602' E	2079	station end	empty, sand recovered from CC	
GeoB24004-2	SO272_11-2	Raggatt Basin	Multi Corer; SVP	14.02.20 10:48	57° 14.320' S	080° 39.599' E	2079	station start		
GeoB24004-2	SO272_11-2	Raggatt Basin	Multi Corer; SVP	14.02.20 11:41	57° 14.329' S	080° 39.606' E	2035	max depth/on ground	6 tubes filled ~10cm; 6 tubes empty;	0.10
GeoB24004-2	SO272_11-2	Raggatt Basin	Multi Corer; SVP	14.02.20 12:50	57° 14.322' S	080° 39.606' E	2032	station end	5 tubes GeoB, 1 tube Abbott/Duggan	
GeoB24005-1	SO272_12-1	Raggatt Basin	Gravity Corer	14.02.20 13:22	57° 11.895' S	080° 43.864' E	2156	station start		
GeoB24005-1	SO272_12-1	Raggatt Basin	Gravity Corer	14.02.20 14:06	57° 11.870' S	080° 43.847' E	2153	max depth/on ground	recovery 1.20 m	1.08
GeoB24005-1	SO272_12-1	Raggatt Basin	Gravity Corer	14.02.20 14:57	57° 11.875' S	080° 43.861' E	2154	station end	Rock in CC, white carbonate at CC recovered	
GeoB24006-1	SO272_13-1	Raggatt Basin	Gravity Corer	14.02.20 15:35	57° 08.678' S	080° 49.444' E	2395	station start		
GeoB24006-1	SO272_13-1	Raggatt Basin	Gravity Corer	14.02.20 16:25	57° 08.640' S	080° 49.417' E	2396	max depth/on ground	recovery 1.85 m	1.76
GeoB24006-1	SO272_13-1	Raggatt Basin	Gravity Corer	14.02.20 17:23	57° 08.636' S	080° 49.421' E	2397	station end	Gravel in CC	
GeoB24007-1	SO272_14-1	Raggatt Basin	Gravity Corer	14.02.20 19:34	57° 18.243' S	081° 17.006' E	2444	station start		
GeoB24007-1	SO272_14-1	Raggatt Basin	Gravity Corer	14.02.20 20:23	57° 18.240' S	081° 17.009' E	2444	max depth/on ground	recovery 1.75 m	1.65
GeoB24007-1	SO272_14-1	Raggatt Basin	Gravity Corer	14.02.20 21:46	57° 18.239' S	081° 17.004' E	2442	station end		
GeoB24008-1	SO272_15-1	Raggatt Basin	Gravity Corer	15.02.20 05:27	56° 50.657' S	079° 28.989' E	1858	station start		
GeoB24008-1	SO272_15-1	Raggatt Basin	Gravity Corer	15.02.20 06:07	56° 50.661' S	079° 28.979' E	1854	max depth/on ground	recovery 1.85 m	1.70
GeoB24008-1	SO272_15-1	Raggatt Basin	Gravity Corer	15.02.20 06:51	56° 50.659' S	079° 28.980' E	1858	station end	pipe bend	
GeoB24008-2	SO272_15-2	Raggatt Basin	Multi Corer; SVP	15.02.20 07:16	56° 50.652' S	079° 28.991' E	1873	station start		
GeoB24008-2	SO272_15-2	Raggatt Basin	Multi Corer; SVP	15.02.20 07:59	56° 50.660' S	079° 28.986' E	1859	max depth/on ground	1 tubes filled ~15cm, one tube lost;	0.15
GeoB24008-2	SO272_15-2	Raggatt Basin	Multi Corer; SVP	15.02.20 09:11	56° 50.662' S	079° 28.983' E	1858	station end	6 tubes GeoB, 5 tubes Abbott/Duggan	
GeoB24009-1	SO272_16-1	Raggatt Basin	Gravity Corer	15.02.20 10:41	56° 41.189' S	079° 41.820' E	1940	station start		
GeoB24009-1	SO272_16-1	Raggatt Basin	Gravity Corer	15.02.20 11:21	56° 41.151' S	079° 41.872' E	1939	max depth/on ground	recovery 2.78 m	2.75
GeoB24009-1	SO272_16-1	Raggatt Basin	Gravity Corer	15.02.20 12:08	56° 41.148' S	079° 41.871' E	1940	station end		
GeoB24009-2	SO272_16-2	Raggatt Basin	Multi Corer; SVP	15.02.20 12:09	56° 41.148' S	079° 41.873' E	1942	station start		
GeoB24009-2	SO272_16-2	Raggatt Basin	Multi Corer; SVP	15.02.20 12:55	56° 41.153' S	079° 41.869' E	1943	max depth/on ground	1 tube filled ~5cm, 11 tubes empty	0.05
GeoB24009-2	SO272_16-2	Raggatt Basin	Multi Corer; SVP	15.02.20 14:03	56° 41.146' S	079° 41.868' E	1943	station end	1 tubes GeoB	
GeoB24010-1	SO272_17-1	Raggatt Basin	Gravity Corer	15.02.20 16:11	56° 41.570' S	080° 19.609' E	2702	station start		
GeoB24010-1	SO272_17-1	Raggatt Basin	Gravity Corer	15.02.20 17:08	56° 41.564' S	080° 19.603' E	2699	max depth/on ground	recovery 1.22 m	1.12
GeoB24010-1	SO272_17-1	Raggatt Basin	Gravity Corer	15.02.20 18:07	56° 41.564' S	080° 19.600' E	2701	station end		
GeoB24011-1	SO272_19-1	Labuan Basin	Gravity Corer	17.02.20 03:28	54° 51.850' S	080° 00.796' E	3626	station start		
GeoB24011-1	SO272_19-1	Labuan Basin	Gravity Corer	17.02.20 04:38	54° 51.826' S	080° 00.822' E	3625	max depth/on ground	recovery 7.48 m	7.48
GeoB24011-1	SO272_19-1	Labuan Basin	Gravity Corer	17.02.20 05:53	54° 51.825' S	080° 00.833' E	3624	station end		

Appendix D GeoB24001 to GeoB24011 smear slides

				Texture [%]			Composition, abiogene [%]										Composition, biogene [%]						
Sample No.	Station	Depth [cm]	Sediment Name	Sand	Silt	Clay	Quartz	Feldspar	Rock Fragment	Mica	Clay	Volcanic Glass	Inorg. Calcite	Dolomite	Cement	Pore Space	Accessor minerals	Foraminifers	Nannofossils	Diatoms	Radiolariens	Sponge Spicules	Silicoflagelates	Fish remains
1	GeoB24001-1	65	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	<5	95	<5			<5											70	5	10-15	10	
2	GeoB24001-1	102	Diatom Ooze	5	90	5				5	<5						<5			75	5	5	5	
3	GeoB24001-1	107	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	5	90	5														75	5	10	10	
4	GeoB24001-1	165	Sponge Spicule-bearing Diatom Ooze	15	80	5												5		75	5	10	5	
5	GeoB24001-1	203	Diatom Ooze	5	90	5											<5			85	5	5	<5	
6	GeoB24001-1	212	Sponge Spicule-bearing Diatom Ooze	5	90	5														80	5	10	5	
7	GeoB24001-1	254	Sponge Spicule-bearing Diatom Ooze	<5	95	<5				<5										75	5	10	<5	
8	GeoB24001-1	274	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														70	10	15	5	
9	GeoB24001-1	293	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	<5	95	<5				<5										75	10	10	<5	
10	GeoB24001-1	329	Radiolarian-bearing Diatom Ooze	10	80	10				<5	<5									75	10	5	5	
11	GeoB24001-1	347	Foram- and Radiolarian-bearing Diatom Ooze	15	80	5				<5								10		65	15	5	5	
12	GeoB24001-1	375	Radiolarian-bearing Diatom Sponge Spicule Ooze	10	85	5												<5		35	5-10	50	5	
13	GeoB24001-1	377	Foram-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	15	80	5	<5											5-10		55	10	20	5	
14	GeoB24001-1	405	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	10	85	5					<5						<5	5		45	15	20	<5	<5
15	GeoB24001-1	448	Foram-, Sponge Spicule- and Radiolarian-bearing Diatom Ooze	10	85	5				<5								10		50	20	15	<5	
16	GeoB24001-1	477	Radiolarian- and Sponge Spicule-bearing Diatom Ooze							5	5									60	10	20		
17	GeoB24001-1	502	Radiolaran-, Sponge Spicule- and Foram-bearing Diatom Ooze	20	75	5				<5								20		55	10	10-15		
18	GeoB24001-1	523	Foram-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	15	80	5											<5	10		60	10	15		
19	GeoB24001-1	556	Foram-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	15	80	5											<5	10		60	10	15	<5	
20	GeoB24001-1	610	Sponge Spicule-bearing Diatom Foram Ooze	35	60	5				<5							<5	40		30	5	15	<5	
21	GeoB24001-1	652	Sponge Spicule-bearing Foram Diatom Ooze	25	70	5				<5							<5	30		45	5	15		
22	GeoB24001-1	656	Sponge Spicule-bearing Foram Diatom Ooze	25	70	5											<5	30		45	5	15	<5	
23	GeoB24001-1	680	Sponge Spicule- and Radiolarian-bearing Foram Diatom Ooze	20	75	5											<5	25		40	15	15	<5	
24	GeoB24001-1	748	Silicoflagellates- and Foram-bearing Diatom Ooze	15	80	5											<5	20		55	5	5-10	10	
25	GeoB24001-1	789	Sponge Spicule- and Foram-bearing Diatom Ooze	15	80	5											<5	20		60	5	10	<5	
26	GeoB24001-1	814	Radiolarian-, Sponge Spicule- and Foram-bearing Diatom Ooze	20	75	5											<5	20		50	10	15	<5	
27	GeoB24001-1	893	Foram-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	15	80	5				<5							<5	10		50	15	15	<5	5
28	GeoB24001-1	924	Foram-, Sponge Spicule- and Radiolarian-bearing Diatom Ooze	15	80	5				<5							<5	10		45	20	15	5	
29	GeoB24001-1	943	Foram-, Sponge Spicule- and Radiolarian-bearing Diatom Ooze	15	80	5				<5							<5	10		50	20	10	5	
30	GeoB24001-1	976	Sponge Spicule-, Silt- and Radiolarian-bearing Diatom Ooze	5	90	5				5		<5					10			50	20	10	<5	
31	GeoB24001-1	CC	Sponge Spicule-, Silt- and Radiolarian-bearing Diatom Ooze	10	85	5				5		5					15			40	20	10	5	
32	GeoB24003-1	15	Sponge Spicule - and Radiolarian-bearing Diatom Ooze	5-10	90	<5				<5							<5	5		50	20	15	5	
33	GeoB24003-1	22	Silicoflagellates-, Sponge Spicule- and Radiolarian-bearing Diatom Ooze	<5	95	<5				<5							<5	<5		55	20	10	10	
34	GeoB24003-1	93	Radiolarian Diatom Ooze	5-10	90	<5				<5							5	5-10		45	30	5	5	
35	GeoB24003-1	123	Sponge Spicule-bearing Radiolarian Diatom Ooze	5	90	5				<5							<5	5-10		40	35	10	5	
36	GeoB24003-1	189	Foram-and Sponge Spicule-bearing Radiolarian Diatom Ooze	10	85	5				<5							<5	10		40	30	10	5	
37	GeoB24003-1	245	Silt- and Sponge Spicule-bearing Diatom Radiolarian Ooze	5	90	5				5							10	5		30	35	10	5	
38	GeoB24003-1	272	Foram, - Sponge Spicule and Diatom-bearing Radiolarian Ooze	10	85	5	<5		5	5	<5						5	10		20	35	10	5	
39	GeoB24003-1	313	Diatom- and Foram-bearing Nannofossil Ooze	10	20	70												15	65	10	5	5		
40	GeoB24003-1	CC	Foram-bearing Nannofossil Ooze	10	15	75												15	75		5	<5	<5	
41	GeoB24004-1	12	Sponge Spicule- and Silt-bearing Radiolarian Diatom Ooze	10	85	5			<5	5		<5					10	5		35	30	10	<5	
42	GeoB24004-1	CC	Foram Ooze	80	15	5				<5							5	85		<5		5		
43	GeoB24005-1	39	Foram Ooze	70	25	5	<5			5		<5					5	85						
44	GeoB24005-1	73	Silt-bearing Foram Ooze	60	35	5	<5			5		<5					10	75			<5	<5		
45	GeoB24005-1	104	Sponge Spicule-, Silt and Radiolarian-bearing Clay	5	40	55	<5		5	5	50						10			5	10	10	<5	
46	GeoB24006-1	6	Sponge Spicule-, Silt-, Radiolarian ad Foram-bearing Diatom Ooze	15	80	5			5	5							10	20		30	15	10	5	
47	GeoB24006-1	40	Foram Ooze	50	35	15			<5	5							5	80			<5	5		
48	GeoB24006-1	131	Silt-bearing Clay	5	45	50	<5		10	10	45						20			<5	5	5		

Table D GeoB24001 to GeoB24011 smear slides (continued)

				Texture [%]			Composition, abiogene [%]											Composition, biogene [%]						
Sample No.	Station	Depth [cm]	Sediment Name	Sand	Silt	Clay	Quartz	Feldspar	Rock Fragment	Mica	Clay	Volcanic Glass	Inorg. Calcite	Dolomite	Cement	Pore Space	Accessor minerals	Foraminifers	Nannofossils	Diatoms	Radiolariens	Sponge Spicules	Silicoflagelates	Fish remains
49	GeoB24007-1	44	Radiolarian- and Silt-bearing Clay	20	40	40			10	15	35						25				10	5		
50	GeoB24007-1	128	Foram-bearing Clay	15	15	70				5	65						5	15			5	5		
51	GeoB24007-1	149	Silt-bearing Clay	10	35	55			20	5	55						10				5	5		
52	GeoB24008-1	19	Silt-, Sponge Spicule- and Silicoflagelates-bearing Radiolarian Diatom Ooze	5	90	5				5							10	5		35	25	10	10	
53	GeoB24008-1	67	Silt- and Sponge Spicule-bearing Diatom Radiolarian Ooze	5	80	15			5	5							10			30	35	10	5	
54	GeoB24008-1	97	Silt-, Sponge Spicule-, Foram- and Radiolarian-bearing Diatom Ooze	10	75	15				5							10	10		40	20	10	5	
55	GeoB24008-1	162	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5				<5							<5			50	25	15	5	
56	GeoB24009-1	24	Silt-, Foram- and Diatom-bearing Radiolarian Ooze	20	70	10				<5							10	20		20	40	5-10		
57	GeoB24009-1	87	Nannofossil-, Silt-, Radiolarian- and Sponge Spicule-bearing biosiliceous Ooze	20	70	10			5	5	5	5					20		10	5	20	20	5	
58	GeoB24009-1	176	Radiolarian- and Foram-bearing Nannofossil Ooze	10	20	70												15	65	5	10	5		
59	GeoB24009-1	228	Radiolarian- and Foram-bearing nannofossil Ooze	10	25	65												20	60		15	5		
60	GeoB24009-1	CC	Radiolarian- and Foram-bearing Nannofossil Ooze	20	20	60					5							20	55	5	10	5		
61	GeoB24010-1	4	Silt-, Foram- and Radiolarian-bearing Diatom Ooze	20	75	5			5	5							15	15		35	20	5		
62	GeoB24010-1	15	Clay-, Silt-, Radiolarian- and Diatom-bearing Foram Ooze	30	50	20				5	10						10	45		15	10	<5	<5	
63	GeoB24010-1	61	Sponge Spicule-, Diatom-, Radiolarian- and Silt-bearing Clay	10	40	50	5			5	25	5					15	5		15	15	10		
64	GeoB24011-1	33	Silt-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5			10											55	10	20	5	
65	GeoB24011-1	51	Silicoflagellate- and Sponge Spicule-bearing Diatom Ooze	5	90	5														70	5	15	10	
66	GeoB24011-1	91	Sponge Spicule Diatom Ooze	5	90	5														65	5	25	5	
67	GeoB24011-1	128	Silicoflagellate-bearing Sponge Spicule Diatom Ooze	5	90	5														55	5	25	15	
68	GeoB24011-1	134	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	5	85	10				<5							<5			60	5	20	10	
69	GeoB24011-1	142	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	5	85	10														70	5	15	10	
70	GeoB24011-1	163	Silicoflagellate- and Sponge Spicule-bearing Diatom Ooze	5	90	5														60	5	20	15	
71	GeoB24011-1	189	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														70	10	15	5	
72	GeoB24011-1	199	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														55	20	20	5	
73	GeoB24011-1	230	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5						5					<5			55	15	15	5-10	
74	GeoB24011-1	256	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5														70	15	10	5	
75	GeoB24011-1	300	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									60	20	10	5	
76	GeoB24011-1	330	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														60	15	20	5	
77	GeoB24011-1	362	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					<5						<5			65	10	15	5	
78	GeoB24011-1	408	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									60	20	10	5	
79	GeoB24011-1	468	Clay-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	85	10					10									65	10	10	5	
80	GeoB24011-1	520	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									65	15	10	5	
81	GeoB24011-1	542	Clay-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	85	10					10									65	10	10	5	
82	GeoB24011-1	588	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					5									55	10	25	5	
83	GeoB24011-1	631	Radiolarian- and Silicoflagellates-bearing Sponge Spicule Diatom Ooze	5	90	5														50	10	30	10	
84	GeoB24011-1	651	Silicoflagellates-bearing Sponge Spicule Diatom Ooze	5	90	5														55	5	30	10	
85	GeoB24011-1	719	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					5									60	10	20	5	
49	GeoB24007-1	44	Radiolarian- and Silt-bearing Clay	20	40	40			10	15	35						25				10	5		
50	GeoB24007-1	128	Foram-bearing Clay	15	15	70				5	65						5	15			5	5		
51	GeoB24007-1	149	Silt-bearing Clay	10	35	55			20	5	55						10				5	5		
52	GeoB24008-1	19	Silt-, Sponge Spicule- and Silicoflagelates-bearing Radiolarian Diatom Ooze	5	90	5				5							10	5		35	25	10	10	
53	GeoB24008-1	67	Silt- and Sponge Spicule-bearing Diatom Radiolarian Ooze	5	80	15			5	5							10			30	35	10	5	
54	GeoB24008-1	97	Silt-, Sponge Spicule-, Foram- and Radiolarian-bearing Diatom Ooze	10	75	15				5							10	10		40	20	10	5	
55	GeoB24008-1	162	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5				<5							<5			50	25	15	5	
56	GeoB24009-1	24	Silt-, Foram- and Diatom-bearing Radiolarian Ooze	20	70	10				<5							10	20		20	40	5-10		
57	GeoB24009-1	87	Nannofossil-, Silt-, Radiolarian- and Sponge Spicule-bearing biosiliceous Ooze	20	70	10			5	5	5	5					20		10	5	20	20	5	
58	GeoB24009-1	176	Radiolarian- and Foram-bearing Nannofossil Ooze	10	20	70												15	65	5	10	5		
59	GeoB24009-1	228	Radiolarian- and Foram-bearing nannofossil Ooze	10	25	65												20	60		15	5		

Table D GeoB24001 to GeoB24011 smear slides (continued)

Texture [%] Composition, abiogene [%] Composition, biogene [%]

Sample No.	Station	Depth [cm]	Sediment Name	Sand	Silt	Clay	Quartz	Feldspar	Rock Fragment	Mica	Clay	Volcanic Glass	Inorg. Calcite	Dolomite	Cement	Pore Space	Accessor minerals	Foraminifers	Nannofossils	Diatoms	Radiolariens	Sponge Spicules	Silicoflagelates	Fish remains
60	GeoB24009-1	CC	Radiolarian- and Foram-bearing Nannofossil Ooze	20	20	60					5							20	55	5	10	5		
61	GeoB24010-1	4	Silt-, Foram- and Radiolarian-bearing Diatom Ooze	20	75	5			5	5							15	15		35	20	5		
62	GeoB24010-1	15	Clay-, Silt-, Radiolarian- and Diatom-bearing Foram Ooze	30	50	20				5	10						10	45		15	10	<5	<5	
63	GeoB24010-1	61	Sponge Spicule-, Diatom-, Radiolarian- and Silt-bearing Clay	10	40	50	5			5	25	5					15	5		15	15	10		
64	GeoB24011-1	33	Silt-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5			10											55	10	20	5	
65	GeoB24011-1	51	Silicoflagellate- and Sponge Spicule-bearing Diatom Ooze	5	90	5														70	5	15	10	
66	GeoB24011-1	91	Sponge Spicule Diatom Ooze	5	90	5														65	5	25	5	
67	GeoB24011-1	128	Silicoflagellate-bearing Sponge Spicule Diatom Ooze	5	90	5														55	5	25	15	
68	GeoB24011-1	134	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	5	85	10				<5							<5			60	5	20	10	
69	GeoB24011-1	142	Silicoflagellates- and Sponge Spicule-bearing Diatom Ooze	5	85	10														70	5	15	10	
70	GeoB24011-1	163	Silicoflagellate- and Sponge Spicule-bearing Diatom Ooze	5	90	5														60	5	20	15	
71	GeoB24011-1	189	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														70	10	15	5	
72	GeoB24011-1	199	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														55	20	20	5	
73	GeoB24011-1	230	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5						5					<5			55	15	15	5-10	
74	GeoB24011-1	256	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5														70	15	10	5	
75	GeoB24011-1	300	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									60	20	10	5	
76	GeoB24011-1	330	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5														60	15	20	5	
77	GeoB24011-1	362	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					<5						<5			65	10	15	5	
78	GeoB24011-1	408	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									60	20	10	5	
79	GeoB24011-1	468	Clay-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	85	10					10									65	10	10	5	
80	GeoB24011-1	520	Sponge Spicule- and Radiolarian-bearing Diatom Ooze	5	90	5					5									65	15	10	5	
81	GeoB24011-1	542	Clay-, Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	85	10					10									65	10	10	5	
82	GeoB24011-1	588	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					5									55	10	25	5	
83	GeoB24011-1	631	Radiolarian- and Silicoflagellates-bearing Sponge Spicule Diatom Ooze	5	90	5														50	10	30	10	
84	GeoB24011-1	651	Silicoflagellates-bearing Sponge Spicule Diatom Ooze	5	90	5														55	5	30	10	
85	GeoB24011-1	719	Radiolarian- and Sponge Spicule-bearing Diatom Ooze	5	90	5					5									60	10	20	5	

Appendix E GeoB24001 to GeoB24011 core descriptions

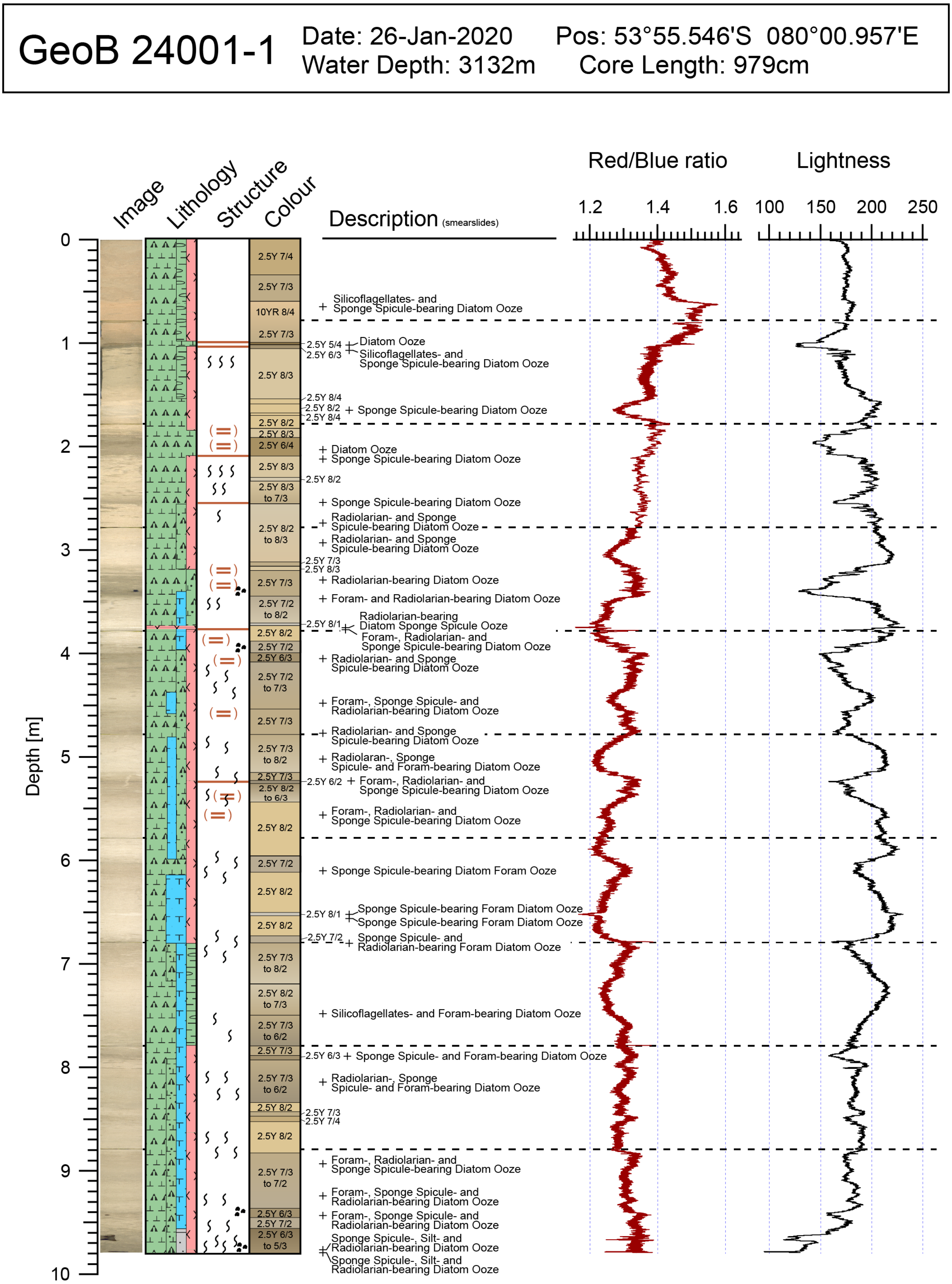


Fig. E.1 Core description of GeoB 24001-1.

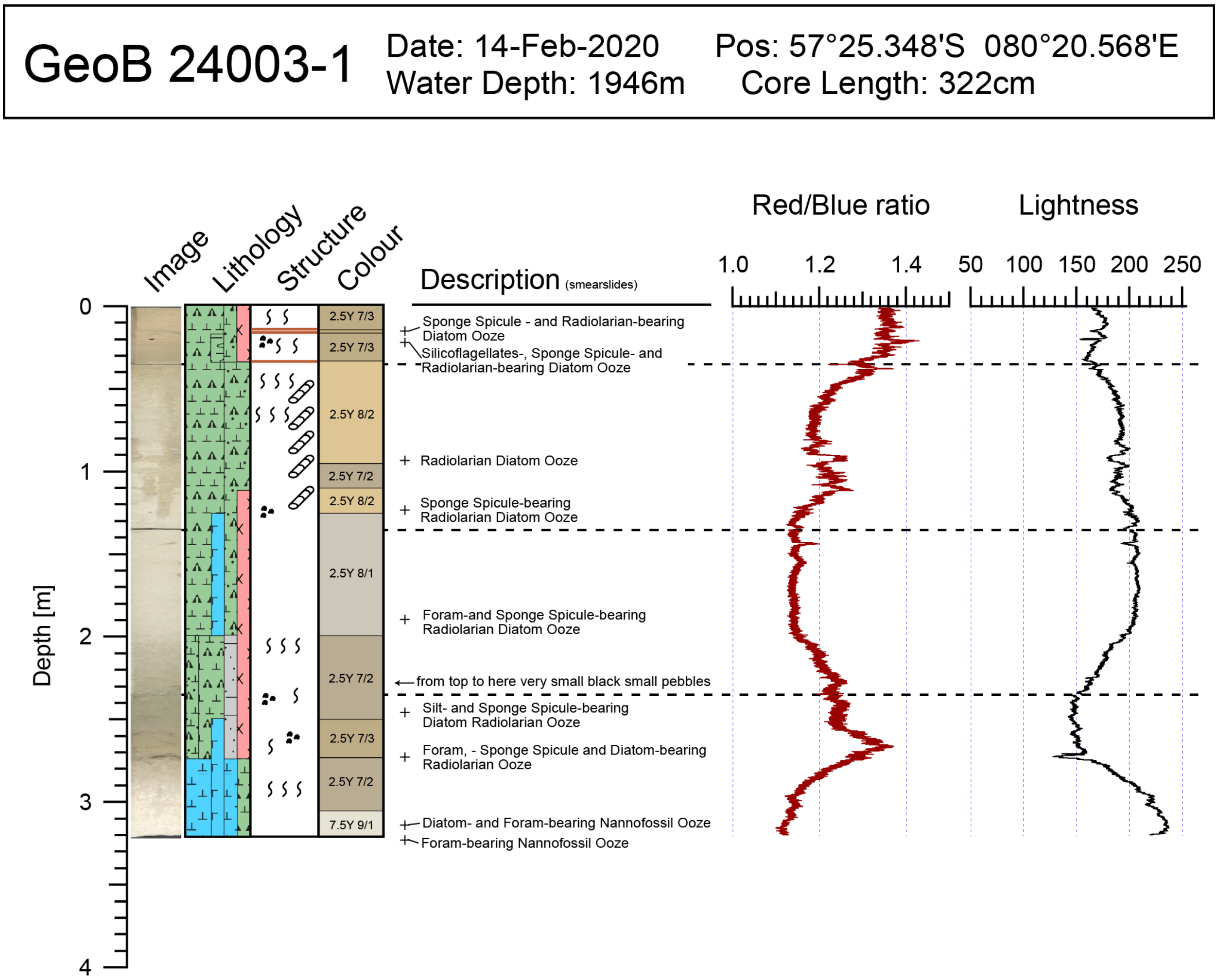


Fig. E.2 Core description of GeoB 24003-1.

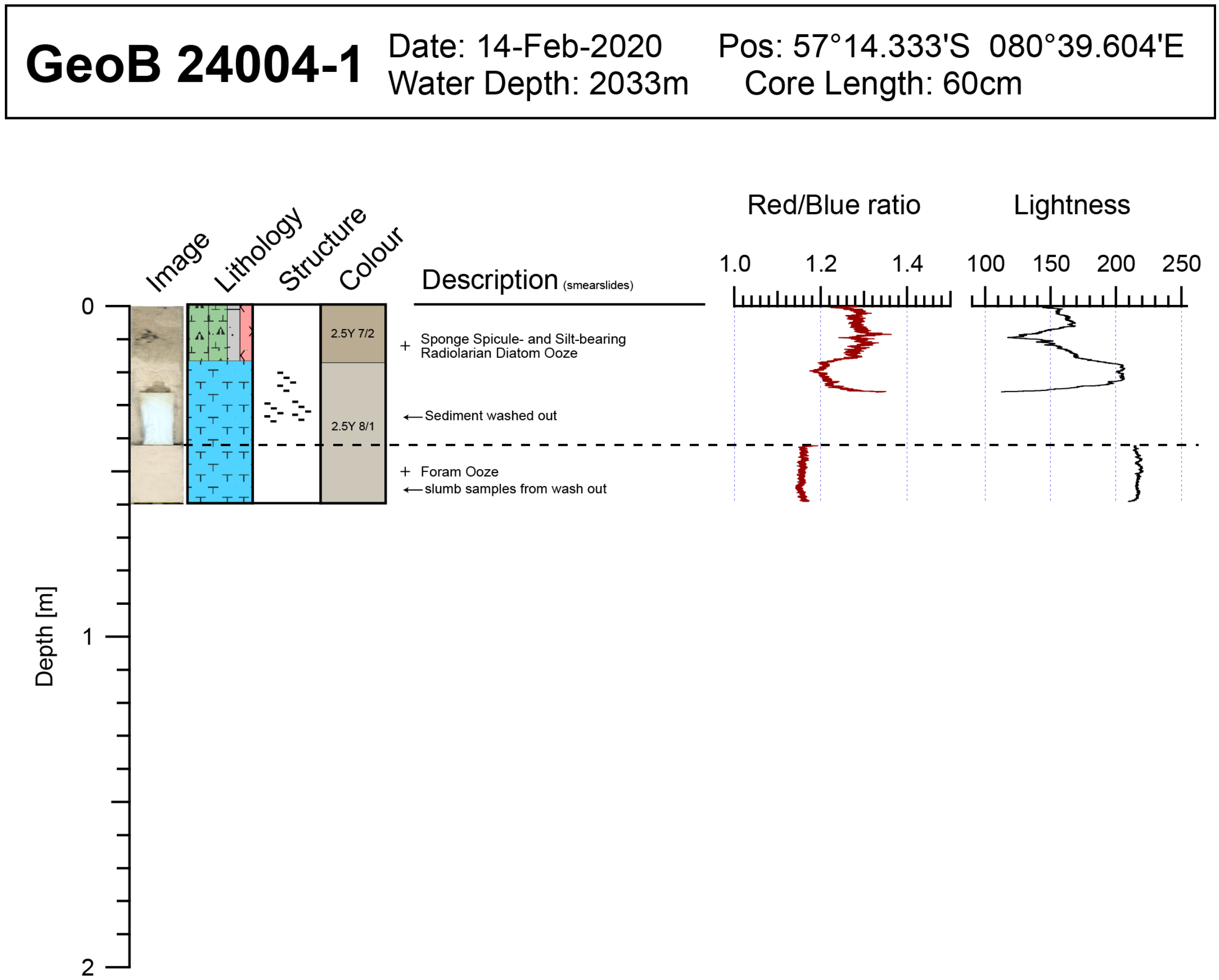


Fig. E.3 Core description of GeoB 24004-1.

GeoB 24005-1	Date: 14-Feb-2020 Water Depth: 2153m	Pos: 57°11.870'S 080°43.847'E Core Length: 108cm

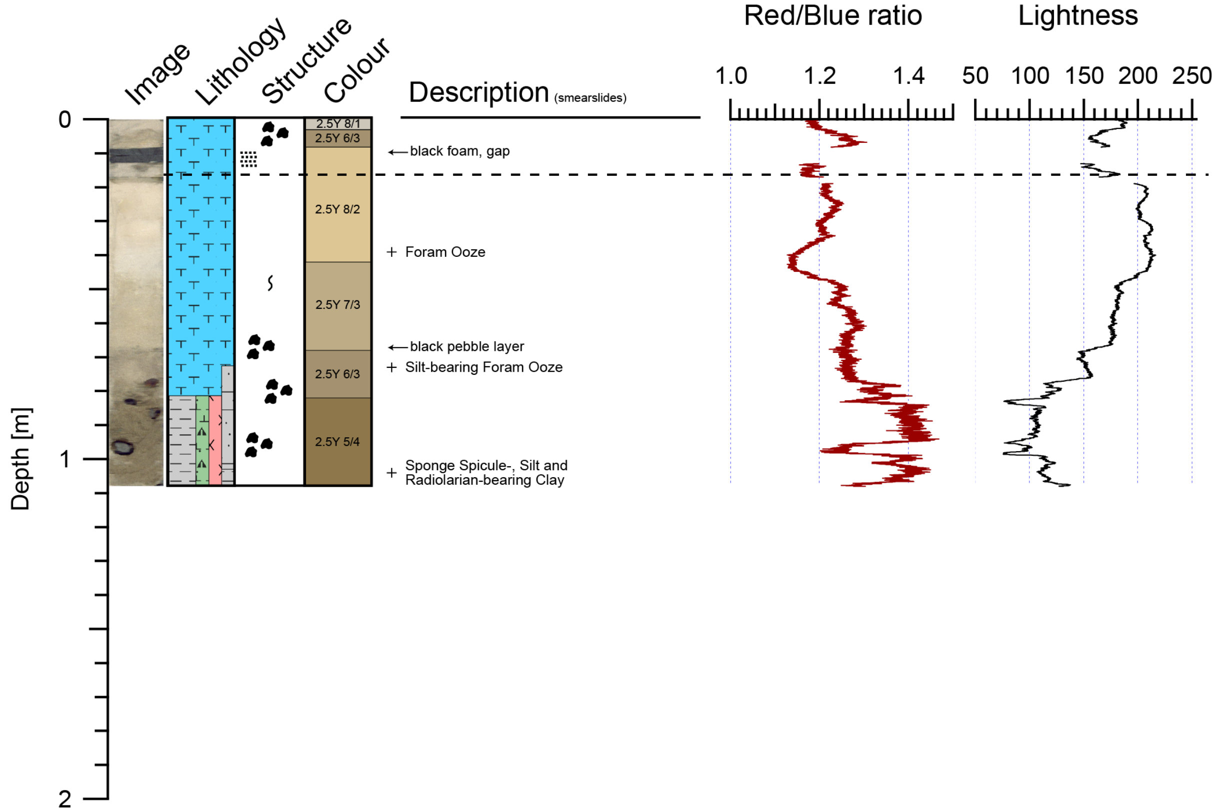


Fig. E.4 Core description of GeoB 24005-1

GeoB 24006-1	Date: 14-Feb-2020 Water Depth: 2396m	Pos: 57°08.640'S 080°49.417'E Core Length: 176cm

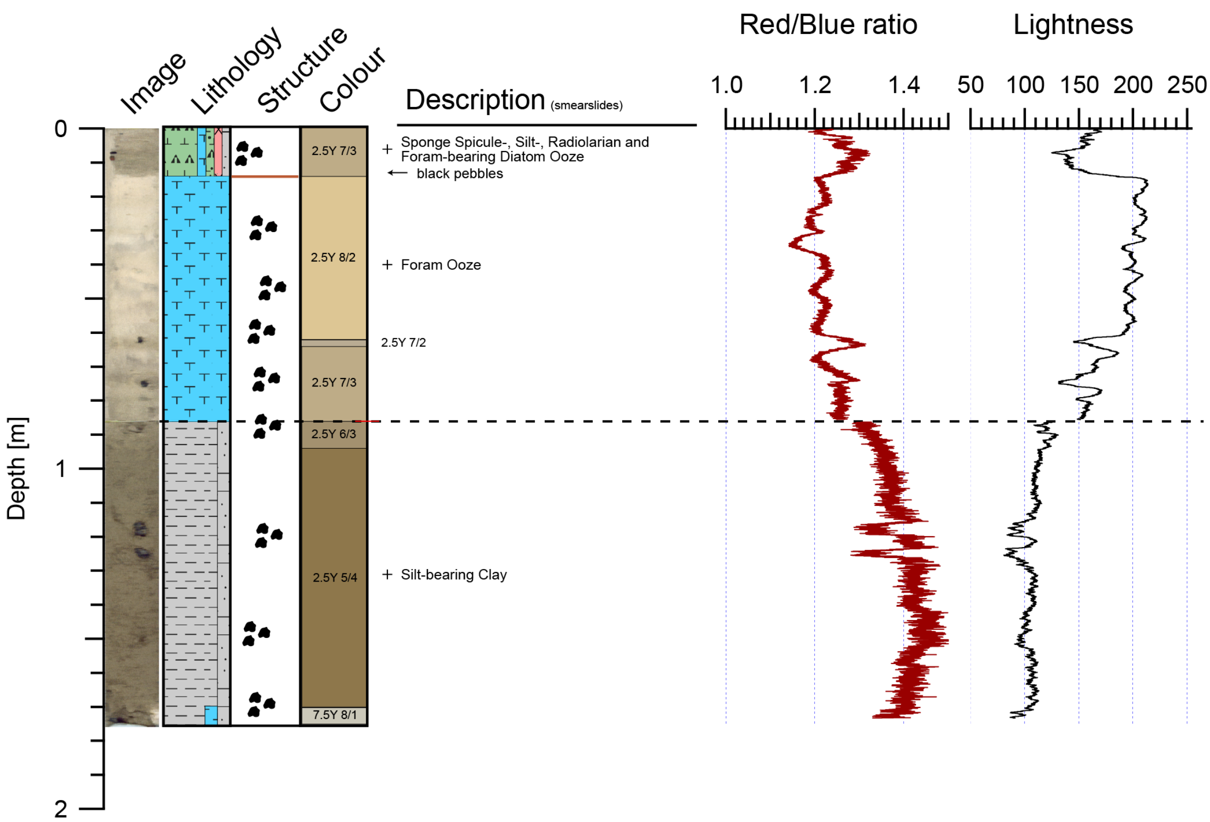


Fig. E.5 Core description of GeoB 24006-1

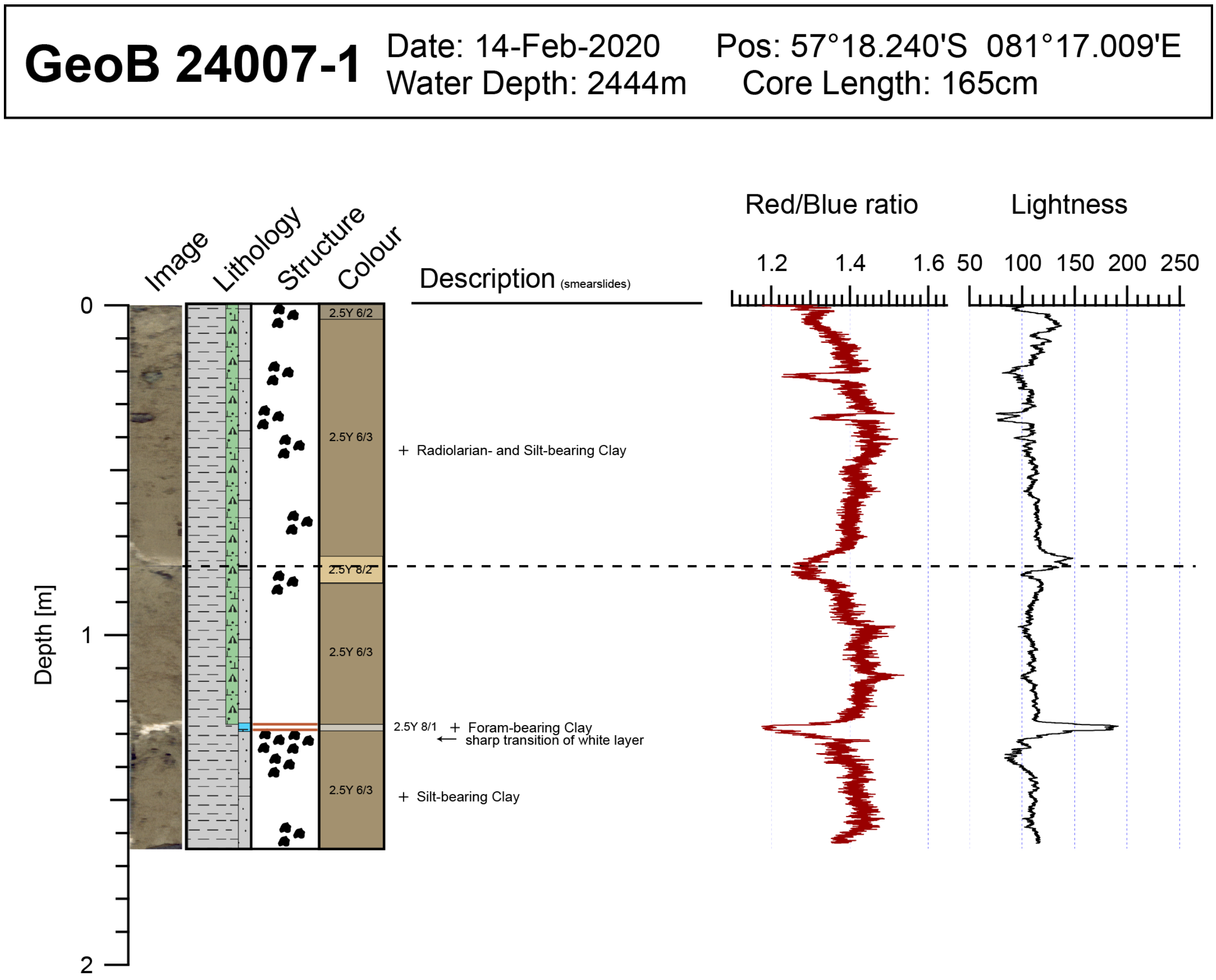


Fig. E.6 Core description of GeoB 24007-1.

GeoB 24008-1	Date: 15-Feb-2020 Water Depth: 1854m	Pos: 56°50.661'S 079°28.979'E Core Length: 170cm

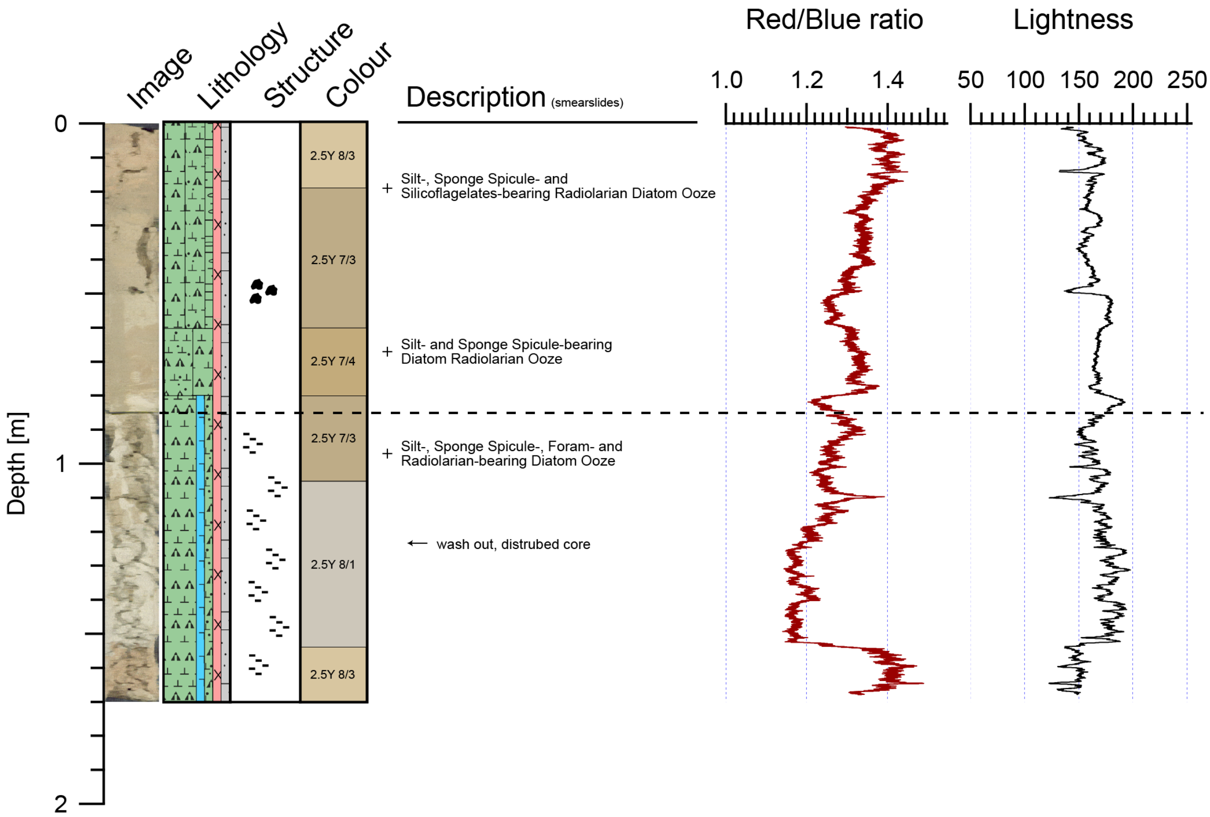


Fig. E.7 Core description of GeoB 24008-1

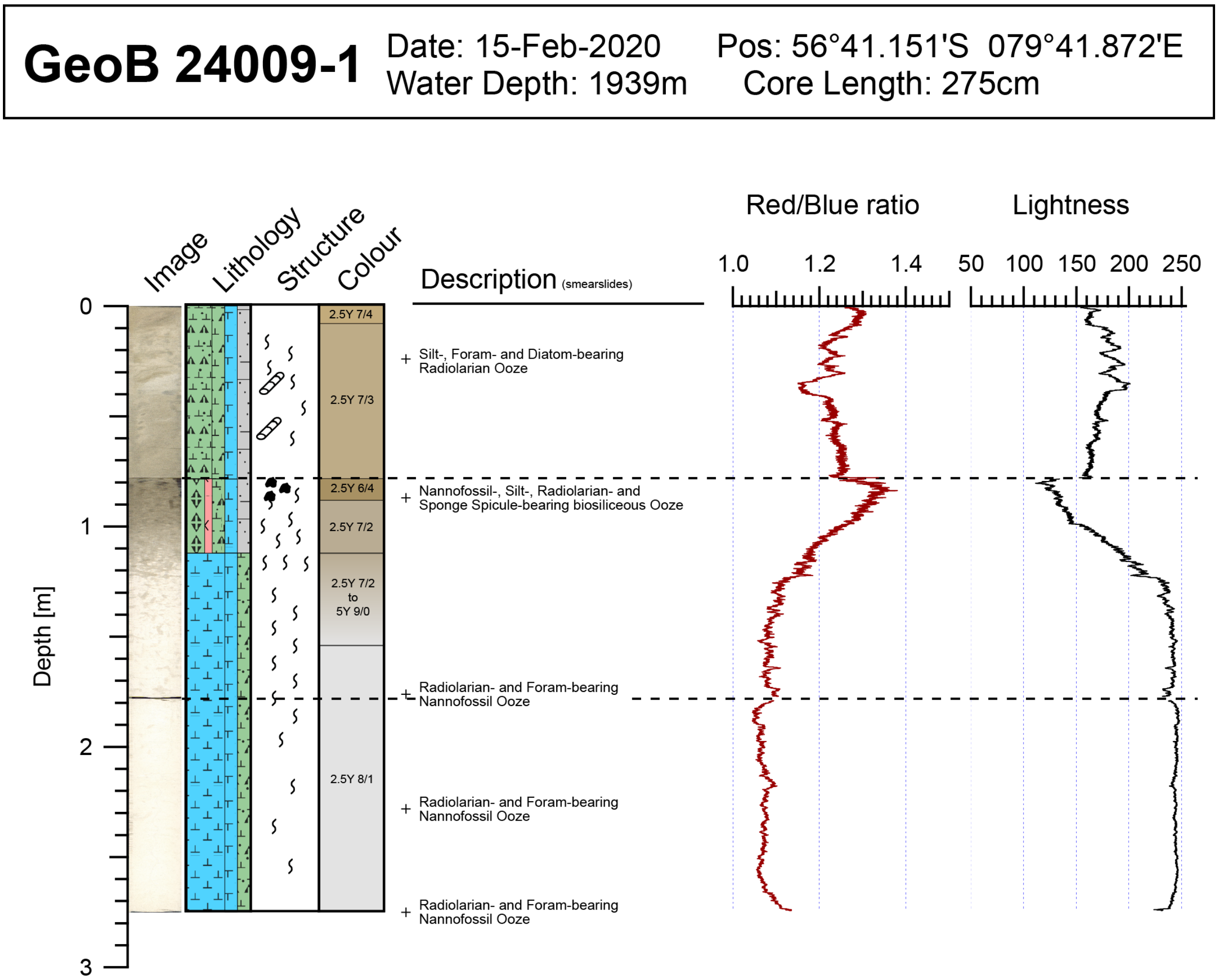


Fig. E.8 Core description of GeoB 24009-1.

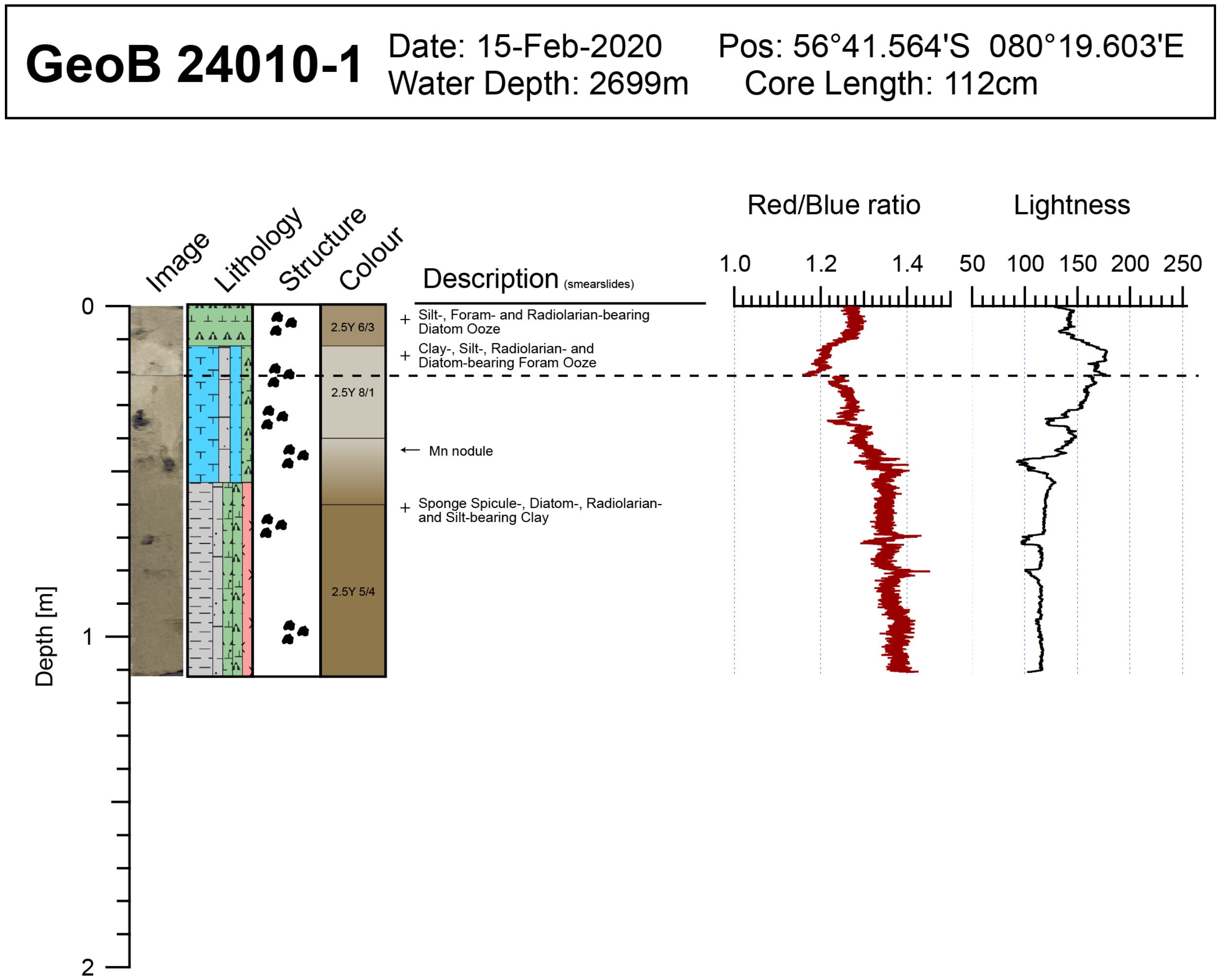


Fig. E.9 Core description of GeoB 24010-1.

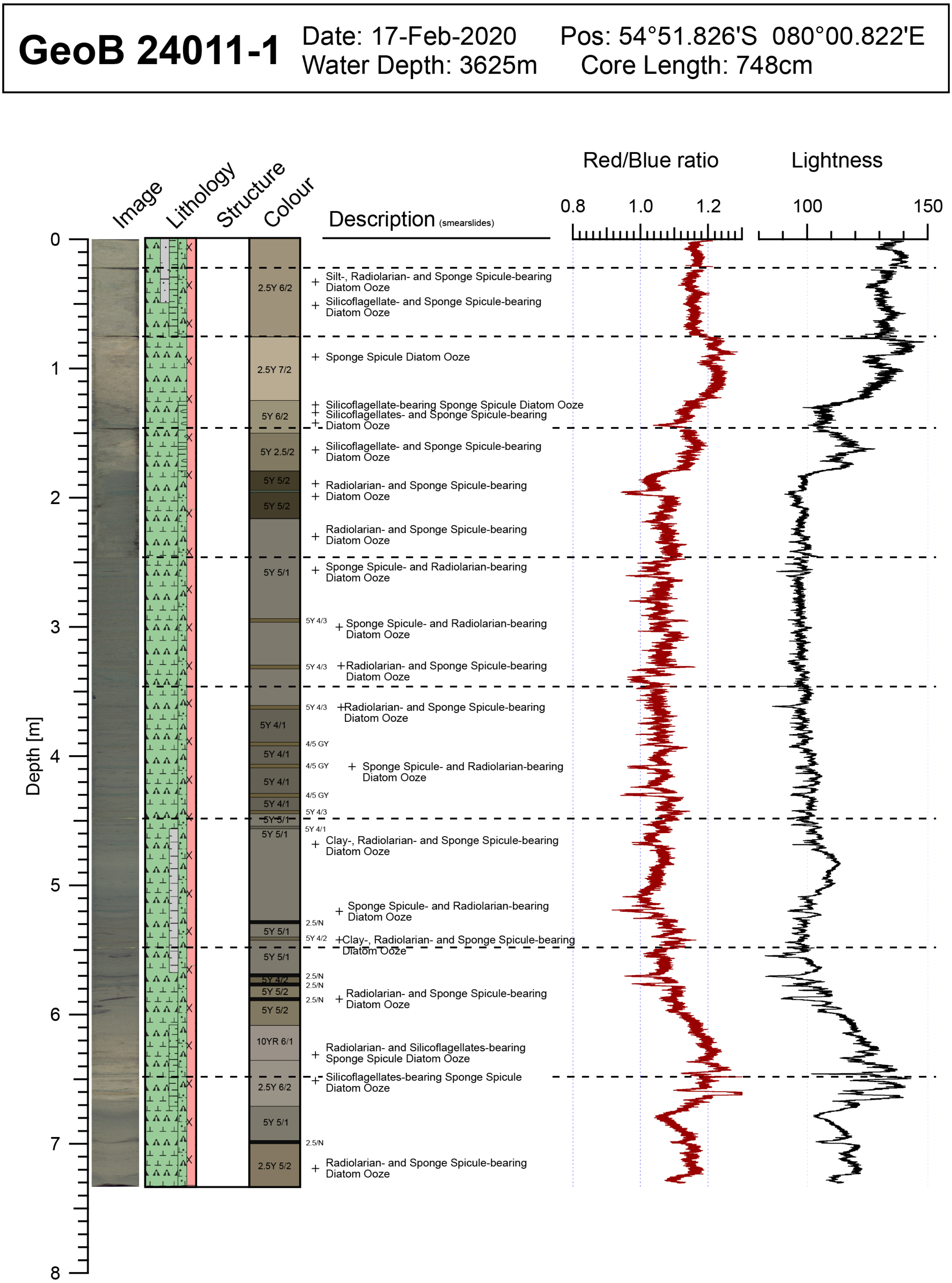


Fig. E.9 Core description of GeoB 24011-1.

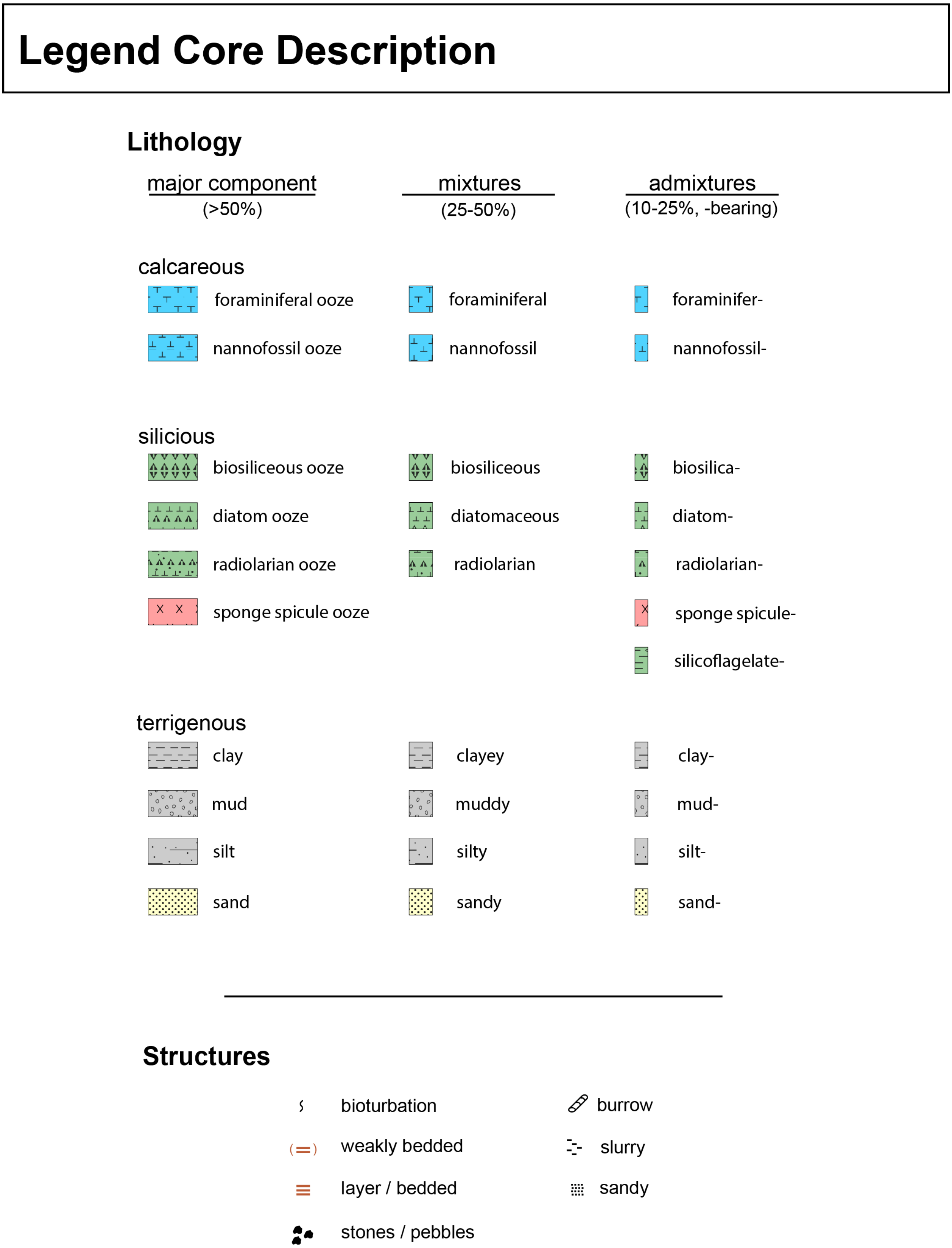


Fig. E.10 Description key.