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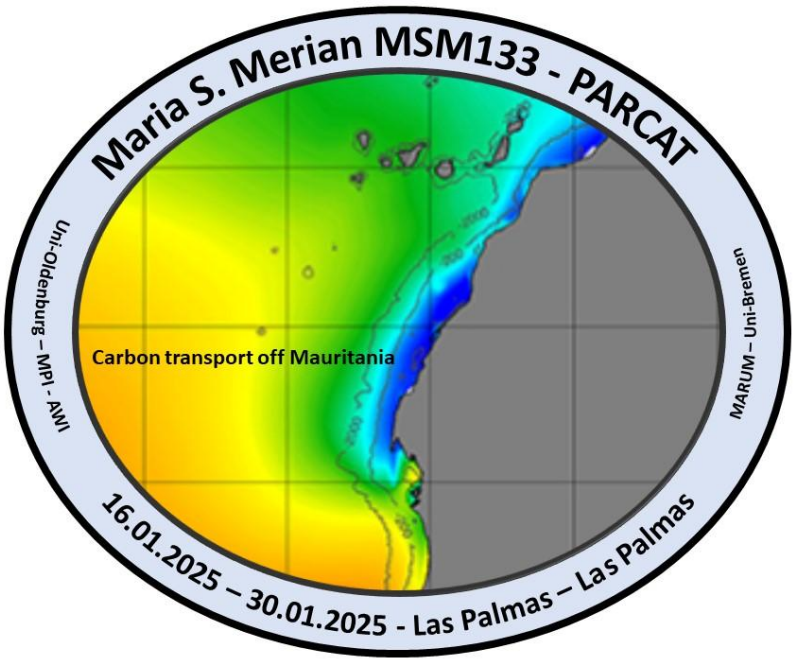
RV MARIA S. MERIAN
Short Cruise Report
Cruise MSM133

Las Palmas (Spain) – Las Palmas (Spain)
16.01.2025 – 30.01.2025

Chief Scientist: Prof. Dr. Morten Iversen
Captain: Björn Maass



PARCAT - Particle and carbon transport from shelf to ocean off Mauritania

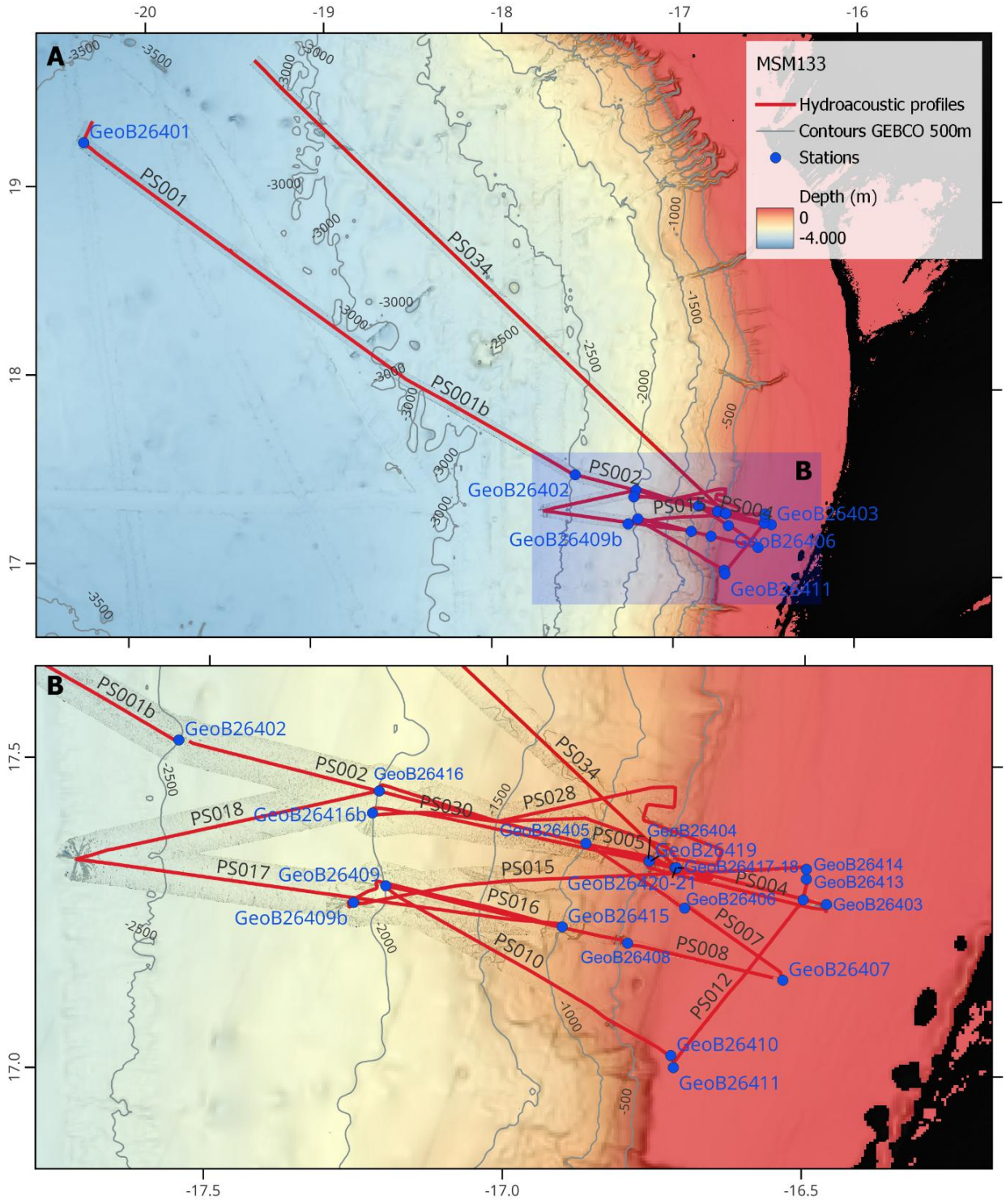


Fig. 1: Map of cruise track and station during MSM133 with the station names as 'GeoB244XX' and the hydroacoustic surves indicated with PSXXX.

Objectives

MSM133 was conducted by a consortium of scientists from the Alfred Wegener Institute, MARUM – Centre for Marine Environmental Sciences at the University of Bremen, the Max Planck Institute for Marine Microbiology, University of Oldenburg, and the University of Bayreuth. The primary objective of MSM133 was to investigate the vertical and lateral transport of organic matter along the Mauritanian margin and its contribution to deep-sea carbon sequestration. To address these questions, we deployed free-drifting sediment traps to measure short-term variability in particle flux, alongside in situ optical systems to assess aggregate size distribution and settling velocities. Additional pelagic sampling included In-Situ-Pumps, marine snow catchers, water column profiling, and plankton net tows. Hydroacoustic surveys using ADCP, multibeam, and Parasound provided insights into current dynamics, seafloor topography, and suspended particle distributions. Benthic sampling with multi-corers and grabs allowed us to investigate the remineralization of organic matter and its long-term sequestration in sediments. Onboard incubations were conducted to measure biological production and transformation rates in both the water column and seafloor.

The work area of MSM133 was located along the Mauritanian margin, a key region for studying the interactions between coastal upwelling, lateral transport, and deep-sea carbon sequestration. The Mauritanian upwelling system is one of the most productive regions of the global ocean, fueling high rates of primary production and particle flux. However, a significant fraction of organic matter produced in the surface ocean is laterally transported rather than settling directly to the deep sea. This region is characterized by strong boundary currents, recurring nepheloid layers, and extensive sediment resuspension, all of which contribute to the redistribution of organic carbon and nutrients. Despite its importance, the relative contributions of vertical and lateral transport to deep-sea carbon storage remain uncertain.

The aim of MSM133 was to investigate the transport, transformation, and sequestration of organic matter along a depth gradient from the Mauritanian shelf to the deep ocean. A key focus was on the role of nepheloid layers in redistributing organic carbon and nutrients, particularly in regions of enhanced lateral transport. The cruise aimed to assess the balance between vertical flux and lateral advection, identifying the processes that regulate particle retention, remineralization, and export efficiency across different water depths. In addition, we sought to quantify the microbial and geochemical transformations of sinking organic matter, including the role of oxygen availability in driving carbon and nitrogen cycling within sedimenting particles and at the seafloor. During the cruise, we investigated the following hypotheses:

- *The interaction between nepheloid layers and sinking particles enhances lateral transport of organic matter, leading to increased deposition at slope and deep-sea basin sites.*
- *Organic matter reaching the deep ocean undergoes significant microbial alteration, influencing the efficiency of long-term carbon storage.*
- *The oxygen concentration in suspended particle layers plays a critical role in determining the remineralization rates of organic carbon and nitrogen.*
- *Resuspension and lateral transport processes redistribute sedimented organic matter, affecting benthic community structure and biogeochemical cycling.*
- *The composition and molecular signatures of particulate organic matter change along the transport pathway from the productive surface ocean to deep-sea sediment traps and benthic environments.*

Narrative

On Wednesday, January 15th, the research expedition MSM133 aboard RV MARIA S. MERIAN officially began as 19 scientists embarked in the port of Las Palmas, Gran Canaria, Spain. This was the first of three voyages under the MARUM Excellence Cluster unit RECEIVER, focused on studying the vertical and lateral transport of organic matter in the ocean. MSM133 targeted the Mauritanian shelf off northwest Africa, MSM134 will do the same for the shelf off Morocco, while MSM136 will investigate the Irish Shelf. The overarching objective of the cruises is to improve our understanding of organic matter dynamics, their role in carbon cycling, and their contribution to long-term CO_2 storage in deep-sea sediments.

The first day was dedicated to unpacking containers, setting up laboratories, and configuring the wide array of technical equipment required for the cruise. This included sediment traps for studying vertical fluxes, in situ pumps, marine snow catchers, camera systems, and various samplers for pelagic analyses. Hydroacoustic systems, such as ADCP, Parasound, and multibeam bathymetry along with sediment sampling tools like multi-corers and grabs were used to study the different benthic environments. Collaboration between the crew and scientific team was essential in ensuring all instruments were fully operational before the first station.

At 08:00 on January 16th, RV MARIA S. MERIAN departed Las Palmas under calm and sunny conditions. During the two-day transit south, final preparations continued, and on January 18th at 22:00, we arrived at our first station, located in international waters at 19°14.34'N and 020°19.98'W, with a water depth of 3390 m. Sampling at this station included biogeochemical analyses of particulate and dissolved organic matter, nutrient measurements, and vertical particle size distribution profiling using in situ imaging systems. All operations proceeded smoothly, marking a successful start to the scientific program.

Following the deep-ocean station, we proceeded to a grid station at 2500 m depth, where the same comprehensive sampling protocol was repeated. From there, a hydroacoustic survey guided us toward the Mauritanian shelf (80 m depth), where we initiated the next phase of pelagic and benthic investigations. The first week of the cruise set the stage for an intensive research campaign, with a diverse range of sampling techniques deployed to explore organic matter cycling.

During the second week, research efforts intensified as we focused on two transects extending from the shallow Mauritanian shelf (~100 m depth) to deeper offshore waters (2000–2500 m). A major component of the work was a dedicated 24-hour process study investigating the formation and dynamics of nepheloid layers, which play a crucial role in transporting organic matter across the shelf and slope.

A variety of advanced techniques were employed to characterize both the pelagic and benthic environments. Water samples for particulate and dissolved organic matter analyses were collected using in situ pumps and the CTD-Rosette. In situ camera systems were deployed to assess particle size distribution and abundance, while marine snow catchers enabled isolation and analysis of sinking aggregates. Free-drifting sediment traps provided data on vertical export fluxes of organic carbon. Benthic investigations involved multi-corer sampling of surface sediments to examine organic matter composition and alteration processes, as well as grab sampling for direct rate measurements of nutrient recycling in sandy sediments.

Hydroacoustic surveys using ADCP, Parasound, and multibeam echosounders mapped seafloor topography, assessed current velocities and directions, and detected suspended and settling particles. The highlight of this phase was the 24-hour nepheloid layer study, which combined hydroacoustic data with physical sampling to trace the origins, transport pathways, and composition of these turbid layers. Initial findings revealed significant spatial variability in nepheloid layer characteristics. Bottom nepheloid layers near the shelf break appeared particularly pronounced, likely influenced by bottom currents, internal waves, and sediment resuspension. Intermediate nepheloid layers exhibited distinct particle size distributions, suggesting lateral transport processes

were also at play. These results supported our hypothesis that nepheloid layers serve as conduits for organic matter transport from the productive shelf to the deep ocean, with potential implications for long-term carbon sequestration.

Throughout the expedition, collaboration between scientists from MARUM, the Alfred Wegener Institute, the University of Oldenburg, the Max Planck Institute for Marine Microbiology, and the University of Bayreuth proved instrumental in addressing the complex dynamics of organic matter transport and transformation. The interdisciplinary nature of the project fostered a productive exchange of expertise in biogeochemistry, oceanography, sedimentology, and geochemistry.

On January 26th, we completed our final station, marking the end of the sampling phase of MSM133. At 15:20, the last deployment of the in-situ camera was conducted, after which we began our transit back to Las Palmas. The team remained highly motivated, ensuring final data processing and sample preparation continued smoothly. The professionalism and dedication of the RV MARIA S. MERIAN crew were essential to the success of the mission, and their support was deeply appreciated by the scientific team.

As we approached Las Palmas on January 30st, reflections on the cruise underscored the significance of the research undertaken. The wealth of data collected would contribute valuable insights into organic matter transport, its role in carbon cycling, and its long-term fate in the deep ocean. With MSM133 concluded, the focus now shifted to upcoming expeditions, MSM134 and MSM136, which would further expand our understanding of organic matter dynamics in different marine environments.

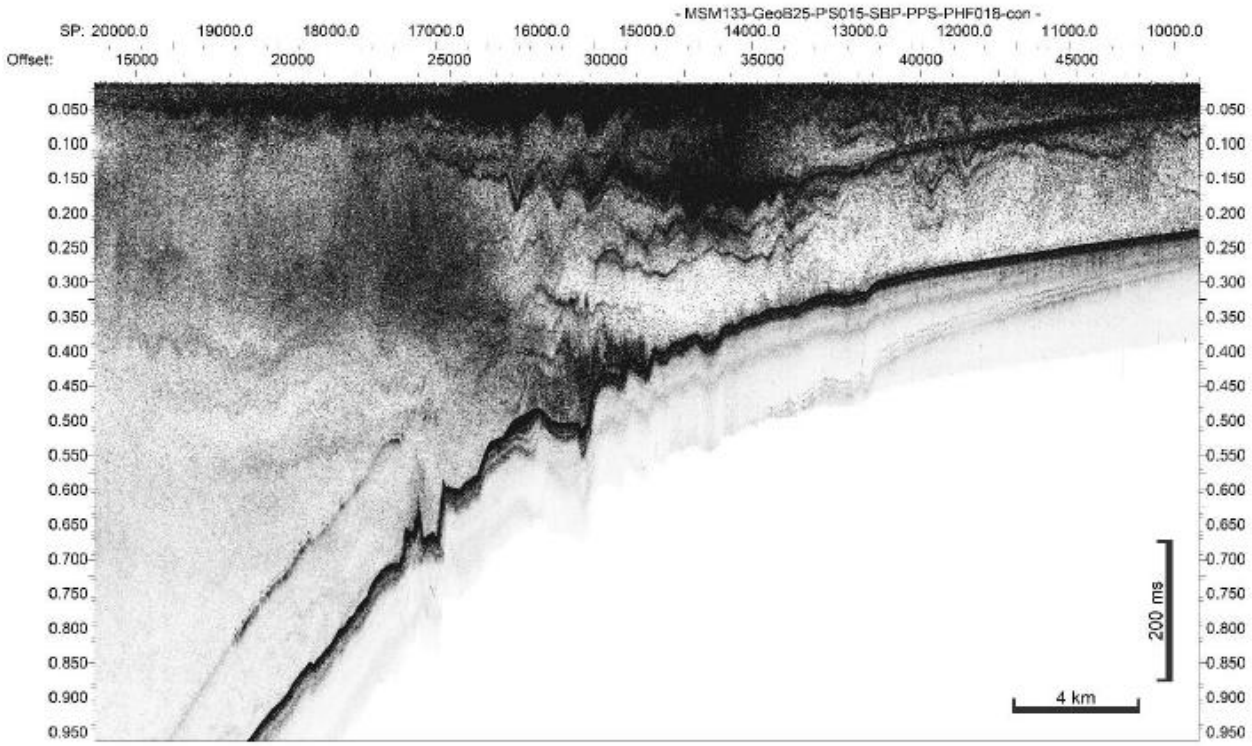


Fig. 2: Parasound image showing a distinct nepheloid layer originating from the shelf break during the MSM133. The dark signal highlights suspended particulate matter being resuspended and transported. This observation illustrates the dynamic processes at the shelf break.

Cruise participants

Name	Discipline	Institution
Iversen, Morten, Prof.	Particle flux/Chief Scientist	AWI/MARUM
Marchant, Hannah, Dr.	Nitrogen cycling	MARUM/MPI
Miramontes-Garcia, Elda, Dr	Hydroacoustics	MARUM/Uni-B.
Lumor, Prospero	Hydroacoustics	Uni-B.
Bernhard, Renée	Hydroacoustics	Uni-B.
Stührenberg, Jördis	Nitrogen cycling	MPI
Case, Ella	Polysaccharides	MARUM/Uni-B
Pamphile dos Santos, Julia	Pelagic biogeochemistry	MARUM/MPI
Murawski, Sandra	Pelagic biogeochemistry	AWI
Konrad, Christian	In situ optics	AWI
Jensen, Klara	Benthic carbon dating	AWI
Reuter, Runa	In situ optics and aggregates	MARUM/AWI
Staniek, Maren	Pelagic biogeochemistry	MARUM/AWI
Rosmann, Mara	Carbon dating	AWI
Grotheer, Hendrik, Dr.	Carbon dating	AWI/MARUM
Dittmar, Thorsten, Prof	Dissolved organic matter	Uni-Old./MPI
Bruhnke, Tamina	Dissolved organic matter	Uni-Old.
Pohl, Florian, Dr.	Microplastics	Uni-Bayr.
Kockisch, Brit	Sediment dynamics	Uni-B.

Institutions

AWI	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research
MARUM	Centre for Marine Environmental Sciences at the University of Bremen
Uni-B.	Geosciences Department, University of Bremen
MPI-MM	Max Planck Institute for Marine Microbiology
Uni-Old.	ICBM, University of Oldenburg
Uni-Bayr.	University of Bayreuth

Station list

Activity	Date / Time	Device	Device Comment	Position	Position	Depth
No.	[UTC]			Lat	Lon	[m]
MSM133_1-1	18.01.2025 22:50	CTD	GeoB26401_1	19° 14,324' N	020° 19,964' W	3896
MSM133_1-2	18.01.2025 23:29	In Situ Camera	GeoB26401_2	19° 14,324' N	020° 19,965' W	3388
MSM133_1-3	19.01.2025 03:01	CTD	GeoB26401_3	19° 14,326' N	020° 19,965' W	3387
MSM133_1-4	19.01.2025 06:06	CTD	GeoB26401_4	19° 14,343' N	020° 19,978' W	3385
MSM133_2-1	20.01.2025 02:55	CTD	GeoB26402_1	17° 31,858' N	017° 33,023' W	2472
MSM133_2-2	20.01.2025 04:56	In Situ Camera	GeoB26402_2	17° 31,858' N	017° 33,009' W	2460
MSM133_2-3	20.01.2025 08:59	CTD	GeoB26402_3	17° 31,857' N	017° 33,009' W	2474
MSM133_2-4	20.01.2025 09:45	Parasound P70	GeoB26402_4	17° 31,857' N	017° 33,009' W	2469
MSM133_2-5	20.01.2025 09:45	Multibeam Echosounder	GeoB26402_5	17° 31,858' N	017° 33,010' W	2473
MSM133_3-1	20.01.2025 18:02	CTD	GeoB26403_1	17° 16,556' N	016° 27,606' W	95
MSM133_3-2	20.01.2025 18:27	In Situ Camera	GeoB26403_2	17° 16,555' N	016° 27,606' W	93
MSM133_3-3	20.01.2025 19:08	Marine Snow Catcher	GeoB26403_3	17° 16,556' N	016° 27,605' W	94
MSM133_3-4	20.01.2025 19:23	Marine Snow Catcher	GeoB26403_4	17° 16,556' N	016° 27,605' W	94
MSM133_3-5	20.01.2025 19:38	In Situ Pump	GeoB26403_5	17° 16,555' N	016° 27,606' W	94
MSM133_3-6	20.01.2025 21:54	Multi Corer	GeoB26403_6	17° 16,555' N	016° 27,605' W	93
MSM133_3-7	20.01.2025 22:58	van Veen Grab	GeoB26403_7	17° 15,870' N	016° 27,683' W	92
MSM133_4-1	21.01.2025 01:55	CTD	GeoB26404_1	17° 20,673' N	016° 45,516' W	471
MSM133_4-2	21.01.2025 02:40	In Situ Camera	GeoB26404_2	17° 20,676' N	016° 45,529' W	495
MSM133_4-3	21.01.2025 03:49	In Situ Pump	GeoB26404_3	17° 20,678' N	016° 45,523' W	491
MSM133_4-4	21.01.2025 06:25	Multi Corer	GeoB26404_4	17° 20,677' N	016° 45,516' W	484
MSM133_5-1	21.01.2025 08:25	CTD	GeoB26405_1	17° 22,322' N	016° 51,905' W	1015
MSM133_5-2	21.01.2025 09:32	In Situ Camera	GeoB26405_2	17° 22,322' N	016° 51,905' W	1015
MSM133_5-3	21.01.2025 12:43	Plankton Net	GeoB26405_3	17° 22,322' N	016° 51,905' W	1012
MSM133_5-4	21.01.2025 13:56	In Situ Pump	GeoB26405_4	17° 22,323' N	016° 51,906' W	1014
MSM133_5-5	21.01.2025 17:08	Multi Corer	GeoB26405_5	17° 22,320' N	016° 51,908' W	1014
MSM133_6-1	21.01.2025 19:41	van Veen Grab	GeoB 26406_1	17° 16,107' N	016° 41,915' W	226
MSM133_6-2	21.01.2025 20:12	van Veen Grab	GeoB26406_2	17° 16,111' N	016° 41,915' W	226

MSM133_6-3	21.01.2025 20:36	van Veen Grab	GeoB26406_3	17° 16,113' N	016° 41,917' W	228
MSM133_6-4	21.01.2025 20:53	van Veen Grab	GeoB26406_4	17° 16,117' N	016° 41,918' W	226
MSM133_6-5	21.01.2025 21:10	van Veen Grab	GeoB26406_5	17° 16,120' N	016° 41,921' W	226
MSM133_6-6	21.01.2025 21:27	van Veen Grab	GeoB26406_6	17° 16,121' N	016° 41,921' W	227
MSM133_7-1	21.01.2025 23:46	CTD	GeoB26407_1	17° 09,208' N	016° 31,986' W	99
MSM133_7-3	22.01.2025 00:49	Multi Corer	GeoB26407_3	17° 09,208' N	016° 31,987' W	100
MSM133_8-1	22.01.2025 03:12	CTD	GeoB26408_1	17° 12,666' N	016° 47,638' W	400
MSM133_8-2	22.01.2025 03:58	In Situ Camera	GeoB26408_2	17° 12,666' N	016° 47,638' W	400
MSM133_8-3	22.01.2025 04:57	Multi Corer	GeoB26408_3	17° 12,666' N	016° 47,638' W	399
MSM133_9-1	22.01.2025 08:56	CTD	GeoB26409_1	17° 18,061' N	017° 12,006' W	1964
MSM133_9-2	22.01.2025 09:43	Marine Snow Catcher	GeoB26409_2	17° 18,062' N	017° 12,006' W	1967
MSM133_9-3	22.01.2025 09:57	Marine Snow Catcher	GeoB26409_3	17° 18,061' N	017° 12,006' W	1969
MSM133_9-4	22.01.2025 11:19	Trap, drifting	GeoB26409_4	17° 17,947' N	017° 12,089' W	1967
MSM133_9-5	22.01.2025 11:59	CTD	GeoB26409_5	17° 17,967' N	017° 12,133' W	1969
MSM133_9-6	22.01.2025 13:37	In Situ Camera	GeoB26409_6	17° 17,966' N	017° 12,133' W	1970
MSM133_9-7	23.01.2025 09:50	In Situ Camera	GeoB26409_7	17° 16,349' N	017° 15,361' W	2076
MSM133_9-8	23.01.2025 15:16	Multi Corer	GeoB26409_8	17° 17,931' N	017° 12,907' W	2001
MSM133_10-1	22.01.2025 21:02	van Veen Grab	GeoB26410_1	17° 01,881' N	016° 43,050' W	104
MSM133_10-2	22.01.2025 21:16	van Veen Grab	GeoB26410_2	17° 01,877' N	016° 43,051' W	107
MSM133_10-3	22.01.2025 21:29	van Veen Grab	GeoB26410_3	17° 01,882' N	016° 43,052' W	105
MSM133_10-4	22.01.2025 21:42	van Veen Grab	GeoB26410_4	17° 01,884' N	016° 43,053' W	107
MSM133_10-5	22.01.2025 21:56	van Veen Grab	GeoB26410_5	17° 01,888' N	016° 43,053' W	107
MSM133_10-6	22.01.2025 22:10	van Veen Grab	GeoB26410_6	17° 01,890' N	016° 43,055' W	106
MSM133_10-7	22.01.2025 22:24	van Veen Grab	GeoB26410_7	17° 01,896' N	016° 43,057' W	106
MSM133_11-1	22.01.2025 23:10	van Veen Grab	GeoB26411_1	17° 00,650' N	016° 43,013' W	104
MSM133_12-1	23.01.2025 02:11	van Veen Grab	GeoB26412_1	17° 17,012' N	016° 29,996' W	103
MSM133_13-1	23.01.2025 02:51	van Veen Grab	GeoB26413_1	17° 19,017' N	016° 29,689' W	105
MSM133_13-2	23.01.2025 03:09	van Veen Grab	GeoB26413_2	17° 19,017' N	016° 29,689' W	106
MSM133_14-1	23.01.2025 03:40	van Veen Grab	GeoB26414_1	17° 19,979' N	016° 29,692' W	107
MSM133_15-1	23.01.2025 19:45	CTD	GeoB26415_1	17° 14,208' N	016° 54,202' W	968
MSM133_15-2	23.01.2025 20:44	In Situ Camera	GeoB26415_2	17° 14,218' N	016° 54,192' W	976

MSM133_15-3	23.01.2025 22:32	Multinet	GeoB26415_3	17° 14,218' N	016° 54,192' W	989
MSM133_15-4	23.01.2025 23:50	Multi Corer	GeoB26415_4	17° 14,218' N	016° 54,194' W	972
MSM133_16-1	24.01.2025 09:56	CTD	GeoB26416_1	17° 27,186' N	017° 12,786' W	2010
MSM133_16-2	24.01.2025 10:38	Marine Snow Catcher	GeoB26416_2	17° 27,184' N	017° 12,786' W	2136
MSM133_16-3	24.01.2025 10:52	Marine Snow Catcher	GeoB26416_3	17° 27,185' N	017° 12,786' W	2007
MSM133_16-4	24.01.2025 12:03	Trap, drifting	GeoB26416_4	17° 27,100' N	017° 12,841' W	2012
MSM133_16-5	24.01.2025 12:32	CTD	GeoB26416_5	17° 27,210' N	017° 12,950' W	2021
MSM133_16-6	24.01.2025 14:09	In Situ Camera	GeoB26416_6	17° 27,208' N	017° 12,951' W	2020
MSM133_16-7	24.01.2025 16:57	In Situ Pump	GeoB26416_7	17° 27,208' N	017° 12,954' W	2021
MSM133_16-8	24.01.2025 20:20	CTD	GeoB26416_8	17° 27,206' N	017° 12,942' W	2022
MSM133_16-9	24.01.2025 21:24	Multi Corer	GeoB26416_9	17° 27,185' N	017° 12,786' W	2011
MSM133_16-10	24.01.2025 23:25	Parasound P70	GeoB26416_10	17° 27,218' N	017° 12,803' W	2015
MSM133_16-11	24.01.2025 23:25	Multibeam Echosounder	GeoB26416_11	17° 27,232' N	017° 12,805' W	2015
MSM133_16-12	24.01.2025 23:25	ADCP (38kHz)	GeoB26416_12	17° 27,247' N	017° 12,806' W	2014
MSM133_17-1	25.01.2025 14:57	CTD	GeoB26417_1	17° 20,045' N	016° 42,902' W	316
MSM133_17-2	25.01.2025 15:44	In Situ Camera	GeoB26417_2	17° 20,045' N	016° 42,902' W	317
MSM133_17-3	25.01.2025 19:57	CTD	GeoB26417_3	17° 20,045' N	016° 42,902' W	316
MSM133_17-4	25.01.2025 22:25	In Situ Pump	GeoB26417_4	17° 20,045' N	016° 42,902' W	316
MSM133_18-1	26.01.2025 01:09	CTD	GeoB 26418_1	17° 20,010' N	016° 42,773' W	320
MSM133_19-1	26.01.2025 03:04	In Situ Camera	GeoB26419_1	17° 20,683' N	016° 45,523' W	493
MSM133_19-2	26.01.2025 07:04	CTD	GeoB26419_2	17° 20,683' N	016° 45,522' W	492
MSM133_19-3	26.01.2025 08:07	In Situ Pump	GeoB26419_3	17° 20,683' N	016° 45,522' W	490
MSM133_20-1	26.01.2025 11:12	CTD	GeoB26420_1	17° 20,055' N	016° 42,905' W	317
MSM133_20-2	26.01.2025 12:18	Marine Snow Catcher	GeoB26420_2	17° 20,053' N	016° 42,907' W	317
MSM133_20-3	26.01.2025 12:37	Marine Snow Catcher	GeoB26420_3	17° 20,054' N	016° 42,908' W	316
MSM133_20-4	26.01.2025 12:53	Multi Corer	GeoB26420_4	17° 20,054' N	016° 42,908' W	317
MSM133_21-1	26.01.2025 14:00	Multi Corer	GeoB26421_1	17° 20,017' N	016° 42,773' W	321
MSM133_21-2	26.01.2025 14:28	In Situ Camera	GeoB26421_2	17° 20,017' N	016° 42,772' W	319