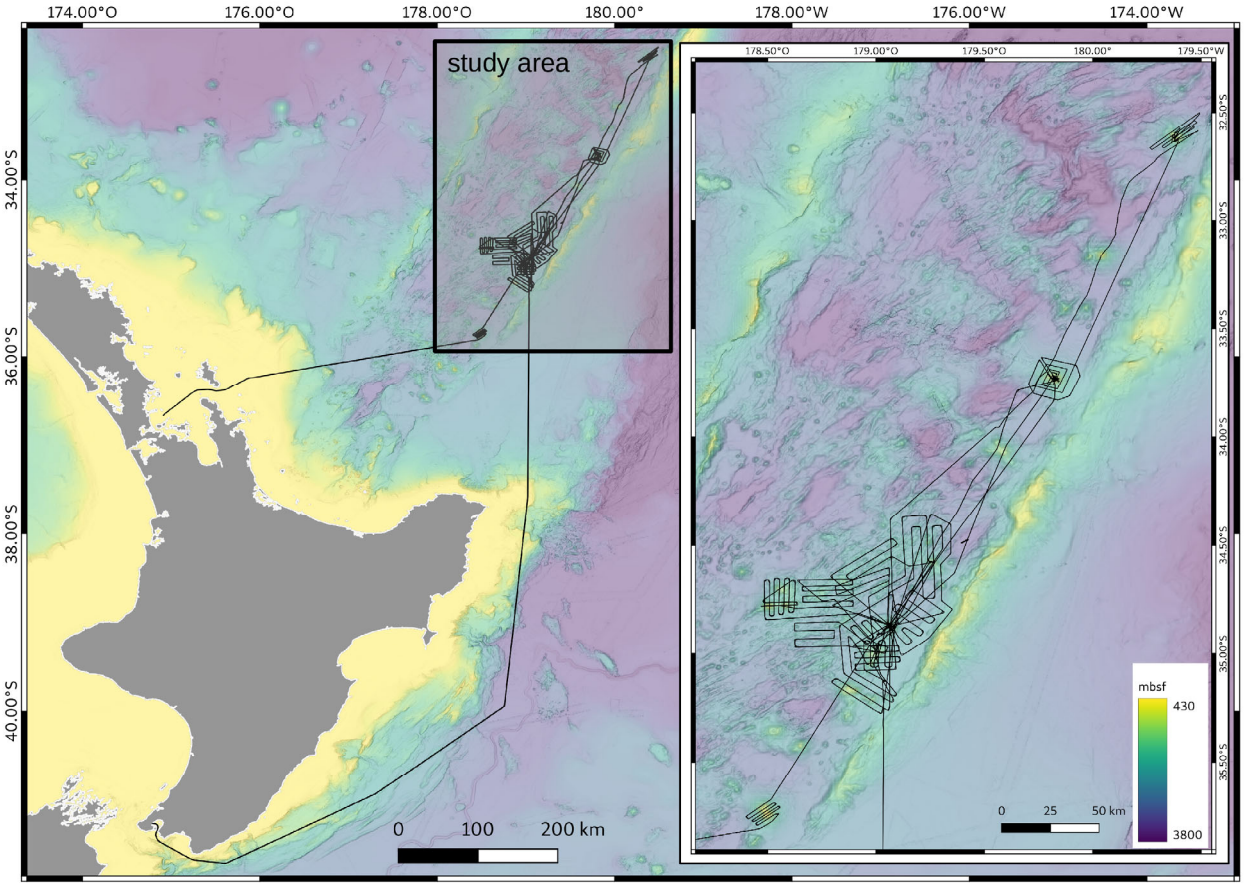
Wolfgang Bach
Fachbereich Geowissenschaften und MARUM - Center for Marine Environmental Sciences
Universität Bremen
Klagenfurter Str. 2
28359 Bremen

Tel.: +49 (0)421 218 65400
Fax: +49 (0)421 218 65429
email: wbach@uni-bremen.de

Short Cruise Report
SONNE SO311

Wellington – Auckland
26.03.2025 – 01.05.2025
Chief Scientist: Wolfgang Bach
Captain: Oliver Meyer



Objectives

Research project SO311 DRILLBROTHERS investigates the complex magmatic, hydrothermal, and microbiological processes of the submarine Brothers Volcano in the southern Kermadec Arc. The volcano covers an area of about 7 km by 11 km and rises approximately 1000 m above the seafloor. Within the volcano, there is a caldera up to 1879 m deep, containing two young volcanic cones: the Upper Cone (1196 m) and the Lower Cone (1304 m). During the IODP Expedition 376, deep research drilling was conducted, but the upper basement was barely sampled. These layers will now be examined through MeBo drilling.

Recent discoveries have shown that hydrothermal systems along submarine arc volcanoes host large polymetallic sulfide deposits, making them an important target for deep-sea mineral exploration and a significant analog for fossil Cu-Au deposits mined on land. However, little is known about the distribution of mineralization and microbial habitats beneath the seafloor. The mechanisms of metal transfer from fractionating magma into the overlying hydrothermal system and the ability of arc-related magmas to concentrate metals are also not fully understood.

The MeBo drilling aims to obtain core material to study the recent volcanic development of the Brothers Volcano and the shallow hydrothermal mixing processes crucial for the transport and distribution of metals and metalloids. These drillings are related to the 2018 IODP Expedition 376, which investigated the deeper subsurface of the volcano. The new drillings will provide samples from the upper 70 to 80 m of the basement, as the core recovery rate was very low in that interval during the IODP drillings. The analysis will focus on targeted petrological and microbiological investigations to decipher the volcanic-hydrothermal development and the formation of hydrothermal metal enrichments, as well as to study microbial habitats and their ecological function in the deep biosphere of island arc volcanoes.

A key research goal is to investigate water-rock interactions and hydrothermal mineralization. The hydrothermal vents of the Brothers Volcano are fundamentally different: the Upper Cone features acidic “white smokers,” while the northwest rim of the caldera hosts classic “black smokers.” These differences reflect the variable flow rates of magmatic gases. The ascent of magmatic vapors and brines in island arc volcanoes influences the style of mineralization under the seafloor and the composition of the vent fluids, vent biota, and the transfer of metals and nutrients into the oceans. Hydrothermal systems in arc volcanoes undergo dynamic transitions due to changes in magma degassing rates. Magma degassing is dominated by H_2O, CO_2, H_2S, and/or SO_2, leading to drastic differences in fluid composition, often within a single volcanic edifice like Brothers Volcano.

Brothers Volcano hosts unique microbial ecosystems thriving in acidic fluids and fixing carbon chemolithoautotrophically. The connection between microbial ecosystems and magmatic and hydrothermal activity is strong, yet much remains unclear.

The coring of basement was aimed to provide crucial new insights into how magmatic differentiation and magma degassing impact metal transport within an island arc volcano. Additionally, the project will investigate the diversity and extent of microbial life in extreme volcanic environments.

Narrative

R/V SONNE left the port of Wellington, New Zealand, in the early afternoon of March 26. Prior to this, MARUM's MeBo200 marine drilling rig on board was tested in the harbor basin. Our course took us along the southern coast of New Zealand's North Island and past the Bay of Plenty to our working area at around 35°S and 179°E. There, in water depths between 1300 and 1800 meters, is a large submarine volcano called *Brothers*, which is home to various types of hot springs. On board are 34 researchers, including eleven members of the team that will deploy MeBo200. The cruise is being jointly organized and conducted by MARUM - Center for Marine Environmental Sciences at the University of Bremen and the GeoZentrum Nordbayern at Friedrich-Alexander-Universität Erlangen/Nürnberg (FAU). Researchers from New Zealand and Canada are also taking part in the SO311 cruise.

The scientific team covers the disciplines of geology, volcanology, geochemistry, microbiology and oceanography and also includes technical personnel with different objectives and tasks. Daily meetings promote exchange between the various groups on board.

In ideal weather, R/V SONNE covered a distance of 520 nautical miles before we arrived in the working area in the late afternoon of March 28. The station work began immediately after arrival. First, the CTD probe was deployed to accurately determine the sound velocity profile of the water column in the working area. The first water samples were taken from different depths using the NISKIN water samplers arranged around the probe. The evening of the March 28 was also used to test the functionality of the TV-guided grab (TVG). In the night hours, the underwater volcano Healy, which is less than ten nautical miles away from Brothers, was surveyed with the ship's own multibeam echo sounder EM122. Following rock sampling with the TVG, the first MeBo well was to be drilled on a fairly steep crater wall in the northwest of Brothers caldera (NWC), but hour-long surveying on the course of the 29th of March showed that the terrain is too steep and irregular and therefore unsuitable for a promising drilling location. A second, flatter area with evidence of extinct hydrothermal activity in the southeast of the caldera (SEC) was instead selected for the MeBo deployment.

After another night of EM122 surveying work at Healy, samples of the seabed at the SEC drilling location were taken in advance using the TVG on March 30th prior to and after a failed MeBo deployment there. Rock and water column sampling in the Brothers caldera took up most of the day of March 31, while another MeBo had to abandoned due to technical difficulties incurred upon lowering the drill rig in the water column. After nightly surveying work northeast of Brothers, MeBo could be launched successfully and drilling in the SEC area began midday on April 1. Geophysical measurements by our colleagues from the Geological and Nuclear Sciences (GNS) Institute of New Zealand indicate that the subsurface at the drilling location must be hydrothermally altered (Caratori-Tontini et al., 2012). In order to reach these layers of interest to us, MeBo had to drill through the overlying layer of slope debris. This was achieved during Station 017, and several meters of drill core of hydrothermally mineralized basement from a depth of 15 to 25 m were recovered. Unfortunately, further deepening of the borehole was not possible, because the borehole wall became unstable and blocked the drill pipe. Drilling hence had to be

abandoned in the evening hours of April 3.

In the second half of the week, the fine weather temporarily came to an end and we spent a two-day period of stormy seas surveying the seabed with the SONNE's EM122 echo sounder. The wider area around *Brothers*, including a volcano to the north-east called *Kibblewhite*, was mapped. Two CTD-towyo profiles where also done, one between Brothers and Healy and one crossing the southern caldera wall at Brothers.

The storm moved through quickly and MeBo200 was deployed again in the morning of April 6. The target of this drilling operation (Station 027) was the Upper Cone, the larger of the two young volcanic cones growing on the caldera floor in the southern part of *Brothers*. In the summit region of the cone, there is no slope debris that could cause trouble during drilling.

Drilling initially went very well. After about 36 hours, however, drilling had to be abandoned because the drill pipe had become stuck. But when the drill core was removed on board the SONNE, it became clear that the drilling had been very successful. The volcanic rock was cored almost completely over a distance of several meters. These cores represent volcanic tephra that was cemented by rising hydrothermal solutions. The rock was transformed into clay minerals and former cavities between the rock fragments were filled with sulfate minerals and elemental sulfur.

A nighttime reconnaissance survey with the multibeam echo sounder took us to the Kibblewhite volcano 35 km northeast of Brothers in the morning hours of April 8. Kibblewhite is considered to be hydrothermally active (Wright et al., 2006); however, a CTD survey and two TV grab deployments did not reveal any evidence of hydrothermal activity. Back at Brothers in the evening of the 8th, we deployed the TV-guided grab to sample hydrothermally mineralized basement on the northwest caldera wall. We had discovered these deposits in 2016 during cruise SO253 with the remotely operated vehicle MARUM Quest 4000m (Koschinsky et al., 2017). The TVG samples that have now been recovered show spectacular veins with iron, zinc and copper sulfides that form a prominent stockwork zone. As we cannot drill with MeBo in the steep caldera wall, we were using the TV-guided grab to sample rocks from the subsurface on near-vertical slopes that have been exposed by rockfalls. However, the TVG broke down after station 038 (oil leak) and had to be taken out of service for repairs.

The next deployment of MeBo200 (Station 039) took place on the northern edge of the caldera, where a hydrothermal field was discovered and mapped with high precision during a US research expedition in 2018. With the excellent map material, we were able to place MeBo directly next to the active smoker field in an ash-covered area and drill a well. We had hoped to be able to sample the ascent paths of the hydrothermal solutions when drilling the borehole directly next to the hydrothermal field. Unfortunately, this expectation was not confirmed. At the drilling location, the subsurface consists only of unconsolidated ash and fresh lava rock down to a depth of approximately 35 m. As was to be expected, borehole collapse made coring challenging, and drilling was abandoned in the late morning hours of April 11.

A low-pressure trough brought stormy seas making another MeBo deployment impossible. The TVG was also temporarily out of order. We used this time to survey two large submarine volcanoes located about 40 km west of Brothers and to investigate hydrothermal activity using hydroacoustic methods and CTD. However, neither *Rapuhia*

nor *Giljanes* showed any evidence of hydrothermal venting.

For most of the day of April 13, we deployed the chain bag dredge to sample rocks from volcanic spreading ridges between the Brothers and Healy volcanoes. The next MeBo deployment took place on the 14th and 15th of April at Healy Volcano, 20 km southwest of Brothers, in an attempt to sample young volcanic cones that are associated with hydrothermal activity in 1300 m water depth. Drilling progressed well down to a depth of almost 40 m, but the unconsolidated tephra could not be cored and the hole was abandoned after 28 hours of operation. After completion of the MeBo drilling, further volcanic structures in the vicinity of the Brothers and Healy volcanoes were sampled using the chain bag dredge.

A severe tropical storm (cyclone TAM) reached us midday of April 16 and made it impossible to conduct any kind of station work at Brothers volcano. Since slightly more favorable sea conditions were forecast northeast of Brothers, we traveled 280 km to our other work area, the Haungaroa volcano. On April 17, the sea state became so severe that we had to suspend all station operations and go into “weather mode”. But by the afternoon of April 18, the chain bag dredge could be used again to recover rock samples from Haungaroa at seven station in the course of two days. Haungaroa had already been visited during the SO253 cruise, during which previously unknown hydrothermal vents were discovered and sampled by the MARUM Quest 4000m submersible was for the first time (Kleint et al., 2019). The outlets of hydrothermal solutions and volcanic gases were clearly visible in our water column data recorded by the multibeam echo sounder. Being able to locate the hydrothermal vents hydroacoustically facilitated sampling the hydrothermal plume with the CTD/water bottle rosette on April 19.

We left Haungaroa in the evening of the 19th of April to transit to Ngatoroirangi volcano, which lies roughly halfway between Haungaroa and Brothers. In still stormy seas, four dredge deployments were carried out up the slopes of Ngatoroirangi, all of which brought very interesting petrological rock samples on board. One dredge also contained large chunks of elemental sulphur. The smell of rotten eggs (indicative of H_2S degassing) and the colonization by Bathymodialus mussels, which live in symbiosis with H_2S-oxidizing bacteria, indicate hydrothermal activity. Using the multibeam echosounder, obvious gas bubble flares – like at sister volcano Haungaroa – could not be clearly detected. However, near-bottom acoustic anomalies were identified in the water column and these domains were sampled with the CTD/water bottle rosette on April 20th. After a nighttime transit to Brothers, we continued sampling stockwork samples with the TVG and conducted a total of three CTD stations for hydrothermal plume sampling. Lengthy and extensive repair work of the TVG had been successful and the tool could be deployed again after a hiatus of eleven days.

Next, MeBo was deployed again in the afternoon of April 22 (Station 084) to core hydrothermally mineralized basement beneath another hydrothermal sulfide mounds in the northwestern caldera rim, 270 m east of Station 051. Again, based on a highly detailed map from our US colleagues, we were able to identify a drilling location directly above the massive sulfide field and place MeBo200 there with pinpoint accuracy. However, the borehole did not reach the hoped-for hydrothermal stockwork zone. Instead, the core liners were filled with loose volcanic tephra, as we discovered after the drilling was aborted midday of April 23. The remainder of that day were used to sample rocks from the NWC

and SEC areas and sample outflowing plume water south of Brothers caldera.

We decided to revisit Ngatoroirangi to locate the source of hydrothermal activity there and reached the area after a night of transiting in mapping mode. A total of nine TVG and four CTD deployments were successfully accomplished there over the course of 38 hours. Repeated crossings of the summit area allowed us to clearly depict the hydrothermal gas flares hydroacoustically in a water depth of 350 m, which guided our sampling of hydrothermal vent field. Repeated deployments of the TVG allowed us to collect information on the spatial extent and compositional variability of the Kearoa hydrothermal field. TVG-based video footage indicated a large area of diffuse venting, spanning about 200 m across, with vigorous hydrothermal venting and strong particle plumes in its western part. In CTD Station 099 we were able to locate the presumed center of the hydrothermal field, above which a massive cloud of dark sulfide particles spread out. Valuable samples for mineralogical and microbiological investigations could be taken from this particle plume, using the rosette water sampler. Another highlight was the recovery of vent structures that exhibit a broad range of metal and metalloid mineralization and are coated with a layer of elemental sulfur. We named the newly discovered vent field *Kearoa* in honor of Ngatoroirangi's wife, who was involved in his voyages of discovery.

Back at the Brothers volcano on April 26, we started our last MeBo drilling, targeting the SEC area in the southeastern part of the caldera floor, where we had been able to core hydrothermally altered basement during Station 017. But drilling did not go as well as anticipated, with periods of minimal penetration rates alternating with events of intense torque caused by partial borehole wall collapse. Station 103 was abandoned midday on April 28th. The remainder of that day was used to complete sampling of rocks and plume water at the NWC site on the northwestern caldera wall of Brothers. Mapping and sampling featured northeast of Brothers (including Kibblewhite) comprised the station work of April 30. Again, no hydrothermal activity could be noticed at Kibblewhite.

Our transit to Auckland was started a bit early to allow for packing of our samples and equipment and demobbing of MeBo. The Rumble III volcano was mapped en route to Auckland (Station 112). We reached Auckland harbor in the morning hours of May 1st as scheduled and ended cruise SO311 there.

Acknowledgements

We thank Captain Oliver Meyer and the entire crew for superb support of all science operations throughout the entire expedition. We thank the German Research Fleet Coordination Centre (Leitstelle) for varied advice and organizational support. We thank the BMBF for funding the research expedition (grant 03G0311A) and general support for the DRILLBROTHERS project. Additional funding was provided by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany´s Excellence Strategy – EXC-2077 – 390741603

Teilnehmerliste

1.	Wolfgang Bach	*Chief Scientist*	Uni. Bremen
2.	Manuel Keith	Deputy *Chief Scientist*	FAU
3.	Jan Falkenberg	Mineralization	FAU
4.	Bernd Schleifer	Technical Support	FAU
5.	Nils Baumann	Volcanology	FAU
6.	Alica Höß	Volcanology	FAU
7.	Fabian Hampel	Petrology	FAU
8.	Hans Reiser	Petrology	FAU
9.	Paul Berndt	Hydroacoustics	Uni. Bremen
10.	Joely Maak	Biomarkers	
11.	Mira von der Gracht	Physical Properties	Uni. Bremen
12.	Tino Wallrath	Mineralization	Uni. Bremen
13.	Aaron Röhler	CTD	Uni. Bremen
14.	Fanny Röhler	CTD	Uni. Bremen
15.	Anke Meyerdierks	Molecular Ecology	MPIMM
16.	Charlotte Recke	Molecular Ecology	MPIMM
17.	Shane Rooyakkers	Volcanology	GNS
18.	Neville Palmer	Physical properties	GNS
19.	Alessio Bagnasco	Physical properties	Uni. Genova
20.	Kelsey McKenzie	Microbiology	Uni Canterbury
21.	Johannes Scheffler	Mineralization	Memorial U St John's
22.	Carlos Guerra Braga	Mineralization	Uni Ottawa
23.	Markus Eifried	Meteorology	DWD
24.	Markus Bergenthal	MeBo	MARUM
25.	Siefke Fröhlich	MeBo	MARUM
26.	Arunima Gopikristnan	MeBo	MARUM
27.	Anh Mai	MeBo	MARUM
28.	Frauke Ahrlichv	MeBo	MARUM
29.	Werner Schmidt	MeBo	MARUM
30.	Julia Krahl	MeBo	MARUM
31.	Marius Schulze	MeBo	MARUM
32.	Michael Reuter	MeBo	MARUM
33.	Birgit Meyer-Schack	MeBo	MARUM

Institute

Uni. Bremen	Universität Bremen
FAU	Friedrich-Alexander-Universität Erlangen-Nürnberg
MPIMM	Max-Planck-Institute for Marine Microbiology
GNS	Institute of Geological and Nuclear Sciences
Uni. Canterbury	University of Canterbury
Memorial Univ. St. John’s	Memorial University St. John’s
Uni. Ottawa	University of Ottawa
Uni. Genova	Università degli studi di Genova, Italy
DWD	Deutscher Wetterdienst
MARUM	Center for Marine Environmental Sciences, University of Bremen

Stationsliste

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
SONNE	MARUM	2025		[UTC]	[°N]	[°W]	[m]	
SO311_1-1	26601	28/03	CTD	5:03	35° 07,331' S	179° 02,133' E	2273	max. depth
SO311_2-1	26602	28/03	EM122	7:03	35° 07,347' S	179° 02,138' E	2273	Start
SO311_2-1	26602	28/03	EM122	16:33	34° 51,612' S	179° 03,408' E	1509	End
SO311_3-1	26603	28/03	TVG	20:36	34° 51,654' S	179° 03,471' E	1617	Sampling
SO311_4-1	26604	29/03	MeBo	3:42	34° 51,704' S	179° 03,555' E	1705	Hoisting
SO311_5-1	26605	29/03	EM122	0:00	34° 57,544' S	178° 53,904' E	2226	Start
SO311_5-1	26605	29/03	EM122	15:40	35° 04,389' S	179° 05,169' E	2237	End
SO311_6-1	26606	29/03	TVG	20:11	34° 52,576' S	179° 04,915' E	1657	Sampling
SO311_7-1	26607	29/03	MeBo	23:29	34° 52,581' S	179° 04,928' E	1639	On ground
SO311_8-1	26608	30/03	TVG	9:55	34° 52,550' S	179° 05,005' E	1586	Sampling
SO311_9-1	26609	30/03	EM122	11:44	34° 56,848' S	178° 56,674' E	1897	Start
SO311_9-1	26609	30/03	EM122	16:40	34° 50,087' S	178° 58,903' E	2329	End
SO311_10-1	26610	30/03	CTD	18:53	34° 52,247' S	179° 03,728' E	1779	max. depth
SO311_11-1	26611	30/03	TVG	21:31	34° 52,951' S	179° 02,435' E	1664	Sampling
SO311_12-1	26612	31/03	TVG	0:04	34° 53,232' S	179° 02,080' E	1815	Sampling
SO311_13-1	26613	31/03	CTD	2:24	34° 52,554' S	179° 04,860' E	1666	max. depth
SO311_14-1	26614	31/03	MeBo	3:13	34° 52,580' S	179° 04,947' E	1624	in water
SO311_15-1	26615	31/03	EM122	7:51	34° 55,128' S	179° 06,081' E	2265	Start
SO311_15-1	26615	31/03	EM122	17:20	34° 48,147' S	179° 18,545' E	1954	End
SO311_16-1	26616	31/03	TVG	20:37	34° 52,319' S	179° 03,058' E	1567	Sampling
SO311_17-1	26617	01/04	MeBo	2:47	34° 52,563' S	179° 04,957' E	1616	begin drilling
SO311_17-1	26617	03/04	MeBo	21:20	34° 52,550' S	179° 04,951' E	1604	stop drilling
SO311_18-1	26618	03/04	CTD	7:42	34° 54,132' S	179° 03,996' E	1809	Start deep tow
SO311_18-1	26618	03/04	CTD	16:52	34° 57,862' S	178° 59,363' E	1673	End deep tow
SO311_19-1	26619	03/04	EM122	17:04	34° 57,894' S	178° 59,251' E	1701	Start
SO311_19-1	26619	03/04	EM122	22:49	34° 55,312' S	178° 52,255' E	2450	End
SO311_20-1	26620	04/04	TVG	1:03	35° 02,734' S	178° 58,147' E	1214	Sampling
SO311_21-1	26621	04/04	CTD	3:40	34° 59,019' S	178° 59,976' E	1604	max. depth
SO311_22-1	26622	04/04	PS/EM	4:46	34° 57,120' S	179° 00,776' E	1819	Start
SO311_22-1	26622	04/04	PS/EM	5:42	35° 02,974' S	178° 59,302' E	1605	End
SO311_23-1	26623	04/04	EM122	20:56	35° 03,001' S	178° 59,294' E	1609	Start
SO311_23-1	26623	04/04	EM122	6:57	34° 52,072' S	179° 03,991' E	1861	End
SO311_24-1	26624	04/04	CTD	17:00	34° 51,637' S	179° 03,459' E	1556	Start deep tow
SO311_24-1	26624	05/04	CTD	0:13	34° 54,663' S	179° 03,942' E	1898	End deep tow
SO311_25-1	26625	05/04	CTD	1:33	34° 51,667' S	179° 03,451' E	1578	max. depth
SO311_26-1	26626	05/04	EM122	2:25	34° 51,646' S	179° 03,446' E	1588	Start
SO311_26-1	26626	05/04	EM122	18:51	34° 52,183' S	179° 03,829' E	1835	End
SO311_27-1	26627	05/04	MeBo	22:57	34° 52,931' S	179° 04,103' E	1211	begin drilling
SO311_27-1	26627	07/04	MeBo	4:56	34° 52,958' S	179° 04,079' E	1201	stop drilling
SO311_28-1	26628	07/04	CTD	7:01	34° 52,957' S	179° 04,076' E	1197	max. depth
SO311_29-1	26629	07/04	EM122	8:59	34° 57,970' S	178° 59,365' E	1653	Start
SO311_29-1	26629	07/04	EM122	18:14	34° 34,062' S	179° 14,268' E	1592	End
SO311_30-1	26630	07/04	TVG	20:02	34° 34,458' S	179° 15,270' E	1161	Sampling
SO311_31-1	26631	07/04	TVG	16:47	34° 34,469' S	179° 15,342' E	1088	Sampling
SO311_32-1	26632	08/04	CTD	0:50	34° 34,440' S	179° 15,207' E	1223	max. depth
SO311_33-1	26633	08/04	TVG	4:47	34° 51,669' S	179° 03,456' E	1573	Sampling

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
SONNE	MARUM	2025		[UTC]	[°N]	[°W]	[m]	
SO311_34-1	26634	08/04	TVG	6:50	34° 51,777' S	179° 03,472' E	1623	Sampling
SO311_35-1	26635	08/04	EM122	8:43	35° 15,417' S	179° 02,748' E	1962	Start
SO311_35-1	26635	08/04	EM122	12:17	35° 16,421' S	179° 01,011' E	1973	End
SO311_36-1	26636	08/04	TVG	19:41	34° 51,867' S	179° 04,877' E	1420	Sampling
SO311_37-1	26637	08/04	CTD	21:26	34° 51,489' S	179° 03,086' E	1316	Start
SO311_38-1	26638	09/04	TVG	0:20	34° 51,482' S	179° 03,123' E	1323	Sampling
SO311_39-1	26639	09/04	MeBo	5:48	34° 51,529' S	179° 03,065' E	1335	begin drilling
SO311_39-1	26639	10/04	MeBo	18:41	34° 51,482' S	179° 03,144' E	1345	stop drilling
SO311_40-1	26640	10/04	CTD	22:13	34° 52,238' S	179° 03,729' E	1793	max. depth
SO311_41-1	26641	11/04	EM122	0:09	34° 48,860' S	178° 54,328' E	2310	Start
SO311_41-1	26641	11/04	EM122	20:01	34° 46,596' S	178° 30,286' E	668	End
SO311_42-1	26642	11/04	CTD	20:30	34° 46,754' S	178° 28,468' E	1592	Start deep tow
SO311_42-1	26642	12/04	CTD	4:30	34° 46,608' S	178° 32,590' E	1579	End deep tow
SO311_43-1	26643	12/04	EM122	5:56	34° 47,283' S	178° 39,168' E	1993	Start
SO311_43-1	26643	12/04	EM122	17:49	34° 39,574' S	178° 38,874' E	2436	End
SO311_44-1	26644	12/04	DRG	22:47	34° 57,104' S	179° 00,206' E	1817	on bottom
SO311_44-1	26644	12/04	DRG	23:16	34° 57,101' S	179° 00,339' E	1755	off bottom
SO311_45-1	26645	13/04	DRG	0:58	34° 57,189' S	179° 00,736' E	1815	on bottom
SO311_45-1	26645	13/04	DRG	1:32	34° 57,202' S	179° 00,884' E	1718	off bottom
SO311_46-1	26646	13/04	DRG	3:25	34° 57,940' S	179° 02,376' E	1825	on bottom
SO311_46-1	26646	13/04	DRG	4:10	34° 57,945' S	179° 02,577' E	1706	off bottom
SO311_47-1	26647	13/04	DRG	5:58	34° 58,233' S	179° 03,388' E	2052	on bottom
SO311_47-1	26647	13/04	DRG	6:55	34° 58,174' S	179° 03,126' E	1827	off bottom
SO311_48-1	26648	13/04	DRG	8:48	34° 59,630' S	179° 02,680' E	1785	on bottom
SO311_48-1	26648	13/04	DRG	9:26	34° 59,589' S	179° 02,417' E	1632	off bottom
SO311_49-1	26649	13/04	EM122	11:31	34° 57,972' S	178° 48,738' E	2488	Start
SO311_49-1	26649	13/04	EM122	18:24	34° 51,050' S	178° 49,402' E	1952	End
SO311_50-1	26650	13/04	DRG	22:02	35° 01,480' S	178° 59,946' E	1462	on bottom
SO311_50-1	26650	13/04	DRG	22:43	35° 01,496' S	178° 59,673' E	1312	off bottom
SO311_51-1	26651	14/04	MeBo	18:24	34° 59,531' S	179° 00,778' E	1368	begin drilling
SO311_51-1	26651	15/04	MeBo	1:56	34° 59,536' S	179° 00,775' E	1368	stop drilling
SO311_52-1	26652	15/04	EM122	10:00	34° 45,830' S	178° 49,601' E	2081	Start
SO311_52-1	26652	15/04	EM122	17:06	34° 36,211' S	179° 03,319' E	1947	End
SO311_53-1	26653	15/04	DRG	21:16	34° 51,540' S	179° 03,402' E	1456	on bottom
SO311_53-1	26653	15/04	DRG	21:40	34° 51,502' S	179° 03,292' E	1754	off bottom
SO311_54-1	26654	15/04	DRG	23:37	34° 52,534' S	179° 04,835' E	1669	on bottom
SO311_54-1	26654	15/04	DRG	23:59	34° 52,515' S	179° 04,913' E	1623	off bottom
SO311_55-1	26655	16/04	DRG	1:51	34° 51,424' S	179° 06,185' E	2161	on bottom
SO311_55-1	26655	16/04	DRG	2:43	34° 51,443' S	179° 05,903' E	1886	off bottom
SO311_56-1	26656	16/04	EM122	5:00	34° 40,323' S	179° 04,384' E	2351	Start
SO311_56-1	26656	16/04	EM122	20:45	33° 37,699' S	179° 49,467' E	2517	End
SO311_57-1	26657	17/04	EM122	20:33	32° 42,012' S	179° 41,556' W	2918	Start
SO311_57-1	26657	17/04	EM122	23:12	32° 35,116' S	179° 31,078' W	2496	End
SO311_58-1	26658	18/04	DRG	0:49	32° 37,211' S	179° 37,864' W	918	on bottom
SO311_58-1	26658	18/04	DRG	1:48	32° 37,018' S	179° 37,585' W	689	off bottom
SO311_59-1	26659	18/04	DRG	2:54	32° 36,979' S	179° 38,036' W	914	on bottom

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
SONNE	MARUM	2025		[UTC]	[°N]	[°W]	[m]	
SO311_59-1	26659	18/04	DRG	3:43	32° 36,840' S	179° 37,744' W	773	off bottom
SO311_60-1	26660	18/04	DRG	4:43	32° 36,622' S	179° 38,058' W	892	on bottom
SO311_60-1	26660	18/04	DRG	5:22	32° 36,497' S	179° 37,877' W	794	off bottom
SO311_61-1	26661	18/04	DRG	6:52	32° 37,783' S	179° 36,936' W	1108	on bottom
SO311_61-1	26661	18/04	DRG	7:40	32° 37,621' S	179° 36,678' W	951	off bottom
SO311_62-1	26662	18/04	EM122	9:33	32° 34,254' S	179° 32,064' W	597	Start
SO311_62-1	26662	18/04	EM122	17:40	32° 30,080' S	179° 30,751' W	839	End
SO311_63-1	26663	18/04	CTD	19:46	32° 36,959' S	179° 37,474' W	671	max. depth
SO311_64-1	26664	18/04	DRG	22:03	32° 35,813' S	179° 36,422' W	1266	on bottom
SO311_64-1	26664	18/04	DRG	22:47	32° 35,974' S	179° 36,643' W	1111	off bottom
SO311_65-1	26665	19/04	DRG	0:22	32° 35,508' S	179° 37,239' W	1358	on bottom
SO311_65-1	26665	19/04	DRG	1:09	32° 35,721' S	179° 37,428' W	1152	off bottom
SO311_66-1	26666	19/04	DRG	3:27	32° 38,005' S	179° 37,069' W	1189	on bottom
SO311_66-1	26666	19/04	DRG	4:08	32° 37,939' S	179° 36,797' W	1109	off bottom
SO311_67-1	26667	19/04	EM122	11:48	33° 41,384' S	179° 54,367' E	2279	Start
SO311_67-1	26667	19/04	EM122	20:04	33° 43,305' S	179° 48,484' E	887	End
SO311_68-1	26668	19/04	DRG	21:29	33° 43,973' S	179° 49,513' E	550	on bottom
SO311_68-1	26668	19/04	DRG	22:12	33° 43,770' S	179° 49,664' E	331	off bottom
SO311_69-1	26669	19/04	DRG	23:35	33° 43,894' S	179° 49,303' E	596	on bottom
SO311_69-1	26669	20/04	DRG	0:29	33° 43,618' S	179° 49,384' E	383	off bottom
SO311_70-1	26670	20/04	DRG	1:56	33° 44,390' S	179° 49,839' E	792	on bottom
SO311_70-1	26670	20/04	DRG	2:40	33° 44,188' S	179° 50,008' E	657	off bottom
SO311_71-1	26671	20/04	DRG	3:58	33° 44,738' S	179° 50,418' E	911	on bottom
SO311_71-1	26671	20/04	DRG	4:41	33° 44,532' S	179° 50,629' E	1049	off bottom
SO311_72-1	26672	20/04	CTD	21:48	33° 43,959' S	179° 50,228' E	751	max. depth
SO311_73-1	26673	20/04	EM122	4:27	33° 43,579' S	179° 49,117' E	347	Start
SO311_73-1	26673	20/04	EM122	11:34	33° 49,919' S	179° 49,209' E	2093	End
SO311_74-1	26674	20/04	CTD	21:48	34° 51,986' S	179° 03,528' E	1844	max. depth
SO311_75-1	26675	21/04	TVG	0:42	34° 51,766' S	179° 03,475' E	1677	Sampling
SO311_76-1	26676	21/04	TVG	2:38	34° 51,473' S	179° 03,110' E	1335	Sampling
SO311_77-1	26677	21/04	TVG	5:24	34° 51,457' S	179° 03,307' E	1373	Sampling
SO311_78-1	26678	21/04	CTD	7:20	34° 53,005' S	179° 03,706' E	1483	max. depth
SO311_79-1	26679	21/04	EM122	9:22	34° 59,938' S	179° 08,145' E	2258	Start
SO311_79-1	26679	21/04	EM122	16:58	34° 21,467' S	179° 15,555' E	2769	End
SO311_80-1	26680	21/04	TVG	20:56	34° 52,397' S	179° 04,865' E	1679	Sampling
SO311_81-1	26681	21/04	TVG	23:15	34° 51,767' S	179° 03,475' E	1620	Sampling
SO311_82-1	26682	22/04	DRG	1:22	34° 51,789' S	179° 03,477' E	1660	on bottom
SO311_82-1	26682	22/04	DRG	1:36	34° 51,786' S	179° 03,467' E	1597	off bottom
SO311_83-1	26683	22/04	CTD	3:18	34° 51,458' S	179° 03,305' E	1368	max. depth
SO311_84-1	26684	22/04	MeBo	7:48	34° 51,446' S	179° 03,350' E	1387	begin drilling
SO311_84-1	26684	23/04	MeBo	0:31	34° 51,461' S	179° 03,346' E	1399	stop drilling
SO311_85-1	26685	23/04	TVG	3:31	34° 51,464' S	179° 03,328' E	1390	Sampling
SO311_86-1	26686	23/04	TVG	6:28	34° 52,553' S	179° 04,885' E	1664	Sampling
SO311_87-1	26687	23/04	CTD	8:35	34° 53,490' S	179° 03,778' E	1603	max. depth
SO311_88-1	26688	23/04	EM122	9:26	34° 53,488' S	179° 03,780' E	1608	Start
SO311_88-1	26688	23/04	EM122	19:32	33° 43,745' S	179° 49,062' E	511	End

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
SONNE	MARUM	2025		[UTC]	[°N]	[°W]	[m]	
SO311_89-1	26689	23/04	TVG	23:58	33° 43,593' S	179° 49,381' E	387	Sampling
SO311_90-1	26690	24/04	TVG	2:12	33° 43,681' S	179° 49,543' E	351	Sampling
SO311_91-1	26691	24/04	CTD	3:40	33° 43,683' S	179° 49,546' E	355	max. depth
SO311_92-1	26692	24/04	TVG	5:34	33° 43,681' S	179° 49,532' E	531	Sampling
SO311_93-1	26693	24/04	CTD	6:40	33° 43,680' S	179° 49,530' E	355	max. depth
SO311_94-1	26694	24/04	EM122	8:47	33° 43,171' S	179° 49,195' E	686	Start
SO311_94-1	26694	24/04	EM122	19:34	33° 43,693' S	179° 49,178' E	453	End
SO311_95-1	26695	24/04	TVG	20:22	33° 43,883' S	179° 49,312' E	598	Techn.Def.
SO311_96-1	26696	24/04	EM122	21:57	33° 44,011' S	179° 49,275' E	676	Start
SO311_96-1	26696	24/04	EM122	22:44	33° 43,664' S	179° 49,765' E	410	End
SO311_97-1	26697	25/04	TVG	1:56	33° 43,689' S	179° 49,409' E	425	Sampling
SO311_98-1	26698	25/04	TVG	4:24	33° 43,689' S	179° 49,328' E	416	Sampling
SO311_99-1	26699	25/04	CTD	5:22	33° 43,680' S	179° 49,519' E	346	max. depth
SO311_100-1		25/04	EM122	6:50	33° 43,676' S	179° 49,526' E	356	Start
SO311_100-1		25/04	EM122	6:59	33° 43,653' S	179° 49,640' E	342	End
SO311_101-1	26901	25/04	TVG	9:18	33° 43,671' S	179° 49,521' E	350	Sampling
SO311_102-1	26902	25/04	EM122	10:14	33° 44,560' S	179° 49,148' E	664	Start
SO311_102-1	26902	25/04	EM122	19:32	34° 52,394' S	179° 05,025' E	1462	End
SO311_103-1	26903	25/04	MeBo	23:17	34° 52,564' S	179° 04,942' E	1623	begin drilling
SO311_103-1	26903	27/04	MeBo	21:54	34° 52,562' S	179° 04,933' E	1629	stop drilling
SO311_104-1	26904	28/04	TVG	2:09	34° 51,665' S	179° 03,460' E	1607	Sampling
SO311_105-1	26905	28/04	TVG	4:49	34° 51,664' S	179° 03,473' E	1617	Sampling
SO311_106-1	26906	28/04	CTD	6:09	34° 51,664' S	179° 03,471' E	1617	max. depth
SO311_107-1	26907	28/04	EM122	11:04	34° 38,645' S	178° 47,515' E	2298	Start
SO311_107-1	26907	28/04	EM122	18:45	34° 33,135' S	179° 04,178' E	2025	End
SO311_108-1	26908	28/04	TVG	21:19	34° 34,552' S	179° 15,728' E	955	Sampling
SO311_109-1	26909	29/04	TVG	0:50	34° 48,291' S	179° 08,429' E	2991	Sampling
SO311_110-1	26910	29/04	CTD	3:49	34° 54,376' S	179° 00,319' E	2066	max. depth
SO311_111-1	26911	29/04	EM122	10:39	34° 54,376' S	179° 00,319' E	2066	Start
SO311_111-1	26911	29/04	EM122	20:05	35° 48,554' S	178° 27,636' E	-	End