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R/V Kaimei Cruise Report

KM22-15 Leg. 2

Understanding the actual condition of marine pollutants and their impact on marine ecosystems

Off Shikoku area

Dec. 22, 2022– Jan. 9, 2023

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Acknowledgements

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Contents

Cruise information

Cruise ID: KM22-15 Leg. 2
Vessel: KAIMEI
Title of the cruise: Understanding the actual condition of marine pollutants and their impact on marine ecosystems
Chief Scientist: Masashi Tsuchiya, JAMSTEC
Cruise period: Dec. 22, 2022–Jan. 9, 2023
Port of call: Yokosuka–Yokosuka (Yokosuka, Kanagawa, Japan)
Research Area: off Shikoku area
Research map:

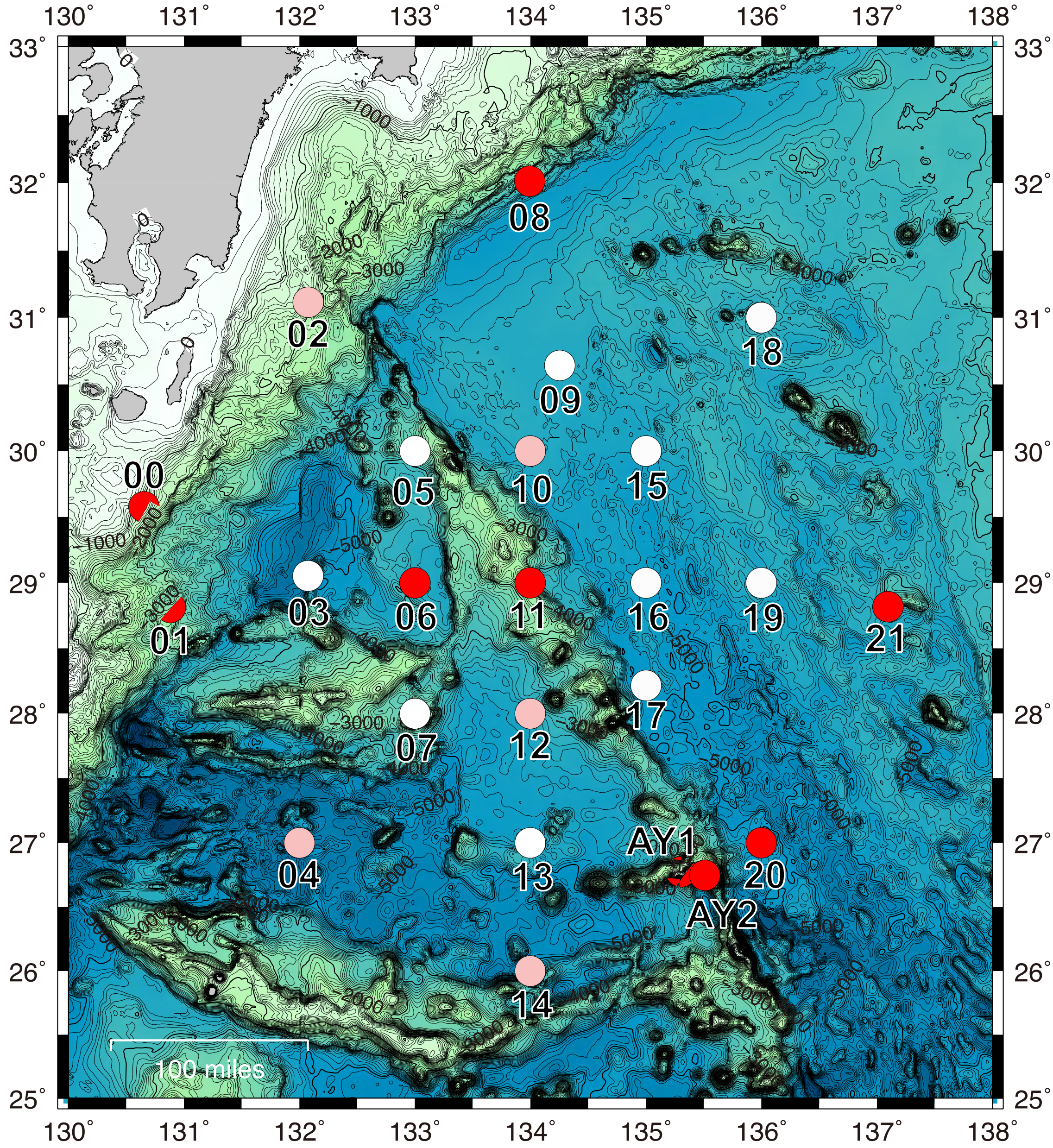


Figure 1. Map showing the sampling points during KM22-15 Leg. 2 cruise. Red circles indicate sampling sites, pink circles indicate skipped sites and white circles indicate planned sites.

List of participants

Scientific Party

Chief Scientist

Masashi TSUCHIYA	[Japan Agency for Marine-Earth Science and Technology]

Vice chief scientists

Akinori YABUKI	[Japan Agency for Marine-Earth Science and Technology]
Ryota NAKAJIMA	[Japan Agency for Marine-Earth Science and Technology]

Onboard Scientists

Shiye ZHAO	[Japan Agency for Marine-Earth Science and Technology]
Akito OGAWA	[National Museum of Nature and Science]
Naoto JIMI	[Nagoya University]
Misato SAKO	[Nagoya University]
Masanori OKANISHI	[Hiroshima Shudo University]
Hiroki KISE	[National Institute of Advanced Industrial Science and Technology]
Takumi MATSUO	[National Museum of Nature and Science]
Natsumi HOOKABE	[Tokyo University]
Zongjing DENG	[National Museum of Nature and Science]
Shinta FUJIMOTO	[Yamaguchi University]
Yuka KUSHIDA	[Rissho University]
NURLATIFAH	[Kumamoto University]
Takasuke OSAWA	[APEX CORPORATION]

Marine Technician

Observation Engineer (NME)

Chief Marine Technician	Ryo KIMURA
2nd Technician	Satomi OGAWA

CTD water sampling & multiple corer sampling Operator (MWJ)

Arii YASUHIRO
Tun Htet AUNG
Riho FUJIOKA
Yuta SHINOMIYA
Aine YODA

Crew of the *R/V* KAIMEI

Captain	Naoto KIMURA
Chief Officer	Akira SUZUKI
2nd Officer	Masaki OKADA
Jr.2nd Officer	Yasuto IIDA
3rd Officer	Kanta OZAWA
Jr.3rd Officer	Aoi TSURUMAKI
Chief Engineer	Kazuhiko KANEDA
1st Engineer	Kenichi SHIRAKATA
2nd Engineer	Ryuzo MIKAMI
3rd Engineer	Kohshun IKEZAKI
Chief Electronic Operator	Tokinori NASU
2nd Electronic Operator	Keisuke OI
3rd Electronic Operator	Kohei IKEDA
Boat Swain	Yosuke KUWAHARA
Able Seaman	Tatsuo FUJII
Able Seaman	Kenji NAKAE
Able Seaman	Satoshi SHIMPO
Able Seaman	Saikan HIRAI
Able Seaman	Shinya UENO
Able Seaman	Yuta OHJIRI
Sailor	Shinnosuke INOUE
No.1 Oiler	Yuji HIGASHIGAWA
Oiler	Toru HIDAKA
Assistant Oiler	Kyotaro MARUYAMA
Assistant Oiler	Riku MIZUNO
Assistant Oiler	Kota MATSUMURA
Chief Steward	Yukihide CHIKUBA
Steward	Toshiyuki ASANO
Steward	Masaru SUGIYAMA
Steward	Toshiyuki TAKAMA

1. Introduction and objectives of the cruise

This study will clarify the distribution and behavior of plastic litter, including microplastics (MP), in deep-sea areas, and understand its impact on deep-sea organisms and ecosystems. In particular, we will clarify the actual state of plastic pollution in the open ocean. In addition, we will elucidate the diversity of marine organisms through environmental DNA analysis and understand the actual situation through bait camera surveys, as well as optimize environmental impact assessment methods and develop tools. It is a pressing issue worldwide to understand changes in marine biodiversity, which is considered one of the most important indicators of global environmental change, and to obtain knowledge that will contribute to the assessment of the impact of human activities on ecosystems. Understanding the actual state of MPs pollution in the ocean is essential for identifying the sources and spill pathways of plastic waste in order to properly implement plastic regulations and marine spill countermeasures. In addition, there is little information on the effects of changes in the marine environment on deep-sea ecosystems, and comprehensive biological surveys using multiple methods and integrated analysis with environmental data need to be promoted. In addition, in order to understand the actual impact of human activities on deep-sea ecosystems and their diversity, and to obtain knowledge that will contribute to their assessment and conservation, it is necessary to develop new measurement techniques, conduct surveys targeting marine plastic waste and biodiversity in the deep sea, and improve and optimize impact assessment methods in the marine environment. To achieve these goals, it is necessary to develop new measurement techniques and conduct surveys targeting marine plastic waste and deep-sea biodiversity. We conducted research cruises in the seas around Japan to investigate the actual distribution of marine plastic litter and the distribution and habitat of deep-sea biological communities, while incorporating the methods we have developed.

The area off the coast of Shikoku targeted in Leg. 2 is located at the midpoint between the western Pacific garbage patch area conducted in YK19-11 and KM20-08 and the area around the Nansei Islands conducted in KM22-02 and is an important area for clarifying the extent and path of garbage accumulation. The sediment samples were collected off the Boso Peninsula in YK19-11, and MPs were detected, but the distribution density of MPs differed from core to core, possibly due to the influence of turbidite. In addition, since the number of samples collected was small, it is necessary to confirm the heterogeneity of the distribution. To achieve these objectives, MPs were sampled at the sea surface using a neuston net, and sediments were sampled during multicorer observations. In addition, MPs were collected in the water column using an in-situ pump system. A beam trawl observations were used to collect large debris, including plastic debris, and organisms attached to them. From the vessel, visual observation, and videography of meso- to macro-plastic debris floating in the surface layer were conducted.

2. Survey items

Figure 2. Survey items. CTD/Niskin (upper left), multiple corer and beam trawl (upper right), beam trawl (middle left), GoPro camera (middle right), neuston net (lower left), *in situ* pump (lower middle) and microplatics detection system with hyperspectral camera (lower right)

3. Summary and the cruise results

3.1. Actual condition of marine debris including microplastics and its impact on marine ecosystems

3.1.1. Neuston net sampling for floating microplastics (Zhao and Nakajima)

A total of 24 surface net tows were carried out at 8 sampling stations between 25°N-33°N and 130°W- 138°W, in and out of the Kuroshio Re-circulation gyre (Table 3-1). Floating microplastic samples were collected using a neuston net with a perpendicular mouth opening of 75 cm height and 100 cm width, equipped with a 333 µm mesh opening net with a collecting mesh bag at the cod-end. The net without cod-end was rinsed from the outside with running seawater prior to use. At each station, the net was towed three times at ca. 1-1.5 knots for 20 min from the starboard side (Figure 3-1). A flow meter was installed at the net mouth to estimate the volume of water filtered during each tow. The collected samples were fixed with ca. 2-3% formalin and stored at room temperature until analysis. Overall, the abundances of microplastics collected with the neuston net were higher in the center of the gyre compared to the edge or outside of the gyre. In addition to the microplastic sampling, floating macro-debris were recorded with a forward-facing 4K video camera. Microplastic samples from the neuston net will be subjected to enumeration and identification of plastic types using ATR-FT-IR. Video data will be played onshore and all items of debris will be identified through video analysis. The obtained data will be submitted to JAMSTEC Data Management Group (DMG).

Table 3-1. Sampling sites for neuston net towing.

Station	Year	Month	Day	Time (UTC)	Latitude (N)		Longitude (E)	
St. 1	2022	12	27	2:45	32	2.09960	133	58.7303
St. 1	2022	12	27	3:20	32	2.1	133	58.9467
St. 1	2022	12	27	4:35	32	2.3848	134	00.1319
St. 2	2022	12	28	4:43	29	35.1523	130	40.7142
St. 2	2022	12	28	7:45	29	35.0664	130	41.7103
St. 2	2022	12	28	8:11	29	35.06	130	41.8012
St. 3	2022	12	29	2:37	28	48.5548	130	53.2955
St. 3	2022	12	29	5:47	28	49.1179	130	53.2384
St. 3	2022	12	29	6:04	28	49.5422	130	53.1009
St. 4	2022	12	30	3:00	29	0.2957	133	00.1462
St. 4	2022	12	30	6:30	29	0.533	133	00.1908
St. 4	2022	12	30	6:54	29	0.9776	133	00.6317
St. 5	2023	01	02	0:10	29	0.9113	133	59.1609
St. 5	2023	01	02	0:52	29	0.8554	133	59.1506
St. 5	2023	01	02	1:10	29	0.8561	133	59.1507
St. 6	2023	01	02	23:56	26	46.4886	135	22.2043
St. 6	2023	01	03	0:24	26	47.1352	135	21.6413
St. 6	2023	01	03	0:52	26	47.7423	135	21.0655
St. 7	2023	01	04	3:15	26	59.9873	136	02.8539
St. 7	2023	01	04	3:40	27	0.3431	136	03.0492
St. 7	2023	01	04	7:10	26	59.9135	135	59.901
St. 8	2023	01	06	2:17	28	49.9726	137	04.9763
St. 8	2023	01	06	2:41	28	50.136	137	04.5163
St. 8	2023	01	06	3:37	28	50.3175	137	04.1679

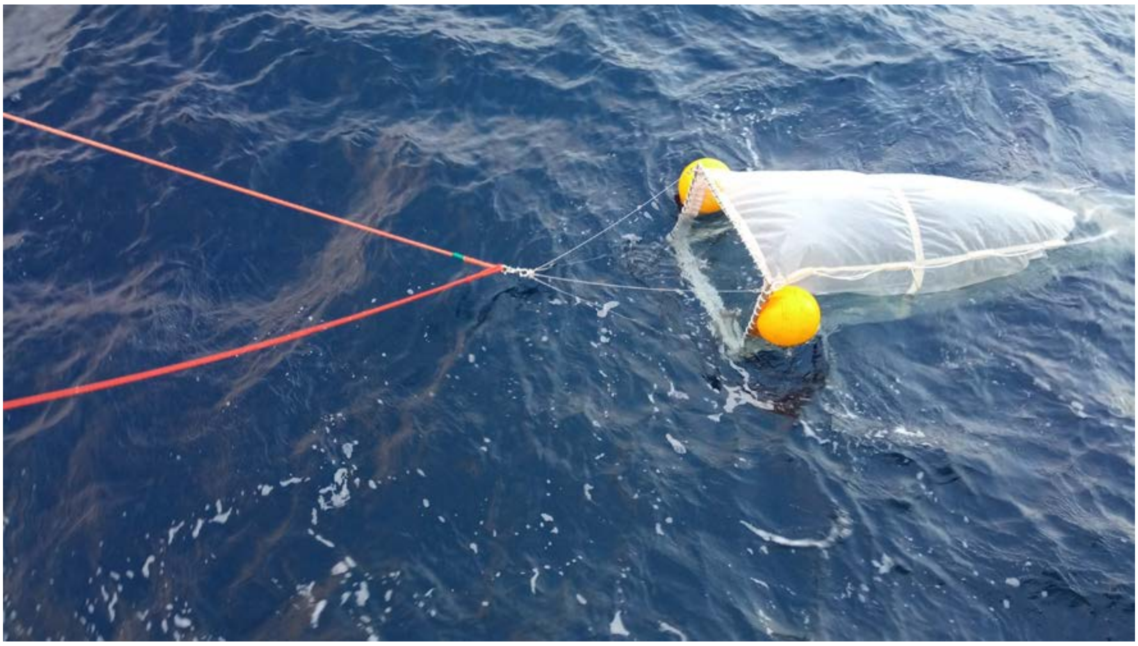


Figure 3-1. Neuston net (Photo by S. Zhao)

3.1.2. Floating macro-debris observation by video camera (Nakajima)

Macro-debris floating on the surface water were recorded using a digital camera (GoPro) from both the starboard and port sides of the vessel throughout the cruise. The cameras were installed to handling bars of the ship at 8.2 m height from the sea surface with a camera angle of ca. 45°. The GoPro was connected to mobile batteries allowing a continuous recording. The video was taken during daytime for ca. 9 hours during the cruise.

3.1.3. eDNA samples from neuston-net collected floating microplastics (Zhao)

A total of 56 particles were picked out in the net-collected particles to account for the genomic characteristics of microbial community colonized on the surface. Each particle was placed into a Cyrovial with 2 ml RNAlater for further analysis. Meanwhile, Two 2-L surface seawater at each neuston net station, collected by the bucket, were filtered with the Sterivex filter for free-living microbes. All the eDNA samples were saved at -80oC.

3.1.4. In-situ pump sampling for subsurface microplastics (Zhao)

Subsurface water samplings were carried out at 6 stations (Table 3-2) with two in-situ pumps (WTS-LV, McLane Research). The pumps were tethered to a single wire (Figure 3-2) and deployed at 10 m, pycnocline, 500 m and 1000 m. Prior to deploying the pumps at each station, a CTD profile should be acquired to determine the specific layers such as water depth, pycnocline. Two casts were conducted at each station to covering 4 depths. The Seawater was directed through a series of filters of the pump: The samples passed through the pre-combusted stacked 1.0 µm glass fiber filter. All pump samplings were programmed to run for 1.0 hours at each depth resulting in ca. 100-200 L seawater filtered. The collected filters were wrapped with an aluminum foil and stored frozen until analysis. Microplastic samples from the in-situ pump will be subjected to enumeration and identification of plastic types using micro-FT-IR. The obtained data will be submitted to JAMSTEC Data Management Group (DMG).

Table 3-2. Sampling sites for subsurface water sampling.

Station	Year	Month	Day	Time (UTC)	Latitude (N)		Longitude (E)	
St. 1	2022	12	26	0:30	32	2.3446	134	0.6968
St. 2	2022	12	29	4:30	28	49.059	130	53.237
St. 3	2022	12	29	23:40	29	0.7559	132	59.517
St. 4	2023	01	02	2:20	29	0.9113	133	59.1612
St. 5	2023	01	03	23:30	26	59.9055	135	59.7939
St. 6	2023	01	06	4:40	28	49.9702	137	4.9827

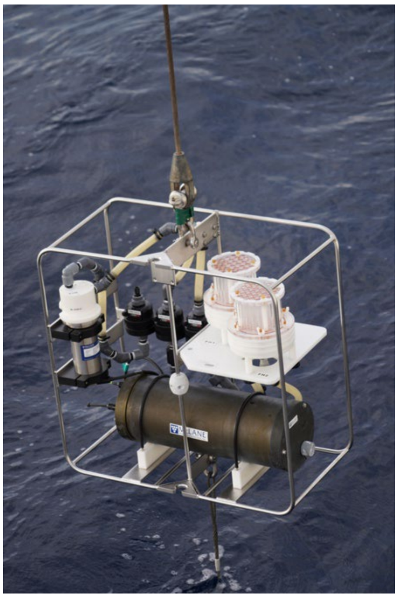


Figure 3-2. The deployment of McLane Pump (Photo by Ryo Kimura)

3.1.5. Occurrence of seafloor litter and plastic additives (Nakajima and Nurlatifah)

Trawling a beam trawl net were conducted at Stations 08, 00, 06, 11 and 20, at which seafloor debris were collected at Stations 08, 00 and 06. Majority of the debris collected were plastic debris such as food packages and adhesive tape. Those debris will be subjected for plastic polymer type identification and plastic additives such as phthalate ethers and heavy metals.

3.1.6. Distribution of microplastics in the deep-sea sediment (Tsuchiya)

Sediment samples were collected by the multiple corer (covering 43.0 cm^2 seafloor surface area) at Stations #00, 01, 06, 08, 11, 20 and 21 (Table 3-3). We used two types of the core, acrylic and aluminum-made core tubes. Aluminum-made tubes were used in this study for microplastic analysis to prevent plastic contamination. Three sediment cores collected with aluminum-made core tube were used for microplastic analysis, and one sediment core sample collected with acrylic tube was used for sediment structure analysis with X-CT at each station. A sediment core sample was sliced every 1 cm down to the bottom of the core, and two other cores were sliced every 1 cm down to 5 cm for microplastic analysis on board.

Sediment samples will be treated according to the procedure described by Nakajima et al. (2019) and extracted microplastics will be counted under a fluorescence microscope of FTIR microscopy. For sediment structure analysis, we will conduct smear slide descriptions, X-CT analysis, grain size measurements to decipher the sediment source and transport processes using these data.

Table 3-3. List of sediment samples for MPs analysis.

St.	Cast	Tube	Date & time	Lat. (N)	Long. (E)	Depth (m)	Site	Length (cm) *
08	01	01 04 08	2022Dec26 16:26 JST	32-02.3023	134-01.4756	3527	Nankai Trough	21 (5) (5)
01	02	01 04 08	2022Dec29 11:26 JST	28-48.4846	130-53.2923	3226	Tokara	17 (5) (5)
06	03	01 04 08	2022Dec30 11:44 JST	29-00.3946	133-00.0753	4445	Kikai Basin	23 (5) (5)
11	04	01 04 08	2023Jan01 8:57 JST	29-01.0787	133-59.4974	2791	Kyushu-Palau Ridge	27 (5) (5)
20	05	01 04 08	2023Jan04 12:04 JST	26-59.9473	136-02.8365	5163	Shikoku Basin	32 (5) (5)
21	06	01 04 08	2023Jan06 11:09 JST	28-49.9335	137-05.0099	4219	Shikoku Basin	31 (5) (5)

* Retrieved length

3.1.7. Distribution of plastic additives in the deep-sea sediment (Nurlatifah)

Chemical additives, such as plasticizers, antioxidants, lubricants, UV stabilizers, have been added to the production of plastics to enhance its quality and lifespan. As plastics waste enters the ocean, it is exposed to light, moisture, heat, etc. and degrades into smaller pieces. During this process, the chemical additives may leach to the surrounding environment, as well as to deep-sea sediments. Sediment cores were collected at Stations 08, 01, 06, 11, 20, and 21 with depth of sediment collected varied between 18 to 30 cm. All cores were then cut every 1 cm and then stored in aluminum foil at -20^{o}C before analysis. Each layer will then be subjected for plastic additives analysis including phthalate esters, fatty acids, amide esters, etc. to investigate the possible leaching from macro/microplastics.

3.1.8. Understanding biofouling assemblages of marine plastics (Naoto Jimi, Nagoya University; Akito Ogawa, National Museum of Nature and Science; Masanori Okanishi, Hiroshima Shudo University; Shinta Fujimoto, Yamaguchi University; Hiroki Kise, AIST; Yuka Kushida, Rissho University; Natsumi Hookabe, Takumi Matsuo, Zongjing Deng, The University of Tokyo; Ryota Nakajima, JAMSTEC; Nurlatifah, Kumamoto University

Marine plastic is currently a subject of study in oceanography and is garnering attention. Plastic can be colonized by organisms and understanding the composition of these can sometimes allow for the understanding of the dynamics of plastic in the ocean. Additionally, many studies suggest that the ingestion of microplastic by organisms can lead to the transfer of harmful substances, but the impacts on the colonizing organisms are unclear. The present study aims to collect plastic-adhering organisms and explore the composition and any potential transfer of harmful substances.

Samples

We conducted sediment collections via beam trawl from six operations at five locations (conducted twice at St. #00): St. #08 (3447 m deep) at Nankai Trough, St. #00-1 and St. #00-2 (1179 m deep) off Tokara, St. #06 (4438 m deep) at west bottom of the Kyushu-Palau Ridge, St. #11 (2793 m deep) at a terrace of the Kyushu-Palau Ridge, and St. #20 (5153 m deep) at east bottom of the Kyushu-Palau Ridge (Figure 3-3). As a result, sediment was collected at all locations (Figure 3-4A–E) except for the second instance at St. #00 (Figure 3-4F). The sediment was collected with an Oregon type beam trawl of 3 m span with two plankton nets hanging inside the opening to collect finer particles. The sediment supernatant was filtered through a 350 µm net. The remaining sediments were then separated using 1 mm and/or 2 mm mesh sieves. Those particles trapped inside the plankton nets were processed separately. The debris and organisms were sorted under microscopes or naked eye on board. The marine debris retrieved at St. #06 consisted of socks and a few plastic packages, and the socks had attached a sea urchin. However, it is likely that this is an artificial situation based on the ecology of the sea urchin and the retrieved condition. We also collected biological specimens from sediments: Porifera, Cnidaria, Annelida, Mollusca, Nematoda, Crustacea, Nemertea, Echinodermata, Vertebrata, and taxa belonging to metazoan meiofauna. Two fishes, a synaphobrachid collected at St. #08 and a gonostomatid collected at St. #06, and several benthopelagic shrimps collected at St. #00-1 will be subjected for the analyses of plastic additives such as plasticizers and UV stabilizers onshore.

Plastic-adhering organisms were collected using a Neuston net at St. #20. A toothbrush, a fragment of a tire (?), and a plastic cap were obtained, all of which had organisms adhered to them. Larger organisms were collected by forceps, while small organisms were washed out using freshwater and then collected by a 63 µm mesh net. An eunicid polychaete worm adhered to the plastic bottle cap. The eunicid worm did not match the morphology of any known Japanese species, suggesting a high possibility that the plastic cap had floated over from somewhere abroad. Additionally, many meiofauna were found to survive, and it was made clear that even small organisms could survive adhering to plastic and floating out to the open ocean. Additionally, pumices were collected with the plastics, and differences were observed between the organisms adhered to the pumices and those adhered to the plastic. These differences might be due to their place of origin or the different preferences of the organisms for their adhesion substrate.

Beam trawl operation

This time was the second attempt on the research vessel *Kaimei* to operate a beam trawl survey using an Oregon type beam trawl of 3 m span (AORI) following the KM22-02 cruise. The operation was carried out using streel wires instead of the PC ropes during the KM22-02 cruise. The configuration of the beam trawl and wires was similar to the protocols of other research vessels, e.g., *Shinsei maru* and *Hakuho maru*. The detailed configuration of the beam trawl is shown in figure 4. The beam trawl was unrolled by an auxiliary winch, and replaced by the main steel wire winch, and then the transponder was attached 30 m above the junction of the lead-in wire and the main wire. After attaching the transponder, the main wire was unwound at a speed of 0.5 m/s to a depth above the tidal currents of the surface water. The tidal currents were confirmed with an ADCP prior to commencing operations. After confirming that the depth of the transponder exceeded the surface currents, the unrolling speed was increased to 1.0 m/s. The vessel moved forward at 0.5 knots towards the water during deployment and at 0.5 knots towards the ground before the total length of the wires reached the water depth. The winch was stopped once when the total length of the wires reached the water depth to confirm that the transponder was following the vessel and moving forward relative to the seabed. When the wire length exceeded the water depth, the winch speed was reduced to 0.5 m/s. The beam trawl was considered to have landed on the bottom when the transponder was at 100–130 m above the water depth. After landing, the beam trawl was towed for 30 minutes (St. #00-2) or one hour (Sts. #08, #06, #00-1, and #11). At St. #20, since the tension did not increase much, the towing time was extended from 0.5 to 1.5 hours. After the tow, the vessel was hoisted at a slow speed (0.2–0.3 m/s) until the beam trawl left the bottom and then reeled in at a speed of 1 m/s. The trawl was considered to have left the bottom when the transponder was at 230 m above the water depth. At St. #08, #00-1, #06, #11, and #20, we successfully collected bottom sediments (Figure 3-4A–E). The collected sediments were sandy mud at St. #00-1, fine mud mixed with pumice at St. #08, St. #06, and St.#11, and only small amount of gravel pumice at St. #20.

At St. #00-2 (Figure 3-4F), the net and bridle wires were entangled with the trawl frame, and as the net was in a coiled state, the collection was unsuccessful. We assume that the net was entangled prior to trawling due to the absence of sediment. It is likely that the net floated up for some reason while the research vessel slowed down for casting the net, allowing the bridle wires to become entangled. As an improvement protocol if our guess is correct, it is considered effective to stop the winch once and confirm moving ahead and following the vessel of the transponder. before landing the trawl nets on the bottom. However, without camera footage, it is not possible to determine more detailed information about the situation.

At St. #20, the beam trawl's frame was in a reversed attitude upon deployment, but it was judged that it would return to its original position during trawling, so it was casted as is. There was little increase in tension during trawling, and only a small amount of sediment was retrieved. It is likely that the frame remained in a reversed state during trawling, making it impossible to collect sediment effectively. Since some amount of pumice was collected, it is possible that a small amount of mud was also through into the nets on the bottom, but it is highly likely that the mud was washed away during the hoisting the nets to sea surface. Therefore, it is necessary to stop introducing the nets and reposition the frame correctly when such a reversed attitude is observed on sea surface.

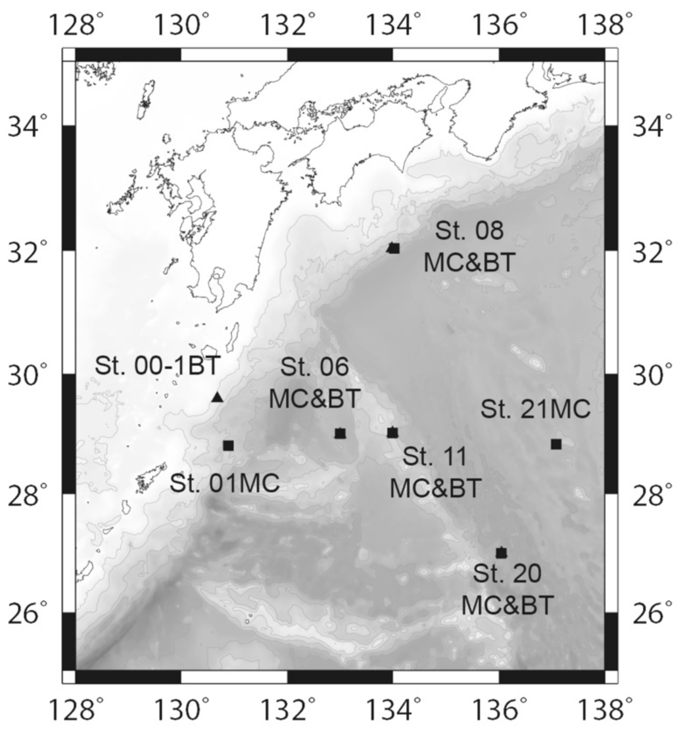


Figure 3-3. Sampling locations of beam trawl (BT in the map).

Figure 3-4. Collected sediments in each sampling location (A–E) and entangled trawl net at St. 00-2 (F). A, St. #08; B, St. #00-1; C, St. #06; D, St. #11; E, St. #20; F, St. #00-2.

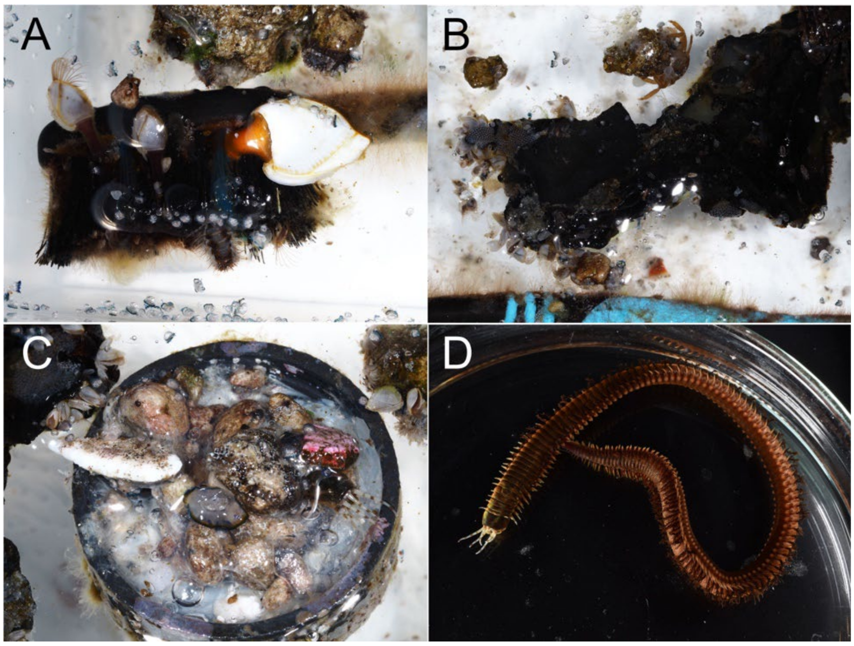


Figure 3-5. Fouling organisms with plastics collected by a Newston net. A, a toothbrush (brush head); B, a fragment of tire (?); C, a plastic cap; D, an eunicid worm collected from C.

3.1.9. Assessment of the Semi-automatic microplastic analyzer conjunction with hyperspectral camera (Nakajima, Osawa)

We conducted a confirmation test for the semi-autonomous microplastic analyzer, which is being developed by JAMSTEC, during the cruise. During the cruise, fresh seawater was pumped into the machine and the particles including microplastics were filtered onto a paper filter. The samples on the filter were scanned by a hyperspectral camera and the filters were stored by rolling in the sample storage unit. In total, xx images of subsurface water particles including microplastics were obtained during this cruise. We will fix some problems that were identified during the cruise to improve the analysis process of the analyzer.

3.2. Environmental DNA monitoring

3.2.1. Deep-sea fish sampling (Yabuki)

In conducting the metabarcoding analysis, the sufficient volume of reference sequences is essential. Thanks to Mitofish database, the reference sequences of many deep-sea fishes are already available. On the other hand, some of the deep-sea fishes still remain to be studied well and their reference sequences are also still unavailable. In this cruise, four deep-sea fishes were obtained by beam-trawl sampling and one deep-sea fish was obtained by the water pump equipped in the CTD system (Table 1). As those five fishes could not be identified on-board, they will be subjected for the taxonomic identification by the expert(s) and their barcode sequences will be determined and deposited to the database.

Table 3-4. List of the deep-sea fishes.

Sample ID	Date (JST)	Time (JST)	Latitude	Longitude	Depth (m)	Site No
KM22-15L2-BT1-1	2022/12/27	10:29	32-02.0025N	133-29.3766E	3646	#08

KM22-15L2-BT2-1	2022/12/28	11:35	29-35.3911N	130-40.8119 E	1179	#00
KM22-15L2-BT2-2	2022/12/28	11:35	29-35.3911N	130-40.8119 E	1179	#00
KM22-15L2-CTD2-1	2023/1/2	6:30	29-59.5772N	133-58.8114 E	1300	#11
KM22-15L2-BT6-1	2023/1/5	10:00	27-00.2959N	136-02.9988 E	5140	#20

3.2.2. CTD water sampling (Yabuki, Okanishi)

Environmental DNA (eDNA) metabarcoding analysis provides a useful information for estimating the biodiversity in aquatic ecosystems. The deep-sea water sample collected by using Niskin bottle in the CTD system (Figure 3-6) can be utilized as an initial material from which eDNA is extracted. During KM22-15 Leg. 2 cruise, CTD water sampling was carried out five times in total at off Shikoku (Table 3-5). Collected water samples were immediately filtrated with Sterivex filters and then the filters were filled with approximately 2.0 mL of RNAlater on-board. The filtrated samples (i.e., Sterivex filters) were refrigerated at 4°C for overnight and then moved and kept in -80°C. After the cruise, eDNA analysis for metabarcoding of marine organisms, such as diplonemid protists and ophiuroids, will be conducted.

Figure 3-6. CTD with Niskin bottle

Table 3-5. List of water samplings using Niskin bottles

Date (JST)	CTD ID.	Time (JST)	Latitude (N)	Longitude (E)	Depth (m)	Site No	Niskin No.	Filter Name
2022/12/29	001M001	6:28	28-48.51	130-53.29	3217	#1	1~36	KM22-15L2-C1N1~12
2023/1/2	011M001	6:11	28-59.56	133-58.78	2567	#11	1~36	KM22-15L2-C2N1~12
2023/1/3	AY1M001	8:28	26-46.47	135-22.36	374	#AY1	1~36	KM22-15L2-C3N1~12
2023/1/3	AY2M001	13:50	26-45.08	135-50.54	1495	#AY2	1~36	KM22-15L2-C4N1~12
2023/1/6	021M001	5:45	28-49.97	137-04.98	4175	#21	1~36	KM22-15L2-C5N1~12

The water samples in three Niskin bottles were filtered into a single Sterivex tube.

3.2.3. CTD

Personnel

Masashi Tsuchiya	(JAMSTEC)	(Principal Investigator)
Akinori Yabuki	(JAMSTEC)	
Aine Yoda	(MWJ)	(Operation Leader)
Tun Htet Aung	(MWJ)	
Riho Fujioka	(MWJ)	

Instruments

Instruments used in this cruise are as follows:

Winch and cable system

39.2 kN traction with AHC winch system (MacArtney A/S) for 8,000 m steel armored cable (Rochester Wire & Cable, LLC, Virginia, USA)

The CTD package was deployed from starboard by using a folding gallows.

Frame and water sampler

Aluminum frame for 36-position 12 L water sample bottles with an aluminum rectangular fin (54 cm × 90 cm)

Compact underwater slip ring swivel (Hanayuu Co., Ltd., Shizuoka, Japan)

36 position carousel water sampler, SBE 32 serial no. 324510-1086 (Sea-Bird Scientific, Washington, USA)

12 L sample bottle, model OTE 110 (OceanTest Equipment, Inc., Florida, USA)
(No TEFLON coating) [For all 36 bottles]

Deck unit

SBE 11 plus (Sea-Bird Scientific)
Serial no. 11P90876-0872

Underwater unit

Pressure sensor, SBE 9plus (Sea-Bird Scientific, Washington, USA)
Serial no. 09P84583-1235 (134402) (calibration date: August 4, 2022)

Temperature sensor
Primary, SBE 3Plus (Sea-Bird Scientific, Washington, USA)

Serial no. 03P2453 (calibration date: Jun 8, 2022)
Secondary, SBE 3Plus (Sea-Bird Scientific, Washington, USA)
Serial no. 03P4818 (calibration date: May 28, 2022)

Conductivity sensor
Primary, SBE 4C (Sea-Bird Scientific, Washington, USA)
Serial no. 041172 (calibration date: May 24, 2022)
Secondary, SBE 4C (Sea-Bird Scientific, Washington, USA)
Serial no. 043889 (calibration date: June 8, 2021)

Dissolved oxygen sensor
Primary, SBE 43 (Sea-Bird Scientific, Washington, USA)
Serial no. 432471, (calibration date: June 5, 2021)
Secondary, SBE 43 (Sea-Bird Scientific, Washington, USA)
Serial no. 430205 (calibration date: July 27, 2022)

Transmissometer, C-Star, WET Labs, Inc., Philomath, Oregon, USA
Serial no. 1727DR (calibration date: May 2, 2022)

Chlorophyll fluorometer (Seapoint Sensors Inc., New Hampshire, USA)
Serial no. 3700, Gain: 30X (0 $\mu g\ L^{-1}$ - 5 $\mu g\ L^{-1}$)

Turbidity meter (Seapoint Sensors Inc., New Hampshire, USA)
Serial no. 14954, Gain: 100X (0 FTU - 25 FTU)

PAR sensor, PAR-Log ICSW (Satlantic, LP, Nova Scotia, Canada)
Serial no. 1026 (calibration date: July 6, 2015)

Altimeter, PSA-916T (Teledyne Benthos, Inc.)
Serial no. 66557 (Cast 008M001, 001M001)
Serial no. 1239 (Cast 006M001~021M001)

Pump, SBE 5T (Sea-Bird Scientific)
Primary serial no. 058088
Secondary serial no. 058145

Bottom contact switch (Sea-Bird Scientific, Washington, USA)

Software

Data acquisition software, SEASAVE-Win32, version 7.26.7.121
Data processing software, SBEDataProcessing-Win32, version 7.26.7.129

Data Collection

The CTD system was powered on at least 20 minutes in advance of the data acquisition to stabilize the pressure sensor. The data was acquired at least two minutes before and after the CTD cast to collect atmospheric pressure data on the ship's deck.

The CTD package was lowered into the water from the starboard side and held 10 m beneath the surface to activate the pump. After the pump was activated, the package was lifted to the surface and lowered to 40 m then the package was stopped to operate the active heave compensator of the winch. The package was lowered again at a rate of 1.0 $m\ s^{-1}$ to the bottom. For some casts, CTD was lowered at 0.5 $m\ s^{-1}$ to adjust to the ship's working shift. For the up cast, the package was lifted at a rate of 1.0 $m\ s^{-1}$ except for bottle firing stops.

As a rule, the bottle was fired after waiting from the stop for more than 30 seconds. For depths where vertical gradient of water properties was expected to be large (from surface to thermocline), the bottle was fired after waiting from the stop for 60 seconds to enhance exchanging the water between inside and outside of the bottle. At 50 m from the surface, the package was stopped to stop the active heave compensator of the winch.

Problems Encountered

During cast 001M001, when CTD was being lowered to the depth of 2725m, altimeter value shifted slowly to about 12m~13m and displayed the same value until it reached 40m of upcast. Ship's echo sounder depth for that cast was 3227 m. Because of altimeter showing abnormal value, CTD was lowered at 0.3 m s^{-1} from 110m above bottom (calculated from comparing Ship's echo sounder depth and CTD depth), and then lowered at a slower rate of 0.2 m s^{-1} when it reached about 60m above bottom. CTD was stopped for a moment at 3217m CTD depth to confirm sensor's data (ship's echo sounder depth 3227 m). To confirm CTD's distance above bottom, we tried to lower CTD very slowly until bottom contact switch (BCS) alarm sounds (which was supposed to be about 2m lower from that stopping point since BCS rope length was 8m). Doing so, although the armored cable wire has been taken out and wire length was increasing, CTD depth didn't change from 3217m. Considering CTD has already touched bottom, CTD was lifted up to 3208m and stopped there for water sampling. When trying to lift up the CTD, before CTD depth changed from 3217m, bottom contact switch alarm went on and then went off when it was brought up to 3208m. Once CTD was brought back on deck, all sensors were visually inspected and no problem was found. Also, there was no problem with data of all sensors, except altimeter, therefore, only altimeter was replaced with a spare one. Although there appeared to be a kink formed at 10m of armored cable above CTD system, it was concluded that next CTD cast could be done without problem.

During upcast of 011M001, at 1320m, there was shift and nose in data of secondary salinity data and secondary dissolved oxygen data. Upon inspection on deck, there was small fish stuck in secondary TC duct. Upcast data of secondary temperature, salinity from 1320m to 1m and upcast data of dissolved oxygen from 1325m to 1m was considered as bad data.

Data Processing

The following are the data processing software (SBEDataProcessing-Win32) and original software data processing module sequence and specifications used in the reduction of CTD data in this cruise.

DATCNV converted the raw data to engineering unit data. DATCNV also extracted bottle information where scans were marked with the bottle confirm bit during acquisition. The duration was set to 3 seconds, and the offset was set to 0.0 second. The hysteresis correction for both primary and secondary SBE 43 data (voltage) was applied for both profile and bottle information data.

TCORP (original module, version 1.1) corrected the pressure sensitivity of the primary SBE 3 for both profile and bottle information data.

BOTTLESUM created a summary of the bottle data. The data were averaged over 3 seconds.

ALIGNCTD compensated SBE 43 data by advancing 4 seconds for primary and 5 seconds for secondary sensor output (voltage) relative to the temperature data.

WILDEDIT marked extreme outliers in the data files. The first pass of WILDEDIT obtained an accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, temperature, conductivity and oxygen data.

CELLTM used a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. Typical values used were thermal anomaly amplitude alpha = 0.03 and the time constant 1 $beta^{-1}$ = 7.0.

FILTER performed a low pass filter on pressure and depth with time constant of 0.15 seconds. In order to produce zero phase lag (no time shift) the filter runs forward first then backwards.

WFILTER performed as a median filter to remove spikes in transmissometer, chlorophyll fluorometer and turbidity meter. A median value was determined by 49 scans of the window.

SECTIONU (original module, version 1.1) selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the start time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the depth of the package was 1 dbar below the surface. The minimum and maximum numbers were automatically calculated in the module.

LOOPEDIT marked scans where the CTD was moving less than the minimum velocity of 0.0 m s^{-1} (traveling backwards due to ship roll).

DESPIKE (original module, version 1.0) removed spikes of the data. A median and mean absolute deviation was calculated in 1 dbar pressure bins for both down cast and up cast, excluding the flagged values. Values greater than 4 mean absolute deviations from the median were marked bad for each bin. This process was performed 2 times for both primary and secondary data of temperature, conductivity and oxygen.

DERIVE was used to compute oxygen (SBE 43).

BINAVG averaged the data into 1m depth bins and 1s time bins. The center value of the first bin was set equal to the bin size. The bin minimum and maximum values are the center value plus and minus half the bin size. Scans with depths greater than the minimum and less than or equal to the maximum were averaged. Scans were interpolated so that a data record exist every meter.

BOTTOMCUT (original module, version 0.1) deleted the deepest bin when the averaged scan number of the deepest bin was smaller than the average scan number of the bin just above.

DERIVE was re used to compute salinity, potential temperature, and density.

SPLIT was used to split data into the down cast and the up cast.

Station List

The CTD station information for this cruise is summarized in Table 3-6.

Table 3-6. Station summary of the CTD water sampling measurement.

KM22-15 Leg2 CTD cast table

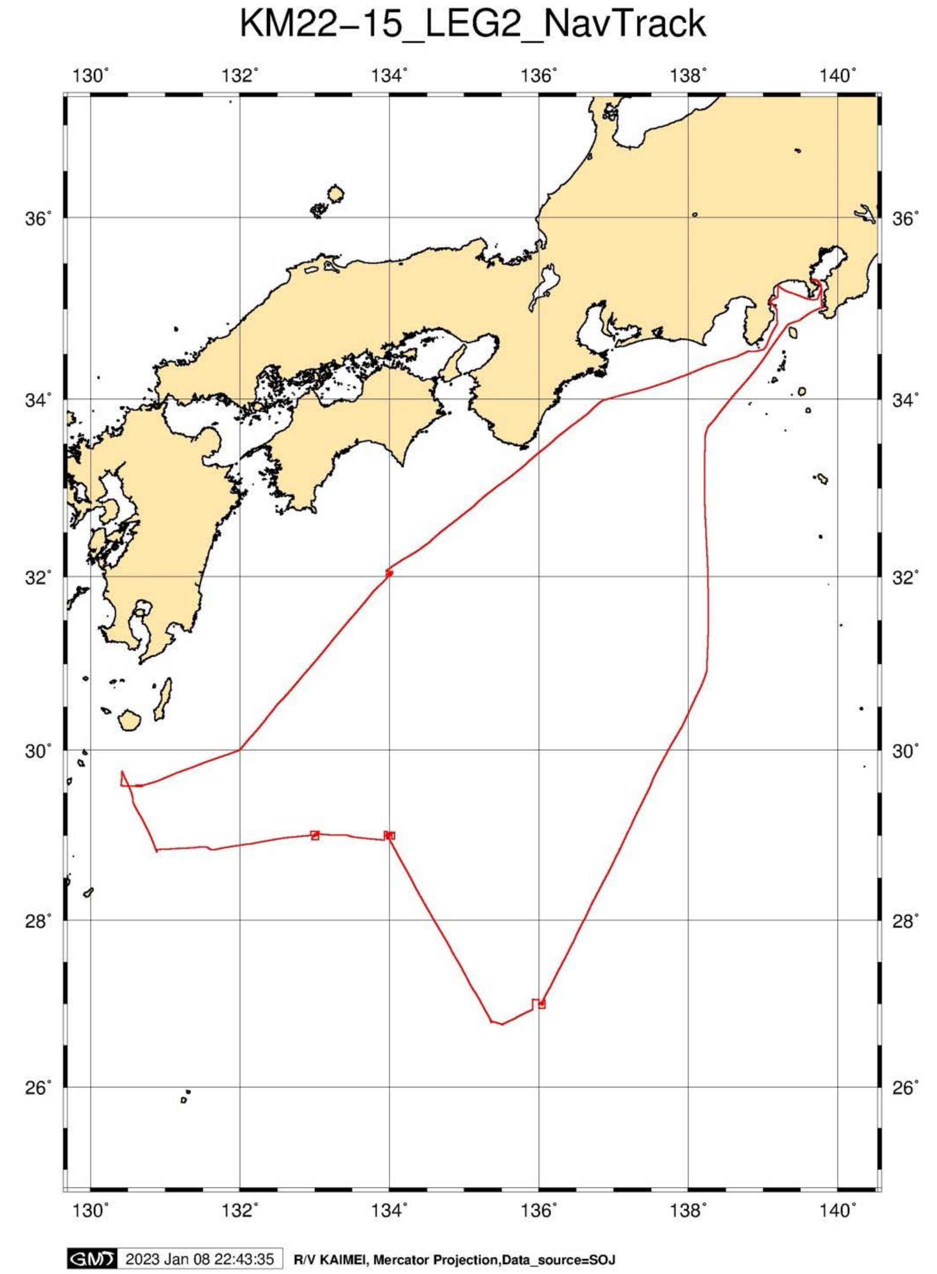
Stnnbr	Castno	Date(UTC)	Time(UTC)		BottomPosition		Depth	Wire	HT Above	Max	Max	CTD	Remark
		(mmddyy)	Start	End	Latitude	Longitude	(m)	Out (m)	Bottom (m)	Depth	Pressure	Filename	
008	1	122522	23:37	00:24	32-02.14N	133-59.88E	3648.5	1217.0	-	1201.0	1213.0	008M001	
001	1	122822	19:10	22:19	28-48.51N	130-53.29E	3227.4	3226.1	-	3217.0	3263.8	001M001	CTD着底
006	1	122922	22:13	23:01	29-00.22N	133-00.02E	4432.0	1220.3	-	1201.0	1212.7	006M001	
011	1	010123	19:09	21:56	28-59.56N	133-58.78E	2585.6	2591.0	10.5	2567.0	2600.4	011M001	
AY1	1	010223	23:11	23:38	26-46.47N	135-22.36E	396.0	373.8	8.3	374.0	376.8	AY1M001	
AY2	1	010323	04:15	05:19	26-45.08N	135-30.54E	1502.6	1507.0	7.4	1495.0	1510.3	AY2M001	
020	1	010323	22:15	23:00	26-59.96N	135-59.91E	4961.9	1206.6	-	1200.0	1211.5	020M001	
021	1	010523	19:11	21:53	28-49.97N	137-04.98E	4220.8	4194.8	9.0	4175.0	4245.2	021M001	

4. Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.
This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.
Users of information on this report are requested to submit Publication Report to JAMSTEC.

http://www.godac.jamstec.go.jp/darwin/explain/1/e#report
E-mail: submit-rv-cruise@jamstec.go.jp

Appendix: Navigation



Appendix: Cruise Log

R/V "KAIMEI" KM22-15 Cruise Log

Date & Time (JST = UTC+9h)	Description	Weather / Wind / Sea Condition
Leg2		
2022/12/22 Thu.	Noon Position: 35-09.6N,139-26.3E (West Off Miura Peninsula)	o / NNE-6 / 4
8:00	Onboard "KAIMEI" at JAMSTEC	
9:00	Let go all shore lines & left JAMSTEC for off Atami	
9:15	Research meeting	
10:00-11:00	Carried out education & training for scientists	
16:00	Arrived at off Atami, SAGAMI Bay	
2022/12/23 Fri.	Noon Position: 35-04.8N,139-06.2E (SAGAMI Bay)	bc / SW-7 / 5
2022/12/24 Sat.	Noon Position: 35-04.7N,139-05.7E (SAGAMI Bay)	bc / West-4 / 3
9:00	Carried out practiced life boat station drill, then practiced fire and water proof station drills	
20:00	Proceeded to research area (off Shikoku)	
2022/12/25 Sun.	Noon Position: 33-54.4N,136-43.9E (south off Daiousaki)	bc / NW-6 / 4
	Proceeding to resarach area (off Shikoku)	
2022/12/26 Man.	Noon Position: 32-02.4N,134-00.7E (NANKAI trough)	bc / NNW-4 / 3
4:00	Arrived at #08 site, off Shikoku	
5:29	Released at XBT at 32-03.5903N, 133-57.3476E	
06:08-07:55	Carried out MBES site survey	
08:34-09:28	Carried out CTD sampling survey (w.o. 1,217m)	
10:09-11:44	Carried out in-situ filtration operation (w.o. 160m)	
12:48-14:41	Carried out in-situ filtration operation (w.o. 1,000m)	
15:00-17:25	Carried out multiple corer operation (w.o. 3,590m)	
2022/12/27 Tue.	Noon Position: 32-02.1N,133-58.7E (NANKAI trough)	bc / WNW-3 / 2
08:23-13:20	Carried out towing beam troll (w.o. 3,720m)	
11:45-12:08	Carried out towing Neuston net	
11:49-11:52	Sampled surface water	
12:10-12:33	Carried out towing Neuston net	
13:25-13:57	Carried out towing Neuston net	
14:00	Proceeded to #00 site	
2022/12/28 Wed.	Noon Position: 29-35.4N,130-40.8E (South off Tanegashima)	c / NNW-4 / 2
9:00	Arrived at #00 site	
9:02	Released at XBT at 29-35.7111N, 130-43.7676E	
09:27-10:24	Carried out MBES site survey	
10:52-13:33	Carried out towing beam troll (w.o. 1,100m)	
13:38-14:05	Carried out towing Neuston net	
13:42-13:47	Sampled surface water	
14:16-16:37	Carried out towing beam troll (w.o. 1,215m)	
16:45-17:07	Carried out towing Neuston net	
17:09-17:33	Carried out towing Neuston net	
17:35	Proceeded to #01 site	

R/V "KAIMEI" KM22-15 Cruise Log

Date & Time (JST = UTC+9h)	Description	Weather / Wind / Sea Condition
2022/12/29 Thu.	Noon Position: 28-48.5N,130-53.3E (East off Amami-Ohshima)	o / North-5 / 3
3:30	Arrived at #01 site	
04:07-07:23	Carried out CTD sampling survey (w.o. 3,270m)	
08:22-10:02	Carried out in-situ filtration operation (w.o. 170m)	
10:15-12:28	Carried out multiple corer operation (w.o. 3,260m)	
11:37-11:59	Carried out towing Neuston net	
13:00-14:37	Carried out in-situ filtration operation (w.o. 170m)	
14:47-15:09	Carried out towing Neuston net	
15:11-15:35	Carried out towing Neuston net	
15:12-15:15	Sampled surface water	
15:42	Proceeded to #06 site	
2022/12/30 Fri.	Noon Position: 29-00.4N,133-00.1E (KIKAI Basean)	o / NE-3 / 3
4:45	Arrived at #06 site	
07:10-08:04	Carried out CTD sampling survey (w.o. 1,200m)	
08:17-09:49	Carried out in-situ filtration operation (w.o. 110m)	
10:16-13:03	Carried out multiple corer operation (w.o. 4,507m)	
11:59-12:20	Carried out towing Neuston net	
13:23-15:12	Carried out in-situ filtration operation (w.o. 1,000m)	
15:30-15:51	Carried out towing Neuston net	
15:54-16:18	Carried out towing Neuston net	
17:12-19:40	Carried out MBES site survey	
2022/12/31 Sat.	Noon Position: 28-59.4N,133-00.4E (KIKAI Basean)	c / NNW-5 / 3
08:10-12:50	Carried out towing beam troll (w.o. 4,451m)	
13:20	Proceeded to #11 site	
18:20	Arrived at #11 site, then started to MBES site survey	
22:40	Finished to MBES site survey	
2023/01/01 Sun.	Noon Position:29-00.1N,133-59.4E (SHIKOKU Basean)	bc / NNW-3 / 2
7:00	Pray for safety of cruise to KONPIRASAN	
07:45-09:46	Carried out multiple corer operation (w.o. 2,842m)	
2023/01/02 Man.	Noon Position: 29-00.8N,133-59.1E (SHIKOKU Basean)	bc / WNW-3 / 2
04:05-06:59	Carried out CTD sampling survey (w.o. 2,589m)	
08:04-09:48	Carried out in-situ filtration operation (w.o. 135m)	
09:09-09:32	Carried out towing Neuston net	
09:11-09:15	Sampled surface water	
09:52-10:14	Carried out towing Neuston net	
10:17-10:39	Carried out towing Neuston net	
10:48-12:42	Carried out in-situ filtration operation (w.o. 1,000m)	
13:04-17:04	Carried out towing beam troll (w.o. 2,830m)	
18:20	Proceeded to #AY1 site	

R/V "KAIMEI" KM22-15 Cruise Log

Date & Time (JST = UTC+9h)	Description	Weather / Wind / Sea Condition
2023/01/03 Tue.	Noon Position: 26-45.2N,135-30.5E (SHIKOKU Basean)	o / NW-4 / 3
7:30	Arrived at #AY1 site	
08:06-08:41	Carried out CTD sampling survey (w.o. 375m)	
08:56-09:18	Carried out towing Neuston net	
08:59-09:02	Sampled surface water	
09:21-09:43	Carried out towing Neuston net	
09:45-10:07	Carried out towing Neuston net	
10:30	Proceeded to #AY2 site	
11:50	Arrived at #AY2 site	
13:12-14:22	Carried out CTD sampling survey (w.o. 1,494m)	
14:30	Proceeded to #20 site	
17:26	Arrived at #20 site, then started to MBES site survey	
20:39	Finished to MBES site survey	
2023/01/04 Wed.	Noon Position: 27-00.0N,136-02.8E (SHIKOKU Basean)	c / North-5 / 3
07:12-08:03	Carried out CTD sampling survey (w.o. 1,200m)	
08:15-09:40	Carried out in-situ filtration operation (w.o. 138m)	
10:18-13:35	Carried out multiple corer operation (w.o. 5,227m)	
12:15-12:37	Carried out towing Neuston net	
12:17-12:22	Sampled surface water	
12:40-13:00	Carried out towing Neuston net	
14:25-16:23	Carried out in-situ filtration operation (w.o. 1,000m)	
16:28-16:53	Carried out towing Neuston net	
2023/1/5 Thu.	Noon Position: 27-01.1N,136-03.0E (SHIKOKU Basean)	bc / NNW-4 / 3
08:07-13:26	Carried out towing beam troll (w.o. 5,203m)	
14:00	Proceeded to #21 site	
2023/01/06 Fri.	Noon Position: 28-50.0N,137-04.8E (SHIKOKU Basean)	r / NW-4 / 3
2:00	Arrived at #AY1 site	
04:09-06:56	Carried out CTD sampling survey (w.o. 4,195m)	
08:03-09:37	Carried out in-situ filtration operation (w.o. 155m)	
09:47-12:30	Carried out multiple corer operation (w.o. 5,227m)	
11:18-11:39	Carried out towing Neuston net	
11:41-12:02	Carried out towing Neuston net	
12:37-12:59	Carried out towing Neuston net	
12:39-12:40	Sampled surface water	
13:15-14:53	Carried out in-situ filtration operation (w.o. 500m)	
15:00	Proceeded to YOKOSUKA	
18:00	Research meeting	
2023/01/07 Sat.	Noon Position: 33-13.4N,138-13.2E (West off Hachijo-jima)	o / WNW-4 / 3
	Proceeding to YOKOSUKA	
2023/01/08 Sun.	Noon Position: 35-01.1N,139-48.1E (TATEYAMA Bay)	b / North-3 / 2
	Proceeding to YOKOSUKA	
2023/01/09 Man.		
8:50	Sent out 1st shore line, arrived at JAMSTEC at YOKOSUKA, then completed voy. No.KM22-15Leg2	

Appendix: Operation Log

2022/12/26									
CTD吊上げ	8:32:26	32-02.1696N	133-59.7776E	316	335	8.3	108	1.4	3651
CTD着水	8:34:29	32-02.1694N	133-59.7784E	316	337	8.3	108	1.4	3651
CTD水切り	9:24:17	32-02.0164N	134-00.4320E	316	346	10.3	108	1.5	3594
揚収	9:28:23	32-02.0515N	134-00.4152E	317	352	6.9	109	1.7	3593
ろ過装置　吊上げ	10:08:55	32-02.3443N	134-00.6956E	316	342	8.8	101	1.7	3557
ろ過装置　着水	10:09:22	32-02.3445N	134-00.6957E	316	343	7.9	101	1.7	3556
水切り	11:42:14	32-02.4887N	134-01.0776E	335	339	4.4	92	1.8	3539
揚収	11:44:17	32-02.4889N	134-01.0780E	335	340	4.8	92	1.8	3539
ろ過装置　吊上げ	12:47:37	32-02.3593N	134-00.1179E	351	326	4.3	87	1.7	3600
ろ過装置　着水	12:48:53	32-02.3826N	134-00.1545E	355	312	3.0	90	1.7	3595
ろ過装置2個目取付	13:03:40	32-02.5570N	134-00.6757E	341	302	4.7	81	2.0	3552
ろ過装置　着水	13:05:17	32-02.5822N	134-00.7253E	341	322	5.3	81	2.0	3550
2個目水切り	14:28:37	32-02.6542N	134-00.8863E	275	318	5.0	91	2.2	3538
2個目揚収	14:31:04	32-02.6477N	134-00.9461E	276	308	6.5	90	2.1	3537
1個目水切り	14:40:15	32-02.6159N	134-01.1948E	275	332	7.0	94	2.1	3532
1個目揚収	14:41:31	32-02.6046N	134-01.2202E	275	349	5.2	93	2.1	3532
MC									
吊上げ	14:58:24	32-02.4996N	134-00.8119E	269	314	8.2	91	2.1	3543
着水	15:00:00	32-02.4996N	134-00.8119E	269	314	8.2	91	2.1	3543
トラポン着水	15:10:42	32-02.4181N	134-01.1213E	271	327	7.1	96	1.9	3545
着底	16:26:14	32-02.3154N	134-01.4123E	290	325	9.1	98	2.2	0
トラポン水切り	17:16:30	32-02.2566N	134-01.6678E	290	347	6.2	104	2.1	0
本体水切り	17:23:27	32-02.2072N	134-01.8693E	291	004	4.4	97	1.9	0
揚収	17:26:30	32-02.1709N	134-01.9736E	291	002	6.3	97	2.0	0
2022/12/27									
吊上げ	8:20:16	32-02.1424N	133-58.8773E	295	299	5.7	107	1.3	3656
着水	8:23:18	32-02.1423N	133-58.8773E	296	298	5.5	107	1.3	3662
曳航開始	10:23:00	32-01.9924N	133-59.4445E	285	316	2.5	96	1.3	3647
曳航終了 巻き取り開始	11:29:42	32-02.0933N	133-58.7719E	285	301	4.9	79	1.5	3677
離底したと思われる	11:43:19	32-02.1001N	133-58.7264E	285	334	2.8	78	1.5	3661
トラポン水切り	12:39:29	32-02.1389N	133-59.1159E	265	352	3.4	74	1.7	3653
ビームトロール水切り	13:16:26	32-02.3581N	133-59.9761E	265	357	1.6	75	1.8	3644
ビームトロール揚収	13:19:46	32-02.3718N	134-00.0549E	265	326	2.4	76	1.8	3637
2022/12/28									
#00_ビームトロール　1回目									
吊上げ	10:49:07	29-35.4720N	130-40.6459E	273	334	5.7	94	0.9	1159
着水	10:52:52	29-35.4722N	130-40.6854E	272	346	5.2	94	1.0	1162
着底	11:36:55	29-35.4006N	130-40.8184E	271	327	4.7	87	1.0	1179
曳航終了 巻き取り開始	12:41:39	29-34.9336N	130-40.5097E	272	331	4.6	69	1.3	1173
離底したと思われる	12:47:31	29-34.8992N	130-40.4866E	272	325	4.6	67	1.3	1171
トラポン水切り	13:03:38	29-34.9034N	130-40.5267E	272	347	5.9	64	1.4	0
ビームトロール水切り	13:31:10	29-35.0306N	130-40.9255E	266	322	4.7	61	1.7	1207
ビームトロール揚収	13:33:28	29-35.0411N	130-40.9334E	270	315	5.3	62	1.7	2911
#00_ビームトロール　2回目									
吊上げ	14:13:52	29-35.2179N	130-40.6084E	250	325	4.2	65	1.7	1168
着水	14:15:00	29-35.2184N	130-40.6103E	251	336	6.4	64	1.7	1166
着底	15:05:32	29-35.3889N	130-41.1423E	251	347	4.4	67	1.8	1252
曳航終了 巻き取り開始	15:40:35	29-35.1350N	130-40.9751E	250	336	7.4	81	1.9	1207
離底したと思われる	15:47:43	29-35.0901N	130-40.9459E	251	316	6.5	82	1.8	2411
トラポン水切り	16:05:45	29-35.0814N	130-41.0098E	259	341	4.8	84	1.7	1212
ビームトロール水切り	16:36:49	29-35.1406N	130-41.7791E	260	329	6.0	89	1.7	1288
ビームトロール揚収	16:36:56	29-35.1407N	130-41.7820E	259	327	6.2	89	1.7	1289

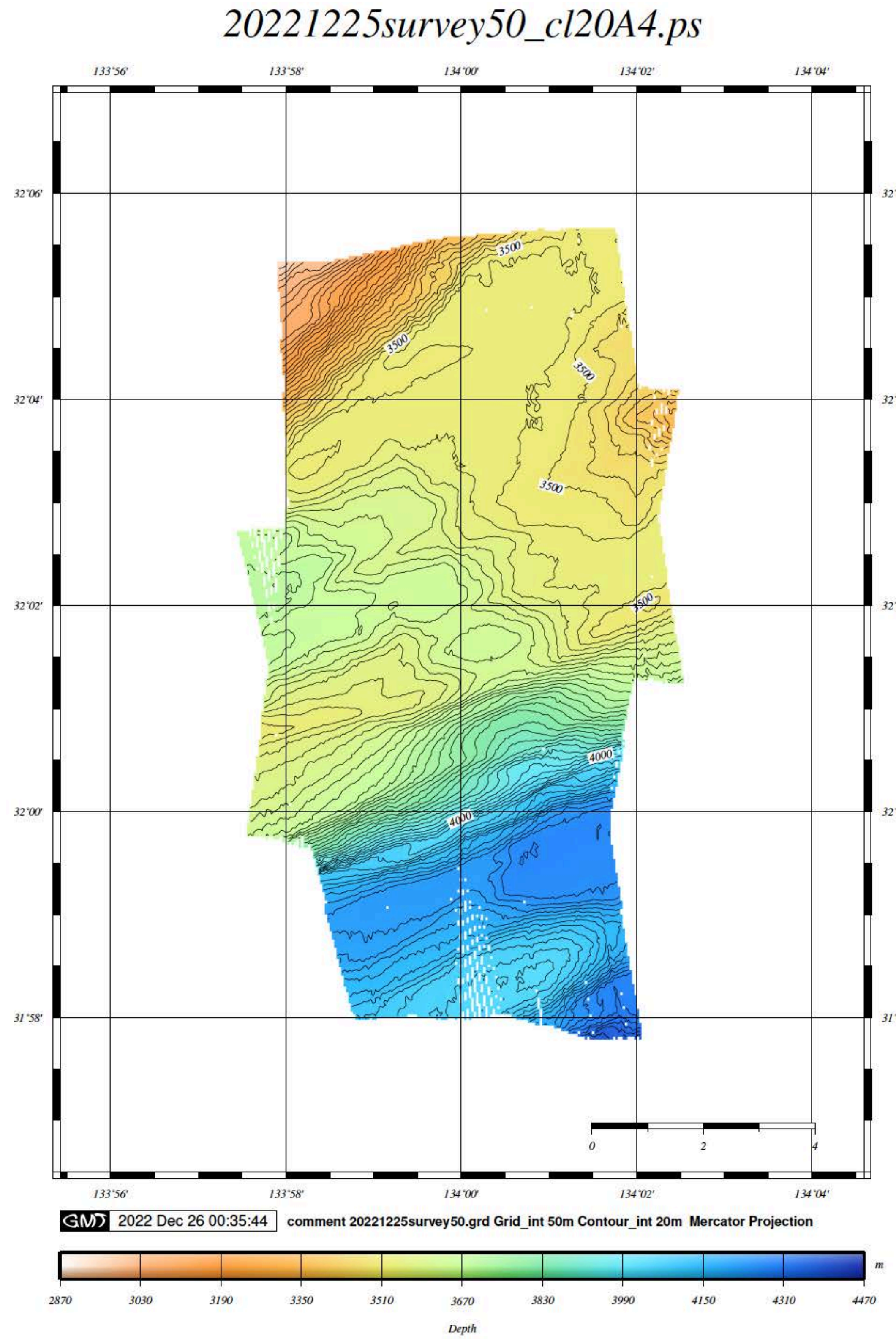
2022/12/29									
CTD_#01									
水切り	7:19:52	28-48.5155N	130-53.2957E	350	348	5.7	191	0.2	3225
揚収	7:22:56	28-48.5151N	130-53.2958E	351	326	6.2	192	0.2	3226
MC									
吊上げ	10:12:17	28-48.5153N	130-53.2956E	351	356	8.4	214	0.1	3227
着水	10:15:19	28-48.5153N	130-53.2956E	351	356	8.6	214	0.1	3227
着底	11:26:28	28-48.5152N	130-53.2960E	351	345	9.2	172	0.2	3612
巻上開始	11:29:54	28-48.5153N	130-53.2960E	351	347	9.2	174	0.2	3227
トラポン水切り	12:19:37	28-48.9299N	130-53.2958E	350	355	7.3	224	0.2	3171
水切り	12:25:27	28-48.9299N	130-53.2956E	351	354	6.3	219	0.2	3198
揚収	12:28:18	28-48.9296N	130-53.2957E	350	351	6.9	237	0.2	3166
現場ろ過装置									
吊上げ	12:58:10	28-49.0594N	130-53.2370E	005	358	8.3	249	0.3	3137
1個目着水	12:59:31	28-49.0599N	130-53.2366E	005	008	9.3	252	0.3	3140
2個目着水	13:09:34	28-49.0589N	130-53.2375E	007	337	7.8	212	0.3	3138
2個目水切り	14:31:01	28-49.0597N	130-53.2371E	005	356	7.3	258	0.3	3136
2個目揚収	14:32:37	28-49.0595N	130-53.2369E	005	352	7.1	266	0.3	3140
1個目水切り	14:36:56	28-49.0595N	130-53.2371E	005	347	8.9	270	0.3	3140
1個目揚収	14:38:30	28-49.0597N	130-53.2365E	005	348	8.4	264	0.3	3144
ニューストンネット									
着水	14:47:39	28-49.1332N	130-53.2368E	358	003	8.5	242	0.4	3124
揚収	15:09:43	28-49.6855N	130-53.0493E	355	333	8.7	264	0.4	3071
着水	15:11:54	28-49.7493N	130-53.0300E	355	345	8.0	270	0.4	3073
揚収	15:33:37	28-50.3125N	130-52.7613E	359	351	8.9	282	0.4	3127
2022/12/30									
CTD_#6									
吊上げ	7:07:36	28-59.7956N	133-00.3502E	111	018	8.9	329	1.1	4431
着水	7:10:02	28-59.8265N	133-00.3202E	101	010	7.7	330	1.1	4433
水切り	8:01:45	29-00.5348N	132-59.7230E	061	028	4.0	328	1.3	4428
揚収	8:04:25	29-00.5790N	132-59.6761E	061	015	6.6	327	1.2	4429
isP									
吊上げ	8:15:03	29-00.6156N	132-59.6281E	085	015	4.4	326	1.3	4427
着水	8:17:07	29-00.6164N	132-59.6275E	084	012	5.4	326	1.3	4429
水切り	9:43:00	29-00.3816N	133-00.1344E	090	054	4.7	337	1.1	4438
揚収	9:49:00	29-00.3812N	133-00.1344E	090	055	4.7	337	1.1	4436
MC吊上げ	10:13:15	29-00.3812N	133-00.1344E	090	055	4.7	337	1.1	4436
着水	10:16:05	29-00.3812N	133-00.1344E	090	055	4.7	337	1.1	4436
着底	11:44:25	29-00.3811N	133-00.1346E	091	028	5.7	341	0.8	4446
巻上開始	11:45:16	29-00.3808N	133-00.1343E	090	034	5.3	341	0.8	4446
トラポン水切り	12:53:53	29-00.0642N	133-00.1473E	050	030	5.2	330	0.7	4448
水切り	13:00:51	29-00.1410N	133-00.1513E	049	028	6.2	325	0.6	4444
揚収	13:02:47	29-00.1653N	133-00.1511E	050	031	6.3	324	0.6	4446
ニューストンネット									
着水	12:00:24	29-00.2902N	133-00.1456E	151	041	6.2	337	0.7	4442
揚収	12:22:27	28-59.9883N	133-00.1901E	145	057	5.7	343	0.7	4441
現場ろ過装置									
1個目吊上げ	13:22:02	28-59.9785N	133-00.3083E	055	036	6.7	331	0.6	4444
1個目着水	13:23:19	28-59.9877N	133-00.3117E	055	023	5.1	329	0.6	4441
2個目着水	13:38:27	29-00.2200N	133-00.2884E	050	018	6.2	336	0.7	4445
2個目水切り	15:08:49	29-00.3066N	133-00.2731E	050	027	4.8	322	0.4	4446
2個目揚収	15:11:00	29-00.3453N	133-00.2405E	049	034	4.4	320	0.5	4442
1個目水切り	15:21:07	29-00.4917N	133-00.2084E	050	051	5.0	326	0.4	4447
1個目揚収	15:22:35	29-00.5052N	133-00.2046E	050	050	3.7	323	0.4	4452
2022/12/31									
BT_#06									
吊上げ	8:07:18	29-00.0248N	132-59.8379E	137	237	1.9	320	1.3	4436
着水	8:08:11	29-00.0245N	132-59.8381E	137	215	2.1	320	1.3	4436
曳航開始	10:13:44	28-59.8672N	132-59.9886E	137	348	5.6	319	1.1	4441
巻取り開始	11:16:08	28-59.4359N	133-00.4001E	137	001	5.9	314	1.1	4442
曳航終了	11:26:09	28-59.4094N	133-00.4250E	137	344	9.3	314	1.1	4441
トラポン水切り	12:28:08	29-00.4754N	132-59.9376E	335	339	13.0	308	0.9	4442
水切り	12:49:31	29-00.8378N	132-59.6036E	336	325	9.0	307	0.8	4436
揚収	12:50:23	29-00.8533N	132-59.5905E	336	336	11.9	306	0.8	4438

2023/1/1										
MC										
吊上げ	7:45:07	29-01.3329N	133-59.7204E	356	003	4.3	186	0.9	2752
着水	7:45:49	29-01.3268N	133-59.7139E	356	000	3.4	186	0.9	2758
着底	8:57:44	29-01.1202N	133-59.5164E	355	357	7.4	190	1.1	2792
トラポン水切り	9:36:36	29-01.0491N	133-59.4477E	355	019	4.9	186	1.1	2798
水切り	9:44:43	29-00.9554N	133-59.3587E	356	343	4.5	193	1.3	2801
揚収完了	9:46:36	29-00.9085N	133-59.3345E	356	357	4.8	193	1.3	2802
2023/1/2									
CTD_#11									
水切り	6:56:08	28-59.3659N	133-58.4006E	031	267	3.5	223	0.5	2455
揚収	6:58:28	28-59.3767N	133-58.3998E	031	299	5.2	223	0.6	2455
isP									
吊上げ	8:02:39	29-00.9113N	133-59.1610E	020	270	4.3	232	0.4	2796
着水	8:04:15	29-00.9113N	133-59.1612E	020	274	3.4	217	0.6	2795
水切り	9:46:13	29-00.8664N	133-59.1321E	031	281	7.0	223	1.0	2791
揚収	9:48:00	29-00.8542N	133-59.1282E	030	272	5.6	225	1.0	2791
isP 2回目									
吊上げ	10:47:30	29-00.7822N	133-59.0807E	040	254	4.2	222	1.2	2766
着水	11:48:39	29-00.7804N	133-59.0792E	040	252	4.4	221	1.2	2763
水切り	12:29:09	29-00.7135N	133-59.0020E	037	284	3.8	236	1.2	2740
揚収	12:30:37	29-00.6973N	133-58.9808E	037	281	4.0	237	1.3	2738
水切り	12:39:40	29-00.6424N	133-58.9060E	038	297	5.2	238	1.3	2715
揚収	12:41:17	29-00.6361N	133-58.8954E	037	306	6.2	237	1.4	2707
BT									
吊上げ	13:03:26	29-01.4575N	134-00.0467E	052	299	4.0	227	1.1	2943
着水	13:04:00	29-01.4558N	134-00.0441E	052	299	4.7	228	1.1	2940
トラポン着水	13:24:13	29-01.2499N	133-59.7081E	052	278	5.6	228	1.3	2760
曳航開始	14:14:39	29-00.9812N	133-59.2626E	040	289	6.3	229	1.5	2798
着底	14:39:03	29-01.1439N	133-59.4018E	041	281	7.0	230	1.4	2796
曳航終了 巻き取り開始	15:45:21	29-01.5864N	133-59.7816E	041	276	6.5	236	1.2	2801
離底したと思われる	15:55:27	29-01.6410N	133-59.8288E	040	279	6.1	235	1.2	2640
トラポン水切り	16:38:54	29-01.5832N	133-59.6047E	292	275	6.7	240	1.0	2715
ビームトロール水切り	16:59:42	29-01.4001N	133-59.0989E	291	286	5.7	232	0.8	2734
ビームトロール揚収	17:04:00	29-01.3663N	133-59.0023E	290	286	6.9	230	0.8	2707
2023/1/3									
CTD_#AY1									
吊上げ	8:06:02	26-46.4695N	135-22.3599E	331	352	5.1	335	0.4	396
着水	8:08:38	26-46.4695N	135-22.3601E	330	336	5.6	337	0.4	395
水切り	8:38:44	26-46.5071N	135-22.3098E	329	334	5.5	298	0.4	444
揚収	8:41:00	26-46.5071N	135-22.3098E	329	334	5.5	298	0.4	444
ニューストンネット									
着水	8:56:00	26-46.5071N	135-22.3098E	329	334	5.5	298	0.4	444
揚収	10:07:00	26-46.5074N	135-22.3101E	329	334	5.5	298	0.4	444
CTD_#AY2									
吊上げ	13:10:16	26-44.9521N	135-30.6951E	340	327	6.5	313	0.5	1526
着水	13:12:31	26-44.9609N	135-30.6855E	340	315	6.8	314	0.5	1525
水切り	14:19:36	26-45.1560N	135-30.4100E	340	322	6.6	284	0.5	1470
揚収	14:21:43	26-45.1639N	135-30.3941E	340	321	6.9	284	0.5	1469
2023/1/4									
CTD_#20									
吊上げ	7:11:30	26-59.9906N	135-59.9977E	335	318	7.4	258	0.3	4953
着水	7:11:59	26-59.9901N	135-59.9971E	336	320	6.9	258	0.3	4944
水切り	8:00:42	26-59.9172N	135-59.8180E	332	336	7.1	232	0.3	4979
揚収	8:03:08	26-59.9097N	135-59.8013E	331	347	7.3	221	0.4	4987
MC_#20									
吊上げ	10:17:39	26-59.9721N	136-02.8460E	350	357	7.9	266	0.6	5178
着水	10:18:42	26-59.9721N	136-02.8458E	351	358	7.8	267	0.6	5178
着底	12:04:09	26-59.9715N	136-02.8459E	004	003	6.1	288	0.5	5164
離底	12:06:20	26-59.9721N	136-02.8460E	004	356	6.3	282	0.4	5165
トラポン水切り	13:26:36	27-00.8258N	136-03.2317E	355	001	7.0	289	0.3	5160
水切り	13:33:20	27-00.8806N	136-03.2301E	355	349	6.8	266	0.3	5151
揚収	13:35:17	27-00.8925N	136-03.2282E	355	355	6.6	266	0.3	5160
ニューストンネット									
着水	12:15:03	26-59.9881N	136-02.8542E	018	333	4.9	286	0.5	5167
揚収	12:35:45	27-00.2944N	136-03.0148E	020	343	6.2	276	0.4	5159
着水	12:39:54	27-00.3418N	136-03.0484E	020	353	7.8	291	0.4	5156
揚収	13:01:15	27-00.7080N	136-03.2593E	021	348	6.6	285	0.3	5161

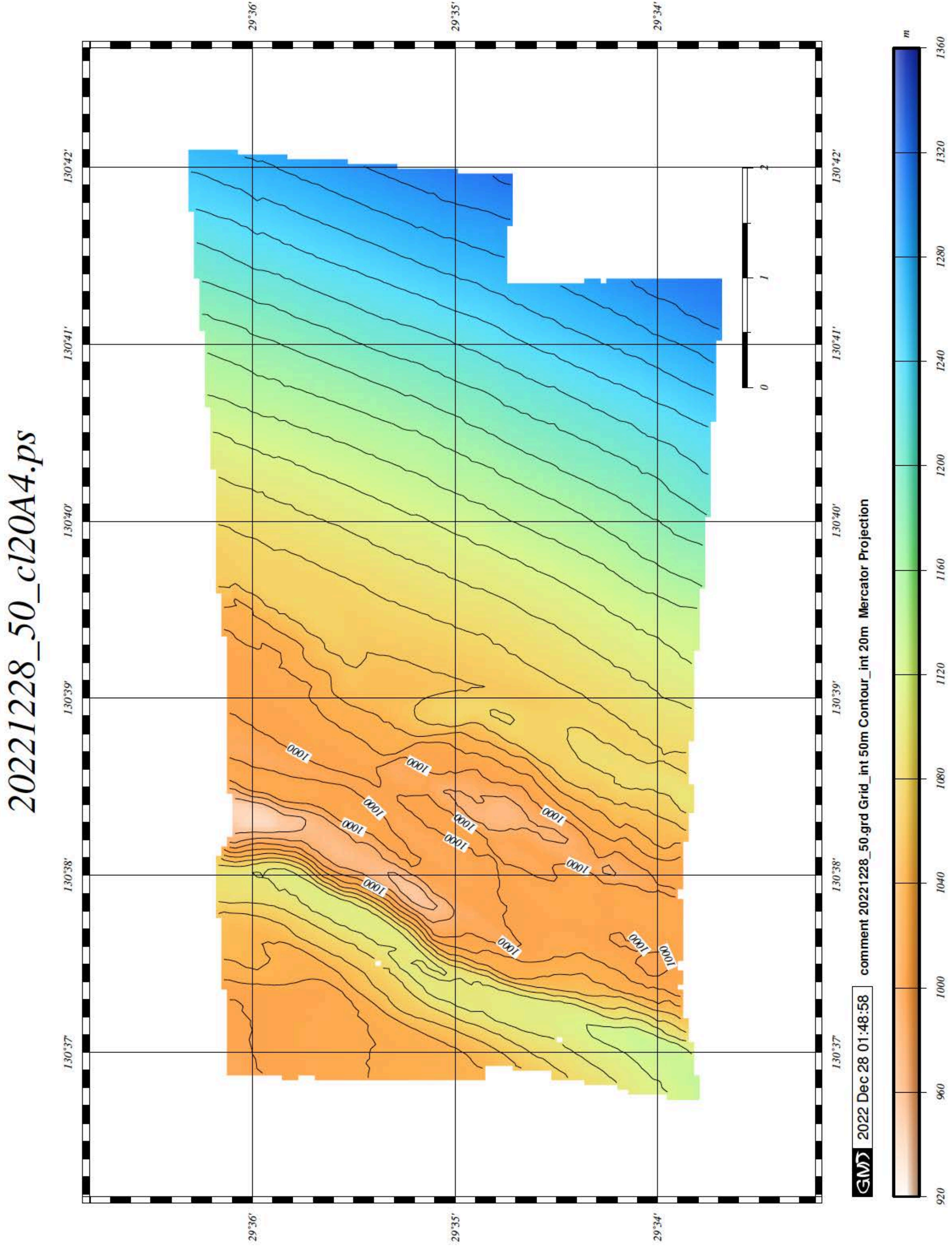
2023/1/5									
BT_#20									
吊上げ	8:06:01	26-59.8397N	136-03.3026E	353	022	10.9	275	0.4	5155
着水	8:07:53	26-59.8693N	136-03.2669E	356	001	8.0	248	0.6	5154
トラポン着水	8:30:22	26-59.9768N	136-03.0567E	000	000	7.6	265	0.5	5162
着底	9:54:35	27-00.2325N	136-02.9992E	019	005	5.4	262	0.7	5157
曳航開始	10:01:49	27-00.2922N	136-02.9988E	020	015	6.7	269	0.7	5158
曳航終了 巻き取り開始	11:31:58	27-01.0462N	136-02.9988E	020	001	7.5	278	0.6	5174
離底したと思われる	11:47:46	27-01.1446N	136-02.9989E	019	347	6.1	283	0.5	5163
トラポン水切り	12:59:29	27-01.2096N	136-02.9622E	001	012	6.6	297	0.4	5177
ビームトロール水切り	13:18:12	27-01.3619N	136-02.7900E	360	351	6.3	300	0.5	5160
ビームトロール揚収	13:22:22	27-01.3938N	136-02.7670E	000	001	9.8	298	0.5	5159

Appendix: Bathymetry at each sampling site

Station #08



Station #00



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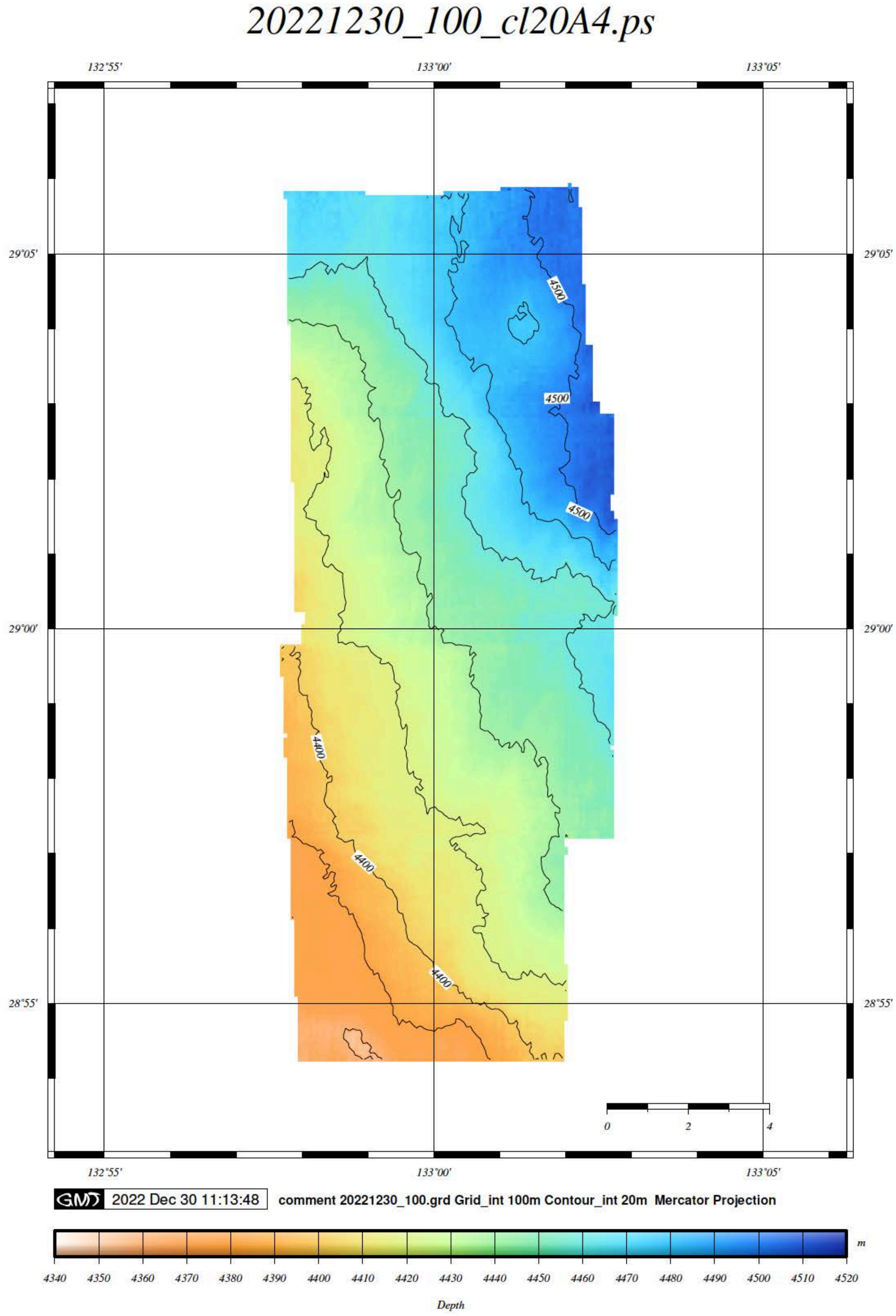
130°38'
130°39'
130°40'
130°41'
130°42'
29°36'
29°35'
29°34'
1000
0
1
2
2022 Dec 28 01:48:58
comment 20221228_50.grd Grid_int 50m Contour_int 20m Mercator Projection
920
960
1000
1040
1080
1120
1160
1200
1240
1280
1320
1360
m
Depth

Station #06



20221230_100_cl20A4.ps
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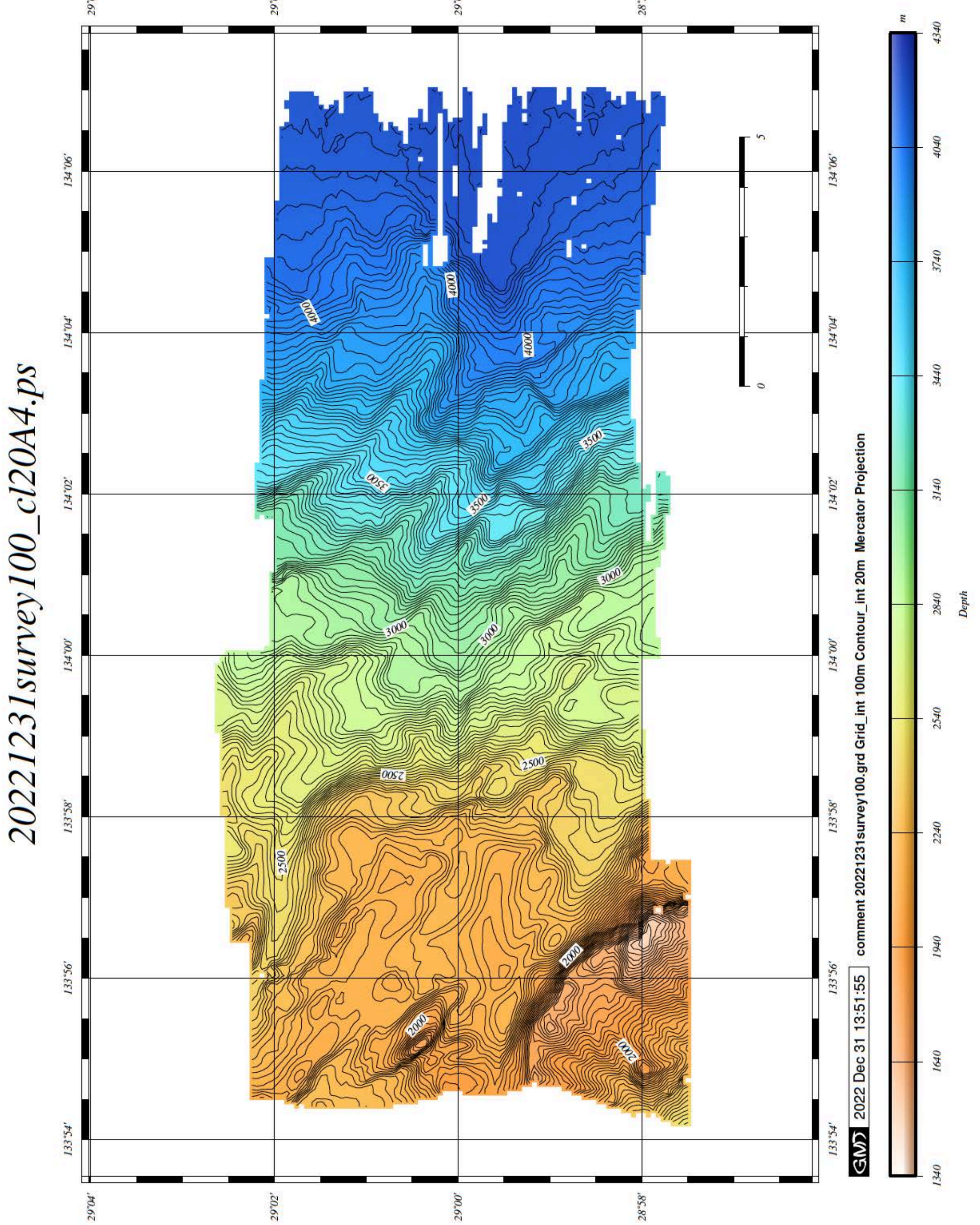
133°00'
133°05'
29°05'
29°00'
28°55'
4500
4500
4500
4400
4400
4400
0
2
4
2022 Dec 30 11:13:48
comment 20221230_100.grd Grid_int 100m Contour_int 20m Mercator Projection
m
4340
4350
4360
4370
4380
4390
4400
4410
4420
4430
4440
4450
4460
4470
4480
4490
4500
4510
4520
Depth

Station #11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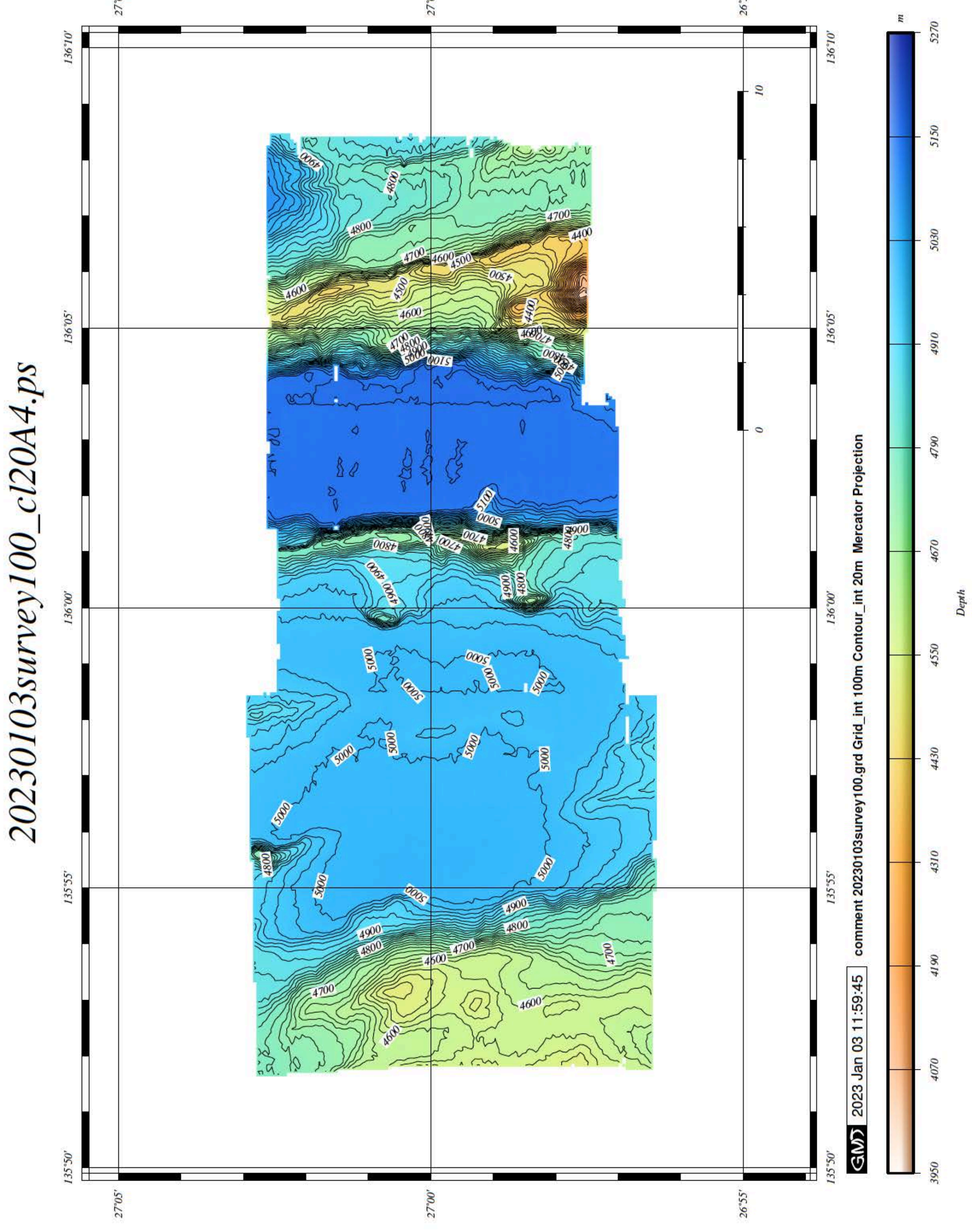
Depth
m

Station #20



20230103survey100_cl20A4.ps
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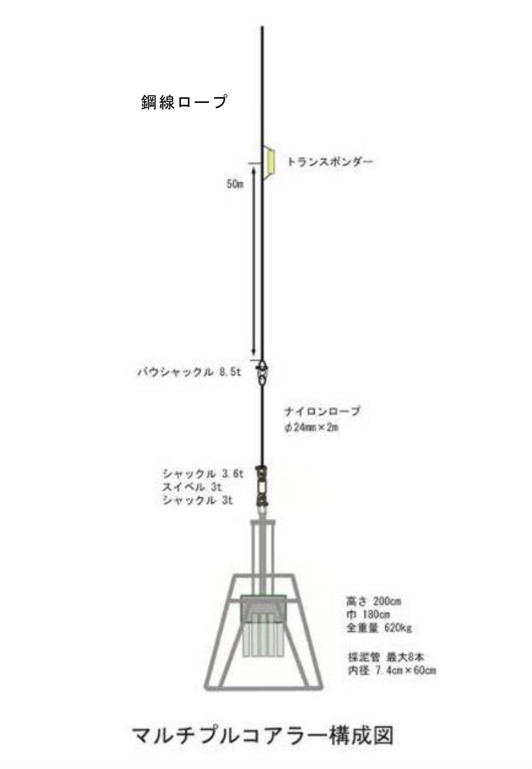
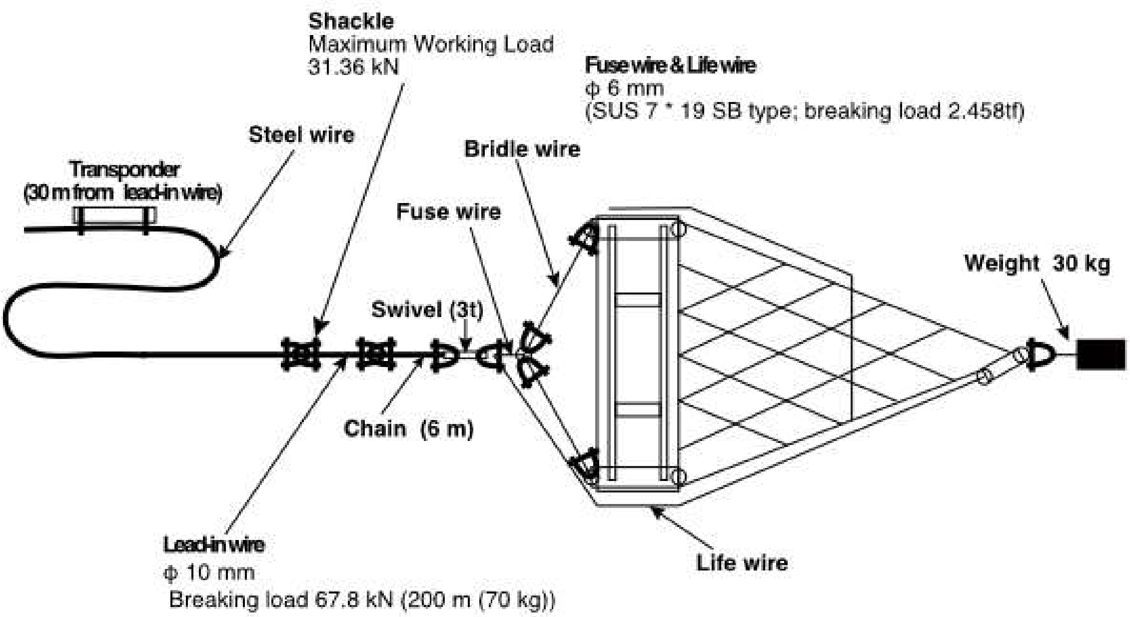
2023 Jan 03 11:59:45
Depth
m
3950
4070
4190
4310
4430
4550
4670
4790
4910
5030
5150
5270
27°05'
27°00'
26°55'
135°50'
135°55'
136°00'
136°05'
136°10'
0
10

Appendix: Multiple core system configuration

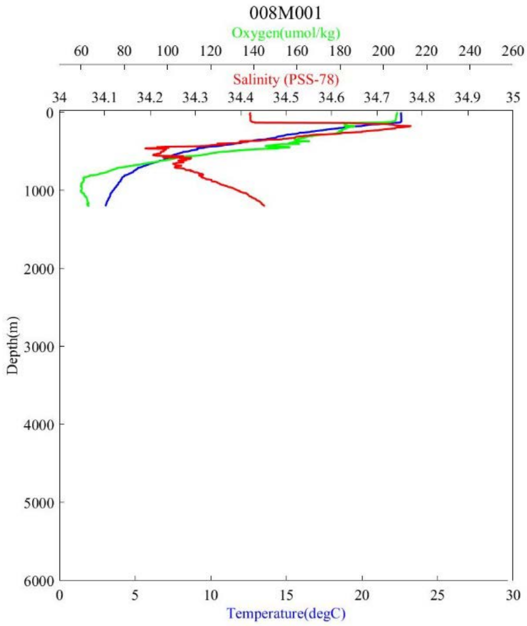


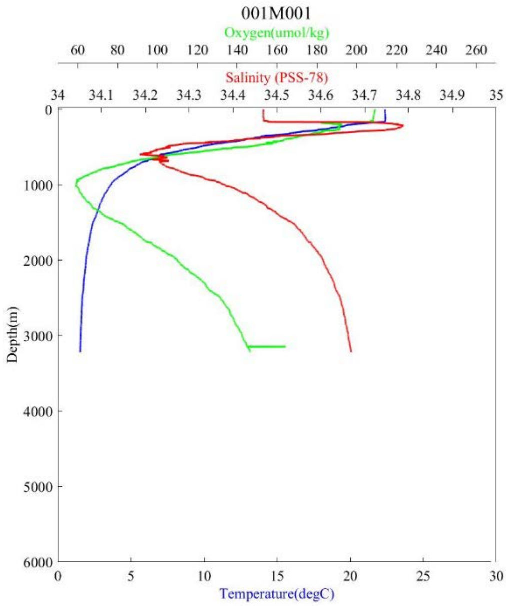
Appendix: Beam trawl system configuration

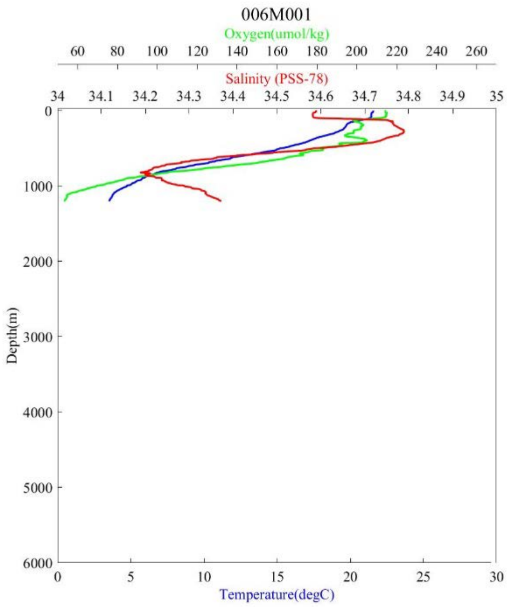


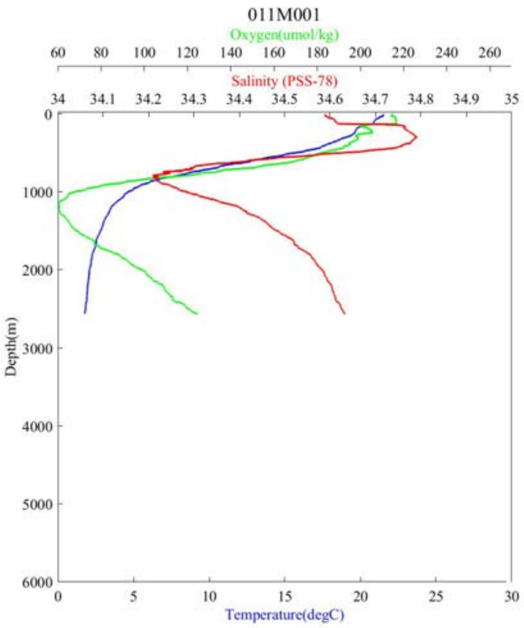
Schematic drawing of the Oregon-type beam trawl.

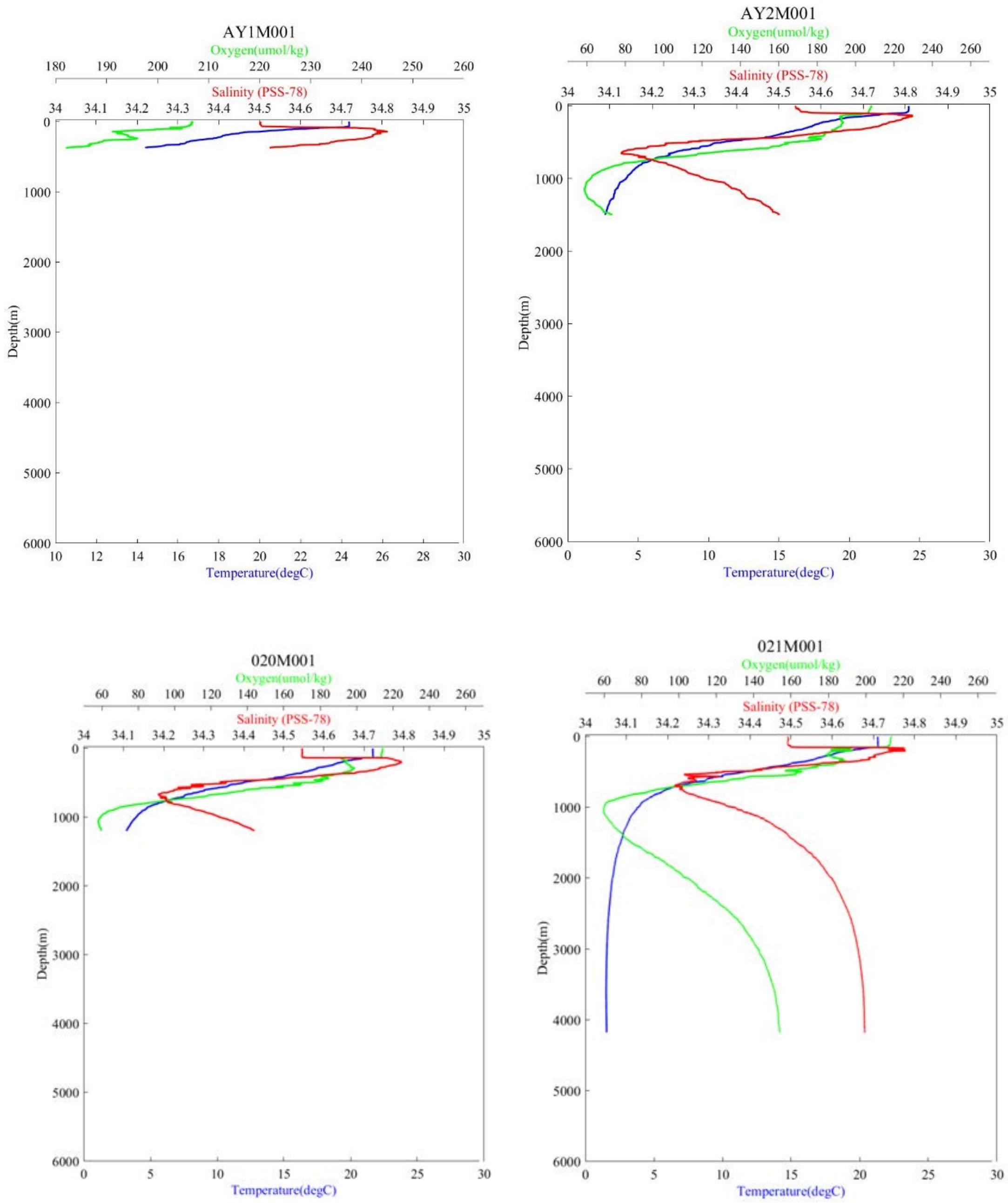
Appendix: CTD · DO profiles











CTD · DO profiles

(26th December 2022 –6th January 2023)