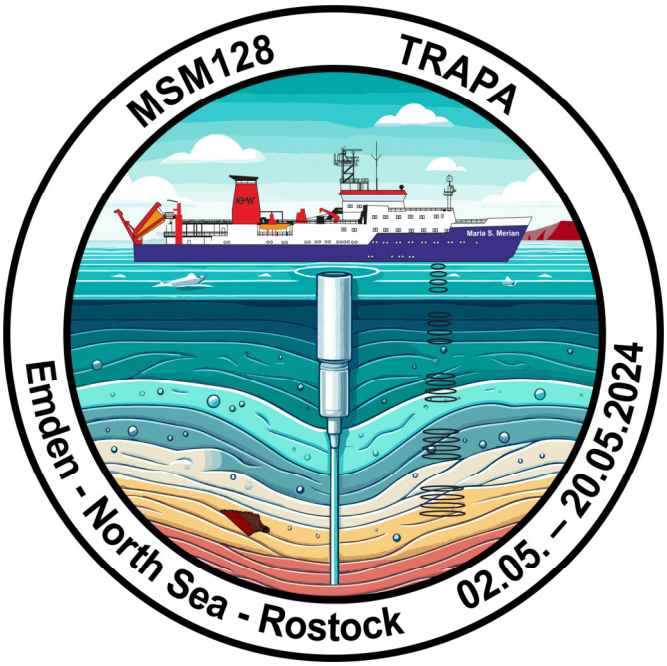
Prof. Dr. Sebastian Krastel
Christian-Albrechts-Universität zu Kiel
Institute of Geosciences
Otto-Hahn-Platz 1
D24118 Kiel, Germany

Tel.: +49-431-880 3914
Fax: +49-431-880 4432
email: sebastian.krastel@ifg.uni-kiel.de

Short Cruise Report
RV MARIA S. MERIAN - Cruise MSM128

Emden - Rostock
02.05.2024 – 20.05.2024
Chief Scientist: Prof. Dr. Sebastian Krastel
Captain: Sören Janssen



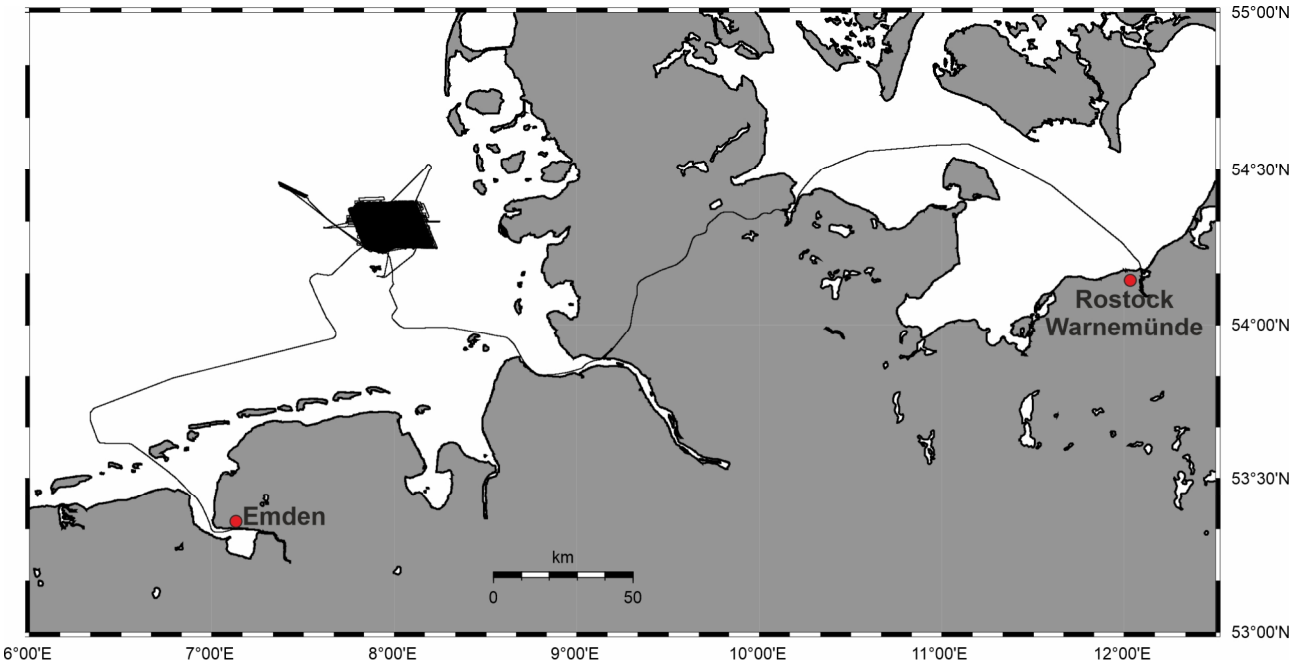


Fig 1: Track chart of Cruise MSM128 (Emden – Rostock).

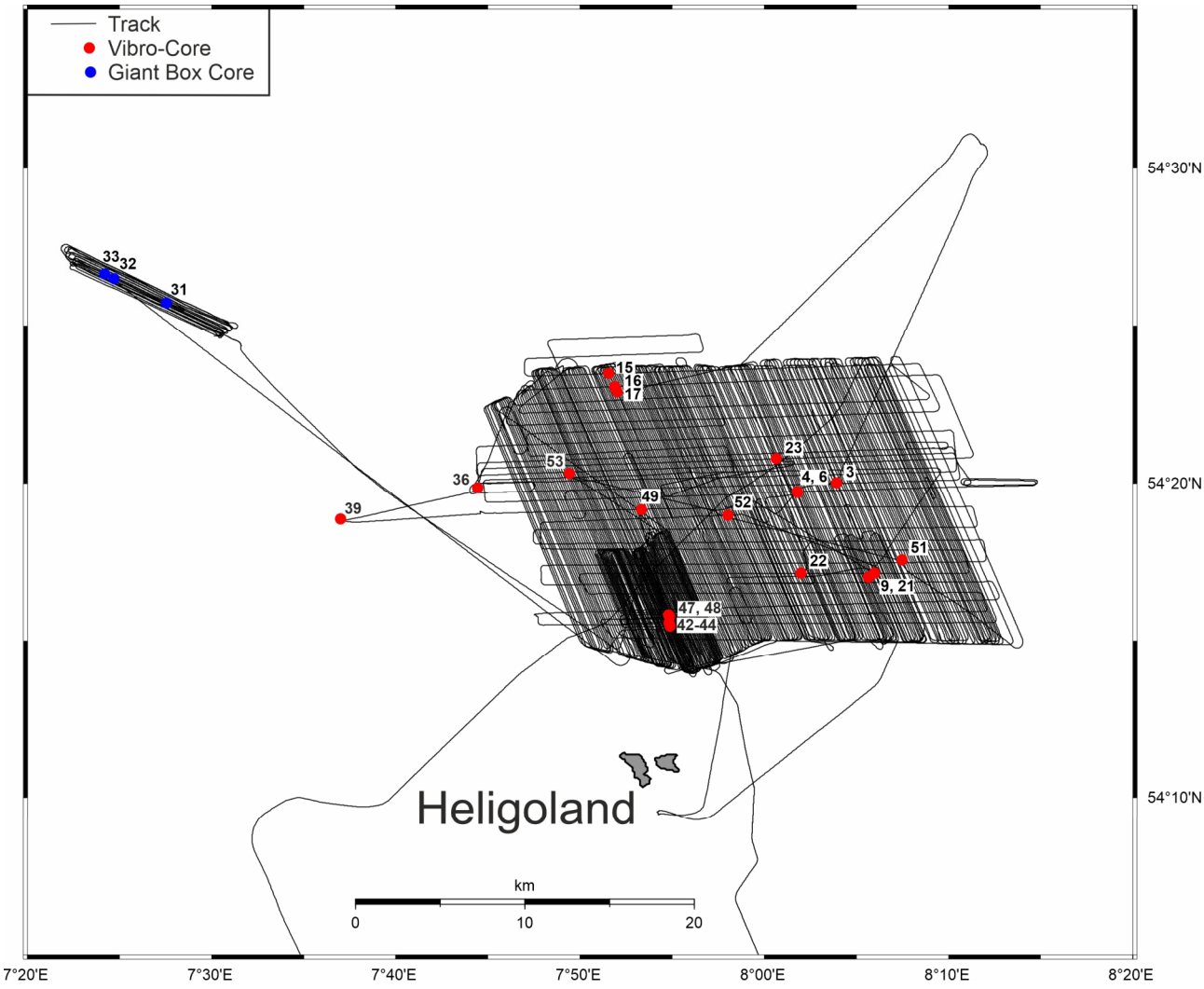


Fig. 2: Track chart of the MSM128 working area.

Objectives

The main objective of the research cruise is to reconstruct the Late Pleistocene and Early Holocene landscape in the present day North Sea area north of Heligoland that was once extensively exploited by Late Palaeolithic hunter-gatherer groups. For this early popu-lation Heligoland must have been of im-mense importance as a landmark that could be seen from very far. It was a reference point in a vast landscape and at times per-haps the only solid object in a dynamic land-scape. At the same time Heligoland is the source region of unique red flint, which was extracted there and transported over far dis-tance into the present inland already in the Late Palaeolithic. The reconstruction of the Late Palaeolithic living and migration condi-tions in the area of the North Sea, especially around Heligoland, is therefore one of the central unresolved questions of today's Stone Age research for northern Central Europe.

In this regard, our research cruise aims at (1) determining the Late Pleistocene and Early Holocene topographical and hydro-graphical preconditions for hunter-gatherer colonisation, (2) reconstructing the dynamic change of this landscape, i.e. the distribution of land, sea, river and channel systems, and the time-scales of this change and, on the basis of this information, (3) developing models of the palaeolandscape that would allow us to pinpoint suitable locations of hunter-gatherer settlements. In order to achieve these objectives, we propose to map a 20x23 km wide area northeast of Heligoland with a Parasound system at very high lateral resolution.

Narrative

Most of the scientific team of Cruise MSM128 boarded the RV MARIA S. MERIAN in Emden on the afternoon of 1 May. Three team members had already arrived on 30 April to set up our equipment. The scientific crew embarking in Emden consisted of 14 scientists from Kiel University; one of these scientists is also affiliated with the Landesamt für Denkmalpflege Baden-Württemberg. In addition, one scientist each from the Leibniz Centre for Archaeology, the National Museum of Denmark, and the Universiti Malaysia Terengganu completed the scientific team. We left our berth in Emden port at 10:00 a.m. on 2 May and, after a few circles to compensate the magnetic compass, passed through the sea lock under sunny skies and very calm seas.

We had already reached the working area off Heligoland in the evening the same day and immediately started the hydroacoustic survey in very good weather conditions. The first aim was to collect about SSE-NNW profiles in our central survey area NE of Heligoland; the size of the survey area was ~20 km x 23 km. The profile spacing was set to ~200 m. We also tried to collect multibeam and Parasound data in parallel using a trigger device for the systems as we assumed that they would interfere strongly if they are not triggered. However, the reduced ping-rate of the Parasound resulted in a loss of lateral resolution. We therefore decided to operate the Parasound without the multibeam system. On the morning of 4 May, we briefly interrupted our measurements to meet up with RV ALKOR, which had also been surveying in the working area with colleagues from Kiel University for the past 10 days. During the night, RV ALKOR recorded Innomat sediment echosounder data, which are very important for our research and were included in our cruise planning. As the amount of data was too large to transmit via satellite, we received a hard drive with all the data from our colleagues on RV ALKOR.

Two cores (MSM128_3 and 4) were taken on the morning of 4 May in order to sample some prominent reflectors. The first core returned a full liner of sand and gravel of almost 6 meters. The second core failed but was successfully repeated in the afternoon of the same day (MSM128_6). This core targeted a section of relatively well stratified units and contained finer material. The Parasound survey was then continued. As some data was already available in the working area, a grid of approximately 200 metres profile spacing was completed by midday on 6 May. Core

MSM128_9 was taken in the afternoon of 6 May in a depression characterized by well stratified sediments. Afterwards, we collected some E-W tie-lines before continuing to increase the line density in a SSE-NNW direction on 7 and 8 May. We also started collecting EM712 multibeam data on 6 May as we found that the quality of the Parasound data was not affected by the EM712 multibeam system. Interferences on the EM712 system were accepted as the multibeam data collection was not the main objective of the survey.

Three cores were taken on 8 May in the north-west corner of our main survey area. This area is characterized by different generations of channels. Two of the cores targeting different channels and the overlying sediments were successful (MSM128_15 and 16). The third core (MSM128_17) was collected adjacent to the depressions. The vibrocorer penetrated fully but we were unable to get the liner out of the core barrel. The hydroacoustic survey was continued until the morning of 11 May. Three cores (MSM128_21 -23) were taken on the morning of 11 May. The first two cores targeted an organic rich layer, where the pollen spectrum suggested a deposition in the early Holocene. This layer was identified in core MSM128_9, but in this core it was only present in the core catcher and in the bottom few centimeters of the core. Based on our hydroacoustic survey, we selected two locations where this layer was expected to be present at shallower subsurface depths. This approach was successful based on initial visual inspection. The third core was taken in a small local depression below the Holocene transgression surface. The depression is filled by flat lying stratified reflections. This core also contained thick layers of organic-rich material. Preliminary analysis of the pollen material suggests that this core covers the period of interest, i.e. the Late Pleistocene and the Early Holocene.

The hydroacoustic survey of our main area was interrupted on the evening of 12 May in order to survey a small area of the sea floor further west. This area is thought to contain abundant sandeel populations. Sandeels are an important prey fish for harbour porpoises. Our aim was to test whether sandeels could be detected by the backscatter signal of the EM712 multibeam. We collected two identical sets of profiles; one at night time and the second during the day, as sandeels hide in the sediment at night and feed in the water column during the day. Detailed data processing will be required to evaluate the success of this approach as differences are expected to be very subtle because sandeels do not have a swim bladder, which would be relatively easy to detect with acoustic data. Three Giant Box Cores (MSM128_31-33) were collected on 13 May for ground truthing. All Giant Box Corers sampled relatively homogeneous fine sand; one box corer contained two sandeels. We then continued our hydroacoustic survey in our main working area north of Heligoland. The survey was interrupted on the morning of 14 May to collect two vibrocores (MSM128_36 and 39) about 10 nm west of our main working area. This area was intensively surveyed during RV MARIA S. MERIAN Cruise MSM99/2 in 2021. The aim of these cores was to sample ancient tidal flats, which can be used to reconstruct sea levels after the Last Glacial Maximum. a topic that is also highly relevant to the TRAPA cruise. Both cores were successful. The following afternoon and night were used to collect additional E-W tie-lines in the main working area.

Further analysis of the cores on board revealed that small depressions filled with stratified sediments are the most promising sites for the recovery of sedimentary sequences covering the period of interest of the TRAPA cruise. Using the now very dense hydroacoustic grid, we were able to identify more of these small depressions. A very promising set of depressions is located in the south-western part of the working area, less than 10 km off Heligoland. Vibrocores were taken in two of these depressions on 15 May. Two cores targeted the thickest stratigraphic intervals in the center of the depressions (MSM128_42 and 43). A third core was taken at the edge of the depression to ensure that we penetrated the base reflector of the depression (MSM128_44). All three cores appear to show a very promising laminated sedimentary sequence with a high organic

content. A first analysis of the pollen spectrum suggests a Late Pleistocene/Early Holocene deposition of these sediments.
The depressions are small and sometimes only visible on a single profile, although we had now reached a very close profile spacing of 100 meters. This suggests that these depressions were pond-like structures in the late Pleistocene and early Holocene, when this area was not yet flooded. Due to the small size of these infilled ponds, we reduced the profile spacing to 50 m over an area of 5 km x 8 km. We mainly recorded these profiles during the day, as there were several lobster baskets in this area that were not visible in the dark. Nights were used to fill in small gaps in our existing grid. The data revealed an additional pond-like structure that was successfully sampled on 16 May (MSM128_47 and 48). Core MSM128_49 was taken for stratigraphic control. A final set of cores was taken on 17 May (MSM128_51 – 53) from various parts of the working area to sample further prominent reflectors for stratigraphic control. The remainder of the time was used to complete the 50 m line spacing around the pond-like structures and to extend the survey area slightly to the west. The scientific program of cruise MSM128 was completed at 04:00 on19 May when we began our transit to Rostock. We arrived in Rostock at 08:30h on 20 May.
RV MARIA S. MERIAN Cruise MSM128 was a great success. Thanks to the exceptionally good and stable weather, all work could be carried out as planned. During the cruise, we surveyed an area of approx. 24 km x 20 km with close line spacing; in one part of the area the profile spacing was condensed to less than 50 meters. We successfully collected sediment cores with the vibrocorer at 19 locations with a total core length of a ~107 meters. The new data will allow to reconstruct the Late Pleistocene and Early Holocene landscape north of Heligoland in order to assess the habitable space and migration routes of humans and animals during this period.

Acknowledgements

The scientific party of RV MARIA S. MERIAN Cruise MSM128 gratefully acknowledges the very friendly and most effective cooperation with Captain Janssen and his crew. Their great flexibility and their perfect technical assistance substantially contributed to make this cruise a scientific success. We also appreciate the valuable support by the Leitstelle Deutsche Forschungsschiffe (German Research Fleet Coordination Centre) at the University of Hamburg. The expedition was funded by the Deutsche Forschungsgemeinschaft.
.

List of Participants

Name	Discipline	Institution
Krastel, Sebastian, Prof.	Chief Scientist	CAU
Rabbel, Wolfgang, Prof.	Co-Chief Scientist	CAU
Chen, Kee Soo	Hydroacoustics	UMT
Detjens, Stine	Hydroacoustics	LEIZA-ZBSA
Felgendreher, Meret	Hydroacoustics	CAU
Garbers, Jonas	Hydroacoustics	CAU
Knüppel, Julia	Hydroacoustics	CAU
Marxen, Hanna	Hydroacoustics	CAU

Straßburger, Chris	Hydroacoustics	CAU
Supka, Ruth	Hydroacoustics	CAU
Thamm, Viktoria	Hydroacoustics	CAU
Theden, Christian	Hydroacoustics	CAU
Dreibrodt, Stefan, Dr.	Sedimentology	CAU/LAD-BW
Krüger, Sascha	Sedimentology	NATMUS
Huygen, Finn	Sedimentology	CAU
Heinrich, Sven	Technician	CAU
Jaehmlich, Heiko	Technician	CAU

CAU	Christian-Albrechts-Universität zu Kiel, Germany
LAD-BW	Landesamt für Denkmalpflege-Baden-Württemberg
LEIZA-ZBSA	Leibniz-Zentrum für Archäologie - Zentrum für Baltische und Skandinavische Archäologie
NATMUS	The National Museum of Denmark, Environmental Archaeology and Materials Science

Stationlist

Station	Date / Time UTC	Device	Latitude	Longitude	Depth (m)	Comment
MSM128_1-1	02.05.24 21:03	PS	54° 15,484' N	007° 51,044' E	26	profile start
MSM128_1-1	04.05.24 04:23	PS	54° 15,009' N	008° 04,329' E	17	profile end
MSM128_1-2	03.05.24 10:32	EM712	54° 23,809' N	008° 03,562' E	20	profile start
MSM128_1-2	03.05.24 13:40	EM712	54° 23,627' N	008° 02,857' E	18	profile end
MSM128_2-1	03.05.24 08:02	SVP	54° 23,794' N	008° 03,684' E	21	
MSM128_3-1	04.05.24 08:00	VC	54° 20,005' N	008° 03,908' E	18	567 cm recovery
MSM128_4-1	04.05.24 09:03	VC	54° 19,699' N	008° 01,802' E	21	failed, no recovery
MSM128_5-1	04.05.24 08:58	PS	54° 19,707' N	008° 01,774' E	21	profile start
MSM128_5-1	04.05.24 12:44	PS	54° 19,126' N	008° 00,319' E	20	profile end
MSM128_6-1	04.05.24 13:09	VC	54° 19,720' N	008° 01,786' E	19	599 cm recovery
MSM128_7-1	04.05.24 13:33	PS	54° 19,254' N	008° 00,185' E	20	profile start
MSM128_7-1	06.05.24 13:38	PS	54° 19,638' N	007° 58,748' E	20	profile end
MSM128_7-2	06.05.24 09:22	EM712	54° 22,476' N	007° 46,706' E	26	profile start
MSM128_7-2	06.05.24 13:39	EM712	54° 19,633' N	007° 58,778' E	20	profile end
MSM128_8-1	06.05.24 14:28	SVP	54° 17,130' N	008° 06,048' E	22	
MSM128_9-1	06.05.24 14:41	VC	54° 17,137' N	008° 05,982' E	21	586 cm recovery
MSM128_10-1	06.05.24 15:28	EM712	54° 18,981' N	007° 58,873' E	19	profile start
MSM128_10-1	07.05.24 06:58	EM712	54° 15,021' N	008° 11,522' E	17	profile end
MSM128_10-2	06.05.24 15:28	PS	54° 18,991' N	007° 58,790' E	20	profile start
MSM128_10-2	07.05.24 06:58	PS	54° 14,997' N	008° 11,542' E	16	profile end
MSM128_11-1	07.05.24 07:05	SVP	54° 14,998' N	008° 11,990' E	17	
MSM128_12-1	07.05.24 07:16	PS	54° 15,145' N	008° 12,272' E	17	profile start
MSM128_12-1	07.05.24 20:56	PS	54° 15,038' N	008° 08,148' E	18	profile end
MSM128_12-2	07.05.24 07:16	EM712	54° 15,174' N	008° 12,261' E	17	profile start
MSM128_12-2	07.05.24 20:56	EM712	54° 15,016' N	008° 08,165' E	18	profile end
MSM128_13-1	07.05.24 21:05	SVP	54° 15,127' N	008° 08,614' E	18	
MSM128_14-1	07.05.24 21:07	EM712	54° 15,149' N	008° 08,651' E	18	profile start
MSM128_14-1	08.05.24 08:56	EM712	54° 14,948' N	008° 07,190' E	17	profile end
MSM128_14-2	07.05.24 21:07	PS	54° 15,149' N	008° 08,651' E	18	profile start
MSM128_14-2	08.05.24 08:56	PS	54° 14,972' N	008° 07,191' E	17	profile end
MSM128_15-1	08.05.24 12:27	VC	54° 23,475' N	007° 51,544' E	22	593 cm recovery
MSM128_16-1	08.05.24 13:01	VC	54° 23,060' N	007° 51,879' E	23	600 cm recovery
MSM128_17-1	08.05.24 13:24	VC	54° 22,895' N	007° 51,995' E	24	failed, no recovery
MSM128_17-2	08.05.24 13:36	SVP	54° 22,877' N	007° 51,937' E	24	
MSM128_18-1	08.05.24 14:18	EM712	54° 23,845' N	007° 59,413' E	19	profile start
MSM128_18-1	08.05.24 19:48	EM712	54° 15,034' N	008° 06,286' E	16	profile end
MSM128_18-2	08.05.24 14:18	PS	54° 23,835' N	007° 59,484' E	19	profile start
MSM128_18-2	08.05.24 19:48	PS	54° 15,011' N	008° 06,303' E	16	profile end
MSM128_19-1	08.05.24 19:58	SVP	54° 15,015' N	008° 06,686' E	16	
MSM128_20-1	08.05.24 20:00	EM712	54° 15,011' N	008° 06,700' E	17	profile start
MSM128_20-1	11.05.24 06:48	EM712	54° 16,996' N	008° 05,521' E	21	profile end

Station	Date / Time UTC	Device	Latitude	Longitude	Depth (m)	Comment
MSM128_20-2	08.05.24 20:00	PS	54° 15,009' N	008° 06,702' E	16	profile start
MSM128_20-2	11.05.24 06:48	PS	54° 16,996' N	008° 05,521' E	21	profile end
MSM128_21-1	11.05.24 06:57	VC	54° 17,005' N	008° 05,653' E	21	598 cm recovery
MSM128_22-1	11.05.24 07:49	VC	54° 17,136' N	008° 01,987' E	17	587 cm recovery
MSM128_23-1	11.05.24 08:37	VC	54° 20,774' N	008° 00,632' E	18	452 cm recovery
MSM128_23-2	11.05.24 08:51	SVP	54° 20,707' N	008° 01,018' E	18	
MSM128_24-1	11.05.24 09:29	PS	54° 19,577' N	007° 54,729' E	23	profile start
MSM128_24-1	12.05.24 18:36	PS	54° 24,344' N	007° 31,593' E	26	profile end
MSM128_24-2	12.05.24 18:36	EM712	54° 24,348' N	007° 31,594' E	26	profile end
MSM128_25-1	11.05.24 17:48	SVP	54° 23,651' N	007° 48,837' E	23	
MSM128_26-1	12.05.24 18:39	SVP	54° 24,410' N	007° 31,573' E	26	
MSM128_27-1	12.05.24 18:57	EM712	54° 24,809' N	007° 30,343' E	26	profile start
MSM128_27-1	12.05.24 18:57	EM712	54° 25,522' N	007° 28,290' E	26	profile end
MSM128_28-1	12.05.24 22:13	SVP	54° 24,665' N	007° 30,147' E	27	
MSM128_29-1	13.05.24 05:02	SVP	54° 25,045' N	007° 31,002' E	27	
MSM128_30-1	13.05.24 18:58	PS	54° 27,169' N	007° 22,227' E	29	profile start
MSM128_30-1	13.05.24 19:47	PS	54° 25,515' N	007° 28,313' E	26	profile end
MSM128_31-1	13.05.24 20:12	BC	54° 25,732' N	007° 27,559' E	27	
MSM128_32-1	13.05.24 20:54	BC	54° 26,510' N	007° 24,721' E	29	
MSM128_33-1	13.05.24 21:31	BC	54° 26,658' N	007° 24,215' E	29	
MSM128_34-1	13.05.24 21:56	PS	54° 26,513' N	007° 24,632' E	28	profile start
MSM128_34-1	14.05.24 07:57	PS	54° 19,836' N	007° 44,425' E	24	station end
MSM128_35-1	13.05.24 21:56	EM712	54° 26,496' N	007° 24,671' E	28	profile start
MSM128_35-1	14.05.24 07:57	EM712	54° 19,835' N	007° 44,423' E	24	profile end
MSM128_36-1	14.05.24 08:03	VC	54° 19,843' N	007° 44,440' E	24	593 cm recovery
MSM128_37-1	14.05.24 08:48	PS	54° 19,840' N	007° 44,504' E	24	profile start
MSM128_37-1	14.05.24 09:24	PS	54° 18,903' N	007° 37,000' E	30	profile end
MSM128_38-1	14.05.24 08:48	EM712	54° 19,843' N	007° 44,457' E	24	profile start
MSM128_38-1	14.05.24 09:24	EM712	54° 18,904' N	007° 37,001' E	30	profile end
MSM128_39-1	14.05.24 09:33	VC	54° 18,857' N	007° 36,999' E	30	597 cm recovery
MSM128_40-1	14.05.24 10:22	SVP	54° 19,049' N	007° 44,589' E	24	
MSM128_41-1	14.05.24 10:28	PS	54° 19,046' N	007° 44,749' E	24	profile start
MSM128_41-1	15.05.24 10:04	PS	54° 13,836' N	007° 56,114' E	16	profile end
MSM128_41-2	14.05.24 10:28	EM712	54° 19,040' N	007° 44,778' E	24	profile start
MSM128_41-2	15.05.24 10:04	EM712	54° 13,840' N	007° 56,077' E	16	profile end
MSM128_42-1	15.05.24 10:29	VC	54° 15,461' N	007° 54,886' E	21	526 cm recovery
MSM128_43-1	15.05.24 10:52	VC	54° 15,538' N	007° 54,841' E	22	513 cm recovery
MSM128_44-1	15.05.24 11:17	VC	54° 15,568' N	007° 54,812' E	22	591 cm recovery
MSM128_44-2	15.05.24 11:28	SVP	54° 15,570' N	007° 54,811' E	22	
MSM128_45-1	15.05.24 11:38	PS	54° 15,573' N	007° 55,101' E	22	profile start
MSM128_45-1	16.05.24 10:07	PS	54° 18,403' N	007° 53,754' E	23	profile end
MSM128_45-2	15.05.24 11:38	EM712	54° 15,568' N	007° 55,144' E	22	profile start
MSM128_45-2	16.05.24 10:07	EM712	54° 18,397' N	007° 53,783' E	23	profile end

Station	Date / Time UTC	Device	Latitude	Longitude	Depth (m)	Comment
MSM128_46-1	15.05.24 17:49	SVP	54° 15,816' N	007° 47,585' E	25	
MSM128_47-1	16.05.24 10:39	VC	54° 15,825' N	007° 54,802' E	22	431 cm recovery
MSM128_48-1	16.05.24 11:04	VC	54° 15,769' N	007° 54,850' E	22	562 cm recovery
MSM128_49-1	16.05.24 11:55	VC	54° 19,153' N	007° 53,333' E	24	595 cm recovery
MSM128_49-2	16.05.24 12:15	SVP	54° 19,094' N	007° 53,307' E	23	
MSM128_50-1	16.05.24 12:32	PS	54° 17,989' N	007° 53,337' E	23	profile start
MSM128_50-1	17.05.24 10:50	PS	54° 14,950' N	008° 14,028' E	16	profile end
MSM128_50-2	16.05.24 12:32	EM712	54° 17,970' N	007° 53,305' E	23	profile start
MSM128_50-2	17.05.24 10:50	EM712	54° 14,980' N	008° 14,030' E	16	profile end
MSM128_51-1	17.05.24 11:33	VC	54° 17,555' N	008° 07,471' E	16	563 cm recovery
MSM128_52-1	17.05.24 12:31	VC	54° 18,975' N	007° 58,018' E	22	580 cm recovery
MSM128_53-1	17.05.24 13:29	VC	54° 20,310' N	007° 49,413' E	23	572 cm recovery
MSM128_53-2	17.05.24 13:42	SVP	54° 20,285' N	007° 49,436' E	24	
MSM128_54-1	17.05.24 14:18	PS	54° 18,346' N	007° 54,319' E	23	profile start
MSM128_54-2	19.05.24 02:00	EM712	54° 15,479' N	007° 49,641' E	24	profile end
MSM128_54-1	19.05.24 02:00	PS	54° 15,479' N	007° 49,641' E	24	profile end
MSM128_54-2	17.05.24 14:18	EM712	54° 18,346' N	007° 54,319' E	23	profile start