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Short Cruise Report
MARIA S. MERIAN cruise MSM98 (GPF 20-3_092)

Emden – Emden (Germany)
08.01.2021 – 23.01.2021
Chief Scientist: Miriam Römer
Captain: Björn Maaß

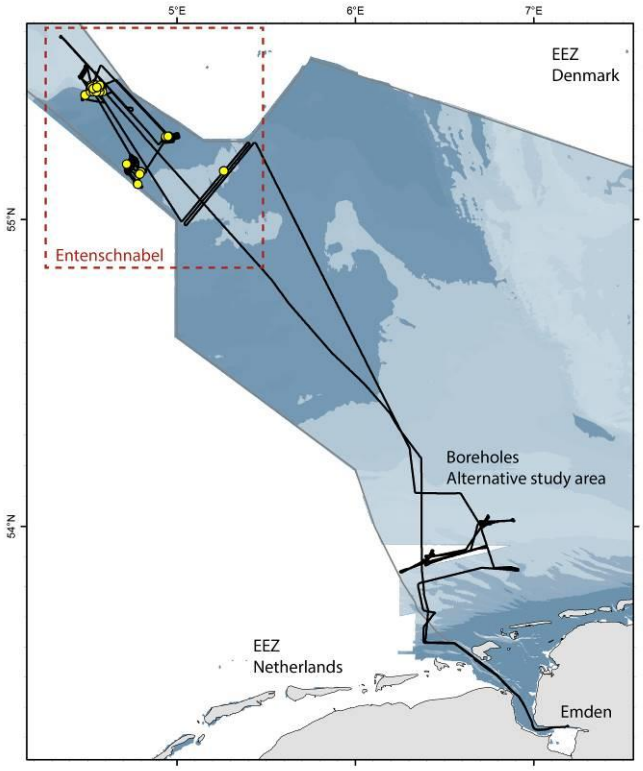

Figure 1: Overview of the ships track (black line) and stations (yellow dots) of MSM98.

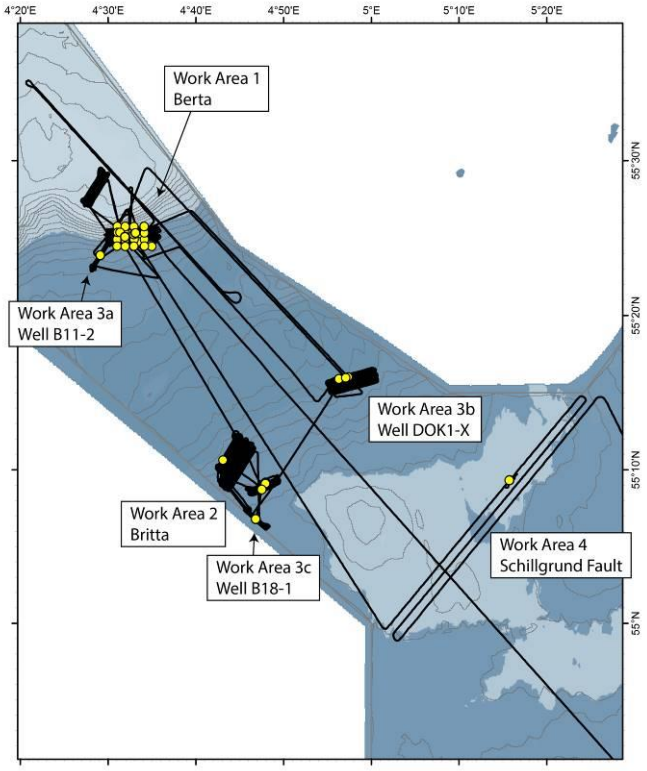

Figure 2: Map of the primary work area in the Entenschnabel in the German North Sea.

Objectives

Methane seeping from the seafloor, particularly in shallow shelf-regions, is one source of atmospheric methane, but exact amounts are still discussed. This holds for natural seepages, but also for methane, which may escape from active and abandoned oil & gas wells. During research cruise HE537 (July 2019) we studied the seafloor at the German Exclusive Economic Zone (EEZ) of the North Sea for gas seepage. While none of the nine studied abandoned wells (of about 100 in the German EEZ) released obviously gas, we found hundreds, so far unknown gas flares in the study area. Particularly the flanks of the salt dome Berta were identified as hotspot also exhibiting 10-fold enriched methane concentrations in the water column, but the intensity, temporal variation, rates, local atmospheric methane concentrations, microbial fate and isotopic nature of the gas remained unknown. In the frame of this cruise, we intended to answer these open questions by an interdisciplinary approach using hydroacoustic and electromagnetic measurements, gas geochemistry and microbiology. Our studies should also base on gas samples taken by a small-size remotely operated vehicle (ROV). Extending our previous investigations, we planned to further characterize the nature of the active gas system at the recently discovered seep sites in the German North Sea including the quantity of emitted methane, the gas source and fate, and further test, whether yet unstudied abandoned wells release gas. A better knowledge about shallow seep systems along continental shelf margins would be needed to evaluate the importance for gas exchange and fluid fluxes from the seafloor into the water column and eventually into the atmosphere.

AIM 1 Quantities of emitted methane: How much gas is released in form of gas bubbles from the seafloor?

AIM 2 Variability of gas emissions: Although our initial study did not systematically investigate the temporal variability, first results do indicate that flares are not stable over times of hours and days. Better understanding about the variability and the controlling factors would be crucial to evaluate the gas quantities released.

AIM 3 Source of the emitted fluids: Gas samples taken directly at the seeps sites at the seafloor allow constraining the gas source from gas composition and isotopic investigations.

AIM 4 Fate of the released methane: Does methane released from the seafloor in the ‘Entenschnabel’ reach the sea-air interface and contribute to the atmospheric inventory?

AIM 5 Pockmarks generation: Are the depressions detected at salt diapir Britta formed by fluid release? Are they related to the drilling activities at this site?

AIM 6 Integrity of wells: Our initial study focused on nine abandoned well sites in the ‘Entenschnabel’-area and did not indicate leakage. However, leaking wells have been reported for three wells in the Norwegian North Sea. Further investigations on other wells in the ‘Entenschnabel’-area would be needed to extent our knowledge on potential leakage in the German sector.

AIM 7 Faults acting as fluid migration pathways: Focused water column mapping along the Schillgrund fault zone would help to evaluate the fluid flow patterns in this part of the ‘Entenschnabel’.

AIM 8 Electromagnetic signature and quantity of shallow subsurface gas: Electromagnetic and acoustic profiling pro-vide means to locate and quantify the concentration of free gas in the sediment. While bubbles represent temporary pulses, the amount of gas in the shallow subsurface links to the long-term impact of methane seepage in the working area. Additional electromagnetic soundings contribute to understand the subsurface sediment signatures associated with gas migration and seepage in the ‘Entenschnabel’.

Narrative

On Friday, 08 January 2021, RV MARIA S. MERIAN left her mooring at the Nordkai in Emden's inland harbor at 08:30 local time to start cruise MSM98 in the North Sea. Before we were allowed to sail, all crewmembers and scientific participants spent four days in quarantine in single rooms in a hotel in Leer. In addition, all participants were tested twice for Covid-19 and after all tests were negative, everyone was able to board the ship on January 06, 2021 and begin preparations for departure. Our two containers with the scientific equipment as well as the Golden Eye had already been delivered from Bremen and Hannover on January 04 and 05, so we could quickly start unloading the containers, setting up the labs and preparing the equipment we had brought with us. On 07. January 2021 all the measuring instruments were prepared for operation and lashed down until we set sail. At the start of our expedition, we were very lucky with the weather, so that we were able to reach our working areas in the Entenschnabel in relatively calm seas for the time of year on the evening of 08. January 2021. We used the first night at sea for a first hydroacoustic mapping in our main study area to get an overview of the current activity of gas seeps. Data that we have already recorded here in 2019 showed numerous gas bubble seeps that we intended to investigate in more detail during this expedition.

Our initial mapping confirmed the activity of gas bubble seeps in our main study area and so we were able to start directly with the planned sampling program on Saturday, 09 January 2021. As the weather continued to be very kind to us, the Golden Eye was first successfully deployed to image electromagnetic indications of gases in the upper sediment layers. Subsequently, the use of a small ROV gave us our first visual impressions of the gas bubble seeps. The positions of these gas bubble outlets had to be located in order to place a sonar lander next to them, which was done successfully in the afternoon. The lander stayed on the seafloor for five days and observed the temporal variability of the gas bubble seeps. The first working day at sea was completed successfully with a CTD water sampling program and sediment sampling with a multicorer. We used the night of January 10 for more hydroacoustic mapping and checked additional areas for gas bubble seeps. We were also able to complete all of our planned stations on Sunday, 10 January, 2021 in excellent weather conditions. An EK60 echo sounder brought along and installed in the moon pool was first calibrated in the morning to also quantitatively evaluate gas plumes in the collected echograms. Further water samples and sediment samples were taken using the CTD and multicorer, and the ROV was used again to hunt for gas bubbles. On Monday morning of 11 January 2021 the sea was still calm enough to monitor a known flare location in high resolution with the echo sounder, which will allow us to estimate fluxes of escaping methane. In a flare area near a salt dome discovered during Heincke cruise HE537, we were able to conduct systematic CTD samplings with the aid of ADCP profiles to look for flow directions. First results of CTD measurements directly above a flare show a 5-fold increase in methane concentrations compared to the surrounding area. Hydroacoustic surveys conducted at night recorded more flares and even two wrecks lying on the seabed, which are marked on the nautical charts, however. We were also able to observe three flare locations over an entire tidal cycle, which allowed us to gain very valuable insights into their activity and intensity. This was only possible because the ship could be kept in position with an accuracy of much less than 10 meters, despite the sometimes very stormy sea with waves up to 5 m high and a wind force of up to Beaufort 9.

During the night of Thursday, 14 January 2021, the sea calmed down so that we again had ideal conditions for all instrument deployments. First, we recovered the sonar lander on Thursday morning. The data were immediately reviewed and backed up, giving a great time series showing activity from multiple gas bubble releases over five days. The day continued to be very rewarding. After obtaining sediment samples in the area of the gas bubble seeps with the multicorer in beautiful sunrise weather, we deployed the ROV to sample the now well-known gas seep locations. The ROV team succeeded to catch three gas samples for isotopic analyses. At the end of the day, the Golden Eye was used again with the electric

dipole-dipole system for a 7-hour survey over the known seep area with the aim of detecting shallow gas in the sediment.
On the following Friday, 15 January 2021, everything also went perfectly. After more sediment samples were taken with the multicorer, the sonar lander was deployed a second time. This deployment is not far from the first position, but at gas seeps that probably correlate with a fault system in the subsurface above a salt dome. Again, the instrument remained on the seafloor for four days. Friday afternoon we moved to our second working area where we discovered some depressions on the seafloor in 2019. Here we started with electromagnetic surveys with Golden Eye, which we were able to navigate directly over the depressions thanks to MERIAN's excellent Dynamic Positioning precision. These turned out to be areas of firmer substrate, densely populated by sponges and other filter-feeding organisms, as we flew over them using Golden Eye's video images. The first successful gravity core deployment on Saturday, 16 January 2021, ultimately showed us that this firmer substrate consisted of peat. A ROV dive on Saturday afternoon completed our impressions of the peats, their colonization and the extent of these areas on the seabed. Late Saturday afternoon we sampled the water column of a nearby old borehole with a CTD and mapped the surrounding area with hydroacoustics during the night to check whether methane migrates through the sediments at these locations and escapes into the water column. On Sunday, 17 January2021, we finished our investigations in the area of the depressions with another Golden Eye mission and a ROV dive to search for gas bubbles. On Monday, 18 January 2021, the multicorer was used to sample two abandoned drill sites. Also, water samples were taken using the CTD-Rosette at those locations. The samples will be analyzed for their methane concentration in the laboratories on land to assess whether the old drill sites are sources of methane escaping to the sea and the atmosphere. Weather conditions were perfect on Tuesday, 19 January 2021, to recover the sonar lander after the second deployment and four days of measurements of our seafloor observatory. Assessing the recorded data the deployment of the lander was found to be again very successful. The data will be very useful to analyze the variability of the gas emissions. The rest of the day proofed to become even more successful. The ROV completed two important tasks during one dive: On the one hand, a sonar transponder was recovered, which got lost during an earlier dive. Since the transponder is almost as heavy as the ROV, the task turned out to be quite complex, but was professionally solved by the deck crew and the ROV team using a hook with a sling. On the other hand, gas samples were successfully collected. The sampled sites were difficult to find, as the release of gas bubbles was intervallic rather than continuous. During the rest of the day, a detailed hydroacoustic survey was conducted to quantify the amount of gas released around the sample sites.
The winds started to pick-up on Wednesday, 20 January 2021. Nevertheless, the conditions still allowed surveying the last remaining working area: The Schillgrund Fault at the Southern edge of the Central Graben. The hydroacoustic survey aimed to clarify, whether this deep-rooted fault is a migration pathway for gases. Completing three out of the planned six 40 km long profiles, we decided to escape the approaching storm with up to predicted 7.5 m waves and focus the remaining two days on hydroacoustic surveys of possible gas emissions at abandoned drill sites near the shores of the East Frisian Islands. One of those sites has also been sampled with the Rosette on Friday, 22 January 2021, after the abating storm allowed station work again. The scientific program ended just before midnight. The pilot assisting the port entry to Emden came aboard as planned at 6am on Saturday, 23 January 2021. After clearing the labs and storing all goods in the containers, the scientific crew of MSM98 left MARIA S. MERIAN until 2pm greatly satisfied with the achievements of the two-week cruise.

Figure 3: Cruise participants of MARIA S. MERIAN cruise MSM98.

Acknowledgements

We would like to thank Captain Björn Maaß and the crew of R/V MARIA S. MERIAN for the excellent support during our cruise, for the hospitality and friendliness on board. We thank the crew on deck, in the engine rooms and the galley for providing and supporting an excellent working environment. We also thank the German Research Fleet Coordination Centre for the organization and support during preparation of the cruise. The ship time was provided by the German Research Foundation (DFG) within the METEOR/MERIAN program.

Cruise participants (scientific crew):

1.	Miriam Römer	Chief Scientist	MARUM
2.	Katrin Schwalenberg	Electromagnetics	BGR
3.	Udo Barckhausen	Electromagnetics	BGR
4.	Dennis Hagedorn	Electromagnetics	BGR
5.	Katja Heeschen	CTD	GFZ
6.	Martin Blumenberg	Gasgeochemistry	BGR
7.	Stefan Schlömer	Gasgeochemistry.	BGR
8.	Martin Krüger	Microbiology	BGR
9.	Szymon Krupinski	ROV	MARUM
10.	Pablo Gutierrez Flores	ROV	MARUM
11.	Stefanie Gaide	Hydroacoustics	FB5
12.	Janice Malnati	ICOS/Sediments	FB5
13.	Yann Marcon	Sonar Lander	MARUM

Institutes:
MARUM – Center for Marine Environmental Sciences, University of Bremen
FB5 – Department of Geosciences, University of Bremen
BGR – Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany
GFZ – Geoforschungszentrum Potsdam, Germany

Station list:

Date	Station no.	Instru-ment	GeoB-Number	Location	Begin (UTC)	End (UTC)	Lat (N)	Lon (E)	Water depth (m)	Comments
09/01/21	001-1	GE	24401-1	Berta	07:04	11:12	55° 25.13	04°32.77	43	
09/01/21	002-1	ROV	24402-1	Berta	11:39	13:49	55°25.32	04°33.14	42	Marum BlueRov
09/01/21	003-1	Sonar Lander	24403-1	Berta	13:40		55°25.313	04°33.141	42	Placed 2 m SW of bubblestream
14/01/21	003-1	Sonar lander	24403-1	Berta		08:15			42	Recovery of Lander
09/01/21	004-1	CTD	24404-1	B11-2	16:05	16:30	55°23.8884	04°29.1251	44	9 samples; on top of bore hole
09/01/21	004-2	CTD	24404-2	B11-2	17:01	17:18	55°23.8809	04°29.1402	44	9 samples; 20 m SE of bore hole
09/01/21	004-3	CTD	24404-3	B11-2	17:35	17:52	55°23.9000	04°29.1395	44	9 samples; 20 m NE of bore hole
09/01/21	004-4	CTD	24404-4	B11-2	18:05	18:22	55°23.8891	04°29.1069	44	9 samples; 20 m W of bore hole
09/01/21	005-1	MIC	24405-1	B11-2	18:43	18:55	55°23.8876	04°29.1250	44	1 tube: 3 cm sed; on bore hole
09/01/21	005-2	MIC	24405-2	B11-2	19:05	19:11	55°23.8859	04°29.1249	44	1 tube: 3 cm sed; on bore hole
10/01/21	006-1	CTD	24406-1	Berta	09:50	10:17	55°25.4322	04°31.0507	40	9 samples; Grid Berta: W of flare at fault
10/01/21	007-1	CTD	24407-1	Berta	10:38	10:58	55°25.3229	04°31,9509	41	9 samples; Grid Berta betw flares
10/01/21	008-1	CTD	24408-1	Berta	11:50	12:07	55°25.3422	04°32.7994	42	9 samples; Grid Berta: WNW of flare cluster
10/01/21	009-1	ROV	24409-1	Berta	12:52	13:04	55°25.076	04°33.916	43	Marum BlueRov
10/01/21	009-2	ROV	24409-2	Berta	13:34	14:24	55°25.0804	04°31.9023	41	GEO-Engieneering BlueRov; gas streams
10/01/21	009-3	ROV	24409-3	Berta	15:10	16:27	55°25.0704	04°31.9335	41	Marum BlueRov; gas cluster, no samples
10/01/21	010-1	MIC	24410-1	Berta	17:18	17:25	55° 24.7618	04°33.4193	43	Failure: empty; background
10/01/21	010-2	MIC	24410-2	Berta	17:30	17:35	55° 24.7601	04°33.4196	43	Failure: empty; background
10/01/21	010-3	MIC	24410-3	Berta	17:40	17:47	55° 24.7622	04°33.4199	44	Failure: empty; background
10/01/21	011-1	GC	24411-1	Berta	18:14	18:22	55° 24.760	04°33.402	43	Failure: empty; background
10/01/21	011-2	GC	24411-2	Berta	18:30	18:36	55° 24.761	04°33.400	43	Failure: empty; background
11/01/21	012-1	GC	24412-1	Berta	07:00	07:07	55° 25.36	04°31.10	40	Failure: empty
11/01/21	013-1	MIC	24413-1	Berta	07:20	07:28	55° 25.3718	04°31.1232	41	Failure: empty
11/01/21	013-2	MIC	24413-2	Berta	07:40	07:41	55° 25.3734	04°31.1224	40	Failure: empty
11/01/21	013-3	MIC	24413-3	Berta	07:48	07:55	55° 25.3725	04°31.1205	40	Failure: empty
11/01/21	014-1	CTD	24414-1	Berta	11:12	11:25	55°24.9100	04°31.0539	42	8 samples; Grid Berta: Profile B11-4 W
11/01/21	015-1	CTD	24415-1	Berta	11:53	12:12	55°24.9076	04°31.9261	42	8 samples; Grid Berta: bore hole B11-4

11/01/21	016-1	CTD	24416-1	Berta	12:38	12:58	55°24.9094	04°32.9797	43	8 samples; Grid Berta: Profile B11-4
11/01/21	017-1	CTD	24417-1	Berta	13:20	13:40	55°24.9110	04°34.1466	43	8 samples; Grid Berta: Profile B11-4 E
12/01/21	018-1	CTD	24418-1	Berta	08:03	08:30	55°25.0777	04°31.9452	42	9 samples;20 m E of flare position
12/01/21	019-1	CTD	24419-1	Berta	09:04	09:29	55°25.0764	04°31.9354	43	11 samples;20 m E of flare position
12/01/21	020-1	CTD	24420-1	Berta	11:39	12:00	55°24.4652	04°31.0512	44,5	9 samples;Grid Berta; Southern line (W)
12/01/21	021-1	CTD	24421-1	Berta	12:17	12:35	55°24.4628	04°31.9593	43	8 samples;Grid Berta; Southern line (W→E)
12/01/21	022-1	CTD	24422-1	Berta	13:00	13:18	55°24.4600	04°34.9824	45	8 samples;Grid Berta;Southern line (E; 5)
12/01/21	023-1	CTD	24422-1	Berta	13:39	13:54	55°24.4667	04°34.1435	44	8 samples;Grid Berta; Southern line (W→E)
12/01/21	024-1	CTD	24424-1	Berta	14:16	15:36	55°25.3170	04°34.1505	43	8 samples;Grid Berta; flare line (E)
13/01/21	025-1	CTD	24425-1	Berta	12:01	12:20	55°25.7430	04°31.0649	36	7 samples;Grid Berta;Northern line (W)
13/01/21	026-1	CTD	24426-1	Berta	12:51	13:12	55°25.7443	04°31.9725	40	7 samples;Grid Berta;Northern line (W→E)
13/01/21	027-1	CTD	24427-1	Berta	13:35	14:00	55°25.7383	04°32.9675	41	8 samples;Grid Berta;Northern line (W→E)
13/01/21	028-1	CTD	24428-1	Berta	14:17	14:36	55°25.7427	04°34.1406	43	8 samples;Grid Berta;Northern line (E)
13/01/21	029-1	CTD	24429-1	Berta	15:06	15:26	55°24.4675	04°32.9723	43	8 samples;Grid Berta;Southern line (E)
14/01/21	030-1	MIC	24430-1	Berta	08:55	09:05	55°25.3659	04°31.1176	41	2 tubes 10 cm; BW and sediment: Berta Flare
14/01/21	030-2	MIC	24430-2	Berta	09:45	09:50	55°25.3653	04°31.1142	41	4 tubes empty: Berta Flare
14/01/21	030-3	MIC	24430-3	Berta	10:07	10:11	55°25.3659	04°31.3653	41	1 tubes 2 cm; BW and sediment: Berta Flare
14/01/21	031-1	ROV	24431-1	Berta	10:45	12:08	55°25.073	04°31.936	43	2 gas samples
14/01/21	031-2	ROV	24431-2	Berta	12:35	13:09	55°25.080	04°31.925	43	1 gas sample
14/01/21	032-2	GE	24432-1	Berta	13:35	21:20	55°25.24	04°32.93	41.5	GE with electrical dipole dipole system; flare
15/01/21	033-1	MIC	24433-1	Berta	07:05	07:13	55°25.0766	04°31.9320	43	1 tube with 3 cm sediment; 1 BW
15/01/21	033-2	MIC	24433-2	Berta	07:27	07:34	55°25.0800	04°31.9320	42.5	empty
15/01/21	033-3	MIC	24433-3	Berta	07:42	07:49	55°25.0801	04°31.9322	42.5	empty
15/01/21	033-4	MIC	24433-4	Berta	07:55	08:04	55°25.0787	04°31.9313	42.5	empty; 1 BW
15/01/21	033-5	MIC	24433-5	Berta	08:13	08:21	55°25.0809	04°31.9318	42.5	2 tubes with 4 cm sediment; 2 BW
15/01/21	034-1	MIC	24434-1	Berta	08:47	08:58	55°25.3167	04°33.1205	42	2 tubes with 5 cm sediment; 2 BW

15/01/21	034-2	MIC	24434-2	Berta	09:20	09:34	55°25.3139	04°33.1252	42	empty
15/01/21	035-1	GC	24435-1	Berta	09:56	10:04	55°25.33	04°33.12	42	empty
15/01/21	036-1	Sonar Lander	24436-1	Berta	11:20	12:56	55°25.079	04°31.929	42	Lander positioning with "GEO Engineering" ROV
19/01/21	036-2	Sonar Lander	24436-2	Berta	07:30	08:03				Recovery
15/01/21	037-1	GE	24437-1	Britta	14:53	23:05	55°09.079	04°47.794	43	EM Survey Pockmarks, Britta
16/01/21	038-1	MIC	24438-1	Britta	07:12	07:35	55°09.0817	04°47.9104	43.5	Britta Pockmark 1; 1 tubes 2 cm sediment; 1 BW
16/01/21	038-2	MIC	24438-2	Britta	07:45	07:50	55°09.0820	04°47.9233	43.5	Britta Pockmark 1; 1 tube 2 cm sediment; 1 BW
16/01/21	039-1	MIC	24439-1	Britta	08:04	08:12	55°09.1047	04°47.9329	43.5	Britta Pockmark 2; 1 tube 10 cm sediment; 1 BW
16/01/21	039-2	MIC	24439-2	Britta	08:27	08:33	55°09.1048	04°47.9341	43	Britta Pockmark 2; 3 tube 30 cm sediment; 2 BW
16/01/21	040-1	MIC	24440-1	Britta	09:04	09:11	55°09.1301	04°47.9389	43	Britta Pockmark 3; 2 tubes sediment; 1 BW
16/01/21	041-1	MIC	24441-1	Britta	09:51	09:58	55°09.1503	04°47.9510	43	Britta Pockmark 4; 1 tube 5 cm sediment; 1 BW
16/01/21	042-1	MIC	24442-1	Britta	10:24	10:34	55°09.1630	04°47.9745	43	Britta Pockmark 4; 1 tube 5 cm sediment; 1 BW
16/01/21	042-2	MIC	24442-2	Britta	10:37	10:50	55°09.1730	04°47.9723	43.5	Britta Pockmark 4; 1 tube 5 cm sediment; 1 BW
16/01/21	043-1	GC	24443-1	Britta	11:12	11:19	55°09.1046	04°47.9341	43	Britta Pockmark 4; 42 cm sediment
16/01/21	044-1	ROV	24444-1	Britta	12:28	13:24	55°09.0843	04°47.9350	43	Britta Pockmark survey
16/01/21	045-1	CTD	24445-1	B18-1	14:40	15:00	55°06.7815	04°46.8297	42	8 samples; B18-1 (right at borehole)
16/01/21	045-2	CTD	24445-2	B18-1	15:10	15:30	55°06.7779	04°46.8164	42	8 samples; B18-1 (downstream 250°; 15 m)
16/01/21	045-3	CTD	24445-3	B18-1	15:40	15:57	55°06.7835	04°46.8139	42	8 samples; B18-1 (downstream 280°, 15 m)
16/01/21	045-4	CTD	24445-4	B18-1	16:08	16:27	55°06.7816	04°46.8497	43	8 samples; B18-1 (upstream 90°, 15 m)
17/01/21	046-1	GE	24446-1	Britta	07:00	12:03	55°08.705	04°47.511	43	EM Survey Chimneys next to salt dome Britta
17/01/21	047-1	ROV	24447-1	Britta	12:41	14:12	55°10.6062	04°43.1144	45	flare cluster&pockmark 5km NW of Britta, no samples

18/01/21	048-1	MIC	24448-1	B18-1	07:03	07:16	55°06.7807	04°46.8306	42	3 tubes > 10 cm sediment; 1 tube 3 cm; 2 BW
18/01/21	049-1	MIC	24449-1	DOK1-X well	08:58	09:08	55°15.8865	04°56.3239	47	3 tubes > 10 cm sediment; 2 BW
18/01/21	050-1	CTD	24450-1	DOK1-X well	10:05	10:35	55°15.8867	04°56.3230	47	8 samples; well position; bottle 4 leak
18/01/21	050-2	CTD	24450-2	DOK1-X well	10:05	12:08	55°15.8888	04°56.3392	47	8 samples; 15m 90° from well position, downstream
18/01/21	050-3	CTD	24450-3	DOK1-X well	11:19	11:41	55°15.8856	04°56.3387	48	8 samples; 15m 110° from well position,downstrea m
18/01/21	050-4	CTD	24450-4	DOK1-X well	11:51	12:09	55°15.8882	04°56.3109	47	8 samples; 15m 260° from well position,upstream
18/01/21	051-2	CTD	24451-2	DOK1-X flare 1	13:04	13:25	55°16.0066	04°57.3691	48	5 samples; flare site; no signal in EM; near pipeline
18/01/21	051-2	CTD	24451-2	DOK1-X flare 1	13:32	13:50	55°16.0066	04°57.3705	47	5 samples; flare site; no signal in EM; near pipeline
18/01/21	052-1	CTD	24452-1	DOK1-X flare 2	14:51	15:11	55°15.9566	04°57.1044	47	8 samples; on flare site; clear in EM before CTD
18/01/21	052-2	CTD	24452-2	DOK1-X flare 2	15:20	15:45	55°15.9557	04°57.1016	46	8 samples; 5m downstream flare; clear in EM before CTD
19/01/21	053-1	ROV	24453-1	Berta	08:27	08:50	55°25.070	04°31.927	42	recovery of beacon; successfull; GeoEngeneering ROV
19/01/21	054-1	ROV	24454-1	Berta	09:34	10:42	55°25.3176	04°33.1427	43	gas sampling at flare cluster; 2 bags; Marum ROV
20/01/21	055-1	CTD	24455-1	Thor-1	09:17	09:38	55°09.3138	05°15.7494	43	8 samples; well position; 5 m from bottom; storm
20/01/21	055-2	CTD	24455-2	Thor-1	09:48	10:05	55°09.3214	05°15.7617	41	8 samples; 15m 40° from well; downstream; storm
20/01/21	055-3	CTD	24455-3	Thor-1	10:17	10:42	55°09.3102	05°15.7620	42	8 samples; 15m 70° from well; downstream; storm
20/01/21	055-4	CTD	24455-4	Thor-1	10:55	11:16	55°09.3170	05°15.7380	42	8 samples; 15m 270° from well; downstream; storm
22/01/21	056-1	CTD	24456-1	D1 - well	07:08	07:45	53°53.877	06°24.669	27	5 samples; CTD slide bar on well position; max 20m depth

CTD:CTD-Rosette
MIC: Mini-Multicorer
ROV: Remotely operated vehicle
GC: Gravity corer
GE: Golden Eye