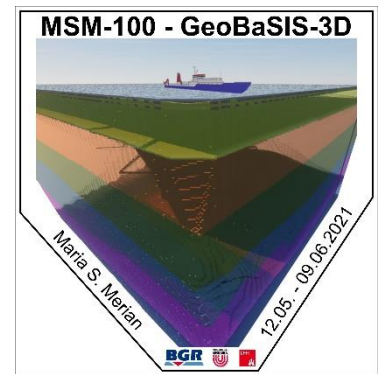


Dr. Axel Ehrhardt
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)
Stilleweg 2
30655 Hannover
Tel. 0511 / 643 3135
Email: Axel.Ehrhardt@bgr.de



R/V MARIA S. MERIAN
Short Cruise Report
Cruise MSM100

Emden – Emden
12.05.2021 – 09.06.2021

Chief-Scientist: Axel Ehrhardt
Captain: Björn Maaß

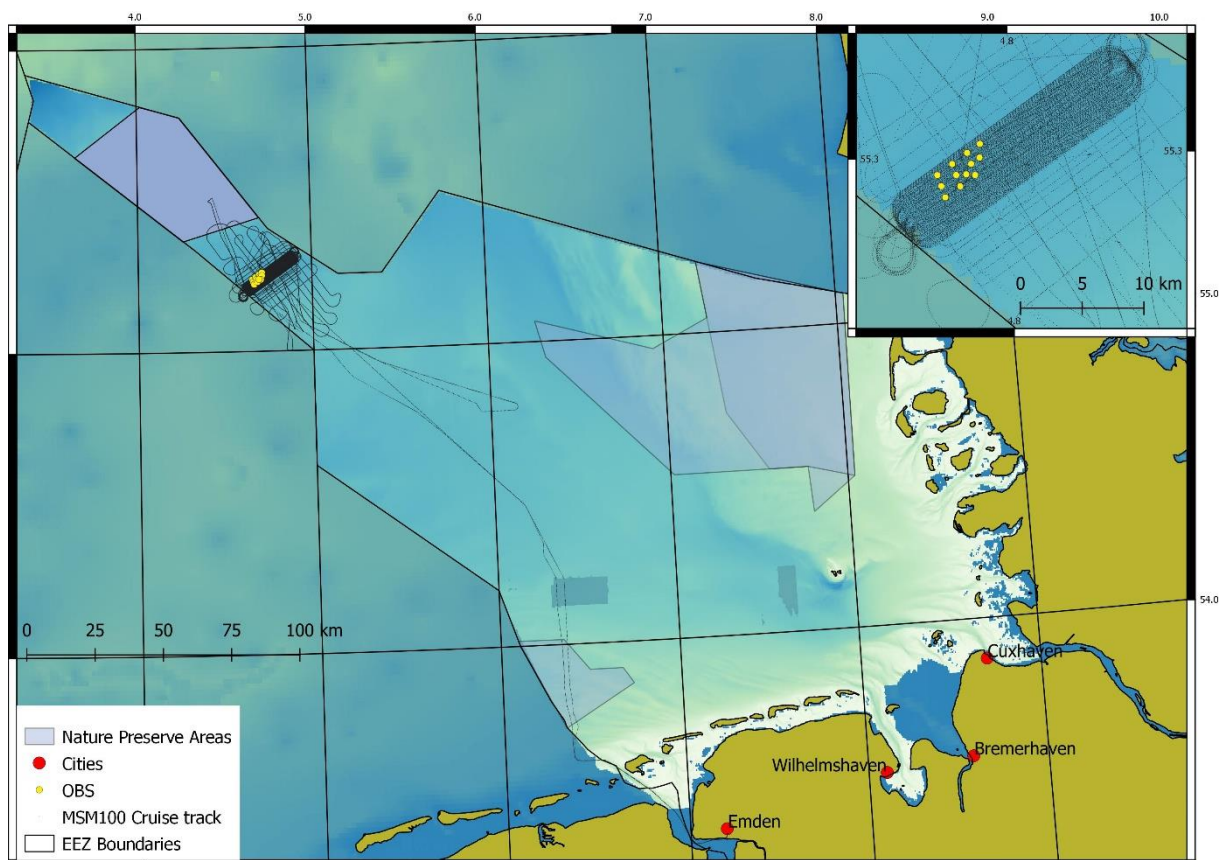


Fig. 1: Cruise plot of MSM100. The black dots mark the position of R/V MARIA S. MERIAN during the cruise. The close-up in the upper right frame depicts the 3D-survey box. The coarser line net shows the 2D lines that were acquired during a bad weather period. The Dutch EEZ and the Doggerbank Nature Preserve area were only used for turns or retrieving the equipment without data acquisition.

Objectives

Within the transition to renewable energy, the integrity of barriers and seals in the deep underground becomes increasingly important for storage purposes, e.g. for CO₂ in the framework of Carbon Capture and Storage (CCS) or for synthetic energy gases in the course of the change to renewable energy (Power2Gas). The tasks of this project are exemplary studies on the integrity of barrier formations of Cenozoic shale layers in the German North Sea. If the barrier formation is not closed, either because of abandoned drill holes or along natural pathways it enables discharge of fluids into the North Sea. Thus, the second topic is the understanding of migration of fluids along pathways through seal formations. For the first time we acquired high-resolution 3D multi-channel seismic and ocean bottom seismometers (OBS) data to image the Cenozoic sediments in detail, in order to identify and interpret the fault systems that may enable fluid migration to the surface and to transfer the interpretation into a 3D geological model. By means of the high-resolution data, we will image fault systems that were previously postulated in the “sub-seismic” domain. The data will cover different fault systems, seeps, and undisturbed strata in close proximity. The outcome of this study will be a profound understanding of fault systems and structures in the Cenozoic sediments like polygonal-, crestal- or step faults as well as tunnel valleys and especially how they communicate. Such a study on potential seal bypass systems is missing so far in the German North Sea.

Narrative

On May 11th 2021 the scientific/technical party of MSM100 embarked on the Research Vessel MARIA S. MERIAN, after a 10-day Covid-19 quarantine within a hotel in Varel. All scientists and technicians were tested negative. We used May 11th and 12th to mobilize all the heavy equipment, while being in the port of Emden. On Wednesday, May 12th evening we left the port of Emden and sailed towards the research area in the “Entenschnabel” area of the German Exclusive Economic Zone (EEZ) (Fig. 1).

After the arrival in the research area in the morning of May 13th we started deploying “click-detectors” in the framework of a common project with the Stiftung Deutsches Meeresmuseum (Stralsund). These “click-detectors” should monitor the presence of harbor porpoises in the survey area during and after our seismic survey. After the deployment of the “click-detectors” we started the deployment of 12 Ocean Bottom Seismometers (OBS). Because of the obligation to remove everything after finishing the survey, the anchors of the OBS were connected with a rope to the floating body of the OBS. After releasing the OBS from the anchor the OBS should pop up and the anchor would be retrieved by means of the rope. Because of the significant tide related bottom currents we used two anchors, welded together. After all OBS were deployed, we started handling tests of the paravans. During the night, we acquired Parasound sediment echosounder profiles.

On May 14th we started to deploy the 3D seismic equipment. Both streamer cables had to be equipped with collars for the compass birds and acoustic transponder (digirange) units and with Aux modules for the Quiet Sea Passive Acoustic Monitoring (PAM) system. Because of a defect bird on the port side streamer cable and issues with the power line to the tail buoy, we had to retrieve the port side equipment again in the evening. During the night, the starboard equipment stayed deployed and Parasound data was collected.

On May 15th the bird and the power line were fixed and the port side equipment was deployed. At noon we started with the first sail line of the 3D seismic survey.

From May 16th to May 20th we acquired 3D seismic data. We observed a bad weather period on the weather forecast with high wind speeds (8 – 9 Bft) and high swell and wind sea (up to 2.8 m), so we decided to retrieve the entire equipment on May 20th at 13:00 LT. During the bad weather window from May 20th to May 24th we switched to 2D seismic data acquisition and acquired 18 2D seismic lines. In order to test the new OBS anchor system we released and picked up two OBS successfully.

Station List

Table 2: Table of acquired 3D reflection seismic lines during MSM100. 3D survey locations is plotted in Fig. 1. The survey area consists out of 105 sail lines with a sail line distance of 50 m, resulting in an area of approximately 94 km². Additional 12 sail lines were used as 'fill-in lines'. SOL: Start of Line; EOL: End of Line; UTC: Coordinated Universal Time (UTC=MEST-2h); SP: Shot-Point

Line name	BGR-	Date (SOL)	UTC Time (SOL)	SP (SOL)	Lat (SOL)	Lon (SOL)	Date (EOL)	UTC Time (EOL)	SP (EOL)	Lat (EOL)	Lon (EOL)
102A001		15.05.2021	14:18:08	1000	55.23018	4.62134	15.05.2021	16:42:09	2491	55.32478	4.86339
342A002		15.05.2021	17:28:05	2441	55.29791	4.87834	15.05.2021	19:52:35	0950	55.20321	4.63658
106A003		15.05.2021	20:39:27	1000	55.22981	4.62179	15.05.2021	23:03:13	2491	55.32438	4.86386
346A004		15.05.2021	23:52:56	2441	55.29744	4.87889	16.05.2021	02:16:04	0950	55.20300	4.63682
110A005		16.05.2021	03:01:44	1000	55.22947	4.62220	16.05.2021	05:25:53	2491	55.32383	4.86451
350A006		16.05.2021	06:10:49	2441	55.29714	4.87925	16.05.2021	08:35:29	0950	55.20266	4.63724
114A007		16.05.2021	09:20:01	1000	55.22905	4.62270	16.05.2021	11:44:02	2491	55.32364	4.86475
354A008		16.05.2021	12:31:58	2441	55.29673	4.87974	16.05.2021	15:01:53	0950	55.20228	4.63771
118A009		16.05.2021	15:47:26	1000	55.22873	4.62308	16.05.2021	18:11:20	2491	55.32317	4.86531
358A010		16.05.2021	18:57:51	2441	55.29635	4.88019	16.05.2021	21:22:35	0950	55.20198	4.63805
122A011		16.05.2021	22:07:35	1000	55.22827	4.62363	17.05.2021	00:31:38	2491	55.32286	4.86567
362A012		17.05.2021	01:18:22	2441	55.29601	4.88060	17.05.2021	03:41:36	0950	55.20153	4.63858
126A013		17.05.2021	04:26:07	1000	55.22794	4.62403	17.05.2021	06:49:48	2491	55.32244	4.86618
366A014		17.05.2021	07:36:20	2441	55.29567	4.88101	17.05.2021	10:01:00	0950	55.20116	4.63903
130A015		17.05.2021	10:45:10	1000	55.22758	4.62447	17.05.2021	13:09:26	2491	55.32216	4.86651
370A016		17.05.2021	13:56:39	2441	55.29529	4.88146	17.05.2021	16:20:00	0950	55.20077	4.63948
134A017		17.05.2021	17:07:18	1000	55.22721	4.62491	17.05.2021	19:30:49	2491	55.32169	4.86708
374A018		17.05.2021	20:16:47	2441	55.29491	4.88191	17.05.2021	22:41:17	0950	55.20052	4.63980
138A019		17.05.2021	23:25:53	1000	55.22684	4.62534	18.05.2021	01:50:08	2491	55.32126	4.86759
378A020		18.05.2021	02:36:14	2441	55.29451	4.88239	18.05.2021	04:59:47	0950	55.20006	4.64036
142A021		18.05.2021	05:45:30	1000	55.22647	4.62579	18.05.2021	08:08:52	2491	55.32096	4.86795
382A022		18.05.2021	08:56:09	2441	55.29416	4.88281	18.05.2021	11:20:29	0950	55.19970	4.64078
146A023		18.05.2021	12:04:30	1000	55.22612	4.62622	18.05.2021	14:28:47	2491	55.32070	4.86826
386A024		18.05.2021	15:14:28	2441	55.29381	4.88322	18.05.2021	17:38:18	0950	55.19926	4.64132
150A025		18.05.2021	18:24:26	1000	55.22573	4.62668	18.05.2021	20:47:56	2491	55.32024	4.86881
390A026		18.05.2021	21:34:54	2441	55.29342	4.88369	18.05.2021	23:59:07	0950	55.19902	4.64159
154A027		19.05.2021	00:42:44	1000	55.22534	4.62714	19.05.2021	03:07:00	2491	55.31994	4.86917
394A028		19.05.2021	03:52:47	2441	55.29303	4.88416	19.05.2021	06:16:14	0950	55.19855	4.64217
158A029		19.05.2021	07:03:21	1000	55.22498	4.62759	19.05.2021	09:27:03	2491	55.31952	4.86967
398A030		19.05.2021	10:14:04	2441	55.29267	4.88458	19.05.2021	12:38:21	0950	55.19826	4.64251
162A031		19.05.2021	13:22:52	1000	55.22463	4.62799	19.05.2021	15:20:16	2213	55.30163	4.82480
402A032		19.05.2021	16:33:10	2441	55.29227	4.88506	19.05.2021	18:56:45	0950	55.19779	4.64308
166A033		19.05.2021	19:43:59	1000	55.22428	4.62843	19.05.2021	22:07:31	2491	55.31876	4.87058
406A034		19.05.2021	22:52:30	2441	55.29195	4.88544	20.05.2021	01:16:48	0950	55.19753	4.64338
170A035		20.05.2021	02:01:26	1000	55.22387	4.62892	20.05.2021	04:25:43	2491	55.31845	4.87094
410A036		20.05.2021	05:12:42	2441	55.29154	4.88593	20.05.2021	07:36:21	0950	55.19708	4.64393
174A037		20.05.2021	08:23:40	1000	55.22353	4.62933	20.05.2021	10:47:53	2491	55.31801	4.87148
414A038		25.05.2021	12:09:18	2441	55.29129	4.88662	25.05.2021	14:33:20	0950	55.19683	4.64461
178A039		25.05.2021	15:18:38	1000	55.22301	4.62956	25.05.2021	17:41:36	2491	55.31759	4.87158
418A040		25.05.2021	18:29:02	2441	55.29089	4.88710	25.05.2021	20:52:40	0950	55.19656	4.64494
182A041		25.05.2021	21:37:55	1000	55.22264	4.62999	26.05.2021	00:02:03	2491	55.31715	4.87211
422A042		26.05.2021	00:45:06	2441	55.29058	4.88747	26.05.2021	03:09:14	0950	55.19611	4.64549
186A043		26.05.2021	03:52:23	1000	55.22227	4.63044	26.05.2021	06:13:03	2491	55.31689	4.87241
426A044		26.05.2021	07:05:13	2441	55.29016	4.88798	26.05.2021	09:28:10	0950	55.19584	4.64580
190A045		26.05.2021	10:13:10	1000	55.22189	4.63089	26.05.2021	12:37:37	2491	55.31641	4.87299
430A046		26.05.2021	13:20:56	2441	55.28981	4.88839	26.05.2021	15:44:55	0950	55.19536	4.64638
194A047		26.05.2021	16:31:28	1000	55.22155	4.63129	26.05.2021	18:50:52	2491	55.31609	4.87336
434A048		26.05.2021	19:38:54	2441	55.28939	4.88890	26.05.2021	22:08:59	0950	55.19508	4.64672
198A049		26.05.2021	22:51:44	1000	55.22128	4.63163	27.05.2021	01:15:28	2491	55.31572	4.87381

Table 3: Table of acquired 2D reflection seismic lines during MSM100. The locations of the seismic lines are in the vicinity of the 3D survey area (Fig. 1). SOL: Start of Line; EOL: End of Line

Line name	Date (SOL)	UTC Time (SOL)	SP (SOL)	Lat (SOL)	Lon (SOL)	Date (EOL)	UTC Time (EOL)	SP (EOL)	Lat (EOL)	Lon (EOL)
BGR21-812A001	21.05.2021	10:14:09	1975	55.18707	4.67094	21.05.2021	10:41:28	2265	55.16031	4.70335
BGR21-802A002	21.05.2021	12:29:47	1000	55.16766	4.69500	21.05.2021	14:50:42	2722	55.27939	4.97115
BGR21-801A003	21.05.2021	15:39:45	2626	55.24800	5.01347	21.05.2021	18:15:44	1022	55.13898	4.76289
BGR21-813A004	21.05.2021	19:59:23	2694	55.14271	4.81059	21.05.2021	22:31:41	950	55.30082	4.60830
BGR21-811A005	22.05.2021	00:28:36	1000	55.26412	4.57156	22.05.2021	02:44:11	2514	55.35728	4.82098
BGR21-807A006	22.05.2021	03:31:05	2540	55.32294	4.87319	22.05.2021	05:53:10	958	55.22203	4.61702
BGR21-810A007	22.05.2021	06:42:01	1025	55.25628	4.58843	22.05.2021	08:55:34	2508	55.34913	4.83078
BGR21-806A008	22.05.2021	10:05:50	2357	55.30360	4.85265	22.05.2021	12:12:23	950	55.21447	4.62414
BGR21-809A009	22.05.2021	13:41:16	1000	55.24369	4.59898	22.05.2021	15:57:10	2510	55.34066	4.84278
BGR21-819A010	22.05.2021	17:19:43	2124	55.28186	4.82218	22.05.2021	19:09:37	950	55.20744	4.63167
BGR21-808A011	22.05.2021	21:25:00	1000	55.23493	4.61210	22.05.2021	23:35:12	2507	55.33161	4.85548
BGR21-828A012	23.05.2021	00:43:51	1541	55.28522	4.96662	23.05.2021	02:19:13	2644	55.18571	5.09581
BGR21-827A013	23.05.2021	03:59:53	3255	55.15722	5.07302	23.05.2021	07:25:23	1043	55.36077	4.82359
BGR21-826A014	23.05.2021	09:19:54	1478	55.33382	4.80780	23.05.2021	12:39:14	3696	55.13041	5.05933
BGR21-825A015	23.05.2021	14:03:20	4050	55.09744	5.06540	23.05.2021	18:34:48	1033	55.36857	4.70983
BGR21-824A016	23.05.2021	19:58:15	860	55.37347	4.64742	24.05.2021	00:32:01	3902	55.09670	4.99785
BGR21-823A017	24.05.2021	02:03:26	4300	55.05976	5.00364	24.05.2021	06:30:56	1074	55.34589	4.61497
BGR21-822A018	24.05.2021	07:44:24	1000	55.34603	4.58074	24.05.2021	11:00:07	3249	55.14384	4.84572