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Short Cruise Report
R/V MARIA S. MERIAN, MSM97 (GPF 20-3_085)

Emden – Emden
13.11.2020 – 25.11.2020

Chief-Scientist: Axel Ehrhardt
Captain: Ralf Schmidt

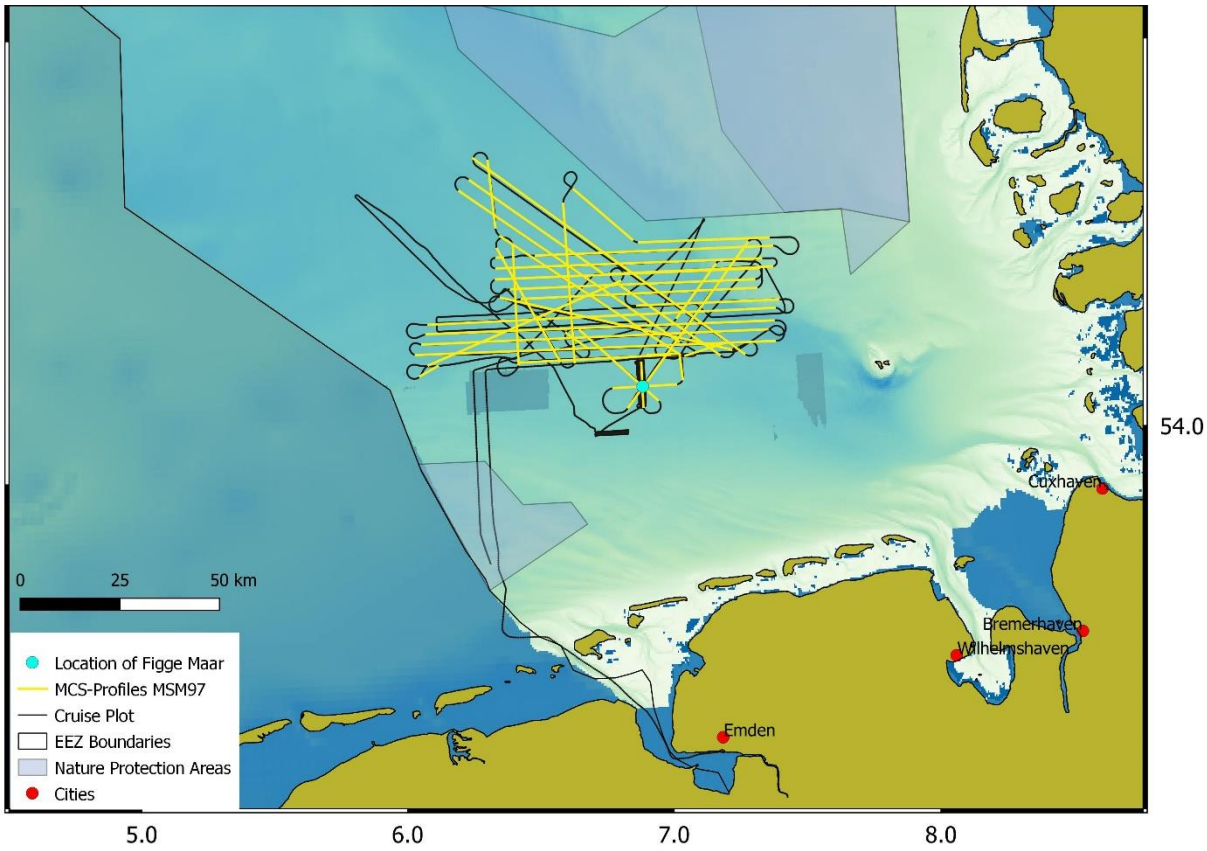

Fig. 1: Cruise plot of MSM97 (GPF 20-3_085). The acquired seismic lines are indicated by the yellow lines. Location of the Figge Maar blow-out structure is marked by the turquoise dot.

Objectives:

The geological storage of fluids is of particular interest in regard to the use of renewable energy and the reduction of greenhouse-gas emissions. Therefore, reservoir and barrier formations in the German North Sea come into focus. Due to the widespread distribution of storage and barrier rocks at suitable depths and in combination with a relatively low tectonic overprint, the West Schleswig Block region in the German North Sea shows a high prospectivity for CO_2 storage.

By means of this high-resolution 2D reflection seismic survey, we want to investigate the potential impairment of geological barriers at the top of geological storage formations (i.e. claystones and salt of the Upper Buntsandstein, clay formations of the Lower Cretaceous and of the Tertiary). The seismic acquisition setup with a 2400 m active streamer cable with 384 channels will allow a precise image of near-surface structures, such as Quaternary channels, seismic pipe structures, chimneys, polygonal fault systems and crestal faults. With the acquired data, the sediments of the Mesozoic and Cenozoic up to the seafloor (2-3 seconds of twoway-traveltime) will be imaged in high-resolution for the first time. The imaged fault systems will be investigated regarding their ability to build seal bypass systems. In addition, we intend to use these methods to investigate the fluid pathways at the recent blowout area at well B1 of 1964 ('Figge Maar'), which is located at the southern rim of the West Schleswig Block area. The imaged fault system will be mapped and investigated regarding the formation of a seal bypass system.

Narrative:

On Thursday, November 12 2020, the scientific/technical party of MSM97 (GPF 20-3_085) embarked the Research Vessel MARIA S. MERIAN, after a 3-day Covid-19 test camp at a hotel in Leer. All scientists and technicians were twice tested negatively. We used November 12 to mobilize all the heavy equipment, while being in the port of Emden. On Friday, November 13, we left the port of Emden and steamed towards our research area in the German Bight, about 40 nautical miles northwest of Helgoland (Fig. 1). The transit time was only 10 hours and we used the time to finalize our technical setup. Our MMO (Marine Mammal Observer) was already on the observation deck to check if any marine mammals are present. In the afternoon, we deployed our equipment and after the soft-start, we started to acquire seismic data. Beside the reflection seismic data, gravity data and hydro acoustic data acquisition was carried out.

November 14 - November 18: After a short period of low winds the wind speed increased to 7 - 9 Beaufort. The azimuth of some seismic had to be adapted as certain profile directions were normal to the wind direction, which should be avoided. Even though weather conditions were not ideal, we acquired good quality seismic data. However, at Wednesday, November 18, it was necessary to retrieve the entire outboard equipment due to severe weather conditions.

Until Friday, November 20, we used the time to carry out a small hydro acoustic survey in the target area of the “Figge-Maar” blow-out structure, in order to exactly localize the small structure (500 m in diameter), as we wanted to image this structure also by means of the reflection seismic data acquisition. The exact position helped us to do a proper line planning.

On Friday, November 20, the weather conditions improved and we deployed our airguns and streamer cable again. As no marine mammals were reported from the MMO, we restarted the measurements with a soft-start. Until Saturday, November 21, a star-shaped pattern of seismic profiles was acquired across the “Figge-Maar” blow-out structure. Because the “Figge-Maar” is located in the center of a main maritime traffic route within the North Sea we shortened the seismic cable to 1200 m active length.

On Saturday, November 21, we extended the streamer cable again to 2400 m active length and adapted the azimuth of the seismic profiles with respect to the prevailing wind and sea state conditions.

From Saturday, November 21, until Tuesday, November 24, we closed the data gaps in the survey area of the West-Schleswig Block. Weather conditions improved again.
On Tuesday, November 24, we stopped the seismic data acquisition at 06:00 a.m., retrieved all equipment on board and started the demobilization. We met the pilot at the rendezvous position on Wednesday, November 25, at 08:30 a.m., and headed towards the port of Emden, where the scientific/technical party disembarked R/V MARIA S. MERIAN.

Acknowledgements:

We would like to thank Captain Ralf Schmidt and the entire crew of R/V MARIA S. MERIAN for the excellent support during our cruise, for the hospitality and friendliness on board. The ship time was provided by the German Research Foundation (DFG) within the METEOR/MERIAN program.

MSM97 scientific/technical party:

Table 1: Technical and scientific party of the cruise MSM97 (GPF 20-3_085). BGR: Bundesanstalt für Geowissenschaften und Rohstoffe (Hannover). Gravionic: GRAVIONIC GmbH, - German Geoservices - Jasperallee 15 38102 Braunschweig

Name	Discipline	Institution
Udo Barckhausen	Gravity / Hydroacoustics	BGR
Thomas Behrens	Streamer / Airguns	BGR
Ümit Demir	Seismic Acquisition System	BGR
Timo Ebert	Streamer / Airguns	BGR
Axel Ehrhardt	Chief-Scientist	BGR
Martin Engels	Processing	BGR
Boris Hahn	Seismic Acquisition System	BGR
Benno Hankers	MMO	Gravionic
Gesa Kuhlmann	Hydroacoustics	BGR
Michael Schnabel	Co-Chief Scientist / Processing	BGR
Peter Steinborn	Seismic Acquisition System	BGR
Heidrun Stück	Hydroacoustics	BGR

Table 2: Table of acquired 2D reflection seismic lines during MSM97 (GPF 20-3_085). Locations are plotted in Fig. 1. SOL: Start of Line; EOL: End of Line

MSM97	SOL					EOL					azimuth
Profile	SP	Date	UTC	Latitude	Longitude	SP	Date	UTC	Latitude	Longitude	[degree]
BGR20-101	2	13.11.2020	19:09:13	54.263248	7.119478	4795	14.11.2020	03:08:31	54.627941	6.301600	309
BGR20-102	2	14.11.2020	03:58:07	54.651132	6.344094	2861	14.11.2020	08:44:01	54.426765	6.840511	130
BGR20-103	3	14.11.2020	08:54:49	54.424197	6.865772	2902	14.11.2020	13:44:43	54.419468	7.497211	92
BGR20-104	82	14.11.2020	14:29:07	54.439240	7.456278	4857	14.11.2020	22:26:37	54.449818	6.431202	273
BGR20-105	1	14.11.2020	22:58:31	54.474158	6.433980	118	14.11.2020	23:10:13	54.473544	6.458624	95
BGR20-105A	5	15.11.2020	00:07:07	54.474271	6.586343	3628	15.11.2020	06:09:25	54.465910	7.501211	92
BGR20-106	2	15.11.2020	07:55:49	54.484993	7.490475	2089	15.11.2020	11:24:31	54.491531	6.988891	273
BGR20-107	17	15.11.2020	11:36:49	54.498566	6.962824	1273	15.11.2020	13:42:25	54.619454	6.745488	315
BGR20-108	191	15.11.2020	15:20:13	54.587872	6.702762	2663	15.11.2020	19:27:25	54.229788	6.715024	181
BGR20-109	2	15.11.2020	19:57:49	54.233656	6.658369	2037	15.11.2020	23:21:19	54.493853	6.437496	336
BGR20-110	1	16.11.2020	00:04:19	54.497502	6.499287	2220	16.11.2020	03:46:13	54.231441	6.499128	182
BGR20-111	1	16.11.2020	05:12:13	54.235021	6.499786	1998	16.11.2020	08:31:55	54.234365	7.081866	92
BGR20-112	557	16.11.2020	12:03:19	54.251324	7.488991	6931	16.11.2020	22:40:43	54.262902	6.105320	273
BGR20-113	1	16.11.2020	23:17:31	54.285807	6.132489	5600	17.11.2020	08:37:25	54.278613	7.462814	92
BGR20-114	1	17.11.2020	09:39:31	54.297760	7.489000	6103	17.11.2020	19:49:43	54.308815	6.148976	273
BGR20-115	161	17.11.2020	21:02:43	54.330095	6.159658	5320	18.11.2020	05:38:37	54.326004	7.495885	92
BGR20-116A	1	18.11.2020	06:44:31	54.344220	7.512729	2564	18.11.2020	11:00:49	54.349375	6.966834	272
BGR20-117	1	20.11.2020	09:54:43	54.296145	6.688485	447	20.11.2020	10:39:19	54.260661	6.765988	130
BGR20-117A	342	20.11.2020	12:38:55	54.301206	6.740675	2270	20.11.2020	15:51:43	54.133821	7.026390	137
BGR20-118	1	20.11.2020	16:47:07	54.120678	6.969366	780	20.11.2020	18:05:01	54.220003	6.970621	2
BGR20-119	1	20.11.2020	18:25:01	54.236813	6.997718	510	20.11.2020	19:15:55	54.236219	7.108861	92
BGR20-119A	572	20.11.2020	19:22:07	54.231733	7.120274	1005	20.11.2020	20:05:25	54.177919	7.126420	178
BGR20-120	128	20.11.2020	20:21:01	54.166880	7.099826	1267	20.11.2020	22:14:55	54.166737	6.858427	272
BGR20-121	1	20.11.2020	23:32:14	54.121464	6.911302	3035	21.11.2020	04:35:37	54.477049	7.408227	41
BGR20-122A	1	21.11.2020	11:02:19	54.316751	7.117321	867	21.11.2020	12:28:55	54.432346	7.278584	41
BGR20-123	1	21.11.2020	13:59:31	54.392987	7.424283	4392	21.11.2020	21:18:37	54.401402	6.484067	273
BGR20-124	68	21.11.2020	22:09:07	54.425135	6.427784	4550	22.11.2020	05:37:19	54.417375	7.446348	92
BGR20-125	1	22.11.2020	06:14:13	54.373388	7.430353	3951	22.11.2020	12:49:13	54.378372	6.523658	272
BGR20-126	1	22.11.2020	14:17:38	54.383114	6.442959	3531	22.11.2020	20:10:37	54.238414	7.318344	108
BGR20-127	570	22.11.2020	21:18:00	54.226727	7.369242	5670	23.11.2020	05:57:00	54.699673	6.362330	311
BGR20-128	1	23.11.2020	06:28:31	54.693329	6.417353	985	23.11.2020	08:06:54	54.542348	6.435481	178
BGR20-129	32	23.11.2020	08:21:24	54.521693	6.452282	3429	23.11.2020	14:01	54.234133	7.119898	128
BGR20-129a	3527	23.11.2020	14:10	54.230498	7.141849	4139	23.11.2020	15:12	54.254059	7.296351	77
BGR20-130	1	23.11.2020	16:04	54.227772	7.273570	2386	23.11.2020	19:47	54.401262	6.895941	310
BGR20-131	250	23.11.2020	20:45	54.407187	6.906771	1389	23.11.2020	22:39:36	54.355521	6.675999	251
BGR20-131a	1	23.11.2020	22:42:24	54.354224	6.670432	2763	24.11.2020	03:18:36	54.238598	6.152905	251
BGR20-132	145	24.11.2020	04:41:36	54.214762	6.117782	333	24.11.2020	05:00:24	54.235888	6.187151	65