RV Littorina

Cruise Report LI 17-08

North Sea

Project:

Nordfriesland Süd

"Der geologisch/sedimentologische Aufbau und die Habitatverteilung im Übergangsbereich Watt – Schelf zwischen der Amrumbank und der Eiderrinne - Nordsee"

May 15th – 25th, 2017

Institute of Geosciences (IfG)

Sedimentology, Coastal and Continental Shelf Research

Christian-Albrechts-University (CAU), Kiel

Dr. Klaus Schwarzer

Dr. Daniel Unverricht

M.Sc. Tim Willems

CONTENT

bjective of the cruise

The cruise L17-08 took place in the frame of the research project "Nordfriesland Süd – der geologisch/sedimentologische Aufbau und die Habitatverteilung im Übergangsbereich Watt – Schelf zwischen der Amrumbank und der Eiderrinne" (Nordfriesland South – the geological/sedimentological built up and habitat distribution in the transition zone between the tidal flats and the shelf zone between Amrum-Bank and Eider-Channel). The project is a cooperation between the Agency for Coastal Protection, National Park and Marine Conservation of Schleswig-Holstein (LKN), the State office for Agriculture, Environment and Rural Areas Schleswig-Holstein (LLUR) and Kiel University. The objectives are high resolution investigations of the sedimentary deposits of the subsurface, a stratigraphic classification of the mapped units, and the elaboration of a high resolution map of the sediment- and habitat distribution in this area.

The data sets will be used to fill gaps in the knowledge of sedimentological- and geological characteristics of this area. Another question is if the pre- Holocene subsurface still affects geomorphological forms and the morphological/sedimentological buildup of the present seafloor. This study also serves as a data pool to satisfy EU directives regarding marine habitats, seafloor characteristics and environmental impacts.

L17-08 was the first of a number of upcoming research cruises in the frame of this project. Here we focused on creating an overview of geological features and sedimentary structures of the seafloor and the and the upper subsurface down to about 10 m below the seafloor. We put special attention on the seaward extension of the base of tidal flats and the influence of tidal channels, shaping the geological structures and sediment distributions.

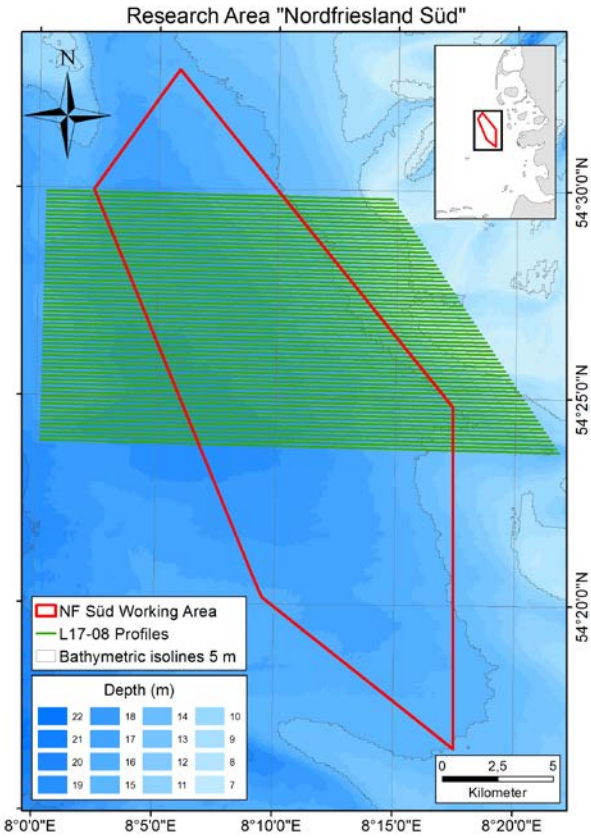

Fig. 1: Working area of "Nordfriesland Süd" (red lines). Tracks of hydroacoustic surveys (green lines). Bathymetry taken from www.gpdn.de.

Abbreviations used in this report

Conductivity Temperature Depth probe	CTD
Institute of Geosciences	IfG
Multibeam Echosounder	MB
1624 – Side-Scan Sonar (towed)	SSS (1624)
C3D – Side-Scan Sonar (towed)	SSS (C3D)
Innomar Subbottom Profiler (hull mounted)	SES
Underwater Video	UWV
LKN	Landesbetrieb für Küstenschutz, National-Park und Meeresschutz Schleswig-Holstein
LLUR	Landesamt für Landwirtschaft, Umwelt und ländliche Räume Schleswig-Holstein

Scientific Crew

Name	*Function*	*Institute*	*Time on board*
Dr. Klaus Schwarzer	Chief scientist	IfG, Kiel University	From 16.05.2017
Dr. Peter Richter	Scientist	IfG, Kiel University	Until 16.05.2017
Dr. Daniel Unverricht	Scientist	IfG, Kiel University	Complete
M.Sc. Tim Willems	Scientist	IfG, Kiel University	Complete

Cruise Narrative

Mo. 15.05.2017

Weather:	E, 1 – 2, sunny
09:00	Departure, transit through Kiel Canal, heading for working area, transit to Cuxhaven
20:00	Arrival in Cuxhaven port

Tu. 16.05.2017

Weather:	S, 2 – 3, rainy
06:00	Departure, transit to southern part of working area
11:20	CTD-profile
11:30	Deployment of devices (SSS, SES, MB), start hydroacoustic measurements
17:15	End of hydroacoustic measurements, SSS, SES out of water, transit to Büsum, Change of crew members (Peter Richter leaves, Klaus Schwarzer arrives)

We. 17.05.2017

Weather:	0, cloudy
7:30	Departure, transit to northern part of working area
12:00	CTD-profile
12:35	Deployment of devices (SSS, SES, MB)
12:50 – 00:00	Hydroacoustic measurements

Th. 18.05.2017

Weather:	WSW, 4 – 5, cloudy
00:00 – 24:00	Hydroacoustic measurements

Fr. 19.05.2017

Weather:	0, foggy
00:00 – 15:30	Hydroacoustic measurements
15:30	End of hydroacoustic measurements, SSS, SES out of water, transit to Büsum
20:00	Arrival at Büsum harbor

Sa. 20.05.2017

Weather:	W, 3 – 4, cloudy, later sunny
07:30	Departure, transit to northern part of working area
13:30	Deployment of devices (SSS, SES, MB)
13:40 – 00:00	Hydroacoustic measurements

Su. 21.05.2017

Weather:	W, 1 – 2, sunny
00:00 – 24:00	Hydroacoustic measurements

Mo. 22.05.2017

Weather:	0, sunny
00:00 – 24:00	Hydroacoustic measurements

Tu. 23.05.2017

Weather:	0, sunny, changing to WNW, 5 – 7
00:00 – 11:00	Hydroacoustic measurements
11:15 – 11:45	CTD, UWV
12:00	Hydroacoustic measurements
16:00	End of hydroacoustic measurements due to bad weather conditions SSS, SES out of water, transit to Helgoland harbor
17:40	Arrival in Helgoland harbor

We. 24.05.2017

Weather:	WNW, 3 -4, sunny & cloudy
07:30	Transit to working area
10:30 – 17:15	Grab sampling
18:00	Deployment of devices (SSS,, SES, MB)
18:15 – 24:00	Hydroacoustic measurements

Th. 25.05.2017

00:00 – 8:30	End hydroacoustic measurements
8:45	SSS, SES & MB out of water
9:00 – 16:40	Grab sampling
16:50	Heading to Büsum
21:00	Arrival in Büsum harbor

Methods

Two Sidescan Sonar systems were used to collect high resolution hydroacoustic data to create maps of the seafloor sediment backscatter characteristics and sediment distribution patterns. The images ae a reflection of the acoustic energy that is backscattered from the seafloor and is displayed in different levels of grey (Blondel et al., 1997). SSS devices were towed behind the vessel with a speed of 4.5 to 5 knots. The range was 100 m to each side, with an overlapping of each swath with the neighboring swath of 20 m (line spacing between the profiles: 0,1 nautical mile (nm)).
The SSS Teledyne Benthos C3D was used from 16. – 19. May. It runs with a frequency of 200 kHz. Due to negative influences of the SES subbottom profiler to the data quality, the SSS Teledyne Benthos SIS - 1624 (see Fig. 2 a) was replacing the C3D from May 20th. The dual frequency Benthos 1624 works with a 100 kHz and 400 kHz simultaneously. The track lines of all hydroacoustic profiles are shown in Fig. 1 and Tab. 1.

Multibeam surveys were performed with the shipboard SeaBeam 1185 (L3-Communications, ELAC Nautik GmbH), operating with a frequency of 180 kHz. Bathymetric and backscatter data can be collected simultaneously with an opening angle of 153.5° resulting in a swath of about 6 – 7 times of the water depth. The data was acquired and recorded using the software Hydrostar (L3-Communicatioins, ELAC Nautik GmbH).

The Parametric sub-bottom profiler Innomar SES-2000 compact was used for collecting data of the built up of the subsurface down to about 15 m below the seafloor. The starboard-

mounted SES works with two different frequencies that are transmitted simultaneously at high sound pressures. The frequency overlap generates new frequencies which are used to penetrate the seafloor (for more details see (Innomar Technologie, 2009). The system operates in chirp frequency mode.

At the beginning of each survey the devices for hydroacoustic measurements were calibrated for sound velocity using data from CTD profiles of the water-column.

A Van- Veen- Grab Sampler (fig. 2 b) was used to collect sediment samples from the seafloor. Every grab sample was described, photographed and sampled (see Tab. 2). In addition, ground truthing was performed at one profile (see Tab. 4) with a Mariscope Underwater Video System while drifting with the current velocity of about 0.5 - 1 kn.

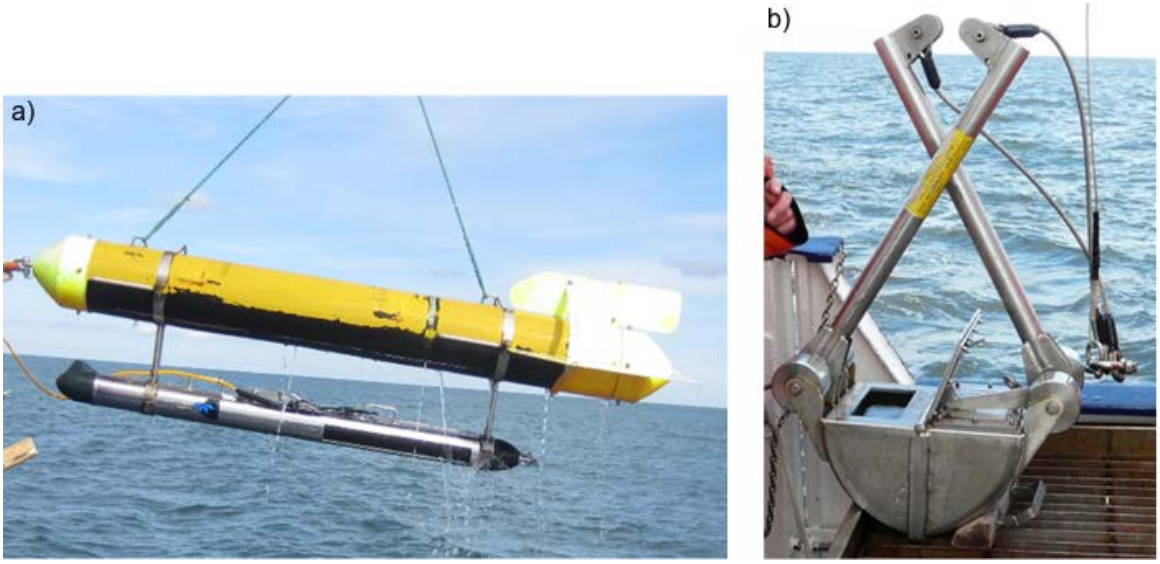

Fig. 2: a) Sidescan sonar towfish with a bouncy for stabilization in the water column; b) Van Veen Grab Sampler

Preliminary Scientific Results

The SSS mosaic resulting from 62 profiles (Fig. 3) covers an area of about 116 km^2. The surveyed area is generally characterized by a high amount of zones of low backscatter values (bright colors). Highest backscatter values (dark colors) can be seen in the north and in the south of the eastern part of the SSS mosaic. Especially the western part of the mapped area reveals lower backscatter values. Further, the western area is also slightly elevated (1 – 2 m) in comparison to the middle- part. This elevation is associated with the extension of the geomorphological structure of Amrumbank extending towards south. The transition from the brighter area to the slightly darker middle-part of the SSS recordings is marked by linear parallel backscatter variations. These variations can be interpreted as ripple structures (Blondel, 2009). The ripple valleys seem to contain coarse grained sediment, which is displayed by higher backscatter values (Fig. 4). The ripples show a height of about 0.5 m with wavelength from five to ten meters.

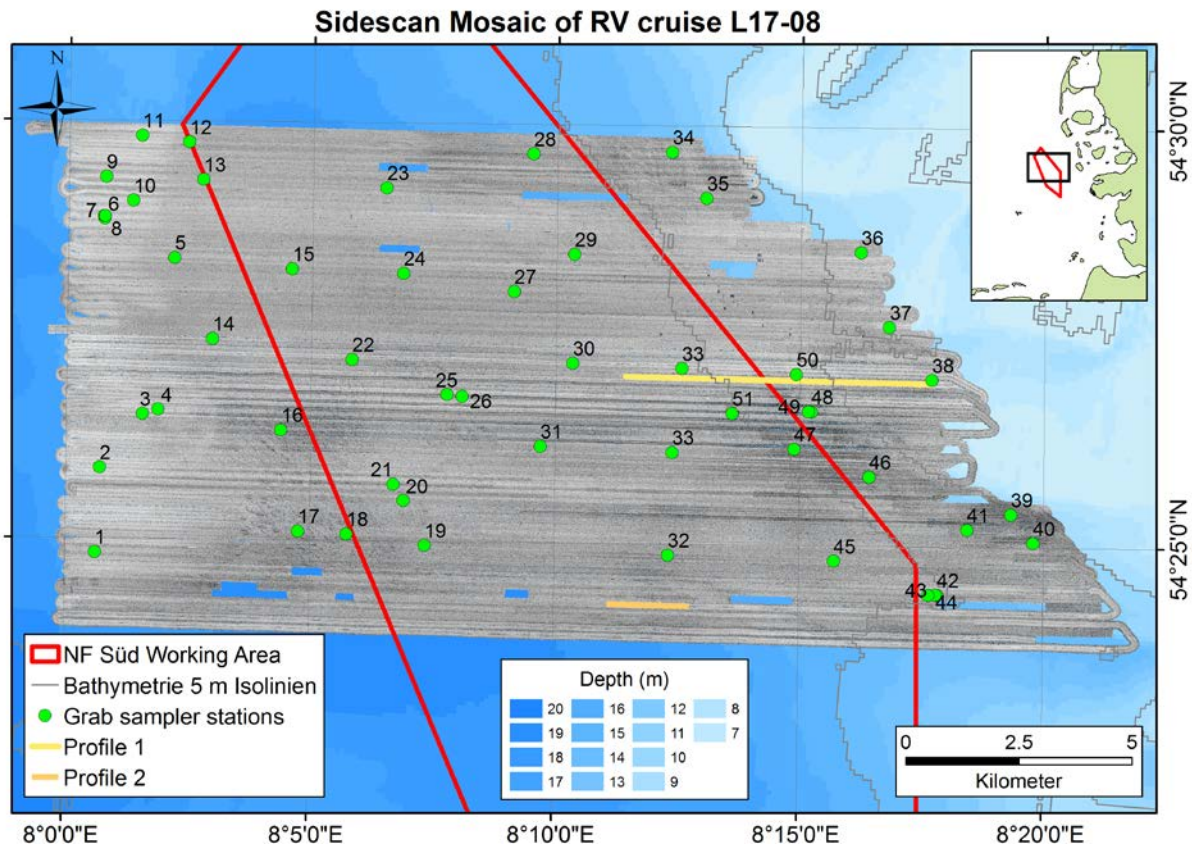

Fig. 3: Sidescan mosaic (light colors represent low backscatter while dark colors represent high backscatter) and grab sampling stations (green dots) of the cruise L17-08.

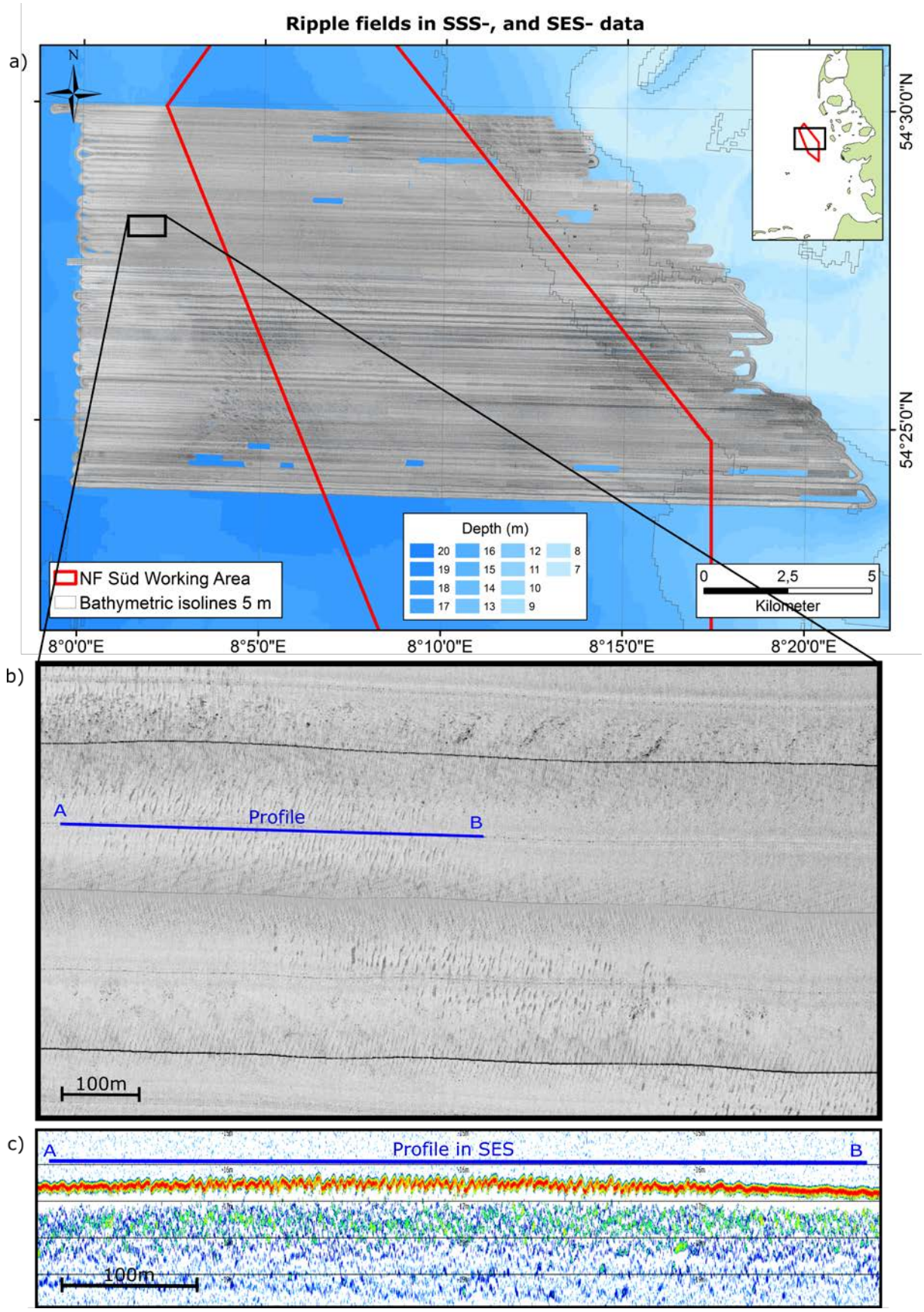

Fig. 4: a) SSS- mosaic overview; b) a area of ripples marks the border between brighter (left) and darker (right) backscatter in SSS recordings; c) Ripples can clearly be detected as well in SES profiles.

SSS recordings revealed occasional positions with higher backscatter intensities and patchy appearance on varying scales - ten to hundreds of meters. These surface reflections may be associated either with bioactivity, e.g. the tube worm *Lanice conchilega* (Heinrich et al., 2017; Degraer et al., 2008), or with morphodynamic structures, e.g. sorted bedforms (Murray et al., 2004; Diesing et al., 2006). In addition, N – S and NW – SE trending fishing traces can be seen in the SW- and the NE of the investigated area. Those are marked by two parallel running stripes of backscatter variations.

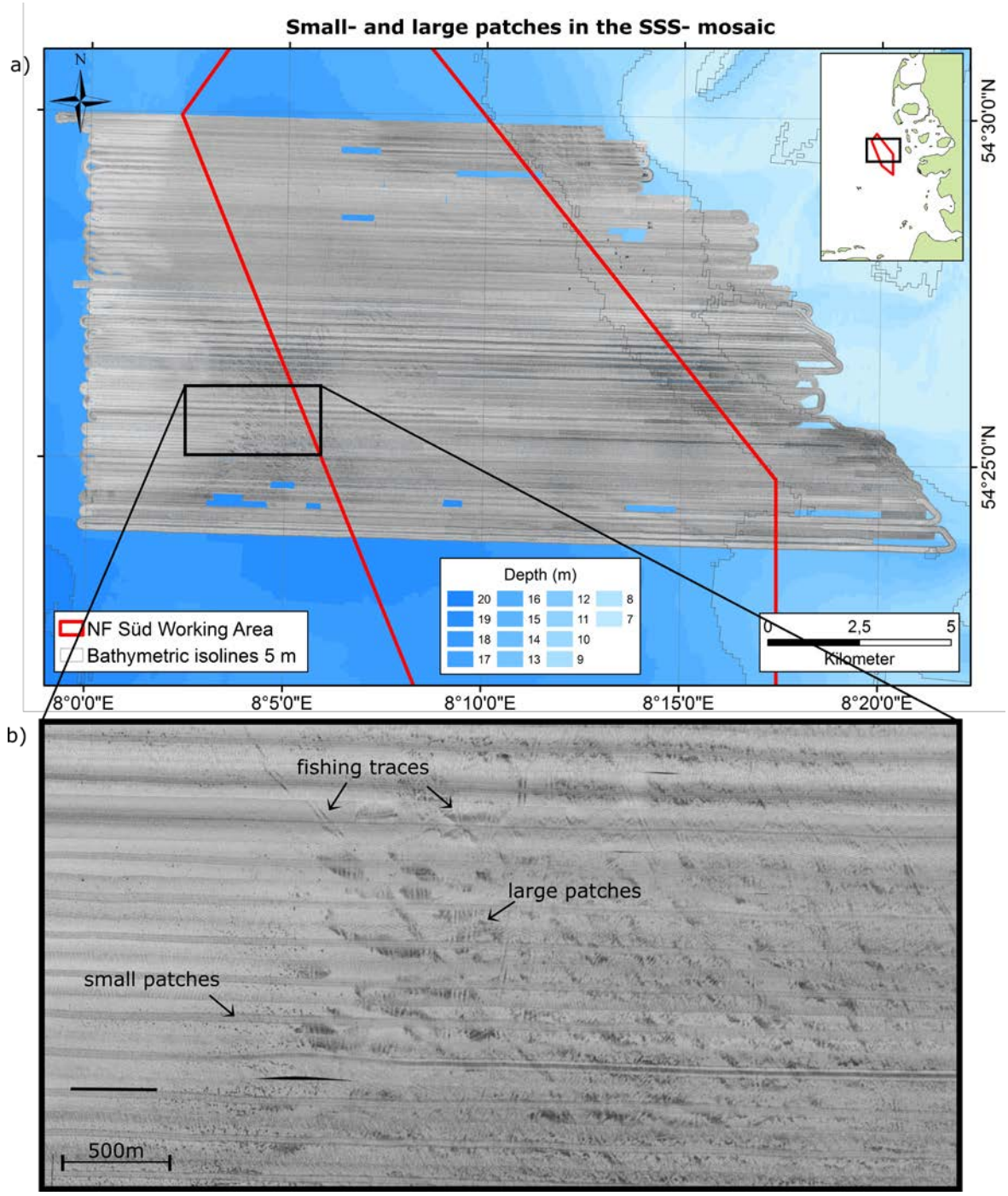

Fig. 5: a) SSS- mosaic overview; b) Zoom into SSS- mosaic with visible fishing traces, small-, and larger patches with high backscatter compared to the surrounding area;

Based on the SSS-mosaic, grab sampling was carried out on 51 stations (see Tab. 2). The Sediment probes were described aboard, sieved and classified according to Folk & Ward (1957).

The central part of the recorded area is dominated by fine sand containing small amounts of mud. Most samples were weakly bioturbated. Small populations of junvenile *Lanice conchilega* tubeworms were also found in the majority of samples (Fig. 6, pictures NFS250517-05 and NFS250517-27. Further, *Ensis* razors clams and sea urchins were found occasionally.

The slightly elevated and brighter part of the SSS- mosaic in the west area contains middle- to fine sand, as seen in the sample NFS250517-09.(Fig. 6). No bioturbation was identified, but sometimes living Macoma shells was found.

The sediment in the patchy areas is characterized by grain sizes from mud to fine sand. It is often strongly bioturbated and contains *Nereis*, *Macoa*, *Ensis* and sea urchins. The picture of sample number NFS250517-18 shows an example for this area.

A lot of biological activity also characterizes the south-eastern darker part in the SSS- mosaic. The muddy fine sand is often strongly bioturbated and contains more than 1 % of shell fragments, facal pellets, living crabs and brittle stars on the surface as well as worms inside the sediment (see picture NFS250517-40, which also contains a lot of junvenile *Lanice conchilega* and sample number NFS250517-46).

Fig. 7 shows two SES – transects: Profile 1: line 20170520_4_b; profile 2: line 20170523_5b, extending from west to east in water depths of about 11 – 18 m. Seismic reflectors are illuminated by different colors, depending on the intensity of acoustic energy reflection (red: highest intensity; blue; lowest intensity). The profile contains five examples of the most abundant seismological sediment structures (Posamentier et al., 1988; Van Wagoner et al., 1988), marked by number 1 to 5.

Six seismic units could be differentiated (Fig. 7). The seismic facies are classified as follows:

1) Presumably pre- Holocene Sediments marked by a strong reflector at the top, leading to very weak and diffuse-, or no internal reflections. It forms the base of acoustic penetration and can be seen as the border between Pleistocene and Holocene deposits (Zeiler et al., 2000; Figge, 1980)
2) Downlap structure 1; predominantly parallel- layered sediments with differing dipping angles, which unconformably fill morphological structures of the underlying sediment. The dipping angle of the sediment layers decreases towards the western deeper parts. The thickness of the sediment body exceeds the maximum penetration depth of about 7 m in places where layer 1 is not visible. The top is cut unconformably by the seafloor in the western part and layer 3 in the eastern part.
3) Downlap structure 2; the seismic facies is marked by clearly distinct sedimentary layers, that unconformably overly “Downlap structure 1”. The dipping angle of the layers varies, with low angles in the western part and higher angles in the eastern part. The top of the structure is marked by a truncation, cutting the comprising layers in about 16 m depth.

4) Offlap structure; the continuous and parallel reflector slightly dips towards west at a constant angle. This seismic unit unconformably overlies unit 3 and is cut truncated at the top (surface)
5) Surface; the surface represents the strongest reflector.
6) Incised valley; a valley eroded into the underlying structure (1) and was refilled in clearly laminated fashion (Dalrymple, 2006).
7) Local elevation of a deeper structure. This structure has a marked top- reflector and seems to break through layer 1 from deeper part.

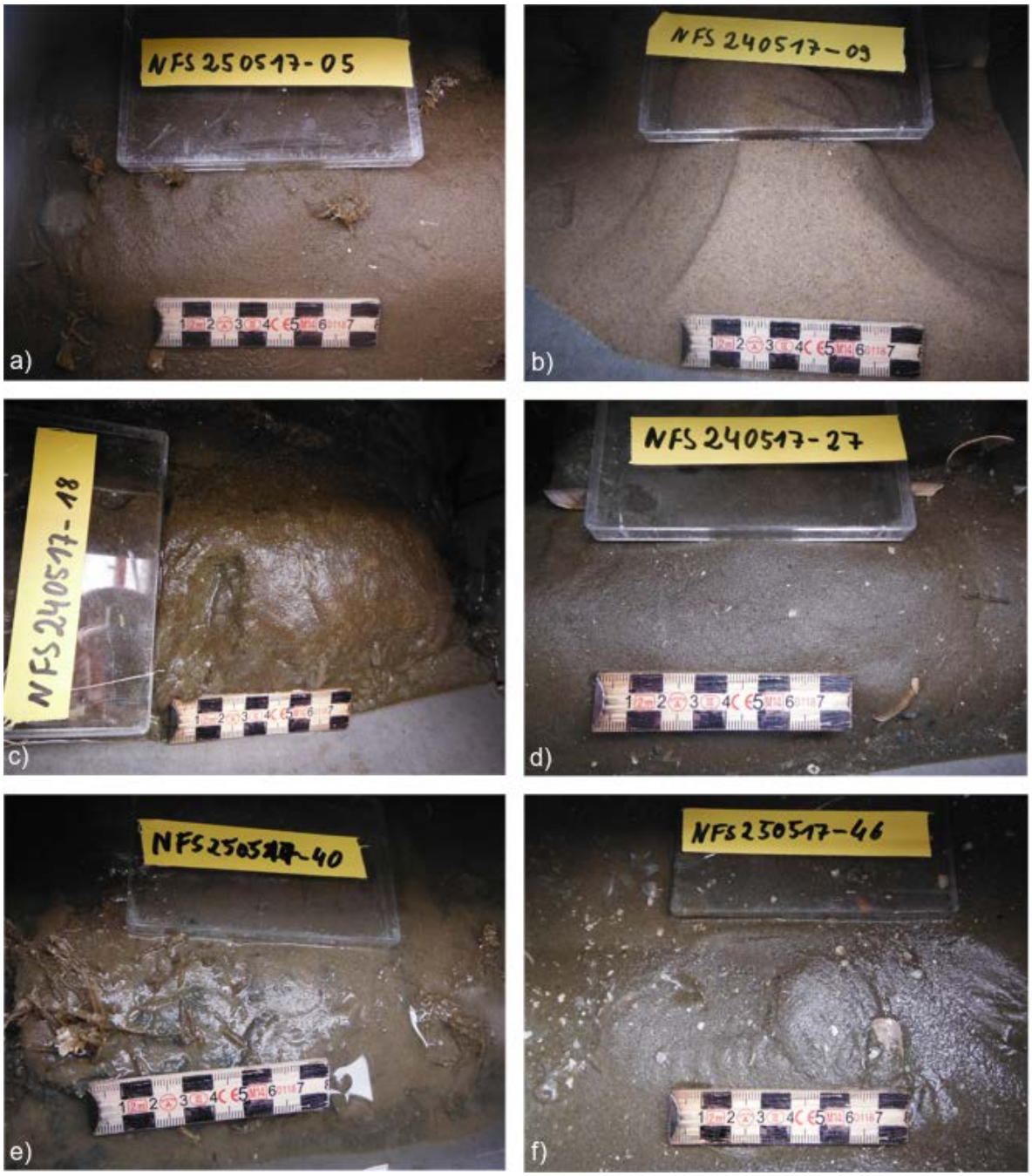

Fig. 6: Van Veen Grab Sampler probes: a) NFS250517-05; b) NFS240517-09; c) NFS240517-18; d) NFS240517-27; e) NFS250517-40; f) NFS250517-46; Sampling locations are shown in Fig. 1.

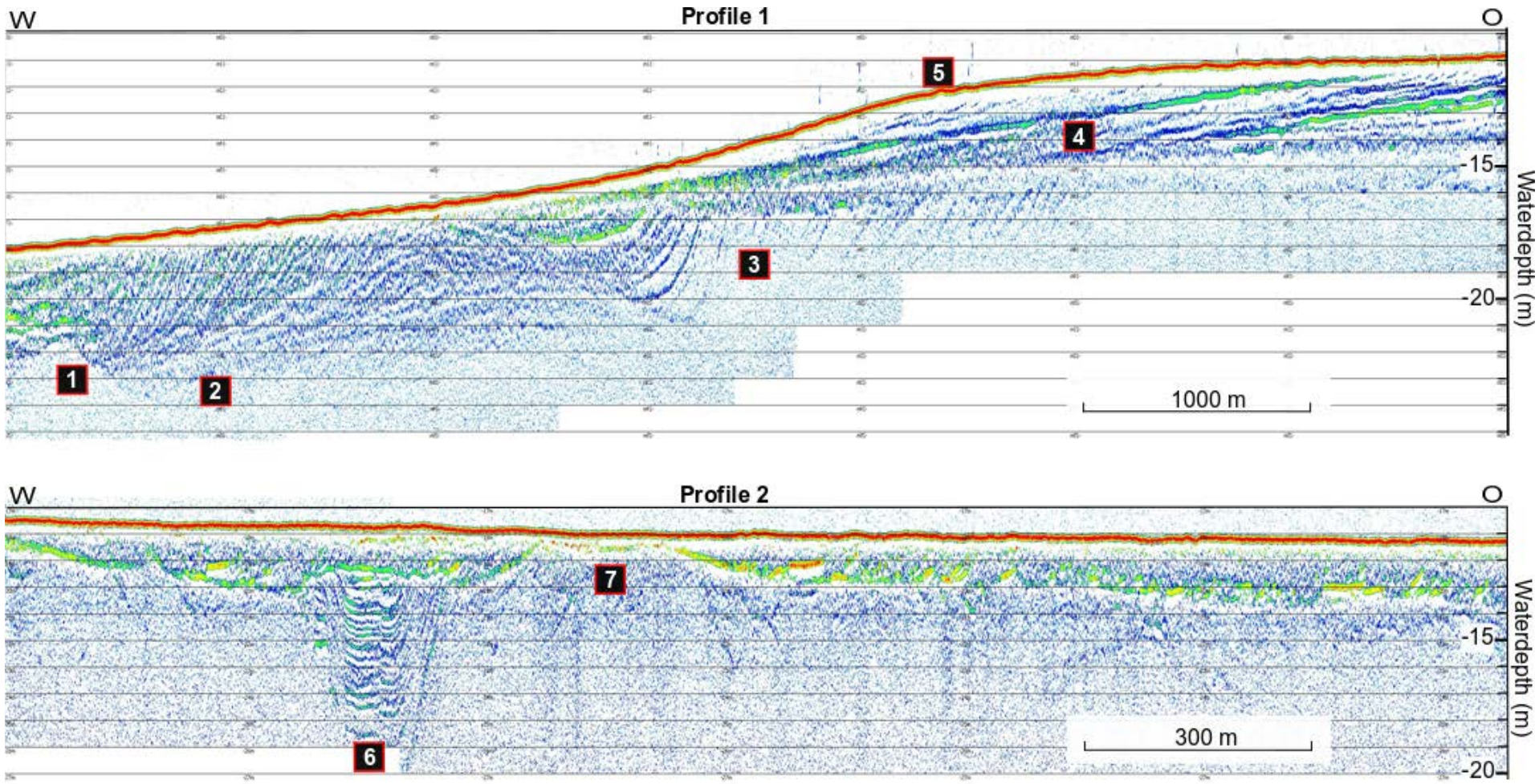

Fig. 7: Two SES Profiles representing some common seismological structures of the research area; profiles are shown in Fig1. a) Profile 1, b) Profile 2. Numbers represent different structures: 1) Pre- Holocene Sediments; 2) Downlap structure 1, 3) Downlap structure 2, 4) Offlap structure, 5) Surface, 6) Incised valley, 7) Local elevation of a deeper structure.

Tables

Tab. 1: Hydroacoustic measurement (SSS, SES, MB)

No.	Date	Time (UTC)	Latitude	Longitude	Remarks
1	17.05.2017	10:52	54°29.917	08°00.298	start profile (SSS; SES; MB)
1	17.05.2017	12:28	54°29.817	08°12.995	end profile (SSS; SES; MB)
2	17.05.2017	12:32	54°29.722	08°13.002	start profile (SSS; SES; MB)
2	17.05.2017	14:08	54°29.819	08°00.307	end profile (SSS; SES; MB)
3	17.05.2017	14:15	54°29.718	08°00.021	start profile (SSS; SES; MB)
3	17.05.2017	16:01	54°29.615	08°14.067	end profile (SSS; SES; MB)
4	17.05.2017	16:05	54°29.507	08°14.051	start profile (SSS; SES; MB)
4	17.05.2017	17:40	54°29.630	08°00.201	end profile (SSS; SES; MB)
5	17.05.2017	17:46	54°29.533	08°00.355	start profile (SSS; SES; MB)
5	17.05.2017	19:28	54°29.412	08°13.960	end profile (SSS; SES; MB)
6	17.05.2017	19:30	54°29.316	08°13.990	start profile (SSS; SES; MB)
6	17.05.2017	21:13	54°29.436	08°00.261	end profile (SSS; SES; MB)
7	17.05.2017	21:21	54°29.344	08°00.379	start profile (SSS; SES; MB)
7	17.05.2017	23:02	54°29.221	08°13.829	end profile (SSS; SES; MB)
8	17.05.2017	23:07	54°29.115	08°13.981	start profile (SSS; SES; MB)
8	18.05.2017	00:58	54°29.239	08°00.400	end profile (SSS; SES; MB)
9	18.05.2017	01:07	54°29.139	08°00.302	start profile (SSS; SES; MB)
9	18.05.2017	02:55	54°29.015	08°13.883	end profile (SSS; SES; MB)
10	18.05.2017	02:59	54°28.940	08°13.496	start profile (SSS; SES; MB)
10	18.05.2017	04:40	54°29.050	08°00.156	end profile (SSS; SES; MB)
11	18.05.2017	04:45	54°28.950	08°00.360	start profile (SSS; SES; MB)
11	18.05.2017	06:43	54°28.738	08°15.078	end profile (SSS; SES; MB)
12	18.05.2017	06:45	54°28.725	08°14.878	start profile (SSS; SES; MB)
12	18.05.2017	08:45	54°28.850	08°00.387	end profile (SSS; SES; MB)
13	18.05.2017	08:51	54°28.744	08°00.190	start profile (SSS; SES; MB)
13	18.05.2017	10:46	54°28.617	08°16.070	end profile (SSS; SES; MB)
14	18.05.2017	10:52	54°28.517	08°16.329	start profile (SSS; SES; MB)
14	18.05.2017	12:56	54°28.656	08°00.330	end profile (SSS; SES; MB)
15	18.05.2017	12:59	54°28.540	08°00.194	start profile (SSS; SES; MB)
15	18.05.2017	15:05	54°28.422	08°16.544	end profile (SSS; SES; MB)
16	18.05.2017	15:11	54°28.320	08°16.504	start profile (SSS; SES; MB)
16	18.05.2017	17:14	54°28.470	07°59.040	start profile (SSS; SES; MB)
17	18.05.2017	17:18	54°28.367	08°00.262	end profile (SSS; SES; MB)
17	18.05.2017	19:27	54°28.220	08°16.69	start profile (SSS; SES; MB)
18	18.05.2017	19:30	54°28.090	08°13.500	end profile (SSS; SES; MB)
18	18.05.2017	21:37	54°28.271	08°00.244	start profile (SSS; SES; MB)
19	18.05.2017	21:40	54°28.159	08°00.284	end profile (SSS; SES; MB)
19	18.05.2017	23:45	54°28.034	08°16.355	start profile (SSS; SES; MB)
20	18.05.2017	23:48	54°27.929	08°16.518	end profile (SSS; SES; MB)
20	19.05.2017	01:58	54°28.072	08°00.332	start profile (SSS; SES; MB)
21	19.05.2017	02:02	54°27.975	08°00.254	end profile (SSS; SES; MB)

21	19.05.2017	04:18	54°27.830	08°17.053	start profile (SSS; SES; MB)
22	19.05.2017	04:23	54°27.735	08°17.219	end profile (SSS; SES; MB)
22	19.05.2017	06:17	54°27.917	08°00.241	start profile (SSS; SES; MB)
23	19.05.2017	06:23	54°27.288	08°00.487	end profile (SSS; SES; MB)
24	19.05.2017	08:25	54°27.509	08°17.479	start profile (SSS; SES; MB)
24	19.05.2017	08:29	54°27.422	08°17.523	start profile (SSS; SES; MB)
24	19.05.2017	10:42	54°27.592	08°00.242	end profile (SSS; SES; MB)
25	19.05.2017	10:45	54°27.770	08°00.262	start profile (SSS; SES; MB)
25	19.05.2017	12:52	54°27.636	08°17.751	end profile (SSS; SES; MB)
26	20.05.2017	11:33	54°27.492	08°00.260	start profile (SSS; SES; MB)
26	20.05.2017	13:43	54°27.336	08°17.636	end profile (SSS; SES; MB)
27	20.05.2017	13:53	54°27.143	08°17.962	start profile (SSS; SES; MB)
27	20.05.2017	15:54	54°27.237	08°17.807	end profile (SSS; SES; MB)
28	20.05.2017	16:00	54°27.373	08°00.185	start profile (SSS; SES; MB)
28	20.05.2017	18:02	54°27.237	08°17.801	end profile (SSS; SES; MB)
29	20.05.2017	18:08	54°26.961	08°18.100	start profile (SSS; SES; MB)
29	20.05.2017	20:12	54°27.106	08°00.233	end profile (SSS; SES; MB)
30	20.05.2017	20:15	54°27.196	08°00.225	start profile (SSS; SES; MB)
30	20.05.2017	22:20	54°27.046	08°17.964	end profile (SSS; SES; MB)
31	20.05.2017	22:27	54°26.724	08°18.588	start profile (SSS; SES; MB)
31	21.05.2017	00:39	54°26.906	08°00.357	start profile (SSS; SES; MB)
32	21.05.2017	00:42	54°26.997	07°59.926	end profile (SSS; SES; MB)
32	21.05.2017	02:53	54°26,654	08°18.252	start profile (SSS; SES; MB)
33	21.05.2017	00:58	54°26.553	08°18.616	end profile (SSS; SES; MB)
33	21.05.2017	05:13	54°26.722	08°00.217	start profile (SSS; SES; MB)
34	21.05.2017	05:15	54°26.826	08°00.122	end profile (SSS; SES; MB)
34	21.05.2017	07:25	54°26.644	008°18.470	start profile (SSS; SES; MB)
35	21.05.2017	07:28	54°26.373	008°18.881	end profile (SSS; SES; MB)
35	21.05.2017	09:40	54°26.515	008°00.233	start profile (SSS; SES; MB)
36	21.05.2017	09:42	54°26.601	08°00.018	end profile (SSS; SES; MB)
36	21.05.2017	11:47	54°26.459	08°17.762	start profile (SSS; SES; MB)
37	21.05.2017	11:50	54°26.1662	08°17.757	end profile (SSS; SES; MB)
37	21.05.2017	13:59	54°26.325	08°00.208	start profile (SSS; SES; MB)
38	21.05.2017	14:00	54°26.422	08°00.054	end profile (SSS; SES; MB)
38	21.05.2017	16:08	54°26.263	08°18.199	start profile (SSS; SES; MB)
39	21.05.2017	16:12	54°25.977	08°17.815	start profile (SSS; SES; MB)
39	21.05.2017	18:24	54°26.132	08°00.229	end profile (SSS; SES; MB)
40	21.05.2017	18:26	54°26.239	08°00.128	start profile (SSS; SES; MB)
40	21.05.2017	20:37	54°26.073	08°18.390	end profile (SSS; SES; MB)
41	21.05.2017	20:40	54°25.780	08°18.347	start profile (SSS; SES; MB)
41	21.05.2017	22:48	54°25.942	08°00.206	end profile (SSS; SES; MB)
42	21.05.2017	22:50	54°26.025	08°59.976	start profile (SSS; SES; MB)
42	22.05.2017	00:58	54°25.876	08°17.878	end profile (SSS; SES; MB)
43	22.05.2017	01:01	54°25.584	08°17.726	start profile (SSS; SES; MB)
43	22.05.2017	03:11	54°25.747	08°00.164	end profile (SSS; SES; MB)
44	22.05.2017	03:14	54°25.846	08°00.200	start profile (SSS; SES; MB)

44	22.05.2017	05:24	54°683	08°16.667	end profile (SSS; SES; MB)
45	22.05.2017	05:27	54°25.370	08°20.009	start profile (SSS; SES; MB)
45	22.05.2017	07:53	54°25.553	08°00.236	end profile (SSS; SES; MB)
46	22.05.2017	07:56	54°25.646	08°00.162	start profile (SSS; SES; MB)
46	22.05.2017	10:17	54°25.472	08°19.830	start profile (SSS; SES; MB)
47	22.05.2017	10:18	54°25.179	08°20.237	end profile (SSS; SES; MB)
47	22.05.2017	12:44	54°25.358	08°00.254	start profile (SSS; SES; MB)
48	22.05.2017	12:45	54°25.441	07°59.999	end profile (SSS; SES; MB)
48	22.05.2017	15:10	54°25.272	08°20.115	start profile (SSS; SES; MB)
49	22.05.2017	15:12	54°24.975	08°20.494	end profile (SSS; SES; MB)
49	22.05.2017	17:43	54°25.168	08°00.183	start profile (SSS; SES; MB)
50	22.05.2017	17:45	54°25.247	08°00.047	end profile (SSS; SES; MB)
50	22.05.2017	20:09	54°25.093	08°20.300	start profile (SSS; SES; MB)
51	22.05.2017	20:11	54°24800	08°20.658	end profile (SSS; SES; MB)
51	22.05.2017	22:35	54°24.968	08°00.194	start profile (SSS; SES; MB)
52	22.05.2017	22:38	54°25.076	08°00.4049	end profile (SSS; SES; MB)
52	23.05.2017	01:06	54°24.885	08°20.520	start profile (SSS; SES; MB)
53	23.05.2017	01:09	54°24.595	08°20.824	end profile (SSS; SES; MB)
53	23.05.2017	03:42	54°24.774	08°00.152	start profile (SSS; SES; MB)
54	23.05.2017	03:45	54°24.881	08°00.057	start profile (SSS; SES; MB)
54	23.05.2017	06:10	54°24.692	08°20.724	end profile (SSS; SES; MB)
55	23.05.2017	06:13	54°24.397	08°21.144	start profile (SSS; SES; MB)
55	23.05.2017	08:40	54°24.593	08°00.160	end profile (SSS; SES; MB)
56	23.05.2017	08:41	54°24.679	08°00.149	start profile (SSS; SES; MB)
56	23.05.2017	11:55	54°24.495	08°20.962	end profile (SSS; SES; MB)
57	23.05.2017	11:58	54°24.196	08°21.345	start profile (SSS; SES; MB)
57	23.05.2017	12:01	54°24.326	08°06.037	end profile (SSS; SES; MB)
57	24.05.2017	16:34	54°24.335	08°05.270	start profile (SSS; SES; MB)
57	24.05.2017	17:13	54°24.384	08°00.161	end profile (SSS; SES; MB)
58	24.05.2017	17:15	54°24.471	08°00.003	start profile (SSS; SES; MB)
58	24.05.2017	19:49	54°24.176	08°21.507	end profile (SSS; SES; MB)
59	24.05.2017	19:49	54°23.997	08°21.477	start profile (SSS; SES; MB)
59	24.05.2017	22:21	54°24.192	08°00.139	end profile (SSS; SES; MB)
60	25.05.2017	22:23	54°24.271	07°59.996	start profile (SSS; SES; MB)
60	25.05.2017	01:01	54°24.090	08°21.404	start profile (SSS; SES; MB)
61	25.05.2017	01:03	54°23.809	08°21.740	end profile (SSS; SES; MB)
61	25.05.2017	03:44	54°24.000	08°00.183	start profile (SSS; SES; MB)
62	25.05.2017	03:46	54°24.082	07°.59.935	end profile (SSS; SES; MB)
62	25.05.2017	06:22	54°23.922	08°19.496	start profile (SSS; SES; MB)

Tab. 2: Grab Sampling Stations

No.	Date	Time (UTC)	Latitude	Longitude	Waterdepth (m)	Remarks
1	24.05.2017	08:32	54°24,834	08°00,610	18,4	2nd try
2	24.05.2017	08:47	54°25,861	08°00,706	18,27	
3	24.05.2017	09:01	54°26,495	8°01,563	18,3	
4	24.05.2017	09:12	54°26,553	8°01,881	18,5	
5	24.05.2017	09:31	54°28,363	8°02,186	19,5	
6	24.05.2017	10:15	54°27,820	8°00,749	18,6	2nd try
7	24.05.2017	10:21	54°27,851	8°00,735	18,5	
8	24.05.2017	10:34	54°28,848	8°00,736	17,8	
9	24.05.2017	10:43	54°29,321	8°00.763	17,3	
10	24.05.2017	10:54	54°29,043	8°01,306	17,4	
11	24.05.2017	11:08	54°29,816	8°01,493	18,8	
12	24.05.2017	11:19	54°29,753	8°02,442	18,5	
13	24.05.2017	11:34	54°29,299	8°02,748	19	
14	24.05.2017	11:56	54°27,402	8°02,967	19	
15	24.05.2017	12:19	54°28,242	8°04,578	19,3	2nd try
16	24.05.2017	12:38	54°26,326	8°04,000	19,5	
17	24.05.2017	12:53	54°25,113	8°04,767	19,4	
18	24.05.2017	13:05	54°25,091	8°05,747	19,2	2nd try
19	24.05.2017	13:16	54°24,962	8°07,351	19,1	
20	24.05.2017	13:28	54°25,497	8°06,994	19	
21	24.05.2017	13:35	54°25,699	8°06,693	18,9	
22	24.05.2017	13:52	54°27,174	8°05,830	18,3	
23	24.05.2017	14:15	54°29,221	8°06,505	17,2	
24	24.05.2017	14:28	54°28,210	8°06,872	18,1	
25	24.05.2017	14:45	54°26,761	08°07,773	18	
26	24.05.2017	14:53	54°26,744	8°08,079	17,8	
27	24.05.2017	15:14	54°28,005	08°09,140	16,7	2nd try
28	25.05.2017	13:06	54°29,657	8°09,495	10,3	
28	25.05.2017	13:10	54°29,652	8°09,502	10,3	
29	25.05.2017	12:50	54°28,461	8°10,355	17,1	
30	25.05.2017	12:36	54°27,159	8°10,329	18,2	
31	25.05.2017	12:22	54°26,155	8°09,157	19	
32	25.05.2017	11:26	54°25,874	8°12,237	18,4	
33	25.05.2017	11:42	54°26,107	8°12,400	18	2nd try
34	25.05.2017	12:00	54°27,111	8°12,584	17	
35	25.05.2017	13:27	54°29,690	8°12,329	14	
36	25.05.2017	13:40	54°29,149	8°13,036	13,6	
37	25.05.2017	13:59	54°27,623	8°16,816	9,9	
38	25.05.2017	14:14	54°27,619	08°16,810	9	
39	25.05.2017	14:30	54°26,999	08°17,684	9,6	
40	25.05.2017	07:13	54°25.394	8°19,343	10,15	
41	25.05.2017	07:00	54°25,037	8°19,807	\	
42	25.05.2017	07:30	54°25,210	8°18,454	12,5	

43	25.05.2017	08:27	54°24,429	8°17,833	15,5	
43	25.05.2017	08:10	54°24,441	8°17,812	15:40	
44	25.05.2017	08:43	54°24,428	8°17,652	08:43	2nd try
45	25.05.2017	09:02	54°24,926	8°15,723	16,07	
46	25.05.2017	09:19	54°25,833	8°16,422	14,5	
47	25.05.2017	09:34	54°26,161	8°14,893	15,8	
48	25.05.2017	09:53	54°26,602	8°15,217	14	2nd try
49	25.05.2017	10:37	54°26,612	8°15,184	14,4	
50	25.05.2017	10:??	54°27,050	8°14,919	13,3	
51	25.05.2017	11:03	54°26,577	8°13,622	16,4	

Tab.: 3: CTD

No.	Date	Time (UTC)	Latitude	Longitude	Waterdepth (m)	Remarks
1	16.05.2017	09:20	08°19.383	54°12.213	11	
2	17.05.2017	12:00	08°00.397	54°29.868	15	
3	23.05.2017	11:24	?	?	20	

Tab. 4: Video profile

No.	Date	Time (UTC)	Latitude	Longitude	Waterdepth (m)	Remarks
1	23.05.2017	11:34	54°24.817	08°04.670	15.5	start profile
1	23.05.2017	11:47	54°24.877	08°04.767	13	end profile

References

Blondel, P. 2009. The handbook of sidescan sonar, 316 pp. (Springer).

Blondel, P. und Murton, B. 1997. Handbook of seafloor imagery, 314 pp. (John Wiley & Sons).

Dalrymple, R. 2006. Incisesd valleys in time and space: An introduction to the volume and an examination of the controls on valley formation and filling. Queens University, Kingston, Ontario Canada: Dept. of Geological Sciences and Geological Engineering.

Degraer, S., et al. 2008. Very-high resolution side-scan sonar mapping of biogenic reefs of the tube-worm Lanice conchilega. Remote Sensing of Environment, 112, 3323-3328.

Diesing, M., Kubicki, A., Winter, C., Schwarzer, K., 2006. Decadal scale stability of sorted bedforms, German Bight, southeastern North Sea. Continental Shelf Res., 26 (8), 902-916.

Figge, K. 1980. Das Elbe-Urstromtal im Bereich der Deutschen Bucht (Nordsee) . Eiszeitalter und Gegenwart, 30.

Folk, R.L., Ward, W. C. 1957. Brazos River bar: a study in the significance of grain size parameters. J. of Sed. Petrol., 27, 3-26.

Heinrich, C., Feldens, P., Schwarzer, K. 2017. Highly dynamic biological seabed alterations revealed by side scan sonar tracking of Lanice conchilega beds offshore the island of Sylt (German Bight). Geo-Marine Letters, 37, 289-303.

Innomar Technologie, GmbH. 2009. SES-2000 Parametric Sub-bottom Profiler User’s Guide. s.l. : Innomar Technologie GmbH.

Murray, A. B., Thieler, E. R., 2004. A new hypothesis and exploratory modelfor the formation of large-scale inner-shelf sediment sorting and "rippled scour depressions". Continental Shelf Res., 24 (3), 295-315.

Posamentier, H. W. und Vail, P. R. 1988. Eustatic controls on clastic deposition II - Sequence and. Sea-Level Changs - An Integrated Approach. 1988, Bd. 42.

Van Wagoner, J. C., et al. 1988. An overwerview of the fundamentals of sequnce stratigraphy and key definitions. [Hrsg.] SEPM Special Publications. Sea-Level Changes - An integrated Approach. 42, 1988.

Zeiler, M., Schulz- Ohlberg, J., Figge, K., 2000. Materialinventur an der deutschen Nordseeküste. Die Küste, 62, 53-87.