LITTORINA 17-14

(24.08.-31.08.2017)

North Sea - Dithmarschen Bay

Cruise report / Fahrtbericht

Vom Sediment zum Topp-Prädator – Einfluss von Eigenschaften des Meeresbodens auf Benthos und benthivore Vögel

Teilprojekt STopP-See

STopP-Synthese

BMBF-funding, grant no: 03F0672B

Institut für Geowissenschaften

Sedimentologie, Küsten- und Schelfgeologie

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1. Objective of the cruise

The cruise LI17-14 was carried out in the frame of the BMBF-funded project STopP - Synthesis (From Sediment to Top Predator - Influence of seabed characteristics on benthos and benthivore birds), which belongs to the KÜNO (Küstenforschung Nordsee - Ostsee) network. The objective of the cruise was to collect data of the sedimentological seafloor conditions and subsurface built-up by high resolution hydroacoustic measurements in the STopP II investigation area (see fig.1). The area is located south of the STopP I area (2013-2015), more close to the Elbe Estuary, as the gradient in salinity and discharged matter might be a controlling factor for the environmental development of the seafloor, especially sediment and species distribution. The lack of back barrier islands compared to the STopP I working area and an increased tidal range within this inner part of the German Bight (Figge 1980) is influencing the sedimentlogical/geological characteristics. Complementary to AL480 (Schwarzer & Wittbrodt, 2016) the data sets of LI17-14 will be used to fill the existing spatial gaps between the up to now existing data sets.

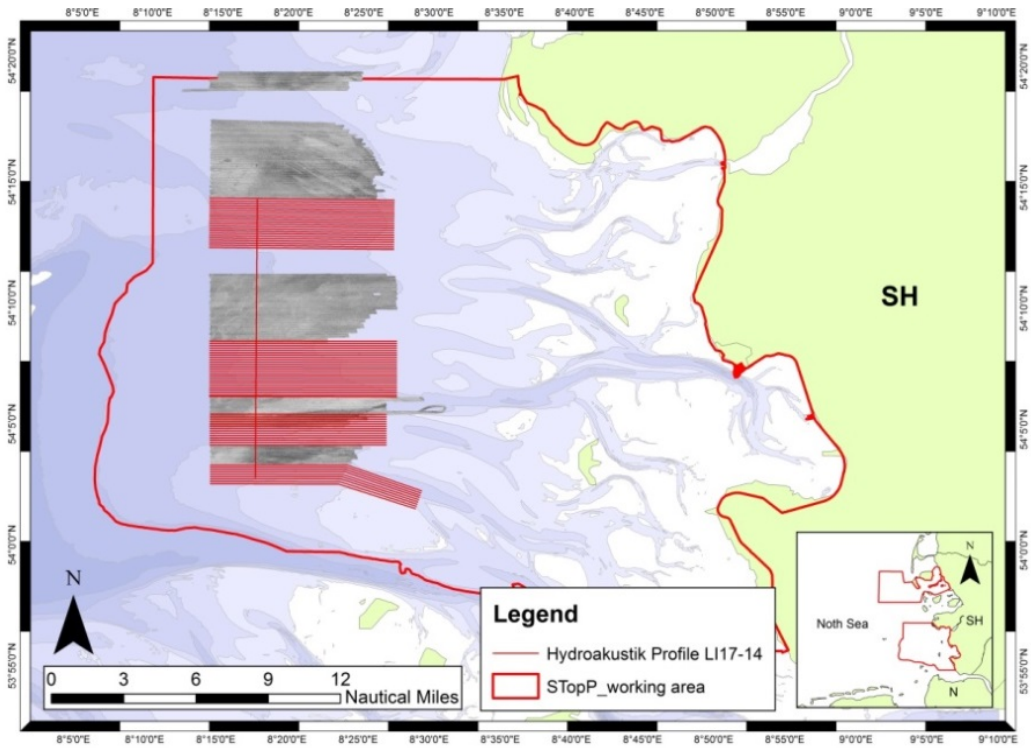

Figure 1: Overview of the STopP II working area. The Sidescan Sonar mosaic of AL480 carried out in 2016 (five separate regions, Sidescan Sonar mosaic - grey colors) and the hydroacoustic profiles of LI17-14.

Combined with data about the distribution of benthic organisms and seabird occurrence the data which was collected during LI17-14 will serve as a baseline dataset for the elaboration of food web structures in this area. This knowledge will improve the general understanding of the interrelation between the seafloor sediment distribution, subsurface properties and benthic organisms. This interdisciplinary understanding is a basic goal within STopP and will be used for the development/improvement of models for the distribution of seabirds depending on marine habitat development. Decisive parts of these models will include model generalization, model transferability as well as modeling of future scenarios of habitat development. In LI17-14 we focused on the influence of tidal channels and river mouth systems on the local geological built-up and the sediment distribution as well as on the occurrence of benthic organisms within sediment samples (especially living *Ensis*).

Abbreviations used

SSS – Sidescan Sonar system
SES – Sediment echosounder
MB - Multibeam

2. Participants of the cruise:

Dr. Klaus Schwarzer (chief scientist), Inst. of Geosciences, Kiel University
Kerstin Wittbrodt (scientist), Inst. of Geosciences, Kiel University
Giuliana Andrea Diaz Mendoza (scientist), Inst. of Geosciences, Kiel University

3. Cruise Narrative

Th, 24.08.2017, cloudy/sunny
06:30 departing Geomar Pier, heading to working area via Kiel Canal

Fr, 25.08.2017, cloudy/sunny, W, waves 1.5m
03:10 CTD measurement
03:37 start multibeam calibration profile
04:07 end multibeam calibration profile
05:20 suspending devices (SSS)
05:30 start of profiling „Süderpiep“ (SSS, MB)

Sa, 26.08.2017, sunny, waves < 0.5 m
17:30 end of profiling „Süderpiep“ (SSS, MB), suspending SES
17:43 start of transit to profiles „Falsches Tief“
20:52 end of transit and start profiling „Falsches Tief“

Su, 27.08.2017, sunny, W-NW 3-4, waves 1 m
12:52 end of profiling (SSS, MB, SES) „Falsches Tief“, transit to profiles „Norderelbe“
14:17 end of transit and start profiling (SSS, MB, SES) „Norderelbe“

Mo, 28.08.2017, sunny, S, waves < 0.5 m
03:25 end profiling (SSS, MB, SES) „Norderelbe“ and transit to N-S profile
03:45 start profiling (SSS, MB, SES) N-S
06:38 end profiling (SSS, MB, SES) N-S, transit to profiling „Norderpiep“
07:01 start profiling (SSS, MB, SES) „Norderpiep“

13:15 end of profiling (SSS, MB, SES) „Norderpiep“
13:30 devices out of water (SSS, SES) and transit to Helgoland
15:00 arrival Helgoland harbor

Tu, 29.08.2017, sunny, waves < 0.5 m
03:00 departing Helgoland, heading to working area
05:00 start sampling Van-Veen grab sampler
19:40 end of sampling Van-Veen grab sampler
20:15 devices into water (SSS, SES)
21:08 start profiling (SSS, MB, SES) continuation profiles „Norderpiep“

We, 30.08.2017, cloudy, E 3-4, waves < 0.5 m
00-00 continuation profiling (SSS, MB, SES) „Norderpiep“

Th, 31.08.2017, cloudy, raining, waves < 0.5 m
00:18 end of profiling (SSS, MB, SES)
00:50 devices out of water (SSS, SES)
01:00 departing working area, heading to Kiel via Kiel Canal
15:00 arrival Kiel Geomar Pier

4. Methods

The towed SSS Teledyne Benthos 1624 was applied to collect high resolution hydroacoustic data to create maps of backscatter characteristics of the seafloor from which, combined with data from grab samples, sediment distribution patterns will be obtained. The 1624 was towed behind the vessel with a towing speed of about 4 knots. The SSS was mounted below a floating device (see fig. 2) which was connected with a wire to a depressor weight. The SSS was towed about 10 m behind the depressor. This configuration leads to an improved stability of the SSS in the water column during profiling and omits additionally huge corrections of the layback as the depressor keeps the system close to the research vessel during heave and lowering operations. The advantage of this towing configuration is a lowering of the influence of the ships movement and wave influence to the data.

The SSS Benthos 1624 operates in the chirp mode with two frequencies, 100 kHz and 400 kHz. A range of 100 m to each side was set during profiling. Based on the backscatter intensities (dark = high backscatter, bright = low backscatter) grey values were displayed within the SSS-measurements. The basic principles of the system setup and data acquisition can be taken from common literature (Lurton 2002; Blondel 2009). After post-processing the high resolving acoustic images are used to elaborate sedimentological and environmental facies of the seafloor (see Lurton 2002).

A mobile high resolution parametric sediment echosounder (Innomar-SES) was used simultaneously on selected profiles to get further information of the subsurface built-up and to identify the geological architecture in the investigation area.

Multibeam data were collected with the shipboard system SeaBeam 1185 (L3-Communications, ELAC Nautik GmbH) and acquired using the software Hydrostar (L3-Communications, ELAC Nautik GmbH). The operating frequency of the system was 180 kHz. Ground truthing of the SSS data was done by grab sampling with a Van-Veen-Grab Sampler. Additionally the sampler content was sieved over a 2 mm sieve to have a closer look on shell content and living benthic organisms. Due to our objectives, shells and shell fragments of *Ensis* as well as living individuals are of special interest as these species has become an essential food source for sea birds within the last years (Tulp et al. 2010).

The SSS mosaics and the position of grab sampling stations are shown in figure 4. In table 1 and 2 all stations and profiles executed during the cruise are listed. In total 1150 km of profiles were mapped resulting in an area of about 195 km² divided into five smaller zones. In total 58 grab samples were taken.

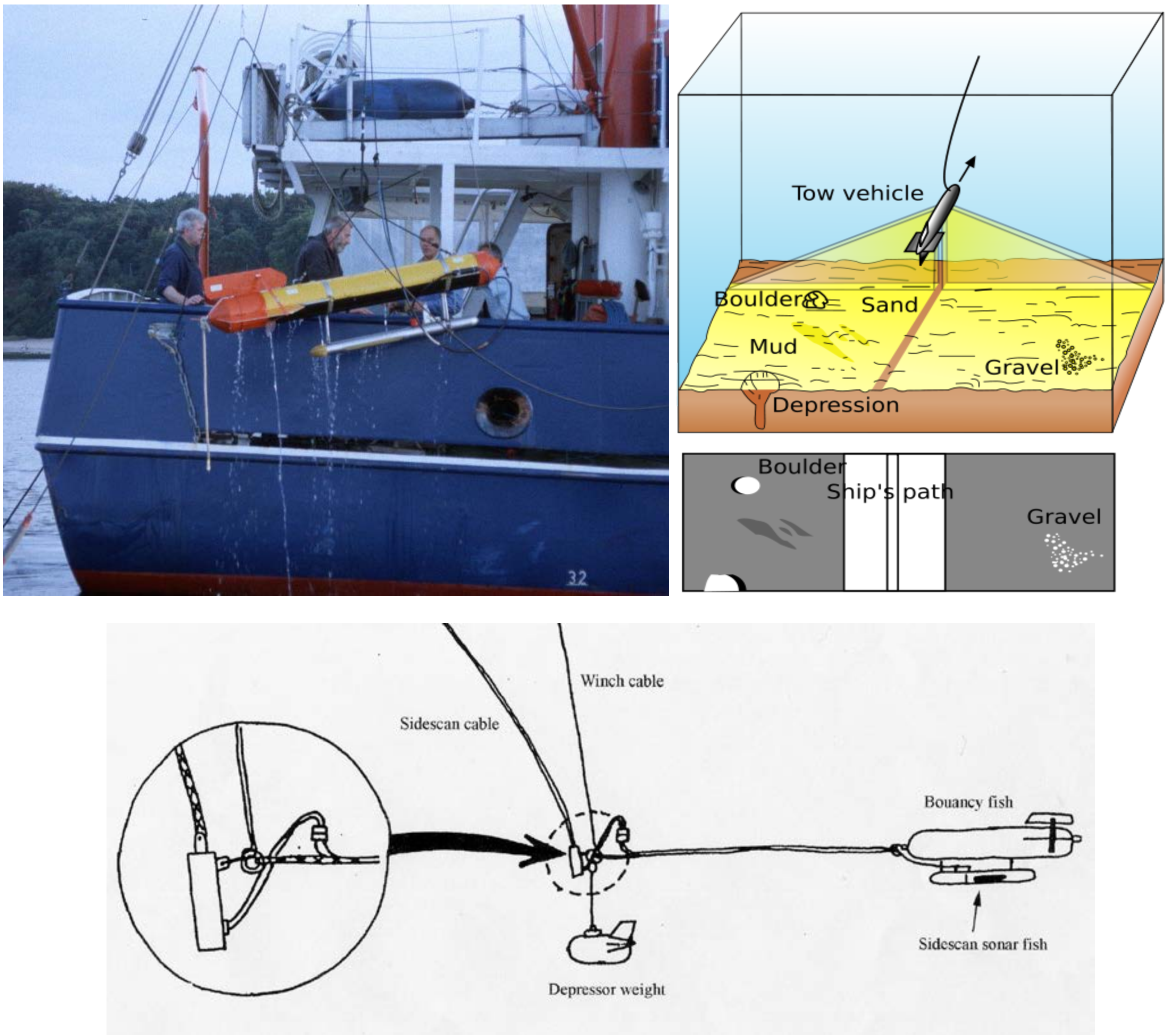

Figure 2: Left: Sidescan Sonar Teledyne Benthos 1624 system fixed below the flotation device used for hydroacoustic profiling. Right: Sketch of data acquisition with a towed Sidescan Sonar system and presentation of typical seafloor characteristics appearing in the record (https://upload.wikimedia.org/wikipedia/commons/thumb/5/5b/Side-scan_sonar.svg/220px -Side-scan_sonar.svg.png). Figure below: Towing configuration applied during LI17-14.

5. Preliminary results

The SSS mosaics resulting from 67 profiles are shown in figure 4. Within these mosaics several prominent structures of varying backscatter intensities can be observed (for details see fig. 5 + 6). Sharp as well as gradual transitions between high and low backscatter values are occure. Large scaled structures with low backscatter values were commonly found to be orientated in SW-NE direction. Within the region „Norderpiep“ these large scale structures are showing a contrary NW – SE orientation. These findings were already made within the SSS measurements of AL480 in 2016 (Schwarzer & Wittbrodt, 2016) and could be now proven for larger aerial extent. The sediments found in these low backscattering areas in “Norderpiep” respectively “Eidermündung” are characterized as fine to medium sand based on laboratory analysis of samples from AL480. The sediments found in the low backscatter structures in the southern parts of the working area (“Süderpiep”, “Falsches Tief”, “Norderelbe”) were identified as silt to fine sand due to a first onboard sediment description during LI17-14. The region „Norderelbe“ was found to be characterized by several prominent backscatter structures and transitions. Figures 5 + 6 show details of the SSS mosaic from „Norderelbe“ area. Areas of high backscatter were identified to be composed of fine sand and silt with a very high amount (app. 75 %) of shell debris of mussel. Bright patches within these areas were identified to be composed of fine sand lying on top of the mussel-shells. In the „Norderelbe“ area, some regions showing prominent bedforms (large ripple structures) directed towards onshore were found within the SSS mosaic. These obviously current induced structures were characterized by a SE - NW striking with crest orientation reversing with tidal currents. This could be clearly observed within the SES data during profiling (see fig. 8) as the orientation of the crests changed from ebb-tide to flood tide. They were characterized by heights of up to 70 cm and crest distances of up to 8.5 m.

The grain size of the sediments range from silt to medium sand while very fine sediments dominate the largest parts of the working area. Nearly all stations show a layer of very fine sediment on top of the seafloor. At several grab sampling stations the benthic organism *Lanice conchilega* was found, which is well known for influencing the physical characteristics of the seafloor causing higher backscatter values (Degraer et al. 2008, Heinrich et al., 2016). So far, the influence of this organism on the backscatter played an important role for the SSS data collected during all cruises in the frame of this project. The positive effect of *Lanice conchilega* on surrounding benthic communities and habitat conditions is mentioned by several authors (Jones & Jago 1993, Callaway 2006, Van Hoey 2007, Rabaut et al. 2007, Van Hoey et al. 2008, Rabaut et al. 2009, Heinrich et al., 2016). Besides *Lanice Conchilega* large amounts of trumpet worms (see fig. 3) were found especially at stations characterized by very fine material. Quite often barely or no other living organisms or shells were found within the sediment at these stations besides this Polychaet which shows similar tube buildings like *Lanice conchilega* but is living within the sediment.

Figure 3: Trumpet worms found within the 2 mm sieve of the grab samples. Sizes of trumpet worms reach up to 4 cm.

Gas, appearing within the subsurface and resulting from the decomposition of organic material of deeper layers led to reduced signal penetration. Only within the upper 2-3 m signal reflections of different layers are visible. This local characteristic is caused by the general different subsurface built-up of the nearshore shelf of the STopP II working area as the southern part of STopP II is located in the former "Elbe spillway" (Figge 1980) which was active during the deglaciation. This spillway was eroded down to -30 NN and filled up during the Holocene transgression. As the sealevel was rising slowly during the last 7.500 years a huge amount of organic material (peat Gyttja) was formed and deposited within this area. The decomposition of this material is the source of the gas. This effect, known as "basin effect", causes acoustic blanking in the records (Anderson et al. 1998).

Partly subsurface channels and layered structures can be identified within the SES profiles (e.g. see fig. 7). This is especially true for the working region „Norderpiep". Within the regions „Süderpiep", „Falsches Tief" and „Norderelbe" subsurface structures were limited and occurred mainly eastern part of the hydroacoustic profiles.

6. References

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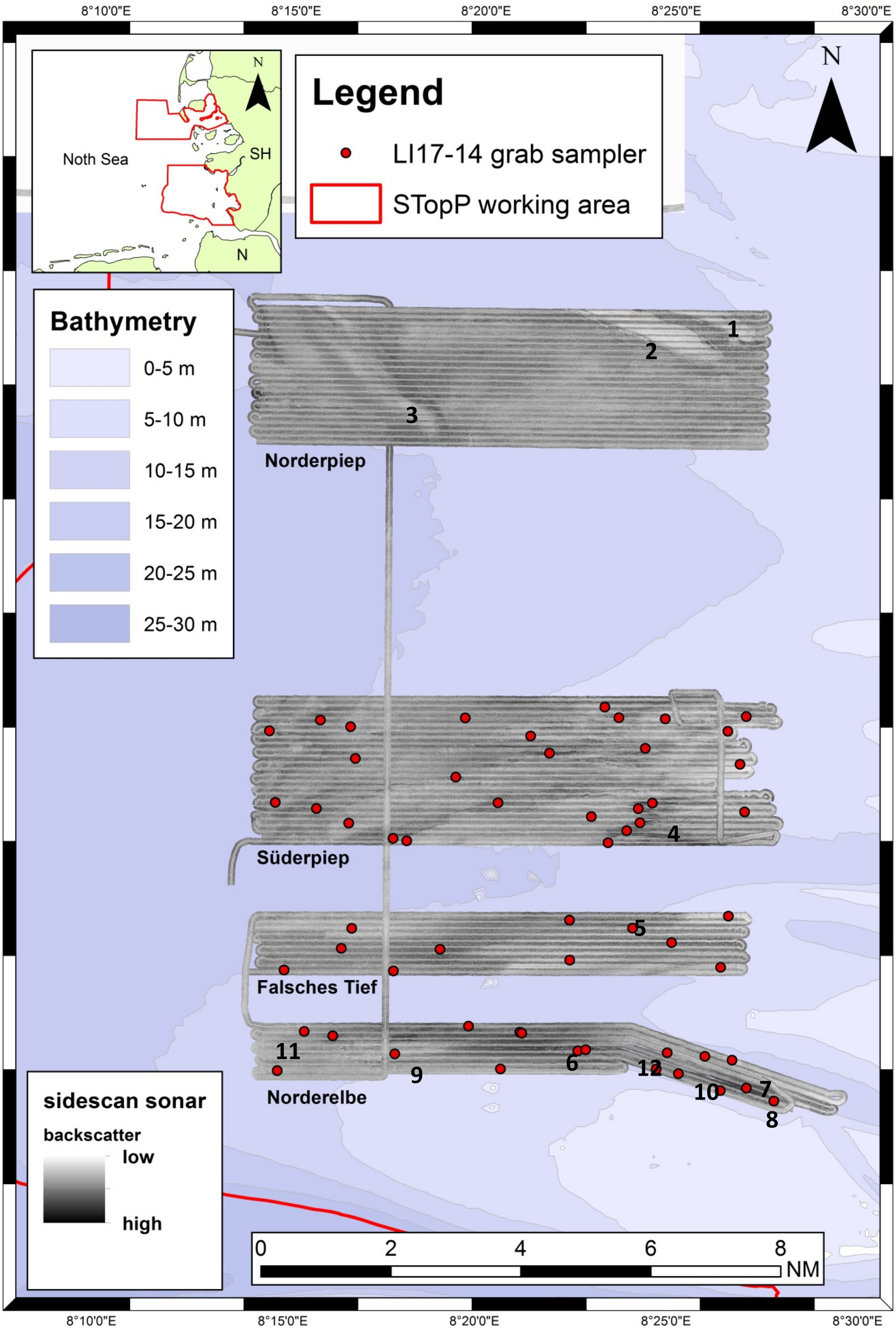
7. Appendices



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igure 4: Overview of Van-Veen-Grab sampling stations shown in the SSS mosaic. Black num- bers (1-12) indicate positions of images showing different structures in detail (figures 5 + 6).

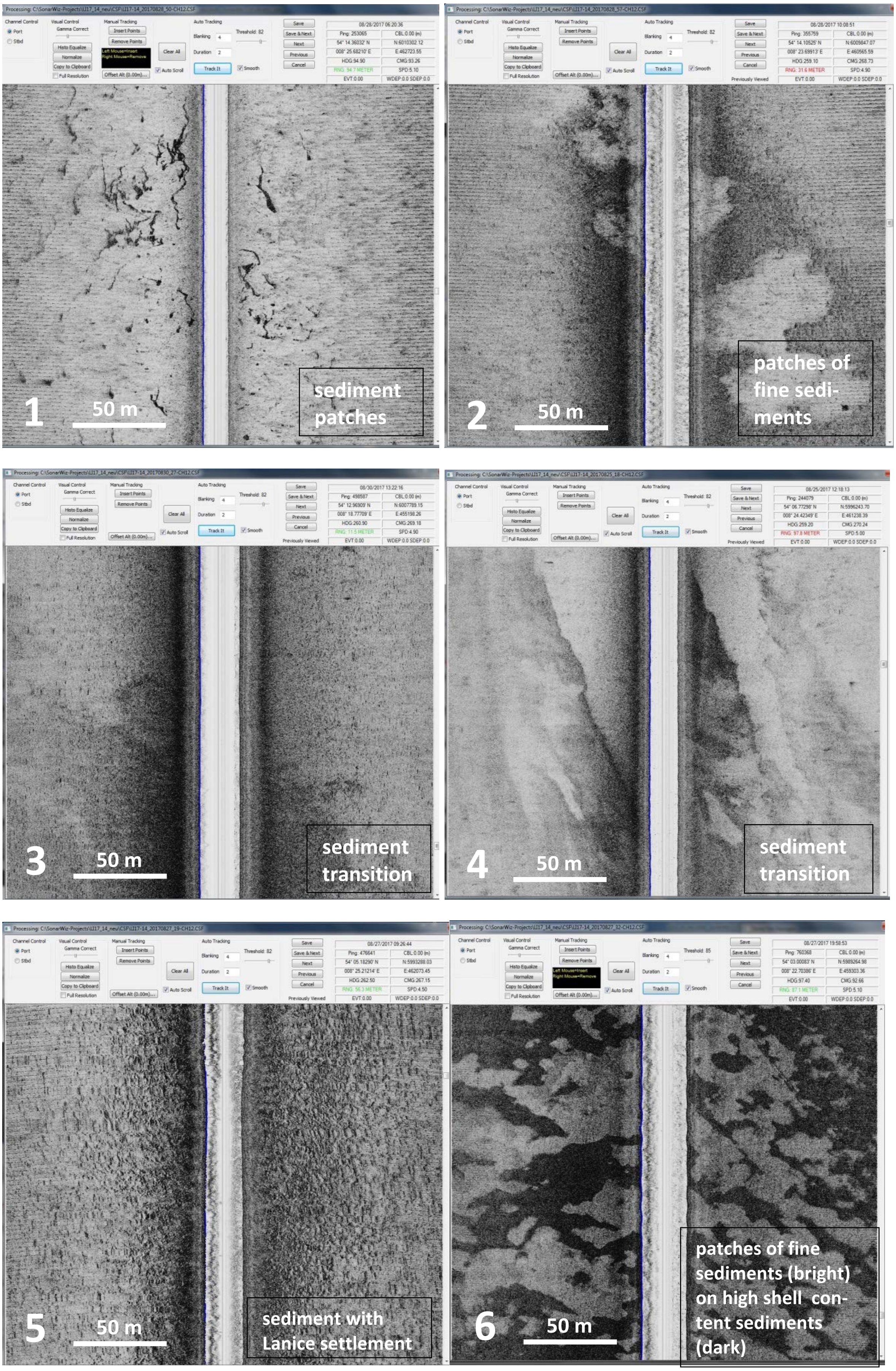

Figure 5: Screenshots from SSS waterfall window. Areas with high (dark) and low (bright) backscatter caused by different sediments, seafloor structures and none/high shell content. Locations see fig. 4.

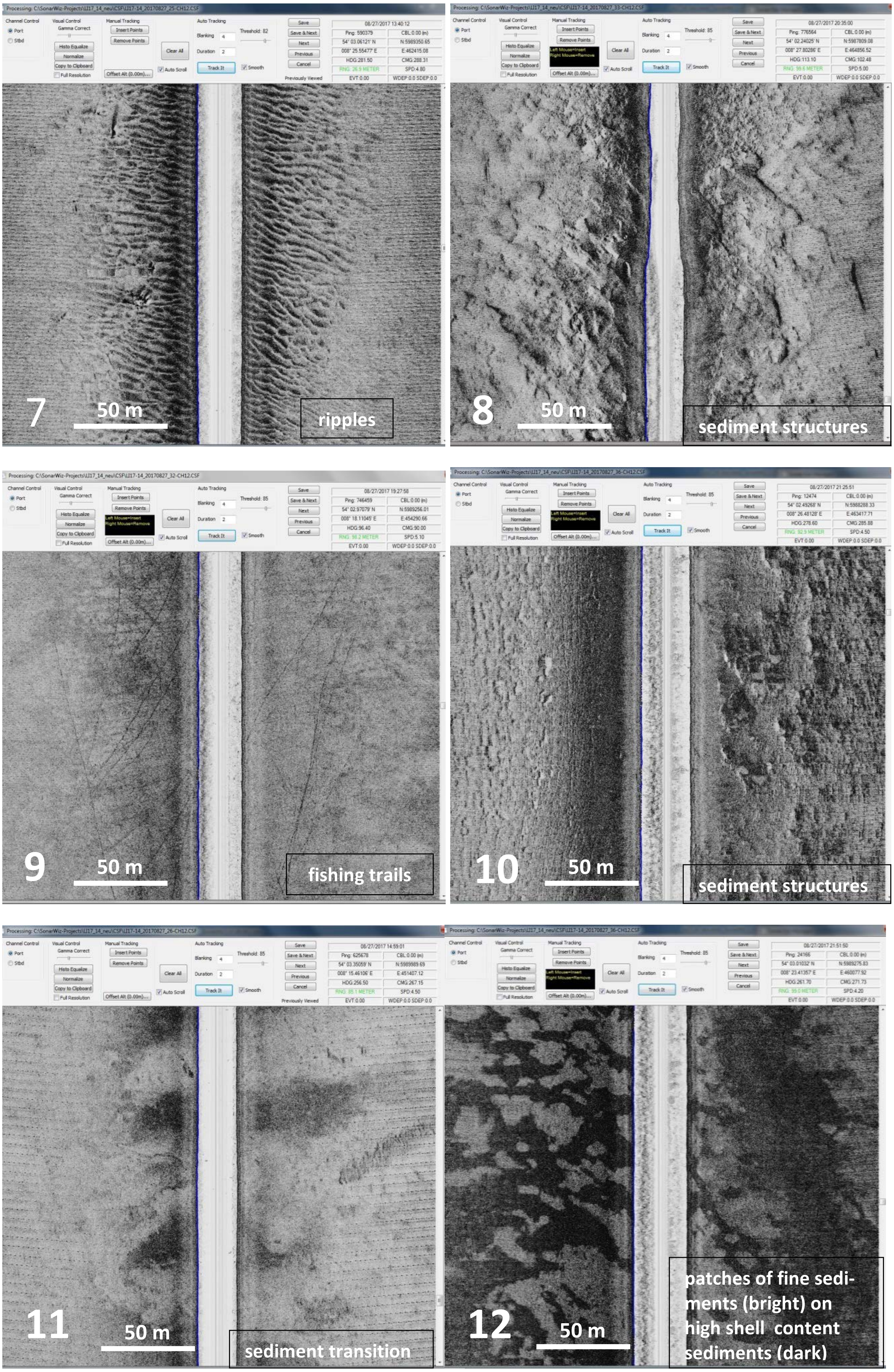

Figure 6: SSS waterfall window screenshots showing high (dark) and low (bright) backscatter caused by different sediments, seafloor structures and none/high shell content. Locations see fig. 4.

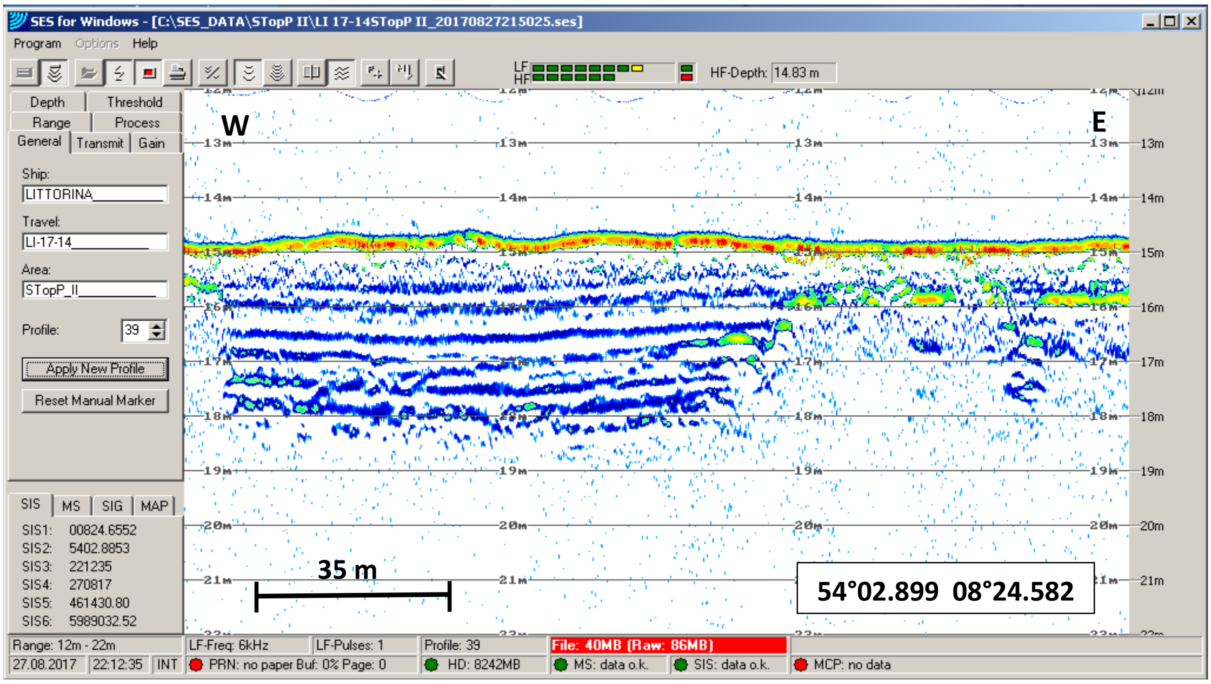

Figure 7: Screenshot of SES measurement in the „Norderelbe" region, showing layered reflectors within the subsurface disturbed by occuring gas in the right side (E) of the screenshot.

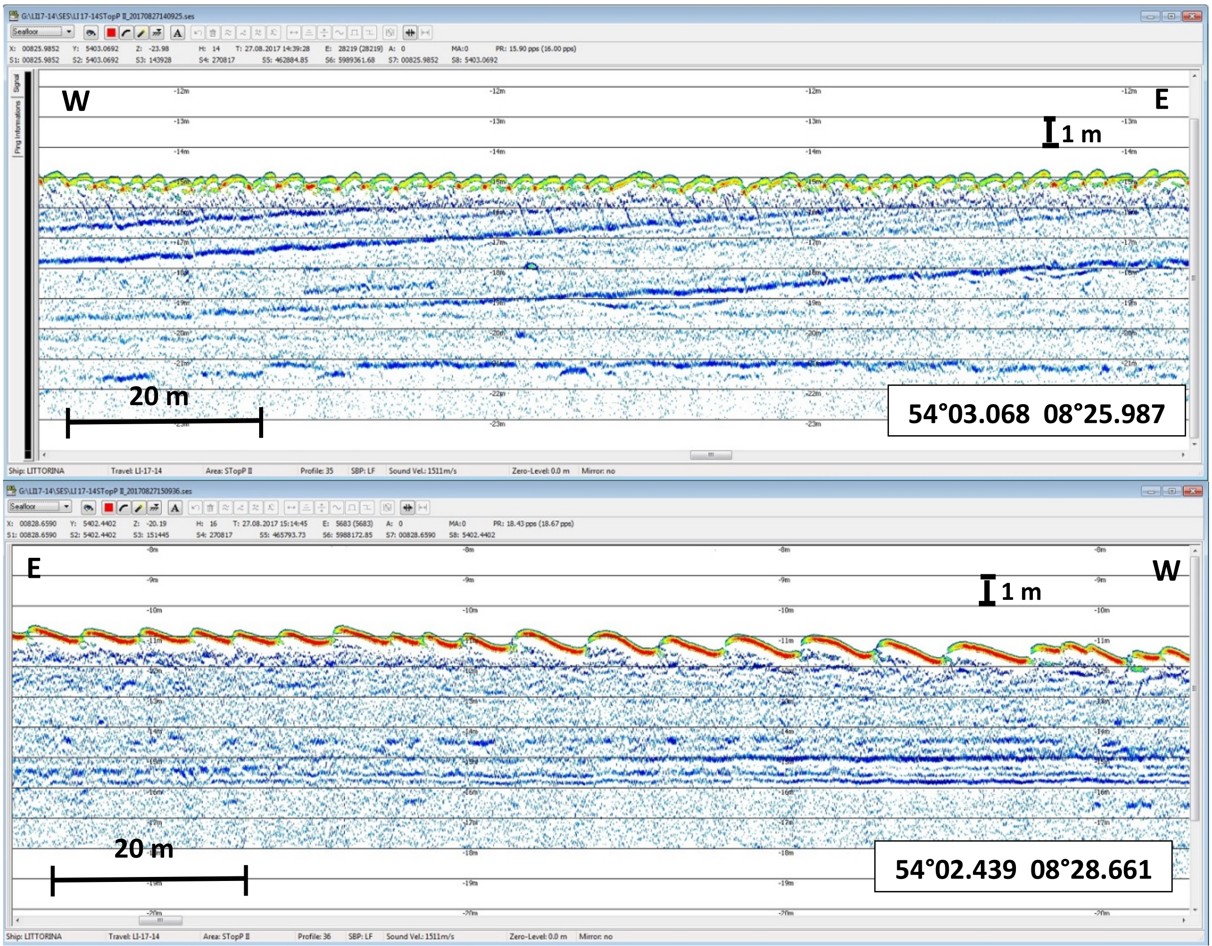

Figure 8: Screenshots of ripple structures within "Norderelbe". These structures can as well be observed within the SSS data (fig. 7). The profile was taken during ebb tide. Heights of the bedforms are up to 70 cm; crest-distances are up to 8.5 m.

Table 1: Hydroacoustic profiles (SSS, SES, MB).

Profile	Date	Time [UTC]	Latitude	Longitude	Comments	Device
1	25.08.2017	05:30	54°06.288	8°14.371	profile start	SSS; MB
1	25.08.2017	07:04	54°06.352	8°27.606	profile end	SSS; MB
2	25.08.2017	07:08	54°06.445	8°27.280	profile start	SSS; MB
2	25.08.2017	08:41	54°06.388	8°14.334	profile end	SSS; MB
3	25.08.2017	08:45	54°06.584	8°14.156	profile start	SSS; MB
3	25.08.2017	10:15	54°06.654	8°27.526	profile end	SSS; MB
4	25.08.2017	10:21	54°06.547	8°27.568	profile start	SSS; MB
4	25.08.2017	12:14	54°06.474	8°14.314	profile end	SSS; MB
5	25.08.2017	12:18	54°06.708	8°14.302	profile start	SSS; MB
5	25.08.2017	13:53	54°06.735	8°27.551	profile end	SSS; MB
6	25.08.2017	13:56	54°06.839	8°27.580	profile start	SSS; MB
6	25.08.2017	15:28	54°06.777	8°14.221	profile end	SSS; MB
7	25.08.2017	15:31	54°06.869	8°14.380	profile start	SSS; MB
7	25.08.2017	17:16	54°06.933	8°27.579	profile end	SSS; MB
8	25.08.2017	17:16	54°06.973	8°27.639	profile start	SSS; MB
8	25.08.2017	18:43	54°06.970	8°14.233	profile end	SSS; MB
9	25.08.2017	18:44	54°06.996	8°14.192	profile start	SSS; MB
9	25.08.2017	20:16	54°07.119	8°26.072	profile end	SSS; MB
10	25.08.2017	20:17	54°07.157	8°26.192	profile start	SSS; MB
10	25.08.2017	21:35	54°07.184	8°14.283	profile end	SSS; MB
11	25.08.2017	21:36	54°07.154	8°14.194	profile start	SSS; MB
11	25.08.2017	23:01	54°07.316	8°26.928	profile end	SSS; MB
12	26.08.2017	23:05	54°07.414	8°26.865	profile start	SSS; MB
12	26.08.2017	00:45	54°07.369	8°14.309	profile end	SSS; MB
13	26.08.2017	00:47	54°07.455	8°14.410	profile start	SSS; MB
13	26.08.2017	02:12	54°07.517	8°27.122	profile end	SSS; MB
14	26.08.2017	02:15	54°07.608	8°26.977	profile start	SSS; MB
14	26.08.2017	03:44	54°07.554	8°14.246	profile end	SSS; MB
15	26.08.2017	03:47	54°07.647	8°14.327	profile start	SSS; MB
15	26.08.2017	05:17	54°07.712	8°26.997	profile end	SSS; MB
16	26.08.2017	05:19	54°07.844	8°26.859	profile start	SSS; MB
16	26.08.2017	06:35	54°07.750	8°14.162	profile end	SSS; MB
17	26.08.2017	06:36	54°07.778	8°14.106	profile start	SSS; MB
17	26.08.2017	08:05	54°07.897	8°26.543	profile end	SSS; MB
18	26.08.2017	08:05	54°07.922	8°26.663	profile start	SSS; MB
18	26.08.2017	09:21	54°07.392	8°14.090	profile end	SSS; MB
19	26.08.2017	09:21	54°07.392	8°14.090	profile start	SSS; MB
19	26.08.2017	10:48	54°08.095	8°27.540	profile end	SSS; MB
20	26.08.2017	10:54	54°08.196	8°27.525	profile start	SSS; MB
20	26.08.2017	12:37	54°08.138	8°14.250	profile end	SSS; MB
21	26.08.2017	12:41	54°08.220	8°14.371	profile start	SSS; MB
21	26.08.2017	14:05	54°08.290	8°27.564	profile end	SSS; MB

22	26.08.2017	14:08	54°08.400	8°27.445	profile start	SSS; MB
22	26.08.2017	15:50	54°08.329	8°14.259	profile end	SSS; MB
23	26.08.2017	15:53	54°08.437	8°14.351	profile start	SSS; MB
23	26.08.2017	17:30	54°08.442	8°26.255	profile end	SSS; MB
24	26.08.2017	18:48	54°06.287	8°27.645	profile start	SSS; MB
24	26.08.2017	20:21	54°06.238	8°14.238	profile end	SSS; MB
25	26.08.2017	20:52	54°04228	8°14.026	profile start	SSS; MB; SES
25	26.08.2017	22:18	54°04.291	8°26.910	profile end	SSS; MB; SES
26	26.08.2017	22:21	54°04.389	8°26.792	profile start	SSS; MB; SES
26	27.08.2017	00:01	54°04.332	8°14.398	profile end	SSS; MB; SES
27	27.08.2017	00:04	54°04.440	8°14.405	profile start	SSS; MB; SES
27	27.08.2017	01:41	54°04.476	8°26.848	profile end	SSS; MB; SES
28	27.08.2017	01:45	54°04.566	8°26.853	profile start	SSS; MB; SES
28	27.08.2017	03:22	54°04.523	8°14.371	profile end	SSS; MB; SES
29	27.08.2017	03:24	54°04.620	8°14.413	profile start	SSS; MB; SES
29	27.08.2017	05:00	54°04.672	8°26.861	profile end	SSS; MB; SES
30	27.08.2017	05:00	54°04.672	8°26.861	profile start	SSS; MB; SES
30	27.08.2017	06:37	54°04.714	8°14.378	profile end	SSS; MB; SES
31	27.08.2017	06:38	54°04.705	8°14.253	profile start	SSS; MB; SES
31	27.08.2017	08:09	54°04.872	8°26.808	profile end	SSS; MB; SES
32	27.08.2017	08:09	54°04.873	8°26.808	profile start	SSS; MB; SES
32	27.08.2017	09:43	54°04.895	8°14.383	profile end	SSS; MB; SES
33	27.08.2017	09:43	54°04.895	8°14.383	profile start	SSS; MB; SES
33	27.08.2017	11:10	54°05.048	8°26.835	profile end	SSS; MB; SES
34	27.08.2017	11:14	54°05.163	8°26.785	profile start	SSS; MB; SES
34	27.08.2017	12:52	54°05.099	8°14.372	profile end	SSS; MB; SES
35	27.08.2017	13:16	54°03.391	8°14.433	profile start	SSS; MB; SES
35	27.08.2017	15:04	54°02.447	8°29.221	profile end	SSS; MB; SES
36	27.08.2017	15:09	54°02.321	8°29.303	profile start	SSS; MB; SES
36	27.08.2017	17:07	54°03.314	8°14.413	profile end	SSS; MB; SES
37	27.08.2017	17:12	54°03.213	8°14.413	profile start	SSS; MB; SES
37	27.08.2017	19:11	54°02.221	8°29.243	profile end	SSS; MB; SES
38	27.08.2017	19:11	54°02.221	8°29.243	profile start	SSS;MB; SES
38	27.08.2017	20:58	54°03.100	8°14.412	profile end	SSS; MB; SES
39	27.08.2017	20:58	54°03.100	8°14.412	profile start	SSS; MB; SES
39	27.08.2017	22:38	54°02.198	8°28.310	profile end	SSS; MB; SES
40	27.08.2017	23:14	54°02.278	8°27.903	profile start	SSS; MB; SES
40	28.08.2017	01:04	54°02.913	8°14.432	profile end	SSS; MB; SES
41	28.08.2017	01:07	54°02.816	8°14.453	profile start	SSS; MB; SES
41	28.08.2017	02:10	54°02.871	8°23.646	profile end	SSS; MB; SES
42	28.08.2017	02:14	54°02.756	8°23.672	profile start	SSS; MB; SES
42	28.08.2017	03:25	54°02.717	8°14.224	profile end	SSS; MB; SES
43	28.08.2017	03:29	54°02.618	8°14.447	profile start	SSS; MB; SES
43	28.08.2017	03:53	54°02.616	8°17.470	profile end	SSS; MB; SES
44	28.08.2017	03:53	54°02.616	8°17.470	profile start	SSS; MB; SES

44	28.08.2017	06:xx	54°13xxx	8°xxxx	profile end	SSS; MB; SES
45	28.08.2017	06:29	54°14.420	8°17.554	profile start	SSS; MB; SES
45	28.08.2017	06:57	54°14.594	8°13.902	profile end	SSS; MB; SES
46	28.08.2017	06:57	54°14.594	8°13.902	profile start	SSS; MB; SES
46	28.08.2017	08:31	54°14.408	8°27.263	profile end	SSS; MB; SES
47	28.08.2017	08:31	54°14.408	8°27.263	profile start	SSS; MB; SES
47	28.08.2017	10:06	54°14.352	8°14.204	profile end	SSS; MB; SES
48	28.08.2017	10:09	54°14.215	8°14.142	profile start	SSS; MB; SES
48	28.08.2017	11:39	54°14.198	8°27.223	profile end	SSS; MB; SES
49	28.08.2017	11:43	54°14.143	8°27.325	profile start	SSS; MB; SES
49	28.08.2017	13:15	54°14.123	8°14.220	profile end	SSS; MB; SES
50	29.08.2017	21:06	54°14.035	8°14.212	profile start	SSS; MB; SES
50	29.08.2017	22:42	54°14.013	8°27.273	profile end	SSS; MB; SES
51	29.08.2017	22:43	54°14.004	8°27.451	profile start	SSS; MB; SES
51	29.08.2017	00:24	54°13.945	8°14.103	profile end	SSS; MB; SES
52	30.08.2017	00:26	54°13.839	8°14.232	profile start	SSS; MB; SES
52	30.08.2017	01:57	54°13.828	8°27.272	profile end	SSS; MB; SES
53	30.08.2017	02:00	54°13.746	8°27.243	profile start	SSS; MB; SES
53	30.08.2017	03:32	54°13.750	8°14.196	profile end	SSS; MB; SES
54	30.08.2017	03:36	54°13.647	8°14.166	profile start	SSS; MB; SES
54	30.08.2017	05:39	54°13.631	8°27.271	profile end	SSS; MB; SES
55	30.08.2017	05:12	54°13.537	8°27.251	profile start	SSS; MB; SES
55	30.08.2017	06:44	54°13.548	8°14.156	profile end	SSS; MB; SES
56	30.08.2017	06:44	54°13.548	8°14.156	profile start	SSS; MB; SES
56	30.08.2017	08:20	54°13.446	8°27.148	profile end	SSS; MB; SES
57	30.08.2017	08:23	54°13.35	8°27.265	profile start	SSS; MB; SES
57	30.08.2017	09:46	54°13.698	8°14.191	profile end	SSS; MB; SES
58	30.08.2017	09:51	54°13.258	8°14.254	profile start	SSS; MB; SES
58	30.08.2017	11:14	54°13.230	8°27.259	profile end	SSS; MB; SES
59	30.08.2017	11:16	54°13.159	8°27.235	profile start	SSS; MB; SES
59	30.08.2017	12:46	54°13.167	8°14.181	profile end	SSS; MB; SES
60	30.08.2017	12:50	54°13.058	8°14.178	profile start	SSS; MB; SES
60	30.08.2017	14:18	54°13.049	8°27.277	profile end	SSS; MB; SES
61	30.08.2017	14:22	54°12.959	8°27.249	profile start	SSS; MB; SES
61	30.08.2017	15:54	54°12.972	8°14.185	profile end	SSS; MB; SES
62	30.08.2017	15:58	54°12.869	8°14.191	profile start	SSS; MB; SES
62	30.08.2017	17:20	54°12.859	8°27.244	profile end	SSS; MB; SES
63	30.08.2017	17:20	54°12.859	8°27.244	profile start	SSS; MB; SES
63	30.08.2017	18:40	54°12.770	8°14.165	profile end	SSS; MB; SES
64	30.08.2017	18:40	54°12.770	8°14.165	profile start	SSS; MB; SES
64	30.08.2017	20:02	54°12.661	8°27.302	profile end	SSS; MB; SES
65	30.08.2017	20:04	54°12.550	8°27.318	profile start	SSS; MB; SES
65	30.08.2017	21:22	54°12.571	8°14.179	profile end	SSS; MB; SES
66	30.08.2017	21:26	54°12.465	8°14.184	profile start	SSS; MB; SES
66	30.08.2017	22:57	54°12.467	8°27.284	profile end	SSS; MB; SES

67	30.08.2017	22:57	54°12.467	8°27.284	profile start	SSS; MB; SES
67	01.09.2017	00:18	54°12.372	8°14.201	profile end	SSS; MB; SES

Table 2: Van-Veen-Grab sampling stations.

Station	Date	Time [UTC]	Latitude	Longitude	water depth [m]
1	29.08.2017	05:46	54°42.318	8°27.785	13.6
2	29.08.2017	06:01	54°02.515	8°27.050	15.3
3	29.08.2017	06:15	54°02.469	8°26.379	14.7
4	29.08.2017	06:31	54°02.940	8°26.674	13.2
5	29.08.2017	06:47	54°02.992	8°25.954	14.1
6	29.08.2017	07:00	54°02.271	8°25.272	15.8
7a	29.08.2017	07:12	54°03.046	8°24.980	15.1
7b	29.08.2017	07:25	54°03.043	8°24.975	15.0
8	29.08.2017	07:42	54°02.796	8°24.678	15.7
9	29.08.2017	07:55	54°03.090	8°22.826	15.3
10	29.08.2017	08:08	54°03.065	8°22.845	15.2
11	29.08.2017	08:23	54°03.330	8°21.169	15.1
12	29.08.2017	08:35	54°03.342	8°21.117	15.2
13	29.08.2017	08:51	54°02.775	8°20.629	11.5
14	29.08.2017	09:05	54°03.429	8°19.779	14.9
15	29.08.2017	09:20	54°02.997	8°17.863	14.2
16	29.08.2017	10:03	54°03.265	8°16.219	14.1
17	29.08.2017	10:17	54°03.320	8°15.434	14.5
18	29.08.2017	10:29	54°02.720	8°14.791	13.6
19	29.08.2017	10:45	54°04.269	8°14.931	15.6
20	29.08.2017	11:02	54°04.610	8°16.443	15.5
21	29.08.2017	11:17	54°04.916	8°16.699	16.0
22	29.08.2017	11:35	54°04.271	8°17.804	13.9
23	29.08.2017	11:47	54°04.605	8°19.013	13.0
24	29.08.2017	12:05	54°04.462	8°22.419	10.9
25	29.08.2017	12:20	54°05.077	8°22.416	13.7
26	29.08.2017	12:33	54°04.957	8°24.065	10.9
27	29.08.2017	12:43	54°04.739	8°25.097	9.3
28	29.08.2017	12:59	54°04.436	8°26.406	9.8
29	29.08.2017	13:13	54°05.149	8°26.585	10.9
30	29.08.2017	13:29	54°06.754	8°26.972	11.0
31	29.08.2017	13:40	54°07.483	8°26.850	8.9
32	29.08.2017	13:50	54°07.993	8°26.579	10.7
33	29.08.2017	13:59	54°08.225	8°27.002	10.8
34	29.08.2017	14:12	54°08.175	8°24.885	11.8
35	29.08.2017	14:24	54°08.395	8°23.846	12.0
36	29.08.2017	14:35	54°08.349	8°23.280	12.3
37	29.08.2017	14:43	54°08.192	8°23.662	12.4
38	29.08.2017	14:54	54°07.725	8°24.343	12.2

39	29.08.2017	15:08	54°06.876	8°24.547	12.8
40	29.08.2017	15:17	54°06.795	8°24.189	13.7
41	29.08.2017	16:03	54°06.574	8°24.236	14.9
42	29.08.2017	16:13	54°06.450	8°23.879	16.2
43	29.08.2017	16:22	54°06.265	8°23.389	16.7
44	29.08.2017	16:34	54°06.663	8°22.948	15.0
45	29.08.2017	16:47	54°07.638	8°21.849	14.0
46	29.08.2017	16:57	54°07.896	8°21.357	13.7
47	29.08.2017	17:10	54°08.167	8°19.623	15.1
48	29.08.2017	17:24	54°07.253	8°19.379	15.6
49	29.08.2017	17:36	54°06.865	8°20.469	15.2
50	29.08.2017	17:50	54°06.260	8°18.122	17.8
51	29.08.2017	18:04	54°06.298	8°17.763	17.4
52	29.08.2017	18:19	54°06.526	8°16.573	17.5
53	29.08.2017	18:31	54°06.750	8°15.723	17.3
54	29.08.2017	18:43	54°06.834	8°14.659	18.4
55	29.08.2017	18:59	54°07.528	8°16.732	16.3
56	29.08.2017	19:04	54°08.016	8°16.598	16.7
57	29.08.2017	19:27	54°08.113	8°15.812	16.9
58	29.08.2017	19:43	54°07.930	8°14.483	17.8