FS Alkor AL-480 06/07 2016
(27.06.-09.07.2016)

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

Klaus Schwarzer
Kerstin Wittbrodt

1. Objective of the cruise

The cruise 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 benthivorous birds). The objective of this cruise was to collect high resolution hydroacoustic data of the geological structure and physical properties of the seafloor in the STopP II – Synthesis offshore Dithmarschen. This research area is located south of the STopP I area (Schwarzer & Wittbrodt, 2015; see fig. 1), more close to the Elbe Estuary, as the gradient in salinity and discharged matter might be a controlling factor for sediment and species distribution. The data sets will be used to fill gaps within the knowledge of sedimentological and geological characteristics of this area. Combined with data about the distribution of benthic organisms and seabird occurrence the data will serve as baseline knowledge for the evaluation of food web structures. These steps will improve the general understanding of the interrelation between the seafloor and subsurface properties associated with benthic organisms and their environmental influences. Based on this knowledge model development, model generalization, model transferability as well as modelling of future scenarios of habitat development should be improved as it has been done already in STopP I.

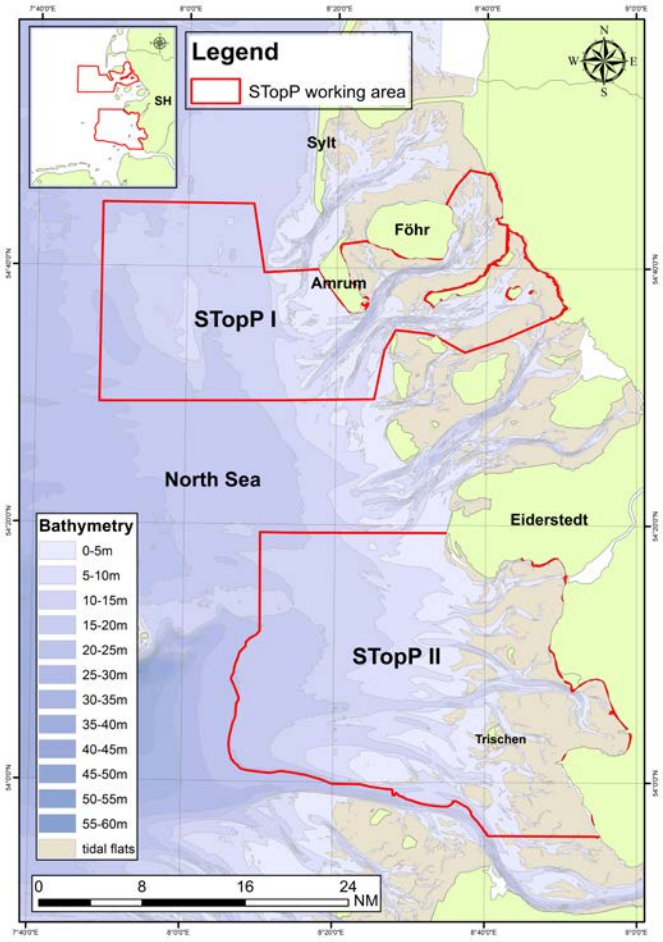

Figure 1: Working areas of STopP I and STopP II, under investigation of IFG and FTZ Büsum.

In AL-480 we specifically focused on the influence of tidal channels and river mouth systems on the local geological built-up and the sediment distribution as well as benthos occurrence within sediment samples (especially living *Ensis*) to improve baseline knowledge in the Synthesis working area .

2. Participants of the cruise:

1. **Dr. Klaus Schwarzer** (chief scientist), Inst. of Geosciences, Kiel University
2. **Kerstin Wittbrodt** (scientist, PhD student), Inst. of Geosciences, Kiel University
3. **Dr. Peter Richter** (scientist), Inst. of Geosciences, Kiel University
4. **Andre Wagner** (technician), Inst. of Geosciences, Kiel University
5. **Annelie Düring** (scientist, BSc-student), Inst. of Geosciences, Kiel University
6. **Jan Bargmann** (scientist), Inst. of Geosciences, Kiel University
7. **Florian Schreiber** (scientist), Inst. of Geosciences, Kiel University
8. **Carsten Nöthlich** (scientist), Inst. of Geosciences, Kiel University
9. **Antonia Wilke** (scientist), Inst. of Geosciences, Kiel University

3. Cruise Narrative

Abbreviations used in this report:

C3D - Sidescan Sonar (towed)	**SSS C3D**
Innomar Subbottom Profiler	**SES**
Grab Sampler	**GS**
Conductivity – Temperature – Depth probe	CT**D**
Giant Grab Sampler	**GGS**

Mo. 27.06.2016

Weather:	cloudy
07:30	Departing Kiel, transit through Kiel Canal
20:00	Arrival Brunsbüttel

Tu. 28.06.2016

Weather	cloudy, SW 4
06:00	Departing Brunsbüttel
11:00	Arrival working area
11:15	CTD station
11:35	Deployment of device (C3D)
11:59	Start profiling (SSS; SES)

We. 29.06.2016

Weather:	cloudy, SE 4
00:00-00:00	Profiling (SSS; SES)

Th. 30.06.2016

Weather:	cloudy, partly sunny, SW 2

00:00-00:00 Profiling (SSS; SES)

Fr. 01.07.2016
Weather: cloudy, partly sunny, SW 5
05:26 End of profiling (SSS; SES)
05:35 Devices out of water (C3D)
06:14 Start of grab sampling
15:26 End of grab sampling; Transit profiling
16:30 Deployment of device (C3D)
16:39 Start profiling (SSS; SES)

Sa. 02.07.2016
Weather: cloudy, rainy, SW 6
00:00-00:00 Profiling (SSS; SES)

Su. 03.07.2016
Weather: cloudy, SW 6
00:00-00:00 Profiling (SSS; SES)

Mo. 04.07.2016
Weather: cloudy, partly sunny, SW 4
05:00 End of profiling (SSS, SES)
05:10 Device out of water (C3D), Transit grab sampling
06:32 Start grab sampling
09:30 Interruption grab sampling
10:08 Start of GGS sampling (4 stations)
12:10 End of GGS sampling
12:36 Continuing grab sampling
15:23 End grab sampling, Transit Profiling
16:05 Deployment of device (C3D)
16:16 Start of profiling (SSS; SES)

Tu. 05.07.2016
Weather cloudy, SE 3
05:10 Interruption of profiling (SSS; SES)
05:15 Device out of water (C3D)
05:59 Start GGS sampling (2 stations)
06:25 End GGS sampling
06:49 Start grab sampling
08:18 Interruption grab sampling due to bad weather forecast, Transit to Helgoland
10:25 Arrival Helgoland

We. 06.07.2016
Weather: cloudy, partly sunny
00:00-00:00 Helgoland due to bad weather conditions

Th. 07.07.2016
Weather: SW 4
06:00 Departing Helgoland

06:49 Start of grab sampling
15:04 End of grab sampling
16:25 Deployment of device (C3D)
16:34 Start of profiling (SSS, SES)

Fr. 08.07.2016
Weather: SW 3
12:24 End of profiling (SSS, SES)
12:30 Device out of water (C3D)
12:44 Start of grab sampling
15:30 End of grab sampling, CTD; Transit to Brunsbüttel
19:45 Arrival Brunsbüttel

Sa. 09.07.2016
Weather: sunny
05:00 Departing Brunsbüttel
13:30 Arrival of FS Alkor at GEOMAR Pier Westshore

4. Methods

The towed Sidescan Sonar system **Teledyne Benthos C3D** was applied to collect high resolution hydroacoustic data to create maps of the seafloor sediment backscatter characteristics and sediment distribution patterns in the survey area. The **C3D** was towed behind the vessel with a towing speed of about 4 knots. The **C3D** is working in the chirp mode with a frequency of 200 kHz. A range of 100 m on each side was set for the measurements. Based on the backscatter intensities dark (high backscatter) and bright (low backscatter) grey values were displayed within the SSS-measurements. The basic principles behind SSS-measurements can be taken from common literature (Blondel & Murton 1997; Lurton 2002; Blondel 2009). After post-processing the high resolving acoustic images of the Sidescan Sonar will be used to elaborate geological facies of the seafloor (see Lurton 2002).

Additionally the hull mounted high resolution parametric sediment echosounder (**Innomar-SES**) was used to get further information of the subsurface built-up and to identify the geological architecture in the investigation area.

Ground truthing was done by **grab sampling** with a Van-Veen-Grab Sampler **(**see fig. 2**)** and analyzing sediment samples. Additionally sampler content was sieved over a 2 mm sieve for having a closer look on shill content and living benthic organisms. Based on the objectives of the project shells and shell fragments of *Ensis* as well as living individuals were of special interest as these species serves as a diet for diving birds.

To gain in situ samples with an undisturbed sediment surface a GGS (50 x 50 cm) was used (fig. 2). When contacting the seafloor the tension of the wire buckles, a release opens and by

pulling the wire back the shovel of the giant grab sampler closes, capturing the sediment inside the steel boxes. Afterwards each sample was described, photographed, sampled and sieved over a 2 mm sieve as well for having a closer look on shell content and living organism.

Tracklines of all hydroacoustic profiles and the position of sampling stations are shown in figure 3 and 4. In table 1 - 4 all stations and profiles of the cruise are listed.

The described bunch of methods was used to get an overview of sediment distribution patterns and sediment properties in the working area, which are decisive for the occurrences and distribution of different benthic species.

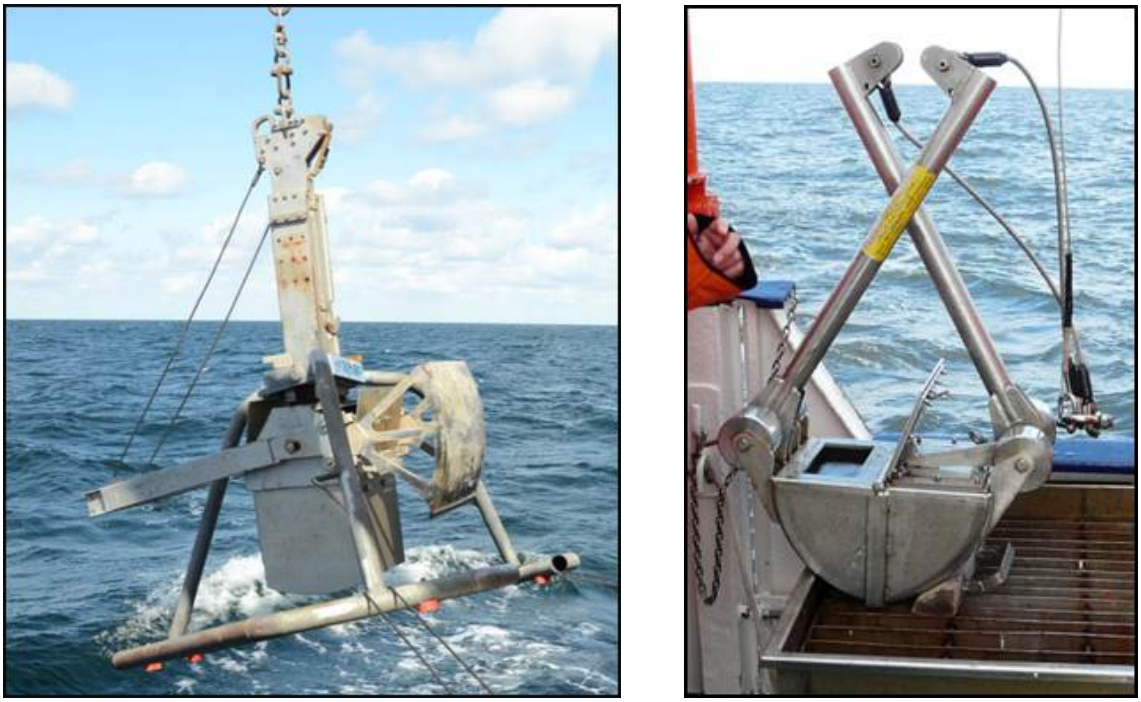

Figure 2: Giant grab sampler (GGS) (left) and Van-Veen-Grab-Sampler (right).

5. Preliminary scientific results

The discontinuous Sidescan Sonar mosaics resulting from 92 profiles (fig. 3) are shown in figures 4 - 7. In total an area of about 218 km^2 was mapped divided into five smaller SSS mosaiced areas. All areas are located offshore tidal channels.

The surveyed regions are characterized by large areas of homogeneous low backscatter values (light colors) which appear especially in the central and southern parts identified as medium sands (northern area) to silt (southern area) within a first onboard sediment description. In the northern and southern parts areas of eye-catching high backscatter values (dark colors) were found as well. They were identified as fine sand with high shell content (northern parts) to

fine sand/silt with shell and *Lanice conchilega* coverage (northern + southern parts) within first onboard sediment description. In the central surveyed region areas of high backscatter composed of coarse sand to gravel with high shell content (figure 10) of around 75 % were found. Detailed locations of these backscatter characteristics can be seen in figures 5 - 7. The edges of the high backscatter areas in the southern parts were embossed by sharp transitions to low backscatter values (light colors). In the northern parts gradual changes from high to low backscatter values as well as areas of alteration of light and dark values were present. Throughout the entire SSS mosaic areas of small scale alteration of high and low backscatter values were found as well (see fig. 4-7). Within the SSS mosaic in the northern working area prominent north-west to south-east striking low backscatter structures were identified composed of fine to medium sands (see figure 5).

Based on the Sidescan Sonar mosaic, sediment sampling was carried out at 119 stations. Additionally 7 locations were selected for giant grab sampling (fig. 4). Based on onboard sediment description a gradient in grain size towards finer sediments was found from north to south. All sample stations were used to take a closer look at benthos content, especially at *Ensis* occurrence, which is a focus organism within the project as it has become an essential food source for sea birds within the last years (Tulp et al. 2010). The entire grab content was sieved through a sieve with 2 mm mesh width and photographed. In figure 5 some pictures of the giant grab samples and details of related sieve content with highly variable shell amounts are shown. They are a helpful impression of the general content of shill and living organisms within the working area. A lot of living juvenile *Ensis* were found within the gab samplers and giant grab samplers, located especially within the first 2 - 4 cm of the sediment (see figures 8 and 9). The locations are shown in figure 4. In figure 8 C the tube building Polychaet *Lanice conchilega* is present on the sediment surface within the giant grab sampler. This organism can be responsible for eye-catching high backscatter values (Degraer et al. 2008) in Sidescan Sonar images and serve as nursery area for juvenile benthic organisms as it was shown within giant grab sampling during the AL-440 in 2014 in the STopP I working area at Amrum Bank (Schwarzer & Wittbrodt, 2014). The positive effect of *Lanice conchilega* on surrounding benthos communities and habitat conditions was mentioned by several authors within the last decades (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). Ground truthing via grab sampler stations within the northern and southern working area has shown that certain parts of high backscatter values were caused by *Lanice conchilega* in these areas.

Besides Sidescan Sonar measurements, grab sampling and giant grab sampling sediment echosounder (SES) data were collected to get information about the sedimentological built-up and thickness of subsurface layers in the working area. These measurements show major dif-

ferences compared to the STopP I working area and within the STopP II working area along a north-south gradient. Prominent channel structures and subsurface layers found within the Amrum Bank area (STopP I) only could be found in the northern parts of the working area of STopP II. The central and southern parts were characterized by limited signal penetration into the subsurface up to three meters without channel structures or prominent layers (see fig. 11). These differences were caused by the general different subsurface built-up of the nearshore shelf of the STopP II working area shaped/influenced by the closely located former "Elbe spillway" (Figge 1980) and probably occurring gas effects within this area. Additionally the lack of back barrier islands compared to the STopP I working area and an increased tidal ranges within this inner part of German Bight (Figge 1980) is influencing the sedimentlogical/ geological characteristics.

6. References

Blondel, P. & Murton, B.-J., 1997. Handbook of seafloor imagery. - 314 pp. (Springer)

Blondel, P., 2009. The Handbook of Sidescan Sonar.- 316 pp. (Springer).

Callaway, R., 2006. Tube worms promote community change. Marine Ecology Progress Series, 308, p. 49-60.

Degraer, S., Moerkerke, G., Rabaut, M., Van Hoey, G., Du Four, I., Vincx, M., Henriet, J.P., Van Lancker, V., 2008. Very-high resolution side-scan sonar mapping of biogenic reefs of the tube-worm *Lanice conchilega.* Remote Sensing of Environment, 112, p. 3323-3328.

Figge, K., 1980. Das Elbe-Urstromtal im Bereich der Deutschen Bucht (Nordsee). Eiszeitalter und Gegenwart, 30, 203-211.

Heinrich, C., Feldens, P., Schwarzer, K., 2016. Highly dynamic biological seabed alterations revealed by side scan sonar tracking of Lanice conchilega beds offshore the island of Sylt (German Bight). Geo-Mar Lett., doi: 10.1007/s00367-016-0477-z

Jones, S.-E. & Jago, C.-F., 1993. In situ assessment of modification of sediment properties by burrowing invertebrates. Mar. Biol., 115, 133-142.

Lurton, X., 2002. An introduction to Underwater acoustics. Principles and applications. London, 347 pp. (Springer).

Rabaut, M., Guilini, K., van Hoey, G., Vincx, M., Degraer, S., 2007. A bio-engineered soft-bottom environment: The impact of *Lanice Conchilega* on the benthic species-specific densities and community structure. Estuarine, Coastal and Shelf Sci., 75, 525-536.

Rabaut, M., Vincx, M. & Degraer, S., 2009. Do *Lanice conchilega* (sandmason) aggregations classify as reefs? Quantifying habitat modifying effects. Helgoländer Marine Res., 63, 37-46.

Schwarzer, K., Wittbrodt, K., 2014. ALKOR - 440 - Cruise Report, 30.06.-12.07.2014. STopP (Vom Sediment zum Topp-Prädator – Einfluss von Eigenschaften des Meeresbodens auf Benthos und benthivore Vögel, Teilprojekt STopP-See), 19 pp., doi:10.3289/CR_AL440.

Schwarzer, K., Wittbrodt, K., 2015. ALKOR-465 - Cruise Report, 10.10. - 23.10.2015, KÜNO-Project STopP (Vom Sediment zum Topp-Prädator – Einfluss von Eigenschaften des Meeresbodens auf Benthos und benthivore Vögel, 20 pp., doi:10.3289/CR_AL465.

Tulp, I., Craeymeersch, J., Leopold, M., van Damme, C., Fey, F. & Verdaat, H., 2010. The sole of the invasive bivalve *Ensis directus* as food source for fish and birds in the Dutch coastal zone. Estuarine, Coastal and Shelf Sci., 90, 116-128.

Van Hoey, G., 2007. The effect of the presence of *Lanice conchilega* on the soft-bottom benthic ecosystem in the North Sea. In: Reesm H.-L., Eggleton, J.-D., Rachor, E., Vanden Berghe, E. (eds.). Structure and dynamics of the North Sea benthos. ICES Cooperative Res. Rep., 288, 188-199.

Van Hoey, G., Guilini, K., Rabaut, M., Vincx, M., Degraer, S., 2008. Ecological implications of the presence of the tube-building polychaete *Lanice conchilega* on soft-bottom benthic ecosystems. Mar. Biol., 154, 1009-1019.

7. Appendices

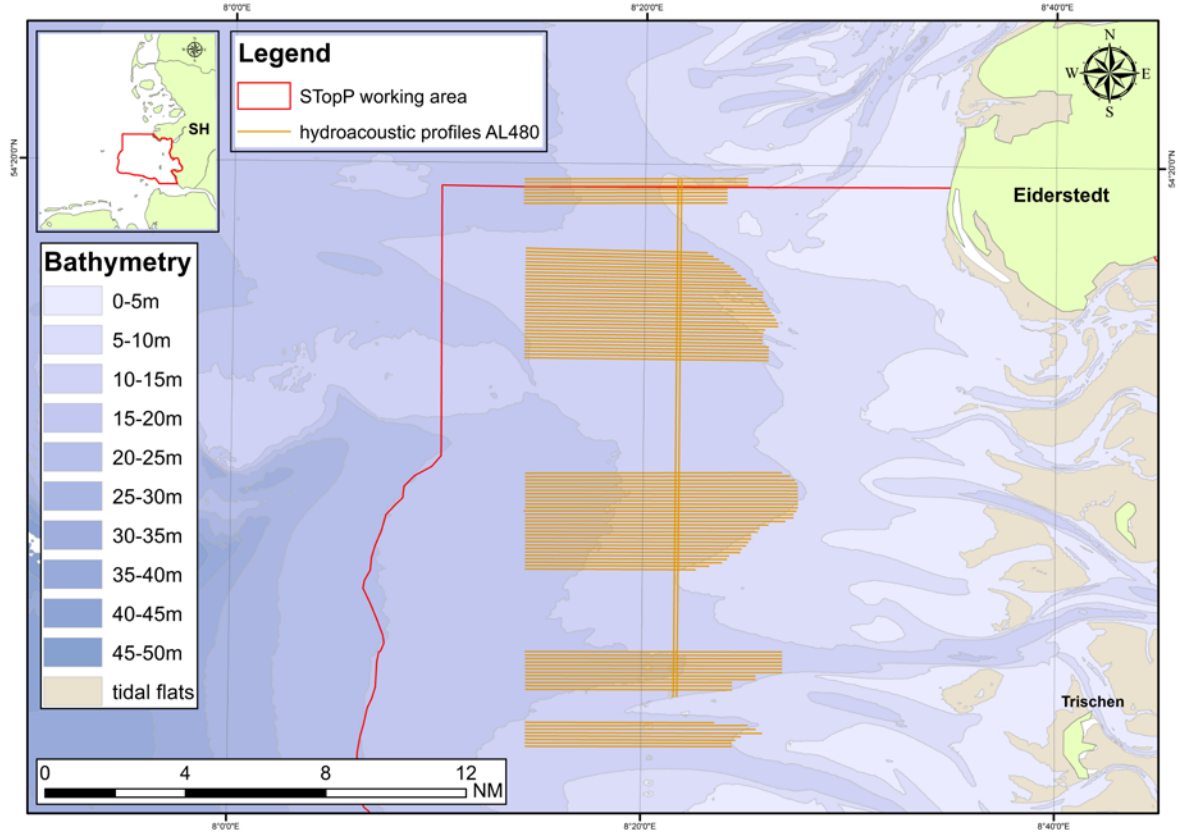

Figure 3: Hydroacoustic profiles of AL480 and their location orientated to tidal channel systems in the STopP II working area.

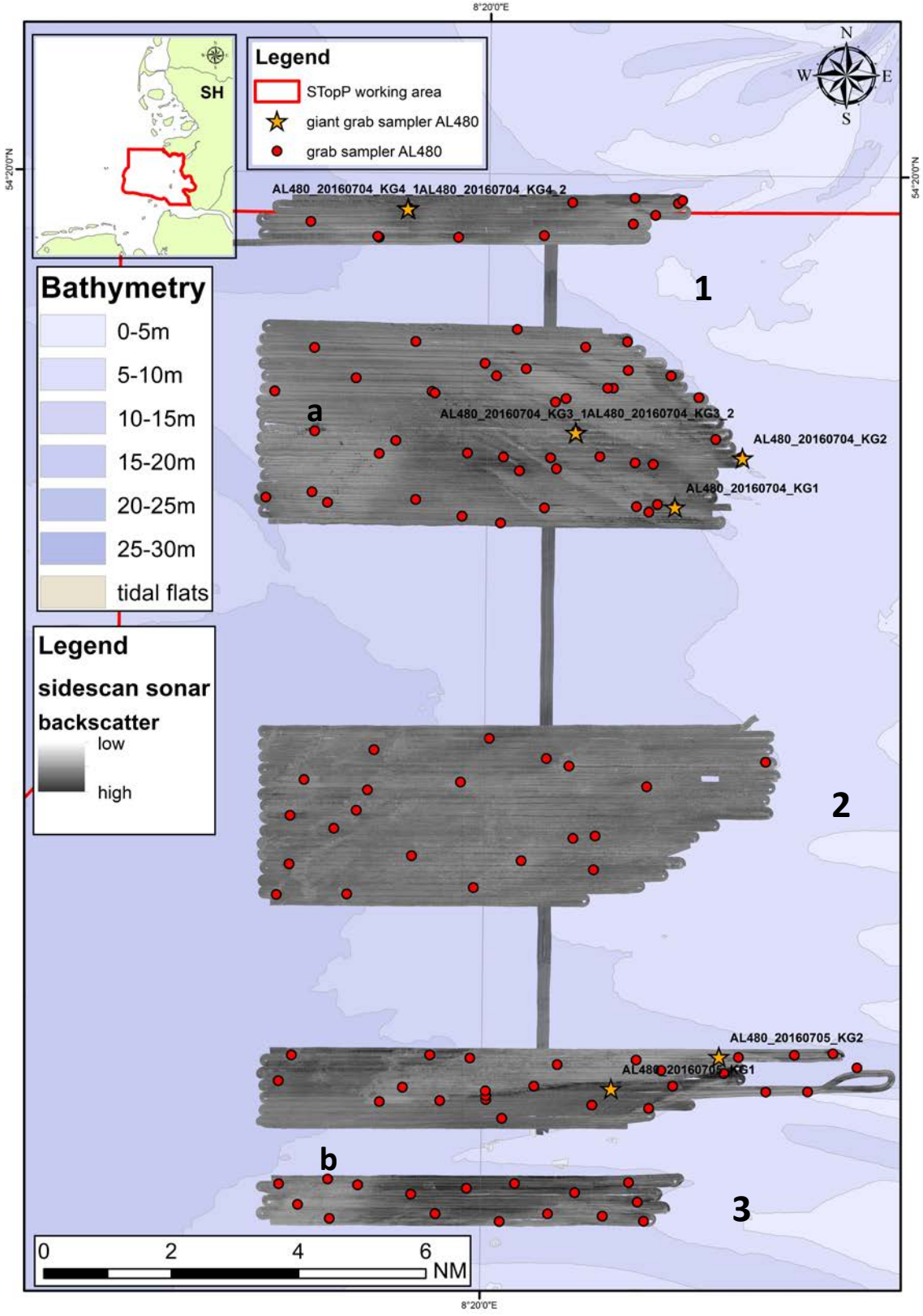

Figure 4: The Sidescan Sonar mosaic of AL480 and locations of grab sample stations and giant grab sampler stations. 1 – 3 - Locations of detail SSS-Mosaic maps of figure 5-7. a + b – Locations of grab samples shown in figure 10.

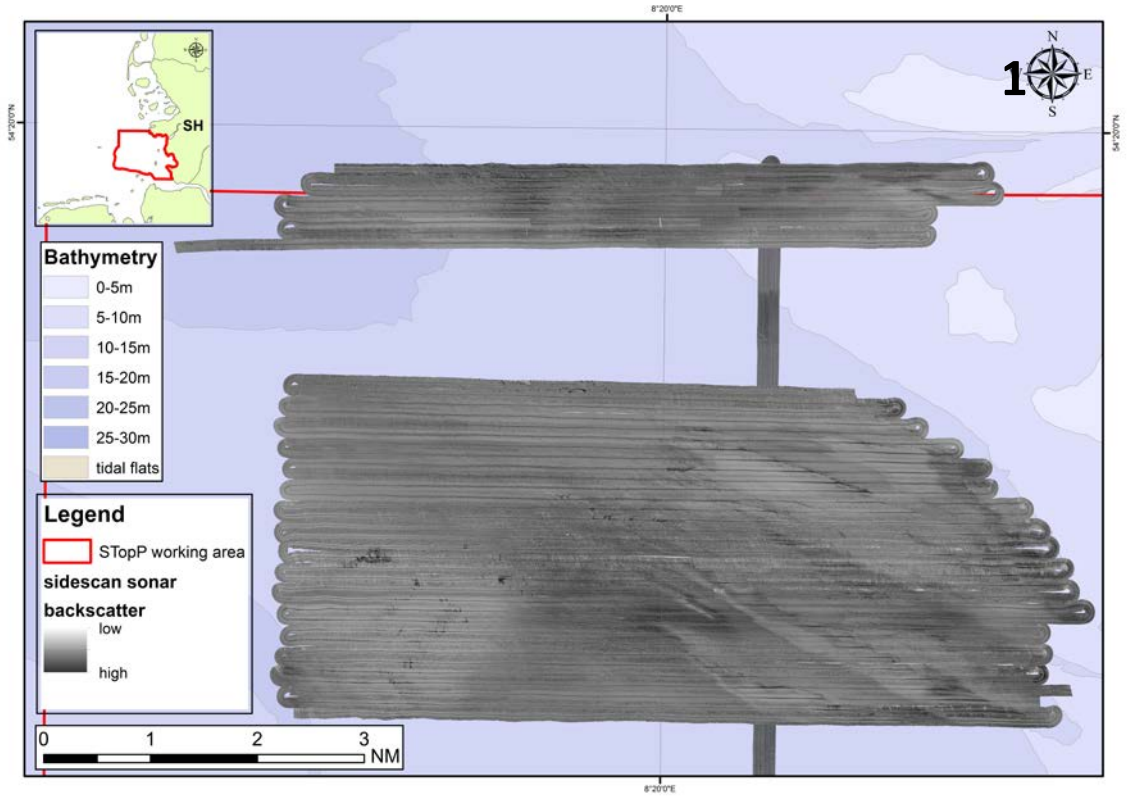

Figure 5: Detail of Sidescan Sonar mosaic of the northern parts of the working area of AL480..

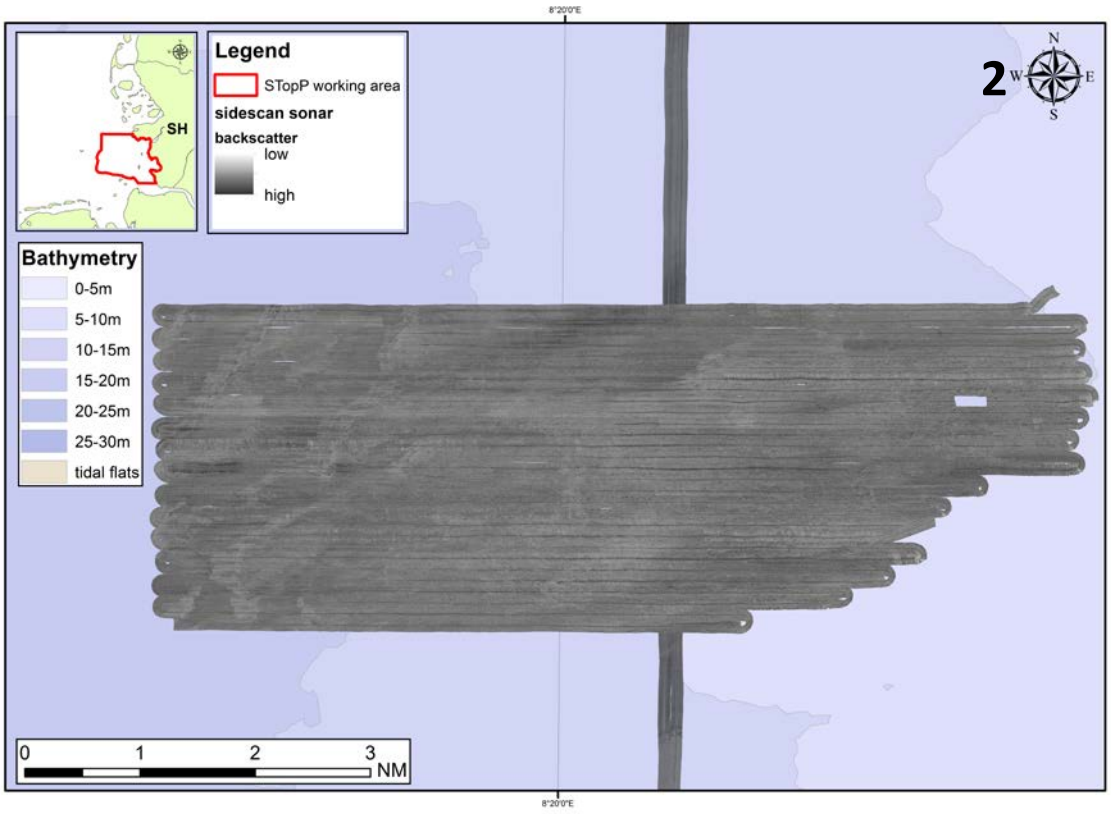

Figure 6: Detail of Sidescan Sonar mosaic of the central parts of the working area of AL480.

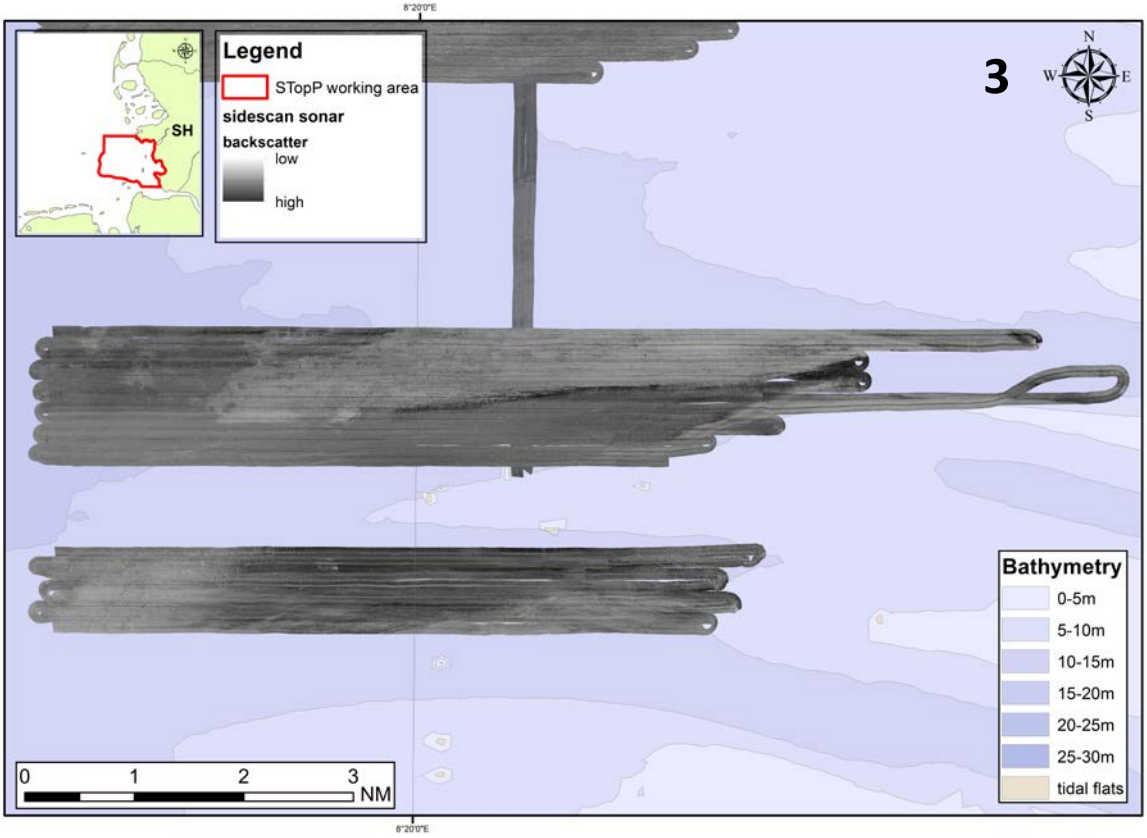

Figure 7: Detail of Sidescan Sonar mosaic of the southern parts of the working area of AL480.

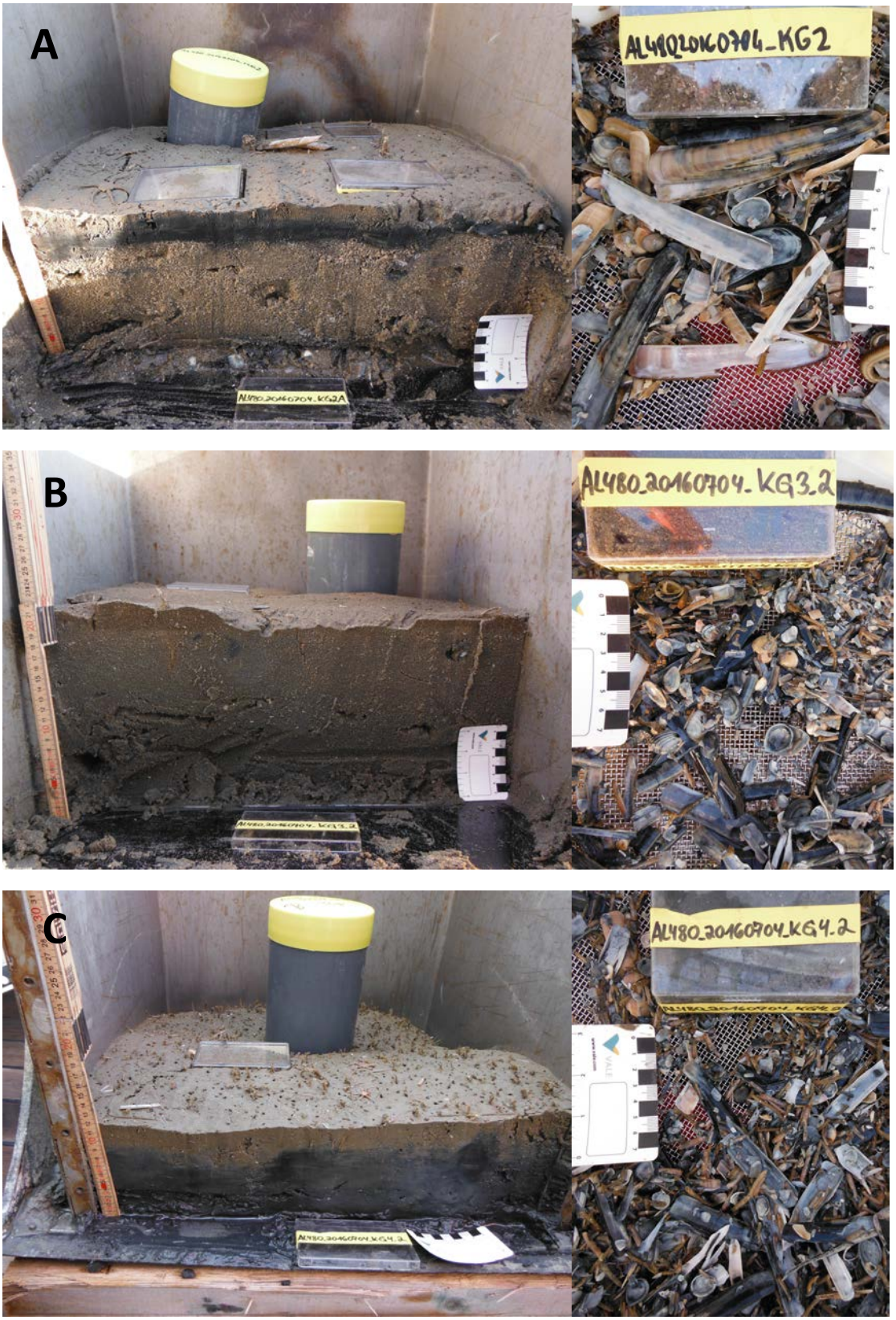

Figure 8: Pictures of giant grab sampler sections and details of associated sieve contents (**A**: AL480-20160704_KG2, **B**: AL480-20160704_KG3_2, **C**: AL480-20160704_KG4_2). Within all three giant grab samplers juvenile living *Ensis* were found within the first 2-4 cm. Locations see figure 4.

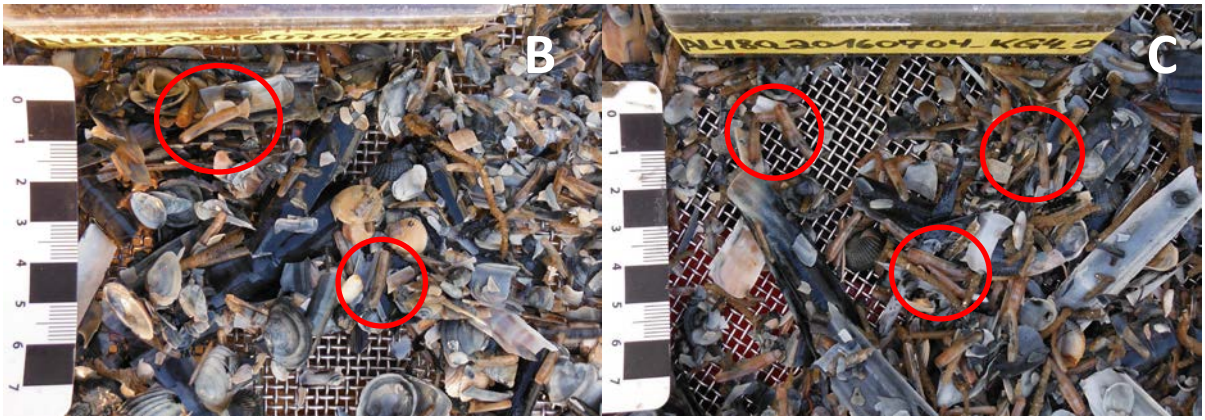

Figure 9: Detail picture of giant grab sampler sieve contents of **B**: AL480-20160704_KG3_2 and **C**: AL480-20160704_KG4_2 (figure 8) showing the juvenile *Ensis* within the sieves of the giant grab samplers (see red circles).

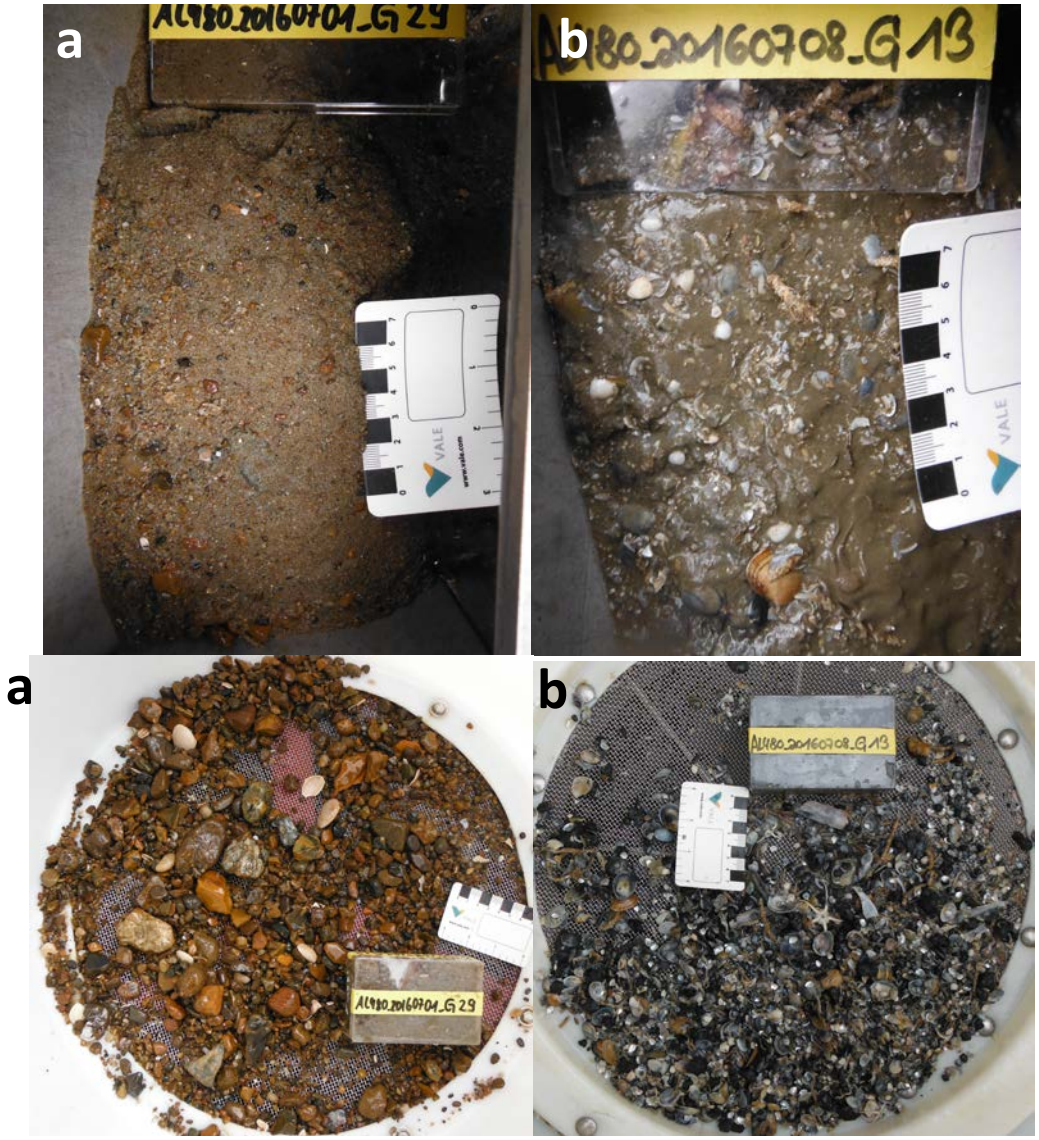

Figure 10: Pictures of grab samplers with high gravel (a) and high shill (b) content with associated sieve content. Locations of the grab sampler stations are given in figure 4.

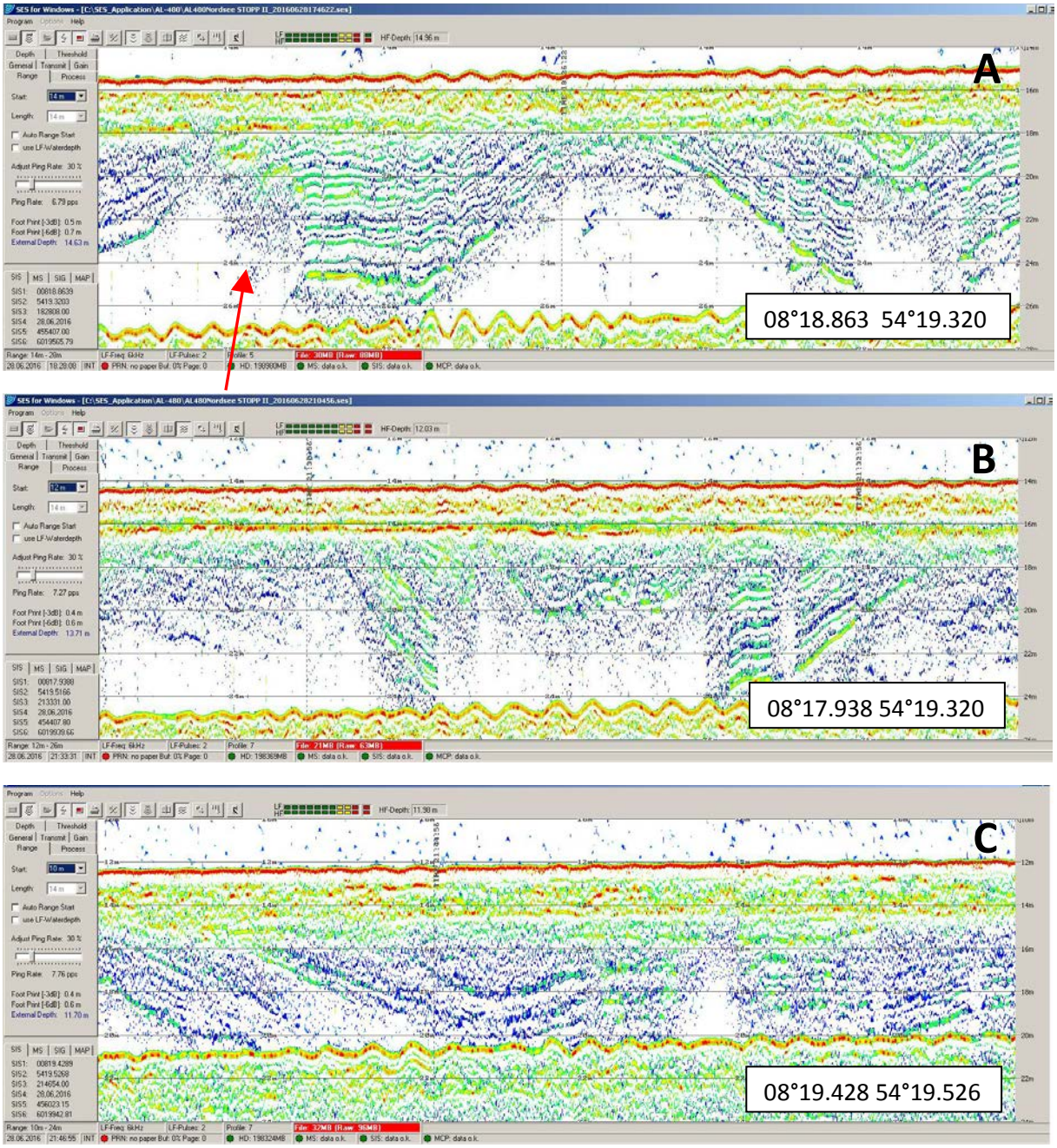

Figure 11: Screenshots of selected SES Profiles within the working area. Several subsurface structures like depressions or channels can be identified in the northernmost part of the area **(A+B)**. Also some gas effects were visible within the SES measurements, leading to loss of reflector signals (see arrow) (**A**).

Tab 1.: Hydroacoustic profiling

No	Date	Time [UTC]	Latitude	Longitude	Remarks
1	28.06.2016	11:57	54°18.885	08°13.762	start profile (SSS; SES)
1	28.06.2016	13:15	54°19.006	08°23.878	end profile (SSS; SES)
2	28.06.2016	13:20	54°19.041	08°24.068	start profile (SSS; SES)
2	28.06.2016	14:41	54°18.996	08°14.075	end profile (SSS; SES)
3	28.06.2016	14:46	54°19.099	08°14.930	start profile (SSS; SES)
3	28.06.2016	16:10	54°19.166	08°23.968	end profile (SSS; SES)
4	28.06.2016	16:17	54°19.252	08°23.951	start profile (SSS; SES)
4	28.06.2016	17:43	54°19.187	08°14.085	end profile (SSS; SES)
5	28.06.2016	17:46	54°19.293	08°14.083	start profile (SSS; SES)
5	28.06.2016	19:12	54°19.353	08°23.958	end profile (SSS; SES)
6	28.06.2016	19:29	54°19.472	08°24.927	start profile (SSS; SES)
6	28.06.2016	20:56	54°19.395	08°14.635	end profile (SSS; SES)
7	28.06.2016	21:04	54°19.509	08°14.632	start profile (SSS; SES)
7	28.06.2016	22:33	54°19.594	08°24.750	end profile (SSS; SES)
8	28.06.2016	22:39	54°19.636	08°25.026	start profile (SSS; SES)
8	29.06.2016	00:04	54°19.558	08°14.809	end profile (SSS; SES)
9	29.06.2016	01:21	54°14.542	08°13.997	start profile (SSS; SES)
9	29.06.2016	03:02	54°14.496	08°26.003	end profile (SSS; SES)
10	29.06.2016	03:08	54°14.592	08°26.037	start profile (SSS; SES)
10	29.06.2016	04:48	54°14.617	08°14.193	end profile (SSS; SES)
11	29.06.2016	04:53	54°14.730	08°14.185	start profile (SSS; SES)
11	29.06.2016	06:34	54°14.691	08°26.981	end profile (SSS; SES)
12	29.06.2016	06:55	54°14.790	08°26.014	start profile (SSS; SES)
12	29.06.2016	08:27	54°14.815	08°14.290	end profile (SSS; SES)
13	29.06.2016	08:34	54°14.907	08°14.196	start profile (SSS; SES)
13	29.06.2016	10:03	54°14.918	08°25.800	end profile (SSS; SES)
14	29.06.2016	10:08	54°14.962	08°25.849	start profile (SSS; SES)
14	29.06.2016	11:37	54°14.970	08°14.361	end profile (SSS; SES)
15	29.06.2016	11:43	54°15.114	08°14.119	start profile (SSS; SES)
15	29.06.2016	13:12	54°15.121	08°25.773	end profile (SSS; SES)
16	29.06.2016	13:21	54°15.161	08°25.773	start profile (SSS; SES)
16	29.06.2016	14:50	54°15.200	08°14.198	end profile (SSS; SES)
17	29.06.2016	14:54	54°15.293	08°14.194	start profile (SSS; SES)
17	29.06.2016	16:22	54°15.279	08°25.763	end profile (SSS; SES)
18	29.06.2016	16:29	54°15.370	08°25.846	start profile (SSS; SES)
18	29.06.2016	17:58	54°15.390	08°14.206	end profile (SSS; SES)
19	29.06.2016	18:04	54°15.483	08°14.296	start profile (SSS; SES)
19	29.06.2016	19:38	54°15.467	08°26.466	end profile (SSS; SES)
20	29.06.2016	19:45	54°15.586	08°26.490	start profile (SSS; SES)
20	29.06.2016	21:21	54°15.583	08°14.070	end profile (SSS; SES)
21	29.06.2016	21:27	54°15.679	08°14.232	start profile (SSS; SES)
21	29.06.2016	22:59	54°15.683	08°26.274	end profile (SSS; SES)
22	29.06.2016	23:05	54°15.749	08°26.247	start profile (SSS; SES)
22	30.06.2016	00:37	54°15.750	08°14.326	end profile (SSS; SES)
23	30.06.2016	00:43	54°15.902	08°14.115	start profile (SSS; SES)
23	30.06.2016	02:15	54°15.868	08°26.131	end profile (SSS; SES)

24	30.06.2016	02:23	54°15.975	08°26.107	start profile (SSS; SES)
24	30.06.2016	03:59	54°15.982	08°14.194	end profile (SSS; SES)
25	30.06.2016	04:05	54°16.106	08°14.202	start profile (SSS; SES)
25	30.06.2016	05:45	54°16.061	08°25.922	end profile (SSS; SES)
26	30.06.2016	05:53	54°16.178	08°25.856	start profile (SSS; SES)
26	30.06.2016	07:32	54°16.173	08°14.172	end profile (SSS; SES)
27	30.06.2016	07:39	54°16.267	08°14.219	start profile (SSS; SES)
27	30.06.2016	09:10	54°16.249	08°25.745	end profile (SSS; SES)
28	30.06.2016	09:17	54°16.338	08°25.728	start profile (SSS; SES)
28	30.06.2016	10:37	54°16.327	08°14.300	end profile (SSS; SES)
29	30.06.2016	10:43	54°16.465	08°14.073	start profile (SSS; SES)
29	30.06.2016	12:11	54°16.469	08°25.588	end profile (SSS; SES)
30	30.06.2016	12:17	54°16.498	08°25.552	start profile (SSS; SES)
30	30.06.2016	13:42	54°16.522	08°14.324	end profile (SSS; SES)
31	30.06.2016	13:47	54°16.672	08°14.067	start profile (SSS; SES)
31	30.06.2016	15:11	54°16.624	08°25.080	end profile (SSS; SES)
32	30.06.2016	15:17	54°16.710	08°24.903	start profile (SSS; SES)
32	30.06.2016	16:40	54°16.753	08°14.192	end profile (SSS; SES)
33	30.06.2016	16:44	54°16.853	08°14.200	start profile (SSS; SES)
33	30.06.2016	18:08	54°16.806	08°24.963	end profile (SSS; SES)
34	30.06.2016	18:15	54°16.904	08°24.655	start profile (SSS; SES)
34	30.06.2016	19:36	54°16.940	08°14.170	end profile (SSS; SES)
35	30.06.2016	19:41	54°17.041	08°14.226	start profile (SSS; SES)
35	30.06.2016	21:01	54°16.994	08°24.490	end profile (SSS; SES)
36	30.06.2016	21:08	54°17.083	08°24.283	start profile (SSS; SES)
36	30.06.2016	22:27	54°17.105	08°14.359	end profile (SSS; SES)
37	30.06.2016	22:34	54°17.262	08°14.103	start profile (SSS; SES)
37	30.06.2016	23:50	54°17.205	08°23.939	end profile (SSS; SES)
38	30.06.2016	23:55	54°17.256	08°23.960	start profile (SSS; SES)
38	01.07.2016	01:09	54°17.299	08°14.310	end profile (SSS; SES)
39	01.07.2016	01:15	54°17.446	08°14.114	start profile (SSS; SES)
39	01.07.2016	02:36	54°17.366	08°23.579	end profile (SSS; SES)
40	01.07.2016	02:43	54°17.453	08°23.273	start profile (SSS; SES)
40	01.07.2016	04:03	54°17.530	08°14.205	end profile (SSS; SES)
41	01.07.2016	04:08	54°17.630	08°14.225	start profile (SSS; SES)
41	01.07.2016	05:26	54°17.544	08°22.996	end profile (SSS; SES)
42	01.07.2016	16:46	54°11.327	08°26.727	start profile (SSS; SES)
42	01.07.2016	18:35	54°11.245	08°11.245	end profile (SSS; SES)
43	01.07.2016	18:39	54°11.156	08°14.266	start profile (SSS; SES)
43	01.07.2016	20:29	54°11.230	08°27.177	end profile (SSS; SES)
44	01.07.2016	20:38	54°11.117	08°27.381	start profile (SSS; SES)
44	01.07.2016	22:27	54°11.035	08°14.348	end profile (SSS; SES)
45	01.07.2016	22:32	54°10.985	08°14.204	start profile (SSS; SES)
45	02.07.2016	00:25	54°11.032	08°27.404	end profile (SSS; SES)
46	02.07.2016	00:28	54°10.904	08°27.624	start profile (SSS; SES)
46	02.07.2016	02:21	54°10.856	08°14.268	end profile (SSS; SES)
47	02.07.2016	02:26	54°10.764	08°14.287	start profile (SSS; SES)
47	02.07.2016	04:18	54°10.823	08°27.528	end profile (SSS; SES)
48	02.07.2016	04:24	54°10.727	08°27.519	start profile (SSS; SES)

48	02.07.2016	06:22	54°10.658	08°14.256	end profile (SSS; SES)
49	02.07.2016	06:26	54°10.557	08°14.280	start profile (SSS; SES)
49	02.07.2016	08:08	54°10.625	08°27.528	end profile (SSS; SES)
50	02.07.2016	08:15	54°10.528	08°27.520	start profile (SSS; SES)
50	02.07.2016	10:04	54°10.441	08°14.390	end profile (SSS; SES)
51	02.07.2016	10:09	54°10.404	08°14.194	start profile (SSS; SES)
51	02.07.2016	12:00	54°10.455	08°27.444	end profile (SSS; SES)
52	02.07.2016	12:05	54°10.312	08°27.586	start profile (SSS; SES)
52	02.07.2016	13:46	54°10.241	08°14.453	end profile (SSS; SES)
53	02.07.2016	16:52	54°10.220	08°14.205	start profile (SSS; SES)
53	02.07.2016	15:34	54°10.238	08°27.473	end profile (SSS; SES)
54	02.07.2016	15:39	54°10.142	08°27.305	start profile (SSS; SES)
54	02.07.2016	17:23	54°10.078	08°14.278	end profile (SSS; SES)
55	02.07.2016	17:27	54°09.980	08°14.265	start profile (SSS; SES)
55	02.07.2016	19:09	54°10.046	08°27.355	end profile (SSS; SES)
56	02.07.2016	19:20	54°09.934	08°26.901	start profile (SSS; SES)
56	02.07.2016	21:11	54°09.891	08°14.242	end profile (SSS; SES)
57	02.07.2016	21:16	54°09.782	08°14.304	start profile (SSS; SES)
57	02.07.2016	22:47	54°09.860	08°25.954	end profile (SSS; SES)
58	02.07.2016	22:54	54°09.719	08°25.825	start profile (SSS; SES)
58	03.07.2016	00:21	54°09.668	08°14.401	end profile (SSS; SES)
59	03.07.2016	00:25	54°09.620	08°14.193	start profile (SSS; SES)
59	03.07.2016	01:56	54°09.669	08°25.532	end profile (SSS; SES)
60	03.07.2016	02:01	54°09.954	08°25.259	start profile (SSS; SES)
60	03.07.2016	03:30	54°09.494	08°14.282	end profile (SSS; SES)
61	03.07.2016	03:35	54°09.401	08°14.284	start profile (SSS; SES)
61	03.07.2016	05:01	54°09.440	08°25.292	end profile (SSS; SES)
62	03.07.2016	05:06	54°09.442	08°25.329	start profile (SSS; SES)
62	03.07.2016	06:40	54°09.297	08°14.285	end profile (SSS; SES)
63	03.07.2016	06:46	54°09.207	08°14.331	start profile (SSS; SES)
63	03.07.2016	08:08	54°09.241	08°25.045	end profile (SSS; SES)
64	03.07.2016	08:15	54°09.142	08°24.806	start profile (SSS; SES)
64	03.07.2016	09:42	54°09.108	08°14.308	end profile (SSS; SES)
65	03.07.2016	09:45	54°09.047	08°14.218	start profile (SSS; SES)
65	03.07.2016	11:06	54°09.077	08°24.598	end profile (SSS; SES)
66	03.07.2016		54°08.911	08°24.354	start profile (SSS; SES)
66	03.07.2016	12:31	54°08.875	08°14.395	end profile (SSS; SES)
67	03.07.2016	12:34	54°08.837	08°14.159	start profile (SSS; SES)
67	03.07.2016	13:53	54°08.856	08°.24.128	end profile (SSS; SES)
68	03.07.2016	13:58	54°08.755	08°23.985	start profile (SSS; SES)
68	03.07.2016	15:14	54°08.723	08°14.315	end profile (SSS; SES)
69	03.07.2016	15:19	54°08.625	08°14.303	start profile (SSS; SES)
69	03.07.2016	16:24	54°08.652	08°22.645	end profile (SSS; SES)
70	03.07.2016	16:28	54°08.543	08°22.611	start profile (SSS; SES)
70	03.07.2016	17:36	54°08.524	08°14.305	end profile (SSS; SES)
71	03.07.2016	20:02	54°06.232	08°29.037	start profile (SSS; SES)
71	03.07.2016				end profile (SSS; SES)
72	03.07.2016	20:04	54°06.200	08°29.326	start profile (SSS; SES)
72	03.07.2016	22:18	54°06.058	08°14.441	end profile (SSS; SES)

73	03.07.2016	22:22	54°05.990	08°14.287	start profile (SSS; SES)
73	04.07.2016	00:09	54°06.063	08°26.730	end profile (SSS; SES)
74	04.07.2016	00:12	54°05.918	08°26.905	start profile (SSS; SES)
74	04.07.2016	01:59	54°05.879	08°14.355	end profile (SSS; SES)
75	04.07.2016	02:05	54°05.794	08°14.359	start profile (SSS; SES)
75	04.07.2016	03:53	54°05.848	08°26.820	end profile (SSS; SES)
76	04.07.2016	03:57	54°05.757	08°26.818	start profile (SSS; SES)
76	04.07.2016	05:00	54°05.716	08°19.695	interruption of profile (SSS; SES)
76	04.07.2016	16:16	54°05.714	08°19.670	restart of profile (SSS; SES)
76	04.07.2016	17:00	54°05.685	08°14.358	end profile (SSS; SES)
77	04.07.2016	17:05	54°05.589	08°14.357	start profile (SSS; SES)
77	04.07.2016	19:06	54°05.656	08°29.989	end profile (SSS; SES)
78	04.07.2016	19:18	54°05.908	08°30.589	start profile (SSS; SES)
78	04.07.2016	21:26	54°05.492	08°14.381	end profile (SSS; SES)
79	04.07.2016	21:31	54°05.397	08°14.374	start profile (SSS; SES)
79	04.07.2016	23:04	54°05.467	08°25.369	end profile (SSS; SES)
80	04.07.2016	23:17	54°05.326	08°24.492	start profile (SSS; SES)
80	05.07.2016	00:43	54°05.287	08°14.503	end profile (SSS; SES)
81	05.07.2016	00:48	54°05.252	08°14.321	start profile (SSS; SES)
81	05.07.2016	02:16	54°05.260	08°24.314	end profile (SSS; SES)
82	05.07.2016	02:22	54°05.165	08°24.215	start profile (SSS; SES)
82	05.07.2016	03:46	54°05.115	08°14.369	end profile (SSS; SES)
83	05.07.2016	03:53	54°05.024	08°14.369	start profile (SSS; SES)
83	05.07.2016	05:12	54°05.060	08°23.883	end profile (SSS; SES)
84	07.07.2016	16:34	54°04.172	08°14.412	start profile (SSS; SES)
84	07.07.2016	17:53	54°04.215	08°23.525	end profile (SSS; SES)
85	07.07.2016	18:13	54°04.151	08°25.129	start profile (SSS; SES)
85	07.07.2016	19:46	54°04.083	08°14.395	end profile (SSS; SES)
86	07.07.2016	19:53	54°03.980	08°14.414	start profile (SSS; SES)
86	07.07.2016	21:21	54°04.035	08°24.617	end profile (SSS; SES)
87	07.07.2016	21:26	54°03.395	08°24.599	start profile (SSS; SES)
87	07.07.2016	22:54	54°03.859	08°14.529	end profile (SSS; SES)
88	07.07.2016	22:58	54°03.800	08°14.359	start profile (SSS; SES)
88	08.07.2016	00:20	54°03.853	08°24.695	end profile (SSS; SES)
89	08.07.2016	00:27	54°03.709	08°24.631	start profile (SSS; SES)
89	08.07.2016	01:57	54°03.671	08°14.471	end profile (SSS; SES)
90	08.07.2016	02:04	54°03.590	08°14.428	start profile (SSS; SES)
90	08.07.2016	03:33	54°03.632	08°24.402	end profile (SSS; SES)
91	08.07.2016	03:38	54°03.532	08°24.383	start profile (SSS; SES)
91	08.07.2016	05:05	54°03.495	08°14.401	end profile (SSS; SES)
92	08.07.2016	06:06	54°04.952	08°21.718	start profile (SSS; SES)
92	08.07.2016	09:19	54°19.607	08°21.750	end profile (SSS; SES)
93	08.07.2016	09:22	54°19.607	08°21.602	start profile (SSS; SES)
93	08.07.2016	12:24	54°05.014	08°21.615	end profile (SSS; SES)

Tab 2.: Stations Grab Sampling

Station	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]	Remarks
1	01.07.2016	06:14	54°14.798	08°25.046	13.40	grab_sieved_2mm
2	01.07.2016	06:32	54°14.829	08°24.580	13.88	grab_sieved_2mm
3	01.07.2016	06:43	54°14.707	08°24.349	12.89	grab_sieved_2mm
4	01.07.2016	06:54	54°14.793	08°24.017	13.21	grab_sieved_2mm
5	01.07.2016	07:08	54°15.480	08°23.970	13.48	grab_sieved_2mm
6	01.07.2016	07:26	54°15.461	08°24.458	13.25	grab_sieved_2mm
7	01.07.2016	07:49	54°15.581	08°26.832	12.86	grab_sieved_2mm
8	01.07.2016	08:07	54°15.860	08°26.128	13.25	grab_sieved_2mm
9	01.07.2016	08:18	54°16.513	08°25.668	12.85	grab_sieved_2mm
10	01.07.2016	08:42	54°16.651	08°23.372	13.40	grab_sieved_2mm
11	01.07.2016	08:52	54°16.650	08°23.219	13.94	grab_sieved_2mm
12	01.07.2016	09:09	54°16.483	08°22.102	13.92	grab_sieved_2mm
13	01.07.2016	09:48	54°16.428	08°21.821	13.85	grab_sieved_2mm
14	01.07.2016	10:02	54°15.966	08°22.382	13.25	grab_sieved_2mm
15	01.07.2016	10:19	54°15.574	08°23.027	13.58	grab_sieved_2mm
16	01.07.2016	10:33	54°15.548	08°21.701	13.77	grab_sieved_2mm
17	01.07.2016	10:42	54°15.379	08°21.860	13.04	grab_sieved_2mm
18	01.07.2016	10:54	54°14.761	08°21.547	13.46	grab_sieved_2mm
19	01.07.2016	11:10	54°14.516	08°20.375	14.44	grab_sieved_2mm
20	01.07.2016	11:25	54°15.341	08°20.869	13.42	grab_sieved_2mm
21	01.07.2016	11:37	54°15.556	08°20.439	13.21	grab_sieved_2mm
22	01.07.2016	11:54	54°15.611	08°19.470	13.33	grab_sieved_2mm
23	01.07.2016	12:09	54°14.619	08°19.341	14.50	grab_sieved_2mm
24	01.07.2016	12:24	54°14.874	08°18.093	14.29	grab_sieved_2mm
25	01.07.2016	12:37	54°14.814	08°15.729	12.46	grab_sieved_2mm
26	01.07.2016	12:46	54°14.977	08°15.312	13.17	grab_sieved_2mm
27	01.07.2016	12:58	54°14.887	08°14.075	16.00	grab_sieved_2mm
28	01.07.2016	13:17	54°16.558	08°14.283	13.90	grab_sieved_2mm
29	01.07.2016	13:31	54°15.937	08°15.365	12.23	grab_sieved_2mm
30	01.07.2016	13:47	54°15.592	08°17.102	12.38	grab_sieved_2mm
31	01.07.2016	13:52	54°15.799	08°17.550	17.00	grab_sieved_2mm
32	01.07.2016	14:12	54°16.576	08°18.507	17.30	grab_sieved_2mm
33	01.07.2016	14:19	54°16.551	08°18.584	17.20	grab_sieved_2mm
34	01.07.2016	14:47	54°19.230	08°15.205	19.20	grab_sieved_2mm
35	01.07.2016	15:07	54°18.992	08°17.043	18.80	grab_sieved_2mm
36	01.07.2016	15:14	54°19.007	08°17.006	18.70	grab_sieved_2mm
37	01.07.2016	15:26	54°19.452	08°17.837	17.90	grab_sieved_2mm
38	04.07.2016	06:32	54°19.004	08°19.177	13.28	grab_sieved_2mm

39	04.07.2016	06:47	54°19.043	08°21.479	10.21	grab_sieved_2mm
40	04.07.2016	07:00	54°19.566	08°22.238	9.80	grab_sieved_2mm
41	04.07.2016	07:14	54°19.643	08°23.914	11.40	grab_sieved_2mm
42	04.07.2016	07:27	54°19.235	08°23.867	11.23	grab_sieved_2mm
43	04.07.2016	07:36	54°19.377	08°24.469	11.25	grab_sieved_2mm
44	04.07.2016	07:46	54°19.564	08°25.077	11.84	grab_sieved_2mm
45	04.07.2016	07:53	54°19.611	08°25.191	12.45	grab_sieved_2mm
46	04.07.2016	08:17	54°16.851	08°24.918	12.61	grab_sieved_2mm
47	04.07.2016	08:27	54°16.935	08°23.763	13.27	grab_sieved_2mm
48	04.07.2016	08:38	54°17.383	08°23.739	13.34	grab_sieved_2mm
49	04.07.2016	08:49	54°17.294	08°22.616	14.18	grab_sieved_2mm
50	04.07.2016		54°17.564	08°20.779	15.22	grab_sieved_2mm
51	04.07.2016	09:14	54°16.945	08°21.026	14.56	grab_sieved_2mm
52	04.07.2016	12:36	54°16.832	08°20.234	15.34	grab_sieved_2mm
53	04.07.2016	12:48	54°17.026	08°19.921	15.03	grab_sieved_2mm
54	04.07.2016	12:57	54°17.360	08°18.055	16.01	grab_sieved_2mm
55	04.07.2016	13:11	54°16.778	08°16.466	15.81	grab_sieved_2mm
56	04.07.2016	13:21	54°17.249	08°15.339	15.86	grab_sieved_2mm
57	04.07.2016	14:16	54°08.640	08°14.469	21.30	grab_sieved_2mm
58	04.07.2016	14:32	54°09.888	08°14.815	21.20	grab_sieved_2mm
59	04.07.2016	14:44	54°10.452	08°15.179	21.10	grab_sieved_2mm
60	04.07.2016	14:57	54°10.933	08°17.043	19.10	grab_sieved_2mm
61	04.07.2016	15:08	54°10.300	08°16.879	20.30	grab_sieved_2mm
62	04.07.2016	15:23	54°09.691	08°15.989	20.00	grab_sieved_2mm
63	05.07.2016	06:49	54°05.993	08°30.036	11.20	grab_sieved_2mm
64	05.07.2016	07:01	54°06.213	08°29.392	10.60	grab_sieved_2mm
65	05.07.2016	07:15	54°05.608	08°28.722	11.23	grab_sieved_2mm
66	05.07.2016	07:23	54°06.184	08°28.362	12.12	grab_sieved_2mm
67	05.07.2016	07:36	54°06.144	08°26.867	14.60	grab_sieved_2mm
68	05.07.2016	07:47	54°05.889	08°26.484	15.28	grab_sieved_2mm
69	05.07.2016	07:58	54°05.684	08°25.113	15.10	grab_sieved_2mm
70	05.07.2016	08:10	54°05.931	08°24.795	15.58	grab_sieved_2mm
71	05.07.2016	08:18	54°06.091	08°24.133	15.73	grab_sieved_2mm
72	07.07.2016	07:18	54°05.713	08°14.576	16.44	grab_sieved_2mm
73	07.07.2016	07:29	54°06.119	08°14.919	16.45	grab_sieved_2mm
74	07.07.2016	07:42	54°09.978	08°16.583	15.15	grab_sieved_2mm
75	07.07.2016	07:52	54°05.631	08°17.894	16.11	grab_sieved_2mm
76	07.07.2016	08:10	54°06.141	08°18.616	15.31	grab_sieved_2mm
77	07.07.2016	08:29	54°06.099	08°19.689	15.41	grab_sieved_2mm
78	07.07.2016	08:44	54°05.666	08°21.405	15.79	grab_sieved_2mm
79	07.07.2016	08:57	54°09.608	08°22.983	15.90	grab_sieved_2mm
80	07.07.2016	09:07	54°06.009	08°22.025	15.59	grab_sieved_2mm

81	07.07.2016	09:57	54°05.601	08°27.606	12.50	grab_sieved_2mm
82	07.07.2016	10:20	54°05.331	08°24.478	13.80	grab_sieved_2mm
83	07.07.2016	10:32	54°05.376	08°22.958	16.06	grab_sieved_2mm
84	07.07.2016	10:50	54°05.156	08°20.553	16.69	grab_sieved_2mm
85	07.07.2016	11:00	54°05.449	08°20.123	18.09	grab_sieved_2mm
86	07.07.2016	11:06	54°05.511	08°20.122	18.57	grab_sieved_2mm
87	07.07.2016	11:12	54°05.587	08°20.113	18.22	grab_sieved_2mm
88	07.07.2016	11:26	54°05.426	08°18.895	18.34	grab_sieved_2mm
89	07.07.2016	11:38	54°05.400	08°17.283	18.87	grab_sieved_2mm
90	07.07.2016	11:56	54°09.124	08°14.800	18.94	grab_sieved_2mm
91	07.07.2016	12:23	54°08.661	08°16.351	18.78	grab_sieved_2mm
92	07.07.2016	12:40	54°09.271	08°18.076	17.98	grab_sieved_2mm
93	07.07.2016	12:54	54°10.438	08°19.367	17.81	grab_sieved_2mm
94	07.07.2016	13:08	54°11.129	08°20.127	17.24	grab_sieved_2mm
95	07.07.2016	13:20	54°10.819	08°21.662	16.41	grab_sieved_2mm
96	07.07.2016	13:28	54°10.703	08°22.269	16.60	grab_sieved_2mm
97	07.07.2016	13:41	54°10.389	08°24.353	15.32	grab_sieved_2mm
98	07.07.2016	13:58	54°10.790	08°27.532	16.30	grab_sieved_2mm
99	07.07.2016	14:26	54°09.566	08°22.391	18.60	grab_sieved_2mm
100	07.07.2016	14:36	54°09.076	08°22.948	17.50	grab_sieved_2mm
101	07.07.2016	14:51	54°09.210	08°21.012	19.00	grab_sieved_2mm
102	07.07.2016	15:04	54°08.780	08°19.741	19.40	grab_sieved_2mm
103	08.07.2016	12:44	54°04.165	08°23.955	12.68	grab_sieved_2mm
104	08.07.2016	12:52	54°03.858	08°24.194	11.99	grab_sieved_2mm
105	08.07.2016	13:03	54°03.558	08°24.367	12.42	grab_sieved_2mm
106	08.07.2016	13:17	54°03.633	08°23.264	14.25	grab_sieved_2mm
107	08.07.2016	13:28	54°03.998	08°22.520	14.66	grab_sieved_2mm
108	08.07.2016	13:40	54°03.660	08°21.802	15.83	grab_sieved_2mm
109	08.07.2016	13:49	54°04.133	08°20.914	14.83	grab_sieved_2mm
110	08.07.2016	13:59	54°03.533	08°20.513	19.80	grab_sieved_2mm
111	08.07.2016	14:11	54°04.051	08°19.628	19.10	grab_sieved_2mm
112	08.07.2016	14:21	54°03.647	08°18.798	20.10	grab_sieved_2mm
113	08.07.2016	14:32	54°03.951	08°18.144	19.20	grab_sieved_2mm
114	08.07.2016	14:45	54°04.089	08°16.723	19.40	grab_sieved_2mm
115	08.07.2016	14:56	54°04.174	08°15.924	20.00	grab_sieved_2mm
116	08.07.2016	15:05	54°03.557	08°15.978	20.20	grab_sieved_2mm
117	08.07.2016	15:13	54°03.771	08°15.125	20.50	grab_sieved_2mm
118	08.07.2016	15:23	54°04.092	08°14.616	21.00	grab_sieved_2mm

Tab 3.: Stations Giant Grab Sampling

Station	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]	Remarks
1	04.07.2016	10:08	54°14.789	08°25.046	13.81	
2	04.07.2016	10:29	54°15.571	08°26.851	13.19	
3	04.07.2016	10:57	54°15.947	08°22.381	14.28	empty, second trial
	04.07.2016		54°15.952	08°22.370	14.23	
4	04.07.2016	11:47	54°19.458	08°17.821	16.72	
	04.07.2016	12:07	54°19.447	08°17.812	16.41	
5	05.07.2016	05:59	54°05.638	08°23.466	14.15	
6	05.07.2016	06:24	54°06.153	08°26.345	13.87	

Tab 4.: CTD stations

No	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]
1	28.06.2016	11:15	54°18.804	08°12.615	15
2	07.07.2016	15:15	54°08.730	08°19.741	16
3	07.07.2016	16:04	54°04.184	08°13.467	17
4	08.07.2016	15:35	54°04.092	08°14.616	18