FS Alkor AL-440 06/07 2014
(30.06.-12.07.2014)

Cruise Report / Fahrtbericht

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

Teilprojekt STopP-See

Institut für Geowissenschaften
Sedimentologie, Küsten- und Schelfgeologie

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1. Objective of the cruise

The cruise was carried out in the frame of the BMBF-funded project STopP (Vom Sediment zum Topp-Prädator – Einfluss von Eigenschaften des Meeresbodens auf Benthos und benthivore Vögel). The objective of this cruise was to collect high resolution data of the geological structure and physical properties of the seabottom sediments in the STopP-Sea area around Amrumbank (North Sea, see fig. 1). This knowledge will be used to improve the understanding of the interrelation between sea surface and subsurface properties associated with benthic organisms and their influence as source of food for sea birds.

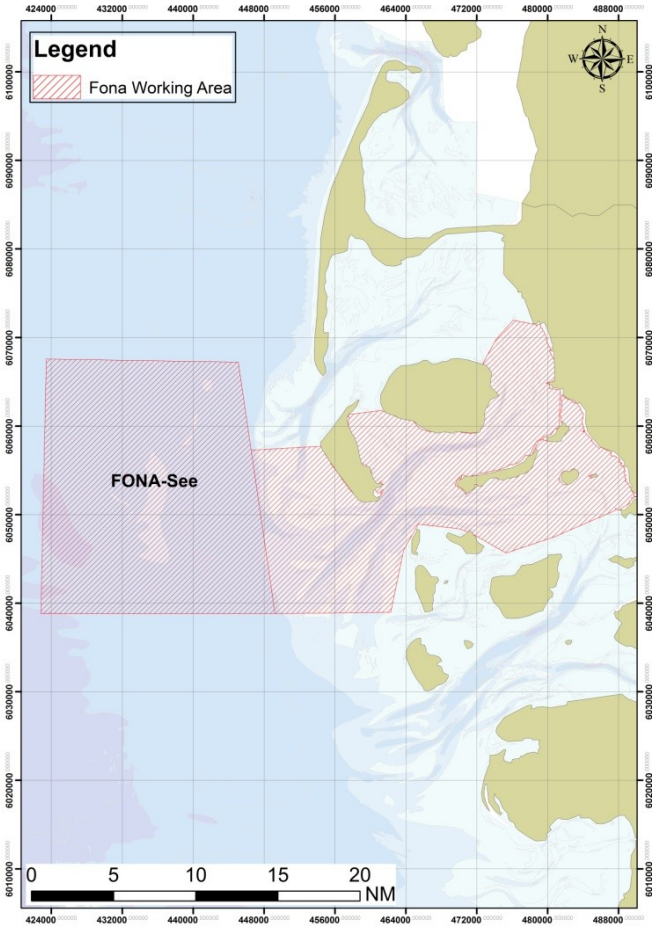

Figure 1: Working areas STopP-subtidal (FONA-See)

2. Abbrevations used in this report:

Benthos C3D - Side-Scan Sonar (towed)	**SSS**
Benthos C3D - Subbottom Profiler (towed)	**SBP**
Benthos 1624 - Side-Scan Sonar (towed)	**SSS 1624**
Parametraic Subbottom Profiler (Innomar)	**SES**
Grab Sampler	**GS**
Giant Grab Sampler	**GGS**
Underwater Video	**UWV**
CTD	**CTD**

3. Participants of the cruise:

1. **Dr. Klaus Schwarzer** (chief scientist), Inst. of Geosciences, Kiel University
2. **Kerstin Wittbrodt** (PhD student, scientist), Inst. of Geosciences, Kiel University
3. **Dr. Peter Richter** (scientist), Inst. of Geosciences, Kiel University
4. **Gitta Ann von Rönn** (PhD student, scientist), Inst. of Geosciences, Kiel University
5. **Adrian Metzgen** (scientist), Inst. of Geosciences, Kiel University
6. **Jakob Mager** (scientist), Inst. of Geosciences, Kiel University
7. **Eric Steen** (technician), Inst. of Geosciences, Kiel University (30.06.-04.07.2014)
8. **Sabine Horn** (PhD student, scientist), AWI List/Sylt
9. **Cosima Merkel** (MSc stduent, scientist), AWI List/Sylt
10. **Maria Alexandra Ruales Guerra** (scientist), Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein

4. CRUISE NARRATIVE

Mo. 30.06.2014

Weather:	sunny, partly cloudy, NW 4
07:20	Departing Kiel (SH), transit through Kiel Canal
17:00	Arrival Brunsbüttel

Tu. 01.07.2014

Weather	cloudy, NW 4
05:30	Departing Brunsbüttel, heading for working area
12:35	CTD profile
12:45	Deployment of devices (C3D)

We. 02.07.2014

Weather:	cloudy, NW 5
08:23	Devices out of water
08:38	CTD profile
10:24	Start of grab sampling
14:45	End of grab sampling
15:56	GGS (1 station)
17:00	Deployment of devices (C3D)

Th. 03.07.2014

Weather:	cloudy, SW 6
09:27	Devices out of water
10:05	CTD profile
10:53	Start of grab sampling
15:10	End of grab sampling
15:45	Deployment of devices (C3D)

Fr. 04.07.2014

Weather: sunny, S-SW 5
05:00 Devices out of water
06:04 Start of GGS sampling
08:53 End of GGS sampling, transit to Helgoland
12:00 Arrival Helgoland
15:00 Departing Helgoland, heading for working area
18:05 Deployment of devices (C3D)

Sa. 05.07.2014

Weather: cloudy, foggy, SE 4
13:20 Devices out of water
13:25 CTD profile
13:35 Underwater Video Station
14:45 Underwater Video Station
15:07 Underwater Video Station
15:35 Underwater Video Station
15:58 Underwater Video Station
16:30 Deployment of devices (C3D)

Su. 06.07.2014

Weather: cloudy, SE 3
06:10 Devices out of water
06:25 Start of grab sampling
13:10 End of grab sampling
13:25 CTD profile
14:00 Deployment of devices (C3D)

Mo. 07.07.2014

Weather: cloudy - sunny, SW 4
06:15 Devices out of water
06:30 Start of GGS sampling
10:10 End of GGS sampling
10:55 CTD profile
11:05 Deployment of devices (C3D)

Tu. 08.07.2014

Weather cloudy, NE 4
05:20 Devices out of water,
05:25 CTD profile, transit to Helgoland due to increasing bad weather conditions
08:30 Arrival Helgoland

We. 09.07.2014

Weather: cloudy, NE 3
05:30 Departing Helgoland, heading for working area
07:50 CTD profile
08:00 Deployment of devices (C3D), profiling

Th. 10.07.2014

Weather: sunny, NE 4
06:10 Devices out of water
06:20 Start of grab sampling
14:35 End of grab sampling
15:44 Underwater Video station
16:10 Underwater Video station
17:05 Deployment of devices (C3D)

Fr. 11.07.2014

Weather: sunny, NE 5
04:40 Devices out of water
05:07 Start of GGS sampling
05:45 End of GGS sampling
05:50 Transit back to Kiel via Kiel Kanal
21:30 Arrival at Kiel GEOMAR Pier

Sa. 12.07.2014

Weather: cloudy-partly sunny
06:00 Unloading of FS Alkor at GEOMAR Pier

Tab. 1: Hydroacoustic profiling

No	Date	Time (UTC)	Latitude	Longitude	Remarks
1	01.07.2014	13:19	54°29.529'	08°03.977'	start profile
1	01.07.2014	16:21	54°44.846'	08°03.53'	end profile
2	01.07.2014	16:29	54°45.065'	08°03.668'	start profile
2	01.07.2014	19:33	54°29.547'	08°04.143'	end profile
3	01.07.2014	19:41	54°29.576'	08°04.318'	start profile
3	01.07.2014	22:47	54°44.856'	08°03.858'	end profile
4	01.07.2014	22:59	54°45.040'	08°04.049'	start profile
4	02.07.2014	02:03	54°29.601'	08°04.475'	end profile
5	02.07.2014	02:15	54°29.444'	08°04.668'	start profile
5	02.07.2014	05:17	54°44.941'	08°04.183'	end profile
6	02.07.2014	05:23	54°45.040'	08°04.330'	start profile
6	02.07.2014	08:23	54°29.568'	08°04.812'	end profile
7	02.07.2014	17:09	54°29.872'	08°05.478'	start profile
7	02.07.2014	20:23	54°44.997'	08°04.523'	end profile
8	02.07.2014	20:30	54°44.960'	08°04.681'	start profile
8	02.07.2014	23:39	54°29.636'	08°05.144'	end profile
9	02.07.2014	23:51	54°29.543'	08°05.330'	start profile
9	03.07.2014	02:57	54°44.913'	08°04.875'	end profile
10	03.07.2014	03:05	54°45.032'	08°05.027'	start profile
10	03.07.2014	06:08	54°29.569'	08°05.470'	end profile
11	03.07.2014	06:15	54°29.585'	08°05.640'	start profile
11	03.07.2014	09:23	54°44.997'	08°05.187'	end profile
12	03.07.2014	16:02	54°29.531'	08°05.790'	start profile
12	03.07.2014	19:04	54°44.987'	08°05.359'	end profile
13	03.07.2014	19:11	54°44.978'	08°05.538'	start profile
13	03.07.2014	22:16	54°29.662'	08°05.979'	end profile

14	03.07.2014	22:27	54°29.549'	08°06.141'	start profile
14	04.07.2014	01:39	54°44.927'	08°05.698'	end profile
15	04.07.2014	01:48	54°45.076'	08°05.901'	start profile
15	04.07.2014	04:54	54°29.675'	08°06.306'	end profile
16	04.07.2014	18:18	54°29.523'	08°06.455'	start profile
16	04.07.2014	21:23	54°44.970'	08°06.036'	end profile
17	04.07.2014	21:29	54°44.992'	08°06.206'	start profile
17	05.07.2014	00:39	54°29.654'	08°06.647'	end profile
18	05.07.2014	00:50	54°29.568'	08°06.831'	start profile
18	05.07.2014	03:50	54°44.906'	08°06.378'	end profile
19	05.07.2014	03:58	54°45.054'	08°06.541'	start profile
19	05.07.2014	07:04	54°29.580'	08°06.981'	end profile
20	05.07.2014	07:09	54°29.584'	08°07.148'	start profile
20	05.07.2014	10:11	54°44.928'	08°06.711'	end profile
21	05.07.2014	10:20	54°45.062'	08°06.854'	start profile
21	05.07.2014	13:15	54°29.622'	08°07.323'	end profile
22	05.07.2014	16:47	54°46.102'	08°07.015'	start profile
22	05.07.2014	20:03	54°29.599'	08°07.470'	end profile
23	05.07.2014	20:09	54°29.620'	08°07.611'	start profile
23	05.07.2014	23:26	54°46.003'	08°07.184'	end profile
24	05.07.2014	23:34	54°45.961'	08°07.427'	start profile
24	06.07.2014	02:43	54°29.706'	08°07.809'	end profile
25	06.07.2014	02:51	54°29.528'	08°08.006'	start profile
25	06.07.2014	06:04	54°45.997'	08°07.503'	end profile
26	06.07.2014	16:57	54°29.520'	08°08.155'	start profile
26	06.07.2014	20:11	54°46.008'	08°07.682'	end profile
27	06.07.2014	20:18	54°45.994'	08°07.847'	start profile
27	06.07.2014	23:31	54°29.653'	08°08.317'	end profile
28	06.07.2014	23:38	54°29.572'	08°08.467'	start profile
28	07.07.2014	02:53	54°45.928'	08°08.021'	end profile
29	07.07.2014	03:00	54°46.093'	08°08.160'	start profile
29	07.07.2014	06:15	54°29.606'	08°08.645'	end profile
30	07.07.2014	11:12	54°45.826'	08°08.371'	start profile
30	07.07.2014	14:25	54°29.668'	08°08.812'	end profile
31	07.07.2014	14:43	54°29.497'	08°08.951'	start profile
31	07.07.2014	18:04	54°46.004'	08°08.546'	end profile
32	07.07.2014	18:11	54°45.983'	08°08.730'	start profile
32	07.07.2014	21:34	54°29.608'	08°09.157'	end profile
33	07.07.2014	21:40	54°29.637'	08°09.319'	start profile
33	08.07.2014	01:11	54°45.947'	08°08.880'	end profile
34	08.07.2014	01:17	54°46.034'	08°09.012'	start profile
34	08.07.2014	04:30	54°29.713'	08°09.489'	end profile
35	08.07.2014	04:38	54°29.530'	08°09.661'	start profile
35	08.07.2014	04:57	54°31.105'	08°09.614'	profile interrupted
35	09.07.2014	08:05	54°30.633'	08°09.603'	profile restart
35	09.07.2014	11:07	54°45.970'	08°09.226'	end profile
36	09.07.2014	11:14	54°46.014'	08°09.385'	start profile
36	09.07.2014	14:26	54°29.642'	08°09.812'	end profile
37	09.07.2014	14:36	54°29.530'	08°09.996'	start profile
37	09.07.2014	17:50	54°45.939'	08°09.557'	end profile

38	09.07.2014	17:56	54°46.094'	08°09.741'	start profile
38	09.07.2014	20:58	54°29.614'	08°10.154'	end profile
39	09.07.2014	21:01	54°29.372'	08°10.225'	start profile
39	09.07.2014	23:58	54°45.967'	08°09.879'	end profile
40	10.07.2014	00:06	54°46.026'	08°10.044'	start profile
40	10.07.2014	02:58	54°29.687'	08°10.488'	end profile
41	10.07.2014	03:08	54°29.572'	08°10.639'	start profile
41	10.07.2014	06:02	54°46.009'	08°10.199'	end profile
42	10.07.2014	17:14	54°45.910'	08°00.142'	start profile
42	10.07.2014	20:21	54°30.052'	08°00.636'	end profile
43	10.07.2014	20:28	54°29.983'	08°00.464'	start profile
43	10.07.2014	23:28	54°45.826'	07°59.972'	end profile
44	10.07.2014	23:38	54°45.842'	07°59.796'	start profile
44	11.07.2014	02:36	54°30.029'	08°00.301'	end profile
45	11.07.2014	02:44	54°29.878'	08°00.132'	start profile
45	11.07.2014	04:31	54°38.807'	07°59.880'	profile interrupted

Tab. 2: Stations Grab Sampling

Station	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]	Remarks
1	02.07.2014	10:24	54°29.686'	08°04.282'	17.46	biology sample
2	02.07.2014	11:06	54°32.012'	08°04.218'	16.49	biology sample
3	02.07.2014	11:50	54°34.792'	08°04.014'	16.62	biology sample
4	02.07.2014	12:28	54°37.196'	08°04.036'	13.93	biology sample
5	02.07.2014	12:52	54°37.590'	08°03.981'	13.65	biology sample
6	02.07.2014	13:32	54°40.387'	08°04.052'	11.23	biology sample
7	02.07.2014	14:17	54°44.247'	08°03.808'	13.92	biology sample
8	02.07.2014	14:42	54°44.652'	08°03.790'	13.66	biology sample
9	03.07.2014	10:53	54°44.745'	08°04.645'	13.61	biology sample
10	03.07.2014	11:22	54°43.483'	08°05.253'	9.82	biology sample
11	03.07.2014	11:56	54°41.523'	08°04.999'	11.71	biology sample
12	03.07.2014	12:20	54°40.917'	08°04.568'	11.31	biology sample
13	03.07.2014	13:17	54°35.518'	08°05.188'	15.48	biology sample
14	03.07.2014	13:38	54°35.331'	08°04.852'	16.08	biology sample
15	03.07.2014	13:59	54°35.147'	08°05.162'	15.65	biology sample
16	03.07.2014	14:28	54°34.082'	08°05.029'	16.21	biology sample
17	03.07.2014	14:52	54°33.518'	08°05.548'	15.97	biology sample
18	06.07.2014	06:35	54°44.859'	08°06.614'	12.2	biology sample
19	06.07.2014	07:18	54°41.079'	08°06.689'	15.4	biology sample
20	06.07.2014	07:49	54°39.843'	08°05.814'	15.1	biology sample
21	06.07.2014	08:05	54°39.797'	08°05.830'	14.95	/
22	06.07.2014	08:22	54°39.756'	08°06.882'	14.3	/
23	06.07.2014	08:32	54°39.700'	08°06.745'	14.2	biology sample
24	06.07.2014	08:57	54°38.697'	08°06.487'	15	biology sample

25	06.07.2014	09:18	54°38.712'	08°06.520'	14.4	/
26	06.07.2014	10:01	54°38.107'	08°05.884'	13.61	biology sample
27	06.07.2014	10:21	54°38.062'	08°05.845'	13.66	biology sample
28	06.07.2014	10:50	54°36.475'	08°07.102'	11.74	biology sample
29	06.07.2014	11:27	54°34.094'	08°06.732'	12.53	biology sample
30	06.07.2014	12:07	54°30.892'	08°06.714'	15.03	biology sample
31	06.07.2014	12:49	54°29.727'	08°06.400'	16.44	biology sample
32	06.07.2014	13:10	54°29.837'	08°06.705'	16.31	biology sample
33	10.07.2014	06:20	54°45.688'	08°09.229'	11.59	biology sample
34	10.07.2014	06:48	54°44.621'	08°08.781'	13.9	biology sample
35	10.07.2014	07:20	54°42.947'	08°06.788'		biology sample
36	10.07.2014	07:49	54°41.699'	08°09.043'	13.7	biology sample
37	10.07.2014	08:18	54°40.716'	08°07.548'	14.9	biology sample
38	10.07.2014	08:41	54°40.388'	08°07.135'	15	biology sample
39	10.07.2014	08:59	54°40.293'	08°07.194'	14.9	biology sample
40	10.07.2014	09:43	54°39.200'	08°08.717'	13.9	biology sample
41	10.07.2014	10:04	54°38.766'	08°09.063'	14.3	/
42	10.07.2014	10:20	54°38.335'	08°09.538'	13.2	biology sample
43	10.07.2014	10:46	54°37.783'	08°08.167'	13.77	biology sample
44	10.07.2014	11:17	54°36.863'	08°08.105'	14.29	/
45	10.07.2014	11:26	54°36.853'	08°07.993'	13.88	biology sample
46	10.07.2014	11:54	54°35.185'	08°08.185'	12.7	biology sample
47	10.07.2014	12:20	54°33.788'	08°09.177'	12.62	biology sample
48	10.07.2014	12:46	54°32.296'	08°08.944'	13.98	biology sample
49	10.07.2014	13:26	54°31.477'	08°07.542'	15.08	biology sample
50	10.07.2014	13:46	54°31.304'	08°07.760'	14.55	/
51	10.07.2014	14:05	54°30.208'	08°08.290'	14.5	biology sample
52	10.07.2014	14:33	54°29.338'	08°09.585'	14.7	biology sample

Tab.3: Stations Box Corer Sampling

Station	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]	Remarks
1	02.07.2014	15:56	54°37.606'	08°03.981'	13.41	
2	04.07.2014	06:04	54°37.500'	08°03.929'	13.3	empty, second trial
	04.07.2014	06:12	54°37.485'	08°03.928'	13.2	
3	04.07.2014	06:39	54°35.516'	08°05.169'	14.53	
4	04.07.2014	07:02	54°34.811'	08°03.792'	15.7	empty, second trial
	04.07.2014	07:10	54°34.812'	08°03.797'	15.4	
5	04.07.2014	07:41	54°33.512'	08°05.545'	14.2	2 GGS
	04.07.2014	07:46	54°33.500'	08°05.530'	13.95	
6	04.07.2014	08:23	54°32.010'	08°04.395'	16.1	

	04.07.2014	08:41	54°32.019'	08°04.368'	15.8	empty, third trial
	04.07.2014	08:53	54°32.037'	08°04.359'	15.9	
7	07.07.2014	06:32	54°29.839'	08°06.724'	17.72	
8	07.07.2014	07:43	54°38.684'	08°06.512'	15.28	
9	07.07.2014	08:10	54°39.142'	08°06.718'	14.15	
10	07.07.2014	08:23	54°39.239'	08°06.717'	15.54	empty, second trial
	07.07.2014	08:31	54°39.232'	08°06.715'	15.04	empty, third trial
	07.07.2014	08:43	54°39.231'	08°06.708'	15.05	
11	07.07.2014	09:39	54°41.072'	08°06.687'	14.21	
12	07.07.2014	10:03	54°41.413'	08°06.477'	14.6	
13	11.07.2014	05:06	54°40.389'	08°07.121'	13.14	
14	11.07.2014	05:38	54°38.760'	08°09.074'	12.32	

Tab. 4: CTD stations

No	Date	Time (UTC)	Latitude	Longitude	Waterdepth [m]
1	01.07.2014	12:35	/	/	19.00
2	02.07.2014	08:38	54°29.536`	08°04.571`	16.80
3	03.07.2014	10:05	54°44.905`	08°05.034`	13.46
4	05.07.2014	15:20	54°29.371`	08°07.370`	17.00
5	06.07.2014	13:25	54°29.825`	08°06.656`	16.50
6	07.07.2014	10:55	/	/	/
7	08.07.2014	05:25	54°31.189`	08°09.615`	/
8	09.07.2014	07:50	54°30.207`	08°09.597`	16.05

Tab. 5: Video profiles

o	Date	Time [UTC]	Latitude	Longitude	Waterdepth [m]	Action
1	05.07.2014	13:55	54°33.013`	08°07.070`	15.00	start profile
	05.07.2014	14:09	54°33.004`	08°07,054`		end profile
2	05.07.2014	14:45	54°38.484`	08°06.194`	14.80	start profile
	05.07.2014	14:55	54°38.457`	08°06.377`		end profile
3	05.07.2014	15:07	54°38.945`	08°06.780`	15.43	start profile
	05.07.2014	15:17	54°39.035`	08°06.744`		end profile
4	05.07.2014	15:35	54°41,058`	08°06.680`	15.85	start profile
	05.07.2014		54°41.081`	08°06.655`		end profile
5	05.07.2014	15:58	54°43,509`	08°05.236`	11.30	start profile
	05.07.2014	16:06	54°43,519`	08°05.231`		end profile
6	10.07.2014	15:44	54°38.754`	08°09.069`	12.09	start profile
	10.07.2014	15:50	54°38.748`	08°09.005`		end profile
7	10.07.2014	16:10	54°40.381`	08°07.127`	13.02	start profile
	10.07.2014	16:19	54°40.305`	08°07.056`		end profile

5. Methods

The sidescan sonar systems **Teledyne Benthos C3D** and **Benthos 1624** were applied to aquire high resolution hydroacoustic data to generate maps of the seafloor sediment backscatter characteristics and sediment distribution patterns in the survey area. Both systems were in a towed mode with a towing speed of 5 knots. The **Teledyne Benthos C3D** is working in the chirp mode with a frequency of 200 kHz. The dual frequency **Benthos 1624** is working with a 100 kHz as well as 400 kHz. A range of 100 m to each side was applied for both systems. The **Teledyne Benthos C3D** SSS has a subbottom profiler included which was used to get simultaneously information about the subsurface characteristics and the geological built-up of the seafloor. Additionally the hull mounted high resolution sub bottom profiler system (**Innomar-SES**) was used to get further subsurface sediment characteristics. Ground truthing was done by **grab sampling** and **under water video** observations. For the video surveys an underwater video system Mariscope was used in a towed mode. Towing velocity was always below 1m/s. To get in situ samples with an undisturbed sediment surface a giant grab sampler was used. Each grab was described, photographed and sampled. These methods were 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. Tracklines of all hydroacoustic profiles and the position of sampling stations are shown in figures 2 and 4. In table 1-5 all stations and profiles are listed.

6. Preliminary scientific results

The SSS mosaic resulting from 45 profiles is shown in figure 3. An area of about 240 km^2 was mapped. The surveyed area is characterized by zones of high backscatter values (dark colors) which appear along the entire tracklines. The edges of these high backscatter areas were embossed by sharp transitions to low backscatter values (light colors). In the north-western, central and southern parts, areas of striking elongated sediment structures were found which are characterized by small scale alteration of light and dark backscatter values (see fig. 4). These structures are identified as “sorted bedforms” (Cacchione et al. 1984, Diesing et al. 2006), which are highly elongated patches of rippled coarse sand, which tend to be tens to hundreds of meters wide and hundreds to thousands of meters long (Cacchione et al. 1984; Goff et al. 2005). Their orientation is approximately shore perpendicular and they are slightly depressed by up to 1 m with respect to surrounding seafloor. They can be clearly identified in the SSS-backscatter (Goff et al. 2005). Typically they are observed in offshore environments with limited sediment supply (Cacchione et al. 1984, Murray & Thieler 2004).

Based on the SSS-mosaic sediment sampling was carried out at 52 stations and 14 box corer staions (see fig. 5, 6 and 7) of which 46 were also used for biological sampling. In figure 6 and 7 some pictures of the grab samples and GGS-samples and their locations in the survey area are shown. Especially the grab sample pictures of station AL440-20140710_G12 and

AL440-20140710_G17 as well as the GGS pictures AL440-20140707_KG6 and AL440-20140711_KG1 (see fig. 8) present the occurrence of the benthic organism *Lanice conchilega* which obviously was responsible for the eye-catching high backscatter values (Degraer et al. 2008, Heinrich et al. 2014, in preparation) in large parts of the working area. The populations of *Lanice conchilega* also were found in the underwater video profiles showing dense population in some areas. In these video profiles, sediment structures which were found in the sidescan sonar waterfall window, like ripple structures, were also present. As there seems to be no essential difference in the grain size distribution of stations with *Lanice conchilega* cover and without, the differences in backscatter strength within the working area are obviously induced by the *Lanice conchilega* populations (Degraer et al. 2008).

Besides SSS-measurements, grab sampling and GGS-sampling subbottom profiler data were collected to get information of the geological built-up and thickness of layers in the working area. Within these profiles several channel structures were identified (see figure 9) characterized by an E-W/SE-NW orientation.

7. References

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8. Appendices

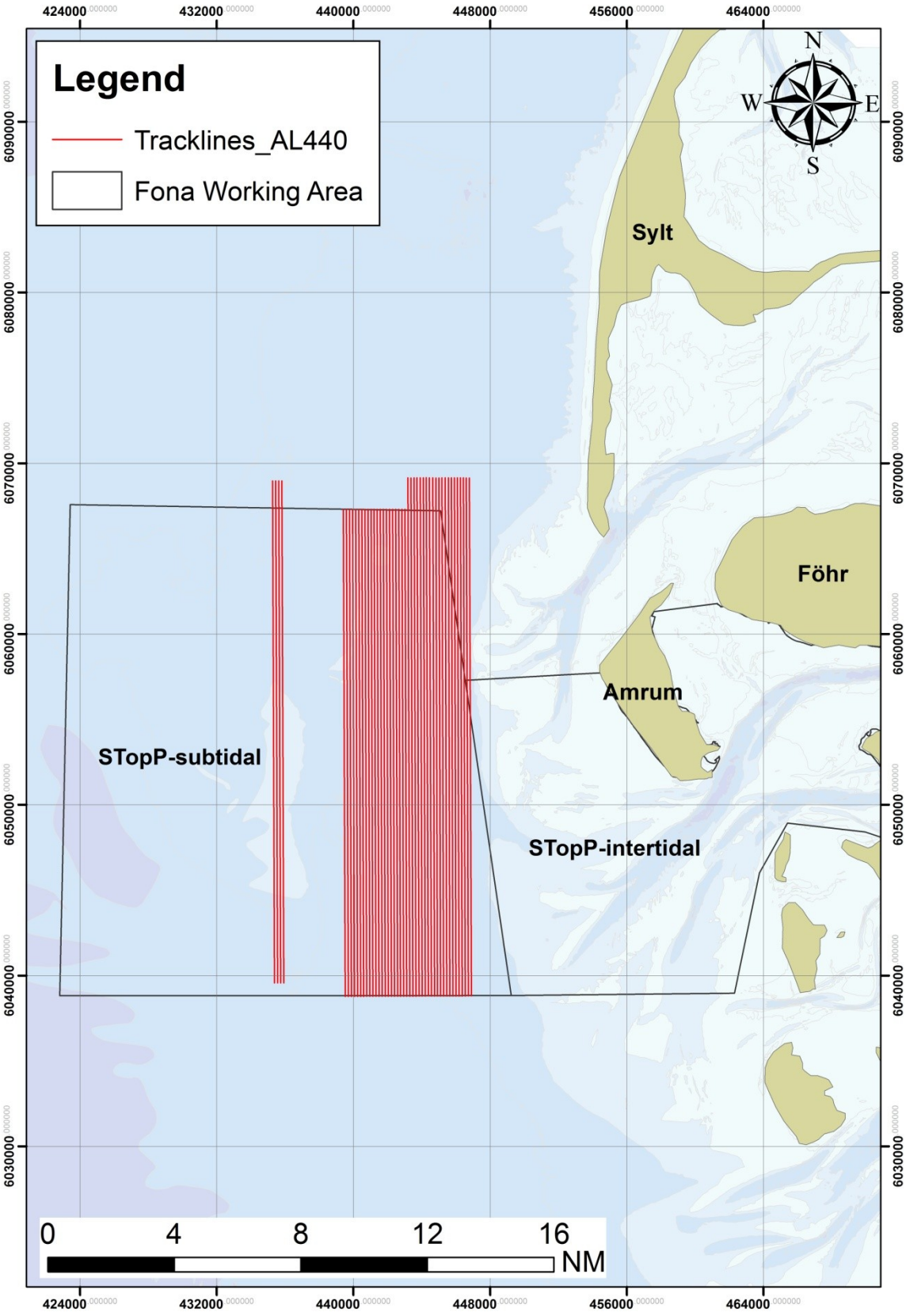

Figure 2: Location and overview of cruise profiles.

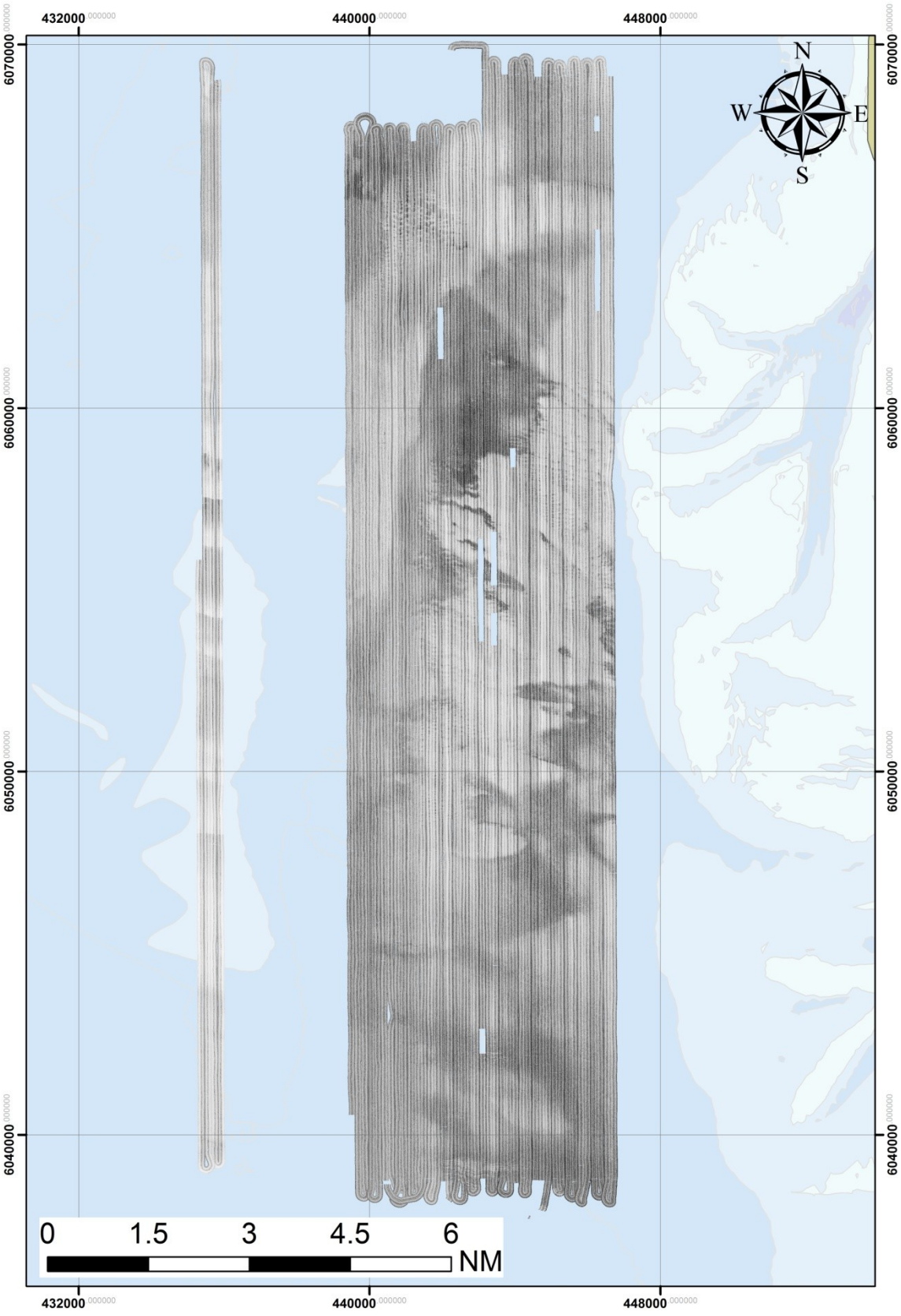

Figure 3: SSS-mosaic with details of eye-catching sediment structures/transitions

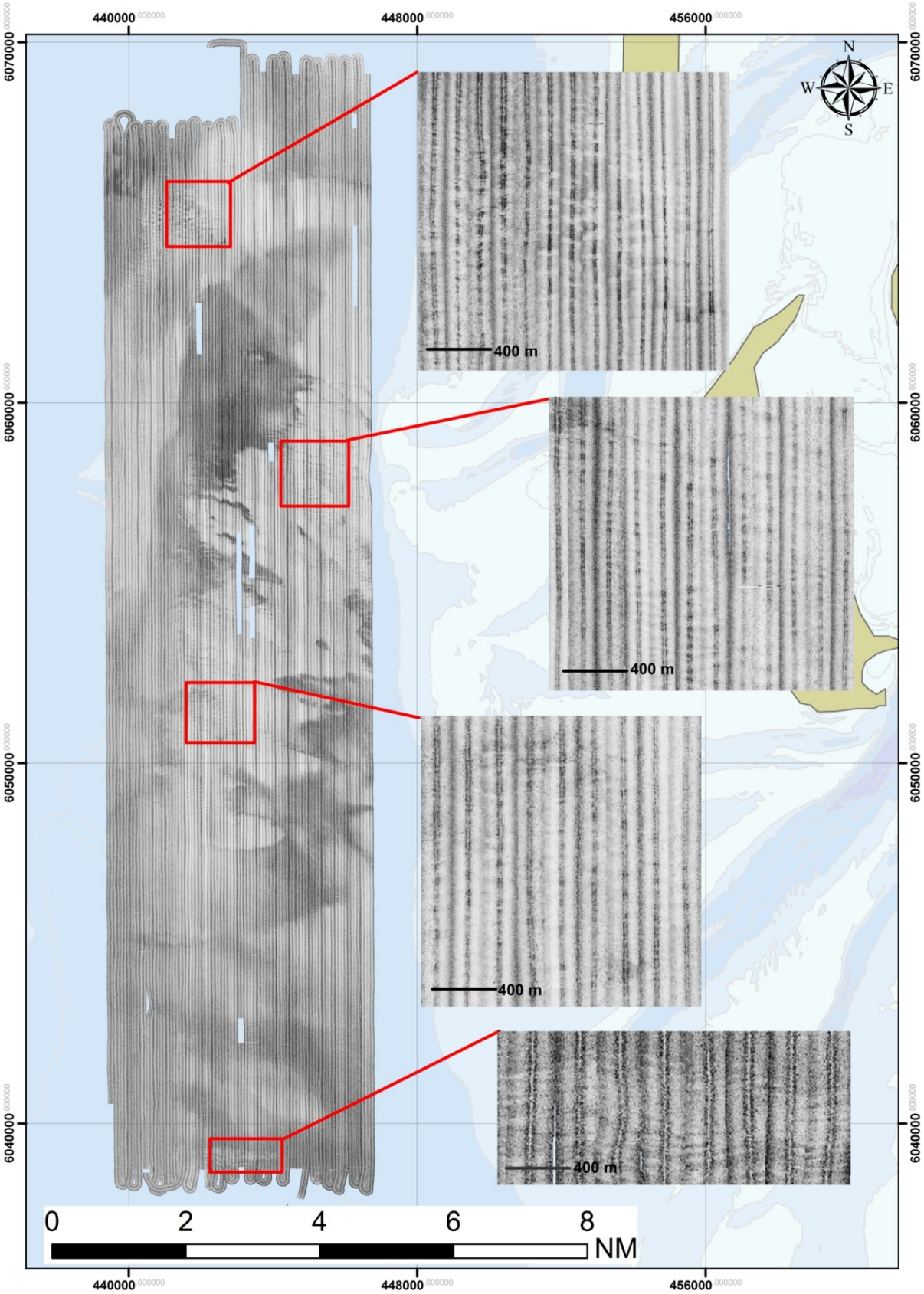

Figure 4: SSS-mosaic with details of eye-catching sediment transitions identified as sorted bedforms

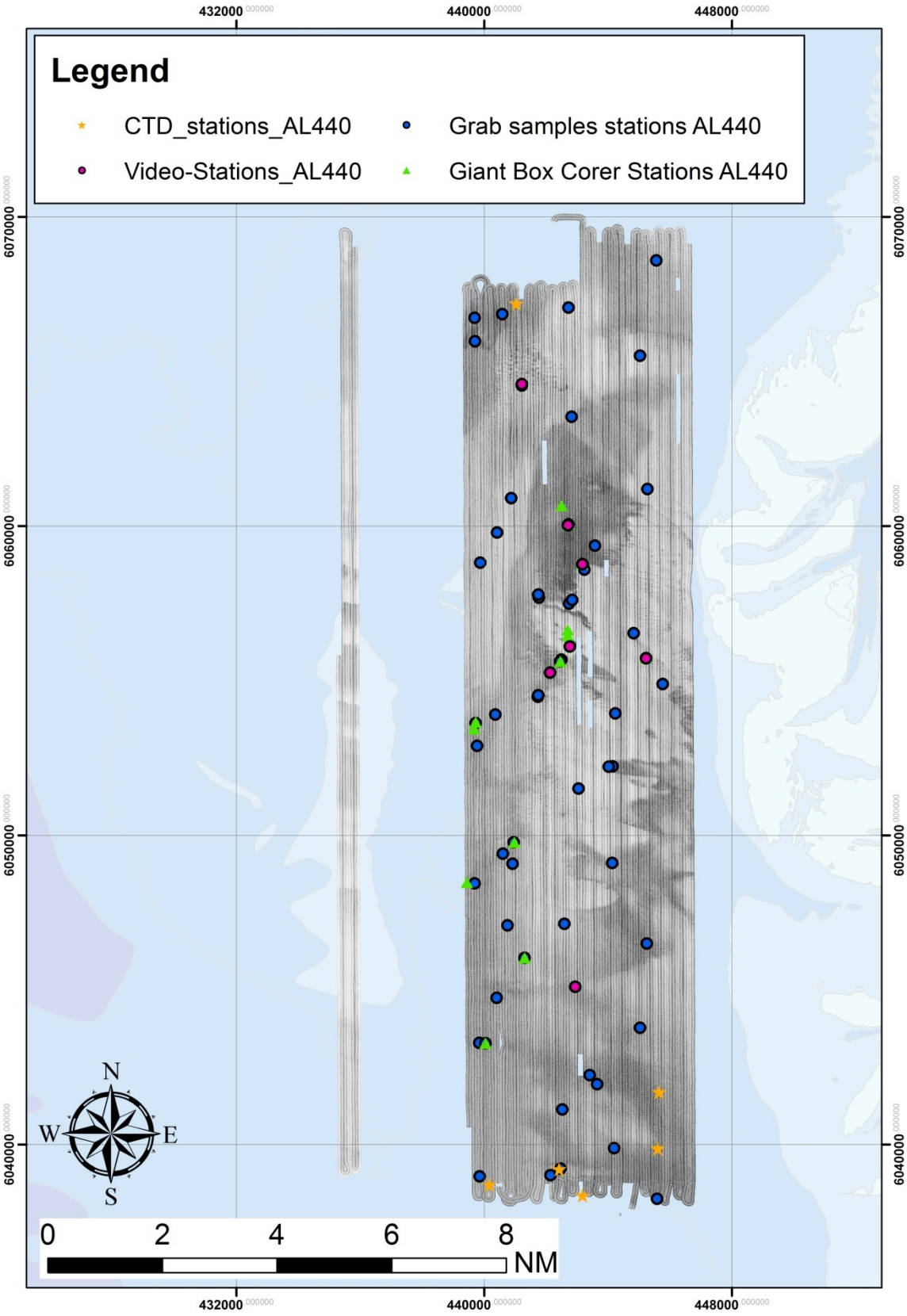

Figure 5: Side-scan mosaic with CTD stations (orange stars), video stations (red circles), grab samples stations (blue circles) and box corer stations (green triangles)

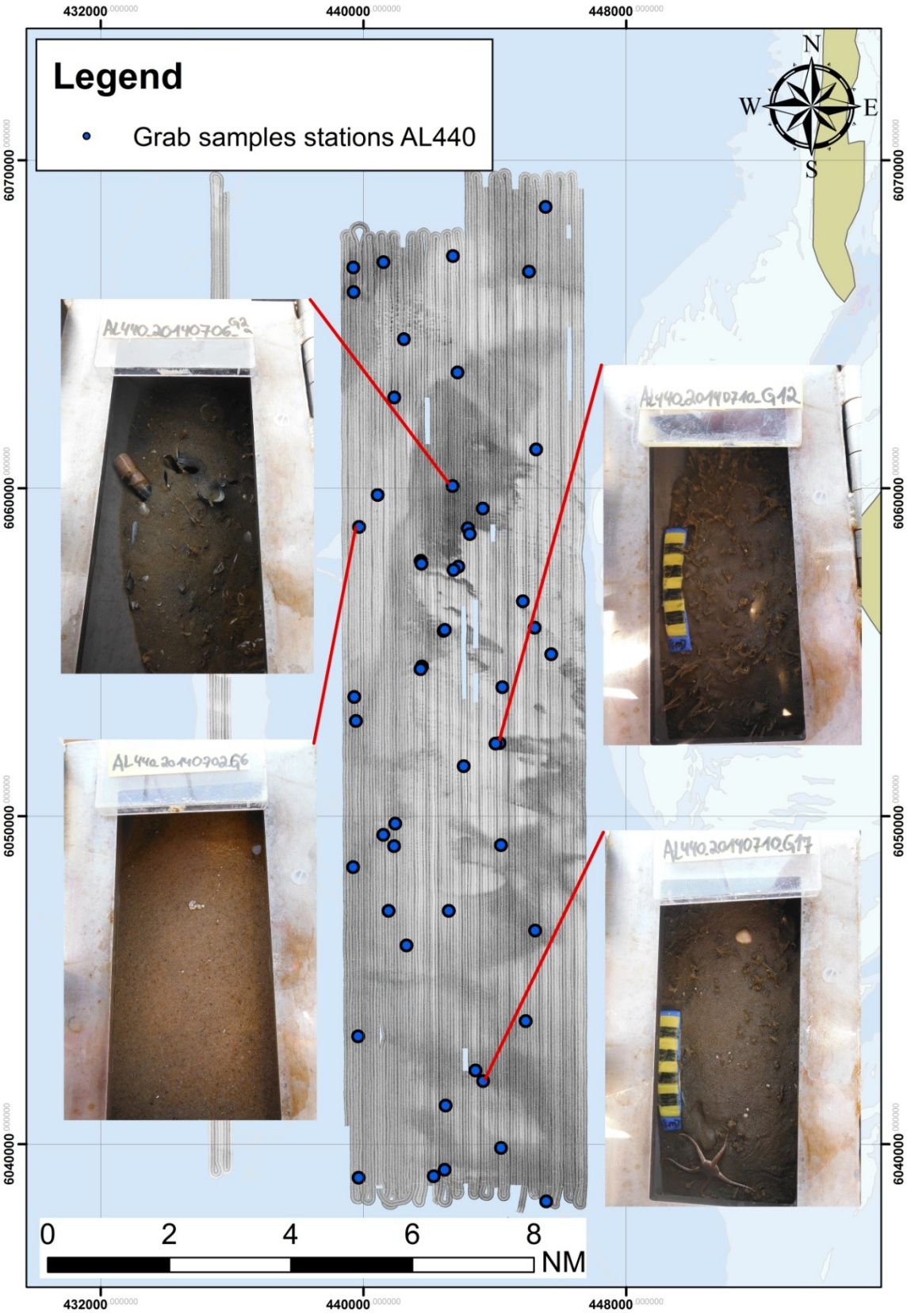

Figure 6: Side-scan mosaic, grab samples stations and example of grab samples pictures

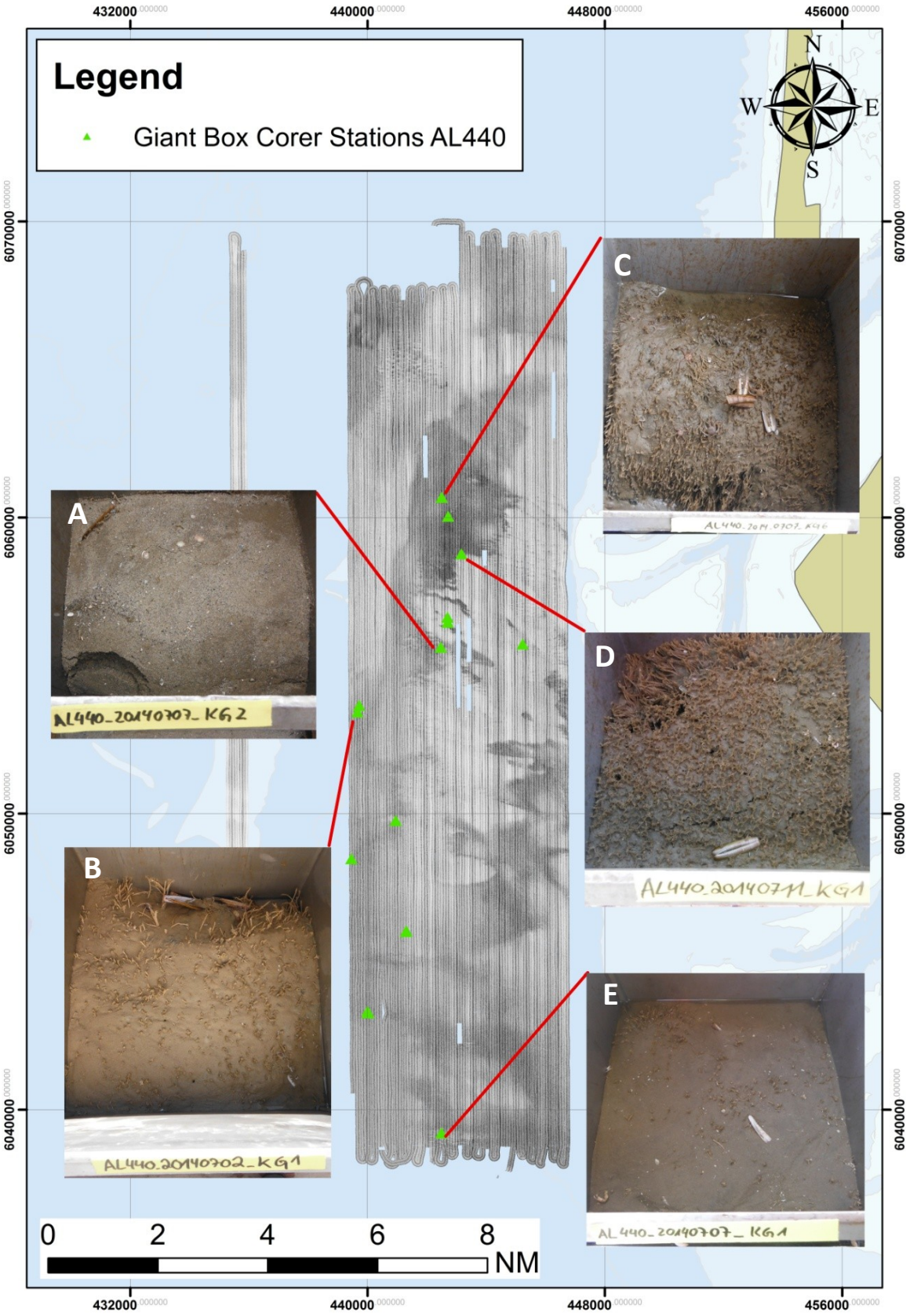

Figure 7: SSS-mosaic, GGS sampling stations and examples of samples pictures (**A**: AL440-20140707_KG2, **B**: AL440-20140702_KG1, **C**: AL440-20140707_KG6, **D**: AL440-20140711_KG1, **E**: AL440-20140707_KG1)

Figure 8: Pictures of GGS cross sections (**A**: AL440-20140707_KG2, **B**: AL440-20140702_KG1, **C**: AL440-20140707_KG6, **D**: AL440-20140711_KG1, **E**: AL440-20140707_KG1).

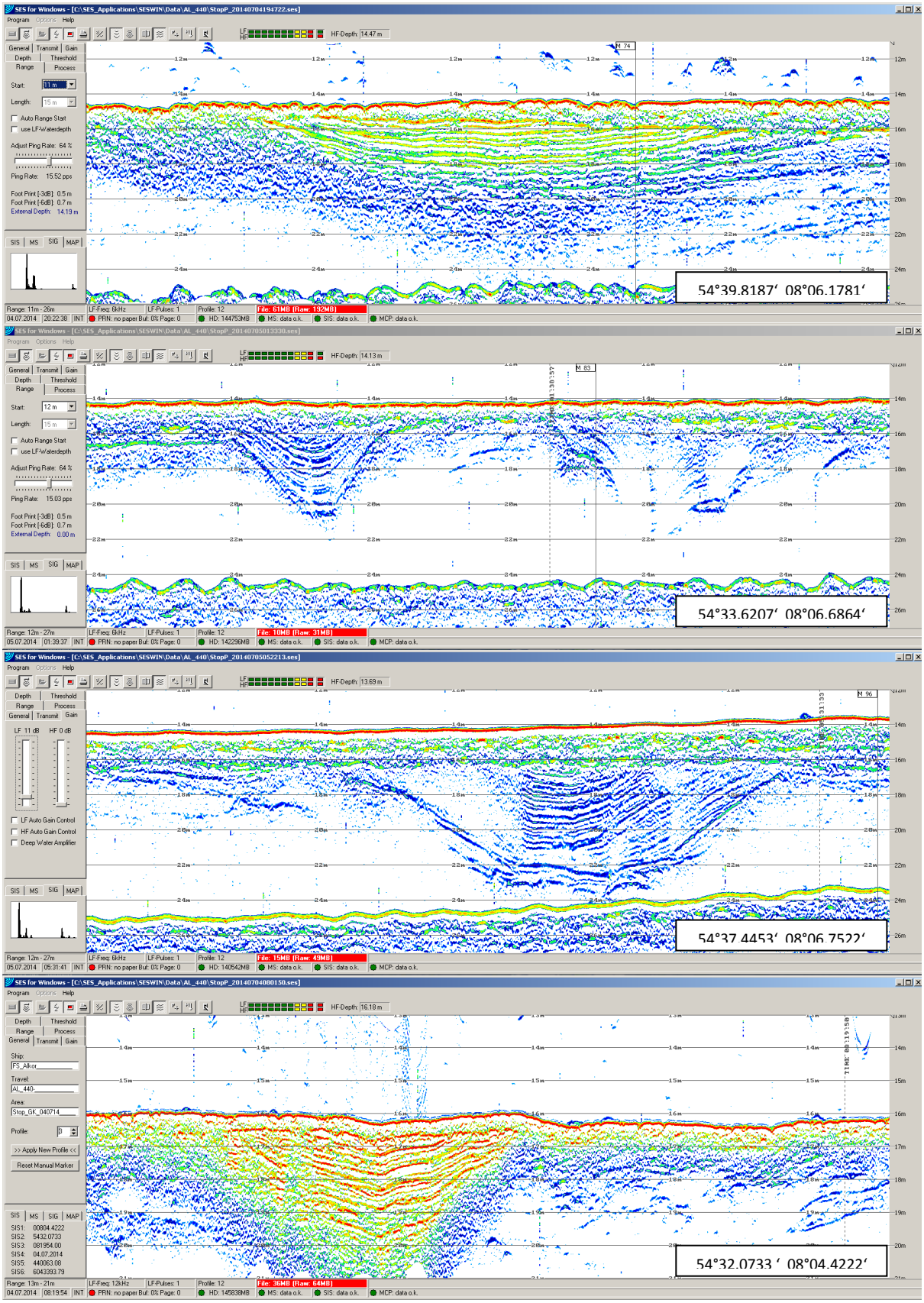

Figure 9: Screenshots of SES Profiles showing channel structures