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Scientific Cruise Reports

R/V „Pelagia“

Cruise 273a

2. – 18. August 2007

Report of the Chief Scientist

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BSH
Federal Maritime and Hydrographic Agency
Hamburg

R/V „Pelagia“

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Tasks of the Cruise

Charting of the oceanographic and chemical water quality in the North Sea during the maximum summer thermal development by means of discrete water sampling and a towed continuously profiling CTD systems.

Scientific Crew

Dr. Hartmut Heinrich	Chief Scientist, Marine Physics
Achim Schulz	Marine Physics
Andreas Pfeiffer	Marine Physics
Jens Wemheuer	Marine Physics
Reimund Ludwig	Marine Physics
Ole Kattein	Marine Physics
Johanna Schweers	Marine Physics, student
Rita Kramer	Marine Chemistry, Nutrients
Roswitha Velten	Marine Chemistry, Nutrients
Sven Kranz	Marine Chemistry, Nutrients
Ilse Bünz	Marine Chemistry, Nutrients
Manfred Schimanski	Marine Chemistry, Nutrients
Gudrun Flessner	Marine Chemistry, student
Elke Hammermeister	Marine Chemistry, Organic contaminants
Udo Ziebarth	Marine Chemistry, Organic contaminants

Scientific Background

BSH started in 1999 a time series on mapping the annual maximum heat content and the annual maximum depth of the summer thermocline of the Greater North Sea (Fig. 1). The aims of the time series are to map the influence of climate on the oceanographic structure of the North Sea, to identify the inputs from the Northeast Atlantic and the Baltic Sea, and to assess its consequences for the North Sea ecosystems.

The North Sea is a marginal sea of the Atlantic Ocean situated on the Northwest European Shelf and is connected to the open ocean via the northern margin and, to a minor degree via the English Channel. As a consequence, the southern North Sea is largely influenced by the rather warm water of the temperate part of the NE Atlantic. The northern North Sea receives cooler waters from the north western part of the NE Atlantic and from the Norwegian Sea. The Dogger-Fisher-Bank complex and the wedge-shaped general bathymetry of the Greater North Sea prevent largely the spreading of cool deep water into the Southern North Sea. Therefore, the shallow southern North Sea is very susceptible to physical changes in the temperate Northeast Atlantic and to local atmospheric influences. In the northern North Sea the influence of the local atmosphere on the water body is mainly limited to the uppermost 10th of metres. The underlying water derives its thermal conditions largely from the open ocean.

Temperatures of the different water masses, including derived parameters like heat content and the depth of the thermocline during the time of the maximum heat content are suitable sensors for detecting the influence and consequences of climatic changes. In combination with salinity, these factors are the predominant rulers of subsequent changes in the North Sea ecosystems.

This summer cruise provides BSH with the opportunity for monitoring the concentrations of additional environmental descriptors like oxygen, chlorophyll, nutrients and a variety of hazardous substances.

Another purpose of the summer cruise is monitoring of eutrophication parameters (nutrients, oxygen, transparency) and hazardous substances (pesticides in 2007) in the Greater North Sea for assessing the contamination of the German Bight within a wider perspective. These measurements are part of OSPAR's Joint Assessment and Monitoring Programme JAMP.

Cruise Diary

Sampling action, weather and other information (see also tables)

2 Aug 2007

Arrival of the scientific crew and equipment in Cuxhaven.

Placement and installation of containers and other equipment on board of R/V Pelagia. After some re-arrangements all containers had a fine place. There were difficulties to connect the different power cables of containers and the ship because of lacking adapters. The ship informed the Chief Scientist about problems with the large crane which should not cause a problem.

Legend:

1. sampling information
2. weather conditions
3. towed instrument information
4. seabird and mammal observations

MEST: Mid European Summertime (UTC + 2h)

3 August 2007

Before departure safety instructions for the scientific crew.

0900 MEST Medem Reede

Pelagia disembarks under fine weather conditions from Cuxhaven heading to Medem Reede for the first sampling location.

1. A bucket for salinity, temperature, nutrient and oxygen sampling (very turbid water), Secchi disk and the glass bottle sampler for organic contaminants.

1310 MEST Station 3

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. blue sky and gentle breeze from W;
3. still difficulties with the BSH data collection and distribution software "Reiseassistent"; power supply for the containers in the process of improvement and fully working at 1600

1750 MEST Station 7

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. blue sky and gentle breeze from W;

3. towed system "Delphin" deployed without difficulties; some minor problems with the software

4 August 2007

0050 MEST Station 8

1. CTD with sampling for nutrients and oxygen; 10 l and 100 l glass bottles for organic contaminants
2. clear sky, gentle breeze from SW
3. "Delphin" out of water while ship on station; software problems of the "Delphin" solved (length of data string)

1040 MEST Station 9

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottles for organic contaminants;
2. clear sky, light-gentle breeze from SW
3. "Delphin" out of water while ship on station

1940 MEST Station 10

1. CTD with sampling for nutrients and oxygen; Secchi disk;
2. clear sky, light-gentle breeze from SW
3. "Delphin" out of water while ship on station
4. sea birds: mostly herring gulls, 2 adult and 1 juvenile gannet, 1 Kittiwake, 1 Skua

2355 MEST Station 11

1. CTD with sampling for nutrients and oxygen; two 10 l and one 100 l glass bottles for organic contaminants;
2. clear sky, light-gentle breeze from SW
3. "Delphin" out of water while ship on station

5 August 2007

0415 MEST Station 12

1. CTD with sampling for nutrients and oxygen; two 10 l and one 100 l glass bottles for organic contaminants;
2. clear sky, light-gentle breeze from SW
3. "Delphin" out of water while ship on station

0920 MEST Station 13

1. CTD with sampling for nutrients and oxygen; Secchi disk; one 100 l glass bottles for organic contaminants;
2. clear sky, light air
3. "Delphin" out of water while ship on station

1350 MEST Station 14

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottles for organic contaminants
2. clear sky, light air
3. "Delphin" out of water while ship on station
4. 2 Guillemots resting close to the ship; 1 Cormorant passing towards northwest; 2 tame pigeons out of water;

1850 MEST Station 15

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. clear sky, light air
3. "Delphin" out of water while ship on station
4. one of the pigeons drops into the North Sea and sinks after 10 minutes

6 August 2007

0115 MEST Station 16

1. CTD with sampling for nutrients and oxygen
2. clear sky, light air
3. "Delphin" out of water while ship on station

0630 MEST Station 17

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottles for organic contaminants
2. clear sky, light air
3. "Delphin" out of water while ship on station
4. many resting Guillemots, different gulls

1510 MEST Station 18

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. clear sky, light air

3. "Delphin" out of water while ship on station
4. some flying Gannets and Kittiwakes

2240 MEST Station 19

1. CTD with sampling for nutrients and oxygen
2. nearly clear sky, calm - light air from S
3. "Delphin" out of water while ship on station

6 August 2007

0600 MEST Station 20

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottles for organic contaminants
2. nearly clear sky, light breeze from S
3. "Delphin" out of water while ship on station

1000 MEST Station 21

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. nearly clear sky, light breeze from S
3. "Delphin" out of water while ship on station
4. some Black-headed and Herring gulls, and Kittiwakes

1445 MEST Station 22

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. high clouds approaching from E, light breeze from SE
3. "Delphin" out of water while ship on station
4. some gull and Guillemots

1950 MEST Station 23

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. very cloudy, gentle – moderate breeze from NE-N
3. "Delphin" out of water while ship on station

2135 MEST Station 24

1. CTD with sampling for nutrients and oxygen
2. no observation
3. "Delphin" out of water while ship on station; instrument remains out of water until Station 26 because of shallow water

2245 MEST Station 25

1. CTD with sampling for nutrients and oxygen
2. no observation
3. "Delphin" remains out of water until Station 26 because of shallow water

8 August 2007**0755 MEST Station 26**

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. some clouds, fresh breeze from NW-N
3. "Delphin" deployed after departure from Station

1525 MEST Station 27

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. some clouds, fresh - moderate breeze from NW-N
3. "Delphin" out of water while ship on station

2000 MEST Station 28

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. decreasing cloudiness, moderate breeze
3. "Delphin" out of water while ship on station

9 August 2007**0355 MEST Station 29**

1. CTD with sampling for nutrients and oxygen; two 10 l and one 100 l glass bottle
2. no observation
3. "Delphin" out of water while ship on station; power failure in the "Delphin" container, loss of raw data, reduced data set survived

0825 MEST Station 30

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. high dense clouds, moderate breeze from NW-N, swell from NW
3. "Delphin" out of water while ship on station
4. occasionally Gannets

1220 MEST Station 31

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. dense clouds; moderate breeze, decreasing
3. "Delphin" out of water while ship on station; some valves of CTD water bottles were open while sampling
4. some gulls

1605 MEST Station 32

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. few clouds, calm – light air
3. "Delphin" out of water while ship on station; test of the influence of open valves; no differences in O₂ compared to bottles with closed valves
4. some Gannets and gulls; at 1700 a Harbour porpoise some cables behind the vessel and a Grey seal one cable off port side

2000 MEST Station 33

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. very few clouds, calm
3. "Delphin" out of water while ship on station

10 August 2007**0215 MEST Station 34**

1. CTD with sampling for nutrients and oxygen
2. very few clouds; light air
3. "Delphin" out of water while ship on station; a difficulty with the winch of the A-frame lasts $\frac{3}{4}$ hour

1220 MEST Station 35

1. CTD with sampling for nutrients and oxygen; Secchi disk; one 100 l glass bottle
2. clear sky; calm - light air
3. "Delphin" out of water while ship on station
4. at 1115 two Bottle-nose dolphins "playing" with the vessel

2015 MEST Station 36

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. clear sky; calm – light air, light swell from N
3. "Delphin" out of water while ship on station

11 August 2007**0205 MEST Station 37**

1. CTD with sampling for nutrients and oxygen
2. no observation
3. "Delphin" out of water while ship on station; power failure in the "Delphin" container, loss of raw data, reduced data set survived; for 2 ½ hours reduced cruise speed because change of oil in the main engine

0550 MEST Station 38

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. full cloud coverage; moderate breeze from NW, swell from NW
3. "Delphin" out of water while ship on station

1435 MEST Station 39

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. full cloud coverage, drizzle, gentle breeze from N, swell from N
3. "Delphin" out of water while ship on station

2030 MEST Station 40

1. CTD with sampling for nutrients and oxygen; Secchi disk; four 10 l bottles, two Gemini sediment corers
2. full cloud coverage, drizzle, moderate breeze from N
3. "Delphin" out of water while ship on station

12 August 2007**0645 MEST Station 41**

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. some clouds, light – gentle breeze from NE

3. "Delphin" out of water while ship on station

1100 MEST Station 42

1. CTD with sampling for nutrients and oxygen; Secchi disk
2. some clouds, light air
3. "Delphin" out of water while ship on station
4. some Herring gulls and some juvenile other gulls

1830 MEST Station 43

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. full cloud coverage, light breeze (from NE)
3. "Delphin" out of water while ship on station

13 August 2007

0015 MEST Station 44

1. CTD with sampling for nutrients and oxygen; one 100 l glass bottle
2. full cloud coverage, drizzle, light breeze, weak swell; after station thunderstorm with heavy showers; later observation of Perseide meteorites
3. "Delphin" out of water while ship on station; difficulties with CTD software; after reset OK

0910 MEST Station 45

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle
2. many clouds, fresh breeze from SW
3. "Delphin" out of water while ship on station; removal of O₂ sensor for calibration
4. some Kittiwakes, Captain reports "dolphins" before station

1635 MEST Station 46

1. CTD with sampling for nutrients and oxygen; Secchi disk; one 100 l glass bottle
2. full cloud coverage, drizzle, fresh breeze from SE
3. "Delphin" out of water while ship on station; re-installation of O₂ sensor

2200 MEST Station 47

1. CTD with sampling for nutrients and oxygen
2. full cloud coverage, fresh breeze from S, strong swell

3. "Delphin" out of water while ship on station
4. five Bottle-nose dolphins close to the ship

14 August 2007

0200 MEST Station 48

1. CTD with sampling for nutrients and oxygen; one 100 l glass bottle
2. no observations
3. "Delphin" out of water while ship on station; without reason CTD software was shut down and changes made in configuration files

0910 MEST Station 49

1. CTD with sampling for nutrients and oxygen, Secchi disk
2. some clouds, fresh – strong breeze from S
3. "Delphin" out of water while ship on station

1500 MEST Station 50

1. CTD with sampling for nutrients and oxygen; Secchi disk; one 100 l glass bottle
2. variable cloud coverage; fresh breeze from SE, increasing
3. "Delphin" out of water while ship on station

2135 MEST Station 51

1. CTD with sampling for nutrients and oxygen; two 10 l and one 100 l glass bottle
2. variable cloud coverage; strong breeze from SE
3. "Delphin" out of water while ship on station

15 August 2007

0800 MEST Station 52

1. cancellation of station because of high waves

1640 MEST Station 53

1. CTD with sampling for nutrients and oxygen; Secchi disk; two 10 l and one 100 l glass bottle; water barrels for calibration lab
2. full cloud coverage, fresh – strong breeze from WNW
3. "Delphin" out of water

End of sampling; heading for Aberdeen

16 August 2007

1600 MEST arrival at Aberdeen road, anchor down

17 August 2007

1038 MEST embarkation at Aberdeen harbour Regent Quay

End of 1st leg

First preliminary results

In contrast to 2006 where a hot July had a strong imprint on the oceanographic summer maximum conditions cool and windy weather conditions during the second quarter of the year 2007 prevented the situation from a further temperature increase.

In the surface layer (2-15 m) temperature was about 2,5°C lower than in the preceding year but still well above the long-term average.

The average temperature above bottom in the shallow and fully mixed southern North Sea was at 16,5°C, i.e. about 0.5 °C below SST. In the southern part of the Central North Sea temperatures in the depth range of 15 – 50 m were at their maximum (55 N: 15°C) since the start of the summer cruises in 1998. Between 56 - 60 N the temperature in this depth range remains since years nearly constant at 11,7°C. Below the thermocline the water temperature between 56 – 60 N was at 8.5°C which is 0.5°C higher than last year but in the range of the foregoing years. The relatively warm water in 2007 just above the thermocline is probably due to deeper mixing of warmer surface water in late spring or early summer. Vertical temperature sections from the towed Delphin system are presented in Fig. 2a. Spatial surface and bottom temperature distributions are presented in Fig. 3a.

The salinity conditions in the surface water is best characterised by the course of the 34 isohaline in the eastern part of the North Sea. In 2007 a broad rim of lower salinity water extended from the Dutch coast at 6 E to 7 E at Ringkøbing Fjord (56 N, Jutland) and then to 2 E at 60 N. This is because of the higher river runoff in mid and eastern Europe and subsequently a stronger discharge of Baltic Sea low salinity water into the Norwegian coastal current. There was no major change in the salinity distribution of the deeper North Sea. Vertical salinity sections from the towed Delphin system are presented in Fig. 2b. Spatial surface and bottom salinity distributions are presented in Fig. 3a.

Due to the good mixing conditions the oxygen saturation in the southern North Sea and above the thermocline in the central and northern North Sea was slightly above 100 %. Below the thermocline oxygen saturation ranged between 80 and 90 %. It is worth mentioning nearly persistent appearance of a relative oxygen depression west of Ringkøbing Fjord (56 N, Jutland) at 6 E. Vertical oxygen saturation sections from water samples are presented in Fig. 2c. Spatial surface and bottom oxygen saturation distributions are presented in Fig. 3c.

Secchi depth south of a line Dogger – Fisherbank ranged from 6 – 10 m and north of this line down to a maximum of 16 m below surface (Fig 3c).

In conclusion the average temperature maximum in 2007 did not surmount the values of 2006 due to the lower air temperatures and the vigorous winds. The only increase has been observed just above the thermocline in the central North Sea. However, a preliminary estimate of the heat content of the greater North Sea revealed a very slight increase relative to 2006. The salinity distribution in the upper part of the water column was typical for wet years whereas in the deeper water no changes relative to the preceding year could be observed. Cloudy weather conditions in the second quarter of 2007 prevented obviously from higher levels in primary production thus, leading to a relatively good visibility in the water column and a good oxygen saturation.

Comments on the suitability of the vessel

We are grateful to the Master and the crew of R/V Pelagia for the warm welcome and support we had on board. The co-operation with bridge and deck was brilliant. This holds also for the communication with NIOZ before entering the vessel. We enjoyed very much having been on board.

The vessel provides much space for safe storage of materials, containers and laboratory work. The behaviour of the vessel, its movements under heavier weather conditions are surprisingly comfortable.

It is recommended the ships crew should harmonise maintenance work, e. rust removal, painting etc. with the scientific work carried out during the cruise in order to avoid sample contamination.

Technical problems encountered were solved more or less quickly and easily. The initial problem connecting containers to electric power could be solved ingeniously. It is recommended that in future both, scientific and ships crew clarify the situation with respect to plugs, sockets and adapters when planning the cruise, since different countries run different plug'n socket systems.

In case scientific work is carried out in containers stored within the vessel a better air conditioning in the container locker is recommended, especially when outside temperature is elevated.

The permanent installation of a drying oven for filters and biological samples is recommended.

The accessibility of the wet laboratory from the deck is ingeniously solved. Hand pallet trucks can easily transport heavy or voluminous samples or equipment into the wet lab without difficulties. The wet laboratory lacks some additional storage place for, e.g. freezers or chemical containers in easy reach.

It is recommended to motivate scientific crews to carefully tidy up and clean the laboratories before leaving the vessel. The crew should regularly check the proper function of water discharge pipes.

Life on board is rather comfortable. It is worth mentioning the cookie box which was always filled with little chocolate snacks balancing depressed serotonin levels. There is enough space for meetings and for social activities. Some sports equipment and a sauna is kindly appreciated. Cabins are comfortable but the crew should regularly check the proper function of water discharge pipes. It is recommended to motivate scientific crews to carefully tidy up and clean their cabins before leaving the vessel. Carpets and beddings need some refreshing.

Figures and Tables

Fig. 1: Track chart and sampling locations during leg “a” of Pelagia 273. The cruise started on 3 August in Cuxhaven/GE and ended on 18 August in Aberdeen/UK.

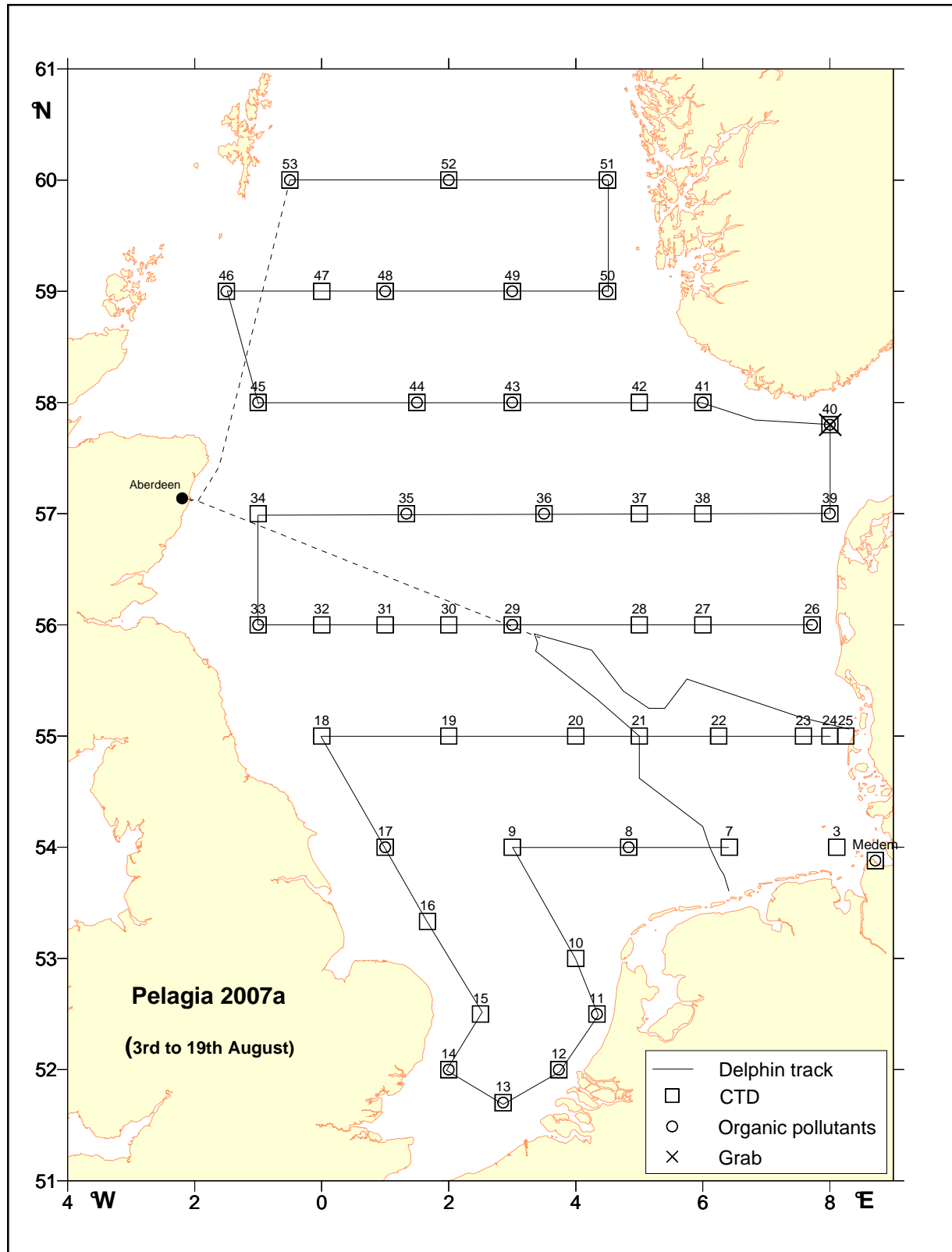


Table 1: Sampling locations and sampling times

No.	BSH no.	Depth	LAT			LON			Phi	Lam	Date	Arrival UTC	Departure UTC
1	Medem	-18	53	52,8	N	8	43	E	53,88	8,72	2007-08-03	07:55	08:40
2	3	-21	54	0	N	8	6,48	E	54,00	8,11	2007-08-03	11:10	11:30
3	7	-27	54	0	N	6	25,02	E	54,00	6,42	2007-08-03	17:50	18:21
4	8	-39	54	0	N	4	50	E	54,00	4,83	2007-08-04	00:48	01:40
5	9	-38	54	0	N	3	0	E	54,00	3,00	2007-08-04	08:43	09:20
6	10	-29	53	0	N	4	0	E	53,00	4,00	2007-08-04	17:13	17:25
7	11	-15	52	30	N	4	20	E	52,50	4,33	2007-08-04	21:55	22:20
8	12	-24	52	0	N	3	44	E	52,00	3,73	2007-08-05	02:15	02:53
9	13	-40	51	42,2	N	2	51,4	E	51,70	2,86	2007-08-05	07:21	07:49
10	14	-28	52	0	N	2	0	E	52,00	2,00	2007-08-05	11:50	12:18
11	15	-46	52	30	N	2	30	E	52,50	2,50	2007-08-05	16:51	17:15
12	16	-25	53	20	N	1	40	E	53,33	1,67	2007-08-06	23:14	23:22
13	17	-42	54	0	N	1	0	E	54,00	1,00	2007-08-06	04:27	05:16
14	18	-64	55	0	N	0	0	E	55,00	0,00	2007-08-06	13:07	13:18
15	19	-25	55	0	N	2	0	E	55,00	2,00	2007-08-06	20:40	20:52
16	20	-45	55	0	N	4	0	E	55,00	4,00	2007-08-07	03:58	04:15
17	21	-35	55	0	N	5	0	E	55,00	5,00	2007-08-07	07:58	08:11
18	22	-40	55	0	N	6	15	E	55,00	6,25	2007-08-07	12:45	12:54
19	23	-21	55	0	N	7	35	E	55,00	7,58	2007-08-07	17:50	17:58
20	24	-15	55	0	N	8	0	E	55,00	8,00	2007-08-07	19:37	19:46
21	25	-10	55	0	N	8	15	E	55,00	8,25	2007-08-07	20:45	20:54
22	26	-25	56	0	N	7	43,2	E	56,00	7,72	2007-08-08	05:55	06:59
23	27	-44	56	0	N	6	0	E	56,00	6,00	2007-08-08	13:24	13:55
24	28	-41	56	0	N	5	0	E	56,00	5,00	2007-08-08	18:00	18:11
25	29	-66	56	0	N	3	0	E	56,00	3,00	2007-08-09	01:36	02:31
26	30	-82	56	0	N	2	0	E	56,00	2,00	2007-08-09	06:24	06:42
27	31	-73	56	0	N	1	0	E	56,00	1,00	2007-08-09	10:18	10:25
28	32	-80	56	0	N	0	0	E	56,00	0,00	2007-08-09	14:03	14:16
29	33	-62	56	0	N	1	0	W	56,00	-1,00	2007-08-09	17:59	18:25
30	34	-67	57	0	N	1	0	W	57,00	-1,00	2007-08-10	01:33	01:40
31	35	-97	57	0	N	1	20	E	57,00	1,33	2007-08-10	10:19	10:38
32	36	-62	57	0	N	3	30	E	57,00	3,50	2007-08-10	18:13	18:44
33	37	-55	57	0	N	5	0	E	57,00	5,00	2007-08-11	00:04	00:12
34	38	-49	57	0	N	6	0	E	57,00	6,00	2007-08-11	03:50	04:45
35	39	-23	57	0	N	8	0	E	57,00	8,00	2007-08-11	12:35	13:06
36	40	-505	57	48	N	8	0	E	57,80	8,00	2007-08-11	18:33	20:30
37	41	-299	58	0	N	6	0	E	58,00	6,00	2007-08-12	04:48	05:25
38	42	-122	58	0	N	5	0	E	58,00	5,00	2007-08-12	09:00	09:19
39	43	-71	58	0	N	3	0	E	58,00	3,00	2007-08-12	16:29	17:07
40	44	-100	58	0	N	1	30	E	58,00	1,50	2007-08-12	22:15	22:44
41	45	-111	58	0	N	1	0	W	58,00	-1,00	2007-08-13	07:12	07:49
42	46	-75	59	0	N	1	30	W	59,00	-1,50	2007-08-13	14:36	14:55
43	47	-129	59	0	N	0	0	E	59,00	0,00	2007-08-13	20:06	20:26
44	48	-119	59	0	N	1	0	E	59,00	1,00	2007-08-14	23:56	00:30
45	49	-135	59	0	N	3	0	E	59,00	3,00	2007-08-14	07:08	07:44
46	50	-230	59	0	N	4	30	E	59,00	4,50	2007-08-14	12:58	13:32
47	51	-257	60	0	N	4	30	E	60,00	4,50	2007-08-14	19:36	20:20
48	52	-97	60	0	N	2	0	E	60,00	2,00	2007-08-15	skipped due to weather conditions	
49	53	-120	60	0	N	0	30	W	60,00	-0,50	2007-08-15	14:40	15:10

Table 2: Locations, times and samples

No.	BSH no.	Depth	Date	Arrival UTC	Depart UTC	CTD	GLASS100L	GLASS10L	SEDIMENT	Delphin track
1	Medem	-18	2007-08-03	07:55	08:40	bucket	1	2		
2	3	-21	2007-08-03	11:10	11:30	1				
3	7	-27	2007-08-03	17:50	18:21	1				1
4	8	-39	2007-08-04	00:48	01:40	1	1	2		2
5	9	-38	2007-08-04	08:43	09:20	1	1	1		3
6	10	-29	2007-08-04	17:13	17:25	1				4
7	11	-15	2007-08-04	21:55	22:20	1	1	2		5
8	12	-24	2007-08-05	02:15	02:53	1	1	2		6
9	13	-40	2007-08-05	07:21	07:49	1	1			7
10	14	-28	2007-08-05	11:50	12:18	1	1	2		8
11	15	-46	2007-08-05	16:51	17:15	1				9
12	16	-25	2007-08-06	23:14	23:22	1				10
13	17	-42	2007-08-06	04:27	05:16	1	1	3		11
14	18	-64	2007-08-06	13:07	13:18	1				12
15	19	-25	2007-08-06	20:40	20:52	1				13
16	20	-45	2007-08-07	03:58	04:15	1	1			14
17	21	-35	2007-08-07	07:58	08:11	1				15
18	22	-40	2007-08-07	12:45	12:54	1				16
19	23	-21	2007-08-07	17:50	17:58	1				17
20	24	-15	2007-08-07	19:37	19:46	1				
21	25	-10	2007-08-07	20:45	20:54	1				
22	26	-25	2007-08-08	05:55	06:59	1	1	3		18
23	27	-44	2007-08-08	13:24	13:55	1	1	1		19
24	28	-41	2007-08-08	18:00	18:11	1				20
25	29	-66	2007-08-09	01:36	02:31	1	2	4		21
26	30	-82	2007-08-09	06:24	06:42	1				22
27	31	-73	2007-08-09	10:18	10:25	1				23
28	32	-80	2007-08-09	14:03	14:16	1				24
29	33	-62	2007-08-09	17:59	18:25	1	1	2		25
30	34	-67	2007-08-10	01:33	01:40	1				26
31	35	-97	2007-08-10	10:19	10:38	1	1			27
32	36	-62	2007-08-10	18:13	18:44	1	1	2		28
33	37	-55	2007-08-11	00:04	00:12	1				29
34	38	-49	2007-08-11	03:50	04:45	1	1	1		30
35	39	-23	2007-08-11	12:35	13:06	1	2	1		31
36	40	-505	2007-08-11	18:33	20:30	1	1	4		32
37	41	-299	2007-08-12	04:48	05:25	1	1	2		33
38	42	-122	2007-08-12	09:00	09:19	1				34
39	43	-71	2007-08-12	16:29	17:07	1	1	2		35
40	44	-100	2007-08-12	22:15	22:44	1	1		2	36
41	45	-111	2007-08-13	07:12	07:49	1	1	2		37
42	46	-75	2007-08-13	14:36	14:55	1	1	2		38
43	47	-129	2007-08-13	20:06	20:26	1				39
44	48	-119	2007-08-14	23:56	00:30	1	1			40
45	49	-135	2007-08-14	07:08	07:44	1				41
46	50	-230	2007-08-14	12:58	13:32	1	1			42
47	51	-257	2007-08-14	19:36	20:20	1	1	2		43
48	52	-97	2007-08-15	skipped due to weather conditions		1	1	2		
49	53	-120	2007-08-15	14:40	15:10	1	1	2		44

Table 3: Weather recordings

No.	BSH no.	Date	Arrival UTC	WIND BEAUFORT	WIND DIRECTION	CLOUDINESS
1	Medem	2007-08-03	07:55	3	W	3/10
2	3	2007-08-03	11:10	3	W	3/10
3	7	2007-08-03	17:50	3	W	3/10
4	8	2007-08-04	00:48	3	SW	2/10
5	9	2007-08-04	08:43	2-3	SW	2/10
6	10	2007-08-04	17:13	2-3	SW	1/10
7	11	2007-08-04	21:55	2-3	SW	1/10
8	12	2007-08-05	02:15	2-3	SW	1/10
9	13	2007-08-05	07:21	1		1/10
10	14	2007-08-05	11:50	1		1/10
11	15	2007-08-05	16:51	1		1/10
12	16	2007-08-06	23:14	1		0/10
13	17	2007-08-06	04:27	1		0/10
14	18	2007-08-06	13:07	1		0/10
15	19	2007-08-06	20:40	1-2	S	1/10
16	20	2007-08-07	03:58	2	S	1/10
17	21	2007-08-07	07:58	2	S	1/10
18	22	2007-08-07	12:45	2	SE	3/10
19	23	2007-08-07	17:50	3-4	NNE	7/10
20	24	2007-08-07	19:37			
21	25	2007-08-07	20:45			
22	26	2007-08-08	05:55	5	NNW	3/10
23	27	2007-08-08	13:24	4-5	NNW	3/10
24	28	2007-08-08	18:00	4	NNW	2/10
25	29	2007-08-09	01:36			
26	30	2007-08-09	06:24	4	NNW	.10/10
27	31	2007-08-09	10:18	4	NW	9/10
28	32	2007-08-09	14:03	1	NW	1/10
29	33	2007-08-09	17:59	0		1/10
30	34	2007-08-10	01:33	1	NW	1/10
31	35	2007-08-10	10:19	1	NW	0/10
32	36	2007-08-10	18:13	1	NW	0/10
33	37	2007-08-11	00:04			
34	38	2007-08-11	03:50	4	NW	7/10
35	39	2007-08-11	12:35	3	N	.10/10
36	40	2007-08-11	18:33	4	N	.10/10
37	41	2007-08-12	04:48	2-3	NE?	2/10
38	42	2007-08-12	09:00	1	NE	2/10
39	43	2007-08-12	16:29	2	NE	.10/10
40	44	2007-08-12	22:15	2		.10/10
41	45	2007-08-13	07:12	5	SW	4/10
42	46	2007-08-13	14:36	5	SE	.10/10
43	47	2007-08-13	20:06	5	S	.10/10
44	48	2007-08-14	23:56			
45	49	2007-08-14	07:08	5-6	S	2/10
46	50	2007-08-14	12:58	5	SE	CHANGING
47	51	2007-08-14	19:36	6	SE	CHANGING
48	52	2007-08-15	bad weather conditions	6-7	SW	.10/10
49	53	2007-08-15	14:40	5-6	WNW	.10/10

Fig 2a: Temperature sections measures with the towed Dolphin system (raw data)

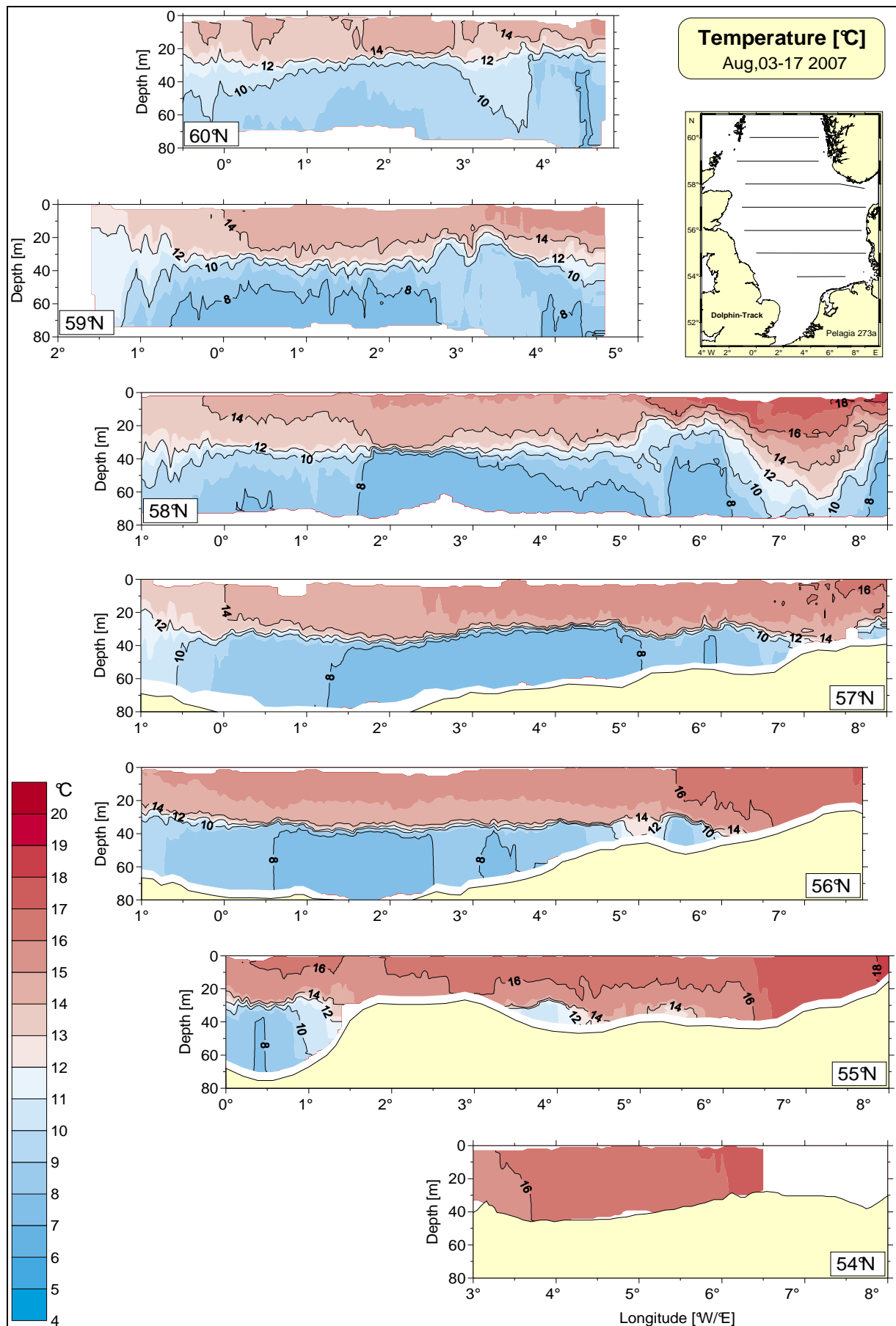


Fig. 2b: Salinity sections measured with the towed Delphin system (raw data)

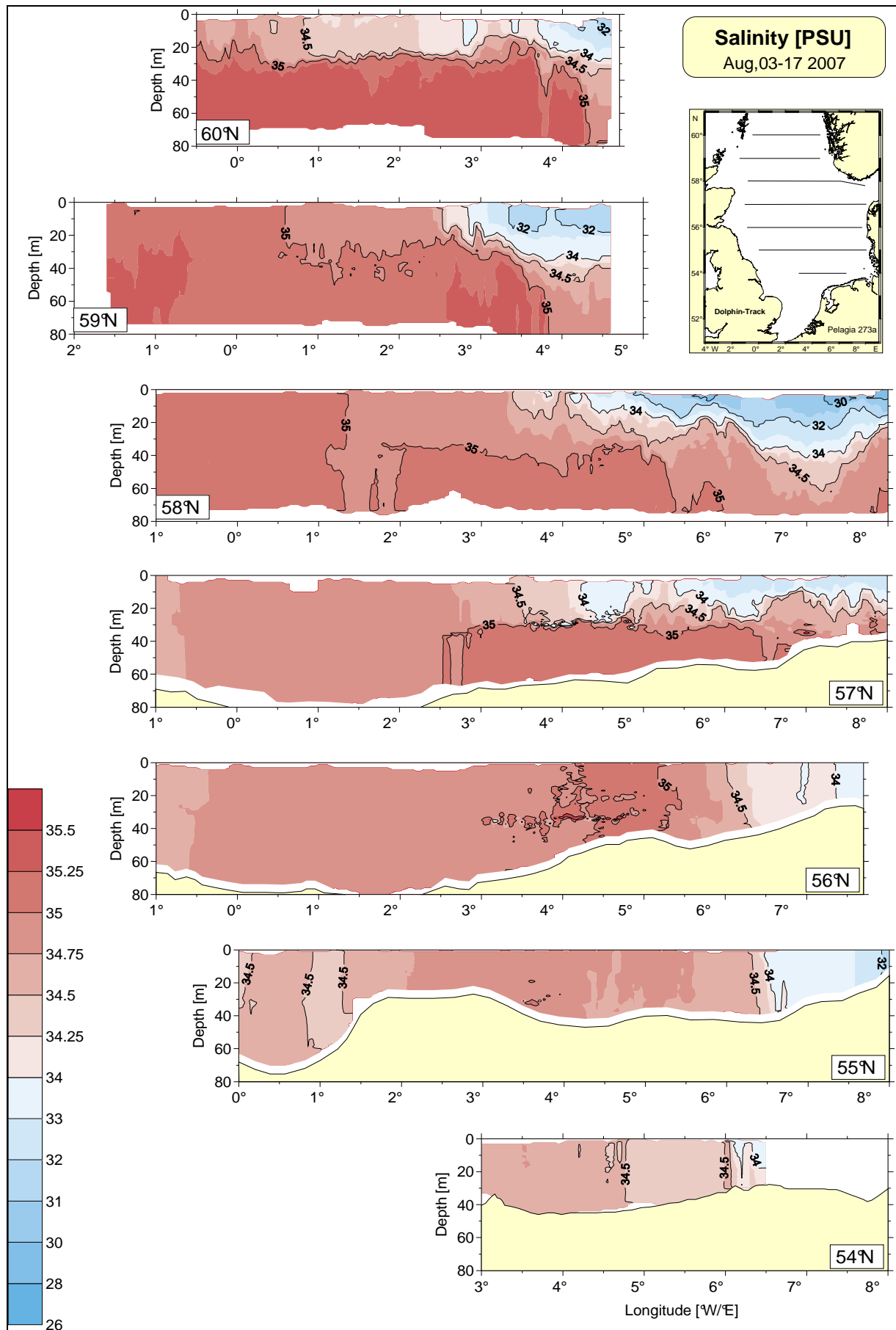


Fig. 2c: Oxygen saturation sections (water samples)

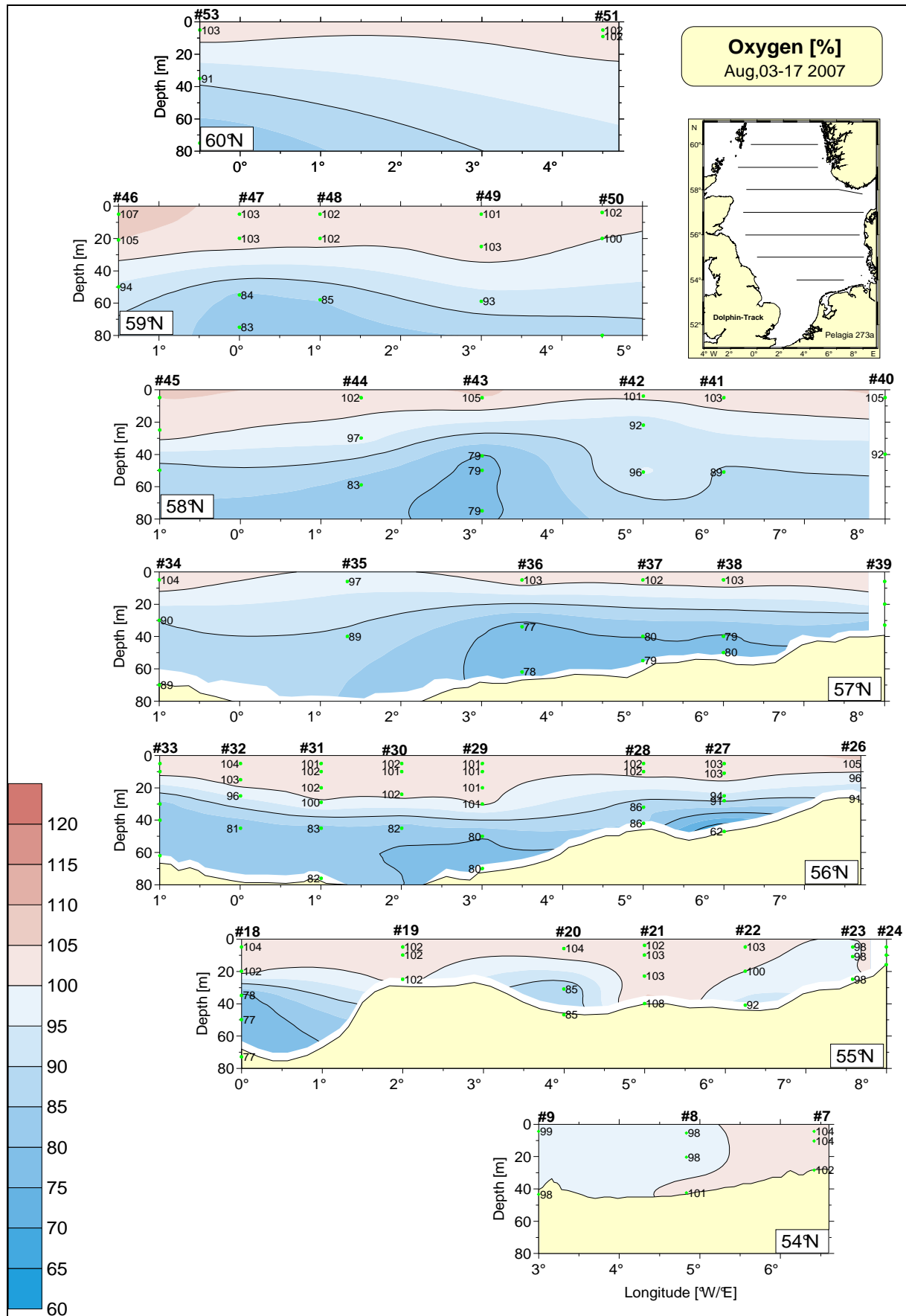


Fig. 3a: Surface and bottom distributions of Temperature and Salinity (raw CTD data)

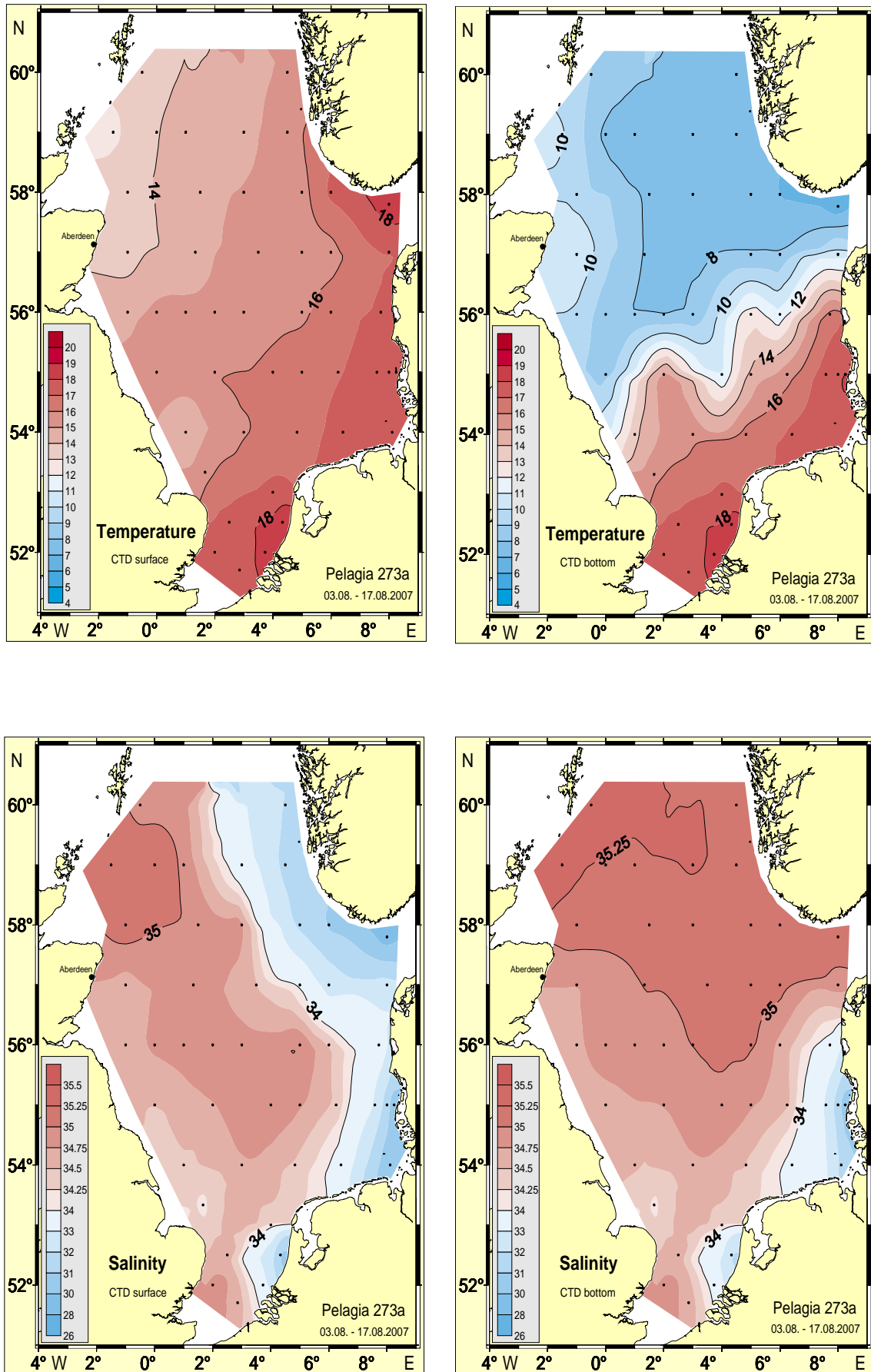
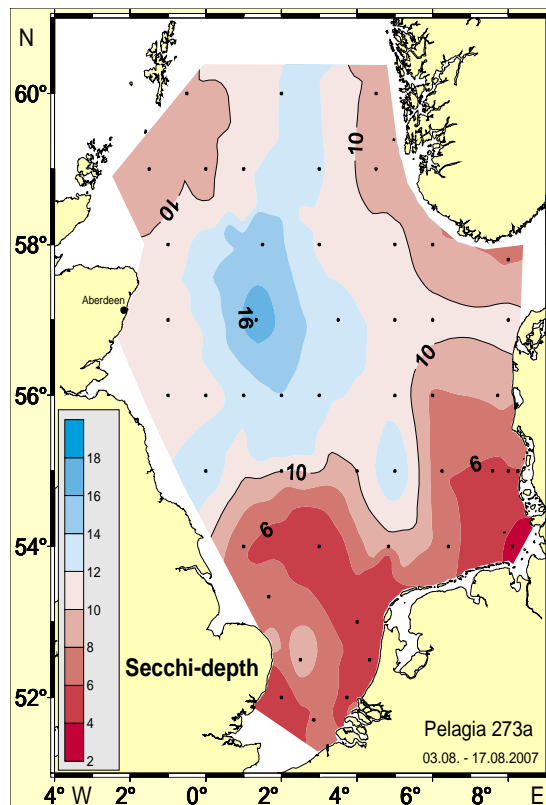
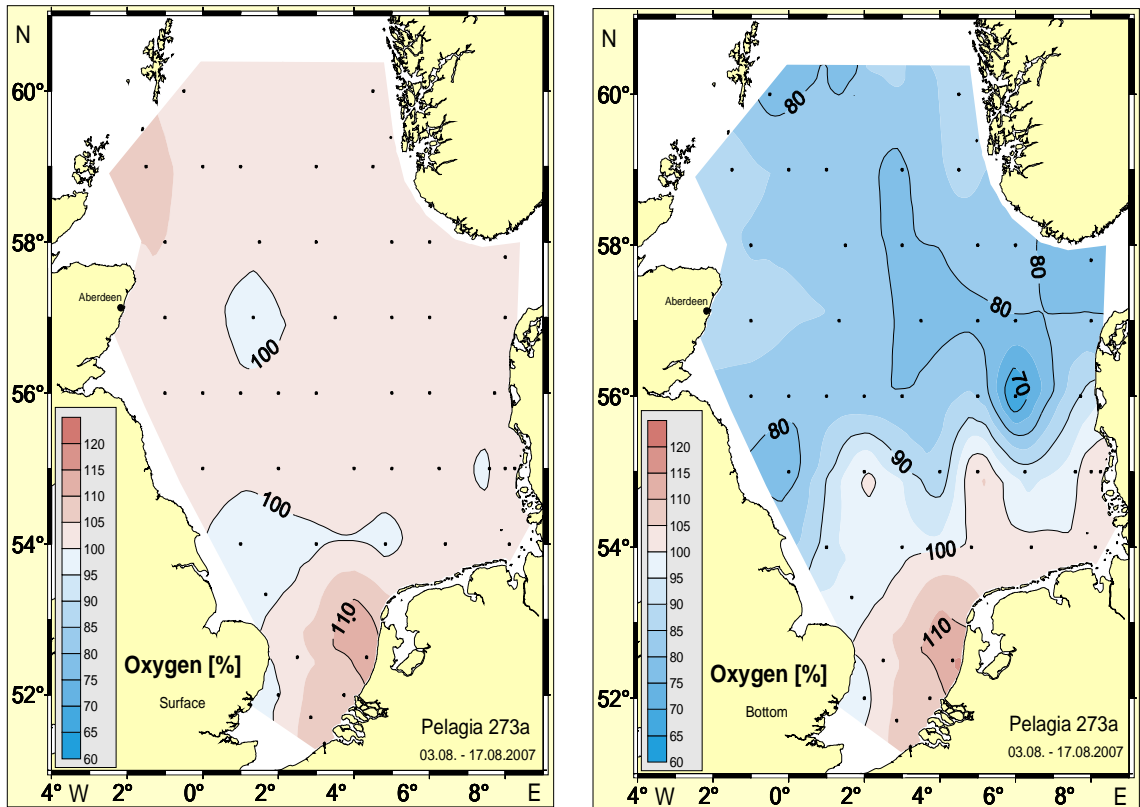


Fig. 3b: Surface and bottom distributions of Oxygen saturation and Secchi Depth



Equipment and Methods

Oceanography

- CTD/Rosette (Seabird SBE 19 with 12 standard bottles, oxygen sensor and Fluorometer)
- Delphin (Standardversion with CTD, fluorometer, oxygen sensor)
- Thermosalinograph
- Secchi disc

Nutrient concentrations

- $\text{PO}_4\text{-P}$ after Murphy and Riley (1962)
- $\text{SiO}_4\text{-Si}$ after Koroleff (1971)
- $\text{NO}_2\text{-N}$ after Bendschneider and Robinson (1952)
- $\text{NO}_3\text{+NO}_2\text{-N}$ after Bendschneider and Robinson (1952)
- $\text{NH}_4\text{-N}$ after Berthelot (1859)
- $\text{N}_{\text{org, extractable}}$ extraction with 2M KCl
- $\text{N}_{\text{residual}}$ high temperature oxidation
- $\text{P}_{\text{particulate}}$ after Liebezeit, G. (1995). Particulate phosphorus fractions in a mangrove estuary. *Senckenberg. Marit.* 25: 123-126
- TOC high temperature oxidation

Oxygen Concentrations

- Oxygen after Winkler-Carpenter with dissolved Oxygen Analyser (DOA), photometric end point identification

Organic Pollutants

- N.Theobald, W.Lange, A.Rave, U.Pohle und P.Koennecke, *Dt. Hydrogr. Z.*, 43, 311 (1990): Ein 100-l Glaskugelschöpfer zur kontaminationsfreien Entnahme von Seewasser für die Analyse lipo-philer organischer Stoffe
- N.Theobald, W.Lange, W.Gähler und F.Renner, *Fresenius J. Anal. Chem.* (1995), 353, 50 - 56: "Mass spectrometric investigations of water extracts of the river Elbe for the determination of potential inputs of pollutants into the North Sea"