



Baltic Sea Research Institute Warnemünde

Cruise Report

r/v "Prof. A. Penck"

Cruise- No. 07PE / 07 / 07

23 March – 2 April, 2007

Western and Central Baltic Sea

This report is based on preliminary data

Leibniz-Institut für Ostseeforschung Warnemünde
an der Universität Rostock
Seestraße 15
D-18119 Rostock- Warnemünde
GERMANY

☎ +49-381-5197-0

📄 +49-381-5197 440

1. **Cruise No.:** 07PE / 07 / 07
2. **Dates of the cruise:** from 23 March 2007 to 2 April 2007
3. **Particulars of the research vessel:**
Name: Prof. Albrecht Penck
Nationality: Germany
Operating Authority: IOW
4. **Geographical area in which ship has operated:**
western and central Baltic Sea
5. **Dates and names of ports of call**
6. **Purpose of the cruise**
Monitoring cruise in the framework of HELCOM programme
7. **Crew:**
Name of master: G. Kasch
Number of crew: 10
8. **Research staff:**
Chief scientist: Dr. R. Feistel
Scientists: S. Bednorz, S. Trinkler
Engineers: I. Schuffenhauer
Technicians: J. Donath, B. Sadkowiak, S. Busch, G. Plüschke
9. **Co-operating institutions:**
10. **Scientific equipment**
CTDO bathysonde, plankton net

11. General remarks and preliminary results

The deep water masses formed during and after the 2002/2003 inflow succession are still present in the central Baltic Sea, after having turned mostly to anoxic conditions in the meantime, in particular in the Western Gotland Basin between the Landsort and the Karlsö Deeps. Weak baroclinic inflow activity in 2005 and 2006 temporarily eased the stagnating conditions in particular between the Stolpe Sill and the Eastern Gotland Basin, see the bottom oxygen concentration map, attached. During the time of this cruise **a minor progressing inflow process could be observed** between the Stolpe Sill and the Eastern Gotland Basin, coined by warm ($> 6^{\circ}\text{C}$) and slightly oxic (about 1 ml/l) water properties, as shown in the transect from the Kiel Bight to the Gotland Basin, attached.

The cruise was carried out under calm to moderate **wind conditions**. A **stable high-pressure cell** with central pressures up to 1035 hPa prevailed over Scandinavia and the central Baltic Sea for the entire period of time. In the beginning of the cruise, a low over Germany (1010 hPa) caused easterly winds in the western Baltic with BF6, in gusts to BF8, and heavy swell from the east. East of Bornholm, low winds to windless conditions were dominating. This situation was responsible for **enduring outflow conditions** from the Baltic to the Kattegat. Between the beginning and the end of the cruise, the Landsort level decreased from +10 cm to -10 cm, corresponding to a water export of about 80 km³ during one week. In the Fehmarn Belt, a heavy surface current was observed from the ship's drift. At the Darss Sill mast, down to the deepest layers, low-salinity (< 10 psu) brackish water was measured between 26 March and 2 April. The blocking situation was particularly pronounced on the 28 and 29 March, when a trough from Spitsbergen over the North Sea down to Tunisia separated the high over the Baltic Sea from a high-pressure belt extending from Greenland to the Canary Islands.

During the cruise, the surface water temperatures varied from 5.5°C off Warnemünde to 3.1°C south of the Karlsö Deep. The formation of a shallow thermocline was observed. The morning air temperatures varied between 3.9 and 6°C, the air pressure ranged from 1025 to 1035 hPa. Clear sky conditions with some haze and cirrus but without dense cloud cover or precipitation were observed all along the cruise. In the **Western Gotland Sea, visibilities up to 17 m depth** were found, surprisingly in conjunction with a fairly high density of **algae (likely Aphanizomenon)** in the surface layer.

Since there was no cruise in 2006 about the same time of the year, data will be discussed in comparison to the observation of the same season in 2005.

In the **Kiel and Lübeck Bights** (TF 360 and TF 22), surface salinities of about 15 psu (Table 1, attached) are fairly high and must be attributed to the local wind and wave conditions. The SiO_4 concentrations of about 16 $\mu\text{mol/l}$ are very high compared to 2005, when only 3.7 and 1.3 $\mu\text{mol/l}$ were measured. PO_4 concentrations of 0.2 $\mu\text{mol/l}$ are comparable to those of 2005. While in the Kiel Bight the nitrate is already exhausted (0.02 $\mu\text{mol/l}$), the Lübeck Bight still shows high winter levels (14 $\mu\text{mol/l}$). The conditions in the near-bottom layers are similar to those at the surface. The oxygen supersaturation is insignificant, if at all.

In the **Arkona Basin** (TF 113), high near-bottom salinities (19.4 psu) indicate temporary inflow conditions. The water is well oxygenated (7.5 ml/l) and has surface water temperatures (5°C). This layer is thin (4 m), already at 40 m depth the salinity is lower than 17 psu. Since outflow conditions prevail, this layer is likely caused by an actual baroclinic transfer of dense, wind-mixed water from the Belt Sea.

In the **Bornholm Basin** (TF 213), warm ($> 9^\circ\text{C}$) and low-oxygen conditions (0.9 ml/l) were found below the Stolpe Sill depth (60 m) with salinities up to 16 psu. This water originates from warm inflow conditions in the fall of 2006 and still feeds the Stolpe channel and adjacent basins with warm and slightly oxygenated water. Nitrate is high at the bottom (8.9 $\mu\text{mol/l}$) and the surface (3.0 $\mu\text{mol/l}$). Phosphate is low at both levels. Small temperature maxima are found at 62 m (9.1 °C) and at 80 m (9.3 °C). Oxygen falls below 2 ml/l beneath 66 m and below 1 ml/l beneath 78 m (sensor raw data).

In the **south-western Gotland Basin** (TF 256), an oxygen minimum is found at 63 m (4.4 ml/l), a clear maximum at 67 m (5.7 ml/l), decreasing again to 4 ml/l at the bottom, a still remarkably high concentration after the returning to stagnant conditions in various other regions. Apparently an inflowing water layer is detected here. Temperature reaches its maximum near the bottom at 73 m with 7.1 °C. Further downstream (TF 259), the oxygen level is significantly reduced to 0.6 ml/l near the bottom, and the inflow layer could not be detected any more.

In the **Gotland Basin** (TF 271), hydrogen sulphide is found near the bottom (−2.5 ml/l oxygen equivalent). Below 70 m, the surface oxygen level drops rapidly to a minimum of 0.2 ml/l at 86 m, increases to a maximum of 0.5 ml/l at 107 m, and drops again below 0.1 ml/l at 128 m. H_2S is found at 150 m and below, with a maximum of −2.5 ml/l at the bottom. The temperature profile exhibits several weakly pronounced minima and maxima between 127 m and 160 m, below these levels the temperature is rather constant at 6 °C. This indicates some weak inflow activity in intermediate layers in the past months. The near-bottom temperatures and salinities are almost exactly the same as in 2005, hinting on very little or even no inflow activity at the deepest levels in this basin.

In the **Landsort Deep** (TF 284), a weak oxygen maximum of 8.6 ml/l is found at 39 m depth. Between 40 m and 50 m, the temperature profile shows 2 maxima and 2 minima ranging between 3.0 °C and 3.6 °C. Oxygen is less than 0.1 ml/l in layers deeper than 88 m, H₂S is detected everywhere below 100 m with a maximum of -0.8 ml/l at 200 m and -0.5 ml/l near the bottom. Very weak temperature oscillations occur at about 122, indicating some recent lateral exchange at this depth. Compared to 2005, the near-bottom salinity has slightly increased from 10.98 to 11.06 psu, indicating some inflow in this period even in the very deep, likely, overflowing stagnant waters from upstream basins..

In the **Karlsö Deep** (TF 245), the situation is rather similar. The near bottom salinity has increased from 9.95 psu to 10.10 psu between 2005 and now, the actual H₂S concentration is -0.6 ml/l. Oxygen drops below 0.5 ml/l at 76 m depths, Below 90 m, the water column is anoxic.

Stagnant waters prevail in the deep water of all deeps visited in the northern Baltic Proper, while moderate ventilation is found in all southern basins. This again suggests some inflow activity in the recent past which is still in progress.

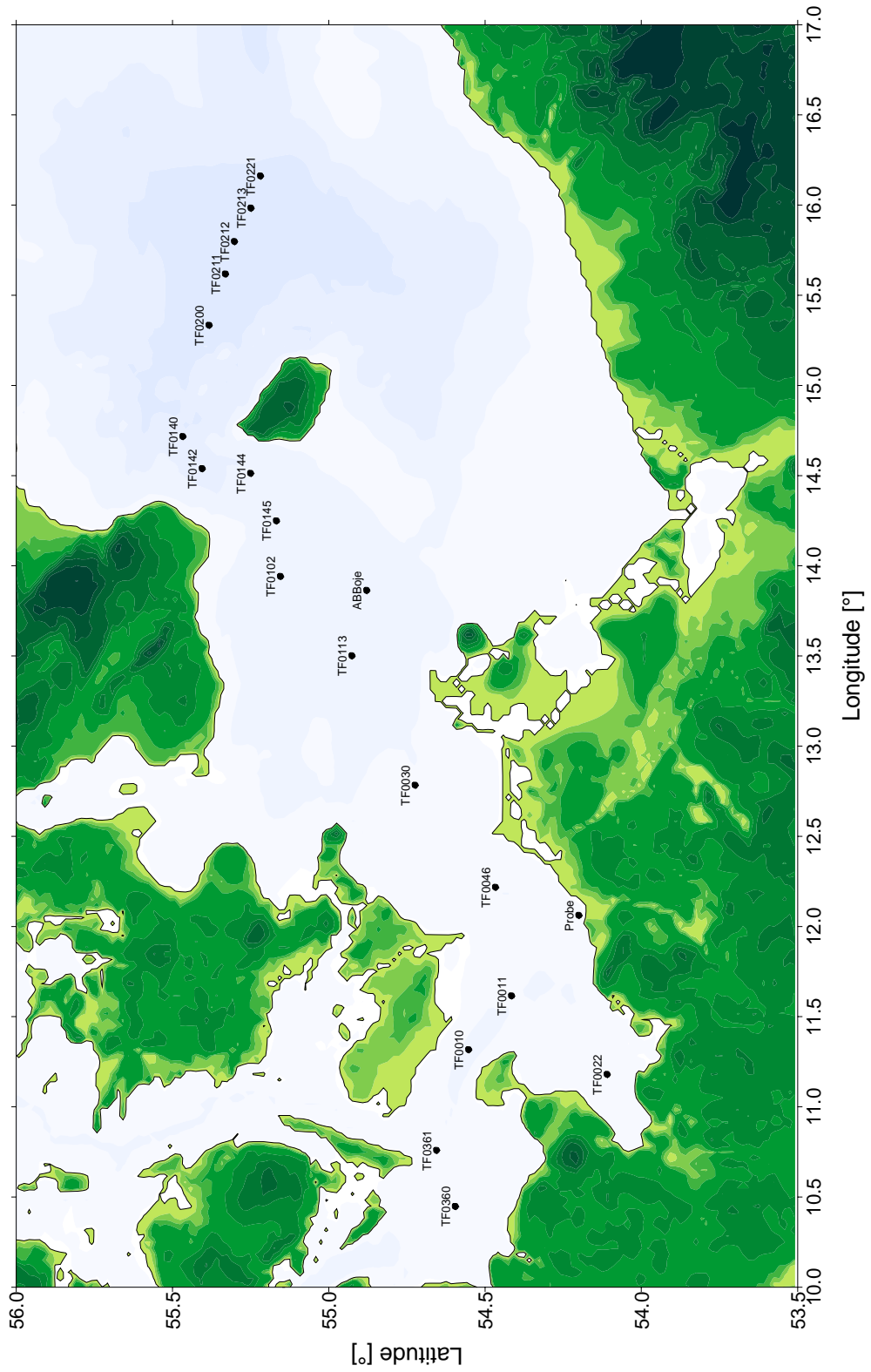
The station program had to be reduced due to technical problems occurring at the vessel's CTD winch. In addition to the regular program, four moorings could be recovered providing detailed insight into the deep-water inflow activity between the Stolpe Channel and the Eastern Gotland Basin going on since September/November 2006.

Rainer Feistel
scientist in charge

Attachments:

- station charts
- tables of preliminary results (surface layer and near bottom layer)
- transects of temperature and salinity between Kiel Bight and northern Gotland Sea
- map showing oxygen concentrations in the near bottom water layer
- preliminary map showing areas of near-bottom hydrogen sulphide and oxygen deficiency

Monitoring
Station map 07PE0707
23.03.2007 09:37 UTC - 01.04.2007 07:49 UTC
20 Stationen



K11.srf

IOW 2007, Sektion Physik - J.Donath

Monitoring

Station map 07PE0707

28.03.2007 07:07 UTC - 31.03.2007 13:03 UTC

21 Stationen

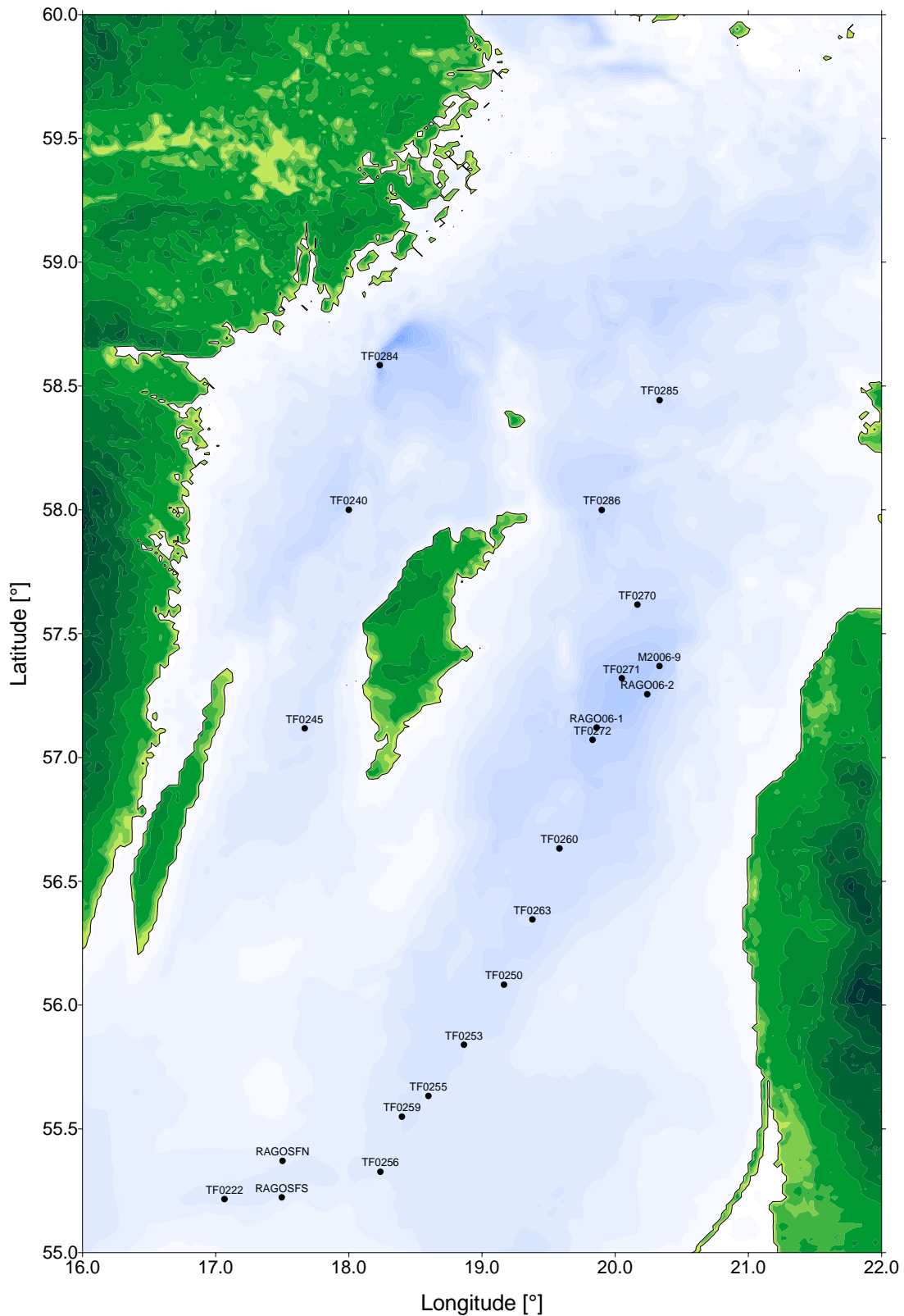


Table 1: Preliminary data from the surface layer of selected regions

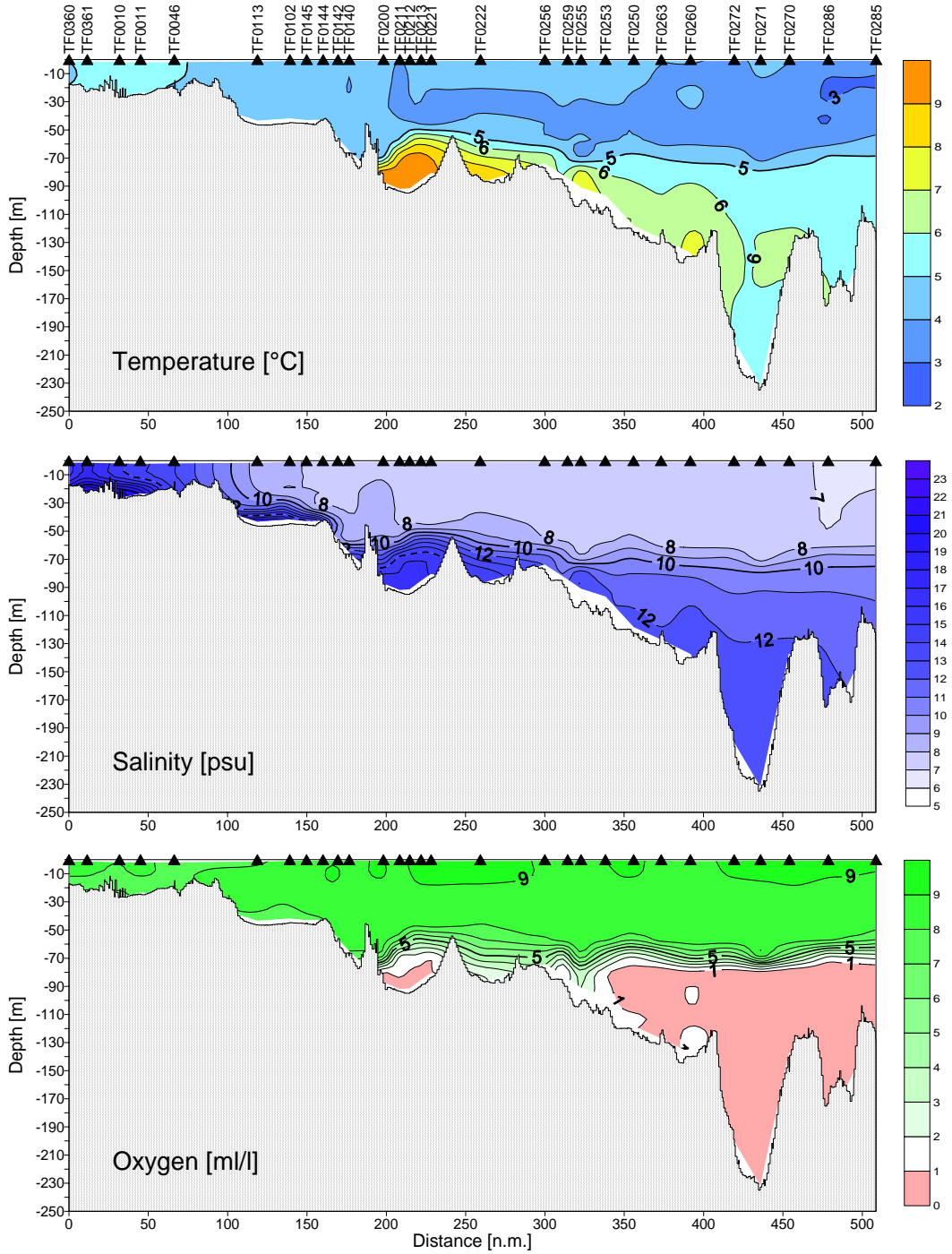
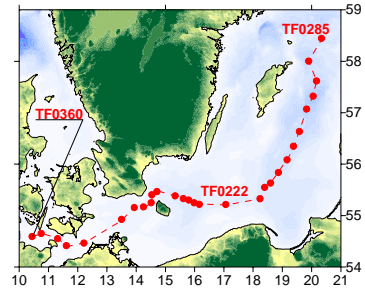
Location / Date	Station / Number	Temp. °C	Salinity psu	NO ₂₊₃ µmol/l	PO ₄ µmol/l	SiO ₄ µmol/l	O ₂ ml/l
Kiel Bight 23.03.2005	TF0360 4	5.00	15.42	0.02	0.20	16.20	8.89
Lübeck Bight 24.03.2007	TF0022 6	5.04	14.92	3.24	0.19	16.00	8.28
Arkona Basin 27.03.2007	TF0113 10	4.45	8.59	3.34	0.75	16.20	8.59
Bornholm Deep 27.03.2007	TF0213 11	4.29	7.95	2.99	0.87	15.80	8.67
SE Gotland Basin 31.03.2007	TF0259 29	4.54	7.51	1.76	0.41	11.40	9.00
Gotland Deep 29.03.2007	TF0271 19	4.25	7.32	2.32	0.42	11.70	8.76
Farö Deep 29.03.2007	TF0286 16	3.56	6.85	2.26	0.58	15.90	9.14
Landsort Deep 28.03.2007	TF0284 14	2.42	6.46	1.45	0.41	15.90	9.45
Karlsö Deep 28.03.2007	TF0245 12	3.27	6.88	2.45	0.62	16.20	8.94

Table 2: Preliminary data from the near-bottom layer of selected regions

Location / Date	Station / Number	Depth m	Temp. °C	Salinity psu	NO ₂₊₃ µmol/l	PO ₄ µmol/l	SiO ₄ µmol/l	O ₂ ml/l
Kiel Bight 23.03.2005	TF0360 4	18	5.07	18.96	0.37	0.05	10.00	8.02
Lübeck Bight 24.03.2007	TF0022 6	20	4.38	17.81	14.03	0.67	24.50	5.12
Arkona Basin 27.03.2007	TF0113 10	43	4.98	19.43	1.79	0.36	5.50	7.52
Bornholm Deep 27.03.2007	TF0213 11	85	9.29	16.21	8.94	1.70	48.80	0.85
SE Gotland Basin 31.03.2007	TF0259 29	84	5.80	10.93	5.44	2.84	46.50	0.64
Gotland Deep 29.03.2007	TF0271 19	232	5.98	12.63	0.00	4.63	67.40	-2.45
Farö Deep 29.03.2007	TF0286 16	188	6.01	12.18	0.00	3.75	57.30	-0.95
Landsort Deep 28.03.2007	TF0284 14	438	5.68	11.06	0.00	3.55	54.30	-0.45
Karlsö Deep 28.03.2007	TF0245 12	104	5.12	10.10	0.00	3.75	52.40	-0.61

07PE0707

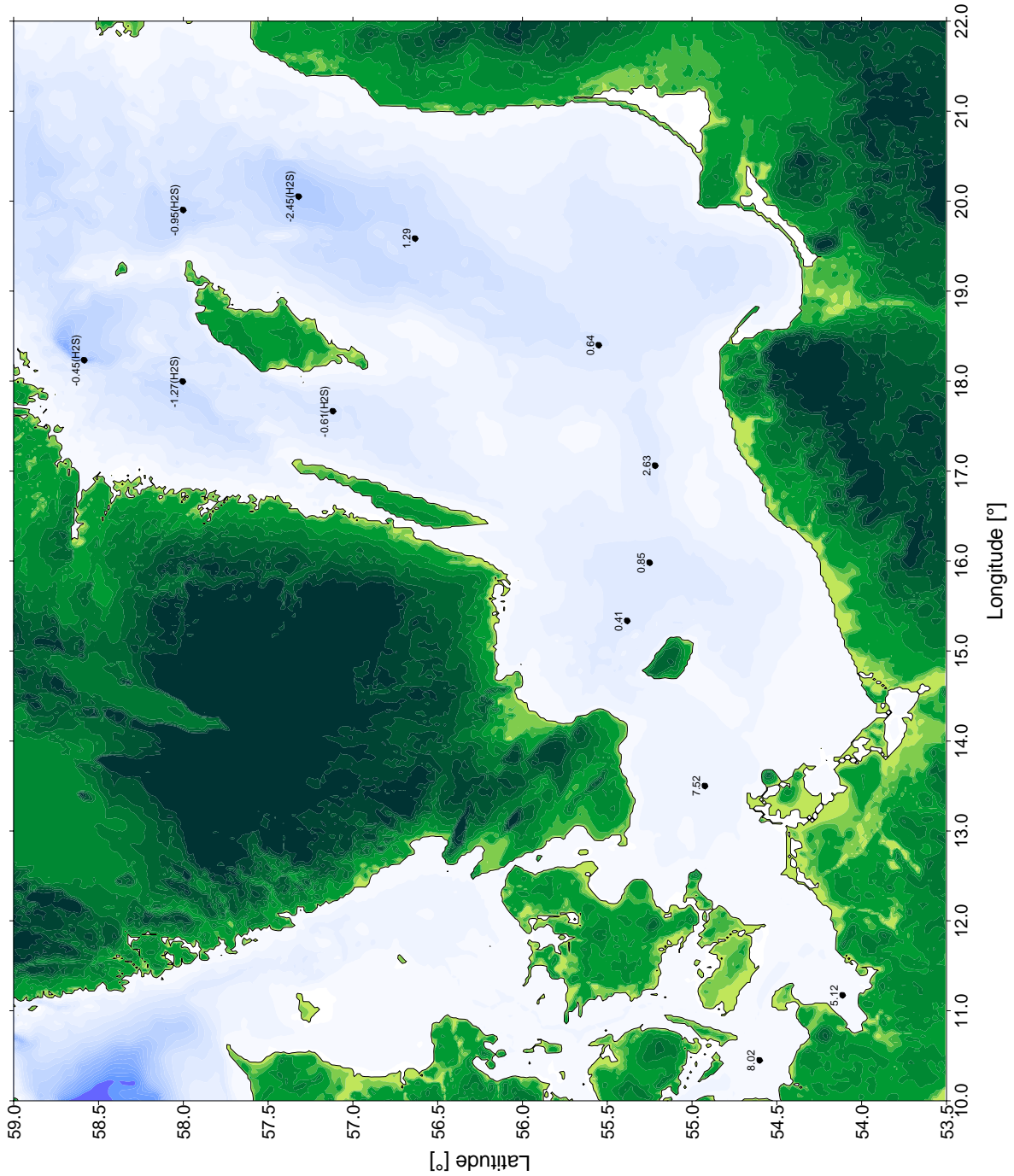
Kiel Bight - Gotland Sea
 23.03.2007 12:24 - 01.04.2007 07:49 UTC



05.srf

IOW 2007, Sektion Physik - J.Donath

Monitoring
07PE0707
23.03. - 01.04.2007
oxygen bottom
concentration [ml/l]



O2.srf
IOW 2007, Sektion Physik - J.Donath

