

Institut für Ostseeforschung Warnemünde



an der Universität Rostock BALTIC SEA RESEARCH INSTITUTE

Leibniz Institute for Baltic Sea Research Warnemünde

r/v „Professor Albrecht Penck“

Monitoring cruise

Cruise- No. 07 / PE / 08 / 17

29th July – 07th August 2008

Kiel Bight to northern Gotland Sea

this report is based on preliminary data

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Cruise No. 07/PE/08/17
r/v „Professor Albrecht Penck“

Warnemünde 10th August 2008

The third monitoring cruise of the Leibniz Institute for Baltic Sea Research Warnemünde in 2008 was carried out with r/v „Professor Albrecht Penck“ between July 29th and August 7th 2008. The cruise is part of the German contribution to the HELCOM COMBINE program and contributes to IOW's long term data series in the central Baltic Sea.

Scientific staff participating:

Günther Nausch (scientist in charge)	29.07. – 07.08.2008
Jan Donath	29.07. – 07.08.2008
Kirsten Isensee	29.07. – 07.08.2008
Meike Kilian	29.07. – 07.08.2008
Ramona Kirsch	29.07. – 07.08.2008
Benedikt Niesterok	29.07. – 07.08.2008
Ingo Schuffenhauer	29.07. – 07.08.2008

The area under investigation covered the Baltic Sea between Kiel Bight and the northern Gotland Sea. Marine meteorological, hydrographic, hydrochemical and hydrobiological investigations were performed according to the COMBINE program of HELCOM. The station map is attached to this report.

During the first part of the cruise an extensive high covering Scandinavia and Finland influenced the area under investigation. Air pressure varied only slightly around 1022hPa. Wind speed was generally low and did not exceed 4 Bft. Several times calm situations were observed. After the high had moved southeastwards, an intensive low over Denmark developed on 3rd to 4th August. Air pressure decreased within 24 hours from 1010hPa to 985hPa. As a result a heavy storm of Bft 7-8 occurred, occasionally wind speed >25 m/s (Bft 10) was observed. This extreme weather situation caused an interruption of the research program.

The following hydrographic and hydrochemical characteristics have been observed during the cruise (cf. Tables 1 and 2 and Figs. 3 and 4):

- Surface temperatures varied between 22.08°C (Bornholm Deep) and 17.31°C (Mecklenburg Bight) and are, especially in the central Baltic Sea, well above the long term mean for the period 1971-1990 (in brackets). The reason can be seen in the long lasting warm and calm weather period before and during the first part of the cruise.

Lübeck Bight	19.49°C (17.45°C)
Arkona Basin	19.54°C (17.00°C)
Bornholm Deep	22.08°C (17.56°C)
Gotland Deep	20.33°C (17.13°C)
Farö Deep	21.04°C (17.69°C)
Landsort Deep	20.02°C (18.20°C)

Due to the strong storm, the surface layer was mixed deeper down, thus causing a drop of the surface temperature by 2-3°C.

- In the western Baltic Sea, a baroclinic inflow event could be observed. Thus, at the Darss Sill on July 30th near to the bottom the following values were measured: S = 19.14 psu, T = 13.20°C and O₂ = 2.03 ml/l. The high temperatures in the deep water of the Arkona Basin (Fig. 3) document also baroclinic inflow activities. The strong storm event terminated this process, however.
- The major Baltic inflow from January 2003 was the last strong inflow event into the Baltic Sea. In the Bornholm and Gdansk Basin baroclinic inflow events influenced the deep water conditions in the following years. Thus, the deep water of the Bornholm Basin was free of hydrogen sulphide during the present cruise. The oxygenation resulted also in high nitrate and low phosphate concentrations below the halocline. However, the effects of the baroclinic inflows could influence the deep basins around Gotland only marginally, if any. Thus, the stagnation period continues there documented by decreasing salinity in the bottom layer:

	July 2005	July 2006	July 2007	July/Aug. 2008
Gotland Deep	12.73 psu	12.62 psu	12.89 psu	12.66 psu
Farö Deep	12.22 psu	12.11 psu	12.15 psu	12.13 psu
Landsort Deep	11.14 psu	11.06 psu	11.23 psu	11.07 psu
Karlsö Deep	10.35 psu	10.25 psu	10.41 psu	10.27 psu

- A further deterioration of the oxygen situation in the deep water was observed. Hydrogen sulphide concentrations (expressed as negative oxygen equivalents) in the near-bottom layer increased compared to the last cruise in May:

	July 2005	July 2006	July 2007	July/Aug. 2008
Gotland Deep	- 2.97 ml/l	- 4.42 ml/l	-3.95 ml/l	-4.93 ml/l
Farö Deep	- 1.42 ml/l	- 2.56 ml/l	-2.84 ml/l	-3.84 ml/l
Landsort Deep	- 0.14 ml/l	- 1.01 ml/l	-1.02 ml/l	-1.18 ml/l
Karlsö Deep	- 0.81 ml/l	- 1.88 ml/l	-2.74 ml/l	-1.76 ml/l

- Also the vertical extension of the hydrogen sulphide containing layer increased. At stations 271 (Gotland Deep) and 286 (Farö Deep) hydrogen sulphide was found between around 125 m and the bottom. At station 284 (Landsort Deep) the layer between 100 m and the bottom (436 m) was anoxic.
- As a result of the major Baltic inflow in January 2003 bottom water temperature had decreased in the Baltic deep water. However, deep water temperatures increased soon afterwards and are laying over the long-term mean again:

	July 2005	July 2006	July 2007	July 2008	Mean 1971/90
Bornholm Deep	6.97°C	7.96°C	8.83°C	7.22°C	6.12°C
Gotland Deep	5.97°C	5.95°C	6.82°C	6.40°C	5.62°C
Farö Deep	6.03°C	6.19°C	6.06°C	6.16°C	5.20°C
Landsort Deep	5.82°C	5.78°C	5.73°C	5.81°C	4.76°C
Karlsö Deep	5.34°C	5.23°C	5.14°C	5.32°C	4.18°C

- The nutrient situation in the bottom near layer reflects the present stagnation period. The phosphate and silicate as well as the ammonium concentrations in the anoxic water layers are on a high level whereas nitrate was not present.
- The calm, sunny and warm weather before and at the beginning of the cruise caused an intensive development of cyanobacteria in the surface layer of large areas of the Baltic Sea.

Bloom formation could be observed in the Arkona, Bornholm and eastern, northern and western Gotland basin. The surface nutrient concentrations reflect this mass development of cyanobacteria. Nitrate and also phosphate were near to the detection limit at almost all stations sampled. However, below the strong thermocline elevated phosphate concentrations were measured allowing a further development of cyanobacteria if upwelling processes can transport these nutrients in the mixed surface layer. In the Bornholm and Gotland Basin, the decomposition of sedimenting cyanobacteria caused an intensive oxygen depletion in the thermokline. After the storm event, no obvious surface accumulation could be seen.

Attachments

Tables 1 and 2: Preliminary results of selected parameters in the surface layer and the near bottom layer (unvalidated results)

Figs. 1-2: Track charts

Fig. 3: Transect from the Kiel Bight to the northern Gotland Basin for temperature, salinity and oxygen (unvalidated data)

Fig. 4: Oxygen/hydrogen sulphide in the bottom near layer for selected stations

Günther Nausch

Scientist in charge

Table 1: Surface water layer (about 1 m depth)

Area Date	Stat. Name/No.**	Temp. °C	Sal. psu	PO ₄ ³⁻	NO ₂₃ ^{-*} µmol/l	SiO ₄
Kiel Bight 29.07.2008	360/0006	19.06	13.37	0.09	0.07	4.6
Meckl.Bight 30.07.2008	012/0008	17.31	9.58	0.21	0.06	12.9
Lübeck Bight 30.07.2008	022/0007	19.49	13.04	0.02	0.04	2.6
Arkona Basin 30.07.2008	113/0019	19.54	7.65	0.06	0	14.0
Bornholm Deep 31.07.2008	213/0030	22.08	7.59	0.03	0	12.6
Stolpe Channel 01.08.2008	222/0033	20.94	7.36	0.05	0	13.6
SE Gotland Basin 01.08.2008	259/0035	21.24	7.33	0.03	0.03	12.7
Gotland Deep 02.08.2008	271/0042	20.33	6.71	0.02	0.01	7.4
Farö Deep 02.08.2008	286/0044	21.04	6.22	0.01	0	6.0
Landsort Deep 03.08.2008	284/0047	20.02	6.33	0.01	0	6.6
Karlsö Deep 03.08.2008	245/0050	20.02	7.07	0	0.01	9.1

* $\sum \text{NO}_2^- + \text{NO}_3^-$

** see attached map

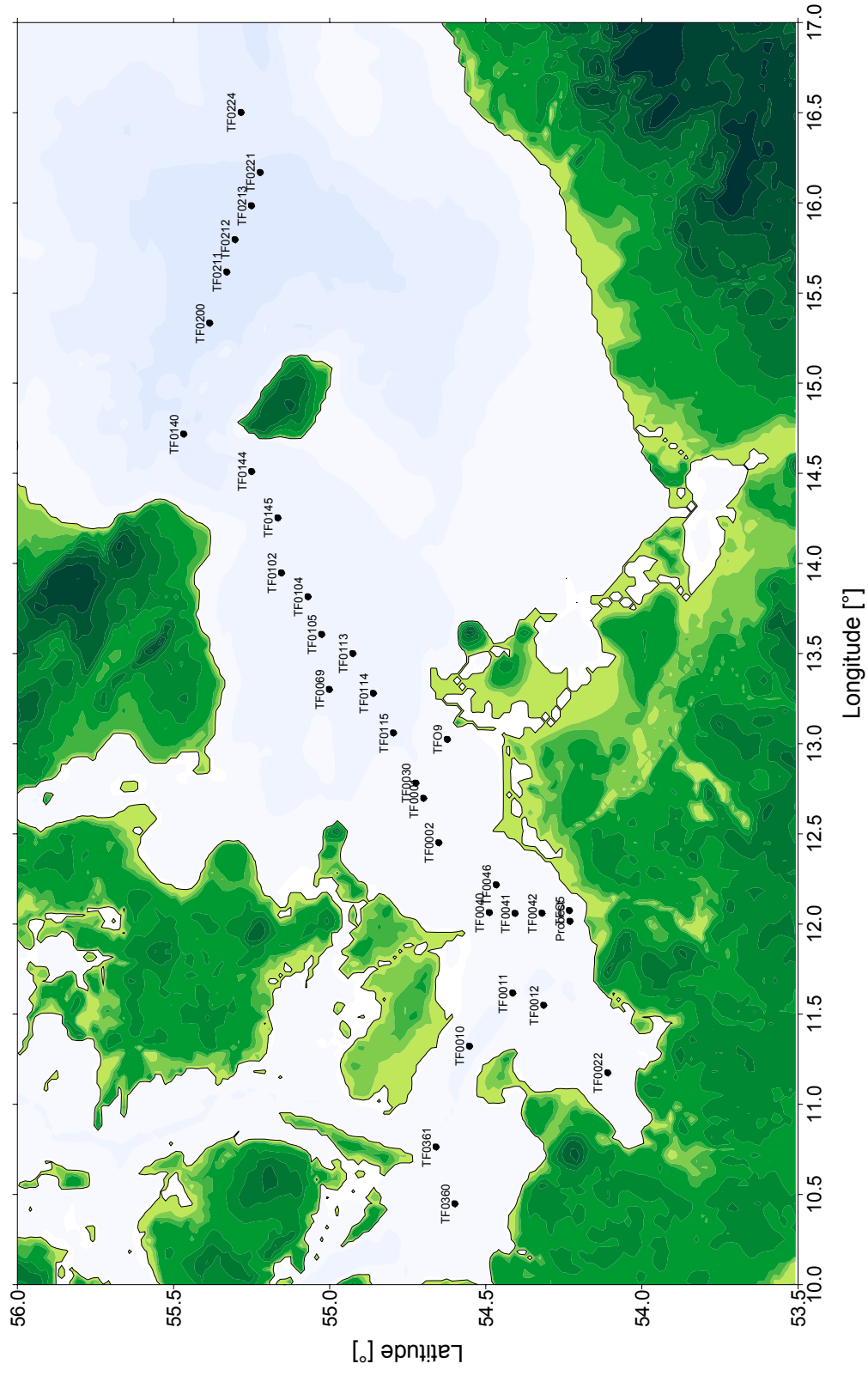
Table 2: Near bottom layer

Area Date	Stat. Name/No.**	Depth m	Temp. °C	Sal. psu	O ₂ ml/l	PO ₄ ³⁻	NO ₂₃ ^{-*} μmol/l	SiO ₄
Kiel Bight 29.07.2008	360/0006	17	11.49	22.61	3.59	0.54	0.16	22.2
Meckl.Bight 30.07.2008	012/0008	23	10.73	26.50	3.63	0.96	3.75	22.0
Lübeck Bight 30.07.2008	022/0007	21	10.29	23.96	2.22	0.96	2.18	30.2
Arkona Basin 30.07.2008	113/0019	44	12.66	17.10	2.87	1.28	7.42	30.8
Bornholm Deep 31.07.2008	213/0030	87	7.22	15.69	0.52	1.90	8.26	54.6
Stolpe Channel 01.08.2008	222/0033	87	6.71	13.74	2.11	2.70	7.80	56.5
SE Gotland Basin 01.08.2008	259/0035	86	5.75	10.77	1.31	2.44	5.72	43.2
Gotland Deep 02.08.2008	271/0042	234	6.40	12.66	-4.93	4.05	0	84.5
Farö Deep 02.08.2008	286/0044	190	6.16	12.13	-3.84	4.90	0	75.0
Landsort Deep 03.08.2008	284/0047	436	5.81	11.07	-1.18	3.75	0	58.0
Karlsö Deep 03.08.2008	245/0050	106	5.32	10.27	-1.76	3.85	0	59.6

* $\sum \text{NO}_2^- + \text{NO}_3^-$

** see attached map

stationmap
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32 Stationen

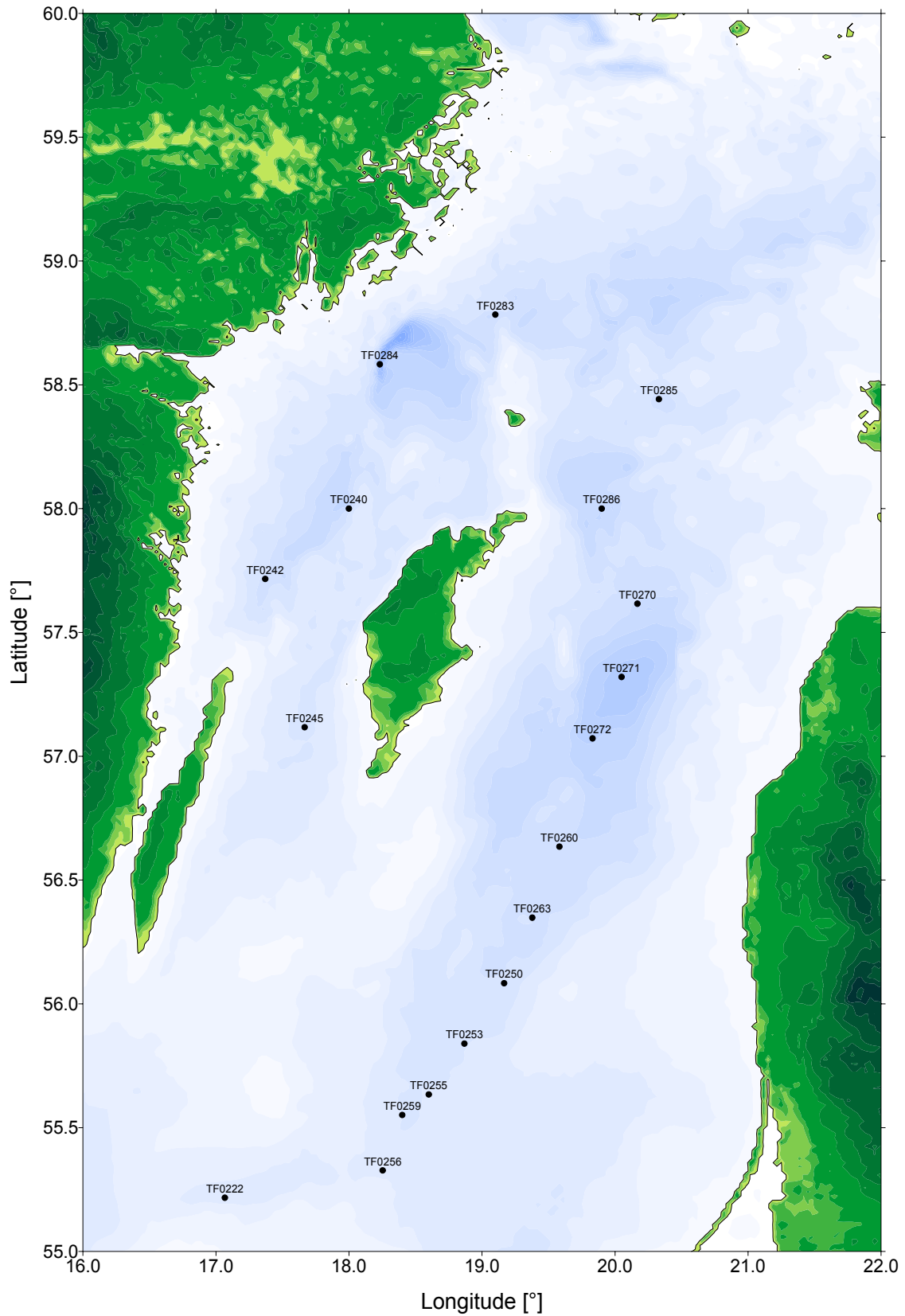


stationmap K2

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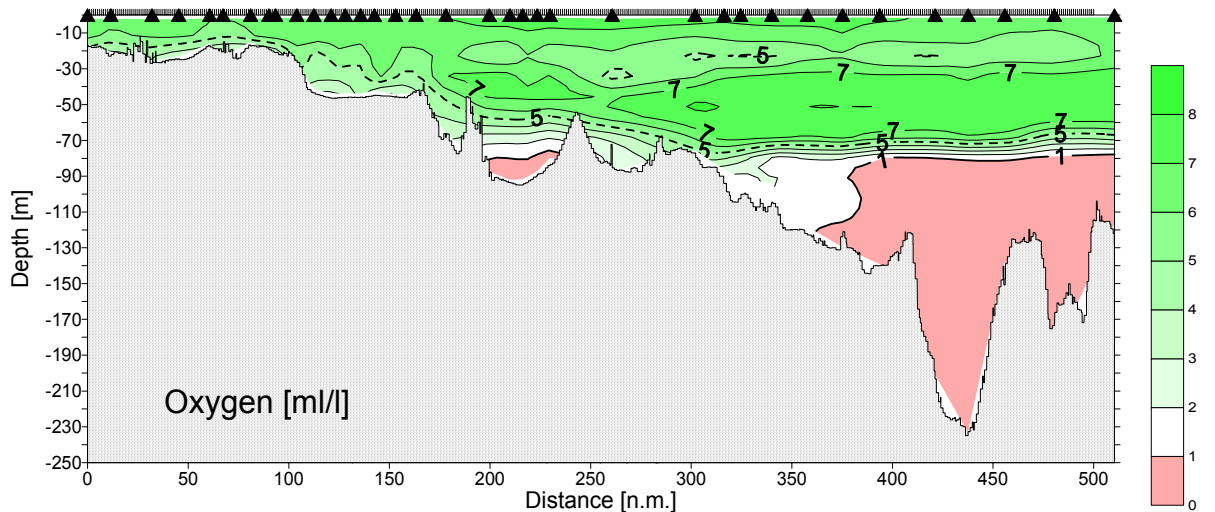
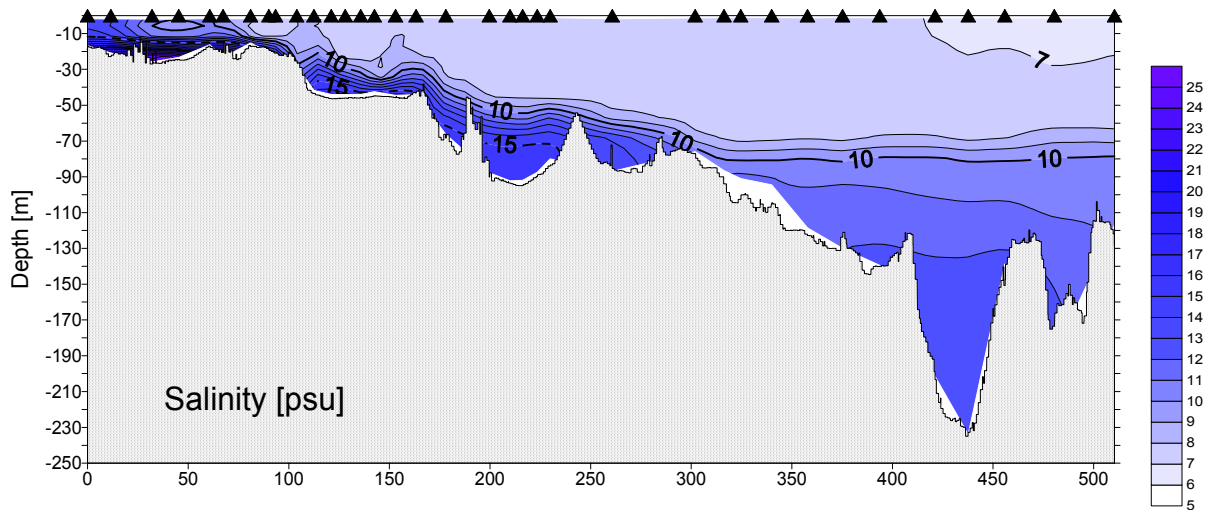
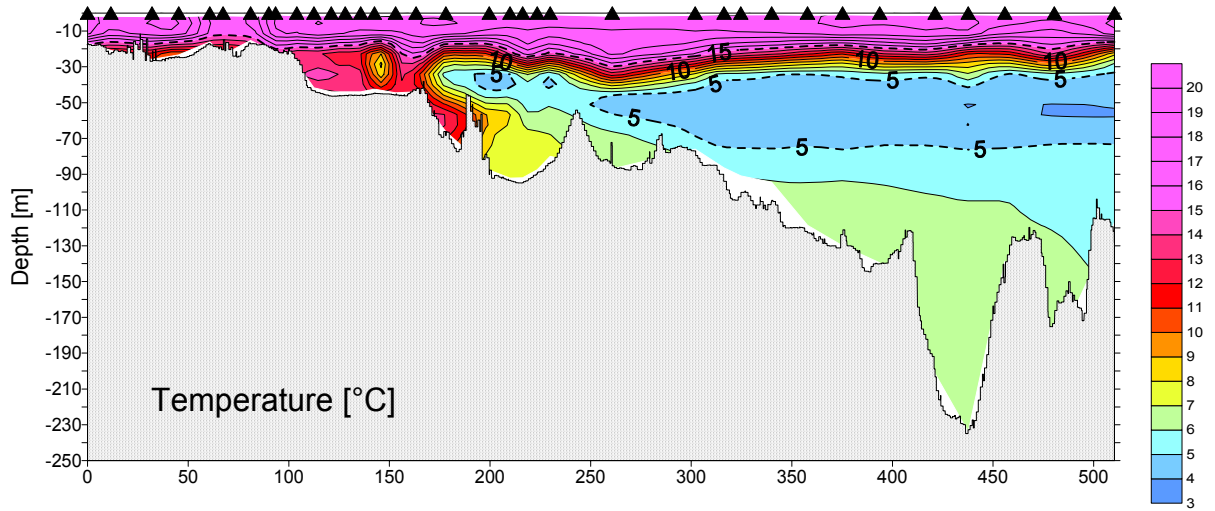
18 stations



monitoring 07PE1017

Kiel Bight - Gotland Sea

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Monitoring
07PE0817
29.07. - 07.08.2008

oxygen bottom
concentration [ml/l]

