

Baltic Sea Research Institute Warnemünde

r/v „Gauss“

Monitoring cruise

Cruise- No. 11 / 06 / 06 (Gauss 462)

18th July – 28th July 2006

Kiel Bight to northern Gotland sea

this report is based on preliminary data

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The third monitoring cruise in 2006 performed by the Baltic Sea Research Institute Warnemünde in the frame of the HELCOM COMBINE program was carried out with r/v „Gauss“ between July 18th and July 28th 2006.

Scientific staff participating:

Günther Nausch (scientist in charge)	18.07. – 28.07.2006
Sandra Bednorz	18.07. – 28.07.2006
Barbara Deutsch	18.07. – 28.07.2006
Jan Donath	18.07. – 28.07.2006
Ines Hand	18.07. – 28.07.2006
Bernd Sadkowiak	18.07. – 28.07.2006
Doris Setzkorn	18.07. – 28.07.2006
Sven Trinkler	18.07. – 28.07.2006
Stefan Weinreben	18.07. – 28.07.2006
Klaus-Peter Wlost	18.07. – 28.07.2006

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 whole cruise a system of high pressure cells influenced the area under investigation. Air pressure varied only slightly between 1017hPa and 1023hPa. Wind speed was generally low and did not exceed 4 Bft. Several times calm situations were observed. In the first half of the cruise wind came from varying directions, the second part of the cruise was dominated by winds from westerly directions. Sky was mostly sunny and only seldom covered by light clouds. Consequently air temperature was high. During day time 20 – 24°C were measured, only slightly decreasing during the night.

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

- Surface temperature varied between 22.19°C (Stolpe Channel) and 18.76°C (Gotland Deep) and are 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 cruise.

Lübeck Bight	20.48°C (17.45°C)
Arkona Basin	21.57°C (17.00°C)
Bornholm Deep	21.48°C (17.56°C)
Gotland Deep	18.76°C (17.13°C)
Farö Deep	19.45°C (17.69°C)
Landsort Deep	20.69°C (18.20°C)

- The relatively cold and long lasting winter, followed by an extended warm period resulted in the development of a very sharp thermocline with extreme gradients. In the Bornholm Basin this thermocline was found already at around 10m whereas the thermocline was located at around 15 m in the eastern Gotland Basin. The sunny and calm weather caused the formation of a secondary thermocline at around 5 m at most of the stations.
- The cold winter and the rapid warming afterwards resulted also in an extremely cold winter water. For example, at station 271 (Gotland Deep) 1.90°C were measured in 50 m water depth level.
- The major Baltic inflow from January 2003 was the last strong inflow event into the Baltic Sea. The deep basins were additionally influenced by a warm summer inflow in 2003. The effects of these events faded out and a new stagnation period started already in 2005 and continued in 2006 in all deep basins of the central Baltic Sea. Thus, salinity in the bottom layer decreased further compared to July 2005:

	July 2005	July 2006
Gotland Deep	12.73 psu	12.62 psu
Farö Deep	12.22 psu	12.11 psu
Landsort Deep	11.14 psu	11.06 psu
Karlsö Deep	10.35 psu	10.25 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:

	May 2006	July 2006
Gotland Deep	- 3.61 ml/l	- 4.42 ml/l
Farö Deep	- 2.33 ml/l	- 2.56 ml/l
Landsort Deep	- 0.50 ml/l	- 1.01 ml/l
Karlsö Deep	- 0.86 ml/l	- 1.88 ml/l

- Also the vertical extension of the hydrogen sulphide containing layer increased. At station 271 (Gotland Deep) hydrogen sulphide was found between around 137 m and the bottom and at station 286 (Karlsö Deep) the layer between 120 m and the bottom was anoxic. Especially extreme was the situation at station 284 (Landsort Deep). Already in 70 m water depth a hydrogen sulphide concentration of – 0.23 ml/l was measured. The whole water body below that depth was anoxic.
- As a result of the major Baltic inflow bottom water temperature had decreased in the Baltic deep water. Meanwhile, temperatures have exceeded the long-term mean again:

	July 2003	July 2004	July 2005	July 2006	Mean 1971/90
Bornholm Deep	3.71°C	5.12°C	6.97°C	7.96°C	6.12°C
Gotland Deep	4.63°C	6.51°C	5.97°C	5.95°C	5.62°C
Farö Deep	6.00°C	5.87°C	6.03°C	6.19°C	5.20°C
Landsort Deep	5.88°C	5.69°C	5.82°C	5.78°C	4.76°C
Karlsö Deep	4.90°C	5.29°C	5.34°C	5.23°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 increased further compared to the observation in 2005 and also to measurements in May 2006 whereas nitrate was not present.

- The calm, sunny and warm weather caused an intensive development of cyanobacteria in the surface layer of large areas of the Baltic Sea. In contrast to previous years, surface accumulations were mainly observed in the western Baltic Sea, the Arkona and Bornholm Basins whereas the eastern and western Gotland Basin were not affected so much. The surface nutrient concentration 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.

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 18.07.2006	360/0004	22.07	12.28	0.01	0	7.4
Meckl.Bight 18.07.2006	012/0002	19.60	8.32	0.14	0.22	7.3
Lübeck Bight 18.07.2006	022/0003	20.48	10.12	0.02	0.22	8.2
Arkona Basin 20.07.2006	113/0027	21.57	7.49	0.02	0	8.2
Bornholm Deep 21.07.2006	213/0043	21.48	7.31	0	0.07	6.8
Stolpe Channel 21.07.2006	222/0046	22.19	7.18	0.02	0.19	7.8
SE Gotland Basin 21.07.2006	259/0048	19.75	7.12	0	0.11	7.8
Gotland Deep 23.07.2006	271/0055	18.76	6.80	0.02	0.06	8.6
Farö Deep 23.07.2006	286/0057	19.45	6.53	0.02	0.04	6.4
Landsort Deep 24.07.2006	284/0061	20.69	6.78	0.01	0.02	8.2
Karlsö Deep 25.07.2006	245/0063	20.36	6.96	0.02	0.04	8.4

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

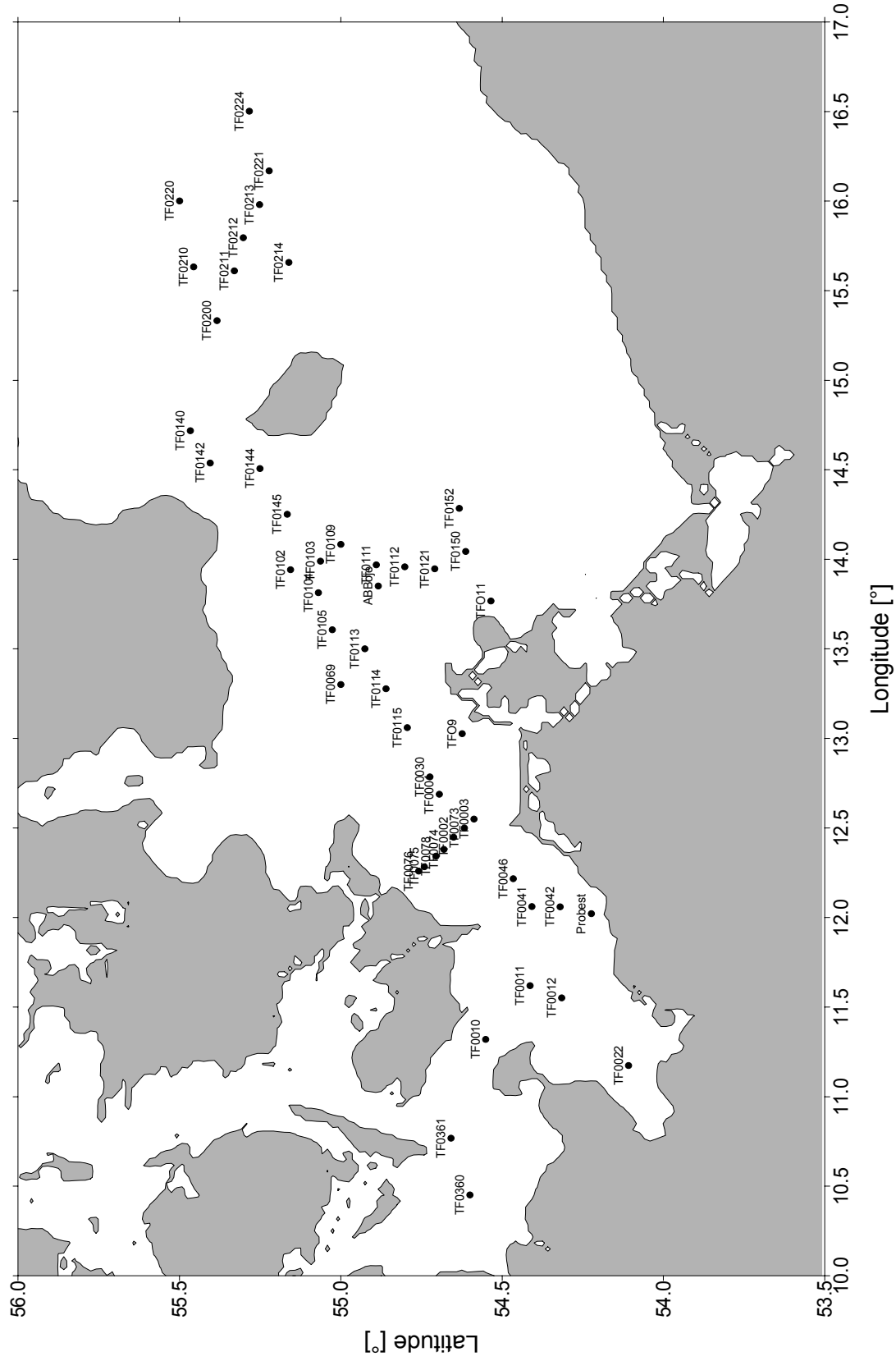
** see attached map

Table 2: Near bottom layer

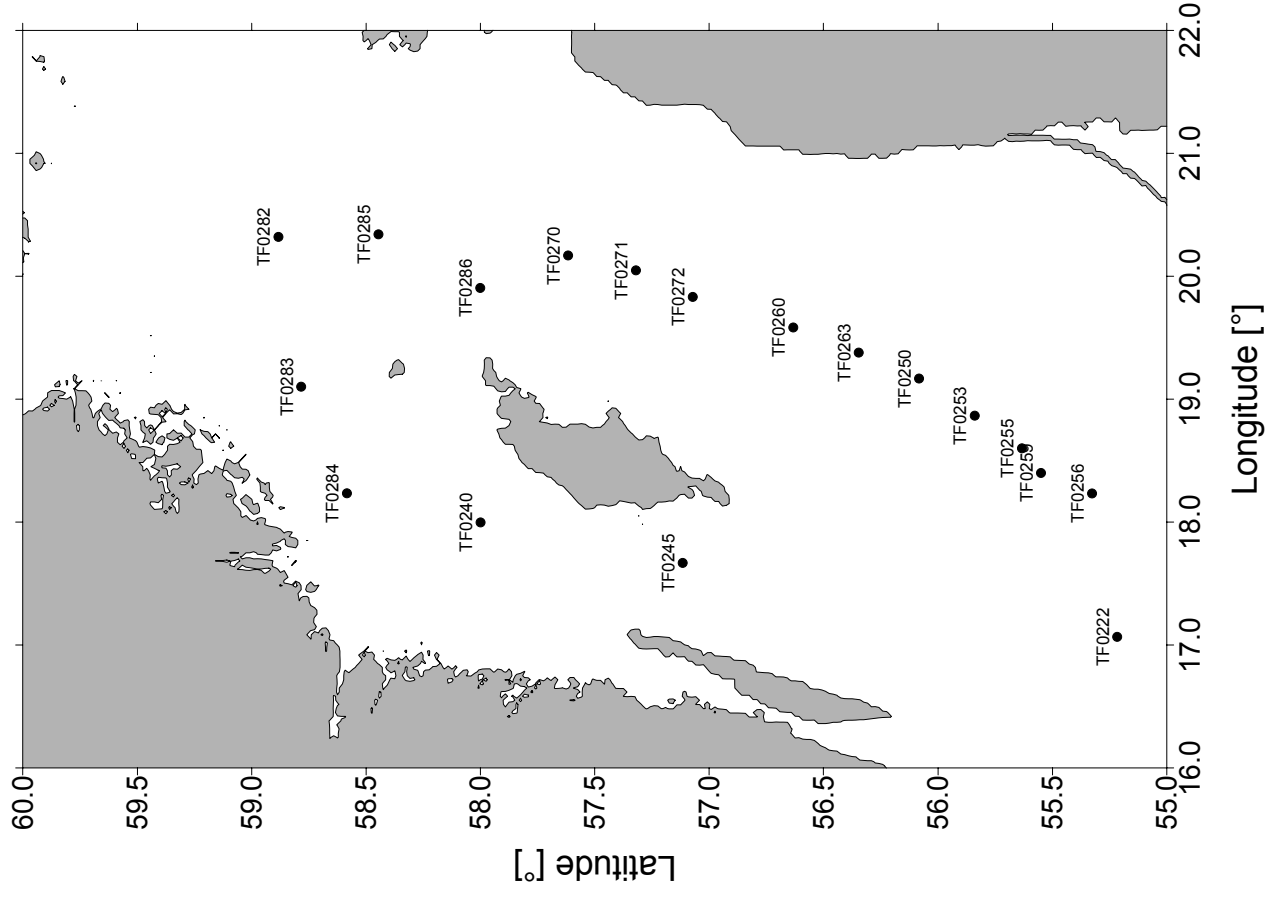
Area Date	Stat. Name/No.**	Depth m	Temp. °C	Sal. psu	O ₂ ml/l	PO ₄ ³⁻	NO ₂₃ ^{-*} µmol/l	SiO ₄
Kiel Bight 18.07.2006	360/0004	17	10.57	21.64	5.82	0.54	0.08	11.9
Meckl.Bight 18.07.2006	012/0002	23	7.71	26.15	2.48	1.14	3.66	43.0
Lübeck Bight 18.07.2006	022/0003	22	6.05	23.75	1.65	0.88	3.10	54.9
Arkona Basin 20.07.2006	113/0027	45	8.84	21.13	3.60	0.99	1.48	25.6
Bornholm Deep 21.07.2006	213/0043	87	7.96	16.50	-0.81	7.55	0	84.3
Stolpe Channel 21.07.2006	222/0046	88	6.03	14.02	0.98	2.70	7.80	56.5
SE Gotland Basin 21.07.2006	259/0048	86	5.33	10.68	0.30	2.73	5.30	47.2
Gotland Deep 23.07.2006	271/0055	232	5.95	12.62	-4.42	5.75	0	81.4
Farö Deep 23.07.2006	286/0057	187	6.19	12.11	-2.56	4.45	0	66.9
Landsort Deep 24.07.2006	284/0061	434	5.78	11.06	-1.01	3.60	0	55.6
Karlsö Deep 25.07.2006	245/0063	100	5.23	10.25	-1.88	3.85	0	61.2

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

** see attached map



Monitoring
station map TF110606
18.07. - 28.07.2006
52 stations on part 1

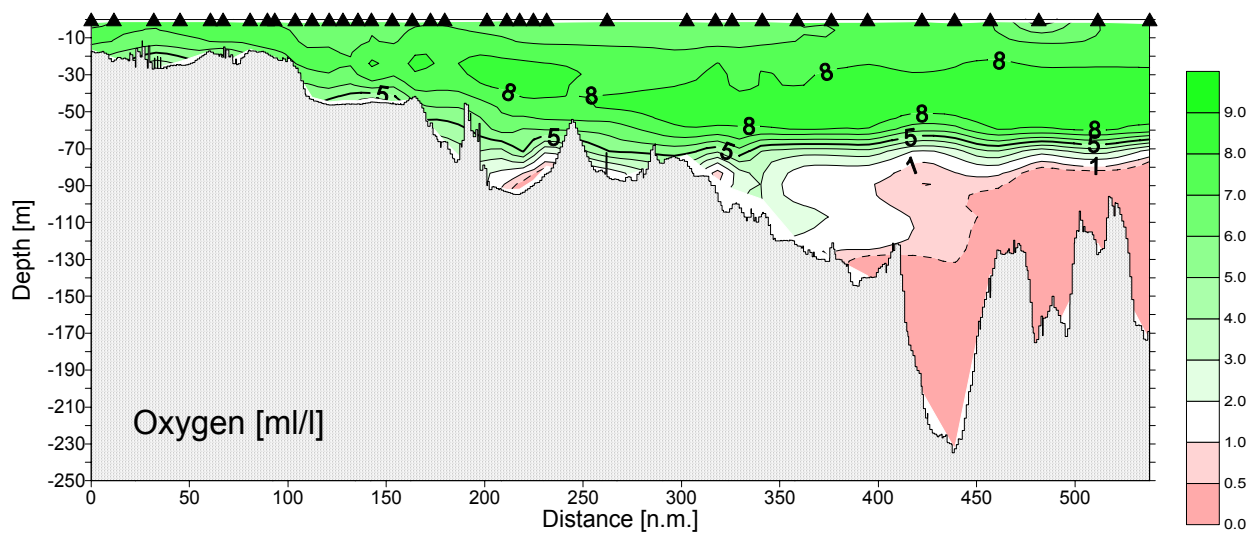
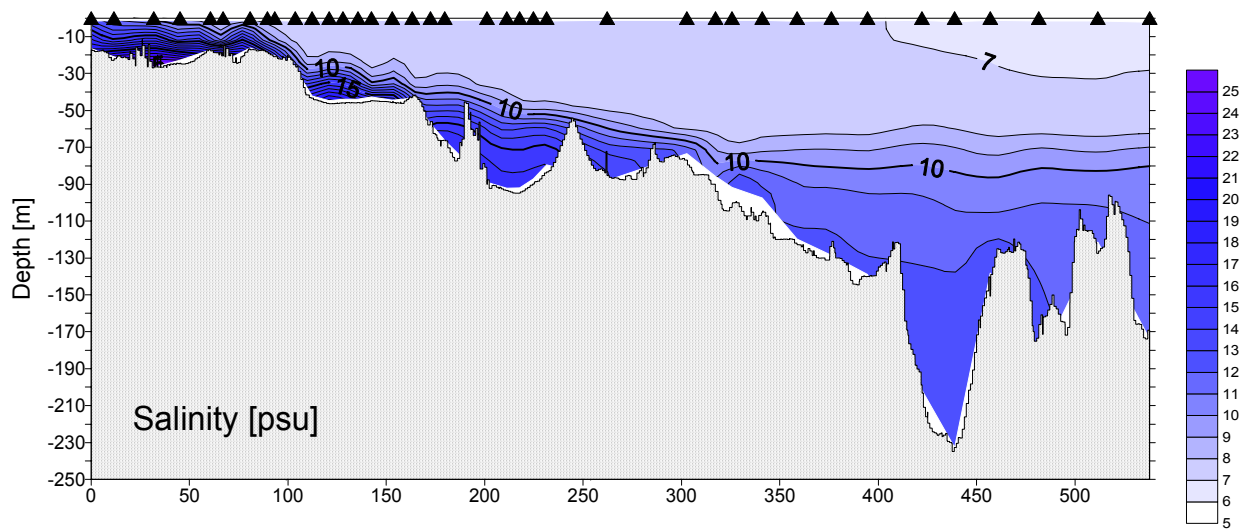
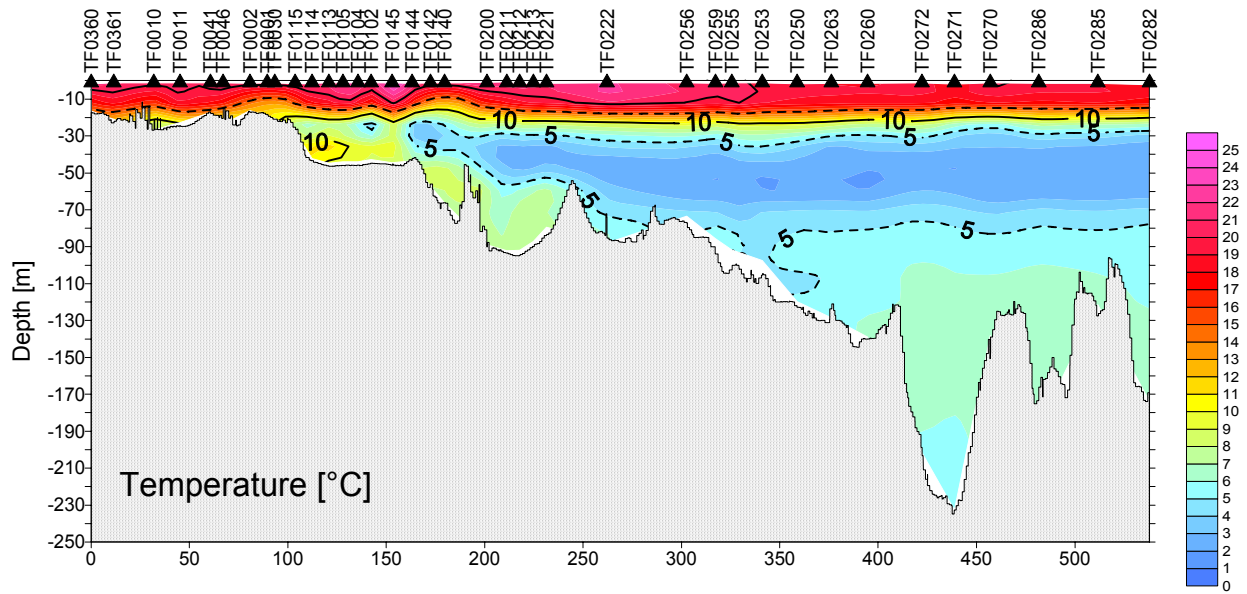


Monitoring
station map TF110606
18.07. - 28.07.2006
18 stations on part 2

Monitoring 110606

Kiel Bight - Gotland Sea

18.07.2006 23:00 - 24.07.2006 02:59 UTC



Monitoring

TF1100606

18.07.2006 - 28.07.2006

Oxygen bottom concentration [ml/l]

