

Baltic Sea Research Institute Warnemünde

C r u i s e R e p o r t

r/v "Gauss "

Cruise- No. 11 / 04 / 08

This report is based on preliminary data

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.: 11 / 04 / 08

2. Dates of the cruise: from 29.10.2004 to 10.11.2004

3. Particulars of the research vessel:

Name: Gauss
Nationality: Germany
Operating Authority: BSH Hamburg

4. Geographical area in which ship has operated:

Western Baltic, Southern Baltic, Bornholm Sea, Gotland Sea

5. Dates and names of ports of call

02.11.2004, Saßnitz

6. Purpose of the cruise

Monitoring Cruise for Baltic BMP

7. Crew:

Name of master: Ktn. Schütt
Number of crew: 19

8. Research staff:

Chief scientist: Dr. M. Schmidt
Scientists, engineers and technicians

Blaurock	Manuela	29.10. - 04.11.2004	IOW
Glockzin	Ines	29.10. - 04.11.2004	IOW
Dr. Zettler	Michael	29.10. - 04.11.2004	IOW
Sadkowiak	Birgit	29.10. - 10.11.2004	IOW
Hehl	Uwe	29.10. - 10.11.2004	IOW
Hand	Ines	29.10. - 10.11.2004	IOW
Donath	Jan	29.10. - 10.11.2004	IOW
Grütmüller	Annett	29.10. - 10.11.2004	IOW
Schuffenhauer	Ingo	29.10. - 10.11.2004	IOW
Himburg	Anja	29.10. - 10.11.2004	IOW
Simon	Heike	29.10. - 10.11.2004	IOW
Plüschke	Günter	03.11. - 10.11.2004	IOW
Hoffmann	Detleff	03.11. - 10.11.2004	TUHH
Wlost	Peter	29.10. - 29.10.2004	IOW

9. Co-operating institutions:

Bundesamt für Seeschifffahrt und Hydrographie Hamburg

10. Scientific equipment:

- CTD SBE-911+ equipped with temperature, depth, conductivity and oxygen sensors, Dr. Haard fluorometer and a water sampler rosette

- Autosal 8400A
- autoanalyser EVOLUTION III,
- Titrino 716 DMS Winkler Oxygen titration set
- Spectrometer
- Plankton nets WP2, filtration sets
- van Veen grab, video camera, dredge

General remarks and preliminary results

The cruise took place under meteorological conditions as usual for the season. Working the western part of the cruise from Kiel Bight to Arkona and the Pommeranian Bight, the wind was easterly and moderate. Rainy and foggy condition prevented strong cooling during nighttime and the water column appears well stratified, colder and less saline water in a surface layer and warmer more saline water below.

The second leg of the cruise in the Bornholm Sea and Gotland Sea was mainly determined by weak or moderate winds and moderate sea state. Hence, all stations could be worked and two moorings in the Gotland Sea could be recovered and layed out without problems. Partly clear night skies and low air temperature caused strong surface cooling and convection has homogenised surface water down to winter water layer.

95 hydrographic stations were worked. Each station started with a CTD-cast combined with water sampling for oxygen and nutrient determination. At several stations casts with plankton nets WP2 are taken. The depth was chosen according to the CTD-profiles. The samples are filtrated and frozen.

The station work is supplemented by underway measurements of surface temperature and salinity, wind speed, air temperature, air pressure and humidity as well.

At seven selected stations makrozoobenthos was sampled. Station work involved video inspection, grabbing with Van Veen grab, three samples each station. Organisms were extracted from the samples with help of sieves with 1 mm width. Sampling was completed with dredging some minutes with 5 mm mesh width. The stations represent Fehmarn Belt, Lübeck Bight, Mecklenburg Bight, Darß Sill, Arkona Sea, Bornholm Sea and Pommeranian Bight. Except Bornholm Sea all stations were crowded by Macrozoobenthos, in the Bornholm Basin the near bottom water was hypoxic and no benthic life was possible. At westerly stations settlement of Brittlestars (*Ophiura albida*) and Starfishs (*Asterias rubens*) was obvious. In the northern part of the Arkona Sea mussels of genus *Astarte* were sampled for genetic investigation.

Samples are taken for a reconsideration of biomass factors used for HELCOM. For a calibration of the length/carbon-relation of zooplankton species selected individuals are identified and measured and then frozen in liquid nitrogen for further analysis in the laboratory.

The hydrographic conditions in the western part of the Baltic Sea between Kiel Bight over the Arkona Sea to Bornholms Gatt is governed by warm saline water near the bottom. From Kiel Bight to Darß Sill there is "horizontal stratification", salinity decreases eastward in the whole water column. East of Darß Sill vertical gradients play major role, surface salinity is about 8 and varies only slightly. The warm saline water continues in the Arkona Sea as a bottom layer of about 10 m height, separated from the surface water by a sharp halocline and thermocline in

about 35 m depth. The bottom water has maximum salinity of 18, a temperature of 14 °C and high oxygen concentration which allows for the rich benthic life.

In the Pommeranian Bight temperature and salinity is almost constant everywhere. Some more saline water is found at the slope to the Arkona Basin which seems to penetrate eastward in geostrophic balance leaving the slope to the right. At all stations in the Pommeranian Bight the water is oxic. (Figure 6)

The nutrient situation in the surface layer demonstrates the typical autumnal development. Due to mineralization processes nutrients start to increase. It is remarkable that the phosphate enrichment, esp. in the western Baltic Sea up to the Stolpe Channel, has progressed far whereas nitrate concentrations still remain on a relative low level. High phosphate and ammonium concentrations and the absence of nitrate reflect the anoxic conditions in the bottom near layers of the Bornholm and Gotland Deep as well as in the western Gotland Basin.

The warm saline bottom layer continues into Bornholms Gatt. Also in the Bornholm Basin patches of this water mass are found in about 60 m depth, but its density is not sufficient to replace the bottom water there. Hence, four main water masses are found in the Bornholm Basin. A well mixed surface layer has a temperature of about 10 °C and salinity of 8. In about 40 m depth a sharp thermocline separates the surface water from a layer of winter water with a temperature of 4-5 °C. Below the winter water layer patches of warm water are found which must have been passed Bornholms Gatt earlier and have replaced the winter water there. A part of the winter water must have left the Bornholm basin through Bornholms Gatt, a minor signature of this water type can be found even in the western Arkona Sea at station TF0114. Bornholm Sea deep water in 70 m to 90 m depth reveals a salinity of 17 and a temperature from 5 to 6 °C. The bottom water is hypoxic or anoxic.

Density of the warm intermediate water is higher than the adjacent Gotland Sea water and can pass the Stolpe Furrow in sporadic events. Such an event could be observed in the end of the cruise, when some stations near Stolpe Furrow have been worked repeatedly. Compare Figure 3 and Figure 4, where a patch of warmer water has passed Stolpe Furrow. At the same time there seems to be some outflow of cold winter water from Gotland Basin through Stolpe Furrow towards Bornholm Basin.

The density of the inflowing water is significantly smaller than that of the bottom water and the overflowing water fits into the water body at 100 m to 130 m depth. A long tail of slightly warmer water marks the path of the inflowing water mass, see Figure 5. Hence four main water bodies characterize the hydrographic state of the Gotland Sea. The surface layer is rather uniform, surface temperature is about 10 °C and varies probably mostly due to the daily weather conditions. Salinity decreases slightly from south-west to northeast. At 40 m depth the completely mixed surface water is separated by a very sharp thermocline from the winter water which is still colder than 4 °C. This layer is about 40 m thick and is separated from the underlying water by a smooth halocline. Several wiggles in the thermocline indicate internal waves and baroclinic eddies.

Deep water oxygen concentration is remarkably low in the whole Gotland Basin, well below 1 ml/dm³ at depth greater than 70 m. A bottom layer of 20 – 30 m thickness in the Gotland Deep is generally anoxic (Figure 8). Similar conditions are found in the Landsort Deep and Karlsö Deep (Figure 7). Hence, a pool of hypoxic water has been formed again, which will determine the hydrography of the Baltic during the next month.

The sediment trap in the central Gotland Basin was routinely changed. The complete set of samples from the previous 5 months could be retrieved without problems. In the new mooring an additional experimental sediment trap device including an underwater video system was installed for operation over the next period. Installation and deployment of this mooring was performed according to plan.

Table 1: Surface layer (0 - 10m)

Area	Station	Temperature	Salinity	PO ₄ ³⁻	NO ₂₃ ⁻ *	SiO ₄
Date	Name/ No. **	°C	PSU	µmol/dm ³	µmol/dm ³	
Kiel Bight Oct 29 2004	TF0360/07	11,08	17,15	0,49	0,75	14,4
Meckl. Bight Oct 30 2004	TF0012/14	10,90	14,05	0,36	0,05	12,7
Lübeck Bight Oct 30 2004	TF0023/10	11,02	15,08	0,34	0,05	12,9
Arkona Basin Oct 31 2004	TF0113/24	11,02	8,14	0,31	0,23	10,6
Pom. Bight Nov 02 2004	TF0162/54	10,35	7,84	0,35	0,06	16,4
Bornholm Deep Nov 01 2004	TF0213/37	9,93	7,39	0,36	0,22	9,1
Stolpe Channel Nov 03 2004	TF0222/58	9,20	7,32	0,5	0,15	11,7
SE Gotland Basin Nov 03 2004	TF0259/60	10,56	7,21	0,22	0,24	5,3
Gotland Deep Nov 04 2004	TF0271/67	9,91	6,94	0,27	0,79	10,4
N Gotland Basin Nov 05 2004	TF0285/69	10,12	6,80	0,2	0,71	10,3
Landsort Deep Nov 06 2004	TF0284/72	9,46	6,46	0,29	0,72	13,1
Karlsö Deep Nov 06 2004	TF0245/75	9,91	6,96	0,36	0,17	13,4

* $\Sigma \text{NO}_2^- + \text{NO}_3^-$; NO₂ was present only in traces in most areas under investigation

** See maps

List of Figures:

Figure 1: Station map (western part)

Figure 2: Station map (Central Baltic Sea)

Figure 3: Transsect through Bornholm Basin and Stolpe Furrow 31.10.- 3.11.04

Figure 4: Transsect through Bornholm Basin and Stolpe Furrow 7.11- 8.11.04

Figure 5: Transsect Kiel Bight to Gotland Sea

Figure 6: Transsect Ystad – Pommeranian Bight

Figure 7: Transsect Western Gotland Sea

Figure 8: Oxygen content of bottom water

Monitoring
 Station map TF110408
 29.10.2004 - 09.11.2004
 72 Station (Part1)

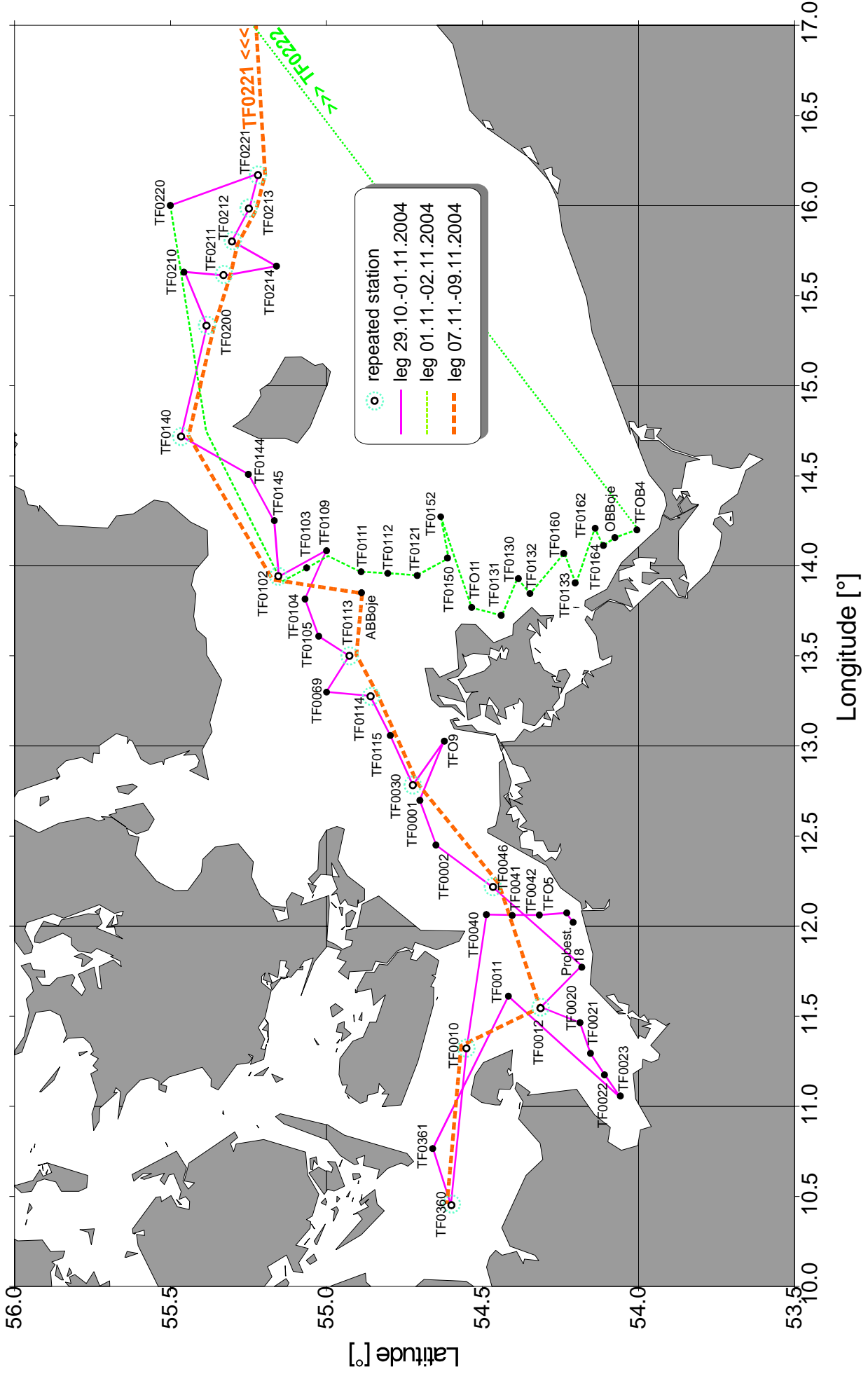
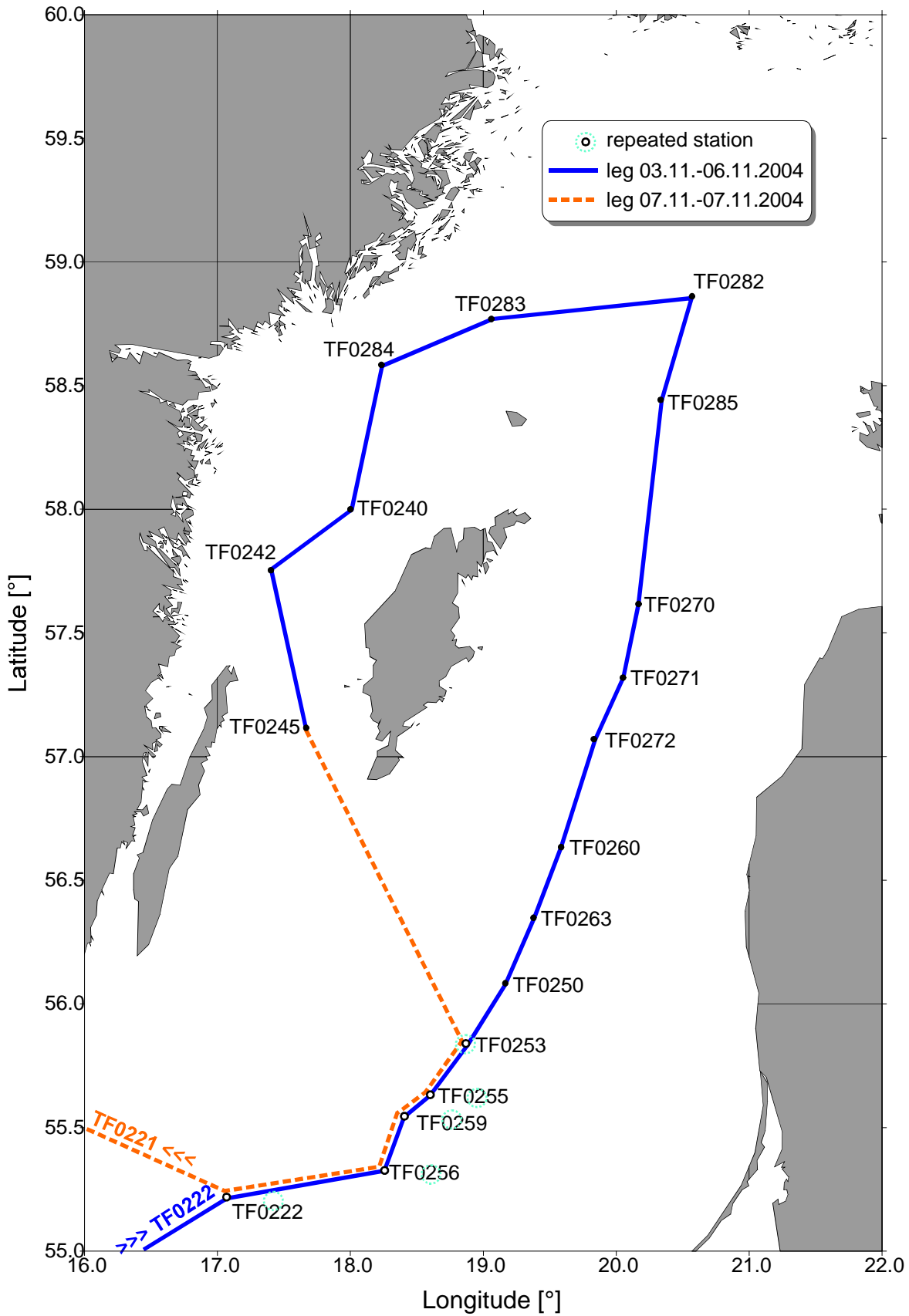


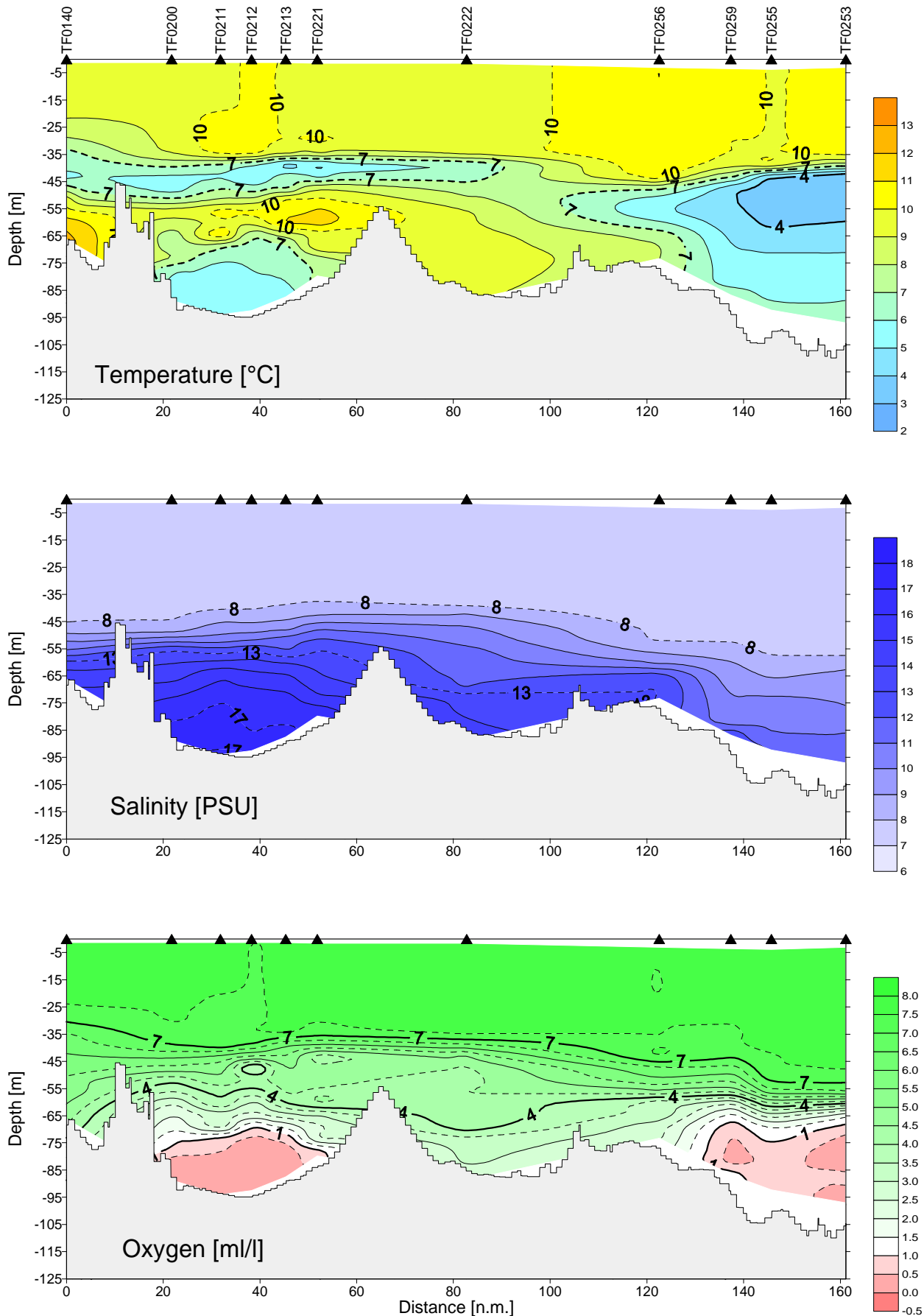
Figure 1



Transsect through Bornholm Basin and Stolpe Furrow

Figure 3

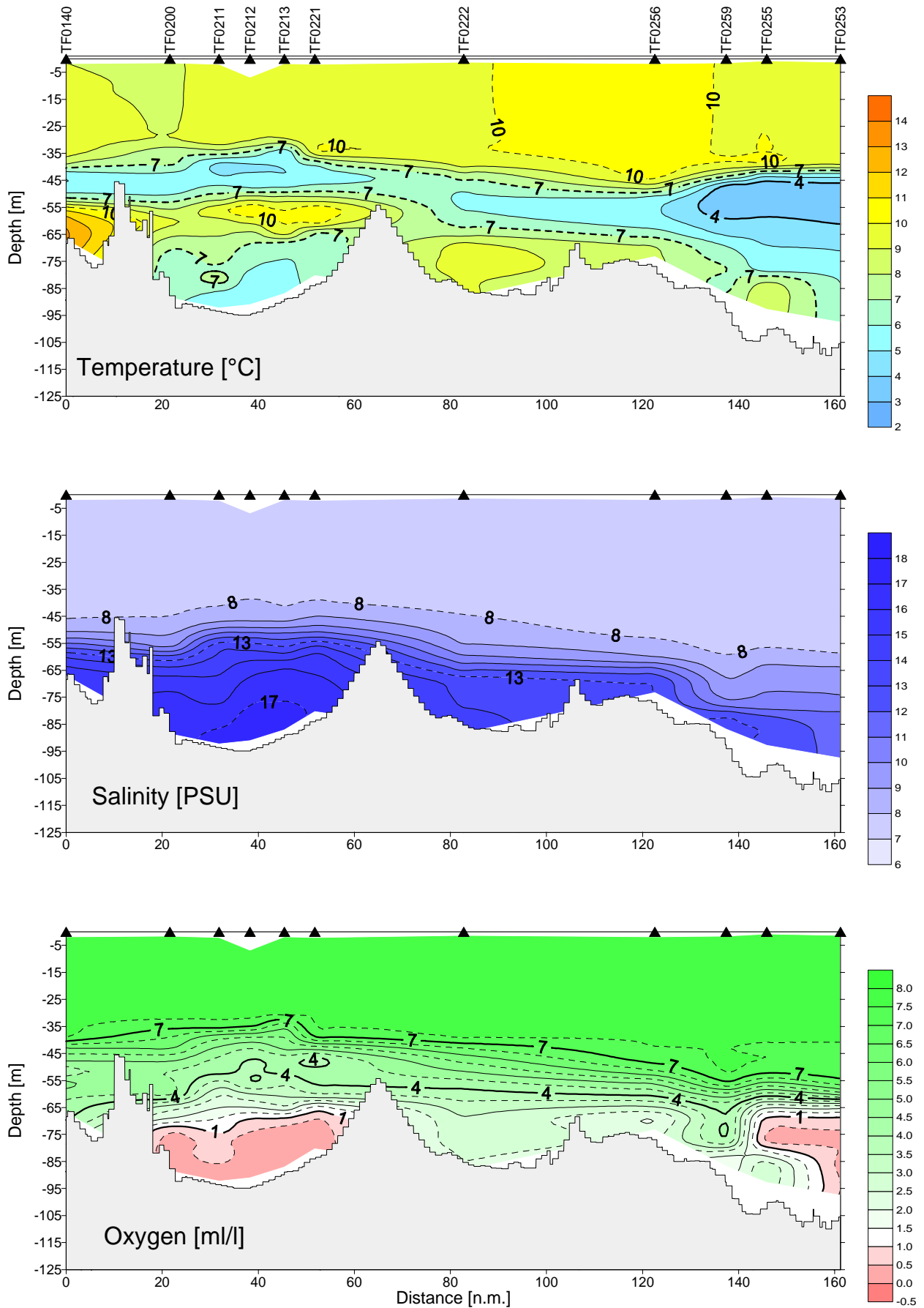
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Transsect through Bornholm Basin and Stolpe Furrow

Figure 4

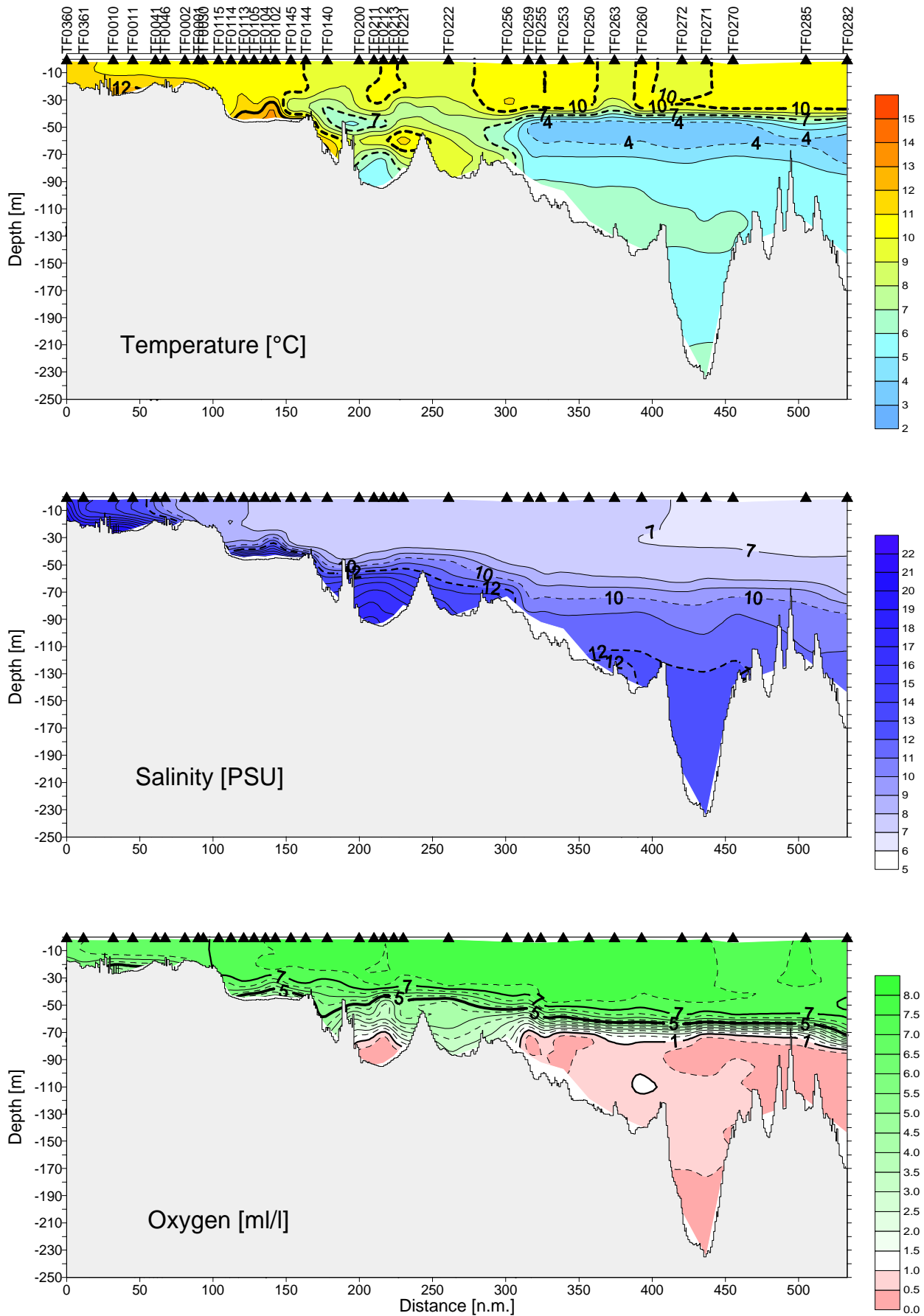
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Transsect Kiel Bight to Gotland Sea

Figure 5

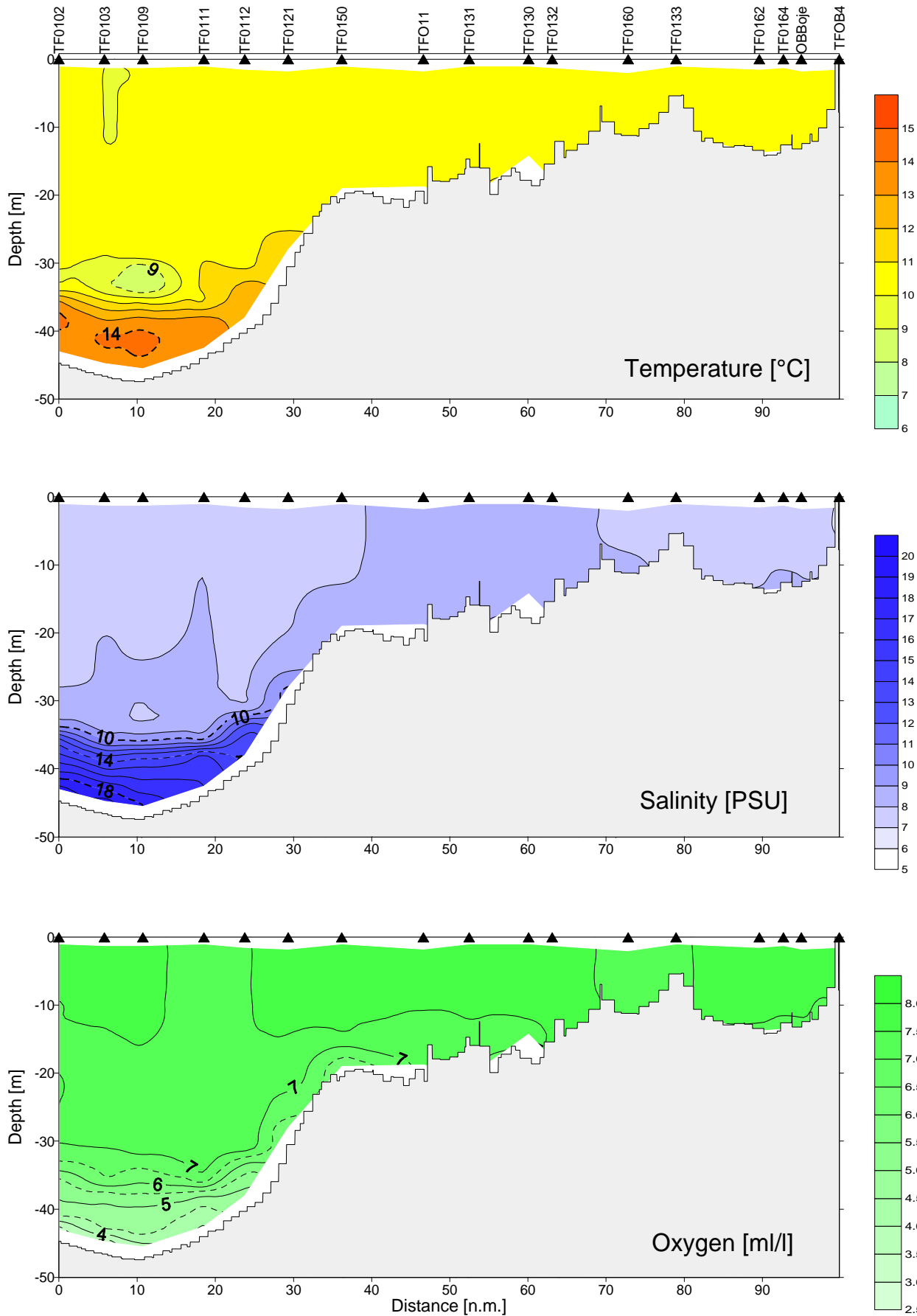
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Transsect Ystad - Pommeranian Bight

Figure 6

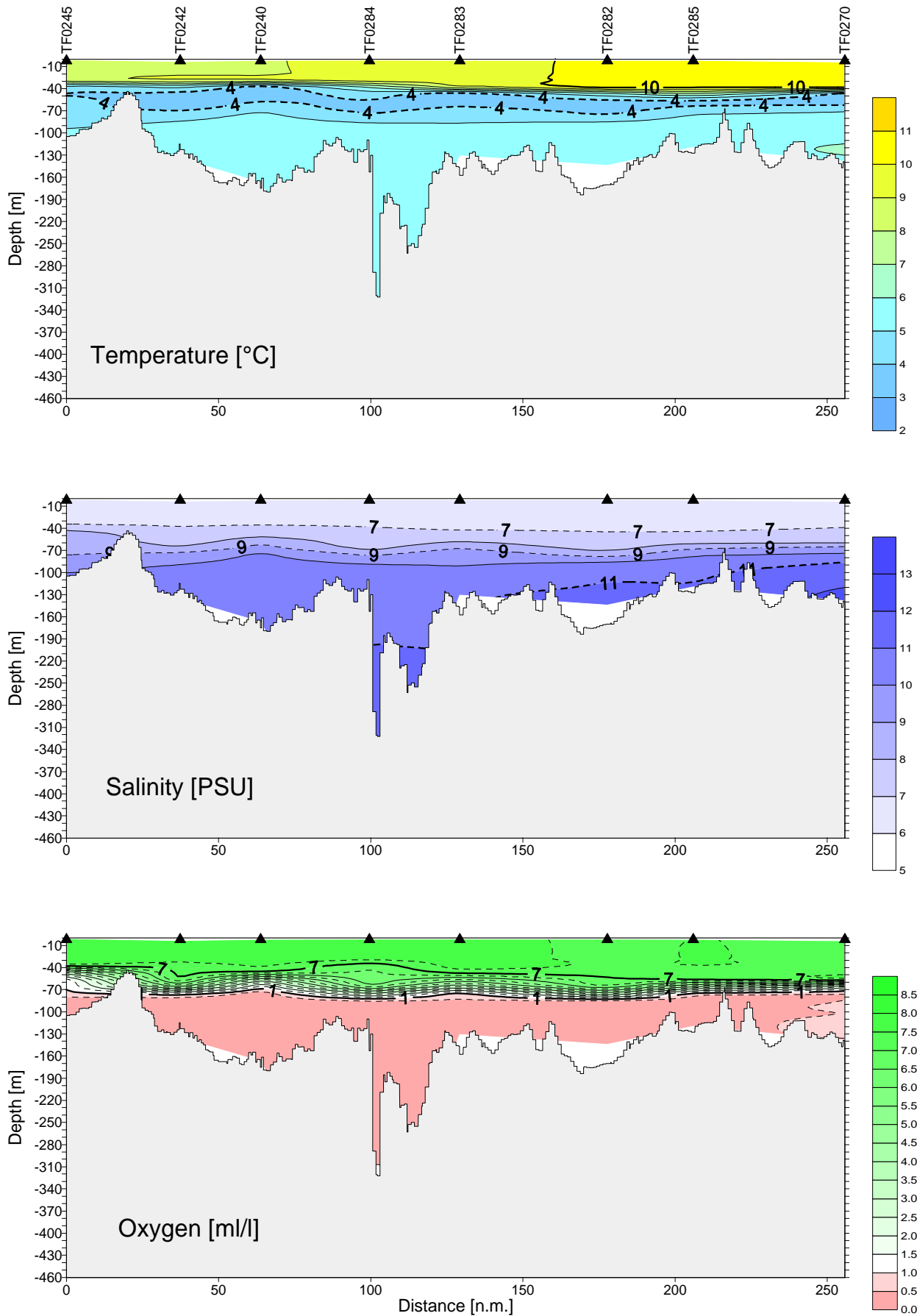
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Transsect Western Gotland Sea

Figure 7

TF110408 - 2004 October
05.11.2004 14:15 - 06.11.2004 20:30 UTC



Monitoring

TF110408

29.10.2004 - 09.11.2004

Oxygen bottom concentration [ml/l]

