

Baltic Sea Research Institute Warnemünde


Cruise Report


r/v "Gauss"

Cruise- No. 11 / 02 / 02

This report is based on preliminary data

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1. **Cruise No.:** 11 / 02 / 02
2. **Dates of the cruise:** from 27 March 2002 to 07 April 2002
3. **Particulars of the research vessel:**
 - Name: Gauss
 - Nationality: Germany
 - Operating Authority: Bundesamt für Seeschifffahrt und Hydrographie
4. **Geographical area in which ship has operated:**
western and central Baltic Sea
5. **Dates and names of ports of call**
28.03.2002 Rostock, 31.03.-02.04.2002 Sassnitz
6. **Purpose of the cruise**
Monitoring Cruise in the framework of HELCOM programme
7. **Crew:**
 - Name of master: K.P. Walde
 - Number of crew: 20
8. **Research staff:**
 - Chief scientist: R.Feistel
 - Scientists: H.Disterheft, D.Betke, G.Liehr, B.Hambach
 - Engineers: S.Weinreben
 - Technicians: J.Donath, A.Welz, G.Lehnert, B.Buuk
9. **Co-operating institutions:**
10. **Scientific equipment**
CTDO bathysonde, Plankton net, Secchi disk

11. General remarks and preliminary result

The area under investigation covered the Baltic Sea between the Kiel Bight and the Northern Gotland Basin as shown in the station maps attached. Marine meteorological, hydrographic, marine chemical and biological investigations were performed according to both the Baltic Monitoring (BMP) and the Coastal Monitoring Programme (CMP) of HELCOM.

During the whole cruise, high-pressure conditions over central Europe determined the **weather** of the Baltic Sea area. Calm weather with low wind speeds and cloudy skies prevailed except the 5th April with NNE winds up to BF 8. Air temperatures were measured between 4.5 and 7.3°C in the Southern Baltic, 6.6 and 10.7°C in the Pomeranian Bight, and between 3.4 and 4.2°C in the Central Baltic. Except very few occasional drizzle or snow showers, there was no precipitation.

The hydrographic, hydrochemical and hydrobiological parameters observed during the cruise near to surface and near to seafloor are given in Table 1 and 2. Hydrographic overview sections of temperature, salinity and oxygen from Kiel Bight to NE Gotland Basin are attached as well, where the not yet validated O₂ figures from the CTDO sensor are too low by a factor of about 1.7.

In the **surface water**, exceptionally high nitrate values of up to 66 µmol/l have been measured in the Oder Bank. Very high nutrient concentrations (up to 370 µmol/l NO₃) had already been reported earlier from the river waters themselves (Küstengewässerbericht 1/2002) probably due to fertilizer wash-out during the heavy local rainfalls in February 2002 (82 mm, 273 % of the average, highest since 1891). Water surface temperatures were found as 4.6 to 5.3°C between Kiel Bight and Bornholm, 4.7 to 6.5°C SE of Ruegen, and 2.9 to 4.2°C around Gotland.

All over the central Baltic, there was only H₂S and no oxygen found in depths below about 100m, and no H₂S was found above (see map attached). Compared to autumn 2001, the **anoxic boundary** has moved to deeper layers. The results of the rather warm salty inflow in September 1997 are still present in form of persisting unusually high deep water temperatures. The smaller inflow events of autumn 1999 and November 2001 are less well recognized and differently pronounced.

Bornholm Deep: The recent inflow of November 2001 led to a sudden rise by > 2°C in temperature, almost 1 psu in salinity and nearly 5 ml/l in oxygen in December in the bottom-near waters. Since then, this signal is fading, so e.g. from February to March 2002 from 9.20 to 8.73°C, from 16.09 to 15.46 psu, and from 1.45 to 1.14 ml/l O₂. Due to the warmth of that inflow, the bottom water temperature is persistently high by still almost 2°C above the long-time average of 6.62°C between 1971 and 1990. In the last years, annual mean salinity has fluctuated between 15.5 and 16.5 psu but is currently as low as 14.9 psu, even below the long-time mean of 15.4 psu. The oxygen content is on average level compared to the last years, but significantly below the long-time value of 1.75 ml/l.

Station 256 (N of Rixhoeft / Rozewie, PL): There is a hint on a continuing fresh water flow from the Bornholm Basin to the Baltic Proper. At 70m depth, oxygen has a minimum of 0.83, below that it is increasing again to 3.08 ml/l at 75m. At the O₂ minimum depth, there is a leap in T from 5.45 to 5.96°C and in S from 10.17 to 11.07 psu within just 1m. They finally reach 6.17°C and 11.46 psu at the bottom.

Gotland Deep: The inflow of November 2001 had reached the Gotland Deep in January 2002 and provided low-level oxygen concentrations in depths below 195m, while the layer above, up to 150m, was anoxic. Already in February this could no longer be observed, and now in April everywhere below 100m depth H₂S is found in higher concentrations (up to -2.91 oxygen equivalent) than in February (-0.97), which in turn was lower than the long-time mean (-1.11) and the annual average (-3.75) at 200m in 2001. Downward, the H₂S level is slightly diminishing. Salinity at 200m depth (11.96 psu) is practically constant since 2001 (annual mean: 11.98 psu) and is lower than the mean of 1971-90 (12.30 psu) and the maximum after the 1997 inflow (annual 1998: 12.32 psu). The salt water input was merely sufficient to compensate for losses by vertical turbulent/diffusive exchange. The recent inflow events (2001, 1999) are easier recognized by changes of deep-water temperature than of salinity. The current value of 6.31°C in 200m depth exceeds those of November and December 2001, as well as the annual means of 2000 (6.28°C) and 2001 (6.20°C). The long-time average is significantly colder (5.57°C), such that the state of unusually high temperatures since 1998 is still maintained.

Farö Deep: The salt water inflow of November 2001 seems to have reached Farö Deep now in March/April. The rather constant bottom temperature of about 5.9°C between October 2001 and February 2002 has now risen to 6.16°C, salinity from 11.3 to 11.5 psu, and hydrogen sulphide has eased from -3.10 to -2.21 (oxygen equivalent). Still the whole water column below 100m is anoxic. The deviation of T and S from the long-time average has even grown, but that of oxygen has decreased.

Landsort Deep: For more than a year almost constant conditions are prevailing with T about 0.5° and S about 0.6 psu below the long-time average.

Karlsö Deep: The continuous warming trend observed in all 2001 had reached its summit in February with 4.93°C near the bottom and is now at 4.83°C apparently reversing. The same holds for salinity, which has decreased from 9.75 in February to 9.47 psu now. The strength of the decrease (0.3 psu per month) appears remarkable.

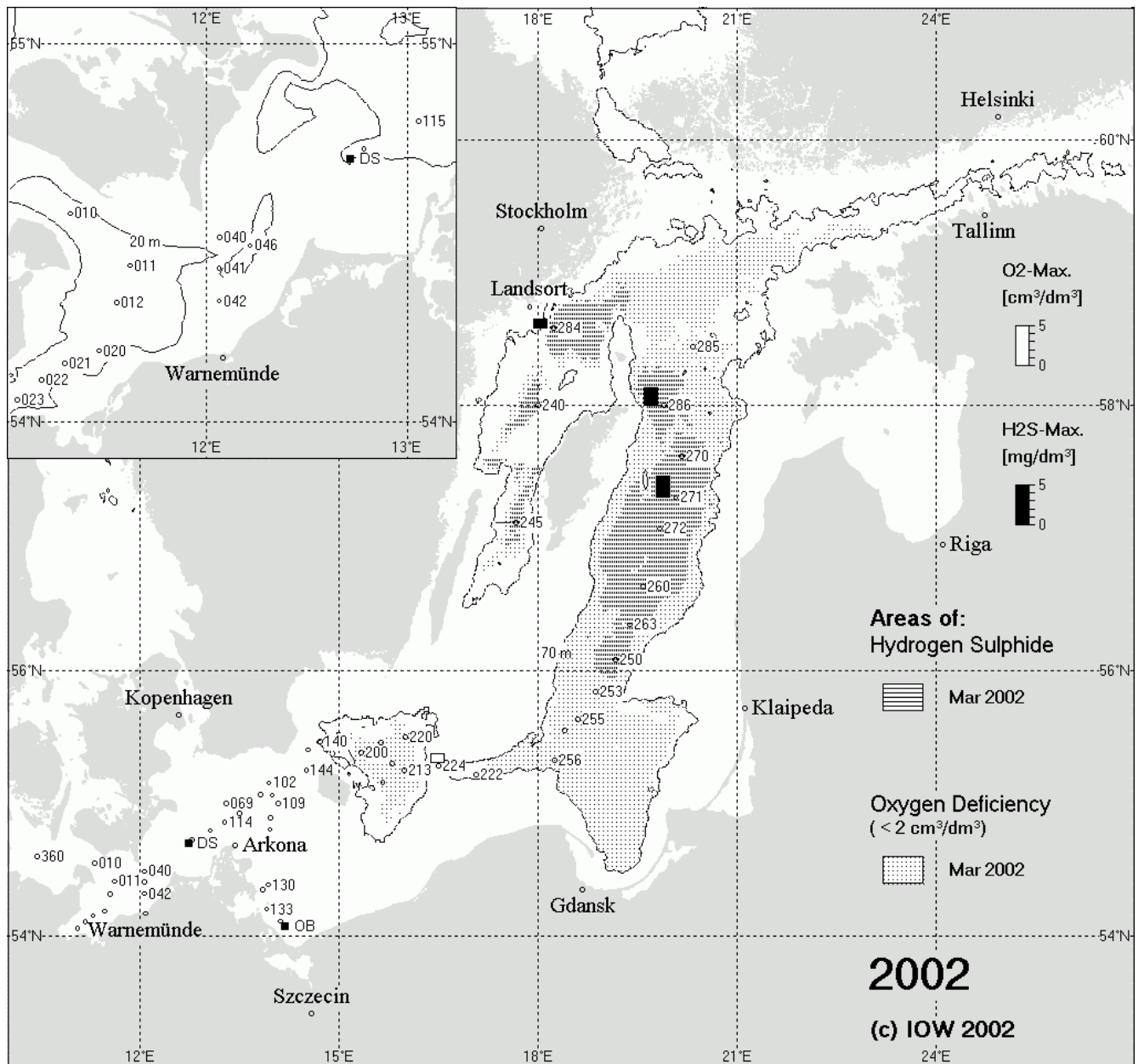
Appendix: maps and list of stations

Table 1: Surface layer (0 - 10m)

Area	Station	Temperature	Salinity	PO ₄ ³⁻	NO ₂ ^{3- *}
Date	Name/ No. **	°C	PSU	µmol/dm ³	µmol/dm ³
Kiel Bight 28.03.2002	361/10	4.29	10.84	0.02	0.88
Meckl. Bight 27.03. 2002	012/2	4.00	8.48	0.14	0.11
Lübeck Bight 27.03. 2002	023/5	4.60	9.83	0.09	0.02
Arkona Basin 29.03. 2002	113/24	3.88	7.69	0.20	0.02
Pom. Bight 31.03. 2002	162/54	5.17	6.72	0.18	48.60
Bornholm Deep 30.03. 2002	213/39	3.39	7.24	0.62	2.32
Stolpe Channel 30.03. 2002	222/37	3.30	7.12	0.74	2.43
SE Gotland Basin 05.04. 2002	259/75	3.45	7.14	0.64	1.65
Gotland Deep 04.04. 2002	271/68	3.41	7.15	0.71	2.61
Fårö Deep 04.04. 2002	286/66	3.27	7.11	0.57	2.61
Landsort Deep 03.04. 2002	284/64	3.29	6.26	0.23	0.01
Karlsö Deep 03.04. 2002	245/62	2.88	6.96	0.62	3.56

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

** See maps

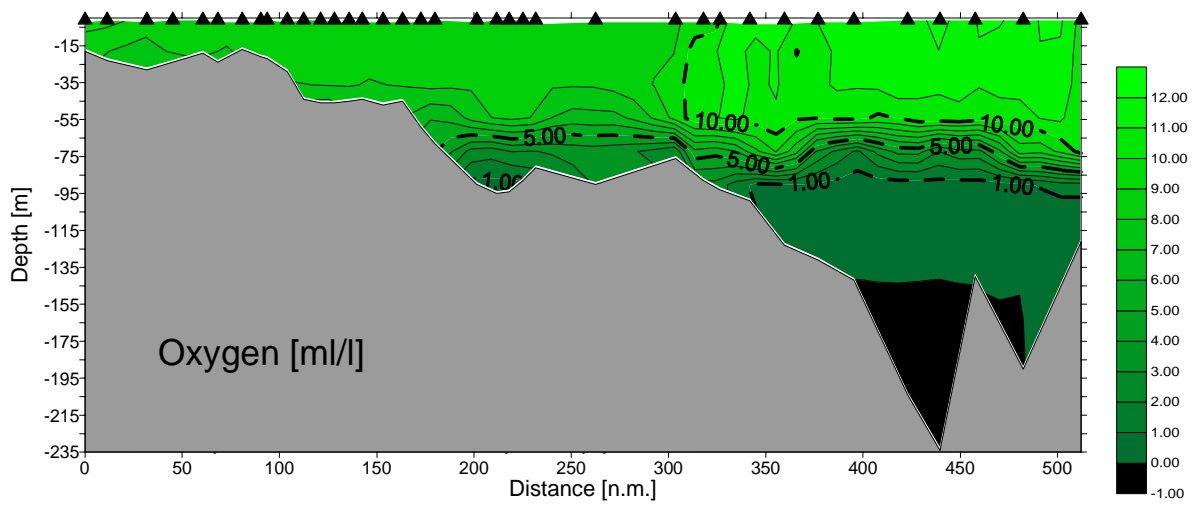
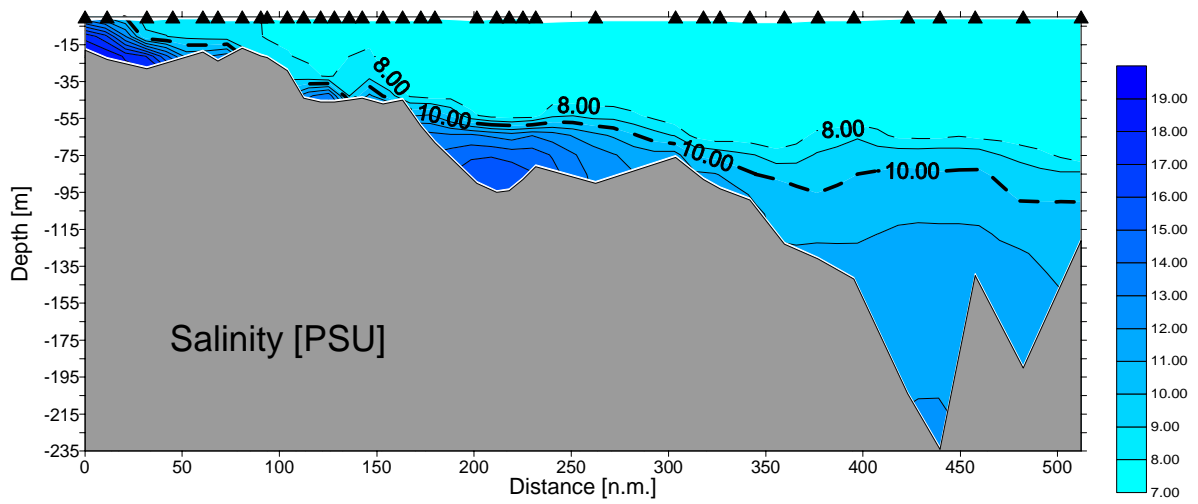
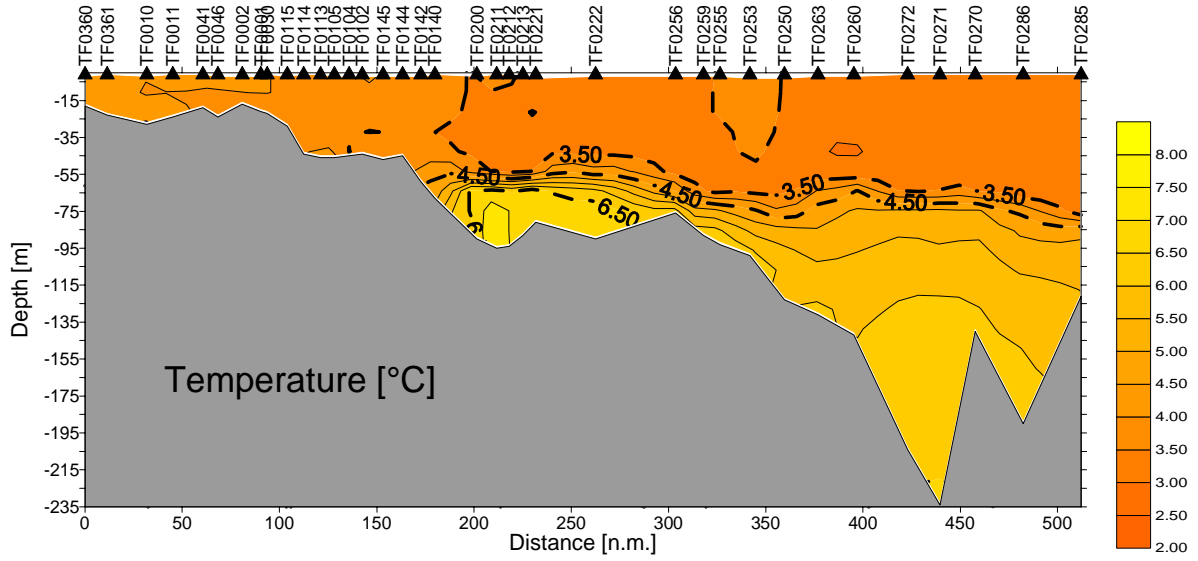


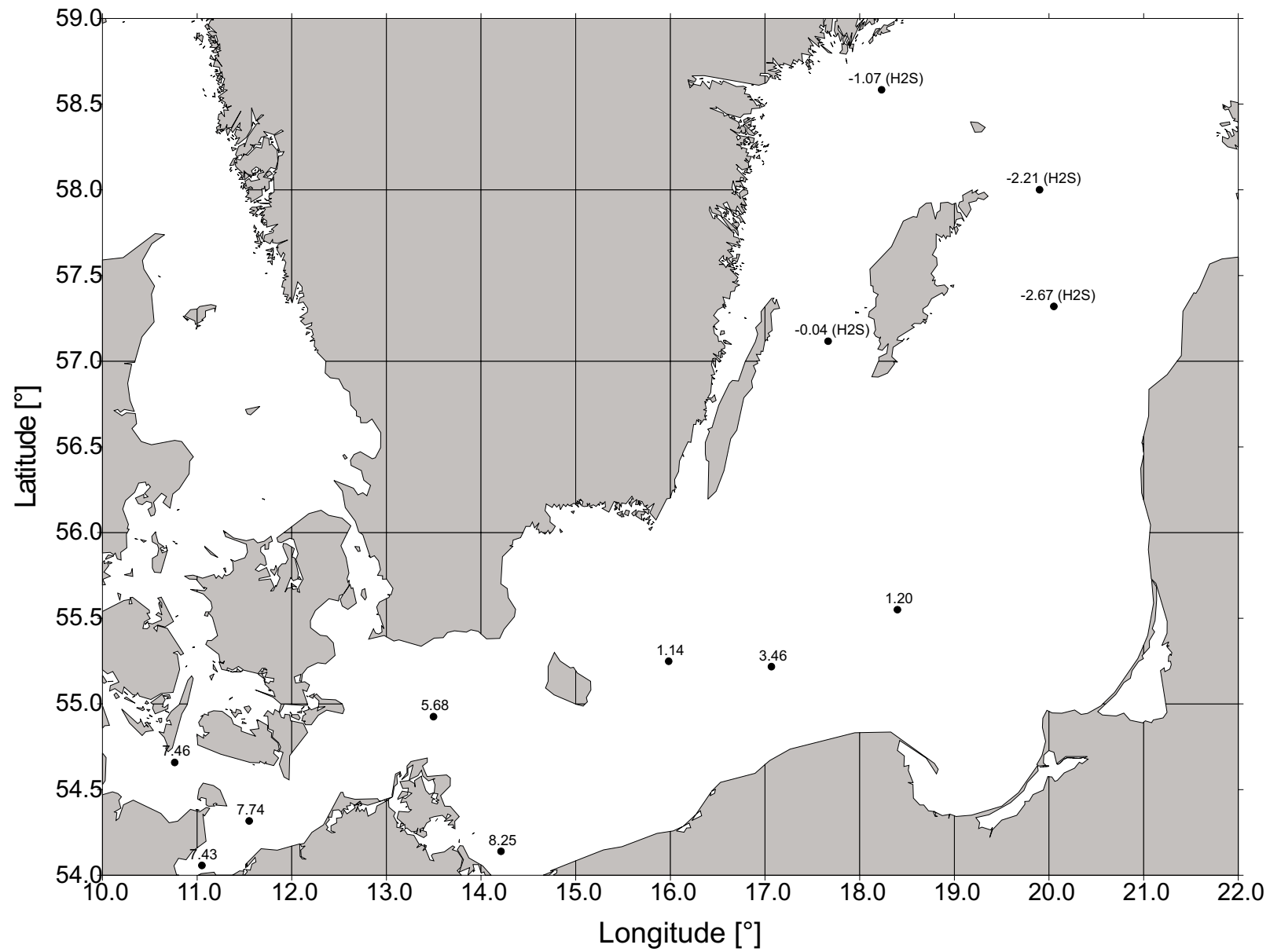
Map of regions with oxygen deficiency (<2 ml/l) and hydrogen sulphide abundance as being measured in March/April 2002. Shown are the 70m (main) and 20m (upper left) isobaths.

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Gesamte Ostsee

28.03.02 04:03 - 05.04.02 08:04 UTC





Station map Monitoring 2002

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Oxygen bottom
concentration

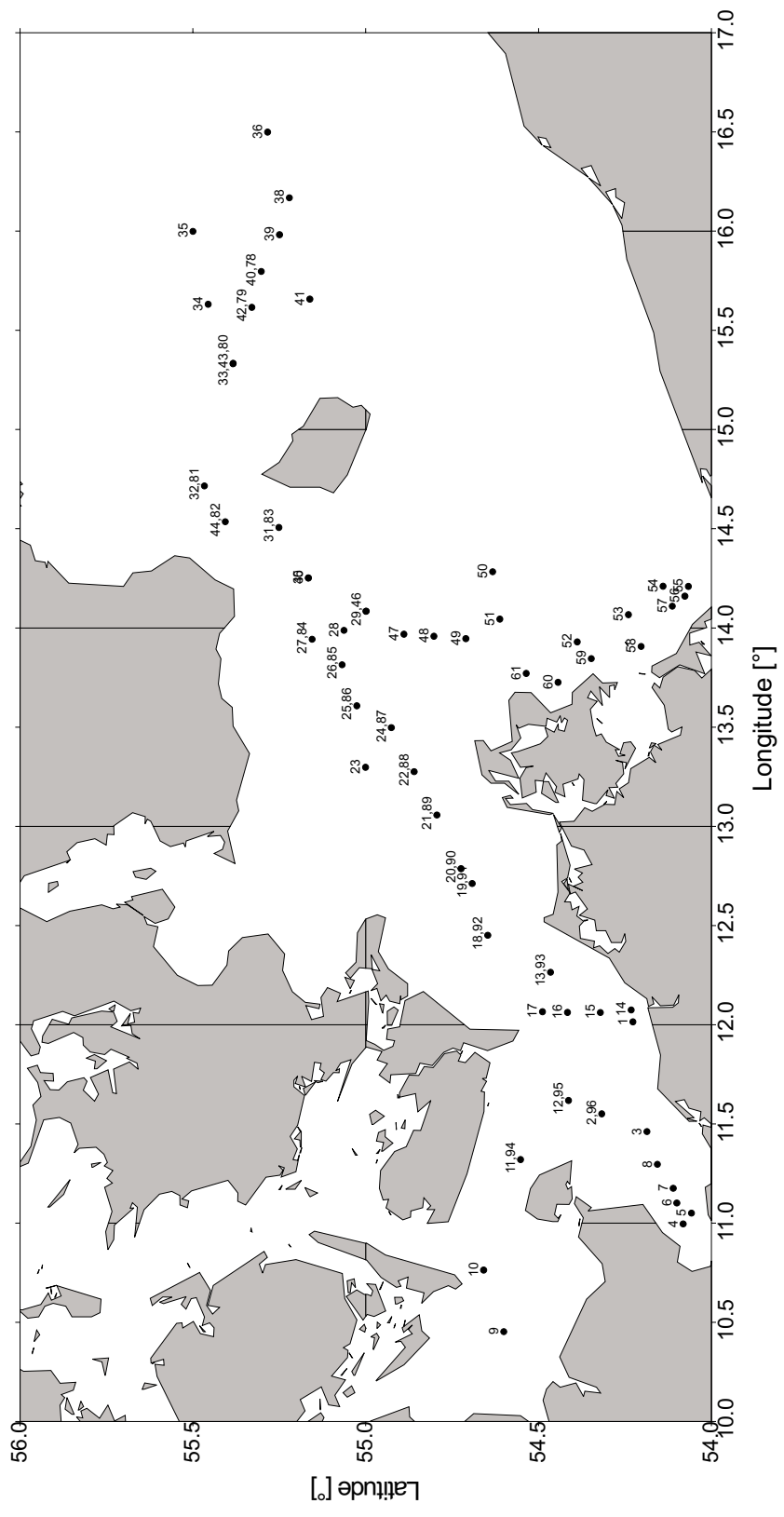
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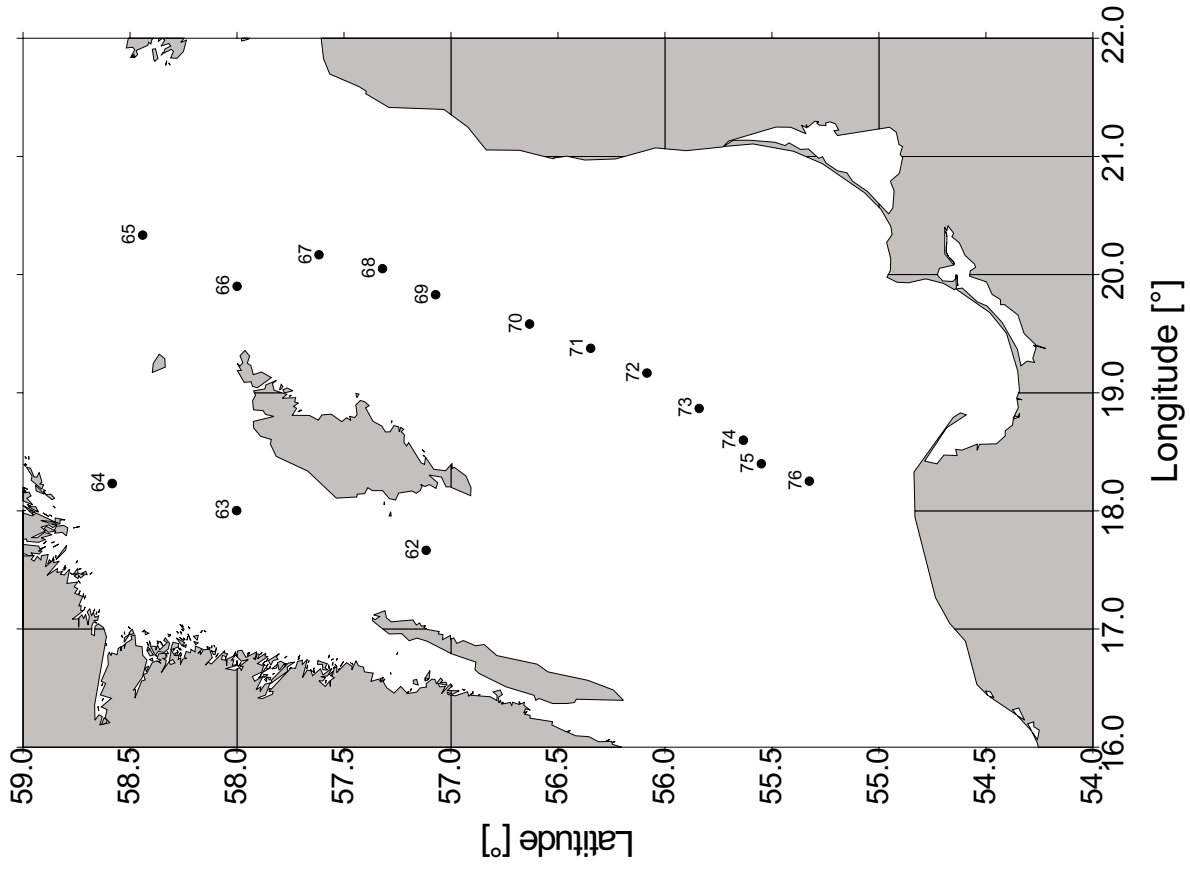
Station map Monitoring 2002

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81 stations (part 1)

27.03.02 - 07.04.02





Station map Monitoring 2002

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15 stations (part 2)

27.03.02 - 07.04.02