Bundesamt für Seeschifffahrt
und Hydrographie
Hamburg and Rostock

Hamburg, January 2003

Report of the chief scientist
Research Vessel GAUSS
Cruise No. 385

16 July - 2 August 2002

Objectives

The main objective of GAUSS cruise no. 385 was an assessment of the large-scale oceanographic situation, including oxygen conditions, in the German Bight and North Sea. Additionally, nutrients, chlorophyll distribution, organic pollutant loads and petroleum hydrocarbons were measured in large sea areas.

Participants:

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Cruise narrative (Fig. 1, cruise track)

The cruise started in Hamburg on 16 July 2002. The track led from the German Bight to the Strait of Dover, from where six parallel latitudinal transects were covered between England/Scotland and Denmark/Norway, up to the northern boundary of the North Sea at 60° North. During the whole cruise, a "DELPHIN" towfish measured the water temperature, salinity, dissolved oxygen content, water turbidity, and chlorophyll concentration between surface and seabed. Simultaneously, the same parameters (excl. oxygen) were measured near the surface (4 m depth) using a thermosalinograph. The vessel stopped at 54 stations to take water samples using special sampling equipment in order to determine dissolved nutrients, oxygen levels, organic pollutants at some of the stations, and some other parameters. The investigations were interrupted for 12 hours to allow two technical staff members to disembark in Edinburgh. Besides BSH employees, also a working group from Hamburg University took part in the investigations. The chemical parameters were determined at the laboratories of the BSH and Hamburg University. A preliminary evaluation of the DELPHIN data was carried out on board.

RV "GAUSS" Cruise 385 / 16.07. - 31.07.2002

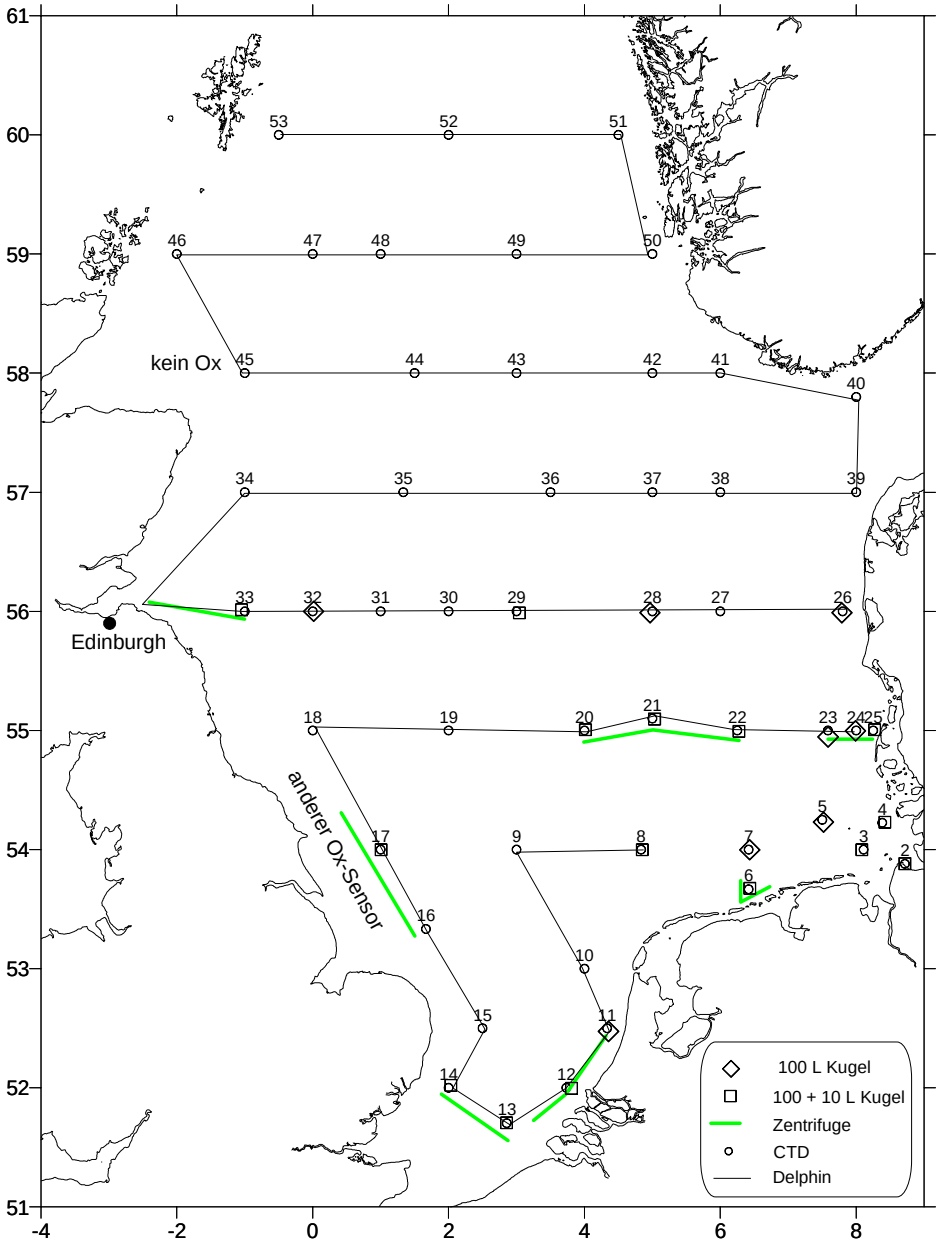

Abb. 1

Assessment of the oceanographic situation of the North Sea in summer 2002

The most important and remarkable result is the very good oxygen situation in the North Sea in the summer of 2002 (Fig. 2c, near-bottom oxygen saturation). The DELPHIN measurements showed lower chlorophyll concentrations (Fig. 3); the Figure gives the DELPHIN data obtained on the east-west transects. Chlorophyll is a measure of phytoplankton production; here, the chlorophyll concentration is given in relative units.

In the summer of 2002, less phytoplankton was generally observed in the North Sea than in the preceding three years. The observations made one year earlier have

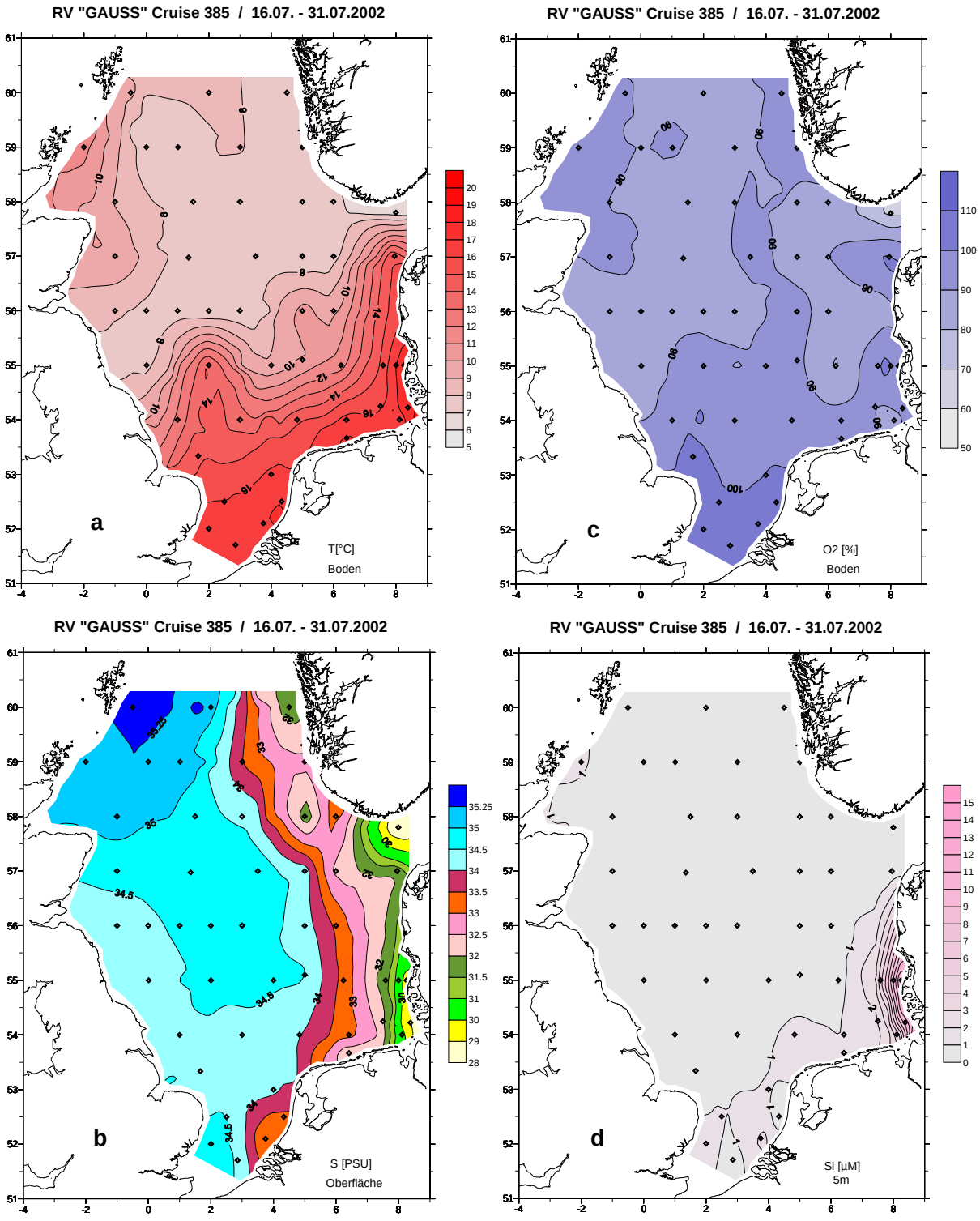

Abb. 2 a - d

been confirmed: DELPHIN found chlorophyll maxima at moderate depths near the thermocline. A striking observation in some areas was unusually transparent water (at the surface) with very low chlorophyll levels. Only about 30 nm west of Sylt, small patches of Noctiluca, the typical bioluminescent alga, were observed visually and by the instruments. Stronger chlorophyll concentrations were found off the mouth of the river Rhine, southeast of the Dogger Bank, off Sylt and the coast of Jutland and,

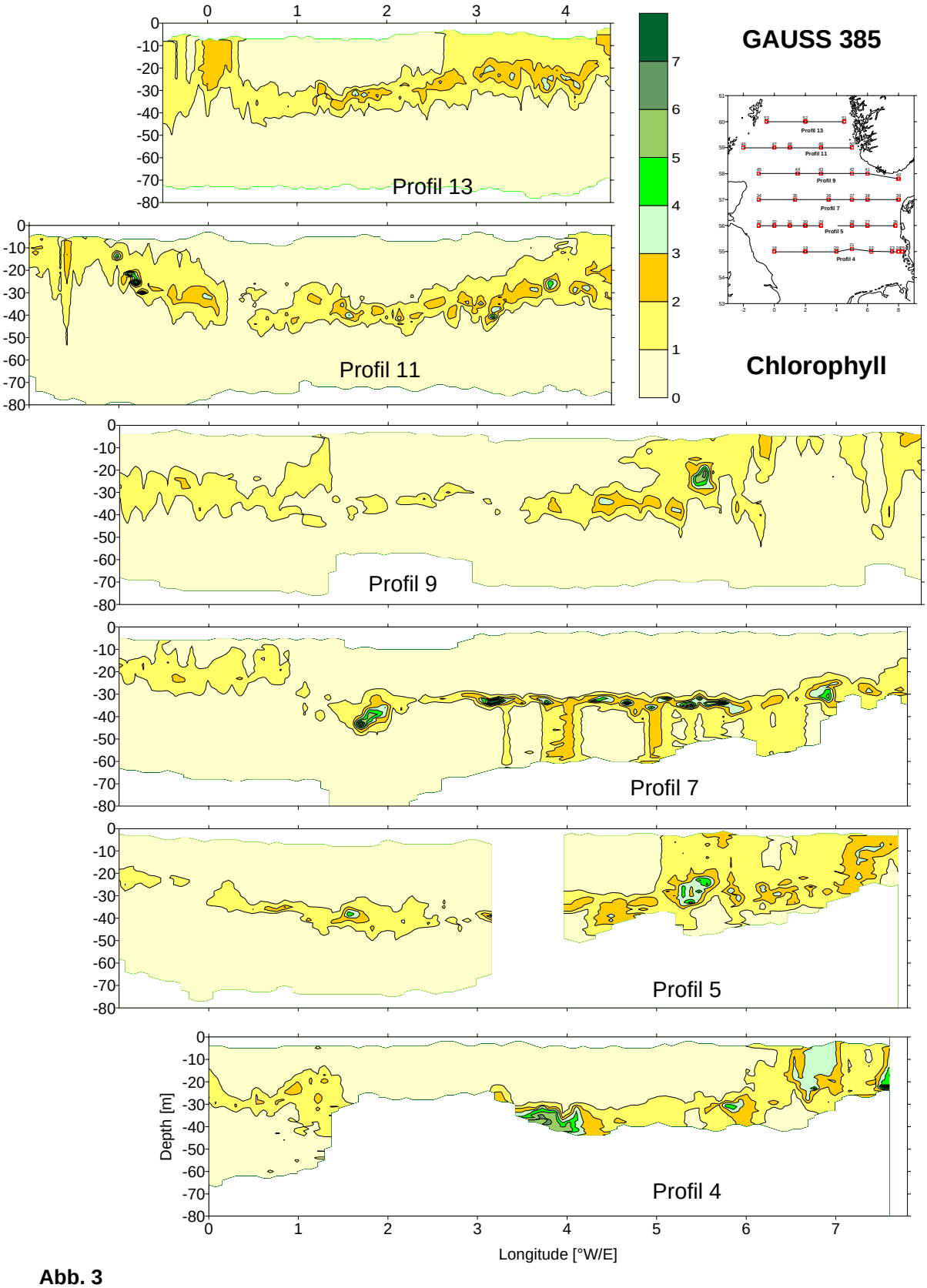

Abb. 3

caused by upwelling of nutrient-rich water from deeper layers, between the English coast and the Dogger Bank. In the northern German Bight and off Jutland, the lowest oxygen saturation values recorded, about 75-80 %, were measured near the bottom. These values are good for the season. Because of the thicker surface layer in the

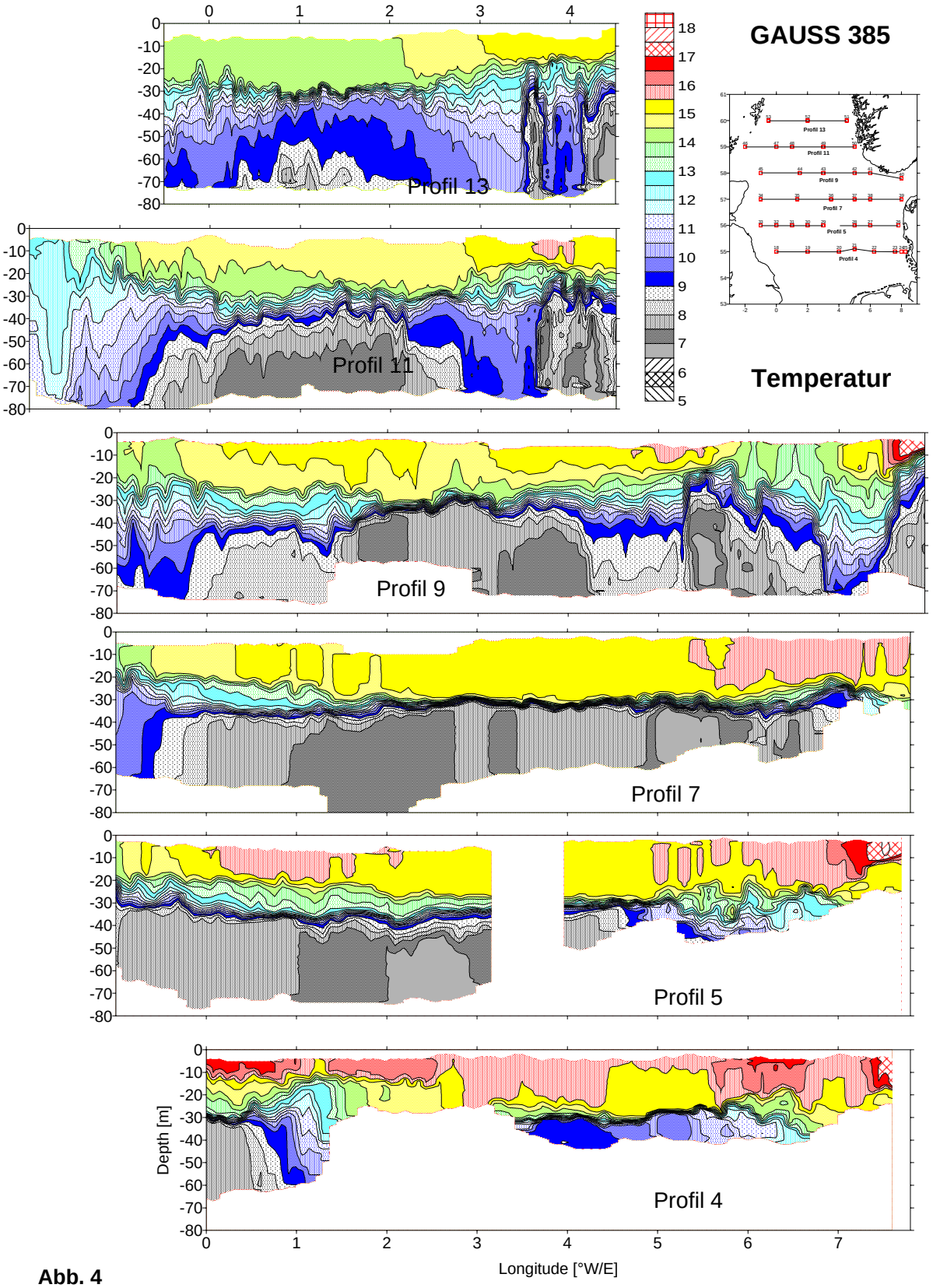

Abb. 4

shallow areas off Sylt and the coast of Jutland (Fig. 4, vertical temperature sections) the bottom water layer is only a few metres thick, so that in calm weather conditions, with continued depletion, the plant biomass still available in that area for bacterial decomposition could have led to an even stronger depletion of oxygen.

A noteworthy observation was stronger primary production near the thermocline in some areas, caused by intermediary maxima of oxygen distribution with marked oversaturation, which contradicts the hypothesis that there is no primary production in the surface layer in summer when nutrients are depleted.

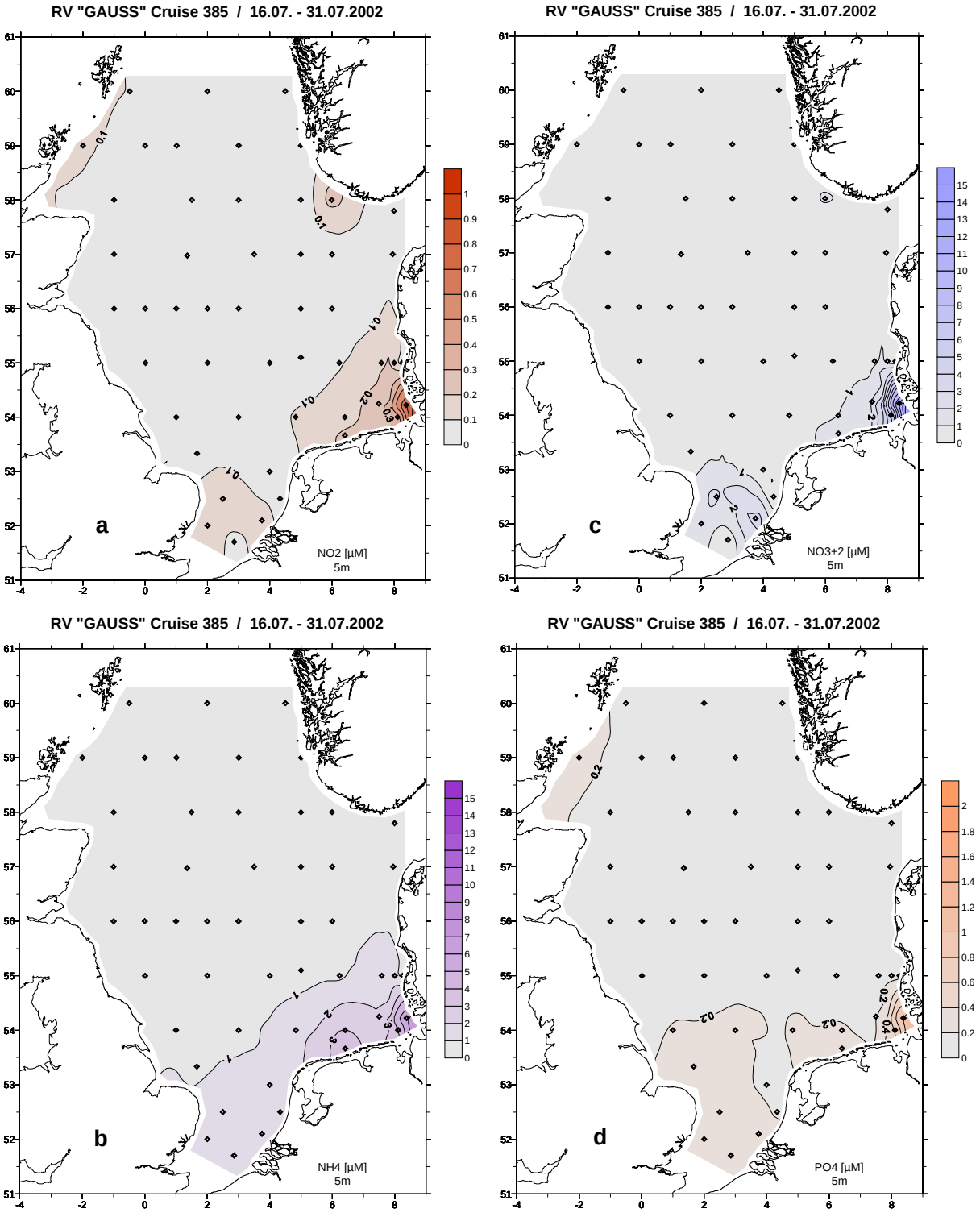

Abb. 5 a - d

Despite the good overall situation, the data collected during this year's cruise clearly reflected the known problem areas of the North Sea. These problem areas still are the large river estuaries, the region between the Dogger Bank and the English coast, the "old" Elbe valley, and the area off the German/Jutlandic coast. Together with stronger primary production, the oceanographic conditions in these areas lead to stronger oxygen consumption. However, near-bottom oxygen saturation values below 75 % were not measured in any of the above areas in this year. As former laboratory tests have shown, the situation does not become critical for fish and bottom-living species until oxygen saturation drops below 40 %.

In July, the southern half of the North Sea was warmer than the long-term mean (Figs. 2a and 4). Contributing factors were the warmer and deeper upper mixed layer and the warmer bottom layer. The heat content of water in the area extending north of the Dogger Bank to the northern boundary of the North Sea also was above the climatological mean. The mixed upper layer with its thickness between 30 and 40 metres was up to 2 °C too warm and has definitely stored more heat. Temperatures below the clearly defined thermocline were between 7 and 8 °C; temperatures just under 7 °C were only measured immediately north of Dogger Bank, above Little Fisher Bank, and in a few places in the Norwegian Deep. On the whole, also temperatures in the bottom layer were 1 °C to 1.5 °C above the mean values. The anomalies are within the range of interannual variability based on long time series in the North Sea. The reduced heat transports in the North Atlantic Current observed by RV GAUSS in the eastern North Atlantic in this year have not had an impact on the North Sea so far. The salinity and temperature increase which had already been observed in the Faeroe-Shetland Channel in 2001 was also observed in the Fair-Isle Passage in the summer of 2002, but here mainly in the inflow of Atlantic water east of the Shetland Islands (Fig. 2b). A tongue of highly saline water with salinities exceeding 35.3 (exactly 35.36) has been observed in the North Sea for the first time in several years. On the whole, however, Atlantic water in the northern North Sea has only spread to about 58° N. The Baltic outflow and Norwegian Coastal Current showed the usual pattern.

The inflow of Atlantic water through the English Channel seems to be low, as in the preceding year. We did not measure salinities over 35 in that area.
Nutrients showed the low concentrations in the upper mixed layer which are typical of the summer season, with higher values observed only off the estuaries (Figs. 2d and 5a-d).

Increasing transports of Atlantic water into the North Sea are expected to cause changes in the ecological situation and a faster renewal of North Sea water.

The data from this cruise are presently being processed and evaluated.