

**INSTITUTE OF MARINE RESEARCH
BERGEN, NORWAY**

CRUISE REPORT

*Environmental investigations in the Greenland Sea and northern Norwegian Sea.
May-June 2003.*

*By
Francisco Rey and Kjell Arne Mork*

CRUISE NUMBER: JH2003206
VESSEL: R/V "JOHAN HJORT"
DEPARTURE: Ålesund, Norway on May 27, 2003
ARRIVAL: Tromsø, Norway on June 16, 2003
PORT OF CALL: Bodø, Norway on May 29, 2003
PARTICIPANTS:

Name	Affiliation	Responsability
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Kjell Arne Mork	Institute of Marine Research	Hydrography
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Jarle Kristiansen	Institute of Marine Research	Instrument chief
Lage Drivenes	Institute of Marine Research	Instrument operator
Jean-Claude Gascard	LODYC, France	Scientist, hydrography
Thierry Monglon	LODYC, France	Technician
Elodie Kestenare	LODYC, France	Technician
Sandra Sequeira	LODYC, France	Technician

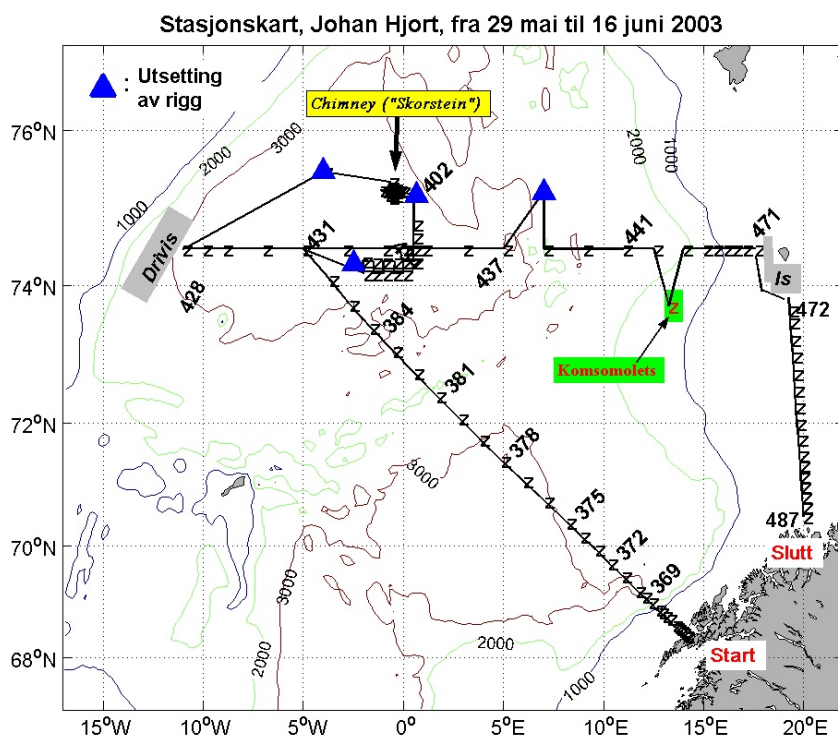
SCIENTIFIC OBJECTIVES

The cruise had several major objectives:

- 1) To carry out physical and chemical oceanographic investigations at selected stations in the Greenland Sea and northern Norwegian Sea.
- 2) To carry out physical, chemical and biological oceanographic observations at the standard Norwegian section Gimsøy-NW , Fugløya-Bjørnøya and Bjørnøya-W as part of IMR` s own monitoring activities.
- 3) To collect water and sediment samples for the determination of diverse radionuclides in the northern Norwegian Sea and Barents Sea, including monitoring activities at the site of a sunken Russian submarine.
- 4) To deploy current meters (ARGOS) in the Greenland Sea.
- 5) To carry out detailed mapping of convective "chimneys" in the Greenland Sea.

CRUISE TRACK

Figure 1 shows the cruise track and the positions of the oceanographic stations where sampling was carried out.



SAMPLING METHODOLOGY

Physical oceanography

The hydrographic work was carried out with a CTD-water sampling package from SeaBird Inc. with data being collected both during down- and upcast. The package consisted of a SBE 911plus CTD with double sensors for temperature and conductivity. All sensors were calibrated at the factory one month before the cruise. A LADCP was mounted on the CTD in order to obtain vertical current profiles.

The CTD was also equipped with a 12 position SBE 32 Caroussel with 10 liter Niskin bottles. At all stations water samples for calibration of the conductivity sensors were collected at all depths deeper than 1000 db or from the deepest sampling level. The samples will be analysed ashore. Three (3) sets of 20 salinity samples each from different areas were also collected in order to assess the influence of storage time on conductivity analyses.

A ship-mounted ADCP was used to measure current velocity and direction during the whole cruise. Data were averaged every ten minutes and stored. Due to the lack of a proper reference acoustic layer in the deeper waters of the Norwegian Sea, a DGPS positioning system was used to determine the exact position of the vessel during the measurements, especially during station work.

Chemical Oceanography

Oxygen concentration was measured using the Winkler method with visual determination of the titration end-point. Titration was done on whole samples (about 120 ml) using a 1 ml automatic burette (Metrohn) with a dispensing precision of 0.001 ml. Calibration of the thiosulfate solution (about 0.1 N) was as done on each run. The reproducibility of the method estimated as the standard deviation of six replicates drawn from four different 10 l Niskin bottles was better than 0.3 micromol kg⁻¹ at an oxygen concentration of about 300 micromol kg⁻¹. Sampling procedures, reagents preparation and analyses were done following WOCE recommendations as stated in Culbertson (1991). Conversion of volumetric to weight concentrations were done as recommended by WOCE using potential temperature from the CTD bottle

file. A test of a new type of oxygen sensor based on fluorescence yield (Optode, Anderaa Instr.) was planned to be carried out during the cruise. Unfortunately, defect connections hindered this.

Seawater samples for the analysis of nitrate, nitrite, phosphate and silicic acid were collected just after the sampling for oxygen. After rinsing three times, samples were drawn into 15 ml high-density polyethylene test tubes with pressure caps added 0.2 ml chloroform as a preservative and kept dark and refrigerated at 4 °C until analysis ashore.

The nutrient analyses were performed using a system build up by the following items:

- Pump system from Ismatec, Switzerland.
- Reaction units of own fabrication
- Autosampling, detection and computing units from SANplus Segmented Flow Analyzer, Skalar Analytical B.V., The Netherlands.

The methods used were adaptations of standard methods (Strickland and Parsons, 1972) slightly modified to the autoanalyzer system (Føyn et al., 1981). The precision for the different analyses (ten samples drawn from the same Niskin sampler) at full scale was less than 0.2% for nitrite, nitrate and silicic acid and less than 2 % for phosphate.

Biological oceanography

- Water sampling. Samples for biological analyses were obtained from the Niskin bottles on the Caroussel

- Chlorophyll

Samples for chlorophyll analyses were collected in 263 ml plastic bottles and filtered through glassfiber type F filters. The filters were immediately frozen for analysis ashore.

- Phytoplankton taxonomy

Samples for quantitative analysis of phytoplankton were drawn from the Niskin bottles into 100 ml brown glass bottles and 20 % formaldehyde was added for conservation.

- Zooplankton

Samples for zooplankton biomass and species composition were collected by vertical tows at selected depth intervals by means of a 56 cm opening WP-2 plankton net with a 180 µm mesh size. The samples were split into two, one part being preserved with formaldehyde for later determination of species composition. The other part was passed through three different meshsize nets, 2000, 1000 and 180 µm, and the fractions collected into preweighted aluminium containers, dried at 60 oC and then frozen, for later determination of dried weight ashore.

UNDERWAY MEASUREMENTS

Chlorophyll in vivo fluorescence (WebStar Mini fluorometer), temperature and salinity (SBE 21 Thermosalinograph, Seabird Inc.) were continuously monitored on water from the ship's water intake at 5 meters depth.

PRELIMINARY RESULTS

The hydrographical conditions along the section from Gimsøy and northwestwards are shown in Figs 2 to 4. As in previous years it was easy to identify the main watermasses in the area, the Atlantic water ($T > 0.5^{\circ}\text{C}$; $S > 35.0$) and the Greenland Sea water ($T < 0.5^{\circ}\text{C}$; $S < 34.9$) in the upper 500 meters. The area between these two water masses is called Arctic Front.

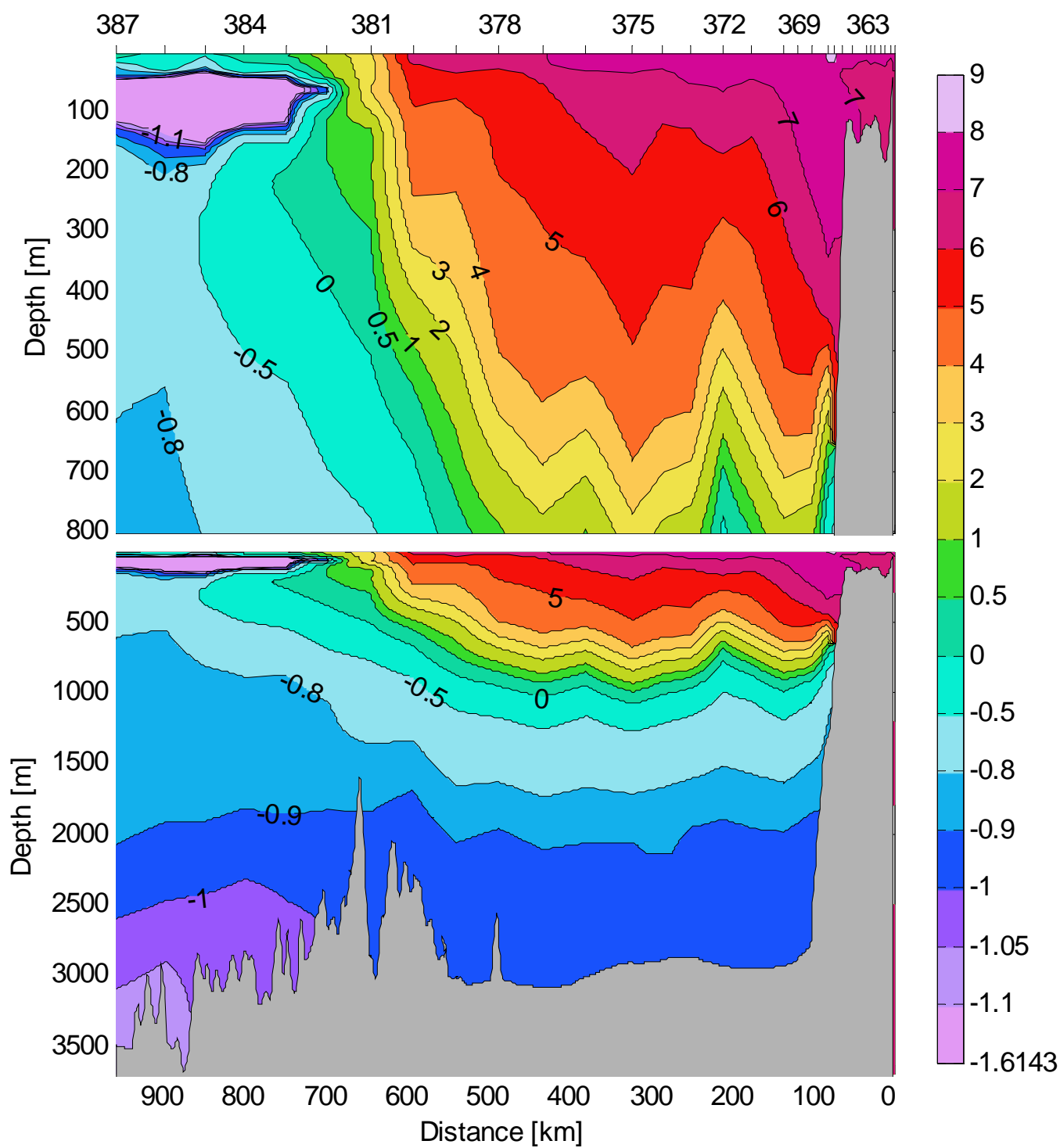


Figure 2. Potential temperature in the Gimsøy-NW section during May/June 2003

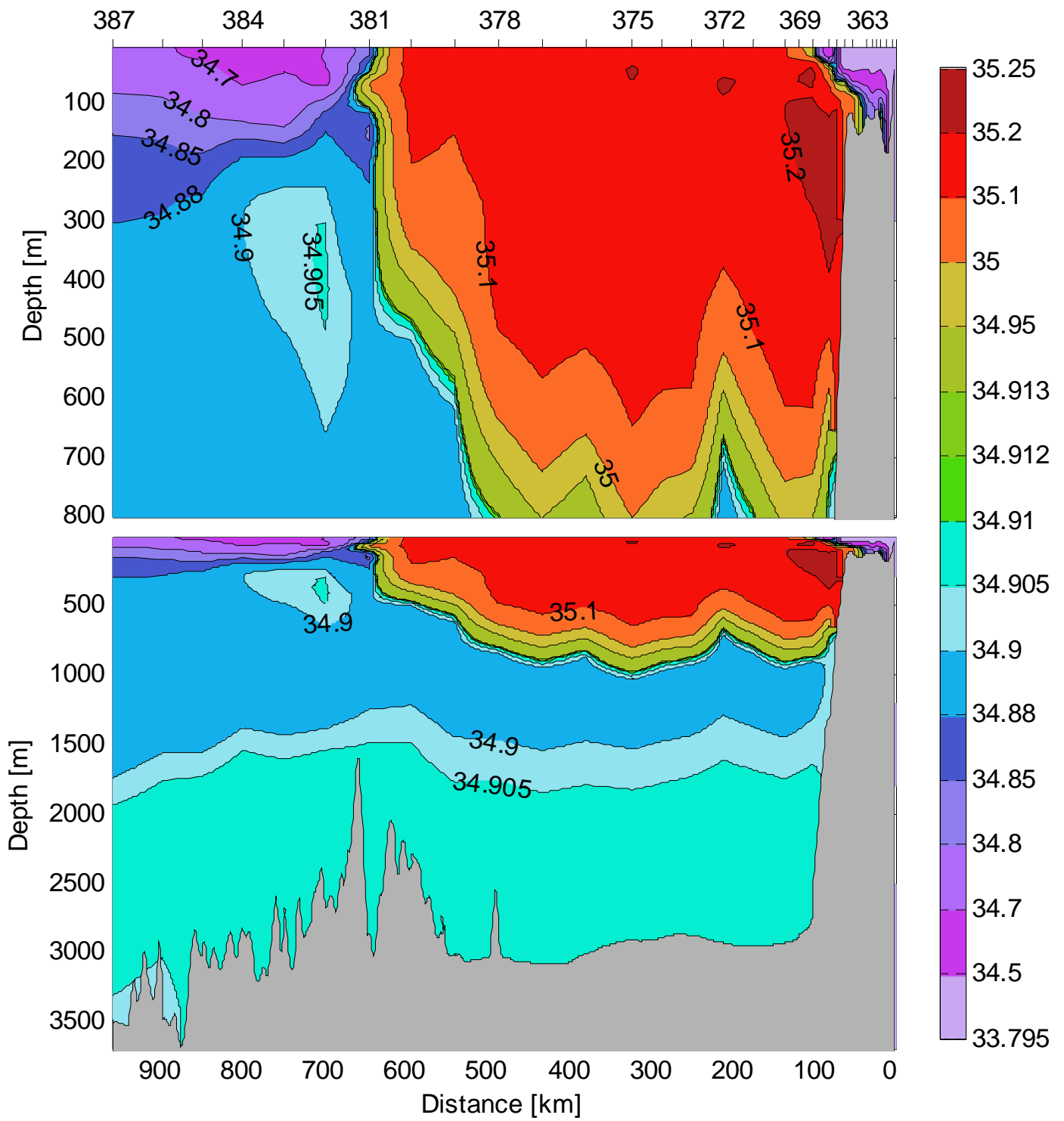


Figure 3. Salinity in the Gimsøy-NW section during May/June 2003.

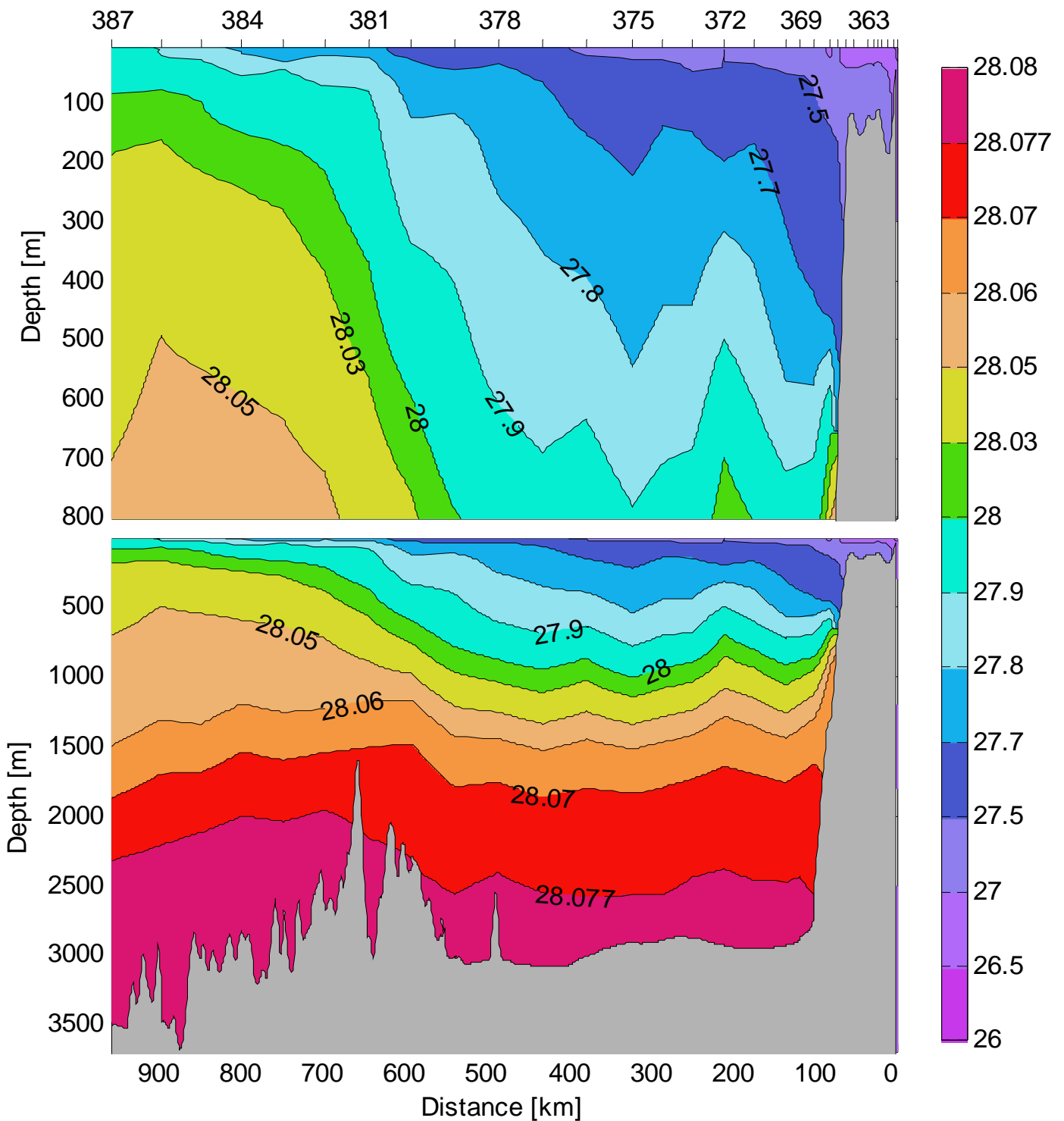


Figure 4. Sigma-theta in the Gimsøy-NW section during May/June 2003.

The nutrient distribution along the section is shown in Figs. 5 and 6. The distribution pattern of nitrate and silicate suggest that the phytoplankton spring bloom was well developed at both ends of the section in the areas. At the continental shelf the strong decline in both nitrate and silicate concentrations indicates that the spring bloom was dominated by a mixed phytoplankton population. On the Greenland Sea side however, the relative higher nitrate concentrations with respect to silicate suggest that here the spring bloom was strongly dominated by diatoms. Microscopical observations of the phytoplankton species composition made onboard confirmed this assumption. At the Atlantic water area close to the Arctic Front the relative higher nutrient concentrations suggest a later phytoplankton development.

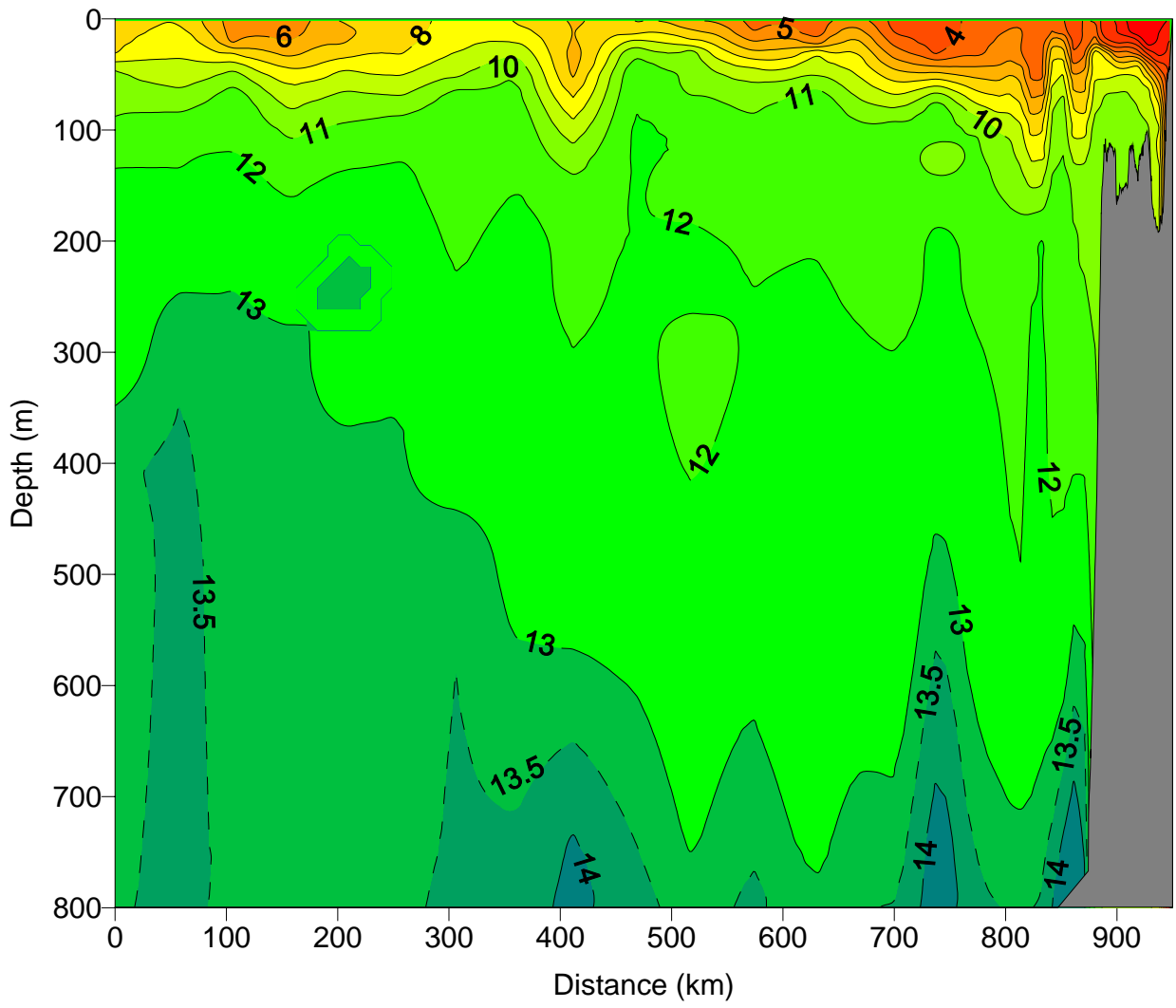


Figure 5. Nitrate in the Gimsøy-NW section during May/June 2003.

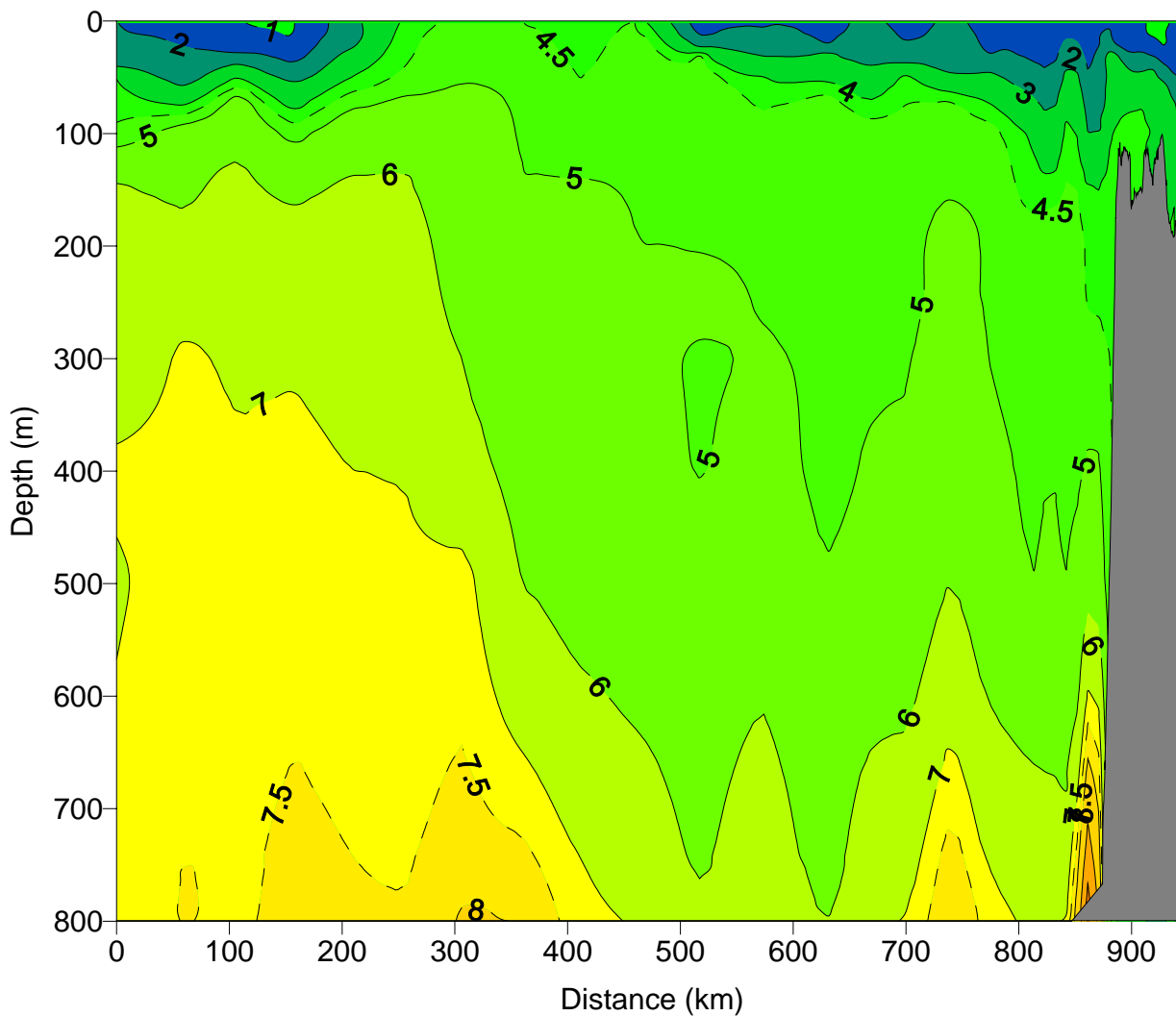


Figure 6. Silicate in the Gimsøy-NW section during May/June 2003

One of the purposes of the cruise was to deploy Argos drifting CTD-buoys in the Greenland Sea. In connection with this work we were informed of the presence of an eddy in the area with deep convection down to about 2500 meters. We used the opportunity of being in the vicinity to have a closer look to this phenomenon since its importance for deep water formation. We found the “chimney” at $74^{\circ}40' \text{ N}$ and $0^{\circ}30' \text{ W}$ and a series of transects were designed to map the chimney. Fig. 7 shows the hydrography of the chimney on a east-west section.

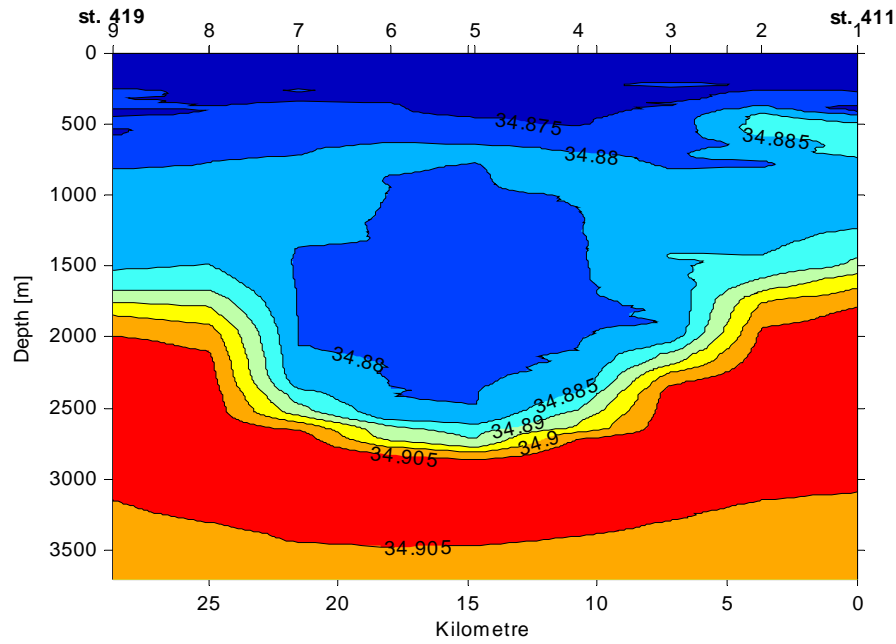
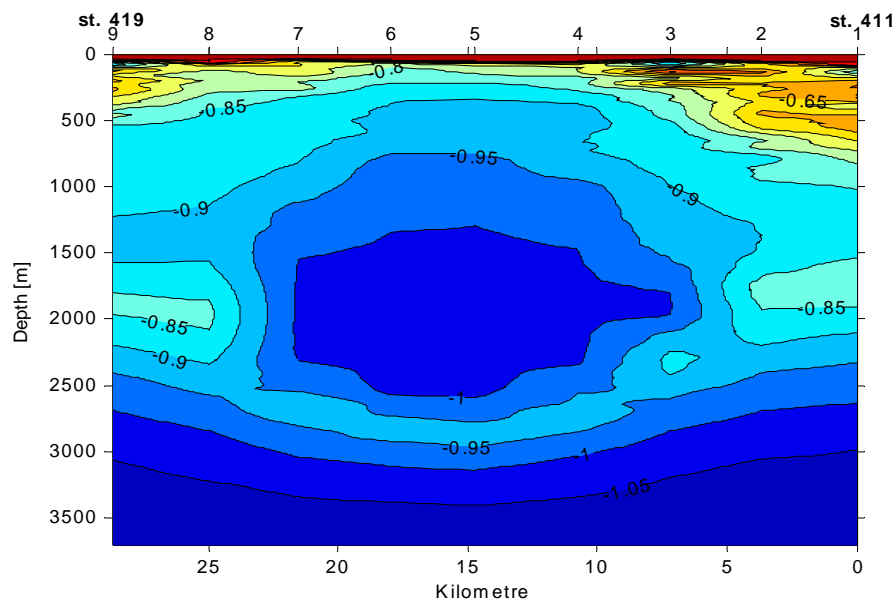
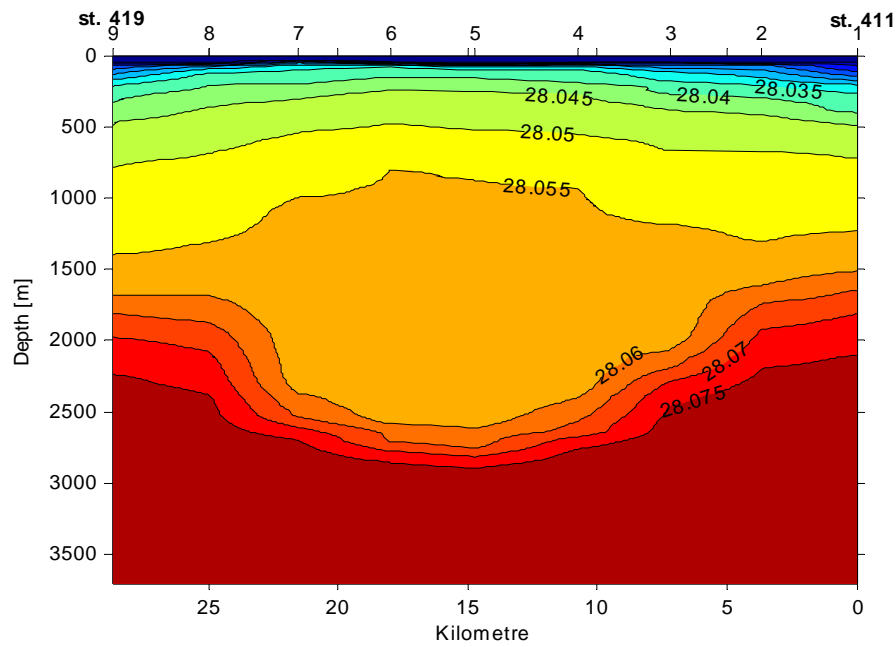


Figure 7. Hydrographic sections across the chimney.

Culberson, C.H. (1991) Dissolved oxygen. In: WOCE Operations Manual. Vol.3, Section 3.1, Part 3.1.3: WHP Operations and Methods. WOCE Report No. 68/91, Woods Hole.

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Strickland, J.D.H. and T.R. Parsons (1972) A practical handbook of seawater analysis. Bull. Fish. Res. Bd. Canada. 167: 1-311.

WHPO (1991) WOCE Operations Manual. WHP Office Report WHPO 91-1 WOCE Report No. 68/91. Woods Hole Mass, USA.

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