

Northwest Atlantic



Fisheries Organization

Serial No. N4618

NAFO SCR Doc. 02/17

SCIENTIFIC COUNCIL MEETING – JUNE 2002

Oceanographic Investigations off West Greenland 2001

by

Erik Buch and Mads Hvid Nielsen

Division for Operational Oceanography
Danish Meteorological Institute

Abstract

Results of the 2001 summer cruise to the standard sections along the west coast of Greenland are presented together with CTD data gathered during trawl surveys.

The time series of mid-June temperatures and salinities on top of Fylla Bank revealed 2001 to be a year close to average conditions. Pure Irminger Water was observed only at the Cape Farewell Section, while Modified Irminger Water could be traced all the way from Cape Farewell to Holsteinsborg in June 2001.

1. Introduction

The North Atlantic marine climate is largely controlled by the so-called North Atlantic Oscillation (NAO), which is driven by the pressure difference between the Azores High and the Iceland Low pressure cells. The NAO index during the 2001 winter did after 4 years of positive values again assume a negative value, however only slightly negative, Fig. 1.

West Greenland lies within the area, which normally experiences warm conditions when the NAO index is negative. As can be seen from Fig. 2 the annual mean air temperature anomaly in Nuuk was 1.43°C, which is slightly higher than the previous year.

Changes in the ocean climate in the waters off West Greenland generally follow those of the air temperatures. In 2001 however, the mean temperature on top of Fylla Bank in the middle of June (Fig. 3) was well below the values of the previous 3 years. These 3 years did however show anomalously high values due to an eastward displacement of the NAO Pattern (ICES, 2000, Buch and Nielsen, 2001). The 2001 temperature value ($T = 1.74^{\circ}\text{C}$) is slightly above the average value of 1.67°C for the whole 50-year period, which correlates well with the slightly negative value of NAO. The 2001 conditions therefore most likely reflect a return to normal conditions.

2. Measurements

The 2001 cruise was carried out according to the agreement between the Greenland Institute of Natural Resources and Danish Meteorological Institute during the period June 6-June 11, 2001 onboard the Danish naval ship "TULUGAQ". Observations were performed on the following stations (see also Fig. 4):

- Cape Farewell St. 1 - 5
- Cape Desolation St. 1 - 5
- Frederikshaab St. 1 - 5
- Fylla Bank St. 1 - 5
- Sukkertoppen St. 1 - 5
- Holsteinsborg St. 1 - 5

On each station the vertical distributions of temperature and salinity was measured from surface to bottom, except on stations with depths greater than 750 m, where 750 m was the maximum depth of observation.

The cruise was blessed with favourable weather and ice conditions. “Vestice” was not present at the Holsteinsborg section. Close to Cape Farewell “Storis” was present, Fig. 5, but fortunately not in quantities preventing the measuring program being carried out.

3. Data handling

Measurements of the vertical distribution of temperature and salinity were carried out using a SEABIRD SBE 9-01 CTD. For the purpose of calibration of the conductivity sensor of the CTD, water samples were taken at great depth on stations with depths greater than 500 m. The water samples were after the cruise analysed on a Guildline Portosal 8410 salinometer.

The CTD data were analysed using SEASOFT 4.225 software provided by SEABIRD.

CTD data collected by the Greenland Institute of Natural Resources during cruises with R/V Paamiut using the same instrumentation have gone through the same calibration and quality check.

All quality-controlled data are stored in the Marine Database at the Danish Meteorological Institute from where copies have been sent to ICES and MEDS.

4. Oceanographic conditions off West Greenland in 2001

The surface temperatures and salinities observed during the 2001 cruise are shown in Fig. 6. The cold and low salinity conditions observed off Southwest Greenland reflect the inflow of Polar Water carried to the area by the East Greenland Current. Water of Atlantic origin ($T > 3^{\circ}\text{C}$; $S > 34.5$) is found at the surface only at the outermost stations on the Cape Farewell Section.

The 2001 mean salinity value (33.40) on top of Fylla Bank (Fig. 7) was slightly higher than in 2000, and equal to the average value for the entire period.

The vertical distribution of temperature, salinity and density as well as TS-relations at sections along the West Greenland coastline is given in Fig. 8-18. In addition to data from the six standard sections obtained during the TULUGAQ cruise in early June, data from the Disko Bay and further north obtained during the R/V PAAMIUT cruise in August are shown.

In the surface layer relatively strong gradients between the cold, low-saline Polar Water and the warm, high-saline water of Atlantic origin was observed from Frederikshaab and southward, the gradient however, being weaker at the Cape Desolation section than on the other two. At Fylla Bank the core of Polar Water was observed across the bank a depth of 50-100 m. (see also Fig. 8), while further north this cold core of Polar water could not be traced.

At Egedesminde and northwards a cold layer is found between approximately 40 and 150 m with extreme low temperatures at around 75m. This cold water most likely is Polar Water transported to the West Greenland waters by a side branch of the southward flowing Baffin Current.

Temperature and salinity observations at greater depth showed that pure Irminger Water ($T \sim 4.5^{\circ}\text{C}$, $S > 34.95$ PSU) was clearly present at the Cape Farewell section, but has not advected beyond this point. Modified Irminger Water ($34.88 < S < 34.95$) was present in great quantities at all sections up to the Holsteinsborg section, however most clearly at the southernmost sections.

Northwest Atlantic Mode Water ($3.5 < T < 4.5$; $34.5 < S < 34.88$) was observed at all sections from Cape Farewell to Nugsuaq.

6. Conclusions

The oceanographic conditions off West Greenland during the summer 2001 was characterised by:

- Climatic conditions – NAO, Nuuk Air Temperatures, medio June temperature and salinities on top of Fylla Bank – were close to average conditions
- Pure Irminger Water was only observed at the Cape Farewell region
- Modified Irminger Water was in June observed all the way from Cape Farewell to Holsteinsborg

7. References

Buch, E. & Nielsen, M.H. (2001). Oceanographic Investigations off West Greenland 2000. NAFO Scr. Doc 01/02

ICES (2000). The 1999/2000 ICES Annual Ocean Climate Status Summary. Prepared by the Working Group on Oceanic Hydrography. Editor: Bill Turrell. (<http://www.ices.dk/status/clim9900/>)

Jones P. D., Jonsson T. and Wheeler D. (1997). Extension to the North Atlantic Oscillation using early instrumental pressure observations from Gibraltar and South-West Iceland. *Int. J. Climatol.* 17, 1433-1450.

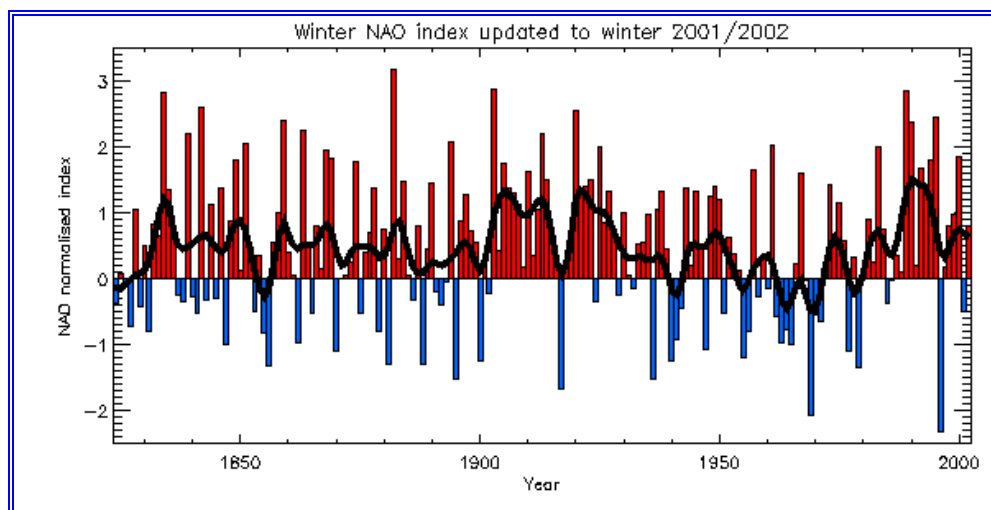


Fig. 1. Time series of the winter NAO (December to March average). After Jones et al (1997) updated to the winter 2001-2002.

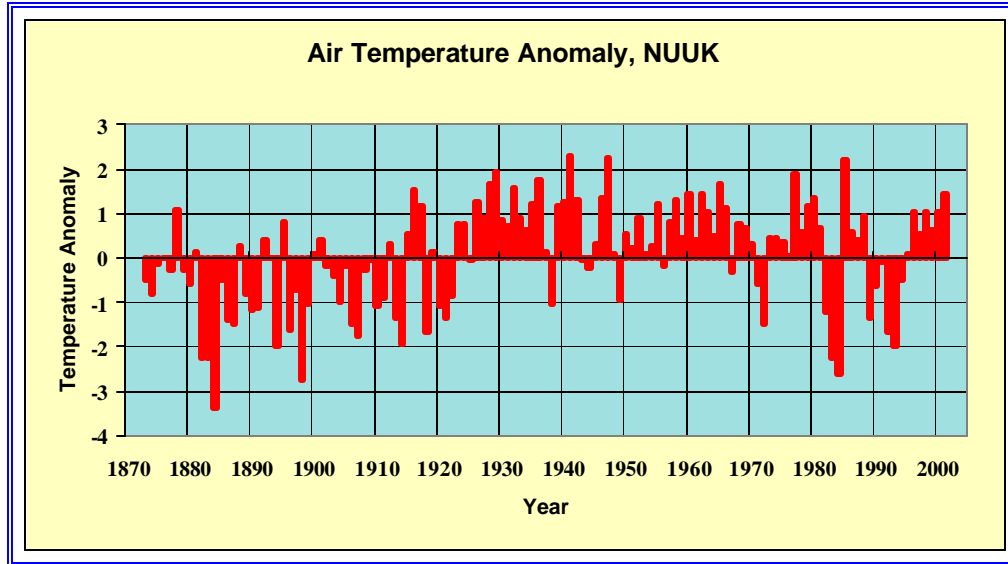


Fig. 2. Anomaly in the annual mean air temperature observed at NUUK for the period 1873 to 2001. (The anomaly is taken relative to the mean temperature for the whole period).

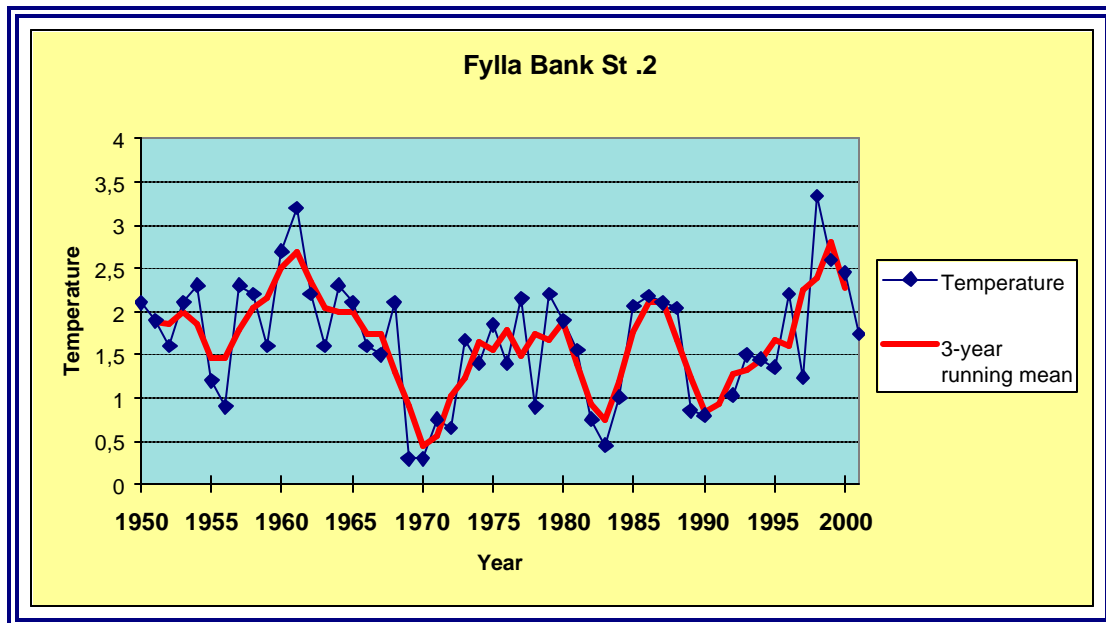


Fig. 3. Time series of mean temperature (observations and 3 year running mean) on top of Fylla Bank (0 - 40 m) in the middle of June.

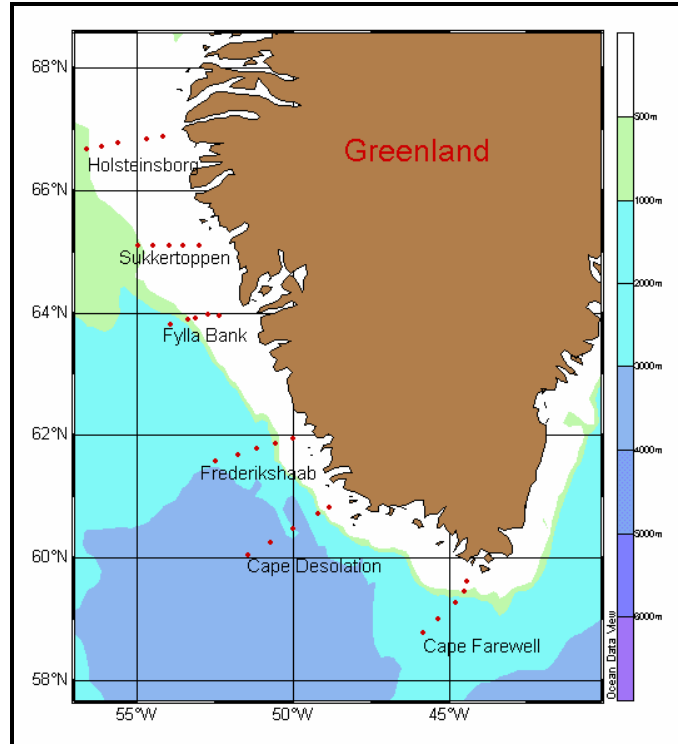


Fig. 4. Position of the standard sections off West Greenland

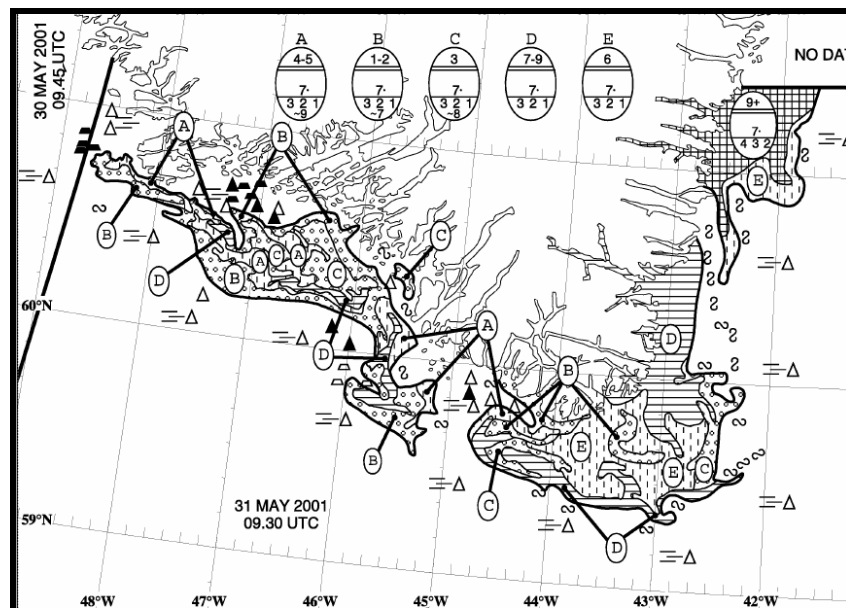


Fig. 5. Distribution of sea ice in the Cape Farewell region May31, 2001.

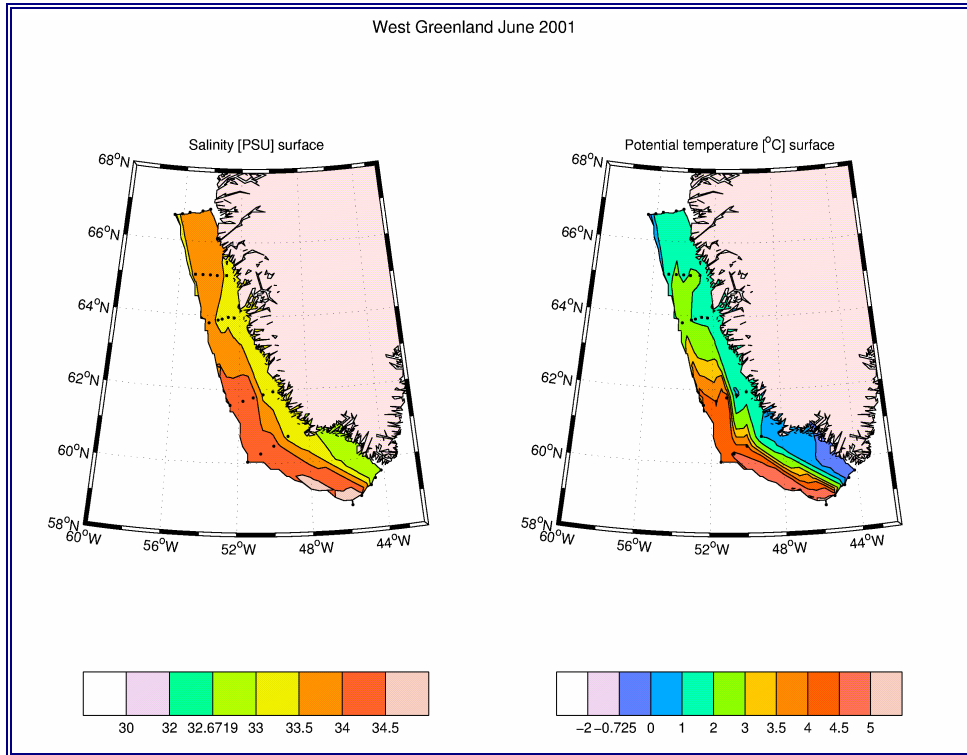


Fig. 6. Surface temperature and salinity, June 2001.

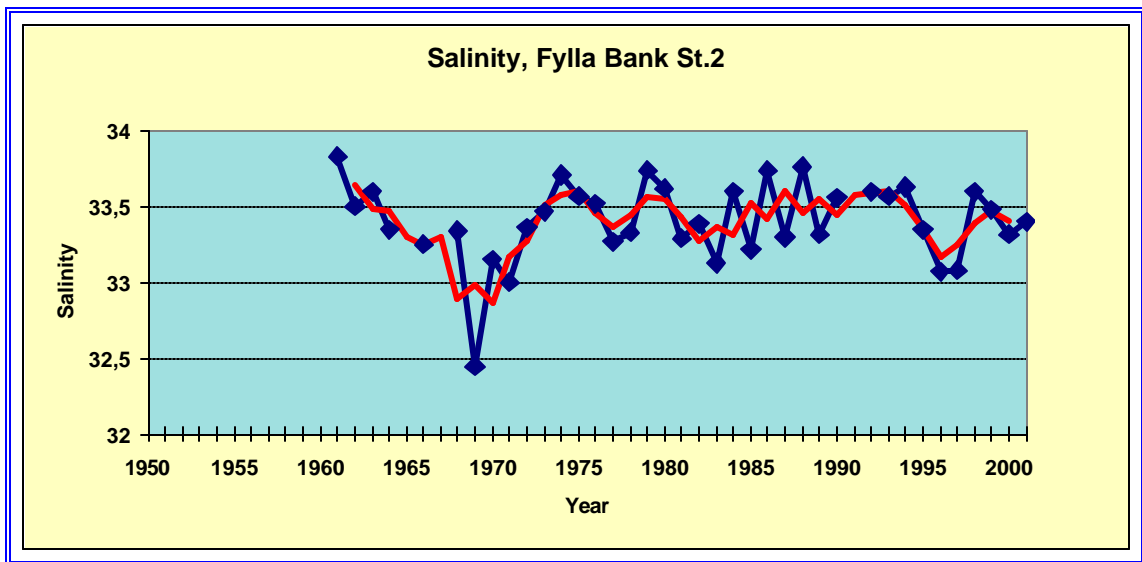


Fig. 7. Time-series of the mean salinity (observations and 3 year running mean) on top Fylla Bank (0-40m) in the middle of June

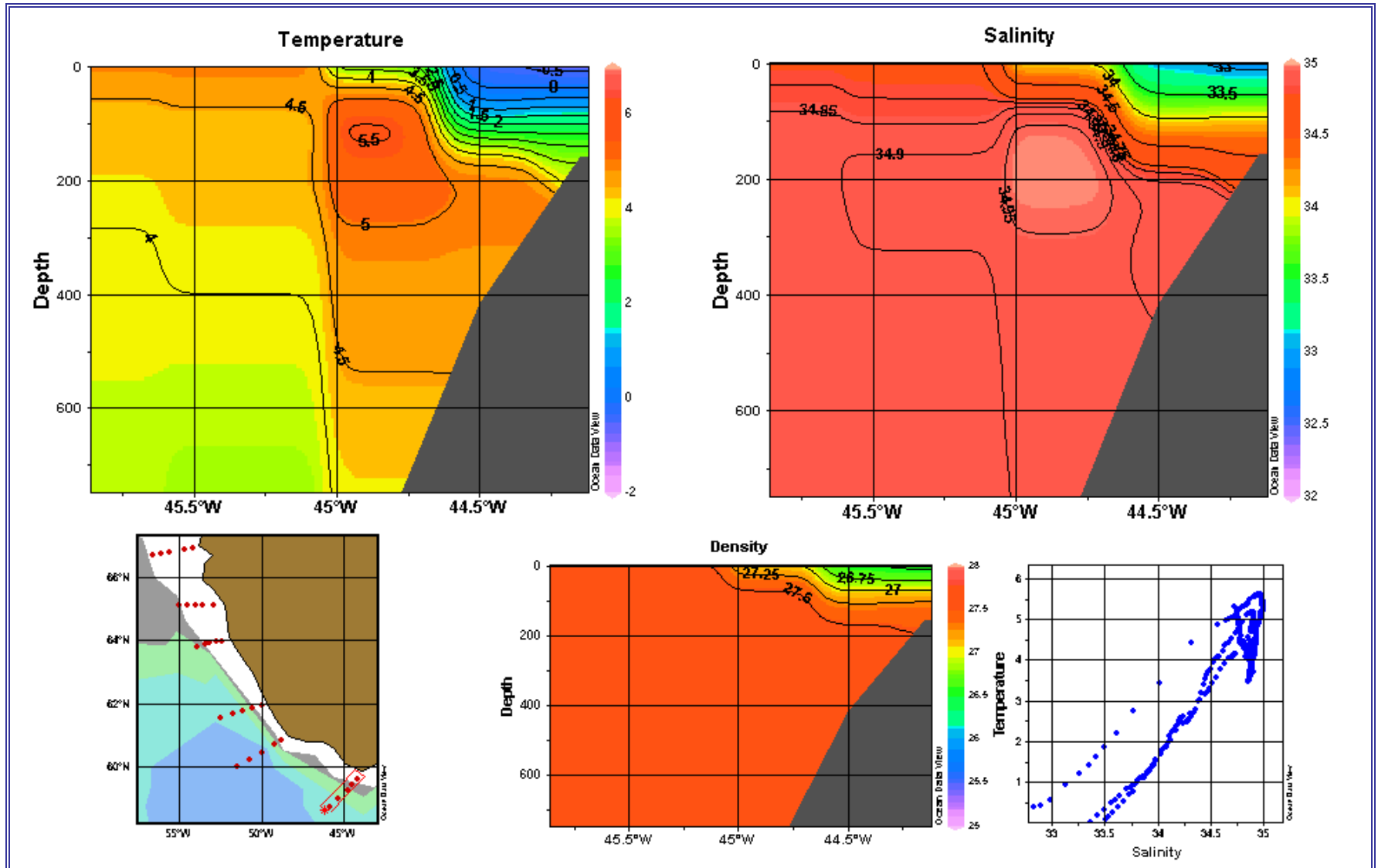


Fig. 8. Vertical distribution of temperature, salinity and density at the Cape Farewell section, June 6, 2001.

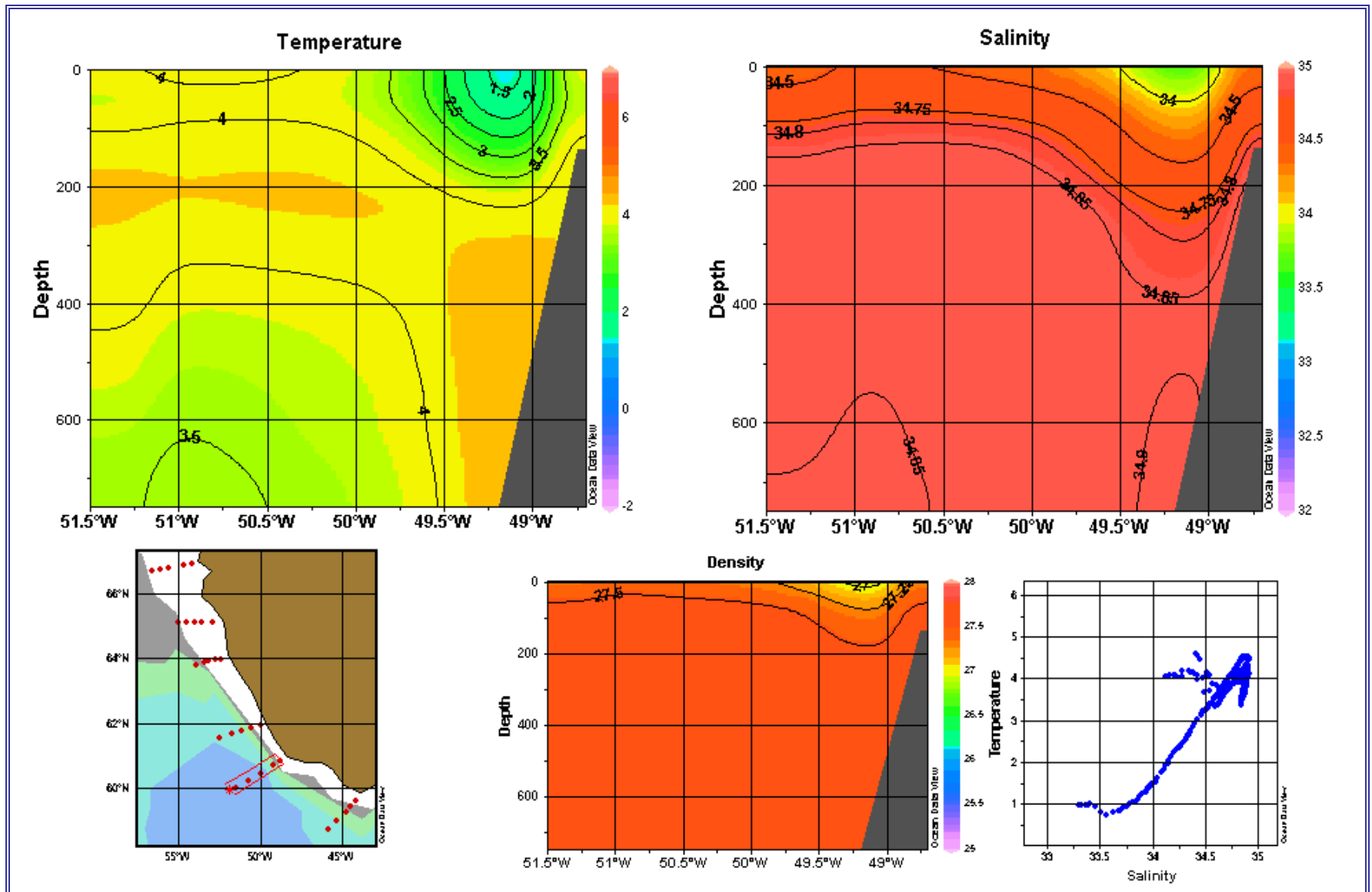


Fig. 9. Vertical distribution of temperature, salinity and density at the Cape Desolation Section, June 7, 2001.

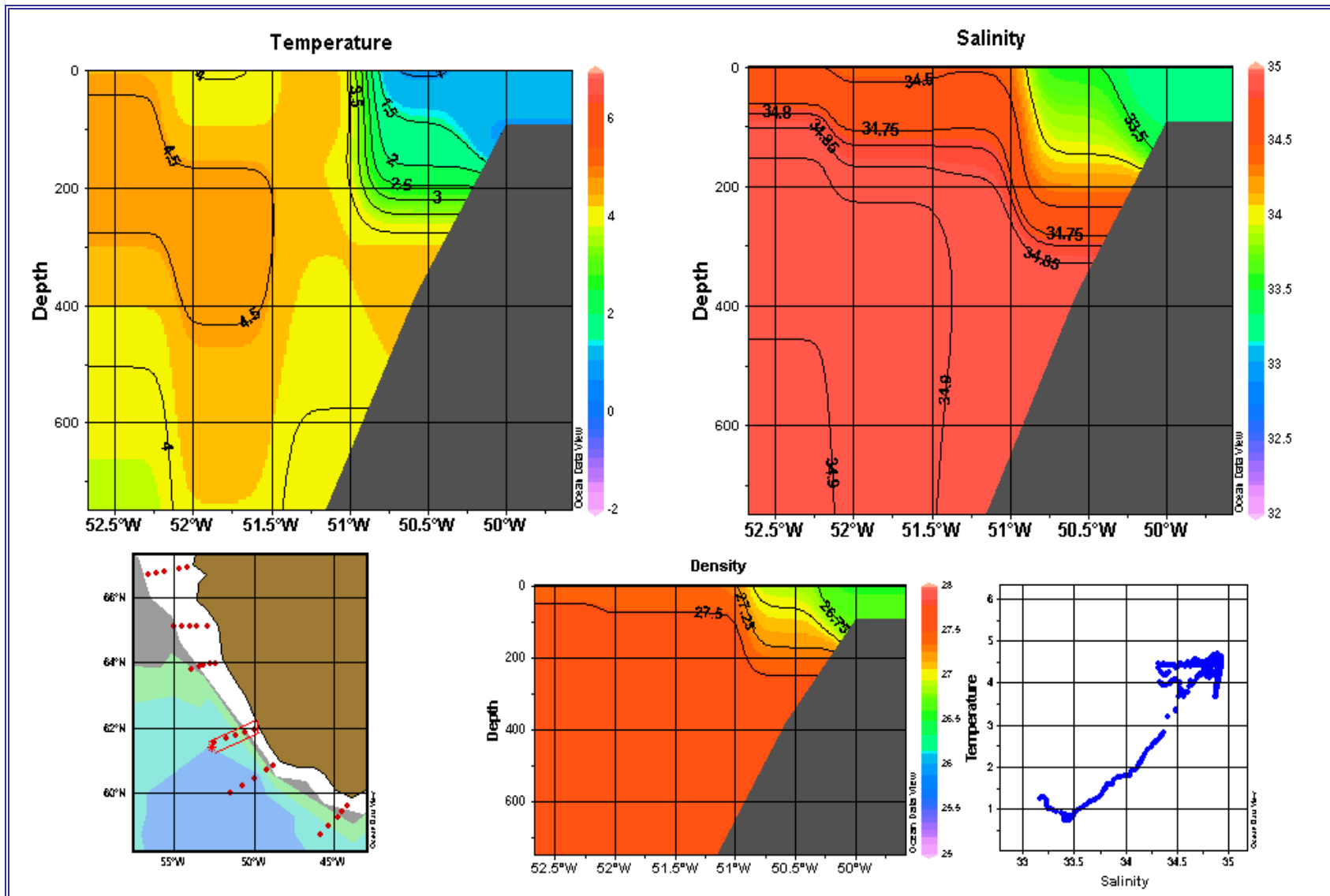


Fig. 10. Vertical distribution of temperature, salinity and density at the Frederikshaab Section, June 8, 2001.

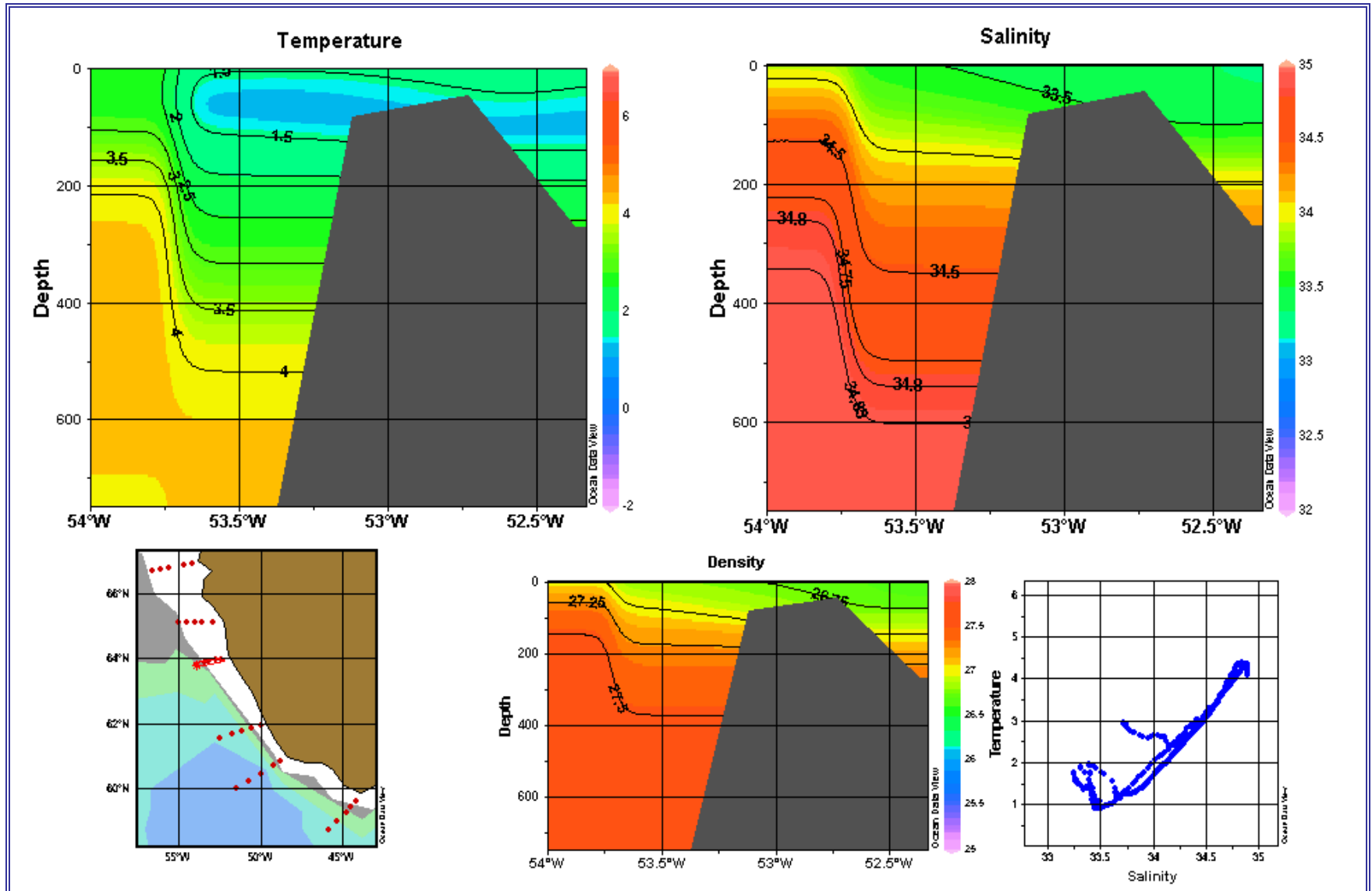


Fig. 11. Vertical distribution of temperature, salinity and density at the Fylla Bank Section, June 9, 2001.

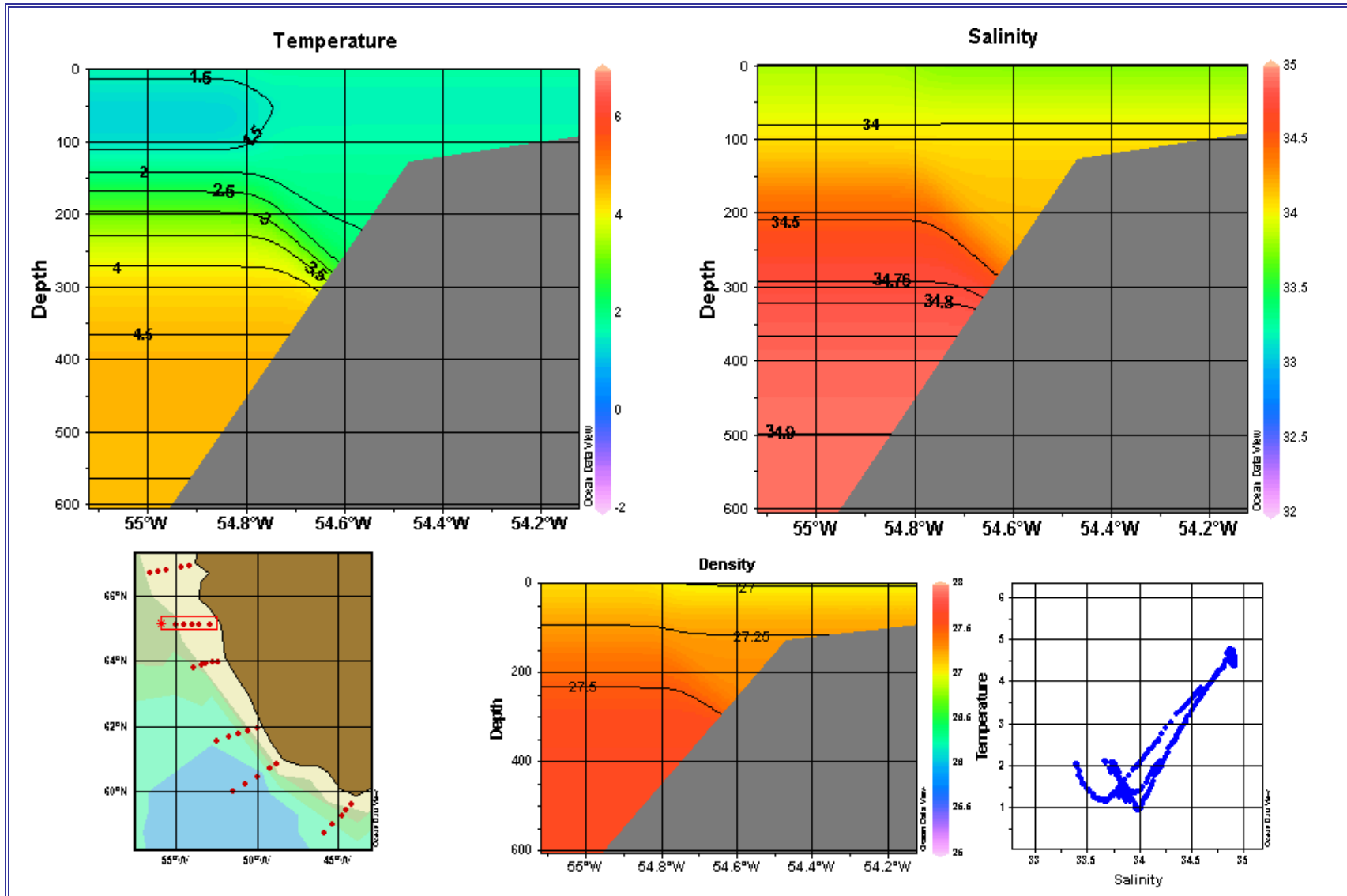


Fig. 12. Vertical distribution of temperature, salinity and density at the Lille Hellefiske Bank Section, June 10, 2001.

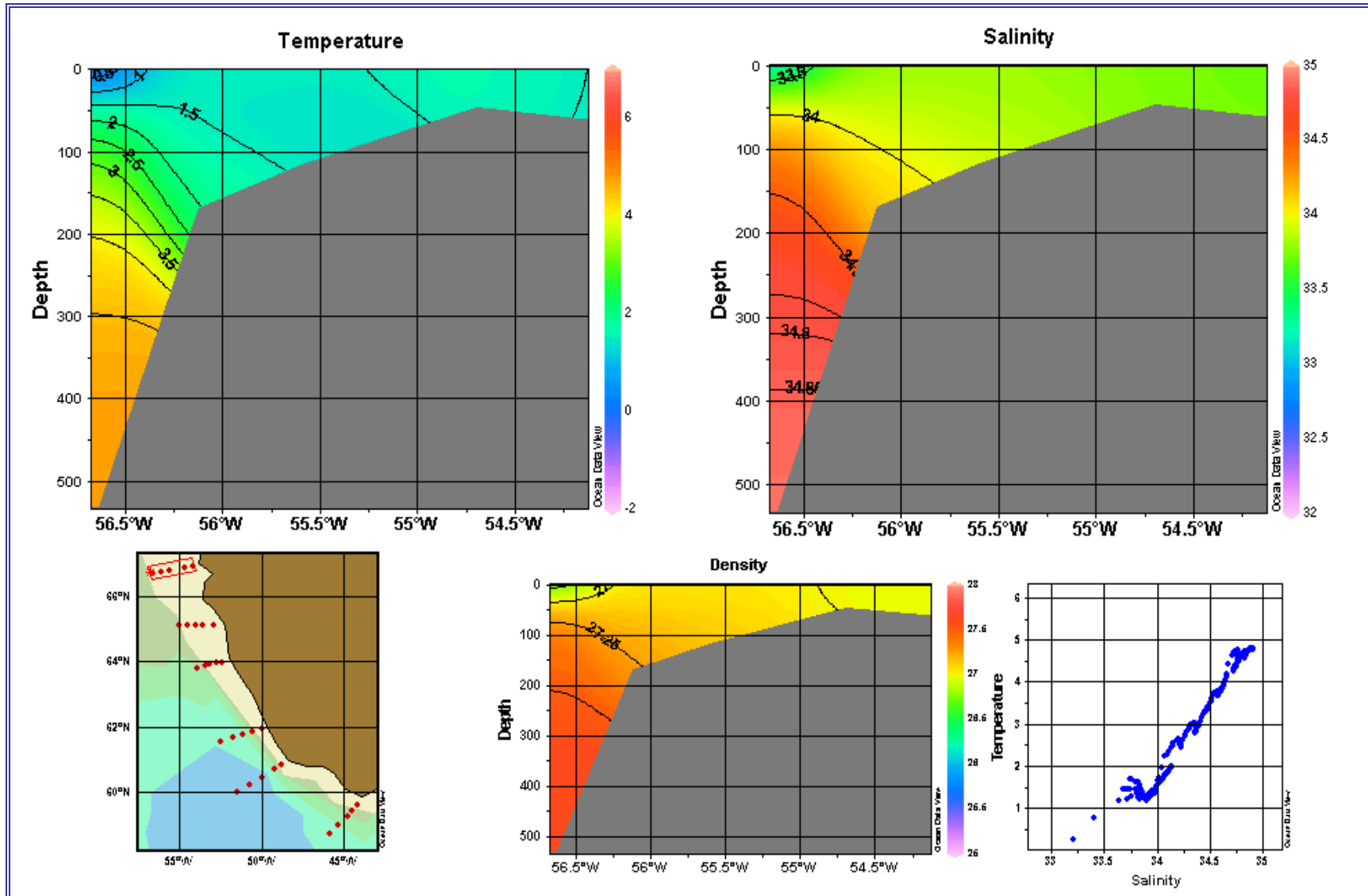


Fig. 13. Vertical distribution of temperature, salinity and density at the Holsteinsborg Section, June 10-11, 2001.

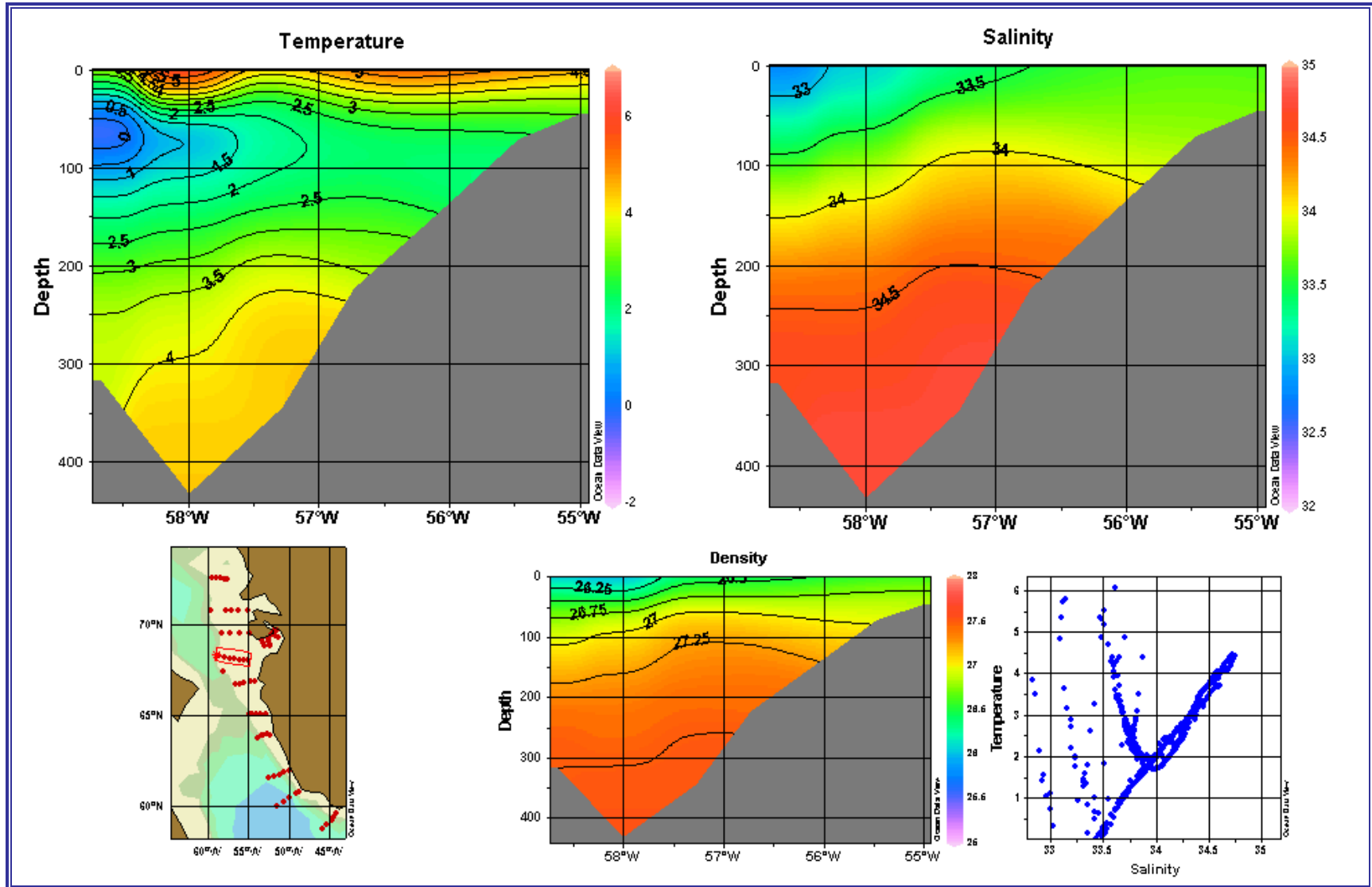


Fig. 14. Vertical distribution of temperature, salinity and density at the Egedesminde Section, August 6, 2001.

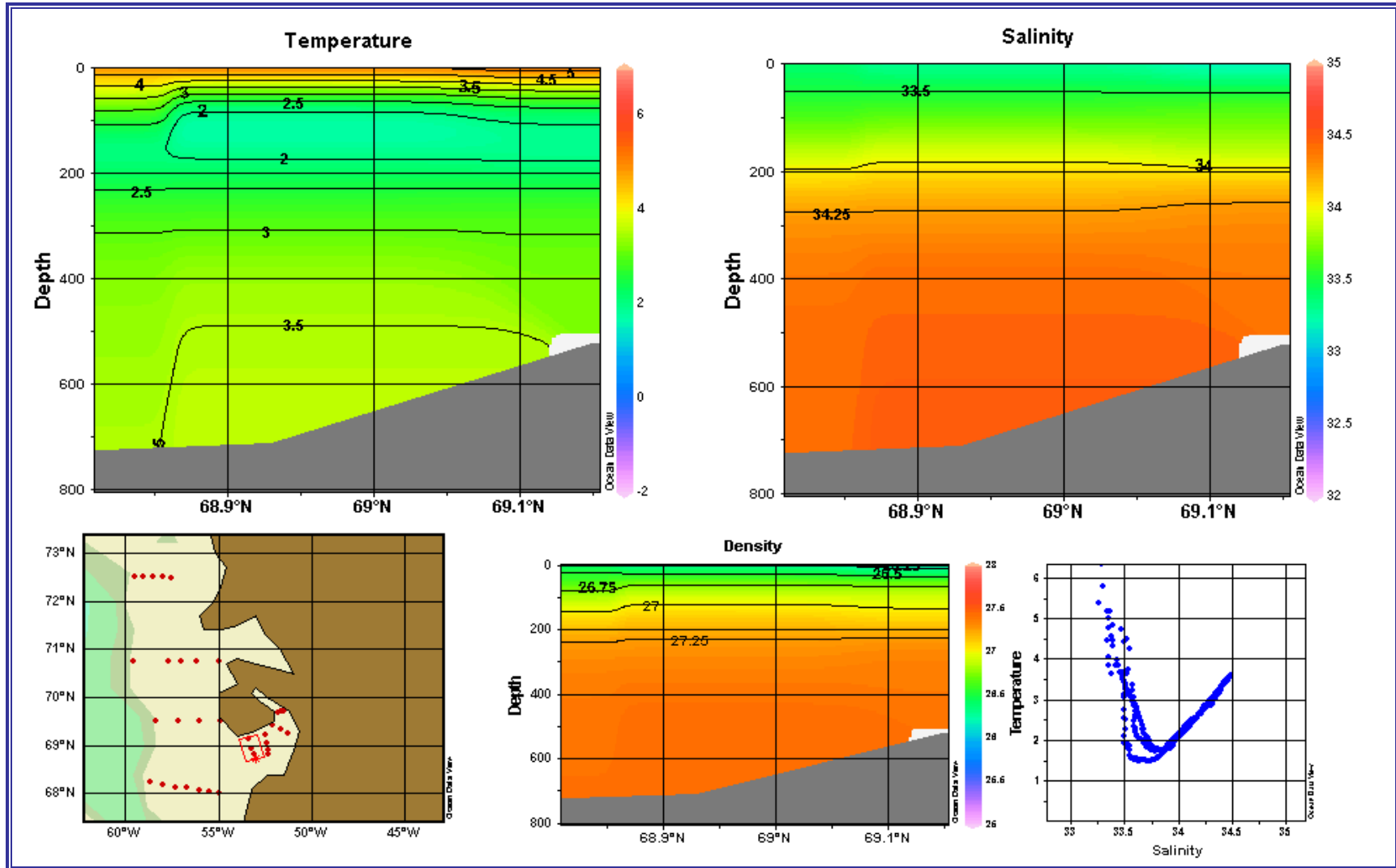


Fig. 15. Vertical distribution of temperature, salinity and density at the Godhavn-Egedesminde Section, August 14, 2001.

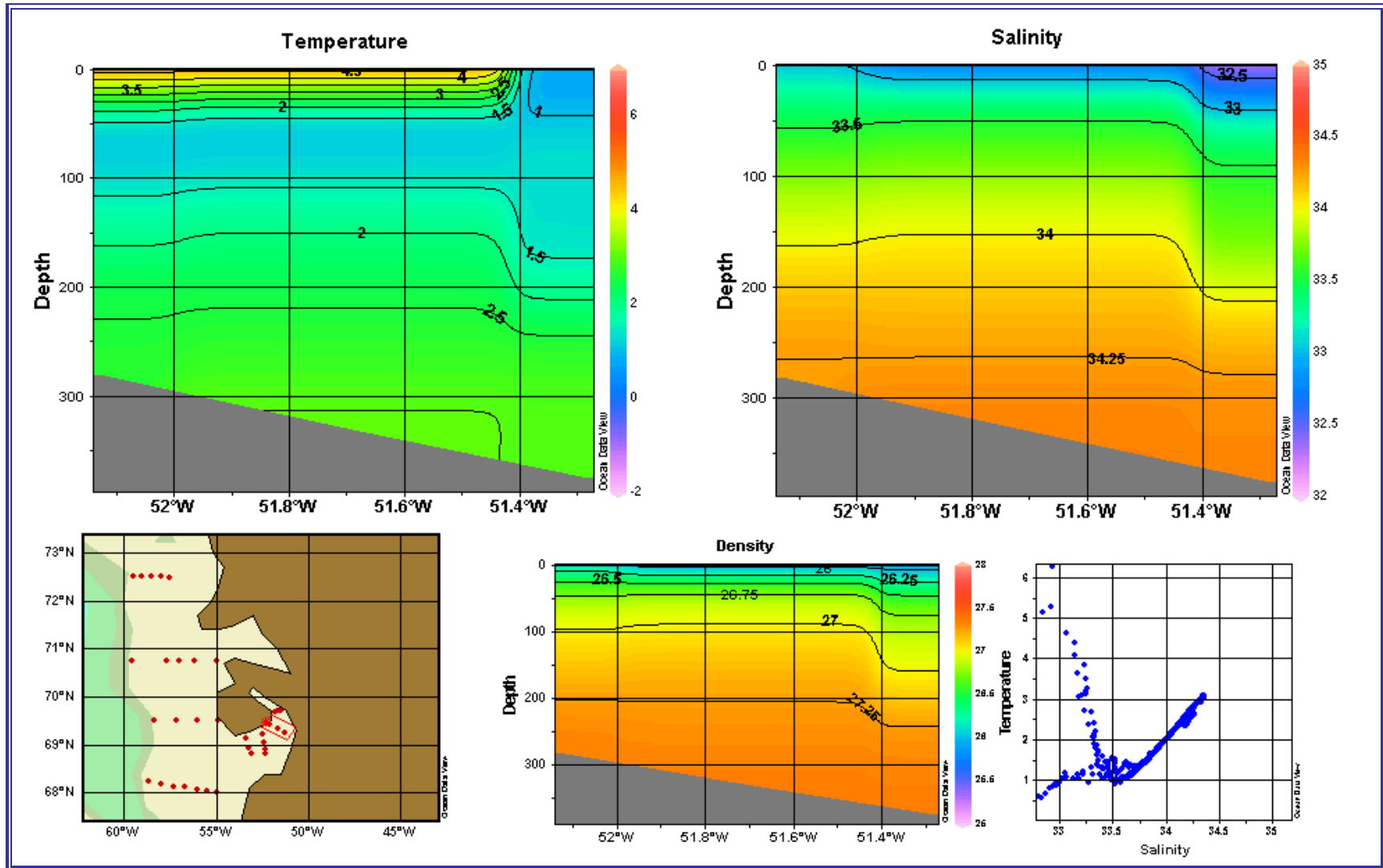


Fig. 16. Vertical distribution of temperature, salinity and density at the Jakobshavn Section, August 24, 2001.

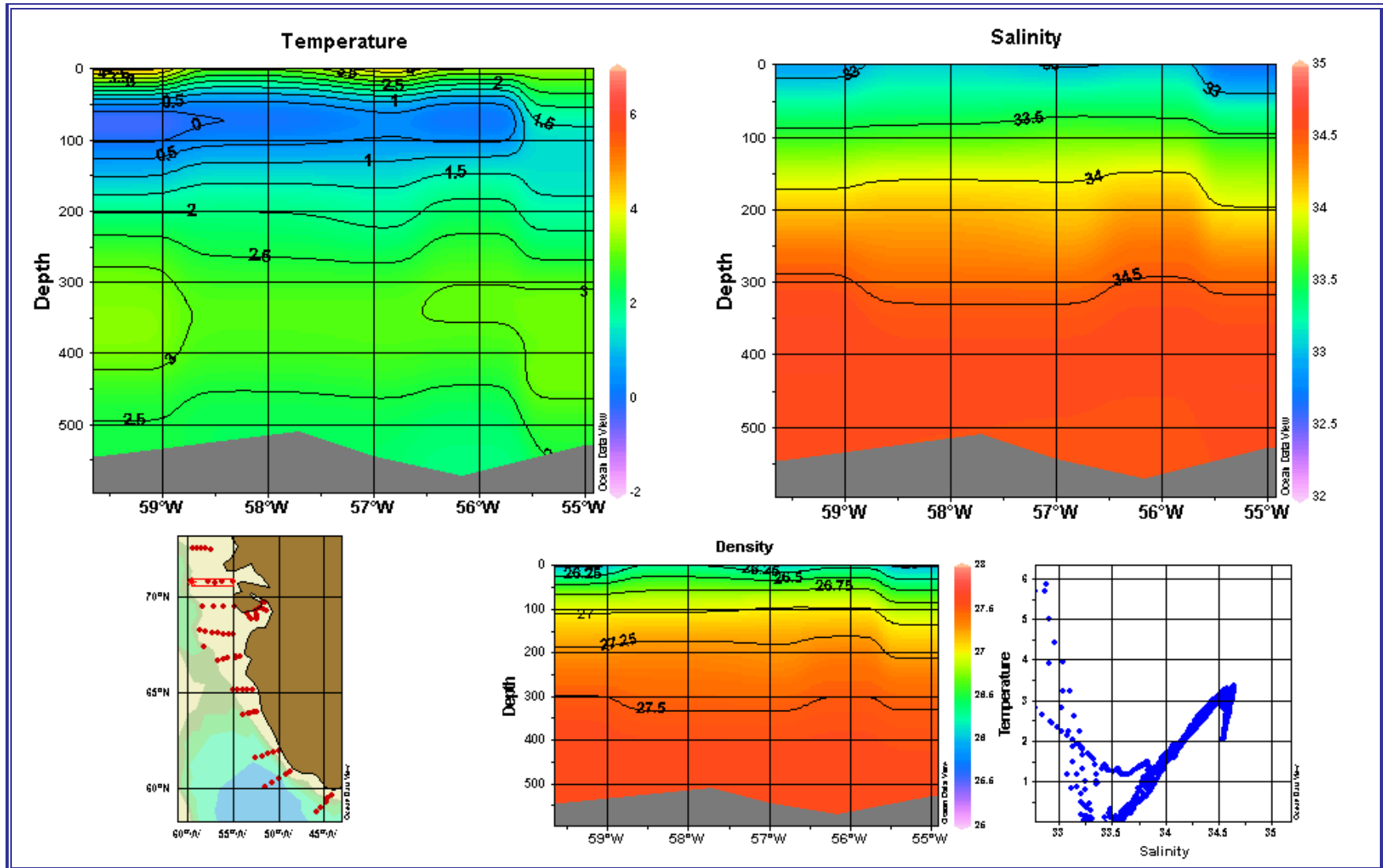


Fig. 17. Vertical distribution of temperature, salinity and density at the Nugssuaq Section, August 20, 2001.

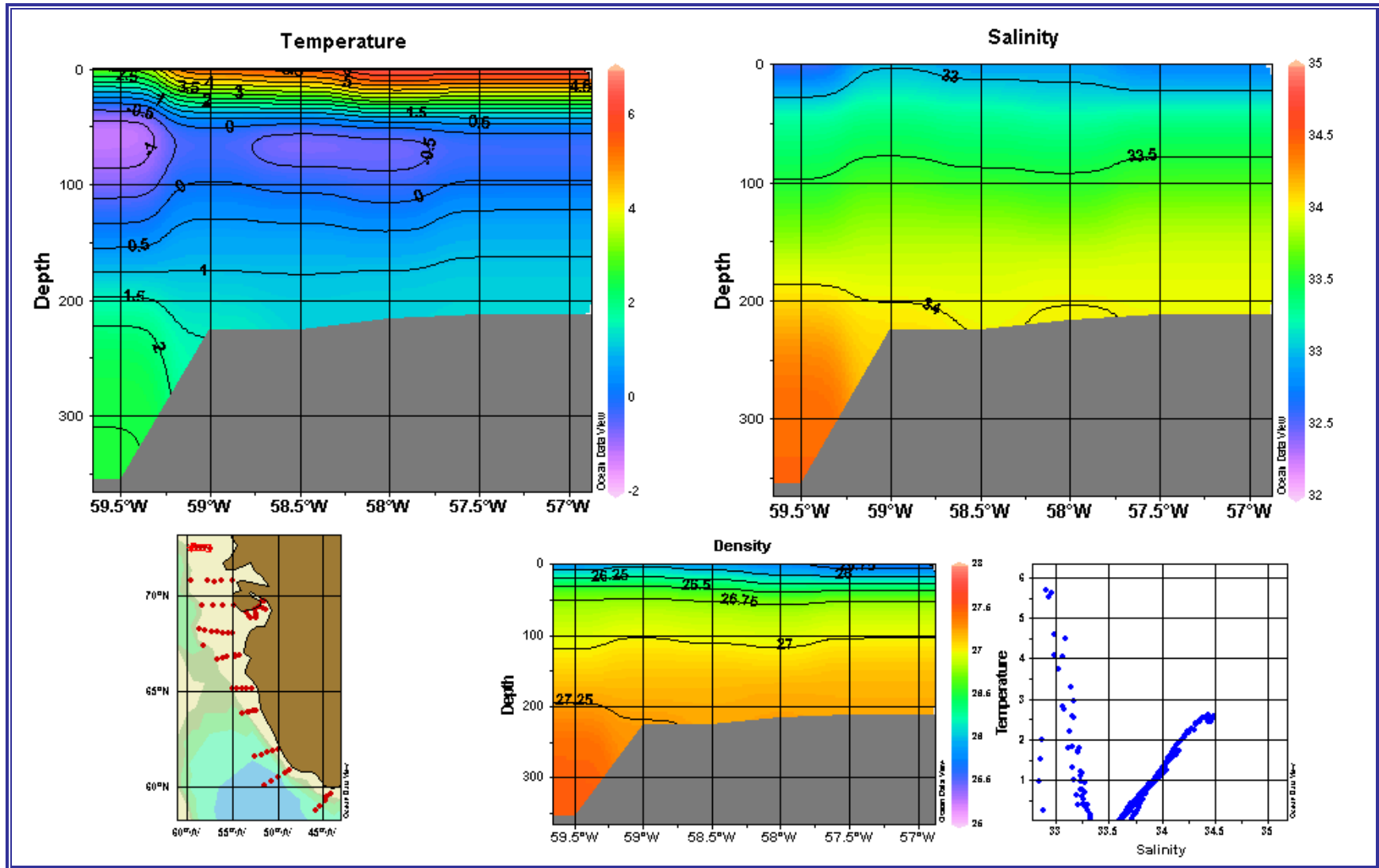


Fig. 18. Vertical distribution of temperature, salinity and density at the Upernavik Section, August 19, 2001.