MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK NR33 0HT

1994 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA: CRUISE 10
(PROVISIONAL: Not to be quoted without prior reference to the author)

STAFF:
K S Leonard (SIC part a)
D S Woodhead (SIC part b)
J M Rees (part a)
B J Fogg
R D Ibbett
P Blowers
S M Cogan
R Bonfield
D J Allington
B R Taylor
P A Gurbutt (part b)

DURATION: Part a: Left Lowestoft 1930h, 2 September 1994
Docked Tromsö 0330h, 17 September 1994

Part b: Left Tromsö 0900h, 18 September 1994
Docked South Shields 1530h, 5 October 1994

(All times Greenwich Mean Time)

LOCATION: Part a: North Sea, NE Atlantic Ocean, Denmark Strait, Greenland Sea, Norwegian Sea.

Part b: Western Barents Sea, Norwegian Sea and North Sea.

AIMS:

1. To determine the present contribution of artificial radionuclides from the Sellafield discharges to the contamination of the Arctic Seas, and, using isotopic ratios, differentiate this from other sources.

2. To place the observed distribution of the contaminant radionuclides into hydrographic context.

3. To examine the record of past inputs of artificial radionuclides into Arctic Seas as preserved in the surface seabed sediments.

NARRATIVE

Part a.

Access to Russian waters was denied; thus plan b was carried out, as described in the cruise programme. A cruise track with site numbers is given in figure 1.

RV CIROLANA departed from Lowestoft at approximately 1930h on Friday 2 September 1994 and proceeded northwards along the British coast, passing through the Pentland Firth on 4 September. En route, surface seawater samples were collected at 7 stations (sites nos. 1-7) and processed for Cs determinations. In addition, at site number 4, a large surface seawater sample was collected and preliminary processing was carried out to determine the redox distribution of Pu. Whilst on station the CTD system was tested to a depth of approximately 80m. With favourable weather conditions, CIROLANA proceeded on a direct course to south-west Iceland arriving at site number 20 on the evening of 6 September. Between site numbers 8 and 22 surface seawater samples were collected and processed for the determination of Cs, Pu, Tc, Sr and I radionuclides. For quality assurance purposes, a blank determination for the assay of Pu was also carried out. A number of XBTs were also deployed en route to provide hydrographic information.

At approximately 2330h on 7 September work commenced on a transect across the Denmark Strait (site nos. 23-29). As originally planned, hydrographic information (deployed CDT - 4 stations and XBTs) was obtained together with collection of surface, middle and bottom seawater samples, for the suite of radiochemical and nutrient determinands. The transect was successfully completed on the evening of 8 September. Further surface seawater samples were collected along the Greenland coastline (site nos. 30-32) during the morning of 9 September. During the early evening work commenced on the transect from site number 33 toward Jan Mayen (site number 38). CTD and XBT deployments at 3 sites were carried out and seawater samples were collected at different depths, surface, middle and bottom for radionuclide and nutrient determinations.

On the early evening of 10 September, RV CIROLANA proceeded on a northerly course toward the Fram Strait collecting surface seawater samples on passage. After completing site number 42, on 11 September, it was necessary to deviate from the intended course track in an easterly direction, to avoid large ice floes, and site number 43 was relocated by 5° in an easterly direction. Thereafter, further progress to the north was slow and became increasingly more difficult, particularly after daylight hours, because of significant ice floes and poor visibility. With the likelihood of not achieving the western section of the Fram Strait stations (site notes. 44-48) this section of the transect was revised. Site numbers 44 and 47 were abandoned and site numbers 45, 46 and 48 were relocated south and east to the 77° parallel. During 13 September XBTs were deployed and surface water seawater samples were collected at each of the sites on the western section of the Fram Strait. Hydrographic information and middle/bottom waters were obtained at site number 45. Although the CTD was deployed at site numbers 46 and 48, seawater samples at depth were not collected due to problems with the firing mechanism (site no. 46) and, subsequently, fraying of the CDT cable wire (site no. 48). Repeat deployments were not appropriate because of deteriorating weather condition from high winds (force 7-8) and large sea swells at each of the stations. A reversible

thermometer was broken whilst recovering the CDT at site number 46. Fraying of the cable wire caused by chaffing at the block was repaired.

During the early morning of 14 September, RV CIROLANA proceeded to the eastern section of the Fram Strait on the intended latitude. Although surface seawater samples were collected at site number 49, it was not possible to deploy the CDT due to continuing bad weather. On the evening weather conditions improved and the remainder of the transect of the Fram Strait was completed successfully (including 2 CTD stations). During the period 15-16 September, RV CIROLANA proceeded on a southerly passage collecting surface seawater samples (sites nos. 54-62) for radionuclide determinations. RV CIROLANA docked at Tromsö at 0330h on 17 September for the mid-cruise break and a change of scientific staff.

Part b.

CIROLANA sailed from Tromsö at 0900h on 18 September, making a northerly passage through the Fjords with a pilot on board. At 1400h site 63 was reached at the start of the Fugloya-Bear Island-Spitzbergen section along the 20° E meridian. At site 63, an attempt to deploy the CDT was aborted due to wind and swell but an XBT was successfully launched and surface water samples collected. A similar result was obtained overnight (18-19 September) at sites 64-67. By 0700h, conditions had ameliorated sufficiently to permit the deployment of the CDT and the remainder of that day and all of 20 September was spent completing the section (sites 68-77) collecting a total of 11 CDT profiles, 11 sets of surface, mid- and bottom water samples, 3 sediment cores (from 6 attempts) and making 9 successful XBT deployments. Overnight, CIROLANA made a south-easterly passage around Spitzbergen to longitude 25° E and commenced a northerly transect on this meridian at 1000h on 21 September; this was completed around midnight. On 22 September, further northerly progress was made at longitude 27° 30'E to 79°30'N, close to the edge of soft pack ice, completing a total of 5 CDT profiles, the collection of 7 surface water samples, 5 sets of mid- and bottom water samples, 2 cores and 5 XBT deployments. Site 83 was deleted from the programme because of ice conditions. The southerly transect along longitude 29° 55'E commenced at 2030h on 22 September (site 86) and was completed at 0430h on 25 September (site 101) with 6 XBT deployments, 14 CDT profiles, 16 surface water samples and 7 sets of mid- and bottom water samples. From 0900h 25 September until 0445h the following day a series of stations was worked off the north Norwegian coast (sites 102-107) before returning to sites 63-67 to complete the CTD and coring transect along longitude 20° E (i.e. the observations lost on 18-19 September) finishing at 0130h on 27 September. The northerly transect at 25°E was resumed at 1300h (site 108) and truncated at site 112 at midnight (sacrificing sites 113-117 due to the need to make up time). The section west of Bear Island was started at 1030h on 28 September and completed at 1915h the same day. On 29 September a series of 7 CDT stations was worked in the vicinity of 73° 40'N and 13° 25'E to sample bottom water to detect any possible release of plutonium and caesium from the wreck of the Soviet nuclear submarine Komsomolets (site 122-125). On 30 September and 1 October a southerly passage was made towards and along the Norwegian coast collecting surface water samples on route. Sampling at sites 129-140 was sacrificed to ensure the availability of time to complete the westerly transect along 65°N (and timely arrival for dry docking). The westerly transect was completed at 2340h on 2 October and a southerly course was set, collecting surface water samples at 1° intervals until the final collection at 60° N, 4° E at ~ 2045h on 3 October. With the scientific programme complete, a course was set for South Shields where CIROLANA entered dry dock at ~1530h on 5 October.

RESULTS

Using the nominal calibrations of the CTD for temperature and salinity, the data have been processed to produce four sections: the Nordic WOCE section north of the Denmark Strait, 71° N section from Greenland to Jan Mayen, the section along 20°E between Norway and Spitzbergen (Bear Island section) and the section from Spitzbergen along 29° 55'N.

On the Denmark Strait section (Figs 2a and b) the surface waters are of polar origin with salinities less than 34.3 psu and temperatures from >-1°C to 2°C. The polar water extends deeper on the Icelandic side of the section whereas there is Arctic Intermediate Water on the Greenland side. The Jan Mayen section (Figs 3a and b) shows a strong pycnocline with polar water overlying water with a component of Greenland Sea Deep Water.

The Bear Island Section (20°E) (Figs 4a and b) clearly shows the warm lower salinity Norwegian Coastal Current overlying the Atlantic water entering the Barents Sea. The sharp horizontal temperature gradient south of Bear Island (500 km along section) is indicative of the flow out of the Barents Sea and shown in many previous sections (Dickson, 1970; Blindheim, 1989). The waters at the northern end of the section are of more polar origin. These features can be seen in the southward section along 29° 55'E. At the northern end there is a lens of cold fresher water at 50m. (Figs 5a and b).

Seawater samples were processed on board to extract Technetium, Caesium and Plutonium isotopes yielding:

Technetium:	65 samples
Caesium:	220 samples
Plutonium:	51 samples

Raw seawater samples (0.45 µm millipore filtered) are being returned to the laboratory for the determination of Strontium-90 (100 samples), Iodine-129 (40 samples) and nutrients (141 samples). Suspended load measurements will be made on 51 samples. Nine sediment cores have been subsampled for radiometric analysis.

K S Leonard
D S Woodhead
11 October 1994

INITIALLED:

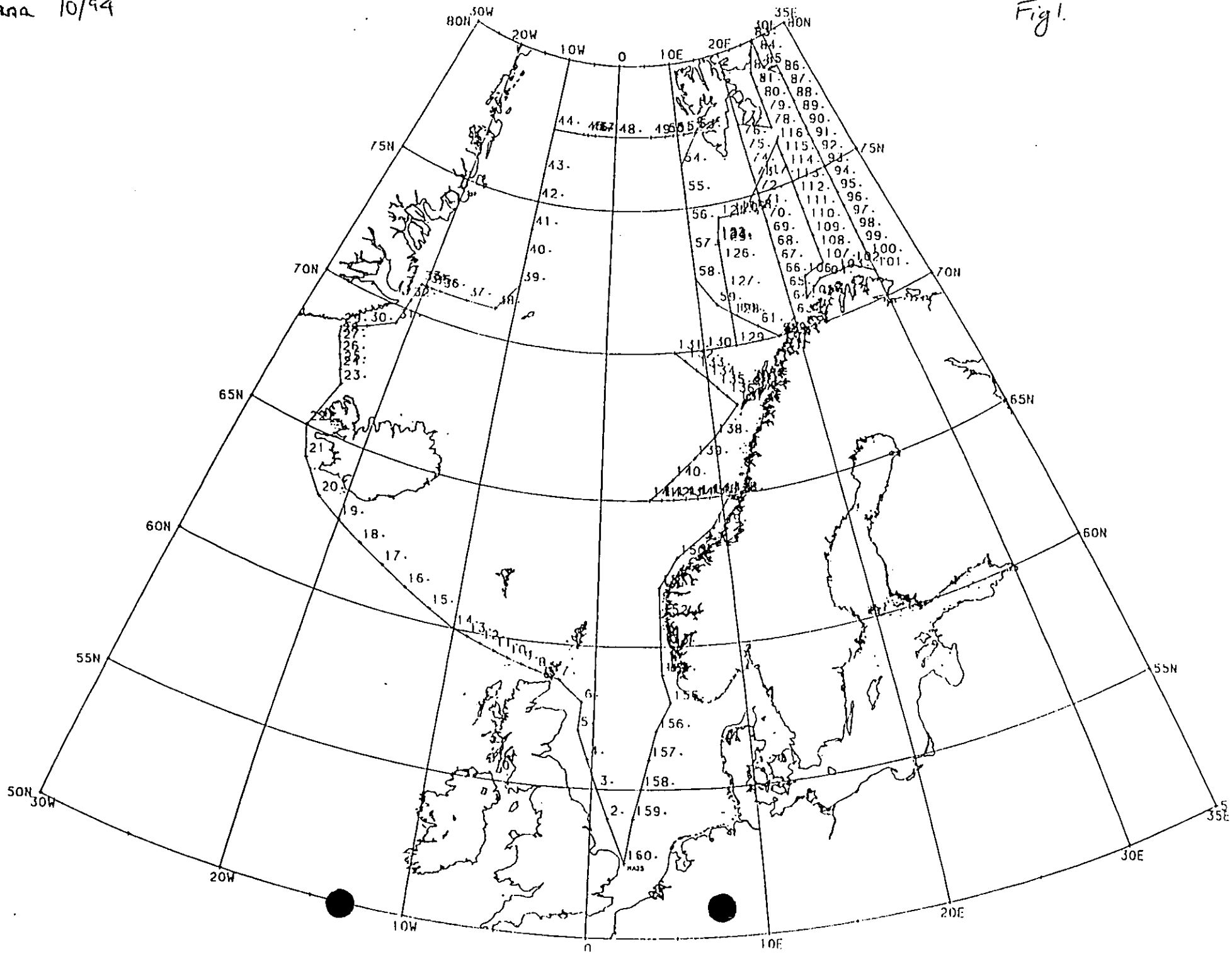
SEEN IN DRAFT: W Guyatt - Master
M G C Rogers - Senior Fishing Mate

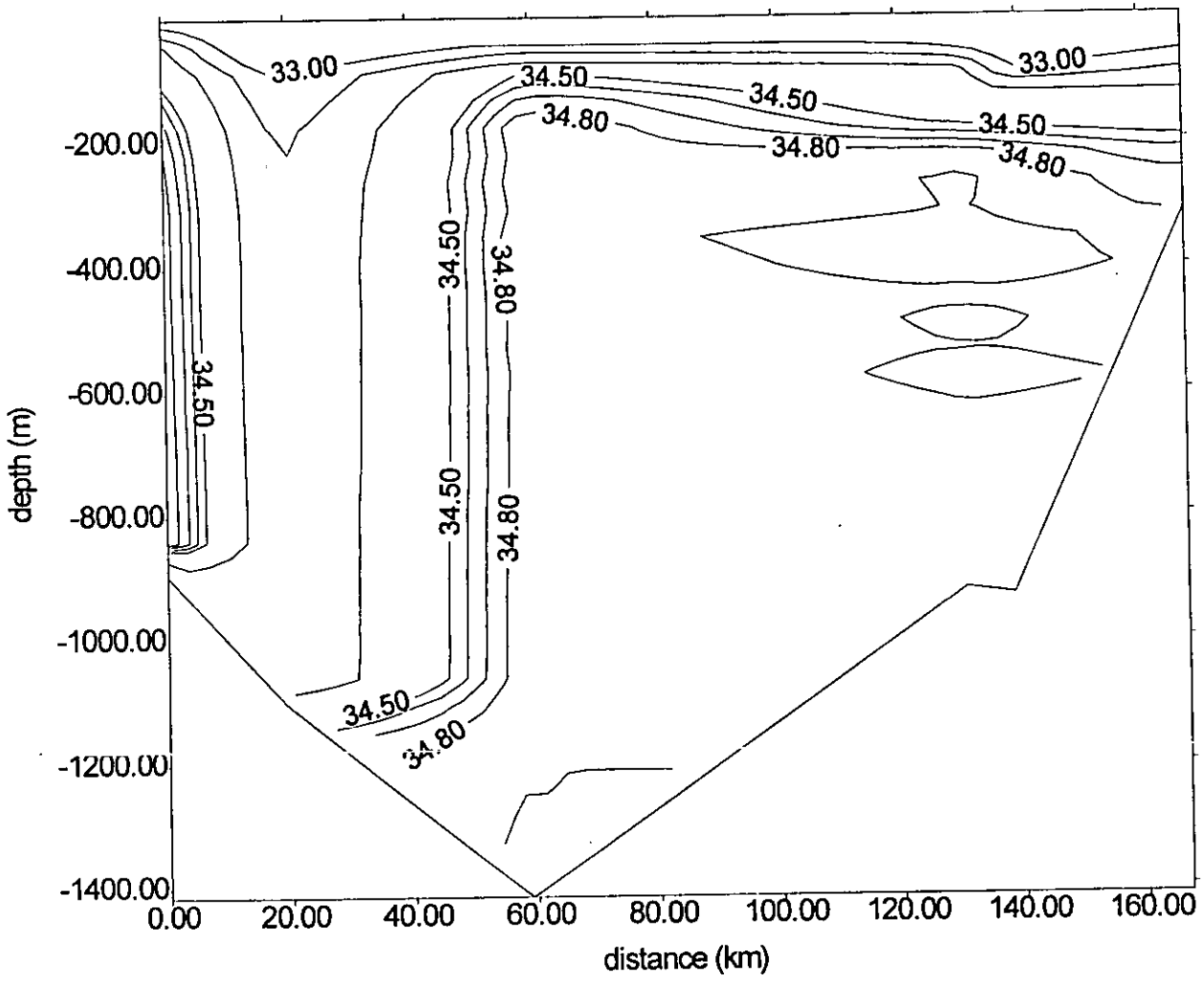
DISTRIBUTION:

Basic List +
Staff on cruise

Circlona 10/94

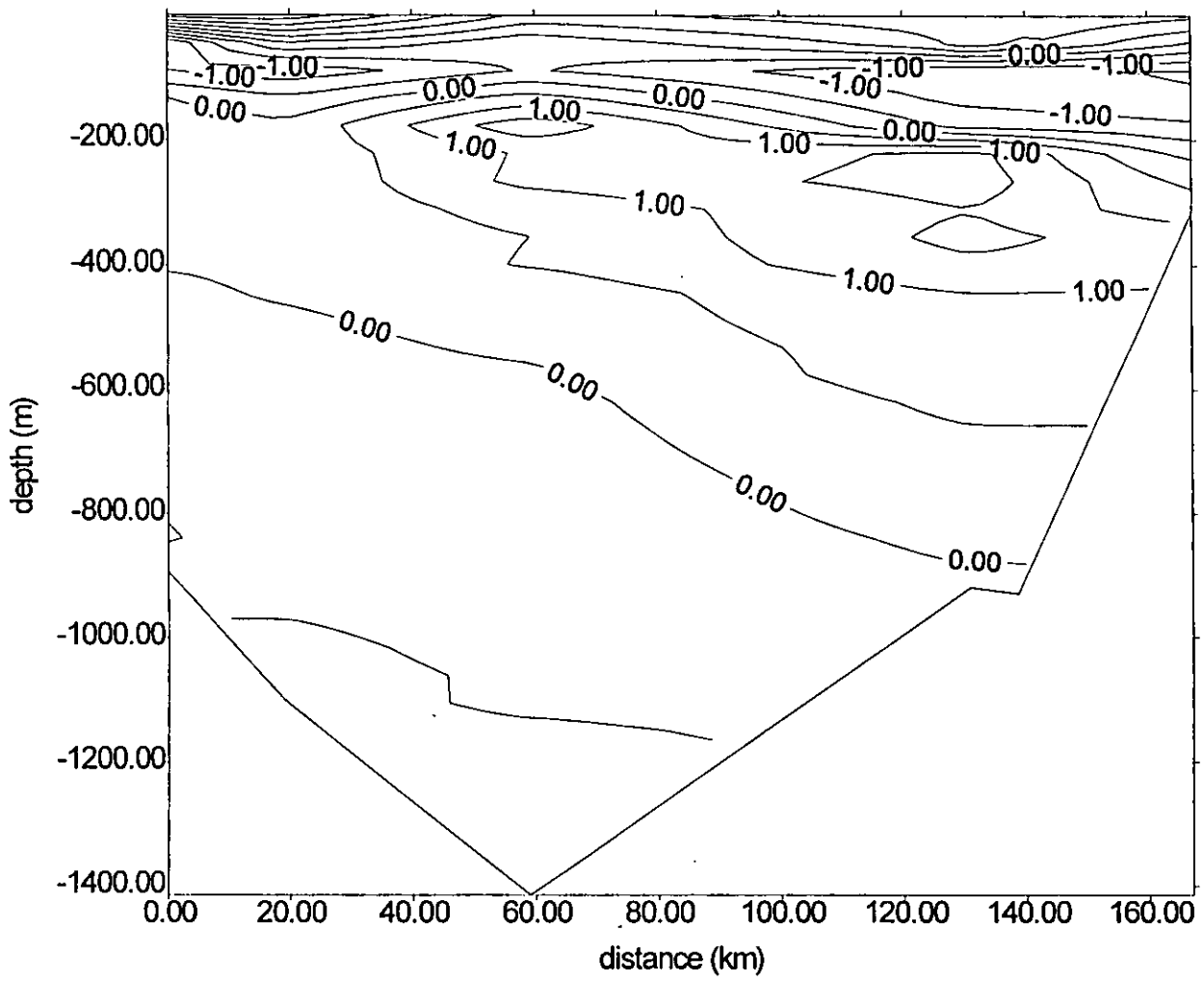
Fig 1.





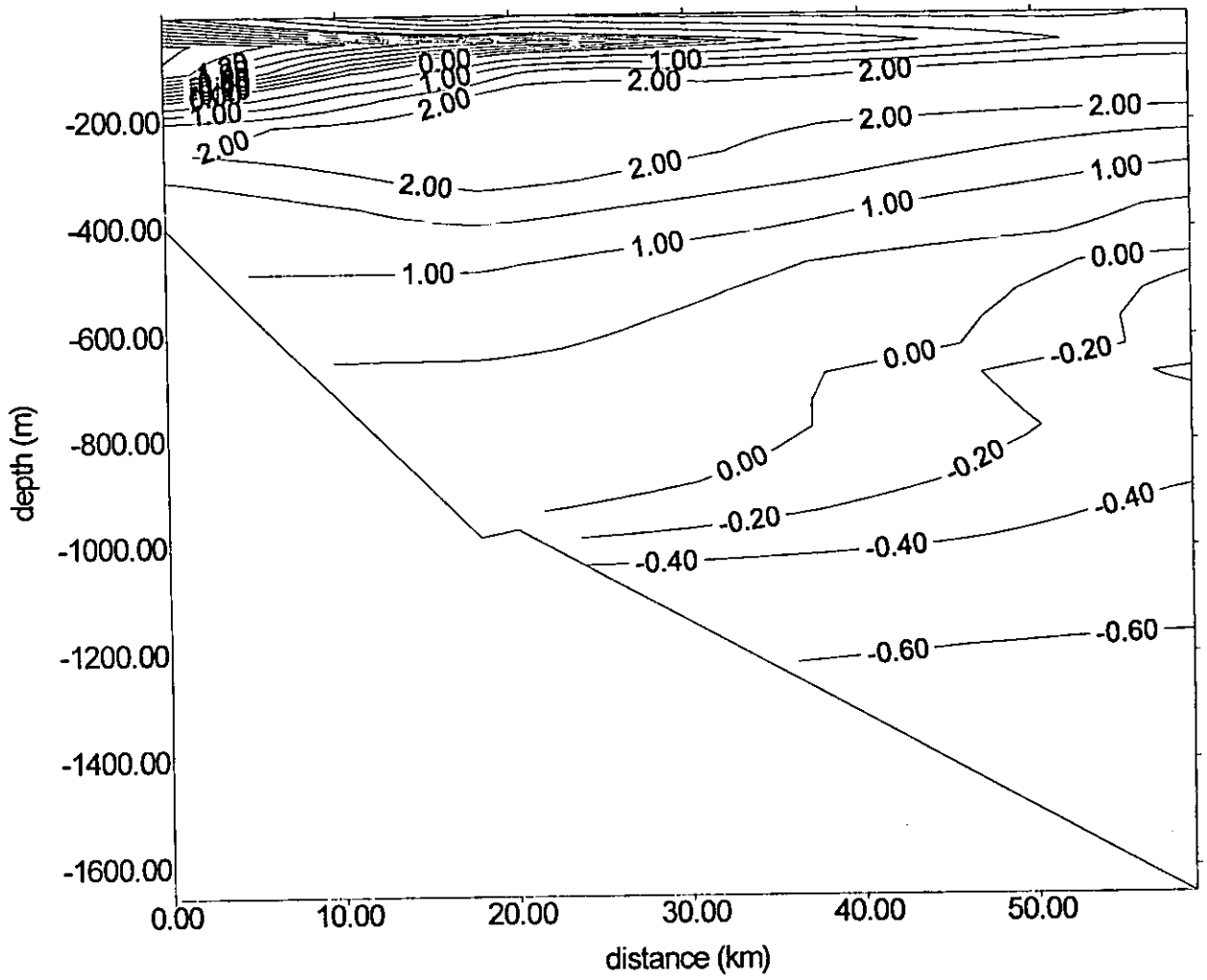
Denmark Strait Section (Iceland to Greenland)
Salinity (psu)

Fig 2a



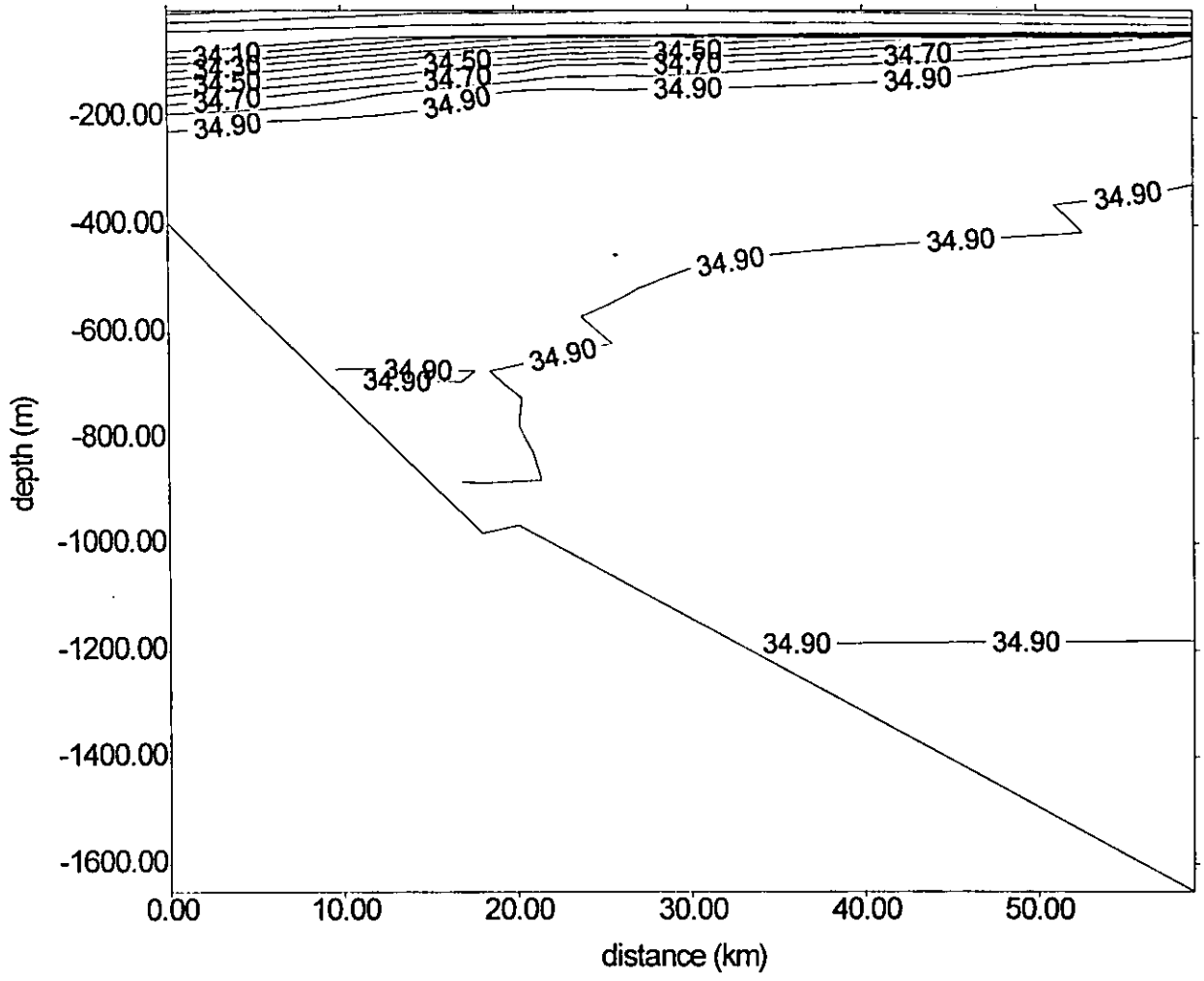
Denmark Strait Section (Iceland to Greenland)
Temperature (degrees C)

Fig 26



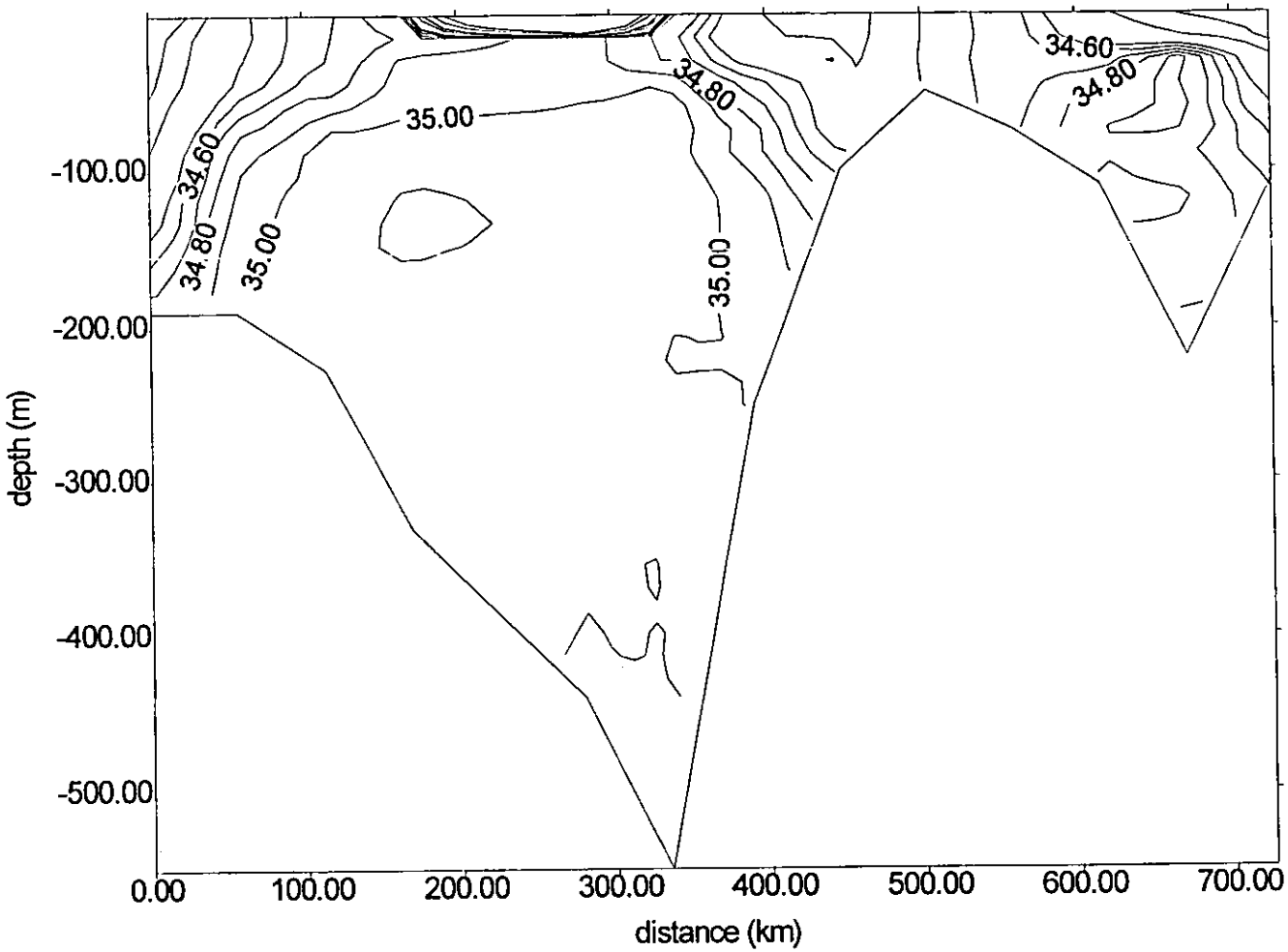
Jan Mayen Section (71N - from coast of Greenland)
Temperature (degrees C)

Fig 3a



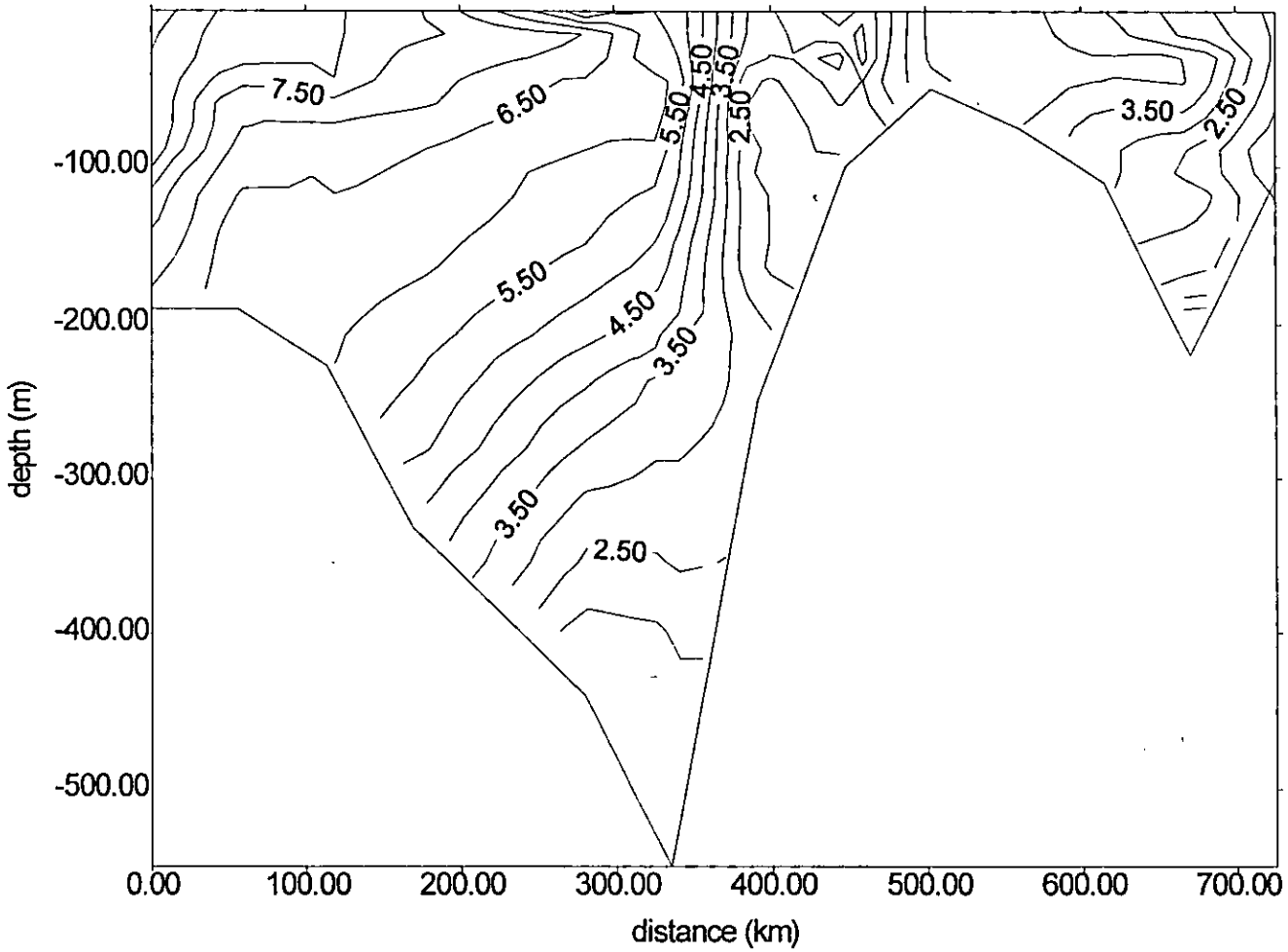
Jan Mayen Section (71N - from Greenland coast)
Salinity (psu)

Fig 3b



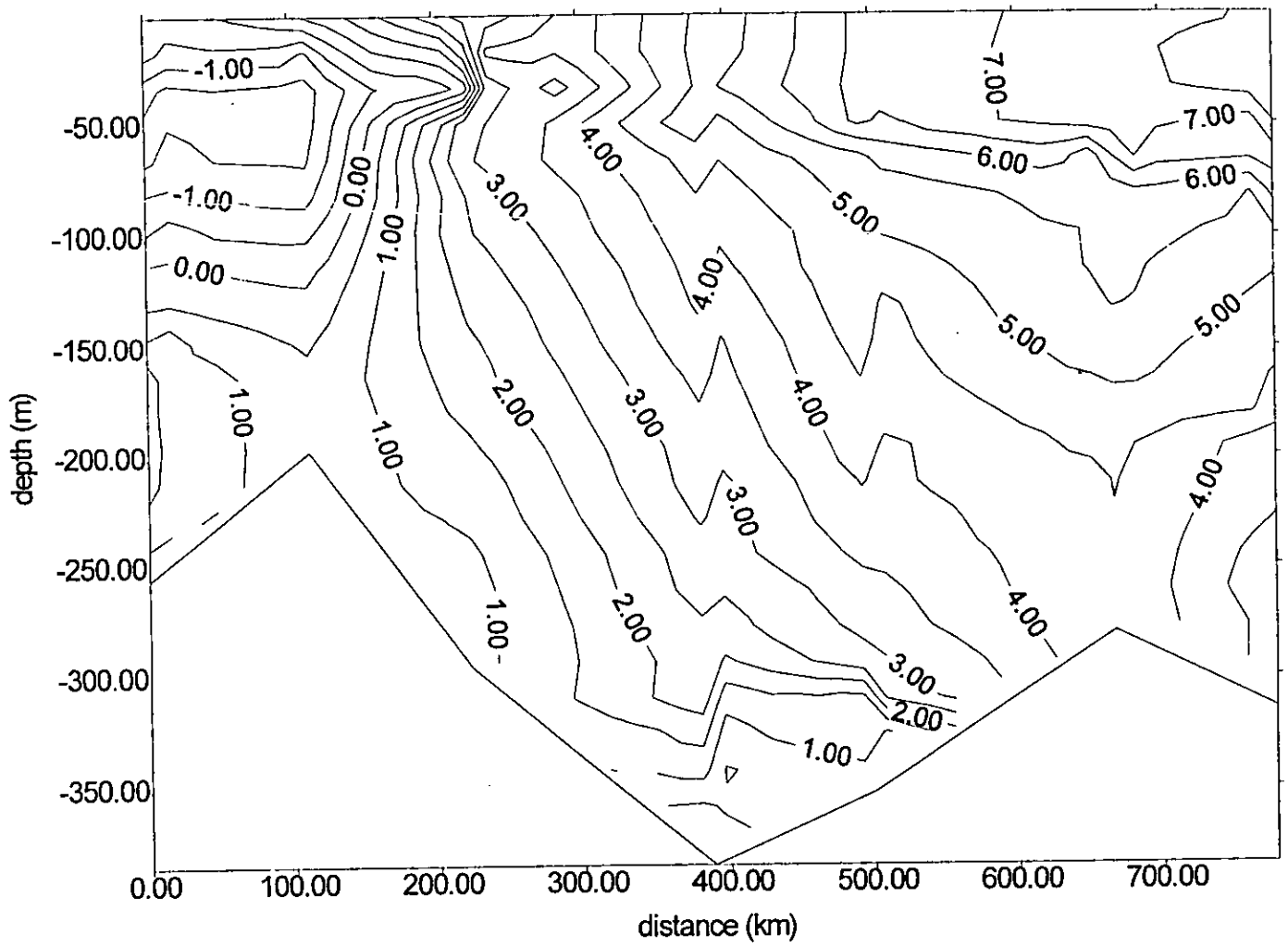
Bear Island Section from Norway to Spitsbergen along 20E
Salinity (psu)

Fig 4a



Norway to Spitsbergen Section along 20E (Bear Island section)
Temperature (degrees C)

Fig 4b



Spitsbergen to Norway along 29 55E
Temperature (degrees C)

Fig 5a