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Biological Oceanography Cruise : LF 31 2000 (Part 1)

Cruise Report
(July 30 - August 03)

Personnel

R. Gowen (SIC)	SSO	DARD
F. Gordillo	RA	QUB
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A. Walne		SAHFOS
J. Sidey		SAHFOS

Cruise Objectives

1. to map the near surface distribution of physical and biological variables in the vicinity of the Isle of Man-Dublin tidal mixing front
2. to map sea-bed characteristics in the vicinity of the Isle of Man-Dublin tidal mixing front using Roxanne
3. to collect water samples for determination of chlorophyll and dissolved nutrients and ring net samples of zooplankton at the two DARD stations.
4. to service the DARD mooring

Cruise Narrative

Lough Foyle departed Belfast at 0700 on Monday, July 31 and sailed for the western end of transect 1 (Figure 1). A trial tow with the SAHFOS U-tow was successfully undertaken but further deployments were cancelled due to rough weather. Lough Foyle spend the remainder of the day and overnight at anchor off the Skerries. The following morning (August 01) Lough Foyle sailed for the DARD inshore station where three zooplankton samples were collected with a 200 μm mesh ring net and water column sampling was carried out. Owing to continued strong southerly winds, the mooring service and sampling at the DARD offshore station was cancelled. Surface mapping of temperature, salinity dissolved nutrients and chlorophyll was successfully completed along all four transects and U-tow was successfully towed across three transects.

Preliminary results

The 14.8° C isotherm shows the location of the Isle of Man – Dublin tidal mixing front (Figure 2a) which marks the boundary between stratified and mixed water in the western and eastern Irish Sea respectively. The thermal boundary appears to be reinforced by a horizontal salinity gradient across the study area (Figure 2b). The transition between

thermally stratified and mixed water along transect 4 is clearly shown by the U-tow section (Figure 2c). The front was most clearly defined across transect 4, with a 0.8° C temperature difference over 5 km and this transect line was chosen for the process studies undertaken in cruise LF 31 2000 (Part 2). The Roxanne data on sea-bed characteristics compliment the water column data in showing a transition from soft sediment in the western Irish Sea to a harder and more coarse sediment in the eastern Irish Sea.

Acknowledgements

I would like to thank the Captain, Officers and Crew for their assistance during the cruise.

R. Gowen

August 23, 2000

Figure 1. A map of the Irish Sea showing the location of the transect lines and standard DARD sampling stations.

Figure 1

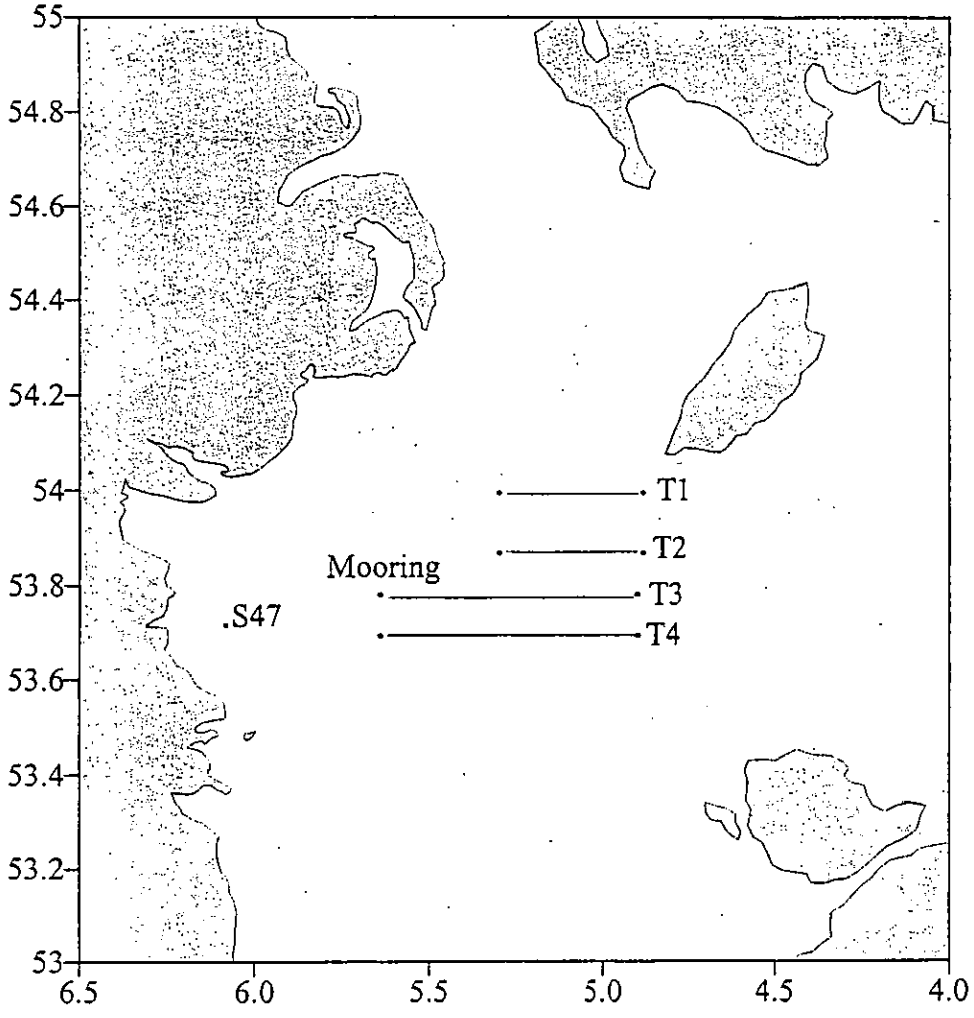
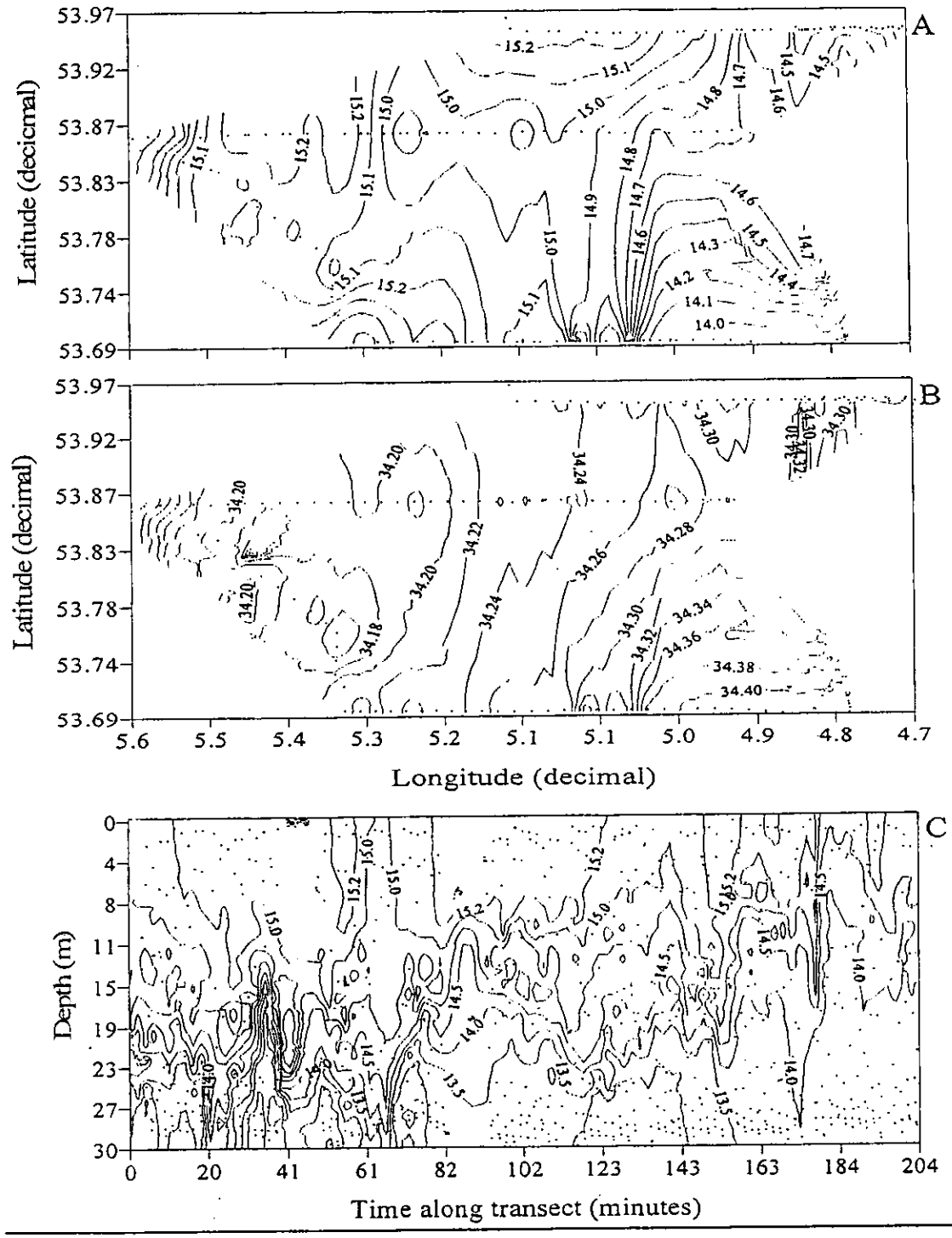
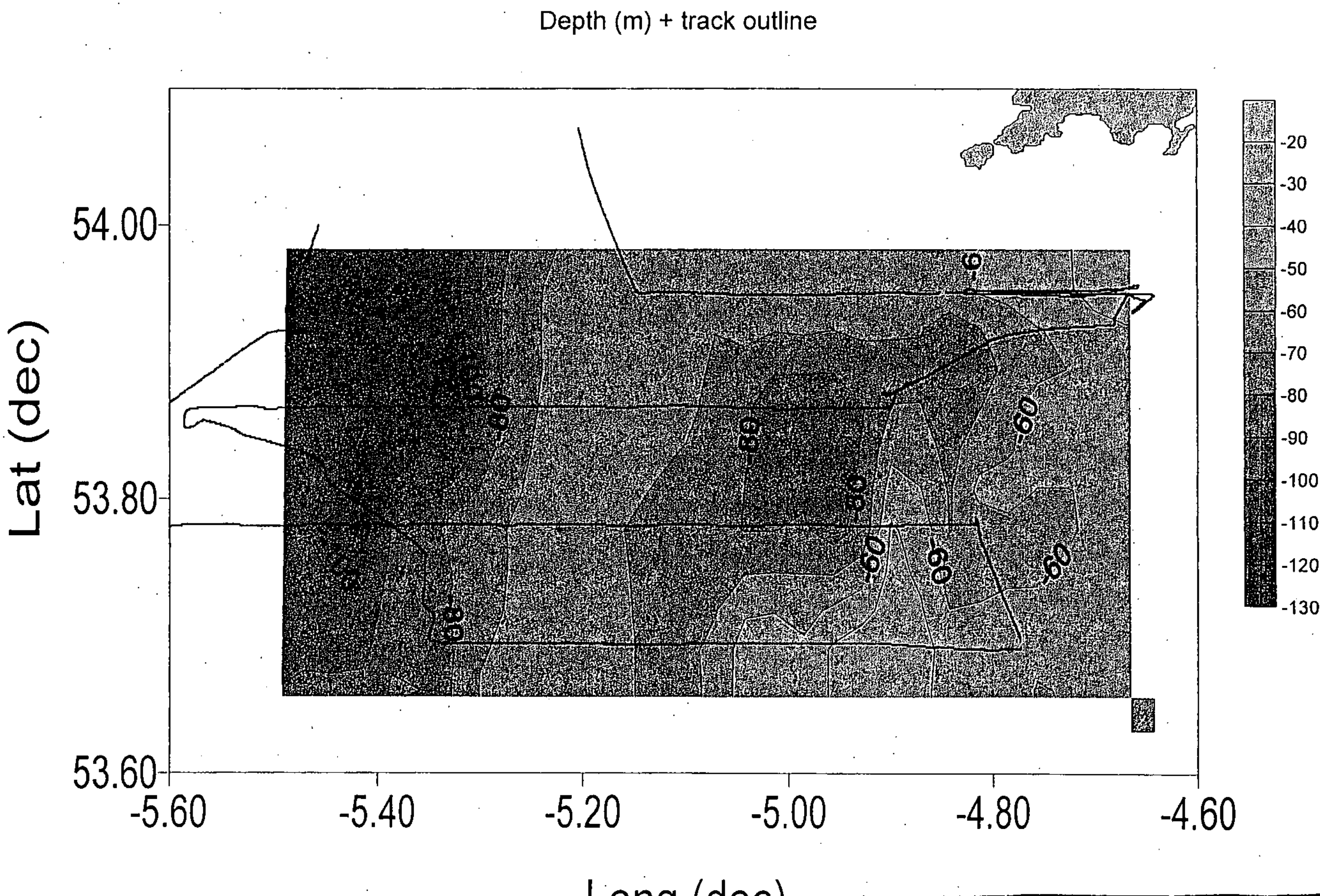
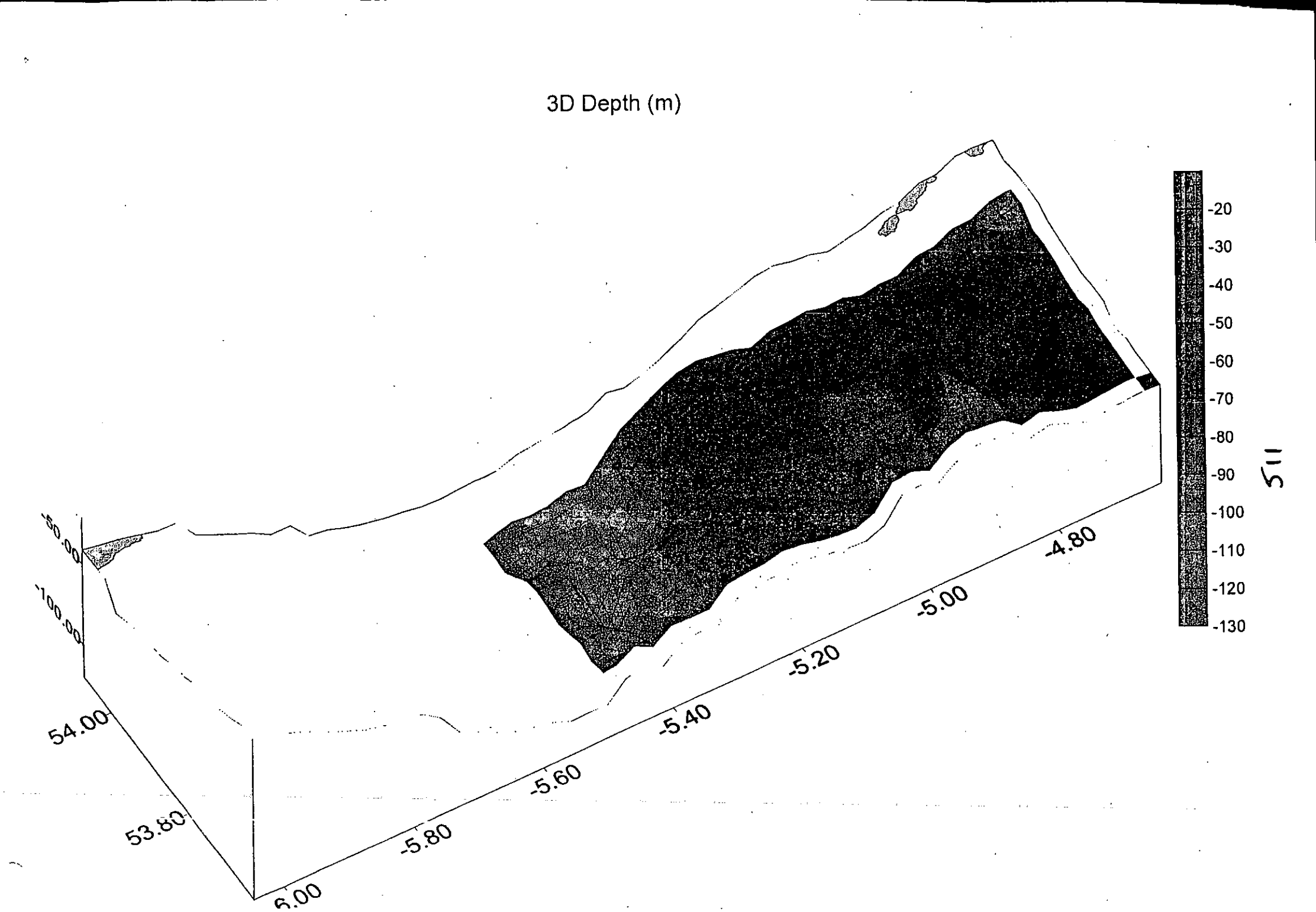
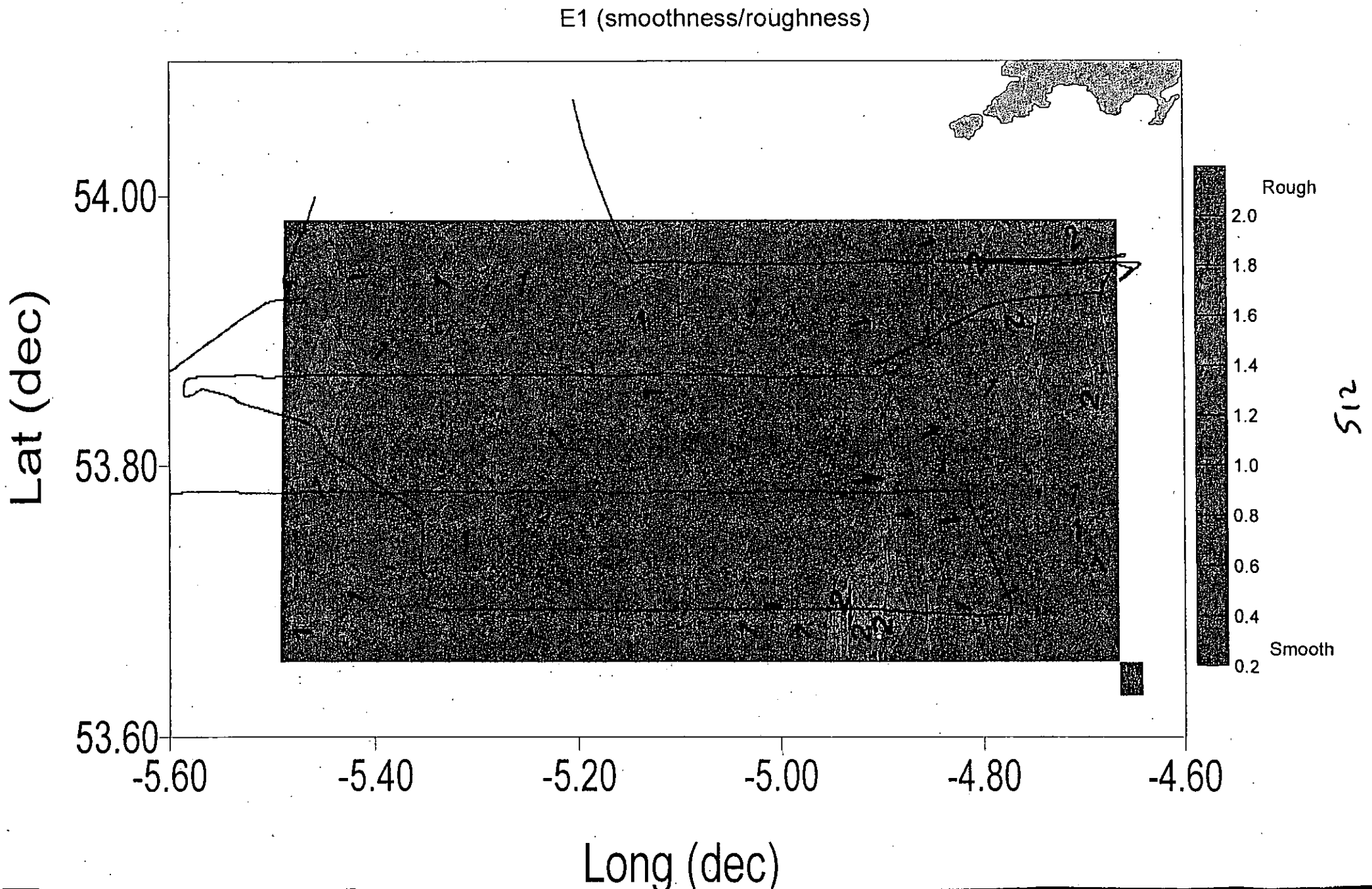


Figure 2. The distribution of temperature and salinity across the frontal region. A, near surface temperature; B, near surface salinity; C, vertical distribution of temperature in the upper 30 m of the water column.




Depth (m) + track outline
Lat (dec)
54.00
53.80
53.60
Long (dec)
-5.60
-5.40
-5.20
-5.00
-4.80
-4.60
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-60
-80


3D Depth (m)
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-50.00
-100.00
54.00
53.80
6.00
-5.80
-5.60
-5.40
-5.20
-5.00
-4.80


E1 (smoothness/roughness)
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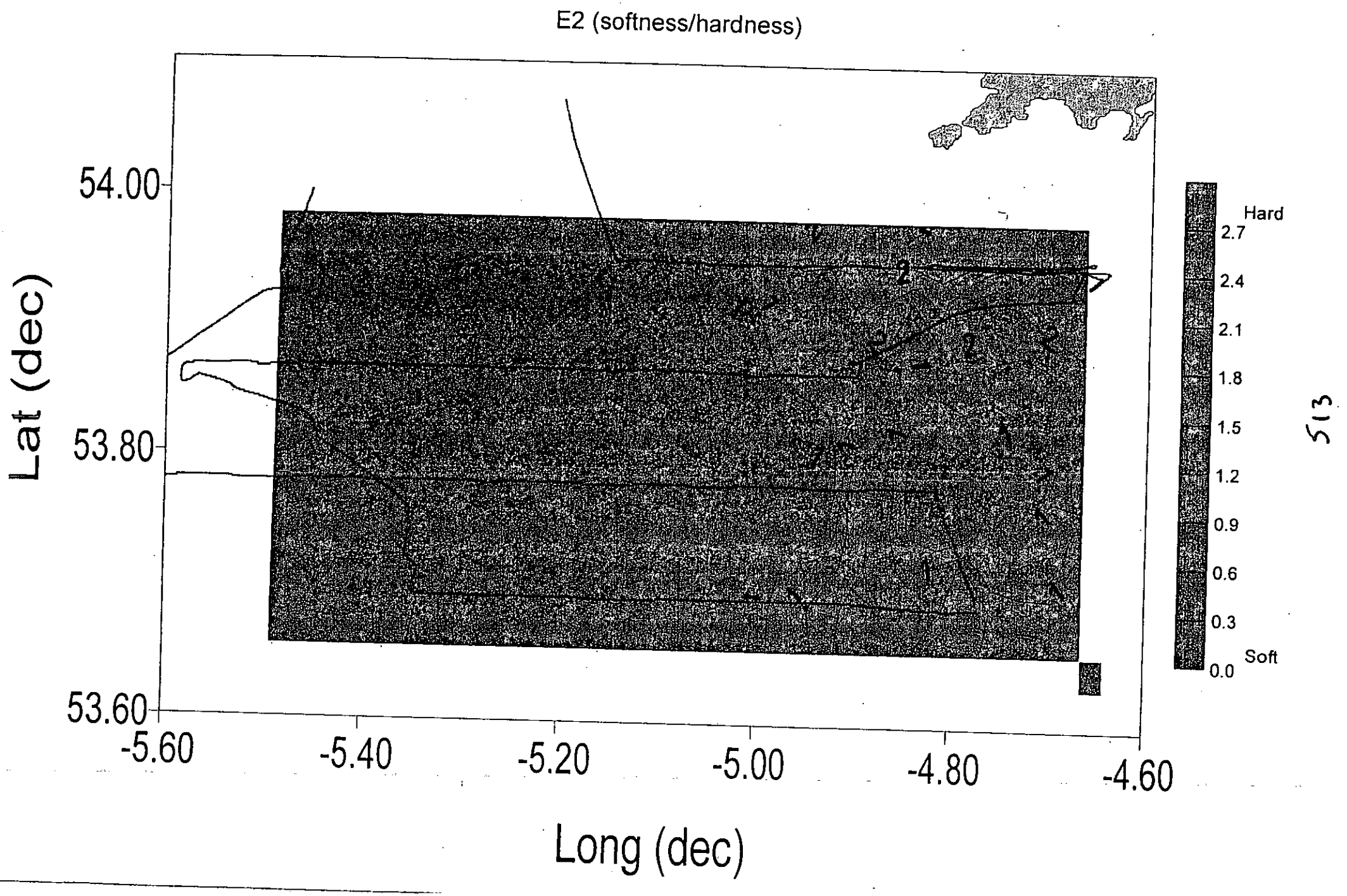
53.80
53.60
Lat (dec)
-5.60
-5.40
-5.20
-5.00
-4.80
-4.60
Long (dec)
Rough
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
Smooth
0.2

512


E2 (softness/hardness)
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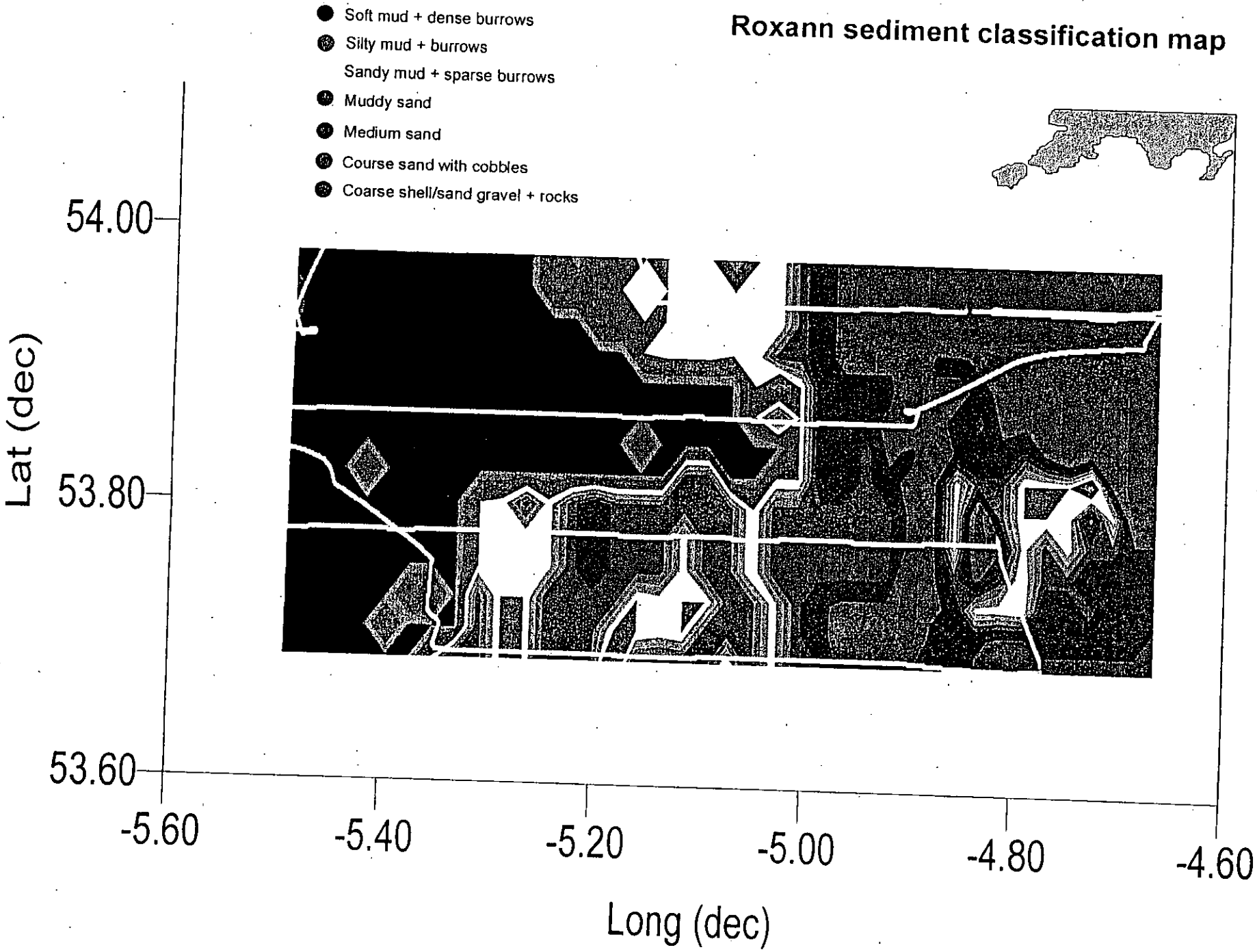
53.80
53.60
Lat (dec)
-5.60
-5.40
-5.20
-5.00
-4.80
-4.60
Long (dec)
Hard
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
Soft
513

Roxann sediment classification map



5752

Biological Oceanography Cruise : LF 31 2000 (Part 2)

Cruise Report
(August 04 - August 09)

Personnel

R. Gowen (SIC)	SSO	DARD
B. Stewart	SSO	DARD
M. Trimmer		University of London (QMW)
J. Nicholls		University of London (QMW)
X. Irigoien		Southampton Oceanography Centre
K. Woods		Plymouth Marine Laboratory (CCMS)

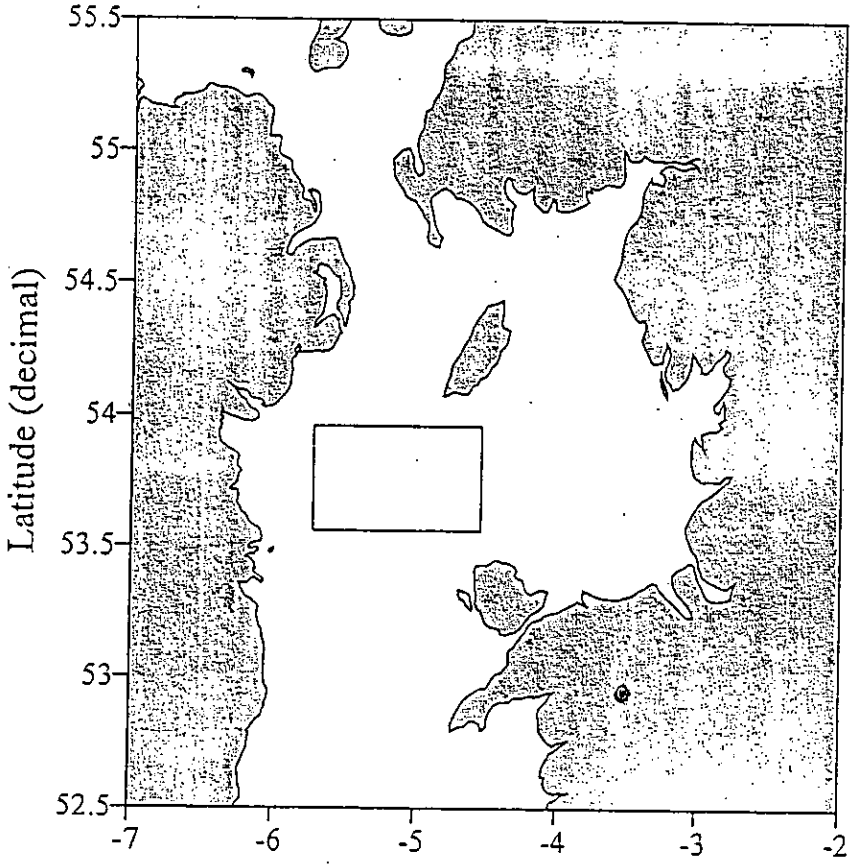
Cruise Objectives

1. to investigate the coupling between primary production and benthic mineralisation rates in the vicinity of the Isle of Man- Dublin tidal mixing front
2. to undertake measurements of primary production and chlorophyll biomass for comparison with satellite derived estimates
3. to quantify copepod egg production in relation to food (phytoplankton) availability and quality
4. to service the DARD mooring

Cruise Narrative

Lough Foyle departed Belfast at 2100 on Friday, August 04 and sailed for Station F1(Figure 1). At 0500 on Saturday August 05 water samples were collected from selected depths for ship board productivity measurements using a C^{14} incubation technique. At 0600 copepod samples were collected (using a 200 µm mesh ring net) for egg production experiments. Sediment samples were collected at 0800 using a box corer. Sub-cores were used to estimate rates of oxygen uptake, sulphate reduction and nutrient efflux. Additional sediment samples were collected to quantify sediment organic carbon and pigment content. On completion of the sampling at station F1, two additional stations were worked. On Sunday August 06, the sampling and process studies outlined above were repeated at station F2. On completion of the work at F2, the DARD mooring was serviced and standard water column sampling and zooplankton collection undertaken at the DARD offshore station. Sampling and process studies were carried out at Station F3 on Monday August 07, with two additional stations worked. Stations F4 and F5 were worked on Tuesday August 08. On completion of sampling, near surface temperature and salinity were recorded along three transect lined (Figure 1) before Lough Foyle sailed for Belfast. The ship docked at 0900 on Wednesday August 09.

Figure 1. A map of the Irish Sea showing the location of the process stations DARD mooring station and surface mapping transect lines.



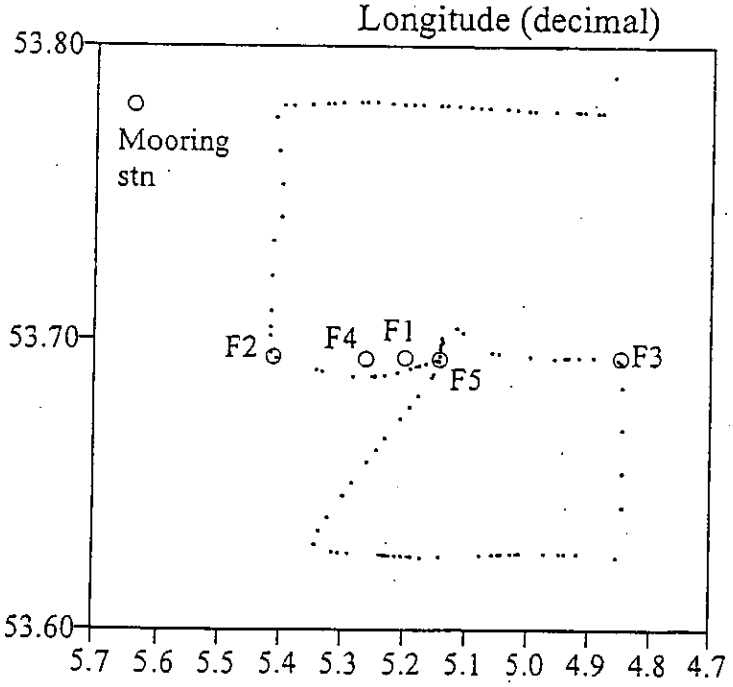


Figure 2. The distribution of temperature, dissolved nitrate and chlorophyll across the tidal mixing front. A, temperature (°C); B, nitrate (μM); C, chlorophyll (mg m^{-3}).

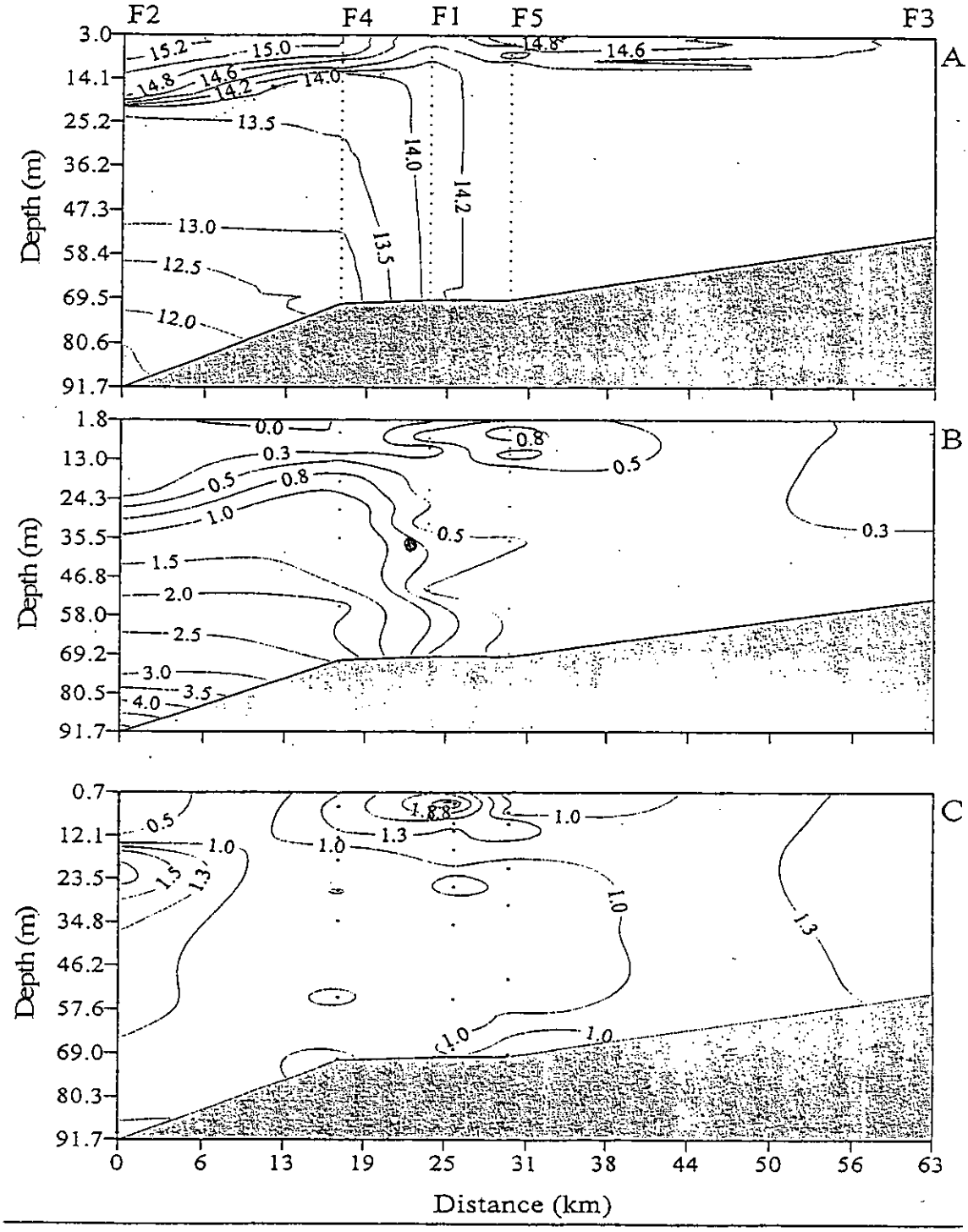
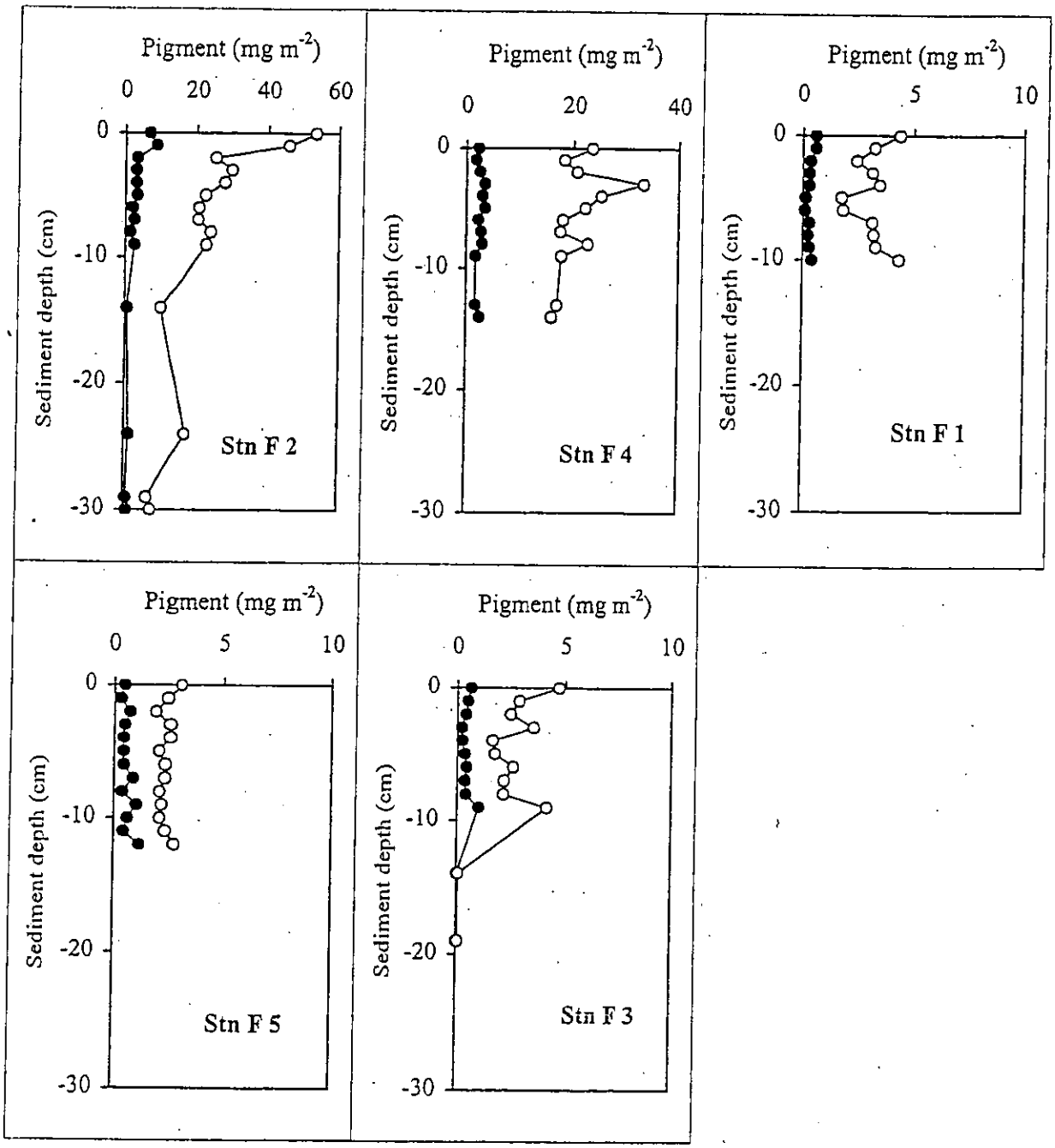


Figure 3. Profiles of pigment (mg chlorophyll and pheopigment m^{-2}) in sediment from each of the process stations. Pheopigment O.



Preliminary results

Vertical profiles of temperature show the process stations were located along a transect line which crossed the tidal mixing front (Figure 2a). At the western most station (F2) there was a surface to bottom temperature difference of 3.9 °C and the bottom temperature was 11.4 °C. In contrast the water column at F3, the most easterly station was isothermal at 14.3 °C. The distribution of dissolved nitrate (Figure 2b) and phytoplankton chlorophyll (Figure 2c) reflect the thermal structure across the front. Nitrate was below the level of detection in near surface stratified waters, but increased with depth to a maximum of 5.13 μM at 90 m. To the mixed (eastern) side of the front nitrate was ≤ 0.5 μM. Lowest phytoplankton biomass (≈ 0.5 mg m^{-3}) was observed in near surface stratifed waters. There was evidence of a small sub-surface chlorophyll maximum (1.5 mg m^{-3}) at 24 m and elevated biomass (2.2 mg m^{-3}) in surface waters at the frontal boundary.

There was a marked transition in sediment type across the front. Bottom sediment at the stratifed station was mud. Across the front sediment changed from muddy sand to sandy mud. At the eastern most station the sediment consisted of a 10 cm layer of sand and shell debris overlying sandy mud. These changes in sediment type reflect differences in the deposition of fine particles and organic material across the front. This is illustrated by the pigment content of upper sediment layers (Figure 3). Surface sediment at the stratifed station contained ≈ 50 mg pigment m^{-2} compared to 20 mg m^{-2} on the immediate stratifed side of the front and ≈ 5 mg m^{-2} on the mixed side of the front.

Acknowledgements

I would like to thank the Captain, Officers and Crew for their assistance during the cruise.

R. Gowen

August 24, 2000