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NOGAP B.6; VOLUME 1: BEAUFORT SEA CURRENT MEASUREMENTS, MARCH-AUGUST 1987

by

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Sidney, B.C.

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Canada

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Canadian Data Report Of Hydrography and Ocean Sciences

These reports provide a medium for the documentation and dissemination of data in a form directly useable by the scientific and engineering communities.

Generally, the reports will contain raw and/or analyzed data but will not contain interpretations of the data. Such compilations will commonly have been prepared in support of work related to the programs and interests of the Ocean Science and Surveys (OSS) sector of the Department of Fisheries and Oceans.

Data Reports are produced regionally but are numbered and indexed nationally. Requests for individual reports will be fulfilled by the issuing establishment listed on the front cover and title page. Out of stock reports will be supplied for a fee by commercial agents.

Regional and headquarters establishments of Ocean Science and Surveys ceased publication of their various report series as of December 1981. A complete listing of these publications and the last number issued under each title are published in the *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 38: Index to Publications 1981. The current series began with Report Number 1 in January 1982.

Rapport statistique canadien sur l'hydrographie et les sciences océaniques

Ces rapports servent de véhicule pour la compilation et la diffusion des données sous une forme directement utilisable par les scientifiques et les techniciens.

En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

Les rapports statistiques sont produits à l'échelon régional mais sont numérotés et placés dans l'index à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page de titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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Contents

Abstract

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As part of the NOGAP B.6 program, with major objectives to determine hydrocarbon pathways and primary productivity of the waters overlying the MacKenzie Shelf, four subsurface taut-line moorings were deployed in the spring of 1987 along the 200 meter contour in the Beaufort Sea. Each mooring was comprised of a pair of current meters and a sequential sediment trap. One current meter was located as close to the surface as predicted ice keel depths would allow and the other was 50 meters above the bottom in close association with the sediment trap. The moorings were recovered during the summer open-water season in 1987. The measurements are summarized in this report as time series plots, at fixed depths, of temperature, salinity, current speed, current direction and light transmission.

Key words: Arctic, Beaufort Shelf, oceanography, currents, temperature, salinity, light transmission, time series.

Résumé

McCullough, D., R.W. Macdonald, K. Iseki, and E.C. Carmack, 1988. NOGAP B.6; Beaufort Sea current measurements March-August 1987. Can. Data Rep. Hydrogr. Ocean Sci.: 60(1). 42pp

Au printemps 1987, quatre amarrages ont été enstallés sur le contour de 200 mètres dans la mer de Beaufort, dans le cadre du programme NOGAP B.6, avec les objectifs principaux la détermination des trajectoires des hydrocarbures et de la production primaire des eaux au-dessus du plateau continental Mackenzie. Chaque amarrage consistait en deux courantomètres et d'un capteur de sédiments. Un des courantomètres était situé aussi près de la surface que permis par les profondeurs des quilles formées sous une crête de pression, l'autre 50 mètres au dessus du fond, près du capteur de sédiments. Les amarrages ont été récupérés pendant l'été 1987 quand l'état des glaces l'a permis. Ce rapport résume les mesures sous la forme des séries chronologiques, à profondeurs prescrits, de la temperature, de la salinité, de la vitesse et direction de courant, et de la transmission de lumière.

Mots-clé: Arctique, plateau continental de Beaufort, océanographie, courants, température, salinité, transmission de lumière, séries chronologiques.

Acknowledgements

This work was funded by **Indian and Northern Affairs, Canada**, as part of the **Northern Oil and Gas Action Program.** We thank S. Moorhouse, G. Miskulin, R.Cooke and the staff of Arctic Electronics for expert field and shop support, T. Warnes and J.Linguanti of Computing Services, and H. Melling for scientific advice. In addition, thanks are due to the officers and crew of the C.S.S. *John P. Tully* for mooring recoveries and to Energy, Mines and Resources, Polar Continental Shelf Project in Tuktoyaktuk, N.W.T. for accommodations and technical support. S. Thomson assisted with advice on report layout. A. Ages translated the abstract into French. The manuscript was prepared using LaTeX.

1 INTRODUCTION

As part of an inter-disciplinary study (NOGAP B.6) to measure the transport and fate of hydrocarbons over the Beaufort Shelf, and primary productivity of these coastal waters, we deployed 4 subsurface moorings along the 200 meter isobath at locations ranging from the Mackenzie Canyon to Cape Bathurst. The moorings were deployed, using ski-equipped aircraft support, from the ice cover in the spring of 1987 and were recovered during the summer open-water season from the C.S.S *John P. Tully*. Data were collected during total ice cover, through ice break-up and into full open water conditions, thus theoretically covering periods of near minimum to maximum primary productivity. The centerpiece instrument on each mooring was a sequential sediment trap designed to obtain, by catching particle fallout, a record which would contain in it the seasonal productivity cycle for the duration of the deployment. The data and descriptions of the sediment traps are detailed in a separate report and will not be covered in this document. Above and below the sediment traps self-recording current meters were installed to provide information about currents and water properties to assist in identifing water masses and transport.

This report presents current, salinity, temperature, and light transmission data in tabular or graphic form.

1.1 Stations

Figure 1 shows the locations of the mooring stations along the 200 meter shelf contour. The installations were undertaken during the spring (2 in March, 1 in April, 1 in May, 1987.) from the sea ice; therefore exact sites were dictated by ice conditions in the area of interest. The moorings were designed for deployment in 200 m of water at predetermined sites using hydrographic charts of the Beaufort Sea. For each site the aircraft pilot would navigate to the chosen area using a (Global Navigation) GNS 500 VLF/Omega positioning system. Past experience shows that these avionics can place the aircraft inside a radius of 1000 m from the true position. Exact station locations were chosen from the air as the support aircraft circled the preselected site looking for a safe landing strip. Once the deployment team was on the ice a Radar Devices, transit satellite navigation system (satnav) was set-up and initialized to continue receiving and displaying position information while the avionics were shut down. Transit satnav fixes, unlike Omega, are not continuous; a good quality position fix is received and recorded approximately once every 50 minutes in the Arctic (frequency decreases with latitude). This instrument provides an accurate position update as the deployment proceeds, which is especially useful if the ice floe is drifting. The fix closest to the time of mooring anchor set-down during deployment was taken as the final position for the mooring. Precision of the satnav system is within 300 m of the true geodetic location.

Table 1: Mooring Station Summary

Site	Latitude	Longitude	depth (m)
SS-1	70° 46.0'N	127° 18.9'W	210
SS-2	71° 28.8'N	128° 44.7'W	170
SS-3	70° 57.7'N	134° 29.1'W	180
SS-4	69° 58.3'N	138° 36.8'W	268

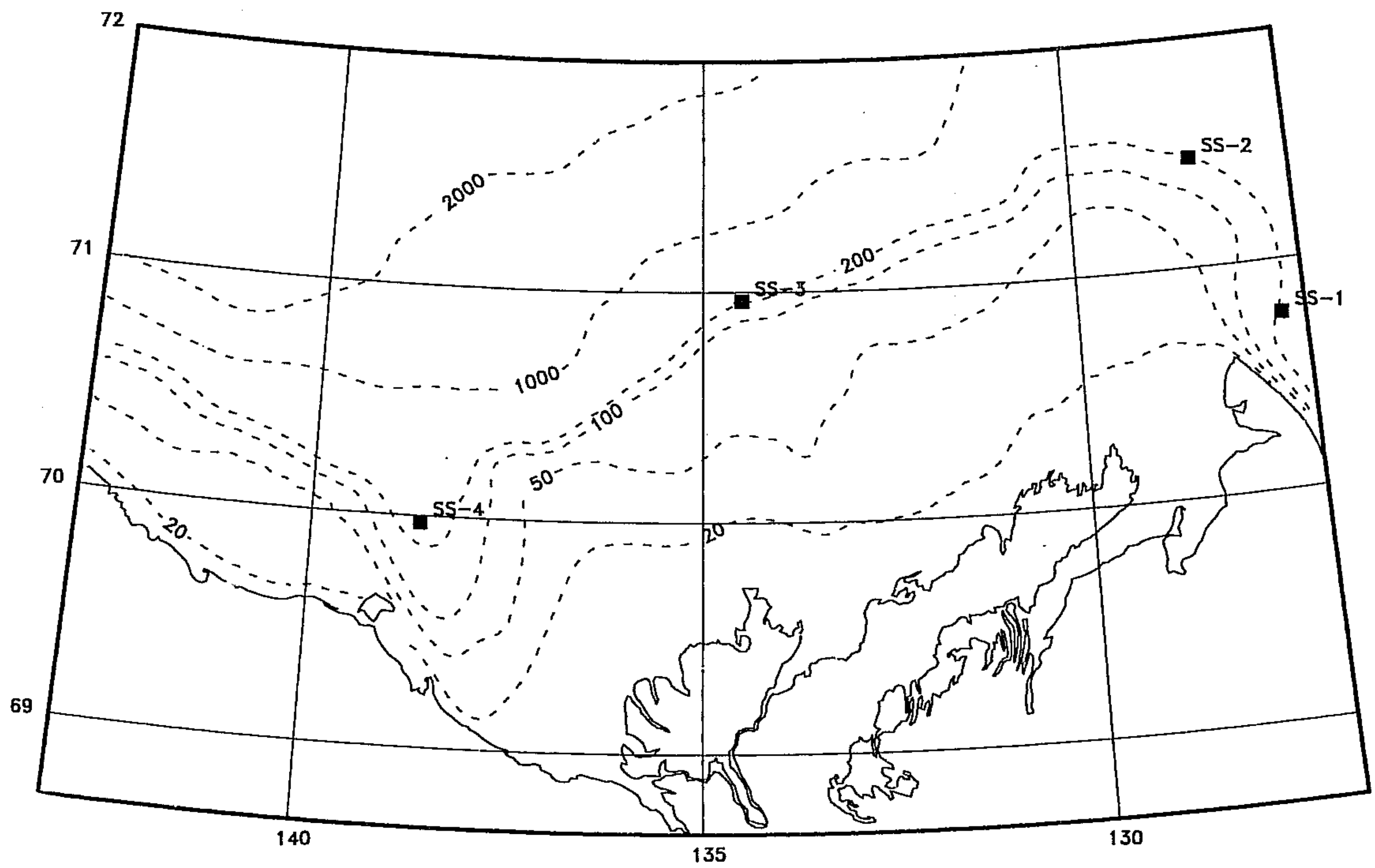

Figure 1: Sediment-trap/current meter mooring locations

2 METHODS

2.1 Instrumentation

In total, 8 arctic modified Aanderaa Recording Current Meters (RCM4's) were deployed. Sampling intervals were set to 60 minutes, allowing over one year's data collection.

Modifications to the RCM4's were as follows: circuit board resistors for temperature and conductivity were changed to increase the resolution of the sensors and restrict the measurement range to encompass the expected values in the defined study regions. The temperature range was set at -2.5 °C to +2.5 °C with a resolution of about 0.005 °C. Salinity range was set at 29 to 35 parts per thousand (ppt) with a resolution of 0.006. The current meter cases were lengthened to accommodate an extra battery, a desirable feature for long deployments in cold waters. To facilitate deployment through a 115 cm hole in the ice, the directional vanes on the instruments were constructed to fold down before entering the hole and then manually "latched up" once they were below the ice.

Two of these instruments were re-configured (by Aanderaa Instruments) to accommodate Sea Tech transmissometers which measured percent transmission (%TX) of red (660 nm) light over a 25 cm path length. These meters were deployed with the shallow current meters at sites SS-1 and SS-3. The data from these units were logged on channel 4 of the RCM4 datalogger and recorded with the other parameters on magnetic tape. Power for the transmissometer and its circuitry within the RCM4 was provided by a pair of internal AA size lithium batteries.

Table 2: Summary of Recording Instruments (RCM4)

Site	S/N	Depth (m)	Deployment Date(d/m/y)	Recovery Date(d/m/y)	Comments
SS-1	7906	33	30/03/87	22/08/87	% TX†
SS-1	3223	160	30/03/87	22/08/87	
SS-2	5473	40	22/05/87	24/08/87	
SS-2	1932	120	22/05/87	24/08/87	
SS-3	7907	35	01/04/87	18/08/87	%TX, clock spikes‡
SS-3	1930	130	01/04/87	18/08/87	
SS-4	5471	28	26/04/87	26/08/87	
SS-4	1939	218	26/04/87	26/08/87	

† % TX refers to instruments equipped with transmissometers.

‡Clock spikes (stopages) resulted in loss of data and in uncertainty in the collection time of the data.

2.2 Mooring Design, Deployment and Recovery

All four moorings were single-point, taut-line designs with chain clump anchors and subsurface flotation. Target water depth for deployment, in all cases, was 200 meters. This isobath, along much of the Beaufort shelf, coincides with sharply increasing water depths and can be considered to approximate the beginning of the "Shelf Break". Figure 2 is a schematic of the mooring configuration used at the 4 sites.

Mooring plans included deployment in the spring from the ice with recovery and subsequent re-deployment from a survey vessel during the summer open water season. Mooring designs and

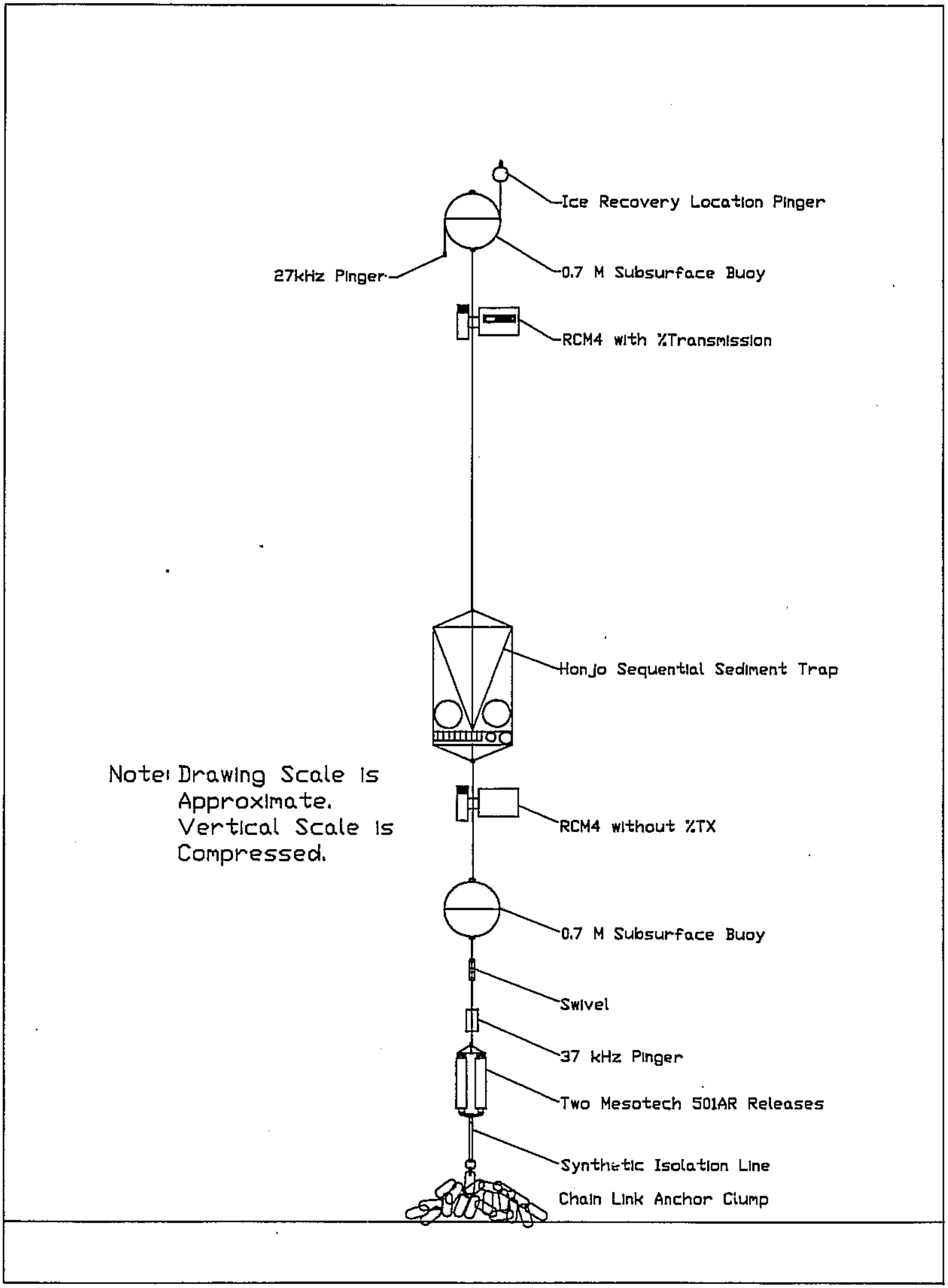

Figure 2: Mooring configuration

deployment/recovery techniques differ considerably between sea- ice and sea-going programs; it was therefore necessary to design these arrays to work with both methods.

To insure proper instrument configuration within the water column, the moorings were computer modeled to fit various design options open to us. A current velocity profile was determined for the water column through consultation with recognized authorities on Beaufort Sea current structure. Past current measurements made in the region were used to generate a representative profile; for all four locations we expected currents in the top 50 m of the water column to be 50 cm/s with a reduced speed of 25 cm/s from 50 m to the bottom (200 m). Anchor weights, horizontal and vertical forces, and mooring tilts were computed using these estimated current speeds. Moorings were modelled on an IBM-XT personal computer with software derived from algorithms and computations documented by *Bell*, [1977].

Mooring deployments from the ice involve significantly more specialized equipment, techniques and logistics than those carried out from a sea-going vessel. All necessary gear and materials must be transported to the mooring site by fixed wing or rotary aircraft making weight considerations important. This can be a major factor in the mooring design. In an effort to reduce total anchor and component weight for aircraft transport, buoyancy or upthrust was kept to the minimum while still being sufficient to allow only minimal mooring depression at maximum predicted currents.

Frequently, in Arctic moorings over 100 m in length, steel is replaced by Kevlar to make up line segments of reduced weight without loss of strength. Kevlar lines, however, are more delicate than other materials and can fail unpredictably under load if kinked or abraded during mobilization, deployment, recovery or transport [*Woodward and Huggett*; 1980]. Our moorings were to be installed, recovered and re-deployed in similar configuration and then recovered again at the end of one year. It was decided that Kevlar was likely to sustain damage through repeated handling of the lines and thereby jeopardize the integrity of the mooring. After a review of available cables, 1/4 inch Nilspin, a thermoplastic sheathed steel cable, was selected. Past experience demonstrated that Nilspin is extremely tough and can be reused a number of times; it is however, a compromise since it weighs 6 times as much as an equivalent length of equal strength Kevlar. The weight penalty amounted to approximately 32 kg (in air) per mooring. The gains to be made by using Kevlar did not outweigh the handling risks.

Buoyancy for each mooring was provided by two 0.7 m steel floats totalling 270 kg upthrust. One of the buoys was positioned at the top of the array and the other was near the sediment trap at 50 m above bottom. The depth of the uppermost float was dictated by the estimated maximum depth of the ice keels found in the Beaufort Sea. The best estimates for average ice keel depths can be derived from seabed surveys in many locations on the Beaufort shelf. Side scan sonar, echo sounder and shallow seismic records clearly exhibit ice scour evidence, caused by grounded ice keels, in water depths up to 80 m. These deep water scours are recognized, in most instances, to be relict (paleoscours) and may have been formed during periods of lower water levels [*Gilbert and Pederson*; 1986). Chronologically recent scour evidence begins to increase in frequency at about the 40 m depth contour suggesting ice keels of this draft to be a more common maximum [*Barnes et al*; 1984]. To avoid interaction between the upper subsurface float on the mooring and passing ridge keels we attempted to position the float deeper than 35 m. The lower subsurface buoy on the mooring provided extra "stiffness" near the sediment trap and also, in case the top float was lost, could furnish enough buoyancy by itself to ensure recovery.

Exact instrument depths were difficult to achieve due to variable ice conditions. It was often impossible to land precisely at the pre-selected mooring location and the closest alternate site, particularly in areas of steep bathymetric contour, may not have been at the targeted water depth. Therefore mooring designs had to be altered to match conditions at the actual site. Once a site was selected and deployment started, ice drift, especially if orthogonal to isobaths, can cause further changes in water depth. Echo soundings were made throughout the deployment and wire lengths were adjusted to reflect increasing or decreasing water depth. Although each mooring ended up in different water depths, the sediment traps in each case were positioned 55 m above the sea-bed and the upper current meter depths varied between 30 to 40 meters below mean water. Upon recovery none of the moorings showed signs of ice keel interference.

2.3 Calibration

Current meters were deployed with sensors for current speed, direction, water temperature, and conductivity. Two of the meters were modified to accept data from a transmissometer mounted in the directional vanes.

As long as the Savonius speed sensor is in good condition and the bearings are well maintained and adjusted there is no need to calibrate this sensor. Rotational thresholds were tested, before and after deployment, following Aanderaa methods and confirmed to be within factory specifications. Accuracy for this sensor is given as ± 1 cm/s.

The direction sensing compass located in the base of the pressure case, provided a magnetic bearing of current direction at the time of sensor sampling. All magnetic screws and fittings in the vicinity of the compass were removed and non-magnetic batteries installed to reduce error. The geomagnetic flux in the Beaufort Sea area exhibits a strong vertical component due to the proximity of the north magnetic pole ($\approx$1700 km N.E.) where the magnetic inclination is 90^o [*Merrill and McElhinny*, 1983]. The accuracy of a standard magnetic compass such as the one used in the RCM4 current meter is adversely affected by the vertical component of the earth's magnetic field at high latitudes. In an effort to quantify the induced error caused by inclination, all the instruments were calibrated in Tuktoyaktuk against a precision reference compass. The current meter was mounted (complete with pressure case) on a turntable and compass output was recorded at 20 degree intervals for comparison to the reference unit. Variance between the units was logged and correction constants were determined for input to final compass calibration equations at the time of data processing. The factory specification for RCM4 compasses is $\pm 5^o$ under the best conditions, an additional 5^o error is estimated, given the geomagnetic difficulties associated with Arctic latitudes. The result is an approximate $\pm 7^o$ imprecision (rms) for all current directions as published in this report. Magnetic current vectors were converted to true bearings by adding the estimated compass declination for each site to the current direction records.

Temperature sensors on each instrument were calibrated in a saltwater bath. Temperature inside the insulated bath container was controlled to within 0.002 C^o. Sensor output was recorded at 6 or 7 points across its range, and a polynomial equation fitted to derive calibration coefficients. Bath temperature checks during the progress of the calibration were provided by a platinum resistance thermometer which verified that accuracy and precision equal the resolution of 0.005 C^o.

Conductivity sensors on the current meters were calibrated in the same bath at three different conductivities within the measurement range of the cell (typically 20 to 30 mmhos/cm). The salinity of the bath was determined by analyzing samples on a Guildline Autosal salinometer. Then a linear equation for conductivity was fitted to the points and calibration coefficients were determined. These methods result in an estimated accuracy of ± 0.1 ppt at a precision of ± 0.03 ppt.

Calibration of the transmissometer/RCM4 packages was performed according to the Sea Tech instruction manual. The transmissometer was connected to the RCM4 and the output on data channel 4 was recorded during the test. The lenses were cleaned and a voltmeter was attached to the transmissometer output. The voltage and corresponding RCM4 binary output were recorded for an unblocked and blocked light path. This "air calibration" furnishes values for 0% and 100%

transmission and a linear coefficient for interpreting the collected data after recovery. Stated accuracy for this instrument is ±0.5 % transmission.

Table 3: Estimated Accuracy of Measured Parameters

Parameter	Accuracy	Precision	Resolution
Speed (cm/s)	±2%	±7%	0.05
Direction (°True)	±5	±7	0.35
Temperature (°C)	±0.005	±0.005	0.005
Conductivity Ratio	±0.0025	±0.0008	0.00016
% Transmission	±5	±1.0	0.3

3 DATA PROCESSING

3.1 Procedures

When the current meter data tapes were returned from the field the first step in processing was to translate the records from the 1/4 inch field tapes to a hard-disk equipped, IBM-XT, desk- top computer. The translation interface was an Applied Microsystems Ltd. model 769D which read from a Sony reel to reel tape recorder. The data records were then transmitted to the Institute of Ocean Sciences, Central Computing, Vax 11/785 for storage on 9 track magnetic tape and data processing. Each current meter file was then edited to check the instrument timing, delete pre- and post- deployment data cycles and remove obvious data "spikes". Header files containing information specific to each instrument including timing, mooring location, calibration coefficients, and comments were generated and attached to the data. The raw data values or "N" numbers were then corrected and converted to appropriate engineering units through application of formulae and coefficients produced during pre-deployment laboratory calibrations.

Salinity was computed from calibrated values for temperature, conductivity, and sensor depth. Only one instrument had a pressure sensor, therefore elevation was calculated from measured water depth and known mooring segment lengths. Sounder errors in 200 m of water and other methodological inaccuracies result in approximate elevation imprecisions of ±2 m. Salinity was calculated from conductivity using the Practical Salinity Scale 1978 [*Lewis and Perkin*; 1978].

3.2 Data display

Appendices 1 to 3 present the calibrated and corrected current meter data. Appendix 1 contains time series plots of daily averaged data for each instrument. Current velocity is displayed as North/South (V) and East/West (U) components and combined (U,V) stick plots where stick length and inclination depict speed and direction respectively. Due to page space limitations, light transmission records for stations SS-1 and SS-3 are plotted separately with the matching stick plot. The shallow RCM4 at site SS-3 (S/N 7907 - 35 m) was the only instrument that exhibited significant problems and data loss. This current meter stopped recording several times during the deployment resulting in a loss of 29.46 days out of a total 140 day deployment. The record from instrument recovery (Aug 18/87) to the last clock stoppage (approximately July 16/87) can be correlated to real time by counting back the hourly increments from the known shut down time. Data collected between the first and last clock errors however, cannot be fixed accurately in time because it is impossible to determine the duration of each missing segment. Rather than discard the entire record for this instrument the plots were graphically modified to display both the chronologically certain and uncertain portions of the data set. The gap in the plot represents the total amount of missing data and the dotted lines show the approximate dispersion of missing segments. Appendix 2 is composed of progressive vector diagrams illustrating current direction and relative speed against the Julian date. Plotted symbols are described in the key and a reference mark to true north drawn. Station SS-3 has a shortened record due to the missing data; it is however still useful for resolving current trends. The last Appendix contains 10 day average values computed from current meter data segments which have been selected to match the timing of the sequential sediment trap cycles. Every 10 days, starting shortly after deployment, an empty receptacle was moved under the collection cone of the sediment trap. After 13 cycles, a 130 day time series of sediment samples was collected. Condensing the physical oceanographic data, through averaging, to match the temporal resolution of the sediment time series allows a direct comparison of biological and physical parameters within identical time segments.

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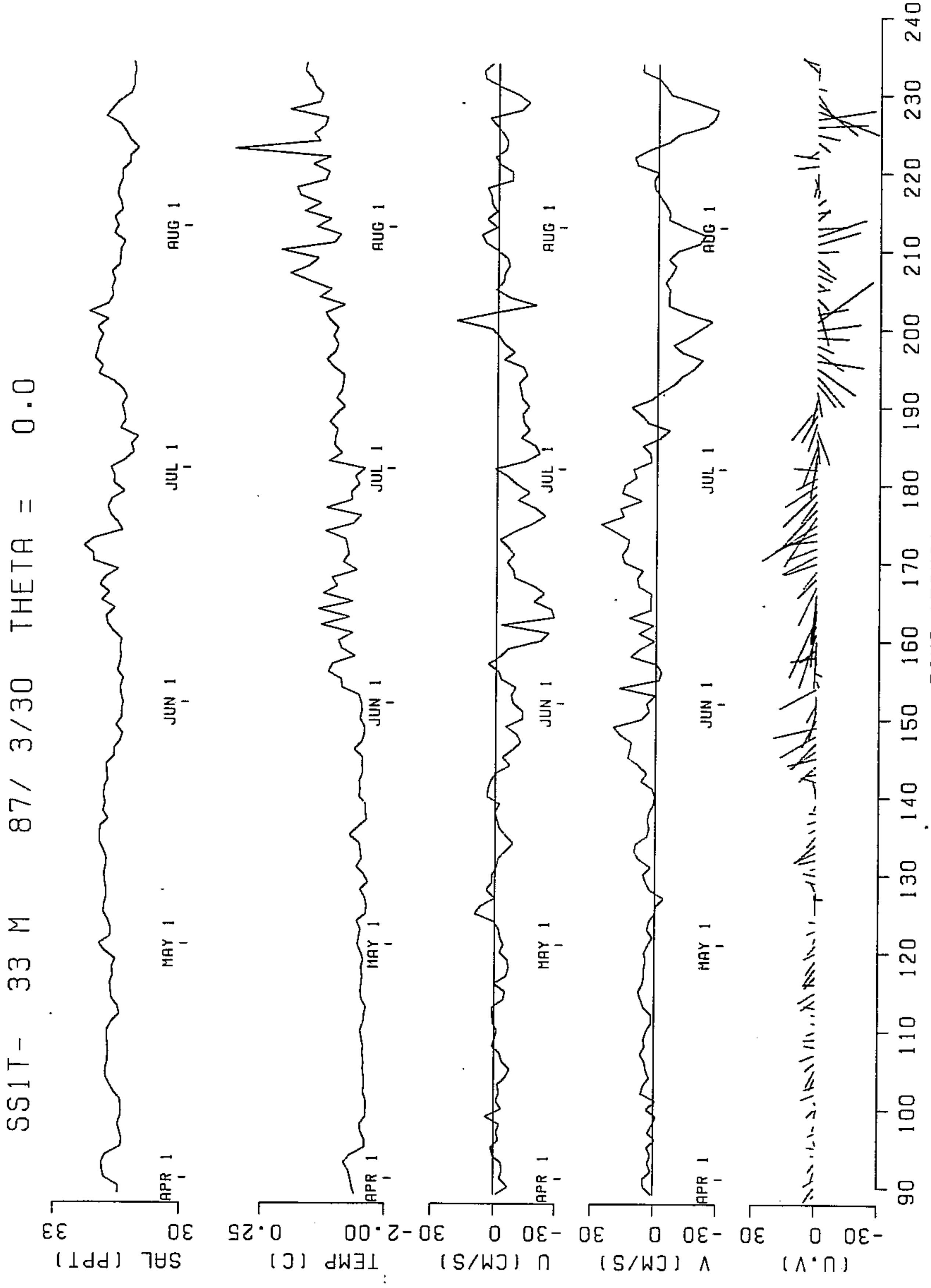
APPENDIX 1; TIME SERIES U-V STICK PLOTS



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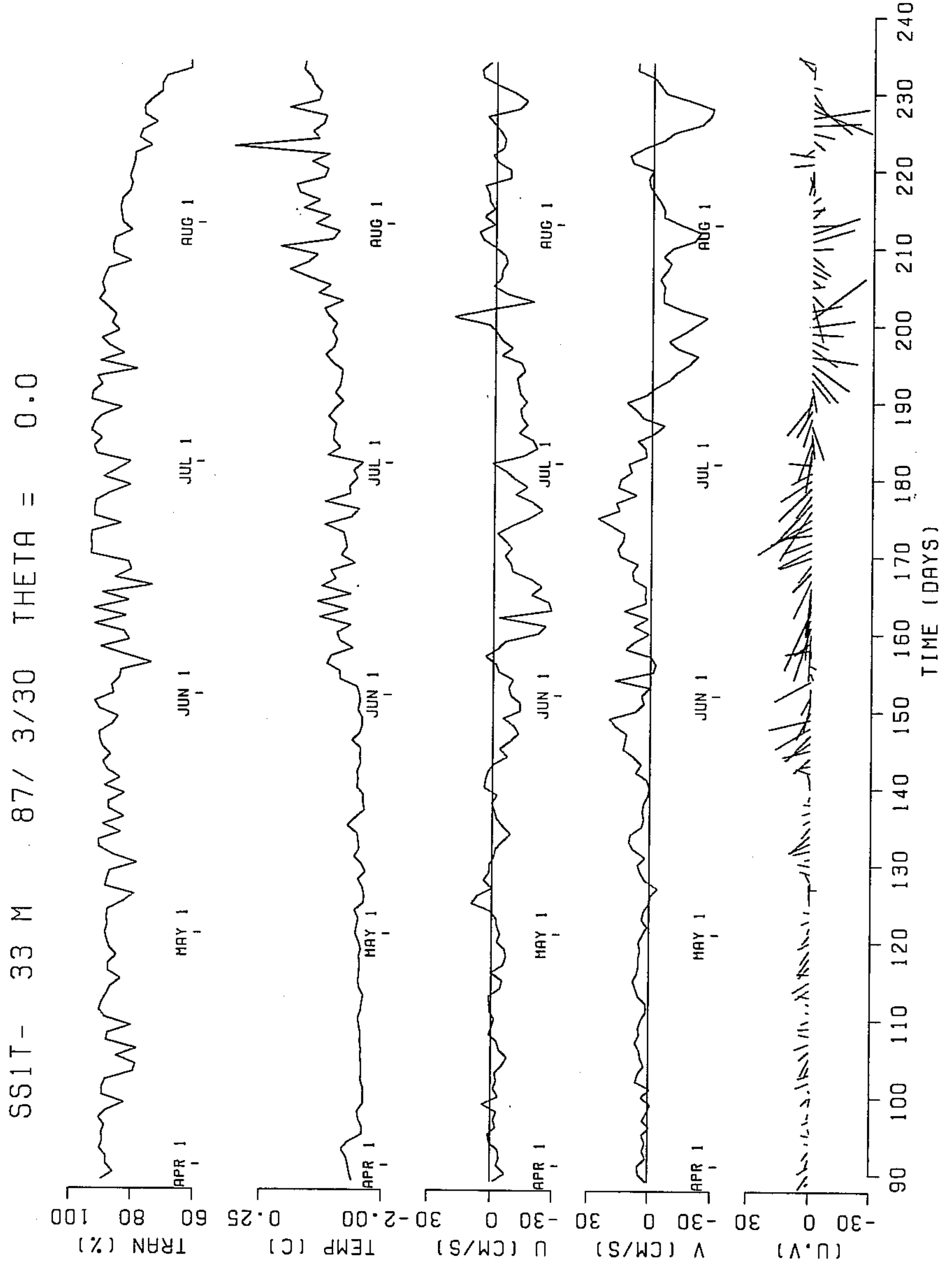
SAL (PPT)
TEMP (C)
U (CM/S)
V (CM/S)
(U,V)
APR 1
MAY 1
JUN 1
JUL 1
AUG 1
TIME (DAYS)



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TRAN (%)
TEMP (C)
U (CM/S)
V (CM/S)
(U.V)
TIME (DAYS)
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MAY 1
JUN 1
JUL 1
AUG 1
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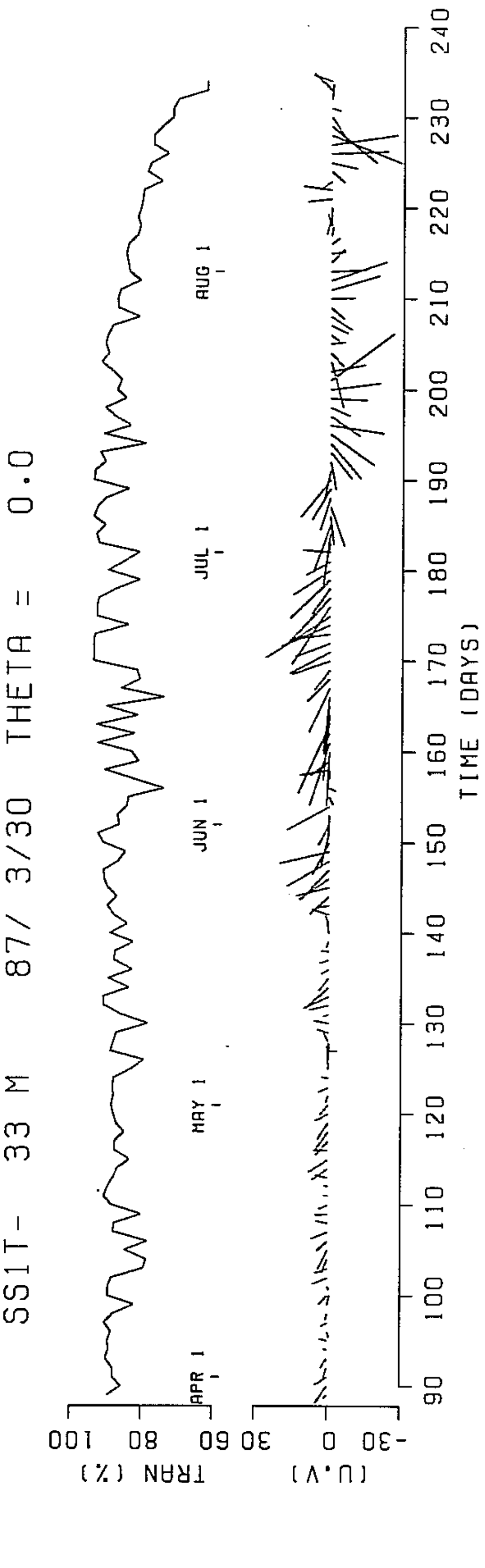
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JUL 1
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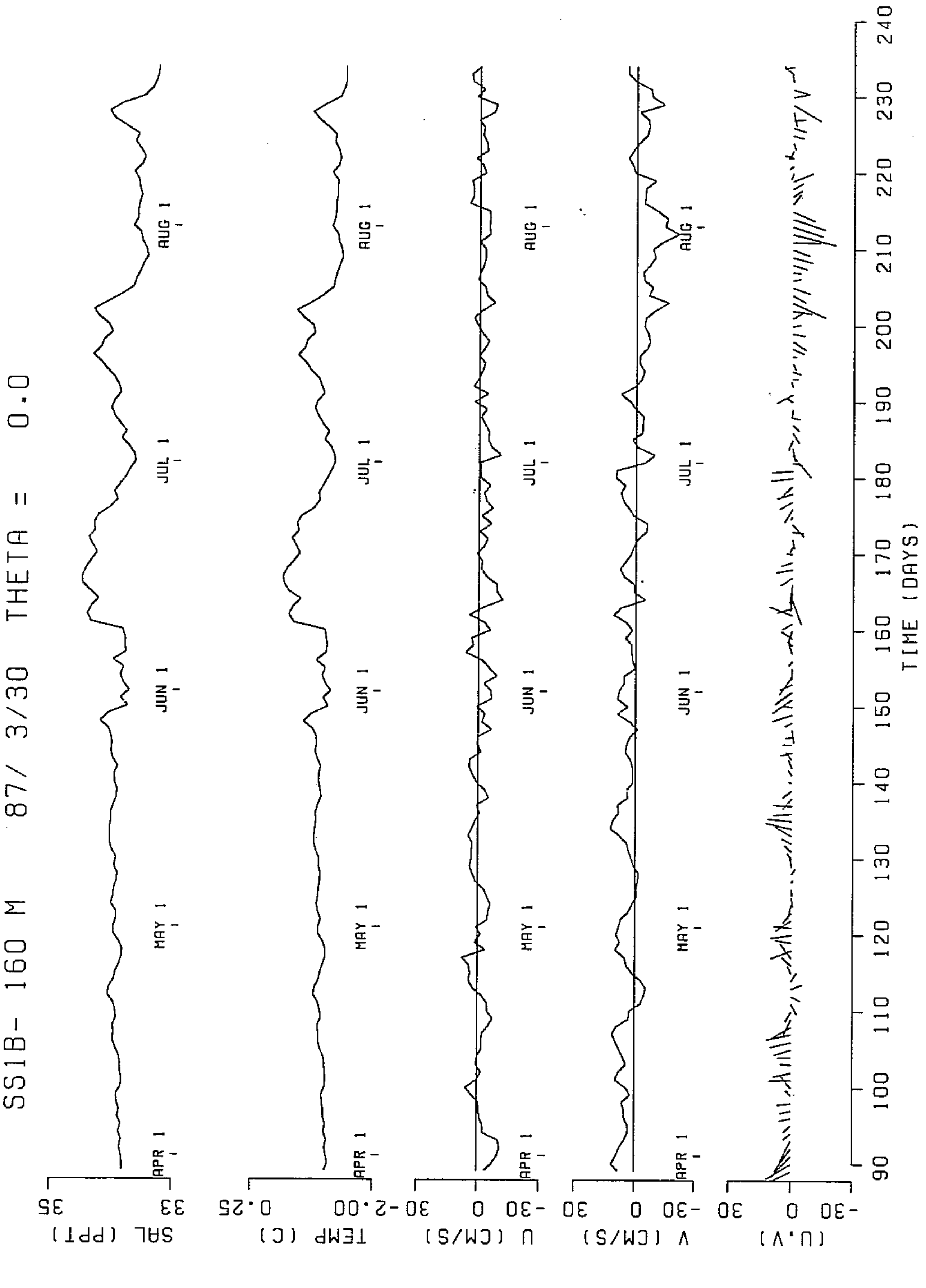
TIME (DAYS)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V (CM/S)
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(U,V)
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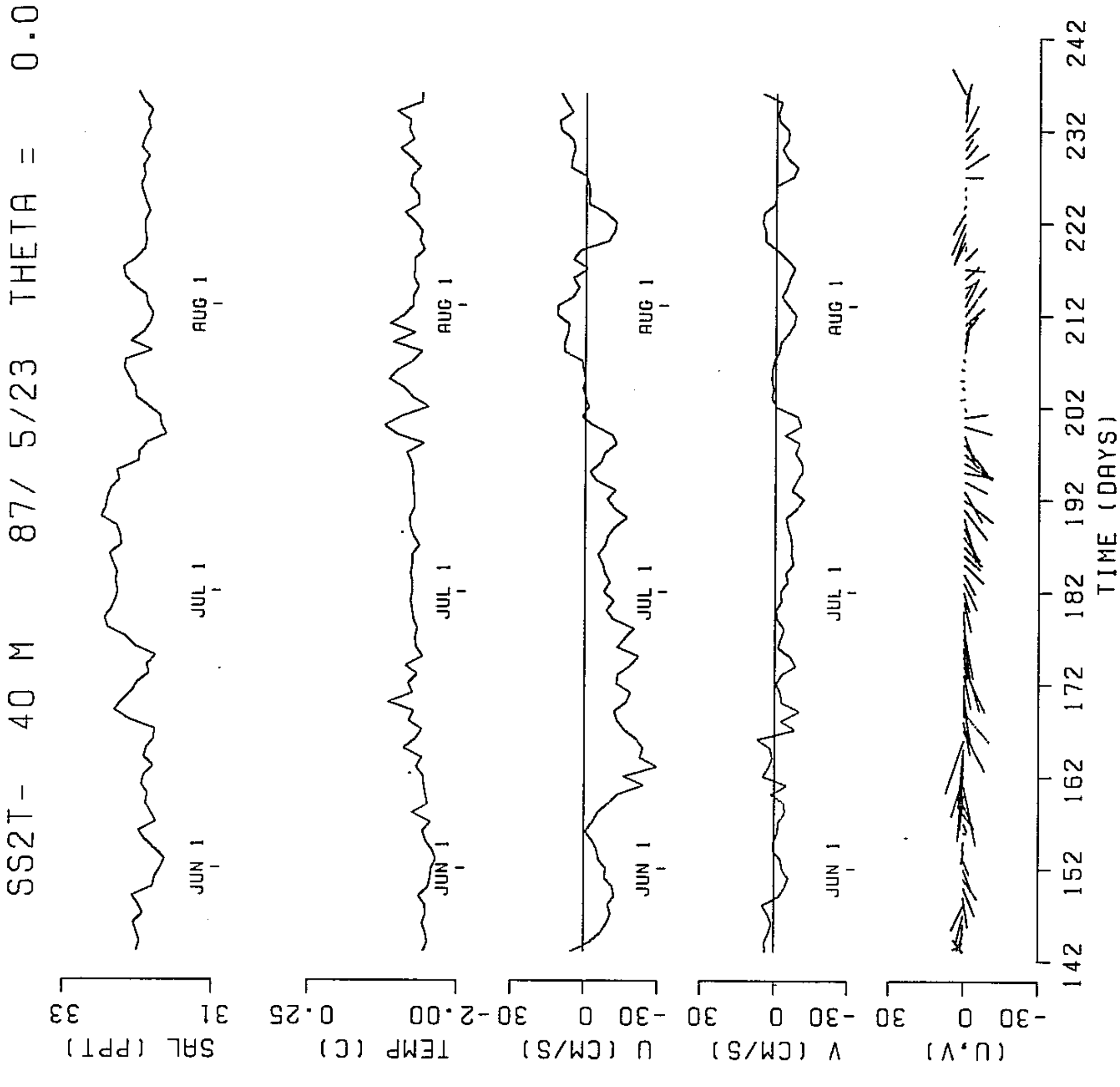
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(U,V)
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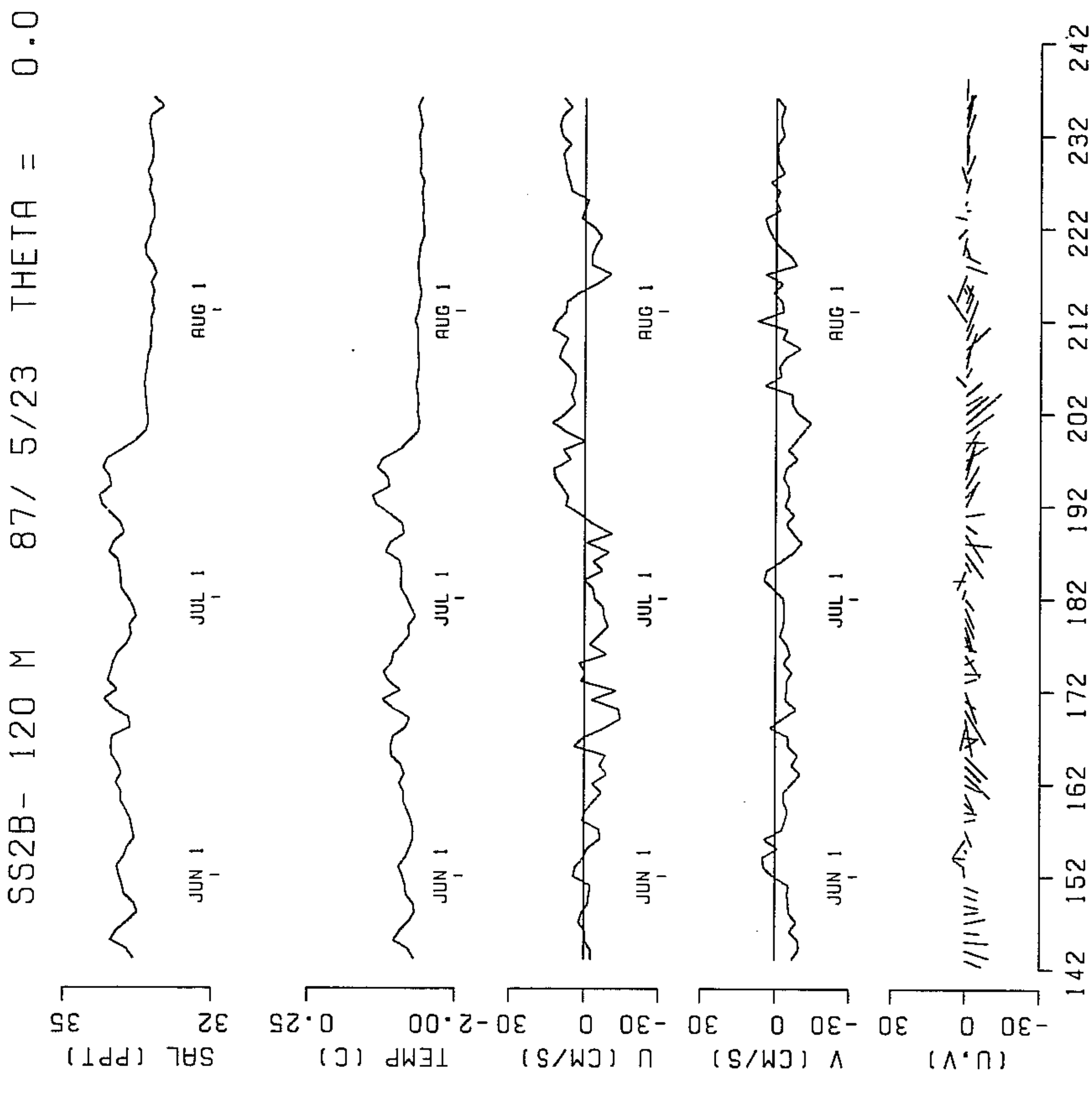
TIME (DAYS)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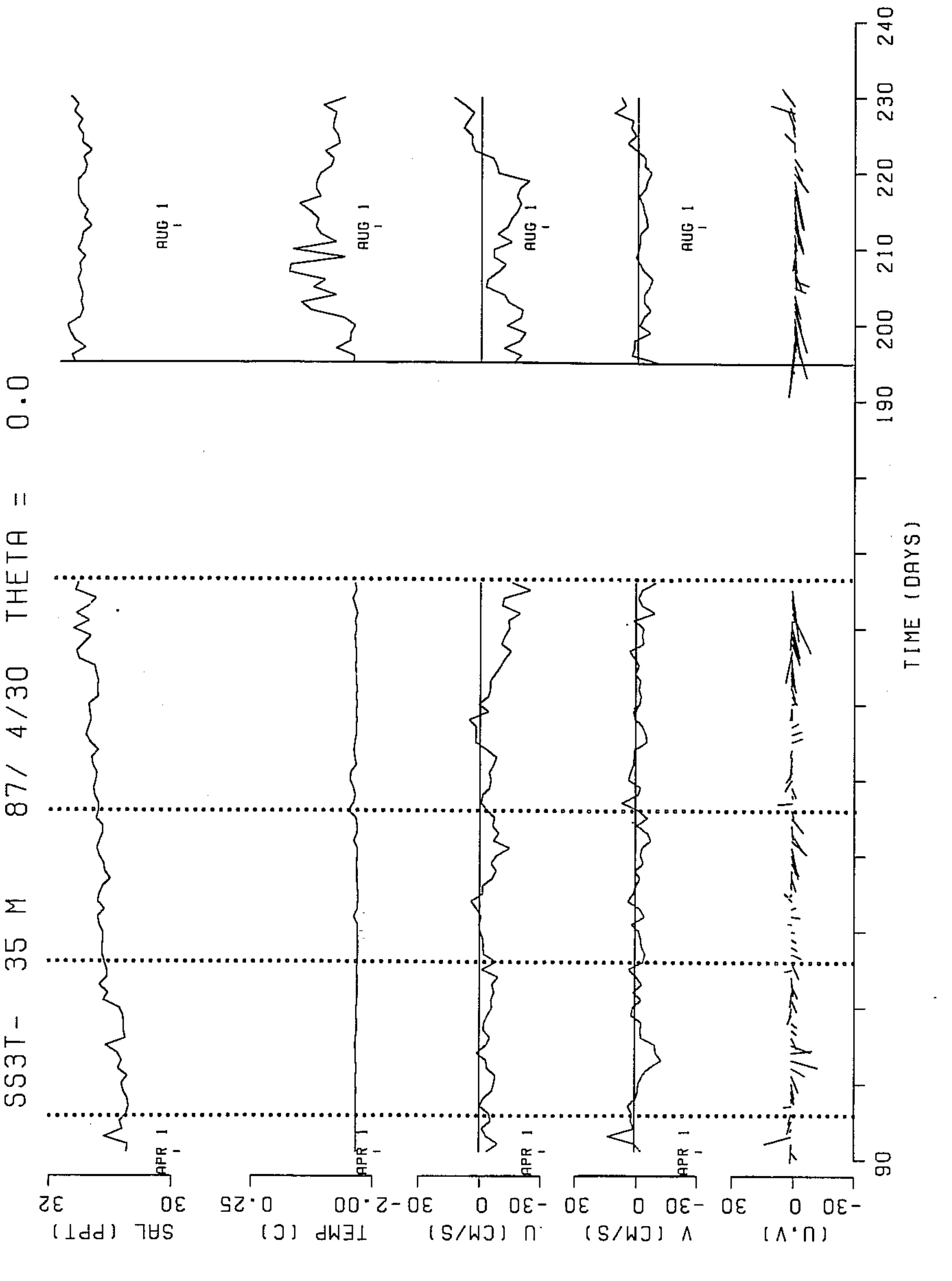
TIME (DAYS)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TEMP (C)
U (CM/S)
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(U,V)
TIME (DAYS)
APR 1
AUG 1
90
190
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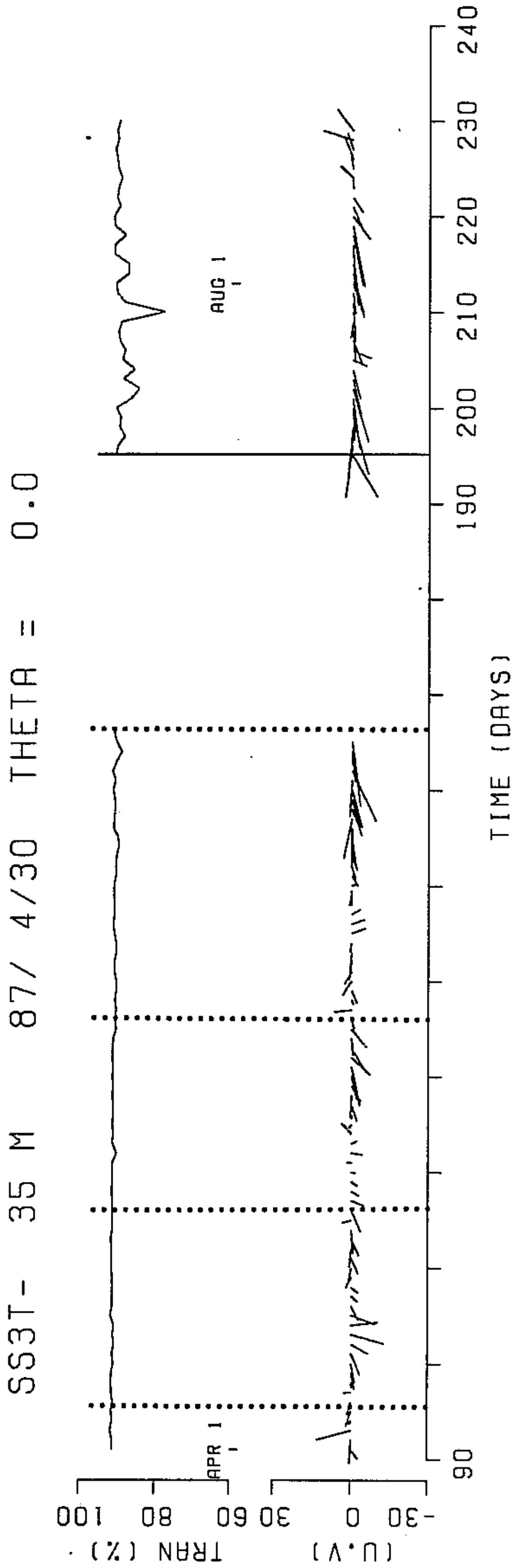
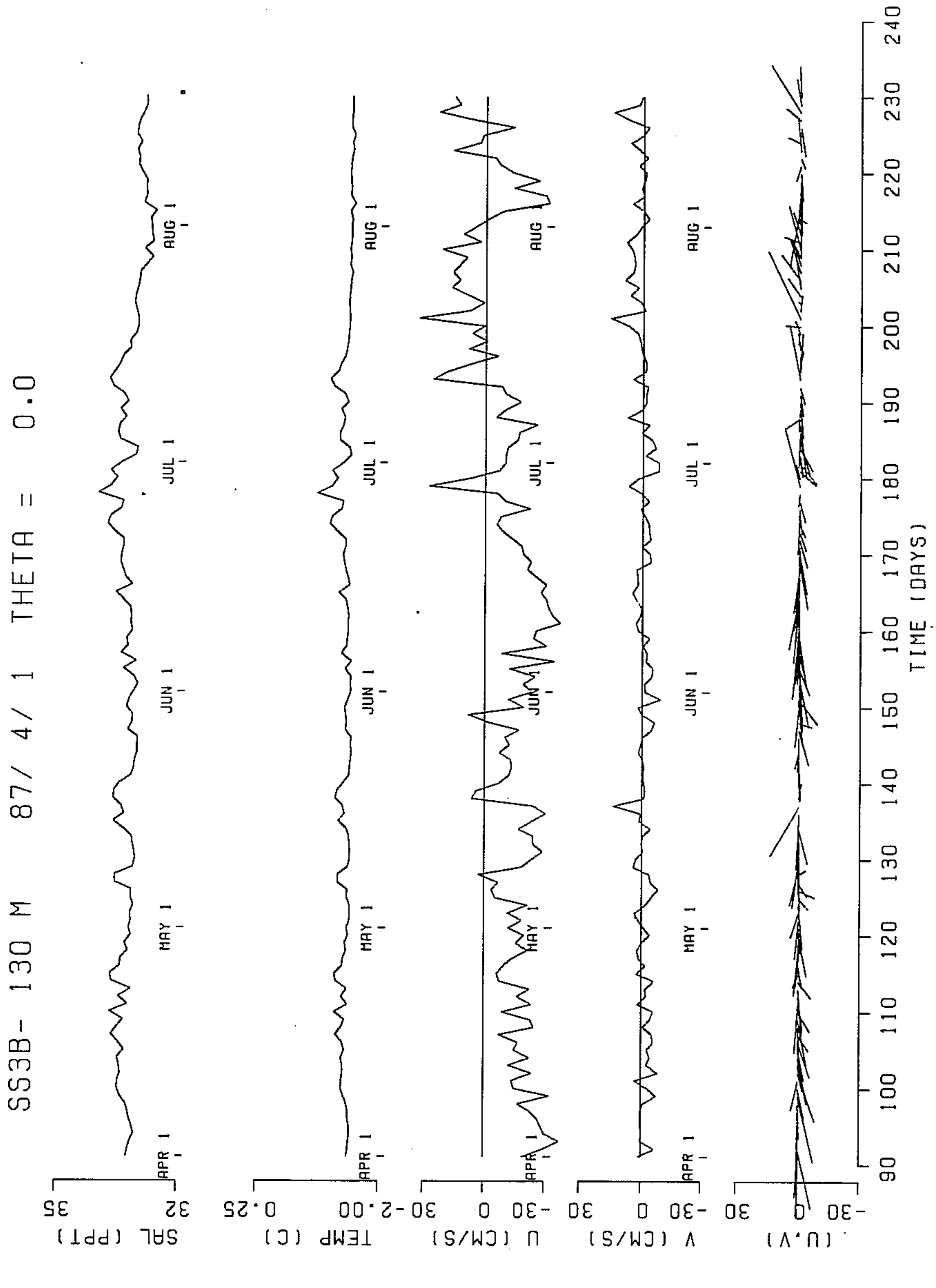
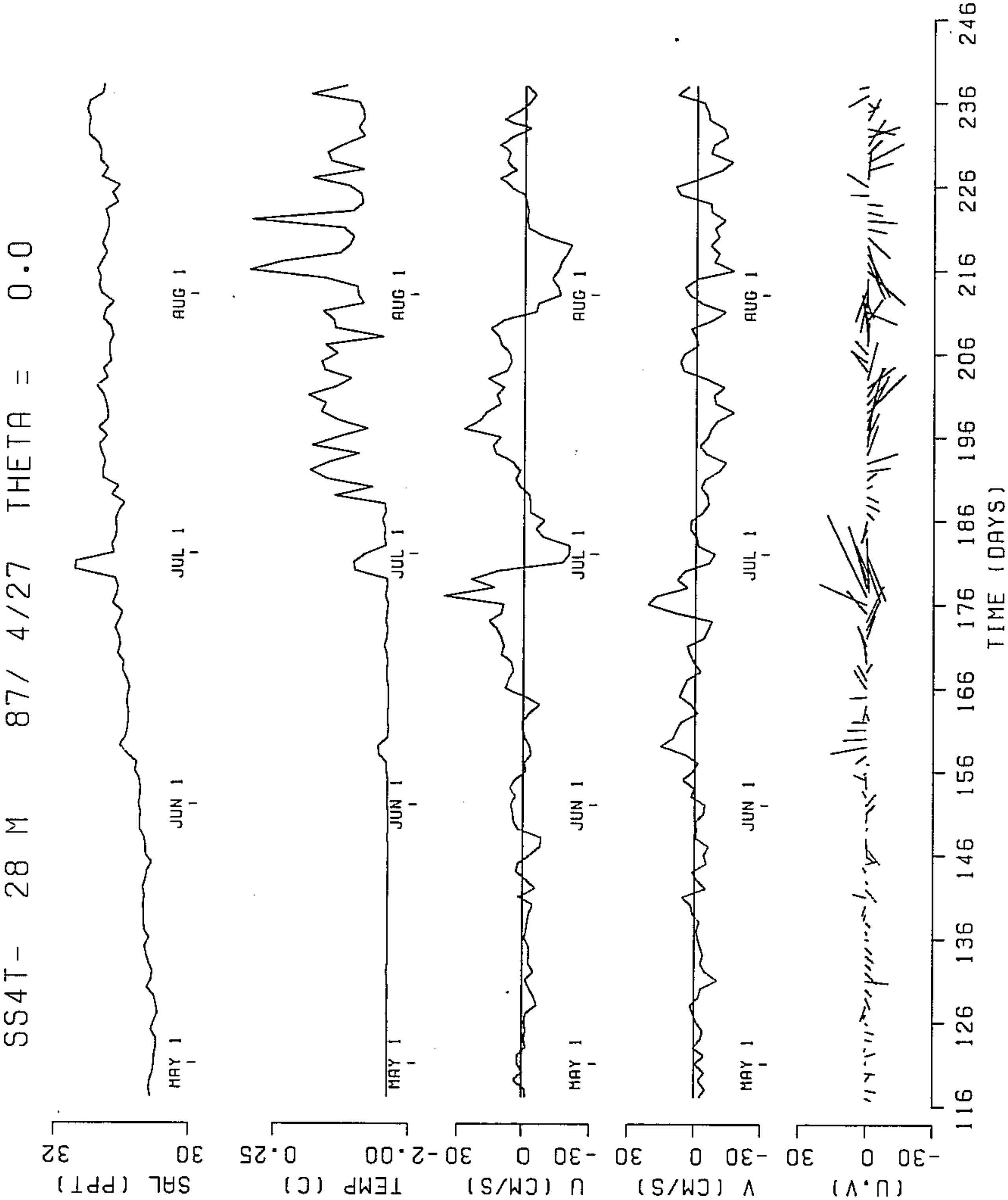
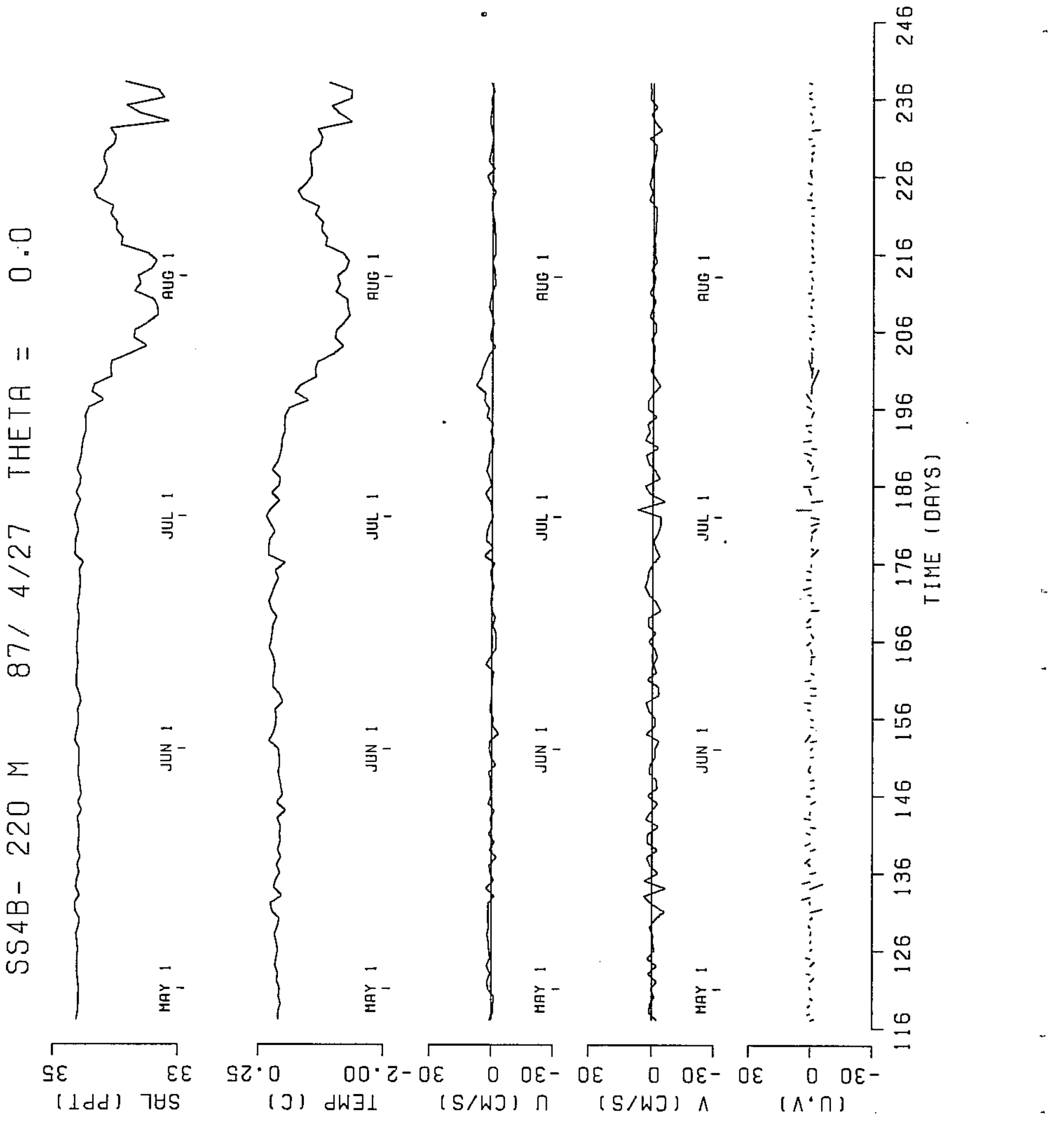
230
240



SS3T- 35 M 87/ 4/30 THETA = 0.0
TRAN (%)
100
80
60
(U,V)
30
0
-30
APR 1
AUG 1
90
190
200
210
220
230
240
TIME (DAYS)

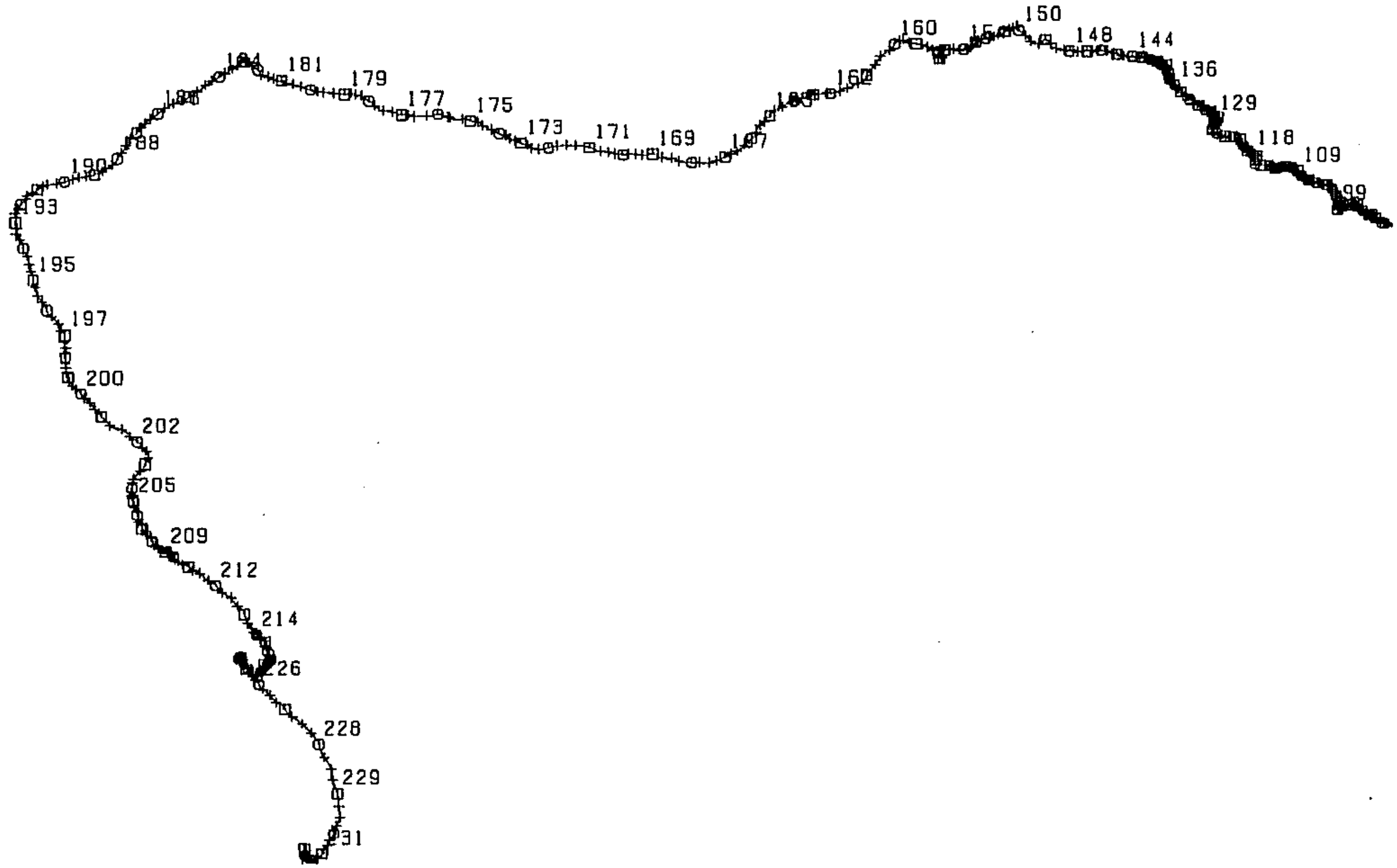

SS3B- 130 M 87/ 4/ 1 THETA = 0.0
SAL (PPT)
35
32
TEMP (C)
0.25
-2.00
U (CM/S)
30
0
-30
V (CM/S)
30
0
-30
(U,V)
30
0
-30
APR 1
MAY 1
JUN 1
JUL 1
AUG 1
TIME (DAYS)
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240


SS4T- 28 M 87/ 4/27 THETA = 0.0
SAL (PPT)
30
32
TEMP (C)
-2.00
0.25
U (CM/S)
-30
0
30
V (CM/S)
-30
0
30
(U,V)
-30
0
30
MAY 1
JUN 1
JUL 1
AUG 1
116
126
136
146
156
166
176
186
196
206
216
226
236
246
TIME (DAYS)



SS4B- 220 M 87/ 4/27 THETA = 0.0
SAL (PPT)
35
33
TEMP (C)
0.25
-2.00
U (CM/S)
30
0
-30
V (CM/S)
30
0
-30
(U,V)
30
0
-30
MAY 1
JUN 1
JUL 1
AUG 1
116
126
136
146
156
166
176
186
196
206
216
226
236
246
TIME (DAYS)

APPENDIX 2; PROGRESSIVE VECTOR PLOTS

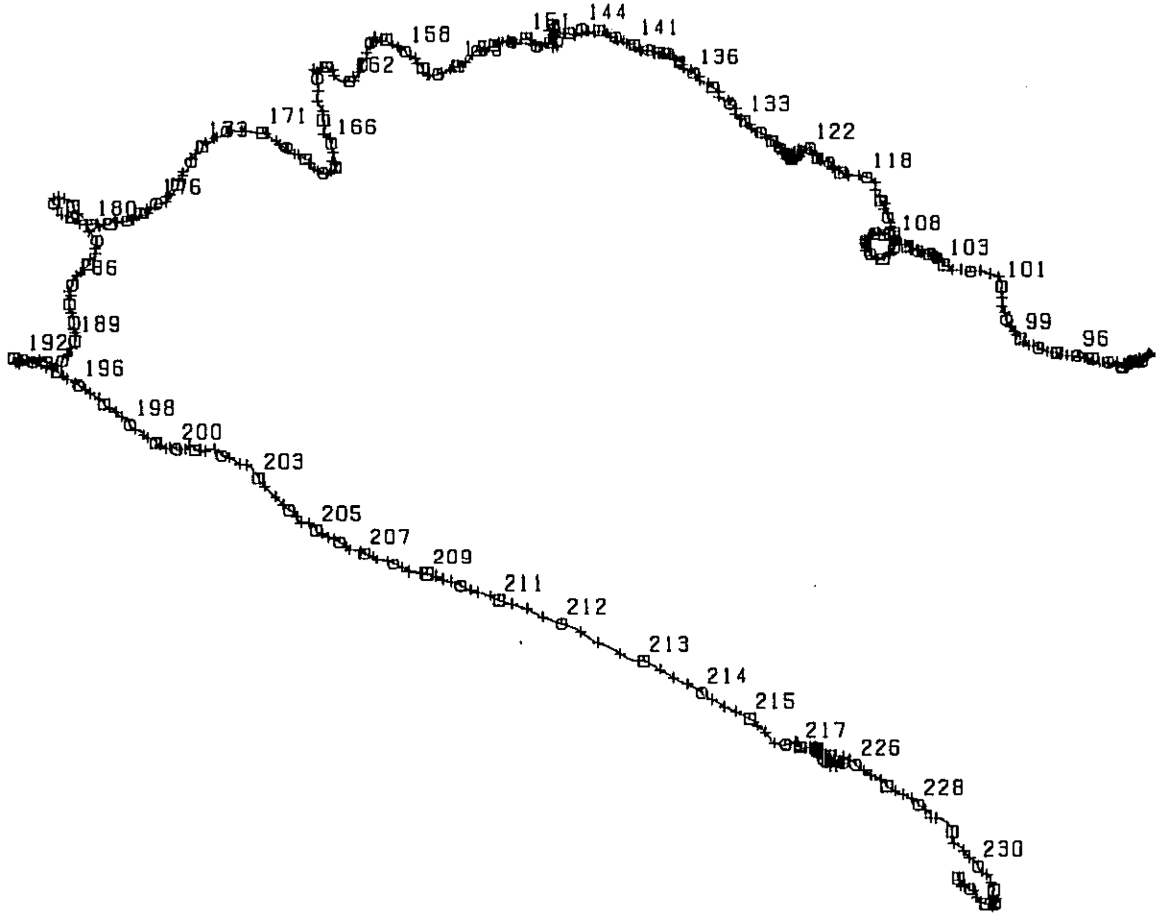


BEAUFORT SEA SHELF 70-45.* 127-18.*
PROGRESSIVE VECTOR DIAGRAM

△START OF OBSERVATIONS
⊡ODD NUMBERED DAYS
⊕EVEN NUMBERED DAYS
+SIX HOUR INTERVAL

STN	DEPTH	ID	START	NO DAYS
SS1TOP	33.0 M	7906	89 /87	146

SCALE
10 KM

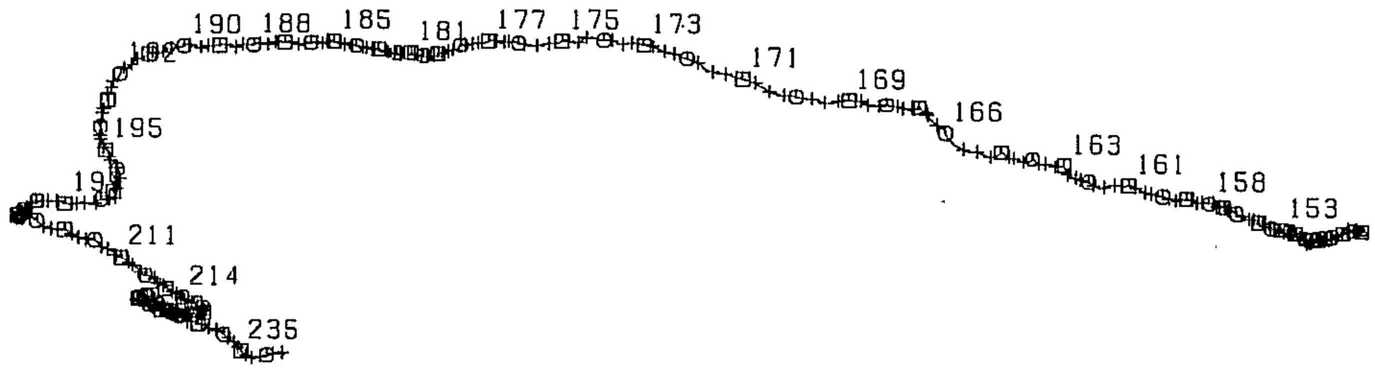


BEAUFØRT SEA SHELF 70-45.* 127-18.*
PRØGRESSIVE VECTØR DIAGRAM

△ START ØF ØBSERVATIØNS
□ ØDD NUMBERED DAYS
○ EVEN NUMBERED DAYS
+ SIX HØUR INTERVAL

STN	DEPTH	ID	START	NØ DAYS
SS1BØT	160.0M	3223	89 /87	146

SCALE
10 KM

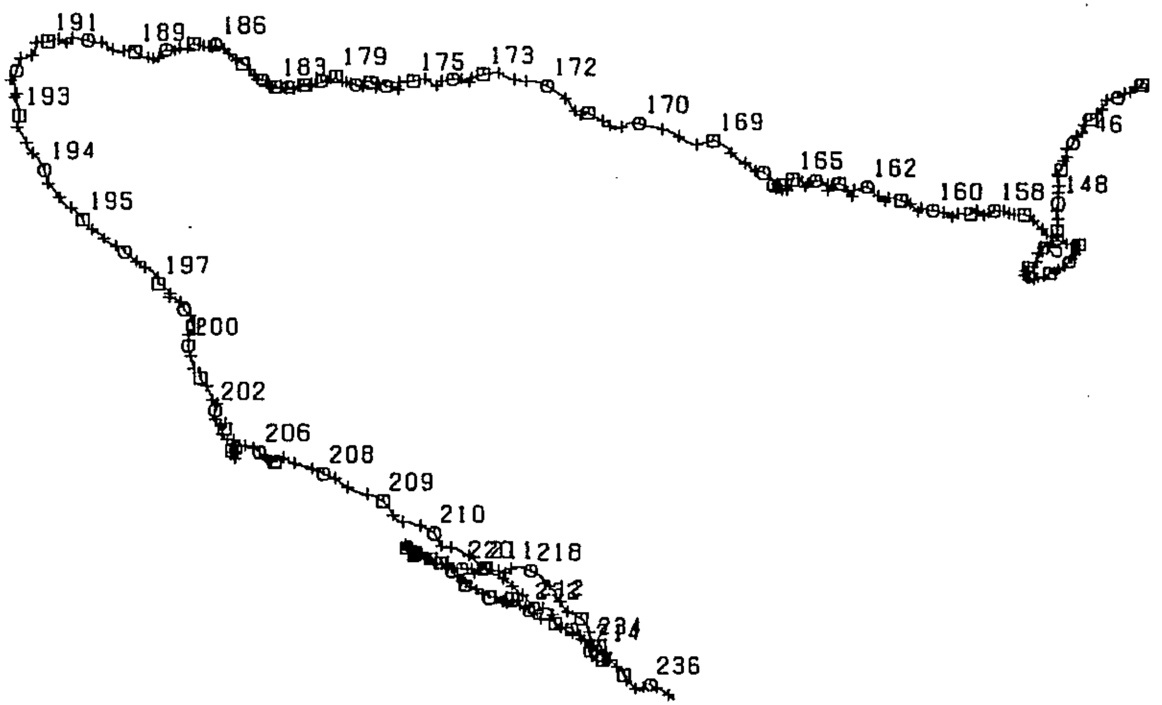


BEAUFORT SEA SHELF 71-28.* 128-44.*
PROGRESSIVE VECTOR DIAGRAM

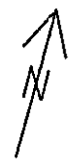
△START OF OBSERVATIONS
□ODD NUMBERED DAYS
○EVEN NUMBERED DAYS
+SIX HOUR INTERVAL

STN	DEPTH	ID	START	NO DAYS
SS2TOP	40.0 M	5473	142/87	94

SCALE
10 KM



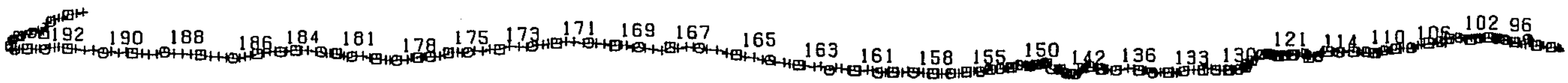
BEAUFORT SEA SHELF 71-28.* 128-44.*
PROGRESSIVE VECTOR DIAGRAM



△START OF OBSERVATIONS
□ODD NUMBERED DAYS
○EVEN NUMBERED DAYS
+SIX HOUR INTERVAL

STN	DEPTH	ID	START	NO DAYS
SS2BOT	120.0M	1932	142/87	94

SCALE ⊢┼┼┼┤
10 KM

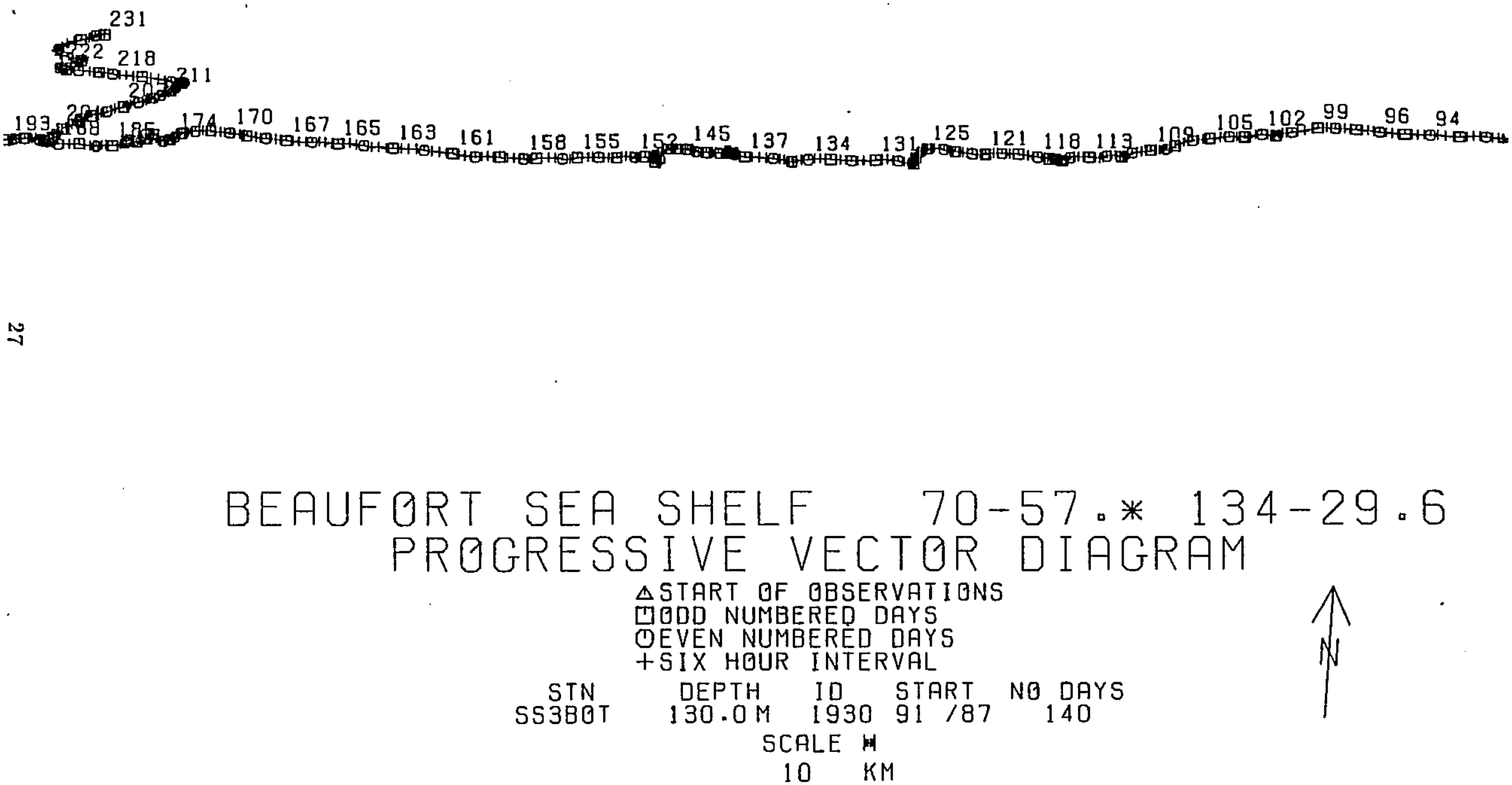


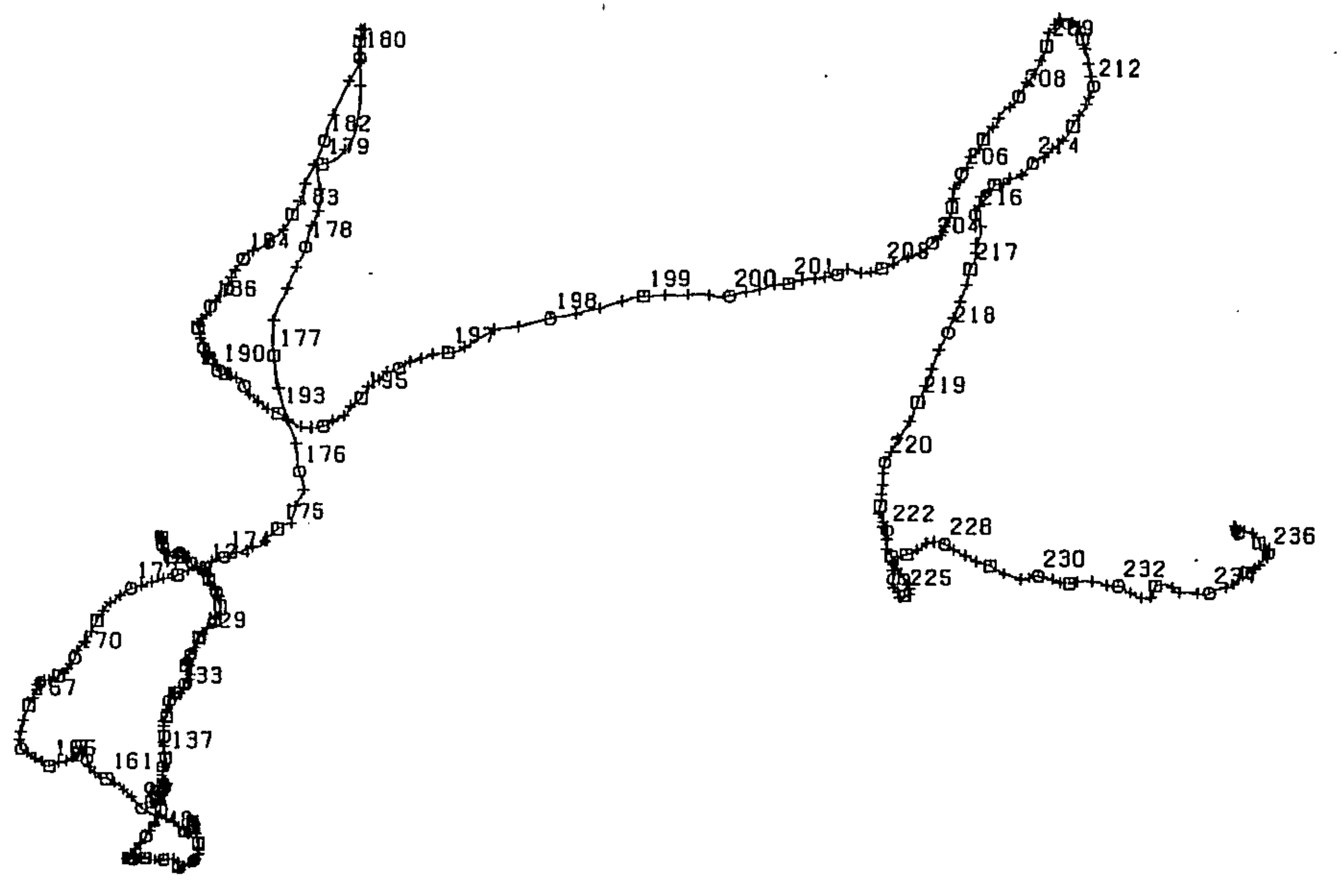
BEAUFØRT SEA SHELF   70-57.* 134-29.6
PRØGRESSIVE VECTØR DIAGRAM

△START ØF ØBSERVATIØNS
⊡ØDD NUMBERED DAYS
⊖EVEN NUMBERED DAYS
+SIX HØUR INTERVAL

STN	DEPTH	ID	START	NØ DAYS
SS3TØP	35.0 M	7907	91 /87	110

SCALE
10 KM


231
218
211
193
174
170
167
165
163
161
158
155
152
145
137
134
131
125
121
118
113
109
105
102
99
96
94
BEAUFØRT SEA SHELF 70-57.* 134-29.6
PRØGRESSIVE VECTØR DIAGRAM
△START ØF ØBSERVATIØNS
□ØDD NUMBERED DAYS
⊖EVEN NUMBERED DAYS
+SIX HØUR INTERVAL
STN DEPTH ID START NØ DAYS
SS3BØT 130.0M 1930 91 /87 140
SCALE
10 KM
N

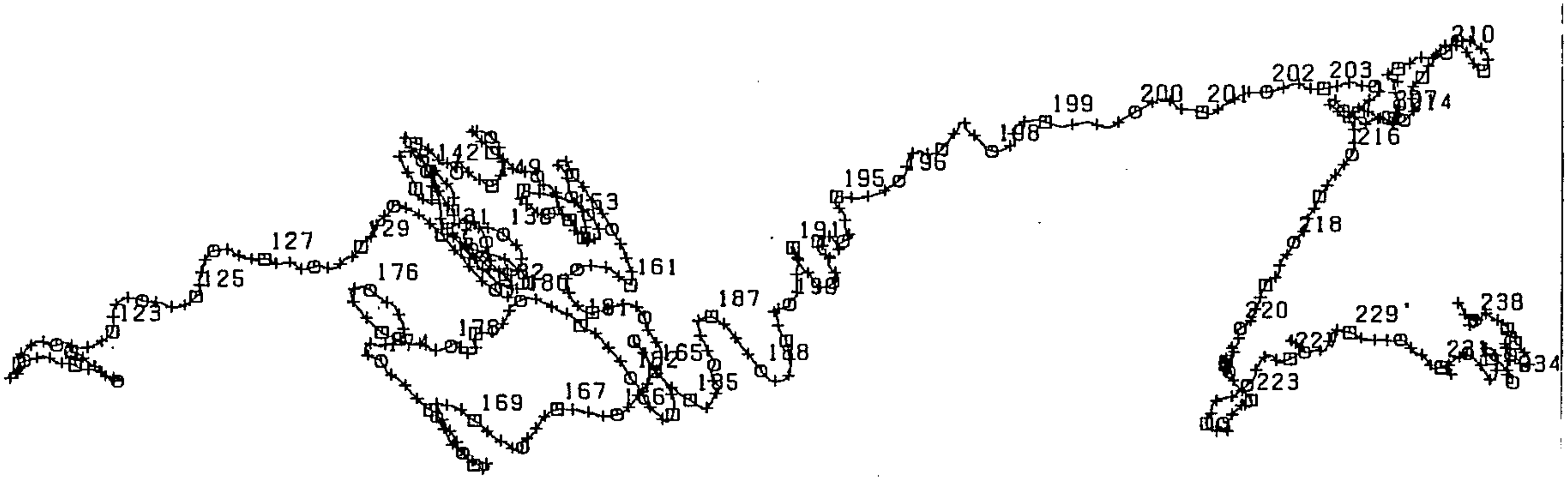


BEAUFORT SEA SHELF 69-58.* 138-36.*
PROGRESSIVE VECTOR DIAGRAM

△START OF OBSERVATIONS
□ODD NUMBERED DAYS
○EVEN NUMBERED DAYS
+SIX HOUR INTERVAL

STN	DEPTH	ID	START	NO DAYS
SS4TOP	28.0 M	5471	116/87	122

SCALE ⊢+++⊣
10 KM



BEAUFØRT SEA SHELF 69-58.* 138-36.*
PRØGRESSIVE VECTØR DIAGRAM

△START ØF ØBSERVATIØNS
□ØDD NUMBERED DAYS
ØEVEN NUMBERED DAYS
+SIX HØUR INTERVAL

STN	DEPTH	ID	START	NØ DAYS
SS4BØT	220.0 M	1939	116/87	122

SCALE ⊢+++++⊣
10 KM

APPENDIX 3; 10 DAY AVERAGES PLOTS AND TABLES

The 10 day periods have been chosen to coincide with the sequential sediment trap collection intervals.

10 Day Averages Matching Trap Cycles

Station SS-1 (33 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	End
240	31.47	-1.61	189.17	4.06	87.63	94	104
480	31.66	-1.60	234.53	5.25	85.46	104	114
720	31.66	-1.57	220.46	5.68	87.70	114	124
960	31.79	-1.56	184.78	5.20	86.67	124	134
1200	31.81	-1.52	211.76	6.28	87.23	134	144
1440	31.52	-1.50	273.67	11.03	88.20	144	154
1680	31.52	-1.11	272.59	12.26	82.75	154	164
1920	31.88	-1.21	303.37	18.88	87.99	164	174
2160	31.54	-1.12	301.65	17.14	87.76	174	184
2400	31.39	-1.13	264.38	16.58	89.91	184	194
2640	31.98	-0.95	202.43	16.24	86.72	194	204
2880	31.62	-0.68	182.60	11.87	85.56	204	214
3120	31.42	-0.50	204.94	5.90	81.31	214	224

Station SS-1 (160 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	End
240	33.86	-1.10	151.17	6.18	0.00	94	104
480	33.93	-1.02	194.66	5.01	0.00	104	114
720	33.88	-1.06	131.65	5.50	0.00	114	124
960	33.96	-0.98	129.91	4.19	0.00	124	134
1200	33.94	-1.00	149.09	5.47	0.00	134	144
1440	33.90	-1.02	232.60	5.03	0.00	144	154
1680	34.00	-0.90	203.77	6.92	0.00	154	164
1920	34.38	-0.49	212.45	7.83	0.00	164	174
2160	33.86	-1.05	232.62	7.21	0.00	174	184
2400	33.90	-1.02	229.19	6.18	0.00	184	194
2640	34.15	-0.77	192.58	8.57	0.00	194	204
2880	33.61	-1.26	188.46	12.41	0.00	204	214
3120	33.57	-1.28	189.26	6.12	0.00	214	224

Station SS-2 (40 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	End
240	31.89	-1.55	215.75	7.76	0.00	144	154
480	31.84	-1.47	272.15	11.62	0.00	154	164
720	31.93	-1.30	273.03	20.04	0.00	164	174
960	32.22	-1.34	253.43	10.62	0.00	174	184
1200	32.32	-1.28	235.92	13.57	0.00	184	194
1440	31.90	-1.29	205.74	8.48	0.00	194	204
1680	32.01	-1.20	113.49	8.43	0.00	204	214
1920	32.00	-1.30	199.08	6.28	0.00	214	224
2160	31.93	-1.23	149.85	6.22	0.00	224	234

Station SS-2 (120 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	Julian Day End
240	33.76	-1.25	164.02	6.72	0.00	144	154
480	33.69	-1.29	240.08	8.41	0.00	154	164
720	33.81	-1.18	245.36	11.70	0.00	164	174
960	33.68	-1.25	232.98	5.93	0.00	174	184
1200	33.91	-1.09	234.24	10.08	0.00	184	194
1440	33.64	-1.21	137.79	9.25	0.00	194	204
1680	33.26	-1.42	114.99	11.07	0.00	204	214
1920	33.22	-1.45	233.29	7.56	0.00	214	224
2160	33.25	-1.46	117.77	5.76	0.00	224	234

Station SS-3 (35 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	Julian Day End
240	30.86	-1.65	252.05	6.09	91.05	94	104
480	31.00	-1.66	248.64	8.28	91.22	104	114
720	31.20	-1.68	239.07	5.54	91.13	114	124
960	31.21	-1.67	234.42	7.22	91.06	124	134
1200	31.31	-1.60	247.74	7.12	90.44	134	144
1440	31.37	-1.65	229.10	6.39	90.59	144	154
1680	31.49	-1.64	259.42	13.69	90.51	154	164
1920						164	174
2160		Missing Data				174	184
2400						184	194
2640	31.57	-1.30	258.29	18.07	86.97	194	204
2880	31.51	-0.92	255.71	11.78	88.84	204	214
3120	31.49	-1.07	254.35	16.14	88.84	214	224

Timing Problems on Above Dataset.

Station SS-3 (130 Meters)

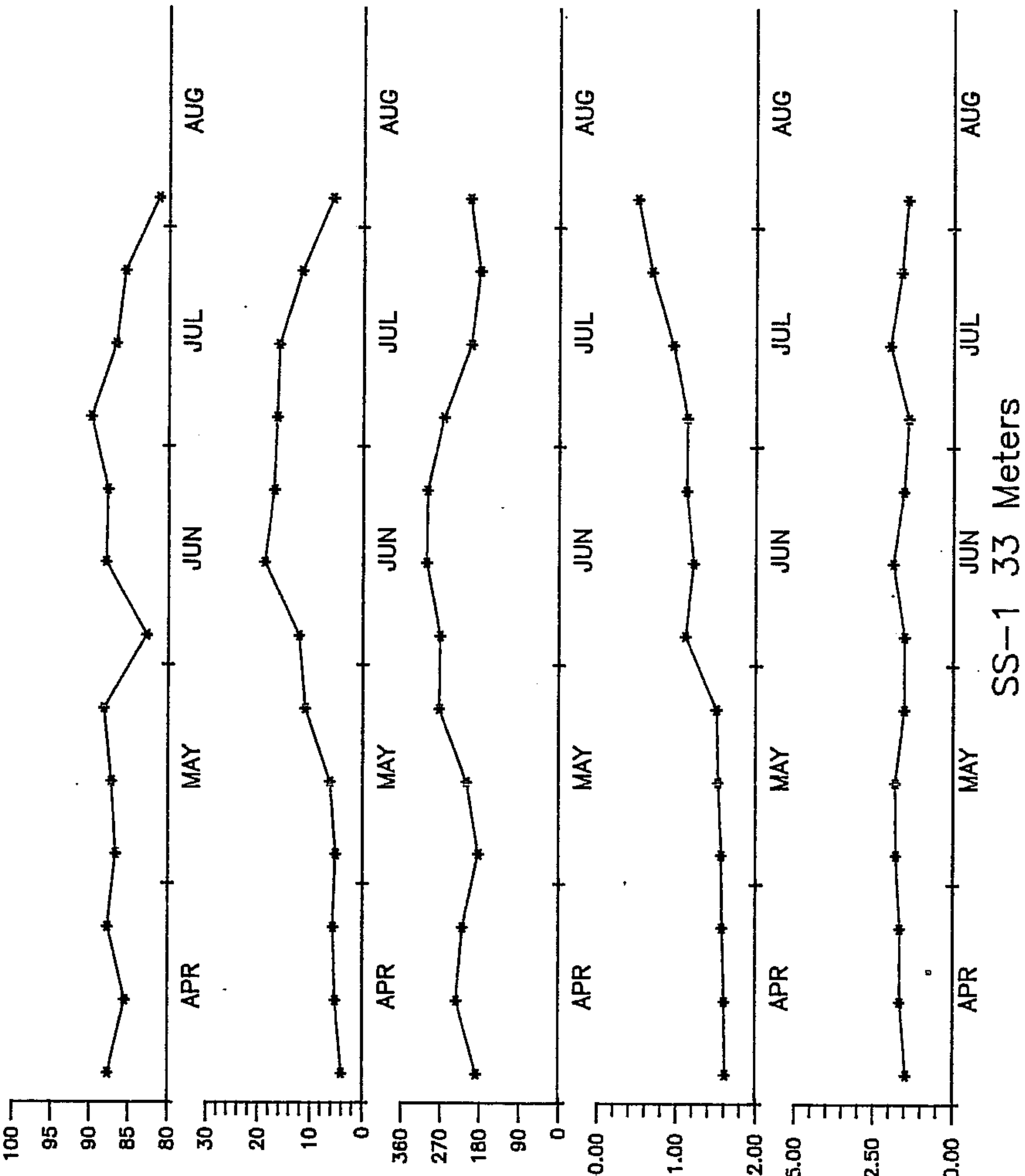
N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	Julian Day End
240	33.36	-1.37	264.77	22.18	0.00	94	104
480	33.43	-1.33	256.25	17.86	0.00	104	114
720	33.32	-1.36	271.30	14.81	0.00	114	124
960	33.22	-1.40	239.17	17.01	0.00	124	134
1200	33.36	-1.34	239.07	13.82	0.00	134	144
1440	33.14	-1.43	241.60	14.67	0.00	144	154
1680	33.24	-1.40	268.57	26.76	0.00	154	164
1920	33.44	-1.32	263.68	20.44	0.00	164	174
2160	33.55	-1.20	227.53	12.82	0.00	174	184
2400	33.47	-1.28	240.18	16.08	0.00	184	194
2640	33.19	-1.38	114.36	7.96	0.00	194	204
2880	32.87	-1.44	83.74	13.06	0.00	204	214
3120	32.91	-1.45	239.62	16.99	0.00	214	224

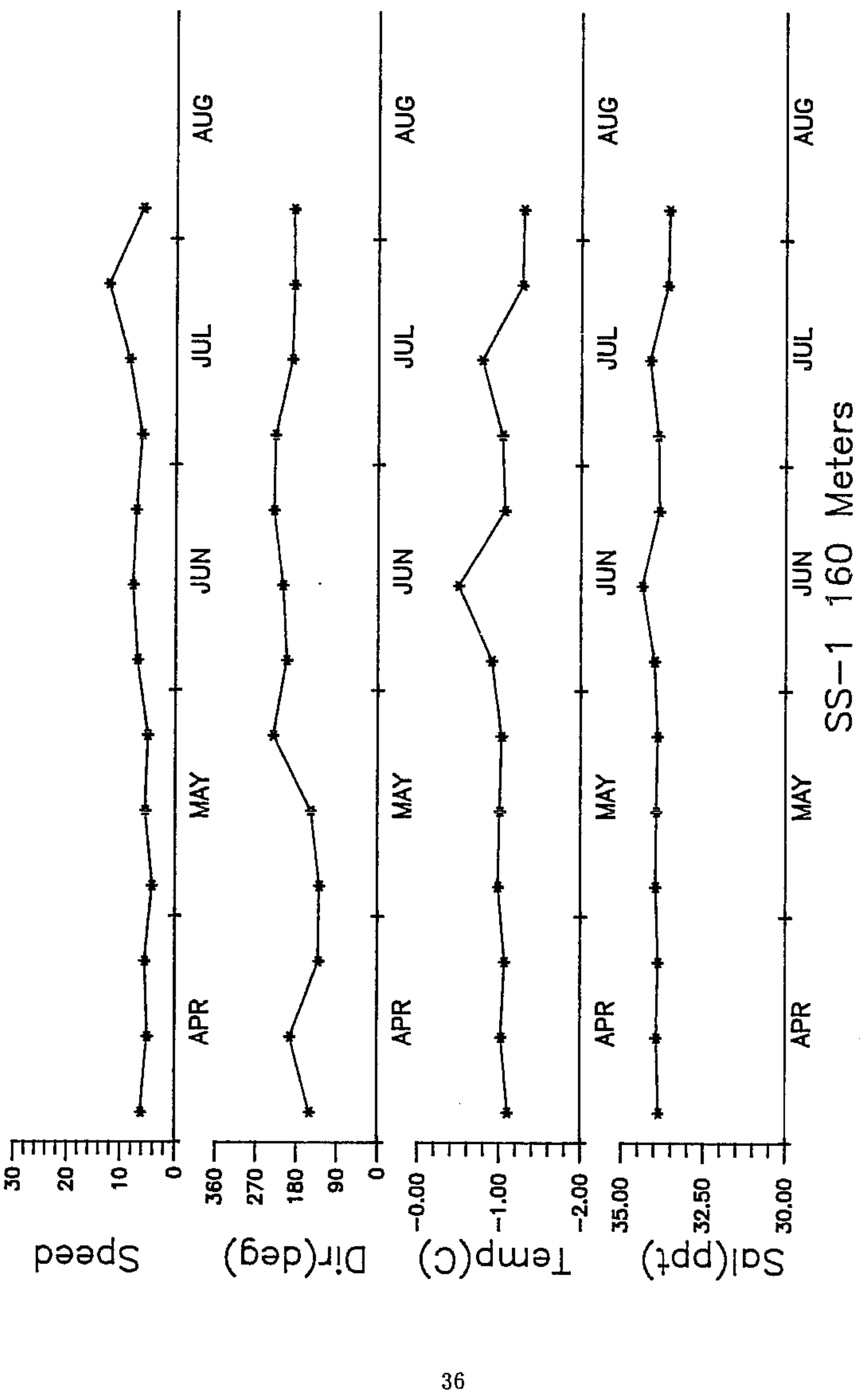
Station SS-4 (28 Meters)

N	Sal	Temp	Dir	Speed	%TX	Julian Day Start	End
240	30.55	-1.64	229.59	4.59	0.00	124	134
480	30.67	-1.65	197.71	4.29	0.00	134	144
720	30.69	-1.64	170.66	4.95	0.00	144	154
960	30.89	-1.62	194.72	5.87	0.00	154	164
1200	31.02	-1.61	125.64	9.76	0.00	164	174
1440	31.23	-1.49	134.87	22.40	0.00	174	184
1680	31.18	-1.17	189.73	6.94	0.00	184	194
1920	31.29	-0.80	113.66	16.88	0.00	194	204
2160	31.26	-0.78	141.53	11.86	0.00	204	214
2400	31.29	-0.78	228.44	12.52	0.00	214	224

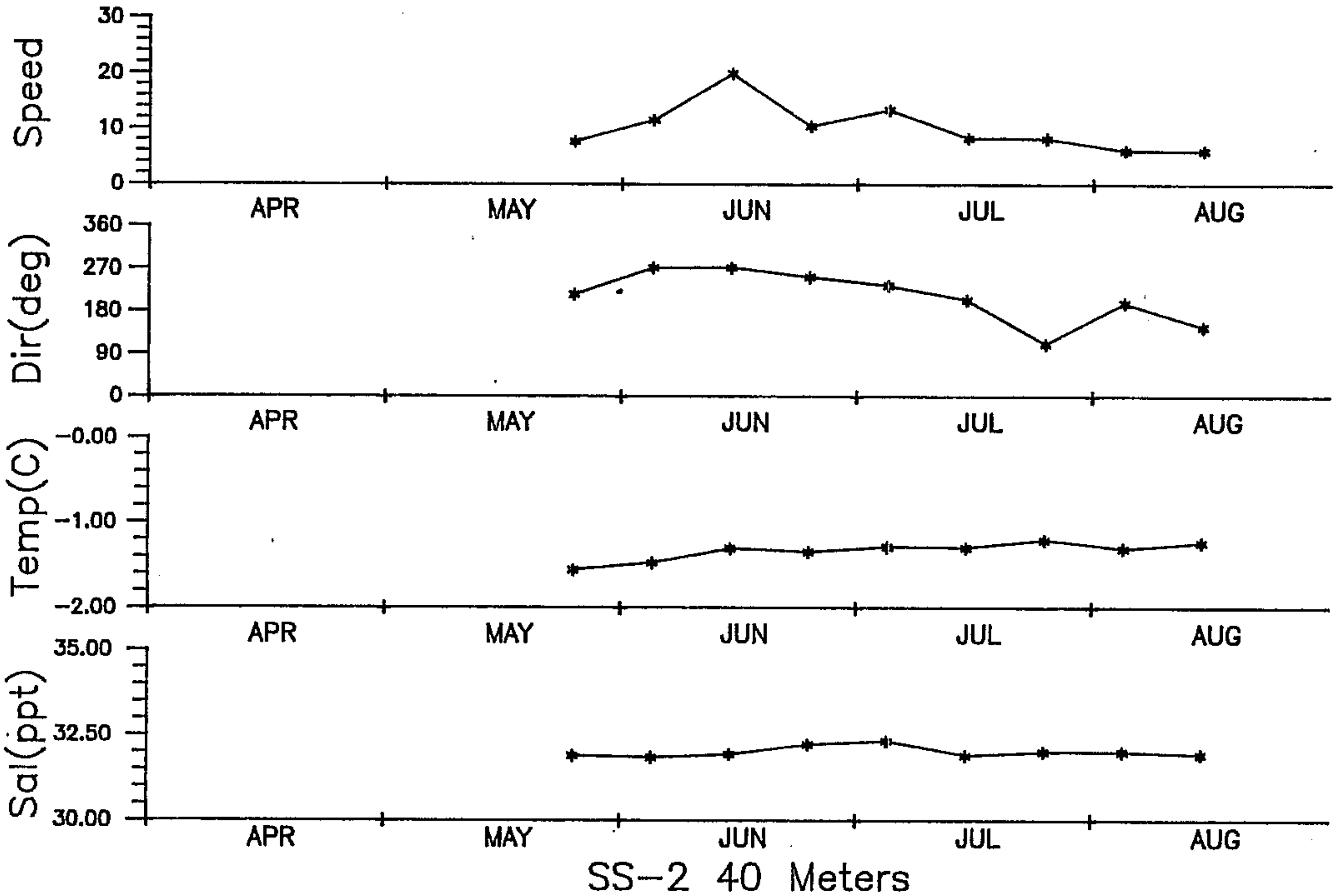
Station SS-4 (220 Meters)

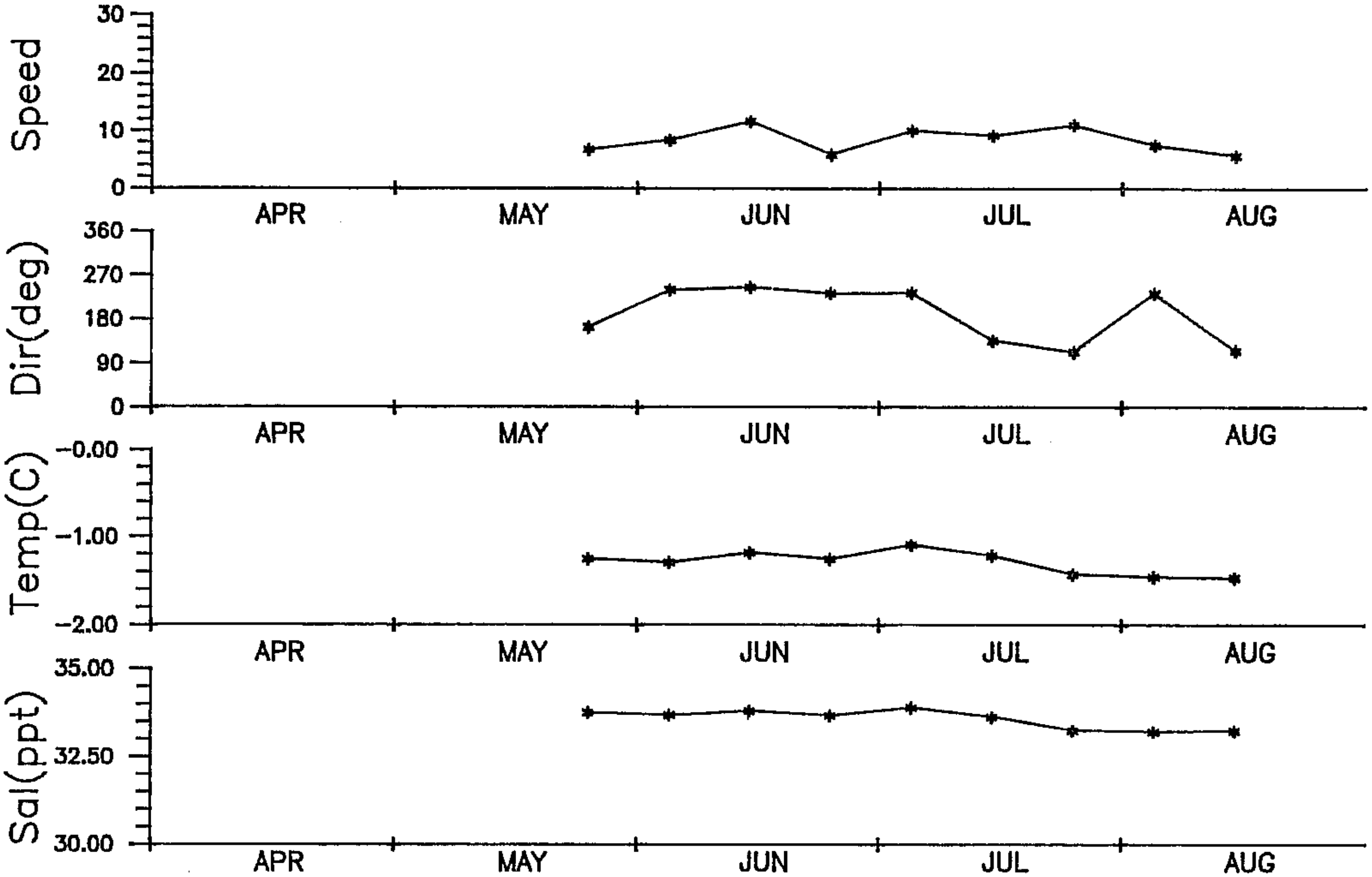
N	Sal	Temp	Dir	Speed	%TX	Julain Day Start	End
240	34.62	-0.07	137.19	2.63	0.00	124	134
480	34.60	-0.12	191.23	2.88	0.00	134	144
720	34.60	-0.10	158.21	2.34	0.00	144	154
960	34.61	-0.06	182.50	2.54	0.00	154	164
1200	34.61	0.01	257.41	2.44	0.00	164	174
1440	34.63	0.01	142.16	3.62	0.00	174	184
1680	34.57	-0.10	128.73	3.26	0.00	184	194
1920	34.23	-0.58	108.83	3.61	0.00	194	204
2160	33.58	-1.22	179.73	1.50	0.00	204	214
2400	33.91	-0.91	229.85	1.57	0.00	214	224


Trans
100
95
90
85
80
Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
-0.00
-1.00
-2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG
SS-1 33 Meters

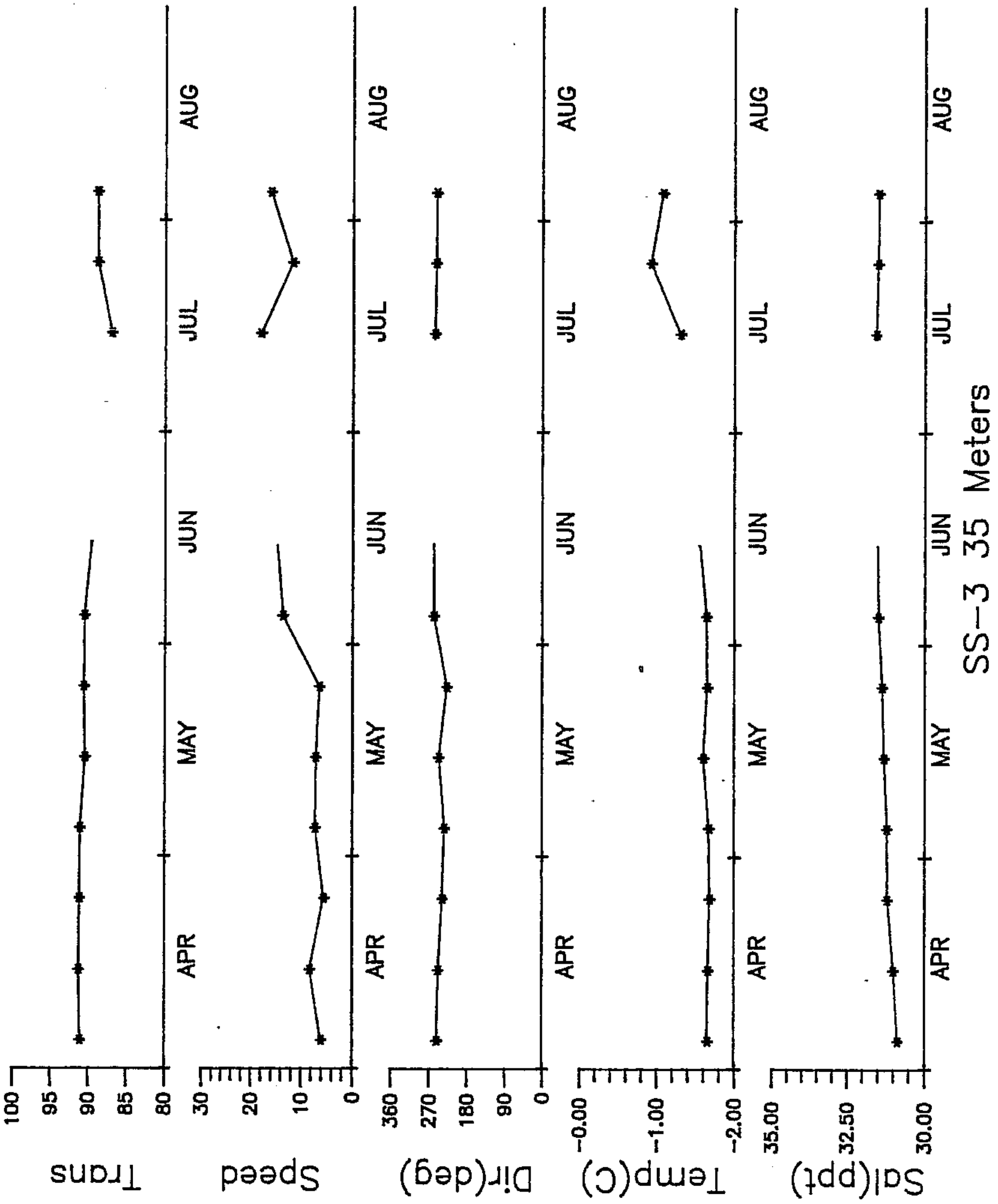


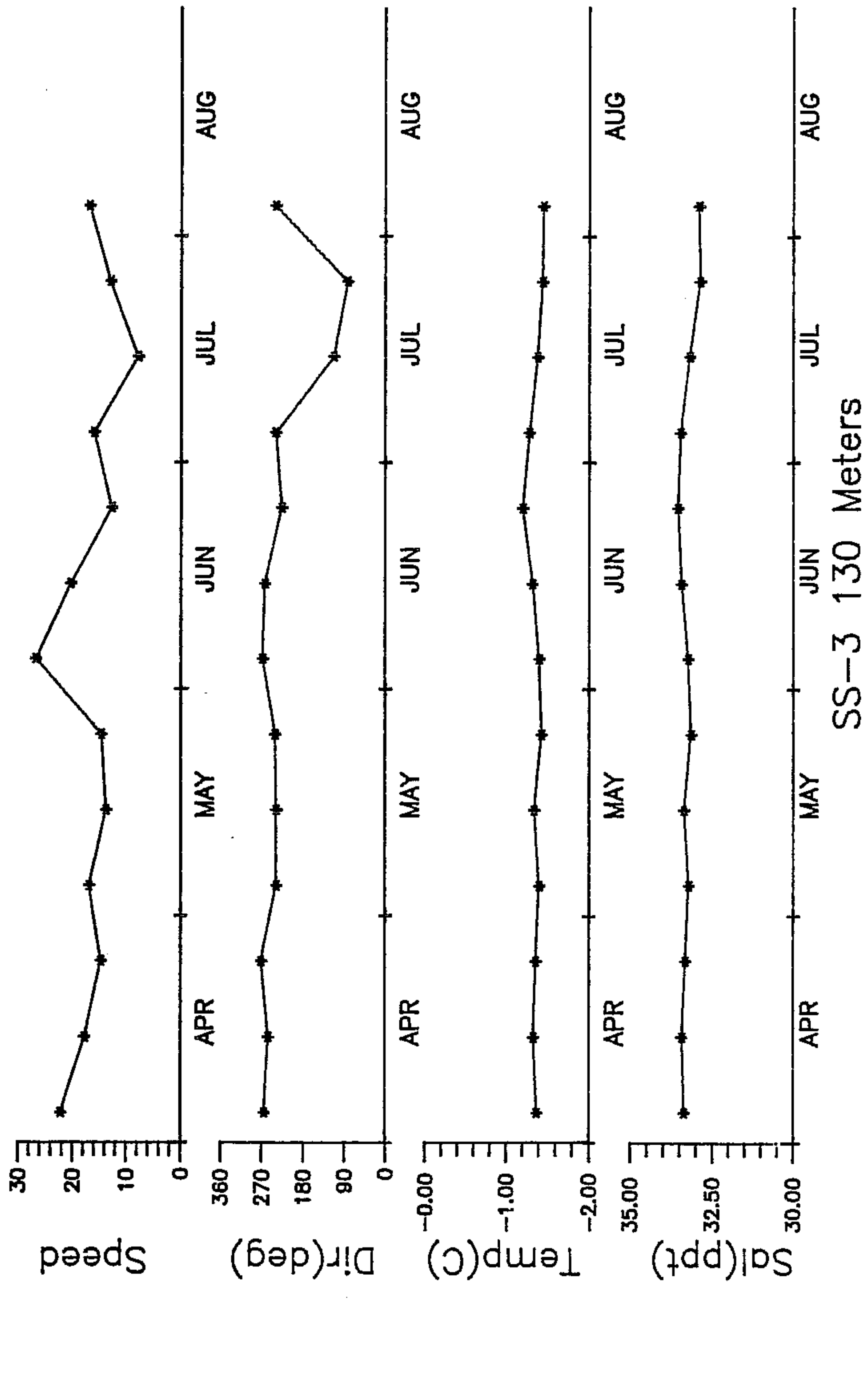
SS-1 160 Meters
Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
-0.00
-1.00
-2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG

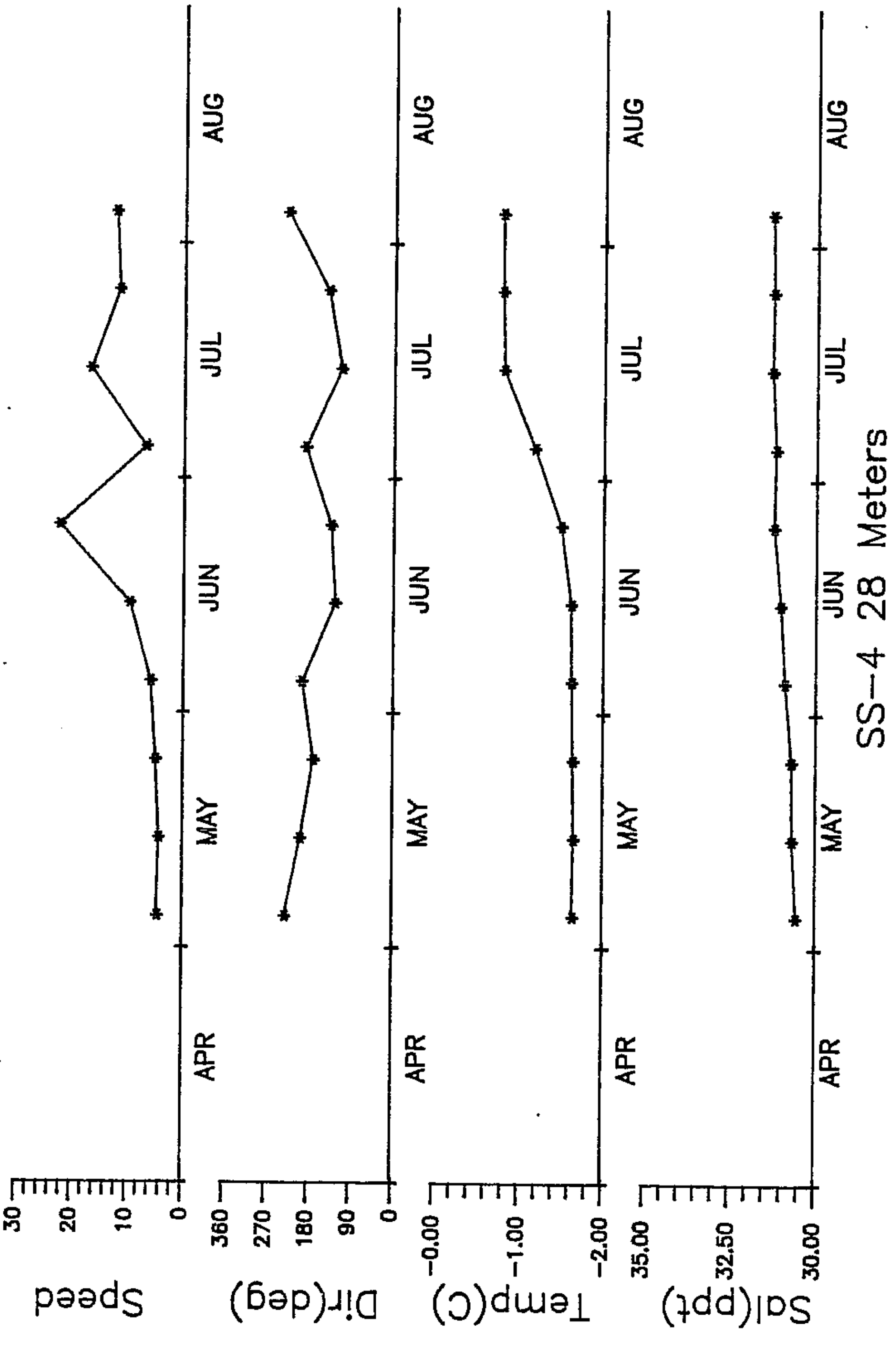

Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
-0.00
-1.00
-2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG
SS-2 40 Meters

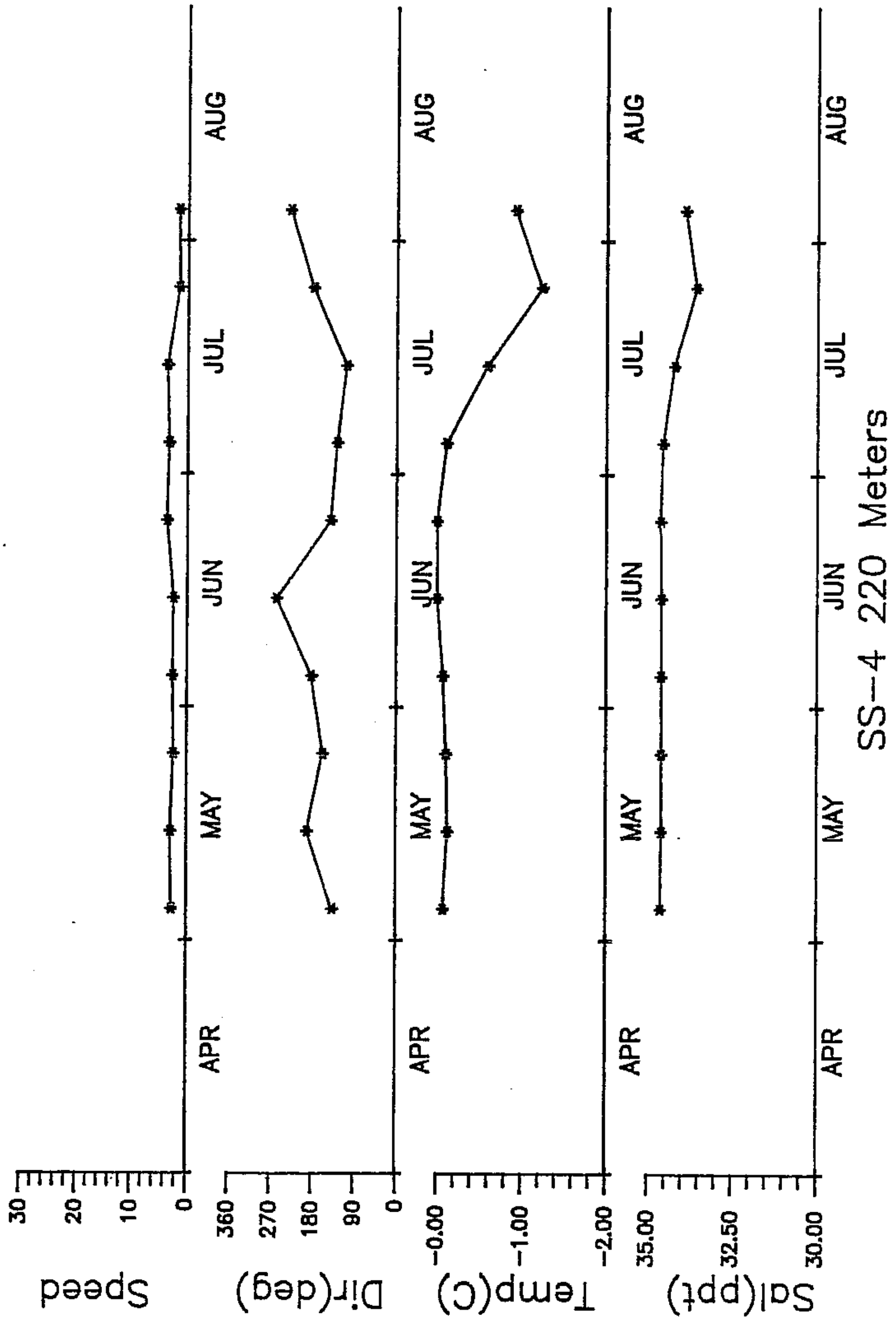


SS-2 130 Meters


Trans
Speed
Dir(deg)
Temp(C)
Sal(ppt)
100
95
90
85
80
30
20
10
0
360
270
180
90
0
-0.00
-1.00
-2.00
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG
SS-3 35 Meters


SS–3 130 Meters
Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
–0.00
–1.00
–2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG


SS-4 28 Meters
Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
-0.00
-1.00
-2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG



SS-4 220 Meters
Speed
30
20
10
0
Dir(deg)
360
270
180
90
0
Temp(C)
-0.00
-1.00
-2.00
Sal(ppt)
35.00
32.50
30.00
APR
MAY
JUN
JUL
AUG

Other NOGAP B.6 Data Reports Published Previously in the Canadian Data Report of Hydrography and Ocean Sciences Series

Macdonald, R.W., K. Iseki, E.C. Carmack, D.M. Macdonald, M.C. O'Brien, and F.A. McLaughlin, 1988. Data Report: NOGAP B.6; Beaufort Sea Oceanography, September, 1986. *Can. Data Rep. Hydrogr. Ocean Sci.:* **58**, 68pp.

Cuypers, L.E., A.W. Blaskovich, E.C. Carmack, and R.W. Macdonald, 1988. NOGAP B.6; Physical data collected in the Beaufort Sea, September, 1986. *Can. Data Rep. Hydrogr. Ocean Sci.:* **59**, 149pp.