REPORT OF FIELD ACTIVITIES: 1987

G.S.C. PROJECT 830007

BEAUFORT SEA COASTAL ZONE GEOTECHNICS

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INTRODUCTION

During the summer of 1987, a large group of field programs was carried out under the Geological Survey of Canada's Beaufort Sea Coastal Zone Geotechnics Project. These programs were supported by the Northern Oil and Gas Action Plan (NOGAP, Project D.1). This report is a compendium of seven individual reports on the field programs carried out.

In all cases, the field program relied on the logistic support of the Inuvik Scientific Resource Centre and the Polar Continental Shelf Project in Tuktoyaktuk. This support is gratefull acknowledged. The programs put an unusually large burden on the Program Support Division of the Atlantic Geoscience Centre, but the cheerful hard work of Borden Chapman, Mike Hughes, Don Locke and Bob Murphy got the job done most efficiently.

PART 1

Field Activities Report
Ellice Island, Mackenzie Delta, N.W.T.
July 12-August 20, 1987

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Acknowlegdements

Appreciation is expressed to P. Hill for his guidance in selecting the study area and helpful discussions during the field program. I am very grateful for the co-operation and assistance of D. Locke, who provided technical field support, J. Milne, who helped with the field work and M. Barter, the coxswain for the jet boat. Gratitude is extended to the Inuvik Research Labratory and the Polar Continental Shelf Project for logistical support and to G. Stroud who greatly assisted in the mobilization and demobilization of the camp.

Introduction

A six week field program, July 12-August 20, 1987, was carried out in the Olivier Islands area of the Mackenzie Delta, Northwest Territories (Figure 1). Fieldwork was sponsored by the Northern Oil and Gas Action Program and initiated as part of an MSc. Thesis in Geology. The purpose of the fieldwork was twofold: to collect oceanographic data along the distal portion of a major river system where the channel debouches into the Beaufort Sea and to collect sedimentologic data from the Olivier Islands and surrounding, exposed, sand bars.

Various methods of data collection were implemented. Oceanographic work included the deployment of 2 Aanderra current meters, Nisken water sampling, CTD measurements, 3.5 kHz high resolution seismic and sidescan profiling and bottom grab sampling. Vibracoring, gravity coring, minicoring and detailed environmental mapping provided much of the sedimentology data which was additionally supplemented by low level aerial photographs taken from a Cessna 206.

The collection of the majority of field data was facilitated by the Doppler, a 7 metre, jet propulsion vessel especially designed to navigate shallow waters. Where the water depth was less than 0.5 metres deep a 4 metre zodiac was used to transport the crew. Helicopter support was used for the vibracoring portion of the program.

The purpose of this report is to summarize sample locations and sampling methods established during the program and to provide suggestions for future fieldwork within the Olivier Islands area.

Jet Boat Operations

1. *Navigation and Positioning*

The study area was initially flown by helicopter to obtain an appreciation of the size of the area and to delineate recently exposed sand flats to aid in navigation. It was discovered that the position and extent of these flats had changed considerably from 1985 airphotos. Because of the shallow water, less than 1 metre in many localities, and the flat lying topography of the area the depth sounding and radar equipment on the Doppler were often inadequate for navigation. Consequently, frequently traveled boat routes had to be depth sounded with a metre stick and staked with the zodiac. Once these main channel routes were established navigation in the deeper parts of the channel was less difficult.

Station positions were obtained with a Mini Ranger navigation system. Three transponders were positioned approximately 7 kilometres apart to ensure that a minimum of 2 positioning fixes could be taken at each sampling station. Locations were accurate to within 50 meters.

2. *Oceanographic Work*

A water sampling transect was selected along the axis of both major channels to determine the variability of grain size and salinity from the deep, established, channel margins to the shallow channel mouth, at the coast. The first transect was 15 kilometres long on a bearing of 350 degrees, the second was 9 kilometres in length at 280 degrees. Sample stations were at intervals of 2.4 to 3 kilometres. Stations were sampled at 4 different times throughout the summer -July 24, July 29, August 16, and August 17- to detect suspended sediment concentration variations both from higher to moderate river flow conditions and subsequent to a storm surge. In addition to the sample stations 2 Aanderra current metres were deployed (along the first transect) on July 22, 1987 and retrieved on August 18, 1987. The location and type of oceanographic samples are shown in Figure 2.

2a. Methods

A standard procedure of oceanographic data collecting was followed at each sample location. Initially a flocculation camera was lowered to the channel bottom to take photographs of clay floccules at 2 second intervals. This was followed by water and salinity sampling and CTD measurements. The station work was completed by obtaining a sediment sample from the channel bottom.

Water samples were obtained with 1-litre Nisken bottles via 2 methods. Where the channel bottom did not exceed 11 metres 4 Nisken bottles were attached to a 3/16 inch cable at 3 metre intervals (1, 4, 7, and 10 metres) and retrieved with a hydraulically driven winch. Because of mechanical problems with the winch motor this method became too time consuming. Alternatively, in channel depths greater than 11 metres a single Nisken bottle was affixed to a rope cable and hand lowered to each successive depth. In both cases a small portion of the Nisken water sample was placed into a salinity vial at each depth, on alternate water stations, to monitor any salinity fluctuations. The remainder of the water sample was stored in a 1-litre Nalgene bottle and filtered that evening or the next day.

An Aanderra current meter, modified to record CTD measurements, was used to obtain water column profiles at each station. Data was recorded at 3 metre intervals, from the surface to the bottom of the water column, by lowering the current meter with a hydraulic winch. Where the river debouches into the Beaufort Sea , CTD measurements were recorded at 1 metre intervals to more accurately detect higher salinity concentrations. All measurements were displayed on a deck recording unit which received the information through a conductive cable fixed just above the CTD transducer.

Bottom sediments were collected with an Eckman grab sampler. In many cases the channel bottom was too hard to allow penetration of the sampler and a grab was not obtained.

3. *Seismic and Sidescan Data*

An RTT 1000, 3.5 and 7 kHz, high resolution, subbottom profiling system was used simultaneously with an EG and G 259 sidescan fish to characterize the geometry of the two major channels. Four profiles were completed along the major channel axis and perpendicular to the channel axis (Figure 3). The shallowest depth at which both instruments recorded the channel bottom was 3.5-4 metres, depending on the sea conditions during the profiling.

4. *Gravity Coring*

Gravity cores were taken to provide sedimentologic information from the active channel bottom, which could then be compared to sediment cores taken from abandoned channels. In addition grain size data from the gravity cores would aid in determining the sediment load capacity of the rivers.

Five gravity cores were obtained using a gravity corer equipped with two 23 kg (50 lb) weights. The corer was attached to the winch cable, allowed to free fall to the channel bottom and retrieved with the winch. Ten coring locations were chosen from the 3.5 kHz and sidescan records where surficial channel bottom sediments appeared to be soft and uncompacted (for ease of corer penetration), where well preserved sedimentary structures were observed and where the water depth was greater than 6 metres. In all cases penetration was poor, the maximum being 12.7 cm. Rarely was a core obtained on the first attempt and after 3 unsuccessful attempts the site was abandoned. At these latter locations the channel surface appeared too compacted for penetration, causing the corer to fall on its side. All cores were disturbed upon recovery.

Land Based Operations

1. *Mapping*

Detailed mapping was carried out over a 2 kilometre square area, in the northern portion of Pitt Island, to establish and outline the subaerial deltaic environments and to choose favourable vibracore sites. In addition, most sand flats along the two major rivers were mapped during periods of low water levels. Nineteen pits were logged and photographed and, where appropriate, samples were taken for ostracod analysis. Nine, 10 cm long, push cores were extracted in those areas

inaccessible for vibracoring.

2. *Vibracoring*

Seventeen vibracores were taken from the environments mapped on Pitt Island and from sand flats exposed along West Island (Figure 4). Sites were selected to ensure that at least 2 cores were taken from the same environment but at different localities.

2a. Methods

The vibracoring equipment was transported by the Doppler, unloaded into the zodiac and carried ashore to the stations located on the sand flats of West Island. For the major coring program on Pitt Island the equipment was slung to a central location by a 206 Bell Jet Ranger helicopter and transported to the sites by a Honda 125 ATV with attached trailer.

The equipment consisted of a vibrating head, a motor, a 20 foot steel tripod with collapsible legs, a winch, a snatch block, a flex shaft and twenty, 10 foot, 3 inch outer diameter, 1/8 inch thick aluminum core tubes. At each station the tripod was set up over the core site and the head was attached, via U-grips, to the aluminum core tube. After the motor was turned on the tube was guided into the ground until it reached permafrost (75 cm-125 cm). The motor was turned off immediately to avoid unnecessary disturbance of the core. The top of the tube was measured, to determine the amount of sediment compaction, filled with water and sealed tightly with a rubber plug to provide suction. After the vibrating head was removed a rope was attached from the snatch block to the aluminum tube and the sediment and tube were pulled out of the ground with the winch. The tube was cut to the top of the sediment, capped and labeled. All cores were transported upright to a central location, placed in hand made core boxes and slung to the campsite.

Recommendations

Several suggestions for future fieldwork and program support are proposed based on the data collected during the 1987 field season and the difficulties encountered gathering the data.

Fieldwork

1. An oceanographic transect should be completed from the coast, outward to the end of the Mackenzie River sediment plume, to document the change in SSC and salinity concentrations. Underwater photographs would be necessary to observe any clay flocculation with the introduction of salt water offshore. The SSC, in the channels of the Olivier Islands, was sufficiently high enough to completely blacken all of the photographs taken in August 1987.

2. A vibracoring program in water depths less than 2 metres would be necessary in determining the grain size and sediment history of the radial bars which exist at the channel mouths. Because of the shallow water depths in this area neither seismic profiling nor gravity coring could be completed. Information from these bars will help uncover the depositional patterns at the river mouth and the mechanisms for such rapid shallowing of the channel at the coast.
3. Vibracoring of several sand bars and point bars, inaccessible by the Doppler, would strengthen the data set of cores representative of the deltaic environments. Knowing the structure of these active bars would provide insight into their formation and growth and ultimately the formation and growth of the Olivier Islands, assuming a similar development.
4. Additional seismic profiling and detailed mapping could easily be carried out within several localities of the Olivier Islands where only reconnaissance studies could be completed during the 1987 field program.

Program Support

1. The Doppler was adequate for all of the scientific operations completed during the program. However, offshore transects could not be carried out because of the inadequate radar system on the boat. For future work a Sat Nav or GPS is recommended.
2. To improve oceanographic operations a small, light, aluminum, winch is recommended. The A.G.C. winch weighed 450 pounds, occupied a substantial part of the working space on the boat and was often in need of repair.
3. A proper mount designed for mounting the 3.5 transducer to the side of the Doppler would have greatly improved the ease with which the transducer could be lowered into the water, for profiling and raised above the water surface, between stations.
4. For more efficient use of time in future programs, more helicopter support is recommended.
5. Because the field area is now somewhat familiar a summer program of 3-4 weeks would be sufficient to complete the work outlined above.

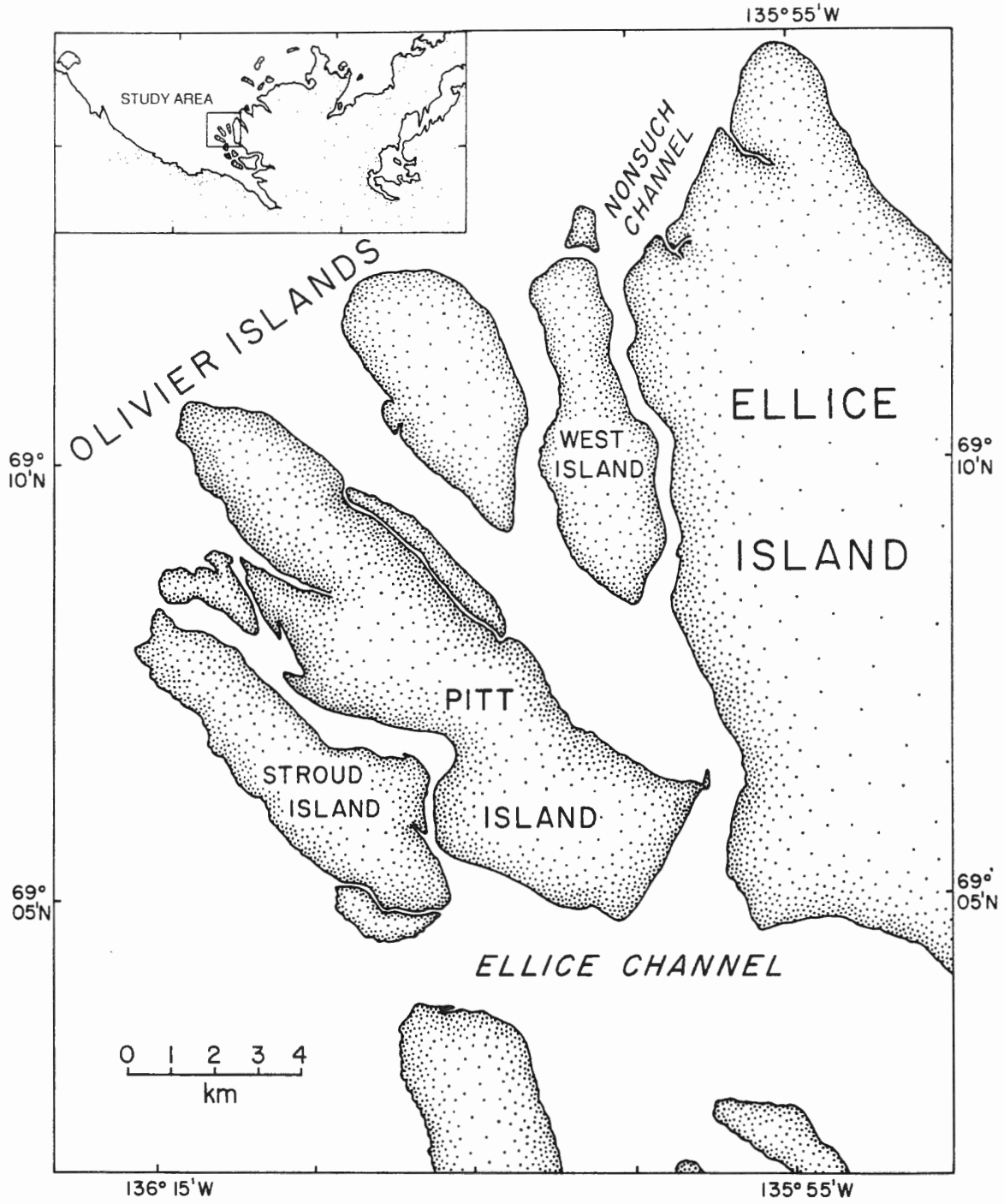

Figure 1. Location of the study area.

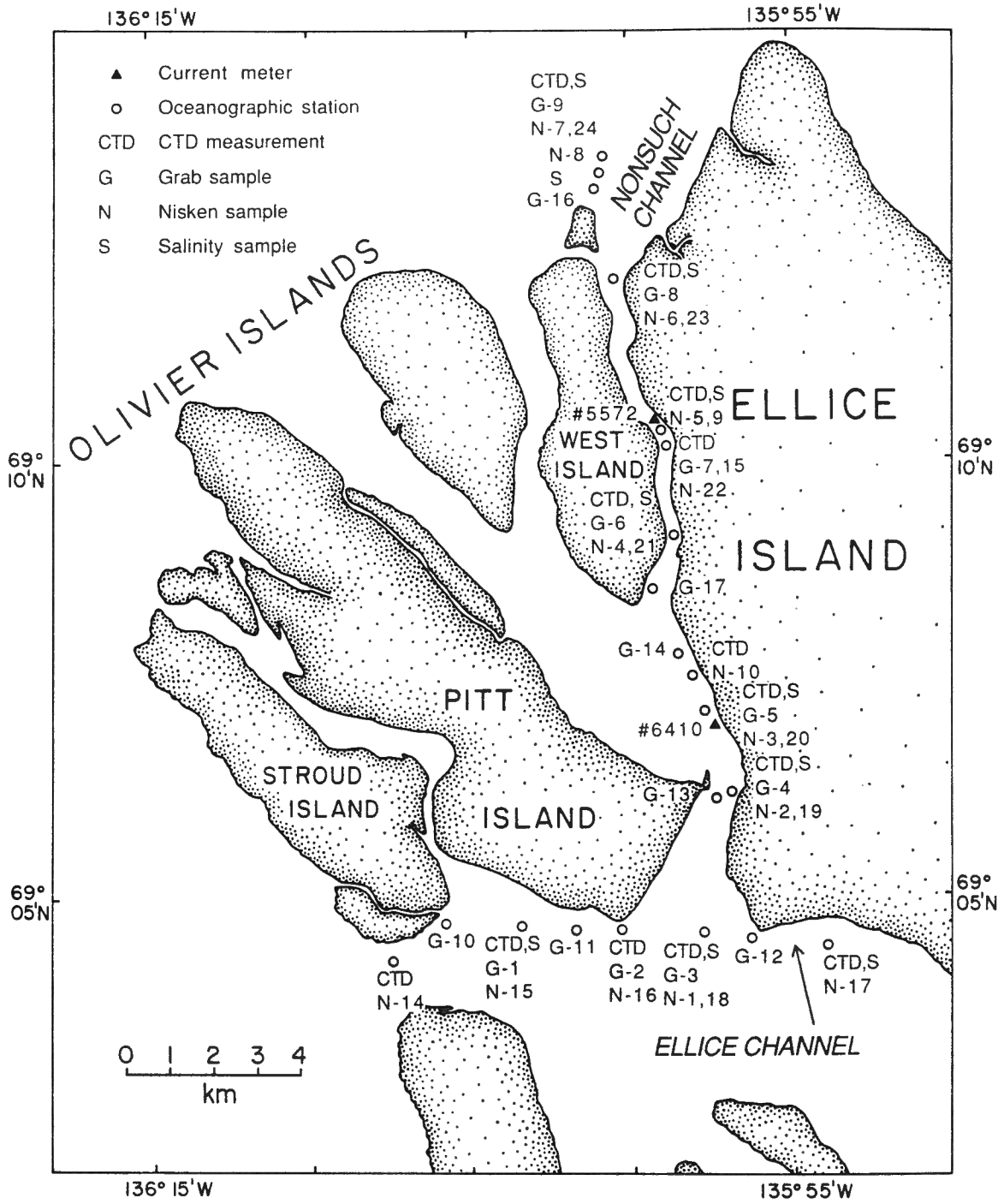

Figure 2. Location and type of oceanographic samples.

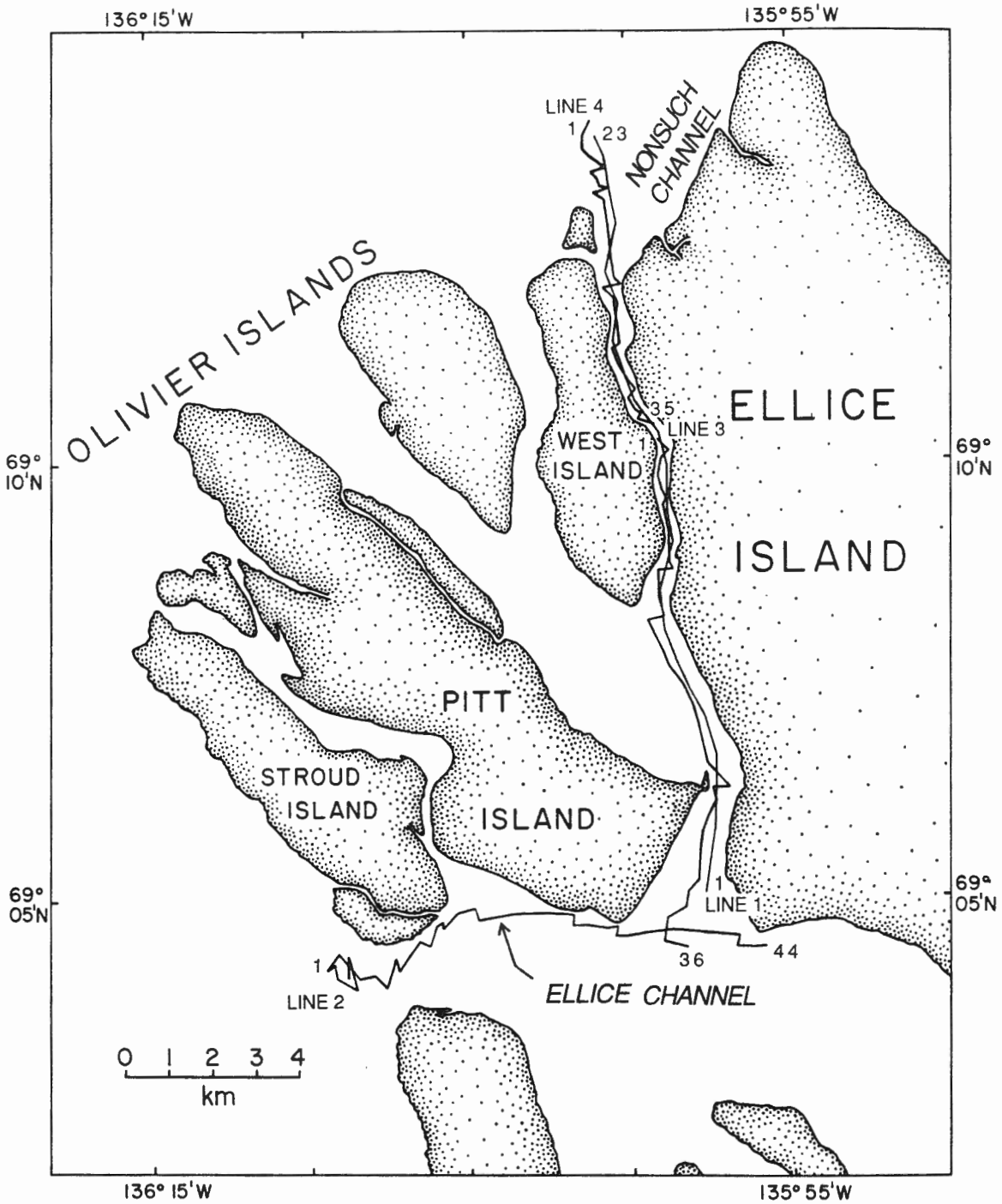

Figure 3. Position of seismic and sidescan track plots.

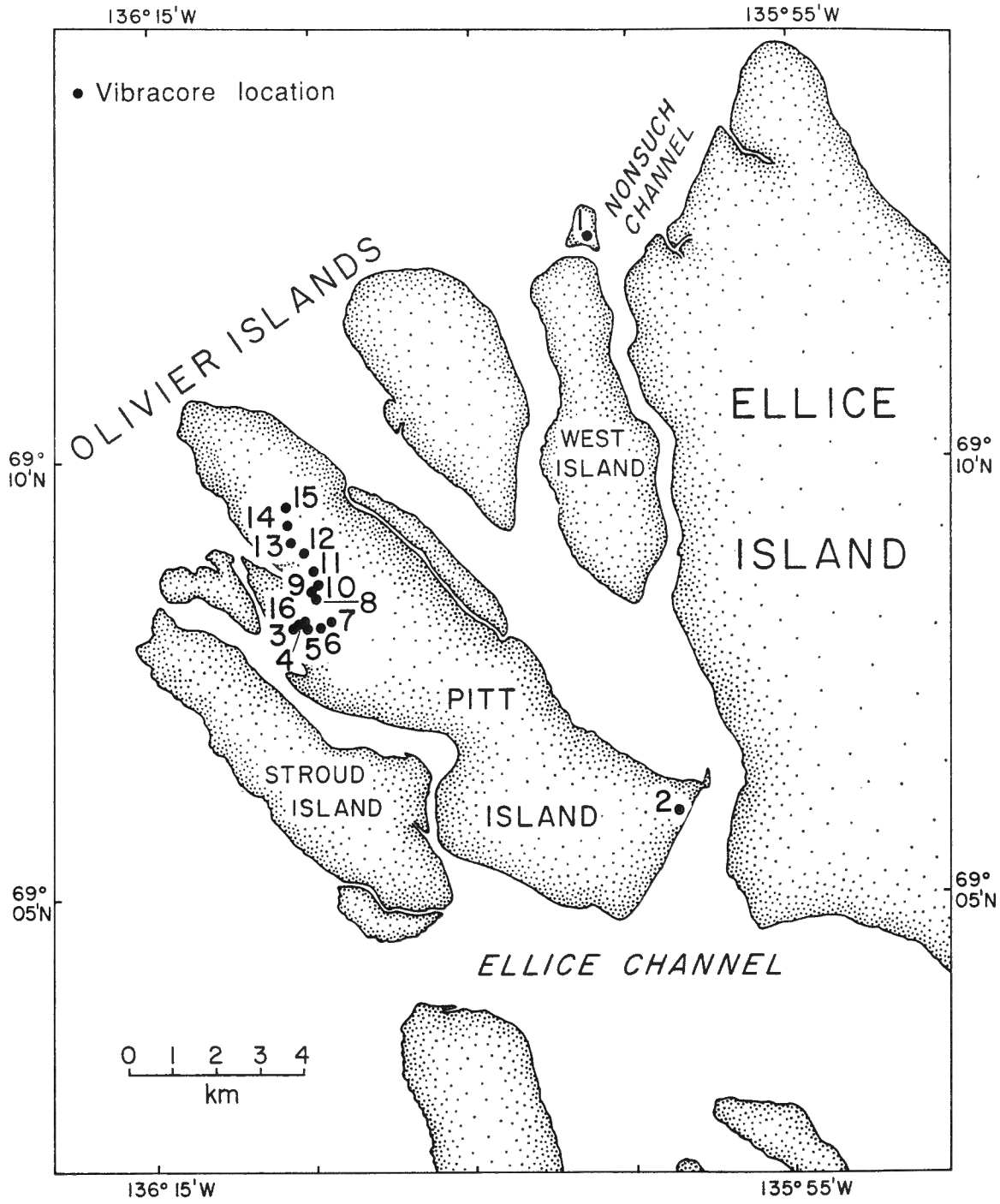

Figure 4. Vibracore locations.

PART 2

MACKENZIE RIVER DELTA - SEDIMENT SAMPLING 1987

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A sediment sampling program was conducted in the Mackenzie delta in cooperation with Phil Hill, AGC, to examine the dispersion of particulate material through the delta and into the Beaufort Sea. Suspended, bottom and bank sediment samples, Plankton camera profiles and CTDs were variously collected at a total of 63 stations. Stations were occupied at the head of the delta (Arctic Red River), from Inuvik to Shallow Bay at the foot of the delta and in the region of Ellice Island. Additional samples were collected at Campbell Lake south of Inuvik. The proposed transect through the plume to salt water and the river stations from Inuvik to Arctic Red River were not sampled due lack of vessel support.

During the time of sampling the Mackenzie river was in flood condition due to unusually heavy rainfall in the Liard Basin which resulted in SPM concentrations of about 3000 mg/l at Fort Simpson. Hence, SPM concentrations were extremely high throughout the delta, ranging from 300 to 600 mg/l in most areas. Samples collected at the intersection of Reindeer and Middle channels had values over 1000 mg/l which could have been due in part to strong winds opposing the current. SPM values measured in 1981 were an order of magnitude lower than those of 1987.

As a result of the extreme sediment conditions no results were possible from the camera profiles in the main channel areas. Profiles were obtained along the length of the small slough leading to the camp on Ellice Island which show the transition from opaque (400 mg/l) to clean water (2.5 mg/l), and in Campbell Lake. CTD profiles show complete mixing and no indication of salt intrusion at any of the stations occupied. Current speeds ranged from 50 to 90 cm/sec and were again fairly uniform through the water column.

Further progress on this study is dependent on support becomming available for sample analysis.

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
01	Middle Channel at end of Oniak Ch.	X		870812001	SS	0	460.83	
				002	SS	5	600.29	
				003	SS	4	502.55	
				004	SS	3	517.13	
				005	SS	2	469.25	
				006	BS	6		
02	Luker Channel			007	SS	0	142.30	
03	Bombardier Channel-West End			008	SS	0	44.24	
04	Bombardier Channel-East End	X		009	SS	2	55.76	
				010	SS	1.5	54.00	
				011	SS	1	57.52	
				012	BS	1.75		
				013	SS	0	56.60	
05	East Channel near Inuvik	X		014	SS	6	80.11	
				015	SS	4	78.64	
				016	SS	2	75.76	
				017	SS	0	70.93	
				018	BS	6.5		
06	Opposite Inuvik			019	Bank			Syringe Core
				020	Bank			
				021	Bank			Syringe Core
				022	Bank			Section through Bank
				023	Bank			Section through Bank
				024	Bank			Section through Bank
				025	Bank			Section through Bank

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
07	Downstream from Inuvik			870812026	Bank			
August 13								
01	MacKenzie River Above Arctic Red River	X		870813001	BS	14		Mid Channel
				002	SS	19	537.74	Moved further upstream
				003	SS	10	552.46	
				004	SS	0	543.21	
02	MacKenzie River Above Arctic Red River			005	SS	2	449.90	North Side
				006	SS	0	446.22	
03	MacKenzie River Above Arctic Red River			007	SS	0.8	485.85	South Side
				008	SS	0	366.67	
04	MacKenzie River Above Arctic Red River			009	Bank			South Shore - Syringe Core
				010	Bank			South Shore - Syringe Core
				011	Bank			South Shore - Syringe Core
				012	Bank			30 m Inland
				013	Bank			40 m Inland
05	MacKenzie River Above Arctic Red River			014	Bank			North Shore - Scree Slope
06	Arctic Red River 2 km Upstream from mouth			015	Bank			Syringe Core
				016	Bank			Section - 5 cm
				017	Bank			Section - 5 cm
				018	Bank			Section - 5 cm
07	Arctic Red River 3 km Upstream from mouth	X		019	SS		270.51	Central Channel
				020	BS			
				021	Bank			South Shore

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
07	Arctic Red River - 3 km (cont'd)			870813022	SS	2	298.18	Central Channel
				023	SS	0	260.74	
				024	Bank			North Bank
08	MacKenzie River at Arctic Red River Ferry Crossing			025	SS	10	470.21	West Side
				026	SS	0	564.09	
09	MacKenzie River at Arctic Red River Ferry Crossing			027	SS	17	625.82	Middle Channel
				028	SS	0	531.32	
10	MacKenzie River at Arctic Red River Ferry Crossing			029	SS	4	487.32	East Side
				030	SS	0	480.31	
August 14								
01	Campbell Lake (south of Inuvik)	X		870814001	SS		1264.31	North end opposite inflow water from surface of grab Syringe Core
				002	BS			
				003	BS			
				004	SS	2	3.18	
				005	SS	4	3.36	
				006	SS	0	2.74	
02	Campbell Lake (south of Inuvik)			007	SS	3	2.14	approx. 1 km from Entrance
				008	SS	4	2.09	
				009	SS	0	2.28	
				010	BS		2.13	Surface of Grab
				011	BS			Syringe Core
				012	BS			

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
03	Campbell Lake	X		870814013	SS	2	1.88	approx. 2 km from Entrance
				014	SS	4	1.59	
				015	SS	6	1.69	
				016	SS	0	1.61	
				017	BS	7	10483.57	Surface of Grab
				018	BS			
				019	BS			
04	Campbell Lake			020	BS	2.4		Close to South Shore
05	Campbell Lake			021	BS	10.5		100 m offshore
06	Campbell Lake			022	BS			Mouth of N. Inflow Stream
07	Campbell Lake			023	BS			Approx. 500 m upstream
08	Campbell Lake			024	BS			Approx. 1000 m upstream
09	Campbell Lake	X		025	SS	0	2.35	
				026	SS	2	1.75	
				027	BS			
				028	Bank			
010	Campbell Lake			029	SS	0	0.95	At Highway
August 15								Ellice Island Camp
01	Nonesuch Channel	X		870815001	SS	3	431.38	Seaward End
				002	SS	6	447.15	
				003	SS	4	335.46	
				004	SS	0	447.96	
				005	BS			
				007	BS			Syringe Core

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
02	Off Nonesuch Channel	X		870815006	SS	5	533.45	1 mi from 01
				008	SS	3	467.57	
				009	SS	1.5	424.29	
				010	SS	0	341.81	
				011	BS	5		
03	Off Nonesuch Channel	X		012	SS	0	405.38	2.1 mi from 01
				013	SS	2	500.19	
				014	SS	5	504.89	
				015	SS	6	580.91	
				016	BS			
04	Off Nonesuch Channel	X		017	SS	3	453.98	3.3 mi from 01
				018	SS	1.5	448.35	
				019	SS	0	372.85	
				020	BS			
05	Off Nonesuch Channel	X		021	SS	1	403.19	4.2 mi from 01
				022	SS	0	401.07	
				023	BS	1		
				024	BS	1.5		
06	Mouth of Marina Slough	X		025	SS	0	258.14	Start of Transect towards camp.
				026	BS			
07	Marina Slough	X		027	SS	3	19.19	0.6 mi from mouth
				028	SS	0	19.37	
				029	BS			
08	Marina Slough	X		030	SS	3	7.64	1.2 mi from mouth
				031	SS	0	7.45	
				032	BS			

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
09	Marina Slough	X		870815033	SS	6	5.29	2.1 mi from mouth
				034	SS	0	2.75	
				035	SS	0		
10	Marina Slough	X		036	SS	6	2.34	3.4 mi from mouth
				037	SS	0	2.00	
				038	BS			
August 16								
	Battery Site West I.			870816001	Bank			Station Number not recorded
11	SW of Olivier Island	X	X	002	SS	1	447.24	K.J. (Kim Jenner) Stn 14
				003	SS	4	532.88	
				004	SS	7	600.29	
				005	BS			Sand
				006	BS			mud lump
12	E. of End of Olivier Island	X	X	007	SS	1	477.62	KJ 15
				008	SS	4	564.42	
				009	SS	7	546.06	
				010	SS	11	572.10	
				011	BS			
13	Mid Point Olivier to Ellice	X	X	012	SS	1	510.04	KJ 16
				013	SS	4	578.49	
				014	SS	8	643.03	
				015	SS	12	764.43	
				016	BS			Off Anchor
				017	BS			Off Grab

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
14	South of Ellice Island	X	X	870816018	SS	1	390.91	KJ 17
				019	SS	3	449.04	
				020	SS	8	537.16	
				021	SS	10	650.70	
				022	SS	13	804.76	
				023	SS	16	718.25	
August 17								
15	South end of Nonesuch Channel	X	X	870817001	SS	1	381.16	KJ 18
				002	SS	4	510.70	
				003	SS	7	578.12	
				004	BS			
16	Nonesuch Channel	X	X	005	SS	1	376.44	KJ 19
				006	SS	4	399.78	
				007	SS	7	414.99	
				008	SS	10	406.14	
				009	BS			
17	Nonesuch Channel	X	X	010	SS	1	280.84	KJ 20
				011	SS	4	443.89	
				012	SS	7	416.43	
				013	SS	10	509.69	
				014	BS			
18	Nonesuch Channel	X	X	015	SS	1	359.19	KJ 21
				016	SS	4	370.68	
				017	SS	7	380.14	
				018	SS	10	404.22	
				019	SS	13	441.32	
				020	BS			

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
19	Nonesuch Channel	X	X	870817021	SS	1	290.31	KJ 22
				023	SS	4	373.73	
				024	SS	7	393.38	
				025	SS	10	392.30	
				026	SS	21	395.69	
				027	BS			From anchor
20	Nonesuch Channel	X	X	028	SS	1	320.95	KJ 23
				029	SS	4	427.28	
				030	SS	7	555.78	
				031	SS	9	597.20	
				032	BS			
21	Nonesuch Channel	X	X	033	SS	1	460.17	KJ 24
				034	SS	4	472.39	
				035	SS	5.5	491.65	
				036	BS			
				037	Bank			Opposite sample site on dry bar
				038	Bank			Syringe Core
August 18								
30	Ellice Island Camp			870818001	Bank			Syringe Core
				002	SS	0	133.60	
				003	Bank			
				004	Bank			
31	Marina			005	Bank			Syringe Core
				006	Bank			
32	South of Camp			007	SS	0		Overflow Pond
				008	Bank			

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
33	Stream from Tundra (Section from Headwater)			870818009	SS	0	14.37	
				010	SS	0	30.20	
				011	SS	0	67.39	
				012	SS	0	37.47	
				013	SS	0	116.42	
August 20								
22	South of Ellice, Langley Channel		X	870820001	SS	9		
				002	SS	5		
				003	SS	0		
				004	BS			
23	Langley Channel	X	X	005	SS	26	720.84	
				006	SS	8		
				007	SS	0		
				008	BS			Off anchor
				009	Bank			Top of Bank
				010	Bank			1 m below - syringe core
24	West End of Marcus Channel (off Reindeer Channel)	X	X	011	SS	0	701.94	
				012	SS	1.5		
				013	BS			
				014	Bank			Syringe Core
				015	Bank			
25	Channel North of Intersection with Middle Channel		X	016	SS	4.5		
				017	SS	0	1009.97	
				018	BS			
26	Intersection of Reindeer and Middle Channel	X	X	019	SS	11		
				020	SS	7	1320.80	
				021	SS	4	1279.97	
				022	SS	0	1239.97	
				023	BS			

STN	LOCATION	CAM	CTD	ID #	TYPE	DEPTH	SPM (mg/L)	COMMENT
27	Middle Channel Downstream of Marcus Channel		X	870820024	SS	8	1610.88	
				025	SS	4	1502.71	
				026	SS	0	1139.96	
				027	BS			
28	East End of Marcus Channel		X	028	SS	4	1159.77	
				029	SS	0	964.97	
				030	BS			
				031	Bank			
				032	Bank			Syringe Core
29	Entrance to Bombardier Channel (Luker Channel)		X	033	SS	2.5	335.84	
				034	SS	0	338.02	
				035	BS			
August 22								
30	6920.4 136 59.2			870821001	SS	0		Offshore
				002	SS	8.5	8.24	
				003	BS			
31	6921.14 136 29.6			004	SS	6		
				005	SS	0	82.95	
				006	BS			
32	240° MAG Off Ellice Artificial Island			007	BS			
				008	SS	0		

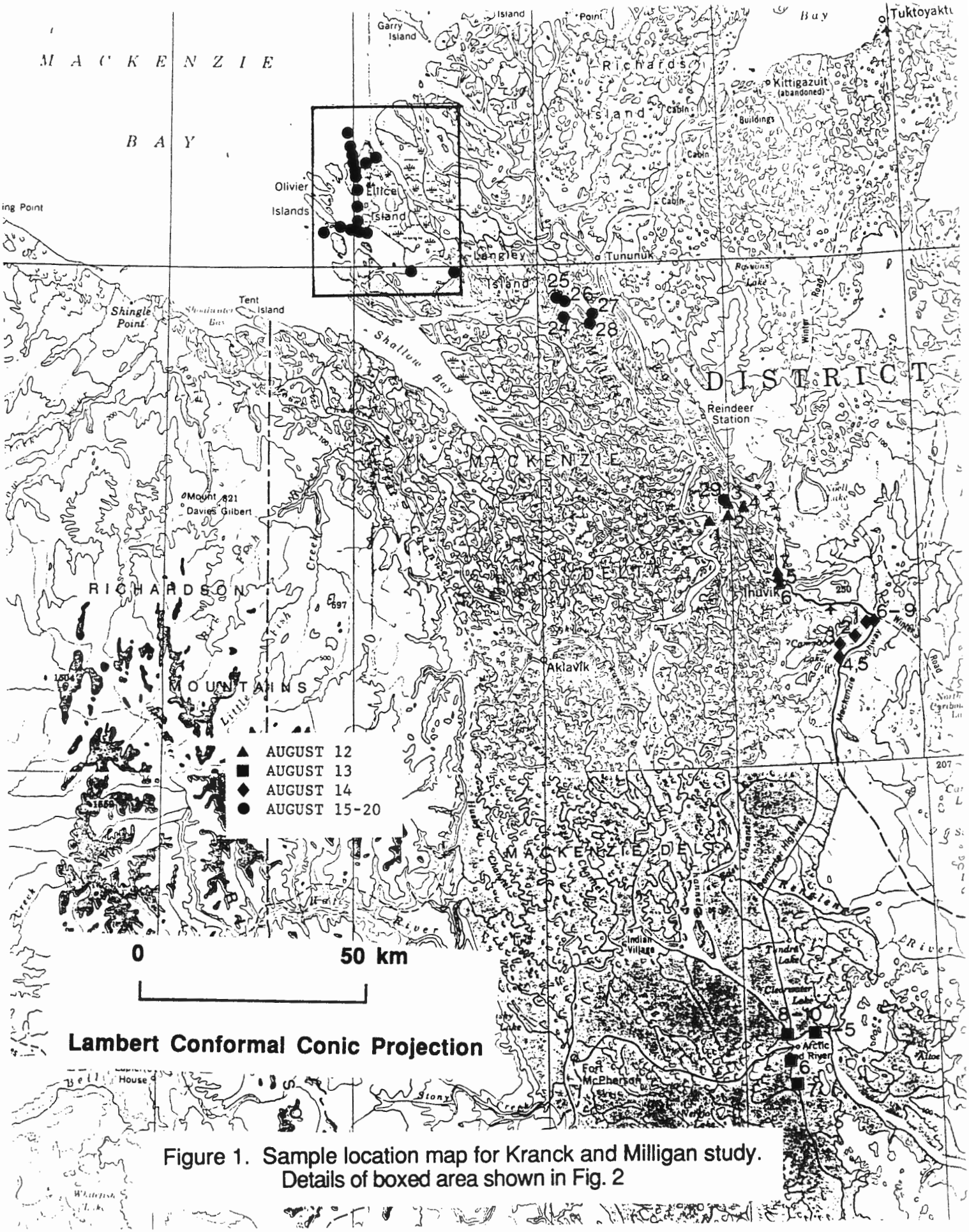

Figure 1. Sample location map for Kranck and Milligan study. Details of boxed area shown in Fig. 2

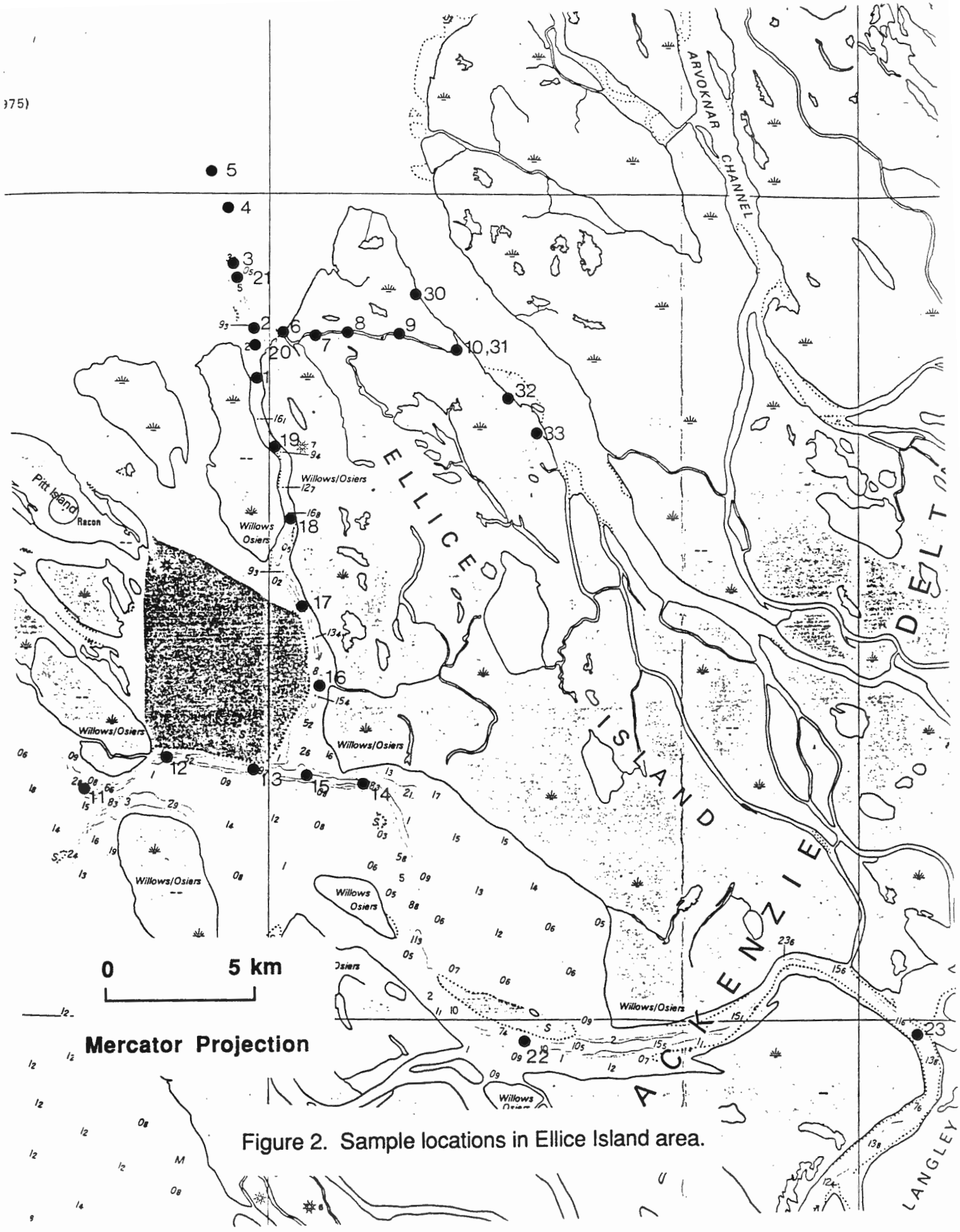

Figure 2. Sample locations in Ellice Island area.

PART 3

CRUISE REPORT

CSS JOHN P. TULLY

BEAUFORT SEA

AUGUST 7 TO AUGUST 12, 1987

BY

ROBERT A. HARMES

A bottom sampling program was carried out onboard CSS JOHN P. TULLY between August 7 and August 12, 1987 in the Canadian Beaufort Sea. A total of 36 grab samples and 35 water samples were collected along previously run seismic lines. The purpose of the program was to provide ground truth to aid in the interpretation of the seismic data and to increase our knowledge of the grain size distribution of surface sediments in the Beaufort Sea. We had also planned to piston core at each site but the winch needed to handle the large diameter corer was not functional so that part of the program had to be cancelled.

Two sub-samples/ push cores were taken at station #29 to be run through a flume tank at Dalhousie University by John Grant. The flume tank test gives an indication of the transportability of the surface sediments by bottom currents.

In addition to sampling, a TRIPOD owned by the United States Geological Survey was deployed in 60m of water on the Yukon Shelf. The TRIPOD is equipped with current meters, cameras for photographing the sea floor and upward looking sonar to observe ice activity during winter freeze-up. It will be recovered during the 1988 field season.

NAVIGATION: Standard Satellite Navigation was used to position the ship for sampling. Sat-Nav is not a consistently accurate positioning system so there may be slight errors in the co-ordinates listed for the stations.

SAMPLE LOCATIONS

	LATITUDE	LONGITUDE
TRIPOD	70 14.34'N	140 21.48 W
STN #		
1	69 38.2 N	137 48.0 W
2	69 36.0 N	137 45.0 W
3	69 30.2 N	137 35.5 W
4	69 27.3 N	137 30.7 W
5	69 25.4 N	137 27.5 W
6	69 22.6 N	137 25.4 W
7	69 21.13 N	137 22.61 W
8	not recorded	
9	69 19.02 N	137 17.72 W
10	69 18.22 N	137 16 46 W
11	69 17.38 N	137 15.09 W
12	69 53.4 N	136 26.0 W
13	70 3.0 N	136 37.0 W
14	70 12.2 N	136 52.0 W
15	70 19.0 N	137 5.0 W
16	70 34.1 N	134 10.2 W
17	70 33.0 N	134 9.0 W
18	70 30.25 N	134 8.1 W
19	70 30.0 N	134 2.0 W
20	70 29.9 N	134 1.7 W
21	70 27.3 N	133 55.8 W
22	70 23.0 N	133 46.0 W
23	70 15.3 N	133 29 8 W
24	70 14.0 N	133 28.39 W
25	70 12 98 N	133 25.0 W
26	70 6.1 N	133 20.83 W
27	70 4.15 N	133 49.14 W
28	70 4.4 N	133 39.7 W
29	70 4.0 N	133 29.0 W
30	70 4.0 N	133 20.0 W
31	70 4.0 N	133 10.0 W
32	69 56.4 N	133 24.6 W
33	69 52.2 N	133 16.5 W
34	69 49.7 N	133 11.4 W
35	70 26.3 N	133 20.3 W
36	70 25.8 N	133 18.8 W

CONCLUSIONS: The major part of the sampling program had to be cancelled due to equipment failure. This problem should be addressed before the 1988 field season.

PART 4

CRUISE REPORT

CCGS NAHIDIK

September 11 - 18, 1987
Beaufort Sea

Philip R. Hill

Scientific Staff:	Phil Hill (Chief Scientist) Mike Hughes Bob Murphy Roy Sparkes John Lewis (Geophysics Contractor) Rob Edsall (Geophysics Contractor) Murray Graham (Navigation Contractor) Barry Nacyk (Navigation Contractor)
Ship's Master:	Captain Tom Hull

OBJECTIVES

This cruise forms part of GSC Project 830007, Beaufort Sea Coastal Zone Geotechnics, funded by the Northern Oil and Gas Action Program (NOGAP). The objectives of the cruise were:

1. To test the prototype IKB directional hydrophone, designed by IKB Technologies Ltd as a means of obtaining high resolution seismic data in extremely shallow water depths (< 10 m).
2. To obtain high quality, high resolution seismic reflection profiles in the coastal zones of Mackenzie Bay and eastern Richards Island.
3. To obtain vibracores and piston cores in areas profiled in 1986 (Garry Island to North Head and Kugmallit Bay) and in the areas of Mackenzie Bay and eastern Richards Island.
4. To recover Seadata 635-9 current meter lost north of Ellice Island.
5. To recover wave and current meters deployed on beach between Tibjak Point and Tininerk Bay.
6. To obtain water column and surficial sediment samples on an opportunity basis for Elliott Burden (Memorial University of Newfoundland) for a study of pollen distribution and transportation and dinoflagellate taxonomy.
7. To obtain minicore subsamples of grab samples for flume studies by Jon Grant of Dalhousie University. The aim of this work is to obtain erosion and suspension criteria for Beaufort Sea muds.

EQUIPMENT

(a) Seismic and Sidescan

Sources
EG&G Model 230 Boomer (Uniboom)
Datasonics Model BPR-510 Bubble Pulser

Receivers
IKB Technlogies Directional Hydrophone
NSRFC Ministreamer
Datasonics BPH-540 Streamer

Sub-bottom Profiler
Raytheon PTR 3.5 kHz Profiler

Sidescan Sonar
Klein Model 531T 100 kHz
with K Maps Model 606 Slant Range Correction

(b) Coring and Sampling

BIO 10 ft Vibracorer
Piston Corer
Van Veen Grab Sampler

TOWING AND SAMPLING CONFIGURATION

The configuration of equipment used on Nahidik is shown in Figure 1. The ship's crew constructed two 10-m booms which were used for towing the two streamers. The ship's forward crane was used to tow the Uniboom and IKB catamarans from the starboard side. The bubble pulser was towed from the port side boom. The sidescan was towed from a third boom mounted at the bow. All equipment was therefore towed from forward positions, avoiding propellor noise and ship's wake.

Vibracoring was carried out from the forward deck using the 10 ton crane. The ship was first anchored at the bow. The vibracorer was lifted horizontally on two hooks, then lowered to a

vertical position over the side. The redundant hook was then removed, the vibracorer was swung away from the ship and lowered into the water approximately 5 m from the ship. The vibracorer was operated from the doghouse on the stern, while maintaining walkie-talkie contact with the deck crew on the bow.

Grab and water samples were taken from the stern using the starboard Hiab crane.

NAVIGATION

Challenger Surveys Ltd. was contracted to provide navigation services for the cruise. They used a Syledis network provided by GSI. Both shipboard navigators were efficient and helpful throughout the cruise. Two problems arose leading to a significant loss of time. The first was that the distance between the Stokes Point and Garry Island shore stations was too large to obtain synchronisation of the Stokes Point signal. This was resolved within 24 hours by GSI, who moved a shore station to King Point. The second problem was a loss of accurate navigation in the region of the baseline between the King Point and Garry Island stations. This meant that ship's navigation was used for parts of seismic lines and some core sites in the vicinity of the baseline, with a consequent loss of precision.

RESULTS

(a) Geophysics

A track plot of seismic and sidescan profiles is shown in Figure 2. The IKB directional hydrophone produced considerably improved records compared to the NSRFC ministreamer. Using the Uniboom source firing at 1/8 or 1/16 sec, the resolution obtained exceeded that of the 3.5 kHz profiler. Despite the masking effect of shallow gas along many of the shallow water lines, the high signal to noise ratio and improved shot-to-shot coherence produced high quality records during good weather. Data quality deteriorated markedly during bad weather, particularly with the longer period swells. More detailed comments on the IKB hydrophone performance can be found in Lewis (1987).

The bubble pulser source provided surprisingly deep penetration for such a portable piece of equipment. The signal is dominantly low frequency, so that resolution is much lower than the Uniboom. However, the bubble pulser sometimes produced deeper penetration than the Uniboom. Better results were usually obtained using the NSRFC ministreamer rather than the Datasonics streamer provided with the bubble pulser.

Due to weather and additional steaming required due to difficulties with the navigation, approximately 24 hours of seismic working time was lost in the Mackenzie Bay region. For this reason, the intended survey in this region was not completed. The high resolution records obtained in Mackenzie Bay with the IKB hydrophone showed a transition from well-stratified sediments in relatively deep water (> 7 m) to sediments showing relatively poor seismic penetration in shallow water. The poor penetration seems due primarily to the presence of shallow gas. Windows through the gas masking shows that the sediments inshore of 7 m water depth are also well-stratified.

Seismic lines were also obtained northeast of Richards Island along the potential pipeline route from Amauligak to North Head and along a repetitive sidescan line in the same area. Two seismic lines were obtained north of Kugmallit Bay, complementing the 1986 survey. Line 87-3 showed a field of pockmarks on the sidescan record. These features were clearly related to venting of shallow gas which was visible in the seismic records.

(b) Sampling

The vibracoring procedure went extremely smoothly due to the excellent handling capacity of the ship and the expertise of the ship's crew. A total of 47 vibracores were obtained. Locations are shown in Figure 3. Sixteen cores were obtained in a single 12-hr shift. Samples were obtained in stiff silts and muds which were not penetrated during the previous year's cruise using the gravity corer. The core barrel was almost always more than 80% full. Sample quality appeared to be very high, even in the softer near-surface muds. Some difficulties were encountered in the fine sands of eastern Kugmallit Bay, but one full-barreled core was eventually recovered from this region.

No piston cores were attempted on this cruise.

Grab and surface water samples were collected routinely at each coring site. A total of 49 grabs and 38 water samples were obtained. Three grab samples were of sufficient quality to obtain a minicore sub-sample for flume studies by Jon Grant of Dalhousie University.

(c) Wave/Current Meter Recovery

Despite an extensive search for the Seadata 635-9 meter deployed in Mackenzie Bay, we had no success in recovering it. At no time was any response obtained from the acoustic release and no sighting was made of any buoys. A possible double target was present on the sidescan record, 200 m from the original deployment site, but extensive grappling in the target area failed to obtain results.

The current meters moored close to the beach between Tibjak Point and Tininerk Bay were recovered with no problems. All four meters were in good shape. Sand and gravel covered the feet of both tripods attesting to significant sediment transport at the two sites.

ACKNOWLEDGEMENTS

Captain Tom Hull, the officers and crew of the Nahidik provided friendly and efficient assistance during all scientific operations. Logistic assistance through the Inuvik Scientific Resource Centre and the Polar Continental Shelf Project are gratefully acknowledged.

NAHIDIK 87 - DAILY LOG

All times in GMT

FRIDAY SEPTEMBER 11

13.00 Ship arrived in Tuk.

14.00 Crew change began. Vibracore put together and tested on deck. Seismic and sidescan gear put together through afternoon.

SATURDAY SEPTEMBER 12

04.00 Ship left dock. Steaming for Mackenzie Bay.

13.30 Arrive on site for Seadata 635-9 current meter search. Winds light, becoming a stiff breeze from SW. Ship was positioned onto exact location and we attempted to interrogate the acoustic release. No response to outgoing chirp. Began sidescan survey using 100 kHz fish. Straight lines were difficult to maintain, but a distinctive double target was detected 200 m due south of the original deployment site. Repeated crossings detected the same target 4 times within a 40 m radius. The ship was relocated above the new position and attempts were again made to interrogate the release, with no response. The release signal was then transmitted, but no confirming response was heard from the release. An extensive visual search was then carried out in case the release had been activated, but there were no sightings. Following this, dragging commenced with the ship anchored at various sites very close to the target. The ship required anchoring as it was drifting at approx. 2 kts. due to the wind. This also produced no results. Finally a second short sidescan survey was conducted between the original site and the new target with the higher resolution 500 kHz fish. No useable targets were detected during this survey. The search was finally abandoned at 19.10.

19.10 Steamed to first vibracoring site. Vibracoring operation very smooth. Obtained six cores, most > 2 m, along seismic line BKSLD84-302.1 and NAH87-9 (to be run). Also grabs and water samples for Elliot Burden obtained at same sites. Wind had dropped, sea almost calm and excellent conditions for working.

SUNDAY SEPTEMBER 13

02.00 Last core on deck.

03.00 Streaming seismic gear ready to run onto Line 87-9. Operation a little lengthy but efficient, especially for first time. All systems operating. Seas calm.

05.00 Approx. 1 hour after starting Line 87-9, the wind increased very suddenly to NW30 causing rapid deterioration of line quality. Ship hove to on anchor to ride out storm. Performance of IKB unit in very shallow water at start of Line 87-9 was very encouraging. Reflectors in top 20 ms and below show much more coherence than for ministreamer. Sediment load in water is extreme, indicating substantial resuspension. Water samples taken. Approx. 0.5 cm sediment settled to bottom.

16.00 Weather improving enough to begin vibracoring. Started at end of Line 87-9 in 3.5 m water.

17.30 Navigation down due to synchronisation problems between Stokes and Garry towers. Carrying on with racon fixes using range and bearing, plus Satnav where available. Solution to problem with navigation seems to be for GSI to move shore stations

22.30 Out of range for racon fixes. Murray Graham contacted Challenger management about moving shore station to obtain better coverage in Mackenzie Bay. Heading east to pick up navigation again.

MONDAY SEPTEMBER 14

00.15 Navigation back up using Pullen station. Deployed seismic gear for running eastern end of Line 87-7. Sizeable swell remaining after storm, but winds light.

13.45 End of seismic, pulling gear on board. Completed parts of Lines 87-7, 87-6 and all of 87-14. Navigation held out to approx. 136° 35'. Challenger report that shore station was moved to King Point last evening. Steaming to first coring site, north of Garry Island.

TUESDAY SEPTEMBER 15

02.00 Completed coring along seismic lines 86-20 and 86-15, with a total of 16 cores. Good recovery (generally > 2.5 m) with 3-5 minutes vibration. Grab and water samples for Elliot Burden also taken at each site. Winds diminishing to near calm. Steaming towards end of repetitive sidescan line.

03.00 Deployed seismic and sidecan gear for Line 87-2 (repetitive sidescan line) running NE from Hooper Island to Amauligak, followed by Line 87-1 (pipeline route). All systems running.

14.30 Completed Lines 1 and 2. Good quality data obtained under calm seas. Gear pulled in, steaming for Issigak borrow site. Weather: clear with light SW wind.

18.00 On site for Issigak vibracore attempt.

19.00 Two cores recovered, both under 1-m. However both show a < 50 cm bed of inversely graded gravel at the seabed, overling dense silty mud. Second, longer core stopped in very fine silty sand, with high organic content, which left a black carbon smudge on the fingers. Steaming to core sites along line 87-10.

21.15 Began vibracoring along Line 87-10. On transit, wind had come up very quickly from dead calm to NW 20kts.

WEDNESDAY 16 SEPTEMBER

02.00 End vibracoring. Seven cores obtained. Several delays due to minor problems with vibracorer and positioning across Syledis baseline. About to steam to start of Line 87-10 for seismic work, when main generator failed and ship's gyro went down.

04.15 Begin steaming towards start of line. Weather has moderated considerably.

14.00 Finish running seismic lines. Completed lines 87-9, 87-10 and part of 87-6. Good quality data. Steaming towards Shingle Point to right the Racon tower which is not working.

16.00 Finish work on racon tower. Steaming to core sites.

18.30 Completed core sites, starting on beach between Shingle Point and King Point. Four cores obtained, penetrating beneath coastal sand into underlying dense silt and clay. One contained visible ice. Starting to run seismic line 87-6, heading east.

THURSDAY SEPTEMBER 16

06.00 End seismic line 87-6. Steaming for Tuk.

13.00 Arrive Tuk. Picked up Darren Tuele. Offloaded some gear

15.15 Depart Tuk heading towards current meter moorings between Tibjak Point and Tininerk

Bay.

18.15 All moorings safely recovered. Camera station on shore taken down. Fairway buoy had washed ashore on same beach, so Nahidik recovered it at the same time.

20.00 Three vibracores taken at the mooring sites. Low recovery of mainly sand. Steaming to Tuk to drop off Darren.

22.15 Depart Tuk to resume vibracoring.

FRIDAY 18 SEPTEMBER

02.00 Four vibracores recovered across bank in Kugmallit Bay. Poor recovery in three due to fine sand bottom. Fourth had a full barrel but liner got stuck. Steaming towards Line 87-3 to begin seismic.

03.05 Started line 87-3.

09.30 Completed seismic lines 87-3 and 87-4. Steaming towards Kittigazuit and Inuvik.

NAHIDIK 87 - LINE INVENTORY

Line	SOL			EOL			7 kHz	Boom.	B.P.	IKB	Eel	Sidescan
	Day	Time	Fix	Day	Time	Fix						
1	258	08:53	1581	258	14:12	1760	X	X	X	X	X	X
2	258	03:26	1347	258	08:43	1580	X	X	X	X	X	X
3	261	03:05	2385	261	05:53	2495	X	X	X	X	X	X
4	261	06:01	2496	261	09:14	2610	X	X	X	X	X	X
6	257	04:35	0967	257	09:52	1174	X	X	X	X	X	X
6B	259	07:39	1869	259	10:27	1970	X	X	X	X	X	X
6C	259	21:02	2086	260	00:52	2232	X	X	X	X	X	X
6D	260	01:58	2233	260	05:41	2364	X	X	X	X	X	X
7	257	00:58	0868	257	03:25	0966	X	X	X	X	X	X
9	256	03.55	0821	256	05:39	0860	X	X	X	X	X	X
9A	259	11:02	1975	259	13:34	2079	X	X	X	X	X	X
10	259	05:09	1783	259	07:38	1868	X	X	X	X	X	X
14	257	10:11	1178	257	13:45	1304	X	X	X	X	X	X

NAHIDIK 87 - TAPE LOG

Tape	Start					End				
	Line	Day	Time	Fix	Counter	Line	Day	Time	Fix	Counter
46	9	256	03:55	0821	0000	9	257	0539	0860	1366
47	7	257	0058	0868	0000	7	257	0236	0932	EOT
48	7	257	0237	0934	0000	7	257	0325	0966	1049
48	6	257	0435	0967	1049	6	257	0523	0997	EOT
49	6	257	0524	0998	0000	6	257	0700	1057	EOT
50	6	257	0701	1059	0000	6	257	0837	1122	EOT
51	6	257	0838	1124	0000	6	257	0952	1174	1388
51	14	257	1011	1178	1388	14	257	1035	1193	EOT
52	14	257	1036	1194	0000	14	257	1211	1250	EOT
53	14	257	1213	1152	0000	14	257	1345	1304	EOT
54	2	258	0326	1347	0000	2	258	0501	1428	EOT
55	2	258	0502	1425	0000	2	258	0637	1496	EOT
56	2	258	0638	1497	0000	2	258	0816	1562	EOT
57	2	258	0817	1564	0000	2	258	0843	1580	0750
57	1	258	0853	1581	0768	1	258	1137	1667	EOT
58	1	258	1139	1669	0000	1	258	1412	1760	2813
58	10	259	0509	1783	2813	10	259	0546	1805	EOT
59	10	259	0547	1807	0000	10	259	0722	1856	EOT
60	10	259	0723	1858	0000	10	259	0738	1868	0400
60	6B	259	0739	1869	0400	6B	259	0858	1916	EOT
61	6B	259	0859	1918	0000	6B	259	1027	1970	EOT
62	9	259	1102	1975	0000	9	259	1237	2034	EOT
63	9	259	1238	2035	0000	9	259	1334	????	1307
63	6C	259	2102	2086	1307	6C	259	2130	2104	EOT
64	6C	259	2132	2105	0000	6C	259	2306	2165	EOT
65	6C	259	2307	2167	0000	6C	260	0044	2227	EOT
66	6C	260	0045	2228	0000	6C	260	0052	2232	0300
66	6D	260	0158	2233	0300	6D	260	0325	2285	EOT
67	6D	260	0326	2286	0000	6D	260	0503	2239	EOT
68	6D	260	0503	2340	0000	6D	260	0541	2364	0888
68	3	261	0305	2385	0888	3	261	0359	2420	EOT
69	3	261	0400	2421	0000	3	261	0536	2481	EOT
70	3	261	0537	2482	0000	3	261	0553	2495	0470
70	4	261	0601	2496	0470	4	261	0720	2545	EOT
71	4	261	0722	2546	0000	4	261	0858	2601	EOT
72	4	261	0859	2602	0000	4	261	0914	2610	0400

NAHIDIK 87 - CORE LOG

Sample No.	Sample type	Day	Time	Lat.	Long.	Water depth (m)	Core length (m)
2	VC	255	20:20	69.28317	137.23333	14.64	1.55
5	VC	255	21:20	69.28967	137.24983	17.08	N/R
8	VC	255	22:15	69.26150	137.28983	15.56	2.16
11	VC	255	23:17	69.23000	137.21333	9.46	2.35
14	VC	256	00:50	69.19883	137.13917	6.71	0.51
17	VC	256	01:37	69.16750	137.06383	2.75	2.03
21	VC	256	17:00	69.13650	136.98817	3.36	2.27
24	VC	256	18:10	69.11167	136.94833	3.36	2.50
27	VC	256	20:22	69.22700	136.57617	3.05	2.64
30	VC	256	21:02	69.25000	136.62383	3.97	1.80
33	VC	256	22:15	69.29283	136.71783	N/R	2.62
36	VC	257	15:15	69.67550	135.79183	6.71	2.01
39	VC	257	15:50	69.68267	135.74433	6.71	2.57
42	VC	257	16:30	69.68900	135.69700	8.54	1.54
45	VC	257	16:50	69.69350	135.66333	8.54	2.72
48	VC	257	18:05	69.69750	135.63467	8.24	2.78
51	VC	257	18:45	69.70183	135.60033	8.54	2.68
54	VC	257	19:30	69.70850	135.55367	8.54	2.68
57	VC	257	20:02	69.71500	135.50500	8.85	2.55
60	VC	257	20:30	69.72167	135.45667	8.85	2.70
63	VC	257	21:08	69.72783	135.40817	8.54	2.78
66	VC	257	22:10	69.67483	135.10750	8.54	2.21
69	VC	257	22:40	69.69150	135.12583	6.10	2.54
72	VC	257	23:10	69.70800	135.14767	6.41	2.64
75	VC	258	00:20	69.71633	135.15783	7.32	2.25
78	VC	258	00:50	69.72450	135.16833	7.32	2.68
81	VC	258	01:30	69.74117	135.18783	7.93	1.89
84	VC	258	01:48	69.75733	135.20900	9.15	2.63
87	VC	258	18:10	69.74267	136.00300	9.46	0.38
88	VC	258		69.74250	136.00383	9.46	1.09
91	VC	258	21:30	69.39783	136.94217	10.98	2.41
94	VC	258	22:05	69.37650	136.89333	9.76	2.41
97	VC	258	22:35	69.355	136.84900	7.93	1.32
100	VC	258	23:05	69.33433	136.80350	6.71	2.24
103	VC	259	00:10	69.32600	136.78367	6.71	2.77
106	VC	259	01:10	69.31167	136.75583	6.10	1.65
109	VC	259	01:45	69.29150	136.71167	4.88	2.68
112	VC	259	18:55	69.07033	137.83367	0.61	0.80
113	VC	259	19:17	69.07067	137.83400	1.98	0.94
116	VC	259	19:46	69.07067	137.83350	1.98	1.30
117	VC	259	20:15	69.07100	137.83167	4.58	1.68
124	VC	260	18:35	69.59450	132.99583	5.19	1.04
125	VC	260	19:20	69.59450	132.99617	5.19	1.34
127	VC	260	19:30	69.59367	132.98967	3.66	0.52
130	VC	261	00:05	69.50950	133.10783	6.10	0.86
132	VC	261	00:35	69.51683	133.10817	5.19	0.23
134	VC	261	01:00	69.52217	133.10867	5.49	0.71
136	VC	261	01:20	69.52917	133.10933	5.79	2.76

VC = BIO Vibracorer

N/R = Not Recorded

NAHIDIK 87 - GRAB SAMPLE LOG

Sample No.	Sample Type	Day	Time	Lat.	Long.	Water Depth (m)	# of Subsamples	Notes
1	VV	255	20:04	69.28350	137.23300	14.64		
4	VV	255	21:02	69.29017	137.24983	17.08		
7	VV	255	22:05	69.26200	137.29017	15.56		
10	VV	255	23:07	69.23050	137.21333	9.46		
13	VV	256	00:36	69.19900	137.13850	6.71		
16	VV	256	01:40	69.16800	137.06383	2.75		
20	VV	256	16:53	69.13650	136.98733	3.36		
23	VV	256	18:05	69.11167	136.94833	3.36		
26	VV	256	20:19	69.22700	136.57617	3.05		
28	VV	256	20:54	69.25000	136.62383	3.97		
31	VV	256	22:02	69.29283	136.71783	N/R		
35	VV	257	15:17	69.67583	135.79133	8.54		
38	VV	257	15:48	69.68317	135.74500	6.71		
41	VV	257	16:28	69.68933	135.69650	8.54		
44	VV	257	16:58	69.69367	135.66233	8.54		
47	VV	257	18:05	69.69767	135.63400	8.24		
50	VV	257	18:46	69.70217	135.60000	8.54		
53	VV	257	19:28	69.70883	135.55333	8.54		
56	VV	257	20:00	69.71533	135.50450	8.85		
59	VV	257	20:32	69.72217	135.45650	8.85		
62	VV	257	21:07	69.72817	135.40767	8.85		
65	VV	257	22:10	69.67517	135.10657	8.54		
68	VV	257	22:39	69.69183	135.12500	6.10		
71	VV	257	23:11	69.70817	135.14683	6.41		
74	VV	258	00:20	69.71650	135.15700	7.32		
77	VV	258	00:47	69.72467	135.16750	7.32		
80	VV	258	01:25	69.74133	135.18717	7.93	1	Flume sample
83	VV	258	01:46	69.75783	135.20850	9.15		
86	VV	258	18:08	69.74250	136.00350	9.46		
90	VV	258	21:28	69.39767	136.94117	10.98		
93	VV	258	22:03	69.37650	136.89333	9.76		
96	VV	258	22:35	69.35500	136.84800	7.93		
99	VV	258	23:05	69.33433	136.80233	6.71		
102	VV	259	00:12	69.32600	136.78267	6.71		
105	VV	259	01:11	69.31167	136.75467	6.10		
108	VV	259	01:45	69.29150	136.71067	4.88		
110	Hand	259	16:00	69.00883	137.56467	2.00		Sample from cliff
114	VV	259	19:17	69.07067	137.83400	1.98		
115	VV	259	19:45	69.07050	137.83433	1.98		
118	VV	259	20:15	69.07083	137.83233	4.78	1	Flume sample
119	CM	260	16:55	69.59450	132.99517	5.00		
120	CM	260	17:05	69.59383	132.98983	5.00		
121	CM	260	17:15	69.59383	132.98983	5.00		
123	VV	260	18:35	69.59450	132.99700	5.19		
126	VV	260	19:30	69.59350	132.99067	3.68		
129	VV	261	00:05	69.50917	133.10857	6.10		
131	VV	261	00:40	69.51650	133.10883	5.19		
133	VV	261	00:58	69.52183	133.10933	5.49		
135	VV	261	01:20	69.52900	133.10983	5.79		

VV = Van Veen Grab Sampler
CM = Samples taken from base of current meter stand.
N/R = Not Recorded

NAHIDIK 87 - WATER SAMPLES

Sample No.	Sample type	Day	Time	Lat.	Long.	Water Depth (m)	Sample Depth (m)	Sample Volume (L)
3	Bucket	255	20:57	69.28350	137.23300	14.64	0	.5
6	Bucket	255	22:56	69.23050	137.21333	9.46	0	.5
9	Bucket	256		69.23050	137.21333	9.46	0	.5
12	Bucket	256	00:35	69.19900	137.13850	6.71	0	.5
15	Bucket	256	01:38	69.16800	137.06383	2.75	0	.5
18	Bucket	256	14:30	69.15433	137.02533	N/R	0	.5
19	Bucket	256	16:50	69.13650	136.98733	3.36	0	.5
22	Bucket	256	17:50	69.11167	136.94833	3.36	0	.5
25	Bucket	256	20:15	69.22700	136.57617	3.05	0	.5
29	Bucket	256	20:57	69.25000	136.62383	3.97	0	.5
32	Bucket	256	22:24	69.29283	136.71783	N/R	0	.5
34	Bucket	257	15:12	69.67583	135.79133	8.54	0	.5
37	Bucket	257	15:47	69.68317	135.74500	6.71	0	.5
40	Bucket	257	16:27	69.68933	135.69650	8.54	0	.5
43	Bucket	257	16:57	69.69367	135.66233	8.54	0	.5
46	Bucket	257	17:50	69.69767	135.63400	8.24	0	.5
49	Bucket	257	18:45	69.70217	135.60000	8.54	0	.5
52	Bucket	257	19:27	69.70383	135.55333	8.54	0	.5
55	Bucket	257	19:58	69.71533	135.50450	8.85	0	.5
58	Bucket	257	20:31	69.72217	135.45650	8.85	0	.5
61	Bucket	257	21:06	69.72817	135.40767	8.85	0	.5
64	Bucket	257	22:07	69.67517	135.10667	8.54	0	.5
67	Bucket	257	22:38	69.69183	135.12500	6.10	0	.5
70	Bucket	257	23:10	69.70817	135.14683	6.41	0	.5
73	Bucket	258	00:15	69.71650	135.15700	7.32	0	.5
76	Bucket	258	00:45	69.72467	135.16750	7.32	0	.5
79	Bucket	258	01:24	69.74133	135.18717	7.93	0	.5
82	Bucket	258	01:45	69.75783	135.20850	9.15	0	.5
85	Bucket	258	18:07	69.74250	136.00350	9.46	0	.5
89	Bucket	258	21:27	69.39767	136.94117	10.98	0	.5
92	Bucket	258	22:02	69.37650	136.89333	9.76	0	.5
95	Bucket	258	22:34	69.35500	136.84800	7.93	0	.5
98	Bucket	258	23:04	69.33433	136.80233	6.71	0	.5
101	Bucket	259	00:12	69.32600	136.78267	6.71	0	.5
104	Bucket	259	01:10	69.31167	136.75467	6.10	0	.5
107	Bucket	259	01:44	69.29150	136.71067	4.88	0	.5
111	Bucket	259	18:55	69.07067	137.83383	0.61	0	.5
122	Bucket	260	18:30	69.59450	132.99700	5.19	0	.5
128	Bucket	261	00:03	69.50917	133.10867	6.10	0	.5

N/R = Not Recorded

NAHIDIK 1987 CONFIGURATION – PHASE II (HILL)

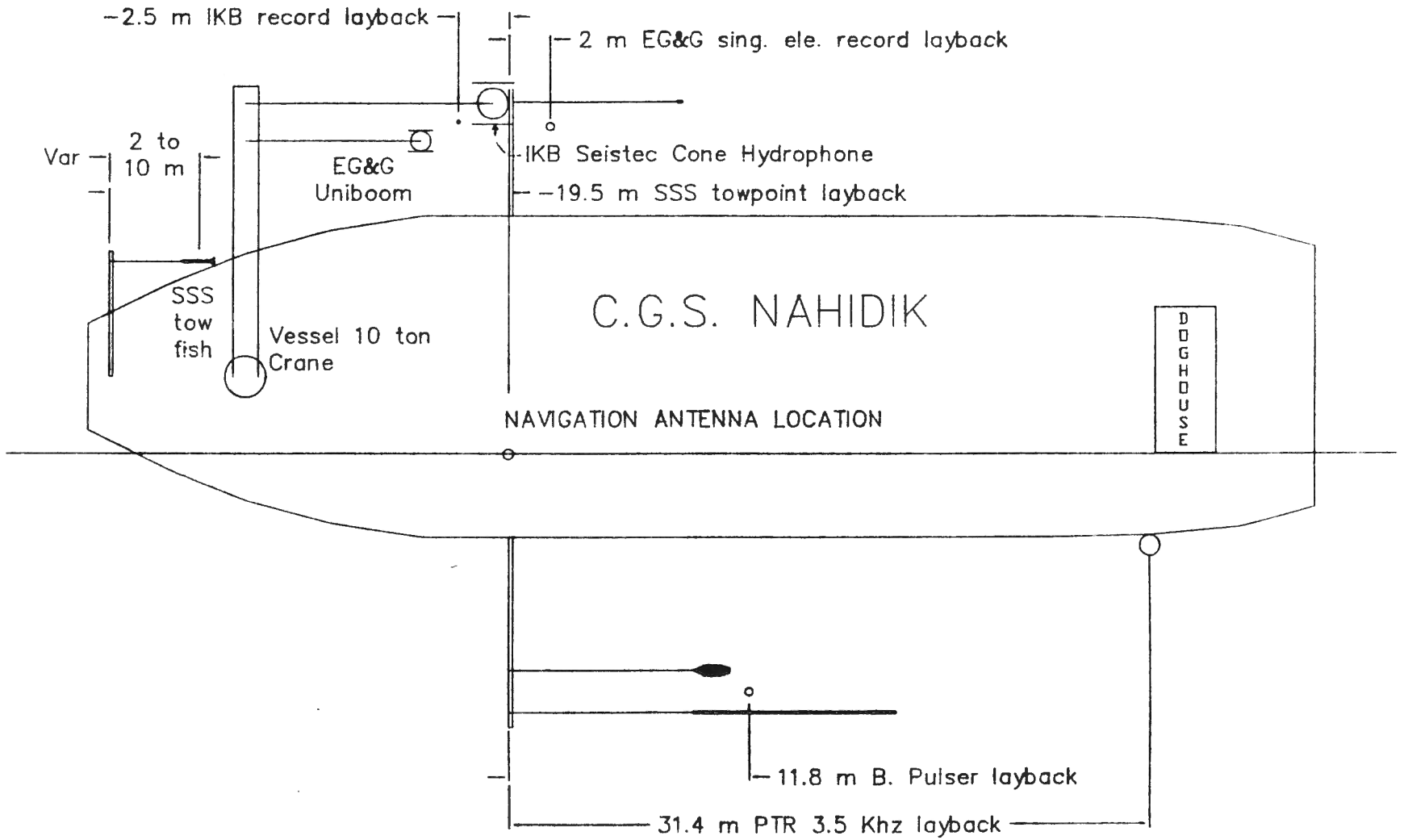

FIGURE 1

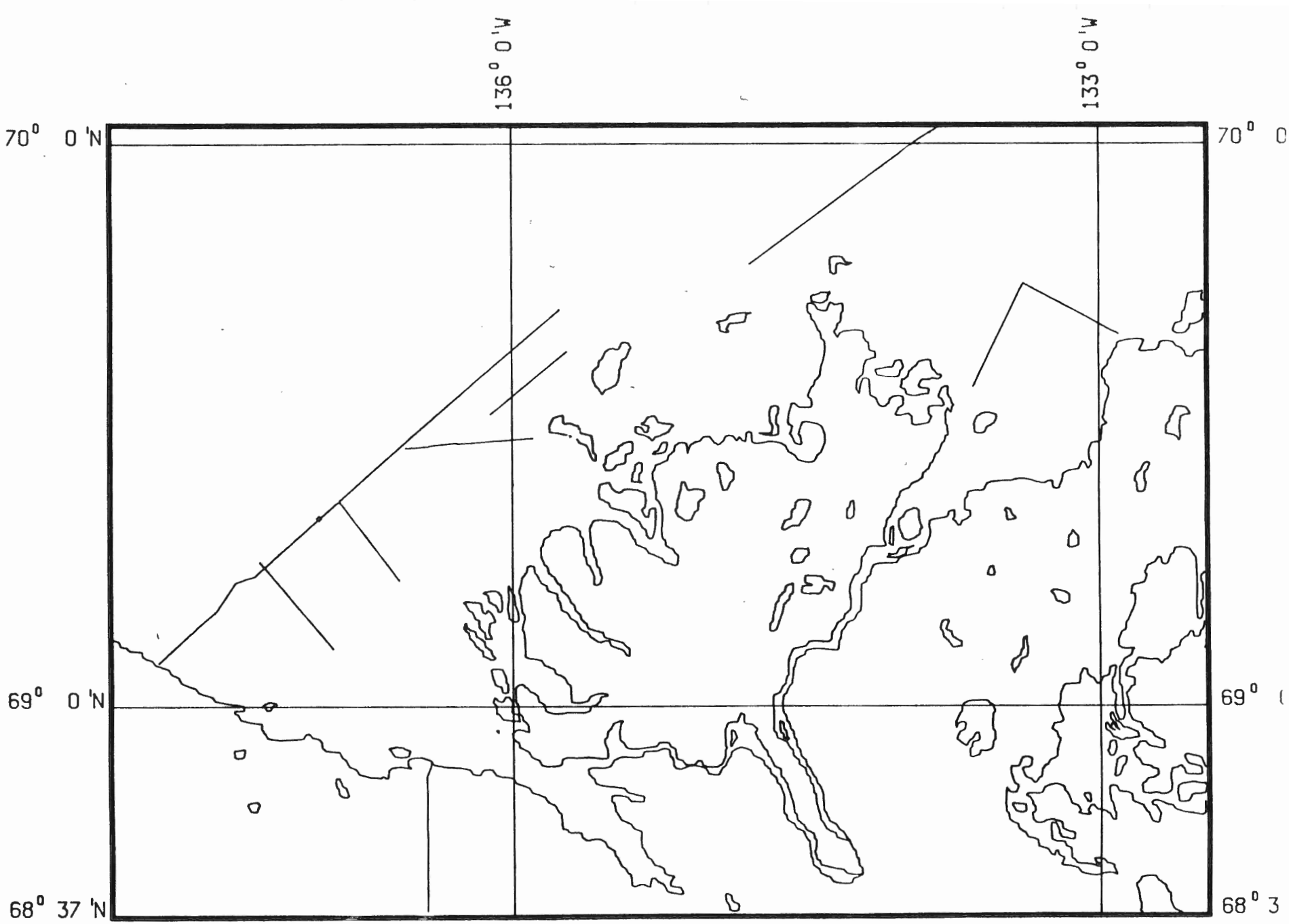

Figure 2. Seismic and sidescan survey track plot for Nahidik-87 cruise.

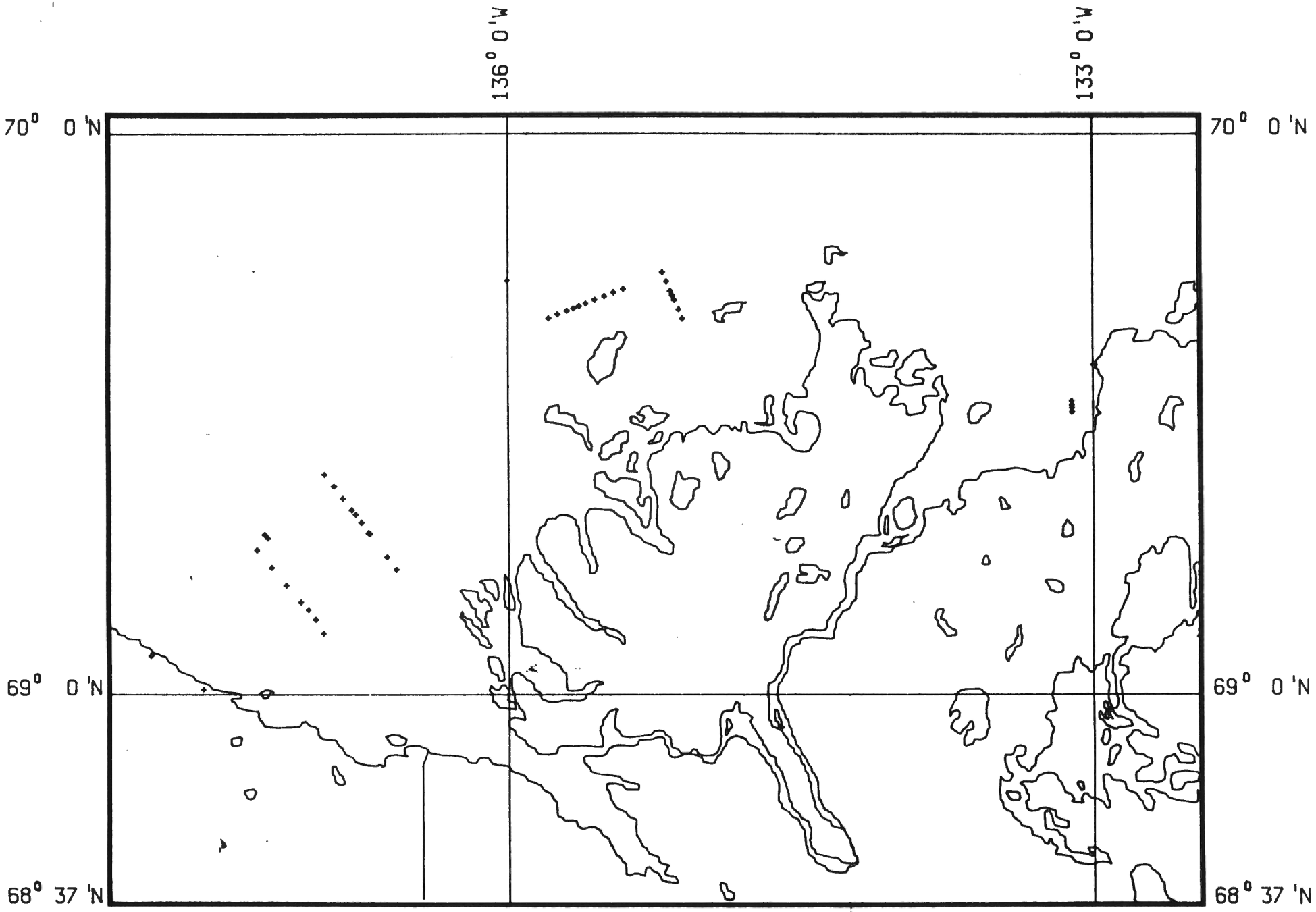

Figure 3. Sample locations for Nahidik-87 cruise. At each station vibracore, grab and water samples were taken.

PART 5

FIELD SURVEY AND CRUISE REPORT

USGS R/V KARLUK

20 August - 16 September 1987

Tuktoyaktuk Peninsula Coast and
Inner Beaufort Sea Shelf

Scientific Staff:
Arnaud Héquette (AGC)
Peter Barnes (USGS)
Ed Kempema (Univ. of Seattle)
Borden Chapman (AGC)
Archie McLean (Navigation Contractor)

20 January 1988

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20 January 1988

INTRODUCTION

The 1987 survey is a joint GSC/USGS co-operative project planned with Peter Barnes of the USGS Marine Geology Pacific Branch; the field survey and the cruise are parts of GSC Project 830007, Beaufort Sea Coastal Zone Geotechnics, funded by NOGAP. This survey was a reconnaissance survey of the NW coast and nearshore zone of Tuktoyaktuk Peninsula, particularly the area located between Tuktoyaktuk and McKinley Bay.

OBJECTIVES

The major objectives of the 1987 survey were:

1) To obtain high resolution seismic reflection profiles in the inner shelf area off Tuktoyaktuk Peninsula (< 10 m).

2) To obtain sidescan sonar records in the inner shelf area off Tuktoyaktuk Peninsula.

3) To collect surficial sediment samples in the nearshore zones of Tuktoyaktuk Peninsula.

4) To obtain bathymetric profiles of the shoreface of coastal sites undergoing rapid erosion. The aim of this work is to monitor the recent shoreface variations by comparing these data with previous bathymetric data (i.e. Field Sheets of the Hydrographic Survey).

5) To deploy current meters off Tibjak beach to obtain wave data for a study concerning longshore sediment transport along that spit.

6) To survey pre-storm and post-storm beach profiles along Tibjak beach and to collect beach samples along each transect for the longshore sediment transport study.

7) To deploy video cameras on the backshore of Tibjak beach to record the morphological changes on the beach and the incoming wave characteristics during the period of the longshore sediment transport study.

8) To collect sediment samples and make observations along the shore of the Tuktoyaktuk Peninsula in order to characterize the coastal environments.

9) To obtain water samples and surficial sediments samples for Elliott Burden (Memorial University of Newfoundland) for a study of pollen distribution and transportation.

EQUIPMENT

A) High Resolution Seismic
Source: ORE Boomer System
Receivers: Benthos hydrophone, NSRFC Ministreamer

B) Fathometer and sub-bottom profiler
Raytheon PTR 7 kHz & 200 kHz Profiler

C) Side-scan Sonar
Klein 100 kHz fish; Klein 500 kHz fish

D) Sampling
Grab sampler

NAVIGATION

Challenger Surveys Ltd. was contracted to provide navigation services for the cruise. They used a Syledis network provided by GSI. The three shore stations were located at Atkinson Point, Toker Point, and Pullen Island. Usually the positioning was accurate enough to enable us tu use distance fixes on the records, but despite the competence and efficiency of the navigator, navigation problems occurred from time to time resulting in time intervals between fixes and ship's radar positioning, this navigation technique being by far less accurate than the Syledis navigation system. This problem was related to the increasing distance between the ship and the Pullen Island shore station, so the loss of accuracy of navigation occurred mostly in the vicinity of McKinley Bay.

RESULTS

A) High Resolution Seismic

The quality of the records is unequal depending mainly on the weather conditions. During fair weather conditions, the records were of reasonable quality for such shallow waters, with an usually hard sub-bottom reflector (sandy ?) which often result in poor penetration and noise in the records. During bad weather, the quality deteriorated rapidly, this being related to wave oscillations amplitude and hydrophone interactions. Especially during bad weather, better results were obtained with the NSRFC hydrophone.

A total of 31 lines were run (Table 1), most of them in a N-S and SW-NE orientation; the mean spacing between the lines is 10 km. They form a grid of lines running parallel and roughly perpendicular to the general orientation of the coast.

Near the coast, a deep reflector (30 - 35 m below sea bed) is often visible, showing a gently seaward dipping surface. This surface is overlain by a wedge-shaped sequence which thickens seaward. Further analyses may result in correlation with the offshore stratigraphy (c.f. Hill et al., in prep.). The upper unit, which in some places is covered by a thin veneer of surficial muds, is sometimes well stratified and may tentatively be correlated with the postglacial transgressive unit (reworked littoral sands ?) of O'Connor (1981). Series of relatively shallow depressions (5-10 m) infilled with probable Holocene marine sediments (thaw lakes ?, lagoons ?, channels ?) were encountered from time to time. These profiles are of sufficient quality to plan coring and drilling programs in the future that will give valuable information about the Late-Holocene depositional environments and relative sea level changes on the Canadian Beaufort Sea Shelf.

B) Side-scan sonar

The side-scan sonar was used on the same lines of the high resolution seismic, so the same navigation problems apply to these records.

Both fish, the 100 kHz and 500 kHz, usually produced high quality records. The major objective of this side-scan sonar survey was to look for ice-scours and other ice-induced bedforms (i.e. strudel ice-scours); because of the high quality of the records, very good results during data reduction are expected.

In addition to the reconnaissance lines surveyed, a repetitive survey line of Steve Blasco's ESRF #A-D line (extending parallel to the coast at c.a. 10 m water depth) was run.

C) Bathymetry

The fathometer and sub-bottom profiler (Raytheon PTR 7 & 200 kHz) were used routinely on every lines, but specific bathymetric records were performed off Tibjak Point (4 lines), Toker Point (5 lines) and Atkinson Point (1 line).

At Tibjak Point and Atkinson Point, bathymetric lines perpendicular to the coast were run, using the Karluk and a skiff equipped with an echo sounder. For each line, both the Karluk and the skiff started the transect from a bouy, at a depth of about 3 m, precisely positioned with the Syledis navigation system aboard the Karluk. Karluk course extended in an offshore direction while the skiff navigated toward the coast using the bouy and the Karluk as an alignment to stay on line. Usually, the skiff was able to run each line up to the beach. Both fathometer, on the Karluk and on the skiff, were calibrated in calm weather with a plumbline.

At Atkinson Point, the water level was tied to a bench mark, so the bathymetric profile can be tied to the hydrographic charts datum. At Tibjak Point, the water level was tied to a temporary bench mark; with the help of Tuktoyaktuk tide records, it will be possible to tie the profiles to the datum with an accuracy assumed to be less than 10 cm because of the short distance between Tibjak Point and Tuktoyaktuk.

At Toker Point, only the Karluk was used and the water level was not tied to a bench mark. However, again for a reason of proximity to Tukyoyaktuk, the records depths relative to the datum can be inferred from Tuktoyaktuk tide records with a satisfactory accuracy.

Off Toker Point, a series of ridges (height: c.a. 2 m; width: 100 m) and troughs were encountered, from the shore to a few kilometres offshore. Five lines were run through the ridges, with an average spacing of 500 m between the lines. Mapping of these ridges with sediment distribution is expected (c.f. **D) Sampling**).

D) Sampling

From the Karluk, sediment samples were collected with a grab sampler which was operated by hand. Most of the samples were collected along the lines which extend across the ridge system off Toker Point. Some of the grab samples were sub-sampled for Elliot Burden's study of pollen distribution in modern sediment. At these locations, surface water samples were collected as well for the same study.

On land, sediment samples were collected by hand. On the beaches, only the surficial layer (c.a. 1 mm) was collected in order to obtain sediments representative of one single hydrodynamical event. Cross sections, in barrier beaches and in bluffs, were also sampled. Two cores were obtained on Atkinson barrier spit. Both cores have a length of approximately 1.2 m and were collected with a pulling device operated by hand. One core comes from the modern berm on the seaward side and the other one was collected near the lagoon on the other side of the barrier. X-radiographs of the former showed a variety of modern foreshore sedimentary structures (i.e. seaward dipping lamination and short scale cross-stratification). The base of the other core shows two distinct organic rich units; both have been sampled for palynological analyses in order to obtain information on depositional environments and possible proximity to sea level. Radiocarbon dating of these two (probably Holocene) units is expected. Various other organic material was also collected along the coast for dating the initial development of modern coastal features like barriers or dune complex (c.f. **Beach sample log**).

E) Current meters deployment

Four current meters were deployed in the surf zone, off Tibjak Point, for obtaining information

on the incident wave climate. The Karluk was used for this operation. A Seadata 621 and a S4 current meters were deployed in c.a. 3.5 m of water, at about 200 m from the beach, and a Seadata 635-9 and a Neil Brown current meter in 5 m of water, 400-500 m from the beach. The Seadata current meters were aligned perpendicular to the beach (parallel to expected normal wave orthogonals). The burst interval was 3 hours and each burst lasted 1024 sec. Instruments were deployed on August 27th and were later recovered by Phil Hill with the Nahidik on September 17th.

F) Beach profile surveys

Three topographic transects perpendicular to the shoreline were surveyed along Tibjak beach at the begining of the field program and after storm conditions in order to measure volumetric changes of beach sediments. Each profile extends from the dunes in the backshore to a depth of c.a. 1 m in the subtidal zone. A measuring tape and a theodolite were used; an accuracy of less than 5 cm in the vertical plan can be expected. John Milne and Phil Hill provided assistance during the surveys. Sediment samples were collected as well along the transects when textural variations occurred.

G) Video monitoring study

Two video cameras were deployed in the backshore of Tibjak beach on August 20 th. The cameras were mounted on top of 3.5 m high aluminium ladders, near the edge of a low cliff (2 m) in the middle part of the spit. The current meters were deployed directly off this site. One camera was oriented alongshore while the other one was looking offshore. The camera looking along the beach worked well, but unfortunately, the camera looking seaward never worked because of a power input problem.

The camera recorded every 3 hours during a 2 min period, at the same time as the current meters were deployed off the beach. The quality of the video records is usually good except when some rain drops partially shadow the lens. A first processing of the data obtained with this video monitoring system with the help of Rob Holman at the Department of Oceanography (Dalhousie University) gave good results. With a computer software averaging the 2 min recording in a single image, the resulting image shows the nearshore topography with a sand bar system on which the incident waves break. The comparison of successive 2 min-average images shows the evolution of the bar system.

KARLUK 1987 - DAILY LOG

August 20: Arrival in Tuktoyaktuk.

August 21: Video equipment shipped to Tibjak Point by helicopter. Search for a good site to set up the cameras. Begin to fix the ladders on top of low cliff, middle of Tibjak beach with John Milne and Gibb Perliot (Arctic Sciences Ltd).

August 22: Cameras set up (settings: recording interval: 3 hrs, recording duration: 2 min); start of recording: 16:00.

3 beach profiles surveyed + sediment sampled on the beach and foreshore. For each profile, stakes were installed in the backshore (coastal dunes) in order to mesure the erosion of the coastline. 1 bluff erosion survey line installed on top of the 5-6 m high bluff north of the beach survey site; 2 markers identified with orange paint and n^{o}: 87-AGC#3.

August 23: Day at the Polar Shelf; helicopters not available.

August 24: Beach sampling and observations with the helicopter: Hutchison Bay shore, the short (2.5 km long) barrier island SW of Bols Point, Bols Point, the long barrier island NE of Bols Point, Atkinson Point spit, the barrier island SW of Atkinson Point.

August 25: Beach sampling and observations with the helicopter: Warren Point, Toker Point.

Arrival of the Karluk in Tuktoyaktuk.

August 26: Reconnaissance trip with Peter Barnes and Erk Reimnitz along the Tuktoyaktuk peninsula coast with the helicopter: stops at Tibjak Point, Warren Point, Atkinson Point and in McKinley Bay.

Departure of the Karluk during the evening; spent the night behind Topkak Point.

August 27: Onshore observations of the coastal environment of Topkak Point: beach, spit ridges complex, small-scale washover fans, coastal dunes.

Deployment of the current meters off Tibjak during the afternoon.

August 28: Bad weather; waiting in Tuk harbour.

August 29: Line K-87-1 run in Kugmallit Bay, near Delta front. Line K-87-2 run in Tuk harbour.

Video tapes changed at Tibjak beach; the camera looking offshore did not work.

August 30 and **31:** Bad weather; waiting in Tuk harbour.

September 1: Lines K-87-3, line K-87-4 and line K-87-5 run north and northeast of Toker Point. line K-87-6, line K-87-7 and line K-87-8 run in the Tuft Point-Warren Point area.

September 2: Line K-87-9 run in Hutchison Bay, line K-87-10 parallel to the coast towards the SW (continuation of Steve Blasco's line ASRF #AD).

September 3: Lines K-87-11 to K-87-14 in Hutchison Bay-Bols Point area.

September 4: Bathymetry lines (K-87-15 to K-87-19) off Toker Point across the series of ridges. Lines K-87-19 to K-87-22 in the Toker Point area.

September 5: Repetitive survey of Tibjak beach profiles and new sampling of beach material. Changing of video tapes.

September 6: Bathymetry lines of Tibjak beach (K-87-23 and K-87-24). Lines K-87-25 and K-87-26 run in the Tibjak-Toker Point area. Sampling along line K-87-19: grab samples on crests and in troughs of ridges complex off Toker Point. Observations and sampling in cliff section at Tuft Point.

September 7: Lines K-87-27, K-87-28 (Steve Blasco's repetitive survey corridor ESRF#A-D), and K-87-29 and K-87-30 in McKinley Bay.

September 8: Bad weather; waiting in McKinley Bay.

September 9: Lines K-87-31 and K-87-32 in McKinley Bay. Collection of 2 cores in Atkinson Point spit.

September 10: Lines K-87-33 and K-87-37 in McKinley Bay; lines K-87-34 , K-87-35 and K-87- 36 north of Atkinson Point.

September 11: Lines K-87-38 and K-87-39 in McKinley Bay; lines K-87-40 to K-87-44 off Atkinson Point. Sampling along line K-87-35 off Atkinson Point.

September 12: Lines K-87-45 and K-87-46 in Hutchison Bay; line K-87-47 north of Tuft Point.

September 14: Lines 48, K-87-49, K-87-50 and K-87-51 near Toker Point. Sampling along line K-87-15 north of Toker Point.

September 15: Lines K-87-52, K-87-53, K-87-54 and K-87-55. Sampling along lines K-87-22 and K-87-25.

KARLUK 87 - LINE INVENTORY

LINE	SOL			EOL			ROLL			
	Day	Time	Fix	Day	Time	Fix	7&200 kHz	Seismic	SSS	
1	241	0940	001	241	1135	110	1/2		1	1
2	241	1412	111	241	1620	407	2/3		1	-
3	244	0829	410	244	0844	419	4		1	1
4	244	0941	420	244	1131	458	4		1	2
5	244	1245	460	244	1555	675	5/6		2	2
6	244	1610	676	244	1720	712	6		2	2
7	244	1726	713	244	1910	765	6		2	2/3
8	244	1914	766	244	2050	814	6/7		2	3
9	245	0829	002	245	1154	167	7/8		3	4
10	245	1202	168	245	1638	503	8,9/10		3	4/5
11	246	0844	505	246	0922	551	10		-	-
12	246	0948	552	246	1304	710	11		4	6
13	246	1312	711	246	2001	923	12,13/14		4/5	6/7
14	246	2017	924	246	2200	066	14/15		-	-
15	247	0926	068	247	0938	094	15		-	-
16	247	0940	095	247	0952	123	15		-	-
17	247	0959	124	247	1009	146	15		-	-
18	247	1012	147	247	1027	175	15		-	-
19	247	1039	176	247	1200	279	15/16		5	8
20	247	1202	280	247	1313	378	16		5	8
21	247	1323	379	247	1612	598	16/17		5	8
22	247	1647	599	247	1926	746	18		5/6	9
23	249	0930	748	249	0943	790	19		-	-
24	249	1016	791	249	1030	840	19		-	-
25	249	1125	841	249	1354	1025	19/20		6	9/10
26	249	1413	1026	249	1507	1081	20		-	-
27	250	0807	001	250	0841	048	21		-	-
28	250	0900	049	250	1627	616	21,22/23		7,8/9	11/12
29	250	1631	617	250	1723	675	23/24		9	12
30	250	1750	676	250	1859	755	25		-	-
31	251	1010	757	251	1126	822	-		10	-
32	251	1130	823	251	1406	915	26		10	13
33	253	0739	917	253	0950	1065	26		10/11	14
34	253	1019	1066	253	1155	1163	27		11	14
35	253	1205	1164	253	1431	1237	27/28		11/12	15
36	253	1436	1238	253	1600	1280	28		12	15
37	253	1709	1281	253	1859	1336	28		12	15
38	254	0943	001	254	1027	023	29		-	-
39	254	1031	024	254	1201	069	29/30		-	-
40	254	1203	070	254	1253	114	30		-	-
41	254	1254	115	254	1309	156	30		-	-
42	254	1510	164	254	1653	244	30		12	16
43	254	1659	245	254	1939	390	31		13	16
44	254	1951	391	254	2107	426	31/32		-	-
45	255	1011	428	255	1104	478	32		-	-
46	255	1418	490	255	1621	614	32/33		13	16
47	255	1658	616	255	1918	672	33/34		-	-

KARLUK 87 - LINE INVENTORY (cont'd)

LINE	SOL			EOL			ROLL			
	Day	Time	Fix	Day	Time	Fix	7&200 kHz	Seismic	SSS	
48	257	1236	674	257	1257	695	34	-	-	
49	257	1636	708	257	1719	811	34	-	-	
50	257	1720	812	257	1731	841	34	-	-	
51	257	1734	842	257	1850	1038	34/35	-	-	
52	258	0832	001	258	1312	334	35	14	17	
53	258	1330	335	258	1440	523	36	-	-	
54	258	1454	524	258	1708	807	36/37	-	-	
55	258	1726	808	258	1747	857	37	-	-	
56	258	1759	858	258	1813	910	37	-	-	
57	258	1833	911	258	1843	946	37	-	-	

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Hill, P.R., Blasco, S.M., Burden, E. and O'Connor, M.J. (in prep.). Late Quaternary Stratigraphy and Sedimentation of the Canadian Beaufort Shelf - 1: East of Mackenzie Trough.

O'Connor, M.J. (1981). An evaluation of the regional surficial geology of the southern Beaufort Sea. Report prepared for the Geological Survey of Canada.

KARLUK 87 - BEACH SAMPLE LOG

Sample No.	Day	Location	Latitude	Longitude	Notes
1TT0-1	234	Tibjak	69°35'54"	132°58'24"	Backshore (P.0)
1TT0-2	234	Tibjak	69°35'54"	132°58'24"	M. Foreshore (P.0)
1TT0-3	234	Tibjak	69°35'54"	132°58'24"	L. Foreshore (P.0)
1TT0-4	248	Tibjak	69°35'54"	132°58'24"	Backshore (P.0)
1TT0-5	248	Tibjak	69°35'54"	132°58'24"	M. Foreshore (P.0)
1TT1-1	234	Tibjak	69°35'42"	132°58'50"	Backshore (P.1)
1TT1-2	234	Tibjak	69°35'42"	132°58'50"	Berm (P.1)
1TT1-3	234	Tibjak	69°35'42"	132°58'50"	M. Foreshore (P.1)
1TT1-4	234	Tibjak	69°35'42"	132°58'50"	L. Foreshore (P.1)
1TT1-5	248	Tibjak	69°35'42"	132°58'50"	M. Foreshore (P.1)
1TT1-6	248	Tibjak	69°35'42"	132°58'50"	Trough (P.1)
1TT1-7	248	Tibjak	69°35'42"	132°58'50"	Bar Crest (P.2)
1TT2-1	234	Tibjak	69°35'36"	132°59'00"	Berm (P.2)
1TT2-2	234	Tibjak	69°35'36"	132°59'00"	M. Foreshore (P.2)
1TT2-3	234	Tibjak	69°35'36"	132°59'00"	L. Foreshore (P.2)
1TT2-4	234	Tibjak	69°35'36"	132°59'00"	Dune Base (P.2)
1TT2-5	248	Tibjak	69°35'36"	132°59'00"	Trough (P.2)
1TT2-6	248	Tibjak	69°35'36"	132°59'00"	L. Foreshore; bk, pt. (P.2)
1TT2-7	248	Tibjak	69°35'36"	132°59'00"	M. Foreshore (P.2)
87-24-1	249	Tibjak	69°35'48"	132°59'00"	Nearshore Bar (P.1)
1TH1-1	236	Hutchison Bay	69°43'28"	132°04'36"	HWL
1TH1-2	236	Hutchison Bay	69°43'28"	132°04'36"	Backshore (R-M)
1TH1-3	236	Hutchison Bay	69°43'28"	132°04'36"	Berm
1TH1-4	236	Hutchison Bay	69°43'28"	132°04'36"	M. Foreshore
1TH1-5	236	Hutchison Bay	69°43'28"	132°04'36"	L. Foreshore
1TH2-1	236	Hutchison Bay	69°43'53"	132°02'36"	Berm
1TH2-2	236	Hutchison Bay	69°43'53"	132°02'36"	M. Foreshore
1TH2-3	236	Hutchison Bay	69°43'53"	132°02'36"	L. Foreshore (R-M)
1TH2-4	236	Hutchison Bay	69°43'53"	132°02'36"	Dune
1TH3-1	236	Hutchison Bay	69°45'18"	131°59'10"	Backshore(Trough of R-M)
1TH3-2	236	Hutchison Bay	69°45'18"	131°59'10"	Backshore (Crest of R-M)
1TH3-3	236	Hutchison Bay	69°45'18"	131°59'10"	M. Foreshore

KARLUK 87 - BEACH SAMPLE LOG (Continued)

Sample No.	Day	Location	Latitude	Longitude	Notes
1TB1-1	236	Bols Pt. Lagoon Beach	69°50'04"	131°42'48"	Transverse Bar
1TB1-2	236	Bols Pt. Lagoon Beach	69°50'04"	131°42'48"	In Trough (R-M)
1TB1-3	236	Bols Pt. Lagoon Beach	69°50'04"	131°42'48"	H. Foreshore
1TB2-1	236	N. Bols Pt. Barrier	69°51'15"	131°43'24"	Backshore
1TB2-2	236	N. Bols Pt. Barrier	69°51'15"	131°43'24"	Berm
1TB2-3	236	N. Bols Pt. Barrier	69°51'15"	131°43'24"	M. Foreshore
1TB3-1	236	M. Bols Pt. Barrier	69°49'04"	131°48'00"	M. Foreshore
1TB3-2	236	M. Bols Pt. Barrier	69°49'04"	131°48'00"	Berm
1TB3-3	236	M. Bols Pt. Barrier	69°49'04"	131°48'00"	Lagoon Side
1TB4-1	236	S. Bols Pt. Barrier	69°47'58"	131°51'25"	Berm
1TB4-2	236	S. Bols Pt. Barrier	69°47'58"	131°51'25"	M. Foreshore
1TA1-1	236	E. Atkinson Pt.	69°57'20"	131°24'48"	Berm
1TA1-2	236	E. Atkinson Pt.	69°57'20"	131°24'48"	M. Foreshore
1TA1-3	236	E. Atkinson Pt.	69°57'20"	131°24'48"	L. Foreshore
1TA2-1	236	W. Atkinson Pt.	69°56'24"	131°27'42"	Berm
1TA2-2	236	W. Atkinson Pt.	69°56'24"	131°27'42"	M. Foreshore
1TA2-3	236	W. Atkinson Pt.	69°56'24"	131°27'42"	L. Foreshore
1TA3-1	236	N. Barrier S.W. Atk.	69°54'42"	131°30'00"	Berm
1TA3-2	236	N. Barrier S.W. Atk.	69°54'42"	131°30'00"	M. Foreshore
1TA3-3	236	N. Barrier S.W. Atk.	69°54'42"	131°30'00"	L. Foreshore
1TA4-1	236	S. Barrier S.W. Atk.	69°53'50"	131°31'00"	Crest Swash Bar
1TA4-2	236	S. Barrier S.W. Atk.	69°53'50"	131°31'00"	M. Foreshore
1TA4-3	236	S. Barrier S.W. Atk.	69°53'50"	131°31'00"	L. Foreshore
1TA4-4	236	S. Barrier S.W. Atk.	69°53'50"	131°31'00"	Berm
1TT3-1	237	Toker Pt.	69°38'52"	132°53'36"	Berm
1TT3-2	237	Toker Pt.	69°38'52"	132°53'36"	M. Foreshore
1TW1-1	237	E. Warren Pt.	69°45'36"	132°18'30"	Berm
1TW1-2	237	E. Warren Pt.	69°45'36"	132°18'30"	M. Foreshore
1TW2-1	237	M. Warren Pt.	69°45'14"	132°20'50"	Berm
1TW2-2	237	M. Warren Pt.	69°45'14"	132°20'50"	M. Foreshore
1TW2-3	237	M. Warren Pt.	69°45'14"	132°20'50"	Backshore
1TW3-1	237	W. Warren Pt.	69°44'34"	132°28'24"	Berm
1TW3-2	237	W. Warren Pt.	69°44'34"	132°28'24"	M. Foreshore

KARLUK 87 - BEACH SAMPLE LOG (Continued)

Sample No.	Day	Location	Latitude	Longitude	Notes
CW3-1	237	Warren Pt.	69°44'34"	132°28'24"	Section 3 (Unit 1)
CW3-2	237	Warren Pt.	69°44'34"	132°28'24"	Section 3 (Unit 2)
CW2-1	237	Warren Pt.	69°45'10"	132°20'50"	Section 2 (Unit 1)
CW2-2	237	Warren Pt.	69°45'10"	132°20'50"	Section 2 (Unit 2)
CW2-4	237	Warren Pt.	69°45'10"	132°20'50"	Section 2 (Unit 4)
CW2-5	237	Warren Pt.	69°45'10"	132°20'50"	Section 2 (Unit 5)
W5-1	238	Warren Pt.	69°44'30"	132°29'00"	Section 5 (Unit 1)
W5-4	238	Warren Pt.	69°44'30"	132°29'00"	Section 5 (Unit 4)
TU-B	249	Tuft Pt.	69°44'28"	132°33'12"	Unit B2
TU-C	249	Tuft Pt.	69°44'28"	132°33'12"	Unit C
Mc-1-3	236	McKinley Bay	69°52'50"	131°05'36"	3 m Top of Section
A2-87-S	252	Atkinson Pt.	69°57'04"	131°25'40"	Surface of Core A2-87

CORES

Sample No.	Day	Latitude	Longitude	Notes
A1-87	252	69°57'15"	131°25'50"	
A2-87	252	69°57'04"	131°25'40"	

ORGANIC MATERIAL

Sample No.	Day	Latitude	Longitude	Notes
PB-1	236	69°50'04"	131°42'48"	Peat on foreshore at B1
1TT3-3	237	69°38'52"	132°53'36"	Peat on foreshore, Toker Pt.
1TW3-3	238	69°44'25"	132°28'00"	Vegetation under eolian sands, Warren Pt.
W5-2	238	69°44'30"	132°29'00"	Veg. top of unit 2, sect. 5, Warren Pt.
W5-3	238	69°44'30"	132°29'00"	Peat at base of old eolian sands, Unit 3, sect. 5
AT-D1	251	69°56'54"	131°26'48"	Roots base dune, Atkinson Pt.
A3-87	254	69°56'54"	131°27'00"	Peat on foreshore, Atkinson Pt.

KARLUK 87 - GRAB SAMPLE LOG

Sample No.	Day	Location	Latitude	Longitude	Water Depth (m)
87-19-1	249	Off Toker Pt.	69°39'07"	132°52'02"	1.5
87-19-2	249	Off Toker Pt.	69°39'11"	132°52'03"	3
87-19-7	249	Off Toker Pt.	69°39'19.4"	132°52'00.1"	2.5-3
87-19-8	249	Off Toker Pt.	69°39'22"	132°51'58.5"	4.3
87-19-9	249	Off Toker Pt.	69°39'22"	132°51'58.5"	4.3
87-19-10	249	Off Toker Pt.	69°39'26.9"	132°51'59.7"	3
87-19-11	249	Off Toker Pt.	69°39'38.9"	132°51'59.8"	5.2
87-19-12	249	Off Toker Pt.	69°39'43.5"	132°52'00.1"	3.5
87-19-13	249	Off Toker Pt.	69°39'46.9"	132°51'59.7"	5
87-19-14	249	Off Toker Pt.	69°39'56.9"	132°52'00.8"	6
87-19-15	249	Off Toker Pt.	69°39'49"	132°51'58.3"	4
87-19-16	249	Off Toker Pt.	69°40'06.8"	132°51'58.9"	5
87-35-1	254	Off Atkinson Pt.	69°57'38.8"	131°25'03.6"	3
87-35-2	254	Off Atkinson Pt.	69°57'41.5"	131°25'14"	5
87-35-3	254	Off Atkinson Pt.	69°58'05.7"	131°25'13.6"	6.5
87-35-4	254	Off Atkinson Pt.	69°58'29"	131°25'14.2"	8.3
87-35-5	254	Off Atkinson Pt.	69°58'29"	131°25'14.2"	8.3
87-35-6	254	Off Atkinson Pt.	69°59'05.4"	131°25'12.5"	10
87-35-7	254	Off Atkinson Pt.	70°00'15.3"	131°25'12.6"	12
87-35-8	254	Off Atkinson Pt.	70°02'48.9"	131°25'08.1"	14

KARLUK 87 - GRAB SAMPLE LOG (Continued)

Sample No.	Day	Location	Latitude	Longitude	Water Depth (m)
87-9-1	255	Hutchison Bay	69°42'38.2"	132°12'34.3"	2
87-9-2	255	Hutchison Bay	69°44'26.8"	132°12'36.9"	4.3
87-9-3	255	Warren Pt. Shoal	69°45'55.8"	132°12'33.3"	4.3
87-9-4	255	South of Beluga Shoal	69°47'47.7"	132°12'34.7"	6
87-9-5	255	Beluga Shoal	69°48'25.4"	132°12'40.9"	2.8
87-9-6	255	North of Beluga Shoal	69°49'21.6"	132°12'32.9"	7
87-9-7	255	North of Beluga Shoal	69°51'08.2"	132°12'35.3"	8.7
87-9-8	255	North of Beluga Shoal	69°53'05.8"	132°12'40.3"	9.7
87-9-9*	255	North of Beluga Shoal	70°00'23"	132°12'31.8"	17.5
87-15-1	257	Off Toker Pt.	69°39'23.5"	132°48'54.6"	1.3
87-15-2	257	Off Toker Pt.	69°39'26.6"	132°48'59"	2.3
87-15-3	257	Off Toker Pt.	69°39'26.1"	132°48'57.1"	2
87-15-4	257	Off Toker Pt.	69°39'31.2"	132°48'56.7"	2
87-15-5	257	Off Toker Pt.	69°39'51.5"	132°48'54.9"	4.2
87-15-6	257	Off Toker Pt.	69°40'05.4"	132°48'54.9"	3.1
87-15-7	257	Off Toker Pt.	69°40'20.4"	132°48'54.4"	4.5
87-15-8	257	Off Toker Pt.	69°40'27"	132°48'54.7"	3.7
87-15-9	257	Off Toker Pt.	69°40'34.7"	132°48'53.1"	4
87-15-10	257	Off Toker Pt.	69°40'50.2"	132°48'53"	5.5
87-22-1	258	NW Toker Pt.	69°47'58.9"	133°00'02"	9
87-22-2	258	NW Toker Pt.	69°50'49.2"	132°59'46.7"	11
87-25-1	258	James Shoal	69°44'17.1"	132°59'57.5"	4.2
87-25-2	258	West Toker Pt.	69°40'37"	133°00'00.5"	8.5
87-25-3	258	West Toker Pt.	69°38'07.5"	133°00'00.8"	

* Equivalent to 87-46.1

KARLUK 87 - WATER SAMPLES*

Sample No.	Day	Location	Latitude	Longitude	Water Depth (m)	Sample Depth (m)
87-19-1P	249	Off Toker Pt.	69°39'07"	132°52'02"	1.5	0
87-35-1P	254	Off Atkinson Pt.	69°57'38.8"	131°25'03.6"	3	0
87-35-2P	254	Off Atkinson Pt.	69°57'41.5"	131°25'14"	5	0
87-35-3P	254	Off Atkinson Pt.	69°58'05.7"	131°25'13.6"	6.5	0
87-35-4P	254	Off Atkinson Pt.	69°58'29"	131°25'14.2"	8.3	0
87-35-6P	254	Off Atkinson Pt.	69°59'05.4"	131°25'12.5"	10	0
87-35-7P	254	Off Atkinson Pt.	70°00'15.3"	131°25'12.6"	12	0
87-35-8P	254	Off Atkinson Pt.	70°02'48.9"	131°25'08.1"	14	0

* All samples have a volume of 1 ℓ (2 × 0.5 ℓ)

PART 6

BEACH DYNAMICS STUDY

TIBJAK BEACH
BEAUFORT SEA COAST

August 22 to September 17 1987

Philip R. Hill and Arnaud Hequette

INTRODUCTION

A coastal dynamics project was carried out at a beach site north of Tuktoyaktuk between August 22 and September 17 1987. The objectives of the study were to collect wave, current and beach profile data from a coastal site along the Tuktoyaktuk Peninsula. These field data are needed to supplement numerical model studies of coastal zone sediment transport (Keith Philpott Consulting Ltd., 1985; 1987).

The site selected for this study is located on the eastern side of Kugmallit Bay, between Tibjak Point and Tininerk Bay (Fig. 1) and is referred to herein as Tibjak Beach. Several criteria were used for selecting the site. Logistic problems were minimised by using a location close to Tuktoyaktuk: Tibjak Beach was only 10 minutes from Tuktoyaktuk by helicopter and less than 2 hours by boat. This allowed frequent visits to the site for beach profile measurements, equipment deployment and equipment maintenance. For future comparisons between field data and numerical models, a straight section of beach was required: Tibjak Beach fulfills this requirement, although a complicating factor was the presence of shore parallel bars on the lower shoreface. Finally, cliffs with a significant elevation were required to mount video cameras for environmental observations. Small sections of tundra cliff with elevations greater than 3 m were available at Tibjak Beach.

The field work was carried out jointly by GSC personnel and through a contract to Arctic Sciences Ltd. The contractors were charged with preparing wave and current meters for deployment and building a time lapse video camera sytem.

METHODS

Wave and Current Measurements

Two separate moorings were deployed. These consisted of a tripod mounted burst sampling Seadata instrument to measure directional waves and a second separate current meter to independently measure currents. The Seadata instruments were set to burst sample for 1024 s every 3 hours. Details of the moorings will be contained in a separate report by Arctic Sciences Ltd.The locations of the instruments are shown in Figure 2.

1. 5 m water depth	Seadata 635-9 Wave recorder Neil Brown "smart" VACM
2. 3.5 m water depth	Seadata 621 meter Inter-Ocean S4 current meter.

Video Camera Installation

A time-lapse video camera system was built for the contractor by Lobsiger Associates Ltd. Two video cameras were mounted in weather proof containers with a controller unit containing a timer and photocell. This assembly was mounted on a 4 m high tower built from two aluminium step ladders. The cameras were positioned so that one viewed along the beach and the second out to sea. Several flags were positioned in the field of view for later positioning during processing. The cameras were set to record for 2 minutes every 3 hours during daylight. This required that the videotape be changed every 7 -10 days.

Beach Profile Surveys

Three survey lines perpendicular to shore were set up within the field of view of the video cameras (Fig. 2). Surveys were carried out using a Wild T2 Theodolite and Wild N2 surveying level.

Sampling

Samples of surficial beach sediment were collected by hand at surveyed positions along the beach profiles. Vibracores were collected from offshore from the CCGS Nahidik using the BIO Vibracorer.

FIELD OPERATIONS

22 August

Video camera system set up by A. Hequette and G. Pierlot. Beach profiles Ti-0, Ti-1 and Ti-2 staked and surveyed.

27 August

Offshore instruments deployed from R/V Karluk by D. Tuele.

29 August

Hequette checks cameras and discovers that one (looking ofshore) is not functioning. Attempts restart. Videotapes changed at 16.15.

5 September

Hill and Hequette to site after relatively strong storm event. Remeasured beach profiles Ti-0, Ti-1 and Ti-2. Replaced videotapes. It is apparent that the offshore camera is still not working. Once again attempt to restart.

8 September

Review of videotapes at PCSP (no VCR available during long weekend) indicates that the alongshore camera also stopped working on 2 September. Hill returned to site and replaced battery. Camera reset and operational.

17 September

Tuele boards CCGS Nahidik and recovers offshore instruments successfully. Three vibracores were collected at the site. Hill and Tuele demob video camera station. Noted that the Tuk fairway buoy had broken loose and drifted across the site, washing ashore north of the camera station.

PRELIMINARY RESULTS

Wave and Current Data

Data recovery from the offshore wave and current meters is shown in Figure 3. Almost 100% data recovery was obtained from the Seadata 621 and the two current meters. However, the Seadata 635-9 tape did not fully advance and the record terminated on September 5. Data from these instruments will be available in a future report by Arctic Sciences Ltd.

Videotapes

The offshore-looking camera did not work throughout the program due to a problem in the controller circuitry. Time series videotape data were obtained from the alongshore-looking camera. A summary of the videotape scenes is given in Table 1.

Beach Profiles

Beach profiles were measured on two separate days, August 22 and September 5, the latter during a relatively strong storm event when water levels were raised. The measured profiles are shown in Figure 4. These profiles show a significant erosion of the foreshore between the above dates.

Sampling

Twenty surficial sediments samples were obtained along the beach profiles on both days that the profiles were measured. Locations of the samples with respect to the profiles are shown on Figure 4. Three vibracores were collected close to the current meter locations (Fig. 2).

ACKNOWLEDGEMENTS

This field program would not have been possible without the logistic support of the Polar Continental Shelf Project, Tuktoyaktuk. Peter Barnes of the U.S. Geological Survey took on the onerous task of deploying the wave and current instrumentation from the R/V Karluk. Captain Tom Hull and the coastguard ship Nahidik made the recovery of the equipment look easy. Dave Fissel of Arctic Sciences Ltd. co-ordinated a logistically difficult contract and despite many changes in course ensured the acquisition of high quality wave and current data. Bruce Pinchin of Keith Philpott Consulting Ltd. provided advice on choosing an appropriate study site.

TABLE 1

VIDEOTAPE LOG

DAY	START TIME	COMMENTS
TAPE 1		
22 August	16.00	
"	19.00	
"	20.00	
23 August	07.00	
"	10.00	
"	13.00	
"	16.00	
"	19.00	
"	22.00	
24 August	10.00	
"	13.00	Raindrops on lens.
"	16.00	
"	19.00	
"	22.00	
25 August	10.00	
"	13.00	
"	16.00	
"	19.00	
"	22.00	Offshore bar exposed.
26 August	07.00	Foggy (lens condensation?)
"	10.00	Raindrops on lens. Offshore bar exposed.
"	13.00	Small area of offshore bar exposed.
"	16.00	Raindrops on lens.
"	19.00	Raindrops on lens. Almost completely obscured.
"	22.00	Raindrops on lens.
27 August	07.00	
"	10.00	
"	13.00	
"	16.00	
"	19.00	
"	22.00	
28 August	07.00	
"	10.00	Raindrops on lens.
"	13.00	
"	16.00	
"	19.00	
"	22.00	
29 August	10.00	Raindrops on lens.
"	13.00	Raindrops on lens.
"	16.00	

TABLE 1 (cont'd)

TAPE 2		
29 August	22.00	Raindrops on lens.
30 August	10.00	
"	13.00	Raindrops on lens.
"	16.00	
"	19.00	
"	22.00	
31 August	10.00	High water level.
"	13.00	
"	16.00	
"	19.00	
"	22.00	
1 September	10.00	Raindrops on lens.
"	13.00	Raindrops on lens.
"	16.00	Raindrops on lens.
"	19.00	Raindrops on lens.
"	22.00	Raindrops on lens.
2 September	10.00	Raindrops on lens.
"	13.00	Raindrops on lens. Almost obscured.
"	16.00	Raindrops on lens.
"	19.00	Bar partly exposed.
"	22.00	Bar partly exposed.
TAPE 3		
8 September	18.51	
"	19.05	
9 September	10.05	
"	13.05	
"	16.05	
"	19.05	
10 September	10.05	Large area of exposed oblique bars.
"	13.05	Large area of exposed oblique bars.
"	16.05	
"	19.05	
11 September	10.05	Large area of exposed oblique bars.
"	13.05	Large area of exposed oblique bars."
"	19.05	
12 September	10.05	Completely obscured by rain.
"	13.05	Bars exposed.
"	16.05	
"	19.05	
13 September	10.05	
"	13.05	
"	16.05	
"	19.05	

TABLE 3 (cont'd)

Tape 3 (cont'd)		
14 September	10.05	
"	13.05	
"	16.05	
"	19.05	
15 September	10.05	
"	13.05	
"	16.05	
"	19.05	
16 September	10.06	
"	13.06	
"	16.06	
"	19.06	
17 September	10.06	Raindropson lens. Almost obscured.

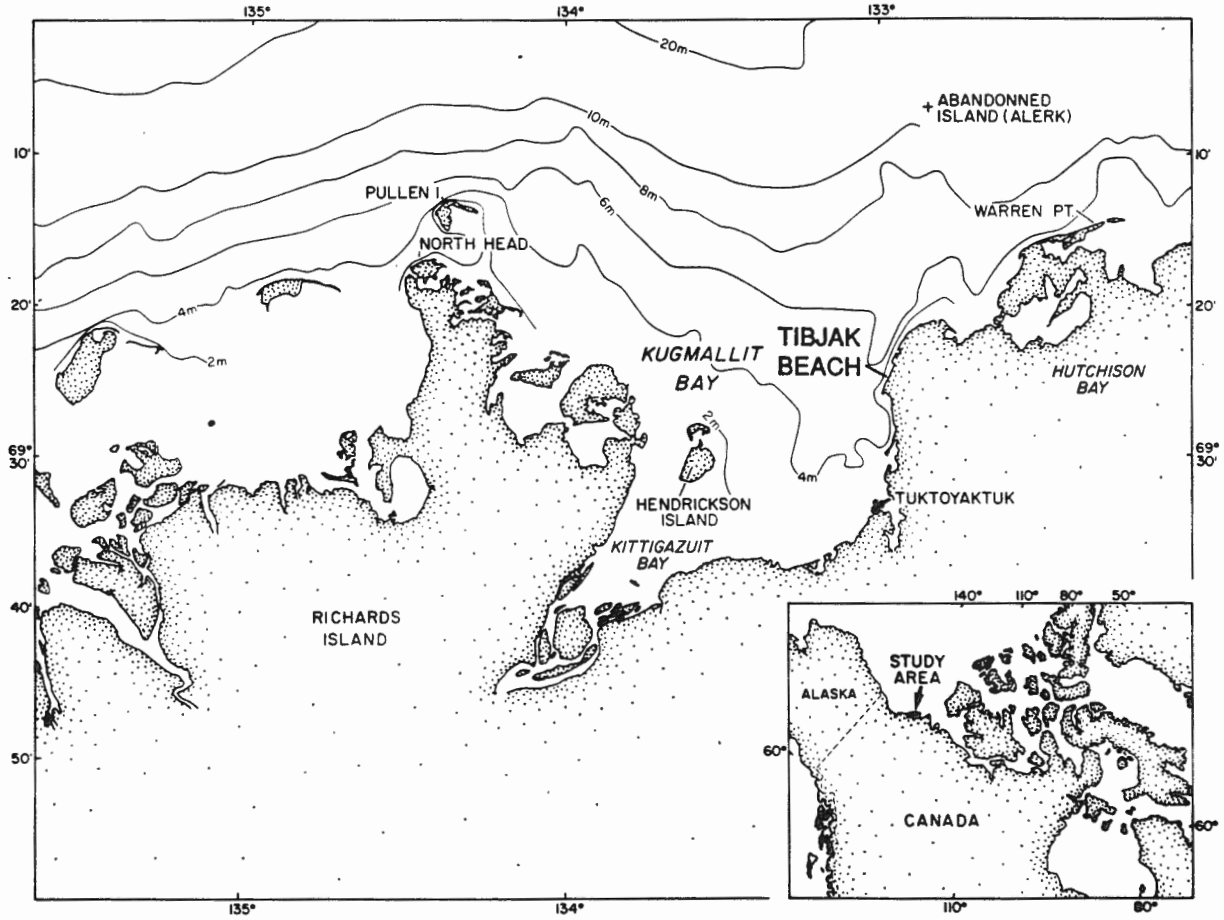


Figure 1. Location of Tibjak Beach Study Area

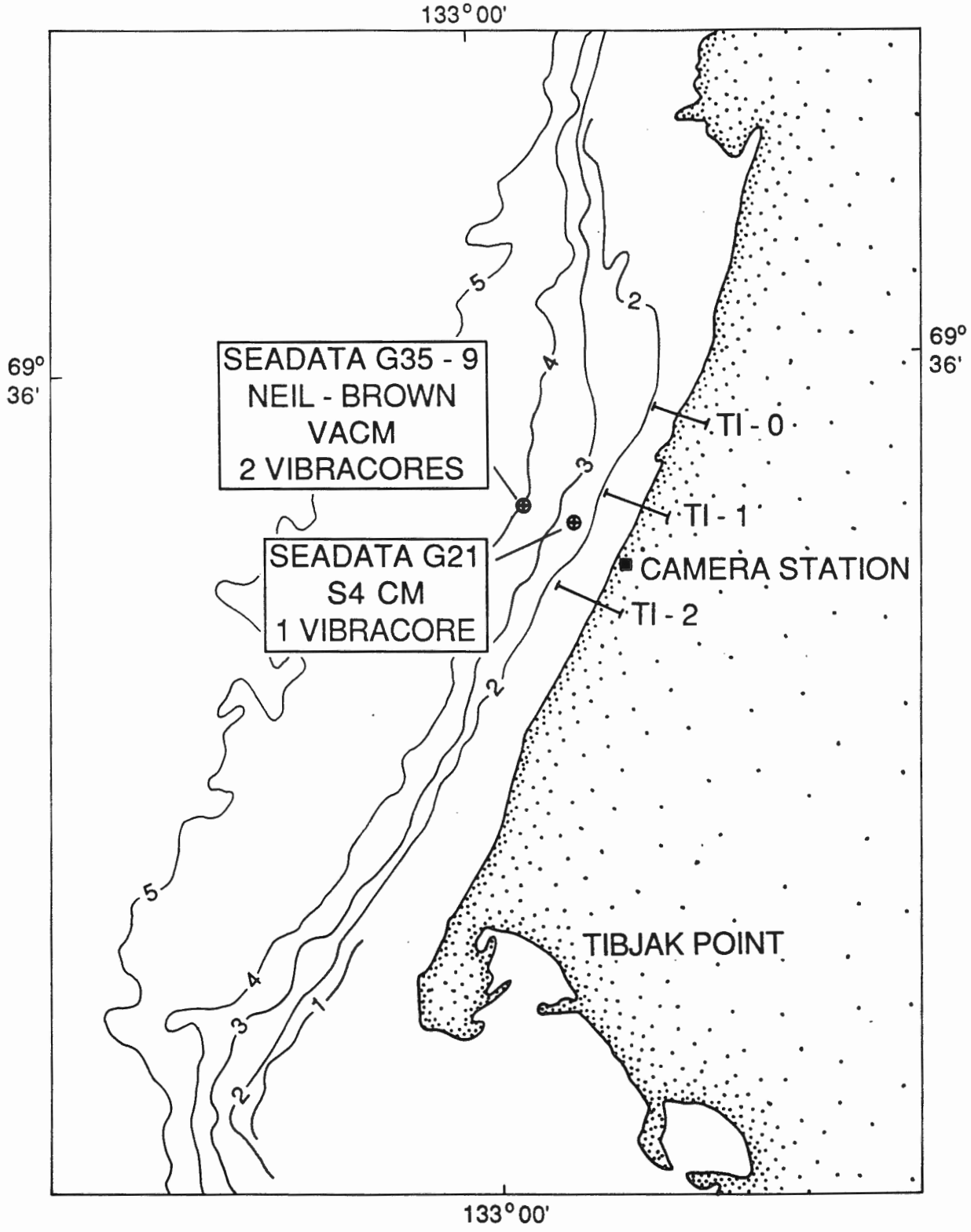


Figure 2. Plan of Tibjak Beach site showing locations of measured profiles, camera station and wave/current meters.

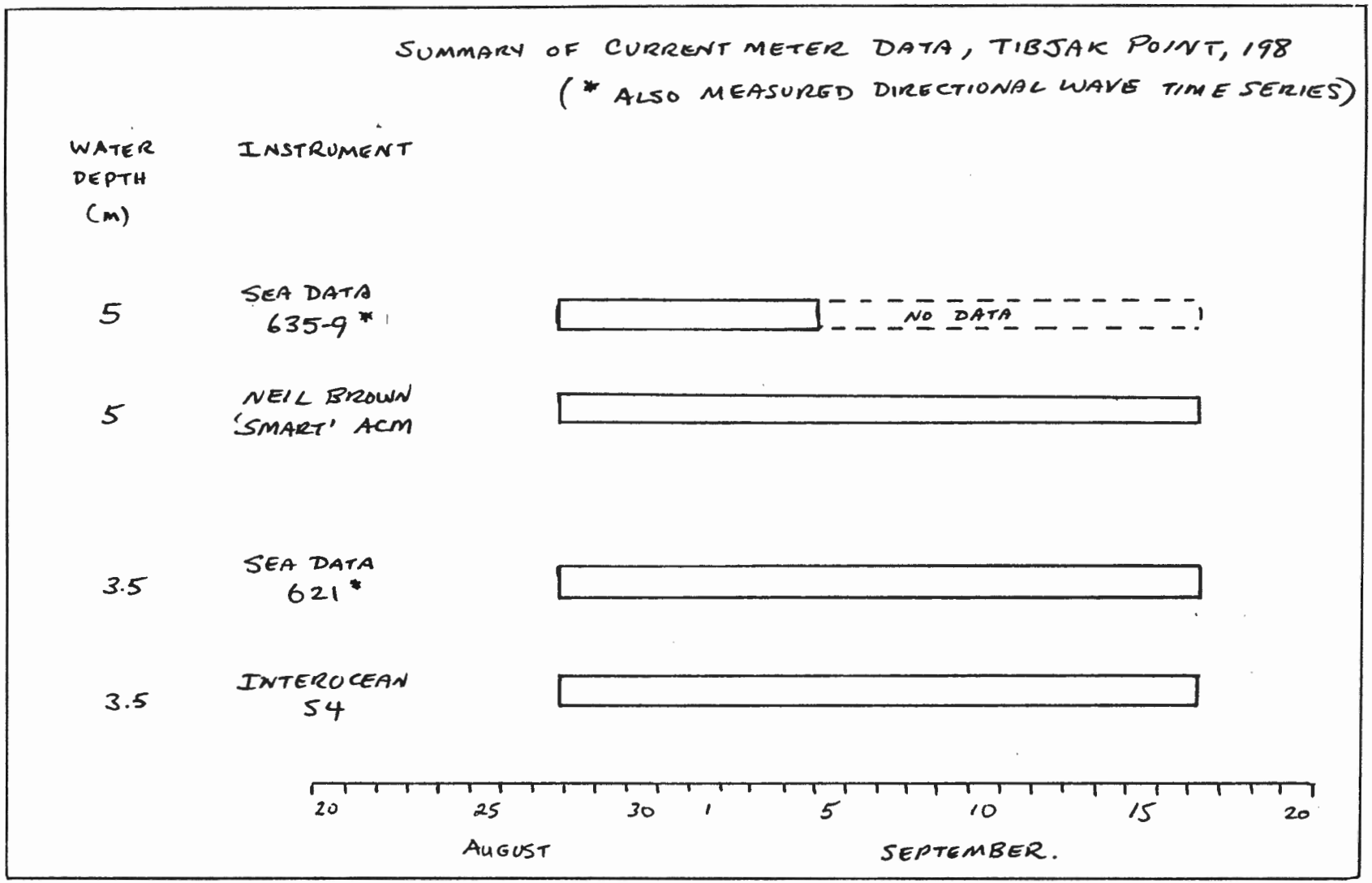
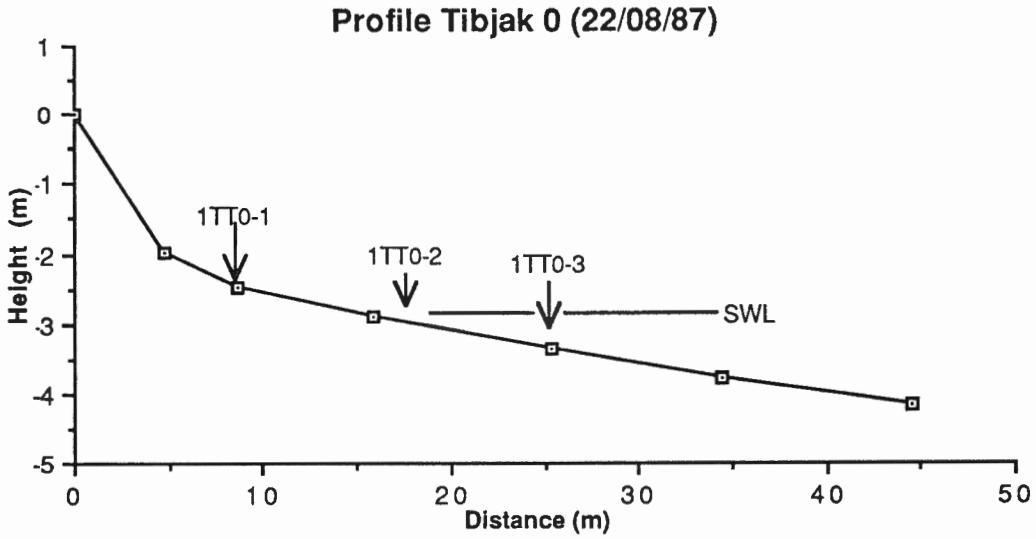
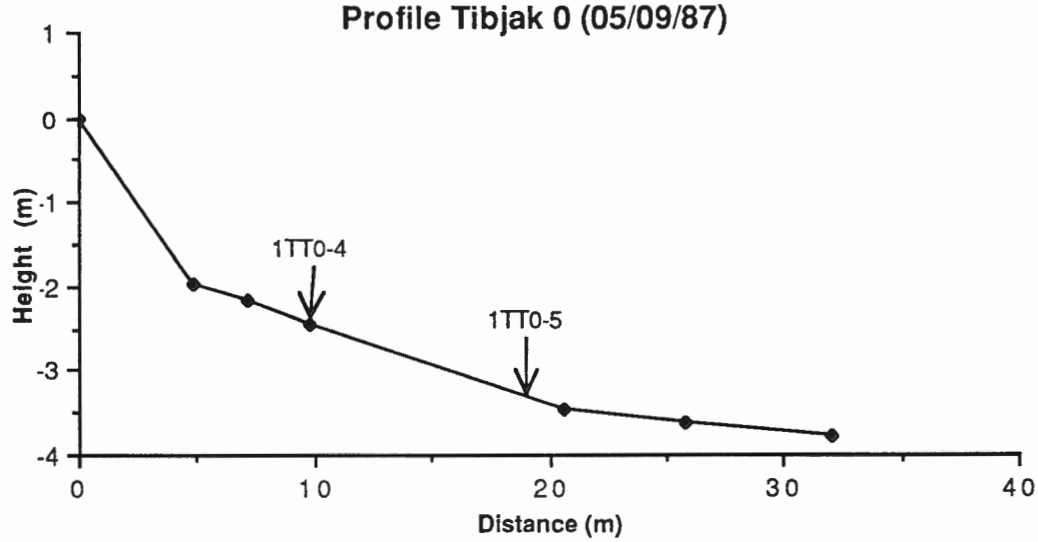

SUMMARY OF CURRENT METER DATA, TIBJAK POINT, 198
(* ALSO MEASURED DIRECTIONAL WAVE TIME SERIES)
WATER DEPTH (m)
INSTRUMENT
5
SEA DATA 635-9 *
NO DATA
5
NEIL BROWN 'SMART' ACM
3.5
SEA DATA 621 *
3.5
INTEROCEAN 54
20
25
30
1
5
10
15
20
AUGUST
SEPTEMBER.

FIG. 3





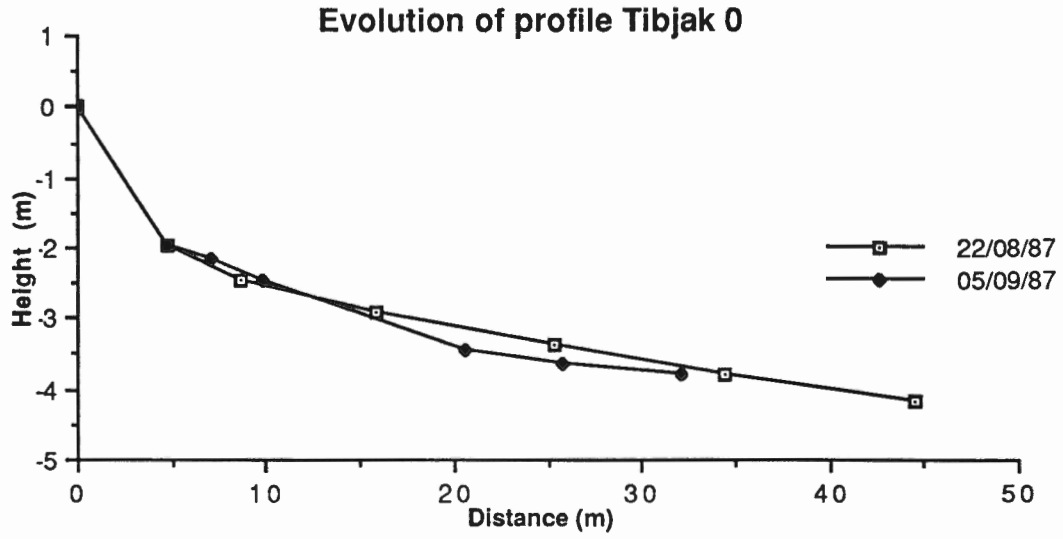
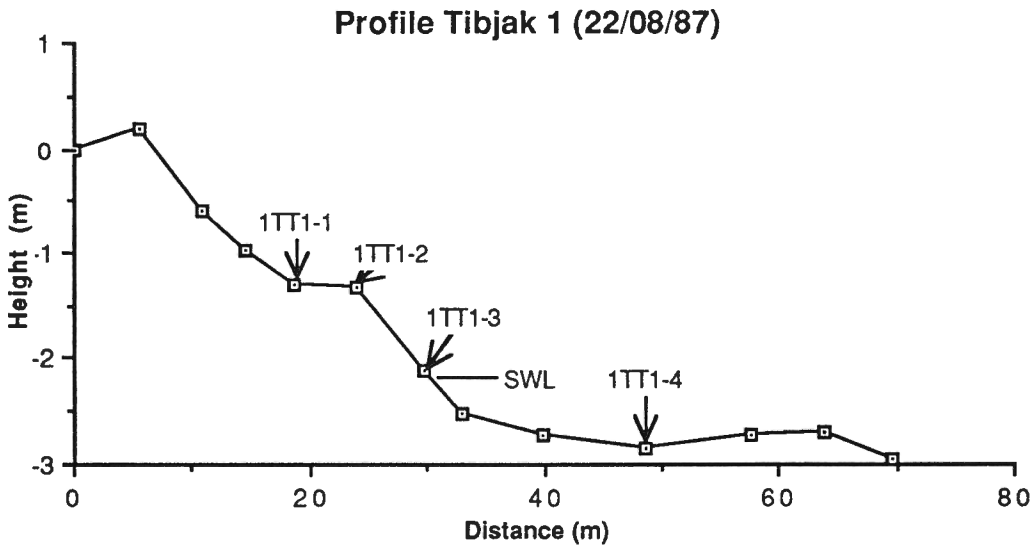
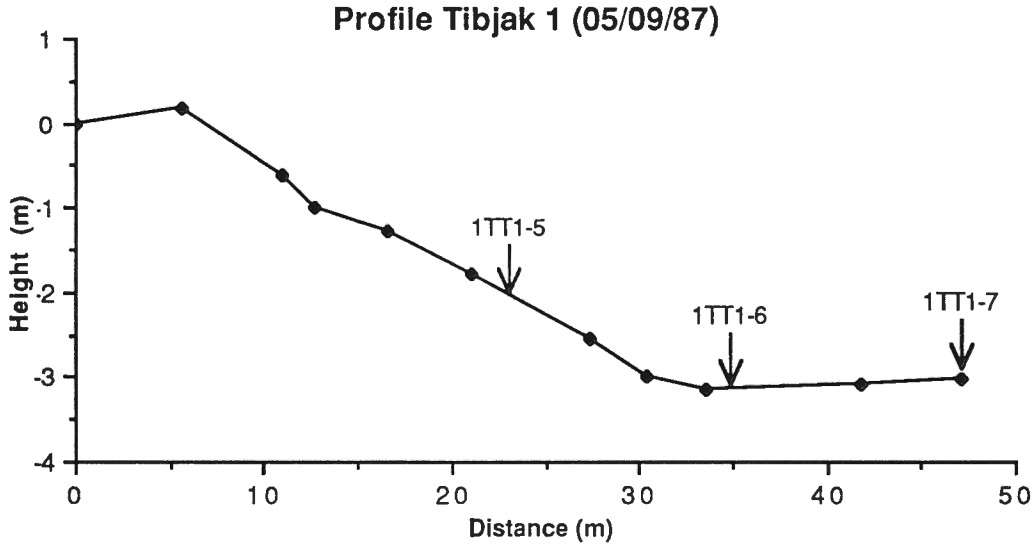


Figure 4. Measured beach profiles at Tibjak Beach. See Figure 2 for locations.


Profile Tibjak 1 (22/08/87)
Height (m)
Distance (m)
1TT1-1
1TT1-2
1TT1-3
SWL
1TT1-4


Profile Tibjak 1 (05/09/87)
Height (m)
Distance (m)
1TT1-5
1TT1-6
1TT1-7

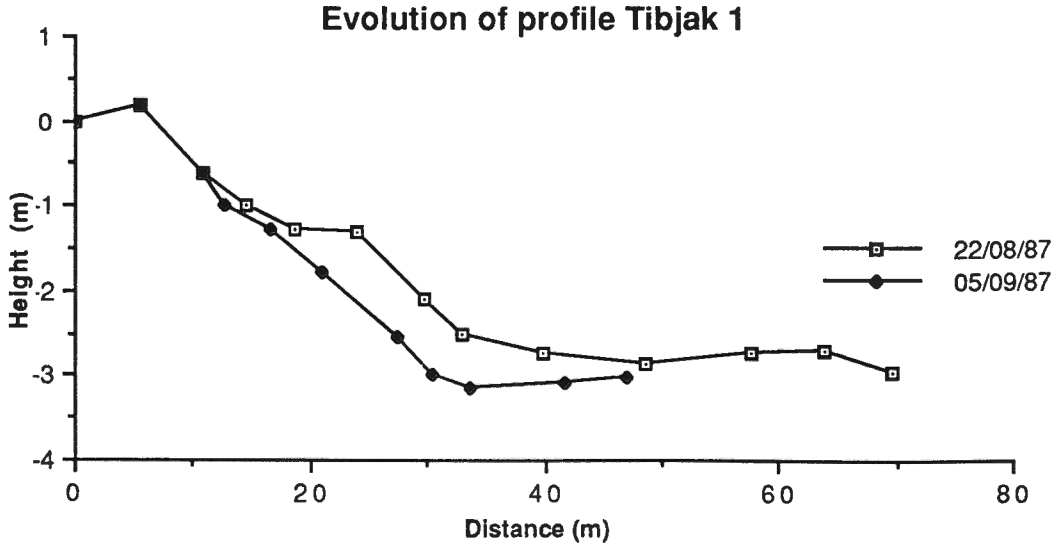
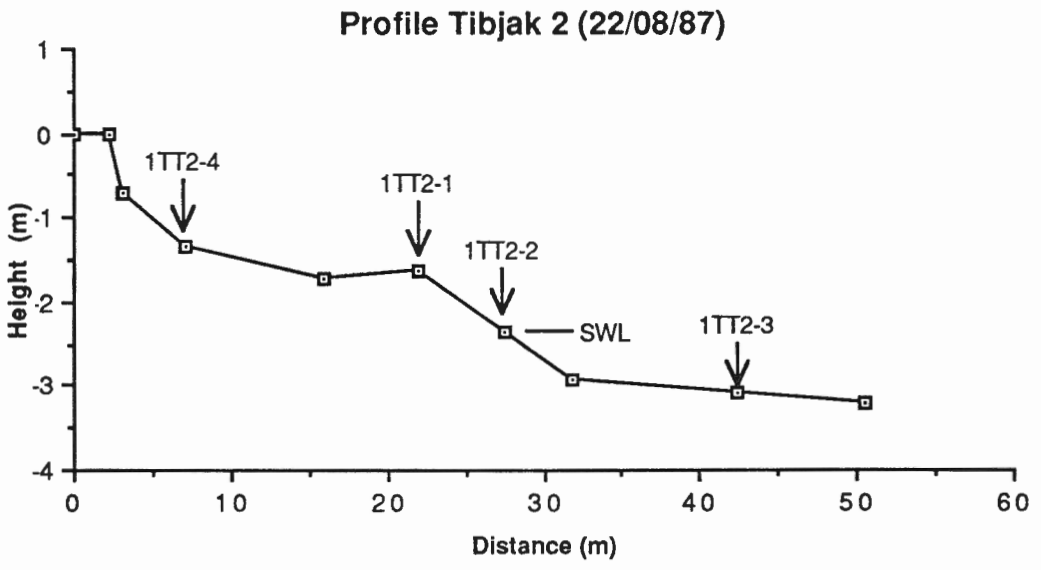
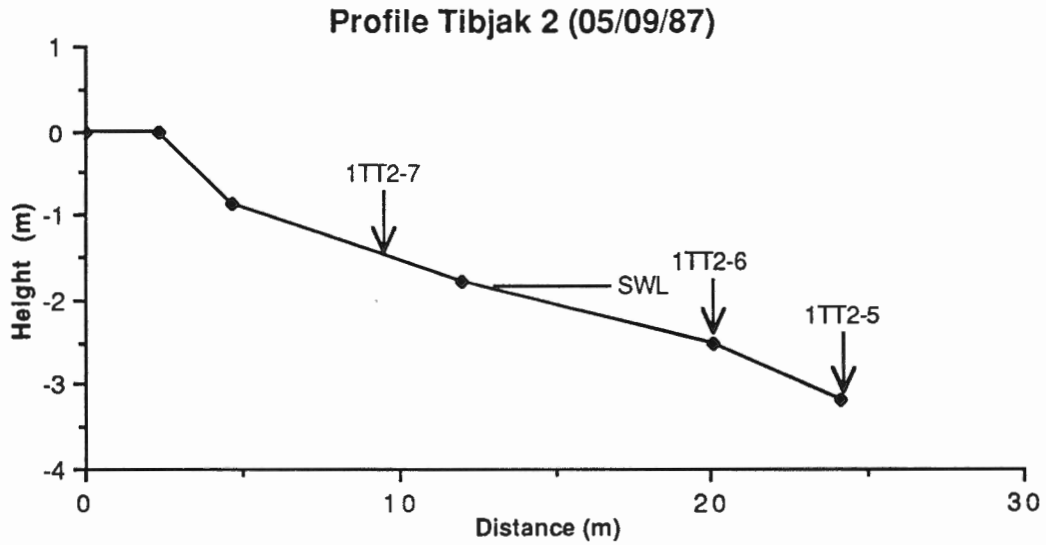

Evolution of profile Tibjak 1
Height (m)
Distance (m)
22/08/87
05/09/87

Fig. 4 (cont'd)


Profile Tibjak 2 (22/08/87)
Height (m)
Distance (m)
1TT2-4
1TT2-1
1TT2-2
SWL
1TT2-3


Profile Tibjak 2 (05/09/87)
Height (m)
Distance (m)
1TT2-7
SWL
1TT2-6
1TT2-5

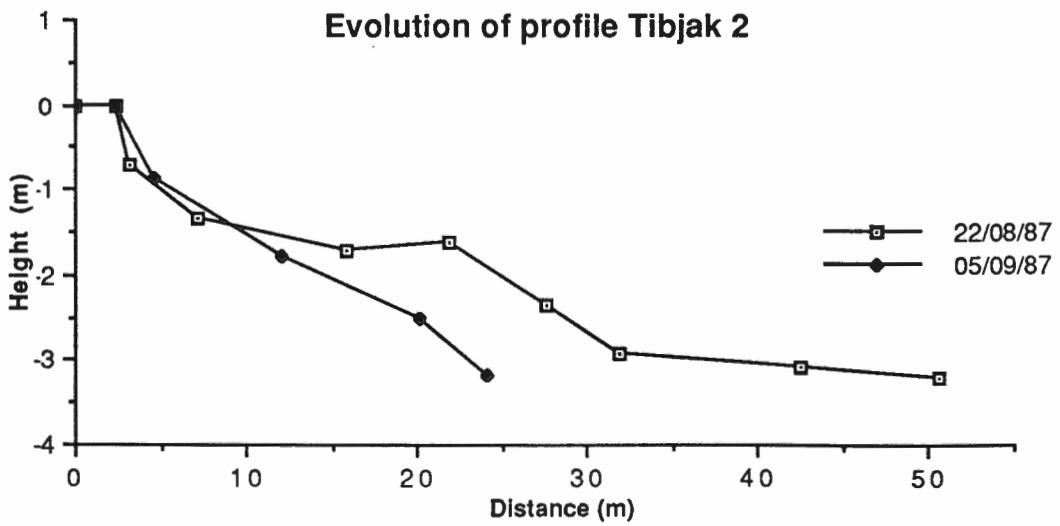

Evolution of profile Tibjak 2
Height (m)
Distance (m)
22/08/87
05/09/87

Fig. 4 (cont'd)

PART 7

FAR-FIELD OCEANOGRAPHIC MEASUREMENTS AT THE AMAULIGAK F-24 WELL-SITE, AUGUST-OCTOBER, 1987

by

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We thank Dr. P. Hill, Atlantic Geoscience Centre, Bedford Institute of Oceanography (BIO) and Drs. R. MacDonald and E. Cormak, Institute of Ocean Sciences (IOS), for loan of the current meters and other equipment used in this project. Mssrs. R. Cooke, H. Pite and D. Seiberg of IOS also assisted in providing calibration data, while Mr. Paul D'Entrement of BIO expertly built and prepared some of the mooring components. Mr. T. Juhasz and D. Spear of Oceanetic Measurement Systems, Sidney, B.C. prepared some of the equipment and participated in the deployment and recovery at two mooring sites.

We also thank Gulf Canada Resources Ltd., particularly the many personnel at Nalluk base, and on the Molikpaq and the various vessels used, for their assistance throughout the project. We especially wish to thank Mr. D. McGonigal of Gulf Canada, Project Supervisor, for his advice, assistance and support throughout all parts of the project.

Arctic Sciences Ltd. personnel who contributed to the project include: Mr. G. Wilton, Technical Supervision; Mr. G. Pierlot, Electronics Support; Ms. F. Welsman, Word Processing; and Mr. D. Stover, Drafting.

1. EXECUTIVE SUMMARY

An extensive set of water velocity and other oceanographic measurements were collected at several locations around the Amauligak F-24 drill site in the summer and fall of 1987. The oceanographic measurement program had two major components: near-field data collection in the immediate vicinity of the Molikpaq drilling platform; and far-field data collection at sites of 1 to 11 km away, where the effect of the drilling structure on oceanographic conditions is expected to be minimal.

This report deals with the far-field measurements, carried out under contract to Gulf Canada Resources Ltd. The far-field data were collected between August 18 and October 17, 1987, using equipment provided by the Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, N.S. and by the Institute of Ocean Sciences, Sidney, B.C.

The results from the data processing are presented in this report. Of the ten complete current meter records, the mean speeds varied from 0.20 m/s (near-surface) to 0.06 m/s (near-bottom). The largest current measurement of 0.75 m/s was obtained at the near-surface current meter. During the period of mid-August to late September, when eight of the ten records were obtained, the measurement indicated a preference for easterly flows in the middle and lower portions of the water column. Near the surface, the net flow was directed northward.

Data recovery rates were generally high in this project. Of the eleven possible current meter records, ten complete and one partial data set were obtained. Two of the full data records had suspect directional data.

2. INTRODUCTION

An extensive set of current meter and wave measurements were collected in the vicinity of Gulf Canada Resources Limited's Amauligak F-24 well-site from August to October, 1987. The current meter data were collected through a collaborative industry-government project, involving Gulf Canada Resources Limited; the Atlantic Geoscience Centre, Bedford Institute of Oceanography (BIO), Department of Energy Mines and Resources, Dartmouth, N.S.; two agencies of the Department of Fisheries and Oceans (Institute of Ocean Sciences (IOS), Sidney, B.C. and Marine Environmental Data Service (MEDS), Ottawa, Ontario). Two oceanographic consulting companies, Arctic Sciences Ltd. and Oceanetic Measurements Ltd., were involved in the field operations and Arctic Sciences Ltd. carried out the data processing and report preparation.

This report describes current meter data obtained. The wave data are reported on separately by MEDS.

3. CURRENT METER DATA

3.1 DATA ARCHIVAL

3.1.1 MEASUREMENT TIMES AND LOCATIONS

Current meter moorings were operated at six sites around the Amauligak F-24 well-site (Figure 1). A summary of the mooring locations, time and instrument configurations are presented in Table 1 and Figure 2. Note that all times in this report are given in local or Mountain Daylight Time (Universal Time + 6).

A detailed chronology of activities related to the study, follow:

August 15	D. Tuele (Arctic Sciences), T. Juhasz and D. Spear (Oceanetics) arrive at Gulf's "Nalluk" base in Tuktoyaktuk.
August 16	Missing freight shipments are located; current meters are tested and data recording started.
August 17	Personnel and equipment transferred from "Nalluk" base to M.V. Miscaroo, via M.V. Arctic Ivik.
August 18	Moorings 2 and 3 deployed by Juhasz and Spear; moorings 1 and 4 deployed by Tuele. Waverider receiver equipment installed on M.V. Miscaroo and tested by Tuele.
August 19	Mooring 5 deployed by Tuele; tools and instrument packing boxes transferred to M.V. Arctic Ivik. Personnel return to Tuktoyaktuk.
August 20	Packaged and stored empty boxes at Nalluk base; personnel departed south on August 21.
September 18	D. Tuele of Arctic Sciences arrived at Gulf's Nalluk Base, then to the M.V. Miscaroo to demobilize waverider receiver and reinstall on the Molikpaq.
September 19	Gulf personnel were instructed on wave receiver operations; D. Tuele returned to Nalluk base.
September 20	Mooring recovery equipment was prepared and transferred to the Molikpaq, by way of the M.V. Arctic Ivik
September 21	The far-field current meter moorings numbers 4 and 5 were recovered from the M.V. Kalvik.

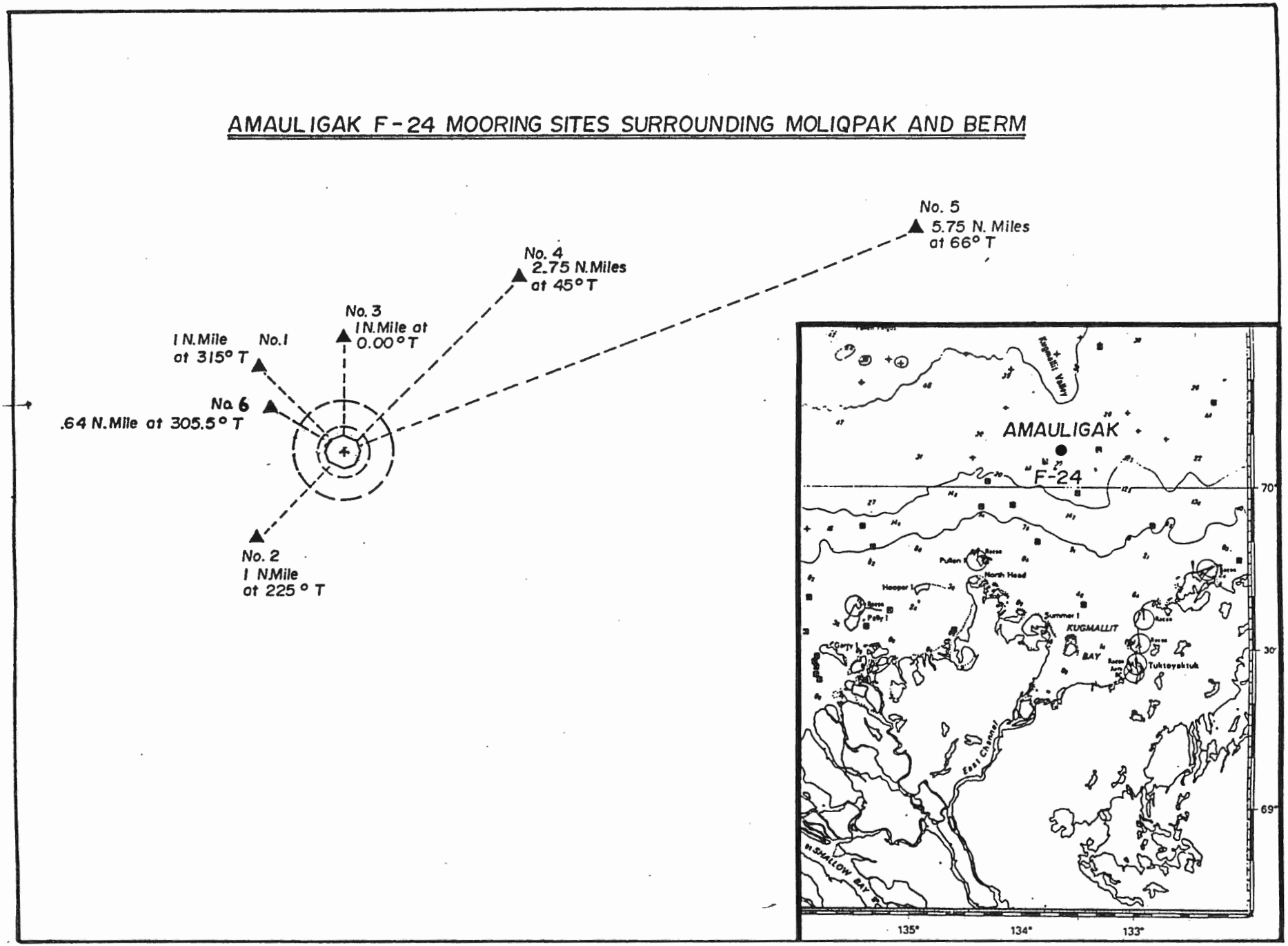


Figure 1: Map showing the sites of all moored current meters, in relation to the Amauligak F-24 well-site.

TABLE 1

Current meter and wave mooring summary, Amauligak F-24, 1987.

Mooring Site	Location	Water Depth (m)	Sample Interval (min)	Instrument Type	S/N	Depth (m)	Times First Record-MDT	Last
1	70°04.038 133°39.727	32.5	180	WR		Surface		
2	70°02.607 133°39.930	32.0	10 10 10	VACM RCM4 RCM4	216 5474 5456	7 16 28	1420 Aug 18	1330 Oct 5
3	70°04.298 133°37.813	32.8	10 10 10	VACM RCM4 RCM4	217 7920 7910	7 16.8 28.8	1520 Aug 18	1150 Oct 5
4	70°05.000 133°31.990	32.0	10 10	RCM5 RCM5	8695 8696	10 27.5	1620 Aug 18	1450 Sep 21
5	70°05.000 133°12.975	26.3	10	RCM5	8697	21.8	1050 Aug 19	1630 Sep 21
6	70°03.66 133°39.34	32	10 10	RCM5 RCM5	8697 8695	10 20	1140 Sep 27	1910 Oct 17
Amauligak F-24	70°03.290 133°37.808							

Instrument Types: WR - Datawell Waverider Buoy
RCM4, RCM5 - Aanderaa Instruments model RCM4, RCM5
VACM - Applied Microsystems VACM

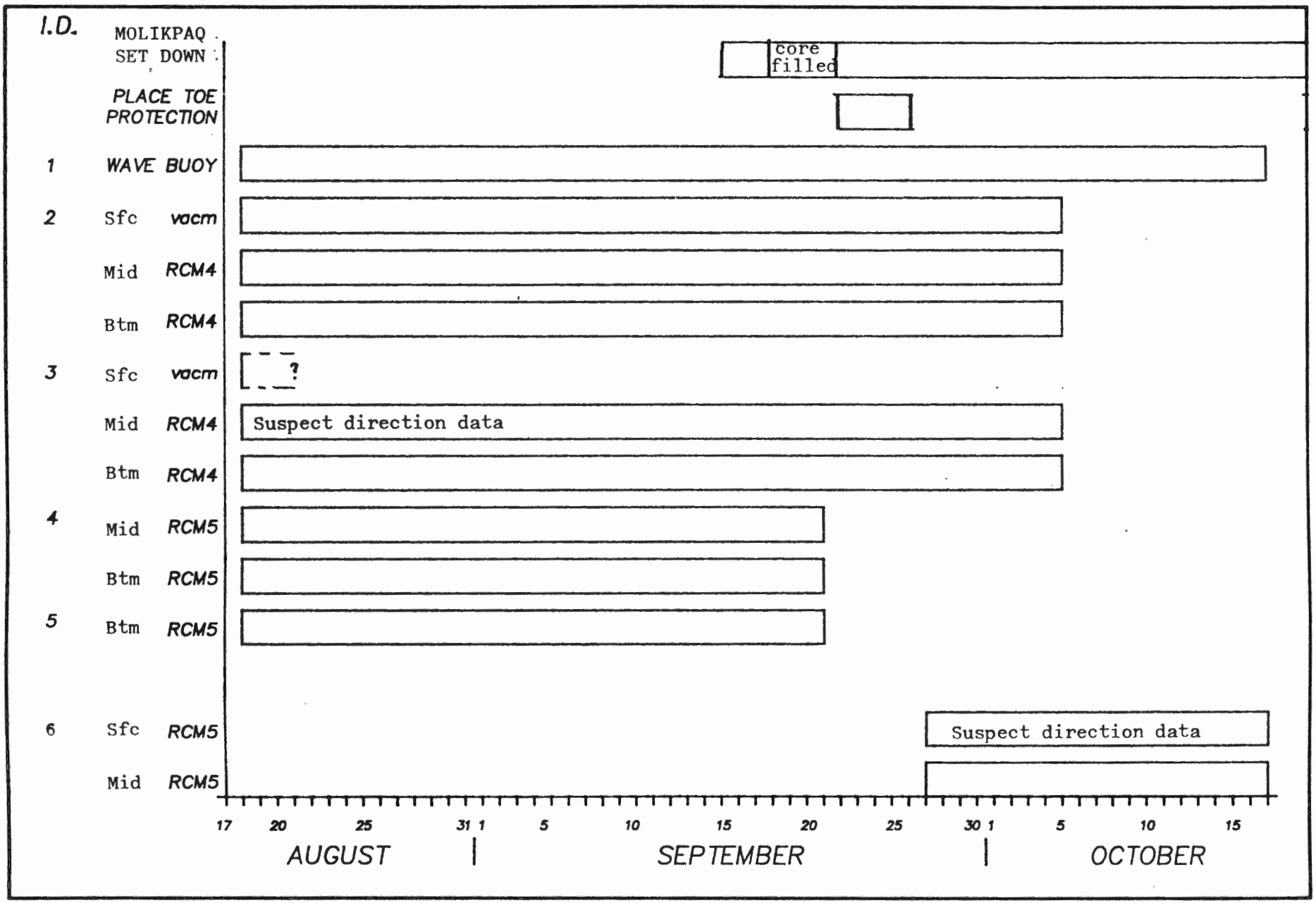


Figure 2: A bar chart indicating the duration of current meter measurements.

September 22-23	D. Tuele returned to Nalluk base to prepare oceanographic equipment. D. McGonigal (Gulf) arrives at Nalluk base.
September 24-25	D. Tuele assigned to other duties.
September 26	D. Tuele and D. McGonigal transferred to Molikpaq and then to M.V. Ikaluk. The Aanderaa current meters used on mooring numbers 4 and 5 were shut down. Two of these instruments were refurbished and powered up for redeployment.
September 27	Using the M.V. Ikaluk, two Aanderaa current meters were deployed at mooring site 6.
September 28-October 2	D. Tuele assigned to other duties, then returned south.
October 5	T. Juhasz of Oceanetic Measurements Ltd., and D. McGonigal of Gulf recovered current meter moorings 2 and 3 from the M.V. Kalvik.
October 6	T. Juhasz and D. McGonigal returned South.
October 13-16	D. Tuele returned to Molikpaq by way of Nalluk base and worked on other projects.
October 17	D. Tuele transferred to M.V. Kalvik to recover waverider buoy and current meter mooring 7.
October 18	Shut down and demobilize current meters and waverider receiver on the Molikpaq.
October 19-20	Pack equipment and arrange for shipment south.
October 21	D. Tuele departs from Nalluk Base.

3.1.2 MOORING DESIGN

The general configuration of the subsurface moorings used to support the current meters are shown in Figure 3. More detailed mooring diagrams and the field log sheets for deployment/recovery and instrument operations are provided in Appendix A.

The current meters used in this study were Aanderaa model RCM-4 or RCM-5 and Applied Microsystems model VACM. The model VACM units measure current velocity components at 0.5 second intervals, from which a 10 minute vector average current was derived and recorded on tape. The Aanderaa units measured mean speeds over the 10 minute sample intervals, along with an instantaneous direction sample. The model RCM-5's were equipped with the

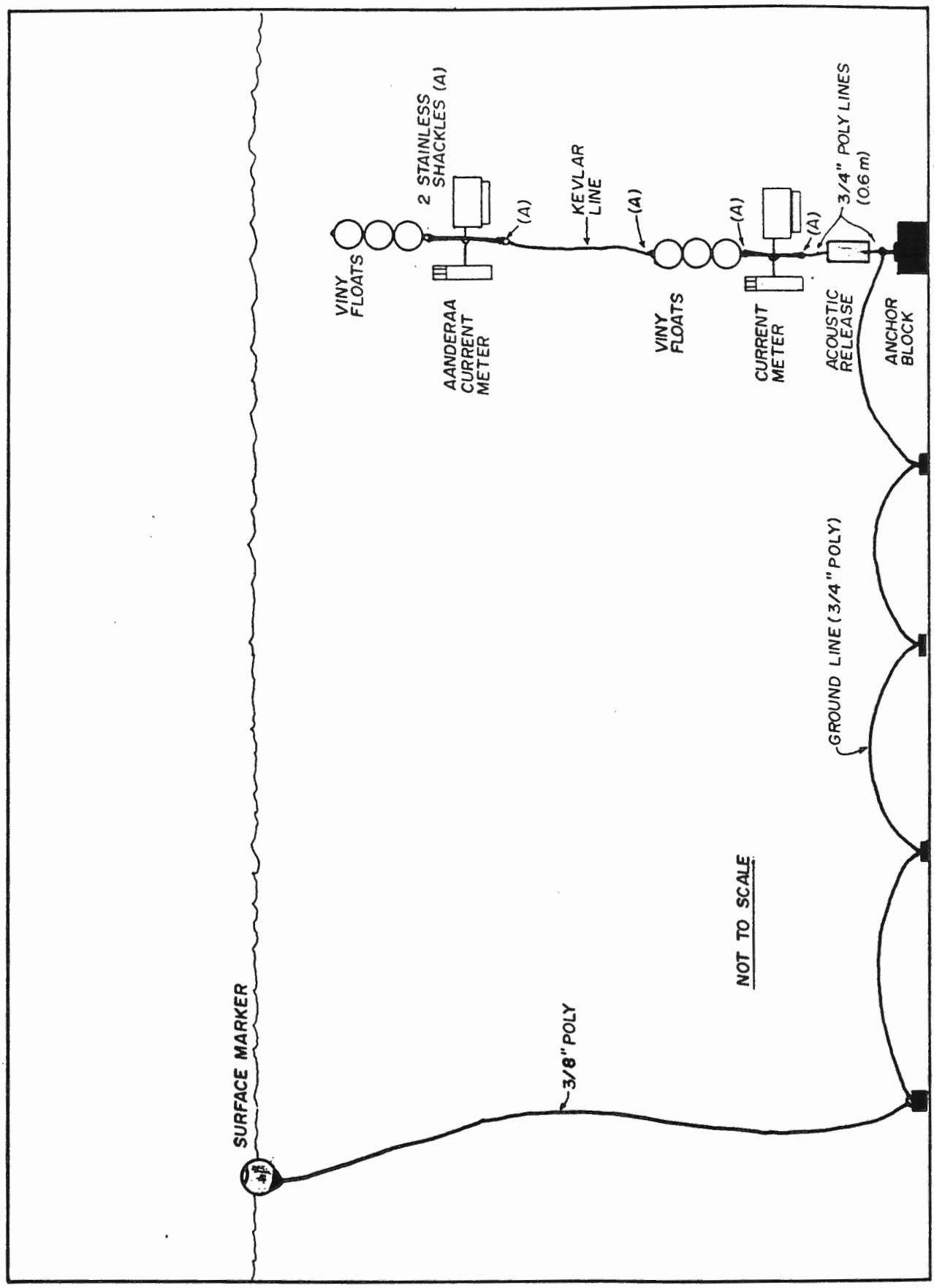


Figure 3: Typical mooring configuration used to support subsurface current meters. The particular configuration shown is for mooring site 4.

paddle-type speed rotors, to reduce the effects of wave orbital velocities on the measured mean flow.

The main leg of the mooring consisted of one, two or three in-line current meters. Each current meter was supported by plastic viny floats, in groups of two or three mounted in-line on 3/4" poly rope or a stainless steel rod. Each plastic viny float measures approximately 0.3 m diameter having a net buoyancy of 20 kg. The mooring lines were either 2 in 1 nylon braided rope (sites 2 and 3), Kevlar rope (sites 4, 5) and polypropylene rope (site 6).

The primary recovery device was an acoustic release; either the InterOcean model 1090 (sites 2 and 3) or the Mesotech model 501AR (sites 4 and 5). The main leg was anchored with a concrete anchor poured into a 45 gallon steel drum, weighing approximately 590 pounds in water. The anchor was connected to the mooring through an iron chain embedded into the concrete.

The mooring used a second leg to support a small surface marker, and to serve as a back up recovery method should the acoustic release malfunction. The two mooring legs wee connected through approximately 100 m length of 3/4 inch polypropylene line. This line, having small weights attached at regular intervals, facilitated ship-based dragging for the mooring as another back up recovery system.

Care was taken to use non-magnetic materials in the main leg mooring, so as to minimize compass errors in the ocean current directional data. The only magnetic material in the mooring was the short (0.5 m) length of chain used for attachment to the concrete anchor.

The mooring design at site 6, deployed in late September, differed from the others in one important respect. It had a marker buoy attached to the uppermost buoyancy package. The additional marker buoy was used for two reasons: there was no acoustic release available to incorporate into the mooring; and a second marker buoy was considered important to alert ships to the presence of the mooring in order that the likelihood of ship collisions be minimized.

At sites 2, 3 and 6, the upper portion of the mooring was well within the wave zone. There is some risk of contamination of velocity measurements, due to wave-driven mooring motion, particularly for sites 2 and 3, where the middle and near-bottom instruments were not equipped with wave zone rotors. Wave contamination should not be a significant problem for the uppermost current meter, as the instrument was designed for wave zone measurements.

All current meter moorings were successfully recovered, but the upper two current meters from site 3 were both damaged on recovery. The damage apparently resulted from ship impact.

The mooring used to support the MEDS waverider buoy was the standard MEDS mooring (see Figure 4) with two deviations: the rubber shock cord was attached directly to the swivel-shackle hardware beneath the buoy and heavier chain links (2.5 inch) of shorter length were used as the anchor (the total anchor weight was considerably larger than would have been used in the MEDS design).

3.1.3 DATA PROCESSING

Conversion and Timing Check

The raw data, as stored on magnetic tape, were initially converted and transferred to computer compatible format using microcomputer systems. For the three data tapes obtained at mooring sites 4 and 5, a high frequency (approximately 40,000 Hz) signal was imprinted on the raw data tapes; a low pass R-C electronic filter had to be applied to the tape deck output to permit successful translation of the raw data tape.

The timing of each instrument was checked by comparing the expected number of records derived from instrument start and stop times, with the actual number of data scans. In most data records, the numbers agreed to within one data scan. Larger discrepancies were found in: the data of Aanderaa S/N 5474 (site 2; 16 m), where the recorded data was short by two records; the data of Aanderaa S/N 8696 (site 4; 27.5 m), where six additional records were obtained; and the data of S/N 8697 (site 5; 19.5 m) where the recorded data was short by three records. No timing check could be conducted on the uppermost two data sets at site 3 (S/N 217 and 720), because neither instrument was functioning correctly on recovery, due to apparent ship-related mooring damage.

Calibration Procedures

The raw current meter output was converted to engineering units through application of the following equation:

$$X = X(0) + X(1)*N + X(2)*N^2 + X(3)*N^3$$

where X is the measured quantity in engineering units, N is the raw output count from the instrument and X(0), X(1) and X(2) are the polynomial coefficients derived from the most recent laboratory calibration data. Note that for speed sensors, the manufacturers' formulae are applied, due to the difficulty of providing adequate calibrations for current velocities in a laboratory setting. The algorithm for speed measurements from the Applied Microsystems VACM had a different functional form:

$$\begin{aligned} X &= 1.23 * N/100 \text{ for } N<17 \\ &= (1.0 + .0912 * N)/100 \text{ for } 17 \leq N < 200 \\ &= (3.5 + .0787 * N)/100 \text{ for } N \geq 200 \end{aligned}$$

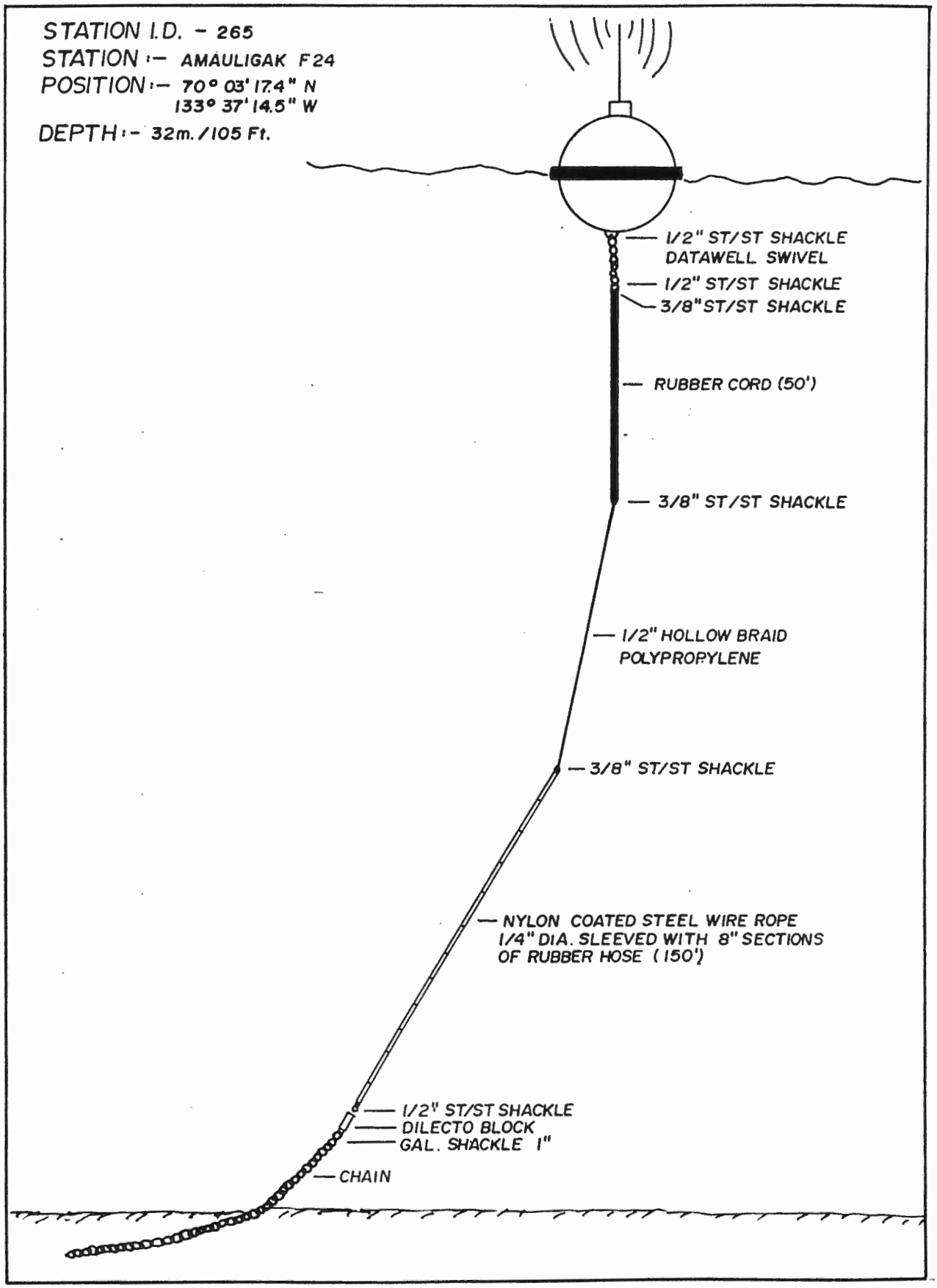


Figure 4: Surface mooring used for the Marine Environmental Data Services (MEDS) Waverider buoy.

The calibration coefficients applied for each instrument are shown in Table 2.

For the directional data, additional corrections were applied to the three instruments supplied by the Bedford Institute of Oceanography, which corrected for directional errors due to the internal magnetic field (Keenan, 1979). The corrections were scaled to the approximate horizontal geomagnetic field strength of 7,000 nanoTesla in the study area. All directional data were converted to degrees clockwise from true north, by correcting for the magnetic variation of 42°W. Seawater salinity was computed from temperature, conductivity data and the pressure for the nominal instrument depth. The Practical Salinity Scale (1978) algorithm (Lewis, 1981) was applied to these data.

Edit Procedures

To detect and eliminate spurious or erroneous data, a first difference test was applied to all measured parameters.

The first difference test levels, and numbers of erroneous data values detected, are summarized in Table 3.

Unusual Occurrences

The site 3 current meter mooring was apparently struck by a ship in the early part of its operational period. This resulted in virtually no data recovery from the uppermost current meter at 7 m depth. The mid-depth instrument, situated at 16 m depth also sustained some damage, apparent on recovery, consisting of a missing speed sensor and dislocated gimbal housing. However, the data recorded was not affected in any obvious manner until late on September 29, when the data deteriorated to unuseable measurements.

The directional data obtained from the uppermost current meter at site 6 is suspect, in view of the very small level of variation. The directional steadiness at the 10 m level is in marked contrast with the much greater variations in current directions measured at 20 m depth on the same mooring. It is suspected that the current meter vane at the 10 m depth may have been inhibited from turning due to fouling by a rope or some other object.

A very high degree of directional steadiness was also noted in the data obtained for site 2, 16 m depth. Again, fouling of the vane by a mooring line may have been the problem.

The temperature measurements computed for the near-bottom instrument at site 2 (S/N 5456) appear to be too large (6.3 to 8.1°C) for this depth. An error in calibration is the likely problem here.

QUANTITY	UNITS	X(0)	X(1)	X(2)	X(3)
Applied Microsystems VACM S/N 216 - Institute of Ocean Sciences Calibration					
temperature	°C	-6.22512	9.86348×10^{-3}	-1.48699×10^{-6}	1.34611×10^{-11}
conductivity ratio		-0.795556	3.9804×10^{-4}		
direction	° true	0.0	1.4		
Applied Microsystems VACM S/N 217 - Institute of Ocean Sciences Calibration					
direction	° true	0.0	1.4		
Aanderaa RCM-4 S/N 5474 - Institute of Ocean Sciences					
temperature	°C	-2.175	0.004527	-1.5393×10^{-1}	7.672×10^{-11}
conductivity ratio		0.45427	1.5875×10^{-4}		
pressure	dbars	-0.814603	0.0153930		
direction	° true	1.5	0.349		
speed	m/s	0.015	0.0028		
Aanderaa RCM-4 S/N 5456 - Institute of Ocean Sciences					
temperature	°C	-2.672	0.02295	-1.344×10^{-5}	0.1937×10^{-8}
conductivity ratio		0.45697	1.5883×10^{-4}		
direction	° true	1.5	0.349		
speed	m/s	0.015	0.0028		
Aanderaa RCM-4 S/N 7910 - Institute of Ocean Sciences					
temperature	°C	-2.332	0.049912	-1.3097×10^{-7}	-7.7767×10^{-11}
conductivity	mmho/cm	19.8220	0.0068587		
direction	° true	1.5	0.349		
speed	m/s	0.015	0.0028		
Aanderaa RCM-4 S/N 7920 - Institute of Ocean Sciences					
temperature	°C	-2.387	0.0050347	-7.92222×10^{-8}	3.09876×10^{-11}
conductivity ratio		19.81447	0.0068789		
direction	° true	1.5	0.349		
speed	m/s	0.015	0.0028		
Aanderaa RCM-5 S/N 8695 - Bedford Institute of Oceanography					
temperature	°C	-2.493	0.02277	-1.344×10^{-6}	1.937×10^{-9}
conductivity	mmho/cm	23.15	0.044		
direction*	° true	1.5	0.349		
speed	m/s	0.011	0.003127		
Aanderaa RCM-5 S/N 8696 - Bedford Institute of Oceanography					
temperature	°C	-2.521	0.0228		
conductivity	mmho/cm	23.76	0.04426		
direction*	° true	1.5	0.349		
speed	m/s	0.011	0.003127		
Aanderaa RCM-5 S/N 8697 - Bedford Institute of Oceanography					
temperature	°C	-2.543	0.02279		
conductivity	mmho/cm	23.68	0.04419		
direction*	° true	1.5	0.349		
speed	m/s	0.011	0.003127		

Table 2: Calibration coefficients applied to the raw temperature, conductivity, pressure and directional data from each current meter.

* Further corrections to directions were applied, derived from laboratory measurements of the errors due to magnetic effects internal to each instrument.

PARAMETER	FIRST DIFFERENCE	NUMBER POINTS CHANGED
Applied Microsystems VACM S/N 216 - Institute of Ocean Sciences		
temperature	1.0	0
conductivity	1.5	22
N-S velocity	0.2	2
E-W velocity	0.2	9
Applied Microsystems VACM S/N 217 - Institute of Ocean Sciences		
N-S velocity	0.1	0
E-W velocity	0.1	2
Aanderaa RCM-4 S/N 5474 - Institute of Ocean Sciences		
temperature	0.5	0
conductivity	0.5	1
salinity	0.5	2
N-S velocity	0.1	5
E-W velocity	0.1	4
pressure	0.5	71
Aanderaa RCM-4 S/N 5456 - Institute of Ocean Sciences		
temperature	0.5	1
conductivity	0.5	4
salinity	0.5	4
N-S velocity	0.1	15
E-W velocity	0.1	20
Aanderaa RCM-4 S/N 7910 - Institute of Ocean Sciences		
temperature	0.5	1
conductivity	0.5	2
salinity	0.5	4
N-S velocity	0.1	7
E-W velocity	0.1	4
Aanderaa RCM-4 S/N 7920 - Institute of Ocean Sciences		
temperature	0.5	0
conductivity	0.5	1
salinity	0.5	24
N-S velocity	0.1	14
E-W velocity	0.1	14
Aanderaa RCM-5 S/N 8695 - Bedford Institute of Oceanography		
temperature	0.5	76
conductivity	0.5	27
salinity	0.1	1
N-S velocity	0.1	1
E-W velocity		
Aanderaa RCM-5 S/N 8696 - Bedford Institute of Oceanography		
temperature	1.0	0
conductivity	0.7	2
salinity	---	---
N-S velocity	0.15	4
E-W velocity	0.15	13
Aanderaa RCM-5 S/N 8697 - Bedford Institute of Oceanography		
temperature	0.5	6
conductivity	1.0	0
salinity	1.0	1
N-S velocity	0.1	1
E-W velocity	0.1	3

Table 3: Summary of the number of errors detected and removed, using the first difference test method described in the text.

3.2 DATA PRODUCTS AND PRELIMINARY ANALYSIS RESULTS

3.2.1 TIME SERIES PLOTS

The time series plots of the edited data are shown in Appendix B. The time series displays are shown as separate plots for velocity parameters (speed, direction, east-west and north-south velocity component) and temperature, conductivity and salinity parameters. For the latter group, some of the current meters provided by the Institute of Ocean Sciences (S/N's 5456, 5474, 7910 and 7920) had narrow measurement ranges for temperature and conductivity. Occurrences of measured values falling outside of the limited ranges are indicated by dashed lines in the time series plots.

3.2.2 FREQUENCY DISTRIBUTIONS

The joint-bivariate distribution of speed and direction measurements are tabulated in Appendix C.

3.2.3 SUMMARY OF BASIC STATISTICS AND VELOCITY PLOTS

A statistical summary of each current meter record is provided in Table 4. Plots of the measured current vectors are displayed in Figures 5 and 6.

The vector averaged velocities and directional distributions are presented for each site, in Figure 7. The results indicate that the net flow at depth was eastward during the mid-August to late September deployment period for sites 2, 3, 4 and 5. The near-surface current meter data available for site 2 indicate a generally northerly set for currents in the upper portion of the water column.

The magnitude of the currents decreased with increasing depth, as one would expect for a predominantly wind-driven oceanographic regime. The strongest currents were measured by the near-surface current meter at site 2 (7 m depth), with mean and maximum speeds of .21 and .76 m/s, respectively.

The near-bottom current speeds were noticeably larger at sites 3 and 4 by comparison to sites 2 and 5. Both of the sites having larger currents are located over a more steeply sloping bottom. The slope of the sea-bed previously had been suggested (Fissel and Birch, 1984) as one influence on currents in the beaufort Sea, an area where near-bottom currents are often aligned with local bathymetric contours.

The current measurements from late September to mid-October at site 6, were directed westward, presumably in response to the prolonged easterly winds experienced during this period. The mean and maximum measured speeds were 0.11 and 0.59 m/s (10 m depth) and 0.11 and 0.35 m/s (20 m depth).

2/7 ← SITE 2/7m DEPTH

start date is 1987 8 18 14 14 37.0
stop date is 1987 10 5 13 54 37.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	0.0602313	0.182544	0.762808	-0.39385
ew_velocity	m/s	-0.013439	0.136643	0.373219	-0.361399
temperature	degrees C	6.11703	1.86015	9.82537	2.60337
conductivity	mmhos	26.6557	2.66569	31.4972	17.4077
salinity	ppt	26.3161	2.13697	29.2433	17.11
pressure	dbars	7			
speed	m/s	0.204872	0.117599	0.762975	0.0123
direction	degrees N	183.45	115.338	359.6	1.20001

Table 4: Summary of basic statistics for each current meter record.

2/29

start date is 1987 8 18 14 0 0.0
stop date is 1987 10 5 14 30 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	-0.0107965	0.0733314	0.257733	-0.242102
ew_velocity	m/s	0.0313179	0.0824965	0.358379	-0.171627
? temperature	degrees C	7.28673	0.584836	8.07092	6.32812
conductivity	mmhos	22.1085	0.0884137	22.2627	21.9697
? salinity	ppt	20.7458	0.268506	21.1971	20.2996
pressure	dbars				
speed	m/s	0.106657	0.0436441	0.3762	0.015
direction	degrees N	153.669	92.1586	359.694	0.0429993

3/28

start date is 1987 8 18 15 10 0.0
stop date is 1987 10 5 12 0 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	-0.0172242	0.0698643	0.225227	-0.28044
ew_velocity	m/s	0.0448229	0.0880398	0.397125	-0.259919
temperature	degrees C	1.49025	1.53003	2.82874	-1.0417
conductivity	mmhos	26.5673	0.371052	26.8384	25.7754
salinity	ppt	30.2842	1.07134	32.2397	26.3876
pressure	dbars				
speed	m/s	0.110263	0.0527347	0.4182	0.015
direction	degrees N	135.896	78.1537	359.694	0.391998

2/16

start date is 1987 8 18 14 10 0.0
stop date is 1987 10 5 13 30 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
? ns_velocity	m/s	0.147013	0.0561069	0.409671	0.0390139
ew_velocity	m/s	0.00146058	0.0363799	0.0571296	-0.2203
pressure	kg/cm2	12.4963	0.446343	14.623	11.2962
conductivity	mmhos	26.4587	0.00492995	26.4639	26.2662
salinity	ppt	29.3367	0.308246	31.6504	29.0442
temperature	degrees C	2.31175	0.320137	2.37509	-0.154072
speed	m/s	0.150642	0.0577346	0.4096	0.0402
? direction	degrees N	113.412	158.309	359.694	0.0429993

3/10

start date is 1987 8 18 15 10 0.0
stop date is 1987 9 29 23 50 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	-0.0306488	0.112626	0.391909	-0.30275
ew_velocity	m/s	0.0919351	0.132391	0.553156	-0.280479
temperature	degrees C	2.57826	0.467597	2.71377	-0.149551
conductivity	mmhos	26.847	0.0231404	26.8515	26.2874
salinity	ppt	29.5714	0.427448	31.8035	28.9993
pressure	dbars				
speed	m/s	0.167392	0.0682579	0.5554	0.0313647
direction	degrees N	135.445	78.5575	359.694	0.0429993

Table 4, continued ...

4/10

start date is 1987 8 18 16 5 0.0
stop date is 1987 9 21 13 55 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	-0.0039621	0.0931998	0.425292	-0.278517
ew_velocity	m/s	0.10973	0.0988266	0.459277	-0.179693
temperature	degrees C	4.73741	1.56638	8.5238	-0.0470764
conductivity	mmhos	28.184	1.03855	31.878	26.422
salinity	ppt	29.2282	1.51884	32.7111	25.976
pressure	dbars				
speed	m/s	0.152951	0.0543519	0.464415	0.011
direction	degrees N	117.142	72.8741	359.736	0.182129

4/28

start date is 1987 8 18 15 31 0.0
stop date is 1987 9 21 13 41 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	0.00830839	0.05851	0.25461	-0.173179
ew_velocity	m/s	0.0477076	0.0437893	0.293565	-0.130301
temperature	degrees C	1.73215	2.5857	5.6238	-1.1986
conductivity	mmhos	27.3198	1.32526	29.381	25.5304
salinity	ppt	30.9875	0.931152	32.1282	28.8278
pressure	dbars				
speed	m/s	0.0759171	0.043847	0.376859	0.0109936
direction	degrees N	103.652	72.9193	359.965	0.347259

5/20

start date is 1987 8 19 10 43 0.0
stop date is 1987 9 21 16 13 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	0.011762	0.0444792	0.151084	-0.170641
ew_velocity	m/s	0.0305952	0.0434333	0.171681	-0.153546
temperature	degrees C	2.64795	1.86689	5.70696	-0.74259
conductivity	mmhos	27.5207	0.507097	28.4083	26.0662
salinity	ppt	30.3725	1.37016	32.2128	28.0384
pressure	dbars				
speed	m/s	0.0640481	0.0289329	0.211123	0.011
direction	degrees N	128.637	100.738	359.888	0.270416

6/20

start date is 1987 9 27 11 10 0.0
stop date is 1987 10 17 18 40 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
ns_velocity	m/s	-0.0233836	0.0680527	0.265056	-0.233827
ew_velocity	m/s	-0.0700449	0.0890269	0.126666	-0.523042
temperature	degrees C	3.11376	1.48416	5.37237	-0.814595
conductivity	mmhos	27.8444	0.561689	28.842	26.246
salinity	ppt	30.2836	0.883504	32.4151	28.691
pressure	dbars	20			
speed	m/s	0.111812	0.0742174	0.586368	0.011
direction	degrees N	217.647	80.9322	359.694	0.0429993

6/10

start date is 1987 9 27 11 20 0.0
stop date is 1987 10 17 18 30 0.0

QUANTITY	UNITS	MEAN	STD.DEV.	MAXIMUM	MINIMUM
?ns_velocity	m/s	0.103965	0.067194	0.335083	-0.0239533
ew_velocity	m/s	-0.0485088	0.0284394	0.0510019	-0.142693
temperature	degrees C	3.26596	1.38101	5.52466	0.96666
conductivity	mmhos	26.0537	1.07945	27.9222	24.0335
salinity	ppt	27.9965	0.76712	30.5791	26.0697
pressure	dbars	10			
speed	m/s	0.115133	0.0723195	0.351843	0.010689
?direction	degrees N	334.062	9.24667	351.667	16.3373

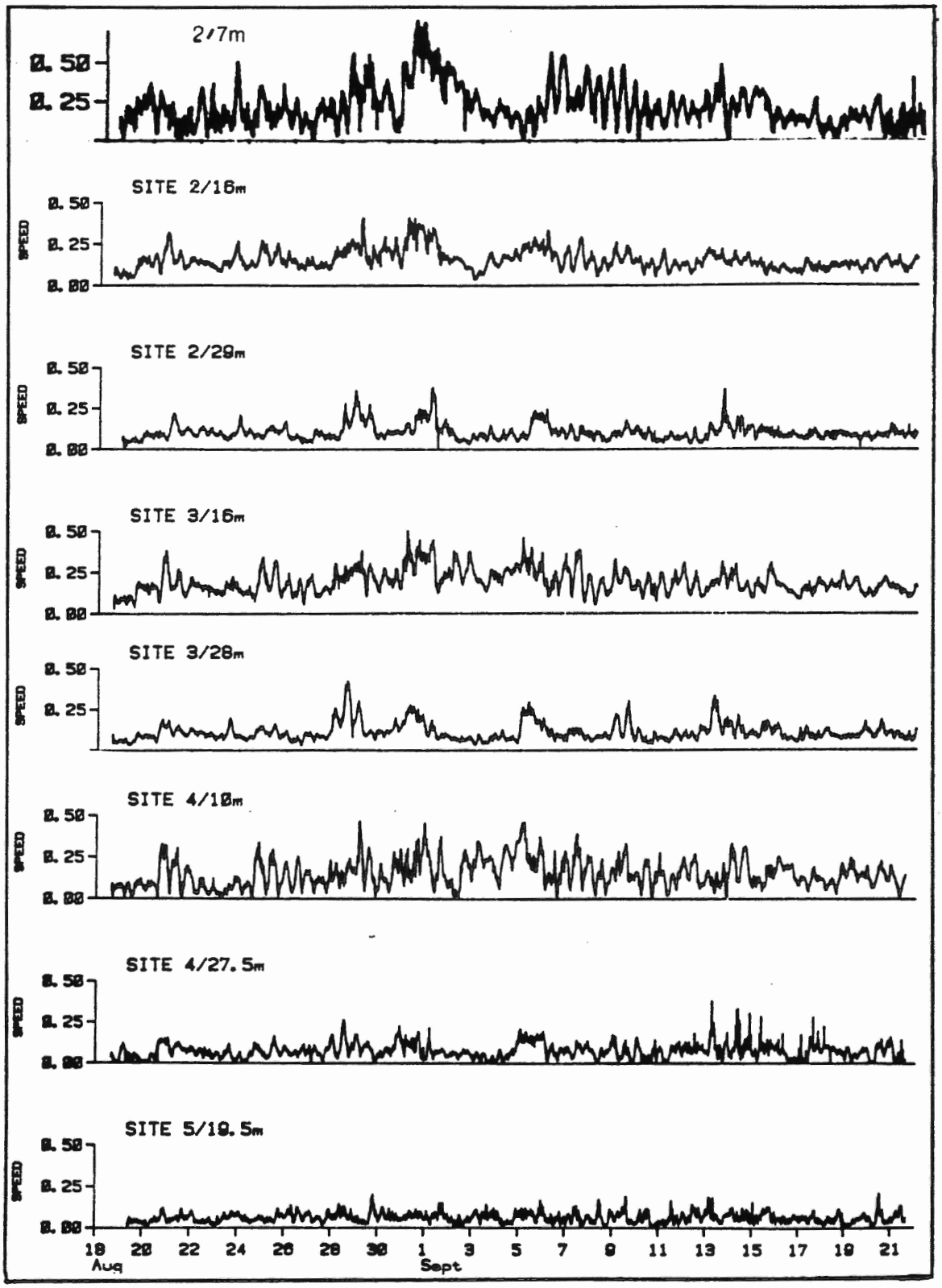


Figure 5: Current speeds measured at sites 2, 3, 4 and 5 from August 18 to September 21, 1987.

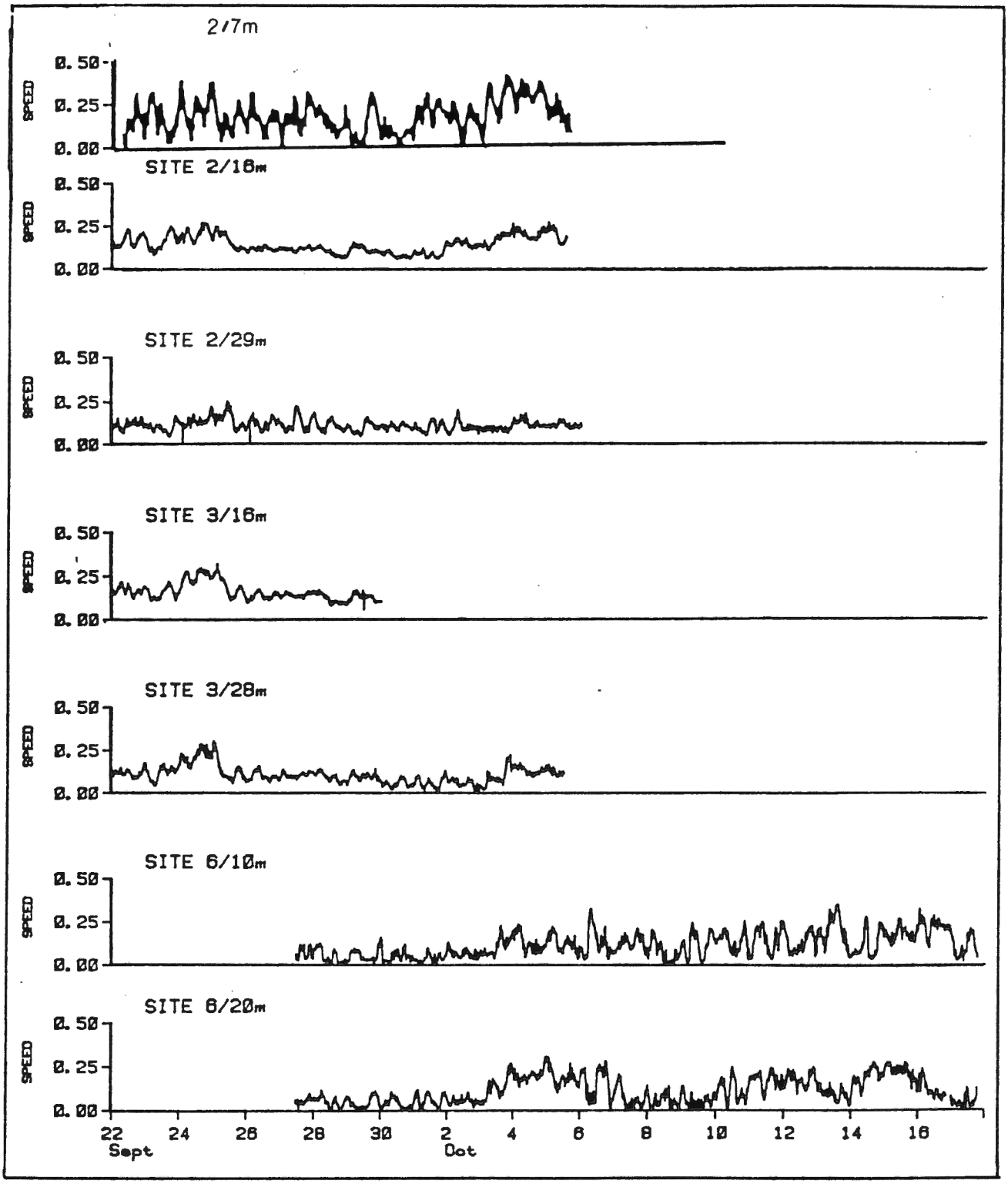


Figure 6: Current speeds measured at sites 2, 3 and 6 from September 22 to October 18, 1987.

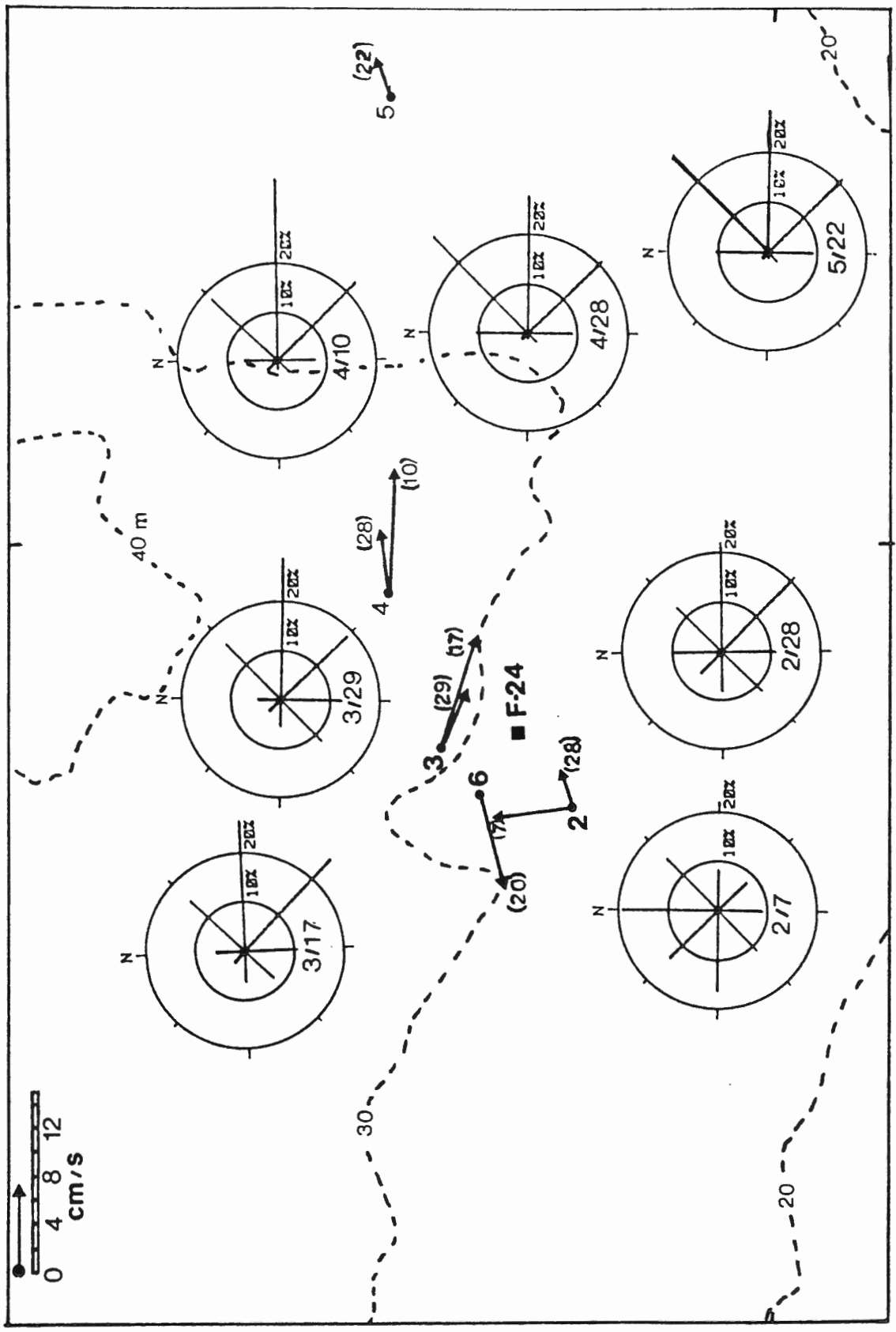


Figure 7: Vector average currents and current distributions, as displayed for each measurement site site and depth.

4. REFERENCES

Fissel, D.B. and J.R. Birch, 1984. Sediment transport in the Canadian Beaufort Sea. Rep. by Arctic Sciences Ltd., for Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, N.S. 165 p.

Keenan, P.V., 1979. Sources of compass error with the Aanderaa recording current meter. Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Lewis, E.L., 1981. The practical salinity scale 1978 and its antecedents. In: Background papers and supporting data on the practical salinity scale 1978, UNESCO Tech. Papers in Marine Sci. 37, UNESCO, Paris.

APPENDIX A

FIELD LOG SHEETS FOR

DEPLOYMENT/RECOVERY AND INSTRUMENT OPERATIONS

WAVE RIDER BUOY #1

CRUISE NAME/NO. Gulf "175"

SHIP: "MISCAROO" Gulf

STATION ID: #1

LAT. (assigned):

LONG. (assigned):

DEPTH (chart):

PERSONNEL

1. D. TUELÉ
2. T. Juhasz
3. D. Spear
4.
5.

DEPLOYMENT

DATE: Aug 18 1987

TIME/ZONE: Mountain 1135 MDT

LORAN C, x:

y:

LAT. (actual): 70°04'02.3"

LONG. (actual): 133°39'43.6"

DEPTH (sounder): 32.5 metres

RECOVERY

DATE: Oct 17 1987

TIME/ZONE: MDT 1700

LORAN C, x:

y:

LAT. (actual):

LONG. (actual):

DEPTH. (sounder):

RELEASE NO. 1, MFR.: NO. CODE:

RELEASE NO. 2, MFR.: NO: CODE:

PINGER, FREQ.: DEPTH: BAT. V.:

TOPFLOAT, DEPTH: COLOR: MARKINGS:

DEPLOYMENT NOTES

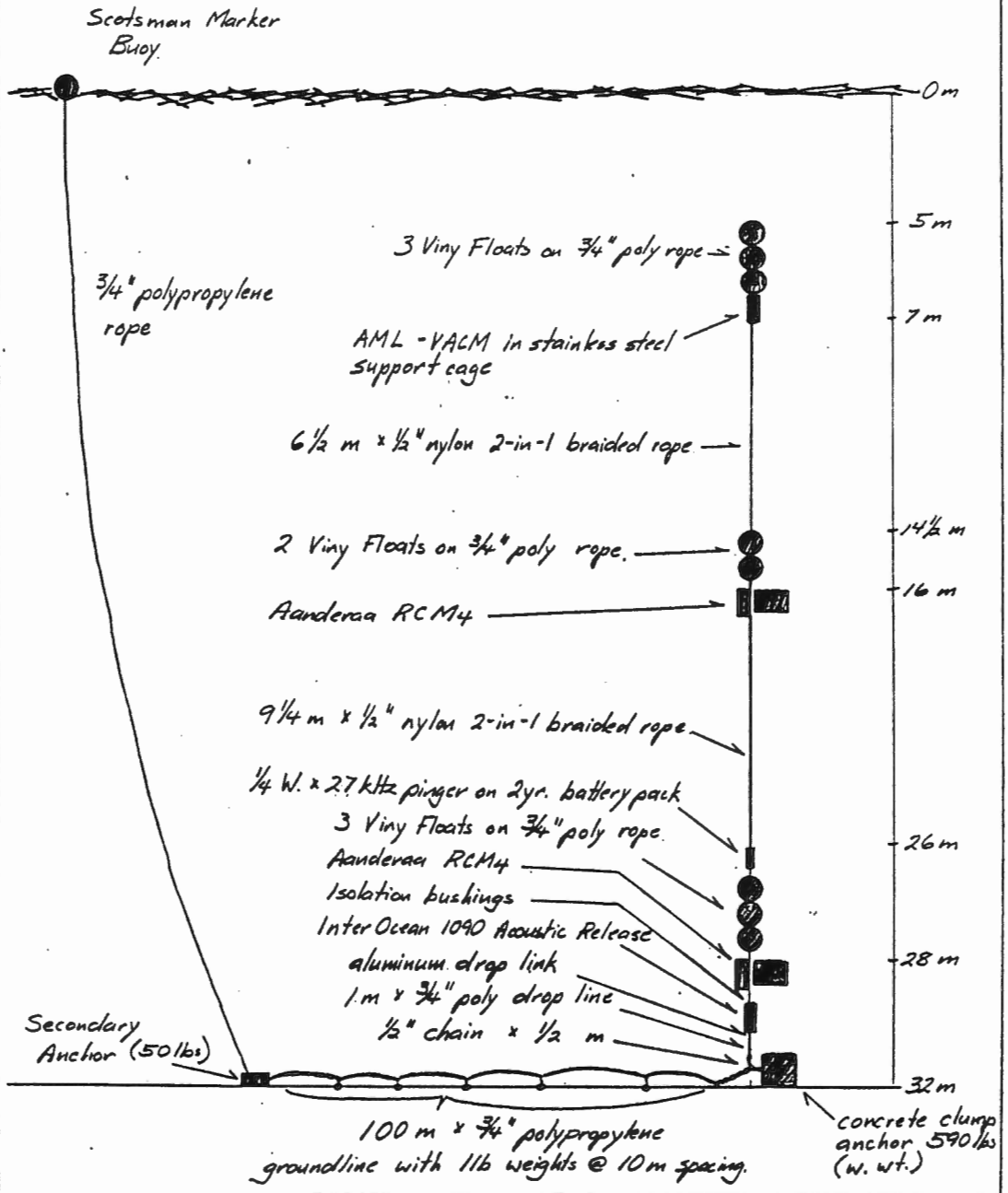
MEDS WAVE BUOY 27.900 mhz
Bottom time 1135 MDT
Distance to Berm Centre 1848 m
Heading to Berm Centre 138°

RECOVERY NOTES

Oct 17/87

at site - 1600 MDT
out of water - 1730

Oceanographic Measurements Program For Farfield Waves and Currents - Amauligak F-24 Site



NB:
- Sacrificial anodic protection provided where needed.
- non-magnetic hardware (stainless steel) used near instruments
- contact between dissimilar metals is avoided or isolated by plastic bushings and washers.

Farfield Current Meter Moorings #2 and #3
Gulf Canada Resources Ltd - Amauligak F-24

SCALE: N/A	APPROVED BY: T. Johnson	DRAWN BY: T.J.
DATE: Sep 4, 87		

OCEANETIC Measurement Limited
~~3212 Carman Street Victoria B.C. V8P4M3~~

DRAWING NUMBER

Mooring # 2

MOORED INSTRUMENT LOG

CRUISE NAME/NO. Amauligak F-24 Current Meter Survey

SHIP: Miscaroo

STATION ID: Mooring #2

LAT. (assigned):

LONG. (assigned):

DEPTH (chart): 32 m.

PERSONNEL

1. T. Juhász	Oceanetic
2. D. Spear	Oceanetic
3.	
4.	
5.	

DEPLOYMENT

DATE: Aug. 18, 87

TIME/ZONE: 1407 MDT

~~LORAN C~~, N: 7771097

E: 550832

LAT. (actual): 70° 02' 36.4" N

LONG. (actual): 133° 39' 55.8" W

DEPTH (sounder): 32.0 m

RECOVERY

DATE: Oct. 5, 87

TIME/ZONE: 1337 MDT

LORAN C, x:

y:

LAT. (actual): } on station.

LONG. (actual):

DEPTH. (sounder):

RELEASE NO. 1, MFR.: InterOcean 1090 NO. #206 CODE: ADEF

RELEASE NO. 2, MFR.: / NO: / CODE: /

PINGER, FREQ.: 1/4 watt Hydroprod. 27kHz 1/2 5 ping/sec. DEPTH: 26 m BAT. V.: 22.03

TOPFLOAT, DEPTH: 5m 3 vinyl COLOR: Orange MARKINGS: OML

DEPLOYMENT NOTES

① Groundline Marker Buoy.
1411 MDT Aug. 18, 87
N 7771001 E 550755
70° 02' 33.3" 133° 40' 03.2"
② 13" ϕ scotsman buoy marker
5m slack line.

RECOVERY NOTES

- marker buoy was missing
- mooring released and surfaced on 1st attempt.

INSTRUMENT AML VACM S No. #216

TAPE SIZE 4" MIL .5 TURN ON CLK RESET 1610 MI

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	#20	4000	0120	#20	2023	0120
2	TEMP	0006	2000	0001	0006	2000	0001
3	COND	0001	0121	0001	0002	0121	0001
4	PRES/TEMP	0601	0095	0014	1201	0095	0000
5	DIR	0000	0000	/	0000	0000	/
6	SPEED	2000	0216		2000	0216	
MANUAL							
TIMED		1624:37	MDT		1634:37	MDT	

SAMPLING INTERVAL 10 MIN DEPTH 7 m

PRESSURE SENSOR N/A SN° TAPE ID #216

ROTOR REV/COUNT _____ DATE Aug. 16, 87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE _____

Battery V = 11.76 V. Avc. = .2

I.D. #20

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED							

- no final cycle time check possible (see time word on tape)
- turned off 1637 MDT last cycle on tape 1630 MDT
- battery V = 10.89.

CRUISE ID Amauligak F24 DATE Oct. 5 87

Mooring #2

INSTRUMENT RCM4 Aanderaa S No. 5474

TAPE SIZE 3" MIL .5 mil TURN ON CLK RESET 1030 MDT

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	0601	0601	0601			
2	TEMP	0044	0044	0047			
3	COND	0000	0000	0000			
4	PRES/TEMP	1023	1023	1023			
5	DIR	1000	0643	0826			
6	SPEED	0000	0102	0433			
MANUAL							
TIMED		1040	1050	0900 17 Aug MDT			

SAMPLING INTERVAL 10 MIN DEPTH 16 m

PRESSURE SENSOR SN° TAPE ID 5474

ROTOR REV/COUNT 4 rev/count. DATE Aug. 16, 87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE

Battery V. = 10.19

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED		1600 MDT					

- off 1601 MDT
- battery V = 8.9

CRUISE ID Amauligak F34 DATE Oct. 5, 87

Mooring #2

CURRENT METER RECORD SHEET

PROJECT: _____ SERIAL NO.: 5474

	SENSOR PARAMETER	SENSOR MODEL #	SENSOR SERIAL	CALIBRATION COEFFICIENTS
CH1 =	REF. #			601
CH2 =	PRESSURE	3000	51825-6	0-200 psi
CH3 =	COND.	2105	5325	20 to 27 mS/cm
CH4 =	NARROW TEMP.	SLOW		-2°C to +3°C
CH5 =	DIRECTION	1248	8366	
CH6 =	SPEED	2542	2534	4 REV./COUNT
CH7 =				

DEPLOYMENT INFORMATION

Sample interval 10 minutes

First record time/date (GMT): _____

First record printout: _____

Other printout: _____

Site: _____ Position: _____

Geographical description: _____

Water depth: _____ Instrument depth: _____ Ice thickness _____

Instrument in water time/date (GMT): _____

Mooring complete time/date (GMT): _____

Comments:

RECOVERY INFORMATION

Release time/date (GMT): _____

Instr. out time/date (GMT): _____

Last record printout: _____

Last record time/date (GMT): _____

Current meter condition and comments:

INSTRUMENT Aanderaa RCM4 S No. 5456

TAPE SIZE 3" MIL .5 mil TURN ON CLK RESET 10:10 MDT

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	0590	0590	0590			
2	TEMP	0635	0636	0616			
3	COND	0000	0000	0000			
4	PRES/TEMP	1023	1023	1023			
5	DIR	0916	0919	0499			
6	SPEED	0000	0037	0000			
MANUAL							
TIMED		10:20	10:30	17 Aug. 0910	MDT		

SAMPLING INTERVAL 10 MIN DEPTH 28m

PRESSURE SENSOR SN° TAPE ID 5456

ROTOR REV/COUNT 4 rev/count DATE 16-08-87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE

Battery V = 10.15

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED		1600 MDT					

-turned off 1601

-battery V = 8.83

CRUISE ID Amauligak F-24 DATE Oct 5, 87

Mooring # 2

CURRENT METER RECORD SHEET

PROJECT: _____ SERIAL NO.: 5456

	SENSOR			CALIBRATION COEFFICIENTS
	PARAMETER	MODEL #	SERIAL	
CH1 =	REF. #			591
CH2 =	WIDE TEMP	SLOW		-2 TO +21
CH3 =	COND.	2105	5269	20 → 27 mS/cm FR = .45677 + .00015883 N
CH4 =	NARROW TEMP			SEE A² CAL '84
CH5 =	DIRECTION	1248	8322	SEE PLOT
CH6 =	SPEED	2542	3103	4 REV. / COUNT
CH7 =				

DEPLOYMENT INFORMATION

Sample interval 10 minutes

First record time/date (GMT): _____

First record printout: _____

Other printout: _____

Site: _____ Position: _____

Geographical description: _____

Water depth: _____ Instrument depth: _____ Ice thickness _____

Instrument in water time/date (GMT): _____

Mooring complete time/date (GMT): _____

Comments:

RECOVERY INFORMATION

Release time/date (GMT): _____

Instr. out time/date (GMT): _____

Last record printout: _____

Last record time/date (GMT): _____

Current meter condition and comments:

Mooring #3

MOORED INSTRUMENT LOG

CRUISE NAME, NO.: Amauligak F-24 Current Meter Survey
SHIP: Miscaroo
STATION ID: Mooring #3
LAT. (assigned):
LONG. (assigned):
DEPTH (chart): 32 m

PERSONNEL

1. Ti Juhász	Oceanetic
2. D. Spear	Oceanetic
3.	
4.	
5.	

DEPLOYMENT

DATE: Aug. 18, 87
TIME/ZONE: 1512 MDT
~~LORAN C~~, N: 7774 273
E: 552 104
LAT. (actual): 70° 04' 17.9" N
LONG. (actual): 133° 37' 48.8" W
DEPTH (sounder): 32.8 m

RECOVERY

DATE: Oct. 5, 87
TIME/ZONE: 1200 MDT on surface
LORAN C, x:
y:
LAT. (actual): on station
LONG. (actual):
DEPTH. (sounder):

RELEASE NO. 1, MFR.: InterOcean 1090 NO. #199 CODE: ABCD
RELEASE NO. 2, MFR.: / NO: / CODE: /
PINGER, FREQ.: Helle 27 kHz ¼ Watt 1 ping/sec. DEPTH: 26m BAT. V.: 21.85
TOPFLOAT, DEPTH: 5m 3 Vinys COLOR: Orange MARKINGS: OML

DEPLOYMENT NOTES

① Groundline Marker Buoy
1514 MDT Aug. 18, 87
N 7774 370 E 552 118
70° 04' 21.1" N 133° 37' 47.3" W

② 13" ø Scotsman buoy marker
5m slack line.

RECOVERY NOTES

Put on

- repeated release commands sent proper release reply given, but mooring does not surface.
- recovery completed by groundline
- mooring pops up during recovery indicating it was fouled.
- noted on recovery:
  top 3 vinies were broken
  top instrument badly damaged
  " " support cage twisted.
  midwater instrument also damaged
- Assume damage from collision with

INSTRUMENT AML VACM S No. #217

TAPE SIZE 4" MIL .5 TURN ON CLK RESET 1400 MDT

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	#20	2025	0120	#20	2025	0120
2	TEMP	0007	2001	0000	0007	2001	0001
3	COND	0001	0000	0000	0002	0189	0001
4	PRES/TEMP	0601	0000	0000	1201	0132	0000
5	DIR	0000	0000	/	0000	0000	/
6	SPEED	2003	0000		2004	0065	
MANUAL							
TIMED		14 14:37	MDT		14 24:37	MDT	

SAMPLING INTERVAL 10 MIN DEPTH 7m

PRESSURE SENSOR n/a SN° TAPE ID 217

ROTOR REV/COUNT DATE Aug. 16/87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE

Battery V = 11.76. V. Average = .2

I.D. #20

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED							

- not cycling - completely flooded appr 1/2 l water
- all sensors were knocked off - rotor cage twisted 90°
- instrument support cage also badly damaged
- data tape advanced for a short period

CRUISE ID Amauligak F24 DATE Oct. 5, 87

Mooring #3

INSTRUMENT Aanderaa RCM4 S No. 7920

TAPE SIZE 3" MIL .5 mil. TURN ON CLK RESET 1050 MDT

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	0713	0713	0713			
2	TEMP	1023	1023	1023			
3	COND	0000	0000	0000			
4	PRES/TEMP	0610	0020	0296			
5	DIR	0816	0879	0759			
6	SPEED	0103	0022	0055			
MANUAL							
TIMED		1100	1110	0550 17 Aug	MDT		

SAMPLING INTERVAL 10 MIN DEPTH 16 m

PRESSURE SENSOR SN° TAPE ID 7920

ROTOR REV/COUNT 4 rev/count DATE Aug. 16/87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE

Battery V = 10.17V

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL		not					
TIMED		cycling					

- rotor missing - rotor arch loose and bent.
- instrument still on vane but gimbal housing no longer attached to gimbal rod
- battery voltage = 5.94
- some water in pressure case however flooding must have occurred during recovery
- full data tape collected.

CRUISE ID Amauligak F-24 DATE Oct 5, 87

Mooring #3

CURRENT METER RECORD SHEET

PROJECT: _____ SERIAL NO.: 7920

	SENSOR			CALIBRATION COEFFICIENTS
	PARAMETER	MODEL #	SERIAL	
CH1 =	REF. #			714
CH2 =	NARROW TEMP	SLOW		-2°C TO +3°C
CH3 =	COND	2976	8056	20 TO 27 mS/cm
CH4 =	TIME CODE	995006	12	1 BIT /MIN
CH5 =	DIRECTION	1248	12814	MAKI VANE
CH6 =	SPEED	2542	5685	4 REV./COUNT
CH7 =				

DEPLOYMENT INFORMATION

Sample interval 10 minutes

First record time/date (GMT): _____

First record printout: _____

Other printout: _____

Site: _____ Position: _____

Geographical description: _____

Water depth: _____ Instrument depth: _____ Ice thickness _____

Instrument in water time/date (GMT): _____

Mooring complete time/date (GMT): _____

Comments:

RECOVERY INFORMATION

Release time/date (GMT): _____

Instr. out time/date (GMT): _____

Last record printout: _____

Last record time/date (GMT): _____

Current meter condition and comments:

INSTRUMENT Aandevaa RCM4 S No. 7910

TAPE SIZE 3" MIL .5 TURN ON CLK RESET 1100 MDT

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	not recorded	0757	0758	0757		
2	TEMP		1023	1023	1023		
3	COND		0000	0000	0000		
4	PRES/TEMP		0020	0030	0316		
5	DIR		0828	0832	0881		
6	SPEED		0000	0000	0000		
MANUAL							
TIMED		1110	1120	1130	Aug. 17 time not recorded.		

SAMPLING INTERVAL 10 MIN DEPTH 28m

PRESSURE SENSOR SN° TAPE ID 7910

ROTOR REV/COUNT 4 rev/count DATE Aug. 16/87

EXPANDED CONDUCTIVITY RANGE SN°

EXPANDED TEMPERATURE RANGE

Battery V = 10.12

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED		1600 MDT					

- turned of 1601
- battery V = 8.8

CRUISE ID Amauligak F-24 DATE Oct. 5, 87

Mooring #3

CURRENT METER RECORD SHEET

PROJECT: _____ SERIAL NO.: 7910

	SENSOR			CALIBRATION COEFFICIENTS
	PARAMETER	MODEL #	SERIAL	
CH1 =	REF. #			758
CH2 =	NARROW TEMP.	SLOW		-2° TO +3°C
CH3 =	COND	2976	8061	20 → 27 mS/cm
CH4 =	TIME CODE	995006	3	1 BIT/MIN
CH5 =	DIRECTION	1248	12811	SEE PLOT
CH6 =	SPEED	2542	5673	4 REV. /COUNT
CH7 =				

DEPLOYMENT INFORMATION

Sample interval 10 minutes

First record time/date (GMT): _____

First record printout: _____

Other printout: _____

Site: _____ Position: _____

Geographical description: _____

Water depth: _____ Instrument depth: _____ Ice thickness _____

Instrument in water time/date (GMT): _____

Mooring complete time/date (GMT): _____

Comments:

RECOVERY INFORMATION

Release time/date (GMT): _____

Instr. out time/date (GMT): _____

Last record printout: _____

Last record time/date (GMT): _____

Current meter condition and comments:

MOORING 4

MOORED INSTRUMENT LOG

CRUISE NAME/NO. Gulf "175"

SHIP: Miscaroo / Kaluik

STATION ID: #4

LAT. (assigned): 70° 05.00 N

LONG. (assigned): 133° 32.00 W

DEPTH (chart): 32m

PERSONNEL

1. DT
2.
3.
4.
5.

DEPLOYMENT

DATE: Aug 18 1987

TIME/ZONE: 1600 MDT

LORAN C, x:

y:

LAT. (actual): 70° 04.60 N

LONG. (actual): 133° 31 59.4 W

DEPTH (sounder): 32 m

RECOVERY

DATE: Sept 21 1989

TIME/ZONE: 1500 MDT

LORAN C, x:

y:

LAT. (actual):

LONG. (actual):

DEPTH. (sounder):

RELEASE NO. 1, MFR.: AR 6428 CH. NO.: 03 CODE: 03

RELEASE NO. 2, MFR.: NO: CODE:

PINGER, FREQ.: DEPTH: BAT. V.:

TOPFLOAT, DEPTH: COLOR: MARKINGS:

DEPLOYMENT NOTES

CM 8695 10m depth
CM 8696 27.5m depth

8695 in water ≈ 1605 MDT
8696 in water ≈ 1609 MDT

anchor on bottom 1611 MDT
Surface marker in place

RECOVERY NOTES

Marker buoy at site took 4 attempts to recover acoustic release.
Inst. out of water ≈ 1500
CMs sat in boxes on Kaluik until Sept 26

INSTRUMENT RCM 5 $ S No. 8695

TAPE SIZE 3½ MIL ____ TURN ON CLK RESET 1005 Aug 16
First Sample 1015

Ref 717

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	716					
2	TEMP	974					
3	COND	8000					
4	~~PRES/TEMP~~	7590					
5	DIR	1023					
6	SPEED						
MANUAL							
TIMED							

SAMPLING INTERVAL 10 MIN DEPTH ≈ 10m

PRESSURE SENSOR ____ SN° TAPE ID ____

ROTOR REV/COUNT 4 DATE ____

EXPANDED CONDUCTIVITY RANGE SN° 998

EXPANDED TEMPERATURE RANGE ____

Instrument off time & Sept 26, 1987 1401 MDT

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED							

CRUISE ID Amaviqak #4 mooring near surface DATE Oct 05/87

AGC

INSTRUMENT RCM 5$ S No. 8696

TAPE SIZE 3½ MIL ____ TURN ON CLK RESET 0941 Aug 16

Ref 730 First Sample 0951

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	729					
2	TEMP	974					
3	COND	0000					
4	~~PRES/TEMP~~	1023					
5	DIR						
6	SPEED	46					
MANUAL							
TIMED							

SAMPLING INTERVAL 10 MIN DEPTH ≈ 27.5m

PRESSURE SENSOR SN° TAPE ID ____

ROTOR REV/COUNT 4 DATE ____

EXPANDED CONDUCTIVITY RANGE SN° 996

EXPANDED TEMPERATURE RANGE ____

Instrument off time : Sept 26, 1987 1408 MDT

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED							

CRUISE ID Amauligak #4 mooring near bottom DATE Oct 05/87

MOORING "5

42

MOORED INSTRUMENT LOG

CRUISE NAME/NO. Gulf "175

SHIP: Miscaroo / Kaluik

STATION ID: # 5

LAT. (assigned): 70° 05.00 N

LONG. (assigned): 133° 13.00 W

DEPTH (chart): 24m

PERSONNEL

1. DT
2.
3.
4.
5.

DEPLOYMENT

DATE: Aug 19 1987

TIME/ZONE: 0930 MDT

LORAN C, x:

y:

LAT. (actual): 70° 05.00 N

LONG. (actual): 133° 12.58.55W

DEPTH (sounder): 26.3m

RECOVERY

DATE: Sept 21 1987

TIME/ZONE: 1600 MDT

LORAN C, x:

y:

LAT. (actual):

LONG. (actual):

DEPTH. (sounder):

RELEASE NO. 1, MFR.: AR 6466 CH. NO: 04 CODE: 06

RELEASE NO. 2, MFR.: NO: CODE:

PINGER, FREQ.: DEPTH: BAT. V.:

TOPFLOAT, DEPTH: COLOR: MARKINGS:

DEPLOYMENT NOTES

CM 8697 19.5m

Inst. in water ≈ 1035 MDT

anchor on bottom 1037 MDT

Surface marker in place

RECOVERY NOTES

release up first time

Marker buoy in place

CM up at 1630

Inst. out of water 1647

CM sat in boxes on deck Kaluik until Sept 26

INSTRUMENT RCM 5$ S No. 8697

TAPE SIZE 3½ MIL ____ TURN ON CLK RESET 0953 Aug 16/
First Sample 1003

RS 466

CHAN No.		TAPE RECORD DEPLOYMENT					
1	REF	466					
2	TEMP	978					
3	COND	000					
4	~~PRES/TEMP~~	1023					
5	DIR	108					
6	SPEED						
MANUAL							
TIMED							

SAMPLING INTERVAL 10 MIN DEPTH ≈ 19.5m
PRESSURE SENSOR SN° TAPE ID ____
ROTOR REV/COUNT 4 DATE ____
EXPANDED CONDUCTIVITY RANGE SN° 1000
EXPANDED TEMPERATURE RANGE ____

Instrument off time: Saturday Sept 26, 1401 MDT

CHAN No.		TAPE RECORD RETRIEVAL					
1	REF						
2	TEMP						
3	COND						
4	PRES/TEMP						
5	DIR						
6	SPEED						
MANUAL							
TIMED							

CRUISE ID Amadigak #5 mooring near seabed DATE Oct 05/87

Deployment # 7

ARCTIC SCIENCES LTD

PHYSICAL OCEANOGRAPHY, ICE PHYSICS, REMOTE SENSING AND TECHNICAL SERVICES

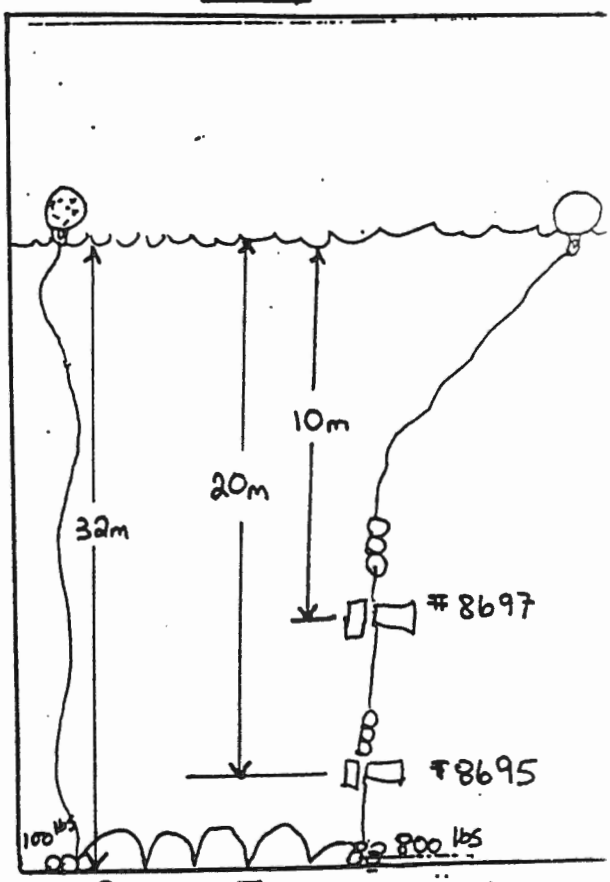
Gulf F-24

Sept 26, 1987

MOORING DEPLOYMENT IKaluK

Site/6
Station: (F-24)
Platform: _____
Lat.: _____
Long.: _____
Date: _____
Time Zone: MDT
Wind: NE 15
Sea State: .5-1m

Diagram



1. Time Data MDT

1129 reference marker in
1120 first C.M. in
1120 second C.M. in
____ third C.M. in
1128 weight released
____ mooring submerged

2. Depth (at time of weight release) 32m

3. Position (at time of weight release)

a. Radar
feature: MAC range .64 miles bearing 305.5° T
feature: _____ range _____ bearing _____
feature: _____ range _____ bearing _____

b. Syledis
feature _____
feature _____
feature _____

c. Reference marker
range 50 m bearing 120° (To MAC)

Both meters turned o
Sept 26 1500 MDT

meter - 8697 @ 10m
meter - 8695 @ 20m

Both meters off at
Oct 17 2015 MDT

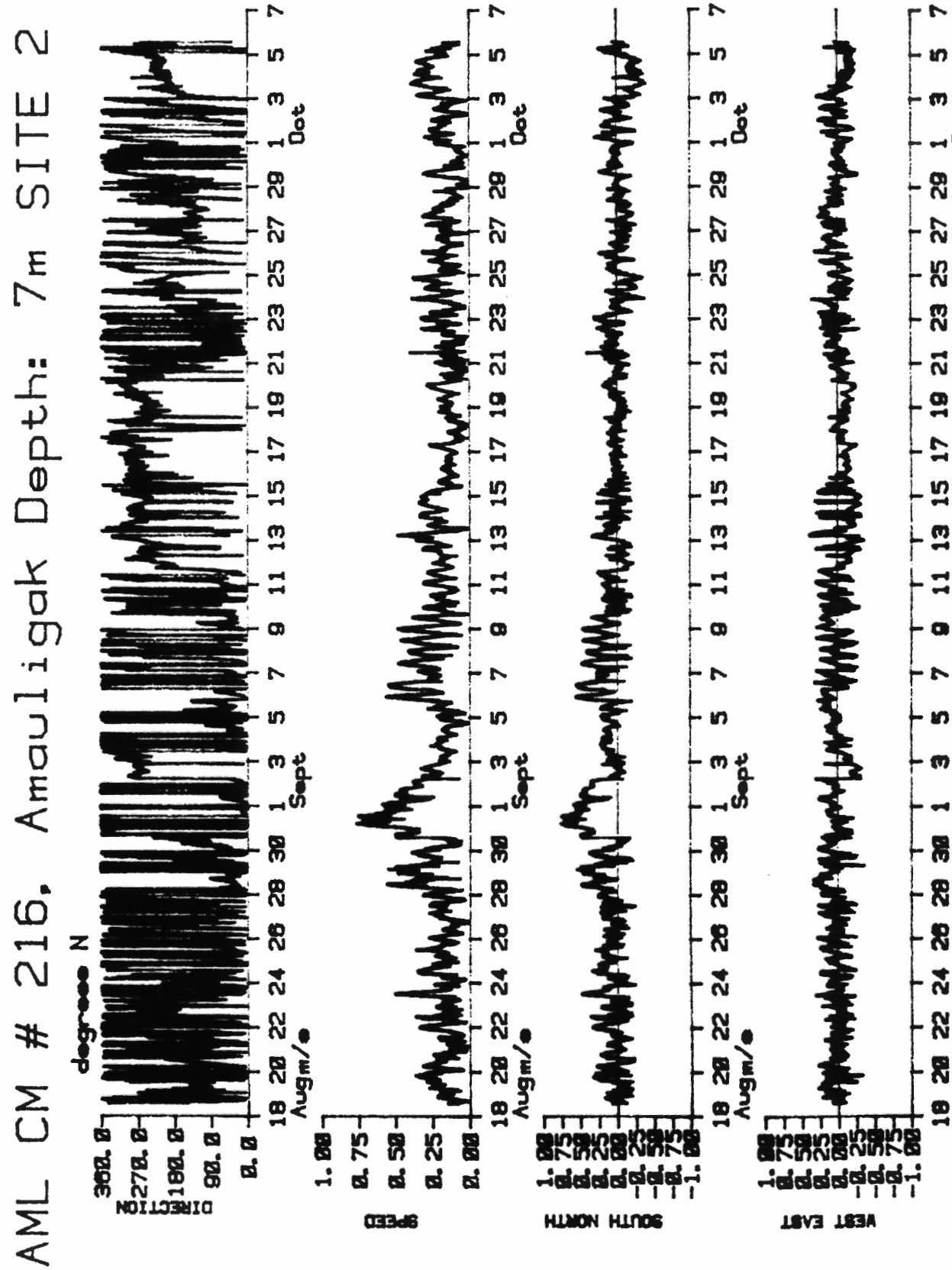
meters out of water a
Oct 17 1915 MDT

4. Comments:

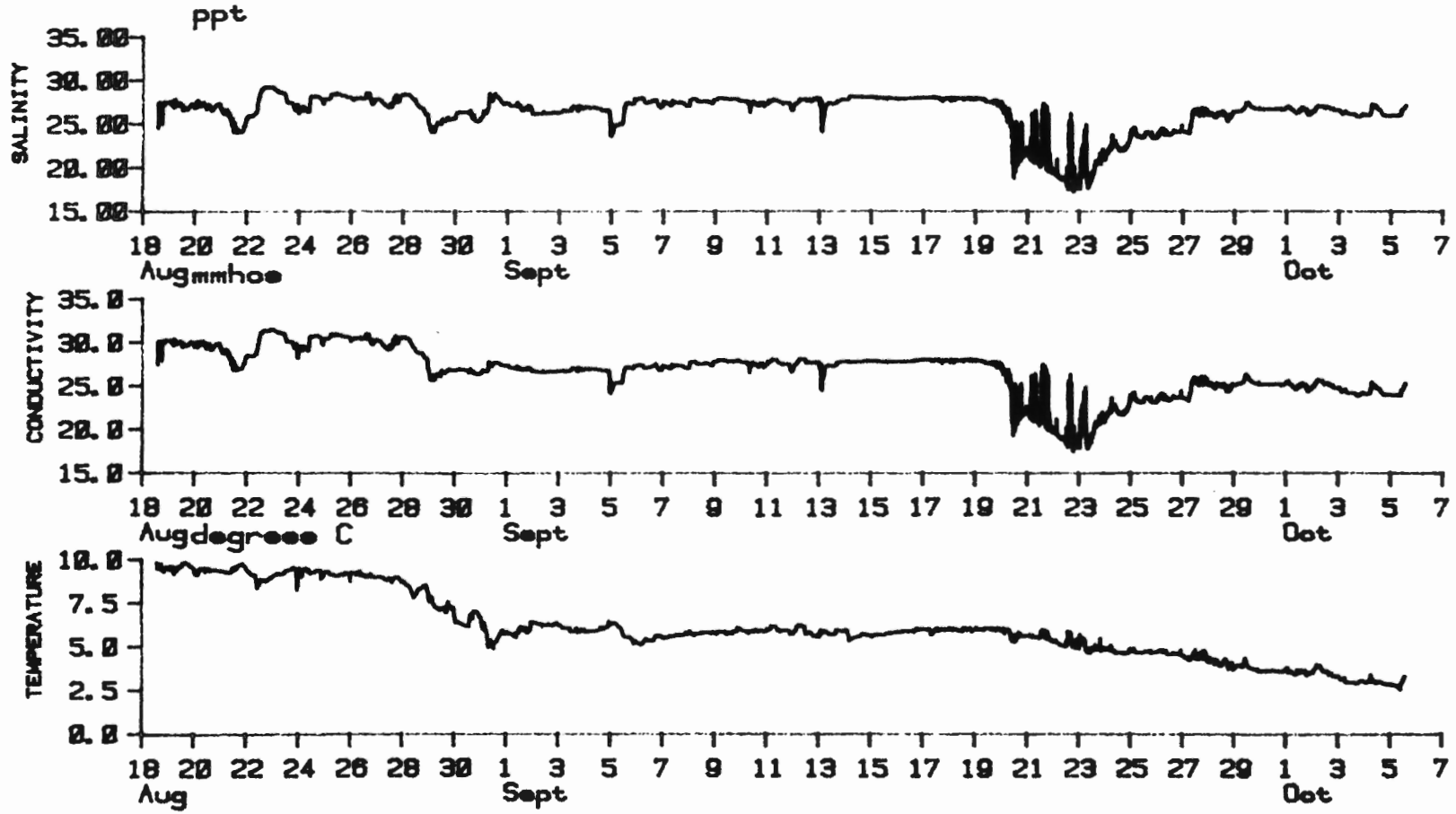
1986 MILLS ROAD, R.R.2, SIDNEY, B.C. V8L 3S1, (604) 656-0177

APPENDIX B

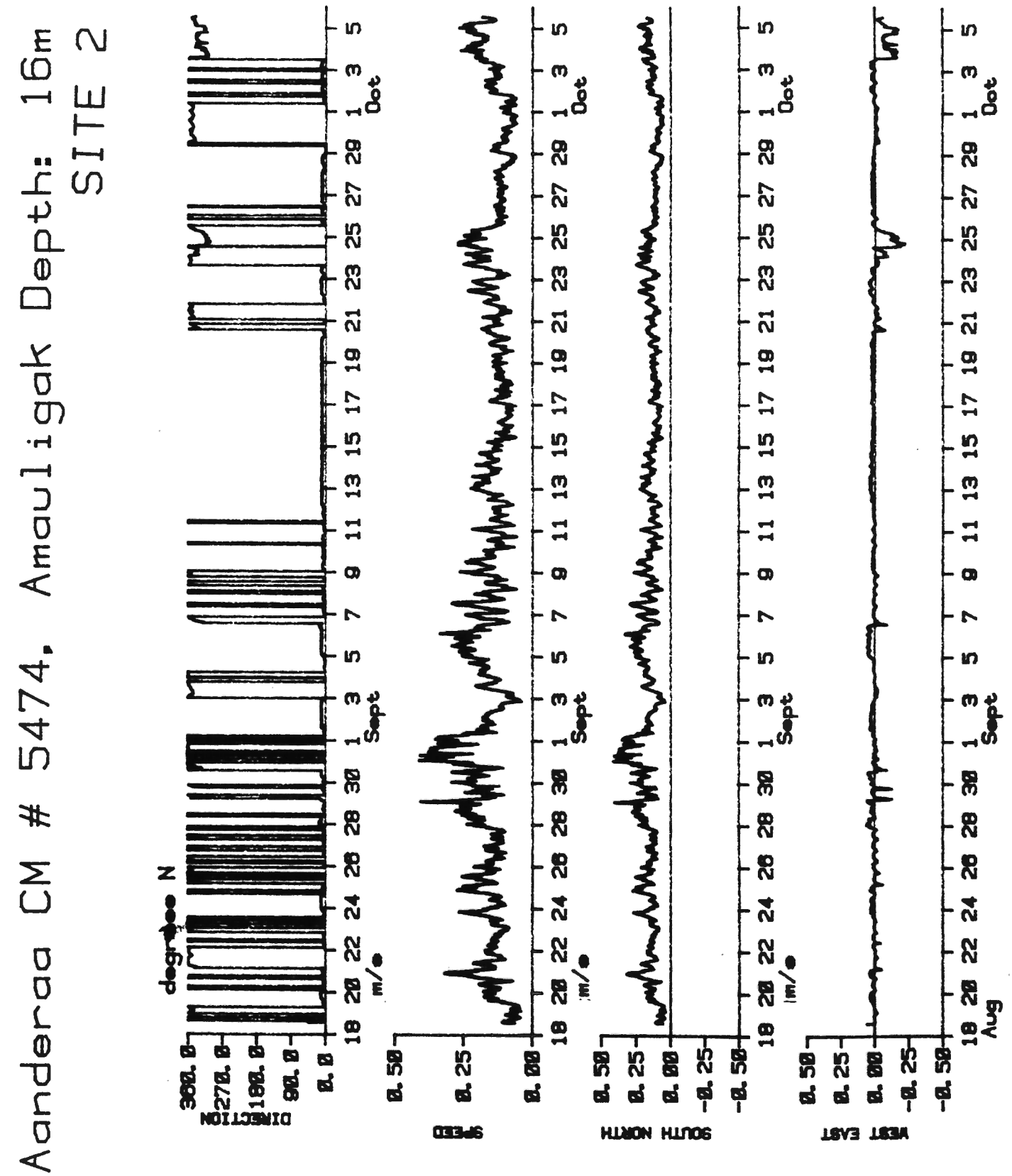
TIME SERIES PLOTS OF EDITED CURRENT METER DATA


AML CM # 216, Amauligak Depth: 7m SITE 2
DIRECTION
degrees N
360.0
270.0
180.0
90.0
0.0
SPEED
Augm/s
1.00
0.75
0.50
0.25
0.00
SOUTH NORTH
WEST EAST
18 20 22 24 26 28 30 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 1 3 5 7
Aug
Sept
Oct

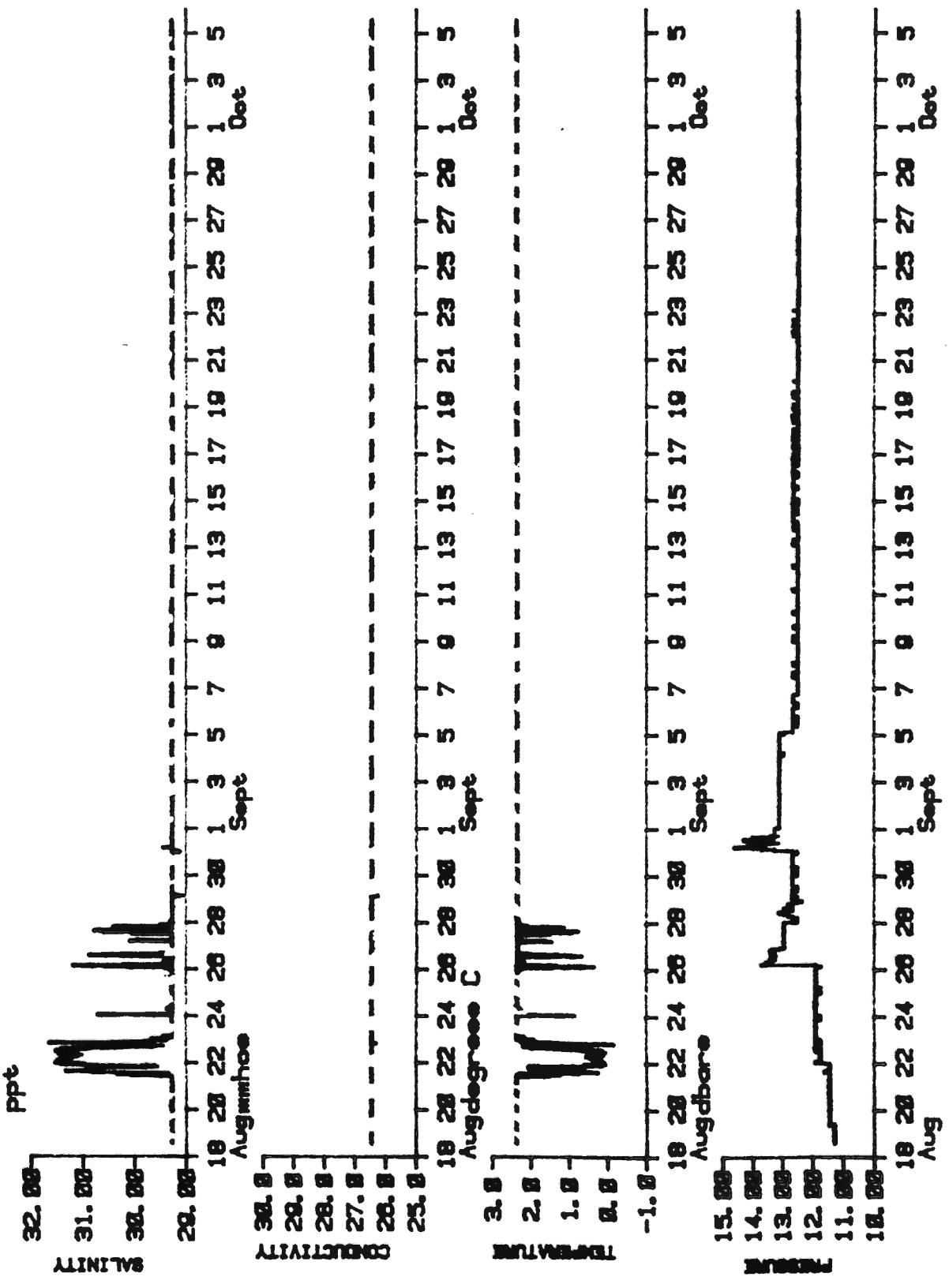
AML CM # 216, Amauligak Depth: 7m SITE 2



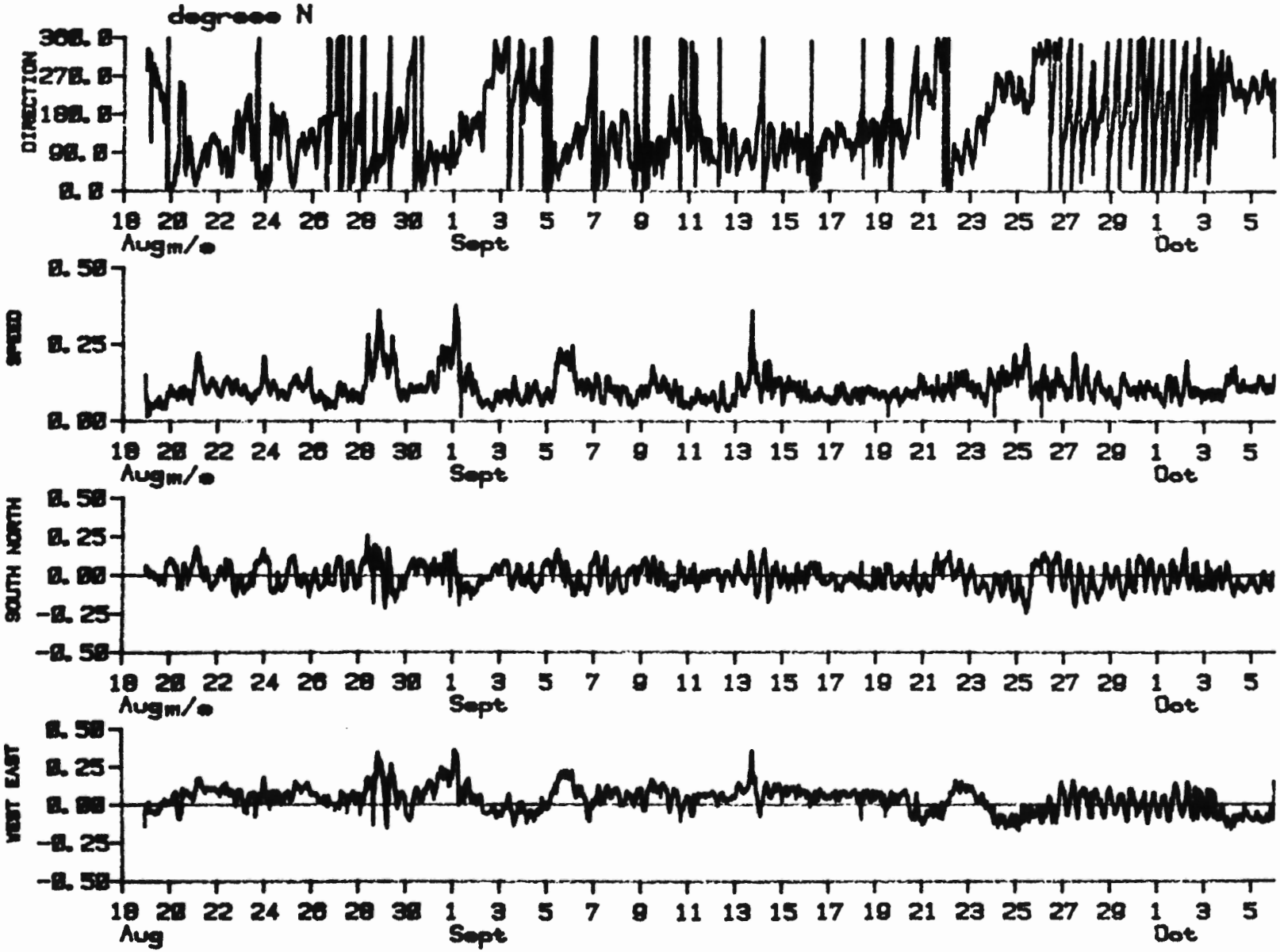
(Directional Data Suspect)



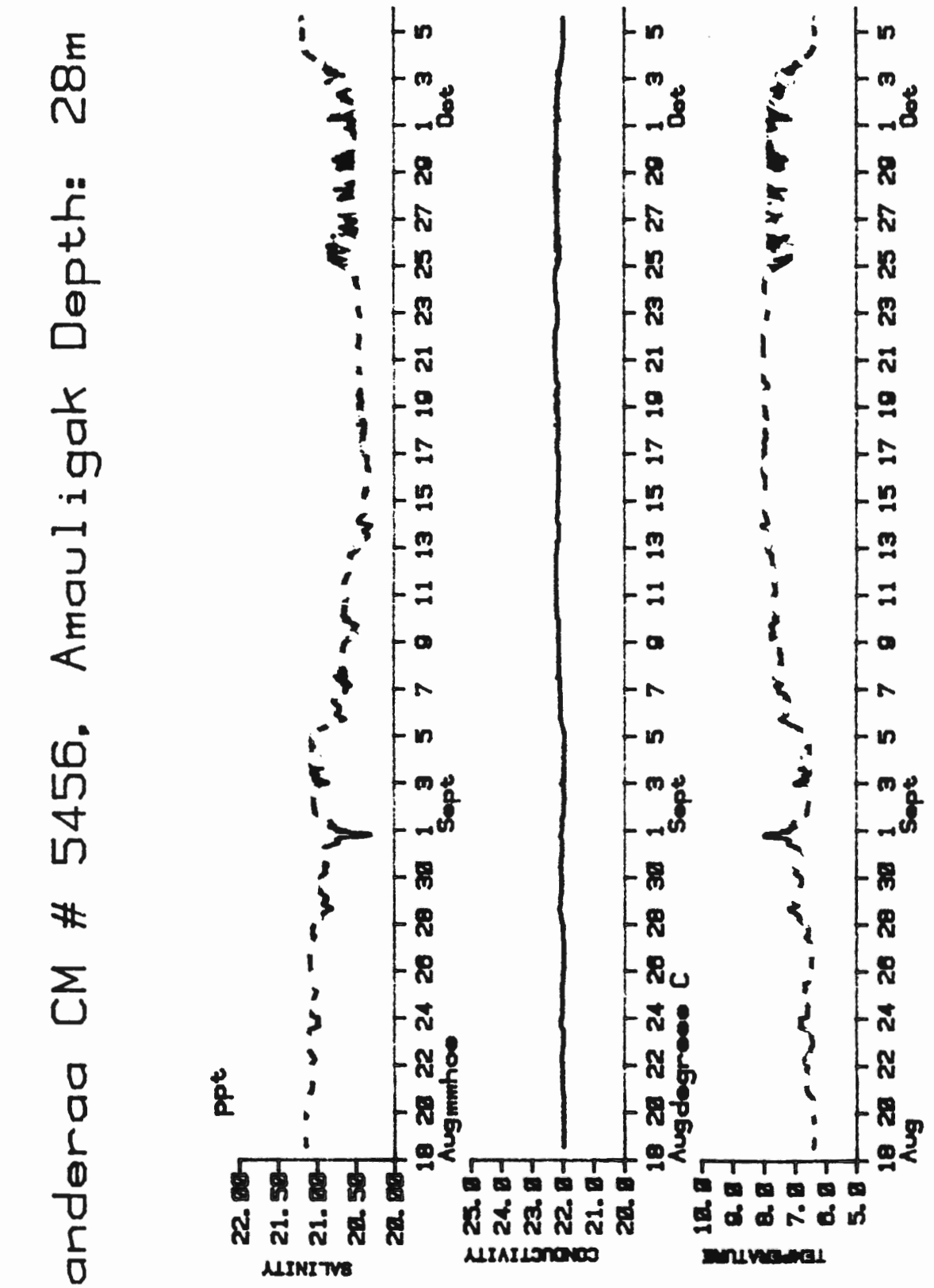
Aanderaa CM # 5474, Amauligak Depth: 16m

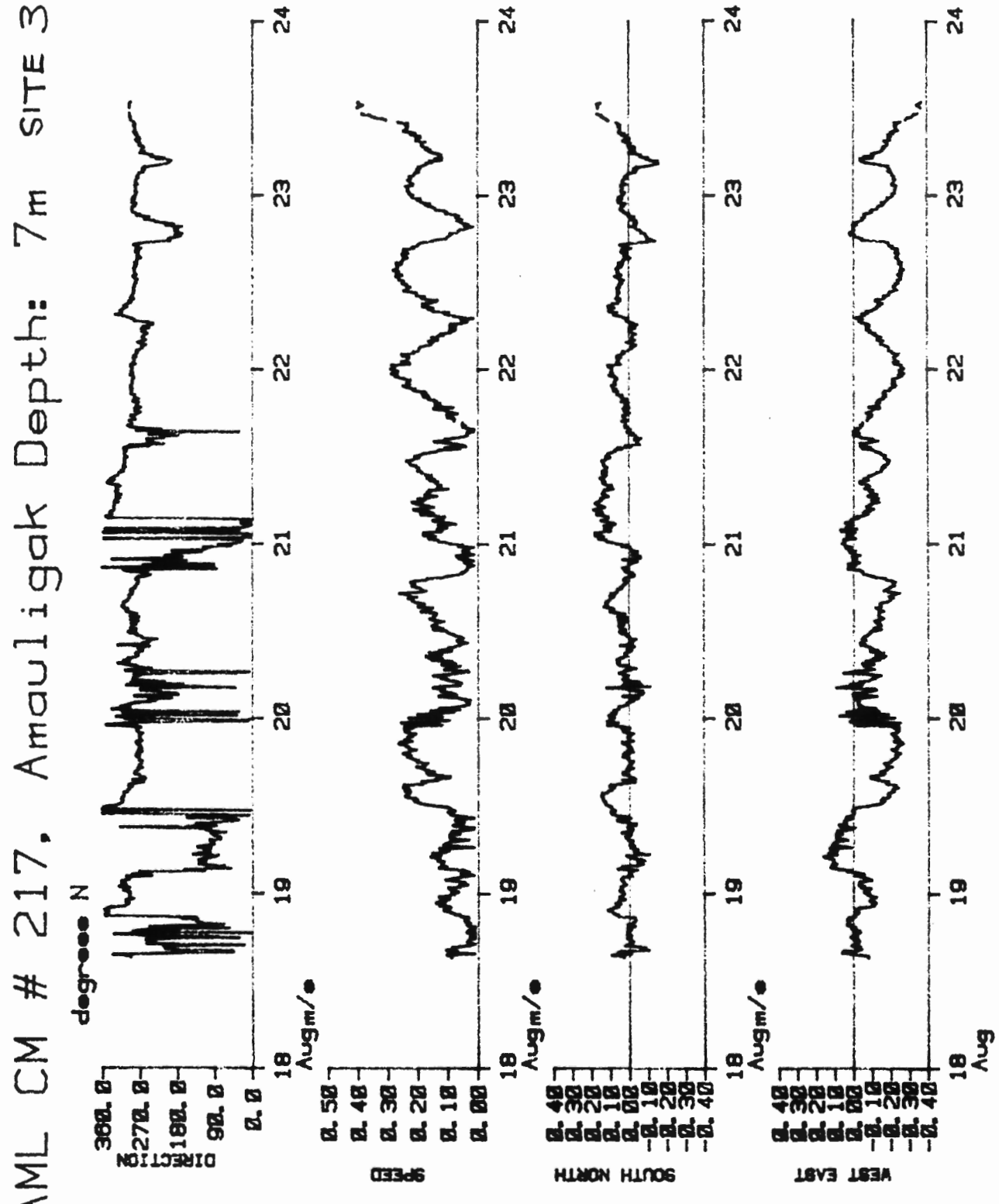


Aanderaa CM # 5456, Amauligak Depth: 28m
SITE 2

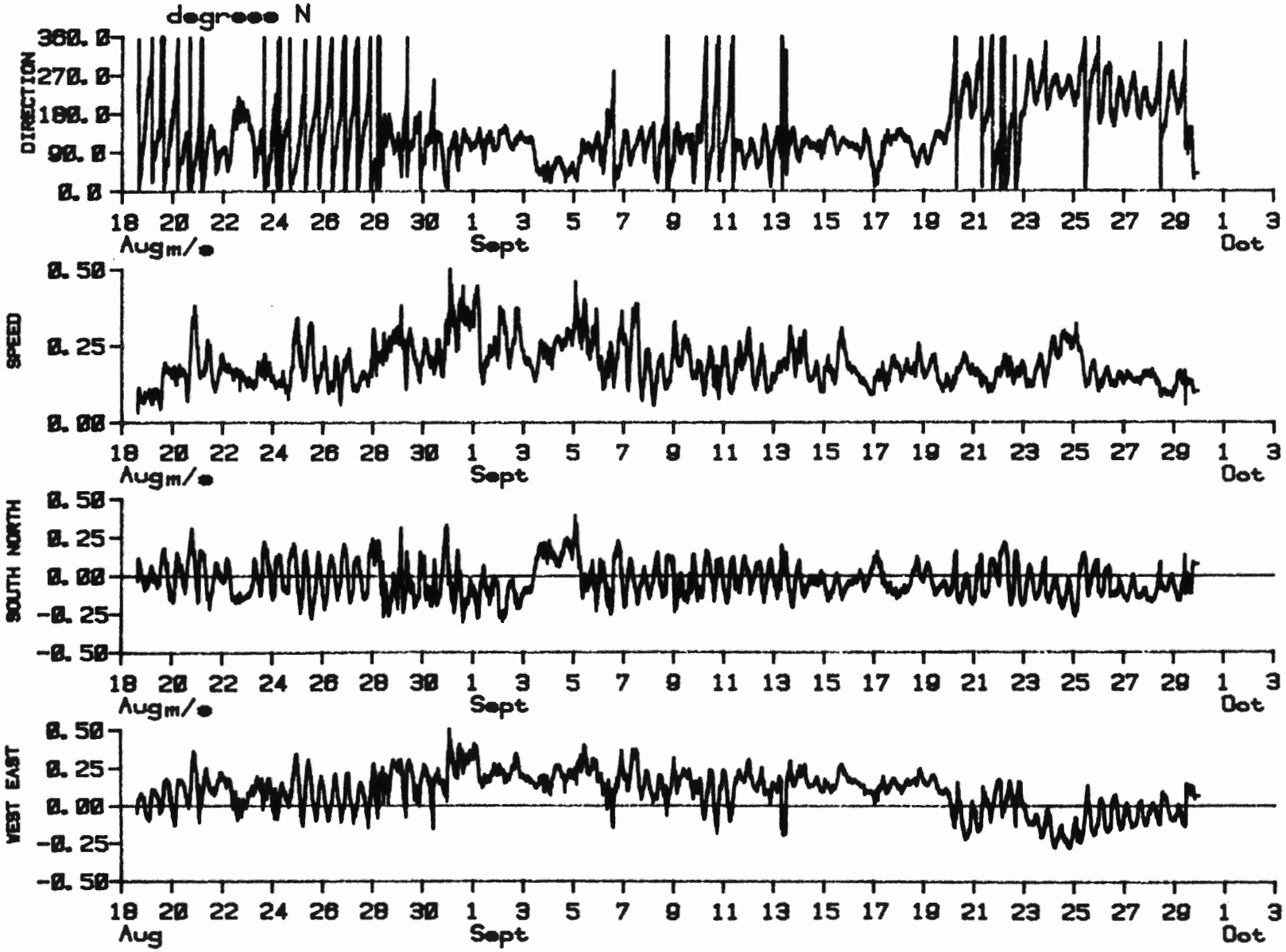


Aanderaa CM # 5456, Amauligak Depth: 28m

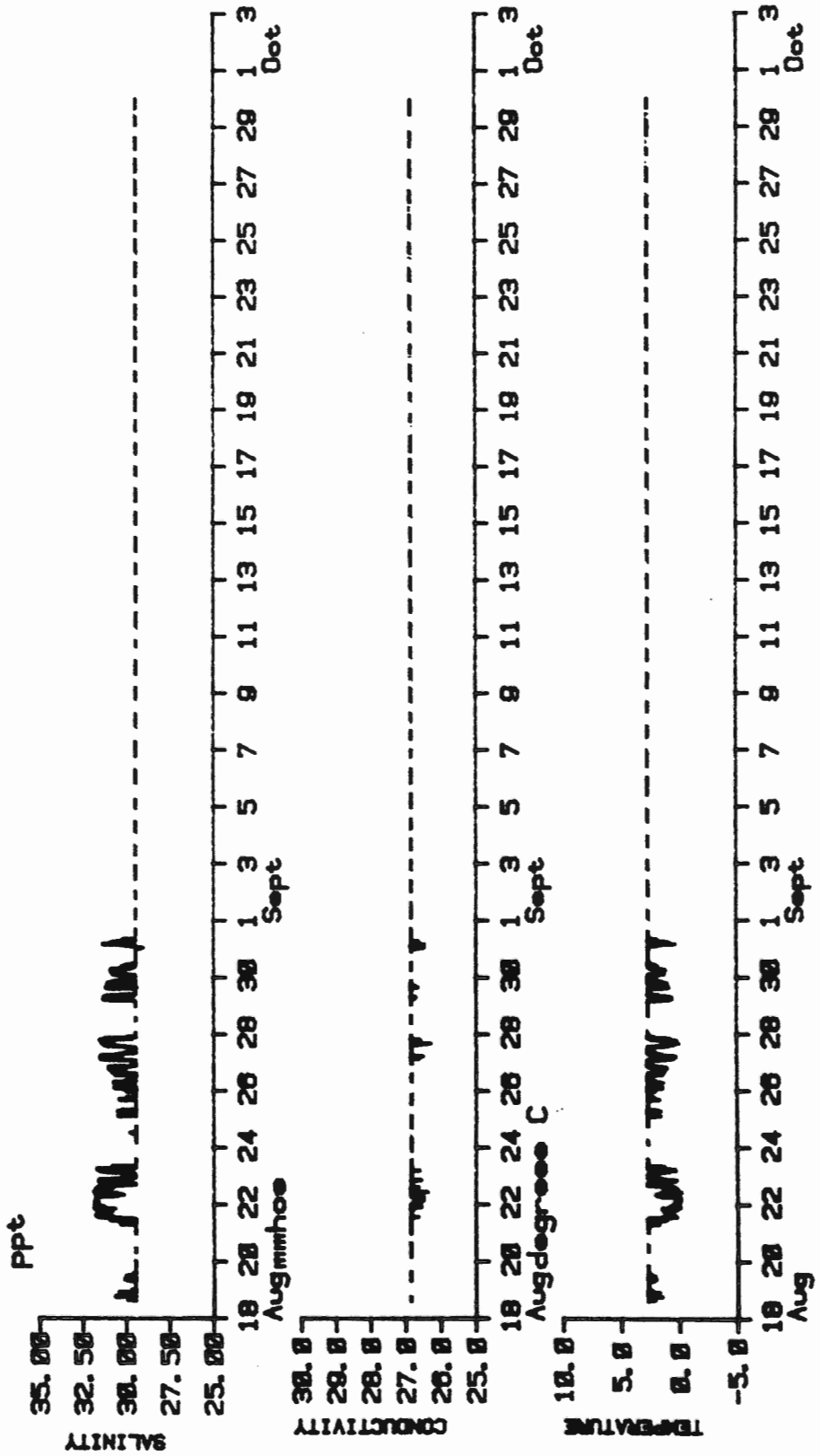



AML CM # 217. Amauligak Depth: 7m SITE 3
DIRECTION
degrees N
360.0
270.0
180.0
90.0
0.0
SPEED
m/s
0.50
0.40
0.30
0.20
0.10
0.00
SOUTH NORTH
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
WEST EAST
18
19
20
21
22
23
24
Aug

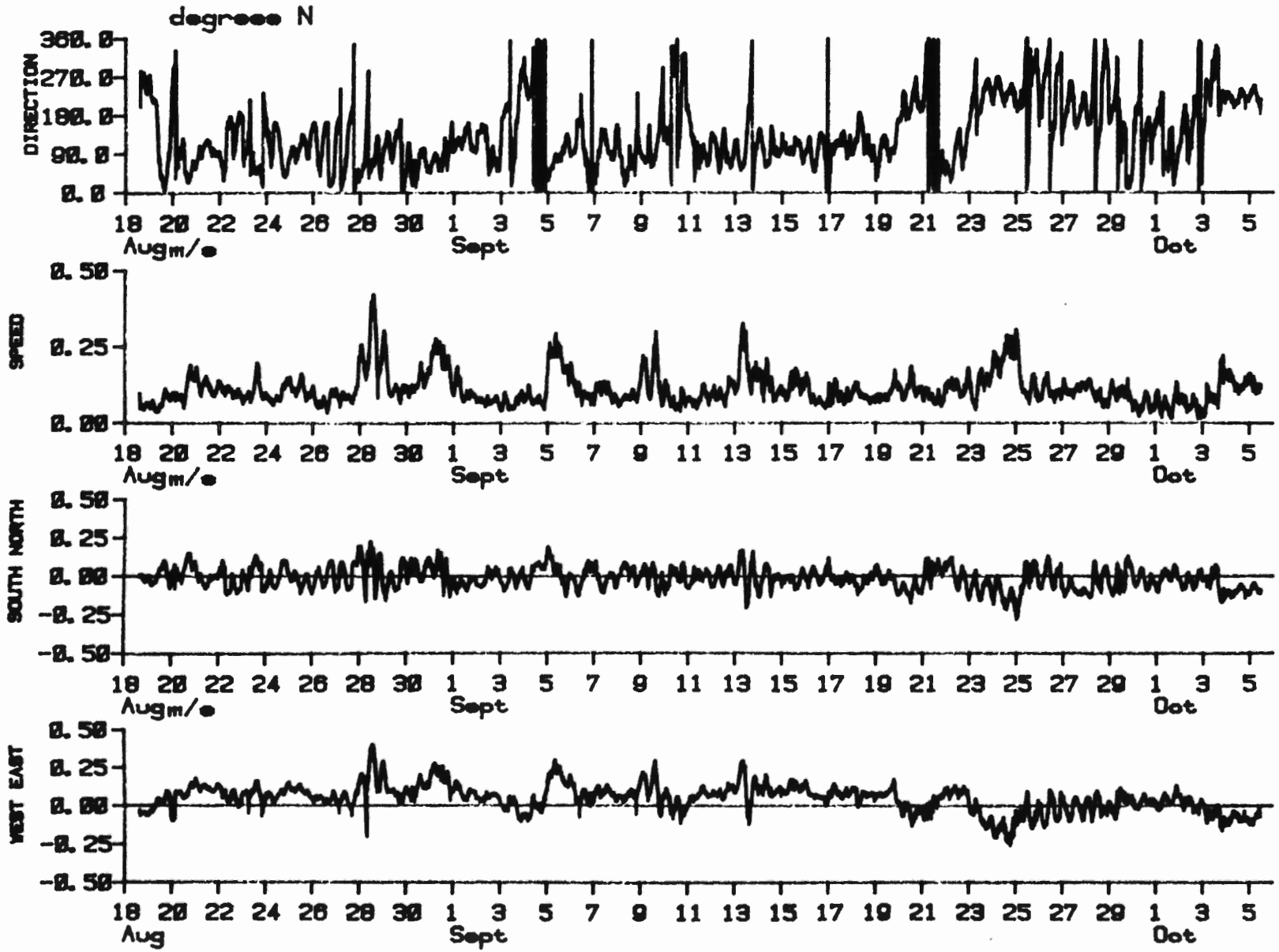
Aanderaa CM # 7920, Amauligak Depth: 16m
SITE 3

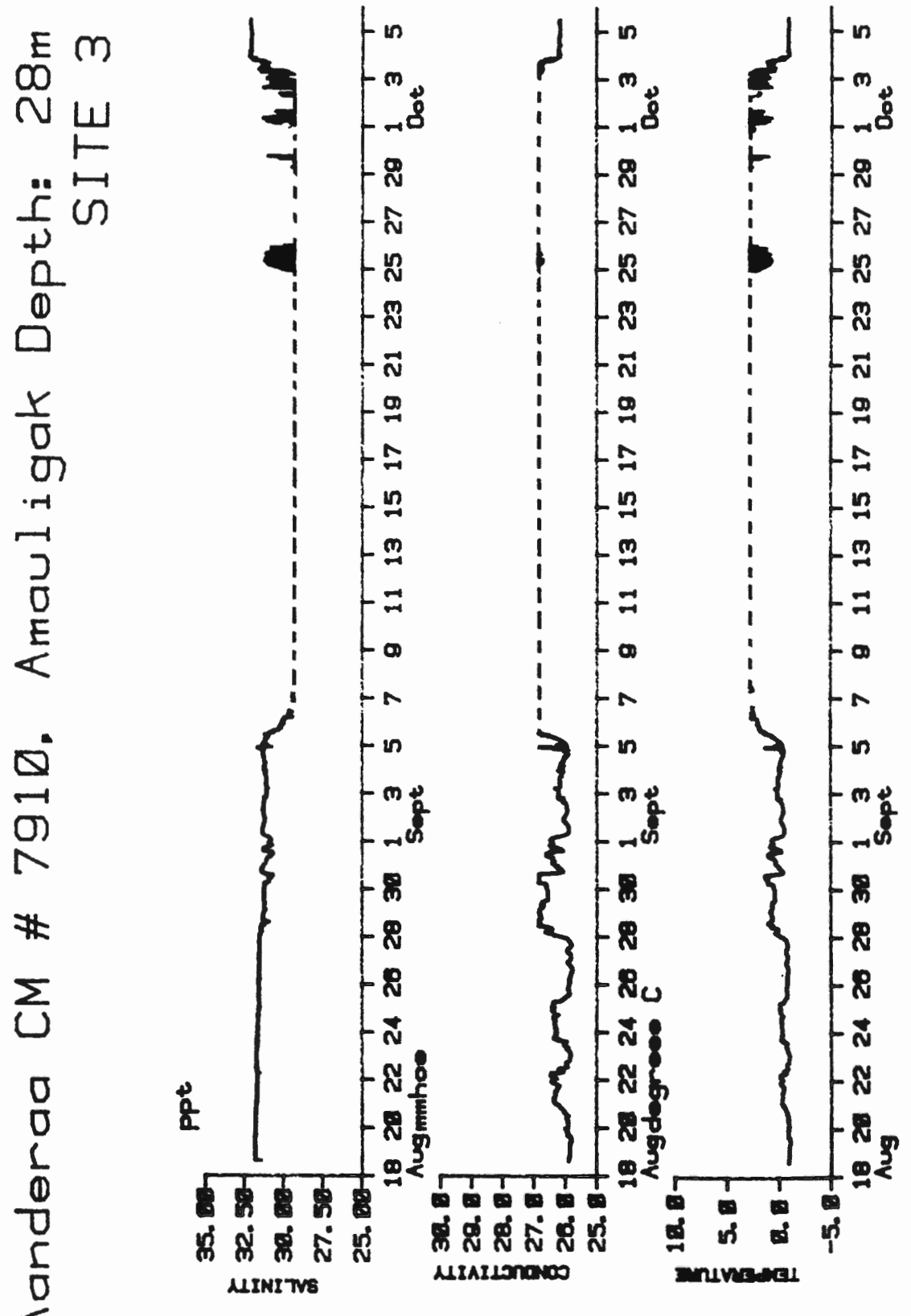


Aanderaa CM # 7920, Amauligak Depth: 16m
SITE 3

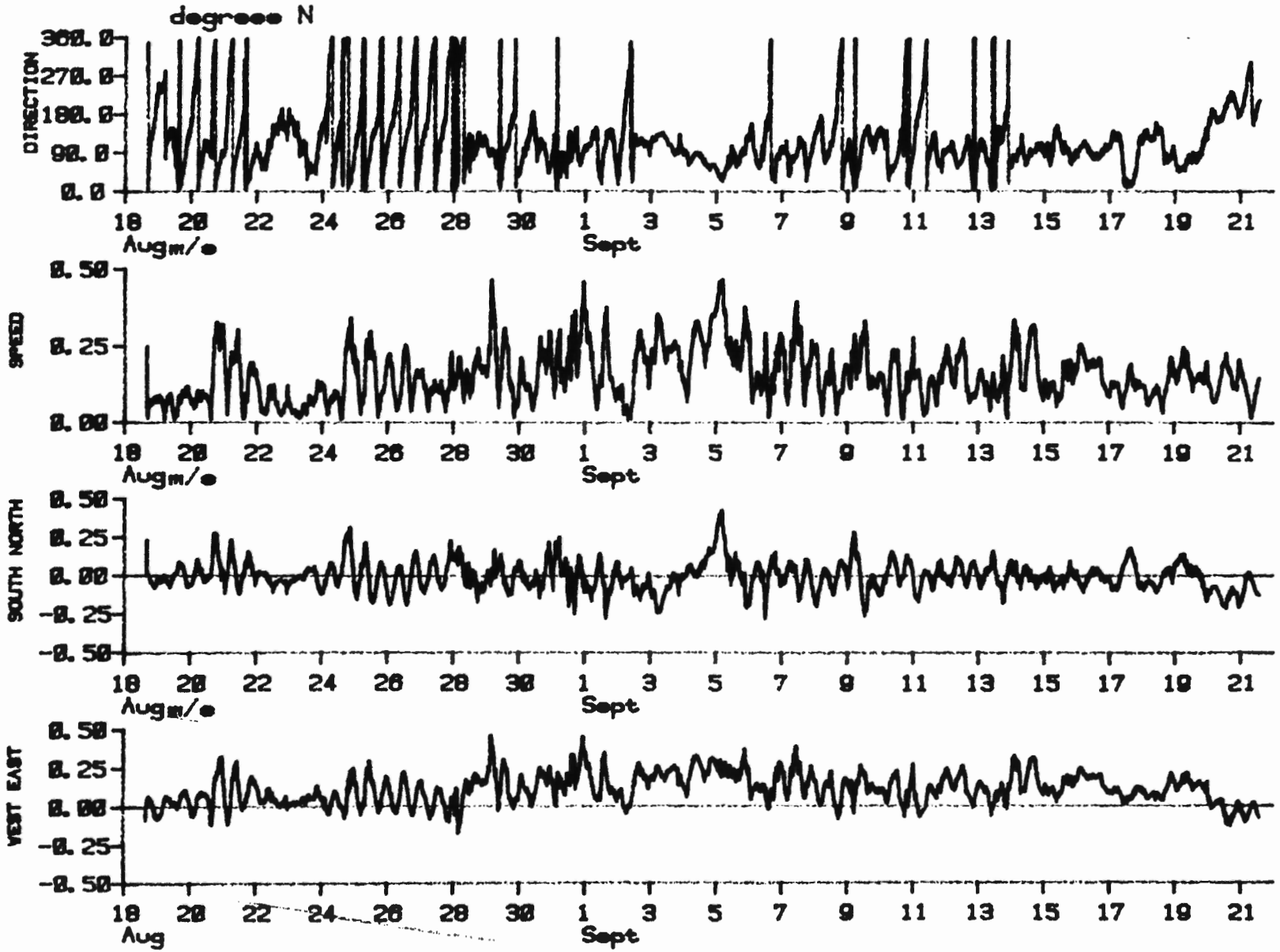


Aanderaa CM # 7910, Amauligak Depth: 28m
SITE 3

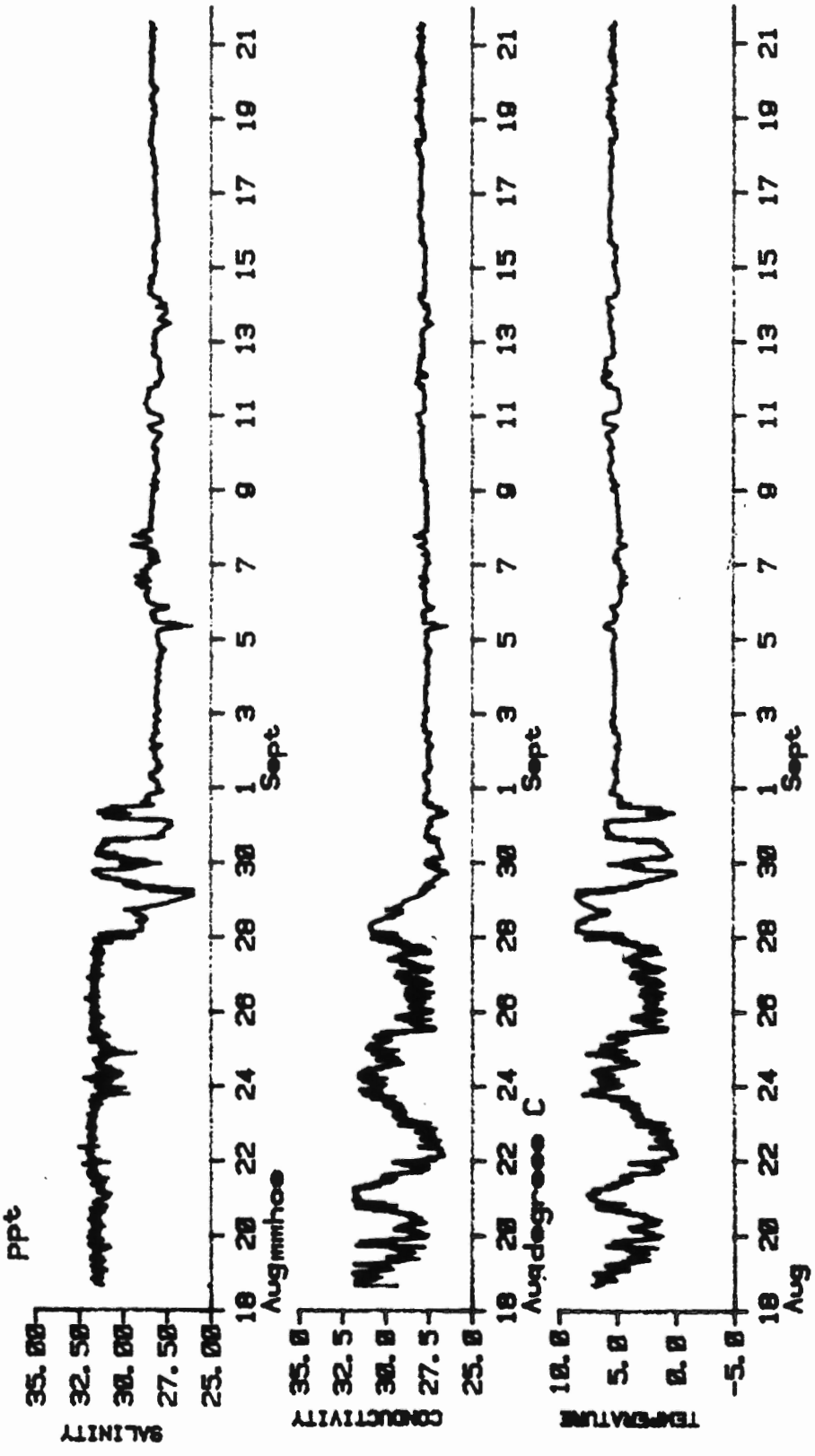



Aanderaa CM # 7910, Amauligak Depth: 28m
SITE 3
SALINITY
ppt
CONDUCTIVITY
mmhos
TEMPERATURE
degrees C
Aug
Sept
Oct

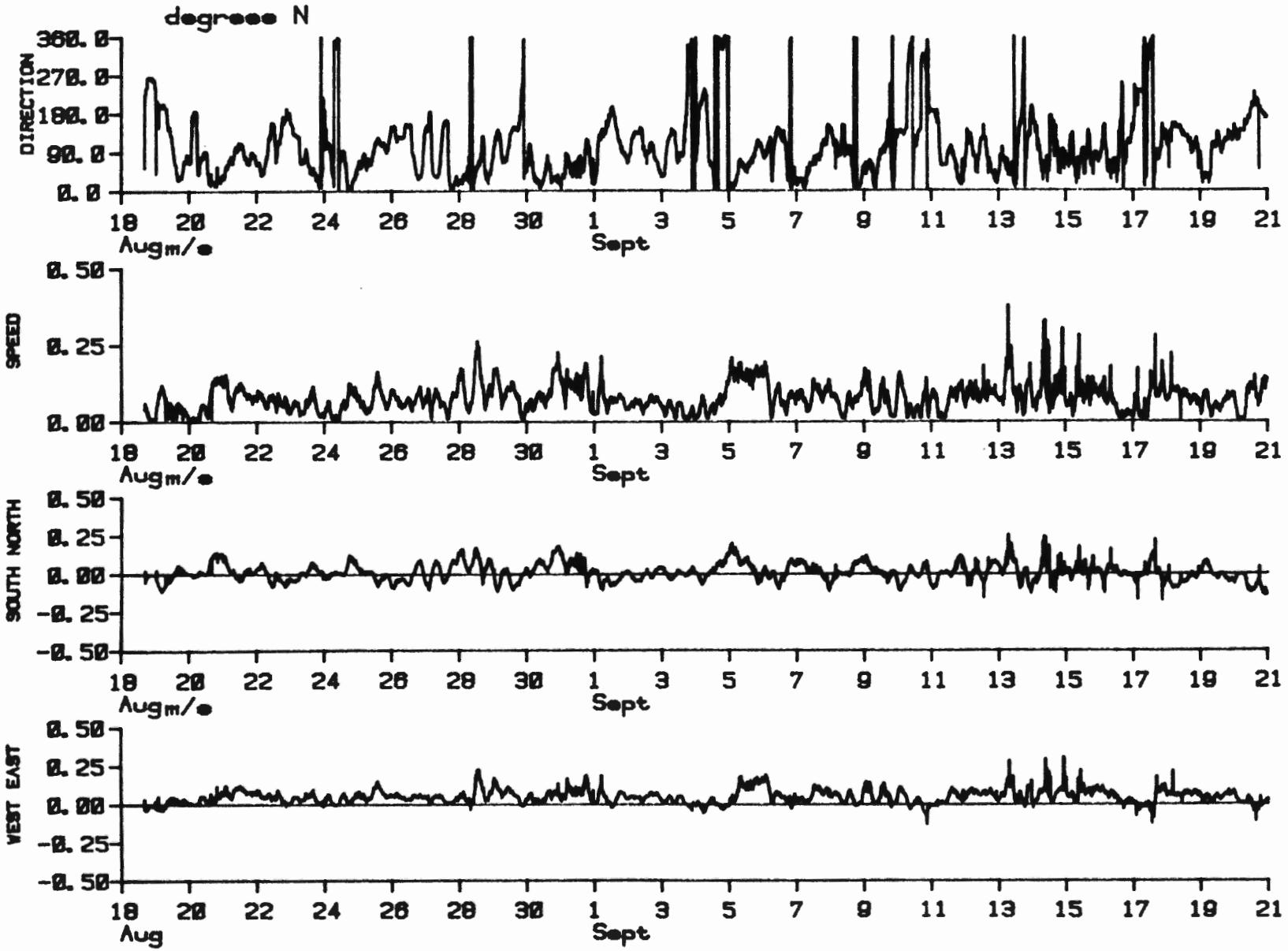
Aanderaa CM # 8695, Amauligak Depth: 10m
SITE 4



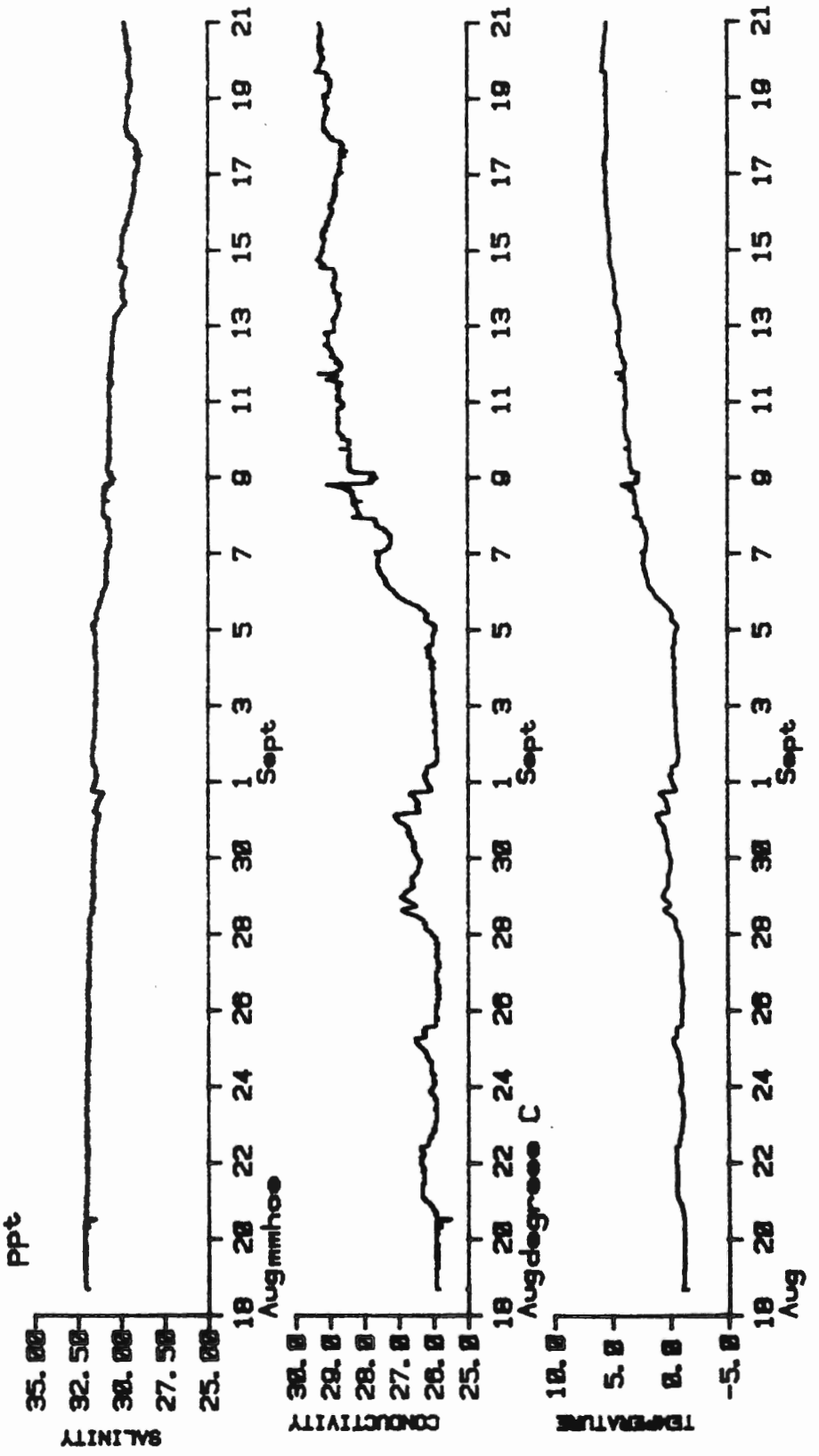
Aanderaa CM # 8695, Amauligak Depth: 10m
SITE 4



Aanderaa CM # 8696, Amauligak Depth: 27.5m
SITE 4

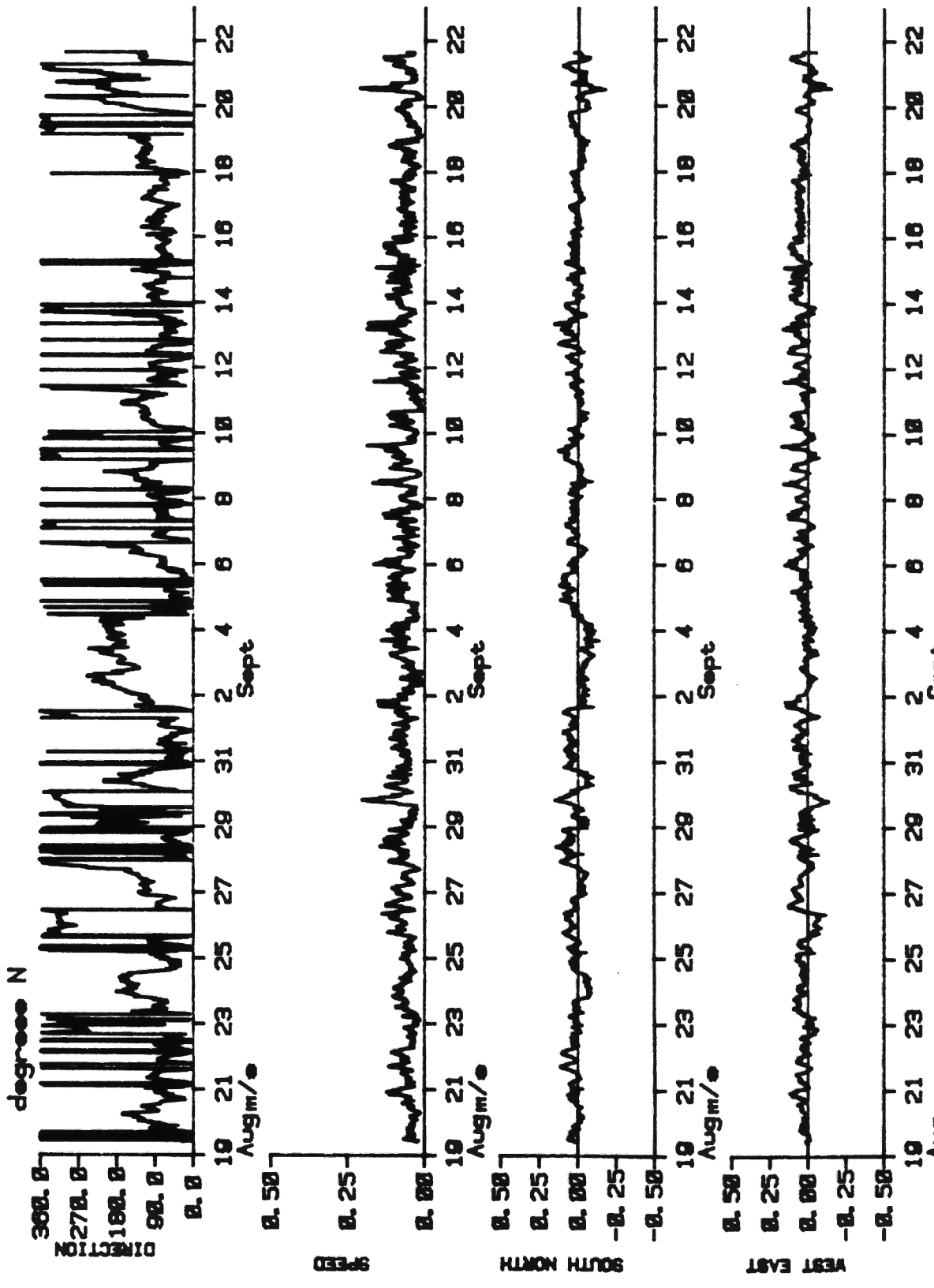


Aanderaa CM # 8696. Amauligak Depth: 27.5m
SITE 4

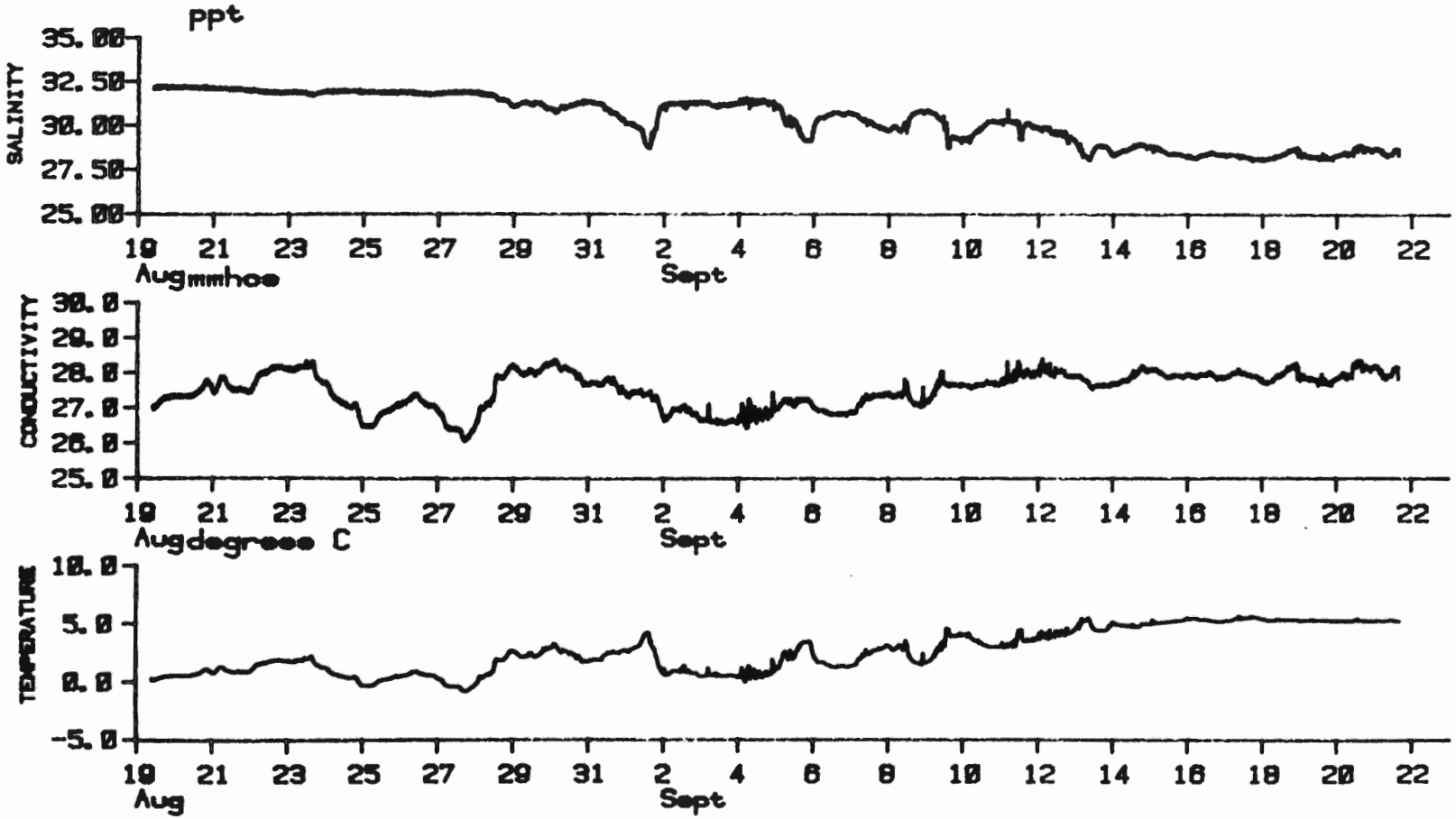


Aanderaa CM # 8697, Amauligak Depth: 19.5m

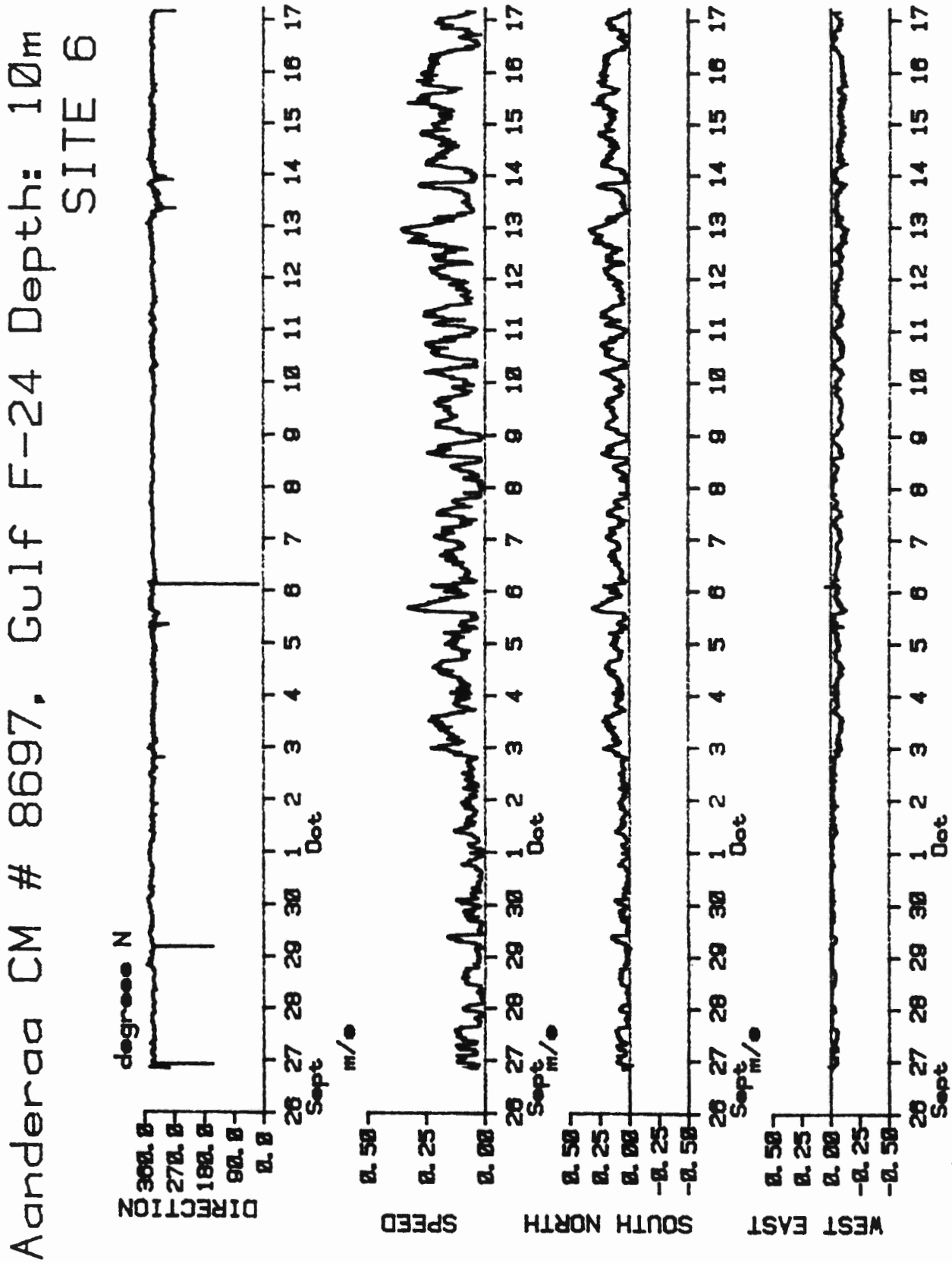
SITE 5



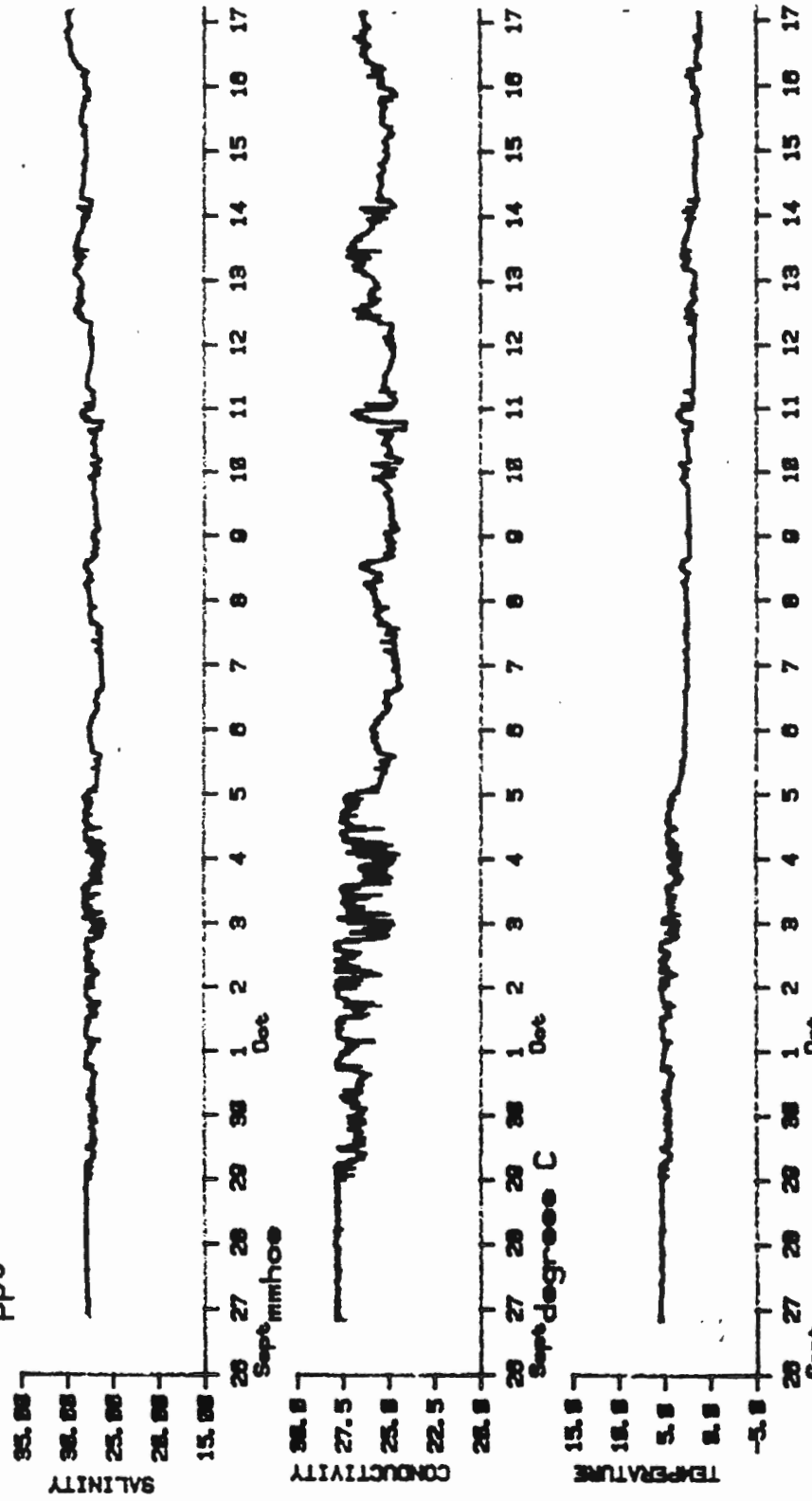
Aanderaa CM # 8697, Amauligak Depth: 19.5m
SITE 5



(Directional Data Suspect)

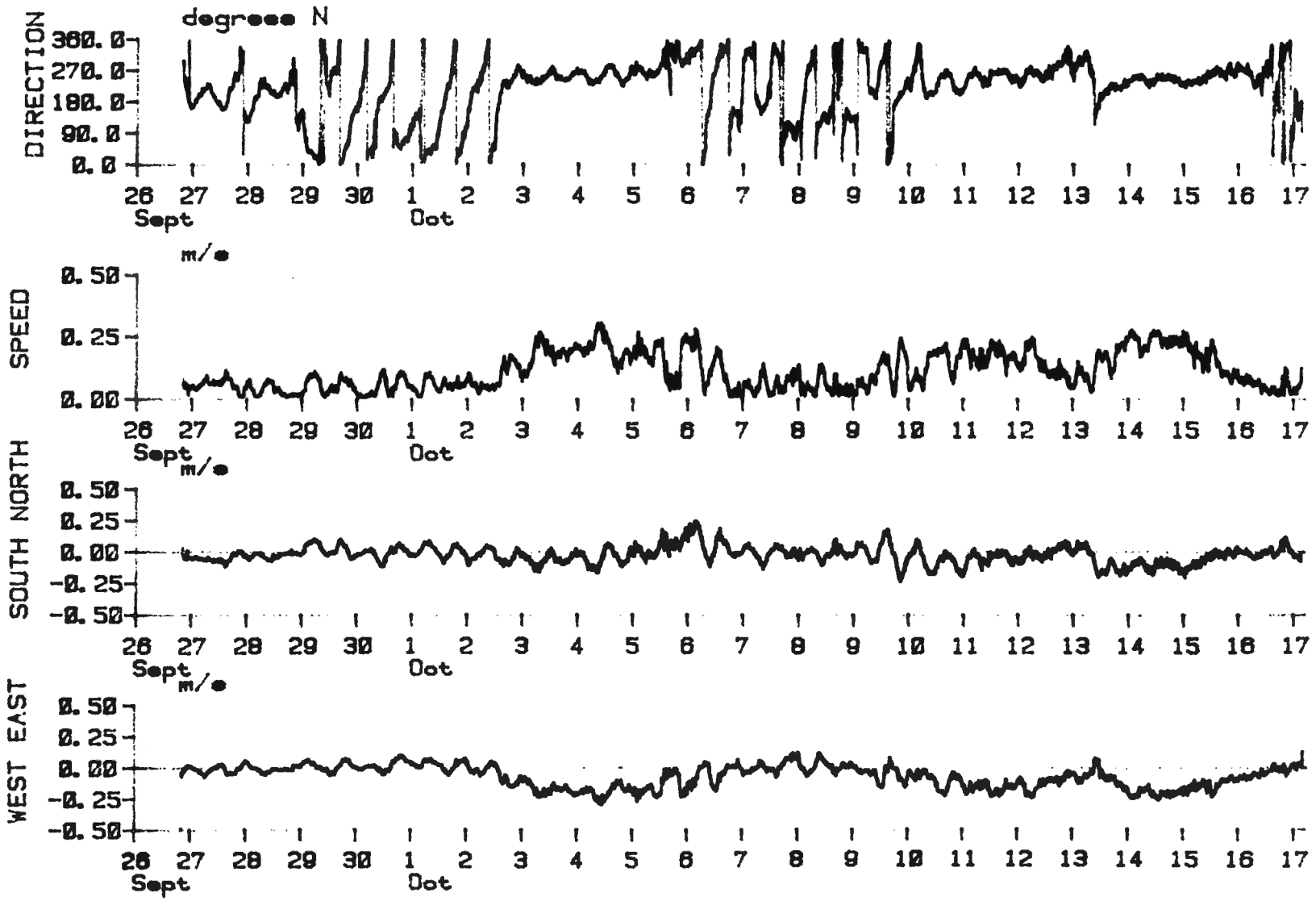


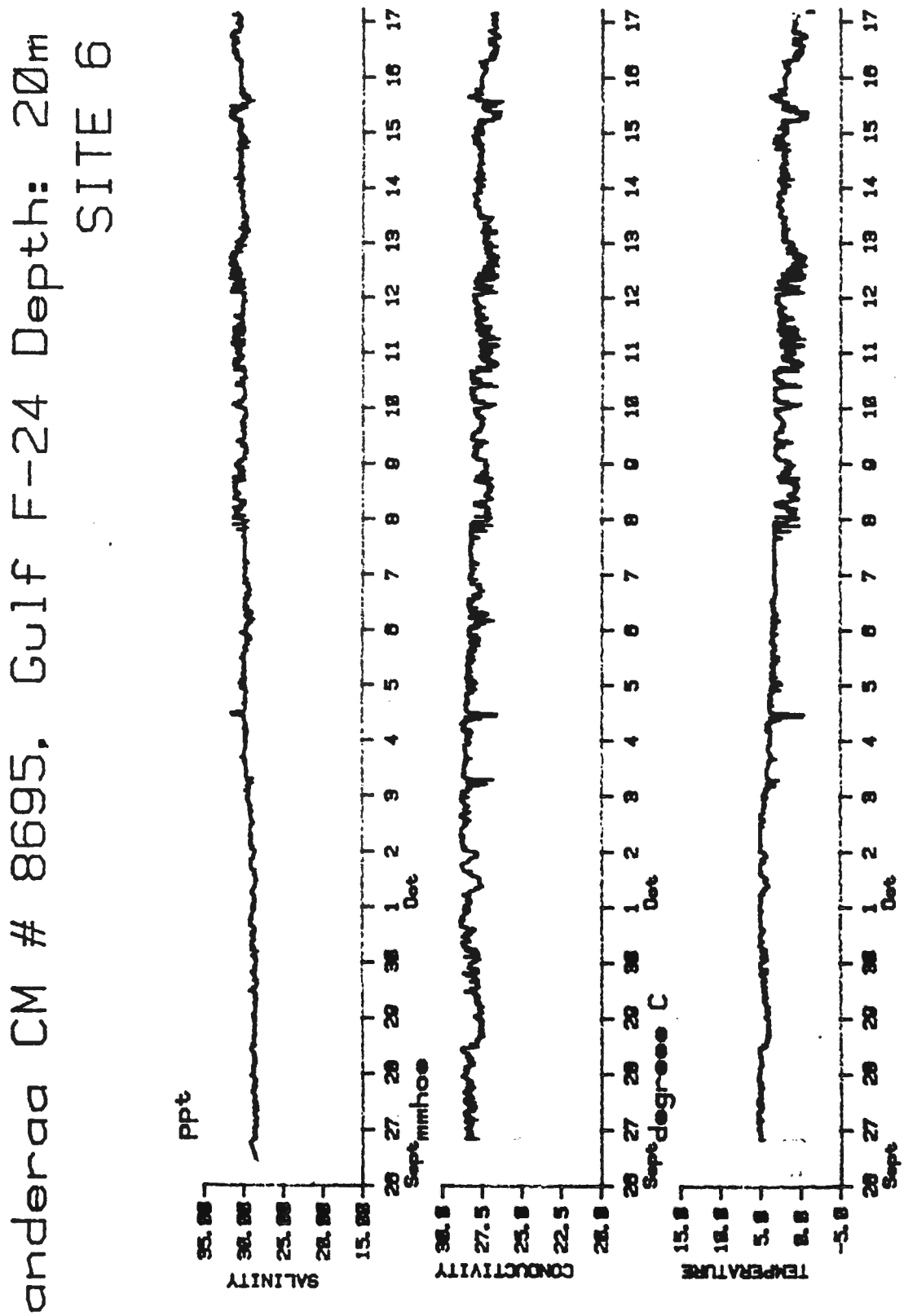
Aanderaa CM # 8697, Gulf F-24 Depth: 10m
SITE 6



Aanderaa CM # 8695, Gulf F-24 Depth: 20m

SITE 6




Aanderaa CM # 8695, Gulf F-24 Depth: 20m
SITE 6
SALINITY
ppt
CONDUCTIVITY
mmhos
TEMPERATURE
degrees C
Sept
Oct

APPENDIX C
JOINT BIVARIATE DISTRIBUTIONS OF
CURRENT SPEED AND DIRECTION

Site 6/7 m depth

216
start date 1987 8 18 14 14 37 stop date is 1987 10 5 13 54 37

	speed(m/s)															
	0.02 TO 0.06	0.06 TO 0.12	0.12 TO 0.18	0.18 TO 0.24	0.24 TO 0.30	0.30 TO 0.36	0.36 TO 0.42	0.42 TO 0.48	0.48 TO 0.54	0.54 TO 0.60	0.60 TO 0.66	0.66 TO 0.72	0.72 TO 0.78	0.78 TO 0.84	0.84 TO 0.90	
DIR																PERCENT
0	6	28	43	56	16	43	57	67	28	27	12	10	6			5.8
10	16	35	38	44	15	17	47	40	30	7	1					4.2
20	10	28	43	44	23	25	25	14	5							3.2
30	9	21	55	50	64	66	17	8	6	2						4.4
40	8	21	34	36	42	33	6	2								2.7
50	10	26	37	56	53	16	7	3	1							3.1
60	14	25	29	37	42	12	3									2.4
70	21	35	32	43	37	11										2.6
80	8	15	19	37	19	2										1.5
90	12	34	20	45	5											1.7
100	13	27	28	42	10											1.8
110	15	21	35	40	7	1										1.7
120	10	31	37	38	8	2										1.8
130	15	29	44	32	15	4										2.0
140	9	22	37	33	12	4										1.7
150	8	25	38	25	10	7										1.7
160	11	25	24	18	7	3										1.3
170	9	32	29	29	4	2	1									1.6
180	9	33	49	27	20	13	7									2.3
190	10	33	42	28	17	27	16									2.5
200	9	26	45	21	26	28	2									2.3
210	9	24	39	37	40	23										2.5
220	7	31	41	43	32	5										2.3
230	5	25	67	42	23	5										2.4
240	17	37	74	51	23	6	1									3.1
250	9	44	57	53	29	17										3.1
260	10	30	93	57	39	16										3.6
270	18	53	85	60	43	23										4.1
280	10	69	76	69	39	18										4.1
290	15	51	48	47	40	13	2									3.2
300	13	49	49	49	48	3	2									3.1
310	11	36	41	26	27	14	5									2.3
320	8	44	41	34	27	13	5									2.5
330	9	48	52	45	24	29	21	1		1						3.4
340	14	36	49	40	18	14	12	15	14	2	4	2				3.2
350	14	30	52	51	32	17	29	42	20	15	8	11	3			4.7
	5.9	17.3	23.7	21.8	13.7	7.8	3.9	2.8	1.5	0.8	0.4	0.3	0.1	0.0	0.0	

NO. OF RECORDS 6831
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 74

(Direction Data Suspect)
Site 2/16 m depth

5474
start date 1987 8 18 13 50 0 stop date is 1987 10 5 13 10 0

	speed(m/s)														
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60
DIR															PERCENT
0		266	957	1187	539	312	150	63	22	17	3				50.9
10		37	329	392	266	141	64	8							17.9
20															0.0
30															0.0
40			1												0.0
50															0.0
60															0.0
70															0.0
80															0.0
90															0.0
100															0.0
110															0.0
120															0.0
130															0.0
140															0.0
150															0.0
160															0.0
170															0.0
180															0.0
190															0.0
200															0.0
210															0.0
220															0.0
230															0.0
240															0.0
250															0.0
260															0.0
270															0.0
280															0.0
290															0.0
300				2	16	7	10								0.5
310			2	9	38	105	21								2.5
320			3	5	13	17	1								0.6
330			8	15	105	50	4								2.6
340		83	149	84	44	26	2								5.6
350		131	308	420	248	99	30	25	61	13	1				19.3
	0.0	7.5	25.4	30.6	18.4	11.0	4.1	1.4	1.2	0.4	0.1	0.0	0.0	0.0	

NO. OF RECORDS 6909

Site 2/28 m depth

5456
start date 1987 8 18 23 10 0 stop date is 1987 10 5 23 40 0

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0		56	86	18	2											2.3
10		41	89	31	4											2.4
20	2	34	67	23	14	2	2	1								2.1
30	1	24	67	24	24	11										2.2
40	2	28	62	30	17	10	3									2.2
50	1	48	78	46	23	27	3	2								3.3
60	4	69	96	49	29	34	5	10	8	4						4.5
70	2	61	140	63	44	26	9	4	5	1						5.1
80	2	72	134	58	17	23	4	6	10							4.7
90		81	127	33	18	11	1	4	1							4.0
100		99	167	50	15	5	1									4.9
110	1	92	171	52	10	11	4									4.9
120		73	151	48	8	8										4.2
130		94	179	54	13	5										5.0
140		67	182	51	18	8										4.7
150		53	133	30	16	3										3.4
160		70	147	26	10	5										3.7
170		59	96	19	6											2.6
180		37	68	23	12	2										2.1
190		16	41	22	9	7	1									1.4
200		21	73	25	13	8										2.0
210		45	80	40	18	4										2.7
220		44	86	80	14	4										3.3
230		22	92	45	4											2.4
240		49	59	30	4											2.1
250		45	60	33	3											2.0
260		30	77	40	1											2.1
270	2	40	61	24	1											1.9
280		60	25	5												1.3
290		31	35	7												1.1
300		27	43	7												1.1
310		20	43	13	3											1.1
320	1	25	49	21	7											1.5
330		31	80	13	2											1.8
340	1	50	52	10												1.6
350	1	63	83	7	1											2.2

0.3	47.5	5.5	0.5	0.3	0.0	0.0	0.0			
25.7	16.6	3.1	0.4	0.1	0.0	0.0				

NO. OF RECORDS 6909
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 7

Site 3/7 m depth

217
start date 1987 8 18 15 14 37 stop date is 1987 8 23 14 44 37

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0	1	2	3	3	2											1.6
10	1		1	2												0.6
20		1	3	2												0.9
30		2	1	3												0.9
40		4	2													0.9
50		1	1													0.3
60	1		2													0.4
70	2		1	1												0.6
80	1	4	1	2												1.2
90	2	1	5	2												1.5
100		1	3													0.6
110	3	1	4	3												1.6
120	1			1												0.3
130	2	3	1	1												1.0
140				1												0.1
150				1												0.1
160	2	2	1													0.7
170	2	4	1													1.0
180	2	5	2													1.3
190		2	3	3												1.2
200		2	1	1	1											0.7
210		6	2								1					1.3
220	1	2	1		1											0.7
230	3	3	3	2	1											1.8
240	5	6	4	2	1											2.6
250	4	4	5	5	5	1										3.5
260	3	7	9	7	15	11	1									7.8
270	2	6	11	13	16	45	17									16.1
280	2	5	8	16	21	39	29	4								18.2
290	1	8	15	11	5	10	6	4	2	10	1					10.7
300	3	8	6	9	14	14	1									8.1
310		4	2	4	5	4										2.8
320		2	3	7	8	1										3.1
330	1	1	1	4	6	2										2.2
340			7	4												1.6
350	1	2	8	1	2											2.0
	6.7	14.5	17.7	16.3	15.1	18.6	7.9	1.2	0.3	1.5	0.3	0.0	0.0	0.0	0.0	

NO. OF RECORDS 683
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 22

Site 3/17 m depth

7920
start date 1987 8 18 15 10 0 stop date is 1987 9 29 23 50 0

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0			20	34	23	16	1	2								1.6
10		1	17	29	15	12	8	7	4							1.5
20		3	20	30	24	14	2	3	4							1.6
30		6	56	49	45	21	24	15	7	10	3	1				3.9
40		5	10	36	56	22	28	19	6	1						3.0
50		7	15	40	57	40	32	19	7							3.6
60		1	11	65	76	34	38	15	5	2						4.0
70		4	22	58	62	33	54	18	7	1						4.2
80		3	21	45	84	28	18	25	16	3		1				4.0
90		7	19	85	115	80	44	29	31	10	3			1		6.9
100		4	28	103	144	84	64	31	25	18	8	1				8.4
110		10	42	82	159	104	74	39	24	25	8					9.3
120		5	31	68	102	96	57	18	21	10	6	2				6.8
130		8	26	77	93	39	55	20	30	13	1					5.9
140		8	20	64	59	29	12	16	7	3						3.6
150		6	22	43	36	13	17	6								2.3
160		3	20	61	32	11	12									2.3
170		3	20	87	54	8	5									2.9
180	1	2	13	71	49	3	1									2.3
190			10	71	36	4	2									2.0
200		2	14	56	37		11									2.0
210		1	14	44	26	4	8	4								1.7
220		1	19	48	19	11	13	10	1							2.0
230		1	20	37	17	9	11	7								1.7
240			20	30	10	16	13	3								1.5
250			15	31	18	15	23	2								1.7
260			20	21	14	23	13	1								1.5
270			20	21	26	6	2									1.2
280		3	10	18	26	5										1.0
290			12	28	13	6										1.0
300			12	10	10	4										0.6
310			12	14	7	2										0.6
320		1	12	22	5											0.7
330		1	17	13	4	1										0.6
340		1	15	27	13	3										1.0
350		4	17	22	23	5										1.2
	0.0		11.3		26.0		10.5		3.2		0.5		0.0		0.0	
		1.7		26.9		13.1		5.1		1.6		0.1		0.0		

NO. OF RECORDS 6101

Site 3/29 m depth

7910
start date 1987 8 18 15 10 0 stop date is 1987 10 5 12 0 0

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0		35	38	1												1.1
10	1	45	53	3												1.5
20	1	33	71	14	6	2										1.8
30	3	56	86	29	22	7	2									3.0
40		72	76	43	21	15	5									3.4
50	1	76	109	41	37	25	12	1	3	3						4.5
60	1	98	74	59	38	25	12	12	3	6	3					4.8
70	3	105	107	51	20	50	18	4	1	7	2					5.4
80	2	124	185	55	32	30	41	2		3						6.9
90	3	114	258	101	35	12	8	3	1							7.8
100	3	90	204	64	22	4	7	11								5.9
110	2	93	155	96	27	6	11	3								5.7
120	1	98	117	56	21	3	2	1								4.3
130	8	89	117	48	30	5	1	1								4.3
140	8	75	122	29	16	1	1									3.7
150	5	64	99	19	3											2.8
160	6	78	121	45	4											3.7
170	4	43	105	15	3											2.5
180	3	41	64	24	8		2									2.1
190	1	45	88	25	14	1	5									2.6
200	8	57	60	29	14	5	7	4								2.7
210	7	50	53	57	17	25	3	1								3.1
220	4	29	53	62	27	18	5	2								2.9
230	1	18	66	46	8	6	18	1								2.4
240	1	29	40	21	4	11	9	1								1.7
250	2	19	46	24	5	1	2									1.4
260	2	39	16	9	16	3										1.2
270	2	40	26	14	2	1										1.2
280		18	28	6	1											0.8
290	4	17	31	11												0.9
300	4	21	14	9	1											0.7
310	1	22	19	4	1											0.7
320	2	30	16	3												0.7
330	2	14	13	4												0.5
340	2	25	27													0.8
350	1	26	14													0.6
	1.4	40.3		6.6		2.5		0.1		0.1		0.0		0.0		
	28.0		16.2		3.7		0.7		0.3		0.0		0.0			

NO. OF RECORDS 6876
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 18

Site 4/10 m depth

8695
start date 1987 8 18 16 5 0 stop date is 1987 9 21 13 55 0

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0	7	11	22	9	7	5	3									1.3
10	2	16	27	17	17	8	3	4	1							2.0
20	4	19	26	23	8	4	2	6	1			11				2.2
30	3	21	22	20	7	2	2	6	3	1	8	5				2.1
40	8	29	29	35	21	22	11	5	4	8	1	1				3.6
50	16	41	40	44	35	37	28	7	7	5						5.4
60	13	44	58	65	57	61	32	4	17							7.3
70	5	21	59	66	73	53	39	9	3	1						6.8
80	10	19	77	87	71	59	38	34	23	11	3	1				9.0
90	12	20	66	85	85	67	51	49	17	7	2	5				9.7
100	11	13	79	75	53	74	60	17	16	3						8.3
110	8	24	60	56	59	52	34	13	1							6.4
120	10	37	71	66	38	49	22	10	10	1						6.5
130	6	37	67	61	26	24	20	20	22	2						5.9
140	14	40	48	25	18	22	6	4	3							3.7
150	18	28	27	31	23	6	2									2.8
160	15	35	33	22	4		2	1								2.3
170	8	27	24	10	10	2										1.7
180	8	28	10	9	13	3										1.5
190	10	9	14	6	9	3										1.1
200	4	5	7	18	5	1										0.8
210	12	9	8	7	7	2										0.9
220	3	7	5	11	4											0.6
230	2	19	7	1	1											0.6
240	6	20	3													0.6
250	2	10														0.2
260	3	10	3													0.3
270	6	6	5													0.4
280	3	11	5													0.4
290	6	10	6		1											0.5
300	4	11	7	3		1										0.5
310	2	6	12		4	1										0.5
320	3	4	19	3	6	4										0.8
330	4	10	9	6	9	4										0.9
340	5	7	12	4	1	6	2									0.8
350	5	12	21	13	1	9	10	1								1.5
	5.4	14.0	20.5	18.2	14.0	12.1	7.6	3.9	2.7	0.8	0.3	0.5	0.0	0.0	0.0	

NO. OF RECORDS 4815
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 69

Site 4/28 m depth

8696
start date 1987 8 18 16 31 0 stop date is 1987 9 21 14 41 0

	speed(m/s)														
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0	18	33	30	12	4											2.2
10	24	49	71	48	20	1										4.8
20	32	55	90	40	27	1										5.5
30	50	90	94	36	13	9	3									6.6
40	37	83	45	26	6	9	1		3	1						4.7
50	46	92	60	53	13	7	4									6.2
60	78	150	106	40	19	4	2		1							9.0
70	37	130	105	16	12											6.7
80	28	163	68	19	11			3								6.6
90	23	123	67	12	12											5.3
100	29	136	85	15	16	1										6.3
110	25	109	73	27	10	3										5.5
120	12	116	73	21	4											5.1
130	24	111	55	48												5.3
140	10	68	88	16												4.1
150	16	64	25	2	2											2.4
160	27	37	15	5												1.9
170	33	27	15	21	1											2.2
180	12	44	23	10												2.0
190	4	32	31		2											1.5
200	1	30	10													0.9
210	4	4	1													0.2
220	9	14		2												0.6
230	6	7	1													0.3
240	4		1													0.1
250	2															0.0
260	3															0.1
270																0.0
280	2			1												0.1
290	6	1		1												0.2
300	6	2	3	1	1											0.3
310	2	9	9													0.4
320	1	8		1												0.2
330	4	12	3													0.4
340	10	10	10	5												0.8
350	8	31	12	10												1.4
	14.2	28.5	3.9	0.2	0.1	0.0	0.0	0.0								
	41.3	11.0	0.8	0.1	0.0	0.0	0.0									

NO. OF RECORDS 4456
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 430

Site 5/22 m depth

8697.
start date 1987 8 19 10 3 0 stop date is 1987 9 21 15 33 0

	speed(m/s)														
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0	45	99	50	7												4.3
10	38	88	43													3.6
20	40	103	27													3.7
30	39	125	20	1	4											4.1
40	41	134	22	5												4.3
50	28	171	39	10	8											5.5
60	32	234	89	21	5											8.2
70	28	221	96	18	1											7.8
80	33	171	66	10	1											6.0
90	31	153	67	10												5.6
100	22	116	60	16												4.6
110	50	121	73	11												5.5
120	43	83	22	9												3.4
130	34	56	30	2												2.6
140	33	45	20													2.1
150	28	66	7													2.2
160	22	75	9													2.3
170	19	34	14													1.4
180	19	44	16	4												1.8
190	11	23	25	3												1.3
200	10	27	11	3	3											1.2
210	18	30	12	1	1											1.3
220	15	12			2	1										0.6
230	14	9	1													0.5
240	10	5														0.3
250	10	5														0.3
260	10	8														0.4
270	5	12	3													0.4
280	6	14	1													0.5
290	11	16	10	1												0.8
300	11	15	13	8	2											1.1
310	11	30	30	1	5	1										1.7
320	15	37	24	7	3											1.9
330	25	45	15													1.8
340	38	69	22													2.8
350	40	90	47	5												3.9
	19.1	55.7	21.2	3.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

NO. OF RECORDS 4645
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 141

Direction Data Suspect
Site 6/10 m depth

8697_2/
start date 1987 9 27 11 20 0 stop date is 1987 10 17 18 30 0

	speed(m/s)														
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60
DIR															PERCENT
0															0.0
10					1										0.0
20															0.0
30															0.0
40															0.0
50															0.0
60															0.0
70															0.0
80															0.0
90															0.0
100															0.0
110															0.0
120															0.0
130															0.0
140															0.0
150	1														0.0
160															0.0
170															0.0
180															0.0
190															0.0
200															0.0
210															0.0
220															0.0
230															0.0
240															0.0
250															0.0
260		1													0.0
270		1													0.0
280			2												0.1
290		2	1												0.1
300	1	5													0.2
310		35	1												1.3
320	35	142	82	38	8	3									11.0
330	278	434	408	341	364	257	83	24	11						78.6
340	62	59	18	21	20	20	23	9	6						8.5
350	1					1									0.1
	13.5		18.3		14.0		3.8		0.6		0.0		0.0		0.0
		24.3		14.3		10.0		1.2		0.0		0.0		0.0	

NO. OF RECORDS 2799
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 125

Site 6/20 m depth

8695_2
start date 1987 9 27 11 20 0 stop date is 1987 10 17 18 30 0

	speed(m/s)															
	0.02 TO 0.04	0.04 TO 0.08	0.08 TO 0.12	0.12 TO 0.16	0.16 TO 0.20	0.20 TO 0.24	0.24 TO 0.28	0.28 TO 0.32	0.32 TO 0.36	0.36 TO 0.40	0.40 TO 0.44	0.44 TO 0.48	0.48 TO 0.52	0.52 TO 0.56	0.56 TO 0.60	
DIR																PERCENT
0	8	11	10	5	4											1.4
10	9	8	15	1												1.2
20	6	10	7													0.8
30	5	13	21													1.4
40	7	13	13													1.2
50	4	19	11													1.2
60	6	9	8													0.8
70	9	15	4	2												1.1
80	11	15	1													1.0
90	10	6	4													0.7
100	4	14	4													0.8
110	12	16	10	4												1.5
120	13	27	7	3												1.8
130	13	17	2	4												1.3
140	21	17	4	2												1.6
150	17	29	8	2												2.0
160	10	25	12	4	2											1.9
170	7	27	10		3											1.7
180	12	21	9	7	2											1.9
190	17	30	8	5	9	1	1									2.6
200	13	37	14	4	32	11	1									4.1
210	19	46	18	4	16	9	1									4.1
220	26	40	16	21	20	25	8									5.7
230	18	21	13	40	42	56	31	4								8.2
240	6	20	28	33	72	47	35	5								9.0
250	7	30	31	51	62	52	14	4								9.2
260	12	31	35	40	64	70	3	2								9.4
270	12	28	24	19	29	29	5									5.3
280	2	21	19	12	9	20	4									3.2
290	9	15	18	8	5	8	3									2.4
300	11	17	11	4	4	3	4									2.0
310	5	13	13	2	4	7	2									1.7
320	6	28	9	1	4	5	4	1								2.1
330	6	23	14	3	4	3	5									2.1
340	5	19	11	4	2	3	1									1.6
350	7	21	6	5	4	1										1.6
	13.3	27.5	16.4	10.6	14.4	12.8	4.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

NO. OF RECORDS 2736
NO. OF RECORDS BELOW STALL SPEED (0.02 m/s) 188