FIELD PROGRAM REPORT

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SEDIMENT STABILITY MONITORING - COHASSETT SITE A-52

by

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1.0 ABSTRACT

The Cohasset A-52 drill site of Petro-Canada is situated in 34 m of water approximately 25 km southwest of Sable Island (lat: 43-51-09N; long:60-37-44W; see fig.1). It is located south of West Bar in an area dominated by shoreface-connected ridges. The drill rig Rowan Gorilla 1 was situated on the south flank of such a shoreface ridge during drilling operations of January - March, 1986. The local bed dips at a slope of approximately 3 degrees to the south and is composed of medium - coarse size siliceous sand. Seismic data suggests that this sand ridge has migrated to the south in modern times. Thus the Cohasset site appears to be a region of net-sand infilling. The site is intermittantly rippled and mega-rippled by waves and currents. Sand transport and scouring around the spud cans is considered by the diving observers, Wolf Sub-Ocean Ltd., to be significant. This is thought to be due to winter storm-driven currents and wave motion. The Geological Survey of Canada was invited by Petro-Canada Ltd. to carry out a joint study on the transport of sand at the Cohasset site in order to assess seabed erosion and deposition and the conditions under which sand transport takes place. Six (6) storm events were experienced during this study. The most severe wave conditions of the study were experienced during our arrival at the rig. During the subsequent detection period the most severe conditions experienced were:

MAXIMUM SIGNIFICANT WAVE HEIGHT............ 4.5 m
MAXIMUM MEAN WAVE PERIOD.................... 7.2 s
MAXIMUM NEAR BED CURRENT.................... 0.8 m/s
MAXIMUM WIND SPEED.......................... 27 m/s

Sand was seen in suspension, the bed was covered with hummocky megaripples and scouring around the spud cans was taking place at the time of our arrival; that is during the passage of storm 1. Despite the passage of several subsequent storms active suspended sediment transport of sand was detected only under storm 6. The prevailing direction of net sediment tranport appears to be to the west. Transport took place predominantly as bedload. Wave and current formed ripples were detected during each of the UFO dives. These appeared to change size and orientation from dive to dive, and illustrated bedload transport of sand under storms 2 - 6. The majority (90%) of the suspended particulate matter detected in the sampling program was organic. Diatoms, organic detritus and pellets were suspended by wave motion during the middle four storms of the study: 30 January, 2 February, 5 February and 6 February, 1986. Minor amounts (< 10%) of fine-grain sand were sampled throughout the study, but appeared to bear no relationship to wave or current strength. Sand was suspended during storms 1 and 6 which occurred on 29 January and 10 February, 1986. It is concluded that the natural seabed is stable under the storm conditions 2 - 5 observed during this study. It is also concluded that active transport of bottom sediment (mean diameter - 0.4 mm) took place during the storm 1 (of the 29 January, 1986). Threshold conditions for sand suspension were exceeded during this storm and were barely reached during storm 6. Megaripples are intermittantly present. They form and are destroyed within days of the passage of storms.

2.0 LIST OF CONTENTS

	PAGE
1.0 ABSTRACT	1
2.0 LIST OF CONTENTS	2
3.0 SUMMARY SHEET	3
4.0 ITINERARY	4
5.0 DESCRIPTION OF METHODS	8
5.1 WATER SAMPLING	8
5.2 TRANSMITTANCE MEASUREMENTS	8
5.3 CURRENT MONITORING	9
5.3.1 PROFILING DATA	9
5.3.2 BURST SAMPLE DATA	9
5.4 WAVE MONITORING	10
5.5 ATMOSPHERIC DATA	10
5.6 TIME LAPSE CAMERA	10
5.7 UFO VIDEO	11
5.8 BOTTOM SAMPLING	11
6.0 RESULTS	11
7.0 INTERPRETATIONS	16
8.0 RECOMMENDATIONS	17
9.0 ACKNOWLEDGEMENTS	18

3.0 JOB SUMMARY SHEET

ROWAN GORILLA 1 - SEDIMENT STABILITY STUDY

LOCATION: LATITUDE.. 43-51-09N LONGITUDE.. 60-37-44W

WATER DEPTH:........................ 34 m

STUDY DURATION:..................... 15 days

STUDY START:........................ 29 January, 1986

STUDY TERMINATION:.................. 13 February, 1986

NUMBER OF BOTTLE CASTS:............. 39

NUMBER OF CURRENT PROFILES:......... 37

NUMBER OF BOTTOM SAMPLES:........... 1

NUMBER OF TIME LAPSE ROLLS:......... 11

NUMBER OF UFO VIDEO DIVES........... 53

NUMBER OF ATTENUANCE TIME SERIES:... 60

BURST SAMPLER DEPLOYMENT TIME:...... 3 days

S-4 761:DEPLOYED.. 1430, 10 FEB. RECOVERED.. 1630, 12 FEB

S-4 759:DEPLOYED.. 1420, 10 FEB. RECOVERED.. 1600, 12 FEB

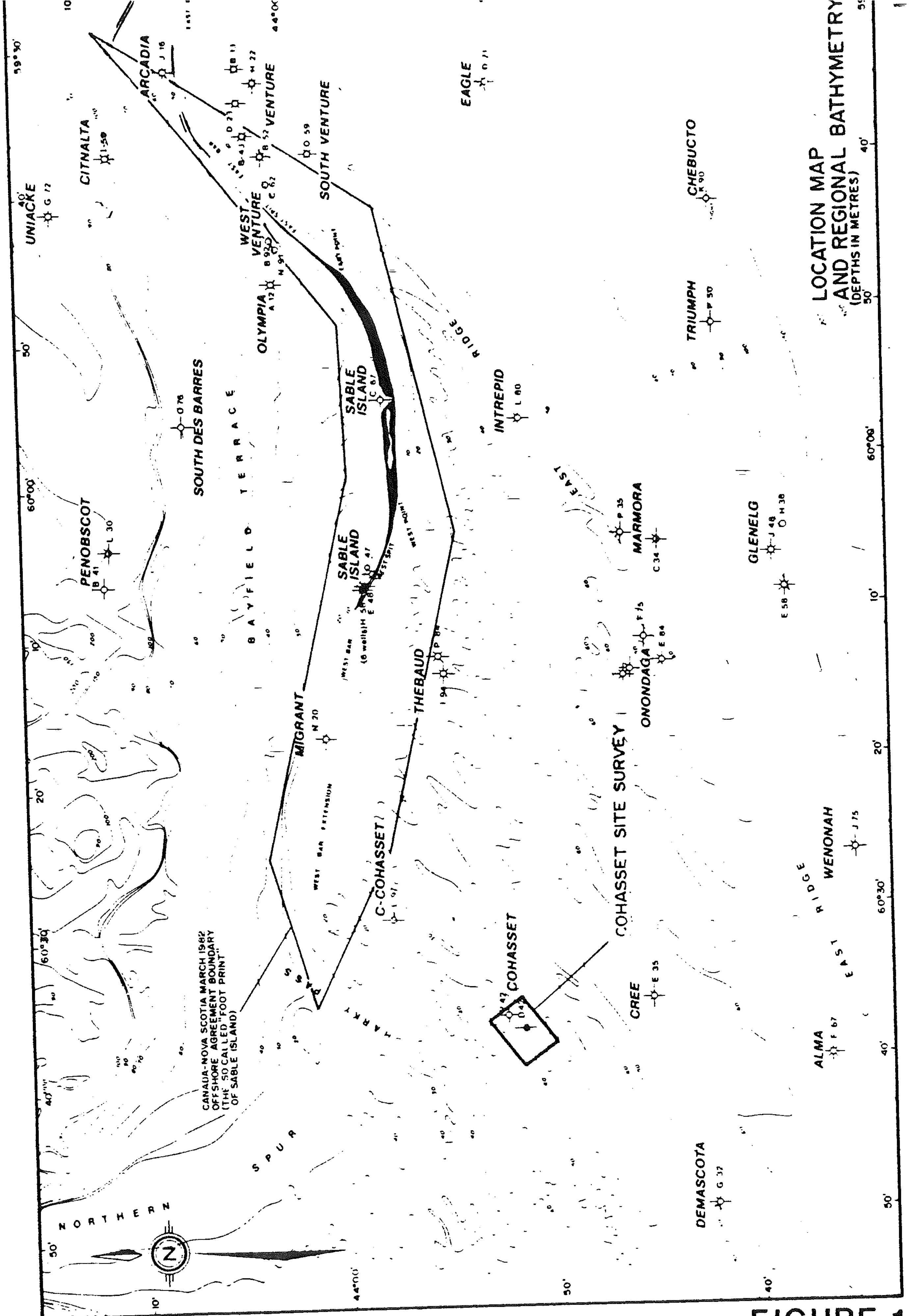
NUMBER OF STORMS................ 6

MAXIMUM SIGN. WAVE HEIGHT....... 4.5 m

MAXIMUM MEAN WAVE PERIOD........ 7.2 s

MAXIMUM NEAR-BED CURRENT........ 0.8 m/s

MAXIMUM WIND SPEED.............. 27 m/s



LOCATION MAP
AND REGIONAL BATHYMETRY
(DEPTHS IN METRES)
COHASSET SITE SURVEY
CANADA-NOVA SCOTIA MARCH 1982 OFFSHORE AGREEMENT BOUNDARY (THE SO CALLED "FOOT PRINT" OF SABLE ISLAND)
UNIACKE
CITNALTA
ARCADIA
VENTURE
SOUTH VENTURE
WEST VENTURE
EAGLE
CHEBUCTO
OLYMPIA
SABLE ISLAND
SOUTH DES BARRES
BAYFIELD TERRACE
INTREPID
RIDGE
EAST
TRIUMPH
PENOBSCOT
MARMORA
GLENELG
THEBAUD
ONONDAGA
MIGRANT
C-COHASSET
COHASSET
CREE
WENONAH
EAST RIDGE
ALMA
DEMASCOTA
NORTHERN SPUR
WEST BAR EXTENSION

FIGURE 1

4.0 ITINERARY

TIME(GMT)	DATE	OPERATION
1130	29 JAN. 86	TO SEALAND HELICOPTER HANGER
1230	29 JAN. 86	FLIGHT TO ROWAN GORILLA 1
1330	29 JAN. 86	ARRIVE AT RIG
1600	29 JAN. 86	CURRENT METER PROFILE 1
1600	29 JAN. 86	MOVE CONTAINER TO STARBOARD LOCATION
1700	29 JAN. 86	CURRENT METER PROFILE 2
1800	29 JAN. 86	CURRENT METER PROFILE 3
1900	29 JAN. 86	CURRENT METER PROFILE 4
2000	29 JAN. 86	CURRENT METER PROFILE 5
2100	29 JAN. 86	CURRENT METER PROFILE 6
		SET-UP OF WINCHES AND LAB
1130	30 JAN. 86	BLOWN HYDRAULIC HOSE ON WINCH
1200	30 JAN. 86	CURRENT METER PROFILE 7
1300	30 JAN. 86	CURRENT METER PROFILE 8
1415	30 JAN. 86	CAST 1 (6 BOTTLES)
1500	30 JAN. 86	CURRENT METER PROFILE 9
1730	30 JAN. 86	CAST 2 (6 BOTTLES)
1800	30 JAN. 86	CURRENT METER PROFILE 10
2100	30 JAN. 86	CURRENT METER PROFILE 11
2045	30 JAN. 86	CAST 3 (2 BOTTLES)
0000	31 JAN. 86	CAST 4 (2 BOTTLES)
1030	31 JAN. 86	CAST 5 (2 BOTTLES)
1200	31 JAN. 86	CURRENT METER PROFILE 12
1230	31 JAN. 86	CAST 6 (4 BOTTLES)
1315	31 JAN. 86	RE-INITIALISE S4-761
1409	31 JAN. 86	RE-INITIALISE S4-759
1500	31 JAN. 86	CURRENT METER PROFILE 13
1530	31 JAN. 86	S4-761 IN WATER
1730	31 JAN. 86	S4-759 IN WATER
1800	31 JAN. 86	CURRENT METER PROFILE 14
1800	31 JAN. 86	BOTTOM GRAB 1 (STBD MID-SHIPS)
1845	31 JAN. 86	CAST 7 (2 BOTTLES)
2100	31 JAN. 86	CURRENT METER PROFILE 15
0200	1 FEB. 86	TIME-LAPSE ROLL 1: TEST
1000	1 FEB. 86	CAST 8 (2 BOTTLES)
1200	1 FEB. 86	CURRENT METER PROFILE 16
1222	1 FEB. 86	START TIME-LAPSE ROLL 2
1300	1 FEB. 86	CAMERA IN WATER
1415	1 FEB. 86	CAST 9 (2 BOTTLES)
1500	1 FEB. 86	CURRENT METER PROFILE 17
1800	1 FEB. 86	ATTENUANCE METER IN WATER
1800	1 FEB. 86	CURRENT METER PROFILE 18
2100	1 FEB. 86	CURRENT METER PROFILE 19
0950	2 FEB. 86	ATTENUANCE TIME SERIES 3
1000	2 FEB. 86	CAST 10 (2 BOTTLES)
1100	2 FEB. 86	CAMERA RECOVERY
1110	2 FEB. 86	CAMERA FRAME DROPPED
1200	2 FEB. 86	CURRENT METER PROFILE 20
1300	2 FEB. 86	ATTENUANCE TIME SERIES 4
1400	2 FEB. 86	FRAME AND CAMERA RECOVERED BY WOLF SUB-OCEAN

TIME(GMT)	DATE	OPERATION
		TIME LAPSE ROLL 2 FULLY ADVANCED
1420	2 FEB. 86	ATTENUANCE TIME SERIES 5
1500	2 FEB. 86	CURRENT METER PROFILE 21
1645	2 FEB. 86	ATTENUANCE TIME SERIES 6
1648	2 FEB. 86	TIME LAPSE ROLL 3 STARTED
1735	2 FEB. 86	ATTENUANCE TIME SERIES 7
1800	2 FEB. 86	CAMERA FRAME IN WATER
1800	2 FEB. 86	CURRENT METER PROFILE 22
1835	2 FEB. 86	ATTENUANCE TIME SERIES 8
1840	2 FEB. 86	CAST 11 (2 BOTTLES)
1935	2 FEB. 86	ATTENUANCE TIME SERIES 9
2040	2 FEB. 86	ATTENUANCE TIME SERIES 10
2100	2 FEB. 86	CURRENT METER PROFILE 23
2115	2 FEB. 86	CAST 12 (2 BOTTLES)
2250	2 FEB. 86	CAST 13 (2 BOTTLES)
0200	3 FEB. 86	CAST 14 (2 BOTTLES)
1100	3 FEB. 86	CAST 15 (2 BOTTLES)
1115	3 FEB. 86	ATTENUANCE METER PROFILE 13
1130	3 FEB. 86	RECOVER CAMERA FRAME
		TIME LAPSE ROLL 3 FULLY ADVANCED
1200	3 FEB. 86	CURRENT METER PROFILE 24
1330	3 FEB. 86	TIME LAPSE ROLL 4 STARTED
1400	3 FEB. 86	CAMERA FRAME IN WATER
1500	3 FEB. 86	CURRENT METER PROFILE 25
1513	3 FEB. 86	ATTENUANCE METER PROFILE AND TIME SERIES 14
1800	3 FEB. 86	CURRENT METER PROFILE 26
1820	3 FEB. 86	ATTENUANCE METER TIME SERIES 15
1845	3 FEB. 86	BOTTLE CAST 16 (2 BOTTLES)
2000	3 FEB. 86	ATTENUANCE TIME SERIES 16
2055	3 FEB. 86	ATTENUANCE TIME SERIES 17
2100	3 FEB. 86	CURRENT METER PROFILE 27
2115	3 FEB. 86	ATTENUANCE TIME SERIES 18
2130	3 FEB. 86	BOTTLE CAST 17 (2 BOTTLES)
2315	3 FEB. 86	ATTENUANCE TIME SERIES 19
1005	4 FEB. 86	ATTENUANCE TIME SERIES 20
1010	4 FEB. 86	BOTTLE CAST 18 (2 BOTTLES)
1130	4 FEB. 86	RECOVER CAMERA FRAME
		TIME LAPSE 4 FULLY ADVANCED
1200	4 FEB. 86	CURRENT METER PROFILE 28
1215	4 FEB. 86	TIME LAPSE ROLL 5 STARTED
1300	4 FEB. 86	CAMERA FRAME IN WATER
1405	4 FEB. 86	ATTENUANCE TIME SERIES 21
1500	4 FEB. 86	CURRENT METER PROFILE 29
1515	4 FEB. 86	BOTTLE CAST 19 (2 BOTTLES)
1525	4 FEB. 86	ATTENUANCE TIME SERIES 22
1750	4 FEB. 86	ATTENUANCE TIME SERIES 23
1800	4 FEB. 86	CURRENT METER PROFILE 30
1830	4 FEB. 86	BOTTLE CAST 20 (2 BOTTLES)
2045	4 FEB. 86	ATTENUANCE TIME SERIES 24
2100	4 FEB. 86	CURRENT METER PROFILE 31
2300	4 FEB. 86	ATTENUANCE TIME SERIES 25
1145	5 FEB. 86	CAST 21 (2 BOTTLES)
1155	5 FEB. 86	ATTENUANCE TIME SERIES 26

TIME(GMT)	DATE	OPERATION
1200	5 FEB. 86	CURRENT METER PROFILE 32
1230	5 FEB. 86	CAMERA FRAME INBOARD
		TIME LAPSE ROLL 5 FULLY ADVANCED
1355	5 FEB. 86	ATTENUANCE TIME SERIES 27
1400	5 FEB. 86	TIME LAPSE ROLL 6 STARTED
1415	5 FEB. 86	CAMERA FRAME IN WATER
1500	5 FEB. 86	CURRENT METER PROFILE 33
1535	5 FEB. 86	ATTENUANCE TIME SERIES 28
1700	5 FEB. 86	ATTENUANCE TIME SERIES 29
1715	5 FEB. 86	CAST 22 (2 BOTTLES)
1800	5 FEB. 86	CURRENT METER PROFILE 34
1830	5 FEB. 86	ATTENUANCE TIME SERIES 30
1945	5 FEB. 86	CAST 23 (2 BOTTLES)
1949	5 FEB. 86	ATTENUANCE TIME SERIES 31
2100	5 FEB. 86	CURRENT METER PROFILE 35
2100	5 FEB. 86	ATTENUANCE TIME SERIES 32
2130	5 FEB. 86	CAST 24 (2 BOTTLES)
2300	5 FEB. 86	ATTENUANCE TIME SERIES 33
2320	5 FEB. 86	CAST 25 (2 BOTTLES)
0100	6 FEB. 86	ATTENUANCE TIME SERIES 34
0110	6 FEB. 86	CAST 26 (2 BOTTLES)
0200	6 FEB. 86	ATTENUANCE TIME SERIES 35
0205	6 FEB. 86	CAST 27 (2 BOTTLES)
0300	6 FEB. 86	ATTENUANCE TIME SERIES 36
0305	6 FEB. 86	CAST 28 (2 BOTTLES)
0400	6 FEB. 86	ATTENUANCE TIME SERIES 37
1200	6 FEB. 86	ATTENUANCE TIME SERIES 38
1200	6 FEB. 86	CURRENT METER PROFILE 36
1245	6 FEB. 86	CAST 29 (2 BOTTLES)
1345	6 FEB. 86	CAMERA FRAME INBOARD
		TIME LAPSE ROLL 6 FULLY ADVANCED
1410	6 FEB. 86	TIME LAPSE ROLL 7 STARTED
1430	6 FEB. 86	CAMERA FRAME IN WATER
1443	6 FEB. 86	ATTENUANCE TIME SERIES 39
1535	6 FEB. 86	ATTENUANCE TIME SERIES 40
1710	6 FEB. 86	ATTENUANCE TIME SERIES 41
1735	6 FEB. 86	CAST 30 (2 BOTTLES)
1800	6 FEB. 86	ATTENUANCE TIME SERIES 42
1850	6 FEB. 86	ATTENUANCE TIME SERIES 43
1900	6 FEB. 86	MALFUNCTION OF NEIL BROWN METER
2000	6 FEB. 86	ATTENUANCE TIME SERIES 44
2100	6 FEB. 86	ATTENAUNCE TIME SERIES 45
2245	6 FEB. 86	ATTENUANCE TIME SERIES 46
2300	6 FEB. 86	CAST 31 (1 BOTTLE)
0140	7 FEB. 86	ATTENUANCE TIME SERIES 47
0150	7 FEB. 86	ATTENUANCE TIME SERIES 48
1200	7 FEB. 86	ATTENUANCE TIME SERIES 49
1200	7 FEB. 86	CURRENT METER PROFILE 37
1340	7 FEB. 86	ATTENUANCE TIME SERIES 50
1130	7 FEB. 86	CAMERA FRAME INBOARD
		TIME LAPSE ROLL 7 FULLY ADVANCED
1230	7 FEB. 86	CAST 32 (2 BOTTLES)
1400	7 FEB. 86	TIME LAPSE ROLL 8 STARTED

TIME(GMT)	DATE	OPERATION
1430	7 FEB. 86	CAMERA FRAME DROPPED OVERBOARD
		CAMERA BROKEN FROM FRAME
1735	7 FEB. 86	ATTENUANCE TIME SERIES 51
1830	7 FEB. 86	ATTENUANCE TIME SERIES 52
2000	7 FEB. 86	CAMERA AND FRAME RECOVERED
2005	7 FEB. 86	ATTENUANCE TIME SERIES 53
2230	7 FEB. 86	ATTENUANCE TIME SERIES 54
1115	8 FEB. 86	ATTENUANCE TIME SERIES 55
1200	8 FEB. 86	TIME LAPSE ROLL 8 FULLY ADVANCED
1220	8 FEB. 86	ATTENUANCE TIME SERIES 56
1240	8 FEB. 86	TIME LAPSE ROLL 9 STARTED
1300	8 FEB. 86	CAMERA IN WATER ON NEW FRAME
1450	8 FEB. 86	ATTENUANCE TIME SERIES 57
1700	8 FEB. 86	ATTENUANCE TIME SERIES 58
1710	8 FEB. 86	BOTTLE CAST 33 (2 BOTTLES)
1905	8 FEB. 86	ATTENUANCE TIME SERIES 59
1100	9 FEB. 86	ATTENUANCE TIME SERIES 60
1130	9 FEB. 86	CAMERA FRAME ON BOARD
		TIME LAPSE ROLL 9 FULLY ADVANCED
1140	9 FEB. 86	CURRENT METER S4 - 759 ONBOARD
1140	9 FEB. 86	ATTENUANCE METER ONBOARD
1415	9 FEB. 86	TIME LAPSE ROLL 10 STARTED
1800	9 FEB. 86	CURRENT METER S4 - 761 ONBOARD
1115	10 FEB. 86	CAST 34 (1 BOTTLE)
1220	10 FEB. 86	CAMERA FRAME INBOARD
1230	10 FEB. 86	S4 - 759 INITIALISED AND START LOGGING
1230	10 FEB. 86	S4 - 761 INITIALISED AND START LOGGING
1400	10 FEB. 86	CAMERA FRAME IN WATER
1420	10 FEB. 86	S4 - 761 IN WATER
1430	10 FEB. 86	S4 - 759 IN WATER
1500	10 FEB. 86	CAST 35 (2 BOTTLES)
1900	10 FEB. 86	CAST 36 (1 BOTTLE)
2300	10 FEB. 86	CAST 37 (1 BOTTLE)
0115	11 FEB. 86	CAST 38 (2 BOTTLES)
1100	11 FEB. 86	CAMERA FRAME INBOARD
		TIME LAPSE ROLL 11 FULLY ADVANCED
1130	11 FEB. 86	CAST 39 (2 BOTTLES)
1600	12 FEB. 86	S4 - 759 RECOVERED
1630	12 FEB. 86	S4 - 761 RECOVERED

5.0 DESCRIPTION OF METHODS

5.1 WATER SAMPLING

Samples of the water column were taken at regular intervals in order to determine the concentration of suspended solids per unit volume of water mass. Samples were collected using five litre Niskin samplers deployed on 1/4 inch kevlar cable on a 25 hp Swann winch. The volume and deployment heights of the water samplers (above the seabed) were as follows:

BOTTLE #	HEIGHT (m)	VOLUME (litres)
1	21	5.750
2	11	5.840
3	6	5.754
4	1	5.785

The relative height above the seabed was determined by lowering an 80 kg weight to the seabed and raising it to the appropriate height. Bottles were raised and lowered 0.3 m during triggering in order to avoid settling of the sand-size fraction within the water bottle micro-environment.

Samples were drained fully and the bottles washed in order to capture any sand particles which might have settled within the trapped water samples. The water was passed through an 8 inch (44 micron) Canadian Standard mesh sieve in order to retain the sand and coarse silt. The residue was washed with fresh, tap water and transferred to pre-weighed dishes. The samples were dried and weighed to determine gravimetrically mass per unit volume. The samples were weighed using a Mettler PK 300 digital balance and dried in a Fisher Junior Drying Oven. The dried samples were examined under a Wild binoccular microscope in order to determine composition of the trapped material and the nominal diameter of the inorganic suspended particulate matter.

All samples were retained in 40 dram vials for further inspection.

5.2 TRANSMITTANCE MEASUREMENTS

Vertical profiles and time series 0.5 m above the seabed were periodically made of light transmittance to interpolate between water sampling. A Seatech inc. beam transmissometer was used for this purpose. The instrument has a path length of 0.25 m and beam diameter of 15 mm. It generates a laser light beam at a frequency of 660 nm (red)from an LED. It operates on a power supply of 15 volts D.C. at a current of 0.1 amps. The meter measures light transmittance to an accuracy of +/- 0.5 % over a range of 0 - 100 %. The signal output varies from 0 (0 % transmittance) to 5 (100 % transmittance) volts D.C. The instrument weighs 2.92 kg in air and is 0.75 m in length. It was fitted to a bridle and weighted to measure in a horizontal orientation at a height of 0.5 m above the seabed. The instrument was hand deployed from the starboard side of the rig approximately mid-ship. The height of the unit above the bed was between 0.5 and 1.0 m, and was verified daily by UFO 311 inspection.

5.3 CURRENT MONITORING

Currents were measured in two modes: burst sample mode and time-averaged mode.

5.3.1 PROFILING DATA

Time-averaged current speed and direction were recorded in real time using a Neil Brown Instrument Systems inc. Direct Reading Current Meter. The instrument measures current speed and direction based on the doppler shift in the transmission of sound in two verical orthogonal planes, which resolve current velocity in the horizontal plane. The instrument also records temperature, pressure and conductivity. The instrument was situated at the bow of the rig on the starboard side. It was situated approximately 3 m from the bow leg spud can. Data were logged in two modes: hourly readings of current velocity at a height of 2 m above the bed; and readings at heights of 7, 12, 17, 22, 27 and 32 m at the following times 12:00, 15:00, 18:00 and 21:00 (GMT).

The following parameters were recorded during this part of the program:

CURRENT SPEED (m/s)
CURRENT DIRECTION (T)
DEPTH (m)
TEMPERATURE (C)
CONDUCTIVITY (mohms)
SALINITY (ppt)
METER TILT (T)

Data were recorded in real time from the Current Meter Data Terminal located in the rig control room. The velocity values are the averages of a 60 second integration of data at a sample rate of 5 Hz.

Current profiling was terminated on 7 February, 1986 due to a malfunction of the meter during winch operation. Subsequently readings were taken hourly at 2 m above the bed.

5.3.2 BURST SAMPLE DATA

Burst sample data were collected using 2 InterOcean S4 current meters. The S4 instrument is designed to measure two orthogonal horizontal components of flow. The current is detected by a change in voltage associated with the deflection of a magnetic field created by the meter. The instruments also measure conductivity, temperature and depth. Data are recorded internally on solid state memory boards. A maximum of 265 k bytes of data can be stored in available memory.

The instruments used were deployed on frames which positioned the sensors 0.5 m above the bed. The following were the pre-programmed instrument settings:

SERIAL NUMBER:	04410759	044410761
SAMPLE RATE:	1 Hz	1 Hz
SAMPLE INTERVAL:	30 minutes	3 hours
SAMPLE LENGTH:	60 seconds	57 minutes
START TIME(GMT):	12:30	12:30
START DATE:	10 Feb. 86	10 Feb. 86
SAMPLE TIME(GMT):	12:30	12:30
DATE IN WATER:	10 Feb. 86	10 Feb. 86
TIME IN WATER(GMT):	14:30	14:20
DATE OUT OF WATER:	12 Feb. 86	12 Feb. 86
TIME OUT OF WATER(GMT):	16:00	16:30

The instruments were deployed in a water depth of 34 m on the starboard side of the rig. The instruments were situated approximately 40 m from the rig spud cans.

The instruments failed to log during the initial deployment between 31 January and 9 February, 1986.

5.4 WAVE MONITORING

Wave data were supplied by MacLaren-Plansearch Ltd. who were contracted by Petro-Canada as environmental observers. Wave parameters were determined from a Datawell Wave rider buoy situated approximately 1600 m from the rig on a bearing of 272 degrees true and in a water depth of 34 m. Wave direction was determined by visual observation from the rig. The following data were recorded hourly:

SIGNIFICANT WAVE HEIGHT (m)
MAXIMUM WAVE HEIGHT (m)
PEAK PERIOD (s)
DIRECTION OF PROPAGATION (T).

5.5 ATMOSPHERIC DATA

Atmospheric data were collected by MacLaren-Plansearch Ltd. Wind data were collected using a Bendix Freiz 135 Aerovane Indicator. The vane was located at a height of 110 m above sealevel. The following parameters were noted at hourly intervals:

ATMOSPHERIC PRESSURE (mbars)
WIND SPEED (m/s) AT A HEIGHT OF 110 m ABOVE SEALEVEL
WIND DIRECTION FROM (T).

A more detailed description of this data set is available in MacLaren-Plansearch Ltd.(1986) report to Petro-Canada Ltd.

5.6 TIME LAPSE CAMERA

A standard Canon super - 8 movie camera was used with standard Kodak 4XR 464 film. The film is black and white 4-X reversal film 7277 which is 15 m long and has approximately 3500 frames. The ASA rating of the film was 400. The camera was equipped with a timing unit to allow exposure at intervals of 10 seconds. At this firing rate a roll of film advances fully in 10 hours. The focal length of the camera lens was approximately 35 mm in water. The camera was driven by a 9 volt battery and used ambient light to expose the film. The camera was mounted in a 9 inch O.D. aluminium housing which was bolted to a stainless steel frame which weighed 1200 lbs in air (rolls 2 - 8). A smaller frame was also used in the latter part of the program (rolls 9 - 11). The camera was positioned at a 45 degree angle from the horizontal and imaged an area of approximately 6 m^2 at a distance of approximately 4 m.

The frame was deployed from the starboard side of the rig approximately 20 m outboard. The frame was raised and lowered using the AGC Swann 25 hp winch and boomed outboard using the rig crane.

5.7 UFO VIDEO

Wolf Sub-Ocean Ltd. were contracted by Petro-Canada to provide the daily inspections of the spud cans and any scouring of the seabed around the rig. The UFO 311, a tethered unmanned submersible, was used to make the inspections. The UFO is equipped with an Osprey SIT low-light video camera which was used to record all dives made. The camera lens was wide angle (110 degrees) and was mounted for tilt. The video records were used to obtain information on the following items:

DISTRIBUTION AND TYPE OF BEDFORMS
MAGNITUDE AND DIRECTION OF BOTTOM CURRENTS
ACTIVITY OF BOTTOM SEDIMENTS
SUSPENDED SEDIMENT CONCENTRATION
STATUS AND ORIENTATION OF TIME-LAPSE CAMERA, CURRENT METERS AND ATTENUANCE METERS.

5.8 BOTTOM SAMPLING

A seabed sample was taken from the starboard side of the rig in order to determine the grain size and mineralogy of the bottom sediment. Suspended material, collected during the water sampling program, were compared to the bottom sediment in order to determine the likely origin of the material in transport.

6.0 RESULTS

6.1 GENERAL

All operations aboard the rig were successful. Deployment, recovery and analysis of equipment and results were well integrated and from an operational standpoint are considered successes. The study demonstrates that routine observations collected aboard the rig during drilling can be integrated with seabed monitoring in order to provide a data set essential to the evaluation of seabed stability and the sediment transport phenomenon. The time series of the data collected are shown in figure 2. A number of modifications and improvements to the study are recommended at the end of this report.

Six storms were monitored in this study. These storms were in general short-lived and of low intensity. Monitoring was continuous throughout the storms. Weather and sea-state did not significantly hamper operations. The major characteristics of the six storms are listed below.

STORM..... 1
STORM DATE: 29 January, 1986
STORM PEAK TIME (GMT): 1000
STORM DURATION: 10 hours
PEAK WIND SPEED: 19.5 m/s
WIND DIRECTION FROM: 250 T
PEAK CURRENT SPEED:---
PEAK SIGN. WAVE HEIGHT: 6.6 m
PEAK WAVE PERIOD: 9.4 seconds

STORM..... 2
STORM DATE: 30 January, 1986
STORM PEAK TIME (GMT): 2100
STORM DURATION: 11 hours
PEAK WIND SPEED: 27 m/s
WIND DIRECTION FROM: 180 T
PEAK CURRENT SPEED: 0.37 m/s
PEAK SIGN. WAVE HEIGHT: 2.7 m
PEAK MEAN PERIOD: 6.1 seconds

STORM..... 3
STORM DATE: 2 - 3 February, 1986
STORM PEAK TIME (GMT): 0200, 3 February, 1986
STORM DURATION: 16 hours
PEAK WIND SPEED: 23 m/s
WIND DIRECTION FROM: 130 T
PEAK CURRENT SPEED: 0.42 m/s
PEAK SIGN. WAVE HEIGHT: 3.7 m
PEAK MEAN PERIOD: 6.0 seconds

STORM..... 4
STORM DATE: 5 February, 1986
STORM PEAK TIME (GMT): 1900
STORM DURATION: 14 hours
PEAK WIND SPEED: 24 m/s
WIND DIRECTION FROM: 160 T
PEAK CURRENT SPEED: 0.58 m/s
PEAK SIGN. WAVE HEIGHT: 3.2 m
PEAK MEAN PERIOD: 5.8 seconds

STORM..... 5
STORM DATE: 6 February, 1986
STORM PEAK TIME (GMT): 1800
STORM DURATION: 16 hours
PEAK WIND SPEED: 23 m/s
WIND DIRECTION FROM: 330 T
PEAK CURRENT SPEED: 0.61 m/s
PEAK SIGN. WAVE HEIGHT: 4.5 m
PEAK MEAN PERIOD: 6.9 seconds

STORM..... 6
STORM DATE: 9 - 10 February, 1986
STORM PEAK TIME (GMT): 1000, 10 February, 1986
STORM DURATION: 38 hours
PEAK WIND SPEED: 22.5 m/s
WIND DIRECTION FROM: 130 T
PEAK CURRENT SPEED: 0.77 m/s
PEAK SIGN. WAVE HEIGHT: 4.4 m
PEAK MEAN PERIOD: 7.2 s

6.2 WATER SAMPLING

Five litre water samples were collected routinely from heights of 1 and 6 m above the seabed. Under background conditions very little inorganic particulate matter was suspended in the water column. The suspended sediment concentration (SSC) was less than 2 mg/l and was composed principally (> 90%) of diatoms, and phytoplankton. SSC was in general greatest closest to the seabed. In this region particles of organic detritus and fecal pellets were suspended during storms. The greatest abundance of sand particles occurred in the nearbed zone. These particles were predominantly less than 0.2 mm in diameter. The greatest SSC was sampled in cast 5. It is noted that both the waves and currents were low at this time. The high values of this cast are considered to be due to the bottles hitting the seabed and thus becoming contaminated. This was carefully avoided in subsequent casts. During periods of high current speed (> 0.5 m/s) sand 0.1 mm in diameter was found in suspension. Significant amounts of sand (0.3 - 0.4 mm grain diameter) were detected in suspension at the end of storm 6. These particles were similar in size, shape and composition to local bed material. The conditions at the end of this storm may well correspond to threshold conditions for the suspension of 0.3 - 0.4 mm sand.

Prior to 8 February, 1986 there was an abundance of diatoms and phytoplankton in the water column. Subsequently, the water was relatively clear and comprised particles of inorganic sediment and organic detritus. The organic matter was associated with a water mass of salinity greater than 32 ppt and at a temperature between 2.5 and 3.0 C. The clearer water was at a salinity of 31.8 ppt and at a temperature between 0.5 - 1.7 C.

6.3 ATTENUANCE MEASUREMENTS

The attenuance meter provided instantaneous estimates of SSC and demonstrated short term fluctuations in turbidity. No obvious stratification of the water column was detected in the profile data. However, minor fluctuations in turbidity were observed during passage of waves of period greater than approximately 6 seconds. During the passage of a storm event turbidity generally increased. Organic matter was first suspended at the onset of a storm, followed by siliceous material 0.05 to 0.1 mm in diameter. Only during the most severe storm of the 29 January (storm 1) and 9 - 10 February (storm 6) was 0.4 mm sand observed in suspension. Only a few grains of this diameter were detected and are not considered to be significant in the local sediment transport phenomenon. Turbidity increased to a maximum of 90% transmittance on 8 February 86. This is considered to be due to organic matter settling to the bed during relatively quiet conditions.

6.4 CURRENT MONITORING

The near-bed current meter time series are shown in figure 2. Currents were principally tidal and semi-diurnal. Maximum current speed was 0.7 m/s and the mean current speed was between 0.2 and 0.3 m/s. Current speed fluctuated greatly from hour to hour and from reading to reading. This is considered due in part to vortex shedding off the bow spud can, although wind driven flows are also significant. The direction of flow shows an anisotropic pattern to the north and south. Fluctuations in direction were principally the result of wind forcing. During periods of strong winds, reversals in flow direction were observed, even close to the seabed.

The profiling data showed the current velocity to be generally uniform throughout the water column. Fluctuations were detected in both speed and direction, but appeared to be random in depth and time.

The burst sample data is limited. Records are available for a 48 hour period at the end of the study. This data will be downloaded and analysed spectrally. No conclusions on this data set can be made at this time.

6.5 WAVE MONITORING

The largest waves were detected during our arrival at the rig. The significant wave height was 6.6 m and the period was 7.9 seconds. This was the result of the passage of storm 1. Five winter storms were monitored during the subsequent 14 day survey (see fig. 1). Wave conditions never exceeded the conditions experienced on our arrival. Typically, peak wave conditions occurred approximately 4 - 6 hours after the peak winds. The highest significant wave height during the monitoring program was measured in storm 5 and was 4.5 m. The greatest period was measured in storm 6 and was 7.2 seconds. The correlation between wave height and period was strong. The majority of the waves were locally generated, and were propagated in the direction of the wind. Only during the end of storm 6 did wave conditions exceed the threshold for the suspension of bottom 0.4 mm sand. This storm was not intense but lasted 38 hours. This demonstrates the effect of storm duration on sediment motion and the dominating influence of wave period on sand suspension.

6.6 ATMOSPHERIC DATA

The predominant wind direction was from the northwest and southeast. Despite the passage of five low pressure systems wind strength never exceeded 27 m/s 110 m above sealevel. The five storms were generally short-lived lasting between 10 and 36 hours. During the passage of each low pressure system the winds generally changed direction flattening the waves and reducing the wave period.

6.7 TIME LAPSE CAMERA

Full film exposures were obtained during 11 deployments. Roll

1 was a test roll exposed in the lab. All other rolls were deployed on the seabed. The details of these deployments are as follows:

ROLL #	REP RATE(s)	DEPLOYMENT DATE/TIME(GMT)	PEAK WAVE HT(m)/PER(s)	PEAK CURRENT SPEED(m/s)/DIR
1	10	0200, 1 FEB. 86	---	---
2	10	1300, 1 FEB. 86	2.6 / 5.6	0.38 / 200
3	10	1800, 2 FEB. 86	2.6 / 5.2	0.25 / 180
4	10	1400, 3 FEB. 86	3.7 / 6.8	0.38 / 200
5	10	1300, 4 FEB. 86	2.4 / 5.4	0.24 / 020
6	10	1415, 5 FEB. 86	3.1 / 5.7	0.24 / 000
7	10	1430, 6 FEB. 86	4.5 / 6.5	0.50 / 180
8	5	1430, 7 FEB. 86	2.7 / 5.5	0.53 / 270
9	10	1300, 8 FEB. 86	--- / 4.2	0.28 / 240
10	10	1400, 9 FEB. 86	3.0 / 6.0	0.77 / 270
11	10	1400, 10 FEB. 86	3.6 / 6.3	0.53 / 240

The films are being processed. Thus no conclusions are made on the quality or content of the time-lapse work.

6.8 UFO VIDEO

Spud can videos were recorded each day of the experiment. During each of the dives notes were taken on the degree of scouring around the spud can gear rails and on the distribution and type of bedforms in the immediate vicinity of the rig.

The following is a listing of the dives made during this study:

DIVE NUMBER	DATE	.....TIME (GMT)..... START	END	BEDFORM TYPE
44	4 FEB. 86	1700	1734	MEGARIPPLES
45	5 FEB. 86	1650	1730	RIPPLES
46	6 FEB. 86	1735	1815	RIPPLES
47	7 FEB. 86	2035	2130	RIPPLES
48	8 FEB. 86	1430	1515	RIPPLES
49	8 FEB. 86	1755	1930	RIPPLES
50	9 FEB. 86	1735	1915	RIPPLES
51	10 FEB. 86	1730	1830	RIPPLES
52	11 FEB. 86	1900	1930	RIPPLES
53	12 FEB. 86	1200	1330	RIPPLES

The local seabed is subject to wave and current formed ripples under almost all conditions monitored. Both types were observed on dives 44 - 52. They were sharp-crested and showed no evidence of degradation. Sand transport was evident in some of the videos, particularly around the spud cans where scouring was taking place on several occasions. This indicated that bedload transport of sand was taking place under prevailing conditions. Current formed ripples only were present during dive 53. This indicates that the threshold for bedload transport under waves was not exceeded that day, and that the wave formed ripples of the previous day were degraded within 16 hours.

Large scale bedforms were seen during one dive only. Hummocky megaripples, 1 - 2 m in wavelength and 0.1 m in height were seen during dive 44. These were not present during dive 45 which took place the following day. The divers reported that 2-D megaripples were observed on the seabed immediately after the storm of 15 - 16 January, 1986. These features were in the order of 1 m in height, and are the largest bedform reported from this site. They too were degraded within 24 hours. No storm ridges were observed to migrate through the region.

The water quality was variable. Organic matter was abundant from 29 January to 8 February, 1986. After this time, the water clarity was much greater. This was confirmed by water sampling.

The diversity and abundance of benthic fauna was low. Few sand dollars were seen. The degradation of bedforms is thus considered to be due to hydraulic rather than biological agents.

Mean sand transport direction can be determined by the shape of the spud can scours. This direction, based on observations of dive 51, was to the west. Partial infill of the scour pits was taking place by bedload transport during the period of detection. A planar slip face as a result of this transport was seen on the east side of some of the scour pits. The shape and size of the scours appears to be in balance between vortex shedding and suspension of sand during storms and infilling due to bedload transport during quieter conditions. At this site, and for the period of observation, the scouring process dominated.

7.0 INTERPRETATION

Sediment transport and seabed sediment motion takes place at the Cohasset A - 52 site. The observed sediment motion was low with the majority of the transport taking place as tractive load by the process of ripple migration. Suspension of the local sand, which is 0.4 mm in diameter, is intermittant. It takes place during storm conditions superimposed on the effects of tidal flow maxima. Two storms caused the suspension of 0.4 mm sand; storm 1 and 6. Threshold conditions for suspension were barely reached during storm 6.

The most significant event on sediment transport was storm 1. No quantitative measures of SSC were made, but UFO observations refer to the presence of large quantities of sand in suspension after this storm, which were not seen either after or before this storm event. Hummocky megaripples were also generated in storm 1. These features were subsequently destroyed by wave and current action within 24 hours.

No conclusions on the bedload transport rates and directions can be drawn at this time. Eleven time lapse films will be developed and analysed in order to derive tranport rates under 'fair-weather' conditions. A maximum transport volume can be estimated based on infill of the spud can scour pits. These were only partially infilled during fair-weather transport and suggests a volume transport much less than that of the scour pits. Video coverage could be used to estimate the volume infill.

Video observations indicate that bedforms are generated and destroyed within hours. One metre high 2-D megaripples were reported to be present during mid-January after the passage of a severe storm. These were subsequently destroyed within 24 hours presumeably by storm spin-down effects. The only other bedforms seen at the Cohasset site were wave and current formed ripples. These were almost always active and were oriented in the prevailing direction of the local tidal currents and wave-induced currents.

The prevailing direction of sediment transport, from the spud-can scours, appears to be to the west. That is parallel to the crest of the sand ridge immediately north of the drill site. This transport is in the direction of the maximum tidal flows. It is noted that the prevailing storm driven waves and currents move to the southeast. During severe storms this would cause sand transport and consequent ridge migration to the south. However, no evidence for a southward migration of the sand ridge was obtained during this survey.

It is possible from the results obtained to make some statements on the conditions under which megaripples are generated and destroyed, and the migration rates of ripples. It is also possible to evaluate threshold conditions for the traction and suspension of 0.4 mm sand. It is not possible to evaluate the magnitude of sand transport during storm conditions and the subsequent migration rate of sand ridges. To solve this problem it would be necessary to monitor sediment motion over a storm equivalent to, or more intense than that of 29 January, 1986.

8.0 RECOMMENDATIONS

This study is the first of its kind to be undertaken from an exploration drill rig on the Canadian continental shelf. Its purpose was to evaluate the stability and transport of bedforms in the vicinity of the Cohasset A - 52 site.

The study was considered a success from the standpoint of logistics and data collection. Unfortunatley, it did not answer the question on the migration rate of large scale sand ridges in the region. The reason for this is that high sediment transport appears associated with high-intensity, low-frequency storms. Such storms were not experienced during the 14 day study aboard the rig.

The following recommendations are made as a result of this study.

1. Similar measurements to those undertaken herein should be made to encompass severe winter storms. This may require continuous monitoring for up to 6 weeks to ensure that storms of adequate severity are sampled.

2. The study should be expanded to cover regions in differing water depths and differing grain sizes in order to assess the changes in these parameters within the Sable Island Bank region.

3. Pump sampling of water is recommended rather than discrete sampling using Nudsen bottles. This allows samples to be collected in a near

continuous fashion and from specific depth within 1 m of the bed. It is in this zone that most of the sand transport is presumed to take place. It also provides a larger water sample for analysis.

4. A high-resolution, low-light video camera mounted on a tripod is recommended instead of the conventional super - 8 camera. Real time monitoring could be achieved which would be of value in the design of a sampling strategy and in the evaluation of the generation of bedforms.

5. The time-averaging current meter was deployed within 3 m of the bow spud can. Considerable scatter in the data resulted from vortex shedding and flow accelerations around the cans. More representative results would be obtained if the meter were deployed away from the legs.

6. Comparisons should be made between free flow current velocity and the velocity fluctuations measured adjacent to the bow spud can. Spud can influences, and associated bed stresses could be evaluated. This would be of great value in the study of spud can scouring.

7. An analysis of the return interval of the storms experienced during this study should be made. To be of use in the future, the results obtained herein should be evaluated in terms of the probability and duration of re-occurrence.

8. The threshold conditions for sediment transport and the conditions for bedform genesis should be evaluated against currently existing numeric models of sediment transport.

9.0 ACKNOWLEDGEMENTS

The authors wish to express their gratitude for the co-operation received from the Rowan personnel during the study aboard the Rowan Gorilla 1. We also wish to extend our thanks to the Petro-Canada reps aboard the rig and in particular to Ken McDonald for his help throughout.

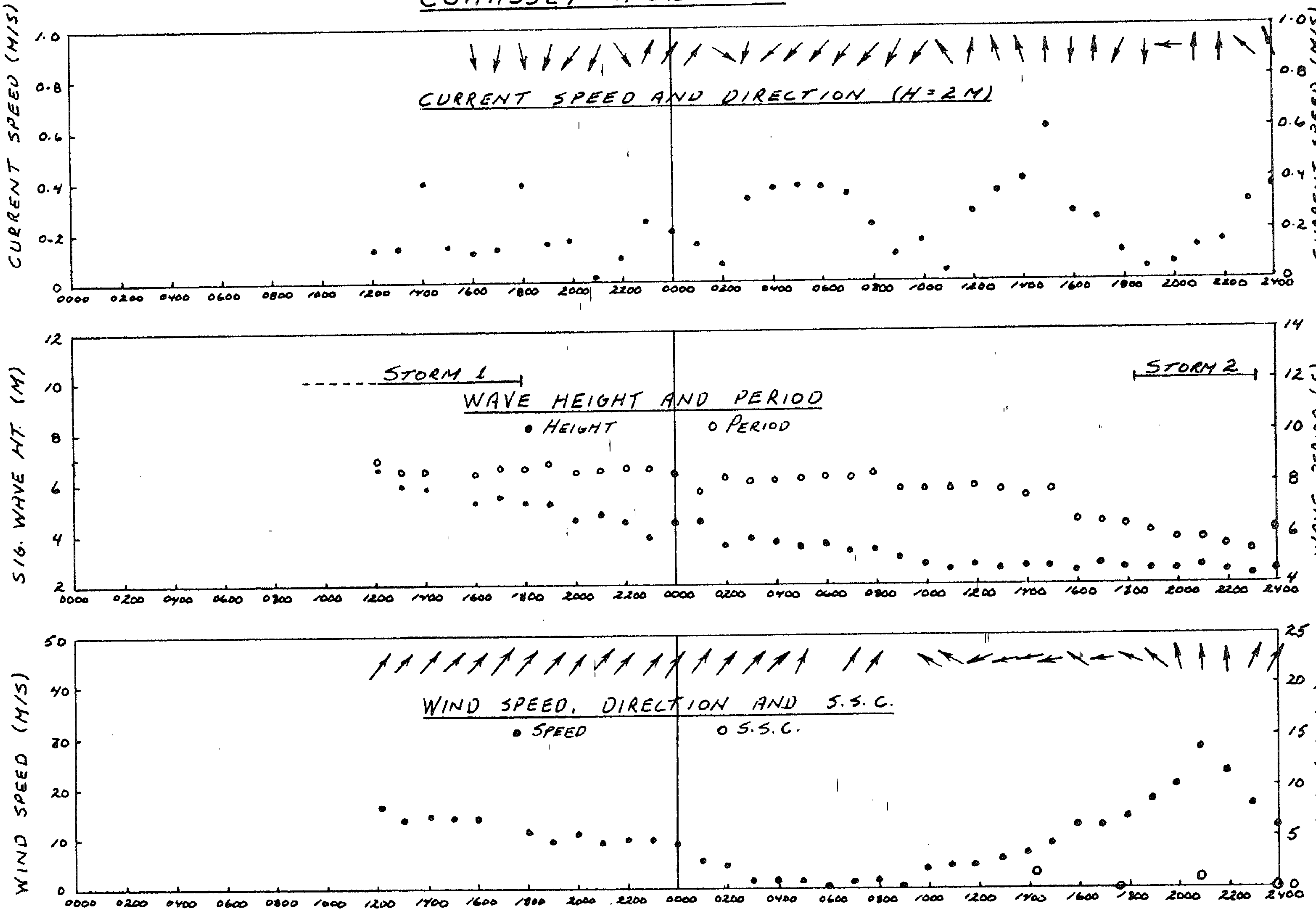
FIGURE CAPTIONS

Figure 1. Location diagram of the Cohasset A-52 site.

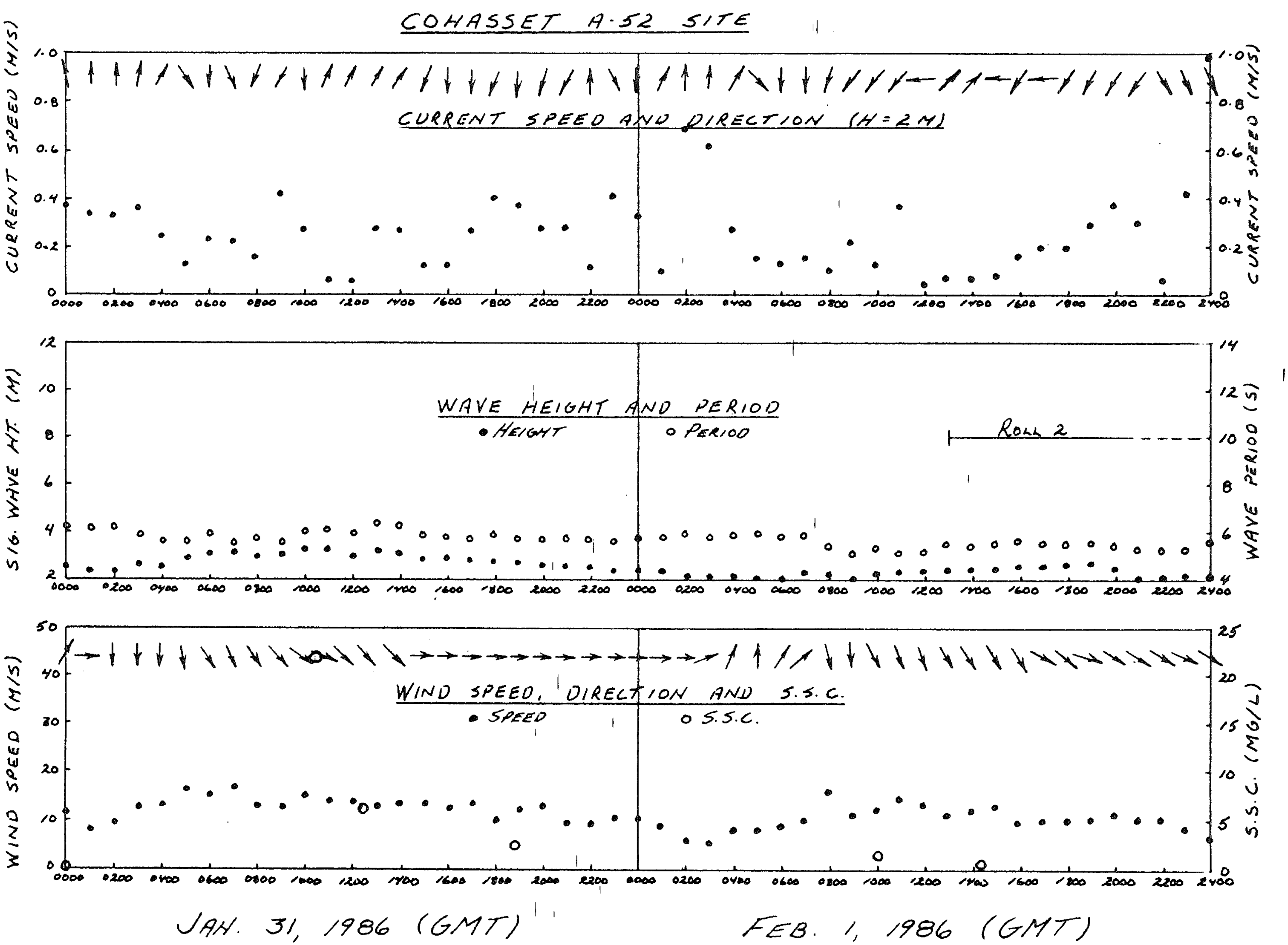
Figure 2.(sheets 1 - 6)

This figure shows the wave, current and atmospheric data for the duration of the Cohasset site A - 52 sediment stability study. Results are plotted from 29 January to 12 February, 1986. The parameters plotted are: current speed and direction 2 m above the bed; significant wave height and mean wave period; wind speed and direction 110 m above sealevel. Also shown are the periods during which measurements were taken i.e. time-lapse camera (roll #), attenuance time series (A#), bottle cast, and UFO dive (D#).

COHASSET A-52 SITE



JAN. 29, 1986 (GMT) JAN. 30, 1986 (GMT)


COHASSET A-52 SITE
CURRENT SPEED AND DIRECTION (H=2M)
CURRENT SPEED (M/S)
WAVE HEIGHT AND PERIOD
• HEIGHT
○ PERIOD
ROLL 2
SIG. WAVE HT. (M)
WAVE PERIOD (S)
WIND SPEED, DIRECTION AND S.S.C.
• SPEED
○ S.S.C.
WIND SPEED (M/S)
S.S.C. (MG/L)
JAN. 31, 1986 (GMT)
FEB. 1, 1986 (GMT)

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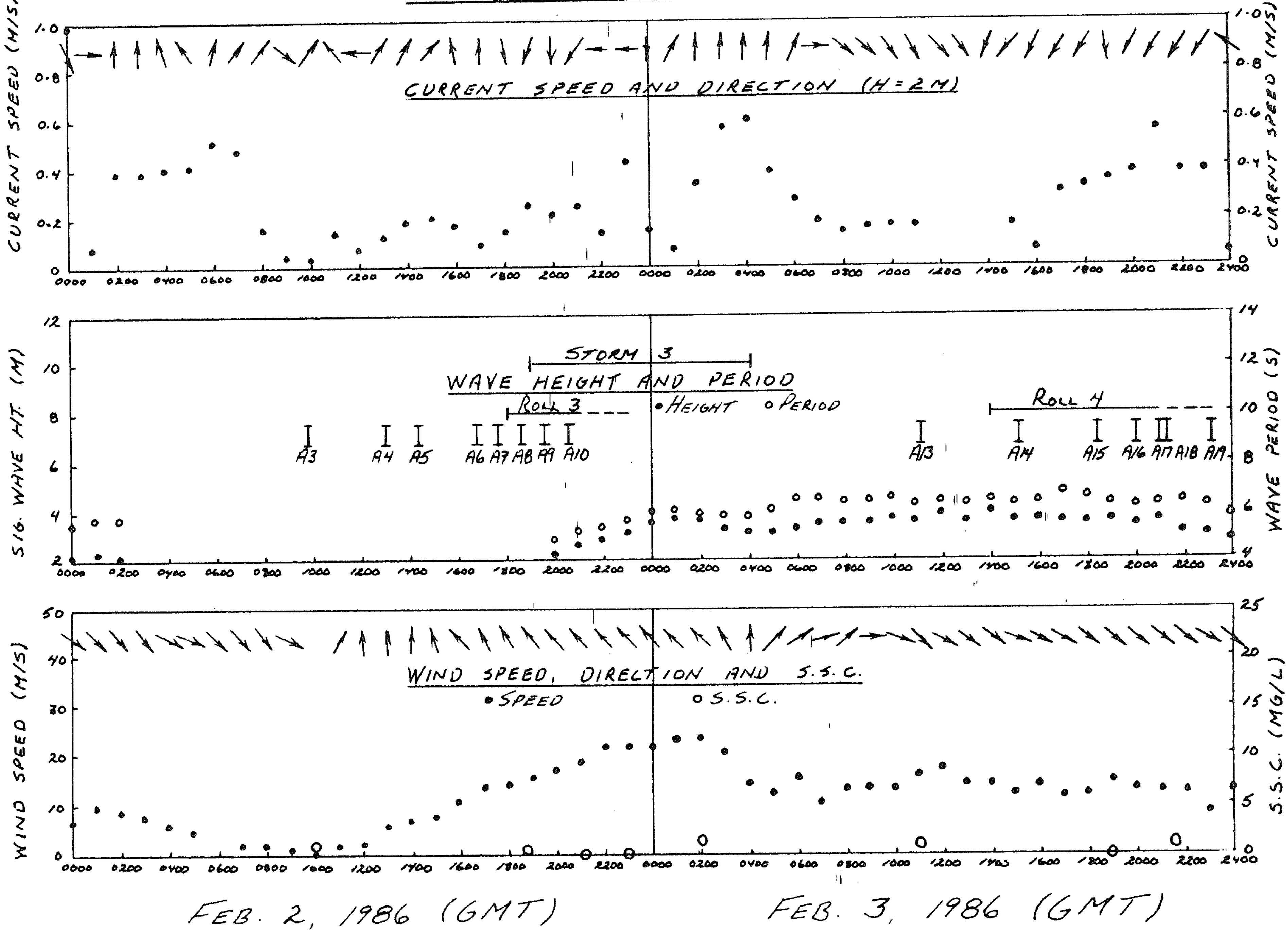

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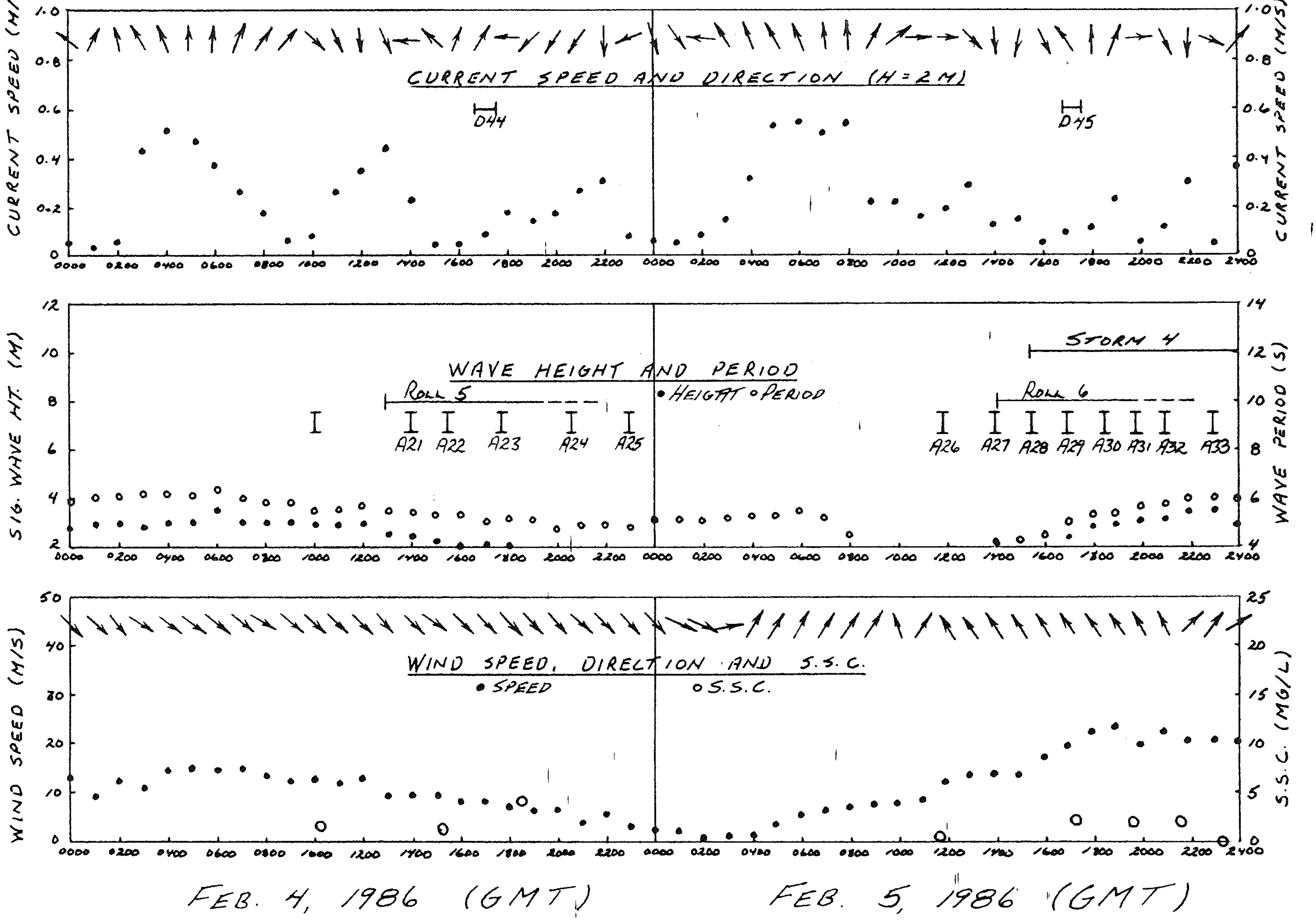

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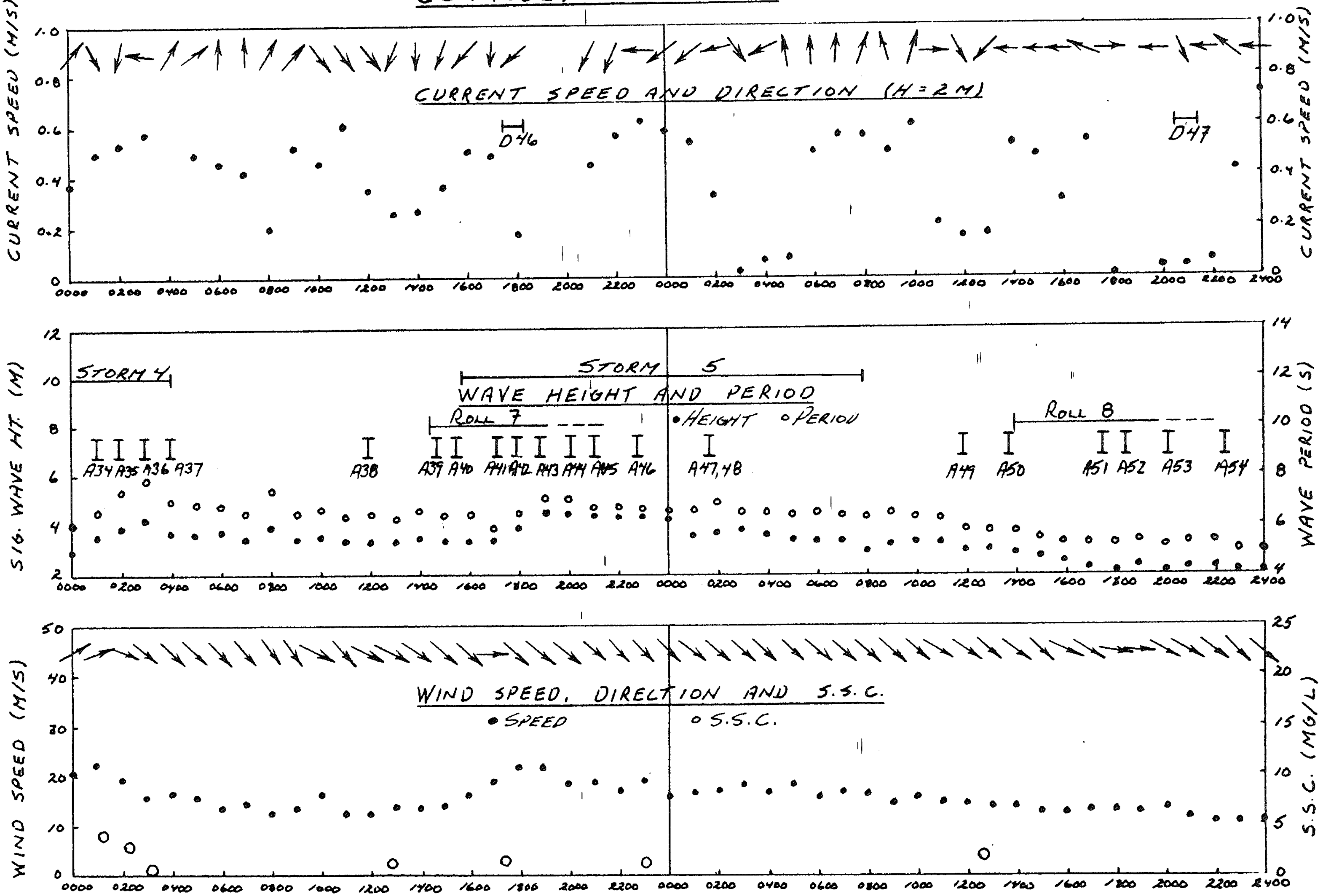

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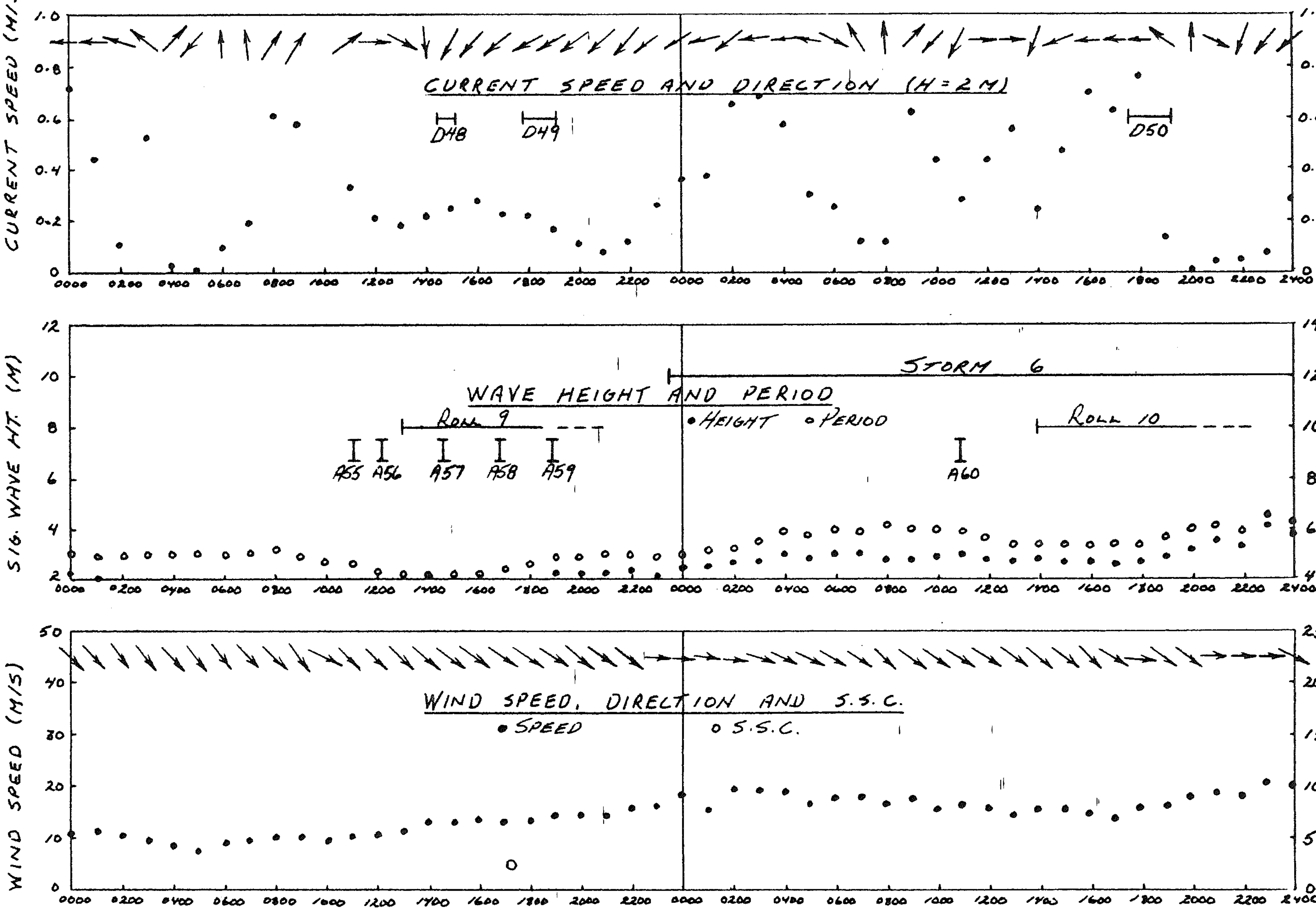

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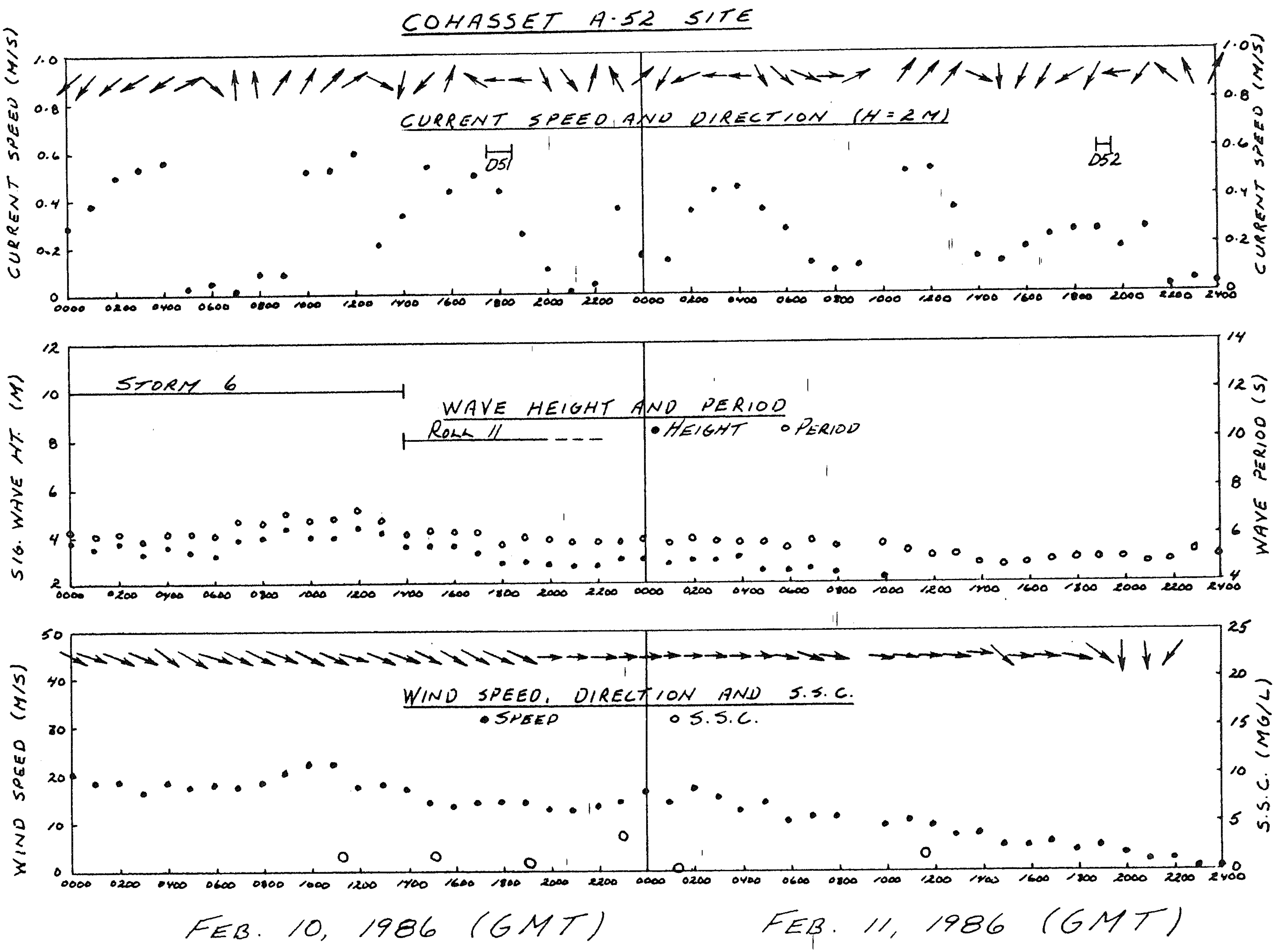
COHASSET A-52 SITE
CURRENT SPEED AND DIRECTION (H=2M)
CURRENT SPEED (M/S)
D51
D52
WAVE HEIGHT AND PERIOD
STORM 6
ROLL 11
• HEIGHT
○ PERIOD
SIG. WAVE HT. (M)
WAVE PERIOD (S)
WIND SPEED, DIRECTION AND S.S.C.
• SPEED
○ S.S.C.
WIND SPEED (M/S)
S.S.C. (MG/L)
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FEB. 11, 1986 (GMT)

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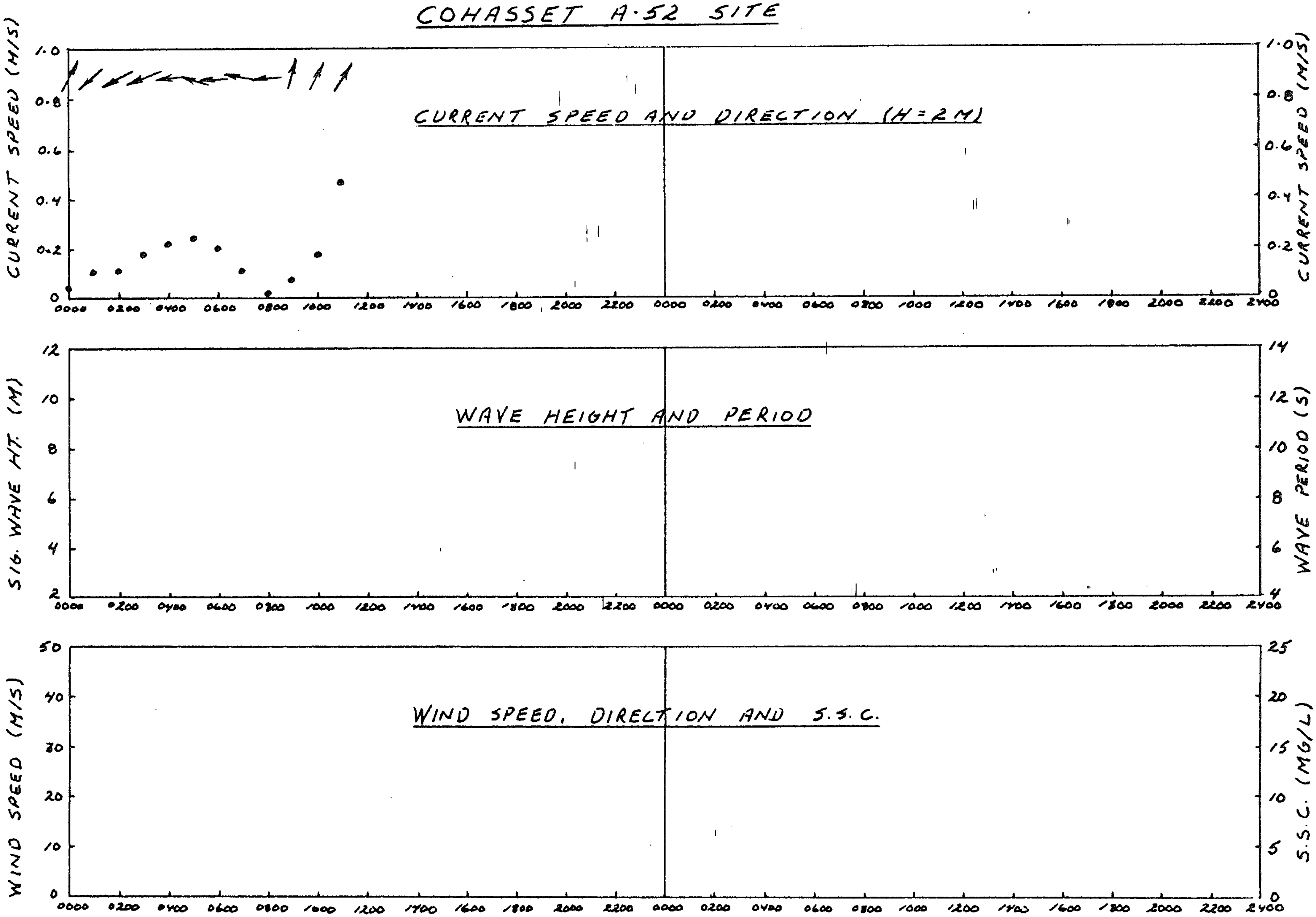

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