J. L. HART Cruise Northumberland Strait, N.B. (95-140)
23 May - 6 June, 1995

by

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CRUISE SUMMARY SHEET

VESSEL........... J. L. HART

CRUISE NUMBER..... 95-140

CRUISE DATES...... 23 MAY - 6 JUNE, 1995

MASTER.......... Capt. P. ANTLE

SCIENTIFIC STAFF..... C.L. AMOS (senior scientist; GSC)
A. ATKINSON (electronics; GSC)
D. BEAVER (navigation; GSC)
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A. MACDONALD (ROV; Env. Canada)
R. MURPHY (sampling; GSC)
K-L.TAY (ROV; Env. Canada)

RESULTS

- Full sidescan mosaics of the three major disposal sites: (1) Cape Journimain (disposal site # 1); (2) Amherst Cove (disposal site # 2); and (3) Cape Tormentine (disposal site # 3).
- Full sidescan mosaic and sub-bottom profile of habitat stability test site (east of Fixed Link; DFO, Moncton survey).
- Sidescan and sub-bottom profile of navigation channel to Summerside (DPW survey).
- Three ROV deployments and video records: (1) central disposal site # 1; (2) northeastern disposal site # 1; and (3) rock ledges off Marine Atlantic dock.
- Ralph2 and S4 deployment (11 days) near disposal site # 1.
- Ralph2 deployment (30 days) near disposal site # 2.
- Bottom camera photographs (10 shots per site) of: (1) three locations on disposal site # 1; (2) one location on disposal site # 2; and (3) three locations along Fixed Link Crossing.
- 27 bottom grabs for grain size analysis and evaluation of silt content.
- 10 Lab Carousel surveys of seabed material.

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1. BACKGROUND

This cruise is in support of an Ocean Disposal Research Grant from Environment Canada (1995/96), the evaluating agent for disposal of material at sea. The main purpose of the grant is to determine the stability and dispersal of material disposed of at sea and the factors which influence disposal site stability. There are many coastal sites where dredging and dumping are presently taking place. Amongst these are: Saint John Harbour, Miramichi Bay, Liverpool Bay, the Fixed Link Crossing, Northumberland Strait etc. According to the Environmental Protection Branch, Environment Canada (Dr. K-L Tay), who are responsible for issuing Ocean Disposal Permits, the Fixed Link Crossing disposal sites have, at present, the highest priority for study. This is because of complaints by lobster fishermen in Northumberland Straits that disposal site # 1 (off Cape Journimain) is unstable, and that silt from this site is fouling the lobster beds to the east. GSC has been asked by Environment Canada to provide information of the stability of this site, and to determine the conditions under which material is moved. Furthermore, if the material is mobile, to determine where it goes.

Work on the Fixed Link Crossing has now begun, and excavation of the footings to bedrock is underway. The material from the excavations is being dumped at disposal site # 2 (Amherst Cove, PEI). Again, we have been asked by Environment Canada to provide information on the levels of material in suspension and the fluxes and pathways of sediment movement during and following the dumping process. As a result, we wish to know if fluid muds develop in the region because of ocean dumping. And if so, under what conditions these fluid muds form, are sustained, and are deposited. Finally, disposal site # 3 (Cape Tormentine), though not in use, may be a reasonable alternative to dumping at sites # 1 and 2 should these sites prove unacceptible. A baseline survey of this site would thus provide valuable information on which to judge its suitability as a disposal site.

We will attempt to answer the above questions by collecting evidence on seabed stability. This includes running a sidescan survey at each of the three disposal sites. Results from site # 1 will be compared to the survey conducted by Canadian Seabed Research Ltd. in 1992. We will deploy benthic instruments (RALPH2 and S4's) in order to monitor any motion of seabed material taking place during the period of the cruise. We will collect grabs, cores and bottom photographs, as well as ROV video in order to determine the existing nature of the disposal sites. The mobility of seabed material will also be examined using the newly-developed, containerised Lab Carousel. Samples will be tested for: (1) the threshold for motion; (2) the sediment transport rate; (3) the settling rate under flow; and (4) the settling rate under still-water.

Good bathymetric control on the disposal sites prior to dumping is not available. Therefore, changes in bathymetry cannot be assessed by resurveying. Nevertheless, we have negotiated with Canadian Hydrographic Survey, that they undertake a swath bathymetric survey of the three disposal sites as part of their regional survey for the Fixed Link Crossing. This will provide benchmark information for future studies.

The Miramichi bay disposal site B was the subject of study by GSC between 1990 and 1994. This work continues as the site can provide a long-term perspective on the fate of dumped material, as well as a test site to evaluate our ability to predict disposal site stability. DPW has collected systematically swath bathymetry from the site, and we have collected a few sidescan lines. As part of our long-term monitoring of disposal sites, we wish to complete a sidescan sonar mosaic of disposal site B.

2. OBJECTIVES

(1) To determine the erodibility of seabed material at disposal site # 1 (off Cape Journimain, NB).

This will be achieved by: (a) compiling a sidescan mosaic of the site, to be draped over swath bathymetry; (b) undertaking 10 Sea Carousel deployments across the site to measure critical thresholds for erosion and erosion rates; (c) collection of 1 m gravity cores, bulk grab samples, and syringe cores at each Sea Carousel site for analysis of biophysical properties and microfabric; and (d) ROV inspection of the disposal site and the region eastwards (down-drift) where the impact is said to be felt.

(2) To determine the sedimentation/settling and fluid mud potential of seabed material at disposal site # 1. This will be achieved by analyses of bulk samples placed in Lab Carousel situated in a container at the Cape Tormentine site, and using local seawater and sediments.

(3) To determine the dispersal of sediment during dumping at disposal site # 2 (Amherst Cove, Borden, PEI). This will be achieved by: (a) deployment of RALPH2 for 4 weeks immediately east of the site; (b) ROV inspection of the site; (c) collection of bulk grab samples of dumped material for subsequent Lab Carousel measurements; and (d) benthic camera photography.

(3) To determine the long-term fate of material dumped in 1993 at disposal site # 1. This will be evaluated by: (a) collection of seabed samples down-drift (eastwards) of the site, and by the deployment of RALPH2 immediately east (downdrift) of the disposal site for the 2 weeks of the cruise.

(4) To determine the nature and stability of disposal site # 3.

(5) To collect sidescan data in a site of special interest to DFO for habitat stability analysis related to the effects of the Fixed Link Crossing.

(6) To collect sidescan data along the navigation corridor to Summerside on behalf of Public Works and Government Services Canada (PWGSC).

3. NAVIGATION

Positioning was maintained using a Magnavox® 4200D differential GPS system with 6 receiver channels. Two systems were used; one on shore, the second on J. L. Hart. The shore-based station received raw GPS signals from the GPS satellites and computed corrections using the software package HPC. These corrections were then transmitted to J. L. Hart on a frequency of 453.575 MHz and were detected onboard using an HYDL-1000 radio receiver. The corrections were used to determine ship's position using the PC-based, AGCNav 3.02. The ship-board receiver antenna was located on the forward starboard corner of the bridge, approximately 11 m forward and 2 m port of the main deck. All positions were logged at 1 Hz and stored each 5 seconds.

The location of the shore-based antenna was on the pier range light (# 1090) Cape Tormentine, N.B. (Lat: 46° 08' 05.397"; Lon: 63° 46' 19.839"). The ellipsoid height was -5.02 m. The site was surveyed from a bench mark on the Cape Tormentine government wharf by CHS. The position of the light was taken from the GSC data bank (NAD 83 coords). The offsets of the antenna from the light position were applied after standard surveying. Ship's position was displayed on the bridge in three modes: survey; bullseye; and chart mode. A remote display was installed in the lower lab on a Toshiba® 5200 (colour display). Plots of ships position while at the dockside showed a maximum scatter of *circa* 5 m. This was the assumed accuracy of the survey positioning.

4. SIDESCAN AND SEISMICS

A SIMRAD® MS992 sidescan sonar system was used throughout the survey. This sidescan operated on two frequencies: 120 and 330 KHz. The sidescan was fired at 65 ms and data were logged on a SE880 digital recorder at a sample rate of 100 micro-seconds, then stored on 2 Gbyte capacity Exabyte® tapes in standard SEGY format. The SIMRAD® recorded 4 channels of sidescan data:

(1) left 120 KHz; (2) right 120 KHz; (3) left 330 KHz; and (4) right 330 KHz. Channels 1 - 4 on the SIMRAD® corresponded to channels 0-3 on the SE880. The sidescan was towed on the starboard side at a depth of 5-10 m above the seabed. This corresponded to a layback of between 20 and 30 m behind the GPS antenna.

A datasonics CHIRP subbottom profiling system was used on the DPW and DFO surveys. The system was model CAP-6000A (DPS 603), which is a wideband, FM, high-resolution, profiling system that operates at swept frequencies between 1 and 30 KHz, and is known as an active pulse sonar system. System control, display, and logging was controlled by a DR-DOS based software package. Data were digitized on a 16 bit D/A converter and stored on Exabyte® tapes in standard SEGY format. Through on-line signal processing, the system was capable of a resolution of 0.075 - 0.15 m. The CHIRP® was operated at a pulse width of 10 ms and at a firing rate of 0.25 s. The output signal strength was 500 Joules. The fish was towed from the port side at a depth of 2 m beneath the sea surface approximately 15 m behind the ship's GPS antenna.

5. S4 CURRENT METER and RALPH2

The InterOcean® S4 current meter is an autonomous, self-recording electromagnetic flow meter. It came equipped to measure two horizontal components of flow and hydrostatic pressure. (This particular model was not equipped to detect temperature, salinity or turbidity) The S4 current meter was programmed to log continuously at a rate of 0.5 Hz. It was placed in a tubular frame and set to a height of 0.5 m above the base. The frame was attached to a single 3/8 inch Sampson braid (50 m in length) and a Scotsman surface float.

RALPH2 is a microprocessor-controlled, free standing instrumented tripod described by Heffler (1984). The package consists of a SeaTech® transmissometer mounted 1.5 m above the bed, two

Neil-Brown acoustical current meters mounted 0.5 and 1.0 m above the base, that recorded two orthogonal components of flow; two transmissometers; an upward-looking sonar and pressure transducer mounted 2.0 m above the bed, and a downward-looking Minolta® XL401, super-8 camera and synchronised 50 J flash. The nodal line of the camera is set 20° from nadir, to produce a field of view approximately 1.0 x 1.5 m. Each roll of super-8 film has over 3600 images which may be viewed either as a movie, or frame-by-frame. RALPH2 is equipped with tilt-and-roll sensors in order to define its attitude, and a fluxgate compass which defines its orientation. The sensitivity and accuracy of the sensors are given in Heffler (1984).

RALPH2 is programmed to sample in either continuous or burst mode. Alternately, it can sample between specified thresholds which are detected on any of its sensors. The system is controlled by a Tattletale6® microprocessor, and data are stored on a 20-Mbyte hard drive. It is powered by two 12-volt Sonnichsen® batteries capable of delivering 126 amp-hours of power. Typically, RALPH2 burst-samples all channels for *circa* 18 minutes each three hours. Under this configuration, it can collect data for about 6 weeks. An example of RALPH2 output is found in Amos *et al.* (1994).

In this study, RALPH2 was equipped with 6 sediment traps at heights above the bed of 0.15, 0.40, 0.70, 0.90, 1.20, and 1.40 m. The topmost trap was raised to a height of 2.00 m for the second (Amherst Cove, disposal site # 2) deployment. The frame was attached to a single 3/8 inch Sampson braid (50 m in length) and a Scotsman surface float.

6. SEA CAROUSEL

Sea Carousel is a benthic annular flume designed for field use in intertidal and subtidal settings. The carousel is 1.0 m in radius with an annulus 0.15 m wide and 0.30 m high. It weighs approximately 150 kg in air and 40 kg in water and is made entirely of aluminium. Flow in the annulus is induced by rotating a movable lid that is driven by a 0.35 hp DC motor powered from the surface. Eight small paddles, spaced equidistantly beneath the lid, induce a flow of water in the annulus. The Carousel is equipped with three optical backscatter sensors (OBS's; Downing, 1983). Two of these are located non-intrusively on the inner wall of the annulus at heights of 0.03 and 0.18 m above the skirt (the skirt is a horizontal flange situated around the outer wall of the annulus 0.04 m above the base; it was designed to standardize penetration of the flume into the seabed). The third OBS detects ambient particle concentration outside the annulus, or it may be used to detect internal sediment concentration at a height between the other two. The OBS sensors give linear responses to particle concentration (of a constant size) for both mud and sand over a concentration range of 0.1 to 50 g/L (Downing and Beach, 1989). A sampling port, through which water samples may be drawn, is situated in the outer wall of the annulus at a height of 0.2 m above the skirt. It is used to calibrate the three sensors under well mixed conditions.

Flow within the carousel was determined from a relationship between azimuthal speed and lid rotation presented in Amos, Grant *et al.* (1992). Mean tangential lid rotational speeds are detected through a shaft end-coder resting on the lid. Tangential (U_y) and vertical (U_w) current speeds are detected by a Marsh-McBirney® EM flow meter (model 513) situated *circa* 0.16 m above the bed. Controller boards for each sensor and necessary power (12 VDC) are derived from an underwater pod located above the annulus. Output voltages from all sensors are digitized and transformed to scientific units on a Campbell Scientific® CR10 data logger and stored on a Campbell Scientific® SM192 storage module (storage capacity of 96,000 data values), also located in the underwater pod. The data logger is interrogated and programmed from the surface using a microcomputer linked to the data logger through an RS232 interface. Maximum sampling rate of all channels is approximately 2 Hz, whereas U_y and U_w may be logged at rates up to 10.66 Hz. All channels may be monitored and displayed on the surface computer allowing the operator to control the experiment interactively. Bed shear stress is varied in time by varying the power supplied to the underwater motor up to 350 Watts via a surface power supply. The data stored from each deployment may be downloaded remotely through the RS232 cable at the end of each experiment and the storage module re-initialized.

A window is located in the inner flume wall for purposes of observing and recording the mechanics of bed failure. Visual observations are made using a Sony® Handycam 8 mm video recorder model CCD-V11 held in an Amphibico®, Amphibian V11 underwater housing. Light is provided by two 100-Watt underwater lights powered from the surface. The housing has a lens that corrects for underwater geometric distortions and so is suitable for accurate image scaling. The camera images 30 frames/s. A co-axial cable connects the camera to a surface monitor for real-time detection. Sequential video images are digitized for particle trajectories at varying heights above the bed. From these, velocity profiles are constructed. From such profiles, thicknesses of the logarithmic part of the benthic boundary layer are determined and friction velocities computed. These latter values may then be compared with laboratory measures.

7. LAB CAROUSEL

Lab Carousel is an annular flume designed to examine the erosion and settling of natural marine sediments under controlled conditions. It has the exact same dimensions as Sea Carousel and so is directly comparable in terms of flow character. The flume is 2 m in diameter (OD), 0.15 m wide, and is filled to a height of 0.30 m. The flume is made of clear acrylic so that flow conditions and bed erosion can be clearly observed. Flow is induced by a lid suspended over the water surface from a central shaft. Eight paddles are fixed equidistantly beneath the lid to induce flow. The shaft is turned by a 0.75 Hp Industrial Drive® motor that is driven by a Focus® controller. A digital display ensures that voltage settings are consistent from experiment to experiment. Three optical backscatter sensors (OBS's) are situated at heights of 0.03, 0.10 and 0.20 m above the flume base, and provide information on the presence and concentration of suspended particulate matter. A Marsh-McBirney® electro-magnetic flow meter is also located in the flume at a height of 0.20 m above the flume bed and gives measures of the vertical and azimuthal components of flow.

The OBS and EM flow meter data were logged on a Campbell Scientific® CR10 data logger and stored on a PC hard-drive. A Sony® Hi8 video camera was situated near the flume base in order to record the erosion and settling process during each experiment. Images were recorded on SVHS and displayed on a 15 inch Panasonic®, high-resolution, colour monitor for analysis.

8. RESULTS

8.1 Sidescan and seismics

A total of 195 line km of sidescan and seismics were collected during a total of 27 hours of surveying (Figure 8.1.1). Detailed track plots are presented for disposal site # 1(Figure 8.1.2), disposal site # 2 (Figure 8.1.3), disposal site # 3 (Figure 8.1.4), region crosslines to Fixed Link Crossing (Figure 8.1.5), PWGSC navigation channel survey (Figure 8.1.6), and DFO habitat stability survey (Figures 8.1.7 and 8.1.8). Sidescan mosaics were completed for each of the three disposal sites (Cape Journimain, Amherst Cove and Cape Tormentine, for Environment Canada), for the main shipping channel between NB and PEI (for DPW), for the Fixed Link Crossing (for

GSCA), and for a region east of the fixed link (habitat stability study, DFO, Moncton). The sidescan lines for the disposal sites were run at 3-4 kts (over ground speed) at a swath width of 50 m/channel or greater. At disposal site # 1, 10 lines were completed. The results showed clear evidence of the ocean dumping from 1992 in the centre of the disposal site. The margins of the site and the western and eastern extremities were strongly reworked and covered by current-rippled sand. There was also evidence for bedrock outcrop throughout the site, although much of the region was veneered in sand and gravel.

Disposal site # 2 was completed at a swath width of 50 m/channel. The region was composed of featureless sand. Some evidence for dumping was visible in the western part of the region.

Disposal site # 3 was completed at a swath width of 100 m/channel. The bottom in the region was generally featureless sand and gravel. The DFO mosaic was also featureless and dominated by a shelly, gravelly and scoured seabed. The DPW line also showed an absence of bed features in the vicinity of the Fixed Link, but demonstrated an abundance of sand ribbons and large-scale bedforms to the northeast.

8.2 RALPH2 and S4

RALPH2 was originally deployed on disposal site # 1 (Cape Jourimain) at 1702 GMT on 25 May, 1995 (day 145). The RALPH2 mooring was caught in the boat propellor during deployment and the surface float lost. RALPH2 was found by a diver and a line was subsequently attached. It was recovered and inspected on 26 May, after 24 hours on the seabed. The frame had been vertical and operating properly to that point. A total of 53 frames had been taken. Several frames were taken on deck as tests, and the instrument redeployed at 2146 GMT, 26 May, 1995.

RALPH2 was recovered at 1830 GMT on 3 June (day 154) having been on the seabed for exactly

9 days. It had taken 573 photos on recovery and had logged 5 Mbytes of data in 20 blocks. The data were downloaded into files named Hart# in hexadecimal format. Initial examination of the data showed the records to be complete and of excellent quality. The records show the strong tidal modulation, with peak currents of 0.7 m/s, and the general absence of wave motion for the duration of the deployment. Sand and silt were recovered in the 6 sediment traps. The mass of material collected showed an inverse relationship with height above the seabed (Figure 8.2.1). Size analysis of the sediment trapped showed them to be composed entirely of silt and clay in about equal proportions. The absence of variation with height above the bed suggests the material was not resuspended within the dump site, but rather was advected in from outside the region. RALPH2 was re-deployed on the eastern edge of disposal site # 2 at 1658 GMT on 4 June, 1995 (day 155) and recovered on 6 July, 1995 at 1400 GMT. Preliminary analyses of the raw data show turbid events at times in the mid stages of the deployment. The sediment traps contained red/brown silty clay (in similar quantities to site # 1) and the frame was covered in a thin film of mud. Data from RALPH2 are presently being analyzed.

The S4 was deployed on 25 May (day 145) at 1727 GMT and was recovered at 1740 GMT on 3 June, 1995 (day 154). The instrument recorded only 2 days of data. The results are considered dubious as they indicated a peak current speed of only 0.10 m/s. The reason for the failure is unknown, as there appeared to be no evidence for battery failure.

8.3 Sea Carousel

Only one deployment of Sea Carousel was possible. This was carried out in the Marine Atlantic harbour, while tied up against the barge *Buzzard.* This site was chosen as it was not possible to anchor J.L. Hart at disposal site # 1 due to failure of the anchoring system. Results from this deployment were very good, and clearly showed resuspension. Unfortunately, the Empire Magnetics® motor performed poorly and stalled at intermediate speeds. On examination, it was found that the motor had leaked oil and had possibly taken in sea water. As the spare motor, being in repair, was unavailable no further surveys were possible.

8.4 Lab Carousel

Lab Carousel was set up in a portable container located at dock B, adjacent to the loading dock of Marine Atlantic. Sea water was obtained from wharf B, Cape Tormentine, and was used to fill the Carousel before each experiment. Bulk samples of sediment, collected during the cruise, were mixed in the flume and allowed to settle for 18 hours. Each experiment comprised three phases: (1) an accelerating phase; (2) a decelerating phase; and (3) a still-water phase. In phase (1), the lid speed was increased in increments as follows: 0.12 m/s (90 mV); 0.22 m/s (110 mV); 0.33 m/s (130 mV); 0.43 m/s (150 mV); 0.54 m/s (170 mV); 0.64 m/s (190 mV); and 0.74 m/s (210 mV; see Figure 8.4.1 for conversion of motor output to lid rotation). This corresponded to a flow speed of: 0.10 m/s; 0.13 m/s; 0.16 m/s; 0.20 m/s; 0.23 m/s; 0.27 m/s; and 0.30 m/s (see Figure 8.4.2 for conversion of motor output to flow speed). The current speed was held constant for 10 minutes at each interval. The purpose of this phase was to determine the threshold for erosion of the deposited bed and the associated erosion rates at each flow velocity. At each increment, three water samples were taken from the sample ports of the flume; one at each of the OBS heights. Water samples were filtered through Millipore® glass fibre filters using a Swinnex® system. The filters were 25 mm in diameter, and were washed with 10 ml of distilled water, dried and weighed for filtered mass. The filtered samples were used to calibrate voltage output from the OBS's to suspended mass in the flume. The calibration of the OBS sensors to suspended sediment concentration (SSC) for each experiment is shown in Figures 8.4.3 to 8.4.8. The form of the relationship is exponential of the general form:

$$SSC = m10^{bOBS} \text{ mg/L}$$

where m and b are empirically derived constants. In phase (2), speed was decremented in the following intervals of flow: 0.23 m/s (170 mV); 0.16 m/s (130 mV), and 0.10 m/s (90 mV). The purpose of this was to observe settling under an applied flow, and the critical deposition threshold.This is determined following a method defined by Willis (Pers. Comm., 1994) whereby the equation of mass deposition is tranformed as follows:

$$D=\partial m/\partial t=SSC_oW_s(1-\tau_o/\tau_d)$$

where W_s is the still water settling rate, τ_o is the prevailing bed shear stress during the measurement of settling, τ_d is the critical shear stress for onset of deposition, and $\partial m/\partial t$ is the still-water mass settling flux.

$$\tau_d=SSC_oW_s(1-\tau_o)/\partial m/\partial t$$

In phase (3), the still-water settling rate of suspended material was determined. This information is basic to the prediction of sediment transport.

Ten (10) analyses on natural sediments from Northumberland Strait were made in this survey. These are summarised in Table 8.4.1.

TABLE 8.4.1. A summary of the Lab Carousel analyses.

EXPERIMENT	SAMPLE #	LOCATION
CTLAB1	003	DISPOSAL SITE # 1
CTLAB2	004	RALPH SITE 1(VIDEO OUTSIDE)

CTLAB3	004	RALPH SITE 1(VIDEO INSIDE)
CTLAB4	004	RALPH SITE 1(VIDEO BELOW)
CTLAB5	007	DISPOSAL SITE # 2
CTLAB6	008	DISPOSAL SITE # 3
CTLA6-1	--	--
CTLAB7	031	MARINE ATLANTIC DOCK
CTLAB8	026	ROV SITE 2
CTLAB9	027	ROV SITE 3
CTLAB10	030	MARINE ATLANTIC DOCK

Only those experiments on material from disposal site # 1 and the Marine Atlantic dock showed evidence of cohesion. The remaining samples were dominantly sandy and moved as granular material. Preliminary time-series plots of the results are shown in Figures 8.4.9 to 8.4.19.

8.5 Seabed sampling

Bottom grab samples were taken in a grid around and to the southeast of disposal site # 1, along the Fixed Link Crossing, and at disposal sites 2 and 3 (Table 8.5.1). The sample sites are shown in Figure 8.5.1. A summary table of these samples is given below.

TABLE 8.5.1. A summary table of the seabed grab samples.

SAMPLE #	**GRAB #**	**LOCATION**
003	1	DISPOSAL SITE # 1
004	2	RALPH SITE # 1
005	3	DISPOSAL SITE # 2
007	4	DISPOSAL SITE # 2
008	5	DISPOSAL SITE # 3
009	6	DISPOSAL SITE # 3

SAMPLE #	GRAB #	LOCATION
010	7	ROV SITE # 1
011	8	ROV SITE # 2
015	9	ROV SITE # 3
016 - 029	10 - 23	GRID SURVEY
030	24	MARINE ATLANTIC
031	25	MARINE ATLANTIC
039	26	ROV SITE # 2
041	27	ROV SITE # 3
042	28	WESTERN FLC
043	29	CENTRAL FLC
044	30	EASTERN FLC

The purpose of the grid was to determine if the fine-grained material, originally deposited on disposal site # 1, had dispersed onto the adjacent lobster grounds. We found only clean fine sand during the course of the survey. No significant amounts of silt nor any dump material was identified in any sample either adjacent to the disposal site or eastwards of it.

Triplicate bulk samples were collected at the centre of each disposal site, as well as in the harbour. These samples were wet seived through a 500 micron mesh and will be used by Environment Canada to evaluate the macrofauna.

8.6 ROV and bottom camera

ROV surveys were undertaken at the centre of disposal site # 1 (ROV site # 1) and to the NE of the site (ROV site # 2). At site # 1, the seabed was characterised by a heterogeneous seabed of sand, gravel and bedrock. No silt or clay (diagnostic of harbour material) was seen at the seabed. Much had been covered or reworked by rippled sand and gravel. Site # 2 was generally covered by a continuous veneer of current-rippled fine sand. No evidence of dumping was seen. We noted a strong current setting to the north. This had a significant effect on the operation and positioning of the ROV.

The bedrock ledges off Cape Tormentine appeared to be largely covered by rippled clean sand. Some evidence for bedrock was seen. The general appearance of the seabed supported the statements of the local fishermen, that much of the lobster habitats (hard seabed) had been buried beneath sand. The large extent of the sand build-up, suggests that this sand had come from offshore and not from the reworking of disposal site material, and was part of a long-term, natural evolution of the region. A series of seabed photographs are presented from disposal site # 1 (Figures 8.6.1 - 8.6.13), from disposal site # 2 (Figures 8.6.14 - 8.6.18), and from the Fixed Link Crossing (Figures 8.6.19 - 8.6.32). The size of each image is about 1 m in width by 0.6 m in height. The trip weight in each frame is about 50 mm across. Also shown is the year, the month and the day when the photograph was taken.

Figures 8.6.1 to 8.6.5 were taken at ROV site # 1 (central disposal site # 1). The clarity of the water was poor and hence the bottom was indistinct. Nevertheless, cobbles interspersed with rippled sand can been seen. On the other hand, there is no clear evidence for bedrock or dumped material. Figures 8.6.6 to 8.6.10 were taken at ROV site # 2 (northwest disposal site # 1). All images showed well-developed current/wave ripples on sand, and the sporadic occurrence of bedrock outcrop (Figure 8.6.8A). Figures 8.6.11 to 8.6.13 were taken from the southwestern part of disposal site # 1. The seabed was generally flat and featureless without the distinct current ripples seen elsewhere. The seabed material was heterolithic in composition, but appeared to be dominated by fines. No benthic fauna were evident.

Figures 8.6.14 to 8.6.18 were taken from the centre of disposal site # 2. The water clarity was much better and the nature of the seabed was distinct. The site was flat and generally featureless. It appeared to be composed of heterolithic material ranging from shelly fine sand to cobbles. The seabed supported an abundant community of bottom attached plants.

Figures 8.6.19 to 8.6.23 were taken from the western Fixed Link site. The seabed was dominated by shelly gravel with a matrix of fine sand. The gravel appeared to be well-sorted and highly compacted (Figure 8.6.23B). The sand was strongly current-rippled (Figure 8.6.22B). All shells appeared whole but disarticulated. No benthic fauna was observed.

No gravity cores were recovered in this cruise. The composition of the bed (fine compacted sand) prevented penetration, and any material retained was washed out during recovery.

9. INTERPRETATIONS AND CONCLUSIONS

A large part of the cruise objectives were either met or exceeded. Those aspects omitted were the Sea Carousel deployments and the collection of gravity cores. Insofar as disposal site # 1 was sandy and reworked, the results from Sea Carousel would have been no better than those obtained from Lab Carousel. The absence of the gravity cores means that the thickness of the reworked layer, and the remaining thickness of dumped material at disposal site # 1 is unknown.

9.1 The stability of disposal site # 1

The survey of disposal site # 1 clearly indicated prior reworking of the silty, reduced dump material, and the existence of a cap of clean mobile sand overlying finer, organic-rich sediment. The sidescan survey indicated that much of the bedrock (evident in the 1993 survey) was now buried beneath sand, and that the spoil mounds had largely been removed. ROV and benthic camera stations showed the sand to be clean and moulded into active current ripples. The source of the sand is unknown, but is likely derived from deeper water to the north or through longshore movement. It is doubtful that it is a reworked product of dredging given the fine nature of the original dumped material. The results from RALPH2 showed strong tidal flows moving the sand largely as bedload. This motion appeared to be mainly to the north. We found no evidence for silt motion, nor the existence of fluid muds. It must be remembered, however, that RALPH2 was deployed during the relatively quiet conditions of late spring; hardly the conditions leading to massive seabed reworking.

Subsequent seabed sampling to the east of disposal site # 1 showed no trace of the fines presumed reworked. We propose, therefore, that all reworked fines are removed from the region once in suspension, but we cannot tell the pathway of the transport nor the ultimate resting site. Furthermore, ROV observations and bottom camera photographs indicated a healthy seabed throughout the region casting doubt on the likelihood of any impact caused by disposal site reworking.

9.2 The stability of disposal site # 2

Bottom sediments from disposal site # 2 were largely composed of shelly sand with a significant fraction of fines. This site showed no evidence for large-scale bedforms nor bedrock in the sidescan mosaic, but dump mounds were clearly detected in the westernmost extremes of the site. Preliminary results from RALPH2 suggested that periods of high turbidity took place. The presence of sand in these samples (which dominated the lowermost trap and decreased in abundance with height) suggested that this material may in part be derived by reworking of the disposal site by waves.

9.3 The stability of disposal site # 3

Disposal site # 3 was composed of clean shelly, fine sand. It was relatively exposed to wave motion and to strong tidal flows. No signs of large scale bedforms or bedrock could be detected in the sidescan survey of the site. ROV observations and seabed photographs were not collected at this site, and so its stability must be considered as unknown.

9.4 The DFO habitat stability site

The region for the sidescan mosaic for DFO (centred in Lat: 046° 11.7'N; Lon: 063° 45.5'W) was covered by sand ribbons and flow-transverse bedforms in 1988 (Fader and Pecore, 1994). Our re-survey of this region showed a monotonous gravelly seabed, devoid of sand. It appears that the sand has moved since the earlier survey, possibly travelling inshore to disposal site # 1.

9.5 General

Although we now know that disposal site # 1 has been reworked, and the reworked material has not become deposited east of the site (an area of sensitive fisheries habitat), we cannot explain under which conditions the material became eroded, nor the direction of transport this material took. Thus, in terms of understanding and predicting the dynamics controlling the long-term behaviour of dumped material, we have advanced little. Unfortunately, our survey is analogous to *closing the barn door after the horse has bolted*; the dumped material having been reworked by agents at work long before we arrived. Advances in our understanding of this subject will come when we are able to monitor reworking and erosion of dumped material *as it happens*, and measuring at the same time the seabed dynamics responsible for the reworking. Results from RALPH2 at site # 2 may help provide a better understanding of disposal site stability in this region.

10. REFERENCES

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11. ITINERARY

DATE/TIME(GMT)	OPERATION
23 MAY/1430	HART DEPARTS FOR CAPE TORMENTINE
23 MAY/1500	AGC STAFF DEPARTS BY VEHICLE FOR CAPE TORMENTINE
23 MAY/2200	AGC12 CONTAINER ARRIVES CAPE TORMENTINE
24 MAY/1130	MOBILIZING CONTAINER ASSEMBLY OF SEA CAROUSEL
24 MAY/2200	HART ARRIVES AT CAPE TORMENTINE
25 MAY/1100	SETTING UP RALPH & S4 FOR DEPLOYMENT DISPOSAL SITE # 1
25 MAY/1300	STARTED S4 LOGGING
25 MAY/1602	STARTED RALPH
25 MAY/1610	DEPART FOR DISPOSAL SITE 1

25 MAY/1702	RALPH ON BOTTOM AT DISPOSAL SITE # 1
25 MAY/1740	RALPH LINE CAUGHT IN BOAT PROP/CUTTING LINE
25 MAY/1727	S4 CURRENT METER ON BOTTOM DISPOSAL SITE # 1
25 MAY/1814	BULK SAMPLE (003) AT DISPOSAL SITE # 1 FOR LAB CAROUSEL
25 MAY/2000	SAMPLE 003 IN LAB CAROUSEL
25 MAY/2200	MEETING WITH DIVER RE. RALPH RECOVERY
26 MAY/1100	SETTING UP SIDESCAN LINES DISPOSAL SITE # 1
26 MAY/1235	HART SAILS FOR DISPOSAL SITE # 1; SIDESCAN SURVEY DISPOSAL SITE # 1
26 MAY/1840	HART RETURNS TO DOCK
26 MAY/1949	DEPART FOR DIVER RECOVERY OF RALPH
26 MAY/2030	DIVER ON BOTTOM/LOCATION OF RALPH
26 MAY/2100	RALPH RECOVERED ON BOARD/TESTING OPERATION
	73 FRAMES ON RALPH/OPERATING CONTINUOUSLY
26 MAY/2130	RALPH ON BOTTOM AT DISPOSAL SITE # 1
26 MAY/2140	BULK SAMPLE (004) FROM RALPH SITE
26 MAY/2200	HART AT DOCKSIDE
26 MAY	LAB CAROUSEL ANALYSIS OF 003 (CTLAB1)
26 MAY/2230	SAMPLE 004 IN LAB CAROUSEL
27 MAY/1100	SETTING UP SIDESCAN LINES FOR DISPOSAL SITE # 2 (BORDEN)
27 MAY/1155	HART SAILS FOR DISPOSAL SITE # 2
27 MAY/1700	FINISH SIDESCAN SURVEY DISPOSAL SITE # 2
27 MAY/1715	2 BULK SAMPLES FROM DISPOSAL SITE # 2 (006, 007)
27 MAY	LAB CAROUSEL OF 004 (CTLAB2)-VIDEO OUTSIDE
	LAB CAROUSEL OF 004 (CTLAB3)-VIDEO INSIDE
	LAB CAROUSEL OF 004 (CTLAB4)-VIDEO BENEATH
27 MAY/2000	SAMPLE 007 IN LAB CAROUSEL
28 MAY/1100	SETTING UP SURVEY LINES FOR DISPOSAL SITE # 3

28 MAY/1145	HART SAILS FOR DISPOSAL SITE # 3
28 MAY/1500	SIDESCAN SURVEY DISPOSAL SITE # 3
28 MAY/1649	2 BULK SAMPLES FROM DISPOSAL SITE # 3 (008, 009)
28 MAY/1710	END OF SIDESCAN SURVEY
28 MAY/1810	HART AT DOCKSIDE
28 MAY	LAB CAROUSEL ANALYSIS OF 007 (CTLAB5)
28 MAY/1900	ENVIRONMENT CANADA ROV MOBILIZED
28 MAY/2100	SAMPLE 008 IN LAB CAROUSEL
29 MAY/1140	HART DEPARTS FOR ROV SURVEY SITES
29 MAY/1155	ROV SURVEY DISPOSAL SITE # 1, SITE 1
29 MAY/1300	ROV SURVEY DISPOSAL SITE # 1, SITE 2
29 MAY/1327	BULK SAMPLE AT ROV SITE 1 (010)
29 MAY/1338	BULK SAMPLE AT ROV SITE 2 (011)
29 MAY/1429	BULK SAMPLE AT ROV SITE 3 (012)
29 MAY/1518	BEGIN GRAB SAMPLING SE OF DISPOSAL SITE (013-029)
29 MAY/1855	BULK SAMPLE FROM MARINE ATLANTIC DOCK (30-31)
29 MAY/1930	HART AT DOCKSIDE
29 MAY	LAB CAROUSEL ANALYSIS OF SAMPLE 008 (CTLAB6)
29 MAY	CALIBRATION OF CURRENTS IN CAROUSEL (CTLAB6-1)
29 MAY/2000	SAMPLE 31 IN LAB CAROUSEL
30 MAY/1315	HART DEPARTS FOR ROV SITE OF ROCK LEDGES
	ROV DEPLOYMENTS ON LEDGES
30 MAY/1500	ATTEMPTING ANCHORING DISPOSAL SITE # 1, NO SUCCESS
30 MAY/1800	ALONGSIDE BUZZARD IN HARBOUR
30 MAY/1810	SEA CAROUSEL DEPLOYMENT 1
30 MAY/1900	HART AT DOCKSIDE
30 MAY/2000	DEMOBING ROV

31 MAY/1100	ADJUSTING CABLES ON SEA CAROUSEL
31 MAY/1250	HART DEPARTS DOCKSIDE FOR HARBOUR SITE
31 MAY/1300	SEA CAROUSEL DEPLOYMENT ABORTED/MOTOR FAILURE
31 MAY/1430	RIGGING BOTTOM CAMERA
31 MAY/1542	CAMERA STATION 1 DISPOSAL SITE # 1, ROV SITE 1
31 MAY/1554	GRAVITY CORE ATTEMPT DISPOSAL SITE # 1, NO RECOVERY
31 MAY/1606	CAMERA STATION 2 DISPOSAL SITE # 1, ROV SITE 2
31 MAY/1617	BULK SAMPLE FOR LAB CAROUSEL ROV SITE 2 (039)
31 MAY/1631	CAMERA STATION 3 DISPOSAL SITE # 1 ROV SITE 3
31 MAY/1645	BULK SAMPLE FOR LAB CAROUSEL, ROV SITE 3 (041)
31 MAY/1717	BULK SAMPLE FIXED LINK (042)
31 MAY/1744	BULK SAMPLE FIXED LINK (043)
31 MAY/1811	BULK SAMPLE FIXED LINK (044)
31 MAY	LAB CAROUSEL ANALYSIS OF SAMPLE 031 (CTLAB7)
31 MAY	BULK SAMPLE 026 IN LAB CAROUSEL (ROV SITE 2)
1 JUNE/1140	HART DEPARTS DOCKSIDE
1 JUNE/1213	CAMERA STATION 4 - FIXED LINK
1 JUNE/1238	CAMERA STATION 5 - FIXED LINK
1 JUNE/1303	CAMERA STATION 6 - FIXED LINK
1 JUNE/1333	CAMERA STATION 7 - DISPOSAL SITE # 2
1 JUNE/1400	BEGIN SIDESCAN SURVEY OF FIXED LINK
1 JUNE/1815	END SIDESCAN SURVEY
1 JUNE/1900	HART AT DOCKSIDE
1 JUNE	LAB CAROUSEL ANALYSIS OF SAMPLE 026 (CTLAB8)
1 JUNE	BULK SAMPLE 027 IN LAB CAROUSEL (ROV SITE 3)
2 JUNE/1100	DEMOBING SEA CAROUSEL (M. HUGHES ARRIVES)
	LOADING CHIRP SYSTEM, CAPT. IN MONCTON

2 JUNE/1215	HART DEPARTS DOCKSIDE
2 JUNE/1300	STARTING RUS1 SIDESCAN LINE (DPW)
2 JUNE/1815	END OF RUS SIDESCAN SURVEY (LINE CUT SHORT)
2 JUNE/1918	HART AT DOCKSIDE
2 JUNE	LAB CAROUSEL ANALYSIS OF SAMPLE 027 (CTLAB9)
2 JUNE	BULK SAMPLE 30? IN LAB CAROUSEL
3 JUNE/1117	HART DEPARTS DOCKSIDE
3 JUNE/1154	BEGIN MOSAIC ON DL LINES (DFO SURVEY)
3 JUNE/1649	END MOSAIC SURVEY LINES (11 LINES COMPLETED)
3 JUNE/1745	S4 ON BOARD
3 JUNE/1800	RALPH ON BOARD
3 JUNE	LAB CAROUSEL ANALYSIS OF BULK SAMPLE 30?
4 JUNE/1100	HART DEPARTS DOCKSIDE
4 JUNE/1130	BEGIN MOSAIC ON DL LINES, DOWNLOADING RALPH
4 JUNE/1625	END DL MOSAIC, STEAMING TO DISPOSAL SITE # 2
4 JUNE/1640	550 SHOTS TAKEN BY RALPH
4 JUNE/1658	RALPH ON SEABED AT DISPOSAL SITE # 2
4 JUNE/1800	HART AT DOCKSIDE
4 JUNE/1900	HART LEAVES FOR BIO

Acknowledgements

We wish to thank the Captain and the crew of the J.L. Hart, G. Lintern and G. Cao for their support in this study. Thanks also go to K. Tay and A. MacDonald (Environment Canada) for their support throughout and especially with provision and operation of the ROV. On site facilities were made available through the courtesy of Marine Atlantic, and we thank the site manager G. Trenholme for his cooperation.

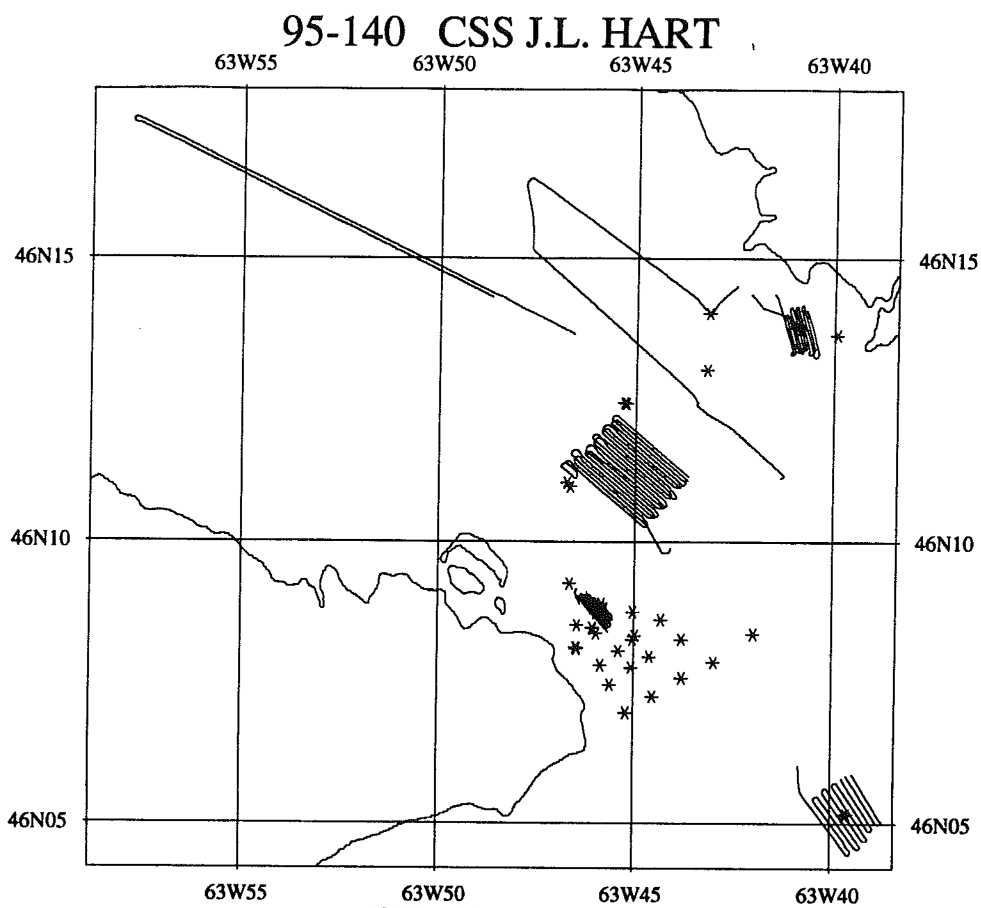


Figure 8.1.1. A track plot of the J.L. Hart cruise 95-014 to Cape Tormentine.

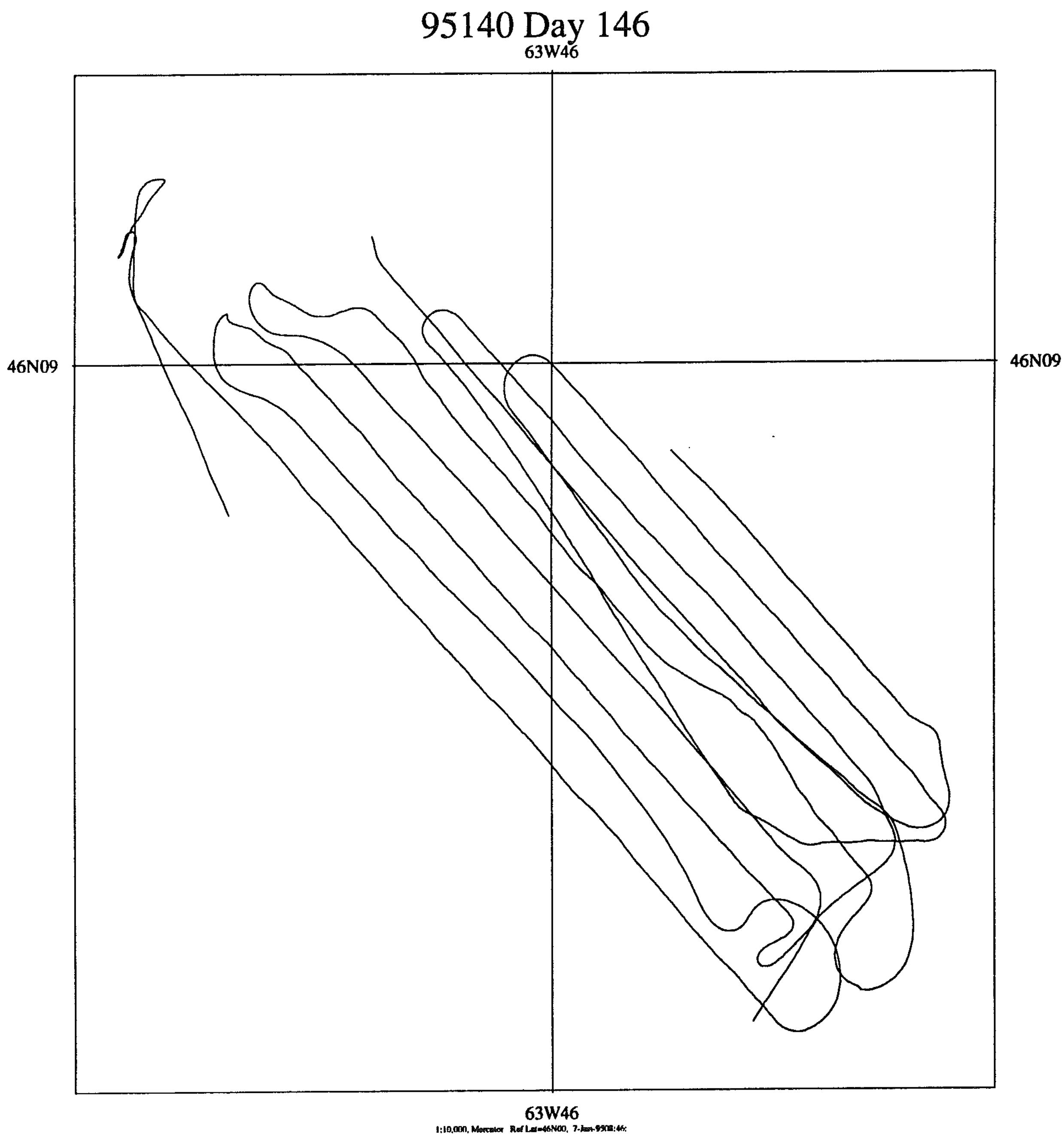


Figure 8.1.2. A detailed track plot of the mosaic of disposal site # 1.

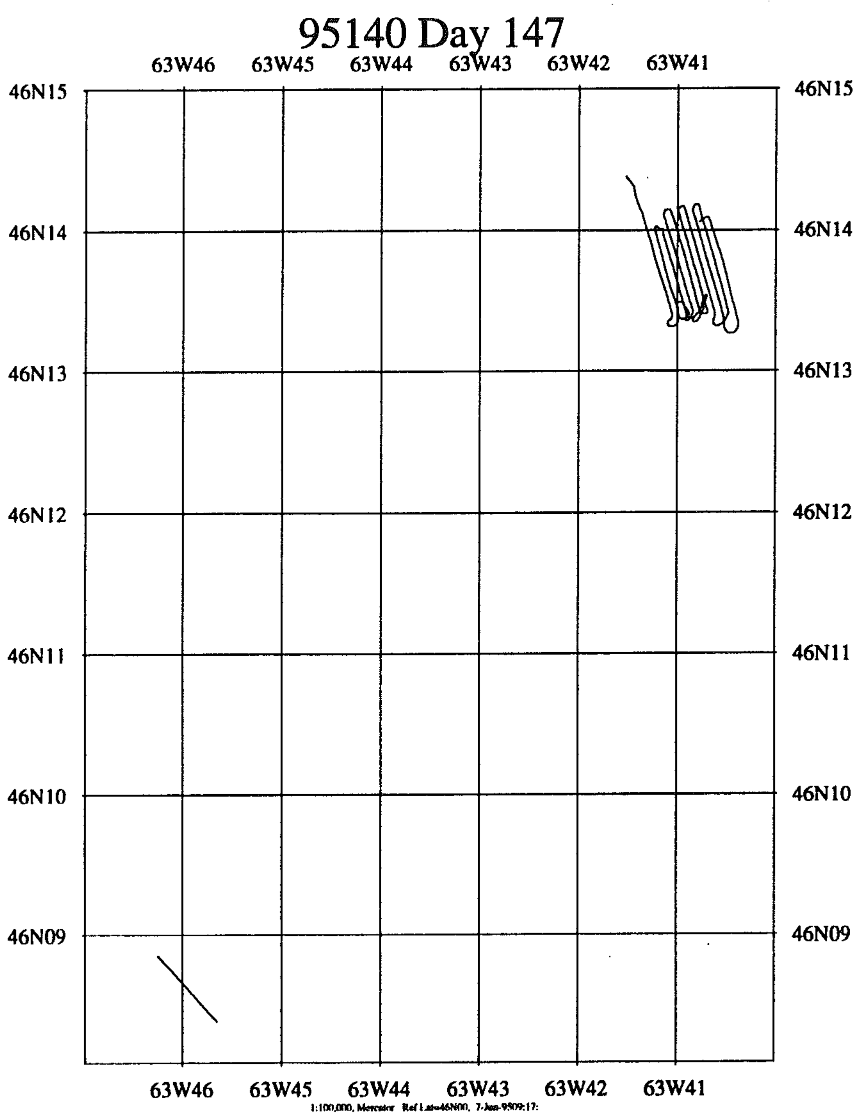


Figure 8.1.3. A detailed track plot of the mosaic of disposal site # 2.

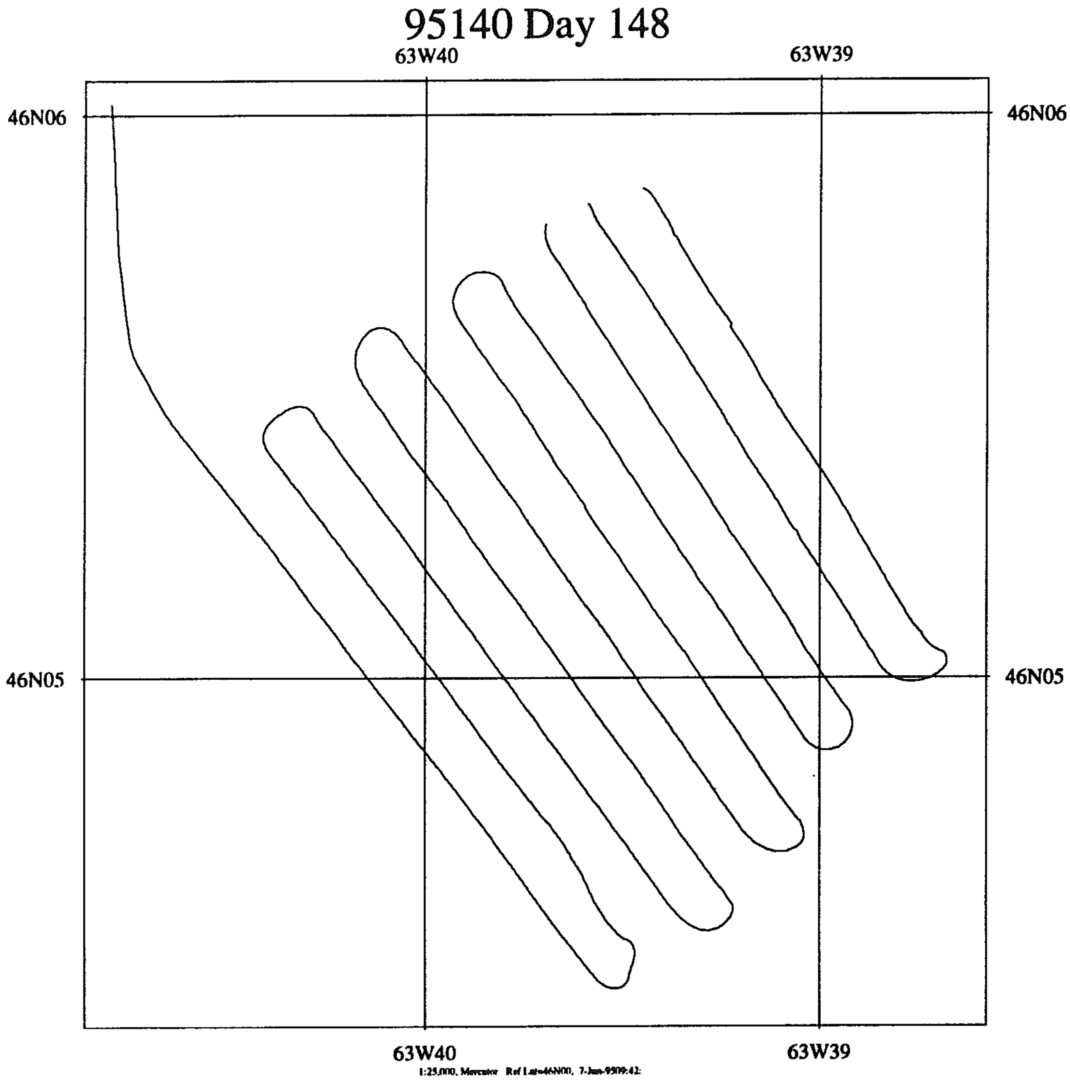


Figure 8.1.4. A detailed track plot of the mosaic of disposal site # 3.

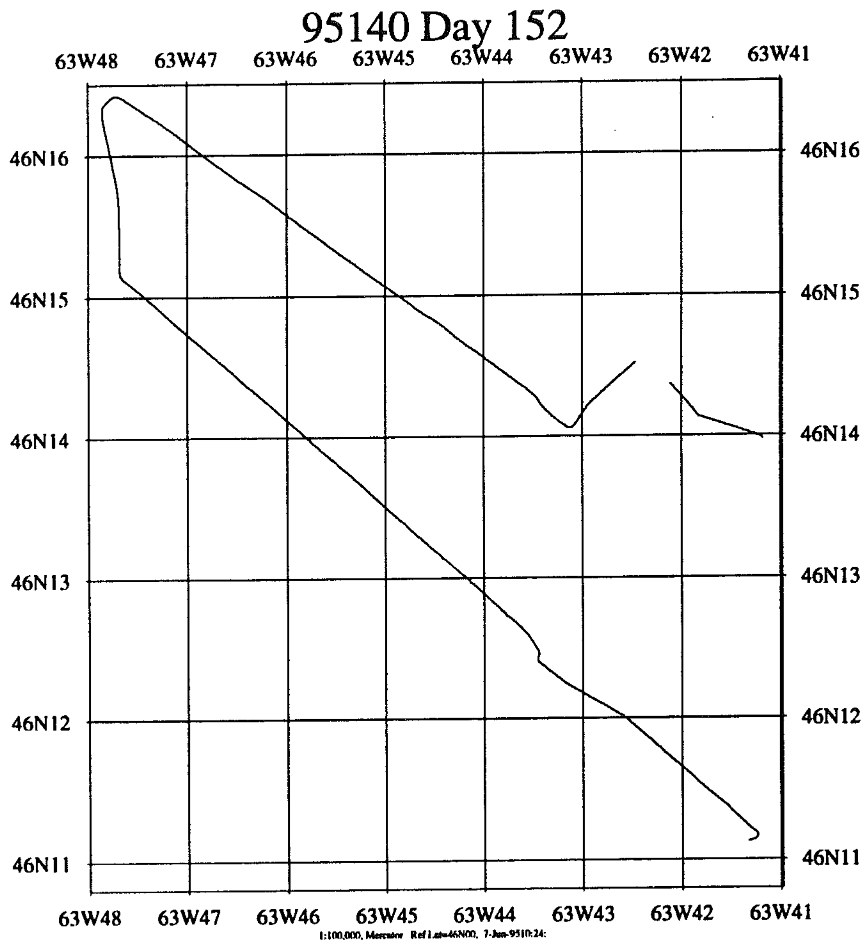


Figure 8.1.5. A detailed track plot of the regional cross lines of the Fixed Link Crossing.

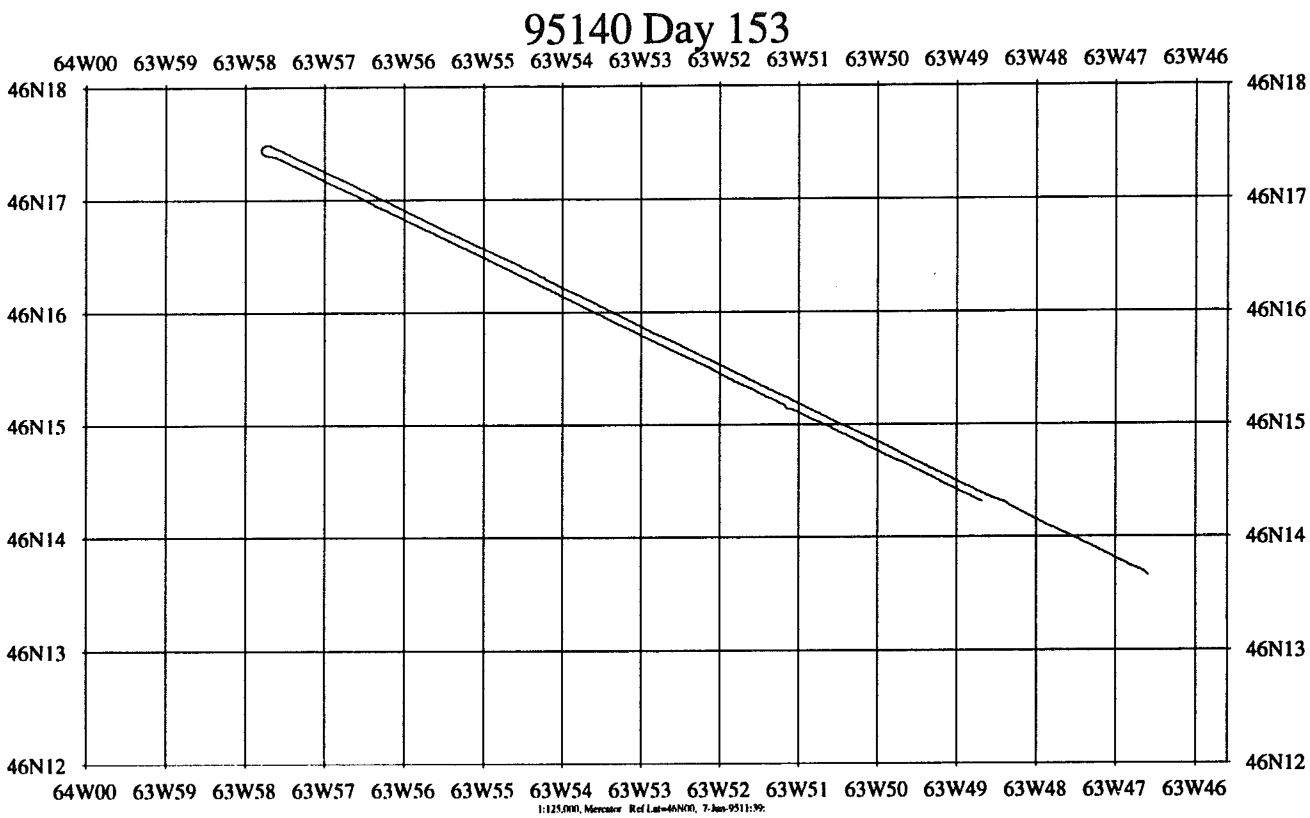


Figure 8.1.6. A detailed track plot of the channel approaches to Summerside (DPW survey).

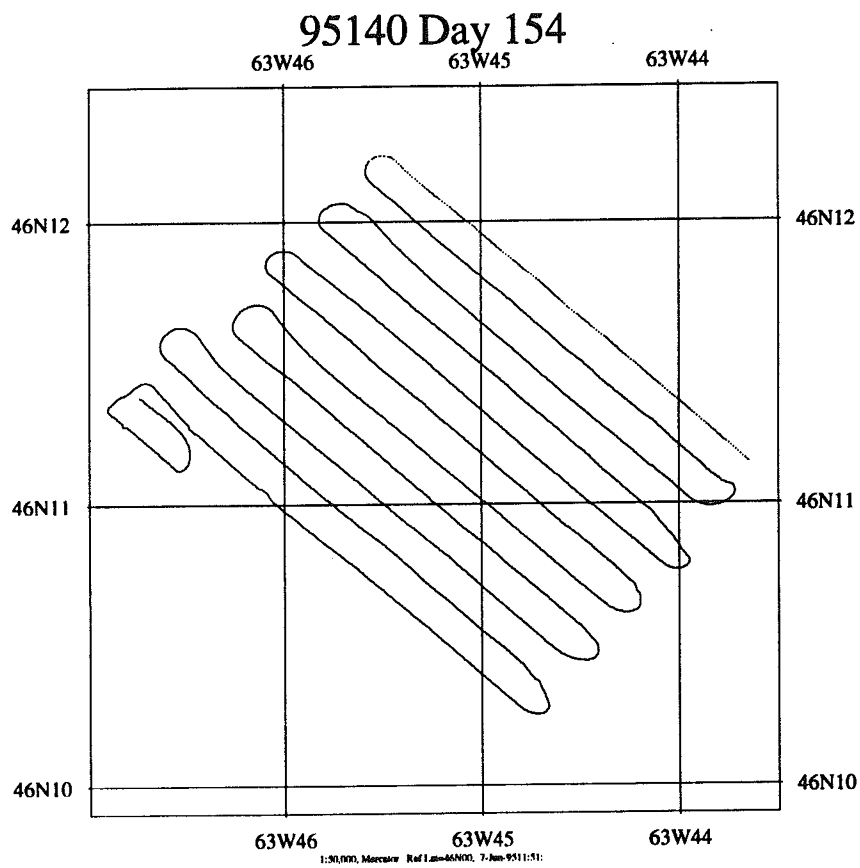


Figure 8.1.7. A detailed track plot of the mosaic of the DFO habitat stability study region survey on 3 June, 1995 (day 154).

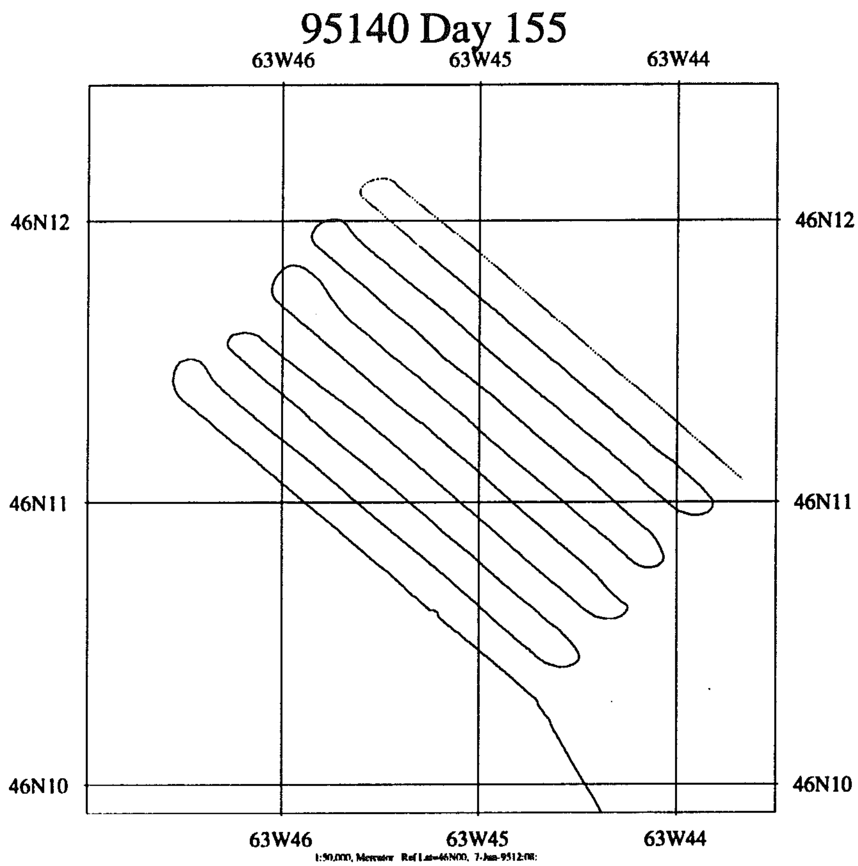


Figure 8.1.8. A detailed track plot of the mosaic of the DFO habitat stability study region survey on 4 June, 1995 (day 155).

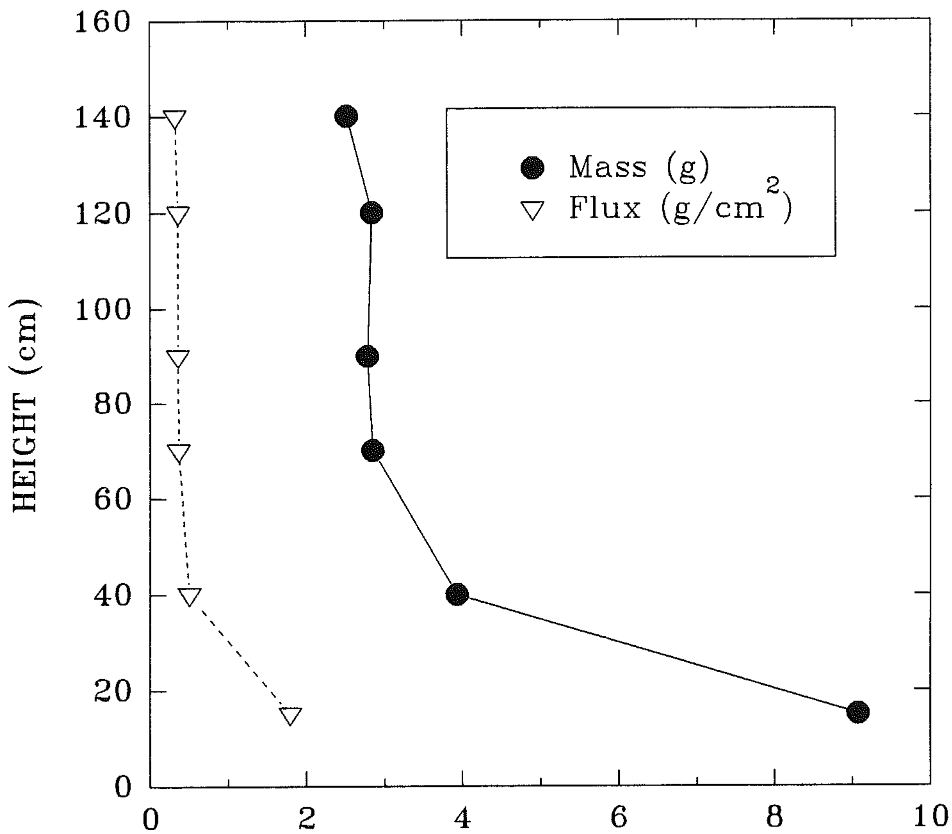


Figure 8.2.1. The mass of sediment collected in the six sediment traps on RALPH2 during its deployment at disposal site # 1. The majority of material was sand sized, and was collected in the lowermost 0.5 m.

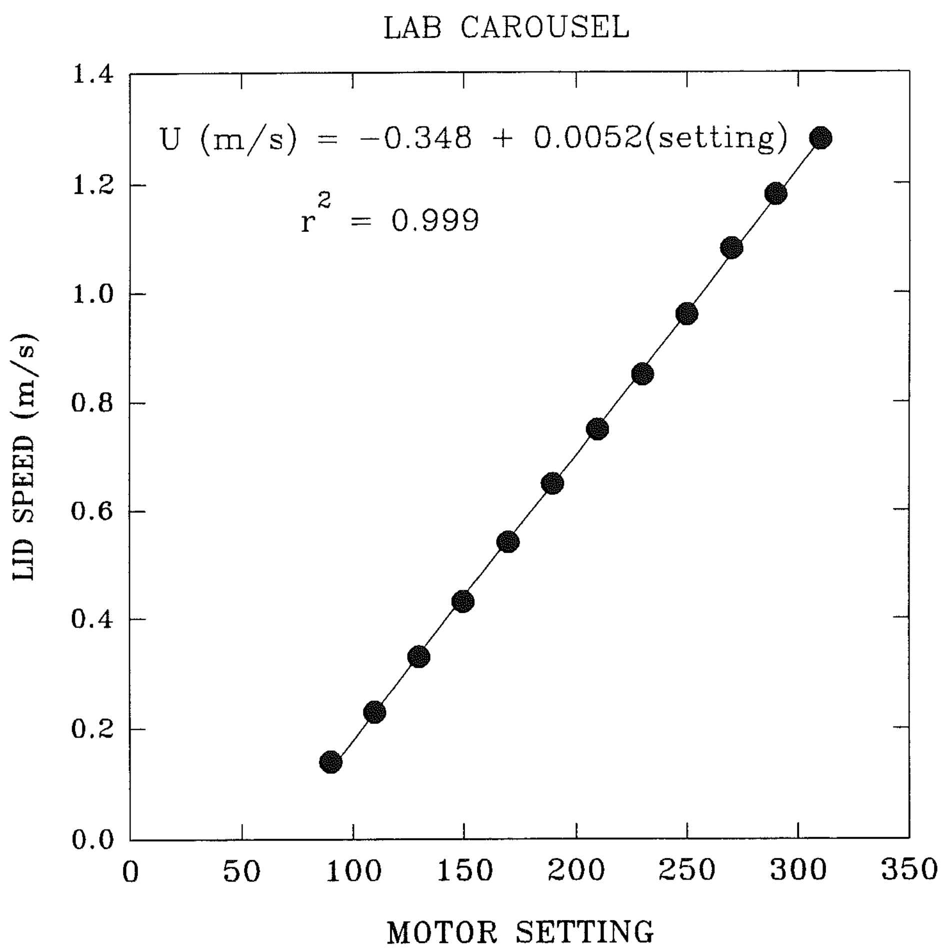


Figure 8.4.1. A regression analysis of the motor setting (mV) and lid speed (m/s) of the Lab Carousel.

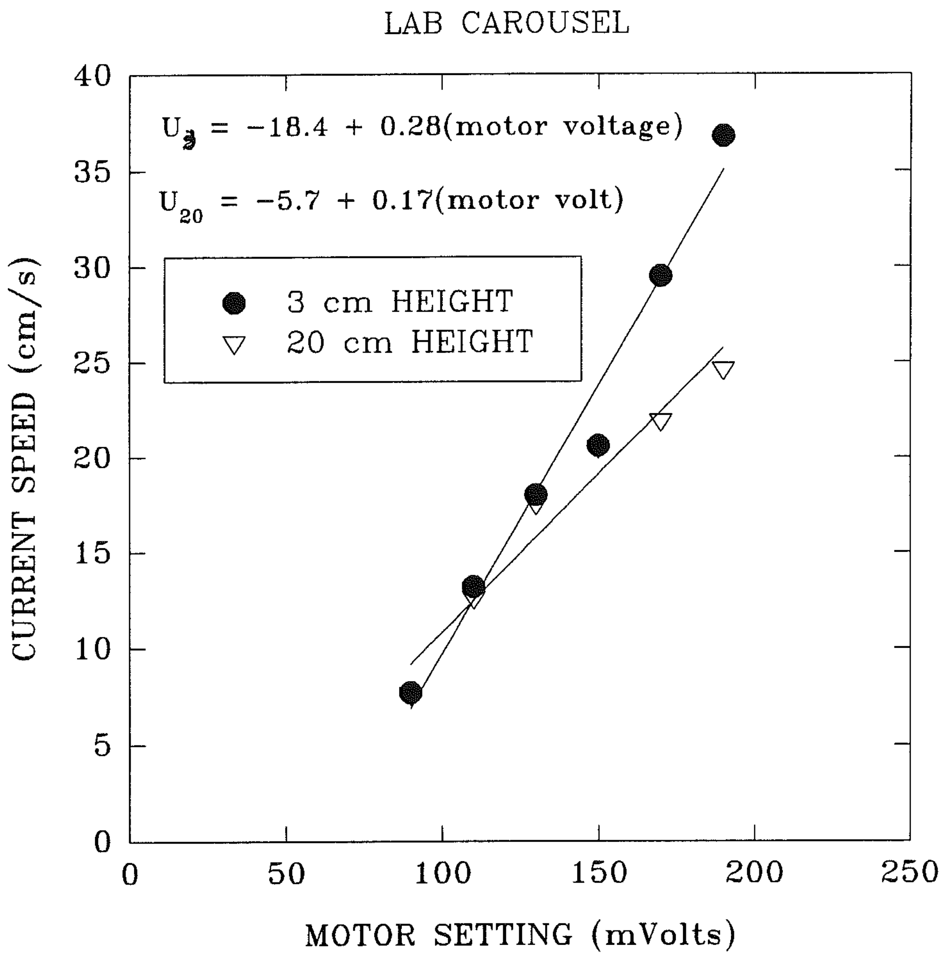


Figure 8.4.2. A regression analysis of the motor setting (mV) and current speed (m/s) measured at heights of 3 and 20 cm in the Lab Carousel.

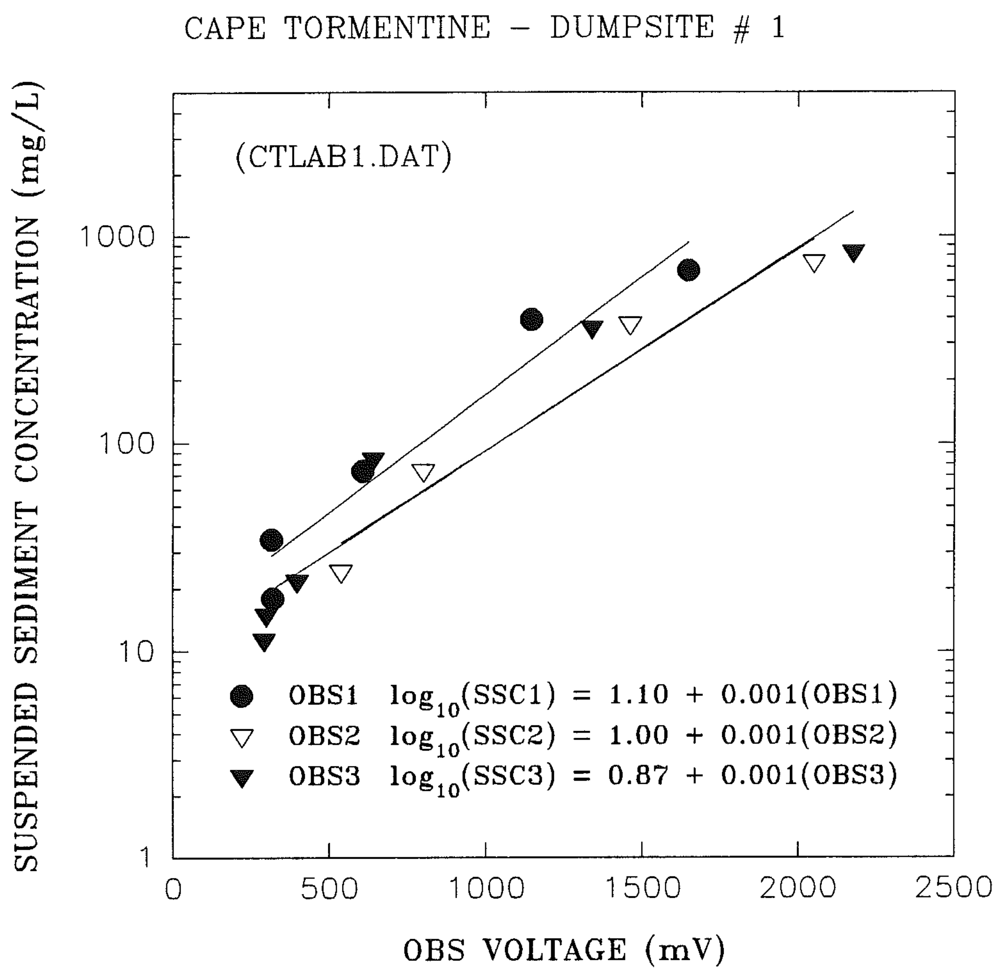


Figure 8.4.3. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab1 (disposal site # 1).

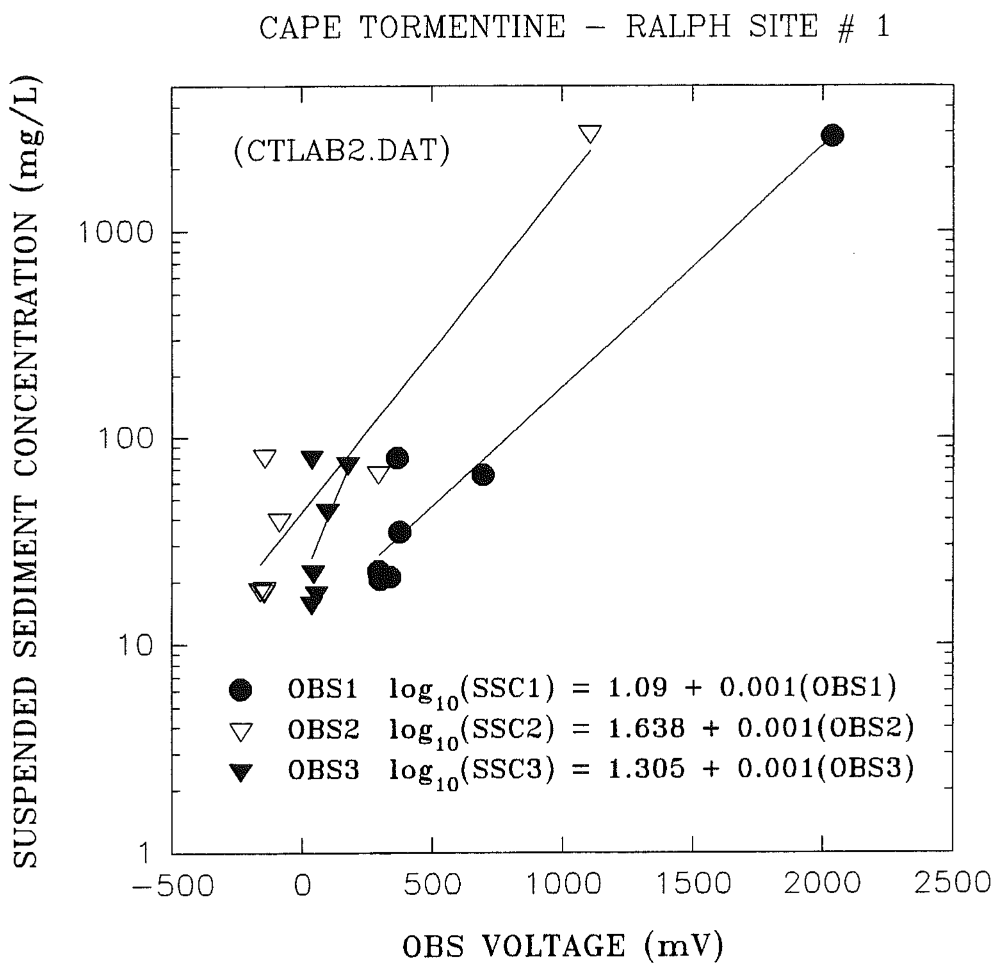


Figure 8.4.4. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab2 (RALPH2 site # 1).

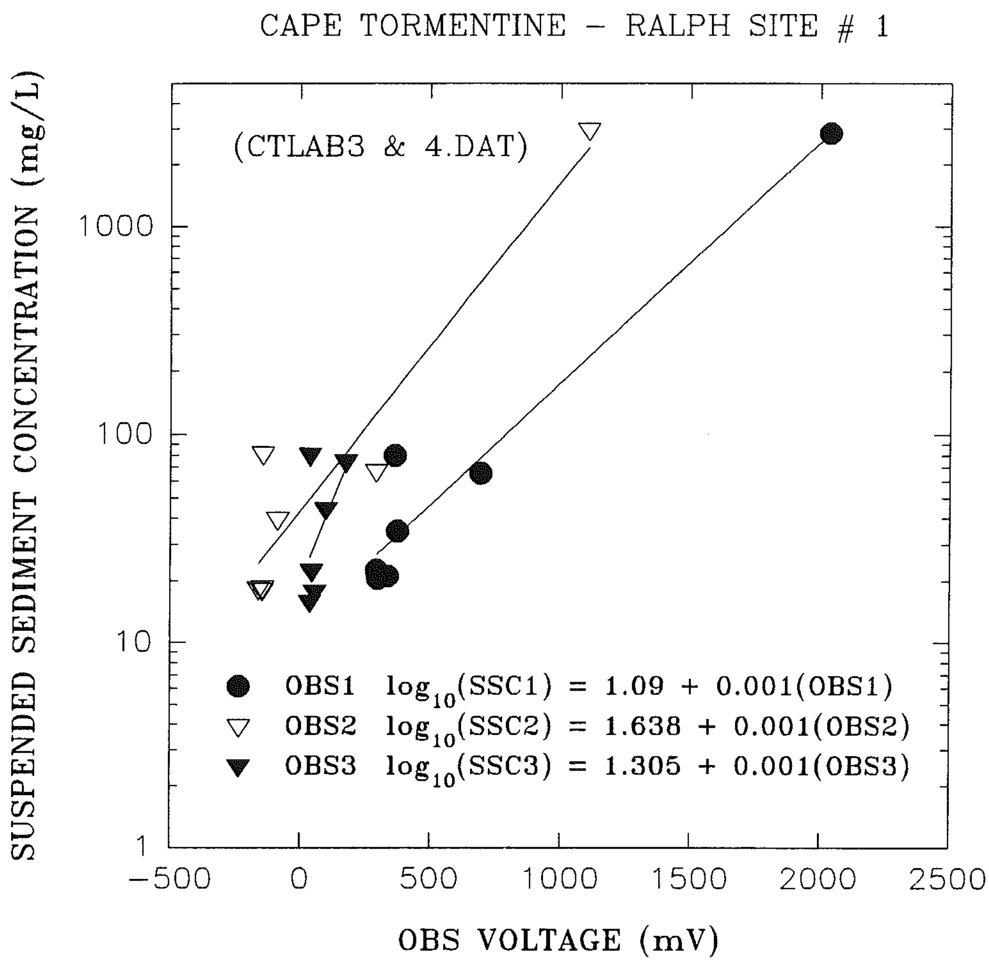


Figure 8.4.5. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab3 (RALPH2 site # 1).

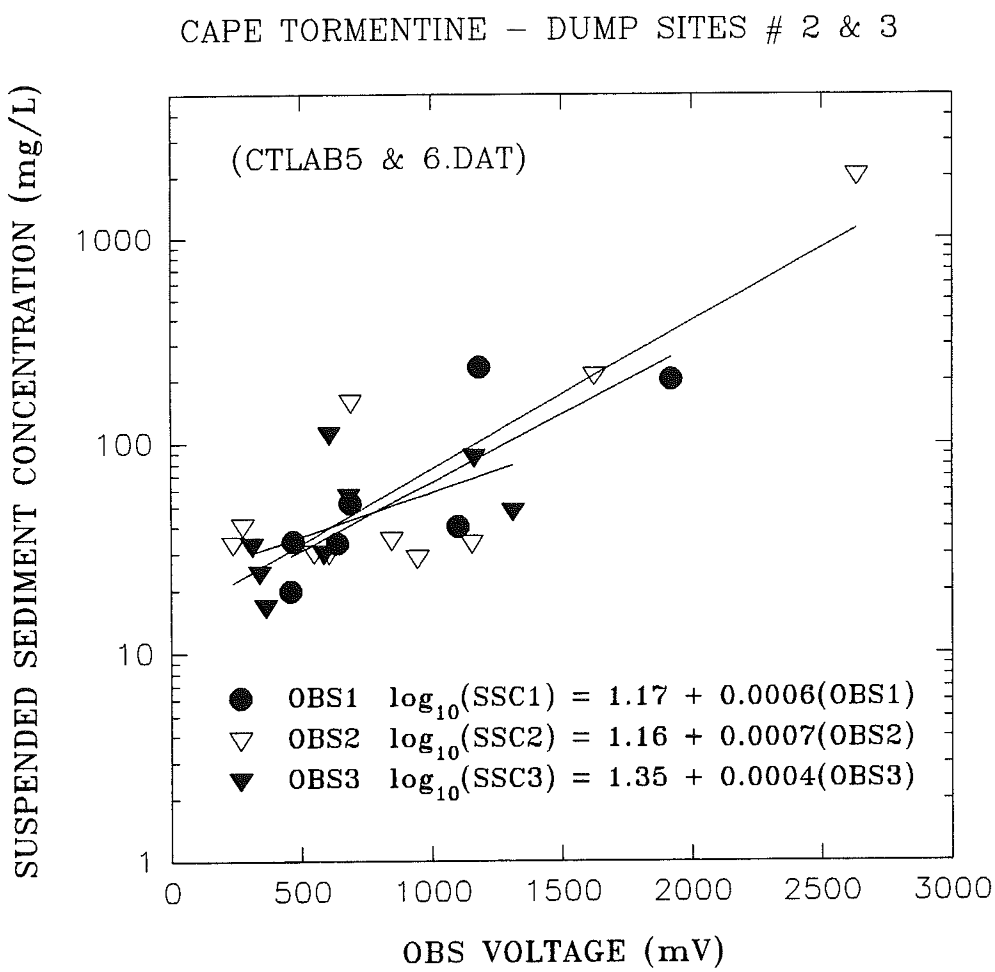


Figure 8.4.6. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab5 & 6 (disposal sites # 2 & 3).

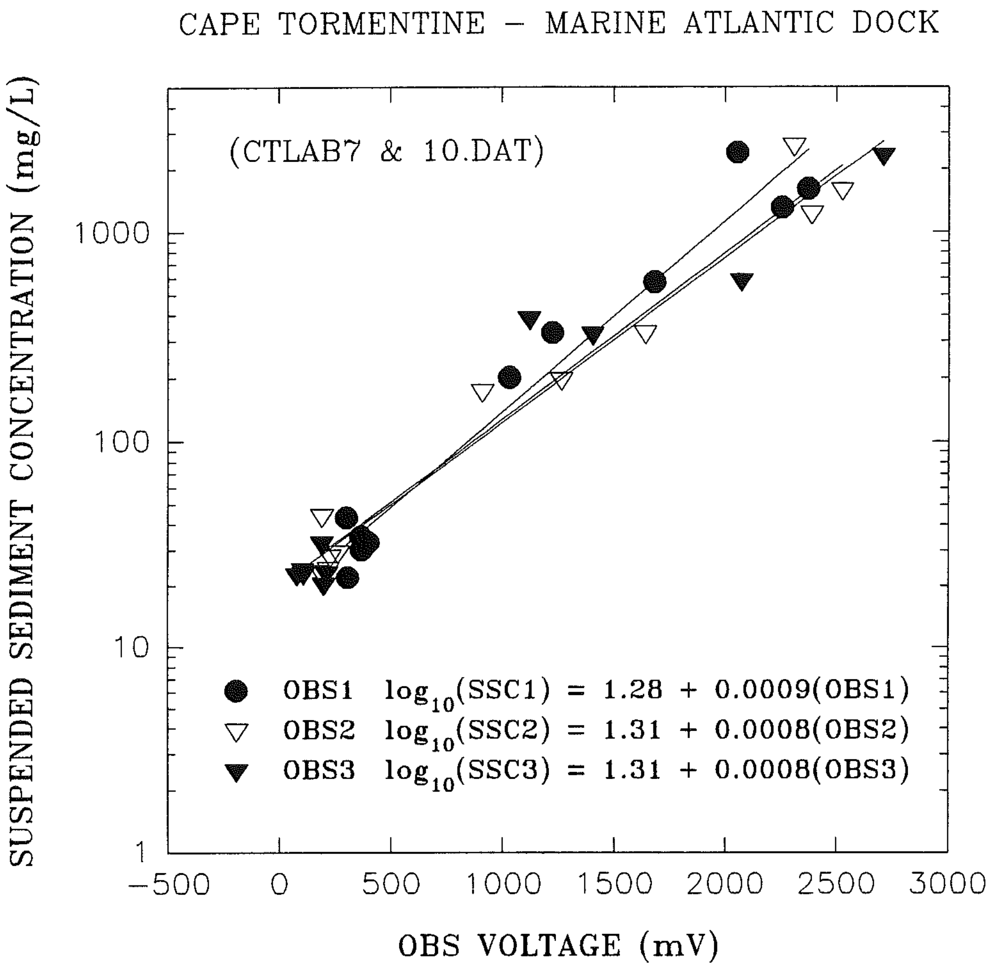


Figure 8.4.7. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab7 & 10 (Marine Atlantic dock).

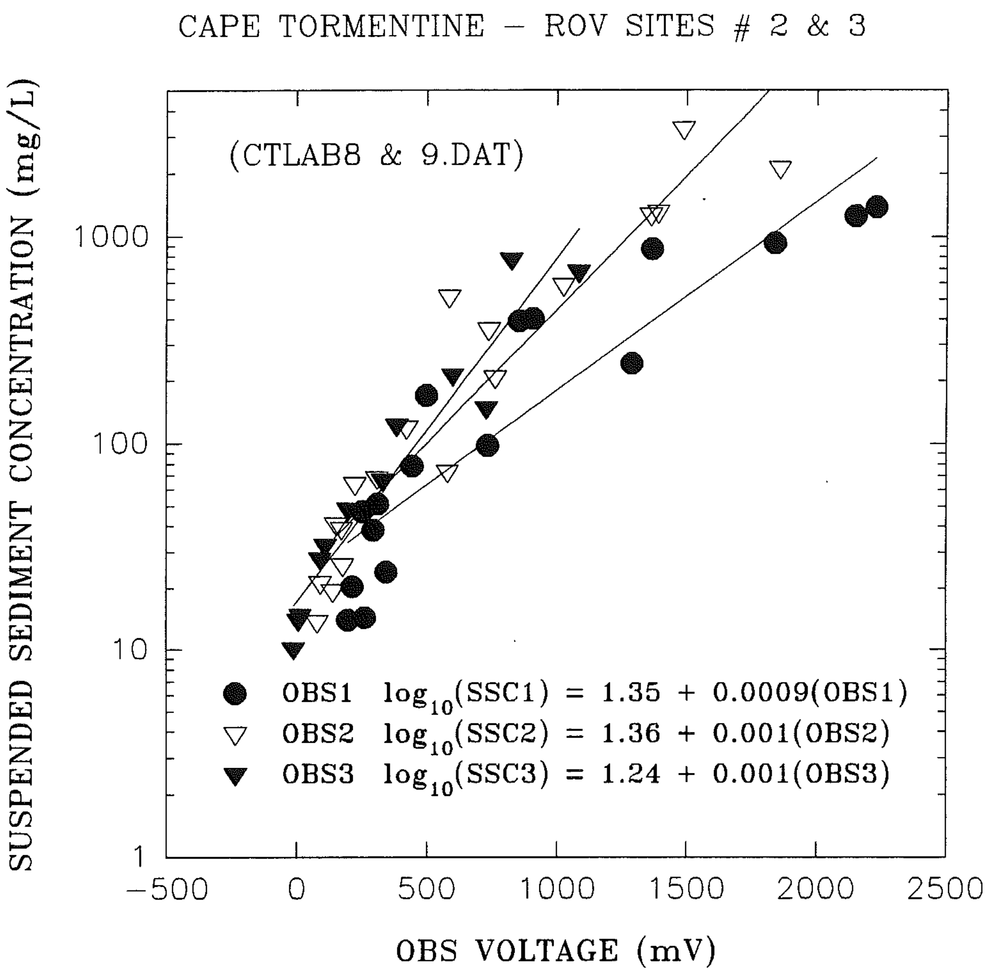


Figure 8.4.8. A regression analysis of OBS output (mV) and suspended sediment concentration (mg/L) for Lab Carousel experiment Ctlab8 & 9 (ROV sites 2 & 3).

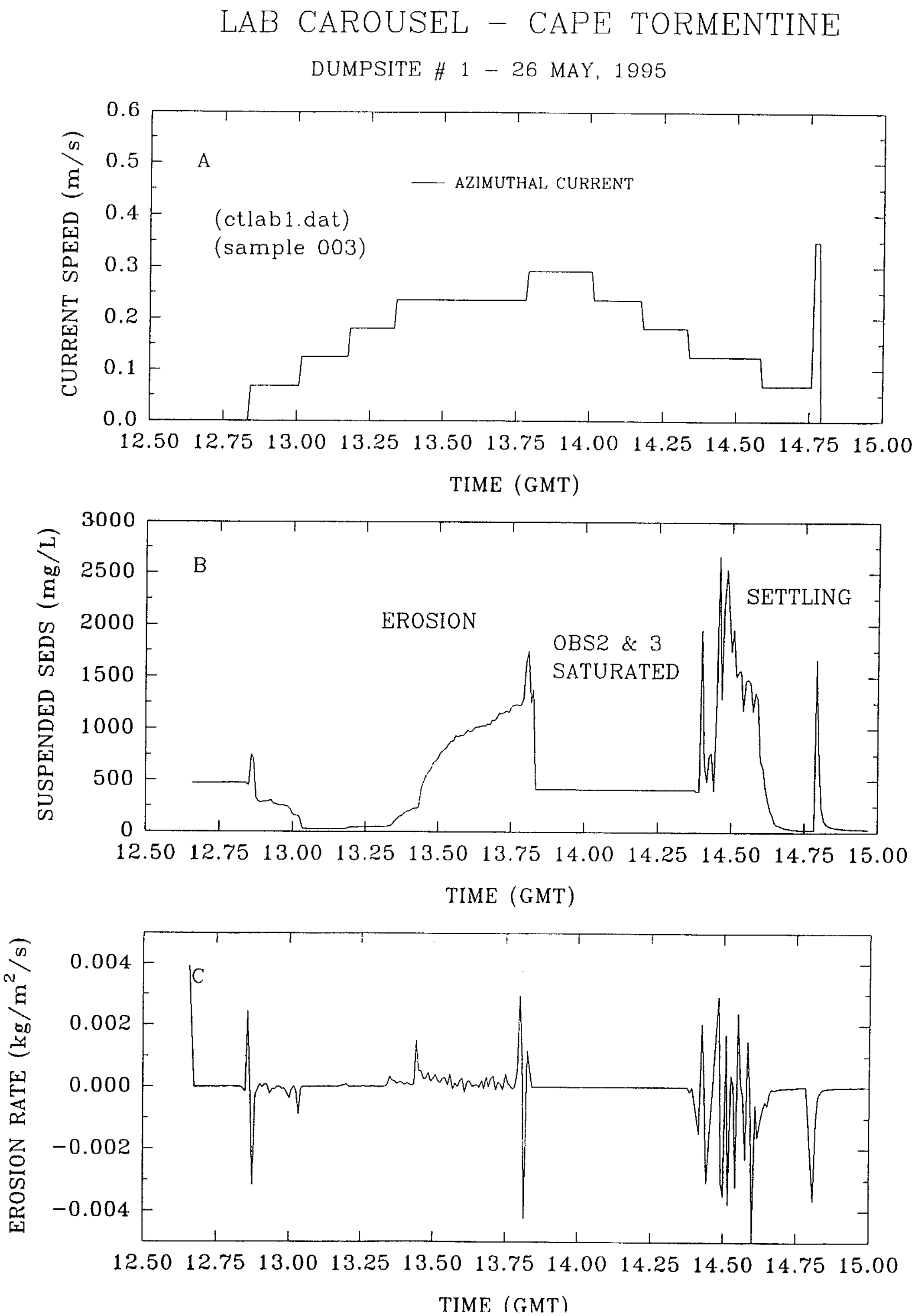


Figure 8.4.9. A time-series plot of Lab Carousel analysis of sample 003 (disposal site # 1).

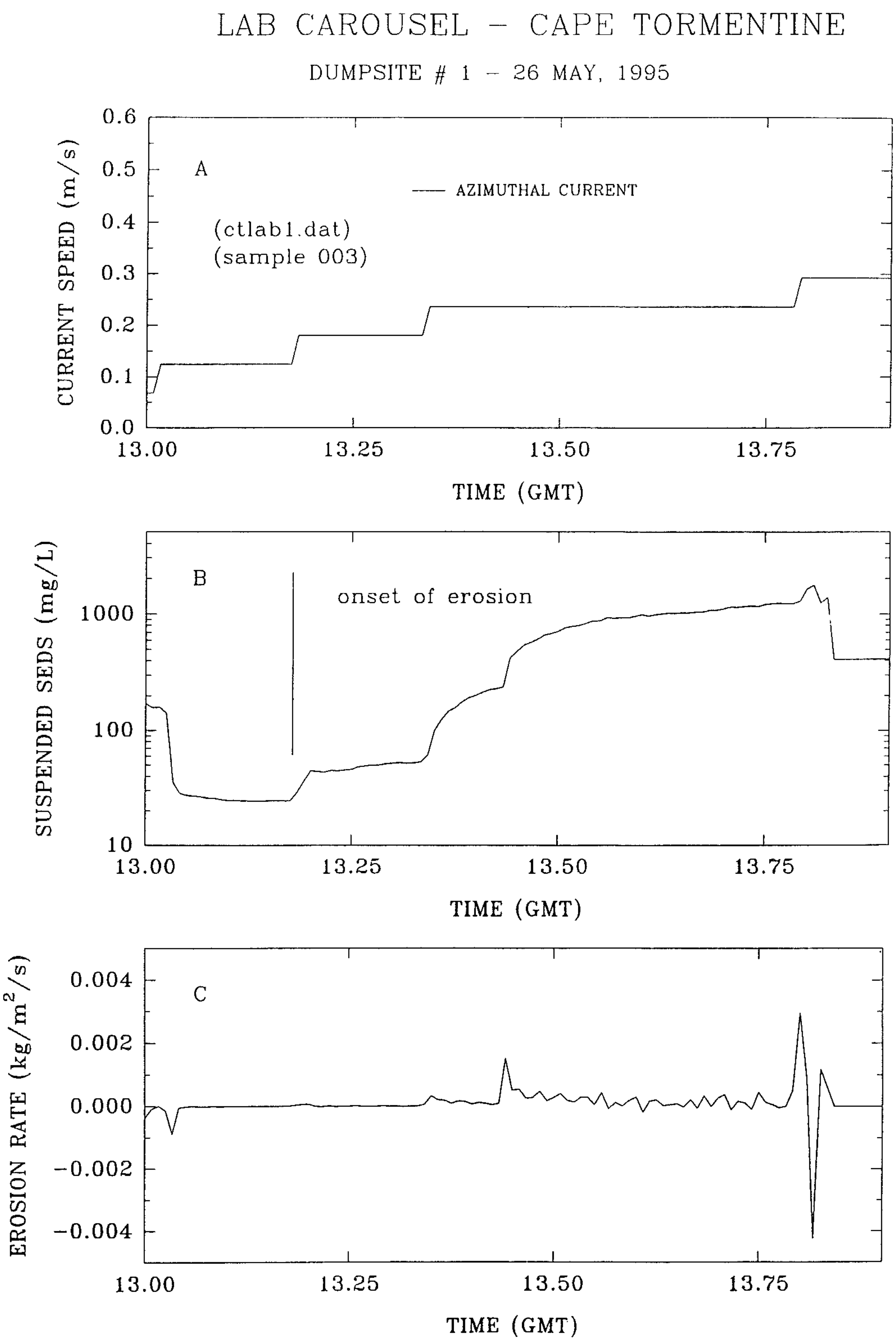


Figure 8.4.10. A time-series plot of Lab Carousel analysis of sample 003 (disposal site # 1).

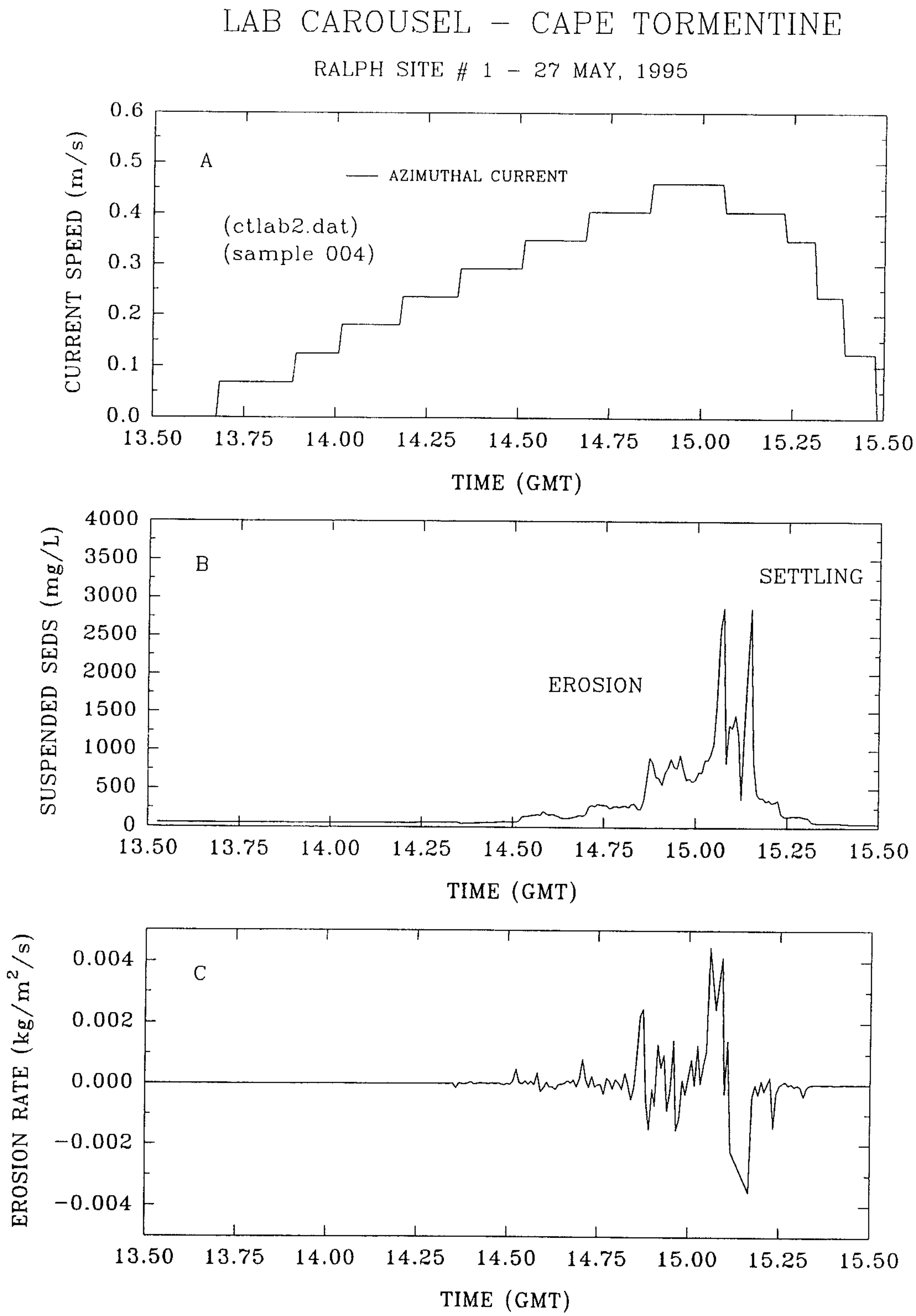


Figure 8.4. 11. A time-series plot of Lab Carousel analysis of sample 004 (RALPH2 site # 1)

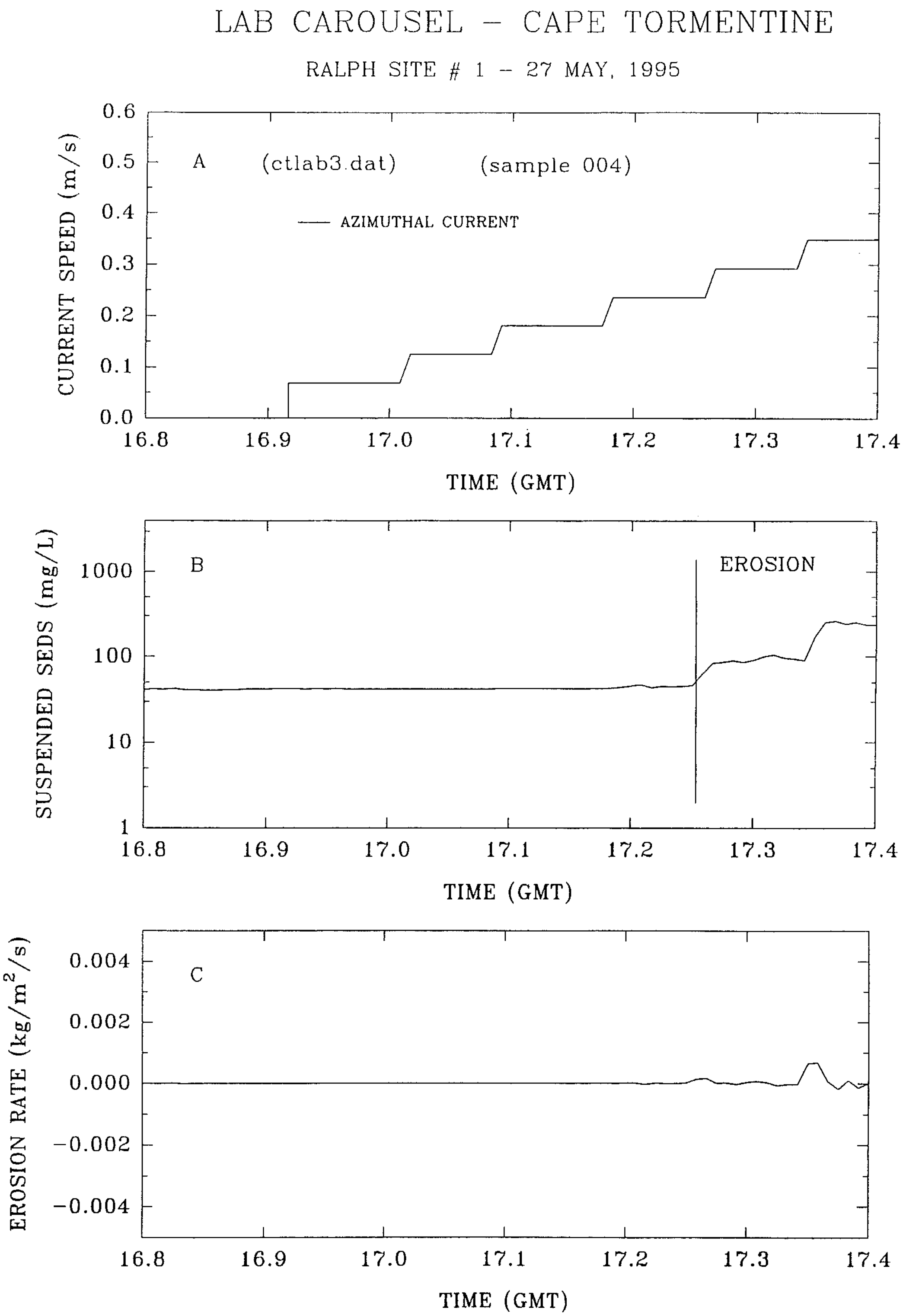


Figure 8.4.12. A time-series plot of Lab Carousel analysis of sample 004 (RALPH2 site # 1).

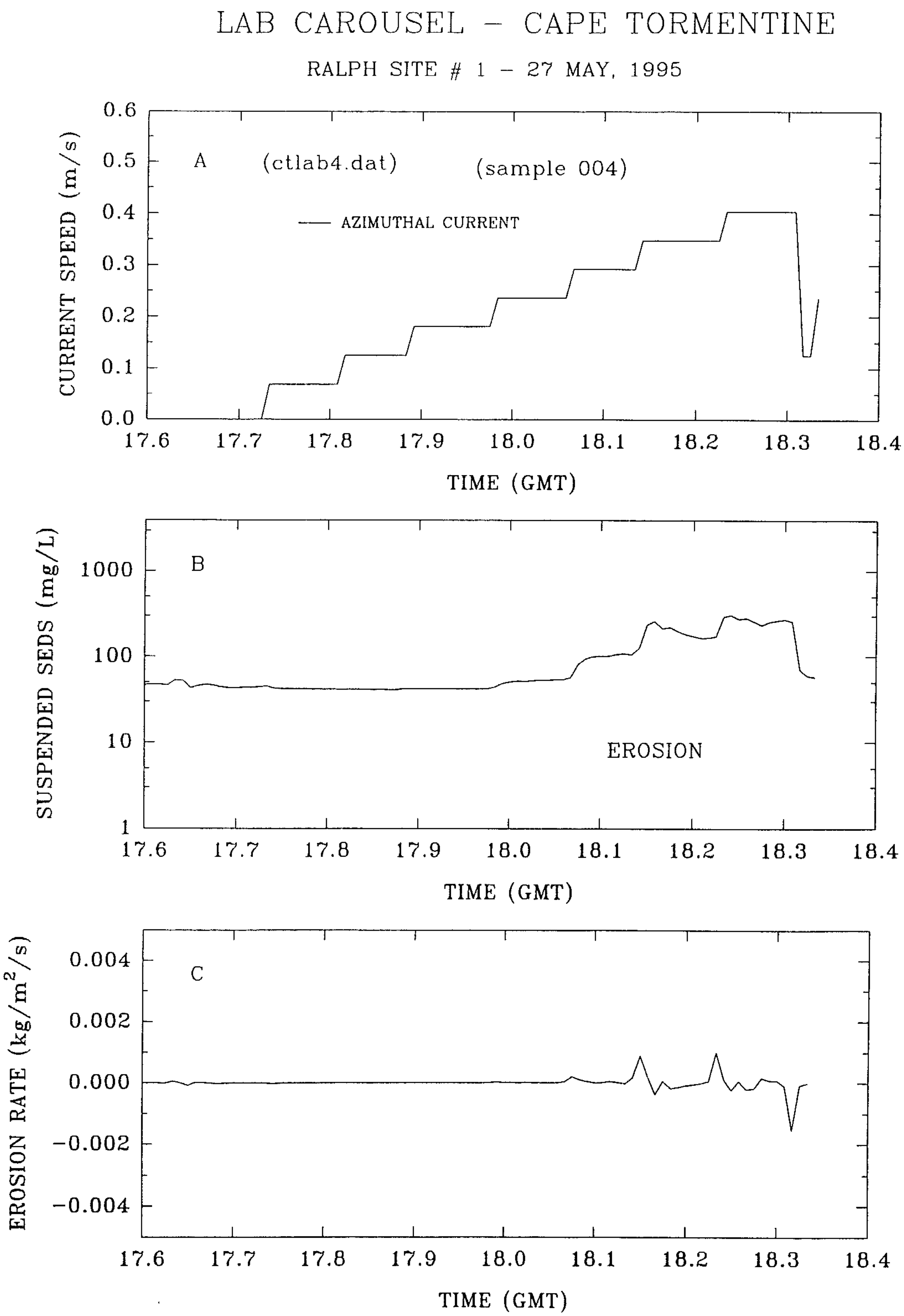


Figure 8.4.13. A time-series plot of Lab Carousel analysis of sample 004 (RALPH2 site # 1)

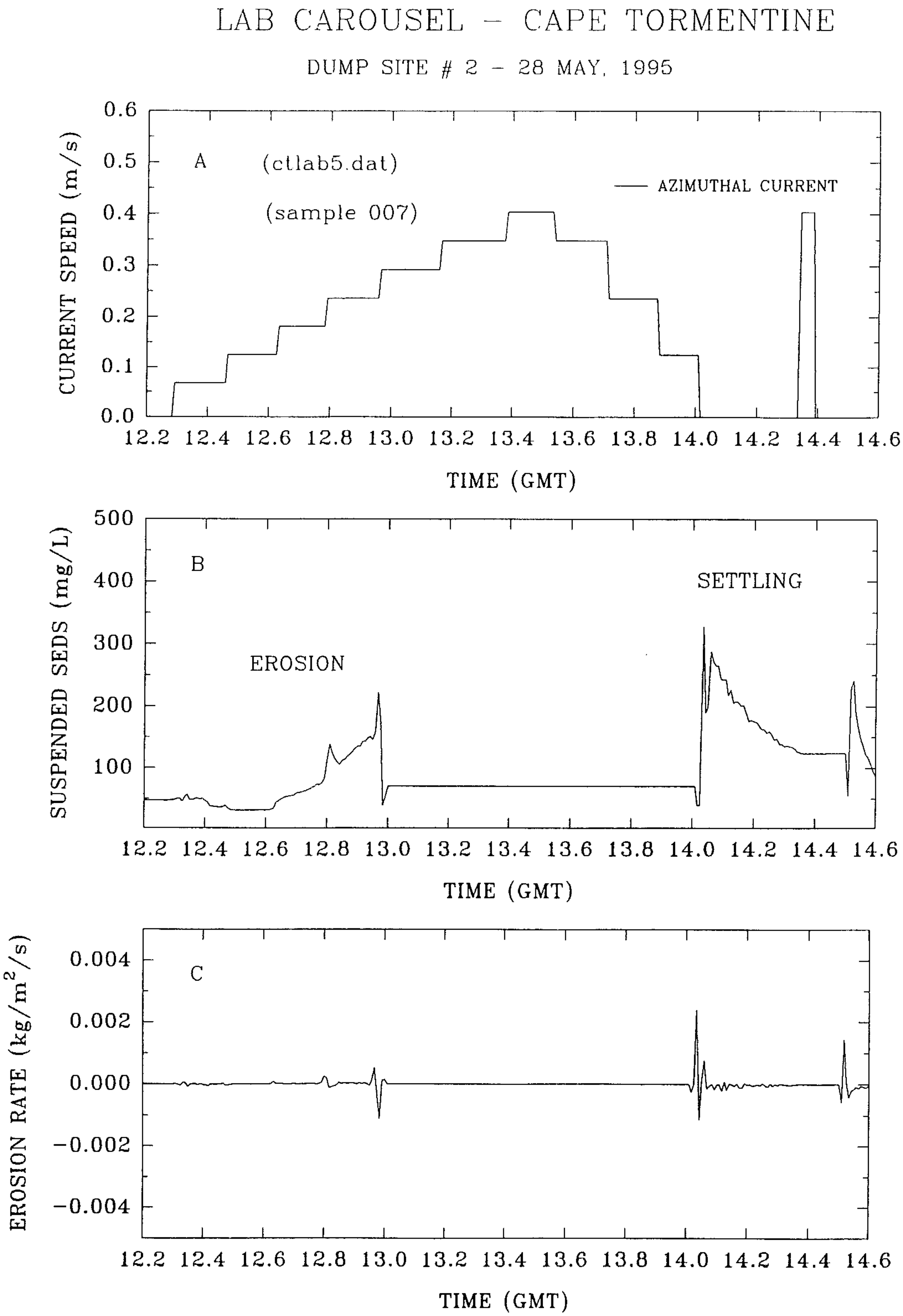


Figure 8.4.14. A time-series plot of Lab Carousel analysis of sample 007 (disposal site # 2)

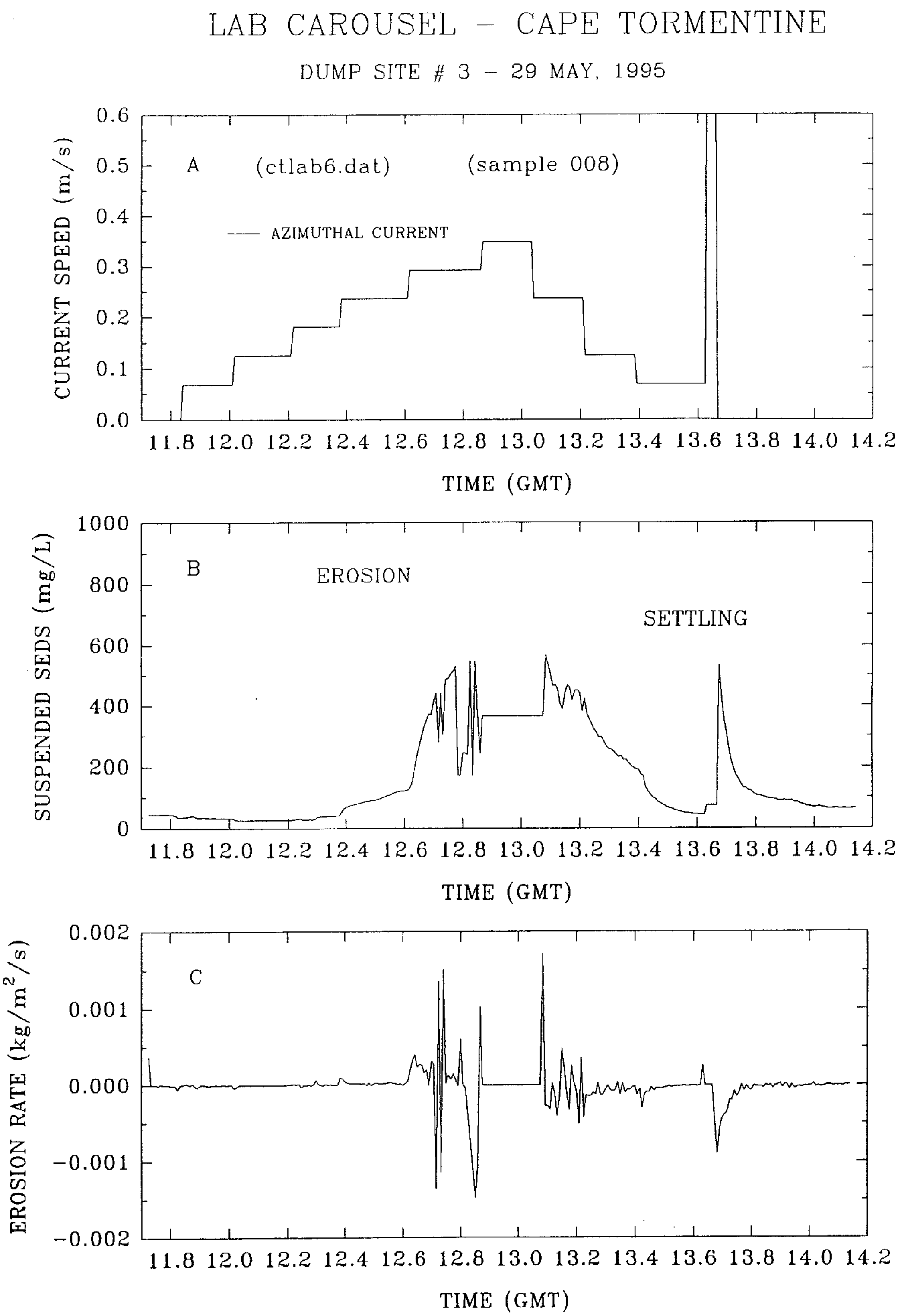


Figure 8.4.15. A time-series plot of Lab Carousel analysis of sample 008 (disposal site # 3).

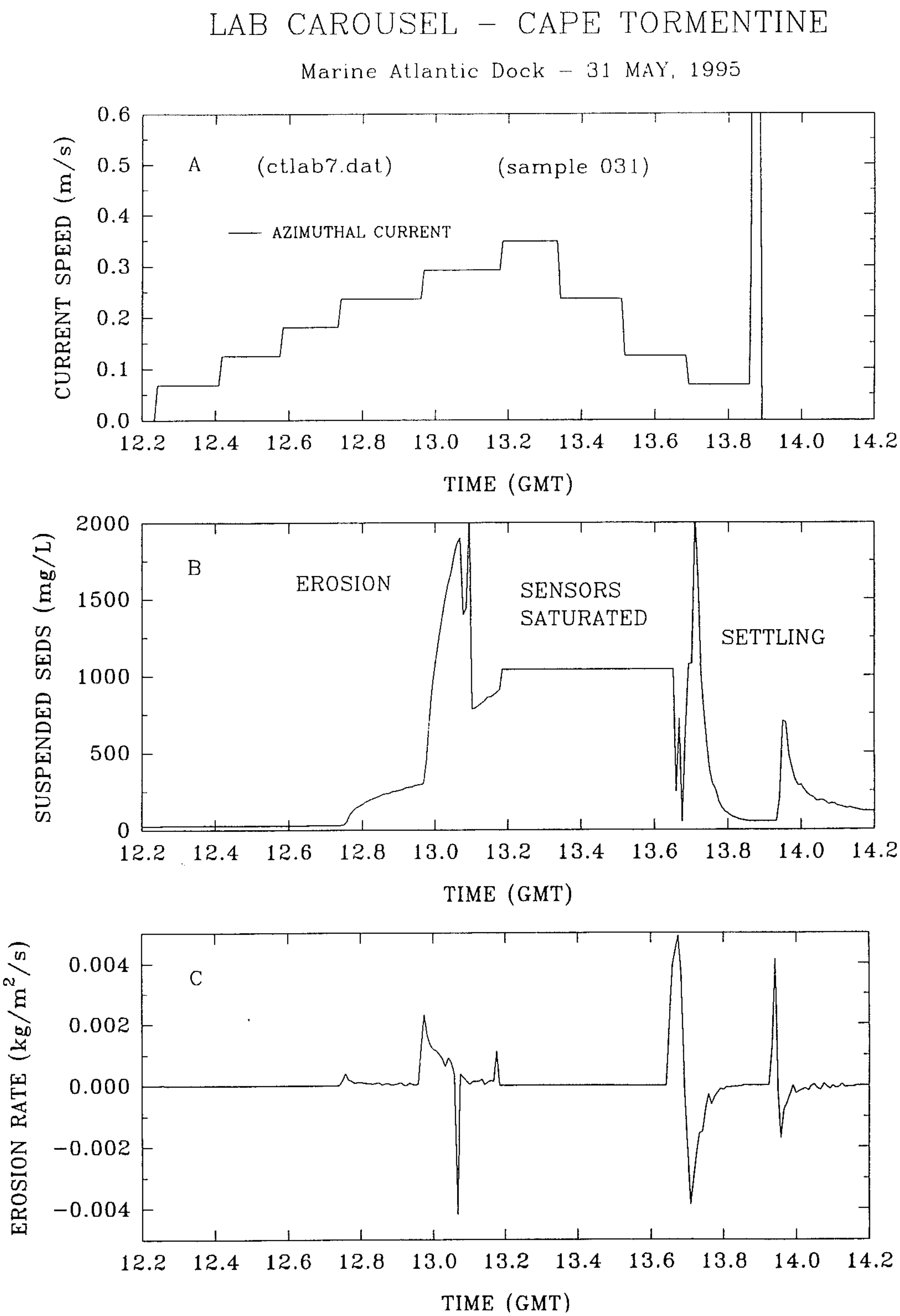


Figure 8.4. 16. A time-series plot of Lab Carousel analysis of sample 031 (Marine Atlantic dock).

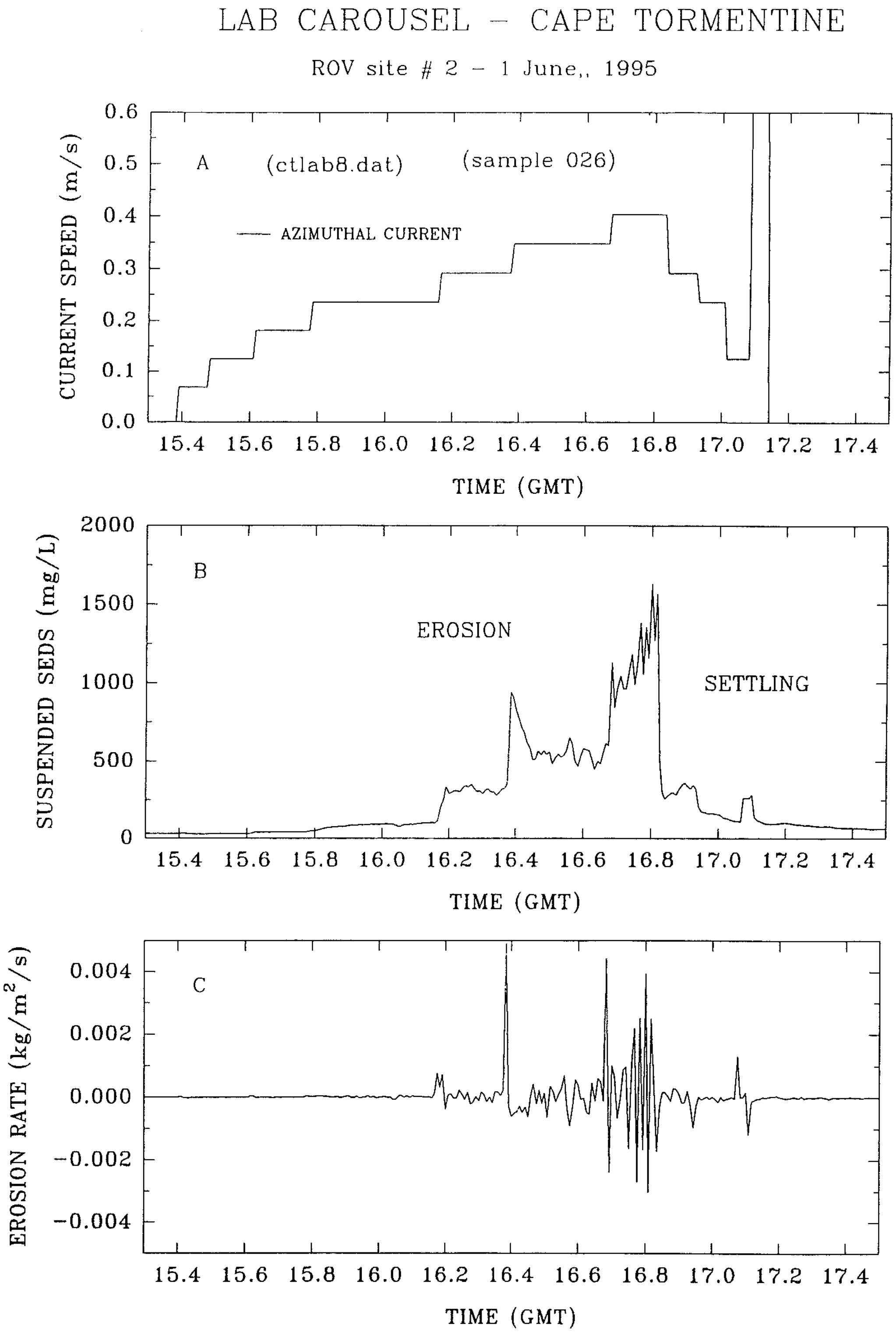


Figure 8.4.17. A time-series plot of Lab Carousel analysis of sample 026 (ROV site # 2)

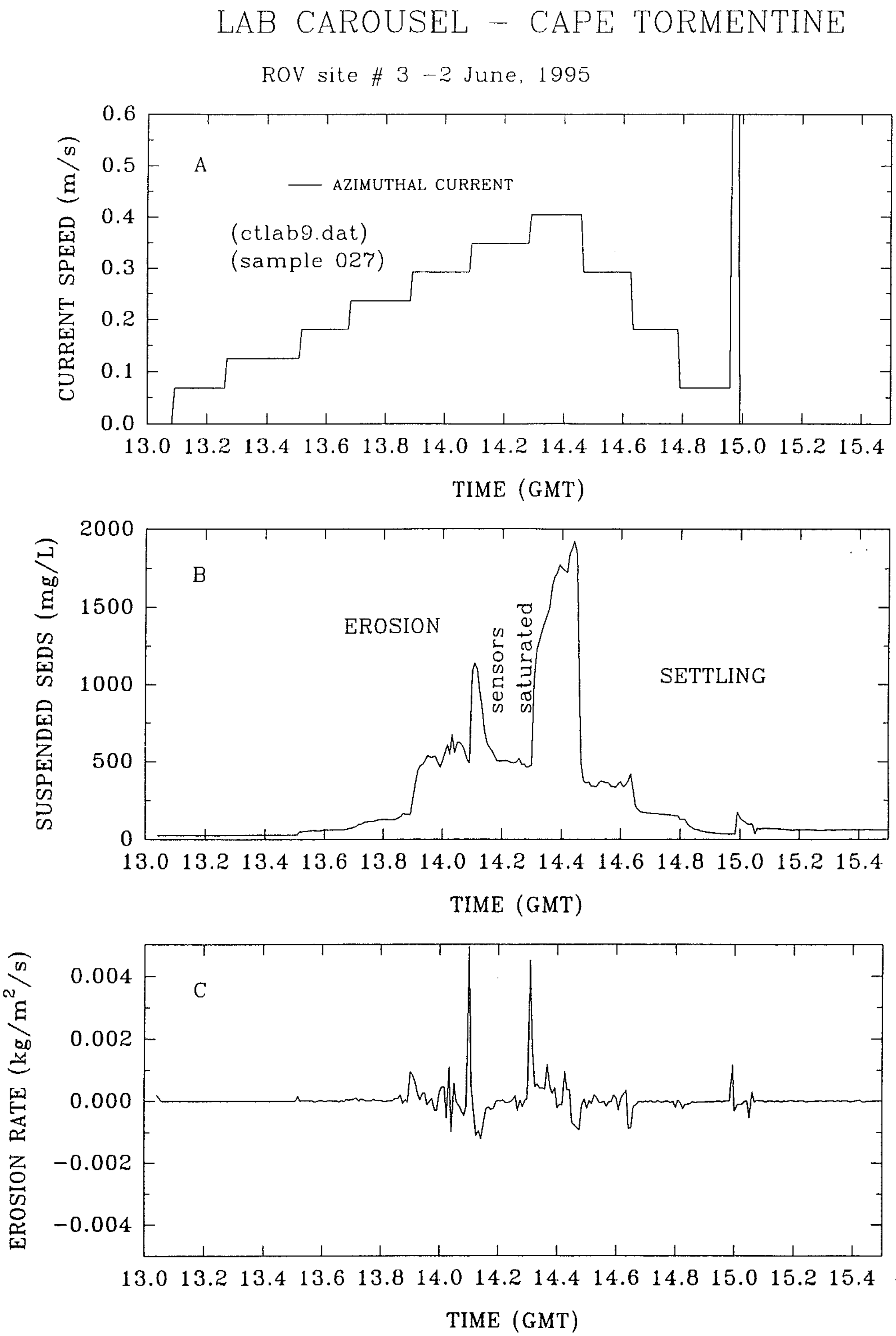


Figure 8.4.18. A time-series plot of Lab Carousel analysis of sample 027 (ROV site # 3).

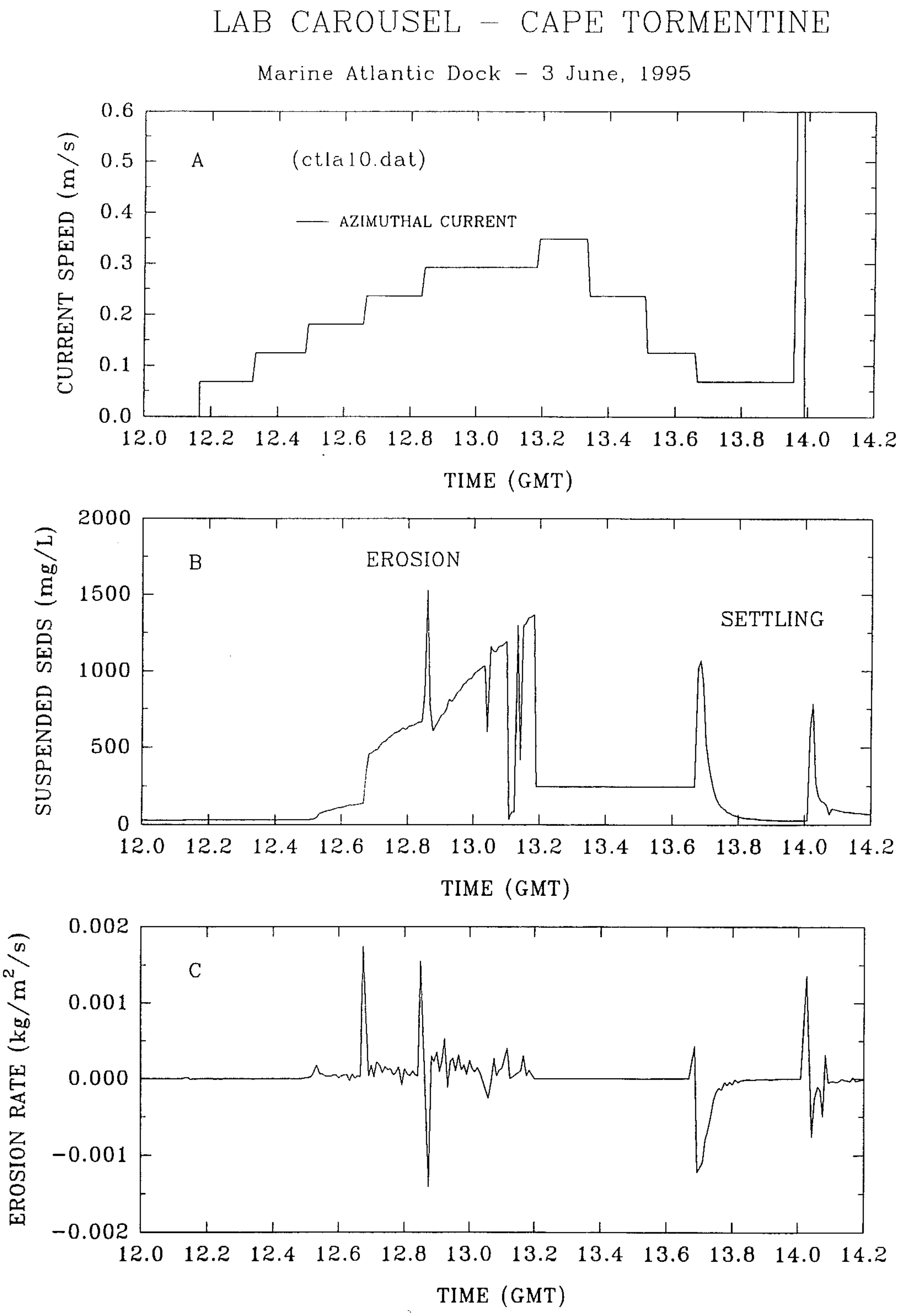
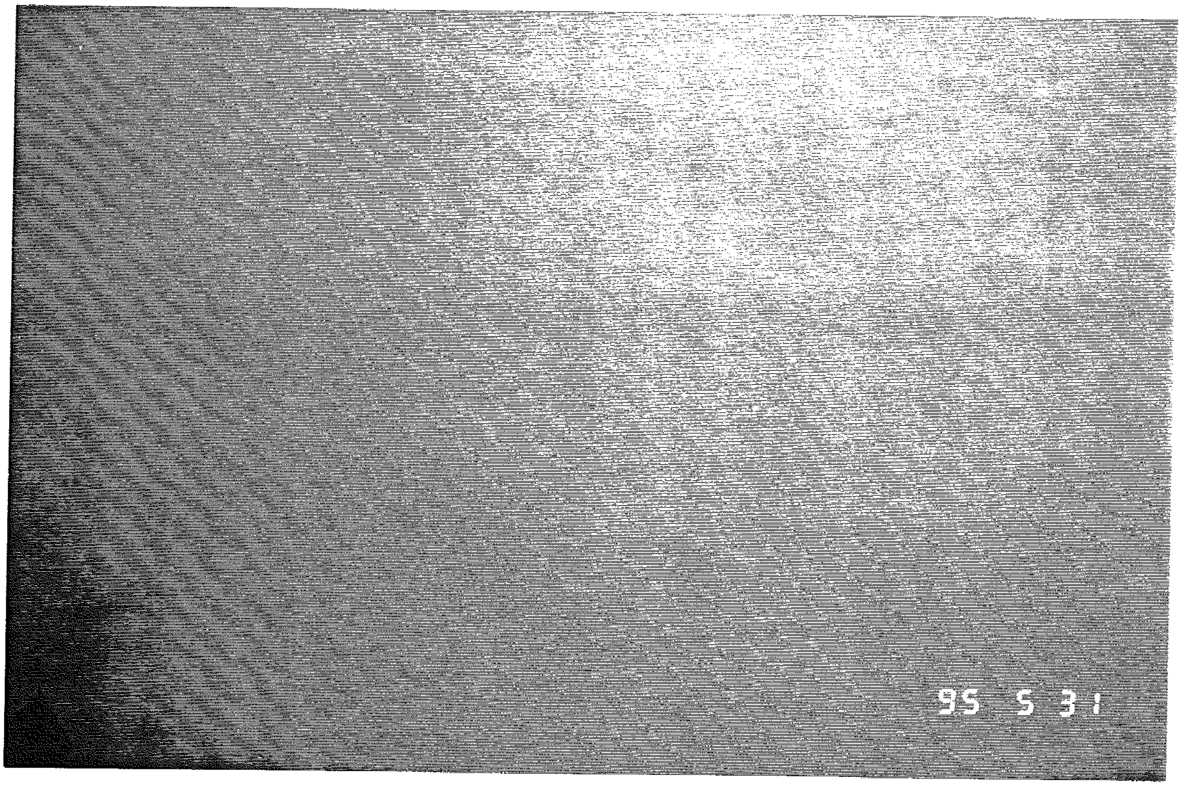


Figure 8.4.19. A time-series plot of Lab Carousel analysis of sample 007 (Marine Atlantic dock)



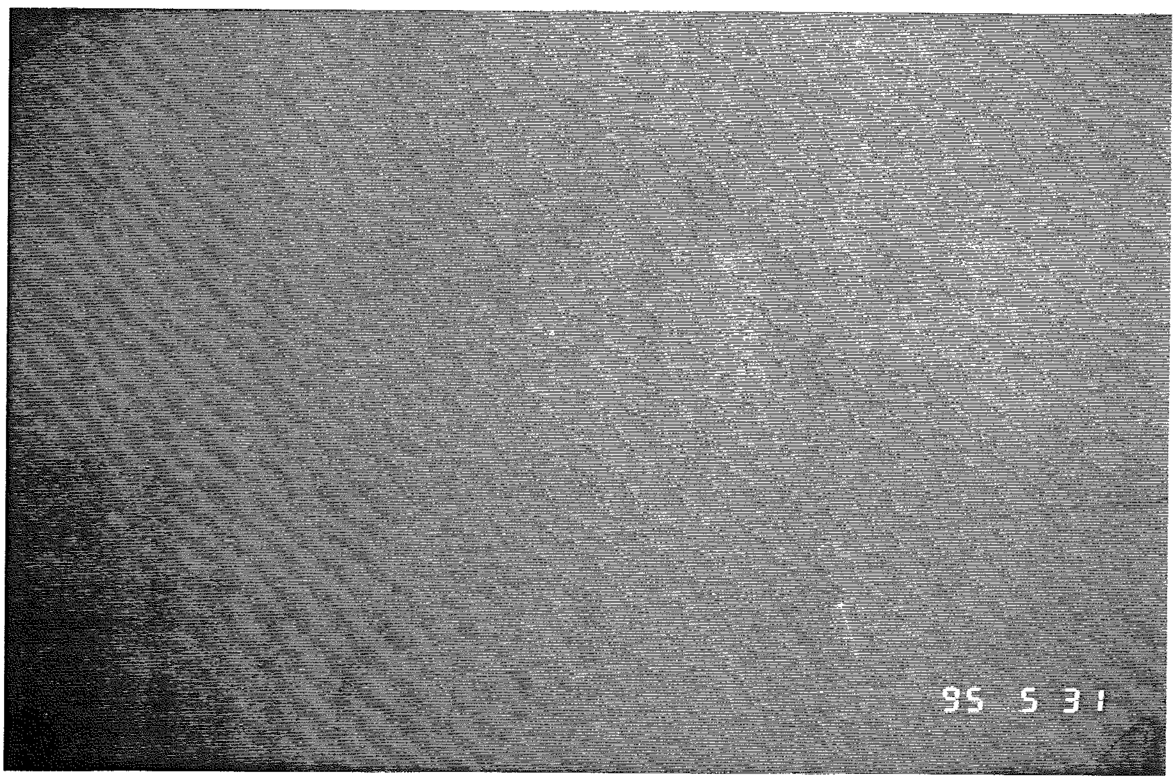


Figure 8.6.1. Seabed photographs from disposal site # 1 (ROV site # 1). The image quality is poor because of a high organic content in the water column. Nevertheless, cobbles can be seen in both photographs. The photograph size is 60 x 100 cm.

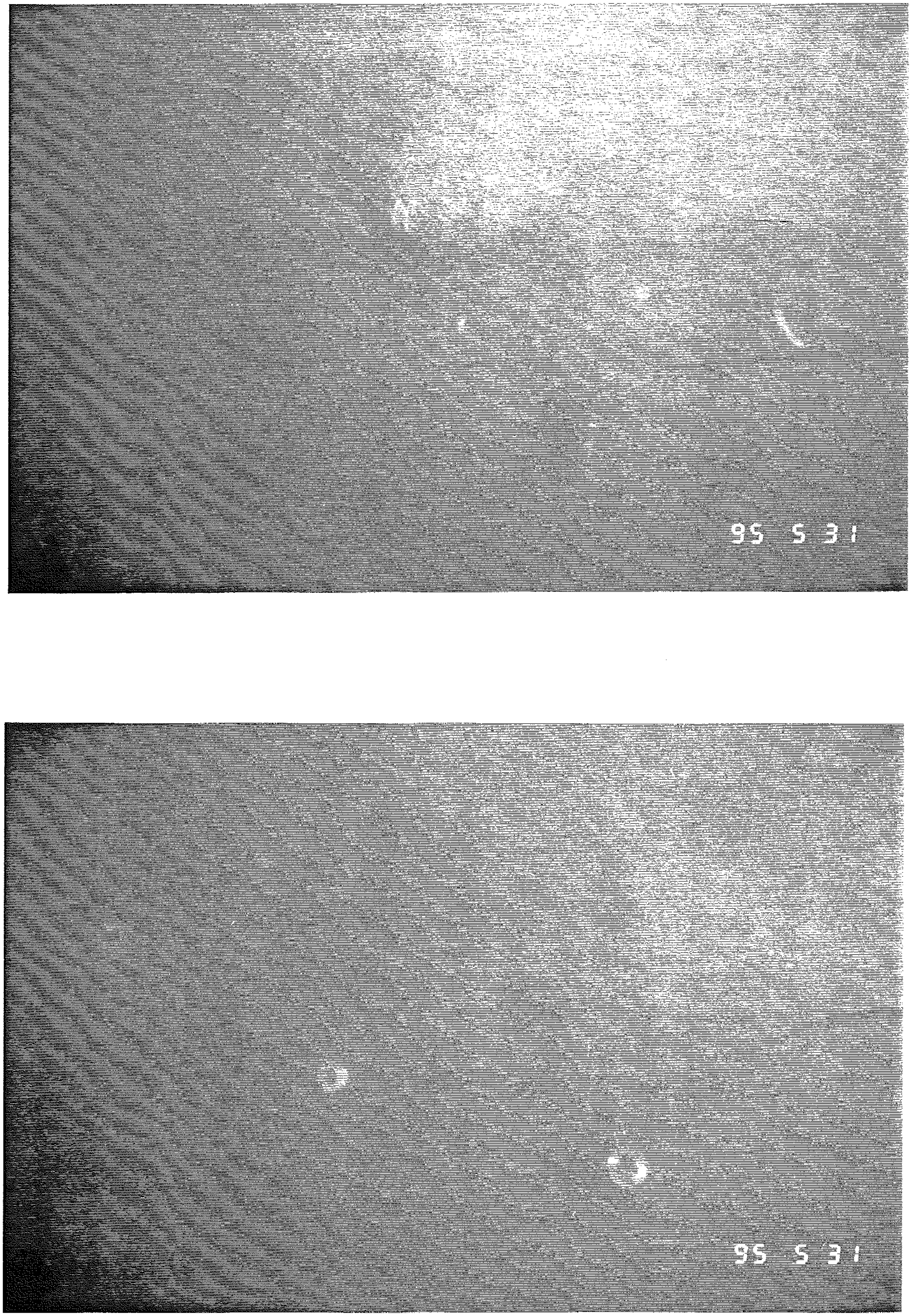
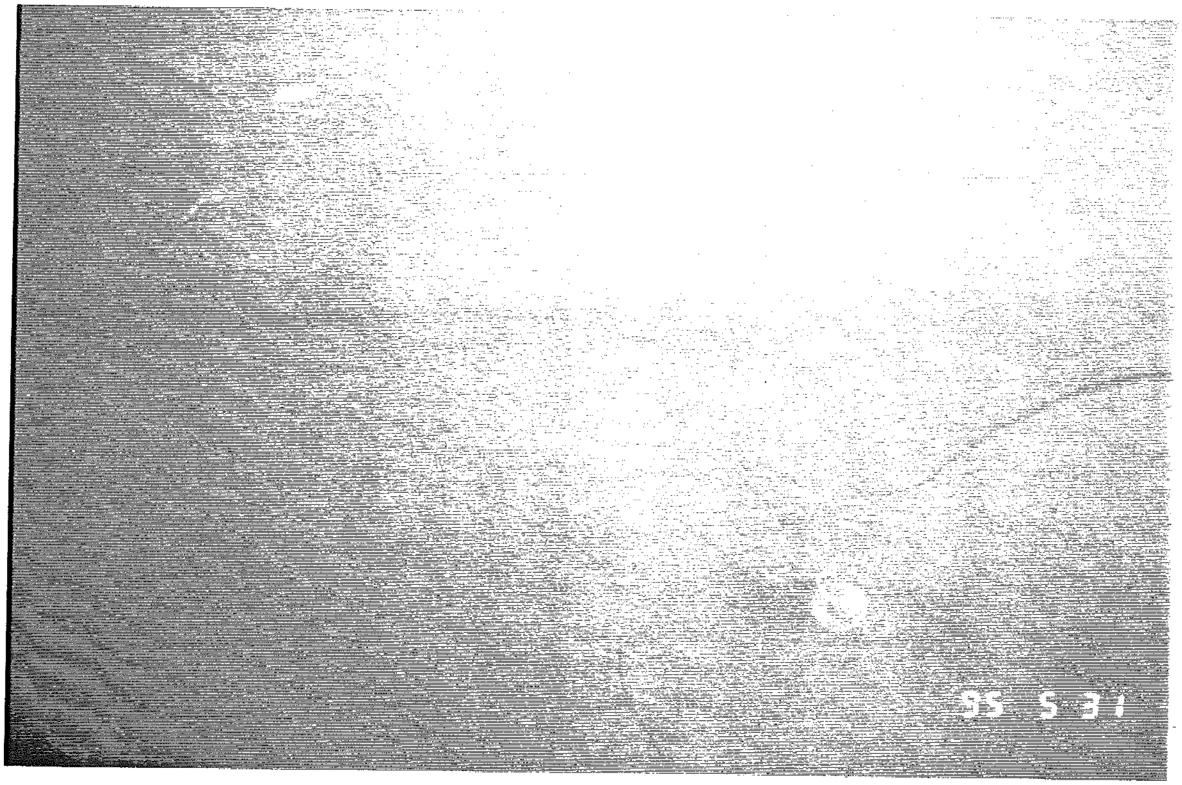


Figure 8.6.2. Seabed photographs from disposal site # 1 (ROV site # 1). A boulder is visible in the upper photograph. The flash trip weight is also seen in both images (approx 5 cm in diameter).



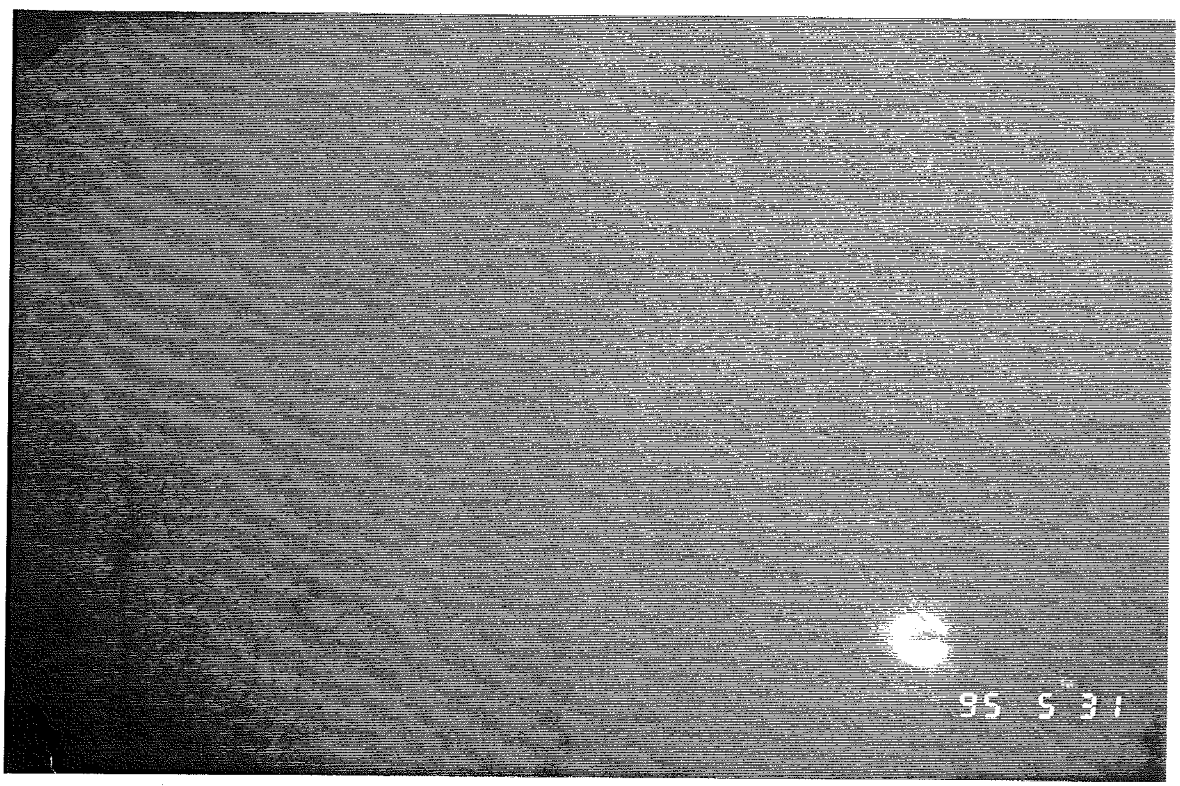
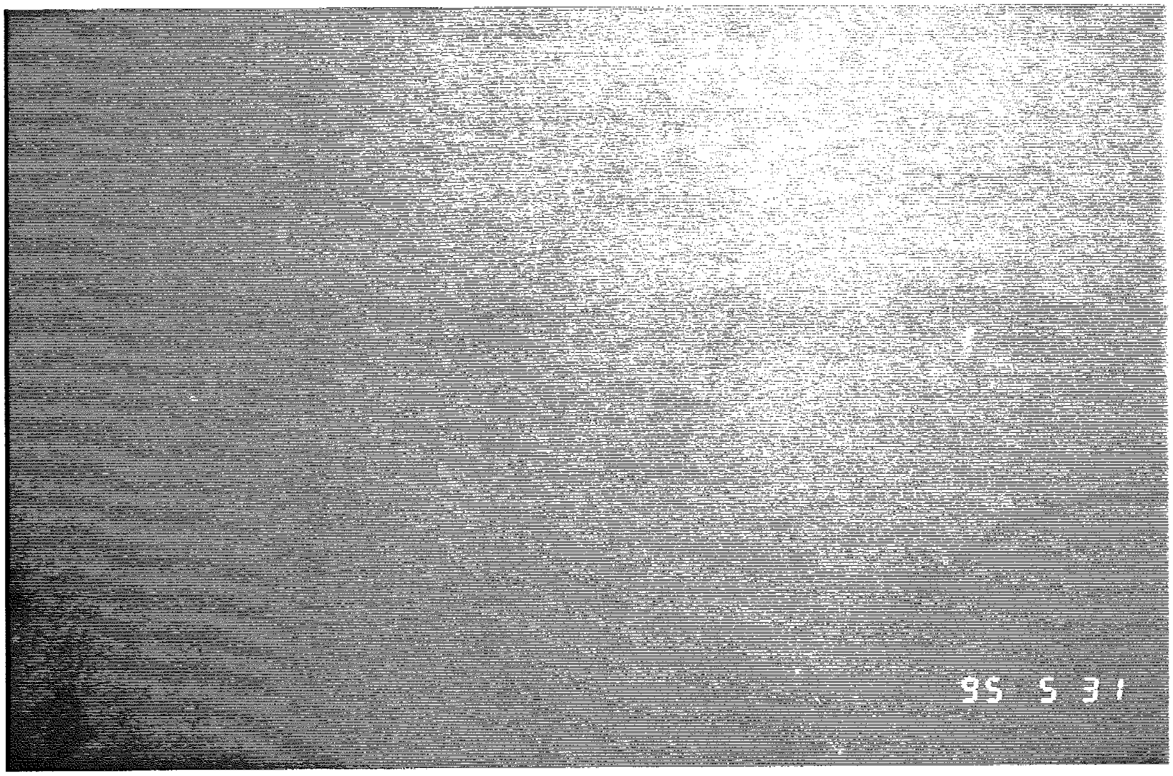


Figure 8.6.3. Seabed photographs from disposal site # 1 (ROV site # 1). Fine sediment and poorly sorted sediment may be diagnostic of dumped material.



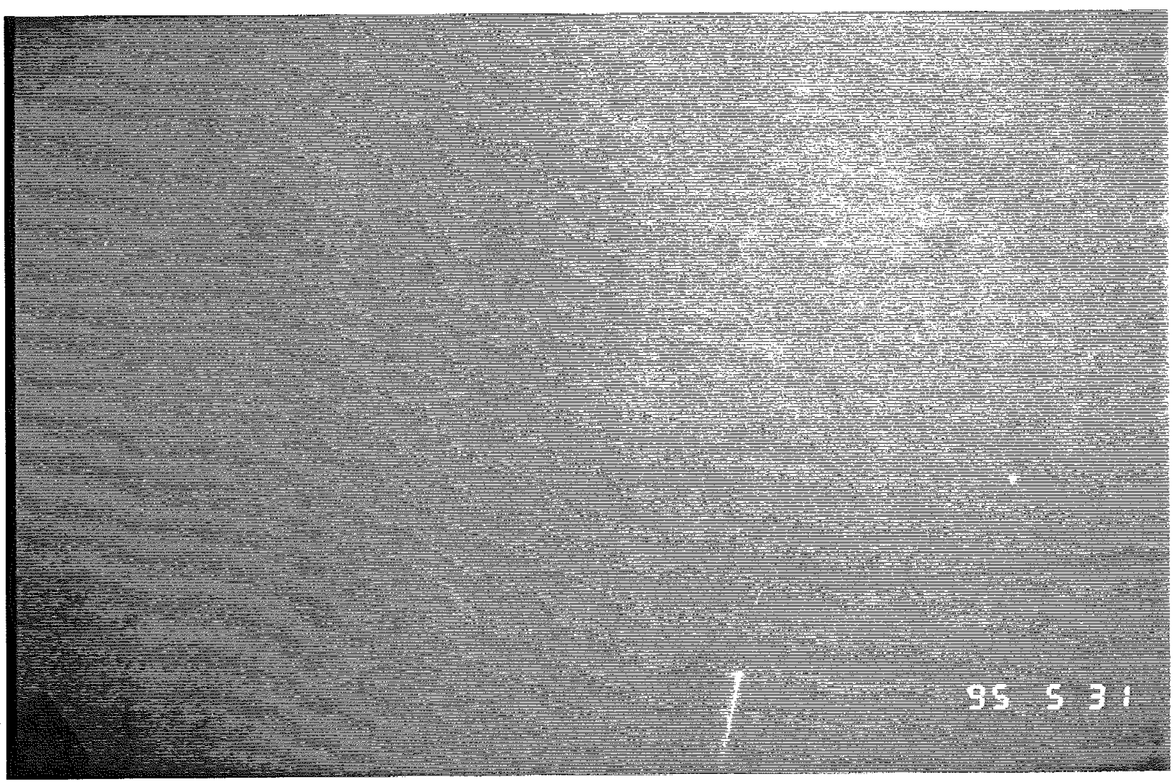


Figure 8.6.4. Seabed photographs from disposal site # 1 (ROV site # 1). The images appear featureless.

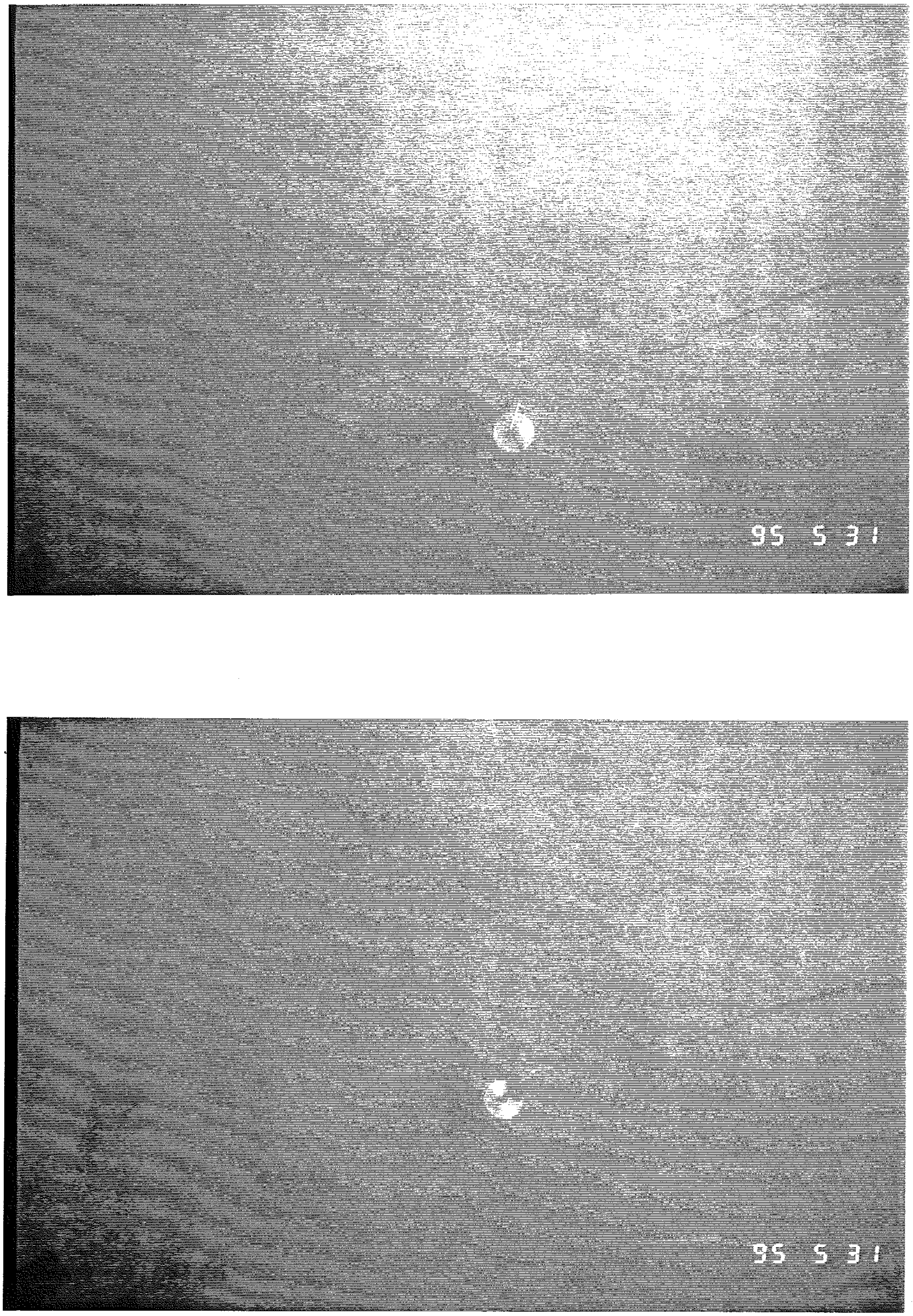
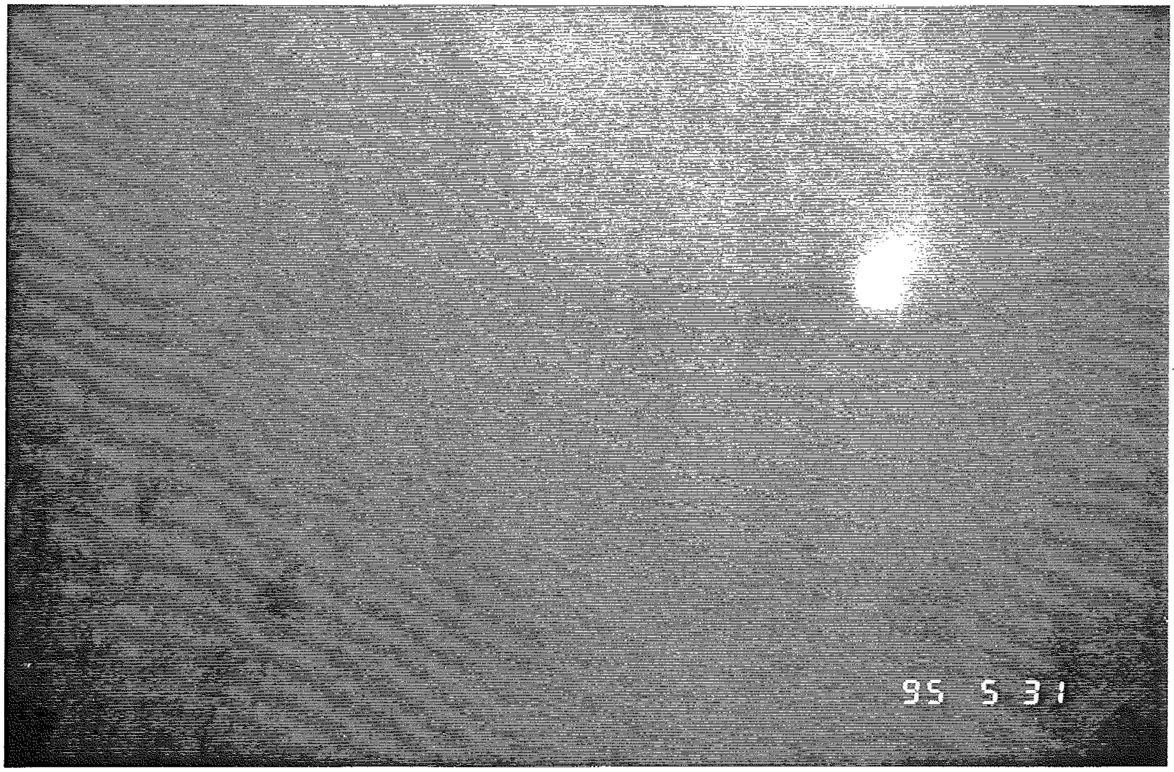


Figure 8.6.5. Seabed photographs from disposal site # 1 (ROV site # 1). A cobble is evindent in the lower image.

Figure 8.6.6. Seabed photographs from disposal site # 1 (ROV site # 2). Current rippled sand is evident in the upper image. A flounder is present in the lower image.



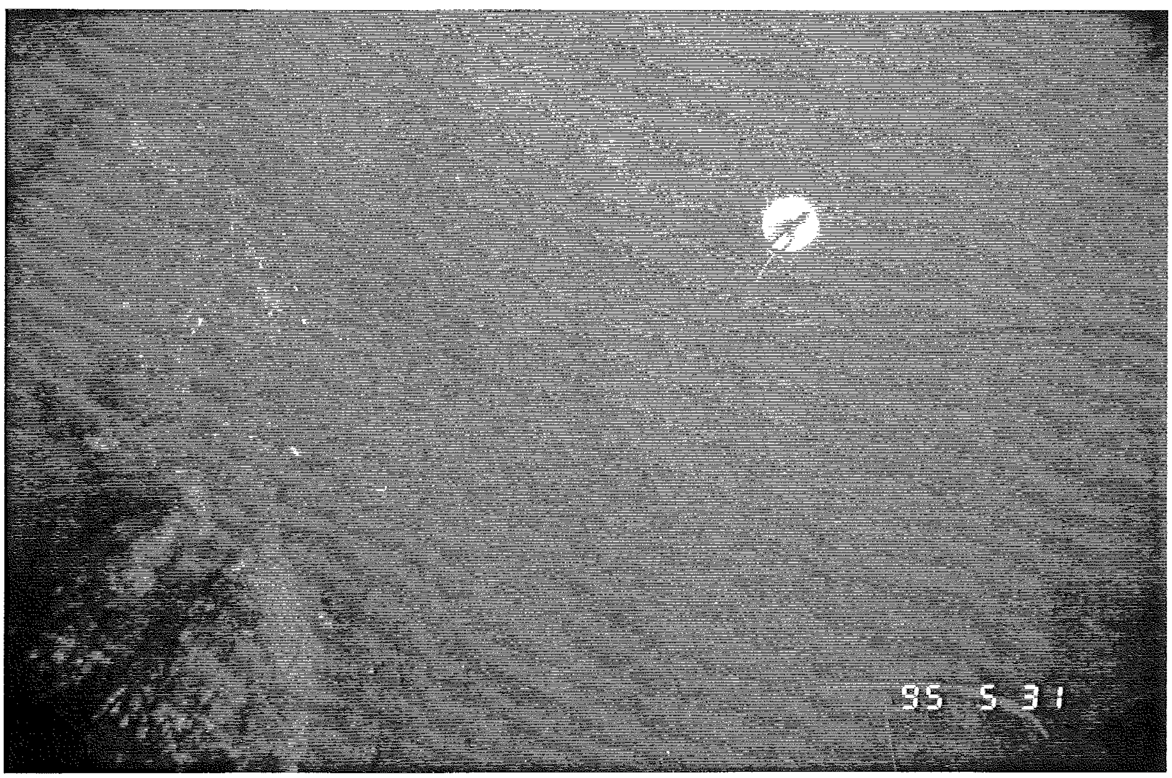
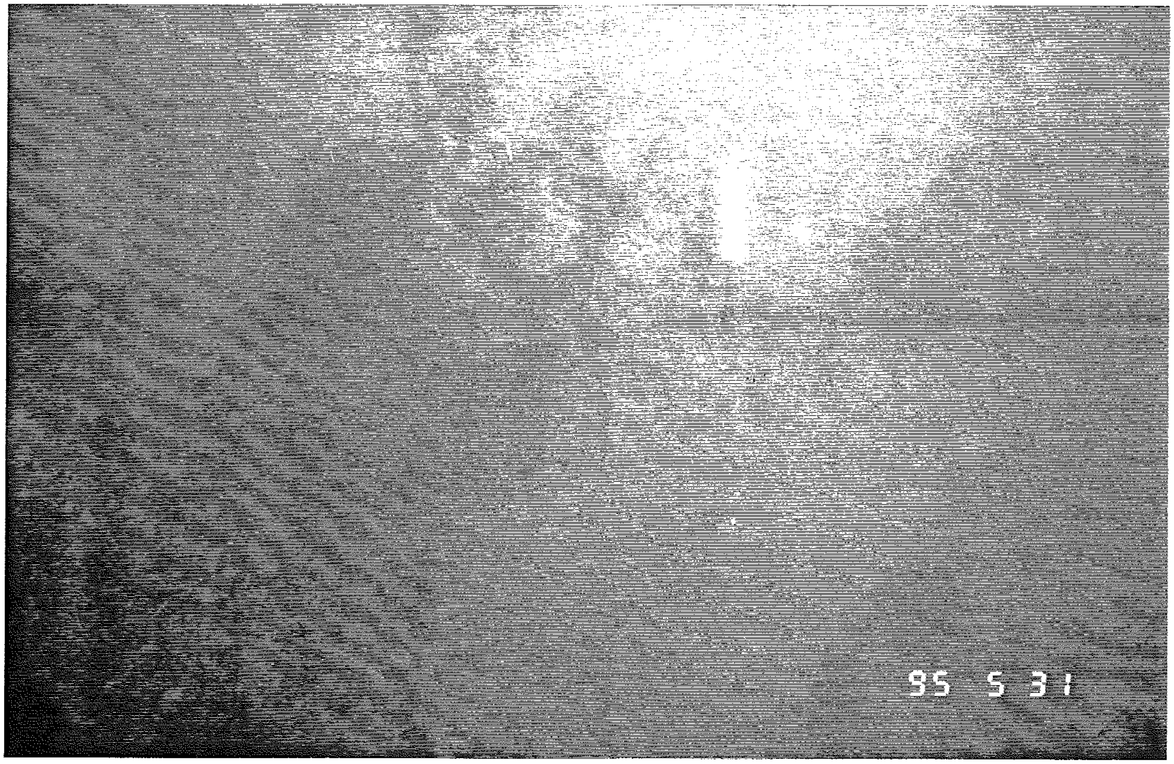


Figure 8.6.7. Seabed photographs from disposal site # 1 (ROV site # 2). Current rippled sand is evident in the upper image. Rippled sand against bedrock is visible in the lower image.



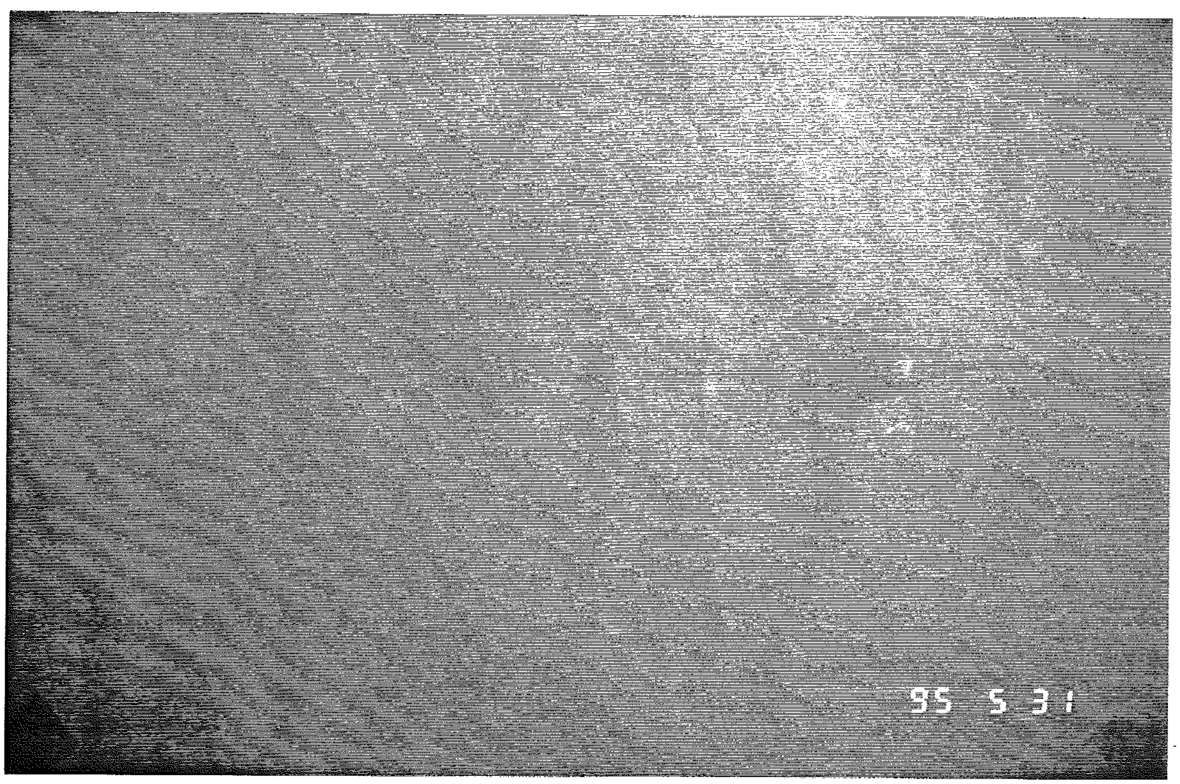


Figure 8.6.8. Seabed photographs from disposal site # 1 (ROV site # 2). Bedrock overgrown by organic matter is clear in the upper image. Current rippled sand dominates in the lower image.

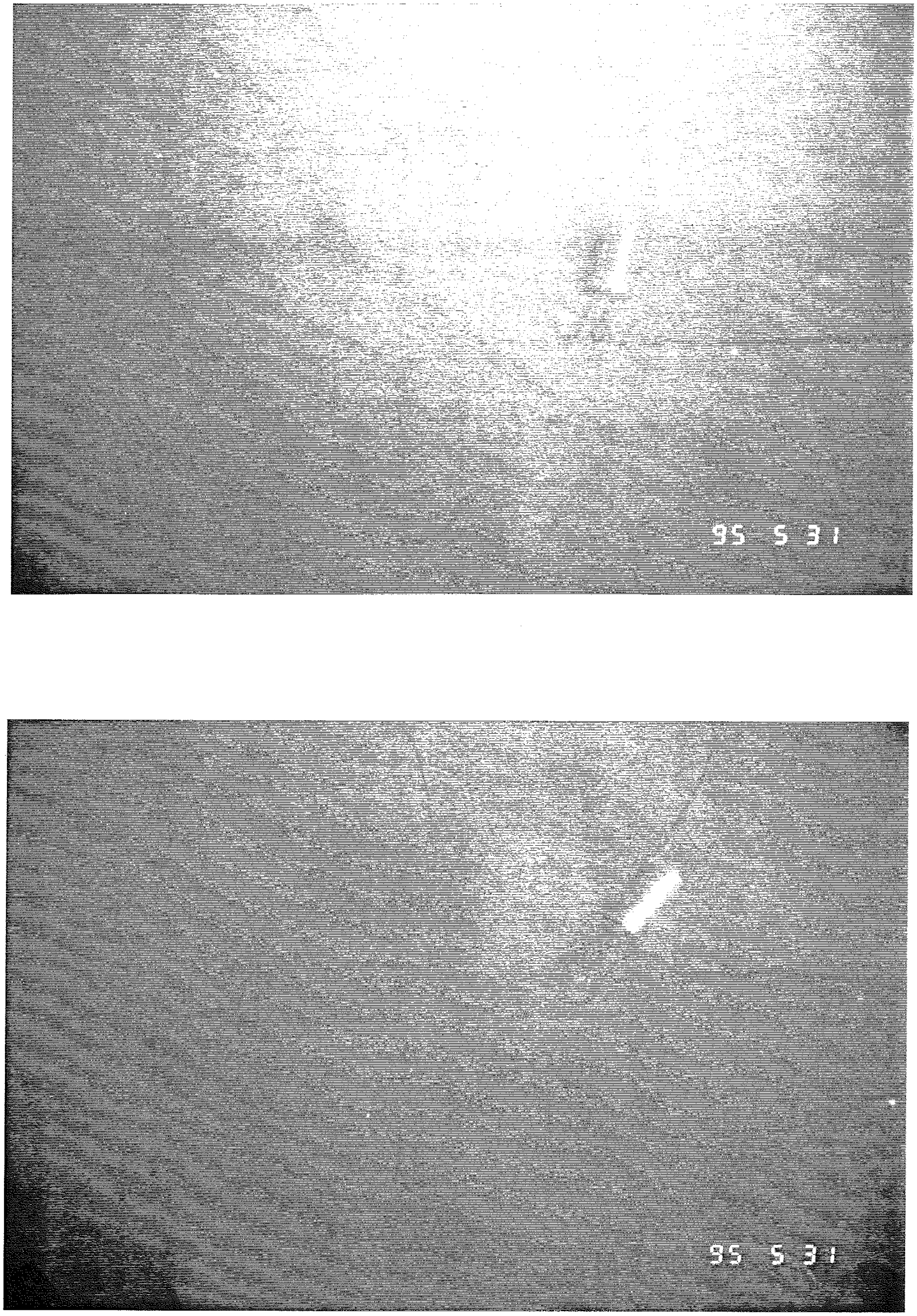


Figure 8.6.9. Seabed photographs from disposal site # 1 (ROV site # 2). Both images show evidence of current rippling in sand.

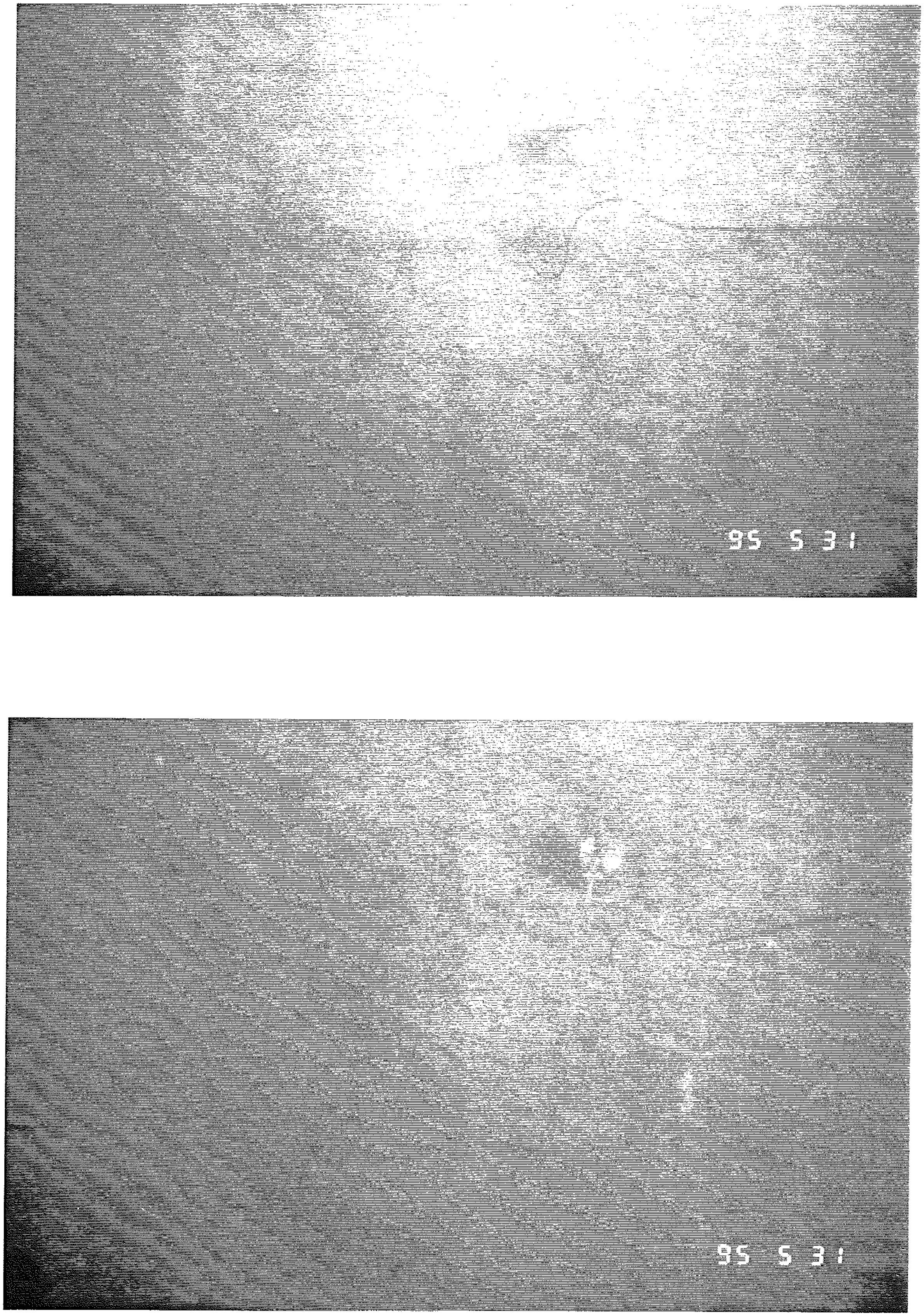


Figure 8.6.10. Seabed photographs from disposal site # 1 (ROV site # 2). Both images show evidence of current rippling in sand.

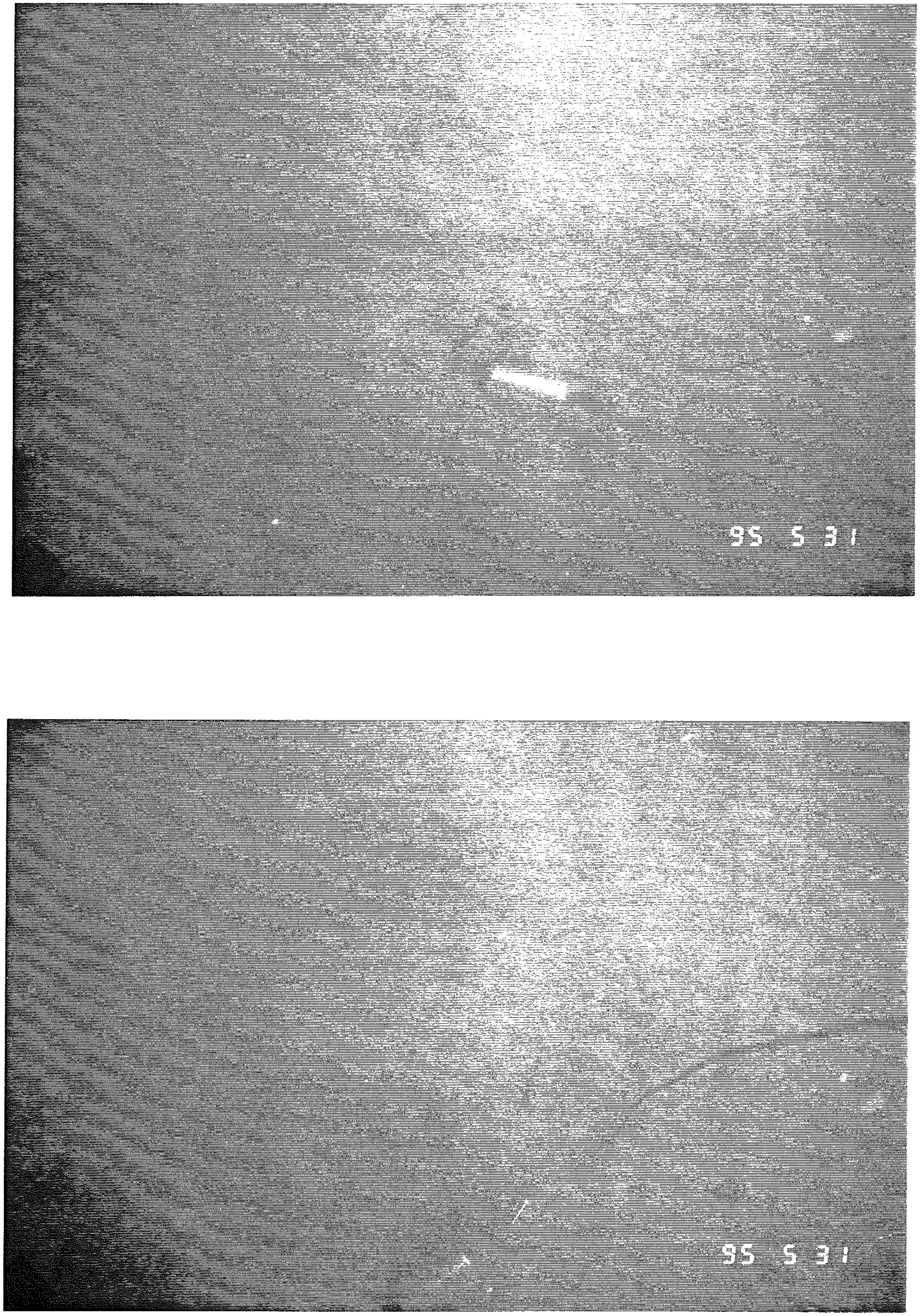
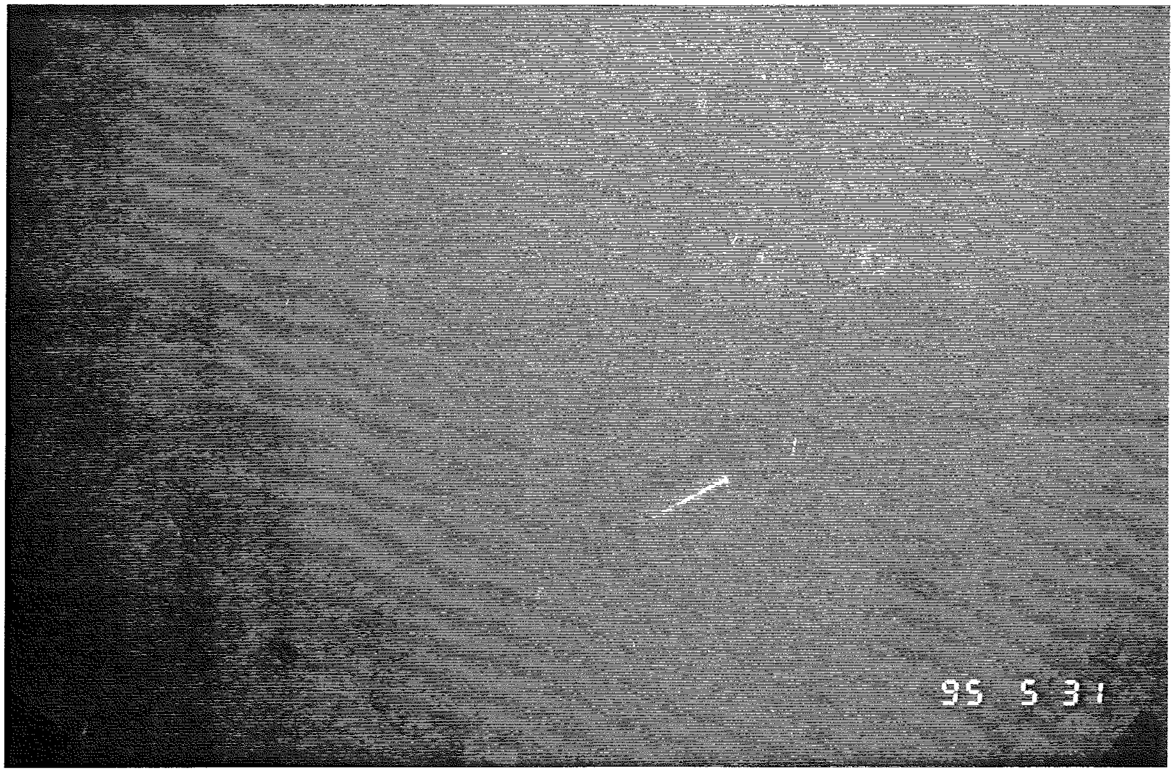


Figure 8.6.11. Seabed photographs from disposal site # 1 (ROV site # 3). The plume from the trip weight suggests a silty bed.



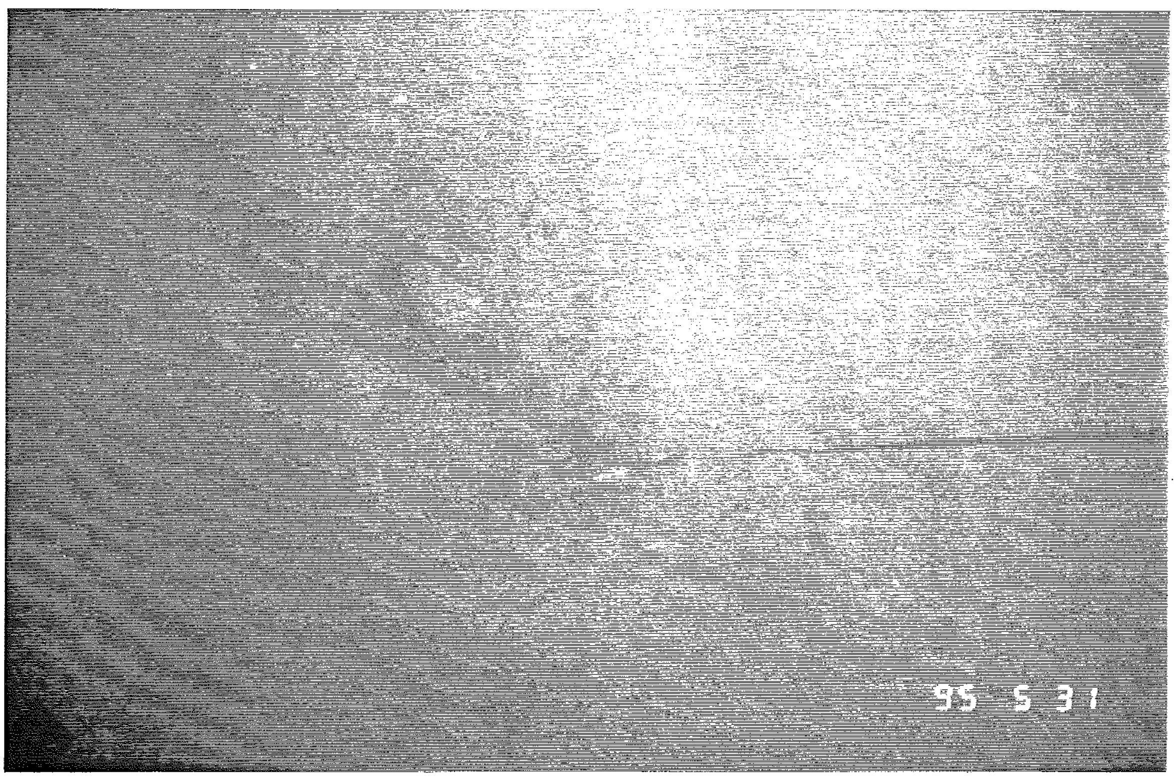


Figure 8.6.12. Seabed photographs from disposal site # 1 (ROV site # 3). A flat gravel and silty bed.

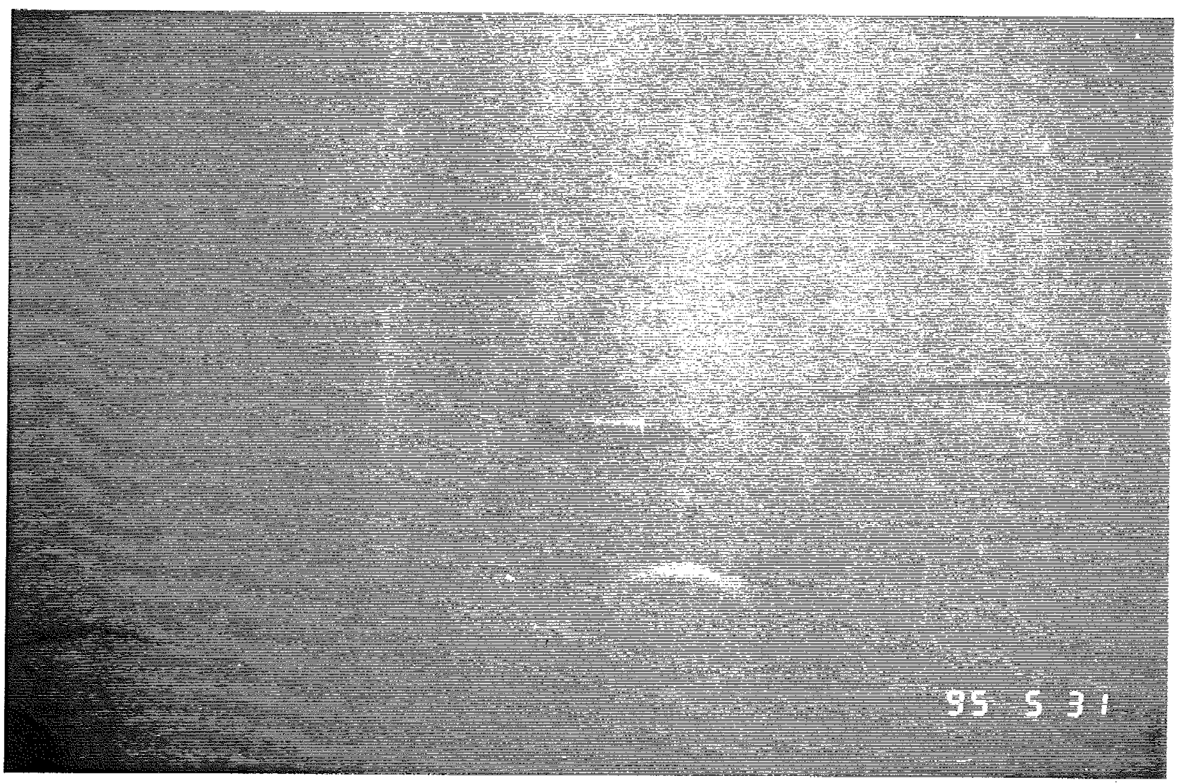


Figure 8.6.13. Seabed photographs from disposal site # 1 (ROV site # 3). A largely silty flat bed.

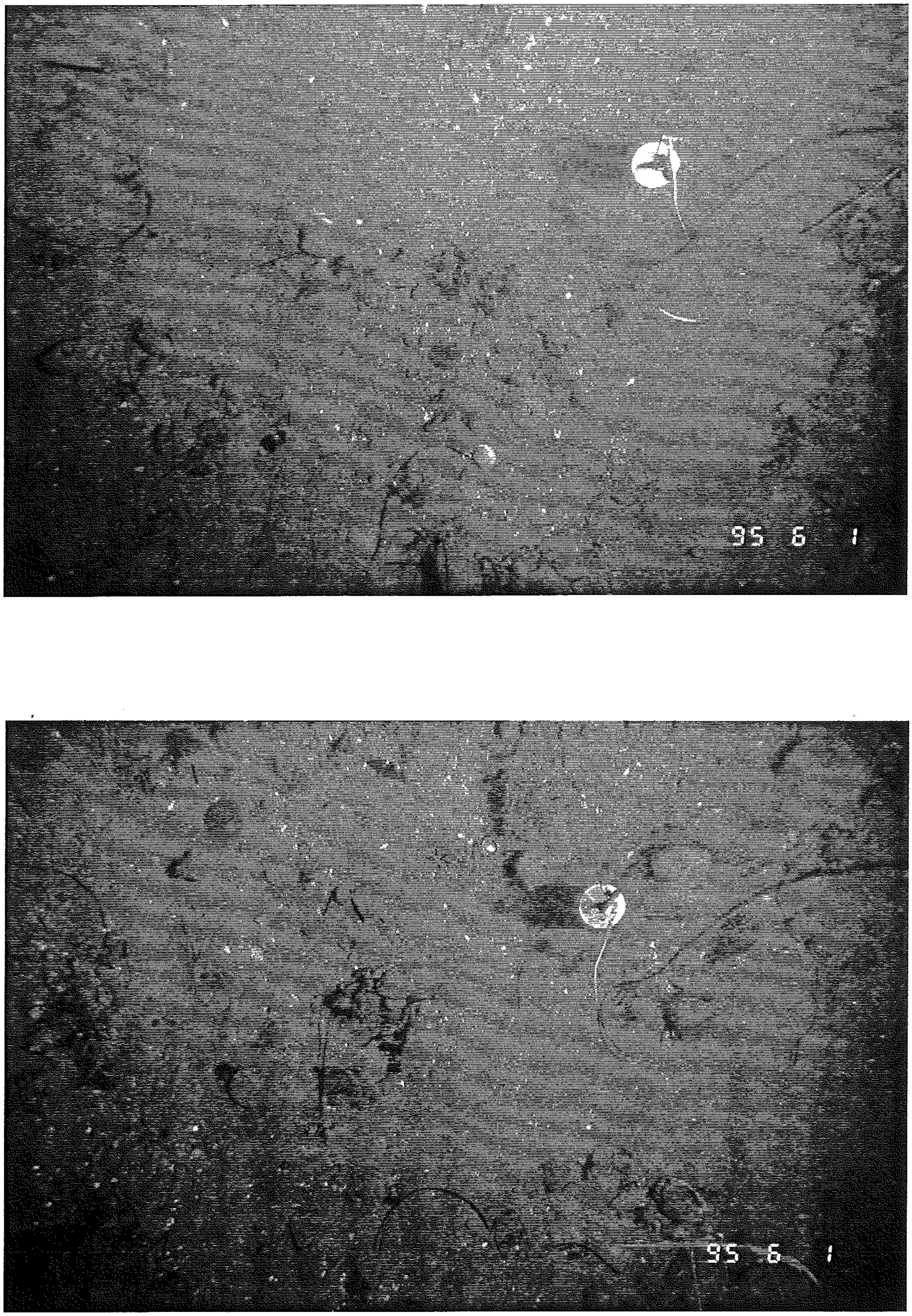
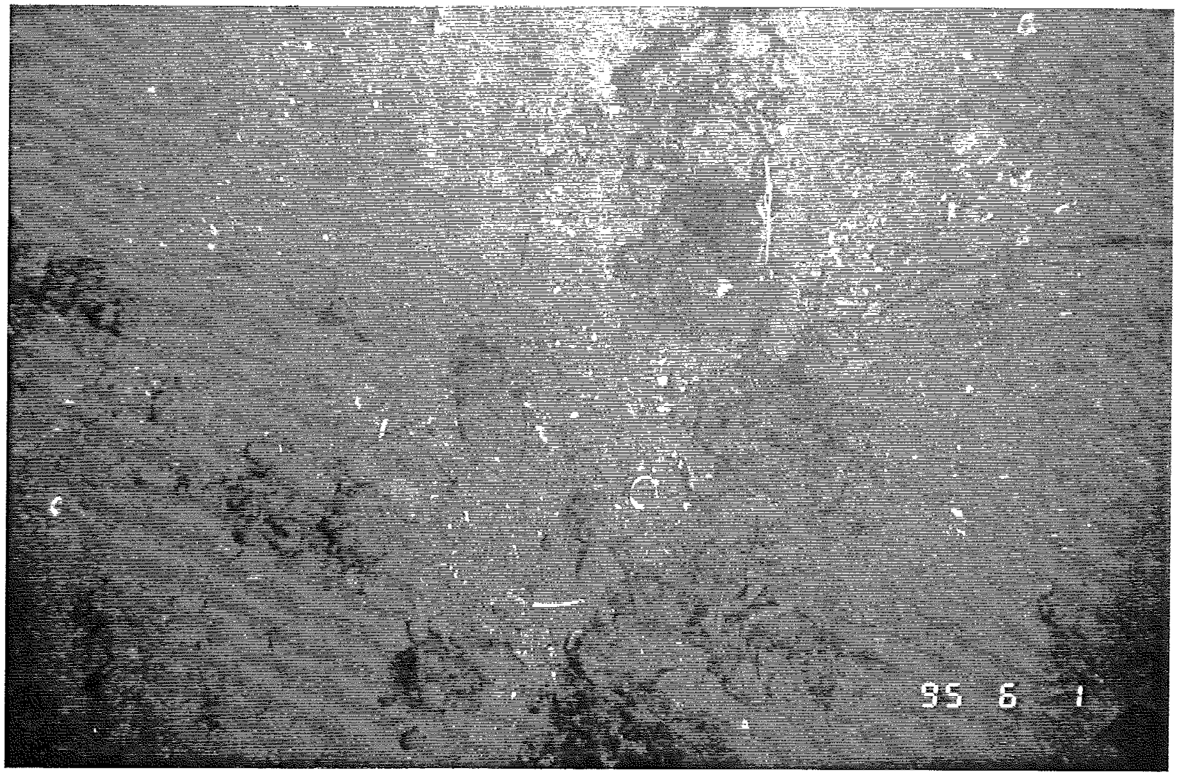


Figure 8.6.14. Seabed photographs from disposal site # 2 (Amherst Cove, PEI). The water clarity is much better than on disposal site # 1. The bed is largely flat, and composed of a wide range in grain sizes. There is also an abundance of organic matter present.



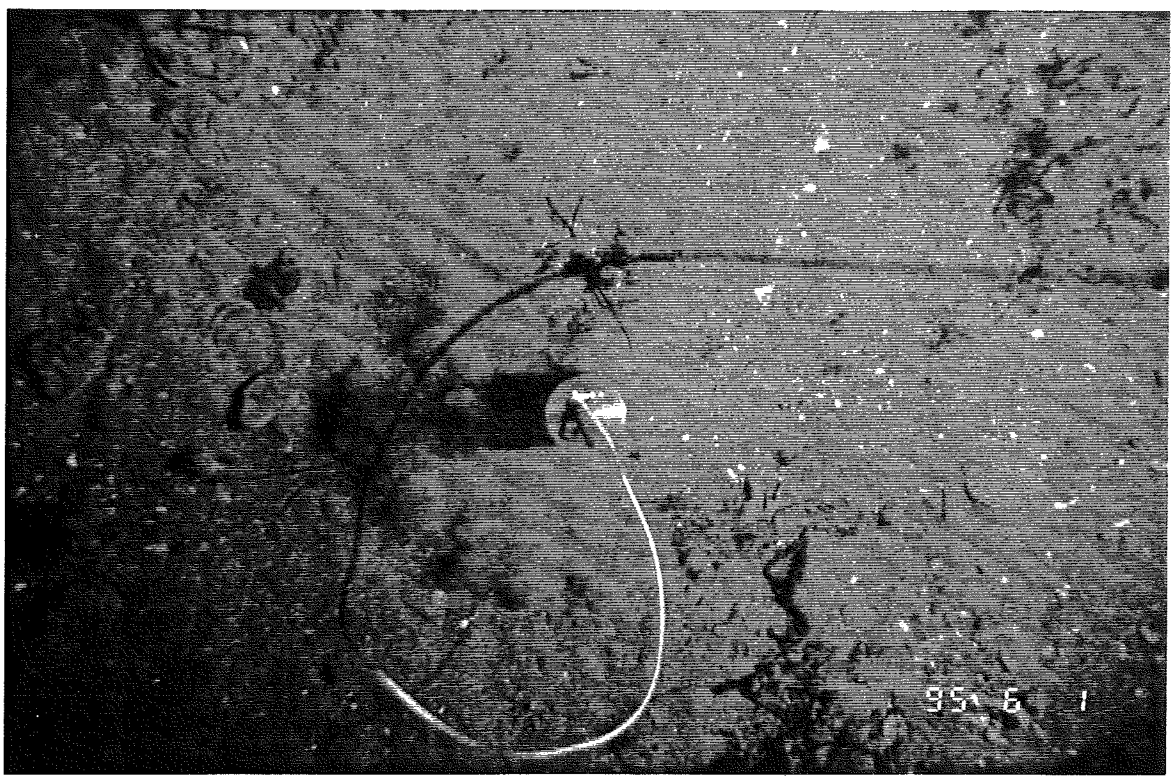


Figure 8.6.15. Seabed photographs from disposal site # 2 (Amherst Cove, PEI). The seabed appears to be largely scoured with a gravelly substrate covered by a thin layer of fine sand. Organic matter is abundant. No evidence for tidal transport of bed material is seen.

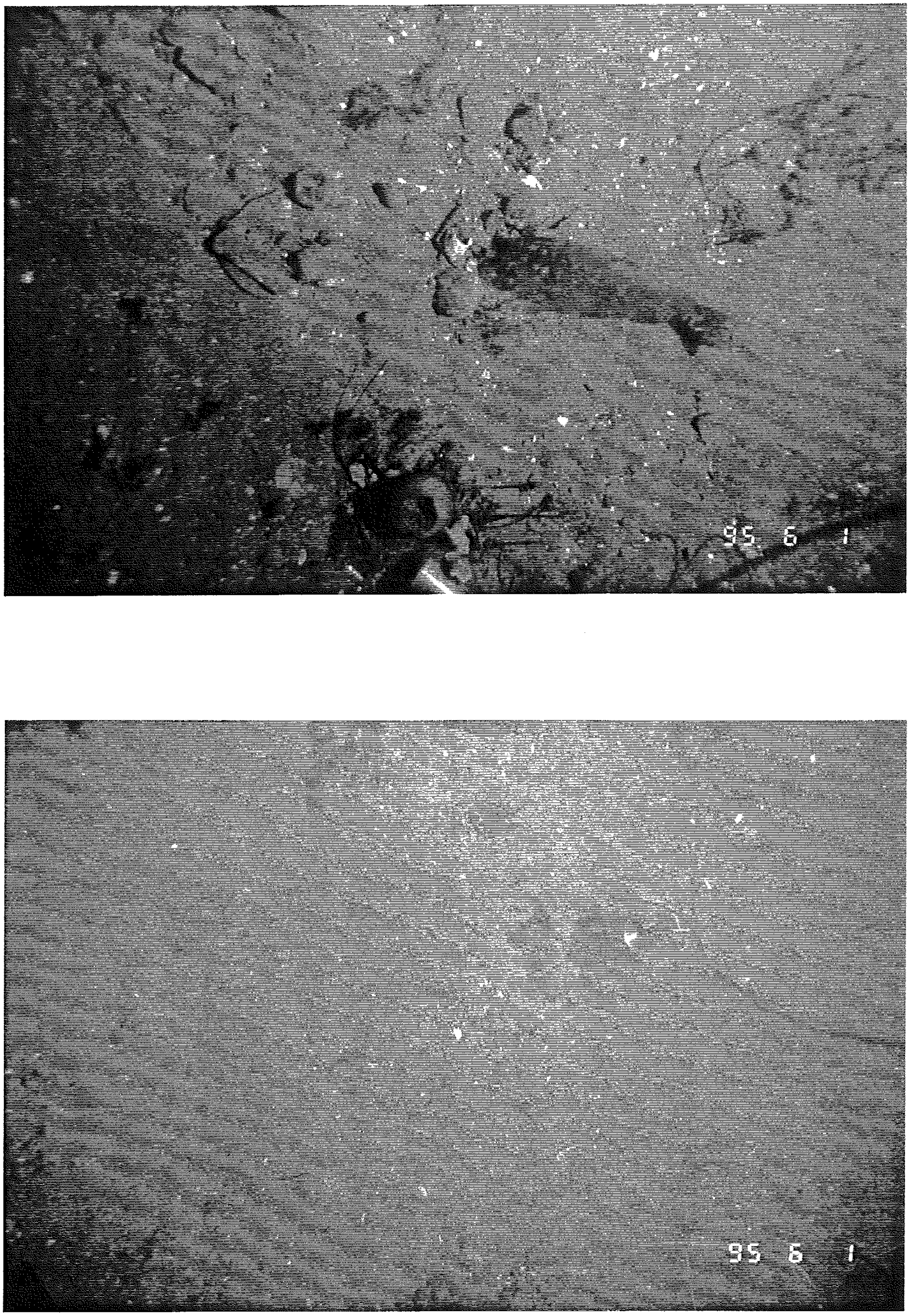


Figure 8.6.16. Seabed photographs from disposal site # 2 (Amherst Cove, PEI). The seabed appears to be largely scoured with a gravelly substrate covered by a thin layer of fine sand. Organic matter is abundant.

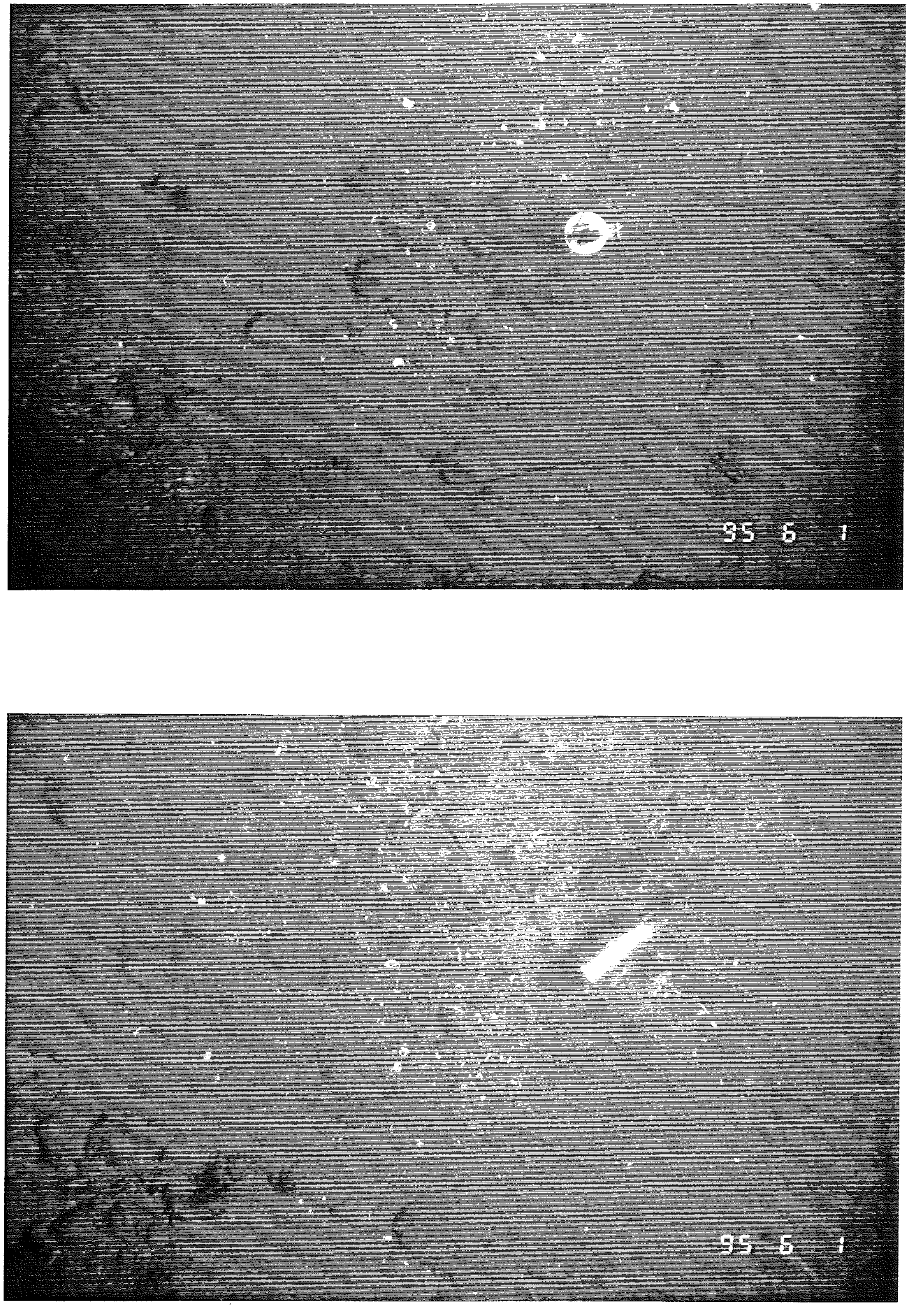


Figure 8.6.17. Seabed photographs from disposal site # 2 (Amherst Cove, PEI). The seabed appears to be largely scoured with a gravelly substrate covered by a thin layer of fine sand. Organic matter is abundant.

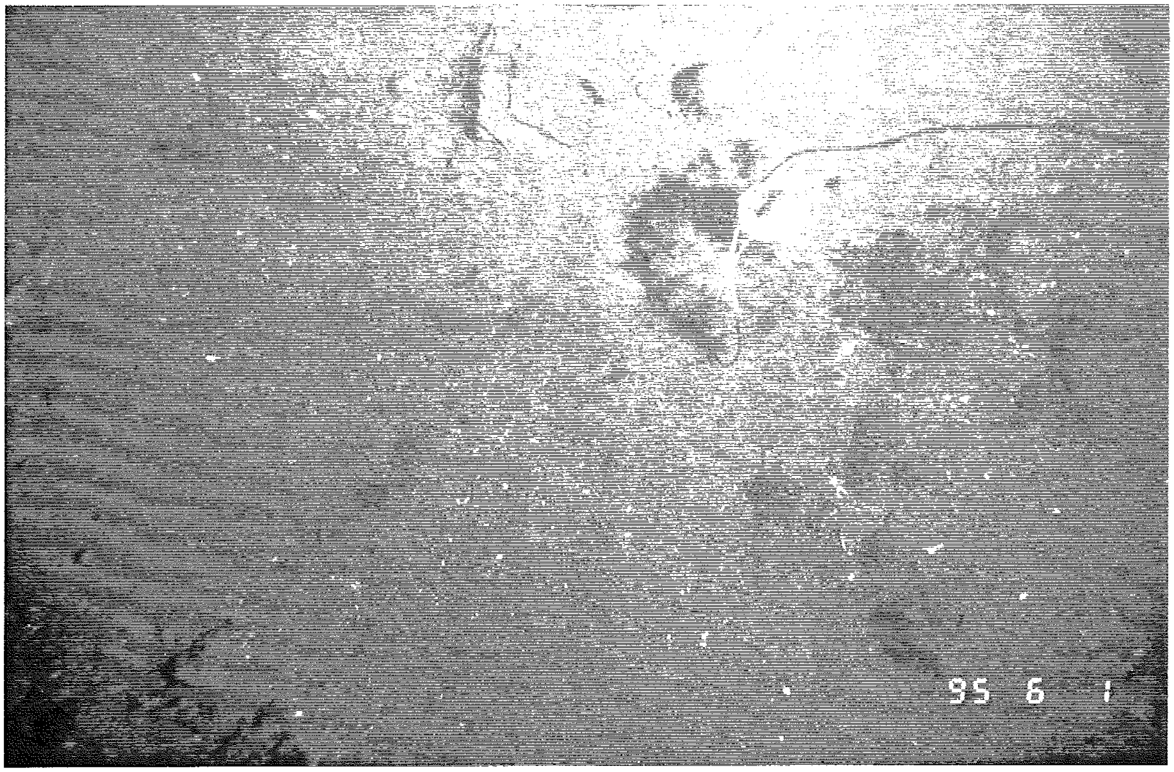
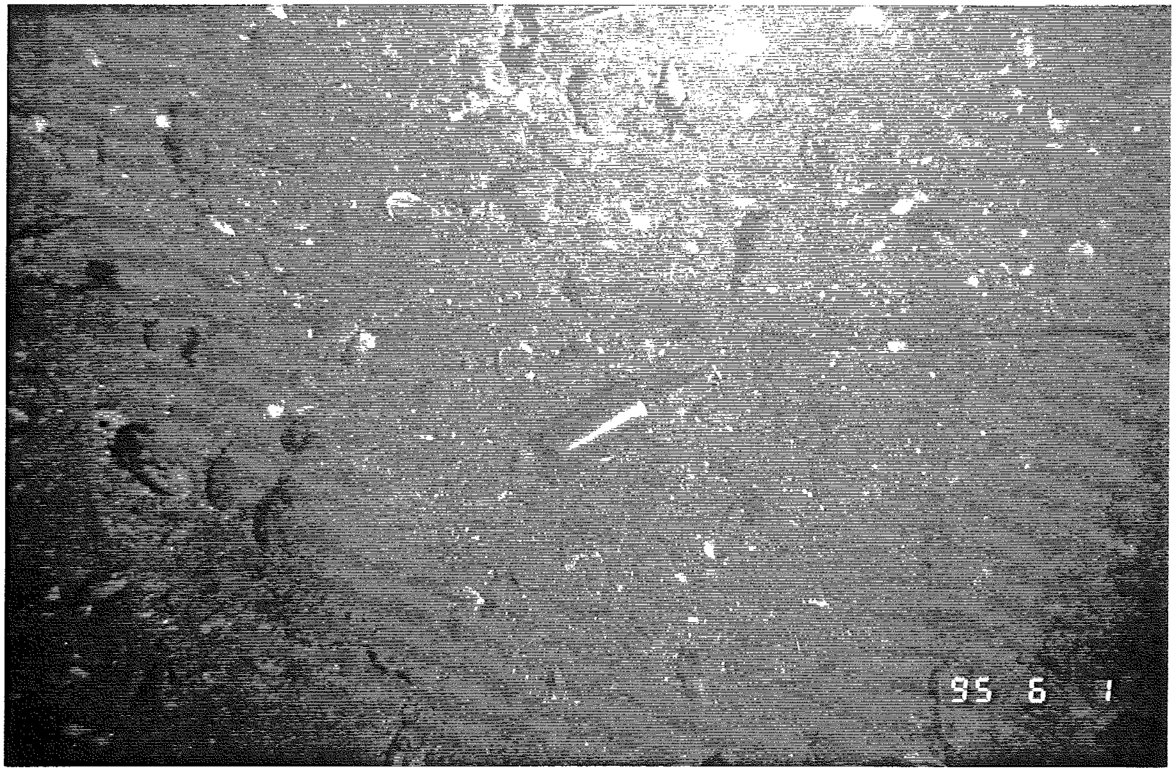


Figure 8.6.18. Seabed photographs from disposal site # 2 (Amherst Cove, PEI). The seabed appears to be largely scoured with a gravelly substrate covered by a thin layer of fine sand. There is an abundance of disarticulated shells in the lower image diagnostic of winnowing and sorting.



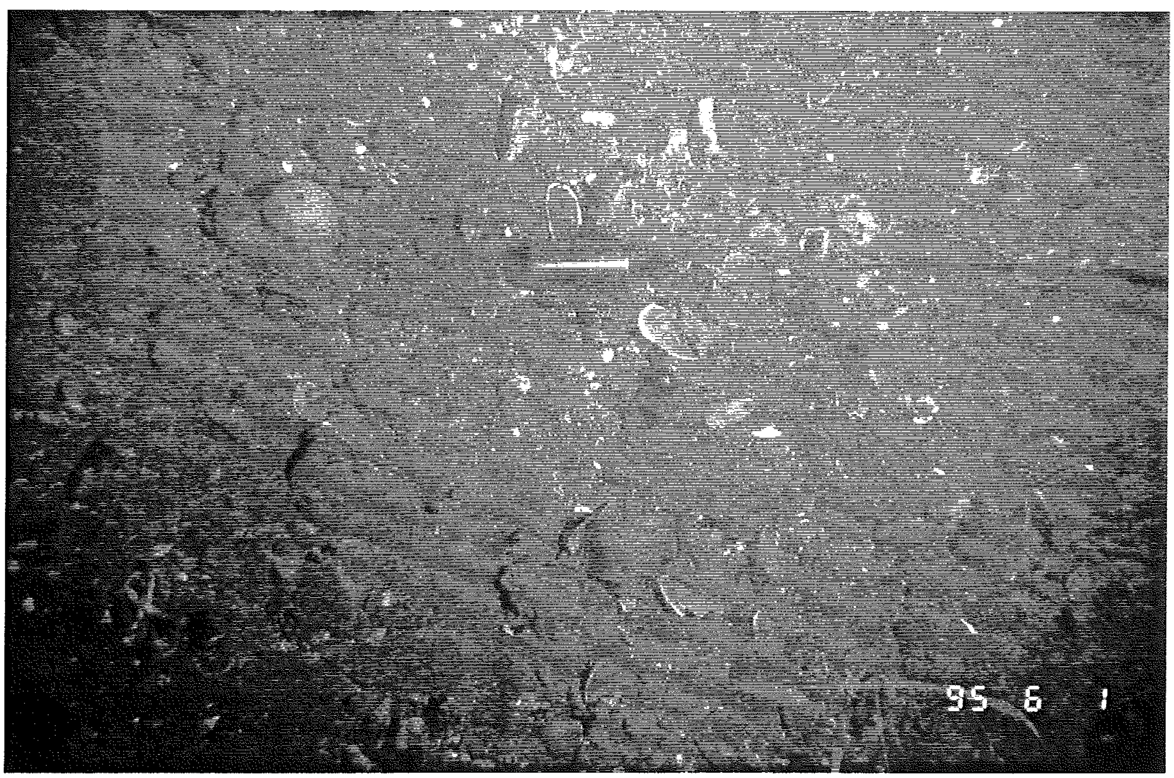


Figure 8.6.19. Seabed photographs from the western end of the Fixed Link Crossing. The seabed is composed of sorted gravel covered with a thin layer of sand.

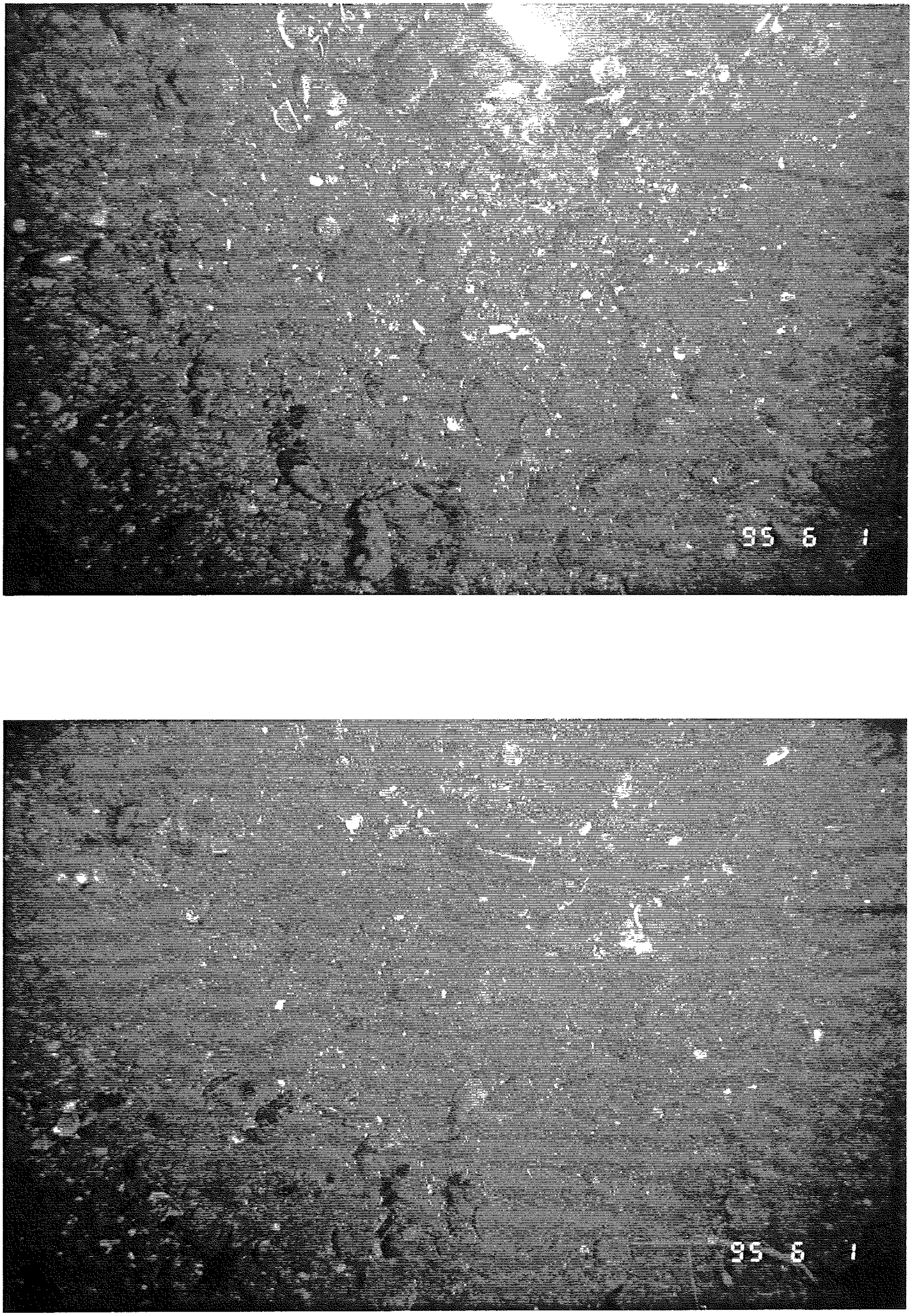


Figure 8.6.20. Seabed photographs from the western end of the Fixed Link Crossing. The seabed is composed of poorly-sorted, angular gravel. There is an abundance of shelly material.

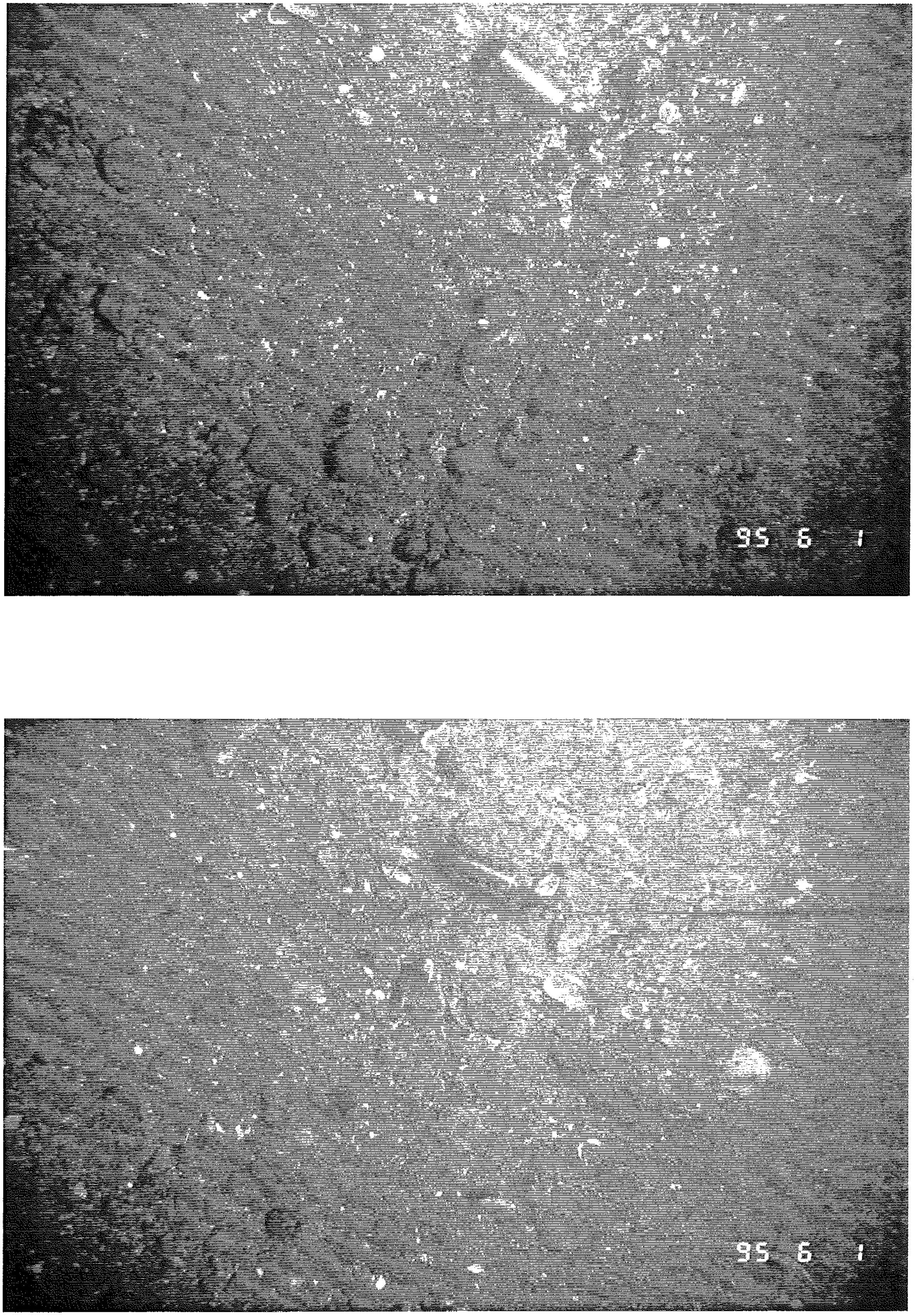


Figure 8.6.21. Seabed photographs from the western end of the Fixed Link Crossing. The seabed is composed of sorted gravel covered with a thin layer of sand.

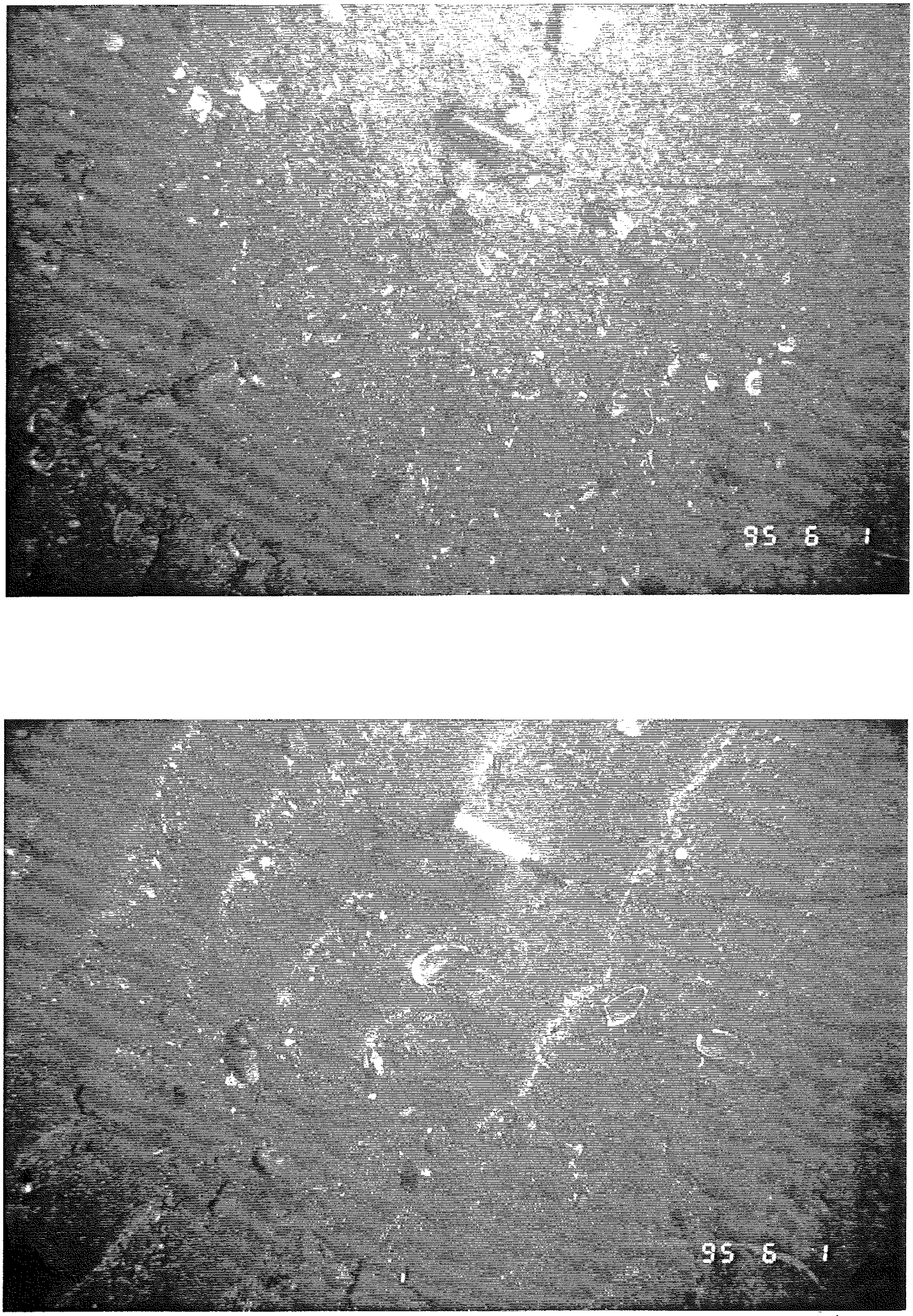
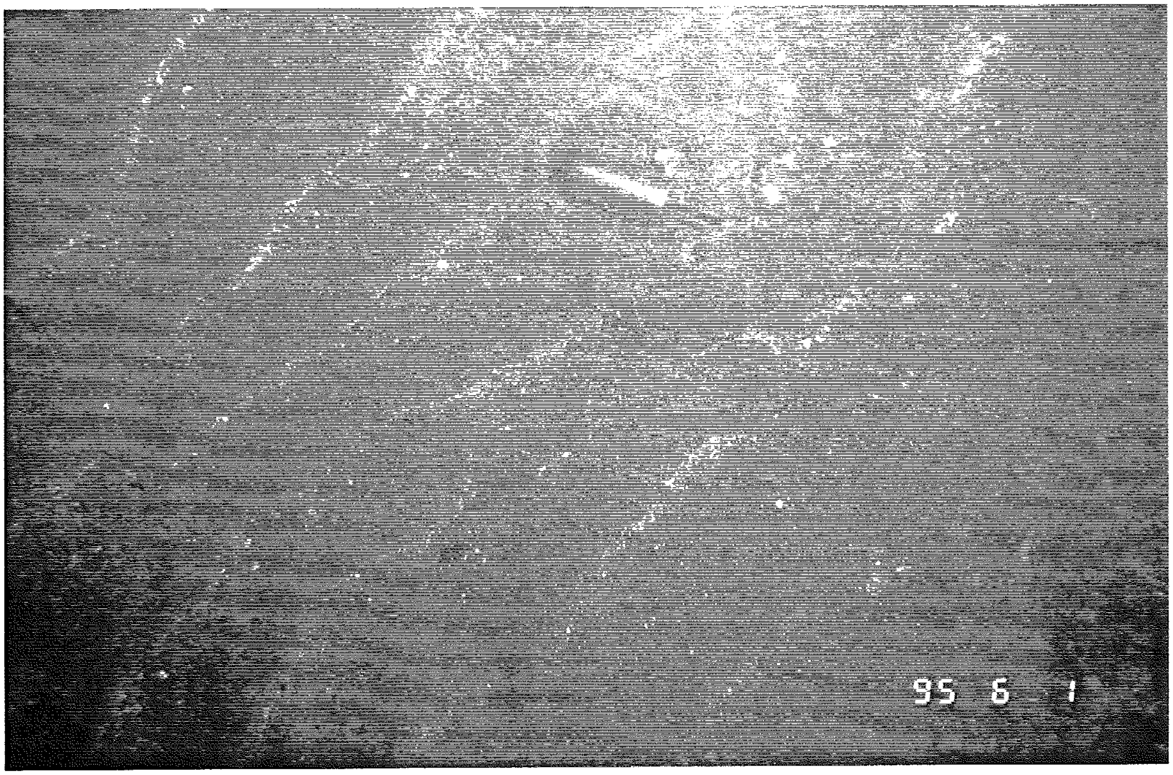


Figure 8.6.22. Seabed photographs from the western end of the Fixed Link Crossing. The seabed is composed of sorted gravel covered with a thin layer of sand. The sand is current rippled (lower image) indicating a strong tidal flow.



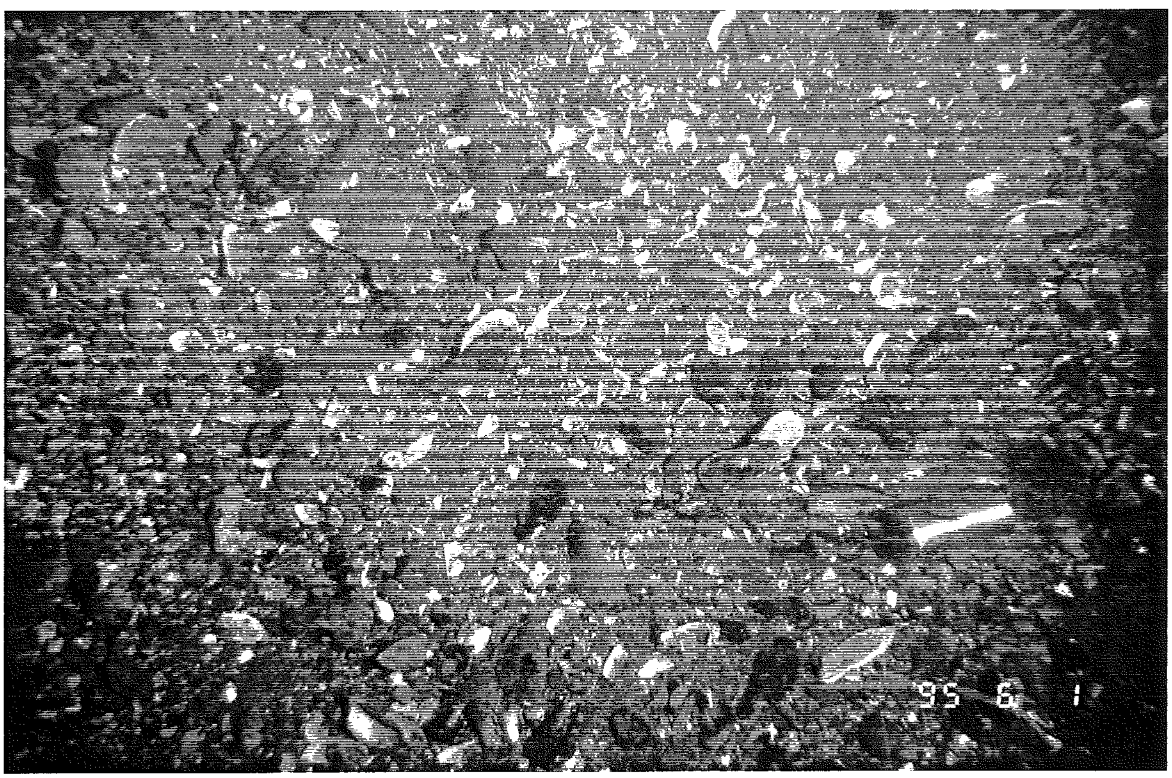


Figure 8.6.23. Seabed photographs from the western end of the Fixed Link Crossing. The seabed is composed of sorted gravel covered with a thin layer of sand. The sand is current rippled (upper image) indicating a strong tidal flow. There is also an abundance of shell debris that has been winnowed and sorted.

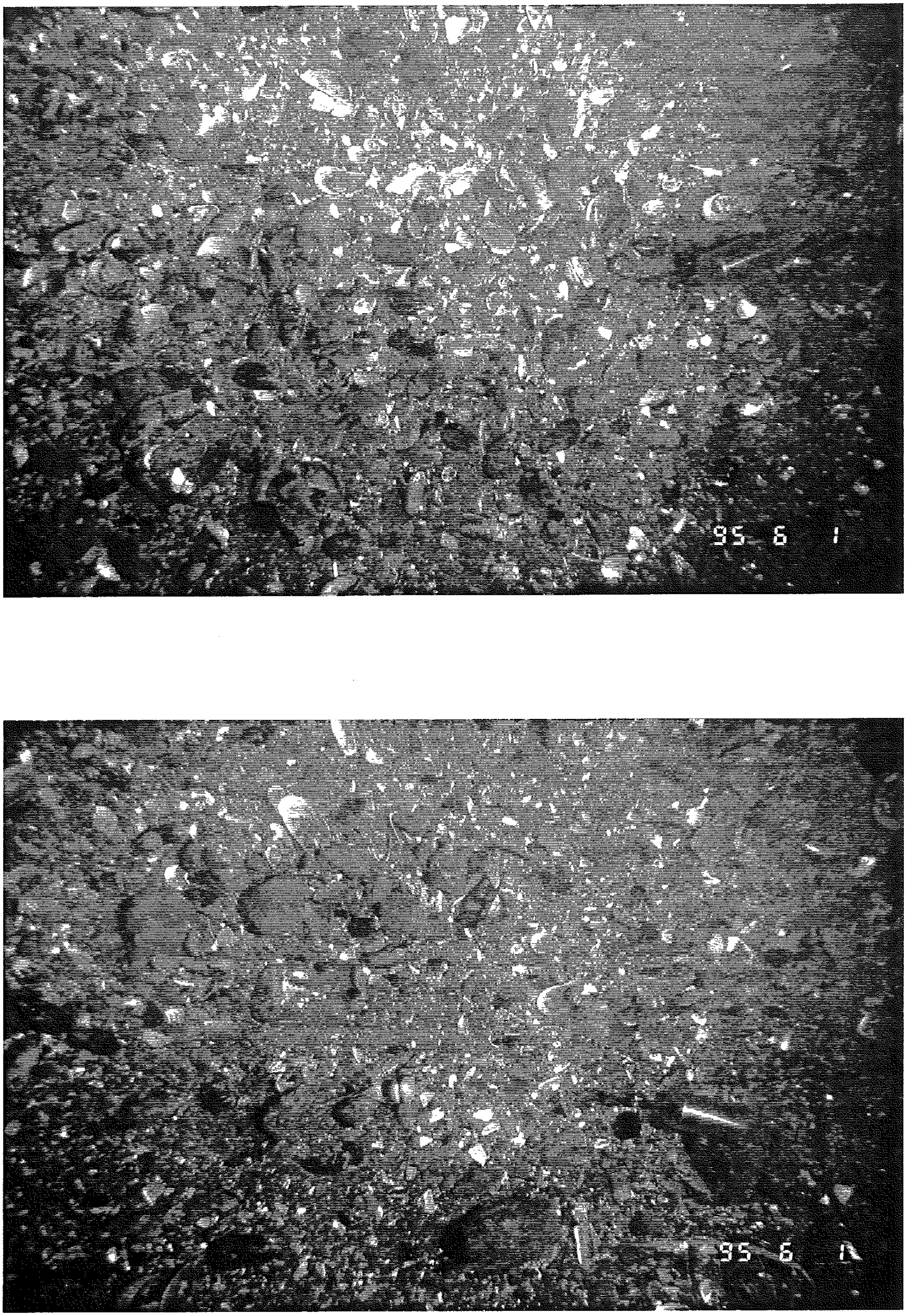


Figure 8.6.24. Seabed photographs from the centre of the Fixed Link Crossing. The seabed is composed of sorted shelly gravel, and rounded cobbles.

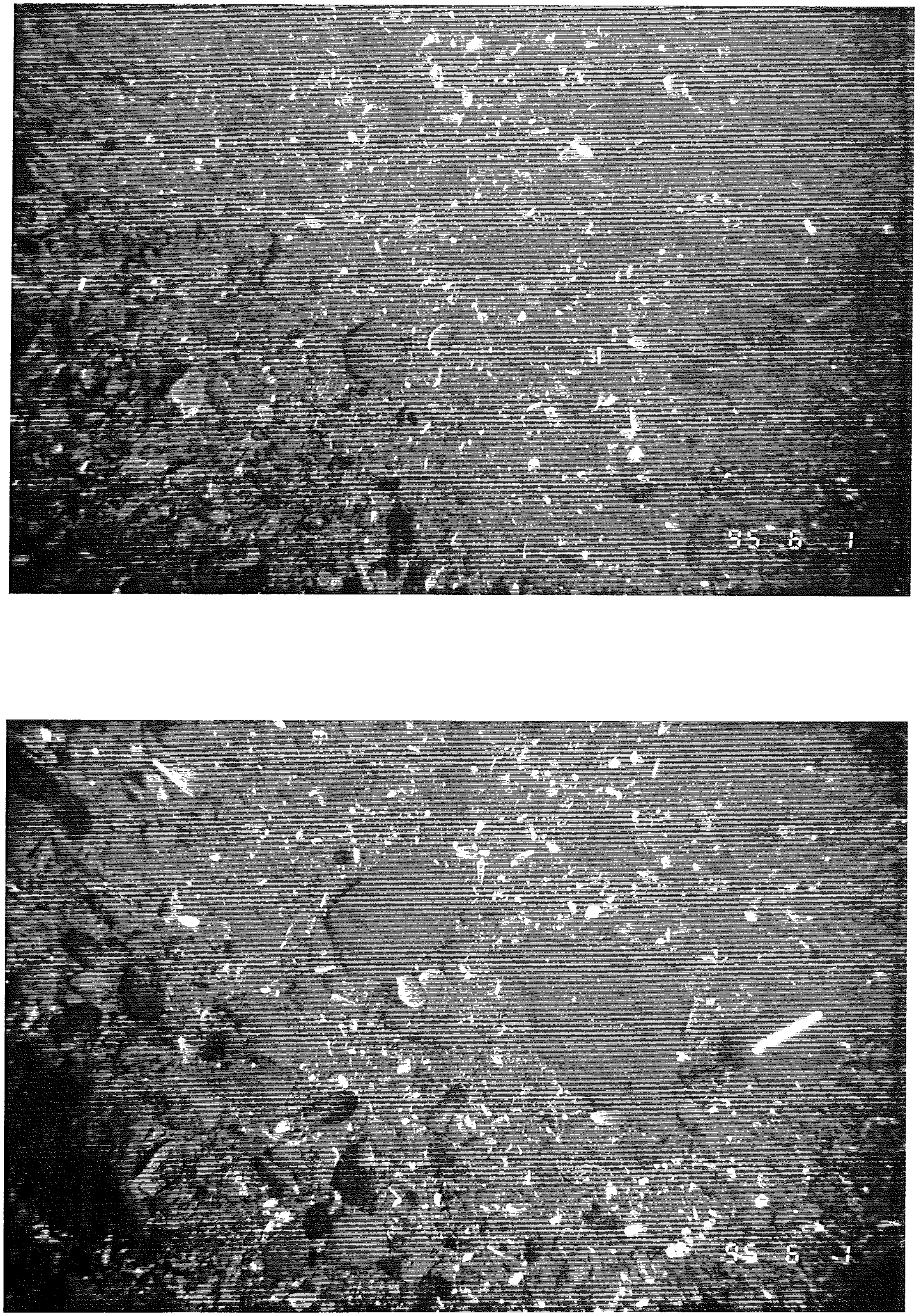


Figure 8.6.25. Seabed photographs from the centre of the Fixed Link Crossing. The seabed is composed of sorted shelly gravel, and rounded cobbles.

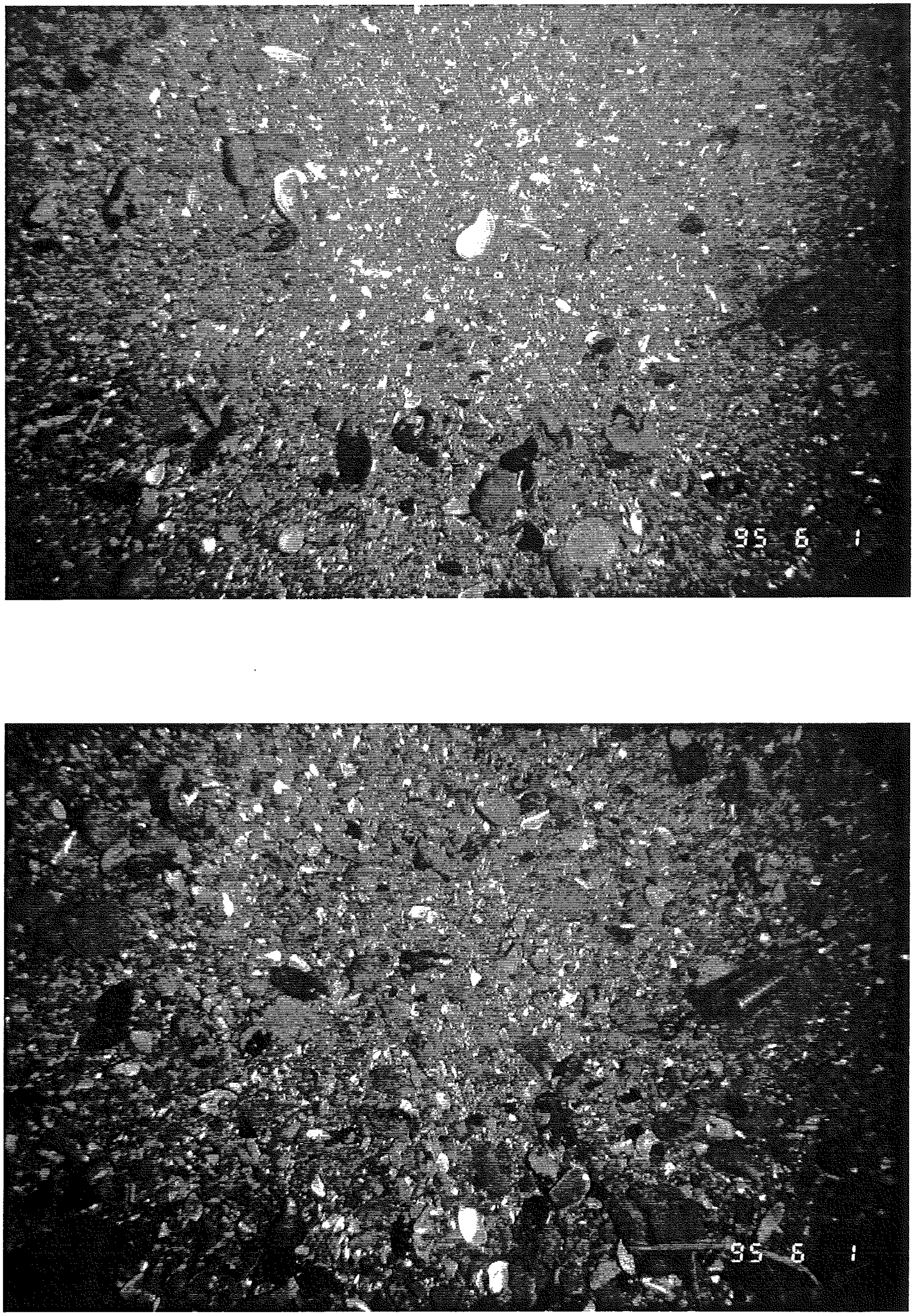


Figure 8.6.26. Seabed photographs from the centre of the Fixed Link Crossing. The seabed is composed of sorted shelly gravel, and rounded cobbles.

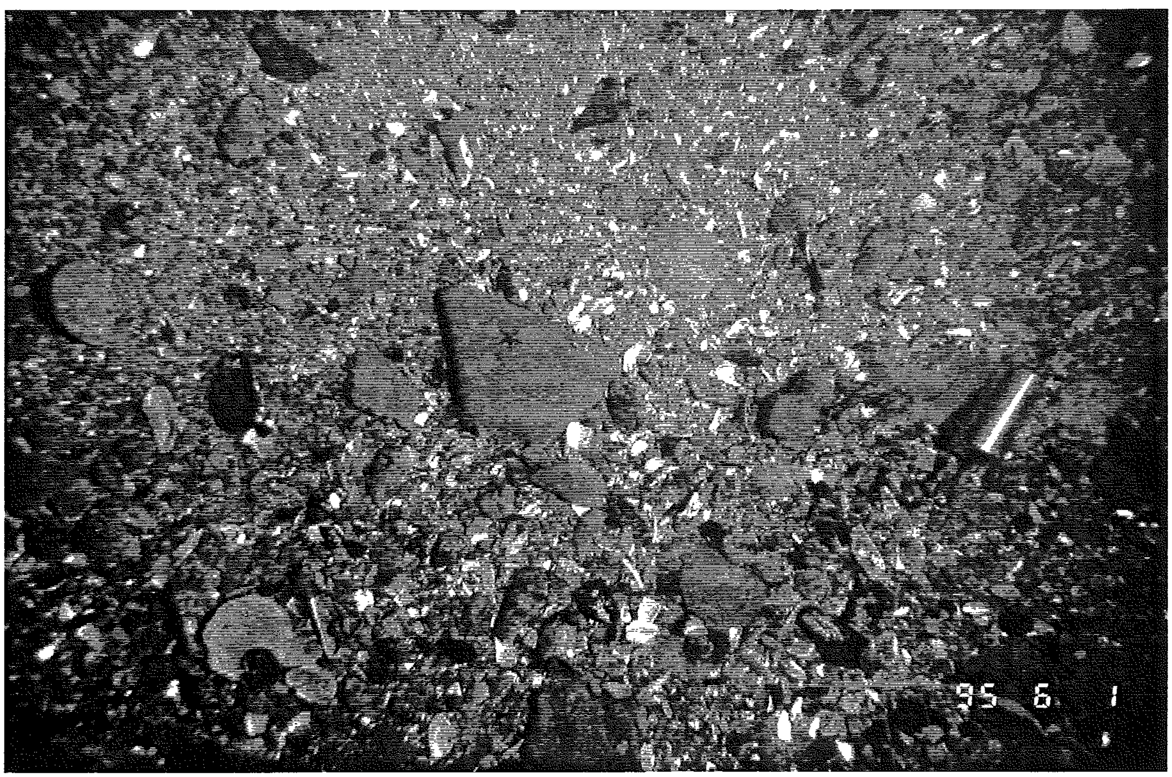


Figure 8.6.27. Seabed photographs from the centre of the Fixed Link Crossing. The seabed is composed of sorted shelly gravel, and rounded cobbles.

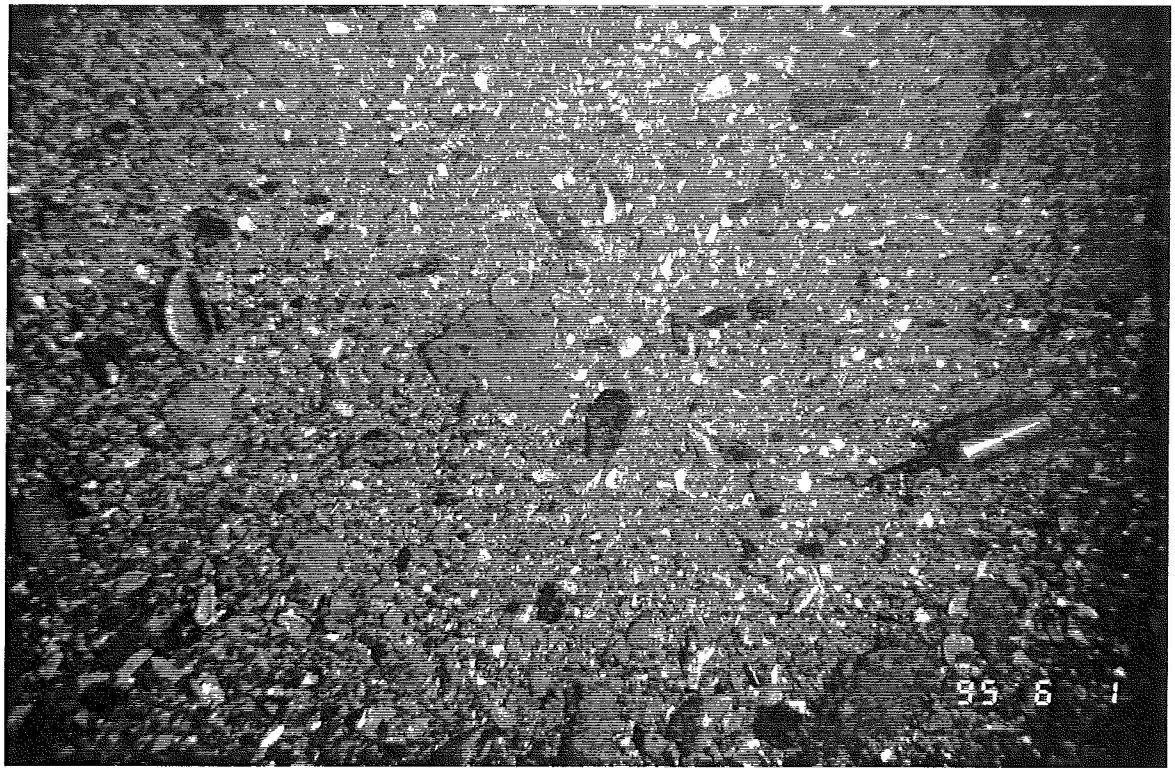


Figure 8.6.28. Seabed photographs from the centre of the Fixed Link Crossing. The seabed is composed of sorted shelly gravel, and rounded cobbles.

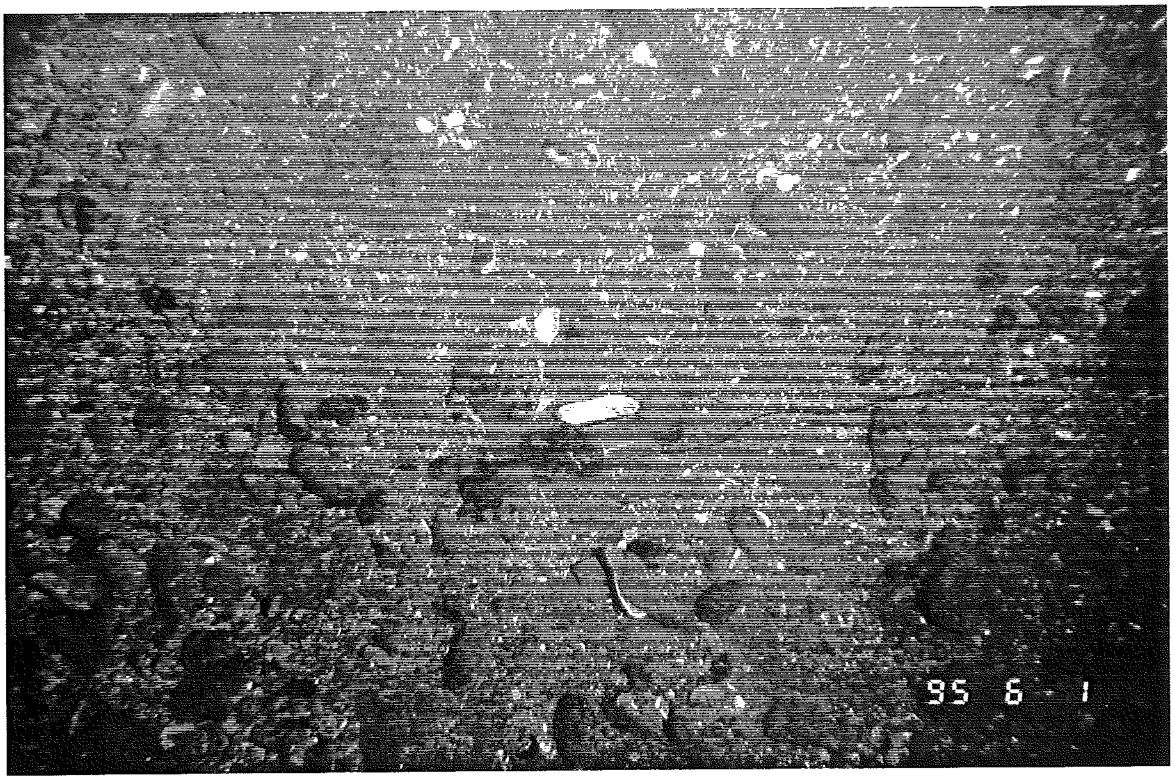


Figure 8.6.29. Seabed photographs from the eastern end of the Fixed Link Crossing. The seabed is composed of sorted shelly sand over densely packed sorted and rounded cobbles and pebbles.

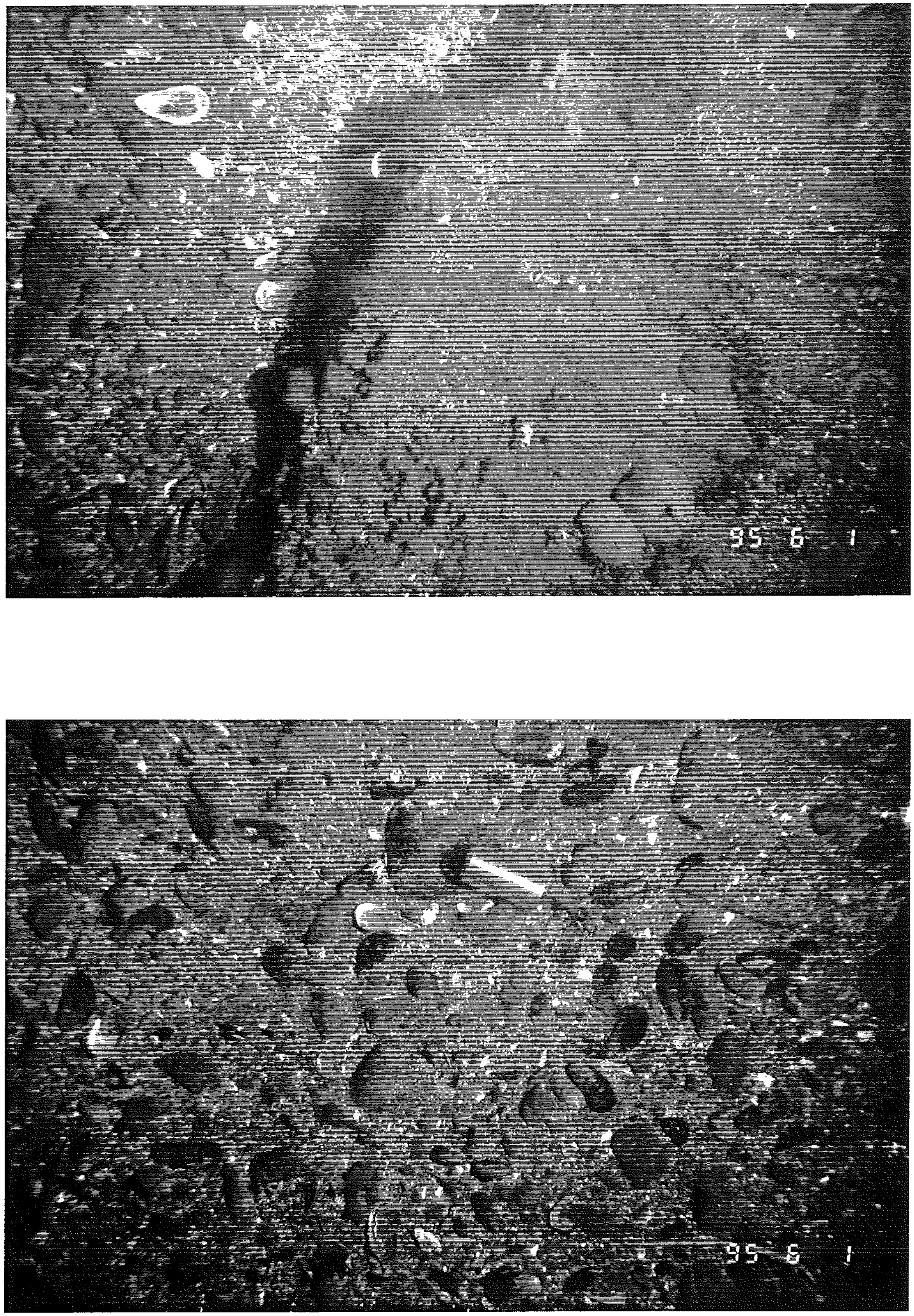


Figure 8.6.30. Seabed photographs from the eastern end of the Fixed Link Crossing. The seabed is composed of sorted shelly sand over densely packed sorted and rounded cobbles and pebbles. Notice the presence of bedrock in the upper image.

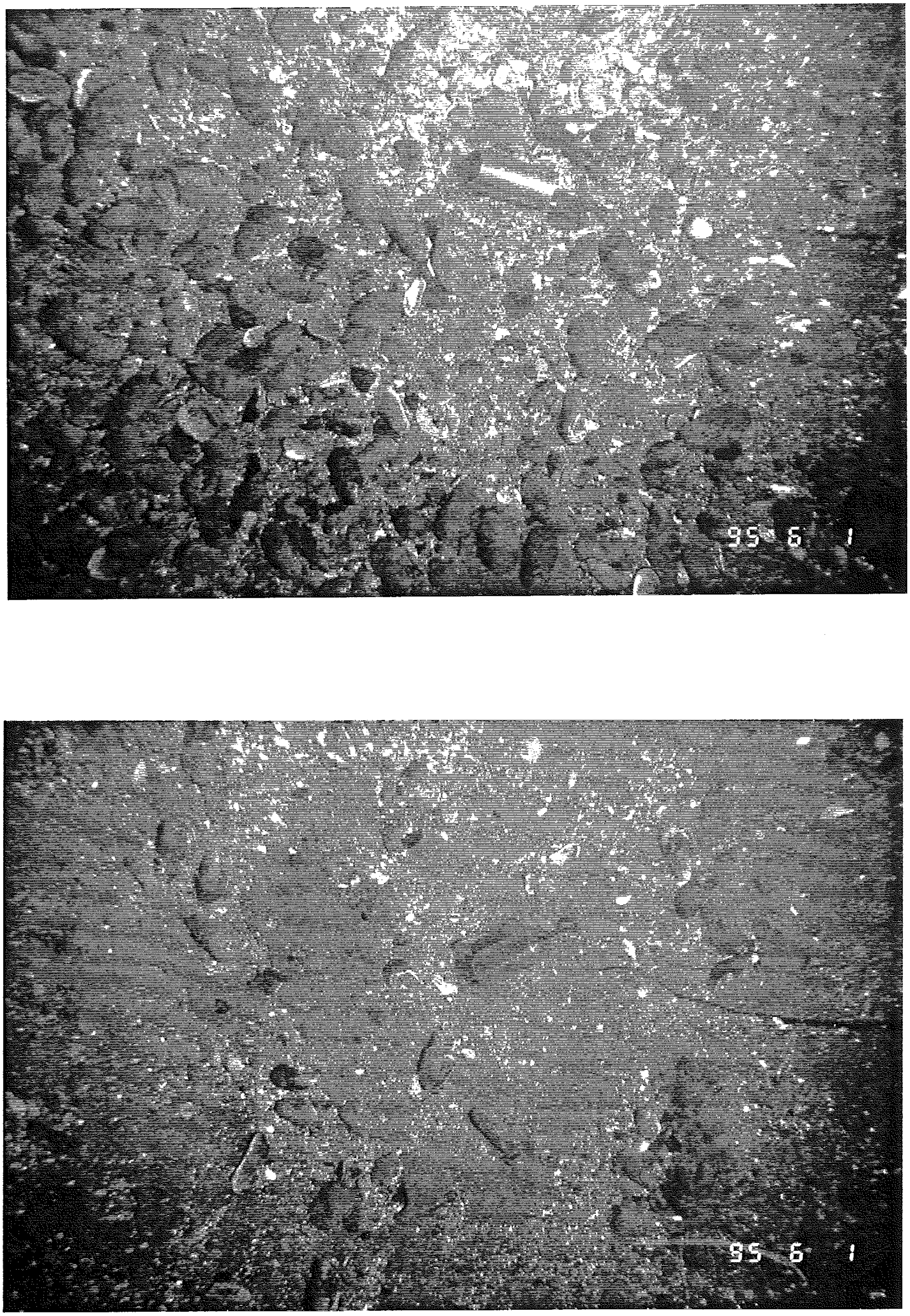


Figure 8.6.31. Seabed photographs from the eastern end of the Fixed Link Crossing. The seabed is composed of sorted shelly sand over densely packed sorted and rounded cobbles and pebbles.

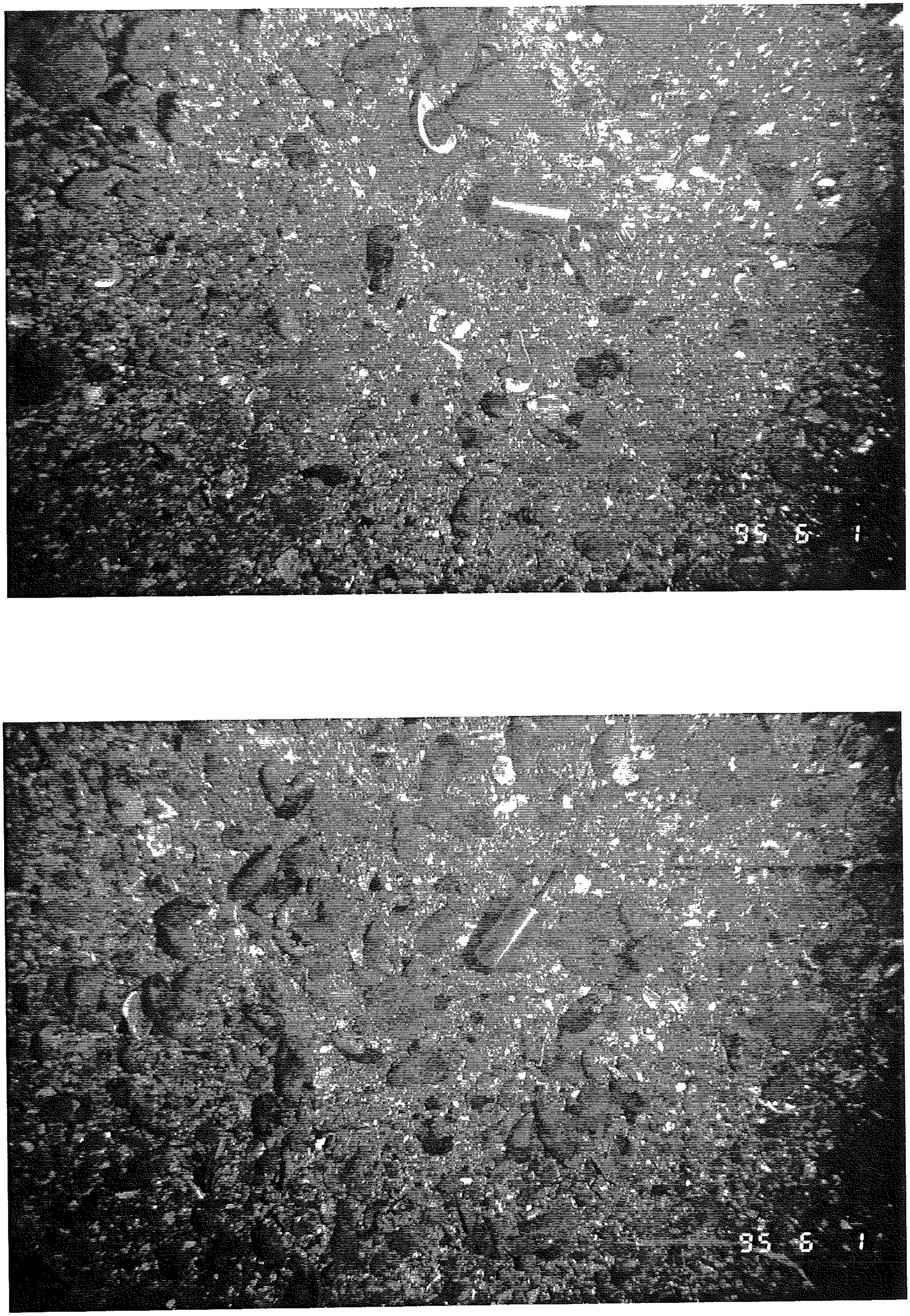


Figure 8.6.32. Seabed photographs from the eastern end of the Fixed Link Crossing. The seabed is composed of sorted shelly sand over densely packed sorted and rounded cobbles and pebbles.

APPENDIXES

(1) Tidal predictions for Cape Tormentine for the May and June, 1995

Table 1: Total sample inventory

Table 2: grab samples

Table 3: core attempts

Table 4: camera stations

Table 5: Ralph sediment trap samples

Table 6: sidescan records

Table 7: digital sidescan and seismic tapes

1

TIDAL SECTION, CHS ATLANTIC

(902) 426-3846

HOURLY PREDICTIONS FOR CAPE TORMENTINE N B
LATITUDE= 46 46   LONGITUDE= 63 46   TIME ZONE= UTC   DT= 1.0000 HOURS

HEIGHTS ARE IN METRES REFERRED TO CHART DATUM

MAY 1995

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 HOUR
1	1.3	1.7	1.9	2.1	2.1	2.0	1.8	1.6	1.4	1.3	1.4	1.5	1.7	2.0	2.2	2.2	2.1	1.9	1.6	1.2	0.9	0.8	0.7	0.8
2	1.0	1.4	1.7	1.9	2.1	2.1	2.0	1.8	1.6	1.5	1.4	1.5	1.6	1.9	2.1	2.2	2.2	2.0	1.8	1.4	1.1	0.9	0.7	0.7
3	0.9	1.1	1.5	1.8	1.9	2.0	2.0	1.9	1.8	1.6	1.5	1.5	1.6	1.7	2.0	2.1	2.2	2.1	1.9	1.6	1.3	1.0	0.8	0.8
4	0.8	1.0	1.3	1.6	1.8	1.9	2.0	2.0	1.9	1.7	1.6	1.6	1.6	1.7	1.8	2.0	2.1	2.1	2.0	1.8	1.5	1.2	1.0	0.9
5	0.9	0.9	1.1	1.4	1.6	1.8	1.9	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.4	1.2	1.0
6	1.0	1.0	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.7	1.6	1.7	1.8	1.9	2.0	2.0	1.9	1.8	1.6	1.4	1.2
7	1.1	1.1	1.1	1.3	1.4	1.6	1.8	1.9	1.9	1.9	1.9	1.8	1.7	1.7	1.6	1.7	1.8	1.9	1.9	1.9	1.9	1.7	1.6	1.4
8	1.3	1.2	1.2	1.3	1.4	1.6	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.7	1.6	1.6	1.6	1.7	1.8	1.9	1.9	1.8	1.7	1.6
9	1.4	1.3	1.3	1.3	1.4	1.5	1.7	1.8	1.9	1.9	1.9	1.9	1.8	1.7	1.6	1.5	1.5	1.6	1.6	1.8	1.8	1.9	1.9	1.8
10	1.7	1.5	1.4	1.4	1.4	1.4	1.6	1.7	1.9	2.0	2.0	2.0	1.9	1.8	1.6	1.5	1.4	1.4	1.4	1.5	1.7	1.8	1.9	1.9
11	1.9	1.8	1.6	1.5	1.4	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.2	1.2	1.3	1.4	1.6	1.8	2.0
12	2.0	2.0	1.9	1.7	1.6	1.5	1.5	1.5	1.7	1.9	2.0	2.1	2.1	2.0	1.8	1.6	1.4	1.2	1.0	1.0	1.1	1.3	1.6	1.9
13	2.1	2.1	2.1	1.9	1.8	1.6	1.5	1.5	1.5	1.7	1.9	2.1	2.2	2.2	2.0	1.8	1.5	1.2	1.0	0.8	0.8	1.0	1.3	1.7
14	2.0	2.1	2.2	2.1	2.0	1.8	1.6	1.5	1.5	1.6	1.8	2.0	2.2	2.3	2.2	2.0	1.7	1.4	1.0	0.8	0.7	0.7	0.9	1.3
15	1.7	2.0	2.2	2.2	2.2	2.0	1.7	1.6	1.5	1.5	1.6	1.8	2.1	2.3	2.3	2.2	1.9	1.6	1.2	0.9	0.6	0.6	0.7	0.9
16	1.4	1.8	2.1	2.2	2.2	2.1	1.9	1.7	1.5	1.4	1.5	1.6	1.9	2.1	2.3	2.3	2.1	1.9	1.5	1.1	0.7	0.5	0.5	0.7
17	1.0	1.4	1.8	2.1	2.2	2.2	2.1	1.8	1.6	1.5	1.4	1.5	1.6	1.9	2.2	2.3	2.3	2.1	1.8	1.4	1.0	0.7	0.5	0.5
18	0.7	1.1	1.5	1.9	2.1	2.2	2.1	2.0	1.7	1.5	1.4	1.4	1.4	1.7	2.0	2.2	2.3	2.2	2.0	1.7	1.3	0.9	0.6	0.5
19	0.6	0.8	1.2	1.6	1.9	2.1	2.2	2.1	1.9	1.7	1.5	1.3	1.3	1.4	1.7	2.0	2.2	2.3	2.2	2.0	1.6	1.2	0.9	0.6
20	0.6	0.7	0.9	1.3	1.7	2.0	2.1	2.1	2.0	1.8	1.6	1.4	1.3	1.3	1.4	1.7	2.0	2.2	2.2	2.1	1.9	1.6	1.2	0.9
21	0.7	0.7	0.8	1.1	1.4	1.7	2.0	2.1	2.1	1.9	1.7	1.5	1.4	1.3	1.3	1.4	1.7	1.9	2.1	2.1	2.0	1.8	1.5	1.2
22	1.0	0.8	0.8	0.9	1.2	1.5	1.8	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.3	1.3	1.4	1.6	1.8	2.0	2.0	2.0	1.8	1.6
23	1.3	1.1	1.0	0.9	1.0	1.3	1.5	1.8	2.0	2.0	2.0	1.8	1.7	1.5	1.3	1.2	1.3	1.4	1.6	1.7	1.9	2.0	1.9	1.8
24	1.6	1.4	1.2	1.1	1.1	1.2	1.4	1.6	1.8	2.0	2.0	2.0	1.8	1.6	1.4	1.3	1.2	1.2	1.3	1.5	1.7	1.8	1.9	1.9
25	1.9	1.7	1.5	1.3	1.2	1.2	1.3	1.4	1.7	1.9	2.0	2.0	1.9	1.8	1.6	1.4	1.2	1.1	1.1	1.2	1.4	1.6	1.8	1.9
26	2.0	1.9	1.8	1.6	1.4	1.3	1.3	1.3	1.5	1.7	1.9	2.0	2.0	1.9	1.8	1.5	1.3	1.1	1.0	1.0	1.1	1.3	1.6	1.8
27	2.0	2.0	2.0	1.8	1.6	1.5	1.4	1.3	1.4	1.6	1.8	2.0	2.1	2.1	1.9	1.7	1.4	1.2	1.0	0.9	0.9	1.0	1.3	1.6
28	1.8	2.0	2.0	2.0	1.8	1.7	1.5	1.4	1.4	1.5	1.7	2.0	2.1	2.2	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.8	1.0	1.3
29	1.6	1.9	2.0	2.1	2.0	1.8	1.7	1.5	1.5	1.5	1.6	1.8	2.1	2.2	2.2	2.1	1.8	1.5	1.2	0.9	0.8	0.7	0.8	1.0
30	1.4	1.7	1.9	2.0	2.1	2.0	1.8	1.7	1.5	1.5	1.6	1.7	1.9	2.1	2.2	2.2	2.0	1.7	1.4	1.1	0.9	0.7	0.7	0.8
31	1.1	1.4	1.7	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.5	1.6	1.8	2.0	2.2	2.2	2.1	1.9	1.6	1.3	1.0	0.8	0.7	0.8

1

TIDAL SECTION, CHS ATLANTIC
(902) 426-3846

HOURLY PREDICTIONS FOR CAPE TORMENTINE N B
LATITUDE= 46 46 LONGITUDE= 63 46 TIME ZONE= UTC DT= 1.0000 HOURS

HEIGHTS ARE IN METRES REFERRED TO CHART DATUM

JUNE 1995

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 HOUR
1	0.9	1.2	1.5	1.8	1.9	2.0	2.0	1.9	1.8	1.6	1.6	1.6	1.7	1.9	2.1	2.2	2.2	2.1	1.8	1.5	1.2	1.0	0.8	0.8
2	0.9	1.1	1.4	1.6	1.8	2.0	2.0	2.0	1.9	1.7	1.6	1.6	1.6	1.7	1.9	2.1	2.1	2.1	1.9	1.7	1.4	1.2	1.0	0.9
3	0.9	1.0	1.3	1.5	1.7	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.8	1.9	2.1	2.1	2.0	1.8	1.6	1.3	1.1	1.0
4	1.0	1.0	1.2	1.4	1.7	1.8	1.9	2.0	1.9	1.9	1.7	1.6	1.6	1.6	1.6	1.8	1.9	2.0	2.0	1.9	1.7	1.5	1.3	1.1
5	1.1	1.1	1.2	1.4	1.6	1.8	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.5	1.5	1.6	1.8	1.9	2.0	1.9	1.8	1.7	1.5	1.3
6	1.2	1.2	1.2	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.6	1.5	1.5	1.5	1.6	1.7	1.8	1.9	1.9	1.8	1.7	1.5
7	1.4	1.3	1.3	1.3	1.5	1.7	1.9	2.0	2.1	2.1	2.0	1.8	1.7	1.5	1.4	1.4	1.4	1.5	1.6	1.8	1.9	1.9	1.8	1.7
8	1.6	1.5	1.4	1.4	1.4	1.6	1.8	1.9	2.1	2.1	2.1	2.0	1.8	1.6	1.4	1.3	1.2	1.2	1.4	1.5	1.7	1.8	1.9	1.9
9	1.8	1.7	1.6	1.5	1.5	1.5	1.7	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.1	1.1	1.1	1.2	1.4	1.7	1.8	2.0
10	2.0	1.9	1.8	1.7	1.6	1.5	1.6	1.7	1.9	2.1	2.2	2.2	2.1	2.0	1.7	1.4	1.2	1.0	0.9	0.9	1.1	1.4	1.6	1.9
11	2.0	2.1	2.0	1.9	1.7	1.6	1.6	1.6	1.7	1.9	2.1	2.3	2.3	2.1	1.9	1.6	1.3	1.0	0.8	0.7	0.8	1.0	1.3	1.7
12	1.9	2.1	2.1	2.1	1.9	1.7	1.6	1.6	1.6	1.7	2.0	2.2	2.3	2.3	2.1	1.9	1.5	1.2	0.9	0.7	0.6	0.7	1.0	1.4
13	1.7	2.0	2.2	2.2	2.1	1.9	1.7	1.6	1.5	1.6	1.7	2.0	2.2	2.3	2.3	2.1	1.8	1.4	1.0	0.7	0.5	0.5	0.7	1.0
14	1.4	1.8	2.1	2.2	2.2	2.0	1.8	1.6	1.5	1.5	1.5	1.7	2.0	2.3	2.4	2.3	2.1	1.8	1.3	0.9	0.6	0.5	0.5	0.7
15	1.1	1.5	1.9	2.1	2.2	2.1	2.0	1.8	1.5	1.4	1.4	1.5	1.7	2.0	2.3	2.3	2.3	2.0	1.7	1.2	0.8	0.6	0.4	0.5
16	0.8	1.2	1.6	2.0	2.1	2.2	2.1	1.9	1.7	1.4	1.3	1.3	1.4	1.7	2.0	2.2	2.3	2.2	2.0	1.6	1.2	0.8	0.6	0.5
17	0.6	0.9	1.3	1.7	2.0	2.2	2.2	2.0	1.8	1.6	1.4	1.2	1.3	1.4	1.7	2.0	2.2	2.3	2.1	1.9	1.5	1.1	0.8	0.6
18	0.6	0.7	1.0	1.5	1.8	2.1	2.2	2.1	2.0	1.7	1.5	1.3	1.2	1.2	1.4	1.7	2.0	2.1	2.2	2.1	1.8	1.5	1.1	0.9
19	0.7	0.7	0.9	1.2	1.6	1.9	2.1	2.1	2.1	1.9	1.6	1.4	1.2	1.2	1.2	1.4	1.7	1.9	2.0	2.1	2.0	1.8	1.5	1.2
20	1.0	0.9	0.9	1.1	1.4	1.7	1.9	2.1	2.1	2.0	1.8	1.6	1.3	1.2	1.1	1.2	1.4	1.6	1.8	1.9	2.0	1.9	1.7	1.5
21	1.3	1.1	1.0	1.1	1.2	1.5	1.8	1.9	2.0	2.0	1.9	1.7	1.5	1.3	1.2	1.1	1.2	1.4	1.6	1.7	1.9	1.9	1.9	1.7
22	1.5	1.4	1.2	1.2	1.2	1.4	1.6	1.8	2.0	2.0	2.0	1.8	1.7	1.5	1.3	1.2	1.1	1.2	1.3	1.5	1.7	1.8	1.9	1.8
23	1.8	1.6	1.5	1.4	1.3	1.4	1.5	1.7	1.9	2.0	2.0	2.0	1.8	1.6	1.4	1.2	1.1	1.1	1.1	1.2	1.4	1.6	1.8	1.9
24	1.9	1.8	1.7	1.6	1.5	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.0	1.8	1.6	1.4	1.2	1.0	1.0	1.0	1.2	1.4	1.6	1.8
25	1.9	1.9	1.9	1.8	1.6	1.6	1.5	1.6	1.7	1.8	2.0	2.1	2.1	2.0	1.8	1.6	1.3	1.1	1.0	0.9	0.9	1.1	1.4	1.6
26	1.8	1.9	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.7	1.9	2.1	2.2	2.1	2.0	1.8	1.5	1.2	1.0	0.9	0.8	0.9	1.1	1.4
27	1.7	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.8	2.0	2.2	2.2	2.2	2.0	1.7	1.4	1.1	0.9	0.8	0.8	0.9	1.1
28	1.4	1.7	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.6	1.7	1.8	2.1	2.2	2.2	2.1	1.9	1.7	1.3	1.1	0.9	0.8	0.8	1.0
29	1.2	1.5	1.8	1.9	2.0	2.0	1.9	1.8	1.7	1.6	1.6	1.7	1.9	2.1	2.2	2.2	2.1	1.9	1.6	1.3	1.0	0.8	0.8	0.9
30	1.1	1.4	1.6	1.8	2.0	2.0	2.0	1.8	1.7	1.6	1.6	1.6	1.7	1.9	2.1	2.2	2.2	2.0	1.8	1.5	1.2	1.0	0.9	0.9

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
001	CAMERA	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-1	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-2	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-3	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-4	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-5	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
001-6	WATER	1451702		46 08.4638	63 46.0609	6.5	DUMP SITE NO.1, CAPE TORMENTINE
002	WATER	1451727		46 08.3629	63 45.9535	7.25	DUMP SITE NO.1, CAPE TORMENTINE
003	GRAB	1451814		46 08.8114	63 45.8847	6.75	DUMP SITE NO.1, CAPE TORMENTINE
004	GRAB	1461817		46 08.4525	63 46.0438	6.7	DUMP SITE NO.1, CAPE TORMENTINE
005	GRAB	1471210		46 08.7908	63 45.9117	5.7	DUMP SITE NO.1, CAPE TORMENTINE
006	GRAB	1471715		46 13.7870	63 40.9405	10.1	DUMP SITE NO.2, AMHERST COVE
007	GRAB	1471722		46 13.8091	63 40.9290	9.9	DUMP SITE NO.2, AMHERST COVE
008	GRAB	1481649		46 05.1521	63 39.6285	12.3	DUMP SITE NO.3, CAPE TORMENTINE
009	GRAB	1461657		46 05.1695	63 39.5752	12.1	DUMP SITE NO.3, CAPE TORMENTINE
010	CAMERA	1491227		46 08.8007	63 45.9164	6.7	DUMP SITE NO.1, CAPE TORMENTINE
011	CAMERA	1491338	1461720	46 08.8987	63 45.8262	6.2	DUMP SITE NO.1, CAPE TORMENTINE

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
012	CAMERA	1491429		46 08.8761	63 45.8479	7.2	DUMP SITE NO.1, CAPE TORMENTINE
013	GRAB	1491518		46 08.7793	63 45.8837	7.6	DUMP SITE NO.1, CAPE TORMENTINE
014	CAMERA	1491529		46 08.7798	63 45.8788	7.9	DUMP SITE NO.1, CAPE TORMENTINE
015	GRAB	1491610		46 09.2495	63 46.6430	5.8	DUMP SITE NO.1, CAPE TORMENTINE
016	GRAB	1491622		46 08.5119	63 46.4525	6.3	DUMP SITE NO.1, CAPE TORMENTINE
017	GRAB	1491637		46 07.7940	63 45.8412	6.2	DUMP SITE NO.1, CAPE TORMENTINE
018	GRAB	1491646		46 08.0487	63 45.3837	7.6	DUMP SITE NO.1, CAPE TORMENTINE
019	GRAB	1491654		46 08.3237	63 44.9737	8.2	DUMP SITE NO.1, CAPE TORMENTINE
020	GRAB	1491701		46 08.6038	63 44.3230	13.0	DUMP SITE NO.1, CAPE TORMENTINE
021	GRAB	1491714		46 08.2563	63 43.8005	12.7	DUMP SITE NO.1, CAPE TORMENTINE
022	GRAB	1491724		46 07.9495	63 44.6014	9.0	DUMP SITE NO.1, CAPE TORMENTINE
023	GRAB	1491731		46 07.7548	63 45.0535	7.6	DUMP SITE NO.1, CAPE TORMENTINE
024	GRAB	1491740		46 07.4479	63 45.6006	8.7	DUMP SITE NO.1, CAPE TORMENTINE
025	GRAB	1491751		46 06.9506	63 45.1877	5.4	DUMP SITE NO.1, CAPE TORMENTINE
026	GRAB	1491759		46 07.2421	63 44.5096	6.3	DUMP SITE NO.1, CAPE TORMENTINE
027	GRAB	1491808		46 07.5670	63 43.7819	9.1	DUMP SITE NO.1, CAPE TORMENTINE
028	GRAB	1491816		46 07.8492	63 42.9766	13.4	DUMP SITE NO.1, CAPE TORMENTINE

TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
029	GRAB	1491827		46 08.3527	63 46.9712	24.8	DUMP SITE NO.1, CAPE TORMENTINE
030	GRAB	1491855		46 08.1016	63 46.4563	6.0	DUMP SITE NO.1, CAPE TORMENTINE
031	GRAB	1491902		46 08.1108	63 46.4792	6.5	DUMP SITE NO.1, CAPE TORMENTINE
032	CAMERA	1501341		46 08.2536	63 45.0280	9.2	DUMP SITE NO.1, CAPE TORMENTINE
033	CAMERA	1501414		46 08.7413	63 45.0330	8.7	DUMP SITE NO.1, CAPE TORMENTINE
034	CAMERA	1501658		46 08.0937	63 46.4760	7.1	DUMP SITE NO.1, CAPE TORMENTINE
035	WATER	1501721		46 08.0935	63 46.4750	7.1	DUMP SITE NO.1, CAPE TORMENTINE
036	CAMERA	1511542		46 08.7985	63 45.9265	8.3	DUMP SITE NO.1, CAPE TORMENTINE
037	CORE	1511554		46 08.7961	63 45.9084	8.3	DUMP SITE NO.1, CAPE TORMENTINE
038	CAMERA	1511606		46 08.8455	63 45.8406	7.6	DUMP SITE NO.1, CAPE TORMENTINE
039	GRAB	1511617		46 08.8476	63 45.8611	7.7	DUMP SITE NO.1, CAPE TORMENTINE
040	CAMERA	1511631		46 08.7396	63 45.9021	8.4	DUMP SITE NO.1, CAPE TORMENTINE
041	GRAB	1511645		46 08.7241	63 45.9549	8.2	DUMP SITE NO.1, CAPE TORMENTINE
042	GRAB	1511717		46 11.0396	63 46.7327	15.5	FIXED LINK, ABEGWEIT PASSAGE
043	GRAB	1511744		46 12.4405	63 45.2334	18.5	FIXED LINK, ABEGWEIT PASSAGE
044	GRAB	1511811		46 14.0322	63 43.1624	13.7	FIXED LINK, ABEGWEIT PASSAGE

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
045	CAMERA	1521213		46 10.9712	63 46.6560	14.8	FIXED LINK, ABEGWEIT PASSAGE
046	CAMERA	1521238		46 12.4491	63 45.2860	17.8	FIXED LINK, ABEGWEIT PASSAGE
047	CAMERA	1521303		46 13.0293	63 43.2130	13.3	FIXED LINK, ABEGWEIT PASSAGE
048	CAMERA	1521333		46 13.7599	63 40.8508	10.4	DUMP SITE NO.2, AMHERST COVE
049	CAMERA	1551658		46 13.6544	63 39.9198	8.3	DUMP SITE NO.2, AMHERST COVE

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 2

GRAB SAMPLES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	TYPE OF SAMPLER	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (M)	NO.OF TRIES	NO. OF SUBSAMPLES	GEOGRAPHIC LOCATION	GRAB SAMPLE NOTES
003	VAN VEEN	1451814	46 08.8114 63 45.8847	6.75	3		DUMP SITE NO.1, CAPE TORMENTINE	GRAB-1.
004	VAN VEEN	1461817	46 08.4525 63 46.0438	6.7	2		DUMP SITE NO.1, CAPE TORMENTINE	GRAB-2.
005	VAN VEEN	1471210	46 08.7908 63 45.9117	5.7	3		DUMP SITE NO.1, CAPE TORMENTINE	MAINLY FINE SANDS (BROWN, UPPER), SOME ORGANIC MATTER (BLACK, LOWER LAYER). GRAB-3.
006	VAN VEEN	1471715	46 13.7870 63 40.9405	10.1	5		DUMP SITE NO.2, AMHERST COVE	GRAB-4.
007	VAN VEEN	1471722	46 13.8091 63 40.9290	9.9	8		DUMP SITE NO.2, AMHERST COVE	GRAB-5.
008	VAN VEEN	1481649	46 05.1521 63 39.6285	12.3	2		DUMP SITE NO.3, CAPE TORMENTINE	GRAB-6.
009	VAN VEEN	1461657	46 05.1695 63 39.5752	12.1	3		DUMP SITE NO.3, CAPE TORMENTINE	GRAB-7.
013	VAN VEEN	1491518	46 08.7793 63 45.8837	7.6			DUMP SITE NO.1, CAPE TORMENTINE	GRAB-8.
015	VAN VEEN	1491610	46 09.2495 63 46.6430	5.8	1		DUMP SITE NO.1, CAPE TORMENTINE	CLEAN, SHELLY, FINE SAND. GRAB-9.
016	VAN VEEN	1491622	46 08.5119 63 46.4525	6.3	4		DUMP SITE NO.1, CAPE TORMENTINE	1ST ATTEMPT: MEDIUM, FINE SAND. 2ND ATTEMPT: CLEAN SHELLY SAND. 3RD ATTEMPT: COBBLES OVER SHELLY FINE SAND. 4TH ATTEMPT: SHELLY FINE SAND. GRAB-10.
017	VAN VEEN	1491637	46 07.7940 63 45.8412	6.2	3		DUMP SITE NO.1, CAPE TORMENTINE	ATTEMPT NO.1
018	VAN VEEN	1491646	46 08.0487 63 45.3837	7.6	2		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-12.
019	VAN VEEN	1491654	46 08.3237 63 44.9737	8.2	1		DUMP SITE NO.1, CAPE TORMENTINE	FINE CLEAN SAND. GRAB-13.
020	VAN VEEN	1491701	46 08.6038 63 44.3230	13.0	1		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-14.
021	VAN VEEN	1491714	46 08.2563 63 43.8005	12.7	1		DUMP SITE NO.1, CAPE TORMENTINE	FINE SHELLY SAND. GRAB-15.

ATLANTIC GEOSCIENCE CENTRE
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TABLE 2

GRAB SAMPLES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	TYPE OF SAMPLER	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (M)	NO.OF TRIES	NO. OF SUBSAMPLES	GEOGRAPHIC LOCATION	GRAB SAMPLE NOTES
022	VAN VEEN	1491724	46 07.9495 63 44.6014	9.0	1		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-16.
023	VAN VEEN	1491731	46 07.7548 63 45.0535	7.6	1		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-17.
024	VAN VEEN	1491740	46 07.4479 63 45.6006	8.7	1		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-18.
025	VAN VEEN	1491751	46 06.9506 63 45.1877	5.4	1		DUMP SITE NO.1, CAPE TORMENTINE	FINE SAND. GRAB-19.
026	VAN VEEN	1491759	46 07.2421 63 44.5096	6.3	2		DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-20.
027	VAN VEEN	1491808	46 07.5670 63 43.7819	9.1	1		DUMP SITE NO.1, CAPE TORMENTINE	FINE SAND. GRAB-21.
028	VAN VEEN	1491816	46 07.8492 63 42.9766	13.4			DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-21.
029	VAN VEEN	1491827	46 08.3527 63 46.9712	24.8			DUMP SITE NO.1, CAPE TORMENTINE	SHELLY, FINE SAND. GRAB-23.
030	VAN VEEN	1491855	46 08.1016 63 46.4563	6.0			DUMP SITE NO.1, CAPE TORMENTINE	GRAB-24.
031	VAN VEEN	1491902	46 08.1108 63 46.4792	6.5			DUMP SITE NO.1, CAPE TORMENTINE	GRAB-25.
039	VAN VEEN	1511617	46 08.8476 63 45.8611	7.7	6		DUMP SITE NO.1, CAPE TORMENTINE	ROV SITE NO. 2. 1ST ATTEMPT: NO SAMPLE. 2ND ATTEMPT: NO SAMPLE. 3RD ATTEMPT: NO SAMPLE. 4TH ATTEMPT: FINE SAND WITH SHELL FRAGMENTS. 5TH ATTEMPT: NO SAMPLE. 6TH ATTEMPT: FINE SHELLY SAND. GRAB-26.
041	VAN VEEN	1511645	46 08.7241 63 45.9549	8.2	3		DUMP SITE NO.1, CAPE TORMENTINE	ROV SITE NO. 3. 2ND ATTEMPT: FINE SAND. GRAB-27.
042	VAN VEEN	1511717	46 11.0396 63 46.7327	15.5	5		FIXED LINK, ABEGWEIT PASSAGE	1ST ATTEMPT: GRAVEL. 2ND ATTEMPT: FINE SAND, SHELLS. 3RD ATTEMPT: COBBLES, FINE SAND. 4TH ATTEMPT: COBBLES, FINE SAND. 5TH ATTEMPT: EMPTY. GRAB-28.
043	VAN VEEN	1511744	46 12.4405 63 45.2334	18.5	4		FIXED LINK, ABEGWEIT PASSAGE	1ST ATTEMPT: FINE SAND, GRAVEL, SHELLS. 2ND ATTEMPT: FINE SAND, GRAVEL, SHELLS. 3RD ATTEMPT: FINE SAND, GRAVEL, SHELLS. 4TH ATTEMPT: FINE SAND, GRAVEL, SHELLS, COBBLES. GRAB-29.

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TABLE 2

GRAB SAMPLES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	TYPE OF SAMPLER	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (M)	NO.OF TRIES	NO. OF SUBSAMPLES	GEOGRAPHIC LOCATION	GRAB SAMPLE NOTES
044	VAN VEEN	1511811	46 14.0322 63 43.1624	13.7	7		FIXED LINK, ABEGWEIT PASSAGE	1ST ATTEMPT: EMPTY. 2ND ATTEMPT: SHELLY GRAVEL, SMALL SAMPLE. 3RD ATTEMPT: SHELLY GRAVEL. 4TH ATTEMPT: COBBLES. 5TH ATTEMPT: SHELLY GRAVEL. 6TH ATTEMPT: EMPTY. 7TH ATTEMPT: SHELLY GRAVEL. GRAB-30.

TABLE 3

CORE SAMPLES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	CORER LENGTH (CM)	APP. PENN (CM)	CORE LENGTH (CM)	NO OF SECT	GEOGRAPHIC LOCATION	NOTES
037	GRAVITY	1511554	46 08.7961 63 45.9084	8.3		0	0	0	DUMP SITE NO.1, CAPE TORMENTINE	1ST ATTEMPT: NO RECOVERY. 2ND ATTEMPT: NO RECOVERY. 3RD ATTEMPT: NO RECOVERY. CORE-1.

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TABLE 4

CAMERA STATIONS

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	TYPE OF CAMERA	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	FRAMES SHOT	DIST OFF. BOTT	STEREO	COLOR1 COLOR2	ASA1 ASA2	FSTOP1 FSTOP2	FOCUS1 FOCUS2	FILM1 FILM2	GEOGRAPHIC LOCATION
001	RALPH	1451702	46 08.4638 63 46.0609	6.5									DUMP SITE NO.1, CAPE TORMENTINE
010	ROV SEACLOPS	1491227	46 08.8007 63 45.9164	6.7									DUMP SITE NO.1, CAPE TORMENTINE
011	ROV SEACLOPS	1491338	46 08.8987 63 45.8262	6.2									DUMP SITE NO.1, CAPE TORMENTINE
012	ROV SEACLOPS	1491429	46 08.8761 63 45.8479	7.2									DUMP SITE NO.1, CAPE TORMENTINE
014	ROV SEACLOPS	1491529	46 08.7798 63 45.8788	7.9									DUMP SITE NO.1, CAPE TORMENTINE
032	ROV SEACLOPS	1501341	46 08.2536 63 45.0280	9.2									DUMP SITE NO.1, CAPE TORMENTINE
033	ROV SEACLOPS	1501414	46 08.7413 63 45.0330	8.7									DUMP SITE NO.1, CAPE TORMENTINE
034	ROV SEACLOPS	1501658	46 08.0937 63 46.4760	7.1									DUMP SITE NO.1, CAPE TORMENTINE
036	ICE HOLE	1511542	46 08.7985 63 45.9265	8.3	10		N	B-W	125	5.6		XPAN	DUMP SITE NO.1, CAPE TORMENTINE
038	ICE HOLE	1511606	46 08.8455 63 45.8406	7.6	10		N	B-W	125	5.6		XPAN	DUMP SITE NO.1, CAPE TORMENTINE
040	ICE HOLE	1511631	46 08.7396 63 45.9021	8.4	10		N	B-W	125	5.6		XPAN	DUMP SITE NO.1, CAPE TORMENTINE
045	ICE HOLE	1521213	46 10.9712 63 46.6560	14.8	10		N	B-W	125	5.6		XPAN	FIXED LINK, ABEGWEIT PASSAGE
046	ICE HOLE	1521238	46 12.4491 63 45.2860	17.8	10		N	B-W	125	5.6		XPAN	FIXED LINK, ABEGWEIT PASSAGE
047	ICE HOLE	1521303	46 13.0293 63 43.2130	13.3	10		N	B-W	125	5.6		XPAN	FIXED LINK, ABEGWEIT PASSAGE
048	ICE HOLE	1521333	46 13.7599 63 40.8508	10.4	10		N	B-W	125	5.6		XPAN	DUMP SITE NO.2, AMHERST COVE
049	RALPH	1551658	46 13.6544 63 39.9198	8.3									DUMP SITE NO.2, AMHERST COVE

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TABLE 5

WATER SAMPLES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

SAMPLE NUMBER	SAMPLE TYPE	JULIAN DAY/TIME	LATITUDE LONGITUDE	DEPTH (MTRS)	BOTTLE VOLUMN	SAMPLE DEPTHS (1-10)	GEOGRAPHIC LOCATION	NOTES
002	WATER	1451727	46 08.362 63 45.953	7.25			DUMP SITE NO.1, CAPE TORMENTINE	S-4 ON TUBULAR FRAME AT 0.5M ABOVE SEABED. LOGGER STARTED AT 1300(UTC) 25 MAY,95. OFF BOTTOM 154/1740:30, ON DECK 154/1744:20. CM-1.
035	WATER	1501721	46 08.093 63 46.475	7.1			DUMP SITE NO.1, CAPE TORMENTINE	ALONGSIDE BUZZARD. ON DECK 1823. SEA CAROUSEL-1.
001-1	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	0.15M.
001-2	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	0.40M.
001-3	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	0.70M.
001-4	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	0.90M.
001-5	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	1.20M.
001-6	WATER	1451702	46 08.463 63 46.060	6.5			DUMP SITE NO.1, CAPE TORMENTINE	1.40M.

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TABLE 6

SIDESCAN RECORDS

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

ROLL NUMBERS	START DAY/TIME	STOP DAY/TIME	LINE NUMBERS	RECORD TYPE	GEOGRAPHIC LOCATION	RECORDER	SIDESCAN SYS
001	1461252	1461823	A-I	SINGLE	DUMP SITE NO.1	ALDEN	SIMRAD
002	1471229	1471706	A, 1-10	SINGLE	DUMP SITE NO.1 AND DUMP SITE NO.2	ALDEN	SIMRAD
003	1481220	1481637	1-10	SINGLE	DUMP SITE NO.3	ALDEN	SIMRAD
004	1521355	1521812	1-3	SINGLE	ABEGWEIT PASSAGE	ALDEN	SIMRAD
005	1531418	1531816	RUS1 AND RUS2	SINGLE	ABEGWEIT PASSAGE	ALDEN	SIMRAD
006	1541157	1541647	DL1-11	SINGLE	ABEGWEIT PASSAGE	ALDEN	SIMRAD
007	1551149	1551628	DL12-21	SINGLE	ABEGWEIT PASSAGE	ALDEN	SIMRAD

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TABLE 7

DIGITAL TAPES

CRUISE NUMBER = 95140
CHIEF SCIENTIST = C.L. AMOS
PROJECT NUMBER = 303047

REEL NUMBER	NARC NUMBER	START DAY/TIME	STOP DAY/TIME	LINE NUMBERS	PARAMETER	GEOGRAPHIC LOCATION	DIGITAL TAPE NOTES
001		1531420	1531812	RUS1 AND RUS2	CHIRP	ABEGWEIT PASSAGE	
002		1541212	1541646	DL1-DL11	CHIRP	ABEGWEIT PASSAGE	
003		1551207	1551421	DL12-DL16	CHIRP	ABEGWEIT PASSAGE	
004		1551424	1551626	DL17-DL21	CHIRP	ABEGWEIT PASSAGE	
1		1461325	1461508	A-F	SIDESCAN	DUMP SITE NO.1	
2		1461545	1461814	G-I	SIDESCAN	DUMP SITE NO.1	
3		1471241	1471250	REPEAT LINE A	SIDESCAN	DUMP SITE NO.1	
4		1471357	1471411	1	SIDESCAN	DUMP SITE NO.2	
5		1471431	1471524	2-5	SIDESCAN	DUMP SITE NO.2	
6		1471540	1471705	6-10	SIDESCAN	DUMP SITE NO.2	
7		1481233	1481504	1-6	SIDESCAN	DUMP SITE NO.3	
8		1481509	1481635	7-10	SIDESCAN	DUMP SITE NO.3	
9		1521410	1521600	1-2	SIDESCAN	ABEGWEIT PASSAGE	
10		1521603	1521810	3	SIDESCAN	ABEGWEIT PASSAGE	
11		1531420	1531812	RUS1 AND RUS2	SIDESCAN	ABEGWEIT PASSAGE	
12		1541212	1541414	DL1-5	SIDESCAN	ABEGWEIT PASSAGE	
13		1541422	1541646	DL6-11	SIDESCAN	ABEGWEIT PASSAGE	
14		1551207	1551626	DL12-21	SIDESCAN	ABEGWEIT PASSAGE	