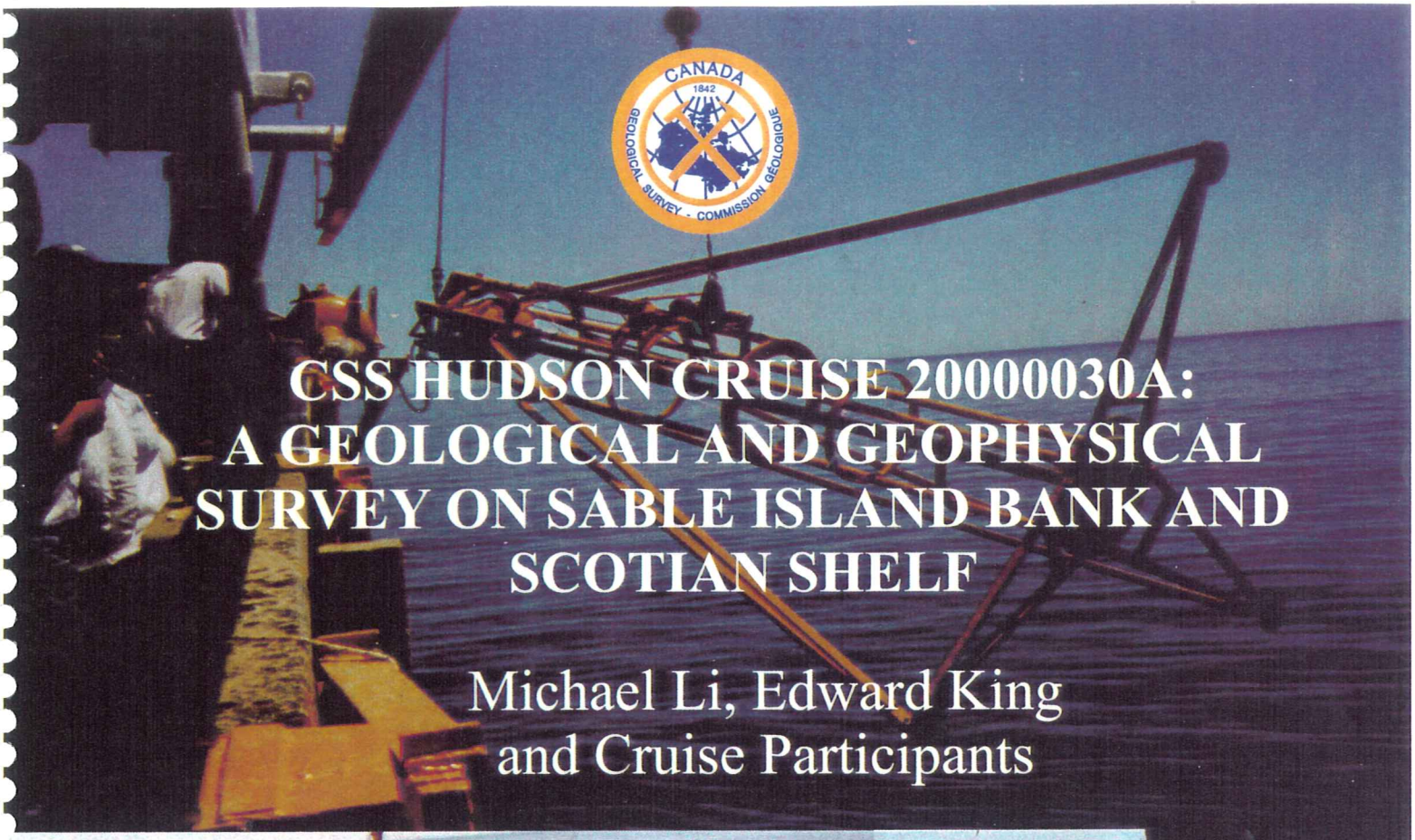
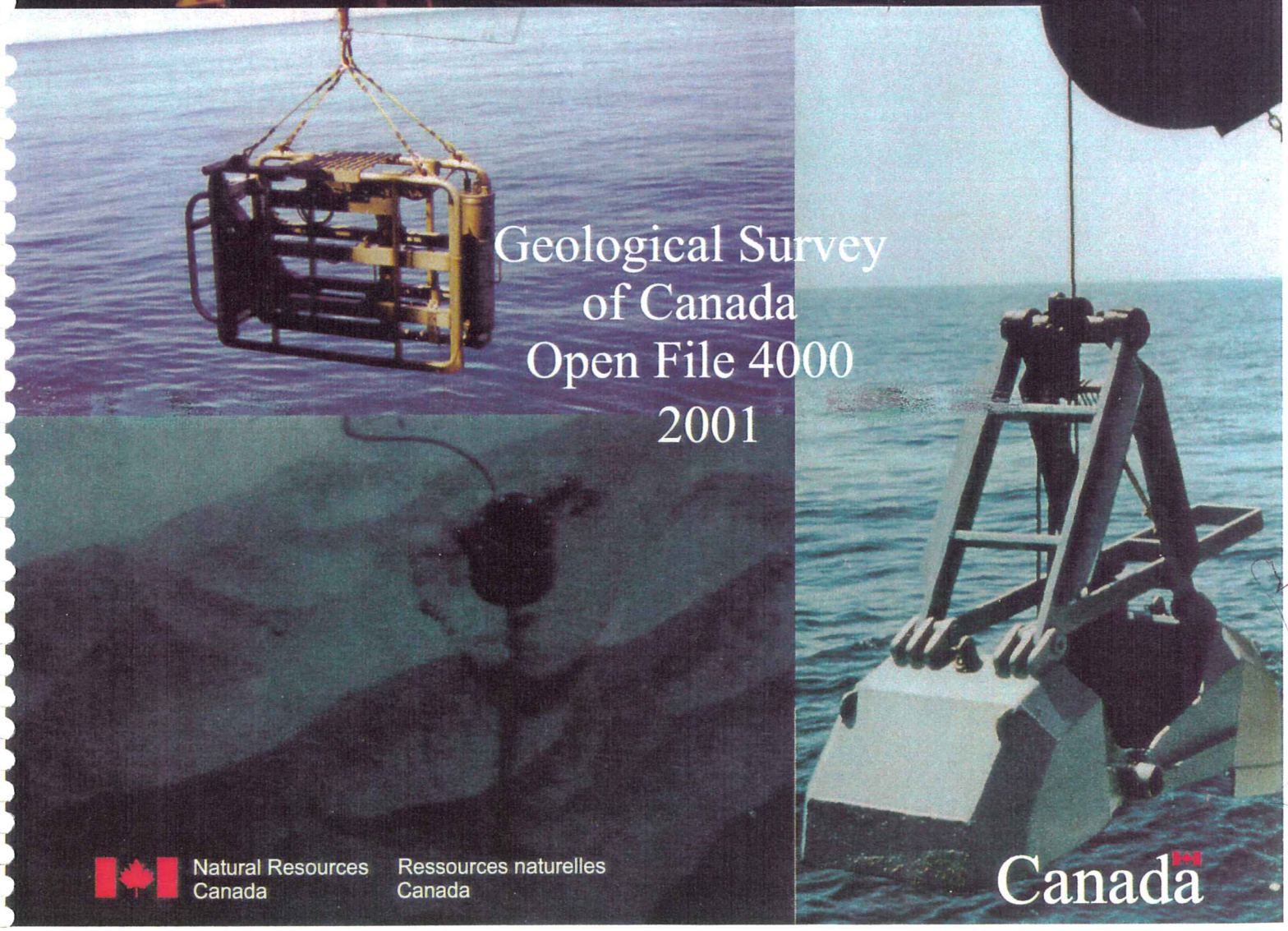


CSS HUDSON CRUISE 20000030A: A GEOLOGICAL AND GEOPHYSICAL SURVEY ON SABLE ISLAND BANK AND SCOTIAN SHELF

Michael Li, Edward King
and Cruise Participants



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CSS HUDSON CRUISE 20000030A: A GEOLOGICAL AND GEOPHYSICAL SURVEY ON SABLE ISLAND BANK AND SCOTIAN SHELF

by

Michael Li, Edward King
Borden Chapman, Paul Girouard, Fred Jodrey, Susan Merchant, Bob Murphy,
Barbe Szlavko, Bruce Wile, Marty Uyesugi, Andrew Campbell

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Geological Survey of Canada
Open File Report 4000

2000

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1. CRUISE SUMMARY

Ship CSS HUDSON

Cruise Number HUD2000030A

Duration 13 - 21 July, 2000

Survey Areas Sable Island Bank and Scotian Shelf

Summary of Accomplishments

6 sand ridge profiles
99 van Veen/IKU grab samples
7 vibrocores
59 sedimentary peels
60 camera stations
~450 km seismic/sidescan survey lines

Scientific Staff

Michael Li	GSCA	senior scientist
Ned King	GSCA	second senior scientist; seismic/sidescan
Andrew Campbell	Dal	seismic/sidescan
Borden Chapman	GSCA	seismic/sidescan
Paul Girouard	GSCA	navigation
Fred Jodrey	GSCA	camera/coring/sampling
Susan Merchant	GSCA	coring/sampling
Bob Murphy	GSCA	camera/coring/sampling
Barbe Szlavko	GSCA	ED at Sea/coring and sampling
Marty Uyesugi	Geoforce	Huntec
Bruce Wile	GSCA	seismic/sidescan

Ship's Personnel

Captain	Leslie M Rhodenizer
Chief Officer	Fred J Emeneau
Second Officer	Glen Fishback
Third Officer	David Boyd
Chief Engineer	James R Spinney
Senior Engineer	Giuseppe Cimello
First Engineer	John Blagdon
Second Engineer	Byron Randall
Third Engineer	Chester A Craig
Electrical Officer	Scott Fulton
Logistics Officer	Perry A West
Boatswain	Claude Warren
Leading Seaman	Donald A Rawding
Leading Seaman	Michael G Worth
Leading Seaman	Gregory D MacClellan

Seaman	K Farcey
Seaman	Arthur W Wilson
Seaman	Paul R Wedge
Seaman	A G Ward
Seaman	John G Baker
Seaman	John D Cook
Oiler	John F Haley
Oiler	J A Boudreau
Chief Cook	Tyrone Saunders
Assistant Cook	RobinG Parker
Storekeeper	Barry MacDonald
Second Steward	Ronald J Cameron
Steward	Alfred Haines
Steward	Mary E Cameron
Steward	Edward Hanlon

2. INTRODUCTION

The NE-SW trending sand ridges on Sable Island Bank (SIB) are one of the most striking morphological features on the Scotian Shelf. It is believed that these shoreface connected sand ridges were formed by the reworking of the glacial and glacial-marine Pleistocene deposits on the bank by aeolian and marine processes during the last sea-level rise (e.g., Amos and King, 1984). For hydrocarbon resource developments, the migration of these sand ridges can produce sediment mobile layers up to 10 m thick and can be hazardous to the design and safety of offshore platforms and pipelines. Thus understanding the morphology and migration of these sand ridges and their interaction with wave-current dynamics is an important engineering issue for offshore energy development and is a critical component of the regional sediment transport pattern on SIB.

Based on grain size data, ridge morphology, and internal bedding structures, Hoogendoorn and Dalrymple (1986) and Dalrymple and Hoogendoorn (1997) suggested that the ridges are migrating to the east and that the migration rate can be as high as 50 meters/year. Field measurements and model predictions of sediment transport on the Scotian Shelf (Amos and Judge, 1991; Li et al., 1997) indeed have shown that strong waves during storms work together with tidal and storm-generated currents to cause eastward net sediment transport. Ingersoll and Ryan (1997) compared repetitive multibeam surveys and 1982 Canadian Hydrographic Service (CHS) bathymetric charts of SIB and found negligible to very low migration rates of the sand ridges on the bank. This conclusion, however, is only tentative because of the lower navigational resolution and data density of the 1982 CHS charts.

Besides the instability of sand ridges, there are a wide range of other potential geohazards for energy development on SIB, e.g., shallow gas, subsurface geotechincal variabilities, and long term sediment and sand ridge mobility. These geohazards occur in different areas on the bank and are variable through geological units. A better-established geological framework of the entire Sable Island bank area, including sediment types and distribution, evolutionary history of the Sable Island sand body, and process of deposition, is required in order to interpret the geohazard features in their proper time/space/process context.

Under the joint funding of PERD and Sable Offshore Energy Inc. (SOEI), the Geological Survey of Canada - Atlantic (GSCA) has initiated a field project to better understand the dynamics and stability of the shoreface-connected sand ridges as well as the distribution of geohazards and the regional geological framework on Sable Island Bank. Several initial and repetitive swath bathymetry surveys have been conducted to define the distribution and morphology of sand ridges at selected sites on SIB (Li et al., 1999; Li et al. in preparation). Repetitive surveys will be processed and compared to quantify the migration rate and direction of the sand ridges and their associated large-scale bedforms. GSC instrumented platform RALPH and S4 wave-current meters will also be deployed along sand ridge transects to simultaneously measure wave-current dynamics and sediment transport during storms at different morphological locations on a sand ridge. These data will enable us to understand the hydrodynamics and sediment transport processes across a sand ridge and how these control the morphology and migration of the sand ridges. As a part of this field project, a general geological/geophysical expedition was conducted from July 13 - 21, 2000 to collect cores and samples, seabed photographs, and sidescan/seismic data along sand-ridge transects at selected sites on SIB.

The scientific objectives of the Hudson 2000030A cruise to Sable Island Bank (Fig. 1) were three fold: to understand the morphodynamics of sand ridges on Sable Island Bank; to collect limited data from key areas for improving our understanding of the glacial and sea-level history of the region, and finally to

Fig. 1 Location map showing sand ridge transects and sidescan/seismic survey lines completed in Hudson2000030A cruise. Inserts show track enlargements. Locations of Figs. 2a and 2b are also shown.

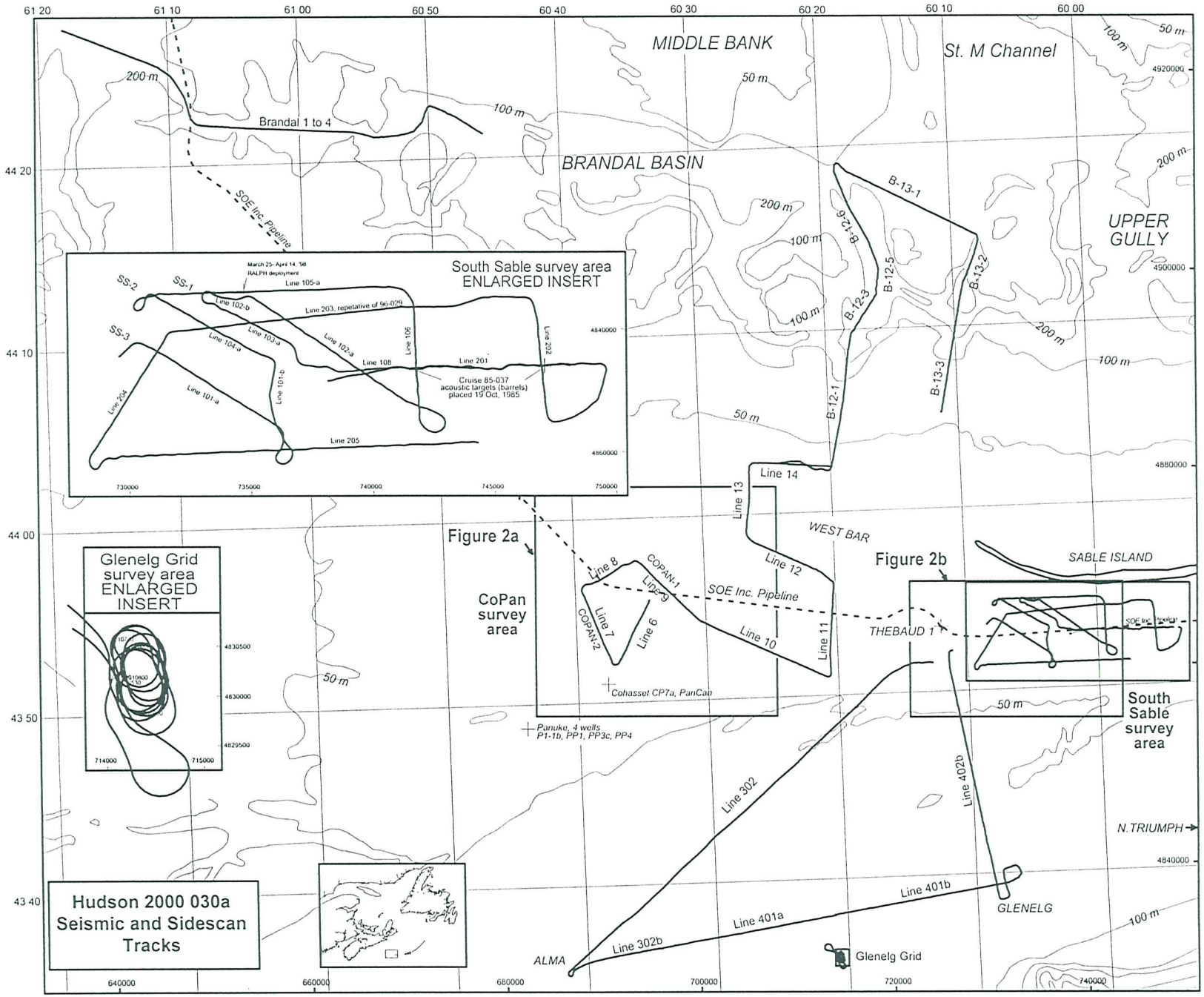

61 20
61 10
61 00
60 50
60 40
60 30
60 20
60 10
60 00
44 20
44 10
44 00
43 50
43 40
MIDDLE BANK
St. M Channel
BRANDAL BASIN
UPPER GULLY
WEST BAR
SABLE ISLAND
200 m
100 m
50 m
Brandal 1 to 4
SOE Inc. Pipeline
B-13-1
B-12-6
B-12-5
B-12-3
B-13-2
B-12-1
B-13-3
Line 14
Line 13
Line 12
Line 11
Line 10
Line 9
Line 8
Line 7
Line 6
COPAN-1
COPAN-2
THEBAUD 1
Figure 2a
Figure 2b
CoPan survey area
South Sable survey area
Cohasset CP7a, PanCan
Panuke, 4 wells
P1-1b, PP1, PP3c, PP4
Line 302
Line 302b
Line 401a
Line 401b
Line 402b
ALMA
GLENELG
N.TRIUMPH
Glenelg Grid
South Sable survey area ENLARGED INSERT
March 25- April 14, '98
RALPH deployment
SS-1
SS-2
SS-3
Line 105-a
Line 102-b
Line 203, repetative of 96-029
Line 103-a
Line 104-a
Line 102-a
Line 106
Line 108
Line 201
Line 202
Line 101-b
Line 101-a
Line 204
Line 205
Cruise 85-037
acoustic targets (barrels)
placed 19 Oct, 1985
Glenelg Grid survey area ENLARGED INSERT
Hudson 2000 030a Seismic and Sidescan Tracks

Figure 1.

study the morphologic and stratigraphic characteristics along potential pipeline corridors in deeper waters on Sable Island Bank. The main activities were divided into three types: bottom camera and sediment sampling, sidescan/seismic surveys, and vibrocoring at selected sites. The specific objectives of the cruise were as follows:

1. To collect bottom photography, van Veen grab samples, IKU grabs and vibrocores at stations along trough-crest-trough transects across sand ridge fields to understand the distribution and variation of surficial sediment grain size, small scale bedforms and shallow sedimentary structures across these sand ridges.

2. To obtain sidescan and seismic data along the cross-ridge transects to determine the cross-section profiles, vertical stratigraphic structures and superimposition of various small to medium scale bedforms on these sand ridges.

3. To obtain sidescan and seismic data along tie lines between SOEI offshore gas fields Thebaud, Alma and Glenelg for identification of geohazards and geologic conditions.

4. To obtain sidescan and seismic data from several regional transects to help establish regional stratigraphic relationships among glacial and early post-glacial deposits and erosion surfaces.

The CCGS Hudson was mobilized on 13 July, 2000 and left BIO in the afternoon of that day. The ship arrived at Sydney in the morning of July 21, terminating this phase of the cruise. Under the direction of Captain Leslie Rhodenizer, the ship's officers and crew did a good job in assisting our surveys and sampling. The scientific staff included GSCA personnel and one Dalhousie student volunteer. The general work platform on Hudson 2000030A was to undertake grab sampling, seabed photography, and coring along sand-ridge transects in the daytime and run seismic/sidescan surveys in the night. The cruise roster is shown in Table 1.

Table 1. Cruise roster of Hudson 2000030A

8:00-16:00	16:00-24:00	20:00-4:00
Michael Li	Ned King	Borden Chapman (4-8)
Bob Murphy	Fred Jodrey (10-6)	Bruce Wile
Susan Merchant (10-6)	Paul Girouard	Andrew Campbell (0-8)
Barbe Szlavko		Marty Uyesugi (6-6)

Though largely successful, this platform sometimes required several hours of unproductive steaming from the end of the survey line to sites of sampling interest. Weather was excellent to good, resulting in no weather down-time, though some adjustment of sample program was implemented at the Captain's suggestion during moderate SW winds. A total of 6 sand ridge profiles were completed in this cruise, 3 each at Co-Pan (Cohasset-Panuke) site and South Sable site (see Figs. 1 and 2). 166 stations were occupied and 7 vibrocores were obtained (see Fig. 2 for the transects and vibrocore locations and Appendix 1 for a list of all stations). Approximately 450 km of seismic/sidescan survey lines were run (Fig. 1). This report is intended to provide a description of day-to-day activities, an overview of technical aspects of the equipment and methods used, and a summary of the preliminary results.

Fig. 2 Sand ridge transects (red lines) and vibrocore (red dots) locations superimposed on color-shaded relief bathymetry maps of (a) CoPan site and (b) South Sable site.

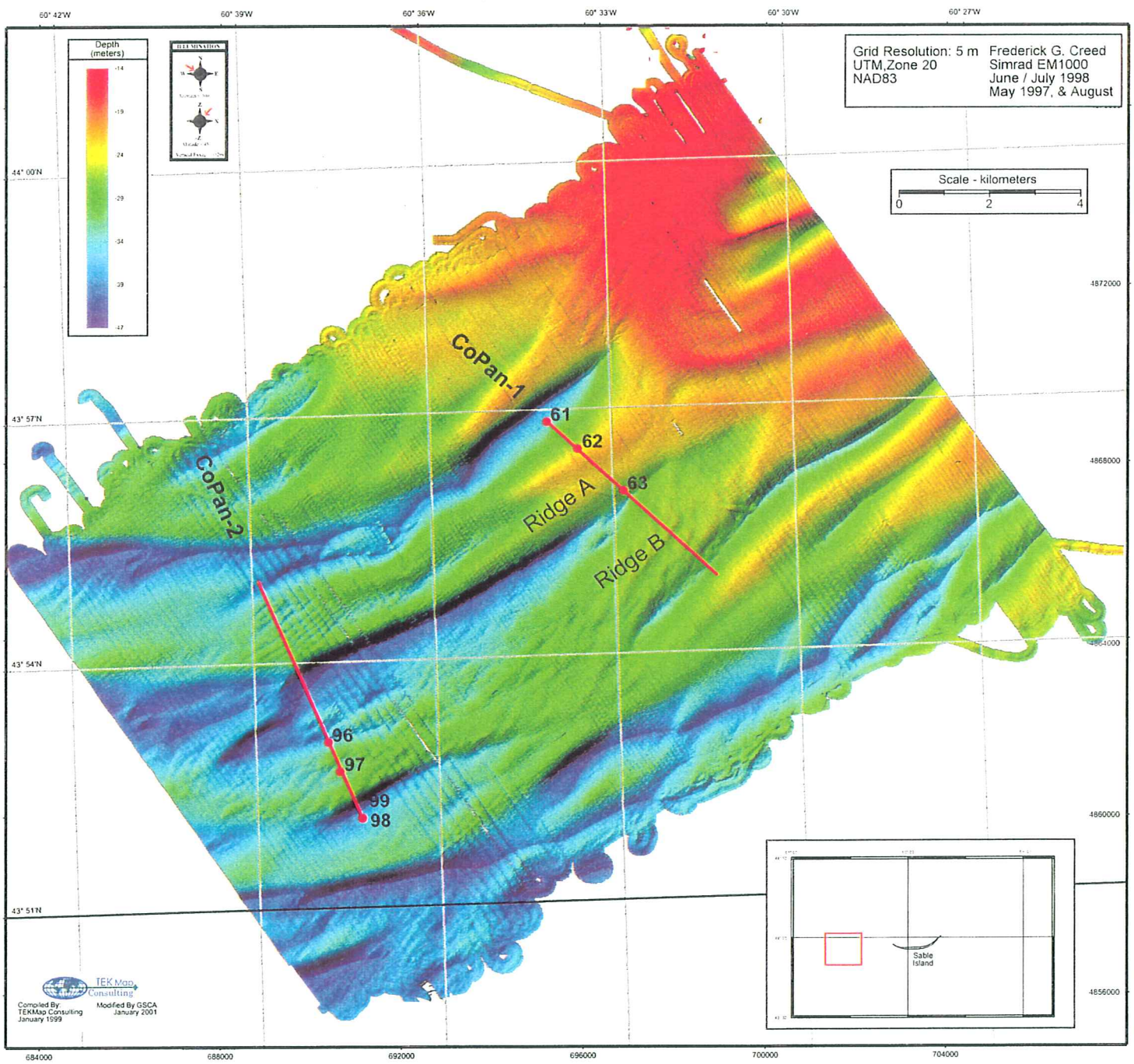

MULTIBEAM BATHYMETRY - COHASSET
with sediment sample transects
and Vibrocore sites
Creed96-501, Creed97-090, & Creed98-100
Depth (meters)
Grid Resolution: 5 m
UTM,Zone 20
NAD83
Frederick G. Creed
Simrad EM1000
June / July 1998
May 1997, & August
Scale - kilometers
0
2
4
CoPan-1
CoPan-2
Ridge A
Ridge B
61
62
63
96
97
99
98
Sable Island
TEK Map Consulting
Compiled By TEKMap Consulting January 1999
Modified By GSCA January 2001
60° 42'W
60° 39'W
60° 36'W
60° 33'W
60° 30'W
60° 27'W
44° 00'N
43° 57'N
43° 54'N
43° 51'N
4872000
4868000
4864000
4860000
4856000
684000
688000
692000
696000
700000
704000

Figure 2a.

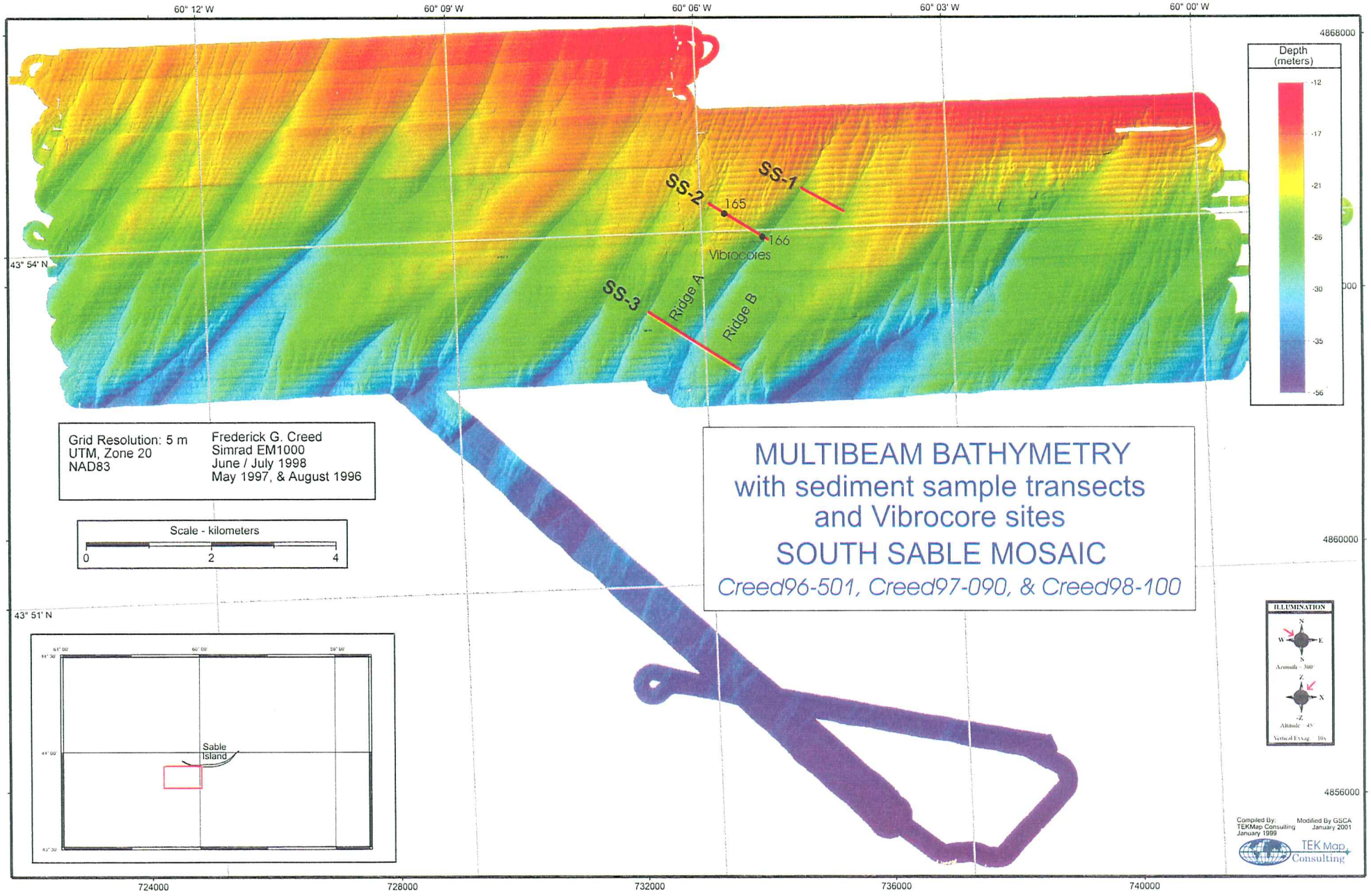

60° 12' W
60° 09' W
60° 06' W
60° 03' W
60° 00' W
4868000
43° 54' N
4860000
43° 51' N
4856000
724000
728000
732000
736000
740000
Depth (meters)
-12
-17
-21
-26
-30
-35
-56
SS-1
SS-2
SS-3
165
166
Vibrocores
Ridge A
Ridge B
Grid Resolution: 5 m
UTM, Zone 20
NAD83
Frederick G. Creed
Simrad EM1000
June / July 1998
May 1997, & August 1996
Scale - kilometers
0
2
4
MULTIBEAM BATHYMETRY
with sediment sample transects
and Vibrocore sites
SOUTH SABLE MOSAIC
Creed96-501, Creed97-090, & Creed98-100
ILLUMINATION
Sable Island
Compiled By:
TEKMap Consulting
January 1999
Modified By GSCA
January 2001
TEK Map Consulting

Figure 2b.

3. NAVIGATION AND LOGGING

Differential GPS (Global Positioning System) navigation was provided by the ship's standard navigation systems (a Magnavox MX380 GPS receiver). NMEA sentences from these systems were combined with the ship's log and gyro, the bridge ELAC 30-kHz sounder, and the fish beacons, through a Baytech MUX in the NAV centre. These sentences were then forwarded to the Bridge AGCNAV system which, in turn, fed the sentences to a Black Box line splitter for distribution throughout the ship.

Both REGULUS and AGCNAV were operational on the bridge although AGCNAV was the system of choice for both navigation display and ship maneuvers. The simplicity of operation of AGCNAV and its Line Running and Station Keeping displays are preferred by both the watch officer and quartermaster. The scientific navigation was observed on five REGULUS systems, running the latest version of the program, Build 20217. These were set up in the Drawing Room, Navigation Room, Forward Lab, Winch Room and GP Lab. The Drawing Room REGULUS system was used as the primary data logger. The data were copied over the network to the shipboard NT server on a daily basis, enabling access to the files from a variety of networked workstations. The data were cleaned and merged using the standard GSCA programs ETOA, INTA, APLOT and the PE editor. Raw E-fomat, raw A-format and cleaned and edited 10 second A-format files were saved on a daily basis and transferred to CD for GSCA archiving. In addition, daily 1 minute cleaned and edited A-format files were produced for immediate use by the scientific staff.

Several multibeam bathymetry surveys have been conducted by GSCA on Sable Island Bank in the past few years (Li et al., 1999). The locations of seismic/sidescan transects across sand ridges and various sampling stations along these transects were determined prior to the cruise, based largely on features visible from these multibeam maps. Positions for cores were selected, based also on existing seismic profiles. The color-classified shaded relief multibeam maps were first used to evaluate the morphology and to determine the sand ridge transects. The gridded depth files were converted to xyz files using the r.stats command of the GIS program GRASS. These xyz files were then imported into the PC program Surfer (UTM based) and vertical profiles along the transects were created. These profiles were used to determine the planned sampling/coring stations along each transect. Generally 10-12 stations were chosen on each transect and they were roughly evenly distributed along the transect. If superimposed smaller bedforms existed, care was taken so that the sample stations were placed consistently on the crests of these smaller bedforms. This dictated the necessity of ±20 m positioning for most stations. Each of these planned stations was named according to its geographical location and transect number. For instance, SS-1-1 represents station 1 of transect 1 at the South Sable site. A list of these stations and the planned activities at each station was circulated on board for the general orientation of the crew and staff. UTM coordinates for the planned sand-ridge transects and sample stations were output to Excel spreadsheets which were used by the navigator to transform into both AGCNAV and REGULUS format navigation files.

Besides lines that were run along the sand-ridge transects, seismic/sidescan surveys were conducted along other tracks on SIB and in adjacent basins to investigate the geologic properties along potential future pipeline routes and to target key areas for improving our understanding of the glacial and sea-level history of the region. Ship's tracks from previous GSC cruises and bathymetric base maps in CAD format were used to determine the positions of these survey lines. Exact coordinates for the Alma and Glenelg sites were provided by SOEI. The on-board routine for deriving exact line placement coordinates (including waypoints along non-linear survey tracks) was simply an output of UTM coordinates from

planned tracks. These were converted to geographic coordinates and supplied to the navigator for transforming to AGCNAV and REGULUS navigation files.

4. SEABED SAMPLING AND PHOTOGRAPHY

Seabed sampling and photography programs were carried out along the planned transects to understand the distribution and variation of surficial sediment grain size, small scale bedforms and shallow sedimentary structures across sand ridges. The key instruments and tools used included a van Veen grab sampler, a large IKU grab sampler, the BIO Bentho camera and vibrocorers. The van Veen grab sampler and the camera were deployed at all sample stations. An IKU grab was taken approximately at every other station and Vibrocoring was attempted only at selected stations.

4.1 van Veen Grab

A medium size van Veen grab sampler (Fig. 3, right of top photo) was used to collect small bulk samples. This was deployed through the ship's winch room with the assistance of two ship's crew members. After retrieval of the sampler, a surface and a blended bulk sample (both in 40 dram vials) were taken. The time the sampler reached the bottom and the position, geographical location and water depth of the station were logged on the logging sheet. The collection of the two subsamples were also noted on the sheet.

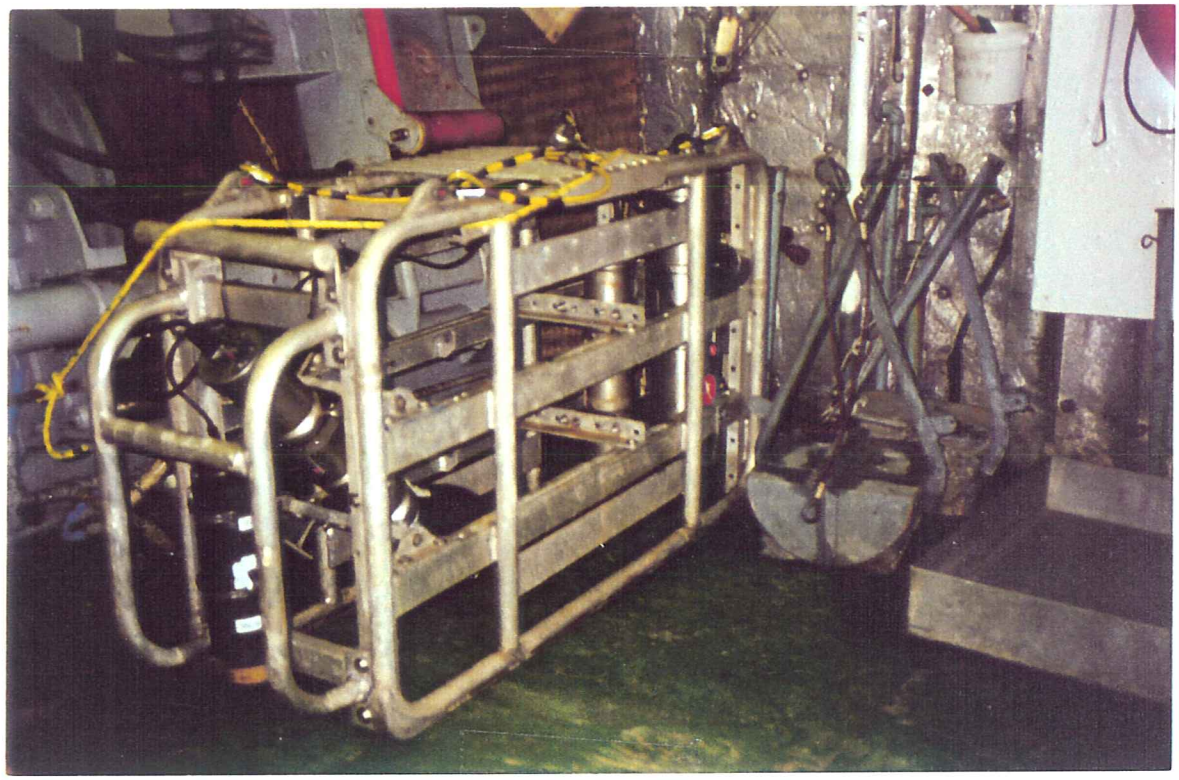
4.2 IKU Grab Sampler

The large IKU grab sampler (Fig. 4, upper) was used to obtain large volume bottom samples at different locations along sand ridge transects. This modified grab is a clam-shell type, capable of collecting 1 m^3 relatively undisturbed sediment. It uses a mechanical advantage from a series of pulleys to close the jaws of the sampler during recovery. Two scientific staff worked with the ship's deck crew to operate the large IKU sampler. The Grove crane and the Pengo winch were used to deploy and recover the IKU grab. Upon recovering of the sampler, a surface sample was first taken using a 40 dram vial. Two box cores were then collected by pushing wedge-shaped rectangular aluminum trays into the IKU sample (Fig. 4, lower). The standard trays were 30 x 30 cm. When the grab was full, larger 30 x 40 cm (deep) trays were also used. The bottom tray was pushed in first and the cover tray was then pushed in with an angle to tightly close the top of the bottom tray. Sand around the trays was dug out to render the retrieval of the push-tray cores. One core was oriented left - right (port to starboard) and the other one from front to back to resolve 3-dimensional structures.

4.3 Resin Peels

The box core trays were carried to the GP Lab where the cover was removed and the surface was smoothed with a scraper. If there was gap between the sediment and the top side of the tray, paper towels were used to fill the space in order to prevent the collapse of the core. The processed cores were then lain on tracks of two 1 x 2 cm wood boards to dry (Fig. 5): the inner board was under the tray to create a slope toward the top of the tray to help the water to drain, and the top of the tray was pushed against the side of the outer board to prevent the tray from sliding off the table in rough weather. After approximately one hour, the cores would be ready to be impregnated with epoxy resin. One layer of Muslin cheese cloth was cut and lain flat on the core surface. Two parts of Cold Cure (Industrial Formulations of Canada Ltd.) were mixed with 1 part of hardener to create the resin mixture which was

Fig. 3 van Veen grab samplers (right of top photo) and Benthos camera (lower photo and left of top photo) used in this cruise.



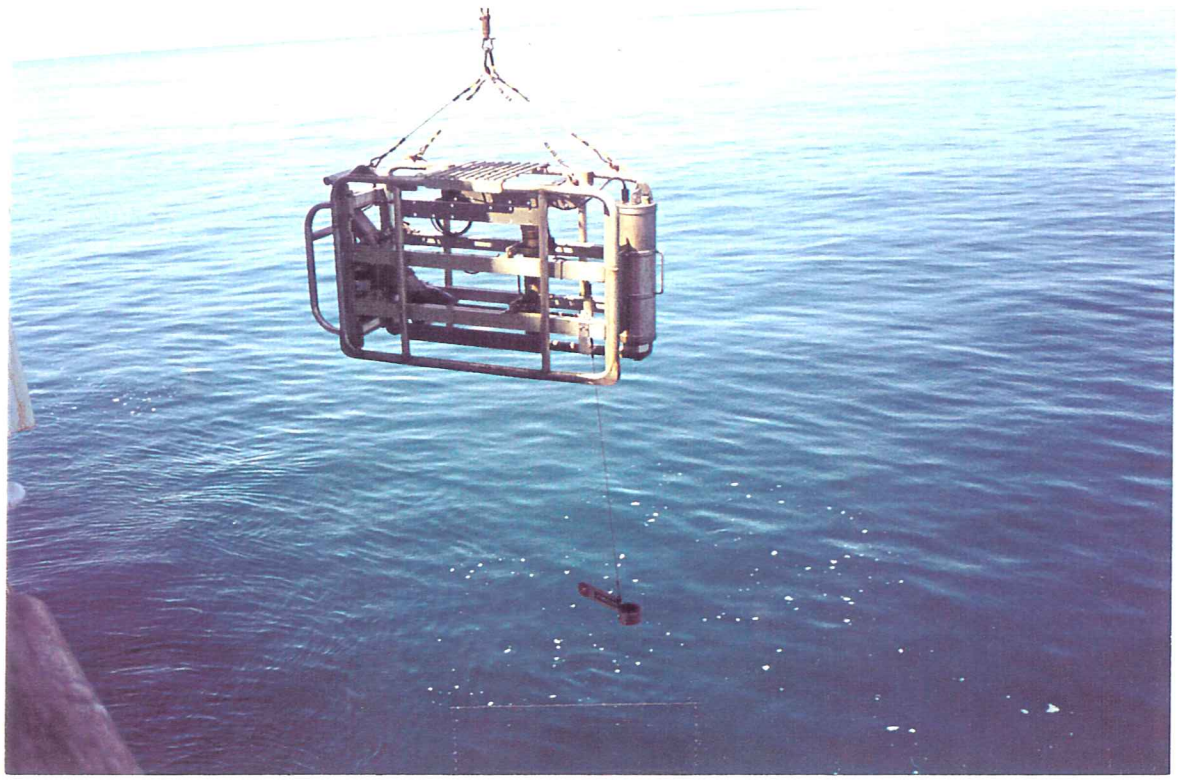


Fig. 3

Fig. 4 Photographs of the large IKU grab sampler (upper) ready to be deployed and push- tray cores (lower) being sampled after recovery of the grab.

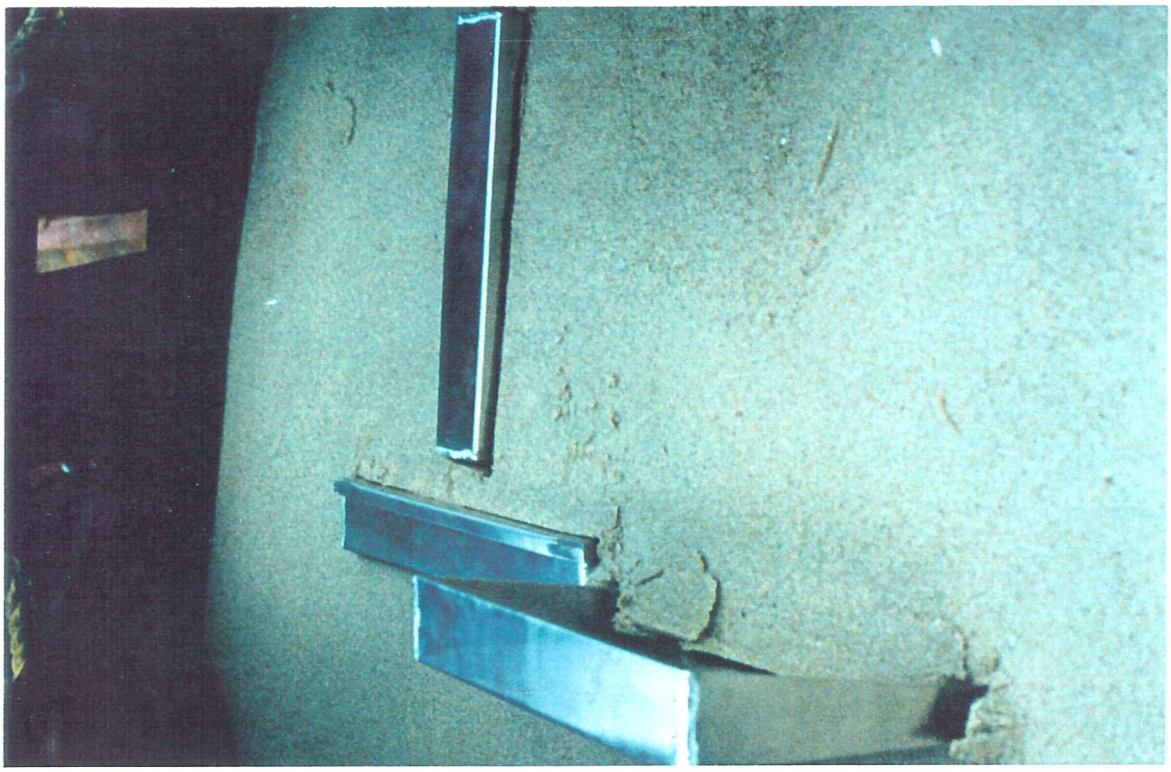


Fig. 4

Fig. 5 Processed resin peels laid down on tracks in the GP lab, while Susan Merchant marks the orientation and station number of the core. The 3-arm GP lab camera frame, used for photographing the resin peels, can be seen in the background.

Fig. 6 The vibrocorer ready to be deployed.

Fig. 5

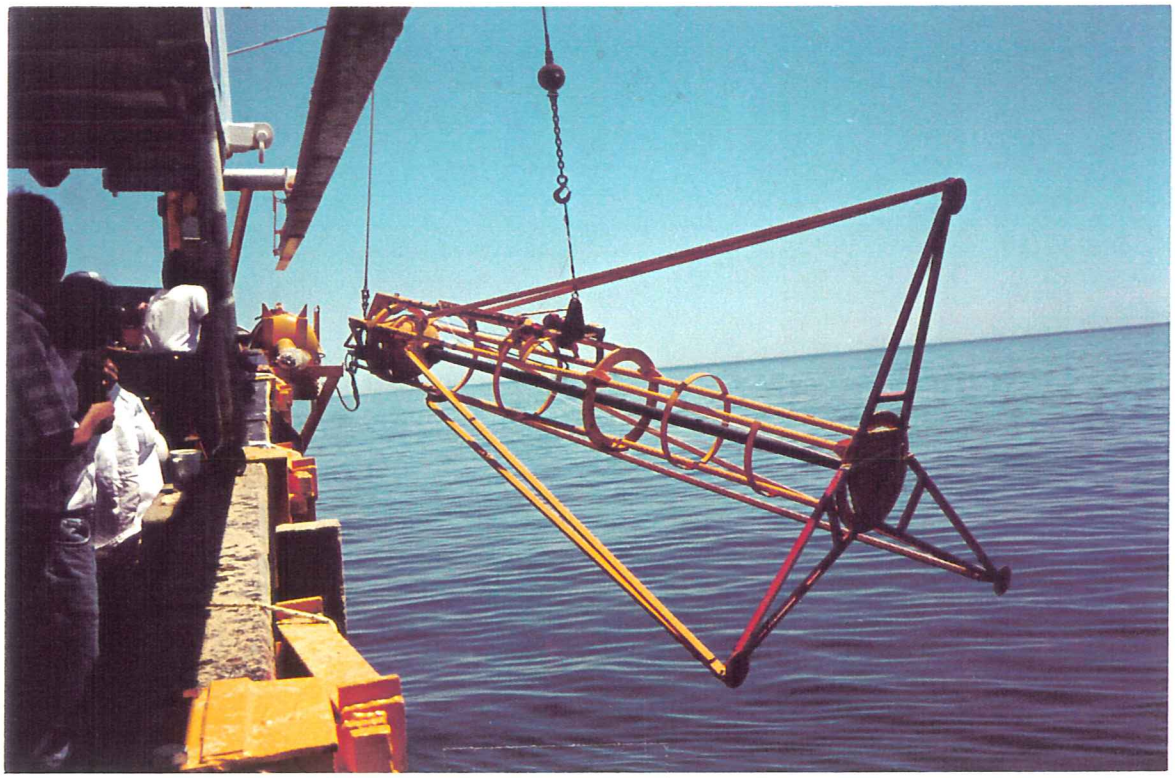


Fig. 6

applied evenly on the box core surface with a coffee stick. Generally 100 ml of resin was used for normal size (30 x 30 cm) peels and 150 ml was used for larger (30 x 40 cm) peels. The resin penetrated the sample to varying depths reflecting the porosity and permeability of sediment laminates. The mean depth of penetration was about 5 mm. The resin-impregnated cores were allowed to dry for 24 hours. The resin peels were then labeled, lifted off from the cores and washed to remove excess loose sand. The end product was the hardened resin relief peels showing variation of grain size and bedding structures which can be interpreted for mobile layer depth, the type of bedforms and depositional environment of the sample.

The dried resin peels were photographed using a 35 mm Pentax K1000 SLR camera with a Vivitar 283 flash light. The camera and the flash light were mounted on the 3-armed, aluminum shipboard GP lab camera frame (Fig. 5). Kodak ASA 200 colour film was used with the f-stop set at 3.8 and shutter speed set at 1/60th of a second. The flash was powered by the ship's AC through an adaptor. Two shots were taken for each peel. Included in each shot was a strip of centimetre tape for scale which was also marked with the cruise number and arrows pointing to the top of the peel. A label was also included to show the station number with the letters R L or F B indicating the right to left or front to back orientation of the IKU box core peel in relation to the IKU frame. After photographing, the peels were carefully stacked in boxes for transportation and storage. A layer of paper towel was put between the peels for protection.

The majority of the photographs were taken with the camera set at the 40 cm mark on the frame arm (measured from top of the arm). The shots for stations 160, 161, 162, 163, 164 were taken with the camera set at the 30 cm mark and the peels raised approximately 3/4 inch. It should be noted that the flash may have to be adjusted for the changed peel settings.

4.4 Benthos Camera

The BIO Benthos camera (Fig. 3, lower photo and left of top photo) was used throughout this cruise. The system consisted of a Benthos 377 deep sea camera, a Benthos 383 flash light and a 1.5 m (5 feet) long trigger wire that links the flash to a 10 cm-diameter compass used for image orientation as well as length scale. A 800 shot Kodak Ektachrome ISO 200 color-slide film was installed at the beginning of the cruise. The f-stop was set at 4.5. A shot is taken when the trip weight (the compass) hits the seafloor and the field of view is approximately 0.7 x 1 m.

The camera was also deployed from the winch room on the boat deck. The 1.5 m trip wire and weight were attached to the flash and pinger for firing the camera and flash. A scientific staff member and two crew members worked together to operate the camera. At each station, the camera was lifted to about 0.5 m off the deck and a shot was taken of the cruise and station number label. The camera was then deployed and two shots were taken at each station. Each time the trip weight hits the seafloor, a shot is taken and the pinger ceases temporarily. A hydrophone and continuous echosounder plot were used to monitor when the trip weight reached the seabed and a shot taken. The camera was lifted off the bottom after the first shot, followed by 10-15 seconds to recharge the flash, and then lowered for the second shot.

4.5 Vibrocorer

The AGC vibrocorer (Amer MacLean vibrocorer, Fig. 6) was used on this cruise to obtain cores at selected sites along sand-ridge profiles. The corer has three main systems: the surface electronics, the underwater unit and the handling system. The mechanical system, the electrical system and the electronic

system are the three main subsystems. The vibrating core head pushes the core barrel down into the sediment as it vibrates up and down by the counter-weighted vibrating motor inside the ball on top of the core head. When the barrel has been fully extended the winch is used to pull the barrel assembly out of the sediment. The barrel length can be 10 feet (3 m) or 20 feet (6 m) with extensions. The standard barrels have an inner diameter of 3.5 inches (8.9 cm) and can be switched to 3.2 inches (8.1 cm) if necessary. The 10 foot high underwater unit weighs about 990 kg (about 1485 kg with extensions).

Because of the height and weight of the vibrocorer, extra care must be used in the deployment and operation of this system. The following routine was used on this cruise. It is wise to test the vibrocorer's electrical system momentarily on deck prior to deployment. The coring unit is lifted off the deck and carried over the side of the ship in the horizontal position by its wire strap using the ship's crane (Arbor) (see Fig. 6). The head of the corer frame should be positioned near the block and the load line is taken up while the corer is lowered away on the crane runner. Finally the unit is lowered to the seabed using the braided rope attached to the vibrating head. When the coring unit reaches the bottom, the electronics are turned on. The power (440 v) is now turned on at the safety switch on the front of the rack. The operator needs to make sure the winch/vibrator toggle switch is in the vibrator position. The Start button now can be pressed to start the vibration. Proper functioning is indicated by a jump of the motor current to around 15 amps and then a fall to 2-5 amps as the vibrator attains normal speed. The corer should reach full penetration in 5 to 8 minutes of operation. When the corer is fully extended, the Stop button is pressed and the toggle selector switch is moved to the winch position. The Retract button is then pushed. A small current draw (up to about 5 amps) should be observed as the winch pulls the core barrel in. When the core head is fully retracted, the cable will pull tight and the current quickly increases to 15 amps. The Stop button should be pressed immediately to avoid breaking the cable. The unit now can be powered down and recovered.

After the vibrocorer is secured on the forward deck, the core is retrieved. Since the cores were to be used for Optically Stimulated Luminescence (OSL) dating, a large piece of black plastic was used as coverage at the base of the corer during the retrieval of cores to minimize the exposure of the cores to light. The retrieved cores were encased in black plastic sheath for the same purpose.

4.6 Station Data and ED_AT_SEA

On this cruise, a two-stage routine was used to collect information relevant to each of the 166 stations: filling the paper station sheet during station holding and subsequent input of station data into the Expedition Database (ED) using the ED_AT_SEA application. As various activities were carried out at each station, station sheets were logged capturing basic information (station number, time and day of year, water depth, depth sounder type, latitude/longitude, and geographic location) as well as information specific to each station type, i.e. information particular to camera, grab and vibrocore station (camera types/film types, stop time/lat/long, grab type, subsamples taken, vibrocore length, number of sections, planned station name, etc.). Of primary importance was the completion of all of the relevant parts of each individual station sheet as close to the completion of the station as possible. This made it considerably easier for subsequent data entry into the local database using ED_AT_SEA.

For logging various station sheets, several features in REGULUS were utilized to capture latitude and longitude for each station. The planned stations were entered into REGULUS at the start of the cruise. Each individual target station was then brought up on screen (in the menu option 'Nav Elements') as the station was approached. When the station was conducted (and 'on bottom' declared), the station log sheet keeper simply pressed 'Ctrl-e' on the keyboard to create a 'Nav Element' which could be opened at a

later time to retrieve the latitude and longitude captured for that station. The time and water depths were captured from the main REGULUS screen at the time of the call 'on bottom'. Of note was the importance (to avoid confusion) of all REGULUS terminals to be set to the same latitude/longitude format, whether it is decimal degrees, degrees-decimal minutes, etc. This avoided the confusion of having multiple formats recorded on the station sheets and the necessity for the ED_AT_SEA data entry to move between different boxes in which to enter the lat/long information (as it converts degrees minutes to the mandatory decimal degrees format).

During periods when stations were spread apart in time (1 - 2 hours) or when technical difficulties were being resolved, data entry into a local version of the Expedition Database (ED) was done using the ED_AT_SEA application. As some of the information remained the same between stations, it made sense to wait and enter, for example, an entire day's stations perhaps a day or two later. At the very least, it was more efficient to accumulate at least 10 or 15 stations before entering them into ED and this was the method utilized on Hudson 2000030A. ED_AT_SEA reports (Station, Grabs, Cameras, Subsamples) were submitted to the senior scientist as interim reports midway through and on completion of the cruise for quality control. Backups were done at the end of each data entry session and on return to BIO. Then the data were eventually corrected and signed off by the chief scientist, and the final backup was submitted to the ED Data Manager (B. Szlavko) for upload into the main ED database. The compilation and input to the database of the station data have become sufficiently streamlined that they were in the on line Expedition Database (http://agc.bio.ns.ca/ED/GSC/ed-f-menu.cgi) within one day of homecoming.

A 6 m draft correction was added to ships echosounder water depth readings. There was some uncertainty as to spurious water depth readings from the ship's12 kHz echosounder so these were checked and, where necessary, corrected to match water depths from previously-collected multibeam data.

5. SEISMIC AND SIDESCAN SURVEYS

The following equipment systems were used in the geophysical survey component of this cruise:

- Simrad MS992 Dual frequency side scan sonar system
- Sleeve Gun/Benthos Streamer Seismic system
- Huntec Deep Tow Boomer/Sparker profiling system
- AGC DIG Digital Logger (Simrad, Seismics and Deep Tow Seismic)
- ORE Trackpoint II Plus

The overall performance of these equipment systems was good to excellent.

5.1 Simrad MS992 Sidescan Sonar

The Simrad MS992 100kHz/330kHz sidescan sonar was operated using a neutral buoyancy package on a tether to a depressor weight. The #3 transponder of the ORE Trackpoint II plus was used for position information with the data string being logged on REGULUS. The sidescan was operated at 100 m per side range with the 100kHz hard copy going to the EPC 1086 graphic recorder and the 330kHz hard copy going to an ALDEN graphic recorder. The sidescan signals from both frequencies were recorded on an AGC DIG data logger and saved to Exabyte tapes.

5.2 Seismic System

The seismic reflection system used in cruise Hud2000030A consisted of a single 6 cubic-inch sleeve gun, a two-stage Benthos eel array and a NSRF tapered eel.

The sleeve gun was towed through the center "A" frame, the gun being deployed and recovered using a winch located on the Port side, aft end of the "flight deck". Hydraulic power for the winch came from the Hypac located next to the winch. A small Norwegian float kept the sleeve gun towing approximately one half meter below the surface. Compressed air, typically 1850PSI, was supplied from the Price W2 compressor located on the flight deck, starboard side. The sleeve gun was fired at a two second rate throughout the program. Timing control and sequencing was generated from the MITS (Master Interval Timing System) box in the GP lab.

The two-stage Benthos eel array has a 25 foot section and a 100 foot section. The eel array was deployed and recovered using the hydraulic winch located aft of the Price compressor container, starboard side of the flight deck. The eel array had TVG added and a filtering configuration of 100 - 9000Hz. The data collected from both sections of this eel were displayed on an EPC9800 graphic recorder located in the GP lab. The AGC DIG #3 data logger was used to save data to Exabyte tapes. Channels 1 and 2 of the AGC DIG logged the raw data from the 100-foot and 25-foot eel sections respectively.

The NSRF tapered eel array was deployed "by hand" from the starboard quarter deck area throughout the program. Krohn-Hite filter settings for this eel were 300Hz and rolling off at 1500Hz. Data collected from this eel were recorded on channel 3 of the AGC DIG Data logger.

5.3 Huntec DTS

The Huntec Deep Tow Seismic (DTS) system is a high resolution, sub-bottom profiler with the acoustic source, energy supply, motion sensor, and two receiving hydrophones housed in an underwater deep towed body. The AGC #3 Deep Tow system was used in this cruise and it had a maximum power output of 1000 joules (60 mfd storage capacitance) with an ED 10 F/C Boomer and a multi-tip sparker source. Only the sparker system was used on this cruise. Normally a LC10 single element hydrophone was mounted inside the tow fish beneath the boomer. A Geoforce GF24/24 (twenty-four foot, twenty-four element) single channel hydrophone array was towed behind the fish. The #2 transponder of the ORE Trackpoint II plus was used by Huntec DTS for position information.

The main deck equipment was a HydroMac Oceanographic winch, which included a multi-way slip ring and a 915 metre, fourteen conductor, armoured tow cable. The lab instrumentation consisted of the Huntec Systems Console and the Huntec Mk III high voltage power control unit (PCU) which provided DC power to the boomer.

Seismic #1 and Seismic #2 signals were displayed on a single EPC 9800. Seismic #1 (either an LC10 or GF16 hydrophone) was processed by the Adaptive Signal Processor (ASP) module then displayed on Channel A of the EPC9800 recorder. Due to problems with the ASP module, a Krohn-Hite filter was substituted for the ASP module from Julian Day 201 (19 July). Seismic #2 (GF24/242Pi streamer) was processed by a second ASP console, then band passed through a 3323R Krohn-Hite filter with a low pass setting of 3500 hertz and displayed on Channel B on the EPC 9800 recorder. A TSS 312B annotator provided time marks on the hard copy records.

The PC based MITS system triggered the DTS and seismic systems. The DTS signals were recorded on the new four channel AGC DIG (version 2.40) digital logger with 8700 Exabyte tape drive:

Channel 1	Seismic #1 - LC10 or GF 16 hydrophone
Channel 2	Seismic #2 - External GF24/24 streamer

Detailed technical and operational description of the HDT system can be found in Geoforce Consultants Ltd. (2000).

6. CRUISE ITINERARY

All times in this cruise itinerary are in Universal Time Coordinated (UTC) unless specified as Atlantic Standard Time (AST). AST is four hours earlier than UTC (three hours for Daylight Savings Time).

July 13/Day of Year (DY)195, Thursday

1600 Departed from BIO dock; Muster and lifeboat drills were conducted shortly after in the Bedford Basin.
1700 Left Bedford Basin for Sable Island Bank
1930 A cruise meeting was held to brief the scientific staff and ship's officer of the cruise

July 14/DY196, Friday

0040? Arrived western Brandal Basin, northwest of Sable Island; prepared gear for seismic/sidescan survey
0123 Started survey of western Brandal Basin, start of line 1, DGPS position 44°27.7960N 61°18.0895W
0809 End of line 4, DGPS position 44°21.3323N 60°45.8444W; Terminated survey of western Brandal Basin, 4 lines (1 to 4) were done; Steamed to Copan site.
1115 van Veen grab at Copan-1-20, station 001, DGPS position 43°54.9352N 60°31.3720W
1134 Camera at Copan-1-20, station 002, DGPS position 43°54.9379N 60°31.3544W
1200 IKU grab at Copan-1-20, station 003, DGPS position 43°54.9309N 60°31.3590W
1243 Camera at Copan-1-19, station 004, DGPS position 43°54.9977N 60°31.4609W
1253 van Veen grab at Copan-1-19, station 005, DGPS position 43°55.0068N 60°31.4626W
1310 van Veen grab at Copan-1-18, station 006, DGPS position 43°55.0464N 60°31.5143W
1322 Camera at Copan-1-18, station 007, DGPS position 43°55.0404N 60°31.5316W
1338 IKU grab at Copan-1-18, station 008, DGPS position 43°55.0448N 60°31.5107W
1410 Camera at Copan-1-17, station 009, DGPS position 43°55.1026N 60°31.6072W
1419 van Veen grab at Copan-1-17, station 010, DGPS position 43°55.1060N 60°31.5977W
1415? IKU grab at Copan-1-16, station 011, DGPS position 43°55.1923N 60°31.7360W
1537 van Veen grab at Copan-1-16, station 012, DGPS position 43°55.1982N 60°31.7199W
1549 Camera at Copan-1-16, station 013, DGPS position 43°55.1871N 60°31.7319W
1623 Camera at Copan-1-15, station 014, DGPS position 43°55.3651N 60°31.9786W
1634 van Veen grab at Copan-1-15, station 015, DGPS position 43°55.3654N 60°31.9659W
1700 van Veen grab at Copan-1-14, station 016, DGPS position 43°55.5473N 60°32.2298W
1714 Camera at Copan-1-14, station 017, DGPS position 43°55.5569N 60°32.2293W
1750 IKU grab at Copan-1-14, station 018, DGPS position 43°55.5521N 60°32.2249W
1818 Camera at Copan-1-13, station 019, DGPS position 43°55.6866N 60°32.4217W

1826 van Veen grab at Copan-1-13, station 020, DGPS position 43°55.6823N 60°32.4371W
1845 van Veen grab at Copan-1-12, station 021, DGPS position 43°55.7718N 60°32.5522W
1858 Camera at Copan-1-12, station 022, DGPS position 43°55.7751N 60°32.5392W
1935 IKU grab at Copan-1-12, station 023, DGPS position 43°55.7766N 60°32.5496W
1959 Camera at Copan-1-11, station 024, DGPS position 43°55.8038N 60°32.5696W
2009 van Veen grab at Copan-1-11, station 025, DGPS position 43°55.8085N 60°32.5646W
2207 Started seismic/sidescan survey along the Copan repetitive transect, start of line 6, DGPS position 43°55.44N 60°34.33W
2307 End of line 6, DGPS position 43°52.21N 60°36.77W
2315 Started seismic/sidescan survey along the Copan-2 sand ridge transect, start of line 7, DGPS position 43°52.19N 60°37.34W

July 15/DY197, Saturday

0008 End of line 7 and start of line 8, transit line between sand ridge transects Copan-2 and Copan-1, DGPS position 43°56.022N 60°39.45W
0049 End of line 8; start of line 9, sand ridge transect Copan-1, DGPS position 43°57.64N 60°35.12W
0146 End of line 9 and start of line 10, West Bar region survey, DGPS position 43°54.22N 60°30.27W
0852 End of line 14, DGPS position 44°02.50N 60°19.80W; Terminated survey at West Bar region, in total 5 lines (10 to 14) were done.
1107 Resumed sampling/coring/camera at Copan-1 transect;
van Veen grab at Copan-1-10, station 026, DGPS position 43°55.8203N 60°32.6018W
1119 Camera at Copan-1-10, station 027, DGPS position 43°55.8227N 60°32.6081W
1133 IKU grab at Copan-1-10, station 028, DGPS position 43°55.8171N 60°32.6142W
1158 Camera at Copan-1-9, station 029, DGPS position 43°55.8898N 60°32.6937W
1212 van Veen grab at Copan-1-9, station 030, DGPS position 43°55.8870N 60°32.6939W
1259 van Veen grab at Copan-1-8, station 031, DGPS position 43°55.9876N 60°32.8361W
1312 Camera at Copan-1-8, station 032, DGPS position 43°55.9890N 60°32.8325W; Probably failed in five tries.
1324 IKU grab at Copan-1-8, station 033, DGPS position 43°55.9845N 60°32.8462W
1343 Camera at Copan-1-8 (repeat), station 034, DGPS position 43°55.9908N 60°32.8420W
1402 Camera at Copan-1-7, station 035, DGPS position 43°56.1458N 60°33.0772W
1412 van Veen grab at Copan-1-7, station 036, DGPS position 43°56.1475N 60°33.0789W
1710 van Veen grab at Copan-1-6, station 037, DGPS position 43°56.2545N 60°33.2054W
1722 Camera at Copan-1-6, station 038, DGPS position 43°56.2449N 60°33.2094W
1738 Camera at Copan-1-5, station 039, DGPS position 43°56.3903N 60°33.4197W
1747 van Veen grab at Copan-1-5, station 040, DGPS position 43°56.3873N 60°33.3969W
1805 van Veen grab at Copan-1-4, station 041, DGPS position 43°56.5186N 60°33.5750W
1817 Camera at Copan-1-4, station 042, DGPS position 43°56.5180N 60°33.5800W
1836 Camera at Copan-1-3, station 043, DGPS position 43°56.6412N 60°33.7590W
1845 van Veen grab at Copan-1-3, station 044, DGPS position 43°56.6392N 60°33.7577W
1905 van Veen grab at Copan-1-2, station 045, DGPS position 43°56.7627N 60°33.9162W
1929 Camera at Copan-1-2, station 046, DGPS position 43°56.7625N 60°33.9217W
1940 IKU grab at Copan-1-2, station 047, DGPS position 43°56.7727N 60°33.9285W
2008 Camera at Copan-1-1, station 048, DGPS position 43°56.8648N 60°34.0691W
2018 van Veen grab at Copan-1-1, station 049, DGPS position 43°56.8651N 60°34.0727W
2032 IKU grab at Copan-1-4, station 050, DGPS position 43°56.5165N 60°33.5993W

2048 IKU grab at Copan-1-6, station 051, DGPS position 43°56.2690N 60°33.2021W; Sampling stopped and steamed to South Sable for night survey.
2254 Seismic/sidescan survey along sand ridge transect South Sable-3, start of line 101a, DGPS position 43°53.81N 60°07.73W
2339 End of line 101a, DGPS position 43°51.92N 60°03.78W

July 16/DY198, Sunday
0031 Start of line 104a, sand ridge transect South Sable-2, DGPS position 43°53.47N 60°04.11W
0110 End of line 104a, DGPS position 43°54.88N 60°07.35W
0136 Start of line 105, South Sable region survey, DGPS position 43°54.89N 60°07.86W
0236 End of line 105, DGPS position 43°54.86N 60°00.19W
0245 Start of line 106, South Sable region survey, DGPS position 43°54.51N 59°59.41W
0322 End of line 106, DGPS position 43°51.8939N 59°59.3482W
0344 Start of line 102a, sand ridge transect South Sable-4, DGPS position 43°52.1913N 59°59.3279W
0447 End of line 102a, DGPS position 43°54.7725N 60°04.4373W
0511 Start of line 103a, sand ridge transect South Sable-1, DGPS position 43°54.6345N 60°05.4599W
0539 End of line 103a, DGPS position 43°53.7286N 60°03.2605W
0552 Start of line 109, South Sable region survey, DGPS position 43°53.1674N 60°02.4207W
0620 End of line 109 and start of line 108, South Sable region survey, DGPS position 43°53.0921N 59°59.9001W
0718 End of line 108, DGPS position 43°52.9860N 59°54.5929W. Terminated seismic/sidescan survey and steamed to Copan site for sampling/coring.
1043 van Veen grab at Copan-2-2, station 052, DGPS position 43°54.9985N 60°38.9002W
1057 Camera at Copan-2-2, station 053, DGPS position 43°56.8648N 60°34.0691W
1114 Camera at Copan-2-3, station 054, DGPS position 43°54.7679N 60°38.7645W
1122 van Veen grab at Copan-2-3, station 055, DGPS position 43°54.7673N 60°38.7648W
1137 van Veen grab at Copan-2-4, station 056, DGPS position 43°54.6465N 60°38.7007W
1148 Camera at Copan-2-4, station 057, DGPS position 43°54.6467N 60°38.6982W
1158 IKU grab at Copan-2-4, station 058, DGPS position 43°54.6453N 60°38.6877W
1224 Camera at Copan-2-6, station 059, DGPS position 43°54.6046N 60°38.6797W
1235 van Veen grab at Copan-2-6, station 060, DGPS position 43°54.5992N 60°38.6701W
1347 Vibrocore at Copan-1-1, station 061, DGPS position 43°56.8556N 60°34.0712W
1550 Vibrocore at Copan-1-4, station 062, DGPS position 43°56.5166N 60°33.5745W
1705 Vibrocore at Copan-1-8, station 063, DGPS position 43°55.9898N 60°32.8448W
1812 van Veen grab at Copan-2-7, station 064, DGPS position 43°54.5021N 60°38.6166W
1826 Camera at Copan-2-7, station 065, DGPS position 43°54.5021N 60°38.6253W
1837 IKU grab at Copan-2-7, station 066, DGPS position 43°54.5035N 60°38.6275W
1912 Camera at Copan-2-8, station 067, DGPS position 43°54.3668N 60°38.5512W
1922 van Veen grab at Copan-2-8, station 068, DGPS position 43°54.3707N 60°38.5529W
1941 van Veen grab at Copan-2-9, station 069, DGPS position 43°54.2403N 60°38.4739W
1955 Camera at Copan-2-9, station 070, DGPS position 43°54.2398N 60°38.4814W
2015 IKU grab at Copan-2-11, station 071, DGPS position 43°54.0263N 60°38.3696W
2126 Camera at Copan-2-11, station 072, DGPS position 43°54.0252N 60°38.3529W
2133 van Veen grab at Copan-2-11, station 073, DGPS position 43°54.0260N 60°38.3531W; Stopped sampling/coring and steamed to South Sable area for night survey.

July 17/DY199, Monday

0018 Start of line 201, South Sable region, DGPS position 43°53.08N 60°00.08W

0120 End of line 201, DGPS position 43°52.96N 59°53.62W

0151 Start of line 202, South Sable region, DGPS position 43°51.89N 59°55.44W

0223 End of line 202 and start of line 203, South Sable region, DGPS position 43°54.51N 59°55.96W

0405 End of line 203 and start of line 204, South Sable region, DGPS position 43°54.0153N 60°06.9681W

0454 End of line 204 and start of line 205, South Sable region, DGPS position 43°51.3758N 60°09.5286W

0651 End of line 205, DGPS position 43°51.3618N 59°57.5622W; Stopped night survey and steamed back to Copan site for sampling/coring.

1026 van Veen grab at Copan-2-13, station 074, DGPS position 43°53.8995N 60°38.2730W

1044 Camera at Copan-2-13, station 075, DGPS position 43°53.9104N 60°38.2737W

1103 Camera at Copan-2-14, station 076, DGPS position 43°53.8756N 60°38.2899W

1122 van Veen grab at Copan-2-14, station 077, DGPS position 43°53.8576N 60°38.2422W

1137 IKU grab at Copan-2-14, station 078, DGPS position 43°53.8524N 60°38.2552W

1205 van Veen grab at Copan-2-15, station 079, DGPS position 43°53.7527N 60°38.1939W

1216 Camera at Copan-2-15, station 080, DGPS position 43°53.7377N 60°38.2390W

1324 Camera at Copan-2-16, station 081, DGPS position 43°53.6953N 60°38.1682W

1348 van Veen grab at Copan-2-16, station 082, DGPS position 43°53.6807N 60°38.1730W

1359 IKU grab at Copan-2-16, station 083, DGPS position 43°53.6776N 60°38.1622W

1435 van Veen grab at Copan-2-17, station 084, DGPS position 43°53.5982N 60°38.1315W

1447 Camera at Copan-2-17, station 085, DGPS position 43°53.5836N 60°38.1592W

1625 Camera at Copan-2-18, station 086, DGPS position 43°53.4814N 60°38.0599W

1640 van Veen grab at Copan-2-18, station 087, DGPS position 43°53.4628N 60°38.0652W

1920 Sampling/coring along South Sable (SS) sand ridge transect 3;
IKU grab at SS-3-1, station 088, DGPS position 43°53.3358N 60°06.6719W

1937 van Veen grab at SS-3-1, station 089, DGPS position 43°53.3352N 60°06.6672W

1952 Camera at SS-3-1, station 090, DGPS position 43°53.3333N 60°06.6482W

2000 Camera at SS-3-2, station 091, DGPS position 43°53.3155N 60°06.6410W

2011 van Veen grab at SS-3-2, station 092, DGPS position 43°53.3145N 60°06.6395W

2016 IKU grab at SS-3-3, station 093, DGPS position 43°53.3023N 60°06.6029W

2035 van Veen grab at SS-3-3, station 094, DGPS position 43°53.2999N 60°06.6112W

2054 Camera at SS-3-3, station 095, DGPS position 43°53.2920N 60°06.6123W; Stopped sampling/coring and steamed toward Thebaud for seismic/sidescan survey.

2152 Start of line 302, tie-line from SOEP gas field Thebaud to Alma, DGPS position 43°51.58N 60°12.83W

July 18/DY200, Tuesday

0405 End of line 302, DGPS position 43°35.1607N 60°41.6150W

0422 Start of line 302b, tie-line from SOEP gas field Alma to Glenelg, DGPS position 43°35.6588N 60°40.3370W

0534 End of line 302b and start of line 401a, continuation of the tie-line from Alma to Glenelg, DGPS position 43°36.6067N 60°32.8900W

0730 End of line 401a, DGPS position 43°37.9559N 60°21.0032W; Stopped night survey and steamed to Copan site for vibrocoring.

1056 Vibrocore at Copan-2-21, station 096, DGPS position 43°53.0273N 60°37.8073W

1207 Vibrocore at Copan-2-22, station 097, DGPS position 43°52.6671N 60°37.6276W
1317 Vibrocore at Copan-2-26, station 098, DGPS position 43°52.0959N 60°37.2808W; No sample, catcher damaged.
1412 Vibrocore at Copan-2-26 repeat, station 099, DGPS position 43°52.0898N 60°37.2831W; No sample, catcher damaged again.
1630 Camera at SS-3-4, station 100, DGPS position 43°53.2592N 60°06.4903W
1639 van Veen grab at SS-3-4, station 101, DGPS position 43°53.2407N 60°06.5035W
1651 IKU grab at SS-3-4, station 102, DGPS position 43°53.2534N 60°06.4932W
1719 van Veen grab at SS-3-5, station 103, DGPS position 43°53.2338N 60°06.4566W
1730 Camera at SS-3-5, station 104, DGPS position 43°53.2272N 60°06.4623W
1741 Camera at SS-3-6, station 105, DGPS position 43°53.2076N 60°06.4075W
1748 van Veen grab at SS-3-6, station 106, DGPS position 43°53.2144N 60°06.4058W
1833 van Veen grab at SS-3-7, station 107, DGPS position 43°53.1904N 60°06.3512W
1844 Camera at SS-3-7, station 108, DGPS position 43°53.1869N 60°06.3557W
1854 IKU grab at SS-3-7, station 109, DGPS position 43°53.1893N 60°06.3636W
1920 Camera at SS-3-8, station 110, DGPS position 43°53.1678N 60°06.3100W
1927 van Veen grab at SS-3-8, station 111, DGPS position 43°53.1662N 60°06.3095W
1941 van Veen grab at SS-3-9, station 112, DGPS position 43°53.1446N 60°06.2555W
1953 Camera at SS-3-9, station 113, DGPS position 43°53.1255N 60°06.2499W
2013 IKU grab at SS-3-9, station 114, DGPS position 43°53.1385N 60°06.2453W
2034 Camera at SS-3-10, station 115, DGPS position 43°53.1036N 60°06.1816W
2045 van Veen grab at SS-3-10, station 116, DGPS position 43°53.1029N 60°06.1857W; Sampling/coring stopped and steamed toward Thebaud for seismic/sidescan survey.
2154 Start of line 402b, tie-line from SOEP gas field Thebaud to Glenelg, DGPS position 43°52.1867N 60°11.2626W

July 19/DY201, Wednesday
0117 End of line 402b, DGPS position 43°38.65N 60°08.33W
0238 Start of line 401b, the remainder of the tie-line from Glenelg to Alma, DGPS position 43°39.45N 60°07.73W
0436 End of line 401b, DGPS position 43°37.9963N 60°21.0196W
0509 Start of line 1000, grid/circle surveys south of Alma-Glenelg, DGPS position 43°35.6032N 60°20.9027W
0816 End of line 1000, DGPS position 43°35.7898N 60°20.5544W; Terminated seismic/sidescan survey and returned South Sable for sampling/coring.
0959 van Veen grab at SS-3-11, station 117, DGPS position 43°53.0709N 60°06.1443W
1011 Camera at SS-3-11, station 118, DGPS position 43°53.0902N 60°06.1289W
1025 Camera at SS-3-12, station 119, DGPS position 43°53.0607N 60°06.0957W
1033 van Veen grab at SS-3-12, station 120, DGPS position 43°53.0564N 60°06.0931W
1046 IKU grab at SS-3-12, station 121, DGPS position 43°53.0608N 60°06.0898W
1102 van Veen grab at SS-3-17, station 122, DGPS position 43°52.8824N 60°05.7348W
1118 Camera at SS-3-17, station 123, DGPS position 43°52.8761N 60°05.7122W
1132 Camera at SS-3-16, station 124, DGPS position 43°52.8903N 60°05.7533W
1139 van Veen grab at SS-3-16, station 125, DGPS position 43°52.8907N 60°05.7543W
1150 IKU grab at SS-3-16, station 126, DGPS position 43°52.8895N 60°05.7403W
1213 van Veen grab at SS-3-15, station 127, DGPS position 43°52.9267N 60°05.8192W
1225 Camera at SS-3-15, station 128, DGPS position 43°52.9305N 60°05.8181W
1303 Camera at SS-3-14, station 129, DGPS position 43°52.9852N 60°05.9200W

1314 van Veen grab at SS-3-14, station 130, DGPS position 43°52.9786N 60°05.9259W
1326 IKU grab at SS-3-14, station 131, DGPS position 43°52.9887N 60°05.9337W
1418 van Veen grab at SS-3-13, station 132, DGPS position 43°53.0331N 60°06.0320W
1436 Camera at SS-3-13, station 133, DGPS position 43°53.0249N 60°06.0161W
1525 Camera at SS-3-18, station 134, DGPS position 43°52.8700N 60°05.6616W
1541 van Veen grab at SS-3-18, station 135, DGPS position 43°52.8603N 60°05.6916W
1607 IKU grab at SS-3-18, station 136, DGPS position 43°52.8489N 60°05.6651W
1627 van Veen grab at SS-3-19, station 137, DGPS position 43°52.8379N 60°05.6101W
1636 Camera at SS-3-19, station 138, DGPS position 43°52.8379N 60°05.6210W
1647 Camera at SS-3-20, station 139, DGPS position 43°52.8272N 60°05.5857W
1712 IKU grab at SS-3-20, station 140, DGPS position 43°52.8326N 60°05.6100W; Stopped sampling/coring and steamed to Brandal Basin for seismic/sidescan survey.
2130 Start of line Brandal 12, survey line in the deep channel of Brandal Basin, DGPS position 44°02.39N 60°20.75W

July 20/DY202, Thursday

0322 End of line Brandal 12 and start of line Brandal 13, continued survey in the deep channel of Brandal Basin, DGPS position 44°14.8960N 60°08.0004W
0530 End of line Brandal 13, DGPS position 44°05.3018N 60°11.2944W; Terminated night survey and streamed back to South Sable to continue sampling/coring.
1000 van Veen grab at SS-3-20, station 141, DGPS position 43°52.8164N 60°05.5920W
1037 van Veen grab at SS-1-13, station 142, DGPS position 43°54.1378N 60°04.2657W
1109 Camera at SS-1-13, station 143, DGPS position 43°54.1376N 60°04.2815W
1110 Camera at SS-1-12, station 144, DGPS position 43°54.1407N 60°04.2830W
1122 Camera at SS-1-11, station 145, DGPS position 43°54.1531N 60°04.2954W
1130 Camera at SS-1-12, station 146, DGPS position 43°54.1487N 60°04.2897W
1154 Camera at SS-1-7, station 147, DGPS position 43°54.2180N 60°04.4638W; Due to complex winds and currents, difficult to maintain station. Thus a series of 21 shots were taken at several stations while Hudson drifted along the transect.
1159 Camera at SS-1-8, station 147, DGPS position 43°54.2050N 60°04.4301W
1202 Camera at SS-1-9, station 147, DGPS position 43°54.1903N 60°04.4035W
1205 Camera at SS-110, station 147, DGPS position 43°54.1646N 60°04.3553W
1221 Camera at SS-1-1, station 147, DGPS position 43°54.3264N 60°04.7568W
1222 Camera at SS-1-2, station 147, DGPS position 43°54.3363N 60°04.7424W
1224 Camera at SS-1-3, station 147, DGPS position 43°54.3221N 60°04.7141W
1227 Camera at SS-1-4, station 147, DGPS position 43°54.2926N 60°04.6710W
1229 Camera at SS-1-5, station 147, DGPS position 43°54.2848N 60°04.6337W
1233 Camera at SS-1-6, station 147, DGPS position 43°54.2666N 60°04.5868W
1259 van Veen grab at SS-1-1, station 148, DGPS position 43°54.3482N 60°04.7604W
1307 van Veen grab at SS-1-2, station 149, DGPS position 43°54.3265N 60°04.7347W
1310 van Veen grab at SS-1-3, station 150, DGPS position 43°54.3144N 60°04.7189W
1314 van Veen grab at SS-1-4, station 151, DGPS position 43°54.2966N 60°04.6660W
1317 van Veen grab at SS-1-5, station 152, DGPS position 43°54.2761N 60°04.6190W
1322 van Veen grab at SS-1-6, station 153, DGPS position 43°54.2620N 60°04.5842W
1328 van Veen grab at SS-1-7, station 154, DGPS position 43°54.2219N 60°04.4747W
1332 van Veen grab at SS-1-8, station 155, DGPS position 43°54.2025N 60°04.4196W
1337 van Veen grab at SS-1-9, station 156, DGPS position 43°54.1942N 60°04.4009W
1342 van Veen grab at SS-1-10, station 157, DGPS position 43°54.1669N 60°04.3393W

1346 van Veen grab at SS-1-11, station 158, DGPS position 43°54.1386N 60°04.3092W
1350 van Veen grab at SS-1-12, station 159, DGPS position 43°54.1486N 60°04.2846W
1357 IKU grab at SS-1-11, station 160, DGPS position 43°54.1538N 60°04.3059W
1412 IKU grab at SS-1-9, station 161, DGPS position 43°54.1886N 60°04.3983W
1428 IKU grab at SS-1-7, station 162, DGPS position 43°54.2280N 60°04.4786W
1437 IKU grab at SS-1-5, station 163, DGPS position 43°54.0779N 60°04.6300W
1452 IKU grab at SS-1-2, station 164, DGPS position 43°54.3165N 60°04.7078W
1617 Vibrocore at SS-2-5, station 165, DGPS position 43°52.1556N 60°05.7049W
1740 Vibrocore at SS-2-12, station 166, DGPS position 43°53.9449N 60°05.2735W

7. PRELIMINARY RESULTS

7.1 van Veen Grab

The van Veen grab sampler was deployed at every sampling station except for two virbrocore sites. The sampler worked well and never failed to retrieve suitable bottom sediment samples. A total of 67 van Veen grab samples were collected along six sand ridge profiles. The station numbers of the van Veen grabs and their profile locations are listed in Tables 2 and 3. Details of the van Veen grabs and their surface subsamples can be found in Appendices 2 and 3. Fig. 7 shows the morphological locations of the grab samples (lower row of numbers) along the cross-section profiles of the sand ridges. The surface subsamples from each grab samples have been submitted to GSCA SedLab for grain size analysis.

7.2 Benthos Camera

The Benthos camera functioned well with no apparent faults. Occasionally it mis-triggered apparently due to constant dragging of the trigger vane/weight when drift of the ship or tidal currents prevented a strictly vertical drop of the camera. Also, the camera pinger occasionally failed to register on the hydrophone, such that a positive indication of camera depth and triggering was not always possible. This was probably due to excessive propeller wash under less than ideal weather or under strong currents. High winds plus strong tidal currents on July 20 (day 202) made it extremely difficult for the ship to maintain position to do camera stations. After discussion with the ship's bridge, it was decided that the ship's heading and speed would be adjusted according to the wind and tidal current conditions and then Hudson was allowed to drift along the South Sable 1 transect. The camera was left in the water during this drift and a series of 21 shots were taken at stations SS-1 to SS-10 (stations 147a-j in Table 3) without lifting the camera to the winch room.

As for van Veen grabs, the BIO Benthos camera was also used at each station. Two shots were generally taken in each drop. A total of 60 camera stations were conducted. The camera station numbers, their profile locations and corresponding planned station numbers are also listed in Tables 2 and 3. Details of the camera stations are given in Appendix 4. Fig. 7 shows the morphological locations of the camera stations (middle row of numbers) along the cross-section profiles of the sand ridges.

Seabed photos collected along sand-ridge transects indicate that water depth and hydrodynamics may determine certain patterns of variations of small-scale bedforms. Fig. 8 displays the seabed photos collected along the CoPan 1A sand ridge profile. The seabed in the stoss-side trough (34 m depth) was covered by organic rich, bioturbated fine sediment with plenty of sand dollars (photo A in Fig. 8). At both the lower stoss and lower lee flanks (32 m depth), seabed changed to rounded inactive wave (photo

Table 2 List of planned station numbers, cruise station numbers, approximate water depth, and profile locations of van Veen grab, IKU grab, bottom camera and vibrocores along sand-ridge profiles at the Co-Pan site.

Planned	Cruise station numbers				Depth	Location on sand ridge
Station #	van Veen	IKU	Camera	Vibrocore	(m)	profile
Copan 1A						
copan-1-1	049	048	061	34		trough
copan-1-2	045	047	046	32		lower stoss flank
copan-1-3	044		043	30		middle stoss flank
copan-1-4	041	050	042	062	29	middle stoss flank
copan-1-5	040		039	24		upper stoss flank
copan-1-6	037	051	038	23		crest
copan-1-7	036		035	25		upper lee flank
copan-1-8	031	033	034	063	27	middle lee flank
copan-1-9	030		029	30		lower-middle lee flank
copan-1-10	026	028	027	32		lower lee flank
Copan 1B						
copan-1-11	025		024	34		trough
copan-1-12	021	023	022	34		lower stoss flank (or trough)
copan-1-13	020		019	29		lower stoss flank
copan-1-14	016	018	017	27		middle stoss flank
copan-1-15	015		014	25		upper-middle stoss flank
copan-1-16	012	011	013	26		crest
copan-1-17	010		009	29		upper lee flank
copan-1-18	006	008	007	29		middle lee flank
copan-1-19	005		004	31		lower-middle lee flank
copan-1-20	001	003	002	34		lower lee flank (or trough)
Copan 2						
copan-2-2	052	053		37		crest of secondary ridge
copan-2-3	055	054		39		trough
copan-2-4	056	058	057	35		lower stoss flank
copan-2-6	060	059		34		lower middle stoss flank
copan-2-7	064	066	065	32		middle stoss flank
copan-2-8	068	067		33		middle stoss flank
copan-2-9	069	070		32		upper-middle stoss flank
copan-2-11	073	071	072	32		crest
copan-2-13	074	075		33		upper lee flank
copan-2-14	077	078	076	33		upper-middle lee flank
copan-2-15	079	080		37		middle lee flank
copan-2-16	082	083	081	41		lower-middle lee flank
copan-2-17	084	085		44		lower lee flank
copan-2-18	087	086		44		trough

Table 3 List of planned station numbers, cruise station numbers, approximate water depth, and profile locations of van Veen grab, IKU grab, and bottom camera along sand-ridge profiles at the South Sable site.

Planned	Cruise station number			Depth	Location on sand
Station #	van Veen	IKU	Camera	(m)	ridge profile
South Sable 1					
ss-1-1	148		147e	25	trough
ss-1-2	149	164	147f	24	lower western flank
ss-1-3	150		147g	24	lower western flank
ss-1-4	151		147h	23	middle western flank
ss-1-5	152	163	147i	22	upper-middle western flank
ss-1-6	153		147j	22	upper western flank
ss-1-7	154	162	147a	22	crest
ss-1-8	155		147b	22	upper eastern flank
ss-1-9	156	161	147c	22	upper-middle eastern flank
ss-1-10	157		147d	25	middle eastern flank
ss-1-11	158	160	145	26	lower-middle eastern flank
ss-1-12	159		144/146	26	lower eastern flank
ss-1-13	142		143	26	trough
South Sable 3A					
ss-3-1	089	088	090	29	trough
ss-3-2	092		091	29	lower-middle lee flank
ss-3-3	094	093	095	28	upper-middle lee flank
ss-3-4	101	102	100	27	crest
ss-3-5	103		104	28	upper stoss flank
ss-3-6	106		105	28	upper-middle stoss flank
ss-3-7	107	109	108	29	upper-middle stoss flank
ss-3-8	111		110	30	middle stoss flank
ss-3-9	112	114	113	31	lower-middle stoss flank
ss-3-10	116		115	32	lower stoss flank (or trough)
South Sable 3B					
ss-3-11	117		118	34	trough
ss-3-12	120	121	119	33	lower stoss flank
ss-3-13	132		133	32	middle stoss flank
ss-3-14	130	131	129	30	middle stoss flank
ss-3-15	127		128	29	upper stoss flank
ss-3-16	125		124	29	crest
ss-3-17	122	126	123	29	crest or upper lee flank
ss-3-18	135	136	134	30	upper-middle lee flank
ss-3-19	137		138	31	lower-middle lee flank
ss-3-20	141	140	139	31	lower lee flank

Fig. 7 Morphological locations of the van Veen grab (lower row of numbers), bottom camera (middle row of numbers) and IKU grab stations (upper row of numbers) along sand-ridge transects at (a) CoPan site and (b) South Sable site.

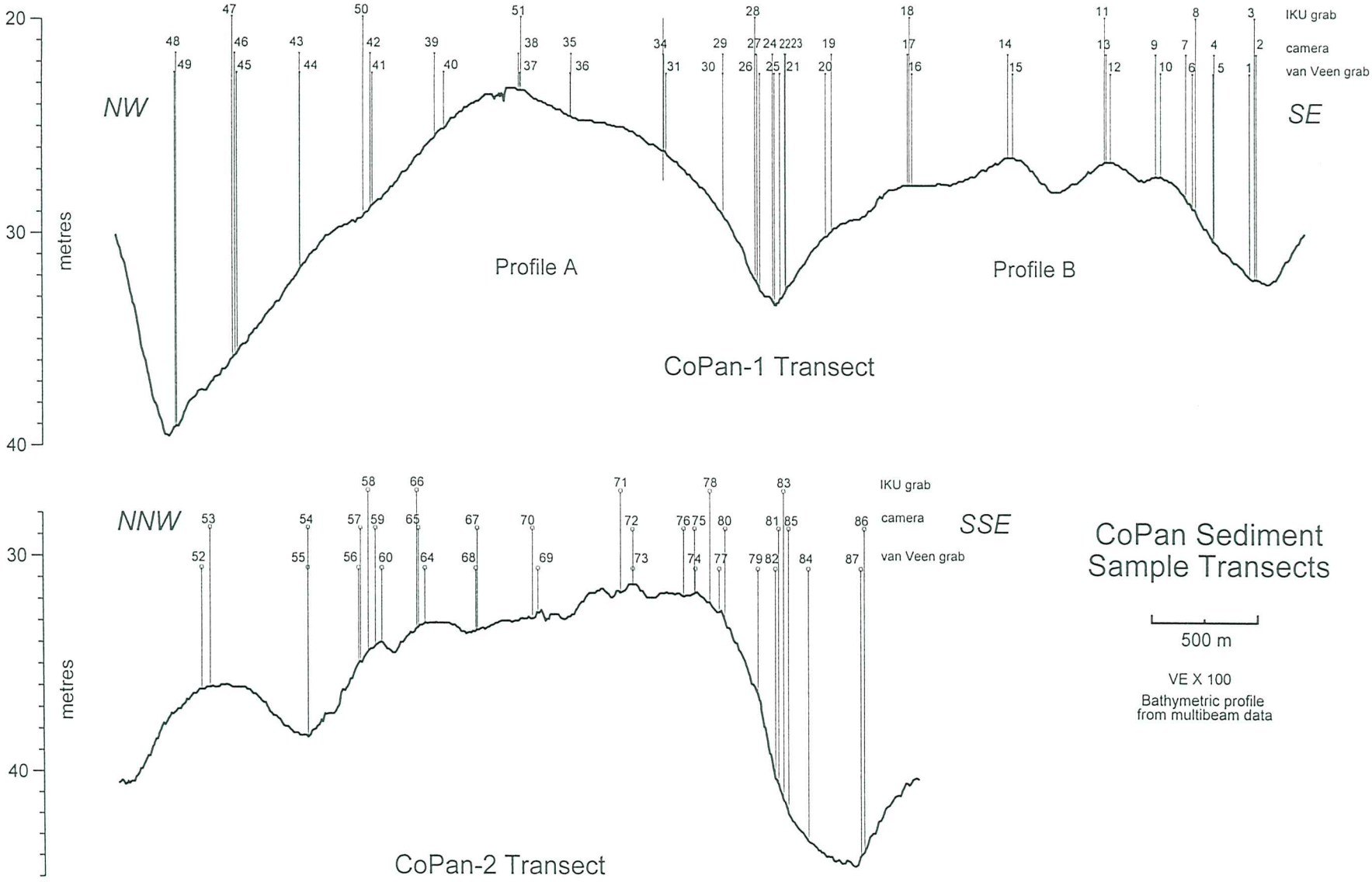

20
30
40
metres
NW
SE
Profile A
Profile B
CoPan-1 Transect
IKU grab
camera
van Veen grab
NNW
SSE
CoPan-2 Transect
CoPan Sediment
Sample Transects
500 m
VE X 100
Bathymetric profile
from multibeam data

Figure 7A.

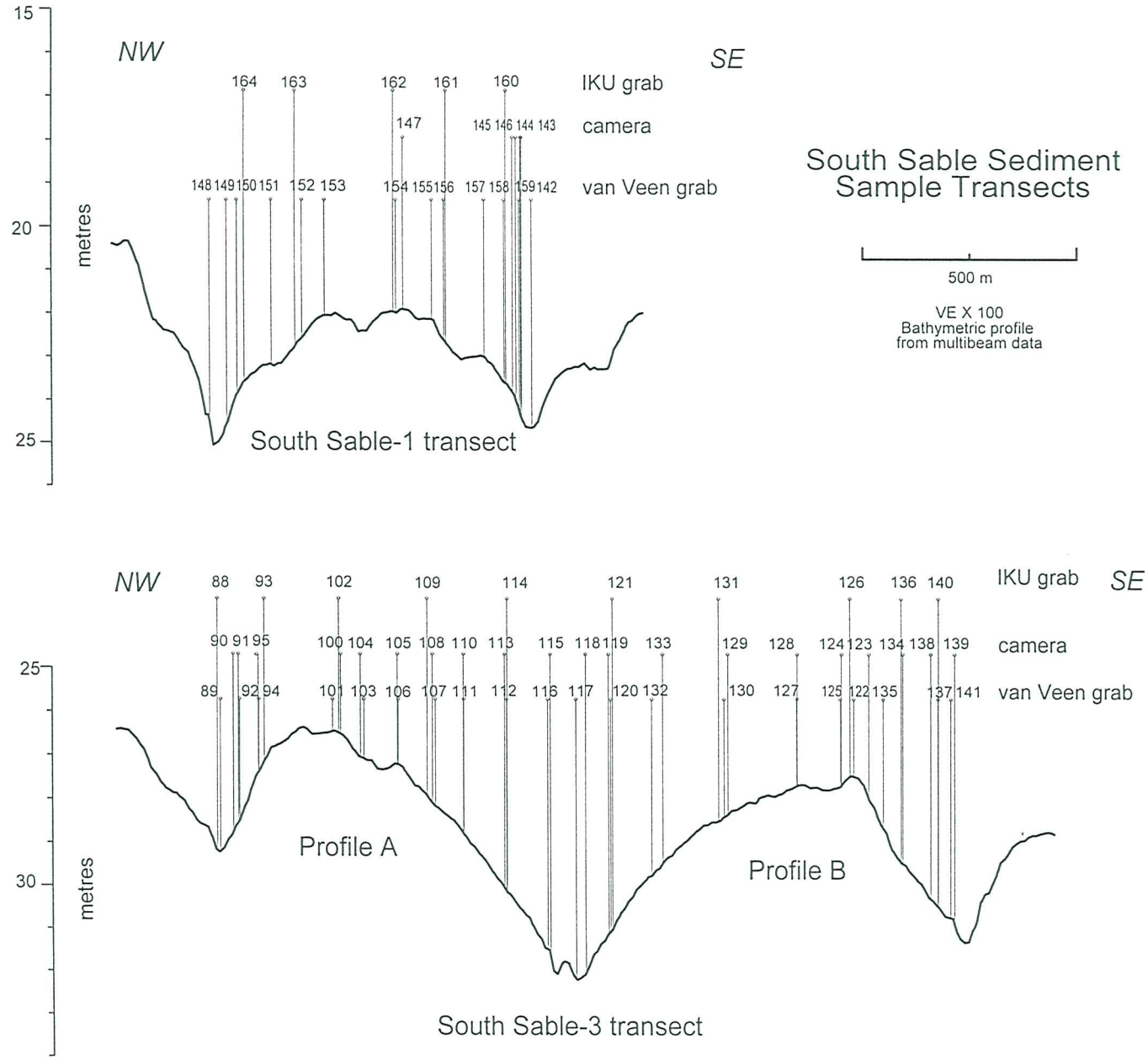

15
20
25
metres
NW
SE
164 163 162 161 160
IKU grab
147
145 146 144 143
camera
148 149 150 151 152 153 154 155 156 157 158 159 142
van Veen grab
South Sable-1 transect
South Sable Sediment
Sample Transects
500 m
VE X 100
Bathymetric profile
from multibeam data
25
30
metres
NW
SE
88 93 102 109 114 121 131 126 136 140
IKU grab
90 91 95 100 104 105 108 110 113 115 118 119 133 129 128 124 123 134 138 139
camera
89 92 94 101 103 106 107 111 112 116 117 120 132 130 127 125 122 135 137 141
van Veen grab
Profile A
Profile B
South Sable-3 transect

Figure 7B.

Fig. 8 Seabed photos collected along Copan 1A sand ridge profile. (A): station 48, stoss-side trough (see Fig. 7A); (B): station 46, lower stoss flank; (C): station 43, middle stoss flank; (D): station 39, upper stoss flank; (E): station 38, crest; (F): station 35, upper lee flank; (G): station 34, middle lee flank; (H) station 29, lower-middle lee flank; and (I) station 27, lower lee flank. The diameter of the compass is about 10 cm.

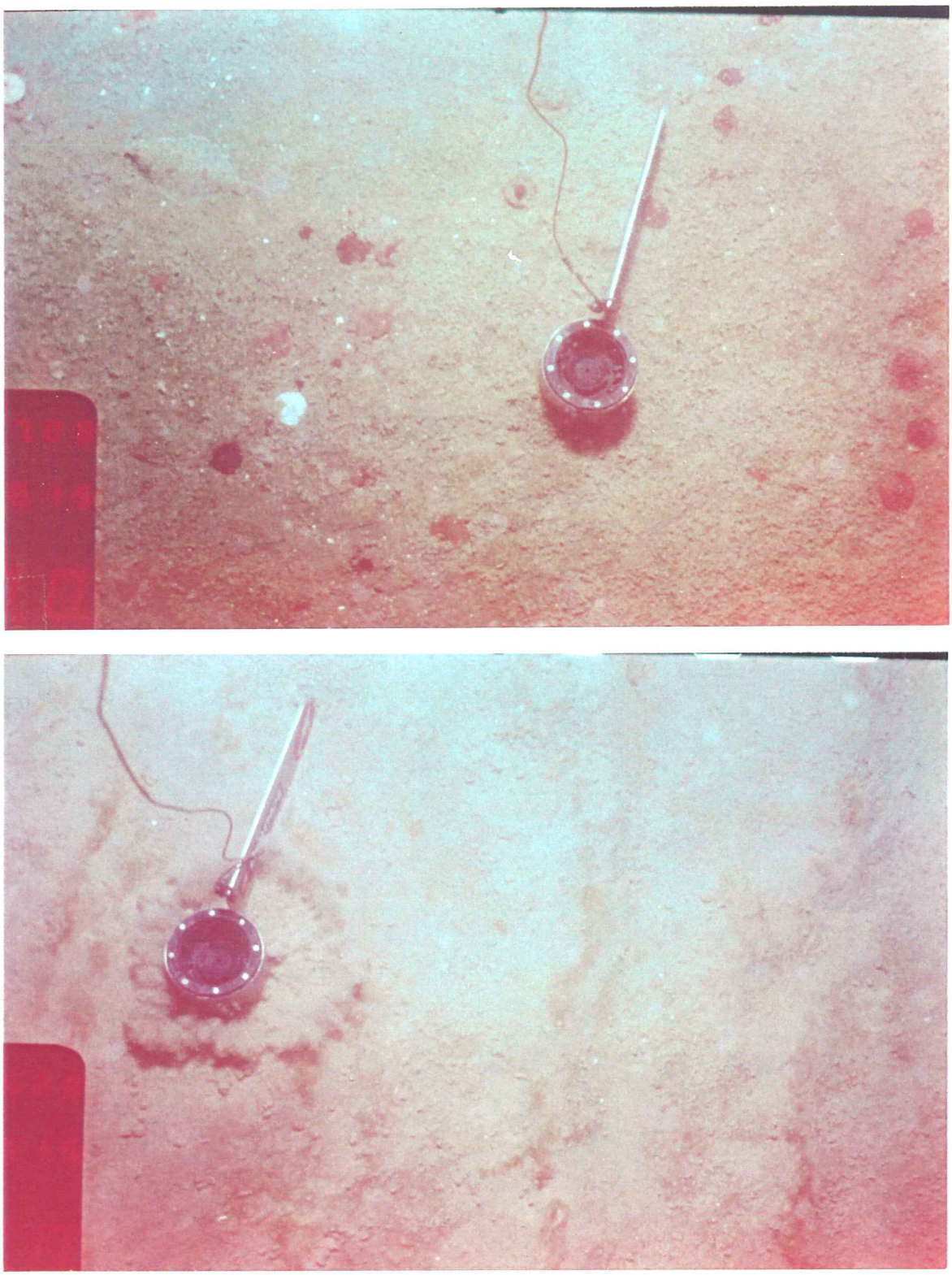


Fig. 8 A (upper): Station 48, stoss-side trough; B (lower): Station 46, lower stoss flank

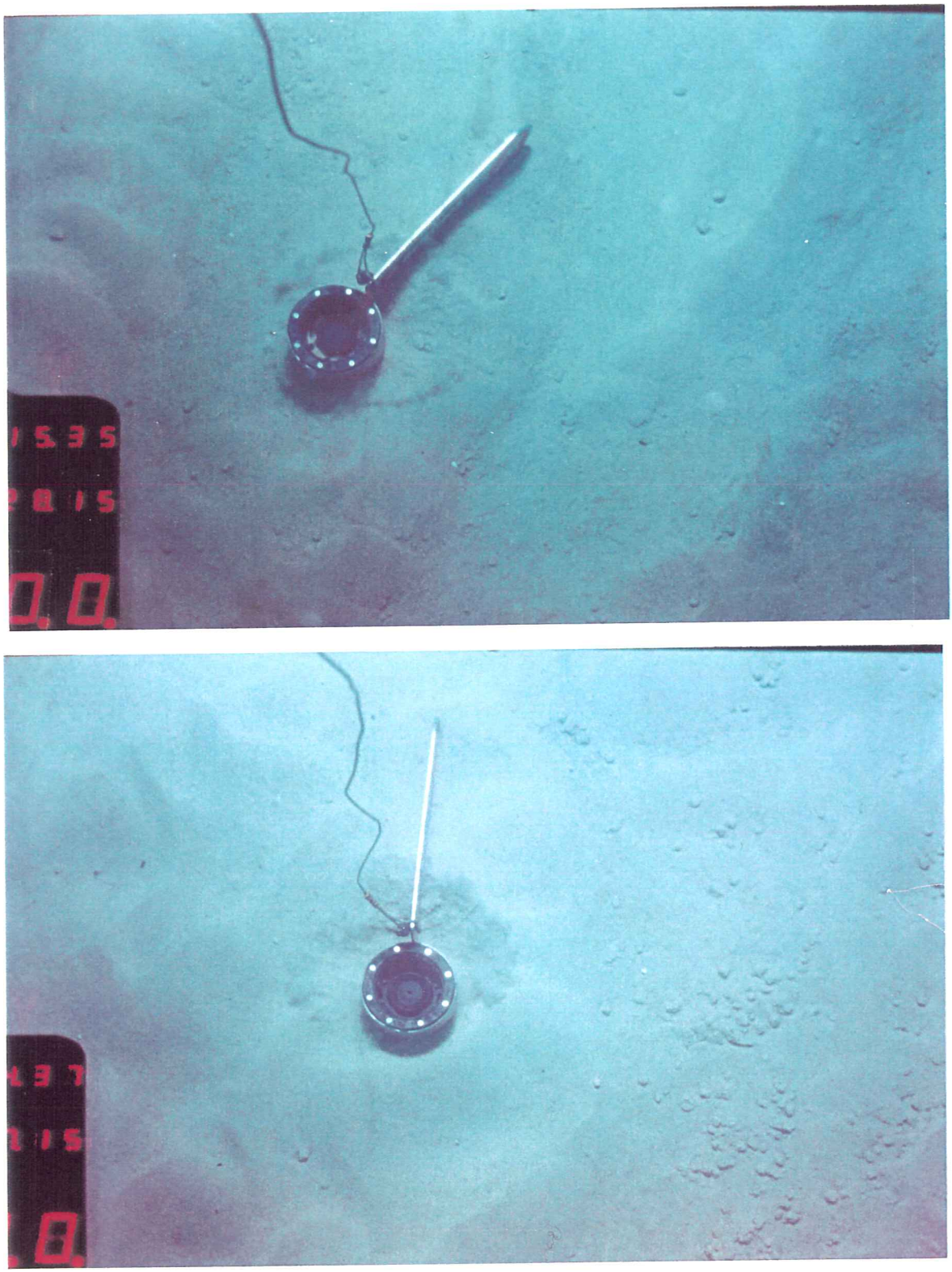


Fig. 8 C (upper): Station 43, middle-stoss flank; D (lower): Station 39, upper stoss flank

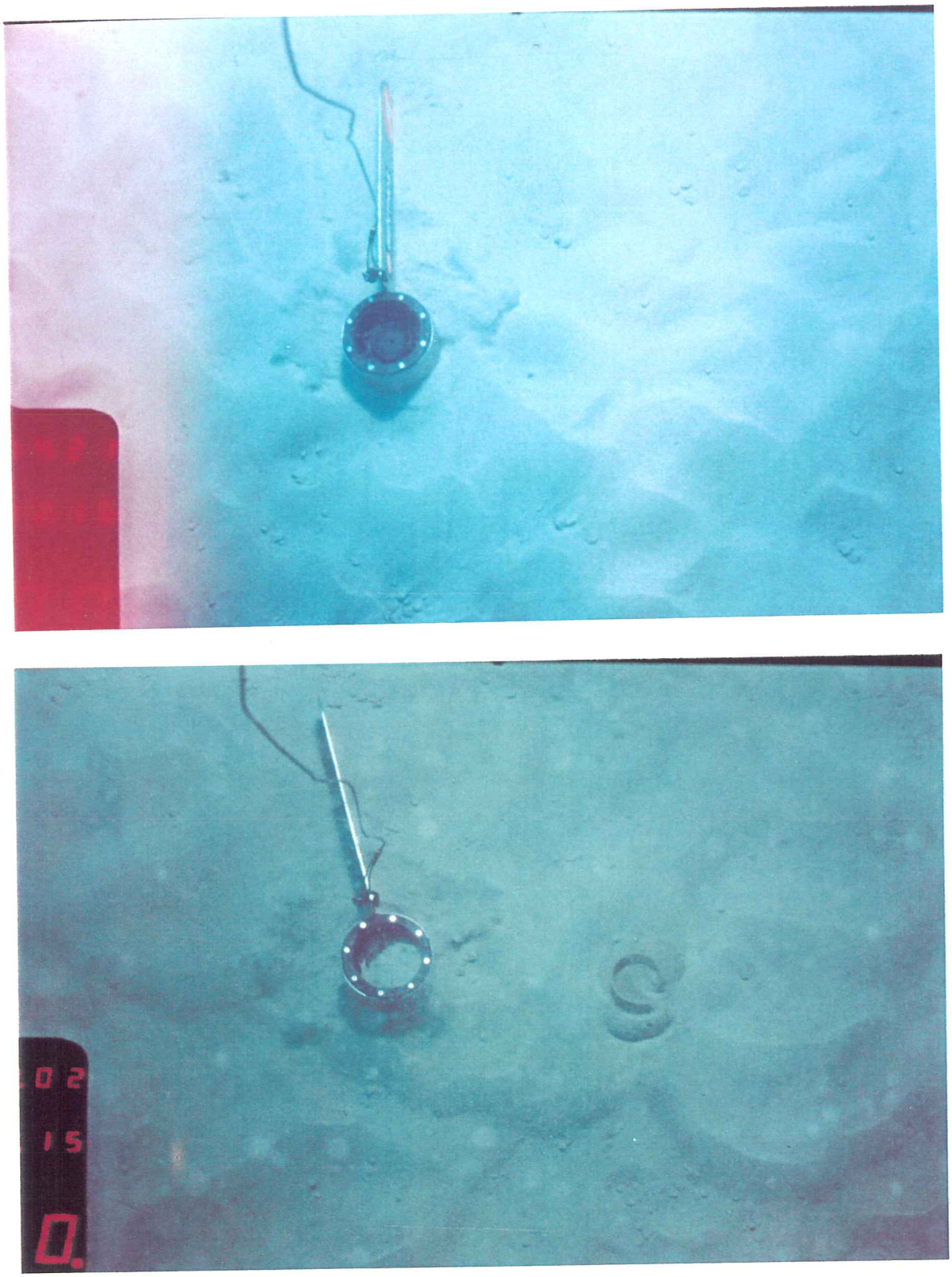


Fig. 8 E (upper): Station 38, crest; F (lower): Station 35, upper lee flank

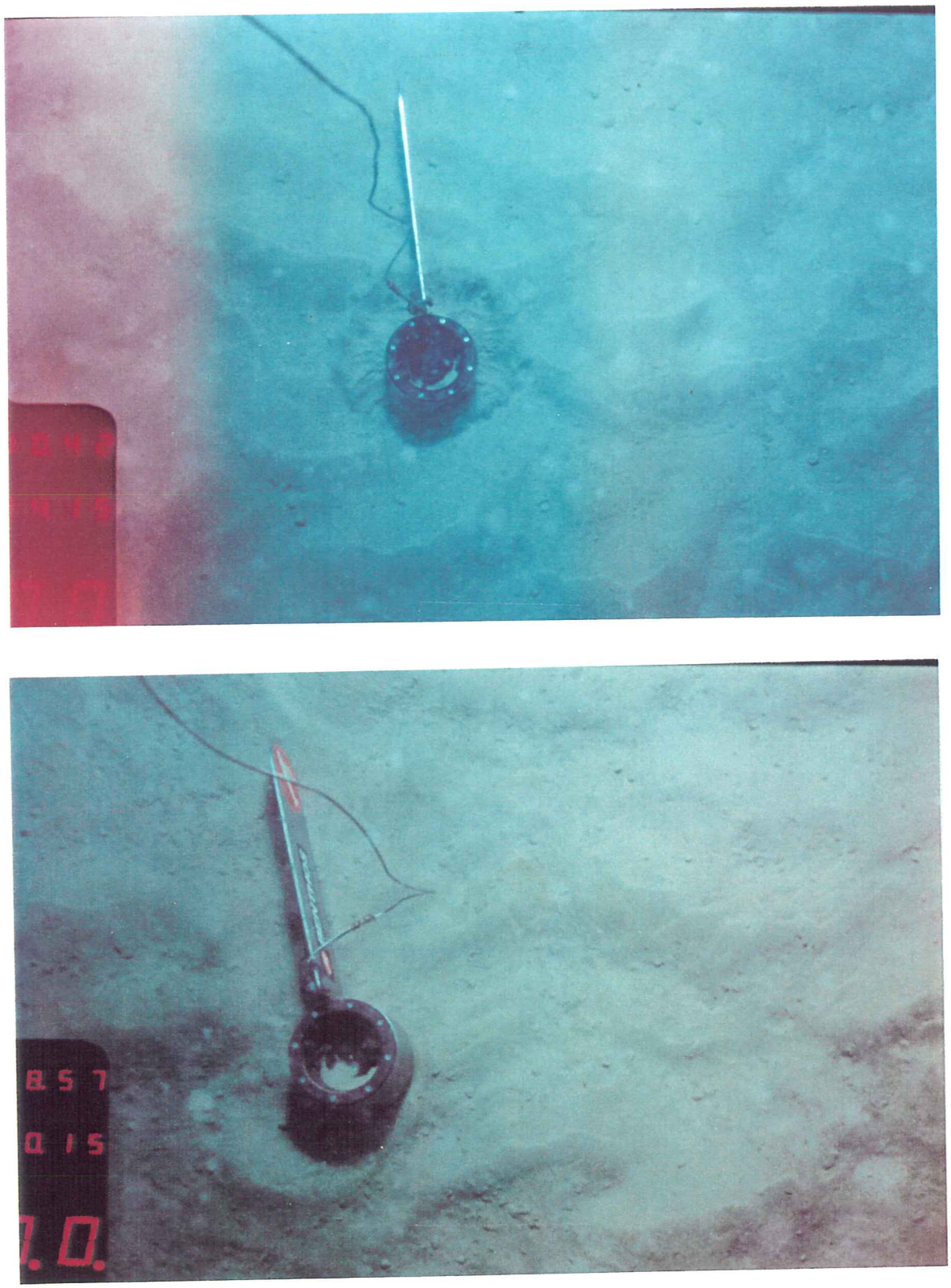


Fig. 8 G (upper): Station 34, middle lee flank; H (lower): Station 29, lower-middle lee flank

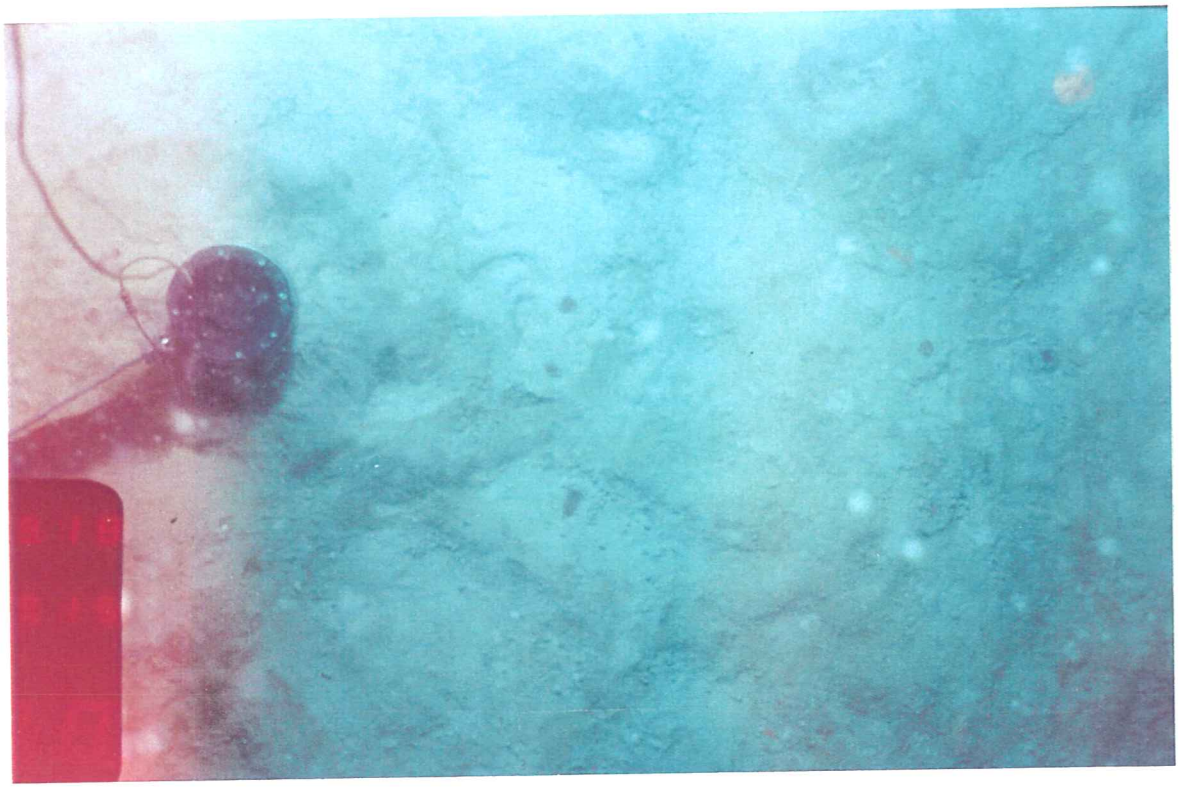


Fig. 8 I: Station 27, lower lee flank

B) or current (photo I) ripples with a surficial dusting of fine sediment. As we move up to the middle to upper-middle stoss or lee flanks (depths 25-30 m), sinuous current ripples became dominant (photos C, F, G and H in Fig. 8). Water depth decreased to a minimum of 23 m over the ridge crest. Sediment became finer and bedforms had changed into 3-D linguoid current ripples (photos D and E of Fig. 8). A similar bedform pattern was also observed along the CoPan 1B profile.

At the deeper CoPan 2 site (depths ranging from 32 to 44 m), a slightly different pattern of bedform variation was found. In the stoss-side trough, the seabed was characterized by a brownish, bioturbated bed covered by a thin layer of fine sediment (photo A in Fig. 9). On the lower and middle stoss flank (photos B and C in Fig. 9), small current ripples had developed in a thin layer of fine sand on top of the larger, but inactive, bedforms with the bioturbated brownish surface. On the upper stoss flank (photo D in Fig. 9), the small current ripples changed into better-developed sinuous current ripples with wavelength of about 20 cm. Over the ridge crest, the 2-D current ripples had further developed into 3-D linguoid current ripples and the brownish surface has been completely covered or reworked (photo E of Fig. 9). As we descend on the lee flank of the ridge, active current ripples were again replaced by a thin layer of fine sediment on top of the bioturbated brownish bed on the middle lee flank (photo F of Fig. 9). On the lower lee flank and in the lee-side trough (photos G and H of Fig. 9), the seabed was once again covered by a thin layer of fine sediment over the bioturbated brownish surface.

The seabed photos collected along the South Sable 3 sand-ridge profiles (depths 27 - 34 m) showed a similar bedform variation pattern to that at the CoPan 2 site (Fig. 10). The only exception is that straight wave ripples instead of current ripples developed over the sand ridge crest at the South Sable 3 site (D and E of Fig. 10). Water depth at the South Sable 1 profile was much shallower, ranging from only 22 to 26 m, and bedforms along this profile (Fig. 11) were significantly different - the seabed was dominated by straight or sinuous wave ripples. Sometimes small current ripples were also found to be running obliquely in the troughs of the wave ripples (F, H, I and G of Fig. 11).

7.3 IKU Grab Sampler

The large IKU grab sampler worked reasonably well in this cruise and consistently recovered 50% to 95% full buckets, allowing two or three sediment peels to be produced for each IKU sample. The IKU sampler was used approximately at every other planned sampling station. Thus a total of 30 IKU grabs were taken. The IKU station numbers, their profile locations and corresponding planned station numbers are also listed in Tables 2 and 3. Details of the IKU stations and their surface/peel subsamples are given in Appendices 2 and 3. The morphological positions of the IKU stations were also shown in Fig. 7 (the upper row of numbers). Turbid water that spilled over the top of IKU and examination of the surface of the IKU samples indicated that to some degree surficial erosion occurred during recovery of the IKU sampler. Rubber covers, as used in some previous cruises, possibly could reduce this erosion (though it may slow down the sampling process). As observed in previous cruises, driving down the box core trays into the IKU samples sometimes can be difficult and more innovative methods for quicker pushing down of trays are desirable.

Station keeping at ±20 m tolerance was deemed necessary so that the actual sample position in relation to bedforms of 30-50 m wavelength was known. This was often difficult under even moderate wind and current conditions. A better approach might be to use the BIO Video Grab and Tow Cam to replace the van Veen grab and Benthos camera. This way, the local lateral variation in bedforms might be better represented.

Fig. 9 Seabed photos collected along Copan 2 sand ridge profile. (A): station 54, trough (see Fig. 7A); (B): station 57, lower stoss flank; (C): station 59, lower middle stoss flank; (D): station 70, upper middle stoss flank; (E): station 72, crest; (F): station 80, middle lee flank; (G): station 85, lower lee flank; (H) station 86, trough.

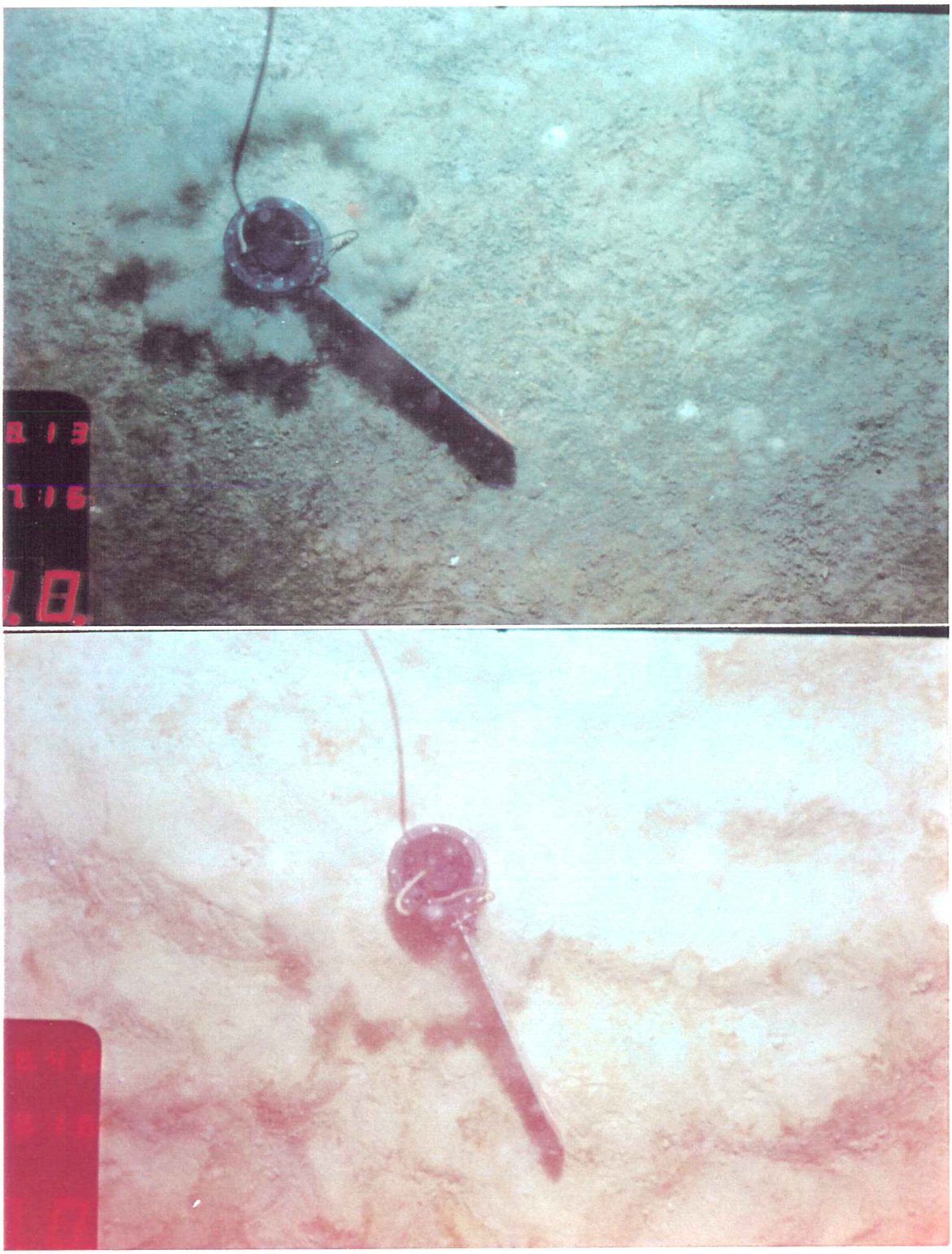


Fig. 9 A (upper): Station 54, trough; B (lower): Station 57, lower stoss flank

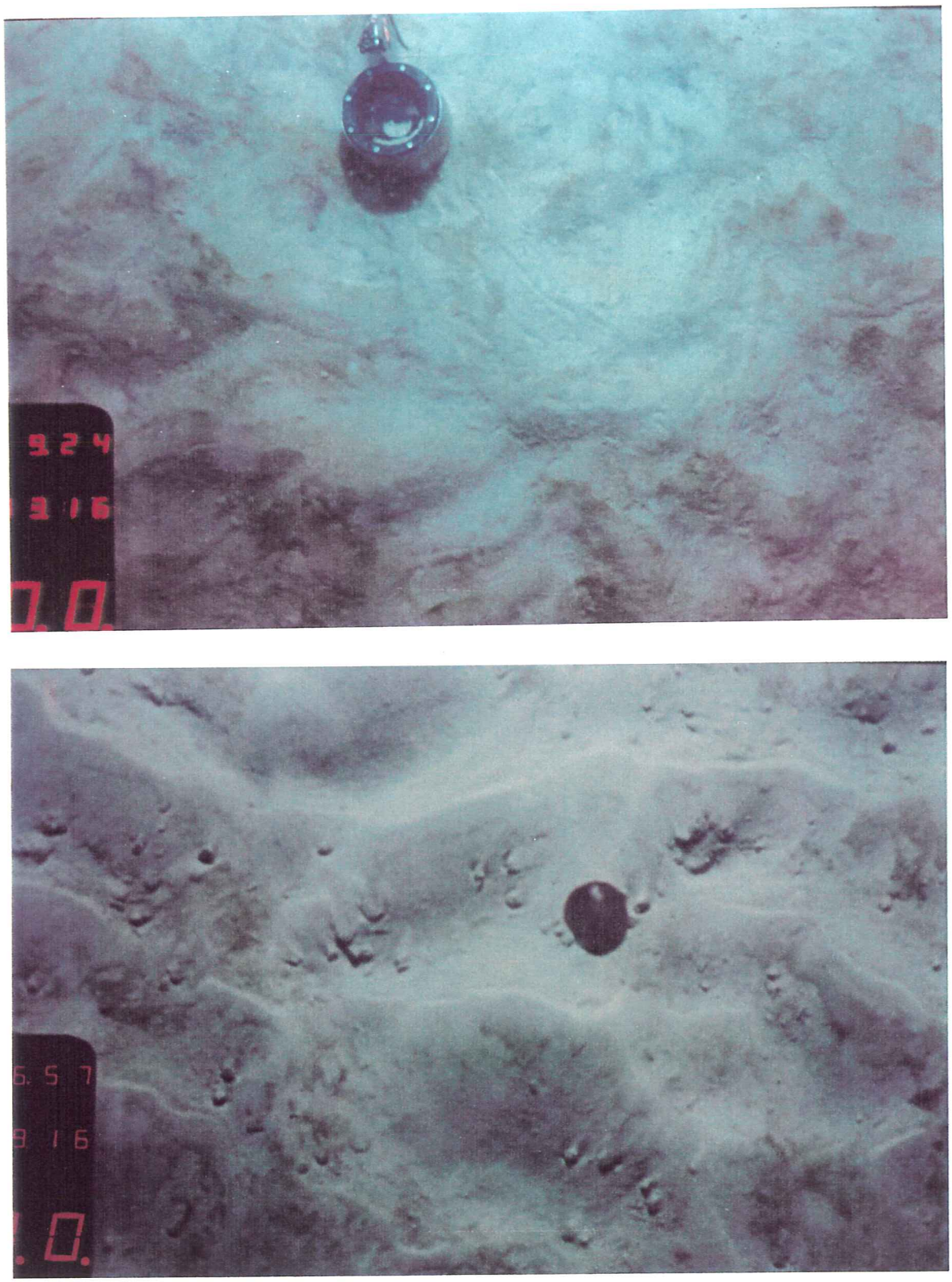


Fig. 9 C (upper): Station 59, lower-middle stoss flank; D (lower): Station 70, upper-middle stoss flank

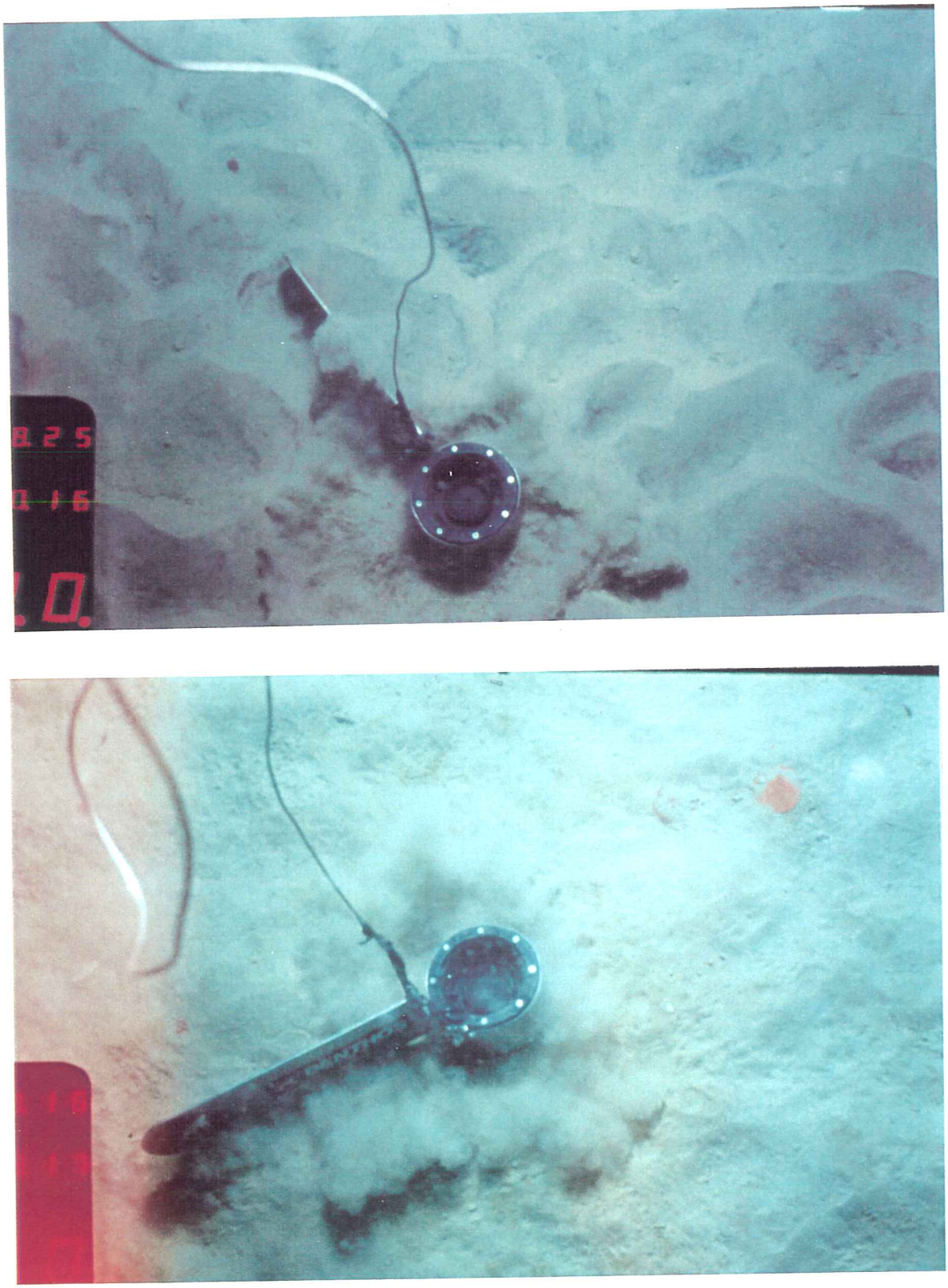


Fig. 9 E (upper): Station 72, crest; F (lower): Station 80, middle lee flank

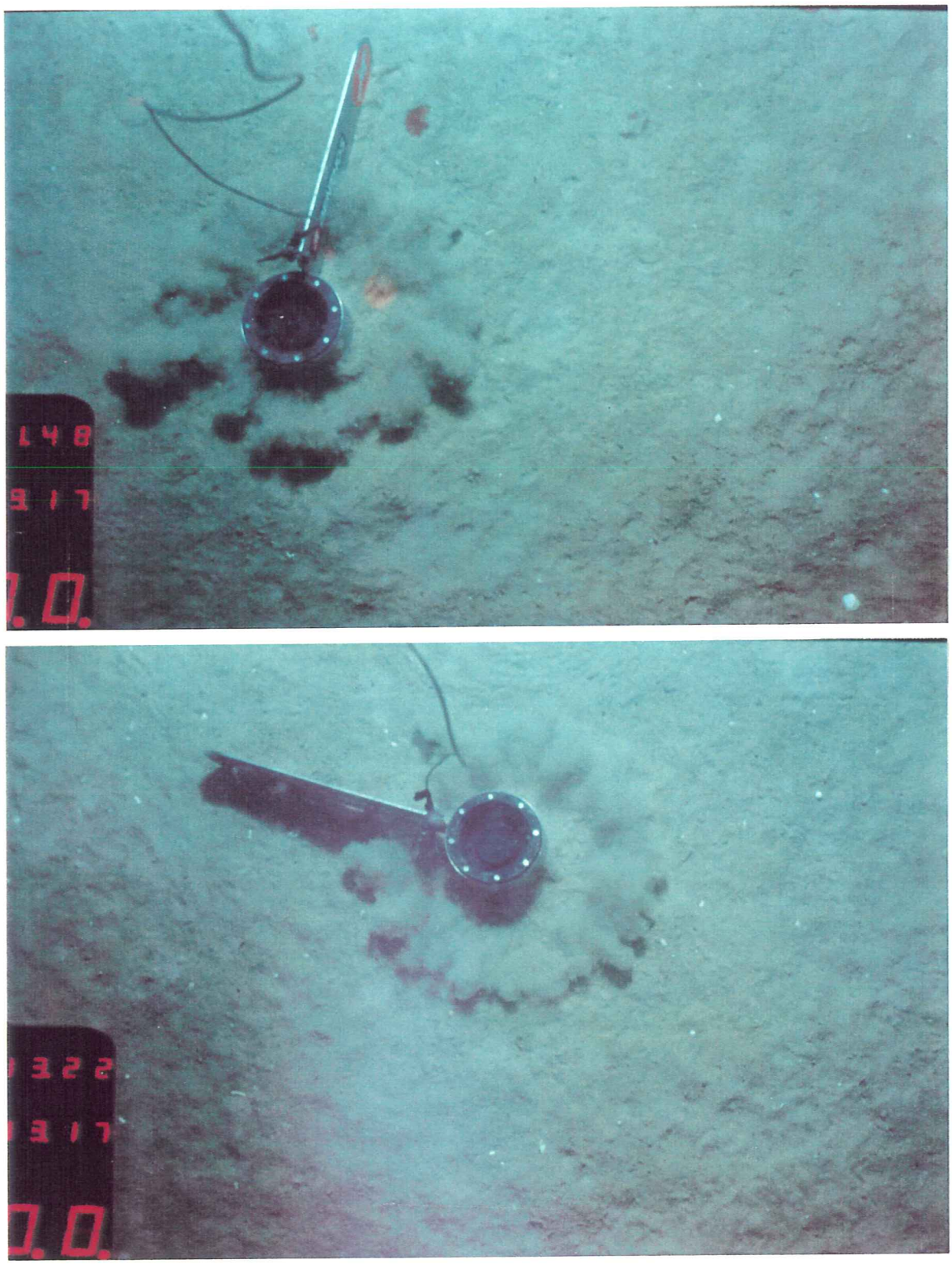


Fig. 9 G (upper): Station 85, lower lee flank; H (lower): Station 86, trough

Fig. 10 Seabed photos collected along South Sable 3B (SS-3B) sand-ridge profile. (A): station 118, trough (see Fig. 7B); (B): station 119, lower stoss flank; (C): station 129, middle stoss flank; (D): station 128, upper stoss flank; (E): station 124, crest; (F): station 123, crest/upper lee flank; (G): station 134, upper-middle lee flank; (H) station 139, lower lee flank.

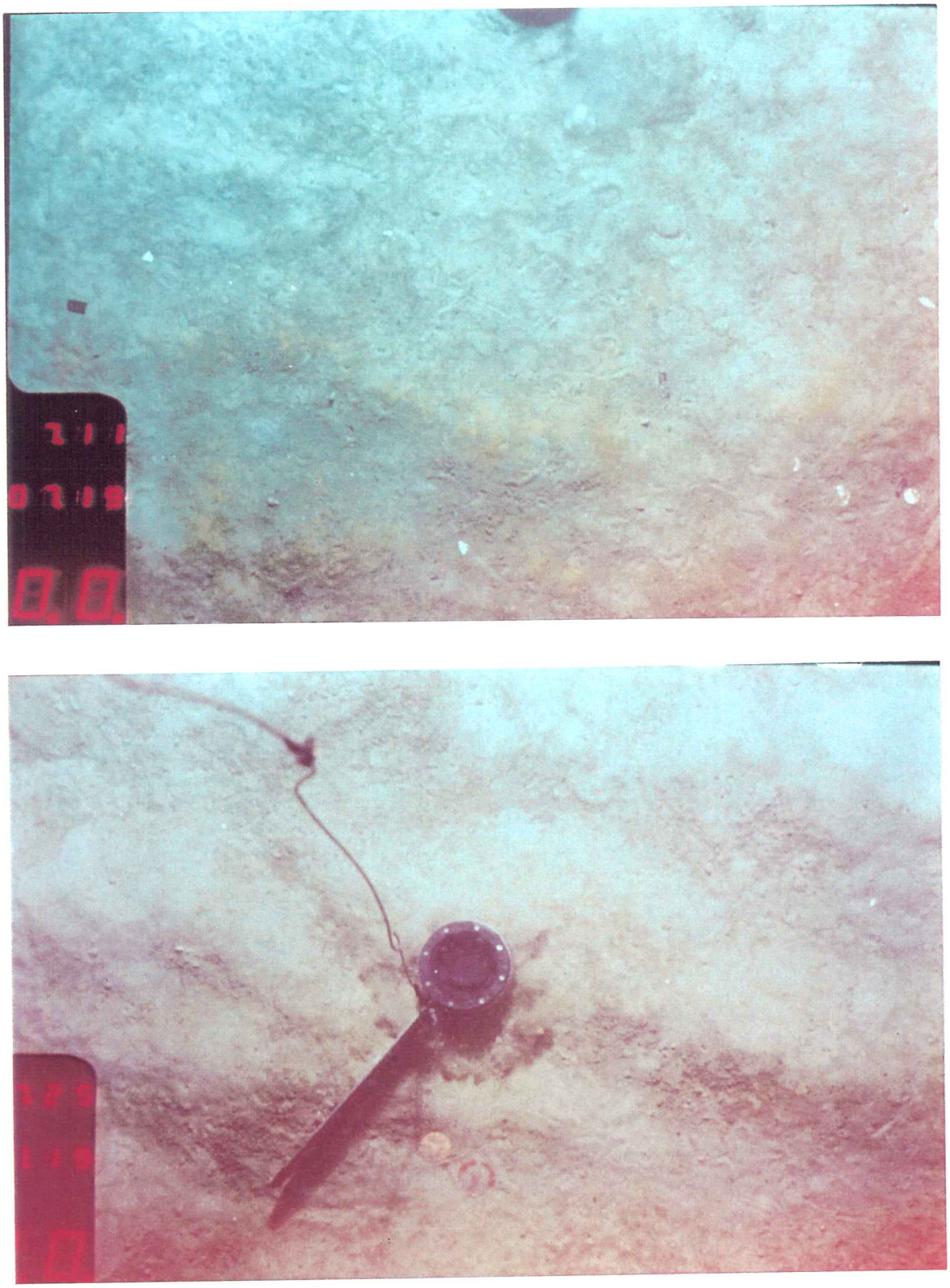


Fig. 10 A (upper): Station 118, trough; B (lower): Station 119, lower stoss flank

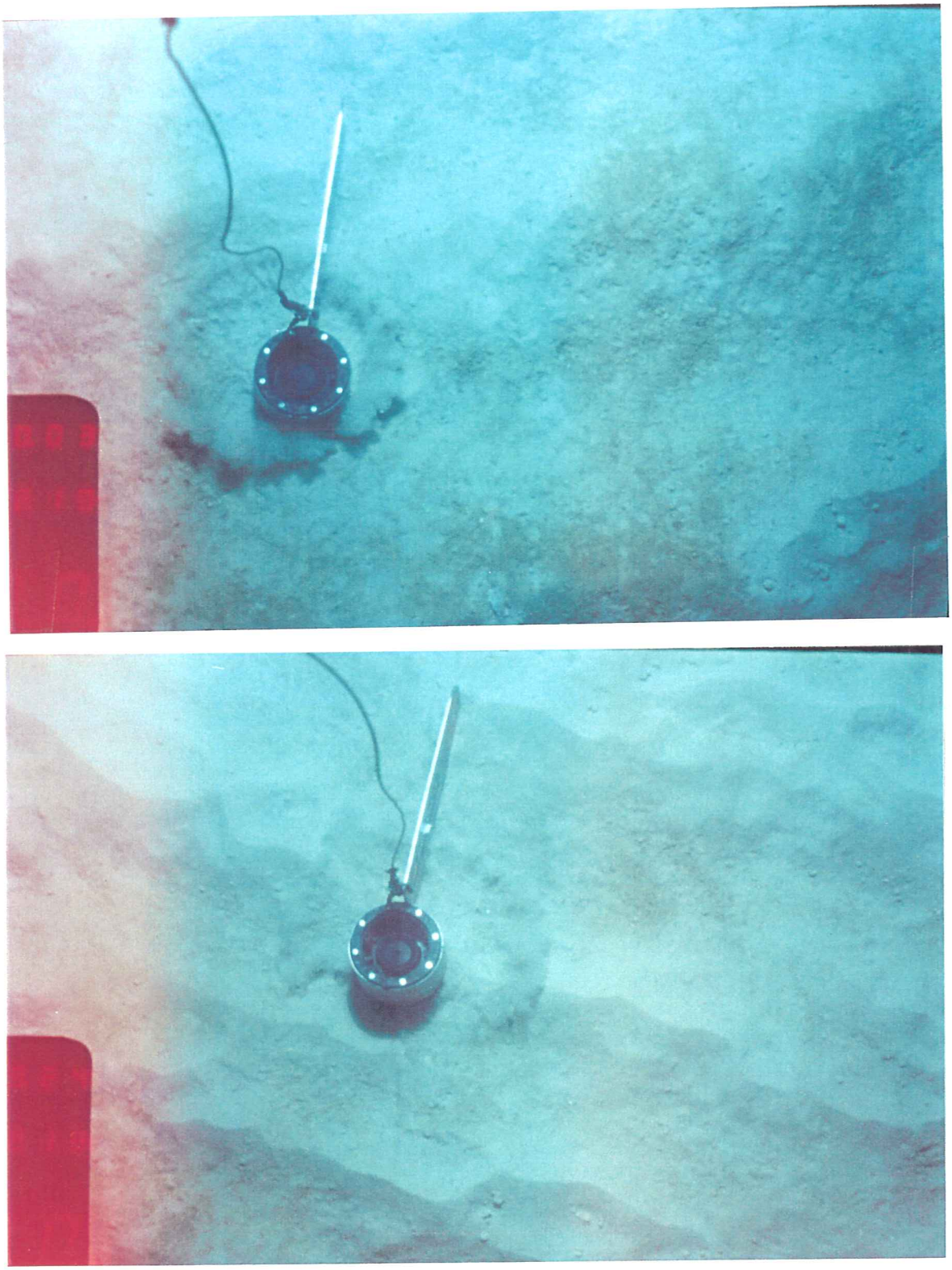


Fig. 10 C (upper): Station 129, middle stoss flank; D (lower): Station 128, upper stoss flank

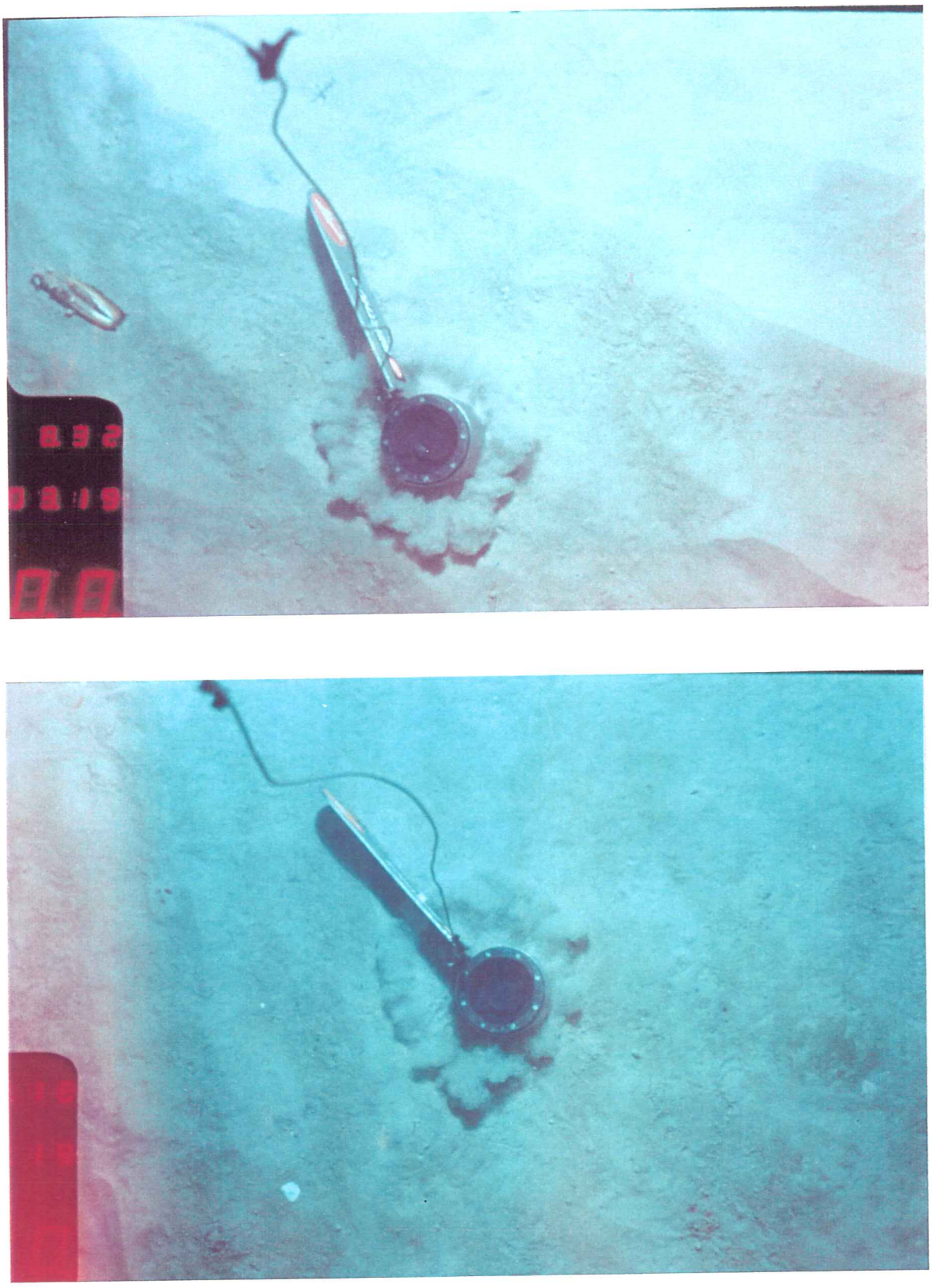


Fig. 10 E (upper): Station 124, crest; F (lower): Station 123, crest/upper lee flank

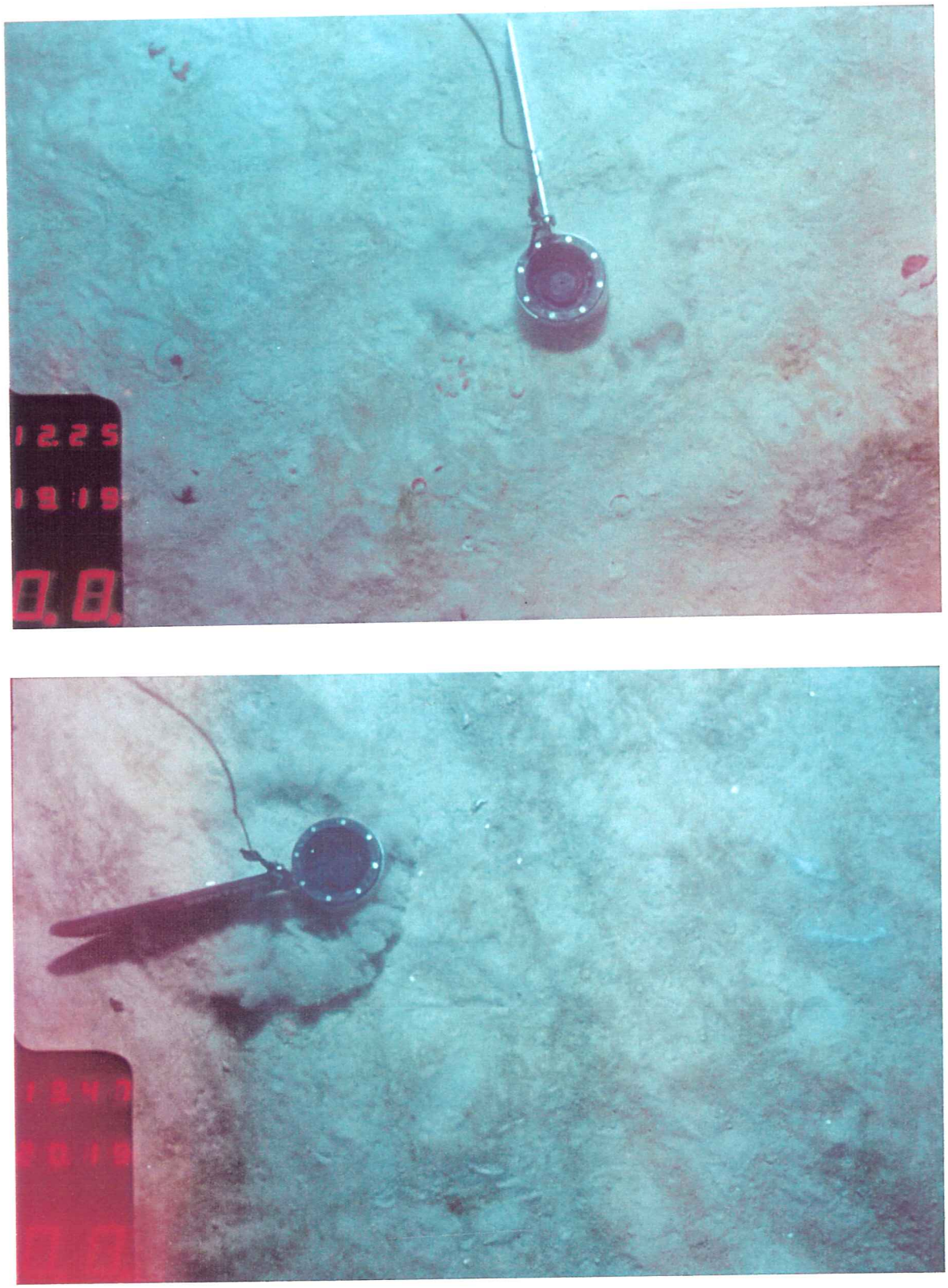


Fig. 10 G (upper): Station 134, upper-middle lee flank; H (lower): Station 139, lower lee flank

Fig. 11 Seabed photos collected along South Sable 1 (SS-1) sand-ridge profile. (A): station 147, trough (see Fig. 7B); (B): station 147, lower western flank; (C): station 147, lower western flank; (D): station 147, middle western flank; (E): station 147, upper-middle western flank; (F): station 147, crest; (G): station 147, upper-middle eastern flank; (H) station 145, lower-middle eastern flank; (I) station 144, upper eastern flank; and (J) station143, trough.

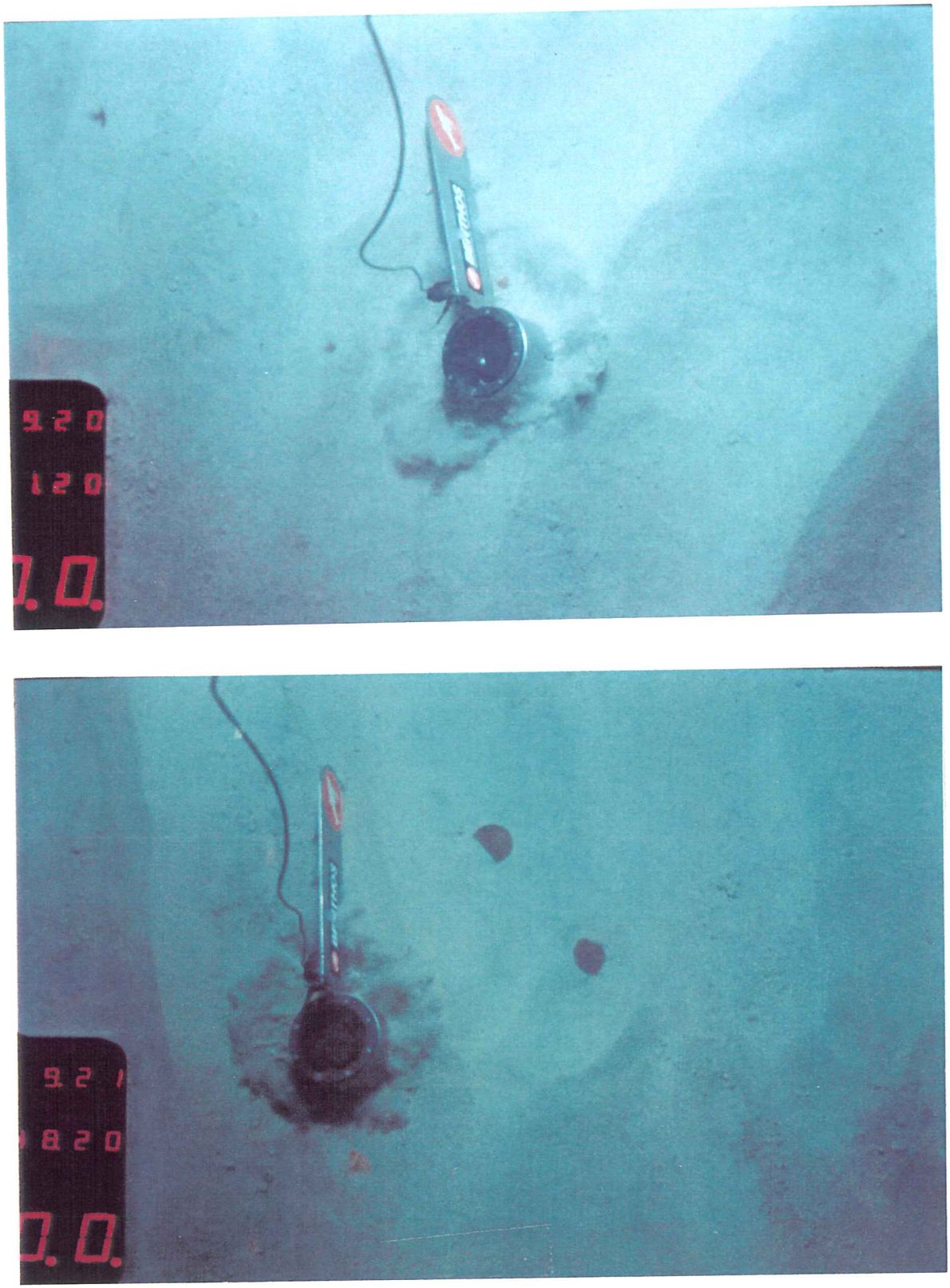


Fig. 11 A (upper): Station 147, trough; B (lower): Station 147, lower western flank

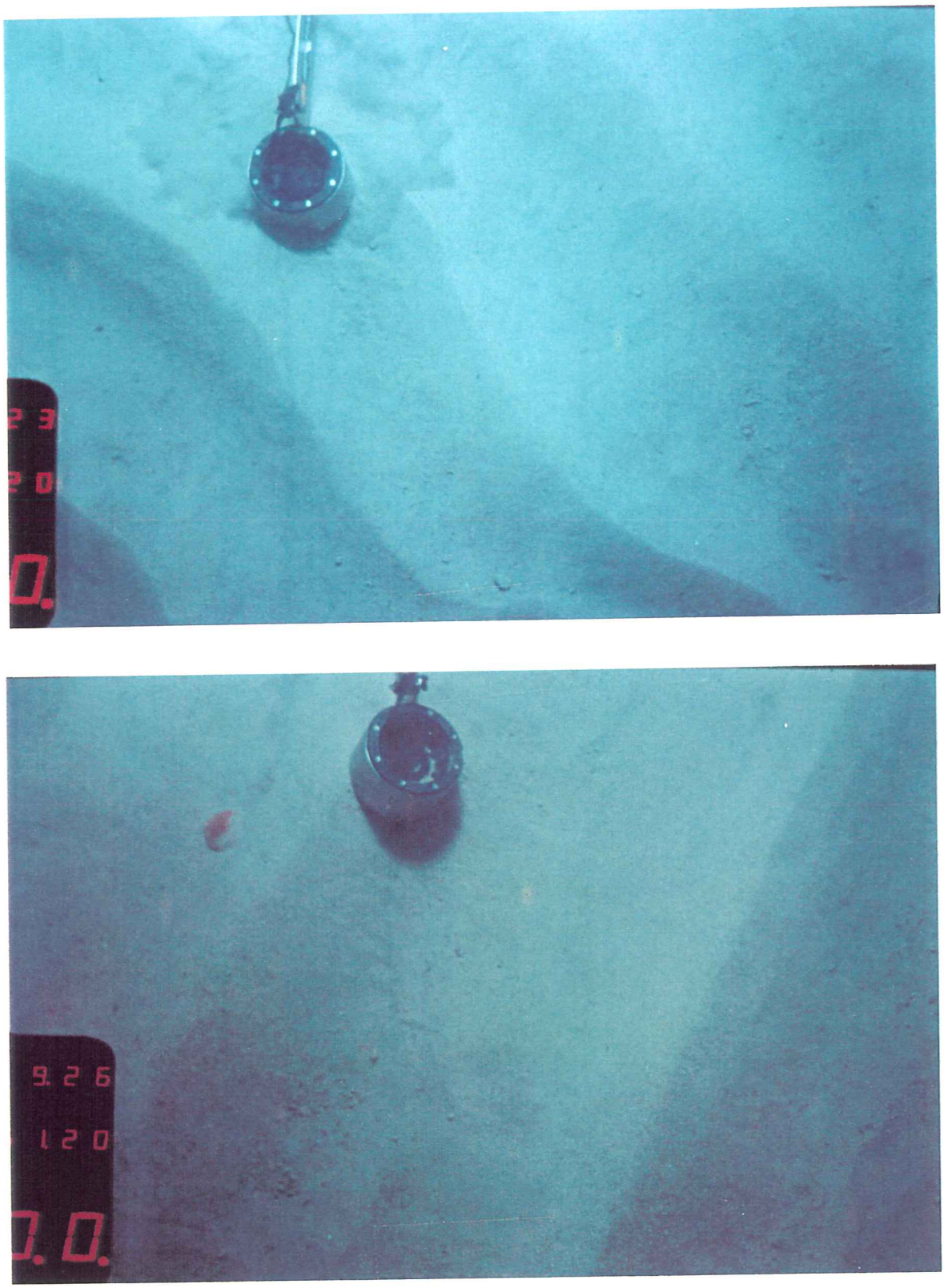


Fig. 11 C (upper): Station 147, lower western flank; D (lower): Station 147, middle western flank

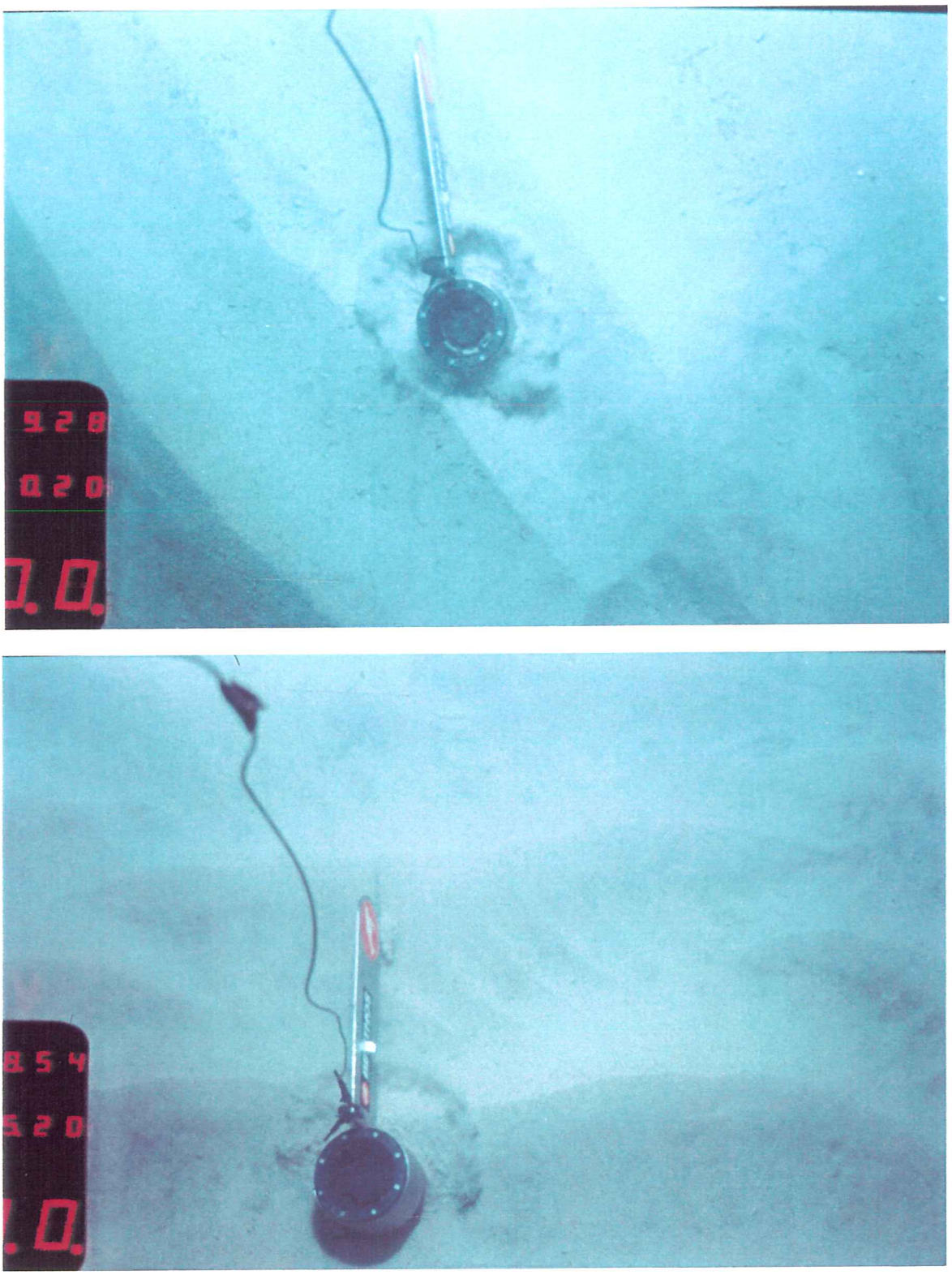
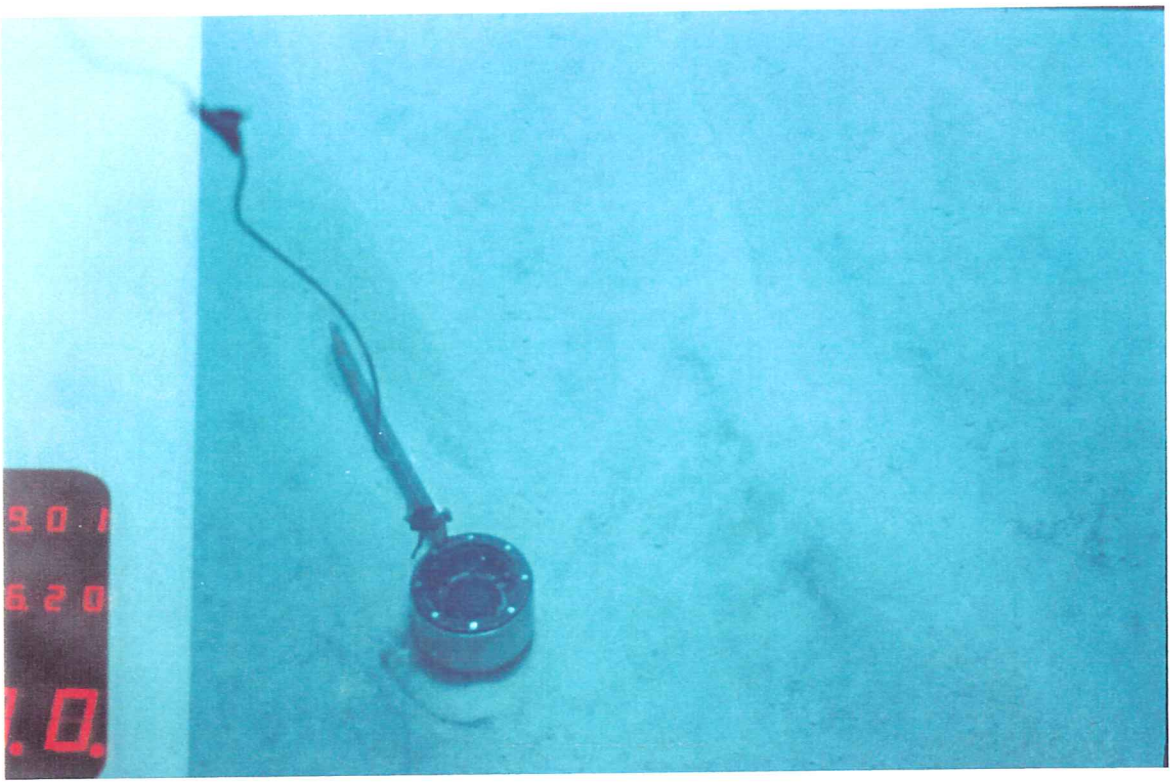


Fig. 11 E (upper): Station 147, upper-middle western flank; F (lower): Station 147, crest



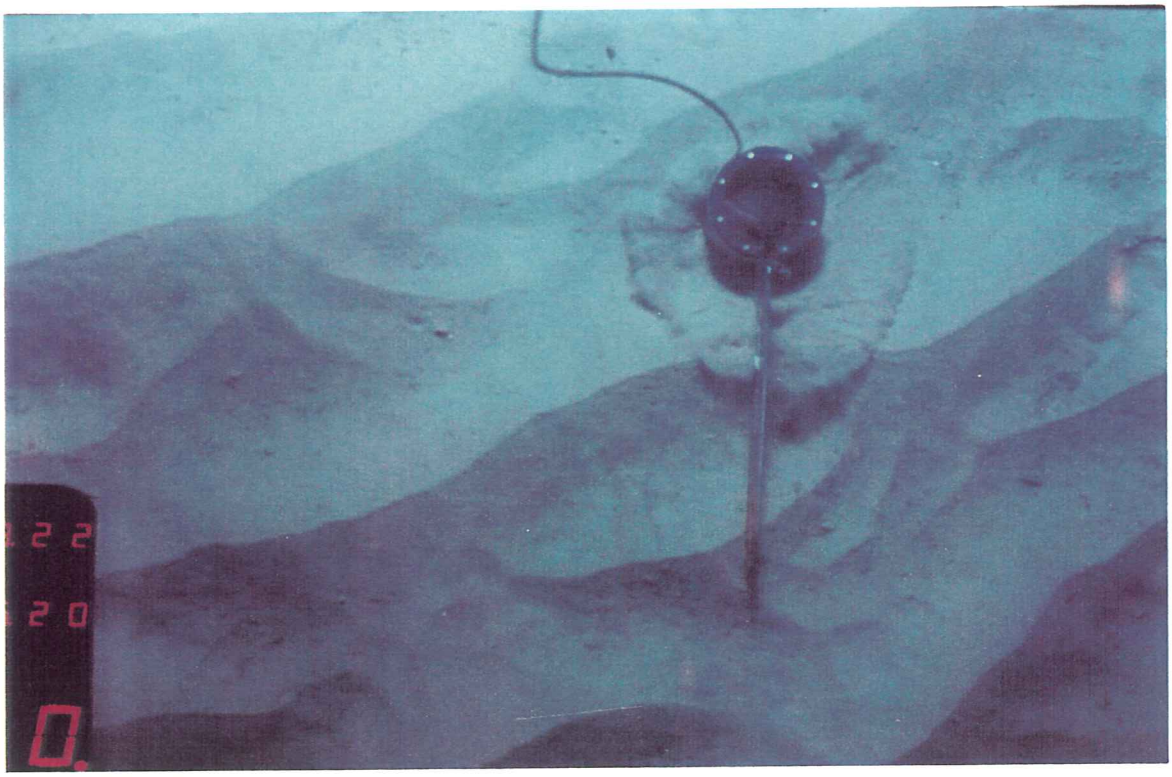


Fig. 11 G (upper): Station 147, upper-middle eastern flank;
H (lower): Station 145, lower-middle lee flank

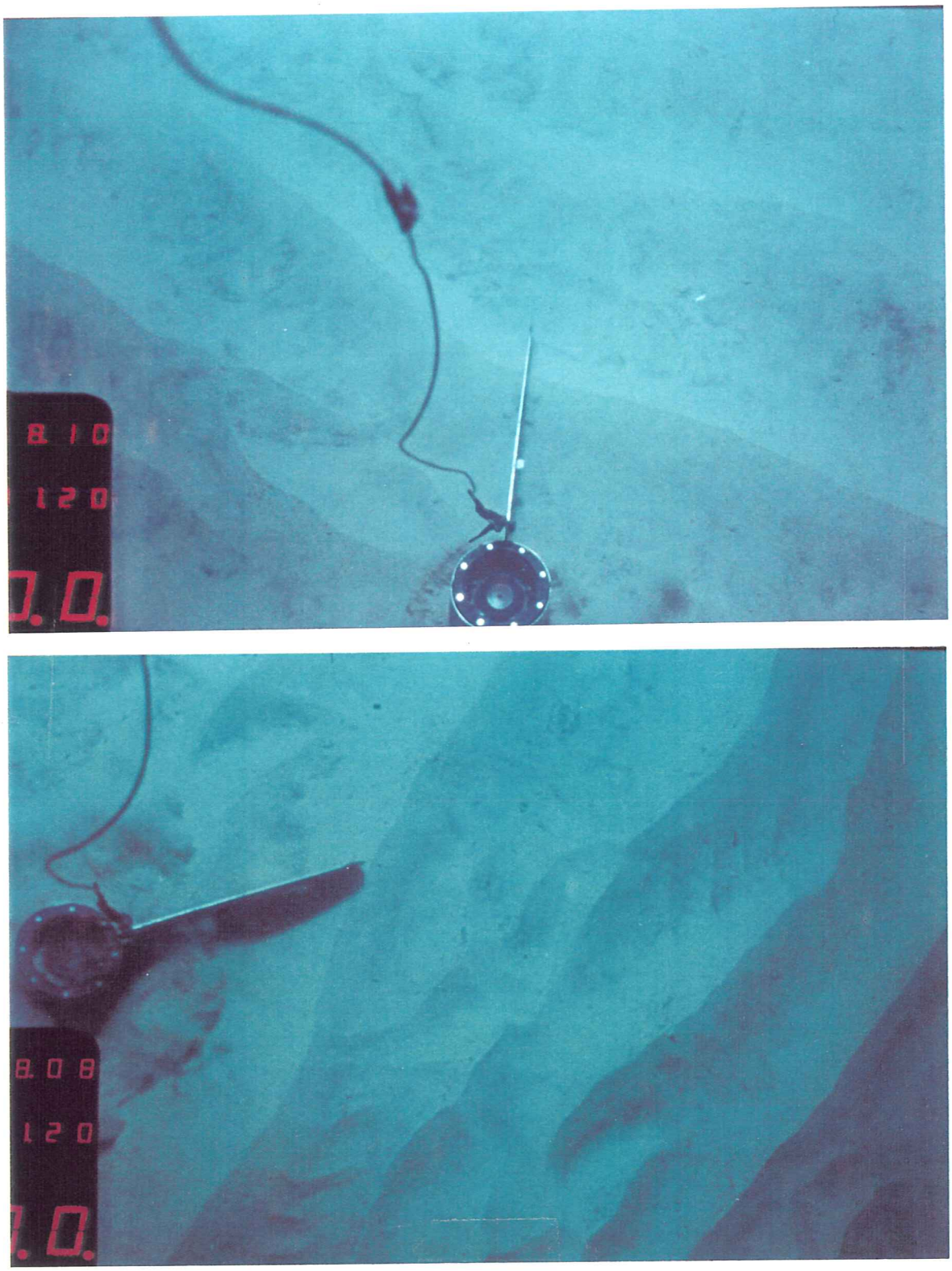


Fig. 11 I (upper): Station 144, upper eastern flank; J (lower): Station 143, trough

7.4 Resin Peels

A total of 59 resin peels were obtained from 30 IKU grab samples. The resin peels displayed various structures, ranging from cross bedding, through parallel laminations, to hummocky cross stratifications (HCS).

At CoPan 1A site, the sedimentary structure of the lower stoss/western trough (station 47, Fig. 12A) is characterized by parallel laminations and low-angle cross laminations at the bottom. This is cut and overlain by HCS which change to sections of parallel laminations that in turn are overlain by ripple cross stratifications and trough cross laminations. The zig-zag 'fault' structure at the mid-right area of the B-F peel (upper photo in Fig. 12A) was caused by disturbance during sampling. At the mid-stoss station (station 50, Fig. 12B), the lower portion of the peel shows medium to high angle cross bedding that are overlain by HCS and swaley bedding. The structure at the sand ridge crest (station 51, Fig. 12C) is characterized by medium-coarse sand, low-angle cross bedding that changes into fine-medium sand, parallel/low angle cross bedding with occasional trough cross bedding. The peels of the mid-lee flank (station 33, Fig. 12D) show high angle cross bedding that changes into HCS, which is then cut/overlain by swaley bedding and ripple cross bedding. The sedimentary structures at the lower lee flank (station 28, Fig. 12E) are characterized by cross bedding and HCS in the lower section. These are overlain by parallel laminations with a reworked layer at the top. The sedimentary structures at the deeper CoPan 2 site (Fig. 13) show similar patterns as that of CoPan 1 sites, except that the grain size has become finer, and HCS are smaller and occur less frequently.

Figure 14 shows the resin peels collected along the South Sable 1 sand ridge transect. This is a sand ridge with nearly symmetrical profile (see Fig. 7b). The resin peel taken from the lower western flank (station 164, Fig. 14A) shows high angle cross bedding at the bottom and this changes upward to low angle cross bedding. The predominant structure at the upper-middle western flank (station 163, Fig. 14B) is low angle cross bedding inter-bedded with parallel laminations. At the ridge crest (station 162, Fig. 14C), the sedimentary structures are characterized by swaley bedding (or HCS?) in the middle section that is sandwiched by low-angle cross bedding in both the lower and upper peel sections. The resin peel at the upper-middle eastern flank (station 161, Fig. 14D) displays a coarse sand lag layer at the bottom. This changes into low angle or parallel bedding in the middle section and the top of the peel is a layer of low angle cross laminations. At the lower eastern flank (station 160, Fig. 14E), the resin peel shows parallel bedding at the bottom. This changes into low angle cross bedding which is overlain by swaley bedding and HCS. The top-most section displays ripple cross and trough cross laminations.

Along the deeper South Sable 3B profile, the resin peels demonstrate the following general structure: On the stoss flank, ridge crest and the upper lee flank, the lower section of the peel is generally characterized by parallel or low angle cross bedding/lamination. These change into HCS in the middle sections of the peels. The top sections often are parallel/low angle laminations or ripple cross stratifications. At the lower lee flank, the lower part of the peels generally show ripple cross laminations which change into parallel/low angle cross bedding/laminations in the upper part. Fig. 15 shows the resin peels collected along the South Sable 3B sand ridge profile.

7.5 Vibrocorer

Fifteen vibrocore sites were originally planned for this cruise with the objective of better understanding the long term episodic nature of sand ridge construction/degradation. These potential vibrocore sites were chosen based on previous seismic profiles (cruise 85-037) and were aimed at

Fig. 12 Photos of resin peels collected along Copan 1A sand ridge profile, south west of Sable Island. The arrow points the top of the IKU sample. B, F indicate back/front and R, L indicate right/left relative to the ship's orientation.

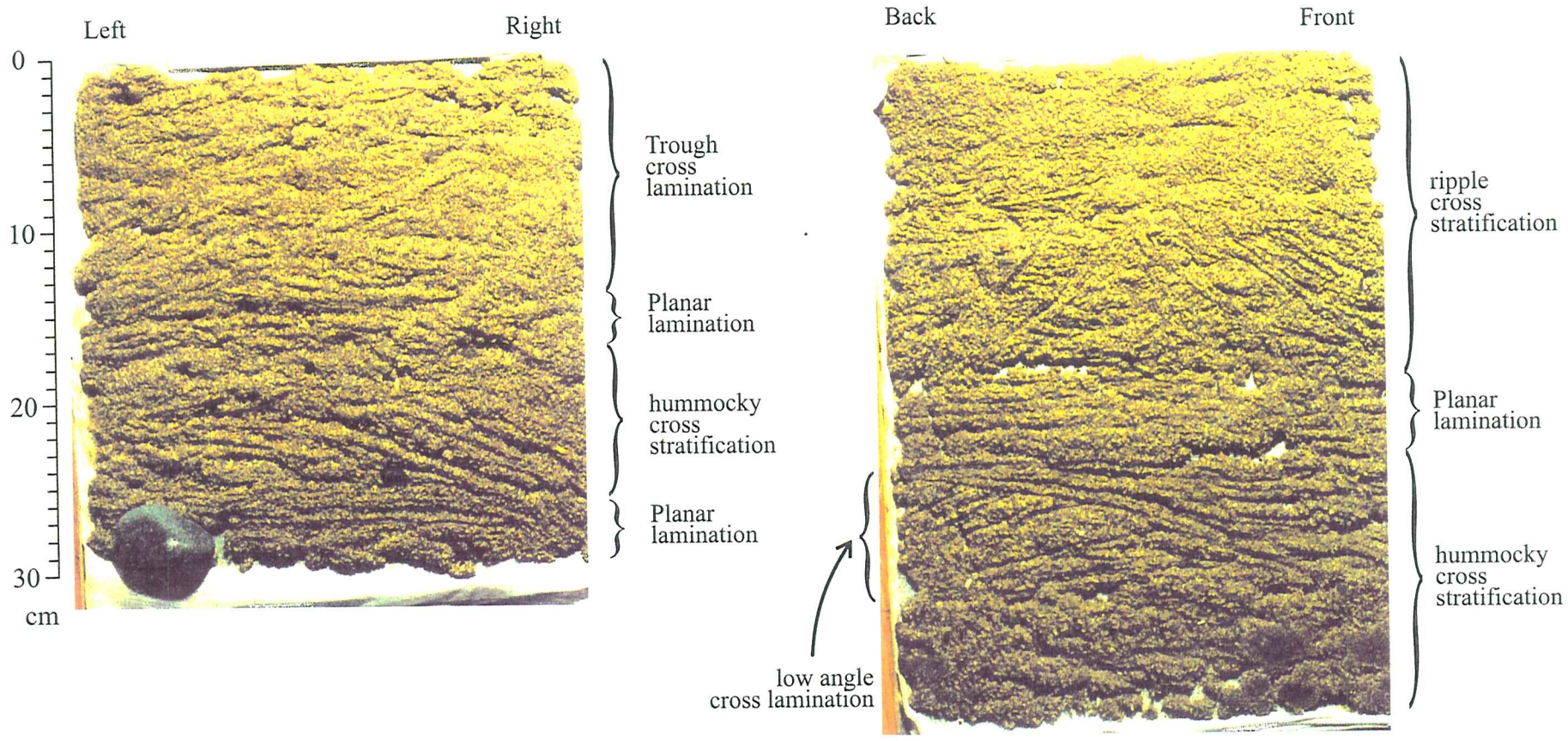


Figure 12A. Station 47, lower stoss-side location

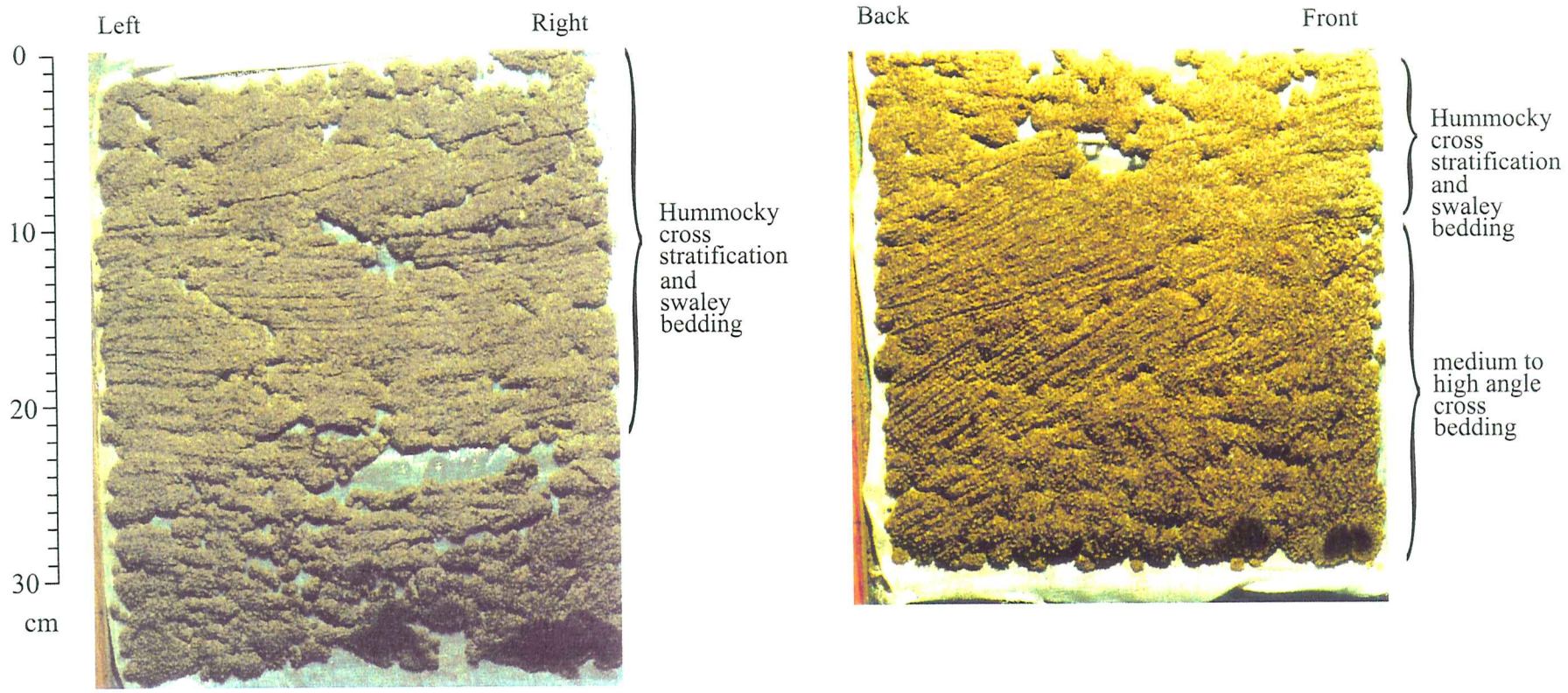


Figure 12B. Station 50, middle stoss-side location

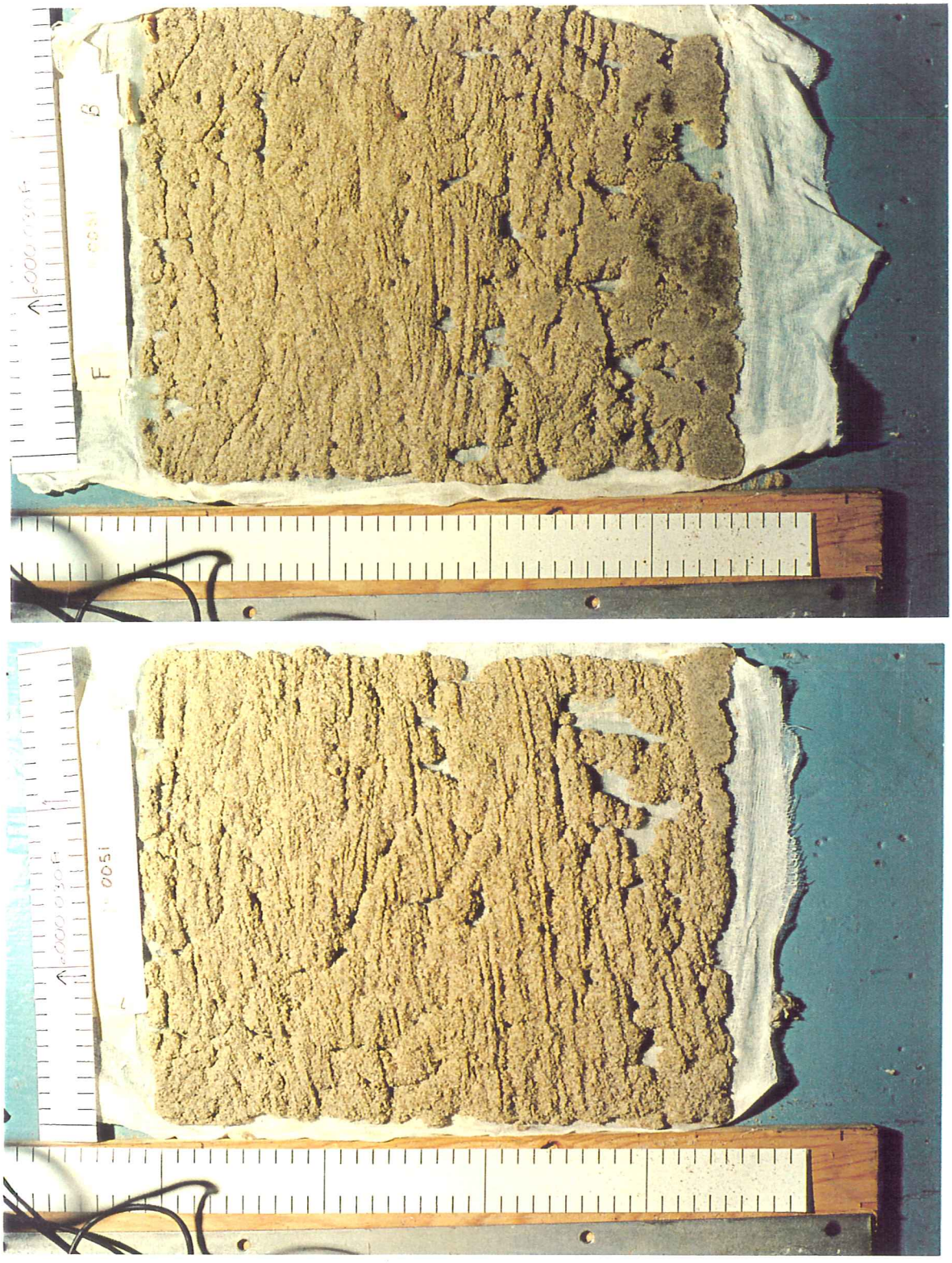


Fig. 12C: Station 51, sand ridge crest

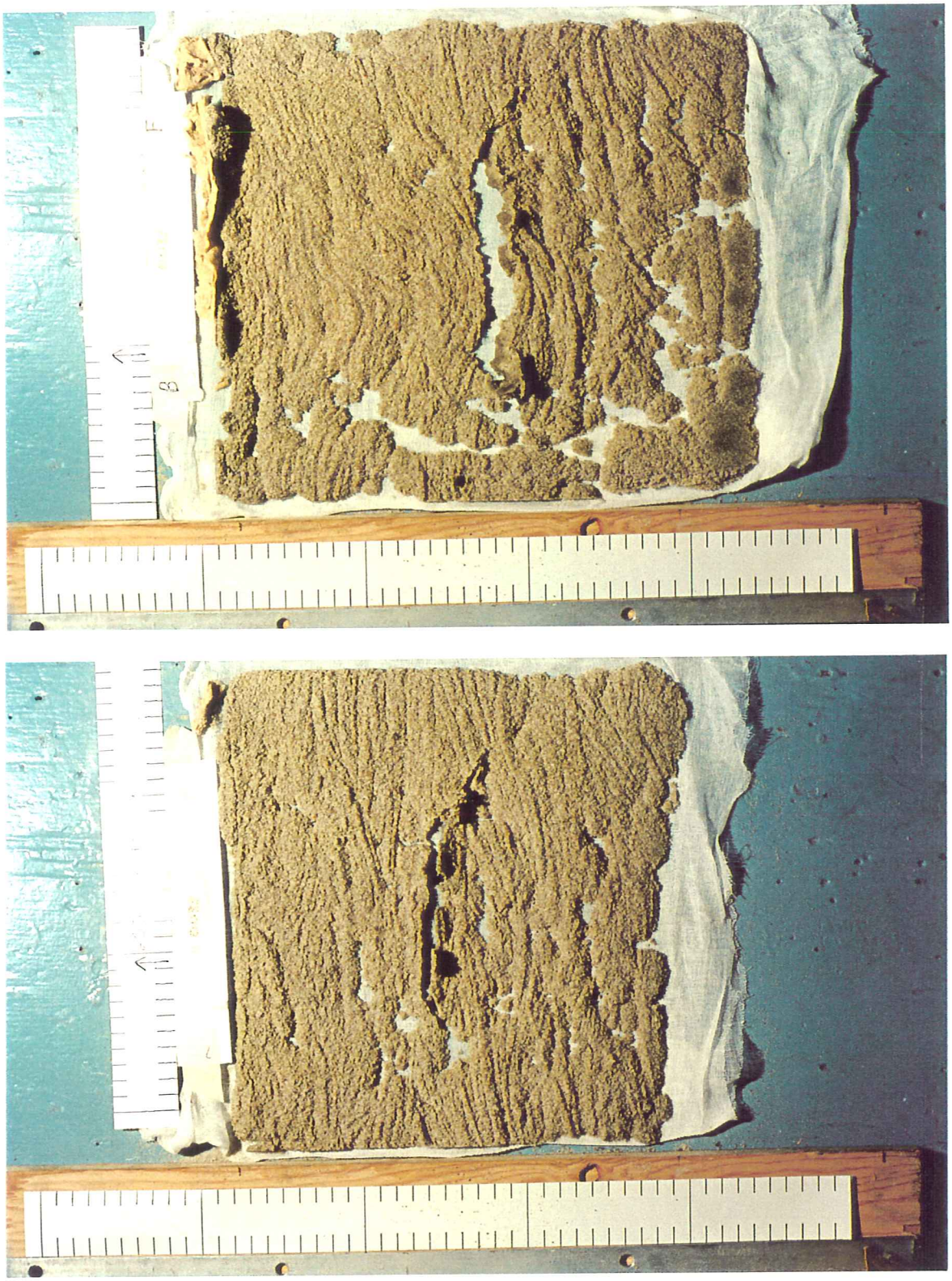


Fig. 12D: Station 33, mid-lee flank

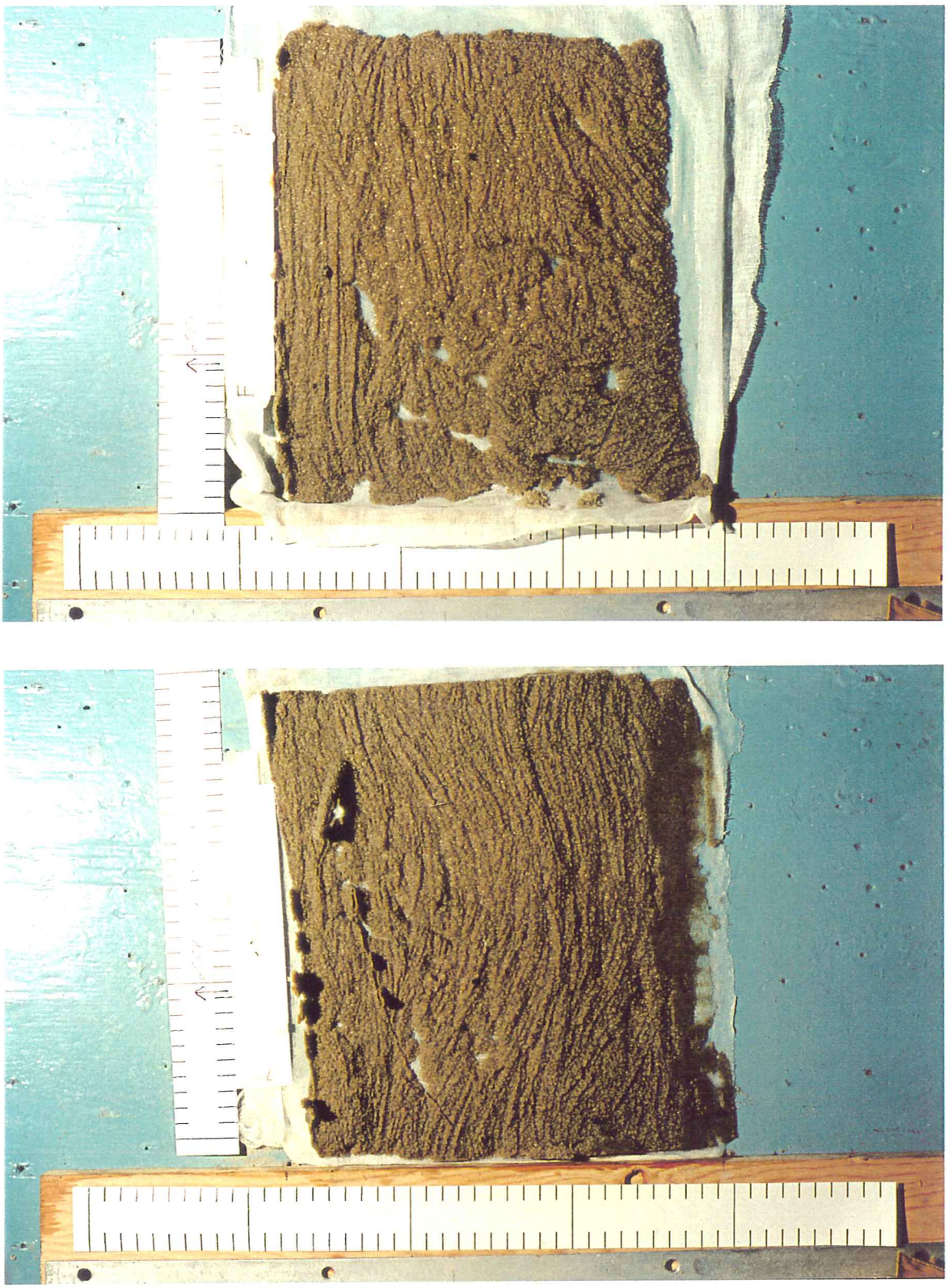


Fig. 12E: Station 28, lower lee flank

Fig. 13 Photos of resin peels collected along Copan 2 sand ridge profile, south west of Sable Island.

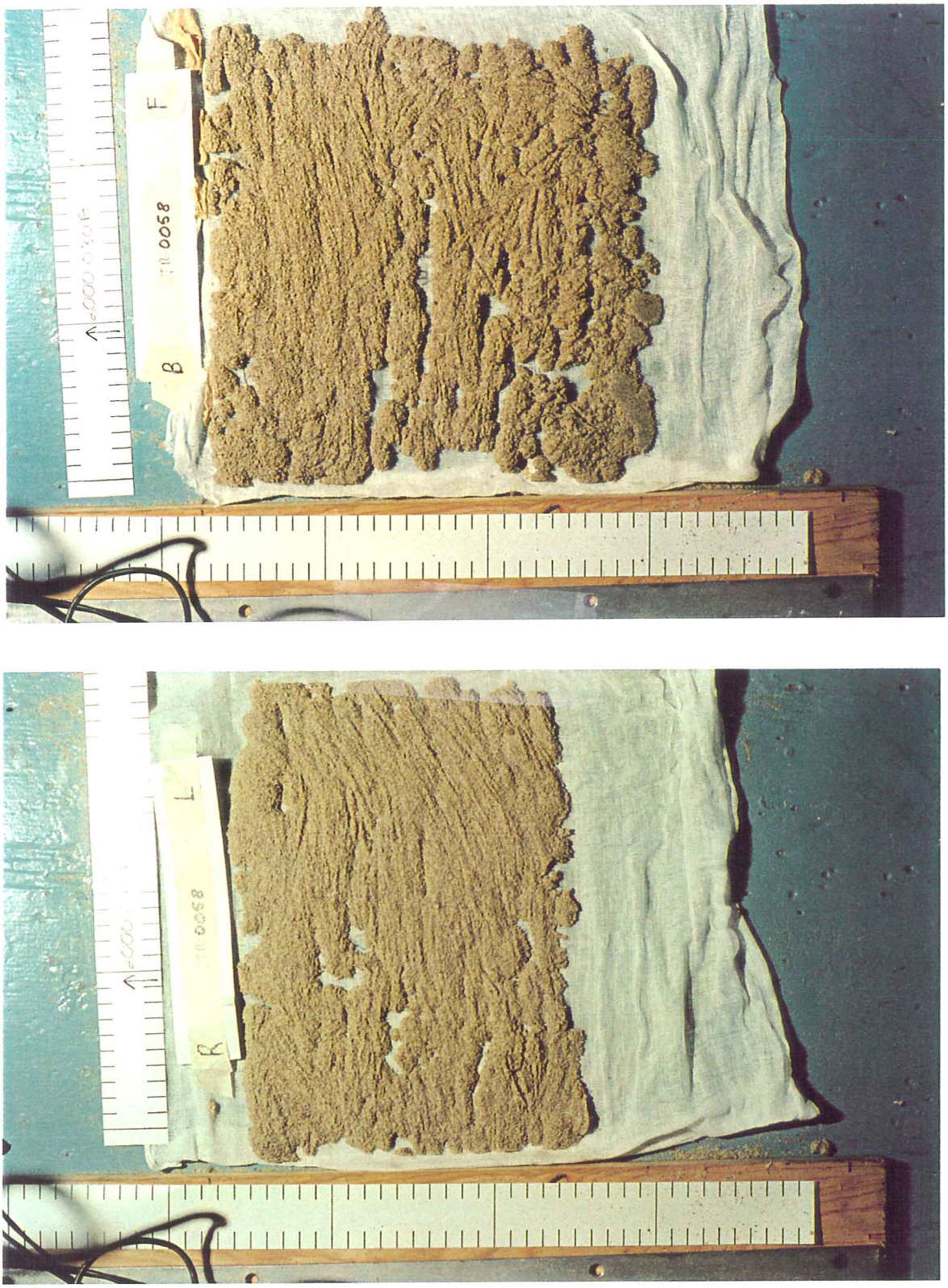


Fig. 13A: Station 58, lower stoss flank

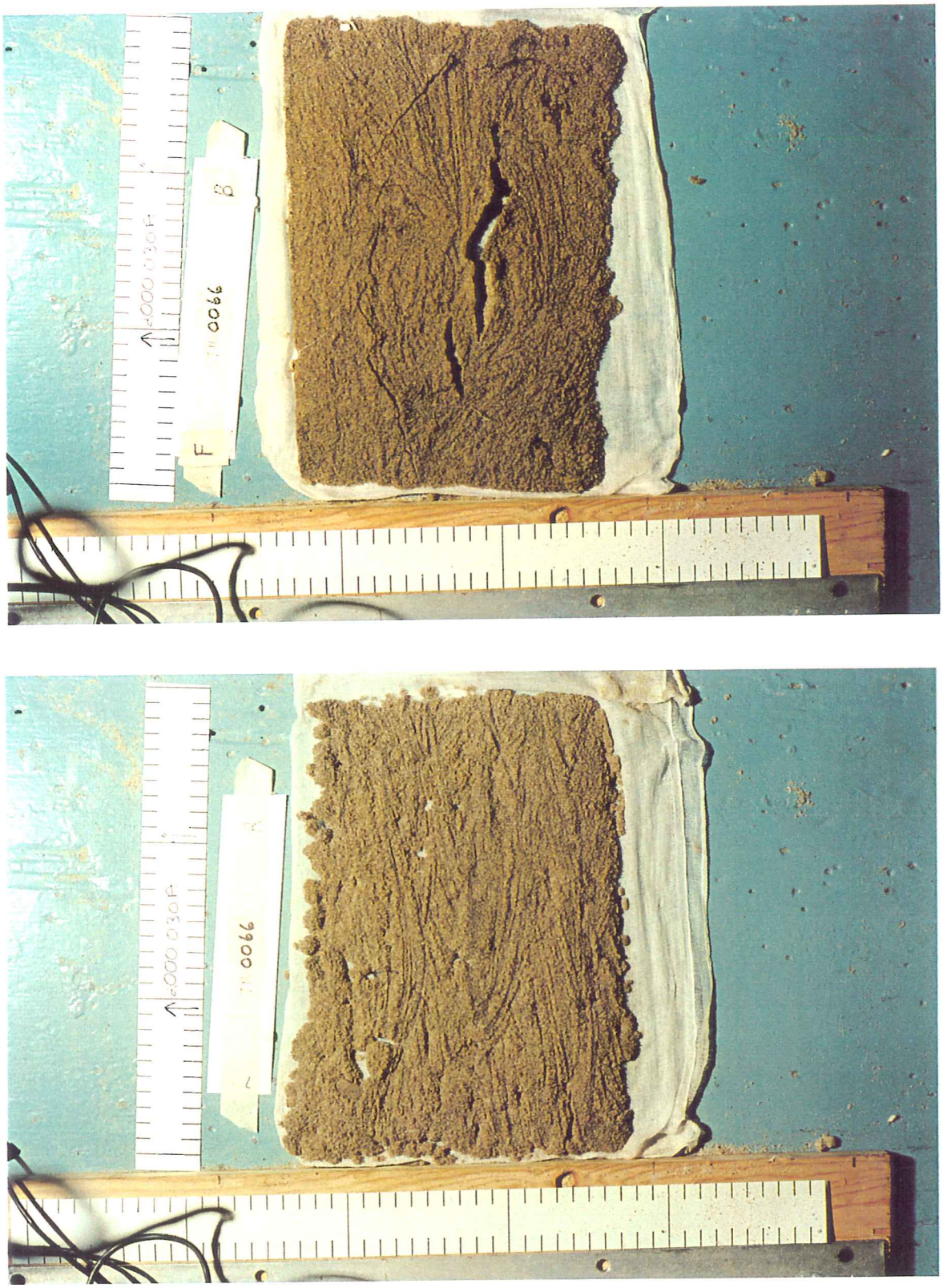


Fig. 13B: Station 66, mid-stoss flank

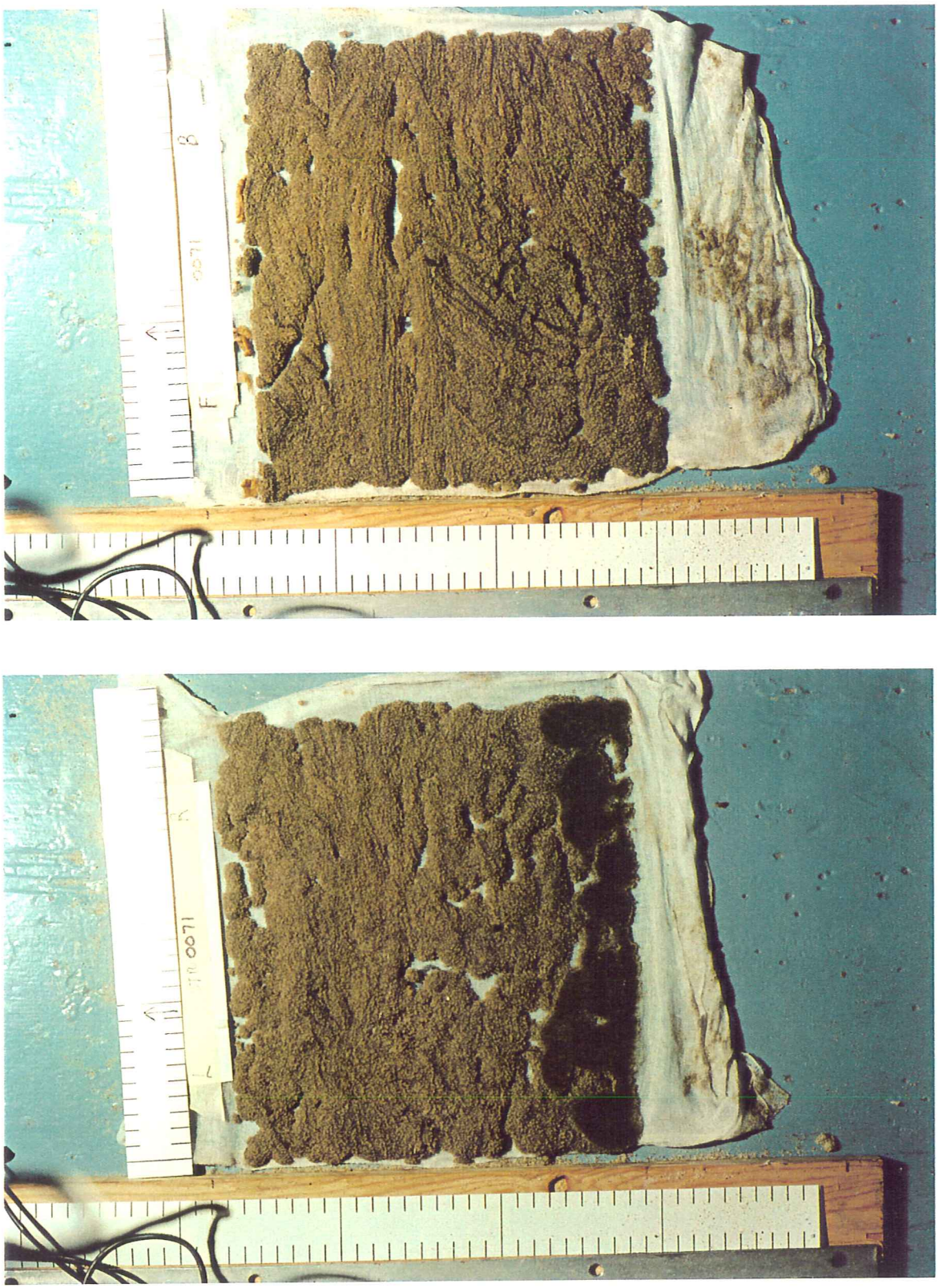


Fig. 13C: Station 71, sand ridge crest

Fig. 13D: Station 78, upper-mid lee flank

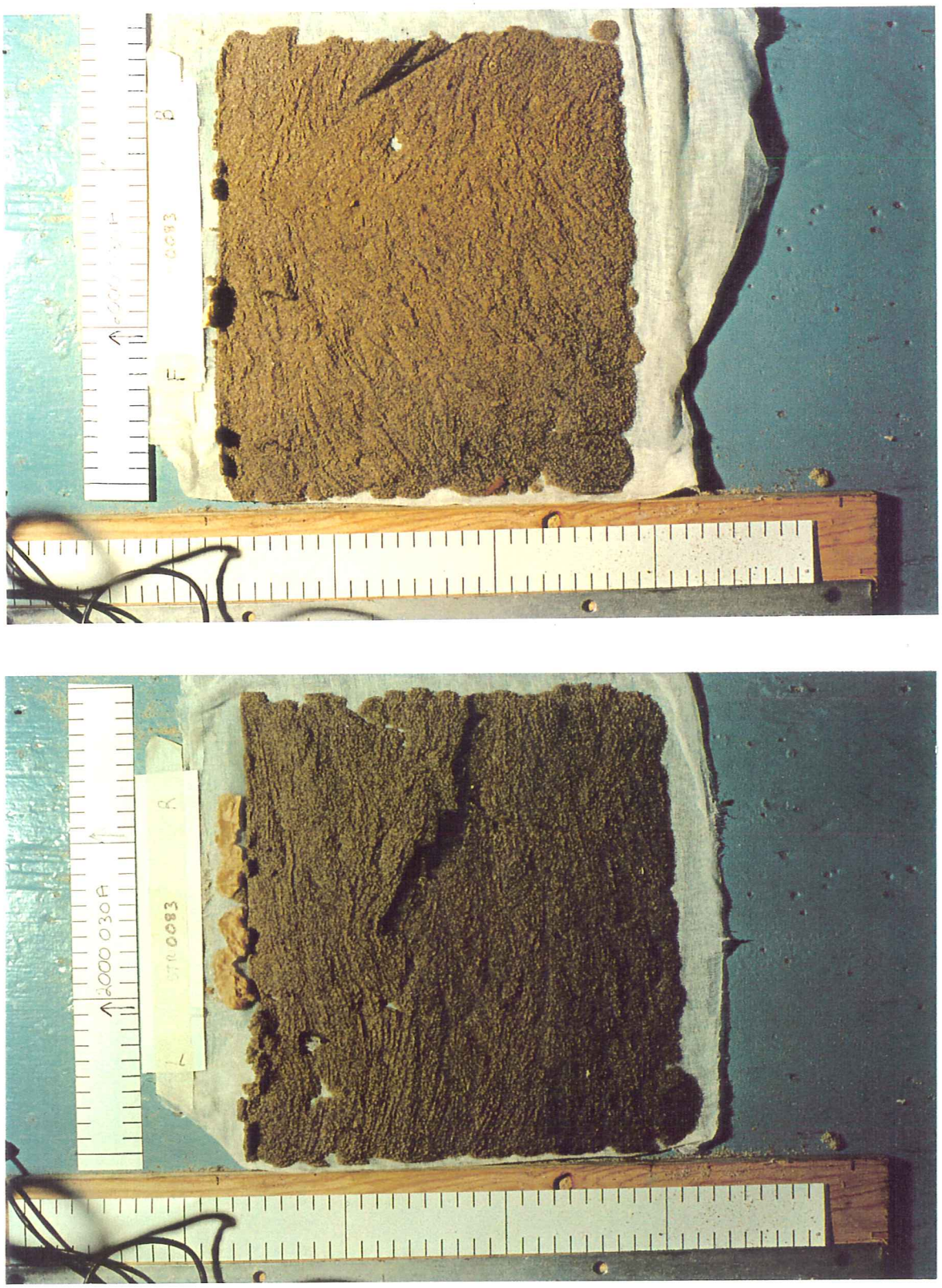


Fig. 13E: Station 83, lower-mid lee flank

Fig. 14 Photos of resin peels collected along South Sable 1 sand ridge profile.

Fig. 14A: Station 164, lower western flank

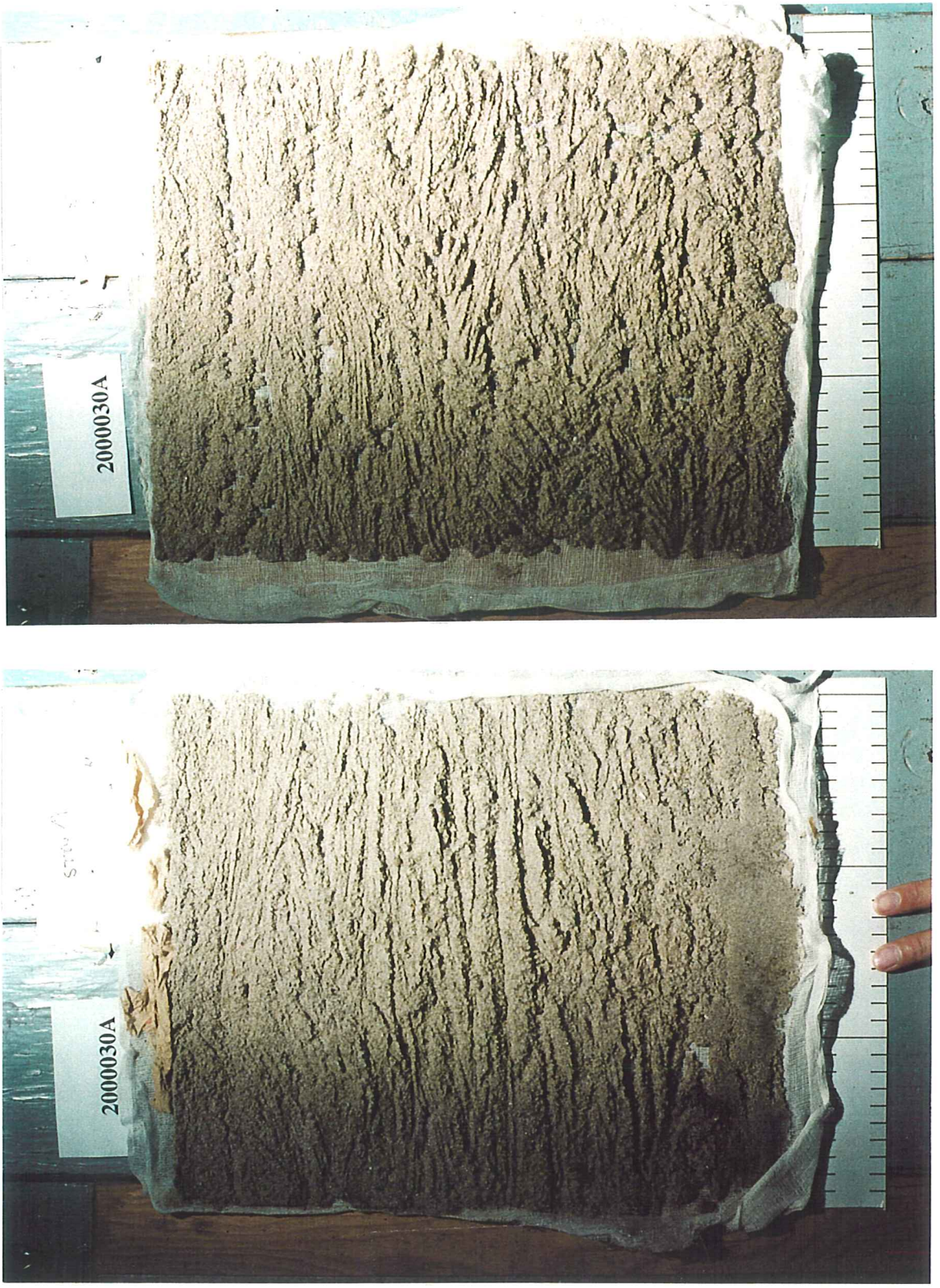


Fig. 14B: Station 163, upper-middle western flank

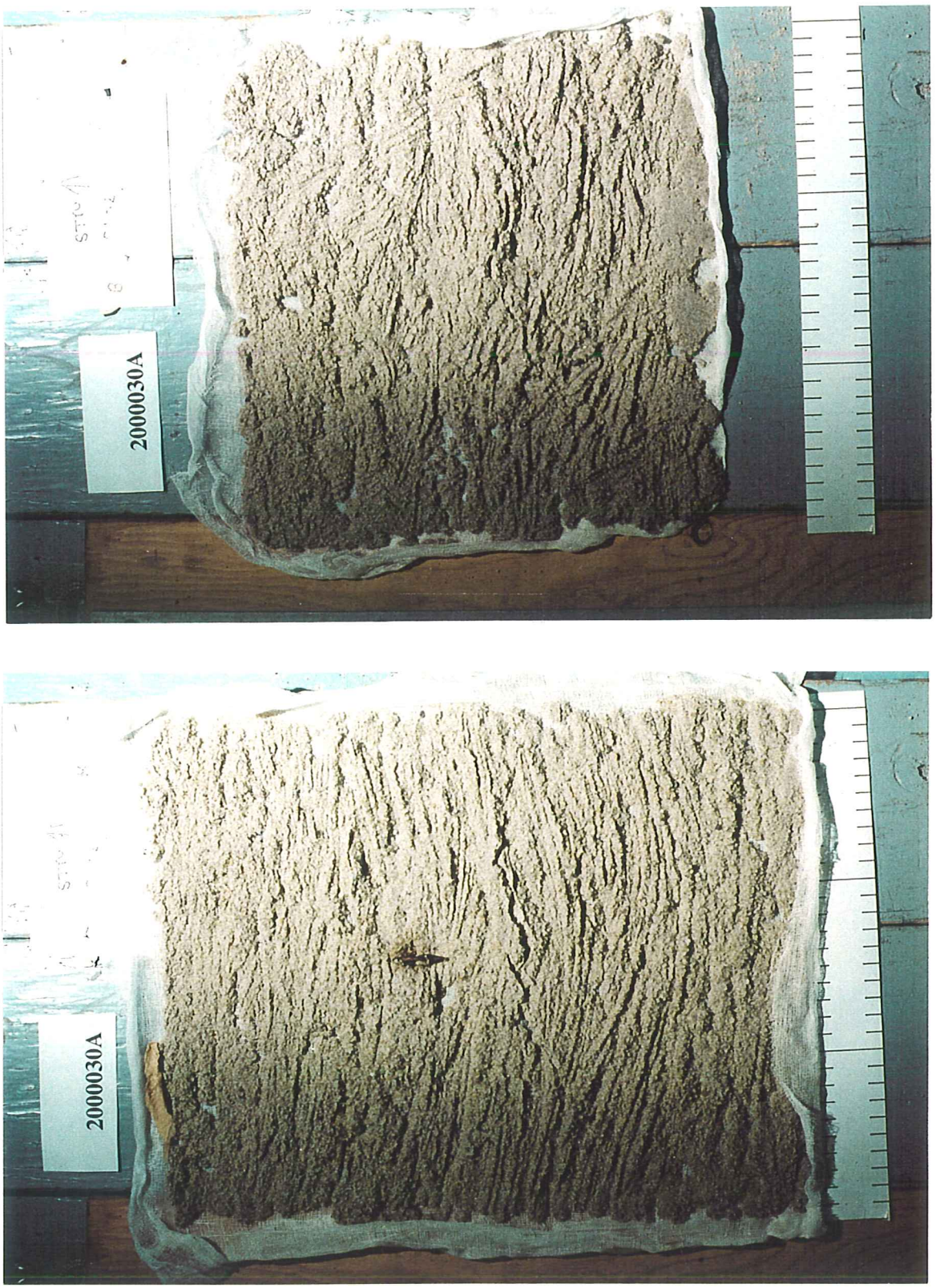


Fig. 14C: Station 162, sand ridge crest

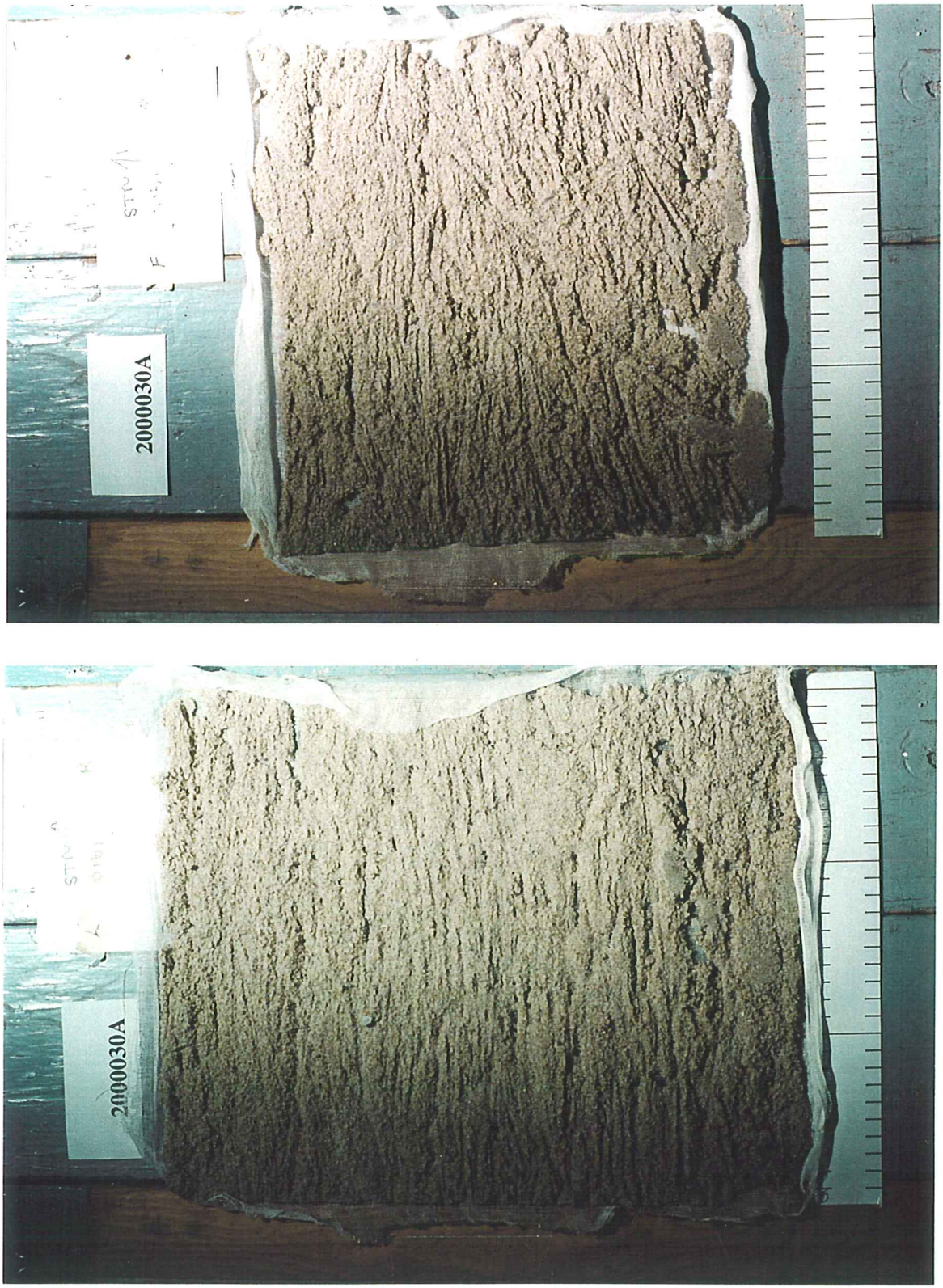


Fig. 14D: Station 161, upper-mid eastern flank

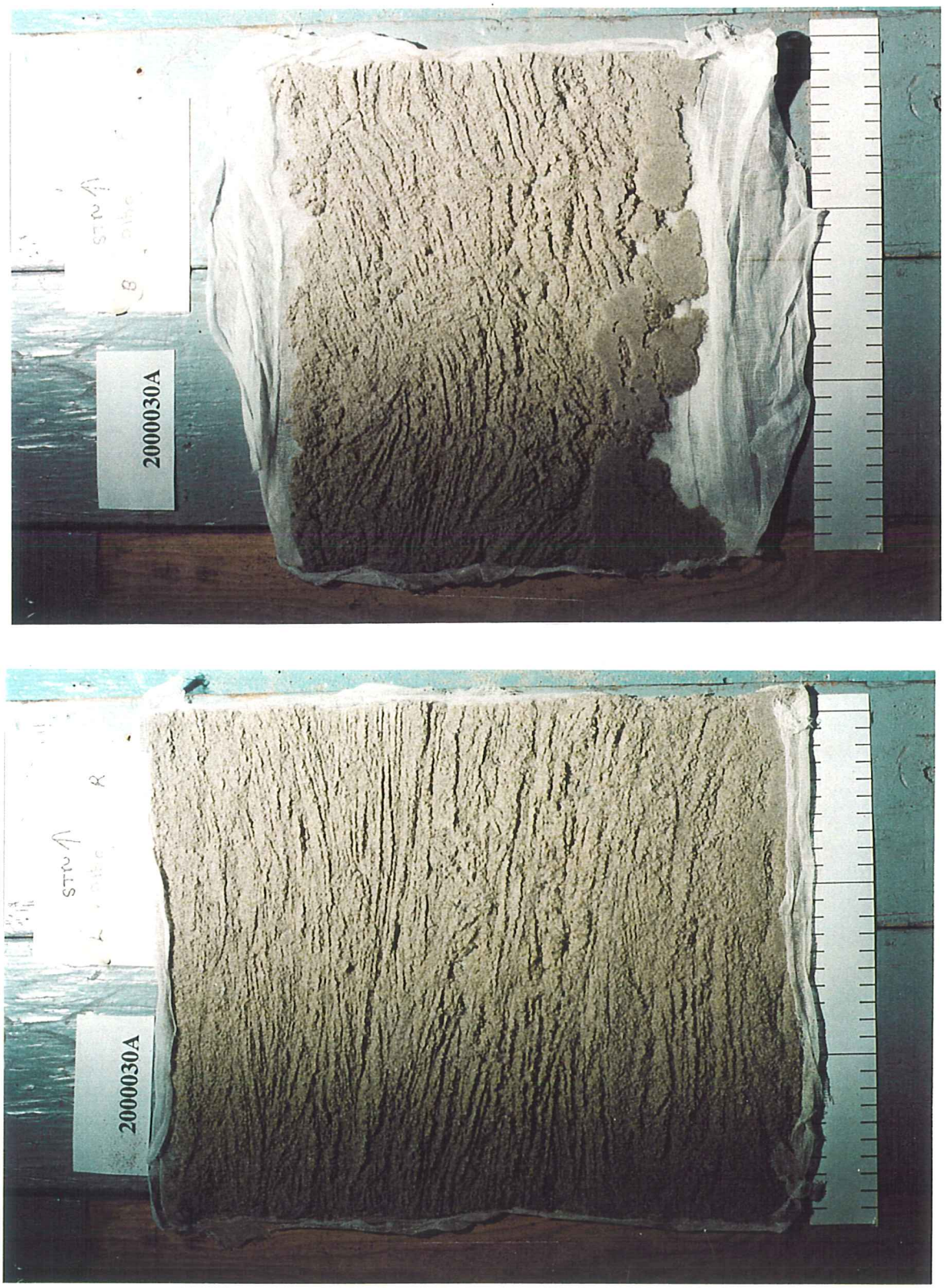


Fig. 14E: Station 160, lower-mid eastern flank

Fig. 15 Photos of resin peels collected along South Sable 3B sand ridge profile.

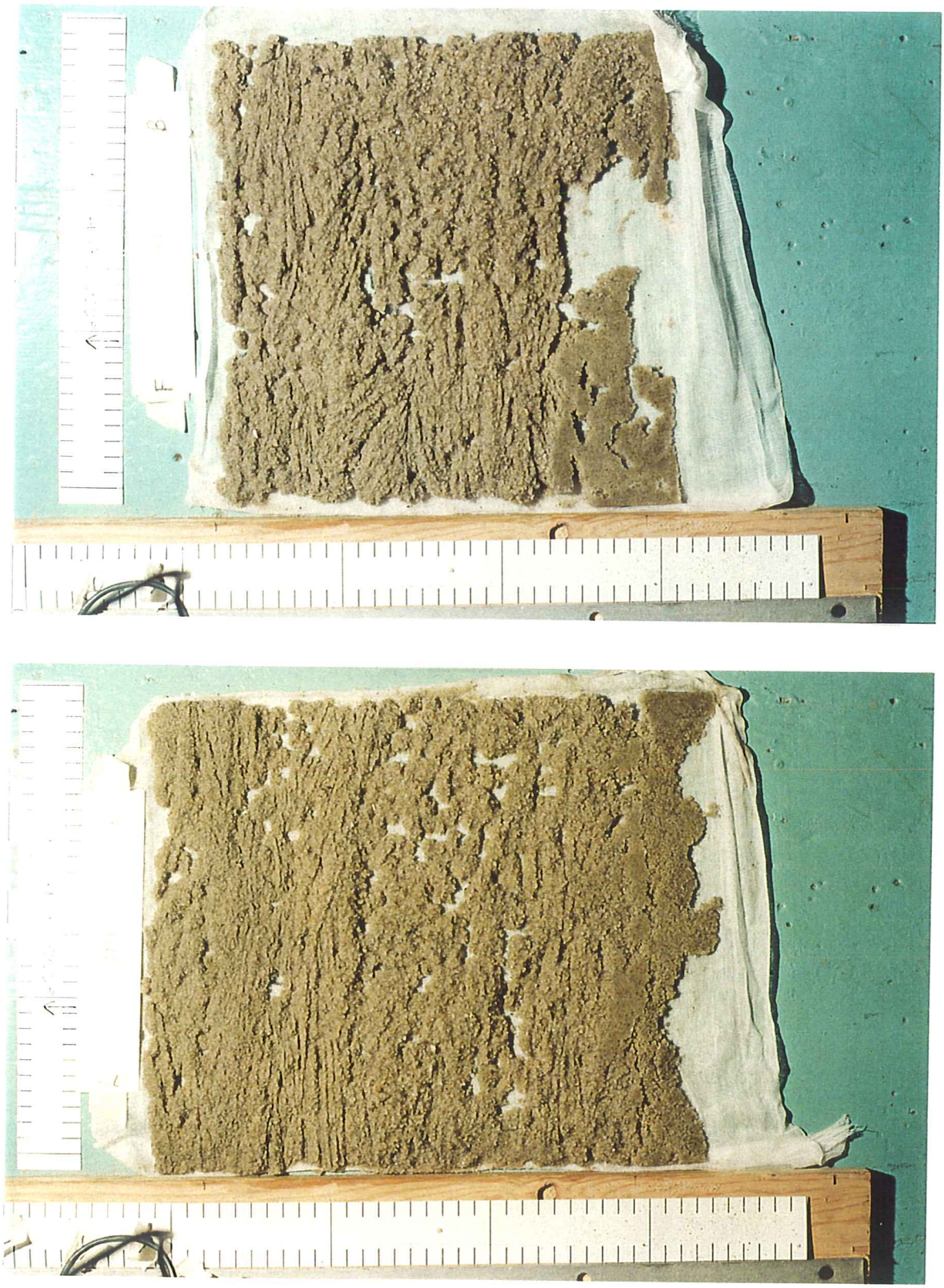


Fig. 15A: Station 121, lower stoss flank

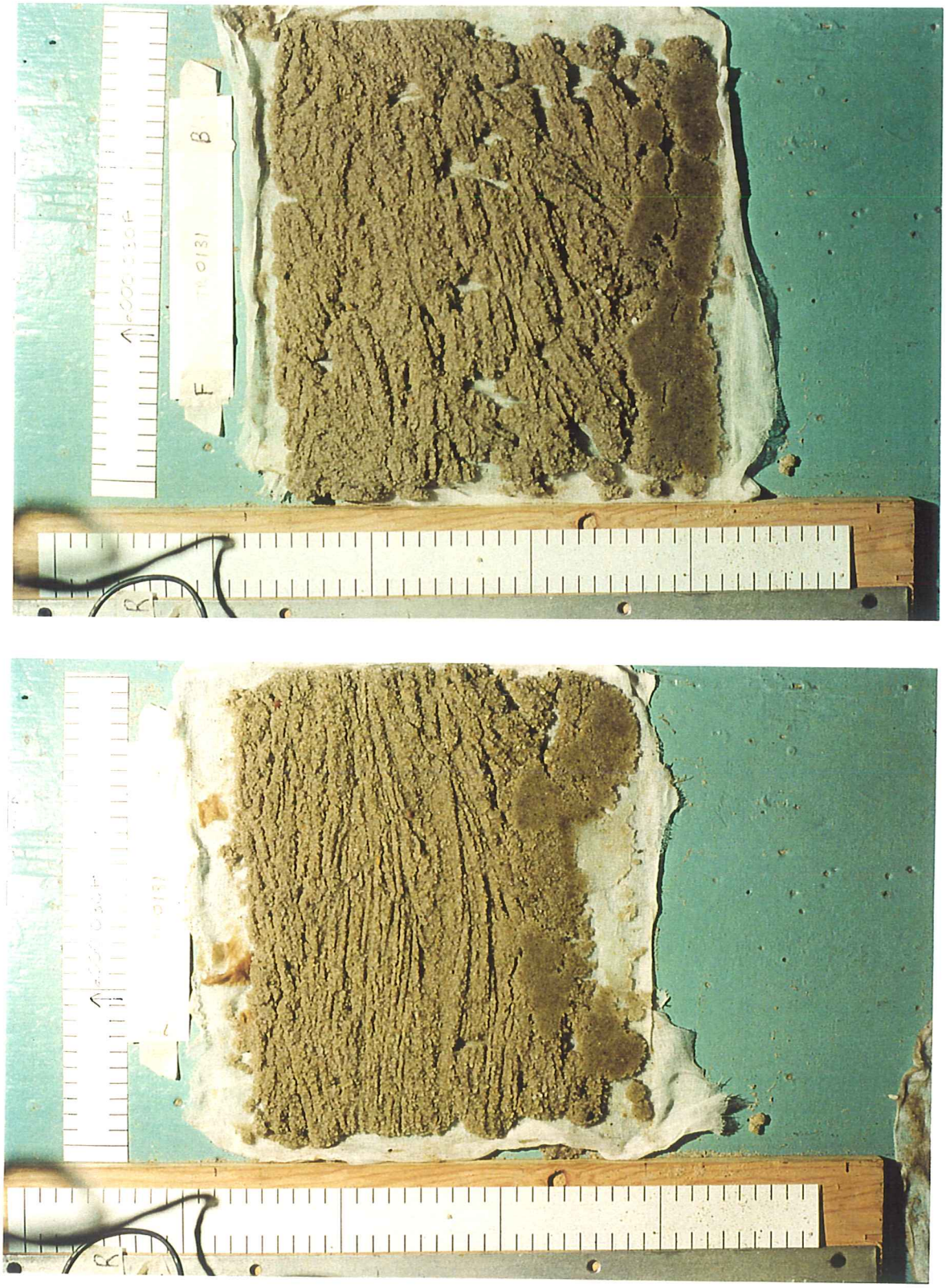


Fig. 15B: Station 131, middle stoss flank

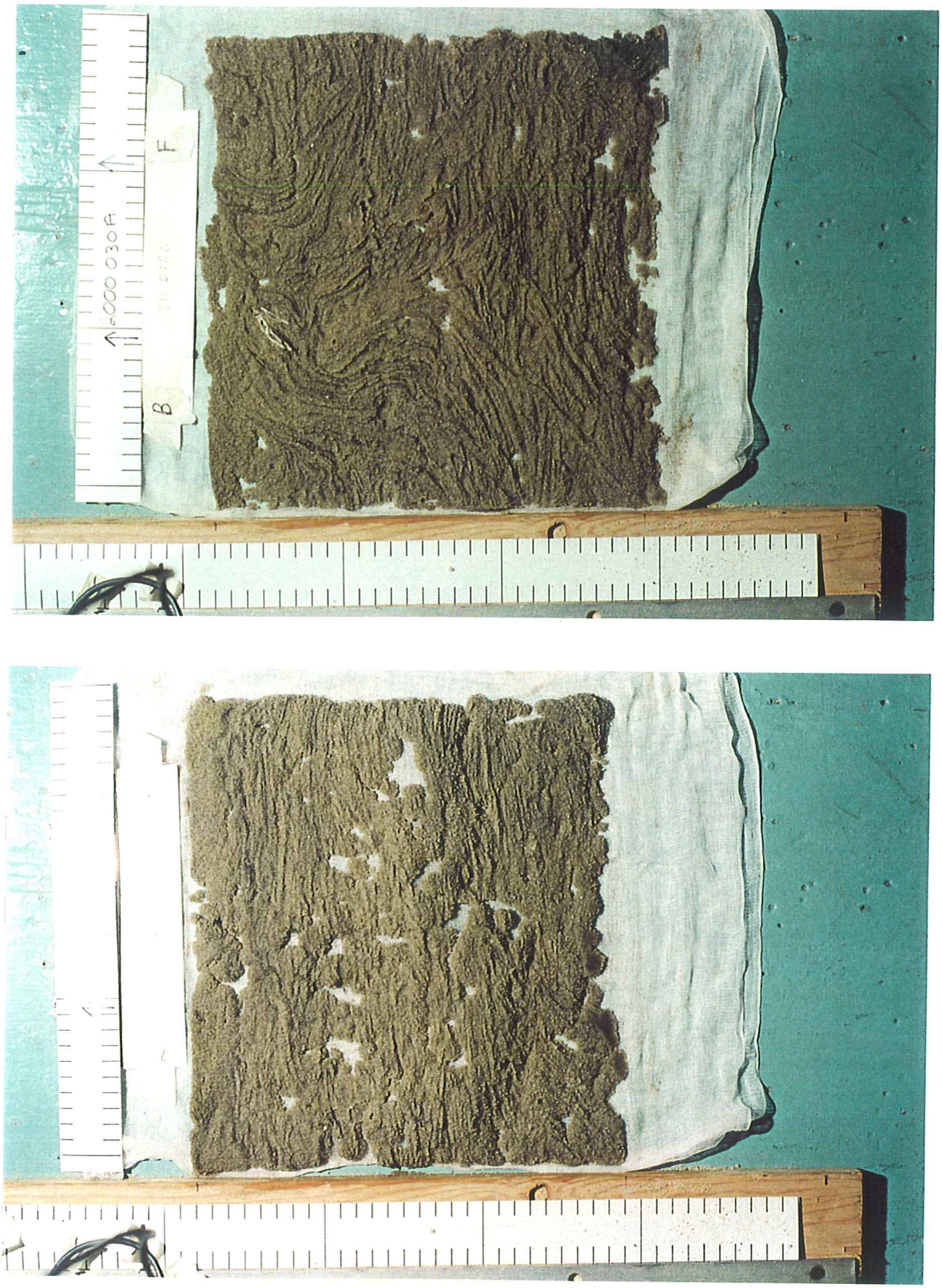


Fig. 15C: Station 126, crest/upper lee flank

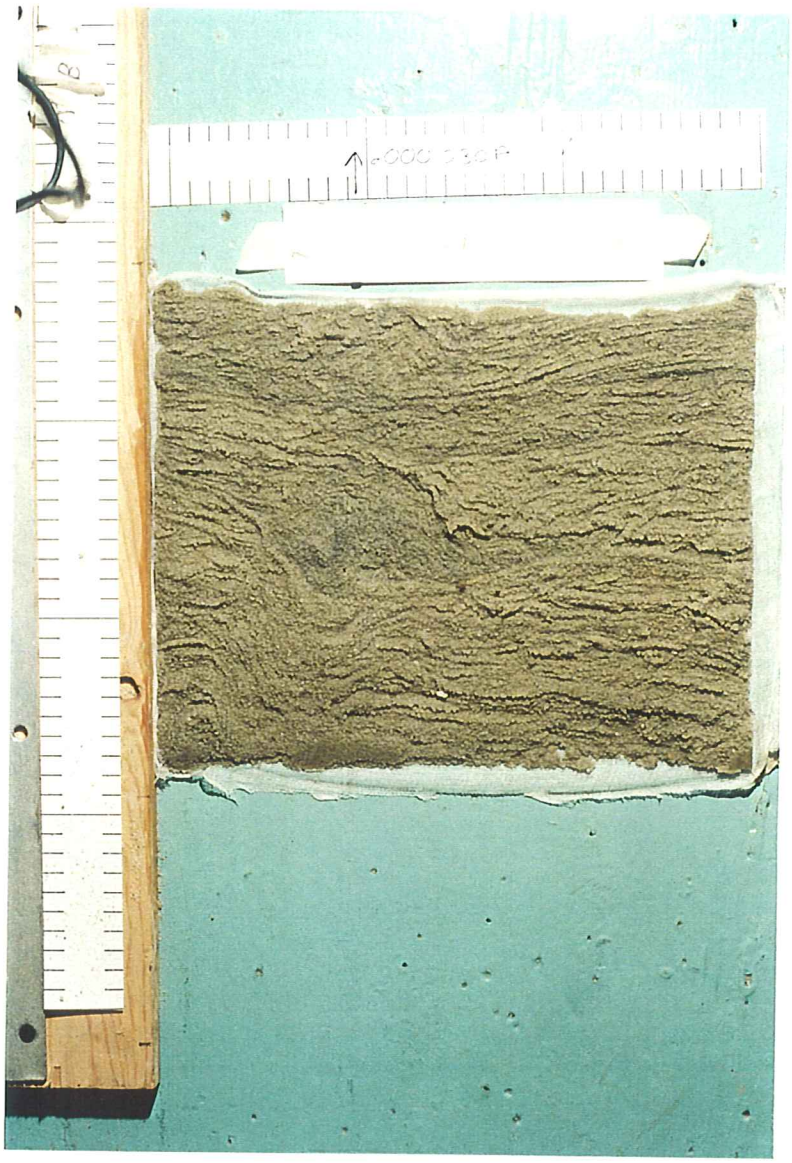


Fig. 15D: Station 136, upper-mid lee flank

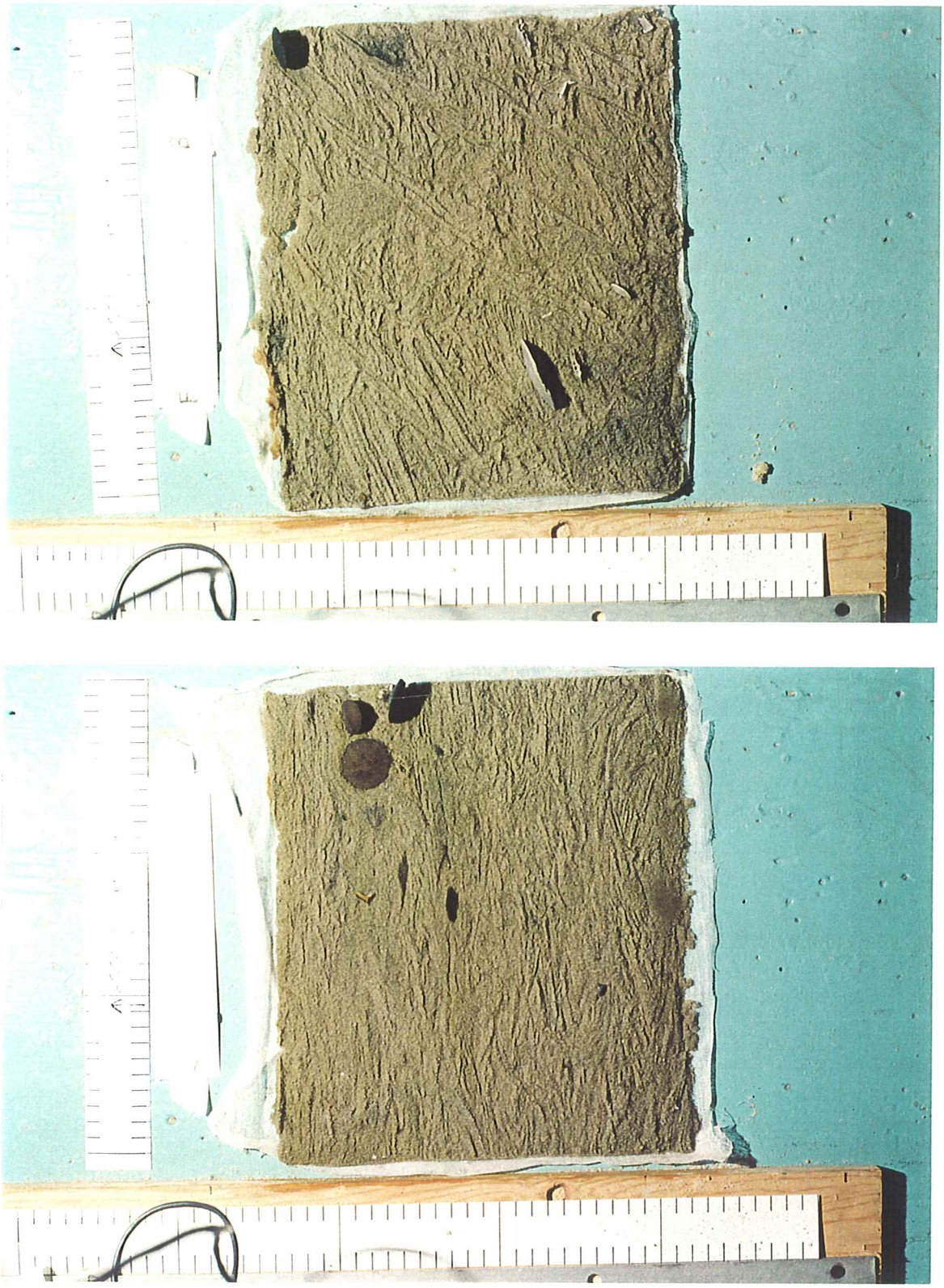


Fig. 15E: Station 140, lower lee flank

penetrating to seismically-defined internal unconformities in the ridges. Due to the limited duration of the cruise, only 8 sites were occupied and 7 cores were obtained (two trials failed to obtain any core at one site due to damaged catchers). The planned station number, cruise station numbers, core lengths and morphological profile locations of the vibrocores obtained in Hudson2000030A cruise are listed in Table 4 and the details of the vibrocore stations are given in Appendix 2. The locations of these vibrocores are superimposed on the multibeam map in Fig. 2, and their morphological profile locations are shown in Figs. 16, 17 and 20, respectively.

The vibrocore results were less than ideal in terms of core length, despite some adjustments made to the apparatus. Still, seven cores were extracted, the longest being 199 cm. All but cores 165 and 166 were recovered using the larger (3.5") barrel. Core analysis is part of an ongoing BSc thesis at Dalhousie University.

Table 4 List of planned station number, cruise station number, core length and morphological profile locations of the vibrocores obtained in Hudson2000030A cruise.

Planned Station #	Vibrocore	Length (cm)	Profile location
copan-1-1	061	92	trough
copan-1-4	062	112	mid-stoss side
copan-1-8	063	55	mid-lee side
copan-2-21	096	168	lower-stoss side of sand ridge (mid-lee side of the superimposed sand wave)
copan-2-22	097	59	upper-stoss side of sand ridge (crest of the superimposed sand wave)
ss-2-5	165	140	mid-stoss side of sand ridge (crest of superimposed sand wave)
ss-2-12	166	199	lower middle lee side of sand ridge

7.6 Seismic and Sidescan Surveys

The Simrad MS992 Dual frequency side scan sonar system worked well through the whole cruise. Occasional paper jams were encountered on the EPC 1086 recorder. The system also suffered cable problems at the umbilical splice near the depressor weight on two successive nights which resulted in loss of a few hours of data, requiring re-running of one transect (Line 201). The sidescan surveys produced good quality records for most survey lines on the bank. It was not deployed in the basin transects because of very irregular topography, deep depths and the possibility of unmapped peaks.

No major equipment problems were experienced with the seismic collection equipment during the cruise. Seismic data quality was judged to be excellent with little sea noise. Some consideration should be given before the next season to the method of deployment of the Benthos eel array, more specifically, being able to sink the array. The towing location of the single- 6 cubic inch gun and the use of a new 50-meter long air/ firing line functioned well. By towing the air/ firing line bundle through a roller block in the center of the A frame next to the DTS roller block, there were no problems with tangling equipment that had occurred in past years. This also made for easy deployment and recovery of the gun. The six cubic inch sleeve gun proved ideal for bank and basin surveying. The NSRF streamer was filtered to provide best near surface resolution while the Benthos 25 and 100 foot streamers provided deeper

information on a split display. The NSRF display, on narrow paper, provided ample resolution to depict some structure in the post-transgression section as well as good resolution to over ½ second depth. The sleeve gun data also successfully registered the Late Wisconsinan transgression lag surface in shallow water (across West Bar) and its truncation by small channel cut and fill.

Overall the Huntec DTS operations went well. There were some minor problems with the aging Systems Console during the mobilization and at the start of the survey. The system was operated in sparker mode with both internal and external (streamer) display. Generally a 1/8 second sweep on the bank and ¼ second sweep in basinal depths was utilized. It performed well with only minor but persistent interruption of data collection at approximately 2 to 4 hour intervals when it failed to trigger for short durations (minutes). Basin profiles were of excellent quality, regardless of weather, while the shallow bank profiles are significantly degraded by heave of the streamer and a narrow time window because of overprinting of the "surface ghost". Nevertheless, augmented with the small sleeve gun profiles, fully adequate registration of the geology was obtained. The Huntec sparker failed to register numerous internal structures in the sand ridges which were successfully registered in older NSRF v-fin data.

The inventories of the seismic/sidescan survey lines, analog records and digital tapes obtained on Hudson 200030A are given in Appendix 5.

7.6.1 Sidescan/seismic Surveys along Sand Ridge Transects

Sidescan/seismic surveys were conducted along the sand ridge transects as depicted in Fig. 2 to determine the cross-section profiles, vertical stratigraphic structures and superposition of various small to medium scale bedforms on the sand ridges. Examples of sidescan sonograms along the transects of CoPan 1A, CoPan 2, South Sable 1 and South Sable 3 are shown in Figs. 16 to 19 respectively. The bottom part of each figure shows the corresponding seabed profiles derived from existing multibeam data, with locations of vibrocores (Figs. 16 and 17) and grabs and camera stations (Figs. 18 and 19) also being displayed. The sidescan sonograms show the long-recognized sharp contact at the "V" notch of the ridge troughs due to the light-colored fine-grained sediment on the lee (eastern) flank and the dark (highly backscattering) coarse sediment on the stoss (western) flank of the ridges (Figs. 16 to 19). Another striking feature observed is the low relief (<10-20 cm?), obliterated(?)'megaripples' that developed over the gravelly, shelly coarse sand in the troughs and on the lower stoss flanks. These megaripples are mostly 2-dimensional (linear, inserts of Figs. 16, 17), but sometimes 3-dimensional (linguoid, inserts of Figs. 18 and 19). The average wavelengths of these 'megaripples' generally range from 5 to 10 m. Where linear, their crests form small oblique angles to the trough axis. The very low relief of these features is troublesome and conflicts with the concept that megaripples usually have height/wavelength ratios at about 0.1. Thus the term 'megaripple' is only tentative here. In the dark bands of these megaripples, the occurrence of large wave(?) ripples is ubiquitous (see all inserts in Figs. 16-19). The average spacing of these large wave ripples is about 1 m and their crests are generally perpendicular to that of the ridges and megaripples. The large wave ripples reflect wave action approximately normal to the Sable Island shoreface and are probably reactivated regularly (storm to storm). The 'megaripples' are also quite ephemeral as discussed in a later section (7.6.3) based on comparisons of sidescan bedform patterns between different cruises.

NSRF sparker profile data collected in cruise 85-037 is superimposed on the sand ridge profile along the CoPan 2B transect in Fig. 17. These high-quality seismic profile data demonstrate an eastward migration pattern beginning early in the ridge development and depict at least three local ridge

Fig. 16 Sidescan sonogram and multibeam seabed profile along the CoPan 1A sand ridge profile. Superimposed are the vibrocore locations and penetration depths.

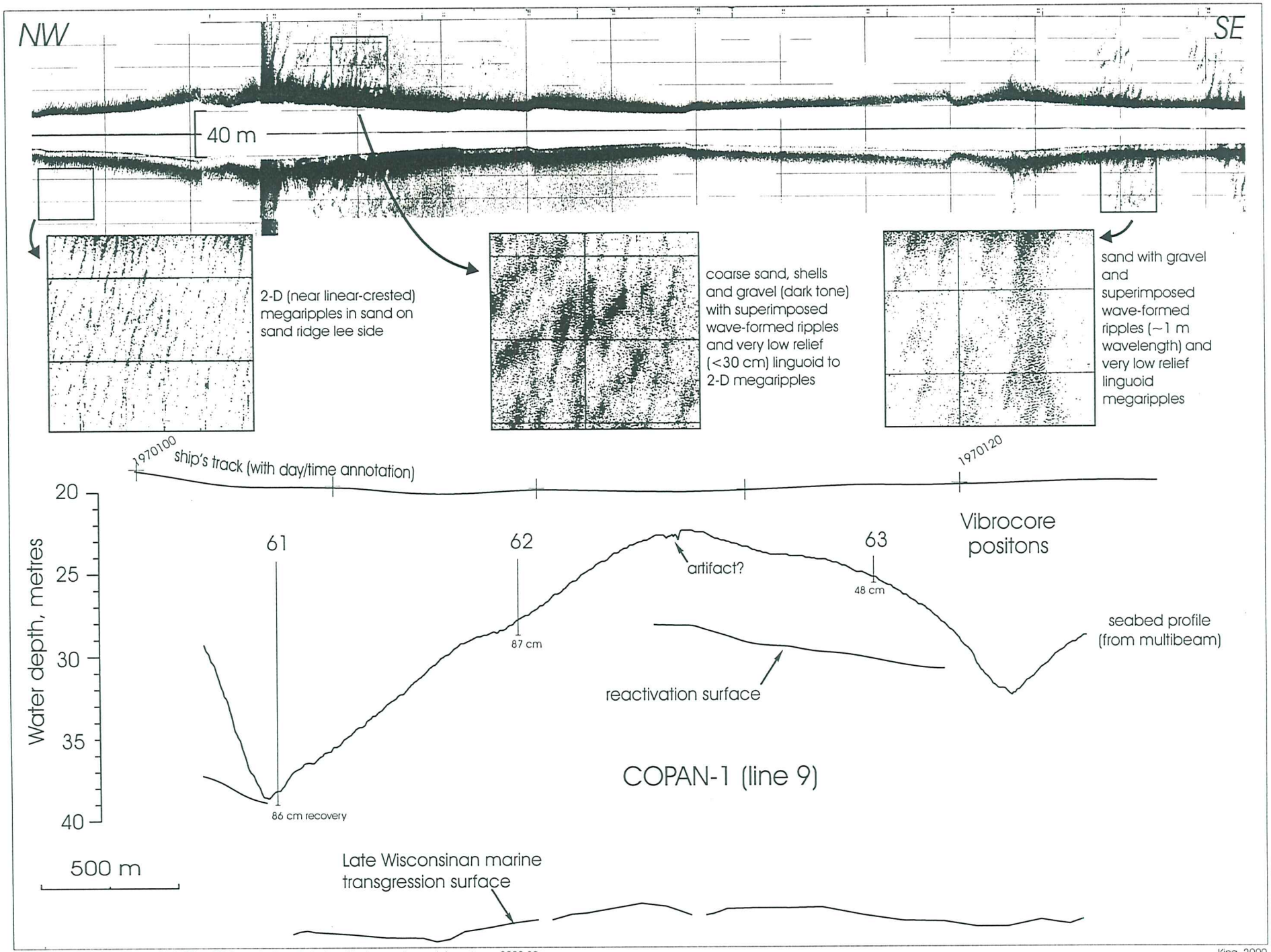

NW
SE
40 m
2-D (near linear-crested) megaripples in sand on sand ridge lee side
coarse sand, shells and gravel (dark tone) with superimposed wave-formed ripples and very low relief (<30 cm) linguoid to 2-D megaripples
sand with gravel and superimposed wave-formed ripples (~1 m wavelength) and very low relief linguoid megaripples
1970100
ship's track (with day/time annotation)
1970120
Vibrocore positons
61
62
63
artifact?
48 cm
87 cm
86 cm recovery
seabed profile (from multibeam)
reactivation surface
COPAN-1 (line 9)
Water depth, metres
20
25
30
35
40
500 m
Late Wisconsinan marine transgression surface
2000-30a, 330 kHz sidescan, 197/0100 to 0123, sub-bottom data from Huntec sparker and sleevel gun, 2000-30a
King, 2000

Figure 16

Fig. 17 Sidescan sonogram and multibeam seabed profile along the CoPan 2 sand ridge profile. Superimposed are the vibrocore locations and penetration depths and the NSRF sparker seismic data from cruise 85-037.

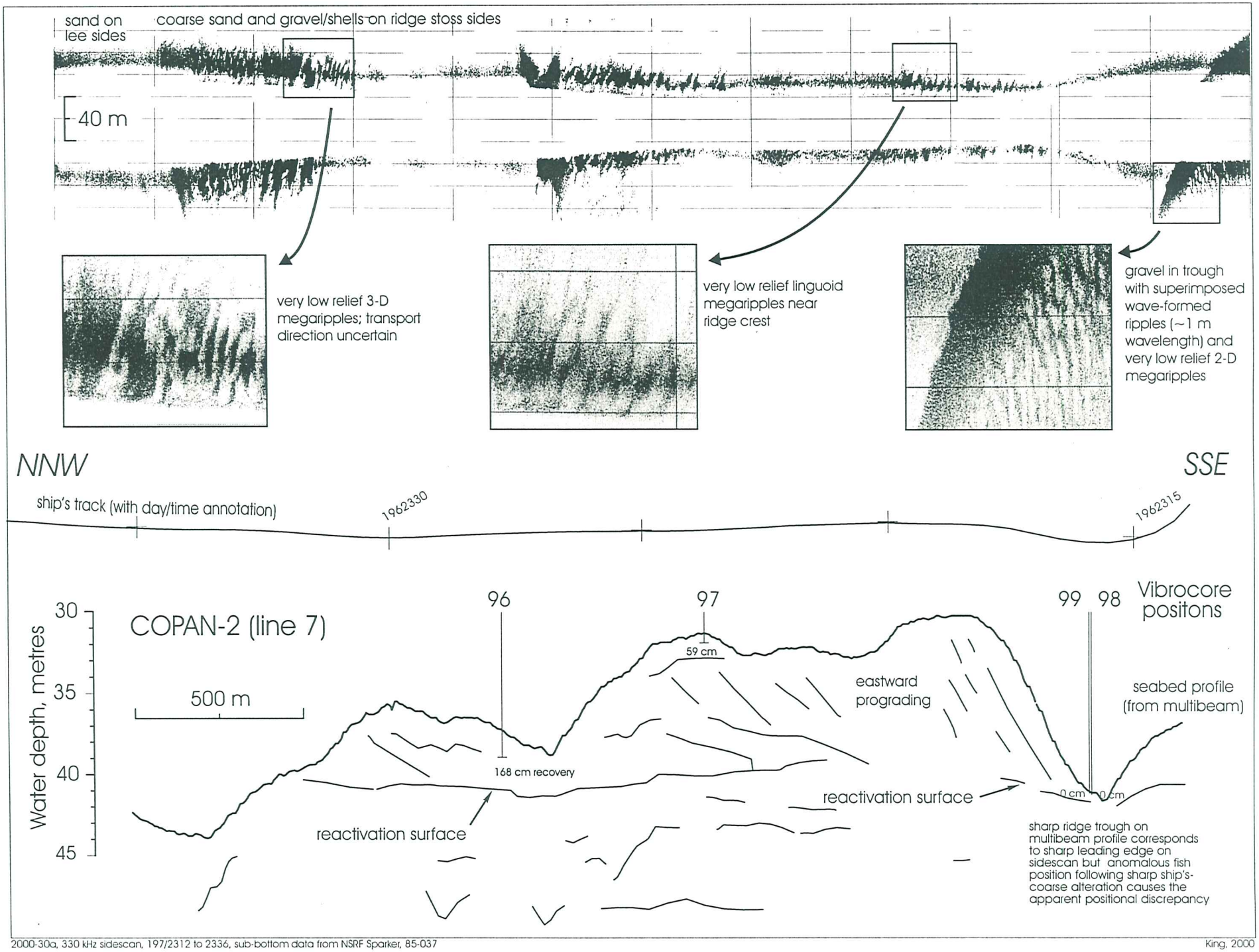

sand on lee sides
coarse sand and gravel/shells on ridge stoss sides
40 m
very low relief 3-D megaripples; transport direction uncertain
very low relief linguoid megaripples near ridge crest
gravel in trough with superimposed wave-formed ripples (~1 m wavelength) and very low relief 2-D megaripples
NNW
SSE
ship's track (with day/time annotation)
1962330
1962315
COPAN-2 (line 7)
Water depth, metres
30
35
40
45
500 m
96
97
99
98
Vibrocore positons
59 cm
168 cm recovery
eastward prograding
seabed profile (from multibeam)
reactivation surface
reactivation surface
0 cm
0 cm
sharp ridge trough on multibeam profile corresponds to sharp leading edge on sidescan but anomalous fish position following sharp ship's-coarse alteration causes the apparent positional discrepancy
2000-30a, 330 kHz sidescan, 197/2312 to 2336, sub-bottom data from NSRF Sparker, 85-037
King, 2000

Figure 17

Fig. 18 Sidescan sonogram and multibeam seabed profile along the South Sable 1 sand ridge transect.

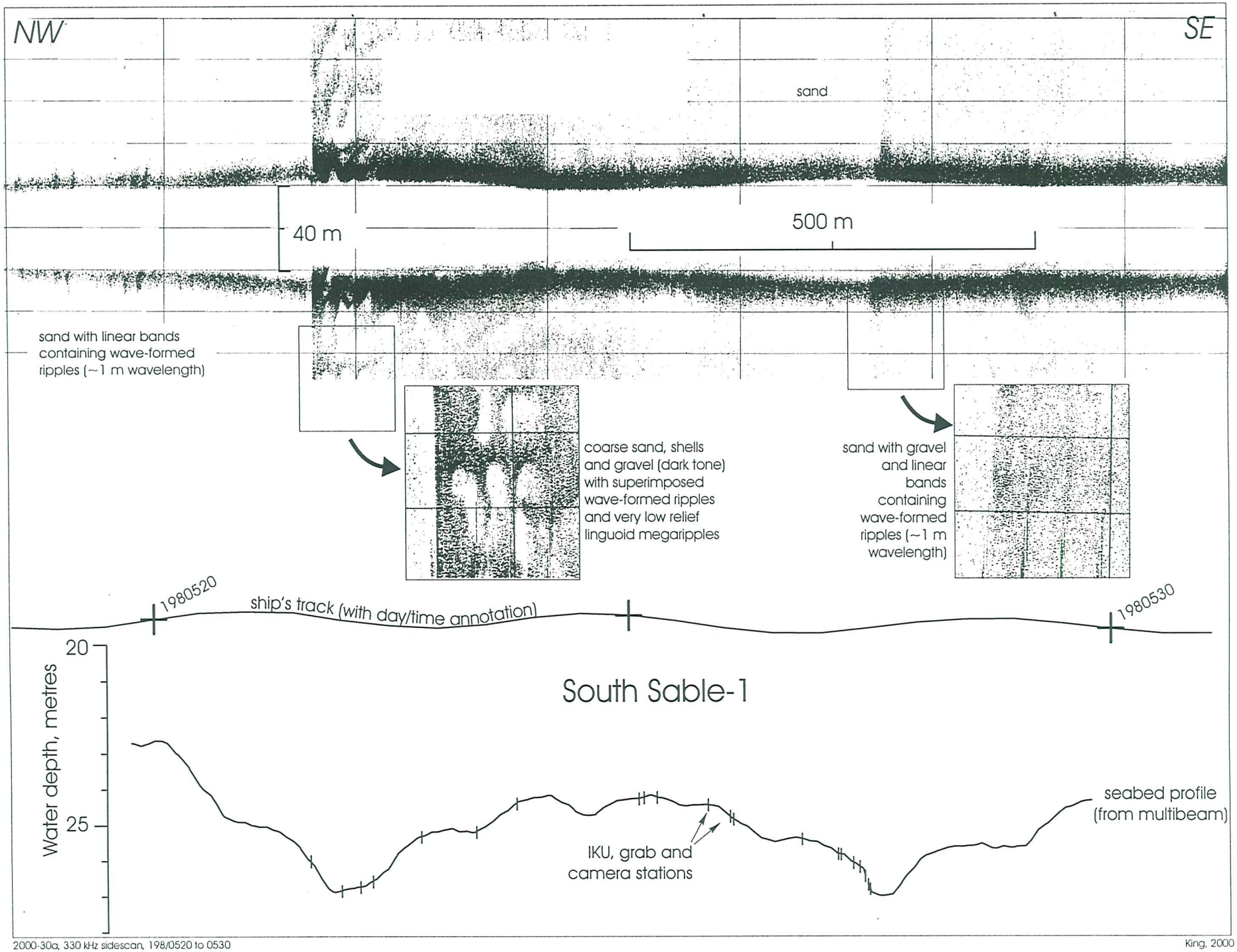

NW
SE
sand
40 m
500 m
sand with linear bands containing wave-formed ripples (~1 m wavelength)
coarse sand, shells and gravel (dark tone) with superimposed wave-formed ripples and very low relief linguoid megaripples
sand with gravel and linear bands containing wave-formed ripples (~1 m wavelength)
1980520
ship's track (with day/time annotation)
1980530
South Sable-1
20
25
Water depth, metres
IKU, grab and camera stations
seabed profile (from multibeam)
2000-30a, 330 kHz sidescan, 198/0520 to 0530
King, 2000

Figure 18

Fig. 19 Sidescan sonogram and multibeam seabed profile along the South Sable 3 sand ridge transect.

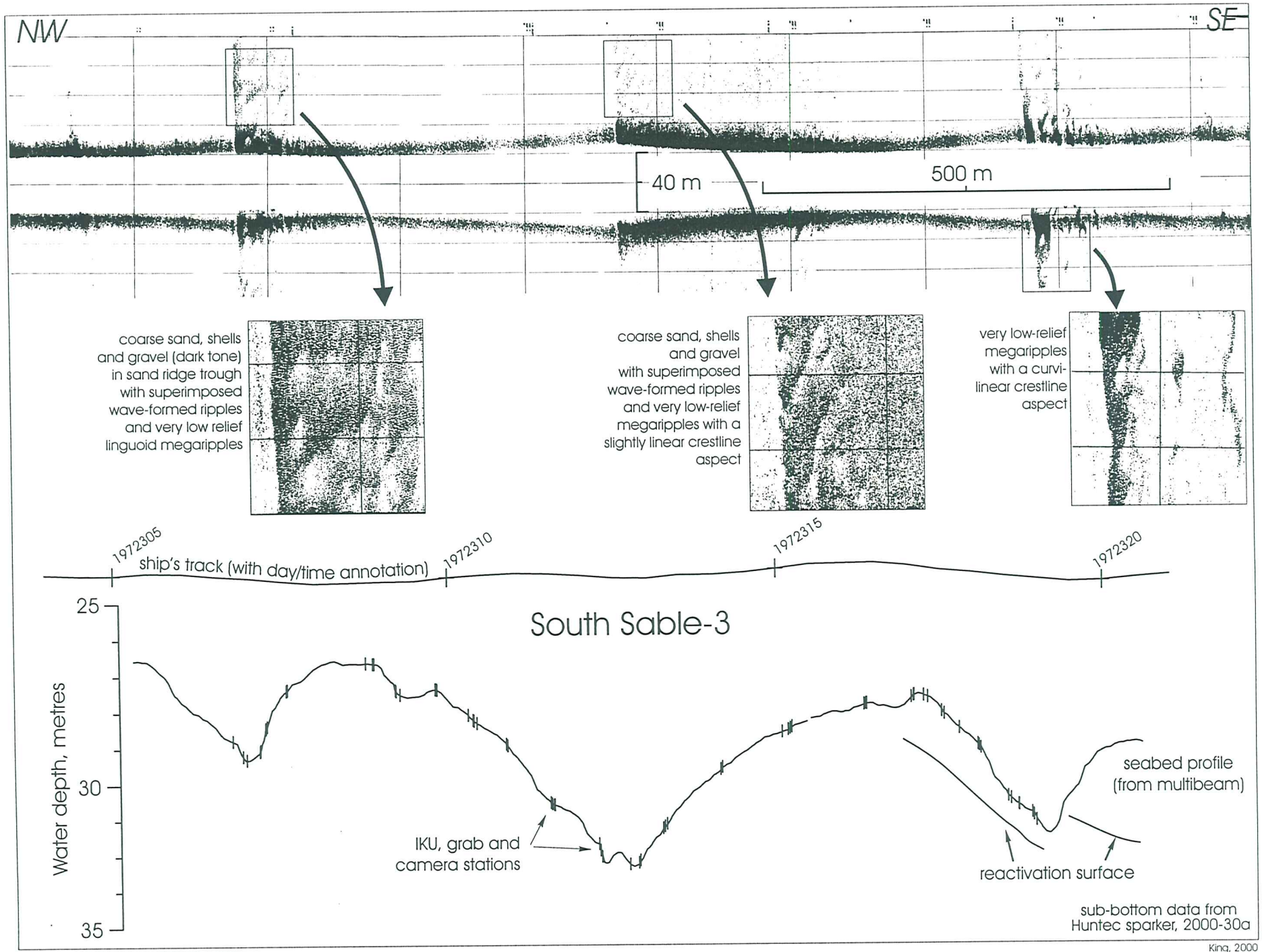

NW
SE
40 m
500 m
coarse sand, shells and gravel (dark tone) in sand ridge trough with superimposed wave-formed ripples and very low relief linguoid megaripples
coarse sand, shells and gravel with superimposed wave-formed ripples and very low-relief megaripples with a slightly linear crestline aspect
very low-relief megaripples with a curvi-linear crestline aspect
1972305
ship's track (with day/time annotation)
1972310
1972315
1972320
South Sable-3
25
30
35
Water depth, metres
IKU, grab and camera stations
seabed profile (from multibeam)
reactivation surface
sub-bottom data from Huntec sparker, 2000-30a
King, 2000
2000-30a, 330 kHz sidescan, 197/2305 to 2321

Figure 19

Fig. 20 Morphological locations of vibrocores along South Sable 2 sand-ridge transect.

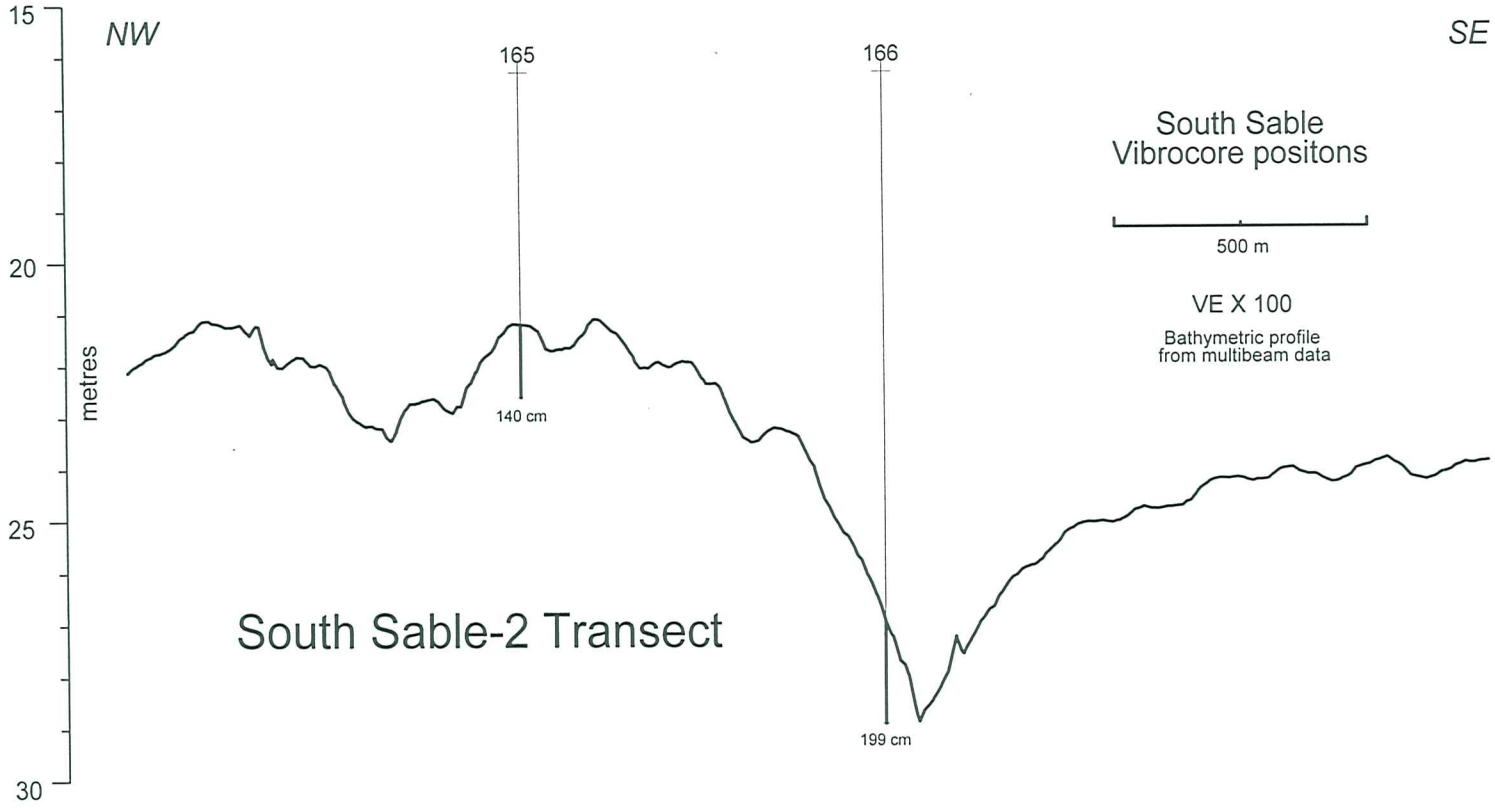

15
20
25
30
metres
NW
SE
165
166
140 cm
199 cm
South Sable-2 Transect
South Sable
Vibrocore positons
500 m
VE X 100
Bathymetric profile
from multibeam data

Figure 20.

re-organization phases throughout its history. Huntec sparker seismic profiles were also collected along the sand ridge transects. Unfortunately, they did not show any discernable structures.

7.6.2 Seabed-placed Acoustic Targets for Ridge Migration Analysis

Steel barrels half-filled with concrete were deployed at six locations south of Sable Island in a 1985 cruise (see locations in Fig. 1) in order to provide reference points (acoustic targets) for bedform migration monitoring. Surveys immediately after the deployment clearly identified some of these targets. The sites were never visited until this cruise.

Lines 106 and 201 were positioned exactly over the 1985 survey lines. Fig. 21 compares the sidescan images collected from these two years. The 2000 survey encountered better weather conditions and little thermocline compared with the 1985 survey. Also, the 100 and 330 kHz 2000 data should in theory be compatible with the older Klein 100 kHz data. Fig. 21 shows that the position of the sand ridge trough was roughly stable during the 15 year span, plotting within 15 to 20 m of each other. Variations in the curvature of this boundary may be due to positional and slant range corrections. Smaller features, however, have clearly changed. The broad zones of gravel/shell hash in the troughs on the older data display nearly E-W oriented large wave ripples (ca 1 m wavelength and hardly visible on the scanned-in image in Fig. 21) and a very sharp boundary along the sand ridge leading edge. On the 2000 data, all the trough zones display irregularly-shaped megaripples with a wavelength of approximately 20 m and a resultant serrated trough boundary. Heights of these megaripples are unresolved on the Huntec profiles and are assumed to be lower than ca 20 cm relief.

The 1985 acoustic targets were not registered in any of the 2000 sidescan imagery. If we assume that lee side sedimentation has buried these targets, this represents a yearly average 2 to 4 m of eastward migration of the leading edge, or 30 to 60 m over the 15 year span. An alternative explanation is that strong erosion has occurred in the trough in association with a westward migration of the trough boundary. This process would have lowered the barrels into the gravel lag in the trough so that their reflection signals are drowned in the high backscatter returns of the lag deposits. In either case, migration of several tens of meters is required. This is inconsistent with the fact that the sidescan surveys from 1985 to 2000 suggest the position change of the sand ridge trough is probably from 15 to 20 m, within the error of navigation accuracy. Findings regarding the mobility of sand ridges are thus inconclusive.

7.6.3 Sidescan Surveys Across 1996 Ralph Site and the 1996 Transect at South Sable

Multibeam data were collected at the shallow water 1996 RALPH deployment site for two separate years (Li et al., 1999). But no adequate sidescan coverage existed. A sidescan/seismic line (line 105a, Fig. 1) was run over this site in this cruise. Sidescan images of excellent quality (Fig. 22) showed that the seabed was dominated by narrow, reflective bands oriented N-S, approximately normal to the shoreline. These correlate with similarly oriented 10 to 40 cm deep 'gutters' depicted on the multibeam data. These gutters are 10 to 40 cm deep and their spacings vary between 20 and 60 m. Large wave ripples, roughly normal to the orientation of the gutters, cover the coarse sediment on the bottom these gutters, while the seabed between the gutters is featureless on the sidescan sonograms.

High-quality sidescan data were collected along a shore-parallel transect in the shallow water (20 m depth) of South Sable in the Hudson 96-029 cruise. This same transect was surveyed on this cruise (Line 203, Fig. 1) to provide a repeat coverage of 3.5 year time separation. Initial comparison of the two data sets shows that the main features such as sand ridge troughs are largely unchanged. However, most

Fig. 21 Comparison of the 1985 and 2000 sidescan images collected at the 'acoustic target' site, South Sable Island.

Serial comparison of sand ridge troughs; 1985 and 2000

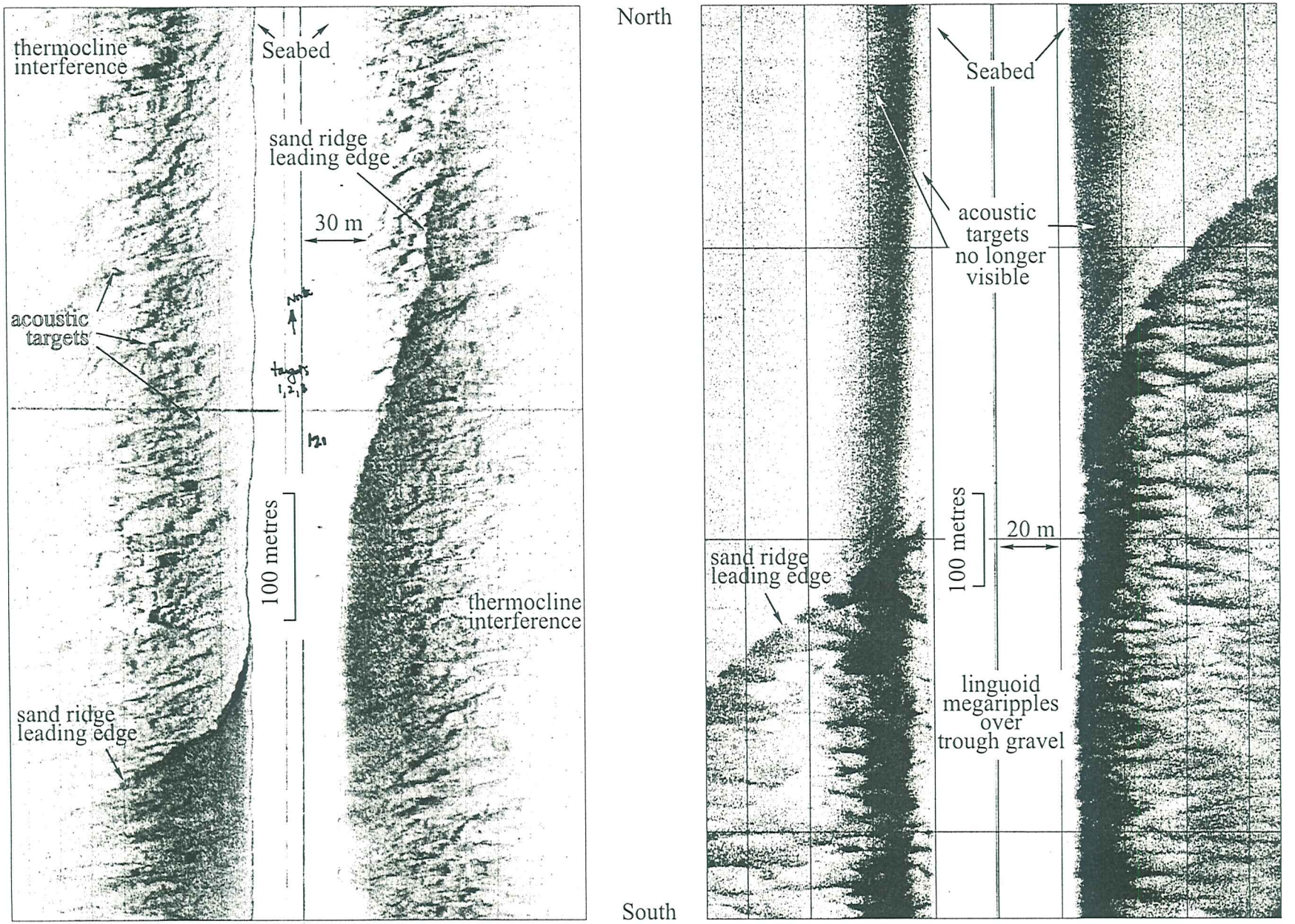


Figure 21

Fig. 22 Sidescan image of the seabed at the shallow water 1996 RALPH deployment site, South Sable.

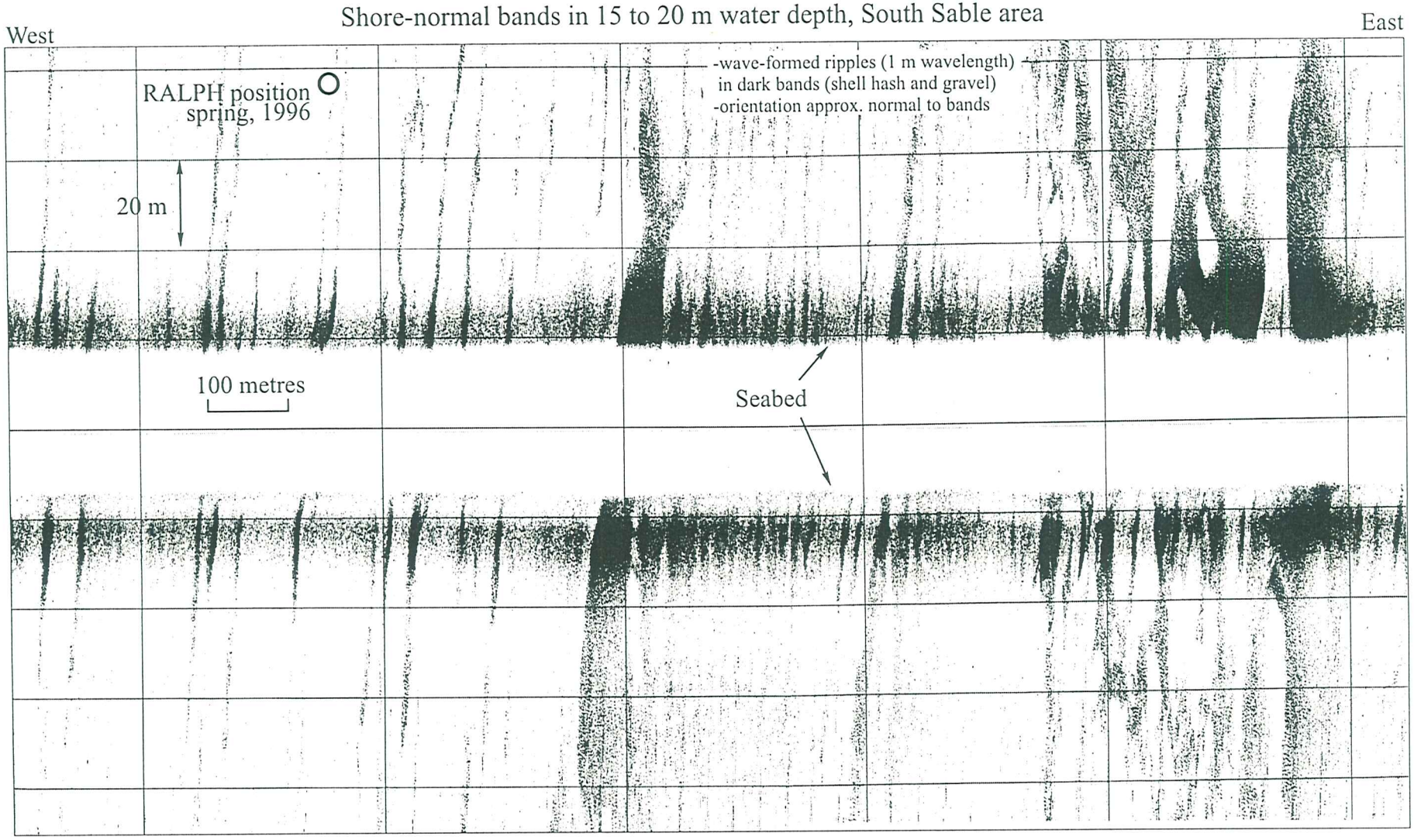

Shore-normal bands in 15 to 20 m water depth, South Sable area
West
East
RALPH position
spring, 1996
-wave-formed ripples (1 m wavelength)
in dark bands (shell hash and gravel)
-orientation approx. normal to bands
20 m
100 metres
Seabed
HN 2000 30a 330 kHz sidescan, 198/0155 to 0206
King, 2000

Figure 22.

details such as type and position of low-relief bedforms (linguoid megaripples and large wave ripples) and patterns of wave-formed ripple patches in gravel/shell hash are largely unrecognizable. This implies that the sand ridges were relatively stable, while the superimposed megaripples and large wave ripples were mobile during this time span (under annual winter storm conditions).

7.6.4 Surveys Along Potential Pipeline Routes of SOEI Tier II Development

Seismic/sidescan surveys were conducted along potential pipeline routes in the deeper water areas of SOEI Tier II development. These were straight lines that tied Thebaud to Alma, Alma to Glenelg, and Glenelg to Thebaud (lines 302, 302b, 401a, 401b, and 402b in Fig. 1). Preliminary examination of these data suggests a much more complex near surface (upper 30- 50 m) stratigraphy at Alma and Glenelg than at shallow development sites on Sable Island Bank. A history of more direct glacial deposition and erosion as well as sea level change gives rise to greater spatial and depth variability in sediment types and accordingly, their geotechnical properties. Apart from this, no readily apparent engineering hazards such as shallow gas are observed. Seismic data along these transects clearly define several regional paleosurfaces (unconformities of King, 1999) and their similar seaward variation patterns from Thebaud to Alma and to Glenelg. In summary, the surveys over the potential pipeline routes provided high quality seismic data, with unprecedented definition of unit characterization and stratigraphic relationships which will prove instrumental in constraining local glacial history while also broadly defining sediment character and thickness along these routes.

7.6.5 Preliminary Results from Other Sidescan/Seismic Surveys

Sub-surface point sources have been observed in previously collected NSRF sparker deep tow transects at the CoPan site, and had been interpreted as expressions of shallow gas. This was re-surveyed (line 6 in Fig. 1) in this cruise in an attempt to reproduce the earlier results. Despite excellent weather conditions, no indication of the point sources was registered. This, in light of failure to register other sand ridge structures, is interpreted as a failure of the Huntec sparker to resolve such features on the bank.

Previous Huntec and NSRF sparker profiles have defined a medium-relief, undulating surface buried at between 15 and 25 m below seabed on the entire outer Sable Island Bank. It appears to represent the top of a seismically homogeneous blanket deposit believed to be of glacigenic origin. The genesis of this surface relief is critical for understanding both glacial and sea level history of the region. A tight grid survey using the Huntec sparker was conducted near Glenelg (Glenelg grid survey in Fig. 1) to resolve the fine scale geometry of this surface. The registration of the surface was good to fair. This coverage will be further analyzed in the seismic interpretation program "WinPics" with an aim to better define its geometry.

Seismic lines (lines 11 to 14 and B-12-1 in Fig. 1) were run just south and north of West Bar to fill in a gap in seismic coverage in this area. The sleeve gun profiles successfully registered the Late Wisconsinan transgression lag surface and demonstrated a clear truncation of the lag surface by relatively deep channeling. This channeling is multi-generation "cut and fill" and a sub-glacial meltwater process is envisioned for their formation. This implies that glacial ice re-advanced to the immediate vicinity of Sable Island sometime in the relatively late stage of the Late Wisconsinan transgression.

Seismic profiles were also collected north of Sable Island and in Brandal Basin with the aim to better understand the stratigraphy and geometry of glacial till, glacimarine and post-glacial current-induced

unconformities. These survey lines depicted stacked tills immediately south of Middle Bank (Fig. 23). These tills are correlated directly (seismically) into the uppermost Gully (Brandal Basin). The shallow stacked tills overly stratified glacimarine sections in the upper Gully (north of Sable Island), and indicate multiple advances of glacial ice just before final retreat. A surficial slump deposit, shown as irregular and blocky topography on the seabed, was also depicted downslope from the steepest edge of the southern part of Middle Bank. Its stratigraphic position and surficial expression suggest a relatively recent event.

ACKNOWLEDGMENT

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Fig. 23 Huntec profile showing multiple tills in Brandal Basin, north of Sable Island.

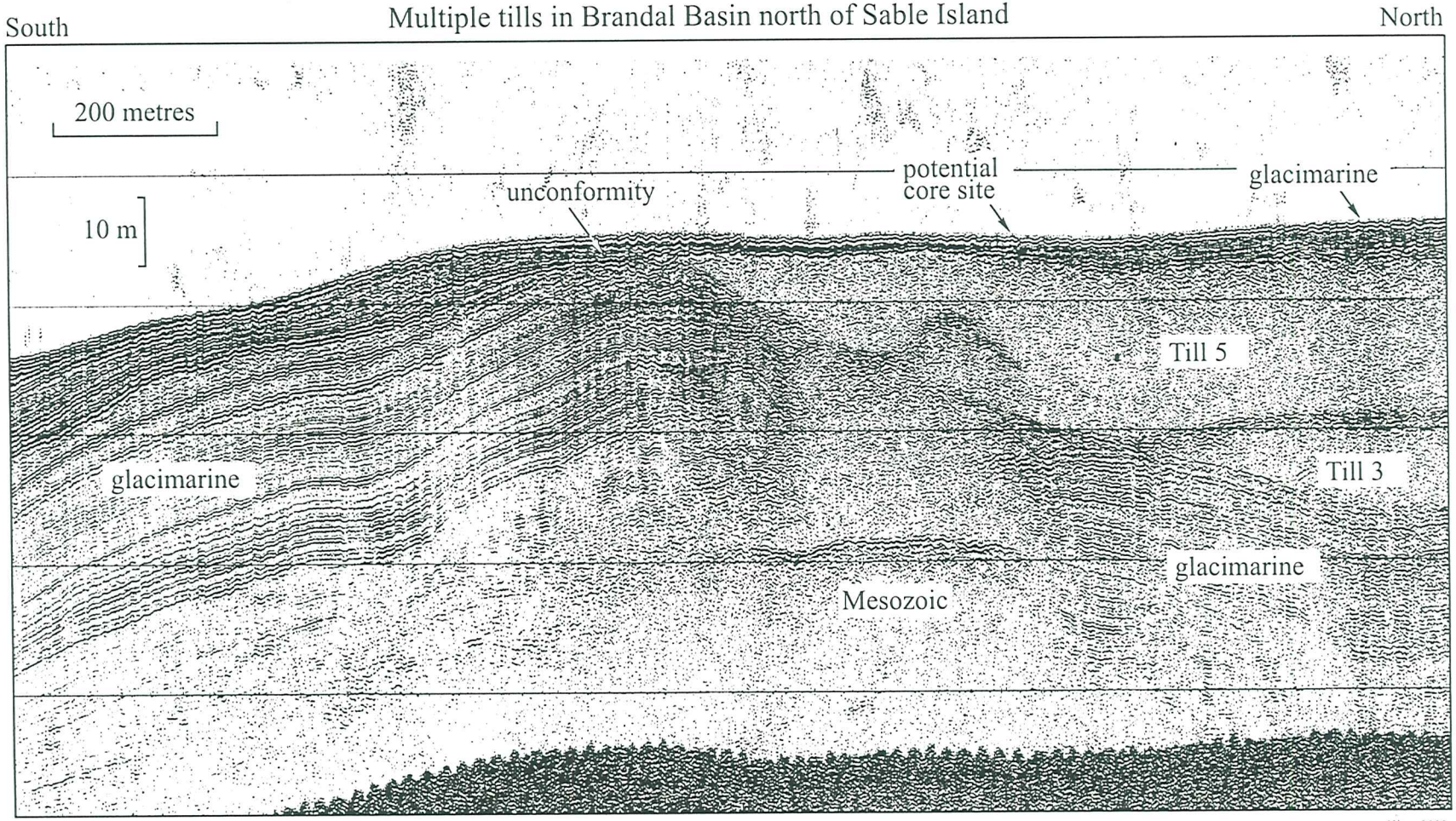
South
Multiple tills in Brandal Basin north of Sable Island
North
200 metres
10 m
unconformity
potential
core site
glacimarine
Till 5
Till 3
glacimarine
glacimarine
Mesozoic
HN 2000 30a Huntec sparker, streamer, 201/2337 to 2349
King, 2000

Figure 23.

REFERENCES

Amos, C.L. and Judge, J.T., 1991. Sediment transport on the eastern Canadian continental shelf. Cont. Shelf Res., 11: 1073-1068.

Amos, C.L. and King, E.L., 1984. Bedforms of the Canadian eastern seaboard: A comparison with global occurrences. Mar. Geol., 57: 167 - 208.

Dalrymple, R.W. and Hoogendoorn, E.L., 1997. Erosion and deposition on migrating shoreface-attached ridges, Sable Island, Eastern Canada. Geoscience Canada, 24: 25-36.

Geoforce Consultants Ltd., 2000. Deep Tow Operations C.C.G.S. Hudson Mission #2000030A/B/C/D, Mission #2000036, Misssion #2000042, Mission #2000047, July 13 - September 23, 2000. Unpublished Technical Report submitted to Natural Resources Canada - Atlantic Region.

Hoogendoorn, E.L. and Dalrymple, R.W., 1986. Morphology, lateral migration and internal structures of shoreface-connected ridges, Sable Island Bank, Nova Scotia, Canada. Geology, 14: 400 - 403.

Ingersoll, R.W. and Ryan, B.A., 1997. Repetitive surveys to assess sand ridge movement offshore Sable Island. Proc. Oceans 97: 1377-1393.

King, E.L. 1999. Towards a Glacial and Post-Glacial Geologic Framework on Sable Island Bank: A Long-term History of Environmental Change. Poster at SEEMAG Conference, BIO, Dartmouth, May 1999.

Li, M.Z., Amos, C.L. and Heffler, D.E., 1997. Boundary layer dynamics and sediment transport under storm and non-storm conditions on the Scotian shelf. Marine Geology, v. 141, no. , p.157-181.

Li, M.Z., Currie, R., Beaver, D., Girouard, P. and Pledge, P., 1999. Multibeam Surveys of Sable Island Bank and the Gully Area of Scotian Shelf: Report on Creed Cruise 98-100. GSCA Internal Cruise Report, 44 p.

Li et al. (in preparation). Multibeam Surveys of Sable Island Bank, Scotian Shelf: Report on Creed Cruise 2000-100. GSC Open File Report.

Appendix 1

List of all stations of Hudson 2000030A cruise.

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0001	Grab	196 / 1115	43.915586	-60.522866	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0002	Camera	196 / 1134	43.915631	-60.522573	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0003	IKU Grab	196 / 1200	43.915515	-60.52265	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0004	Camera	196 / 1243	43.916628	-60.524348	31.00	Scotian Shelf - Sable Island Bank - COPAN Site
0005	Grab	196 / 1253	43.91678	-60.524376	31.00	Scotian Shelf - Sable Island Bank - COPAN Site
0006	Grab	196 / 1310	43.91744	-60.525238	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0007	Camera	196 / 1322	43.91734	-60.525526	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0008	IKU Grab	196 / 1338	43.917413	-60.525178	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0009	Camera	196 / 1410	43.918371	-60.526786	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0010	Grab	196 / 1419	43.918433	-60.526628	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0011	IKU Grab	196 / 1415	43.919871	-60.528933	28.00	Scotian Shelf - Sable Island Bank - COPAN Site
0012	Grab	196 / 1537	43.91997	-60.528665	48.00	Scotian Shelf - Sable Island Bank - COPAN Site
0013	Camera	196 / 1549	43.919785	-60.528865	49.00	Scotian Shelf - Sable Island Bank - COPAN Site
0014	Camera	196 / 1623	43.922751	-60.532976	48.00	Scotian Shelf - Sable Island Bank - COPAN Site
0015	Grab	196 / 1634	43.922756	-60.532765	48.00	Scotian Shelf - Sable Island Bank - COPAN Site
0016	Grab	196 / 1702	43.925805	-60.53697	50.00	Scotian Shelf - Sable Island Bank - COPAN Site
0017	Camera	196 / 1714	43.925948	-60.537155	50.00	Scotian Shelf - Sable Island Bank - COPAN Site
0018	IKU Grab	196 / 1750	43.925868	-60.537081	50.00	Scotian Shelf - Sable Island Bank - COPAN Site
0019	Camera	196 / 1818	43.92811	-60.540361	55.00	Scotian Shelf - Sable Island Bank - COPAN Site
0020	Grab	196 / 1826	43.928038	-60.540618	55.00	Scotian Shelf - Sable Island Bank - COPAN Site
0021	Grab	196 / 1845	43.92953	-60.542536	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0022	Camera	196 / 1858	43.929585	-60.54232	44.00	Scotian Shelf - Sable Island Bank - COPAN Site
0023	IKU Grab	196 / 1935	43.92961	-60.542493	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0024	Camera	196 / 1959	43.930063	-60.542826	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0025	Grab	196 / 2009	43.930141	-60.542743	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0026	Grab	197 / 1107	43.930338	-60.543363	40.00	Scotian Shelf - Sable Island Bank - COPAN Site
0027	Camera	197 / 1119	43.930378	-60.543468	39.00	Scotian Shelf - Sable Island Bank - COPAN Site
0028	IKU Grab	197 / 1133	43.930285	-60.54357	39.00	Scotian Shelf - Sable Island Bank - COPAN Site
0029	Camera	197 / 1158	43.931496	-60.544895	30.00	Scotian Shelf - Sable Island Bank - COPAN Site
0030	Grab	197 / 1212	43.93145	-60.544898	30.00	Scotian Shelf - Sable Island Bank - COPAN Site
0031	Grab	197 / 1259	43.933126	-60.547268	27.00	Scotian Shelf - Sable Island Bank - COPAN Site
0032	Camera	197 / 1312	43.93315	-60.547208	27.00	Scotian Shelf - Sable Island Bank - COPAN Site
0033	IKU Grab	197 / 1324	43.933075	-60.547436	27.00	Scotian Shelf - Sable Island Bank - COPAN Site

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0034	Camera	197 / 1343	43.93318	-60.547366	27.00	Scotian Shelf - Sable Island Bank - COPAN Site
0035	Camera	197 / 1402	43.935763	-60.551286	25.00	Scotian Shelf - Sable Island Bank - COPAN Site
0036	Grab	197 / 1412	43.935791	-60.551315	25.00	Scotian Shelf - Sable Island Bank - COPAN Site
0037	Grab	197 / 1710	43.937575	-60.553423	23.00	Scotian Shelf - Sable Island Bank - COPAN Site
0038	Camera	197 / 1722	43.937415	-60.55349	23.00	Scotian Shelf - Sable Island Bank - COPAN Site
0039	Camera	197 / 1738	43.939838	-60.556995	21.00	Scotian Shelf - Sable Island Bank - COPAN Site
0040	Grab	197 / 1747	43.939788	-60.556615	21.00	Scotian Shelf - Sable Island Bank - COPAN Site
0041	Grab	197 / 1805	43.941976	-60.559583	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0042	Camera	197 / 1817	43.941966	-60.559666	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0043	Camera	197 / 1836	43.94402	-60.56265	31.00	Scotian Shelf - Sable Island Bank - COPAN Site
0044	Grab	197 / 1845	43.943986	-60.562628	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0045	Grab	197 / 1905	43.946045	-60.56527	30.10	Scotian Shelf - Sable Island Bank - COPAN Site
0046	Camera	197 / 1929	43.946041	-60.565361	30.40	Scotian Shelf - Sable Island Bank - COPAN Site
0047	IKU Grab	197 / 1940	43.946211	-60.565475	31.60	Scotian Shelf - Sable Island Bank - COPAN Site
0048	Camera	197 / 2008	43.947746	-60.567818	33.50	Scotian Shelf - Sable Island Bank - COPAN Site
0049	Grab	197 / 2018	43.947751	-60.567878	33.50	Scotian Shelf - Sable Island Bank - COPAN Site
0050	IKU Grab	197 / 2032	43.941941	-60.559988	23.10	Scotian Shelf - Sable Island Bank - COPAN Site
0051	IKU Grab	197 / 2048	43.937816	-60.553368	18.10	Scotian Shelf - Sable Island Bank - COPAN Site
0052	Grab	198 / 1043	43.916596	-60.648336	37.00	Scotian Shelf - Sable Island Bank - COPAN Site
0053	Camera	198 / 1057	43.916796	-60.64814	37.00	Scotian Shelf - Sable Island Bank - COPAN Site
0054	Camera	198 / 1114	43.912798	-60.646075	39.00	Scotian Shelf - Sable Island Bank - COPAN Site
0055	Grab	198 / 1122	43.912788	-60.64608	39.00	Scotian Shelf - Sable Island Bank - COPAN Site
0056	Grab	198 / 1137	43.910775	-60.645011	35.00	Scotian Shelf - Sable Island Bank - COPAN Site
0057	Camera	198 / 1148	43.910778	-60.64497	35.40	Scotian Shelf - Sable Island Bank - COPAN Site
0058	IKU Grab	198 / 1158	43.910755	-60.644795	35.40	Scotian Shelf - Sable Island Bank - COPAN Site
0059	Camera	198 / 1224	43.910076	-60.644661	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0060	Grab	198 / 1235	43.909986	-60.644516	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0061	Vibrocore	198 / 1347	43.947594	-60.567853	34.00	Scotian Shelf - Sable Island Bank - COPAN Site
0062	Vibrocore	198 / 1550	43.941943	-60.559575	29.00	Scotian Shelf - Sable Island Bank - COPAN Site
0063	Vibrocore	198 / 1705	43.933163	-60.547413	26.00	Scotian Shelf - Sable Island Bank - COPAN Site
0064	Grab	198 / 1812	43.908368	-60.64361	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0065	Camera	198 / 1826	43.908368	-60.643755	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0066	IKU Grab	198 / 1837	43.908392	-60.643792	33.00	Scotian Shelf - Sable Island Bank - COPAN Site

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0067	Camera	198 / 1912	43.906113	-60.64252	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0068	Grab	198 / 1922	43.906178	-60.642548	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0069	Grab	198 / 1941	43.904005	-60.641231	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0070	Camera	198 / 1955	43.903996	-60.641356	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0071	IKU Grab	198 / 2015	43.900439	-60.639494	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0072	Camera	198 / 2126	43.90042	-60.639215	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0073	Grab	198 / 2133	43.900433	-60.639218	32.00	Scotian Shelf - Sable Island Bank - COPAN Site
0074	Grab	199 / 1026	43.898325	-60.637883	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0075	Camera	199 / 1044	43.898506	-60.637895	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0076	Camera	199 / 1103	43.897926	-60.638165	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0077	Grab	199 / 1122	43.897626	-60.63737	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0078	IKU Grab	199 / 1137	43.89754	-60.637586	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0079	Grab	199 / 1205	43.895878	-60.636565	37.00	Scotian Shelf - Sable Island Bank - COPAN Site
0080	Camera	199 / 1216	43.895628	-60.637316	38.00	Scotian Shelf - Sable Island Bank - COPAN Site
0081	Camera	199 / 1324	43.894921	-60.636136	38.00	Scotian Shelf - Sable Island Bank - COPAN Site
0082	Grab	199 / 1348	43.894678	-60.636216	41.00	Scotian Shelf - Sable Island Bank - COPAN Site
0083	IKU Grab	199 / 1359	43.894627	-60.636037	41.00	Scotian Shelf - Sable Island Bank - COPAN Site
0084	Grab	199 / 1435	43.893303	-60.635525	44.00	Scotian Shelf - Sable Island Bank - COPAN Site
0085	Camera	199 / 1447	43.89306	-60.635986	42.00	Scotian Shelf - Sable Island Bank - COPAN Site
0086	Camera	199 / 1625	43.891356	-60.634331	44.00	Scotian Shelf - Sable Island Bank - COPAN Site
0087	Grab	199 / 1640	43.891046	-60.63442	44.00	Scotian Shelf - Sable Island Bank - COPAN Site
0088	IKU Grab	199 / 1920	43.88893	-60.111198	29.00	Scotian Shelf - South Sable Island
0089	Grab	199 / 1937	43.88892	-60.11112	32.00	Scotian Shelf - South Sable Island
0090	Camera	199 / 1952	43.888888	-60.110803	29.00	Scotian Shelf - South Sable Island
0091	Camera	199 / 2000	43.888591	-60.110683	29.00	Scotian Shelf - South Sable Island
0092	Grab	199 / 2011	43.888575	-60.110658	29.00	Scotian Shelf - South Sable Island
0093	IKU Grab	199 / 2016	43.888371	-60.110048	29.00	Scotian Shelf - South Sable Island
0094	Grab	199 / 2035	43.888331	-60.110186	29.00	Scotian Shelf - South Sable Island
0095	Camera	199 / 2054	43.8882	-60.110205	29.00	Scotian Shelf - South Sable Island
0096	Vibrocore	200 / 1056	43.883788	-60.630121	38.00	Scotian Shelf - Sable Island Bank - COPAN Site
0097	Vibrocore	200 / 1207	43.877785	-60.627126	33.00	Scotian Shelf - Sable Island Bank - COPAN Site
0098	Vibrocore	200 / 1317	43.868265	-60.621346	38.00	Scotian Shelf - Sable Island Bank - COPAN Site
0099	Vibrocore	200 / 1412	43.868163	-60.621385	38.00	Scotian Shelf - Sable Island Bank - COPAN Site

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0100	Camera	200 / 1630	43.887653	-60.108171	28.00	Scotian Shelf - Sable Island Bank - COPAN Site
0101	Grab	200 / 1639	43.887345	-60.108391	28.00	Scotian Shelf - South Sable Island
0102	IKU Grab	200 / 1651	43.887556	-60.10822	28.00	Scotian Shelf - South Sable Island
0103	Grab	200 / 1719	43.88723	-60.10761	28.00	Scotian Shelf - South Sable Island
0104	Camera	200 / 1730	43.88712	-60.107705	28.00	Scotian Shelf - South Sable Island
0105	Camera	200 / 1741	43.886793	-60.106791	28.70	Scotian Shelf - South Sable Island
0106	Grab	200 / 1748	43.886906	-60.106763	28.60	Scotian Shelf - South Sable Island
0107	Grab	200 / 1833	43.886506	-60.105853	32.00	Scotian Shelf - South Sable Island
0108	Camera	200 / 1844	43.886448	-60.105928	29.00	Scotian Shelf - South Sable Island
0109	IKU Grab	200 / 1854	43.886488	-60.10606	29.00	Scotian Shelf - South Sable Island
0110	Camera	200 / 1920	43.88613	-60.105166	30.00	Scotian Shelf - South Sable Island
0111	Grab	200 / 1927	43.886103	-60.105158	30.00	Scotian Shelf - South Sable Island
0112	Grab	200 / 1943	43.885596	-60.104105	31.00	Scotian Shelf - South Sable Island
0113	Camera	200 / 1953	43.885425	-60.104165	31.00	Scotian Shelf - South Sable Island
0114	IKU Grab	200 / 2013	43.885641	-60.104088	31.00	Scotian Shelf - South Sable Island
0115	Camera	200 / 2034	43.88506	-60.103026	32.00	Scotian Shelf - South Sable Island
0116	Grab	200 / 2045	43.885048	-60.103095	32.00	Scotian Shelf - South Sable Island
0117	Grab	201 / 959	43.884515	-60.102405	33.70	Scotian Shelf - South Sable Island
0118	Camera	201 / 1011	43.884836	-60.102148	33.00	Scotian Shelf - South Sable Island
0119	Camera	201 / 1025	43.884345	-60.101595	32.90	Scotian Shelf - South Sable Island
0120	Grab	201 / 1033	43.884273	-60.101551	32.80	Scotian Shelf - South Sable Island
0121	IKU Grab	201 / 1046	43.884346	-60.101496	33.00	Scotian Shelf - South Sable Island
0122	Grab	201 / 1102	43.881373	-60.09558	30.00	Scotian Shelf - South Sable Island
0123	Camera	201 / 1118	43.881268	-60.095203	30.50	Scotian Shelf - South Sable Island
0124	Camera	201 / 1132	43.881505	-60.095888	29.00	Scotian Shelf - South Sable Island
0125	Grab	201 / 1139	43.881511	-60.095905	29.00	Scotian Shelf - South Sable Island
0126	IKU Grab	201 / 1150	43.881491	-60.095671	29.50	Scotian Shelf - South Sable Island
0127	Grab	201 / 1213	43.882111	-60.096986	29.40	Scotian Shelf - South Sable Island
0128	Camera	201 / 1225	43.882175	-60.096968	29.00	Scotian Shelf - South Sable Island
0129	Camera	201 / 1303	43.883086	-60.098666	30.70	Scotian Shelf - South Sable Island
0130	Grab	201 / 1314	43.882976	-60.098765	30.60	Scotian Shelf - South Sable Island
0131	IKU Grab	201 / 1326	43.883145	-60.098895	30.70	Scotian Shelf - South Sable Island
0132	Grab	201 / 1418	43.867218	-60.100533	32.00	Scotian Shelf - South Sable Island

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0133	Camera	201 / 1436	43.883748	-60.100268	31.70	Scotian Shelf - South Sable Island
0134	Camera	201 / 1525	43.881166	-60.09436	31.00	Scotian Shelf - South Sable Island
0135	Grab	201 / 1541	43.881005	-60.09486	30.50	Scotian Shelf - South Sable Island
0136	IKU Grab	201 / 1607	43.880815	-60.094418	31.00	Scotian Shelf - South Sable Island
0137	Grab	201 / 1627	43.880631	-60.093501	32.10	Scotian Shelf - South Sable Island
0138	Camera	201 / 1636	43.880631	-60.093683	31.90	Scotian Shelf - South Sable Island
0139	Camera	201 / 1647	43.880453	-60.093095	32.70	Scotian Shelf - South Sable Island
0140	IKU Grab	201 / 1712	43.880543	-60.0935	32.20	Scotian Shelf - South Sable Island
0141	Grab	202 / 1000	43.880273	-60.0932	59.00	Scotian Shelf - South Sable Island
0142	Grab	202 / 1037	43.902296	-60.071095	26.00	Scotian Shelf - South Sable Island
0143	Camera	202 / 1109	43.902293	-60.071358	26.00	Scotian Shelf - South Sable Island
0144	Camera	202 / 1110	43.902345	-60.071383	26.00	Scotian Shelf - South Sable Island
0145	Camera	202 / 1122	43.902551	-60.07159	26.00	Scotian Shelf - South Sable Island
0146	Camera	202 / 1130	43.902478	-60.071495	26.00	Scotian Shelf - South Sable Island
0147	Camera	202 / 1154	43.903633	-60.074396	25.00	Scotian Shelf - South Sable Island
0148	Grab	202 / 1259	43.905803	-60.07934	27.00	Scotian Shelf - South Sable Island
0149	Grab	202 / 1307	43.905441	-60.078911	27.00	Scotian Shelf - South Sable Island
0150	Grab	202 / 1310	43.90524	-60.078648	27.00	Scotian Shelf - South Sable Island
0151	Grab	202 / 1314	43.904943	-60.077766	26.00	Scotian Shelf - South Sable Island
0152	Grab	202 / 1317	43.904601	-60.076983	25.00	Scotian Shelf - South Sable Island
0153	Grab	202 / 1322	43.904366	-60.076403	25.00	Scotian Shelf - South Sable Island
0154	Grab	202 / 1328	43.903698	-60.074578	24.00	Scotian Shelf - South Sable Island
0155	Grab	202 / 1332	43.903375	-60.07366	25.00	Scotian Shelf - South Sable Island
0156	Grab	202 / 1337	43.903236	-60.073348	25.00	Scotian Shelf - South Sable Island
0157	Grab	202 / 1342	43.902781	-60.072321	25.00	Scotian Shelf - South Sable Island
0158	Grab	202 / 1346	43.90231	-60.07182	26.00	Scotian Shelf - South Sable Island
0159	Grab	202 / 1350	43.902476	-60.07141	26.00	Scotian Shelf - South Sable Island
0160	IKU Grab	202 / 1357	43.902563	-60.071765	26.00	Scotian Shelf - South Sable Island
0161	IKU Grab	202 / 1412	43.903143	-60.073305	25.00	Scotian Shelf - South Sable Island
0162	IKU Grab	202 / 1428	43.9038	-60.074643	24.00	Scotian Shelf - South Sable Island
0163	IKU Grab	202 / 1437	43.901298	-60.077166	25.00	Scotian Shelf - South Sable Island
0164	IKU Grab	202 / 1452	43.905275	-60.078463	26.00	Scotian Shelf - South Sable Island
0165	Vibrocore	202 / 1617	43.90261	-60.095081	24.00	Scotian Shelf - South Sable Island

Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Station Type	Station Day / Time (UTC)	Latitude	Longitude	Water Depth (M)	Geographic Location
0166	Vibrocore	202 / 1740	43.899081	-60.087558	29.00	Scotian Shelf - South Sable Island

Total Number of Stations: 166

Appendix 2

List of core and grab samples of Hudson 2000030A cruise

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0001	Grab		196 / 1115	43.915586 -60.522866	34.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-20; uniform fine sand.
0003	IKU Grab		196 / 1200	43.915515 -60.52265	34.00			90	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-20; E front to back; H left to right; clean medium sand.
		Peel						40			
		Peel						30			
0005	Grab		196 / 1253	43.91678 -60.524376	31.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-19
0006	Grab		196 / 1310	43.91744 -60.525238	29.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-18; medium sand.
0008	IKU Grab		196 / 1338	43.917413 -60.525178	29.00			100	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-18; B left to right; E front to back.
		Peel						30			
		Peel						40			
0010	Grab		196 / 1419	43.918433 -60.526628	29.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-17
0011	IKU Grab		196 / 1415	43.919871 -60.528933	28.00			97	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-16; A front to back; E left to right.
		Peel						30			
		Peel						40			
0012	Grab		196 / 1537	43.91997 -60.528665	48.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-16
0015	Grab		196 / 1634	43.922756 -60.532765	48.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-15
0016	Grab		196 / 1702	43.925805 -60.53697	50.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-14; 1st try did not trip; 2nd try successful; very fine sand.
0018	IKU Grab		196 / 1750	43.925868 -60.537081	50.00			99	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-14; A front to back; H left to right.
		Peel						30			
		Peel						40			
0020	Grab		196 / 1826	43.928038 -60.540618	55.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-13
0021	Grab		196 / 1845	43.92953	34.00			0	0	Scotian Shelf - Sable Island Bank -	COPAN-1-12

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0021			196 / 1845	43.92953 -60.542536	34.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-12
0023	IKU Grab		196 / 1935	43.92961 -60.542493	34.00			100	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-12; B front to back; H left to right; clean medium sand.
		Peel						40			
		Peel						30			
0025	Grab		196 / 2009	43.930141 -60.542743	33.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-11; sea claws/shells.
0026	Grab		197 / 1107	43.930338 -60.543363	40.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-10; fine sand, shells, sand dollars.
0028	IKU Grab		197 / 1133	43.930285 -60.54357	39.00			77	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-10; B front to back; D left to right; fine sand, sand dollar
		Peel						30			
		Peel						40			
0030	Grab		197 / 1212	43.93145 -60.544898	30.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-9; 1st try did not trip; 2nd try successful; fine sand.
0031	Grab		197 / 1259	43.933126 -60.547268	27.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-8
0033	IKU Grab		197 / 1324	43.933075 -60.547436	27.00			100	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-8; B left to right; E fro to back.
		Peel						30			
		Peel						40			
0036	Grab		197 / 1412	43.935791 -60.551315	25.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-7; shells, fine sand.
0037	Grab		197 / 1710	43.937575 -60.553423	23.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-6
0040	Grab		197 / 1747	43.939788 -60.556615	21.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-5
0041	Grab		197 / 1805	43.941976 -60.559583	29.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-4; 1st try unsuccessful did not trip; 2nd try successful.
0044	Grab		197 / 1845	43.943986 -60.562628	32.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-3; shell fragments.

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0045	Grab		197 / 1905	43.946045 -60.56527	30.10			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-2; no surface subsamp taken - sample partially mixed wh dropped.
0047	IKU Grab		197 / 1940	43.946211 -60.565475	31.60			97	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-2; a B left to right tray unsuccessful so redid peel at posit D; D left to right; E front to back; medium sand, worm tube.
		Peel						30			
		Peel						40			
0049	Grab		197 / 2018	43.947751 -60.567878	33.50			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-1
0050	IKU Grab		197 / 2032	43.941941 -60.559988	23.10			96	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-4; A front to back; E l to right.
		Peel						30			
		Peel						40			
0051	IKU Grab		197 / 2048	43.937816 -60.553368	18.10			95	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-6; B left to right; E fro to back.
		Peel						40			
		Peel						30			
0052	Grab		198 / 1043	43.916596 -60.648336	37.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-2
0055	Grab		198 / 1122	43.912788 -60.64608	39.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-3
0056	Grab		198 / 1137	43.910775 -60.645011	35.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-4
0058	IKU Grab		198 / 1158	43.910755 -60.644795	35.40			95	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-4; B front to back; E l to right
		Peel						30			
		Peel						30			
0060	Grab		198 / 1235	43.909986 -60.644516	34.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-6
0061	Vibrocore		198 / 1347	43.947594 -60.567853	34.00			92	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-1; 5 minute vibration penetration; core encased in black plastic - NOT to be exposed to lig

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0062	Vibrocore		198 / 1550	43.941943 -60.559575	29.00			112	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-4; 5 minute vibration penetration; core encased in black plastic - NOT to be exposed to lig note: slight light exposure at bottc 40 cm.
0063	Vibrocore		198 / 1705	43.933163 -60.547413	26.00			55	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-1-8; 5 minute vibration penetration; core encased in black plastic - NOT to be exposed to lig
0064	Grab		198 / 1812	43.908368 -60.64361	32.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-7
0066	IKU Grab		198 / 1837	43.908392 -60.643792	33.00			70	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-7; B front to back; E l to right
		Peel						30			
		Peel						30			
0068	Grab		198 / 1922	43.906178 -60.642548	33.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-8
0069	Grab		198 / 1941	43.904005 -60.641231	32.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-9
0071	IKU Grab		198 / 2015	43.900439 -60.639494	32.00			40	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-11; B front to back; E left to right.
		Peel						30			
		Peel						30			
0073	Grab		198 / 2133	43.900433 -60.639218	32.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-11
0074	Grab		199 / 1026	43.898325 -60.637883	33.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-13
0077	Grab		199 / 1122	43.897626 -60.63737	33.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-14
0078	IKU Grab		199 / 1137	43.89754 -60.637586	33.00			75	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-14; B front to back; E left to right.
		Peel						30			
		Peel						30			
0079	Grab		199 / 1205	43.895878 -60.636565	37.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-15

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0082	Grab		199 / 1348	43.894678 -60.636216	41.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-16.
0083	IKU Grab		199 / 1359	43.894627 -60.636037	41.00			55	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-16; B front to back; E left to right.
		Peel						30			
		Peel						30			
0084	Grab		199 / 1435	43.893303 -60.635525	44.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-17
0087	Grab		199 / 1640	43.891046 -60.63442	44.00			0	0	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-18; 1st try unsuccessft did not trip; 2nd try successful.
0088	IKU Grab		199 / 1920	43.88893 -60.111198	29.00			70	0	Scotian Shelf - South Sable Island	SS-3-1: D left to right; E front to back.
		Peel						30			
		Peel						40			
0089	Grab		199 / 1937	43.88892 -60.11112	32.00			0	0	Scotian Shelf - South Sable Island	SS-3-1
0092	Grab		199 / 2011	43.888575 -60.110658	29.00			0	0	Scotian Shelf - South Sable Island	SS-3-2
0093	IKU Grab		199 / 2016	43.888371 -60.110048	29.00			80	0	Scotian Shelf - South Sable Island	SS-3-3; B front to back; E left to right.
		Peel						30			
		Peel						40			
0094	Grab		199 / 2035	43.888331 -60.110186	29.00			0	0	Scotian Shelf - South Sable Island	SS-3-3
0096	Vibrocore		200 / 1056	43.883788 -60.630121	38.00			168	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-21; 1st try failed - electrical system shorting out - repaired; 2nd try - 5 minute vibrat penetration; core encased in black plastic; NOT to be exposed to ligl
0097	Vibrocore		200 / 1207	43.877785 -60.627126	33.00			59	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-22; 6 minute vibration penetration; core encased in black plastic; NOT to be exposed to ligl
0098	Vibrocore		200 / 1317	43.868265	38.00			0	1	Scotian Shelf - Sable Island Bank -	COPAN-2-26; 10 minute vibratio

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0098			200 / 1317	43.868265 -60.621346	38.00			0	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-26; 10 minute vibratio penetration; no sample - catcher damaged (perhaps by rock).
0099	Vibrocore		200 / 1412	43.868163 -60.621385	38.00			0	1	Scotian Shelf - Sable Island Bank - COPAN Site	COPAN-2-26; retry of stn 0098; 1 minute vibration penetration; agai no sample - catcher damaged (perhaps by rock).
0101	Grab		200 / 1639	43.887345 -60.108391	28.00			0	0	Scotian Shelf - South Sable Island	SS-3-4
0102	IKU Grab		200 / 1651	43.887556 -60.10822	28.00			100	0	Scotian Shelf - South Sable Island	SS-3-4; B front to back; E left to right.
		Peel						30			
		Peel						30			
0103	Grab		200 / 1719	43.88723 -60.10761	28.00			0	0	Scotian Shelf - South Sable Island	SS-3-5
0106	Grab		200 / 1748	43.886906 -60.106763	28.60			0	0	Scotian Shelf - South Sable Island	SS-3-6
0107	Grab		200 / 1833	43.886506 -60.105853	32.00			0	0	Scotian Shelf - South Sable Island	SS-3-7
0109	IKU Grab		200 / 1854	43.886488 -60.10606	29.00			60	0	Scotian Shelf - South Sable Island	SS-3-7; B left to right; E front to back.
		Peel						30			
		Peel						30			
0111	Grab		200 / 1927	43.886103 -60.105158	30.00			0	0	Scotian Shelf - South Sable Island	SS-3-8
0112	Grab		200 / 1943	43.885596 -60.104105	31.00			0	0	Scotian Shelf - South Sable Island	SS-3-9; 1st try unsuccessful (grab did not trip).
0114	IKU Grab		200 / 2013	43.885641 -60.104088	31.00			50	0	Scotian Shelf - South Sable Island	SS-3-9; 1st attempt - bucket only 25% full so went with 2nd attemp B front to back; E left to right.
		Peel						30			
		Peel						30			
0116	Grab		200 / 2045	43.885048 -60.103095	32.00			0	0	Scotian Shelf - South Sable Island	SS-3-10

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0117	Grab		201 / 959	43.884515 -60.102405	33.70			0	0	Scotian Shelf - South Sable Island	SS-3-11
0120	Grab		201 / 1033	43.884273 -60.101551	32.80			0	0	Scotian Shelf - South Sable Island	SS-3-12
0121	IKU Grab		201 / 1046	43.884346 -60.101496	33.00			100	0	Scotian Shelf - South Sable Island	SS-3-12; E left to right; H front tc back
		Peel						40			
		Peel						30			
0122	Grab		201 / 1102	43.881373 -60.09558	30.00			0	0	Scotian Shelf - South Sable Island	SS-3-17
0125	Grab		201 / 1139	43.881511 -60.095905	29.00			0	0	Scotian Shelf - South Sable Island	SS-3-16
0126	IKU Grab		201 / 1150	43.881491 -60.095671	29.50			90	0	Scotian Shelf - South Sable Island	SS-3-16; E from to back; H left tc right
		Peel						30			
		Peel						30			
0127	Grab		201 / 1213	43.882111 -60.096986	29.40			0	0	Scotian Shelf - South Sable Island	SS-3-15
0130	Grab		201 / 1314	43.882976 -60.098765	30.60			0	0	Scotian Shelf - South Sable Island	SS-3-14
0131	IKU Grab		201 / 1326	43.883145 -60.098895	30.70			70	0	Scotian Shelf - South Sable Island	SS-3-14; B front to back; E left to right.
		Peel						30			
		Peel						30			
0132	Grab		201 / 1418	43.867218 -60.100533	32.00			0	0	Scotian Shelf - South Sable Island	SS-3-13
0135	Grab		201 / 1541	43.881005 -60.09486	30.50			0	0	Scotian Shelf - South Sable Island	SS-3-18
0136	IKU Grab		201 / 1607	43.880815 -60.094418	31.00			55	0	Scotian Shelf - South Sable Island	SS-3-18; 1st try did not trip; 2nd t not enough sample for 2 peels; D l to right; 1 peel only.
		Peel						30			
0137	Grab		201 / 1627	43.880631	32.10			0	0	Scotian Shelf - South Sable Island	SS-3-19

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0137			201 / 1627	43.880631 -60.093501	32.10			0	0	Scotian Shelf - South Sable Island	SS-3-19
0140	IKU Grab		201 / 1712	43.880543 -60.0935	32.20			70	0	Scotian Shelf - South Sable Island	SS-3-20; B front to back; E left to right.
		Peel						30			
		Peel						30			
0141	Grab		202 / 1000	43.880273 -60.0932	59.00			0	0	Scotian Shelf - South Sable Island	SS-3-20
0142	Grab		202 / 1037	43.902296 -60.071095	26.00			0	0	Scotian Shelf - South Sable Island	SS-1-13
0148	Grab		202 / 1259	43.905803 -60.07934	27.00			0	0	Scotian Shelf - South Sable Island	SS-1-1
0149	Grab		202 / 1307	43.905441 -60.078911	27.00			0	0	Scotian Shelf - South Sable Island	SS-1-2
0150	Grab		202 / 1310	43.90524 -60.078648	27.00			0	0	Scotian Shelf - South Sable Island	SS-1-3
0151	Grab		202 / 1314	43.904943 -60.077766	26.00			0	0	Scotian Shelf - South Sable Island	SS-1-4
0152	Grab		202 / 1317	43.904601 -60.076983	25.00			0	0	Scotian Shelf - South Sable Island	SS-1-5
0153	Grab		202 / 1322	43.904366 -60.076403	25.00			0	0	Scotian Shelf - South Sable Island	SS-1-6
0154	Grab		202 / 1328	43.903698 -60.074578	24.00			0	0	Scotian Shelf - South Sable Island	SS-1-7
0155	Grab		202 / 1332	43.903375 -60.07366	25.00			0	0	Scotian Shelf - South Sable Island	SS-1-8
0156	Grab		202 / 1337	43.903236 -60.073348	25.00			0	0	Scotian Shelf - South Sable Island	SS-1-9
0157	Grab		202 / 1342	43.902781 -60.072321	25.00			0	0	Scotian Shelf - South Sable Island	SS-1-10
0158	Grab		202 / 1346	43.90231	26.00			0	0	Scotian Shelf - South Sable Island	SS-1-11

Core / Grab Samples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Sample Type	Subcore (If Any) Type	Day / Time (UTC)	Latitude Longitude	Water Depth (mtrs)	Corer Length (cm)	App. Penn. (cm)	Core Length (cm)	No. of Sections	Location	Comments
0158			202 / 1346	43.90231 -60.07182	26.00			0	0	Scotian Shelf - South Sable Island	SS-1-11
0159	Grab		202 / 1350	43.902476 -60.07141	26.00			0	0	Scotian Shelf - South Sable Island	SS-1-12
0160	IKU Grab		202 / 1357	43.902563 -60.071765	26.00			95	0	Scotian Shelf - South Sable Island	SS-1-11; B front to back; D left tc right.
		Peel						30			
		Peel						40			
0161	IKU Grab		202 / 1412	43.903143 -60.073305	25.00			100	0	Scotian Shelf - South Sable Island	SS-1-9; B front to back; E left to right.
		Peel						30			
		Peel						40			
0162	IKU Grab		202 / 1428	43.9038 -60.074643	24.00			100	0	Scotian Shelf - South Sable Island	SS-1-7; B front to back; E left to right.
		Peel						30			
		Peel						40			
0163	IKU Grab		202 / 1437	43.901298 -60.077166	25.00			100	0	Scotian Shelf - South Sable Island	SS-1-5; B front to back; E left to right.
		Peel						40			
		Peel						40			
0164	IKU Grab		202 / 1452	43.905275 -60.078463	26.00			100	0	Scotian Shelf - South Sable Island	SS-1-2; B front to back; E left to right.
		Peel						40			
		Peel						40			
0165	Vibrocore		202 / 1617	43.90261 -60.095081	24.00			140	1	Scotian Shelf - South Sable Island	SS-2-5; 7 minute vibration penetration; 3.2 inch ID liner; cor encased in black plastic; NOT to b exposed to light.
0166	Vibrocore		202 / 1740	43.899081 -60.087558	29.00			199	1	Scotian Shelf - South Sable Island	SS-2-12; 10 minute vibration penetration; 3.2 inch ID liner; win wire shortout so no barrel retractic core encased in black plastic; NO to be exposed to light.

Total Number of Subcores: 59

Total Number of Sample Stations: 106

Appendix 3

List of subsamples of Hudson 2000030A cruise

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0001	Grab	34.00 196 / 1115	43.915586 -60.522866	2	1 2		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0003	IKU Grab	34.00 196 / 1200	43.915515 -60.52265	1	3		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0005	Grab	31.00 196 / 1253	43.91678 -60.524376	2	4 5		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0006	Grab	29.00 196 / 1310	43.91744 -60.525238	2	6 7		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0008	IKU Grab	29.00 196 / 1338	43.917413 -60.525178	1	8		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0010	Grab	29.00 196 / 1419	43.918433 -60.526628	2	9 10		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0011	IKU Grab	28.00 196 / 1415	43.919871 -60.528933	1	11		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0012	Grab	48.00 196 / 1537	43.91997 -60.528665	2	12 13		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0015	Grab	48.00 196 / 1634	43.922756 -60.532765	2	14 15		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0016	Grab	50.00 196 / 1702	43.925805 -60.53697	2	16 17		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0018	IKU Grab	50.00 196 / 1750	43.925868 -60.537081	1	18		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0020	Grab	55.00 196 / 1826	43.928038 -60.540618	2	19 20		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0021	Grab	34.00 196 / 1845	43.92953 -60.542536	2	21 22		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0023	IKU Grab	34.00 196 / 1935	43.92961 -60.542493	1	23		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0025	Grab	33.00 196 / 2009	43.930141 -60.542743	2	24 25		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0026	Grab	40.00 197 / 1107	43.930338 -60.543363	2	26 27		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0028	IKU Grab	39.00 197 / 1133	43.930285 -60.54357	1	28		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0030	Grab	30.00 197 / 1212	43.93145 -60.544898	2	29		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0030		30.00 197 / 1212	43.93145 -60.544898		30		Grain Size	blended	Scotian Shelf - Sable Island Bank - COPAN Site
0031	Grab	27.00 197 / 1259	43.933126 -60.547268	2	31 32		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0033	IKU Grab	27.00 197 / 1324	43.933075 -60.547436	1	33		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0036	Grab	25.00 197 / 1412	43.935791 -60.551315	2	34 35		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0037	Grab	23.00 197 / 1710	43.937575 -60.553423	2	36 37		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0040	Grab	21.00 197 / 1747	43.939788 -60.556615	2	38 39		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0041	Grab	29.00 197 / 1805	43.941976 -60.559583	2	40 41		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0044	Grab	32.00 197 / 1845	43.943986 -60.562628	2	42 43		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0045	Grab	30.10 197 / 1905	43.946045 -60.56527	2	44 161		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0047	IKU Grab	31.60 197 / 1940	43.946211 -60.565475	1	45		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0049	Grab	33.50 197 / 2018	43.947751 -60.567878	2	46 47		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0050	IKU Grab	23.10 197 / 2032	43.941941 -60.559988	1	48		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0051	IKU Grab	18.10 197 / 2048	43.937816 -60.553368	1	49		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0052	Grab	37.00 198 / 1043	43.916596 -60.648336	2	50 51		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0055	Grab	39.00 198 / 1122	43.912788 -60.64608	2	52 53		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0056	Grab	35.00 198 / 1137	43.910775 -60.645011	2	54 55		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0058	IKU Grab	35.40 198 / 1158	43.910755 -60.644795	1	56		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0060	Grab	34.00 198 / 1235	43.909986 -60.644516	2	57		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0060		34.00 198 / 1235	43.909986 -60.644516		58		Grain Size	blended	Scotian Shelf - Sable Island Bank - COPAN Site
0064	Grab	32.00 198 / 1812	43.908368 -60.64361	2	59 60		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0066	IKU Grab	33.00 198 / 1837	43.908392 -60.643792	1	61		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0068	Grab	33.00 198 / 1922	43.906178 -60.642548	2	62 63		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0069	Grab	32.00 198 / 1941	43.904005 -60.641231	2	64 65		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0071	IKU Grab	32.00 198 / 2015	43.900439 -60.639494	1	66		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0073	Grab	32.00 198 / 2133	43.900433 -60.639218	2	67 68		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0074	Grab	33.00 199 / 1026	43.898325 -60.637883	2	69 70		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0077	Grab	33.00 199 / 1122	43.897626 -60.63737	2	71 72		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0078	IKU Grab	33.00 199 / 1137	43.89754 -60.637586	1	73		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0079	Grab	37.00 199 / 1205	43.895878 -60.636565	2	74 75		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0082	Grab	41.00 199 / 1348	43.894678 -60.636216	2	76 77		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0083	IKU Grab	41.00 199 / 1359	43.894627 -60.636037	1	78		Grain Size	surface	Scotian Shelf - Sable Island Bank - COPAN Site
0084	Grab	44.00 199 / 1435	43.893303 -60.635525	2	79 80		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0087	Grab	44.00 199 / 1640	43.891046 -60.63442	2	81 82		Grain Size Grain Size	surface blended	Scotian Shelf - Sable Island Bank - COPAN Site
0088	IKU Grab	29.00 199 / 1920	43.88893 -60.111198	1	83		Grain Size	surface	Scotian Shelf - South Sable Island
0089	Grab	32.00 199 / 1937	43.88892 -60.11112	2	84 85		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0092	Grab	29.00 199 / 2011	43.888575 -60.110658	2	86		Grain Size	surface	Scotian Shelf - South Sable Island

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0092		29.00 199 / 2011	43.888575 -60.110658		87		Grain Size	blended	Scotian Shelf - South Sable Island
0093	IKU Grab	29.00 199 / 2016	43.888371 -60.110048	1	88		Grain Size	surface	Scotian Shelf - South Sable Island
0094	Grab	29.00 199 / 2035	43.888331 -60.110186	2	89 90		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0101	Grab	28.00 200 / 1639	43.887345 -60.108391	2	91 92		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0102	IKU Grab	28.00 200 / 1651	43.887556 -60.10822	1	93		Grain Size	surface	Scotian Shelf - South Sable Island
0103	Grab	28.00 200 / 1719	43.88723 -60.10761	2	94 95		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0106	Grab	28.60 200 / 1748	43.886906 -60.106763	2	96 97		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0107	Grab	32.00 200 / 1833	43.886506 -60.105853	2	98 99		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0109	IKU Grab	29.00 200 / 1854	43.886488 -60.10606	1	100		Grain Size	surface	Scotian Shelf - South Sable Island
0111	Grab	30.00 200 / 1927	43.886103 -60.105158	2	101 102		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0112	Grab	31.00 200 / 1943	43.885596 -60.104105	2	103 104		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0114	IKU Grab	31.00 200 / 2013	43.885641 -60.104088	1	105		Grain Size	surface	Scotian Shelf - South Sable Island
0116	Grab	32.00 200 / 2045	43.885048 -60.103095	2	106 107		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0117	Grab	33.70 201 / 959	43.884515 -60.102405	2	108 109		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0120	Grab	32.80 201 / 1033	43.884273 -60.101551	2	110 111		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0121	IKU Grab	33.00 201 / 1046	43.884346 -60.101496	1	112		Grain Size	surface	Scotian Shelf - South Sable Island
0122	Grab	30.00 201 / 1102	43.881373 -60.09558	2	113 114		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0125	Grab	29.00 201 / 1139	43.881511 -60.095905	2	115		Grain Size	surface	Scotian Shelf - South Sable Island

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0125		29.00 201 / 1139	43.881511 -60.095905		116		Grain Size	blended	Scotian Shelf - South Sable Island
0126	IKU Grab	29.50 201 / 1150	43.881491 -60.095671	1	117		Grain Size	surface	Scotian Shelf - South Sable Island
0127	Grab	29.40 201 / 1213	43.882111 -60.096986	2	118 119		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0130	Grab	30.60 201 / 1314	43.882976 -60.098765	2	120 121		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0131	IKU Grab	30.70 201 / 1326	43.883145 -60.098895	1	122		Grain Size	surface	Scotian Shelf - South Sable Island
0132	Grab	32.00 201 / 1418	43.867218 -60.100533	2	123 162		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0135	Grab	30.50 201 / 1541	43.881005 -60.09486	2	124 125		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0136	IKU Grab	31.00 201 / 1607	43.880815 -60.094418	1	126		Grain Size	surface	Scotian Shelf - South Sable Island
0137	Grab	32.10 201 / 1627	43.880631 -60.093501	2	127 128		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0140	IKU Grab	32.20 201 / 1712	43.880543 -60.0935	1	129		Grain Size	surface	Scotian Shelf - South Sable Island
0141	Grab	59.00 202 / 1000	43.880273 -60.0932	2	130 163		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0142	Grab	26.00 202 / 1037	43.902296 -60.071095	2	131 132		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0148	Grab	27.00 202 / 1259	43.905803 -60.07934	2	133 134		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0149	Grab	27.00 202 / 1307	43.905441 -60.078911	2	135 136		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0150	Grab	27.00 202 / 1310	43.90524 -60.078648	2	137 138		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0151	Grab	26.00 202 / 1314	43.904943 -60.077766	2	139 140		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0152	Grab	25.00 202 / 1317	43.904601 -60.076983	2	141 142		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0153	Grab	25.00	43.904366	2	143		Grain Size	surface	Scotian Shelf - South Sable Island

Subsamples Report

Expedition: 2000030A

Chief Scientist: Michael Li

Station Number	Type of Sampler	Water Depth (M) Day/Time (UTC)	Latitude Longitude	No. of Subsamples Per Station	Subsample Number	If Subsample Associated With Subcore, Subcore Name	What Type of Analysis Subsample Was Taken For	Subsample Comments	Geographic Location
0153		25.00 202 / 1322	43.904366 -60.076403		144		Grain Size	blended	Scotian Shelf - South Sable Island
0154	Grab	24.00 202 / 1328	43.903698 -60.074578	2	145 146		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0155	Grab	25.00 202 / 1332	43.903375 -60.07366	2	147 148		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0156	Grab	25.00 202 / 1337	43.903236 -60.073348	2	149 150		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0157	Grab	25.00 202 / 1342	43.902781 -60.072321	2	151 152		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0158	Grab	26.00 202 / 1346	43.90231 -60.07182	2	153 154		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0159	Grab	26.00 202 / 1350	43.902476 -60.07141	2	155 156		Grain Size Grain Size	surface blended	Scotian Shelf - South Sable Island
0161	IKU Grab	25.00 202 / 1412	43.903143 -60.073305	1	157		Grain Size	surface	Scotian Shelf - South Sable Island
0162	IKU Grab	24.00 202 / 1428	43.9038 -60.074643	1	158		Grain Size	surface	Scotian Shelf - South Sable Island
0163	IKU Grab	25.00 202 / 1437	43.901298 -60.077166	1	159		Grain Size	surface	Scotian Shelf - South Sable Island
0164	IKU Grab	26.00 202 / 1452	43.905275 -60.078463	1	160		Grain Size	surface	Scotian Shelf - South Sable Island

Total Number of Subsamples: 163

Appendix 4

List of camera stations of Hudson 2000030A cruise

Camera Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Camera Type	Film Type	Start Day / Time (UTC)	Start Latitude / Longitude	Orientation Type	Stop Day / Time (UTC)	Stop Latitude / Longitude	Comments
0039			197 / 1738	43.939838 -60.556995	Vertical	1971738	43.939843 -60.557056	COPAN-1-5; 2 shots taken.
0042	Benthos	Print 400	197 / 1817	43.941966 -60.559666	Vertical	1971817	43.941925 -60.559653	COPAN-1-4; 2 shots taken.
0043	Benthos	Print 400	197 / 1836	43.94402 -60.56265	Vertical	1971836	43.944023 -60.562666	COPAN-1-3; 2 shots taken.
0046	Benthos	Print 400	197 / 1929	43.946041 -60.565361	Vertical	1971932	43.946055 -60.565521	COPAN-1-2; 2 shots taken.
0048	Benthos	Print 400	197 / 2008	43.947746 -60.567818	Vertical	1972009	43.947746 -60.567848	COPAN-1-1; 2 shots taken.
0053	Benthos	Print 400	198 / 1057	43.916796 -60.64814	Vertical	1981057	43.916796 -60.648206	COPAN-2-2; 2 shots taken.
0054	Benthos	Print 400	198 / 1114	43.912798 -60.646075	Vertical	1981114	43.912843 -60.646038	COPAN-2-3; 2 shots taken.
0057	Benthos	Print 400	198 / 1148	43.910778 -60.64497	Vertical	1981148	43.910763 -60.64494	COPAN-2-4; 2 shots taken.
0059	Benthos	Print 400	198 / 1224	43.910076 -60.644661	Vertical	1981225	43.910098 -60.644728	COPAN-2-6; 2 shots taken.
0065	Benthos	Print 400	198 / 1826	43.908368 -60.643755	Vertical	1981827	43.908318 -60.643608	COPAN-2-7; 2 shots taken.
0067	Benthos	Print 400	198 / 1912	43.906113 -60.64252	Vertical	1981913	43.906105 -60.642555	COPAN-2-8; 2 shots taken.
0070	Benthos	Print 400	198 / 1955	43.903996 -60.641356	Vertical	1981958	43.904003 -60.641371	COPAN-2-9; 2 shots taken.
0072	Benthos	Print 400	198 / 2126	43.90042 -60.639215	Vertical	1982127	43.900411 -60.63927	COPAN-2-11; 2 shots taken.
0075	Benthos	Print 400	199 / 1044	43.898506 -60.637895	Vertical	1991045	43.898306 -60.637768	COPAN-2-13; 1 shot taken; problems taking shots (wind vs current/ship prop wash).
0076	Benthos	Print 400	199 / 1103	43.897926 -60.638165	Vertical	1991103	43.897926 -60.638165	COPAN-2-14; 1 shot taken / perhaps more.
0080	Benthos	Print 400	199 / 1216	43.895628 -60.637316	Vertical	1991216	43.89564 -60.636765	COPAN-2-15; 2-3 shots taken (2nd shot at 1218 UTC 43 53.7495 lat 60 38.2651 long).
0081	Benthos	Print 400	199 / 1324	43.894921 -60.636136	Vertical	1991325	43.894818 -60.636118	COPAN-2-16; 2-3 shots taken.

Camera Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Camera Type	Film Type	Start Day / Time (UTC)	Start Latitude / Longitude	Orientation Type	Stop Day / Time (UTC)	Stop Latitude / Longitude	Comments
0002	Benthos	Print 400	196 / 1134	43.915631 -60.522573	Vertical	1961135	43.91566 -60.522786	COPAN-1-20; 2 shots taken; note: no header shots on film for camera stations 0002 to 0086 inclusive.
0004	Benthos	Print 400	196 / 1243	43.916628 -60.524348	Vertical	1961245	43.916738 -60.524321	COPAN-1-19; 3 shots taken (2nd shot at 43 54.9984 lat 60 31.4697 long 1244 UTC time probably did not work)
0007	Benthos	Print 400	196 / 1322	43.91734 -60.525526	Vertical	1961322	43.917313 -60.525533	COPAN-1-18; 2 shots taken.
0009	Benthos	Print 400	196 / 1410	43.918371 -60.526786	Vertical	1961410	43.918378 -60.526811	COPAN-1-17; 2 shots taken.
0013	Benthos	Print 400	196 / 1549	43.919785 -60.528865	Vertical	1961550	43.919765 -60.528961	COPAN-1-16; 2-3 shots taken.
0014	Benthos	Print 400	196 / 1623	43.922751 -60.532976	Vertical	1961623	43.922751 -60.532976	COPAN-1-15; 2 shots taken.
0017	Benthos	Print 400	196 / 1714	43.925948 -60.537155	Vertical	1961714	43.925948 -60.537155	COPAN-1-14; believed to be unsuccessful - presumec no shots taken; believed on bottom but too much drag due to current.
0019	Benthos	Print 400	196 / 1818	43.92811 -60.540361	Vertical	1961819	43.928141 -60.540486	COPAN-1-13; 2 shots taken.
0022	Benthos	Print 400	196 / 1858	43.929585 -60.54232	Vertical	1961859	43.929561 -60.542401	COPAN-1-12; 2 shots taken.
0024	Benthos	Print 400	196 / 1959	43.930063 -60.542826	Vertical	1962000	43.930038 -60.542825	COPAN-1-11; 2 shots taken.
0027	Benthos	Print 400	197 / 1119	43.930378 -60.543468	Vertical	1971119	43.930366 -60.543456	COPAN-1-10; 2 shots taken.
0029	Benthos	Print 400	197 / 1158	43.931496 -60.544895	Vertical	1971158	43.931496 -60.544895	COPAN-1-9; 2 shots taken.
0032	Benthos	Print 400	197 / 1312	43.93315 -60.547208	Vertical	1971314	43.933228 -60.547516	COPAN-1-8; 5 tries but believed to be failed attempts shots may have been taken; did not appear to trigger.
0034	Benthos	Print 400	197 / 1343	43.93318 -60.547366	Vertical	1971343	43.933148 -60.547366	COPAN-1-8; this is a retry of station 0032 at same site; 2 shots taken.
0035	Benthos	Print 400	197 / 1402	43.935763 -60.551286	Vertical	1971402	43.935815 -60.551328	COPAN-1-7; 2 shots taken.
0038	Benthos	Print 400	197 / 1722	43.937415 -60.55349	Vertical	1971723	43.937516 -60.553451	COPAN-1-6; 2 shots taken.
	Benthos	Print 400	197 / 1738	43.939838				

Camera Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Camera Type	Film Type	Start Day / Time (UTC)	Start Latitude / Longitude	Orientation Type	Stop Day / Time (UTC)	Stop Latitude / Longitude	Comments
0085	Benthos	Print 400	199 / 1447	43.89306 -60.635986	Vertical	1991448	43.892721 -60.636038	COPAN-2-17; 2-3 shots taken.
0086	Benthos	Print 400	199 / 1625	43.891356 -60.634331	Vertical	1991716	43.89135 -60.634398	COPAN-2-18; 2 shots taken.
0090	Benthos	Print 400	199 / 1952	43.888888 -60.110803	Vertical	1991952	43.888921 -60.110858	SS-3-1; 2 shots taken.
0091	Benthos	Print 400	199 / 2000	43.888591 -60.110683	Vertical	1992001	43.888513 -60.110605	SS-3-2; 2 shots taken, possibly more.
0095	Benthos	Print 400	199 / 2054	43.8882 -60.110205	Vertical	1992056	43.888245 -60.110046	SS-3-3; 3 shots taken (2nd shot probably bad).
0100	Benthos	Print 400	200 / 1630	43.887653 -60.108171	Vertical	2001631	43.887693 -60.108151	SS-3-4; 2 shots taken.
0104	Benthos	Print 400	200 / 1730	43.88712 -60.107705	Vertical	2001330	43.88712 -60.107763	SS-3-5; 2 shots taken.
0105	Benthos	Print 400	200 / 1741	43.886793 -60.106791	Vertical	2001742	43.886793 -60.106791	SS-3-6; 2 shots taken.
0108	Benthos	Print 400	200 / 1844	43.886448 -60.105928	Vertical	2001844	43.886428 -60.105975	SS-3-7; 2 shots taken.
0110	Benthos	Print 400	200 / 1920	43.88613 -60.105166	Vertical	2001920	43.88611 -60.105206	SS-3-8; 3 shots taken.
0113	Benthos	Print 400	200 / 1953	43.885425 -60.104165	Vertical	2001954	43.885475 -60.104138	SS-3-9; 2 shots taken.
0115	Benthos	Print 400	200 / 2034	43.88506 -60.103026	Vertical	2002035	43.885093 -60.103071	SS-3-10; 3 shots taken.
0118	Benthos	Print 400	201 / 1011	43.884836 -60.102148	Vertical	2011011	43.884858 -60.10206	SS-3-11; 2 shots taken.
0119	Benthos	Print 400	201 / 1025	43.884345 -60.101595	Vertical	2011026	43.884378 -60.101595	SS-3-12; 2 shots taken.
0123	Benthos	Print 400	201 / 1118	43.881268 -60.095203	Vertical	2011119	43.881286 -60.095145	SS-3-17; 2 shots taken.
0124	Benthos	Print 400	201 / 1132	43.881505 -60.095888	Vertical	2011132	43.881371 -60.095816	SS-3-16; 3 shots taken.
0128	Benthos	Print 400	201 / 1225	43.882175 -60.096968	Vertical	2011226	43.882296 -60.097233	SS-3-15; 2-3 shots taken.

Camera Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Camera Type	Film Type	Start Day / Time (UTC)	Start Latitude / Longitude	Orientation Type	Stop Day / Time (UTC)	Stop Latitude / Longitude	Comments
0129	Benthos	Print 400	201 / 1303	43.883086 -60.098666	Vertical	2011305	43.883115 -60.098805	SS-3-14; 2-4 shots taken.
0133	Benthos	Print 400	201 / 1436	43.883748 -60.100268	Vertical	2011436	43.883956 -60.100233	SS-3-13; 2 shots taken.
0134	Benthos	Print 400	201 / 1525	43.881166 -60.09436	Vertical	2011526	43.881191 -60.094083	SS-3-18; 3 shots taken.
0138	Benthos	Print 400	201 / 1636	43.880631 -60.093683	Vertical	2011636	43.880601 -60.093653	SS-3-19; 2 shots taken.
0139	Benthos	Print 400	201 / 1647	43.880453 -60.093095	Vertical	2011648	43.880368 -60.093085	SS-3-20; 3 shots taken.
0143	Benthos	Print 400	202 / 1109	43.902293 -60.071358	Vertical	2021109	43.90231 -60.071366	SS-1-13; 2 shots taken (on the film role - 8 shots for header shot 0143).
0144	Benthos	Print 400	202 / 1110	43.902345 -60.071383	Vertical	2021111	43.902551 -60.07159	SS-1-12; 1 shot taken.
0145	Benthos	Print 400	202 / 1122	43.902551 -60.07159	Vertical	2021127	43.902528 -60.07159	SS-1-11; 2 shots taken.
0146	Benthos	Print 400	202 / 1130	43.902478 -60.071495	Vertical	2021131	43.902375 -60.07137	SS-1-12; 3 shots taken.
0147	Benthos	Print 400	202 / 1154	43.903633 -60.074396	Vertical	2021233	43.904438 -60.076331	total of 19 shots at this station (+ 2 possible at SS-1-9 = 21 shots); NOTE: header shot [0147] at end of series; SS-1-7 1154 UTC 43 54.218 60 4.4638; 1155 UTC 43 54.2106 60 4.4657; 2 shots; SS-1-8 1159 UTC 43 54.205 60 4301; 1159 UTC 43 54.2038 60 4.427; 2 shots; SS-1-9 1202 UTC 43 54.1903 60 4.4035; believe no shot at 1202 UTC 43 54.1854 60 4.3928; believe no shot at 1203 UTC 43 54.1835 60 4.3847; SS-1-10 1205 UTC 43 54.1646 60 4.3553; 1205 UTC 43 54.1693 60 4.351; 2 shots; SS-1-1 1221 UTC 43 54.3264 60 4.7568; 1221 UTC 43 54.3288 60 4.7527; 2 shots; SS-1-2 1222 UTC 43 54.3363 60 4.7424; 1222 UTC 43 54.3356 60 4.7366; 2 shots; SS-1-3 1224 UTC 43 54.3221 60 4.7141; 1224 UTC 43 54.3174 60 4.3174; 2 shots; SS-1-4 1227 UTC 43 54.2926 60 4.671; 1227 UTC 43 54.2932 60 4.6652; 2 shots; SS-1-5 1229 UTC 43 54.2848 60 4.6337; 1229 UTC 43 54.2829 60 4.6294; 2 shots;

Camera Stations Report

Expedition Code: 2000030A

Chief Scientist: Michael Li

Station Number	Camera Type	Film Type	Start Day / Time (UTC)	Start Latitude / Longitude	Orientation Type	Stop Day / Time (UTC)	Stop Latitude / Longitude	Comments
0147			202 / 1154	43.903633 -60.074396				SS-1-6 1233 UTC 43 54.2666 60 4.5868; 1233 UTC 43 54.2663 60 4.5799; 2 shots station sheet - see back.

Total Camera Stations: 60

Appendix 5

Archived seismic/sidescan data of Hudson 2000030A cruise: (a) seismic/sidescan survey lines, (b) analog record inventory and (c) digital tape inventory.

Appendix 5a: Hudson 2000-030a Seismic/Sidescan survey lines

LINE #	START Julian Day/UTC	Laditude	Longitude	UTM, Zone 20		STOP Julian Day/UTC	Laditude	Longitude	UTM, Zone 20		Geographic Location
		Decimal degrees		Easting	Northing		Decimal degrees		Easting	Northing	
Brandal 1	196/0123	44.45965	-61.30172	635103	4924330	196/0421	44.36628	-61.06372	654282	4914379	western Brandal Basin
Brandal 2	196/0421	44.36628	-61.06372	654282	4914379	196/0659	44.3678	-60.84132	671998	4914991	western Brandal Basin
Brandal 3	196/0659	44.3678	-60.84132	671998	4914991	196/0726	44.37897	-60.81976	673683	4916277	western Brandal Basin
Brandal 4	196/0726	44.37897	-60.81976	673683	4916277	196/0809	44.35556	-60.76464	678145	4913795	western Brandal Basin (no line 5)
6	196/2207	43.92473	-60.57178	694929	4866379	196/2307	43.87131	-60.61194	691876	4860352	CoPan repetitive transect
7	196/2315	43.86867	-60.62154	691113	4860036	197/0008	43.93329	-60.65713	688050	4867132	CoPan-2 transect
8	197/0008	43.93329	-60.65713	688050	4867132	197/0049	43.96102	-60.58727	693567	4870373	CoPan-1 to 2 tie
9	197/0049	43.96102	-60.58727	693567	4870373	197/0146	43.90409	-60.50589	700287	4864244	CoPan-1 transit
10	197/0146	43.90409	-60.50589	700287	4864244	197/0314	43.85068	-60.34847	713120	4858706	West Bar region
11	197/0314	43.85068	-60.34847	713120	4858706	197/0442	43.93485	-60.33579	713837	4868088	West Bar region
12	197/0442	43.93485	-60.33579	713837	4868088	197/0555	43.97622	-60.43837	705461	4872422	West Bar region
13	187/0555	43.97622	-60.43837	705461	4872422	197/0701	44.04621	-60.4353	705465	4880203	West Bar region
14	197/0701	44.04621	-60.4353	705465	4880203	197/0852	44.04183	-60.3319	713765	4879980	West Bar region
101a	197/2245	43.89272	-60.14117	729621	4863931	197/2339	43.86514	-60.06263	736038	4861089	SS-3 sample transect, South Sable
101b	198/0007	43.86475	-60.0623	736066	4861047	198/0031	43.89113	-60.06782	735518	4863961	South sable region
102	198/0344	43.86969	-59.98767	742043	4861811	198/0511	43.91082	-60.09282	733433	4866077	SS-4 planned sample transect
103	198/0511	43.91082	-60.09282	733433	4866077	198/0552	43.88635	-60.04242	737578	4863503	along SS-1 sample transect
104	198/0031	43.89113	-60.06782	735518	4863961	198/0110	43.91434	-60.12135	731129	4866388	SS-2 planned sample transect
105	198/0136	43.91482	-60.11487	731647	4866459	198/0236	43.91431	-60.00346	740595	4866721	South sable region
106	198/0245	43.90928	-59.99083	741629	4866199	198/0322	43.86567	-59.98953	741910	4861359	South sable region
108	198/0620	43.88491	-59.99999	740992	4863466	198/0718	43.88316	-59.91137	748118	4863534	South sable region
109	198/0613	43.88457	-60.011	740109	4863396	198/0620	43.88491	-59.99999	740992	4863466	South sable region
201	199/0018	43.88437	-60.00466	740619	4863392	199/0120	43.88323	-59.89606	749348	4863588	South sable region
202	199/0151	43.86482	-59.92403	747177	4861459	199/0223	43.90856	-59.93208	746350	4866293	South sable region
203	199/0223	43.90856	-59.93208	746350	4866293	199/0405	43.90071	-60.11516	731679	4864891	South sable region
204	199/0405	43.90071	-60.11516	731679	4864891	199/0454	43.8557	-60.15865	728358	4859771	South sable region
205	199/0454	43.8557	-60.15865	728358	4859771	199/0651	43.85606	-59.96035	744294	4860378	South sable region
302	199/2152	43.85961	-60.21209	724048	4860059	200/0405	43.58761	-60.69311	686232	4828657	Thebaud to Alma
302b	200/0422	43.5938	-60.67374	687776	4829388	200/0534	43.61043	-60.54524	698094	4831534	Alma to Glenelg
401a	200/0534	43.61043	-60.54524	698094	4831534	200/0730	43.63263	-60.34928	713830	4834486	Alma to Glenelg
401b	201/0238	43.65759	-60.12798	731586	4837852	201/0436	43.6333	-60.35006	713764	4834558	Alma to Glenelg
402b	200/2154	43.86988	-60.18655	726062	4861269	201/0117	43.64502	-60.13934	730719	4836424	Thebaud toGlenelg
1000	201/0509	43.59374	-60.34827	714049	4830169	201/0816	43.59628	-60.34243	714512	4830466	grid/circles south of Alma-Glenelg
Brandal 12	201/2130	44.03991	-60.34677	712580	4879728	202/0322	44.24836	-60.13356	728856	4903454	Brandal Basin, deep channel
Brandal 13	202/0322	44.24836	-60.13356	728856	4903454	202/0530	44.0884	-60.18816	725105	4885536	Brandal Basin, deep channel

Appendix 5b: Hudson 2000-030a Analog Record Inventory

INSTRUMENT	RECORD #	START	STOP	LINE #
Benthos Seismic	1	196/0107	196/0810	Brandal 1 to 4 (no line 5)
Benthos Seismic	2	196/2136	197/0852	6, 7 to 14
Benthos Seismic	3	197/2240	198/0723	101 to 106, 108, 109
Benthos Seismic	4	199/0001	200/0742	201 to 205, 302, 302b, 401a
Benthos Seismic	5	200/2150	201/0440	401b, 402b
Benthos Seismic	6	201/2042	201/0538	Brandal 12
NSRF Seismic	1	196/0130	196/0829	Brandal 1 to 4
NSRF Seismic	2	196/2135	197/0851	6, 7 to 14
NSRF Seismic	3	197/2238	198/0718	101 to 106, 108, 109
NSRF Seismic	4	199/0004	200/0730	201 to 205, 302, 302b, 401a
NSRF Seismic	5	200/2143	201/0438	401b, 402b
NSRF Seismic	6	201/2013	201/0538	Brandal 12
Huntec DTS, sparker	1	196/0120	196/0809	Brandal 1 to 4
Huntec DTS, sparker	2	196/2135	197/2339	6, 7 to 14, 101a
Huntec DTS, sparker	3	197/2341	199/0652	101b to 106, 108, 109, 201 to 205
Huntec DTS, sparker	4	199/2148	200/0729	302, 302b, 401a
Huntec DTS, sparker	5	200/2147	201/0814	401b, 402b, 1000
Huntec DTS, sparker	6	201/2045	201/0529	Brandal 12
Simrad Sidescan, 330 kHz	1	196/2142	196/2356	6 and 7
Simrad Sidescan, 330 kHz	2	197/0008	197/0704	8 to 14
Simrad Sidescan, 330 kHz	3	197/2252	198/0258	101a to 106 a
Simrad Sidescan, 330 kHz	4	198/0302	198/0622	102, 103, 109
Simrad Sidescan, 330 kHz	5	199/0008	199/0652	201 to 205
Simrad Sidescan, 330 kHz	6	199/2152	199/2302	line 302 first part
Simrad Sidescan, 330 kHz	7	199/2304	200/0742	302, 302b, 401a
Simrad Sidescan, 330 kHz	8	200/2150	200/2333	402b
Simrad Sidescan, 330 kHz	9	200/2336	201/0434	402 (latter half) and 401b
Simrad Sidescan, 100 kHz	1	196/2136	196/2239	line 6
Simrad Sidescan, 100 kHz	2	196/2245	197/0149	6, 7, 8, 9
Simrad Sidescan, 100 kHz	3	197/0210	197/0708	10 to 13
Simrad Sidescan, 100 kHz	4	197/2244	198/0000	101a
Simrad Sidescan, 100 kHz	5	198/0004	199/0617	101b, 102, 106
Simrad Sidescan, 100 kHz	6	199/0007	199/0647	201 to 205
Simrad Sidescan, 100 kHz	7	199/0623	199/0654	line 205 end
Simrad Sidescan, 100 kHz	8	199/2154	200/0336	line 302
Simrad Sidescan, 100 kHz	9	200/0342	200/0744	302, 302b, 401a
Simrad Sidescan, 100 kHz	10	200/0000	201/0439	402 (latter half) and 401b
Simrad Sidescan, 100 kHz	11	201/2153	201/2341	14, Brandal 12-1, 12-2, & 12-3

*no sidescan for lines Brandal 1 to 4, 14, 108, first part of line 109, or line 1000

**100 KhZ Sidescan recorded on GSP 1086 and 300 KHz recorded on Alden

Appendix 5c: Hudson 2000-030a Digital Tape Inventory

INSTRUMENT	TAPE #	START	STOP	LINE Number	GEOGRAPHIC LOCATION
		Julian Day/UTC time			
Seismic	1	196/0123	196/2303	1 to 6 (no line 5)	west Brandal Basin & CoPan
Seismic	2	196/2303	200/0730	7 to 14, 101 to 106, 108, 109, 201 to 205, 302, 302b, 401a	CoPan, south sable, Alma
Seismic	3	200/2154	202/0538	401b, 402b, Brandal 12	Glenelg, Thebaud, eastern Brandal Basin
Huntec	1	196/0130	197/0852	1 to 4, 6 to 14	west Brandal Basin, CoPan, West Bar
Huntec	2	197/2258	200/0759	101 to 106, 108, 109, 201 to 205, 302, 302b, 401a	south Sable, Alma
Huntec	3	200/2157	202/0530	401b, 402b, 1000, Brandal 12	Glenelg, Thebaud, eastern Brandal Basin
Sidescan	1	196/2207	197/0656	6 to 13	CoPan, West Bar
Sidescan	2	197/2250	198/0608	101 to 106, 109b	south Sable
Sidescan	3	199/0018	200/0730	201 to 205, 302, 302b, 401a	south Sable, Alma
Sidescan	4	200/2154	201/0436	401b, 402b	Alma, Glenelg