Hudson 92-003
Cruise Report

Edited by:

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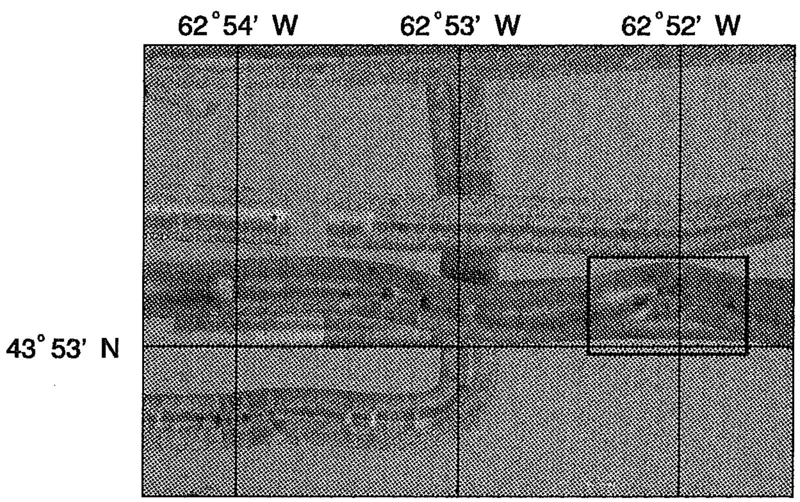

Hudson 92003 Sidescan Mosaic

Processed Data from Inset Area

CRUISE SUMMARY
HUDSON 92-003

Dates: April 21, 1992 - May 1, 1992

Area of Operations: Scotian Shelf (Emerald Basin), Scotian Slope 62^0 to 62^0 30'

Master: Capt. L. A. Strum

Senior Scientist: Dale E. Buckley

Assistant Senior Scientist: Raymond E. Cranston

Responsible Agency: Atlantic Geoscience Centre

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OBJECTIVES

A The primary objective of this expedition was to carry out a series of experiments to evaluate the performance of a large diameter piston coring system that had been mechanically modified over the past 4 to 5 years from earlier designs of the Benthos and University of Rhode Island piston corers. These experiments were designed to test effectiveness of various piston designs, deployment configurations, and other mechanical modifications. Evaluation was to include assessment of the ratio of recovered core length and quality to the depth of penetration of the core in different types of sediment found in Emerald Basin on the Scotian Shelf and on the mid slope of the Scotian Shelf.

B Other testing and evaluation experiments to be carried out during this expedition included evaluation of a differential global positioning system (DGPS). Relative and absolute positioning of equipment and experiments were to be evaluated using the Track Point II acoustic ranging system coupled with the DGPS.

C Sampling of sediments in Emerald Basin and on the mid slope of the Scotian Shelf was designed to determine areas of accumulation and geochemical alteration of sedimentary organic matter. This objective was planned as part of the research program of the Geological Survey of Canada, Global Change Initiative.

CRUISE PERSONNEL

Capt. L.A. Strum	Master, HUDSON
D. Buckley	Senior Scientist, AGC
K. Benthem	Photographer, DFO
J. Burtt	Geochemist, student, Dalhousie
B. Chapman	Electronic Technician, AGC
H. Christian	Geotechnical Engineer, AGC
R. Cranston	Assistant Senior Scientist, Geochemist, AGC
R. Currie	Computer Scientist, AGC
R. Fitzgerald	Geochemist, AGC
D. Heffler	Electronics Engineer, AGC
K. Jarrett	Geotechnical Technologist, contract, AGC
F. Jodrey	Sampling Technician, AGC
L. Johnston	Data Technician, AGC
B. LeBlanc	Geochemical Technician, AGC
D. Locke	Electronic Technician, AGC
B. MacKinnon	Mechanical Engineer, AGC
D. McKeown	Electronics Engineer, DFO
S. Merchant	Curation Technician, AGC
B. Miller	Geological Technician, AGC
B. Murphy	Sampling Technician, AGC
A. Puta-Roberts	Geologist, student, Dalhousie University
J. Smith	Engineer, student, Technical University of N.S.
M. Uyesugi	Electronics Technician, Huntec Contract, AGC
J. Waringer	Geology, student, Dalhousie University
G. Winters	Geochemist, AGC

LOG OF OPERATIONS

Day	Summary of Activities
112-April 21	Depart BIO. Arrive at Test Site #1, Emerald Basin, deploy acoustic beacon, deploy and recover Excaliber. Commence acoustic survey (side scan) of central Emerald Basin.
113-April 22	End overnight acoustic survey, piston core 002, box core 003, lehigh core 004, Excaliber deployment 005 at Test Site #1, Emerald Basin. Commence overnight acoustic survey.
114-April 23	Recover acoustic beacon from test site #1 (after temporary loss when tangled with towed survey gear). Recover Excaliber from test site #1. Piston core 006, Excaliber deployment 007, piston core 008, Lancelot deployment 009 at test site #2. Commence overnight acoustic survey Emerald Basin.
115-April 24	Recover Lancelot, piston core 010, box core 012, piston core 013, at test site #2. Commence overnight acoustic survey Emerald Basin.
116-April 25	End acoustic survey Emerald Basin. piston core 014, piston core 015, piston core 016, site #2. Acoustic survey of pockmark with 3.5 kHz, central Emerald Basin.
117-April 26	Piston core 017 at test site #1. Lehigh core 018, piston core 019, Umel bottom photography, deploy Excaliber 021, navigation calibration at pockmark, central Emerald Basin.
118-April 27	Recover Excaliber and acoustic beacon from pockmark site. Proceed to Scotian Shelf edge, Lehigh core at shelf edge. Commence acoustic profile of shelf slope.
119-April 28	End overnight acoustic profile survey on slope. Lehigh cores 023, 024, 026 Scotian Slope. Commence overnight acoustic profile survey.
120-April 29	End overnight acoustic profile survey on Scotian Slope. Piston core 027 mid-Scotian Slope, Lehigh cores 028, 029, 030 Scotian Slope. Commence overnight acoustic profile survey on Scotian Slope.
121-April 30	End overnight acoustic profile survey on Scotian Slope. Piston core 031, mid-Scotian Slope. Lehigh core 032 Scotian Slope. Grab sample 033 Emerald Bank.
122-May 1	Arrive BIO.

EQUIPMENT LIST / SAMPLES, RECORDS, TAPES

compiled by
B.L. JOHNSTON
(1992)

Sample Inventory

Grabs	1
LeHigh Cores	11
AGC Piston Cores	12
Trigger Cores	11
Box Cores	3
Excaliber	4
Umel Camera Transects	1

Kilometres Data

Huntec DTS540 km
3.5 kHz, Bathymetry571 km
Sleeve Gun Seismic Reflection Profiles545 km
Klein Sidescan Sonar147 km

EQUIPMENT LIST - PERFORMANCE - SUGGESTED IMPROVEMENTS

3.5 Khz Acoustic Profiler (Hull Mounted)

3.5 kHz information was continuously recorded on an EPC 4800 analogue recorder during all overnight and site surveys. The EPC 4800 triggered an ORE 140 transceiver connected to a hull mounted 16 transducer array. All records were recorded at a 0.5 sec sweep with appropriate delays used instead of programs.

Performance

The system performed well and delivered excellent records in softer sediments with reasonable weather conditions.

Klein 100/500 kHz Sidescan Sonar

The Klein 595 Thermal Sidescan Sonar was used to generate short range, high resolution 100/500 Khz data of 300 m and 200 m swath widths (150 m and 100 m each side respectively). Both the 100 kHz and 500 Khz data were logged on a Teac XR-5000 VHS tape recorder in the FM unipolar (+) record mode and a direct record track for recording sync. pulses. A Klein 422S-101HF Tow Fish (100/500 Khz) with a K-Wing depressor was towed on a 600 m cable from a Marquis winch. With all 600 M deployed, layback is about 5 minutes at 2 knots.

Sidescan data was also digitally recorded on an SE880 digital recording system on an XABYTE tape cartridge.

BIO Reflection Seismics

Seismic reflection sound source equipment consisted of 10 and 40 cu inch Texas Instruments sleeve guns with associated airlines, air storage bottles, regulators (etc) operating at 1900-1950 Psi.

High pressure air for the sleeve gun was derived from a 230 cfm Price air compressor. The speed of the compressor was controlled by a variable speed electric motor controller running the compressor at 460 RPM, (approximately 50 % capacity) delivering air at 1850 psi. Baffles (1 inch) were also installed in the intake lines to the first stage to further reduce the low end volume and cut down on the overside dumping of air when supplying the small gun. The motor speed controller operated the compressor at a fraction of its maximum speed/output and thus reduced the normal wear and tear on the compressor. No problems were encountered with the air source during the seismic program.

The sleeve gun was fired at a two or three second rate throughout the cruise. The tow cable bundle was mounted on the port airgun winch and was towed from the port stern roller sheave. Two streamers were used to receive the signals from the sleeve gun.

A Nova Scotia Research Foundation Model LT-18, 6 metre streamer was deployed from a temporary boom on the starboard side. An S.E. eel deployed from a winch on the starboard side of the flight deck was also used. Both the 100'S.E. and 25' S.E. sections were recorded on analogue tape but only the 100' section was recorded on a paper record. One hydraulic power pack was used to service the eel winch, air gun winch and sidescan winch. A leak in the feed valve occurred near the end of the cruise, but did not become serious.

Lab equipment for displaying the seismic signal included the following:

An NSRF pre-amp/termination unit received the NSRF streamer signal and then fed it to a Khron-Hite 3323R filter whose bandpass settings were 180 Hz to 880 Hz. This signal was recorded on an EPC 3200 with a sweep rate of 1 sec for the Emerald Basin survey and a 2 sec sweep for the Scotian Slope survey.

Signals from the S.E. eel were amplified by Controlled delay amplifiers and the 100' was fed to a Khron-Hite 3323R filter with band pass filters set between 180 and 880 Hz. This signal was recorded on an EPC 3200 on a 1 sec sweep for the Emerald Basin survey and a 2 sec sweep for the Scotian Slope survey.

Raw data from sidescan, the NSRF eel, the S.E. eel and Huntec were recorded on VHS cassette tapes on the Teac-XR5000 multi-track recorder.

Sidescan data (100 Khz) was recorded on the SE880 digital recording system on an XABYTE tape cartridge for the Emerald Basin section of the cruise. These data were used by R. Currie for post processing on an HP system.

The EPC 9800 recorded the NSRF data throughout the cruise without loss of data . The resulting records are on a par with records produced on any other recorder in AGC. Ease of operation and flexibility are two important features of this recorder which overcome two shortcomings identified on this cruise. There is a 1-2 sec. layback in record viewing and delays could not be set at 1/4 and 1/2 sec after 1 sec panel delays are reached.

Firing of the sleeve gun was accomplished using the Airgun Firing/Control Unit. Trigger signals for the AFCU and the EPC graphic recorders was derived from the seismic clock.

Ship time was based on the cesium beam controlled SHIPCLOCK computer, which provided accurate timing to the various ship clock repeaters located throughout the ship. The 5-minute pulse output of the AGC SHIPCLOCK repeater was used to trigger the event annotation time for the TSS 312B annotator, to write "day/time, course/speed" on the records of all systems.

Performance

The Price compressor/motor controller combination worked well at the required 460 rpm's. This combination will provide a reliable, maintenance free source of high pressure air for the small air guns over extended periods of time.

No problems were encountered with the EPC 3200 on this cruise. Lab equipment performed well. Note comments made on the EPC 9800 in the preceding paragraphs.

Huntec Deep Tow System (DTS)

The Huntec deep tow system (DTS), number AGC 2, was deployed on this cruise to generate high resolution seismic reflection data. A high voltage boomer sound source of 540 joules generated signals for a LC-10 single hydrophone internally mounted under the boomer plate. A Benthos 10 element 15 foot streamer was towed behind the vehicle and connected to the ship via a 600 meter tow cable on the Hawbolt winch. The Hawbolt winch was on loan from Memorial University of Newfoundland in exchange for their using the smaller AGC winch.

The LC-10 hydrophone data is the "internal hydrophone" data which is amplified and TVG'd through an adaptive signal processor unit and bandpass filtered in the system console before displaying on a EPC 4100 graphic recorder. (SN 139)

The towed streamer data are the "external hydrophone" data which are processed similarly but at lower filter setting through an external Krohn-Hite Model 3700 bandpass filter. These external hydrophone data are also displayed on an EPC 4600 graphic recorder (SN 359). The internal and external data were recorded on a TEAC XR-5000 VHS cassette recorder on direct record channels along with two other channels for (a) the trigger/sync. signal of 1 volt peak, 6.4 kHz EPC sync pulse train with a negative master trigger pulse and a positive fire point pulse; and (b) a master +5v TTL pulse trigger signal. All data were tow vehicle heave compensated in the pressure mode.

G.P. Geophysical Lab Set-up

Klein Sidescan Sonar

Tow fish = 422S-101HF --100/500 Khz - 1 degree beam
Klein 595 graphics recorder/transceiver - paper rate was speed compensated.
scale lines each 15 min on graphic.
Graphic data recorded in regular mode = speed and slant range uncorrected.

Seismics

Raytheon LSR-1811 (x2) line scan recorder
Sweep = 1.0 second in start / stop mode, no delay
Sleeve gun firing rate = 2.0 seconds
40 in^3 Sleeve gun on a 20" Norwegian float
N.S.R.F. LT-18 streamer towed on stbd. quarter
Filtered 180-6500 Hz, 40 db gain + TVG (LSR #1)
Filtered 300-10000 Hz, 40 db gain + TVG (LSR #2)

Huntec D.T.S.

AGC # 1 with 2nd adaptive processor
EPC 4100 x 2 each - S/N 317 & 181
Boomer firing rate = 0.75 sec.
Boomer power = 4 Kvolts (app. 400 joules)
Bottom tracking (adaptive) TVG to max. 4 volt level
Tow vehicle heave compensated in pressure mode
Internal hydrophone filtered - 0.5 to 10 kHz
External hydrophone filtered - 0.5 to 10 kHz

Automatic Graphic Annotation

Technical Survey Services Model 312B-S/N 040
External Event - each 5 min. from seismics clock/timing unit
channel 3 - Hull Profiler 3.5 kHz data on EPC 4100
channel 1 - Seismics data on an EPC 9800 and 3200 in series
channel 2 - Huntec DTS data on an EPC 4100 and an EPC 4600 recorder

TEAC XR5000 Multitrack VHS Cassette Recorder

S/N 723346
Tape speed = 2.4 cm/sec
T120 tape = 2 hr. 52 min.
ID code every 4 seconds in TIME CODE priority
Search for file # 0009 - Title: HN92-003 for recording conditions on tape with time and tape counter (0.1m)

Recording Conditions

Ch. #	Data	Mode	Input Range	Input Zero	Output Level	Output Zero	Filter Type
1	Raw Seismics NSRF	DR	0.3v		2v		
2	Seismics Trigger	FM	3.0v	+000%	5v	0v	LP
3	n/c						
4	DTS Internal Signal	DR	0.3v		2v		
5	DTS Trigger/Sync.	DR	1.0v		5v		
6	DTS External Signal	DR	0.7v		2v		
7	Klein 595 ch1(100 kHz)	FM	1.4v	-100%	2v	+100%	FA
8	Klein 595 Sync.	DR	3.0v		5v		
9	Klein 595 ch2(100 kHz)	FM	1.4v	-100%	2v	+100%	FA
10	n/c						
11	Klein 595 anno.RS232/2	FM	10v				
12	n/c						
13	ID Code	FM	5.0v	+000%	5v	0v	LP
14	DTS master pulse	FM	3.0v	+000%	5v	0v	LP
15	DR - Voice Memo from Mike - each 1 hr.						

TEAC System Set-up

* 1.	Tape servo ch.:	Data
2.	Ch. 13 memo read:	Off
3.	Inhibit on rec.:	On
4.	Erase:	On
* 5.	FM band select:	Hi Band
6.	I.D. code format:	5000
7.	Reverse rec.:	Off
* 8.	Reset initialize:	1
9.	Power fail restart:	0
10.	Power SW. off mode:	2
11.	Cal. switch mode:	0
12.	Tape remain:	min
13.	Beep tone:	on

Bandwidth for DR mode is 100 Hz to 4.69 kHz - S/N = 28db
Bandwidth for FM mode on high band is: DC to 2.5 kHz - SN = 33db
Carrier frequency = 259.2 kHz

Performance

The Huntec Deep Tow system worked 100% of the time and produced acceptable records throughout the cruise. The 3.5 Khz and Huntec DTS interfere with each other, thus downgrading the quality of the Huntec signal.

Table 1. Parameter Start/Stop Times

3.5 KHZ BATHYMETRY	SLEEVE GUN SEISMICS
1130210-1131030	1130210-1131030
1132045-1140933	1132054-1130930
1142130-1150700	1142130-1150700
1160040-1160503	1160630-1160955
1160615-1160955	1181830-1191051
1171607-1172225	1192050-1201100
1181600-1191051	1201950-1211100
1192025-1201100	
1201950-1210435	
1210530-1211100	

HUNTEC (DTS)	KLEIN SIDESCAN
1130210-1131030	1130210-1131030
1132050-1140930	1132057-1140930
1142130-1150645	1142130-1142202
1160615-1160955	1142221-1150655
1181859-1191051	1160040-1160450
1192100-1201100	1160615-1160955
1202000-1211100	

Navigation

Primary navigation was provided by a Magnavox 4200 GPS receiver operating in differential mode. Secondary navigation was provided by a Trimble 10X GPS receiver. Both systems were on line to the 'BIONAV' integrated navigation system. The present satellite configuration consists of 20+ high altitude satellites providing 24 hours per day coverage.

The BIONAV system provided real time displays to the bridge, GP lab, forward lab and winch room. The Navigation technician provided support to the ships officers for waypoint entries for line running, homing etc. Periodic clock adjustments were made as necessary.

Performance

This configuration of GPS receivers with one operating in differential mode worked extremely well in this area. Radio reception was excellent throughout the cruise resulting in only a few periods of interrupted differential corrections. When differential corrections were not available, BIONAV switched to the Trimble 10x to provide uninterrupted navigation for display and logging.

Two ships officers, unfamiliar with Bionav, required some assistance early in the cruise.

Navigation Logging

Data were logged via an RS232 link at 9600 baud directly into port TXA5: on the VAX computer. These data were then reformatted into SHIPAC format for processing via the shipboard data processing system 'SHIPAC'. For the purposes of this cruise, the incoming data string was also reformatted into NMEA format and output on port txa7 for use in high resolution DGPS evaluation.

Navigation quality was excellent with Differential GPS positions being within error limits of 5-10 metres at all times.

Performance

Data were logged on a 24 hour basis throughout the trip. No problems were encountered with this setup.

For further details on navigation performance and differential global positioning evaluation see following sections of this report.

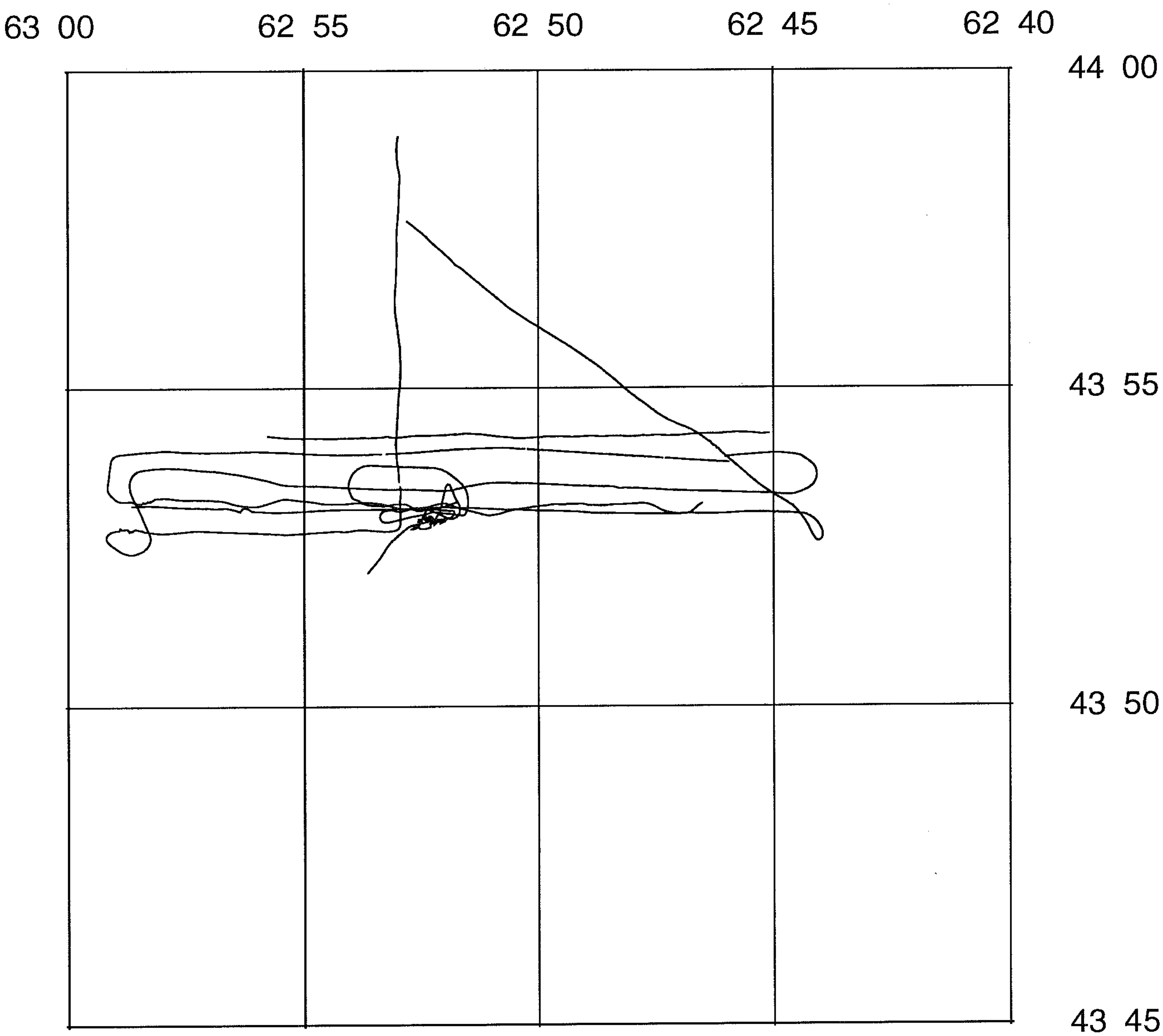
Data Processing (VAX)

Data processing was carried out on a Microvax II minicomputer using the SHIPAC shipboard/shore geophysical processing and display software. Daily plots were done on navigation collected the previous day to continuously monitor navigation quality. The Microvax was configured with 11Mb of memory, a Wren 5 640 Mb disc, a Wren 7 1.2 gigabyte disc, a 95 Mb Tk50 tape cartridge and a 2 gigabyte XABYTE tape cartridge. Communications with the Vax were accomplished through two VT220 (System Console) and one VT240 graphics terminal. An LXY12 line printer was available for printing and an HP7586E pen plotter for plotting.

The final cruise data files were backed up to an XABYTE data cartridge. The backup tape will then be loaded to the shore VAX at BIO for further plotting/processing and then into a multi-parameter database where it will be available to all users. Two backups were created, one to go to curation (S. Hubley) and one to go to AGC data section archives (L.Johnston).

Hudson 92-003 Emerald Bank

SS, 3.5, Huntec, Seismics



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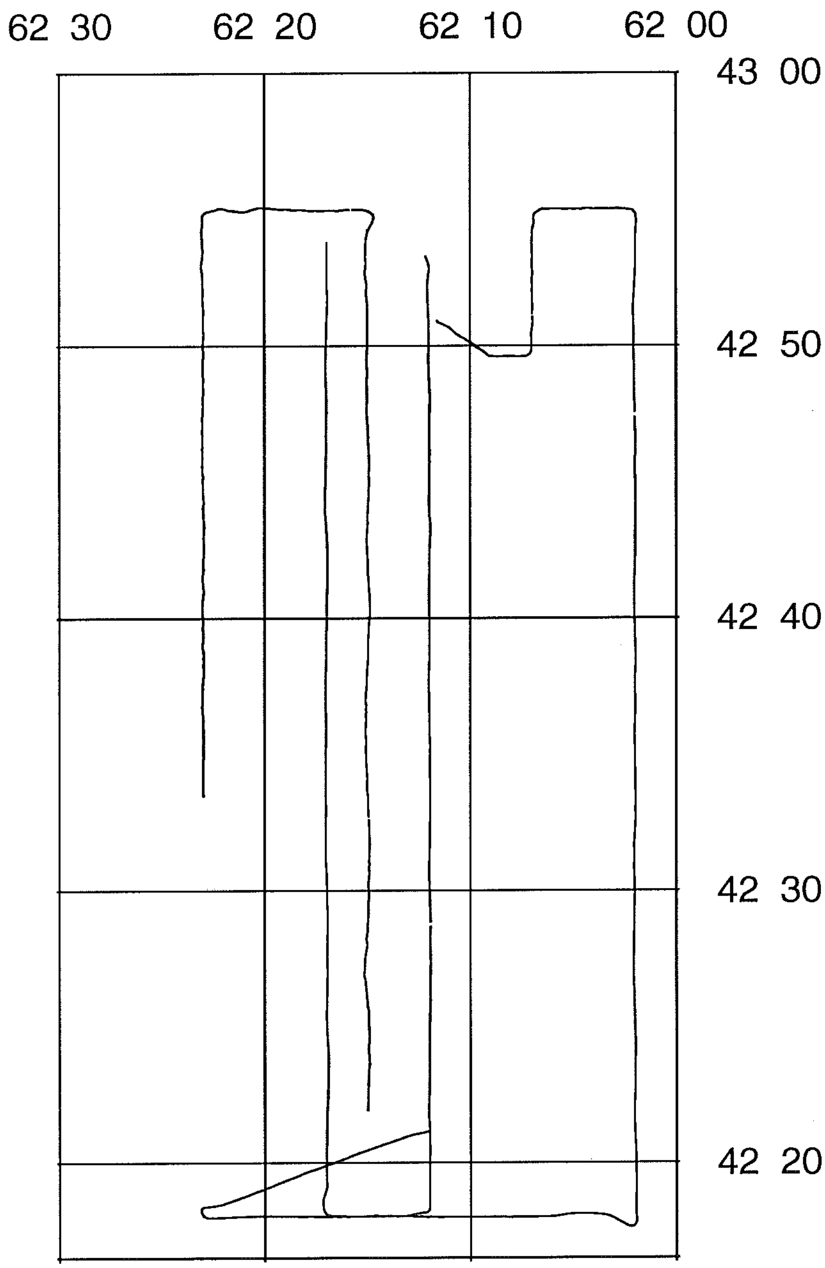
1-MAY-1992 00:36:22.26

HUDSON 92-003 SCOTIAN SLOPE

SIDESCAN, HUNTEC, SEISMICS



MERCATOR 400000. AT 45.00 N

30-APR-1992 23:58:08.81

Performance

SHIPAC is a proven system and as expected there were no problems encountered with the processing procedures.

It is very apparent that this system (SHIPAC) would easily run on a 486 PC. This would certainly improve processing speed and portability. This idea needs further discussion.

Ship Inventory System (Records, Tapes, Samples)

The Dbase 3 Plus based inventory system 'SHIP' (SID - HOUSE inventory package) was used to handle the storage and report generation for all samples, records and tapes collected on the cruise. A full inventory generated by 'SHIP' of all collected data is included at the end of this report.

Hardware for this system includes a BULL Power Mate SX 386 computer operating at 16 Mh with a 1.2 Mb 5 1/4" floppy drive, a 1.2 Mb 3 1/2 " drive and a 40 Mb hard disc. Printing capability was provided by a HEWLETT PACKARD Thinkjet and a backup EPSON FX-100 printer.

Performance

A proven system in use now for three years, it performed as expected. A modification was made to incorporate Lancelot and Excaliber data into this system.

Overall Computer Services (PC's)

A BULL Powermate SX 386 and an Olivetti M380 386 computer were on board. The Bull was designated to support the Dbase 'SHIP' software but it and the Olivetti were available at other times for general computing (word processing etc.). Several printers including AGC'S seagoing LaserJet 2 were available for hard copy.

Performance

This setup works well as it means all personnel do not have to bring their own computers. Virus checkers and a means of insuring file security are definitely required on these dedicated but still general use machines. This topic requires further discussion.

FINS Inventory System (Subsample Analysis)

The Field Inventory System (FINS) was used to inventory all work done on the cores. Labels for subsamples were generated as required as well as summary sheet(s) for each core section to indicate all analysis work done on that section.

Performance

This system performed well and requires minimal training of personnel in its operation.

Sampling Equipment

Bottom Photography

Bottom photos were acquired using the AGC underwater camera frame on which were vertically mounted two Umel cameras. One was loaded with black and white and the other with colour film. The cameras were tripped as usual by a trip wire with a compass weight.

Video camera / Still camera

Video and still were shot of various Hudson onboard equipment operations.

Lehigh Coring

Barrels of 1.5 m length were used on all Lehigh cores. Results were excellent for almost all cores.

AGC Large Diameter Corer

The piston coring system used on this cruise was a large diameter (11 cm ID) system with a capability for 30 meter penetration length. This system was modified for shipboard use on the CSS Hudson. Corer components consist of the following:
(1) Core head: 3m long, 0.6m diameter
(2) Core pipe: 4,25" I.D. with 3/8" and 3/4" wall thickness
(3) Couplings, straight and reduced for connecting barrels
(4) CAB liner
(5) split piston
(6) core catcher and cutter
(7) Trip arm
(8) 4.25" diameter gravity corer, used as trigger weight
(9) 3/4" diameter wire cable (6000 m long) and end termination.
(10) Associated hardware such as set screws etc.

Due to the size of the corer, (maximum 30 m long weighing approximately 4300 lbs) a special handling system was installed on the HUDSON. This system consists of the following:

(1) Rotating core cradle
(2) Outboard support brackets
(3) Monorail transport system
  - Trolley
  - Chain hoists
(4) Lifting winches
(5) Process container which consists of storing, cutting and handling facilities for the core pipe and sample

<u>Performance</u>

This aspect is one of the main objectives of this expedition and will be discussed in some detail later in this report.

<u>Data Listing</u>

Detailed listing of sampling and survey data are provided in Appendix I of this report.

STUDY OF POCKMARKS IN EMERALD BASIN

DALE BUCKLEY

For a number of years it has been known that numerous pockmarks can be found on much of the sea floor of Emerald Basin, Josenhans et al. 1978. This current expedition offered an opportunity to focus some new studies on these features by taking advantage of the excellent navigational capability, the selection of seismic profiling equipment, digitally recorded sidescan sonar, and variety of sampling and analysis equipment on the ship.

Because corer testing could not be carried out during night time operations, a sidescan and seismic profiling survey was conducted in the deepest parts of Emerald Basin. This survey carried out at very low speeds (~2 kts) allowed the deep towed sidescan sonar to obtain detailed records of the distribution and morphology of pock marks in water depths as great as 260 m. At the same tine the high resolution Huntec Deep Towed System, and the 3.5 khz acoustic profiler, obtained detailed sediment profiles through the pockmark fields. Acoustic masking in sediment profiles commonly occurs in many areas of Emerald Basin. This masking, attributed to the presence of methane gas in sediments, usually begins at between 12 and 20 m depth in the sediment profile and obscures any sediment structure below this depth.

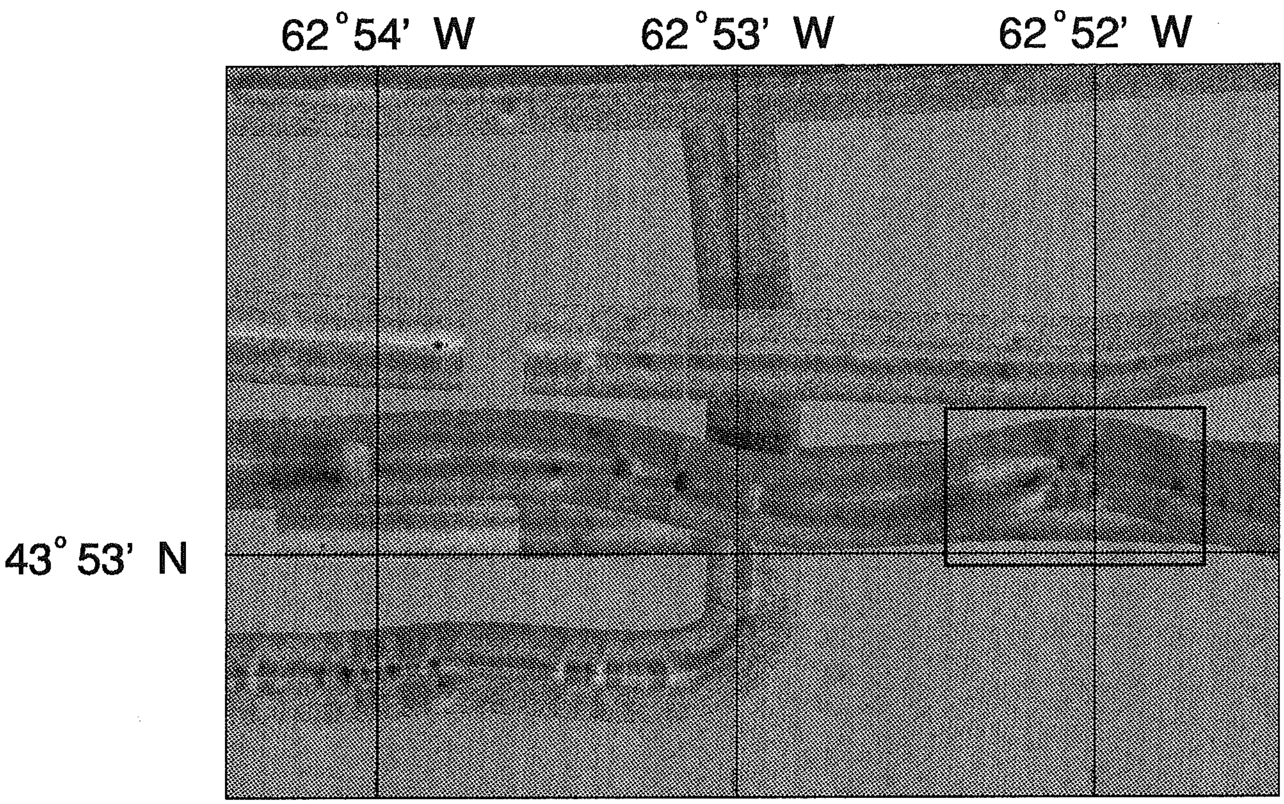
A preliminary map of pockmark distribution was made during the surveys. This map identified pockmarks with various distinct characteristics; (a) pockmarks with no apparent gas in sediments underlying the pockmark, (b) pockmarks with some apparent gas in underlying sediments, but with apparent suppression of the acoustic mask (attributed to gas depletion), (c) pockmarks with well defined gas masking in underlying sediments and no apparent depletion.

A mosaic of digital sidescan records is shown in Fig.1 with details of two pockmarks shown in Fig. 2. Several preliminary observations were made during this survey:

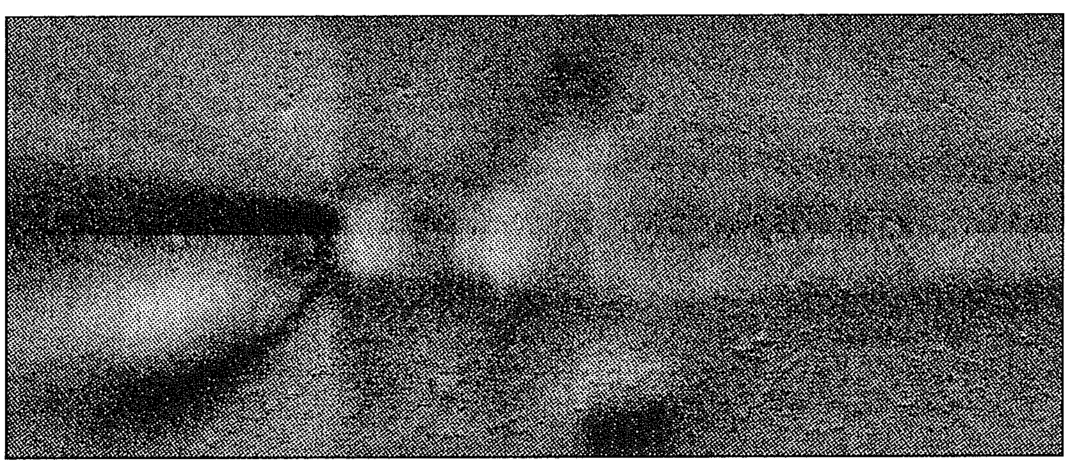
(1) Pockmarks in the east central part of Emerald Basin generally overly sediments with minimal or no indication of gas.
(2) Large pockmarks with well defined gas masks were most frequently found in the west central part of Emerald Basin.
(3) High resolution sidescan records show that some pock marks have small satelite pocks outside the main rim of the pockmark.
(4) Features resembling small slump scarps appear inside some pockmarks.
(5) There is no evidence of ejecta material around or outside the rim of these pockmarks.
(6) Photographic transects across one pockmark failed to show any clear evidence of a distinct sediment type or benthic animal biotope inside the pockmark.
(7) There was no acoustic indication of active venting of gas from any of the pockmarks surveyed in Emerald Basin.

One pockmark, referred to as Pockmark Chapman, was selected for sampling, and in situ testing with Excaliber. This pockmark, about 100 m wide and 9 m deep at the centre, was over sediments in which there was a broad 20 m depression in the gas mask horizon. A Lehigh core (18), and long gravity core (PC-19) were taken from the centre of the pockmark. Results of shipboard analyses of these cores are reported in the Appendices of this report.

Josenhans, H. W., King, L. H., and Fader, G. B. 1978. A side-scan sonar mosaic of pockmarks on the Scotia Shelf. Canadian Journal of Earth Sciences, **15**, 831-840.



Hudson 92003 Sidescan Mosaic



Processed Data from Inset Area

NAVIGATION ON HUDSON 92-003

DAVID HEFFLER

The navigation systems on this cruise were identical to those on Hudson 92-001, with differential GPS as the primary navigation instrument. The US Department of Defence, who operate the GPS system, have degraded the signals for civilian users from last year's 25 m accuracy to about 100 m accuracy. This degradation is called Selective Availability or S/A. However if raw data are monitored at a land station and corrections tellmetered by radio to a ship, accuracies of 2 to 5 m are possible, better than standard GPS without S/A.

AGC has acquired 2 Magnevox MX4200 D GPS sets. We contracted McElhanney Geosurveys (Dartmouth) to telemeter the differential corrections to HUDSON on HF radio from their base station in Cole Harbour. In Emerald Basin, we had continuous correction transmissions with almost no interruptions.

The MX4200D must be manually configured to implement differential corrections. When the correction signals stop, the MX4200D stops outputting data, it does not simply revert to standard GPS. An operator can reconfigure the set to output standard GPS, but then it must be configured again when corrections become available.

To solve this problem we relied on BIONAV. The MX4200D was the primary input source for BIONAV. The Trimble T10X GPS (non-differential), which is normally on Hudson, was configured as the secondary input. If the MX4200D stopped navigating, BIONAV automatically switched to the Trimble. (This was indicated by TX in the upper right corner of the screen instead of MX.)

On a few occasions, the MX4200 stopped navigating, presumably because the satellites it was using differed from those for which corrections were being transmitted. By switching the receiver to standard GPS and then back to differential, this problem could be solved in a few minutes.

In addition, on Hudson 92003, AGC's new ORE Trackpoint II, very short base line acoustic positioning system, was a vital part of the navigation. The transducer was mounted on a ram in the larger moon pool in the GP lab. It was raised and lowered by hand and locked in place by inflating rubber tires on the ram. This was workable for the first test but an automatic raise/lower system should be built. Two people could raise or lower the ram in 5 minutes. For more detailed information on the Trackpoint II system see the following section of this report.

The system console was rack mounted in the GP lab. Target selection and control are by a key pad on the console and positions of towed or bottom mounted transponders are displayed on a small colour screen. The data can also be sent digitally out on RS-232 which was connected (via the ship's -422 wiring) to the navigation centre.

A depth transponding transponder was mounted on the sidescan fish during most of the surveying. It appears to give accurate fish depths. The positional accuracy was good at some times and at other times there was excessive noise in azimuth measurements. We towed the sidescan fish on about 600 m of cable, at a depth of 200 m or more, and 450 m astern.

The system gave good fixes of bottom mounted equipment at a range of 1000 m in 250 m water depth.

A program called ORE.C was used to plot ship and beacon data in real time. The program was written in Borland C on a '486 computer with VGA screen. This computer is fast enough to display the data in a flicker free manner and provide almost instant screen refresh after a scale change or panning of the display. The program accepts ship navigation data from the VAX in NMEA format. It could use data

from any GPS or Loran C set as these output data in the same format. It also accepts the data from the ORE Trackpoint and displays the beacon positions. The ship is shown at true scale and at correct heading and the display can be zoomed in so the ship more than fills the screen. The offsets of the acoustic ram and the GPS antenna are included and the centre of the ship (both fore and aft and in beam) is used for the reference position.
The program logs both data sets to a disk file which it can then redisplay when run in playback mode. It also stores several hours of the track in memory so screen redraws also redraw the track.

The program proved useful for the accurate placement of an acoustic beacon and other samplers near a pockmark. By the end of a the cruise, a clean, well documented version, called AGCNAV 0.00 was generated ready for use on the following Parizeau cruise.

ORE TRACKPOINT II EVALUATION

DAVID L. MCKEOWN

Installation

The Trackpoint II transducer was located in a well about 24.7 m forward of the stern and 0.4 m to starboard of the ship's centre line. It protruded 1.3 m beneath the ship's hull. The transducer was raised and lowered by means of a chain hoist. While this was satisfactory, a small electric hoist would be an improvement. When down, the transducer was secured in the well by inflating rubber tires between the supporting shaft and walls of the well. This worked at all speeds up to 13 kts. The transducer was aligned by locating a hole in a plate attached to the top of its supporting shaft onto a snug fitting pin attached to the deck. There was no opportunity before or after the cruise to check the alignment acoustically by the procedure recommended in the Trackpoint II manual. No systematic directional errors were observed in the analyzed data that can be attributed to this error source, so it is concluded that this alignment arrangement is satisfactory. It could be improved by tapering the top of the locating pin to make mating of the support plate easier.

This transducer location is very near the ship's propellers. Acoustic noise proved to be a problem when the ship went astern while moving on station and when towfish were being positioned in the ship's wake.

Data Collection and Analysis Methodology

Trackpoint II Receiver

Version 8.02B of the software was installed in the receiver. All hydrophone offsets were set to zero. This is important as non-zero settings are reflected in the logged data. If incorrect and not recorded manually, the data cannot be corrected during post-processing. Filtering and smoothing were turned off for all data collection. The Threshold was set to Med-Low. The transponders were interrogated at a 2 sec rate with none assigned priority. This means that each transponder was interrogated during a successive 2 second interval so that with three units in use, each would be interrogated once every six seconds.

Raw slant range data was very smooth (Figure 1). Relative bearing data exhibited some noise and the occasional random spike (Figure 2). The data sets of Figures 1 and 2 were obtained as the ship passed a sea floor transponder. A recursive low-pass filter satisfactorily smooths the noisy relative bearing data as illustrated in Figure 2. However, all of the data described below was processed without any filtering or smoothing other than manual removal of obvious outliers after accepting only fixes with a null or 0 error code.

Ship Position and Heading

The Magnavox differential GPS receiver generates fixes approximately once per second to a resolution of four decimal places in latitude and longitude minutes. BIONAV degraded this to one fix every ten seconds to a resolution of three decimal places. BIONAV was utilized because it was the only convenient way to gain access to the ship's gyro output in an acceptable format. These ship's positions with respect to the GPS antenna were then translated to location of Trackpoint transducer. Trackpoint transducer positions and ship headings at the time of Trackpoint fixes were determined by linear interpolation from adjacent 10 second BIONAV fixes. The differential GPS positions are believed accurate to about 5 m.

Errors of a degree or more can exist in gyro alignment. No systematic directional errors were noted in the data analyzed that can be attributed to this factor.

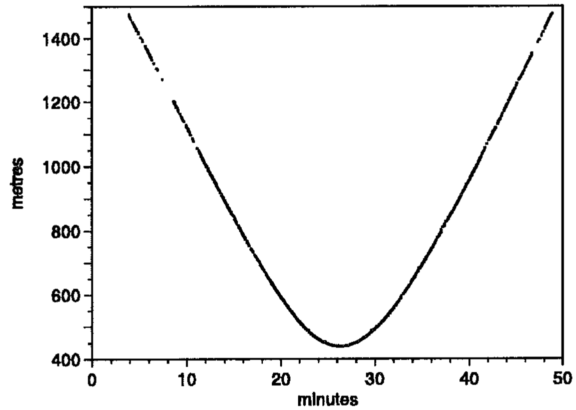


Figure 1. Measured slant range from ship to a sea floor transponder during a transit past it.

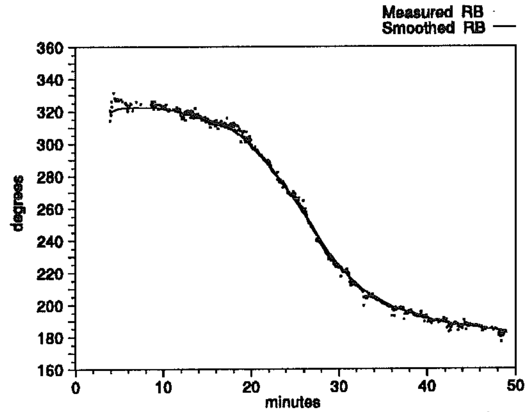


Figure 2. Measured and smoothed bearing of a sea floor transponder relative to the ship during a transit past it.

Data Logging

Serial ASCII data from the Trackpoint II receiver located in the GP lab was transmitted to the Navigation Centre via the ship's RS-232 wiring. Differential GPS receiver fixes passed through BIONAV where ship's heading was appended then logged on the ship's MicroVAX computer which in turn output the data as serial ASCII on the ship's RS-232 wiring. Both data streams were labelled with a common clock time and logged on a PC located in the Navigation Centre.

The Transponders

Four units were available: one model 4327A tellemetering unit set up to acoustically telemeter depth back to the ship; two model 4330A transponders with omnidirectional beam patterns; and, one model 4330A transponder with a directional (40o) beam pattern. All units performed up to expectation as transponders, and the depth information from the tellemetering unit appeared to be very satisfactory.

Slant ranges to 1470 m were consistently achieved. As the interrogation interval was set to 2 seconds, it is thought that this represents a limitation set by maximum allowable round trip travel time in the receiver rather than the maximum operating range of the system.

Battery charging proved to be a problem. Only one model 4334 battery charger was available. It was compatible with the model 4330A transponders, but it could only charge one unit at a time and the recharge period is 14 hours. It cannot be used to charge the model 4327A transponder because the underwater connectors are incompatible. Furthermore, even if the correct charger had been purchased for that transponder, it would have required 28 hours to recharge its dual battery pack. It is recommended that AGC purchase an additional battery charger for the model 4330's, a charger for the model 4327 and spare battery packs.

Sidescan Fish Positioning

Initially the positioning data from the model 4327 tellemetering transponder secured to the tow cable just above the sidescan fish was quite satisfactory. However, as the end of the second night of surveying approached, the relative bearing seemed to become noisier. It was assumed that the batteries needed recharging so, while they were being recharged, a model 4330 transponder with a directional transducer was used on the third night of surveying with acceptable results. When the model 4327 was replaced on the tow fish on the fourth night, relative bearing data remained noisy. The Trackpoint II system generated very acceptable relative bearing data when positioning sea floor transponders located outside the ship's wake (eg. Figure 2). It was postulated that the problem was caused either by interference from bottom reflections in the shallow water of the survey area or by acoustic noise from the ship, particularly its wake.

During a subsequent survey in deep water (500 m), a model 4330 transponder with an omnidirectional transducer was placed on the Huntec DTS cable and the model 4327 tellemetering transponder was placed on the sidescan cable. The two fish were then towed at similar depths although the sidescan layback and hence slant range was somewhat greater. Figure 3 is a scatter plot of the logged relative bearing time series for a 45 minute period. The model 4330 data contains almost no anomalies while there is noticeable scatter from the model 4327 transponder at somewhat longer range.

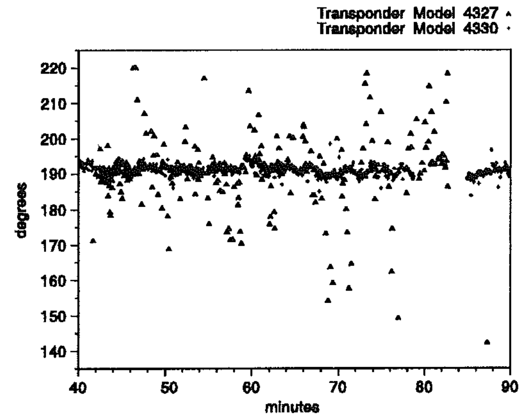


Figure 3. Relative bearings of transponders on two tow fish trailing behind the ship in deep water.

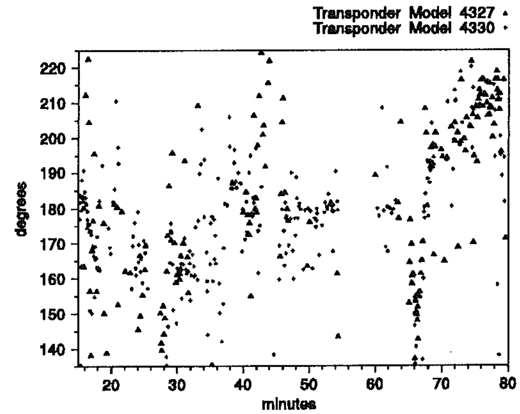


Figure 4. Relative bearings of transponders on a single two fish trailing behind the ship in shallow water.

The deep water test was later repeated in shallow water. This time both transponders were secured immediately above the sidescan towfish. Both units produced very noisy relative bearing data (Figure 4).

It appears as though the system has some problem measuring relative bearing of sources located behind the ship when the transducer is located near the ship's screws and must "look" through the ship's wake. Some of the probleman perhaps be overcome by using a directional model 4330 transponder which directs more of its acoustic energy directly toward the ship's transducer. Unfortunately, the model 4327 tellemetering transponder is a more attractive option for sidescan fish positioning. It is recommended that ORE be contacted for advice.

LeHigh Core at Pockmark Chapman

A model 4330 transponder was mounted on the cable just above the corer. The receiver was set in the Calculated Depth mode which worked very well. Relative bearing and slant range data were somewhat noisy, probably because of excessive ship manoeuvres. "Eyeball" analysis of time series indicated that the corer was about 10 m forward of Trackpoint transducer when sample was collected. This places the core sample at 43^0 52.9024'N, 62^0 52.2141'W.

Piston Core at Pockmark Chapman

A model 4330 transponder was mounted on the cable just above the corer. No useful Trackpoint data was obtained because the ship was being manoeuvred violently in an effort to move the corer into the pockmark. If it is assumed that the corer was hanging directly beneath the crane on the foredeck then the core position was 43^0 52.9102'N, 62^0 52.2544'W.

Camera Station at Pockmark Chapman

For the camera station, the ship was positioned in such a way that it drifted over the target area with very little manoeuvring via the propellers. This produced a very good data set of camera position. Again the Calculated Depth mode worked well. This is a very useful feature of the Trackpoint receiver when positioning instruments lowered from the ship.

During the camera transect, 1244 Trackpoint II fixes were logged. Obvious outliers were then removed as follows:

1. slant ranges (60 fixes);
2. calculated depths (22 fixes while camera was being lowered and geometry precluded computing a Calculated Depth plus 62 obviously erroneous depths);
3. relative bearing and calculated X and Y offsets relative to the Trackpoint transducer were examined together because the relative bearing can change very rapidly if horizontal range is near zero (141 fixes).

The remaining 959 fixes were processed to determine the geographic position of the camera for each fix and the results given to L. Johnson, AGC as an ASCII file of time, lat. and long. on a floppy disc. It is estimated that the combined GPS and acoustic positioning uncertainty of these fixes is 13.5 m.

Excaliber at Pockmark Chapman

A model 4330A transponder was placed on Excaliber before implanting it in the pockmark. Again the Calculated Depth mode was used with great success. The position of Excaliber was determined from 719 fixes of differential GPS and Trackpoint II data as 43^{0} 52.9363'N, 62^{o} 52.2409'W with an uncertainty of 8.2 m.

Position Errors

Introductory Comments

Because no independent system was available to define the position of the transponders, no absolute figure for positioning accuracy can be provided. However, an estimate of the repeatability of the positions can be obtained by computing the standard deviations of large ensembles of fixes collected under various circumstances.

A second problem is that the user usually wants to know the accuracy of a fix in terms of a radius of a circle about the position defined. The Trackpoint II system relies on polar range/bearing measurements to define positions with respect to its transducer thus its position errors are radial (slant range) and tangential (relative bearing). The latter error is an angular one thus its linear dimension is range dependent.

The specifications of position uncertainty found throughout this report must be evaluated in this context.

Distance Between Two Sea Floor Moorings

The RALPH frame (Bottom Beacon) with a second model 4330A transponder attached was placed on the sea floor near Excaliber at Pockmark Chapman (section X.8). Its position as determined from 666 differential GPS plus Trackpoint II range/bearing fixes was 43^{o} 52.9067'N, 62^{o} 52.2777'W with an uncertainty of 9.4 m. This places the Bottom Beacon 73.6 m 12.5 m from Excaliber.

Several baseline crossings were attempted but the depth uncertainty combined with slant range jitter preclude establishing an acceptable measure of the separation.

The separation was derived by cosine law from the Trackpoint II measurements of slant range and relative bearing of the two moorings with respect to ship. Differential GPS ship's position and gyro and transducer reference direction errors do not enter into the computation. Both transponders were assumed to be at the same depth, namely 274 m. The separation based on 523 such determinations was found to be 80.8 m 11.4 m which is consistent with separation derived from independent determination of positions via differential GPS plus range bearing measurements described earlier.

Sidescan Transponder vs. Trackpoint II

A model 4330A transponder and a sidescan transponder were placed on the RALPH frame which was then lowered onto the sea floor. The ship then steamed past the unit twice while the ship/fish slant range was measured directly by the sidescan system. At the same time, the Trackpoint II system provided information on ship/fish and ship/mooring positions. The fish/mooring separation derived from these Trackpoint measurements will be compared to the direct measurement by the sidescan system but this has not yet been done.

PISTON CORE MECHANICAL TESTS

WILLIAM MACKINNON

One of the main objectives of this expedition was to test the performance of the AGC piston corer by designing a series of experiments in which a number of mechanical variables of the corer would be changed at two different core sites. Each of these two core sites had previously been sampled with a standard AGC corer configuration, Piper (1988). One of the test sites in the centre of Emerald Basin (240 m water depth) was in an area of fine-grained sediments, predominantly silty-clay or clayey-silt. The second test site on the eastern slope of Emerald Basin (202 m water depth) was in an area of silty-sand or sandy silt, Buckley (1991).

The piston core used on 92-003 was the AGC large piston corer which consisted of the following components:

1. Core cradle
2. Corehead (weight=3000 lbs...1360 kg, (Big Red))
3. Core barrels
    i) 1 barrel 15.9 cm (6 1/4") OD, 10.8 cm (4 1/4" ID), located at corehead
    ii) remaining barrels 12.7 cm (5") OD, 10.8 cm (4 1/4" ID)
4. Couplings
5. Cutter
6. Catcher
7. CAB liner, 10.5 cm (4.140") OD, 9.9 cm (3.90") ID
8. Pilot core consisting of:
    i) one way valve
    ii) lead weights, 6 @ 23 kg. (50 lbs) each
    iii) 73.7 cm (29") barrel and coupling to hold weights
    iv) 150cm (60") long barrel, 122.7 cm (5" OD), 10.8 cm (4 1/4") ID
    v) cutter
    vi) catcher
9. 2.0 cm (3/4") diameter wire cable on Pengo winch (approx 5500 meters)
10. 1.2 cm (1/2") pilot core cable, length = length of piston corer plus free fall distance
11. Monorail and trolley transport system
12. Sample process container

The coring system used on 92-003 is basically the same system that has been used at AGC since 1988. One objective of this cruise was to test several parameters of the system to study the effects on core recovery and sediment disturbance, and to determine an optimum coring setup (if one exists).

The program consisted of sampling two sites where sediment type and characteristics were known. The first site was used as a benchmark test site where the first and last cores would be taken. The idea was to compare the cumulative effect of any changes made as a result of varying several components (one at a time) which would take place at the second test site. A summary of the parameters changed and the results of the test core follows.

<u>Core # 002</u>

SETUP:
LENGTH: 26 meters
FREE FALL: 450 CM
STRAIGHT CUTTER (ie: no relief)
NO PISTON RETAINING DEVICE

DOUBLE INSTRUMENTED SPLIT PISTON
NO ORIFICE SCREW IN PISTON
ANGLED FINGER CORE CATCHER
RECOVERY: 13 meters
OBSERVATIONS: It appeared that the piston separated before coring was completed. Implosions in the CAB liner occurred between the two sections of the piston. This was probably a result of using an upper split piston that did not have a scalloped cross section. Water was not able to flow past the upper part quickly enough to equalize pressure within the liner. As a result the liner imploded.

Core # 006

SETUP: Similar to core 003 with the following changes:
LENGTH: 15.3 meters
SINGLE INSTRUMENTED SPLIT PISTON
STANDARD ORIFICE SCREW
NEW SEALING RUBBERS ON BOTTOM OF PISTON
RECOVERY: 6.7 meters
OBSERVATIONS: No corer damage.

Core # 008

SETUP: Similar to core 006 with the following changes:
FREE FALL: 150 cm
RECOVERY: 7.9 METERS
OBSERVATIONS: The reduction in free fall actually improved sample recovery. It also appeared that sediment quality improved although further sediment analysis is required.

Core # 010

SETUP: Similar to core 008 with the following changes:
PISTON RETAINING DEVICE INSTALLED
NON INSTRUMENTED SPLIT PISTON
FREE FALL: 450 cm
RECOVERY: 7.0 meters
OBSERVATIONS: No corer damage. Increasing free fall reduced the amount of recovered sediment approximately 1 meter. Perhaps sediment tops are being pushed away as a result of increased impact which results from a greater corer free fall.

Core # 013

SETUP: Similar to core 010 with the following changes:
BOTTOM INSTRUMENTED SPLIT PISTON
RECOVERY: 6.9 meters
NEW TRIP ARM ARRANGEMENT
OBSERVATIONS: The new trip arm that was tested was installed "in line" instead of clamped to the 20 mm support cable and saved about 45 minutes off the recovery time for a corer that is fitted with 5 barrels. The main support cable is directly connected to the trip arm with a separate wire running from the trip arm to the split piston. There was some concern with running the cable end termination and shackle over the Metrox block. Although this didn't prove to be a problem, deck crew were uncomfortable with this arrangement. It would be best if there were a second winch available capable of pulling approximately 4 tons at 50 meters per minute and holding about 100 meters of cable. This would be used for both pilot core and piston core recovery.

Core # 014

SETUP: Similar to core 010 with the following changes:
BOTTOM INSTRUMENTED SPLIT PISTON
FREE FALL: 150 cm
RELIEF CUTTER
RECOVERY: 7.1 meters
OBSERVATIONS: This test seems to confirm that a 150 cm free fall will give equivalent results in core penetration and recovery as a 450 cm free fall.

Core # 015

SETUP: Similar to core 014 with the following change:
LINERS GREASED
RECOVERY: 7.0 meters
OBSERVATIONS: The I.D. of the CAB liners was covered with a silicon based lubricant in an effort to increase core recovery by reducing the friction between the sediment sample and the liner. Since the same amount of core was recovered it appears that this didn't have any significant benefit. However it did cause problems when assembling the core. The liners could not be taped together because of contamination from the lubricant. (ie: The tape would not stick).

Core # 016

SETUP: Similar to core 014 with the following change:
NO PISTON
RECOVERY: 7.7 meters
OBSERVATIONS: This core was assembled with no piston. The top part of the split piston was coupled to end of the wire but the bottom part of the piston was not installed. Therefore this corer was set up as a long gravity core. Approximately 7.7 meters were recovered and preliminary analysis showed no difference in core quality from that obtained from a corer using a piston.

Core # 017

SETUP: Similar to core 016 with the following changes:
LENGTH: 26 METERS
NO TRIP CORE
RECOVERY: 6 METERS
OBSERVATIONS: The cable was directly connected to the core bail on the core head. This resulted in no trip event and thus no free fall. It appeared that due to rough weather there was significant ship heave present while the corer was entering the bottom. The core barrel string was broken at the sixth barrel (from the cutter). Although approximately 6 meters of sediment was recovered it would seem likely that much disturbance occurred.
This site was test site #1 where core 002 was taken. It was hoped to incorporate any changes that seem to improve corer performance at test site #2. However, as noted, since significant sample disturbance resulted from ship motion, this core was not deemed appropriate for comparison purposes.

Core # 019

SETUP: Similar to core 016 with the following change:
LENGTH: 21 meters
RECOVERY: 8.5 meters

OBSERVATIONS: This core site was different than test site #1 but sediment characteristics appear to be similar. Even without the piston installed the corer recovered approximately 8.5 meters of good sample.

Core # 027

SETUP: Similar to core 016 with the following changes:
WATER DEPTH: 2400 meters
LENGTH: 24 meters
RECOVERY: 10 meters
OBSERVATIONS: No corer damage. Sample obtained appears good despite the fact that this was a gravity core (ie: no piston).

Core # 031

SETUP: Similar to core 027 with the following changes:
LENGTH: 18 meters
SPLIT PISTON
RECOVERY: 3 meters
OBSERVATIONS: Rough weather caused corer to bounce on bottom during deployment. The core sample was badly disturbed.

Summary

Sample quality from the above cores will be examined to determine the extent of disturbance present as a result of parameters changed. However the following observations are noted:

1. Increasing the amount of free fall of the piston corer does not result in an increase in core recovered. However it does appear that a lesser amount of free fall (ie: 150 cm as opposed to 450 cm) may cause less sediment disturbance especially in the top 2 to 3 meters.
2. The split piston does not improve sediment quality or quantity. It appears that a less disturbed sample was obtained without the piston. The amount of sample recovered remained roughly the same.
3. A relief cutter did not have an impact on the amount of sediment recovered. However it must be determined if it affects sediment quality.
4. If the corer is set up as a gravity corer (no piston) it should still employ a trip weight (pilot core) to initiate the coring sequence. This will "decouple" the corer from the ship while coring. As seen with core 017 directly connecting the wire to the core bail affects corer performance.

Buckley, D.E. 1991. Deposition and diagenetic alteration of sediment in Emerald Basin, the Scotian Shelf. Continental Shelf Research, **11**, 1099-1122.

Piper, D. J. W. 1988. Cruise report HUDSON 88-010. Atlantic Geoscience Centre, Bedford Institute of Oceanography, 99p.

INSTRUMENTATION FOR PISTON CORER

DAVID HEFFLER

CHATS

The Core Head Acceleration and Tilt System (CHATS) and the Piston Acceleration Logger (PAL) were used on the AGC piston corer system. One CHATS was mounted in the core head and one was attached to the wire above the trip arm. Both halves of the split piston had a PAL but the upper PAL was badly flooded on the first core.

CHATS logs depth (10 cm resolution), acceleration (0.01 g resolution) and tilts (0.1 degree resolution) at 100 scans per second. (The accelerometer in CHATS 2 had a very low sensitivity for some unknown reason.) The data are stored in memory and dumped to a PC after recovery. CHATS can store data for 3 minutes.

PAL is similar to CHATS except that; (1) it has no tilts (and hence can store data for 6 minutes), (2) the depth sensor has 2.0 m resolution.

Cores 27 and 31 were in deep water so the 500 psi pressure sensors in CHATS were replace by 10000 psi units giving only 2 m resolution.

Because of the limited data duration, the loggers must be initiated at the correct time. This is accomplished with a "down-up-down" scenario. CHATS is programmed to do nothing until it reaches a preset depth (50 m for all cores on this cruise). It then records its maximum depth and looks for a depth less than this maximum minus 10 metres. We stop the core near the bottom and then pull in about 20 m of wire, signalling all computers to start logging. (Actually they start 10 seconds after they pass their previously noted maximum depth.)

CHATS does not need to be opened between deployments. The CHATS in the core head was not removed for the entire cruise. The batteries can easily last a cruise. PAL must be opened to unload the data and to change batteries between each deployment.

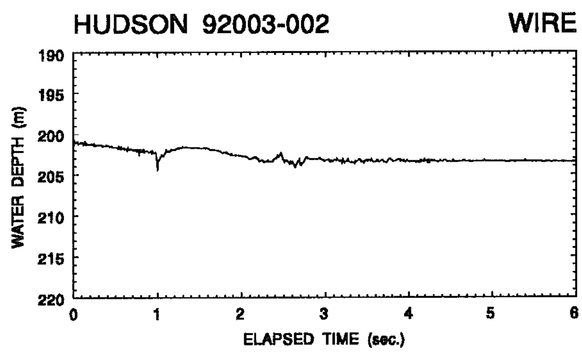
The Upper PAL was flooded on the first deployment. It could not be repaired at sea. 24 of 27 deployments of the two CHATS and the PAL in the lower piston gave good data. This is summarised as follows:

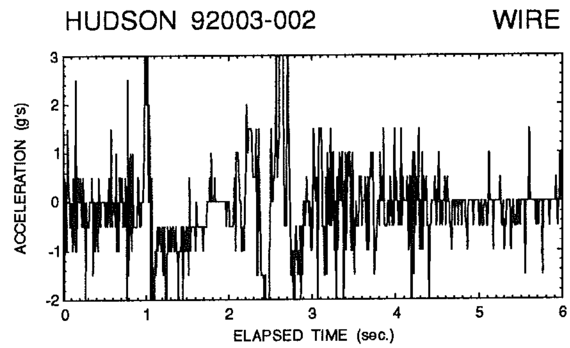
Station #	CHATS1 core head	CHATS2 wire	PAL lower piston
2	good	good	good
6	good	good	good
8	good	good	good
10	good	on trip core	not used
13	good	good	not used
14	good	good	good
15	good	good	good
16	good	not used	not used
17	good	not used	not used
19	good	good	not used
27	too late	too late	not used
31	good	on trip core	stuck in the pipe

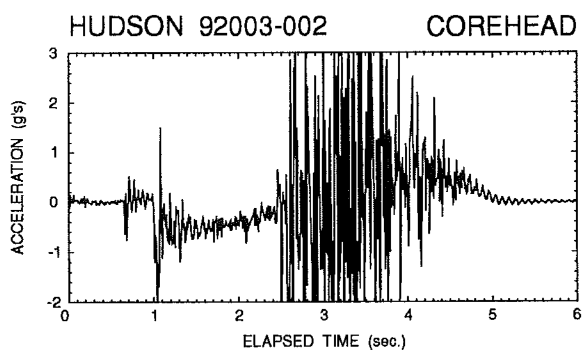
The PAL was not used on core 10 and 13 because a piston with special grabbers was tested. On cores 16, 17, 19,and 27 no piston was used (these were gravity cores). The CHATS was not installed on the wire on cores 16and 17 as there was no trip arm and hence the motions of the head were sufficient. On cores 10, 27 and 31 CHATS 2 was lashed to the trigger core head.

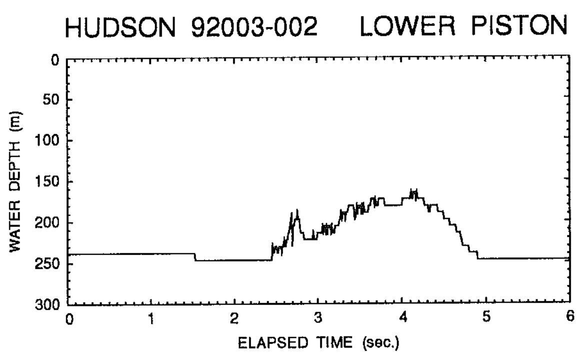
The "down-up-down" technique successfully triggered 25 of the 27 deployments of CHATS and PAL. Core 27 was the first deep water core and the "down-up-down" was done 200 m above the bottom. Both CHATS triggered but had filled their memory before the core tripped. PAL was stuck in the pipe of the last core (31) and the data could not be dumped. The batteries only last about one half day so we will never know if it worked.

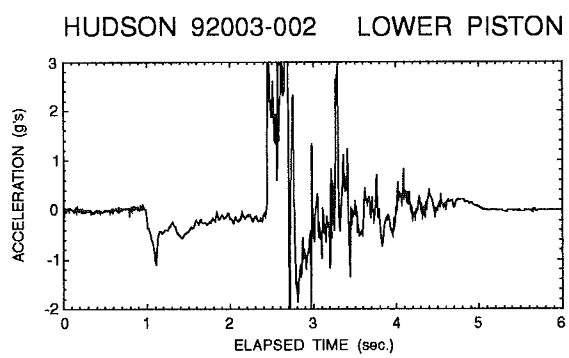
The data are viewed with a program called SCANVU (written in C). This program is used to convert the raw data to calibrated values and produce ascii files of the data near the trip instant. These data were then plotted, using Sigma Plot, on the laser printer.











The depth sensor in the core head showed an accurate height of the core head but there is no way to exactly determine the height above the seafloor. The accelerometer showed the vertical acceleration of the corer as it free fell and then as it penetrated the sediments. The cable attached to the piston seems to add high frequency noise to the accelerometer when the piston was moving up the core pipe. Although this degrades the acceleration measurements slightly, it gives a good indication of when the piston is moving. The tilt sensors shows that the corer is within 5° of vertical for most cores.

The depth sensors in PAL have much less resolution but the pressure is strongly effected by the motion of the piston in the pipe and better resolution would not help. The sensor in the lower PAL is ported through the screw which holds the piston rubber in place. Hence PAL measures the pressure between the sediment and the piston. This shows large (up to 100 kPa) negative pressure at times during the coring. These pressures, caused by cable rebound pulling too hard on the piston, may disturb the sample and also cause liner implosions.

The clocks and the trigger instants of the three computers are slightly asynchronous and it is difficult to exactly determine relative timing of the motions measured by the 2 CHATS and the PAL. This problem may be solved by cross correlating the pressures or the accelerations due to wave motion in the minute before the core.

We have always had a problem interpreting the data because, while we can measure the vertical motions of all parts of the system, we are never sure where the seafloor is. Attaching CHATS to the trigger core demonstrated that this is the solution. We know accurately where the trigger core stops with respect to the bottom. Measurements of the pressure at the trigger corer, before and after the free fall, would allow us to determine the actual height of the core head and piston with respect to the seafloor. This trigger logger only needs to log depth at one or 2 readings per second. A small unit should be built to do this.

LABORATORY CORE PROCESSING

KATE JARRETT

All cores were processed onboard with the exception of one push core in a box core. The processing of the trigger weight, piston and gravity cores included sediment description, split core photography, physical property measurement, geochemical property measurement and subsampling for further land-based measurements.

Processing began on deck upon core recovery. The deck procedures which were followed utilized a core cutting table, located in the processing container, forward of the refrigerated core container. Core samples were removed from the core barrels onto the cutting table, cut into 1.56 m sections, labelled, capped, taped and stored vertically in the refrigerated container. The labelling at this stage included cruise number, core number, up arrow and the section letter code with 'A' being the bottom of the core. All cores were cut with the AGC tube liner cutter.

Core samples were brought into the General Purpose (GP) laboratory and stored there until they reached ambient temperature and then each section was initially measured for whole core magnetic susceptibility on an interval of 5cm using the Sapphire susceptibility meter.

The core liner was split using the AGC Duits device. Following splitting the core sample was split with a wire saw. One half of the split core was used as working half for all sections. The archive half was used for core description and vane shear strength. Core description included; (1) split core photography on a 30 cm interval, (2) colour measurement of the plastic wrap covered sediment on a 5cm interval using the Colormet meter (unfortunately the colormet meter broke when PC 15 was being processed), (3) description of core colour, texture, structure and consistency. The undrained shear strength was measured using the AGC motorized miniature vane device, at a rotation rate of 50^{o}/minute, on the same interval that the geochemical subsampling was done on the working half.

The working half was used for the direct measurement of redox potential and subsampled for onboard analysis which included salinity, sulphate, ammonia, silica, alkalinity, pH pore water, pH sediment and pE. Further analysis for grain size and water content will be done at Bedford Institute of Oceanography. This geochemical subsampling was done on a 10 cm interval for approximately the top one meter then on a 30 cm interval. Additional water content subsamples were taken, for the purpose of testing drying methods, between these 30 cm subsamples.

All removed sections of the working half were filled with foam backer rod to prevent movement of the remaining sediment. Both halves were wrapped in plastic wrap, bagged in plastic core bags, labelled and stored in labelled 'D' tubes in the refrigerated container (4-7^{o}c).

The lehigh cores were processed in a slightly different way. Some of them were measured for whole core magnetic susceptibility on a 5cm interval using the Sapphire susceptibility meter. The core was then extruded horizontally and subsampled for the above mentioned geochemical analysis on a 10 cm interval.

During subsampling of the core, subsample intervals were entered into the Field Inventory Subsample System (FINSS) Dbase program. Labels were printed for the appropriate subsamples and subsample sheets showing core section information, splitting notes, geochemical numbers and subsample intervals were printed.

Data from the core logging are combined with geochemical data and are plotted in profiles for each core in Appendix III.

GEOCHEMISTRY

RAYMOND CRANSTON

Objectives

Objective 1

Pore water analyses were done to provide shipboard chemical data to estimate piston core performance as part of the core testing program. This was done by comparing depth profiles from box, Lehigh and piston cores for various chemical parameters affected by reactions that are taking place in the sediment column. If the profiles overlap without having to shift the depth axes, it can be concluded that less than 10 cm of sediment was lost off the piston core. If the piston core profile has to be offset by 100 cm, for example, for more than one chemical parameter, it is quite probable that at least 100 cm was lost off the top of the core. If chemical concentration-depth gradients change from core to core at the same site, it is concluded that either the sediment column has been stretched (decreased gradients) or compressed (enhanced gradients) as a result of the coring operation.

Objective 2

To determine diagenetic processes in Holocene/Pleistocene sediments in Emerald Basin, on the Scotian Shelf and down the Scotian Slope. In estimating the mechanism for global carbon cycling in ocean sediments, it is important to understand the balance between organic carbon flux to the sea floor, the flux of oxidants into the sea floor, and the carbon burial flux. This study was in part to determine where carbon burial processes vary in an effort to choose study sites for future Joint Global Ocean Flux studies.

Objective 3

A newly designed and assembled in-situ gas/pore water sampler, called EXCALIBER, was tested for the first time. Details of the equipment are available elsewhere in this report. The 41 ml sampling chamber collected an in situ pressurized sample of pore water and gases at a sub-seafloor depth of 50 cm.

Objective 4

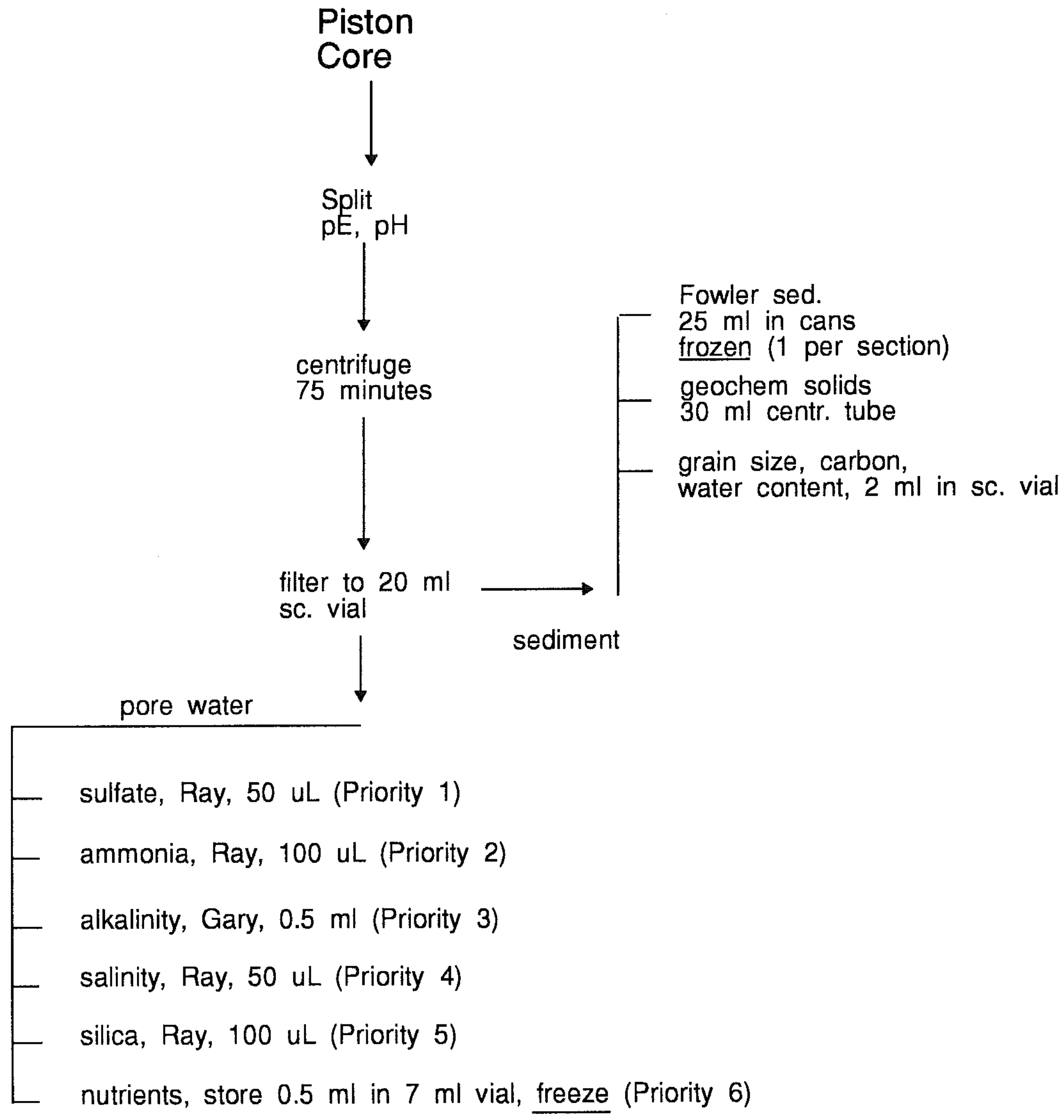
Using very accurate navigational equipment, cores from within a pockmark in Emerald Basin were recovered. This was done to evaluate the sub-seabed conditions in pockmarks in an effort to understand the mechanisms and timing of pockmark formation.

Methods

Piston Core Testing

Two piston core test sites in Emerald Basin were studied by taking multiple piston cores. Geochemical subsamples for pore water and solid phase were collected at 10 cm intervals for the upper core section and at 50 cm intervals in downcore sections. Box and Lehigh (gravity) cores were collected to identify the sediment-water interface. A hand-held methane gas meter (Industrial Scientific HMX 271) was used to check for excess amounts of methane in the sediment sample. The meter has a detection limit of 1000 ppmv methane in air and was calibrated with a 1% methane standard. Approximately 200 ml sediment samples were sealed in 'mason' jars fitted with septums for headspace gas analyses at the Coal Research Lab in Sydney. Flow charts describing the sampling are attached.

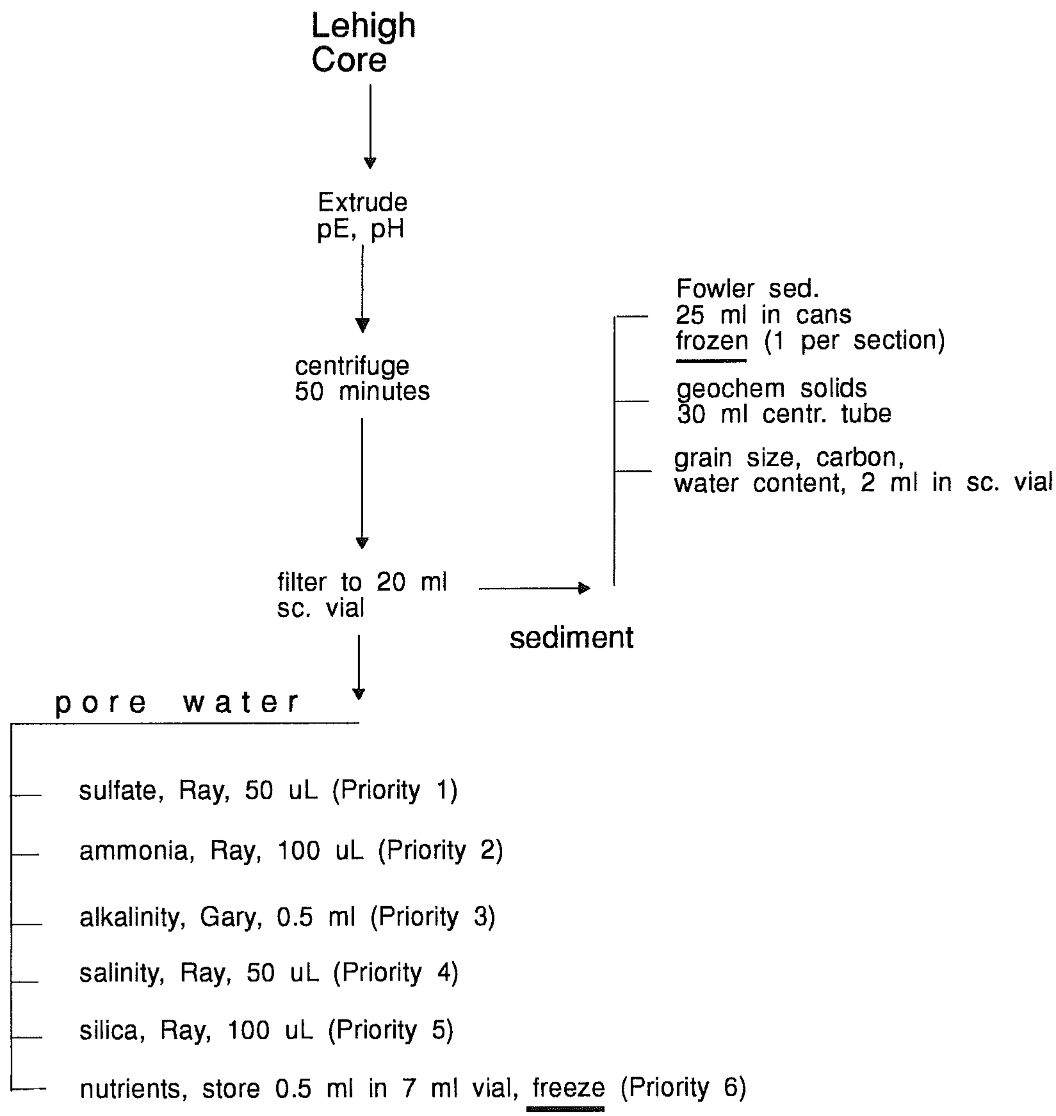
Hudson 92003 (April 92) Emerald Basin/Scotian Shelf Cruise



Geochemical Processing

10 cm resolution - top section (12 core tops, 15 samples each, total 180 samples)
50 cm resolution - lower sections (40 sections, 3 samples/section, total 120 samples)

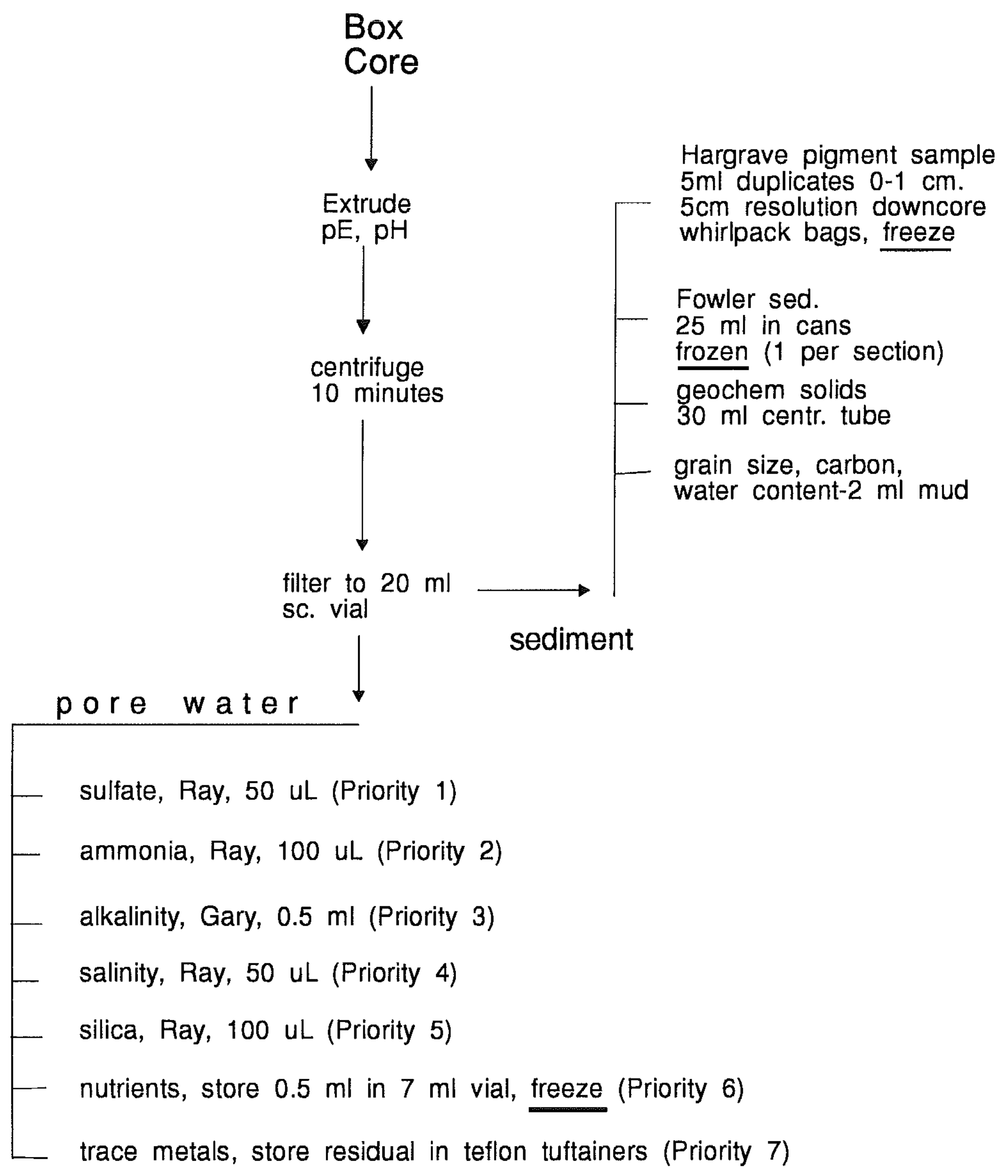
Hudson 92003 (April 92) Emerald Basin/Scotian Shelf Cruise



Geochemical Processing

10 cm resolution, 11 cores, 120 cm long, total 150 samples

Hudson 92003 (April 92) Emerald Basin/Scotian Shelf Cruise



Geochemical Processing

5 cm resolution, 2 cores, 50 cm long, total 20 samples

Core Transects

Gravity cores were taken at 250 m intervals over the depth range from 500 to 2500 m down the Scotian Slope. Samples were processed as outlined in the attached flow charts.

Sediment Redox Potential and pH Analyses

Split core sections were received in the GP lab where eH and pH electrodes were inserted 1 cm into the sediment, at intervals of 10 to 50 cm. The redox potential (uncorrected eH) measured with calomel and platinum electrodes was displayed on a digital meter. The electrodes were calibrated with Zobel solution. The sediment pH was measured using a Ross electrode, standardized with pH 7 buffer.

Sediment Subsampling and Pore Water Collection

Approximately 40 ml portions of wet sediment were removed from the split core and placed in 50 ml centrifuge tubes. Pore water was extracted by centrifuging the samples with 2 table-top centrifuges (IEC-HN-SI) which were held at 3 ^{o}C in the cold room. This was to avoid marked heating of the centrifuges, which will warm the sample and affect equilibrium conditions for some chemical species. Gambols were not used as the centrifuges had solid shafts which allowed centrifuging under most sea conditions. Pore water recovery was often limited to less than 1 ml, however this was enough for pH, alkalinity, ammonia, salinity, silica and sulfate analyses . The pore water was decanted into a syringe and filtered through 1%m filters. A 0.5 ml portion of pore water was frozen for nutrient analyses by the marine chemistry lab at BIO. The centrifuge tubes containing sediment were stored at 4 ^{o} C for subsequent geochemical analyses at BIO. If gas cracks (gaps in the sediment) appeared in capped cores before being split, samples were sealed in 'mason' jars for alkane gas analyses.

Dissolved Sulfate Analyses

A 50 %L portion of pore water was placed in a 15 ml test tube, to which 50 %L of 300 mM barium chloride solution was added. The sulfate combines with the barium to form a fine cloud of barium sulfate precipitate. This was then diluted with 4 ml of de-ionized water and the turbidity of the solution was measured using a hand-held Spectronic Mini 20 analyzer fitted with a nephelometer attachment (manufactured by Milton Roy Inc.). The turbidity meter was calibrated with standard seawater and bottom water collected during the hydrate transects. The precision and accuracy of the method is 10%. Sample storage is not a problem. Some samples were re-centrifuged and re-analyzed days later and very similar results were achieved. The Mini-20 detector was very reliable if warmed up for a few minutes before analyses, and if it was turned off between samples, to avoid pegging the meter needle.

Dissolved Silica Analyses

Dissolved silica was determined using the Ocean Drilling Program colorimetric technique. One hundred microlitres of pore water was added to ammonium molybdate along with an acidic reducing agent to form a blue silicomolybdate complex. The colour density was determined at 812 nm using the same base unit for sulfate analyses; a hand-held Spectronic Mini-20 detector fitted with a colorimeter attachment. The method was standardized with sodium silicate; the accuracy and precision is 10%. Samples were re-analyzed after storage and the results were very good. If the samples are stored cold and in the dark, minimal biodegradation will occur. Dilute standards were stable for at least 2 weeks.

Dissolved Ammonia Analyses

Dissolved ammonia was measured by colorimetric absorbance of the oxidized nitrogen complex in a ferricyanide solution after the method use by ODP. Absorbance was measured at 640 nm with the Mini 20 colorimeter,standardized with ammonium chloride. The precision and accuracy of the methods is

10%. Stored samples and dilute standards appeared to retain their concentrations very well over periods of 2 weeks.

Alkalinity Analyses

Alkalinity and pH of pore water were determined using a standard total alkalinity method. A portion of pore water (0.25 to 1 ml) is measured for pH, then titrated with 0.008 M HCl. The endpoint is determined using a Ross pH electrode. The precision and accuracy of the method is 10% for alkalinity and 0.2 units for pH.

Salinity Analyses

Salinity was determined by diluting 50 %L of sample with 200 %L of distilled water, mixing with a Vortex mixer, and injecting 100 %L into a miniature conductivity meter (Horiba model C-173). Standard seawater was used to calibrate the equipment. Precision and accuracy was determined to be 0.3 $^{o}/_{oo}$.

Results

Geochemical data for sediment and pore water analyses for over 450 samples are presented in the attached tables and core profile plots. Twelve piston, 11 Lehigh, and 2 box cores were processed. Three staff members subsampled the sediment, measured Eh and pH, centrifuged and filtered the pore water. Two staff members analyzed the pore water for ammonia, silica, sulfate, salinity, alkalinity and pH. These data are listed in Appendix II, and selected data are combined with core logs and geotechnical data in the form of profile plots for each core in Appendix III.

A test core was processed on the first day to evaluate methods. This was core 028 from cruise 91020, collected in June, 1991, and stored until April, 1992 in cold storage. The salinity was enhanced by about 1 $^{o}/_{oo}$ due to evaporation during storage. Silica and sulfate analyses were similar to those found when the core was immediately processed in 1991. Ammonia was below detection due to oxidation during storage.

Piston Core Performance

Detailed study of the piston core results has not been done as of this time, however it is clear that taking 7 piston cores at the same site will allow careful evaluation. It appears that cores 8 and 16 provided the best results, with minimal core top loss and no stretching or compaction of the sediment column. Cores 6 and 10 were particularly poor, both showing significant loss off the top, and what appears to be compaction during coring.

Salinity results confirmed that old fresh water conditions underlie the present marine sediments. Over depths of 10 m, salinities decreased from 35 $^{o}/_{oo}$ to less than 32 $^{o}/_{oo}$.

Lehigh Core Transect

Unfortunately, Lehigh cores tend to be only about 1 m long. Serious redox reactions tend to occur below this depth for this region. There was no salinity or sulfate change in the Lehigh cores. It appears that maximum carbon burial is occurring between 500 and 1500 m downslope. Further land-based analyses (organic carbon in sediment; nitrate and phosphate in pore waters) are required to firmly identify where carbon burial is most pronounced.

Excaliber Results

A detailed description of Excaliber is elsewhere in this report. The equipment worked well, collecting an excellent gas and pore water sample on the third attempt, after minor adjustments. The volume of gas was too small to carry out analyses on the ship, using the hand held meters to determine oxygen, hydrogen sulfide, methane and carbon dioxide. It is very apparent that we require a small gas chromatographic system for shipboard operation. This would enhance the value of the Excaliber system, making it a world-class facility for global change research.

Pockmark Results

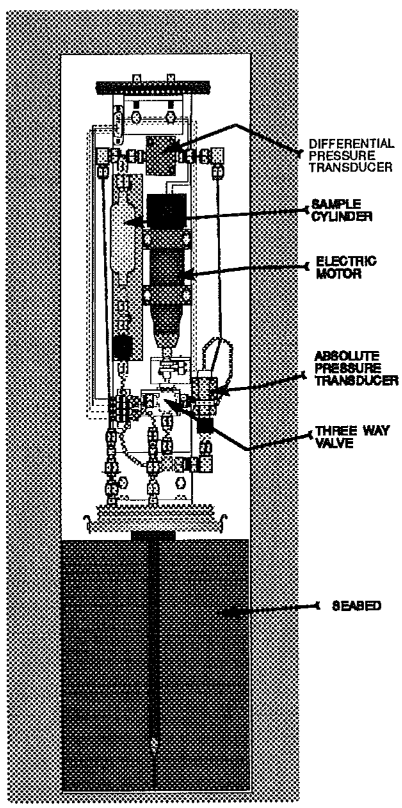
An excellent piston core was recovered from within a pockmark, as is described elsewhere in this report. The core was the most reduced of all sites studied during this trip. Elemental sulfur crystals were recovered, suggesting that a subsurface source of sulfur must have been available in the past. There is normally not enough sulfur in seawater sulfate to form elemental sulfur. It is possible that deep hydrocarbon deposits, containing sulfur, has vented through the pockmarks. Oxidation of the organic sulfur compounds could result in sulfur deposition. If this argument is valid, we would conclude that these pockmarks are related to excess amounts of hydrocarbon gases. The actual mechanism for forming the pockmark may not be due to violent expulsion of fluid and sediment, rather a slower release of gases and pore water from the sediment, thus decreasing the volume of the sediment column at the vent. This preliminary conclusion is suggested by the physical characteristics of the pockmarks as described earlier in this report. Thus the sediment may sink downward, thus forming the cone shaped depression.

EXCALIBER

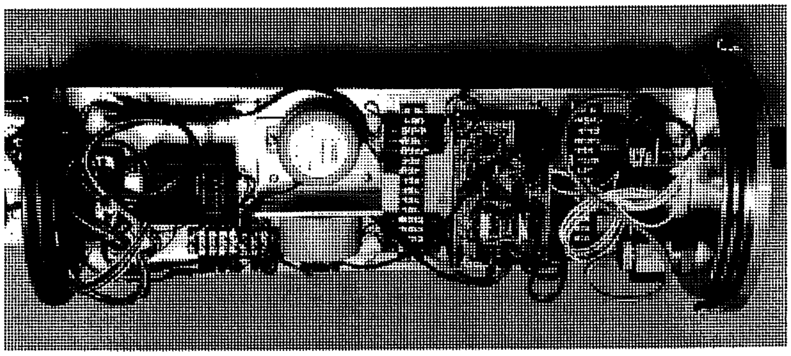
HAROLD CHRISTIAN

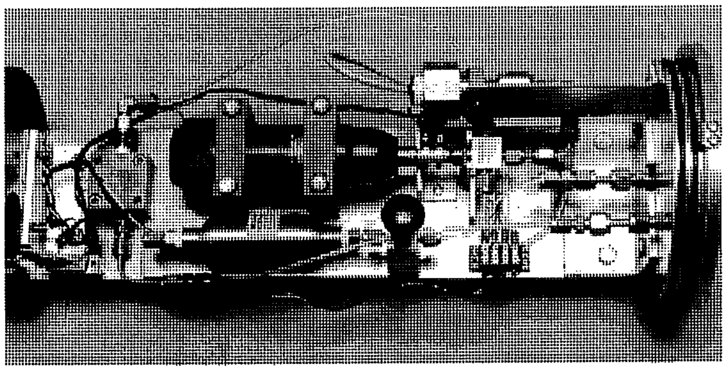
Introduction

Excaliber is an autonomous hermetically sealed in-situ pore water and gas sampler for use in continental shelf water depths. The device is designed to be deployed over the side of a ship and left on the sea floor to collect a sample of the in-situ pore fluid by having the onboard computer open and close a valve. A 40 cc volumetric stainless steel cylinder captures the sample and keeps it under pressure. There is an option to measure differential pore water pressure using a high sensitivity, Validyne DP300 transducer mounted below the sample cylinder. The sample is removed from the instrument for geochemical analysis of the fluid/gas composition by opening the pressure case after retrieval.

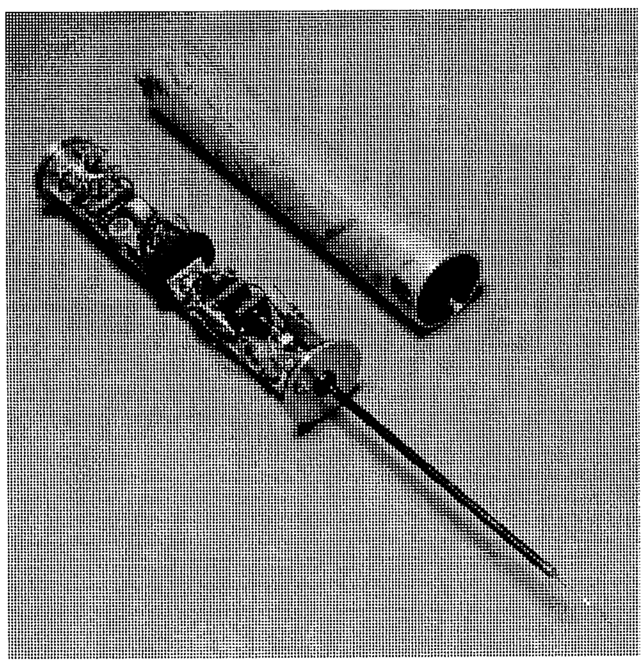


EXCALIBER - Assembly for sample chamber and pressure measurements





Electronics Assembly for Excaliber



Excaliber, with electronics assembly and needle probe

Mechanical

The stinger that is lowered into the seabed is of variable length, presently consisting of a 60 cm double walled system, with an inner stainless steel tube providing the hydraulic connection between the pressure case and a porous poylpropylene filter, placed ten diameters behind the tip. The porosity of the filter is commonly in the range of 20 to 250 microns, with lower values selected for use in fine-grained sediments. The inner tubing outside diameter is nominally 4.75 mm, with an inner bore of 1.25mm. The tubing is connected to a ball valve which is opened/closed by means of a small computer-controlled electric motor. After a predetermined time the ball valve opens allowing pore fluid to travel up the stainless steel tubing to a 40 cc collection bottle. The computer keeps track of the position of the valve by means of two microswitches riding on a cam located on the motor drive shaft.

An outer steel pipe provides stiffening support for the slender hydraulic tubing during penetration and retrieval. A square base made of open steel grating is rigidly connected to the pressure case and spreads the weight of the instrument over an area of 0.58 sq. meters, thereby reducing the surcharge effect.

Electronics

A Tattletale 4 datalogger acquires and stores data from the pressure transducers and tilt sensors, and is downloaded after each deployment to a shipboard computer for decimation and further analysis. Sensors are the same as on Lancelot, with all electronic components being interchangeable.

Operation

There are three distinct stages to the Excaliber test as follows:

1. Penetration, failure, remoulding of sediment and reconsolidation around the probe, producing a differential pressure spike and gradual decay curve to the in-situ ambient value (which should in most cases be equivalent to the hydrostatic pressure, hence zero differential). The consolidation curve provides high quality data which is useful in analytical modelling of consolidation behaviour.
2. After the sediment has closed around the probe, the valve is opened by the computer to permit inflow of pore fluid. The time that the valve opens is preset before deployment, based on general knowledge of the sediment permeability (typically 1 to 2 hours after a specified water depth has been reached). Pressures recorded during the inflow stage are later used to determine the sediment permeability.
3. After a specified sampling time interval has elapsed (1 hour or more), the valve is closed and the sample is sealed awaiting recovery. The pre- and post-sampling absolute pressures should match, giving a double check on the magnitude of excess pore pressure in the seabed.

Results

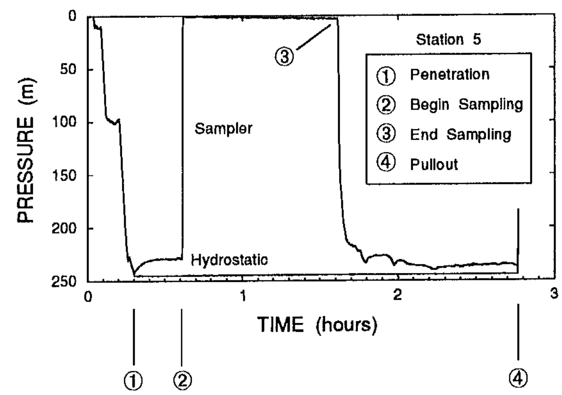
April 21

Instrument: Excaliber
Site: Emerald Basin Station 002
Water Depth: 242m
Time on Bottom: 112 2222
Position: 43^0 53.02' N 62^0 47.88' W
Filter Porosity: 70 microns

The probe was recovered in heavy fog at night; the stinger had soft mud on it. The recovered data showed a slow differential pressure response, indicating that there was air in the system (it turned out that the hydrostatic bulkhead fitting had been improperly sealed and had leaked, allowing mineral oil on the back side of the DPT to leak into the pressure case. Roll and pitch data indicated that the probe had entered the seabed and remained vertical throughout the test. The valve apparently opened while the instrument was still being lowered through the water column, as a result of too high a gain being set on the upper absolute pressure transducer channel; consequently the water sample which at first appeared to be good was actually not from in situ, nor from fluid that had migrated downward around the probe while it was in the bottom. The normal pressure drop within the stinger was not observed for this reason. Measurement of the salinity indicated that the 37.5 cc sample had been diluted by about 6 cc of distilled water and was equal to that of seawater; roughly 10 cc of gas was drawn off.

April 22

Excaliber was set up for overnight deployment. A 5 minute-long calibration was again carried out at approximately 100 m water depth. An acoustic beacon was placed on the frame and a high flyer at the surface to assist in recovery.

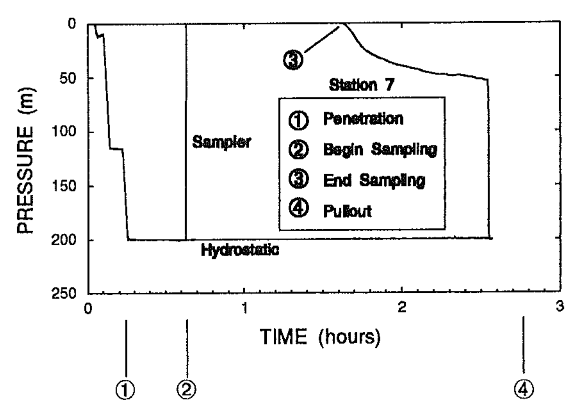


Instrument: Excaliber
Site: Emerald Basin Station 005
Water Depth: 245 m
Time in Water: 113 1908
Time on Bottom: 113 1923
Position: 43^0 52.98' N 62^0 47.93' W
Filter Porosity: 70 microns

The valve operated as desired, opening 30 minutes after the 30 m water depth was reached, and closing after another hour. Only a small amount of gas and 6 cc of water was recovered. Inspection of the filter tip revealed that the pore fluid channel was not cut into the threads very deeply, thereby restricting the inflow of fluid during the sampling stage. A better designed tip was installed.

April 23

Excaliber was redeployed at Site 2. The differential pressure transducer was removed from the system since its output in the previous test was observed to be greatly inhibited, probably as a result of it being overpressured due to a design oversight, during the first drop. It is evident that once the water sampling valve was opened, the pressure drop to atmospheric level contained in the flask, caused a severe overpressure to the DPT, since its back side was still registering 200 m of water pressure. Implementation of an isolation valve should be undertaken if further differential pressure readings are to be attempted in conjunction with water/gas sampling on the same stinger. A 3-way valve could be used in place of the existing shut-off valve.



Instrument: Excaliber
Site: Emerald Basin Station 007
Water Depth: 200 m
Time in Water: 114 1557
Time on Bottom: 114 1610
Position: 43^0 52.98' N 62^0 47.93' W
Filter Porosity: 70 microns
No sample; the filter tip was badly bent in two directions at the threads and sediment entered the tubing, plugging it completely. The cause of the damage is unknown, but probably resulted from

impact with a hard object on the seabed during penetration. After examination of the piston core, it was concluded that the probe was probably stopped by a dense surficial sandy unit up to a metre in thickness. A simple modification was implemented to allow pore fluid to get by the threads on the tip into the tubing; it was found that the tip had been bottoming out in the tapped end of the tubing. This was corrected by cutting several mm off the threaded end of the tip and filing a small notch.

April 26

Excaliber was rigged for a long-term deployment next to the beacon in pockmark Chapman, with the valve opening 2 hours after 30 m water depth, and closing after a further 6 hours of sampling. The data sampling rate was once every 5 seconds (12 scans per minute). Permeability test results are shown in graphical form, based on the inflow data.

Instrument: Excaliber
Site: Emerald Basin Station 021
Water Depth: 275 m
Time in Water: 117 2356
Time on Bottom: 118 0024
Position: 43^0 52.95' N 62^0 52.29' W
Filter Porosity: 70 microns

Excaliber operated perfectly, with the instrument landing inside the pockmark, according to the differential GPS navigation. The valve opened and closed on schedule, and a full water sample was obtained in 2 hours, 20 minutes. The lower absolute pressure dropped as expected to the internal atmospheric level when the valve opened, gradually returning to the hydrostatic value; after which it remained constant until the valve was closed and the instrument retrieved. There was no damage to the probe. A small amount of fine sediment entered the tubing and cylinder, indicating that a finer grade filter should be used for deployments in clays in future.

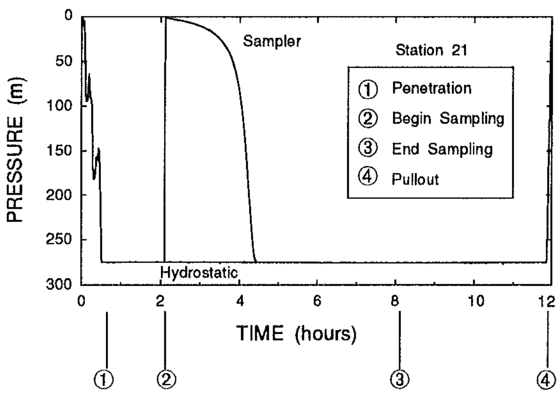
The volume of fluid recovered was 40.3 cc with about 20 cc of gas, assuming a 27.5 : 1 pressure-volume ratio. The coefficient of permeability 0.6 m below the surface of the pockmark as determined by Excaliber is 4.05×10^{-8} cm/sec. The salinity was measured at 31.5 g/l, which meant that 36.8 cc of the fluid in the sample cylinder was of in situ origin.

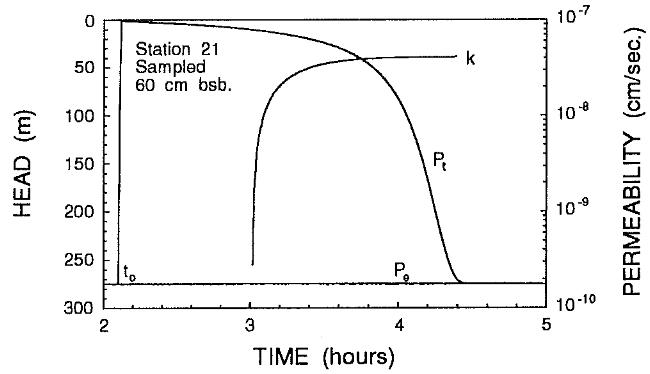
Geochemical analysis of the gas provided the following estimates of gas composition:

Methane	<1 ppm
Hydrogen Sulfide	<1 ppm
Carbon Dioxide	~10,000 ppm
Oxygen	~196,000 ppm
Nitrogen	~760,000 to 780,000 ppm

Given that it was not possible to quantitatively analyze the various gases present in the sample on board the ship, an effort was made to constrain the various concentrations using available portable equipment. Taking an average concentration of N_2 of 770,000 ppm, the degree of fluid gas saturation is as follows:

Methane	below detection limit
Hydrogen Sulfide	below detection limit
Carbon Dioxide	1.1%
Oxygen	23.4%
Nitrogen	88.6%
Total	113.2%





Since the degree of gas saturation cannot exceed 100%, the summation was repeated using a lower bound value for Nitrogen of 760,000 ppm, giving a total of 82.8%. This is close to the lower limit for the existence of free gas in situ, therefore it is felt that there is a possibility that it might exist at shallow depths, but in small quantities at this location.

GEOTECHNICAL

HAROLD CHRISTIAN

Analysis of Coring Disturbance

The physical properties of the sediments recovered by the piston core are shown in profile form along with the geochemical data. As several sites were sampled, the cores were compared in two main groups. Magnetic susceptibility was used as the means of identifying where coring had missed zones, particularly the upper few metres. Compression during sampling was also noted in several cases.

PC-16 provided the best core top but was severely compressed over the bottom 2 m. This was used as the reference core for comparison purposes. PC-06 had compression in its top also. PC-10 apparently missed the zone sampled in PC-16 from 2.3 to 2.8 m.

Undrained shear strength was useful in corroborating the analyses of disturbance, with each core matching the general trend much better after the amount missing was determined. For PC-02, it was the only method available, yet due to a spike encountered both in the trigger weight and the piston core, it was clear that 1.5 m had not been sampled at the top. The following table lists the minimum amount missing from the top of each core, as compared to PC-16 (it should be noted that the trigger weights themselves are not completely reliable; more sediment may be missing than herein indicated).

Core Number	Zone Missed (m)
PC-06	0 - 1.2
PC-08	0 - 1.7
PC-10	0 - 2.4
PC-13	0 - 0.9
PC-14	0 - 2.0
PC-15	0 - 1.7
PC-16	Reference

Other cores were not suited to this analysis, due to their differing locations.

Some geotechnical data have been combined with core logs and geochemical data and are shown as profile plots in Appendix III.

SUMMARY AND EVALUATION

DALE BUCKLEY

This expedition has achieved excellent success in several areas. The evaluation tests performed on the AGC piston corer have revealed several problems that have not been previously quantified by repeated tests at a reference core test site. It now seems clear that incoherent movement of the split piston during coring has resulted in large differential pressures inside the core barrel with the result that core liners are often imploded, or that sensible coring is prevented. Much of this incoherent movement is due to spring-back in the main suspension cable. It also seems clear that large free fall of the piston corer does not improve corer penetration or improve core quality. For the first time good quality analytical data should be available to quantify the amount of sediment sample that is missed at the top of most piston core samples.

This expedition had excellent navigational and instrument positioning capability that now makes it possible to carry out surveys and experiments that were impossible to perform in previous years. An example of this capability was the survey and sampling of a single pockmark that was only 100 m wide and about 9 m deep. The ability to repeatedly return to this feature in 250 m water depth and to place instruments and sampling devices in the pockmark is an example of a significant advance in technical achievement. This achievement also called for a high degree of skill on the part of the officers and crew on HUDSON.

Testing of the Excaliber instrument was also a great success. This success was achieved in spite of the fact that this instrument was designed and built only months and weeks before the beginning of this expedition.

Success of any endeavour, especially oceanographic expeditions, depends most on the dedication and skill of the scientific staff and the ships crew. HUDSON 92-003 had an excellent complement of people who prepared well for the expedition and worked extremely well as teams.

APPENDIX I

SAMPLE AND RECORD INVENTORY

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
001	EXCALIBUR	1122222		43 53.02N	62 47.88W	242	EMERALD BASIN
002	CORE	1131331		43 53.06N	62 47.84W	243	EMERALD BASIN
002TWC	CORE	1131331		43 53.06N	62 47.84W	243	EMERALD BASIN
003	BOXCORE	1131644		43 53.01N	62 47.80W	236	EMERALD BASIN
004	CORE	1131825		43 53.01N	62 47.95W	243	EMERALD BASIN
005	EXCALIBUR	1131923		43 52.98N	62 47.93W	245	EMERALD BASIN
006	CORE	1141341		43 41.40N	62 47.03W	200	EMERALD BASIN
006TWC	CORE	1141341		43 41.40N	62 47.03W	200	EMERALD BASIN
007	EXCALIBUR	1141610		43 52.98N	62 47.93W	200	EMERALD BASIN
008	CORE	1141717		43 41.33N	62 47.14W	200	EMERALD BASIN
008TWC	CORE	1141717		43 41.33N	62 47.14W	200	EMERALD BASIN
009	EXCALIBUR	1141915		43 41.42N	62 47.23W	200	EMERALD BASIN
010	CORE	1151258		43 41.39N	62 47.14W	199	EMERALD BASIN
010TWC	CORE	1151258		43 41.39N	62 47.14W	199	SCOTIAN SLOPE
011	BOXCORE	1151452		43 41.43N	62 47.19W	199	EMERALD BASIN
012	BOXCORE	1151553		43 41.41N	62 47.11W	200	EMERALD BASIN
013	CORE	1151718		43 41.39N	62 47.09W	200	EMERALD BASIN
013TWC	CORE	1151718		43 41.39N	62 47.09W	200	EMERALD BASIN
014	CORE	1161222		43 41.40N	62 47.17W	200	EMERALD BASIN
014TWC	CORE	1161222		43 41.40N	62 47.17W	200	EMERALD BASIN
015	CORE	1161554		43 41.39N	62 47.11W	200	EMERALD BASIN
015TWC	CORE	1161554		43 41.39N	62 47.11W	200	EMERALD BASIN
016	CORE	1161905		43 41.48N	62 47.01W	200	EMERALD BASIN
016TWC	CORE	1161905		43 41.48N	62 47.01W	200	EMERALD BASIN
017	CORE	1171246		43 53.01N	62 47.89W	200	EMERALD BASIN

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TABLE 1

TOTAL SAMPLE INVENTORY

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 050031

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DAY/TIME	SEISMIC DAY/TIME	LATITUDE	LONGITUDE	DEPTH (M)	GEOGRAPHIC LOCATION
018	CORE	1171723		43 52.90N	62 52.24W	266	EMERALD BASIN
019	CORE	1171921		43 52.91N	62 52.23W	270	EMERALD BASIN
019TWC	CORE	1171921		43 52.91N	62 52.23W	270	EMERALD BASIN
020	CAMERA	1172136		43 52.94N	62 52.42W	267	EMERALD BASIN
021	EXCALIBUR	1180024		43 52.95N	62 52.29W	275	SCOTIAN SLOPE
022	CORE	1181736		42 53.92N	62 12.36W	570	SCOTIAN SLOPE
023	CORE	1191236		42 45.98N	62 12.04W	1090	SCOTIAN SLOPE
024	CORE	1191402		42 37.48N	62 11.92W	1474	SCOTIAN SLOPE
025	CORE	1191702		42 29.99N	62 11.96W	1976	SCOTIAN SLOPE
026	CORE	1191845		42 21.46N	62 12.00W	2409	SCOTIAN SLOPE
027	CORE	1201310		42 21.54N	62 11.99W	2416	SCOTIAN SLOPE
027TWC	CORE	1201310		42 21.54N	62 11.99W	2416	SCOTIAN SLOPE
028	CORE	1201615		42 33.79N	62 11.95W	1737	SCOTIAN SLOPE
029	CORE	1201749		42 42.88N	62 11.94W	1224	SCOTIAN SLOPE
030	CORE	1201912		42 51.31N	62 12.09W	750	SCOTIAN SLOPE
031	CORE	1211307		42 21.44N	62 12.04W		SCOTIAN SLOPE
031TWC	CORE	1211307		42 21.44N	62 12.04W		SCOTIAN SLOPE
032	CORE	1211832		42 51.31N	62 12.00W	750	SCOTIAN SLOPE
033	GRAB	1212200		43 23.06N	62 14.07W	107	EMERALD BASIN

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TABLE 2

CORE SAMPLES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	SAMPLE TYPE	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	CORER LENGTH (CM)	APP. PENN (CM)	CORE LENGTH (CM)	NO OF SECT	GEOGRAPHIC LOCATION	NOTES
002	AGC WIDE CORE	1131331	43 53.06N 62 47.84W	243	2440	1890	1287	9	EMERALD BASIN	INSTRUMENTATION ON - UPPER PISTON - LOWER PISTON - CHATS - WIRE DATA RECOVERED FOR ALL 4. METER BLOCK DID NOT WORK ON THIS DROP. PAL PISTON TYPE. LINER TYPE=AGC CAB CUTTER ID= 100MM . CORE HEAD = 3000KG FREE FALL DISTANCE= 460CM. MAX PULLOUT WAS 24 KPS. IMPLOSION AT 29 CM FROM BOTTOM OF 'F' EXTENDING UP TO 74 CM. EXTRUDED SECTION AT 'C-C', BAGGED. PIECE OF LINER FOUND AT 'J-J'. 4 CM WIDE INDENTATION IN CORE AT 'J' WHEN PUSH ROD SLIPPED.
002TWC	TRIGGER WEIGHT	1131331	43 53.06N 62 47.84W	243	188	200	125	1	EMERALD BASIN	
004	LEHIGH	1131825	43 53.01N 62 47.95W	243	150		130	1	EMERALD BASIN	2 ATTEMPTS.
006	AGC LONG CORE	1141341	43 41.40N 62 47.03W	200	1525	1231		5	EMERALD BASIN	CORE HEAD WEIGHT=1361KG. LINER TYPE=AGC CAB. INSTRUMENTATION ON - LOWER PISTON - CHATS - WIRE CUTTER ID = 100CM. WIRE SIZE = 20MM. FREE FALL DIST = 457 CM. METER BLOCK DID NOT WORK. MAX PULLOUT = 20 KPS. 5 BARRELS. PISTON TYPE = SPLIT - PAL SAMPLE FROM BELOW THE CUTTER BAGGED. PISTON WAS 76 CM ABOVE THE SEDIMENT INTERFACE. NO DAMAGE. BACK IN RACK AT 114/1416 U.T.
006TWC	TRIGGER WEIGHT	1141341	43 41.40N 62 47.03W	200	188	0	0	0	EMERALD BASIN	
008	AGC LONG CORE	1141717	43 41.33N 62 47.14W	200	1525	305	793	7	EMERALD BASIN	CORE HEAD WEIGHT= 1361KG. CORE WEIGHT IN WATER=9.5 KPS. PISTON TYPE=SPLIT INSTRUMENTATION ON - LOWER PISTON - CHATS - WIRE 5 BARRELS. FREE FALL DISTANCE WAS 153CM. BACK IN THE RACK AT 114/1455. PISTON DID SPLIT. LOWER PISTON WAS 46 CM ABOVE SEDIMENT.

TABLE 2

CORE SAMPLES

SAMPLE NUMBER	SAMPLE TYPE	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	CORER LENGTH (CM)	APP. PENN (CM)	CORE LENGTH (CM)	NO OF SECT	GEOGRAPHIC LOCATION	NOTES
008TWC	TRIGGER WEIGHT	1141717	43 41.33N 62 47.14W	200	188	0000	0000	0	EMERALD BASIN	
010	AGC WIDE CORE	1151258	43 41.39N 62 47.14W	199	1525	1320	562	4	EMERALD BASIN	REGULAR PISTON WITH SPRING LOADED GRABERS. TRIP WEIGHT APPEARS TO HAVE FALLEN OVER. -CHATS WAS INSTALLED ON TRIP WEIGHT. -CHATS WAS IN THE CORE HEAD. -SECTION D-E LOOKS STRETCHED. 89-92CM RECOVERED AT 'D-D'
010TWC	TRIGGER WEIGHT	1151258	43 41.39N 62 47.14W	199	188	0	0	0	SCOTIAN SLOPE	NO RECOVERY. FELL OVER.
013	AGC WIDE CORE	1151718	43 41.39N 62 47.09W	200	1525	1300	765	5	EMERALD BASIN	GRABERS, NO SPRINGS. CORE HEAD WEIGHT=1361KG. LINER TYPE = AGC CAB. PISTON TYPE = SPLIT. INSTRUMENTATION ON - CHATS AND WIRE. 5 BARRELS. FREE FALL DISTANCE = 460 CM. MAX PULLOUT LOAD = 21 KPS. BACK IN RACK = 115/1808. THE PISTON SPLIT. LOWER PISTON WAS 62 CM ABOVE SURFACE OF SEDIMENT. STYROFOAM INSERTED AT TOP OF 'E-F'. CUTTER SAMPLE.
013TWC	TRIGGER WEIGHT	1151718	43 41.39N 62 47.09W	200	188	0	0	0	EMERALD BASIN	NO RECOVERY. FELL OVER.
014	AGC WIDE CORE	1161222	43 41.40N 62 47.17W	200	1525	1210	671	5	EMERALD BASIN	-SMALL SAMPLE FROM NOSE OF CUTTER, BAGGED. -CUTTER EXTRUDED, 'A-A' (647-654) CM, BAGGED. CORE HEAD WEIGHT=1361 KG. PISTON TYPE = PAL. LINER TYPE = AGC CAB. 5 BARRELS. FREE FALL DISTANCE =5 METRES. BACK IN RACK AT 116/1256. LOWER PISTON WAS 14 CM ABOVE SEDIMENT. NO DAMAGE.
014TWC	TRIGGER WEIGHT	1161222	43 41.40N 62 47.17W	200	188	0	0	0	EMERALD BASIN	NO RECOVERY.
015	AGC WIDE CORE	1161554	43 41.39N 62 47.11W	200	1525	458	720	5	EMERALD BASIN	2 CM AT 'C-C' BAGGED. CORE HEAD WEIGHT= 1361 KG. PISTON TYPE SPLIT AND PAL. LINER TYPE = AGC CAB. INSTRUMENTATION ON LOWER PISTON, CHATS AND WIRE. SMALL ID CUTTER. 5 BARRELS. FREE FALL = 153 CM. MAX PULLOUT = 14 KPS BACK IN RACK AT 116/1648. THE PISTON DID SPLIT. LOWER PISTON WAS 405 CM ABOVE THE SEDIMENT. NO DAMAGE.

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TABLE 2

CORE SAMPLES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	SAMPLE TYPE	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	CORER LENGTH (CM)	APP. PENH (CM)	CORE LENGTH (CM)	NO OF SECT	GEOGRAPHIC LOCATION	NOTES
015TWC	TRIGGER WEIGHT	1161554	43 41.39N 62 47.11W	200	188	0	0	0	EMERALD BASIN	NO RECOVERY.
016	AGC WIDE CORE	1161905	43 41.48N 62 47.01W	200	1525	305	715	5	EMERALD BASIN	APPARENT PEN WAS NOT RELIABLE, WASHED OFF. 4CM EXTRUDED AT 'A-A' (692-696)- BAGGED.CORE HEAD WEIGHT=1361 KG. PISTON TYPE = PAL. LINER TYPE = AGC CAB. INSTRUMENTATION ON CHATS AND WIRE. 5 BARRELS. FREE FALL WAS GRAVITY. MAX PULLOUT = 20 KPS. BACK IN THE RACK AT 116/1932.
016TWC	TRIGGER WEIGHT	1161905	43 41.48N 62 47.01W	200	188	0	0	0	EMERALD BASIN	NO RECOVERY.
017	AGC WIDE CORE	1171246	43 53.01N 62 47.89W	200	2440	1220	795	6	EMERALD BASIN	BARREL #5 BROKE AT TOP. 1 COUPLING DAMAGED AT 5. NO TRIP CORE THIS TIME. BACK IN THE RACK AT 117/1340. BAGGED CATCHER SAMPLE. 8 BARRELS. NO FREE FALL. NO PISTON.
018	LEHIGH	1171723	43 52.90N 62 52.24W	266	150	0	156	1	EMERALD BASIN	TOP OF CORE- APPROX 22 CM BAGGED.
019	AGC WIDE CORE	1171921	43 52.91N 62 52.23W	270	1525	2135	845	6	EMERALD BASIN	NO PISTON. GRAVITY CORE. LINER TYPE = AGC CAB. 7 BARRELS. FREE FALL = 153 CM. INSTRUMENTATION ON CHATS AND WIRE. BACK IN THE RACK AT 117/1955. GAS SAMPLE TAKEN AT CUTTER. SAMPLE AT 'C-C', BAGGED. TWT CUT IN 2 PIECES.
019TWC	TRIGGER WEIGHT	1171921	43 52.91N 62 52.23W	270	188	166	189	1	EMERALD BASIN	TWC CUT IN 2 PIECES.
022	LEHIGH	1181736	42 53.92N 62 12.36W	570	150		117	1	SCOTIAN SLOPE	
023	LEHIGH	1191236	42 45.98N 62 12.04W	1090	150		91.5	1	SCOTIAN SLOPE	
024	LEHIGH	1191402	42 37.48N 62 11.92W	1474	150		58.5	1	SCOTIAN SLOPE	

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TABLE 2

CORE SAMPLES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	SAMPLE TYPE	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	CORER LENGTH (CM)	APP. PENN (CM)	CORE LENGTH (CM)	NO OF SECT	GEOGRAPHIC LOCATION	NOTES
025	LEHIGH	1191702	42 29.99N 62 11.96W	1976	150		161	1	SCOTIAN SLOPE	
026	LEHIGH	1191845	42 21.46N 62 12.00W	2409	150		140	1	SCOTIAN SLOPE	
027	AGC WIDE CORE	1201310	42 21.54N 62 11.99W	2416	2440	1675	863	6	SCOTIAN SLOPE	CORE HEAD WEIGHT=1361. NO PISTON. LINER TYPE = AGC CAB INSTRUMENTATION = CHATS AND WIRE. 8 BARRELS. CATCHER SAMPLE (836-846) BAGGED.
027TWC	TRIGGER WEIGHT	1201310	42 21.54N 62 11.99W	2416	188	162	84	1	SCOTIAN SLOPE	
028	LEHIGH	1201615	42 33.79N 62 11.95W	1737	150		76	1	SCOTIAN SLOPE	
029	LEHIGH	1201749	42 42.88N 62 11.94W	1224	150	105	85	1	SCOTIAN SLOPE	
030	LEHIGH	1201912	42 51.31N 62 12.09W	750	150		140	1	SCOTIAN SLOPE	
031	AGC WIDE CORE	1211307	42 21.44N 62 12.04W		1830	1065	354	2	SCOTIAN SLOPE	0-19CM AT 'C-C'. 'A-A' + CUTTER = 318-354. SPLIT PISTON. 6 BARRELS. FREE FALL= 153 CM. INSTRUMENTATION= LOWER PISTON, WIRE, CHATS.
031TWC	TRIGGER WEIGHT	1211307	42 21.44N 62 12.04W		188	170	185	1	SCOTIAN SLOPE	0-93 SECTION DISTURBED. 0-10, 87-93 HAD TO BE SLICED WITH A SPATULA. SECOND SECTION 93-185 CM VERY DISTURBED, SPATULA USED.
032	LEHIGH	1211832	42 51.31N 62 12.00W	750	150		150	1	SCOTIAN SLOPE	

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TABLE 3

EXCALIBUR STATIONS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	DAY/TIME (UTC)	LATITUDE LONGITUDE DEPTH (M)	(TIME) -IN WATER- -ZERO CHECK- -ON BOTTOM- -OF PULLOUT-	SAMP RATE PER/SEC	DEPTH TO LOG (M)	TILL VALVE OPEN (MIN)	WATER SAMP INT (MIN)	(RECOVERED) SAMP VOL GAS VOL (CC)	TIP DIAM (MM)	TIP POROSITY (MICRONS)	(BOTTLE) INIT PRES FINAL PRES (KPA)	PROBE LEN (CM)
005	1131923	43 52.98N 62 47.93W 245	1908 1915 1923	60	30	30	60	6	4.76	70	100	60
007	1141610	43 52.98N 62 47.93W 200	1557 1603 1610	60	30	30	60	0 0	4.76	70	100 100	60
009	1141915	43 41.42N 62 47.23W 200	1900 1905 1915	60	0				4.76	70		310
001	1122222	43 53.02N 62 47.88W 242	2207 2217 2222	60	30	15	60	37.5 10	4.76	70	100	60
021	1180024	43 52.95N 62 52.29W 275	2356 0001 0024 1150	12	30	120	360	40.3 20	4.76	70	100 2750	60

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TABLE4

GRAB SAMPLES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	TYPE OF SAMPLER	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (M)	NO.OF TRIES	NO. OF SUBSAMPLES	GEOGRAPHIC LOCATION	GRAB SAMPLE NOTES
033	VAN VEEN	1212200	43 23.06N 62 14.07W	107	1	4	EMERALD BASIN	LARGE VANVEEN. MOSTLY SAND. 2 KG SAMPLE TO BE USED FOR ORGANIC CHARACTERIZATION.

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TABLE 5

BOXCORE SAMPLES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	TYPE OF BOXCORE	JULIAN DAY/TIME	LATITUDE LONGITUDE	DEPTH (MTRS)	NO OF ATMTS	NO OF SUBS	NO OF CORES	PHOTOS TAKEN	GEOGRAPHIC LOCATION	NOTES
003	BOXCORE	1131644	43 53.01N 62 47.88W	236	1	0	2	Y	EMERALD BASIN	PUSH CORES TAKEN AT 'E' AND 'G'.
011	BOXCORE	1151452	43 41.43N 62 47.19W	199	0	0	0	N	EMERALD BASIN	NO SAMPLE.
012	BOXCORE	1151553	43 41.41N 62 47.11W	200	2	4	0	N	EMERALD BASIN	2 SURFACE SUBSAMPLES FOR BARRY HARGRAVE (PIGMENTS). 2 SURFACE SAMPLES FOR GEOCHEM.

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TABLE 6

CAMERA STATIONS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

SAMPLE NUMBER	TYPE OF CAMERA	DAY/TIME (GMT)	LATITUDE LONGITUDE	DEPTH (MTRS)	FRAMES SHOT	DIST OFF. BOTT	STEREO	COLOR1 COLOR2	ASA1 ASA2	FSTOP1 FSTOP2	FOCUS1 FOCUS2	FILM1 FILM2	GEOGRAPHIC LOCATION
020	UMEL	1172136	43 52.94N	267	86	250	N	COLOR	200	3.5	250	EKTACHROME	EMERALD BASIN
			62 52.42W					B-W	400	5.6	250	TMY	

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TABLE 7

SEISMIC RECORDS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

ROLL NUMBERS	START DAY/TIME	STOP DAY/TIME	HYDROPHONE	LINE NUMBERS	RECORD TYPE	GEOGRAPHIC LOCATION	RECORDER	SYSTEM / SOUND SOURCE
001	1130210	1131030	NSRF 3 MTR	1, 2	SINGLE	EMERALD BASIN	EPC 9800	AGC SEISMICS SLEEVE GUN 10 CU IN
001	1132300	1140930	SE 25 FT	3,4,5,6	SINGLE	EMERALD BASIN	EPC 3200	AGC SEISMICS SLEEVE GUN 10 CU IN
001	1160629	1160955	SE 100 FT	9	SINGLE	EMERALD BASIN	EPC 3200	AGC SEISMICS SLEEVE GUN 10 CU IN
002	1132054	1140930	NSRF 3 MTR	3,4,5,6	SINGLE	EMERALD BASIN	EPC 9800	AGC SEISMICS SLEEVE GUN 10 CU IN
002	1152130	1150700	SE 25 FT	7,8	SINGLE	EMERALD BASIN	EPC 3200	AGC SEISMICS SLEEVE GUN 10 CU IN
002	1182000	1190705	SE 100 FT	10,11,12	SINGLE	SCOTIAN SLOPE	EPC 3200	AGC SEISMICS SLEEVE GUN 10 CU IN
003	1142130	1150700	NSRF 3 MTR		SINGLE	EMERALD BASIN	EPC 9800	AGC SEISMICS SLEEVE GUN 10 CU IN
003	1190708	1191051	SE 100 FT	12	SINGLE	SCOTIAN SLOPE	EPC 3200	AGC SEISMICS SLEEVE GUN 10 CU IN
004	1160640	1160955	NSRF 3 MTR		SINGLE	EMERALD BASIN	EPC 9800	AGC SEISMICS SLEEVE GUN 10 CU IN
004	1192057	1201100	SE 100 FT	13,14,15	SINGLE	SCOTIAN SLOPE	EPC 3200	AGC SEISMICS SLEEVE GUN 40 CU IN
004	1192057	1201100	SE 100 FT	13,14,15	SINGLE	SCOTIAN SLOPE	EPC 3200	AGC SEISMICS SLEEVE GUN 40 CU IN
005	1181830	1191051	NSRF 3 MTR	10,11,12	SINGLE	SCOTIAN SLOPE	EPB 9800	AGC SEISMICS SLEEVE GUN 10 CU IN
005	1201950	1211100	SE 100 FT	16,12,18,19,20, 21	SINGLE	SCOTIAN SLOPE	EPC 3200	AGC SEISMICS SLEEVE GUN 40 CU IN
006	1192050	1201100	NSRF 3 MTR	13,14,15	SINGLE	SCOTIAN SLOPE	EPC 9800	AGC SEISMICS SLEEVE GUN 40 CU IN
007	1201950	1211100	NSRF 25 FT	16,17,18,19,20, 21	SINGLE	SCOTIAN SLOPE	EPC 9800	AGC SEISMICS SLEEVE GUN 40 CU IN

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TABLE 8

HUNTEC RECORDS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

ROLL NUMBERS	START DAY/TIME	STOP DAY/TIME	HYDROPHONE	LINE NUMBERS	RECORD TYPE	GEOGRAPHIC LOCATION	RECORDER	HUNTEC SYSTEM
001	1130210	1131030	EXTERNAL	1, 2	SINGLE	EMERALD BASIN	EPC 4600	HUNTEC DTS (AGC 1)
002	1132050	1140804	EXTERNAL	3,4,5,6	SINGLE	EMERALD BASIN	EPC 4600	HUNTEC DTS (AGC 1)
003	1140805	1140930	EXTERNAL	6	SINGLE	EMERALD BASIN	EPC 4600	HUNTEC DTS (AGC 1)
004	1142130	1150645	EXTERNAL	7, 8	SINGLE	EMERALD BASIN	EPC 4600	HUNTEC DTS (AGC 1)
005	1160615	1160955	EXTERNAL		SINGLE	EMERALD BASIN	EPC 4600	HUNTEC DTS (AGC 1)
006	1181850	1190217	EXTERNAL	10	SINGLE	SCOTIAN SHELF	EPC 4600	HUNTEC DTS (AGC 1)
007	1190225	2291051	EXTERNAL	11,12	SINGLE	SCOTIAN SLOPE	EPC 4600	HUNTEC DTS (AGC 1)
008	1192100	1201100	EXTERNAL	13,14,15	SINGLE	SCOTIAN SLOPE	EPC 4600	HUNTEC DTS (AGC 1)
009	1201950	1211100	EXTERNAL	16,17,18,19,20,	SINGLE	SCOTIAN SLOPE	EPC 4600	HUNTEC DTS (AGC 1)
001	1130200	1131030	INTERNAL	1, 2	SINGLE	EMERALD BASIN	EPC 4100	HUNTEC DTS (AGC 1)
002	1132050	1140932	INTERNAL	3,4,5,6	SINGLE	EMERALD BASIN	EPC 4100	HUNTEC DTS (AGC 1)
003	1142130	1150645	INTERNAL	7, 8	SINGLE	EMERALD BASIN	EPC 4100	HUNTEC DTS (AGC 1)
004	1160615	1160955	INTERNAL		SINGLE	EMERALD BASIN	EPC 4100	HUNTEC DTS (AGC 1)
005	1181850	1190342	INTERNAL		SINGLE	SCOTIAN SLOPE	EPC 4100	HUNTEC DTS (AGC 1)
006	1190345	1191051	INTERNAL	12	SINGLE	SCOTIAN SLOPE	EPC 4100	HUNTEC DTS (AGC 1)
007	1192100	1201100	INTERNAL	13,14,15	SINGLE	SCOTIAN SLOPE	EPC 4100	HUNTEC DTS (AGC 1)
008	1202000	1211100	INTERNAL	16,17,18,19,20,	SINGLE	SCOTIAN SLOPE	EPC 4100	HUNTEC DTS (AGC 1)

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TABLE 9

3.5 KHZ RECORDS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

ROLL NUMBERS	START DAY/TIME	STOP DAY/TIME	LINE NUMBERS	GEOGRAPHIC LOCATION	RECORDER	SYSTEM / SOUND SOURCE
001	1130210	1130540	1	EMERALD BASIN	EPC 4800	HULL MOUNTED
002	1130542	1131030	1, 2	EMERALD BASIN	EPC 4800	HULL MOUNTED
003	1132045	1140300	3, 4	EMERALD BASIN	EPC 4800	HULL MOUNTED
004	1140300	1140933	5, 6	EMERALD BASIN	EPC 4800	HULL MOUNTED
005	1142130	1150731	7, 8	EMERALD BASIN	EPC 4800	HULL MOUNTED
006	1151913	1152227		EMERALD BASIN	EPC 4800	HULL MOUNTED
007	1160040	1160332		EMERALD BASIN	EPC 4800	HULL MOUNTED
008	1160338	1160955		EMERALD BASIN	EPC 4800	HULL MOUNTED
009	1171607	1172225		EMERALD BASIN	EPC 4800	HULL MOUNTED
010	1181600	1191051		SCOTIAN SLOPE	EPC 4800	HULL MOUNTED
011	1192025	1200022	13	SCOTIAN SLOPE	EPC 4800	HULL MOUNTED
012	1200025	1201100	13,14,15	SCOTIAN SLOPE	EPC 4800	HULL MOUNTED
013	1201950	1211100	16,17,18,19,20, 21	SCOTIAN SLOPE	EPC4800	HULL MOUNTED

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TABLE 10

SIDESCAN RECORDS

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

ROLL NUMBERS	START DAY/TIME	STOP DAY/TIME	LINE NUMBERS	RECORD TYPE	GEOGRAPHIC LOCATION	RECORDER	SIDESCAN SYSTEM
001	1130210	1130439	1	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
002	1130441	1130640	1	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
003	1130640	1131030	2	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
004	1132057	1132330	3	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
005	1132333	1140400	3,4,5	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
006	1140400	1140820	6	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
007	1140820	1140930	6	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
008	1142130	1150130	7	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
009	1150130	1150500	8	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
010	1150500	1150700	8	SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
011	1160040	1160505		SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)
012	1160615	1160955		SINGLE	EMERALD BASIN	KLEIN 595	KLEIN 595 (100-500)

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 11

SEISMICS/SIDESCAN/HUNTEC COMBINED VHS TAPES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

TAPE NUMBERS	START DAY/TIME	STOP DAY/TIME	GEOGRAPHIC LOCATION	CHANNEL INFORMATION
001	1130210	1130514	EMERALD BASIN	
002	1130515	1130810	EMERALD BASIN	
003	1130810	1132125	EMERALD BASIN	
004	1132126	1140015	EMERALD BASIN	
005	1140015	1140206	EMERALD BASIN	
006	1140206	1140359	EMERALD BASIN	
007	1140359	1140656	EMERALD BASIN	
008	1140657	1142149	EMERALD BASIN	
009	1142150	1150045	EMERALD BASIN	
010	1150046	1150325	EMERALD BASIN	
011	1150336	1150630	EMERALD BASIN	
013	1160243	1160708	EMERALD BASIN	
014	1160708	1161000	EMERALD BASIN	
015	1181830	1182123	SCOTIAN SLOPE	
016	1182123	1190012	SCOTIAN SLOPE	
017	1190013	1190308	SCOTIAN SLOPE	
018	1190308	1190551	SCOTIAN SLOPE	
019	1190552	1190932	SCOTIAN SLOPE	
020	1190935	1192221	SCOTIAN SLOPE	
021	1192221	1200113	SCOTIAN SLOPE	
022	1200113	1200408	SCOTIAN SLOPE	
023	1200408	1200718	SCOTIAN SLOPE	
024	1200718	1201010	SCOTIAN SLOPE	
012	1150631	1160240	EMERALD BASIN	
025	1201010	1202202	SCOTIAN SLOPE	

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 11

SEISMICS/SIDESCAN/HUNTEC COMBINED VHS TAPES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

TAPE NUMBERS	START DAY/TIME	STOP DAY/TIME	GEOGRAPHIC LOCATION	CHANNEL INFORMATION
026	1202202	1210053	SCOTIAN SLOPE	
027	1210053	1210346	SCOTIAN SLOPE	
028	1210346	1210637	SCOTIAN SLOPE	
029	1210637	1210931	SCOTIAN SLOPE	
030	1210932	1211100	SCOTIAN SLOPE	

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 12

SEISMIC START/STOP TIMES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 850031

PARAMETER NAME	START DAY/TIME	STOP DAY/TIME	NOTES
AGC SEISMIC	1130210	1131030	
AGC SEISMIC	1132054	1140930	
AGC SEISMIC	1142130	1150700	
AGC SEISMIC	1160630	1160955	
AGC SEISMIC	1181830	1191051	
AGC SEISMIC	1192050	1201100	
AGC SEISMIC	1201950	1211100	

ATLANTIC GEOSCIENCE CENTRE
DATA SECTION
-SHIP- REPORTING PACKAGE

TABLE 13

HUNTEC START/STOP TIMES

CRUISE NUMBER = 92003
CHIEF SCIENTIST = DR. D. BUCKLEY
PROJECT NUMBER = 050031

PARAMETER NAME	START DAY/TIME	STOP DAY/TIME	NOTES
HUNTEC DTS (AGC 1)	1130210	1131030	
HUNTEC DTS (AGC 1)	1132050	1140930	
HUNTEC DTS (AGC 1)	1142130	1150645	
HUNTEC DTS (AGC 1)	1160615	1160955	
HUNTEC DTS (AGC 1)	1181850	1191051	
HUNTEC DTS (AGC 1)	1192100	1201100	
HUNTEC DTS (AGC 1)	1202000	1211100	

TABLE 14

3.5 KHZ START/STOP TIMES

PARAMETER NAME	START DAY/TIME	STOP DAY/TIME	NOTES
3.5 KHZ (HULL MOUNTED)	1130210	1131030	
3.5 KHZ (HULL MOUNTED)	1132045	1140933	
3.5 KHZ (HULL MOUNTED)	1142130	1150700	
3.5 KHZ (HULL MOUNTED)	1160040	1160503	
3.5 KHZ (HULL MOUNTED)	1160615	1160955	
3.5 KHZ (HULL MOUNTED)	1171607	1172225	
3.5 KHZ (HULL MOUNTED)	1181600	1191051	
3.5 KHZ (HULL MOUNTED)	1192025	1201100	
3.5 KHZ (HULL MOUNTED)	1201950	1210435	
3.5 KHZ (HULL MOUNTED)	1210530	1211100	

APPENDIX II

GEOCHEMICAL DATA

Box 91020-028 (collected June 1991; stored and reprocessed April, 1992)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
28	box 91020	0	108001	36.2	28	0	0.46	6	7.4	8.5	6.2
28	box 91020	5	108002	35.9	28	0	0.55	7.1	7.6	4.6	6.6
28	box 91020	10	108003	35.9	28	0	0.58	5.5	7.6	5.2	6.9
28	box 91020	15	108004	35.9	28	0	0.66	6.9	7.6	5.6	7.1
28	box 91020	20	108005	35.6	28	0	0.7	6.2	7.6	5.8	7.2
28	box 91020	25	108006	35.8	28	0	0.72	7	7.5	5.9	7.2
28	box 91020	30	108007							6.4	7.3
28	box 91020	35	108008							6.4	7.4

Piston Core 002

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203002	piston	0	108010	34.7	28	0.13	0.7	4.5	7.4	5.7	7.1
9203002	piston	10	108011	34.7	28	0.13	0.68	4.8	7.4	5.9	7.2
9203002	piston	20	108012	34.7	28	0.17	0.54	4.7	7.4	5.7	6.6
9203002	piston	30	108013	34.7	28	0.25	0.54	6.4	8	5.5	7.6
9203002	piston	40	108014	34.7	28	0.42	0.48	7.6	8	5.4	7.5
9203002	piston	49	108015	34.7	28	0.5	0.38	7.3	8.1	5.2	7.8
9203002	piston	100	108016	33.8	22	1.1	0.6	11.9	7.8	5.8	7.6
9203002	piston	150	108017	33.8	20	1.4	0.7			5.3	7.4
9203002	piston	200	108018	33.6	17	1.7	0.74			4.9	7.4
9203002	piston	250	108019	33.6	14	1.9	0.77	18.4	8	4.7	7.3
9203002	piston	300	108020	33.3	12	2.2	0.77			4.7	7.2
9203002	piston	350	108021	33	11	2.3	0.72	21.4	8.6	4.7	7.3
9203002	piston	400	108022	33	11	2.4	0.7			2.4	7.3
9203002	piston	450	108023	33	10					4.3	7.2
9203002	piston	500	108024							4.2	7.2
9203002	piston	550	108049	33	9	2.7	0.57	19	8.4	3.9	7.2
9203002	piston	600	108050	32.1	4	3.1	0.57	20.6	8.3	2.5	7.4
9203002	piston	650	108051	32.1	2	3.1	0.61	19	8.2	3.0	7.2
9203002	piston	700	108052	32.1	1	2.9	0.51			0.6	7.5
9203002	piston	750	108053	32.1	0	2.9				2.2	7.5
9203002	piston	800	108054	32.1	0					3.1	7.3
9203002	piston	850	108055	32.1	0	3.1	0.57			0.4	7.4
9203002	piston	900	108056	31.6	0	3.2	0.61	17.4	8	0.4	7.1
9203002	piston	950	108057	31.3	0	3.2	0.59	17.4	8.2	1.4	7.2
9203002	piston	1000	108058	31.3	0	2.9			8.4	0.6	7.3
9203002	piston	1050	108059	31.3	0	3.2				1.1	7.4
9203002	piston	1100	108060	31	0					0.7	7.4
9203002	piston	1150	108061	31.6	0	3.2				1.0	7.3
9203002	piston	1200	108062	31.3	0	3.4		14.8	8.3	1.3	7.4
9203002	piston	1250	108063	31.3	0	3.1	0.34			1.7	7.2

Box Core 003

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203003	box	0	108025	34.7	28	0.08	0.27	3.5	7.2	3.7	7.2
9203003	box	5	108026	34.7	28	0.13	0.42	3.6	7.2	2.3	7.1
9203003	box	10	108027	34.7	28	0.15	0.47	3.7	7.4	2.4	7.1
9203003	box	15	108028	34.7	28	0.17	0.52	4.7	7.6	2.6	7.1
9203003	box	20	108029	34.7	28	0.17	0.6	5	7.6	3.8	7.2
9203003	box	25	108030	34.7	28	0.17	0.63	5	7.6	4.0	7.1
9203003	box	30	108031	34.7	28	0.17	0.61	4.9	7.8	4.4	7.2
9203003	box	35	108032	34.7	28	0.19	0.6	5.3	7.9	5.0	7.2
9203003	box	40	108033	34.7	28	0.21	0.56	4.7	7.9	4.5	7.1
9203003	box	45	108034	34.7	28	0.21	0.52	4.6	7.9	5.3	7.1
9203003	box	50	108035	34.7	28	0.21	0.49	4.5	7.7	4.0	7.1
9203003	box	55	108036	34.7	28	0.21	0.47			4.3	7.1

Lehigh Core 004

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203004	Lehigh	0	108037	34.7	28	0.08	0.26	3.1	7.6	2.7	7.1
9203004	Lehigh	10	108038	34.7	28	0.1	0.54	3.7	7.6	3.9	7
9203004	Lehigh	20	108039	34.7	28	0.13	0.58	3.8	7.6	4.8	7.1
9203004	Lehigh	30	108040	34.7	28	0.13	0.48	3.3	7.7	4.4	7
9203004	Lehigh	40	108041	34.7	28	0.13	0.56	4.2	7.8	5.8	7
9203004	Lehigh	50	108042	34.7	28	0.21	0.61	4.6	7.6	5.7	7.2
9203004	Lehigh	60	108043	34.7	28	0.23	0.56	4.8	8	5.5	7.2
9203004	Lehigh	70	108044	34.7	28	0.25	0.58	5.2	8	5.3	7.3
9203004	Lehigh	80	108045	34.7	28	0.27	0.58	4.8	8	5.5	7.3
9203004	Lehigh	90	108046	34.7	28	0.31	0.58	5.1	8	5.6	7.4
9203004	Lehigh	100	108047	34.7	28	0.31	0.52	4.5	7.6	5.7	7.4
9203004	Lehigh	110	108048	34.7	28	0.23	0.56	4.4	7.8	5.6	7.4

Piston Core 006

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203006	piston	0	108064	34.5	28	0	0.44	3.8	7.6	4.2	7.5
9203006	piston	10	108065	34.7	26	0	0.47	3.5	7.6	4.8	7.7
9203006	piston	20	108066	35		0				4.7	7.5
9203006	piston	30	108067	34.7	26	0	0.49	4.3	7.8	4.8	7.6
9203006	piston	40	108068							4.4	
9203006	piston	50	108069	34.5	25	0	0.64	4.5	7.4	5.8	7.5
9203006	piston	60	108070	34.4	24	0.1	0.72	5.1	7.6	5.0	7.3
9203006	piston	70	108071	34.4	24	0.4	0.75	5.8	7.8	4.7	7.2
9203006	piston	80	108072	34.1	22	0.5	0.79	6.3	8	4.9	7.1
9203006	piston	90	108073	33.9	23	0.5	0.82	6.4	7.6	4.9	7.1
9203006	piston	100	108074	33.9	23	0.8	0.82	7.5	7.7	4.6	7.2
9203006	piston	150	108075	33.9	22	1.1	0.82	9.2	8.1	5.1	7.2
9203006	piston	200	108076	33.6	18	1.4	0.86	10	7.8	5.2	7.3
9203006	piston	250	108077	33.3	14	1.9	0.79	11	7.8	5.0	7.3
9203006	piston	300	108078	33	12	2	0.79	13.2	7.9	4.2	7.2
9203006	piston	350	108079	32.4	11	2.2		13.7	8.1	1.8	7.2
9203006	piston	400	108080	32.1	10	2.3	0.46	14.5	8.2	2.0	7.3
9203006	piston	450	108081	31.8	8	2.4	0.51			0.6	7.2
9203006	piston	500	108082	31.6	7	2.7	0.64	15.8	8.1	2.4	7.4
9203006	piston	550	108083	31.6	5	2.8	0.51	15.3	8.2	-0.6	7.4
9203006	piston	600	108084	31.3	4	2.8	0.44	15.3	8.2	0.9	7.2
9203006	piston	650	108085	31	2	3.1	0.39			1.9	7.2

Piston Core 008

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203008	piston	0	108086	34.7	28	0	0.43	3.6	7.5	7.3	7.3
9203008	piston	10	108087	34.7	28	0	0.52	3.3	7.5	5.9	7.5
9203008	piston	20	108088	34.7	28	0	0.5	3.8	7.6	5.6	7.6
9203008	piston	30	108089	34.7	27	0	0.43	2.8	7.3	6.0	7.4
9203008	piston	40	108090	34.7				3.1	7.4	5.4	7.4
9203008	piston	50	108091	34.7	27	0	0.39	4.3	7.7	5.6	7.7
9203008	piston	60	108092	34.7	26	0	0.48	4.3	7.7	5.7	7.4
9203008	piston	70	108093	34.7	27	0	0.53	4.8	7.8	5.2	7.4
9203008	piston	80	108094	34.7	25	0.5	0.55	5.3	7.8	5.4	7.6
9203008	piston	90	108095	34.5	24	0.6	0.57	5.3	7.6	5.3	7.6
9203008	piston	100	108096	34.5	23	0.7	0.59	6.4	8	5.6	7.3
9203008	piston	150	108097	33.9	23	1	0.63	7.4	7.7	5.0	7.2
9203008	piston	200	108098	33.4	21	1.2	0.66	9.2	8	5.2	7.4
9203008	piston	250	108099	33.4	19	1.4	0.71	10.2	8.1	5.0	7.5
9203008	piston	300	108100	33.4	18	1.4	0.71	10.4	8	4.9	7.4
9203008	piston	350	108101	33.4	18	1.6	0.68	11.5	8	4.7	7.4
9203008	piston	400	108102	33.4	17	1.7	0.68	12.3	8	5.0	7.2
9203008	piston	450	108103	33.1	17	1.8	0.53	12.7	8.4	4.6	7.3
9203008	piston	500	108104	32.8	14	1.9	0.52	13.1	8.1	4.2	7.3
9203008	piston	550	108105	32.6	13	2	0.57	13.6	8	1.5	7.3
9203008	piston	600	108106	32.2	10	2.1	0.57	13.6	8	2.6	7.4
9203008	piston	650	108107	32	8	2.2	0.55	14	8.2	-0.1	7.2
9203008	piston	700	108108	31.8	8	2.3	0.5	13.8	8.2	2.0	7.2
9203008	piston	750	108109	31.2	6	2.4				1.7	7.2

Piston Core 010

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203010	piston	0	108110	34.7	28	0	0.45	3.7	7.4	3.9	7.6
9203010	piston	10	108111	34.7	28	0	0.44	4.7	7.8	4.2	7.6
9203010	piston	20	108112	34.2	26	0.5	0.69	6.4	7.7	4.2	7.4
9203010	piston	30	108113	33.9	24	0.7	0.74	7.6	7.8	4.7	7.3
9203010	piston	40	108114	33.6	23	0.9	0.75	7.6	7.7	4.8	7.4
9203010	piston	50	108115	33.6	24	1	0.77	8	7.8	4.8	7.3
9203010	piston	60	108116	33.6	25	1.1	0.72	8.7	7.8	4.5	7.3
9203010	piston	70	108117	33.4	21	1.2	0.72	8.7	7.8	4.8	7.4
9203010	piston	80	108118	33.4	21	1.2	0.72	9.1	8	5.0	7.3
9203010	piston	100	108119	33.4	22	1.4	0.77	9.2	7.9	4.8	7.6
9203010	piston	150	108120	33.1	19	1.6	0.72	10.2	7.9	4.8	7.6
9203010	piston	200	108121	32.8	21	1.7	0.65	12	8.1	3.8	7.3
9203010	piston	283	108124	32.3	17	2	0.57	12.2	8.1	0.9	7.4
9203010	piston	332	108123	32	15	2.1	0.55	12.1	8	2.2	7.3
9203010	piston	383	108122	31.8	13	2.2	0.51	12	8.1	0.6	7.2
9203010	piston	400	108125	31.8	12					-0.9	7.2
9203010	piston	450	108126							0.7	7.2
9203010	piston	500	108127							-0.3	7.1

Piston Core 013

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203013	piston	0	108128	35	28	0	0.28	3.6	7.6	4.9	7.1
9203013	piston	10	108129	35	28	0	0.33	4	7.7	5.4	7.3
9203013	piston	20	108130	35	28	0	0.33	3.8	7.7	5.7	7.5
9203013	piston	30	108131	35	28	0	0.34	3.4	8	5.3	7.3
9203013	piston	40	108132	35	28	0	0.42	4.6	7.8	5.6	7.2
9203013	piston	50	108133	34.8	28	0	0.45	4.4	7.9	5.8	7.3
9203013	piston	60	108134	34.8	28	0.1	0.49	5	8	5.1	7.2
9203013	piston	70	108135	34	28	0.2	0.52	5	7.8	4.8	7
9203013	piston	80	108136	34.5	27	0.2	0.52	5.4	7.8	4.8	7.3
9203013	piston	90	108137	34	27	0.3	0.56	5.7	7.8	4.8	7.2
9203013	piston	100	108138	34	25	0.3	0.57	6.5	7.8	5.0	7.1
9203013	piston	150	108139	33.2	23	0.7	0.67	7.8	7.7	4.8	7.3
9203013	piston	200	108140	33.2	20	0.9	0.69	9.1	7.8	4.6	7.2
9203013	piston	250	108141	33	18	1.1	0.69	10.9	8	4.9	7.3
9203013	piston	300	108142	32.8	17	1.4	0.65	12.3	8	4.3	7.5
9203013	piston	350	108143	32.5	17	1.6	0.59	12.4	8.1	4.1	7.4
9203013	piston	400	108144	32	14	1.7	0.48	13.9	8.1	2.7	7.3
9203013	piston	450	108145	31.8	12	2	0.35			2.8	7.4
9203013	piston	500	108146	31.2	9	2.1	0.38			2.4	7.4
9203013	piston	550	108147		6	2.5	0.36			2.5	7.3
9203013	piston	600	108148	30.8	3	2.4	0.33			1.2	7.3
9203013	piston	650	108149	30.5	2		0.32			1.2	7.2
9203013	piston	700	108150	30.2	2	2.5	0.31			-0.3	7.3

Piston Core 014

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203014	piston	0	108151	35	28	0	0.37	3.6	7.2	4.4	7.5
9203014	piston	10	108152	35	28	0	0.47	4.1	7.7	4.2	7.6
9203014	piston	20	108153	35	28	0	0.37	4.1	8	4.5	7.7
9203014	piston	30	108154	35	28					4.5	7.5
9203014	piston	40	108155	34.5	27	0.4	0.58	6.2	7.7	4.1	7.4
9203014	piston	50	108156	33.9	25	0.5	0.66	6.9	7.7	4.8	7.4
9203014	piston	60	108157	33.9	24	0.5	0.73	7.6	7.8	4.6	7.4
9203014	piston	70	108158	33.7	24		0.76	7.2	7.7	4.4	7.4
9203014	piston	80	108159	33.7	24	0.6	0.79	7.6	7.7	4.8	7.4
9203014	piston	90	108160	33.4	24	0.6	0.79	7.5	7.8	4.7	7.3
9203014	piston	100	108161	33.1	24	0.7	0.73	8	7.7	4.6	7.4
9203014	piston	150	108162	33.1	23	0.8	0.73	9	7.9	4.3	7.6
9203014	piston	200	108163	33.1	23	0.9	0.66	9.6	7.8	4.2	7.4
9203014	piston	250	108164	32.8	22	1.1	0.62	10.1	8.1	3.8	7.4
9203014	piston	300	108165	32.6	18	1.1	0.58	10	7.7	2.5	7.4
9203014	piston	350	108166	32.6	18	1.2	0.58	10.2	7.9	2.8	7.3
9203014	piston	400	108167	32.6	17	1.4	0.41	10.8	8.2	1.4	7.4
9203014	piston	450	108168	32.3	17	1.4		10.3	8.3	-0.5	7.3
9203014	piston	500	108169	32	16	1.4	0.32			-0.6	7.4
9203014	piston	550	108170	31.8	12					1.9	7.2
9203014	piston	600	108171		11					-0.5	7.2

Piston Core 015

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203015	piston	0	108172	35	28	0	0.32	3.7	7.4	3.9	7.6
9203015	piston	10	108173	35	28	0	0.46	4.1	7.6	4.1	7.4
9203015	piston	20	108174	35	28	0	0.48	4.5	7.8	3.9	7.5
9203015	piston	30	108175	34.7	27	0	0.5	4.1	7.3	4.0	7.5
9203015	piston	40	108176	34.2	28	0.3	0.69	6.1	7.9	4.3	7.8
9203015	piston	50	108177	33.7	21	0.8	0.8	9.4	7.7	4.6	7.4
9203015	piston	60	108178	33.4	21	0.7	0.8	9	7.8	4.4	7.3
9203015	piston	70	108179	33.4	23	0.7	0.77	8.2	8	4.1	7.3
9203015	piston	80	108180	33.4	23	0.8	0.77	8.8	7.9	4.0	7.4
9203015	piston	90	108181	33.4	24	0.9	0.77	9	8	3.1	7.4
9203015	piston	100	108182	33.4	20	0.8	0.71	9.6	7.9	4.4	7.6
9203015	piston	150	108183	33.1	19	1	0.69	10	8	3.1	7.5
9203015	piston	200	108184	33.1	17	1.2	0.64	11.2	7.9	4.4	7.4
9203015	piston	250	108185	33.1	16	1.3	0.69	12	7.8	4.7	7.3
9203015	piston	300	108186	32.6	16	1.4	0.69	12.5	7.8	4.5	7.3
9203015	piston	350	108187	32.6	15	1.6	0.62	12.7	8	4.3	7.3
9203015	piston	402	108188	32.3	15	1.6	0.46	13.7	8.2	1.7	7.6
9203015	piston	452	108189	32.3	12	1.7	0.48	13	8	1.4	7.5
9203015	piston	502	108190	32	12	1.9	0.5	14.3	8.2	1.5	7.6
9203015	piston	552	108191	31.8	10	1.7	0.52	15.6	8.1	1.4	7.5
9203015	piston	602	108192	31.5	10	1.9	0.62	15	8	2.6	7.4
9203015	piston	652	108193	31.5	9	2	0.59	15.6	8	2.4	7.3
9203015	piston	701	108194	31.2	8	2	0.48	14.6	8.2	-1.6	7.4

Piston Core 016

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203016	piston	0	108195	35	27	0	0.21	3.1	7.5	4.3	7.5
9203016	piston	10	108196	35	27	0	0.38	3.7	7.5	4.4	7.6
9203016	piston	20	108197	35	28	0	0.31	3.7	7.7	4.4	7.7
9203016	piston	30	108198	35	28	0				4.5	7.9
9203016	piston	40	108199	35	27	0	0.34	4.9	7.7	5.0	7.8
9203016	piston	50	108200	35	28	0	0.38	5	7.8	5.0	7.7
9203016	piston	60	108201	34.7	28	0	0.46	4.9	7.9	4.8	7.9
9203016	piston	70	108202	34.7	28	0	0.57	5.3	7.3	5.2	7.8
9203016	piston	80	108203	34.2	26	0.1	0.62	5.4	7.7	4.7	7.5
9203016	piston	90	108204	34.2	28	0.1	0.57	6	7.7	4.8	7.6
9203016	piston	100	108205	33.9	27	0.2	0.62	6.6	7.7	4.8	7.5
9203016	piston	150	108206	33.7	26	0.3	0.66	7	7.7	4.4	7.7
9203016	piston	200	108207	33.7	24	0.4	0.75	8.2	7.8	4.8	7.5
9203016	piston	250	108208	33.4	22	0.6	0.72	9.1	7.5	4.9	7.6
9203016	piston	300	108209	33.1	20	0.8	0.72	10.1	7.7	4.5	7.5
9203016	piston	350	108210	32.8	20	0.8	0.75	10.8	8	4.6	7.6
9203016	piston	400	108211	32.8	19	1	0.75	11.3	7.9	4.5	7.6
9203016	piston	450	108212	32.6	18	1.1	0.78	12.7	7.8	3.9	7.4
9203016	piston	500	108213	32.3	15	1.3	0.66	14	8.1	4.3	7.6
9203016	piston	550	108214	32	14	1.4		14	7.7	2.1	7.4
9203016	piston	600	108215	31.5	9	1.7	0.7	14.7	7.9	1.8	7.4
9203016	piston	650	108216		7					0.7	7.5

Piston Core 017

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203017	piston	0	108234	35	28	0	0.44	4.1	7.6	4.8	7.4
9203017	piston	10	108235	35	28	0	0.48	5	7.8	4.9	7.4
9203017	piston	20	108236	35	28	0	0.46	5.4	8	5.1	7.3
9203017	piston	30	108237	34.8	28	0	0.46	4.9	8	4.8	7.4
9203017	piston	40	108238	35	28	0	0.49	4.9	7.8	5.1	7.4
9203017	piston	50	108239	34.8	28	0	0.48	5.4	7.9	5.1	7.4
9203017	piston	60	108240	34.8	28	0.4	0.49	6.1	7.7	5.2	7.4
9203017	piston	70	108241	34.8	28	0.5	0.48	6.4	8	5.0	7.3
9203017	piston	80	108242	34.5	28	0.6	0.42	7.3	7.9	4.7	7.5
9203017	piston	90	108243	34.3	28	0.6	0.42	8.1	8.2	4.2	7.5
9203017	piston	100	108244	34.3	28	0.7	0.45	8.5	8.1	4.6	7.5
9203017	piston	150	108245	34.3	28	0.8	0.41	9.9	8.2	4.4	7.4
9203017	piston	200	108246	34	22	1	0.48	11.2	8	4.8	7.5
9203017	piston	250	108247	34	21	1.4	0.54	13.5	8	4.7	7.5
9203017	piston	300	108248	33.8	21	1.6	0.61	13.6	8.1	4.9	7.5
9203017	piston	350	108249	34	26	1.8	0.63			4.8	7.4
9203017	piston	400	108250	33.6	21	1.9	0.63	16.3	8.4	4.5	7.5
9203017	piston	450	108251	33.3	19	2	0.63	17.5	8.4	4.1	7.6
9203017	piston	500	108252	32.5	12	2.2	0.65	19.4	8.2	3.7	7.5
9203017	piston	550	108253		9	2.4	0.63	20.2	8.4	3.4	7.5
9203017	piston	600	108254		7			20.4	8.4	4.1	7.6
9203017	piston	650	108255	32	4	2.8	0.59	20.4	8.4	2.1	7.7
9203017	piston	700	108256	31.8	0	3	0.63	20.8	8.2	2.3	7.5
9203017	piston	750	108257	31.5	0	3.1	0.59	19	8.2	1.7	7.6

Lehigh Core 018

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203018	Lehigh	0	108217	35	28	0	0.22	3.9	7.8	4.3	7.6
9203018	Lehigh	5	108218	35	28	0	0.22	3.5	7.2	5.0	7.7
9203018	Lehigh	10	108219	35	28	0	0.33	3.8	7.6	4.9	7.8
9203018	Lehigh	15	108220	35	28	0	0.38	4.3	7.8	4.8	7.6
9203018	Lehigh	20	108221	34.7	27	0	0.38	4.7	7.3	4.7	7.5
9203018	Lehigh	30	108222	34.7	28	0	0.48	4.4	7.7	4.9	7.5
9203018	Lehigh	40	108223	34.7	28	0.1	0.41	4.9	7.9	4.6	7.6
9203018	Lehigh	50	108224	34.7	26	0.1	0.48	5.1	8	4.6	7.7
9203018	Lehigh	60	108225	34.5	28	0.2	0.46	5.8	7.8	4.9	7.6
9203018	Lehigh	70	108226	34.5	27	0.2	0.49	5.7	8	4.3	7.6
9203018	Lehigh	80	108227	34.2	28	0.3	0.48	7.3	8.1	4.8	7.6
9203018	Lehigh	90	108228	34.5	28	0.3	0.43	8.6	8.1	5.1	7.7
9203018	Lehigh	100	108229	34.2	28	0.5	0.46	8.8	8.1	4.7	7.9
9203018	Lehigh	110	108230	34.5	28	0.6	0.44	9.2	8.2	2.1	7.8
9203018	Lehigh	120	108231	34.2	28	0.6	0.46	10	8.2	3.6	7.8
9203018	Lehigh	130	108232	33.9	28	0.6	0.44	10.5	8.2	4.3	7.9
9203018	Lehigh	140	108233	34.2	28		0.44	10.9	8.1	4.1	8.1

Trigger Core 019

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203019	trigger	0	108258	35	28	0	0.45	2.9	7.5	4.3	7.5
9203019	trigger	10	108259	35	28	0	0.5	3.4	7.4	4.6	7.6
9203019	trigger	20	108260	35	28	0	0.39	2.8	7.1	5.0	7.5
9203019	trigger	30	108261	35	28	0	0.33	3.7	7.7	5.0	7.6
9203019	trigger	40	108262	35	28	0	0.47	4.5	8	4.9	7.6
9203019	trigger	50	108263	35	28	0	0.5	4.5	7.9	4.8	7.6
9203019	trigger	60	108264	35	28	0	0.43	4.5	7.7	4.8	7.6
9203019	trigger	70	108265	35	28	0	0.4	3.3	7.6	5.0	7.7
9203019	trigger	80	108266	35	28	0	0.53	5.4	7.9	5.0	7.7
9203019	trigger	90	108267	35	28	0	0.56	5.2	7.7	4.9	7.8
9203019	trigger	100	108268	35	28	0.2	0.56	7.2	8	4.9	7.7
9203019	trigger	150	108269	35	28	0.4	0.56	8.2	8.1	0.9	7.6

Piston Core 019

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203019	piston	0	108270	35	28	0.3	0.43	6.1	7.8	3.4	7.6
9203019	piston	10	108271	35	28	0.3	0.41	5.2	7.7	3.9	7.6
9203019	piston	20	108272	35	28	0.3	0.43	5.4	7.7	-0.1	7.6
9203019	piston	30	108273	35	28	0.3	0.41	5.4	7.6	3.7	7.9
9203019	piston	40	108274	35	28	0.4	0.44	6.8	7.7	3.3	7.6
9203019	piston	50	108275	34.7	28	0.6	0.43	6.6	7.8	-1.2	7.8
9203019	piston	60	108276	34.7	28	0.5	0.4	6.2	8	3.3	7.7
9203019	piston	70	170277	34.5	27	0.5	0.34	6.6	7.9	3.1	7.7
9203019	piston	80	108278	33.9	24	1.6	0.45	13.8	8.1	-1.4	7.7
9203019	piston	90	108279	33.7	24	1.6		13.9	8.3	1.0	7.8
9203019	piston	100	108280	33.9	25	1.7		16.4	8.4	0.7	7.7
9203019	piston	150	108281	33.4	24	1.7				-0.6	7.7
9203019	piston	200	108282	33.4	8	2.6	0.64	24.7	8.4	-1.7	7.8
9203019	piston	250	108283	33.4	1	2.5	0.6	26.7	8.4	-0.9	7.7
9203019	piston	300	108284	33.4	0	3	0.66	26.8	8.4	-0.7	7.6
9203019	piston	350	108285	33.1	0	3.7	0.71	28	8.2	2.2	7.7
9203019	piston	400	108286	33.1	0	4.9	0.66	26.8	8.2	1.8	7.5
9203019	piston	450	108287	33.1	0	5.5	0.68	26.3	8.1	0.9	7.5
9203019	piston	500	108288	33.1	0	5.7	0.6	24.7	8.1	0.7	7.4
9203019	piston	550	108289	33.1	0	6.1	0.73	25.4	8.1	1.3	7.2
9203019	piston	600	108290	32.8	0	6.6	0.71	23.4	8.1	1.8	7.5
9203019	piston	650	108291	33.1	0		0.68	23.8	8.1	2.0	7.3
9203019	piston	700	108292	32.8	0	7.4	0.56	22.1	8.4	1.4	7.4
9203019	piston	750	108293	32.8	0	8	0.53	22	8.4	1.2	7.3
9203019	piston	800	108294		0					1.2	7.4

Lehigh Core 022 (570 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203022	Lehigh	0	108295	35	28	0.08	0.5	4.1	7.5	4.3	7.6
9203022	Lehigh	10	108296	35	28	0.1	0.5	4	7.5	4.5	7.5
9203022	Lehigh	20	108297	35	28	0.14	0.5	4.3	7.4	4.8	7.6
9203022	Lehigh	30	108298	35	28	0.14	0.52	4.2	7.8	4.3	7.5
9203022	Lehigh	40	108299	35	28	0.18	0.55	4.3	7.7	4.5	7.5
9203022	Lehigh	50	108300	35	28	0.21	0.55	4.8	7.6	3.7	7.6
9203022	Lehigh	60	108301	35	28	0.21	0.68	4.7	7.7	4.3	7.7
9203022	Lehigh	70	108302	35	28	0.25	0.66	4.6	7.7	4.9	7.7
9203022	Lehigh	80	108303	35	28	0.3	0.64	5.5	7.8	4.7	7.6
9203022	Lehigh	90	108304	35	28	0.31	0.63	5.5	7.8	5.0	7.6
9203022	Lehigh	100	108305	35	28	0.31	0.62	5.1	7.7	4.7	7.6
9203022	Lehigh	108	108306	35	28	0.31	0.6	5	7.7	3.4	7.6

Lehigh Core 023 (1000 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203023	Lehigh	0	108307	35	28	0.02	0.41	2.9	7.6	4.1	7.4
9203023	Lehigh	10	108308	35	28	0.1	0.49	3.9	7.8	4.7	7.4
9203023	Lehigh	20	108309	35	28	0.14	0.51	4.5	7.8	3.6	7.4
9203023	Lehigh	30	108310	35	28	0.15	0.5	4.3	7.6	2.8	7.5
9203023	Lehigh	40	108311	35	28	0.21	0.39	4.3	8.2	3.2	7.4
9203023	Lehigh	50	108312	35	28		0.36	4.1	8.1	2.9	7.6
9203023	Lehigh	60	108313	35	28		0.4	4.8	8	3.4	7.7
9203023	Lehigh	70	108314	35	28		0.41			2.7	7.7
9203023	Lehigh	80	108315	35	28		0.36	5.3	8	5.2	7.8
9203023	Lehigh	88	108316	35	28		0.45	6.2	8.1	5.2	8

Lehigh Core 024 (1500 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203024	Lehigh	0	108317	35	28	0.04	0.37	4.6	7.8	5.8	7.3
9203024	Lehigh	10	108318	35	28	0.07	0.4	4.8	7.8	3.6	7.3
9203024	Lehigh	20	108319	35	28	0.1	0.34	4.5	8	5.1	7.6
9203024	Lehigh	30	108320	35	28	0.11	0.36	4.1	8.1	3.3	7.6
9203024	Lehigh	40	108321	35	28	0.12	0.34	4.6	8.1	3.5	7.9
9203024	Lehigh	47	108322	35	28	0.15	0.3	4.7	8.2	4.3	7.9

Lehigh Core 025 (2000 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203025	Lehigh	0	108323	35	28	0	0.36	3.3	7.6	6.5	7.3
9203025	Lehigh	10	108324	35	28	0	0.45	3.5	7	6.2	7.5
9203025	Lehigh	20	108325	35	28	0.01	0.48	3.5	7.3	5.4	7.5
9203025	Lehigh	30	108326	35	28	0.05	0.44	4.4	7.8	4.6	7.5
9203025	Lehigh	40	108327	35	28		0.47	5.2	7.9	4.1	7.6
9203025	Lehigh	50	108328	35	28	0.09	0.5	5.4	8	3.4	7.5
9203025	Lehigh	60	108329	35	28	0.14	0.5	5.4	8	3.6	7.7
9203025	Lehigh	70	108330	35	28	0.16	0.53	5.4	8	4.5	7.7
9203025	Lehigh	80	108331	35	28	0.19	0.47	5.9	8	2.7	7.7
9203025	Lehigh	90	108332	35	28	0.21	0.55	5.4	7.7	2.7	7.6
9203025	Lehigh	100	108333	35	28	0.24	0.47	5.8	8.1	2.8	7.7
9203025	Lehigh	110	108334	35	28	0.24	0.39	5.8	8.1	2.7	7.8
9203025	Lehigh	120	108335	35	28	0.32	0.37	7.5	8.1	2.6	7.8
9203025	Lehigh	130	108336	35	28	0.35	0.4	7.4	8.1	2.0	7.8
9203025	Lehigh	140	108337	35	28	0.35	0.41	7.2	8.1	3.8	7.8
9203025	Lehigh	147	108338	35	28	0.38	0.41	7.1	8.1	3.5	7.7

Lehigh Core 026 (2500 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203026	Lehigh	0	108339	35	28	0.01	0.38	2.4	7.9	6.1	8.1
9203026	Lehigh	10	108340	35	28	0.01	0.4	3.2	7.9	6.2	7.7
9203026	Lehigh	20	108341	35	28	0.03	0.41	3	8	6.0	8
9203026	Lehigh	30	108342	35	28	0.06	0.41	3.2	7.8	3.4	7.5
9203026	Lehigh	40	108343	35	28	0.09	0.38	4	8	4.0	7.5
9203026	Lehigh	50	108344	35	28	0.12	0.36	4.3	8	4.6	7.6
9203026	Lehigh	60	108345	35	28	0.14	0.48	4.4	8	4.6	7.5
9203026	Lehigh	70	108346	35	28	0.14	0.35	5	8	4.2	7.7
9203026	Lehigh	80	108347	35	28	0.17	0.53	4.7	8	4.9	7.6
9203026	Lehigh	90	108348	35	28	0.19	0.53	5	8	3.0	7.4
9203026	Lehigh	100	108349	35	28	0.21	0.51	6	8	2.8	7.6
9203026	Lehigh	110	108350	35	28	0.2	0.53	5.5	8.1	2.8	7.5
9203026	Lehigh	120	108351	35	28	0.21	0.42	5.8	8	4.5	7.5
9203026	Lehigh	130	108352	35	28	0.24	0.44	5.7	8	2.1	7.6
9203026	Lehigh	140	108353	35	28	0.26	0.44	5	8.1	2.7	7.6

Trigger Core 027

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203027	trigger	0	108354	35	28	0	0.35	2.6	7.5	6.6	7.4
9203027	trigger	10	108355	35	28	0	0.4	3.9	7.6	5.7	7.4
9203027	trigger	20	108356	35	28	0	0.47	4.1	7.9	4.3	7.4
9203027	trigger	30	108357	35	28	0	0.5	4.7	7.9	4.5	7.6
9203027	trigger	40	108358	35	28	0	0.5	4.3	8	4.9	7.6
9203027	trigger	50	108359	35	28	0	0.45	4.8	8	5.0	7.6
9203027	trigger	60	108360	35	28	0	0.43	4.8	7.9	5.2	7.6

Piston Core 027

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203027	piston	0	108370	35	28	0	0.47	3.9	7.9	5.8	7.8
9203027	piston	10	108371	35	28	0	0.5	3.7	8	5.7	7.7
9203027	piston	20	108372	35	28	0	0.54	3.9	8	4.8	7.7
9203027	piston	30	108373	35	28	0	0.5	4.2	7.8	5.2	7.7
9203027	piston	40	108374	35	28	0	0.57	5	8	5.3	7.7
9203027	piston	50	108375	35	28	0	0.6	4.7	7.5	5.3	7.6
9203027	piston	60	108376	35	28	0	0.59	4.9	8	4.8	7.6
9203027	piston	70	108377	35	28	0	0.6	5.4	8	5.1	7.5
9203027	piston	80	108378	35	28	0	0.61	5.6	7.5	4.5	7.6
9203027	piston	90	108379	35	28	0	0.6	6	8	2.8	7.7
9203027	piston	100	108380	35	28	0.3	0.66	5.9	7.9	5.0	7.6
9203027	piston	150	108381	35	28	0.4	0.64	6.6	7.9	4.0	7.6
9203027	piston	200	108382	35	28	0.5	0.47	7.1	8	4.5	7.5
9203027	piston	250	108383	35	28	0.5	0.41	7.9	7.8	5.0	7.4
9203027	piston	300	108384	35	27	0.6	0.37	9.2	7.8	4.1	7.4
9203027	piston	350	108385	35	26	0.7	0.35	11.1	8	4.6	7.4
9203027	piston	400	108386	35	27	0.8	0.39	11.8	8	4.2	7.2
9203027	piston	450	108387	35	25	0.9	0.4	14.1	8	4.1	7.5
9203027	piston	500	108388	35	26	1.2	0.44	15.5	8	4.1	7.3
9203027	piston	550	108389	35	21	1.5	0.4	16	7.8	3.6	7.5
9203027	piston	600	108390	35	18	1.8	0.34	19	8	4.4	7.3
9203027	piston	650	108391	35	15	2.1	0.32	19.3	8.1	4.2	7.3
9203027	piston	700	108392	35	11	2.3	0.38	22	8.2	4.6	7.3
9203027	piston	750	108393	35	8	2.4	0.34	24	8.1	3.7	7.4
9203027	piston	800	108394	35	5	2.6	0.54	27	8.1	4.2	7.4

Lehigh Core 028 (1750 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203028	Lehigh	0	108361	35	28	0.03	0.41	3.7	7.9	5.5	7.5
9203028	Lehigh	10	108362	35	28	0.04	0.4	3.4	7.8	4.2	7.4
9203028	Lehigh	20	108363	35	28	0.07	0.46	3.6	7.9	4.1	7.6
9203028	Lehigh	30	108364	35	28	0.08	0.44	4.4	8	2.5	7.6
9203028	Lehigh	40	108365	35	28		0.42	3.8	7.7	4.1	7.8
9203028	Lehigh	50	108366	35	28	0.14	0.44	4.8	8	3.8	7.7
9203028	Lehigh	60	108367	35	28	0.17	0.47	4.5	8	3.2	7.7
9203028	Lehigh	70	108368	35	28	0.17	0.47	5	8	3.6	7.8
9203028	Lehigh	76	108369	35	28	0.18	0.44	5.2	8	5.2	7.7

Lehigh Core 029 (1250 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203029	Lehigh	0	108395	35	28	0.01	0.45	4.5	7.8	4.3	7.5
9203029	Lehigh	10	108396	35	28	0.01	0.4	4.5	8	5.2	7.4
9203029	Lehigh	20	108397	35	28		0.31	4.4	8	3.5	7.6
9203029	Lehigh	30	108398	35	28	0.2	0.33	4.6	8	4.0	7.7
9203029	Lehigh	40	108399	35	28	0.23	0.42	4.4	8	3.6	7.8
9203029	Lehigh	50	108400	35	28	0.24	0.36	4.8	8.1	3.7	7.9
9203029	Lehigh	60	108401	35	28	0.25	0.28	4.8	8.1	3.1	7.8
9203029	Lehigh	70	108402	35	28	0.26	0.3	4.8	8.1	2.7	7.9
9203029	Lehigh	80	108403	35	28	0.26	0.25	4.8	8.2	4.8	7.9
9203029	Lehigh	85	108404	35	28	0.27	0.26	4.8	8.1	3.7	7.9

Lehigh Core 030 (750 m water depth)

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203030	Lehigh	0	108418	35	28	0.09	0.49	4.3	7.6	5.3	7.6
9203030	Lehigh	10	108419	35	28	0.09	0.49	4.8	7.8	5.3	7.8
9203030	Lehigh	20	108405	35	28	0.13	0.47	4.8	7.5	4.2	7.5
9203030	Lehigh	30	108406	35	28	0.13	0.46	5.6	7.7	4.3	7.7
9203030	Lehigh	40	108407	35	28	0.16	0.49	5	7.6	2.7	7.8
9203030	Lehigh	50	108408	35	28	0.16	0.5	5.4	7.6	2.6	7.7
9203030	Lehigh	60	108409	35	28	0.19	0.52	5.6	7.6	3.6	7.7
9203030	Lehigh	70	108410	35	28	0.22	0.49	5.6	7.6	3.9	7.8
9203030	Lehigh	80	108411	35	28	0.25	0.54	5.6	7.6	3.3	7.6
9203030	Lehigh	90	108412	35	28	0.26	0.56	5.3	7.6	3.9	7.7
9203030	Lehigh	100	108413	35	28	0.29	0.54	5.8	7.7	3.5	7.6
9203030	Lehigh	110	108414	35	28	0.26	0.55	5.6	7.7	5.2	7.7
9203030	Lehigh	120	108415	35	28	0.32	0.55	5.8	7.7	3.6	7.6
9203030	Lehigh	130	108416	35	28	0.34	0.5	5.8	7.6	4.6	7.6
9203030	Lehigh	140	108417	35	28	0.38	0.52	6	7.6	4.4	8.1

Trigger Core 031

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203031	trigger	0	108420	35	28	0	0.57	6	7.9	5.0	7.4
9203031	trigger	10	108421	35	28	0	0.66	5.1	7.8	4.8	7.3
9203031	trigger	20	108422	35	28	0	0.66	5.2	7.7	4.4	7.3
9203031	trigger	30	108423	35	28	0	0.6	5.2	7.8	4.9	7.3
9203031	trigger	40	108424	35	28	0	0.57	5.4	8	5.1	7.2
9203031	trigger	50	108425	35	28	0	0.5	6	8.1	4.7	7.3
9203031	trigger	60	108426	35	28	0	0.43	6.5	8.2	3.7	7.4
9203031	trigger	70	108427	35	28	0	0.4	6	8	3.2	7.3
9203031	trigger	80	108428	35	28	0	0.44	6.5	8.1	4.3	7.4
9203031	trigger	90	108429	35	28	0	0.4	3.3	7.6	4.6	7.4
9203031	trigger	100	108430	35	28	0	0.44	3.2	8	5.6	7.5
9203031	trigger	150	108431	35	28	0	0.4	5.3	8	5.3	7.5
9203031	trigger	185	108432	35	28	0	0.54	5.8	8	4.8	7.4

Piston Core 031

Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203031	piston	0	108433	35	28	0.5	0.3	7.1	7.7	4.8	7.5
9203031	piston	10	108434	35	28	0.5	0.29	7.2	7.8	4.0	7.6
9203031	piston	20	108435	35	28	0.5	0.27	7	7.9	4.3	7.4
9203031	piston	30	108436	35	28	0.5	0.31	7.2	7.9	3.7	7.3
9203031	piston	80	108437	35	28	0.6	0.31	8.2	8	4.4	7.3
9203031	piston	130	108438	35	28	0.6	0.25	7.3	8	4.5	7.4
9203031	piston	200	108439	35	24	0.7	0.38	9.5	8	4.2	7.3
9203031	piston	250	108440	35	23	0.8	0.38	10.4	8	4.2	7.3
9203031	piston	300	108441	35	22	0.9	0.44	11.2	8	4.6	7.4

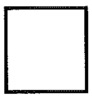
Lehigh Core 032 (750 m water depth)

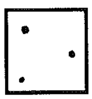
Core	Type	Depth cm	ID	Sal ppt	SO_4 mM	NH_4 mM	Si mM	Alk mN	pH_{pw}	pE	pH_{sed}
9203032	lehigh	0	108442	35	28	0.09	0.38	4.6	7.6	4.4	7.4
9203032	lehigh	10	108443	35	28	0.14	0.35	3.5	7.5	5.8	7.6
9203032	lehigh	20	108444	35	28	0.08	0.35	3.7	7.2	5.7	7.6
9203032	lehigh	30	108445	35	28	0.21	0.4	4.4	7.6	5.7	7.4
9203032	lehigh	40	108446	35	28	0.12	0.4	4.6	7.8	4.5	7.5
9203032	lehigh	50	108447	35	28	0.14	0.46	4.3	7.7	2.9	7.6
9203032	lehigh	60	108448	35	28	0.16	0.48	4.3	7.6	3.6	7.5
9203032	lehigh	70	108449	35	28	0.18	0.51	4.5	7.7	4.4	7.6
9203032	lehigh	80	108450	35	28	0.24	0.51	4.4	7.7	2.7	7.6
9203032	lehigh	90	108451	35	28	0.22	0.51	4.2	7.6	3.0	7.7
9203032	lehigh	100	108452	35	28	0.23	0.55	4.3	7.6	4.2	7.7
9203032	lehigh	110	108453	35	28	0.22	0.58	4.8	7.6	4.4	7.6
9203032	lehigh	120	108454	35	28	0.26	0.53	4.1	7.7	4.2	7.6
9203032	lehigh	130	108455	35	28	0.29	0.55	4.9	7.6	4.2	7.6
9203032	lehigh	140	108456	35	28	0.31	0.46	4.7	7.6	4.8	7.6
9203032	lehigh	150	108457	35	28	0.34	0.51	5.1	7.6	5.6	7.7

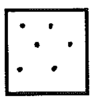
APPENDIX III

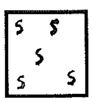
CORE PROFILES OF SEDIMENTOLOGICAL AND GEOCHEMICAL DATA

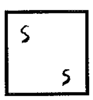
LEGEND

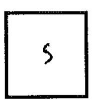
 Silt with clay

 Silt with clay and minor fine sand

 Fine sand with silt

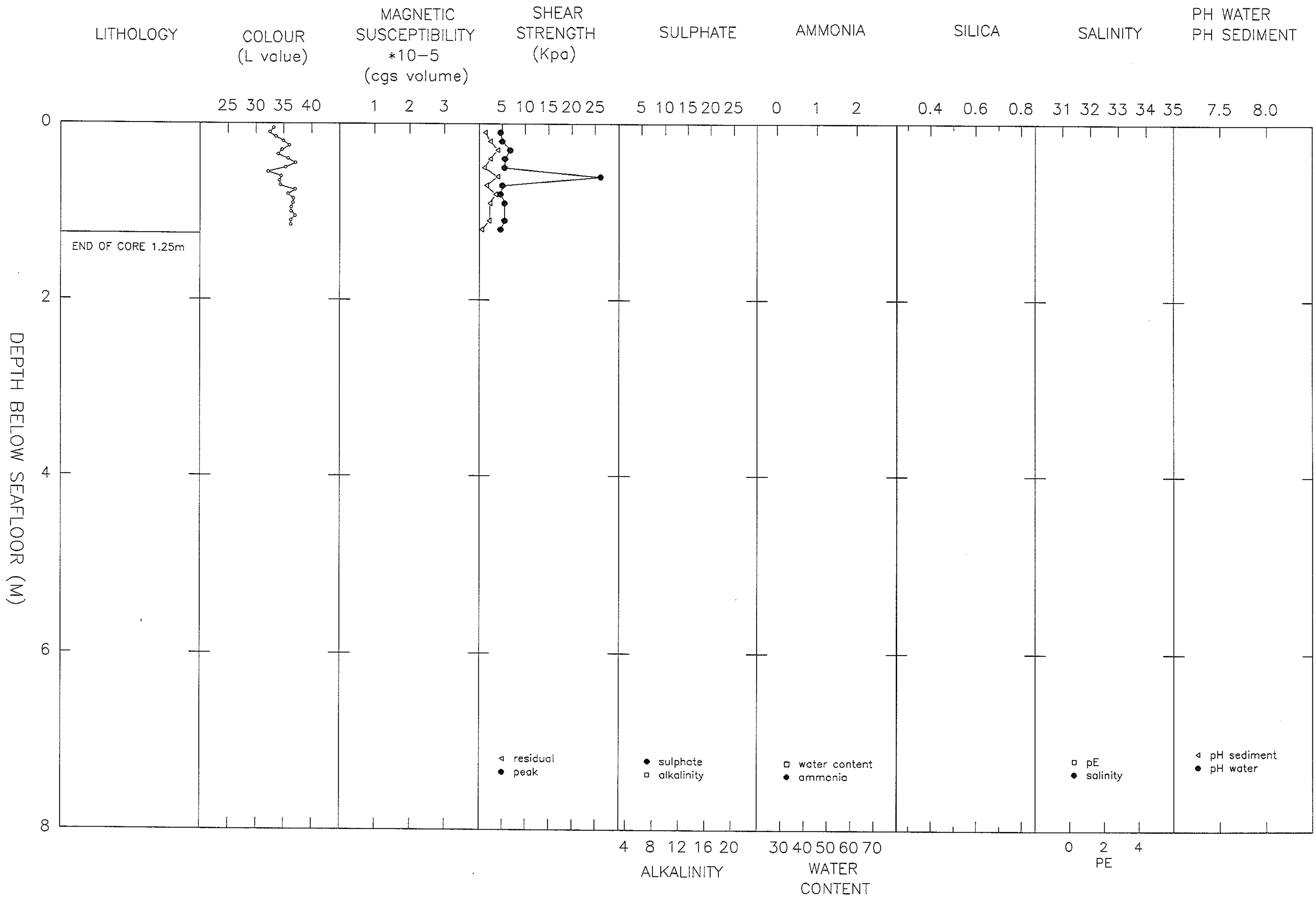
 Highly bioturbated

 Moderately bioturbated

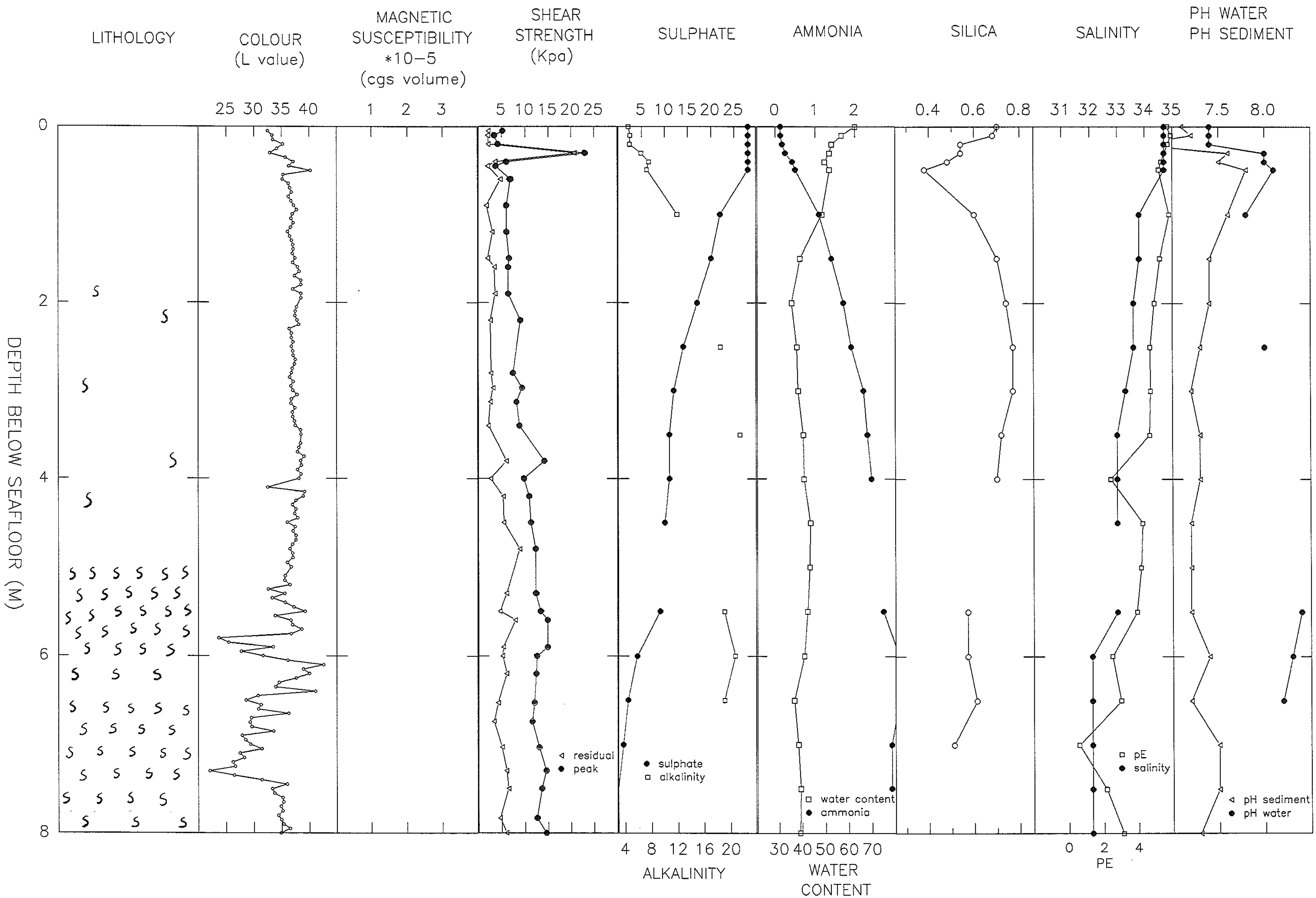
 Minor bioturbation

 Black banding

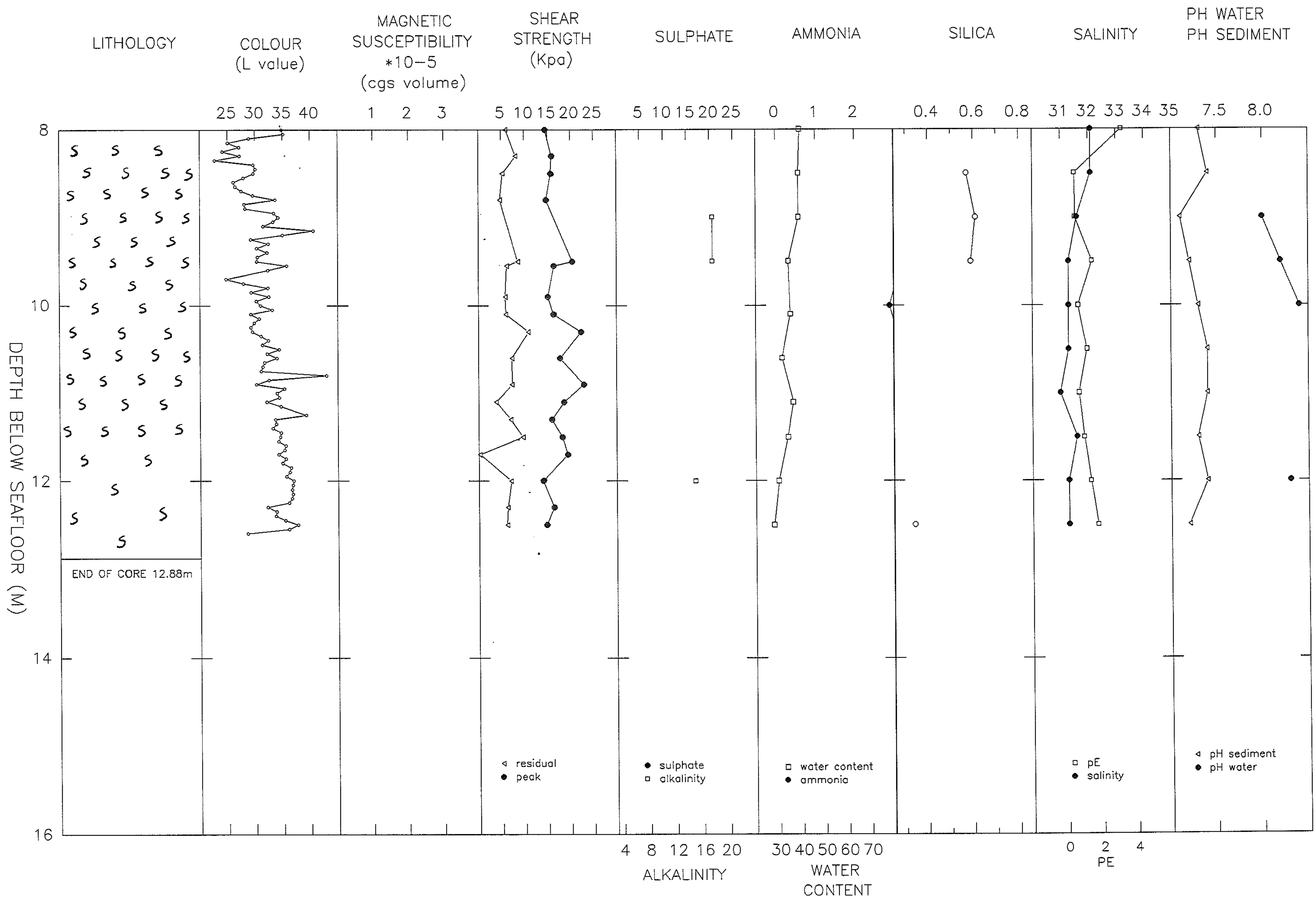
92003 002TWC



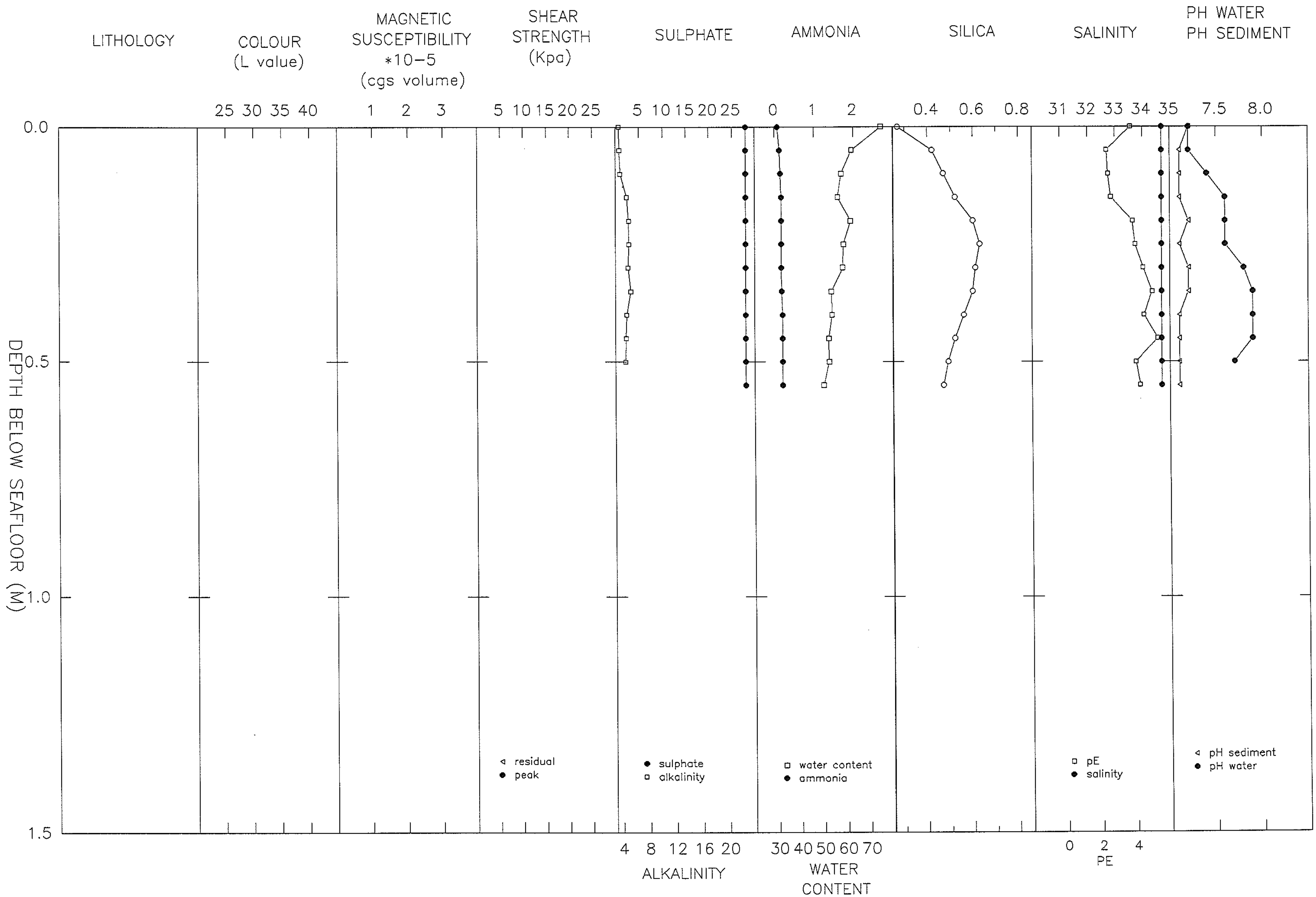
92003 002PC

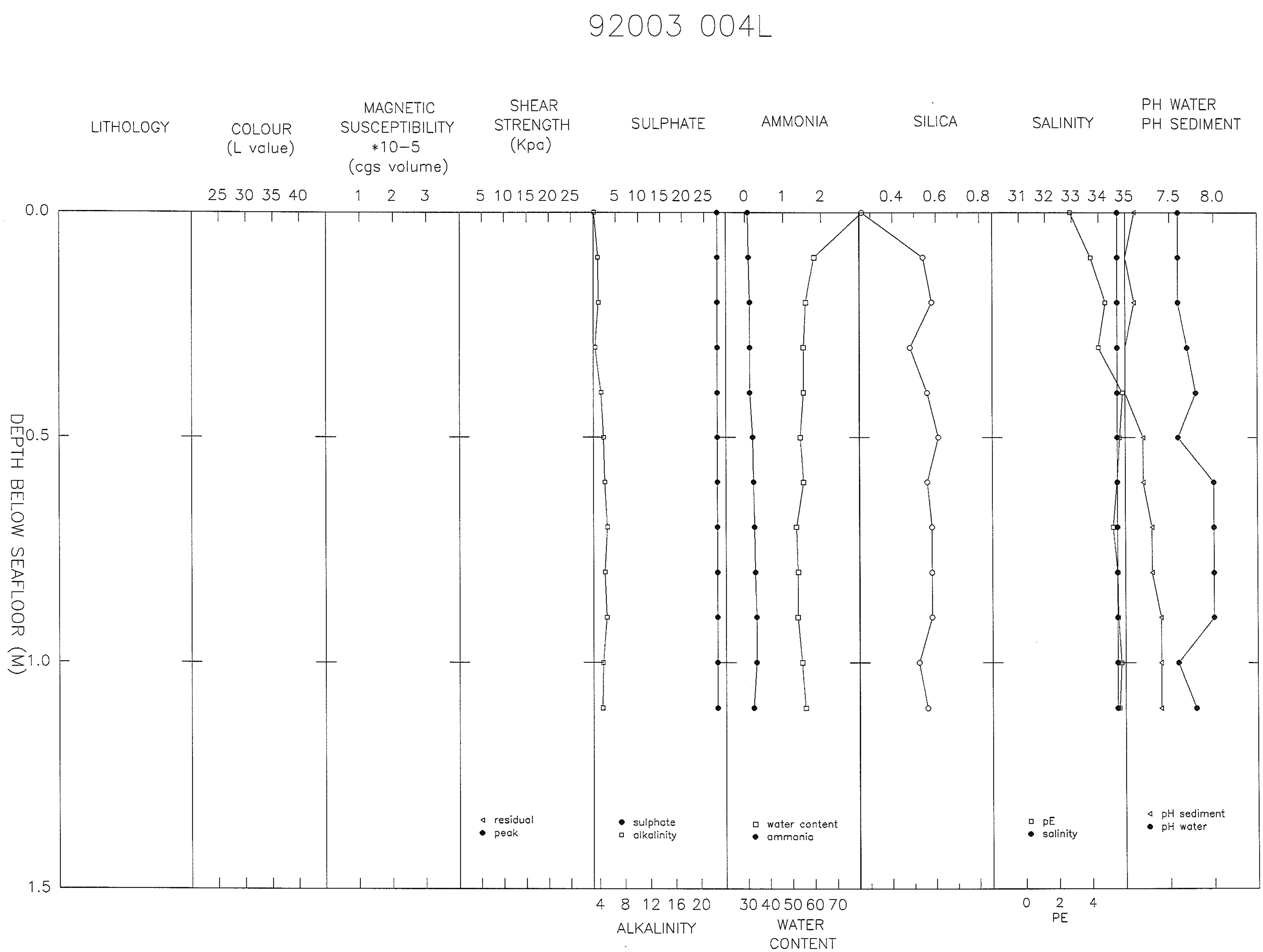

LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
ALKALINITY
WATER CONTENT
PE
DEPTH BELOW SEAFLOOR (M)

92003 002PC


LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
END OF CORE 12.88m
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
ALKALINITY
water content
ammonia
WATER CONTENT
pE
salinity
PE
pH sediment
pH water

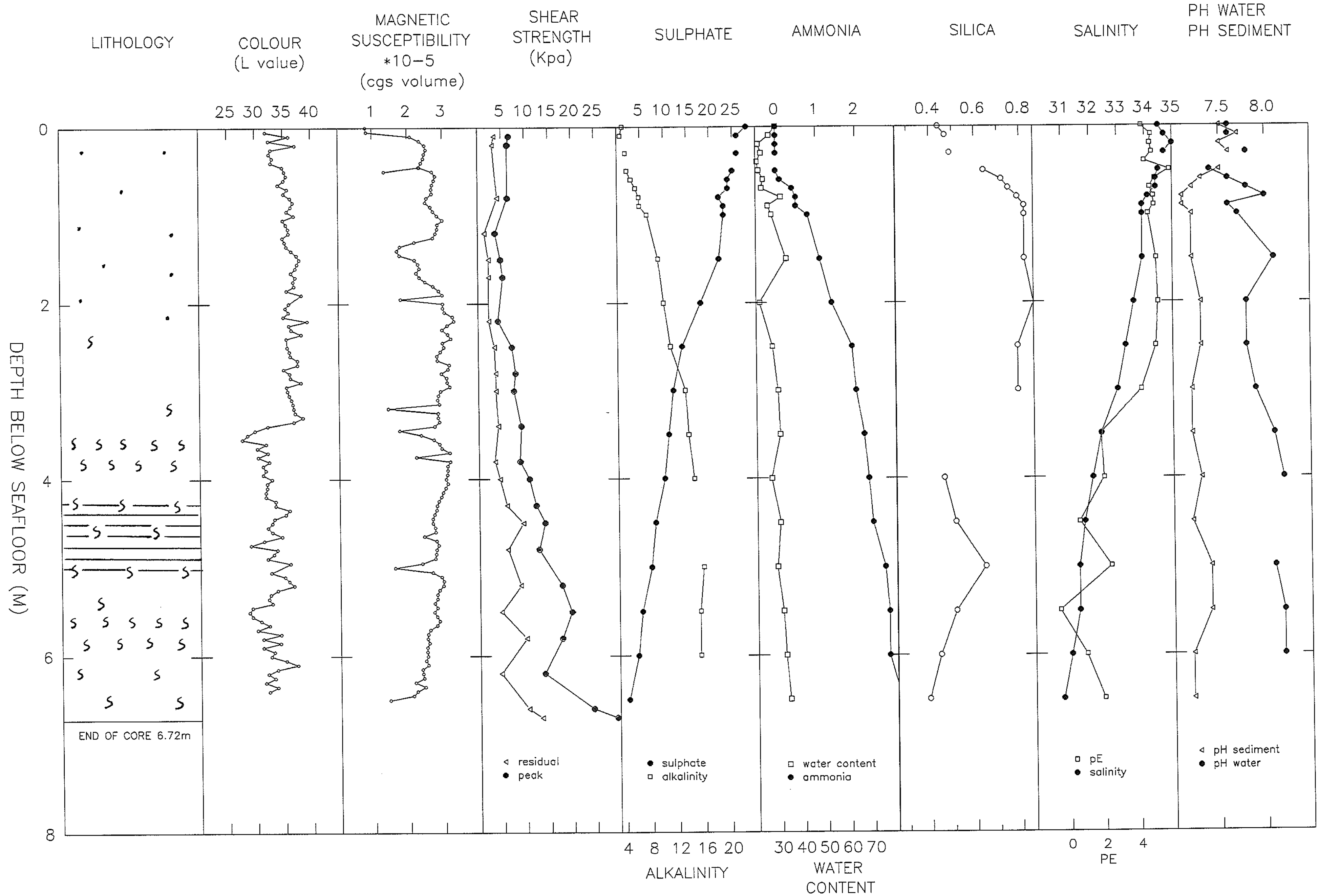
92003 003EBC





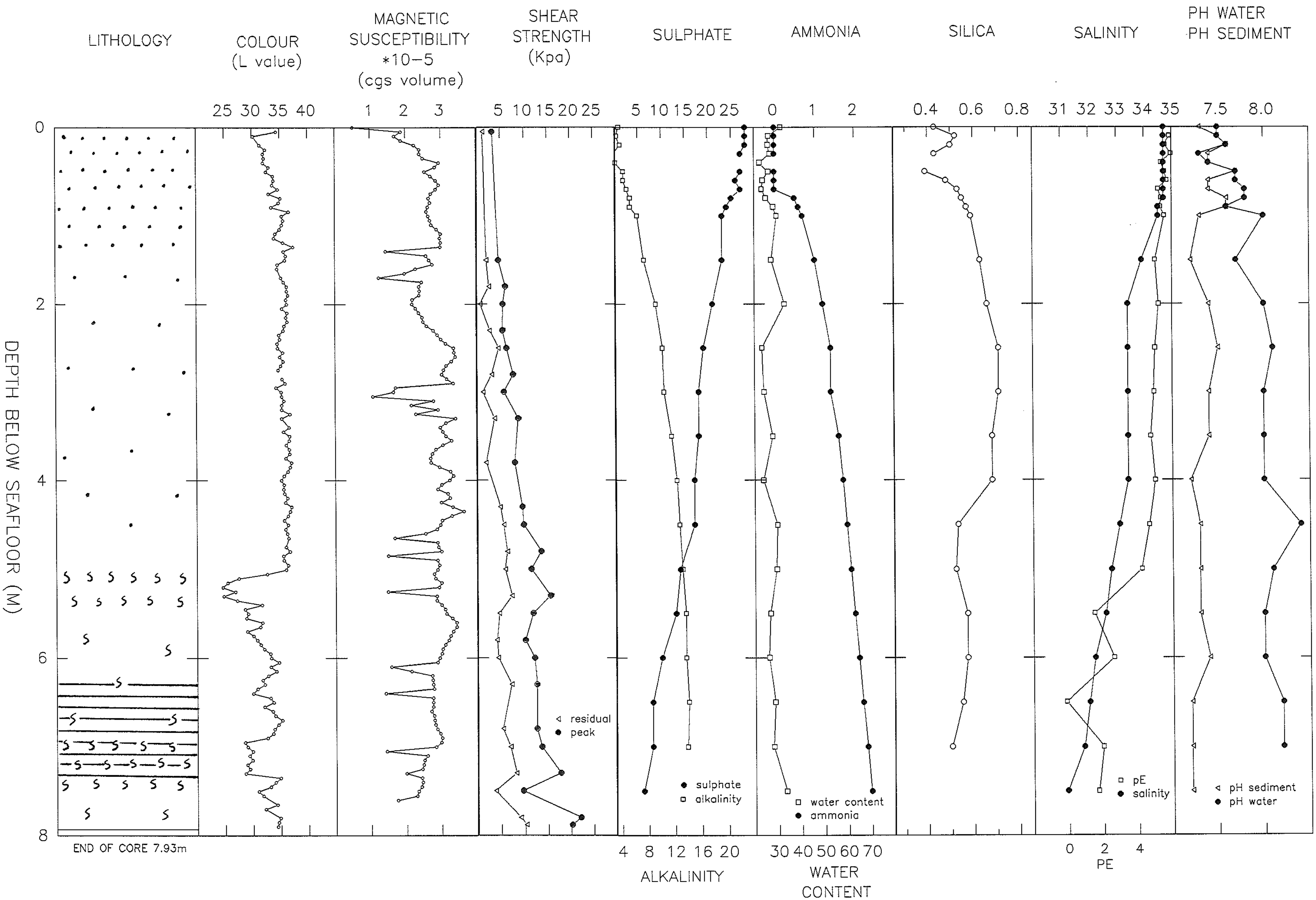
92003 004L
LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
DEPTH BELOW SEAFLOOR (M)
ALKALINITY
WATER CONTENT
PE
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water

92003 006PC

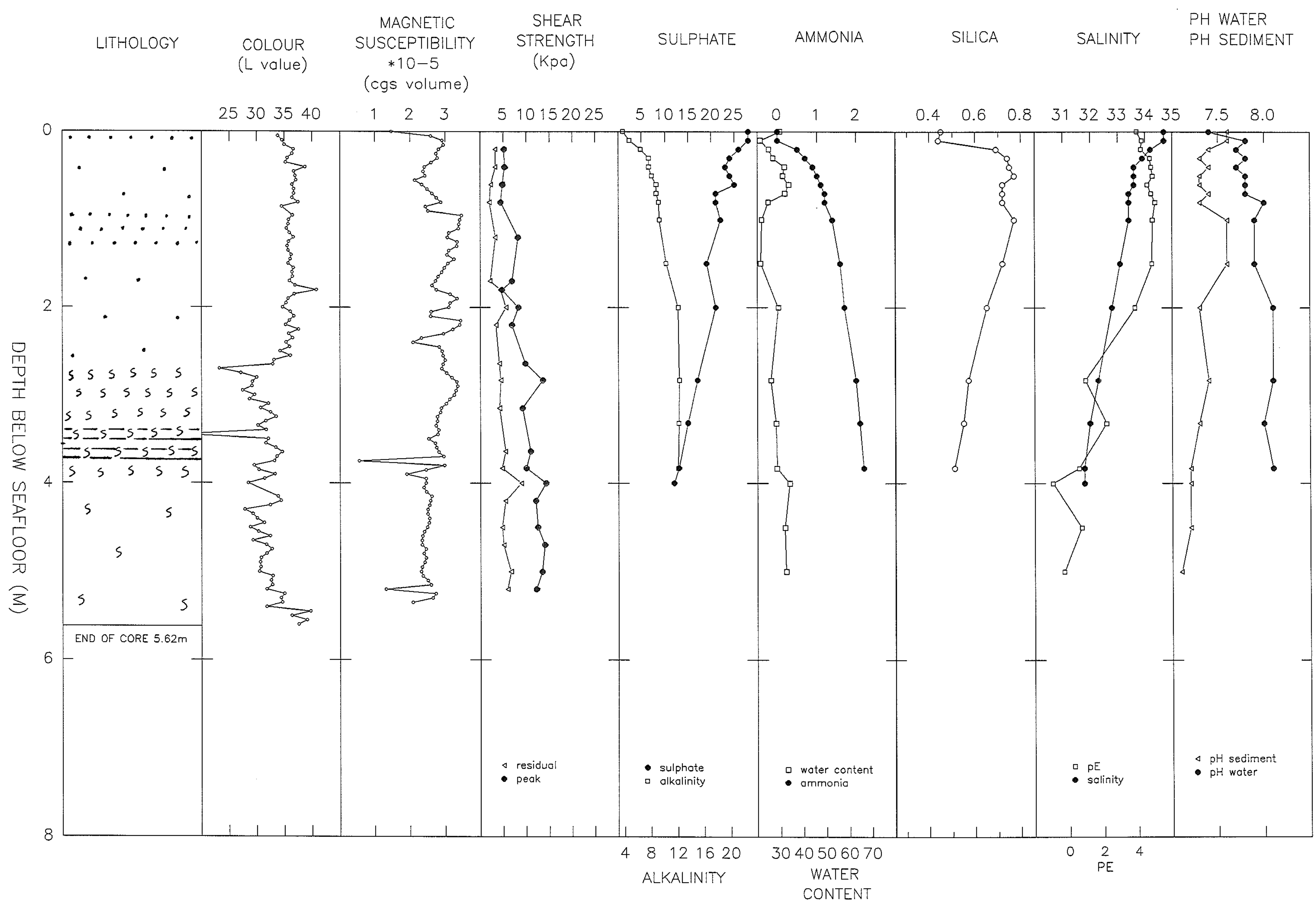


LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
25 30 35 40
1 2 3
5 10 15 20 25
5 10 15 20 25
0 1 2
0.4 0.6 0.8
31 32 33 34 35
7.5 8.0
END OF CORE 6.72m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE
DEPTH BELOW SEAFLOOR (M)
0
2
4
6
8

92003 008PC

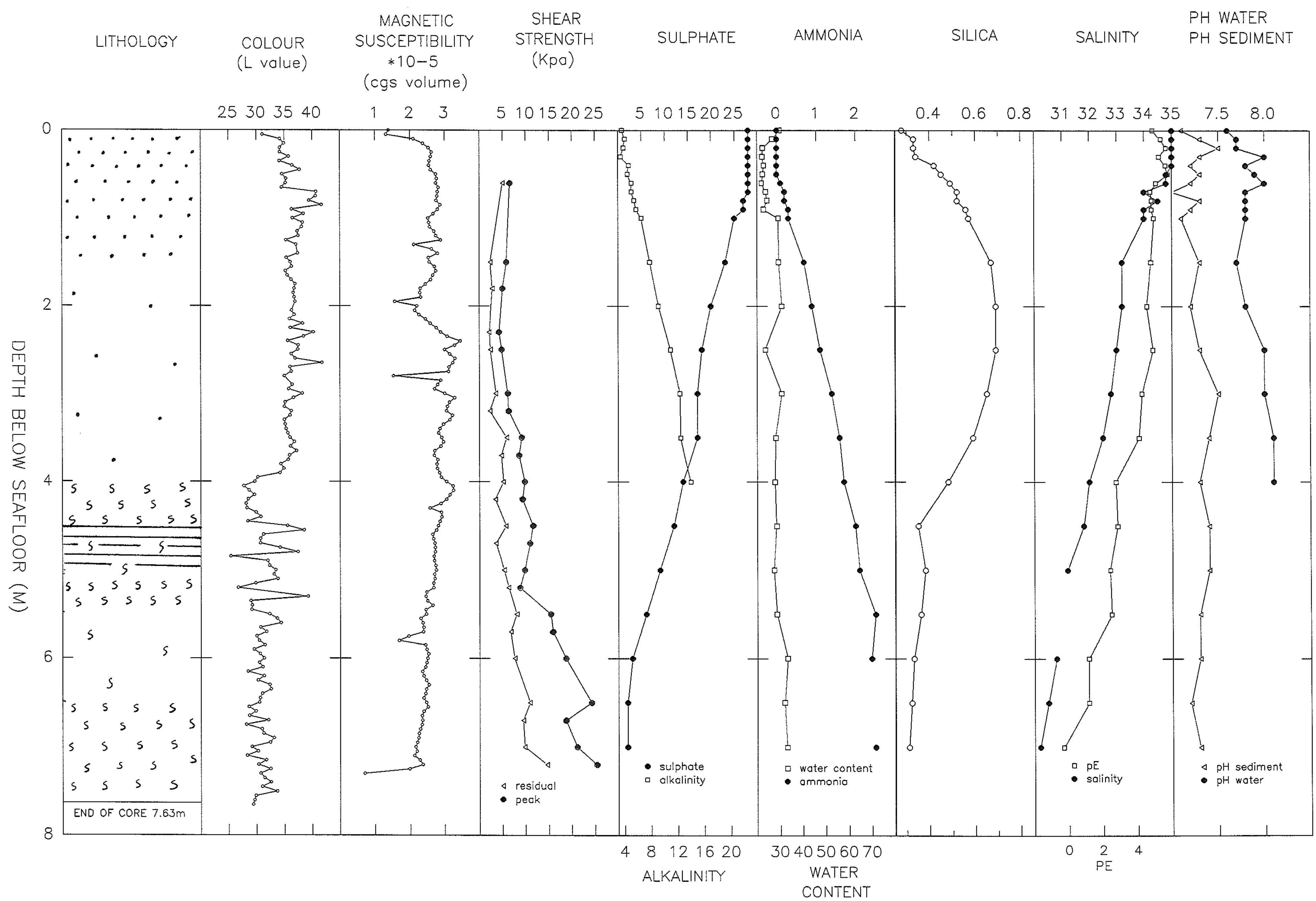

LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
DEPTH BELOW SEAFLOOR (M)
0
2
4
6
8
END OF CORE 7.93m

92003 010PC

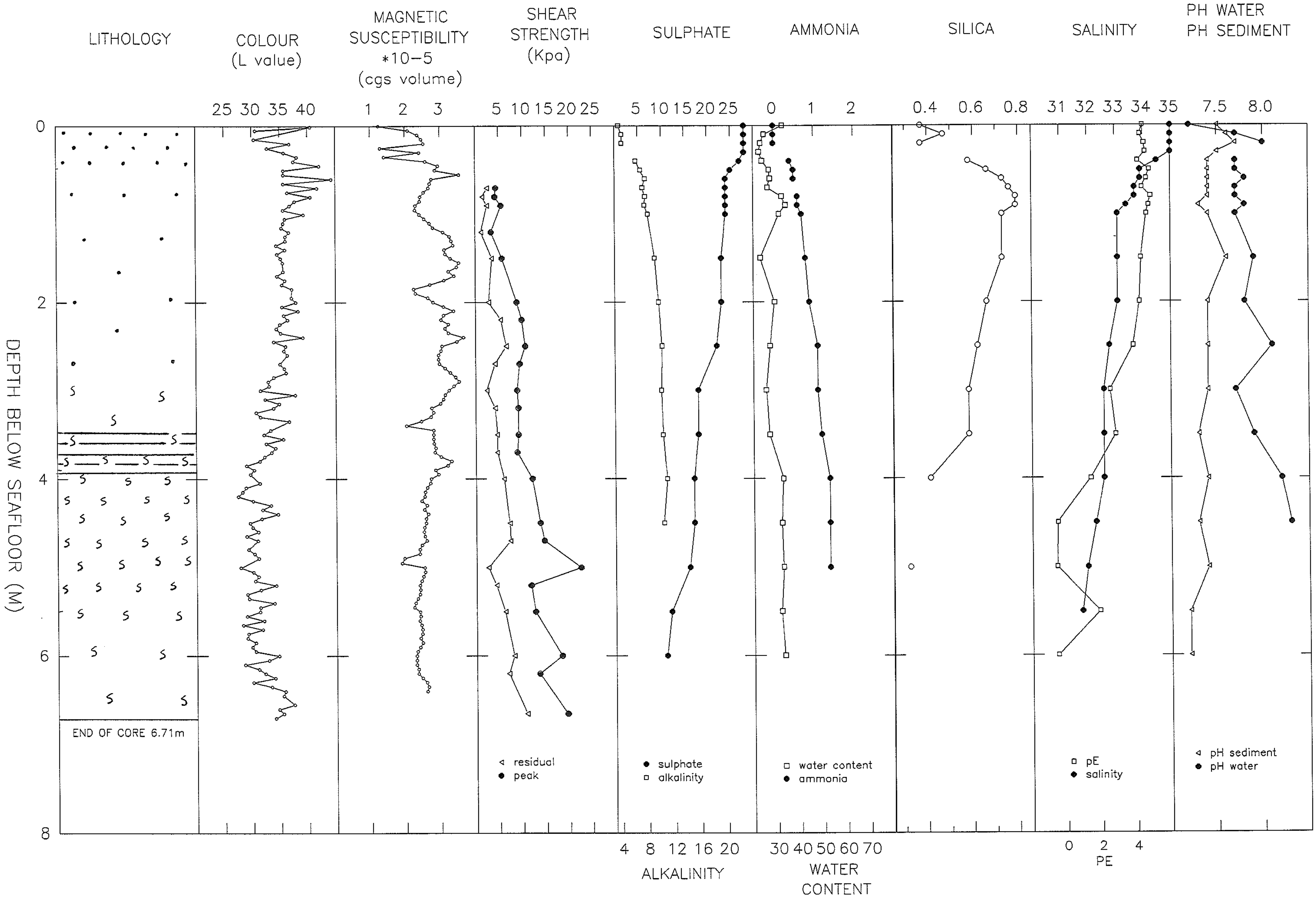


LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
END OF CORE 5.62m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
ALKALINITY
WATER CONTENT
PE
DEPTH BELOW SEAFLOOR (M)

92003 013PC

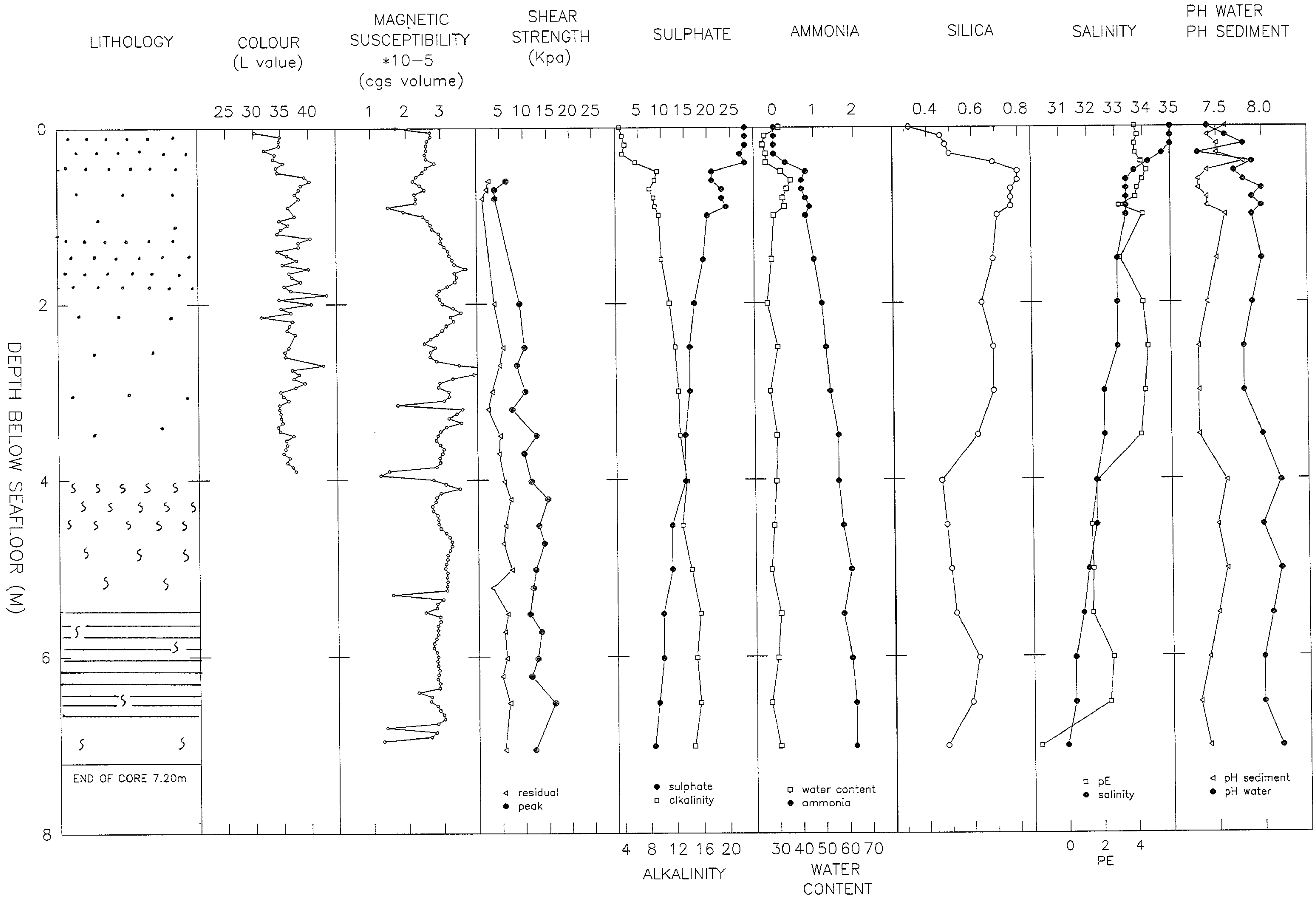

LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
25 30 35 40
1 2 3
5 10 15 20 25
5 10 15 20 25
0 1 2
0.4 0.6 0.8
31 32 33 34 35
7.5 8.0
DEPTH BELOW SEAFLOOR (M)
0 2 4 6 8
END OF CORE 7.63m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

92003 014PC



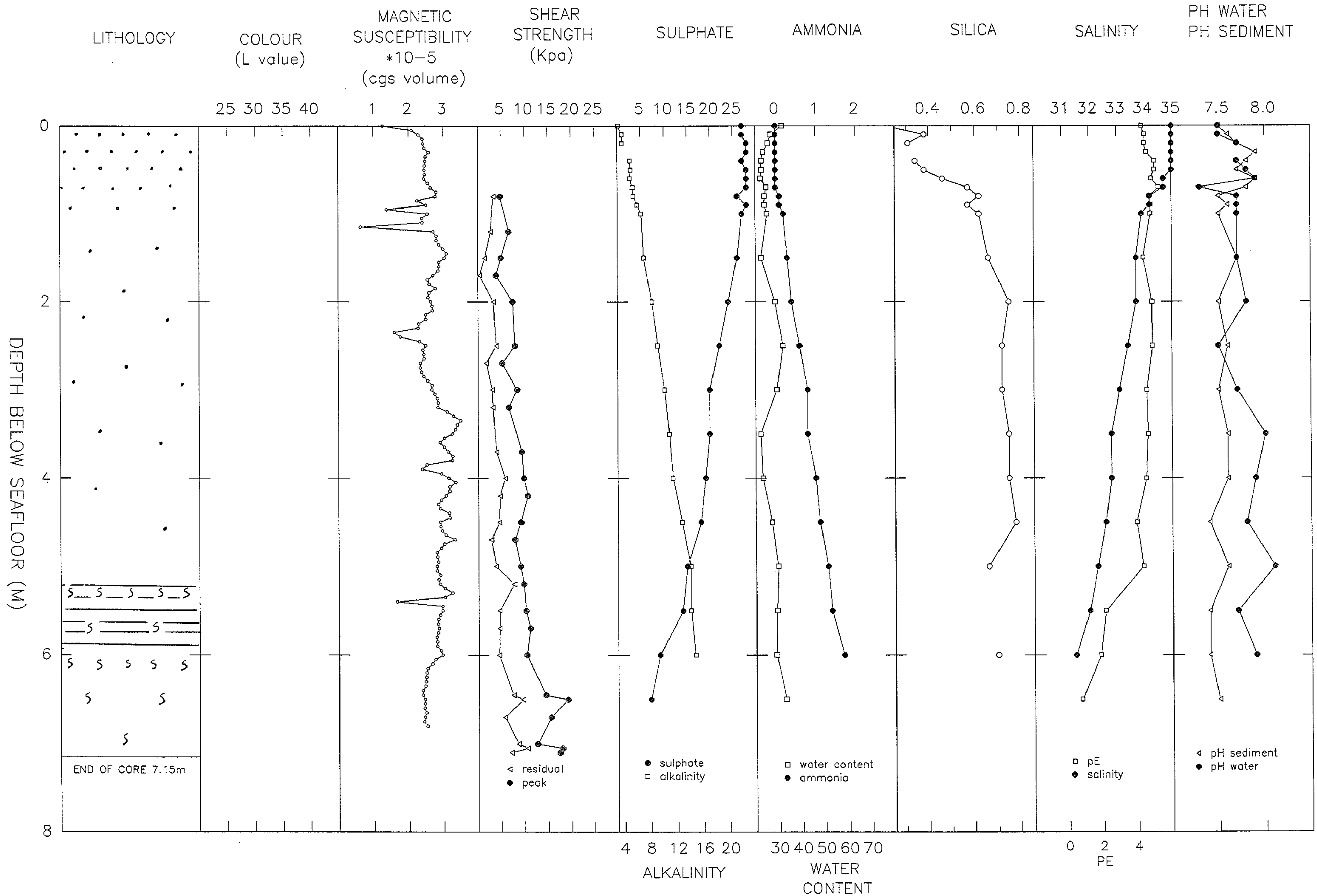
LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
SULPHATE
5 10 15 20 25
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
0
2
4
6
8
DEPTH BELOW SEAFLOOR (M)
END OF CORE 6.71m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

92003 015PC

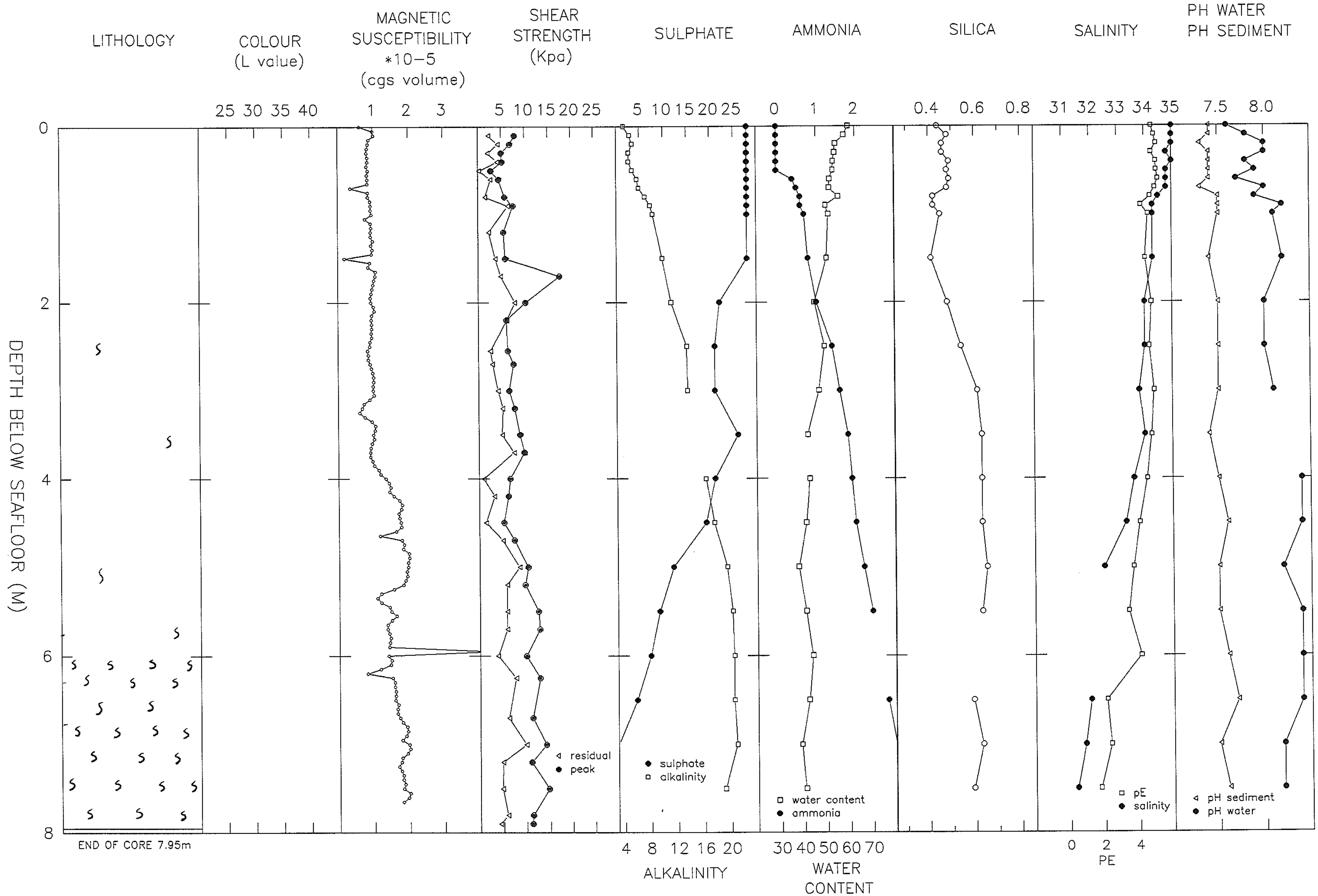


LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
END OF CORE 7.20m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
DEPTH BELOW SEAFLOOR (M)
ALKALINITY
WATER CONTENT
PE

92003 016PC

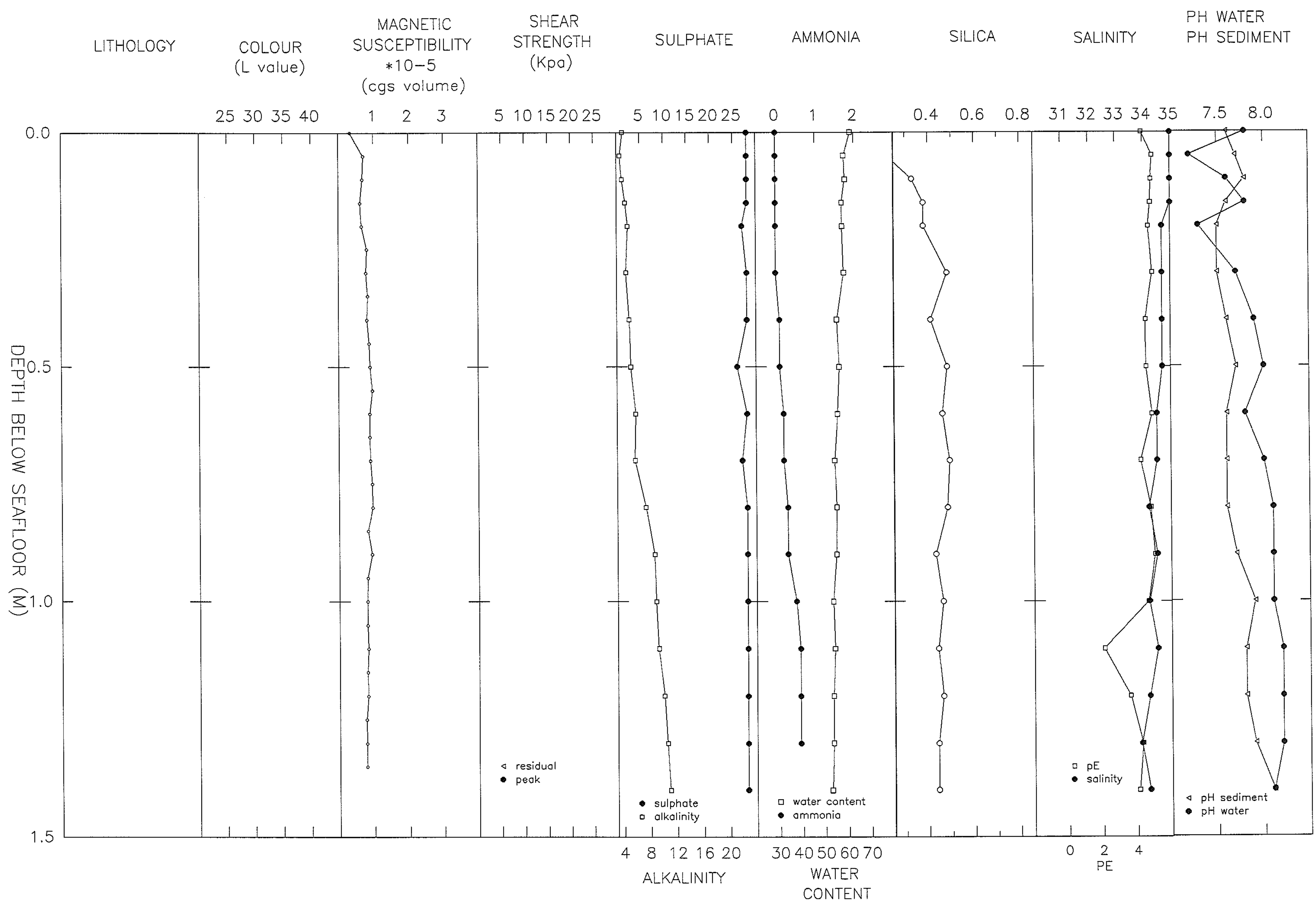

LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
25 30 35 40
1 2 3
5 10 15 20 25
5 10 15 20 25
0 1 2
0.4 0.6 0.8
31 32 33 34 35
7.5 8.0
DEPTH BELOW SEAFLOOR (M)
0 2 4 6 8
END OF CORE 7.15m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

92003 017PC



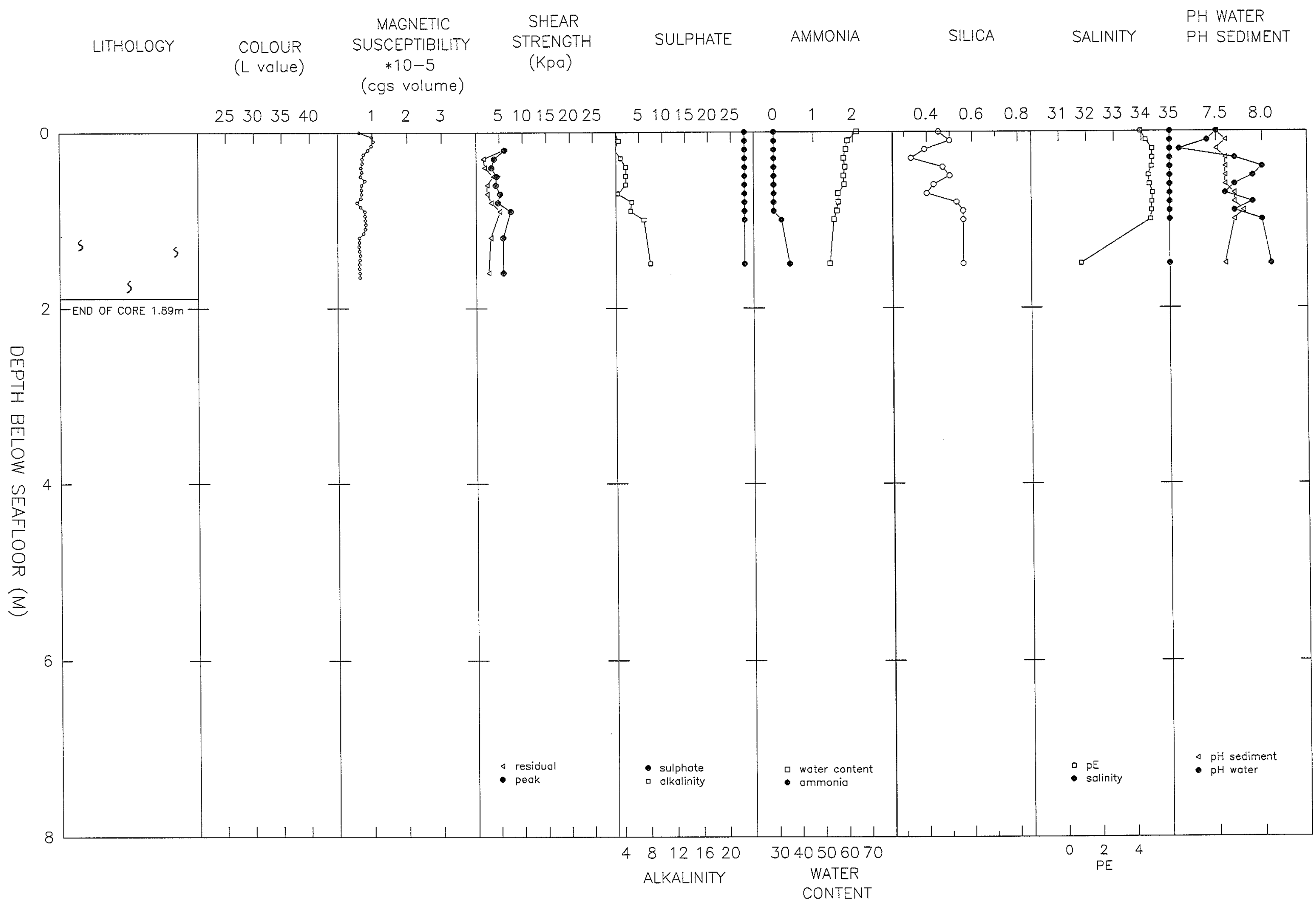
LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
ALKALINITY
water content
ammonia
WATER CONTENT
pE
salinity
PE
pH sediment
pH water
END OF CORE 7.95m

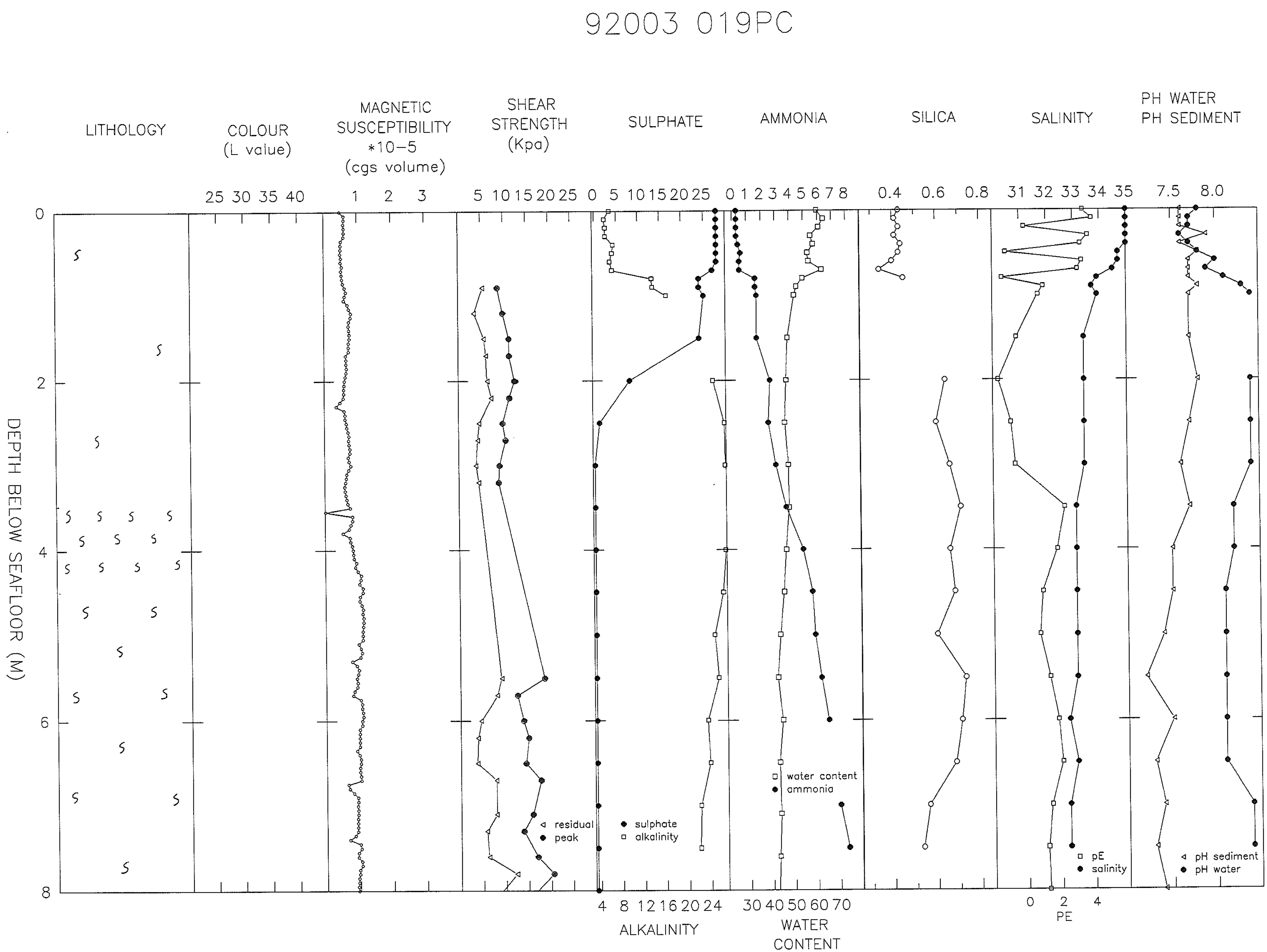
92003 018L



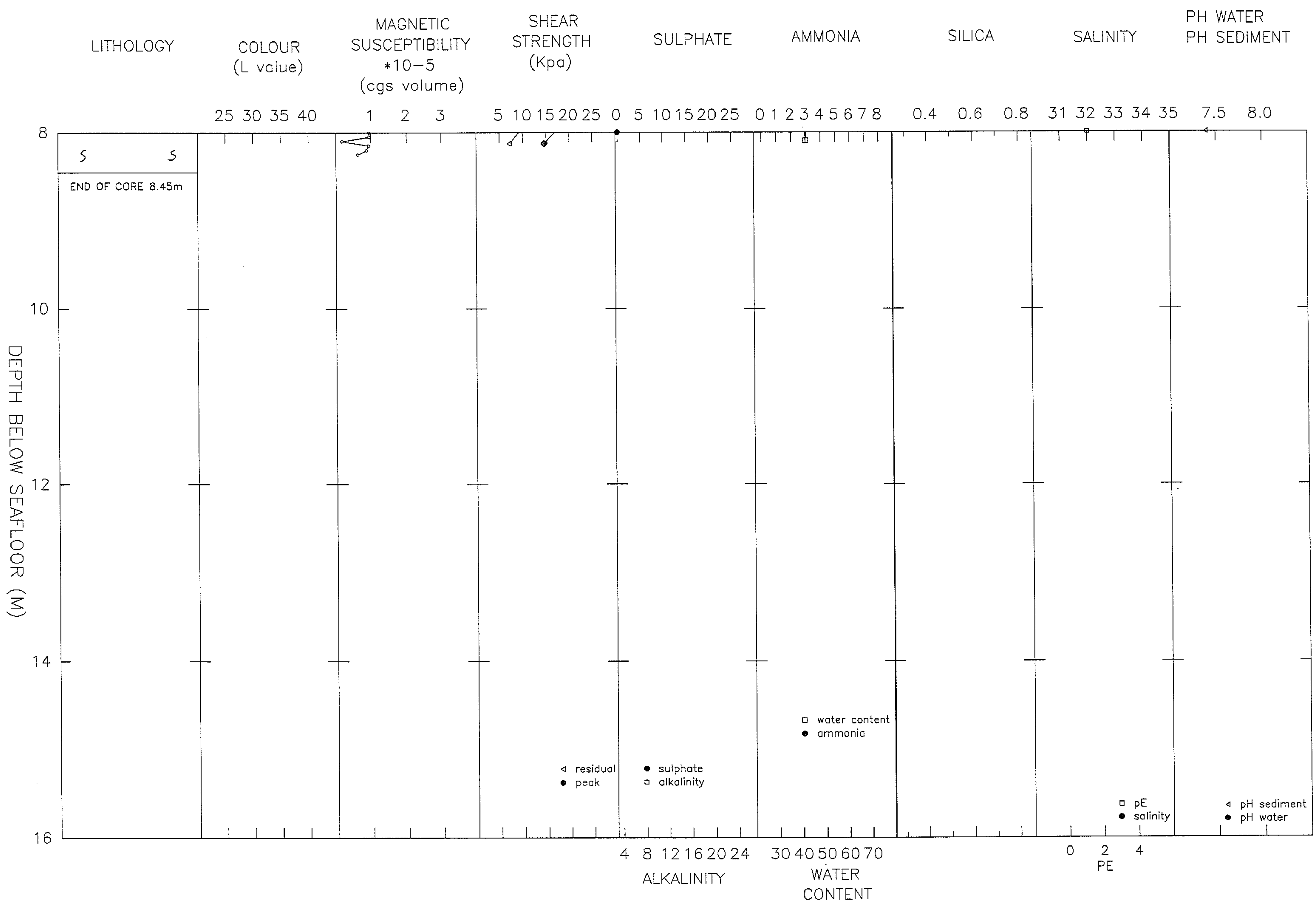
LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)

92003 019TWC



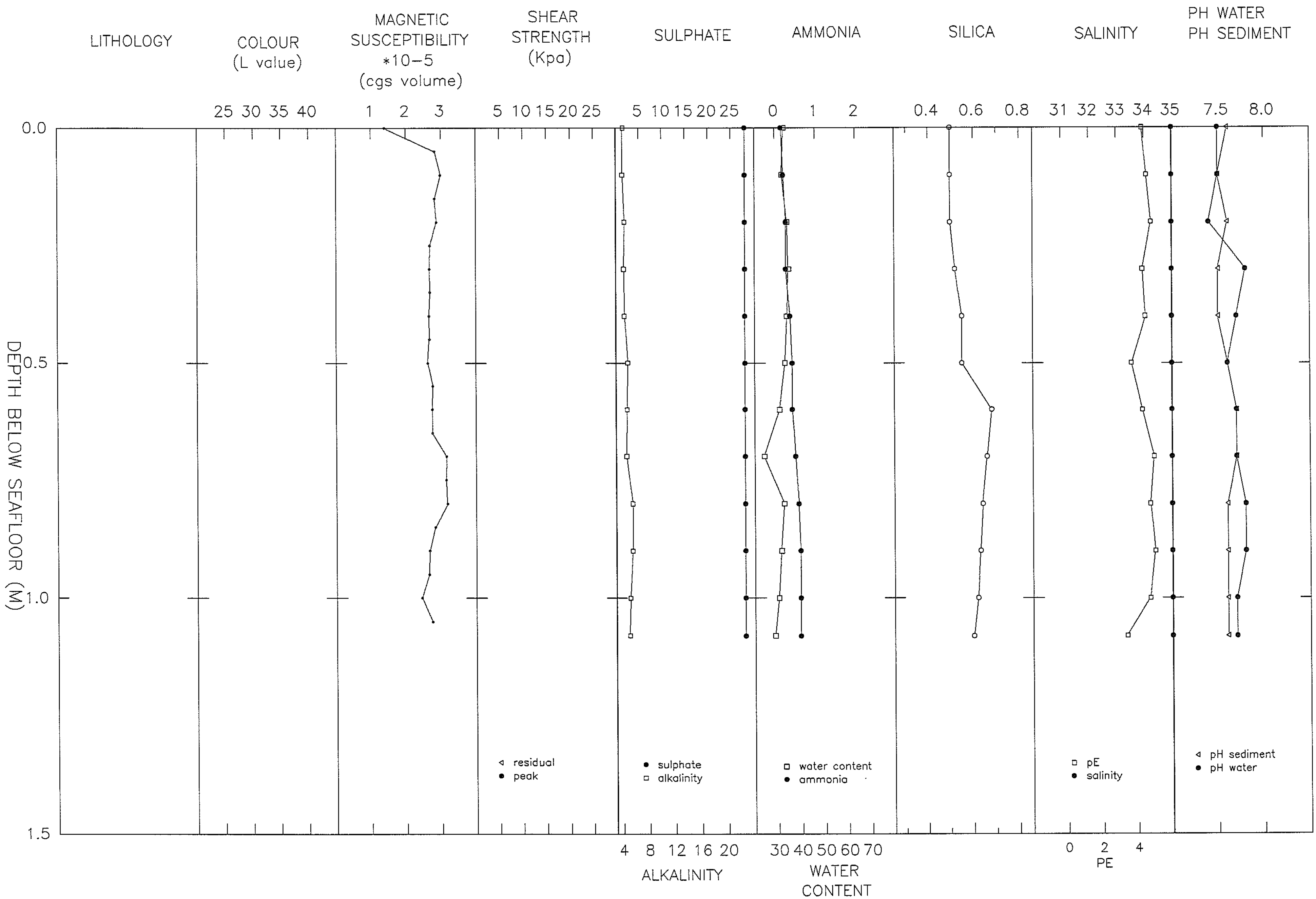

92003 019PC
LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
ALKALINITY
WATER CONTENT
PE
DEPTH BELOW SEAFLOOR (M)

92003 019PC

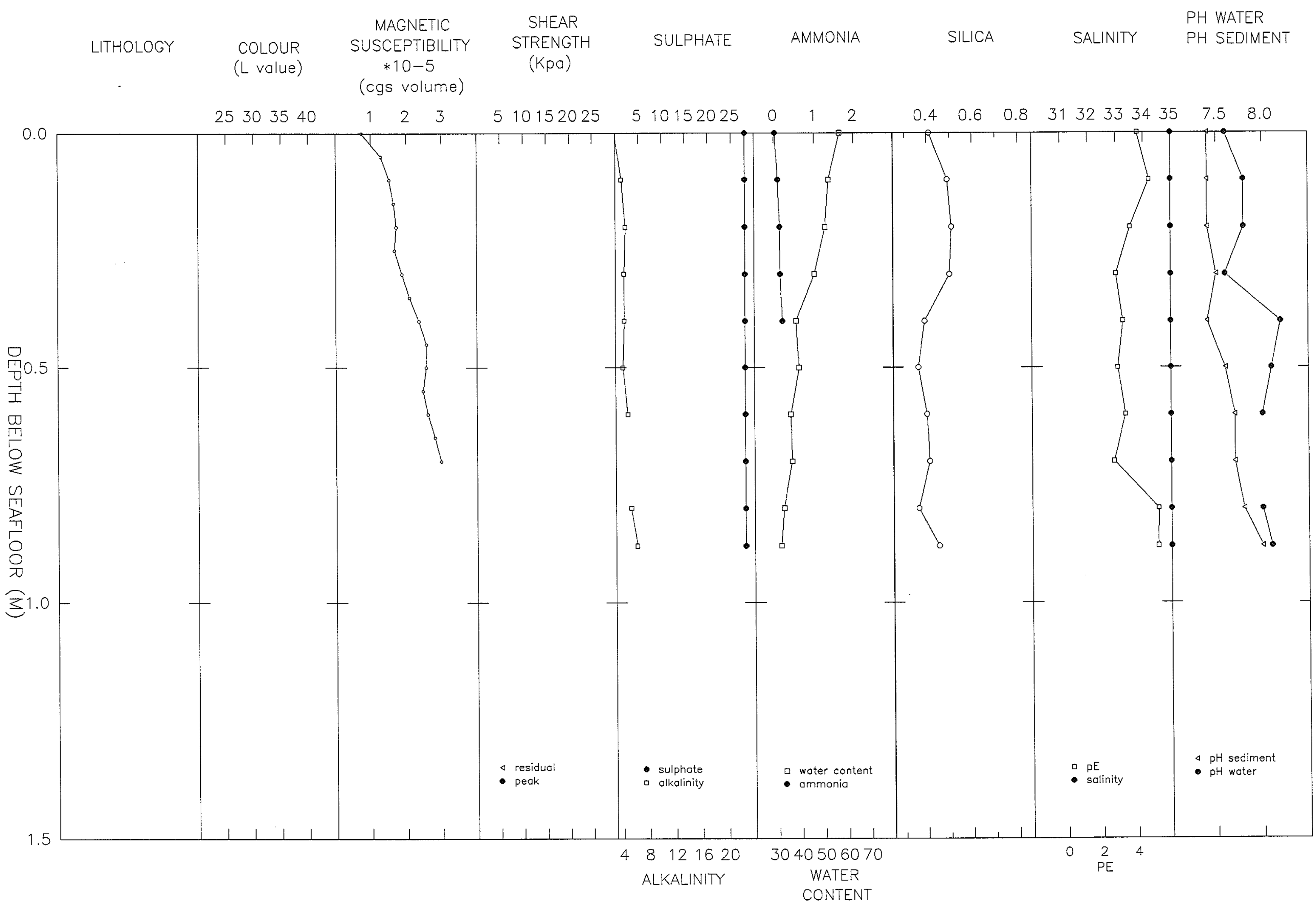


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
SULPHATE
0 5 10 15 20 25
AMMONIA
0 1 2 3 4 5 6 7 8
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
END OF CORE 8.45m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
8
10
12
14
16
DEPTH BELOW SEAFLOOR (M)
4 8 12 16 20 24
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

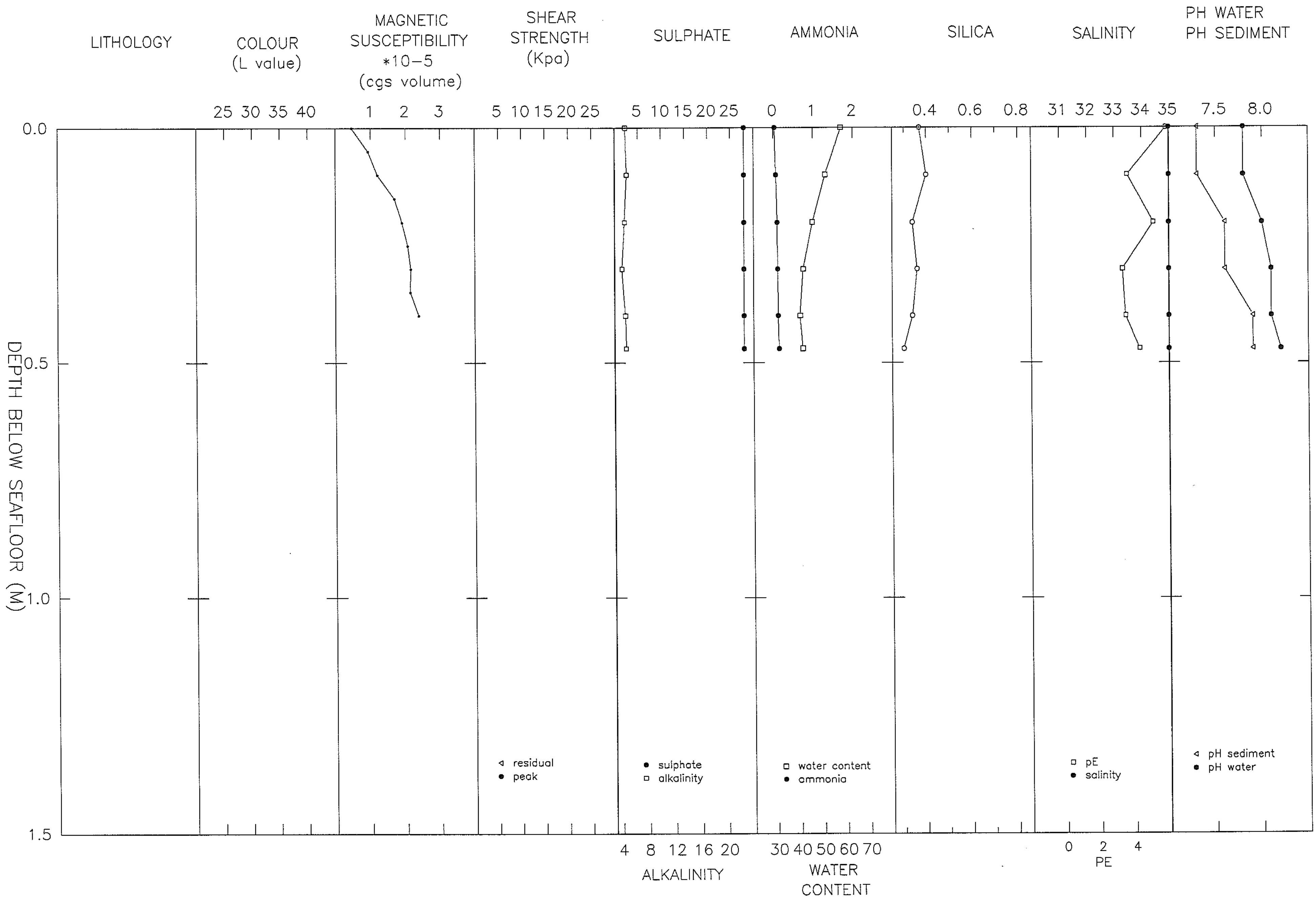
92003 022L


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
SULPHATE
5 10 15 20 25
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

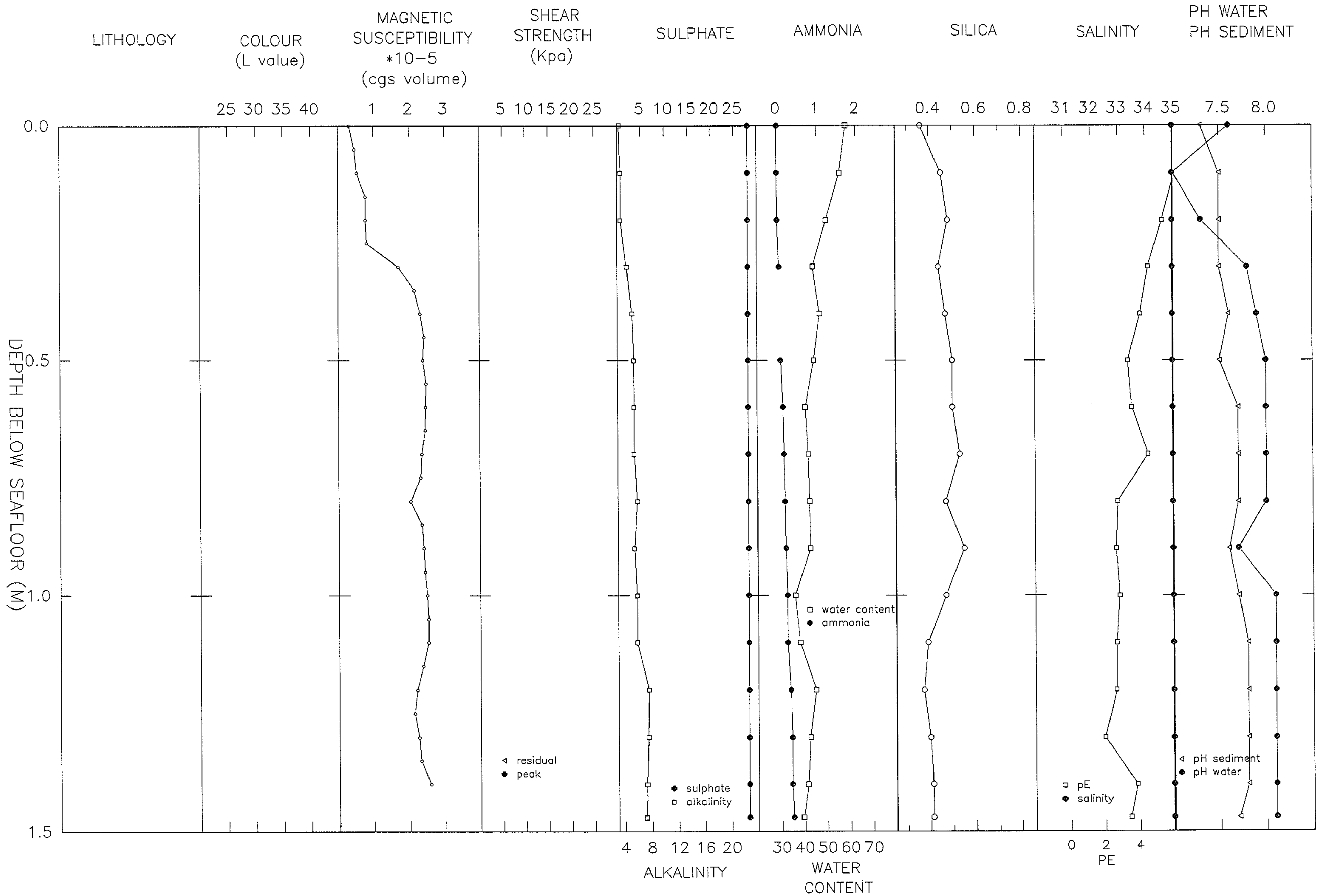
92003 023L


LITHOLOGY
COLOUR
(L value)
25 30 35 40
MAGNETIC
SUSCEPTIBILITY
*10-5
(cgs volume)
1 2 3
SHEAR
STRENGTH
(Kpa)
5 10 15 20 25
SULPHATE
5 10 15 20 25
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER
CONTENT
0 2 4
PE

92003 024L

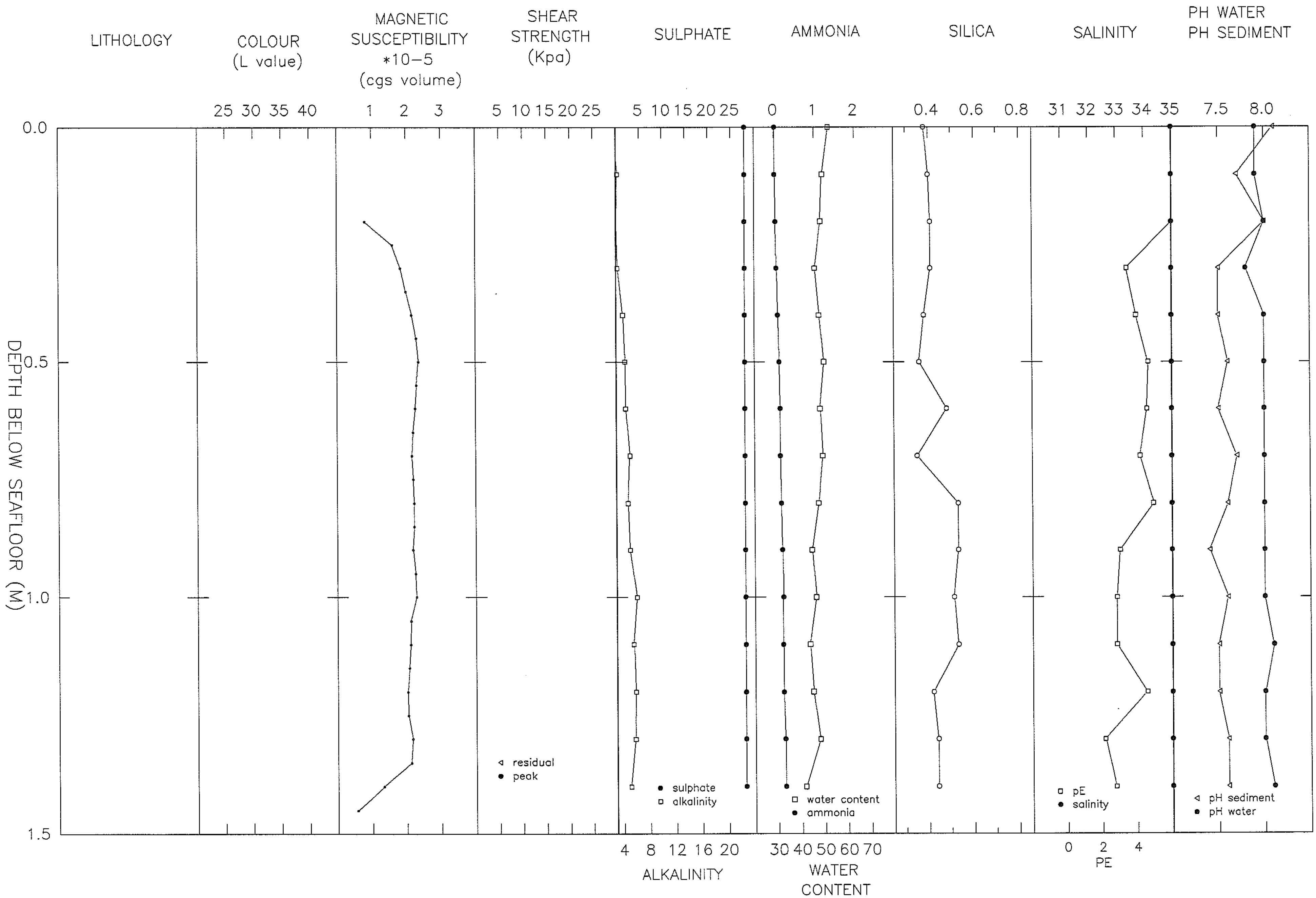

LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
SULPHATE
5 10 15 20 25
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

92003 025L

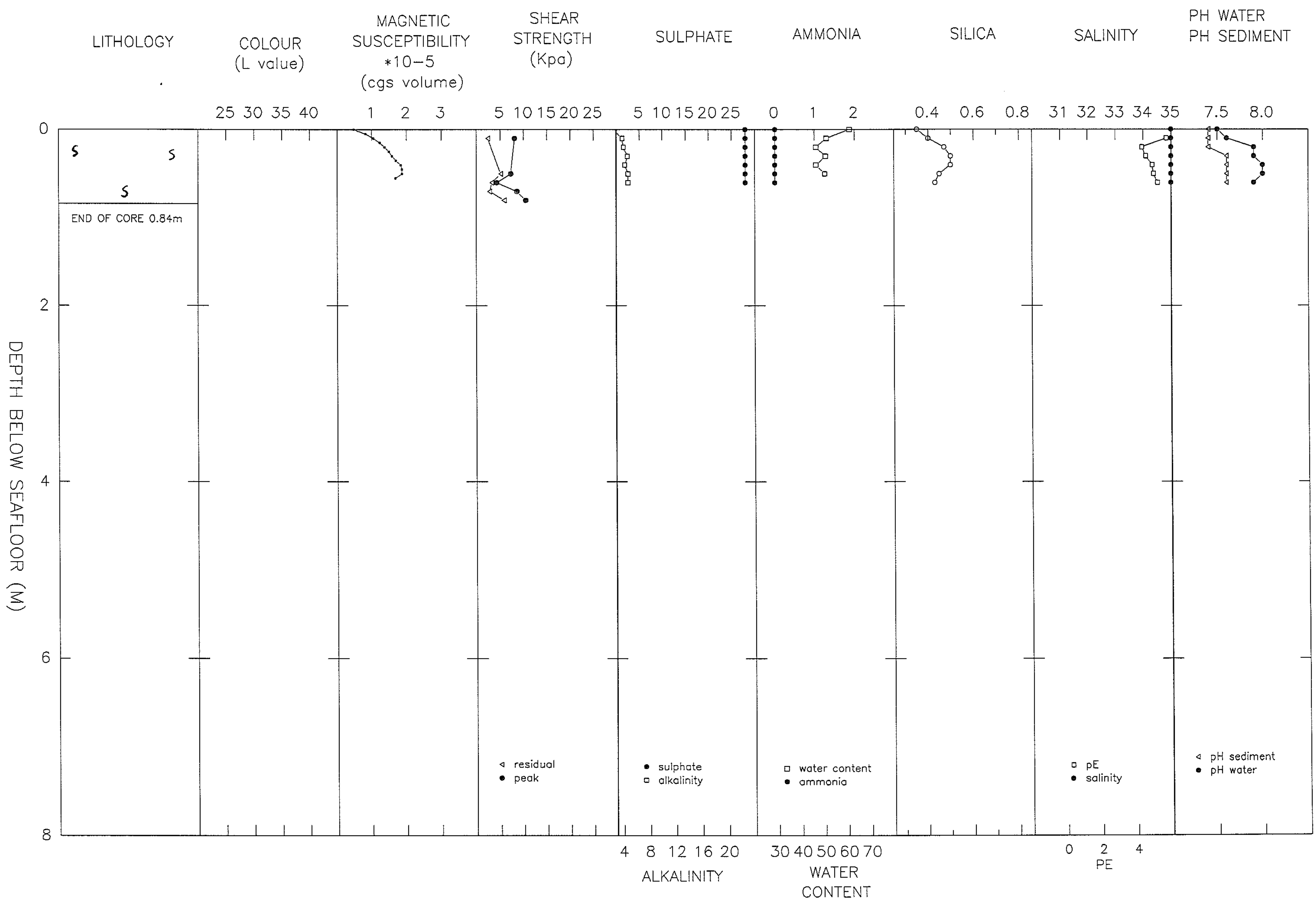


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)

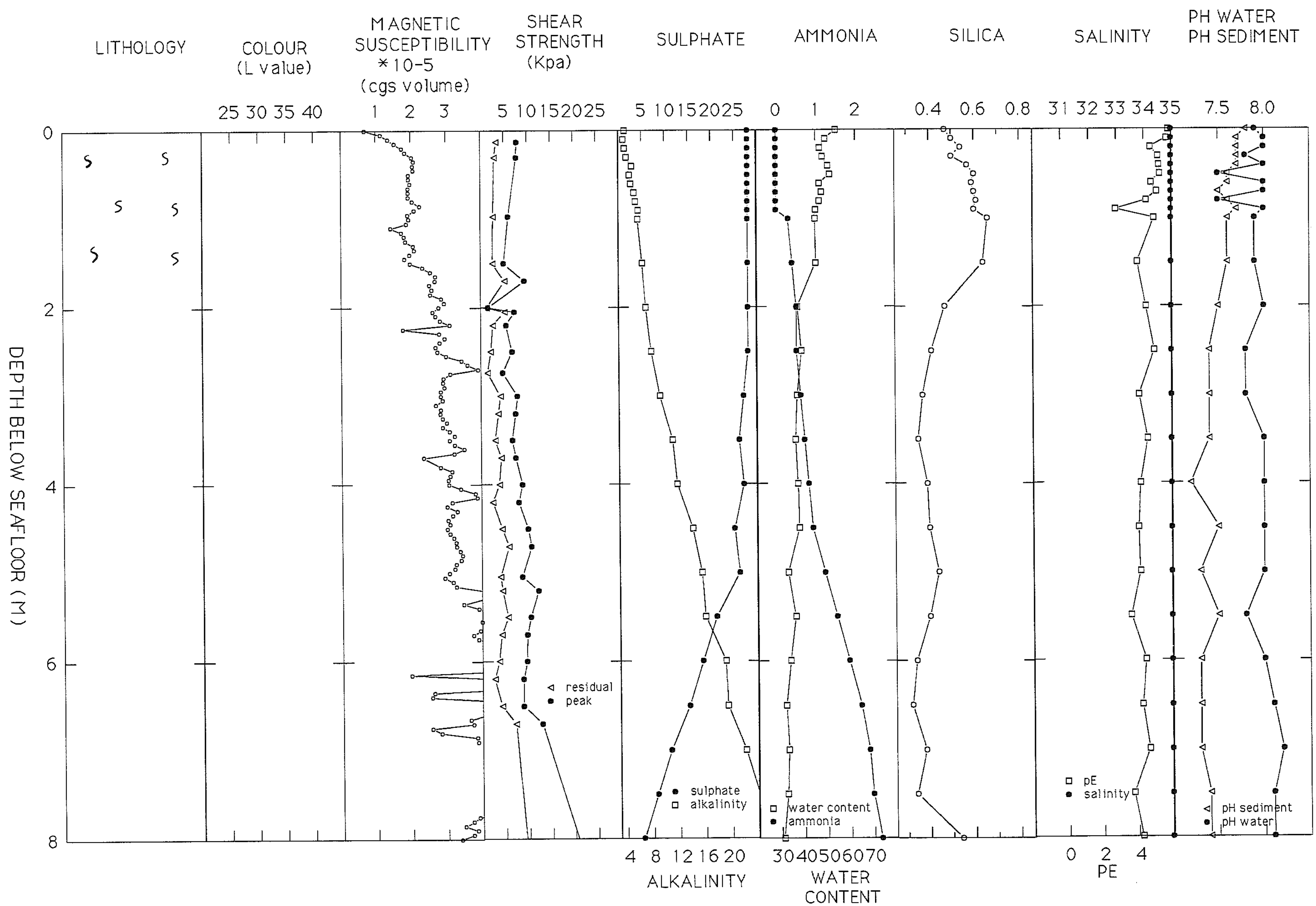
92003 026L


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)

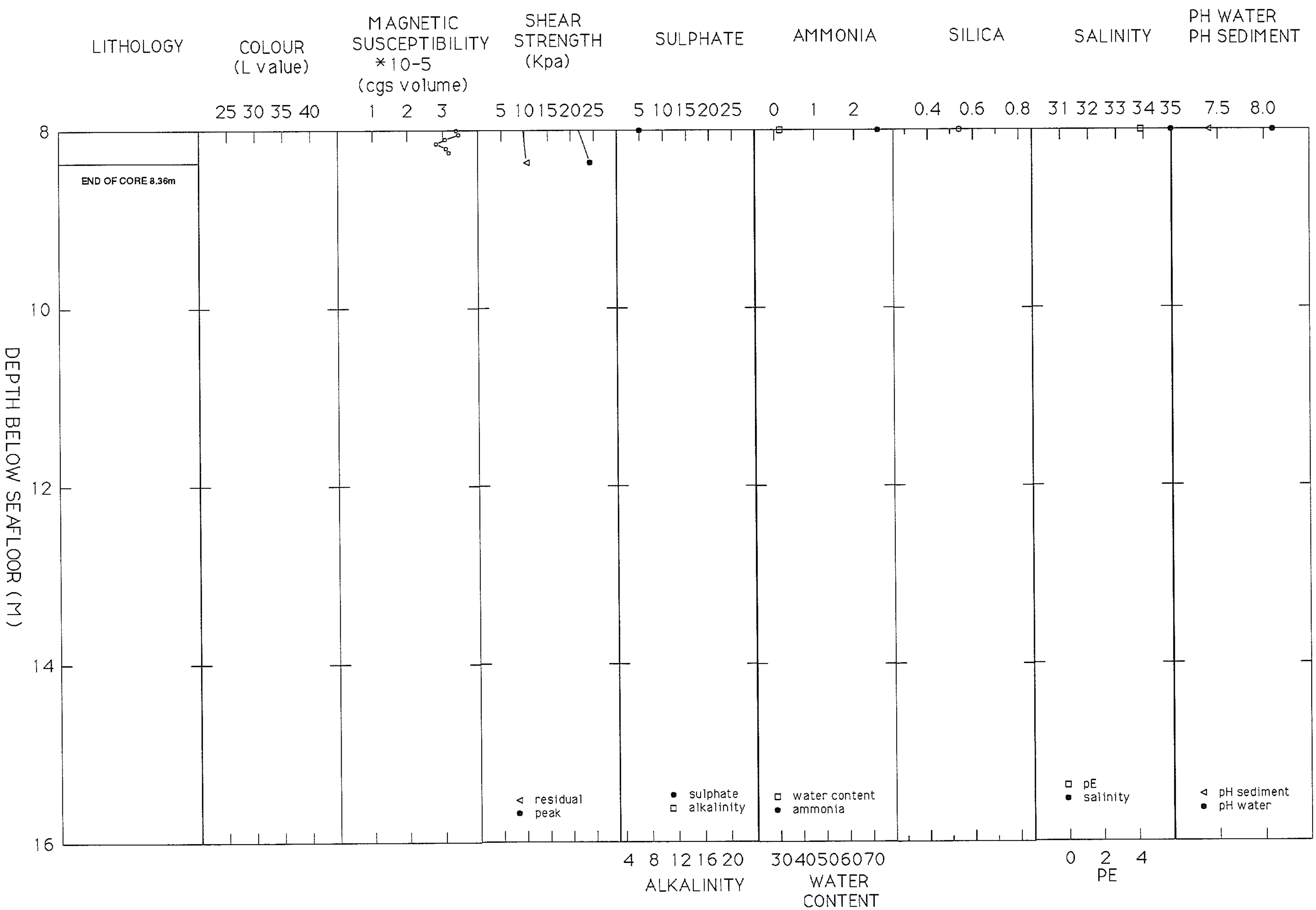
92003 027TWC



92003 027PC

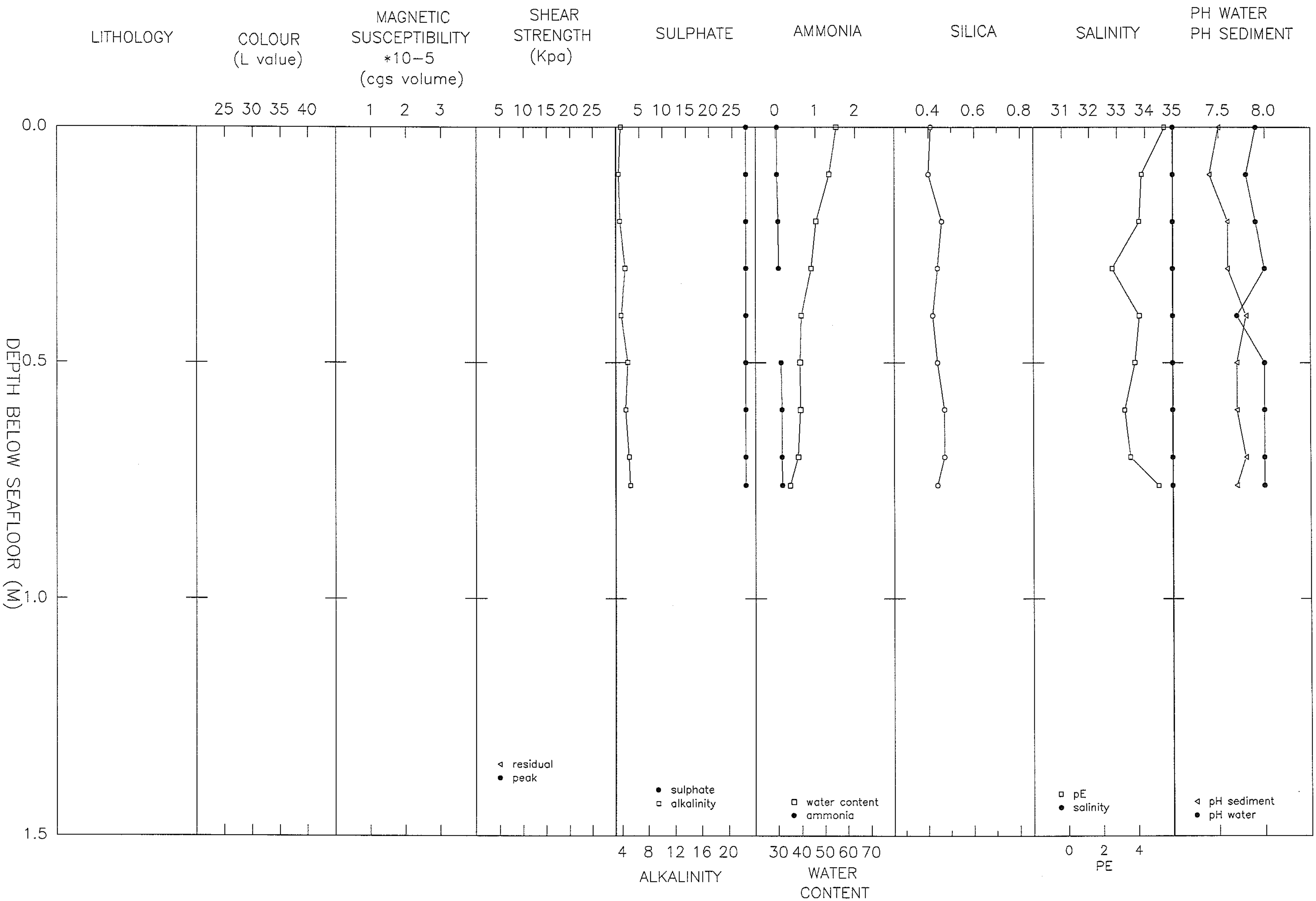

LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10152025
residual
peak
SULPHATE
5 10152025
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
3040506070
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
DEPTH BELOW SEAFLOOR (M)
0 2 4 6 8

92003 027PC

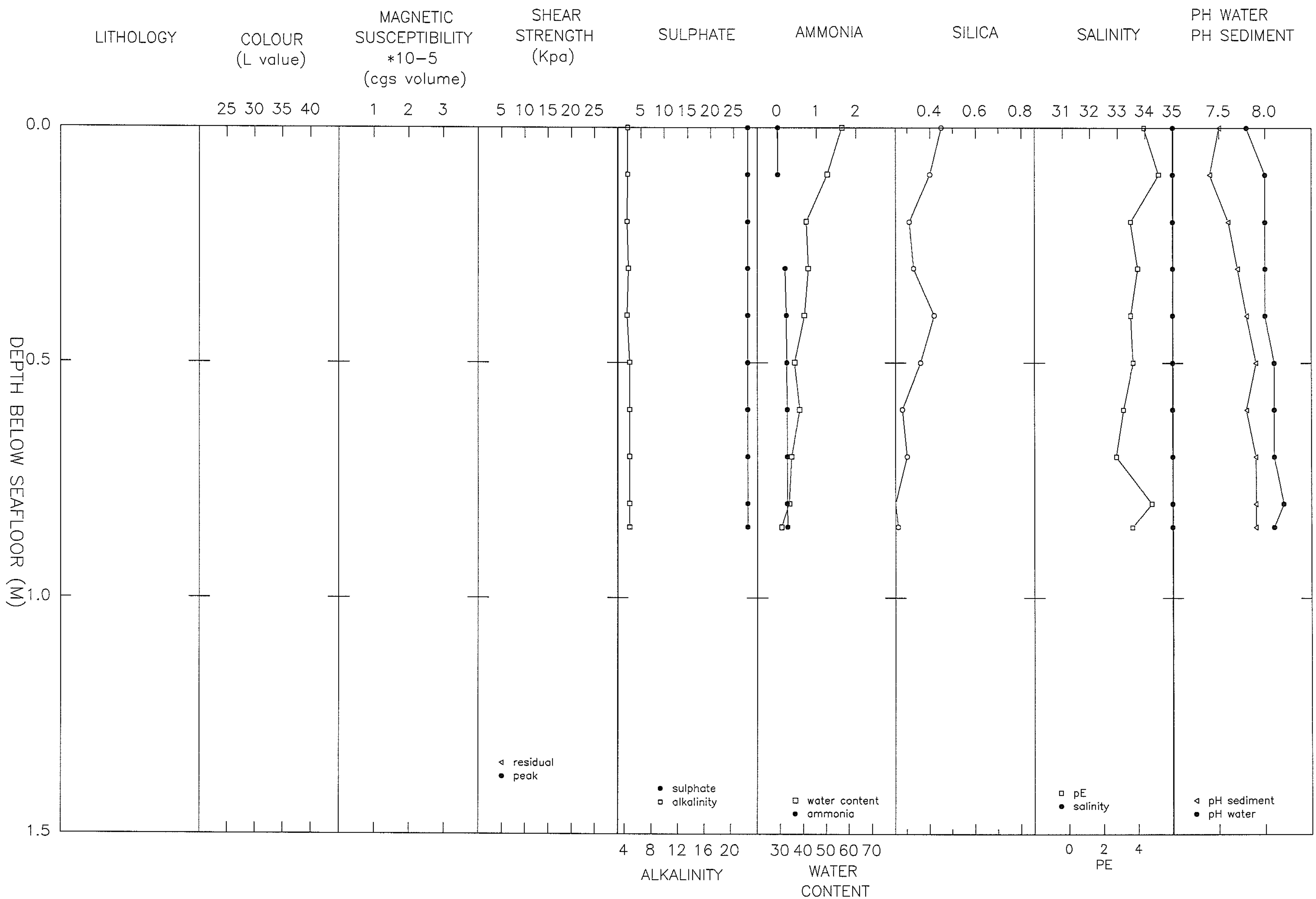


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10152025
SULPHATE
5 10152025
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
END OF CORE 8.36m
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
3040506070
WATER CONTENT
0 2 4
PE
8
10
12
14
16
DEPTH BELOW SEAFLOOR (M)

92003 028L

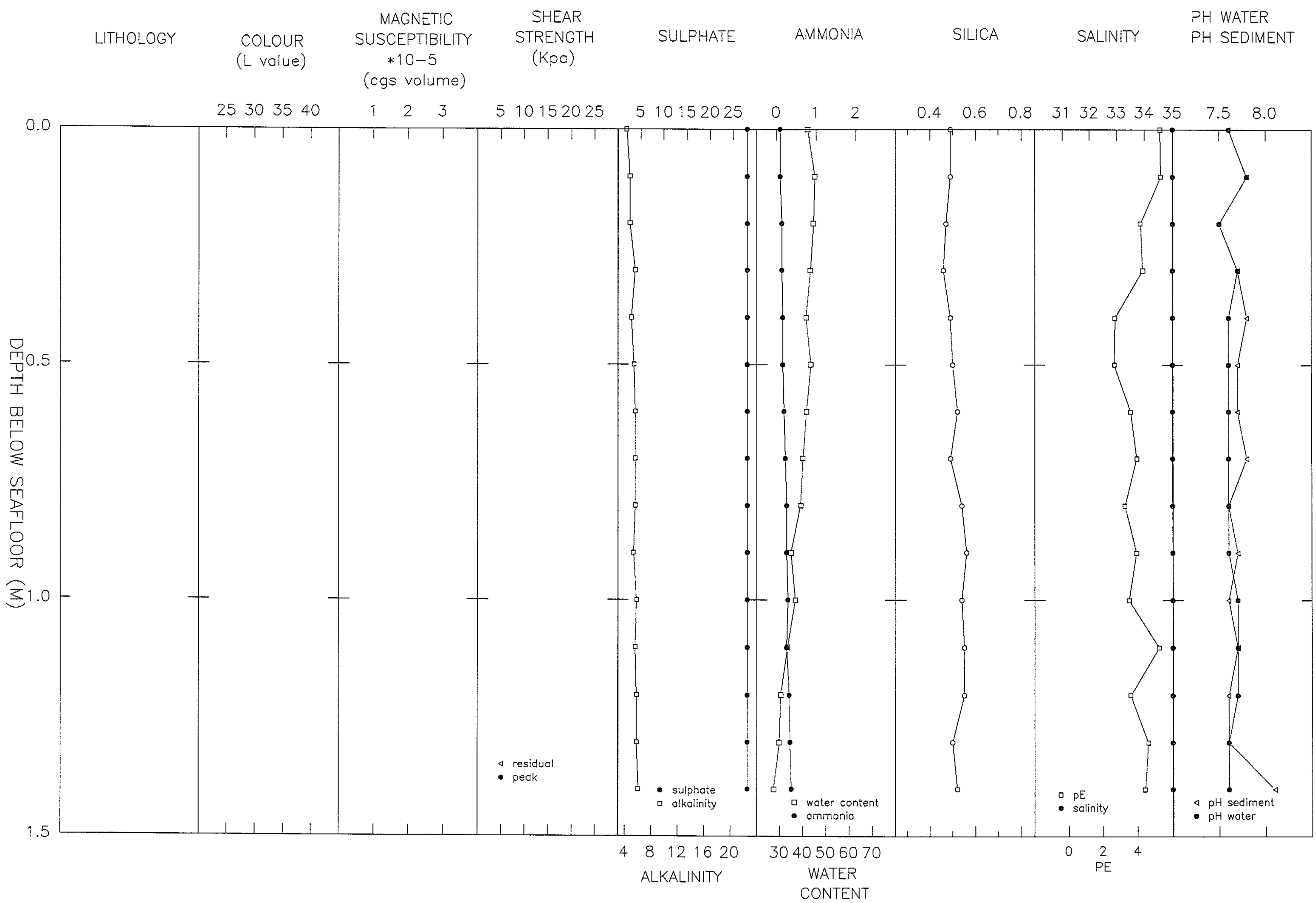

LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
SULPHATE
5 10 15 20 25
AMMONIA
0 1 2
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
PH WATER
PH SEDIMENT
7.5 8.0
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
4 8 12 16 20
ALKALINITY
30 40 50 60 70
WATER CONTENT
0 2 4
PE

92003 029L



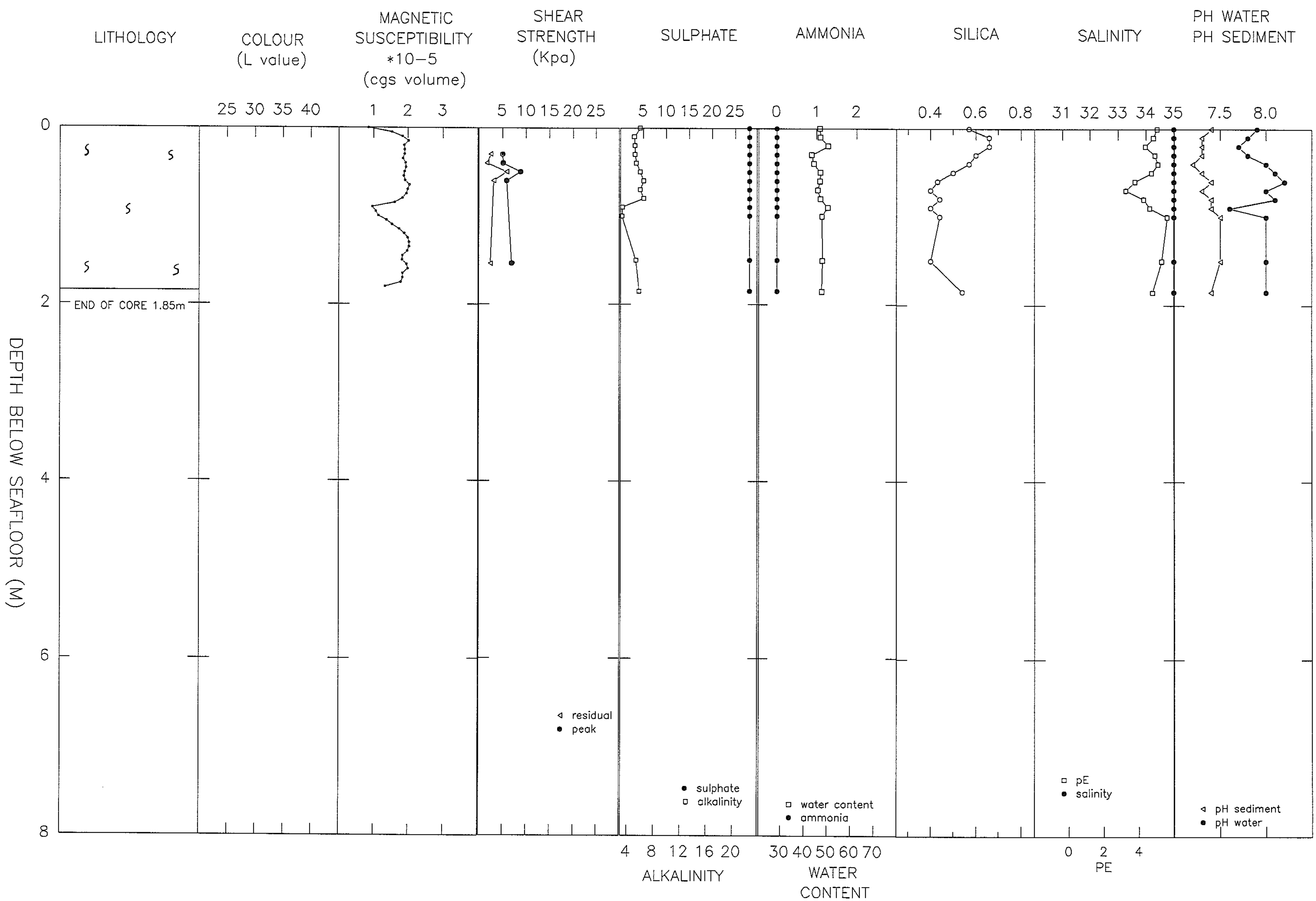
LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)

92003 030L

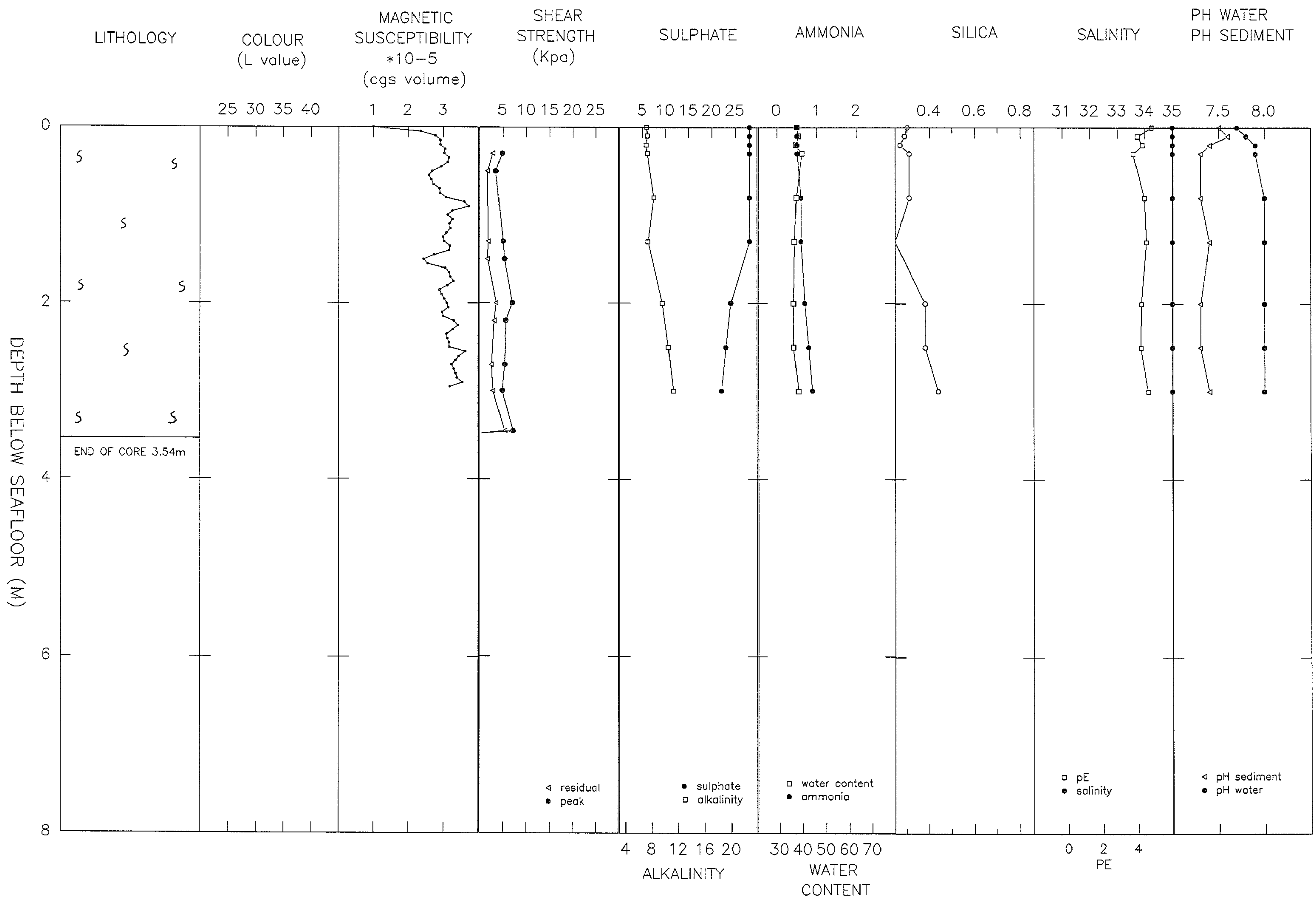


LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
4 8 12 16 20
ALKALINITY
AMMONIA
0 1 2
water content
ammonia
30 40 50 60 70
WATER CONTENT
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
0 2 4
PE
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
0.0
0.5
1.0
1.5
DEPTH BELOW SEAFLOOR (M)

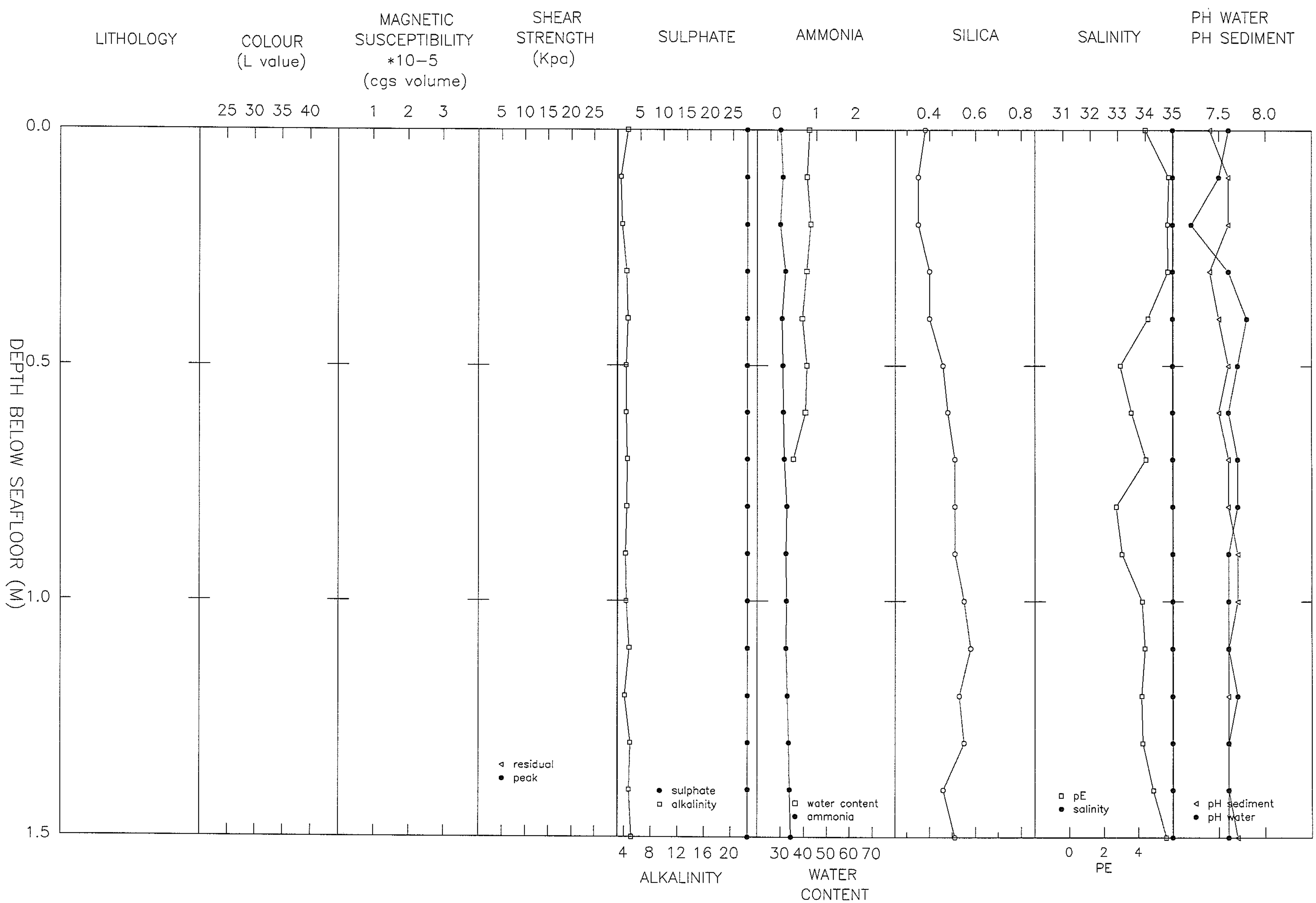
92003 031TWC



92003 031PC


LITHOLOGY
COLOUR (L value)
MAGNETIC SUSCEPTIBILITY *10-5 (cgs volume)
SHEAR STRENGTH (Kpa)
SULPHATE
AMMONIA
SILICA
SALINITY
PH WATER
PH SEDIMENT
END OF CORE 3.54m
DEPTH BELOW SEAFLOOR (M)
residual
peak
sulphate
alkalinity
water content
ammonia
pE
salinity
pH sediment
pH water
ALKALINITY
WATER CONTENT
PE

92003 032L



LITHOLOGY
COLOUR (L value)
25 30 35 40
MAGNETIC SUSCEPTIBILITY *10−5 (cgs volume)
1 2 3
SHEAR STRENGTH (Kpa)
5 10 15 20 25
residual
peak
SULPHATE
5 10 15 20 25
sulphate
alkalinity
ALKALINITY
4 8 12 16 20
AMMONIA
0 1 2
water content
ammonia
WATER CONTENT
30 40 50 60 70
SILICA
0.4 0.6 0.8
SALINITY
31 32 33 34 35
pE
salinity
PE
0 2 4
PH WATER
PH SEDIMENT
7.5 8.0
pH sediment
pH water
DEPTH BELOW SEAFLOOR (M)
0.0 0.5 1.0 1.5