CRUISE REPORT

SHIP UTILIZATION DATA

UNOLS
Rev. 4/83

SHIP NAME R/V R.D. CONRAD	OPERATING INST. L-DGO	PARTICIPATING PERSONNEL
CRUISE (LEG) NO. 28-04	DATES Apr. 25-May 28, 1987	
AREA OF OPERATIONS: Argentine Basin	PORT CALLS: PLACE / DATES: Montevideo — Apr. 19-25, 1987; Rio de Janeiro — May 28-June 1, 1987	
DAYS AT SEA 33 / DAYS IN PORT 4		

CODE	NAME	TITLE	AFFILIATION
1.	Flood, Roger D.	Ch. Sci.	LDGO
2.	Shor, Alexander N.	Co-Ch. Sci.	HIG
3.	Weatherly, Georges L.	Scientist	
4.	Manley, Patricia L.	Scientist	LDGO

Use Reverse If Additional Space Required. (over)

WAS RESEARCH CONDUCTED IN FOREIGN WATERS? yes COUNTRY: Argentina

PRIMARY PROJECTS (those which govern the principal operations, area and movements of the ship)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)
Morphological and Dynamic Studies of Sediment Waves in the Argentine Basin (Project MUDWAVES)	ONR	TO-0204 Scope MW	
DISCIPLINE			

ANCILLARY PROJECTS (which are accomplished on a not-to-interfere basis and contribute to the overall effectiveness of the cruise)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)

X SIGNATURE Roger D. Flood DATE 8/27/87
CHIEF SCIENTIST

TOTAL SCIENTISTS 13 TOTAL TECHNICIANS 5
TOTAL GRAD STUDENTS / TOTAL STUDENTS/OBSERVERS 3

ATTACH PAGE SIZE CRUISE TRACK

COST ALLOCATION DATA

DAYS CHARGED	AGENCY OR ACTIVITY CHARGED	GRANT OR CONTRACT NO.
31	NAVY	N00014-87-K 0204
(No funds available to bill the balance @ new day rate)		

SIGNATURE [signature] DATE 8 Oct 87
Institution Official

5.	Barth, Ginger A.	Scientist	LDGO
6.	Halter, Eric F.	Scientist	HIG
7.	Jones, William K.	Scientist	FSU
8.	Hunley, David G.	Scientist	FSU
9.	Ritch, John E.	Scientist	FSU
10.	Klaus, Adam	Scientist	Moss Landing
11.	Gagnon, Alan R.	Scientist	WHOI
12.	Smith, James A.	Sci. Officer	LDGO
13.	Miller, Joyce E.	Tech.	URI
14.	Ferguson, James S.	Tech.	URI
15.	DiBernardo, John G.	Tech.	LDGO
16.	Blaes, Robert J.	Tech.	LDGO
17.	Maiwiriwiri, Ropate Q.	Tech.	LDGO
18.	Schnack, Enrique	Observer	Argentina
19.	Colado, Ubaldo	Observer	Argentina
20.	Linares, Miguel	Observer	Argentina
21.	Weatherly, Georges	Scientist	FSU

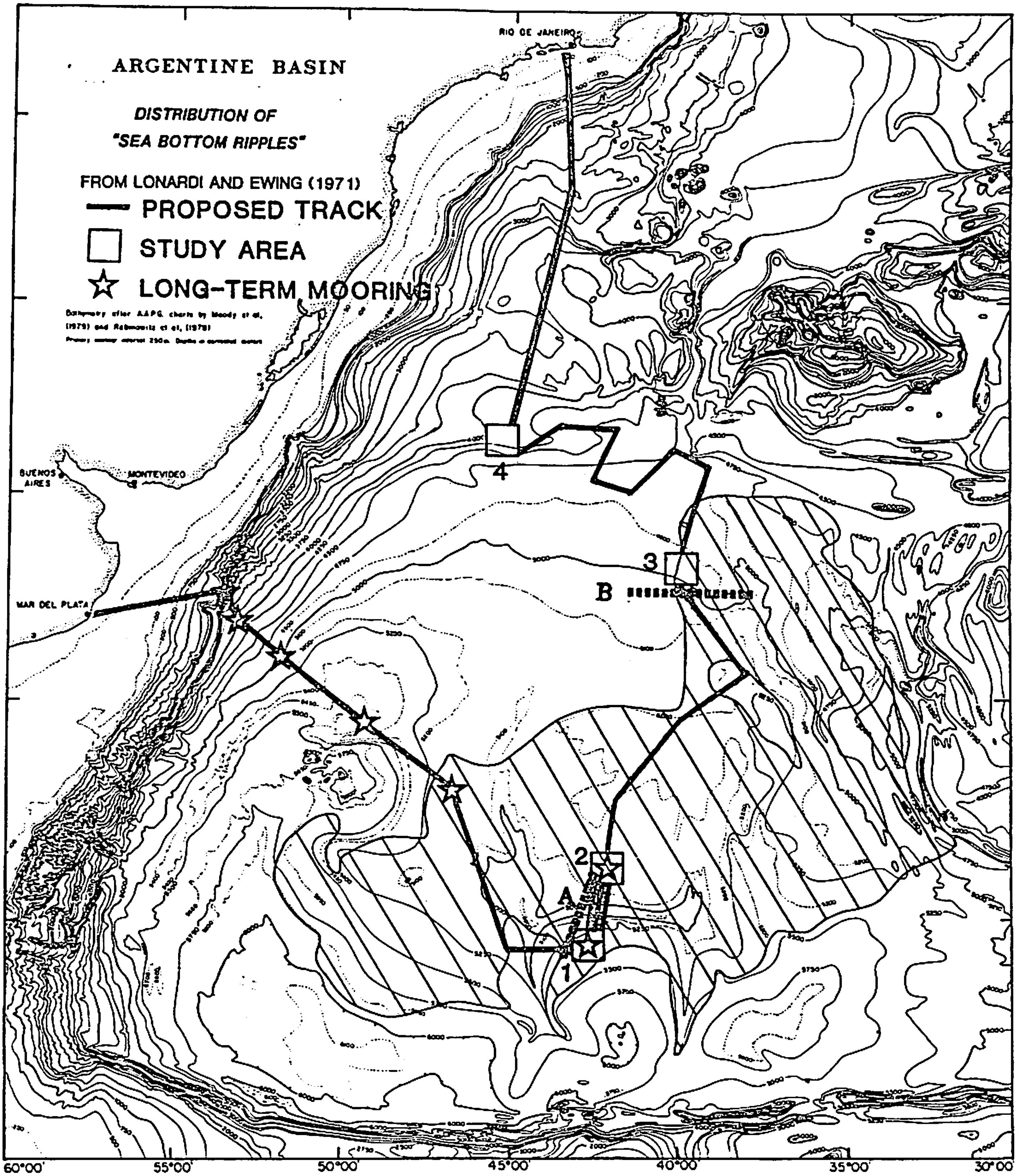

ARGENTINE BASIN
DISTRIBUTION OF
"SEA BOTTOM RIPPLES"
FROM LONARDI AND EWING (1971)
PROPOSED TRACK
STUDY AREA
LONG-TERM MOORING
RIO DE JANEIRO
BUENOS AIRES
MONTEVIDEO
MAR DEL PLATA
1
2
3
4
A
B
25° 00'
30° 00'
35° 00'
40° 00'
45° 00'
60°00'
55°00'
50°00'
45°00'
40°00'
35°00'
30°00'

Fig. 1

Sept. 8, 1987

TO:

Barbee, W.D.	- UNOLS
Dudley, J.	- LDGO
Gerard, S.	- LDGO
Hayes, D.	- LDGO
Cox, L.	- LDGO
Lotti, R.	- LDGO
Raleigh, B.	- LDGO
Kent, D.	- LDGO
Ryan, W.F.B.	- LDGO
Sykes, L.R.	- LDGO
Takahashi, T.	- LDGO
Science Officer	- CONRAD
Captain	- CONRAD

RESEARCH CRUISE REPORT

R/V ROBERT D. CONRAD 28-04

Attached is a copy of a cruise report for the above CONRAD cruise.

Ann Burns
Ann Burns
Marine Office

Enc.

Cruise Report

R/V Robert D. Conrad Cruise 28, Leg 04
April 25 to May 28, 1987

Montevideo, Uruguay, to Rio de Janeiro, Brazil

"Morphological and Dynamic Studies of Sediment Waves in the Argentine Basin (Project MUDWAVES)"

INTRODUCTION

The primary mission of R/V Conrad Cruise 28, Leg 4 (RC2804) was to study the topography, structure, sediments, and bottom water flow in the vicinity of large mud waves. Our study was quite successful and almost all of the cruise objectives were met. Mud waves are large-scale sedimentary features which have been formed through the activity of bottom currents. The waves studied here ranged from 40 to 100 m in height and had wavelengths of about 5 km. Mud waves are often observed along continental margins in places where deep currents play an important part in transporting and depositing sediments. Mud waves are particularly common in the Argentine Basin, due in part to the proximity of the basin to the source of Antarctic Bottom Water and to the large amount of sediment input from the margin. Previous studies of mud waves had suggested a possible model for their activity. We sought to collect the kind of information necessary to determine if the proposed model was realistic. This study is supported by Office of Naval Research Contract N00014-87-K-0204 (scope MW).

CRUISE PARTICIPANTS

The following individuals participated in the shipboard study.

1	Roger D. Flood	L-DGO	chief scientist
2	Patricia Manley	L-DGO	phys. properties
3	Ginger Barth	L-DGO	underway geophys.
4	Alexander Shor	HIG	co-chief scientist
5	Eric Halter	HIG	bottom camera
6	Georges Weatherly	FSU	scientist
7	Ken Jones	FSU	current meters
8	David Hunley	FSU	current meters/ctd
9	John Ritch	FSU	current meters
10	Adam Klaus	Moss Landing	core sampling + curating
11	Alan Gagnon	WHOI	core sampling, C-14
12	Lt. Miguel Linares	Argentine Navy	observer
13	Enrique Schnack	Mar del Plata	observer
14	Ubaldo Coldabo	Mar del Plata	observer
15	Joyce Miller	URI	sea beam
16	Scott Furguson	URI	sea beam
17	Jim Smith	L-DGO	science officer
18	Rob Blaise	L-DGO	navigation/computer
19	John DiBernardo	L-DGO	air gun/compressor
20	Ropate Mawiriwiri	L-DGO	coring bos'n

L-DGO = Lamont-Doherty Geological Observatory
HIG = Hawaii Institute of Geophysics
FSU = Florida State University
Moss Landing = Moss Landing Marine Laboratories
WHOI = Woods Hole Oceanographic Institution
URI = University of Rhode Island
Mar del Plata = University of Mar del Plata, Argentina

EQUIPMENT

Many types of equipment were used to survey the bottom topography, to collect bottom samples, and to measure water properties.

Underway surveying was done using the SeaBeam multi-narrow beam swath echo sounding system, the 3.5 kHz subbottom profiler, and a single-channel seismic system based on either two S80 waterguns or one P400 watergun. These systems performed well at the optimum survey speed of 10 kts. The 3.5 kHz subbottom profiler was run continuously, SeaBeam was run continuously throughout the cruise (except in the Uruguayan and Brazilian EEZ, while crossing the Argentine Shelf, and during some station work), and the seismic gear was run during many of the survey lines in the study areas and continuously between stations. Sixteen sonobuoys were launched.

Bottom samples were collected using a piston corer, a large-diameter gravity corer, and a box corer. The L-DGO piston core collected cores to 18 m long (3 pipe cores). The sound velocity of sediments recovered by the piston corer was determined soon after the core was recovered by measuring sound travel time through the liner. Five of the cores had significant quantities of gas which disrupted the sediment structure soon after core retrevial, and accurate velocity measurements could not be made on those sediments. The large-diameter gravity corer has a 10 foot barrel with a 4" ID. High-quality samples of the near-surface sediments were recovered by this system; however, we experienced two failures where no sediment was recovered (apparently sandy sediment near the margin) and one failure where the core barrel broke off after penetration. The box corer collects a sample of 20 by 30 cm which is 60 cm long. We failed to collect samples at five of the box core stations when the core pre-tripped during descent in rough weather. Good samples were collected when sampling was restricted to calm weather and when the box core was lowered at 40 m/min. In future, the box core should be fitted with a mechanism to avoid the pre-trip during descent. Such a mechanism would allow the core to be lowered more quickly, and would allow good samples to be collected in moderate weather.

Bottom photographs were collected in the major survey areas to determine if bottom flows were active today, the direction of those flows, and whether there were differences in surface sediment micromorphology between wave flanks. We used a bottom-bounce pogo camera capable of taking 25 shots per lowering. A compass visible in the field of view orients the bottom photograph.

Current meter/transmissometer moorings were deployed at six sites by investigators from FSU, four along the margin and in two wave survey areas. All moorings have a current meter and transmissometer at 10 m above bottom and three moorings (1CM, 2CM and 5 tall) also have a meter at 200 m above bottom. One mooring (5 short-term) was recovered after a period of 17 days, this mooring also had two sediment traps on it (for W. Gardner, TAMU). The BASS (Benthic Acoustic Stress Sensor, A. Williams, WHOI) tripod was deployed in study area 5. This tripod, and the current meter moorings, will be recovered in early 1988.

Water properties were measured using an internally recording CTD operated by FSU. Repeated near-bottom CTD casts were made across the wave to determine bottom water structure in both major wave study areas.

Sediment velocities in the upper 100 m were measured using the L-DGO near-bottom hydrophone-pinger experiment. Runs were made in both major study areas.

Ship navigation was by transit and GPS satellite fixes supplemented by 1-minute ship speed/heading data. These data were recorded by both the L-DGO data logger and by the SeaBeam computer system. Navigation data was merged with SeaBeam data, and final navigation adjustments were made by comparing SeaBeam bathymetry on adjacent and crossing tracks.

Stations in the two major wave study areas were navigated by acoustic ranges off transponders. The transponders were located on the current meter moorings, and expendable transponders were also deployed. A relay transponder affixed to the wire allowed the position of the sampling equipment or CTD to be measured directly. We estimate that these transponder positions are accurate to 100 m at each of the two detailed survey sites.

NARRATIVE

The R/V Conrad departed Montevideo, Uruguay, at 2015z, April 25, 1987, shortly after the arrival of the CTD. The seismic gear was streamed, and SeaBeam was started, at 1310z, April 26. Four sites were surveyed on a transect across the margin (sites 1-4). Current meter moorings CM1, CM2, CM3, and CM4 were deployed at these sites, and cores 1GC and 2GC were collected at sites 3 and 4 respectively.

A field of NE-SW trending mudwaves was surveyed at Site 5, centered near 42° 30'S and 45° 05'W, water depth 5100 m, on the north flank of the Zapiola Drift. The wave crests are oriented along N 60 E, and the waves are asymmetric with steeper slopes on the southeast flanks and shallower slopes on the northwest flanks. Subbottom profiles suggest that preferential sediment deposition has occurred on the southeast wave flanks whereas sediments have been eroded from the northwest flanks, thus the waves have migrated towards the southeast. Wave heights range from about 50 to 70 m, and the wave spacing ranges from about 5 to 6 km.

A regional bathymetric (SeaBeam) survey was conducted over an area of 75 km by 100 km to determine regional variations in mud wave characteristics. Many of the survey lines were accompanied by seismic profiles. Mudwaves are continuous along strike for distances up to about 30 km, but most of the waves in this field die out along strike towards the east. Waves terminate abruptly to the west near the crest of a north-northwest striking branch of the Zapiola Drift. Some bifurcations of wave crests were observed. A small, moated seamount (with a height of about 500 m above the surrounding sediment) was observed in the southwest corner of the study area. This seamount appears to be part of a basement ridge, which seismic profiles suggest may control the development of this part of Zapiola Drift.

A well-formed 75-m high wave was chosen for detailed study. Most of the stations were navigated using ranges from three acoustic transponders, one on each of two current meter moorings and an expendable transponder. We collected a transect of four piston cores and three gravity cores over the wave, and two box cores from each wave flank. The gravity cores and piston cores both had an odor of H_2S at depth suggesting reducing conditions and microbial activity. These cores were not split on board. The sediments recovered in the box corer were noticably different on the two wave flanks. Sediments from the apparently depositional southeast flank had a dark brown surficial layer overlying an olive green mud. However, on the apparently erosional northwest flank, olive grey sediments were overlain by a brown surficial layer. While these differences need to be more fully quantified, it appears that near-surface sediments are different on the two wave flanks.

Four bottom camera lowerings were made in this area. These photographs suggest a moderate to strong bottom flow from the east or southeast. All of the photographs on two of the lowerings were obscured by mud, perhaps because of mud on the camera lens or stirred up by the bottom camera.

Preliminary analysis of CTD data suggests that there are noticable cross-wave changes in bottom mixed-layer thickness and temperature. One current meter was deployed for 16 days (5 short-term) and three current meters were deployed to be recovered in early 1988 (mooring 5 tall with meters at 10 and 200 m above bottom and mooring 5 long-term). Mooring 5 tall was deployed on the southeast wave flank and moorings 5 short-term and 5 long-term were deployed on the northwest wave flank. The 16-day record of current meter 5 short-term shows a flow to the west at speeds of 15 to 20 cm/sec (preliminary data from G. Weatherly).

A second set of mudwaves was surveyed at Site 6, centered at 45° 45'S, 49° 08'W, depth 5600 m, on the south flank of the Zapiola Drift. In this area the waves are oriented N 70 W, and their structure suggests that the waves have migrated towards the northeast. As at site 5, the waves are depositional on one flank and erosional on the other. A regional SeaBeam/seismic grid shows that the wave pattern is somewhat complex in that different wave orientations are present within a relatively small area. One marked difference revéaled on the seismic profiler was that waves towards the southern portion of the study area are built of weakly laminated sediments whereas those in the northern portion of the area are built of more reflective sediments. Several wave bifurcations were observed, and some waves end abruptly.

As before, a well-formed wave (one which was poorly laminated on the seismic profiler) was chosen for detailed study. The stations in this area were navigated by two bottom transponders, one transponder on the current meter mooring and one expendable transponder. Five piston cores and four gravity cores were collected across the wave profile. All of the piston cores recovered black sediments at depth which degassed while at the surface to create large pockets in the core and to force mud out of the liner. Holes were drilled to relieve the pressure, and the gas eminating from the holes would burn if ignited suggesting that the gas contained methane. Sediments overlying the presumably methane-rich sediments had a H_2S odor. Five box cores were collected across the wave profile. Visual analysis suggests that near-surface sediments change character across the wave profile.

One long-term current meter was deployed in this area (6CM), and it is located on a wave crest. Several yo-yo CTD stations were taken across the waves, and two bottom camera stations were occupied. The bottom photographs suggest a flow towards the south-southwest.

We returned briefly to Site 5 to recover mooring 5 short-term and deploy mooring 5 long-term, and to complete our CTD and bottom photograph programs.

A third mudwave site was studied briefly, Site 7. At this location the waves strike northwest-southeast and are about 40 m high, and deposition occurs preferentially on the northeast side; however, no erosion is evident on the wave profile. Two piston cores, two gravity cores, and one bottom camera station were occupied. The bottom photographs shows a tranquil sea bed.

Following our work at Site 7, we sought to collect seismic data off the margins of Uruguay and southern Brazil. We continued toward the margin until forced to turn north for Rio de Janeiro by time limitations. SeaBeam and seismic data acquisition were suspended at the 200 mile EEZ limit off Brazil, and we arrived in Rio at about 1000z, May 28.

Table 1

Current Meter Mooring Positions
(preliminary positions)

	Latitude (S)	Longitude (W)	Fix	Area
1CM	38° 36.769'	53° 58.075'	GPS	site 1
2CM	38° 53.672'	53° 29.772'	GPS	site 2
3CM	39° 22.672'	52° 13.662'	DR	site 3
4CM	40° 26.831'	49° 25,018'	GPS	site 4
5 short-term	42° 30.257'	45° 07.853'	XPDR	site 5
5 tall	42° 31,916'	45° 07.131'	XPDR	site 5
5 long-term	42° 30.302'	45° 07.678'	GPS	site 5
6CM	45° 43.836'	49° 09.062'	XPDR	site 6
BASS	42° 29.487'	45° 05.060'	GPS	site 5

Table 2

Camera Stations
(preliminary positions)

	Latitude (S)	Longitude (W)	Fix	Area
Camera Stations				
Camera 01				
start:	42° 30.728'	45° 06.211'	XPDR	site 5
end:	42° 30.620'	45° 07.017'	XPDR	
Camera 02				
start:	42° 30.063'	45° 04.146'	XPDR	site 5
end:	42° 29.507'	45° 03.756	XPDR	
Camera 03				
start:	42° 30.079'	45° 06.781'	XPDR	site 5
end:	42° 30.822'	45° 07.245'	XPDR	
Camera 04				
start:	45° 43.650'	49° 08.885'	XPDR	site 6
end:	45° 43.278'	49° 08.725'	XPDR	
Camera 05				
start:	45° 45.359'	49° 10.246'	XPDR	site 6
end:	45° 45.328'	49° 10.239'	XPDR	
Camera 06				
start:	42° 29.921'	45° 06.640'	DR	site 5
Camera 07				
start:	37° 03.989'	39° 59.785'	DR	site 7

Table 3

Core Locations
(preliminary positions)

	Latitude (S)	Longitude (W)	Fix	Area
Piston Cores				
RC2804-03PC	42° 30.075'	45° 06.428'	DR	site 5
RC2804-05PC	42° 28.630'	45° 06.548'	XPDR	site 5
RC2804-06PC	42° 31.528'	45° 05.913'	XPDR	site 5
RC2804-07PC	42° 31.120'	45° 05.630'	XPDR	site 5
RC2804-19PC	45° 45.548'	49° 08.766'	XPDR	site 6
RC2804-20PC	45° 44.896'	49° 08.723'	XPDR	site 6
RC2804-21PC	45° 43.619'	49° 08.027'	XPDR	site 6
RC2804-22PC	45° 44.628'	49° 08.050'	XPDR	site 6
RC2804-27PC	45° 43.730'	49° 09.431'	XPDR	site 6
RC2804-28PC	37° 03.468'	39° 58.426'	DR	site 7
RC2804-30PC	37° 04.013'	39° 59.411'	DR	site 7
Gravity Cores				
RC2804-01GC	39° 23.355'	52° 17.372'	DR	site 3
RC2804-02GC	40° 26.476'	49° 24.879'	DR	site 4
RC2804-04GC	42° 28.788'	45° 05.340'	XPDR	site 5
RC2804-08GC	42° 31.138'	45° 05.637'	XPDR	site 5
RC2804-13GC	42° 29.196'	45° 06.180'	XPDR	site 5
RC2804-14GC	45° 45.307'	49° 09.451'	XPDR	site 6
RC2804-16GC	45° 43.673'	49° 07.636'	XPDR	site 6
RC2804-17GC	45° 42.485'	49° 09.456'	XPDR	site 6
RC2804-18GC	45° 44.805'	49° 08.977'	XPDR	site 6
RC2804-29GC	37° 03.667'	39° 58.171'	DR	site 7
RC2804-31GC	37° 03.810'	39° 59.540'	DR	site 7
Box Cores				
RC2804-09BC	42° 31.579'	45° 06.191'	XPDR	site 5
RC2804-10BC	42° 30.111'	45° 07.106'	XPDR	site 5
RC2804-11BC	42° 29.802'	45° 07.021'	XPDR	site 5
RC2804-12BC	42° 32.294'	45° 06.786'	XPDR	site 5
RC2804-15BC	45° 44.108'	49° 08.922'	XPDR	site 6
RC2804-23BC	45° 45.312'	49° 07.600'	XPDR	site 6
RC2804-24BC	45° 45.851'	49° 08.947'	XPDR	site 6
RC2804-25BC	45° 43.739'	49° 09.386'	XPDR	site 6
RC2804-26BC	45° 43.579'	49° 08.604'	XPDR	site 6

Table 4

Other Station Data
(preliminary positons)

	Latitude (S)	Longitude (W)	Fix	Area
Hydrophone-Pinger				
H-P 01	0415z-1000z, 8 May			
start:	42° 28.442'	45° 06.909'	SAT	site 5
H-P 02	0330z-1305z, 15 May			
start:	45° 45.612'	49° 08.860'	XPDR	site 6
end:	45° 46.303'	49° 09.091'	XPDR	
H-P 03	1754z-0140z, 20/21 May			
start:	42° 31.017'	45° 07.659'	XPDR	site 5
end:	42° 29.851'	45° 07.700'	XPDR	
CTD Stations				
CTD 1-1	38° 38.545'	53° 57.755'	DR	site 1
CTD 3-1	39° 23.430'	52° 17.291'	SAT	site 3
CTD 4-1	40° 26.727'	49° 24.963'	SAT	site 4
CTD 5-1 (yo-yo)	0710z-1220z, 5 May			
start:	42° 30.820'	45° 02.992'	XPDR	site 5
end:	42° 29.434'	45° 03.875'	XPDR	
CTD 5-2 (yo-yo)	0247z-0933z, 6 May			
start:				site 5
end:				
CTD 5-3 (yo-yo)	0931z-1721z, 7 May			
start:				site 5
end:				
CTD 5-4 (yo-yo)	2100z-0751z, 19/20 May			
start:				site 5
end:				
CTD 6-1 (yo-yo)	0246z-0814z, 13 May			
start:				site 6
end:				
CTD 6-2 (yo-yo)	1338z-0012z, 15/16 May			
start:	45° 46.771'	49° 08.235'	XPDR	site 6
end:	45° 46.469'	49° 08.235'	XPDR	
CTD 6-3 (yo-yo)	0400z-1211z, 17 May			
start:	45° 46.044'	49° 07.932'	XPDR	site 6
end:	45° 44.315'	49° 06.440'	XPDR	

FIGURE CAPTIONS

Figure 1. Track chart of RC28-04 from Montevideo, Uruguay, to Rio de Janeiro, Brazil. Sites of current meter and mudwave studies are noted.

Figure 2. 3.5 kHz subbottom profile at Mudwave Site 5. The mudwave studied in detail is indicated.

Figure 3. SeaBeam bathymetric map of the sampling area at Mudwave Site 5. The box (BC), gravity (GC), and piston (PC) core locations are shown.

Figure 4. Profile of mudwave sampled at Site 5 with the location of sediment cores, bottom photographs, and current meters projected onto the profile.

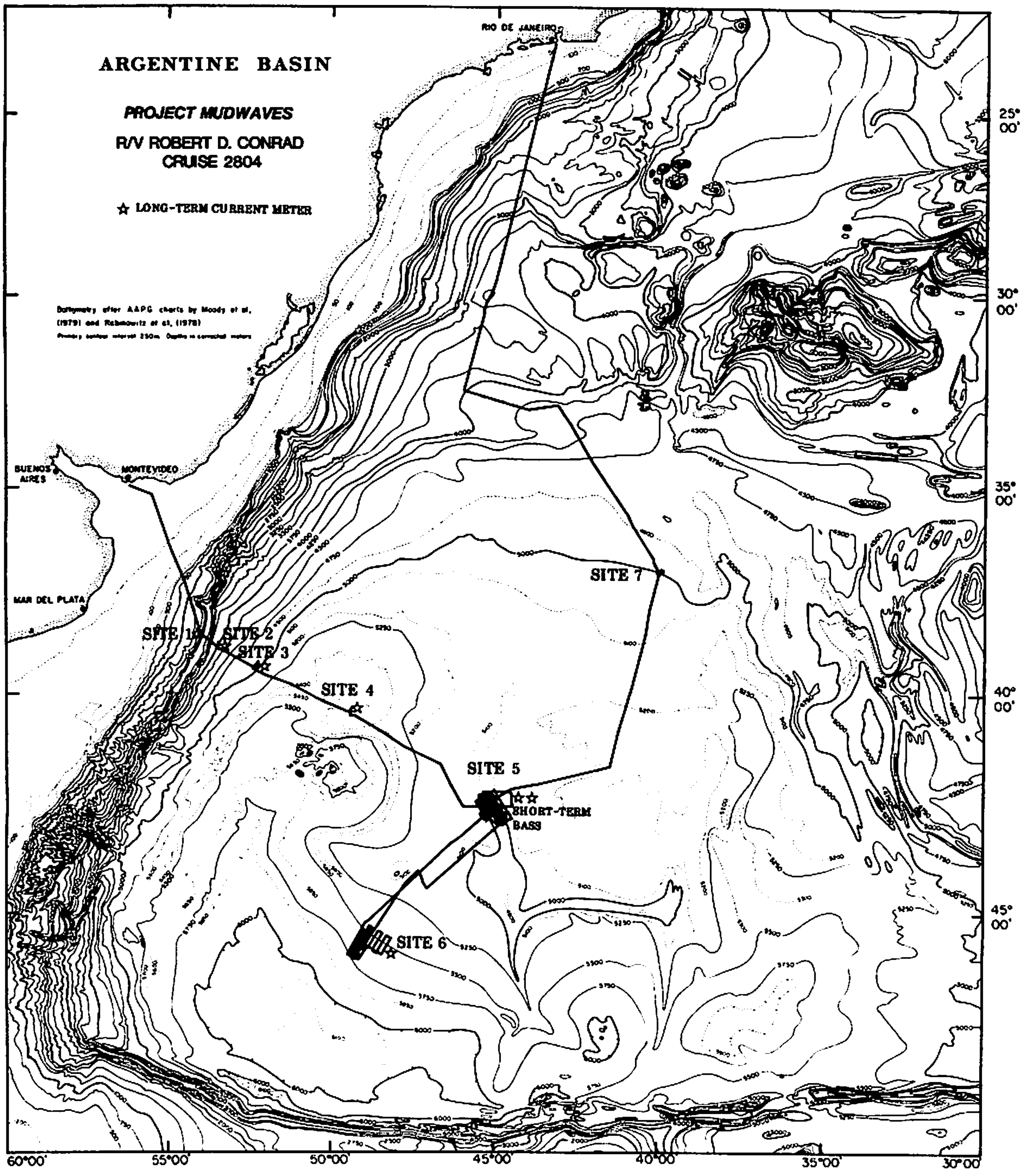
Figure 5. 3.5 kHz subbottom profile at Mudwave Site 6. The mudwave studied in detail is indicated.

Figure 6. Seismic profile (400 cubic inch watergun) across mudwaves at site 6. The wave studied is shown by an arrow.

Figure 7. SeaBeam bathymetric map of the sampling area at Mudwave Site 6. The box (BC), gravity (GC), and piston (PC) core locations are shown.

Figure 8. Profile of mudwave sampled at Site 6 with the locations of sediment cores, bottom photographs, and current meters projected onto the profile.

Figure 9. 3.5 kHz subbottom profile at Mudwave Site 7. The mudwave sampled is indicated.



ARGENTINE BASIN
PROJECT MUDWAVES
R/V ROBERT D. CONRAD
CRUISE 2804
☆ LONG-TERM CURRENT METER
RIO DE JANEIRO
BUENOS AIRES
MONTEVIDEO
MAR DEL PLATA
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
☆☆ SHORT-TERM BASS
25° 00'
30° 00'
35° 00'
40° 00'
45° 00'
60°00'
55°00'
50°00'
45°00'
40°00'
35°00'
30°00'

Figure 1

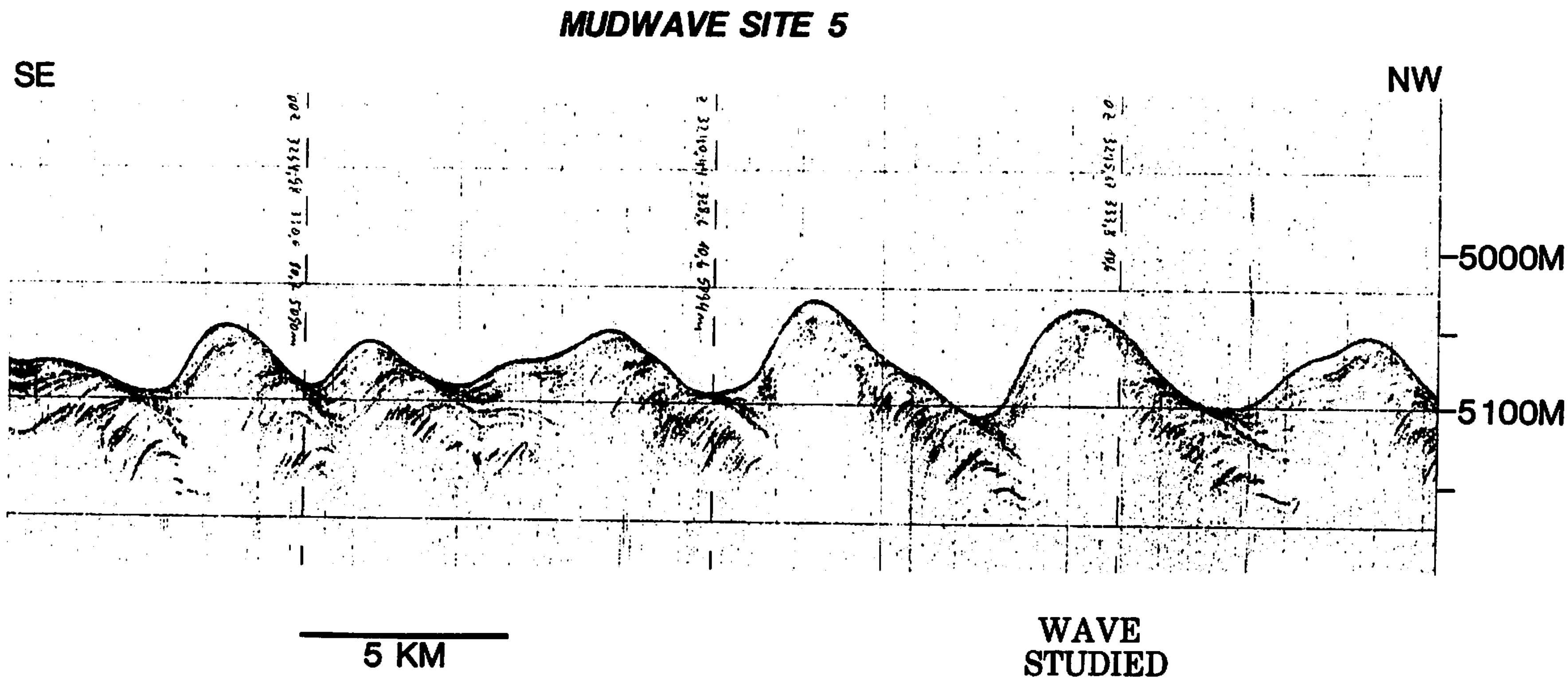
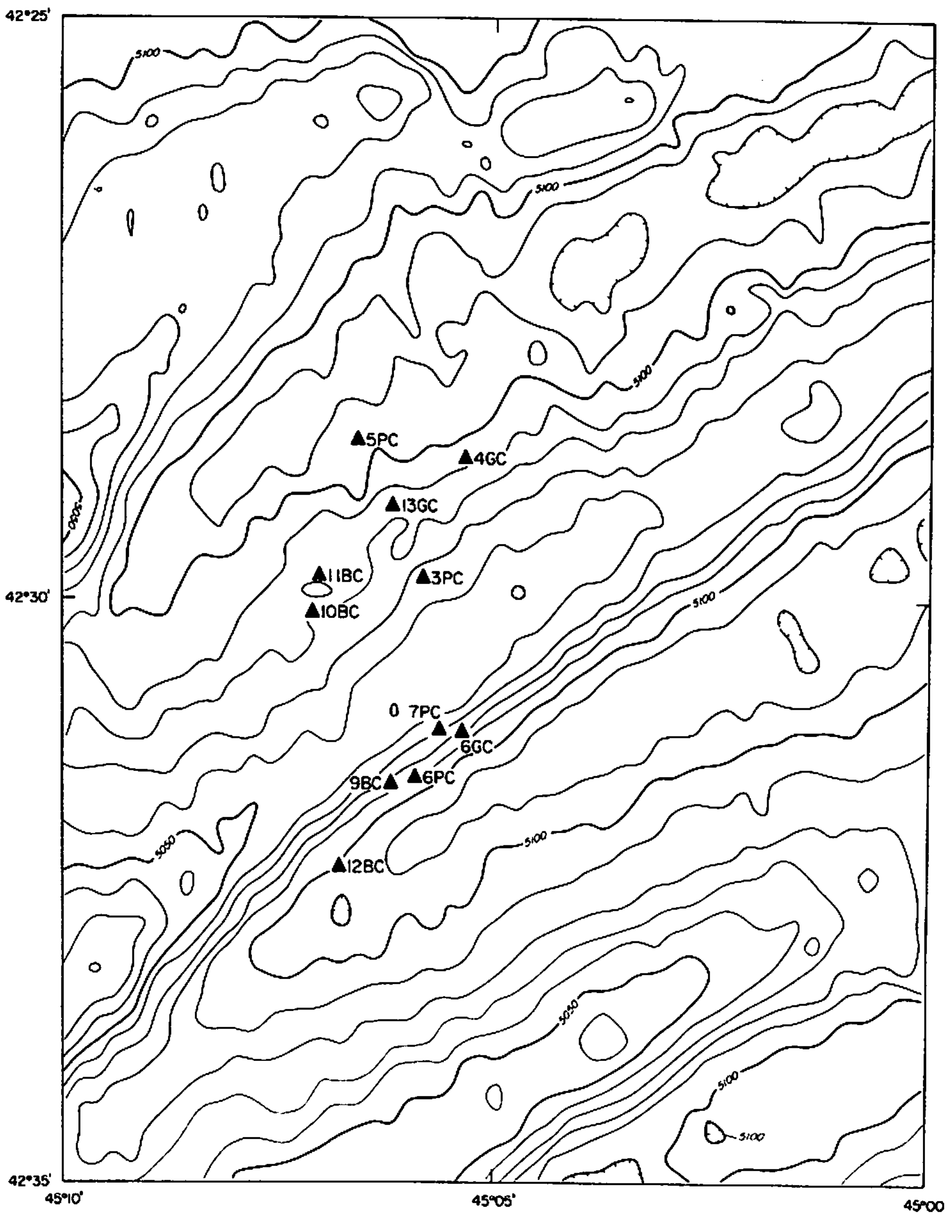


Figure 2



ARGENTINE BASIN - RC2804
MUDWAVE SITE 5
CORE STATION MAP

Figure 3

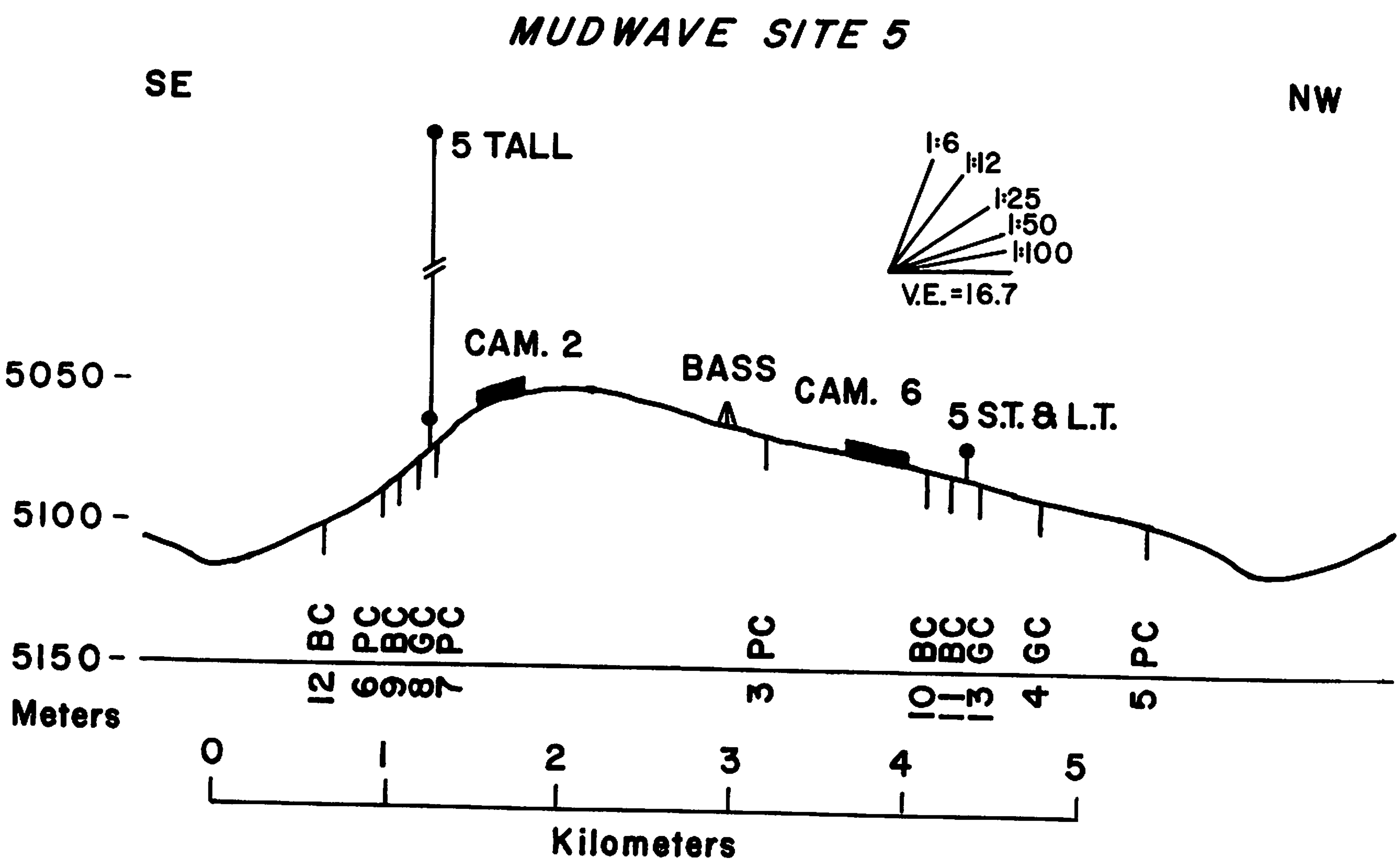

MUDWAVE SITE 5
SE
NW
5 TALL
CAM. 2
BASS
CAM. 6
5 S.T. & L.T.
1:6
1:12
1:25
1:50
1:100
V.E.=16.7
5050
5100
5150
Meters
12 BC
6 PC
9 BC
8 GC
7 PC
3 PC
10 BC
11 BC
13 GC
4 GC
5 PC
0
1
2
3
4
5
Kilometers

Figure 4

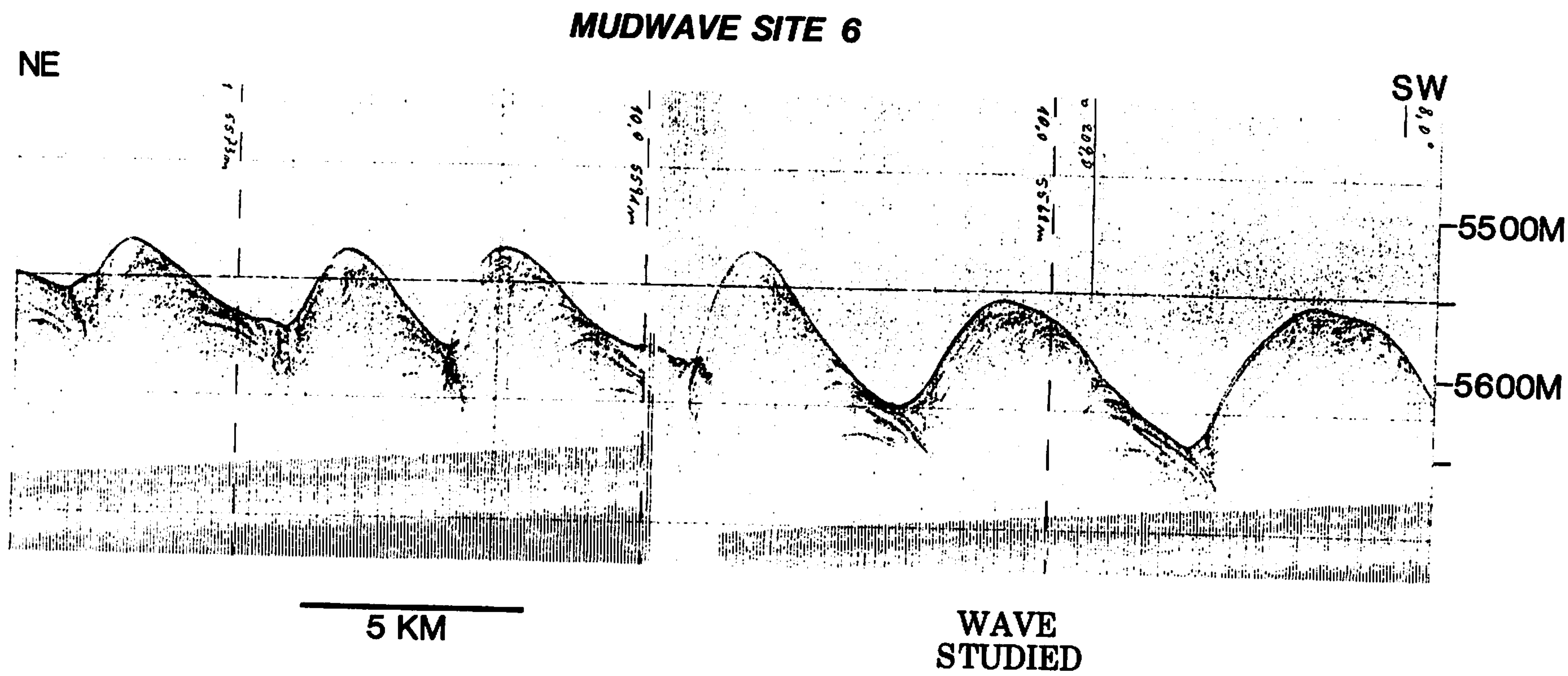


Figure 5

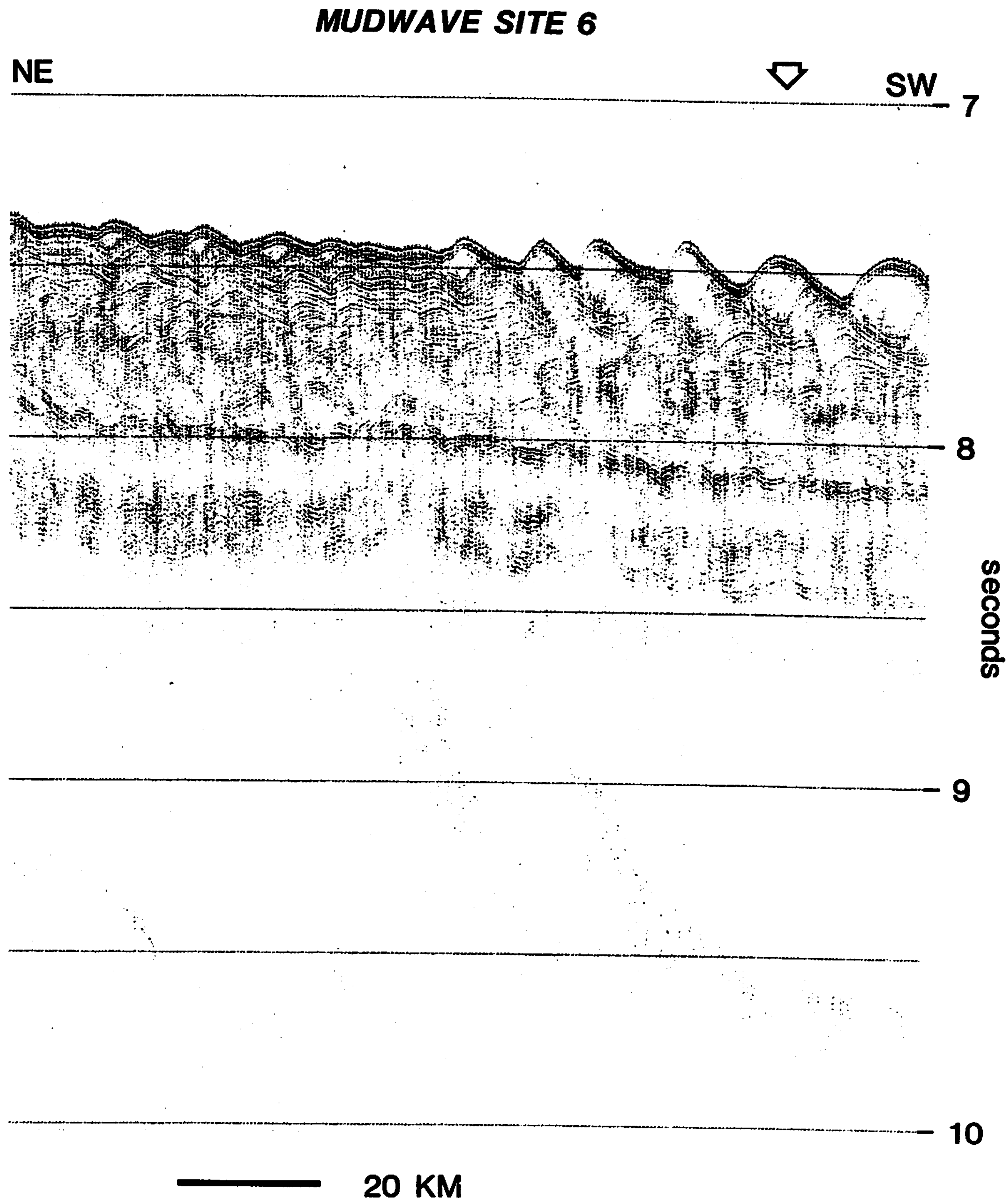
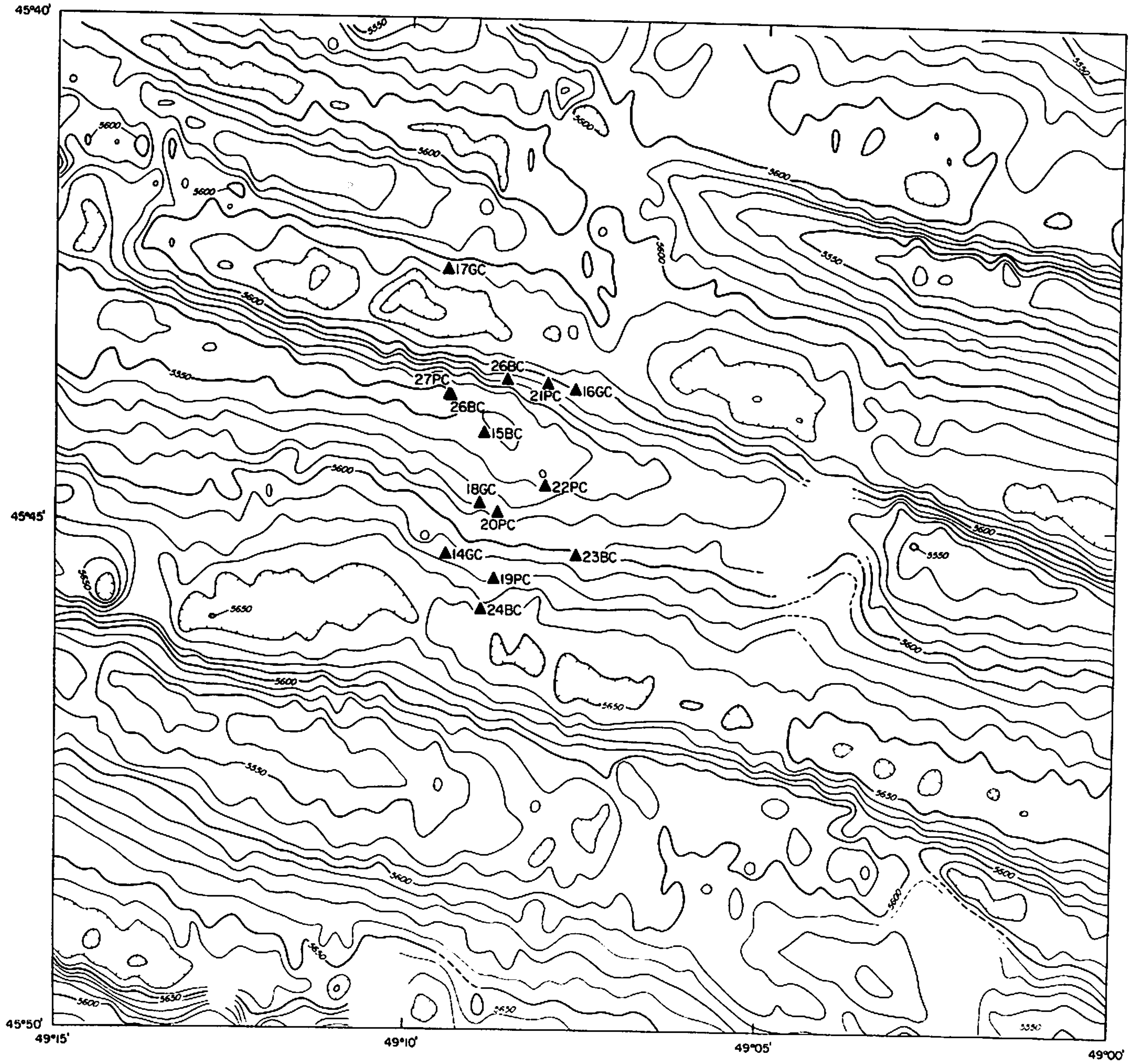
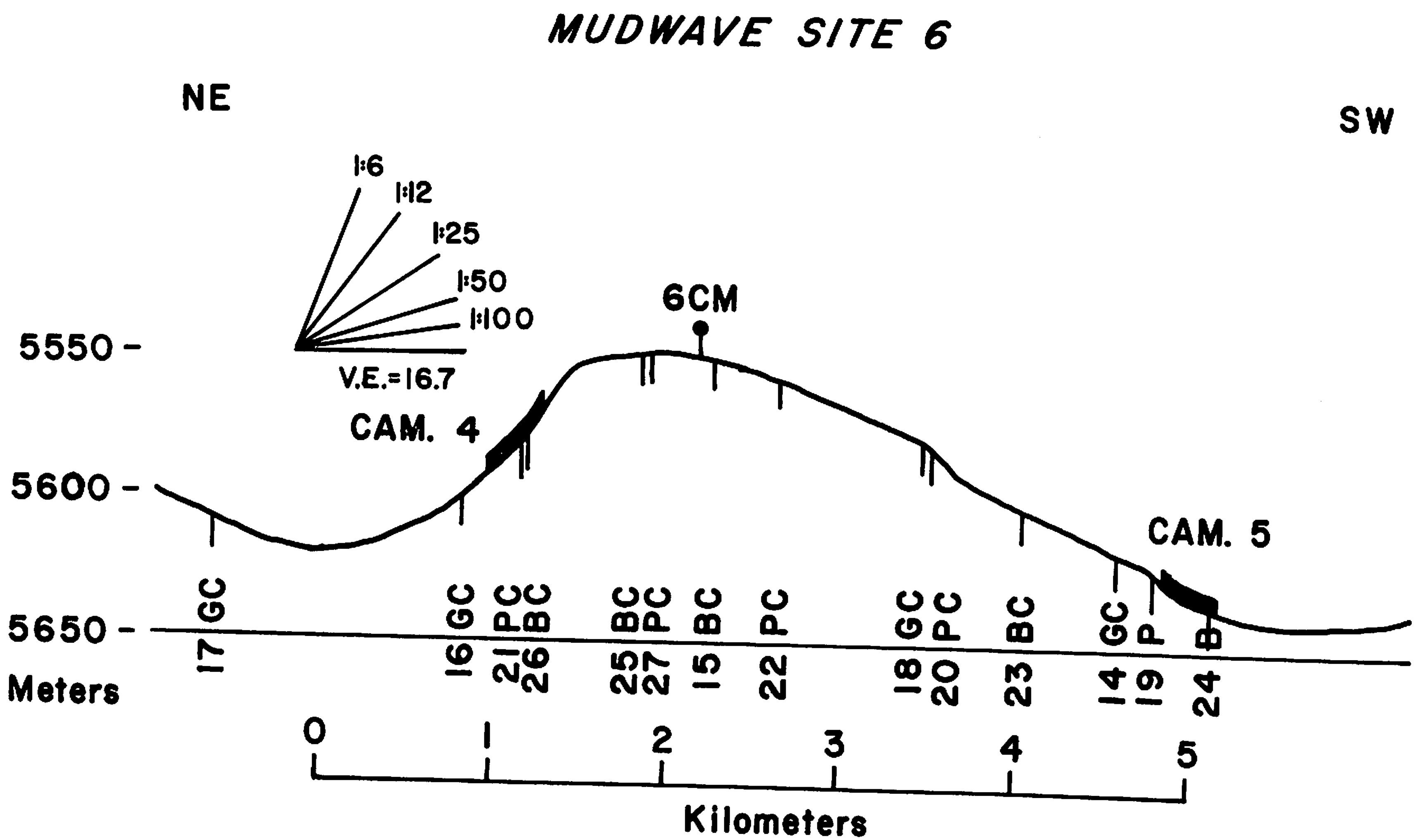


Figure 6



ARGENTINE BASIN - RC2804
MUDWAVE SITE 6
CORE STATION MAP

Figure 7



MUDWAVE SITE 6
NE
SW
1:6
1:12
1:25
1:50
1:100
V.E.=16.7
6CM
CAM. 4
CAM. 5
5550 -
5600 -
5650 -
Meters
17 GC
16 GC
21 PC
26 BC
25 BC
27 PC
15 BC
22 PC
18 GC
20 PC
23 BC
14 GC
19 P
24 B
0
1
2
3
4
5
Kilometers

Figure 8

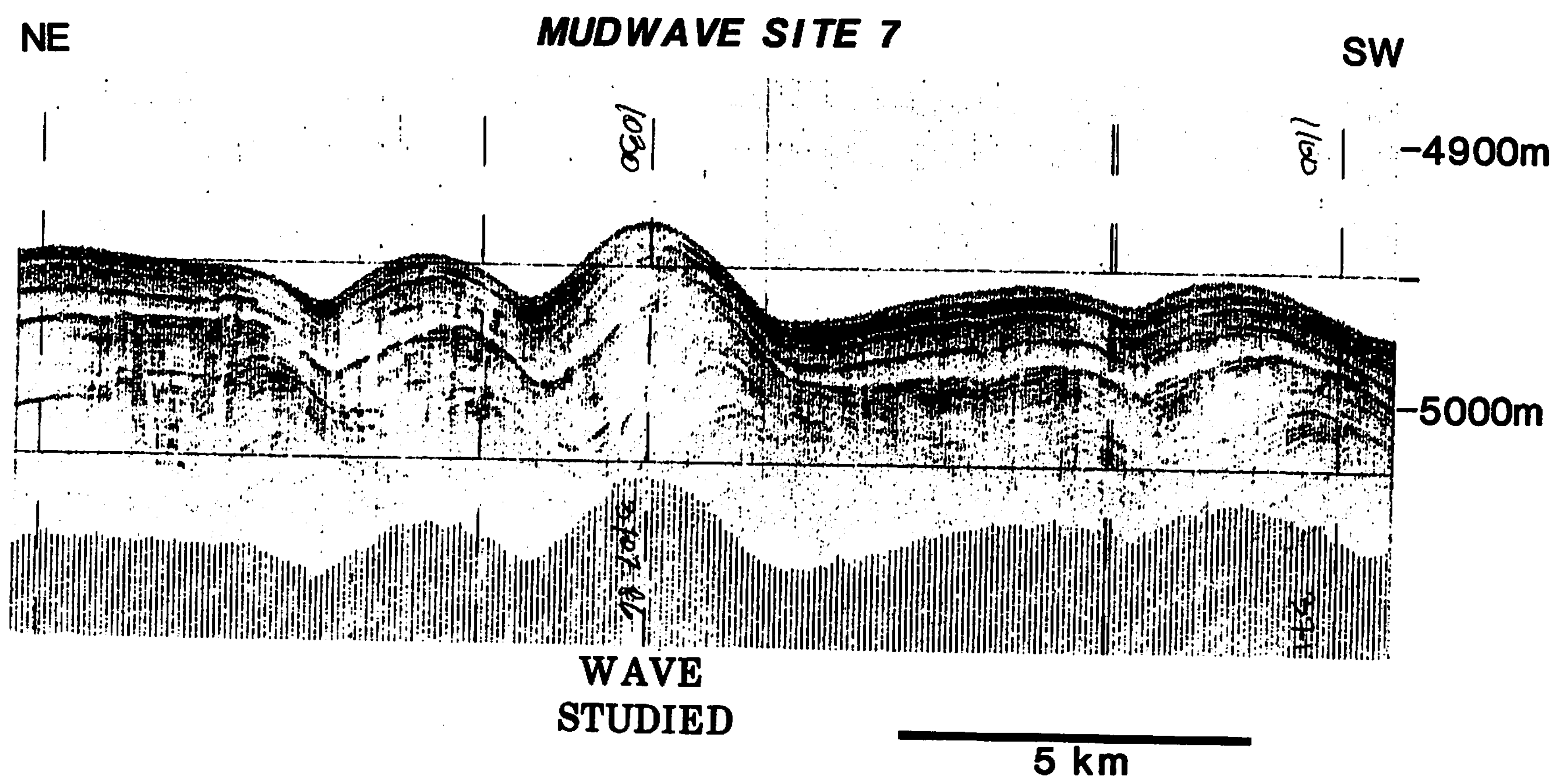


Figure 9