OCEAN DRILLING PROGRAM

LEG 145 SCIENTIFIC PROSPECTUS

NORTH PACIFIC TRANSECT

Dr. Ivan A. Basov
Co-Chief Scientist, Leg 145
Institute of the Lithosphere
Staro Monetny Pereulok 22
Russia

Dr. David K. Rea
Co-Chief Scientist, Leg 145
Department of Geological Sciences
University of Michigan
Ann Arbor, Michigan 48109-1063

Dr. Thomas Janecek
Staff Scientist, Leg 145
Ocean Drilling Program
Texas A&M University Research Park
1000 Discovery Drive
College Station, Texas 77845-9547

Philip D. Rabinowitz
Director
ODP/TAMU

Jack G. Baldauf
Manager of Science Operations
ODP/TAMU

Timothy J.G. Francis
Deputy Director
ODP/TAMU

April 1992

Scientific Prospectus No. 45
First Printing 1992

Copies of this publication may be obtained from the Director, Ocean Drilling Program, Texas A&M University Research Park, 1000 Discovery Drive, College Station, Texas 77845-9547. In some cases, orders for copies may require payment for postage and handling.

DISCLAIMER

This publication was prepared by the Ocean Drilling Program, Texas A&M University, as an account of work performed under the international Ocean Drilling Program, which is managed by Joint Oceanographic Institutions, Inc., under contract with the National Science Foundation. Funding for the program is provided by the following agencies:

Academy of Sciences (Russia)
Canada/Australia Consortium for the Ocean Drilling Program
Deutsche Forschungsgemeinschaft (Federal Republic of Germany)
European Science Foundation Consortium for the Ocean Drilling Program
(Belgium, Denmark, Finland, Greece, Iceland, Italy, The Netherlands, Norway, Spain, Sweden Switzerland, and Turkey)
Institut Français de Recherche pour l'Exploitation de la Mer (France)
National Science Foundation (United States)
Natural Environment Research Council (United Kingdom)
Ocean Research Institute of the University of Tokyo (Japan)

This Scientific Prospectus is based on pre-cruise site-survey information and JOIDES panel discussions. The operational plans within reflect JOIDES Planning Committee and thematic panel priorities. During the course of the cruise, actual site operations may indicate to the Co-Chief Scientists and the Operations Superintendent that it would be scientifically advantageous to amend the plan detailed in this prospectus. It should be understood that any proposed changes to the plan presented here are contingent upon approval of the Director of the Ocean Drilling Program in consultation with the Planning Committee and the Pollution Prevention and Safety Panel.

Abstract

The primary objectives of ODP Leg 145 in the North Pacific Ocean are to determine (1) the high-resolution variations of surface and deep-water circulation and chemistry during the Neogene; (2) the Late Cretaceous and Cenozoic history of atmospheric circulation, ocean chemistry, and continental climate; and (3) the age and nature of the seafloor. To address these objectives, at least six sites will be drilled in horizontal and vertical (depth) transects to record latitudinal changes in ocean fronts and currents, to span changes in deep-water masses, and to place age constraints on plate motion history.

Introduction

Subarctic Pacific sediments contain a critical record of late Mesozoic and Cenozoic oceanographic and climatic changes, but existing sites are too few and generally too disturbed by rotary drilling to permit detailed reconstructions. The region therefore represents a large gap in our knowledge of the evolution of the Earth's climate and oceanic system. This area (Fig. 1) extends over 35 x 10^6 km^2 and includes two major boundary currents (the Oyashio and Alaskan currents), and an oceanic and atmospheric frontal zone (the Subarctic Front), which is believed to have migrated over several degrees of latitude on both short and long time scales. Passes through the Aleutian and Kuril arcs provide exchange sites for deep waters that exert a strong influence upon the properties of North Pacific Intermediate Water. The area is a source of heat and moisture for the North American continent and is one of the most biologically productive areas of the world ocean.

At least six advanced hydraulic piston(APC)/extended core barrel(XCB) cored holes are to be drilled to obtain undisturbed sedimentary sections for studies of Cretaceous and Cenozoic paleoceanography and paleoclimatology of the North Pacific Ocean. The horizontal (latitudinal and longitudinal) and vertical (depth) transects will provide critical information for the reconstruction of latitudinal changes in ocean fronts and surface currents while the vertical transect will address the history of deep-water circulation and ocean chemistry.

Scientific Objectives

Leg 145 has a number of scientific objectives with the overall goal of understanding the paleoceanography and paleoclimatology of the North Pacific.

1) High-resolution Neogene record of the subarctic region.
2) The nature and history of formation of North Pacific Deep Water.
3) The middle Miocene onset of silica deposition - the "silica shift" problem.
4) The Late Cretaceous and Cenozoic record of atmospheric circulation.
5) The Late Cretaceous and Cenozoic record of ocean chemistry.
6) The records of Northern Hemisphere continental climate.
7) Paleoceanography of the late Mesozoic superocean.
8) Tephrochronology of the Kuril and Aleutian arcs.
9) Age and nature of basement in regions where it is poorly understood.

At present, the North Pacific is the terminus of the deep-ocean circulation route originating in the northern North Atlantic and the Southern Ocean, and the beginning of the return surface circulation. These old, deep waters are nutrient-rich, oxygen-poor, and highly corrosive to calcium carbonate. Recent evidence suggests that at various times in the Quaternary there was better calcite preservation in both the deep northeast and northwest Pacific, but it is not clear to what extent these and other changes reflect changes in deep ocean circulation, as opposed to local changes in depositional conditions.

An unusually thick sediment body in the northwest Pacific known as the Meiji Tongue, a drift deposit, holds the key to understanding deep-ocean circulation patterns for two reasons: (1) its apparently recent deposition may have been controlled by production of a young, nutrient-depleted water mass in the late Quaternary; and (2) benthic and planktonic foraminifers are well preserved so that their chemistry can be used for both high-resolution chronology and as a proxy for ocean circulation changes. Thick calcareous-siliceous sediments on Detroit and Patton-Murray seamounts provide similar sites in the northwestern and northeastern Pacific, permitting longitudinal comparisons of Neogene phenomena. High-resolution ice-rafted detritus records from the Patton-Murray and Detroit areas will permit a reconstruction of the timing and extent of glaciation, and comparison of this continental signal to the oxygen isotope record of climate change.

Work in other regions of the world suggests a series of events or rapid changes in ocean circulation and global climate during the late Neogene. These include the latest Miocene, believed to be a time of expansion of Antarctic glaciers, the late Pliocene growth of ice in the Northern Hemisphere, and the more recent increase in amplitudes of Northern Hemisphere glaciation during the middle Pleistocene. The longer term changes appear to have been superimposed upon ongoing high-frequency cycles varying at roughly Milankovitch periods. The effect of these changes upon the North Pacific is largely unknown, given the small number of sites and the absence of calcareous sediments at these sites. Strategic location of drilling sites within the subarctic gyre, situated upon oceanic highs and in the deep basins, will permit generation of latitudinal, longitudinal, and depth transects to complete the global climate picture and circulation throughout the latest Neogene.

Limited recovery from North Pacific and Bering Sea COST wells suggests that regional sedimentation in the Eocene and early Oligocene was calcareous; this was followed by a period of pelagic clay deposition until the middle Miocene, when siliceous sediments began to accumulate throughout the region. The timing and rate of decreased calcareous production is not known; siliceous sediments appeared abruptly between 14 and 15 Ma. While plate migration may account for a part of this trend, it does not explain several elements: the occurrence of *in-situ* calcareous sedimentation in the Bering Sea, and the rapidity and synchroneity of appearance of siliceous sediments throughout the North Pacific. The evidence implies a change in regional circulation and productivity from a mid-Paleogene ocean that was warm, stratified, and with net downward transport (like the North Atlantic today) to a mid-Neogene ocean that was cool and well mixed with net upward transport. Such a change would probably affect nutrient concentrations downstream, leading to lower production in the Atlantic and Indian oceans, and may signal a change in atmospheric circulation and climate. However, the number and location of existing sites are such that considerable doubt remains concerning the extent of the change; most of the sites lie near the continents, and may reflect changes in the boundary currents rather than in the open gyre. Drilling sites within the subarctic gyre will permit an assessment of regional changes in mass flux and global silica budget during the Cenozoic.

Atmospheric circulation and its link to sea-surface circulation and biological productivity is an important component of climatic change. Our understanding of this aspect of climate change during the Cenozoic primarily has come from three North Pacific cores (DSDP Sites 576 and 577 and LL44-GPC-3), generally of low biostratigraphic resolution and all sited along about the same latitude, precluding any understanding of latitudinal variation in the global wind system. Sites located to enhance the latitudinal span of eolian records will permit (1) enhanced definition of any changes in atmospheric circulation associated with the Cretaceous/Tertiary boundary, (2) an evaluation of the latitudinal variability of the known large change in atmospheric circulation associated with the Paleocene/Eocene boundary (important for comparison to computer models of climate change), (3) a test of the suggestion that enhanced Northern Hemisphere atmospheric circulation and concomitant biological productivity were directly responsible for the onset of massive silica sedimentation in the Miocene, and (4) documentation of changes in atmospheric circulation associated with the Pliocene onset of Northern Hemisphere glaciation.

Pelagic clays are reliable recorders of ocean paleochemistry; signals reflecting terrigenous input, sea-floor hydrothermal activity, volcanism, biological activity, authigenesis, bolide impacts, etc., are captured by these clays. Prior work has shown the presence of the Ir anomaly associated with the Cretaceous/Tertiary boundary and the influx of hydrothermal components associated with the earliest Eocene plate-boundary rearrangements. Drilling on the North Pacific transect, especially at sites NW-1A and NW-4A, should recover all these signals along with the geochemical signal associated with the plate-boundary reorganization that occurred during the Late Cretaceous magnetic quiet zone. The rifting episode that resulted in the formation of the Chinook Trough in the central North Pacific is part of this event, and site NW-4A, just south of the trough on somewhat older crust, should provide a clear, proximal geochemical record of intra-plate rifting.

During the middle and latter part of the Cretaceous, the Indo-Pacific was the one broad global ocean; the Atlantic was a narrow salty river. The paleoceanographic history of the Northern Hemisphere portion of this late Mesozoic superocean is very poorly known. Drilling locations planned for Leg 145 underlie the paleo-North Pacific subtropical gyre and should provide a useful record of that old ocean. The validity of our Cretaceous paleoceanographic reconstructions is only as good as our knowledge of the drill site paleo-locations. This is more of a problem in the North Pacific than elsewhere because a major plate-boundary reorganization occurred during the Late Cretaceous magnetic quiet zone, and the exact nature of that history and ensuing Late Cretaceous and Paleogene plate motions remain a matter of interpretation. Seafloor ages at two of the Leg 145 drilling locations may further our understanding of the tectonic history of the North Pacific.

Drilling Approach

Discovery of foraminifer-bearing sediments on Detroit and Patton-Murray seamounts in the last few years allows the techniques of isotope paleoceanography to be applied to the subarctic Pacific Ocean. Drilling in these locations will permit both a depth (2400 to 3800 m) and a longitudinal (148°W to 168°E) transect to be conducted in rapidly deposited sediments, resulting in high-resolution paleoceanographic information. These sediments, dominantly foraminifer-bearing siliceous clays, should provide a record of both carbonate and isotopic chemistry of the North Pacific Deep Water through the Neogene. Silica deposition should reveal detailed records of the activity and productivity of the Oyashio and Alaskan currents, especially the details of the onset of voluminous silica deposition in the North Pacific in the middle Miocene. Continentally derived materials found at these sites, such as ice-rafted debris, hemipelagic mud, and eolian dust, will permit interpretations of the nature of continental climate in the respective source regions. Similarly, these sections should contain a good record of the tephrochronology of the Kuril and Aleutian arcs. The Meiji Tongue, a thick drift deposit prograding southward along the east side of the Emperor Seamounts, should permit recovery of a physical and possibly chemical record of bottom-water movement in this portion of the North Pacific. The Meiji drift is presumed to be Pliocene-Pleistocene in age, but no data are available to address this question.

The Miocene onset of silica deposition in the North Pacific may be the result of the establishment of a more modern deep-water circulation, resulting in the transport of nutrient-rich deep waters to the North Pacific and their subsequent upwelling, or of increased vigor of atmospheric circulation resulting in stronger ocean surface circulation and thus more biological productivity. Drilling at NW-1A and NW-4A should allow the linking of the eolian dust record of atmospheric circulation and the opal record of silica deposition to investigate these questions. NW-1A provides the northernmost site along the north-south transect across the Kuroshio-Oyashio confluence started by DSDP Leg 86 (Sites 578, 579, 580, and 581), and together those sites will permit evaluation of the latitudinal variability of oceanographic processes. Both NW-1A and NW-4A should recover siliceous sediments overlying pelagic clays, which in turn overlie Cretaceous limestones. The pelagic clays at these sites contain a record of eolian processes and ocean paleochemistry; important paleochemical events occur in conjunction with the Cretaceous/Tertiary and Paleocene/Eocene boundaries. Further, the Late Cretaceous rifting event responsible for creation of the Chinook Trough should have left a strong geochemical imprint on the sediments of site NW-4A. These two sites are situated more than 10° north of locations of existing eolian records and will provide some latitudinal definition of the important events seen elsewhere at the Paleocene/Eocene boundary and associated with the general Neogene intensification of circulation.

Lower parts of the section at NW-1A, NW-4A, and DSM-1 consist of Late Cretaceous limestones and will provide information on the nature of the northern subtropical Pacific portion of the large Cretaceous superocean. Basement ages at these sites will help in understanding the details of the Cretaceous tectonic evolution of the North Pacific.

The Drill Sites

NW-1A: This site will serve as a northward extension of the transect begun by Leg 86. It is expected to monitor the extreme northward shifts of the Subarctic Front during the Pliocene-Pleistocene. The record of ice-rafted debris should be very good at NW-1A. The site probably moved north from the highly productive equatorial water mass during Cretaceous Quiet Zone time, and calcareous fossils in the basal sediments should provide good age control and paleoceanographic information. Age and paleomagnetic information obtained from igneous basement (to be drilled if time permits) will provide a data point to constrain northwest Pacific Mesozoic plate reconstructions. Sediments at this site are approximately 360 m thick and are expected to be siliceous clays overlying pelagic clays overlying Cretaceous limestones. The site will be double APC cored until refusal, with XCB coring to basement. If time is available, an XCB/MDCB core will be drilled into basement. Logging operations will consist of the three standard logging runs (geophysical, geochemical, and FMS tool strings).

DSM-1, -2, -2A, -3 and -4: These sites form a depth transect between 2400 m atop Detroit Seamount and 3800 m on Meiji Tongue, which blankets the eastern flank of Detroit Seamount. By comparison with DSDP Site 192 on Meiji Seamount and several piston cores, the proposed sites will have sediment thicknesses upward of 1000 m, rates of sedimentation in excess of 50 m/m.y., and will contain useful amounts of calcareous microfossils. These sections will be the highest latitude carbonate-bearing locations in the open northwest Pacific and will be essential for depth transects and comparison with the Ontong Java Plateau results. Study of the sediments from the Meiji drift may also resolve questions concerning the origin of this sediment body and its relationship to possible major changes in deep-water distribution and flow paths. For the first time, stable-isotopic stratigraphy will be linked with the high-latitude siliceous-microfossil biostratigraphy, magnetic-reversal stratigraphy, and the northwest Pacific record of ice rafting. DSM-1, the shallow site atop Detroit Seamount, will be double APC-cored until refusal and then single XCB/RCB cored to basement, recovering a thick Neogene and thin Paleogene and uppermost Cretaceous sections. Intermediate site DSM-3 will be double APC cored to refusal, followed by a single XCB hole to ≈300 mbsf. The other intermediate sites, DSM-2/2A, are alternate sites and will be drilled in a similar manner to DSM-3, should time become available. The deep site on Meiji Drift, DSM-4, will be double APC-cored to refusal and then single XCB/RCB cored to approximately 800 meters below the seafloor (mbsf).

The three standard logging strings will be run at DSM-1 and DSM-4. Two additional logging strings, one containing a susceptibility tool and one with a magnetic tool, will be run at DSM-1. No logging operations are presently scheduled for DSM-3 due to time constraints.

NW-4A: Recovery of biosiliceous and eolian-derived material at NW-4A will permit determination of the middle Miocene timing of increased biosiliceous production, major changes in atmospheric circulation patterns, and general changes in surface water masses. Information gathered at NW-4A can be combined with that from similar sections at NW-1A to provide a longitudinal transect of atmospheric and oceanic circulation. The site probably moved north from the highly productive equatorial water mass during Cretaceous Quiet Zone time, and calcareous fossils in the basal sediments should provide good age control and paleoceanographic information. Age information obtained from sediments directly overlying basement will provide a data point to constrain north-central Pacific Mesozoic plate reconstructions. Sediment geochemistry of the hydrothermally derived components should record the formation of the Chinook Trough. Sediments at this site are expected to be siliceous clays overlying pelagic clays overlying Cretaceous limestones. We intend to double APC core to refusal and continue with a single XCB hole through the ≈150-m-thick section to basement. No logging operations are presently scheduled at NW-4A due to time constraints.

PM-1A: This site is located in the northeastern Pacific on the broad platform level of the Patton-Murray Seamount group; it is elevated well above the abyssal plain, thus precluding turbidite sedimentation and ensuring recovery of representative pelagic, carbonate-bearing sediments. Examination of 10 piston and gravity cores taken at this locality during 1987 revealed moderate carbonate contents (up to 55%), both benthic and planktonic foraminifers adequate for stable isotopic analysis, biosiliceous zones, abundant ice-rafted debris, and some ash layers. Significant changes in productivity and terrigenous input have occurred in the area, as shown by the repetitive succession of very distinct lithologies. The proposed drilling site consists of ≈300 m of apparently uninterrupted hemipelagic sediments. Sites PM-1B and PM-1C are alternate sites with similar sediment thicknesses. The available ages for the plateau are 25.7 Ma for Murray Seamount and 26.3 Ma for Patton Seamount. Thus the average sedimentation rate might be approximately 1 to 1.5 cm/k.y. Rates were presumably lower in the pre-Pliocene section due both to the northward migration of the site closer to the Alaskan margin and to the effects of continental glaciation. Late Quaternary rates average 6 cm/k.y., with deglaciation rates of 15-20 cm/k.y. At this site we intend to double APC core to refusal, single XCB core as far as possible, and then engage in rotary drilling ≈50 m into basement. The three standard logging strings will be run at this site.

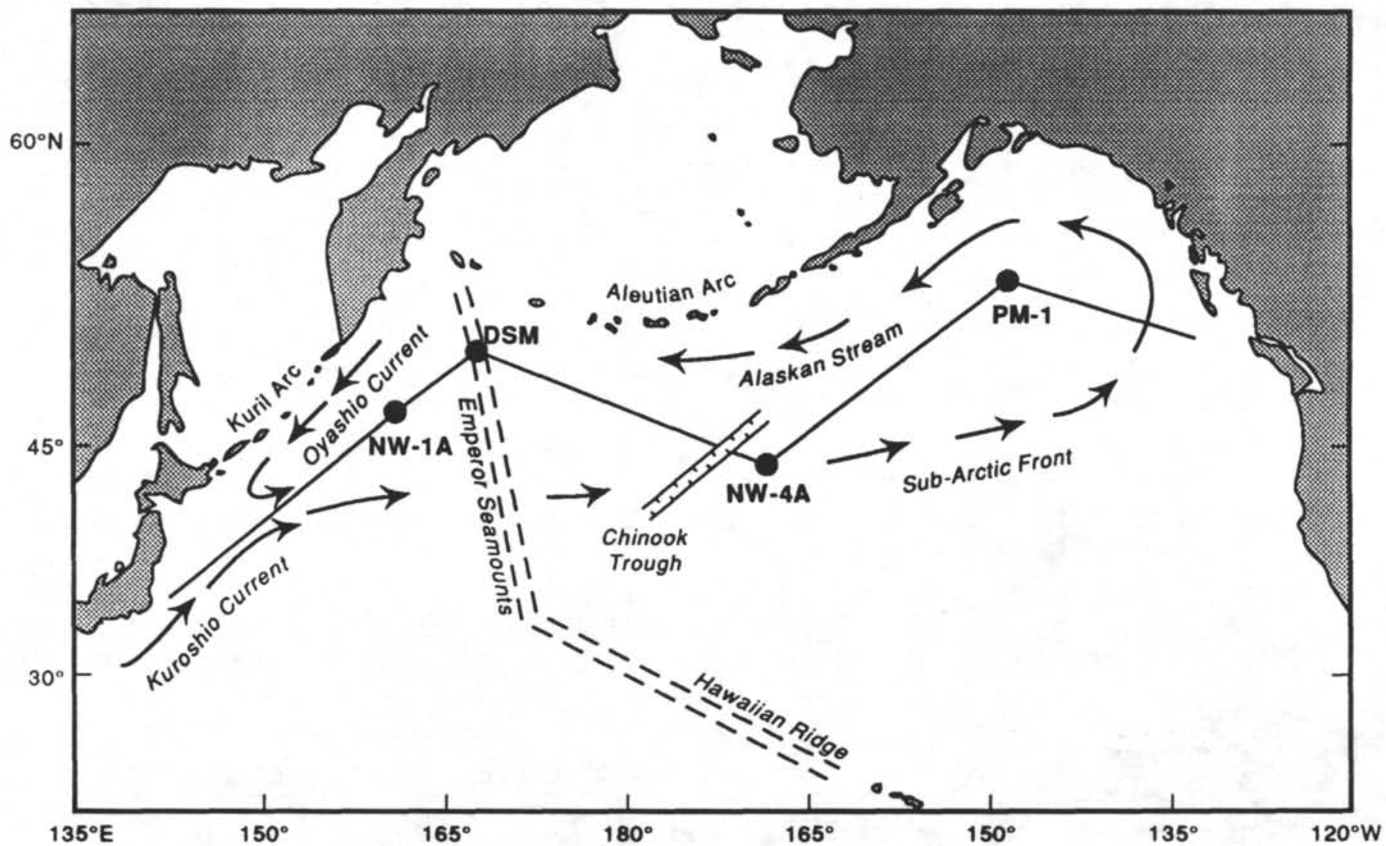


Figure 1. Proposed ship track (straight lines) and site locations (solid circles) for Leg 145. These sites include the northwest Pacific transect sites (NW-1A and NW-4A), the Detroit Seamount sites (DSM-1, -3, and -4), and the Patton-Murray Seamount site (PM-1).

Leg 145 Time Estimates

Primary Sites:

Site	Location Latitude	Location Longitude	Water depth (m)	Penetration (m)	Drill (days)	Log (days)	Total (days)	Transit (nmi)	Transit (days)
Yokohama	35°30'N	139°45'E							
								1221	4.8
NW-1A	47°06'N	161°30'E	5330	360	5.7	1.2	6.9		
								282	1.1
DSM-3	50°21'N	167°37'E	3307	300	3.5	0.0	3.5		
								51	0.2
DSM-1	51°12'N	167°45'E	2415	850	8.2	1.7	9.9		
								30	0.1
DSM-4	51°33'N	168°20'E	3830	800	9.7	1.4	11.1		
								1019	4.0
NW-4A	44°43'N	168°17'W	5700	150	2.9	0.0	2.9		
								956	3.8
PM-1A	54°22'N	148°27'W	3660	350	5.8	1.1	6.9		
								992	3.9
Victoria	48°30'N	123°30'W							
		Subtotals =		2750	35.8	5.4	41.2	4551	17.9
		Grand total =				**59.1 days at sea**			

Alternate Sites:

Site	Location Latitude	Location Longitude	Water depth (m)	Penetration (m)	Drill (days)	Log (days)	Total (days)
DSM-2	51°06'N	167°52'E	2775	300	3.2	0	3.2
DSM-2A	50°12'N	167°46'E	2812	300	3.2	0	3.2
PM-1B	54°25'N	149°13'W	3550	350	5.6	1.1	6.7
PM-1C	54°22'N	148°54'W	3727	400	5.9	1.1	7.0

Note: transit times are calculated for a speed of 10.5 kt.

Leg 145 Logging Estimates

Primary Logging Operations*:

Site	Water depth (m)	Sed. depth (mbsf)	Bsmt. depth (mbsf)	Hole Prep (hr)	SES (hr)	GEO-PHYS (hr)	GEO-CHEM (hr)	FMS (hr)	BHTV (hr)	MAG (hr)	SUSC (hr)	Rig down (hr)	Stand log (hr)	Stand log (days)	Total log (hr)	Total log (days)
NW-1A	5330	360		**4.4**	**4.0**	**6.8**	**7.6**	**5.3**		5.3	5.3	**1.5**	**29.7**	**1.2**	40.3	1.7
DSM-1	2415	800	50	**5.2**	**4.0**	**7.0**	**8.7**	**4.7**		**4.7**	**4.7**	**1.5**	31.1	1.3	**40.5**	**1.7**
DSM-4	3833	800		**5.1**	**4.0**	**7.7**	**9.3**	**5.5**		5.5	5.5	**1.5**	**33.2**	**1.4**	44.3	1.8
PM-1A	3660	300	50	**4.4**	**4.0**	**5.7**	**6.5**	**4.2**	4.3	4.2	4.2	**1.5**	**26.3**	**1.1**	39.0	1.6

Bold entries indicates logging operations scheduled: other tool strings may be run at primary and/or alternate sites on a time available basis.

Possible Secondary Logging Operations*:

Site	Water depth (m)	Sed. depth (mbsf)	Bsmt. depth (mbsf)	Hole Prep (hr)	SES (hr)	GEO-PHYS (hr)	GEO-CHEM (hr)	FMS (hr)	BHTV (hr)	MAG (hr)	SUSC (hr)	Rig down (hr)	Stand log (hr)	Stand log (days)	Total log (hr)	Total log (days)
DSM-2	2775	300		4.3	4.0	4.9	5.6	3.5		3.5	3.5	1.5	23.8	1.0	30.8	1.3
DSM-2A	2812	300		4.3	4.0	4.9	5.6	3.5		3.5	3.5	1.5	23.9	1.0	31.0	1.3
DSM-3	3307	300		4.3	4.0	5.2	6.0	3.9		3.9	3.9	1.5	24.9	1.0	32.6	1.4
PM-1B	3480	300	50	4.4	4.0	5.6	6.4	4.1	4.1	4.1	4.1	1.5	26.0	1.1	38.3	1.6
PM-1C	3727	350	50	4.5	4.0	5.9	6.9	4.4	4.4	4.4	4.4	1.5	27.2	1.1	40.4	1.7
NW-4A	5685	150		4.1	4.0	6.2	6.7	5.0		5.0	5.0	1.5	27.5	1.1	37.6	1.6

*Standard Logging Operation times include: Hole Prep, SES, Rig Down and three logging runs (Geophysical, Geochemical, and FMS).
*Total Logging Operation times include Standard Operations plus Specialty tools (e.g., BHTV, Magnetic tool, and/or Susceptibility tool).

SITE: NW-1A PRIORITY: 1

POSITION: 47°06'N, 161°30'E

WATER DEPTH: 5330 m

SEISMIC RECORD: Lamont-Doherty *Vema*-21 8/27/65 0400 UTC

SEDIMENT THICKNESS: ≈360 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB hole to basement. One MDCB into basement if time allows.

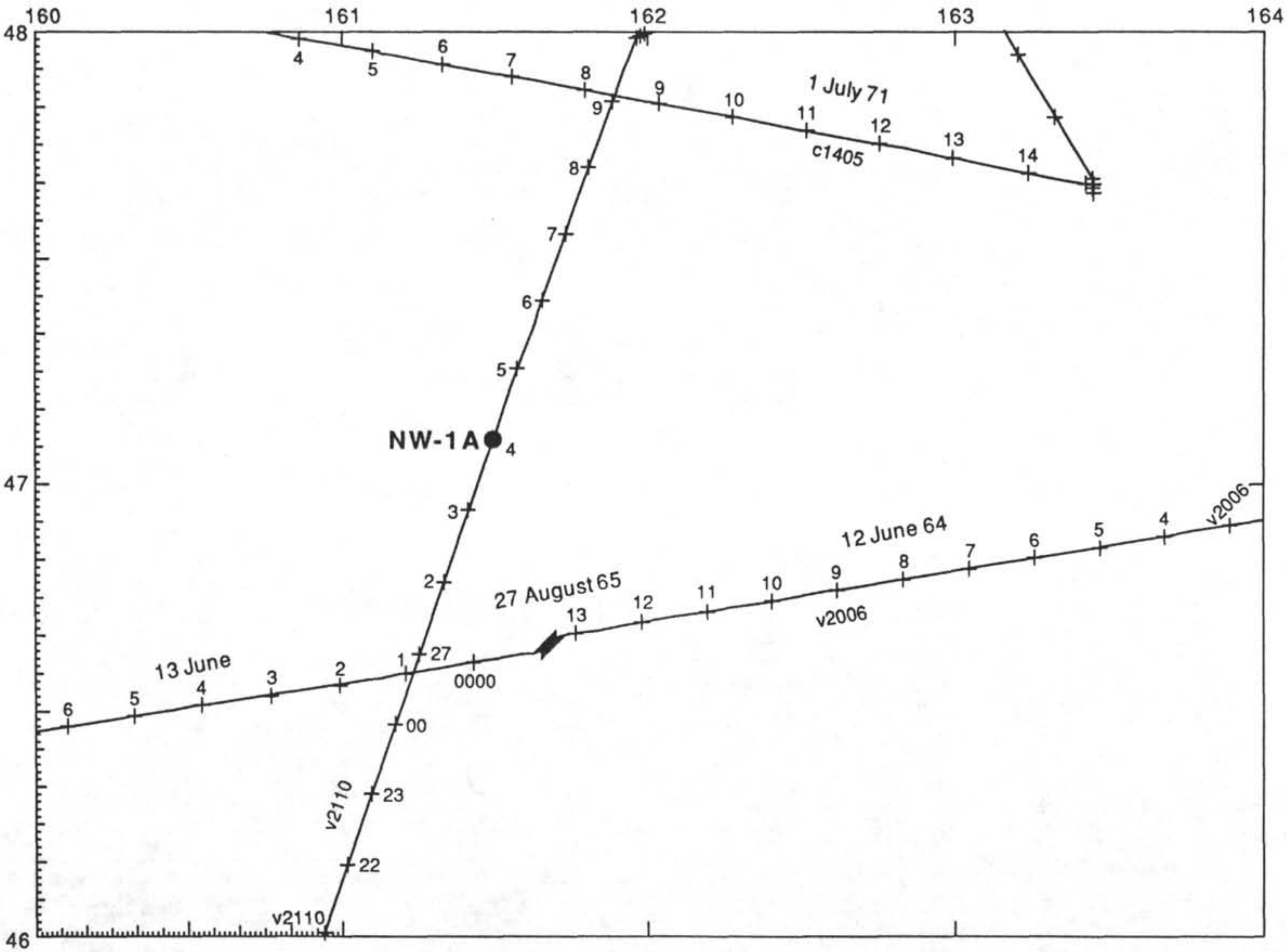
LOGGING: Geophysical and geochemical combination tool strings, and the formation microscanner.

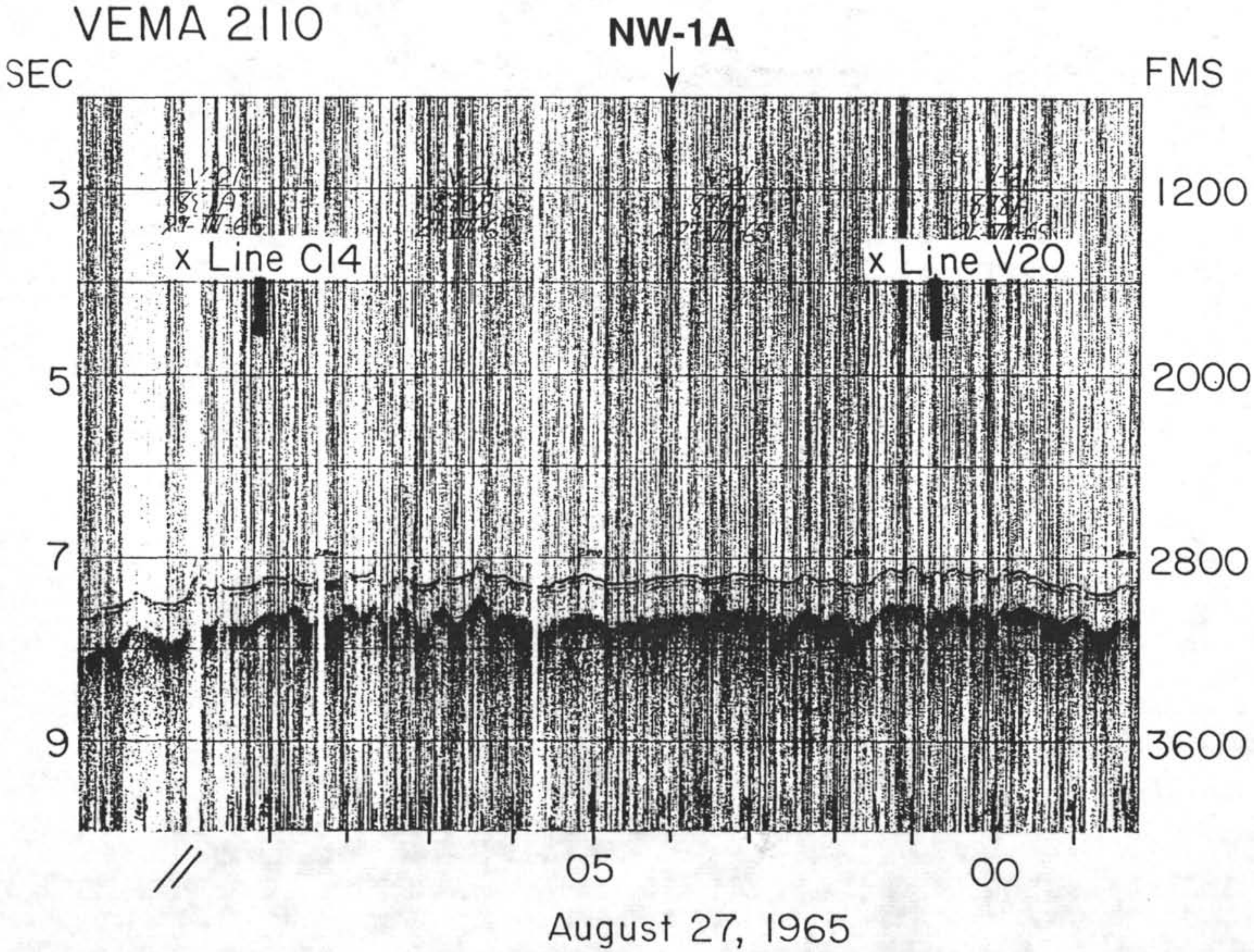
OBJECTIVES: The site will serve as a northward extension of the transect begun by Leg 86. Specific Objectives include determining (1) the high-resolution variations of siliceous productivity, polar-front migration, dust input, atmospheric circulation, and ice-rafting during the Neogene; (2) Paleogene and Late Cretaceous paleoceanographic and paleoclimatic variability; and (3) age and paleolatitude constraints for the Mesozoic plate reconstructions.

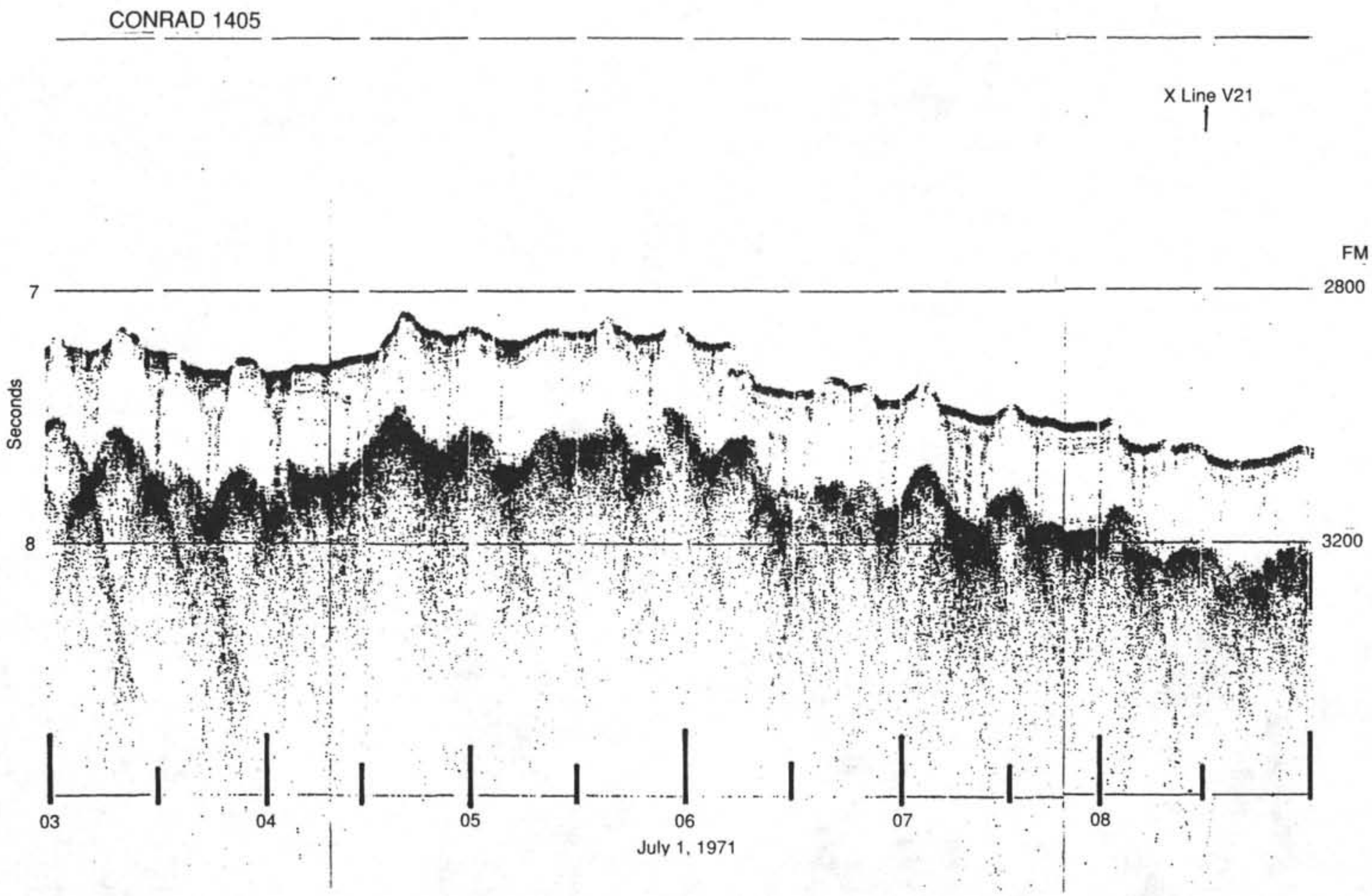
NATURE OF SEDIMENT: Siliceous silty clays, pelagic clay, limestone

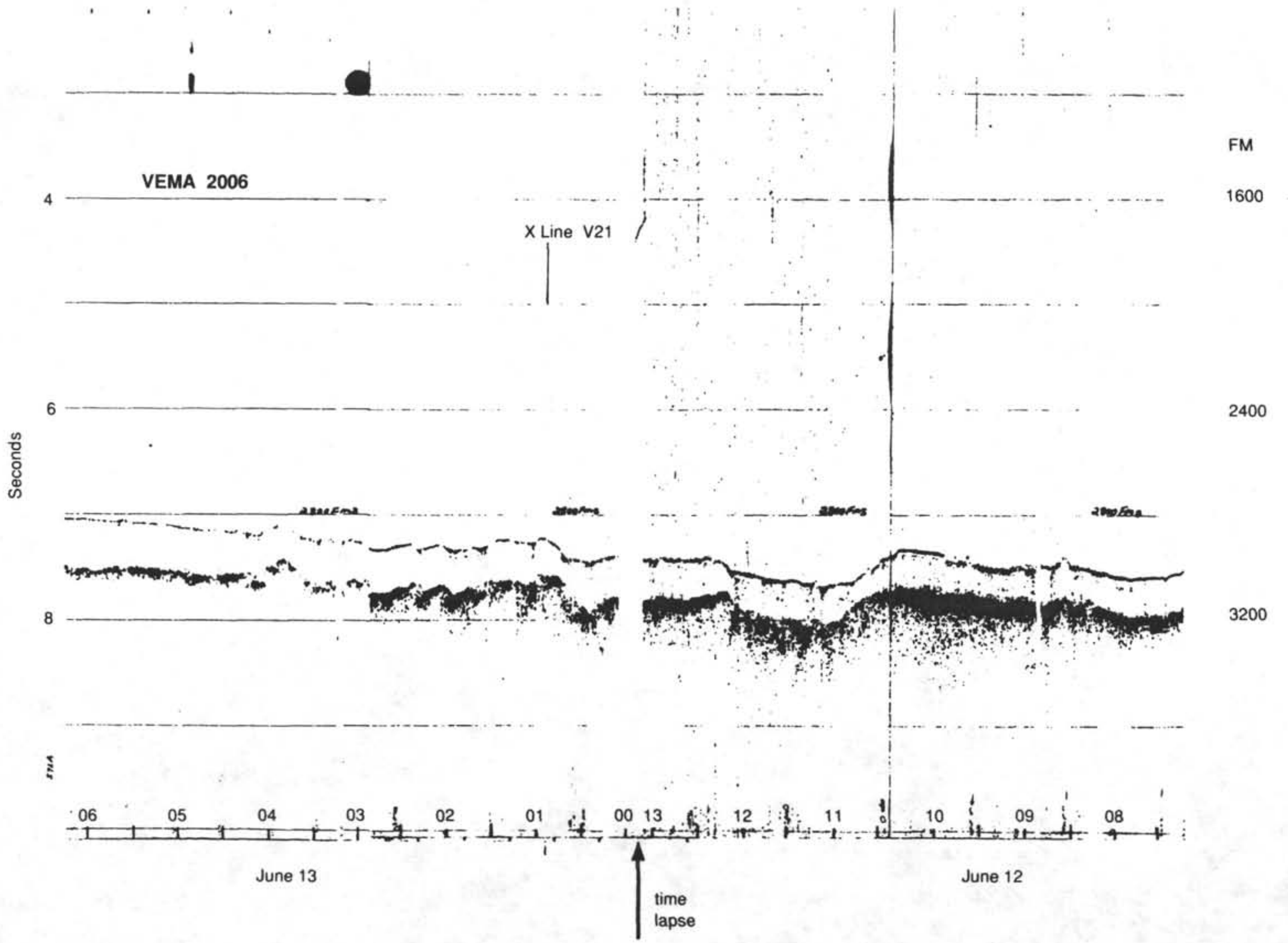
GRAPHIC SUMMARY, SITE NW-1A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
360	mid Cretaceous - Pleistocene	1.6	Pelagic clay with some silica in upper part	mid gyre, low productivity	3.6 m/Ma	Siliceous clays over pelagic clays
? (thin)	mid Cretaceous		limestone	Equator	10 m/Ma	acoustic basement is probably limestone. Site 581 hit basalt at 343 mbsf. ~ 70 meters of chert in limestone
			basalt			


160
161
162
163
164
48
47
46
1 July 71
c1405
NW-1A
12 June 64
v2006
27 August 65
13 June
0000
v2110


VEMA 2110
NW-1A
SEC
FMS
3
5
7
9
1200
2000
2800
3600
x Line C14
x Line V20
05
00
August 27, 1965


CONRAD 1405
X Line V21
FM
7
2800
Seconds
8
3200
03
04
05
06
07
08
July 1, 1971


VEMA 2006
X Line V21
Seconds
4
6
8
FM
1600
2400
3200
06
05
04
03
02
01
00
13
12
11
10
09
08
June 13
June 12
time
lapse

SITE: NW-4A PRIORITY: 1

POSITION: 44°43'N, 168°17'W

WATER DEPTH: 5700 m

SEISMIC RECORD: R/V *S.P. Lee* USGS 1978 Julian Day 273, 2350 UTC

SEDIMENT THICKNESS: ≈150 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB hole to basement.

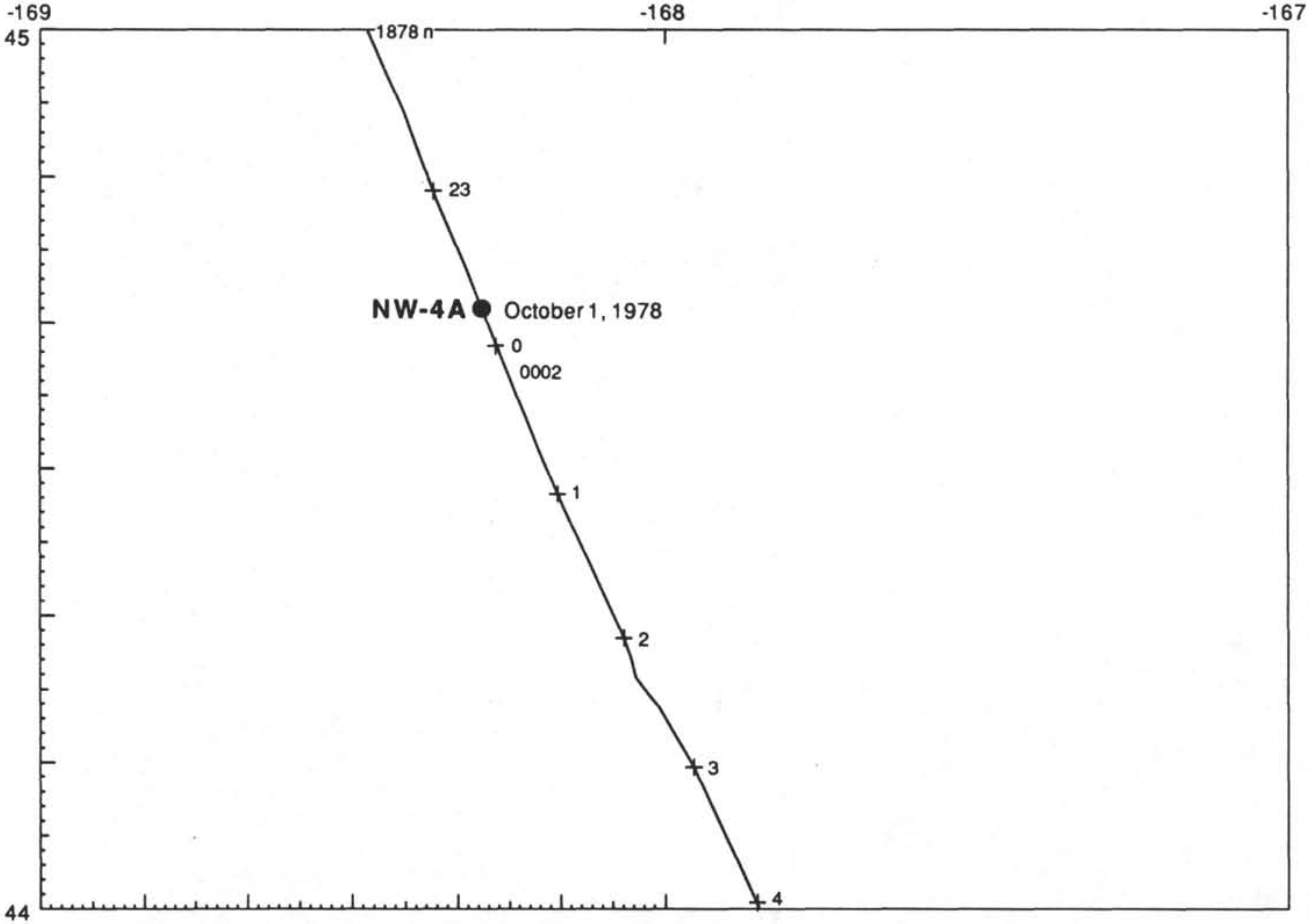
LOGGING: None

OBJECTIVES: The site will serve as an eastern complement to NW-1A to provide a longitudinal transect for determining atmospheric and oceanic circulation. Specific objectives include determining (1) variations of siliceous productivity, polar-front movement, dust input, and atmospheric circulation during the Neogene; (2) Paleogene and Late Cretaceous paleoceanographic variability; (3) age and paleolatitude constraints for north-central Pacific Mesozoic plate reconstructions; and (4) the sediment geochemistry of the hydrothermally derived components that record the formation of the Chinook Trough.

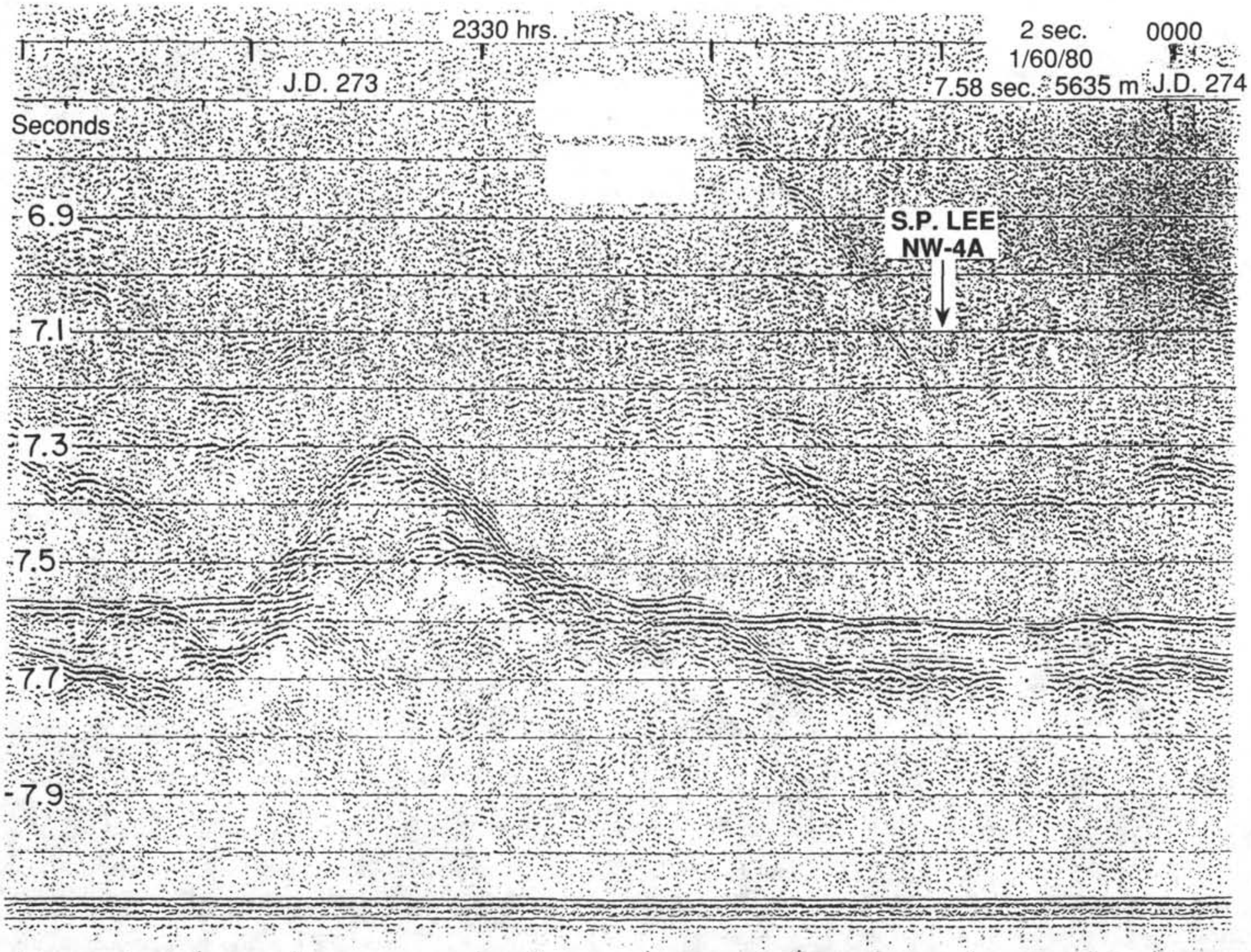
NATURE OF SEDIMENT: Siliceous silty clays, pelagic clay, limestone.

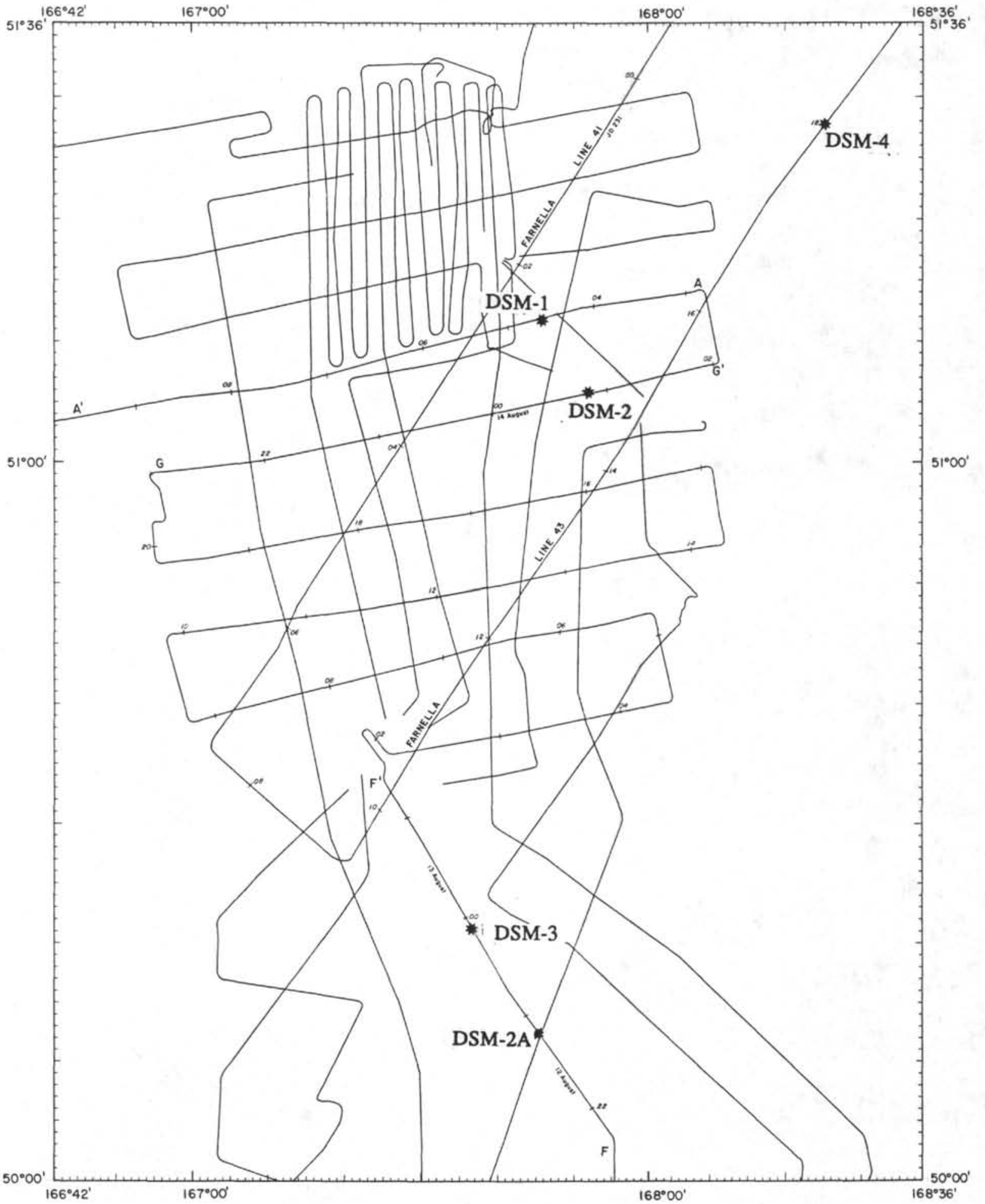
GRAPHIC SUMMARY, SITE NW4A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
75	0 to ? mid Cretaceous	1.6	Pelagic clay	mid gyre	very low 1 m/Ma	
75-150	middle Cretaceous	?	limestone ± chert	north of Equator	10 m/Ma	no nearby sites



S.P. Lee
NPN


2330 hrs.
2 sec.
1/60/80
0000
J.D. 273
7.58 sec.
5635 m
J.D. 274
Seconds
6.9
7.1
7.3
7.5
7.7
7.9
S.P. LEE
NW-4A


166°42'
167°00'
168°00'
168°36'
51°36'
51°00'
50°00'
DSM-1
DSM-2
DSM-3
DSM-2A
DSM-4
LINE 41
LINE 43
FARNELLA
A
A'
G
G'
F
F'
14 August
13 August
12 August

SITE: DSM-1 PRIORITY: 1

POSITION: 51°11.8'N,167°44.7'E

WATER DEPTH: 2415 m

SEISMIC RECORD: R/V *Thomas Washington*, RNDB Leg 6, Aug. 14, 1988, 0436 UTC

SEDIMENT THICKNESS: ≈800 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB/RCB hole to basement.

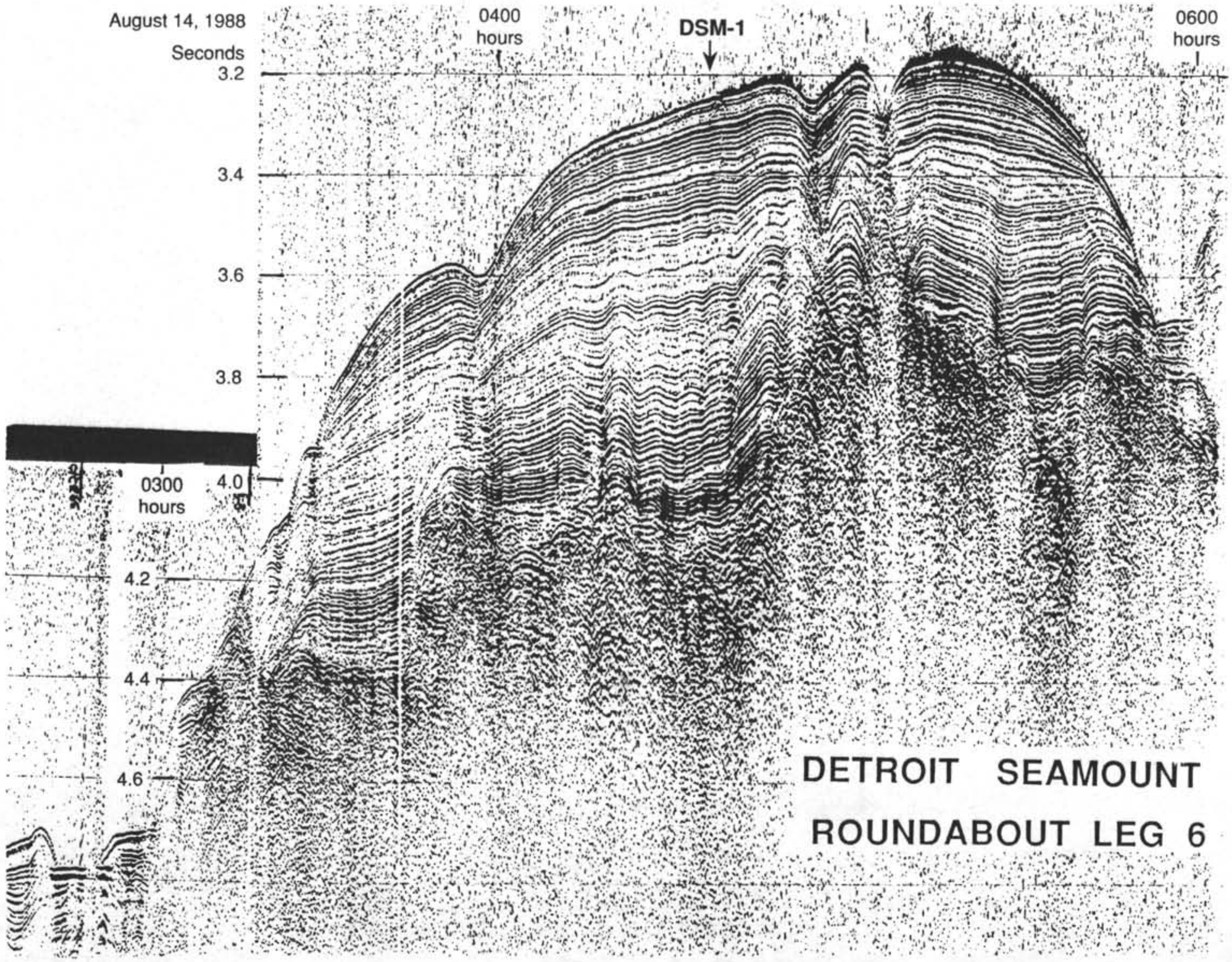
LOGGING: Geophysical and geochemical combination tool strings, formation microscanner, magnetometer tool string, and susceptibility tool string.

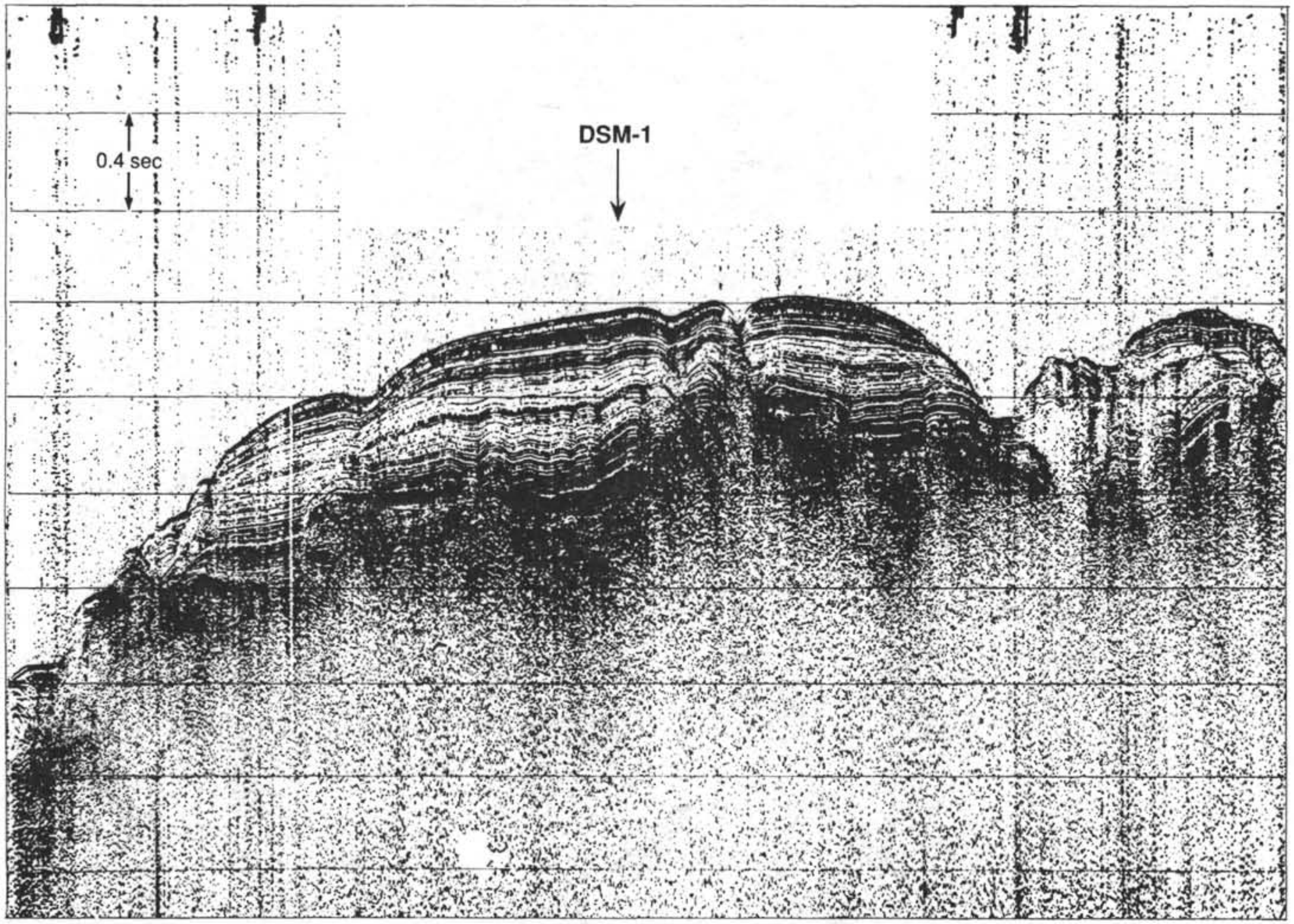
OBJECTIVES: The objectives for drilling on the Detroit Seamount and Meiji Tongue include (1) determining the high-resolution Neogene surface, intermediate, and deep-water circulation history; (2) obtaining a high-resolution biostratigraphic record; and (3) history of sediment transport and ice-rafted debris input in the northwest Pacific.

NATURE OF SEDIMENT: carbonate and silica-bearing muds and clays; ice-rafted debris, ash layers.

GRAPHIC SUMMARY, SITE DSM-1

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
600	Neogene	1.6	Siliceous clays with ash and IRD	Sub-Arctic high productivity zone	~30 m/Ma	
800	latest Cretaceous to early Miocene	2.0 +	chalk	mid gyre low productivity zone	10 m/Ma	
800 +	65-70 Ma		basalt			


August 14, 1988
Seconds
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
0300
hours
0400
hours
DSM-1
0600
hours
DETROIT SEAMOUNT
ROUNDABOUT LEG 6


DSM-1
0.4 sec

SITE: DSM-2 PRIORITY: 2

POSITION: 51°05.6'N,167°51.6'E

WATER DEPTH: 2775 m

SEISMIC RECORD: R/V *Thomas Washington*, RNDB Leg 6, Aug. 14, 1988, 0051 UTC

SEDIMENT THICKNESS: ≈400 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB-coring to 300 m.

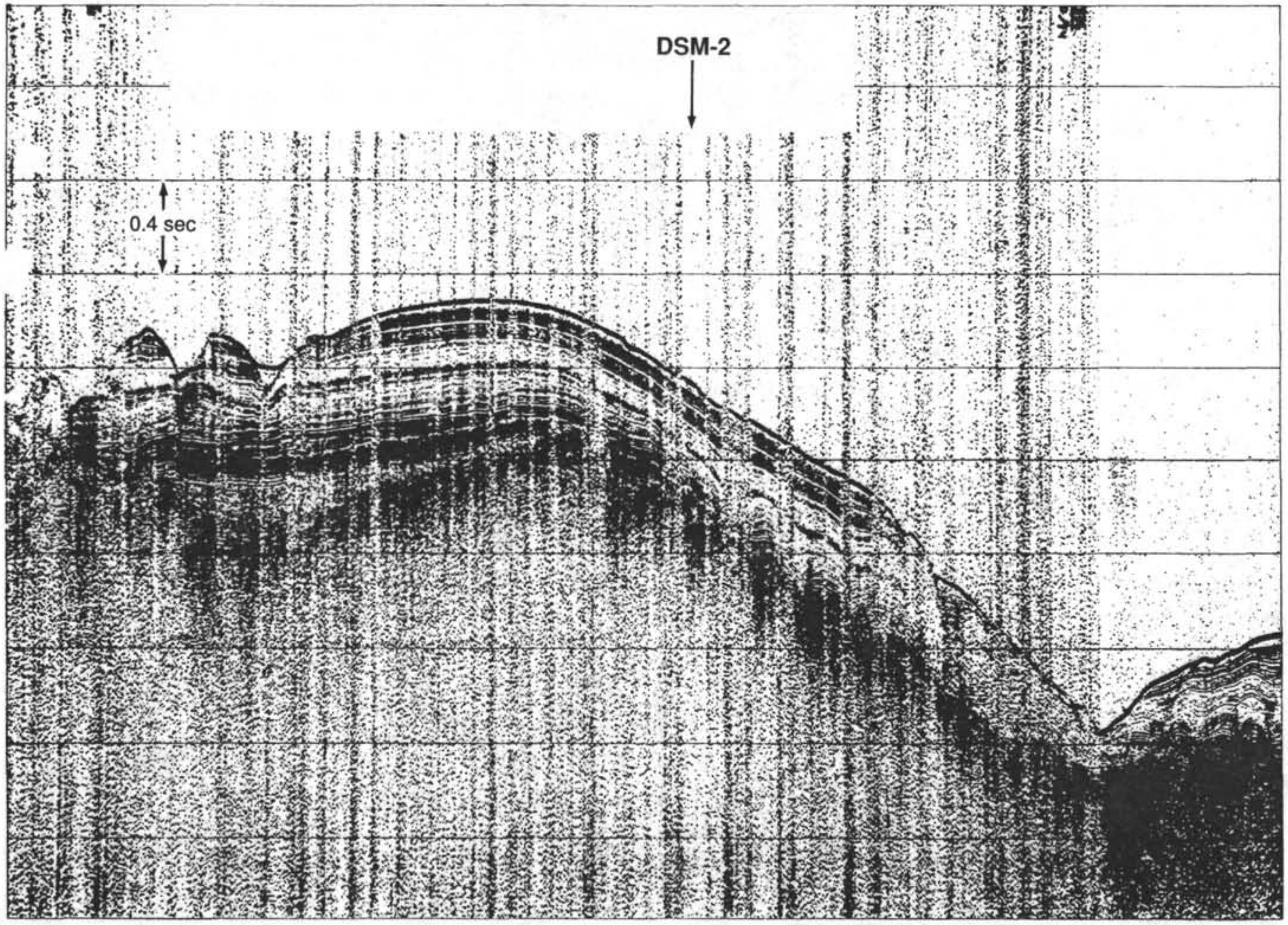
LOGGING: None planned

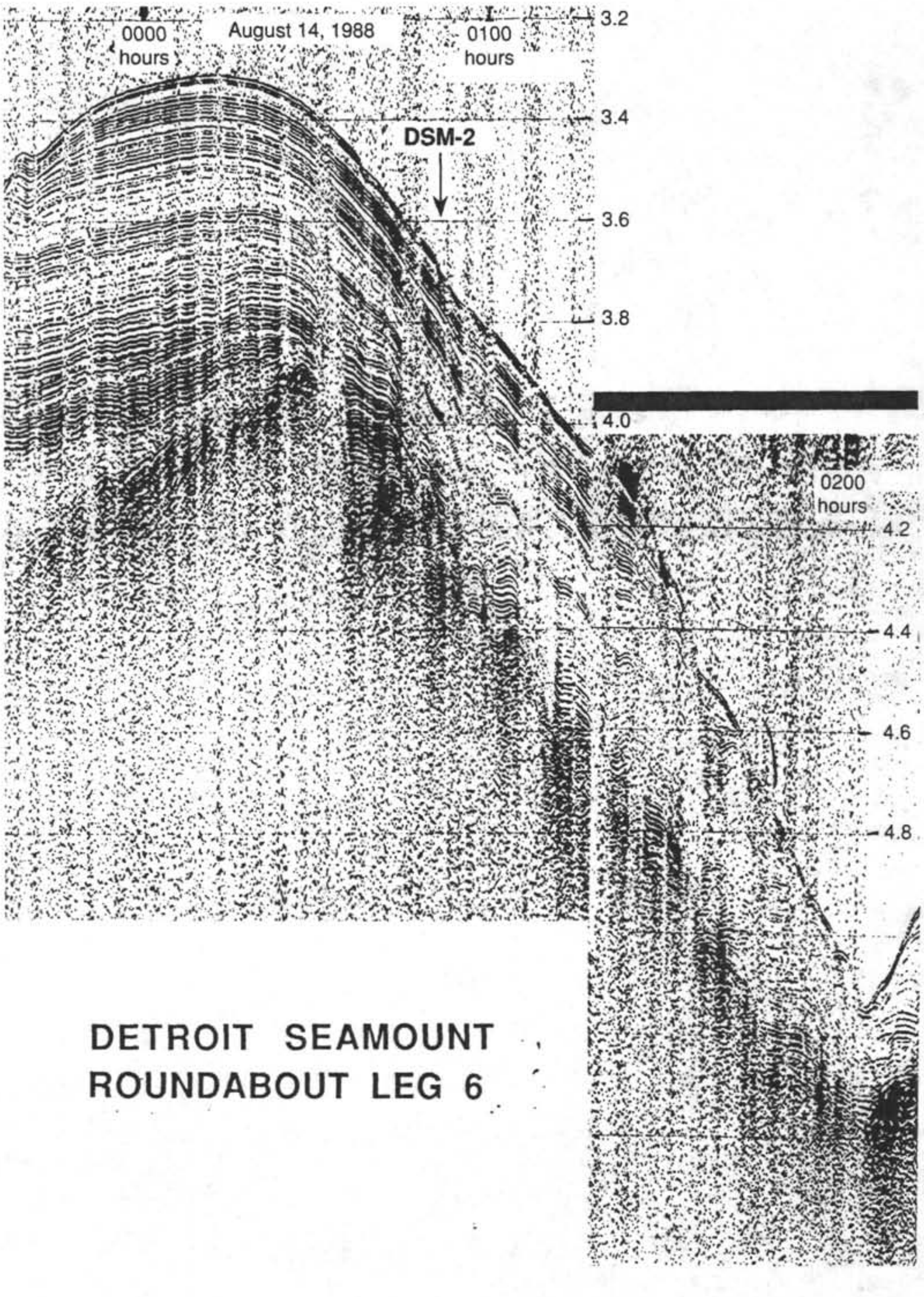
OBJECTIVES: The objectives for drilling a depth transect on the Detroit Seamount and Meiji Tongue include (1) determining the high-resolution Neogene surface, intermediate, and deep-water circulation history; (2) obtaining a high-resolution biostratigraphic record; and (3) history of sediment transport and ice-rafted debris input in the northwest Pacific.

NATURE OF SEDIMENT: carbonate and silica-bearing muds and clays; ice-rafted debris, ash layers.

GRAPHIC SUMMARY, SITE DSM-2

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
400	Neogene	1.6	Siliceous clays	Sub-arctic polar front	30 m/Ma	intermediate - depth site
500?	Paleogene	2.0 +	chalk	mid gyre	10 m/Ma	


DSM-2
0.4 sec



DETROIT SEAMOUNT
ROUNDABOUT LEG 6

SITE: DSM-2A PRIORITY: 2

POSITION: 50°12.4'N, 167°45.6'E

WATER DEPTH: 2812 m

SEISMIC RECORD: R/V *Thomas Washington*, RNDB Leg 6, Aug. 12, 1988, 2248 UTC.

SEDIMENT THICKNESS: ≈480 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB-coring to 300 m.

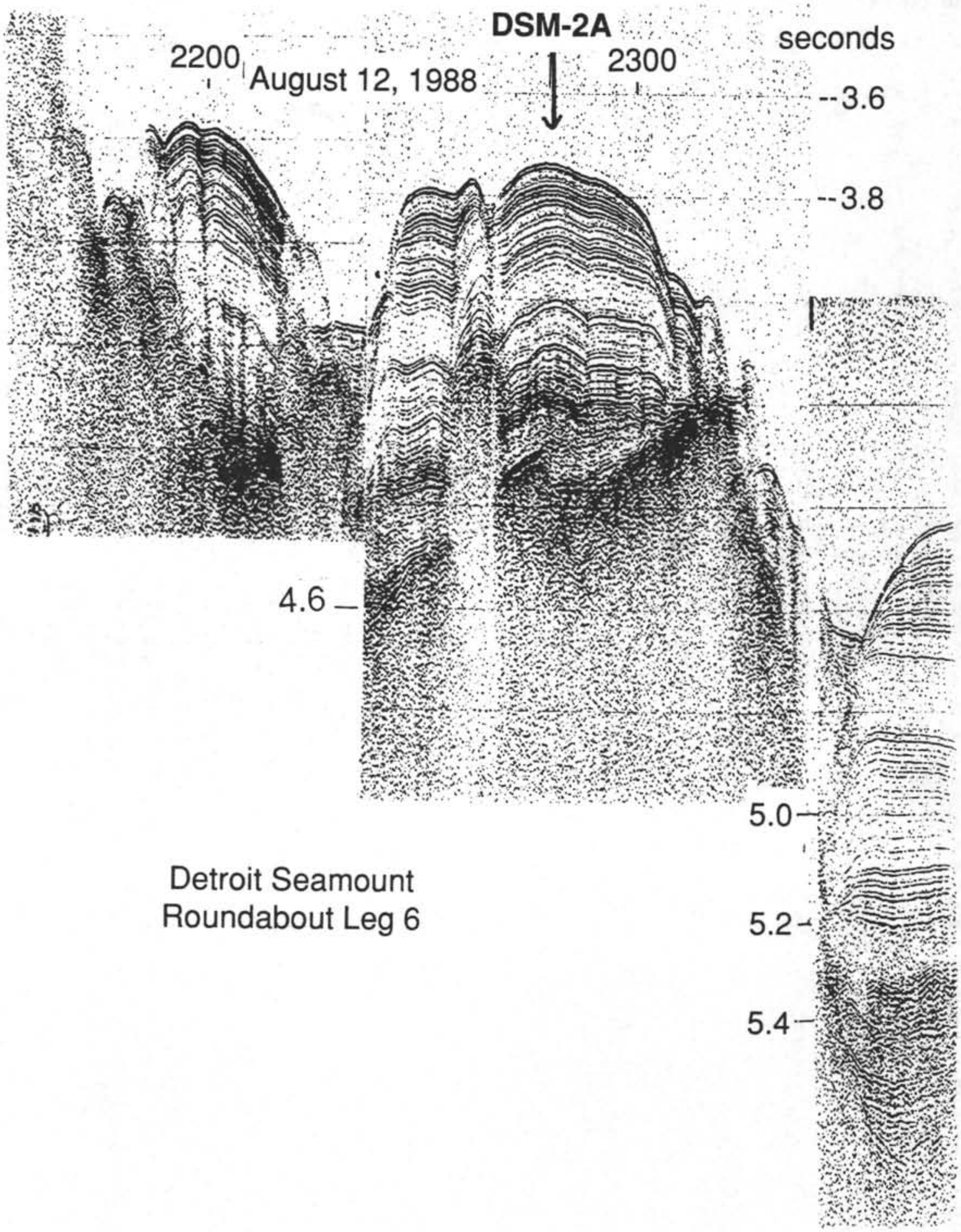
LOGGING: None planned.

OBJECTIVES: The objectives for drilling a depth transect on the Detroit Seamount and Meiji Tongue include (1) determining the high-resolution Neogene surface, intermediate, and deep-water circulation history; (2) obtaining a high-resolution biostratigraphic record; and (3) history of sediment transport and ice-rafted debris input in the northwest Pacific.

NATURE OF SEDIMENT: carbonate and silica-bearing muds and clays; ice-rafted debris, ash layers.

GRAPHIC SUMMARY, SITE DSM-2A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
400	Neogene	1.6	siliceous clays	Sub-Arctic polar front	30 m/Ma	Intermediate depth site
500	Paleogene and uppermost Cretaceous	2.0 +	chalk	mid gyre	10 m/Ma	



Detroit Seamount
Roundabout Leg 6

SITE: DSM-3 PRIORITY: 1

POSITION: 50°21.0'N,167°36.9'E

WATER DEPTH: 3307 m

SEISMIC RECORD: R/V *Thomas Washington*, RNDB Leg 6, Aug. 13, 1988, 2354 UTC

SEDIMENT THICKNESS: >1000 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB-hole to 300 m.

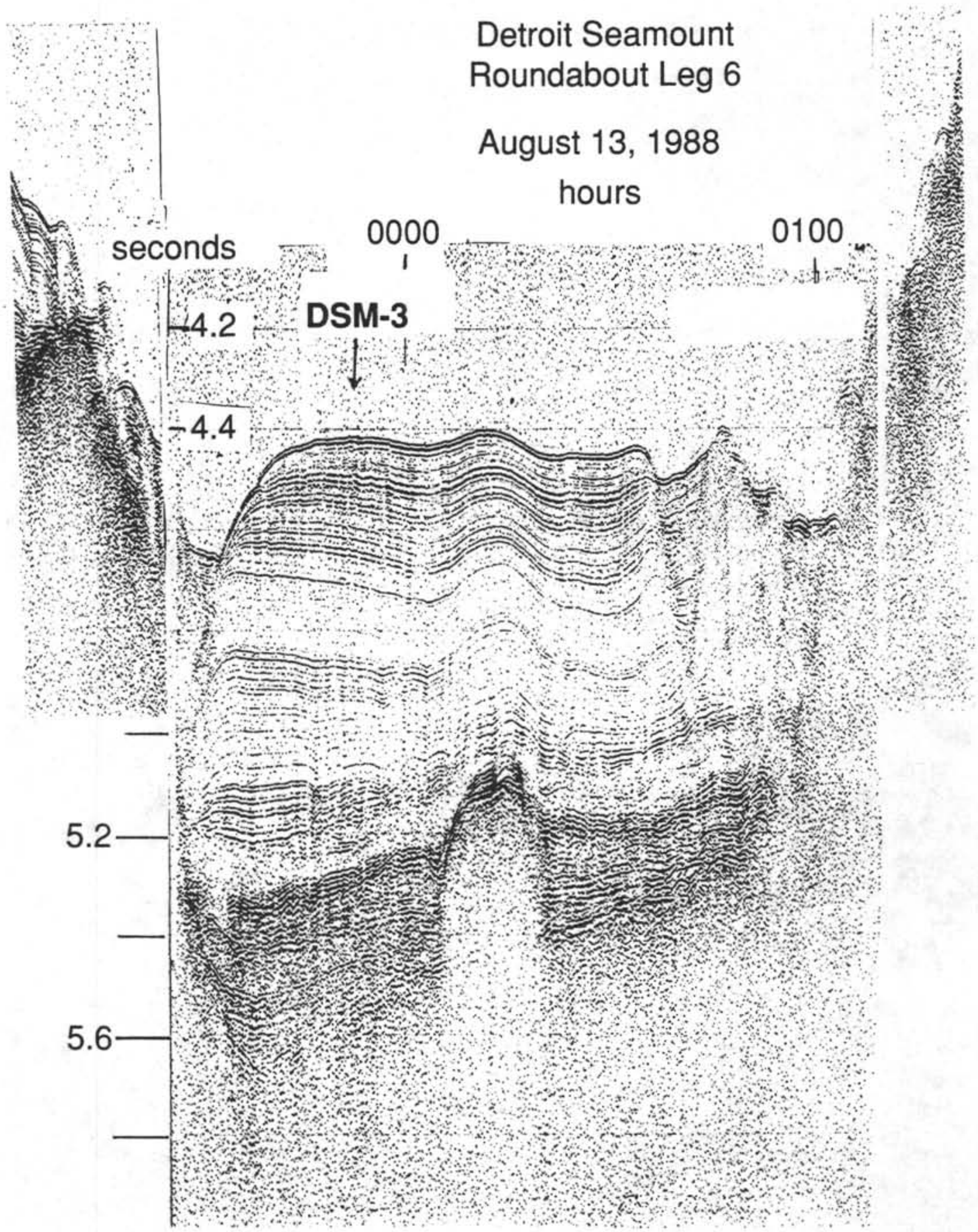
LOGGING: None planned

OBJECTIVES: The objectives for drilling a depth transect on the Detroit Seamount and Meiji Tongue include (1) determining the high-resolution Neogene surface, intermediate, and deep-water circulation history; (2) obtaining a high-resolution biostratigraphic record; and (3) history of sediment transport and ice-rafted debris input in the northwest Pacific.

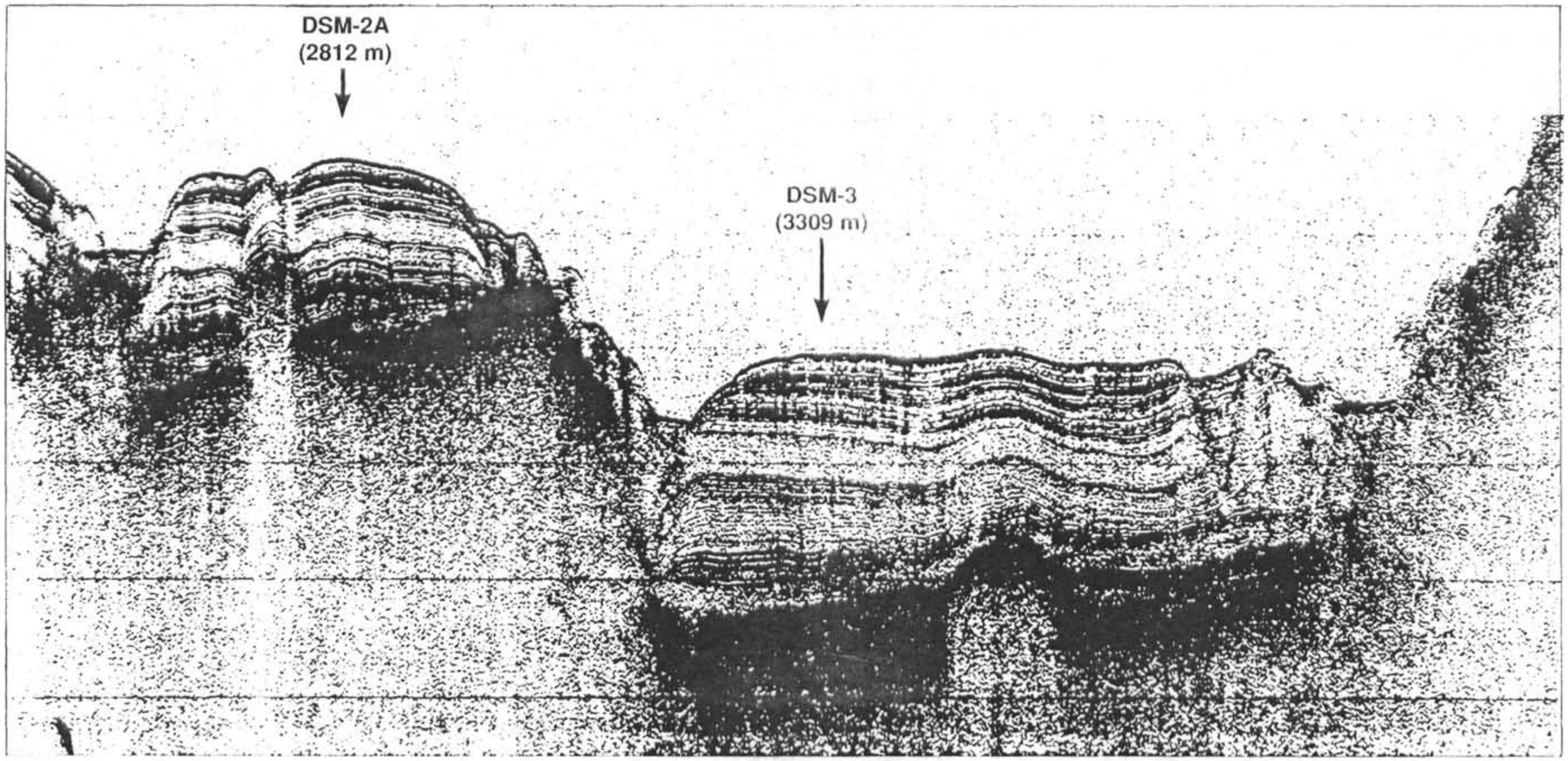
NATURE OF SEDIMENT: carbonate and silica-bearing muds and clays; ice-rafted debris.

GRAPHIC SUMMARY, SITE DSM-3

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
700	Neogene	1.6	siliceous clays	Sub-Arctic polar front	35 m/Ma	This is the preferred intermediate site
1000	Paleogene	1.8		mid gyre	15 m/Ma	


Detroit Seamount
Roundabout Leg 6
August 13, 1988
hours
0000
0100
seconds
4.2
4.4
DSM-3
5.2
5.6

Intermediate Sites



SITE: DSM-4 PRIORITY: 1

POSITION: 51°32.7'N,168°19.5'E

WATER DEPTH: 3830 m

SEISMIC RECORD: *Farnella* , Cruise F2-87-AA, Line 43, Shotpoint 3010, 1800 UTC

SEDIMENT THICKNESS: ≈1100 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB/RCB hole to 800 m.

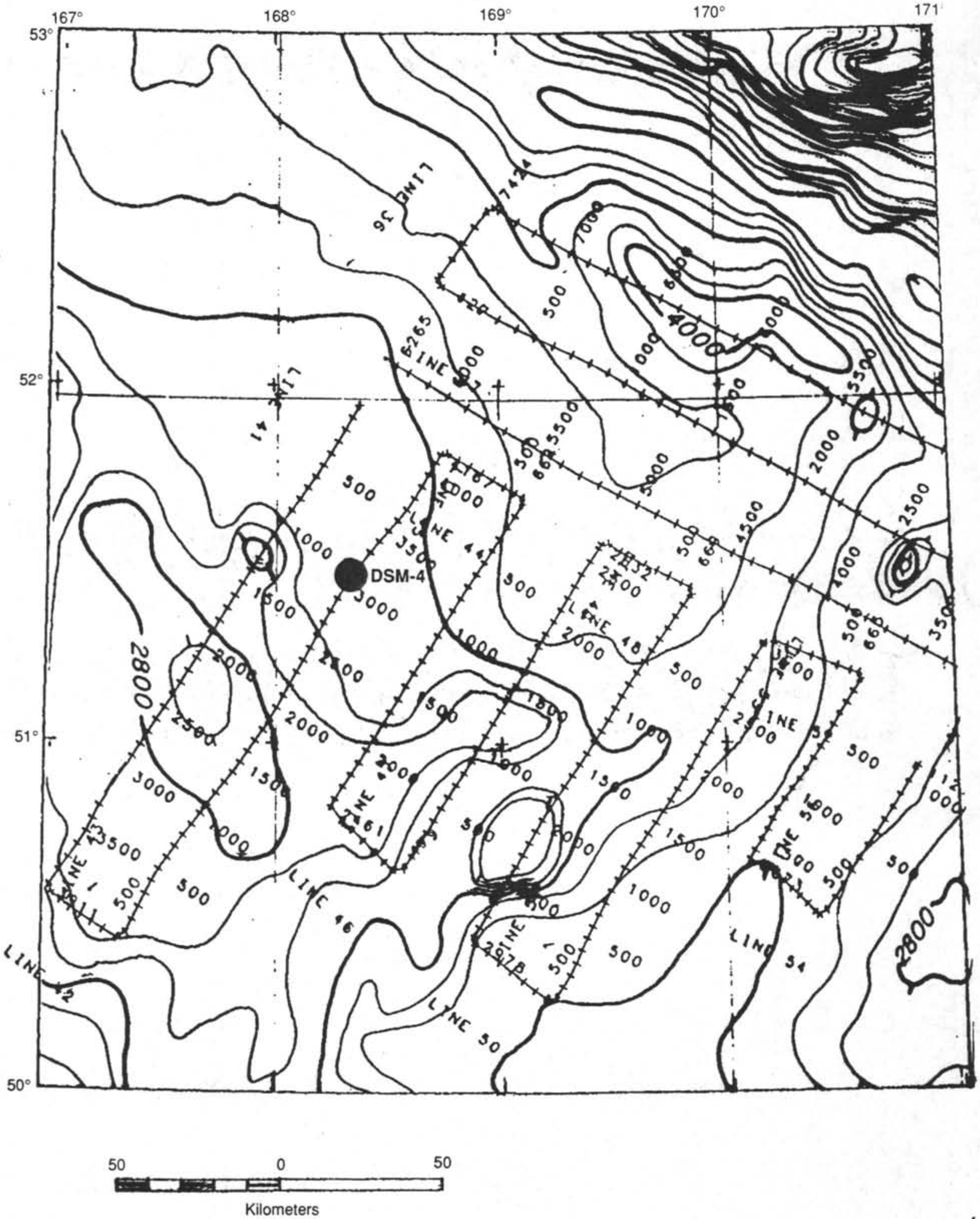
LOGGING: Geophysical and geochemical combination tool strings, and formation microscanner.

OBJECTIVES: The objectives for drilling on the Detroit Seamount and Meiji Tongue include (1) determining the high-resolution Neogene surface, intermediate, and deep-water circulation history; (2) obtaining a high-resolution biostratigraphic record; and (3) history of sediment transport and ice-rafted debris input in the northwest Pacific.

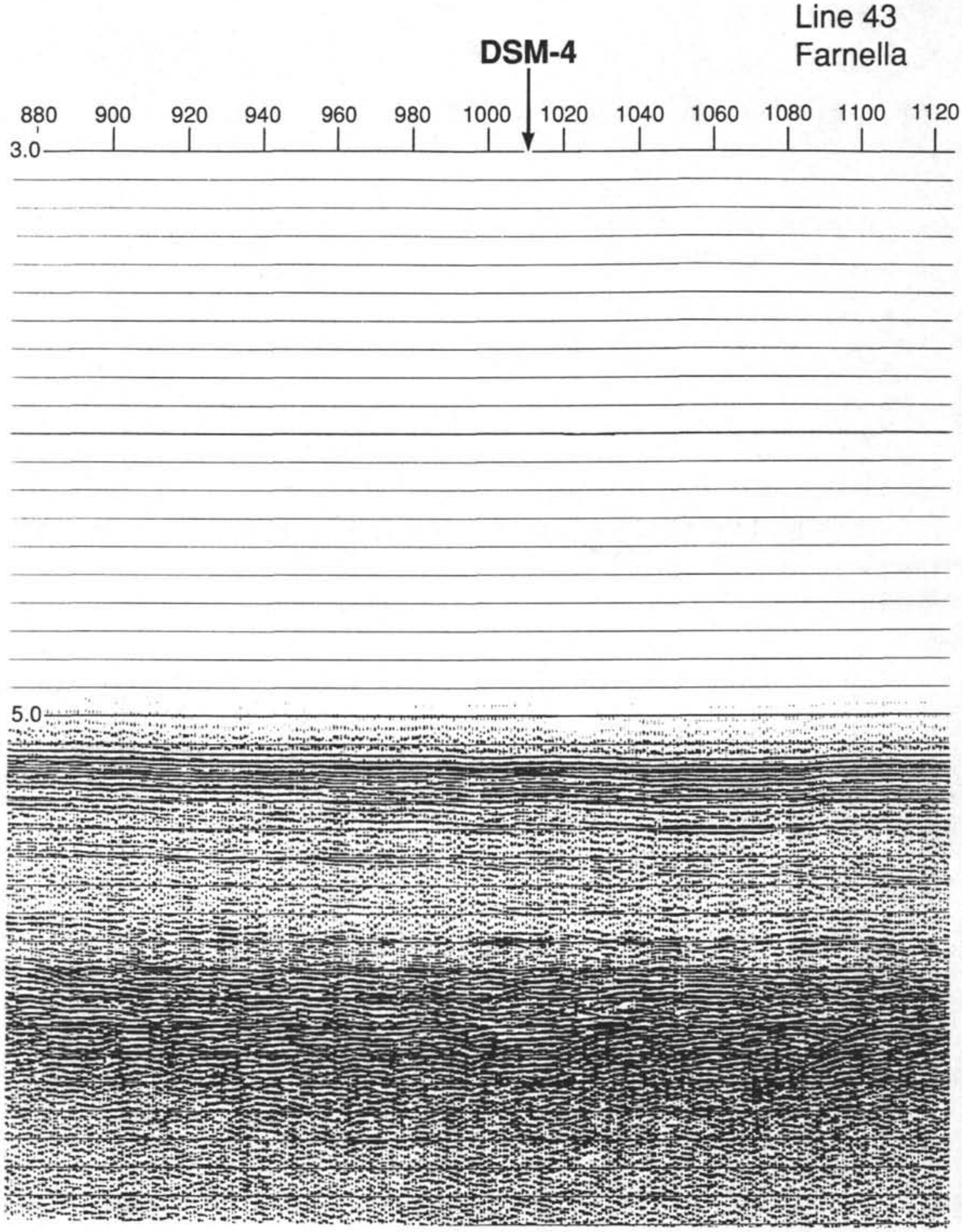
NATURE OF SEDIMENT: carbonate and silica-bearing muds and clays; ice-rafted debris.

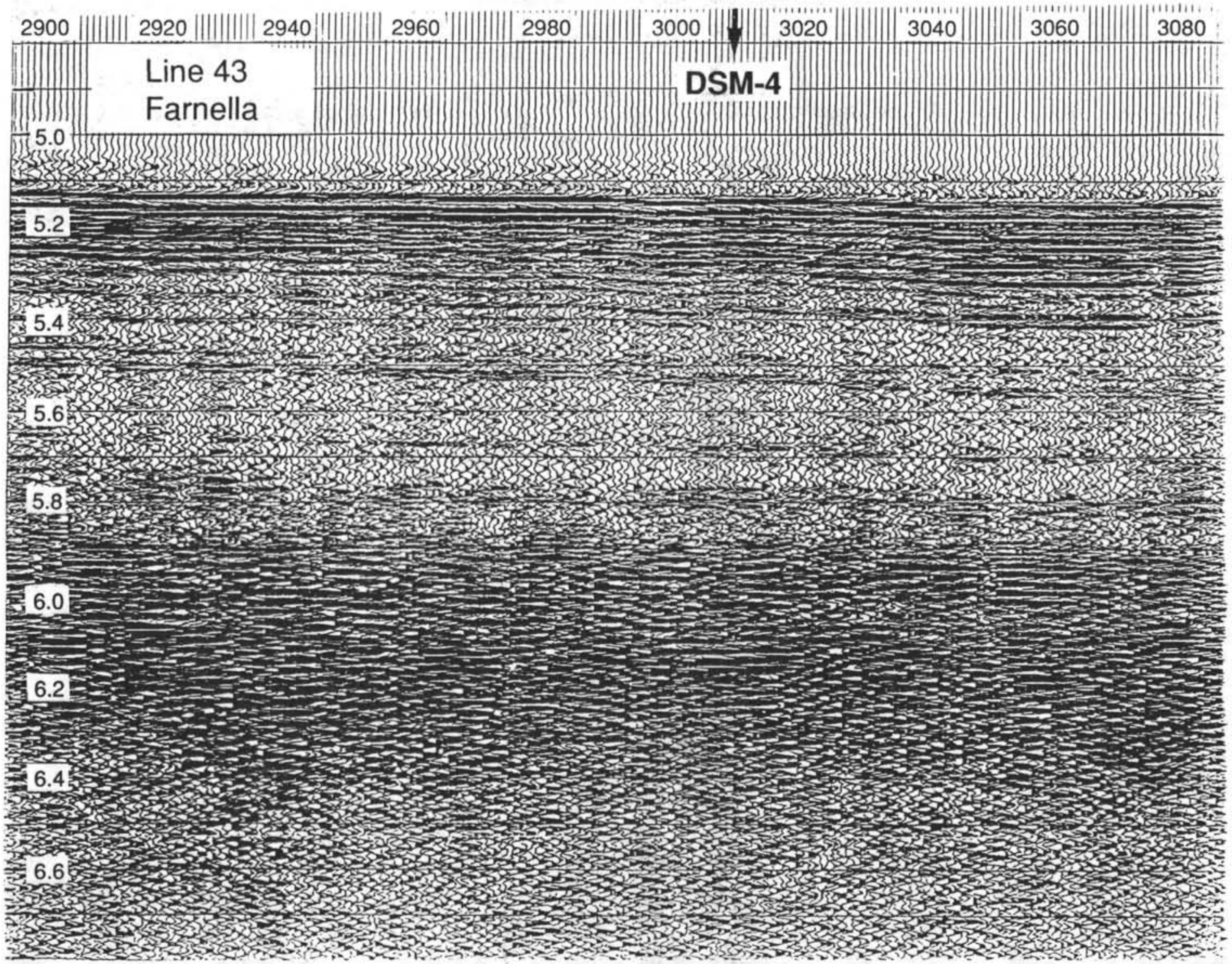
GRAPHIC SUMMARY, SITE DSM-4

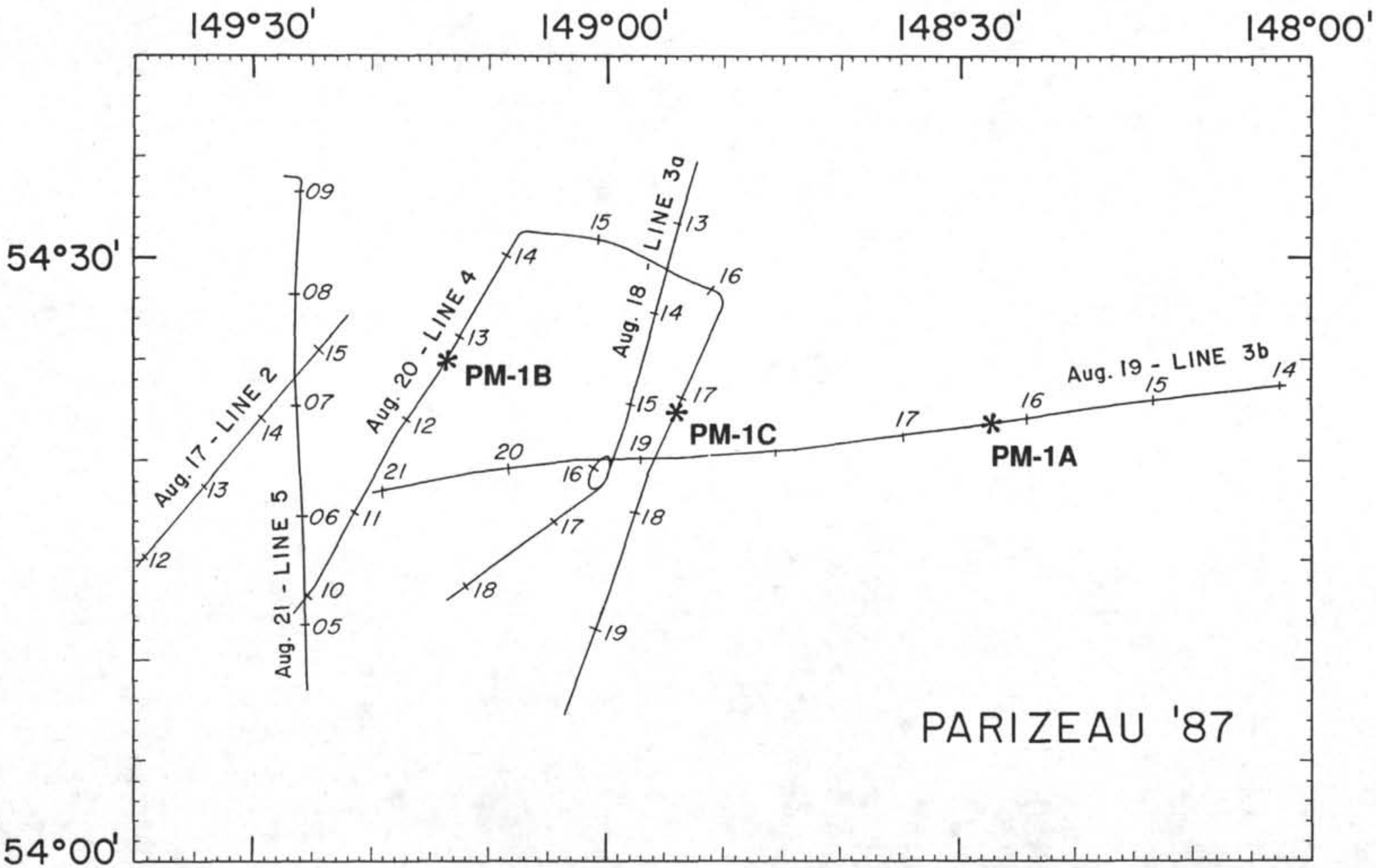
Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
160	Pliocene - Pleistocene	1.6	siliceous silts	drift?	80 m/Ma	Drift deposit - (highly reflective)
700	?	1.8	Si-bearing silts and clays	Sub-Arctic front - mid gyre	10 m/Ma	less reflective
to basement					10 m/Ma	Expect late Cretaceous chalk and limestone over basalt



Detroit Seamount
Site DSM-4
Farnella Cruise F2-87-AA


Line 43
Farnella
DSM-4
880
900
920
940
960
980
1000
1020
1040
1060
1080
1100
1120
3.0
5.0


2900
2920
2940
2960
2980
3000
3020
3040
3060
3080
Line 43
Farnella
DSM-4
5.0
5.2
5.4
5.6
5.8
6.0
6.2
6.4
6.6


149°30'
149°00'
148°30'
148°00'
54°30'
54°00'
Aug. 17 - LINE 2
Aug. 21 - LINE 5
Aug. 20 - LINE 4
Aug. 18 - LINE 3a
Aug. 19 - LINE 3b
PM-1A
PM-1B
PM-1C
PARIZEAU '87

SITE: PM-1A PRIORITY: 1

POSITION: 54°21.9'N,148°27.3'W

WATER DEPTH: 3660 m

SEISMIC RECORD: *Parizeau* 87-11 line 3b, 1618 UTC Aug. 19, 1987

SEDIMENT THICKNESS: ≈300 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB/RCB hole to basement and RCB coring ≈ 50 m into basement.

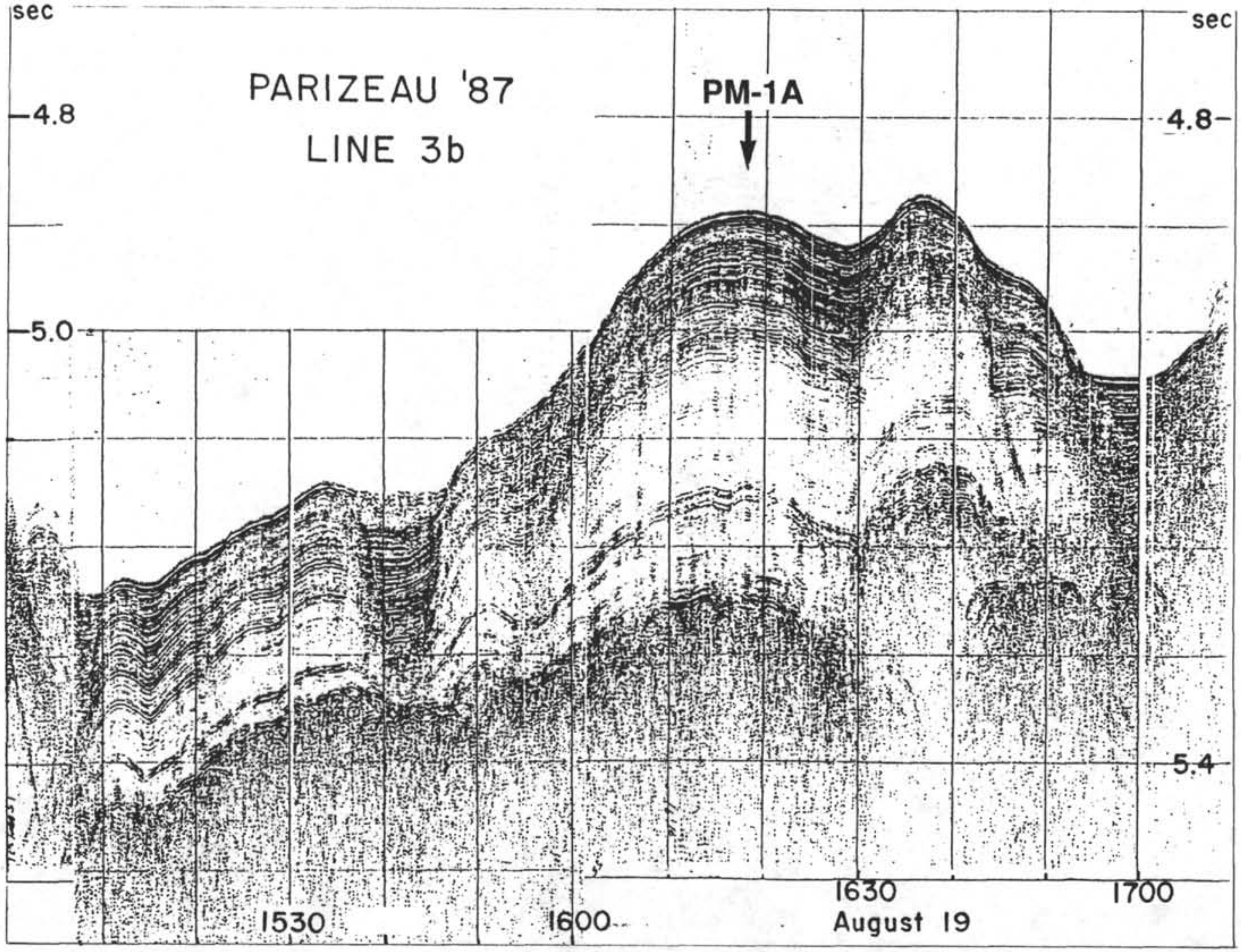
LOGGING: Geophysical and geochemical combination tool strings, and formation microscanner.

OBJECTIVES: The objectives for drilling on the Patton-Murray Seamount include (1) determining the high-resolution paleoclimatic and paleoceanographic evolution of the northeast Pacific; (2) refining the high-latitude Neogene biostratigraphy of the northeast Pacific; and (3) determining the onset and history of glaciation on the adjacent areas of Alaska.

NATURE OF SEDIMENT: Terrigenous to carbonate/siliceous muds with abundant ice-rafted debris in the upper sections. Some ash layers present.

GRAPHIC SUMMARY, SITE PM-1A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
300	Upper Oligocene - Pleistocene	1.7	Hemipelagic muds with Si+$CaCO_3$	Alaskan gyre	10-15 m/Ma	the primary PM - site


sec
sec
PARIZEAU '87
LINE 3b
PM-1A
4.8
4.8
5.0
5.4
1530
1600
1630
1700
August 19

SITE: PM-1B PRIORITY: 2

POSITION: 54°25'N,149°13.3'W

WATER DEPTH: 3550 m

SEISMIC RECORD: *Parizeau* 87-11 line 4, 1245 UTC, Aug. 20, 1987

SEDIMENT THICKNESS: ≈300 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB hole to basement and RCB 50 m into basement.

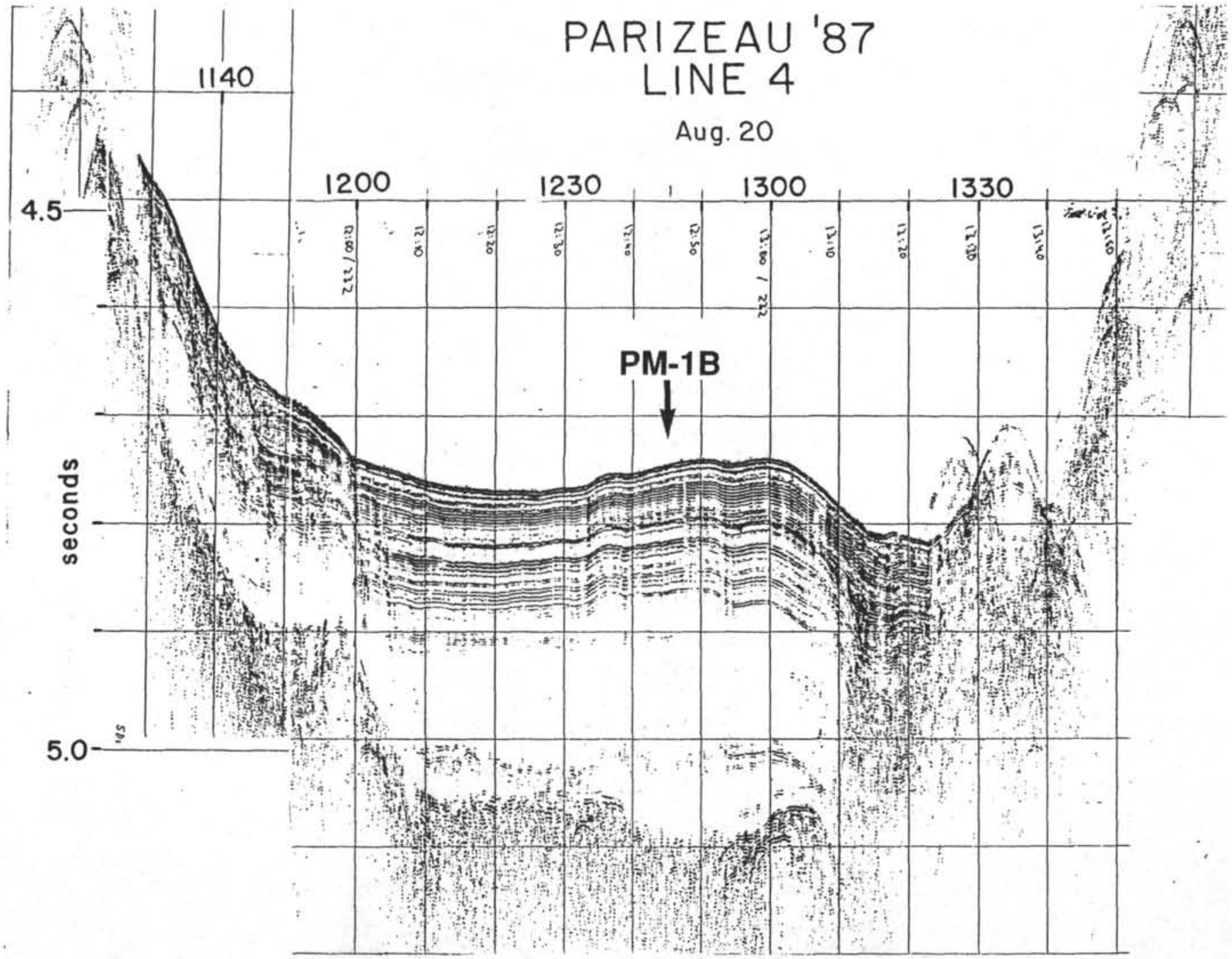
LOGGING: Geophysical and geochemical combination tool strings, and formation microscanner.

OBJECTIVES: The objectives for drilling on the Patton-Murray Seamount include (1) determining the high-resolution paleoclimatic and paleoceanographic evolution of the northeast Pacific; (2) refining the high-latitude Neogene biostratigraphy of the northeast Pacific; and (3) determining the onset and history of glaciation on the adjacent areas of Alaska.

NATURE OF SEDIMENT: Terrigenous to carbonate/siliceous muds with abundant ice-rafted debris in the upper sections. Some ash layers present.

GRAPHIC SUMMARY, SITE PM-1B

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
290	Upper Oligocene to Pleistocene	1.7	Hemipelagic muds with Si+$CaCO_3$	Alaskan gyre	10-15 m/Ma	Alternate site


PARIZEAU '87
LINE 4
Aug. 20
1140
1200
1230
1300
1330
4.5
5.0
seconds
PM-1B

SITE: PM-1C PRIORITY: 2

POSITION: 54°22.3'N, 148°54.1'W

WATER DEPTH: 3727 m

SEISMIC RECORD: *Parizeau* 87-11 line 4, 1711 UTC, Aug. 20, 1987

SEDIMENT THICKNESS: ≈350 m

PROPOSED DRILLING PROGRAM: Double APC-coring to refusal, with single XCB hole to basement and RCB 50 m into basement.

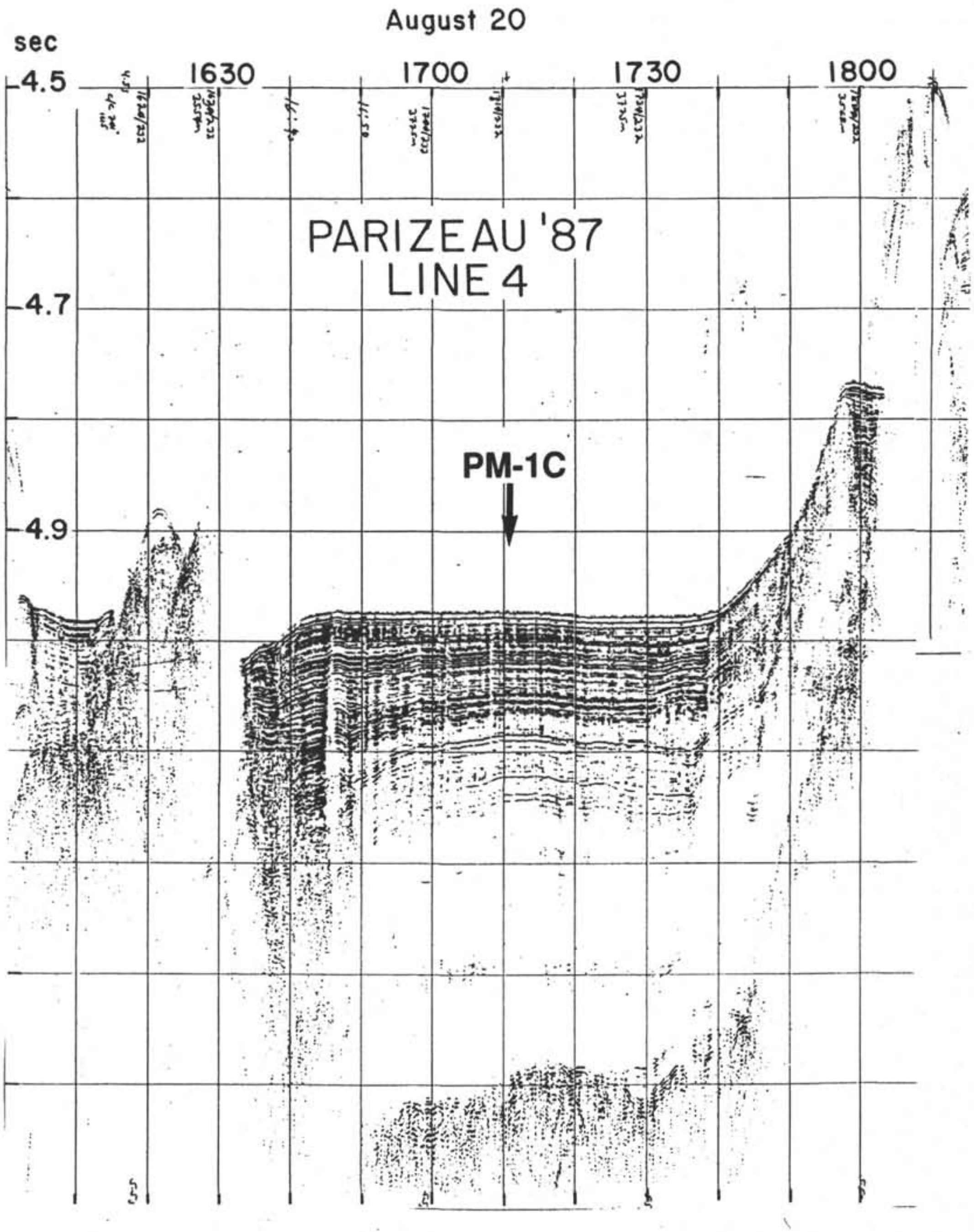
LOGGING: Geophysical and geochemical combination tool strings, and formation microscanner.

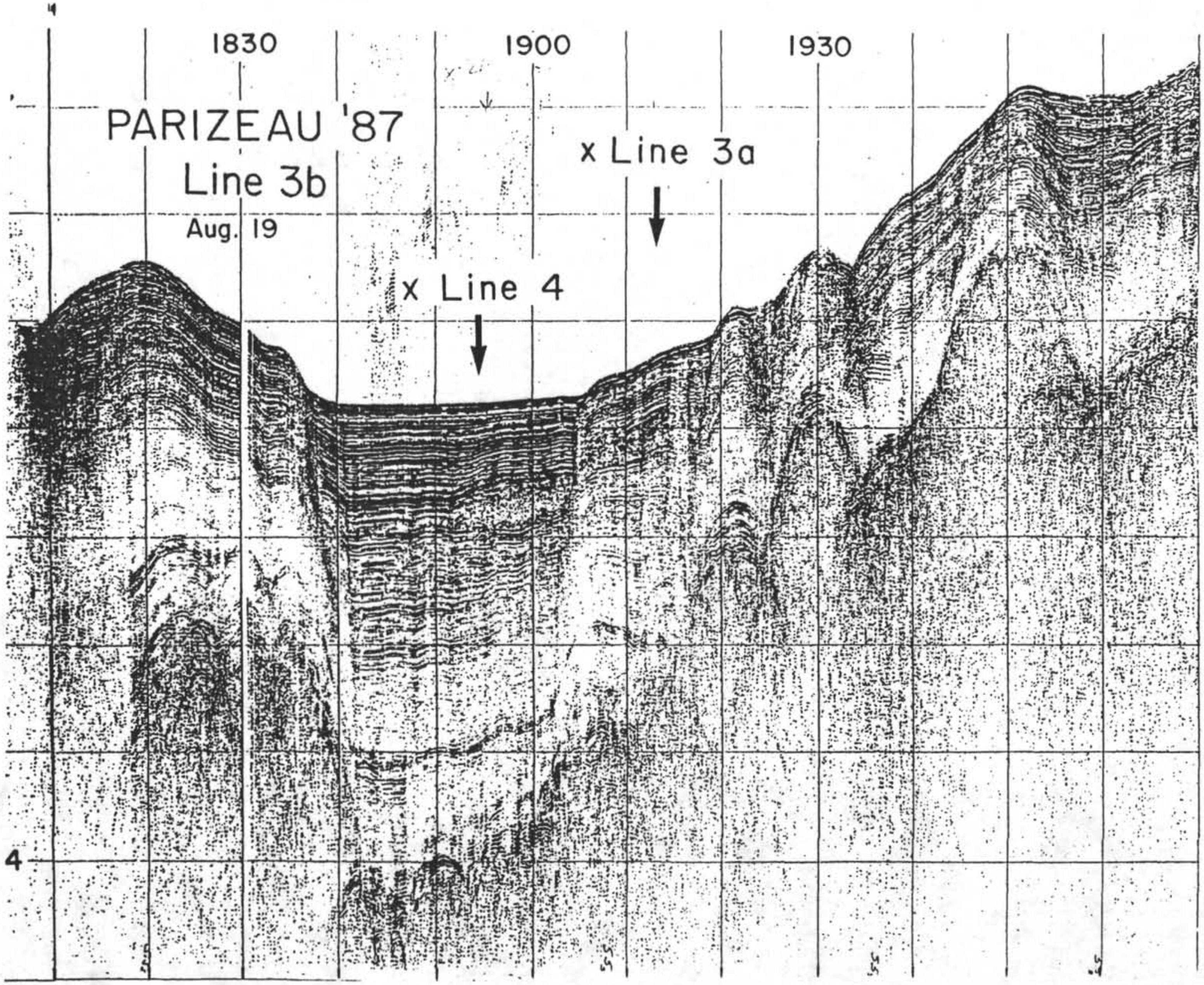
OBJECTIVES: The objectives for drilling on the Patton-Murray Seamount include (1) determining the high-resolution paleoclimatic and paleoceanographic evolution of the northeast Pacific; (2) refining the high-latitude Neogene biostratigraphy of the northeast Pacific; and (3) determining the onset and history of glaciation on the adjacent areas of Alaska.

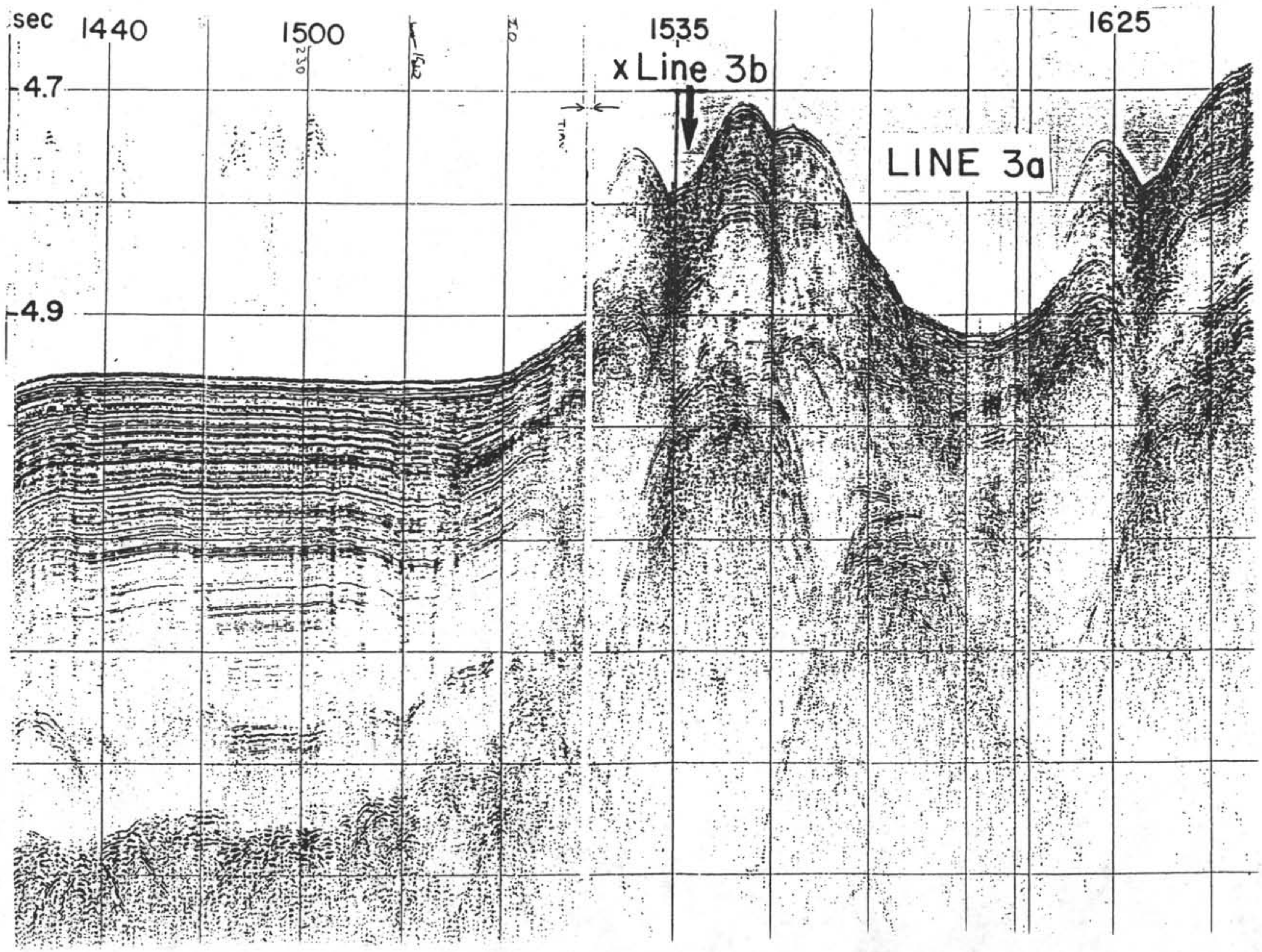
NATURE OF SEDIMENT: Terrigenous to carbonate/siliceous muds with abundant ice-rafted debris in the upper sections. Some ash layers present.

GRAPHIC SUMMARY, SITE PM-1C

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Ave. rate of sediment accumulation*	*Comments*
360	Upper Oligocene to Pleistocene	1.7	Hemipelagic muds with $Si+CaCO_3$	Alaskan gyre	10-15 m/Ma	Alternate site


August 20
sec
4.5
4.7
4.9
1630
1700
1730
1800
PARIZEAU '87
LINE 4
PM-1C


1830
1900
1930
PARIZEAU '87
Line 3b
Aug. 19
x Line 3a
x Line 4
4


sec
1440
1500
1535
1625
x Line 3b
LINE 3a
4.7
4.9

OCEAN DRILLING PROGRAM LEG 145

SCIENTIFIC PARTICIPANTS

Co-Chief Scientist:	Ivan A. Basov Institute of the Lithosphere Staro Monetny Pereulok 22 Moscow 109180 Russia
Co-Chief Scientist:	David K. Rea University of Michigan Department of Geological Sciences 1006 C.C. Little Building Ann Arbor, Michigan 48109-1063
Staff Scientist/Stratigraphic Correlator:	Thomas Janecek Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Sedimentologist:	Eve Arnold University of Rhode Island Graduate School of Oceanography Narragansett Bay Campus Narragansett, Rhode Island 02882-1197
Sedimentologist:	Lawrence Krissek Ohio State University 107 Mendenhall Laboratory 125 South Oval Mall Columbus, Ohio 43210-1398
Sedimentologist:	Barrie McKelvey Department of Geology and Geophysics University of New England Armidale, New South Wales 2351 Australia
Sedimentologist:	Robert Owen University of Michigan Department of Geological Sciences 1006 C.C. Little Building Ann Arbor, Michigan 48109-1063

Sedimentologist:	Hilde Snoeckx University of Michigan Department of Geological Sciences 1006 C.C. Little Building Ann Arbor, Michigan 48109-1063
Sedimentologist:	Ralf Tiedemann Geologisch-Paläontologisches Institut Unviersität Kiel Olshausenstrasse 40 D-2300 Kiel Federal Republic of Germany
Physical Properties Specialist:	Anne K. Rutledge Department of Oceanography Texas A&M University College Station, Texas 77843-3416
Physical Properties Specialist:	John A. Roberts Department of Geology University of Wales College of Cardiff P.O. Box 914 Cardiff CF1 3YE United Kingdom
Physical Properties Specialist:	TO BE NAMED
Stratigraphic Correlator/Paleontologist:	Lloyd D. Keigwin, Jr. Department of Geology & Geophysics Woods Hole Oceanographic Institution Woods Hole, MA 02543
Paleontologist (foraminifers):	Dorothy Pak Lamont-Doherty Geological Observatory of Columbia University Palisades, New York 10964
Paleontologist (nannofossils):	Luc Beaufort Laboratoire de Géologie du Quaternaire CNRS Luminy case 907 13288 Marseille cedex 09 France

Paleontologist (nannofossils):	Gunnar Olafsson Marine Research Institute Hafrannsoknarstofnunin, Skulagata 4 P.O. Box 1390, IS-121 Reykjavik, Iceland
Paleontologist (radiolarians):	Joseph Morley Lamont-Doherty Geological Observatory of Columbia University Palisades, New York 10964
Paleontologist (radiolarians):	Valery V. Shilov Institute of Geology and Mineral Resources of World Oceans Maklin Ave., 1 St. Petersburg 109121 Russia
Paleontologist (diatoms):	John Barron U.S.Geological Survey (MS 915) 345 Middlefield Road Menlo Park, California 94025
Paleontologist (diatoms):	Andrey Y. Gladenokov Institute of the Lithosphere Staro Monetny Pereulok 22 Moscow 109180 Russia
Organic Geochemist:	Rainer Stax Alfred-Wegener-Institut für Polar und Meeresforschung Columbusstrasse 2850 Bremerhaven Federal Republic of Germany
Inorganic Geochemist:	Tom Pedersen Department of Oceanography University of British Columbia Vancouver, B.C. Canada V6T 1Z4
Inorganic Geochemist:	Bonnye Lynn Ingram Department of Geology Stanford University Stanford, California 94305

Petrologist/ Physical Properties Specialist:	Randall A. Keller Oceanography Administration Bldg. 104 Oregon State University Corvallis, Oregon 97331-5503
Paleomagnetist:	Makoto Okada Ocean Research Institute University of Tokyo 1-15-1 Minamidai Nakano-ku Tokyo 164 Japan
Paleomagnetist:	Robin Weeks Department of Geological Sciences University of California Santa Barbara, California 93106
Paleomagnetist/ JOIDES Logging Scientist:	Gilles J. Dubuisson Département de Géologie Ecole Normale Supérieure 24 rue Lhomond 75231 Paris cedex 05 France
JOIDES Logging Scientist:	James F. Bristow University of Leicester Borehole Research Department of Geology Leicester, LE1 7RH United Kingdom
Stratigrapher/Geophysicist:	Tark Hamilton Pacific Geoscience Centre Geological Survey of Canada P.O. Box 6000 Sidney, British Columbia V8L 4B2 Canada
LDGO Logging Scientist:	Peter Demenocal Lamont-Doherty Geological Observatory of Columbia University Palisades, New York 10964
Schlumberger Engineer:	Dave Ritz Schlumberger Offshore Services 369 Tristar Drive Webster, Texas 77598

Operations Superintendent:	Ron Grout Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Development Engineer:	TO BE NAMED
Laboratory Officer:	Burney Hamlin Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Computer Specialist/System Manager:	Wendy Autio Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Computer Specialist/System Manager:	John Eastlund Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist/ Curatorial Representative:	Lorraine Southey Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist/Yeoperson:	Michiko Hitchcox Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist/Photography:	Shan Pehlman Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist/Chemistry:	Chieh Peng Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547

Marine Laboratory Specialist/Chemistry:	Ken McCormick Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Electronics Specialist:	Roger Ball Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Electronics Specialist:	Bill Stevens Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	Mary Ann Cusimano Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	"Gus" Gustafson Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	Robert Kemp Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	Jean Mahoney Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	Jeff Millard Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547

Marine Laboratory Specialist:	Don Sims Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	Monica Sweitzer Ocean Drilling Program Texas A&M University Research Park 1000 Discovery Drive College Station, Texas 77845-9547
Marine Laboratory Specialist:	TO BE NAMED