OCEAN DRILLING PROGRAM

LEGS 143 AND 144 SCIENTIFIC PROSPECTUS

NORTHWEST PACIFIC ATOLLS AND GUYOTS

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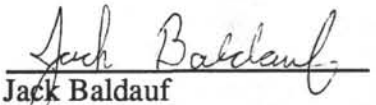

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January 1992

Scientific Prospectus Nos. 43/44
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.

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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 (U.S.S.R.)
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

Legs 143 and 144 constitute an integrated campaign of drilling Cretaceous reef-bearing guyots of the Western Pacific, with the objective of using them as monitors of relative sea-level changes and thereby of the combined effects of the tectonic subsidence (and uplift) history of the seamounts and of global fluctuations of sea level. By comparing records from widely separated guyots, tectonic effects may be separable from eustatic effects. Cores from the volcanic edifice under the reefs will provide data for estimating the paleolatitude of formation of the guyots and for assessing the long-term history of the Dupal isotopic anomaly in the Pacific. Ten drill sites are planned on seven guyots across about 30° of latitude, one site will be drilled on a sediment apron built during three stages of reef development on the adjacent guyot and atoll, and one site will be an engineering test site in the lagoon of a living atoll.

Introduction

The Western Pacific is strewn with chains and clusters of Cretaceous seamounts, many of which are now flat-topped guyots with summit depths of about 1500 m (Matthews et al., 1974; Winterer and Metzler, 1984; McNutt et al., 1990). A large proportion of these are capped by shallow-water reefal sediments overlying the volcanic substrate. These reefs can serve as "dip sticks" to monitor relative changes in sea level during times of reef development, when upward reef growth paced tectonic subsidence of their foundations. The reefal sediments record in their mineralogy, textures, and fossils the timing and sense of rises and falls of relative sea level. The volcanic foundations of the reefs contain in their mineralogy and chemistry clues to the nature of the parent mantle material, the processes of melt extraction and differentiation, and the time of emplacement of the lavas. The guyots thus should yield constraints on a broad range of fundamental questions of Pacific tectonics, global sea-level history, and the enigma of carbonate platform drowning. Guyot drilling on Legs 143 and 144 is an attempt to realize this potential harvest of new data.

Background/Drilling Objectives

Volcanic Edifices

Beginning in the late Barremian (about 120 Ma) a large region of the Pacific, measuring perhaps 3000 km in diameter, was repeatedly, perhaps almost continuously, the scene of large-scale mid-plate volcanism (Menard, 1984; Winterer and Metzler, 1984). Although the source of this volcanism is not certain, it may be represented today by the cluster of Neogene volcanic chains and modern active volcanoes in the Southeast Pacific (McNutt and Fisher, 1987). It is part of the great southern hemisphere belt of volcanism having an isotopic signature termed the "Dupal Anomaly". During the Early Cretaceous, the Ontong Java Plateau may have been an important part–even perhaps the dominant feature–of this South Pacific region of volcanism (Tarduno et al., 1991).

Horizontal and Vertical Tectonic Motions

As new volcanoes formed successively in this region of the central South Pacific, the motions of the Pacific plate carried them along zigzag horizontal trajectories progressively farther northwest by as much as 30° of latitude to their present locations (Duncan and Clague, 1985). Some volcanoes formed over persistent hot spots that generated linear seamount chains, but the origins of most are still uncertain. Changes in plate motion have produced intersecting and overprinting of chains in some places, resulting in complicated geologic histories for some seamounts. The Cretaceous part of this plate-motion history is poorly constrained by existing data.

The more northerly guyots preserve a history of subsidence, followed by emergence above sea level, then resubmergence. Guyots of the Japanese Group (e.g., Seiko Guyot), at 30°-35°N, have summits with drowned barrier reefs and terraced carbonate banks. They have no more than about 200 m of reefal sediments, and radiometric and paleontological dates place them as of probable Albian age. Farther south, in the band about 18°-28°N, reef-bearing guyots are drowned mature atolls with perimeter reefs and lagoonal sediments as much as 700 m thick (e.g., Allison, "Huevo," and "MIT" guyots). Available dates suggest that these have foundations of late Barremian-Aptian age and reefal sediments that may extend into the Albian. Both of these northern bands of guyots were emergent (to as much as 200 m above sea level) and developed a karstic topography prior to their final drowning in the mid-Cretaceous. South of about 20°N, late

Albian (?) and younger pelagic sediments overlie the reefal strata; farther north, where these pelagic sediments are absent, the reefal strata are encrusted by phosporite and manganese oxides.

To the south, in the Marshall Islands region, the reef-bearing guyots show an even more complex history of vertical motions, with as many as three epochs of reef growth. There are numerous modern atolls in the region, and drilling on two of these (Pikinni [formerly called Bikini] and Anewetak [formerly Enewetak, and Eniwetok]) shows they have been growing since Eocene times. Dredges from several guyots in the Marshalls, and drilling results from nearby basinal sites, show the presence of rudist reefs of Late Cretaceous (Campanian and Maestrichtian) age (Larson, Schlanger et al., 1981; Moberly, Schlanger et al., 1986). Moreover, on Wodejebato (formerly Sylvania) Guyot, reefal fossils of a still older reef of Early Cretaceous age have been dredged.

Platform Drowning

Northwest Pacific Cretaceous guyots present the "paradox of platform drowning" in classic form: why do carbonate platforms drown, when the growth potential of healthy platforms is one or two orders of magnitude higher than long-term (10^6 yr) tectonic-subsidence or sea-level-rise rates? Why does one platform reef drown when another on an adjacent edifice survives? A further question is why platform drowning was of such widespread occurrence in the mid-Cretaceous.

Sea-Level Changes

Sequence stratigraphic studies of Cretaceous marine strata on and fringing the continents have been interpreted as indicating large eustatic shifts of sea level, but given the Cretaceous world was essentially ice-free, both the causal mechanisms and the amplitudes are subjects of hot debate; some even question the eustasy itself. Because the reefal sediments of the guyots are essentially antipodal in geography to the continent-tied sequences, and in a wholly different tectonic setting, it is of great interest to obtain sea-level records from a number of coeval Cretaceous guyots, to test and quantify the eustatic hypothesis. Seismic reflection records of the lagoonal facies on the guyots (some with sediments about 600-800 m thick) show many continuous reflectors, reminiscent of the reflectors in Cenozoic atoll lagoons where drilling has shown the reflectors to correlate with sea-level falls.

Biotic Provinces and Migration Routes

The Western Pacific Cretaceous guyots were very far from the main rudist reef regions of the Tethys seaways, the circum-Mediterranean and Caribbean provinces. The affinities of the shallow-water assemblages of the oceanic Pacific are imperfectly known and the drilling should provide clues to their degree of provinciality and migration routes.

Post-Reef History

Biogenic sediments of the pelagic caps, deposited well above the carbonate compensation depth (CCD), should provide not only a good estimate of the age of drowning of the platform but also a reliable oceanic stable-isotope record, especially for the Upper Cretaceous and Paleogene, which are now represented in the Pacific by dissolved samples, mainly from deeper water. The occurrence of high-fertility indicators in the planktonic biotas from the pelagic caps can be used to track the post-reef horizontal trajectories of the guyots.

Summary

By coring selected guyots and flanking basinal sites, we can address in a relatively straightforward way the fundamental problems of:

- Timing and causes of platform drowning.
- Timing and amplitude of relative changes in sea level and their relation to regional tectonics and to sea-level changes recorded in other parts of the globe.
- Seamount latitude changes, as recorded in the paleomagnetism of lagoon sediments as well as in the underlying volcanics.
- Ages of the volcanic edifices, as clues to the direction and rates of age progression.
- Longevity of the mantle source for Dupal lavas.
- Bioprovinciality of Cretaceous reefal organisms and post-reefal paleoceanographic reconstruction.

Drilling Strategy and Logistics

A set of targets, divided amongst the major seamount groups and spanning about 30° of latitude, and selected after weighing all the available reflection seismic, bathymetric, side-scan, magnetic, gravity, dredge, and drill data, has been chosen for drilling to address the aforementioned problems. These scientific targets comprise 11 primary sites on 7 different guyots and 1 basinal fan (Table 1):

- One guyot (Site Seiko-1) in the Japanese Group.
- Three guyots (Sites Allison-A, "Huevo"-A and -B, and "MIT"-1E) in the 18°-28°N band.
- Three guyots (Sites Sylvania-1 and -2A, Harrie-1 and -2, and PEL-3) and one basinal apron site (Sylvania-3) in the Marshall Group.

Leg 143

For logistical reasons, the work is divided between Legs 143 and 144 as shown in Figure 1. Leg 143 is scheduled to embark from Honolulu, Hawaii, on 24 March 1992. On this leg the main target is "Huevo" Guyot, in the western part of the Mid-Pacific Mountains, where seismic data show about 950 m of Lower Cretaceous reefal cap having a karstic summit. There will be a multiple-reentry site in the lagoon, about 1 km inward from the perimeter reef (HUE-A; called Huevo-A in the original proposal), and another single-bit site to a depth of about 300 mbsf (to reach levels beneath the karsted summit zone) on the perimeter reef (HUE-B). Substantial penetration into igneous basement is planned at HUE-A to obtain paleomagnetic and petrologic data. On the way to "Huevo" the ship will drill a single-bit site through the pelagic cap and about 300 m of lagoonal sediments (more if drilling rates permit) near the edge of the lagoon on Allison Guyot, in the central Mid-Pacs (ALL-A). A major objective here is to compare the seismic stratigraphy of the lagoonal sediments with that at "Huevo." After "Huevo" the ship will go to a basinal fan site (SYL-3) southwest of Wodejebato [Sylvania] Guyot in the central Marshall Islands, downslope from Pikinni Atoll. About 800 m of sediment is visible on the seismic profile, and the site should yield not only a (redeposited) record of Early Cretaceous and Campanian-Maestrichtian reefing on Wodejebato, but a record of Eocene-Holocene reefing on Pikinni. After completing operations at SYL-3, the ship will enter the lagoon at Anewetak Atoll for an engineering test, to learn if the ship can be kept positioned for drilling in very shallow water (about 30 m) at proposed site ANE-1. We

anticipate that cores will be taken in the upper part of the lagoonal sediments. The ship will then head to port in Majuro, Marshall Islands at the end of Leg 143. No alternate sites have been formally identified for Leg 143. The two reasons for this are (1) the JOIDES Pollution Prevention and Safety Panel has given permission to move the proposed sites to other locations on the same edifice, and (2) several Leg 144 sites are within a short distance from Leg 143 sites (e.g., SYL-1, SYL-2A, SYL-4, and PEL-3) and could be drilled on Leg 143 if time permitted.

Leg 144

On Leg 144, the ship is scheduled to leave Majuro on 25 May 1992 and head south to Limalok (formerly Harrie) Guyot to drill a potential back reef site (HAR-1) and a more centrally located lagoonal site (HAR-2). Eocene reefal rocks have been dredged here, but there may be older reefs beneath. From Limalok, the ship goes to Lo-En (formerly Hess) Guyot, in the western Marshalls southeast of Anewetak Atoll, to core a 180-m-thick pile of pelagic sediments that caps the underlying (Paleogene?) reefal rocks at PEL-3. About 270 m of penetration through the carbonate platform and 50 m into basement is also planned. Lo-En Guyot has a distinctly different seismic profile than the other Leg 143 and 144 guyots; a carbonate platform or bank is present but there is no apparent perimeter reef. Lo-En Guyot is on the same volcanic pedistal as its living sibling Anewetak. U.S. Geological Survey deep borehole data from Anewetak document the existence of an Eocene bank on top of the volcanic basement. A major objective here is to compare the stratigraphy and facies of Lo-En Guyot with Anewetak. Another major objective is the study of the pelagic cap in order to relate the acoustic stratigraphy of the cap to its depositional and diagenetic history and correlate reflectors with those seen in other settings. Next, the ship goes to Wodejebato Guyot to drill two single-bit sites, SYL-1, near the edge of the lagoon, and SYL-2A, a more centrally located lagoonal site. Before leaving this guyot, a possible additional site, SYL-4, may be drilled into the reef crest in order to investigate the extent and effects of sea level changes on the reef. After Wodejebato is "MIT" Guyot (at about 28°N, 152°W), where a multiple-reentry site will be drilled near the edge of the lagoon (MIT-1). Seismic profiles show about 500-650 m of lagoonal sediment, and multibeam mapping reveals a spectacular karst topography. Substantial penetration (200m) into igneous basement is planned here. Finally, the ship will drill a single-bit site on Seiko Guyot (SEI-1), where seismic profiles and SeaBeam data show a karsted summit, a reef wall 100-200 m high encircling a nearly empty lagoon, and a volcanic hill in the center of the guyot. If time remains near the end of the leg, SEI-2 will be drilled into the perimeter reef using a mini hard rock

guidebase in order to examine the effects of sea level changes on the reef. During the transit from Wodejebato to MIT Guyot a possible additional hole at Site 801, Hole 801C, drilled into Middle Jurassic oceanic basalt during Leg 129, may be reentered to log the lower 150 m, comprising the lowest sedimentary layers and the underlying basement rocks. The ship will head to port at Yokohama, Japan, at the end of Leg 144. The Pollution Prevention and Safety Panel has given permission to shift the proposed sites to other locations on the same edifice if necessary.

Logging

The plan (Table 2) calls for running standard Schlumberger physical property (seismic stratigraphic) and geochemical logs, as well as the formation microscanner (FMS) at all sites. In addition, the borehole televiewer and Japanese downhole magnetometer will be used in the basement section of HUE-A and all Leg 144 sections with basement penetration of at least 50m.

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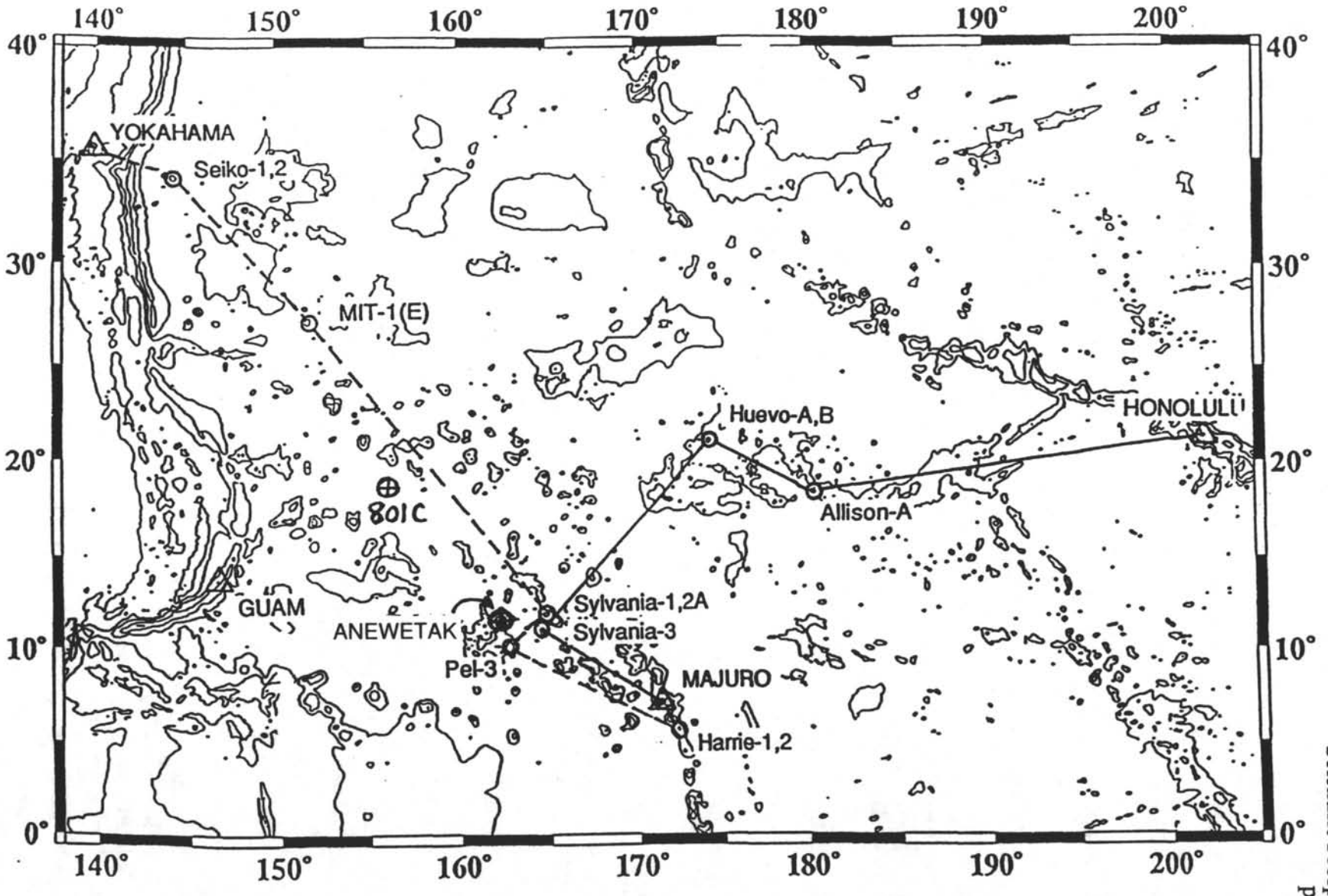


Figure 1. Ship track recommended for Legs 143 (solid line) and 144 (dashed line) by JOIDES Atolls and Guyots Detailed Planning Group.

Table 1a. Leg 143 time estimates.

Site	Location Latitude	Longitude	Water depth (m)	Meters of penetration (sed/bsmt)	Drill (days)	Log (days)	Total (days)	Transit (days)
Honolulu	21°18'N	157°53'W						4.9
ALL-A	18°27'N	179°32'W	1440	500/0	4.3	1.1	5.4	1.4
[1]HUE-A	21°19'N	174°18'E	1365	960/200	17.9	2.1	20.0	0.0
[2]HUE-B	21°22'N	174°18'E	1370	300/0	5.9	1.3	7.2	3.3
SYL-3	11°00'N	164°45'E	4800	850/0	8.8	1.7	10.5	0.7
[3,4]ANE-1	11°22'N	162°19'E	30	50?/0	1.3	0.0	1.3	2.3
Majuro	7°05'N	171°08'E						
		Subtotals =		2660/200	38.2	6.2	44.4	12.6
		Grand total =		**57.0 days**				

Sites/tasks in Detailed Planning Group report that were cut, but will be done if time permits (in order of occurrence during leg):

ALL-A	Deepen hole through limestone and 50 m into basalt	385/50	4.0	0.7	4.7
	APC top 80 m	80	0.7	0.0	0.7
SYL-3	APC cores to 150 m	150	1.4	0.0	1.4

Note: transit times are calculated for a speed of 10.5 kt.
[1]Multiple reentry hole.
[2]Hard-rock guidebase site.
[3]Engineering test site.
[4]Anewetak test takes a total of 2.5 days of extra steaming plus operations.

Table 1b. Leg 144 time estimates.

Site	Location Latitude	Longitude	Water depth (m)	Meters of penetration (sed/bsmt)	Drill (days)	Log (days)	Total (days)	Transit (days)
Majuro	7°05'N	171°08'E						0.5
HAR-1	5°29'N	172°20'E	1500	500/50	5.3	1.3	6.6	0.1
HAR-2	5°33'N	172°21'E	1300	430/0	3.6	0.8	4.4	2.5
PEL-3	10°07'N	162°48'E	1080	455/50	5.3	1.3	6.6	0.7
SYL-1	11°59'N	164°56'E	1350	200/50	3.4	1.2	4.6	0.1
SYL-2A	11°54'N	164°56'E	1350	200/0	2.0	0.8	2.8	4.6
[1,2]MIT-1	27°19'N	151°53'E	1400	650/200	13.5	2.3	15.8	2.1
SEI-1	34°13'N	144°19'E	1550	125/50	2.5	1.1	3.6	1.0
Yokohama	35°28'N	139°34'E						
		Subtotals =		2560/400	35.6	8.8	44.4	11.6
		Grand total =		**56.0 days**				

Sites/tasks in Detailed Planning Group report that were cut, but will be done if time permits (in order of occurrence during leg):

[2]SYL-4	12°04'N	164°58'E	1390	200/0	5.0	0.9	5.9
Hole 801C	18°39'N	156°22'E	5674	0/0	[3]1.3	[4]2.0	3.3
[2]SEI-2	34°14'N	144°20'E	1450	250/50	6.4	1.1	7.5

[1] Multiple reentry hole.

[2]Hard-rock guidebase site; proposed by Co-Chief Scientists following the Detailed Planning Group meeting.

[3]18 hr for site location, pipe trip down and reentry; 14 hr for pipe trip up.

[4]Standard Schlumberger runs in 132 m of basement, stress magnitude test with drill stem packer, borehole televiewer, and Japanese magnetometer.

Table 2. Leg 143/144 logging time estimates.

Site	Location Latitude	Longitude	Water depth (m)	[1]STD (hr)	[2]BHTV (hr)	[3]MAG (hr)		
Leg 143:								
ALL-A	18°27'N	179°32'W	1440	30.4	-	-		
[4]HUE-A	21°19'N	174°18'E	1365	40.3	6.1	3.8		
HUE-B	21°22'N	174°18'E	1370	32.2	-	-		
SYL-3	11°00'N	164°45'E	4800	40.2	-	-		
				143.1	6.1	3.8	=	153.0
Leg 144:								
HAR-1	5°29'N	172°20'E	1500	24.2	4.1	3.2		
HAR-2	5°33'N	172°21'E	1300	18.0	-	-		
PEL-3	10°07'N	162°48'E	1080	23.3	3.8	3.0		
SYL-1	11°59'N	164°56'E	1350	20.9	4.0	2.8		
SYL-2A	11°54'N	164°55'E	1350	18.2	-	-		
[4]MIT-1	27°19'N	151°53'E	1400	42.1	7.5	4.4		
SEI-1	34°13'N	144°19'E	1550	18.7	4.3	3.0		
				165.4	23.7	16.4	=	205.5
Alternate sites:								
SYL-4	12°04'N	164°58'E	1390	20.9	-	-		
SEI-2	34°14'N	144°20'E	1450	19.7	3.6	2.7		

[1]STD = standard logging run; includes seismic stratigraphy package (resistivity, sonic velocity, density, and gamma-ray logs), geochemical package, and the FMS.
[2]BHTV = borehole televiewer; used in basement sections.
[3]MAG = Japanese downhole magnetometer tool; used in basement sections.
[4]VSP is an optional addition to the logging program at Huevo-A and MIT-1.

PROPOSED DRILL SITE DESCRIPTIONS

SITE: ALL-A (Allison Guyot) PRIORITY: 1

POSITION: 18°27'N, 179°32'W

WATER DEPTH: 1440 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 10, 0555Z/7 Dec. 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 885 m

PROPOSED DRILLING PROGRAM: RCB coring, with free fall cone if needed, APC/XCB coring in pelagic cap if time permits

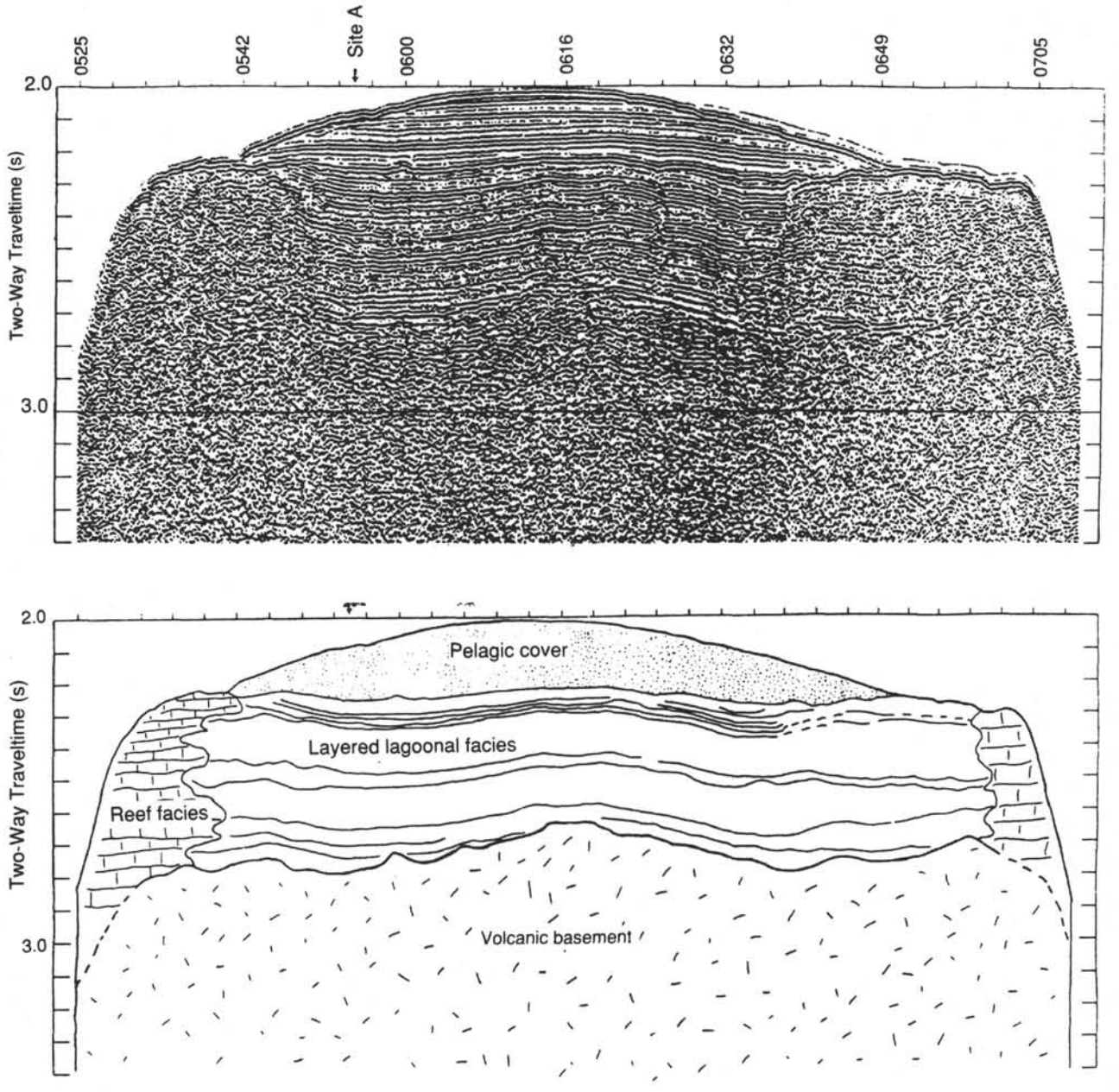
NATURE OF ROCK ANTICIPATED: 160 m of pelagic cap, ca. 725 m of shallow-water limestone (of which we expect to core only the top 340 m), and 50 m of basalt (Note: time constraints will probably only allow rotary coring to 500 mbsf, i.e., no basement penetration)

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS

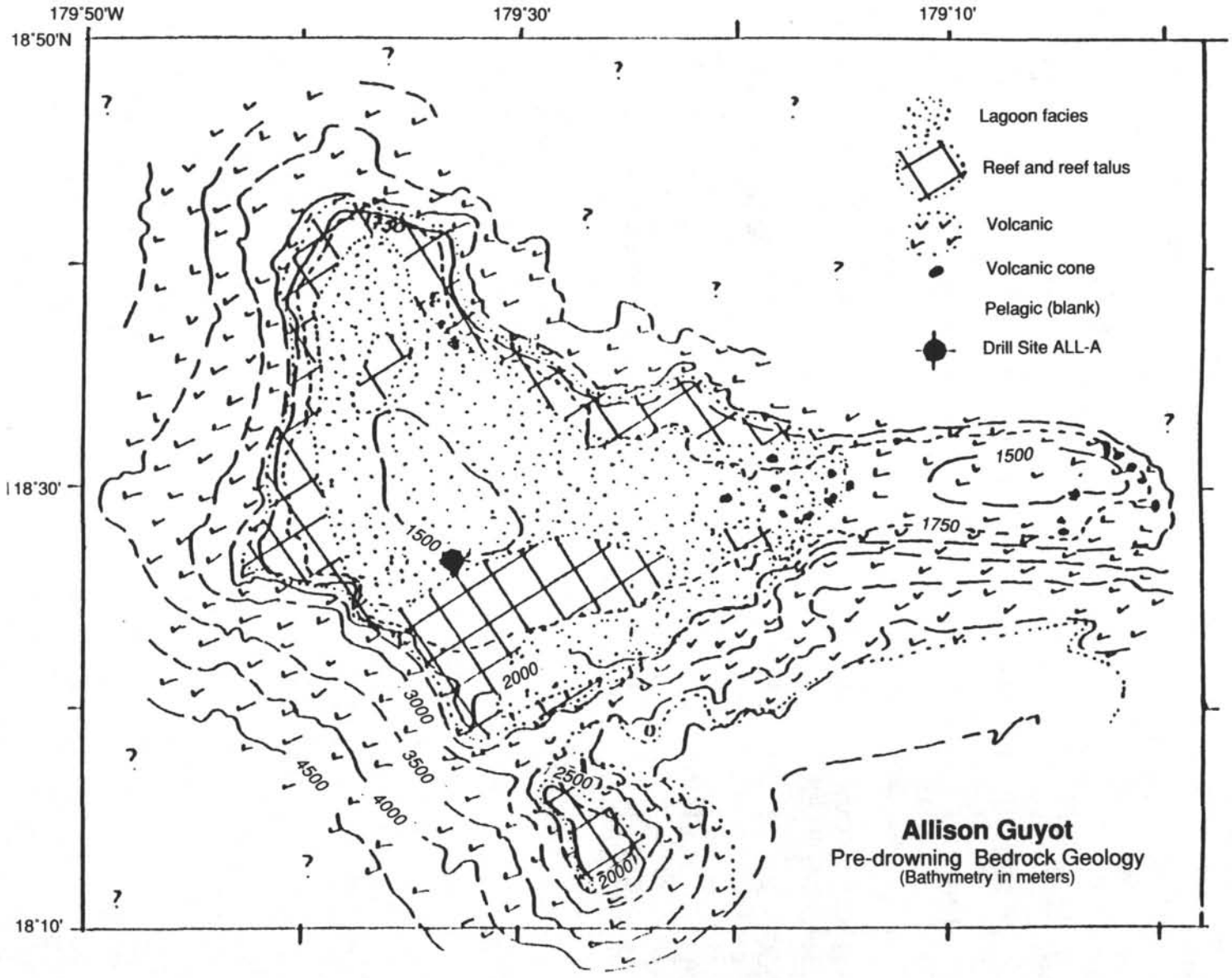
SCIENTIFIC OBJECTIVES: to investigate the history of the pelagic cap and date the pelagic/lagoonal facies contact. To examine subsidence history, sea level cycles, and the causes of drowning using lagoonal and backreef facies sediments. To correlate principal seismic reflectors in the limestone cap with those on Huevo Guyot (HUE-A, HUE-B).

GRAPHIC SUMMARY, SITE ALL-A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
160	Pleistocene to late Albian (?)	1.8	Foram-nanno ooze & chalk	Pelagic, on top of seamount	2m/my	Probably many unconformities - Current - winnowed
885	Albian (?) to late Barremian	2.5	Chalk and limestone	Back reef of an atoll lagoon	25 - 50 m/my	
			Basalt flows	Subaerial volcano		



Single-channel seismic reflection profile and geological interpretation of Allison Guyot. Data collected by R/V Thomas Washington during Leg 10 of the SIO Roundabout Expedition in December 1988.


179°50'W
179°30'
179°10'
18°50'N
18°30'
18°10'
Lagoon facies
Reef and reef talus
Volcanic
Volcanic cone
Pelagic (blank)
Drill Site ALL-A
1500
1750
1500
2000
3000
3500
4500
4000
2500
2000
Allison Guyot
Pre-drowning Bedrock Geology
(Bathymetry in meters)

SITE: HUE-A (Huevo Guyot) PRIORITY: 1

POSITION: 21°19'N, 174°18'E

WATER DEPTH: 1365 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 10, 1906Z/1 Dec. 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 960 m

PROPOSED DRILLING PROGRAM: RCB coring into basement, with multiple reentry

NATURE OF ROCK ANTICIPATED: 35 m of pelagic cap, 925 m of shallow-water limestone, and 200 m of basalt

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: To drill through backreef facies sediments and determine the timing and causes of drowning. To examine subsidence and the effects of sea level fluctuations on the carbonate platform atop Huevo. To correlate seismic reflectors within the carbonate cap with those of Allison Guyot. To determine paleolatitude and geochemistry of basement rocks.

GRAPHIC SUMMARY, SITE HUE-A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
35	Quaternary to late Albian (?)	1.8	Form-nanno ooze	Pelagic	0.5 m/my	
960	Albian (?) to late Barremian	2.5	Chalk and limestone	Backreef part of atoll lagoon	25 - 50 m/my	
		4.5	Basalt flows	Subaerial		

SITE: HUE-B (Huevo Guyot) PRIORITY: 1

POSITION: 21°22'N, 174°18'E

WATER DEPTH: 1370 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 10, 1858Z/1 Dec. 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 860 m

PROPOSED DRILLING PROGRAM: RCB coring to 300 m penetration, with mini-HRB

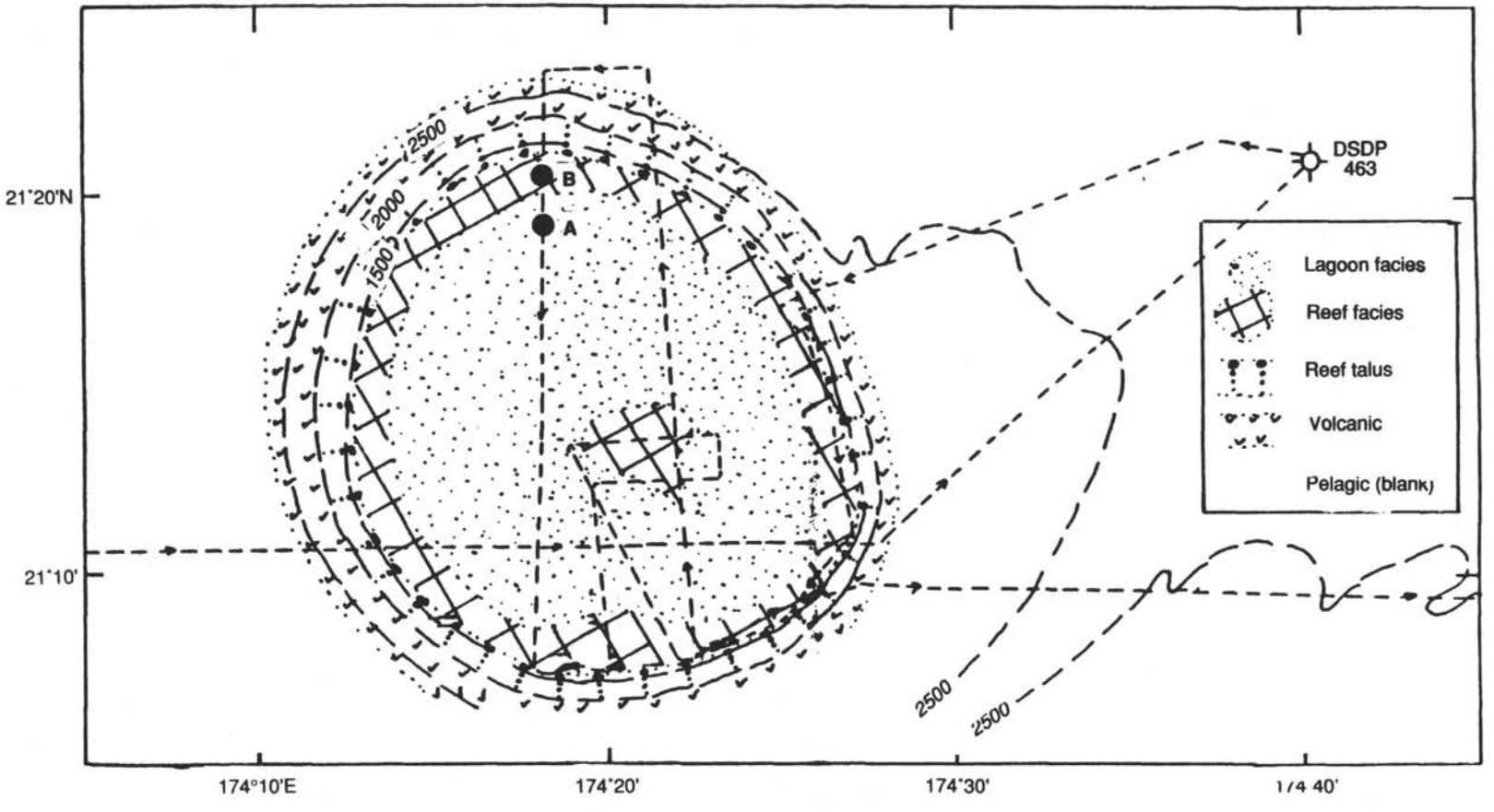
NATURE OF ROCK ANTICIPATED: ca. 300 m of shallow-water limestone

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS

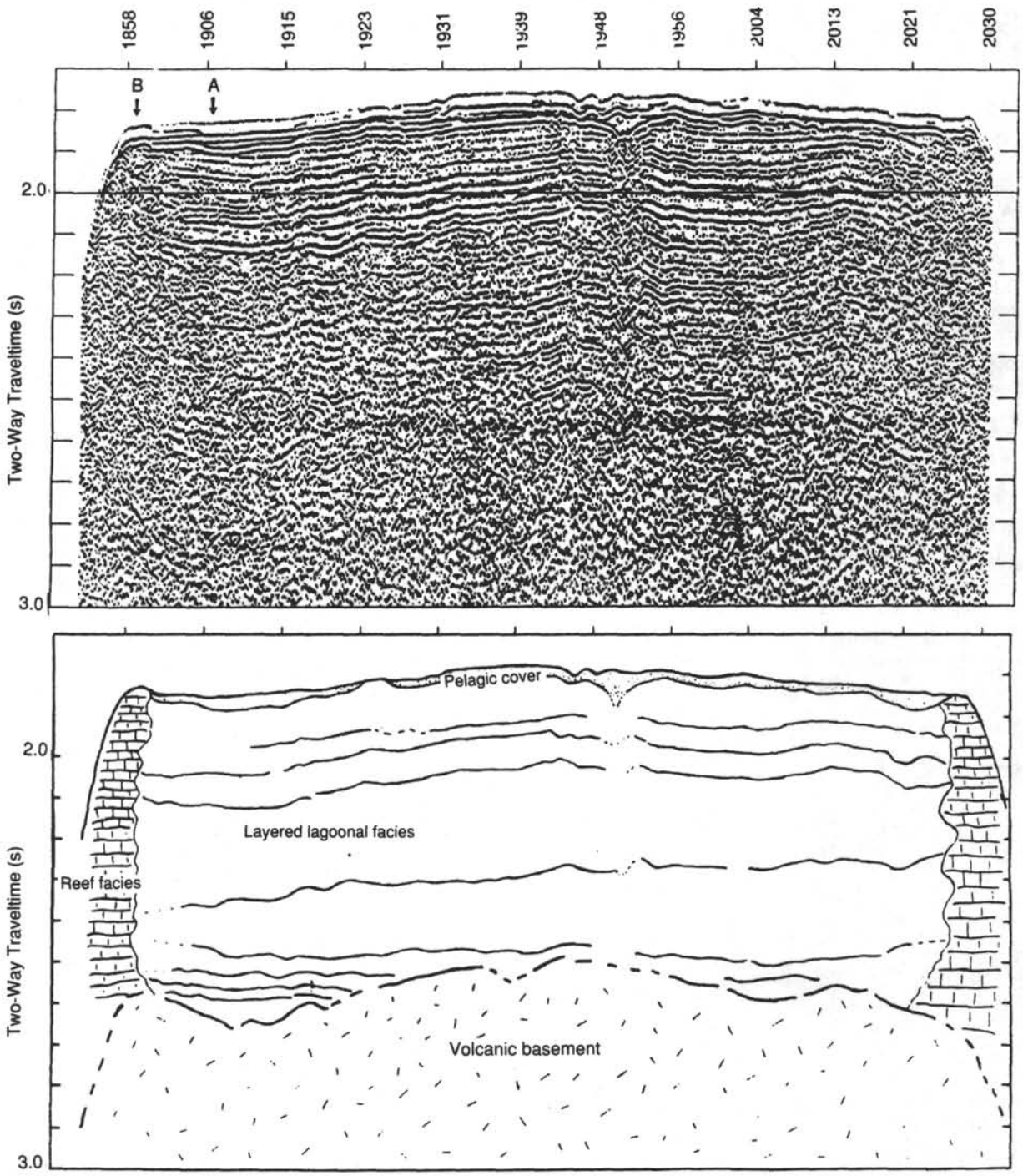
SCIENTIFIC OBJECTIVES: to drill 250-300 m of marginal reef limestones to establish the characteristics of the reef facies and its change with time. To assess the causes of drowning and sea level changes. To examine reef diagenesis.

GRAPHIC SUMMARY, SITE HUE-B

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
860	Albian (?) to late Barremian	2.5	reef limestone	Perimeter reef of atoll	25 - 50 m/my	



Generalized geologic map of Huevo Guyot based on seismic reflection, SeaBeam, and dredge data.
Data collected by R/V Thomas Washington during Leg 10 of the SIO Roundabout Expedition in November 1988.
The proposed drill sites A (lagoonal) and B (reefal) are shown by large circles.
The track of R/V Thomas Washington is shown by a dashed line.
Bathymetric contours at 500 m intervals.



Single-channel seismic reflection profile and geological interpretation of Huevo Guyot. Data collected by R/V Thomas Washington during Leg 10 of the SIO Roundabout Expedition in December 1988.

SITE: SYL-3 (Wodejebato Guyot) PRIORITY: 1

POSITION: 11°00'N, 164°45'E

WATER DEPTH: 4800 m

SEISMIC RECORD: HIG R/V *Moana Wave* MW 8805

SEDIMENT RECORD: none SEDIMENT THICKNESS: >800 m

PROPOSED DRILLING PROGRAM: single bit RCB coring into the top of volcanics

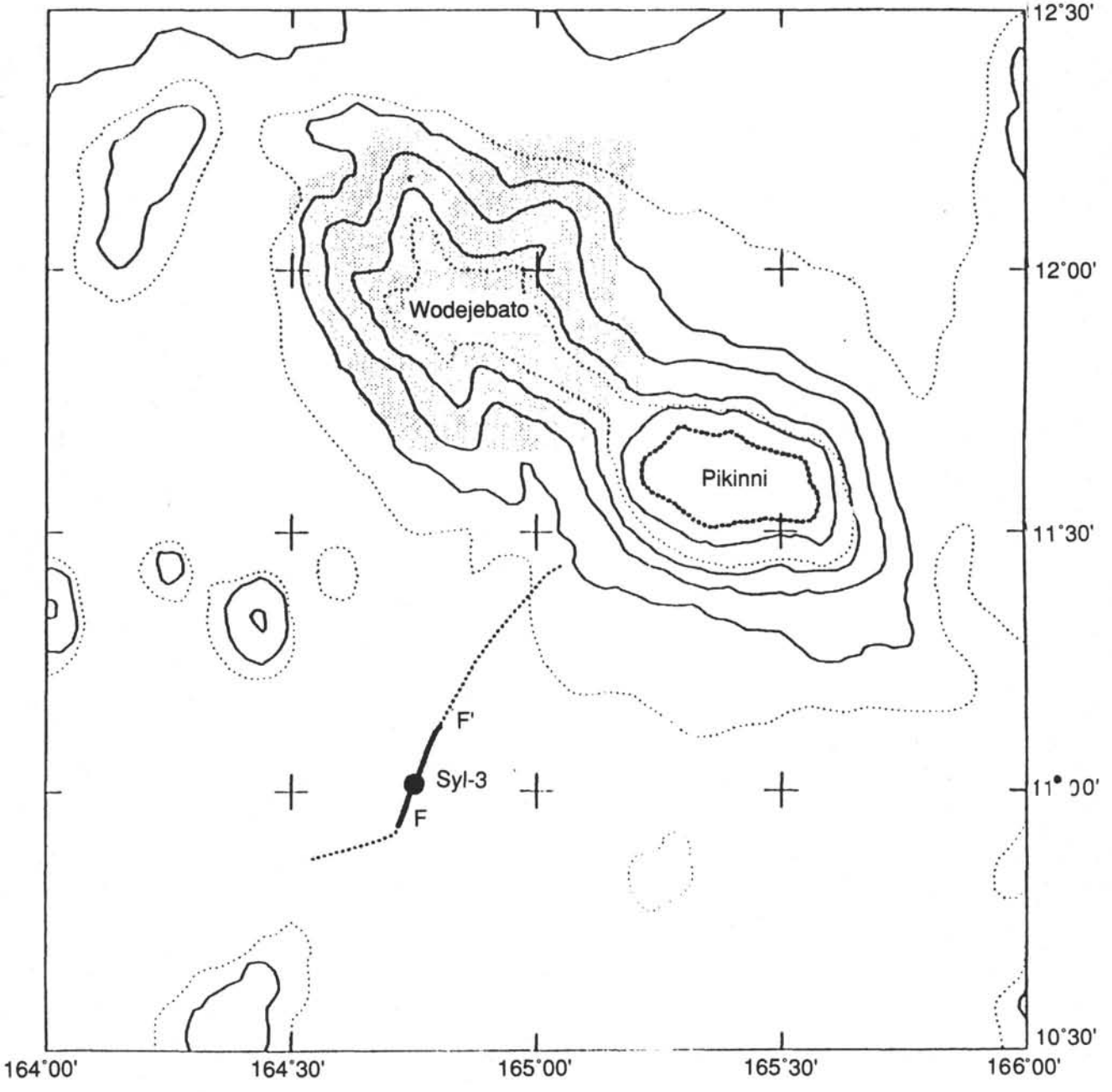
NATURE OF ROCK ANTICIPATED: ca. 850 m of pelagic/turbidite sediments grading to volcanics at the bottom

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS

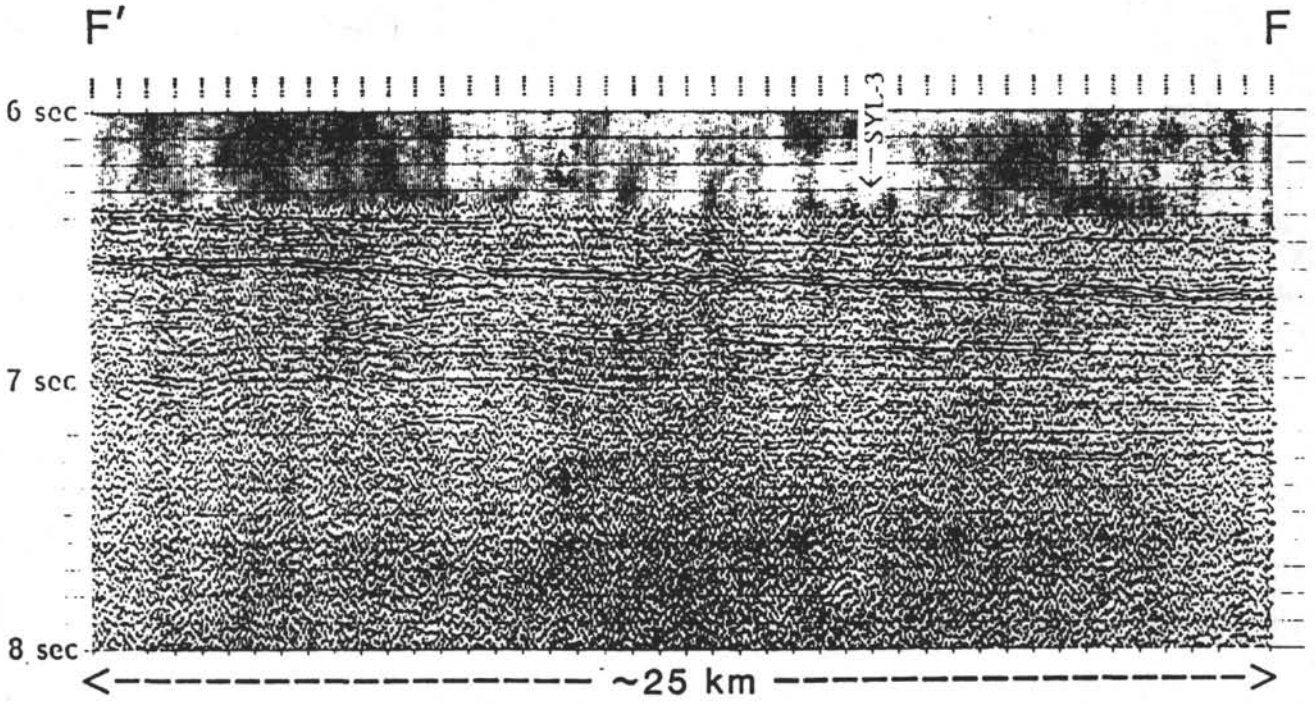
SCIENTIFIC OBJECTIVES: to drill the archipelagic apron flanking Wodejebato (Sylvania) Guyot. To chronicle the history of volcanism and reefing on the guyot. To examine the record of sea level variations preserved in the apron. To study possible causes of drowning of the reefs capping the guyot.

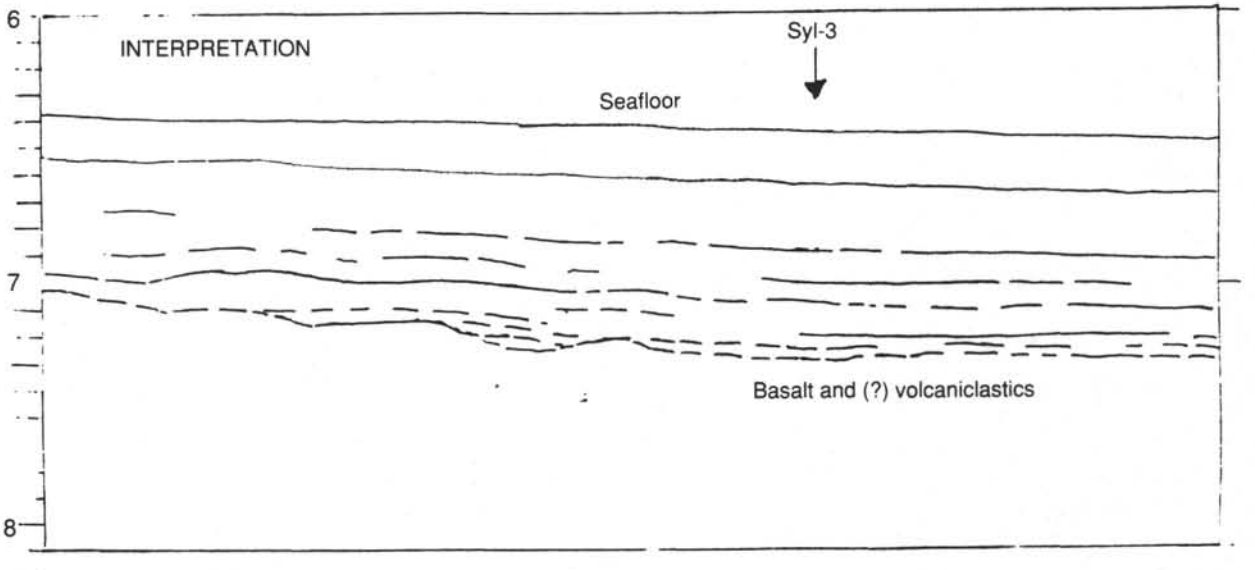
GRAPHIC SUMMARY, SITE SYL-3

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
850	Quaternary to Cretaceous	2.0	Foram-nanno ooze to marly pelagic limestone with turbidite layers	Pelagic	5 - 10 m/my - - - - - - - 40 m/my	
			Basalt and volcaniclastics			



Location of proposed Site SYL-3.





Proposed Site SYL-3 projected on the geological interpretation of seismic profile F-F' obtained during R/V Moana Wave cruise MW8805.

SITE: ANE-1 (Anewetak Atoll) PRIORITY: 1

POSITION: 11°22'N, 162°19'E

WATER DEPTH: 30 m

SEISMIC RECORD: USGS lines 405, 407, and 409

SEDIMENT RECORD: numerous drill holes SEDIMENT THICKNESS: 1450 m

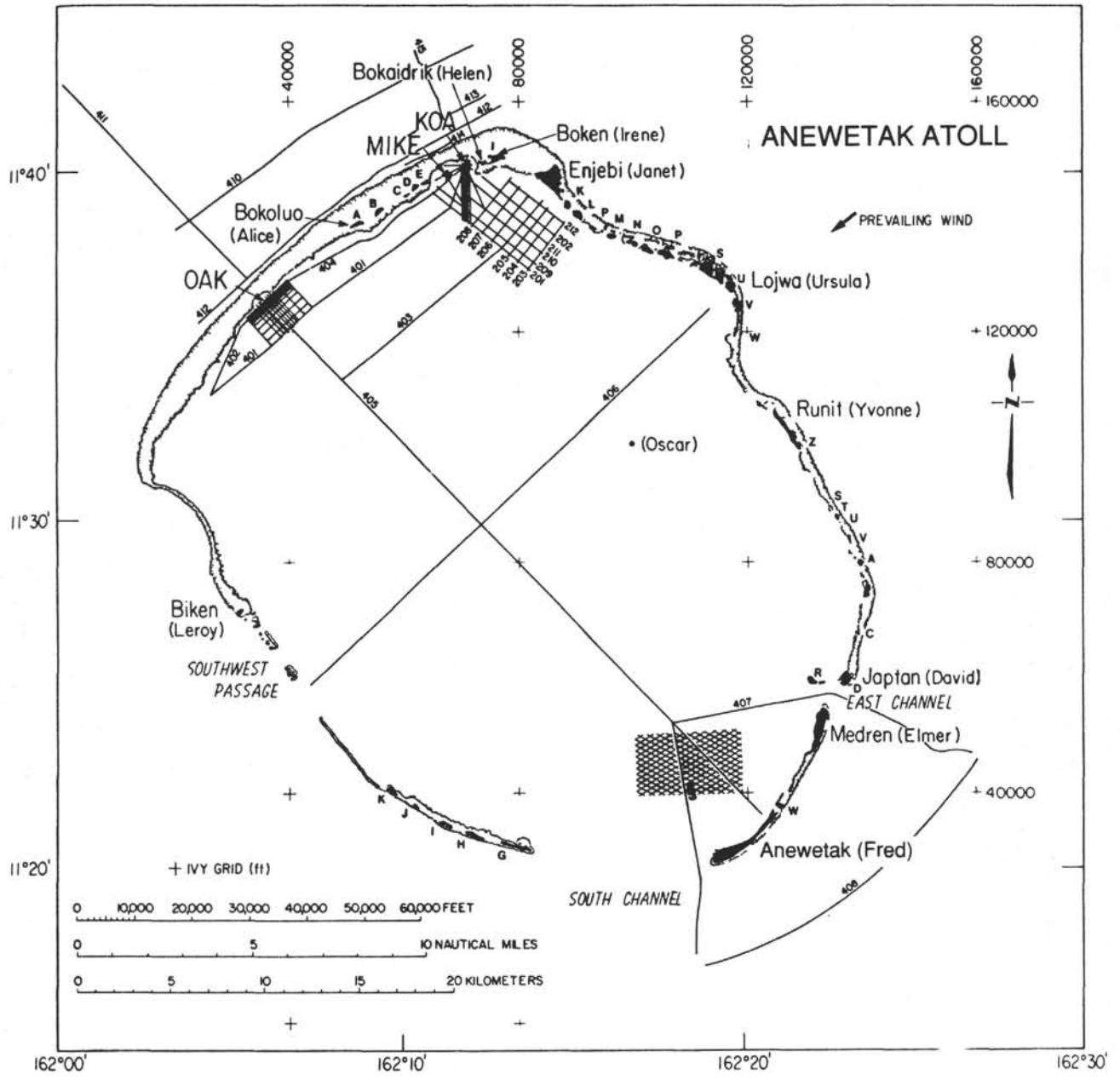
PROPOSED DRILLING PROGRAM: Engineering test of shallow-water drilling

NATURE OF ROCK ANTICIPATED: shallow-water chalk and limestone

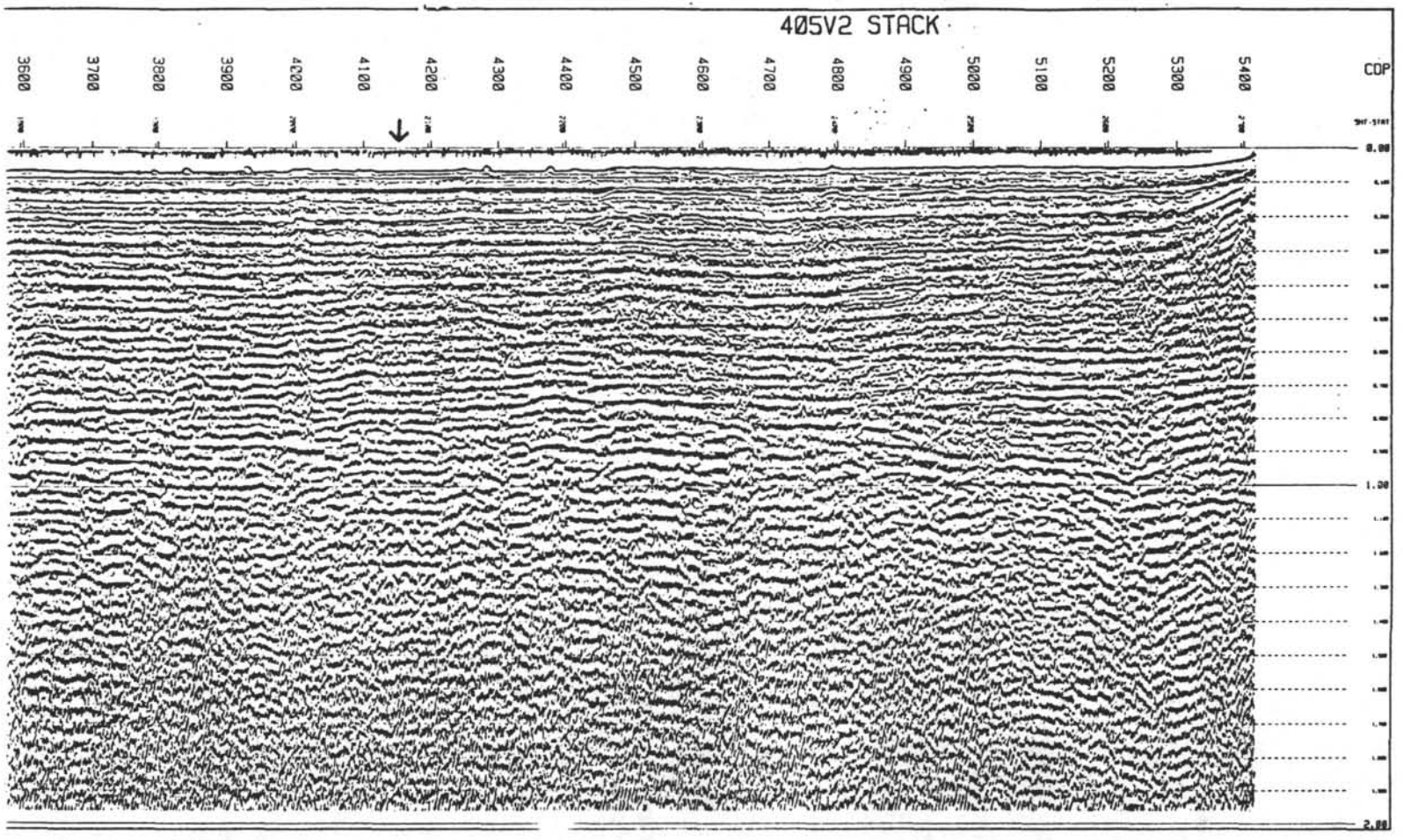
LOGGING: none

GRAPHIC SUMMARY, SITE ANE-1

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
90	Holocene to Pliocene	2.4	Chalk; limestone; coral and foram silts and sands	Shallow lagoonal and near-reef deposits	25 - 50 m/my	
						Solution unconformity
	Miocene					
330						
						Solution unconformity
400						



Sites of U.S.G.S. refraction profile and multi-channel seismic-reflection profiles in Anewetak Atoll, 1984. Proposed Site ANE-1 is to be drilled within the shaded area.



Line 405 seismic profile of Anewetak Atoll obtained by the U.S.G.S. in 1984.
Proposed Site ANE-1 is to be drilled near the area indicated by the arrow.

SITE: HAR-1 (Limalok Guyot) PRIORITY: 1

POSITION: 5°29'N, 172°20'E

WATER DEPTH: 1500 m

SEISMIC RECORD: HIG R/V *Kana Keoki* 810626-02, ~0535Z 2 August 1981

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 500 m

PROPOSED DRILLING PROGRAM: RCB coring into basement, free fall cone if needed

NATURE OF ROCK ANTICIPATED: 40 m of pelagic cap, ca. 460 m of shallow-water limestone, and 50 m of basalt

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: to drill through the marginal reef limestones to establish the characteristics of the reefal facies and its change with time. To determine if there is a Cretaceous reed below the Eocene reef. To determine the timing and causes of demise of the reef related to sea level curves and subsidence history. To examine reef diagenesis. To date the volcanic edifice. To investigate the uplift and subsidence history of the guyot. To determine the paleolatitude of formation of the edifice. To relate the geochemistry of the basalts to the DUPAL/SOPITA anomaly. To correlate seismic reflectors and drowned atoll stratigraphy with Anewetak.

GRAPHIC SUMMARY, SITE HAR-1

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
40	Holocene to Oligocene?	1.7	Foram-nanno ooze to chalk	Pelagic	1 m/my	Greatly winnowed by currents near edge of seamount
500	Eocene to ?	2.6	Limestone	Shallow bank back reef lagoonal	25 - 50 m/my	May contain some dolomitized strata
			Basalt			

SITE: HAR-2 (Limalok Guyot) PRIORITY: 1

POSITION: 5°33'N, 172°21'E

WATER DEPTH: 1300 m

SEISMIC RECORD: HIG R/V *Kana Keoki* 810626-02

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 430 m

PROPOSED DRILLING PROGRAM: double APC coring, with XCB coring across carbonate platform contact, another APC hole in pelagic cap if time permits

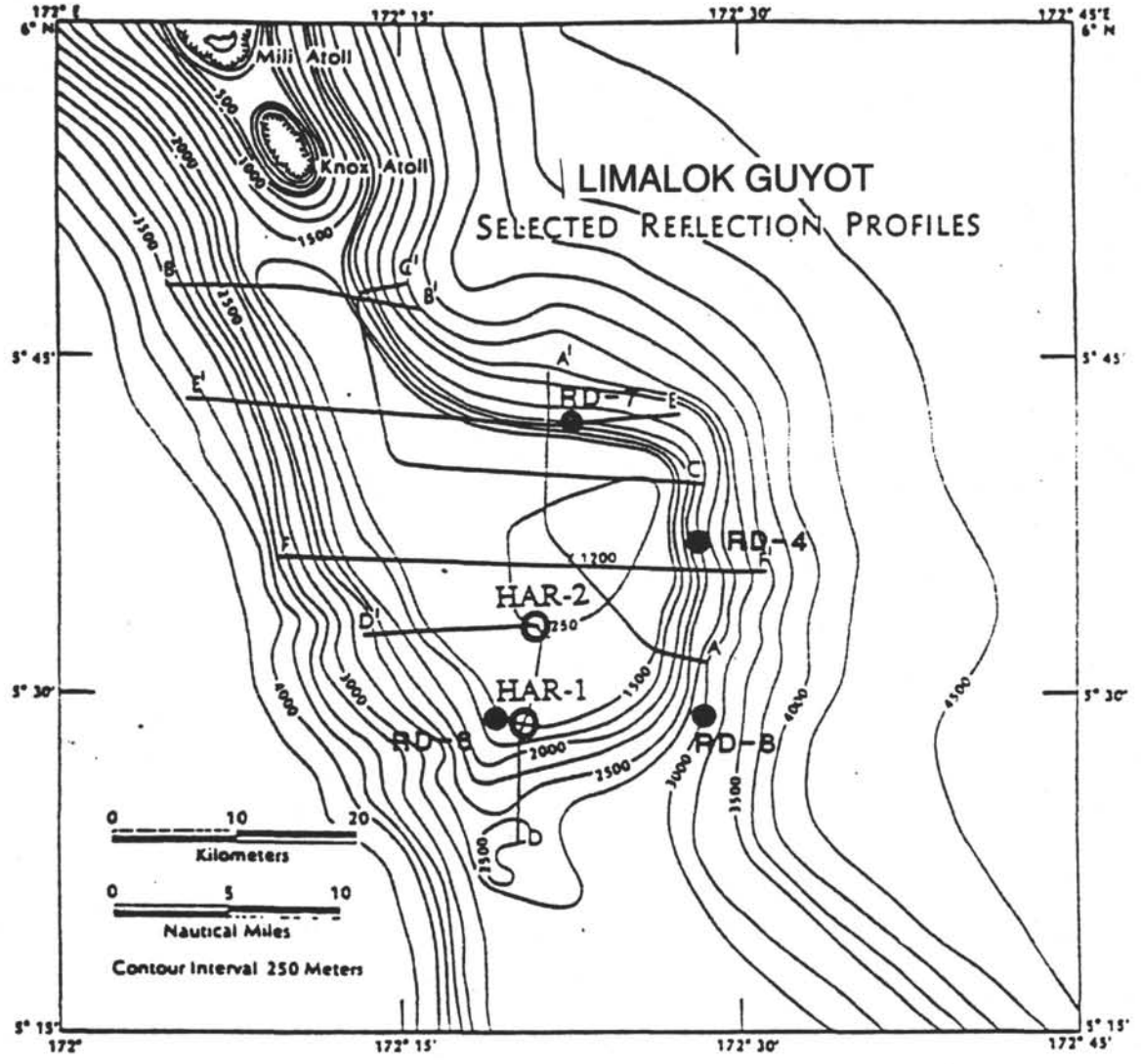
NATURE OF ROCK ANTICIPATED: 170 m of pelagic cap and 260 m of shallow-water limestone

LOGGING: standard Schlumberger, physical properties, and geochemical logging strings, and FMS

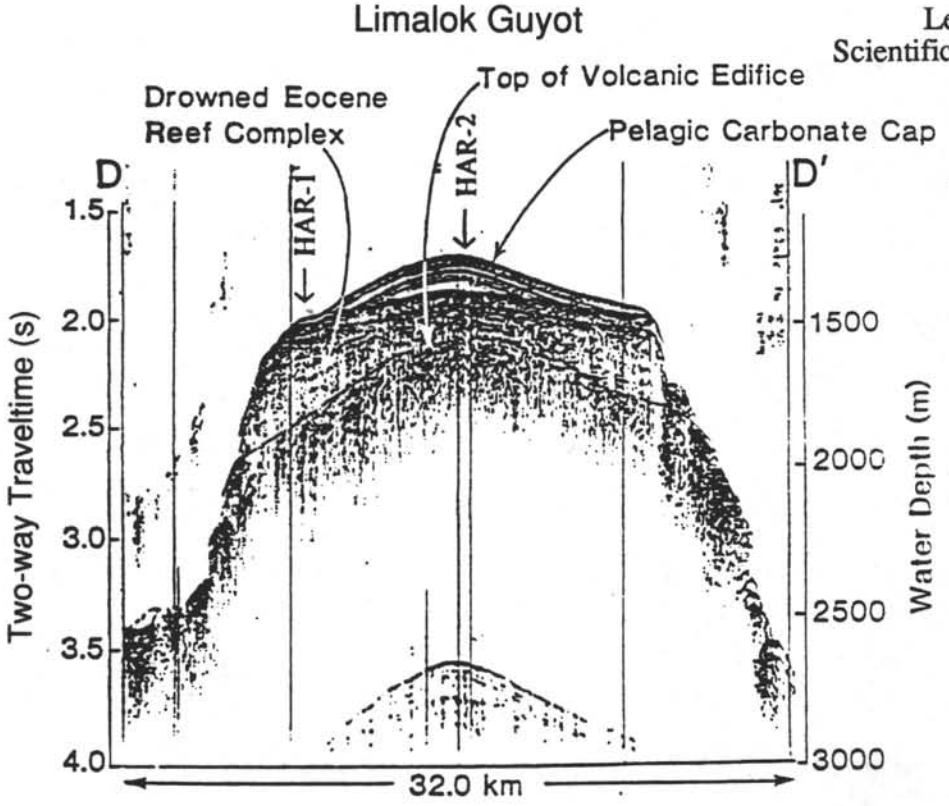
SCIENTIFIC OBJECTIVES: to core pelagic sediments for isotopic and paleoceanographic studies and date the pelagic/lagoonal facies contact. Other objectives the same as for HAR-1 with the exception of the paleolatitude determination and geochemistry of the basalts.

GRAPHIC SUMMARY, SITE HAR-2

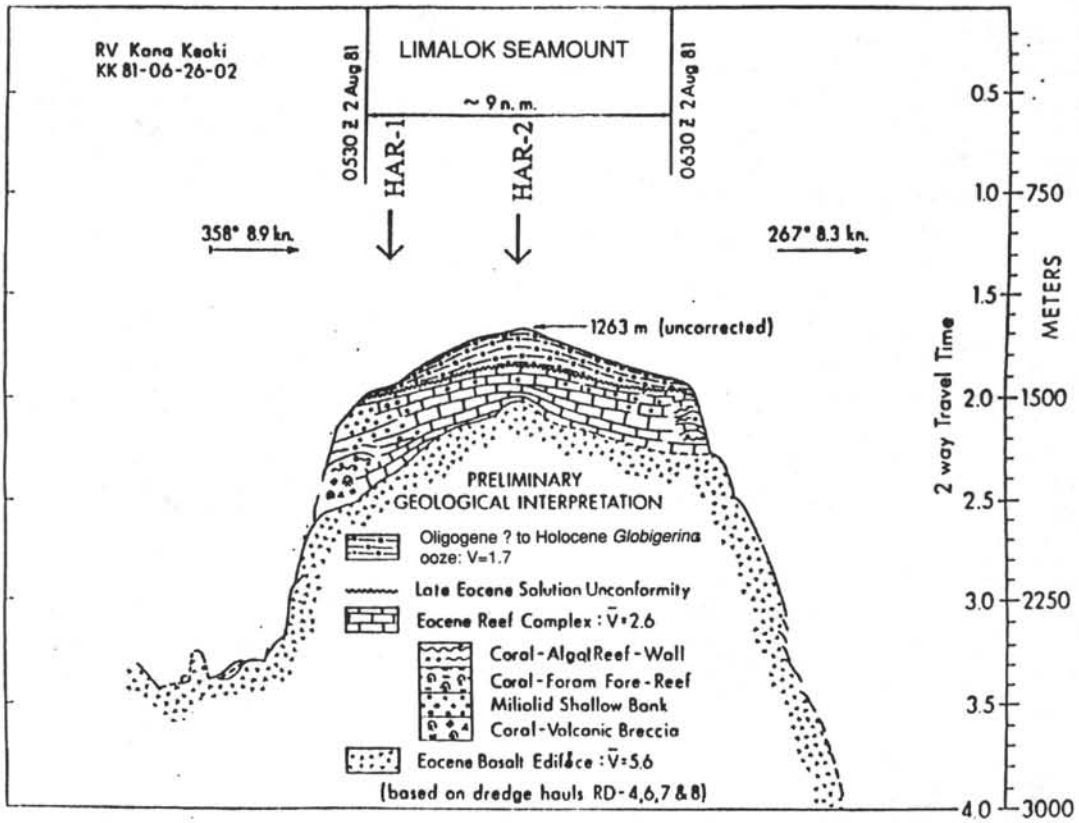
Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
170	Holocene to Oligocene (?)	1.7	Foram-nanno ooze to chalk	Pelagic	2.5 m/my	1) May be winnowed by currents 2) Very thick pelagic cap, one of the most complete carbonate pelagic sections on a guyot
430	Eocene to ?	2.6	Limestone	Lagoon	25 - 50 m/my	1) May contain some dolomitized strata



Bathymetric chart of Limalok Guyot indicating locations of proposed sites HAR-1 and HAR-2 and dredge hauls.



Seismic profile D-D' of Limalok Guyot obtained on R/V Kana Keoki cruise KK810626.



Geological interpretations of seismic profile D-D' of Limalok Guyot.

SITE: PEL-3 (Lo-En Guyot) PRIORITY: 1

POSITION: 10°07'N, 162°48'E

WATER DEPTH: 1080 m

SEISMIC RECORD: HIG R/V *Moana Wave* MW 8805, 1630Z 29 April 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 455 m

PROPOSED DRILLING PROGRAM: RCB coring into basement, free fall cone if needed (A-hole), double APC (B-, C-holes) in pelagic cap if time permits

NATURE OF ROCK ANTICIPATED: 180 m of pelagic cap, ca. 275 m of shallow-water limestone, and 50 m of basalt

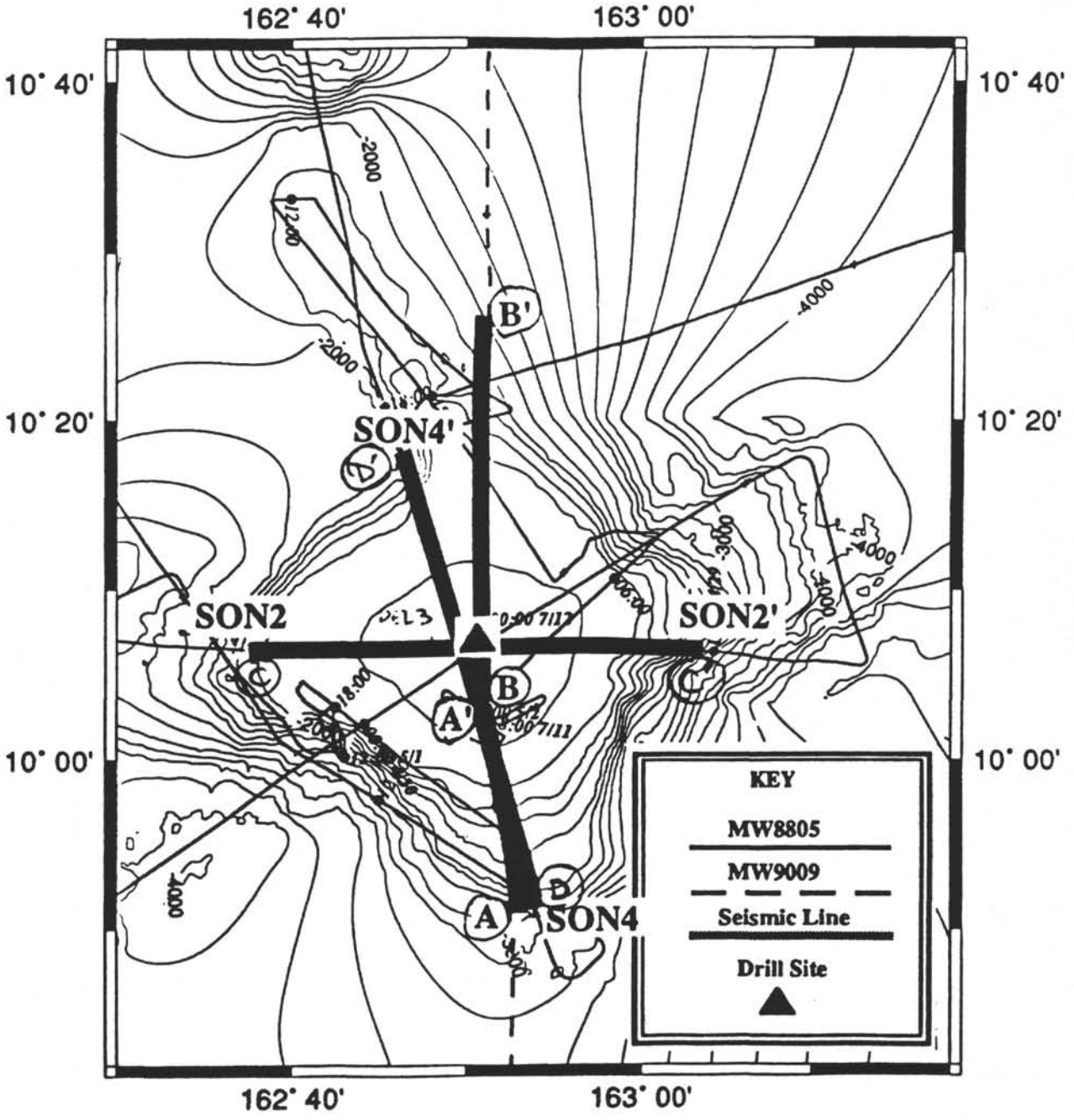
LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

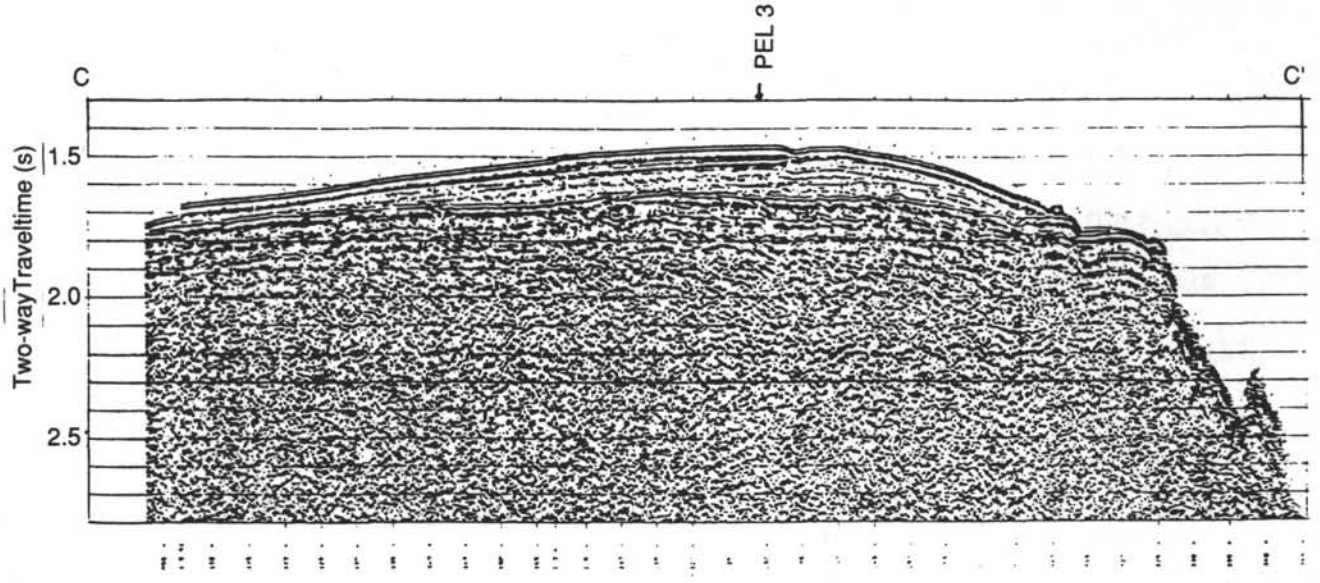
SCIENTIFIC OBJECTIVES: to investigate the paleoceanography of pelagic cap sediments. To relate the acoustic stratigraphy of the cap to its depositional and diagenetic history. To correlate seismic reflectors in the pelagic cap with those seen in other settings. To date the pelagic/limestone interface and infer the age and cause of drowning. To establish the characteristics of shallow-water facies and change with time. To examine the stratigraphy, fauna, growth, drowning, and diagenetic history of the carbonate platform as related to vertical tectonics and sea level history. To compare the stratigraphy and facies of Lo-En Guyot with its living sibling Anewetak that has a past history of an Eocene bank outcrop of the volcanic basement. To date the volcanic edifice, determine the paleolatitude of formation, and acquire geochemical data for comparison with other sites and the DUPAL/SOPITA anomaly.

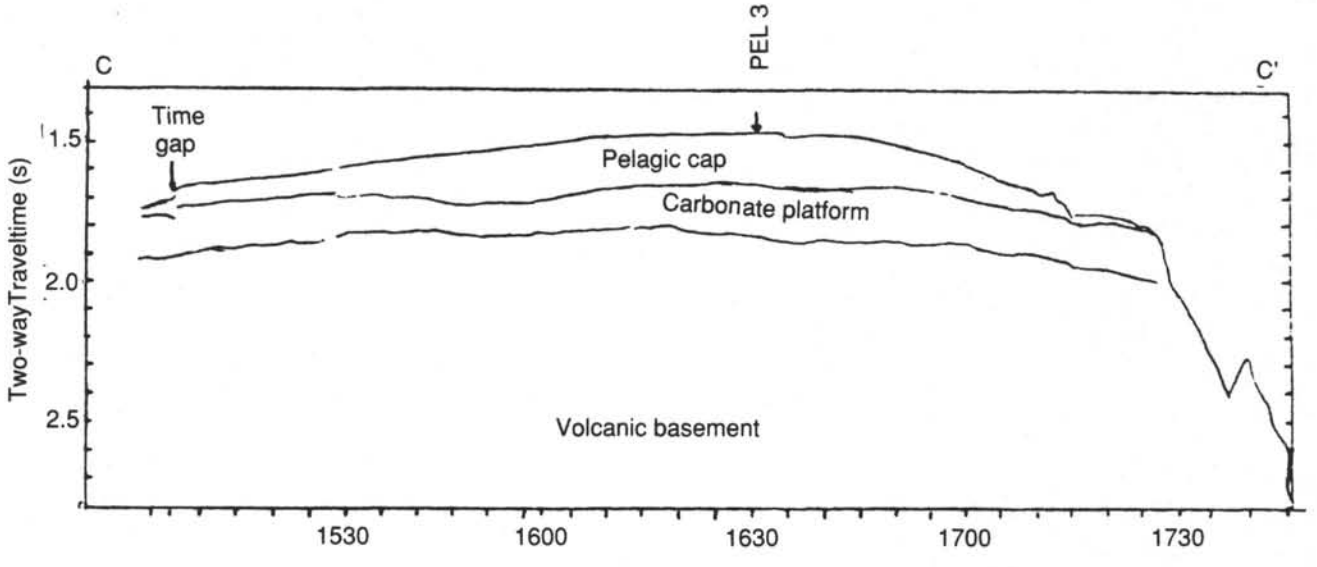
GRAPHIC SUMMARY, SITE PEL-3

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
180	Holocene to Eocene?	1.8	Foram-nanno ooze and chalk	Pelagic	4.5 m/my	1) One of the most complete carbonate pelagic sequences in the region of a guyot 2) May contain some hiatuses
455	Eocene to Albian?	2.5	Limestone	Carbonate platform	25 - 50 m/my	1) Some strata may be dolomitized 2) Some strata may be oolitic deposits
			Basalt			

LO-EN GUYOT


162° 40'
163° 00'
10° 40'
10° 20'
10° 00'
SON4'
SON2
SON2'
SON4
A
A'
B
B'
C
C'
D
D'
KEY
MW8805
MW9009
Seismic Line
Drill Site





Seismic reflection profile and geological interpretation of Lo-En Guyot.
Data obtained in April 1988 by R/V Moana Wave cruise 8805.

SITE: SYL-1 (Wodejebato Guyot) PRIORITY: 1

POSITION: 11°59'N, 164°56'E

WATER DEPTH: 1350 m

SEISMIC RECORD: HIG R/V *Moana Wave* MW 9009, 13 July 1990, 2001-2145 GMT.

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: 200 m

PROPOSED DRILLING PROGRAM: RCB coring to basement, free fall cone if needed (A-hole), double APC (B-, C-holes) in pelagic cap if time permits

NATURE OF ROCK ANTICIPATED: 80 m of pelagic cap, ca. 120 m of shallow-water limestone, and 50 m of basalt

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: To relate the acoustic stratigraphy of the cap to its depositional and diagenetic history. To correlate seismic reflectors in the pelagic cap with those seen in other settings. To date the pelagic/limestone interface. To establish the characteristics of the Cretaceous through Eocene shallow-water facies and the nature of the changes in fauna and flora with time. To examine the diagenesis of the shallow-water limestones. To determine the drowning, emergence, and subsidence history of the atoll limestone relative to sea level. To date the volcanic edifice. To determine the paleolatitude of formation of the volcanic edifice. To obtain the geochemical signature of the volcanic edifice compared to other sites and the DUPAL/SOPITA anomaly.

GRAPHIC SUMMARY, SITE SYL-1

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
80	Holocene to late Eocene	1.8	Foram-nanno ooze and chalk	Pelagic	2 m/my	1) Winnowed by currents 2) Hiatuses
200	Early Eocene to Albian	2.5	Limestone	Back-reef and lagoon	25 - 50 m/my	1) Volcaniclastic strata may be present 2) Hiatuses 3) Some strata may be dolomitized
			Basalt	Volcanic edifice		

SITE: SYL-2A (Wodejebato Guyot) PRIORITY: 1

POSITION: 11°54'N, 164°55'E

WATER DEPTH: 1350 m

SEISMIC RECORD: HIG R/V *Moana Wave* MW 9009, 13 July 1990, 2001-2145 GMT

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 200 m

PROPOSED DRILLING PROGRAM: APC coring, with XCB coring across carbonate platform contact, another APC hole if time permits

NATURE OF ROCK ANTICIPATED: 90 m of pelagic cap and ca. 110 m of shallow-water limestone

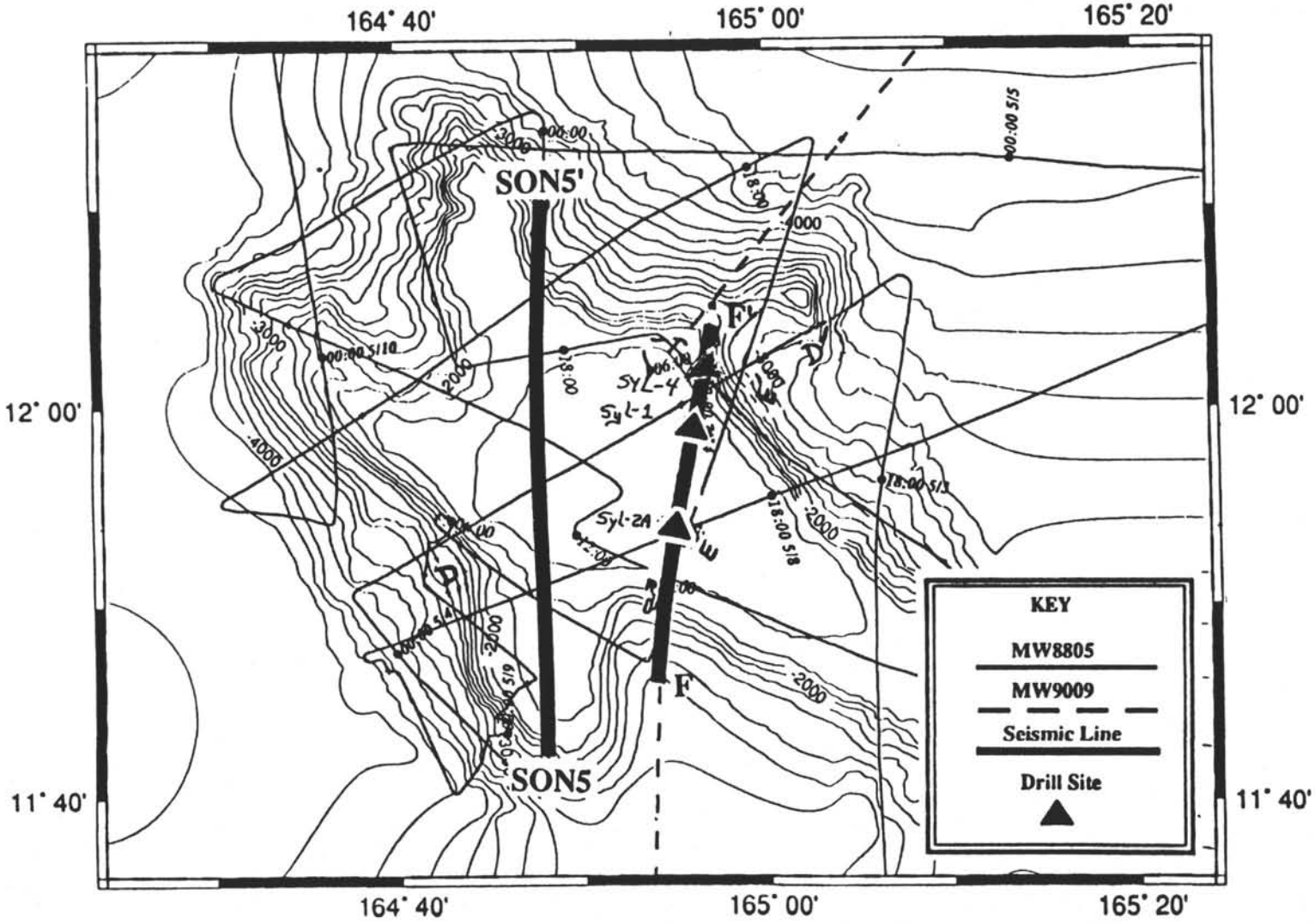
LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS

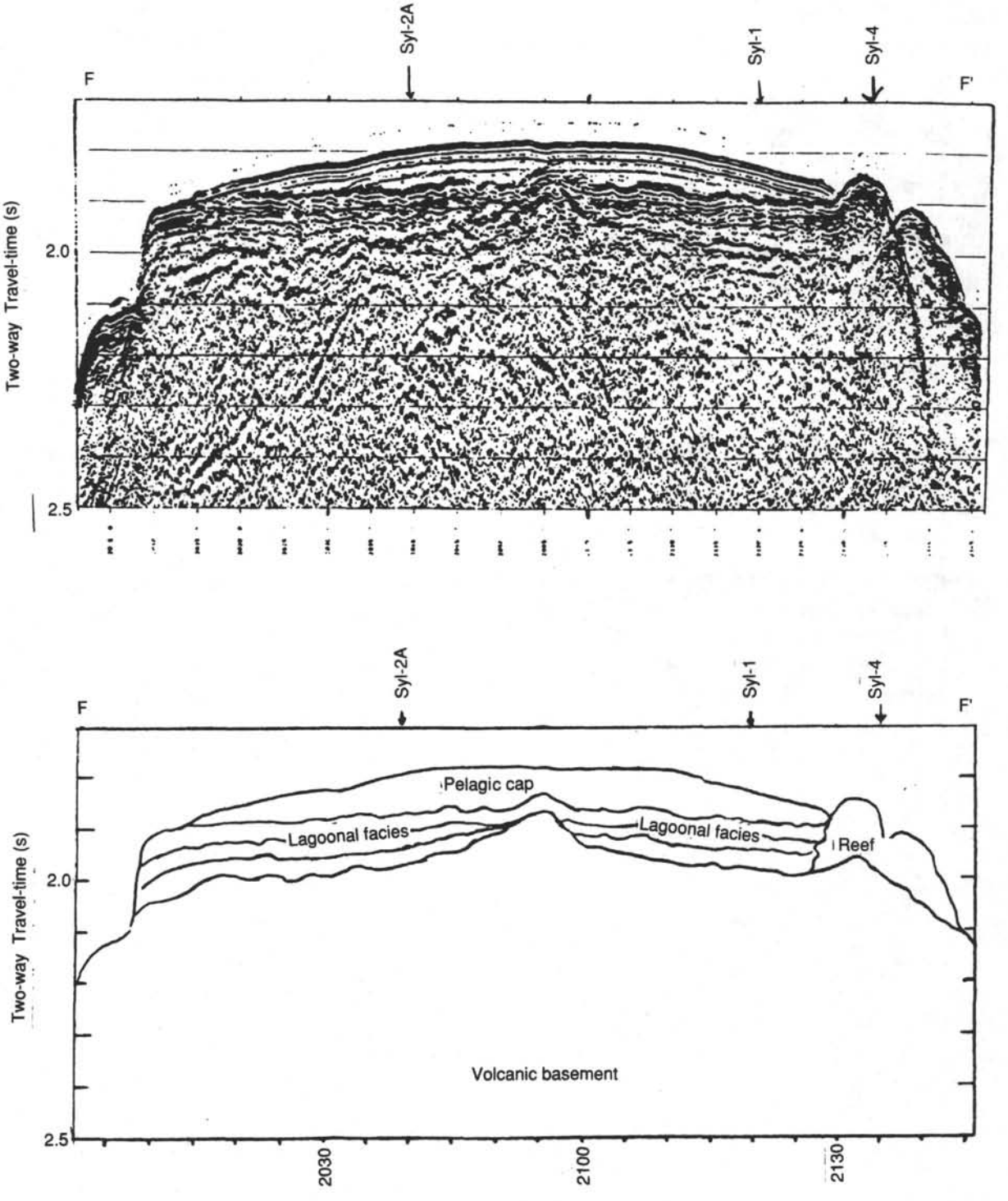
SCIENTIFIC OBJECTIVES: same as for SYL-1 with the exception of paleolatitude determination and geochemistry of the basalts.

GRAPHIC SUMMARY, SITE SYL-2A

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
90	Holocene to late Eocene	1.8	Foram-nanno ooze and chalk	Pelagic	2 m/my	1) Winnowed by currents 2) Hiatuses
200	Early Eocene to Albian	2.5	Limestone	Lagoon	25 - 50 m/my	1) Volcaniclastic strata may be present 2) Hiatuses 3) Some strata may be dolomitized

WODEJEBATO GUYOT





Seismic reflection profile and geological interpretation of Wodejebato Guyot.
Data obtained in July 1990 by R/V Moana Wave cruise 9009.

SITE: MIT-1(E) PRIORITY: 1

POSITION: 27°19'N, 151°53'E

WATER DEPTH: 1400 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 10, 1050Z/ 18 Nov. 1988 (profile B-B') as part of 90-mile web of seismic lines on guyot summit

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 650 m

PROPOSED DRILLING PROGRAM: RCB coring into basement, with multiple reentry and mini-HRB

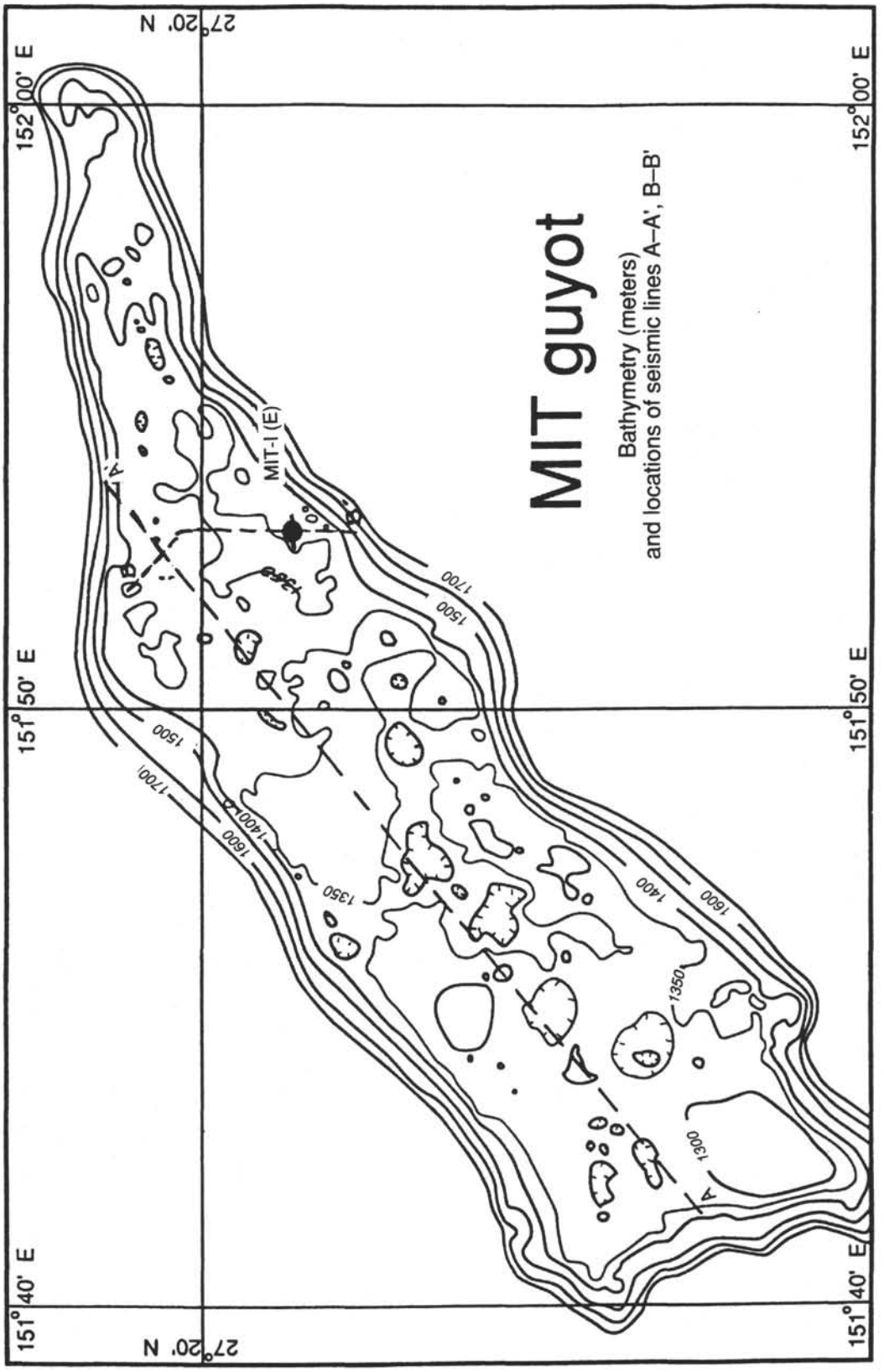
NATURE OF ROCK ANTICIPATED: ca. 650 m of shallow-water limestone and 200 m of basalt

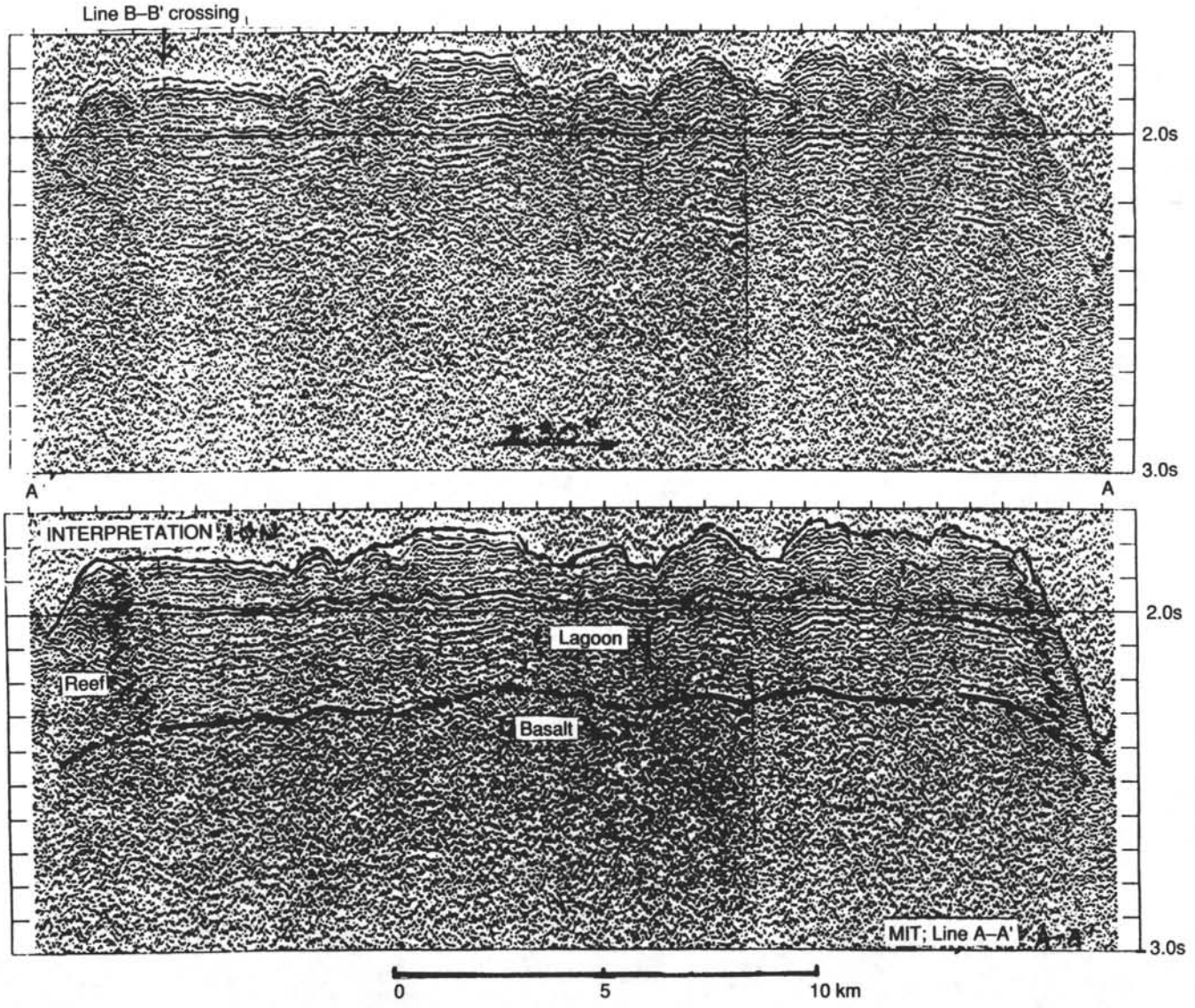
LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: to examine the effects of emergence and karsting on the shallow-water limestone cap. To examine the straitgraphy, faunas, floras, growth, and diagenetics history of the carbonate platform as related to vertical tectonics and sea level history. To date the volcanic edifice and obtain the paleolatitude. To obtain geochemical data from the volcanic edifice for comparison with other sites and the DUPAL/SOPITA anomaly.

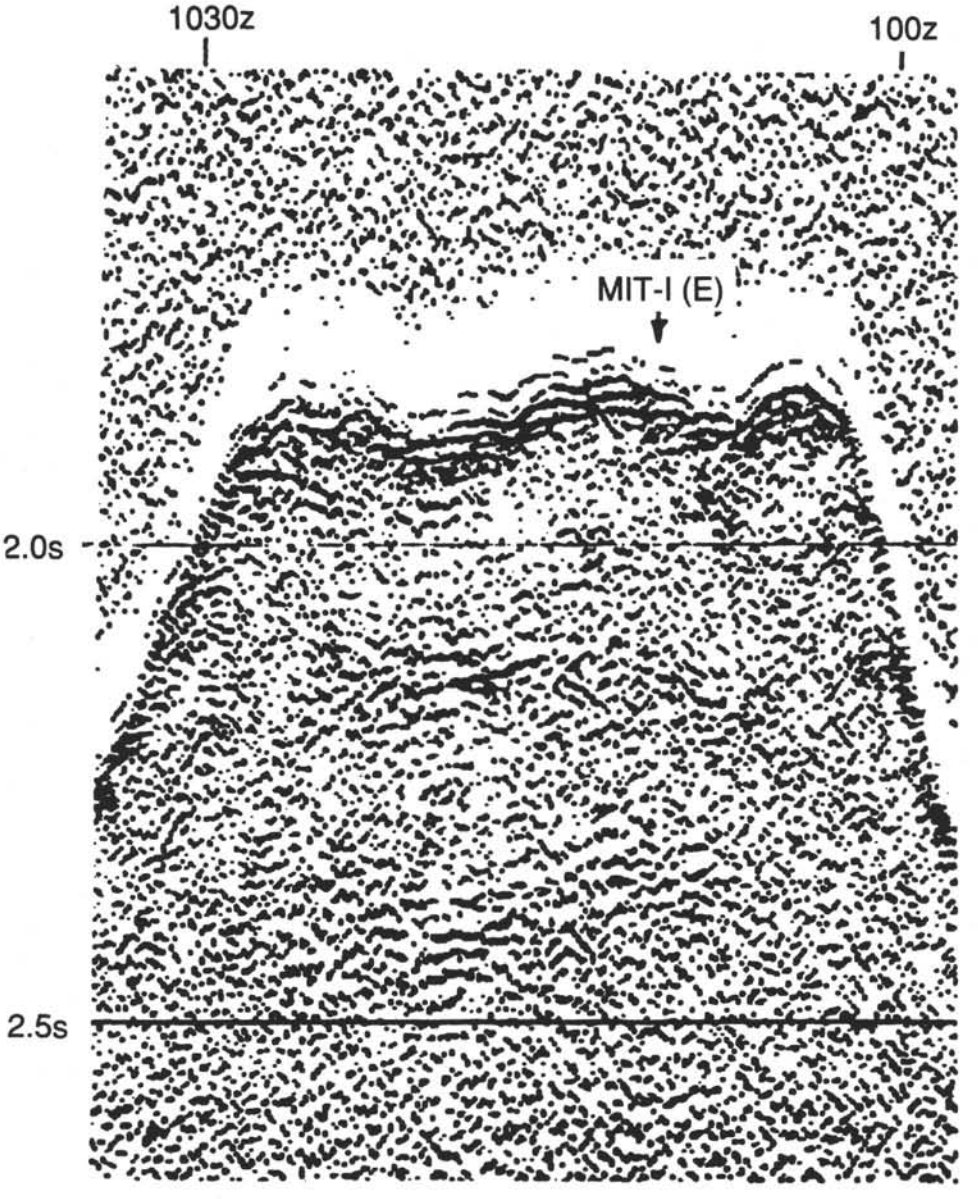
GRAPHIC SUMMARY, SITE MIT-1(E)

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
650	Albian to late Barremian	2.5	Limestone	Backreef lagoon in atoll	50 m/my	
			Basalt			

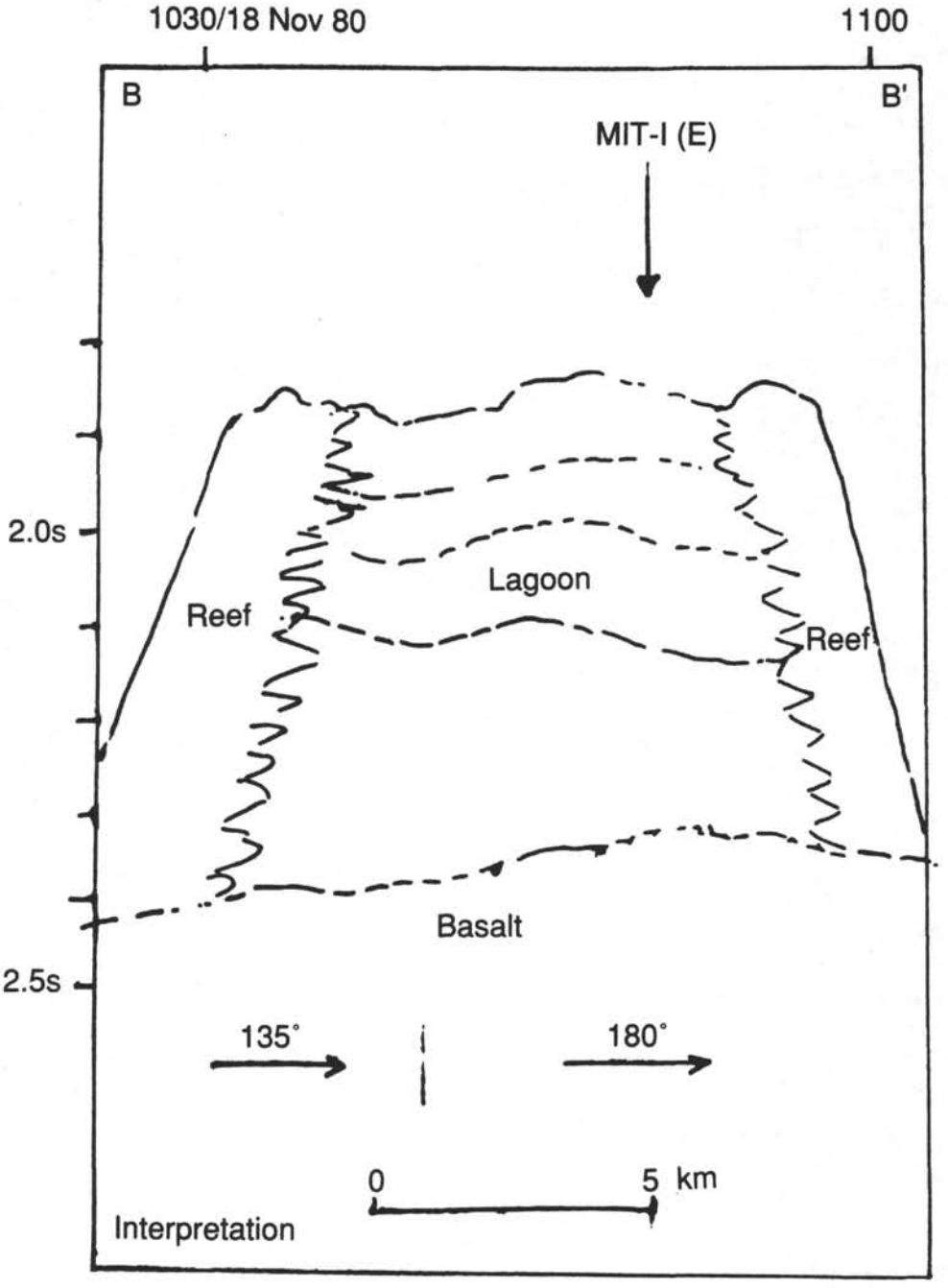

MIT guyot
Bathymetry (meters)
and locations of seismic lines A–A', B–B'
MIT-I (E)
A
A'
B
B'
1350
1400
1500
1600
1700
27°20' N
151°40' E
151°50' E
152°00' E



Line A-A' seismic reflection profile and geological interpretation of MIT Guyot.



Line B-B' single-channel seismic reflection profile of MIT Guyot including the location of proposed Site MIT-1(E).



Line B-B' geological interpretation of MIT Guyot including the location of proposed Site MIT-1(E).

SITE: SEIKO-1 PRIORITY: 1

POSITION: 34°13'N, 144°19'E

WATER DEPTH: 1550 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 11, 1237Z/10 Nov. 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 125 m

PROPOSED DRILLING PROGRAM: RCB coring into basement

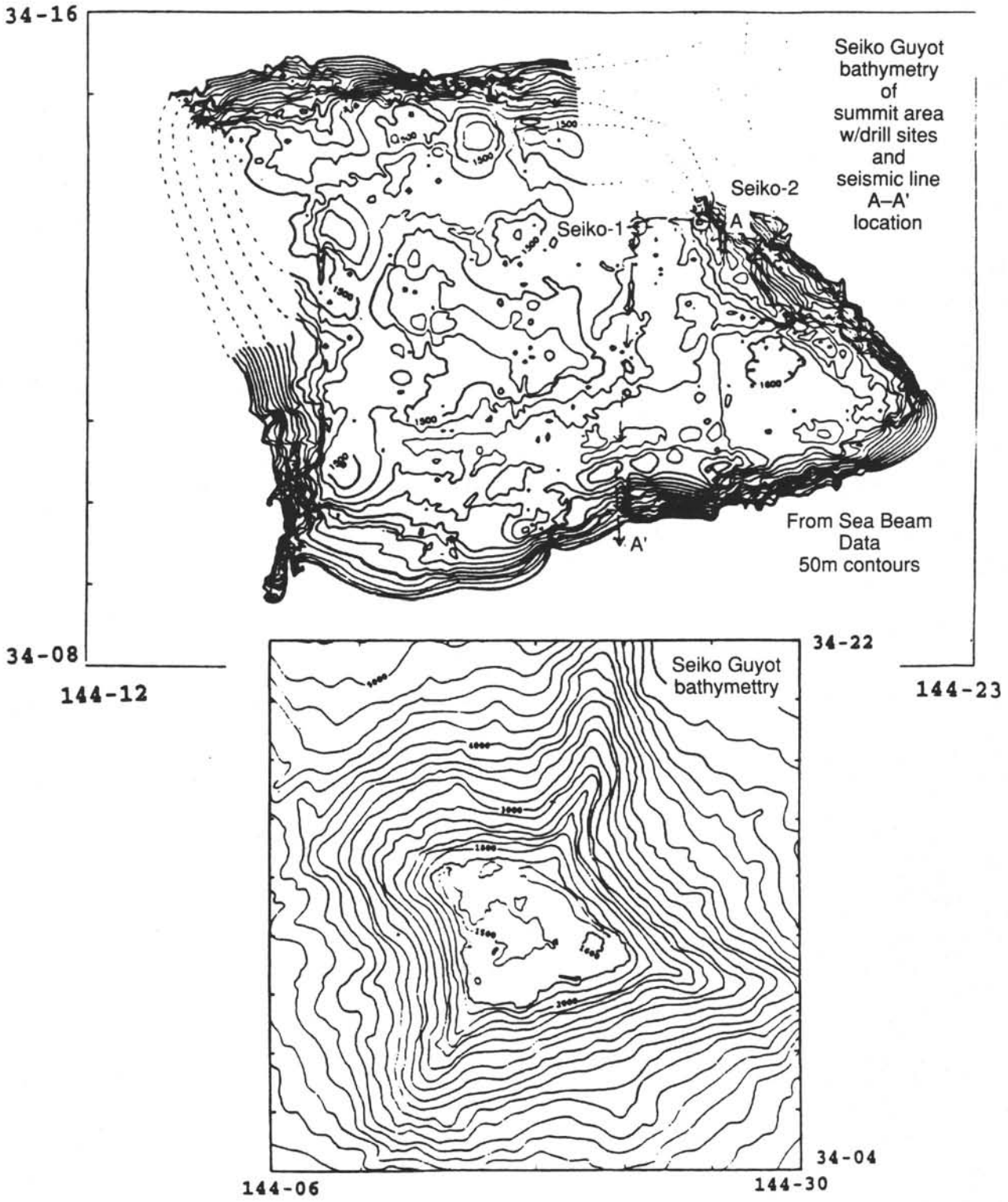
NATURE OF ROCK ANTICIPATED: ca. 30 m of pelagic cap, 95 m of shallow-water limestone, and 50 m of basalt

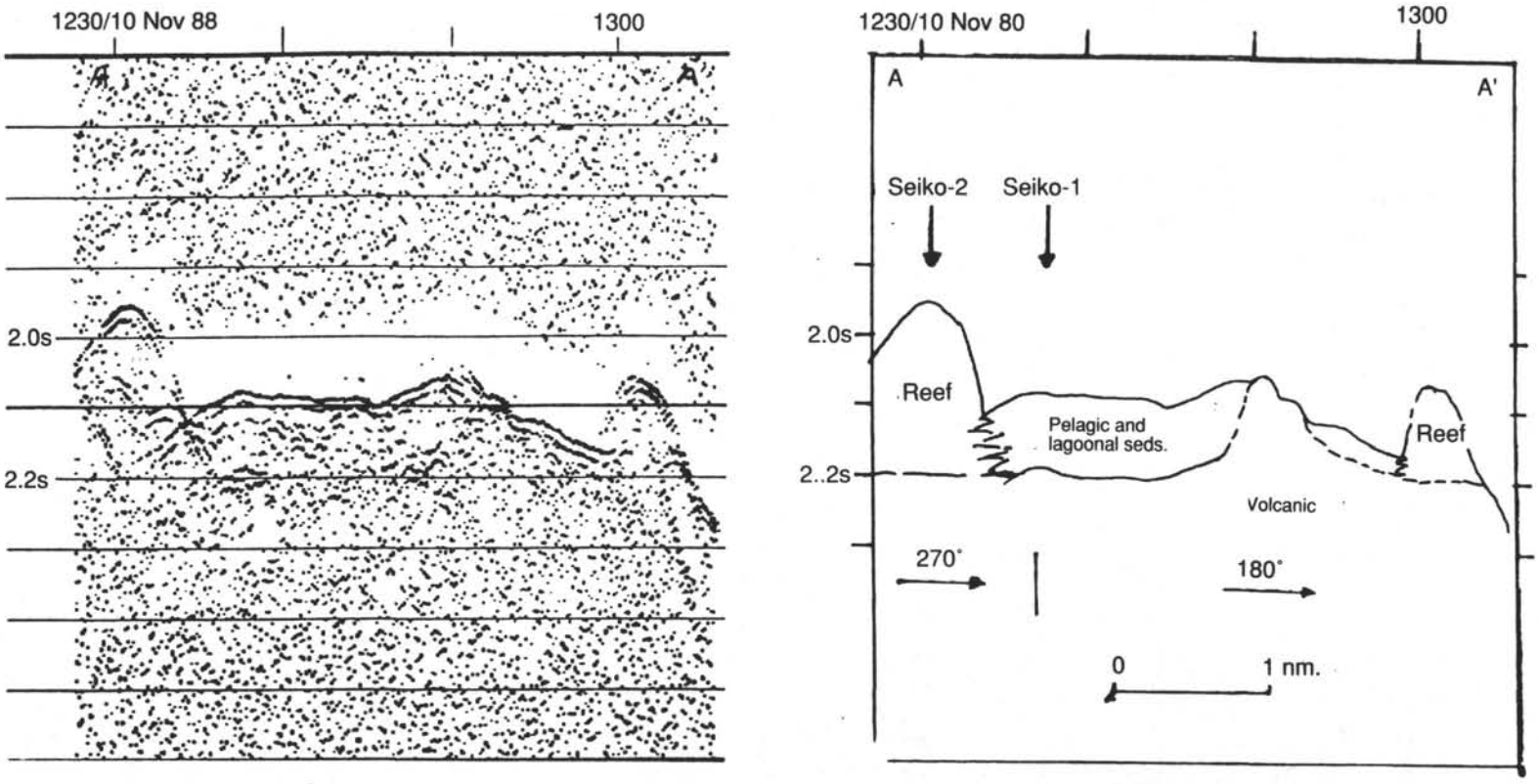
LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: to date the drowning of the atoll and determine its cause. To examine the record of sea level fluctuations, emergence, and karsting on the lagoonal sediments. to examine the stratigraphy, faunas, floras, growth, and diagenetic history of the drowned atoll as related to vertical tectonics and sea level history. To date the volcanic edifice and acquire geochemical data for comparison with the South Pacific DUPAL/SOPITA anomaly.

GRAPHIC SUMMARY, SITE SEI-1

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
30	Cenozoic (?)	1.8	Foram ooze	Pelagic	~5 m/my	
125	Early Cretaceous (?)	2.5	Limestone	Lagoon	~5 m/my	
			Basalt	Subaerial		


34-16
Seiko Guyot
bathymetry
of
summit area
w/drill sites
and
seismic line
A–A'
location
Seiko-2
Seiko-1
A
A'
From Sea Beam
Data
50m contours
34-08
144-12
34-22
144-23
Seiko Guyot
bathymettry
34-04
144-06
144-30



Line A-A' seismic reflection profile and geological interpretation of Seiko Guyot.

SITE: SYL-4 (Wodejebato Guyot) PRIORITY: 2

POSITION: 12°04'N, 164°58'E

WATER DEPTH: 1390 m

SEISMIC RECORD: HIG R/V *Moana Wave*, MW 9009, 13 July 1990, 2001-2145 GMT

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 200 m

PROPOSED DRILLING PROGRAM: RCB coring, with mini-HRB

NATURE OF ROCK ANTICIPATED: ca. 200 m of shallow-water limestone

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS

SCIENTIFIC OBJECTIVES: to date the perimeter reefing history. To examine the record of sea level fluctuations, as well as karsting and its effects on reefs. Other objectives the same as for SEI-1.

GRAPHIC SUMMARY, SITE SYL-4

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
200	Holocene to Early Cretaceous	2.5	Reef Limestone	Reef	25 - 80 m.y.	

SITE: 801C PRIORITY: 2

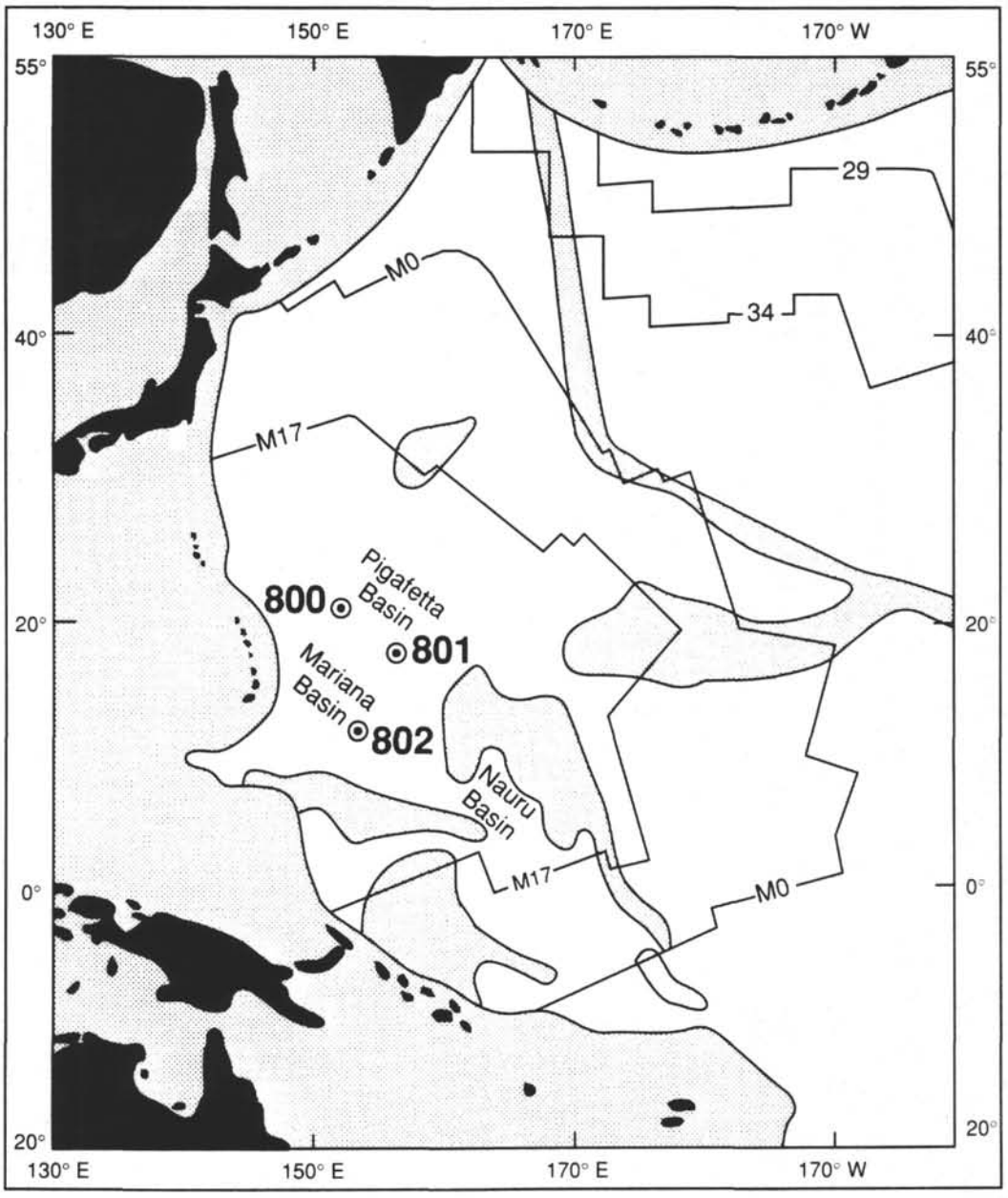
POSITION: 18°38.54'N, 156°21.58'E

WATER DEPTH: 5674 m

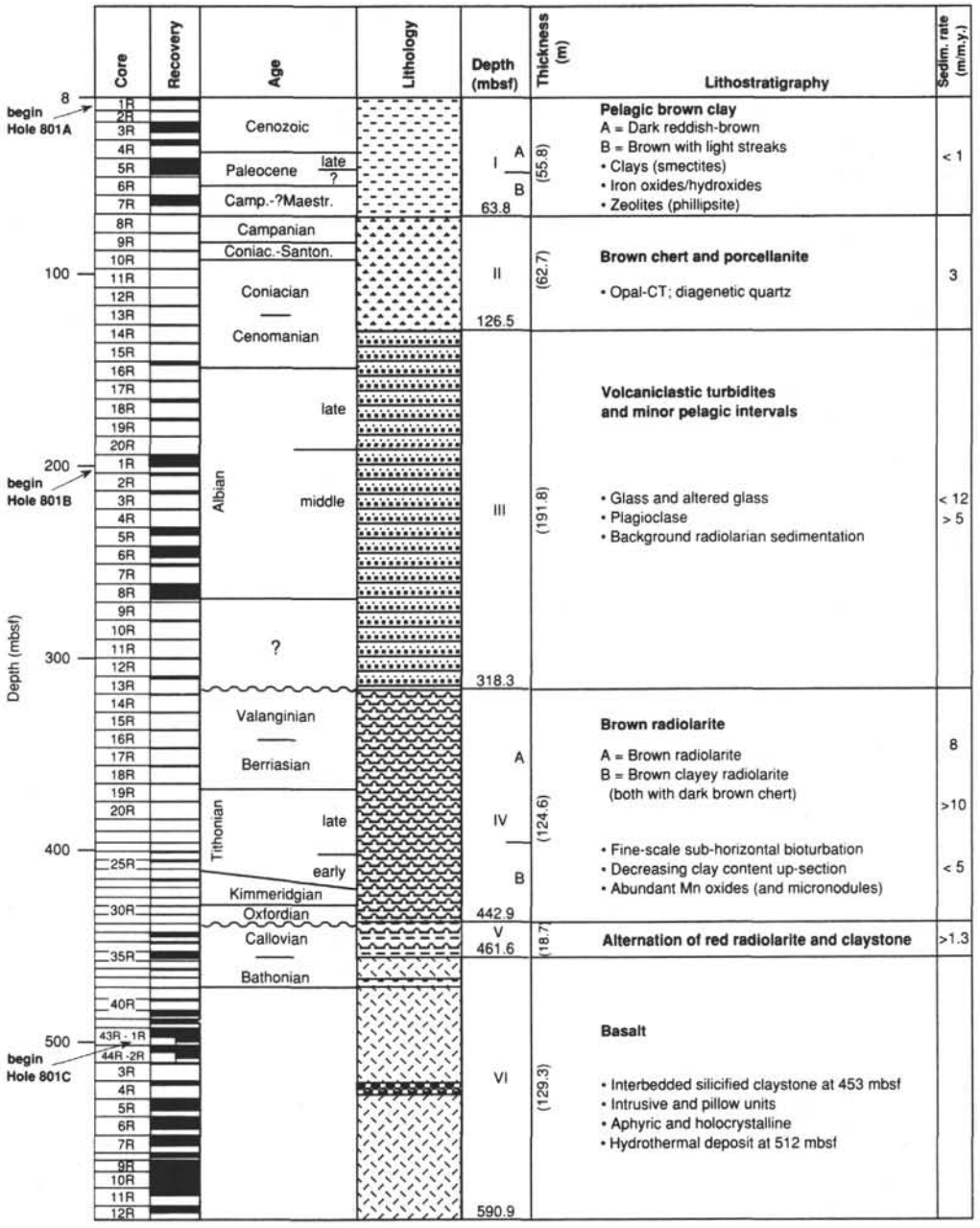
SEISMIC RECORD: *Fred Moore* 35-12 96-channel seismic line 10 2330Z, 24 Nov 1987; NORDA aeromagnetics, shipboard magnetics (Handschumacher)

LOGGING: standard Schlumberger physical properties and geochemical logging strings, FMS, borehole televiewer, downhole magnetometer, and drill-stem packer

SCIENTIFIC OBJECTIVES: complete logging program originally intended for Leg 129.



Bedrock isochrons determined from magnetic anomaly lineation mapping on the Pacific plate (from Larson et al., 1985) superimposed on groups of islands, atolls, and guyots in the western Pacific Ocean. Circles denote locations of ODP Leg 129 Sites 800, 801 and 802.



Stratigraphy of ODP Leg 129 Holes 801A, 801B, and 801C.

SITE: SEIKO-2 PRIORITY: 2

POSITION: 34°14'N, 144°20'E

WATER DEPTH: 1450 m

SEISMIC RECORD: SIO, *Roundabout*, Leg 10, 1230Z/10 Nov. 1988

SEDIMENT RECORD: rock dredges SEDIMENT THICKNESS: ca. 250 m

PROPOSED DRILLING PROGRAM: RCB coring, with mini-HRB

NATURE OF ROCK ANTICIPATED: ca. 250 m of shallow-water limestone and 50 m of basalt

LOGGING: standard Schlumberger, physical properties, and geochemical logging strings, FMS, borehole televiewer, and downhole magnetometer

SCIENTIFIC OBJECTIVES: to date the perimeter reef. To examine the effects of sea level fluctuations, emergence, and karsting on the reef.

GRAPHIC SUMMARY, SITE SEI-2

Sub-bottom depth (m)	*Age*	*Assumed velocity (km/sec)*	*Lithology*	*Paleo-environment*	*Average rate of sediment accumulation*	*Comments*
250	Holocene to Early Cretaceous	2.5	Reef limestone	Reef	~50 m/my	
			Basalt	Subaerial		

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