## 5. SITE 70

#### Shipboard Scientific Party<sup>1</sup>

# SITE DATA

Occupied: October 23-November 1.

Position: Latitude 6° 20.08'N. Longitude 140° 21.72'W.

Water Depth: 5059 meters.

Total Depth: 388 meters, bottom in middle Eocene chert.

Holes Drilled: Three holes.

Cores Taken: Forty-six cores (70-12; 70A-30; 70B-4). Continuous 0 to 331 meters, 383 to 388 meters.

#### RESULTS

An almost complete stratigraphic section was recovered from Quaternary to middle Eocene, consisting of the following lithologic units:

- An upper radiolarian ooze unit (0 to 20 meters) of Quaternary, Pliocene and upper Miocene age; and a cyclic unit of radiolarian ooze and radiolarian-nannofossil ooze (20 to 45 meters) of middle and lower Miocene age.
- A highly calcareous unit of radiolariannannofossil and nannofossil ooze (45 to 324 meters) that becomes a chalk below 177 meters, of lower Miocene and Oligocene age.
- 3) A lower radiolarian ooze unit, semi-indurated, 324 to 328 meters, of upper Eocene age overlying chert (328 to 331 meters) of upper Eocene age, and (384 to 388 meters) of middle Eocene age. The interval 331 to 384 meters was not cored, and probably consists mostly of brown radiolarian ooze. Two zones of hiatus were recognized in the Pliocene and one in the upper part of the upper Eocene.

#### BACKGROUND

Site 70 is located about 20 miles north of the northern boundary of the Clipperton Fracture Zone near  $140^{\circ}$  W. It is the northernmost of the N-S line of sites drilled during Leg 8 to investigate the east-west trending accumulation of sediment centered at about  $2^{\circ}$ N near  $140^{\circ}$ W. It lies about 500 miles south of Site 42 of Leg 5, the southernmost of a line of sites continuing to the north. Site 70 and the following site (71), immediately south of the Clipperton Fracture Zone, were chosen by the JOIDES Pacific Advisory Panel (PAP Sites 24 and 25) in order to compare the stratigraphy of the sediments and the age and nature of the basement on either side of the fracture zone.

The SCAN survey indicated that the area was one of low, broad abyssal hills, 2 to 10 miles in width on E-W profiles, with relatively thick sediment cover. Comparison of E-W and N-S profiles indicated that fine scale topography might be elongated in a north-south direction and that larger scale east-west trends might also be present. Reflection records showed an upper 'transparent' layer, 0.03 to 0.05 seconds thick, locally ponded but generally comformable with deeper reflectors, overlying an intermediate layer, 0.20 to 0.25 seconds thick, containing numerous weak reflectors. Strong reflections from the base of the intermediate layer indicated basement or additional layers of more opaque sediment. Total sediment above acoustic basement was found to be relatively uniform at 0.25 to 0.30 seconds thickness. The proposed site from the SCAN survey  $(06^{\circ} 18.8'N, 140^{\circ} 21.1'W)$  is in a basin about 5 miles in diameter where the reflection records indicated greater than normal sediment accumulation (0.04 second). A piston core taken at the proposed site recovered 12.1 meters of siliceous ooze, Quarternary at the top and Lower to Middle Pliocene at the bottom. Another core taken nearby (06° 24.8'N, 140° 19.7'W) at a depth 86 meters shallower recovered 11.5 meters of a similar section.

Echo sounding and subbottom reflection records from the *Challenger* track generally confirm the results of the SCAN survey: maximum topographic relief is about 200 meters (peak to trough); small scale relief appears rougher along E-W racks ( $\pm$  20 meters with wavelength 1 to 3 miles) than along N-S tracks. The ocean floor and intermediate reflectors are fairly concordant over acoustic basement, whose depth in the

<sup>&</sup>lt;sup>1</sup> Joshua I. Tracey, Jr., U. S. Geological Survey, Washington, D. C.; George H. Sutton, University of Hawaii, Honolulu, Hawaii; W. D. Nesteroff, Université de Paris, France; Jon Galehouse, San Francisco State College, San Francisco, California; C. C. von der Borch, Scripps Institution of Oceanography (present address: Flinders University, Bedford Park, South Australia); T. C. Moore, Oregon State University, Corvallis, Oregon; U. Z. Bilal ul Haq, Geologiska Institutionene, Stockholm, Sweden (present address: Woods Hole Oceanographic Institution, Woods Hole, Massachusetts); and J. P. Beckmann, Geologisches Institute, Zurich, Switzerland.



Figure 1. Airgun record across Site 70 and interpretation.

vicinity of the drilling site is 0.30 to 0.35 second. The depression in which the drilling site is located appears to be at least partially fault controlled and may be tectonically related to the fracture zone.

At Site 70 the prominent reflectors are at 0.050, 0.370 and 0.485 seconds. The 'basement' reflector (0.485 second) is difficult to follow but appears to have a sharp depression at the site (Figure 1 and Figure 12, Chapter 2). It is correlated with inducated Eocene

sediments near the bottom of the deepest hole drilled. The upper reflector is correlated with the Clipperton-Marquesas formation boundary (Figures 6, 7 and 8', Chapter 2). The intermediate reflector may represent the Marquesas-Line Islands boundary. However, the reflector dips steeply and correlation is not good.

A topographic map of the vicinity of Site 70, airgun records, and further site information are given in Chapter 25.

#### **OPERATIONS**

Three holes were drilled on Site 70. The first hole was terminated at a depth of 113 meters below the mud line because of mechanical difficulties after cutting 12 cores. The drill pipe was pulled up 1830 meters, the mechanical problem was corrected without pulling the entire drill string, and coring was resumed in Hole 70A after drilling down to 113 meters. Hole 70A was bottomed in chert at 331.2 meters below the mud line after 30 cores of 218 meters were cut with a recovery of 146 meters. Noteworthy was the recovery of chert cores rather than fragments in the bottom core.

Hole 70B was drilled in an attempt to penetrate the chert encountered in Hole 70A after pulling out and running a new diamond bit. In four cores a total of 5.3 meters of chert was cut with a recovery of 3.8 meters. Actual rotating time while coring chert was 38 hours, giving an average penetration rate of about 14 centimeters per hour. Hole 70B was terminated by a dull bit.

A Welex drill pipe electric log was run as the drill pipe was pulled on Hole 70A.

## LITHOLOGY AND STRATIGRAPHY

At Site 70, Hole 70 and 70A were continuously cored from the sea floor to 331 meters below the sea floor. Recovery was excellent and a continuous sedimentary sequence was obtained from the Quaternary to the upper Eocene. Hole 70B was drilled with only fair recovery in middle Eocene chert, porcelanite, and siliceous limestone from 383 to 388 meters below the sea floor. The interval from 331 to 383 meters was not cored.

Three sedimentary formations are present at Site 70: the Clipperton Oceanic Formation (0 to 45 meters) consisting of a unit of pure radiolarian ooze and a cyclic unit of radiolarian ooze alternating with radiolarian-nannofossil ooze; the Marquesas Oceanic Formation (45 to 323.7 meters) consisting of radiolarian-nannofossil ooze and siliceous nannofossil ooze with one thin interbed of nodular chert; and the Line Islands Oceanic Formation (323.7 to 388 meters) consisting of radiolarian ooze, chert, porcelanite, and siliceous limestone.

Calcareous nannoplankton (mainly coccolithophorids with some discoasters) are by far the most common constituent of the sediments at Site 70 with Radiolaria and diatoms contributing significantly to some intervals.

#### **Clipperton Oceanic Formation**

The Clipperton Oceanic Formation comprises two units at Site 70. The upper unit consists of radiolarian ooze and extends from the sea floor to a depth of 19.8 meters. The ooze is dark grayish brown, moderately mottled with very pale brown. Radiolaria are the dominant constituent (80 to 95 per cent) with diatoms (1 to 15 per cent) the only other common component. Most of the sequence contains no carbonate. The radiolarian ooze unit is Quaternary, Pliocene and late Miocene in age. The contact with the lower unit is sharp and corresponds to the top of the uppermost carbonate-rich bed.

The lower cyclic unit of the Clipperton Oceanic Formation at Site 70 consists of alternating calcareous (radiolarian-nannofossil) and siliceous (radiolarian) oozes between 19.8 and 45 meters below the sea floor. The contacts between beds of the two lithologies are usually sharp and are marked by color changes. Individual beds range from a few centimeters to a few meters in thickness. The radiolarian-nannofossil oozes occupy about 70 per cent of the interval and range in color from light gray to light brownish gray. Most beds are slightly to moderately mottled with very pale brown. Calcareous nannoplankton form 55 to 85 per cent of the radiolarian-nannofossil oozes and Radiolaria 15 to 45 per cent. The radiolarian oozes occupy about 30 per cent of the interval and are mostly dark gravish brown, slightly to moderately mottled with very pale brown. Radiolaria are 80 to 98 per cent of the radiolarian oozes, diatoms 1 to 15 per cent, and calcareous nannoplankton 0 to 10 per cent. Both lithologies are soft and plastic, with the radiolarian oozes slightly stiffer than the radiolarian-nannofossil oozes. One manganese (?) nodule about 2 centimeters in diameter occurs in a bed of radiolarian ooze at 43.25 meters below the sea floor.

The lower cyclic unit of the Clipperton Oceanic Formation is middle and early Miocene in age. The contact with the underlying Marquesas Oceanic Formation is sharp and occurs at the base of the lowermost radiolarian ooze bed.

#### Marquesas Oceanic Formation

The Marquesas Oceanic Formation at Site 70 from 45 to 323.7 meters below the sea floor is highly calcareous (70 to 95 per cent). The sediments comprising the formation are radiolarian-nannofossil oozes with the exception of the interval from 265.8 to 293 meters, in which diatoms are about as abundant as Radiolaria, the beds being called siliceous nannofossil oozes.

The oozes of the Marquesas Oceanic Formation are white to bluish white to light greenish gray to yellowish gray. Some beds are slightly mottled and the middle portion of the formation is slightly speckled with black (probably due to the presence of small grains of manganese and iron). The formation is soft

	Core No.	Interval Below Seafloor (meters)	Cored (m)	Recovered (m)	Comments
Hole 70	1	0-9	9.1	8.8	
	2	9-17		3.1	
	3	17-26	9.1	9.1	
	4	26-35	9.1	7.6	
	5	35-44	9.1	9.1	
	6	44-53	9.1	9.1	
	7	53-62	9.1	9.1	
	8	62-72	9.1	9.1	
	9	72-81	9.1	9.1	
	10	81-90 (90-95)	9.1	9.1	Pipe correction - no gap
	11	95-104	9.1	8.8	
	12	104-113	9.1	6.4	Total depth 113 m
Total			108.3	95.8	88% recovery
Hole 70A	1	113-122	9.1	7.9	Washed
	2	122-131	9.1	9.1	
	3	131-140	9.1	8.2	
	4	140-149	9.1	7.9	
	5	149-158	9.1	9.1	
	6	158-168	9.1	9.1	
	7	168-177	9.1	8.5	
	8	177-186	9.1	9.1	
	9	186-192	6.1	6.1	
	10	192-201	9.1	6.4	
	11	201-210	9.1	6.4	
	12	210-219	9.1	6.1	
	13	219-228	9.1	5.2	
	14	228-238	9.1	3.7	
	15	238-247	9.1	5.2	
	16	247-256	9.1	4.3	
	17	256-262	6.1	4.9	
	18	262-269	6.1	3.1	
	19	269-275	6.1	3.3	
	20	275-281	6.1	0.1	
	21	281-287	6.1	0.9	
	22	287-293	6.1	3.3	
	23	293-299	6.1	3.1	
	24	299-305	6.1	3.7	

TABLE 1Summary of Coring at Site 70

	Core No.	Interval Below Seafloor (meters)	Cored (m)	Recovered (m)	Comments
Hole 70A -	- Continued				
	25	305-311	6,1	3.3	
	26	311-320	9.1	4.5	
	27	320-326	6.1	3.7	
	28	326-328	1.8	1.5	
	29	328-329	1.2	0.05	
	30	329-331	1.5	0.6	Total depth 331 m in Eocene chert
Total			218.1	147.0	67% recovery
Hole 70B		0-383			Drilled ahead
	1	383-384	1.5	1.2	
	2	384-385.5	1.5	1.2	
	3	385.5-387	1.5	1.2	
	4	387-388	0.9	0.1	Total depth 388 m in Middle Eocene chert
Total			5.5	3.8	69% recovery
Total 70, 70	0A, 70B		331.8	246.6	74% recovery

TABLE 1 - Continued

and plastic from the top to about 177 meters and semi-indurated from about 177 meters to the base of the formation.

Calcareous nannoplankton form about 70 to 95 per cent of the Marquesas Oceanic Formation. Radiolaria make up about 5 to 25 per cent and diatoms generally less than 5 per cent except in the 265.8 to 293 meter interval, in which they form about 10 per cent of the sediment.

A hard nodule (manganese?) about 1 centimeter in diameter occurs at 60.21 meters below the sea floor. Gray, nodular chert is present at 188.1 meters as three nodules, 2-centimeters thick, separated from each other by 2-centimeter layers of semi-indurated radiolarian-nannofossil ooze. The radiolarian-nannofossil ooze shows no marked changes in carbonate or silica content near the chert and the contacts are sharp.

The Marquesas Oceanic Formation ranges in age from early Miocene at the top to earliest Oligocene at the base. The contact with the underlying Line Islands Oceanic Formation is sharp and is a disconformity which corresponds to the Oligocene-Eocene boundary.

#### Line Islands Oceanic Formation

The upper portion of the Line Islands Oceanic Formation at Site 70 consists of semi-indurated radiolarian ooze extending from 323.7 to 328.9 meters below the sea floor. The radiolarian ooze is pale brown to brown, slightly to moderately mottled with very pale brown, and composed of 95 per cent Radiolaria. No carbonate is present. The radiolarian ooze is late Eocene in age and is in sharp contact with the underlying beds.

A 3-centimeter thick layer of calcareous radiolarian ooze was recovered between the overlying radiolarian ooze and underlying chert. The ooze is semi-indurated and composed of Radiolaria (55 per cent), calcareous nannoplankton, and recrystallized carbonate. The contact with the underlying chert is sharp.

In the 329 to 331 meter interval about 80 centimeters of reddish brown to brown chert was recovered. The chert is hard and contains two 1 to 2 centimeter thick white porcelanite beds. The chert is late Eocene in age. Because Hole 70A terminated in the chert, the total thickness and relationship to underlying beds are unknown. After terminating Hole 70A, the drill string was pulled, the bit replaced, and drilling was resumed. Hole 70B, located within a few meters of Hole 70A, did not encounter the upper Eocene chert, which appears to be lenticular.

In Hole 70B the 5 meter interval from 383 to 388 meters below the sea floor was cored and about 3.7 meters of interbedded chert, porcelanite, and siliceous limestone were recovered. The chert is various shades of brown, mostly yellowish brown, and contains many portions with reticulate fractures filled with opal. Some of the chert is finely laminated and some shows shale-type fracturing. The porcelanite is white to light gray and often grades into chert. The siliceous limestone is various shades of light orange and light brown and is generally laminated and mottled. Chert and limestone of this interval are discussed in more detail in Part III of this volume (von der Borch and others).

These beds in Hole 70B are middle Eocene in age. Their contact with the overlying upper Eocene beds falls in the uncored interval from 331 to 383 meters below the sea floor.

Figure 6 is a plot of age versus depth, based on the biostratigraphic zonations of the foraminifera, nannoplankton, and Radiolaria, with the time scale, in millions of years, based on that of Berggren (1969).

#### PHYSICAL PROPERTIES

Porosities range between about 40 and 90 per cent and sonic velocities range between about 1.50 and 1.67 km/sec. Most of the sediment at this site contains greater than 65 per cent calcium carbonate (CaCO<sub>3</sub>), and the velocity-porosity data cluster near the theoretical curve for a grain-matrix density of 2.65 g/cm<sup>3</sup> (Figure 2). Except for the upper 45 meters where there is a higher proportion of siliceous material, and the grain-matrix density is somewhat lower, grain-matrix density averages about 1.5 to 1.6 g/cm<sup>3</sup>. Across the Clipperton-Marquesas boundary, at 45 meters, there is an abrupt decrease in porosity, to about 60 per cent, increase in bulk density, and decrease in natural gamma radiation. This boundary is correlated with a prominent subbottom reflection (Figure 6, Chapter 2). Between 170 and 180 meters, where the Marquesas becomes a semi-indurated chalk, there is a further decrease in porosity, to about 50 per cent, and a pronounced increase in sonic velocity from values equal to or less than that for sea water to about 1.60 km/sec. Above 170 meters the velocity is generally below that for sea water. A weak subbottom reflection is observed near this depth (Figures 6 and 7, Chapter 2).

Penetrability decreases with depth throughout the section.

Velocity and density were determined for several samples of chert and one piece of siliceous nannochalk (Chapter 2). The highest velocity measured from this site, 5.72 km/sec, was for a chert of density 2.49 g/cm<sup>3</sup>.

Results of grain-size and carbon-carbonate analyses are tabulated in Appendices II and III, respectively.

## PALEONTOLOGY

# Foraminifera

Three holes were drilled at this site, each one with successively deeper penetration. Hole 70 supplied 12 cores (from 0 to 113 meters), Hole 70A, thirty cores (from 113 to 331 meters), and Hole 70B, four cores (from 383 to a total depth of 388 meters).

Holes 70 and 70A together constitute a continuously cored section down to the top of the Eocene. As in Site 69, the greater part of the drilled section represents the lowermost Miocene (Globorotalia kugleri Zone) and the Oligocene. However, the younger Neogene beds are not as much reduced as in Site 69. They are also predominantly siliceous, but there is a moderately calcareous intercalation with Globorotalia fohsi (s.l.). In general, the foraminiferal content of the samples is higher than in Site 69, but the foraminifera are still outnumbered by the Radiolaria in most washed residues. There are distinct vertical fluctuations in the proportion of the calcareous microfossils (Figure 1, Chapter 11), with two maxima in the Globorotalia kugleri Zone (N. 4) and the Globorotalia opima opima Zone (P. 21).

In the deeper parts of the drilled section, the rocks become progressively harder. Below about 270 meters, they were more resistant to the rock disintegration process used (see Chapter 11) than in any of the other Leg 8 sites.

The sediments of Cores 70-1 and 70-2 are almost entirely siliceous. The highest significant foraminiferal assemblage occurs in Core 70-3, Sections 2 and 3 (depth 19 to 22 meters). It indicates the *Globorotalia mayeri* Zone (N. 14). Between Sections 70-3-5 and 70-5-1 (23 to 36 meters), the samples contain rare specimens of *Globorotalia fohsi lobata*, *G. f. praefohsi* and *G. f. peripheroacuta*. Zones N. 12, N. 11 and N. 10 appear to be represented, but the boundaries cannot be exactly determined. The base of N. 12 is approximately at Section 70-3-6; the base of N. 11 is not higher than 70-4-4.





	DSDP	Leg 8	Site 70					250				icuta	onda				p	ΗY	
DEPTH in meters	BARREL No.	- 0 FORAMINIFERA - 50 percentage of total fauna in > 80 mesh fraction -100	-1:10 -1 FORAMINIFERA -100 planktonic/benthonic -1000 ratio	strong solution EFFECTS weak	Catapsydrax dissimilis	Globigerina nepenthes	Globigerinoides primordius	Globoquadrina altispira globo	Globoquadrina praedehiscens	Globorotalia fohsi fohsi	Globorotalia fohsi lobata	Globorotalia fohsi peripheroa	Globorotalia fohsi peripheror	Globorotalia fohsi praefohsi	Globorotalia kugleri	Globorotalia mayeri	Sphaeroidinellopsis seminulir	BIOSTRATIGRAPI	A G E
	1	<u>}</u>		?														?	?
	2			?															- ?
1	3	2		녙		1				1	1							<u>N:14</u> N:12	۰₩
	4		$\geq$	ב										1				N.11 N.10	MIOCE
	5			2									i					?	-?-
- 50 -	6		$\sum$	3														N.6 to N.4	
ļ .	7	$\geq$	$\geq$	ן נ															OCENE
	8	$\searrow$	5															leri Zor	W
	9	5	ζ												IT			N.4 alia kug	Lower
	10	2		5	IT										Π	Π		lobarot	
[	depth corr.																	Ű	
L100-	11																		

Figure 3. Foraminifera of Site 70. Frequency distribution, ranges of important species and biostratigraphy.

After a series of siliceous samples (from 36 to 45 meters), we find again in Section 70-6-2 a calcareous assemblage which contains already the highest *Catapsydrax dissimilis* and *Globoquadrina praedehiscens*, indicating N. 6 or older. The interval from 70-7-2 to 70-12-4 (54 to 111 meters) is the *Globorotalia kugleri* Zone (N. 4) containing *G. kugleri* and *Globigerinoides primordius*. The true base of the *G. kugleri* Zone is almost certainly lower than 111 meters, because the samples below this depth are poor in foraminifera and the small-sized specimens are possibly absent due to solution. The interval down to 70A-5-5 (156 meters) should also include the *Globigerina ciperoensis ciperoensis* (Zone (P. 22), because the highest *Globorotalia opima opima* is found in Section 70A-5-6. The *G.* 

opima opima Zone (P. 21) is thick and reaches down to 70A-16-1 (253 meters). As in Site 69, it is the most calcareous interval of the entire stratigraphic section, but small species such as *Chiloguembelina cubensis* and *Globigerina ciperoensis angulisuturalis* are preserved only exceptionally (core catcher sample of 70A-10). A subsidiary marker horizon within P. 21 is the earliest *Globorotalia mayeri* at 70A-8-4.

Below 253 meters, foraminifera are again scarcer. Oligocene type faunas occur down to 70A-27-2, 50 centimeters (324 meters). They include *Globigerina ampliapertura*, *G. prasaepis*, *G. galavisi* and a mediumsized *Globorotalia opima* (s.l.). At least the greater part of this interval should be assigned to the *Globigerina* 

D	SDP	Leg 8 Site	70 (cont.)			roensis										>	
S DEPTH in meters	BARREL No.	<ul> <li>C FORAMINIFERA</li> <li>FORAMINIFERA</li> <li>50 percentage of total</li> <li>50 mesh</li> <li>frauna in &gt; 80 mesh</li> <li>fraction</li> </ul>	- 1:10 - 1 FORAMINIFERA - 10 planktonic/benthonic - 100 ratio	strong SOLUTION EFFECTS weak	Catapsydrax dissimilis	Globigerina ciperoensis cipe	Globigerina galavisi	Globigerina tripartita	Globigerinoides primordius	Globoquadrina praedehiscens	Globorotalia kugleri	Globorotalia mayeri	Globorotalia opima opima	Globorotalia opima s. l.	Globorotalia pseudokugleri	BI OSTRATI GRAPH	AGE
	12	5	5						+		$\left  \right $			1		N.4	Lower CENE
	A 1	5	5	Į											i	P.22 to N.4	MIO
	A 2			Z												oensis e	
	A 3	{	$\mathcal{Z}$			-	i	1								.22 na cipero nsis Zon	
- 150 -	A 4	<u> </u>		2		L	-	-								P Iobigerii ciperoe	CENE
	A 5	5	2	5									+	↓		0 •	OFIGC
	A 6	5		Lζ												ima Zon	
	A 7	$\leq$		ļļ												.21 pima opi	Upper
[ ]	A 8			Ę								1				P otalia og	
	A 9 A 10	$\leq$	5													Globor	

Figure 3. Continued.

*ampliapertura* Zone (P. 20). *Pseudohastigerina* is not found down to the bottom of the Oligocene, but this may be due to solution.

Within Section 70A-27-2 (just above the sample at 82 centimeters), we observe the lithologic and faunal change which seems to coincide with the Eocene/Oligocene boundary. Below this level (324 meters), the foraminifera are rare and almost exclusively benthonic, with *Nuttallides truempyi* and *Spiroplectammina trinitatensis*. The presence of *Catapsydrax dissimilis* in the core catcher sample of 70A-28 indicates that the age is most probably not older than the *Orbulinoides beckmanni* Zone (P. 13). The deepest cores, 70A-30 and

70B-1 to 70B-3, could only be studied in thin section. The microfauna appears to be similar to that above, with common Radiolaria and few smaller benthonic foraminifera.

#### Calcareous Nannoplankton and Silicoflagellates

Calcareous nannoplankton are common to abundant in the Miocene and Oligocene parts of the section, but are absent in the upper 20 meters of Hole 70. Silicoflagellates occur sparsely in the Miocene sediments and appear to be absent from the Oligocene. Solution pits and etching were visible on the calcareous nannofossils throughout the entire section, and were especially

D	SDP	Leg 8 Site	70 (cont.)					ralis							,	
DEPTH in meters	BARREL No.	FORAMINIFERA FORAMINIFERA 50 percentage of total found in > 80 mesh fraction	-1:10 FORAMINIFERA 1 FORAMINIFERA 100 planktonic/benthonic 1000 ratio	strong solUTION EFFECTS	Catapsydrax dissimilis	Chiloguembelina cubensis	Globigerina ampliapertura	Globigerina cip. angulisutu	Globigerina galavisi	Globigerina pras <b>ae</b> pis	Globigerina tripartita	Globigerina sp. A	Globorotalia opima opima	Globorotalia opima s.l.	BIOSTRATIGRAPHY	AGE
200	A 11	5													e	
	A 12	$\wedge$	$\mathbf{i}$	5											ima Zor	
	A 13	$\geq$		Ę											el Pima op	DCENE
	A 14	$\leq$	$\langle$	Ę											P.2 otalia o	OFICO
-	A 15	$\leq$	7	5											Globor	Der
-250 -	A 16		ζ	Γ						I			1		-	h
	A 17	5	5				I								a Zone	
	A 18	8		5			İ								berturc	-?-
	A 19	>		1											P.20 mpliap	CENE
	A 20	Ļ		$\square$	$\square$										ina a	160
	A 21		4		Ш										obiger	er O
	A 22	2													Ğ	Low
_300	A 23															

Figure 3. Continued.

pronounced in the lower Oligocene. Forty species of calcareous nannoplankton and three forms of silico-flagellates were observed at Site 70 (Table 2).

Nine distinct biostratigraphic zones were recognizable at Site 70. In addition, there were two intervals that were mixed or otherwise undeterminable, and a barren zone near the top.

Hole 70

Core 1-1 to 3-1:	Barren
Core 3-2 to 3-3:	Discoaster kugleri Zone
Core 34 to 4-3:	Discoaster exilis Zone

Core 4-4 to 4-CC:	Sphenolithus heteromorphus Zone
Core 5-1 to 6-2:	Mixed - undetermined
Core 6-3 to 7-4:	Discoaster druggii Zone
Core 7-4 to 12-CC:	Triquetrorhabdulus carinatus Zone
Hole 70A	
Core 1-1 to 2-1:	Triquetrorhabdulus carinatus Zone
Core 2-2 to 5-6:	Sphenolithus ciperoensis Zone
Core 5-CC to 13-2:	Sphenolithus distentus Zone



Figure 3. Continued.

Core 13-3 to 19-2:	Sphenolithus predistentus Zone
Core 19-3 to 27-1:	Discoaster tani ornatus Zone
Core 27-2 to 28-1:	Undetermined
Core 28-4 to 29-CC:	Eocene
Hole 70B	
Core 3-1:	Eocene

#### Radiolaria

Most of the radiolarian zones of the Neogene (Riedel and Sanfilippo, Leg 4 Report, 1970) were sampled at this site. Two identifiable hiatuses occur in the upper part of the section-in the Upper Pliocene (Core 70-1) and in the Upper Miocene (Core 70-2). Reworked Lower Miocene microfossils are found in a few of the samples of Middle Miocene or younger age and are especially abundant near the hiatuses mentioned above.

The Lower Miocene and Oligocene sections are thick at this site and show little evidence of reworked Radiolaria. However there may be some breaks in the record in the lower part of the Miocene, the Upper Oligocene and near the Lower-Upper Oligocene boundary. The sharp lithologic change marking the Eocene-Oligocene boundary (70A-27-2) may also represent a hiatus. Samples in the upper (calcareous) layer are from the





Figure 4. Calcareous nannoplankton of Site 70. Distribution and biostratigraphy.





Figure 5. Radiolaria at Site 70. Frequency, distribution and biostratigraphy.

	SIT	TE 70																						
RAR	RE																							
FEW	v		-																					
COM	IMO	N				1.00													ata					
ABU	JNDA	ANT			ıta	ontensis	ıta	iferus	ntata	cipata	л,		nuta	apera	tis	nplex	8	pes	teforcip	ta	-	ticus	euchus	
COMMENT	rs				ris alt	delm	cost	uum	is de	is for	llow	olina	t con	a tetr	virgi	ris sin	bariu	in bi	is pro	obus	nnose	risma	ris at	
D - Sus	spect	ed dov	wn-working		ospy	orys	letta	tus m	iddso	ridse	síuo	ius vi	psella	psell	letta	ıddso	us tu	cantu	iddso	etta 1	rtis a	id snj	vqso	
dur	ring d	lrilling	8		rcad	choc	locyc	nnar	rcade	rcade	choc	nnari	rtoca	rtoca	ocyc	rcad	mart	chno	rcad	locyl	eocy	nnar	rcad	s
R – Sus	spect	ed rew	orked	Щ	De	Sti	Ca	Ca	Do	Do	Sti	Ca	Õ	Ĉ	Cal	$D_{c}$	Can	Ly	Do	Ca	Th	Ca	Dc	ENT
old	er mi	crofos	ssils	ZON																				MMO
HOLECO	ORE	SECT.	INTERVAL			_											_							ö
70	5	1	em 81-83	D. alata							1					a.								
	5	3	81-83	ata		Т																		
	5	5	81-83	C. cost						Ι				Ι										R
	5	cc								L	1													R
	6	1	81-83							L	Į.			1	L					T.	۰,			
	6	cc									I			ļ					1					R
	7	1	81-83			ļ							Ł		Ļ				Į.			I		
	7	cc		50											L									
	8	1	81-83	virgini									1											
	8	cc		cletta											L				Т					
	9	2	81-83	Calocy									L	L					L			L		
	9	cc		· ·									ļ		I			T						
	10	1	81-83																					
	10	CC																						
	11	5	81-83										Ι		Ι						_			
	11	сс																						
													2		6952						1000			

Figure 5. Continued.

	SI	TE 70	2													
R	ARE															
FI	EW															
co	OMMO	N						a								
Al	BUND	ANT			s	Sa		forcipat	chus	sus		ls.	lio	įĮį	ulus	
COMME	NTS				rgini	i bip	bust	prae	ateu	mati	tosa	racil	Idad	ried	circ	
D – S	luspec	ted do	wn-working		ta vi	niun	ta ro	oyris	oyris	pris	s ann	nis g	siris	oyris	oyris	
d	luring	drilling	g		vclet	1000	ylet	lsopi	lsopi	urtus	yrti	hon	lsopi	tsopi	lsopi	
R – S	uspec	ted rev	vorked		aloc	ychi	aloc	Dorce	Dorce	anno	heod	Irtop	Dorce	Dorce	Dorce	NTS
0	lder n	nicrofo	ssils	NE	0	7	Ŭ	1	7		-			1	~	AME
HOLE	OPE	SECT	INTEDVAL	ZO												S
HOLE	OKE	SECT.	cm	-			Т	T	<u> </u>	- <b>F</b>						
70	12	1	148-150	ginis			L.		1							
	12	3	81-83	U.Y.			Ļ			ł						
	12	5	0-2								Т					
	12	cc		ı bipes			I									
70A	1	3	81-83	caniun			Į.		1	T						R
	I	cc		Lychno			L	L	Į.	L						
	2	5	81-83				Т									
	2	cc			]		н									
	3	1	148-150	pilio		1		ľ		Ī.		T	1			D
	3	cc		D. pt		2	T		Ι			Î	T			
1	4	2	81-83													
	4	3	81-83									L				R
	4	5	81-83	25												
	4	cc		ouup s					T	1				ŝ.	1	
	5	1	0-2	eocyrtis						Ī						D
	5	cc		The						1						D
	_							3		-	-	-				

Figure 5. Continued.

	SIT	E 70										
RA FEV COU ABU COMMEN D - S C R - S	RE MMON UNDA TTS Suspec during Suspec blder n	N .NT ted dc drillin ted re nicrof	own-working ag worked ossils	ZONE	Dorcadospyris ateuchus	Cannartus prismaticus	Theocyrtis annosa	Artophormis gracilis	Dorcadospyris circulus	Lithocyclia angustum	Dorcadospyris triccros	COMMENTS
70A	6	1	cm 81-83		Т	Т		T	Т			D
	6	cc					Ι		I			
	7	cc										
	8	1	148-150				Ι	I	1			D
	8	cc			I		Î					
	9	2	81-83		1	sili	.ca di	ssol	ved			
	9	cc		250								
	10	1	130-132	s anno	1.5		T.	T.				
	10	cc		ocyrth						1		
	11	2	81-83	The		Í	1	T	1		Ĩ	
	11	cc				I		İ.	İ.			
	12	1	81-83						Ī			
	12	cc				t		1			ſ	R
	13	1	148-150			Ĩ				T		
	13	cc										
	14	1	148-150				Ī			Ī	Ī	

Figure 5. Continued.

		_				-		_	-			-		-				
	SI	TE 70																
RAI	RE																	
FEV	V		—															
CON	AMO	N											oilio					
ABU	JND/	ANT			uchus	lcus	827	lis	ulus	un,	soros.	idripes	udopat		ida	sa	nosa	
COMMEN	rs				is ate	ismat	mosa	graci	is circ	ngusi	is tric	is que	is pse	XIII	s grav	ibero	its spi	
D – Su	spec	ted do	wn-working		ryqre	us pr	rtis av	ormis	spyr	clia a	spyr	spyr	spyr	clia c	otrys	rtis tu	Indeso	
di	iring	drillin	ıg		reade	nnarl	eocyi	tophe	reade	hocy	rcade	reade	reade	hocy	ntrot	eocyi	rcad	STV
R - Su	ispec	ted re	worked	ш	Do	Ca	Th	Ar	Do	Lit	Do	Do	Do	Lii	Ce	Th	De	MIE
HOLEC	opti	erer	INTERVAL	NOZ														CON
HOLECO	JRE	SECT	cm		tr	<u> </u>					T			Ļ				
70A	14	cc							ų.	Į.				i.		ĩ		
	15	2	70-72		ł.													R
	15	4	68-70															
	15	cc		nnosa					I									R
	16	2	81-83	yrtis t		T						10						
	16	сс		Theod					8									
	17	2	81-83			T				T								R
	17	cc			Ì.	ŗ.		1			1			1				R
	18	2	81-83				1											R
	18	cc			1							T				Т		R
	19	2	83-85									1						
	20	cc		rosa							1				2		1	
	21	1	106-108	is tube						Ī								
	21	cc		socyrt				I				82				T	,	R
	22	cc		The				t		T								R
	23	cc								1	T	T						
										1	1							

Figure 5. Continued.



Figure 5. Continued.



Figure 6. Age versus depth at Site 70, based on the biostratigraphic zonations of the foraminifera, calcareous nannoplankton and Radiolaria. Ages based on the time scale of Berggren (1969).

Species	Occurrences (Hole/Core Nos.)
Calcareous Nannoplankton	
Chiasmolithus oamaruensis (Deflandre) Hay, Mohler and Wade	70A/27
Coccolithus bisectus (Hay, Mohler and Wade) as figured in Bramlette and Wilcoxon	70A/2-27
Coronocyclus nitescens (Kamptner) Bramlette and Wilcoxon	70A/5-6; 70/3, 4, 5-7, 9, 10
Cyclococcolithus formosus Kamptner	70A/22?, 26, 27; 70B/3
C. leptoporus (Murray and Blackman) Kamptner	70/3-5
C. neogammation Bramlette and Wilcoxon	70/4-12; 70A/1-19, 21-25
Discoaster adamanteus Bramlette and Wilcoxon	70/3-8, 10-12; 70A/1, 2, 6, 10-17, 26
D. barbadiensis Tan Sin Hok	70A/28, 29; 70B/3
D. brouweri Tan Sin Hok	70/3,4
D. calcaris Gartner	70/3-5,7
D. deflandrei Bramlette and Riedel	70/3-12; 70A/5-19, 21-27
D. dilatus Hay	70/3-6
D. druggii Bramlette and Wilcoxon	70/4-7
D. exilis Martini and Bramlette	70/3-5
D. extensus Hay	70/5,6
D. kugleri Martini and Bramlette	70/3,5?
D. lautus Hay	70/6-9, 11, 12; 70A/1, 2, 7 8, 15
D. nephados Hay	70/6-7
D. perplexus Bramlette and Riedel	70/5;70A/2
D. sp. aff. D. germanicus Martini	70B/3
D. tani nodifer Bramlette and Riedel	70A/12?, 13-19, 21-26
D. tani ornatus Bramlette and Wilcoxon	70A/15, 18, 19, 21-24
D. tani tani Bramlette and Riedel	70A/11?, 14-19, 21-24, 27
D. variabilis Martini and Bramlette	70/3
Discoasteroides kuepperi (Stradner) Bramlette and Sullivan	70A/28, 29; 70B/3
Helicopontosphaera compacta Bramlette and Wilcoxon	70A/14-19, 21-25, 27
H. euphratis (Haq) Martini	70/8, 10; 70A/8, 11, 12, 19
H. kamptneri Hay and Mohler	70/3
Oolithotus anillarum (Cohen) Cohen and Reinhardt	70/7,12
Reticulofenestra pseudoumbilica Gartner	70/3
R. umbilica (Levin) Martini and Ritzkowski	70A/19?, 22?, 25-27
Sphenolithus belemnos Bramlette and Wilcoxon	70/6,8;70A/1,2
S. ciperoensis Bramlette and Wilcoxon	70A/1-6, 7?, 8?
S. distentus (Martini) Bramlette and Wilcoxon	70A/6-19
S. heteromorphus Deflandre	70/4-6

 TABLE 2

 Calcareous Nannoplankton and Silicoflagellate Occurrences in Holes 70, 70A and 70B

Species	Occurrences (Hole/Core Nos.)		
S. moriformis (Bronnimann and Stradner) Bramlette and Wilcoxon	70/6-12; 70A/1-19, 21-23, 25-27		
S. predistentus Bramlette and Wilcoxon	70A/6-11, 14-19, 21-27		
S. pseudoradians Bramlette and Wilcoxon	70A/15-18		
Triquetrorhabdulus carinatus Martini	70/6-12; 70A/1-6		
T. rugosus Bramlette and Wilcoxon	70/3		
Silicoflagellates			
Dictyocha fibula Ehrenberg vars.	70/1-3		
Distephanus speculum (Ehrenberg) Haeckel	70/1-3		

TABLE 2 – Continued

Lower Oligocene and samples from the lower (siliceous) layer are from the Upper Eocene. The faunas in the two samples are markedly different with few species present in both samples that are not changed in form. A large portion of the Upper Eocene is certainly absent just below this core, as Section 70A-28-1 contains a fauna from the zone that spans the Middle to Upper Eocene boundary. The catcher from 70A-27 contains a mixed fauna consisting of species found in Core 27 together with those found in Core 28. Most of the Thyrocyrtis bromia Zone and all of the Thyrocyrtis tetracantha Zone are missing. A piece of indurated siliceous ooze found with the chert in Core 29 is of approximately the same age as the sediments in Core 28-Middle to Upper Eocene. The chert below Core 29 contain few identifiable Radiolaria.

Radiolaria are generally present throughout the section and even abundant in some of the Miocene and Eocene oozes. However, in most of the Oligocene section the radiolarian tests show signs of considerable solution. In a sample from 70A-9-2 all tests have been destroyed by solution and only a few fragments remain. Diatoms are present in samples from both the Oligocene and Miocene and are often abundant in the samples from the Lower Oligocene.

#### REFERENCE

Berggren, W. A., 1969. Cenozoic chronostratigraphy, planktonic foraminiferal zonation and the radiometric time scale. *Nature*. 224, 1072.







AGE	NATURAL GAMMA * 1.0 (Counts/7.6 cm/1.25 min) × 10 <sup>3</sup>	1.5 CORE NO.	METERS	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 10
UPPER OLIGOCENE	Lor ne lige here of	14 A +	-		↑ Rad nanno ooze. Semi indurated. Same description as above.	
DCENE	YM v	16 A + 17 18 A + 19 A + 20 A +	-		/Siliceous nanno ooze. Semi indu- rated bluish white to light greenish gray. Some portions motiled. Dia- toms equal to rads in abundance. Smear summary { nannos 75-80% rads 10-15% diatoms ~10%	
LOWER OLIGC	2 2 2	22 A 23 A 24 A 25 A 26 A	300		Rad nanno ooze. Semi indurated bluish white to yellowish gray. Smear summary $\begin{cases} nannos 75-85\%\\ rads 10-20\%\\ diatoms ~ 5\% \end{cases}$	
U. EOCENE	<u> </u>	27 A 28 A 29 A 30 A	-		Rad ooze. Semi indurated. Pale brown to brown. Smear summary  rads ~ 95% (no CaCO <sub>3</sub> ) Chert. Reddish brown. Porcellanite associated.	
MIDDLE EOCENE		18 28 38 48	-		Chert, Porcellanite & Siliceous Limestone. Interbedded. Chert /yellowish brown. Silica-filled fractures in some zones. Porcell- anite white to light gray. Sili- ceous limestone shades of light orange and light brown.	



Physical Properties, Site 70, 200-400 Meters G./M. DENSITY (g/cm<sup>3</sup>) 2.0 3.0

SITE 7	70	Core 1	Cored	interval:	0-9 m

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 10
QUATERNARY	sent)	sent)	Quaternary	1 1 2 3 4	2	Top	Entire barrel is moderately to badly disturbed (probably occurred during coring). <u>Rad ooze</u> Dark grayish brown (10YR4/2) moderately mottled with very pale brown (10YR7/4) no carbonate <u>Smear summary</u>	
PLIOCENE	(a	(a	Spongaster pentas	5 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4 .5		Rads     80%       Diatoms     1-15%       Sponge Spicules     1%       Fish debris     1%       Microfossil group     Preservation     Abundance       Foraminifera     Benthonic forms only     Rare       Calcareous nannoplankton     Absent       Radiolaria     Poor -     Common	
UPPER MIOCENE		Ş. peregrina	J	8	6		Moderate Comments: Common reworked older Radiolarians.	



Core liner was crushed and compressed. The two sections recovered have probably been compressed and shortened.	AGE
(1)       3         (1)       3         (1)       5         (1)       5         (1)       1         (1)       7         (2)       7         (2)       7         (2)       7          (2)       7	

# SITE 70 Core 2 Cored interval: 9-17 m

m	G.R.A.P.E. POROSITY (%)	BULK (g/	DENSITY /cm <sup>3</sup> )	(	GRAIN MATRI DENSITY (g/cm <sup>3</sup> )	X	SON	IC VELOCITY (km/sec)	SONIC (× 10	IMPEDANCE 6 MKS units)	NATURAL GAM ( × 10 <sup>3</sup> counts/7. 1.25 min)	MA * 6 cm/
20	0 40 60 80	1.0 1.5	2.0 2.5	2.0	2.5	3.0	1.5	1.6	1.7	2.7	1.0	1.5
m 0 2 1 1 2 - 3 - 3 -			2.0 2.5 T T	2.0	(g/cm <sup>-</sup> ) 2.5	3.0	1.5	(km/sec) 1.6	1.7	2.7	1.25 milly 1.0	1.5
4 - 5					$\left\langle \right\rangle$			8				
6—		ĮĮ			]							_
7												-
9						_						-
			- 1 - 1		1		P					

Site 70, Core 2, Physical Properties

AGE FORAMS NANNOS RADS	METERS SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
UPPER MIOCENE (absent) (absent) (absent)			Sections 1-4 are moderately to badly disturbed. <u>Rad Ooze</u> Dark grayish brown (10YR4/2) mottled with very pale brown (10YR7/4) no carbonate. <u>Smear summary</u> <u>Rads</u> 95% Diatoms < 5% Fish debris < 5% <u>Microfossil group</u> <u>Preservation</u> <u>Abundance</u> Foraminifera Poor to moderate Rare Calcareous nanno. Radiolaria Poor to moderate Common Comments: Some reworked older radiolarians.	
Tiene MIDDLE MIDCENE MIDDLE MIDCENE N. 12 (Gr. fohsi lobata) (absent) N. 14 Discoaster exilis Camartus laticonus Camartus petterssoni	3 4 1 5 4 4 1 1 5 4 4 1 1 1 5 7 1 1 1 5 7 1 1 1 5 7 1 1 1 5 7 1 1 1 5 7 1 1 1 1		Rad Nanno Doze         Various shades of gray (moderately mottled) the lighter the color, the greater the carbonate percent interbedded with Nanno Rad Ooze. Grayish brown (10YR5/2) mottled with very pale brown (10YR8/3) one 38cm thick bed of Rad Ooze in Section 3.         Sections 2-3         Smear summary         Nannos 65-90%       Diatoms < 5%	

SITE 70 Core 3 Cored interval: 17-26 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaC 0 50	O <sub>3</sub>
AGE MIOCENE	N. 11 FORAMS	Discoaster exilis	dospyris alata RADS	4 WELENS	2 SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION         Entire barrel is moderately to badly disturbed (probably occurred during coring).         Rad Nanno Ooze. Light gray (10YR7/1) and light brownish gray (10YR6/2).         One 16cm thick bed of Rad Ooze in Section 1.         Smear summary         Nannos       50-75% Rads         Z5-50%         Diatoms       < 5% Sponge Spicules < 5% Forams	% CaC 0 50	
WI DDLE			Dorcados	6 7	4		Calcareous Moderate to good Common nannoplankton Radiolaria Moderate Common		•
	N. 10	Sphenoli thus Sphenoli thus heteromorphus 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			5		Section 5 is quite disturbed and is a mixture of light brownish gray <u>Rad Nanno Ooze</u> (as described above) and dark grayish brown <u>Rad Ooze</u> . The mixing has resulted in what looked like "boundinage" structures. <u>Smear summary of Rad Ooze portion</u> Rads 85% Diatoms 5-15% Nannos < 5% Sponge Spicules < 5%	•	•
								hun	uu

# SITE 70 Core 4 Cored interval: 26-35 m



Site 70, Core 4, Physical Properties

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
	N. 10		D. alata	1	2		Sections 1-3 are badly disturbed, Section 6 is moderately disturbed. <u>Rad Nanno Ooze</u> . Light brownish gray (2.5Y6/2). <u>Smear summary</u> Nannos 55-70% Rads 25-40% Diatoms < 5% Sponge Spicules < 5%	
MIDDLE MIOCENE		d	a		3		Rad Nanno Ooze (as described above) interbedded         with Rad Ooze (as described below).         Microfossil group Foraminifera       Preservation Sec. 1: moderate Common Sec. 2cc moderate- Rare poor         Calcareous Sec. 1: moderate Common to nannoplankton Sec. 2: poor rare Sec. 3: good Sec. 4-6: poor         Radiolaria       Moderate Common Sec. 4-6: poor         Comments:       Some reworked older radiolarians and some mixed younger nannofossils in Section 4-6.	
LOWER MIOCENE	in (absent)	mixed - undetermine	Calocycletta costat		4 5. 6		Rad ooze       Dark grayish brown (2.5Y4/2) slightly mottled with very pale brown (10YR8/4).         Smear summary         Rads       95%         Diatoms       < 5%	

SITE 70 Core 5 Cored interval: 35-44 m


AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
	(absent)	Mixed - undetermined		1	1		Sections 1,2,3, and 4 are moderately disturbed. <u>Rad Nanno Ooze</u> (as described below) interbedded with <u>Rad Ooze</u> grayish brown (2.5Y5/2). <u>Smear summary for Rad Ooze</u> <u>Rads 85% Diatoms</u> , Sponge Spicule and Fish <u>Rad Nanno Ooze</u> . Light gray to white (grayer near top of barrel, whiter near bottom of barrel). Sections 2,3, and 5 are layers of slightly mottled, harder, less plastic, less disturbed ooze alternating with softer, more plastic, more disturbed ooze layers average 10 to 20cm thick.	
R MIOCENE	6		ycletta virginis	4	3		Smear summaryNannos60-80%Rads15-35%Diatoms< 5%	•
ГОМЕ	N. 5 - N.	Discoaster druggi	Calog	6 7 8 8 1 1 1	6		Microfossil groupPreservationAbundanceForaminiferaSec. 1-3 mod- erate Sec. 1-3 mod- erate Sec. 4-cc goodRare erate sec. 4-cc goodCalcareous nannoplanktonSec. 1 (to 60 cm) poor Sec. 2 good Sec. 3-4 moder- ate sec. 5 good Sec. 6 poorRadiolariaPoor to moderate Common Some mixed younger nannofossil in Section 1.	

SITE 70 Core 6 Cored interval: 49-53 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITH	OLOGIC DESCRIPTION		Cat 0 5	% CO₃ 50 10
	N5-N6	Discoaster druggi		111111111111111111111111111111111111111	1		Entire barrel is s Sections 2-6 conta with softer layers <u>Rad Nanno Ooze</u> . N white, the whiter t carbonate content.	lightly to modera in harder layers as described for Very pale brown ( the color, the high	ately disturbed alternating r Barrel 6. IOYR7/3) to gher the		•
Е			a virginis	4	3		Smear summary Nannos F Rads 22 Sponge Spicules t Fish debris t Forams t Diatoms t	55-80% 20-45% crace crace crace crace	Abundanco		
LOWER MIOCEN	I. 4	tue -	Calocyclett		4		Foraminifera Calcareous nannoplankton	Moderate to good Sec. 1 good Sec. 2-5 mod-	Common Common		Ē
	N	orhabdulus carinat		<sup>6</sup>	5		Radiolaria ← Mn? nodule at 7.	erate Sec. 6 poor Poor - mod- erate 2m (60.2m bsf.)	Few to common		
		Triquetro		8	6						
					сс					пп	E E

SITE 70 Core 7 Cored interval: 53-62 m





AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca	% CO <sub>3</sub>
LOWER MIDCENE	N. 4	Triquetrorhabdulus carinatus	Calocycletta virginis		1 2 3 4 6		Entire barrel is slightly to moderately disturbed with harder layers alternating with softer layers as described for Barrel 6. Section 1 is also mixed. Rad Nanno Ooze. White Smear summary Nannos 65-90% Rads 5-30% Forams < 5% Diatoms trace Sponge Spicules trace Fish debris trace Microfossil group Preservation Abundance Foraminifera Moderate to Common good Calcareous Sec. 1 good Common nannoplankton Sec. 2-6 mod- erate Radiolaria Poor to mod- erate Comments: Some mixed younger nannofossils in Section 6.		

SITE 70 Core 8 Cored interval: 62-71 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9 CaC 0 5	6 CO <sub>3</sub> 0 100
LOWER MIOCENE	N. 4	Triquetrorhabdulus corinatus	Calocycletta virginis		1 2 3 4 5 6	Unopened	Sections 1-4 are very soupy. Sections 5 and 6 are quite disturbed and mixed.         Rad Nanno Ooze.         Light gray (2.5Y7/2) to white.         The whiter the color, the higher the carbonate content.         Smear summary         Nannos       55-80% Rads         Nannos       55-80% Sponge Spicules         Site and the state of		•

# SITE 70 Core 9 Cored interval: 72-81 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9 Ca0 0 5	% CO <sub>3</sub> 0 10
LOWER MIOCENE	N. 4	Triquetrorhabdulus carinatus	Calocycletta virginis		1 2 3 4 5 6		Section 2 is very soupy. Entire barrel contains harder layers alternating with softer layers as described for Barrel 6.         Rad Nanno Ooze. White         Smear summary         Nannos       70-85%         Rads       10-25%         Sponge Spicules       5%         Diatoms       trace         Froams       trace         Froaminifera       Moderate to Common good         Calcareous nannoplankton       Poor       Common         Radiolaria       Moderate       Common		
		_	_						1111

#### SITE 70 Core 10 Cored interval: 81-90 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION		% CaCO 0 50	, 100
LOWER MIDCENE	N. 4	Triquetrorhabdulus carinatus	Calocycletta virginis		1 2 3 4 6	Top	Sections 1-4 are very soupy.         Nanno Ooze         White         Smear summary         Nannos       95%         Rads       < 5%	Abundance Common Common		

#### SITE 70 Core 11 Cored interval: 95-104 m





AGE	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
			211111111111111111111111111111111111111	1	Top	Section 2 is moderately disturbed.	
P. 22? LOWER MIDCENE N. 4	Triquetrorhabdulus carinatus	hnocanium bipes Calocycletta virginis	3 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2 3 4 5		Rad Nanno Ooze.       White to 111.2, light greenish gray (5GY8/1) to bottom, white portion is not mottled, light greenish gray portion is moderately mottled higher carbonate content in white portion.         Smear summary       Nannos       50-90%         Nannos       5-45%         Diatoms       < 5%	

#### SITE 70 Core 12 Cored interval: 104-113 m



AGE	ORAMS	ANNOS	RADS	AETERS	SCT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9 CaC	% CO <sub>3</sub>
UPPER OLIGOCENE	P. 22	Triquetrorhabàilus carinatus	Lychnocanium bipes		1 1 2 3 4 5 6	Top	Rad Nanno Ooze.       Yellowish gray (5Y8/1) to         Very pale brown (10YR8/3) to white, moderately mottled.         Smear summary         Nannos       45-80%         Rads       15-50%         Diatoms       5%         Sponge spicules       trace         Fish debris       trace         Fish debris       trace         Foraminifera       Moderate       Rare         Calcareous       Good       Common         nannoplankton       Radiolaria       Moderate       Common         Ratiolaria       Moderate       Common       Common		
								hui	ш

# SITE 70A Core 1A Cored interval: 113-122 m



Sections 1-3 are disturbed. Rad Nanno Ooze. White, Sections 5 and 6 are moderately mottled. Smear summary Nannos 80-95% Rads 3-15% Diatoms < 5% Fish debris trace	A	GE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHO	OGIC DESCRIPTIO	N	Ca 0 5	% CO <sub>3</sub> 50 100
		UPPER OLIGOCENE	P. 22	T. carinatus	Lychnocarium bipes		1 2 3 4 5 6		Sections 1-3 are di <u>Rad Nanno Ooze</u> . Wh moderately mottled. <u>Smear summary</u> Nannos Rads Diatoms - Sponge Spicules - Fish debris - <u>Microfossil group</u> Foraminifera Calcareous nannoplankton Radiolaria	80-95% 3-15% 5% 5% 5% race Preservation Moderate (predomin- ately ben- thonic forms) Sec. 1-3 good Sec. 4-5 mod- erate Sec. 6 good Poor to mod- erate	5 and 6 are Abundance Rare Common Common		

#### SITE 70A Core 2A Cored interval: 122-113 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca 0 5	% CO <sub>3</sub>
UPPER OLIGOCENE	P.22	Sphenolithus ciperoensis	Dorcadospyris papilio		1 2 3 4 5 6	Top	Entire barrel is soupy. Samples were collected from the bottoms of Sections 1-5 and smear slides were examined. Rad Nanno Ooze. White Smear summary Nannos 80-95% Rads 3-18% Diatoms < 5% Sponge Spicules trace <u>Microfossil group Preservation Abundance</u> Foraminifera Moderate Rare Calcareous Poor Common nannoplankton Radiolaria Poor to mod- erate Comments: Common mixed younger radiolarians in Section 1.		

SITE	70A	Core	3A	Cored	interval:	131-140 m
		0010	011	oorea	meet vur.	101 140 11

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
	1		ris papilio		1	Top Unopened	Sections 1 and 2 are soupy.	
			Dorcadospy	2	2		<u>Rad Nanno Ooze</u> . White to light greenish gray (5GY8/1), slightly mottled. Smear summary	•
UPPER OLIGOCENE	P. 22	enolithus ciperoensis	30		3		Nannos 60-80% Rads 15-35% Diatoms < 5% Sponge spicules < 5% Fish debris < 5% Forams trace	•
		Sphe	Theocyrtis annos	8111111	6		Microfossil groupPreservationAbundanceForaminiferaModerateRareCalcareous nannoplanktonSec. 1-5 poor Sec. 6- goodCommonRadiolariaPoor to moder- ateCommon ateComments:Some reworked older radiolarians in Section 3, 5.Sec. 1-5 poor Sec. 6- good	

SITE 70A Core 4A Cored interval: 140-149 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO 0 50	3 100
					1		Sections 1-5 are soupy. Samples were collected from the tops of Sections 1-5 and smear slides were examined.		
	P. 22			2 2 3 1 1 1 1 1 1 1	2		Rad Nanno Ooze. Light greenish gray (5GY8/1) slightly speckled with black (Mn?, Fe?)		
UPPER OLIGOCENE		Sphenolithus ciperoensis	Theocyrtis annosa		4	Unopened	Smear summaryNannos70-90%Rads5-25%Diatoms< 5%		
				7	5		Microfossil group     Preservation     Abundance       Foraminifera     Moderate to good     Common       Calcareous     Sec. 1-6 good     Common		
				8111	6		nannoplankton cc - moderate Radiolaria Poor to moderate Common Comments: Some mixed younger radiolarians.		
	P. 21	S. dis ten tus							

Si	ite	70A, Core 5, G.R.A.P.E. POROSITY (%)	Phys B	ical ULKI	Pro DENSI 2m <sup>3</sup> )	oper ITY	ties G	RAIN MATRI DENSITY (g/cm <sup>3</sup> )	x	SONIC	VELOCITY	SONIC IN	(PEDANCE MKS units)	NATURAL ( × 10 <sup>3</sup> cot 1.25	. GAMMA * ints/7.6 cm/ min)
m	20	40 60 80	1.0	1.5	2.0	2.5	2.0	2.5	3.0	1.5	1.6	1.7	2.7	1.0	1.5
0 -	-			1	-1	1		1		Т	I.			I	-
1-	-														-
2 -	-														-
3-															-
4 -	-														-
5-	-														-
6															_
7—														1	
8-	-	have		Į				$\langle$		$\langle$			$\langle$		-
					ä					1					

AGE	FORAMS	NAMNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCC 0 50	) <sub>3</sub>
UPPER OLIGOCENE	P. 21	Sphenolithus distentus	Theocyrtis amosa		2 3 4		Sections 1-3 are soupy.         Rad Nanno Ooze.       Light greenish gray (5GY8/1)         slight speckled with black (Mn?, Fe?), slightly         mottled.         Smear summary         Nannos       65-85%         Rads       10-30%         Sponge Spicules < 5%		
					5		Calcareous Sec. 1-5 mod- Common nannoplankton erate Sec. 6- poor		
				8			Radiolaria Poor to moder- Common ate Comments: Some mixed vounger radiolarians.		
					6				
									ш

SITE 70A Core 6A Cored interval: 158-167 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCo 0 50	O <sub>3</sub>
UPPER OLIGOCENE	P. 21	Sphenolithus distentus	Theocyrtis annosa		3 4 5	Top	Sections 1-3 are soupy.         Rad Nanno Ooze. Light greenish gray (568/1)         slightly speckled with black (Mn?, Fe?).         Smear summary         Nannos       75%         Rads       20%         Diatoms       < 5%		
								1111	

# SITE 70A Core 7A Cored interval: 168-177 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca(	% CO3	100
UPPER OLIGOCENE	P. 21	Sphenolithus distentus	Theoryrtis amosa		1 2 3 4 5 6		Sections 1-3 are soupy.         Rad Nanno Ooze.       (Semi-indurated) light green- ish gray (56Y8/1) slightly speckled with black (Mn?, Fe?).         Smear summary         Nannos       70-80% Rads         15-25%         Diatoms       < 5%			

# SITE 70A Core 8A Cored interval: 177-186 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHO	LOGIC DESCRIPT	ION	% CaCO <sub>3</sub> 0 50 100
UPPER OLIGOCENE	P. 21 FOR	Sphenolithus distentus	Theogyrtis amosa	Law 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 2 3 4	Top	Microfossil group         Foraminifera         Calcareous         nannoplankton         Radiolaria         Rad Nanno Ooze         (Semi-indurated).         to light bluish grawith black (Mn?, Fe         Chert.       Nodular,grawith black (Mn?, Fe         Mannos       8         Rads       10-1         Forams       <	Preservati Moderate - good Poor Poor Poor y (587/1) sli ?). y (5Y5/1). y (5Y5/1).	on Abundance Common Rare h gray (568/1) ghtly speckled <u>Abundance</u> Common Common Rare	
										1111 1111

SITE 70A Core 9A Cored interval: 186-192 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITH	LITHOLOGIC DESCRIPTION					
ER OLIGOCENE	P. 21	hus distentus	rtis annosa		1	Top	Rad Nanno Ooze. ( (5B9/1) to Tight b speckled with blac Smear summary Nannos 7	<u>Semi-indurated</u> ) b Tuish gray (587/1 k (Mn?, Fe?).	oluish white ), slightly				
UPI		Sphenoli	Theoc	6 7 7	4		Sponge spicules Diatoms Forams Fish debris <u>Microfossil group</u> Foraminifera Calcareous nannoplankton Radiolaria	<pre>6 5% 6 5% trace trace  <u>Preservation</u> Good Poor Poor </pre>	<u>Abundance</u> Common Common Few to common		•		
				8	5					1111			

SITE 70A Core 10A Cored interval: 192-201 m



SITE	5 70	A	Core 11			Cored	interval: 201-210 m	n			
AGE	FORAMS	NANNOS	RADS	METERS	ECT. NO.	LITHOL.	LITH	DLOGIC DESCRIPTIO	N	Ca	% CO <sub>3</sub>
UPPER OLIGOCENE	P. 21	Sphenolithus distentus	Theocyrtis amosa		1 2 3 4 5	Top	Microfossil group         Foraminifera         Calcareous         nannoplankton         Radiolaria         Rad Nanno Ooze. (         (5B9/1) to light b         to moderately spec         As the core was cu         "streaked" the cor         the core color pro         purple. In Sectio         various shades of         from a varying con         different depths.         est (dusky blue, 5         shows abundant bla         micron in diameter         Smear summary         Nannos       60         Rads       10         Diatoms       5         Sponge Spicules       Forams         Fish debris       0         Opaque clay       Microfossil group         Foraminifera       Calcareous         nannoplankton       Radiolaria <td>Preservation Good Poor Poor-mod- erate Semi-indurated) luish gray (587, kled with black t open, the black e; the mixture of ducing various s blue and purple centration of "s At 209.8m the of PB3/2) and the s ck, opaque grain 5-85% 0-30% &lt; 5% &lt; 5% trace trace trace Preservation Good Poor-moderate</td> <td>Abundance Common Common Common bluish white (1) slightly (Mn?, Fe?). ck specks of black and shades of resulting specks" at core is dark- smear slide as about 1 Abundance Common Common Common</td> <td></td> <td></td>	Preservation Good Poor Poor-mod- erate Semi-indurated) luish gray (587, kled with black t open, the black e; the mixture of ducing various s blue and purple centration of "s At 209.8m the of PB3/2) and the s ck, opaque grain 5-85% 0-30% < 5% < 5% trace trace trace Preservation Good Poor-moderate	Abundance Common Common Common bluish white (1) slightly (Mn?, Fe?). ck specks of black and shades of resulting specks" at core is dark- smear slide as about 1 Abundance Common Common Common		


AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHO	LOGIC DESCRIPTION		% CaC0 0 50	D <sub>3</sub>
UPPER OLIGOCENE	P. 21	Sphenolithus distentus	Theocyrtis amosa		1	Top	Rad Nanno Ooze. ( (5B9/1) slightly s Smear summary Nannos Rads Forams Diatoms Sponge Spicules <u>Microfossil group</u> Foraminifera Calcareous nannoplankton Radiolaria	Semi-indurated) peckled with bla 70-80% 15-25% < 5% < 5% 2 5% Preservation Good Sec. 1 poor Sec. 4 Mod- erate Poor-moder- ate	bluish white ck (Mn?,Fe?). Abundance Common Common Common		
										$ _{nn} $	nnl

SITE 70A Core 12A Cored interval: 210-219 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Cat 0 5	% CO3
UPPER OLIGOCENE	P. 21	S. predistentus	Theocyrtis amosa		1	Top	Nanno Ooze.       (Semi-indurated) bluish white         (589/1) slightly speckled with black (Mn?, Fe?), slightly to moderately mottled.         Smear summary         Nannos       85-95%         Rads       3-10%         Diatoms       < 5%		
								huu	1111

SITE 70A Core 13A Cored interval: 219-228 m



511	10		COL	e 14	th c	coreu i	11terval; 220-230 m	-
AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 10
				1	1	Тор		
UPPER OLIGOCENE	P. 21	Sphenolithus predistentus	Theogyrtis annosa	6 7 8	3		Rad Nanno Ooze.(Semi-indurated) light greenish gray (5GY8/1) to pale purple (5P6/2) slightly speckled with black (Mn?, Fe?).Smear summary Nannos80-85% Rads10-15% Diatoms5% Sponge spicules < 5% ForamsAbundance Common CalcareousForaminifera CalcareousModerate ModerateCommon Common RadiolariaRadiolariaModerate-poor Moderate-poorCommon	

SITE 70A Core 14A Cored interval: 228-238 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOL	OGIC DESCRIPTION		9 Ca( 0 5	6 203 0 100
UPPER OLIGOCENE	P. 21	Sphenolithus predistentus	Theocyrtis amosa		1 2 3 4	Top	Rad Nanno Ooze. (Sigray (N8) to bluish speckled with black         Smear summary         Nannos       70-1         Rads       3-1         Diatoms       < 1	emi-indurated) vo white (5B9/1) si (Mn?, Fe?).	Abundance Few Common Few-common		

SITE 70A Core 15A Cored interval: 238-247 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 100
UPPER OLIGOCENE	P. 18 - P. 20	Sphenolithus predistentus	Theocyrtis annosa		1		Entire barrel is disturbed. Rad Nanno Ooze (Semi-indurated) light greenish gray (5GY8/1) to pale purple (5P6/2). Smear summary Nannos 75-95% Rads 3-20% Diatoms < 5% Forams trace Sponge spicules trace Microfossil group Preservation Abundance Foraminifera Moderate Few Calcareous Sec. 1-poor Common nannoplankton Sec. 3-moderate Radiolaria Poor-moderate Few-common	
					<u> </u>			

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHO	OGIC DESCRIPTION		9 CaC	6 CO <sub>3</sub> 0 100
				1			Section 1 is modera	tely disturbed.			
UPPER OLIGOCENE	P. 18 to P. 20	phenolithus predistentus	Theodyrtis annosa		1 2 3 4	Top	Rad Nanno Ooze.       (S         (5B9/1) to light gr       speckled with black         Speckled with black       black         Nannos       75-9         Rads       2-2         Diatoms       < 5	emi-indurated) eenish gray (5G (Mn?, Fe?). (Mn?, Fe?). 5% (0% % % ce <u>Preservation</u> Moderate Sec. 1-mod- erate Sec. 2-4 poor	bluish white Y8/1) slightly <u>Abundance</u> Few Common		•
		St		1111			Radiolaria Comments: Few rewo	Poor-moderate rked older radi	Common olarians.		
										пп	шц



Site 70A, Core 17, Physical Properties

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9 CaC 0 5	6 CO <sub>3</sub> 0 10
LOWER OLIGOCENE   UPPER   OLIGOCENE	P.18 to P.20	A Sphenolithus predistentus	Theocyrtis amosa		1		Rad Nanno Ooze.       (Semi-indurated)         Light greenish gray (568/1).         Smear summary         Nannos       85%         Rads       10-15%         Diatoms < 5%		
		tub	eros	a				mu	nn

SITE 70A Core 18A Cored interval: 262-269 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaC 0 50	O <sub>3</sub>
				1 2 3 4	1	Тор	Section 1 is moderately disturbed. <u>Siliceous Nanno Ooze</u> . ( <u>Semi-indurated</u> ) light greenish gray (5GY8/1), slightly mottled. Smear summary		
LOWER OLIGOCENE	P. 18 to P. 20	b. taniormatus S. predistentus		81111111	3		Nannos       70-85%         Rads       5-15%         Diatoms       5-15%         Sponge spicules < 5%       5%         Forams       trace         Microfossil group       Preservation       Abundance         Foraminifera       Moderate       Rare         predominately       benthonic forms         Calcareous       Poor       Common         Nannoplankton       Poor-moderate       Common		

SITE 70A Core 19A Cored interval: 269-275 m



Site 70A, Core 19, Physical Properties

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Cat	% CO <sub>3</sub> 60 10
- LOWER OLIGOCENE	F P. 18 to P. 20	+ Discoaster tari ornatus	+ Theocyrtis tuberosa		1 2 3 4 5 6	Тор	Siliceous Nanno Ooze.       (Semi-indurated).         Smear summary       Nannos       80%         Nanos       10%       Diatoms       10%         Diatoms       10%       Sponge spicules < 5%		
						<u>viopened</u>	Core Catcher		•

SITE 70A	Core 20A	Cored	interval:	275-281	m
SITE /OA	Core 20A	Cored	interval:	275-281	

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Cat	% CO <sub>3</sub>
IER OLIGOCENE	8 to P.20   F	ni ormatus N	tuberosa		Image: Second second	Тор	Siliceous Nanno Ooze       (Semi-indurated)         Bluish white (5B9/1) layers of harder ooze         alternating with layers of softer ooze (probably         produced by circulating during drilling).         Smear summary         Nannos       75%         Rads       15%         Diatoms       10%         Sponge spicules < 5%		
	٩.	D.	T					ш	ш

SITE 70A Core 21A Cored interval: 281-287 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	97 CaC 0 51	5 CO <sub>3</sub> 0 100
LOWER OLIGOCENE	P. 18 to P. 20	coaster tari orantus	Theocyrtis tuberosa		1	Top	Siliceous Nanno Ooze.       (Semi-indurated) yellow-ish gray (5Y8/1).         Smear summary       Nannos 70%         Rads 20%       Diatoms 10%         Microfossil group       Preservation       Abundance         Foraminifera       Moderate       Rare         Calcareous       Moderate       Common         nanoplankton       Moderate       Common         Radiolaria       Moderate       Common         Comments:       Some reworked older radiolarians.         Abundant diatoms.       Abundant diatoms.		
		Di							шц

SITE 70A Core 22A Cored interval: 287-293 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	0 50	O <sub>3</sub>
AGE	FORAMS	NANNOS	RADS	WETERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9% CaC 0 50	03
LOWER OLIGOCENE	P. 18 to P. 20	Discoaster tani ormatus	Theocyrtis tuberosa	6 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2		Rad Nanno Ooze.(Semi-indurated) bluish white(5B9/1) to light greenish gray (5GY8/1).Smear summaryNannos75-85%Rads10-20%Diatoms5%Sponge spicules < 5%		

SITE 70A Core 23A Cored interval: 293-299 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	0 5	% CO3 0 1	
LOWER OLIGOCENE	P. 18 to P. 20	Discoaster tani ornatus	Theocyrtis tuberosa		1 2 3 4 5 6		Nanno Qoze. (Semi-indurated) bluish white (589/1). Smear summary Nannos 90-95% Rads 5% Diatoms < 5% Sponge spicules trace Microfossil group Preservation Abundance Foraminifera Moderate Rare predominately benthonic forms Calcareous Moderate Common nannoplankton Radiolaria Moderate Common Comments: Few diatoms.			

## SITE 70A Core 24A Cored interval: 299-305 m



	AGE	% CaCO <sub>3</sub>
Rad Nanno Qoze. (Semi-indurated) bluish white	LOWER OLIGOCENE	

SITE 70A Core 25A Cored interval: 305-311 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaC	03
A OLIGOCENE	18 to P. 20 FORAMS	ter tari orartus NANNOS	ocyrtis tuberosa RADS	Meters         Meters<	2 SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION         Samples were collected from the top of each section and smear slides were examined.         Microfossil group       Preservation         Abundance         Foraminifera       Moderate         Foraminifera       Moderate         Calcareous       Moderate         nannoplankton       Poor-moder-         Radiolaria       Poor-moder-         Comments:       Common diatoms. Some reworked older radiolarians.         Rad Nanno Ooze.       (Semi-indurated) bluish white (SB9/1).         Smear summary       Nanos         Nannos       65-75%         Rads       20-30%         Diatoms       5%         Fish debris       trace         Microfossil group       Preservation       Abundance	% CaCu 0 50	
LOWER OLIGOCE	P. 18 to P.	Discoaster tani	Theocyrtis t	8111111	3		Diatoms5%Fish debristraceMicrofossil groupPreservationAbundanceForaminiferaModerateFewCalcareousModerateCommonnannoplanktonRadiolariaPoor-moderateFew-commonComments:Common diatoms.Some reworked older radiolarians.		

SITE 70A Core 26A Cored interval: 311-320 m

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaCO <sub>3</sub> 0 50 10
LOWER OLIGOCENE	P. 18 to P. 20	D. tani ormatus	T. tuberosa	4 7	1	Тор	Rad Nanno Ooze (Semi-indurated)         Yellowish gray (5Y8/1) to bluish white (5B9/1)         not as indurated as rest of barrel.         Smear summary         Nannos 70-90%         Rads 5-25%         Diatoms 5%         Microfossil group       Preservation         Abundance         Foraminifera       Poor-moderate         Predominately       benthonic forms         Calcareous       Sec. 1-2 (97cm)       Common         nanoplankton       poor         Radiolaria       Sec. 2 (33cm)       Common         Offer radiolarians.       Some reworked       older radiolarians.	
UPPER EOCENE	Eocene	undetermined	Thyrsocyrtis bromia	81111111	3		Rad Ooze.(Semi-indurated) pale brown (10YR6/3) to brown (7.5YR5/4), slightly mottled with very pale brown (10YR7/3).Smear summary Rads95%Fish debris < 5% No carbonateMicrofossil group ForaminiferaPreservation Poor-moderate predominately benthonic formsAbundance Few predominately benthonic formsCalcareous nannoplankton 	

## SITE 70A Core 27A Cored interval: 320-326 m



AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca 0 5	% CO <sub>3</sub>
				21111111					
				3					
				5					
				6			Rad Doze (Semi-indurated) brown (7 54P5/4) to		
5	ne	bsent)	ang	8111	1		Smear summary         Rads       95%         Diatoms       5%         Fish debris < 5%		
UPPER EOCENE	Eoce	e)	Podocyrtis goethe				Foraminifera Foraminifera Poor-moderate predominately benthonic forms Calcareous Radiolaria Comments: some mixed younger radiolarians. Abundance Rare Poor-moderate predominately benthonic forms Absent - Few Abundance Rare Poor-moderate predominately benthonic forms Few Abundant Comments: some mixed younger radiolarians.	• •	



AGE	FORAMS	NANNOS	RADS	METERS	ECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca	% CO <sub>3</sub>
				2			See detailed section description.		
				51111111111			<u>Calcareous Rad Ooze</u> ( <u>Semi-indurated</u> ) and <u>Chert</u> .		
							<u>Microfossil group</u> <u>Preservation</u> <u>Abundance</u> Foraminifera Poor Rare predominately benthonic forms		
			eana	7			Calcareous Poor Few nannoplankton		
UPPER EOCENE ?	(absent)	Eocene	Podocyrtis goeth	81111	1		Radiolaria Moderate Common- abundant		
= <u>*</u> _	_ <u>+</u> _	<u>+</u> -	_+_	Ξ		Top Bottom			
								1111	1111

SITE 70A Core 29A Cored interval: 328-329 m
SITE 70A Core 29A	Detailed description Section 1 (328-329 m)
0 cm	
-	Only 8cm of core was recovered.
-	
	S
- 25	
-	
_	
50	
-	
_	<u>Calcareous Rad Ooze.</u> (Semi-indurated). From 0 to
	to 3mm thick laminations.
75	Smear summary
-	Rads 50%
	Nannos 10%
	Fish debris < 5%
	Total carbonate 45%
-	
100	
-	
- 125	Chert. From 3-8cm,brown (7.5YR5/4), softer than
	knife.
-	
150	

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	9 CaC 0 5	6 CO <sub>3</sub> 0 100
	absent	absent	absent		1		See detailed section description. Total recovery is about 70-75cm.         See detailed section description. Total recovery is about 70-75cm.         Chert with two thin Porcellanite beds.         Microfossil group       Preservation         Foraminifera       Absent		
	1	1				5		huul	IIII

SITE 70A Core 30A Cored interval: 329-331 m

SITE 70A	Core 30A	Detailed description Section 1 (329-331 m)
25		<u>Chert</u> (70-75cm thick) subhorizontally fractured, harder than knife,concretionary structures in pieces #9 and #14. Color: Reddish brown (5YR5/3) at top to brown (7.5YR5/4) near middle,to brown (10YR5/3) at bottom.
50 		Porcelanite. 1cm thick bed at top of piece #12, 2cm thick bed at top of piece #15,both beds are white.
	$\square \left( \left( \begin{array}{c} 5 \\ 5 \end{array} \right) \left( 6 \\ 7 \\ 8 \\ 7 \\ 8 \\ 9 \\ 9 \\ 9 \\ 9 \\ 9 \\ 9 \\ 9 \\ 9 \\ 9$	Vial containing small chip of chert Piece #1 contact dips at approximately 30° Piece #12 Chert Piece #1 Contact dips at approximately 20° Porcelanite chert chert Structures in chert dip at 10- 15° Piece #1

See detailed section description. Total recovery is about 110cm.	AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Ca 0	% CO <sub>3</sub> 50 100
forms only) Radiolaria (downmixed assemblage only)		absent	absent	absent		1		See detailed section description. Total recovery is about 110cm.         See detailed section description. Total recovery is about 110cm.         See detailed section description. Total recovery is about 110cm.         See detailed section description. Total recovery is about 110cm.         See detailed section description. Total recovery is about 110cm.         See detailed section description.         See detailed section.         See detailed sectiled sectiled section. <td></td> <td></td>		

SITE 70B Core 1B Cored interval: 383-384 m

SITE 70B	Core 1B	Detailed description Section 1(383-384 m)
		Total recovery is about 110cm.
25	7	<u>Chert</u> (Pieces #1-7, and #14-27) subhorizontally fractured,harder than knife. Piece #7 is finely laminated. Pieces #22 and 23 contain reticulate fractures filled with opal. Shale-type fractur- ing has occurred between Pieces 26 and 27.
-	11	Color: Pieces #1-7 are moderate yellowish brown (10YR4/3). Pieces #14-21 are dark yellowish brown (10YR4/2). Pieces #22-27 are pale yellow- ish brown (10YR6/2) at top to yellowish red
50 	13 0 15 16	(STR4/6) at Dottom.
-		
- 75	21 22 23	<u>Siliceous limestone</u> (Pieces #8-13) laminated with layers 1-3mm thick which dip up to 20°, mottled with some burrows cutting across bedding grayish orange (10YR7/4).
- 100	24 25 26	
-	27	
125 		

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL	LITHOLOGIC DESCRIPTION	Cat 0 5	% CO <sub>3</sub> 50 100
							See detailed section description. Total recovery is about 110cm.		
	absent	absent	absent	<sup>7</sup>	1		<u>Chert</u> and <u>Porcelanite</u> (interbedded).		

SITE 70B Core 2B Cored interval: 384-385.5 m

0 cm		
-	1	Total recovery is about 110cm.
-	28-0 ZA	
-	4A	
-	4B	
- 25	5 bag	
	7	Chert and Porcelanite (interbedded). Pieces 1-5
_	9	of porcelanite in Piece 2A and at the top of Piece
_		to shale-type fracturing.
50	10	Piece #7 is porcelanite? at the top grading into
-		Pieces #8 and 9 are intermediate between chert
-	11B 11A	Piece #10 is chert-porcelanite interbedded with
-	Sa	Piece #11 is chert-porcelanite with a few veins.
75	A 12	Piece #13-17 interbedded chert and porcelanite,
_ /3		Pieces #18and 19 are chert with some inclusions
-		
-	14	
-	00000	
100	17	
-	18	
-	19	
- 125		Color: Various shades of brown (reddish, pale,
_		light, yellowish, olive), mostly yellowish brown (10YR5/2), some of the porcelanite is white to
-		light gray.
-		
-		
- 150		

AGE	ORAMS	ANNOS	RADS	IETERS	CT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	% CaC	2 <b>0</b> 3
				$\begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 $	1 2 3 4 5		See detailed section description. Total recovery is about 130cm.         Microfossil group       Preservation         Abundance         Foraminifera       Benthonic forms Rare only         Calcareous nannoplankton       Poor       Rare         Radiolaria       Absent		
	absent	Eocene	absent	8	6		Siliceous Limestone and Chert(with two thinporcelanite beds).Microfossil groupPreservationAbundanceForaminiferaBenthonicRareforms onlyPoorRarenannoplanktonRabundanceAbundanceRadiolariaAbundanceAbundance		

SITE 70B	Core 3B	Cored interval:	385.5-387 m	1

SITE 70B	Core 3B	Detailed description Section 1 (385.5-387 m)
		Total recovery is about 130cm.
25 	(15 to 20 small pieces)	<u>Siliceous limestone</u> (Pieces #1-4 and top of #5) subhorizontally fractured. Piece #4 is quite laminated (lmm thick) and mottled with layers dipping at about 10°.
50	5	Color: Very pale orange (10988/2), light brown and olive brown. <u>Chert</u> (bottom of Piece #5 through #19) subhorizon-
75	8 9 0 10 11	<pre>tally fractured. Pieces #9 and 19 contain veins filled with opal. Pieces #10 shows shale-type fracturing near base. Pieces #14 and 16 - top portions are slightly calcareous. Color: Dark reddish brown (2.5YR3/4) at top to reddish black (10P2/1) at base</pre>
- 100	12	Porcelanite - 1cm thick bed at top of Piece #7
- - -	14 15 16 0	and 5 mm thick bed at top of #10.
125	10	

AGE	FORAMS	NANNOS	RADS	METERS	SECT. NO.	LITHOL.	LITHOLOGIC DESCRIPTION	Cat 0 5	% CO <sub>3</sub>
								1111	1111
					1				
				2	2				
				3					
				TITIT					
				4	3				
				<u>i I I I I</u>	4				
				6					
					5				
				7					
				8					
					6				
				-	-	*****	Chert Core Catcher		
	absent	absent	absent					ш	ш

SITE 70B Core 4B Cored interval: 387-388 m





Site 70, Core 1, Sections 1-6.



Site 70, Core 2, Sections 1, 2.





Site 70, Core 3, Sections 1-4, 6.



Site 70, Core 4, Sections 1-5.



Site 70, Core 5, Sections 1-6.



Site 70, Core 6, Sections 1-6.

![](_page_125_Figure_0.jpeg)

Site 70, Core 7, Sections 1-6.

![](_page_126_Figure_0.jpeg)

Site 70, Core 8, Sections 1-6.

![](_page_127_Figure_0.jpeg)

![](_page_128_Figure_0.jpeg)

![](_page_128_Figure_1.jpeg)

Site 70, Core 10, Sections 1, 3-6.

![](_page_129_Figure_0.jpeg)

![](_page_130_Figure_0.jpeg)

Site 70, Core 12, Sections 2-5.

![](_page_131_Figure_0.jpeg)

Site 70A, Core 1, Sections 2-6.

![](_page_132_Figure_0.jpeg)

Site 70A, Core 2, Sections 1-6.

![](_page_133_Figure_0.jpeg)

Site 70A, Core 4, Sections 2-6.

![](_page_134_Figure_0.jpeg)

![](_page_135_Figure_0.jpeg)

![](_page_136_Figure_0.jpeg)

Site 70A, Core 8, Sections 2, 4, 5, 6.

![](_page_137_Figure_0.jpeg)

Site 70A, Core 9, Sections 2, 3, 4.

![](_page_138_Figure_0.jpeg)

Site 70A, Core 10, Sections 1-5.

![](_page_139_Figure_0.jpeg)

Site 70A, Core 11, Sections 2-5.

![](_page_140_Figure_0.jpeg)

Site 70A, Core 12, Sections 1-4.

![](_page_141_Figure_0.jpeg)

Site 70A, Core 13, Sections 2, 3, 4.

Site 70A, Core 14, Sections 2, 3.

![](_page_142_Figure_0.jpeg)

Sections 2, 3.

![](_page_143_Figure_0.jpeg)

Site 70A, Core 17, Sections 1-4.

Site 70A, Core 18, Sections 1, 2.






Site 70A, Core 21, Section 1.





Site 70A, Core 23, Sections 1, 2.

280



Site 70A, Core 24, Sections 1, 2, 3.

281





Site 70A, Core 28, Section 1.





Site 70B, Core 3, Section 1.

283