

17. COCCOLITH STRATIGRAPHY, LEG 10, DEEP SEA DRILLING PROJECT¹

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INTRODUCTION

Leg 10 of the Deep Sea Drilling Project, February to April 1970, through the Gulf of Mexico from Galveston to Miami, recovered 162 cores at 13 drilling sites (Figure 1). Light-microscope techniques were used to study the coccoliths of 270 samples from these cores. The zonal assignment of the cores examined, given in Table 1, uses the coccolith zones described in the Leg 3 report (Bukry and Bramlette, 1970) and the Leg 7 report (Bukry, 1971a), with the addition of a new Paleocene subzone. An index of the species considered follows a summary of the coccolith stratigraphy. Coccolith species identified in specific samples are listed for each hole by time-stratigraphic series and biostratigraphic zone.

SAMPLE DESIGNATION

Sample numbers for each site consist of elements in the following sequence: cruise-leg number; drill-hole number; core number; core-section number; interval in centimeters below the top of each core-section plastic liner. For example, 10-94-5-1 (63-64 cm), indicates that the sample came from Leg 10, Hole 94, the fifth barrel of core recovered from that hole, the first section from the top of that core, and from 63 to 64 cm below the top of the section. Core sections are 1.5 meters long; most core runs were 9.1 meters long, but occasionally the core liners were not full. In this report, the tops of recoveries are arbitrarily placed at the top of the core runs, and an approximate depth in meters below the sea floor follows each sample number.

SUMMARY OF COCCOLITH STRATIGRAPHY

Hole 85

In Hole 85, Quaternary nannoplankton assemblages containing reworked Upper Cretaceous taxa characterize all samples studied, which lie between 27 and 212 meters below the sea floor. The coring site is just seaward of the Campeche Escarpment. The sediment samples are poorly sorted as to size, and the reworked Cretaceous taxa are common resistant forms such as *Arkhangelkskia cymbiformis*, *Eiffellithus turriseifeli*, *Micula decussata*, *Predisphaera cretacea*, and *Watznaueria barnesae*. These forms typify nearshore Quaternary sediments in areas such as this and the Black Sea, where nearby Cretaceous deposits are eroded. The truly Quaternary assemblages are best represented in samples from Cores 4 and 5.

Hole 86

Coccolith assemblages from the upper nine cores (14 to 551 m) at Site 86 on the Campeche Escarpment are Holocene to upper Miocene, middle Oligocene, and Paleocene. The Holocene to upper Miocene assemblages are well preserved and diversified; the genus *Scyphosphaera* is especially well represented. The middle Oligocene assemblages are typically open ocean in aspect, but the upper and lower Paleocene coccolith assemblages show an abundance of *Braarudosphaera* and *Micrantholithus*, which are typical of shallow-water deposits. The middle Paleocene *Helolithus kleinelli* Zone is well developed throughout Core 8, but lacks *Braarudosphaera* and *Micrantholithus*. These shallow-water indicators are most abundant and attain their largest size in samples from the lower Paleocene *Cruciplacolithus tenuis* Zone of Core 9, where they are the dominant taxa of the assemblage.

Hole 87

Coccoliths are rare in the two samples examined from Hole 87. Middle or upper Miocene taxa are mixed with Eocene taxa. Among the taxa with limited ranges, the oldest is *Discoaster saipanensis* [middle and upper Eocene] and the youngest, *Catinaster coalitus* [lower upper Miocene]. The depth of the samples examined is about 649 meters below the sea floor. Similar samples were obtained by DSDP Leg 1 in the same area at Site 3 from cores at 611 meters and 620 meters. These samples also contain sparse upper Miocene coccoliths with reworked Eocene and Cretaceous taxa.

Hole 88

The five cores of coccolith ooze from Hole 88 range from Holocene at the surface to lower Pliocene or upper Miocene at the 131 meter depth. The Quaternary assemblages are especially rich and contain most of the taxa described by Boudreux and Hay (1969) from the Nicaragua Rise. *Emiliania annula* is abundant in the lower Pleistocene of Core 2 and upper Pliocene of Core 3.

Hole 89

A Holocene to upper Miocene section of coccolith-rich sediment was discontinuously cored from the surface to 376 meters. Quaternary and upper Pliocene samples contain reworked Cretaceous taxa, whereas upper Miocene samples contain Paleocene and Eocene reworked taxa in addition to Cretaceous forms. Coccoliths are common except in the upper Miocene Core 6, which contains abundant detrital material that dilutes the assemblage.

Hole 90

Hole 90 is located at the base of the continental rise, east of the Mexican coast. Whereas the upper four cores

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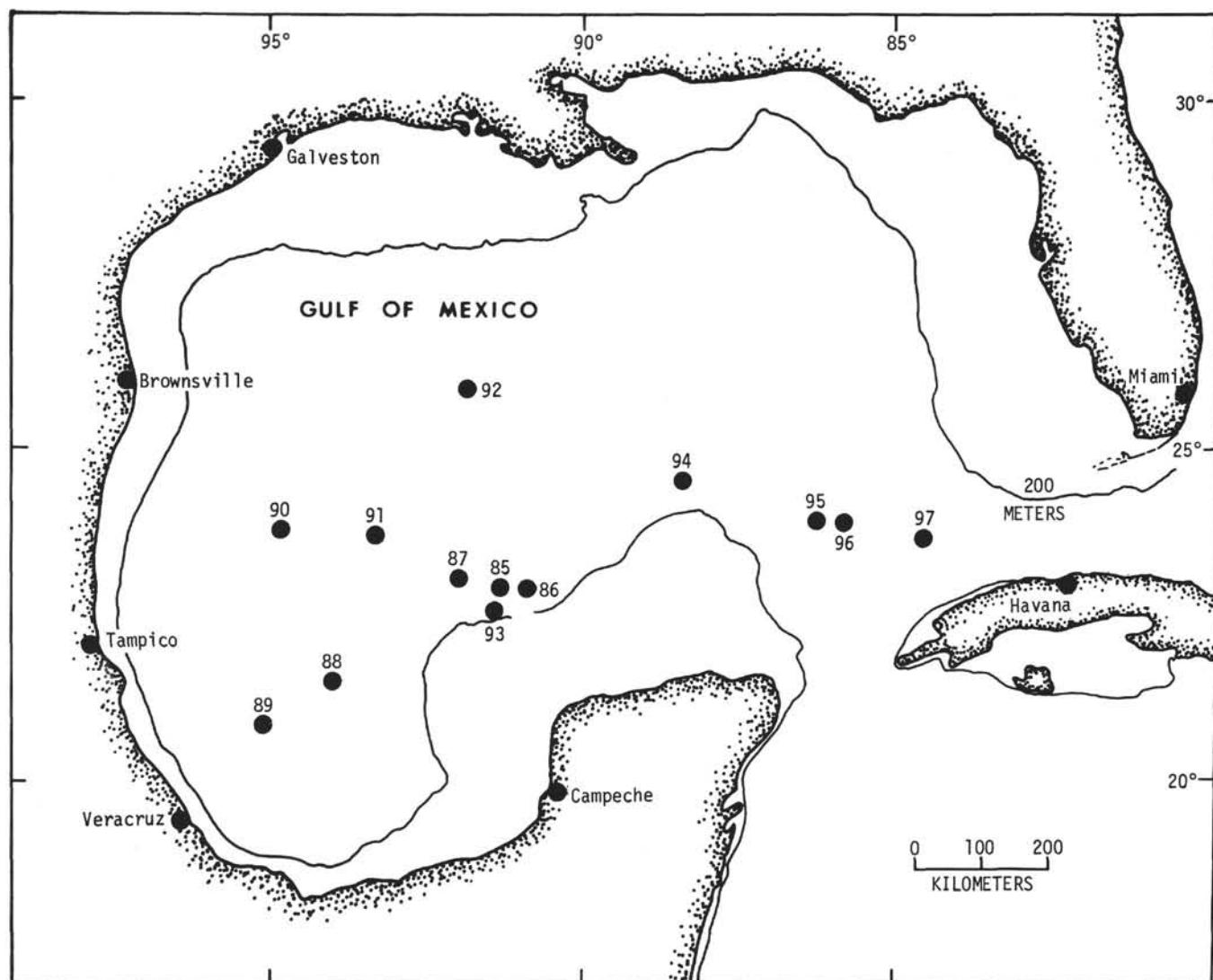


Figure 1. Sites cored during Leg 10, Deep Sea Drilling Project, in the Gulf of Mexico.

recovered nearly pure Holocene to upper Miocene coccolith ooze, the deeper nine cores recovered upper Miocene to middle Miocene sediment that is diluted by detrital material. *Discoaster quinqueramus* is generally common in the upper Miocene samples from Cores 5 to 7, and this indicates a correlation to the *Discoaster quinqueramus* Zone. In deeper cores (9-13) from 472 to 764 meters, assemblages diluted by detritus are apparently mixed. The occurrence of *Catinaster coalitus*, *C. mexicanus*, *Cyclococcolithina leptopora*, *Discoaster bollii*, and *D. braarudii* in a sample from the base of Core 11 at 682 meters indicates the lower upper Miocene for that level. The oldest assemblages in Core 13 are considered middle middle Miocene on the basis of *Cyclococcolithina leptopora*, *Discolithina multipora*, *Discoaster* sp. cf. *D. bollii*, *D. exilis*, *D. variabilis*, *Reticulofenestra pseudoumbilica*, and *Sphenolithus neobabies*. All these taxa have their first common occurrence in the middle Miocene. In addition, the absence of the dominant species of the lower Miocene—*Cyclococcolithina neogammation* and *Discoaster deflandrei* (which also range into the lower middle Miocene)—provides further support for the middle middle Miocene assignment.

Hole 91

Hole 91 is located on the abyssal plain of the northern Gulf of Mexico at the base of the continental rise to the Texas Gulf Coast. Coccoliths are generally rare throughout the 25 cores, which range in age from Holocene or late Pleistocene at 61 meters, to late or middle Miocene at 896 meters. Whereas the upper Pliocene to upper upper Miocene coccolith assemblages are composed of normal complements of diagnostic taxa in Cores 8 to 10, the younger sediment in Cores 1 to 7 and the older sediment in Cores 11 to 25 are barren, containing only a few long-ranging taxa, or reworked Upper Cretaceous taxa.

Hole 92

Eleven cores were cut at this location on the Sigsbee Escarpment to determine if this physiographic feature is a result of salt intrusion. Samples from Cores 2 to 11 were examined. Cores 2 to 5 are Pleistocene with reworked Upper Cretaceous, and the detrital component greatly dilutes the Pleistocene coccoliths. Rare specimens of *Coccolithus pelagicus*, *Helicopontosphaera kampfneri*, and reworked Cretaceous taxa in Core 6 indicate an

TABLE I
Zonal and Geologic Age Assignments of Cores from Deep Sea Drilling Project Leg 10 as Indicated by Coccoliths in Examined Samples

Age	Zone or Stage	Hole												
		85	86	87	88	89	90	91	92	93	94	95	96	97
Pleistocene and Holocene	<i>Emiliania huxleyi</i>	1-3	1		1	1	1	1-7	2-4	1				1
	<i>Gephyrocapsa oceanica</i>	4-5			1	1-2	1				1	1	1?	1
	<i>Coccolithus doronicoides</i>		2		2		2	8	5					1
Miocene	<i>Discoaster brouweri</i>		3		3-4	3	3	8-9			2			
	<i>Reticulofenestra pseudoumbilica</i>		3								3			
	<i>Ceratolithus rugosus</i>				5	4	4				4			
Oligocene	<i>Ceratolithus tricorniculatus</i>		4								5			
	<i>Discoaster quinqueramus</i>					5-6	5-7	10		1	5-8			2
	<i>Discoaster neohamatus</i>							9-10	11-25					3
	<i>Discoaster hamatus</i>													4
	<i>Catinaster coalitus</i>						11							
	<i>Discoaster exilis</i>						13							
	<i>Sphenolithus heteromorphus</i>										9			
	<i>Helicopontosphaera ampliaperta</i>													
	<i>Sphenolithus belemnos</i>													
	<i>Triquetrorhabdulus carinatus</i>										10			
Eocene	<i>Sphenolithus ciperoensis</i>											2	2	
	<i>Sphenolithus distentus</i>		5									3		4
	<i>Sphenolithus predistentus</i>									11-14	4-5			
	<i>Helicopontosphaera reticulata</i>													
	<i>Discoaster barbadiensis</i>									14-16	6			5
	<i>Reticulofenestra umbilica</i>										17			
	<i>Chiphragmalithus quadratus</i>									18-21	7			
Paleocene	<i>Discoaster sublodoensis</i>									22-26	8			
	<i>Discoaster lodoensis</i>									28-30				
	<i>Marthasterites tribachiatus</i>													
	<i>Discoaster diastypus</i>													
	<i>Discoaster multiradiatus</i>									33-34	10	3-5		
	<i>Discoaster mohleri</i>		7								35			
Late Cretaceous	<i>Heliolithus riedeli</i>		7											
	<i>Heliolithus kleinelli</i>		8											
	<i>Fasiculithus tympaniformis</i>													
	<i>Cruciplacolithus tenuis</i>		9							36	11-12			
	Maestrichtian													
	Campanian or Santonian										13-15			6-8
	Santonian											16-17		
	Turonian													
	Cenomanian												12	

indeterminate late Cenozoic age. Samples from deeper cores are barren of coccoliths.

Hole 93

A single surface core was recovered from Hole 93 in a submarine canyon that incises Campeche Bank. The top core section was nearly empty, and the shallowest sample, designated 10-93-1-1 (128-129 cm) (depth approximately 10 cm), is a Holocene coccolith ooze containing a large form of *Ceratolithus cristatus*. The deepest sample (approximately 1 m), 10-93-1-2 (65-67 cm), contains an upper Miocene coccolith assemblage, (including *Ceratolithus tricorniculatus*, *Discoaster quinqueramus*, and *Triquetrorhabdulus rugosus*), that is considered to represent the *Discoaster quinqueramus* Zone.

Hole 94

Coring Site 94 is at the margin of Campeche Bank. Cores 1 to 10, ranging in age from late Pleistocene to earliest Miocene, were cut discontinuously between the surface and 339 meters. Cores 11 to 27 and 32 to 36 were cut continuously and recovered a middle Oligocene to lower Paleocene section, including an exceptionally thick middle Eocene. The only samples available from Cores 37 to 40 are barren.

The Pleistocene to upper Miocene coccolith ooze samples from Cores 1 to 5 contain a plexus of large *Scyphosphaera* species typifying warm, moderately shallow, oceanic deposits. This relation is demonstrated at the coring sites of equatorial Leg 7 where *Scyphosphaera* is more common in the shallow Sites 62 and 64 (respectively 2591 and 2052 m water depth) than at the deeper Site 63 (4472 m). The upper Miocene *Discoaster quinqueramus* Zone assemblages of Cores 6 to 8 resemble those of the tropical Pacific Ocean because of their lack of *Reticulofenestra pseudoumbilica* and also because they have *Discoaster berggrenii* more abundant than *D. quinqueramus* in the lower part of the zone (Core 8).

Identification of the *Helicopontosphaera ampliaperta* Zone of the lower Miocene in deep-ocean sediment has been based on the recognition of an assemblage where *Discoaster deflandrei* is the overwhelmingly dominant discoaster; *Cyclococcolithina neogammation* dominates the cyclococcolithids; and *Sphenolithus heteromorphus* is common (Bukry, 1971a). In Core 9 the name-giving species of the *Helicopontosphaera ampliaperta* Zone is present for only the second time in Deep Sea Drilling Project cores. The wide geographic occurrence of this species includes Trinidad, California, Indonesia, and Italy (Bramlette and Wilcoxon, 1967). Its limited oceanic occurrence can be attributed to either an ecologic preference for lowered salinities of coastal, and therefore shallow, waters, or to a greater solution susceptibility than other species of *Helicopontosphaera*. Although this species was cosmopolitan, and the stratigraphic interval of its occurrence has been cored repeatedly by the Deep Sea Drilling Project, only in this core and in one from Leg 4 in the Caribbean has the taxon been reported.

The occurrence in Hole 94 of many taxa that do not occur in coeval deep-ocean coccolith ooze suggests that the deposition depth at Hole 94 rarely approached that of

a normal ocean basin. For example, comparison with Eocene coccolith assemblages of equivalent age from Gulf Coastal Plain outcrops and from cores of Leg 3 in the deep South Atlantic shows that in diversity and preservation the assemblages from Leg 10 in the Gulf of Mexico are more similar to the outcrop assemblages, which presumably represent deposition at continental-shelf depths (Table 2). The taxonomic differences between these areas result from varying degrees of coccolith solution susceptibility and to ecologic controls. Neritic assemblages show the most diversity and best preservation. Progressively deeper offshore assemblages lose diversity and show more solution etching of specimens. Two important controls in ordering the sequence of coccolith depletion in more offshore areas are the increase in salinity seaward of coastal waters and the decrease in calcite saturation with depth. The following list of lower Tertiary coccolith genera is ranked from those least likely to occur in deep-ocean deposits to those most characteristic of such deposits: *Transversopontis*, *Syracospaera*, *Rhabdosphaera*, *Discolithina* [perforate], *Micrantholithus*, *Braarudosphaera*, *Lophodolithus*, *Scyphosphaera*, *Helicopontosphaera*, *Discolithina* [imperforate], *Sphenolithus*, *Chiasmolithus*, *Reticulofenestra*, *Dictyococcites*, *Cyclococcolithina*, *Coccolithus*, and *Discoaster*.

There are more specimens of *Transversopontis*, *Rhabdosphaera*, *Discolithina*, and *Braarudosphaera* in the middle and lower Eocene assemblages. Therefore, assuming a deposition-depth control for Eocene coccolith dissolution, the middle and lower Eocene assemblages of Hole 94 were deposited at shallower depths than those of the upper Eocene.

Several hiatuses exist in the lower part of Hole 94. Missing intervals include the lower Oligocene *Helicopontosphaera reticulata* Zone, upper part of the upper middle Eocene *Reticulofenestra umbilica* Zone, lower Eocene *Marthasterites tribrachiatius* Zone, lower Eocene *Discoaster diastypus* Zone, and all of the middle Paleocene. The common occurrence of *Cyclococcolithina reticulata* down to the base of the upper Eocene section indicates that the lower part of the upper Eocene *Discoaster barbadiensis* Zone also is missing. The middle Eocene is particularly well represented at this site. A range chart of key middle and upper Eocene species is included in Table 3.

Paleocene assemblages of Cores 33 to 36 are not very diverse. The common occurrence of *Campylosphaera eodela* in the *Discoaster multiradiatus* Zone of Core 33 is repeated in Hole 95 and also in Hole 96, where it is accompanied by *Rhomboaster cuspis*. The occurrence of *Campylosphaera eodela* and *Rhomboaster cuspis* in assemblages of the upper *Discoaster multiradiatus* Zone is recorded as the *Campylosphaera eodela* Subzone. This biostratigraphic unit also occurs in Trinidad, on the Blake Plateau in the Atlantic Ocean (JOIDES Core 4), and on the Shatsky Rise in the Pacific Ocean (DSDP Hole 47.2).

Hole 95

Hole 95, on the Campeche Escarpment, was drilled to determine how long this area had been accumulating pelagic sediment. Samples available from the upper 17 cores contain good coccolith assemblages representing

TABLE 2

Occurrence of Selected Upper and Middle Eocene Coccoliths in the Upper Eocene Yazoo Clay and Middle Eocene Formación Aragón of the Gulf Coastal Plain Compared with Respective Coeval Occurrences in Hole 94 of DSDP Leg 10 and Holes 19 and 20C from the South Atlantic Ocean. The South Atlantic Samples are Believed to Represent a Residuum from Partial Calcite Solution Occurring at Great Depth of Deposition in Response to Aggressive Bottom Waters (see the "Mesolytic Dissolution Facies" of Hsu and Andrews, 1970)

	Upper Eocene Coccoliths																			
	<i>Bramletteius serraculoides</i>																			
Gulf Coastal Plain Yazoo Clay	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gulf of Mexico 10-94-14-1(122-123 cm)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Atlantic Ocean 3-19-5-4 (79-80 cm)	X		X	X	X			X	X	X	X					X			X	X
	Middle Eocene Coccoliths																			
	<i>Campylosphaera delta</i>																			
Gulf Coastal Plain Formación Aragón	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gulf of Mexico 10-94-20-3 (67-68 cm)	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X
South Atlantic Ocean 3-20C-5C-1(148-150 cm)	X		X	X		X	X		X	X	X					X		X	X	X

TABLE 3
 Occurrence of Key Coccoliths in Middle and Upper Eocene Samples from Leg 10, Hole 94. A Sedimentary Discontinuity
 That Cuts Out the Lower *Discoaster barbadiensis* Zone and Practically All of the *Reticulofenestra umbilica* Zone
 Accounts for the Great Floral Change Between Samples 10-94-16-3 (63-64 cm) and 10-94-17-1 (17-18 cm)

moderately shallow pelagic Pleistocene to Upper Cretaceous (Santonian) deposits. The occurrence of species of *Braarudosphaera*, *Micrantholithus*, *Pemma*, *Rhabdosphaera*, and the fossil holococcoliths *Lanternithus* and *Peritrichelina*, which typically are absent from coeval pelagic deposits from oceanic depths (Gartner and Bukry, 1969; Bukry, 1970; Bukry and others, 1971), provides an indication of the shallow-pelagic nature of the deposits. The section at Site 95 was cored discontinuously.

Core 1, cut at the surface, is in the Pleistocene *Gephyrocapsa oceanica* Zone, with reworked Miocene or Pliocene. Samples from 90 to 203 meters in Cores 2 to 5 contain upper and middle Oligocene assemblages. The lower Oligocene was bypassed in coring; a sample from the upper part of Core 6 contains an upper Eocene *Discoaster barbadiensis* Zone assemblage, including *Cyclococcolithina reticulata* which indicates the upper part of this zone. Lower cores sampled rich assemblages of middle Eocene coccoliths and contained a few species of *Discothina*, *Helicopontosphaera*, and *Rhabdosphaera* which signify moderately shallow pelagic deposits. A short interval recovered in Cores 10 to 12 (364 m to 391 m deep), contains upper Paleocene and lower Paleocene assemblages. The lower Paleocene *Cruciplacolithus tenuis* Zone is dominated by *Braarudosphaera* spp., a characteristic of most shallow-water coccolith assemblages. Modern *Braarudosphaera* is most abundant in coastal areas of lower than normal salinity such as the Gulf of Maine (Gran and Braarud, 1935) and the Gulf of Panama (Smayada, 1966).

The Upper Cretaceous samples from Cores 13 to 17 contain assemblages comparable to the Taylor Marl and Austin Chalk of Texas and are part of the Santonian-Campanian succession. *Broinsonia parca* occurs in Core 13 and *Marthasterites* sp. cf. *M. furcatus* in Core 17.

Hole 96

Hole 96 was drilled on a knoll in the Catoche Tongue area west of the Florida Straits to determine whether knolls in the eastern Gulf of Mexico have resulted from igneous or salt intrusion. Mechanical difficulties prevented completion of the objective. Of five cores taken, the lower three recovered upper Paleocene *Discoaster multiradiatus* Zone assemblages, Core 2 is upper Oligocene *Sphenolithus ciperoensis* Zone, and samples from Core 1 at 102, 105, and 108 meters are considered Pleistocene. Core 1 coccoliths are almost entirely reworked Upper Cretaceous. The diverse reworked assemblage probably represents erosion from lower Campanian strata. The Paleocene of Cores 3 to 5 is represented by a nonreworked assemblage. The presence of *Campylosphaera eodela* and *Rhomboaster cuspis* in this assemblage indicates the upper *Discoaster multiradiatus* Zone (the *Campylosphaera eodela* Subzone).

Hole 97

Coccolith assemblages from this site at the western approach to Florida Straits range in age from Holocene at the surface to early Cenomanian at 333 meters. Coring was discontinuous. The Cenozoic samples contain abundant coccoliths, but the Upper Cretaceous samples contain only rare coccoliths in a matrix of calcareous silt.

Core 1 has a condensed Quaternary section containing the characteristic Gulf or Caribbean assemblage illustrated by Boudreux and Hay (1969). As at other sites in the Gulf of Mexico (Holes 89, 90, and 93), the *Ceratolithus cristatus* specimens in near-surface samples of probable Holocene age are distinctly larger than specimens from the underlying Pleistocene beds. Samples at 106 and 110 meters from Core 2 contain assemblages with *Discoaster berggrenii*, *D. quinqueramus*, *D. surculus*, *Sphenolithus abies*, and *Triquetrorhabdulus rugosus*, indicating the upper Miocene *Discoaster quinqueramus* Zone. *Cocco lithus pelagicus* is abundant in these samples, but *Reticulofenestra pseudoumbilica* is missing. This same relation exists in *Discoaster quinqueramus* Zone samples from the tropical Pacific Ocean (Bukry, 1971ab) and represents a significant disjunction in the occurrence of *R. pseudoumbilica*. If the temperature-tolerance range for living *C. pelagicus* (6°C minimum, 15°C maximum; McIntyre and Bé, 1967) can be extrapolated to the late Miocene, then a period of cooling in the tropics is indicated. *R. pseudoumbilica* is common in younger sediment in the tropics until the middle Pliocene where it becomes extinct.

Upper Miocene *Discoaster neohamatus* Zone samples from Core 3 contain a spectacular diversity of *Discoaster* species, many of which represent mixing from slightly older late Miocene or middle Miocene strata.

Samples from the lower part of Core 4, described as a burrowed uniform soft chalk, contain middle Oligocene *Sphenolithus distentus* Zone assemblages including specimens of *Braarudosphaera bigelowi*, *Helicopontosphaera* spp., and *Peritrichelina joidea*. These assemblages typically indicate moderately shallow deposition. The uppermost sample from the core contains an apparently mechanically brecciated mixture of middle Miocene taxa and taxa from the lower upper Miocene *Discoaster hamatus* Zone. As this core is stratigraphically about 60 meters deeper than Core 3, which has a similar, though slightly younger, upper Miocene assemblage, no distinct hiatus can be demonstrated. Rather, the mechanically brecciated nature of this young sediment at the top of Core 4 suggests downhole slumping of the sediment.

Coccoliths are poorly preserved in the upper Eocene sediment of Core 5, and the assemblage suggests deep-water deposition. The remaining cores are Upper Cretaceous and contain sparse assemblages of resistant taxa. On the basis of negative evidence (the lack of certain resistant cosmopolitan Santonian to Maestrichtian taxa such as *Micula decussata*), samples from Cores 6 to 8 can be considered Cenomanian or Turonian. In Core 12 at 333 meters a representative Cenomanian assemblage is present. It includes *Cretarhabdus decorus*, *Eiffellithus turris eiffeli*, *Prediscosphaera* sp., and *Watznaueria* sp. aff. *W. britannica*.

Coccolith Species Considered

- Apertapetra gronosa* (Stover)
- Arkhangelskiella cymbiformis* Vekshina
- Arkhangelskiella specillata* Vekshina
- Bidiscus rotatorius* Bukry
- Braarudosphaera africana* Stradner
- Braarudosphaera bigelowi* (Gran and Braarud)

- Braarudosphaera discula* Bramlette and Riedel
Braarudosphaera rosa Levin and Joerger
Braarudosphaera turbinea Stradner
Bramletteius serratuloides Gartner
Broinsonia parca (Stradner)
Campylosphaera dela (Bramlette and Sullivan)
Campylosphaera eodela Bukry and Percival
Catinaster calyculus Martini and Bramlette
Catinaster coalitus Martini and Bramlette
Catinaster mexicanus Bukry
Ceratolithus cristatus Kamptner
Ceratolithus rugosus Bukry and Bramlette
Ceratolithus tricorniculatus Gartner
Chiasmolithus altus Bukry and Percival
Chiasmolithus bidens (Bramlette and Sullivan)
Chiasmolithus californicus (Sullivan)
Chiasmolithus consuetus (Bramlette and Sullivan)
Chiasmolithus expansus (Bramlette and Sullivan)
Chiasmolithus gigas (Bramlette and Sullivan)
Chiasmolithus grandis (Bramlette and Riedel)
Chiasmolithus solitus (Bramlette and Sullivan)
Chiastozygus amphipons (Bramlette and Martini)
Chiastozygus bifarius Bukry
Chiastozygus disgrégatus (Stover)
Chiphragmalithus calathus Bramlette and Sullivan
Chiphragmalithus cristatus (Martini)
Chiphragmalithus fulgens (Stradner)
 basionym: *Nannotetraster fulgens* Stradner in Martini, E. and Stradner, H., 1960, Erdoel-Z., 76, p. 268, figs. 10, 16.
Chiphragmalithus quadratus Bramlette and Sullivan
Chiphragmalithus spinosus (Stradner)
Coccolithus crassus Bramlette and Sullivan
Coccolithus cribellum (Bramlette and Sullivan)
Coccolithus doronicoides Black and Barnes
Coccolithus eopelagicus (Bramlette and Riedel)
Coccolithus fenestratus (Deflandre and Fert)
Coccolithus matalosus Stover
Coccolithus pelagicus (Wallich)
Coccolithus pseudogammation Bouché
Coccolithus staurion Bramlette and Sullivan
Corollithion signum Stradner
Cretarhabdus conicus Bramlette and Martini
Cretarhabdus crenulatus Bramlette and Martini
Cretarhabdus decorus (Deflandre)
Cribrosphaera ehrenbergii Arkhangelsky
Cruciplacolithus tenuis (Stradner)
Cyclolithella bramlettei (Hay and Towe)
Cyclolithella? robusta (Bramlette and Sullivan)
Cyclococcolithina cricota (Gartner)
Cyclococcolithina formosa (Kamptner)
Cyclococcolithina gammation (Bramlette and Sullivan)
Cyclococcolithina leptopora (Murray and Blackman)
Cyclococcolithina macintyreai (Bukry and Bramlette)
 basionym: *Cyclococcolithus macintyreai* Bukry and Bramlette, 1969, Tulane Stud. Geol. Paleont., v. 7, p. 132, pl. 1, figs. 1-3.
Cyclococcolithina neogammation (Bramlette and Wilcoxon)
Cyclococcolithina protoannula (Gartner)
Cyclococcolithina reticulata (Gartner and Smith)
- Cyclococcolithina rotula* (Kamptner)
Cylindralithus serratus Bramlette and Martini
Dictyococcites abisectus (Müller)
Dictyococcites bisectus (Hay, Mohler and Wade)
Dictyococcites scrippsae Bukry and Percival
Discoaster araneus Bukry
Discoaster asymmetricus Gartner
Discoaster aulakos Gartner
Discoaster barbadiensis Tan
Discoaster bellus Bukry and Percival
Discoaster berggrenii Bukry
Discoaster bollii Martini and Bramlette
Discoaster braarudii Bukry
Discoaster brouweri Tan
Discoaster calcaris Gartner
Discoaster challengerii Bramlette and Riedel
Discoaster deflandrei Bramlette and Riedel
Discoaster delicatus Bramlette and Sullivan
Discoaster distinctus Martini
Discoaster exilis Martini and Bramlette
Discoaster gemmeus Stradner
Discoaster gemmifer Stradner
Discoaster hamatus Martini and Bramlette
Discoaster kuepperi Stradner
Discoaster lenticularis Bramlette and Sullivan
Discoaster lodoensis Bramlette and Riedel
Discoaster lubinaensis Bystricka
Discoaster mediosus Bramlette and Sullivan
Discoaster mirus Deflandre
Discoaster mohleri Bukry and Percival
Discoaster moorei Bukry
Discoaster multiradiatus Bramlette and Riedel
Discoaster neohamatus Bukry and Bramlette
Discoaster ornatus Stradner
Discoaster pentaradiatus Tan
Discoaster perclarus Hay
Discoaster perplexus Bramlette and Riedel
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Discoaster saipanensis Bramlette and Riedel
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Discoaster tani nodifer Bramlette and Riedel
Discoaster tani tani Bramlette and Riedel
Discoaster variabilis pansus Bukry and Percival
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Helicopontosphaera parallela (Bramlette and Wilcoxon)
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 basionym: *Tranolithus gabalus* Stover, 1966, Micropaleontology, v. 12, p. 146, pl. 4, fig. 22, pl. 9, fig. 5.

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COCCOLITHS IN SELECTED SAMPLES

HOLE 85

(lat 22°50.49'N., long 91°25.37'W., depth 3749 m)

Holocene

(*Emiliania huxleyi* Zone)

10-85-1-6, 63-64 cm; depth 27 m;
?E. huxleyi, *H. kamptneri*, *R. clavigera*, *S. histrica*. Reworked Upper Cretaceous taxa: *A. cymbiformis*, *E. turrisieiffeli*, *M. decussata*, *P. cretacea*, *W. barnesae*

10-85-3-6, 63-64 cm; depth 107 m:

E. annula, *?E. huxleyi*, *Gephyrocapsa* sp., *H. kamptneri*, *H. wallichii*, *Scapholithus* sp. Reworked Upper Cretaceous taxa: *B. parca*, *C. crenulatus*, *C. ehrenbergii*, *E. augustus*, *P. cretacea*, *V. octoradiata*, *W. barnesae*, *W. biporta*.

Pleistocene

(*Gephyrocapsa oceanica* Zone)

10-85-4-1, 62-63 cm; depth 190 m:

C. leptopora, *D. japonica* s.l., *E. annula*, *G. oceanica*, *Gephyrocapsa* sp., *H. kamptneri*, *O. antillarum*, *R. clavigera*, *R. stylifera*, *Scapholithus* sp., *S. histrica*. Reworked Upper Cretaceous and upper Tertiary taxa: *D. brouweri* s.l., *D. deflandrei*, *D. pentaradiatus*, *E. turrisieiffeli*, *M. decussata*, *W. barnesae*.

10-85-5-2, 63-64 cm; depth 212 m:

D. japonica, *G. oceanica*, *H. kamptneri*, *R. stylifera*, *S. histrica*.

HOLE 86

(lat 22°52.48'N., long 90°57.75'W., depth 1481 m)

Upper Pleistocene or Holocene

(Upper *Gephyrocapsa oceanica* Zone or
Emiliania huxleyi Subzone)

10-86-1-1, 63-64 cm; depth 14 m:

C. cristatus, *C. leptopora*, *D. japonica*, *D. multipora*, *?E. huxleyi*, *G. oceanica* [rare], *H. kamptneri*, *R. clavigera*, *R.*

stylifera, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* sp. Reworked Upper Cretaceous taxon: *M. decussata*.

Lower Pleistocene (*Coccolithus doronicoides* Zone)

10-86-2-1, 62-63 cm; depth 53 m:

C. cristatus, *C. leptopora*, *D. japonica*, *D. macropora*, *E. annula*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *S. pulcherrima*, *S. recurvata*, *S. histrica*. Reworked Miocene or Pliocene taxa: *C. macintyrei*, *S. abies*.

Upper Pliocene (*Discoaster brouweri* Zone, *Discoaster pentaradiatus* Subzone)

10-86-3-1, 63-64 cm; depth 162 m:

C. rugosus, *C. macintyrei*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. variabilis variabilis*, *D. japonica*, *D. multipora*, *E. annula*, *H. kamptneri*, *H. sellii*, *Rhabdosphaera* sp., *S. apsteinii*, *S. pulcherrima*. Reworked Miocene or Pliocene taxa: *D. quinqueramus*, *S. abies*.

Lower Pliocene (*Reticulofenestra pseudoumbilica* Zone, *Discoaster asymmetricus* Subzone)

10-86-3-4, 63-64 cm; depth 166 m:

C. rugosus, *C. pelagicus*, *C. leptopora*, *C. macintyrei*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. perplexus*, *D. japonica*, *D. multipora*, *R. pseudoumbilica*, *Rhabdosphaera* sp., *S. intermedia*, *S. abies*, *S. neoabies*.

Upper Miocene (*Ceratolithus tricorniculatus* Zone)

10-86-4-1, 63-64 cm; depth 258 m:

C. tricorniculatus, *C. pelagicus* [rare], *C. leptopora*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. variabilis pansus*, *D. variabilis variabilis*, *D. japonica*, *H. kamptneri*, *R. pseudoumbilica*, *Rhabdosphaera* sp., *S. apsteinii*, *S. pulcherrima*, *S. recurvata*, *S. abies*, *S. neoabies*, *Thoracosphaera* sp., *T. rugosus*. Reworked Oligocene or Miocene taxa: *C. eopelagicus*, *D. deflandrei*.

10-86-4-3, 63-64 cm; depth 261 m:

C. tricorniculatus, *C. macintyrei*, *C. rotula*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. variabilis pansus*, *D. japonica*, *H. kamptneri*, *H. sellii*, *R. pseudoumbilica*, *Scyphosphaera* sp. cf. *S. apsteinii*, *S. pulcherrima*, *S. recurvata*, *S. abies*, *S. neoabies*, *Thoracosphaera* sp., *T. rugosus*. Reworked Oligocene or Miocene taxa: *C. eopelagicus*, *D. deflandrei*.

Middle Oligocene (*Sphenolithus distentus* Zone)

10-86-5-1, 101-102 cm; depth 372 m:

C. eopelagicus, *C. neogammation*, *D. abisectus*, *D. scrippae*, *D. deflandrei*, *D. tani nodifer*, *H. intermedia*, *S. distentus*, *S. moriformis*, *Z. bijugatus*.

10-86-5-4, 63-64 cm; depth 376 m: [Same as above].

Upper Paleocene (*Discoaster mohleri* Zone)

10-86-7-2, 78-79 cm; depth 500 m:

B. bigelowi, *B. rosa*, *C. californicus*, *C. consuetus*, *C. pelagicus* s.l., *C. tenuis*, *C. robustus*, *Discoaster mohleri*, *F. tympaniformis*, *M. fornicatus*, *S. anarrhopus*, *T. craticulus*, *Z. sigmoides*.

10-86-7-4, 63-64 cm; depth 503 m:

B. bigelowi, *B. discula*, *B. rosa*, *C. californicus*, *C. pelagicus* s.l., *C. robustus*, *Discoaster mohleri*, *Ellipsolithus* sp. cf. *E. distichus*, *E. macellus*, *F. tympaniformis*, *M. fornicatus*, *S. anarrhopus*, *T. craticulus*, *Z. sigmoides*.

Upper Paleocene
(*Heliolithus riedeli* Zone)

10-86-7-5, 63-64 cm; depth 505 m:

B. bigelowi [abundant], *C. californicus*, *Discoaster mohleri*, *E. distichus*, *E. macellus*, *F. tympaniformis*, *H. riedeli* [rare], *S. anarrhopus*, *T. craticulus*, *Z. chiastus*.

Upper Paleocene
(*Heliolithus kleinelli* Zone)

10-86-8-1, 143-144 cm; depth 509 m:

C. consuetus, *C. pelagicus*, *C. robustus*, *F. tympaniformis*, *H. kleinelli*, *S. anarrhopus*, *T. craticulus*, *Z. chiastus*, *Z. sigmoides*.

10-86-8-4, 63-64 cm; depth 513 m:

B. discula, *C. consuetus*, *C. pelagicus*, *C. tenuis*, *F. tympaniformis*, *H. kleinelli*, *S. anarrhopus*, *T. craticulus*, *Z. simplex*.

Lower Paleocene
(*Cruciplacolithus tenuis* Zone)

10-86-9-1, 63-64 cm; depth 551 m:

B. bigelowi [abundant], *B. discula* [abundant] *C. pelagicus*, *C. tenuis*, *M. fornicatus*, *Thoracosphaera* sp., *Z. sigmoides*.

HOLE 87

(lat 23° 00' 90" N., long 92° 05' 16" W., depth 3761 m)

Upper Miocene With Reworked Eocene and Oligocene

10-87-1-1, 125-126 cm; depth 649 m:

C. coalitus, *D. brouweri* s.l., *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*, *S. abies*. Reworked taxa: *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. saipanensis*, *H. parallela*, *R. umbilica*.

HOLE 88

(lat 21° 22' 93" N., long 94° 00' 21" W., depth 2532 m)

Holocene
(*Emiliania huxleyi* Zone)

10-88-1-1, 63-64 cm; depth 1 m:

C. cristatus, *C. leptopora*, *D. japonica*, ?*E. huxleyi*, *G. oceanica*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *Scapholithus* sp., *S. apsteinii*, *S. histrica*, *Thoracosphaera* spp. Reworked taxa: *C. crenulatus*, *D. bisectus*, *W. barnesiae*.

Pleistocene
(*Gephyrocapsa oceanica* Zone)

10-88-1-4, 63-64 cm; depth 5 m:

C. cristatus, *C. leptopora*, *D. japonica*, *D. multipora*, *G. oceanica*, *Gephyrocapsa* sp., *H. kamptneri*, *H. sellii*, *R. clavigera*, *R. stylifera*, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* sp. Reworked taxa: *C. neogammation*, *W. barnesiae*.

Pleistocene
(*Coccolithus doronicoides* Zone)

10-88-2-6, 63-64 cm; depth 59 m:

C. cristatus, *C. leptopora*, *C. macintyreai*, *D. japonica*, *D. multipora*, *E. annula*, *G. caribbeanica*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *R. stylifera*, *Scapholithus* sp., *S. pulcherrima*, *S. histrica*, *T. saxea*. Reworked taxa: *C. crenulatus*, *W. barnesiae*.

Upper Pliocene
(*Discoaster brouweri* Zone,
Cyclococcolithus macintyreai Subzone)

10-88-3-3, 73-74 cm; depth 101 m:

C. macintyreai, *D. asymmetricus*, *D. brouweri*, *D. japonica*, *E. annula*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *S. pulcherrima*, *T. saxea*.

Upper Pliocene
(*Discoaster brouweri* Zone,
Discoaster pentaradiatus Subzone)

10-88-3-6, 70-71 cm; depth 104 m:

C. cristatus, *C. rugosus*, *C. doronicoides*, *C. leptopora*, *C. macintyreai*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. japonica*, *E. annula*, *H. kamptneri*, *H. sellii*, *S. apsteinii*, *Scyphosphaera* spp., *Thoracosphaera* spp.

10-88-4-5, 66-67 cm; depth 107 m:

C. rugosus, *C. leptopora*, *C. macintyreai*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. japonica*, *E. annula* s.l., *H. kamptneri*, *H. sellii*, *H. wallichii*, *S. pulcherrima*.

Upper Miocene or Lower Pliocene
(*Ceratolithus rugosus* Zone)

10-88-5-1, 54-55 cm; depth 128 m:

Ceratolithus sp. cf. *C. cristatus*, *C. rugosus*, *C. tricorniculatus*, *C. leptopora*, *C. macintyreai*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. variabilis variabilis*, *D. multipora* s.l., *H. kamptneri*, *R. pseudoumbilica*, *S. globulata*, *S. pulcherrima*, *S. neoabies*, *T. saxea*.

10-88-5-6, 63-64 cm; depth 131 m:

C. rugosus, *Ceratolithus* sp. cf. *C. rugosus*, *C. tricorniculatus*, *C. macintyreai*, *D. brouweri*, *D. brouweri* s.l. [large], *D. pentaradiatus*, *D. surculus*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*, *S. abies*.

HOLE 89
(lat 20° 53' 41" N., long 95° 06' 73" W., depth 3067 m)

Holocene
(*Emiliania huxleyi* Zone)

10-89-1-1, 111-112 cm; depth 1 m:

C. cristatus [large] *C. leptopora*, ?*E. huxleyi*, *G. oceanica*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* sp.

Pleistocene
(*Gephyrocapsa oceanica* Zone)

10-89-1-3, 63-64 cm; depth 4 m:

C. cristatus, *C. leptopora*, *G. oceanica* [abundant], *H. kamptneri*, *H. sellii*, *R. clavigera*, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* sp., *U. mirabilis*.

Upper Pliocene
(Discoaster brouweri Zone)

10-89-3-1, 63-64 cm; depth 120 m:

C. cristatus, *C. leptopora*, *C. macintyrei*, *D. brouweri*, *D. pentaradiatus* [abundant], *E. annula*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *R. stylifera*, *S. histricalis*. Reworked Upper Cretaceous taxa: *E. augustus*, *M. decussata*, *W. barnesae*.

Lower Pliocene
(Ceratolithus rugosus Zone)

10-89-4-1, 69-70 cm; depth 220 m:

C. rugosus, *Ceratolithus* sp. cf. *C. rugosus*, *C. leptopora*, *C. macintyrei*, *D. asymmetricus* [rare], *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. japonica*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*, *S. globulata*, *S. pulcherrima*, *S. abies*.

10-89-4-3, 63-64 cm; depth 224 m:

C. rugosus, *Ceratolithus* sp. cf. *C. rugosus*, *C. tricorniculatus* [some bizarre specimens], *C. leptopora*, *C. macintyrei*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. multipora*, *H. kamptneri*, *H. sellii*, *R. pseudoumbilica*, *S. abies*.

Upper Miocene
(Discoaster quinqueramus Zone)

10-89-5-1, 117-118 cm; depth 299 m:

C. macintyrei, *D. brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. surculus*, *Discoaster* sp. cf. *D. surculus*, *D. variabilis variabilis*, *D. japonica*, *H. kamptneri*, *R. pseudoumbilica*, *S. neoabies*, *T. rugosus*. Reworked taxa—Eocene or Oligocene: *C. formosa*; Paleocene: *C. tenuis*.

10-89-6-1, 99-100 cm; depth 376 m:

C. tricorniculatus, *D. brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. variabilis variabilis*, *D. japonica*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*, *Rhabdosphaera* sp., *S. abies*. Reworked taxa—Cretaceous: *C. ehrenbergii*, *W. barnesae*; Eocene: *C. reticulata*, *D. bisectus*, *L. nascens*, *R. umbilica*.

HOLE 90
(lat 23° 47.80' W., long 94° 46.09' N., depth 3713 m)
Zone)

Holocene
(Emiliania huxleyi Zone)

10-90-1-1, 63-64 cm; depth 1 m:

C. cristatus [large, robust specimens], *C. leptopora*, *D. japonica*, ?*E. huxleyi*, *G. oceanica*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *S. histricalis*, *Thoracosphaera* sp., *U. mirabilis*.

Upper Pleistocene
(Gephyrocapsa oceanica Zone)

10-90-1-6, 63-64 cm; depth 8 m:

C. cristatus, *D. japonica*, *D. multipora* s.l., *G. caribbeanica*, *G. oceanica* [abundant], *H. kamptneri*, *R. clavigera*, *Scapholithus* sp.

Lower Pleistocene
(Coccolithus doronicoides Zone)

10-90-2-1, 63-64 cm; depth 71 m:

C. cristatus, *C. leptopora*, *D. japonica*, *E. annula*, *G. caribbeanica*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *R. stylifera*, *Scapholithus* sp., *S. pulcherrima*, *S. recurvata*, *S. histricalis*, *T. saxeae*, *U. mirabilis*. Reworked taxa—Upper Cretaceous: *Z. deflandrei*; Miocene: *D. bollii*.

10-90-2-4, 63-64 cm; depth 75 m:

C. cristatus, *C. pelagicus*, *C. leptopora*, *D. multipora* s.l., *E. annula*, *Gephyrocapsa* sp. cf. *G. caribbeanica*, *H. kamptneri*, *Scapholithus* sp., *S. pulcherrima*, *S. histricalis*. Reworked Eocene or Oligocene taxon: *C. formosa*.

Upper Pliocene
(Discoaster brouweri Zone)

10-90-3-1, 63-64 cm; depth 130 m:

C. rugosus, *C. pelagicus*, *C. leptopora*, *C. macintyrei*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. japonica*, *E. annula*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *S. pulcherrima*, *Syracosphaera* sp.

10-9-3-3, 63-64 cm; depth 133 m:

Ceratolithus sp. cf. *C. cristatus*, *C. doronicoides*, *C. pelagicus*, *C. leptopora*, *C. macintyrei*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *Discoaster* sp. cf. *D. surculus*, *H. sellii*, *Scyphosphaera* sp., *T. saxeae*. Reworked Upper Cretaceous taxa: *E. turrisieffeli*, *W. barnesae*.

Upper Miocene or Lower Pliocene
(Ceratolithus rugosus Zone)

10-90-4-1, 103-104 cm; depth 188 m:

Ceratolithus sp. cf. *C. rugosus*, *C. tricorniculatus*, *C. leptopora*, *C. macintyrei*, *D. brouweri*, *Discoaster* sp. aff. *D. brouweri* [large] *D. pentaradiatus*, *D. surculus*, *H. kamptneri* [rare] *R. pseudoumbilica* [some specimens mimic *D. bisectus*] *S. abies*, *S. neoabies*.

10-90-4-3, 63-64 cm; depth 191 m:

Ceratolithus sp. cf. *C. rugosus*, *C. tricorniculatus*, *C. leptopora*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *H. kamptneri*, *R. pseudoumbilica*, *S. abies*, *S. neoabies*.

Upper Miocene
(Discoaster quinqueramus Zone)

10-90-5-1, 63-64 cm; depth 237 m:

C. tricorniculatus [rare] *C. macintyrei*, *D. brouweri* s.l., *Discoaster* sp. cf. *D. exilis* [webbed rays], *D. pentaradiatus*, *D. quinqueramus*, *Discoaster* sp. cf. *D. surculus*, *D. variabilis*, *R. pseudoumbilica*, *S. abies*, *T. rugosus*. Reworked Upper Cretaceous taxon: *M. decoratus*.

10-90-6-2, 63-64 cm; depth 295 m:

C. pelagicus, *D. berggrenii*, *D. brouweri*, *D. quinqueramus*, *D. variabilis variabilis*, *D. multipora*, *S. abies*, *T. rugosus*. Reworked Upper Cretaceous taxa: *C. crenulatus*, *W. barnesae*.

10-90-7-2, 63-64 cm; depth 343 m:

C. pelagicus, *D. brouweri*, *D. quinqueramus*, *D. variabilis pansus*, *D. variabilis variabilis*, *H. sellii*, *S. abies*. Reworked

taxa—Upper Cretaceous: *P. cretacea*, *W. barnesae*; Eocene: *C. eopelagicus*, *D. barbadiensis*, *R. umbilica*.

**Upper Miocene
(? Zone)**

10-90-9-1, 59-60 cm; depth 472 m:

Catinaster sp. cf. *C. calyculus*, *C. pelagicus*, *C. macintyreai*, *Discoaster* sp. aff. *D. brouweri* [large, 5- and 6-rayed], *D. variabilis variabilis*, *D. japonica*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*. Reworked taxa—Upper Cretaceous: *C. ehrenbergii*, *M. decussata*, *W. barnesae*; Eocene: *D. lodoensis*.

10-90-10-1, 52-53 cm; depth 596 m:

C. pelagicus, *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*. Reworked Upper Cretaceous taxa: *C. crenulatus*, *M. decussata*, *W. barnesae*.

**Upper Miocene
(*Catinaster coalitus* Zone)**

10-90-11-2, 63-64 cm; depth 677 m:

C. coalitus, *C. mexicanus*, *C. eopelagicus*, *C. macintyreai*, *C. rotula*, *D. bollii*, *D. brouweri* s.l., *D. signus*, *H. kamptneri*, *R. pseudoumbilica*, *S. neoabies*. Reworked taxa—Upper Cretaceous: *E. turriseiffeli*, *Z. deflandrei*; Eocene: *D. barbadiensis*.

10-90-11-6, 63-64 cm; depth 682 m:

C. coalitus, *C. mexicanus*, *C. eopelagicus*, *C. lepropora*, *D. bollii*, *D. braarudii*, *D. deflandrei*, *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*, *S. abies*, *S. neoabies*.

**Middle Miocene
(*Discoaster exilis* Zone)**

10-90-13-1, 62-63 cm; depth 764 m:

C. eopelagicus, *C. pelagicus*, *C. leptopora*, *C. macintyreai*, *C. rotula*, *D. bollii*, *D. braarudii*, *D. exilis*, *D. subsurculus*, *D. variabilis variabilis*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*, *Rhabdosphaera* sp. Reworked Upper Cretaceous taxa: *E. turriseiffeli*, *W. barnesae*.

HOLE 91

(lat 23° 46.40'N., long 93° 20.77'W., depth 3763 m)

Upper Pleistocene or Holocene

10-91-1-1, 100-101 cm; depth 61 m:

G. oceanica, *H. kamptneri*. Reworked Upper Cretaceous taxa: *B. parca*, *C. ehrenbergii*, *P. cretacea*, *W. barnesae*.

10-91-2-5, 63-64 cm; depth 132 m:

C. leptopora, *D. japonica*, *G. oceanica*, *H. kamptneri*, *H. wallichii*, *R. clavigera*. Reworked Upper Cretaceous taxon: *A. cymbiformis*.

10-91-3-6, 63-64 cm; depth 167 m:

H. kamptneri. Reworked taxa—Upper Cretaceous: *E. turriseiffeli*, *G. costatum porolatum*, *M. decussata*, *P. cretacea*; upper Tertiary: *R. pseudoumbilica*, *S. abies*.

10-91-7-5, 62-63 cm; depth 413 m:

C. leptopora, *Gephyrocapsa* sp., *H. kamptneri*, *H. sellii*, *R. clavigera*, *Thoracosphaera* sp. Reworked Upper Creta-

ceous taxa: *C. crenulatus*, *E. augustus*, *E. turriseiffeli*, *M. decussata*, *P. cretacea*, *V. octoradiata*, *W. barnesae*.

**Pliocene or Pleistocene
(Transitional)**

10-91-8-2, 63-64 cm; depth 492 m:

C. cristatus, *C. doronicoides*, *C. leptopora*, *C. macintyreai*, *D. brouweri* [rare], *D. japonica*, *E. annula*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *Scapholithus* sp., *S. apsteinii*, *S. pulcherrima*, *S. histrica*, *U. mirabilis*. Reworked Upper Cretaceous taxa: *M. decussata*, *P. cretacea*.

**Upper Pliocene
(*Discoaster brouweri* Zone,
Discoaster pentaradiatus Subzone)**

10-91-9-6, 63-64 cm; depth 538 m:

C. rugosus, *C. leptopora*, *C. macintyreai*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. japonica*, *E. annula*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *S. pulcherrima*.

**Upper Miocene
(*Discoaster quinqueramus* Zone)**

10-91-10-2, 63-64 cm; depth 653 m:

C. pelagicus, *C. rotula*, *D. berggrenii*, *D. braarudii*, *D. brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*, *Sphenolithus*? sp. aff. *S. neoabies*. Reworked taxa—Upper Cretaceous: *M. decussata*, *W. barnesae*; Eocene: *D. barbadiensis*.

Middle Miocene or Upper Miocene

10-91-11-2, 63-64 cm; depth 772 m:

C. pelagicus, *Discoaster* sp., *H. kamptneri*, *R. pseudoumbilica*.

10-91-14-2, 63-64 cm; depth 800 m:

C. pelagicus, *C. rotula*, *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*, *S. neoabies*. Reworked taxa—Upper Cretaceous: *W. barnesae*; Eocene: *C. dela*, *D. mirus*.

10-91-16-3, 63-64 cm; depth 819 m:

C. pelagicus, *C. leptopora*, *D. brouweri* s.l., *D. variabilis variabilis*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*, *S. neoabies*. Reworked taxa—Upper Cretaceous: *A. cymbiformis*, *E. turriseiffeli*, *M. decussata*, *W. barnesae*; Eocene or Oligocene: *C. neogammation*, *D. bisectus*, *H. parallela*, *I. recurvus*, *M. attenuatus*.

10-91-18-6, 95-96 cm; depth 843 m:

D. bollii, *D. variabilis variabilis*, *H. kamptneri*, *R. pseudoumbilica*, *S. neoabies*. Reworked Eocene or Oligocene taxa: *C. formosa*, *R. umbilica*.

10-91-22-2, 63-74 cm; depth 868 m:

C. leptopora, *D. variabilis variabilis*, *R. pseudoumbilica*.

10-91-25-4, 63-64 cm; depth 896 m:

C. eopelagicus, *C. pelagicus*, *C. leptopora*, *C. macintyreai*, *D. variabilis variabilis*, *D. multipora*, *H. kamptneri*, *R. pseudoumbilica*. Reworked Cretaceous taxon: *W. barnesae*.

HOLE 92

(lat 25° 50.69'N., long 91° 49.29'W., depth 2573 m)

Pleistocene or Holocene

10-92-2-5, 63-64 cm; depth 38 m:

G. oceanica, *Gephyrocapsa* sp. [small]. Reworked taxa—Upper Cretaceous: *A. cymbiformis*, *A. specillata*, *C. crenulatus*, *C. ehrenbergii*, *E. turriseiffeli*, *G. costatum* *costatum*, *M. decussata*, *P. cretacea*, *V. octoradiata*; Miocene or Pliocene: *S. abies*.

10-92-3-5, 64-65 cm; depth 94 m:

Gephyrocapsa sp. [small]. Reworked Upper Cretaceous taxa: *A. cymbiformis*, *C. ehrenbergii*, *E. turriseiffeli*, *M. decussata*, *P. cretacea*, *W. barnesae*, *Zygodiscus* sp.

10-92-4-5, 62-63 cm; depth 132 m:

Discolithina sp. cf. *D. japonica*, *G. oceanica*, *Gephyrocapsa* sp. [small]. Reworked Upper Cretaceous taxon: *M. decussata*.

Lower Pleistocene*(Coccolithus doronicoides Zone)*

10-92-5-6, 63-64 cm; depth 180 m:

E. annula, *G. carribeanica*, *H. kampfneri*, *S. histricalis*. Reworked Upper Cretaceous taxa: *A. cymbiformis*, *B. parca*, *C. crenulatus*, *C. ehrenbergii*, *E. turriseiffeli*, *L. floralis*, *M. decussata*, *P. augustus*, *P. cretacea*, *V. octoradiata*, *W. barnesae*.

Miocene, Pliocene, or Pleistocene

10-92-6-2, 63-64 cm; depth 222 m:

C. pelagicus, *H. kampfneri*. Reworked Upper Cretaceous taxa: *E. turriseiffeli*, *M. decussata*, *P. cretacea*, *W. barnesae*.

Series Unknown10-92-7-1, 129-130 cm; depth 258 m:
[barren].10-92-8-1, 63-64 cm; depth 262 m.
[barren].**HOLE 93**

(lat 22° 37.25'N., long 91° 28.78'W., depth 3090 m)

Holocene*(Emiliania huxleyi Zone)*

10-93-1-1, 128-129 cm; depth 0 m:

C. cristatus [large], *C. pelagicus*, *C. leptopora*, *D. multipora* s.l., ?*E. huxleyi*, *G. oceanica*, *H. kampfneri*, *H. wallichii*, *R. clavigera*, *Rhabdotherax* sp., *S. histricalis*, *Thoracosphaera* sp.

Upper Miocene*(Ceratolithus quinqueramus Zone)*

10-93-1-2, 65-67 cm; depth 1 m:

C. tricorniculatus [rare] *C. pelagicus*, *C. leptopora*, *C. macintyreai*, *D. berggrenii*, *D. brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. surculus*, *D. variabilis*, *H. kampfneri*, *R. pseudoumbilica*, *S. neoabies*, *T. rugosus*.

HOLE 94

(lat 24° 31.64'N., long 88° 28.16'W., depth 1793 m)

Upper Pleistocene
(Gephyrocapsa oceanica Zone)

10-94-1-2, 63-64 cm; depth 1 m:

C. leptopora, *D. japonica*, *D. multipora* s.l., *G. oceanica*, *H. kampfneri*, *H. sellii*, *H. wallichii*, *R. clavigera*, *Rhabdotherax* sp., *Scapholithus* sp., *S. apsteinii*, *S. histricalis*, *Thoracosphaera* sp.

Upper Pliocene
(Discoaster brouweri Zone,
Discoaster pentaradiatus Subzone)

10-94-2-1, 63-64 cm; depth 53 m:

C. rugosus, *C. leptopora*, *C. macintyreai*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. perplexus*, *D. surculus*, *D. japonica*, *E. annula*, *H. kampfneri*, *R. clavigera*, *S. histricalis*.

Lower Pliocene
(Reticulofenestra pseudoumbilica Zone,
Discoaster asymmetricus Subzone)

10-94-3-1, 63-64 cm; depth 101 m:

C. rugosus, *C. leptopora*, *C. macintyreai*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. variabilis*, *pansus*, *D. japonica*, *D. multipora*, *H. kampfneri*, *H. sellii*, *Rhabdosphaera* sp., *R. pseudoumbilica*, *S. globulata*, *S. pulcherrima*, *S. abies*, *S. neoabies*.

10-94-3-6, 63-64 cm; depth 108 m:

C. rugosus, *C. macintyreai*, *C. rotula*, *D. asymmetricus*, *D. brouweri*, *D. pentaradiatus* [abundant], *D. perplexus*, *D. surculus*, *D. japonica*, *H. kampfneri*, *H. sellii*, *Rhabdosphaera* sp., *R. pseudoumbilica*, *S. globulata*, *S. pulcherrima*, *Scyphosphaera* spp., *S. neoabies*, *S. histricalis*, *Thoracosphaera* sp.

Upper Miocene or Lower Pliocene
(Ceratolithus rugosus Zone)

10-94-4-1, 63-64 cm; depth 130 m:

C. rugosus, *Ceratolithus* sp. cf. *C. rugosus*, *C. tricorniculatus*, *C. leptopora*, *C. macintyreai*, *C. rotula*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *D. japonica*, *D. multipora* s.l., *H. kampfneri*, *H. sellii*, *R. pseudoumbilica*, *S. apsteinii*, *S. globulata*, *S. pulcherrima*, *S. abies*, *S. neoabies*.

10-94-4-6, 60-61 cm; depth 137 m:

C. rugosus, *C. tricorniculatus*, *C. macintyreai*, *C. rotula*, *D. brouweri*, *D. pentaradiatus* [abundant], *D. surculus*, *D. japonica*, *D. multipora* s.l., *H. kampfneri*, *R. pseudoumbilica*, *S. apsteinii*, *S. globulata*, *S. pulcherrima*, *S. abies*, *S. neoabies* [abundant].

Upper Miocene
(Ceratolithus tricorniculatus Zone)

10-94-5-1, 63-64 cm; depth 169 m:

C. tricorniculatus, *C. pelagicus*, *C. macintyreai*, *C. rotula*, *D. challengerii*, *D. pentaradiatus*, *D. quinqueramus* [rare], *D. surculus*, *D. japonica*, *H. kampfneri*, *R. pseudoumbilica*, *Rhabdosphaera* sp., *S. globulata*, *S. abies*, *S. neoabies*, *T. rugosus* [rare].

Upper Miocene

(Discoaster quinqueramus Zone)

10-94-5-6, 63-64 cm; depth 176 m:

C. tricorniculatus, *C. pelagicus*, *C. leptopora*, *D. brouweri*, *D. challengerii*, *D. pentaradiatus*, *D. quinqueramus* [common], *D. surculus*, *D. variabilis variabilis*, *D. japonica*, *H. kampfneri*, *R. pseudoumbilica*, *S. globulata*, *S. pulcherrima*, *S. abies* [abundant], *S. neoabies*, *T. rugosus*.

10-94-6-6, 63-64 cm; depth 215 m:

C. pelagicus, *C. cricottus*, *C. macintyrei*, *C. rotula*, *D. brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. surculus*, *D. variabilis variabilis*, *H. kampfneri*, *S. abies*, *S. neoabies*.

10-94-7-5, 63-64 cm; depth 248 m:

C. pelagicus, *C. leptopora*, *C. rotula*, *D. brouweri*, *D. quinqueramus*, *D. surculus*, *D. variabilis pansus*, *D. variabilis variabilis*, *H. kampfneri*, *H. sellii*, *S. abies*, *S. neoabies*.

10-94-8-3, 63-64 cm; depth 254 m:

C. pelagicus, *C. leptopora*, *D. berggrenii*, *D. brouweri* s.l., *D. quinqueramus*, *D. surculus*, *D. variabilis variabilis*, *D. japonica* s.l., *H. kampfneri*, *S. abies*, *S. neoabies*, *T. rugosus*.

10-94-8-5, 63-64 cm; depth 256 m:

C. pelagicus, *C. leptopora* [rare], *D. berggrenii* [abundant], *D. brouweri* s.l., *D. challengerii*, *D. pentaradiatus*, *D. surculus*, *D. japonica*, *D. multipora*, *H. kampfneri*, *H. sellii*, *Scyphosphaera* sp. cf. *S. globulata*, *S. pulcherrima*, *S. abies* [abundant], *Thoracosphaera* sp., *T. rugosus*.

Lower Miocene

(Helicopontosphaera ampliaperta Zone)

10-94-9-1, 63-64 cm; depth 293 m:

C. eopelagicus, *C. leptopora* [rare], *C. neogammation*, *D. aulakos*, *D. deflandrei* [abundant], *Discoaster* sp. cf. *D. exilis*, *D. anisotrema*, *H. ampliaperta*, *H. kampfneri*, *R. pseudoumbilica*, *Scyphosphaera* sp., *S. heteromorphus*, *S. moriformis*.

10-94-9-6, 63-64 cm; depth 300 m:

C. eopelagicus, *C. neogammation*, *Discoaster* sp. cf. *D. aulakos*, *D. deflandrei*, *Discolithina* sp. aff. *D. japonica*, *H. ampliaperta*, *R. pseudoumbilica* [rare], *S. heteromorphus*.

Lower Miocene(Triquetrorhabdulus carinatus Zone,
Dictyococcites abiseptus Subzone)

10-94-10-1, 79-80 cm; depth 331 m:

C. eopelagicus, *C. neogammation*, *D. abiseptus*, *D. scrippsae*, *D. deflandrei*, *D. multipora* s.l., *H. obliqua*, *H. parallela*, *S. dissimilis*, *S. moriformis*, *R. gartneri*, *Rhabdothorax* sp., *Thoracosphaera* sp.

Middle Oligocene

(Sphenolithus predistentus Zone)

10-94-11-6, 63-64 cm; depth 369 m:

C. eopelagicus, *C. neogammation*, *D. abiseptus*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. compacta*, *H. intermedia*, *O. aureus*, *P. joidesa*, *R. gartneri*, *Sphenolithus* sp. cf. *S. distentus*, *S. moriformis*, *S. predistentus*, *Thoracosphaera* sp., *Z. bijugatus*.

10-94-12-4, 59-60 cm; depth 374 m:

C. eopelagicus, *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. parallela*, *P. vadosa*, *R. gartneri*, *S. predistentus*, *Z. bijugatus*.

10-94-13-3, 100-102 cm; depth 381 m:

C. eopelagicus, *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. compacta*, *L. minutus*, *P. joidesa*, *R. gartneri*, ?*R. tenuis* [stems], *S. distentus* [rare], *S. moriformis*, *S. predistentus*, *Thoracosphaera* sp., *Z. bijugatus*.

10-94-14-1, 30-32 cm; depth 407 m:

B. rosa, *B. serraculoides*, *C. eopelagicus*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. compacta*, *Helicopontosphaera* sp. cf. *H. intermedia*, *H. reticulata*, *L. minutus*, *P. vadosa*, ?*R. tenuis* [stems], *S. moriformis*, *S. predistentus*, *Z. bijugatus*.

Upper Eocene

(Discoaster barbadiensis Zone)

10-94-14-1, 122-123 cm; depth 408 m:

B. discula, *B. rosa*, *B. serraculoides*, *C. eopelagicus*, *C. pseudogammation*, *C. formosa*, *C. neogammation*, *C. reticulata*, *D. scrippsae*, *D. barbadiensis*, *D. deflandrei*, *D. saipanensis*, *D. tani nodifer*, *D. tani tani*, *H. compacta*, *H. reticulata*, *I. recurvus* [rare], *P. papillatum*, *P. joidesa*, *R. umbilica*, *S. predistentus*, *Z. bijugatus*.

10-94-14-3, 63-64 cm; depth 411 m:

B. bigelowi, *B. serraculoides*, *C. eopelagicus*, *C. formosa*, *C. neogammation*, *C. reticulata*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis*, *I. recurvus* [rare], *M. aequalis*, *R. umbilica*.

10-94-14-4, 62-63 cm; depth 413 m:

B. bigelowi, *B. rosa*, *B. serraculoides*, *C. oamaruensis*, *C. formosa*, *C. neogammation*, *C. protoannula*, *C. reticulata*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis*, *D. tani tani*, *H. compacta*, *H. reticulata*, *Micrantholithus* sp., *P. papillatum*, *P. joidesa*, *R. umbilica*, *S. predistentus*, *Z. bijugatus*.

10-94-15-4, 75-76 cm; depth 417 m:

B. bigelowi, *B. serraculoides*, *C. eopelagicus*, *C. formosa*, *C. neogammation*, *C. reticulata* [abundant], *D. bisectus*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis*, *D. tani tani*, *H. compacta*, *H. reticulata*, *I. recurvus* [rare], *M. inversus*, *P. vadosa*, *R. umbilica*, *Z. bijugatus*.

10-94-16-1, 63-64 cm; depth 419 m:

B. bigelowi, *B. serraculoides*, *C. dela* [rare], *C. eopelagicus*, *C. formosa*, *C. neogammation*, *C. protoannula*, *C. reticulata*, *D. bisectus*, *D. barbadiensis*, *D. saipanensis*, *D. tani nodifer*, *D. tani tani*, *H. compacta*, *H. reticulata*, *M. aequalis*, *R. umbilica*, *V. arca* [rare], *Z. bijugatus*.

10-94-16-3, 63-64 cm; depth 422 m:

B. bigelowi, *B. discula* [large] *B. serraculoides*, *C. eopelagicus*, *C. formosa*, *C. neogammation*, *C. protoannula*, *C. reticulata*, *D. bisectus*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis* [some specimens mimic *D. lodoensis*], *D. tani nodifer*, *D. tani tani*, *H. compacta*, *H. reticulata*, *M. inversus*.

sus, M. aequalis, P. papillatum, P. vadosa, R. samodurovi, S. pseudoradians, Z. bijugatus.

Middle Eocene
(Lower Reticulofenestra umbilica Zone)

10-94-17-1, 17-18 cm; depth 424 m:

B. discula, B. rosa, B. serraculoides, C. dela, C. grandis, C. cibellum, C. eopelagicus, C. staurion, D. barbadiensis, D. deflandrei, H. compacta, M. procerus, R. samodurovi, S. furcatolithoides, S. pseudoradians, T. inversus. Reworked Eocene taxon: *D. mirus.*

10-94-17-2, 63-64 cm; depth 426 m:

B. discula, B. serraculoides, C. dela, C. grandis, C. solitus, C. staurion, C. formosa, D. barbadiensis, Discoaster sp. cf. D. deflandrei, M. inversus, M. procerus, R. samodurovi, S. furcatolithoides, T. inversus.

10-94-17-5, 6-7 cm; depth 430 m:

B. discula, B. serraculoides, C. dela, C. grandis, C. solitus, C. cibellum, C. eopelagicus, C. formosa, Cyclococcolithina sp. cf. C. neogammation, D. barbadiensis, Discoaster sp. cf. D. deflandrei, D. gemmifer [4-rayed], D. stradneri, H. compacta, M. procerus, R. samodurovi, S. furcatolithoides, T. inversus, Z. bijugatus.

Middle Eocene
(Chiphragmalithus quadratus Zone)

10-94-18-1, 63-64 cm; depth 434 m:

B. discula [abundant], *B. serraculoides, C. dela, C. grandis, C. solitus, C. quadratus, C. eopelagicus, C. pseudogammation, C. staurion, C. formosa, D. barbadiensis, Discoaster, sp. cf. D. deflandrei, D. wemmelensis, D. oamaruensis, D. plana, H. compacta, M. procerus, P. larvalis, R. samodurovi, S. furcatolithoides, T. inversus, Z. bijugatus.*

10-94-18-4, 63-64 cm; depth 438 m:

B. discula, B. rosa, B. serraculoides [small], *C. dela, C. grandis, C. solitus, C. spinosus, C. pseudogammation, C. staurion, C. formosa, D. barbadiensis, Discoaster sp. cf. D. deflandrei, D. tani nodifer, H. compacta, M. aequalis, R. samodurovi, T. inversus, Z. bijugatus.*

10-94-19-2, 65-66 cm; depth 444 m:

B. bigelowi, B. discula, C. dela, C. grandis, C. spinosus, C. staurion, C. formosa, D. barbadiensis, Discoaster sp. cf. D. deflandrei, D. tani nodifer, D. wemmelensis, H. lophota, R. samodurovi, S. radians, T. inversus, Z. bijugatus.

10-94-19-5, 63-64 cm; depth 448 m:

B. discula, B. rosa, C. dela, C. gigas, C. grandis, Ch. cristatus, C. pseudogammation, C. staurion, C. bramlettei, C. formosa, D. barbadiensis, D. distinctus, D. tani nodifer, D. wemmelensis, Helicopontosphaera sp. cf. H. lophota, H. seminulum, M. aequalis, R. samodurovi, S. furcatolithoides, S. radians, S. fimbriata, T. inversus, Z. bijugatus.

10-94-20-3, 67-68 cm; depth 445 m:

B. discula, B. rosa, C. dela, C. gigas, C. grandis, C. solitus, Ch. cristatus, C. bramlettei, C. formosa, D. barbadiensis, D. distinctus, D. stradneri, D. tani nodifer, D. wemmelensis, D. plana, H. seminulum, R. samodurovi [some speci-

mens resemble *D. scrippsae*], *S. furcatolithoides, S. radians, T. inversus, Z. bijugatus.*

10-94-21-2, 0-2 cm; depth 462 m:

B. discula, B. rosa, C. dela, C. gigas, C. grandis, C. solitus, Ch. cristatus, Chiphragmalithus sp. cf. C. quadratus, C. bramlettei, C. formosa, D. distinctus, D. mirus, H. lophota, H. seminulum, L. rotundus, Rhabdosphaera sp. cf. R. scabrosa, S. furcatolithoides, Thoracosphaera sp., T. inversus.

Middle Eocene
(Discoaster sublodoensis Zone)

10-94-22-1, 63-64 cm; depth 470 m:

B. discula, B. rosa [large], *C. grandis, C. eopelagicus, C. formosa, D. barbadiensis, D. lodoensis, D. stradneri, D. sublodoensis, D. tani nodifer, R. samodurovi, S. radians, T. inversus, Z. bijugatus.*

10-94-22-2, 63-64 cm; depth 471 m:

B. discula, C. dela, C. solitus, C. staurion, C. formosa, D. barbadiensis, D. distinctus, D. lodoensis, D. sublodoensis, T. inversus, Z. dubius.

10-94-23-1, 93-94 cm; depth 479 m:

B. discula, B. rosa, C. dela, C. grandis, C. solitus, C. eopelagicus, C. pseudogammation, C. staurion, C. bramlettei, C. formosa, D. barbadiensis, D. distinctus, D. lodoensis, D. tani nodifer, H. lophota, H. seminulum, R. inflata, S. radians, Syracosphaera sp. cf. S. formosa, T. inversus, Z. dubius, Z. bijugatus.

10-94-24-1, 118-119 cm; depth 488 m:

B. discula, C. dela, C. solitus, Ch. cristatus, C. staurion, C. bramlettei, C. formosa, D. barbadiensis, D. distinctus, D. gemmeus, D. mirus; D. sublodoensis, D. wemmelensis, D. plana, H. lophota, H. seminulum, L. mochlophorus, L. rotundus, P. larvalis, R. samodurovi, R. inflata, R. morionum, R. scabrosa, S. radians, T. inversus, Z. dubius, Z. bijugatus.

10-94-25-1, 63-64 cm; depth 497 m:

C. dela, C. grandis, C. solitus, C. eopelagicus, C. staurion, C. bramlettei, C. formosa, D. barbadiensis, D. distinctus, D. lodoensis, D. mirus, D. stradneri, D. sublodoensis, D. distincta, D. plana, D. solida, E. lajollaensis, H. lophota, R. samodurovi, R. inflata, R. scabrosa, S. fimbriata, Z. dubius, Z. bijugatus.

10-94-26-1, 125-126 cm; depth 501 m:

B. discula, C. dela, C. grandis, C. solitus, C. calathus, C. eopelagicus, C. pseudogammation, C. staurion, C. bramlettei, C. formosa, D. barbadiensis, D. lodoensis, D. sublodoensis, D. plana, H. lophota, H. seminulum, R. samodurovi [some specimens resemble *D. scrippsae*], *R. inflata, R. tenuis, S. radians, S. fimbriata, S. formosa, T. inversus, Z. bijugatus.*

10-94-26-2, 63-64 cm; depth 502 m:

C. dela, C. grandis, C. pseudogammation, C. formosa, D. barbadiensis, B. lodoensis, D. sublodoensis, D. versa [large] *H. lophota, L. mochlophorus, R. samodurovi s.l., R. inflata, S. radians, Z. bijugatus.*

10-94-26-4, 63-64 cm; depth 505 m:

C. dela, *C. grandis*, *C. solitus*, *C. calathus*, *C. pseudogammation*, *C. staurion*, *C. bramlettei*, *C. formosa*, *C. gammation*, *D. barbadiensis*, *D. lodoensis*, *D. mirus*, *D. sublodoensis*, *D. plana*, *E. lajollaensis*, *H. lophota*, *H. seminulum* [small], *L. mochlophorus*, *R. samodurovi* s.l., *R. morionum*, *S. radians*, *T. inversus*, *Z. dubius*, *Z. bijugatus*.

Lower Eocene
(*Discoaster lodoensis* Zone)

10-94-28-1, 124-125 cm; depth 533 m:

C. dela, *C. grandis*, *C. solitus*, *C. formosa*, *C. gammation*, *D. barbadiensis*, *D. lodoensis*, *D. mirus*, *D. distincta*, *D. versa* [large], *E. lajollaensis*, *R. samodurovi* s.l., *S. radians*, *T. inversus*, *Z. dubius*, *Z. bijugatus*.

10-94-28-2, 63-64 cm; depth 534 m:

C. dela, *C. grandis*, *C. solitus*, *C. calathus*, *C. staurion*, *C. formosa* [small], *C. gammation*, *D. barbadiensis*, *Discoaster* sp. cf. *D. distinctus*, *D. lodoensis*, *D. mirus*, *D. sublodoensis*, *D. wemmelensis*, *D. plana*, *D. versa* [large], *H. lophota*, *H. seminulum*, *R. samodurovi* s.l., *R. morionum*, *R. truncata*, *S. radians*, *Z. dubius*, *Z. bijugatus*.

10-94-28-4, 63-64 cm; depth 537 m:

C. dela, *C. expansus*, *C. crassus*, *C. pseudogammation*, *C. formosa* [small], *C. gammation*, *D. barbadiensis*, *D. lodoensis*, *D. plana*, *D. versa* [large], *H. lophota*, *H. seminulum*, *L. rotundus*, *R. samodurovi* s.l., *R. spinula*, *S. radians*, *S. fimbriata*, *T. pulcher*, *T. inversus*, *Z. dubius*, *Z. bijugatus*.

10-94-30-1, 62-63 cm; depth 571 m:

C. dela, *C. conseetus*, *C. pelagicus* s.l., *D. barbadiensis*, *D. kuepperi*, *D. lodoensis*, *D. plana*, *E. lajollaensis*, *L. nascens*, *L. reniformis*, *Sphenolithus* sp. aff. *S. furacatolioides*, *S. radians*, *Syracosphaera* sp. cf. *S. formosa*, *T. pulcheroides*, *Z. dubius*, *Z. bijugatus*. Reworked Paleocene taxa: *C. eodela*, *S. anarrhopus*, *T. craticulus*.

10-94-30-2, 62-63 cm; depth 573 m:

C. dela, *C. eodela*, *C. pelagicus* s.l., *C. gammation*, *D. barbadiensis*, *D. lodoensis*, *D. kuepperi*, *D. plana*, *L. nascens*, *M. tribachiatus*, *Sphenolithus* sp. cf. *S. anarrhopus*, *S. radians*, *T. pulcheroides*, *Z. bijugatus*.

Upper Paleocene
(*Discoaster multiradiatus* Zone,
Campylosphaera eodela Subzone)

10-94-33-1, 41-43 cm; depth 612 m:

B. discula, *B. rosa*, *C. eodela*, *C. californicus*, *C. consuetus*, *C. pelagicus* s.l., *D. multiradiatus*, *D. ornatus*, *D. plana*, *T. eminens* [small], *Z. distentus*.

10-94-33-2, 43-45 cm; 614 m:

B. africana, *C. eodela*, *C. consuetus*, *C. grandis*, *C. pelagicus* s.l., *D. multiradiatus*, *D. plana*, *S. anarrhopus*, *T. craticulus*, *Z. distentus*.

10-94-34-3, 64-65 cm; depth 619 m:

C. eodela, *C. californicus*, *C. consuetus*, *C. pelagicus* s.l., *D. lenticularis*, *D. multiradiatus*, *D. ornatus*, *E. macellus*, *F. tympaniformis*, *T. craticulus*, *Z. distentus*.

Upper Paleocene
(*Discoaster mohleri* Zone)

10-94-35-1, 111-113 cm; depth 625 m:

C. californicus, *C. consuetus*, *C. pelagicus* s.l., *C. ? robusta*, *D. mohleri*, *D. ornatus*, *D. rimosa*, *E. distichus*, *F. involutus*, *F. tympaniformis*, *S. anarrhopus*, *T. craticulus*, *Z. distentus*.

Lower Paleocene
(*Cruciplacolithus tenuis* Zone)

10-94-36-1, 99-101 cm; depth 627 m:

B. bigelowi, *C. pelagicus* s.l., *C. tenuis*, *Micrantholithus* sp., *Z. sigmoides*.

Series Unknown

10-94-38-1, 63-64 cm; depth 635 m:

[Barren].

HOLE 95
(lat 24°09.99'N., long 86°23.85'W., depth 1633 m)

Pleistocene
(*Gephyrocapsa oceanica* Zone)

10-95-1-1, 63-64 cm; depth 1 m:

C. cristatus, *D. perplexus*, *D. japonica*, *Discolithind?* sp. cf. *D. macropora*, *D. multipora*, *G. caribbeanica*, *G. oceanica*, *H. kamptneri*, *H. sellii*, *H. wallichii*, *O. antillarum*, *R. clavigera*, *Scapholithus* sp., *S. apsteinii*, *S. histrica*, *Thoracosphaera* sp. Reworked Miocene or Pliocene taxon: *C. macintyreai*.

10-95-1-5, 63-64 cm; depth 7 m:

B. bigelowi, *C. cristatus*, *C. pelagicus* [rare], *D. perplexus*, *D. japonica*, *E. annula*, *G. oceanica*, *H. kamptneri*, *H. sellii*, *R. clavigera*, *S. histrica*, *Thoracosphaera* sp., *U. mirabilis*. Reworked Miocene and Pliocene taxa: *C. rugosus*, *C. macintyreai*, *D. deflandrei*, *D. pentaradiatus*, *D. surculus*.

Upper Oligocene
(*Sphenolithus ciperoensis* Zone)

10-95-2-6, 63-64 cm; depth 90 m:

C. eopelagicus, *C. fenestratus*, *C. neogammation*, *D. abiseptus*, *D. scrippsae*, *D. deflandrei*, *H. intermedia*, *H. truncata*, *R. gartneri*, *S. ciperoensis*, *S. moriformis*, *T. carinatus* [long].

Middle Oligocene
(*Sphenolithus distentus* Zone)

10-95-3-6, 63-64 cm; depth 129 m:

B. bigelowi, *B. rosa*, *Chiasmolithus* sp. [rims], *C. eopelagicus*, *Coccolithus* sp. cf. *C. fenestratus*, *D. abiseptus*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. segmenta*, *H. intermedia*, *H. parallela*, *M. aequalis*, *R. gartneri*, *S. ciperoensis*, *S. distentus*, *S. moriformis*, *S. predistentus*.

Middle Oligocene
(*Sphenolithus predistentus* Zone)

10-95-4-4, 63-64 cm; depth 163 m:

B. bigelowi, *B. rosa*, *C. eopelagicus*, *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani modifer*, *H. intermedia*, *S. predistentus*, *Z. bijugatus*.

10-95-5-1, 63-64 cm; depth 199 m:

B. bigelowi, *B. discula*, *B. rosa*, *C. eopelagicus*, *C. fenes-tratus*, *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. compacta* [common], *H. intermedia*, *L. minutus*, *M. aequalis*, *P. vadosa*, *R. gartneri*, *S. predistentus*, *Z. bijugatus*.

10-95-5-4, 63-64 cm; depth 203 m:

B. bigelowi, *B. rosa*, *C. eopelagicus*, *C. neogammation*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani tani*, *H. compacta*, *P. joidesa*, *P. vadosa*, *R. gartneri*, *S. moriformis*, *S. predistentus*, *Z. bijugatus*.

Upper Eocene

(*Discoaster barbadiensis* Zone)

10-95-6-1, 63-64 cm; depth 237 m:

B. bigelowi, *B. rosa*, *B. serraculoides*, *C. eopelagicus*, *C. formosa*, *C. protoannula*, *C. reticulata*, *D. bisectus*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis*, *D. tani nodifer*, *D. tani tani*, *H. compacta*, *M. aequalis*, *P. joidesa*, *P. vadosa*, *R. umbilica*, *S. moriformis*, *Z. bijugatus*.

10-95-6-6, 63-64 cm; depth 244 m:

B. bigelowi, *B. serraculoides*, *C. eopelagicus*, *C. formosa*, *C. neogammation*, *C. protoannula*, *D. bisectus*, *D. scrippsae*, *D. barbadiensis*, *D. saipanensis*, *D. tani nodifer*, *D. tani tani*, *H. compacta*, *L. minutus*, *M. aequalis*, *M. basquensis*, *M. inaequalis*, *P. papillatum*, *P. joidesa*, *S. pseudoradians*, *Z. bijugatus*.

Middle Eocene

(*Chiphramolithus quadratus* Zone)

10-95-7-1, 63-64 cm; depth 275 m:

B. bigelowi, *B. discula* [abundant], *B. rosa*, *B. seraculoides*, *C. dela*, *C. consuetus*, *C. grandis*, *C. solitus*, *C. fulgens*, *C. spinosus*, *C. eopelagicus*, *C. fenestratus*, *C. staurion*, *D. barbadiensis*, *D. deflandrei*, *D. tani nodifer*, *Helicopontosphaera* sp. cf. *H. compacta*, *M. inversus*, *R. samodurovi*, *S. furcatolithoides*, *S. pseudoradians*, *T. inversus*, *Z. bijugatus*.

10-95-7-6, 62-63 cm; depth 282 m:

B. discula, *B. rosa*, *B. serraculoides* [few, small], *C. dela*, *C. grandis*, *C. solitus*, *C. spinosus*, *C. epogelagicus*, *C. pseudogammation*, *C. staurion*, *C. formosa*, *D. barbadiensis*, *D. gemmeus*, *D. plana*, *Helicopontosphaera* sp. cf. *H. lophota*, *R. samodurovi*, *S. furcatolithoides*, *T. inversus*.

Middle Eocene

(*Discoaster sublodoensis* Zone)

10-95-8-1, 63-64 cm; depth 333 m:

C. dela, *C. grandis*, *C. eopelagicus*, *C. pseudogammation*, *C. staurion*, *C. formosa*, *C. bramlettei*, *D. barbadiensis*, *D. mirus*, *D. sublodoensis*, *H. lophota*, *R. inflata* [common], *S. radians*, *Triquetrorhabdulus* sp. cf. *T. inversus*, *Z. bijugatus*.

10-95-8-6, 62-63 cm; depth 340 m:

C. dela, *C. grandis*, *C. acanthodes*, *C. pseudogammation*, *C. staurion*, *C. formosa*, *C. bramlettei*, *D. barbadiensis*, *Discoaster* sp. cf. *D. distinctus*, *D. gemmeus*, *Discoaster* sp.

cf. *D. stradneri*, *D. sublodoensis*, *H. lophota*, *Triquetrorhabdulus* sp. cf. *T. inversus*, *Z. bijugatus*.

Upper Paleocene

(*Discoaster multiradiatus* Zone, *Campylosphaera eodela* Subzone)

10-95-10-1, 61-62 cm; depth 364 m:

B. bigelowi, *B. discula*, *C. eodela*, *C. consuetus*, *D. delicatus*, *D. lenticularis*, *D. multiradiatus*, *D. ornatus*, *D. rimosa*, *E. macellus*, *F. tympaniformis*, *S. anarrhopus*, *T. craticulus*, *Z. adamas*, *Z. distentus*, *Z. simplex*.

Lower Paleocene

(*Cruciplacolithus tenuis* Zone)

10-95-11-1, 108-110 cm; depth 377 m:

B. africana, *B. bigelowi*, *B. discula*, *B. rosa*, *C. pelagicus* s.l., *C. tenuis*, *Thoracosphaera* sp., *Z. sigmoides*.

10-95-12-1, 60-62 cm; depth 386 m:

B. bigelowi, *B. discula*, *C. pelagicus* s.l., *C. tenuis*, *Z. sigmoides*.

Cretaceous or Lower Paleocene

10-95-13-1, 63-64 cm; depth 395 m:

B. bigelowi, *B. discula*, *W. Barnesae* [rare], *Z. sigmoides* [rare].

Upper Cretaceous

(Lower Campanian or Upper Santonian)

10-95-13-4, 63-64 cm; depth 400 m:

Amphizygus sp., *A. gronosa*, *B. turbinea*, *B. parca*, *C. amphipons*, *C. conicus*, *C. serratus*, *E. augustus*, *M. decussata*, *W. barnesae*, *Z. deflandrei*, *Z. minimus*, *Z. phacelosus*.

10-95-14-1, 74-75 cm; depth 400 m:

Amphizygus sp., *A. gronosa*, *B. turbinea*, *B. parca*, *C. amphipons*, *C. signum*, *E. augustus*, *G. concavum*, *L. grilli*, *M. decussata*, *P. multicarinata*, *W. barnesae*, *Z. deflandrei*, *Z. phacelosus*.

10-95-15-4, 64-65 cm; depth 413 m:

A. gronosa, *B. turbinea*, *C. amphipons*, *C. signum*, *E. augustus*, *E. turri-seiffeli*, *W. barnesae*, *Z. deflandrei*.

Upper Cretaceous

(Santonian)

10-95-16-3, 63-64 cm; depth 421 m:

A. gronosa, *C. amphipons*, *C. bifarius*, *E. augustus*, *E. turri-seiffeli*, *Micrantholithus* sp., *W. barnesae*, *Z. deflandrei*.

10-95-17-1, 63-64 cm; depth 427 m:

A. gronosa, *C. amphipons*, *C. signum*, *E. augustus*, *E. turri-seiffeli*, *Marthasterites* sp. cf. *M. furcatus furcatus*, *Micrantholithus* sp., *M. decussata*, *P. augustus*, *W. barnesae*, *Z. deflandrei*, *Z. minimus*.

10-95-17-3, 63-64 cm; depth 430 m:

A. gronosa, *B. rotatorius*, *C. amphipons*, *C. interruptus*, *E. turri-seiffeli*, *Marthasterites* sp. cf. *M. furcatus*, *M. decussata*, *P. angustus*, *W. barnesae*, *Z. deflandrei*, *Z. variradiatus*.

10-95-17-6, 62-63 cm; depth 434 m:

A. gronosa, *B. rotatorius*, *C. amphipons*, *C. signum*, *E. augustus*, *E. turriseiffeli*, *L. cayeuxi*, *L. maleformis*, *Martasterites* sp. cf. *M. furcatus furcatus*, *S. laffithei*, *W. barnesae*, *Z. deflandrei*.

HOLE 96

(lat 23° 44.56'N., long 85° 45.80'W., depth 3439 m)

Pleistocene (?) With Reworked Upper Cretaceous

10-96-1-2, 63-64 cm; depth 102 m:

H. kampfneri. Reworked Upper Cretaceous taxa: *C. ehrenbergii*, *E. augustus*, *M. decussata*, *P. cretacea*, *W. barnesae*.

10-96-1-4, 63-64 cm; depth 105 m:

Reworked Upper Cretaceous taxa: *A. gronosa*, *B. parca*, *C. amphipons*, *C. disgragatus*, *C. ehrenbergii*, *E. augustus*, *G. concavum*, *G. costatum costatum*, *M. simplex*, *M. decussata*, *P. cretacea*, *T. gothicus trifidus*, *V. octoradiata*, *W. barnesae*, *Z. compactus*, *Z. deflandrei*, *Z. lacunatus*, *Z. phacelosus*.

10-96-1-6, 63-64 cm; depth 108 m:

Reworked Upper Cretaceous taxa: *A. snyderi*, *A. cymbiformis*, *B. parca*, *C. amphipons*, *C. disgragatus*, *C. ehrenbergii*, *E. augustus*, *E. turriseiffeli*, *G. costatum costatum*, *M. furcatus*, *M. decussata*, *M. decoratus*, *P. cretacea*, *V. octoradiata*, *W. barnesae*, *W. biporta*, *Z. deflandrei*, *Z. lacunatus*.

Upper Oligocene

(*Sphenolithus ciperoensis* Zone)

10-96-2-1, 63-64 cm; depth 200 m:

C. eopelagicus, *C. fenestratus*, *C. neogammation*, *D. abisectus*, *D. scrippsae*, *D. deflandrei*, *D. segmenta*, *H. intermedia*, *H. parallela*, *H. truncata*, *H. wilcoxonii*, *S. moriformis*, *T. carinatus*, *Z. bijugatus*.

10-96-2-3, 63-64 cm; depth 203 m:

C. eopelagicus, *C. neogammation*, *D. abisectus*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. segmenta*, *H. intermedia*, *H. parallela*, *S. ciperoensis*, *S. moriformis*.

10-96-2-6, 63-64 cm; depth 207 m:

C. eopelagicus, *C. fenestratus*, *D. abisectus*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. tani nodifer*, *D. segmenta*, *H. parallela*, *H. truncata*, *R. gartneri*, *S. distentus*, *S. moriformis*, *T. carinatus*, *Z. bijugatus*.

Upper Paleocene

(*Discoaster multiradiatus* Zone,
Campylosphaera eodela Subzone)

10-96-3-1, 63-64 cm; depth 302 m:

C. eodela, *C. bidens*, *D. lenticularis*, *D. multiradiatus*, *D. ornatus*, *D. rimosa*, *R. cuspis*, *T. eminens*, *Z. distentus*.

10-96-3-6, 63-64 cm; depth 309 m:

B. bigelowi, *C. eodela*, *C. bidens*, *C. consuetus*, *Discoaster* sp. cf. *D. araneus*, *Discoaster* sp. cf. *D. mediosus*, *D. multiradiatus*, *D. ornatus*, *D. rimosa*, *R. cuspis*, *T. eminens*, *Z. distentus*.

10-96-5-1, 61-62 cm; depth 330 m:

B. bigelowi, *C. eodela*, *C. bidens*, *C. californicus*, *C. consuetus*, *D. lubinaensis*, *D. multiradiatus*, *D. ornatus*, *D. rimosa*, *E. distichus*, *F. tympaniformis*, *T. eminens*, *Z. distentus*. Miocene taxon present as contaminant: *D. berggrenii*.

HOLE 97

(lat 23° 53.05'N., long 84° 26.74'W., depth 2930 m)

Holocene

(*Emiliania huxleyi* Zone)

10-97-1-1, 92-93 cm; depth 1 m:

C. cristatus [large], *Discolithina* sp. cf. *D. japonica*, ?*E. huxleyi*, *G. oceanica*, *H. kampfneri*, *H. sellii*, *P. scutellum*, *R. stylifera*, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* sp., *U. mirabilis*. Reworked Miocene or Pliocene taxa: *C. macintyrei*, *D. brouweri*, *D. deflandrei*.

Upper Pleistocene

(*Gephyrocapsa oceanica* Zone)

10-97-1-2, 63-64 cm; depth 2 m:

C. cristatus, *C. leptopora*, *G. oceanica*, *Gephyrocapsa* sp. [small], *H. kampfneri*, *P. scutellum*, *R. clavigera*, *Scapholithus* sp., *S. histrica*, *Thoracosphaera* spp. Reworked Upper Cretaceous taxa: *B. parca*, *M. decussata*.

Lower Pleistocene

(*Coccolithus doronicoides* Zone)

10-97-1-4, 63-64 cm; depth 5 m:

C. doronicoides, *C. pelagicus*, *C. leptopora*, *C. macintyrei* [rare], *D. brouweri* [few], *D. perplexus*, *D. japonica*, *E. annula*, *H. kampfneri*, *H. sellii*, *R. clavigera*, *Scapholithus* sp., *S. apsteinii*, *S. pulcherrima*, *S. histrica*, *U. mirabilis*.

Upper Miocene

(*Discoaster quinqueramus* Zone)

10-97-2-1, 63-64 cm; depth 106 m:

C. pelagicus, *C. leptopora*, *C. macintyrei*, *D. brouweri* s.l., *D. pentaradiatus*, *D. quinqueramus*, *D. surculus*, *D. variabilis* variabilis, *H. kampfneri*, *S. abies*, *T. rugosus*.

10-97-2-4, 63-64 cm; depth 110 m:

C. pelagicus [abundant], *C. macintyrei*, *D. berggrenii*, *D. brouweri* s.l., *D. challenger*, *D. perclarus*, *D. quinqueramus*, *D. surculus*, *D. variabilis* variabilis, *H. kampfneri*, *H. sellii*, *S. abies*, *S. neoabies*, *T. rugosus*.

Upper Miocene, With Mixing

(*Discoaster neohamatus* Zone)

10-97-3-3, 63-64 cm; depth 144 m:

C. pelagicus, *C. macintyrei*, *C. rotula*, *D. braarudii*, *D. brouweri* s.l., *D. challenger*, *Discoaster* sp. cf. *D. hamatus*, *D. neohamatus*, *D. perclarus*, *Discoaster* sp. cf. *D. pentaradiatus*, *D. variabilis* variabilis, *H. kampfneri*, *H. sellii*, *R. pseudoumbilica*, *S. neoabies*, *T. rugosus*. Reworked Miocene taxa: *C. coalitus*, *C. neogammation*, *D. bollii*, *D. calcaris*, *D. deflandrei*, *D. hamatus*.

Upper Miocene, With Mixing

(*Discoaster hamatus* Zone)

10-97-4-2, 10-11 cm; depth 202 m:

C. calyculus, *C. pelagicus*, *C. macintyrei*, *C. rotula*, *D. braarudii*, *D. calcaris*, *D. hamatus*, *D. bellus*, *D. subsur-*

culus, *D. variabilis variabilis*, *H. kampfneri*, *H. sellii*, *R. pseudoumbilica* [abundant], *S. abies*, *T. rugosus*. Reworked Miocene taxa: *C. eopelagicus*, *D. deflandrei*, *D. kugleri*, *D. moorei*, *D. signus*.

Middle Oligocene
(Sphenolithus distentus Zone)

10-97-4-2, 63-64 cm; depth 202 m:

C. altus, *C. eopelagicus*, *C. neogammation*, *D. abiseptus*, *D. deflandrei*, *H. intermedia*, *H. parallela*, *H. truncata*, *S. distentus*, *S. moriformis*, *S. predistentus*, *Z. bijugatus*.

10-97-4-5, 63-64 cm; depth 207 m: *B. bigelowi*, *C. eopelagicus*, *C. neogammation*, *D. abiseptus*, *D. scrippsae*, *D. deflandrei*, *H. truncata*, *P. joidesa*, *R. gartneri*, *Scyphosphaera* sp., *S. distensus*, *S. moriformis*, *Thoracosphaera* sp., *Z. bijugatus*.

Upper Eocene
(Discoaster barbadiensis Zone)

10-97-5-1, 127-128 cm; depth 250 m:

B. serraculoides, *C. eopelagicus*, *C. formosa*, *C. protoanula*, *D. bisectus*, *D. scrippsae*, *D. deflandrei*, *D. saipanensis*, *D. tani nodifer*, *D. tani tani*, *P. vadosa*, *R. umbilica*, *Z. bijugatus*.

Upper Cretaceous

10-97-6-1, 117-118 cm; depth 295 m:

A. gronosa, *C. amphipons*, *E. turriseiffeli*, *Parhabdolithus* sp. cf. *P. embergeri*, *W. barnesae*.

10-97-7-1, 109-110 cm; 305 m:

A. gronosa, *C. amphipons*, *C. signum*, *C. crenulatus*, *E. turriseiffeli*, *P. angustus*, *Prediscosphaera* sp., *W. barnesae*, *Zygodiscus* spp.

10-97-7-2, 60-61 cm; 306 m:

[Barren].

10-97-8-1, 75-76 cm; depth 308 m:

W. barnesae [rare].

10-97-8-4, 63-64 cm; depth 313 m:

Bidiscus sp., *C. amphipons*, *C. crenulatus*, *C. ehrenbergii*, *E. turriseiffeli*, *Parhabdolithus* sp. cf. *P. embergeri*, *W. barnesae*.

Upper Cretaceous
(Lower Cenomanian)

10-97-12-1, 31-32 cm; depth 333 m:

A. gronosa, *Biscutum* sp., *Chiastozygus* sp. cf. *C. amphipons*, *C. matalosus*, *C. crenulatus*, *C. decorus*, *E. tur-*

riseiffeli, *P. augustus*, *P. embergeri*, *P. granulatus*, *Prediscosphaera* sp., *W. barnesae*, *Watznaueria* sp. aff. *W. britannica*, *Z. gabalus*, *Z. ponticulus*.

REFERENCES

- Boudreux, J.E. and Hay, W.W., 1969. Calcareous nannoplankton and biostratigraphy of the late Pliocene-Pleistocene-Recent sediments in the Submarex cores. *Revista Espanola de Micropaleontologia*, **1**, 249.
- Bramlette, M.N. and Wilcoxon, J.A., 1967. Middle Tertiary calcareous nannoplankton of the Cipero section, Trinidad, W.I. *Tulane Stud. Geol.*, **5**, 93.
- Bukry, D., 1970. Coccolith age determinations Leg 2, Deep Sea Drilling Project. Initial Reports of the Deep Sea Drilling Project, Volume II. Washington (U.S. Government Printing Office). 349.
- _____, 1971a. Coccolith stratigraphy Leg 7, Deep Sea Drilling Project. Initial Reports of the Deep Sea Drilling Project, Volume VII. Washington (U.S. Government Printing Office). 1513.
- _____, 1971b. Coccolith stratigraphy Leg 9, Deep Sea Drilling Project. Initial Reports of the Deep Sea Drilling Project, Volume IX. Washington (U.S. Government Printing Office). 817.
- Bukry, D. and Bramlette, M.N., 1970. Coccolith age determinations Leg 3, Deep Sea Drilling Project. Initial Reports of the Deep Sea Drilling Project, Volume III. Washington (U.S. Government Printing Office). 589.
- Bukry, D., Douglas, R.G., Kling, S.A. and Krasheninnikov, V., 1971. Planktonic microfossil biostratigraphy of the northwestern Pacific Ocean. Initial Reports of the Deep Sea Drilling Project, Volume VI. Washington (U.S. Government Printing Office). 1253.
- Gartner, S., Jr. and Bukry, D., 1969. Tertiary holococcoliths. *J. Paleontology*, **43**, 1213.
- Gran, H.H. and Braarud, T., 1935. A quantitative study of the phytoplankton in the Bay of Fundy and the Gulf of Maine (including observations on hydrography, chemistry and turbidity). *J. Biol. Board Canada*, **1**, 279.
- Hsü, K.J. and Andrews, J.E., 1970. Lithology. Initial Reports of the Deep Sea Drilling Project, Volume III. Washington (U.S. Government Printing Office). 445.
- McIntyre, A. and Bé, A.W.H., 1967. Modern Coccolithophoridae of the Atlantic Ocean-I. Placoliths and Cyrtoliths. *Deep-Sea Res.*, **14**, 561.
- Smayada, T.J., 1966. A quantitative analysis of the phytoplankton of the Gulf of Panama. III General ecological conditions and the phytoplankton dynamics at 8°45'N, 79°23'W from November 1954 to May 1957. *Bull. Inter-Amer. Trop. Tuna Comm.*, **11**, 355.