16. PHYTOPLANKTON STRATIGRAPHY, SOUTHWEST PACIFIC, DEEP SEA DRILLING PROJECT, LEG 30

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INTRODUCTION

Leg 30 of the Deep Sea Drilling Project, April to June 1973, which began at Wellington, New Zealand, and ended at Apra, Guam, investigated the southwest Pacific (Figure 1), recovering 249 cores at five drilling sites, Sites 285-289. Light-microscope techniques were used to study the phytoplankton in 305 samples from these cores. Coccoliths are present most consistently; silicoflagellates and diatoms are rarely present. The zonation employed in coccolith zonal assignments of core samples (summarized in Figures 2 and 3) follows that of Bukry (1973c). Silicoflagellate and diatom zones are from Burckle (1972) and Bukry and Foster (1973).

SITE SUMMARIES

Site 285

(lat 26°49.16'S, long 175°48.24'E, depth 4658 m)

Site 285 is in the deepest area of the South Fiji Basin. A total of 14 cores was cut to a subbottom depth of 584 meters. Coccolith assemblages range in age from early middle Miocene (Core 7A) to Pliocene (Core 2). Slight to moderate solution of coccoliths is common in much of the upper section. In Core 5 (73 to 84 m) and below, secondary calcite overgrowth on discoasters becomes progressively thicker with depth, limiting species identification. Within a diatom- and silicoflagellate-rich sediment in Cores 3 and 4 (36 to 65 m) however, discoasters show exceptional morphologic detail (see Plate 1).

In Core 2 (17 to 27 m) the upper coccolith assemblages appear to be an early Pliocene mixture. The Miocene-Pliocene boundary lies above Sample 285-2-3, 26-27 cm (20 m), which contains *Ceratolithus tricorniculatus* and *Triquetrorhabdulus rugosus* but no *Ceratolithus acutus* or *C. rugosus.*

The late Miocene *Discoaster neohamatus* Zone assemblages of Cores 3 and 4 (36 to 65 m) include excellently preserved discoasters and *Minylitha convallis.* A lack of obscuring overgrowths on such ortholithid forms as these is common in sediments rich in volcanic ash or biogenic silica. Siliceous phytoplankton are sufficiently common in Cores 3 and 4 to permit identification of the *Coscinodiscus plicatus* Zone of diatoms and the *Dictyocha aspera* Zone of silicoflagellates (Figure 4). All of these associated phytoplankton groups are represented mainly by warm-water and cosmopolitan species.

Although a few reworked specimens of *Discoaster hamatus* occur in Sample 285-4-1, 50-51 cm (55 m), the species is abundant throughout Core 5 (73 to 84 m), where its association with *Catinaster calyculus* suggests assignment to the upper part of the *Discoaster hamatus* Zone. The oldest silicoflagellate assemblage at Site 285 is present near the base of Core 5 (Figure 4). Rare occurrences of *Corbisema triacantha* and *Distephanus* sp. cf. *D. longispinus* suggest assignment of the assemblage to the latest part of the *Distephanus longispinus* Zone.

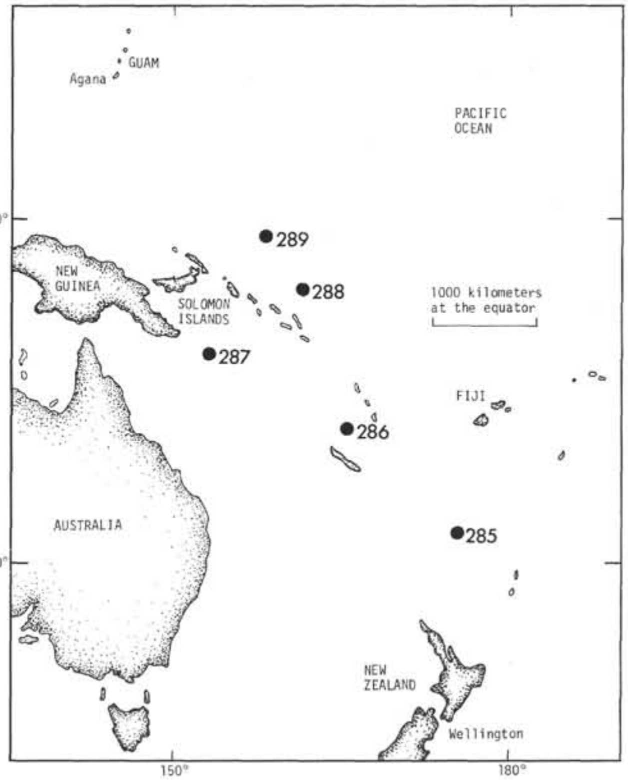

Figure 1. *Sketch map showing sites drilled on DSDP Leg 30.*

The oldest definitive coccolith assemblage of Sample 285A-7A-2, 85-86 cm (558 m) is assigned to the early middle Miocene *Sphenolithus heteromorphus* Zone on the basis of the presence of *Cyclicargolithus floridanus, Cyclococcolithina macintyrei, Discoaster* sp. cf. *D. deflandrei, D.* sp. cf. *D. variabilis,* and *Sphenolithus heteromorphus.* A sample from the bottom section of Core 7 contains only a few thickly overgrown species, including some that are probably reworked such as *Dictyococcites bisectus* and *Discoaster* sp. cf. *D. druggii.* Correlation of the sample is based on the occurrence of short-ranging *Sphenolithus heteromorphus* (Figure 2).

Site 286

(lat 16°31.92'S, long 166°22.18'E, depth 4465 m)

Site 286 is between the north and south New Hebrides trenches. A total of 41 cores were cut to a depth of 706

Series or Subseries	Zone	Subzone	Sites 285	286	287	288	289
Holocene	*Emiliania huxleyi*				1-2/2-2		
Pleistocene	*Gephyrocapsa oceanica*			1-2/2-2	3-1	1-1/1-2	1-1/2-2
	Crenalithus doronicoides	*Gephyrocapsa caribbeanica*					3-2/4-4
		Emiliania annula				?2-2/4-1	4-5/4-6
Upper Pliocene	*Discoaster brouweri*	*Cyclococcolithina macintyrei*			6-2	5-3/5-6	5-1/6-3
		Discoaster pentaradiatus		?4-1	7-1		6-6/8-6
		Discoaster tamalis					9-3/9-6
Lower Pliocene	*Reticulofenestra pseudoumbilica*	*Discoaster asymmetricus*					10-3
		Sphenolithus neoabies	2-1/2-2				11-3/15-3
	Ceratolithus tricorniculatus	*Ceratolithus rugosus*					
		Ceratolithus acutus					16-3
Upper Miocene		*Triquetrorhabdulus rugosus*	2-3				16-6/17-1
	Discoaster quinqueramus	*Ceratolithus primus*	2-4				17-2/22-3
		Discoaster berggrenii				6-3	23-5/27-3
	Discoaster neohamatus	*Discoaster neorectus*	3-1/4-6			6-6	27-6/34-1
		Discoaster bellus					
Middle Miocene	*Discoaster hamatus*		5-1/5-6			7-2/8-1	34-3/37-3
	Catinaster coalitus						?38-3/39-5
	Discoaster exilis	*Discoaster kugleri*	1A-2			9-1	40-3
		Coccolithus miopelagicus	2A-1/5A-1			10-2	41-2/47-3
	Sphenolithus heteromorphus		6A-1/7A-2; ?7A-6				48-3/52-6
Lower Miocene	*Helicopontosphaera ampliaperta*						53-3/57-3
	Sphenolithus belemnos						58-3/61-3
	Triquetrorhabdulus carinatus	*Discoaster druggii*					
		Discoaster deflandrei				11-2/2A-2	61-6/82-3
		Cyclicargolithus abisectus					
Oligocene	*Sphenolithus ciperoensis*			6-2/6-5		3A-2	83-2/85-1
	Sphenolithus distentus				10-4		86-2/91-3
	Sphenolithus predistentus			7-6		5A-1/6A-1	93-3/100-1
	Helicopontosphaera reticulata	*Reticulofenestra hillae*		8-2			
		Coccolithus formosus					101-2/102-1
		Coccolithus subdistichus		9-2/10-1			
Upper Eocene	*Discoaster barbadiensis*			10-4/17-2; ?18-1			103-1/108-1
Middle Eocene	*Reticulofenestra umbilica*	*Discoaster saipanensis*		19-1/33-2			109-1
		Discoaster bifax					?111-1
	Nannotetrina quadrata	*Coccolithus staurion*					
		Chiasmolithus gigas			11-2		?111-3/113-1
		Discoaster strictus			12-1/14-2		
	Discoaster sublodoensis	*Rhabdosphaera inflata*			15-1/15-2		
		Discoasteroides kuepperi					
Lower Eocene	*Discoaster lodoensis*						
	Tribrachiatus orthostylus						
	Discoaster diastypus				16-1		

Paleocene	*Discoaster multiradiatus*	*Campylosphaera eodela*				
		Chiasmolithus bidens				
	Discoaster nobilis					
	Discoaster mohleri					116-1/118-1
	Heliolithus kleinpellii					
	Fasciculithus tympaniformis					
	Cruciplacolithus tenuis				8A-1/8A-2	
Upper Cretaceous	*Micula mura*				?9A-1/9A-2	?123-1/126-1
	Lithraphidites quadratus				?9A-4	
	Tetralithus trifidus				10A-2	127-1/129-1
	Broinsonia parca					
	Eiffellithus augustus				12A-1	

Figure 2. *Upper Cretaceous (Campanian) to Holocene coccolith zonation of core samples from DSDP Leg 30. Numbers assigned to zones represent the core-section number, a 1.5-meter cored interval. Where several samples are assigned to a zone, the highest and lowest sections are listed with a slash between. Poorly diagnostic samples are assigned to an interval of several zones or are queried. Older Cretaceous stratigraphy is summarized in Figure 3.*

Stage	Site 288
Santonian to Turonian	13A-1/14A-1
Turonian	15A-1
Albian to Turonian	23A-2/20A-1
Albian	24A-1/25A-1
Aptian or Albian	26A-1
?	27A-2/30A-1

Figure 3. *Pre-Campanian Cretaceous coccolith stratigraphy of Site 288.*

meters. Basalt was cored in Cores 36 to 41 (649 to 706 m). Coccolith samples range in age from late middle Eocene in Core 33 (606 to 615 m) to late Pleistocene in Core 1 (0 to 7 m). The greater part of the cored section, Cores 8 to 33 (131 to 615 m), sampled a thick interval of late middle Eocene, late Eocene, and earliest Oligocene.

Diatoms and silicoflagellates occur only in Core 1. In Sample 286-1-2, 90-91 cm (17 m), *Dictyocha stapedia* dominates among the silicoflagellates, *Ethmodiscus rex* among the diatoms. A count of 100 silicoflagellates shows 90% *Dictyocha stapedia*, 5% *D. epiodon*, 4% *Octactis pulchra*, and 1% *Distephanus* sp. cf. *D. speculum*, an assemblage that indicates the late Pleistocene *Dictyocha epiodon* Zone. The diatom assemblage contains the warm-water Pleistocene guide species *Pseudoeunotia doliolus*, which indicates the Pleistocene *Pseudoeunotia doliolus* Zone. Other diatoms present include *Asteromphalus heptactis*, *A. imbricatus*, *Bacteriastrum* sp., *Coscinodiscus africanus*, *C. excentricus*, *C. lineatus*, *Diploneis* sp., *Nitzschia marina*, *Rhizosolenia bergonii*, *R. styliformis*, *Thalassionema* sp., and *Thalassiosira oestrupii*. Reworking from older strata is most clearly demonstrated in the assemblage of Miocene and Pliocene discoasters that includes *Catinaster coalitus*, *Discoaster deflandrei*, *D. quinqueramus*, *D. surculus*, and *D. variabilis*, among other species.

Siliceous phytoplankton are less abundant in deeper samples from Core 1 but provide evidence for a Pleistocene age. Sample 286-1-4, 110-111 cm (3 m), for example, contains rare *Dictyocha stapedia*, *Octactis pulchra*, *Ethmodiscus rex*, *Hemidiscus cuneiformis*, *Nitzschia marina*, *Rhizosolenia bergonii*, and *Roperia tesselata*. In 286-1-5, 30-31 cm (4 m), a count of 100 silicoflagellates shows 96% *Dictyocha stapedia*, 3% *Distephanus speculum varians*, and 1% *Dictyocha epiodon*.

Sample 286-2-2, 60-61 cm (19 m) contains a good assemblage of the *Gephyrocapsa oceanica* Zone of coccoliths, which includes *Ceratolithus cristatus*, *Emiliania annula*, *Gephyrocapsa oceanica*, and *G. sinuosa*.

The early Oligocene *Helicopontosphaera reticulata* Zone coccolith assemblages of Cores 8 to 10 (133 to 169 m) are distinctive in the common occurrence of *Coccolithus subdistichus* sensu amplo. *Discoaster gartneri* and *Helicopontosphaera reticulata*, generally missing in open-ocean deposits of this zone, occur together in Sample 286-9-2, 50-51 cm (151 m). Samples lower in the zone contain intensively etched (-3) placoliths but only slightly etched (-1) discoasters (preservation code follows Bukry, 1973b). Although *C. subdistichus* is missing in Sample 286-9-5, 50-51 cm (156 m), the presence of

Age	Zone	Sample (Location in cm)	Depth (m)	*Corbisema triacantha*	*Dictyocha aspera*	*D. fibula*	*D.* sp. cf. *D. medusa*	*D. rhombica*	*Distephanus boliviensis major*	*D. crux*	*D.* sp. cf. *D. longispinus*	*D. pseudocrux*	*D. speculum pentagonus*	*D. speculum speculum*	*Mesocena circulus*	*M. diodon*	*Dictyocha/Distephanus* ratio
Late Miocene	*Dictyocha aspera*	285-3-1, 125	37		84	6		6		1				2			297/3=99.0
		285-3-2, 101	39		79	3	<1	10						7	<1		278/21=13.2
		285-3-5, 50	43		77	4	<1	10		1		<1	<1	7	<1		275/25=11.0
		285-3-6, 50	44		78	4	<1	8		2			<1	8			268/32=8.4
		285-4-6, 50	62		58	13		14	<1	1			<1	12	1		253/43=5.9
Middle Miocene	*Distephanus longispinus*	285-5-6, 50	82	<1	69	2	<1	5		12	2		6	2		<1	231/68=3.4

Figure 4. *Occurrence, expressed as percentages, of silicoflagellates at Site 285. Percentages based on counts of 300 specimens per sample. The increasing ratio of* Dictyocha *to* Distephanus *suggests warmer paleotemperatures with decreasing age (Mandra, 1969).*

Isthmolithus recurvus and the absence of rosette discoasters suggests the *Coccolithus subdistichus* Subzone. Sample 286-10-1, 66-67 cm (169 m), immediately below, contains both *C. subdistichus* and *I. recurvus.*

Late Eocene coccolith assemblages with the distinctive species *Discoaster saipanensis, Isthmolithus recurvus,* and *Reticulofenestra reticulata* occur in Sample 286-10-4, 50-51 cm (174 m). Coccolith assemblages are moderately etched (-2 or -3) in the late Eocene of Cores 10 to 17 (169 to 311 m). Several samples, such as 286-12-2, 60-61 cm (208 m) and 286-14-2, 50-51 cm (246 m), contain *Helicopontosphaera reticulata.*

Moderate etching and fragmentation of coccoliths are typical in the late middle Eocene of Cores 19 to 33 (340 to 615 m). The species array in this interval is fairly uniform and suggests a high rate of sedimentation during a brief period near the end of the middle Eocene. All 11 samples examined contain species suggesting assignment to the upper *Discoaster saipanensis* Subzone, an interval probably representing less than 2 m.y. (Bukry, 1973b). A sedimentation rate greater than 137 bubnoffs (μm/yr, mm/10^3 yr, or m/10^6 yr) is indicated. An abundance of volcanogenic detritus and deposition in graded beds, described by shipboard scientists, accounts for the high sedimentation rate. The occurrence of *Helicopontosphaera heezenii* and *Pemma papillatum* in 286-29-2, 79-80 cm (531 m) probably suggests reworking from shallower areas.

Samples examined from Cores 34 and 35 (625 to 649 m), just above basalt, are nonfossiliferous.

Site 287
(lat 13°54.67'S, long 153°15.93'E, depth 4632 m)

Site 287 is in the Coral Sea Basin southeast of New Guinea. Coccolith assemblages range in age from earliest Eocene for material just above basalt in Core 16 (236 to 238 m) to Holocene in Core 1 (0 to 8 m).

Late Quaternary coccolith assemblages are well preserved in samples from Cores 1 and 2. Core 1 contains such species as *Cyclococcolithina leptopora, Emiliania huxleyi, Gephyrocapsa caribbeanica, G.* sp. cf. *G. ericsonii, G. oceanica, G. omega, Helicopontosphaera wallichii, Rhabdosphaera claviger, Umbilicosphaera sibogae,* and some displaced *Sphenolithus abies.*

The late Pleistocene *Gephyrocapsa oceanica* Zone of Sample 287-3-1, 105-106 cm (37 m) contains an abundance of excellently preserved *Emiliania annula.* Other species present include *Ceratolithus cristatus, Discolithina japonica, Emiliania ovata, Gephyrocapsa oceanica, Helicopontosphaera kamptneri, Rhabdosphaera claviger, R. stylifer,* and some displaced *Discoaster brouweri* and *Sphenolithus abies.*

The middle Eocene *Nannotetrina quadrata* Zone of Cores 11 to 14 (179 to 217 m) contains abundant coccoliths throughout. Diatoms and radiolarians are common and silicoflagellates sparse in part of the interval, Samples 287-12-4, 50-51 cm to 287-11-6, 14-15 cm (188 to 195 m). A comparison of the coccolith paleotemperature indicating ratio of *Discoaster/Chiasmolithus* (Bukry, 1973a) between Sample 287-12-4, which contains siliceous phytoplankton, and 287-13-2, which contains no siliceous phytoplankton, shows the same ratio, or no significant paleotemperature change. Other nonsiliceous middle Eocene assemblages in Cores 11 and 13 do show higher *Discoaster/Chiasmolithus* ratios that indicate warmer temperatures and probably reduced upwelling (Figure 5).

Rosette discoasters flourished in the late Paleocene and Eocene but became extinct in the late Eocene, leaving nonrosette discoasters to dominate the cooler Oligocene. Fluctuations in the relative abundance of rosette species such as *Discoaster barbadiensis* and nonrosette species such as *D. distinctus* were determined to test for possible paleotemperature significance. The results of counts of 300 for the warmest and coolest middle Eocene assemblages, as suggested by the *Discoaster/Chiasmolithus* ratio, show mixed correlations suggesting no paleotemperature significance for the rosette/nonrosette discoaster ratio (Figure 5).

Age	Sample (Interval in cm)	Depth (m)	*Discoaster*/ *Chiasmolithus*	Rosette discoaster/ Nonrosette discoaster
Middle Eocene	11-2, 50-51	181	75/25	
	11-4, 50-51	185	81/19	81/19
	11-5, 50-51	187	84/16	69/31
	11-6, 14-15	188	57/43	52/48
	12-1, 100-101	190	45/55	67/33
	12-2, 50-51	191	58/42	
	12-3, 50-51	193	55/45	
	12-4, 50-51	195	52/48	
	13-2, 50-51	199	52/48	
	14-2, 50-51	209	60/40	

Figure 5. Discoaster/Chiasmolithus *ratio based on counts of 300 specimens in a sequence of samples at Site 287. Higher ratios indicate warmer paleotemperatures. Rosette/nonrosette discoaster ratios for selected samples show no correlation to paleotemperatures.*

Rare silicoflagellates occur in the upper four sections of Core 12 (190 to 195 m). The composite assemblage includes *Corbisema hastata minor, C. triacantha, Dictyocha* sp. cf. *D. deflandrei, Naviculopsis foliacea;* and *N. constricta. Corbisema triacantha* and *Dictyocha* sp. cf. *D. deflandrei* occur only in the sample showing the greatest diversity, 287-12-4, 50-51 cm. The specimens of *D.* sp. cf. *D. deflandrei* differ from those of the Oligocene by having a basal ring with sulcate inner margins, as illustrated by Glezer (1966, pl. 12, fig. 14-19).

The coccolith *Rhabdosphaera inflata,* associated with *Discoaster sublodoensis, Ellipsolithus lajollaensis, Reticulofenestra dictyoda*, and *Triquetrorhabdulus inversus* in Sample 287-15-1, 89-90 cm (217 m), indicates the upper portion of the *Discoaster sublodoensis* Zone. The deepest sample available, 287-16-1, 43-44 cm (236 m), contains coccoliths of the lower *Discoaster diastypus* Zone, as indicated by the presence of *Chiasmolithus bidens, Discoaster* sp. cf. *D. diastypus, D. lenticularis, D. multiradiatus, D.* sp. cf. *D. nobilis*, and *Tribrachiatus* sp. cf. *T. contortus,* among other species.

Site 288
(lat 5°58.35'S, long 161°49.53'E, depth 3000 m)

Site 288 is on the Ontong-Java Plateau, a shallow area northeast of New Guinea. A total of 43 cores was cut discontinuously through a 989-meter section that ranged in age from Early Cretaceous to Quaternary on the basis of coccoliths.

Coccoliths are the dominant fossil group through the section; silicoflagellates and diatoms occur only in Core 1 (0 to 3 m). Silicoflagellates are rare; only two species are present: *Dictyocha epiodon* and *D. stapedia.* Diatoms are most common, though solution thinned, in Sample 288-1-2, 50-51 cm (2 m), where species present include *Coscinodiscus africanus, C. excentricus, C. nodulifer, Hemidiscus cuneiformis, Nitzschia marina, Pseudoeunotia doliolus, Rhizosolenia bergonii*, and *Thalassiothrix longissima.* Coccolith assemblages in these late Pleistocene samples are noteworthy for the very common occurrence of *Ceratolithus* and *Gephyrocapsa.*

Samples from Cores 2 to 4 (10 to 58 m) contain coccolith assemblages that are chaotic mixtures of late Miocene and Pliocene species. They lack *Gephyrocapsa* and occur above latest Pliocene assemblages of Core 5; therefore, the Core 2 to Core 4 samples are probably latest Pliocene to earliest Pleistocene. Significant erosion during that time is suggested by the common occurrence of a full array of late Miocene to Pliocene discoasters.

A series of discontinuous cores (6 to 11) sampled various zones and subzones through the Miocene between 86 and 238 meters. Typical of tropical Miocene coccolith ooze, discoasters are abundant and moderately (+2) overgrown. For comparative studies, Miocene discoasters are much less overgrown at Site 288 than at nearby Site 289, where specimens show thick, irregular overgrowth (+3 and +4).

Oligocene assemblages of Cores 2A to 6A (305 to 467 m) contain abundant discoasters and sphenoliths and are slightly more overgrown (+3) than Miocene assemblages. The dominance of *Discoaster* and *Sphenolithus* indicates tropical waters (Bukry, 1973b) and the absence of any marginal-marine indicators such as *Peritrachelina, Braarudosphaera*, or even *Helicopontosphaera* indicates deep-ocean deposition.

Core 7A at 495 meters was void of sediment, and Core 8A at 533 meters recovered only 2 meters of early Paleocene coccolith ooze. Zonal assignment of the two samples from this core raises some question of zone definitions. The *Cruciplacolithus tenuis* Zone as originally defined by Mohler and Hay (1967) is simply recognized as the interval between the first occurrence of two widespread and distinctive species, *Cruciplacolithus tenuis* at the base and *Fasciculithus tympaniformis* at the top. This definition has proved to be useful in Paleocene sections and does not preclude the occurrence of other species of *Fasciculithus* such as *F. magnus* at DSDP 47.2 and *F. pileatus* at Site 288, which precede *F. tympaniformis.* The earliest occurrences of *Ellipsolithus macellus* and *Cyclococcolithina*? *robusta* have been suggested as guide fossils for zones and subzones occupying the upper part of the original *C. tenuis* Zone (see Martini, 1970; Gartner, 1971). Sample 288A-8-2, 68-69 cm (534 m) contains *C. tenuis, C.*? *robusta, Ellipsolithus* sp., and *F. pileatus* and is therefore assigned to the upper part of the *C. tenuis* Zone of Mohler and Hay (1967). Gartner's (1971) *C.* ? *robusta* Zone (=subzone) would seem an appropriate subzonal designation.

Coccoliths are common to abundant in Cretaceous samples from Cores 9A to 30A (571 to 989 m). Maestrichtian assemblages lack *Broinsonia parca, Lithraphidites quadratus,* or *Micula mura* sensu stricto. Some coccolith specimens resembling *M. mura* occur in Sections 1 and 2 of Core 9A. The highest occurrence of *Broinsonia parca* and *Tetralithus trifidus*, indicating late Campanian or early Maestrichtian, is in Core 10 (200 to 210 m). The early Campanian assignment of 288A-12-1, 118-120 cm (686 m), is based on the presence of *Broinsonia parca, Eiffellithus augustus,* and *Tetralithus aculeus.*

Below this level, coccolith oozes have undergone diagenesis and generally lack the biostratigraphic zonal guide fossils used to suggest marginal-marine zonations. No specimens of *Marthasterites, Braarudosphaera, Kamptnerius,* or *Corollithion* are identified; therefore, only general stage assignments based on such taxa as *Gartnerago obliquum* (Core 14A), *Tetralithus pyramidus* (Cores 13A to 15A), and *Chiastozygus disgregatus* (Core 14A) are possible for these open-ocean assemblages.

In samples of limestone from Core 20 and below (847 to 989 m), only the most diagenetically resistant species were found. These species are dominated by *Watznaueria barnesae* and include *Chiastozygus* sp., *Eiffellithus turriseiffeli, Manivitella pemmatoidea, Parhabdolithus embergeri, Zygodiscus bicrescenticus,* and *Z. compactus.*

The first occurrence of *E. turriseiffeli* is in Core 26A, but this may be a function of the much poorer preservation in the deeper cores. An age of Aptian or Albian or younger is indicated for the basal cores. Other guide fossils for the Aptian and early Albian, such as *Parhabdolithus angustus* and *Prediscosphaera cretacea*, or *Lithraphidites alatus* for the Cenomanian (Roth, 1973), are missing. The lowest occurrence of *P. cretacea* is in Core 20; its absence in deeper samples suggests that it is probably more susceptible to removal by diagenesis than *Eiffellithus turriseiffeli.*

Site 289
(lat 0°29.92′S, long 158°30.69′E, depth 2206 m)

Site 289 on the Ontong-Java Plateau was completely cored from the sea floor to extrusive basaltic basement (0 to 1261 m). Although coccoliths indicate essentially continuous accumulation of sediment from late middle Eocene to Quaternary, preservation is much poorer at this site than at Site 288. *Discoaster* specimens in particular have irregular, moderate (+2, +3) to heavy (+3, +4) overgrowth throughout the pre-Pliocene section of Cores 16 to 118 (150 to 1112 m), making identifications difficult in many samples. No significant siliceous phytoplankton assemblages were observed in coccolith smear-slide preparations. Only rare, solution-thinned, and fragmented specimens occur at some levels in the *Sphenolithus predistentus* Zone, *Discoaster neohamatus* Zone, and Pliocene to Quaternary.

The coccolith assemblages are those of a tropical shallow ocean area. *Discoaster* and *Sphenolithus* are abundant, and *Hayaster, Scyphosphaera, Discolithina,* and *Oolithotus* more common than at deep-ocean sites. Low-latitude coccolith zonation is applicable through the cored interval, although the marker species of *Ceratolithus* in the upper Miocene and lower Pliocene are sparse. One problem interval, the *Triquetrorhabdulus carinatus* Zone overlapping the Oligocene-Miocene boundary, requires reexamination of species and zonal definitions because one of the key marker species, *Discoaster druggii,* appears to be discontinuous in its distribution.

The *Triquetrorhabdulus carinatus* Zone is especially thick at Site 289, occurring in Cores 61 to 82 (579 to 773 m). *Discoaster druggii* is most common in samples from Cores 71 and 61 and rare or absent in intervening samples. This uneven distribution suggests a major ecologic control of *D. druggii* that would make its use in discontinuously cored sections difficult. *D. druggii* has been used as a biostratigraphic guide because it is a large and distinctively shaped species that can be detected at very low abundance levels. But its intermittent distribution through the upper part of the zone here and at Sites 214 and 238 suggests potential correlation irregularities resulting from false first occurrences. Detailed studies of the phylogeny, morphotypes, and biogeography of *D. druggii* from many sections are needed to improve the biostratigraphic subdivision of the lower Miocene by coccoliths.

The deepest sample available, 289-129-1, 127-128 cm (1212 m), is a limestone containing an abundant, overgrown coccolith assemblage of probable late Campanian age that includes *Broinsonia bevieri, B. parca, Cretarhabdus crenulatus, Cribrosphaera* sp. cf. *C. ehrenbergii, Manivitella pemmatoidea, Prediscosphaera cretacea, Tetralithus pyramidus, T. trifidus,* and *Watznaueria barnesae.*

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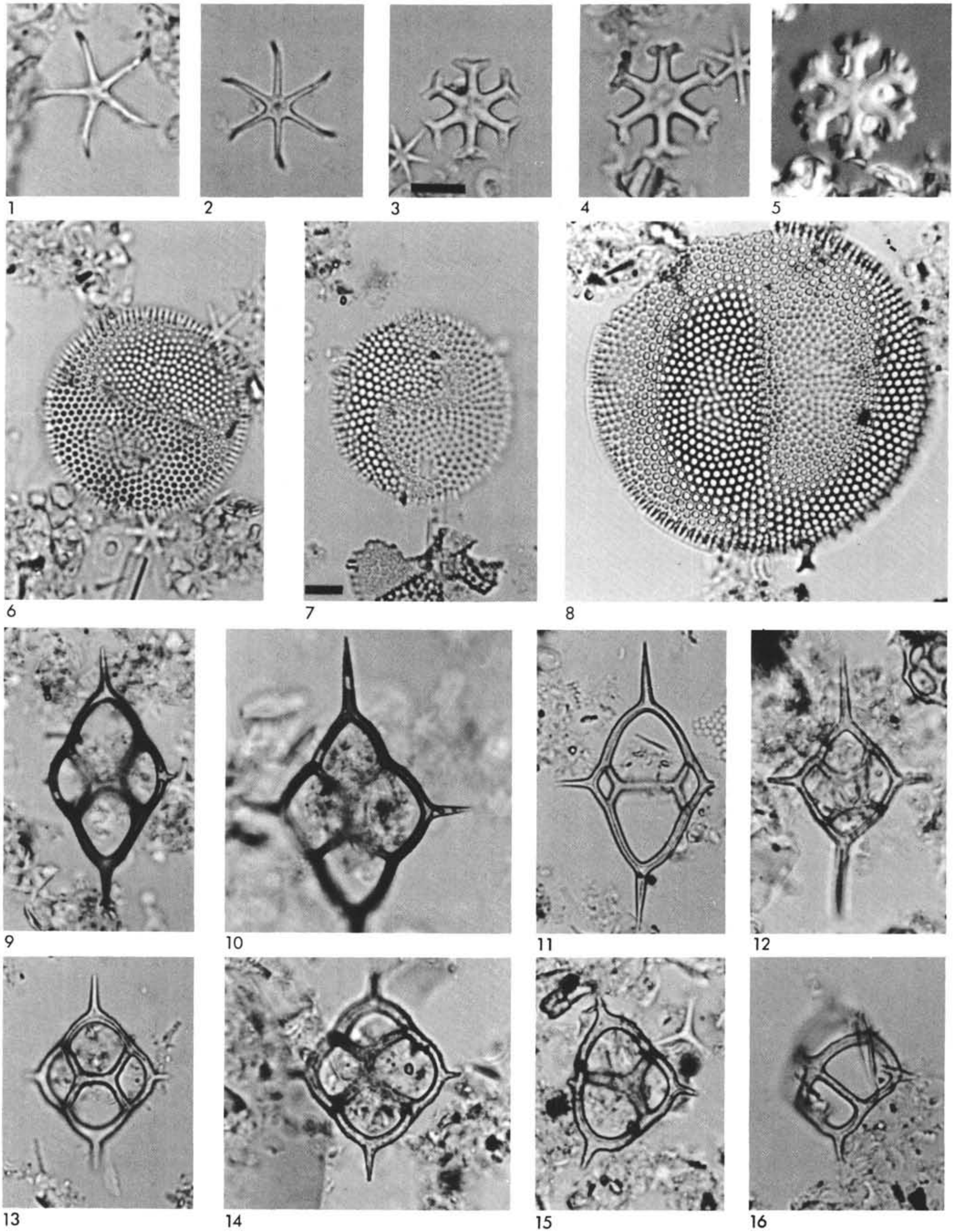
PLATE 1

Miocene Phytoplankton Site 285
(Figures 1-5 magnified 1000×; scale bar 10 μm)
(Figures 6-16 magnified 700×; scale bar 10 μm)

Figure 1	*Discoaster hamatus* Martini and Bramlette; 285-5-6, 50-51 cm (82 m).
Figure 2	*Discoaster neohamatus* Bukry and Bramlette; 285-3-1, 125-126 cm (37 m).
Figures 3, 4	*Discoaster pansus* (Bukry and Percival); 285-3-1, 125-126 cm (37 m).
Figure 5	*Discoaster* sp. aff. *D. variabilis* Martini and Bramlette; 285-3-1, 125-126 cm (37 m).
Figures 6-8	*Coscinodiscus plicatus* Grunow. 6. 285-3-1, 125-126 cm (37 m). 7, 8. 285-4-6, 50-51 cm (62 m).
Figures 9, 10	*Dictyocha aspera* (Lemmermann). 9. 285-3-1, 125-126 cm). 10. 285-4-6, 50-51 cm (62 m).
Figures 11, 12	*Dictyocha fibula* Ehrenberg s. ampl. 11. 285-3-1, 125-126 cm (37 m). 12. 285-5-6, 50-51 cm (82 m).
Figure 13	*Dictyocha rhombica* (Schulz); 285-4-6, 50-51 cm (62 m).
Figure 14	*Distephanus* sp. cf. *D. longispinus* (Schulz); 285-5-6, 50-51 cm (82 m).
Figure 15	*Corbisema triacantha* (Ehrenberg); 285-5-6, 50-51 cm (82 m).
Figure 16	*Dictyocha medusa* Haeckel; 285-5-6, 50-51 cm (82 m).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