16. SMALLER CRETACEOUS FORAMINIFERS OF LEG 43, DEEP SEA DRILLING PROJECT

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INTRODUCTION

Six holes, numbered 382-387, were drilled during Leg 43. Their locations are listed in Table 1 and illustrated in Figure 1. Site 383 was abandoned after slight penetration because of drilling difficulties. Drilling at all other sites penetrated considerable thicknesses of Cretaceous strata. The lithology at these sites is illustrated in Figure 2. No rocks older than Cretaceous were encountered.

Despite the considerable sequence of Cretaceous penetrated, foraminifers are common only at Site 382, where they represent a portion of the lower Campanian; at Site 384, where they represent most of the Maestrichtian in an upper sequence, and, by orbitolines in reefal facies, a portion of the Aptian in a lower sequence; and at Site 386, where the upper Albian through lower Cenomanian yields good material. At other Mesozoic horizons in these holes and at other sites, Mesozoic rocks are mostly varicolored claystones of sparse to zero foraminiferal content in which only agglutinated and small hyaline benthic forms occur. Dark organic claystones dominate the Lower Cretaceous of Site 386, and the Albian-Cenomanian forms occur in thin chalky interbeds of a portion of these clays. Well-indurated Neocomian limestone and calcareous claystone in the bottom of Site 387 are barren of foraminifers, despite the presence of some megafossils.

Results are arranged according to site number and by faunal list for the site. Common and persistent species are presented in distribution charts as well (Tables 2-4). Taxonomic comments of informal style accompany Sites 384 and 386, but full systematic treatment will be postponed until a subsequent report.

SITE 382

Cretaceous foraminifers occur within laminal and thin beds of chalk. These are interbedded with barren, varicolored volcanogenic silty clays, which quickly become dominant with depth. Chalks of Core 16, at the top of the Cretaceous, consist of foraminifers and nannofossils. Those of Core 17 are rich in radiolarians. Very few samples of greater depth yielded foraminifers (Figure 3).

Both foraminifers and radiolarians are more or less recrystallized and overgrown. Preservation varies from fair to poor. The recovery of usable specimens was poor for most samples. Of 53 samples processed, 23 provided information. Benthic forms listed below are represented in most instances by one specimen from one sample. Even the planktonic occurrences cited in the distribution chart (Table 2) are often based on one or two specimens of poor quality.

Faunal Intervals

Interval: Core 16, Sections 1 through 4.
Correlation: Upper Campanian?
Fauna: Planktonics.
Archaeoglobigerina sp., *Globigerinelloides subcarinatus* (Bronnimann)?, *G. volutus* (White), *Globotruncana arca* (Cushman), *G. elevata* (Brotzen), *G. fornicata* Plummer, *G. hilli* Pessagno?, *G. lapparenti* Brotzen, *G. linneiana* (d'Orbigny), *G. stephensoni* Pessagno, *G. stuartiformis* Dalbiez, *G. ventricosa* (White), *Heterohelix pulchra* (Brotzen), *H. striata* (Ehrenberg), *Pseudoguembelina costulata* (Cushman), *Pseudotextularia elegans* (Rzehak).
Fauna: Benthonics.
Aragonia cf. A. velascoensis (Cushman), *Bolivinita eleyi* Cushman, *B. planata* Cushman, *Bolivinopsis emmendorfi* Jennings, *Bulimina referata* Jennings, *Dentalina basiplanata* Cushman, *Fissurini orbignyana* (Sequenza), *Gaudryina carinata* Franke?, *Gavelinella rubiginosa* Cushman, *Lenticulina velascoensis* White, *Pleurostomella cf. P. subnodosa* Reuss, *Verneuilina* sp.

Interval: Core 16, Section 5 through Core 19, Section 4.
Correlation: Lower Campanian, *Globotruncana elevata* Zone (Cita and Gartner 1971, p. 295).
Fauna: Planktonics.
Globotruncana arca (Cushman), *G. elevata* (Brotzen), *G. fornicata* Plummer, *G. lapparenti* Brotzen, *G. linneiana* (d'Orbigny), *G. stuartiformis* Dalbiez, *G. ventricosa* (White), *Pseudotextularia elegans* (Rzehak).
Fauna: Benthonics.
Bigenerina gracilis Cushman (1 specimen), *Gaudryina carinata* Franke, *Pleurostomella cf. P. subnodosa* Reuss, *Valvulineria allomorphinoides* (Reuss).

The dominant species of both intervals are the same, namely *Globotruncana arca* (Cushman), *G. elevata* (Brotzen), *G. fornicata* Plummer, *G. lapparenti* Brotzen, *G. linneiana* (d'Orbigny), and *G. stuartiformis* Dalbiez. These are long-ranging forms that typify the Campanian and extend well into the Maestrichtian. The absence of firm indicators of the latter eliminates the possibility of correlation therewith. The upper interval contains *G. subcarinatus* (Bronnimann)? and *G. hilli* Pessagno? which suggest upper Campanian, if

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TABLE 1
Drilling and Coring Summary, Leg 43, 1975

Site	Dates Occupied	Hours on Site	Latitude Longitude	Water Depth (m)	Pene-tration (m)	No. of Cores	Meters Cored	Meters Recov-ered	% Recov-ered	Oldest Sediment	Deepest Unit
382	5 July-9 July	90 1/2	34°25.04'N 56°32.25'W	5527	520.5	25	232.2	163.4	70.4	Lower Campanian or older	Volcaniclastic Breccia
383	10 July-12 July	36	39°14.88'N 53°21.18'W	5277	120.3	2	19.1	4.9	26.0	Pleistocene	Sand
384	12 July-15 July	54 1/2	40°21.65'N 51°39.80'W	3910	330.3	22	195.3	110.5	57.0	Barremian/Aptian	Basalt
385	18 July-20 July	64	37°22.17'N 60°09.45'W	4956	392.9	24	227.6	63.4	27.9	Lower Maestrichtian or older	Volcaniclastic Breccia
386	24 July-31 July	166	31°11.21'N 64°14.94'W	4783	973.8	66	626.7	438.2	69.9	Lower Albian	Basalt
387	1 Aug.-7 Aug.	138	32°19.20'N 67°40.00'W	5118	794.5	50	467.9	178.2	38.1	Upper Berriasian-lower Valanginian	Basalt
Total 6 Sites		549	–	–	3132.3	189	1768.8	958.6	54.2		

correctly identified. On the other hand, *G. calcaratta* Cushman is lacking, although it is known to occur nearby (Site 10, Leg 2, Cita and Gartner, 1971). It is possible that *G. calcarata* does not appear at the base of the upper Campanian and that Core 16, Sections 1 through 4, represent basal upper Campanian, as the coccoliths indicate (see Calcareous Nannoplankton in Site Report). For this reason the interval has been listed separately above.

The faunules below Core 16 are certainly typical of the *Globotruncana elevata* Zone, as defined by Cita and Gartner (1971), and correlate with the lower Campanian.

SITE 384

Cretaceous foraminifers occur in two portions of this hole. The first is a sequence of foraminifer-nannofossil chalk that contains a rich planktonic fauna of the Maestrichtian. Underlying and separated therefrom by 10 uncored meters is an Aptian rudist reefal complex. In the latter, orbitolinids are abundant, but smaller foraminifers are uncommon to rare, very poorly preserved benthics of a few, unidentifiable species.

The Maestrichtian-Danian contact was recovered. It is physically faint but distinct. The basal Danian contains many burrows filled with considerable Cretaceous clay. As a result, samples from the Danian yield a mixture of Cretaceous and Tertiary forms. Such mixing is not uncommon and may prove more understandable in view of the source of such mixing in this instance.

The recurrent species of the Maestrichtian are plotted in the distribution chart (Table 3). The total fauna of each biozone and interval is listed below. All three foraminifer zones of the Maestrichtian, or their equivalent, occur, but their boundaries are not sharp. It is evident that the interval from 13-3, 33-34 cm through 14-1, 150 cm, correlates with the *Abathomphalus mayaroensis* Zone (Bolli, 1957) and that most of Core 15 is correlative with the *Globotruncana arca* Zone (Cita and Gartner, 1971). The top of the latter biozone was chosen at 15-2, 150 cm. *Globotruncana gansseri* does not occur in the interval of the *G. gansseri* Zone, but does occur in the basal portion of the *A. mayaroensis* Zone. Its occurrence in this zone indicates that most of the interval is lower Maestrichtian, limiting the Cretaceous-Danian lacuna to uppermost Maestrichtian and about 1×10^6 years at most (U.C. 17, van Hinte, 1976, fig. 2).

Faunal Intervals

Interval: Core 13, Section 3, 33 cm to Core 14, Section 1, 150 cm.

Correlation: upper Maestrichtian, *Abathomphalus mayaroensis* Zone (Bolli, 1957, p. 54).

Fauna: Planktonics.

Abathomphalus mayaroensis (Bolli), *Bucherina sandidgei* Bronnimann and Brown?, *Globigerinelloides asperus* (Ehrenberg), *G. multispina* (Lalicker), *G. subcarinatus* (Bronnimann), *G. volutus* (White), *Globotruncana arca* (Cushman), *G. contusa* (Cushman), *G. elevata* (Brotzen), *G. gansseri* Bolli, *G. stephensoni* Pessagno, *G. stuarti* (de Lapparent), *Globotruncanella havanensis* (Voorwijk), *G. intermedia* (Bolli), *Gublerina hedbergi* Bronnimann and Brown, *G. robusta* de Klasz, *Heterohelix glabrans* (Cushman), *H. globulosa* (Ehrenberg), *H. planata* (Cushman), *H. pulchra* (Brotzen), *H. striata* (Ehrenberg), *Planoglobulina acervulinoides* (Egger), *P. brazoensis* Martin, *P. carseyae* (Plummer), *Pseudoguembelina cornuta* Sieglie, *P. costulata* (Cushman), *P. excolata* (Cushman), *P. palpebra* Bronnimann and Brown, *P. deformis* (Kikoine), *P. elegans* (Rzehak), *P. intermedia* de Klasz, *Racemiguembelina fructicosa* (Egger), *R. powelli* Smith and Pessagno, *Rugoglobigerina hexacamerata* Bronnimann, *R. milamensis* Smith and Pessagno, *Ventilabrella multicamerata* de Klasz.

Fauna: Benthonics.

Aragonia trinitatensis (Cushman and Parker), *Bulimina aspera* Cushman and Parker, *Chrysalogonium cretaceum* Cushman and Church, *Dentalina gracilis* d'Orbigny, *D. legumen* Reuss, *D. megalopolitana* Reuss, *Gavelinella rubiginosa* (Cushman), *Gyroidinoides beisseli* (White)?, *G. globosa* (Hagenow), *G.*

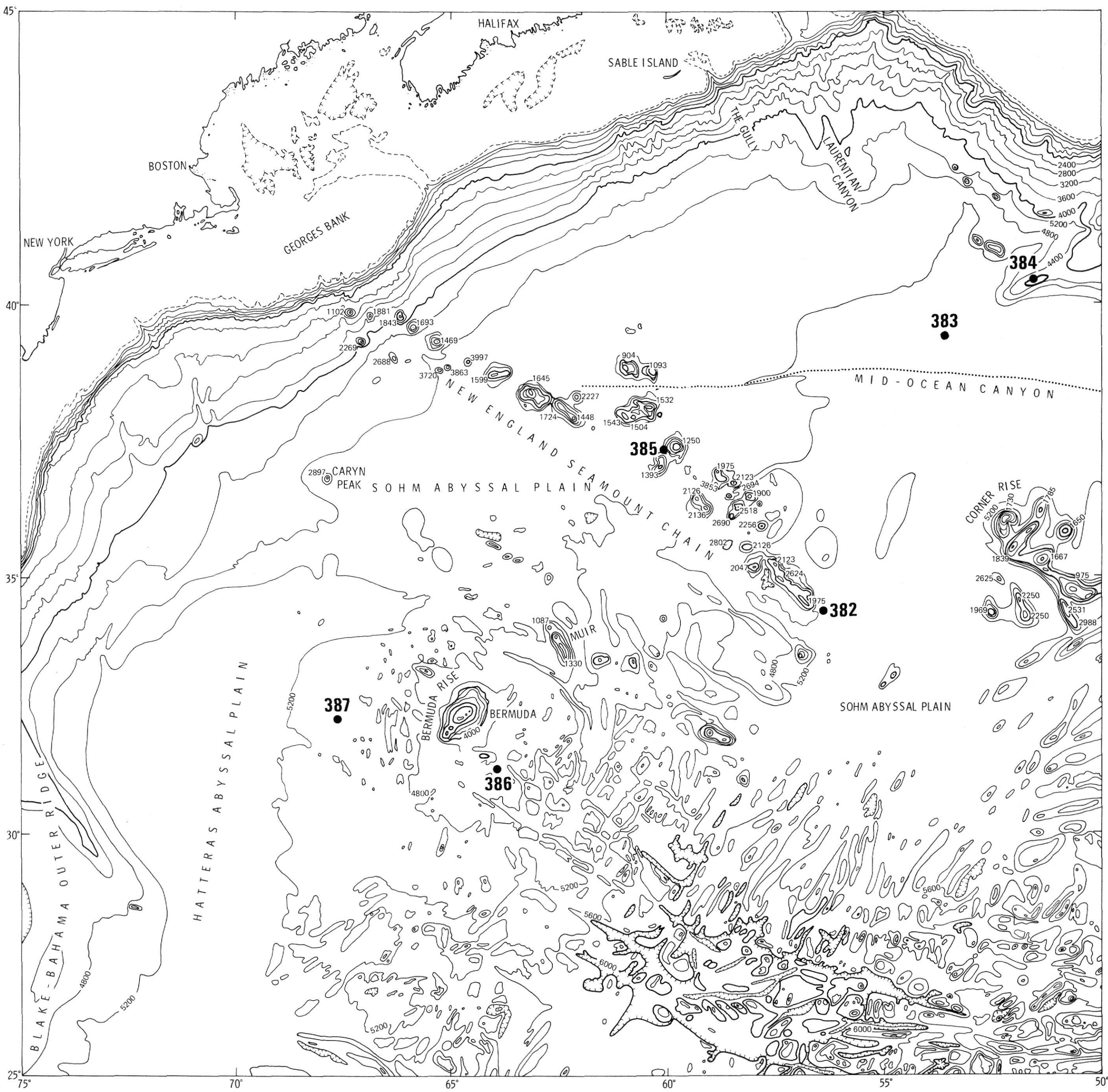

Figure 1. *Location of sites drilled during Leg 43.*

pontoni Brotzen, *Lenticulina macrodisca* (Reuss)?, *L. velascoensis* White, *Neoflabellina gibbera* Wedekind?, *Nodosarella coalinguaensis* Cushman and Church, *N. subnodosa* (Guppy), *Pseudoclavulina amorpha* (Cushman), *Reussella szajnochae* (Grzybowski), *Rotorbinella supracretacea* (Schijfsma), *Semivulvulina dentata* (Alth).

The top of the zone is the Cretaceous-Tertiary contact, as noted above. The base of the zone was chosen as the bottom of Core 14, Section 1, because *G. mayaroensis* occurs in Sample 14-1, 120-122 cm, and is absent from samples below.

Interval: Core 14, Section 1, 150 cm to Core 15, Section 2, 150 cm.

Correlation: middle Maestrichtian, *Globotruncana gansseri* Zone (Bolli, 1957, p. 54; not Premoli Silva and Bolli, 1973, p. 500).

Fauna: Planktonics.

Bucherina sandidgei Bronnimann and Brown?, *Globigerinelloides asperus* (Ehrenberg), *G. multispina* (Lalicker), *G. subcarinatus* (Bronnimann), *G. volutus* (White), *Globotruncana arca* (Cushman), *G. contusa* (Cushman), *G. elevata* (Brotzen), *G. fornicata* Plummer, *G. patelliformis* Gandolfi, *G. stephensoni* Pessagno, *G. stuarti* (de Lapparent), *Globotruncanella havanensis* (Voorwijk), *G. intermedia* (Bolli), *Gublerina cuvillieri* Kikoine, *G. glaessneri* Bronnimann and Brown, *G. hedbergi* Bronnimann and Brown, *G. robusta*

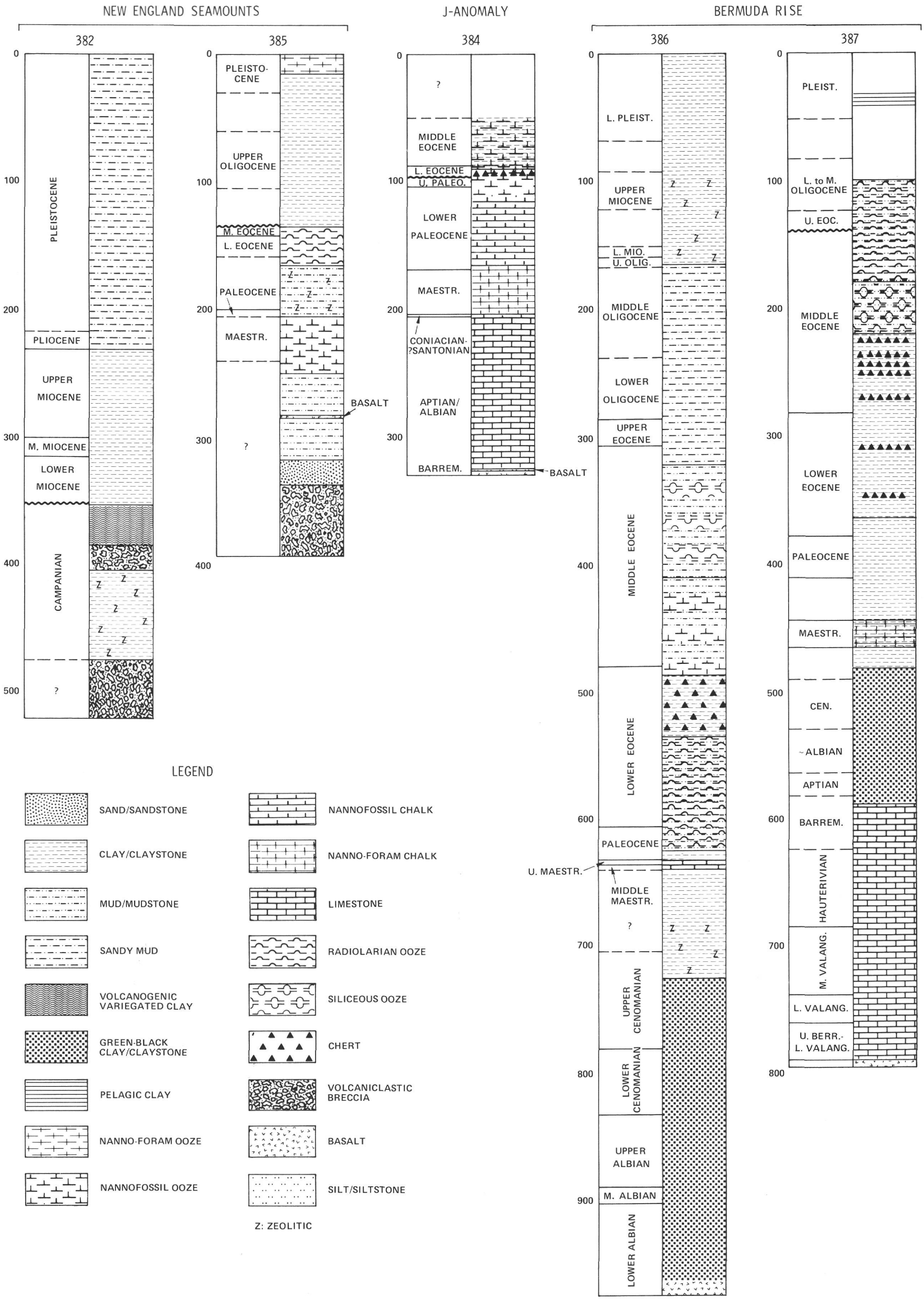

Figure 2. *Lithology of sites drilled during Leg 43.*

TABLE 2
Recurrent Planktonic Species of Site 382

Sample (Interval in cm)	*Archaeoglobigerina* sp.	*P. elegans* (Rzehak)	*G. elevata* (Brotzen)	*G. fornicata* Plummer	*G. stuartiformis* Dalbiez	*G. arca* (Cushman)	*G. lapparenti* Brotzen	*G. linneiana* (D'Orbigny)	*G. ventricosa* (White)	*G. hilli* Pessagno?	*G. stephensoni* Pessagno	*G. volutus* (White)	*G. subcarinatus* (Bronnimann)?	*H. striata* (Ehrenberg)	*H. pulchra* (Brotzen)
16-1, 70-72; 86-88; 131-135	x	x		x	x	x	x	x		?	x	x	x	x	x
16-2, 04-06	x							x		?	?	x	x	x	x
16-3, 03-05; 26-28; 86-88; 126-128	x	x	x	x	x	x	x	x		?	x	x		x	x
16-4, 00-02; 22-24; 58-60	x	x	x	x	x	x	x	x		?	x	x			
16-5, 134-135				x	x	x	x	x	?		?				
16-6, 86-88		x		x	x	x	x	x							
16, CC		x		x	x	x	x								
17-1, 75-77			x	x	x	?	x	x	x						
17-2, 20-22		x		x	x	x	x	x							
17-3, 04-06; 148-150			x	x	x	x			x						
17-4, 26-28		x	x	x	x	x	x	x	x						
17-5, 122-124			x	x	x	x									
18-2, 65-67				x	x	x	x	x							
19-3, 38-40		x		x	x	x	x	x							
19-4, 87-89			x	x	x										

de Klasz, *Heterohelix glabrans* (Cushman), *H. globulosa* (Ehrenberg), *H. planata* (Cushman), *H. pulchra* (Brotzen), *H. punctulata* (Cushman), *H. striata* (Ehrenberg), *Pseudoguembelina cornuta* Sieglie, *P. costulata* (Cushman), *P. excolata* (Cushman), *P. palpebra* Bronnimann and Brown, *Pseudotextularia carseyae* (Plummer), *P. deformis* (Kikoine), *P. elegans* (Rzehak), *P. intermedia* de Klasz, *Racemiguembelina fructicosa* (Egger), *R. powelli* Smith and Pessagno, *Rugotruncana subcircumnodifer* (Gandolfi), *Ventilabrella manuelensis* Martin, *V. multicamerata* de Klasz.

Fauna: Benthonics.

Aragonia ouezzanensis (Rey), *A. trinitatensis* (Cushman and Parker), *Gavelinella rubiginosa* (Cushman), *Guttulina trigonula* (Reuss), *Gyroidinoides beisseli* (White)?, *Lenticulina velascoensis* White, *Pseudoclavulina amorpha* (Guppy), *Reussella szajnochae* (Grzybowski), *Semivulvulina dentata* (Alth), *Spiroplectammina sigmoidina* Lalicker.

There is some faunal break between levels 15-3, 60-62 cm and 15-2, 60-62 cm, as several species make their first appearance in or just above the latter and they are associated with the *G. gansseri-G. arca* zonal boundary (e.g., Pessagno, 1967, 1973).

Interval: Core 15, Section 2, 150 cm to 15, CC.

Correlation: lower Maestrichtian, *Globotruncana arca* Zone (Cita and Gartner, 1971, p. 293).

Fauna: Planktonics.

Globigerinelloides asperus (Ehrenberg), *G. multispina* (Lalicker), *G. subcarinatus* (Bronnimann), *G. volutus* (White), *Globotruncana arca* (Cushman), *G. elevata* (Brotzen), *G. fornicata* Plummer, *G. lapparenti* Brotzen, *G. linneiana* (d'Orbigny), *G. stephensoni* Pessagno, *G. stuarti* (de Lapparent), *G. ventricosa* (White), *G. witwickae* El-Naggar?, *Globotruncanella havanensis* (Voorwijk), *G. intermedia* (Bolli), *Gublerina glaessneri* Bronnimann and Brown, *G. hedbergi* Bronnimann and Brown, *G. robusta* de Klasz, *Heterohelix glabrans* (Cushman), *H. globulosa* (Ehrenberg),

TABLE 3
Recurrent Planktonic Species of Site 384

Sample (Interval in cm)	*H. glabrans* (Cushman)	*H. globulosa* (Ehrenberg)	*H. pulchra* (Brotzen)	*H. striata* (Ehrenberg)	*P. costulata* (Cushman)	*P. elegans* (Rzehak)	*G. multispina* (Lalicker)	*G. subcarinatus* (Bronnimann)	*G. arca* (Cushman)	*G. elevata* (Brotzen)	*G. stuarti* (de Lapparent)	*G. havanensis* (Voorwijk)	*P. intermedia* de Klasz	*G. lapparenti* Brotzen	*R. pennyi* Bronnimann	*G. fornicata* Plummer	*G. witwickae* El-Naggar?	*V. manuelensis* Martin	*V. multicamerata* de Klasz	*G. intermedia* (Bolli)	*P. excolata* (Cushman)	*G. contusa* (Cushman)	*B. sandidgei* Bron. & Brown?	*R. powelli* Smith & Pessagno	*R. fructicosa* (Egger)	*A. mayaroensis* (Bolli)	*P. carseyae* (Plummer)	*G. gansseri* Bolli
13-3, 100-102			x	x	x	x			x	x	x	x				?			x	x		x	x		x	x	x	x
13-4, 80-82	x		x	x	x	x	x	x	x	x	x	x				?			x		x	x	x		x	x	x	x
13-5, 66-68	x		x		x	x			?	x	x	x							x			x	x		x	x	x	
13-6, 70-72	x				x		x	x	?	x	x	x	x						x	x	x	x			x		x	
13, CC			x			?	x	x	?	x	x	x	x						x	?	x	x	x	x	x		x	
14-1, 120-122	x	x	x	x			x	x	?	x	x	x	x									x	x	x	x	x		
14-2, 50-52	x		x				x	x	?	x	x	x	x						x			x	x	x				
14-3, 58-60							x	x	x	x	x	x	x						x			x	x	x				
14-4, 50-52	x		x	x				x	x	x	x	x								x	x	x						
14-5 (no core recovery)																												
14-6 (no core recovery)																												
14, CC	x	x	x	x	x	x	x	x	x	x	x	x	x	x	?				x	x	x	x						
15-1, 80-82	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x							
15-2, 60-62	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x									
15-3, 60-62		x	x		x		x	x	x	x	x	x	x	x	x		x	x										
15-4, 60-62		x	x	x			x	x	x	x	x	x		x	x	x	x	x										
15-5, 70-72			x	x	x	x	x	x	x	x	x	x			x	x	x	x										
15-6, 75-77	x	x	x	x	x		x	x	x	x		x		x	x	x	x	x										
15, CC	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x										

TABLE 4
Persistent Planktonics of Site 386

Sample (Interval in cm)	*H. trochoidea* (Gandolfi)	*T. roberti* (Gandolfi)	*T. praeticinensis* Sigal	*T. breggiensis* (Gandolfi)	*T. subticinensis* (Gandolfi)	*T. ticinensis* (Gandolfi)	*T. primula* (Premoli Silva and Luterbacher)	*P. buxtorfi* (Gandolfi)	*R. apenninica* (Renz)	*R. evoluta* Sigal?	*P. stephani* (Gandolfi)	*H. libyca* Barr	*S.* sp.	*S. cenomana* (Schacko)	*G. caseyi* (Bolli, Loeblich and Tappan)	*H. planispira* (Tappan)	*H. amabilis* Loeblich and Tappan	*H. infracretacea* (Glaessner)	*H. delrioensis* (Carsey)
47-1 (no sample)																			
47-2, 120-121								?		x									
47-3, 108-110								x		x	?								x
47-4, 40-42															x	x		?	x
47-5, 52-54										x	x			x		x	x		
47-6, 72-74	no forams																		
48-1 (no sample)																			
48-2, 59-61									?	x	?								x
48-3 (no core recovery)																			
48-4 (no core recovery)																			
48-5 (no core recovery)																			
48-6 (no core recovery)																			
49-1, 144-145									x	x	x				x	x	x		x
49-2, 133-134	no forams																		
49-3, 42-43															x		x		?
49-4, 88-90										x	?								x
49-5 (no sample)																			
49-6 (no sample)																			
50-1, 90-91								?	x	x	x				x	x	x		?
50-2, 142-144				x				x		?	x	x			x		x		
50-3, 31-33								?	?	?					x	x			
50-4, 135-137										x	x					x			?
50-5, 136-138									?	x	x			x	x	x	x	x	x
50-6 (no core recovery)																			
51-1, 05-07									x	x	?					x		x	
51-2, 126-128									x	x	?				x	x			
51-3, 50-52									x	x	x	?	x	x	x				?
51-4, 107-108								x	x	?	x	x			x	x			
51-5, 140-141								x	x	?	x	x	x						
51-6, 77-79									x		x	x	x		x	x			
52-1 (no sample)																			
52-2, 06-08	no forams																		
52-3, 82-84								x	x		x	x			x	x			
52-4, 26-28								x	x		x	x			x	x			
52-5 (no sample)																			
52-6, 58-60				x		x		x	x		x	x	x	.	x				
53-1, 06-07	?			x		x		x	x			x				x	x		
53-2, 04-06						x		x	x		x	x			x	x			
53-3, 86-88				x		x		x								x		x	?
53-4, 106-107	?			x		x						?			x	x			
53-5 (no core recovery)																			
53-6 (no core recovery)																			
54-1, 134-136	no forams																		
54-2, 43-45		?		x		x	x	x	?										
54-3, 50-51				x		x	x	x											
54-4, 22-24	no forams																		
54-5, 45-47; 83-84	no plankton																		
54-6, 00-01				x		x	x												
55-1, 77-79; 110-111	x	x		x	x	x	x										x		?
55-2, 79-81	x	?		x		x	x										x		
55-3, 10-12				x		x													
55-4, 115-116	no residue																		
55-5, 83-84	x	x		x	x	?											x		
55-6, 149-150; CC	?	x		x	x	?	x									x			
56-1 (no sample)																			
56-2 (no sample)																			
56-3, 59-60; 113-115		x		x	x														
56-4, 07-09; 77-79	x	x	?	x	x											x	x		
56-5, 82-84	no residue																		
56-6, CC					x											x	x		
57-1, 143-145	x		x	x	x														
57-2, 128-130			x	x												x	x		
57-3, 118-120	no forams																		
57-4 (no sample)																			
57-5, 07-08	no forams																		
57-6, 80-82; CC	x	x		x												x	x		

H. planata (Cushman), *H. pulchra* (Brotzen), *H. punctulata* (Cushman), *H. striata* (Ehrenberg), *Pseudoguembelina costulata* (Cushman), *P. elegans* (Rzehak), *P. intermedia* de Klasz, *Rugoglobigerina pennyi* Bronnimann, *Ventilabrella manuelensis* Martin.

Fauna: Benthonics.

Allomorphina trochoides (Reuss), *Aragonia ouezzanensis* (Rey), *Charltonia madrugaensis* (Cushman and Bermudez), *Gavelinella rubiginosa* (Cushman), *Lenticulina macrodisca* (Reuss), *L. similovortex* Hanzlikova,

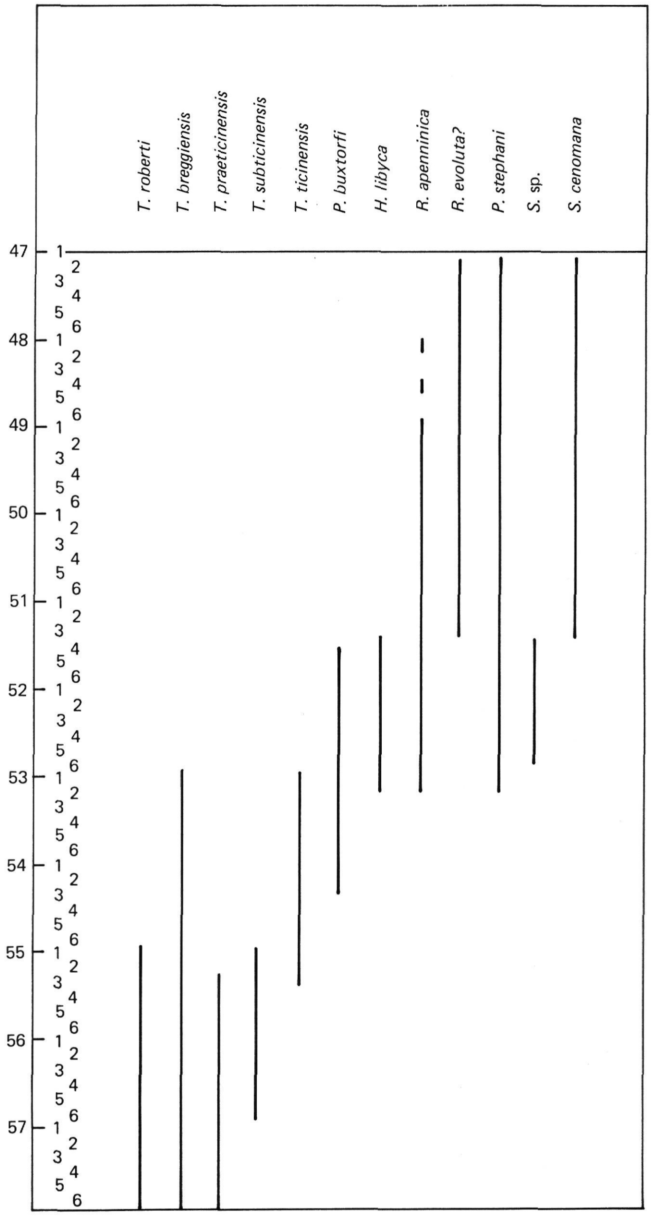

Figure 3. *Ranges of important planktonics of Site 386.*

L. velascoensis White, *Pseudoclavulina amorpha* (Cushman), *Spiroplectammina junacea* Cushman?, *S. sigmoidina* Lalicker.

Sample 15, CC is separated from the top of Core 16 by an uncored interval of 10 meters. The base of the *G. arca* Zone is consequently unknown in fact.

Interval: Core 16 through bottom of Core 21.

Correlation: lower Aptian (based on orbitolinids).

Fauna: Planktonics.

None.

Fauna: Benthonics.

Gaudryina sp., ?*Arenobulimina* sp.

Preservation is very poor. It is not possible to be sure that test composition is agglutinated.

Taxonomic Comments

Globotruncana arca (Cushman) of these samples shows considerable variation (Plate 4, Figures 1-9). In spiral aspect its chambers are distinctively petaloid and typically number seven or eight in the last whorl. These properties persist and serve to unite the variants. The peripheral carinae vary from two widely spaced ones (Plate 4, Figure 2), to two closely set or touching ones (Plate 4, Figures 5-7), to a solitary keel. I have prepared no thin sections, but presume the last variant would show two keels on earlier chambers. The variation provokes some comments.

Forms with closely set keels and cameral properties like the second variant mentioned above resemble *Globotruncana falsostuarti* Sigal. However, Dr. Sigal has examined examples that I sent to him and has reported that they are unrelated to *G. falsostuarti* and are variants of *G. arca* only (personal communication). van Hinte (1963) has reported a similar form under the nomen of *G. rosetta* (Carsey), although that assignment seems questionable for both his species and this one.

Postuma (1971, p. 36) has mentioned the possibility of synonymy for *G. rosetta* and *G. leupoldi*, as has Caron (1972, p. 554), but the latter noted that there are differences in range and biconvexity. To this can be added difference in spiral shape of chambers. I do not think that these variants with closely appressed keels can be synonymous with *G. leupoldi* or *G. rosetta*, but they may be synonymous with *G. falsostuarti*. They accompany typical forms of *G. arca* throughout these samples.

Bucherina sandidgei Bronnimann and Brown? varies from forms with moderate spiral flattening and only obtuse angulation of spiral periphery to forms with pronounced spiral flattening and ill-defined discontinuous keel. In the first of these the height of the spire is quite variable but is overshadowed by axial elongation of chambers (Plate 5, Figures 1, 2). This variant is scarcely distinguishable from *Rugoglobigerina rotundata* Bronnimann. The second extreme of variation falls short of *B. sandidgei* in its evolution of carina (Plate 5, Figures 3, 4) and has a ventral umbilical covering of tegillae on many well-preserved specimens. The pitch of coiling varies erratically in all forms, especially in the last whorl. Both variants occur in the same sample and many specimens are intermediate between the two. There is no difference in stratigraphic distribution.

Many specimens of *Globotruncana elevata* (Brotzen) show a faint second peripheral keel, particularly in the area of junction of ventral and dorsal cameral sutures (Plate 5, Figures 9, 10). Specimens with and without the second keel are indistinguishable otherwise and both occur together in varying mixture throughout the Maestrichtian sequence. This faint carination would seem to correspond to that implied by Bronnimann and Brown's report (1955, p. 545, pl. 21, fig. 11-13) on the holotype of *G. rosetta* (Carsey), but the species has been interpreted more broadly (e.g., Pessagno, 1967, p. 352). My material from the type locality of *G. rosetta* (*vide*, Plummer, 1931, p. 196) contains forms identical to those figured by Plummer (1926, pl. 2, fig. 9a-c; 1931, pl. 13, fig. 11a-c), and they are unicarinate. Possibly the holotype bears two fused keels of slight distinction. In any event, the nature of *G. rosetta* and its relation to other species, particularly *G. elevata*, is very confusing to me and I prefer to avoid its use.

I could not separate *Globotruncanella havanensis* (Voorwijk) and *G. petaloidea* (Gandolfi). There are individual specimens of seeming identity with the holotypes of both, but there are so many intermediates and such patternless occurrence of variation that I was unable to employ any reliable basis for distinction.

SITE 385

Coring procedure, poor recovery, and complexity of stratigraphy complicate understanding of the top of the Cretaceous at this site. The bottom of the recovery of Core 11, namely Sample 11-2, 148-150 cm, contains a mixture of basal Danian (P.1) and upper Maestrichtian (*Abathomphalus mayaroensis* Zone) forms. We learned from Site 384, in which the Cretaceous-Tertiary contact was cored and recovered, that bioturbation carried Cretaceous material into the Tertiary. The fauna of Sample 11-2, 148-150 cm is richer in Danian than Maestrichtian specimens, although both are abundant. The Maestrichtian specimens appear abraded. For these reasons, it is concluded that the bottom of recovery of Core 11 penetrated a bioturbated zone above the Cretaceous-Tertiary contact.

Core 12 recovered only 2.15 meters of reddish brown to greenish gray clay, which yielded uncommon, small hyaline benthics and small agglutinates. The drilling time record gave some suggestion that the core recovery was from the lower part of the cored interval and that the upper part of the cored interval was foraminifer-nannofossil chalk of the fauna foretold by the Cretaceous contaminants of the bottom of Core 11. Core 12 was followed by an uncored interval of 9.6 meters.

Cores 13, 14, and 15 were alternated with preceding uncored intervals of about 10 meters. With one exception mentioned below, the recovery was varicolored red, green, and gray, often banded clays. In these, foraminifers are uncommon to rare, and the fauna consists of primitive agglutinated species, such as those of *Hormosina, Glomospira*, and *Bathysiphon*, and rare hyaline forms.

The exception to these conditions is a sample, 13-3, 25-27 cm, taken from a light gray, thin layer. This sample yielded a planktonic fauna of the upper Maestrichtian, *Abathomphalus mayaroensis* Zone. The occurrence of this fauna well below anything like it, at a level which is an approximate multiple of drill pipe length below the top of the Cretaceous, suggests that it is redrilled cavings from uphole. Nannoplankton do not support this possibility and it must be considered unlikely. However, if Sample 13-3, 25-27 cm, is accepted at face value, its correlation with the upper Maestrichtian must follow.

Below Core 15, Section 1, 83 cm, the pastel clays give way to chocolate brown to dark gray clays with an increasing volcanogenic component. These become decreasingly fossiliferous and the fauna is composed solely of tiny agglutinated forms of little calcareous cement, such as those described by Krasheninnikov (1973, 1975). In short, the foraminifers of Site 385 are of two kinds. The first is an upper Maestrichtian assemblage, known indirectly from fillings in the basal Paleocene, and from one questionable sample. The second is a peculiar assemblage of agglutinates (Krasheninnikov, 1973, 1975) from the variegated clays.

Maestrichtian Fauna

Correlation: upper Maestrichtian, *Abathomphalus mayaroensis* Zone (Bolli, 1957, p. 54).

Contributory samples: 11-2, 148-150 cm; 13-3, 25-27 cm.

Fauna: Planktonics.

Abathomphalus mayaroensis Bolli, *Globotruncana arca* (Cushman), *G. contusa* (Cushman), *G. elevata* (Brotzen), *G. gansseri* Bolli, *G. lapparenti* Brotzen, *G. stuarti* (de Lapparen), *G. stuartiformis* Dalbiez, *Globotruncanella petaloidea* (Gandolfi), *Gublerina robusta* de Klasz, *Planoglobulina acervulinoides* (Egger), *Pseudoguembelina costulata* (Cushman), *Pseudotextularia deformis* (Kikoine)?, *P. elegans* (Rzehak), *Racemiguembelina fructicosa* (Egger), *Rugoglobigerina hexacamerata* Bronnimann, *R. milamensis* Smith and Pessagno, *R. rotundata* Bronnimann, *Ventilabrella multicamerata* de Klasz.

Fauna: Benthonics.

Aragonia trinitatensis (Cushman and Jarvis), *A. velascoensis* (Cushman), *Bifarina hispidula* (Cushman)?, *Bolivinopsis grzybowski* Frizzel, *Bulimina* sp., *Gaudryina carinata* Franke, *G. monmouthensis* Olsson, *Globulina prisca* Reuss, *Marssonella* sp., *Nodosarella sp., Nuttallinella florealis* (White), *Reussella szajnochae* (Grzybowski), *Semivulvulina* dentata (Alth).

Agglutinated Fauna

Correlation: none.

Contributory samples: 12-1, 96-98 cm; 12-2, 09-11 cm; 14-1, 59-61 cm; 14-1, 106-108 cm; 14-3, 84-86 cm; 14, CC; 15, CC.

Fauna: Planktonics.

None

Fauna: Benthonics.

Ammodiscus asperellus Krasheninnikov, *A. cretaceus* (Reuss), *Aragonia trinitatensis* (Cushman and Jarvis), *Bulimina navarroensis* Cushman and Parker, *Fissurini orbignyana* (Sequenza), *Glomospira charoides* (Jones and Parker), *G. corona* Cushman and Jarvis, *Glomospirella gaultina* (Berthelin), *Haplophragmoides decussatus* Krasheninnikov, *H. fraudentulus* Krasheninnikov, *H. menitens* Krasheninnikov, *H. pervagatus* Krasheninnikov, *Hormosina ovulum* (Grzybowski), ?*Hyperammina gaultina* (Dam), *Labrospira pacifica* Krasheninnikov, *Lenticulina velascoensis* White, *Marssonella oxycona* (Reuss)?, *Nodellum velascoense* (Cushman), *Nodosaria sceptrum* Reuss, *Paratrochamminoides vitreus* Krasheninnikov, *Pilulina antiqua* Krasheninnikov, *Placetina cf. P. conversa* (Grzybowski), *Praecystammina globigerinaeformis* Krasheninnikov, *Pseudobolivina cuneata* Krasheninnikov, *P. munda* Krasheninnikov, *Pseudoclavulina amorpha* (Cushman), *Semivulvulina dentata* (Alth), *Siphogeneroides brevispinosa* Cushman, *Spiroplectammina mexiaensis* Lalicker, *Trochammina gyroidinaeformis* Krasheninnikov, *T. insueta* Krasheninnikov, *Uvigerinammina jankoi* Majzon, *Verneuilina cretacea* Karrer.

SITE 386

Site 386 is a deep bore and core recovery was good, but neither the Cenozoic nor the Mesozoic yielded much foraminiferal material.

The Upper Cretaceous is composed of pastel clays and claystones which are barren or contain small faunules of tiny hyaline or agglutinated benthics. Beneath these are dark, greenish gray to black claystones, often with laminae and thin layers of light gray chalk and radiolarian calcarenite. Beginning with Core 47 and continuing through Core 57, many of these layers contain good planktonic assemblages and some benthics. Samples 59-2, 50-51 cm, and 59-4, 52-54 cm, yielded a few globigeriniform planktonics, but none were recovered from Core 58 or from below Core 59. The occurrence of specimens in this interval, Cores 47-57, is rather erratic and the preservation is fair to poor.

The fauna is a classic one of the upper Albian into lower Cenomanian (Gandolfi, 1942). The more important, persistent, and dominant forms are presented in the distribution chart (Table 4). These, the additional planktonics, and the benthics are listed below. Although this interval includes several foraminiferal biozones, only the one faunal list is offered. Study of the fauna is not complete and several desirable illustrations are not available, but it is hoped that these deficiencies may be corrected in a subsequent report.

Interval: Cores 47 through 57.

Correlation: upper Albian into lower Cenomanian.

Fauna: Planktonics.

Globigerinelloides asperus (Ehrenberg), *G. caseyi* (Bolli, Loeblich and Tappan), *Hedbergella amabilis* Loeblich and Tappan, *H. delrioensis* (Carsey), *H. infracretacea* (Glaessner), *H. libyca* Barr, *H. planispira* (Tappan), *H. simplicissima* Magne and Sigal?, *H. trochoidea* (Gandolfi), *Planomalina buxtorfi* (Gandolfi), *Praeglobotruncana delrioensis* (Plummer)?, *P. stephani* (Gandolfi), *Rotalipora apenninica* (Renz), *R. evoluta* Sigal?, *Schackoina cenomana* (Schacko), *S.* sp., *Thalmanninella subticinensis* (Gandolfi), *T. ticinensis* (Gandolfi), *Ticinella breggiensis* (Gandolfi), *T. praeticinensis* Sigal, *T. primula* (Premoli Silva and Luterbacher), *T. roberti* (Gandolfi).

Fauna: Benthonics.

Arenobulimina dorbignyi (Reuss), *Dentalina cf. D. guttifera* d'Orbigny, *D. soluta* Reuss, *Dorothia ouachensis* (Sigal)?, *Guadryina carinata* Franke?, *G. dividens* Grabert?, *Osangularia cheniourensis* (Sigal), *Pleurostomella obtusa* Berthelin, *P. subnodosa* (Reuss), *Pseudoclavulina gaultina* (Morozova)?, *P.* sp., *Textularia roemeri* Lalicker.

The frequency of questioned assignments reflects small size, poor preservation, and scarcity of specimens.

Taxonomic Comments

The lineage of *Ticinella roberti, T. praeticinensis, Thalmanninella subticinensis*, and *T. ticinensis* appears to be confirmed by specimens of this interval (Plate 1, Figures 1-12). They illustrate each species and its morphological distinctions. However, many specimens are intermediate between species and are only arbitrarily assignable. Consequently, the appearances and extinctions of these species cannot be determined precisely with reliability and their ranges shown in Table 4 must be viewed with this in mind.

It was found that *T. praeticinensis* can be separated from *T. roberti* more easily by its spiro-umbilical compression and consequently somewhat obtuse peripheral outline of chambers than by ornamentation (Plate 1, Figure 5). Also the passage from advanced *Thalmanninella subticinensis* with incipient keel on the final chambers to pronouncedly carinate forms is abrupt. Lightly although definitely keeled specimens, such as the holotype (*vide* Caron and Luterbacher, 1969, pl. 8, fig. 6a-c), are few. Toward the end of the range of *T. ticinensis* some specimens show broadening of the umbilicus and shift of accessory apertures from the umbilicus out upon the sutures.

The validity and status of *Thalmanninella* is a question of long standing. The logic of Sigal's (1948) definition is appealing to me despite fear of difficulty in application. I can apply *Thalmanninella* to the material of these samples and think it is more informative to do so.

The specimens assigned to *Rotalipora evoluta* Sigal? appear to have arisen from *R. apenninica* (*vide* Caron and Luterbacher, 1969) by vaulting of ventral surfaces of chambers. This produces an angulate umbilical shoulder and, typically, an umbilical carina, which is more persistent and pronounced upon early chambers of the last whorl. The chambers become more pyramidal, the sutural depressions shallower and narrower, and the test thicker. The dorsal properties vary gradually and erratically and are unreliable for separation from *R. apenninica.* Change proceeds from forms that resemble *R. apenninica* in dorsal aspect but differ ventrally to forms of reduced chamber number and extremity of all properties (Plate 2, Figure 6).

This species is assigned to *R. evoluta* Sigal with question. The holotype of *R. evoluta* (Sigal, 1948, pl. 1, fig. 3a-c) is a thin form of close proximity to *R. apenninica*, as has been noted (e.g., Reichel, 1950, p. 605, footnote 9; Luterbacher and Premoli Silva, 1962, p. 268). It appears to differ from the latter (Sigal, 1948, p. 100) by uncoiling and lobulation, but these properties vary so much that the basis for separation is of questionable validity. The paratype (*idem*, pl. 2, fig. 2a-b) appears to have an angulate, carinate, umbilical shoulder, ventrally vaulted chambers, and a relatively thick test (from fig. 2a; peripheral view not included). Also it has only five rapidly expanding chambers.

The specimens of this study resemble the paratype in ventral properties, and the younger, more evolved ones are very similar to it (Plate 2, Figure 6). The taxonomic problem arises from the possible synonymy of the holotype and *R. apenninica* and its possible lack of consanguinity with the paratype. The latter appears to be a separate species in the material of this study. I believe that it is the form reported from America (Loeblich and Tappan, 1961, p. 294, pl. 7, fig. 1-4; Pessagno, 1967, pl. 53, fig 6-8) as *R. evoluta* Sigal.

Hedbergella libyca Barr varies considerably in ornamentation. The most distinctive variant extreme bears elongate ridges of more or less meridional arrangement (Plate 3, Figures 1, 2). These lose their arrangement and prominence, giving way to random rugosities, which become spinose. It is interesting that this species occurs here as Barr reported it from Libya, namely common but restricted to the lower part of the *R. apenninica* Zone *s.l.*

Spinosity is common on other forms. Hedbergellids of *H. delrioensis* or *H. amabilis* properties are very spinose and of questionable assignment (Plate 3, Figures 7-11).

Praeglobotruncana stephani (Gandolfi) (Plate 2, Figures 7-10) is typically quite spinose. In addition, it varies considerably in chamber number, arrangement, and lobulation. Some specimens have barely five chambers, which are unusually lobulate for this species.

Accessory apertures are not detectable on most ticinellids. The distribution of *T. primula* is quite uncertain because of this and because of its variation in other properties.

There is also guesswork in recognition of *H. trochoidea* because of obscured umbilical regions and its general resemblance to *T. roberti* and to deformed specimens of *T. breggiensis.*

Two similar schackoinids occur rarely in these samples. Both have elongate, bottle-shaped chambers with parallel sides and elongate tubulospines, which are crushed and broken away. *Schackoina* sp. has five chambers in the final whorl, and in some specimens the two or three initial chambers of the last whorl appear to have no spines. However, the chambers are very elongate; those with spines are of the *S. cenomana* form, and four of the final five chambers are arranged in the fashion of a cross, at positions approximately 90° apart. This species resembles an extreme variant of *Schackoina pentagonalis aperta* Reichel (1948, p. 396, fig. 2g). Luterbacher and Premoli Silva (1962, p. 268, pl. 22, fig. A3 and A4) have reported that *S. pentagonalis aperta* is a clavihedbergellinid with ampullate termina on its chambers. There is a difference in chamber shape between *Schackoina* sp. and all citations of *S. pentagonalis* or *S. pentagonalis aperta* except the one mentioned above. *Schackoina* sp. seems to differ from *S. cenomana*, with which it occurs in Core 51, only in number of chambers. Consequently, it seems that this form must ultimately be included in *S. cenomana* or defined as new.

Schackoina cenomana (Schacko) has been interpreted in two ways. Reichel (1948, p. 400) considered it to be a form with two or more tubulospines on some chambers, and he recognized subspecies according to the number of multispinose chambers and arrangement of spines. Forms with one spine per chamber were defined as *S. gandolfi.*

On the other hand, *S. cenomana* is often considered to be a form with four bottle-shaped chambers that are arranged in a cross and bear one tubulospine each (e.g., Loeblich and Tappan, 1961; Pessagno, 1967; Eicher and Worstell, 1970). According to this view, *S. gandolfi* is a junior synonym of *S. cenomana.*

Reichel's revision of the genus is orderly and taxonomically appealing, but Eicher and Worstell's observations (*idem*, p. 298, pl. 9, fig. 2, 4) provide a solution to Reichel's interpretation of Schacko's types, namely that the polyspinosity of chambers which Reichel reported is a result of a tubulospine from an early chamber projecting through the periphery of a later, enveloping chamber, giving an appearance of two spines on the later chamber.

Schackoines are so uncommon in these samples that their stratigraphic value is impaired. However, it is interesting to note that *Schackoina* sp. precedes *S. cenomana*, and that *S. cenomana* appears at a horizon which may be correlated with the Vraconian-Cenomanian boundary.

Pseudoclavulina gaultina tricarinata Neagu is a distinctive form of promising stratigraphic value. It appears to be synonymous with the species that Gandolfi assigned to *P. eggeri* (Cushman) in text and to *Clavulina parisiensis* (d'Orbigny) in illustrations (1942, p. 43; pl. 11, fig. 5-6; pl. 12, fig. 3-4). Presumably it is the form that Klaus reported from the Gruyere syncline (1960a, p. 764, 766, 777, 780) and from Breggia (1960b, p. 289) as *P.* cf. *eggeri.* More recently it has been reported from the Indian Ocean under the nomen of *P. gabonica* Le Calvez, de Klasz and Brun (Scheibnerova, 1975, p. 722, pl. 2, fig. 5-8), from the northwest Pacific as *P. gaultina* (Morozova) (Luterbacher, 1975, p. 706, pl. 3, fig. 15), and from the southwest Pacific as *Pseudoclavulina* sp. 2 (McNulty, 1976, p. 371, 373, pl. 2, fig. 3, 4). The range is Albian and part of the Cenomanian.

Correlation and Foraminiferal Zones

In order to simplify the information of Table 4, the ranges of the more important planktonic species are presented in Figure 3.

From this range chart it is evident that two horizons of marked faunal change occur. One of these is located at the horizon of Core 51, Section 3, and another is located at Core 53, Section 2. The interval between these appears to be equivalent to the Vraconian. The upper boundary corresponds well with the Vraconian-Cenomanian boundary; but the lower horizon may not represent the base of the Vraconian because the base has been associated with the appearance of *Planomalina buxtorfi* (Gandolfi) (van Hinte, 1976, p. 508, fig. 8), which occurs at Core 54, Section 3, in these samples.

Also it appears that other horizons may be of significance, notably that at Core 55, Section 1, near which *Ticinella roberti* (Gandolfi) and *T. praeticinensis* Sigal disappear and *Thalmanninella subticinensis* (Gandolfi) gives rise to *T. ticinensis* (Gandolfi).

The ranges reveal interesting foraminiferal biozones, which are listed below.

Thalmanninella ticinensis Zone: This biozone is defined by the appearance of *T. ticinensis s.l.* (including both *T. ticinensis* and *T. subticinensis*) at its base and the appearance of *P. buxtorfi* at its top. This is similar to the *Rotalipora ticinensis* Zone of Bolli (1957, p. 53, fig. 10). The horizon of Core 55, Section 1, that is mentioned above, occurs within this zone.

Planomalina buxtorfi Zone: This zone is defined by the appearance of *P. buxtorfi* at the base and by the appearance of *R. apenninica* at the top. The upper horizon is marked by the appearance of *H. libyca* and *P. stephani* also. It is equivalent to the *R. ticinensis-P. buxtorfi* Zone of van Hinte (1976, p. 508, fig. 8).

Rotalipora apenninica Zone: This zone is defined by the appearance of *R. apenninica* at the base and by *R. evoluta*? at the top. The upper boundary is also marked by the extinction of *P. buxtorfi* and *H. libyca* and the appearance of *S. cenomana.* This horizon correlates with the Vraconian-Cenomanian boundary. The zone is the same as van Hinte's (1976) *P. buxtorfi-R. apenninica* Zone and correlates with the upper Vraconian. The *R. apenninica* Zone was defined (Bolli, 1957, p. 53, fig. 10) by the total range of *R. apenninica s.l.*, but subsequently restricted (Bolli, 1959, chart 1) to the upper part of that range. With clarification of *R. apenninica* (Renz) and the proposal of other rotaliporine zones (e.g., *R. cushmani-greenhornensis* Subzone, Pessagno, 1969, p. 8), it has been redefined (e.g., Barr, 1972, p. 4, text-fig. 2; van Hinte, 1976).

It appears that an additional zone is likely. It would be defined at the base by the appearance of *R. evoluta*? and *S. cenomana* and the extinction of *P. buxtorfi* and *H. libyca.* The top would be defined by the appearance of *R. cushmani-greenhornensis.* I judge *R. evoluta*? to be the same as Pessagno's *R. evoluta* Sigal and his *R. evoluta* Zone (1969, p. 8) to be correlative with this speculative one.

SITE 387

Although a considerable succession of Cretaceous was drilled at this site, foraminifers are very rare. Most samples from the Upper Cretaceous marly chalk (Unit 4B) yield no residue at all, and those from the Lower Cretaceous limestones provide fragments of barren, recrystallized limestone. A very few samples from the intervening red, greenish gray to black claystones contain scarce, tiny agglutinates such as have been mentioned as occurring in the claystones of other sites, such as Site 385, and have been described so well by Krasheninnikov (1973, 1975).

Samples of the core catcher were examined routinely and many others as well, but only 24 were collected and only four of these yielded a few poorly preserved forams.

From the Maestrichtian (correlated by nannofossils), Samples 27, CC and 28-1, 107-109 cm yielded a few specimens of: *Bolivina* ssp., *Bulimina quadrata* Plummer?, *Globigerinelloides multispina* (Lalicker) *Guembelitrea cretacea* Cushman, *Heterohelix pulchra* (Brotzen), *Heterohelix* ssp., *Stilostomella plummerae* (Cushman), *Tappanina costifera* (Cushman). Each of the foregoing species is represented by one to three tiny specimens.

From the underlying red clays (Unit 4C) one sample, 29-4, 36-37 cm, yielded a few tiny agglutinates like those of samples from similar rock of previous sites (e.g., Site 385): *Hormosina* sp., *Haplophragmoides cf. H. menitens* Krasheninnikov, *Labrospira inflata* Krasheninnikov, *Plectina cf. P. conversa* (Grzybowski), *Pseudobolivina munda* Krasheninnikov, *P. lagenaria* Krasheninnikov, *Uvigerinammina* sp.

Again the species are represented by one or two tiny specimens.

From the top of the Barremian limestones (Unit 6) Samples 38, CC and 39-1, 122-124 cm yielded: *Hedbergella* ssp. (tiny, recrystallized), fragmentary lagenids (*Lenticulina, Marginulina, Nodosaria, Vaginulina, Ramulina* and *Lagena*), *Neobulimina* sp., *Gavelinella* sp. These limestones are well indurated and even the softer layers yielded only crystalline debris devoid of recognizable foraminifers.

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PLATE 1

Figures 1-3 — *Ticinella roberti* (Gandolfi). 200×, from Sample 386, 56-4, 77-79 cm.

Figures 4-6 — *Ticinella praetincinensis* Sigal. 200×, from Sample 386, 57-2, 128-130 cm.

Figures 7-9 — *Thalmanninella subtincinensis* (Gandolfi). 200×. from Sample 386, 55, CC. The chambers of Fig. 7 and Fig. 9 are angulate but are quite inflated; the keel of Fig. 8 extends over only the first chambers, diminishing into pustules.

Figures 10-12 — *Thalmanninella ticinensis* (Gandolfi). 150× from Sample 386, 53-1, 6-7 cm. An advanced variant.

(See Pg. 500)

PLATE 2

Figures 1-3 — *Rotalipora apenninica* (Renz).
1. 125×, from Sample 386, 52-6, 58-60 cm.
2. 125×, from Sample 386, 52-6, 58-60 cm.
3. 150×, from Sample 386, 52-6, 58-60 cm.

Figures 4-6 — *Rotalipora evoluta* Sigal?
4. 125×, from Sample 386, 50-1, 90-91 cm.
5. 150×, from Sample 386, 50-1, 90-91 cm.
6. 125×, from Sample 386, 50-1, 90-91 cm.

Figures 7-10 — *Praeglobotruncana stephani* (Gandolfi). 150×, from Sample 386, 50-1, 90-91 cm.

Figures 11-12 — *Tincinella breggiensis* (Gandolfi). 150×, from Sample 386, 55, CC.

(See Pg. 501)

PLATE 3

Figures 1-6 — *Hedbergella libyca* Barr.
1. 175× from Sample 386, 51-6, 77-79 cm.
2. 600×, from Sample 386, 51-6, 77-79 cm.
3. 175×, from Sample 386, 51-6, 77-79 cm.
4. 200×, from Sample 386, 51-6, 77-79 cm.
5. 150×, from Sample 386, 52-4, 26-28 cm.
6. 300×, from Sample 386, 52-4, 26-28 cm.

Figures 7-8 — *Hedbergella* sp.

7. 175×, from Sample 386, 51-4, 107-108 cm.
8. 200×, from Sample 386, 53-1, 6-7 cm.

Figures 9-11 — *Hedbergella amabilis* (Loeblich and Tappan).

9. 200‖, from Sample 386, 53-1, 6-7 cm.
10. 200×, from Sample 386, 49-1, 144-145 cm.
11. 200×, from Sample 386, 53-1, 6-7 cm.

Figure 12 — *Pseudoclavulina gaultina tricarinata* Neagu, 125×, from Sample 386, 50-2, 142-144 cm.

(See Pg. 502)

PLATE 1

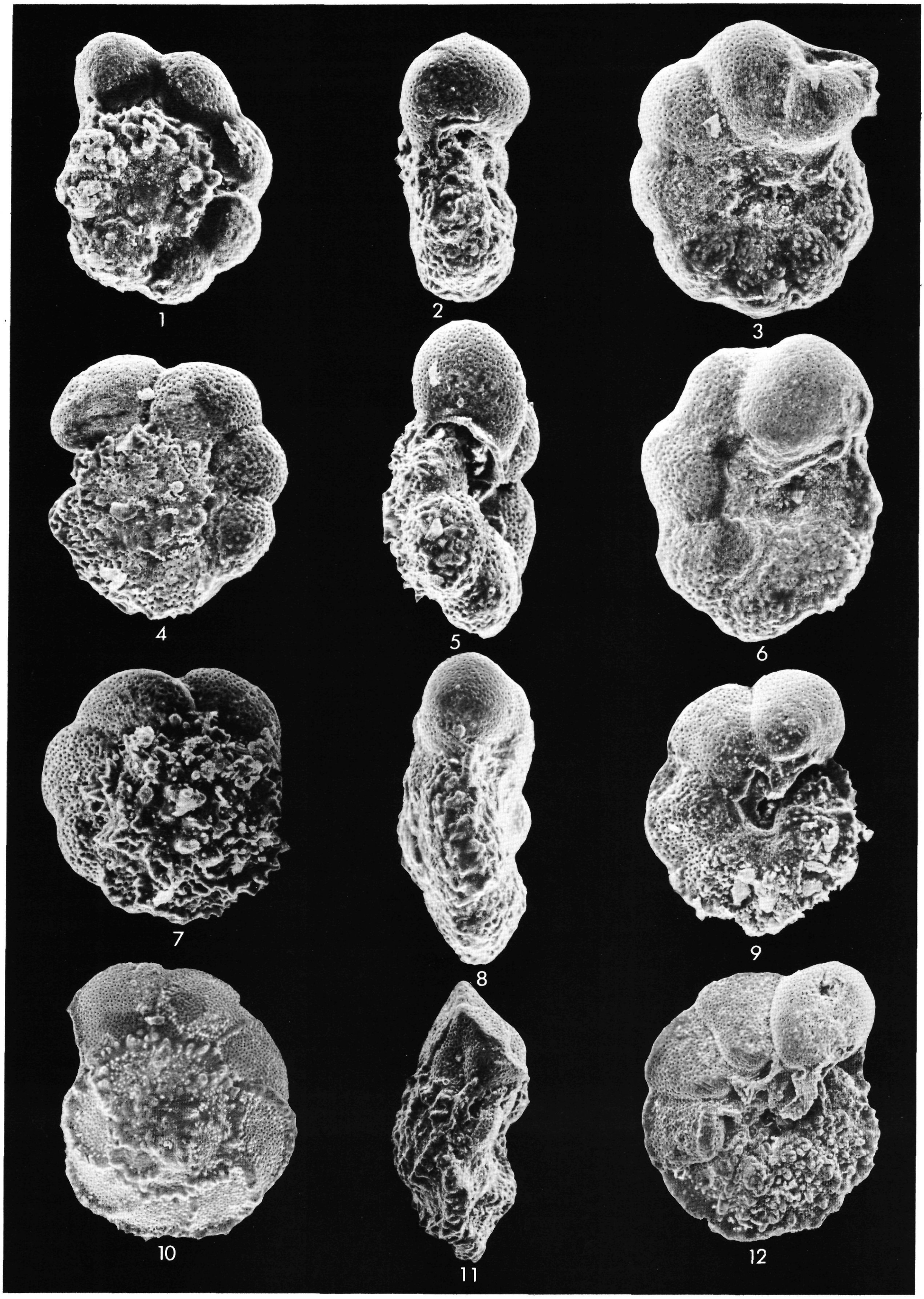

PLATE 2

PLATE 3

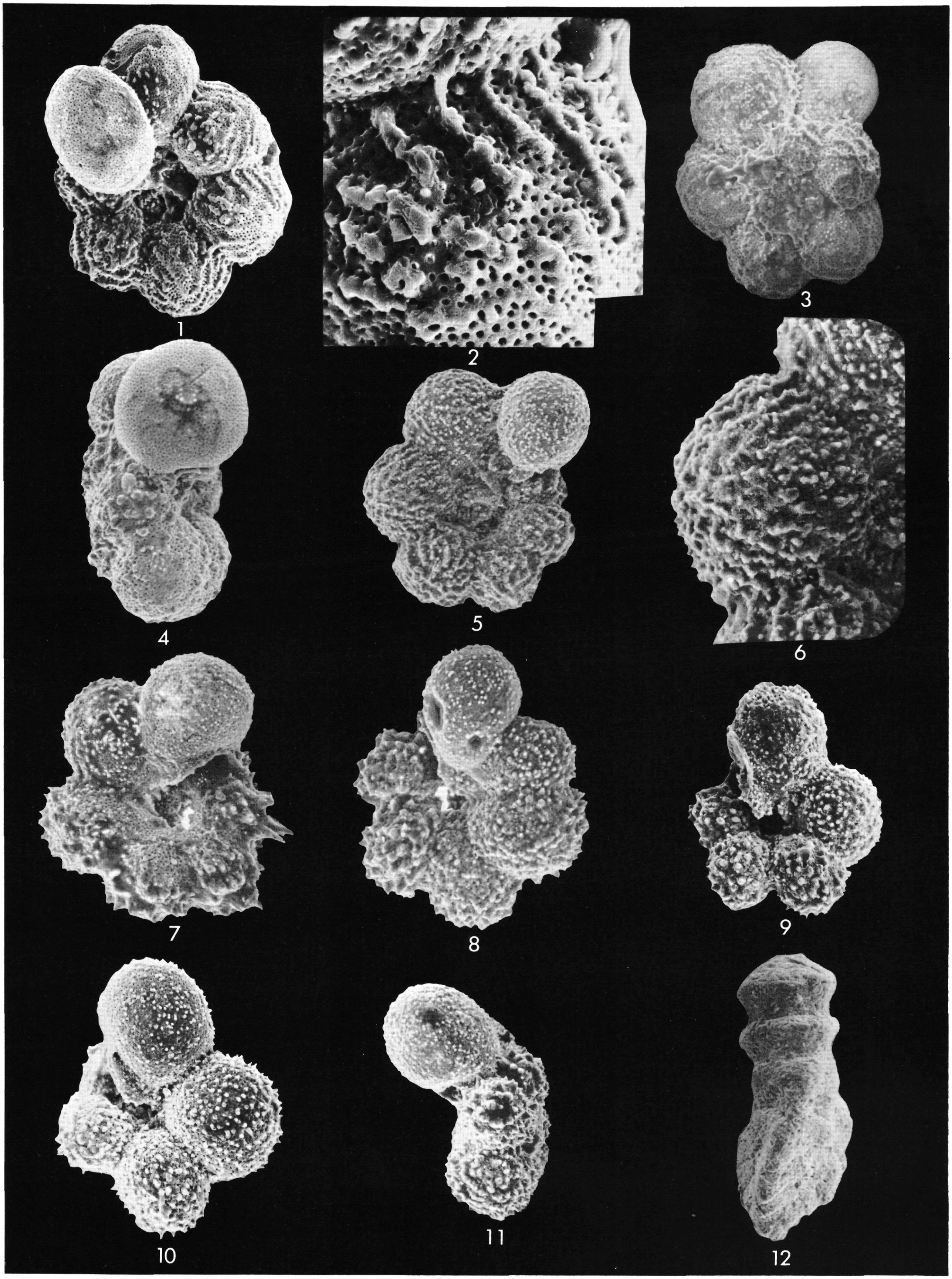

PLATE 4

Figures 1-9 — *Globotruncana arca* (Cushman).
1. 100×, from Sample 384, 14-3, 58-60 cm.
2,3. 100×, from Sample 384, 15, CC.
4. 100×, from Sample 384, 14-3, 58-60 cm.
5. 100×, from Sample 384, 14-4, 50-52 cm.
6-9. 100×, from Sample 384, 14-3, 58-60 cm.

Figures 4-6 resemble *Globotruncana falsotuarti* Sigal. Figures 7-9 are similar to *Globotruncana stuarti* (de Lapparent), except for cameral shape. All specimens have cameral properties illustrated by Figure 1.

Figures 10-12 — *Globotruncana stuarti* (de Lapparent). 100×, from Sample 384, 14-3, 58-60 cm.

(See Pg. 504)

PLATE 5

Figures 1-5 — *Bucherina sandidgei* Bronnimann and Brown?.
1,2. 150×, from Sample 384, 14-3, 58-60 cm; peripherally angulate but unkeeled.
3,4. 150×, from Sample 384, 14-1, 120-122 cm.
5. 150×, from Sample 384, 14-3, 58-60 cm.

Figures 6-8 — *Globotruncana witwackae* El-Naggar?. 100×. from Sample 384, 15-4, 60-62 cm.

Figures 9-10 — *Globotruncana elevata* (Brozten). 100×, from Sample 384, 14-3, 58-60 cm.

Figures 11,12 — *Globotruncanella intermedia* (Bollii). 125×, from Sample 384, 14, CC.

(See Pg. 505)

PLATE 4

PLATE 5