

~~APPENDIX to be placed in Microfiche at GSA~~

M.S. II G-10792 **TITLE:** No evidence for Cretaceous-Tertiary boundary-age deep water deposits in the Caribbean and Gulf of Mexico

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APPENDIX includes:

Figure 1. Site 540 foraminiferal abundance data

Figure 2. Foraminiferal assemblages showing dissolution effects.

Figure 3. Biostratigraphy of DSDP Site 153.

Figure 4. Graphic correlation showing (in-) completeness of Site 536 across the K/T boundary and comparison with El Kef (K-T boundary stratotype), Mimbral and Cuba.

Tables 1a, 1b. Percent abundance data of planktic foraminifera at DSDP Site 536.

Table 2. Percent abundance data of planktic foraminifera at DSDP Site 540.

Table 3. Percent abundance data of planktic foraminifera at DSDP Site 95.

DISCUSSION: Nannofossil investigation by James Pospichal.

DSDP SITE 540

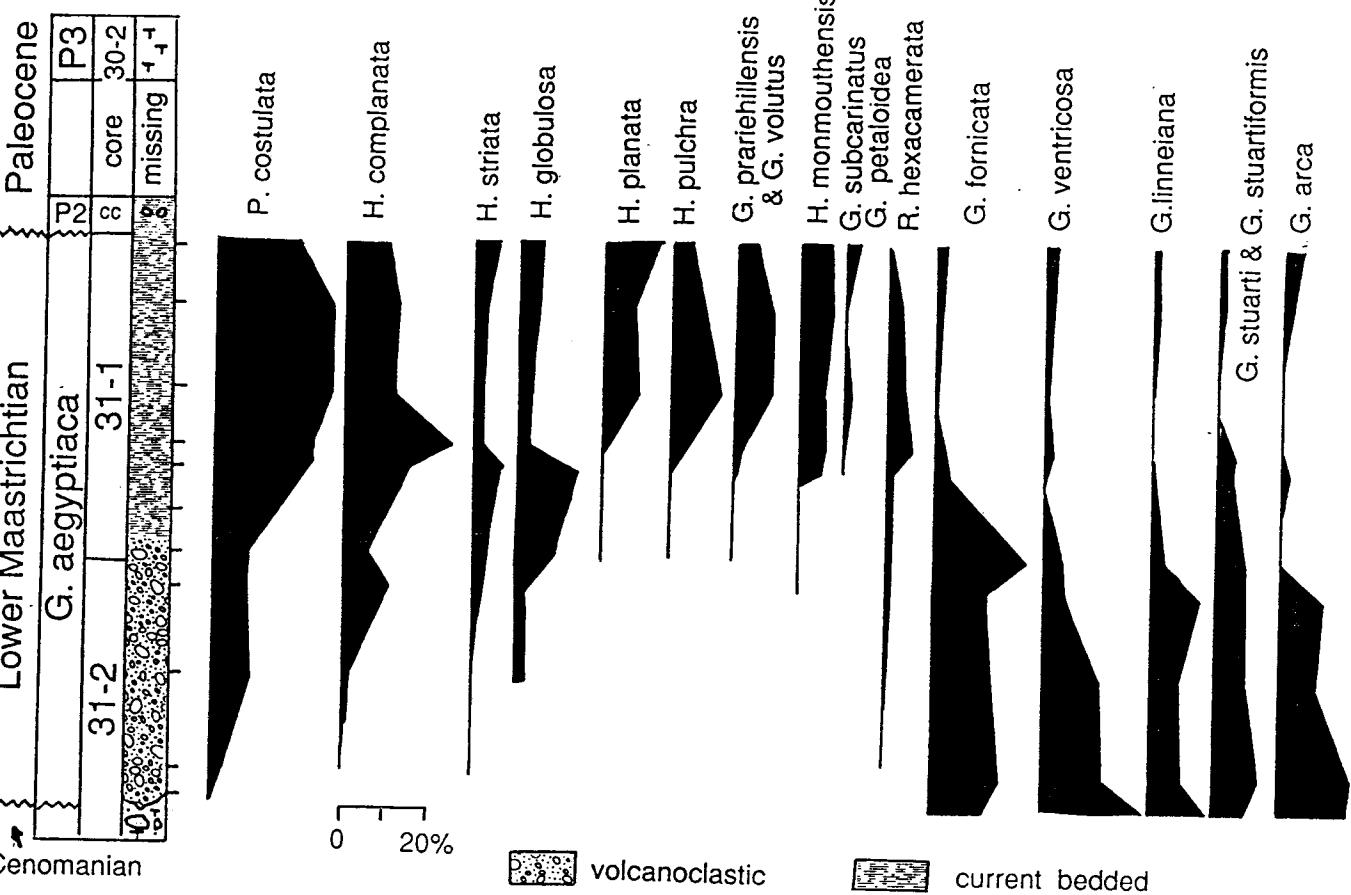


Figure 1. Relative percent abundances of Upper Lower Cretaceous planktic foraminifera in DSDP Site 540, cores 31-1 and 31-2 which directly underlie sediments of Tertiary Zone P2 age. Note, the relative abundance change between core-sections 1 and 2 is due increased carbonate dissolution in the volcanoclastic sediments. This results in increased abundance of dissolution-resistant taxa (globotruncanids).

DSDP Site 540

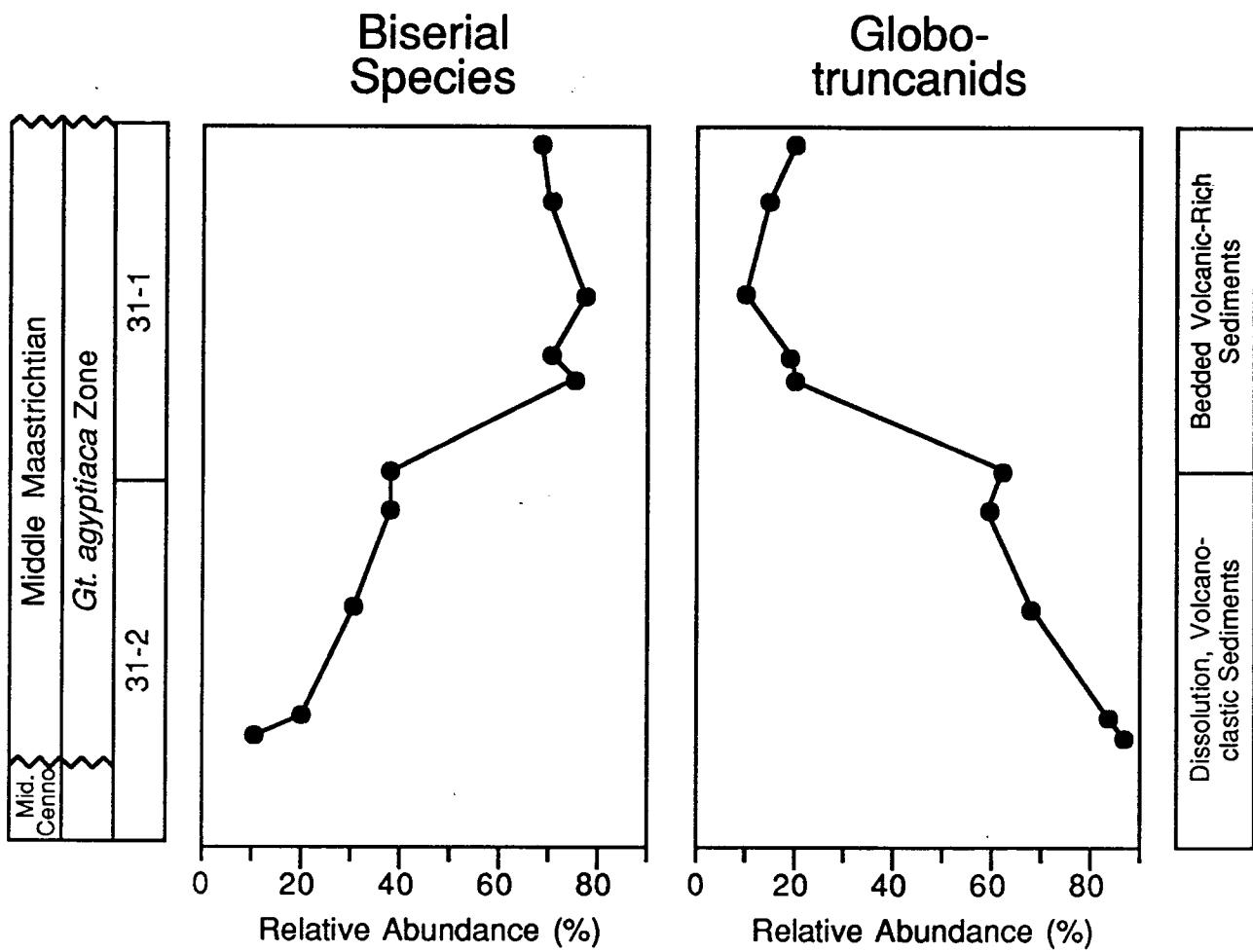


Figure 2

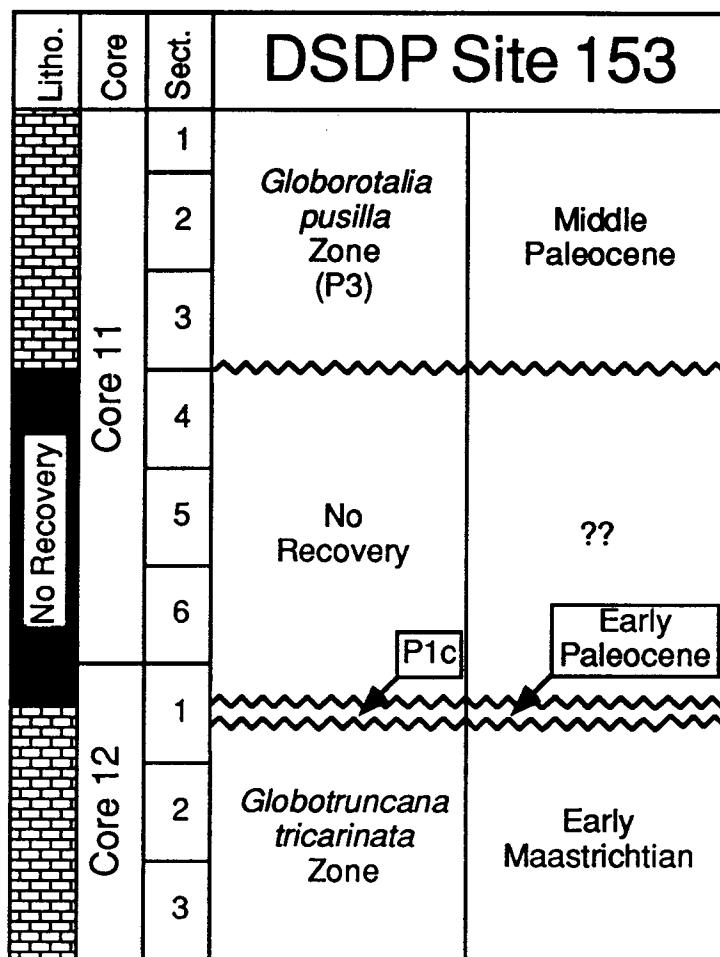


Figure 3

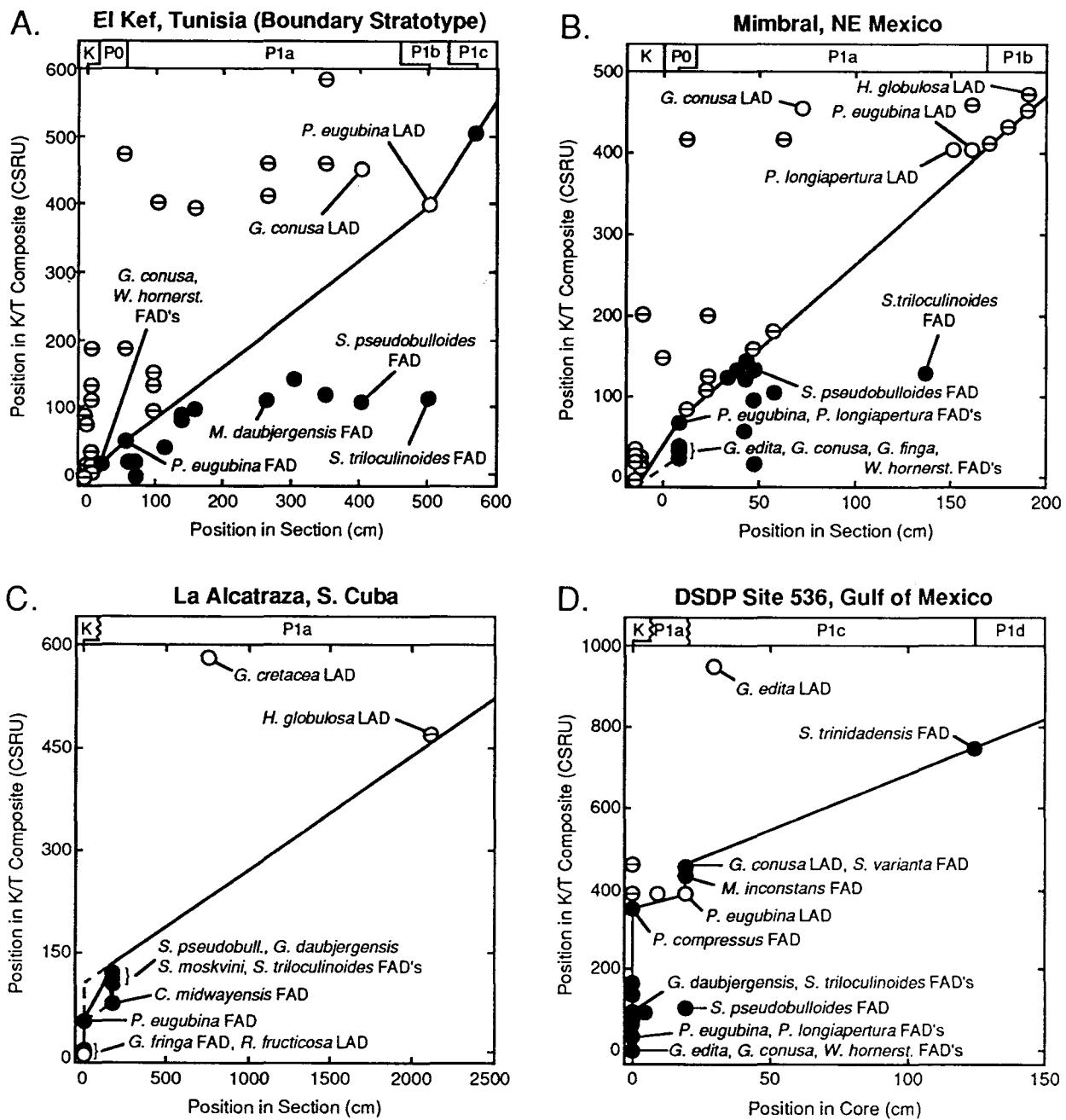


Figure 34

Figure 3. Graphic correlations with K/T composite sections. A: El Kef, Tunisia, B: Mimbral NE Mexico, C: La Alcatraza, Cuba, D: DSDP Site 536. O = last appearance datum of Tertiary taxa, Θ = last appearance datum of Cretaceous survivor taxa, • = first appearance datum. Solid line of correlation represents the interpretation most consistent with biostratigraphic information. Lines of correlation: inclined = interval of net sediment accumulation, vertical = lithological position (X axis) and relative temporal duration (Y axis) of depositional hiatus. CSRU = composite reference units of MacLeod and Keller (1991a,b). Biostratigraphic zonation above each plot is that of Keller (1988, 1989).

Table 1a. Relative percent abundance of planktic foraminifera species
at DSDP Site 536, Early Paleocene. x = < 1%

Core-section cm-interval	9-3 100	9-3 126	9-3 145	9-4 15	9-4 35	9-4 55	9-4 75	9-4 96	9-4 115	9-4 145	9-4 10	9-5 20	9-5 30	9-5 40	9-5 50	9-5 60	9-5 70	9-5 77
<i>Chiloguembelina crinita</i>	x			x					x			x						
<i>Chiloguembelina midwayensis</i>	2	2	4	7	8	3	8	8	5	4	5	5	5	6	3	x	4	x
<i>Chiloguembelina taurica</i>		1	2	4	3	1	4	4	5	2	x	2	4	1	1	5		
<i>Chiloguembelina waiparaensis</i>	18	34	23	12	16	21	18	13	34	20	20	30	17	24	23	5	5	x
<i>Woodringina claytonensis</i>		2	2	2	2	3	2	2	4	4	7	7	5	6	5	4	x	
<i>Woodringina hornerstownensis</i>	x	5	14	18	14	17	7	16	12	10	15	3	12	10	15	10	2	2
<i>Eoglobigerina danica</i>																2		x
<i>Eoglobigerina edita</i>														x	x	5	4	6
<i>Eoglobigerina eobuloides</i>								x					x		4	2	x	
<i>Eoglobigerina iodina</i>												1		x	10	10	3	
<i>Eoglobigerina fringa</i>															9	2	5	
<i>Eoglobigerina trivialis</i>	x	1	1	x	x		1	x	x	x	x	1	1	x	x	x	x	
<i>Globanomalina pentagona</i>	1	3	2	4	5	5	6	7	6	6	x	6	4	4	4	5	6	4
<i>Globanomalina taurica</i>											1		x				1	
<i>Globanomalina tetragona</i>				x											x	x		
<i>Globanomalina polycamera</i>	2	x	x	x	1	1		x	x	1			x	x	x		4	3
<i>Globoconusa conusa</i>																	x	x
<i>Globoconusa daubjergensis</i>	x	1	x	x	x	x	x	x	1		1	x	x	x	x	x	3	7
<i>Guembelitria cretacea</i>		2		2	4	2	2	7		2	14	1	5	5	4	3	3	2
<i>Guembelitria irregularis</i>	1		4	5	3	3	3	x	6	27	2	x	2	2	x	x	2	
<i>Guembelitria trifolia</i>				x	x		x	x		x	1	2	2	x				
<i>Igorina spiralis</i>	x	x		1	x		x											
<i>Morozovella inconstans</i>	7	8	15	8	6	4	7	6	3	7	x	2	2	2	2	3		
<i>Morozovella trinidadensis</i>	1	1	1	1	1	1	1	1										
<i>Murciglobigerina aquiensis</i>	x																	
<i>Murciglobigerina chascanona</i>	x		2	x	x	x	x	x	x	1		x		x				
<i>Parvularugoglobigerina eugubina</i>															23	15	15	
<i>P. eugubina-taurica trans.</i>												2	x	8	4			
<i>Parvularugoglobigerina longiapertura</i>															3	27	40	
<i>Planorotalites compressus</i>	46	22	20	20	18	22	25	14	14	12	3	10	10	7	7	2	7	5
<i>Subbotina moskvini</i>	1	x	1	x	1	3	1	2	1	4	3	2	5	4	6	1		
<i>Subbotina pseudobuloides</i>	6	9	7	6	8	8	8	9	6	16	1	18	22	14	14			
<i>Subbotina triloculinoides</i>	3	1	x	2	3	x	2	x	x		x	2	1	1	x	x		
<i>Subbotina varianta</i>	5	3	2	4			1	1	x	3		2	x	x				
<i>Subbotina triangularis</i>	2	x	x	x	1	1	x	x							x	x	x	
<i>Pseudoguembelina costulata</i>														x	x	x		
<i>Heterohelix complanata</i>													x		x		x	
<i>Heterohelix globulosa</i>												x		x	x	x		
Total No. specimens counted	477	594	595	364	416	416	457	456	432	475	418	443	416	528	449	531	612	333

Table 1b. Relative percent abundances of planktic foraminiferal species at DSDP Site 536, Late Cretaceous. x = <1%

Core-section cm-interval	9-5 80	9-5 90	9-5 100	9-5 110	9-5 120	9-5 140	few poorly preserved foraminifera, abundant volcanic shards, pyrite sphalerite and radiolaria
<i>Globotruncana egyptiaca</i>	2	x	x		x		
<i>Globotruncana arca</i>	3	2	x	x	x		
<i>Globotruncana bulloides</i>			x		x		
<i>Globotruncana duwi</i>	x						
<i>Globotruncana esnehensis</i>	x						
<i>Globotruncana falsostuarti</i>		x	2	x	4		
<i>Globotruncana linneiana</i>	7	5	4	4	7		
<i>Globotruncana orientalis</i>	x	x	x		3		
<i>Globotruncana rosetta</i>	x						
<i>Globotruncana ventricosa</i>	x	x	x				
<i>Globotruncanita conica</i>					x		
<i>Globotruncanita pettersi</i>	x				x		
<i>Globotruncanita stuarti</i>	x	x	x	x	x		
<i>Globotruncanita stuartiformis</i>		x	x	x	x		
<i>Rosita fornicata</i>	x	2	x	x	x		
<i>Rosita patelliformis</i>	2	x	x				
<i>Rosita plummerae</i>							
<i>Gansserina cf. gansseri</i>							
<i>Globigerinelloides aspera</i>	7	9	7	6	3		
<i>Globigerinelloides rosebudensis</i>			x	x	x		
<i>Globigerinelloides subcarinatus</i>	2	4	3	2	x		
<i>Globigerinelloides volutus</i>	x						
<i>Globotruncanella petaloidea</i>	2	x	x		4		
<i>Hedbergella holmdelensis</i>	x	x	2		x		
<i>Hedbergella monmouthensis</i>	6	3	4	x	x		
<i>Heterohelix complanata</i>	4	4	11	12	9		
<i>Heterohelix dentata</i>	x	x	x	x	x		
<i>Heterohelix glabrans</i>	x	x	x	x			
<i>Heterohelix globulosa</i>	10	3	6	4	4		
<i>Heterohelix navarroensis</i>	x	x	x	2	x		
<i>Heterohelix planata</i>			2	2	3		
<i>Heterohelix striata</i>	x	x	x	2	5		
<i>Planoglobulina carseyae</i>	x	x					
<i>Pseudoguembelina costulata</i>	35	45	33	45	32		
<i>Pseudoguembelina excolata</i>	x	x	x	x	4		
<i>Pseudoguembelina kempensis</i>	3	3	2	5	2		
<i>Pseudoguembelina pulpebra</i>	x	x	x	x	x		
<i>Pseudoguembelina punctulata</i>	x	x			x		
<i>Pseudotextularia deformis</i>			x				
<i>Pseudotextularia elegans</i>	x	x	x	x	x		
<i>Gublerina robusta</i>					x		
<i>Racemiguembelina fructicosa</i>	x						
<i>Racemiguembelina powelli</i>		x					
<i>Rugoglobigerina hexacamerata</i>	4	5	6	4	5		
<i>Rugoglobigerina rugosa</i>	2	x	x	x	x		
<i>Rugoglobigerina scotti</i>	x		x	x	x		
<i>Ventriabellla mannelensis</i>	x						
<i>Ventriabellla multicamerata</i>	x						
Total No. of specimens counted	216	273	274	237	240		

Table 2. Planktic foraminiferal species and number of specimens present in 5 cm centimeters of sediment per sample at DSDP Site 540, Late Cretaceous.
Preservation is poor with strong dissolution in predominantly volcanic sediments.

Core-section cm-interval	31-1 8	31-1 30	31-1 70	31-1 95	31-1 105	31-1 125	31-1 145	31-2 10	31-2 50	31-2 95	31-2 105
<i>Globotruncana egyptiaca</i>			4	1				3			
<i>Globotruncana arca</i>	1	6		3	3	1	10	11			6
<i>Globotruncana bulloides</i>	3	5	6				5	8	5		
<i>Globotruncana falsostuarti</i>	2	6	3	3	12		13	5	8	1	7
<i>Globotruncana linneiana</i>	4	4			4		4	12	10	3	6
<i>Globotruncana orientalis</i>	7			2			2	1	7	7	2
<i>Globotruncana rosetta</i>									1	1	1
<i>Globotruncana ventricosa</i>			1		1		7		3	5	
<i>Globotruncanita angulata</i>	2								2	1	
<i>Globotruncanita conica</i>											
<i>Globotruncanita stuarti</i>	1	3			2		6				
<i>Globotruncanita stuartiformis</i>	2	1		3			2	7	6	4	3
<i>Rosita fornicata</i>	3	4	1	2	3	1	26	6	15	2	4
<i>Rosita patelliformis</i>	4	1			5		1	8	5	5	1
<i>Rosita plummerae</i>					1		2		11		
<i>Gansserina cf. gansseri</i>	1										2
<i>Gansserina wiedenmayeri</i>											
<i>Globigerinelloides aspera</i>	7	13	9	1	4		1				
<i>Globigerinelloides subcarinatus</i>		2	3								
<i>Globigerinelloides volutus</i>	2	6	14	1	1						
<i>Globotruncanella petaloidea</i>	6		2		2			1			
<i>Hedbergella monmouthensis</i>	2	13	10	1	8			1			
<i>Hedbergella holmdelensis</i>	9	4	3	1	2						
<i>Heterohelix complanata</i>	18	29	29	20	28		9	12	3	1	
<i>Heterohelix dentata</i>	9		2		1						
<i>Heterohelix glabrans</i>	10	15	29	1	1		3				
<i>Heterohelix globulosa</i>	10	9	8	5	26		12	3	5		
<i>Heterohelix navarroensis</i>	3	3	19	1	3						
<i>Heterohelix planata</i>	25	13	22		1		2				
<i>Heterohelix pseudotessera</i>			1								
<i>Heterohelix striata</i>	8	7	4	2	11		5	4	2	1	
<i>Planoglobulina carseyae</i>		1									
<i>Pseudoguembelina costulata</i>	38	61	70	17	41	1	11	8	10	2	1
<i>Pseudoguembelina excolata</i>		2	1		1			1	2		
<i>Pseudoguembelina kempensis</i>				2	6			1			
<i>Pseudoguembelina pulpebra</i>		2	1	1	3		3	1	5	1	3
<i>Pseudotextularia deformis</i>					3			4	4		
<i>Pseudotextularia elegans</i>	1	3	1	1	5		3	6	3	3	
<i>Gublerina robusta</i>	1	1		1							
<i>Rugoglobigerina hexacamerata</i>	2	8	10	5	5		4	3	3	1	
<i>Rugoglobigerina rugosa</i>				1	1		1		1	2	1
<i>Ventrilabella multicamerata</i>							1				
<i>Archeoglobigerina blowi</i>								2	3	2	
Total No. of specimens counted	182	224	255	75	184	3	132	106	111	42	35

Table 3. Relative percent abundance of planktic Foraminifera at DSDP Site 95, Paleocene. x = < 1%

Core-section cm-interval	13-1 80	13-1 111	13-1 128	13-1 141	13-2 3	13-2 15	13-2 23
Chiloguembelina midwayensis	x						x
Chiloguembelina waiparaensis	x	4					
Woodringina claytoensis	8	8			2	2	x
Woodringina hornerstownensis	17	27			70	77	77
Eoglobigerina danica					13	12	9
Eoglobigerina edita							
Eoglobigerina eobulloides	2					x	x
Eoglobigerina fodina							
Eoglobigerina simplicissima	3	x			x	x	x
Globanomalina pentagona	x				x	x	
Globanomalina taurica	x				x		x
G. eugubina-taurica trans.		x				x	
Globoconusa conusa	x	x			x		x
Globoconusa daubjergensis	x						
Guembelitria cretacea	45	39			x	3	x
Guembelitria danica	6	2			x	x	x
Guembelitria irregularis	8	9					
Guembelitria trifolia	4	x					
Parvularugoglob. eugubina					5	x	8
P. longiapertura							x
Planorotalites compressus	x	x			x		
Subbotina moskvini		x					
Subbotina pseudobulloidies	x	x			x		x
Subbotina triloculinoides	x						
Pseudoguembelina costulata	x						
Globigerinelloides aspera		x			x	x	
Total No. specimens counted	386	278	dissol.	dissol.	323	307	
Zone	P1c	P1c	Hiatus	Hiatus	P1a	P1a	P1a

Also examined: 12-4, 72 cm, 12-4, 144 cm, 13-1, 63 cm, Danian assemblage Zone P1c.

13-2, 106 cm, dissolution, mostly benthics present. 13-3, 100 cm, Middle Maastrichtian

G. aegyptiaca Zone (*G. conica*, *G. arca*, *G. stuarti*, *G. stuartiformis*, *R. formicata*,

G. ventricosa, *G. linneiana*, *G. havanensis*, *H. carinata*, *V. multicamerata*,

G. aspera, *Gublerina robusta*, *H. dentata*, *P. elegans*.)

Nannofossil investigation by James Pospichal

Nannofossils may suggest a younger upper Maastrichtian age, although they also indicate that the latest Maastrichtian is missing. Calcareous nannoplankton in the Maastrichtian sediments of Sites 536 and 540 are poorly preserved with calcite overgrowths complicating positive identification of species. Nevertheless, reexamination of the Maastrichtian interval of Site 536 (core 9-5, 90-140 cm) by James Pospichal indicates the presence of rare *Micula prinsii* in sample 9-5, 90 cm and few to common *M. murus* and common *Lithaphridites quadratus* in the 50 cm interval below (J. Pospichal, 1993, written commun.). Rare to few reworked lower Maastrichtian and Campanian species are also present. Preservation in Tertiary samples and the topmost Maastrichtian sample (9-5, 80 cm) at Site 536 is too poor for positive identification.

Micula prinsii, the uppermost Maastrichtian index taxon (*M. prinsii* Zone), is short ranging and morphologically intergrades with ancestral *M. murus* (the index taxon of the preceding zone). Since the Site 536 *M. prinsii* populations are confined to one sample near the top of the Maastrichtian sediments and resemble early transitional morphotypes, this suggests that at least the top of the Maastrichtian is missing. At Site 540 (cores 31-1 to 31-2), *M. murus* and *L. quadratus* are also present, but no *M. prinsii* were found. This suggest that this interval is older than Site 536 (9-5, 90-140 cm) and no younger than the *M. murus* Zone.

The age discrepancy between the foraminiferal and nannofossil biostratigraphies may be largely due to the poor nannofossil preservation and carbonate dissolution. Despite this discrepancy, however, both microfossil groups indicate that at least the uppermost Maastrichtian (*M. prinsii* Zone in Site 540) is missing. Alvarez et al.'s (1992) claim that the depositional age of the Maastrichtian sediments of Sites 536 and 540 "cannot be distinguished from the age of the K-T boundary" (p. 698) is, therefore, incorrect.