

3. MID-CRETACEOUS PLANKTONIC FORAMINIFERS FROM BLAKE NOSE: REVISED BIOSTRATIGRAPHIC FRAMEWORK¹

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ABSTRACT

During Ocean Drilling Program Leg 171B, an Aptian to Turonian sedimentary succession yielding exceptionally well-preserved planktonic foraminiferal faunas was recovered at Sites 1049, 1050, and 1052. Most of the standard Tethyan planktonic foraminiferal zones have been recognized within the mid-Cretaceous section, with the exception of two Albian zones not reached by any of the drilled holes. In addition, some emphasis is brought here on the current problems concerning the definition of the Aptian/Albian and Albian/Cenomanian boundaries.

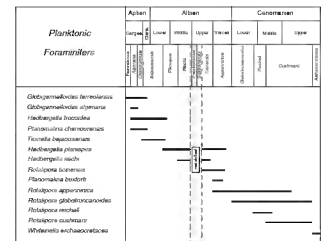
INTRODUCTION

This paper summarizes the biostratigraphic results of an extensive shore-based study of the planktonic foraminiferal assemblages from a detailed sampling of the mid-Cretaceous beds drilled during Ocean Drilling Program Leg 171B. Based on this revision, a zonal framework slightly different from that used during the cruise (Norris et al., 1998) is proposed (Figure F1).

MATERIALS AND METHODS

Two hundred fourteen samples were examined in the Cenomanian to Aptian interval: 46 from Site 1049, 75 from Site 1050, and 93 from Site 1052.

F1. Stratigraphic ranges of age diagnostic planktonic foraminifers, p. 5.



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Foraminifers from unlithified ooze were soaked in a 3% solution of hydrogen peroxide with a small amount of Calgon added, warmed on a hot plate, and then washed with tap water over a 63- μ m sieve. Semilithified ooze and chalk were first partially fragmented by hand and then soaked in hydrogen peroxide and Calgon before washing.

BIOSTRATIGRAPHIC FRAMEWORK

The zonal scheme initially established for the Tethyan area on the basis of well-calibrated Lower Cretaceous stratotypic and Vocontian sections in southeast France (Moullade, 1966, 1974) permitted refinement in the subdivision of the pelagic "upper Aptian" beds cored at Site 1049 (Tables T1, T2, T3). Four successive zones are now precisely identified: the *Globigerinelloides ferreolensis* Interval Zone, the *Globigerinelloides algeriana* Total Range Zone and the *Planomalina cheniourensis* Interval Zone, corresponding to the middle and upper part of the Gargasian (upper Aptian) substage, and the *Ticinella bejaouaensis* Interval Zone (pro parte), corresponding to the Clansayesian (latest Aptian) substage.

During the Second International Symposium on Cretaceous Stage Boundaries held in Brussels (8–16 September 1995), the Albian Working Group identified in the Vocontian area a possible G-S-S-P (global boundary stratotype section and point) for the lower boundary of the Albian Stage. The selected section, offering a wide range of paleontological features that could be used to define the boundary, is located at "Col de Pré-Guittard" (west of La Motte-Chalancon, Drôme, southeast France). However, in this section placement of the Aptian/Albian boundary is not yet precisely known (Hart et al., 1996). Therefore, the proposition of Moullade (1966), based on a precise upper Clansayesian/lowermost Albian ammonite calibration throughout the entire Vocontian realm, is still retained here despite the reservations of Bréhéret et al. (1986). As far as foraminifers are concerned, the Aptian/Albian boundary is thus placed within the *T. bejaouaensis* Zone. Due to the lack of any significant planktonic foraminiferal first occurrence within this interval, the "lower Albian" part of this zone (defining the Aptian/Albian boundary by its base) is indicated by the first occurrence of *Pleurostomella subnodosa* (Moullade, 1966; Sigal, 1977; Hart et al., 1996), a worldwide and easily identifiable benthic foraminifer.

The *Hedbergella planispira* Interval Zone and the *Hedbergella rischi* Interval Zone (pro parte) correspond to the "middle Albian." The morphologic transition from *H. rischi* to *Ticinella primula* does not occur in the Site 1049 material but was observed in Holes 1050C and 1052E (Tables T4, T5) within the *Rotalipora ticinensis* Interval Zone. The oldest Albian samples of Sites 1050 and 1052 yield *R. ticinensis*, suggesting that the recovered Leg 171 "upper Albian" is not complete; the lower part of the upper Albian was not reached, since the *Ticinella praeticinensis* and *Rotalipora subticinensis* Interval Zones are not found in these holes.

The first occurrence of *Rotalipora appenninica* coincides with that of *Planomalina buxtorfi* in Hole 1052E. According to Parize et al. (1998), the lower boundary of the Vraconian (= uppermost Albian) substage must be now placed at the first occurrence of *R. subticinensis*, and not at that of *R. appenninica* as formerly proposed by Moullade (1966). *Biticinella breggiensis*, generally not used as a zonal marker since it is not regularly represented in these upper Albian/lower Vraconian levels, is relatively common in Hole 1050C, ranging through the *R. ticinensis* and the base of *R. appenninica* Interval Zones.

T1. Occurrence of Lower Cretaceous foraminifers, Hole 1049A, p. 6.

T2. Occurrence of Lower Cretaceous foraminifers, Hole 1049B, p. 7.

T3. Occurrence of Lower Cretaceous foraminifers, Hole 1049C, p. 8.

T4. Occurrence of Cretaceous foraminifers (below the *Helvetoglobbruncana helvetica* Zone), Hole 1050C, p. 9.

T5. Occurrence of Lower Cretaceous foraminifers, Hole 1052E, p. 11.

All the Cenomanian zones defined in the Tethyan Realm are represented in Hole 1050C: the *Rotalipora globotruncanoides* Interval Zone ("lower Cenomanian"), the *Rotalipora reicheli* Interval Zone ("middle Cenomanian," pro parte), the *Rotalipora cushmani* Total Range Zone ("middle" to "upper Cenomanian") and the *Whiteinella archaeocretacea* Interval Zone, pro parte ("uppermost Cenomanian").

At the Brussels Symposium (1995) a new proposal recommended that the lower boundary of the Cenomanian Stage should be defined by the first appearance of the planktonic foraminifer *Rotalipora globotruncanoides*. Some problems still remain concerning the taxonomic definition of this species which is in the process of revision. In addition, it is necessary to better calibrate this bio-event with the ammonite biostratigraphy. On the basis of an integrated study of a section at "Mont Risou" (near Rosans/Moydans, Drôme, southeast France) (= "Col de Palluel" section in Moullade, 1966), proposed as a G-S-S-P, the following planktonic foraminifer bioevents—straddling the boundary—can be recognized (Gale et al., 1996): the simultaneous first appearance of *Rotalipora gandolfii* and *Rotalipora tehamahensis* (= our *R. aff. globotruncanoides*; Tables T4, T5), the last appearance of *R. ticinensis*, and the first appearance of *R. globotruncanoides*.

Such a succession of bioevents has been determined in Hole 1050C, but has not been determined exactly in Hole 1052E, in which the overlap between *R. ticinensis* and *R. gandolfii* was not observed.

The Cenomanian/Turonian boundary occurs only at Site 1050. Planktonic foraminifer abundance changes and stable isotopic geochemistry for this interval are reported in Huber et al. (1999).

CONCLUSION

The five Ocean Drilling Program Leg 171B holes (1049A, 1049B, 1049C, 1050C, and 1052E) in which mid-Cretaceous sediments were recovered allowed us to study in detail a continuous (with the exception of two zones in the Albian) planktonic foraminiferal succession from the upper Aptian to the uppermost Cenomanian. The generally excellent preservation of the material permitted the recognition of most of the standard bioevents already defined in the Tethyan Realm within the upper Aptian, Albian, and Cenomanian stages.

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Table T1. Occurrence of Lower Cretaceous foraminifers, Hole 1049A.

Core, section, interval (cm)	Depth (mbsf)	Preservation	<i>Praehedbergella infracretacea</i>	<i>Hedbergella trocoidea</i>	<i>Hedbergella planispira</i>	<i>Hedbergella rischi</i>	<i>Globigerinelloides aptiensis</i>	<i>Globigerinelloides ferreolensis</i>	<i>Globigerinelloides algeriana</i>	<i>Planomalina cheniourensis</i>	<i>Ticinella bejaouaensis</i>	Zones
171B-1049A-												
19X-1, 67-71	144.57	M	R	R	R							<i>Rischi</i>
19X-2, 68-72	146.08	M	F	R	F							
19X-3, 57-61	147.47	M	F	R								
19X-4, 64-68	149.04	M	F	F	R							
19X-5, 42-46	150.32	G	F	F								
19X-CC, 35-38	150.93	VG	A	F	A							
20X-1, 53-58	154.03	M	F	R	R							
20X-2, 6-11	155.06	M	F	F	R							
20X-3, 102-106	157.52	M	R	R								
20X-4, 128-133	159.28	VG	F	A	R				F		<i>Planispira</i>	
20X-5, 68-73	160.18	VG	F	A					F			
20X-6, 7-12	160.57	VG	F	A					F		<i>Bejaouaensis</i>	
20X-CC, 33-36	161.49	G	F	C					R			
21X-1, 65-69	166.75	G	C	C			R		R			<i>Cheniourensis</i>
21X-2, 65-69	165.25	M	C	C			F		F			
21X-3, 65-69	166.75	M	C	R		R		F				
21X-CC, 49-51	167.70	M	C	F		R		F				<i>Algeriana</i>
22X-1, 60-63	173.30	M	F	C		R		R				
22X-CC, 20-25	174.01	P	R									?

Notes: Preservation: M = moderate, G = good, VG = very good. Abundance: R = rare, F = few, C = common, A = abundant. Boxes around abundance entries define zone indexes.

Table T2. Occurrence of Lower Cretaceous foraminifers, Hole 1049B.

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Praehedbergella cf. sigali</i>	<i>Hedbergella maslakovae</i>	<i>Praehedbergella infracretacea</i>	<i>Hedbergella trocoidea</i>	<i>Hedbergella planispira</i>	<i>Hedbergella rischi</i>	<i>Blowiella</i> sp.	<i>Globigerinelloides aptiensis</i>	<i>Globigerinelloides ferreolensis</i>	<i>Globigerinelloides algeriana</i>	<i>Planomalina cheniourensis</i>	<i>Ticinella bejaouaensis</i>	Zones
171B-1049B-															
11X-1, 27-29	137.97	G		F			R	R							<i>Rischi</i>
11X-1, 112-114	138.82	G		F			R	F							
11X-2, 7-9	139.27	G		F				C							
11X-CC, 33-36	140.08	G		R	A		R								<i>Planispira</i>
12X-1, 17-19	147.47	G		R	F							R	R		<i>Bejaouaensis</i>
12X-2, 17-19	148.96	M		F	R					F	F				<i>Cheniourensis</i>
12X-3, 17-19	150.47	M		F	F					R	F	R			<i>Algeriana</i>
12X-4, 17-19	151.97	G		F	F					F	C	C			
12X-4, 62-64	152.42	M		F	F					R	F	R			
12X-5, 33-36	153.13	G		F	R					C	C	F			<i>Ferreolensis</i>
12X-CC, 16-18	153.66	P	F	F				R	R	R					

Notes: Preservation: P = poor, M = moderate, G = good. Abundance: R = rare, F = few, C = common, A = abundant. Boxes around abundance entries define zone indexes.

Table T3. Occurrence of Lower Cretaceous foraminifers, Hole 1049C.

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Præhedbergella infracretacea</i>	<i>Hedbergella trocoidea</i>	<i>Hedbergella planispira</i>	<i>Hedbergella rischi</i>	<i>Globigerinelloides aptiensis</i>	<i>Globigerinelloides ferreolensis</i>	<i>Globigerinelloides algeriana</i>	<i>Planomalina cheniourensis</i>	<i>Ticinnella bejaouaensis</i>	Zones
171B-1049C-												
11X-3, 17-19	132.87	G	F		R	R						<i>Rischi</i>
11X-4, 17-19	133.87	M	F		R	F						
11X-CC, 30-31	134.53	VG	A		R	F						
12X-1, 17-19	139.47	G	F		R	R						
12X-2, 17-19	140.97	P	R		R	R						
12X-3, 17-19	142.47	P	R		R	R						
12X-4, 17-19	143.97	M	F		R	R						
12X-5, 17-19	145.47	M	F	F	R				F		<i>Planispira</i>	
12X-6, 16-18	146.96	G	F	A					F		<i>Bejaouaensis</i>	
12X-6, 104-106	147.84	G	F	A					C			
12X-CC, 18-19	148.28	VG	F	A			R			C		
13X-1, 17-19	149.87	G	A	A			R		R		<i>Cheniourensis</i>	
13X-2, 17-19	150.57	VG	A	F			R		C			
13X-3, 17-19	152.87	M	F	F			F		R			
13X-CC, 48-49	153.28	M	F	R			R	F	F		<i>Algeriana</i>	

Notes: Preservation: P = poor, M = moderate, G = good, VG = very good.
 Abundance: R = rare, F = few, C = common, A = abundant. Boxes around abundance entries define zone indexes.

Table T4. Occurrence of Cretaceous foraminifers (below the Helvetica Zone), Hole 1050C. (See table note. Continued on next page.)

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Hedbergella planispira</i>	<i>Hedbergella delrioensis</i>	<i>Hedbergella simplex</i>	<i>Hedbergella rischi</i>	<i>Costellagerina libyca</i>	<i>Alanlordella benionensis</i>	<i>Planomalina praebuxtorffi</i>	<i>Planomalina buxtorffi</i>	<i>Schackoia aff. cenomana</i>	<i>Schackoia cenomana</i>	<i>Hedbergella almadensis</i>	<i>Ticinella praeticinensis</i>	<i>Ticinella primula</i>	<i>Biticinella breggiensis</i>	<i>Rotalipora subticinensis</i>	<i>Rotalipora ticinensis</i>	<i>Rotalipora appenninica</i>	<i>Rotalipora gandolfii</i>	<i>Rotalipora aff. globotruncanoides</i>	<i>Rotalipora globotruncanoides</i>	<i>Rotalipora montsalvensis</i>	<i>Rotalipora reicheli</i>	<i>Rotalipora deeckeii</i>	<i>Rotalipora greenhornensis</i>	<i>Rotalipora cushmani</i>	<i>Praeglobotruncana delrioensis</i>	<i>Praeglobotruncana stephani</i>	<i>Praeglobotruncana gibba</i>	<i>Whiteinella baltica</i>	<i>Whiteinella paradubia</i>	<i>Whiteinella archaeocretacea</i>	<i>Whiteinella praehelvetica</i>	<i>Dicarinella algeriana</i>	<i>Dicarinella imbricata</i>	<i>Dicarinella hagni</i>	<i>Heterohelix moremani</i>	<i>Guembelitra cenomana</i>	Zones				
171B-1050C-																																												
21R-1, 5-9	500.25	M	R																										R	F	F	F	F	F	C	F	C	R	C		Archaeocretacea			
21R-1, 27-31	500.47	G	R																										R	F	F	F	F	F	C	F	C	F	C					
21R-1, 48-52	500.68	M	R																										R	F	F	F	F	F	C	F	C	R	C					
21R-1, 72-76	500.92	M	R																										R	F	F	F	F	F	C	F	C	R	C					
21R-1, 93-97	501.13	M																											R	F	F	F	F	F	C	F	C	R	C					
21R-1, 110-113	501.30	G																											R	F	F	F	F	F	C	F	C	R	C					
21R-2, 51-55	502.21	G																											R	F	F	F	F	F	C	F	C	R	C					
21R-3, 59-62	503.79	M																											R	F	F	F	F	F	C	F	C	R	C					
21R-4, 36-38	505.06	M	R																										R	F	F	F	F	F	C	F	C	R	C					
21R-5, 47-50	506.67	M	R																									R	F	F	F	F	F	C	F	C	R	C						
21R-6, 21-24	507.91	M	R																									R	F	F	F	F	F	C	F	C	R	C						
21R-7, 0-1	508.30	M	R																									R	F	F	F	F	F	C	F	C	R	C						
21R-CC, 0-1	509.49	M																										R	F	F	F	F	F	C	F	C	R	C						
21R-CC, 30-32	509.80	M	R																									R	F	F	F	F	F	C	F	C	R	C						
22R-1, 4-8	509.84	G	R																									R	F	F	F	F	F	C	F	C	R	C						
22R-1, 50-51	510.30	VG																										R	F	F	F	F	F	C	F	C	R	C						
23R-1, 14-16	519.54	G	F																									R	F	F	F	F	F	C	F	C	R	C						
23R-1, 142-146	520.82	M	R																									R	F	F	F	F	F	C	F	C	R	C						
23R-2, 81-85	521.71	M	R																									R	F	F	F	F	F	C	F	C	R	C						
23R-3, 7-11	522.45	P																										R	F	F	F	F	F	C	F	C	R	C						
23R-3, 125-127	523.65	M	F																									R	F	F	F	F	F	C	F	C	R	C						
23R-4, 75-77	524.75	M	F																									R	F	F	F	F	F	C	F	C	R	C						
23R-5, 68-72	526.08	M	R																									R	F	F	F	F	F	C	F	C	R	C						
23R-6, 35-40	527.25	G	F																									R	F	F	F	F	F	C	F	C	R	C						
23R-7, 32-36	528.72	G	R																									R	F	F	F	F	F	C	F	C	R	C						
23R-CC, 18-21	529.25	VG	R																									R	F	F	F	F	F	C	F	C	R	C						
24R-1, 96-99	530.06	G	R																									R	F	F	F	F	F	C	F	C	R	C						
24R-2, 71-75	531.31	G	R																									R	F	F	F	F	F	C	F	C	R	C						
24R-3, 42-44	531.88	VG	R																									R	F	F	F	F	F	C	F	C	R	C						
24R-3, 69-71	532.15	VG	R	R																								R	F	F	F	F	F	C	F	C	R	C						
25R-1, 145-148	540.15	VG	R	R																								R	F	F	F	F	F	C	F	C	R	C						
25R-2, 40-42	540.60	G	R	R																								R	F	F	F	F	F	C	F	C	R	C						
25R-3, 147-150	543.17	G	R	R																								R	F	F	F	F	F	C	F	C	R	C						
25R-CC, 21-22	544.08	VG	R																									R	F	F	F	F	F	C	F	C	R	C						
26R-1, 56-58	548.96	VG	R																									R	F	F	F	F	F	C	F	C	R	C						
26R-2, 113-115	551.03	G	R																									R	F	F	F	F	F	C	F	C	R	C						
26R-3, 68-73	552.08	G	R	R																								R	F	F	F	F	F	C	F	C	R	C						

Table T4 (continued).

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Hedbergella planispira</i>	<i>Hedbergella delrioensis</i>	<i>Hedbergella simplex</i>	<i>Hedbergella rischi</i>	<i>Costellagerina libyca</i>	<i>Alanlordella bentonensis</i>	<i>Planomalina praebuxtorffi</i>	<i>Planomalina buxtorffi</i>	<i>Schackoina aff. cenomana</i>	<i>Schackoina cenomana</i>	<i>Hedbergella almadenensis</i>	<i>Ticinella praeticinensis</i>	<i>Ticinella primula</i>	<i>Biticinella breggiensis</i>	<i>Rotalipora subticinensis</i>	<i>Rotalipora ticinensis</i>	<i>Rotalipora appenninica</i>	<i>Rotalipora gandolfii</i>	<i>Rotalipora aff. globotruncanoides</i>	<i>Rotalipora globotruncanoides</i>	<i>Rotalipora montsalvensis</i>	<i>Rotalipora reicheli</i>	<i>Rotalipora deeckeii</i>	<i>Rotalipora greenhornensis</i>	<i>Rotalipora cushmani</i>	<i>Praeglobotruncana delrioensis</i>	<i>Praeglobotruncana stephani</i>	<i>Praeglobotruncana gibba</i>	<i>Whiteinella baltica</i>	<i>Whiteinella paradubia</i>	<i>Whiteinella archaeoretacea</i>	<i>Whiteinella praehevetica</i>	<i>Dicarinella algeriana</i>	<i>Dicarinella imbricata</i>	<i>Dicarinella hagni</i>	<i>Heterohelix moremani</i>	<i>Guembelitra cenomana</i>	Zones			
26R-4, 69-73	553.59	G	R	R																																							
26R-5, 39-41	554.79	VG	R	R															F	R	F																						
26R-CC, 12-14	555.60	VG	R																R	R	F																						
27R-1, 69-72	558.69	G	R	C				F	C	R	R		R					F	F		R	R																					
27R-2, 65-69	560.15	G	C	C	R			F					R	R				F	F	R	R																						
27R-3, 129-131	562.29	VG	R	C	R			F	R	R	R		R	R				F	F																								
27R-4, 68-72	563.18	G	R	R	R			F					R	C	R			R	R																								
27R-5, 77-81	564.77	M	R	C	R			F			R		R	F	F			F	R																								
27R-6, 16-19	565.66	VG	R	C	F			C			R		R	R	C			F	F																								
27R-CC, 23-25	567.65	VG	R		R			F					R	R	R			F	F	F																							
28R-1, 75-78	568.35	G	R	C	R			F					R	R	F	R	F																										
28R-2, 112-115	570.22	G	R	C	R			F					R	R	F	R	F																										
28R-3, 97-100	571.57	G	R	C	R			F					R	R	F	R	F																										
28R-4, 99-102	573.09	G	R	C	R			F					R	R	F	R	F																										
28R-5, 25-28	573.85	VG	R	C	R			F					R	R	F	R	F																										
28R-6, 103-106	576.13	G	R	C	R			F					R	R	F	R	F																										
28R-CC, 15-17	577.36	G	C	R	R			F			R		R	F	R	F	F																										
29R-1, 113-115	578.33	G	C	R				F		R			R	F	R	R	F																										
29R-2, 86-88	579.56	G	C	R				F		R			R	F	R	R	F																										
29R-3, 4-7	580.24	G	C	R	R			F		R			R	F	R	R	F																										
29R-4, 80-82	582.50	G	C	R	R			F		R			R	F	R	R	F																										
29R-5, 46-48	583.66	G	C	R				F		R			R	F	R	R	F																										
29R-6, 59-61	585.29	G	C	R	R			F		R			R	F	R	R	F																										
29R-CC, 6-8	586.00	G	R	F	R			F		R			R		R	F	F																										
30R-1, 33-35	587.13	VG	R	F	R			F					F		R	F	F																										
30R-2, 75-77	589.05	G	R	F	R	R		F		R			F	R		R	F																										
30R-3, 74-78	590.54	G	F	R	R			F					R	R		F	F																										
30R-4, 67-71	591.97	G	F	R	R			F		R			R	R		F	F																										
30R-5, 76-79	593.56	VG	F	R	R			F					R		C	F	C																										
30R-6, 75-79	595.05	G	F	R	R			R					R		C	F	C																										
30R-CC, 25-27	595.81	VG	F	R	R			R		F			R		R	F	A																										
31R-1, 44-46	596.84	VG	F	R				F		R			R	R		F	F																										
31R-2, 77-80	598.67	VG	F	R				F		R			R	R		F	F																										
31R-3, 21-23	599.61	VG	F	R				F		R			R	R		F	F																										
31R-4, 118-120	602.08	VG	F	R				F		R			R	R		F	F																										
31R-5, 19-21	602.59	G	F	R	R			F		R			R	R		F	F																										
31R-6, 97-98	604.87	VG	F	R				F		R			R	R		F	F																										
31R-CC, 25-27	605.39	VG	F	R	R			F		F			F	R		R	F																										

Note: Abundance: M = moderate, G = good, VG = very good, R = rare, F = few, C = common, A = abundant. Boxes around abundance entries define zone indexes.

Table T5. Occurrence of Lower Cretaceous foraminifers, Hole 1052E. (See table note. Continued on next page.)

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Hebergella planispira</i>	<i>Hebergella deliroensis</i>	<i>Hebergella simplex</i>	<i>Hebergella rischi</i>	<i>Costelagerina ilbyca</i>	<i>Favusella washitensis</i>	<i>Alaniordella bentonensis</i>	<i>Alaniordella ultramicro</i>	<i>Planomalina praebuxtorfi</i>	<i>Planomalina buxtorfi</i>	<i>Schackoina cenomana</i>	<i>Hebergella almadensis</i>	<i>Ticinella roberti</i>	<i>Ticinella praeticinensis</i>	<i>Ticinella primula</i>	<i>Biticinella breggiensis</i>	<i>Biticinella cf. breggiensis</i>	<i>Rotailipora subticinensis</i>	<i>Rotailipora ticinensis</i>	<i>Rotailipora appenninica</i>	<i>Rotailipora gandolii</i>	<i>Rotailipora aff. globotruncanoides</i>	<i>Rotailipora globotruncanoides</i>	<i>Praeglobotruncana deliroensis</i>	<i>Praeglobotruncana stephani</i>	<i>Heterohelix moremani</i>	<i>Guembelitra cenomana</i>	Zones		
171B-1052E-																																
36R-2, 27-31	474.97	M	R																			R	R	R	F	F	R					
36R-3, 11-15	476.31	P																					R	R	R	R	R					
36R-4, 84-87	478.54	P	R					R															R	R	R	R	R					
36R-5, 22-26	479.42	M	R																				R	R	R	R	R					
36R-6, 68-70	481.38	G	F R					R		F													R	R	R	R	R					
36R-CC, 0-1	482.55	P	R							?																						
37R-2, 32-35	484.13	G	R F				R			R													R	R	A	F	R					
37R-6, 74-78	490.55	M	R R					R		R													R	R	F	R	R					
37R-CC, 0-1	492.45	G	R R							R													R	R	F	R	R					
38R-3, 98-103	496.38	G	F				F			R													R	R	F	R	R					
38R-5, 103-108	499.43	G	F							R													R	R	F	R	R					
38R-CC, 0-1	501.08	G	R R					R		R													R	R	F	R	R					
39R-2, 23-28	503.73	G	R R							R													R	R	F	R	R					
39R-6, 89-95	509.89	VG	F				R			R													R	R	F	R	R					
39R-CC, 24-25	510.60	VG	F				R	R		R													R	R	F	R	R					
40R-1, 75-80	511.35	M	R				F																R	R	F	R	R					
40R-2, 0-4	512.10	P	R																													
40R-2, 90-92	513.00	M	R R				R	R	R		F												R	R	F	R	R					
40R-5, 69-71	516.79	VG	R R				A	R	R		F							R					R	R	F	R	R					
41R-1, 98-101	521.28	VG	C F				F	R	R	F	F	R	R										R	R	F	R	R					
41R-3, 49-52	523.79	G	F				F	R	R	F	F												R	R	F	R	R					
41R-6, 14-16	527.94	VG	R C R				F	F	R	F	F	R	R										R	R	F	R	R					
41R-CC, 20-23	529.52	VG	F				F	R	R	F	A	R											R	R	F	R	R					
42R-1, 64-69	530.54	M	F				F	R	R	F	F												R	R	F	R	R					
42R-2, 0-4	531.40	VG	F				C			R	R	C											R	R	F	R	R					
42R-2, 71-75	532.44	G	F R					F	F	F							R						R	R	F	R	R					
42R-5, 18-22	536.08	G	C F				R		F	R													R	R	C	F	R					
42R-CC, 10-14	538.33	G	R R				F	F	F	F			R										R	R	F	R	R					
43R-2, 47-50	541.41	M	C F				R		F	F	F			R									R	R	F	R	R					
43R-5, 107-110	546.51	VG	C					F	F	F													R	R	F	R	R					
43R-CC, 30-33	549.51	M					R		F														R	R	F	R	R					
44R-2, 54-55	551.14	P	R						R														R	R	F	R	R					
44R-4, 103-106	554.63	G	R R						F				R		R								R	R	F	R	R					
44R-6, 101-104	557.61	G	R R						F				R		R								R	R	F	R	R					
44R-CC, 16-19	558.07	VG	F R R						F				R	R	R								R	R	F	R	R					
45R-1, 93-96	559.63	G	F R R						R				R		R								R	R	F	R	R					
45R-2, 45-48	560.65	G	F R R						R				R		R								R	R	F	R	R					
45R-CC, 0-4	561.00	G	F R R						R								F						R	R	F	R	R					
46R-1, 13-17	568.43	M	F R F						F				R		F								R	R	F	R	R					
46R-2, 22-26	569.48	M	F R F						F				R		R	F							R	R	F	R	R					
46R-3, 10-13	570.86	G	F R F						F				R		R	F							R	R	F	R	R					
46R-4, 48-51	572.74	G	F R F						F				R		R	R							R	R	F	R	R					
46R-5, 12-14	573.88	G	F R F						F				R		R	R							R	R	F	R	R					
46R-6, 16-19	575.42	G	F R F						F				R		R	R							R	R	F	R	R					
46R-CC, 8-10	575.66	M	F R R						R														R	R	F	R	R					
47R-2, 71-73	580.21	G	F R R						R														R	R	F	R	R					
47R-4, 46-48	582.96	G	F R R						R														R	R	F	R	R					
47R-6, 46-48	585.96	G	F R R						F				R		R								R	R	F	R	R					
47R-7, 42-43	587.42	M	F R R						R														R	R	F	R	R					
48R-1, 8-11	587.68	G	R R R						R														R	R	F	R	R					
48R-4, 7-10	592.17	G	R R R						R														R	R	F	R	R					
48R-7, 21-24	596.81	M	R R						R														R	R	F	R	R					
48R-CC, 19-21	597.41	M	R R						R														R	R	F	R	R					
49R-1, 130-133	598.60	M	R R						R														R	R	F	R	R					
49R-3, 16-19	600.46	M	R R						R														R	R	F	R	R					
49R-5, 1-4	603.31	M	R R						R														R	R	F	R	R					
49R-CC, 0-2	604.39	G	R R						R														R	R	F	R	R					
50R-1, 128-131	608.18	G	R		R				R														R	R	F	R	R					

Table T5 (continued).

Core, Section, Interval (cm)	Depth (mbsf)	Preservation	<i>Hedbergella planispira</i>	<i>Hedbergella delrioensis</i>	<i>Hedbergella simplex</i>	<i>Hedbergella rischi</i>	<i>Costellagerina libyca</i>	<i>Favusella washitensis</i>	<i>Alarlordella bentonensis</i>	<i>Alarlordella ultramirca</i>	<i>Planomalina praebuxtorffi</i>	<i>Planomalina buxtorffi</i>	<i>Schackoia cenomana</i>	<i>Hedbergella almadensis</i>	<i>Ticinella roberti</i>	<i>Ticinella praeticinensis</i>	<i>Ticinella primula</i>	<i>Biticinella breggiensis</i>	<i>Biticinella cf. breggiensis</i>	<i>Rotalipora subticinensis</i>	<i>Rotalipora ticinensis</i>	<i>Rotalipora appenninica</i>	<i>Rotalipora gandolfii</i>	<i>Rotalipora aff. globotruncanoides</i>	<i>Rotalipora globotruncanoides</i>	<i>Praeglobotruncana delrioensis</i>	<i>Praeglobotruncana stephani</i>	<i>Heterohelix moremani</i>	<i>Guembelitra cenomana</i>	Zones	
50R-2, 100-103	609.40	G	R																												
50R-CC, 0-2	610.73	M	R					R											R												
51R-1, 79-82	617.39	M	R		R				R																				R		
51R-2, 58-60	618.68	G	R		R				R																				R		
51R-CC, 13-14	619.31	M	R					R																							
52R-1, 145-148	623.15	G	F						F					R					F												
52R-2, 84-87	624.04	G	R		R				F										R												
52R-3, 105-108	625.75	G	R		R				F										R												
52R-CC, 22-24	627.20	G	F	R	F				R										F												
53R-1, 2-5	627.22	G	R		R				R										R												
53R-3, 137-139	631.57	G	R		R				R										R												
53R-5, 18-21	633.38	G	R		R				R																						
53R-CC, 0-2	635.18	G						R	R									F					F								
54R-1, 18-21	636.98	G				R			R																						
54R-2, 134-137	639.64	G	R						R						R				R		R										
55R-1, 147-150	647.87	M	R		R				R																						
55R-2, 124-128	649.14	M	R																R		R										
55R-4, 63-66	651.53	M	F						R						R				R		R										
55R-6, 12-15	654.02	M	F	R	R				R						R						F										
55R-CC, 1-4	655.91	G	R		R														R												
56R-1, 60-64	656.60	P	R																												
57R-1, 65-69	666.25	M	R	R	R				R										R		F										
57R-2, 32-35	666.93	M	R	R	R				R										R	R											
57R-3, 50-53	668.61	M	R						R																						
57T-4, 21-24	669.82	G	R																												
57R-5, 42-45	671.53	M	F	R	R				R																						
57R-6, 10-14	672.71	M	R																												
57R-7, 74-77	674.85	M	F		R				R																						
57R-CC, 23-26	675.48	G	R						R																						
58R-1, 47-51	675.67	G	F		R				R																						
58R-2, 125-129	677.93	M			R				R																						
58R-3, 26-30	678.44	G			R																										
58R-4, 13-17	679.81	M			R																										
58R-5, 16-20	681.34	M	R						R																						
58R-CC, 17-20	682.57	G	R		R										R						R										

Notes: Preservation: P = poor, M = moderate, G = good, VG = very good. Abundance: R = rare, F = few, C = common, A = abundant. Boxes around abundance entries define zone indexes.