7. CENOZOIC RADIOLARIANS AT SITE 462, DEEP SEA DRILLING PROJECT LEG 61, WESTERN TROPICAL PACIFIC[1]

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ABSTRACT

Radiolarians are numerous, and moderately to well preserved, in almost all samples from the Pliocene to middle Eocene at this site. The section is, however, practically useless for normal stratigraphic purposes because of the pervasive reworking of older forms into younger levels, which is estimated to account for 30 to 50% of the assemblages in some samples.

INTRODUCTION

The sequence of radiolarian assemblages at Site 462 (7°14.25′N, 165°01.83′E, water depth 5181 m) is so confused by reworking of older forms into younger levels that Patrick De Wever asked us to attempt to sort it out while he concentrated on the spyrids, the artostrobiids, and the Cretaceous samples. Our work was based on samples taken and prepared by him.

OBSERVATIONS

Our results are shown in Table 1. All the preparations examined contained abundant radiolarians, except those from Core 462-1, in which they are sparse. In the tabulation, the preservation of each assemblage is categorized as poor (P), moderate (M), or good (G). Since dissolution often results in the concentration of spyrids, collosphaerids, and orosphaerids, we have kept note of samples in which relative abundances of these groups were higher than normal.

Collosphaerids appear to be concentrated in the preparations from Hole 462, Sections 4-6, 5-1, 5-2, 11-3, 11-4, and 12-4.

Spyrids appear to be concentrated in the preparations from Hole 462, Sections 10-2, 17-1 through 18-6, 21-5, 26-1, 26-2, 26-3, 26-4, and 30-2.

Orosphaerids appear to be concentrated in the preparations from Sections 462-12-1 and 462-16-2.

High concentrations of sponge spicules, possibly resulting from selective dissolution and/or from influx of shallower-water material, were noted in the preparations from Hole 462, Sections 16-2, 18-6, 20-3, 20-4, 23-2 through 23-6, Sample 34,CC, Sections 38-2 and 38-4, Sample 38,CC, and Section 39-3.

Entries in the column headed "Sorting?" indicate whether the assemblage seems to be normal (N), abnormally coarse (C), abnormally fine (F), or to have the medium grain sizes concentrated by winnowing (W).

The main body of the tabulation shows estimated relative abundances of species, according to the following scheme: abundant (A), tens of thousands of specimens on a slide; common (C), thousands; few (F), 50–1000; rare (R), 3–50; very rare (+), 1 or 2. On each slide are about 20,000 to 40,000 radiolarians.

The columns headed "Estimated Reworking" give Riedel's estimates (as percentages) of radiolarians of different ages reworked into each assemblage. These numbers are of course very rough. All concentrations up to 1% are recorded as 1.

The relationship between radiolarian zones and epoch boundaries is nearly always established by correlations with calcareous microfossils. A basis for establishing this relation is shown in Figure 1, in which the limits of radiolarian zones are shown in relation to calcareous-nannofossil zones and sub-zones of Okada and Bukry (1980). This was done by surveying all of the DSDP *Initial Reports* volumes from Leg 10 through Leg 50, and recording the relations of the critical radiolarian events to Bukry's zonal assignments in those volumes.

COMMENTS

In the tabulation, species are arranged in order of their first occurrences. Because of the extensive reworking in the section, these lowest occurrences constitute the principal basis of our stratigraphic interpretation. As is evident from the left-hand side of the table, the placement of some zonal boundaries is uncertain because of our inablilty to determine evolutionary transitions and upper limits of stratigraphic ranges in this sequence.

There seem also to be some departures from the usual order of earliest appearances (as summarized by Riedel and Sanfilippo, 1978), which should be investigated in nearby sequences less affected by reworking. The most striking of these anomalies are the following:

1) The earliest occurrences of *Podocyrtis ampla ampla* and *P. ampla fasciolata* are abnormally high.

2) The earliest occurrences of *Thyrsocyrtis bromia* and *Calocyclas turris* are abnormally low in relation to the first occurrences of *Theocampe pirum*, the *Lithocyclia aristotelis* group, *Thyrsocyrtis tetracantha*, and *Carpocanistrum azyx*.

3) The earliest occurrences of *Stichocorys delmontensis* and *Artostrobium doliolum* are abnormally low.

4) The isolated, abnormally low occurrences of *Siphocampe corbula, Dictyocoryne ontongensis*, and *Spongaster tetras* in Sample 462-15,CC can be explained only by their having fallen down the hole.

[1] *Initial Reports of the Deep Sea Drilling Project*, Volume 61.

Martini (1971) Zones	Okada and Bukry (in press) Zones		Calcareous-Nannofossil Subzone		Radiolarian Zones, Events, and Ages (Theyer et al., 1978)
NN21	CN15	*Emiliania huxleyi*			
NN20	CN14	*Geophyrocapsa oceanica*	CN14b	*C. cristatus*	*Lamprocyrtis haysi* Zone
			CN14a	*E. ovata*	
NN19	CN13	*Crenalithus doronicoides*	CN13b	*G. caribbeanica*	*L. neoheteroporos*—→*L. haysi*
			CN13a	*E. annula*	
NN18	CN12	*Discoaster brouweri*	CN12d	*C. macintyrei*	*Pterocanium prismatium* Zone
NN17			CN12c	*D. pentaradiatus*	
NN16			CN12b	*D. sulculus*	Tm *S. peregrina* (2.5 m. y.)
			CN12a	*D. tamalis*	
NN15	CN11	*Reticulofenestra pseudoumbilica*	CN11b	*D. asymmetricus*	*Spongaster pentas* Zone
			CN11a	*S. neoabies*	
13/14	CN10	*Amaurolithus tricorniculatus*	CN10c	*C. rugosus*	
NN12			CN10b	*C. acutus*	*S. berminghami*—→*S. pentas* (4.4 m. y.)
			CN10a	*T. rugosus*	*Stichocorys peregrina* Zone
NN11	CN9	*Discoaster quinqueramus*	CN9b	*A. primus*	*S. delmontensis*—→*S. peregrina* (6.2 m. y.)
			CN9a	*D. berggrenii*	*Ommatartus penultimus* Zone
					Tm *O. hughesi* (7.8 m. y.)
NN10	CN8	*Discoaster neohamatus*	CN8b	*D. neorectus*	*Ommatartus antepenultimus* Zone
			CN8a	*D. bellus*	*C. petterssoni*—→ *O. hughesi*
NN9	CN7	*Discoaster hamatus*	CN7b	*C. calyculus*	
			CN7a	*H. carteri*	
NN8	CN6	*Catinaster coalitus*			*Cannartus petterssoni* Zone
NN7	CN5	*Discoaster exilis*	CN5b	*D. kugleri*	Bm *C. petterssoni* (11.2 m. y.)
NN6			CN5a	*C. miopelagicus*	*Dorcadospyris alata* Zone
NN5	CN4	*Sphenolithus heteromorphus*			*D. dentata*—→*D. alata* (15.4 m. y.)
	CN3	*Helicosphaera ampliaperta*			*Calocycletta costata* Zone
NN2	CN2	*Sphenolithus belemos*			Bm *C. costata* (18.4 m. y.)
					Stichocorys wolffii Zone
					Bm *S. wolffii* (19.2 m. y.)
	CN1	*Triquetrorhabdulus carinatus*	CN1c	*D. druggii*	*Stichocorys delmontensis* Zone
NN1			CN1b	*D. deflandrei*	Tm *T. annosa* (22.2 m. y.)
					Cyrtocapsella tetrapera Zone
					Bm *C. tetrapera* (22.6 m. y.)
			CN1a	*C. abisectus*	*Lychnocanoma elongata* Zone
NP25	CP19	*Sphenolithus ciperoensis*	CP19b	*D. bisectus*	Bm *L. elongata* (24.2 m. y.)
NP24			CP19a	*C. floridanus*	*Dorcadospyris ateuchus Zone*
NP23	CP18	*Sphenolithus distentus*			*T. triceros*—→*D. ateuchus*
	CP17	*Sphenolithus predistentus*			
NP22	CP16	*Helicosphaera reticulata*	CP16c	*R. hillae*	*Theocyrtis tuberosa* Zone
NP21			CP16b	*C. formosus*	*L. aristotelis*—→*L. angusta*
			CP16a	*C. subdistichus*	
19/20	CP15	*Discoaster barbadiensis*	CP15b	*I. recurvus*	*Thyrsocyrtis bromia* Zone
NP18			CP15a	*C. oamaruensis*	
NP17	CP14	*Reticulofenestra umbilica*	CP14b	*D. saipanensis*	Bm *C. azyx*
					Podocyrtis goetheana Zone
					Bm *P. goetheana*
					Podocyrtis chalara Zone
NP16			CP14a	*D. bifax*	*P. mitra*—→*P. chalara*
					Podocyrtis mitra Zone
					P. sinuosa—→*P. mitra*
	CP13	*Nannotetrina quadrata*	CP13c	*C. staurion*	*Podocyrtis ampla* Zone
			CP13b	*C. gigas*	*P. phyxis*—→*P. ampla*
NP15			CP13a	*D. strictus*	*Thyrsocyrtis triantha* Zone
					Bm *E. lagena*
NP14	CP12	*Discoaster sublodoensis*	CP12b	*R. inflata*	*Theocampe mongolfieri* Zone
					Bm *T. mongolfieri*
			CP12a	*D. kuepperi*	*Theocotyle cryptocephala* Zone
					T. nigriniae—→*T. cryptocephala*
12/13	CP11	*Discoaster lodoensis*			*Phormocyrtis striata* Zone
	CP10	*Tribrachiatus orthostylus*			Bm *T. anaclasta*
					Buryella clinata Zone
NP11	CP9	*Discoaster diastypus*	CP9b	*D. binodosus*	*B. tetradica*—→*B. clinata*
NP10			CP9a	*T. contortus*	

Figure 1. Relation of radiolarian zones to calcareous-nannofossil zones. Numbers in parentheses indicate ages in millions of years.

Parts of the sequence in Hole 462 that seem not to be seriously disturbed by reworking are the major part of Core 5, the lower half of Core 6, Core 8 through the upper part of Core 12, the lower half of Core 13 through Core 18, the lower half of Core 19, the lower half of Core 21, Cores 24 through 25, most of Core 27, the lower part of Core 28, the lower part of Core 29 through Core 31, the bottom of Core 32 and the top of Core 33, and Cores 35 through 36. In Hole 462A, Core 1 seems to be not much disturbed by reworking. These parts of the sequence are the most useful for locating biostratigraphic boundaries.

There is some discrepancy between the correlation of the top two cores in Hole 462A with the sequence in Hole 462, as indicated by the radiolarians, and that which would be expected on the basis of drilling depth. The radiolarians in Core 462A-1 are similar to those above the bottom of Core 462-8, and the assemblages in Core 462A-2 are similar to those in Cores 462-22 to 462-24.

SPECIES LIST

The purpose of this list is to provide bibliographic references to the taxa mentioned in this chapter. The only literature references given are to the original description, and to our present concept of the species if different from or more detailed than the original one.

***Acrobotrys tritubus* Riedel**
Acrobotrys tritubus Riedel, 1957, p. 80, pl. 1, fig. 5. Riedel and Sanfilippo, 1978, p. 65, pl. 3, fig. 1.

***Artophormis gracilis* Riedel**
Artophormis gracilis Riedel, 1959, p. 300, pl. 2, figs. 12, 13.

***Artostrobium doliolum* Riedel and Sanfilippo**
Artostrobium doliolum Riedel and Sanfilippo, 1971, p. 1599, pl. 1H, figs. 1–3; pl. 8, figs. 14, 15. Westberg and Riedel, 1978, p. 20, pl. 3, figs. 10, 11.

***Buryella clinata* Foreman**
Buryella clinata Foreman, 1973, p. 433, pl. 8, figs. 1–3; pl. 9, fig. 19. Riedel and Sanfilippo, 1978, p. 65, pl. 3, fig. 4.

***Calocyclas hispida* (Ehrenberg)**
Anthocyrtis hispida Ehrenberg, 1873, p. 216.
Calocyclas hispida (Ehrenberg), Riedel and Sanfilippo, 1978, p. 65, pl. 3, fig. 6.

***Calocyclas turris* Ehrenberg**
Calocyclas turris Ehrenberg, 1873, p. 218. Riedel and Sanfilippo, 1978, p. 65, pl. 3, figs. 7, 8.

***Calocycletta costata* (Riedel)**
Calocyclas costata Riedel, 1959, p. 296, pl. 2, fig. 9. Riedel and Sanfilippo, 1978, p. 66, pl. 3, fig. 9.

***Calocycletta virginis* Haeckel**
Calocyclas (Calocycletta) virginis Haeckel, 1887, p. 1381, pl. 74, fig. 4.
Calocycletta virginis (Haeckel), Riedel and Sanfilippo, 1978, p. 66, pl. 3, figs. 13, 14.

***Cannartus laticonus* Riedel**
Cannartus laticonus Riedel, 1959, p. 291, pl. 1, fig. 5. Westberg and Riedel, 1978, p. 20, pl. 2, figs. 1–3.

***Cannartus petterssoni* Riedel and Sanfilippo**
Cannartus(?) petterssoni Riedel and Sanfilippo, 1970, p. 520, pl. 14, fig. 3. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 2.

***Carpocanistrum azyx* Sanfilippo and Riedel**
Carpocanistrum azyx Sanfilippo and Riedel, 1973, p. 530, pl. 35, fig. 9. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 5.

***Carpocanopsis bramlettei* Riedel and Sanfilippo**
Carpocanopsis bramlettei Riedel and Sanfilippo, 1971, p. 1597, pl. 2G, figs. 8–14; pl. 8, fig. 7. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 6.

***Carpocanopsis cingulata* Riedel and Sanfilippo**
Carpocanopsis cingulata Riedel and Sanfilippo, 1971, p. 1597, pl. 2G, figs. 17–21; pl. 8, fig. 8. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 4.

***Centrobotrys gravida* Moore**
Centrobotrys gravida Moore, 1971, p. 744, pl. 5, fig. 8. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 8.

***Cyclampterium milowi* Riedel and Sanfilippo**
Cyclampterium milowi Riedel and Sanfilippo, 1971, p. 1593, pl. 3B, fig. 3; pl. 7, figs. 8, 9. Riedel and Sanfilippo, 1978, p. 67, pl. 4, fig. 14.

***Cyrtocapsella cornuta* Haeckel**
Cyrtocapsa (Cyrtocapsella) cornuta Haeckel, 1887, p. 1513, pl. 78, fig. 9.
Cyrtocapsella cornuta Haeckel, Riedel and Sanfilippo, 1978, p. 68, pl. 4, fig. 17.

***Cyrtocapsella tetrapera* Haeckel**
Cyrtocapsa (Cyrtocapsella) tetrapera Haeckel, 1887, p. 1512, pl. 78, fig. 5.
Cyrtocapsella tetrapera Haeckel, Riedel and Sanfilippo, 1978, p. 68, pl. 4, fig. 18.

***Dictyocoryne ontongensis* Riedel and Sanfilippo**
Dictyocoryne ontongensis Riedel and Sanfilippo, 1971, p. 1588, pl. 1E, figs. 1, 2; pl. 4, figs. 9–11. Riedel and Sanfilippo, 1978, p. 68, pl. 5, fig. 1.

***Dictyophimus craticula* Ehrenberg**
Dictyophimus craticula Ehrenberg 1873, p. 223. Riedel and Sanfilippo, 1978, p. 68, pl. 4, fig. 19.

***Dorcadospyris alata* (Riedel)**
Brachiospyris alata Riedel, 1959, p. 293, pl. 1, figs. 11, 12.
Dorcadospyris alata (Riedel), Riedel and Sanfilippo, 1978, p. 68, pl. 5, fig. 2.

***Dorcadospyris ateuchus* (Ehrenberg)**
Ceratospyris ateuchus Ehrenberg, 1873, p. 218.
Dorcadospyris ateuchus (Ehrenberg), Riedel and Sanfilippo. 1978, p. 68, pl. 5, fig. 3.

***Dorcadospyris dentata* Haeckel**
Dorcadospyris dentata Haeckel, 1887, p. 1040, pl. 85, fig. 6. Riedel and Sanfilippo, 1978, p. 68, pl. 5, fig. 4.

***Eusyringium fistuligerum* (Ehrenberg)**
Eucyrtidium fistuligerum Ehrenberg, 1873, p. 229.
Eusyringium fistuligerum (Ehrenberg), Riedel and Sanfilippo, 1978, p. 68, pl. 5, figs. 6, 7.

***Eusyringium lagena* (Ehrenberg)**
Lithopera lagena Ehrenberg, 1873, p. 241.
Eusyringium lagena (Ehrenberg), Riedel and Sanfilippo, 1978, p. 68, pl. 5, fig. 8.

***Lamptonium fabaeforme chaunothorax* Riedel and Sanfilippo**
Lamptonium fabaeforme chaunothorax Riedel and Sanfilippo, 1970, p. 524, pl. 5, figs. 8, 9. Riedel and Sanfilippo, 1978, p. 69, pl. 5, fig. 11.

***Lamptonium fabaeforme constrictum* Riedel and Sanfilippo**
Lamptonium fabaeforme constrictum Riedel and Sanfilippo, 1970, p. 523, pl. 5, fig. 7. Riedel and Sanfilippo, 1978, p. 69, pl. 5, fig. 12.

***Lithochytris vespertilio* Ehrenberg**
Lithochytris vespertilio Ehrenberg, 1873, p. 239. Riedel and Sanfilippo, 1978, p. 69, pl. 6, fig. 4.

***Lithocyclia angusta* (Riedel)**
Trigonactura angusta Riedel, 1959, p. 292, pl. 1, fig. 6.
Lithocyclia angusta (Riedel), Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 5.

***Lithocyclia aristotelis* (Ehrenberg) group**
Astromma aristotelis Ehrenberg, 1847, p. 55, fig. 10.
Lithocyclia aristotelis (Ehrenberg) group, Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 6.

***Lithocyclia crux* Moore**
Lithocyclia crux Moore, 1971, p. 737, pl. 6, fig. 4. Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 7.

***Lithocyclia ocellus* Ehrenberg group**
Lithocyclia ocellus Ehrenberg, 1854, pl. 36, fig. 30.
Lithocyclia ocellus Ehrenberg group, Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 8.

***Lithopera neotera* Sanfilippo and Riedel**
Lithopera neotera Sanfilippo and Riedel, 1970, p. 454, pl. 1, figs. 24–26, 28. Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 10.

Table 1. Occurrences of radiolarian species in samples from Site 462. (Abbreviations explained in text.)

Chronostratigraphy	Radiolarian Zones	Sample (Interval in cm)	*B. clinata*	*C. hispida*	*L. ocellus* group	*P. striata exquisita*	*P. striata striata*	*P. diamesa*	*P. sinuosa*	*D. craticula*	*T. crypt. nigriniae*	*T. crypt. cryptocephala*	*T. mongolfieri*	*L. vespertillo*	*T. triacantha*	*L. fab constrictum*	*L. fab. chaunothorax*	*E. lagena*	*E. fistuligerum*	*P. mitra*	*S. triconiscus*	*P. ampla fasciolata*	*P. trachodes*	*P. chalara*	*P. goetheana*	*T. bromia*	*C. turris*	*P. ampla ampla*	*T. pirum*	*L. aristotelis* group	*T. tetracantha*	*C. azyx*	*T. triceros*	*L. jacchia*	*L. amphitrite*	*A. gracilis*	*C. milowi*
Pliocene	*S. pentas*	1-1, 112-114																																		
		1-2, 62-64																																		
		1-3, 86-88																																	+	
		1-4, 90-92											+																							
		1-5, 108-110					+						R																							
		1-6, 62-64											+																							
		1, CC																																		
		2-CC																																		
		3-1, 95-97					+						R																						+	
		3-2, 69-71																											+							
		3-4, 77-79																																		
		3-6, 22-24																																		
		3, CC																																		
	S. peregrina	4-1, 145-147																											+							
		4-2, 75-77																																		
upper Miocene		4-3, 70-72																																		
		4-4, 34-36																								+										
		4-4, 101-103		R									R		+			+																		
		4-5, 53-55																																		
		4-5, 75-77																									+									
		4-6, 30-32																											+							
		4, CC																																		
		5-1, 110-112																																		
	O. penultimus + *O. antepenultimus*	5-2, 112-113																																		
		5-3, 68-70																																		
		5-5, 57-59	+																									+								
		5, CC																																		
		6-1, 56-58											+																							
		6-2, 96-98											+															+								
		6-3, 65-67											+																							
		6-4, 78-80																																		
		6-5, 99-101																																		
		7-1, 117-119													+																					
	C. petterssoni	7-3, 119-121							R				R		R								+				+			+						
		7-4, 64-66																																		
		7-5, 63-65																						+		+	R									
		8-1, 107-109			+				+						+																					
		8-2, 100-102																																		
		8-3, 118-120																																		
		8-4, 61-63																										+								
middle Miocene		8, CC																																		
		10-2, 67-69																																		
		10-4, 96-98	+										+																							
		10-5, 50-52											+																							
		10, CC																																		
	D. alata	11-1, 147-149																																		
		11-2, 77-79																																		
		11-3, 127-129																																		
		11-4, 3-5																																		
		11, CC											+						+																	
		12-1, 39-41																																		
		12-4, 116-118						+	+				+		+				+							R		+								
		12-5, 23-25							+										+								+									
		12-6, 99-101	+	F	R			R	R				F	R	F			R	R						F			R								
		12, CC																																		
		13-1, 88-90							R						R			R																		
		13-2, 88-90							R				R		R					R						R	+							+		
		13-3, 88-90							R										R																	
		13-4, 88-91																												+						
		13-5, 88-90							R				R						R									+								

Table 1. (Continued).

C. gravida	*L. crux*	*T. tuberosa*	*L. angusta*	*T. annosa*	*D. ateuchus*	*S. delmontensis*	*L. elongata*	*C. cingulata*	*C. cornuta*	*C. tetrapera*	*C. virginis*	*C. bramlettei*	*S. wolffii*	*D. dentata*	*D. alata*	*L. neotera*	*L. renzae*	*C. costata*	*P. corona*	*A. doliolum*	*S. corbula*	*C. laticonus*	*O. antepenultimus*	*L. thornburgi*	*S. peregrina*	*C. petterssoni*	*D. ontongensis*	*O. hughesi*	*P. prismatium*	*A. tritubus*	*S. omnitubus*	*S. berminghami*	*S. pentas*	*S. tetras*	Preservation	Sorting?	Estimated Reworking (%) Mio.	Olig.	Eoc.	Cret.
																									R										M	N	?			
																																		M	N				
						+											+			+					R						R				M	N	1			
													+												F				+						M	N	1		1	
						F	+			R			+			+			R	R			R		C			+	+		R				M	N	1		1	
													+												F				+			-	+	+	M	N	1		1	
						F				R						+			R	+					C				+		R	-	+	R	M	N	1			
						F	+							+	+			+		R					R							-	-	-	M	N	1		1	
						R																										-	-	-	M	N	5		1	
						R							R			+				R					R				+			-	R	R	M	N	1			
																																		P	N	1			
																																-	+	-	M	N				
																									C			R	R		F	F	+	R	M	N	5		1	
																										+						R	-		M	N				
						F				R																									P	N	1			
						F							+						R	R		+			R				+	R	R		R	-		M	N	1		1	
						F																			R				+	R		F			M	N	5	1	5	
						F																			C				+	R	R	F			M	N				
									R						+											R				R	R				M	C	50		1	
						C			R		+					R			R	+		R	F		F				-	R	R	R			M	N	5		1	
						F																			C				+						M	N				
						F																			C				+	R	F	R	-	-	M	N				
						F																			F		-		-	R	R	R	-	-	M	N				
						C										R			F	F		R	F		R				-	R	-			R	M	N	1			
						C										R			F	R			F		R				+	R	-	R		+	M	N			1	
									R																										M	N	5			
											+			+															-	-	-				M	N	5		1	
						C		+	R	R			R			R	R	+	R	+		R	+		-				+	-	-			R	M	N	5		1	
									R																			R	R	+	-	-		R	M	N	5		1	
									-											R								R	R	-	-	-	R	-	-	M	N				
						C		+	R	+		+		R	+	F	R		R	R		R		R	R	+	R	R	-	-	-	R	-	-	G	N				
	+								F									R									R	-	-	-	-	-	-	-	M	W	1	1	1	
						C		F	F	R	+	R	F			R	R	R	R	R		R		+	R	R	-	-	-	-	-	-	-	-	M	W	5		1	
									F									R									-							M	W	5		1	
																		R									-	-	-				-	M	W	5		5	
				+		C	R	R	R	R	R		F			F		R	F	F		F			R	C		R	-	-					M	W	1		1	
																											R	R						G	N				
						C			F							F			F	F		F		R	R	R	-	-						M	N			1	
																F			R	F					R	-	-	-						+	M	N	1			
																									+	-	-	-	-						M	N				
																									R				-						M	N			1	
						C			R		+					+	R	R	R	+		R	F		F	R									M	N			1	
																R				F	-			+	-									M	N				
						A			F					A		R	F	R		C	+	+	F	F	+	+									M	N				
									R										-				R	-	-										M	N				
						C		+	F	R		+	C			R	F	F	+	F	R	+	R	+	+	+									M	N				
										+						+			-	F	-	+	-	-	-										M	N			1	
						F			+				F						-																P	N				
						A		+	F	F		R	C				F	R	C	F	R	-													M	N			1	
																			F		-	-													P	W			5	
				+		C		+		R	F	F	F	+	+				R	R	-	-													M	N			10	
		+																	R																M	N		1		
	R		R			C	R	R	F	F	F	+	C		+		R	F	R	-															M	N		1	10	
		+																		-															M	W				
		+																		-															M	N		1	1	
																				-															M	W		1	5	
																				-															M	W		1	1	

Table 1. (Continued).

Chronostratigraphy	Radiolarian Zones	Sample (Interval in cm)	*B. clinata*	*C. hispida*	*L. ocellus* group	*P. striata exquisita*	*P. striata striata*	*P. diamesa*	*P. sinuosa*	*D. craticula*	*T. crypt. nigriniae*	*T. crypt. cryptocephala*	*T. mongolfieri*	*T. vespertillo*	*T. triacantha*	*L. fab constrictum*	*L. fab. chaunothorax*	*E. lagena*	*E. fistuligerum*	*P. mitra*	*S. triconiscus*	*P. ampla fasciolata*	*P. trachodes*	*P. chalara*	*P. goetheana*	*T. bromia*	*C. turris*	*P. ampla ampla*	*T. pirum*	*L. aristotelis* group	*T. tetracantha*	*C. azyx*	*T. triceros*	*L. jacchia*	*L. amphitrite*	*A. gracilis*	*C. milowi*
		13-6, 88-90						+	+				R	+	+								+			R	+									
		13,CC							R																											
		14-2, 86-88																	+																	
		14-4, 142-144											F						+	+						R										
		14-5, 109-111							+						R																					
		14-6, 76-79											+																							
		14,CC																																		
		15-1, 51-53																																		
	C. costata	15,CC											+						+																	
	S. delmontensis + S. wolffii	16-2, 68-70											+																							
		17-1, 34-36													+																					
	C. tetrapera	17-2, 104-106											R																							
		17-3, 55-57																																		
		17-6, 132-134																	+																	
		18-2, 75-77											+																							
		18-3, 85-87											R																							
	L. elongata	18-4, 36-38			+				+				R		+				+							+									R	
		18-5, 74-76			+								R																							
		18-6, 21-23																		+																
		19-2, 142-144		+			+	+	R				F		R				F	R	R														F	
		19-5, 113-115																																		
		19-6, 23-25																																	F	
		20-3, 118-120																																		
		20-4, 25-27		R	R			R	R				R	+					R																C	
		20-5, 56-58		R	R														R							-		-							
		20,CC			R				R				R																							
		21-1, 35-37		R	+		+	+	F				F		R				R		+					F	F						R		R	
		21-3, 120-122																								-							+			
		21-5, 78-80			R								R													-							R		F	
		21,CC							+																	-							+			
		22-3, 106-108							R																	R							F			
		22-5, 20-22		R				F	R					+	F					F			+			F	R						F		C	
	D. ateuchus + T. tuberosa	23-1, 131-133	R	R	R	F		R				R	F	F	F				R	C	F					C							+		C	R
		23-2, 93-95							F					R																			R			
		23-3, 52-54							F					R																			R			
		23-4, 67-69			R				F					R						F													R			
		23-5, 53-55	R	-	R				F				F	R	C				R	R	+					R	+			-	R		F	+	F	R
		23-6, 31-33	+		R									R																	+		R			
		23,CC																																		
		24-2, 81-83																												+			R		C	R
		24-4, 14-16																																		
		25-1, 142-144		-																	-					-	-		-	-	+	-	F	-	-	A	F
		25-3, 75-77																																		F	
		25-4, 141-143			R																									+			R		C	F
		25-5, 54-56																																		R
		25-6, 123-125		-																						-				-	-					R
		25,CC		-																						-				-	-					R
		26-1, 147-148																										R	+							F	
		26-2, 62-64		+									F	R	F				R	+	R			+	+	F				R	F			R		R	-
		26-3, 46-48		-																	+						-	R	-	+		F	+	-	F	F
		26-4, 33-35		R									+		R						R					R	-	R	R	R		F	R	-	F	R
		26-5, 73-75		+					F					R												F			-	F						+
		27-1, 116-118		R	R				F												F					F	F	R	F	F	R	F	F	R	+	+
		27-2, 57-59		R	+															R	R					F	F	R	R	F	R	F	F	R		-
		27-3, 82-83		-																	-					-	-	-	+	R	-	R	R	-	F	+
		27-5, 83-85		R																	R					F	F	R	F	F	R	R	F	-		-
	T. bromia	27-6, 127-129		R																	R					R	F		F	F	R	R	F	-	R	-
		27,CC																		R																
		28-1, 50-52		R																+	R					F	R	R	F	F	R	R	F	-	R	-
		28-2, 109-111		R																	R					F	F	R	F	C	R	R	F	-	R	-

Table 1. (Continued).

C. gravida	*L. crux*	*T. tuberosa*	*L. angusta*	*T. annosa*	*D. ateuchus*	*S. delmontensis*	*L. elongata*	*C. cingulata*	*C. cornuta*	*C. tetrapera*	*C. virginis*	*C. bramlettei*	*S. wolffii*	*D. dentata*	*D. alata*	*L. neotera*	*L. renzae*	*C. costata*	*P. corona*	*A. doliolum*	*S. corbula*	*C. laticonus*	*O. antepenultimus*	*L. thornburgi*	*S. peregrina*	*C. petterssoni*	*D. ontongensis*	*O. hughesi*	*P. prismatium*	*A. tritubus*	*S. omnitubus*	*S. berminghami*	*S. pentas*	*S. tetras*	Preservation	Sorting?	Estimated Reworking (%) Mio.	Olig.	Eoc.	Cret.
						A	R	C	C	F	C	F	C		+				F	+															M	W			1	
		+																		R															M	W		1	5	
														R	R					+															M	N			1	
					+	A	R	F	C	F	A	F	C	R	R			C	R	-															M	W			1	
		+																	F	-															M	W		1	1	
																			F	-															M	N			1	
						A		F	F		C	F	C	+	R	R	+	C	-	-															M	N				
					-	C		R	R	-	R	R	F	+	+	R	R	F	-	-	-															P	N				
				-	+	C		+	R	R	F	-	F	R	+	R	R	F			R							R					+			M	N			1	
		+	-	-	-	F		F	F	R	R	+	F	-	-	-	-	-			-															P	N		1	1	
			-	R	R	-					R	-	-	-	-	-	-	-			-															P	N			1	
			-	+	R	-		F	C	C	?	-	-	-	-	-	-				-															M	N			1	
			-	R	R	-		F	F	F	-	-	-																						M	N				
			-	R	R	R		R	+	+	-	-	-																						P	N			1	
			-	R	R	R			-	-	-	-	-																						P	N			1	
			-	R	+	R		F	-	-	-	-																							P	N			1	
			-	R	+	R	F	-	-	-				-																					P	N			1	
			-	R	+	R	F	-	-	-				-																					P	N			1	
			-	R	-		R	-	-	-			-																						P	N			1	
			+	R	+	F	-	-		-																									P	W			20	
			-	R	+	F	-		-		-																								M	N				
				R		C		-	-	-		-																							M	N				
			+	F	R	C			-	-																									M	N				
			R	F	F	R	-						-																						M	W			5	
			R	F	R	-							-																						M	N			5	
			-			-							-																						M	N			10	
			+	F	R																														M	N			10	
			R	F	+																														M	N				
			+	F	-	-	-																												M	N			1	
			-	F	-																														M	N			1	
					+																														M	W			5	
			C	F	R																														M	N			5	
			F	R	R																														M	W			20	
			F	+	+																														M	N			20	
			F	R	+																														M	W			20	
			F	-	+																														M	C			20	
			C	+	-																														M	W			20	
			F		-																														M	W			10	
			C		-																														M	N				
F	+	C	R		-																														M	N				
		C																																	M	W				
-	R	A	R		-																														M	N				
		C																																	M	N				
		C	R																																M	N			1	
			+																																M	N				
			R																																M	N				
R			+																																M	N				
F	R	F	R																																P	N				
R		F	-																																P	N			10	
F	R	R	R																																P	W			1	
F	-	-	+		+																														P	N			1	
-	-	-	-																																M	C			30	
-	-	-	-																																M	N			1	
-	-	-	-																																M	N			1	
-	-	R	R		R																														M	N				
-	-	-	-																																M	N				
-	-	-	-																																M	N				
																																			M	C			5	
-	-	-	-																																M	W			1	
-	-	-	-																																M	W				

Table 1. (Continued).

Chronostratigraphy	Radiolarian Zones	Sample (Interval in cm) \ Taxa	*B. clinata*	*C. hispida*	*L. ocellus* group	*P. striata exquisita*	*P. striata striata*	*P. diamesa*	*P. sinuosa*	*D. craticula*	*T. crypt. nigriniae*	*T. crypt. cryptocephala*	*T. mongolfieri*	*L. vespertillo*	*T. triacantha*	*L. fab constrictum*	*L. fab. chaunothorax*	*E. lagena*	*E. fistuligerum*	*P. mitra*	*S. triconiscus*	*P. ampla fasciolata*	*P. trachodes*	*P. chalara*	*P. goetheana*	*T. bromia*	*C. turris*	*P. ampla ampla*	*T. pirum*	*L. aristotelis* group	*T. tetracantha*	*C. azyx*	*T. triceros*	*L. jacchia*	*L. amphitrite*	*A. gracilis*	*C. milowi*
upper Eocene	*T. bromia*	28-3,77-79		F		+	+	R					C	F	C				F	F						C	F			R	F	R		R			
		28-4, 75-77																		F										R							-
		28-5, 95-97		R																F				F			F			-	F						
		28-6, 31-32																										R	+	+	-	F			F		+
		28-6, 99-101		-																						-	-	R	-	-	-	F	-	-	F		+
		29-1, 109-111		F				R					F		F				F	R	R						F	F	R	F	F	R	R	F	-	R	-
		29-2, 135-137							R											R				R													
		29-5, 70-72	+	R																-	R				-		R	F		-	F	F	R	R	F	-		-
		30-2, 63-65		-																							R	F		R	F	R	-	F	F	-	-	-
		30-3, 14-16		+																	R						R			-	R	R	-	F	F	-	R	-
		31-2, 23-25		R											F				F		R		R	R			F	F		R	R	F	F	R	F	R	R	-
		31-2, 70-72		R				+													R						R	F		R	R	R	R	R	F	R	R	-
		32-3, 100-112							F											F				R				+						R			
		32-4, 60-62		-																						-	-		R	R	-	-	F	F	R	R	-
		32-CC																								+			F	F	+	+	F	F	+	F	-
	T. bromia	33-1, 77-79	R	-			+																				R	+		R	F	F	+	F	F	F	-	-
		33-2, 8-10							F											R				R													
		33-2, 24-26		R					-											-	R				-		-	R		R	F	F	-	F	F	F	+	-
		33-CC		-					-											-	-						-	-		R	F	-	-	R	F	F	R	-
		34-CC				R			F						R		R			R												R						
		35-1, 15-17	R						+		R		F								-						R	R		F	F	R	+	F	F	F	R	-
		35-CC		+																	-						R	R		R	F	F	+	F	F	R	R	-
		36-1, 77-79		R							+			+							R						F	R		R	F	F	R	R	F	+?	-	-
		36-2, 45-47		R			+																				C	F		R	F	C	F	F	F	-	-	-
		36-2, 103-105		F					+					-													F	F		R	F	F	F	F	F	+?	-	-
		36-CC		R					+					-													C	F		-	F	F	F	R	F	-	-	-
		37-1, 87-89	R	F			R		F				C	R	C				F	F	R	R	F	R		C	F	+		R	R	R		-	-		
		37-2, 42-44		R					R	+				R					F	R		R	R									F		-			
		37-2, 143-145												R																+							
		37-3, 139-141							F					F						R				R		F	F	R		+		R					
		37-4, 141-142								+			C	F	C				F									R			R	F	F				
		37-5, 65-67	R	F					F					F	C				F	F	R	R	F	R	-	F	F	+			F	F	R				
		37-6, 68-70							F					F						F				F					R	R		F	F				
		37-CC							F	+				F	C			R	F	F		R	R	F		R	F	+	R	R	R	R	R	-			
	P. goetheana	38-1, 111-113		C					-		R		C		C			R	F	-		-	-	-	-	F	R		-	-	-	-	-	-	-	-	-
		38-2, 100-102	R				R		F	+				F	C							-	R	-	-	R	-	-	R	+	-	-	-	-			
		38-3, 32-34	R	F																R		+	R	-	-	+	R	+	-	-	-	-	-	-	-	-	-
		38-4, 69-71	R				R						C		C			R	C	C	R	-	R	+	-	-	R	-	-	-	-	-	-	-			
		38-5, 66-68																		C		-		R	+	R	-	-	-	-				-			
		38-CC		F			+		F										F	F	R	-		R	+	R	-	-	-	-	-	-	-	-	-	-	-
mid. Eoc.	*P. chalara + P. mitra*	39-2, 114-116	R	F					F	R			A	F	C			R	C	C	+	-	R	R	-	-	-	-	-	-	-	-	+	-	-	-	-
		39-3, 68-70	R	F						-				F	F			R	F	F	R	+	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39-4, 103-105	-	F					R	-				R	F			R	F	F	R	R	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39-5, 9-11	R	F		R	R	+	R	-	-	-	C	R	F	-	-	R	F	F	R	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
	P. ampla	41-CC	R	F		+	R	R	R	R	F	R	C	+	+	+	R	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
middle Miocene	*C. petterssoni*	A1-1, 42-43																																			
		A1-2, 99-101											+																								
		A1-3, 50-52																																			
		A1-4, 47-49							+				R		+								+														
		A1-5, 138-140																+																			
		A1-6, 73-75											+		+								+														
		A1-CC							+				+					+																			
Oligocene	*D. ateuchus*	A2-1, 38-40		R	R				R				R	+	R			+	+	+	+			R		R	+			-		R	-	-	R	F	-
		A2-1, 42-44																									-			-		+	-	-	-	F	-
		A2-1, 87-89																									-			-			-	-	R	F	-
		A2-6, 41-43							F				R	R	F				R		R			R		R	-			+		+	R	R	R	F	-
	T. tuberosa	A2-CC		R	R				F				R	R	F				R				R	R		R	F	+		R	R	R	F	-	R	F	R

Table 1. (Continued).

C. gravida	*L. crux*	*T. tuberosa*	*L. angusta*	*T. annosa*	*D. ateuchus*	*S. delmontensis*	*L. elongata*	*C. cingulata*	*C. cornuta*	*C. tetrapera*	*C. virginis*	*C. bramlettei*	*S. wolffii*	*D. dentata*	*D. alata*	*L. neotera*	*L. renzae*	*C. costata*	*P. corona*	*A. doliolum*	*S. corbula*	*C. laticonus*	*O. antepenultimus*	*L. thornburgi*	*S. peregrina*	*C. petterssoni*	*D. ontongensis*	*O. hughesi*	*P. prismatium*	*A. tritubus*	*S. omnitubus*	*S. berminghami*	*S. pentas*	*S. tetras*	Preservation	Sorting?	Estimated Reworking (%) Mio.	Olig.	Eoc.	Cret.
			-	-																														M	N			5	
																																		M	C			10	
				-																														M	C			20	
-	-	+	-	R	R																													M	W				
-	-	-	-	R	R																													M	N				
	-	-	-	-	-																													M	W			1	
																																		M	C			10	
	-	-	-	-																														M	N			1	
	-	-	-	-																														P	N				
	-	-	-	-																														M	N				
	-	-	-	-																														M	N			1	
	-	-	-	-																														M	N			1	
				R		R																												M	C			10	
	-	-	-	-																														M	N				
	-	-	-	-																														M	N				
	-	-	-	-		+																												M	W			1	1
																																		M	C			10	
	-	-	-	-																														M	C			1	
	-	-	-	R																														M	N				
																																		M	C			50	
	-	-	-	-																														M	W			1	
	-	-	-	-																														M	N				
	-	-	-	-																														M	N			1	
	-	-	-	-																														M	C			1	
	*	*	*	*																														M	C			1	
	-	-	-	-																														M	C			1	
			-																															M	C			20	
				-																														M	C			20	
				-																														M	C			10	
				-																														M	C			20	
			-																															M	C			30	
																																		M	C			30	
																																		M	C			30	
-	-	-	-																															M	C			30	
																																		M	N				
	-	-	-	-																														M	N			10	
																																		M	C			1	
																																		M	C			5	
																																		M	C			20	
-	-	-	-																															M	W			?	
																																		M	C			?	
																																		M	C			?	
																																		M	C			?	
																																		M	C			?	
							-	+	-		-	-	R	-	-	R	F	-	-	F	F	R	F	R	R	F	-	-	-	-	-	-			G	N				
+							-	-	F		R	-	R	F	-	R	R	-	+	R	F	-	R	-	+	+	-	-	-	-	-	-			M	N			1	
							-		+		+			R			+		+	R	R		R		-	-		+	-						G	N			1	
					+		-	-	F		R	+	-	F	R	R	F	+	+	F	+	-	F	+	+	F	-	+						G	N		1	1	
							-	+	F		R	-	-	F	-	R	F	R	+	F	F	R	F	R	R	R	-	+						G	N				
							+	R	F		+	+	-	F	-	R	F	R	+	F	F	-	F	R	R	F	-	+		-				M	N			1	
																																		M	N			1	
	R	-	+	R	R	R	-	-																										M	N			5	
	-	-	-	+	F	R	-	-																										P	C				
	-	-	-	R	F	F	-	-																										P	C				
	R	+	F	R	R	R	-	-																										M	N			5	
	C	-	F	R	-	R	-	-																										M	N			30	

Lithopera renzae **Sanfilippo and Riedel**
Lithopera renzae Sanfilippo and Riedel, 1970, p. 454, pl. 1, figs. 21–23, 27. Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 11.
Lithopera thornburgi **Sanfilippo and Riedel**
Lithopera thornburgi Sanfilippo and Riedel, , 1970, p. 455, pl. 2, figs. 4–6. Riedel and Sanfilippo, 1978, p. 70, pl. 6, fig. 12.
Lophocyrtis jacchia **(Ehrenberg)**
Thyrsocyrtis jacchia Ehrenberg, 1873, p. 261.
Lophocyrtis jacchia (Ehrenberg), Riedel and Sanfilippo, 1978, p. 70, pl. 7, fig. 1.
Lychnocanoma amphitrite **Foreman**
Lychnocanoma amphitrite Foreman, 1973, p. 437, pl. 11, fig. 10. Riedel and Sanfilippo, 1978, p. 70, pl. 7, figs. 2, 3.
Lychnocanoma elongata **(Vinassa)**
Tetrahedrina elongata Vinassa, 1900, p. 243, pl. 2, fig. 31.
Lychnocanoma elongata (Vinassa), Riedel and Sanfilippo, 1978, p. 70, pl. 7, fig. 4.
Ommatartus antepenultimus **Riedel and Sanfilippo**
Ommatartus antepenultimus Riedel and Sanfilippo, 1970, p. 521, pl. 14, fig. 4. Westberg and Riedel, 1978, p. 22, pl. 2, figs. 4, 5.
Ommatartus hughesi **(Campbell and Clark)**
Ommatocampe hughesi Campbell and Clark, 1944, p. 23, pl. 3, fig. 12.
Ommatartus hughesi (Campbell and Clark), Riedel and Sanfilippo, 1978, p. 71, pl. 7, fig. 7.
Phormocyrtis striata exquisita **(Kozlova)**
Podocyrtis exquisita Kozlova, *in* Kozlova and Gorbovetz, 1966, p. 106, pl. 17, fig. 2.
Phormocyrtis striata exquisita (Kozlova), Riedel and Sanfilippo, 1978, p. 71, pl. 7, fig. 10.
Phormocyrtis striata striata **Brandt**
Phormocyrtis striata Brandt, 1935, *in* Wetzel, 1935, p. 55, pl. 9, fig. 12.
Phormocyrtis striata striata Brandt, Riedel and Sanfilippo, 1978, p. 71, pl. 7, fig. 11.
Phormostichoartus corona **Haeckel**
Cyrtophormis (Acanthocyrtis) corona Haeckel, 1887, p. 1462, pl. 77, fig. 15.
Phormostichoartus corona Haeckel, Riedel and Sanfilippo, 1978, p. 71, pl. 7, fig. 12.
Podocyrtis ampla ampla **Ehrenberg**
Podocyrtis ampla Ehrenberg, 1873, p. 248. Riedel and Sanfilippo, 1978, p. 71, pl. 8, fig. 1.
Podocyrtis ampla fasciolata **Nigrini**
Podocyrtis ampla fasciolata Nigrini, 1974, p. 1069, pl. 1K, figs. 1, 2; pl. 4, figs. 2, 3. Riedel and Sanfilippo, 1978, p. 71, pl. 8, fig. 2.
Podocyrtis chalara **Riedel and Sanfilippo**
Podocyrtis chalara Riedel and Sanfilippo, 1970, p. 535, pl. 12, figs. 2, 3. Riedel and Sanfilippo, 1978, p. 71, pl. 8, fig. 3.
Podocyrtis diamesa **Riedel and Sanfilippo**
Podocyrtis diamesa Riedel and Sanfilippo, 1970, p. 533, pl. 12, figs. 4–6. Riedel and Sanfilippo, 1978, p. 72, pl. 8, fig. 4.
Podocyrtis goetheana **(Haeckel)**
Cycladophora goetheana Haeckel, 1887, p. 1376, pl. 65, fig. 5.
Podocyrtis goetheana (Haeckel), Riedel and Sanfilippo, 1978, p. 72, pl. 8, fig. 6.
Podocyrtis mitra **Ehrenberg**
Podocyrtis mitra Ehrenberg, 1854, pl. 36, fig. B20. Riedel and Sanfilippo, 1978, p. 72, pl. 8, fig. 7.
Podocyrtis sinuosa **Ehrenberg**
Podocyrtis sinuosa Ehrenberg, 1873, p. 253. Riedel and Sanfilippo, 1978, p. 72, pl. 8, fig. 9.
Podocyrtis trachodes **Riedel and Sanfilippo**
Podocyrtis trachodes Riedel and Sanfilippo, 1970, p. 535, pl. 11, fig. 7; pl. 12, fig. 1. Riedel and Sanfilippo, 1978, p. 72, pl. 8, fig. 10.
Pterocanium prismatium **Riedel**
Pterocanium prismatium Riedel, 1957, p. 87, pl. 3, figs. 4, 5. Riedel and Sanfilippo, 1978, p. 72, pl. 9, fig. 1.
Sethochytris triconiscus **Haeckel**
Sethochytris triconiscus Haeckel, 1887, p. 1239, pl. 57, fig. 13. Riedel and Sanfilippo, 1978, p. 73, pl. 9, fig. 6.
Siphocampe corbula **(Harting)**
Lithocampe corbula Harting, 1863, p. 12, pl. 1, fig. 21.
Siphocampe corbula (Harting), Riedel and Sanfilippo, 1978, p. 73, pl. 9, fig. 7.
Solenosphaera omnitubus **Riedel and Sanfilippo**
Solenosphaera omnitubus omnitubus Riedel and Sanfilippo, 1971, p. 1586, pl. 1A, fig. 24; pl. 4, figs. 1, 2. Riedel and Sanfilippo, 1978, p. 73, figs. 8, 9.
Spongaster berminghami **(Campbell and Clark)**
Spongasteriscus berminghami Campbell and Clark, 1944, p. 30, pl. 5, figs. 1, 2.
Spongaster berminghami (Campbell and Clark), Riedel and Sanfilippo, 1978, p. 73, pl. 2, figs. 14–16.
Spongaster pentas **Riedel and Sanfilippo**
Spongaster pentas Riedel and Sanfilippo, 1970, p. 523, pl. 15, fig. 3. Riedel and Sanfilippo, 1978, p. 74, pl. 2, figs. 5–8.
Spongaster tetras **Ehrenberg**
Spongaster tetras Ehrenberg, 1860, p. 833. Riedel and Sanfilippo, 1978, p. 74, pl. 2, figs. 2, 3.
Stichocorys delmontensis **(Campbell and Clark)**
Eucyrtidium delmontense Campbell and Clark, 1944, p. 56, pl. 7, figs. 19, 20.
Stichocorys delmontensis (Campbell and Clark), Westberg and Riedel, 1978, p. 22, pl. 3, figs. 1–5.
Stichocorys peregrina **(Riedel)**
Eucyrtidium elongatum peregrinum Riedel, 1953, p. 812, pl. 85, fig. 2.
Stichocorys peregrina (Riedel), Westberg and Riedel, 1978, p. 22, pl. 3, figs. 6–9.
Stichocorys wolffii **Haeckel**
Stichocorys wolffii Haeckel, 1887, p. 1479, pl. 80, fig, 10. Riedel and Sanfilippo, 1978, p. 74, pl. 9, fig. 12.
Theocampe mongolfieri **(Ehrenberg)**
Eucyrtidium mongolfieri Ehrenberg, 1854, pl. 36, fig. 18B.
Theocampe mongolfieri (Ehrenberg), Riedel and Sanfilippo, 1978, p. 76, pl. 9, fig. 13.
Theocampe pirum **(Ehrenberg)**
Eucyrtidium pirum Ehrenberg, 1873, p. 232.
Theocampe pirum (Ehrenberg), Riedel and Sanfilippo, 1978, p. 76, pl. 9, fig. 14.
Theocotyle cryptocephala cryptocephala **(Ehrenberg)**
Eucyrtidium cryptocephalum Ehrenberg, 1873, p. 227.
Theocotyle cryptocephala cryptocephala (Ehrenberg), Riedel and Sanfilippo, 1978, p. 78, pl. 9, fig. 19.
Theocotyle cryptocephala nigriniae **Riedel and Sanfilippo**
Theocotyle cryptocephala nigriniae Riedel and Sanfilippo, 1970, p. 525, pl. 6, figs. 5, 6. Riedel and Sanfilippo, 1978, p. 78, pl. 9, fig. 19.
Theocyrtis annosa **(Riedel)**
Phormocyrtis annosa Riedel, 1959, p. 295, pl. 2, fig. 7.
Theocyrtis annosa (Riedel), Riedel and Sanfilippo, 1978, p. 78, pl. 10, fig. 3.
Theocyrtis tuberosa **Riedel**
Theocyrtis tuberosa Riedel, 1959, p. 298, pl. 2, figs. 10, 11. Riedel and Sanfilippo, 1978, p. 78, pl. 1, fig. 11.
Thyrsocyrtis bromia **Ehrenberg**
Thyrsocyrtis bromia Ehrenberg, 1873, p. 260. Riedel and Sanfilippo, 1978, p. 78, pl. 10, figs. 4, 5.
Thyrsocyrtis tetracantha **(Ehrenberg)**
Podocyrtis tetracantha Ehrenberg, 1873, p. 254.
Thyrsocyrtis tetracantha (Ehrenberg), Riedel and Sanfilippo, 1978, p. 80, pl. 10, figs. 8, 9.
Thyrsocyrtis triacantha **(Ehrenberg)**
Podocyrtis triacantha Ehrenberg, 1873, p. 254.
Thyrsocyrtis triacantha (Ehrenberg), Riedel and Sanfilippo, 1978, p. 82, pl. 10, figs. 10, 11.
Tristylospyris triceros **(Ehrenberg)**
Ceratospyris triceros Ehrenberg, 1873, p. 220.
Tristylospyris triceros (Ehrenberg), Riedel and Sanfilippo, 1978, p. 82, pl. 10, fig. 12.

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