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11. RADIOLARIAN STRATIGRAPHY, LEG 138[1]

T.C. Moore, Jr.[2]

ABSTRACT

A group of 46 radiolarian species was used in this study of Leg 138 sites. The recovery of the sections was complete in the intervals that were cored using the APC system and nearly complete in the deeper sections. The northeastern sites (844 and 845) were sampled down through the middle Miocene into the uppermost part of the lower Miocene (middle part of the *Calocycletta costata* Zone). In the southeastern sites and those of the eastern transect (846 through 854) sediments were of late Miocene age (*Diartus petterssoni* Zone) and younger. Preservation of the radiolarian fauna was good to moderately good in most of the sites. Only in Sites 853 and 854 was the section older than late Pliocene barren of radiolarians. Reworked older radiolarians were found in the upper Miocene and Pliocene parts of the sections in most sites. Reworked upper Miocene radiolarians were even found in the upper Pliocene of Sites 853 and 854 where the upper Miocene part of the sections were barren of radiolarians. The development of an orbitally tuned time scale for the last 10 m.y. allowed the differentiation between radiolarian datums that appear to be synchronous (within 150,000 yr) in the eastern equatorial Pacific Ocean and those which appear to be diachronous. Of the 39 datums examined in this time interval, only 10 met this working definition of synchrony within the study area.

INTRODUCTION

During Leg 138, 11 sites were drilled in the eastern equatorial Pacific Ocean: four in the extreme eastern portion of the basin, along 90°W longitude and seven farther to the west, along 110°W longitude (Table 1). These sites were positioned so as to sample biogenic sediments derived from all the major current systems of the equatorial Pacific (see "Introduction" chapter in Mayer, Pisias, Janecek, et al., 1992). The oldest sediments sampled at these sites were middle to late Miocene in age, with sites in the northeast containing sediments extending to the middle *Calocycletta costata* Zone and those in the southeast and west extending into the upper Miocene—generally to the *Diartus petterssoni* Zone. Radiolarians were found in all the sites; however, preservation of the fauna varied from site to site and from age to age. In the most northern sites (those that lie beneath the North Equatorial Current), sediments older than Pliocene were barren of radiolarians. All other sites contained radiolarians to just above basaltic basement. Usually, the sediments recovered within a few meters of basement were diagenetically altered and contained no siliceous microfossils.

Table 1. Leg 138 site locations.

Site	Latitude	Longitude
844	7°55.28′N	90°28.85′W
845	9°34.95′N	94°35.45′W
846	3°5.70′S	90°49.08′W
847	0°11.59′N	95°19.23′W
848	2°59.63′S	110°28.79′W
849	0°10.98′N	110°31.18′W
850	1°17.84′N	110°31.28′W
851	2°46.22′N	110°34.30′W
852	5°17.57′N	110°4.58′W
853	7°12.66′N	109°45.08′W
854	11°13.43′N	109°35.65′W

METHODS

Sampling and Sample Preparation

All sites were triple cored with the APC in their upper portions to ensure the full recovery of the section. Below the depth that the APC corer could penetrate (about 150 m in most sites), the XCB was used to core to basement. In a few cases, this lower section was also double-cored. A composite section was constructed for all holes at a site while on board the ship (Hagelberg, Shackleton, Pisias, et al., 1992). This composite section was based on the correlation of GRAPE, magnetic susceptibility, and scanned color data.

On board the ship, the radiolarian stratigraphy was defined primarily using three to six samples per core from only one hole. However, the detailed shipboard correlation of the holes allowed for the immediate use of a few samples from all holes at a site to constrain more closely individual biostratigraphic datums. This detailed hole-to-hole correlation also allowed for the construction of a composite section and the development of an efficient sampling plan for more closely spaced sampling after the cruise was over. During post-cruise sampling, additional samples were taken from Sites 845, 846, 848, and 852 to assure a resolution of individual datums in these sites of between 50 and 100 k.y.

Sample preparation followed the standard techniques described by Sanfilippo et al. (1985). Samples were commonly treated with NaOH to remove clays adhering to the tests and were sieved at 63 μm. A strewn slide of the coarse residue was prepared. The abundance of individual species has been denoted by R = rare (<10 specimens); F = few, (10–100 specimens); C = common (100–200 specimens), and A = abundant (>200 specimens) and has been summarized for each site in a species range chart (Figs. 1 through 11). In these charts, a "-" signifies that a species was looked for and not found, + = one or two specimens were found that were thought to be reworked, and ? = a dubious identification. For each sample examined, qualitative estimates of radiolarian abundance and preservation were made for the sample as a whole: 5 = abundant , 4 = common–abundant, 3 = common, 2 = few, 1 = rare, and 0 = barren; and for preservation, 3 = good, 2 = moderate, and 1 = poor. The relative abundance of reworked older radiolarians also has been indicated where they are present in the samples (3 = common, 2 = few, 1 = trace). These estimates are presented in the species range charts (Figs. 1 through 11).

Included in these range charts is a complete list of samples that were examined from a site. The samples from all holes have been ordered according to their composite depths (mcd, meters composite depth). The standard mbsf (meters below seafloor) also has been given for each sample. The magnetic reversal stratigraphy determined for each site is shown between the depth and sample columns. These data were taken from the "Magnetic Stratigraphy" sections of the site

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[2] Department of Geological Sciences, C.C. Little Bldg., University of Michigan, Ann Arbor, MI 48109-1063, U.S.A.

Site 844 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	Amphirhopalum ypsilon	Spongaster tetras	Collosphaera tuberosa	Stylatractus universus	Lamprocyrtis neoheteroporus	Anthocyrtidium angulare	Theocorythium vetulum	Theocorythium trachelium	Lamprocyrtis nigriniae	Pterocorys minythorax	Lamprocyrtis heteroporus	Pterocanium prismatium	Anthocyrtidium jenghisi	Theocalyptra davisiana	Stichocorys peregrina	Anthocyrtidium pliocenica	Phormostichoartus fistula	Lychnodictium audax	Phormostichoartus doliolum	Didymocyrtis penultima
Collosphaera tuberosa	0	1.40	Bruhnes	A 1H-1, 0-1	5	3		R	R	R					R	R	F				R						
	4.09	4.09		B 1H-3, 109-111	5	3		R	R	R	–				R	R	F				R						
	4.53	4.53		B 1H-CC	5	2		R	R	R	–				R	R	F				R						
Amphirhopalum ypsilon	9.1	9.60		C 1H-CC	5	3		–	R	–	R				R	R	F				R						
	8.6	9.73		B 2H-3, 110-112	4	2	1	R	R	–	R				R	R	F				R						
	9.94	11.43	J	A 1H-CC	5	3		R	R		R	–	–		R	R	F				R						
Anthocyrtidium angulare	11.6	12.73		B 2H-5, 110-112	4	2	1	R	R		R	R	R	–	R	R	F				R						
	14.48	15.61	O	B 2H-CC	4	2	1	R	R		R	R	R	F	R	–	F	–	–		R						
Pterocanium prismatium	27.6	19.05		B 4H-3, 113-114	3	1	2	R	R		R	R	–	F	–	–	–	R	R		R						
	18.62	19.92		C 2H-CC	3	1	3	R	–		R	R	–	F	–	–	–	R	–		R						
	18.1	20.35		B 3H-3, 110-112	5	2	3	–	R		R	R	–	C	–			R	R	–	R						
	30.6	22.05		B 4H-5, 113-114	4	2	3	–	R		R	–		C				R	R	R	R	–					
Anthocyrtidium jenghisi	21.1	23.35	Guass	B 3H-5, 110-112	3	2	3	R	R		R	–		C				R	–	R	–	R	–			–	
	33.48	24.93		B 4H-CC	3	2	2	R	R		R	–		F				–	R	R	–	F	R			–	
	24.05	26.05		B 3H-CC	3	2	3	–	–		R	–		–				–	–	–	–	–	–		–	–	–
Stichocorys peregrina	28.66	31.01	Gilbert	C 3H-CC	3	3	3	–	–		R			R				–	–	R		R	R	–	R	R	R
	27	31.70		D 1H-3, 0-1	3	2	3	–	–		R			R					–	R		F	R	R	R	R	R
	28.5	33.20		D 1H-3, 150-151	3	2	3	–	–		R			–					–	R		F	R	R	R	R	F

Figure 1. Site 844 Radiolarian species range chart. Samples ordered by meters composite depth (mcd). Magnetostratigraphy from site chapters in Mayer, Pisias, Janecek, et al. (1992) and Schneider et al. (this volume). Abundance estimates (Ab) of radiolarians in the total sample: 5 = abundant , 4 = common-abundant, 3 = common, 2 = few, 1 = rare, 0 = barren. Preservation estimates of the radiolarian assemblages: 3 = good, 2 = moderate, 1 = poor. The presence of reworked, older radiolarians (Mx): 3 = common, 2 = few, 1 = trace. Relative abundance of individual species: R = rare (<10 specimens); F = few, (10–100 specimens); C = common (100–200 specimens), and A = abundant (>200 specimens). A"-" signifies that a species was looked for and not found, + = one or two specimens found that are thought to be reworked, and ? = a dubious identification.

chapters in Mayer, Pisias, Janecek, et al. (1992) and from subsequent corrections to this report (Schneider et al., this volume), to which the reader should refer for precise locations of the magnetic boundaries. The magnetic data presented here are an expedient way of showing the occurrence of biostratigraphic datums relative to the paleomagnetic stratigraphy available for a site.

Species Selection

Not every radiolarian species of stratigraphic usefulness has been noted in this study. A list of those species chosen, together with taxonomic references and notes, is given in the Appendix. In general, the species selected are relatively easy to identify, are robust, and although not necessarily abundant, consistently appear within their normal stratigraphic range. With a few exceptions I have also avoided the use of species that have a gradual morphologic transition in their evolutionary linages (e.g., much of the *Didymocyrtis* lineage). Exceptions to this general rule include those species whose first or last appearances define zonal boundaries (e.g., *Diartus petterssoni–D. hughesi*).

The data presented in Alexandrovich (1992) and Johnson et al. (1989), as well as in earlier works (Johnson and Nigrini, 1985; Johnson and Wick, 1982; Theyer et al., 1978; Johnson and Knoll, 1975), have indicated (1) which species appear to have synchronous first and last appearances, (2) which ones appear to be diachronous, and (3) which are questionable. For stratigraphic purposes I have tried to include all those species that meet the criteria listed above and that appear to have synchronous first or last appearances. For the purpose of investigating the nature of diachronous events, I have also included several species that do not have synchronous datums within the eastern equatorial Pacific Ocean.

Zonation

Recently, Johnson et al. (1989) proposed a new and very detailed radiolarian stratigraphy for the tropical Indian Ocean that has been tied to paleomagnetic stratigraphy. However, this zonation only extends back into the Pliocene and involves a redefinition of the *Stichocorys peregrina* Zone, which makes it difficult to merge their new zonation with the most widely used zonation of tropical Cenozoic radiolarians published by Sanfilippo et al. (1985). Johnson et al. (1989) also noted that a few of the species used in their zonation are rare in the Pacific Ocean; thus, it might be inappropriate to use all of this zonation in the region sampled during Leg 138. To overcome these difficulties and yet to take advantage of a finer zonal resolution, the zonations of Johnson et al. (1989) and Sanfilippo et al. (1985) have been emended and joined into a single zonal scheme. In so doing, species that are easily recognized, usually well preserved, and minimally diachronous have been selected to serve as zonal markers. In the *Initial Reports* volume for this leg, a different zonal scheme was used in an attempt to merge the zonations of Johnson et al. (1989) and Sanfilippo et al. (1985). This scheme was set up early in the cruise. Subsequent study has shown that many of the species used in that trial scheme did not meet the criteria listed above; thus, it was abandoned.

ZONAL DEFINITIONS

Buccinosphaera invaginata (Johnson et al., 1989; Nigrini, 1971; Caulet, 1979).

Defined by the range of *Buccinosphaera invaginata*.

Remarks. The nominate species for this zone was not noted in the samples investigated from Leg 138 samples, probably because of inadequate sample spacing at the top of the section.

Collosphaera tuberosa (Johnson et al., 1989; Nigrini, 1971; Caulet, 1979).

Top = FAD of *Buccinosphaera invaginata*. **Bottom** = LAD of *Stylatractus universus*.

Stylatractus universus (Johnson et al., 1989; Nigrini, 1971; Caulet, 1979).

Top = LAD of *Stylatractus universus*. **Bottom** = FAD of *Collosphaera tuberosa*.

Site 844 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*	*Carpocanopsis cristata*	*Lithopera thornburgi*	*Cyrtocapsella cornuta*	*Lithopera renzae*	*Dorcadospyris alata*	*Giraffospyris toxaria*	*Calocycletta caepa*	*Calocycletta robusta*	*Stichocorys armata*	*Liriospyris parkerae*	*Acrocubus octopylus*
S. peregrina	30	34.70	C3A	D 1H-4, 150-151	3	2	2	F	R	_	R	_												_				
Didymocyrtis penultima	37.1	40.75		B 5H-3, 114-116	4	3	1	R	R	R	C	R												R				
	38.18	42.33		C 4H-CC	5	3	2		R	R	C	_												F				
	40.1	43.75		B 5H-5, 114-116	5	3			_	R	C	R	_	_										R				
Didymocyrtis antepenultima	42.9	46.55	C4	B 5H-CC	5	3			_	R	C	R	C	_										F				
	46.6	50.70		B 6H-3, 110-111	5	2				R	C	_	C	R	_									F				
	48.5	52.60		B 6H-4, 150-151	5	2	1			R	C	_	C	R	R									F				
	47.56	52.81		C 5H-CC	4	2	1			R	C	R	C	R	R									F				
	49.6	53.70	C4A	B 6H-5, 110-111	4	2	1			R	C	R	C	R	R	_	_							F				
Diartus petterssoni	52.52	56.62		B 6H-CC	5	3	1			R	C	R	_	R	C	R	*		_					F				
	56.1	62.80		B 7H-3, 110-111	5	3	1			_	C	R		R	C	R	*		R					F				
	57.2	63.85		C 6H-CC	5	3	2			_	C	_		R	C	F	*	_	R					F				
	59.1	65.80	C5	B 7H-5, 110-111	5	3	1				C	R		R	C	F	*	_	_					F				
	62.09	68.76		B 7H-CC	5	3	2				C	R		R	C	F	F	_	R					F				
	65.6	72.75		B 8H-3, 110-111	3	2	1				C	R		R	C	F	F	R	_					F				
	66.73	74.38		C 7H-CC	4	2					C	R		R	C	F	F	_	R					F				
	68.6	75.75		B 8H-5, 110-111	4	2	1				C	R		R	C	F	F	R	R					R				
	71.46	78.61		B 8H-CC	3	2					F	R		R	R	F	F	R	_					R				
	75.2	83.85		B 9H-3, 123-124	5	3	1				C	R		R	F	F	F	R	R					F				
	76.3	85.61		C 8H-CC	5	3	1				C	R		R	F	F	F	R	R					F				
	81.1	89.75		B 9H-CC	5	3					C	R		R	R	F	F	R	R					F				
	84.6	95.23		B 10H-3, 110-111	5	3					C	R		R	F	F	C	_	_					F				
	85.78	95.96		C 9H-CC	5	3					C	R		R	C	F	F	_	_					F				
	87.6	98.23		B 10H-5, 110-111	5	3					C	_		R	F	F	C	R	R					C				
	90.27	100.90		B 10H-CC	5	3					C	R		R	R	R	C	_	R					C				
	94.92	105.93		C 10H-CC	5	3					C	R		R	F	F	C	R	R					C				
	94.1	107.60		B 11H-3, 110-111	5	3					C	R		R	R	F	F	R	R	_				C				
	97.1	110.60		B 11H-5, 110-111	5	3					C	R		R	R	R	_	R	_	R	_	_		C				
Dorcadospyris alata	99.99	113.49		B 11H-CC	5	3					C	R		R	_	R	_	_	_	R	R	R		C				
	104.66	116.61		C 11H-CC	5	3					C	R		R	_	F	R	R	_	C	R	R		C				
	104	117.53		B 12H-3, 106-107	5	3					C	R		R		F	R	_	R	C	R	R		C				
	109.59	123.12		B 12H-CC	5	3					F	_		R		F	R	_	R	F	_	_		R				
	114.15	126.15		C 12H-CC	5	3					C	_		R		F	R	_	R	C	R	R		C				
	113	126.80		B 13H-3, 109-110	5	3					C	R		R		F	_	R	R	C	R	_		F				
	118.95	132.75		B 13H-CC	5	3					C	R		R		F	_	_	R	C	R	_		C				
	123.62	136.62		C 13H-CC	5	3					C	R		R		F	_	R	R	C	R	_		C	_			
	123	137.83		B 14H-3, 110-112	5	3					F	R		R		F		_	R	C	R	_		C	R			
	128.26	143.09		B 14H-CC	5	3					F	R		R		F		_	R	C	R	_		C	R			
	132	147.00		B 15H-3, 110-111	5	3					F	R		R		F		R	R	C	R	_		C	R			
	135	150.00		B 15H-5, 110-111	5	3					C	R		R		F		R	R	C	R	_		C	R			
	137.82	152.82		B 15H-CC	5	3					C	R		R		F		R	_	C	R	_		C	R			
	142.8	157.70		C 15H-CC	5	3					C	R		R		F		R	_	C	R	R		C	R			
	142	158.18		B 16H-3, 110-111	5	3					C	R		R		F		_		C	R	_	_	C	R			
	147.43	163.61		B 16H-CC	5	3					C	R		R		F		_		C	R	_	_	C	R			
	151	166.60		B 17H-3, 110-111	5	3					C	R		R		F		_		C	R	R	_	F	R			
	154	169.60		B 17H-5, 110-111	5	3					F	R		R		F		R		C	R	R	_	F	R			
	157.07	172.67		B 17H-CC	5	3					C	R		R		F		_		C	R	_	_	R	F			
	161	178.05		B 18H-3, 110-111	5	3					C	R		R		F		R		C	R	R	_	R	F			
	161.5	178.50		C 17H-CC	5	3					C	R		R		F		_		C	R	R	R		F			
	166.43	183.48		B 18H-CC	5	3					C	R		R		F		_		C	R	_	_		F	R		
	170	187.20		B 19H-3, 98-99	5	3					C	R		R		F		_		C	R	R	_		F	F		
	171.19	188.14		C 18H-CC	5	3					F	R		R		F		_		C	R	R	_		C	F		
	175.83	193.03		B 19H-CC	5	3					C	R		R		F		_		C	R	_	_		F	C		_
	180	198.63		B 20H-3, 110-111	5	3					F	R		R		F		R		C	R	R	_		C	C		_
	180.8	200.15		C 19H-CC	5	3					F	R		R		F		_		C	R	R	_		C	C		_
	183	201.63		B 20H-5, 110-111	5	3					F	R		R		R		_		C	R	_	_		C	C	_	_
	185.58	204.21		B 20H-CC	5	2					C	R		R		_		R		C	R	_	R		C	C	R	_
	189	207.63		B 21X-3, 110-112	5	2					C	R		R		R		_		C	R	_	_		C	F	R	R
	192	210.63		B 21X-5, 110-112	5	2					C	R		R		R		_		C	R	_	R		C	F	R	R
	194.69	213.32		B 21X-CC	5	2					C	R		R		R		_		C	R	R	_		C	F	R	R

Figure 1 (continued).

Amphirhopalum ypsilon (Johnson et al., 1989; Nigrini, 1971; Caulet, 1979).

Top = FAD of *Collosphaera tuberosa*. **Bottom** = LAD of *Anthocyrtidium angulare*.

Anthocyrtidium angulare (Johnson et al., 1989; Nigrini, 1971; Caulet, 1979).

Top = LAD of *Anthocyrtidium angulare*. **Bottom** = LAD of *Pterocanium prismatium*.

Remarks. Events usually included in this Zone are FAD *Lamprocyrtis nigriniae* and LAD *Lamprocyrtis neoheteroporos*.

Pterocanium prismatium (Sanfilippo et al., 1985).

Top = LAD of *Pterocanium prismatium*. **Bottom** = LAD of *Stichocorys peregrina*.

Remarks. Events usually included in this zone are as follows:

Site 844 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Acrocubus octopylus*	*Carpocanopsis bramlettei*	*Calocycletta costata*	*Dorcadospyris dentata*	*Liriospyris stauropora*	*Eucyrtidium diaphanes*	*Carpocanopsis cingulata*	*Didymocyrtus prismatica*
Dorcadospyris alata	199	217.63		B 22X-3, 110-111	5	3		—	—						
	204.27	222.90		B 22X-CC	5	2		R	R	—					
	208	226.63		B 23X-3, 110-111	5	2		—	—	*					
	211	229.63		B 23X-5, 110-111	5	2		R	R	—					
Calocycletta costata	213.9	232.90		B 23X-CC	5	3		R	R	F					
	218	236.63		B 24X-3, 110-111	5	3		R	R	F	—				
	221	239.63		B 24X-5, 110-111	5	2		R	—	F	*				
	223.65	242.28		B 24X-CC	5	2		R	R	R	—				
	228	246.63		B 25X-3, 109-111	5	2		R	R	C	R				
	231	249.63		B 25X-5, 109-111	5	2		R	R	C	F				
	232.04	250.67		B 25X-CC	5	3		R	R	F	R	—			
	237	255.63		B 26X-3, 112-113	4	3		R	R	F	F	R			
	240	258.63		B 26X-5, 109-110	5	3		R	R	F	R	R	—		
	243.06	261.69		B 26X-CC	5	3		R	R	F	R	R	R		
	243.3	261.93		B 27X-CC	5	3		R	R	F	R	R	R		
	261.66	280.29		B 28X-CC	5	3		R	—	R	R	R	R		
	266	284.63		B 29X-3, 110-111	5	2		R	R	F	R	R	R	—	
	269	287.63		B 29X-5, 109-110	5	2		R	R	F	R	R	F	R	
	271.75	290.38		B 29X-CC	4	2		R	R	—	R	R	R	R	
	281.47	300.10		B 30X-CC	5	2		—	—	R	—	R	R	—	—
	288	306.63		B 31X-5, 110-111	4	2		—	R	F	R	—	R	R	R

Figure 1 (continued).

1. LAD of *Anthocyrtidium jenghisi,*
2. FAD of *Anthocyrtidium angulare,*
3. LAD of *Theocorythium vetulum,*
4. FAD of *Theocalyptra davisiana,* and
5. FAD of *Theocorythium trachelium.*

Anthocyrtidium jenghisi (Johnson et al., 1989, emended herein).

Top = LAD of *Stichocorys peregrina.* **Bottom** = LAD of *Phormostichoartus doliolum.*

Remarks. The last appearance datum of *A. jenghisi* appears to be diachronous within the eastern equatorial Pacific (Table 14); therefore, the definition of the upper boundary of this zone (as used in this study) has been changed to be coincident with the LAD of *Stichocorys peregrina.* This datum may be diachronous as well; however, I found it to be more consistent than that of *A. jenghisi* in the material studied. The base of the *A. jenghisi* Zone has been emended to coincide with the last appearance of *Phormostichoartus doliolum.* This change effectively does away with the *Phormostichoartus fistula* and *Stichocorys peregrina* zones, as used by Johnson et al. (1989). This latter change was necessary because *Phormostichoartus fistula* is extremely rare in the study area, and its LAD is markedly diachronous. Although these changes reduce the resolution of the zonal scheme, they do emphasize the use of synchronous datums and remove the confusion over the use of the *Stichocorys peregrina* Zone, engendered by the Johnson et al. scheme (1989).

Phormostichoartus doliolum (Johnson et al., 1989, emended herein).

Top = LAD of *Phormostichoartus doliolum.* **Bottom** = LAD of *Didymocyrtis penultima.*

Remarks. *Anthocyrtidium prolatum,* the LAD of which was used by Johnson et al. (1989) to define the base of this zone, has not been consistently found in the eastern equatorial Pacific. The LAD of *Didymocyrtis penultima,* which apparently occurs somewhat before the LAD of *Anthocyrtidium prolatum,* has been substituted as a zonal marker.

Stichocorys peregrina (Sanfilippo et al., 1985, emended herein).

Top = LAD of *Didymocyrtis penultima.* **Bottom** = Evolutionary transition from *Stichocorys delmontensis* to *Stichocorys peregrina.*

Remarks. Neither *Spongaster pentas* nor *S. berminghami* (the evolutionary transition of which was used by Sanfilippo et al. [1985] to define the top of this zone) were found consistently in the sites studied. Furthermore, Johnson et al. (1989) found that the FAD of *S. pentas* was diachronous in the tropical Indian Ocean. The LAD of *Didymocyrtis penultima* has been substituted as a zonal marker. Events usually included in this zone are as follows:

1. LAD of *Solenosphaera omnitubus,*
2. LAD of *Calocycletta caepa,* and
3. LAD of *Stichocorys johnsoni.*

Didymocyrtis penultima (Sanfilippo et al., 1985).

Top = Evolutionary transition from *Stichocorys delmontensis* to *Stichocorys peregrina.* **Bottom** = LAD of *Diartus hughesi.*

Remarks. Event usually included in this zone is the FAD of *Solenosphaera omnitubus.*

Didymocyrtis antepenultima (Sanfilippo et al., 1985).

Top = LAD of *Diartus hughesi.* **Bottom** = Evolutionary transition from *Diartus petterssoni* to *Diartus hughesi.*

Diartus petterssoni (Sanfilippo et al., 1985).

Top = Evolutionary transition from *Diartus petterssoni* to *Diartus hughesi.* **Bottom** = FAD of *Diartus petterssoni.*

Dorcadospyris alata (Sanfilippo et al., 1985).

Top = FAD of *Diartus petterssoni.* **Bottom** = Evolutionary transition from *Dorcadospyris dentata* to *Dorcadospyris alata.*

Calocycletta costata (Sanfilippo et al., 1985).

Top = Evolutionary transition from *Dorcadospyris dentata* to *Dorcadospyris alata.* **Bottom** = FAD of *Calocycletta costata.*

Remarks. The base of this zone was not identified in the sites drilled during Leg 138. The oldest datum recognized was the LAD of *Didymocyrtis prismatica* (in Sites 844 and 845), which is thought to occur within the middle part of the *C. costata* Zone (Sanfilippo et al., 1985).

RESULTS

Site 844

Radiolarians sampled at Site 844 range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the latest part of the early Miocene (*Calocycletta costata* Zone). The oldest material recovered that could be identified at the zonal level was from Sample 138-844B-31X-5, 110–111 cm. In general, radiolarians are well preserved and abundant in the samples studied (Fig. 1). However, a more thorough study of the fauna was hindered by several factors. First, in the Pleistocene–Pliocene part of the section, the accumulation rate is fairly low; thus, with the broad sampling scheme used (two samples per core plus core catchers), not all of the zonal boundaries and datum events could be precisely located. Second, in the *Anthocyrtidium angulare* through the upper part of the *Diartus petterssoni* zones (lower Pleistocene–upper Miocene), the samples contained rare-to-common reworked radiolarians from the older part of the section (upper and middle Miocene). This reworking was accompanied by a decrease in preservation and served to make zonal identifications more difficult. Third, many samples contained abundant diatoms, which masked the radiolarians. Finally, preservation was not uniformly good. Dissolution and reprecipitation of silica within the sediment aggregated it into clumps that remained after the initial acid treatment and sieving. In addition to the moderate-to-poor preservation in the Pliocene and uppermost Miocene, preservation in the upper part of the *Diartus petterssoni* Zone and in the lower part of the *Dorcadospyris alata* and *Calocycletta costata* zones was only moderate. In spite of these difficulties, the recovered section appears to be nearly complete.

Of the many species often identified in studies of radiolarians from tropical regions, a few do not seem to appear at this site. It may be that the rare occurrence of *Collosphaera tuberosa* results from its not appearing in this region of relatively high productivity. *Spongaster pentas* also was not found in any of the samples, and *Spongaster berminghami* was found only rarely. *Spongaster tetras*, however, appeared to be consistently present. Specimens of *Lamprocyrtis neoheteroporos* (as well as *L. heteroporos*) appear intermittently. Many stratigraphically important tropical species, such as *Dorcadospyris alata* and *D. dentata*, never dominate the assemblage, and in Leg 138 samples they were even more rare than usual. All of these slight differences noted in the assemblages of this site might be attributed to the cooler waters and highly productive character of the eastern tropical Pacific Ocean.

Site 845

Radiolarians sampled at Site 845 (Fig. 2) ranged in age from the Quaternary (*Collosphaera tuberosa* Zone) to the latest part of the early Miocene (*Calocycletta costata* Zone). The oldest material recovered is nearly identical with that of Site 844, with the last occurrence of *Didymocyrtis prismatica* found near the bottom of the section in both sites (in Samples 138-845A-30X-6, 110–111 cm, and 138-844B-31X-5, 110–111 cm).

The Pleistocene–Pliocene section has been expanded, but with only moderate-to-poor preservation of the radiolarian assemblage. *Spongaster pentas* was not identified, and *S. berminghami* was not found consistently. I also noted that *Theocorythium trachelium* was sparse and somewhat erratic in its occurrence, while its predecessor, *T. vetulum*, was common and consistently present in its normal range. Traces of reworked older radiolarians from the middle to upper Miocene section were found intermittently in the Pliocene and uppermost Miocene parts of the section.

Radiolarians were common to abundant throughout the Miocene interval, except in the section just above the basement (Core 138-845A-30X is barren of radiolarians below Section 1). Preservation in the rest of the Miocene section was generally moderate, with intervals of poor preservation within the *Diartus petterssoni* and *Dorcadospyris alata* zones. Dissolution and reprecipitation of silica within the sediment aggregated it into clumps that remained after initial acid treatment and sieving.

All the major radiolarian zones of the upper and middle Miocene sections were identified, as were most of the datums commonly noted by previous studies of the tropical oceans. One datum is of particular interest. Just below the base of the *Diartus petterssoni* Zone occurs the apparent final appearance of *Dorcadospyris alata*. The legs of the specimens in these samples are more robust than usual for *D. alata*, and the spines on the legs are barely discernable. Below this level, a short interval was observed where specimens of *D. alata* are not found; and deeper, the more typical form of *D. alata* appears. *D. alata* is the last known species in a long evolutionary lineage; however, the apparent final appearance of the robust form of *D. alata* is somewhat younger than the LAD for *D. alata* indicated in previous studies. It is unclear at present if this younger LAD results from a real stratigraphic difference, from differences in the time scales used, or possibly because previous studies have noted only the final appearance of the more typical *D. alata*.

Site 846

Radiolarians sampled in Site 846 (Fig. 3) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the middle Miocene (*Dorcadospyris alata* Zone). The oldest material that could be identified to the zonal level is from Sample 138-846B-38X-CC.

The Pleistocene–Pliocene section is highly expanded (average accumulation rate of approximately 4 to 5 cm/k.y.; Shackleton et al., 1992) and yielded a detailed record of radiolarian events. The radiolarian fauna is abundant and moderately well preserved. The range of *Spongaster berminghami* was impossible to define because of its rare occurrence. *Anthocyrtidium prolatum* and *Spongaster pentas* are not found in the samples studied.

Radiolarians are common to abundant throughout the upper and middle Miocene parts of the section, and preservation was moderate. Below Core 138-846B-32X, however, biogenic silica shows signs of dissolution and re-precipitation. All samples in deeper cores had to be treated with NaOH to break up sediment aggregates. In and below Core 138-138-846B-40X (in which chert was found), all samples studied were barren of radiolarians.

All the major radiolarian zones of the upper and middle Miocene were identified, as were most of the datums commonly noted by previous studies of the tropical oceans. Incomplete recovery of Cores 138-846B-25X and -26X made the placement of the boundary between the *Didymocyrtis penultima* and *Stichocorys peregrina* zones imprecise in this hole. The last occurrence of *Calocycletta caepa* also falls into this recovery gap. Cores 138-846D-25X and -26X, however, fill this gap nicely and tie down these datums to within about 2 m. *Lithopera thornburgi* appears to be unusually rare at this site. Little confidence should be placed in the noted ranges of this species. The dissolution of biogenic silica in the lower part of the section (below Core 138-845B-31X) may have removed some of the more delicate species (e.g., *L. thornburgi*) and added to the difficulty of accurately defining datum levels.

Site 847

Radiolarians sampled in Site 847 (Fig. 4) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late Miocene (*Diartus petterssoni* Zone). The oldest material recovered that could be identified to the zonal level was from Sample 138-847B-25X-CC.

Preservation and abundance of the radiolarians are generally good within the Pleistocene–Pliocene section. Slight dissolution and reprecipitation of biogenic silica does occur in this part of the section and necessitated the cleaning of many of the sieved residues with NaOH (even within Core 138-847B-1H). Only a trace amount of reworking of older radiolarians into the younger part of the section was seen.

Site 845 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Pr	Mx	Amphirhopalum ypsilon	Spongaster tetras	Collosphaera tuberosa	Stylatractus universus	Lamprocyrtis neoheteroporus	Anthocyrtidium angulare	Theocorythium vetulum	Theocorythium trachelium	Lamprocyrtis nigriniae	Pterocorys minythorax	Lamprocyrtis heteroporus	Pterocanium prismatium	Anthocyrtidium jenghisi	Theocalyptra davisiana	Stichocorys peregrina	Anthocyrtidium pliocenica	Phormostichoartus fistula	Lychnodictium audax	Phormostichoartus doliolum	Didymocyrtis penultima	Solenosphaera omnitubus	Stichocorys johnsoni	Stichocorys delmontensis
Collosphaera tuberosa	4.1	4.1		A 1H-3, 110-111	5	2		R	R	R	_				R	R	F				R									
	7.1	7.1		A 1H-5, 110-111	4	2		R	R	R	_				_	R	F				R									
	7.6	7.6		A 1H-CC	5	2		R	R	R	_				R	R	F				R									
	9.73	12.09		B 1H-CC	4	2		R	R	_	_				R	R	F				R									
Stylatractus universus	11.7	12.58		A 2H-3, 110-111	5	2		R	R	R	R				R	R	F				R									
	14.7	15.58		A 2H-5, 110-111	5	1		R	R	R	R				R	R	F				R									
Amphirhopalum ypsilon	17.21	18.09		A 2H-CC	5	1		_	R	_	R				_	R	F				R									
	21.2	22.06		A 3H-3, 110-111	5	1		R	R	?	R	_			R	R	F				R									
	22.04	22.9		A 3H-4, 44-45	4	1		R	R	_	R	_			_	R	R				R									
	22.82	23.68		A 3H-4, 122-123	5	2		R	R	_	R	_			R	R	R				R									
	23.61	24.47		A 3H-5, 51-52	4	1		_	R	_	R	_	_		R	R	R				R									
	24.2	25.06		A 3H-5, 110-111	5	2		R	R		R	R	?	_	_	R	R				R									
Anthocyrtidium angulare	25.11	25.97		A 3H-6, 51-52	4	1		R	R		R	R	R	_	_	R	R				R									
	25.59	26.45		A 3H-6, 99-100	4	1		R	R		R	R	R	_	_	R	R				R									
	26.99	27.85		A 3H-CC	4	1		R	R		R	R	R	F	R	R	R				R									
	27.4	29.53		A 4H-1, 80-81	4	1		R	R		R	R	R	R	R	_	R				R									
	28.2	30.33		A 4H-2, 10-11	4	1		R	R		R	R	R	R	R	_	R				R									
	29.84	30.84		C 1H-CC	4	1		R	R		R	R	R	F	_	_	R				R									
	28.98	31.11		A 4H-2, 88-89	4	2		R	R		R	R	R	R	R	_	R		_		R									
	30.7	32.83		A 4H-3, 110-111	4	1		R	R		R	R	R	F	R	?	R		_		R									
	31.52	33.65		A 4H-4, 42-43	4	1	1	R	R		R	R	R	F	_	?	R	_	_		R									
	33.7	35.83		A 4H-5, 110-111	4	2		_	R		R	R	R	F	_	_	_	R	_		R									
	35.09	37.22		A 4H-6, 99-100	4	1		R	R		R	R	R	R	_	_	_	R	_		R									
Pterocanium prismatium	36.49	38.62		A 4H-CC	5	2		R	R		R	R	R	F	_	_	_	R	R		R									
	36.3	39.81		A 5H-1, 20-21	4	1	1	R	R		R	R	_	R			_	R	R	_	R	_								
	37.09	40.6		A 5H-1, 99-100	4	1		_	R		R	R	_	R				R	_	_	R	_								
	39.52	41.4		C 2H-CC	4	1		R	R		R	_	_	F				R	R	*	R	_								
	40.2	43.71		A 5H-3, 110-111	0	0		_	_		_	_	_	_				_	_	_	_	_								
	43.2	46.71		A 5H-5, 110-111	5	2	2	R	R		R	R	_	F				R	_	R	R	_								
	46.09	49.6		A 5H-CC	5	2	2	R	R		R	R		F				R	R	R	R	_								
	48.63	51.93		C 3H-CC	4	2		R	R		R	R		F				R	_	R	R	_								
Anthocyrtidium jenghisi	48.08	52.16		A 6H-2, 98-99	4	1		R	R		R	R		R				R	_	R	_	R								
	48.8	52.88		A 6H-3, 20-21	4	1		R	R		R	R		F				R	R	R	_	R								
	49.7	53.78		A 6H-3, 110-111	5	2		R	R		R	R		F				R	R	R		R								
	50.5	54.58	K	A 6H-4, 40-41	3	1	1	R	R		R	_		R				R	_	R		R	_							
	51.29	55.37		A 6H-4, 119-120	4	1	1	R	R		R	R		R				_	_	R		R	_							
	52.1	56.18	M	A 6H-5, 50-51	4	1		R	R		R	_		R				_	R	R		R	_							
	52.7	56.78		A 6H-5, 110-111	4	1		_	_		R	_		R				_	_	R		R	_	_						
	55.64	59.72		A 6H-CC	4	1		R	R		R	_		F				_	R	R		F	R	R						
	55.31	60.17		A 7H-1, 21-22	4	1	1	_	R		R	_		R				_	R	R		F	_	R						
	56.09	60.95		A 7H-1, 99-100	4	1	1	_	R		R			R					R	R		F	_	R	_					
	56.9	61.76		A 7H-2, 30-31	4	1	1	_	R		R			R					R	R		F	R	R	_					
	57.7	62.56		A 7H-2,110-111	4	1		_	_		R			R					R	R		F	R	R	_					
	58.5	63.36		A 7H-3, 40-41	4	1		_	_		R			R					_	R		F	_	R	_	_				
Phormostichoartus doliolum	59.2	64.06		A 7H-3, 110-111	4	1			_		R			F					R	R		F	R	R	R	R				
	59.8	64.66		A 7H-4, 20-21	4	1	1				R			F					R	R		F	R	R	_	R				
	60.6	65.46		A 7H-4, 100-101	4	1					R			R					_	R		F	R	R	_	R				
	59.97	66.7	C	B 6H-CC	4	1					R			R					R	_		C	R	R	_	R				
	62.2	67.06		A 7H-5, 110-111	4	1	2				R			F					_	R		F	R	R	R	?				
	64.91	69.77	N	A 7H-CC	4	1	2				R			R					_	R		F	R	R	R	_	_			
	64.81	71.11		A 8H-1, 21-22	4	1					R			R					_	_		F	R	_	_	R	?			
Stichocorys peregrina	65.6	71.9	S	A 8H-1, 100-101	4	1	1				R			R						_		F	R	_	R	R	R			
	67.2	73.5		A 8H-2, 110-111	3	0					R			R						R		F	R	R	_	R	R			
	68	74.3	Th	A 8H-3, 40-41	4	1	1				R			–						R		F	R	R	R	R	R			
	68.7	75		A 8H-3, 110-112	4	1					R			–						_		F	R	R	R	R	F			
	69.85	76.46		B 7H-CC	4	1					R			R						_		C	R	R	R	R	R	_		
	70.85	77.15		A 8H-5, 25-26	4	1					R			R						R		F	R	R	R	R	R	_		
	71.7	78		A 8H-5, 110-112	4	1	3				R			–						R		F	R	R	R	R	R	R		
	74.55	80.85		A 8H-CC	5	2	3				R			–						R		F	R	R	R	R	R	_		
	78.2	86.21		A 9H-3, 110-111	4	1	3				R			–						R		F	R	R	R	R	R	R		
	80.1	88.11	C3An1	A 9H-4, 150-151	3	1					R									R		F	R	R	R	R	R	R		
	81.2	89.21		A 9H-5, 110-111	4	1					R									R		F	R	R	R	R	F	R		
	84.07	92.08		A 9H-CC	3	1	2				R									R		F	R	R	R	R	R	R		
	84.9	93.38		A 10H-1, 130-131	3	1	1				R									R		F	R	R	R	R	R	R		
	85.68	94.16	C3An2	A 10H-2, 58-59	4	1					R									R		F	R	R	R	R	R	R		
	86.5	94.98		A 10H-2, 140-141	3	0					R									R		F	R	R	R	R	R	R	_	_
	87.7	96.18		A 10H-3, 110-111	4	1	3				R									R		F	R	R	R	R	F	R	R	R
	89.06	97.92		B 9H-CC	3	1					R									R		F	R	R	R	_	R	_	_	R
	90.7	99.18		A 10H-5, 110-111	4	1	2				R									R		F	R	R	R	R	R	R	R	R
D. penultima	91.38	99.86		A 10H-6, 28-29	3	1					R									R		F	R	R	R	R	R	R	R	F

Figure 2. Site 845 radiolarian species range chart. Notation as specified in Figure 1.

Site 845 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	Solenosphaera omnitubus	Stichocorys johnsoni	Stichocorys delmontensis	Calocycletta caepa	Siphostichartus corona	Diartus hughesi	Botryostrobus miralestensis	Diartus petterssoni	Stichocorys wolffii	Cyrtocapsella japonica	Carpocanopsis cristata	Lithopera thornburgi	Cyrtocapsella cornuta	Lithopera renzae	Dorcadospyris alata	Giraffospyris toxaria	Calocycletta robusta
Didymocyrtis penultima	91.9	100.4		A 10H-6, 80-81	4	1		R	R	F		–												
	93.61	102.1		A 10H-CC	4	2	2	R	R	F	–	–												
	93.25	103	C3An3	A 11H-1, 15-16	4	1	1	–	R	F	R	?												
	94.4	104.2		A 11H-1, 130-131	4	2		R	R	F	R	R												
	95.22	105		A 11H-2, 62-63	4	1		–	R	F	R	R												
	96	105.8		A 11H-2, 140-141	4	1		–	R	F	R	–												
	97.2	107	C4n1	A 11H-3, 110-111	5	2		–	R	F	R	–												
	100	109.8		A 11H-5, 110-111	5	2	2	–	R	F	R	–	–											
	100.9	110.7		A 11H-6, 29-30	5	2			R	F	R	–	•											
Didymocyrtis antepenultima	101.4	111.2		A 11H-6, 80-81	4	1			R	F	R	R	R											
	103.2	113		A 11H-CC	5	2			–	F	R	R	R											
	102.8	114.1		A 12H-1, 20-21	4	2			R	F	R	–	F											
	103.9	115.2	C4n2	A 12H-1, 130-131	5	2			R	F	R	R	F											
	104.7	116		A 12H-2, 60-61	4	1			R	F	R	–	F											
	105.5	116.8		A 12H-2, 140-141	5	2			R	F	R	R	F											
	106.7	118		A 12H-3, 110-111	5	2			R	F	R	R	F											
	108.2	120.1		B 11H-CC	5	2			R	F	R	R	F											
	109.1	120.4		A 12H-5, 50-51	4	1			R	F	R	–	F											
	109.7	121	C4n3	A 12H-5, 110-111	5	2			R	F	R	R	F	–										
	110.4	121.7		A 12H-6, 30-31	5	2			R	F	R	R	F	R										
	111.3	122.6		A 12H-6, 120-121	4	1			R	F	R	R	F	R										
	112.4	123.7		A 12H-CC	5	1			R	F	R	R	F	R										
	116.2	128.8		A 13H-3, 110-111	5	2	1		R	F	R	R	F	R	–									
	117.1	129.7		A 13H-4, 48-49	5	2			R	F	R	R	F	R	R									
	117.6	130.6		B 12H-CC	5	2			R	F	R	R	F	R	R	–								
Diartus petterssoni	119.2	131.8		A 13H-5, 110-111	5	2	1		–	F	R	R	R	R	F	–								
	119.9	132.5	C4An1	A 13H-6, 31-32	5	2	1		–	F	R	R	R	R	F	–								
	120.8	133.4		A 13H-6, 122-123	5	2			?	F	R	R	R	R	F	–								
	122.1	134.7		A 13H-CC	5	2			–	F	R	R	R	R	F	R								
	121.8	135.8		A 14H-1, 20-21	5	2			–	F	R	R		R	F	R								
	123.7	137.7		A 14H-2, 59-60	5	2	1		?	F	R	R		R	F	R								
	125.7	139.7	C4An2	A 14H-3, 110-111	5	1	1		–	F	R	R		R	F	R								
	128.7	142.7		A 14H-5, 110-111	5	2	1		–	F	R	R		R	F	R	–							
	131.7	145.7		A 14H-CC	5	2	1		?	F	R	R		R	F	R	–							
	135.2	151.1	C4An3	A 15H-3, 110-111	5	2	1		–	F	R	R		R	F	R	–							
	136.6	153		B 14H-CC	4	2			–	F	R	–		R	F	R	–							
	138.2	154.1		A 15H-5, 110-111	5	2	2		–	F	R	R		R	F	R	•							
	138.9	154.8		A 15H-6, 29-30	4	1			–	F	R	R		R	F	R	R							
	139.8	155.7	C5n1	A 15H-6, 119-120	4	1	1		?	F	R	R		R	F	R	R	–						
	141.1	157		A 15H-CC	4	1	2		–	F	R	R		R	F	R	R	–						
	140.8	158.5		A 16H-1, 20-21	4	1			–	F	R	R		R	F	R	R	–						
	142.7	160.5		A 16H-2, 62-63	4	0	1		–	F	–	R		R	F	–	R	R	–					
	144.7	162.4		A 16H-3, 110-112	4	1	2		–	F	R	R		R	F	R	R	R	–					
	147.7	165.4	C5n2	A 16H-5, 110-112	4	1	2		–	F	R	R		R	F	R	R	R	–					
	150.6	168.4		A 16H-CC	4	2	2			F	R	R		R	F	R	F	R	–					
	151.4	170.2		A 17H-1, 129-130	4	1				F	R	R		R	F	R	F	–	–					
	152.2	171		A 17H-2, 59-60	4	1				F	R	R		R	F	R	R	–	–					
	153	171.8		A 17H-2, 140-141	4	1				F	R	R		R	F	R	F	R	–					
	154.2	173		A 17H-3, 110-111	4	1	1			F	R	R		R	F	R	F	R	–					
	155.6	175.3	C5n3?	B 16H-CC	5	1				F	R	R		R	R	R	R	R	–					
	157.2	176		A 17H-5, 110-111	5	2	1			F	R	R		R	F	R	F	–	R		–			
	160	178.8		A 17H-CC	4	1	1			F	R	R		R	R	R	R	R	R		–			
	160.9	180.2		A 18H-1, 130-131	4	1				F	R	R		R	F	R	R	R	–		–			
	161.7	181		A 18H-2, 59-60	4	1				F	R	R		R	R	R	F	–	–	–	–	–		
	162.5	181.8		A 18H-2, 139-140	4	1	1			F	R	R		R	F	R	F	R	R	•	–	–		
	163.7	183		A 18H-3, 110-111	4	1				F	R	R		R	R	R	F	R	–	•	R	–	–	
Dorcadospyris alata	164.3	183.6		A 18H-4, 20-21	4	1				F	R	R		R	–	R	R	R	R	R	–	–	–	
	165	184.3	C5An1	A 18H-4, 90-91	4	1				F	R	R		R	–	R	R	R	–	R	–	R	R	
	165.2	184.5		B 17H-CC	5	1				F	R	R		R	–	R	–	–	R	–	R	R	–	
	166.7	186		A 18H-5, 110-111	4	1				F	R	R		R	–	R	R	R	–	R	R	R	–	
	169.7	189		A 18H-CC	5	2				F	R	R		R	–	R	R	R	–	F	R	–	R	
	173.2	193.9		A 19H-3, 109-110	5	2				F	R	R		R	–	R	R	R	R	F	R	–	R	
	176.2	196.9		A 19H-5, 109-110	5	2				F	R	R		R	–	R	R	–	R	F	R	–	R	
	179.2	199.8		A 19H-CC	5	2				F	R	R		R	–	R	R	R	R	F	R	R	R	
	179.6	201.9		A 20H-1, 20-21	5	2				F	R	R		R	–	R	–	R	R	F	R	–	R	–
	183.7	204.2	C5An3	B 19H-CC	4	1				F	R	R		R	–	R	–	R	–	F	R	–	–	R
	183.5	205.8		A 20H-3, 110-111	5	2	1			F	R	R		R		R	–	R	R	F	R	R	R	R
	186.5	208.8		A 20H-5, 110-111	5	2				F	R	R		R		R		–	–	F	–	R	R	R
	188.7	211.1	C5An4	A 20H-CC	5	2				F	R	R		R		R		–	R	F	R	R	R	R
	192.2	215.4		A 21H-3, 110-112	5	2				F	R	R		R		R		R	R	F	R	R	–	R

Figure 2 (continued).

Site 845 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	Lithopera renzae	Dorcadospyris alata	Giraffospyris toxaria	Lithopera thornburgi	Calocycletta caepa	Calocycletta robusta	Stichocorys armata	Liriospyris parkerae	Acrocubus octopylus	Carpocanopsis bramlettei	Calocycletta costata	Dorcadospyris dentata	Liriospyris stauropora	Eucyrtidium diaphanes	Carpocanopsis cingulata	Didymocyrtus prismatica
Dorcadospyris alata	195.2	218.4	C5AAn	A 21H-5, 110-112	5	2		R	R	R	R	R	R										
	198.1	221.4		A 21H-CC	5	2		R	R	R	R	R	R										
	198.8	224		A 22H-1, 120-121	5	2		R	–	R	–	R	R										
	199.8	225		A 22H-2, 70-71	5	2		R	R	–	R	R	R										
	201.7	226.9	C5ABn	A 22H-3, 110-111	4	1		R	R	–	R	*	R										
	204.7	229.9		A 22H-5, 110-111	4	1		R	R	R	R	*	R	–									
	207.6	232.8		A 22H-CC	4	1		R	R	R	R	*	F	–									
	208	233.2		A 23X-1, 90-91	4	1		R	–	R	–	–	F	–									
	208.9	234.1		A 23X-2, 30-31	4	1		R	R	R	–	–	F	R									
	211.2	236.4		A 23X-3, 110-111	4	1		R	R	R	–		F	R		?							
	214.2	239.4		A 23X-5, 110-111	4	1		R	R	–	–		F	R	–	?							
	216.6	241.8		A 23X-CC	4	2		R	R	R	–		F	R	–	–							
	218.5	243.7		A 24X-CC	5	1		R	R	R			F	R	–	–	–						
	226.7	251.9		A 25X-1, 20-21	4	1		R	R	R			F	R	R	R	R						
	227.7	252.9		A 25X-1, 120-121	4	1		–	R	R			F	–	R	R	R						
	230.6	255.8		A 25X-3, 110-111	4	1		–	R	R			F	–	R	R	R						
	233.6	258.8		A 25X-5, 110-111	4	1		R	R	R			F	R	R	R	R						
	234.4	259.6		A 25X-6, 40-41	5	1		–	R	R			F	R	R	R	R	–					
	235.2	260.4		A 25X-5, 120-121	4	1		R	R	R			F	R	R	R	R	R					
	236.1	261.3		A 25X-CC	4	1		R	R	R			F	R	R	R	R	F					
	240.2	265.4		A 26X-3, 110-112	4	2		R	R	R			F	F	R	R	R	F					
	243.2	268.4		A 26X-5, 110-112	4	1		R	R	R			F	R	R	R	R	F					
	245.5	270.8		A 26X-CC	5	2		R	R	R			F	R	R	R	R	F					
	248	273.2		A 27X-2, 110-111	4	1		R	R	R			F	R	R	R	R	F					
	250.1	275.3		A 27X-3, 130-131	4	1		R	R	R			F	R	R	R	R	F	–				
	250.9	276.1		A 27X-4, 60-61	4	1		R	?	R			F	R	R	R	R	F	–				
Calocycletta costata	251.7	276.9		A 27X-4, 140-141	4	1		R	–	R			F	R	R	R	R	F	R	–			
	252.5	277.7		A 27X-5, 70-71	4	1		R	–	R			F	R	R	R	R	F	R	–			
	254	279.2		A 27X-6, 110-111	4	1		R	–	R			F	–	R	R	R	F	R	–			
	254.9	280.1		A 27X-7, 10-11	4	1		–	–	R			F	R	R	R	R	F	R	R	–		
	255.5	280.8		A 27X-CC	5	2		–	–	R			F	R	–	R	R	F	R	R	–		
	259.1	284.3		A 28X-3, 109-110	5	2		R	–	R			F	R	–	R	R	F	R	R	–		
	259.9	285.1		A 28X-4, 40-41	5	1		–	–	R			F	R	–	R	–	F	R	R	*		
	260.7	285.9		A 28X-4, 120-121	5	1		–		R			F	R		R	R	F	R	R	R		
	262.1	287.3		A 28X-5, 109-110	5	2		R		R			F	R		R	R	F	R	R	R		
	262.8	288		A 28X-6, 30-31	4	1		–		R			F	R		R	R	F	R	R	R		
	263.6	288.8		A 28X-6, 110-111	4	1		R		R			F	R		R	R	F	R	R	R		
	264.6	289.8		A 28X-CC	5	2		R		R			F	R		R	–	F	R	R	R	–	
	268.7	293.9		A 29X-3, 109-111	5	2		R		R			F	R		R	R	F	R	R	R	–	
	271.7	296.9		A 29X-5, 109-111	5	2		R		R			F	R		R	–	F	R	R	R	–	
	274.4	299.6		A 29X-CC	5	2		–		R			F	R		R	–	F	R	R	R	–	
	278.3	303.5		A 30X-3, 107-108	5	2		R		R			F	R		R	R	F	R	R	F	–	
	279.1	304.3		A 30X-4, 40-41	5	2		R		R			F	R		R	R	F	R	R	R	R	–
	279.9	305.1		A 30X-4, 120-121	4	1		R		R			F	R		R	R	F	R	R	R	R	–
	280.7	305.9		A 30X-5, 50-51	4	2		R		R			F	R		R	R	F	R	R	R	R	–
	281.3	306.5		A 30X-5, 107-108	5	2		R		–			F	R		R	R	F	R	R	R	R	–
	282	307.2		A 30X-6, 30-31	4	2		R		R			F	R		R	R	F	R	R	R	R	–
	282.8	308		A 30X-6, 110-111	4	2		R		R			F	R		R	–	F	R	R	R	–	R
	283.9	309.1		A 30X-CC	4	1		R		R			F	R		–	–	F	R	R	R	R	R
	285	310.2		A 31X-1, 110-112	5	2		R		R			F	R		–	R	F	R	R	R	R	R
	288	313.2		A 31X-3, 110-112	0	0		–	–	–			–	–	–	–	–	–	–	–	–	–	–

Figure 2 (continued).

The Pleistocene–Pliocene section is fairly complete, with nearly all the radiolarian zones and datums clearly identified. Specimens of *Phormostichoartus fistula* do appear in the section; however, they are even more rare than usual and their last detected occurrence is coincident with that of *P. doliolum*. The range of *Spongaster berminghami* also was impossible to define because of its rare occurrence. *Anthocyrtidium prolatum* was not found in the samples studied. A few specimens of *Spongaster pentas* were found in Core 138-847-13H at and just below the first appearance of *S. tetras*.

Radiolarians are common to abundant throughout the upper Miocene part of the section, and preservation is generally good. Only the uppermost zones of the upper Miocene (*Stichocorys peregrina* and *Didymocyrtis penultima* Zones) were identified. The upper Miocene interval that was recovered appears to be expanded and offers good stratigraphic resolution. All of the major radiolarian datums above the last occurrence of *Calocycletta caepa* were identified in this section. Specimens of *Acrobotrys tritubus* were not found in the samples studied.

Incomplete recovery of Cores 138-847B-26X and -27X, the occurrence of chert in these two cores, and the extremely poor preservation of the associated radiolarians make the assignment of an age to the deepest interval cored very speculative. A few highly altered radiolarians were recovered from a carbonate crust that was scraped from the surface of one of the pieces of chert (Sample 138-847B-27X-CC). The genera *Didymocyrtis, Lamprocyclas,* and *Dictyocoryne*(?), and the species *Anthocyrtidium (?)pliocenica* and *Stichocorys del-*

montensis could be identified within this sample. Although these identifications are not sufficient to give a definitive age to the sample, they do suggest that it is not much older than the material recovered in Core 138-847B-25X.

Site 848

Radiolarians sampled in Site 848 (Fig. 5) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late Miocene (*Didymocyrtis antepenultima* Zone). The oldest material recovered that could be identified to the zonal level is from Sample 138-848B-10H-4, 150–151 cm. Below this level, all samples were barren of siliceous microfossils.

Preservation and abundance of the radiolarians generally are good within the Pleistocene–Pliocene section, although it does contain a number of reworked older radiolarians. The Pleistocene–Pliocene section is complete, with all the radiolarian zones and datums identified. Because of the relatively low accumulation rate at this site, the zones are compressed. As at Site 846, specimens of *Phormostichoartus fistula* are rare, and their last detected occurrence is considered to be an unreliable datum. A few specimens of *Spongaster pentas, S. berminghami,* and *Acrobotrys tritubus* were found; however, their occurrences are scattered and their first and last appearances are not considered to be reliable datums.

Radiolarians are common to abundant throughout the upper Miocene interval at this site and preservation is generally good, except near the bottom of the recovered section (some individual samples within Cores 138-848B-9H, -10H, and all of Core 138-848B-11H). The deepest reliable datum is the evolutionary transition between *Diartus petterssoni* and *D. hughesi* (between Samples 138-848B-9H-CC and -10H-1, 5–7 cm).

Site 849

Radiolarians sampled in Site 849 (Fig. 6) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late Miocene (*Diartus petterssoni* Zone). The oldest material recovered that could be identified to the zonal level is from Sample 138-849B-36X-CC. Below this level, all samples were barren of siliceous microfossils.

Preservation and abundance of the radiolarians generally are good within the Pleistocene–Pliocene section. No clear indication of the reworking of older radiolarians into the younger part of the section was seen. The Pleistocene–Pliocene section appears to be complete, with all the major zones and radiolarian datums recognized in the samples studied. Specimens of *Phormostichoartus fistula* are slightly more abundant in this section than they are in those recovered at previous sites; however, their generally low abundance makes their last detected occurrence an unreliable datum for intersite correlations. Sufficient specimens of *Spongaster pentas* and *S. berminghami* were found at this site to make useful comparisons with their previously published FAD and LAD (Johnson et al., 1989), but their scattered occurrence in other Leg 138 sites to the north, south, and east prevents them from being useful for correlation with these sites. The LAD of *S. pentas* occurs between Sample 138-849B-11H-3, 110–111 cm, and -849C-10H-CC and has an estimated age of 3.96 to 4.00 Ma. This compares with an estimated age of 3.0–3.6 Ma for the LAD of *S. pentas* in the tropical Pacific made by Johnson and Nigrini (1985; but reported as 4.5–4.6 Ma in Johnson et al., 1989). The LAD of *S. berminghami* occurs between Samples 138-849B-15X-CC and -16X-3, 110–111 cm, and has an estimated age of 5.11–5.23 Ma. This compares with an estimated age of 3.8–4.6 Ma for the LAD of *S. berminghami* in the tropical Pacific Ocean made by Johnson and Nigrini (1985). The differences between this and previous studies in the estimated ages for these two datums may be in part due to the different time scales employed.

High accumulation rates in the lower Pliocene and upper Miocene sections greatly expand the *Stichocorys peregrina* Zone at this site, and most datums within this interval can be closely constrained. However, *Acrobotrys tritubus,* occurs rarely and its first and last appearances cannot be used as reliable datums.

Radiolarians were common to abundant throughout the upper Miocene part of the section, and preservation was generally good except near the bottom of the recovered section (Core 138-849B-37X and the bottom part of Core 138-849B-36X). The deepest reliable datum is the last appearance of *Carpocanopsis cristata* (between Samples 138-849B-35X-3, 110–111 cm, and -35X-5, 111–113 cm). This datum occurs within the middle part of the *Diartus petterssoni* Zone (Sanfilippo et al., 1985).

Site 850

Radiolarians sampled in Site 850 (Fig. 7) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late middle Miocene (*Diartus petterssoni* Zone). The oldest material recovered that could be identified to the zonal level is from Sample 138-850B-42X-CC.

Preservation and abundance of the radiolarians generally are good within the Pleistocene–Pliocene section. Only a trace was seen of reworked older radiolarians in the upper Pliocene part of the section. The Pleistocene–Pliocene section appears to be complete, with all the major zones and radiolarian datums recognized in the samples studied. Sufficient specimens of *Spongaster pentas* and *S. berminghami* were found at this site to make useful comparisons with Site 849, but their scattered occurrence in other Leg 138 sites to the north, south, and east prevents them from being useful for correlation. The LAD of *S. pentas* occurs between Samples 138-850B-8H-4, 110–111 cm, and 138-850C-4H-CC and has an estimated age of 3.95 to 4.2 Ma, nearly identical to age of this datum at Site 849. The LAD of *S. berminghami* occurs between Samples 138-850B-12X-CC and -13X-2, 110–111 cm, and has an estimated age of 5.27 to 5.30 Ma, slightly older than the age of this datum in Site 849. Comparisons with other published estimated ages for these datums are presented in the Site 849 description (above).

Radiolarians are common to abundant throughout the upper to middle Miocene part of the section and preservation generally is good. Below Core 138-850B-31X, preservation decreases somewhat but remains either moderate or moderately good. Moderately well-preserved radiolarians are present in the core-catcher sample of the deepest recovered core (138-850B-42X-CC). The oldest reliable datum is the last appearance of *Carpocanopsis cristata* (between Samples 138-850B-37X-4, 110–111 cm, and -37X-6, 110–111 cm).

Site 851

Radiolarians sampled at Site 851 (Fig. 8) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late middle Miocene (*Diartus petterssoni* Zone). The oldest material recovered that could be identified to the zonal level is from Sample 138-851B-34X-4, 109 cm.

Preservation and abundance of the radiolarians are moderately good within the Pleistocene–Pliocene section. Only a trace was seen of reworking of older radiolarians into the Pleistocene and upper Pliocene parts of the section. The Pleistocene–Pliocene section appears to be complete, with all the major zones and radiolarian datums recognized in the samples studied. Specimens of *Spongaster pentas, S. berminghami,* and *Acrobotrys tritubus* were scattered in their appearance at this site. Radiolarians are common to abundant throughout the upper to upper middle Miocene part of the section, and preservation is generally good. Below Core 138-851B-24X, preservation decreases somewhat, but remains either good or moderately good down to the lowermost part of Core 138-851B-34X. However, the core-catcher sample of this deepest recovered core was barren of radiolarians. The oldest reliable datum is the last appearance of *Carpocanopsis cristata* (between Samples 138-851B-28X-CC and -29X-1, 110–111 cm).

Site 846 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*	*Anthocyrtidium pliocenica*	*Phormostichoartus fistula*	*Lychnodictium audax*	*Phormostichoartus doliolum*
Collosphaera tuberosa	4.1	4.10		B 1H-3, 110-111	5	2		R	R	R	–				R	R	F				R					
	6.5	6.50		B 1H-5, 50-51	5	2		R	R	–	–				–	R	F				R					
	7.05	7.05		B 1H-CC	5	2	1	R	R	–	–				–	R	F				R					
	7.22	7.22		A 1H-CC	5	2		R	R	–	–				–	R	F				R					
	11.1	11.70		B 2H-3, 110-111	5	2		R	R	R	–				–	R	F				R					
	14.1	14.70		B 2H-5, 110-111	5	2		R	R	R	–				R	R	F				R					
Stylatractus universus	15.5	16.10		B 2H-6, 100-101	5	2	1	R	R	R	R				R	R	F				R					
	16.89	17.49		B 2H-CC	5	2		R	R	R	R				R	R	F				R					
Amphirhopalum ypsilon	20.6	22.65		B 3H-3, 110-111	5	2		R	R	–	R				R	R	R				R					
	23.6	25.65		B 3H-5, 110-111	5	2		R	R	–	R	–			–	R	F				R					
	26.17	28.22		B 3H-CC	5	2		R	R	–	R	–			–	R	R				R					
	30.1	33.25		B 4H-3, 110-111	5	2		R	R		R	–			R	–	R				R					
	33.1	36.25		B 4H-5, 110-111	5	2		R	R		R	–			R	R	R				R					
	34.89	38.04		B 4H-6, 139-140	5	2		R	R		R	R			R	R	R				R					
	36.06	39.21		B 4H-CC	5	2		R	R		R	R			F	R	F				R					
Anthocyrtidium angulare	35.7	40.90		B 5H-1, 20-21	5	2		R	R		R	R	–		R	–	R				R					
	37.2	42.40		B 5H-2, 20-21	5	2		R	R		R	R	R		R	–	R				R					
	41.09	44.29		C 4H-CC	5	2		R	R		R	R	R	–	–	R	R				R					
	39.6	44.80		B 5H-3, 110-111	5	2		R	R		R	R	R	–	R	R	R				R					
	40.79	45.99		B 5H-4, 79-80	5	2		R	R		R	R	R	F	R	–	R				R					
	42.69	46.29		D 4H-	5	2		R	R		R	–	R	F	R	–	R				R					
	42.6	47.80		B 5H-5, 110-111	5	2		R	R		R	–	R	F	R	–	R				R					
	45.54	50.74		B 5H-CC	5	2		R	R		R	R	R	F	R	?	R				R					
	45.5	52.00		B 6H-1, 50-51	5	2		R	R		R	R	R	F	R	–	R				R					
	47	53.50		B 6H-2, 50-51	5	2		R	R		R	R	R	F	R	–	R				R					
	50.69	54.74		C 5H-CC	5	2		R	R		R	R	R	F	R	–	–				R					
	49.1	55.60		B 6H-3, 110-111	5	2		R	R		R	R	R	F	R	–	–				R					
	50.5	57.00		B 6H-4, 100-101	5	2		R	R		R	R	R	F	R	–	–				R					
	52.1	58.60		B 6H-5, 110-111	5	2		R	R		R	R	R	F	–	–	–		–		R					
	53.94	60.44		B 6H-CC	5	2		R	R		R	R	R	F	–	–	–	–	–		R					
Pterocanium prismatium	58.64	65.59		C 6H-CC	5	2		R	R		R	R	–	F	–			–	R		R					
	61.68	66.78		D 6H-CC	5	2		R	R		R	R	–	F	–			–	R		R					
	58.6	66.90		B 7H-3, 110-111	5	2		R	R		R	R	–	F	–			–	R		R					
	61.6	69.90		B 7H-5, 110-111	5	2		R	R		R	R	–	F				–	R		R					
	64.26	72.56		B 7H-CC	5	2		R	R		R	R	–	F				–	–		R					
	69.71	76.61		C 7H-CC	4	1		R	R		R	R		F				–	R		R					
	68.2	77.90		B 8H-3, 115-116	5	2		R	R		R	R		F				–	R		R					
	69.5	79.20		B 8H-4, 100-101	5	2		R	R		R	R		F				R	R		R					
	71.1	80.80		B 8H-5, 110-111	5	2		R	R		R	R		F				R	R		R					
	73.96	83.66		B 8H-CC	5	2		R	R		R	R		F				–	R		R					
	77.6	87.75		B 9H-3, 110-111	5	2		R	R		R	R		F				–	R		R					
	79	89.15		B 9H-4, 100-101	5	2		R	R		R	–		F				–	R	–	R					
	80.6	90.75		B 9H-5, 110-111	5	2		R	R		R	R		F				R	R	R	R					
	83.07	93.22		B 9H-CC	5	2		R	R		R	R		F				–	R	R	R					
	87.2	99.75		B 10H-3, 115-116	5	2		R	R		R	R		F				–	R	R	R					
	90.1	102.65		B 10H-5, 113-114	5	2	1	R	–		R	R		F				–	R	R	R					
	93.23	105.78		B 10H-CC	5	2		R	–		R	R		F				R	R	R	R	–				
Anthocyrtidium jenghisi	96.6	110.10		B 11H-3, 114-115	4	1		R	–		R	–		F				–	–	R	–	R				
	97.3	110.80		B 11H-4, 30-31	5	2	2	R	R		R	R		F				–	R	R	–	R				
	97.65	111.60		C 10H-CC	5	2		–	R		R	–		F				–	R	R	–	R				
	99.6	113.10		B 11H-5, 111-112	5	2		R	R		R	R		F				–	R	R	–	F				
	102.26	115.76		B 11H-CC	5	2		R	R		R	R		F				R	R	F	–	C				
	106	120.80		B 12H-3, 110-111	5	2		R	R		R	R		F				–	R	F		C				
	109	123.80		B 12H-5, 110-111	5	2		R	R		R	–		F				–	R	F		C	–			
	111.8	126.60		B 12H-CC	5	2		R	R		R	–		F				–	R	F		C	–			
	115.91	129.41		D 12H-CC	5	2		R	R		R	R		R				–	R	R		F	–			
	114	130.45		B 13H-2, 100-101	5	2	3	R	R		R	–		R				R	R	R		C	R			
	116	132.45		B 13H-3, 115-116	5	2		R	–		R	R		F				R	R	R		C	–			
	117	133.45		B 13H-4, 100-101	5	2	2	R	R		R	–		F				–	R	R		C	R			
	119	135.45		B 13H-5, 115-116	5	2		–	R		R	R		R				–	R	R		F	R			
	120	136.45		B 13H-6	5	2	3	R	R		R	–		R				–	R	F		C	R			
	121.65	138.10		B 13H-CC	5	2		–	R		R	–		R				–	R	R		C	–	–		
	125	142.15		B 14H-3, 115-116	5	2		R	R		R	–		R				–	R	R		C	–	–		
	128	145.15		B 14H-5, 115-116	5	2		R	R		R	?		R				–	R	R		C	–	–	–	
	130.78	147.93		B 14H-CC	5	2		–	R		R	–		R				–	R	R		C	R	–	–	
	135	154.70		B 15H-3, 115-116	5	2		–	R		R	?		F				–	R	R		C	R	–	–	
	136	155.70		B 15H-4, 100-101	5	2		–	R		R	–		R				–	R	R		C	R	–	–	
	138	157.70		B 15H-5, 115-116	5	2		–	R		R	–		R				R	R	R		C	R	–	R	–
P. doliolum	140.62	160.32		B 15H-CC	5	2	1	–	–		R	–		R				R	R	R		C	F	–	–	R

Figure 3. Site 846 radiolarian species range chart. Notation as specified in Figure 1.

Site 846 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Phormostichoartus fistula*	*Phormostichoartus doliolum*	*Didymocyrtis penultima*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*
Stichocorys peregrina	141.6	161.80		B 16H-2, 10-11	5	2	1	C	–	R	R								
	144.9	162.90		D 15H-CC	5	2		C	–	R	R								
	145.22	163.72		C 15H-CC	5	2		C	–	R	R								
	144	164.20		B 16H-3, 115-116	5	2		C	–	R	R								
	145.5	165.70		B 16H-4, 100-101	5	2		C	–	–	F								
	147	167.20		B 16H-5, 115-116	5	2		C	R	R	R								
	149.82	170.02		B 16H-CC	5	2		C	R	R	R								
	154	175.25		B 17H-3, 115-116	5	2		C	–	R	R								
	157	178.25		B 17H-5, 115-116	5	2		C	R	R	R								
	159.65	180.90		B 17H-CC	5	2		C	R	R	R								
	160.3	182.15		B 18H-1, 130-131	5	2		C	R	R	F								
	161.8	183.65		B 18H-2, 130-131	5	2	1	C	–	R	F								
	163.61	184.41		D 17H-CC	5	2		C	R	R	R								
	163	184.85		B 18H-3, 115-116	5	2		C	R	R	R								
	166	187.85		B 18H-5, 115-116	5	2		C	R	R	R								
	169.17	191.02		B 18H-CC	5	2		C	R	R	R								
	173	194.85		B 19H-3, 115-116	5	2		C	R	R	R								
	176	197.85		B 19H-5, 115-116	5	2		C	R	R	F								
	178.65	200.50		B 19H-CC	5	2		C	R	R	R								
	182	203.85		B 20H-3, 115-116	5	2		C	R	R	F								
	185	206.85		B 20H-5, 115-116	5	2		C	R	R	F								
	187.85	209.70		B 20H-CC	5	2		C	R	R	F	–							
	188.5	214.10		B 21H-1, 100-101	5	2		C	R	R	R	R							
	190	215.60		B 21H-2, 100-101	5	2		C	R	R	R	R				–			
	191.59	216.89		D 20H-CC	5	2	2	C	R	R	R	R				R			
	192	217.60		B 21H-3, 114-115	5	2		C	R	R	R	R				–			
	195	220.60		B 21H-5, 114-115	5	2	1	C	R	R	R	R				R			
	197.68	223.28		B 21H-CC	5	2	1	C	R	R	R	R				R			
	201	231.45		B 22H-3, 115-116	5	2		C	–	–	F	R				R			
	204	234.45		B 22H-5, 115-116	5	2		C	R	R	F	R				R			
	207.1	237.55		B 22H-CC	5	2		C	R	R	F	R				R			
	211	245.00		B 23X-3, 115-116	5	2		C	–	R	F	R				–			
	214	248.00		B 23X-5, 115-116	5	2		C	–	R	F	R				–			
	216.26	250.26		B 23X-CC	5	2		C	R	R	F	R				R			
	220	255.40		B 24X-3, 114-115	5	2		C	R	R	F	R				R			
	223	258.40		B 24X-5, 114-115	5	2		C	R	R	F	R				R			
	225.78	261.18		B 24X-CC	5	2	2	C	R	R	F	R	–	–		–			
	230.06	263.41		D 24X-CC	5	2		C	R	R	R	R	–	R		–			
	230	265.10		B 25X-3, 110-111	5	2	1	C	R	R	F	R	R	R	–	–			
	232.7	266.50		D 25X-2, 110-111	5	2		C	R	R	R	R	R	F	–	–			
	232	267.10		B 25X-4, 110-111	5	2		C	R	R	F	R	R	F	–	–			
	232.12	267.22		B 25X-CC	5	2		C	R	R	F	R	–	F	–	R			
Didymocyrtis penultima	235.7	269.50		D 25X-4, 110-111	5	2		C	R	R	R	R	R	C	R	–			
	235.61	270.71		B 26X-CC	5	2		F	R	R	F	R	–	C	R	R			
	238.7	272.50		D 25X-6, 110-111	5	2		F	R	R	R	–	R	C	R	–			
	239.86	273.66		D 25X-CC	5	2		F	R	R	R	R	R	C	–	–			
	242.4	276.20		D 26X-2, 110-111	5	2		F	R	R	F	–	–	C	F	R			
	245.4	279.20		D 26X-4, 110-111	5	2		–	R	R	R	R	R	C	R	R			
	245.39	280.49		B 27X-1, 19-20	5	2		–	R	R	–	–	R	C	F	–			
	248.4	282.20		D 26X-6, 110-111	5	2		–	R		–	–	R	C	R	R			
	247.3	282.40		B 27X-2, 60-61	5	2		–	R		–	–	R	C	F	R			
	249.45	283.25		D 26X-CC	5	2			R		–	–	R	C	R	R			
	249	284.10		B 27X-3, 110-111	5	2			R		–	R	R	C	R	R			
	251	286.10		B 27X-4, 110-111	5	2			R			R	R	C	F	R			
	253.56	288.66		B 27X-CC	5	2			R			R	R	C	R	R			
	255.1	290.20		B 28X-1, 20-21	5	2			R			–	R	C	F	R			
	256.63	291.73		B 28X-2, 23-24	5	2			R			–	R	C	F	R			
	257.79	292.89		B 28X-2, 139-140	5	2			R			–	R	C	F	R			
	259	294.10		B 28X-3, 110-111	5	2			R			–	R	C	F	R			
	262	297.10		B 28X-5, 110-111	5	2			R			–	R	C	F	R			
	264.87	299.97		B 28X-CC	5	2			R				R	C	F	R	–		
Didymocyrtis antepenultima	265.2	300.30		B 29X-1, 100-101	5	2			R				R	C	F	R	R		
	268	303.10		B 29X-3, 95-96	5	2			R				R	C	F	R	R		
	271	306.10		B 29X-5, 110-111	5	2			R				R	C	F	R	F	–	
	273.74	308.84		B 29X-CC	5	2			R				R	C	F	R	F	–	
	277	312.10		B 30X-2, 113-114	5	2			R				R	C	F	R	F	–	–
	280	315.10		B 30X-5, 19-20	5	2			R				R	C	F	R	F	R	R
Diartus petterssoni	282.1	317.20		B 30X-6, 70-71	5	2			R				–	C	F	R	F	R	F
	282.81	317.91		B 30X-6, 141-142	4	2			R				–	C	R	R	R	R	F
	283.75	318.85		B 30X-CC	4	2			R					C	F	R	–	R	F

Figure 3 (continued).

Site 846 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*	*Carpocanopsis cristata*	*Lithopera thornburgi*	*Cyrtocapsella cornuta*	*Lithopera renzae*
Diartus petterssoni	284.5	319.60		B 31X-1, 100-101	2	2		–	C	R					
	286	321.10		B 31X-2, 110-111	5	2		–	C	R					
	291	326.10		B 31X-5, 110-111	5	2		R	C	R					
	293.34	328.44		B 31X-CC	4	1		R	C	R					
	297	332.10		B 32X-3, 113-114	5	1		R	C	R					
	300	335.10		B 32X-5, 113-114	5	1		R	C	R					
	302.38	337.48		B 32X-CC	4	1	1	R	C	R					
	303.8	338.90		B 33X-1, 100-101	2	1		–	F	R	–				
	305.3	340.40		B 33X-2, 100-101	4	1		R	F	R	R				
	307	342.10		B 33X-3, 113-114	4	1		R	C	F	F				
	310	345.10		B 33X-5, 116-117	4	1	1	R	C	R	R				
	312.68	347.78		B 33X-CC	4	1		R	F	F	F		–		
	313.42	348.52		B 34X-1, 102-103	5	2		R	F	R	F	–	–		
	314.89	349.99		B 34X-2, 99-100	5	2		R	F	R	C	R	R		
	317	352.10		B 34X-3, 113-114	5	2		R	F	F	F	R	R		
	320	355.10		B 34X-5, 117-118	5	2		R	C	R	F	R	R		
	322.29	357.39		B 34X-CC	5	2		R	F	F	C	–	R		
	326	361.10		B 35X-3, 114-115	5	2		R	F	R	F	–	–		
	329	364.10		B 35X-5, 112-113	5	2		R	R	R	C	R	–		
	331.72	366.82		B 35X-CC	5	2		R	F	F	F	–	–	–	–
	332.7	367.80		B 36X-1, 100-101	5	2	1	R	R	R	R	R	R	*	R
	334.2	369.30		B 36X-2, 100-101	5	2		R	R	R	R	R	–	–	R
	335.7	370.80		B 36X-3, 100-101	5	2	1	R	R	R	–	R	R	C	R
	336	371.10		B 36X-3, 114-115	5	2		R	F	R	R	R	–	F	–
	339	374.10		B 36X-5, 112-113	5	2		R	R	R	R	R	R	F	R
	341.53	376.63		B 36X-CC	5	2		R	R	R	R	R	R	F	R
	342.3	377.40		B 37X-1, 100-101	5	2		R	R	R	R	R	–	–	F
	344	379.10		B 37X-2, 109-110	5	2		R	R	R	–	R	R	C	R
	345.01	380.11		B 37X-CC	5	2		R	R	R	–	R	R	C	F
	351.2	386.30		B 38X-1, 20-21	5	2		R	R	R	–	R	R	C	R
	354	389.10		B 38X-2, 105-106	5	2		R	R	R	–	–	–	F	F
Dorcadospyris alata	358	393.10		B 38X-5, 105-106	5	2		R	–	R		R	–	F	F
	360.2	395.30		B 38X-CC	5	2		R	–	R		R	R	C	F
	373	408.10		B 40X-2, 111-112	0	0		–	–	–		–	–	–	–
	377	412.10		B 40X-5, 110-111	0	0		–	–	–		–	–	–	–

Figure 3 (continued).

Site 852

Radiolarians sampled in Site 852 (Fig. 9) range in age from the Quaternary (*Collosphaera tuberosa* Zone) to the late middle Miocene (*Diartus petterssoni* Zone). The oldest material recovered that could be identified to the zonal level is from Sample 138-852C-13X-5, 110 cm.

Preservation of the radiolarians is no better than moderately good in the samples from this site. Within the Pleistocene–Pliocene section, radiolarians are common, but their preservation is generally moderate or poor to moderate. Reworking of older radiolarians (late Miocene) into the Pleistocene–Pliocene part of the section was found in most samples from Cores 138-852B-1H through -6H. This section appears to be complete, however, with all the major zones and radiolarian datums recognized in the samples studied. Occurrences of *Spongaster pentas* and *S. berminghami* were scattered at this site, making it impossible to use the first and last occurrences of these species for correlation with other sites. The occurrence of *Acrobotrys tritubus* is more consistent at this site than at others, but because of its scattered occurrence at other sites, its first and last appearances cannot be used as reliable datums for correlation.

Radiolarians are common to abundant in the upper to upper middle Miocene part of the section, and preservation generally is moderate or moderately good. Below Core 138-852B-12X, preservation decreases somewhat and the section becomes barren of siliceous microfossils in and below Sample 138-852C-13X-6, 110 cm. The oldest reliable datum is the last appearance of *Cyrtocapsella japonica* (between Samples 138-852B-12H-4, 110–111 cm and -12H-5, 62–63 cm). The last occurrences of *Carpocanopsis cristata* and *Lithopera thornburgi* were not observed in this site, and based on this, it appears that here the basement age may be somewhat younger than at sites farther south on this transect.

Site 853

Radiolarians sampled in Site 853 (Fig. 10) range in age from the Quaternary to late Pliocene. The radiolarian zones lying above the *Amphirhopalum ypsilon* Zone were not sampled at this site. They may be present above 1.1 mbsf, the shallowest sample examined. Below the top of Core 138-853B-3H, all samples examined were barren of siliceous microfossils. Trace fragments of tests were found in a few of the deeper samples; however, these never were adequate for an evaluation of the age of the sediment or the character of the assemblage. Within the Pliocene–Pleistocene part of the section, preservation is poor to moderate, and only a few of the radiolarian datums can be identified with any certainty.

Reworking of upper Miocene radiolarians was found in all the Pliocene–Pleistocene samples. This occurrence of reworking is similar to that found at Site 852; however, it is a little surprising to find comparatively well-preserved Miocene forms in a poorly preserved, younger assemblage when the upper Miocene section at this site does not appear to contain any siliceous microfossils. This suggests that upper Miocene siliceous microfossils were deposited and, at least temporarily, preserved in this region.

Site 854

Radiolarians sampled at Site 854 (Fig. 11) range in age from the Quaternary to the late Pliocene. The *Stylatractus universus* Zone was not identified at this site, but it may lie within the unsampled interval between 2.6 and 3.4 mbsf. Below the bottom of Core 138-854B-2H, all samples examined were barren of siliceous microfossils. Trace fragments of tests were found in a few of the deeper samples; however, these never were adequate for an evaluation of the age of the sediment or the character of the assemblage. Within the upper two cores of Hole 854B (upper Pliocene through Pleistocene), preservation of radiolarians is moderate to moderately good. Most of the major radiolarian datums can be identified.

Although the age of the section containing preserved siliceous microfossils is only slightly older at this site than it is at Site 853 to the south, the degree of preservation of the fauna is somewhat better and the abundance of reworked older microfossils is smaller. Reworking of upper Miocene radiolarians (from the *Diartus petterssoni* Zone) was found in only one sample (138-854B-1H-3, 110 cm, from the *Amphirhopalum ypsilon* Zone). As at Site 853, it is a little surprising to find comparatively well-preserved Miocene forms in a more poorly preserved, younger assemblage when the upper Miocene section at this site does not appear to contain any siliceous microfossils. This suggests that upper Miocene siliceous microfossils were deposited and, at least temporarily, preserved in this region.

RELIABILITY OF RADIOLARIAN DATUMS

In Figures 1 through 11 the samples investigated at each site are presented. Sites containing paleomagnetic data are indicated. The exact levels and samples associated with each radiolarian datum are given in Tables 2 through 12.

The efforts of shipboard stratigraphers resulted in a merging of biostratigraphy, paleomagnetic stratigraphy, and lithostratigraphy (GRAPE, magnetic susceptibility, and color reflectance data) to provide a suite of stratigraphic sections with unprecedented control. These data were used to set up a preliminary chronostratigraphy (Shackleton et al., 1992), which was then fine-tuned to the Earth's orbital parameters (Shackleton et al., this volume). In sites where the character of the lithostratigraphic record did not allow us to tune the record directly, the ages of paleomagnetic reversals and a few key biostratigraphic datums were adjusted to match their tuned ages in other Leg 138 sites. The adjusted time scale for these other sites is not truly "tuned" throughout the recovered section; however, it is as closely comparable to the time scales of the tuned sites as one can make them. The tuned time scale then was used to compare the ages of the radiolarian datums in Tables 13 through 15. These data were plotted for each species (e.g., Figs. 12 and 13) to determine graphically the time range of minimum overlap of the estimated ages for the datums in all sites. The estimated age range for each LAD was based on the age of the youngest sample in which the species appears that is consistent with the data from all the sites (lower bound) and the oldest sample in which the species does not appear that is consistent with the data from all the sites (upper bound). The estimated age range for each FAD was based on the age of the youngest sample in which the species does not appear that is consistent with the data from all the sites (lower bound) and the oldest sample in which the species appears that is consistent with the data from all the sites (upper bound). These upper and lower bounds for the datums define a "minimum age range" for each datum studied in Leg 138 sites.

A minimum age range for 39 biostratigraphic datums was determined for all 11 Sites (844 through 854) having a time scale that either has been directly tuned to orbital parameters or has been tightly linked to a tuned time scale. A plot of the minimum age ranges (Fig. 14) shows that the accuracy of these datums varies from less than 50,000 yr to about 1.8 m.y. A distinct break in the distribution of datum accuracy can be seen at about 150,000 yr (Fig. 14). Given that the sampling program was designed to give a resolution of no more than 50,000 to 100,000 yr, it seems that for the purposes of this study, those 10 biostratigraphic datums having an accuracy of 150,000 yr or less can be considered to be synchronous. These datums and their ages (as determined in all sites) are given in Table 13. A more detailed sampling scheme might well narrow the minimum age range for these datums even farther and place an even more stringent working definition on the concept of "synchronous" biostratigraphic datums.

Because of the differences in the time scales used, the estimated ages of datums presented here are not directly comparable to most earlier works. They are most similar to the results presented by Alexandrovich (1992) and tend to be somewhat older than the ages given by Johnson et al. (1989), especially for datums older than about 1.5 Ma. As a test of the feasibility of converting the time scales of earlier studies, a careful comparison was made between the LAD of *Pterocanium prismatium* as given in this chapter paper and that given by Alexandrovich (1992), Johnson et al. (1989), and Johnson and Nigrini (1985). This was an arduous and painstaking task, requiring good paleomagnetic control for most of the sites studied. Once the time scales used in these earlier studies were adjusted to that presented by Shackleton et al. (this volume), this datum was found to meet the working definition of synchrony used here for both the tropical Indian and Pacific oceans.

Diachronous radiolarian datums (as defined by the 150,000-yr cut off) are given in Table 14 for all sites. When the average of each datum at each site is plotted on site location maps, the ages of these diachronous datums seem to form coherent spatial patterns. These patterns appear to match the distributions of currents and surface watermasses and suggest that each species can be associated with a particular oceanic environment from which it radiates (from the oldest first appearance) or to which it retreats (to the area of youngest last appearance). These patterns are discussed by Moore et al. (this volume).

In Sites 844, 845, and to some extent Site 846, an older part of the section was sampled than that encountered at the remainder of the Leg 138 sites. The estimated ages for datums in this older part of the section (older than approximately 10 Ma) have been based primarily on magnetic stratigraphy and the biostratigraphy of the diatoms and calcareous nannofossils. Their estimated ages are presented in Table 15.

REWORKED OLDER RADIOLARIAN SPECIMENS IN YOUNGER SECTIONS

From the earliest days of radiolarian stratigraphy, scientists have known that specimens of older species can be found mixed into younger sections—sections that are much younger than the reported age of the last appearance of such species. These reworked microfossils did much to confuse early investigators of marine sediments from the Pacific Ocean (e.g., Haeckel, 1887) and delayed by almost 100 yr the development of a radiolarian stratigraphy comparable to that developed for other microfossil groups. Thus, it is not surprising that reworked radiolarians from the middle to upper Miocene have been found reworked into the uppermost Miocene and Pliocene–Pleistocene sections of the record drilled during Leg 138. What is surprising is that similar findings for other microfossil groups have not been consistently observed, or at least reported. It may be that radiolarians are more robust and better survive the reworking process. Certainly, a tendency exists for the older radiolarians to have generally more robust tests (Moore, 1969). I was particularly disconcerted to find comparatively well-preserved radiolarian specimens from the lower

Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples: Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	Amphirhopalum ypsilon	Spongaster tetras	Collosphaera tuberosa	Stylatractus universus	Lamprocyrtis neoheteroporus	Anthocyrtidium angulare	Theocorythium vetulum	Theocorythium trachelium	Lamprocyrtis nigriniae	Pterocorys minythorax	Lamprocyrtis heteroporus	Pterocanium prismatium	Anthocyrtidium jenghisi	Theocalyptra davisiana	Stichocorys peregrina	Anthocyrtidium pliocenica	Phormostichoartus fistula	Lychnodictium audax	Phormostichoartus doliolum	Didymocyrtis penultima	Solenosphaera omnitubus
Collosphaera tuberosa	2.6	2.6		B 1H-2, 110-111	5	3	1	R	R	_					_	R	R				R							
	5.6	5.6		B 1H-4, 110-111	5	3		R	R	R					R	R	R				R							
	6.59	6.59		B 1H-CC	5	3		R	R	R					R	R	R				R							
	9.1	9.23		B 2H-2, 110-111	5	2		R	R	_					R	R	R				R							
	9.52	11.32		A 1H-CC	5	3		R	R	_					_	R	R				R							
	13.6	13.73		B 2H-5, 110-111	5	2		R	R	_	_				R	R	R				R							
Stylatractus universus	16.08	16.21		B 2H-CC	5	2		R	R	R	R				_	R	R				R							
	16.54	18.34		D 2H-CC	5	2		R	R	R	R				R	R	R				R							
Amphirhopalum ypsilon	20.1	20.45		B 3H-3, 110-111	5	3		R	R	_	R				R	R	R				R							
	23.1	23.45		B 3H-5, 110-111	5	3		R	R	_	R				R	R	R				R							
	26.02	26.37		B 3H-CC	5	3		R	R	_	R				R	R	R				R							
	29.6	32.43		B 4H-3, 110-111	5	3		R	R		R	_			R	R	R				R							
	31.07	33.47		C 3H-CC	5	3		R	R		R	R	_		R	R	R				R							
Anthocyrtidium angulare	32.6	35.43		B 4H-5, 110-111	5	3		R	R		R	R	R		R	R	R				R							
	35.58	38.41		B 4H-CC	5	3		R	R		R	R	R		R	_	R				R							
	35.5	39.5		D 4H-CC	5	2		R	R		R	R	R	F	R	_	R				R							
	39.1	41.9		B 5H-3, 110-111	5	3		R	R		R	R	R	F	R		R				R							
	42.1	44.9		B 5H-5, 110-111	5	3		R	R		R	R	R	F	R		R				R							
	45.09	47.89		B 5H-CC	5	3		R	R		R	R	R	F	R		_				R							
	44.88	49.08		D 5H-CC	5	3		R	R		R	R	R	F	_		R				R							
	48.6	53.68		B 6H-3, 109-110	5	3		R	R		R	R	R	F	_		_				R							
	50.09	54.59		C 5H-CC	5	3		R	R		R	R	R	C			_		_		R							
Pterocanium prismatium	51.6	56.68		B 6H-5, 109-110	5	3		R	R		R	R	_	F					R		R							
	54.6	59.68		B 6H-CC	5	3		R	R		R	R	_	F					R		R							
	58.1	64.85		B 7H-3, 109-110	5	3		R	R		R	R	_	F					R		R							
	61.1	67.85		B 7H-5, 109-110	5	3		R	R		R	R	_	F				_	R		R							
	63.64	70.84		D 7H-CC	5	3		R	R		R	R		C				R	R		R							
	64.1	70.85		B 7H-CC	5	3		R	_		R	R		C				R	R		R							
	67.6	75.78		B 8H-3, 109-110	5	2		R	R		R	R		F				R	R		R							
	70.6	78.78		B 8H-5, 110-111	5	3		R	R		R	R		F				R	R		R							
	72.83	81.01		B 8H-CC	5	3		R	R		R	R		F				R	R		R							
	77.1	86.58		B 9H-3, 110-111	5	3		R	R		R	R		F				R	R	_	R							
	80.1	89.58		B 9H-5, 110-111	5	3		R	R		R	R		F				R	R	R	R							
	83.25	91.95		D 9H-CC	5	2		R	R		R	R		R				_	_	R	_	_						
Anthocyrtidium jenghisi	83.1	92.58		B 9H-CC	5	2		R	R		R	R		F				R	R	R	_	R						
	86.6	96.83		B 10H-3, 109-110	5	3		R	R		R	_		F				R	R	R		F						
	88.08	97.98		C 9H-CC	5	2		_	_		R	R		R				R	R	R		F						
	89.6	99.83		B 10H-5, 109-110	5	3		R	_		R	_		F				R	R	R		C						
	92.68	102.91		B 10H-CC	5	3	1	R	_		R	_		F				R	R	R		C	_					
	92.28	103.98		D 10H-CC	5	3		R	R		R	_		R				R	R	R		C	_					
	97.06	108.3		C 10H-CC	5	2		R	R		R			_				R	R	R		C	R					
	96.1	109		B 11H-3, 110-111	5	2		R	R		R			R				_	R	R		F	_					
	99.1	112		B 11H-5, 110-111	5	3		R	R		R			_				_	R	R		C	R					
	101.56	114.46		B 11H-CC	5	3		_	R		R			F				_	R	R		C	R		_			
	106	119.03		B 12H-3, 110-111	5	3		R	R		R			F					R	R		C	_	_	R			
	109	122.03		B 12H-5, 110-111	5	3		_	R		R			R					R	R		C	R	_	R			
	111.58	124.61		B 12H-CC	5	3		R	R		R			F					R	R		C	R	_	R			
	116.44	128.74		C 12H-CC	5	3		_	_		R			F					_	R		C	R	_	_	_		
P. doliolum	115	129		B 13H-3, 110-111	5	3		_	R		R			R					R	R		C	R	R	R	R	_	
Stichocorys peregrina	118	132		B 13H-5, 110-111	5	3		_	_		R			R					R	R		C	R	_	_	R	R	
	121.05	135.05		B 13H-CC	5	3		_	_		R			R					R	R		C	R	R	R	R	R	
	125	140.48		B 14H-3, 110-111	5	3		_	_		R			R					R	R		C	R	_	_	R	R	
	126	141.48		B 14H-4, 110-111	5	3					R			R					R	R		C	R	_	R	R	R	
	130.1	145.1		D 14H-CC	5	3					R			R					R	R		C	R	_	_	R	R	
	130.35	145.83		B 14H-CC	5	3					R			R					R	R		C	F	R	_	R	R	
	134.99	148.79		C 14H-CC	5	3					R			_					R	R		C	R	_	_	R	R	
	134	149.95		B 15H-3, 110-111	5	3	1				R			R					_	R		C	R	_	R	R	R	_
	137	152.95		B 15H-5, 110-111	5	3					R			R					_	R		C	R	R	R	R	R	_
	139.81	155.76		B 15H-CC	5	3					R			R					R	R		C	R	_	R	R	R	?
	144	160.45		B 16X-3, 110-111	5	3					R			_					R	R		C	R	R	R	R	R	?
	147	163.45		B 16X-5, 110-111	5	3					R			R					_	R		C	R	_	_	R	R	_
	148.98	165.43		B 16X-CC	5	2					R			_					_	R		C	R	R	_	R	R	?
	150	169.35		B 17X-3, 110-111	5	2					R			_					_	R		C	R	R	_	R	R	_
	155.13	174.48		B 17X-CC	5	3					R			_					_	R		C	F	R	_	R	R	?
	160	179.35		B 18X-3, 110-111	5	2					R			_						R		C	R	R	R	R	R	?
	163	182.35		B 18X-5, 110-111	5	2					R									R		C	R	_	_	R	R	_
	165.19	184.54		B 18X-CC	5	3					R									R		C	R	R	_	R	R	_
	169	188.35		B 19X-3, 110-111	5	3					R									R		C	R	R	R	R	R	R
	174.52	193.87		B 19X-CC	5	3					R									R		C	R	R	R	R	R	R
	178	197.35		B 20X-3, 109-110	5	3					R									R		C	R	_	R	R	R	R

Figure 4. Site 847 on radiolarian species range chart. Notation as specified in Figure 1.

Site 847 Radiolaria Zone	Depth (mbsf)	(mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Pr	Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*
Stichocorys peregrina	181	200.35		B 20X-5, 109-110	5	3		C	R				R
	183.24	202.59		B 20X-CC	5	2		C	R				R
	188	207.35		B 21X-3, 109-110	5	3		C	R				R
	193.35	212.7		B 21X-CC	5	3		C	R				–
	197	216.35		B 22X-3, 109-110	5	3		C	R				R
	202.97	222.32		B 22X-CC	5	3		C	R		–		R
	207	226.35		B 23X-3, 110-111	5	3		C	R		R		R
	210	229.35		B 23X-5, 110-111	5	3		C	R		R		–
	212.43	231.78		B 23X-CC	5	3		C	F		R		R
	217	236.35		B 24X-3, 110-111	5	3		C	F	–	R	–	R
	220	239.35		B 24X-5, 110-111	5	3		C	C	R	C	–	–
	222.27	241.62		B 24X-CC	5	3		C	C	–	C	R	–
Didymocyrtis penultima	226	245.35		B 25X-3, 109-110	5	2		F	F	R	C	R	–
	229	248.35		B 25X-5, 116-117	5	3		R	R	R	C	R	R
	232.01	251.36		B 25X-CC	5	2		R	R	R	C	R	R
	241.54	260.89		B 27X-CC	1	1			–	–	R	–	–

Figure 4 (continued).

part of the upper Miocene section mixed into poorly preserved Pliocene assemblages of Sites 844, 845, 853, and 854.

A few things appear to be consistent about the pattern of occurrence of the reworked material. First, the age of the oldest reworked specimens found at a site never exceeded the basement age determined for the site. This suggests that the reworked material need not have been transported laterally over large distances. Second, the abundance of the reworked material appears to be inversely correlated to the rate of sediment accumulation. The faster the rain of biogenic sediments, the less common are the reworked older forms. In the very high accumulation rate sites on the equator (849 and 850), no reworked older microfossils were observed in the samples studied. Finally, the temporal pattern of the abundance of reworked material appears to be consistent from site to site within a region (Figs. 15 and 16). In the eastern sites (Fig. 15), few-to-common reworked radiolarian were found in samples from about 2 to 7.5 Ma. This followed a short break in the abundance of reworked radiolarians (7.5–8.5 Ma), which in turn was preceded by an interval between 8.5 and 12 Ma, in which a few reworked specimens were found in many of the samples (especially at Sites 844 and 845). The temporal pattern of the abundances of reworked material in the western transect is somewhat different (Fig. 16). Here, a trace to a few reworked older microfossils are found in many of the samples younger than about 5 Ma. (All samples older than about 3 Ma are barren of radiolarians in site 853.)

I find it difficult to understand what the occurrence of this reworked material is revealing about sedimentary processes on the deep ocean floor. In general, the deepest reworked material found in a section is in samples 4 to 6 m.y. younger than the basement age. Thus, no reworking was detected in a substantial part of the section just above basement. This appears to be too large an interval to represent a measure of stratigraphic resolution and our ability to detect reworked material. Rather, this seems to suggest that a certain amount of time must pass (or material must accumulate) before conditions are right for the exposure and lateral transport of older sediments.

Two requirements may exist for eroding and redepositing these older microfossils: (1) exposure of the older section to erosion and transport by near-bottom currents and (2) the presence of such currents having sufficient strength to transport radiolarian tests. Minor normal faulting associated with cooling or readjustments in mid-plate stresses might expose older sedimentary material to erosion, and in turn, this might explain the time lag between crustal formation and the onset of reworking.

The apparent similarity in the temporal pattern of occurrence of reworking within a region might also argue for temporal fluctuation in the strength of the bottom currents and/or the depth at which the eroding currents occur. A much earlier study of the distribution of hiatuses in the eastern Pacific Ocean noted a maximum in hiatus abundances between about 5 and 15 Ma that could also suggest vigorous deep-water circulation during the mid-Miocene to early Pliocene (Figs. 7, 26, and 27 in Moore et al., 1978; note the differences in the time scales used).

CONCLUSIONS

An emended zonation that combines the work of Johnson et al. (1989) and Sanfilippo et al. (1985) was used to divide the recovered sections into biostratigraphic zones. The real time resolution achieved for these sites came, however, from the combined efforts of the Leg 138 scientists: (1) to recover and blend into a composite section the complete stratigraphic record from each site; (2) to use this composite section to guide detailed sampling for biostratigraphy; (3) to undertake the integration of biostratigraphy, magnetostratigraphy, and lithostratigraphy to make detailed intersite correlations; and (4) to tune the oxygen isotope and GRAPE records to the orbital frequencies to achieve a highly precise astrochronology. With this chronology, one can demonstrate that over the last 10 Ma, about one-quarter (10) of the radiolarian datums are synchronous (within 150,000 yr) in the sites studied. The remaining 29 datums have an accuracy (a minimum range in the estimated ages of the datums) that is generally less than 1 m.y., with most of them less than 0.5 m.y. This degree of accuracy is near what is commonly accepted as the accuracy of biostratigraphic age estimates in the absence of paleomagnetic control.

Reworked older radiolarians were found in the upper Miocene, Pliocene, and Pleistocene sections in most of the sites cored. Peak abundances of reworked material generally were found to range between 2 and 7 Ma. The temporal pattern of the abundances of reworked material is slightly different in the eastern and western transects of these

Site 848 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Pr	Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*	*Anthocyrtidium pliocenica*	*Phormostichoartus fistula*	*Lychnodictium audax*	*Phormostichoartus doliolum*	*Didymocyrtis penultima*
Collosphaera tuberosa	0.1	0.3		A 1H-1, 10-11	5	3		R	R	R					R	R	R				R						
	1.1	1.3		B 1H-1, 110-111	5	3		R	R	R					R	R	R				R						
	2.23	2.43		B 1H-CC	5	3		R	R	R	_				R	R	R				R						
	4.3	7.1		B 2H-1, 60-62	5	3	1	R	R	R	_				R	R	R				R						
Stylatractus universus	5.8	8.6		B 2H-2, 60-62	5	3		R	R	R	R				R	R	R				R						
	6.3	9.1	Br	B 2H-3, 110-111	5	3		R	R	R	R				R	R	R				R						
	6.8	9.6		B 2H-4, 10-12	5	3		R	R	R	R				R	R	R				R						
	9.54	9.74		A 1H-CC	5	3		R	R	R	R				R	R	R				R						
Amphirhopalum ypsilon	7.22	10.02		B 2H-4, 52-54	5	3	1	R	R	_	R				R	R	R				R						
	7.8	10.6		B 2H-4, 110-112	5	2	1	R	R	_	R				R	R	R				R						
	8.3	11.1		B 2H-5, 10-12	5	3		R	R		R				R	R	R				R						
	8.72	11.52		B 2H-5, 52-54	5	3		R	R		R				R	R	R				R						
	9.3	12.1		B 2H-5, 110-111	5	3		R	R		R				R	R	R				R						
	12.27	15.07		B 2H-CC	5	3		R	R		R	_			R	R	R				R						
	11.8	15.75		B 3H-1, 10-12	5	2	1	R	R		R	_			R	R	R				R						
	12.27	16.22		B 3H-1, 57-59	5	3		R	R		R	_	_		R	R	R				R						
	12.8	16.75	Jar	B 3H-1, 110-112	5	3		R	R		R	_	_		R	R	R				R						
	13.29	17.24		B 3H-2, 9-11	5	2		R	R		R	_	_		R	R	R				R						
	13.8	17.75		B 3H-2, 60-62	5	2		R	R		R	_	_		R	R	R				R						
	14.3	18.25		B 3H-2, 110-112	5	2		R	R		R	R	_	_	R	R	R				R						
Anthocyrtidium angulare	14.8	18.75		B 3H-3, 10-12	5	2		R	R		R	R	R	_	R	R	R				R						
	15.28	19.23		B 3H-3, 58-60	5	2	1	R	R		R	R	R	R	R	R	R				R						
	15.8	19.75		B 3H-3, 110-111	5	2		R	R		R	R	R	R	R	R	R				R						
	16.3	20.25		B 3H-4, 10-12	5	3	1	R	R		R	R	R	R	R	_	R				R						
	16.78	20.73		B 3H-4, 58-60	5	3		R	R		R	R	R	R	R	_	R				R						
	17.3	21.25		B 3H-4, 110-112	5	3		R	R		R	R	R	R	R	_	R				R						
	17.8	21.75		B 3H-5, 10-12	5	3		R	R		R	R	R	R	R		R	_			R						
	18.25	22.2		B 3H-5, 55-57	5	3		R	R		R	R	R	R	R		R	_			R						
	18.8	22.75		B 3H-5, 110-111	5	2		R	R		R	R	R	F	R		R	_			R						
	19.29	23.24		B 3H-6, 9-11	5	2		R	R		R	R	R	F	R		R	*			R						
	19.8	23.75		B 3H-6, 60-62	5	3		R	R		R	R	R	F	_		R	R			R						
	20.3	24.25		B 3H-6, 110-112	5	3	1	R	R		R	R	R	F	?		R	R	_		R						
	20.8	24.75		B 3H-7, 10-12	5	2	1	R	R		R	R	R	F	_		R	R	_		R						
	21.28	25.23		B 3H-7, 58-60	5	2	1	R	R		R	R	R	F	_		R	R	_		R						
Pterocanium prismatium	21.3	25.65		B 4H-1, 10-12	5	3	1	R	R		R	R	R	F	?		R	R	R		R						
	21.73	25.68		B 3H-CC	5	2		R	R		R	R	R?	F	_		R	R	R		R						
	21.83	26.18		B 4H-1, 63-65	5	2	1	R	R		R	R	_	F	_		_	R	R		R						
	22.3	26.65	Old	B 4H-1, 110-112	5	2		R	R		R	R	_	F	_		_	R	R		R						
	22.79	27.14		B 4H-2, 9-11	5	2	1	R	R		R	R		F	_		_	R	R		R						
	23.34	27.69		B 4H-2, 64-66	5	3	1	R	R		R	R		F	_		_	R	R	_	R						
	23.8	28.15		B 4H-2, 110-112	5	3	1	R	R		R	R		F	_		_	R	R	_	R						
	24.3	28.65		B 4H-3, 10-12	5	3	2	R	R		R	R		F	_		_	R	R	_	R						
	24.84	29.19		B 4H-3, 64-66	5	3	1	R	R		R	R		F	_			R	R	_	R						
	25.1	29.35		C 4H-1, 60-61	5	3		R	R		R	R		F	_			R	R	_	R						
	25.3	29.65		B 4H-3, 110-110	5	3		R	R		R	_		F	_			R	R	_	R						
	25.98	30.33		B 4H-4, 28-30	5	3		R	R		R	R		F	_			R	R	R	R	*					
	26.6	30.85		C 4H-2, 60-61	5	3		R	R		R	_		R	_			R	R	R	R	*					
	26.54	30.89		B 4H-4, 84-86	5	3	1	R	R		R	_		F	_			R	R	R	R	*					
	27	31.35		B 4H-4, 130-132	5	3	1	R	R		R	_		F	_			R	R	R	R	*					
Anthocyrtidium jenghisi	27.51	31.86		B 4H-5, 31, 33	5	3		R	R		R	_		F	_			R	R	R	_	R					
	28.1	32.35		C 4H-3, 60-61	5	3		R	R		R	_		F	_			R	R	R	_	C					
	28.3	32.65		B 4H-5, 110-111	5	3		R	R		R	_		F	_			R	R	R	_	F	_				
	29.6	33.85		C 4H-4, 60-61	5	3		R	R		R			F	_			R	R	R		C	_				
	30.01	34.36	K	B 4H-6, 131- 131	5	3		R	R		R			F	_			R	R	R		C	_				
	30.31	34.66	M	B 4H-7, 11- 13	5	3		R	R		R			F	?			_	R	R		C	_				
	30.7	35.05		B 4H-7, 50-52	5	3		R	R		R			F	_			_	R	R		C	_				
	31.1	35.35		C 4H-5, 60-61	5	3		R	R		R			F	?			_	R	R		C	_	_			
	31.17	35.52		B 4H-CC	5	2		R	R		R			F	?			_	R	R		C	_	_			
	31.8	36.05		C 4H-5, 130-131	5	3		R	R		R			F	_			_	R	R		C	_	_			
	32.19	36.44		C 4H-6, 19-20	5	3		R	R		R			F	_				R	R		C	_	?	_	_	
	30.8	36.45		B 5H-1, 10-12	5	2	1	R	R		R			F	_				R	R		C	_	?	_	_	
	32.6	36.85		C 4H-6, 60-61	5	3		R	R		R			R					R	R		C	R	?	_	_	
Phormostichoartus doliolum	31.27	36.92		B 5H-1, 57-59	5	2		_	R		R			R					R	R		C	R	R	R	R	
	31.8	37.45		B 5H-1, 110-112	5	2		R	R		R			R					R	R		C	R	R	R	R	_
	32.3	37.95		B 5H-2, 10-12	5	2		_	R		R			R					R	R		C	R	R	R	R	_
	32.8	38.45		B 5H-2, 60-62	5	2		_	R		R			R					R	R		C	R	R	R	R	_
Stichocorys peregrina	34.57	38.82	C	C 4H-CC	5	3		_	_		R			R					R	R		C	F	R	R	R	R
	34.8	40.45	N	B 5H-3, 110-111	5	3			_		R			F					R	R		C	R	R	R	R	R
	37.8	43.45		B 5H-5, 110-111	5	3					R			R					R	R		C	F	R	R	R	R
	38.3	43.95		B 5H-6, 10-12	5	3					R			R					R	R		C	R	R	R	R	R

Figure 5. Site 848 radiolarian species range chart. Notation as specified in Figure 1.

Site 848 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*
Stichocorys peregrina	38.77	44.42		B 5H-6, 57-59	5	3		C										
	39.3	44.95		B 5H-6, 110-112	5	3		C										
	39.78	45.43	S	B 5H-7, 8-10	5	3		C										
	40.53	46.18		B 5H-CC	5	2		C	–									
	40.78	46.48		B 6H-1, 58-60	5	3		C	–									
	41.3	47		B 6H-1, 110-112	5	3		C	–									
	41.8	47.5		B 6H-2, 10-12	5	3		C	R									
	43.4	47.95		C 5H-CC	5	3		C	R									
	42.8	48.5	Th	B 6H-2, 110-112	5	3		C	R									
	43.3	49		B 6H-3, 10-12	5	3		C	R									
	43.8	49.5		B 6H-3, 60-62	5	3		C	R									
	44.3	50		B 6H-3, 110-111	5	3		C	R									
	47.3	53		B 6H-5, 110-111	5	2		C	R									
	47.76	53.46		B 6H-6, 6-8	5	3		C	R				–					
	48.3	54		B 6H-6, 60-62	5	3		C	R				–					
	48.8	54.5		B 6H-6, 110-112	5	3		C	R				–					
	50.17	55.87		B 6H-CC	5	3		C	R				R					
	53.8	60.5		B 7H-3, 110-111	3	2		C	R				R					
	56.8	63.5		B 7H-5, 110-111	5	3		C	R			–	R					
	58.1	65.85		C 7H-4, 60-61	5	2		C	R	–	R	–	R					
	59.77	66.47		B 7H-CC	4	2		C	R	–	R	R	R					
	59.6	67.35		C 7H-5, 60-61	5	3		C	R	–	F	R	R					
	60.1	67.85		C 7H-5, 110-111	5	3		C	R	R	F	R	R					
	60.6	68.35		C 7H-6, 10-11	5	3		C	R	R	F	R	R					
	61.1	68.85		C 7H-6, 60-61	5	3		C	R	R	F	R	R					
	63.3	70.75		B 8H-3, 110-111	5	3		C	R	R	R	R	R					
Didymocyrtis penultima	63.06	70.81		C 7H-CC	5	3		C	R	R	C	R	R					
	63.1	70.85		C 8H-1, 60-61	5	3		C	R	F	C	R	R					
	65.07	71.87		D 7H-CC	4	3		C	R	F	C	R	R					
	66.2	73.65		B 8H-5, 101-102	4	3		C	R	R	C	R	R					
	66.3	73.75		B 8H-5, 110-111	5	3		C	R	R	C	R	R					
	66.6	74.05		B 8H-5, 140-142	4	2		C	R	R	C	R	R					
	67.1	74.55		B 8H-6, 40-42	4	2		F	R	R	C	R	R					
	67.6	75.05		B 8H-6, 90-92	4	2		F	R	R	C	R	R					
	67.79	75.24		B 8H-6, 109-111	4	2			R	R	C	R	R	–				
	69.32	76.77		B 8H-CC	5	3			R	F	C	R	R	–	–			
	72.31	81.41	C4n1	C 8H-CC	5	3			–	R	C	R	R	–	–			
	72.2	81.8		B 9H-3, 50-52	5	3				R	C	R	R	–	–			
Didymocyrtis antepenultima	72.8	82.4		B 9H-3, 110-111	4	2				R	C	F	R	R	–			
	73.75	83.35	C4n2	B 9H-4, 55-57	4	2				R	C	R	R	F	–			
	74.3	83.9		B 9H-4, 110-112	5	3				R	C	R	R	F	–			
	74.75	84.35		B 9H-5, 5-7	5	3				R	C	R	R	F	*			
	75.25	84.85	C4n3	B 9H-5, 55-57	5	3				–	C	R	R	F	R			
	75.7	85.3		B 9H-5, 110-111	4	2				R	C	F	R	F	R			
	76.12	85.72		B 9H-5, 145-147	4	3				R	C	R	R	F	R	–		
	76.6	86.2		B 9H-6, 40-42	5	3				R	C	R	R	F	R	–		
	77.1	86.7		B 9H-6, 90-92	5	3				R	C	R	R	F	R	–	–	
	77.58	87.18		B 9H-6, 138-140	5	3				–	C	R	R	F	R	R	–	
	78.03	87.63		B 9H-7, 33-35	4	3				–	C	R	R	F	R	R	*	
Diartus petterssoni	78.58	88.18	C4An1	B 9H-CC	2	1					C	F	R	F	R	R	–	
	78.25	88.85		B 10H-1, 5-7	4	3					C	R	R	R	R	F	–	
	78.75	89.35		B 10H-1, 55-57	4	3					C	R	R	–	R	F	R	
	79.7	90.3		B 10H-1, 150-151	3	2					C	R	R	–	R	F	F	
	81.2	91.8	C4An2	B 10H-2, 150-151	3	2					C	R	R	–	R	F	R	
	82.3	92.9		B 10H-3, 110-111	5	3					C	F	R	–	R	F	R	
	84.2	94.8		B 10H-4, 150-151	2	1					C	R	–		R	C	R	
	85.3	95.9		B 10H-5, 110-111	0	0					–	–	–		–	–	–	–
	85.7	96.3	C5n1	B 10H-5, 150-151	0	0					–	–	–		–	–	–	–
	88.16	98.76		B 10H-CC	1	1					R	–	–		R	R	–	–
	88.8	101.2		B 11H-1, 112-113	0	0					–	–	–		–	–	–	–
	93.2	105.6		B 11H-5, 43-44	0	0					–	–	–		–	–	–	–

Figure 5 (continued).

Site 849 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	Amphirhopalum ypsilon	Spongaster tetras	Collosphaera tuberosa	Stylatractus universus	Lamprocyrtis neoheteroporus	Anthocyrtidium angulare	Theocorythium vetulum	Theocorythium trachelium	Lamprocyrtis nigriniae	Pterocorys minythorax	Lamprocyrtis heteroporus	Pterocanium prismatium	Anthocyrtidium jenghisi	Theocalyptra davisiana	Stichocorys peregrina	Anthocyrtidium pliocenica	Phormostichoartus fistula	Lychnodictium audax	Phormostichoartus doliolum	Didymocyrtis penultima	Solenosphaera omnitubus
Collosphaera tuberosa	0.1	0.1		B 1H-1, 10-11	5	3		R	R	R					R	R	R				R							
	6.78	6.78		B 1H-CC	5	3		R	R	R					R	R	R				R							
	8.69	8.69		A 1H-CC	5	2		R	R	R	_				_	R	R				R							
	10.68	11.43		C 2H-CC	5	3		R	R	_	_				R	R	R				R							
	10.8	12.75		B 2H-3, 110-111	5	3		R	R	R	_				R	R	R				R							
Stylatractus universus	13.8	15.75		B 2H-5, 110-111	5	3		R	R	R	R				R	R	R				R							
	15.63	17.58		B 2H-CC	5	3		R	R	R	R				R	R	R				R							
Amphirhopalum ypsilon	20.3	24.35		B 3H-3, 110-111	5	3		R	R	_	R				R	R	R				R							
	23.3	27.35		B 3H-5, 110-111	5	2		R	R	_	R	_			R	R	R				R							
	25.21	29.26		B 3H-CC	5	3		R	R		R	R	_	_	R	R	R				R							
Anthocyrtidium angulare	29.8	34.85		B 4H-3, 110-111	5	3		R	R		R	R	R	F	R	_	R				R							
	32.8	37.85		B 4H-5, 110-111	5	3		R	R		R	R	R	F	R	_	R				R							
	35.47	40.52		B 4H-CC	5	3		R	R		R	R	R	F	R		R				R							
	36.7	43.15		B 5H-1, 150-151	5	3		R	R		R	R	R	F	_		_	_			R							
	37.83	44.93		C 4H-CC	5	3		R	R		R	R	R	F	_		_	R	_		R							
	39.3	45.75		B 5H-3, 110-111	5	3		R	R		R	R	R	F	_		_	R	_		R							
	41.48	48.03		D 4H-CC	5	3		R	R		R	R	R	F				R	_		R							
Pterocanium prismatium	42.3	48.75		B 5H-5, 110-111	5	3		R	R		R	R	_	F				R	R		R							
	45.25	51.7		B 5H-CC	5	3		R	R		R	R		F				R	R		R							
	48.8	56.3		B 6H-3, 107-108	5	3		R	R		R	R		F				_	R		R							
	51.9	60.35		D 5H-CC	5	3		R	R		R	R		F				R	R		R							
	54.54	62.04		B 6H-CC	4	2		R	R		R	R		F				R	R		R							
	57.2	66.65		B 7H-2, 150-151	5	3		R	R		R	R		F				R	R		R							
	58.3	67.75		B 7H-3, 110-111	5	3		R	R		R	R		F				R	R	_	R							
	60.92	70.17		D 6H-CC	5	3		R	R		R	_		F				R	R	_	R							
	61.3	70.75		B 7H-5, 110-111	5	3		R	R		R	R		F				R	R	R	R							
	64.26	73.71		B 7H-CC	4	2		R	R		R	_		R				_	R	R	R	_						
Anthocyrtidium jenghisi	67.8	78.5		B 8H-3, 110-111	4	2		R	R		R	R		R				R	R	R	_	R						
	73.59	84.29		B 8H-CC	5	3		R	R		R	R		R				R	R	R	_	C						
	77.3	88.95		B 9H-3, 110-111	5	3		R	R		R	R		R				_	R	R		C						
	77.44	89.24		C 8H-CC	5	3		R	R		R	_		R				R	R	R		F	_					
	80.3	91.95		B 9H-5, 110-111	5	2		R	R		R			R				_	R	R		F	R					
	83.29	94.94		B 9H-CC	5	3		R	R		R			F				_	R	R		C	R					
	86.8	98.6		B 10H-3, 110-111	5	3		R	R		R			R				_	R	R		C	R					
	89.8	101.6		B 10H-5, 110-111	5	3		R	R		R			R					R	R		C	R					
	89.76	102.66		D 9H-CC	5	3		R	R		R			F					R	R		C	R	_				
	92.49	104.29		B 10H-CC	5	2		R	R		R			R					R	R		C	R	R	_	_		
Phormostichoartus doliolum	96.3	109.9		B 11H-3, 110-111	5	3		R	R		R			R					R	R		C	R	R	R	R		
	96.62	111.07		C 10H-CC	5	3		_	_		R			R					R	R		C	R	R	R	R		
	99.3	112.9		B 11H-5, 110-111	5	3		_	R		R			R					R	R		C	R	R	R	R		
	102.16	115.76		B 11H-CC	5	2			R		R			F					R	R		C	R	R	R	R	_	
Stichocorys peregrina	105.8	120.25		B 12H-3, 110-111	5	2			_		R			R					R	R		C	R	R	R	R	R	
	108.8	123.25		B 12H-5, 110-111	5	2			_		R			_					_	R		C	R	R	R	R	R	
	111.73	126.18		B 12H-CC	5	3					R			R					R	R		C	R	R	R	R	R	
	115.3	131.85		B 13H-3, 110-111	5	3					R			R					R	R		C	R	R	R	R	R	
	118.3	134.85		B 13H-5, 110-111	5	3					R			R					R	R		C	R	R	R	R	R	
	121.09	137.64		B 13H-CC	5	3					R			R					_	R		C	R	R	R	R	R	
	124.22	142.22		B 14X-3, 52-53	5	3					R			R					R	R		C	R	R	R	R	R	
	125.16	143.16		B 14X-CC	5	3					R			R					_	R		C	R	R	R	R	R	
	134.4	153.7		B 15X-3, 110-111	5	3					R			_					_	R		C	R	R	R	R	R	
	137.4	156.7		B 15X-5, 110-111	5	3					R			_					_	R		C	R	R	R	R	R	
	139.71	159.01		B 15X-CC	5	3					R									R		C	R	R	R	R	R	
	144.1	164.6		B 16X-3, 110-111	5	3					R									R		C	R	R	R	R	F	
	149.53	170.03		B 16X-CC	5	3					R									R		C	R	R	R	R	R	
	153.8	176.75		B 17X-3, 110-111	5	3					R									R		C	R	R	R	R	R	_
	156.8	179.75		B 17X-5, 110-111	5	3					R									R		C	R	R	R	R	R	R
	159.44	182.39		B 17X-CC	5	3					R									R		C	R	R	R	R	R	R
	163.44	188.39		B 18X-3, 114-115	5	3					R									R		C	R	R	R	R	R	R
	166.41	191.36		B 18X-5, 111-112	5	3					R									R		C	R	R	R	R	R	R

Figure 6. Site 849 radiolarian species range chart. Notation as specified in Figure 1.

sites and may argue for a difference in the strength or position of the currents that transported the reworked radiolarians in these two regions. The exact nature of the reworking process remains an enigma.

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Site 849 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*	*Carpocanopsis cristata*	*Lithopera thornburgi*
Stichocorys peregrina	163.44	188.39		B 18X-3, 114-115	5	3		C	R				_							
	166.41	191.36		B 18X-5, 111-112	5	3		C	R				R							
	168.74	193.69		B 18X-CC	5	3		C	R				R							
	172.6	199		B 19X-3, 110-111	5	3		C	R				R							
	178.23	204.63		B 19X-CC	5	3		C	R				R							
	181.8	210.65		B 20X-3, 110-111	5	3		C	R				R							
	187.16	216.01		B 20X-CC	5	3		C	R				_							
	191.39	221.29		B 21X-3, 109-110	5	3		C	R				R							
	194.39	224.29		B 21X-5, 109-110	5	3		C	R				R							
	196.61	226.51		B 21X-CC	5	3		C	R				R							
	201.1	232.25		B 22X-3, 110-111	5	2		C	R				R							
	206.65	237.8		B 22X-CC	5	3		C	R	_		_	R							
	210.69	242.79		B 23X-3, 109-110	5	3		C	R	R		R	R							
	211.09	244.19		D 22X-CC	5	3		C	R	R		R	_							
	213.69	245.79		B 23X-5, 109-110	5	3		C	R	R		R	R							
	216.34	248.44		B 23X-CC	5	3		C	R	R		R	R							
	220.4	253.3		B 24X-3, 110-111	5	3		C	R	R	R	R	R							
	223.43	256.33		B 24X-5, 113-114	5	3		C	R	R	R	R	R							
	226.12	259.02		B 24X-CC	5	3		C	R	R	R	R	R							
	230.16	264.21		B 25X-3, 116-117	5	3		C	R	R	R	R	R							
	233.09	267.14		B 25X-5, 109-110	5	3		C	R	R	R	R	R							
	235.25	269.3		B 25X-CC	5	3		C	R	R	F	R	R							
	239.85	274.1		B 26X-3, 115-116	5	2		C	R	R	C	F	R							
Didymocyrtis penultima	241.3	275.55		B 26X-4, 110-111	5	3		F	R	R	C	F	R							
	242	276.25		B 26X-CC	5	3		R	R	R	C	R	R							
	249.4	281.2		B 27X-3, 110-111	5	3			R	R	C	F	R							
	252.39	284.19		B 27X-5, 109-110	5	3			R	R	C	F	R							
	254.96	286.76		B 27X-CC	5	3			_	R	C	F	R							
	259.1	293.25		B 28X-3, 110-111	5	3			_	R	C	F	R							
	262.1	296.25		B 28X-5, 110-111	5	3			_	R	C	F	R							
	264.68	298.83		B 28X-CC	5	3				R	C	F	R							
	268.8	303.2		B 29X-3, 110-111	5	3				R	C	F	R	_						
	271.8	306.2		B 29X-5, 110-111	5	3				R	C	F	R	_						
Didymocyrtis antepenultima	274.38	308.78		B 29X-CC	5	2				R	C	F	R	R						
	278.4	312.7		B 30X-3, 110-111	5	2				_	C	F	R	R						
	281.39	315.69		B 30X-5, 109-110	5	3				_	C	F	R	R						
	283.87	318.17		B 30X-CC	5	3				R	C	R	R	F	_	_				
	288	324.05		B 31X-3, 110-111	5	3				R	C	R	R	C	R	R				
	291	327.05		B 31X-5, 110-111	5	2				R	C	R	R	C	R	R				
	288.07	327.57		D 30X-CC	5	2				R	C	R	R	C	R	R				
Diartus petterssoni	293.69	329.74		B 31X-CC	5	2				R	C	R	R	R	R	F				
	297.7	334.7		B 32X-3-110-111	5	2				R	C	R	R	R	R	F	_			
	297.7	337.2		D 31X-CC	5	3				_	C	R	_	_	R	F	R			
	300.7	337.7		B 32X-5, 110-111	5	2				_	C	R	R	_	R	F	R			
	303.37	340.37		B 32X-CC	5	2					C	R	_		R	F	R	_		
	307.3	345.3		B 33X-3, 110-111	4	2					C	R	R		R	F	R	*		
	310.3	348.3		B 33X-5, 110-111	5	2					C	R	R		R	C	F	*		_
	313.06	351.06		B 33X-CC	3	2					C	R	_		R	F	F	*		_
	317	355.9		B 34X-3, 110-111	5	2					C	R	R		R	F	R	F		R
	320	358.9		B 34X-5, 110-111	4	2					C	R	R		R	F	R	R		R
	322.65	372.33		B 34X-CC	3	2					C	R	_		R	F	F	C		_
	326.7	366.55		B 35X-3, 110-111	5	2					C	R	R		R	F	R	C	_	R
	329.71	369.56		B 35X-5, 111-113	5	2					C	R	_		R	F	R	C	R	R
	332.48	372.33		B 35X-CC	4	2					C	R	R		R	F	F	C	R	R
	338.02	377.67		B 36X-3, 112-113	5	2					C	R	R		F	F	R	C	R	R
	339.28	379.13		B 36X-5, 108-109	3	1					C	R	R		R	F	R	F	_	_
	342.01	381.86		B 36X-CC	5	2					C	R	R		R	F	F	C	R	_
	348.24	388.09		B 37X-CC	0	0					_	_	_		_	_	_	_	_	_

Figure 6 (continued).

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* Abbreviations for names of organizations and publication titles in ODP reference lists follow the style given in *Chemical Abstracts Service Source Index* (published by American Chemical Society).

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APPENDIX

Species List and Taxonomic Remarks

Acrobotrys tritubus Riedel. Riedel 1957, p. 80, pl. 1, fig. 5.

Acrocubus octopylus Haeckel. Haeckel, 1887, p. 993, pl. 82, fig. 9; Goll, 1972, p. 961, pl. 37, fig. 1–3.

Amphirhopalum ypsilon Haeckel. Haeckel, 1887, p. 522; Nigrini, 1971, p. 447, pl. 34.1, figs. 7a–7c.

Anthocyrtidium angulare Nigrini. Nigrini, 1971, p. 445, pl. 34.1, figs. 3a–3b; Nigrini and Caulet, 1988, p. 343, pl. 1, figs. 1–2.

Anthocyrtidium jenghisi Streeter. Streeter, 1988, p. 63, pl. 1, figs. 1–4.; Nigrini and Caulet, 1988, p. 350, pl. 1, figs. 10–12.

Anthocyrtidium pliocenica (Seguenza). *Anthocyrtis ehrenbergi* Stohr var. *pliocenica* Seguenza, in Stohr, 1880, p. 232; Nigrini and Caulet, 1988, p. 355, pl. 2, figs. 5, 6.

Botryostrobus miralestensis (Campbell and Clark). *Dictyocephalus miralestensis* in Campbell and Clark, 1944, p. 45, pl. 6, figs. 12–14.

Botryostrobus miralestensis (Campbell and Clark) in Petrushevskaya and Kozlova, 1972, p. 539, pl. 24, fig. 31.

Calocycletta caepa Moore. Moore, 1972, p. 150, pl. 2, figs. 4–7.

Remarks. As noted by Riedel and Sanfilippo (1978), this species is difficult to distinguish from *C. robusta* and *C. virginis* in the lower part of its range, especially for specimens in which the distal terminations have been poorly preserved. In fact, some question exists as to whether this species evolved from *C. robusta* or from *C. virginis* (as suggested by Moore, 1972). At the two sites in this study where the older species of *Calocycletta* were found (Sites 844 and 845), a working taxonomic separation between *C. caepa* and *C. robusta* was made on the basis of the character of the apical horns. The FAD of *C. caepa* is defined as the lowest stratigraphic level where the majority of the specimens that fit into the *C. robusta* group (*sensu* Riedel and Sanfilippo, 1978) have bladed, rather than conical, apical horns.

Calocycletta costata Riedel. Riedel, 1959, p. 296, pl. 2, fig. 9 (as *Calocyclas costata*).

Calocycletta robusta Moore. Moore, 1971, p. 743-744, pl. 10, figs. 5, 6.

Remarks. See the remarks under *Calocycletta caepa* for an attempt to divide the *Calocycletta robusta* Group *sensu* Riedel and Sanfilippo (1978). The LAD of *C. robusta* is defined as the highest stratigraphic level where the majority of the specimens that fit into the *C. robusta* Group (*sensu* Riedel and Sanfilippo, 1978) have conical, rather than bladed, apical horns.

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

Carpocanopsis cingulata Riedel and Sanfilippo. Riedel and Sanfilippo, 1971, p. 1597, pl. 2G, figs. 17–21, pl. 8, fig 8.

Carpocanopsis cristata (Carnevale) s.s. Riedel and Sanfilippo, 1971, p. 1597.

Remarks. This species is used in a restricted sense here. As in Johnson and Nigrini (1985), only specimens resembling those figured by Riedel and Sanfilippo, 1971, pl. lG, fig. 16, and pl. 2G, fig. 1, are included.

Collosphaera tuberosa Haeckel, 1887, p. 97; Nigrini, 1971, p. 445, pl. 34.1, fig. 1.

Cyrtocapsella cornuta (Haeckel). *Cyrtocapsa (Cyrtocapsella) cornuta* in Haeckel, 1887, p. 1513, pl. 78, fig. 9; *Cyrtocapsella cornuta* (Haeckel) in Sanfilippo and Riedel, 1970, p. 453, pl. 1, figs. 19, 20.

Cyrtocapsella japonica (Nakaseko). *Eusyringium japonicum* in Nakaseko, 1963, p. 193, pl. 4, figs. 1–3; *Cyrtocapsella japonica* (Nakaseko) in Sanfilippo and Riedel, 1970, p. 452, pl. 1, figs. 13–15.

Diartus hughesi (Campbell and Clark). *Ommatocampe hughesi* in Campbell and Clark, 1944, p. 23, pl. 3, fig. 12; *Diartus hughesi* (Campbell and Clark) in Sanfilippo and Riedel, 1980, p. 1010.

Diartus petterssoni (Riedel and Sanfilippo). *Cannartus (?) petterssoni* in Riedel and Sanfilippo, 1970, p. 520, pl. 14, fig. 3; *Diartus petterssoni* (Riedel and Sanfilippo), in Sanfilippo and Riedel, 1980, p. 1010.

Didymocyrtis antepenultima (Riedel and Sanfilippo). *Ommatartus antepenultima* in Riedel and Sanfilippo, 1970, p. 521, pl. 14, fig. 4. *Didymocyrtis antepenultima* (Riedel and Sanfilippo) in Sanfilippo and Riedel, 1980, p. 1010.

Didymocyrtis penultima (Riedel). *Panarium penultimum* in Riedel, 1957, p. 76, pl. 1, fig. 1; *Didymocyrtis penultima* (Riedel) in Sanfilippo and Riedel, 1980, p. 1010.

Didymocyrtis prismatica (Haeckel). *Pipettella prismatica* in Haeckel 1887, p. 305, pl. 39, fig. 6. Riedel and Sanfilippo, 1971, pl. 2C, figs. 11–13, pl. 4, fig. 5. Moore, 1971, pl. 12, figs. 1, 2.

Dorcadospyris alata (Riedel). *Brachiospyris alata* in Riedel, 1959, p. 293, pl. 1, figs. 11, 12; Riedel and Sanfilippo, 1970, p. 523, pl. 14, fig. 5.

Dorcadospyris dentata Haeckel. Haeckel, 1887, p. 1040, pl. 85, fig 6; Riedel and Sanfilippo, 1971, pl. 2D, figs. 2–3.

Eucyrtidium diaphanes Sanfilippo and Riedel. Sanfilippo *et al.,* 1973, p. 221, pl. 5, figs. 12–14.

Giraffospyris toxaria (Haeckel). *Podocoronis (Dipocoronis) toxarium* and *Acrocubus (Dipocubus) arcuatus* in Haeckel 1887, p. 980, 993–994, pl. 83, fig. 7, pl. 93, fig. 15; *Giraffospyris toxaria* in Goll, 1969, p. 335, pl. 56, figs. 1, 2, 4, 7. Goll, 1972, p. 965–966, pl. 55, fig. 1.

Lamprocyrtis heteroporos (Hays). *Lamprocyclas heteroporos* Hays, 1965, p. 179, pl. 3, fig. 1. *Lamprocyrtis heteroporos* (Hays) in Kling, 1973, p. 639, pl. 5, figs. 19–21, pl. 15, fig. 6.

Lamprocyrtis neoheteroporos Kling. Kling, 1973, p. 639, pl. 5, figs. 17, 18, pl. 15, figs. 4, 5.

Lamprocyrtis nigriniae (Caulet). *Conarachnium nigriniae* in Caulet, 1971, p. 3, pl. 3, figs. 1–4, pl. 4, figs. 1–4; *Lamprocyrtis nigriniae* (Caulet) in Kling, 1977, p. 217, pl. 1, fig. 17.

Liriospyris parkerae Riedel and Sanfilippo, Riedel and Sanfilippo, 1971, p. 1590, pl. 2C, fig. 15, pl. 5, fig. 4.

Liriospyris stauropora (Haeckel). *Trissocyclus stauropora* in Haeckel, 1887, p. 1513, pl. 78, fig. 9; Riedel and Sanfilippo, 1971, p. 1590–1591, pl. 2C, figs. 16–19.

Lithopera renzae Sanfilippo and Riedel. Sanfilippo and Riedel, 1970, p. 454, pl. 1, figs. 21–23, 27.

Lithopera thornburgi Sanfilippo and Riedel. Sanfilippo and Riedel, 1970, p. 455, pl. 2, figs. 4–6.

Lychnodictyum audax Riedel. Riedel, 1953, p. 810, pl. 85, fig. 9.

Phormostichoartus doliolum (Riedel and Sanfilippo). *Artostrobium doliolum* in Riedel and Sanfilippo, 1971, p. 1599, pl. 1H, figs. 1–3, pl. 8, figs. 14, 15; *Phormostichoartus doliolum* (Riedel and Sanfilippo) in Nigrini, 1977, p. 252, pl. 1, fig. 14.

Phormostichoartus fistula Nigrini. Nigrini, 1977, p. 253, pl. 1, figs. 11–13.

Pterocanium prismatium Riedel. Riedel, 1957, p. 87, pl. 3, figs. 4, 5; emend. Riedel and Sanfilippo, 1970, p. 529.

Pterocorys minythorax (Nigrini). *Theoconus minythorax* Nigrini, 1968, p. 57, pl. I, fig. 8; (N7) in Molina-Cruz, 1977, p. 338, pl. VII, fig. 1. *Pterocorys minythoraxin* Nigrini and Moore, 1979, p. N87, pl. 25, fig. 10.

Siphostichartus corona (Haeckel). Haeckel, 1887, p. 1462, pl. 77, fig. 15; Riedel and Sanfilippo, 1971, p. 1600, pl. 11, figs. 13–15, pl. 2J, figs. 1–5; Nigrini, 1977, p. 257, pl. 2, figs. 5–7.

Solenosphaera omnitubus Riedel and Sanfilippo. Riedel and Sanfilippo, 1971, p. 1586, pl. IA, fig. 24, pl. 4, figs. 1, 2; *Solenosphaera omnitubus omnitubus* Nigrini and Lombari, 1984, p. S7, pl. 1, fig. 4.

Spongaster tetras Ehrenberg. Ehrenberg, 1860, p. 833, Ehrenberg, 1861, p. 301; Benson, 1966, p. 238, pl. 15, fig. 2; Nigrini, 1970, p. 169, pl. 2, fig. 7; Riedel and Sanfilippo, 1971, p. 1589, pl. ID, figs. 2–4; (S40), Molina-Cruz, 1977, p. 334, pl. V, fig. 17.

Stichocorys armata (Haeckel). *Cyrtophormis armata* in Haeckel 1887, p. 1460, pl. 78, fig. 17.

Stichocorys armata in Riedel and Sanfilippo, 1971, p. 1595, pl. 2E, figs. 13–15.

Stichocorys delmontensis (Campbell and Clark, 1944). *Eucyrtidium delmontense* in Campbell and Clark, 1944, p. 56, pl. 7, figs. 19, 20; *Stichocorys delmontensis* in Sanfilippo and Riedel, 1970, p 451, pl. 1, fig. 9; Sanfilippo et al., 1973, pl. 6, fig. 3; Westberg and Riedel, 1978, pl. 3, figs. 1–5.

Stichocorys johnsoni Caulet. Caulet, 1986, p. 851, pl. 6, figs. 5, 6. *Eucyrtidium* sp. cf. *E. diaphanes* Johnson, 1974, pl. 8, fig. 18, Johnson and Nigrini, 1985, p. 506.

Stichocorys peregrina (Riedel). *Eucyrtidium elongatum peregrinum* in Riedel 1953, p. 812, pl. 85, fig. 2; *Stichocorys peregrina* (Riedel) in Sanfilippo and Riedel, 1970, p. 451, pl. 1, fig. 10.

Stylatractus universus Hays. Hays, 1970, p. 215, pl. 1, figs. 1, 2.

Theocalyptra davisiana (Ehrenberg). *Cycladophora ? davisiana* in Ehrenberg, 1861, p. 297; *Theocalyptra davisiana* (Ehrenberg) in Riedel, 1958, p. 239, pl. 4, figs. 2, 3, 10.

Theocorythium trachelium (Ehrenberg). *Eucyrtidium trachelius* in Ehrenberg, 1872a, p. 312; 1872b, pl. 7, fig. 8. Included in this study: *Theocorythium trachelium trachelium* (Ehrenberg) in Nigrini, 1967, p. 79, pl. 8, fig. 2, pl. 9, fig. 2.

Theocorythium vetulum Nigrini. Nigrini, 1971, p. 447, pl. 34.1, figs. 6a, 6b.

Table 2. Site 844 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples Upper Hole Cr T S	Interval (cm)	Lower H Cr T S	Interval (cm)	Depth (mbsf) top	bottom	Depth (mcd) top	bottom
Collosphaera tuberosa	*T Stylatractus universus*	844 - B - 1 H - CC		C - 1 H - CC		4.53	9.1	4.53	9.6
Stylatractus universus	*B Collosphaera tuberosa*	844 - B - 1 H - CC		C - 1 H - CC		4.53	9.1	4.53	9.6
	T Lamprocyrtis neoheteroporos	844 - A - 1 H - CC		B - 2 H - 5,	110 - 112	9.94	11.6	11.43	12.73
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	844 - A - 1 H - CC		B - 2 H - 5,	110 - 112	9.94	11.6	11.43	12.73
	T Theocorythium vetulum	844 - B - 2 H - 5,	110 - 112	B - 2 H - CC		11.6	14.48	12.73	15.61
	B Lamprocyrtis nigriniae	844 - B - 2 H - 5,	110 - 112	B - 2 H - CC		11.6	14.48	12.73	15.61
	B Theocorythium trachelium	844 - B - 2 H - CC		B - 4 H - 3,	113 - 114	14.48	27.6	15.61	19.05
	B Pterocorys minythorax	844 - B - 2 H - CC		B - 4 H - 3,	113 - 114	14.48	27.6	15.61	19.05
	B Anthocyrtidium angulare	844 - B - 2 H - CC		B - 4 H - 3,	113 - 114	14.48	27.6	15.61	19.05
Anthocyrtidium angulare	*T Pterocanium prismatium*	844 - B - 2 H - CC		B - 4 H - 3,	113 - 114	14.48	27.6	15.61	19.05
	T Lamprocyrtis heteroporos	844 - B - 2 H - CC		B - 4 H - 3,	113 - 114	14.48	27.6	15.61	19.05
	T Anthocyrtidium jenghisi	844 - B - 3 H - 3,	110 - 112	B - 4 H - 5,	113 - 114	18.1	30.6	20.35	22.05
	B Theocalyptra davisiana	844 - B - 4 H - 5,	113 - 114	B - 3 H - 5,	110 - 112	30.6	21.1	22.05	23.35
Pterocanium prismatium	*T Stichocorys peregrina*	844 - B - 4 H - 5,	113 - 114	B - 3 H - 5,	110 - 112	30.6	21.1	22.05	23.35
	T Anthocyrtidium pliocenica	844 - B - 3 H - 5,	110 - 112	B - 4 H - CC		21.1	33.48	23.35	24.93
	B Lamprocyrtis neoheteroporos	844 - B - 3 H - 3,	110 - 112	B - 4 H - 5,	113 - 114	18.1	30.6	20.35	22.05
	B Lamprocyrtis heteroporos	844 - B - 3 H - 5,	110 - 112	B - 4 H - CC		21.1	33.48	23.35	24.93
	T Phormostichoartus fistula	844 - C - 3 H - CC		D - 1 H - 3,	0 - 1	28.66	27	31.01	31.7
	T Lychnodictyum audax	844 - B - 3 H - CC		C - 3 H - CC		24.05	28.66	26.05	31.01
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	844 - B - 3 H - CC		C - 3 H - CC		24.05	28.66	26.05	31.01
	B Amphirhopalum ypsilon	844 - B - 4 H - CC		B - 3 H - CC		33.48	24.05	24.93	26.05
	B Spongaster tetras	844 - B - 4 H - CC		B - 3 H - CC		33.48	24.05	24.93	26.05
Phormostichoartus doliolum	*T Didymocyrtis penultima*	844 - B - 3 H - CC		C - 3 H - CC		24.05	28.66	26.05	31.01
	B Pterocanium prismatium	844 - B - 4 H - CC		B - 3 H - CC		33.48	24.05	24.93	26.05
	T Solenosphaera omnitubus	844 - D - 1 H - 3,	150 - 151	D - 1 H - 4,	150 - 151	28.5	30	33.2	34.7
	T Siphostichartus corona	844 - D - 1 H - 4,	150 - 151	B - 5 H - 3,	114 - 116	30	37.1	34.7	40.75
	T Stichocorys johnsoni	844 - D - 1 H - 4,	150 - 151	B - 5 H - 3,	114 - 116	30	37.1	34.7	40.75
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	844 - D - 1 H - 4,	150 - 151	B - 5 H - 3,	114 - 116	30	37.1	34.7	40.75
	T Calocycletta caepa	844 - D - 1 H - 4,	150 - 151	B - 5 H - 3,	114 - 116	30	37.1	34.7	40.75
	B Solenosphaera omnitubus	844 - C - 4 H - CC		B - 5 H - 5,	114 - 116	38.18	40.1	42.33	43.75
Didymocyrtis penultima	*T Diartus hughesi*	844 - B - 5 H - 5,	114 - 116	B - 5 H - CC		40.1	42.9	43.75	46.55
	T Botryostrobus miralestensis	844 - B - 5 H - CC		B - 6 H - 3,	110 - 111	42.9	46.6	46.55	50.7
	T Stichocorys wolffii	844 - B - 6 H - 5,	110 - 111	B - 6 H - CC		49.6	52.52	53.7	56.62
	T Diartus petterssoni	844 - B - 6 H - 3,	110 - 111	B - 6 H - 4,	150 - 151	46.6	48.5	50.7	52.6
	B Stichocorys johnsoni	844 - B - 6 H - CC		B - 7 H - 3,	110 - 111	52.52	56.1	56.62	62.8
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	844 - B - 6 H - 5,	110 - 111	B - 6 H - CC		49.6	52.52	53.7	56.62
	B Diartus hughesi	844 - B - 6 H - 5,	110 - 111	B - 6 H - CC		49.6	52.52	53.7	56.62
	T Cyrtocapsella japonica	844 - B - 7 H - 5,	110 - 111	B - 7 H - CC		59.1	62.09	65.8	68.76
	T Lithopera thornburgi	844 - B - 6 H - CC		B - 7 H - 3,	110 - 111	52.52	56.1	56.62	62.8
	T Carpocanopsis cristata	844 - B - 7 H - CC		B - 8 H - 3,	110 - 111	62.09	65.6	68.76	72.75
	T Lithopera renzae	844 - B - 11 H - 5,	110 - 111	B - 11 H - CC		97.1	99.99	110.6	113.5
	T Cyrtocapsella cornuta	844 - B - 11 H - 3,	110 - 111	B - 11 H - 5,	110 - 111	94.1	97.1	107.6	110.6
Diartus petterssoni	*B Diartus petterssoni*	844 - B - 11 H - 5,	110 - 111	B - 11 H - CC		97.1	99.99	110.6	113.5
	T Dorcadospyris alata	844 - B - 11 H - 5,	110 - 111	B - 11 H - CC		97.1	99.99	110.6	113.5
	B Cyrtocapsella japonica	844 - C - 12 H - CC		B - 13 H - 3,	109 - 110	114.2	113	126.2	126.8
	B Calocycletta caepa s.s.	844 - B - 17 H - 5,	110 - 111	B - 17 H - CC		154	157.07	169.6	172.7
	B Lithoperta thornburgi	844 - B - 15 H - 5,	110 - 111	B - 15 H - CC		135	137.82	150	152.8
	T Stichocorys armata	844 - C - 17 H - CC		B - 18 H - CC		161.5	166.43	178.5	183.5
	T Liriospyris parkerae	844 - B - 20 H - 5,	110 - 111	B - 20 H - CC		183	185.58	201.6	204.2
	T Acrocubus octopyle	844 - B - 20 H - CC		B - 21 X - 3,	110 - 112	185.6	189	204.2	207.6
	T Carpocanopsis bramlettei	844 - B - 22 X - 3,	110 - 111	B - 22 X - CC		199	204.27	217.6	222.9
	T Calocycletta costata	844 - B - 23 X - 5,	110 - 111	B - 23 X - CC		211	213.9	229.6	232.9
Dorcadospyris alata	*Dorcadospyris dentata > Dorcadospyris alata*	844 - B - 24 X - CC		B - 25 X - 3,	109 - 111	223.7	228	242.3	246.6
	T Liriospyris stauropora	844 - B - 25 X - CC		B - 26 X - 3,	112 - 113	232	237	250.7	255.6
	B Liriospyris parkerae	844 - B - 25 X - CC		B - 26 X - 3,	112 - 113	232	237	250.7	255.6
	T Eucyrtidium diaphanes	844 - B - 26 X - 5,	109 - 110	B - 26 X - CC		240	243.06	258.6	261.7
	B Acrocubus octopyle	844 - B - 29 X - CC		B - 30 X - CC		271.8	281.47	290.4	300.1
	T Carpocanopsis cingulata	844 - B - 29 X - 3,	110 - 111	B - 29 X - 5,	109 - 110	266	269	284.6	287.6
	B Giraffospyris toxaria	844 - B - 29 X - 5,	109 - 110	B - 29 X - CC		269	271.75	287.6	290.4
	T Didymocyrtis prismatica	844 - B - 30 X - CC		B - 31 X - 5,	110 - 111	281.5	288	300.1	306.6

Site 850 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*	*Anthocyrtidium pliocenica*	*Phormostichoartus fistula*	*Lychnodictium audax*	*Phormostichoartus doliolum*	*Didymocyrtis penultima*	*Solenosphaera omnitubus*
Collosphaera tuberosa	7.68	7.68		A 1H-CC	5	3		R	R	R					R	R	R				R							
	8.6	8.6		B 1H-4, 110-111	5	2		R	R	R	_				R	R	R				R							
Stylatractus universus	11.65	11.65		B 1H-6, 115-116	5	2		R	R	R	R				R	R	R				R							
	12.78	12.78		B 1H-CC	5	3		R	R	_	R				R	R	R				R							
Amphirhopalum ypsilon	16.74	18.29		A 2H-CC	5	3		R	R		R				R	R	R				R							
	18.12	20.02		B 2H-4, 112-113	5	2		R	R		R	_	_		R	R	R				R							
Anthocyrtidium angulare	21.1	23		B 2H-6, 110-112	5	2		R	R		R	R	R	_	R	R	R				R							
	22.15	24.05		B 2H-CC	5	3		R	R		R	_	R	_	R	R	R				R							
	24.6	26.25		B 3H-2, 110-111	5	3		R	R		R	R	R	F	R	_	R	_			R							
	27.27	28.22		A 3H-CC	5	3		R	R		R	R	R	F	R	_	R	_			R							
	27.55	29.2		B 3H-4, 105-106	5	2		R	R		R	R	R	F	R	_	R	_			R							
	30.6	32.25		B 3H-6, 110-111	5	3		R	R		R	R	R	F	_		R	R			R							
	31.74	33.39		B 3H-CC	5	3		R	R		R	R	R	F	_		_	R	_		R							
Pterocanium prismatium	34.1	38.45		B 4H-2, 110-111	5	3		R	R		R	R	_	F			_	R	R		R							
	36.83	39.83		A 4H-CC	5	3		R	R		R	R		F				R	R		R							
	37.1	41.45		B 4H-4, 110-111	5	3		R	R		R	R		F				R	R		R							
	40.1	44.45		B 4H-6, 110-111	5	3		R	R		R	R		F				R	R		R							
	41.57	45.92		B 4H-CC	5	3		R	R		R	R		F				_	_		R							
	46.21	50.01		A 5H-CC	5	2		R	R		R	R		F				R	R	_	R							
	46.6	51		B 5H-4, 110-111	5	2	1	R	R		R	R		F				R	R	R	R							
	49.6	54		B 5H-6, 110-111	5	2		R	R		R	R		F				R	R	R	R							
	51.08	55.48		B 5H-CC	5	2		R	R		R	R		F				R	R	R	_	_						
Anthocyrtidium jenghisi	53.1	58.6		B 6H-2, 110-111	5	3		R	R		R	R		F				R	R	R	_	R						
	55.81	61.56		A 6H-CC	5	3		R	R		R	R		F				R	R	R		F						
	59.1	64.6	K	B 6H-6, 110-111	5	3	1	R	R		R	_		F				R	R	R		F	_	_				
	60.6	66.1		B 6H-CC	5	2		_	R		R	_		R				_	R	R		F	R	_				
	65.6	72.15	M	B 7H-4, 110-111	5	2		R	R		R			R				_	R	R		F	R	_				
	70.11	76.66		B 7H-CC	5	2	1	R	R		R			R					R	R		C	R	R	_			
	72.1	79.85		B 8H-2, 110-111	5	3	1	R	R		R			F					R	R		F	R	_	R	_		
Phormostichoartus doliolum	75.1	82.85		B 8H-4, 110-111	5	3		_	R		R			R					R	R		C	R	R	R	R		
	74.76	83.76		A 8H-CC	5	3		_	R		R			R					R	R		F	R	R	R	R		
	79.59	87.34		B 8H-CC	5	3		_	R		R			R					R	R		C	R	R	R	R	_	
Stichocorys peregrina	81.6	89.35		B 9H-2, 110-111	5	3		_	_		R			F					R	R		C	R	R	R	R	R	
	84.6	92.35		B 9H-4, 110-111	5	3			_		R			F					R	R		C	R	R	R	R	R	
	89.08	96.83		B 9H-CC	5	3			_		R			F					R	R		C	R	R	R	R	R	
	91.1	98.85		B 10H-2, 110-111	5	3			_		R			R					R	R		C	R	R	R	R	R	
	94.1	101.85		B 10H-4, 110-111	5	3			_		R			R					R	R		C	R	R	R	R	R	
	98.49	106.24		B 10H-CC	5	3					R			R					R	R		C	R	R	R	R	R	
	100.6	108.35		B 11X-2, 110-111	5	3					R			R					R	R		C	R	R	R	R	R	_
	103.6	111.35		B 11X-4, 110-111	5	3					R			R					_	R		C	R	R	R	R	R	_
	106.9	114.65		B 11X-CC	5	3					R			R					?	R		C	R	R	R	R	R	_
	113.1	120.85		B 12X-4, 110-111	5	3					R			R					_	R		C	R	R	R	R	R	_
	117	124.75		B 12X-CC	5	3					R			R					_	R		C	R	R	R	R	R	_
	119.7	127.45		B 13X-2, 110-111	5	3					R			R						R		C	R	R	R	R	F	_
	122.7	130.45		B 13X-4, 110-111	5	3					R			_						R		C	R	R	R	R	R	_
	125.72	133.47		B 13X-6, 112-113	5	3					R			R						R		C	R	R	R	R	R	_
	126.74	134.49		B 13X-CC	5	3					R			R						R		C	R	R	R	R	R	R
	132.4	140.15		B 14X-4, 110-111	5	3					R			_						R		C	R	R	R	R	R	R
	136.38	144.13		B 14X-CC	5	3					R			_						R		C	R	R	R	R	R	R
	141.98	149.73		B 15X-4, 108-109	5	3					R			_						R		C	R	R	R	R	R	R

Figure 7. Site 850 radiolarian species range chart. Notation as specified in Figure 1.

Site 850 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*	*Carpocanopsis cristata*	*Lithopera thornburgi*
Stichocorys peregrina	145	152.75		B 15X-6, 110-111	5	3		C	R				_							
	146.05	153.8		B 15X-CC	5	2		C	R				R							
	155.6	163.35		B 16X-CC	5	3		C	R				R							
	164.9	172.65		B 17X-CC	5	3		C	R				R							
	174.65	182.4		B 18X-CC	5	3		C	R				R							
	179.8	187.55		B 19X-4, 110-111	5	3		C	R				R							
	182.8	190.55		B 19X-6, 110-111	5	2		C	R	_		_	R							
	183.95	191.7		B 19X-CC	5	3		C	R	R		R	R							
	189.4	197.15		B 20X-4, 110-111	5	3		C	R	R	F	R	R							
	193.53	201.28		B 20X-CC	5	3		C	R	R	F	R	R							
	199.14	206.89		B 21X-4, 114-115	5	3		C	R	R	F	R	R							
	203.15	210.9		B 21X-CC	5	3		C	R	R	F	R	R							
	208.75	216.5		B 22X-4, 115-116	5	3		C	R	R	F	R	R							
	212.83	220.58		B 22X-CC	5	3		C	R	R	F	R	R							
Didymocyrtis penultima	215.4	223.15		B 23X-2, 110-111	5	3		C	R	R	C	R	R							
	218.4	226.15		B 23X-4, 110-111	5	3		F	R	R	C	R	R							
	222.39	230.14		B 23X-CC	5	3		R	R	R	C	R	R							
	231.95	239.7		B 24X-CC	5	3			R	R	C	R	R							
	234.7	242.45		B 25X-2, 110-111	5	3			_	R	C	R	R							
	241.73	249.48		B 25X-CC	5	3			?	R	C	F	R	_						
	251.49	259.24		B 26X-CC	5	3			_	R	C	F	R	*						
	253.6	261.35		B 27X-2, 110-111	5	3			_	R	C	F	R	*						
Didymocyrtis antepenultima	256.6	264.35		B 27X-4, 110-111	5	3			_	R	C	F	R	R						
	260.79	268.54		B 27X-CC	5	3				R	C	F	R	R						
	266.29	274.04		B 28X-4, 109-110	5	3				R	C	F	R	F	_					
	270.26	278.01		B 28X-CC	5	3				R	C	F	R	F	_					
	275.9	283.65		B 29X-4, 110-111	5	2				R	C	F	R	F	R	_				
	278.9	286.65		B 29X-6, 110-111	5	2				R	C	F	R	F	R	R				
	279.93	287.68		B 29X-CC	5	3				R	C	F	R	F	R	R				
	282.5	290.25		B 30X-2, 110-112	5	2				R	C	F	R	F	R	R				
	285.5	293.25		B 30X-4, 110-112	5	2				R	C	F	R	F	R	R				
Diartus petterssoni	289.57	297.32		B 30X-CC	5	2				R	C	F	R	R	R	F				
	292.2	299.95		B 31X-2, 110-111	5	2				_	C	F	R	R	R	F	_			
	299.34	307.09		B 31X-CC	5	3				_	C	F	R		R	F	R			
	301.8	309.55		B 32X-2, 110-111	5	2					C	F	R		R	F	R			
	304.8	312.55		B 32X-4, 110-111	5	2					C	F	R		R	C	R			
	307.8	315.8		B 32X-6, 110-111	5	3					C	F	R		R	C	F			_
	308.22	315.97		B 32X-CC	5	2					C	F	R		R	F	R			_
	318.75	326.5		B 33X-CC	5	2					C	F	R		R	F	R			R
	328.5	336.25		B 34X-CC	5	2					C	F	R		R	F	R			R
	330.8	338.55		B 35X-2, 110-111	5	2					C	F	R		R	F	R	_		R
	333.8	341.55		B 35X-4, 110-111	5	2					C	F	R		R	F	R	C		R
	328.2	335.95		B 35X-CC	5	2					C	F	R		R	F	R	C		R
	343.63	351.38		B 36X-4, 133-134	5	2					C	F	_		R	F	R	C		R
	344.67	352.42		B 36X-CC	4	2					C	F	_		R	F	R	C		R
	353.1	360.85		B 37X-4, 110-111	5	2					C	F	R		R	C	R	C	_	_
	356.1	363.85		B 37X-6, 110-111	5	2					C	F	R		R	F	R	C	R	R
	357.28	365.03		B 37X-CC	5	3					C	F	_		R	F	F	C	_	R
	358.37	366.12		B 38X-1, 127-128	4	2					C	F	_		R	F	F	F	R	R
	360.77	368.52		B 38X-CC	4	2					C	F	_		R	F	F	F	R	R
	376.66	384.41		B 39X-CC	5	3					C	F	R		R	F	F	F	R	R
	386.18	393.93		B 40X-CC	5	2					C	F	_		R	F	R	R	_	R
	395.95	403.7		B 41X-CC	5	2					C	F	_		R	F	_	F	R	R
	399.92	407.67		B 42X-CC	5	2					C	R	_		R	R	R	F	R	R

Figure 7 (continued).

Table 3. Site 845 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper, Hole Cr T S	Upper Interval (cm)	Lower, H Cr T S	Lower Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	T *Stylatractus universus*	845 - B - 1 H - CC		A - 2 H - 3,	110 - 111	9.73	11.7	12.09	12.58
Stylatractus universus	B *Collosphaera tuberosa*	845 - A - 2 H - 5,	110 - 111	A - 2 H - CC		14.7	17.21	15.58	18.09
	T *Lamprocyrtis neoheteroporos*	845 - A - 3 H - 5,	51 - 52	A - 3 H - 5,	110 - 111	23.61	24.2	24.47	25.06
Amphirhopalum ypsilon	T *Anthocyrtidium angulare*	845 - A - 3 H - 5,	110 - 111	A - 3 H - 6,	51 - 52	24.2	25.11	25.06	25.97
	T *Theocorythium vetulum*	845 - A - 3 H - 6,	99 - 10	A - 3 H - CC		25.59	26.99	26.45	27.85
	B *Lamprocyrtis nigriniae*	845 - A - 3 H - CC		A - 4 H - 1,	80 - 81	26.99	27.4	27.85	29.53
	B *Theocorythium trachelium*	845 - A - 4 H - 3,	110 - 111	A - 4 H - 4,	42 - 3	30.7	31.52	32.83	33.65
	B *Pterocorys minythorax*	845 - A - 4 H - 4,	42 - 43	A - 4 H - 5,	110 - 111	31.52	33.7	33.65	35.83
	B *Anthocyrtidium angulare*	845 - A - 4 H - CC		A - 5 H - 1,	20 - 21	36.49	36.3	38.62	39.81
Anthocyrtidium angulare	T *Pterocanium prismatium*	845 - A - 4 H - 6,	99 - 100	A - 4 H - CC		36.49	36.49	37.22	38.62
	T *Lamprocyrtis heteroporos*	845 - A - 4 H - 4,	42 - 43	A - 4 H - 5,	110 - 111	31.52	33.7	33.65	35.83
	T *Anthocyrtidium jenghisi*	845 - A - 5 H - 3,	110 - 111	A - 5 H - 5,	110 - 111	40.2	43.2	43.71	46.71
	B *Theocalyptra davisiana*	845 - A - 5 H - CC		C - 3 H - CC		46.09	48.63	49.6	51.93
Pterocanium prismatium	T *Stichocorys peregrina*	845 - C - 3 H - CC		A - 6 H - 2,	98 - 99	48.63	48.08	51.93	52.16
	T *Anthocyrtidium pliocenica*	845 - A - 6 H - 5,	110 - 111	A - 6 H - CC		52.7	55.64	56.78	59.72
	B *Lamprocyrtis neoheteroporos*	845 - A - 6 H - 4,	119 - 120	A - 6 H - 5,	50 - 51	51.29	52.1	55.37	56.18
	B *Lamprocyrtis heteroporos*	845 - A - 6 H - 4,	40 - 41	A - 6 H - 4,	119 - 120	50.5	51.29	54.58	55.37
	T *Phormostichoartus fistula*	845 - A - 6 H - 5,	110 - 111	A - 6 H - CC		52.7	55.64	56.78	59.72
	T *Lychnodictyum audax*	845 - A - 7 H - 3,	40 - 41	A - 7 H - 3,	110 - 111	58.5	59.2	63.36	64.06
Anthocyrtidium jenghisi	T *Phormostichoartus doliolum*	845 - A - 7 H - 3,	40 - 41	A - 7 H - 3,	110 - 111	58.5	59.2	63.36	64.06
	B *Amphirhopalum ypsilon*	845 - A - 6 H - CC		A - 7 H - 1,	21 - 22	55.64	55.31	59.72	60.17
	B *Spongaster tetras*	845 - A - 7 H - 2,	30 - 31	A - 7 H - 2	110 - 111	56.9	57.7	61.76	62.56
Phormostichoartus doliolum	T *Didymocyrtis penultima*	845 - A - 8 H - 1,	21 - 22	A - 8 H - 1,	100 - 101	64.81	65.6	71.11	71.9
	B *Pterocanium prismatium*	845 - B - 6 H - CC		A - 7 H - 5,	110 - 111	59.97	62.2	66.7	67.06
	T *Solenosphaera omnitubus*	845 - A - 8 H - 5,	25 - 26	A - 8 H - 5,	110 - 112	70.85	71.7	77.15	78
	T *Siphostichartus corona*	845 - A - 11 H - 1,	15 - 16	A - 11 H - 1,	130 - 131	93.25	94.4	103	104.2
	T *Stichocorys johnsoni*	845 - A - 10 H - 2,	140 - 141	A - 10 H - 3,	110 - 111	86.5	87.7	94.98	96.18
Stichocorys peregrina	*Stichocorys delmontensis* > *S. peregrina*	845 - A - 10 H - 5,	110 - 111	A 10 H - 6,	28 - 29	90.7	91.38	99.18	99.86
	T *Calocycletta caepa*	845 - A - 10 H - CC		A - 11 H - 1,	15 - 16	93.61	93.25	102.1	103
	B *Solenosphaera omnitubus*	845 - A - 11 H - 1,	130 - 131	A - 11 H - 2,	62 - 63	94.4	95.22	104.2	105
Didymocyrtis penultima	T *Diartus hughesi*	845 - A - 11 H - 6,	29 - 30	A - 11 H - 6,	80 - 81	100.9	101.4	110.7	111.2
	T *Botryostrobus miralestensis*	845 - A - 12 H - 5,	110 - 111	A - 12 H - 6,	30 - 31	109.7	110.4	121	121.7
	T *Stichocorys wolffii*	845 - A - 13 H - 6,	122 - 123	A - 13 H - CC		120.8	122.1	133.4	134.7
	T *Diartus petterssoni*	845 - A - 13 H - 3,	110 - 111	A - 13 H - 4,	48 - 49	116.2	117.1	128.8	129.7
	B *Stichocorys johnsoni*	845 - B - 12 H - CC		A - 13 H - 5,	110 - 111	117.6	119.2	130.6	131.8
Didymocyrtis antepenultima	*D. petterssoni* > *D. hughesi*	845 - B - 12 H - CC		A - 13 H - 5,	110 - 111	117.6	119.2	130.6	131.8
	B *Diartus hughesi*	845 - A - 13 H - CC		A - 14 H - 1,	20 - 21	122.1	121.8	134.7	135.8
	T *Cyrtocapsella japonica*	845 - A - 15 H - 5,	110 - 111	A - 15 H - 6,	29 - 30	138.2	138.9	154.1	154.8
	T *Lithopera thornburgi*	845 - B - 16 H - CC		A - 17 H - 5,	110 - 111	155.6	157.2	175.3	176
	T *Carpocanopsis cristata*	845 - A - 16 H - 1,	20 - 21	A - 16 H - 2,	62 - 63	140.8	142.7	158.5	160.5
	T *Lithopera renzae*	845 - A - 18 H - 2,	139 - 140	A - 18 H - 3,	110 - 111	162.5	163.7	181.8	183
	T *Cyrtocapsella cornuta*	845 - A - 18 H - 3,	110 - 111	A - 18 H - 4,	20 - 21	163.7	164.3	183	183.6
Diartus petterssoni	B *Diartus petterssoni*	845 - A - 18 H - 3,	110 - 111	A - 18 H - 4,	20 - 21	163.7	164.3	183	183.6
	T *Dorcadospyris alata*	845 - A - 18 H - 4,	20 - 21	A - 18 H - 4,	90 - 91	164.3	165	183.6	184.3
	B *Cyrtocapsella japonica*	845 - A - 19 H - CC		A - 20 H - 1,	20 - 21	179.2	179.6	199.8	201.9
	B *Calocycletta caepa s.s.*	845 - A - 21 H - CC		A - 22 H - 1,	120 - 121	198.1	198.8	221.4	224
	B *Lithoperta thornburgi*	845 - A - 22 H - CC		A - 23 X - 1,	90 - 91	207.6	208	232.8	233.2
	T *Stichocorys armata*	845 - A - 23 X - 1,	90 - 91	A - 23 X - 2,	30 - 31	208	208.9	233.2	234.1
	T *Liriospyris parkerae*	845 - A - 24 X - CC		A - 25 X - 1,	20 - 21	218.5	226.7	243.7	251.9
	T *Acrocubus octopyle*	845 - A - 24 X - CC		A - 25 X - 1,	20 - 21	218.5	226.7	243.7	251.9
	T *Carpocanopsis bramlettei*	845 - A - 24 X - CC		A - 25 X - 1,	20 - 21	218.5	226.7	243.7	251.9
	T *Calocycletta costata*	845 - A - 25 X - 6,	40 - 41	A - 25 X - 5,	120 - 121	234.4	235.2	259.6	260.4
Dorcadospyris alata	*Dorcadospyris dentata* > *Dorcadospyris alata*	845 - A - 27 X - 4,	60 - 61	A - 27 X - 4,	140 - 141	250.9	251.7	276.1	276.9
	T *Liriospyris stauropora*	845 - A - 27 X - 6,	110 - 111	A - 27 X - 7,	10 - 11	254	254.9	279.2	280.1
	B *Liriospyris parkerae*	845 - A - 27 X - 7,	10 - 11	A - 27 X - CC		254.9	255.5	280.1	280.8
	T *Eucyrtidium diaphanes*	845 - A - 28 X - 4,	40 - 41	A - 28 X - 4,	120 - 121	259.9	260.7	285.1	285.9
	B *Acrocubus octopyle*	845 - A - 30 X - 6,	110 - 111	A - 30 X - CC		282.8	283.9	308	308.1
	T *Carpocanopsis cingulata*	845 - A - 30 X - 3,	107 - 108	A - 30 X - 4,	40 - 41	278.3	279.1	303.5	304.3
	T *Didymocyrtis prismatica*	845 - A - 30 X - 6,	30 - 31	A - 30 X - 6,	110 - 111	282	282.8	307.2	308

Table 4. Site 846 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Hole, Upper Cr T S	Interval (cm)	Lower H Cr T S	Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	846 - B - 2 H - 5,	110 - 111	B - 2 H - 6,	100 - 101	14.1	15.5	14.70	16.10
Stylatractus universus	*B Collosphaera tuberosa*	846 - B - 2 H - CC		B - 3 H - 3,	110 - 111	16.89	20.6	17.49	22.65
	T Lamprocyrtis neoheteroporos	846 - B - 4 H - 5,	110 - 111	B - 4 H - 6,	139 - 140	33.1	34.89	36.25	38.04
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	846 - B - 5 H - 1,	20 - 21	B - 5 H - 2,	20 - 21	35.7	37.2	40.90	42.40
	T Theocorythium vetulum	846 - B - 5 H - 3,	110 - 111	B - 5 H - 4,	79 - 80	39.6	40.79	44.80	45.99
	B Lamprocyrtis nigriniae	846 - B - 5 H - 3,	110 - 111	B - 5 H - 4,	79 - 80	39.6	40.79	44.80	45.99
	B Theocorythium trachelium	846 - B - 6 H - 4,	100 - 101	B - 6 H - 5,	110 - 111	50.5	52.1	57.00	58.60
	B Pterocorys minythorax	846 - B - 6 H - 2,	50 - 51	C - 5 H - CC		47	50.69	53.50	54.74
	B Anthocyrtidium angulare	846 - B - 6 H - CC		C - 6 H - CC		53.94	58.64	60.44	65.59
Anthocyrtidium angulare	*T Pterocanium prismatium*	846 - B - 6 H - CC		C - 6 H - CC		53.94	58.64	60.44	65.59
	T Lamprocyrtis heteroporos	846 - B - 8 H - 3,	115 - 116	B - 8 H - 4,	100 - 101	68.2	69.5	77.90	79.20
	T Anthocyrtidium jenghisi	846 - B - 9 H - 4,	100 - 101	B - 9 H - 5,	110 - 111	79	80.6	89.15	90.75
	B Theocalyptra davisiana	846 - B - 10 H - CC		B - 11 H - 3,	114 - 115	93.23	96.6	105.78	110.10
Pterocanium prismatium	*T Stichocorys peregrina*	846 - B - 10 H - CC		B - 11 H - 3,	114 - 115	93.23	96.6	105.78	110.10
	T Anthocyrtidium pliocenica	846 - D - 12 H - CC		B - 13 H - 2,	100 - 101	115.91	114	129.41	130.45
	B Lamprocyrtis neoheteroporos	846 - B - 13 H - 5,	115 - 116	B - 13 H - 6,	100 - 101	119	120	135.45	136.45
	B Lamprocyrtis heteroporos	846 - B - 13 H - 3,	115 - 116	B - 13 H - 4,	100 - 101	116	117	132.45	133.45
	T Phormostichoartus fistula	846 - B - 16 H - 4,	100 - 101	B - 16 H - 5,	115 - 116	145.5	147	165.70	167.20
	T Lychnodictyum audax	846 - B - 15 H - 4,	100 - 101	B - 15 H - 5,	115 - 116	136	138	155.70	157.70
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	846 - B - 15 H - 5,	115 - 116	B - 15 H - CC		138	140.62	157.70	160.32
	B Amphirhopalum ypsilon	846 - B - 14 H - 5,	115 - 116	B - 14 H - CC		128	130.78	145.15	147.93
	B Spongaster tetras	846 - B - 15 H - 5,	115 - 116	B - 15 H - CC		138	140.62	157.70	160.32
Phormostichoartus doliolum	*T Didymocyrtis penultima*	846 - B - 15 H - CC		B - 16 H - 2,	10 - 11	140.62	141.6	160.32	161.80
	B Pterocanium prismatium	846 - B - 18 H - 2,	130 - 131	D - 17 H - CC		161.8	163.61	183.65	184.41
	T Solenosphaera omnitubus	846 - B - 20 H - CC		B - 21 H - 1,	100 - 101	187.85	188.5	209.70	214.10
	T Siphostichartus corona	846 - B - 21 H - 2,	100 - 101	D - 20 H - CC		190	191.59	215.60	216.89
	T Stichocorys johnsoni	846 - D - 24 X - CC		B - 25 X - 3,	110 - 111	230.06	230	263.41	265.10
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	846 - B - 25 X - CC		D - 25 X - 4,	110 - 111	232.12	235.7	267.22	269.50
	T Calocycletta caepa	846 - B - 25 X - CC		D - 25 X - 4,	110 - 111	232.12	235.7	267.22	269.50
	B Solenosphaera omnitubus	846 - B - 27 X - CC		B - 28 X - 1,	20 - 21	253.56	255.1	288.66	290.20
Didymocyrtis penultima	*T Diartus hughesi*	846 - B - 28 X - CC		B - 29 X - 1,	100 - 101	264.87	265.2	299.97	300.30
	T Botryostrobus miralestensis	846 - B - 30 X - 2,	113 - 114	B - 30 X - 5,	19 - 20	277	280	312.10	315.10
	T Stichocorys wolffii	846 - B - 30 X - CC		B - 31 X - 1,	100 - 101	283.75	284.5	318.85	319.60
	T Diartus petterssoni	846 - B - 30 X - 2,	113 - 114	B - 30 X - 5,	19 - 20	277	280	312.10	315.10
	B Stichocorys johnsoni	846 - B - 30 X - 5,	19 - 20	B - 30 X - 6,	70 - 71	280	282.1	315.10	317.20
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	846 - B - 30 X - 5,	19 - 20	B - 30 X - 6,	70 - 71	280	282.1	315.10	317.20
	B Diartus hughesi	846 - B - 31 X - 5,	110 - 111	B - 31 X - CC		291	293.34	326.10	328.44
	T Cyrtocapsella japonica	846 - B - 33 X - 1,	100 - 101	B - 33 X - 2,	100 - 101	303.8	305.3	338.90	340.40
	T Lithopera thornburgi	846 - B - 34 X - 1,	102 - 103	B - 34 X - 2,	99 - 100	313.42	314.89	348.52	349.99
	T Carpocanopsis cristata	846 - B - 34 X - 1,	102 - 103	B - 34 X - 2,	99 - 100	313.42	314.89	348.52	349.99
	T Lithopera renzae	846 - B - 35 X - CC		B - 36 X - 1,	100 - 101	331.72	332.7	366.82	367.80
	T Cyrtocapsella cornuta	846 - B - 36 X - 2,	100 - 101	B - 36 X - 3,	100 - 101	334.2	335.7	369.30	370.80
	B Cyrtocapsella japonica	846 - B - 37 X - 1,	100 - 101	B - 37 X - 2,	109 - 110	342.3	344	377.4	379.1
Diartus petterssoni	*B Diartus petterssoni*	846 - B - 38 X - 2,	105 - 106	B - 38 X - 5,	105 - 106	354	358	389.10	393.10

Site 851 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*	*Anthocyrtidium pliocenica*	*Phormostichoartus fistula*	*Lychnodictium audax*	*Phormostichoartus doliolum*	*Didymocyrtis penultima*	*Solenosphaera omnitubus*
Collosphaera tuberosa	5.6	5.6		B 1H-4, 110-111	5	2		R	R	R					R	R	R				R							
	6.45	6.45		A 1H-CC	5	2		R	R	R	_				R	R	R				R							
Stylatractus universus	7.58	7.58	Brunhes	B 1H-CC	5	2		R	R	R	R				R	R	R				R							
	9.86	9.86		E 1H-CC	5	2	1	R	R	R	R				R	R	R				R							
Amphirhopalum ypsilon	10.1	12.45		B 2H-2, 110-111	5	3		R	R	_	R				R	R	R				R							
	15.6	19.1	J	E 2H-5, 110-111	5	2	1	R	R	_	R	*			R	R	R				R							
	17.17	19.52		B 2H-CC	5	3	1	R	R		R	_			R	R	R				R							
	18	21.5		E 2H-6, 100-101	5	3		R	R		R	_			R	R	R				R							
	19.19	22.69		E 2H-CC	5	2	1	R	R		R	R	_	_	R	R	R				R							
Anthocyrtidium angulare	19.6	23.75		B 3H-2, 110-111	5	2		R	R		R	_	R	*	R	_	R				R							
	22.6	26.75		B 3H-4, 110-111	5	3		R	R		R	R	R	F	R	_	R				R							
	25.6	29.75		B 3H-6, 110-111	5	2		R	R		R	R	R	F	R		R	_			R							
	27.1	31.25		B 3H-CC	5	2	1	R	R		R	R	R	R	R		R	R	_		R							
Pterocanium prismatium	29.06	33.26		E 3H-CC	5	2		R	R		R	R	_	F	_		_	R	R		R							
	29.1	34.5	O	B 4H-2, 110-111	5	2		R	R		R	R	_	F	_		_	R	R		R							
	31	36.4		B 4H-3, 150-151	5	3		R	R		R	R		F				R	R		R							
	35.1	40.5		B 4H-6, 110-111	5	2		R	R		R	R		F				R	R		R							
	36.41	41.81		B 4H-CC	4	2		R	R		R	R		F				R	R	_	R							
	38.2	44.5		B 5H-2, 70-71	5	3		R	R		R	R		F				R	R	R	R	_						
	44.6	50.9		B 5H-6, 110-111	5	3		R	R		R	R		F				R	R	R	R	_						
Anthocyrtidium jenghisi	45.89	52.19		B 5H-CC	5	3		R	R		R	_		F				R	R	R	_	R						
	48.12	54.92		E 5H-CC	5	2		R	R		R	R		F				R	R	R	_	R						
	48.1	55.95	K	B 6H-2, 110-111	5	2		R	R		R	_		F				R	R	R		F						
	51.1	58.95		B 6H-4, 110-111	5	3		R	R		R	_		F				R	R	R		F						
	54.1	61.95	M	B 6H-6, 110-111	5	2		R	R		R	_		F				_	R	R		C						
	55.6	63.45		B 6H-CC	5	2		R	R		R			F				_	R	R		C	_	_				
	57.61	65.21		E 6H-CC	5	2		R	R		R			F					R	R		C	R	_				
	58	66.45		B 7H-3, 0-1	4	2		R	R		R			F					R	R		C	R	R				
	59.5	67.95		B 7H-4, 0-1	5	2		R	R		R			F					R	R		C	R	_	_			
	61	69.45		B 7H-5, 0-1	5	2		R	R		R			F					R	R		F	R	R	_			
	62.5	70.95		B 7H-6, 0-1	5	2		R	R		R			F					R	R		C	R	R	R	_		
Phormostichoartus doliolum	65.04	73.49		B 7H-CC	5	3		R	R		R			F					R	R		C	F	R	R	R		
	67.1	75.7		E 7H-CC	5	3		_	R		R			F					R	R		C	R	R	_	R		
	67.1	77		B 8H-2, 110-111	5	3		_	R		R			F					R	R		C	R	R	R	R	_	
Stichocorys peregrina	69.39	78.99	C	C 7H-CC	5	3		_	_		R			R					_	R		C	R	R	_	R	R	
	70.1	80		B 8H-4, 110-111	5	2	1		_		R			F					R	R		C	F	R	R	R	R	
	74.54	84.44		B 8H-CC	5	3			_		R			F					R	R		C	R	R	R	R	R	
	84.14	94.54		B 9H-CC	5	3					R			F					_	R		C	R	R	R	R	R	
	93.46	105.41		B 10H-CC	5	3					R			R					_	R		C	R	R	R	R	R	_
	95.63	107.63		E 10H-CC	5	3					R			R					_	R		C	R	R	R	R	R	_
	95.6	108.75		B 11H-2, 110-111	5	3					R			R					_	R		C	R	R	R	R	R	*
	98.6	111.75		B 11H-4, 110-111	5	3					R			_						R		C	R	R	R	R	R	R
	101.6	114.75		B 11H-6, 110-111	5	3					R			_						R		C	R	R	R	R	R	R
	103.01	116.16		B 11H-CC	5	3					R									R		C	R	R	R	R	R	R
	112.64	127.64		B 12H-CC	5	3					R									R		C	R	R	R	R	R	R

Figure 8. Site 851 radiolarian species range chart. Notation as specified in Figure 1.

Site 851 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*	*Carpocanopsis cristata*	*Lithopera thornburgi*
Stichocorys peregrina	112.64	127.64		B 12H-CC	5	3		C	R				–							
	114.6	130.4		B 13H-2, 110-111	5	3		C	R				R							
	117.64	133.44		B 13H-4, 110-111	5	3		C	R			–	R							
	122.19	137.99		B 13H-CC	5	3		C	R			–	R							
	131.37	148.52		B 14H-CC	5	3		F	R	–		*	R							
	133.68	150.38		E 14H-CC	5	3		F	R	R		–	R							
	133.6	151.95		B 15H-2, 110-111	5	3		F	R	R		R	R							
	136.6	154.95		B 15H-4, 110-111	5	2		C	R	–		R	R							
	140.89	159.24		B 15H-CC	5	3		C	R	R		R	R							
	150	168.55		B 16X-CC	5	3		C	R	R		R	R							
	152.7	176.2		B 17X-2, 110-111	5	3		C	R	R	R	R	R							
Didymocyrtis penultima	155.7	179.2		B 17X-4, 110-111	5	2		F	R	R	C	R	R							
	158.7	182.2		B 17X-6, 110-111	5	2			R	R	C	R	R							
	159.87	183.37		B 17X-CC	5	3			R	R	C	R	R							
	162.4	190.85		B 18X-2, 110-111	5	2			–	R	C	R	R							
	165.4	193.85		B 18X-4, 110-111	5	3				R	C	R	R							
	169.49	197.94		B 18X-CC	5	3				R	C	R	R							
	179.03	208.78		B 19X-CC	5	3				R	C	R	R	–						
Didymocyrtis antepenultima	181.7	217.65		B 20X-2, 110-111	5	2				R	C	R	R	R						
	187.7	223.65		B 20X-6, 110-111	5	3				R	C	F	R	R						
	188.93	224.88		B 20X-CC	5	3				R	C	F	R	F						
	193.9	233.25		B 21X-4, 110-111	5	3				R	C	F	R	F	–					
	196.85	236.2		B 21X-6, 105-107	5	3				R	C	F	R	F	R	–				
	197.14	236.49		B 21X-CC	5	2				R	C	F	R	F	R	R				
	206.06	245.41		B 22X-6, 106-107	5	2				R	C	F	R	F	R	R				
	207.29	246.64		B 22X-CC	5	2				R	C	F	R	F	R	R				
Diartus petterssoni	209.7	254.65		B 23X-2, 110-111	5	3				R	C	F	R	R	R	F				
	212.7	257.65		B 23X-4, 110-111	5	3				R	C	F	R	R	R	F	–			
	215.68	260.63		B 23X-6, 108-109	5	3				–	C	F	R	–	R	F	–			
	216.87	261.82		B 23X-CC	5	3				–	C	F	R		R	F	F			
	226.56	272.66		B 24X-CC	5	2					C	F	R		R	F	R	–		
	236.19	285.29		B 25X-CC	5	2					C	R	R		R	F	R	*		
	238.7	291.5		B 26X-2, 110-111	5	2					C	R	R		R	F	R	–		
	241.7	294.5		B 26X-4, 110-111	5	2					C	F	R		–	F	F	–		
	244.7	297.5		B 26X-6, 110-111	5	2					C	F	R		R	F	R	C		–
	245.25	298.05		B 26X-CC	5	2					C	R	R		R	F	R	C		R
	255.68	310.53		B 27X-CC	5	2					C	R	R		R	F	R	C		–
	265.14	321.04		B 28X-CC	5	2					C	R	R		R	F	R	C	–	R
	266.2	324.6		B 29X-1, 110-111	5	2					C	F	R		R	F	R	F	R	R
	272.83	331.23		B 29X-CC	5	2					C	R	R		R	F	R	C	R	R
	293.96	352.36		B 31X-CC	5	2					C	F	R		R	F	R	C	–	R
	302.94	363.19		B 32X-CC	5	3					C	R	–		R	F	F	F	R	R
	313.13	377.08		B 33X-CC	5	2					C	F	R		R	R	R	R	R	–
	319.98	385.53		B 34X-4, 108-109	4	2					C	–	–		R	F	F	C	R	R
	321.49	387.04		B 34X-CC	0	0					–	–	–		–	–	–	–	–	–

Figure 8 (continued).

Site 852 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*	*Anthocyrtidium pliocenica*	*Phormostichoartus fistula*	*Lychnodictium audax*	*Phormostichoartus doliolum*	*Didymocyrtis penultima*
Collosphaera tuberosa	2.6	2.8		B 1H-2, 110-111	4	2		R	R	R	_				R	R	R				R						
	3.1	3.3		B 1H-3, 10-11	3	2	1	R	R	R	_				_	R	R				R						
	3.8	4		B 1H-3, 80-81	2	2		R	R	R	_				R	R	R				R						
Stylatractus universus	4.39	4.59	Brunhes	B 1H-3, 139-140	2	2		R	R	R	R				R	R	R				R						
	5.1	5.3		B 1H-4, 60-61	2	2	1	R	R	_	R				R	R	R				R						
	5.6	5.8		B 1H-4, 110-111	4	2	1	R	R	R	R				R	R	R				R						
	5.86	5.86		A 1H-CC	4	2		R	R	R	R				R	R	R				R						
Amphirhopalum ypsilon	8.6	8.8		B 1H-6, 110-111	3	2	1	R	R	_	R	_			R	R	R				R						
	8.87	9.07		B 1H-CC	4	2		R	R	_	R	_	_		_	R	R				R						
	11.5	11.75	J	B 2H-2, 110-111	4	2		R	R	_	R	_	_		R	R	R				R						
	13	13.25		B 2H-3, 110-111	4	2	1	R	R		R	_	_	_	R	R	R				R						
Anthocyrtidium angulare	13.5	13.75		B 2H-4, 10-11	3	2		R	R		R	R	R	_	R	R	R				R						
	14	14.25		B 2H-4, 60-61	3	2		R	R		R	R	R	_	_	R	R				R						
	14.5	14.75		B 2H-4, 110-111	4	2		R	R		R	R	R	R	R	_	R				R						
	15	15.25	Matuyama	B 2H-5, 10-11	4	2		R	R		R	R	R	R	R	_	_				R						
	15.5	15.75		B 2H-5, 60-61	2	1		R	R		R	R	R	R	R		_				R						
	16.3	16.55		B 2H-5, 140-141	3	2		R	R		R	R	R	R	R						R						
	16.5	16.75		B 2H-6, 10-11	1	1	1	R	R		R	R	R	R	R						R						
	16.08	16.88		C 2H-CC	4	2		R	R		R	R	R	F	R			_			R						
	17	17.25		B 2H-6, 60-61	4	2		R	R		R	R	R	R	R			_			R						
	17.5	17.75		B 2H-6, 110-111	4	2	1	R	R		R	R	R	F	R			_	_		R						
	18.94	19.19		B 2H-CC	4	2	2	R	R		R	R	R	R	R			_	_		R						
Pterocanium prismatium	19.5	20.3		B 3H-1, 110-111	3	2	2	R	R		R	R	R	F	R			R	R		R						
	20	20.8		B 3H-2, 10-11	4	2	2	R	R		R	R	R	R	R			R	R		R						
	20.5	21.3		B 3H-2, 60-61	1	1	2	_	R		R	R	_	R	_			_	_		_						
	21.59	21.84	Old.	D 2H-CC	4	2	1	R	R		R	R	_	F	_			R	R		R						
	21.3	22.1		B 3H-2, 140-141	3	2	1	R	R		R	R	_	R				_	R		R						
	21.5	22.3		B 3H-3, 10-11	1	1	2	R	R		R	R	_	R				_	R		R						
	22	22.8		B 3H-3, 60-61	2	2	2	R	R		R	R		F				_	R		R						
	22.5	23.3		B 3H-3, 110-111	4	2	1	R	R		R	R		F				R	R		R						
	22.8	23.6		B 3H-3, 140-141	3	2	1	R	R		R	R		F				R	R		R						
	24	24.8		B 3H-4, 110-111	3	2	1	R	R		R	R		F				R	R		R						
	24.5	25.3		B 3H-5, 10-11	3	2	1	R	R		R	R		R				R	R		R						
	25	25.8		B 3H-5, 60-61	4	2	1	R	R		R	R		F				R	R		R						
	25.13	26.53		C 3H-CC	5	3	1	R	R		R	_		F				_	R	_	R						
	25.8	26.6		B 3H-5, 140-141	3	3	1	R	R		R	R		F				R	R	_	R						
	26	26.8		B 3H-6, 10-11	5	3	1	R	R		R	R		F				R	R	_	R						
	26.5	27.3		B 3H-6, 60-61	5	3	1	R	R		R	R		F				R	R	_	R						
	27	27.8		B 3H-6, 110-111	5	2	1	R	R		R	R		F				R	R	R	_						
	27.3	28.1		B 3H-6, 140-141	4	2		R	R		R	R		F				R	R	_	R						
	27.6	28.4		B 3H-7-20-21	4	2	1	R	R		R	R		F				R	R	R	R	_					
	28.49	29.29		B 3H-CC	2	1	1	R	R		R	R		R				R	R	_	_	_					
	29	31.4		B 4H-1, 110-111	5	2		R	R		R	_		F				R	R	R	R	_					
	29.5	31.9		B 4H-2, 10-11	3	2		R	R		R	R		F				_	_	R	_	*					
Anthocyrtidium jenghisi	30	32.4		B 4H-2, 60-61	3	2	1	R	R		R	R		F				R	R	R	_	R					
	30.5	32.9		B 4H-2, 110-111	2	2	1	R	R		R	R		F				R	R	R	_	C					
	33.5	35.9	K	B 4H-4, 110-111	2	2	2	R	R		R	_		R				R	R	R	_	C					
	35.11	36.31		C 4H-CC	4	3	2	R	R		R	R		F				R	R	R		C					
	34	36.4		B 4H-5, 10-11	2	2		R	R		R	_		F				R	R	R		F					
	34.5	36.9		B 4H-5, 60-61	4	3		R	R		R	_		F				_	_	R		F					
	35.3	37.7		B 4H-5, 140-141	4	3		R	R		R	_		F				_	_	_		F					
	35.5	37.9	Mam.	B 4H-6, 10-11	1	1	1	R	R		R	_		F				_	_	R		F					
	36	38.4		B 4H-6, 60-61	4	3	1	R	R		R			F				_	_	R		C					
	36.5	38.9		B 4H-6, 110-111	4	2	1	R	R		R			R				_	R	R		C		_			
	36.8	39.2		B 4H-6, 140-141	4	2		R	R		R			F					_	R		C		_			
	37.42	39.82		B 4H-7, 52-53	4	2		R	R		R			R					R	R		F		_			
	37.97	40.37		B 4H-CC	3	2	1	_	R		R			F					R	_		F	_	R			
	38.5	41.35		B 5H-1, 110-111	3	2	2	R	R		R			F					R	R		C	R	R			
	39	41.85		B 5H-2, 10-11	1	1	1	R	R		R			F					_	_		C	R	R	_	_	
	39.3	42.15		B 5H-2, 40-41	1	1	1	R	R		R			F					_	_		C	_	_	_	_	
	40.57	42.47		D 4H-CC	3	2	1	R	R		R			F					R	R		C	_	R	R	_	
	40	42.85	Gilbert	B 5H-2, 110-111	3	2	1	R	R		R			R					R	R		C	_	R	R	_	
Phormostichoartus doliolum	41.5	44.35		B 5H-3, 110-111	3	2	1	R	R		R			R					R	R		C	R	R	R	R	
	42	44.85		B 5H-4, 10-11	1	1	2	R	R		R			R					R	_		C	R	R	R	R	_
	42.5	45.35		B 5H-4, 60-61	3	2		_	R		R			R					_	R		C	R	R	R	R	_
	43	45.85		B 5H-4, 110-111	3	2	1	_	R		R			R					R	R		C	F	R	R	R	_
Stichocorys peregrina	43.5	46.35		B 5H-5, 10-11	5	3		_	_		R			R					R	R		C	R	R	R	R	R
	44	46.85	Coch.	B 5H-5, 60-61	1	1		_	_		R			R					R	R		C	R	R	R	R	R
	44.5	47.35		B 5H-5, 110-111	3	2	1	_	_		R			R					R	R		R	R	R	R	R	R
	45	47.85		B 5H-6, 10-11	5	3	1	_	_		R			R					R	R		F	R	R	R	R	R

Figure 9. Site 852 radiolarian species range chart. Notation as specified in Figure 1.

Site 852 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Didymocyrtis penultima*	*Stichocorys peregrina*	*Solenosphaera omnitubus*	*Stichocorys johnsoni*	*Stichocorys delmontensis*	*Calocycletta caepa*	*Siphostichartus corona*	*Diartus hughesi*	*Botryostrobus miralestensis*	*Diartus petterssoni*	*Stichocorys wolffii*	*Cyrtocapsella japonica*
Stichocorys peregrina	45.5	48.35		B 5H-6, 60-61	5	3	1	R	F										
	46	48.85		B 5H-6, 110-111	2	1		R	C	–									
	47.49	50.34	S	B 5H-CC	3	1	2	R	F	–									
	52.5	57.45		B 6H-4, 110-111	2	2		R	C	–									
	54	58.95		B 6H-5, 110-111	4	2		R	C	R									
	54.13	59.13	Thv	C 6H-CC	4	2		F	C	R									
	55.5	60.45		B 6H-6, 110-111	3	2	1	R	C	R									
	56.95	61.9		B 6H-CC	4	2	1	F	C	R									
	57.5	63.35		B 7H-1, 110-111	3	2		R	C	R									
	58.8	64.65		B 7H-2, 110-111	4	3	1	R	C	R									
	60.3	66.15		B 7H-3, 110-111	4	3		R	C	R									
	60.79	66.64		B 7H-4, 10-11	4	3		R	C	R									
	61.29	67.14		B 7H-4, 60-61	5	3		F	F	R									
	61.8	67.65		B 7H-4, 110-111	4	3		F	C	R									
	66.36	72.21		B 7H-CC	4	3		F	C	R				–					
	68.5	75.25	C3An1	B 8H-2, 110-111	4	3		R	C	R				R					
	71.5	78.25		B 8H-4, 110-111	4	3		R	C	R				R					
	72	78.75		B 8H-5, 10-11	5	3		F	C	F	–			R					
	72.49	79.24		B 8H-5, 59-60	5	3		F	C	F	R			R					
	73	79.75		B 8H-5, 110-111	4	3		R	C	F	R			–					
	74.5	81.25		B 8H-6, 110-111	5	3		R	C	R	R			R					
	76.02	82.77		B 8H-CC	5	3		F	F	R	R	–		–					
	76.5	85		B 9H-1, 110-111	4	2		F	C	R	R	–	–	R					
	77	85.5		B 9H-2, 10-11	5	3		F	C	F	R	F	–	R					
	78.62	85.92		D 8H-CC	5	3		F	F	R	R	R	–	–					
	78	86.5		B 9H-2, 110-111	4	3		F	C	R	R	F	F	R					
	78.5	87		B 9H-3, 10-11	5	3		F	C	R	R	C	R	R					
Didymocyrtis penultima	79	87.5		B 9H-3, 60-61	5	3		F	F	R	R	C	R	R					
	79.5	88		B 9H-3, 110-111	5	3		F	R	R	R	C	F	R					
	81	89.5		B 9H-4, 110-111	5	3		F	R	R	R	C	R	R					
	84	92.5		B 9H-6, 110-111	5	3		R		R	R	C	F	R					
	84.6	93.1		B 9H-7, 20-21	5	2		F		R	R	C	F	R					
	85.47	93.97		B 9H-CC	4	2		F		–	R	C	R	R					
	87.5	97.5		B 10H-2, 110-111	5	3		R		–	R	C	F	R	–				
	88	98		B 10H-3, 10-11	5	3		R		–	R	C	F	R	–				
Didymocyrtis antepenultima	88.5	98.5		B 10H-3, 60-61	5	3		R		–	R	C	F	R	R				
	89	99		B 10H-3, 110-111	5	3		R		–	R	C	F	R	R				
	89.3	99.3		B 10H-3, 140-141	5	3		R			R	C	F	R	R				
	90.5	100.5		B 10H-4, 110-111	4	3		R			R	C	F	R	R	–			
	93.5	103.5		B 10H-6, 110-111	5	3		R			R	C	F	R	R	–			
	95.05	105.05		B 10H-CC	4	3		R			R	C	F	R	F	–			
	94.51	105.51		B 11H-1, 11-12	5	3		–			R	C	R	R	R	–			
	95	106		B 11H-1, 60-61	5	3					R	C	R	R	F	–			
	95.8	106.8		B 11H-1, 140-141	5	3					R	C	R	R	F	R			
	96	107		B 11H-2, 10-11	5	3					R	C	R	R	F	R			
	96.5	107.5		B 11H-2, 60-61	5	3					R	C	R	R	F	R			
	97	108		B 11H-2, 110-111	5	3					R	C	F	R	F	R	–		
	100	111		B 11H-4, 110-111	4	3					R	C	F	R	F	R	–		
	102	113		B 11H-6, 10-11	5	3					R	C	R	–	F	R	R		
	102.5	113.5		B 11H-6, 60-61	5	3					R	C	F	–	F	R	R		
	103	114		B 11H-6, 110-111	5	3					R	C	F	R	C	R	R		
	104	116.2	C4n1	B 12H-1, 10-11	5	3					R	C	F	–	F	R	F		
Diartus petterssoni	104.5	116.7		B 12H-1, 60-61	5	3					–	C	F	–	R	R	F	–	
	104.53	116.73		B 11H-CC	5	3					R	C	F	R	R	R	F	–	
	105	117.2		B 12H-1, 110-111	4	2					–	C	F	R	–	R	F	–	
	105.32	117.52	C4n2	B 12H-1, 142-143	5	3						C	F	–		R	F	R	
	105.59	117.79		B 12H-2, 19-20	5	3						C	F	–		R	C	R	
	107.18	118.18		D 11H-CC	5	3						C	F	R		R	C	R	
	106.5	118.7		B 12H-2, 110-111	4	3						C	F	R		R	C	R	
	107	119.2	C4n3	B 12H-3, 10-11	5	3						C	R	R		F	C	R	
	107.5	119.7		B 12H-3, 60-61	5	3						C	R	R		F	C	R	
	108	120.2	C5n1	B 12H-3, 110-111	4	2						C	R	R		F	C	R	–
	109.5	121.7		B 12H-4, 110-111	4	2						C	R	R		F	C	R	–
	110.52	122.72		B 12H-5, 62-63	4	2						C	R	R		R	C	R	F
	111	123.2		B 12H-5, 110-111	4	2						C	R	R		F	C	R	F
	112.5	124.7		B 12H-6, 110-111	4	2						C	R	R		R	C	R	F
	113	125.2		B 12H-7, 10-11	2	1						F	R	–		R	F	R	R
	113.94	126.14		B 12H-CC	3	2						F	R	–		F	F	R	R
	116.1	126.5		C 13X-4, 110-111	3	2						F	R	–		F	C	R	F
	117.6	128		C 13X-5, 110-111	2	1						F	–	–		R	F	–	F

Figure 9 (continued).

Table 5. Site 847 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper Hole Cr T S	Interval (cm)	Lower H Cr T S	Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	T *Stylatractus universus*	847 - B - 2 H - 5,	110 - 111	B - 2 H - CC		13.6	16.08	13.73	16.21
Stylatractus universus	B *Collosphaera tuberosa*	847 - D - 2 H - CC		B - 3 H - 3,	110 - 111	16.54	20.1	18.34	20.45
	T *Lamprocyrtis neoheteroporos*	847 - B - 4 H - 3,	110 - 111	C - 3 H - CC		29.6	31.07	32.43	33.47
Amphirhopalum ypsilon	T *Anthocyrtidium angulare*	847 - C - 3 H - CC		B - 4 H - 5,	110 - 111	31.07	32.6	33.47	35.43
	T *Theocorythium vetulum*	847 - B - 4 H - CC		D - 4 H - CC		35.58	35.5	38.41	39.5
	B *Lamprocyrtis nigriniae*	847 - B - 4 H - 5,	110 - 111	B - 4 H - CC		32.6	35.58	35.43	38.41
	B *Theocorythium trachelium*	847 - B - 5 H - CC		D - 5 H - CC		45.09	44.88	47.89	49.08
	B *Pterocorys minythorax*	847 - D - 5 H - CC		B - 6 H - 3,	109 - 110	44.88	48.6	49.08	53.68
	B *Anthocyrtidium angulare*	847 - C - 5 H - CC		B - 6 H - 5,	109 - 110	50.09	51.6	54.59	56.68
Anthocyrtidium angulare	T *Pterocanium prismatium*	847 - C - 5 H - CC		B - 6 H - 5,	109 - 110	50.09	51.6	54.59	56.68
	T *Lamprocyrtis heteroporos*	847 - B - 7 H - 5,	109 - 110	D - 7 H - CC		61.1	63.64	67.85	70.84
	T *Anthocyrtidium jenghisi*	847 - B - 8 H - CC		B - 9 H - 3,	110 - 111	72.83	77.1	81.01	86.58
	B *Theocalyptra davisiana*	847 - B - 9 H - 5,	110 - 111	D - 9 H - CC		80.1	83.25	89.58	91.95
Pterocanium prismatium	T *Stichocorys peregrina*	847 - D - 9 H - CC		B - 9 H - CC		83.25	83.1	91.95	92.58
	T *Anthocyrtidium pliocenica*	847 - D - 10 H - CC		C - 10 H - CC		92.28	97.06	104	108.3
	B *Lamprocyrtis neoheteroporos*	847 - C - 9 H - CC		B - 10 H - 5,	109 - 110	88.08	89.6	97.98	99.83
	B *Lamprocyrtis heteroporos*	847 - C - 10 H - CC		B - 11 H - 3,	110 - 111	97.06	96.1	108.3	109
	T *Phormostichoartus fistula*	847 - C - 12 H - CC		B - 13 H - 3,	110 - 111	116.44	115	128.7	129
	T *Lychnodictyum audax*	847 - B - 11 H - CC		B - 12 H - 3,	110 - 111	101.56	106	114.5	119
Anthocyrtidium jenghisi	T *Phormostichoartus doliolum*	847 - C - 12 H - CC		B - 13 H - 3,	110 - 111	116.44	115	128.7	129
	B *Amphirhopalum ypsilon*	847 - B - 12 H - CC		C - 12 H - CC		111.58	116.44	124.6	128.7
	B *Spongaster tetras*	847 - B - 13 H - 3,	110 - 111	B - 13 H - 5,	110 - 111	115	118	129	132
Phormostichoartus doliolum	T *Didymocyrtis penultima*	847 - B - 13 H - 3,	110 - 111	B - 13 H - 5,	110 - 111	115	118	129	132
	B *Pterocanium prismatium*	847 - B - 16 X - 3,	110 - 111	B - 16 X - 5,	110 - 111	144	147	160.5	163.5
	T *Solenosphaera omnitubus*	847 - B - 18 X - CC		B - 19 X - 3,	110 - 111	165.19	169	184.5	188.4
	T *Siphostichartus corona*	847 - B - 20 X - 3,	109 - 110	B - 20 X - 5,	109 - 110	178	181	197.4	200.4
	T *Stichocorys johnsoni*	847 - B - 24 X - 3,	110 - 111	B - 24 X - 5,	110 - 111	217	220	236.4	239.4
Stichocorys peregrina	*Stichocorys delmontensis* > *S. peregrina*	847 - B - 24 X - 3,	110 - 111	B - 25 X - 3,	109 - 110	217	226	236.4	245.4
	T *Calocycletta caepa*	847 - B - 24 X - 5,	110 - 111	B - 24 X - CC		220	222.27	239.4	241.6

Site 853 Radiolaria

Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples: Core, section interval (cm)	Assemblage Ab	Pr	Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*
Amphirhopalum ypsilon	1.1	1.1	Br	B 1H-1, 110-111	4	2		R	R	_	R				R	R	_				R
	2.6	2.6		B 1H-2, 110-111	4	2		R	R		R				_	R	R				R
	4.05	4.05	J	B 1H-3, 105-106	1	1		R	R		_				_	_	_				R
	4.25	4.25		B 1H-CC	1	1		_	_		_				_	_	_				_
Anthocyrtidium angulare	5.4	5.35		B 2H-1, 110-111	1	2		R	R		R	R	R	F	R	R	_				R
	6.9	6.85		B 2H-2, 110-111	1	1		_	_		_	_	_	_	_	_	_				_
Pterocanium prismatium	8.4	8.35	O	B 2H-3, 110-111	2	2		R	R		R	_	R	F	_	_		R	R		R
	9.9	9.85		B 2H-4, 110-111	2	2	1	R	R		_	R		R				R	R		R
	10.15	10.25		A 1H-CC	3	1	1	R	R		R	R		F				_	R		R
	11.4	11.35		B 2H-5, 110-111	2	1		R	_		R	R		R				R	_		R
?	12.9	12.85		B 2H-6, 110-111	1	1		–	–		–	–		–				–	–	–	–
	14.11	14.06		B 2H-CC	1	1	1	–	–		–	–		–				–	–	–	–
	13.4	15.8	K	B 3H-1, 110-111	1	0	1	–	–		–	–		–				–	–	–	–
	14.88	17.28	M	B 3H-2, 108-109	0	0		–	–		–	–		–				–	–	–	–
	21.6	24	(NOT PLOTTED)	B 3H-CC	0	0		–	–		–	–		–				–	–	–	–
	25.89	26.89		B 4H-4, 109-110	0	0		–	–		–	–		–				–	–	–	–
	28.89	29.89		B 4H-CC	0	0		–	–		–	–		–				–	–	–	–
	38.17	41.62		B 5H-CC	0	0		–	–		–	–		–				–	–	–	–
	47.53	51.33		B 6H-CC	0	0		–	–		–	–		–				–	–	–	–
	57.26	61.41		B 7H-CC	0	0		–	–		–	–		–				–	–	–	–
	66.8	72.05		B 8H-CC	0	0		–	–		–	–		–				–	–	–	–
	72.47	78.42		B 9H-CC	0	0		–	–		–	–		–				–	–	–	–

Figure 10. Site 853 radiolarian species range chart. Notation as specified in Figure 1.

Table 6. Site 848 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper Hole Cr T S	Interval (cm)	Lower H Cr T S	Interval (cm)	Depth (mbsf) top	bottom	Depth (mcd) top	bottom
Collosphaera tuberosa	*T Stylatractus universus*	848 - B - 2 H - 1,	60 - 62	B - 2 H - 2,	60 - 62	4.3	5.8	7.1	8.6
Stylatractus universus	*B Collosphaera tuberosa*	848 - A - 1 H - CC		B - 2 H - 4,	52 - 54	9.54	7.22	9.74	10.02
	T Lamprocyrtis neoheteroporos	848 - B - 3 H - 2,	60 - 62	B - 3 H - 2,	110 - 112	13.8	14.3	17.75	18.25
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	848 - B - 3 H - 2,	110 - 112	B - 3 H - 3,	10 - 12	14.3	14.8	18.25	18.75
	T Theocorythium vetulum	848 - B - 3 H - 3,	10 - 12	B - 3 H - 3,	58 - 60	14.8	15.28	18.75	19.23
	B Lamprocyrtis nigriniae	848 - B - 3 H - 3,	110 - 111	B - 3 H - 4,	10 - 12	15.8	16.3	19.75	20.25
	B Theocorythium trachelium	848 - B - 3 H - 6,	9 - 11	B - 3 H - 6,	60 - 62	19.29	19.8	23.24	23.75
	B Pterocorys minythorax	848 - B - 3 H - CC		B - 4 H - 1,	63 - 65	21.73	21.83	25.68	26.18
	B Anthocyrtidium angulare	848 - B - 3 H - CC		B - 4 H - 1,	63 - 65	21.73	21.83	25.68	26.18
Anthocyrtidium angulare	*T Pterocanium prismatium*	848 - B - 3 H - 7,	58 - 60	B - 4 H - 1,	10 - 12	21.28	21.3	25.23	25.65
	T Lamprocyrtis heteroporos	848 - B - 3 H - 6,	9 - 11	B - 3 H - 6,	60 - 62	19.29	19.8	23.24	23.75
	T Anthocyrtidium jenghisi	848 - B - 4 H - 3,	110 - 111	B - 4 H - 4,	28 - 30	25.3	25.98	29.65	30.33
	B Theocalyptra davisiana	848 - B - 4 H - 4,	130 - 132	B - 4 H - 5,	31 - 33	27	27.51	31.35	31.86
Pterocanium prismatium	*T Stichocorys peregrina*	848 - B - 4 H - 4,	130 - 132	B - 4 H - 5,	31 - 33	27	27.51	31.35	31.86
	T Anthocyrtidium pliocenica	848 - B - 5 H - 1,	10 - 12	C - 4 H - 6,	60 - 61	30.8	32.6	36.45	36.85
	B Lamprocyrtis neoheteroporos	848 - B - 4 H - 4,	28 - 30	C - 4 H - 2,	60 - 61	25.98	26.6	30.33	30.85
	B Lamprocyrtis heteroporos	848 - B - 4 H - 6,	131 - 132	B - 4 H - 7,	11 - 13	30 01	30.31	34.36	34.66
	T Phormostichoartus fistula	848 - C - 4 H - 6,	60 - 61	B - 5 H - 1,	57 - 59	32.6	31.27	36.85	36.92
	T Lychnodictyum audax	848 - C - 4 H - 6,	60 - 61	B - 5 H - 1,	57 - 59	32.6	31.27	36.85	36.92
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	848 - C - 4 H - 6,	60 - 61	B - 5 H - 1,	57 - 59	32.6	31.27	36.85	36.92
	B Amphirhopalum ypsilon	848 - B - 5 H - 1,	110 - 112	B - 5 H - 2,	10 - 12	31.8	32.3	37.45	37.95
	B Spongaster tetras	848 - B - 5 H - 2,	60 - 62	C - 4 H - CC		32.8	34.57	38.45	38.82
Phormostichoartus doliolum	*T Didymocyrtis penultima*	848 - B - 5 H - 2,	60 - 62	C - 4 H - CC		32.8	34.57	38.45	38.82
	B Pterocanium prismatium	848 - B - 5 H - 6,	57 - 59	B - 5 H - 6,	110 - 112	38.77	39.3	44.42	44.95
	T Solenosphaera omnitubus	848 - B - 6 H - 1,	110 - 112	B - 6 H - 2,	10 - 12	41.3	41.8	47	47.5
	T Siphostichartus corona	848 - B - 6 H - 6,	110 - 112	B - 6 H - CC		48.8	50.17	54.5	55.87
	T Stichocorys johnsoni	848 - C - 7 H - 5,	60 - 61	C - 7 H - 5,	110 - 111	59.6	60.1	67.35	67.85
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	848 - B - 8 H - 3,	110 - 111	C - 7 H - CC		63.3	63.06	70.75	70.81
	T Calocycletta caepa	848 - C - 7 H - 4	60 - 61	B - 7 H - CC		58.1	59.77	65.85	66.47
	B Solenosphaera omnitubus	848 - B - 8 H - CC		C - 8 H - CC		69.32	72.31	76.77	81.41
Didymocyrtis penultima	*T Diartus hughesi*	848 - B - 9 H - 3,	50 - 52	B - 9 H - 3,	110 - 111	72.2	72.8	81.8	82.4
	T Botryostrobus miralestensis	848 - B - 9 H - 5,	5 - 7	B - 9 H - 5,	55 - 57	74.75	75.25	84.35	84.85
	T Stichocorys wolffii	848 - B - 10 H - 1,	5 - 7	B - 10 H - 1,	55 - 57	78.25	78.75	88.85	89.35
	T Diartus petterssoni	848 - B - 9 H - 6,	90 - 92	B - 9 H - 6,	138 - 140	77.1	77.58	86.7	87.18
	B Stichocorys johnsoni	848 - B - 9 H - 6,	90 - 92	B - 9 H - 6,	138 - 140	77.1	77.58	86.7	87.18
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	848 - B - 9 H - CC		B - 10 H - 1,	5 - 7	78.58	78.25	88.18	88.85
	B Diartus hughesi	848 - B - 10 H - 1,	5 - 7	B - 10 H - 1,	55 - 57	78.25	78.75	88.85	89.35

Table 7. Site 849 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper (Hole Cr T S)	Interval (cm)	Lower (H Cr T S)	Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	849 - B - 2 H-3,	110 - 111	B-2 H-5	110 - 111	10.8	13.8	12.75	15.75
Stylatractus universus	*B Collosphaera tuberosa*	849 - B - 2 H-CC		B-3 H-3,	110 - 111	15.63	20.3	17.58	24.35
	T Lamprocyrtis neoheteroporos	849 - B - 3 H-5	110 - 111	B-3 H-CC		23.3	25.21	27.35	29.26
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	849 - B - 3 H-CC		B-4 H-3,	110 - 111	25.21	29.8	29.26	34.85
	T Theocorythium vetulum	849 - B - 3 H-CC		B-4 H-3,	110 - 111	25.21	29.8	29.26	34.85
	B Lamprocyrtis nigriniae	849 - B - 3 H-CC		B-4 H-3,	110 - 111	25.21	29.8	29.26	34.85
	B Theocorythium trachelium	849 - B - 4 H-CC		B-5 H-1,	150 - 151	35.47	36.7	40.52	43.15
	B Pterocorys minythorax	849 - B - 4 H-CC		B-5 H-1,	150 - 151	35.47	36.7	40.52	43.15
	B Anthocyrtidium angulare	849 - D - 4 H-CC		B-5 H-5,	110 - 111	41.48	42.3	48.03	48.75
Anthocyrtidium angulare	*T Pterocanium prismatium*	849 - D - 4 H-CC		B-5 H-5,	110 - 111	41.48	42.3	48.03	48.75
	T Lamprocyrtis heteroporos	849 - B - 5 H-1,	150 - 151	C-4 H-CC		36.7	37.83	43.15	44.93
	T Anthocyrtidium jenghisi	849 - D - 6 H-CC		B-7 H-5,	110 - 111	60.92	61.3	70.17	70.75
	B Theocalyptra davisiana	849 - B - 7 H-CC		B-8 H-3,	110 - 111	64.26	67.8	73.71	78.5
Pterocanium prismatium	*T Stichocorys peregrina*	849 - B - 7 H-CC		B-8 H-3,	110 - 111	64.26	67.8	73.71	78.5
	T Anthocyrtidium pliocenica	849 - C - 8 H-CC		B-9 H-5,	110 - 111	77.44	80.3	89.24	91.95
	B Lamprocyrtis neoheteroporos	849 - B - 9 H-3,	110 - 111	C-8 H-CC		77.3	77.44	88.95	89.24
	B Lamprocyrtis heteroporos	849 - C - 8 H-CC		B-9 H-5,	110 - 111	77.44	80.3	89.24	91.95
	T Phormostichoartus fistula	849 - D - 9 H-CC		B-10 H-CC		89.76	92.49	102.66	104.29
	T Lychnodictyum audax	849 - B - 10 H-CC		B-11 H-3,	110 - 111	92.49	96.3	104.29	109.9
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	849 - B - 10 H-CC		B-11 H-3,	110 - 111	92.49	96.3	104.29	109.9
	B Amphirhopalum ypsilon	849 - B - 11 H-3,	110 - 111	C-10 H-CC		96.3	96.62	109.9	111.07
	B Spongaster tetras	849 - B - 11 H-CC		B-12 H-3,	110 - 111	102.2	105.8	115.76	120.25
Phormostichoartus doliolum	*T Didymocyrtis penultima*	849 - B - 11 H-CC		B-12 H-3,	110 - 111	102.2	105.8	115.76	120.25
	B Pterocanium prismatium	849 - B - 14 X-3,	52 - 53	B-14 X-CC		124.2	125.16	142.22	143.16
	T Solenosphaera omnitubus	849 - B - 17 X-3,	110 - 111	B-17 X-5,	110 - 111	153.8	156.8	176.75	179.75
	T Siphostichartus corona	849 - B - 18 X-3,	114 - 115	B-18 X-5,	111 - 112	163.4	166.41	188.39	191.36
	T Stichocorys johnsoni	849 - B - 22 X-CC		B-23 X-3,	109 - 110	206.7	210.69	237.8	242.79
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	849 - B - 26 X-3,	115 - 116	B-26 X-4,	110 - 111	239.9	241.3	274.1	275.55
	T Calocycletta caepa	849 - B - 22 X-CC		B-23 X-3,	109 - 110	206.7	210.69	237.8	242.79
	B Solenosphaera omnitubus	849 - B - 27 X-5,	109 - 110	B-27 X-CC		252.4	254.96	284.19	286.76
Didymocyrtis penultima	*T Diartus hughesi*	849 - B - 29 X-5,	110 - 111	B-29 X-CC		271.8	274.38	306.2	308.78
	T Botryostrobus miralestensis	849 - B - 30 X-CC		B-31 X-3,	110 - 111	283.9	288	318.17	324.05
	T Stichocorys wolffii	849 - B - 32 X-3,	110 - 111	D-31 X-CC		297.7	297.7	334.7	337.2
	T Diartus petterssoni	849 - B - 30 X-CC		B-31 X-3,	110 - 111	283.9	288	318.17	324.05
	B Stichocorys johnsoni	849 - B - 32 X-3,	110 - 111	D-31 X-CC		297.7	297.7	334.7	337.2
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	849 - D - 30 X-CC		B-31 X-CC		288.1	293.69	327.57	329.74
	B Diartus hughesi	849 - B - 32 X-3,	110 - 111	D-31 X-CC		297.7	297.7	318.17	324.05
	T Cyrtocapsella japonica	849 - B - 33 X-CC		B-34 X-3,	110 - 111	313.1	317	351.06	355.9
	T Lithopera thornburgi	849 - B - 33 X-CC		B-34 X-3,	110 - 111	313.1	317	351.06	355.9
	T Carpocanopsis cristata	849 - B - 35 X-3,	110 - 111	B-35 X-5,	111 - 113	326.7	329.71	366.55	369.56

Table 8. Site 850 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper Hole Cr T S	Upper Interval (cm)	Lower H Cr T S	Lower Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	850 - B - 1 H - 4,	110 - 111	B - 1 H - 6,	115 - 116	8.6	11.65	8.6	11.65
Stylatractus universus	*B Collosphaera tuberosa*	850 - B - 1 H - 6,	115 - 116	B - 1 H - CC		11.65	12.78	11.65	12.78
	T Lamprocyrtis neoheteroporos	850 - B - 2 H - 4,	112 - 113	B - 2 H - 6,	110 - 112	18.12	21.1	20.02	23
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	850 - B - 2 H - 4,	112 - 113	B - 2 H - 6,	110 - 112	18.12	21.1	20.02	23
	T Theocorythium vetulum	850 - B - 2 H - CC		B - 3 H - 2,	110 - 111	22.15	24.6	24.05	26.25
	B Lamprocyrtis nigriniae	850 - B - 2 H - CC		B - 3 H - 2,	110 - 111	22.15	24.6	24.05	26.25
	B Theocorythium trachelium	850 - B - 3 H - 4,	105 - 106	B - 3 H - 6,	110 - 111	27.55	30.6	29.2	32.25
	B Pterocorys minythorax	850 - B - 3 H - 6,	110 - 111	B - 3 H - CC		30.6	31.74	32.25	33.39
	B Anthocyrtidium angulare	850 - B - 3 H - CC		B - 4 H - 2,	110 - 111	31.74	34.1	33.39	38.45
Anthocyrtidium angulare	*T Pterocanium prismatium*	850 - B - 3 H - CC		B - 4 H - 2,	110 - 111	31.74	34.1	33.39	38.45
	T Lamprocyrtis heteroporos	850 - B - 3 H - 4,	105 - 106	B - 3 H - 6,	110 - 111	27.55	30.6	29.2	32.25
	T Anthocyrtidium jenghisi	850 - A - 5 H - CC		B - 5 H - 4,	110 - 111	46.21	46.6	50.01	51
	B Theocalyptra davisiana	850 - B - 5 H - 6,	110 - 111	B - 5 H - CC		49.6	51.08	54	55.48
Pterocanium prismatium	*T Stichocorys peregrina*	850 - B - 5 H - CC		B - 6 H - 2,	110 - 111	51.08	53.1	55.48	58.6
	T Anthocyrtidium pliocenica	850 - B - 6 H - 6,	110 - 111	B - 6 H - CC		59.1	60.6	64.6	66.1
	B Lamprocyrtis neoheteroporos	850 - A - 6 H - CC		B - 6 H - 6,	110 - 111	55.81	59.1	61.56	64.6
	B Lamprocyrtis heteroporos	850 - B - 6 H - 6,	110 - 111	B - 6 H - CC		59.1	60.6	64.6	66.1
	T Phormostichoartus fistula	850 - B - 7 H - 4,	110 - 111	B - 7 H - CC		65.6	70.11	72.15	76.66
	T Lychnodictyum audax	850 - B - 7 H - CC		B - 8 H - 2,	110 - 111	70.11	72.1	76.66	79.85
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	850 - B - 8 H - 2,	110 - 111	B - 8 H - 4,	110 - 111	72.1	75.1	79.85	82.85
	B Amphirhopalum ypsilon	850 - B - 8 H - 2,	110 - 111	B - 8 H - 4,	110 - 111	72.1	75.1	79.85	82.85
	B Spongaster tetras	850 - B - 8 H - CC		B - 9 H - 2,	110 - 111	79.59	81.6	87.34	89.35
Phormostichoartus doliolum	*T Didymocyrtis penultima*	850 - B - 8 H - CC		B - 9 H - 2,	110 - 111	79.59	81.6	87.34	89.35
	B Pterocanium prismatium	850 - B - 11 X - 2,	110 - 111	B - 11 X - 4,	110 - 111	100.6	103.6	108.35	111.4
	T Solenosphaera omnitubus	850 - B - 13 X - 6,	112 - 113	B - 13 X - CC		125.72	126.74	133.47	134.5
	T Siphostichartus corona	850 - B - 15 X - 6,	110 - 111	B - 15 X - CC		145	146.05	152.75	153.8
	T Stichocorys johnsoni	850 - B - 19 X - 6,	110 - 111	B - 19 X - CC		182.8	183.95	190.55	191.7
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	850 - B - 22 X - CC		B - 23 X - 2,	110 - 111	212.83	215.4	220.58	223.2
	T Calocycletta caepa	850 - B - 19 X - 6,	110 - 111	B - 19 X - CC		182.8	183.95	190.55	191.7
	B Solenosphaera omnitubus	850 - B - 24 X - CC		B - 25 X - 2,	110 - 111	231.95	234.7	239.7	242.5
Didymocyrtis penultima	*T Diartus hughesi*	850 - B - 27 X - 2,	110 - 111	B - 27 X - 4,	110 - 111	253.6	256.6	261.35	264.4
	T Botryostrobus miralestensis	850 - B - 28 X - CC		B - 29 X - 4,	110 - 111	270.26	275.9	278.01	283.7
	T Stichocorys wolffii	850 - B - 31 X - 2,	110 - 111	B - 31 X - CC		292.2	299.34	299.95	307.1
	T Diartus petterssoni	850 - B - 29 X - 4,	110 - 111	B - 29 X - 6,	110 - 111	275.9	278.9	283.65	286.7
	B Stichocorys johnsoni	850 - B - 30 X - CC		B - 31 X - 2,	110 - 111	289.57	292.2	297.32	300
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	850 - B - 30 X - 4,	110 - 112	B - 30 X - CC		285.5	289.57	293.25	297.3
	B Diartus hughesi	850 - B - 31 X - 2,	110 - 111	B - 31 X - CC		292.2	299.34	299.95	307.1
	T Cyrtocapsella japonica	850 - B - 35 X - 2,	110 - 111	B - 35 X - 4,	110 - 111	330.8	333.8	338.55	341.6
	T Lithopera thornburgi	850 - B - 32 X - CC		B - 33 X - CC		308.22	318.75	315.97	326.5
	T Carpocanopsis cristata	850 - B - 37 X - 4,	110 - 111	B - 37 X - 6,	110 - 111	353.1	356.1	360.85	363.9

Table 9. Site 851 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples Upper (Hole Cr T Sec, Interval (cm))	Samples Lower (H Cr T Sec, Interval (cm))	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	851 - A - 1 H - CC	B - 1 H - CC	6.45	7.58	6.45	7.58
Stylatractus universus	*B Collosphaera tuberosa*	851 - E - 1 H - CC	B - 2 H - 2, 110 - 111	9.86	10.1	9.86	12.45
	T Lamprocyrtis neoheteroporos	851 - E - 2 H - 6, 100 - 101	E - 2 H - CC	18	19.19	21.5	22.69
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	851 - E - 2 H - CC	B - 3 H - 2, 110 - 111	19.19	19.6	22.69	23.75
	T Theocorythium vetulum	851 - B - 3 H - 2, 110 - 111	B - 3 H - 4, 110 - 111	19.6	22.6	23.75	26.75
	B Lamprocyrtis nigriniae	851 - E - 2 H - CC	B - 3 H - 2, 110 - 111	19.19	19.6	22.69	23.75
	B Theocorythium trachelium	851 - B - 3 H - CC	E - 3 H - CC	27.1	29.06	31.25	33.26
	B Pterocorys minythorax	851 - B - 3 H - CC	E - 3 H - CC	27.1	29.06	31.25	33.26
	B Anthocyrtidium angulare	851 - B - 3 H - CC	E - 3 H - CC	27.1	29.06	31.25	33.26
Anthocyrtidium angulare	*T Pterocanium prismatium*	851 - B - 3 H - CC	E - 3 H - CC	27.1	29.06	31.25	33.26
	T Lamprocyrtis heteroporos	851 - B - 3 H - 6, 110 - 111	B - 3 H - CC	25.6	27.1	29.75	31.25
	T Anthocyrtidium jenghisi	851 - B - 4 H - CC	B - 5 H - 2, 70 - 71	36.41	38.2	41.81	44.5
	B Theocalyptra davisiana	851 - B - 5 H - 6, 110 - 111	B - 5 H - CC	44.6	45.89	50.9	52.19
Pterocanium prismatium	*T Stichocorys peregrina*	851 - B - 5 H - 6, 110 - 111	B - 5 H - CC	44.6	45.89	50.9	52.19
	T Anthocyrtidium pliocenica	851 - B - 6 H - CC	E - 6 H - CC	55.6	57.61	63.45	65.21
	B Lamprocyrtis neoheteroporos	851 - E - 5 H - CC	B - 6 H - 2, 110 - 111	48.12	48.1	54.92	55.95
	B Lamprocyrtis heteroporos	851 - B - 6 H - 4, 110 - 111	B - 6 H - 6, 110 - 111	51.1	54.1	58.95	61.95
	T Phormostichoartus fistula	851 - E - 6 H - CC	B - 7 H - 3, 0 - 1	57.61	58	65.21	66.45
	T Lychnodictyum audax	851 - B - 7 H - 5, 0 - 1	B - 7 H - 6, 0 - 1	61	62.5	69.45	70.95
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	851 - B - 7 H - 6, 0 - 1	B - 7 H - CC	62.5	65.04	70.95	73.49
	B Amphirhopalum ypsilon	851 - B - 7 H - CC	E - 7 H - CC	65.04	67.1	73.49	75.7
	B Spongaster tetras	851 - B - 8 H - 2, 110 - 111	C - 7 H - CC	67.1	69.39	77	78.99
Phormostichoartus doliolum	*T Didymocyrtis penultima*	851 - B - 8 H - 2, 110 - 111	C - 7 H - CC	67.1	69.39	77	78.99
	B Pterocanium prismatium	851 - B - 8 H - CC	B - 9 H - CC	74.54	84.14	84.44	94.54
	T Solenosphaera omnitubus	851 - B - 11 H - 2, 110 - 111	B - 11 H - 4, 110 - 111	95.6	98.6	108.75	111.8
	T Siphostichartus corona	851 - B - 12 H - CC	B - 13 H - 2, 110 - 111	112.64	114.6	127.64	130.4
	T Stichocorys johnsoni	851 - B - 14 H - CC	E - 14 H CC	131.37	133.68	148.52	150.4
Stichocorys peregrina	*Stichocorys delmontensis* > *S. peregrina*	851 - B - 17 X - 2, 110 - 111	B - 17 X - 4, 110 - 111	152.7	155.7	176.2	179.2
	T Calocycletta caepa	851 - E - 14 H - CC	B - 15 H - 2, 110 - 111	133.68	133.6	150.38	152
	B Solenosphaera omnitubus	851 - B - 17 X - CC	B - 18 X - 2, 110 - 111	159.87	162.4	183.37	190.9
Didymocyrtis penultima	*T Diartus hughesi*	851 - B - 19 X - CC	B - 20 X - 2, 110 - 111	179.03	181.7	208.78	217.7
	T Botryostrobus miralestensis	851 - B - 21 X - 4, 110 - 111	B - 21 X - 6, 105 - 107	193.9	196.85	233.25	236.2
	T Stichocorys wolffii	851 - B - 23 X - 6, 108 - 109	B - 23 X - CC	215.68	216.87	260.63	261.8
	T Diartus petterssoni	851 - B - 21 X - 6, 105 - 107	B - 21 X - CC	196.85	197.14	236.2	236.5
	B Stichocorys johnsoni	851 - B - 23 X - 4, 110 - 111	B - 23 X - 6, 108 - 109	212.7	215.68	257.65	260.6
Didymocyrtis antepenultima	*D. petterssoni* > *D. hughesi*	851 - B - 22 X - CC	B - 23 X - 2, 110 - 111	207.29	209.7	246.64	254.7
	B Diartus hughesi	851 - B - 23 X - 4, 110 - 111	B - 23 X - 6, 108 - 109	212.7	215.68	257.65	260.6
	T Cyrtocapsella japonica	851 - B - 26 X - 4, 110 - 111	B - 26 X - 6, 110 - 111	241.7	244.7	294.5	297.5
	T Lithopera thornburgi	851 - B - 26 X - 6, 110 - 111	B - 26 X - CC	244.7	245.25	297.5	298.1
	T Carpocanopsis cristata	851 - B - 28 X - CC	B - 29 X - 1, 110 - 111	265.14	266.2	[illegible]	324.6

Table 10. Site 852 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper Hole Cr	Upper T S	Upper Interval (cm)	Lower H Cr	Lower T S	Lower Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	852 - B - 1	H - 3,	80 - 81	B - 1	H - 3,	139 - 140	3.8	4.39	4	4.59
Stylatractus universus	*B Collosphaera tuberosa*	852 - A - 1	H - CC		B - 1	H - 6,	110 - 111	5.86	8.6	5.86	8.8
	T Lamprocyrtis neoheteroporos	852 - B - 2	H - 3,	110 - 111	B - 2	H - 4,	10 - 11	13	13.5	13.25	13.75
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	852 - B - 2	H - 3,	110 - 111	B - 2	H - 4,	10 - 11	13	13.5	13.25	13.75
	T Theocorythium vetulum	852 - B - 2	H - 4,	60 - 61	B - 2	H - 4,	110 - 111	14	14.5	14.25	14.75
	B Lamprocyrtis nigriniae	852 - B - 2	H - 4,	60 - 61	B - 2	H - 4,	110 - 111	14	14.5	14.25	14.75
	B Theocorythium trachelium	852 - B - 3	H - 2,	10 - 11	B - 3	H - 2,	60 - 61	20	20.5	20.8	21.3
	B Pterocorys minythorax	852 - B - 2	H - 4,	110 111	B - 2	H - 5,	10 - 11	14.5	15	14.75	15.25
	B Anthocyrtidium angulare	852 - B - 3	H - 2,	10 - 11	B - 3	H - 2,	60 - 61	20	20.5	20.8	21.3
Anthocyrtidium angulare	*T Pterocanium prismatium*	852 - B - 2	H - CC		B - 3	H - 1,	110 - 111	18.94	19.5	19.19	20.3
	T Lamprocyrtis heteroporos	852 - B - 2	H - CC		B - 3	H - 1,	110 - 111	18.94	19.5	19.19	20.3
	T Anthocyrtidium jenghisi	852 - B - 3	H - 6,	60 - 61	B - 3	H - 6,	110 - 111	26.5	27	27.3	27.8
	B Theocalyptra davisiana	852 - B - 4	H - 1,	110 - 111	B - 4	H - 2,	10 - 11	29	29.5	31.4	31.9
Pterocanium prismatium	*T Stichocorys peregrina*	852 - B - 4	H - 2,	10 - 11	B - 4	H - 2,	60 - 61	29.5	30	31.9	32.4
	T Anthocyrtidium pliocenica	852 - B - 4	H - CC		B - 5	H - 1,	110 - 111	37.97	38.5	40.37	41.35
	B Lamprocyrtis neoheteroporos	852 - C - 4	H - CC		B - 4	H - 5,	10 - 11	35.11	34	36.31	36.4
	B Lamprocyrtis heteroporos	852 - B - 4	H - 5,	10 - 11	B - 4	H - 5,	60 - 61	34	34.5	36.4	36.9
	T Phormostichoartus fistula	852 - B - 4	H - 7,	52 - 53	B - 4	H - CC		37.42	37.97	39.82	40.37
	T Lychnodictyum audax	852 - B - 5	H - 2,	40 - 41	D - 4	H - CC		39.3	40.57	42.15	42.47
Anthocyrtidium jenghisi	*T Phormostichoartus doliolum*	852 - B - 5	H - 2,	110 - 111	B - 5	H - 3,	110 - 111	40	41.5	42.85	44.35
	B Amphirhopalum ypsilon	852 - B - 5	H - 4,	10 - 11	B - 5	H - 4,	60 - 61	42	42.5	44.85	45.35
	B Spongaster tetras	852 - B - 5	H - 4,	110 - 111	B - 5	H - 5,	10 - 11	43	43.5	45.85	46.35
Phormostichoartus doliolum	*T Didymocyrtis penultima*	852 - B - 5	H - 4,	110 - 111	B - 5	H - 5,	10 - 11	43	43.5	45.85	46.35
	B Pterocanium prismatium	852 - B - 5	H - CC		B - 6	H - 4,	110 - 111	47.49	52.5	50.34	57.45
	T Solenosphaera omnitubus	852 - B - 6	H - 4,	110 - 111	B - 6	H - 5,	110 - 111	52.5	54	57.45	58.95
	T Siphostichartus corona	852 - B - 7	H - CC		B - 8	H - 2,	110 - 111	66.36	68.5	72.21	75.25
	T Stichocorys johnsoni	852 - B - 8	H - 5,	10 - 11	B - 8	H - 5,	59 - 60	72	72.49	78.75	79.24
Stichocorys peregrina	*Stichocorys delmontensis > S. peregrina*	852 - B - 9	H - 3,	10 - 11	B - 9	H - 3,	60 - 61	78.5	79	87	87.5
	T Calocycletta caepa	852 - D - 8	H - CC		B - 9	H - 2,	110 - 111	78.62	78	85.92	86.5
	B Solenosphaera omnitubus	852 - B - 9	H - 7,	20 - 21	B - 9	H - CC		84.6	85.47	93.1	93.97
Didymocyrtis penultima	*T Diartus hughesi*	852 - B - 10	H - 3,	10 - 11	B - 10	H - 3,	60 - 61	88	88.5	98	98.5
	T Botryostrobus miralestensis	852 - B - 11	H - 1,	60 - 61	B - 11	H - 1,	140 141	95	95.8	106	106.8
	T Stichocorys wolffii	852 - B - 12	H - 1,	110 - 111	B - 12	H - 1,	142 - 143	105	105.32	117.2	117.52
	T Diartus petterssoni	852 - B - 11	H - 4,	110 - 111	B - 11	H - 6,	10 - 11	100	102	111	113
	B Stichocorys johnsoni	852 - B - 11	H - CC		B - 12	H - 1,	110 - 111	104.53	105	116.73	117.2
Didymocyrtis antepenultima	*D. petterssoni > D. hughesi*	852 - B - 12	H - 1,	10 - 11	B - 12	H - 1,	60 - 61	104	104.5	116.2	116.7
	B Diartus hughesi	852 - B - 11	H - CC		B - 12	H - 1,	110 - 111	104.53	105	116.73	117.2
	T Cyrtocapsella japonica	852 - B - 12	H - 4,	110 - 111	B - 12	H - 5,	62 - 63	109.5	110.52	121.7	122.72

Site 854 Radiolaria Zone	Depth (mbsf)	Depth (mcd)	Magnetic stratigraphy	Samples Core, section interval (cm)	Assemblage Ab	Assemblage Pr	Assemblage Mx	*Amphirhopalum ypsilon*	*Spongaster tetras*	*Collosphaera tuberosa*	*Stylatractus universus*	*Lamprocyrtis neoheteroporus*	*Anthocyrtidium angulare*	*Theocorythium vetulum*	*Theocorythium trachelium*	*Lamprocyrtis nigriniae*	*Pterocorys minythorax*	*Lamprocyrtis heteroporus*	*Pterocanium prismatium*	*Anthocyrtidium jenghisi*	*Theocalyptra davisiana*	*Stichocorys peregrina*
Collosphaera tuberosa	1.1	1.1	Brunhes	B 1H-1, 110-111	5	2		R	R	R	_				R	R	R				R	
	2.6	2.6		B 1H-2, 110-111	4	2		R	R	R	_				R	R	R				R	
Amphirhopalum ypsilon	3.4	3.4		B 1H-3, 40-41	3	2		R	R	_	R				R	R	R				R	
	4.1	4.1		B 1H-3, 110-111	4	2	1	R	R		R	_			R	R	R				R	
	5.6	5.6	J	B 1H-4, 110-111	4	2		R	R		R	R			R	R	R				R	
	6.4	6.4		B 1H-5, 40-41	3	2		R	R		R	R	_	_	R	R	R				R	
Anthocyrtidium angulare	7.1	7.1		B 1H-5, 110-111	4	3		R	R		R	R	R	F	R	R	R				R	
	7.9	7.9		B 1H-6, 40-41	2	2		R	R		R	R	R	F	R	R	_				R	
	8.38	8.38		B 1H-CC	4	2		R	R		R	R	R	F	R	R	R				R	
	8.8	9.1		B 2H-1, 40-41	4	2		R	R		R	R	_	F	_	_	_	_			R	
	9.5	9.8		B 2H-1, 110-111	5	2		R	R		R	R	R	F	_		_	R	_		R	
	10.3	10.6	O	B 2H-2, 40-41	2	3		R	R		R	R	R	F			_	R	_		R	
Pterocanium prismatium	11	11.3		B 2H-2, 110-111	3	2		R	R		R	R	_	F			_	_	R		R	
	12.5	12.8		B 2H-3, 110-111	4	2		R	R		R	_	_	F				_	R	_	R	
	14	14.3		B 2H-4, 110-111	4	2		R	R		R	_		F				R	R	R	R	
	14.8	15.1		B 2H-5, 40-41	4	2		R	R		R	_		F				_	R	R	R	
	15.5	15.8		B 2H-5, 110-111	4	2		R	R		R	R		F				_	R	R	R	_
Anthocyrtidium jenghisi	16.3	16.6	K	B 2H-6, 40-41	3	2		R	R		R	R		F				_	R	R	_	R
	17	17.3	M	B 2H-6, 110-111	3	2		R	R		R	R		F				R	_	R		C
	17.8	18.1		B 2H-7, 36 37	2	1		_	_		_	_		R				_	_	_		R
	18.04	18.34		B 2H-CC	2	1		_	_		_	_		R				_	_	_		R
?	19.87	20.92	C3An1	A 2H-CC	0	0		_	_		_	_		_				_	_	_		_
	19	21.35		B 3H-1, 110-111	0	0		_	_		_	_		_				_	_	_		_
	20.36	21.61		A 3X-CC	0	0		_	_		_	_		_				_	_	_		_
	20.5	22.85		B 3H-2, 110-111	0	0		_	_		_	_		_				_	_	_		_
	22	24.35		B 3H-3, 110-111	0	0		_	_		_	_		_				_	_	_		_
	27.95	30.3		B 3H-CC	0	0		_	_		_	_		_				_	_	_		_
	37.35	39.95		B 4H-CC	0	0		_	_		_	_		_				_	_	_		_

Figure 11. Site 854 radiolarian species range chart. Notation as specified in Figure 1.

Table 11. Site 853 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples Hole	Upper Cr T S	Interval (cm)	Lower H Cr T S	Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	853 -			B - 1 H - 1	110 - 111	< 1.1		< 1.1	
Stylatractus universus	*B Collosphaera tuberosa*	853 -			B - 1 H - 1	110 - 111	< 1.1		< 1.1	
	T Lamprocyrtis neoheteroporos	853 - B - 1	H - CC		B - 2 H - 1	110 - 111	4.25	5.4	4.25	5.35
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	853 - B - 1	H - CC		B - 2 H - 1	110 - 111	4.25	5.4	4.25	5.35
	T Theocorythium vetulum	853 - B - 1	H - CC		B - 2 H - 1	110 - 111	4.25	5.4	4.25	5.35
	B Lamprocyrtis nigriniae	853 - B - 2	H - 1	110 - 111	B - 2 H - 2	110 - 111	5.4	6.9	5.35	6.85
	B Theocorythium trachelium	853 - B - 2	H - 1	110 - 111	B - 2 H - 2	110 - 111	5.4	6.9	5.35	6.85
	B Pterocorys minythorax	853 - B - 1	H - 2	110 - 111	B - 1 H - 3	105 - 106	2.6	4.05	2.6	4.05
	B Anthocyrtidium angulare	853 - B - 2	H - 3	110 - 111	B - 2 H - 4	110 - 111	8.4	9.9	8.35	9.85
Anthocyrtidium angulare	*T Pterocanium prismatium*	853 - B - 2	H - 2	110 - 111	B - 2 H - 3	110 - 111	6.9	8.4	6.85	8.35
	T Lamprocyrtis heteroporos	853 - B - 2	H - 2	110 - 111	B - 2 H - 3	110 - 111	6.9	8.4	6.85	8.35

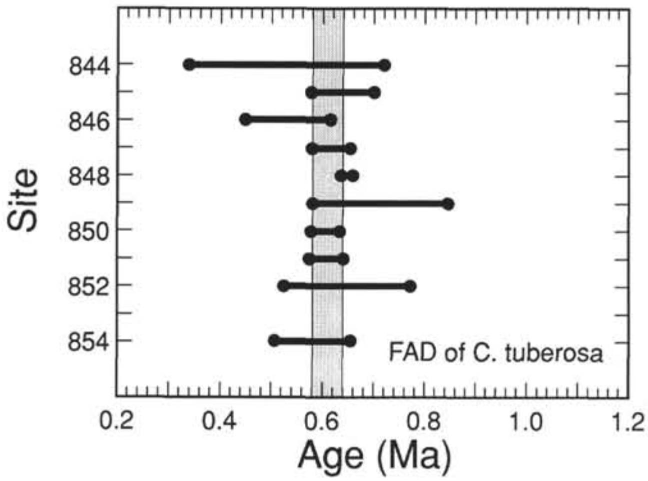

Figure 12. Minimum age range for the first appearance datum (FAD) of *Collosphaera tuberosa* in Leg 138 Sites. From Table 13, the youngest sample in which this species does not appear (that is consistent with the data from other sites) is in Site 851 (at 0.64 Ma). It does not appear in Site 850 at 0.63 Ma, but does appear at this younger age in Site 848; thus, an inconsistency exists between the data from these two sites. The oldest samples in which the species appears (that is consistent with the data from other sites) is at 0.58 Ma in Sites 845, 847, 849, and 850. Based on the Leg 138 data, the minimum age range for this species is 0.06 m.y.

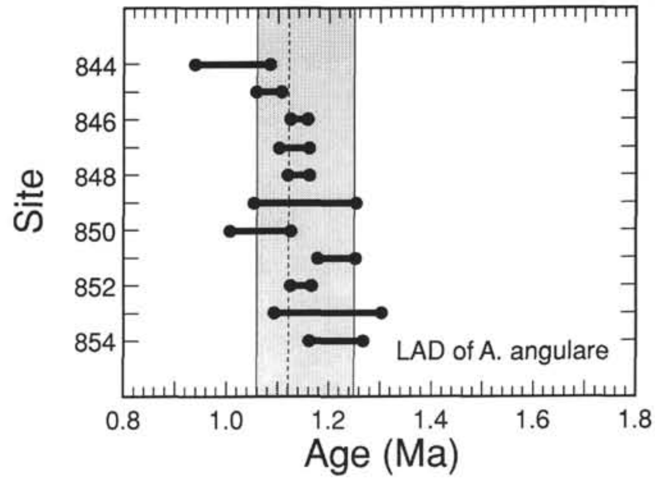

Figure 13. Minimum age range for the last appearance datum (LAD) of *Anthocyrtidium angulare* in Leg 138 Sites. From Table 14, the youngest samples in which this species appears (that is consistent with the data from other sites) is at 1.25 Ma in Sites 849 and 851. The oldest sample in which it does not appear (that is consistent with the data from other sites) is at 1.05 Ma in Site 845. The minimum age range, based on data from all the Leg 138 sites, is 0.20 m.y. Note that the minimum age range for this species is somewhat shorter if data from Sites 844 and 845 are ignored (dotted line defines alternate upper boundary of minimum age range).

Table 12. Site 854 radiolarian species datums, ordered by meters composite depth (mcd).

ZONE Base	Datum	Samples: Upper (Hole Cr T S)	Upper Interval (cm)	Samples: Lower (H Cr T S)	Lower Interval (cm)	Depth (mbsf) top	Depth (mbsf) bottom	Depth (mcd) top	Depth (mcd) bottom
Collosphaera tuberosa	*T Stylatractus universus*	854 - B - 1 H - 2,	110 - 111	B - 1 H -3,	40 - 41	2.6	3.4	2.6	3.4
Stylatractus universus	*B Collosphaera tuberosa*	854 - B - 1 H - 2,	110 - 111	B - 1 H -3,	40 - 41	2.6	3.4	2.6	3.4
	T Lamprocyrtis neoheteroporos	854 - B - 1 H - 3,	110 - 111	B - 1 H -4,	110 - 111	4.1	5.6	4.1	5.6
Amphirhopalum ypsilon	*T Anthocyrtidium angulare*	854 - B - 1 H - 5,	40 - 41	B - 1 H -5,	110 - 111	6.4	7.1	6.4	7.1
	T Theocorythium vetulum	854 - B - 1 H - 5,	40 - 41	B - 1 H -5,	110 - 111	6.4	7.1	6.4	7.1
	B Lamprocyrtis nigriniae	854 - B - 1 H - CC		B - 2 H -1,	40 - 41	8.38	8.8	8.38	9.1
	B Theocorythium trachelium	854 - B - 1 H - CC		B - 2 H -1,	40 - 41	8.38	8.8	8.38	9.1
	B Pterocorys minythorax	854 - B - 1 H - CC		B - 2 H -1,	40 - 41	8.38	8.8	8.38	9.1
	B Anthocyrtidium angulare	854 - B - 2 H - 2,	40 - 41	B - 2 H -2,	110 - 111	10.3	11	10.6	11.3
Anthocyrtidium angulare	*T Pterocanium prismatium*	854 - B - 2 H - 2,	40 - 41	B - 2 H -2,	110 - 111	10.3	11	10.6	11.3
	T Lamprocyrtis heteroporos	854 - B - 2 H - 1,	40 - 41	B - 2 H -1,	110 - 111	8.8	9.5	9.1	9.8
	T Anthocyrtidium jenghisi	854 - B - 2 H - 3,	110 - 111	B - 2 H -4,	110 - 111	12.5	14	12.8	14.3
	B Theocalyptra davisiana	854 - B - 2 H - 5,	110 - 111	B - 2 H -6,	40 - 41	15.5	16.3	15.8	16.6
Pterocanium prismatium	*T Stichocorys peregrina*	854 - B - 2 H - 5,	110 - 111	B - 2 H -6,	40 - 41	15.5	16.3	15.8	16.6

Table 13. Synchronous radiolarian datums in Leg 138 Sites.

Sites	844		845		846		847		848		849		850		851		852		853		854		Summary			
Datums	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age (Ma) top	bot.	Age top	(Ma) bot.	Age (Ma) top	bot.	Min. (m.y.)	Range	Dat. Acc (m.y.)	Age (Ma)
T Stylatractus universus	0.34	0.72	0.40	0.42	0.39	0.42	0.41	0.49	0.48	0.56	0.40	0.51	0.41	0.58	0.39	0.46	0.39	0.45			0.50	0.65	0.41	0.51	0.10	0.46
B Collosphaera tuberosa	0.34	0.72	0.58	0.70	0.45	0.61	0.58	0.65	0.63	0.65	0.58	0.85	0.58	0.63	0.49	0.65	0.53	0.77			0.50	0.65	0.58	0.65	0.06	0.61
T Lamprocyrtis neoheteroporos	0.93	1.08	1.02	1.05	0.99	1.05	1.07	1.09	1.09	1.12	0.96	1.04	1.00	1.13	1.11	1.18	1.11	1.15	1.08	1.30	0.78	1.03	1.02	1.12	0.10	1.07
T Theocorythium vetulum	1.08	1.45	1.12	1.19	1.22	1.28	1.22	1.26	1.15	1.19	1.04	1.25	1.19	1.32	1.25	1.39	1.21	1.24	1.08	1.30	1.16	1.26	1.16	1.26	0.10	1.21
B Anthocyrtidium angulare	1.45	1.93	1.74	1.80	1.69	1.82	1.71	1.78	1.75	1.79	1.73	1.76	1.70	1.93	1.66	1.78	1.76	1.80	1.90*	2.18*	1.77	1.91	1.75	1.79	0.05	1.77
T Pterocanium prismatium	1.45	1.93	1.67	1.74	1.69	1.82	1.71	1.78	1.69	1.74	1.73	1.76	1.70	1.93	1.66	1.78	1.61	1.71	1.59	1.90	1.77	1.91	1.70	1.78	0.08	1.74
B Theocalyptra davisiana	2.57	2.94	2.62	2.86	2.71	2.80	2.71	2.79	2.64	2.71	2.62	2.81	2.65	2.73	2.73	2.77	2.74	2.76			2.49*	2.59*	2.65	2.76	0.11	2.71
T Diartus hughesi	7.47	7.75	7.59	7.63	7.64	7.66			7.51	7.65	7.62	7.84	7.71	7.78	7.52	7.72	7.62	7.66					7.62	7.72	0.10	7.67
D. petterssoni > D. hughesi	8.63	8.93	8.63	8.67	8.59	8.75			8.72	8.82	8.53	8.62	8.59	8.72	8.57	8.82	8.61	8.89					8.59	8.72	0.13	8.66
T Stichocorys wolffii	8.53	8.93	8.80	8.85	8.84	8.87			8.82	8.89	8.90	9.03	8.81	9.03	8.94	8.98	8.89	8.97					8.84	8.97	0.13	8.91
T Cyrtocapsella japonica	9.91	10.20	10.06	10.11	10.03	10.15					9.88	10.20	10.10	10.20	10.05	10.12	9.95	10.05					10.05	10.15	0.10	10.10

* denotes datum ages not used in determining the minimum age range

Table 14. Diachronous radiolarian datums in Leg 138 Sites.

Sites	844		845		846		847		848		849		850		851		852		853		854		Summary			
Datums	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Age (Ma) Top	Bot.	Min. (m.y.)	Range	Dat. Acc. (m.y.)	Age (Ma)
T Anthocyrtidium angulare	0.93	1.08	1.05	1.10	1.12	1.15	1.09	1.15	1.12	1.15	1.04	1.25	1.00	1.13	1.18	1.25	1.11	1.15	1.08	1.30	1.16	1.26	1.05	1.25	0.20	1.15
B Lamprocyrtis nigriniae	1.08	1.45	1.19	1.28	1.22	1.28	1.15	1.22	1.22	1.25	1.04	1.25	1.19	1.32	1.18	1.25	1.21	1.24	1.30	1.59	1.44	1.55	1.21	1.45	0.24	1.33
B Theocorythium trachelium	1.45	1.93	1.45	1.49	1.60	1.65	1.50	1.54	1.47	1.52	1.43	1.54	1.46	1.63	1.66	1.78	1.76	1.80	1.30	1.59	1.44	1.55	1.47	1.78	0.31	1.63
B Pterocorys minythorax	1.45	1.93	1.49	1.60	1.49	1.52	1.54	1.70	1.75	1.79	1.43	1.54	1.63	1.70	1.66	1.78	1.24	1.28			1.44	1.55	1.49	1.78	0.29	1.64
T Lamprocyrtis heteroporos	1.45	1.93	1.49	1.60	2.07	2.09	2.04	2.13	1.47	1.52	1.54	1.61	1.46	1.63	1.56	1.66	1.61	1.71	1.59	1.90	1.55	1.65	1.49	2.09	0.60	1.79
T Anthocyrtidium jenghisi	2.21	2.57	2.03	2.33	2.35	2.39	2.45	2.61	2.35	2.47	2.48	2.51	2.45	2.52	2.27	2.37	2.38	2.43			2.12	2.30	2.27	2.52	0.25	2.40
T Stichocorys peregrina	2.57	2.94	2.86	2.88	2.71	2.80	2.79	2.80	2.64	2.71	2.62	2.81	2.73	2.86	2.73	2.77	2.76	2.81			2.49	2.59	2.49	2.88	0.39	2.69
B Lamprocyrtis neoheteroporos	2.94	3.46	3.10	3.17	3.35	3.37	3.34	3.36	3.18	3.25	3.22	3.31	3.13	3.19	3.13	3.29	3.14	3.18			2.88	3.31	3.14	3.36	0.22	3.25
B Lamprocyrtis heteroporos	2.94	3.46	3.10	3.17	3.42	3.44	3.34	3.36	3.18	3.25	3.22	3.31	3.13	3.19	3.13	3.29	3.14	3.18			2.88	3.31	3.14	3.44	0.30	3.29
T Anthocyrtidium pliocenica	2.94	3.46	3.29	3.59	3.30	3.35	3.20	3.34	3.59	3.66	3.22	3.31	3.13	3.19	3.37	3.45	3.52	3.63					3.13	3.63	0.50	3.38
B Amphirhopalum ypsilon	3.46	3.84	3.59	3.64	3.65	3.75	3.92	4.09	3.80	3.93	3.96	4.00	3.81	3.95	3.95	4.10	4.00	4.06					3.59	4.00	0.41	3.80
B Spongaster tetras	3.46	3.84	3.97	4.04	4.04	4.13	4.11	4.23	4.05	4.15	4.17	4.32	4.20	4.32	4.15	4.27	4.12	4.18					3.46	4.23	0.77	3.84
T Lychnodictyum audax	3.84	5.18	3.97	4.04	3.99	4.04	3.56	3.71	3.66	3.68	3.76	3.96	3.68	3.81	3.67	3.77	3.76	3.78					3.67	4.04	0.37	3.86
T Phormostichoartus doliolum	3.84	5.18	3.97	4.04	4.04	4.13	4.09	4.11	3.66	3.68	3.76	3.96	3.81	3.95	3.77	3.95	3.81	3.95					3.66	4.11	0.45	3.89
B Pterocanium prismatium	3.46	3.84	4.33	4.36	4.72	4.73	4.83	4.87	4.75	4.79	4.74	4.75	4.76	4.84	4.51	4.88	4.49	4.98					3.46	4.84	1.38	4.15
T Phormostichoartus fistula	5.18	5.30	3.29	3.59	4.31	4.34	4.09	4.11	3.66	3.68	3.69	3.76	3.48	3.68	3.45	3.52	3.46	3.52					3.52	5.30	1.78	4.41
T Didymocyrtis penultima	3.84	5.18	4.74	4.85	4.13	4.18	4.11	4.23	4.05	4.15	4.17	4.32	4.20	4.32	4.15	4.27	4.12	4.18					4.13	4.85	0.72	4.49
B Theocorythium vetulum	5.30	5.55	5.30	5.35	4.81	4.89	4.87	4.89	4.90	4.95	4.75	5.00	5.39	5.52	5.38	5.45	5.41	5.51					4.87	5.45	0.58	5.16
T Solenosphaera omnitubus	5.55	5.81	5.30	5.35	5.38	5.47	5.37	5.48	4.95	4.99	5.39	5.42	5.36	5.39	5.38	5.45	4.98	5.08					4.98	5.81	0.83	5.40
T Siphostichartus corona	5.81	6.88	7.06	7.14	5.50	5.53	5.66	5.76	5.42	5.50	5.59	5.62	5.75	5.76	5.83	5.88	5.90	6.06					5.50	7.14	1.64	6.32
T Stichocorys johnsoni	5.81	6.88	6.44	6.54	6.42	6.49	6.42	6.48	6.30	6.35	6.23	6.33	6.31	6.36	6.25	6.28	6.24	6.28					6.24	6.48	0.24	6.36
T Calocycletta caepa	5.81	6.88	6.98	7.06	6.56	6.65	6.48	6.52	6.17	6.23	6.23	6.33	6.31	6.36	6.28	6.33	6.77	6.80					6.17	7.06	0.89	6.62
S. delmontensis > S. peregrina	5.81	6.88	6.76	6.81	6.56	6.70	6.42	6.59	6.57	6.84	6.61	6.68	6.65	6.72	6.63	6.68	6.80	6.84					6.56	6.81	0.25	6.69
B Solenosphaera omnitubus	7.20	7.47	7.14	7.20	7.26	7.32			7.06	7.45	6.97	7.07	7.12	7.17	6.80	7.01	7.20	7.28					6.97	7.28	0.31	7.13
T Botryostrobus miralestensis	7.75	8.13	8.21	8.25	8.37	8.59			8.02	8.20	8.21	8.35	8.19	8.35	8.13	8.24	8.07	8.11					8.07	8.59	0.52	8.33
T. Diartus petterssoni	8.15	8.45	8.59	8.63	8.37	8.59			8.49	8.57	8.21	8.35	8.35	8.40	8.27	8.31	8.38	8.53					8.27	8.59	0.32	8.43
B Stichocorys johnsoni	8.93	9.67	8.67	8.72	8.59	8.72			8.49	8.57	8.90	9.03	8.72	8.81	8.87	8.94	8.97	9.11					8.49	9.03	0.54	8.76
T. Carpocanopsis cristata	10.20	10.50	10.37	10.52	10.78	10.84					10.80	10.90	10.60	10.70	10.64	10.72							10.37	10.84	0.47	10.61

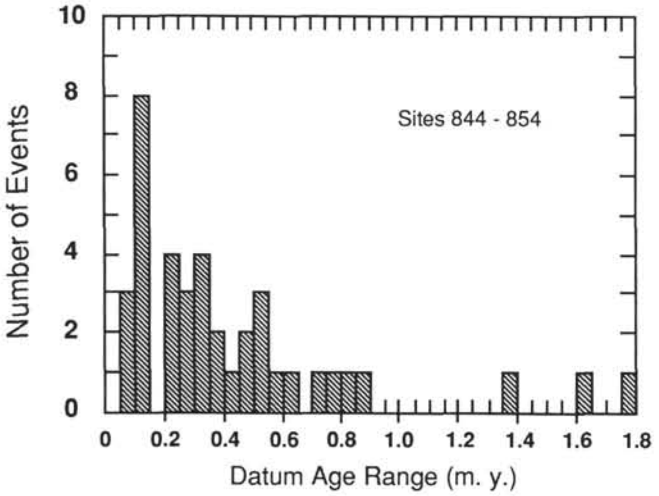

Figure 14. Minimum age range for 39 radiolarian datums (0–10 Ma) in Leg 138 sites.

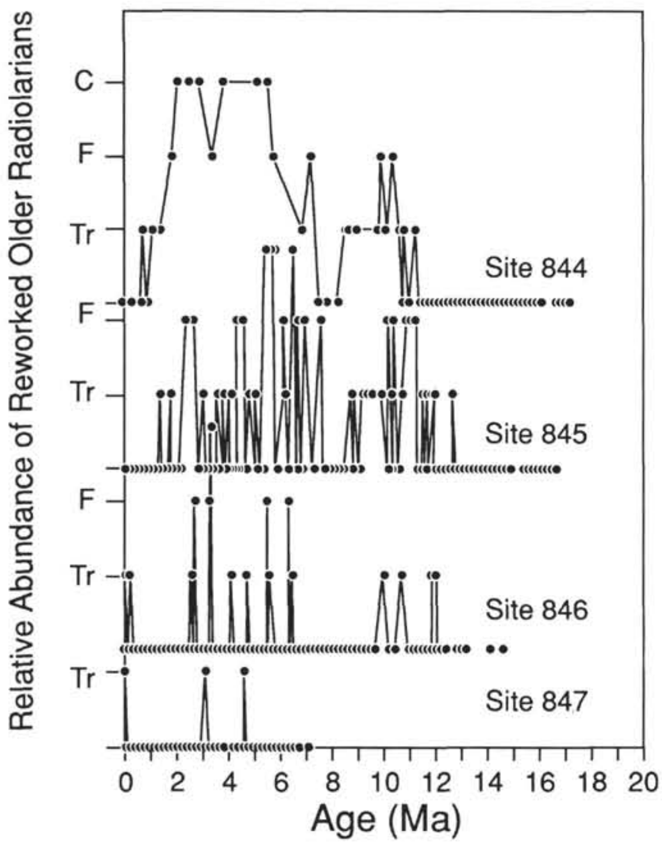

Figure 15. Abundance of reworked older radiolarians in Leg 138 sites from the eastern transect.

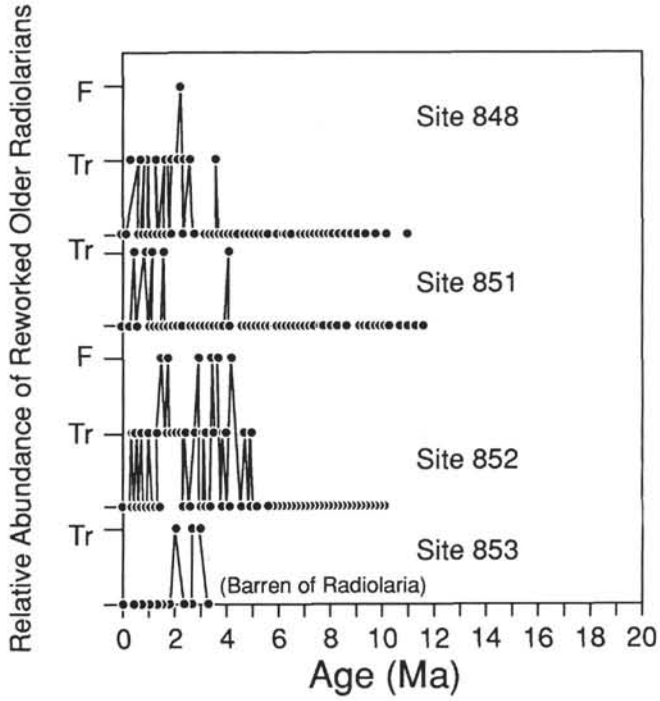

Figure 16. Abundance of reworked older radiolarians in Leg 138 sites from the western transect.

Table 15. Radiolarian datums in Leg 138 material older than about 10 Ma.

Sites	844		845		846		Summary			
	Age (Ma)		Age (Ma)		Age (Ma)		Min. Range		Dat. Acc.	Age
Datums	Top	Bot.	Top	Bot.	Top	Bot.	(m.y.)		(m.y.)	(Ma)
T Lithopera renzae	11.82	11.90	11.74	11.81	11.76	11.81	11.76	11.90	0.14	11.83
T Dorcadospyris alata	11.82	11.90	11.84	11.87			11.82	11.87	0.05	11.85
T Cyrtocapsella cornuta	11.74	11.82	11.81	11.84	11.90	11.98	11.81	11.98	0.17	11.89
B Cyrtocapsella japonica	12.33	12.35	12.43	12.50	12.35	12.44	12.33	12.44	0.12	12.39
B. Diartus petterssoni	11.82	11.90	11.81	11.84	13.00	13.22	11.82	13.22	1.40	12.52
B Lithopera thornburgi	12.98	13.05	13.60	13.63			12.98	13.63	0.65	13.30
B Calocycletta caepa s.s.	13.51	13.60	13.12	13.19			13.12	13.49	0.37	13.30
T Stichocorys armata	13.76	13.90	13.63	13.67			13.63	13.67	0.05	13.65
T Liriospyris parkerae	14.42	14.50	14.18	14.61			14.18	14.61	0.43	14.39
T Acrocubus octopyle	14.50	14.59	14.18	14.61			14.23	14.61	0.38	14.42
T Carpocanopsis bramlettei	14.88	15.02	14.18	14.61			14.18	14.78	0.61	14.48
T Calocycletta costata	15.17	15.25	15.01	15.05			15.01	15.05	0.04	15.03
Dorcadospyris dentata > D. alata	15.47	15.57	15.85	15.86			15.36	15.86	0.50	15.61
T Liriospyris stauropora	15.66	15.77	15.90	15.92			15.61	15.92	0.31	15.76
B Liriospyris parkerae	15.66	15.77	15.92	15.93			15.61	15.93	0.32	15.77
T Eucyrtidium diaphanes	15.84	15.92	16.01	16.03			15.84	16.03	0.18	15.93
T Carpocanopsis cingulata	16.48	16.55	16.35	16.36			16.35	16.55	0.21	16.45
B Giraffospyris toxaria	16.55	16.62					16.55	16.62	0.07	16.59
B Acrocubus octopyle	16.62	16.86	16.43	16.45			16.43	16.86	0.43	16.64
T Didymocyrtis prismatica	16.86	17.02	16.42	16.43			16.42	17.02	0.60	16.72