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15. DIATOM BIOSTRATIGRAPHY OF THE JAPAN SEA: LEG 127[1]

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ABSTRACT

A series of excellent upper Miocene through Quaternary diatomaceous sequences recovered at four sites during Leg 127 was examined for diatoms. The diagenetic transition from opal-A to opal-CT is a diachronic horizon from the uppermost part of the *Denticulopsis katayamae* Zone (8.5 Ma) at Hole 797B to the uppermost part of the *Neodenticula kamtschatica* Zone (5.73 Ma) at Hole 795A. The diatom zonation of Koizumi (1985) best divides the upper Miocene to Quaternary sequences above the opal-A/opal-CT boundary and also is useful to date carbonate concretions including diatoms below the boundary. Forty diatom datum levels were evaluated biostratigraphically based on the sediment accumulation rate curve, and several isochronous datum levels are newly proposed for the Japan Sea area. A warm-water current did not penetrated into the Japan Sea through the Tsushima strait during the late Miocene and Pliocene time, because subtropical warm-water diatoms are essentially not present in such sediment samples. The occurrences of diatom are cyclic throughout the Quaternary sediments and are affected by eustatic sea level changes.

INTRODUCTION

Leg 127 of the Ocean Drilling Program was expected to provide complete sedimentary sequences from the Japan Sea as the reference sections for resolving geologic certainties from the on-land sections.

Huzioka (1972) proposed that the modern Japan Sea originated in a subsided region on the Green Tuff Orogeny when a warm current from the Pacific Ocean invaded the present-day Japan Sea area on the basis of warmer climatic condition of the Daijima-type floras as compared with the Aniai-type floras during early Miocene time. Koizumi (1979, 1988) considered that the sediments, which accompany the Aniai-type floras, exclusively include fresh-water diatoms and are older than 18 Ma. These sediments have been recognized in areas along the periphery of the Japan Sea and in a piston-core from the northeast flank of the Yamato Rise. On the other hand, a mixed diatom association of fresh-water and brackish-water forms accompanying the Daijima-type floras from 17.5–16 Ma are estimated to be of brackish-water origin.

A series of paleomagnetic data from southwest Japan (Otofuji and Matsuda, 1983, 1984; Hayashida and Ito, 1984; Otofuji, Hayashida, and Torii, 1985) and northeast Japan (Otofuji, Matsuda, and Nohda, 1985) suggested the opening of Japan Sea at about 15 Ma. The date also indicated that southwest and northeast Japan had been situated adjacent to the Asian continent until 21 Ma, and then rotated to the present position before 12 Ma when the Japan Sea opened by a back-arc spreading. The reconstruction of the Japanese Islands based on these paleomagnetic data is in conflict with the results from paleobotany on land and diatom assemblages in the water-mass.

Biosiliceous sediments are developed above a shallow-marine calcareous coarse sandstone including warm shallow-marine mollusks and large foraminifers of the Nishikurosawa stage and are underlain by continental to shallow-marine volcaniclastics and coal layers of the Daijima stage. They are distributed extensively in marginal areas of the Japan Sea and originated in a sedimentary environment characterized by subsiding, silled small basins during the rotation of the Japanese Islands and the rising sea level during the climatic optimum in the early middle Miocene (Koizumi and Matoba, 1989; Koizumi, 1990). Most of the younger than middle Miocene diatomaceous sediments along the Japan Sea side were resulted from the convergence of cold and warm currents over the continental slope (Koizumi, 1983).

It is regretted, however, that sediments originating in the fresh-water or brackish-water were not recovered and also that the opal-A/opal-CT transformation affected the distribution of the diatoms at all four sites. Across the diagenetic transition from opal-A to opal-CT, diatoms underwent dissolution and reprecipitation at the upper Miocene.

Nevertheless, excellent upper Miocene and Pliocene diatomaceous sequences were recovered at all four sites (Fig. 1). The purpose of this chapter is (1) to report the age assignment based on diatom biostratigraphy for the opal-A/opal-CT boundary at each site, (2) to present a diatom zonation for the upper Miocene through Quaternary, and (3) to propose age assignment for selected diatom datum levels in the Japan Sea area.

METHODS OF STUDY

Sample material was placed in an oven at 60°C for 24 hr, and 0.1 g of dried-up materials was boiled in a 100 mL beaker with about 10 mL of hydrogen peroxide solution (15%) for several seconds and then left to stand for 24 hr after diluting with distilled water. After pouring off the suspension, the residue was diluted with 50 mL of distilled water and homogenized for about 3 s in an ultrasonic washer (Clean Matic; 20 W, 40 kHz). Using a micropipette (Justor-Jv 500 µL), 0.25 mL of this solution was placed on a cover glass (18 × 18 mm in size), dried on a hot plate at 50°C, and then mounted on a glass slide using Pleurax.

All diatoms were identified and counted until the number of individual specimens totaled 200, excluding *Bacteriastrum* spp. and *Chaetoceros* spp. Several samples did not have enough diatoms to total 200 specimens.

The diatom zonation of Koizumi (1985) was adapted with minor change to the samples of Leg 127 in the Japan Sea. Sediment accumulation rate curves based on the paleomagnetic stratigraphy and the diatom zonal datum levels provided the means of estimating the absolute ages of the selected diatom datum levels. All diatom datum levels were standardized to the paleomagnetic reference time scale of Berggren et al. (1985).

RESULTS AND DISCUSSION

Diatom Zonation

The diatom zonation described in Koizumi (1985) was used in part as modified by Akiba (1986) based on taxonomic revisions of Akiba and Yanagisawa (1986). The definition for the top of *Denticulopsis*

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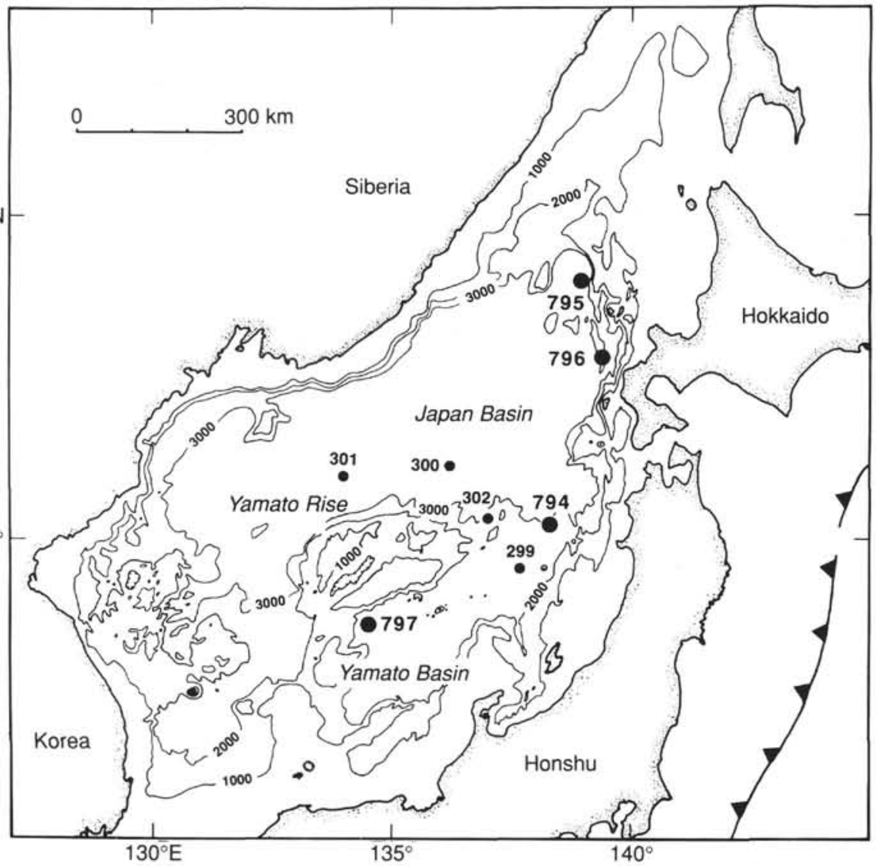

Figure 1. Location of Sites 794 to 797 occupied on ODP Leg 127 in the Japan Sea. Bathymetric contours in meters.

praedimorpha Zone is changed from the last occurrence to the rapid decrease datum at 10.6 Ma of *Denticulopsis praedimorpha* (Koizumi, 1990). Figure 2 summarizes the lower Miocene to Quaternary diatom zonation and zonal datum levels used to date samples in Leg 127. The following subtropical warm-water age-diagnostic species are scarce in Leg 127 materials: *Pseudoeunotia doliolus, Nitzschia reinholdii, Rhizosolenia praebergonii, Nitzschia jouseae, Asterolampra acutiloba*, and *Thalassiosira miocenica*. Therefore, the zonation of Koizumi and Tanimura (1985) could not be applied to the sediments recovered from Sites 794 to 797 of the Japan Sea.

Diatoms occur cyclically with variable abundance and state of preservation through the Quaternary sequences at all four sites in response to glacial cycles in productivity and water-mass conditions affected by eustatic sea level changes during the time, especially at both Sites 794 and 797 in the Yamato Basin. Therefore, the *Actinocyclus oculatus* Zone was not identified at both Sites 797 and 796. A remarkable upcore decrease in abundance of diatoms had been also observed around the Pliocene/Pleistocene boundary at Sites 299, 301, and 302 of previous DSDP Leg 31. It was interpreted at the time that the first significant glacial lowering of sea level and the tectonic uplift of periphery including the Japan Sea occurred at the beginning of the Pleistocene (Koizumi, 1975).

Diatoms are most abundant and preserved above the diagenetic boundary opal-A/opal-CT. Nine diatom zones were recognized in Hole 794A, six zones in Hole 795A, seven zones in Hole 796A, and nine zones in Hole 797B (Table 5). The lowest diatom zone at each site has became gradually younger from Site 797 in the southern Yamato Basin to northern Site 795 of the Japan Basin. The depth of the diagenetic boundary is approximately 300 mbsf except about 224 mbsf at Site 796. It means that the sedimentation rate is higher in the northern sites than in the southern sites.

Tough diatoms decline rapidly in abundance below the opal-A/opal-CT boundary, frustules are occasionally preserved in some carbonate concretions below the transition at both Holes 795B and 797B. A carbonate layer from Sample 127-795B-13R-1, 79–81 cm (481.81 mbsf), has poorly preserved specimens of *Denticulopsis dimorpha* and *Denticulopsis hustedtii,* and belongs to the upper Miocene *Denticulopsis dimorpha* Zone. Carbonates from Samples 127-795B-21R-2, 75–90 cm (560.5 mbsf), 127-795B-22R-CC (572.8 mbsf), 127-795B-26R-2, 22–28 cm (608.18 mbsf), and 127-795B-28R-4, 44–45 cm (630.65 mbsf), contain *Denticulopsis praedimorpha* and are assigned to the middle Miocene *Denticulopsis praedimorpha* Zone. At Hole 797B, carbonate nodules from both Samples 127-797B-37X-2, 84 cm (342.64 mbsf), and 127-797B-38X-1, 22 cm (350.22 mbsf), also contain *Denticulopsis praedimorpha* and are assigned to the middle Miocene *Denticulopsis praedimorpha* Zone (Table 1).

Many reworked extinct diatoms are present throughout the upper Miocene to the Quaternary sequences at all four sites. They are especially abundant during the Quaternary. They are mainly *Actinocyclus ingens, Denticulopsis dimorpha, Denticulopsis hustedtii, Denticulopsis hyalina, Goniothecium tenue, Neodenticula kamtschatica, Neodenticula koizumii,* and *Rouxia californica*. At both northern Sites 795 and 796 in the Japan Basin, *Thalassiosira* species such as *T. antiqua, T. jacksonii, T. marujamica,* and *T. zabelinae* are abundantly added to the reworked assemblage in the Quaternary to uppermost Pliocene sequences.

Tables 1, 2, 3, and 4 list the stratigraphic distribution of diatoms, zonal subdivision, and geologic age at each site. Table 5 arranges from

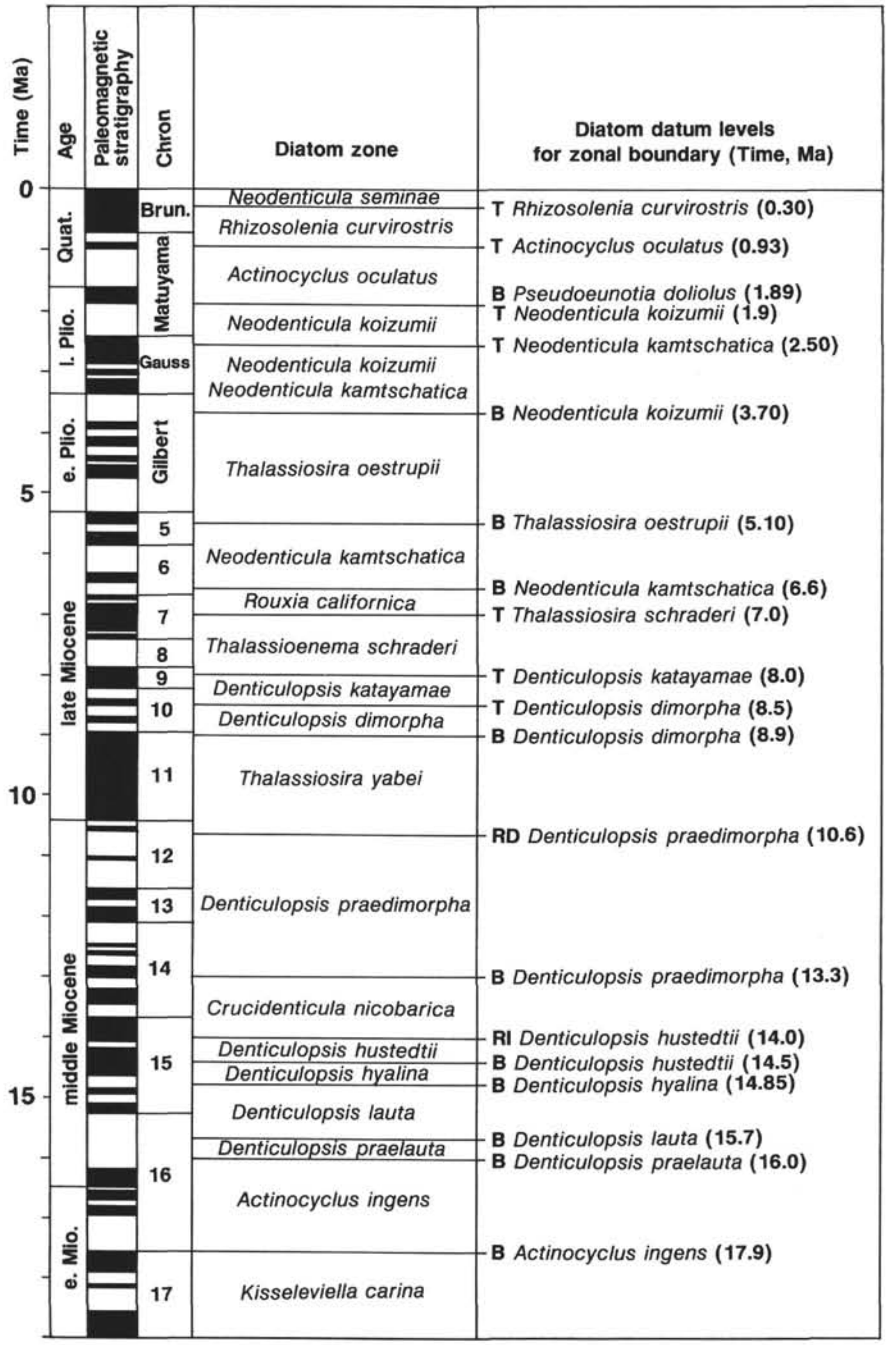

Figure 2. Diatom zones and datum levels for zonal boundaries with absolute ages used on ODP Leg 127. Paleomagnetic stratigraphy after Berggren et al. (1985). T = top of species range of last appearance datum, B = base of species range of first appearance datum, RD = rapid decrease datum of species, RI = rapid increase datum of species.

south to north the diatom zones and rock intervals of samples studied at each site of Leg 127.

Age of the Opal-A/Opal-CT Boundary

The age of the opal-A/opal-CT boundary at each site was estimated by extrapolating the sedimentation rates based on diatom datum levels above the boundary. Accordingly, the opal-A/opal-CT boundary at Hole 794A (293 mbsf) is estimated at 8.26 Ma in the *Denticulopsis katayamae* Zone (Fig. 7). Similarly, the age of the opal-A/opal-CT boundary at Hole 795A (325 mbsf) is 5.73 Ma, and the boundary at Hole 796A (224 mbsf) is 6.07 Ma in the *Neodenticula kamtschatica* Zone (Fig. 8). Opal-A is transformed to opal-CT below depths of 295 mbsf in sediments about 8.5 Ma old at Hole 797B (Fig. 7). The diagenetic boundary between sediments containing biogenic opal-A and those containing opal-CT forms a distinctively diachronic plane in the Japan Sea.

Diatom Datum Levels

Stratigraphically useful upper Miocene to Quaternary diatom datum levels based on the data provided from Leg 127 will be

Table 1. Stratigraphic occurrences of Neogene diatoms in Hole 797B. Circle indicates reworked specimens.

Core, section, interval (cm)	Depth below seafloor (m)	Abundance (10^7 per g)	*Chaetoceros* spp.	*Achnanthes groenlandica*	*A. lanceolata*	*Actinocyclus curvatulus*	*A. ingens*	*A. ingens* var. *nodus*	*A. ochotensis*	*A. octonarius*	*A. oculatus*	*Actinoptychus senarius*	*Amphiprora* sp.	*Amphora* sp.	*Asteromphalus darwinii*	*A. flabellatus*	*A. robustus*	*Aulacosira granulata*	*Azpeitia endoi*	*A. nodulifer*	*A. tabularis*	*Bacillaria paradoxa*	*Bacterosira fragilis*	*Caloneis bacillum*
1-1, 13–15	0.13	2.57	38		1					6	①	13				1				3	4			
2-1, 44–46	6.34	0.77	305			3				5		3												
2-5, 102–104	12.92	1.29	26			1				1													1	
3-3, 14–16	18.54	0.24	25			3				1								1						1
3-7, 14–16	24.54	0.19	69			2				1														
4-4, 102–104	30.42	1.54	226						1	5		2						1						
5-2, 74–76	36.64	0.03	12											1										
5-6, 81–83	42.71	0.03	5																					
6-4, 13–15	48.53	1.47	242							8		21										1		
7-1, 102–104	54.42	0.00																						
7-5, 102–104	60.42	3.43	185			1				2		7												
8-3, 74–76	66.64	0.02	8																					
9-1, 14–16	72.54	3.43	178									8					1							
9-5, 14–16	78.54	0.04	9							1								1						
10-2, 109–111	84.49	0.30	88						1		1	2						1						
10-6, 109–111	90.49	0.24	83			3			2															
11-4, 43–45	96.33	7.71	210			7			1	2		1												
12-1, 109–111	101.99	5.14	75			1						1								1				
12-5, 109–111	107.99	7.71	36			1			1	2														
13-3, 39–41	113.79	7.71	105						1	2		1												
13-7, 39–41	119.79	7.71	125							1		1					1			1				
14-4, 107–109	125.47	3.86	51			1				4	1						1							
15-2, 39–41	131.29	2.57	21									3												
15-6, 39–41	137.29	5.14	48							2	1	5												
16-4, 39–40	143.79	0.96	100							2	1	16												
17-2, 13–14	150.03	0.31	53					①		1		2						1						
17-7, 39–40	155.66	0.43	29				①			1		9												
18-3, 39–40	161.29	2.57	18				①					9												
19-1, 39–40	166.79	1.03	27									2												
19-5, 39–40	172.79	3.86	14									16												
20-3, 38–39	179.28	5.14	14								1	6												
21-5, 39–40	185.89	10.3	7		1		①					1												
21-1, 39–40	191.89	10.3	12				①		2	2		2										1		
22-4, 38–39	200.08	7.71	12	1					1			2					2							
23-2, 40–41	206.70	5.14	18						1			8												
23-6, 40–41	212.70	5.14	19									12						1						
24-4, 39–40	219.19	3.86	21									2												
24-7, 39–40	223.69	2.57	10									5						1						
26-1, 38–39	234.08	1.71	29				3			1		6	1	1										
26-5, 38–39	240.08	1.03	24				1					3												
27-1, 37–38	243.77	1.47	13							1		17			1		1	2						
27-5, 38–39	249.78	1.03	29	1			1			1		11						8						
28-4, 38–39	257.38	1.19	11			2	1			1		28						7						
30-2, 38–39	274.38	0.29	18			1		2		1		3		1				8						
30-6, 38–39	280.38	0.21	12				8	4		3		15						4						
31-4, 38–39	287.08	1.71	8				1			2		44						2						
32-2, 36–37	293.76	0.30	23			2	2	6		1		8			1			13	①					
32-5, 8	297.98	0.49	44				37	6				12						4						
32-6, 37–38	299.77	0.19	8				22	7				15						7						
37-2, 84	342.64	0.30	68				9					2						3						
38-1, 22	350.22	1.71	60				40					2						1						

Table 1 (continued).

Core, section, interval (cm)	*Cocconeis californica*	*C. costata*	*C. pellucida*	*C. placentula* var. *euglypta*	*C. pseudomarginatus*	*C. scutellum*	*Cosinodiscus elegans*	*C. marginatus*	*C. obscurus*	*C. oculus iridis*	*C. radiatus*	*C. stellaris*	*C. subtilis*	*C. symbolophorus*	*C. vetustissimus*	*Cosmiodiscus insignis*	*Crucidenticula punctata*	*Cyclotella kützingiana*	*C. striata*	*C. styroleum*	*Cymatosira debyl*	*Cymatotheca weissflogii*	*Delphineis angustata*	*D. ischaboensis*	*D. surirella*
1-1, 13–15								12		6	12									3					3
2-1, 44–46								5			4								4	1					12
2-5, 102–104								3												1					4
3-3, 14–16								3	1		4									1					4
3-7, 14–16							1	11		1									1		1				
4-4, 102–104								4																	20
5-2, 74–76																									
5-6, 81–83								1																	
6-4, 13–15				10		1		4										1	4	3					4
7-1, 102–104																									
7-5, 102–104								2		1								1	10						
8-3, 74–76								1																	
9-1, 14–16								10										2							
9-5, 14–16								1											1	1					
10-2, 109–111	1							5																	1
10-6, 109–111																		1			1	1		1	
11-4, 43–45		1				1		1		3					2				1	1					2
12-1, 109–111								49		1								1					1		7
12-5, 109–111								19		2														2	7
13-3, 39–41								10																	4
13-7, 39–41						1		11			1														1
14-4, 107–109								37																	
15-2, 39–41								104	1											1					
15-6, 39–41								15			1														
16-4, 39–40								57											2			1			2
17-2, 13–14								28											3						2
17-7, 39–40		1						64																1	
18-3, 39–40								31																	1
19-1, 39–40							1	19																	
19-5, 39–40		1						27																	
20-3, 38–39							1	42													1				
21-5, 39–40		1						11																	
21-1, 39–40								11		1															
22-4, 38–39								35		1			1												1
23-2, 40–41						1		12				1													
23-6, 40–41	2	1						44		2		1											1		
24-4, 39–40			1			1		115						1							1		1		1
24-7, 39–40								163																	
26-1, 38–39	1	2			1		1	90								4									
26-5, 38–39		2				1		167																	
27-1, 37–38		1					1	13									①								
27-5, 38–39		2		1				23																	
28-4, 38–39								125																	
30-2, 38–39						1	1	72																	
30-6, 38–39								20																	
31-4, 38–39			1					11																	
32-2, 36–37			2	1		1	5	7		1		1													
32-5, 8							2	49																	
32-6, 37–38			2				2	9																	
37-2, 84			1			1	4	16						2											
38-1, 22							2	21																	

Table 1 (continued).

Core, section, interval (cm)	*Denticulopsis dimorpha*	*D. hustedtii*	*D. hyalina*	*D. katayamae*	*D. lauta*	*D. praedimorpha*	*D. praehyalina*	*D. praekatayamae*	*Diploneis bombus*	*D. fusca*	*D. interrupta*	*D. nitescens*	*D. oculata*	*D. ovalis*	*D. smithii*	*D. suborbicularis*	*D. weissflogi*	Eunotia spp.	*Fragilaria construens*	*Goniothecium tenue*	*Grammatophora* spp.	*Hemiaulus* spp.	*Hemidiscus cuneifomis*	*Hyalodiscus* sp.	*Mediaria splendida*
1-1, 13–15									2				4				3								
2-1, 44–46									3				4		2	1					1				
2-5, 102–104									3		1		5		1						1				
3-3, 14–16									1																
3-7, 14–16									1																
4-4, 102–104									13																
5-2, 74–76									3					1				1			1				
5-6, 81–83																									
6-4, 13–15									12																
7-1, 102–104																									
7-5, 102–104									11																
8-3, 74–76																									
9-1, 14–16									5		1												1		
9-5, 14–16									1																
10-2, 109–111									2						1						1				
10-6, 109–111		②							9																
11-4, 43–45									6				1												
12-1, 109–111																									
12-5, 109–111									2				1												
13-3, 39–41									1				3								1				
13-7, 39–41									2										1						
14-4, 107–109									4														11		
15-2, 39–41	①								2																
15-6, 39–41									1														7		
16-4, 39–40									2																
17-2, 13–14	②		②						1												1				
17-7, 39–40	①			①																1					
18-3, 39–40																									
19-1, 39–40																									
19-5, 39–40																									
20-3, 38–39																					1				
21-5, 39–40																									
21-1, 39–40																					1				
22-4, 38–39																									
23-2, 40–41																					2				
23-6, 40–41																					1				
24-4, 39–40		①									1														
24-7, 39–40																									
26-1, 38–39								①	1												2				1
26-5, 38–39		①																						1	1
27-1, 37–38			①	①																1			1		
27-5, 38–39			①																	1	2		3	3	
28-4, 38–39																				1	1			1	
30-2, 38–39							①														5				
30-6, 38–39			②																	1				1	1
31-4, 38–39			①																		2				
32-2, 36–37				13	②			②		1					1					3	6			1	
32-5, 8		13		1																1	5				5
32-6, 37–38			①												1					2	3				
37-2, 84		4				9	①					1								1	4				1
38-1, 22		8			②	26															4			2	1

Table 1 (continued).

Core, section, interval (cm)	*Melosira albicans*	*M. westii*	*Navicula directa*	*N. lyra*	*N. pygmaea*	N. spp.	*Neodenticula kamtschatica*	*N. koizumii*	*N. seminae*	*Nitzschia braarudii*	*N. cylindrica*	*N. extincta*	*N. grunowii*	*N. mirina*	*N. reinholdii*	*N. rolandii*	*N. punctata*	*N. sicula*	*N.* sp. 1	*Odontella aurita*	*Paralia clavigera*	*P. sulcata*	*Pinnularia* spp.	*Plagiogramma staurophorum*	Porosira glacialis
1-1, 13–15					1				3	8				1								6			
2-1, 44–46				1		1			6													27			
2-5, 102–104									12													27			
3-3, 14–16			1						2													33			
3-7, 14–16							14	⑧	4																
4-4, 102–104							①		10													49			
5-2, 74–76																						3			
5-6, 81–83							①																		
6-4, 13–15									7													27			2
7-1, 102–104																									
7-5, 102–104			1				①		4						1			1				16		1	
8-3, 74–76															1			1				1			
9-1, 14–16	1						②	⑥	12			1										74			1
9-5, 14–16									1													6			
10-2, 109–111		2					③	1	7				1									62			
10-6, 109–111								2	4													37			
11-4, 43–45	1						①	21	14			3										15			
12-1, 109–111							4	37	5			2										6			1
12-5, 109–111							10	44														3			
13-3, 39–41							6	106														3			
13-7, 39–41							3	20														7			
14-4, 107–109		1					5	5									1					8			
15-2, 39–41		1	1				32	4														3			
15-6, 39–41							30	7														4			
16-4, 39–40							29	3											1			21			
17-2, 13–14							18									1			1	2		16			
17-7, 39–40							37													1		1			
18-3, 39–40							107	5														2			
19-1, 39–40							93															1			
19-5, 39–40							109															2			
20-3, 38–39	2						79	3											1			1			
21-5, 39–40							128														1	1			
21-1, 39–40				1			82												1			2			
22-4, 38–39							64				1				1	1									
23-2, 40–41							73									1						1			
23-6, 40–41							43									1			1			1	1	1	
24-4, 39–40	1						17									3				2		1			
24-7, 39–40																1									
26-1, 38–39							4						1			8				3		1			
26-5, 38–39																3				5		2			
27-1, 37–38													1			3						1			
27-5, 38–39																2						1			
28-4, 38–39																1									
30-2, 38–39																			1	1		6			1
30-6, 38–39																						2			
31-4, 38–39																						1			
32-2, 36–37				1																1	5	8		1	
32-5, 8				1																	7	13		1	
32-6, 37–38																					2	8		1	
37-2, 84																					2	3			
38-1, 22																						3			

Table 1 (continued).

Core, section, interval (cm)	*Pseudoeunotia doliolus*	*Pseudopodosira elegans*	*Rhabdonema japonica*	*Rhaphoneis amphiceros*	*R. elegans*	*Rhizosolenia alata*	*R. barboi*	*R. bergonii*	*R. curvirostris*	*R. hebetata*	*R. imbricata*	*R. miocenica*	*R. setigera*	*R. styliformis*	*Roperia tesselata*	*Rossiella tatsunokuchiensis*	*Rouxia californica*	*Stephanodiscus astrea*	*Stephanogonia hanzawae*	*Stephanopyxis turris*	*S.* spp.	*Synedra jouseana*	*S. jouseana* var.	*Thalassionema bacillaris*	*T. hirosakiensis*
1-1, 13–15	6			1		1					2		4	3	1					1				14	
2-1, 44–46	2			1						21			2	1				1		7				2	
2-5, 102–104				1						63				1						13					
3-3, 14–16	1			1					15	3			2					1						1	
3-7, 14–16							3		13					2						10					
4-4, 102–104									8											24	4			4	
5-2, 74–76																		1		2					
5-6, 81–83																	①			1					
6-4, 13–15				1						1			3							14	1			1	
7-1, 102–104																									
7-5, 102–104		1											3	1						13	4			3	
8-3, 74–76							1						1	1						1					
9-1, 14–16							1		2				3	1						12					
9-5, 14–16																				3					
10-2, 109–111							2	1												10					
10-6, 109–111				1									6	1						4					
11-4, 43–45				2	1		3						1	1						24	2				
12-1, 109–111							1			1			2							15					
12-5, 109–111							1			2										18					
13-3, 39–41							2							1		1				3					
13-7, 39–41				1			5													24	3				
14-4, 107–109							3						2							16	1				
15-2, 39–41							1													21					
15-6, 39–41							1						1	1						17	2				
16-4, 39–40													2	1		1				24	4				
17-2, 13–14														7			②			17					
17-7, 39–40			1				2			3				17		1	①			14	5				
18-3, 39–40							2			1				7						1					
19-1, 39–40			2				12			1				16						4					
19-5, 39–40							16							15						1					
20-3, 38–39							3			3				7						5	1				
21-5, 39–40							4			1				7						3	5				
21-1, 39–40			1				32			1				4							1				
22-4, 38–39							16			4				14						6	4				
23-2, 40–41										1			1	37						16	6				
23-6, 40–41							4						2	37						4					
24-4, 39–40							1							16											
24-7, 39–40										2			1	2						1					
26-1, 38–39							1			1				5			1			14					
26-5, 38–39			1														1			1					
27-1, 37–38			1				11			1							8			4		3			
27-5, 38–39		1					2			3										7	4	2	④		
28-4, 38–39							9			10							1			1	1	6			
30-2, 38–39							2			2							1			3		2			
30-6, 38–39		1					19			1							3			4		1			
31-4, 38–39							9			3							4			2	1	3			
32-2, 36–37			1				7			1										5	3	2	1		
32-5, 8			2				1												6	4	4	2	2		
32-6, 37–38				1																2	1				
37-2, 84			1				2					1		1			1		1	21	4	2	1		
38-1, 22			2				1							3			1			5	2				3

Table 1 (continued).

Core, section, interval (cm)	*T. nitzschioides*	*T. nitzschioides* vars.	*T. schraderi*	*Thalassiosira antiqua*	*T. convexa*	*T. eccentrica*	*T. gravida*	*T. jacksonii*	*T. lacustris*	*T. lineata*	T. manifesta	*T. marujamica*	*T. nidulus*	*T. nordenskioldii*	*T. oestrupii*	*T. pacifica*	*T. plicata*	*T. singularis*	*T. temperi*	*T. trifulta*	*T. zabelinae*	*T.* sp. g	*Thalassiothrix frauenfeldii*	*T. longissima*	*Trachyneis aspera*
1-1, 13–15	38	9								2					9					3			12	2	
2-1, 44–46	42	2				7	1		1	1					2					13			7	2	2
2-5, 102–104	36					1				1					4					13			3	2	
3-3, 14–16	21														1					7			1	2	1
3-7, 14–16	7												1		1					5				1	
4-4, 102–104	31	8				2									4					2			1	4	2
5-2, 74–76	3																								
5-6, 81–83	1																								
6-4, 13–15	72	1		①		2									2					1			1	2	1
7-1, 102–104																									
7-5, 102–104	96	3				1				1					5	1				1			3	3	1
8-3, 74–76	3																							2	
9-1, 14–16	32	1		①		4									13					2				1	
9-5, 14–16		2																						1	
10-2, 109–111	25						1			1					2									3	2
10-6, 109–111	31	1				1														2			1		1
11-4, 43–45	65	5		①			3								3					1			2	1	
12-1, 109–111	47			①			1						1	1	4					1				8	
12-5, 109–111	39				2		3						1		1					2		1		6	
13-3, 39–41	41			1	1								1		1					3			1	4	
13-7, 39–41	97	3		1	1								1							8				4	
14-4, 107–109	91					1	1								2					1			1	3	
15-2, 39–41	16						4						2		1					3				1	
15-6, 39–41	88			1						1					3					6				4	
16-4, 39–40	17			1			1				1				2					2	5			2	
17-2, 13–14	14			2						1					4					3	2			10	
17-7, 39–40	3			5				1					1		1	1				1	8			16	
18-3, 39–40	9			3			4	2							1					4	1			10	
19-1, 39–40	9						1				1	30								1	1			4	
19-5, 39–40	3							3																7	
20-3, 38–39	13			2		1	1	2					1		4					8	2			8	
21-5, 39–40	2							2				25			1					1	2		1	2	
21-1, 39–40	17	10						6				14			3		1			1				4	
22-4, 38–39	16	1					1	8				8	2		1				1	1				7	
23-2, 40–41	5							11				4	2						3	2				11	
23-6, 40–41	8			1	1			12				3							1					14	
24-4, 39–40	15	1					1	1				7									1			5	
24-7, 39–40	10	1										2							1					9	
26-1, 38–39	32							1				3												3	
26-5, 38–39	7																							6	
27-1, 37–38	109			1														1	6					3	
27-5, 38–39	106			4																				3	
28-4, 38–39	2		1																					1	
30-2, 38–39	8		8																1					1	
30-6, 38–39	8	1	2																1					1	
31-4, 38–39	7		4																					2	
32-2, 36–37	18																							2	
32-5, 8	11																							11	
32-6, 37–38																								1	
37-2, 84	82																							19	
38-1, 22	63	3																						6	

Table 1 (continued).

Core, section, interval (cm)	*Triceratium condecorum*	*Trochosira spinosa*	Total number of valves	Diatom zone	Subseries
1-1, 13–15			200		
2-1, 44–46			200	*Neodenticula*	
2-5, 102–104			200	*seminae*	
3-3, 14–16			113		
3-7, 14–16			88		
4-4, 102–104			200		
5-2, 74–76			16	*Rhizosolenia*	Quaternary
5-6, 81–83			5	*curvirostris*	
6-4, 13–15			200		
7-1, 102–104			0		
7-5, 102–104			200		
8-3, 74–76			11	?	
9-1, 14–16			200		
9-5, 14–16			20		
10-2, 109–111			139		
10-6, 109–111			112	*Neodenticula*	
11-4, 43–45			200	*koizumii*	
12-1, 109–111			200		
12-5, 109–111			200		
13-3, 39–41			200	*Neodenticula*	
13-7, 39–41			200	*koizumii*	upper
14-4, 107–109			200		
15-2, 39–41			200		Pliocene
15-6, 39–41			200	———	
16-4, 39–40			200		
17-2, 13–14			145	*Neodenticula*	
17-7, 39–40			200	*kamtschatica*	
18-3, 39–40			200		
19-1, 39–40		2	200		
19-5, 39–40			200		
20-3, 38–39			200		
21-5, 39–40			200		lower
21-1, 39–40			200	*Thalassiosira*	
22-4, 38–39			200	*oestrupii*	Pilocene
23-2, 40–41			200		
23-6, 40–41			200		
24-4, 39–40		3	200		
24-7, 39–40			200	*Neodenticula*	
26-1, 38–39			200	*kamtschatica*	
26-5, 38–39	1	1	200		
27-1, 37–38		1	200	*Rouxia*	
27-5, 38–39			200	*californica*	upper
28-4, 38–39			200		
30-2, 38–39			133	*Thalassionema*	Miocene
30-6, 38–39	1		104	*schraderi*	
31-4, 38–39			200		
32-2, 36–37			138		
32-5, 8			200	*Denticulopsis*	
32-6, 37–38			87	*katayamae*	
37-2, 84			200	*Denticulopsis*	middle
38-1, 22			200	*praedimorpha*	Miocene

discussed first in the Japan Sea area. Figures 3, 4, 5, and 6 give the stratigraphic distribution of these 40 levels, which are defined by first and last occurrence of key species at each site, respectively. It is generally difficult to define the last occurrence of species because of upward reworking. In this study, therefore, the last occurrence is defined by the last horizon in a continuous occurrence of a species. Only late Pliocene and Quaternary datum levels were directly tied to the paleomagnetic stratigraphy at all three sites, except Site 796. The paleomagnetic stratigraphy interpreted as the Gilbert magnetic polarity chron at Hole 794A was abandoned because of the obscured normal/reverse polarity pattern in this part. The others, on the other hand, were correlated indirectly to the paleomagnetic reference time scale by second-order methods using sediment accumulation rate diagrams (Figs. 7 and 8).

The diatom datum levels are as follows:

1. The first occurrence of *Neodenticula seminae* is almost synchronous at Sites 797, 794, and 796 at about 2.6 Ma, except 2.1 Ma at Hole 795A.

2. The first occurrence of *Thalassiosira trifulta* was first dated at about 5.3 Ma near the Miocene/Pliocene boundary.

3. The last and first occurrences of *Rhizosolenia curvirostris* are remarkably synchronous at 0.3–0.4 Ma and about 1.5 Ma, respectively, with the middle to high latitudes of the North Pacific.

4. The last occurrence of *Thalassiosira nidulus* is almost synchronous at 0.3–0.4 Ma with the middle latitude North Pacific. However, its critical horizon could not defined at both Holes 794A and 796A because diatoms are few to very rare in abundance around this interval of these holes.

5. The first occurrence of *Thalassiosira nidulus* is diachronous from 5.1 Ma at Hole 797B to 6.0 Ma at Hole 794A. An older date may be reasonable because the other two holes show the age of about 5.6–5.8 Ma for it.

6. The last occurrence of *Actinocyclus oculatus* is almost synchronous at about 0.9–1.2 Ma with the middle latitude northwest Pacific, except 1.76 Ma at southern Hole 797B which has the cyclic occurrences of diatoms during the Quaternary.

7. The first occurrence of *Actinocyclus oculatus* is remarkably diachronous from 4.2 Ma at Hole 796A to 2.24 Ma at Hole 794A.

8. The last and first occurrences of *Neodenticula koizumii* are remarkably synchronous at 1.8–2.0 Ma and 3.5–3.7 Ma, respectively. The last occurrence of this species is firstly dated here and is very useful as a marker datum for the top of *Neodenticula koizumii* Zone in place of the warm-water *Pseudoeunotia doliolus* in the Japan Sea area. It falls also just below the Pliocene/Pleistocene boundary. The first occurrence of *Neodenticula koizumii* is also synchronous with middle latitude northwest Pacific.

9. The last occurrence of *Thalassiosira antiqua* was typically defined as the last horizon of continuous occurrences at all four sites. There are sporadic reworked occurrences of this species above the datum level because of stout valves of this species. The age of the datum level is estimated at about 2.1–2.7 Ma in the Japan Sea.

10. The first occurrence of *Thalassiosira antiqua* is diachronous from 6.3 to 7.0 Ma in southern Yamato Basin to about 5.7 Ma in northern Japan Basin.

11. The last occurrence of *Neodenticula kamtschatica* is almost synchronous at 2.5–2.9 Ma, with the middle latitude North Pacific.

12. The last occurrence of *Thalassiosira convexa* is nearly synchronous at about 2.3–2.6 Ma but the first occurrence is diachronous because of sporadic and few occurrences of this species in southern part of the Japan Sea.

13. The first and last occurrences of *Rossiella tatsunokuchiensis* are markedly diachronous through all four sites because the occur-

rences of this species are very rare and sporadic. However, this species is a marker for the Pliocene because the occurrences are limited to the Pliocene interval.

14. The last and first occurrences of *Thalassiosira zabelinae* are almost synchronous at about 3.0 Ma and 5.6 Ma, respectively. Reworked specimens of this species sporadically occurred above the horizon of continuous occurrence because of stout valves.

15. The last and first occurrences of *Thalassiosira jacksonii* are diachronous at 3.1–4.3 Ma and at 5.6–6.4 Ma, respectively, in the Japan Sea. The range of this species is the most longest and covers about 3.3 m.y. at southern Hole 797B. This species occurs exclusively in the Pliocene section.

16. The last occurrence of *Thalassiosira marujamica* is about 2.9–3.3 Ma at both Holes 794A and 797B of the Yamato Basin, but it is remarkably diachronous from 4.3 Ma at Hole 796A to 2.7 Ma at Hole 795A in the Japan Basin.

17. The first occurrence of *Thalassiosira marujamica* is nearly synchronous at about 6.4–7.0 Ma in the Yamato Basin.

18. The last and first occurrences of *Nitzschia rolandii* are remarkably synchronous at about 4.6 Ma and 7.7 Ma, respectively, at both Holes 794A and 797B of the Yamato Basin. These datum levels are first dated in the Japan Sea area.

19. The last and first occurrences of *Thalassiosira temperei* may be at about 4.4 Ma and 7.8 Ma, respectively, at Hole 797B. As these datum levels at Hole 794A are based on the continuous occurrence of this species, it is suspected that they may be expanded into upper or lower horizons.

20. The last occurrence of *Rouxia californica* is slightly diachronous from 6.0 Ma at Hole 797B to 5.1 Ma at Hole 794A. The last occurrence of this species is at 5.1 Ma, and rapid decrease is at 6.1 Ma in the middle latitude northwest Pacific (Koizumi and Tanimura, 1985).

21. *Nitzschia pliocena* occurs in Hole 794A only. The range of this species (last and first occurrences) is slightly shorter (7.2–6.3 m.y.) than one in the northern Pacific and California (7.6–6.1 m.y.) (J. A. Barron, pers. comm. 1990).

22. The last occurrence of *Synedra jouseana* is at about 6.0–6.6 Ma at both Holes 794A and 797B of the Yamato Basin.

23. The last occurrences of *Actinocyclus ingens* and *Mediaria splendida*, and *Goniothecium tenue* are first dated at 6.0 Ma and 6.6 Ma, respectively, only in Hole 797B.

24. The last occurrence of *Actinocyclus ingens* var. *nodus* is remarkably diachronous at 8.0 Ma of Hole 797B from 13.5 Ma at the circum-North Pacific (Baldauf and Barron, 1980).

Table 6 summarizes the stratigraphic and areal occurrences, and chronology of important diatom datum levels in a south-north transect from Hole 797B to Hole 795A in the Japan Sea.

SUMMARY

1. The diatom zonation of Koizumi (1985) was recognized through the sequences from upper Miocene to Quaternary above the opal-A/opal-CT boundary and is also useful to date carbonate concretions including diatoms below the boundary.

2. Forty diatom datum levels were evaluated biostratigraphically on the basis of their temporal and spatial distribution in the Japan Sea.

3. The diagenetic boundary between opal-A and opal-CT forms a distinctively diachronic plane from 8.5 Ma at Hole 797B of the Yamato Basin to 5.73 Ma at Hole 795A of the Japan Basin by the extrapolation based on diatom datum levels.

4. Diatoms occur cyclically by variable abundance and states of preservation affected with eustatic sea level changes during the Quaternary sequences at all four sites.

5. Subtropical warm-water diatoms are not included in the upper Miocene to Quaternary sequences.

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FLORAL REFERENCES

References are given for the taxa mentioned in this report. The taxa are arranged alphabetically, separately under the marine planktonic, marine tychopelagic, and benthic and fresh-water diatoms. The taxa that are treated by Hustedt (1927–1966) are referred directly to those works.

Marine Planktonic Diatoms

Actinocyclus curvatulus Janisch: Hustedt, 1929, p. 538, Fig. 307; Koizumi, 1973a, p. 831, Pl. 1, Figs. 1–6; Sancetta, 1982, p. 222, Pl. 1, Figs. 1–3.

A. ingens Rattray: 1890 b, p. 149, Pl. 11, Fig. 7; Koizumi, 1973a, p. 831, Pl. 1, Figs. 13, 14, Pl. 2, Figs. 1, 2.

A. ingens Rattray var. *nodus* Baldauf, in Baldauf and Barron, 1980, p. 104, Pl. 1, Figs. 5–9.

A. ochotensis Jouse, 1968, p. 17, Pl. 2, Figs. 2–5; Koizumi, 1973a, p. 831, Pl. 2, Figs. 8, 9.

A. oculatus Jouse, 1968. p. 18, Pl. 2, Figs. 6, 7; Koizumi, 1973, p. 831, Pl. 2, Figs. 8, 9.

Asterolampra marylandica Ehrenberg: Hustedt, 1929, p. 485, Figs. 270, 271; Koizumi, 1980, Pl. 2, Fig. 24.

Asteromphalus darwinii Ehrenberg: Greville, 1860, p. 116, Pl. 4, Figs. 12, 13; Koizumi, 1980, Pl. 2, Fig. 26.

A. flabellatus (Brebisson) Greville: Hustedt, 1929, p. 498, Fig. 279.

A. robustus Castracane: Hustedt, 1929, p. 496, Fig. 278; Koizumi, 1975b, Pl. 3, Fig. 5.

Azpeitia endoi (Kanaya) P. A. Sims and G. Fryxell, in Fryxell et al., 1986, p. 16. as *Coscinodiscus endoi* Kanaya, Koizumi and Tanimura, 1985, Pl. 4, Fig. 12.

A. nodulifer (Schmidt) G. Fryxell and P. A. Sims, in Fryxell et al., 1986, p. 19, Fig. 17.

A. tabularis (Grumow) G. Fryxell and P. A. Sims, in Fryxell et al., 1986, p.16, Figs. 14–15, 30–1.

Bacterosira fragilis (Gran) Gran: Koizumi, 1975a, Pl. 2, Figs. 5, 6; Sancetta, 1982, p. 227, Pl. 2, Figs. 1–4.

Biddulphia sinensis Greville: Hustedt, 1930, p. 837, Fig. 493; Hendey, 1964, p. 105, Pl. 20, Fig. 1.

Charcotia actinocyclus (Ehrenberg) Hustedt, 1958, p. 126, Figs. 57–80.

Cocsinodiscus elegans Greville: Kanaya, 1959, p. 75, Pl. 3, Figs. 6, 7.

C. marginatus Ehrenberg: Hustedt, 1928, p. 416. Fig. 223; Kizumi, 1975b, Pl. 2, Fig. 18.

C. obscurus A. Schmidt: Hustedt, 1928, p. 418, Fig. 224.

C. oculus iridis Ehrenberg: Hustedt, 1928, p. 454, Fig. 252.

C. radiatus Ehrenberg: Hustedt, 1927, p. 240, Fig. 225.

C. stellaris Roper: Hustedt, 1928, p. 395, Fig. 207.

C. subtilis Ehrenberg: Rattray, 1890a, p. 494, Pl.1, Fig. 16.

C. symbolophorus Grunow: Schrader, 1973, p. 703, Pl. 22, Figs. 8, 9 as Coscinodiscus stellaris Roper var. *symbolophorus* (Grunow) Jørgensen, Koizumi, 1973, p. 832, Pl. 4, Figs. 5, 6.

C. vetustissimus Panctocsek: Hustedt, 1928, p. 412, Fig. 220.

Cosmiodiscus insignis Jouse, 1961, p. 67, Pl. 2, Fig. 8; Koizumi, 1973a, p. 832, Pl. 4, Figs. 7–11.

Crucidenticula punctata (Schrader) Akiba and Yanagisawa, 1985, p. 487, Pl. 1, Figs. 10–12, Pl. 4, Figs. 1–9.

Denticulopsis dimorpha (Schrader) Simonsen, 1979, P.64; Koizumi and Tanimura, 1985, Pl. 1, Fig. 1; Akiba and Yanagisawa, 1985, P. 488, Pl. 15, Figs. 1–25, Pl. 16, Figs. 1–11.

D. husedtii (Kanaya and Simonsen) Simonsen, 1979, p. 64; Koizumi and Tanimura, 1985, Pl.1, Figs. 7, 8; Akiba and Yanagisawa, 1985, p. 488, Pl. 17, Figs. 4, 5, 7–23, Pl. 18, Figs. 1–10, Pl. 19, Figs. 1–5.

D. hyalina (Schrader) Simonsen, 1979, p. 64; Koizumi and Tanimura, 1985, Pl. 1, Fig. 3; Akiba and Yanagisawa, 1985, p. 488, Pl. 10, Figs. 1–16, Pl. 11, Figs. 1–10, Pl. 12, Figs. 1–5.

D. katayamae Maruyama, 1984, p. 58, Pl. 12, Figs. 1–6, Pl. 17, Figs. 1–32; Koizumi and Tanimura, 1985, p. 290, Pl. 1, Figs. 5, 6; Akiba and Yanagisawa, 1985, p. 489, Pl. 17, Figs. 1–3, 6, Pl. 19, Figs. 6–9, Pl.20, Figs. 1–7.

D. praedimorpha (Akiba) Barron, 1981, p. 529, Pl. 4, Figs. 8–10; Koizumi and Tanimura, 1985, Pl.1, Fig. 2; Akiba and Yanagisawa, 1985, p. 489, Pl. 13, Figs. 1–28, Pl. 14, Figs. 1–12.

Goniothecium tenue Brun, 1894, p. 77, Pl. 5, Figs. 5, 6; Koizumi, 1973a, p. 833, Pl. 7, Figs. 7–9.

Hemidiscus cuneiformis Wallich: Hustedt, 1930, p. 904, Fig. 542; Koizumi, 1975a, Pl. 4, Fig. 2.

Mediaria splendida Sheshuk., Sheshukova-Poretzkaya, 1962, p. 210, Figs. 2, 5; Koizumi, 1973, Pl. 7, Figs. 5, 6.

Neodenticula kamtschatica (Zabelina) Akiba and Yanagisawa, 1985, p. 490. Pl. 21, Figs. 7–21, Pl. 22, Figs. 1–12; as *Denticula kamtschatica* Zabelina emend. Koizumi, 1980. p. 396, Pl. 2, Figs. 1–10; as *Denticulopsis kamtschatica* (Zabelina) Simonsen, Koizumi and Tanimura, 1985, Pl. 6, Fig. 7.

N. koizumii Akiba and Yanagisawa, 1985, p. 491, Pl. 21, Figs. 22–28, Pl. 23, Figs. 1–12, Pl. 24, Fig. 19; as *Denticula seminae* Simonsen and Kanaya, Koizumi, 1973, p. 832, Pl. 5, Figs. 7–9, 10–13 (not Figs. 1–6).

N. seminae (Simonsen and Kanaya) Akiba and Yanagisawa, 1985, p. 491, Pl. 24, Figs. 1–11, Pl. 26, Figs. 1–10; as *Denticula seminae* Simonsen and Kanaya, Koizumi, 1973a, Pl. 5, Figs. 1–6.

Nitzschias braarudii Hasle, 1960, p. 22, Fig. 11, Pl. 7, Figs. 58–63.

N. cylindrica Burckle, 1972, p. 239, Pl. 2, Figs. 1–6.

N. extincta Koz. and Sheshuk., in Sheshukova-Poretzkaya, 1967, p. 303, Pl. 47, Fig. 12; Koizumi, 1972, p. 351, Pl. 42, Figs. 10a–11b.

N. fossilis (Frenguelli) Kanaya: Koizumi and Kanaya, 1976, p. 155, Pl. 1, Figs. 11–14; Koizumi and Yanagisawa, 1990, p. 357, Figs. 71–2, 9.

N. grunowii Hasle, 1972, p. 115; Sancetta, 1982, p. 233, Pl. 3, Figs. 8–10; Koizumi and Tanimura, 1985, Pl. 3, Figs. 5, 6.

N. marina Grunow: Kolbe, 1954, p. 40, Pl. 3, Figs. 38–40; Koizumi and Tanimura, 1985, Pl. 6, Figs. 1, 2.

N. plicoena (Brun) Kanaya, in Kanaya and Koizumi, 1970, p. 59; Koizumi, 1975b, p. 877, Pl.4, Figs. 28–32.

N. reinholdii Kanaya: Koizumi and Kanaya, 1976, p. 155, Pl.1, Figs. 15–18; Koizumi and Tanimura, 1985, Pl. 6, Figs. 3, 4.

N. rolandii Schrader emend. Koizumi, 1980, p. 396, Pl.2, Figs. 15–20.

N. sicula (Castracane) Hustedet, 1958, p. 180, Figs. 128–132.

Odontella aurita (Lyngbye) Agardh: Sancetta, 1982, p. 234, Pl.3, Figs. 11, 12.

Porosira glacialis (Grunow) Jørgensen: Hustedt, 1928, p. 315, Fig. 153; Koizumi, 1973, p. 833, Pl. 4, Figs. 15–18.

Pseudoeunotia doliolus (Wallich) Grunow: Hustedt, 1932, p. 259, Fig. 737; Koizumi and Kanaya, 1976, p. 155, Pl. 1, Figs. 9, 10; Koizumi and Yanagisawa, 1990, p. 357, Figs. 73–12, 8.

Pseudopodosira elegans Sheshukova-Poretzkaya, 1964, p. 75, Pl. 2, Figs. 4, 5; Koizumi, 1972, p. 352, Pl. 43, Figs. 3, 4.

Rhizosolenia alata Brightwell: Hustedt, 1937, p. 600, Fig. 345; Koizumi, 1975a, Pl. 1, Fig. 38.

R. barboi Brun: Schrader, 1973, p.709, Pl. 24, Figs. 4, 7; Koizumi, 1975b, Pl. 4, Figs. 52, 53.

R. bergonii Peragallo, Hustedt, 1929, p. 575, Fig. 327; Koizumi and Kanaya, 1976, p. 155, Pl.1, Figs. 20, 21.

R. curvirostris Jouse, 1968, p. 19, Pl.3, Fig. 2; Koizumi, 1973a, Pl. 5, Figs. 29–31.

R. calcar avis M.Schultze: Hustedt, 1929, p. 592, Fig. 339.

R. hebetata (Bailey.) Gran forma *hiemalis* Gran: Hustedt, 1929, p. 590, Fig. 337; Koizumi, 1973a, Pl. 5, Figs. 34, 35.

R. imbricata Brightwell: Hustedt, 1929, p. 580, Figs. 331, 332.

R. miocenia Schrader, 1973, p. 709, Pl. 10, Figs. 2–6; Koizumi and Matoba, 1989, Pl. 1, Fig. 9.

R. semispina Hensen: as *Rhizosolenia hebetata* (Bailey.) Gran forma *semispina* (Hensen) Gran, Hustedt, 1929, p. 592, Fig. 338.

R. setigera Brightwell: Hustedt, 1929, p. 588, Fig. 336.

R. styliformis Brightwell: Hustedt, 1929, p. 584, Fig. 333; Koizumi, 1975a, Pl. 1, Fig. 33.

Roperia tesselata (Roper) Grunow: Hustedt, 1929, p. 524, Fig. 297; Koizumi, 1975b, Pl. 2, Figs. 3, 4.

Rossiella tatsunokuchiensis (Koizumi) Gersonde and Schrader, 1984, p. 106; Akiba, 1985, p. 445, Pl. 19, Figs. 7–12; as *Bogorovia tatsunokuchiensis* (Koizumi) Jouse, Koizumi and Tanimura, 1985, Pl. 1, Fig. 19.

Rouxia californica Peragallo: Hanna, 1930, p. 186, Pl. 14, Figs. 6, 7; Koizumi, 1975a, p. 802, Pl. 1, Fig. 52.

Stephanogonia hanzawae Kanaya, 1959, p. 118, Pl. 11, Figs. 3–7.

Stephanopyxis turris (Greville and Arnott) Ralfs: Hustedt, 1928, p. 304, Fig. 140; Koizumi, 1973, p. 833, Pl. 6, Figs. 13–16.

Synedra jouseana Sheshukova-Poretzkaya, 1962, p. 208, Fig.4; Koizumi, 1973a, p. 833, Pl. 6, Fig. 17.

Thalassionema bacillaris (Heiden) Kolbe: Hasle and Mendiola, 1967, p. 109, Figs. 1–4, 19, 22–26; Simonsen, 1974, p. 37, Pl. 24, Fig. 1.

T. hirosakiensis (Kanaya) Schrader, 1973, p. 711, Pl. 23, Figs. 31–33; Akiba, 1982, p. 49, Figs. 1–5.

T. nitzschioides Grunow: Hustedt, 1932, p. 244, Fig. 725; Koizumi, 1975a, Pl. 1, Figs. 50, 51.

T. schraderi Akiba, 1982, p. 50, Figs. 6–11; Koizumi and Tanimura, 1985, Pl. 1, Fig. 14.

Thalassiosira antiqna (Grunow) Cleve-Euler, 1951, p. 72, Fig. 119a; Koizumi, 1973a, p. 834, Pl. 7, Fig. 12.

T. burckliana Schrader, 1974, p. 916, Pl. 1, Figs. 21–26.

T. convexa Mukhina, 1965, p. 22, Pl. 11, Figs. 1, 2; Koizumi, 1975a, Pl. 4, Figs. 15–20.

T. decipiens (Grunow) Jørgensen: Hustedt, 1928, p. 322, Fig. 158; Koizumi, 1973a, p. 834, Pl. 7, Figs. 16–18.
T. eccentrica (Ehrenberg) Cleve: Fryxell and Hasle, 1972, p. 297, Pl. 1–4, Figs. 1a–18; as *Coscinodiscus excentricus* Ehrenberg, Koizumi, 1973a, Pl. 2, Figs. 11, 12.
T. gravida Cleve: Hustedt, 1928, p. 325, Fig. 161; Koizumi, 1973a, p. 834, Pl. 7, Figs. 19–21.
T. hyalina (Grunow) Gran: Hustedt, 1928, p. 323, Fig.159; Koizumi, 1973a, p. 834, Pl. 8, Figs. 1, 2.
T. jacksoniid Koizumi and Barron, in Koizumi, 1980, p. 396, Pl. 1, Figs. 11–14.
T. lacustris (Grunow) Hasle: Sancetta, 1982, p. 241, Pl. 5, Figs. 6, 7.
T. leptopus (Grunow) Hasle and Fryxell, 1977, p. 20, Figs. 1–14; as *Coscinodiscus lineatus* Ehrenberg, Koizumi, 1975b, Pl. 2, Figs. 5, 6.
T. lineata Jouse, 1968, p. 13, Pl. 1, Figs. 1, 2; Hasle and Fryxell, 1977, p. 22, Figs. 15–25.
T. manifesta Sheshukova-Poretzkaya, 1964, p. 72, Pl. 1, Figs. 6, 7; Akiba, 1985, p. 446, Pl. 9, Figs. 1–3.
T. marujamica Sheshukova-Poretzkaya, 1959, p. 41, Pl. 1, Fig. 7; Akiba, 1985, p. 446, Pl. 13, Figs. 1–7.
T. nidulus (Tempere and Brun) Jouse, 1961, p. 63, Pl. 3, Figs. 4, 5; Koizumi, 1973a, Pl. 7, Figs. 25, 26.
T. nordens kioldii Cleve: Hustedt, 1928, p. 321, Fig. 157; Koizumi, 1973, p. 834, Pl. 8, Fig. 4.
T. oestrupii (Ostenfeld) Proshkina-Lavrenko: Hasle, 1960, p. 8, Pl. 1, Figs. 5–7; Koizumi, 1973a, p. 834, Pl. 7, Fig. 27.
T. plicata Schrader, 1974, p. 917, Pl. 3, Figs. 1, 2, 4–9; Koizumi, 1980, p. 398, Pl. 3, Figs. 22–25.
T. singularis Sheshukova-Poretzkaya, 1967, p. 145, Pl. 14, Fig. 8; Akiba, 1985, p. 446, Pl. 12, Figs. 6–8.
T. temperei (Burn) Akiba and Yanagisawa, 1985, p. 492, Pl. 31, Figs. 1–7; as *Coscinodiscus temperi* Brun, Koizumi, 1973b, p. 134, Pl. 20, Fig. 9.
T. trifulta Fryxell, in Fryxell and Hasle, 1979, p. 16, Figs. 1–24; Koizumi and Tanimura, 1990, Pl. 3, Fig. 7.
T. yabei (Kanaya) Akiba and Yanagisawa, 1985, p. 493, Pl. 27, Figs. 1, 2; Pl. 28, Figs. 1–9; as *Coscinodiscus yabei* Kanaya, Koizumi and Tanimura, 1985, Pl. 3, Figs. 10, 11.
T. zabelinae Jouse, 1961, p. 66, Pl. 2, Figs. 1–7; Koizumi, 1973a, p. 834, Pl. 8, Figs. 10–12.
T. sp.1 Barron, 1980, p. 673, Pl. 5, Figs. 6, 7; Koizumi and Tanimura, 1990, Pl. 4, Figs. 1–3.
Thalassiothrix frauenfeldi Grunow: Hustedt, 1927, p. 247, Fig. 727.
T. longissima (Cleve) Cleve and Grunow: Hustedt, 1927, p. 247, Fig. 726.
Triceratium condecorum Brighwell: Hanna, 1932, p. 221, Pl. 17, Figs. 1, 3; Schrader, 1973, Pl. 12, Fig. 9.
Trochosira spinosa Kitton: Sheshukova-Poretzkaya, 1967, p. 137, Pl. 11, Fig. 6, Pl. 13, Fig. 4.

Marine Tychopelagic and Benthic Diatoms

Actinocyclus octonarius Ehrenberg: Andrews, 1980a, p. 23, Pl. 1, Fig. 1, Pl. 4, Fig. 1.
Actinoptychus senarius (Ehrenberg) Ehrenberg: Sancetta, 1982, p. 225, Pl. 1, Fig. 7.
A. spendens (Shadbolt) Ralfs: Hustedt, 1929, p. 478, Fig. 265.
Amphora ovalis (Kutzing) Kutzing: Hustedt, 1930, p. 342, Fig. 628.
Campyloneis grevillei (Wm. Smith) Grunow: Hustedt, 1933, p. 321, Fig. 781; Hendey, 1964, p. 184, Pl. 27, Figs. 9–11.
Cocconeis antiqna Tempere and Brun: Kanaya, 1959, p. 107, Pl. 10, Figs. 1, 2; Sheshukova-Poretzkaya, 1967, p. 269, Pl. 45, Fig. 1.
C. californica Grunow: Hustedt, 1933, p. 343, Fig. 796.
C. costata Gregory: Hustedt, 1933, p. 332, Fig. 785.
C. decipiens Cleve: Hustedt,1933, p. 353, Fig. 808.
C. pellucida Grunow: Hustedt, 1933, p. 357, Fig. 812.
C. placentula Ehrenberg var. *euglypta* (Ehrenberg) Cleve: Hustedt, 1933, p. 349, Fig. 802c.
C. pseudomarginata Gregory: Hustedt, 1933, p. 359, Fig. 813.
C. scutellum Ehrenberg: Hustedt, 1933, p. 337, Fig. 790.
C. vitrea Brun: Kanaya, 1959, p. 110, Pl. 10, Fig. 6; Sheshukova-Poretzkaya, 1967, p. 271, Pl. 45, Fig. 3a–6.
Cyclotella striata (Kutzing) Grunow: Hustedt, 1927, p. 344, Fig. 176.
C. styroleum Brightwell: Hustedt, 1927, p. 348, Fig. 179.
Cymatosira debyi Temp. and Brun, in Brun and Tempere, 1889: p. 36, Pl. 7, Fig. 18a, b; Sheshukova-Poretzkaya, 1967, p. 237, Pl. 40, Fig. 7, Pl. 41, Fig. 6.
Cymatotheca weissflogii (Grunow) Hendey, 1958, Pl. 1, Figs. 1–28; as *Hemidiscus weissflogii* (Grunow) Hustedt, 1955, p. 11, Pl. 1, Figs. 6–7.
Delphineis angustata (Pantocsek) Andrews, 1977, p. 250, Pl. 1, Figs. 1–4, Pl. 2, Figs. 21–22, Pl. 3, Figs. 29–30.
D. ischaboensis (Grunow) n. comb. Synonym: *Rhaphoneis ischboensis* (Grunow) Mertz, 1966, p. 26, Pl. 5, Figs. 49–51.
D. kippae Sancetta, 1982, p. 230, Pl. 2, Figs. 14–16.
D. margalitalimbata (Mertz) n. comb. Synonym: *Rhaphoneis margaritalimbata* Mertz, 1966, p. 27, Pl. 6, Figs. 1–3.
D. simonsenii (Mertz) Akiba, 1985, p. 439, Pl. 20, Figs. 12–13.
D. surirella (Ehrenberg) Andrews, 1981, p. 83, Pl. 1, 2, Figs. 1–7.
Diploneis bombus Ehrenberg: Hustedt, 1937, p. 704, Fig. 1086.
D. coffeiformis (Schmidt) Cleve: Hustedt, 1937, p. 611, Fig. 1025.
D. constricta (Grun) Cleve: Hustedt, 1937, p. 594, Fig. 1012a.
D. elliptica (Kützing) Cleve: Hustedt, 1937, p. 690, Fig. 1077.
D. fusca (Gregory) Cleve: Hustedt, 1937, p. 654, Fig. 1053.
D. interrupta (Kützing) Cleve: Hustedt, 1937, p. 602, Fig. 1019.
D. nitescens (Gregory) Cleve: Hustedt, 1937, p. 640, Fig. 1047.
D. oculata (Brebisson) Cleve: Hustedt, 1937, p. 675, Fig. 1068a.
D. ovalis (Hilse) Cleve: Hustedt, 1933, p. 671, Fig. 1065.
D. smithii (Brebisson) Cleve: Hustedt, 1937, p. 647, Fig. 1051.
D. suborbicularis (Gregory) Cleve: Hustedt, 1937, p. 612, Fig. 1026.
D. weissflogii (Schmidt) Cleve: Hustedt, 1937, p. 703, Fig. 1085.
Heimiaulus polymorphus Grunow: Hustedt, 1930, p. 880, Fig. 525.
Lithodesmium urduatum Ehrenberg: Hustedt, 1930, p. 789, Fig. 461.
Mastogloia capitata (Brun) Cleve: Hustedt, 1933, p. 571, Fig. 1006.
Melosira albicans Sheshukova-Poretzkaya, 1964, p. 69, Figs. 1, 2, Pl. 2, Fig. 3; Koizumi, 1972, p. 351, Figs. 1, 2.
M. polaris Grunow: Hustedt, 1928, p. 273, Fig. 116.
M. westii W. Smith: Hustedt, 1932, p. 268, Fig. 113.
Navicula directa (W. Smith) Ralfs: Cleve-Euler, 1953, p. 129, Figs. 751a–h; Hendey, 1964, p. 202.
N. lyra Ehrenberg: Hustedt, 1964, p. 500, Figs. 1548–1555.
N. pygmaea Kützing: Hustedt, 1930, p. 312, Fig. 561; Hustedt, 1964, p. 538, Fig. 1574.
Nitzschia granulata Grun: Lohman, 1938, Pl. 22, Fig. 10.
N. punctata (Wm. Smith) Grunow: Hustedt, 1930, p. 401, Fig. 762; Hendey, 1964, p. 278, Pl. 39, Fig. 11.
Paralia clavigera (Grunow) n. comb. Synonym; *Melosira clavigera* Grunow: Hanna, 1970, p. 190, Figs. 52, 54.
Paralia sulcata (Ehrenberg) Cleve: Hendey, 1964, p. 73, Pl. 23, Fig. 5; Sancetta, 1982, p. 235, Pl. 3, Figs. 13–15.
Plagiogrammma staurophorum (Gregory) Heib.: Hustedt, 1931, p. 110, Figs. 635; Hendey, 1964, p. 166, Pl. 36, Fig. 1.
Rhabdonema japonicum Tempere and Brun: Hanna, 1970, p. 192, Figs. 47, 92, 93, 95; Schrader, 1973, Pl. 12, Fig. 10.
Rhaphoneis amphiceros Ehrenberg: Hustedt, 1931, p. 174, Fig. 680.
R. elegans (Pantocsek) Hanna, 1932, p. 213, Pl. 15, Figs. 5–7.
R. miocenica Schrader, 1973, p. 709, Pl. 25, Figs. 1, 11.
Trachyneis aspera (Ehrenberg) Cleve: Hendey, 1964, p. 236, Pl. 29, Fig. 13.

Fresh-water Diatoms

Achnanthes brevipes Agardh: Hustedt, 1933, p. 424, Fig. 876; Hendey, 1964, p. 174, Pl. 28, Figs. 7, 8.
A. dispar Cleve: Hustedt, 1933, p. 394, Fig. 842a–b.
A. groenlandica (Cleve) Grunow: Hustedt, 1933, p. 421, Fig. 874.
A. lanceolata (Brebisson) Grunow: Hustedt, 1933, p. 408, Fig. 863.
Amphora ovalis Kützing: Hustedt, 1930, p. 342, Fig. 628.
Aulacosira granulata (Ehrenberg) Simonsen, 1979, p. 58; as *Melosira granulata* (Ehrenberg) Ralfs, Hustedt, 1927, p. 248, Fig. 104.
Bacillaria paradoxa Gmelin: Hustedt, 1930, p. 396, Fig. 755.
Caloneis bacillum (Grun.) Meresch Kowsky: Hustedt, 1930, p. 236, Fig. 360; Patrick and Reimer, 1966, p. 586, Pl. 54, Fig. 8.
Cocconeis disculus Schumann: Hustedt, 1933, p. 345, Fig. 799.
C. fluminensis (Grunow) Peragallo: Hustedt, 1933, p. 341, Fig. 794.
Cyclotella antiqua Wm. Smith: Hustedt, 1928, p. 349, Fig. 180.
C. chaetoceras Lemmermann: Hustedt, 1928, p. 344, Fig. 175.
C. comta (Ehrenberg) Kützing: Hustedt, 1928, p. 354, Fig. 183.
C. kutzingiana Thwaites: Hustedt, 1928, p. 338, Fig. 171.

Cymbella sinuata Gregory: Hustedt, 1930, p. 361, Fig. 668.
C. tumida (Brebisson) Van Heurck: Hustedt, 1930, p. 366, Fig. 677.
Epithemia argus Kützing: Hustedt, 1930, p. 383, Fig. 727.
E. turgida (Ehrenberg) Kützing: Hustedt, 1930, p. 387, Fig. 733.
Fragilaria construens (Ehrenberg) Grunow: Hustedt, 1931, p. 156, Fig. 670a–c.
F. leptostauron (Ehrenberg) Hustedt: 1931, p. 153, Fig. 668.
F. pinnata Ehrenberg: Hustedt, 1931, p. 160, Fig. 671a–i.
Gomphonema abbreviatum Agardn: Hustedt, 1930, p. 379, Fig. 722.
G. angustatum (Kützing) Raph.: Hustedt, 1930, p. 737, Fig. 690.
G. lanceolatum Ehrenberg: Hustedt, 1930, p. 376, Fig. 700.
G. longiceps Ehrenberg: Hustedt, 1930, p. 375, Fig. 704.
G. olivaceum (Lyngbye) Kützing: Hustedt, 1930, p. 378, Fig. 719.
G. tergestinum (Grunow) Fricke: Hustedt, 1930, p. 377, Fig. 717.
Navicula mutica Kützing: Hustedt, 1966, p. 583, Fig. 1592a–f; Patrick and Reimer, 1966, p. 454, Pl. 42, Fig. 2.
N. pygmaea Kützing: Hustedt, 1964, p. 538, Fig. 1574; Patrick and Reimer, 1966, p. 442, Pl. 39, Fig.4.
Opephora martyi Heribaud: Hustedt, 1930, p. 132, Fig. 120; Patrick and Reimer, 1966, p. 115, Pl. 3, Fig. 3.
Pinnularia alphina Wm. Smith: Hustedt, 1930, p. 324, Fig. 594; Patrick and Reimer, 1966, p. 618, Pl. 58, Figs. 11, 12.
P. appendiculata (Agardh): Hustedt, 1930, p. 317, Fig. 570.
P. borealis Ehrenberg: Hustedt, 1930, p. 326, Fig. 697; Patrick and Reimer, 1966, p. 618, Pl. 58, Fig. 13.
P. molaris Grunow: Hustedt, 1930, p. 316, Fig. 568.
Rhopalodia gibberula (Ehrenberg) O.Moller: Hustedt, 1930, p. 391, Fig. 742.
Stephanodiscus astea (Ehrenberg) Grunow: Hustedt, 1930, p. 110, Fig. 85.
S. niagarae Ehrenberg: Hakansson, 1981, p. 121, Figs. 6–7, 13–22, 57–62.
Synedra ulna (Nitzsch) Ehrenberg: Hustedt, 1930, p. 151, Figs. 158–159.
Tetracyclus laustris Ralfs: Hustedt, 1930, p. 121, Fig. 95; Patrick and Reimer, 1966, p. 102, Pl. 1, fig. 9.

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Table 2. Stratigraphic occurrences of Neogene diatoms in Hole 794A. Circle indicates reworked specimens.

Core, section, interval (cm)	Depth below seafloor (m)	Abundance (10^7 per g)	*Chaetoceros* spp.	*Achnanthes brevipes*	*A. diapar*	*A. lanceolata*	*Actinocyclus curvatulus*	*A. ingens*	*A. ochotensis*	*A. octonarius*	*A. oculatus*	*Actinoptychus senarius*	*Asterolampra marylandica*	*Asteromphalus robustus*	*Aulacosira granulata*	*Azpeitia endoi*	*A. nodulifer*	*A. tabularis*	*Bacillaria paradoxa*	*Bacterosira fragilis*	*Biddulphia sinensis*	*Calloneis bacillum*	*Cocconeis californica*	*C. costata*
1-1, 43–44	0.43	1.7	55			1	3		1			4			2		1	7	1	1	1			
1-2, 43–44	1.93																							
1-3, 109–110	4.09														1									
2-1, 44–45	7.24																							
2-3, 44–45	0.24	0.2	41																					
2-5, 44–45	13.24		15				1				①				4									
3-1, 43–44	16.73		1												2									
3-3, 123–124	20.53	15.4	197				8													1			1	
3-5, 124–125	23.53																							
4-1, 44–45	26.54	0.3	112				1					2		1	1							1		
4-3, 45–46	29.25	0.1	113									1								2				1
4-5, 46–47	35.25	0.3	40							2														
4-7, 45–46	38.78		2												1									
5-3, 48–49	38.78		1				1																	
5-5, 45–46	41.75	15.4	115				65		6		5			3	1									
5-7, 42–43	44.72						1																	
6-3, 44–45	48.24											1												
6-5, 44–45	51.24																							
7-1, 44–45	54.74																							
7-3, 44–45	57.24																							
7-5, 44–45	60.74	0.3	179				2		2			1			2								1	3
7-7, 44–45	63.74	0.6	136				2		8	1	34									1				2
8-3, 44–45	67.24	0.9	331		1	1	3			1	1	2			1		1						1	2
8-5, 44–45	70.24	1.1	197				4								2									
9-1, 43–44	73.73	0.5	144				3		1	2		2												1
9-3, 43–44	76.73	0.3	219				4		1											1				1
9-5, 43–44	79.73	0.6	89				3					1			2									
9-7, 43–44	86.73	3.9	46				1							2										
10-3, 44–45	86.24	2.2	103				2																	1
10-5, 44–45	89.24	1.9	99																					3
11-1, 44–45	92.74	1.3	31									2			1									
11-3, 44–45	95.74	5.1	59									4												1
12-1, 43–44	102.23	3.9	62									5			1									1
12-5, 43–44	108.23	1.3	45									3												
13-1, 43–44	111.73	0.8	78									5			3									2
13-7, 43–44	120.73	0.5	112							4		9			3								1	1
14-5, 44–45	127.24	0.6	97	3			1		2			3			1									1
15-3, 43–44	133.73	7.7	20									6												
15-7, 43–44	139.73	3.9	20							2		4												
16-5, 44–45	146.24	3.9	78							1		6												2
17-3, 44–45	152.94	5.1	33							1		2		1										
17-7, 44–45	158.94	3.9	12									1												
19-1, 43–44	168.93	5.1	28			1	1					1												1
19-5, 43–44	174.93	3.4	33									8												1
20-1, 43–44	178.63	4.3	30									2												1
20-5, 43–44	184.63	1.3	36									1												
21-3, 44–45	191.34	3.4	43									41												
22-1, 44–45	197.94	1.0	34				1					1											1	
22-5, 44–45	203.94	3.2	18									1												
23-3, 44–45	210.64	3.4	12							1		10		3										2
23, cc	216.90	3.4	23									4											1	2
25-1, 44–45	226.94	7.7	13									3												
25-5, 44–45	232.94	3.9	15									75												
26-3, 44–45	239.64	3.9	20									10												
27-1, 43–44	246.43	1.3	28									4												1
27-5, 43–44	252.43	1.7	21									18	1	1										1
28-2, 44–45	257.64	5.1	18									5												
29-1, 44–45	265.84	1.0	21					①				8												1
29-5, 44–45	271.84	1.9	18									3												
30-3, 44–45	278.54	1.3	38									7												
31-1, 44–45	285.04	0.9	29					③				53												1
31-5, 44–45	291.04	0.6	15									114				①								
32-1, 44–45	293.94	1.3	6									167			1									

Table 2 (continued).

Core, section, interval (cm)	C. disculus	C. fluminensis	C. placentula var. euglypta	C. pseudomarginatus	C. scutellum	Cosinodiscus elegans	C. marginatus	C. obscurus	C. oculus iridis	C. radiatus	C. stellaris	C. symbolophorus	Cosmiodiscus insignis	Cyclotella antiqua	C. chaetoceros	C. kützingiana	C. striata	C. styrolerum	Cymatosira debyi	Cymatotheca weissflogii	Cymbella sinensis	C. tumida	Delphineis surirella	Denticulopsis dimorpha	D. hustedtii
1-1, 43–44							11			2						1	1						2		
1-2, 43–44																									
1-3, 109–110																	1								
2-1, 44–45				1																					
2-3, 44–45							7									1	1								②
2-5, 44–45							2															1			②
3-1, 43–44																									
3-3, 123–124																									
3-5, 124–125						1																			
4-1, 44–45					1		3									1							1		①
4-3, 45–46			1		2		3								1		1	1					1		①
4-5, 46–47																							3		
4-7, 45–46																									
5-3, 48–49																									
5-5, 45–46							2																	①	
5-7, 42–43							1																		
6-3, 44–45																									
6-5, 44–45							1																		
7-1, 44–45																									
7-3, 44–45																									
7-5, 44–45						1	1										3	1					1		①
7-7, 44–45							1						1												
8-3, 44–45	1	1					3				1														
8-5, 44–45							7				1			1		1							1		
9-1, 43–44							17										1								
9-3, 43–44							11																1		①
9-5, 43–44	1		1	1	1		66																1		
9-7, 43–44							24										1								
10-3, 44–45							47						1				1			1			4		
10-5, 44–45							34				1						1								
11-1, 44–45							120				1														
11-3, 44–45							61										1								
12-1, 43–44							24						1				1			1			2		
12-5, 43–44							123																1		
13-1, 43–44							92										2								①
13-7, 43–44					1		35				1						6						7		
14-5, 44–45			1		6		16										17				3		5		①
15-3, 43–44							20																		
15-7, 43–44							74																		
16-5, 44–45							65																1		
17-3, 44–45							25						1						1				2		
17-7, 44–45							14						1												
19-1, 43–44							10		1														4		
19-5, 43–44	1						15																1		①
20-1, 43–44							130												1				1		
20-5, 43–44							126				1	1												①	①
21-3, 44–45							64	2																	①
22-1, 44–45					1		113																		①
22-5, 44–45					1		130				1		1												
23-3, 44–45							34	1			1		3												
23, cc					1		85				2														
25-1, 44–45							31		3		1														
25-5, 44–45							27																		
26-3, 44–45							141																		
27-1, 43–44							118																		
27-5, 43–44							107																		
28-2, 44–45							67																		
29-1, 44–45							56					1												①	①
29-5, 44–45							68																		
30-3, 44–45							65	1				1													
31-1, 44–45					1		65																		
31-5, 44–45						1	36																	②	
32-1, 44–45							9																		①

Table 2 (continued).

Core, section, interval (cm)	*D. hyalina*	*D. katayamae*	*D. praedimorpha*	*Diploneis bombus*	*D. coffeiformis*	*D. elliptica*	*D. interrupta*	*D. oculata*	*D. smithii*	*D. weissflogii*	*Epithemia turgida*	*Eunotia* spp.	*Fragilaria construens*	*F. leptostauron*	*Gomphonema abbreviatum*	*G. longiceps*	*G. olivacium*	*G. tergrstinum*	*Goniothecium tenue*	*Grammatophora* spp.	*Hemiaulus polymorphus*	*Hemidiscus cuneiformis*	*Lithodesmium undulatum*	*Mastogloia capitata*	*Melosira albicans*
1-1, 43–44				2				7	1	1															
1-2, 43–44																									
1-3, 109–110																									
2-1, 44–45																									
2-3, 44–45						1		1										1		1					
2-5, 44–45																									
3-1, 43–44														1											
3-3, 123–124																									
3-5, 124–125																									
4-1, 44–45	①			1					2				1	1		1				1					
4-3, 45–46				8		1							1							1					
4-5, 46–47				9													1								
4-7, 45–46																									
5-3, 48–49						1						1													
5-5, 45–46																									
5-7, 42–43																						1			
6-3, 44–45																									
6-5, 44–45																									
7-1, 44–45																									
7-3, 44–45																									
7-5, 44–45	①	②		8																1					
7-7, 44–45				3				1	1																2
8-3, 44–45				2		1														2					
8-5, 44–45				1				1												1					2
9-1, 43–44				2	1														①						
9-3, 43–44									1											1					11
9-5, 43–44					1																				2
9-7, 43–44				1																					3
10-3, 44–45				1																					13
10-5, 44–45				1																					7
11-1, 44–45				1																		7			5
11-3, 44–45																									11
12-1, 43–44																						2			7
12-5, 43–44																									1
13-1, 43–44																									6
13-7, 43–44					2				2											1		1	2		
14-5, 44–45	①				1			1	1		1	1	1		1					2				1	
15-3, 43–44																									
15-7, 43–44									2																
16-5, 44–45												1													
17-3, 44–45																									
17-7, 44–45																									
19-1, 43–44					1																				
19-5, 43–44																				1					
20-1, 43–44	①																			1					
20-5, 43–44																				1					
21-3, 44–45									1										①						
22-1, 44–45							1																		
22-5, 44–45																			①						
23-3, 44–45																									
23, cc																									
25-1, 44–45																									
25-5, 44–45			①																						
26-3, 44–45							1												①						
27-1, 43–44																									
27-5, 43–44																					2				
28-2, 44–45																				1					
29-1, 44–45																				1					
29-5, 44–45																									
30-3, 44–45																			①	2					
31-1, 44–45		①																		1					
31-5, 44–45																				2					
32-1, 44–45																				1					

Table 2 (continued).

Core, section, interval (cm)	*Navicula lyra*	*N. mutica*	*N. pygmaea*	*N.* spp.	*Neodenticula kamtschatica*	*N. koizumii*	*N. seminae*	*Nitzschia braarudii*	*N. fossilis*	*N. granulata*	*N. pliocena*	*N. reinholdii*	*N. rolandii*	*N. sicula*	*N.* spp.	*Odontella aurita*	*Opephora martyi*	*Paralia sulcata*	*Pinnularia appendiculata*	*Plagiogramma staurophorum*	*Porosira glacialis*	*Pseudoeunotia doliolus*	*Pseudopodosira elegans*	*Rhaphoneis amphiceros*	*R. miocenica*
1-1, 43–44					①	①	29	3	2					2				7				3			
1-2, 43–44																									
1-3, 109–110																									
2-1, 44–45																									
2-3, 44–45					②	①												12	1			1			
2-5, 44–45					②													2							
3-1, 43–44					①																				
3-3, 123–124							108																		
3-5, 124–125																									
4-1, 44–45	1				①		11			1						1		6					1		
4-3, 45–46					⑧	④	3									1		5			1				
4-5, 46–47						①	2											6							
4-7, 45–46																									
5-3, 48–49																									
5-5, 45–46							68																		
5-7, 42–43					①	①																			
6-3, 44–45																									
6-5, 44–45																		6							
7-1, 44–45																									
7-3, 44–45																									
7-5, 44–45					③		9									1		84							
7-7, 44–45						56	29											12			2				
8-3, 44–45					③	56	18											14			1				
8-5, 44–45			1		②	10	14											16		1					
9-1, 43–44						32	2											6							
9-3, 43–44		1			3	50										1		12					5	1	
9-5, 43–44					3	39										1		7							
9-7, 43–44					60	58												5					2		
10-3, 44–45					41	10										3		7							
10-5, 44–45					40	18									7	3		7					2		
11-1, 44–45					17	2				1															
11-3, 44–45					42	3									4			3						1	
12-1, 43–44					49	1									2			9					1		
12-5, 43–44					33	1										1		5					1		
13-1, 43–44					30													7							
13-7, 43–44					20									5				24							
14-5, 44–45		1			31											1	1	5					1	2	
15-3, 43–44				1	118													2							
15-7, 43–44				1	71										1			1							
16-5, 44–45					40									1	1			1					6		
17-3, 44–45					110																		2		
17-7, 44–45					134																				
19-1, 43–44				1	101									1				2							
19-5, 43–44					57								4		1								2		
20-1, 43–44	1				24																				
20-5, 43–44					15								1		4			4							
21-3, 44–45													2					2					1		
22-1, 44–45					10								3					3							
22-5, 44–45					3								2					1							
23-3, 44–45					5								10			1							1		
23, cc					6								6			2									
25-1, 44–45					3								1					1							
25-5, 44–45					1						4	1	2		2	4		1					1		
26-3, 44–45					1						1		3		3										
27-1, 43–44															1			1							1
27-5, 43–44													1		1			1							
28-2, 44–45											2		1												
29-1, 44–45													1					3							
29-5, 44–45													1			1									
30-3, 44–45																		4							
31-1, 44–45																		1							
31-5, 44–45																	4								
32-1, 44–45																		2							

Table 2 (continued).

Core, section, interval (cm)	*Rhizosolenia alata*	*R. barboi*	*R. bergonii*	*R. curvirostris*	*R. hebetata*	*R. setigera*	*R. styliformis*	*Rhopalodida gibberula*	*Roreria tesselata*	*Rossiella tatsunokuchiensis*	*Rouxia californica*	*Stephanophxis turris*	*S.* spp.	*Synedra jouseana*	*S. ulna*	*Tetracyclus lacustris*	*Thalassionema bacillaris*	*T. hirosakiensis*	*T. nitzschioides*	*T. schraderi*	*Thalassiosira antiqua*	*T. convexa*	*T. decipiens*	*T. eccentrica*	*T. gravida*
1-1, 43–44					5							4					8		32					3	
1-2, 43–44																									
1-3, 109–110													1												
2-1, 44–45																				1					
2-3, 44–45		1					1					10	6						8		①				
2-5, 44–45		2		2			1				①	4	3						8						
3-1, 43–44												1	1						2						
3-3, 123–124												13							3					4	
3-5, 124–125																			1						
4-1, 44–45			1	2	1				1			23			1				20					1	1
4-3, 45–46				9	1		3					13			1				19						2
4-5, 46–47				4	3	2						151							11						
4-7, 45–46											①	1							4						
5-3, 48–49													2						3						
5-5, 45–46				2								4							21					3	
5-7, 42–43													1							5					
6-3, 44–45												1							1						
6-5, 44–45						1						1	1						3						
7-1, 44–45																									
7-3, 44–45																									
7-5, 44–45												39							24				1		4
7-7, 44–45							5					19							12						2
8-3, 44–45		2			1		2					52	1						67		3			3	
8-5, 44–45		11										34	6						63		1	3			1
9-1, 43–44		9					1					79							23		1	3			4
9-3, 43–44		8					2					24	1						44		1				3
9-5, 43–44	1	7					3					26				1			25		1				
9-7, 43–44		6					2					6							15		1			1	1
10-3, 44–45		2					1					28							21		2	1			1
10-5, 44–45		2					2					37							20						
11-1, 44–45		11					1					16							13		2				
11-3, 44–45		3			1							30	1						19						1
12-1, 43–44												28							46		2				
12-5, 43–44		1					2					9							8					1	
13-1, 43–44						2	7			1		13							19		2				
13-7, 43–44					2		1			1		22							27		2	2		1	
14-5, 44–45							2	2		1		20							23		10	3		1	
15-3, 43–44		3			2		21			1		1		1					8		2				1
15-7, 43–44		7					12					1							8						
16-5, 44–45		26			3		13					3							9						
17-3, 44–45		4			1		10					12	4						8						1
17-7, 44–45		3			1		4					1							6						
19-1, 43–44	1	3					11					5					1		33					1	
19-5, 43–44	1	3					60					6							12		1				
20-1, 43–44					1		14					3							8		1				
20-5, 43–44							12						9	1						10					
21-3, 44–45		30			5		2				5	1	2	⑥					10						
22-1, 44–45		5			2		4				1	8	1						25						
22-5, 44–45					8		3					3							36						
23-3, 44–45		1					1				2	3	1						102		1				
23, cc		8			1						1	12	9						44		1				
25-1, 44–45		5					1				2	2	2	1					137		1				
25-5, 44–45		15			3		1				3	1		1					37						
26-3, 44–45					12		1				3	1		7					9						
27-1, 43–44		32			2		6				2	2		14					10	①					
27-5, 43–44		29			3		6				6	2		1					15						
28-2, 44–45		34			1		3				13			1				27	31	10					
29-1, 44–45		56			7						3			1				4	30	22					
29-5, 44–45		37									3			2					11	73					
30-3, 44–45		65			1		1				6			2				8	21	9					
31-1, 44–45		30			2		4				5	2		3				6	8	10					
31-5, 44–45		8			1		2				1	4		2				3	14	3					
32-1, 44–45		10									1	2		1					1						

Table 2 (continued).

Core, section, interval (cm)	*T. hyalina*	*T. jacksonii*	*T. leptopus*	*T. lineata*	*T. manifesta*	*T. marjamica*	*T. nidulus*	*T. nordenskioldii*	*T. oestrupii*	*T. pacifica*	*T. plicata*	*T. temperi*	*T. trifulta*	*T. yabei*	*T. zabelinae*	*T.* sp. 1	*Thalassiothrix frauenfeldii*	*T. longissima*	*Trachyneis aspera*	Total number of valves	Diatom zone	Subseries
1-1, 43–44									10	4			26				7	2		200	*Neodenticula seminae*	Quaternary
1-2, 43–44																	1	1		2		
1-3, 109–110																				3		
2-1, 44–45																				1		
2-3, 44–45									1				3					20		84		
2-5, 44–45		①		1									1							39	*Rhizosolenia curvirostris*	
3-1, 43–44								1												9		
3-3, 123–124									15	1			41				2	3		200		
3-5, 124–125																				2		
4-1, 44–45									4								1	1		100		
4-3, 45–46							1		1				1					1	1	100		
4-5, 46–47							1		1				1					1		200		
4-7, 45–46																				7		
5-3, 48–49									1											9		
5-5, 45–46									1	2			9					7		135	*Actinocyclus oculatus*	
5-7, 42–43																		1		11		
6-3, 44–45																				3		
6-5, 44–45																				13		
7-1, 44–45																				0		
7-3, 44–45																				0		
7-5, 44–45							1		1								1	1		200		
7-7, 44–45							5											1		200	*Neodenticula koizumii*	upper Pliocene
8-3, 44–45										2			2							200		
8-5, 44–45	2						1	3	5								2	2		200		
9-1, 43–44									2	1			2					4		200		
9-3, 43–44				1			1		2				3		①		2	1		200	*Neodenticula koizumii*	
9-5, 43–44				1					2				1				1	2		200		
9-7, 43–44			1				1		8				1							200		
10-3, 44–45							4	1	3				3		1					200		
10-5, 44–45						2	2	1	4				3		1		1	1		200	——	
11-1, 44–45																				200		
11-3, 44–45						3	2		2				7							200	*Neodenticula kamtschatica*	
12-1, 43–44			1				1		4				8					3		200		
12-5, 43–44							2		1						4		1	2		200		lower Pliocene
13-1, 43–44									2						1		3	2		200	*Thalassiosira oestrupii*	
13-7, 43–44				3		1			10				1				1	1		200		
14-5, 44–45	1		1						11	2			2				3	4	1	200		
15-3, 43–44		1			1				2				5		1			4		200		
15-7, 43–44						4	1		2	1	1		1				1	5		200		
16-5, 44–45					2		1		2				2		3			11		200		
17-3, 44–45		5					1						3		1			5		200		
17-7, 44–45		4				5					1		1		1	18	1	3		200		
19-1, 43–44		7		1		1			4				2					5		200		
19-5, 43–44		7			1	11			1									5		200		
20-1, 43–44		2														4		6		200		
20-5, 43–44							1		1									7		200		
21-3, 44–45					2	7												14		200	*Neodenticula kamtschatica*	upper Miocene
22-1, 44–45		3			1	4									1			10		200		
22-5, 44–45		1			1	1												6		200		
23-3, 44–45						8								①				8		200		
23, cc						10	1					2						2		200		
25-1, 44–45						1						1						4		200		
25-5, 44–45						12						2						6		200		
26-3, 44–45						4												2		200		
27-1, 43–44																		6		200	*Rouxia californica*	
27-5, 43–44					1	1												4		200		
28-2, 44–45																		4		200	*Thalassionema schraderi*	
29-1, 44–45					1													2		200		
29-5, 44–45																		1		200		
30-3, 44–45																		6		200		
31-1, 44–45					1													3		200		
31-5, 44–45																		2		200		
32-1, 44–45														1				1		200		

Table 3. Stratigraphic occurrences of Neogene diatoms in Hole 796A. Circle indicates reworked specimens.

Core, section, interval (cm)	Depth below seafloor (m)	Abundance (10^7 per g)	*Chaetoceros* spp.	*Achnanthes groenlandica*	*Actinocyclus curvatulus*	*A. ingens*	*A. ochotensis*	*A. octonarius*	*A. oculatus*	*Actinoptychus senarius*	*Amphora ovalis*	*Asteromphalus flabellatus*	*Aulacosira granulata*	*Azpeitia endoi*	*A. nodulifer*	*Bacillaria paradoxa*	*Bacterosira fragilis*	*Campyloneis grevillei*	*Charcotia actinochilus*	*Cocconeis californica*	*C. costata*	*C. decipiens*	*C. disculus*
1-1, 13–14	0.13	0.1	11						①	1			1										
2-2, 110–111	5.80	0.4	85		2	①	1	1		2			1		1					1	5		
2-6, 110–111	11.80	0.1	19							1			1	①								1	
3-3, 74–75	16.44	1.3	215		4		1	6	①	1			1								1		
4-1, 83–84	23.03	1.6	435		9		4																
4-5, 120–121	29.40	5.1	28		1		2			1	3						3				8		
5-3, 84–85	35.54	7.5	560	1	4		3														9	1	
6-1, 26–27	41.46	1.5	348		3	①			1	3											13	3	
6-4, 55–56	46.25	1.1	299		3			1	11			1									1		
6-7, 50–51	50.70	0.4	120		3				3	2			4								1		
8-4, 121–122	57.40	0.2	24				1			3			6						2		1		
9, cc	63.38	1	98		2					4			1				2			2	10		
10-1, 40–41	68.80	1.1	112		4	①	15		3	1										1	12	1	3
11-1, 40–41	78.70	7.7	112							1										1	3		
12-1, 41–42	88.51	7.7	64							1										1			
12-7, 41–42	94.51	7.7	39				1			9													
14-1, 40–41	108.00	3.9	39	2			1			6						1				1	1		
14-5, 40–41	114.00	2.6	62	1						4										1	3		
15-1, 40–41	117.60	2.6	41				1			3							1				6		
15,cc	123.13	2.6	34		1					13											2		
16,cc	130.46	3.9	32	1						3											2	1	
17-1, 27–28	136.77	5.1	21				1		1	1											5		1
17-5, 25–26	142.75	0.3	47		2			1	9	2			4		1							1	
18-3, 25–26	149.45	3.4	23							5										1	2		
19-1, 25–26	156.05	5.1	29			①				6		1						1		1	7		
19-4, 25–26	160.55	7.7	33	1		①				2					1					1	2		
20-2, 25–26	167.05	7.9	17		1					19										1	2	1	
21-1, 24–25	175.24	10.3	55							7										1	6		
21-5, 24–25	181.24	7.7	51							7											2		
22-3, 23–24	187.93	0.9	25			①				3										1	10		
23-1, 24–25	194.64	0.9	31			③				2			1	1					1		2		
23-5, 24–25	200.64																						
24-2, 23–22	205.83	0.9	31					2		9											7		
25-1, 24–25	214.04	0.5	33					1		8	1									1	3		1

Table 3 (continued).

Core, section, interval (cm)	*C. placentula* var *euglypta*	*C. pseudomarginatus*	*C. scutellum*	*C. vitrea*	*Cosinodiscus elegans*	*C. marginatus*	*C. obscurus*	*C. oculus iridis*	*C. radiatus*	*C. stellaris*	*C. subtilis*	*C. symbolophorus*	*Cyclotella chaetoceras*	*C. comta*	*C. kützingiana*	*C. striata*	*Cymatosira debyi*	*Delphineis angustata*	*D. ischaboensis*	*D. kippae*	*D. margalitalimbata*	*D. simonsenii*	*D. surirella*	*Denticulopsis dimorpha*	*D. hustedii*
1-1, 13–14						5		1																	①
2-2, 110–111		1	4			7	2			1			1										3		②
2-6, 110–111						4																		①	①
3-3, 74–75				1		8		1						1									1		①
4-1, 83–84			1			7		2															2		①
4-5, 120–121						22										1			1	4		12			①
5-3, 84–85			4			1					1	1													
6-1, 26–27		1	4			9		2							2	1							6		
6-4, 55–56			1			4		3															2		②
6-7, 50–51						8		2	4		3					2							2		
8-4, 121–122		1				8							1	1	1								1	①	
9, cc			6			3		2											2						③
10-1, 40–41		1	5			6		1										1			1		2		
11-1, 40–41			2			3		1																	②
12-1, 41–42			1			6									1										
12-7, 41–42			1			10																	1	①	
14-1, 40–41						6											2		5				1		
14-5, 40–41			2			9															1		3		
15-1, 40–41			1			7		1											1				3		
15,cc		2	1			17													2				3		②
16,cc			1			8											1						2		
17-1, 27–28			2			15													1				1		
17-5, 25–26						6		1	3	2					1										
18-3, 25–26						10																			
19-1, 25–26			1	1		14																			②
19-4, 25–26			1	1		11				1		1											2		①
20-2, 25–26						25		1		1							1								
21-1, 24–25						7				1							4		1				1		
21-5, 24–25	1		1			11				1		2					1					2			
22-3, 23–24						43											2	1					1		②
23-1, 24–25					2	29	1																3		①
23-5, 24–25			1			1																			
24-2, 23–22			2		1	17	1	1				2					1						1		②
25-1, 24–25		1	4			120		1														2		①	③

Table 3 (continued).

Core, section, interval (cm)	*D. hyalina*	*D. lauta*	*Diploneis bombus*	*D. constricta*	*D. oculata*	*D. ovalis*	*D. smithii*	*D. suborbicularis*	*Fragilaria construens*	*F. pinnata*	*Gomphonema angustatum*	*G.* spp.	*Goniothecium tenue*	Grammatophora spp.	*Hemidiscus cuneifomis*	*Mediaria splendida*	*Melosira albicans*	*Navicula mutica*	*N. pygmaea*	*Neodenticula kamtschatica*	*N. koizumii*	*N. seminae*	*Nitzschia cylindrica*	*N. fossilis*	*N. granulata*
1-1, 13–14																	1			11	î				
2-2, 110–111	②						1	1		1	1	1		1			1			12		1			
2-6, 110–111		①											①							⑤		②			
3-3, 74–75			3											1					2	②		1			
4-1, 83–84			1																	②	②	46			
4-5, 120–121																	1		1	50		7			
5-3, 84–85														1					4	③	7	13	2		
6-1, 26–27			1		2	1	1						①	1			1		1	⑤	4	7			
6-4, 55–56			3											1			1			⑦	5	10		1	
6-7, 50–51			3						1						1					④	2	1			
8-4, 121–122														1	1					14	2				
9, cc	①																	1	1	⑤	20	13	2		1
10-1, 40–41				1			1							2			1		2	④	8	5	1		
11-1, 40–41			1														2			51	16				
12-1, 41–42															1		5			45	11				
12-7, 41–42														3	1		3		1	80					
14-1, 40–41							1								2		2			69				1	
14-5, 40–41													①				4			72					
15-1, 40–41													①		3		3			71					
15,cc															6		1			66					
16,cc																	13			88			1		
17-1, 27–28																	2			91					
17-5, 25–26			5										①							4					
18-3, 25–26													①							108					
19-1, 25–26	①													1						90					
19-4, 25–26														1			2			89					
20-2, 25–26																	1			75					
21-1, 24–25																	4			94					
21-5, 24–25																	6			73					
22-3, 23–24	③													4						43					
23-1, 24–25	③		1				1						③							43					
23-5, 24–25																				1					
24-2, 23–22	③												①	1		①			1	68					
25-1, 24–25														1						15					

Table 3 (continued).

Core, section, interval (cm)	*N. grunowii*	*N. marina*	*N. reinholdii*	*N. rolandii*	*N. sicula*	*N.* sp. 1	*Odontella aurita*	*Opephora martyi*	*Paralia sulcata*	*Plagiogramma staurophorum*	*Pinnularia borealis*	*P. molaris*	*Porosira glacialis*	*Pseudoeunotia doliolus*	*Pseudopodosira elegans*	*Rhabdonema japonicum*	*Rhaphoneis amphiceros*	*Rhizosolenia alata*	*R. barboi*	*R. calcar avis*	*R. curvirostris*	*R. hebetata*	*R. setigera*	*R. styliformis*	*Rhopalodia gibberula*
1-1, 13–14									1															1	
2-2, 110–111													1						1			20		3	2
2-6, 110–111									7													1		1	
3-3, 74–75																			4		31	1		1	
4-1, 83–84									1			1	4						7		19	6		1	
4-5, 120–121																		1			6	1		2	
5-3, 84–85													11					1			3	1	1	1	
6-1, 26–27							1	1	5				1				1				1	2		1	
6-4, 55–56			2					1	20		1		1						2			1	1	3	
6-7, 50–51		1	1		1				35					1					1	2	1		3	1	
8-4, 121–122				3			1		3															4	
9, cc							1		6				12		1		1							3	
10-1, 40–41	1		1				1	2	9								2		16					2	
11-1, 40–41						2	1		1													1		2	
12-1, 41–42						1		1	3										2						
12-7, 41–42						3	2		3															1	
14-1, 40–41							5		2														2	4	
14-5, 40–41				1			2		1															1	
15-1, 40–41						1	1	1	8															1	
15,cc									4							1								1	
16,cc						1	3									1									
17-1, 27–28			1			1		1	1								1							7	
17-5, 25–26						1			4							1							1		
18-3, 25–26						1	2			1														8	
19-1, 25–26						1			2										1			5		9	
19-4, 25–26						1	1												1			1		10	
20-2, 25–26									1										16					5	
21-1, 24–25							1		1													1		7	
21-5, 24–25							2											1	1					4	
22-3, 23–24				1					1	1								1				2	1	16	
23-1, 24–25						1	2		2									1	3			2		16	
23-5, 24–25																									
24-2, 23–22							1		1	1						1			10			3		9	
25-1, 24–25						1			2										6			1		2	

Table 3 (continued).

Core, section, interval (cm)	*Roperia tesselata*	*Rossiella tatsunokuchiensis*	*Rouxia californica*	*Stephanodiscus astrea*	*Stephanophyxis turris*	*S.* spp.	*Synedra jouseana*	*Tetracyclus lacustris*	*Thalassionema bacillaris*	*T. hirosakiensis*	*T. nitzschioides*	*Thalassiosira antiqua*	*T. burckliana*	*T. convexa*	*T. eccentrica*	*T. gravida*	*T. hyalina*	*T. jacksonii*	*T. leptopus*	*T. lineata*	*T. marujamica*	*T. nidulus*	*T. nordenskioldii*	*T. oestrupii*	*T. pacifica*
1-1, 13–14			①		12	1					4													1	1
2-2, 110–111				1	27	16					36	①				2				1		①		3	1
2-6, 110–111				1	11	3					6	①													
3-3, 74–75					73	19					13					1								4	
4-1, 83–84					28	10					8														2
4-5, 120–121					28	3					25	②				1	1				①	2		4	
5-3, 84–85					26	7					37					6	1		2	6				14	
6-1, 26–27					15	2					73	①			5	3	1			1	①			1	2
6-4, 55–56					44	6			4		40					4				1		2		4	1
6-7, 50–51	1			1	14	3		1	5		40				1	6				3		1		16,	
8-4, 121–122					14	1				①	11	②				1		①			②			2	1
9, cc			①		14	1			2		20				2	6	2					12		34	
10-1, 40–41				1	27	1					24	5			1	5	1					2		4	
11-1, 40–41					69	3					22	2				5	1							3	
12-1, 41–42					70	4	①				25	4		1		2						1		8	
12-7, 41–42					31	2					33	2				1							1	4	
14-1, 40–41		1			23	1					20	3	4			2	2			1	3	4		9	1
14-5, 40–41					44	2					24	1				4				1	1	2	2	9	
15-1, 40–41					46	4					22	1				3				2				5	
15,cc			①		45	5					19	1				1	1			1				1	
16,cc			①		47	2					17					2								3	
17-1, 27–28					45	2					10					1							1	1	
17-5, 25–26					29	3			1		16				1	2	1	1						7	
18-3, 25–26		4			10	1'					26	6				1								2	
19-1, 25–26					6	2			1	①	11	5				6	3	4			3			4	
19-4, 25–26	1		①		4	1					36	5				3		5				1		2	
20-2, 25–26				1	5	1					24					1		2							
21-1, 24–25					2	4					35	1				2		3		2		1		5	
21-5, 24–25					1	4			1		67					1		1	2					2	
22-3, 23–24					11	1					23	3					1	6			3				
23-1, 24–25			①		15	9					34	2						6			4				
23-5, 24–25						1					1														
24-2, 23–22	1				10	12					11	1			3			4							
25-1, 24–25			②		6	7					7										1				

Table 3 (continued).

Core, section, interval (cm)	*T. temperei*	*T. trifulta*	*T. zabelinae*	*T.* sp. g	*T.* sp. 1	*Thalassoithrix frauenfeldii*	*T. longissima*	*Trachyneis aspera*	Total number of valves	Diatom zone	Subseries
1-1, 13–14									45		
2-2, 110–111		18	①				1		200	*Neodenticula seminae*	
2-6, 110–111		1	②						45		
3-3, 74–75		10					4		200		
4-1, 83–84		30					7		200	*Rhizosolenia curvirostris*	
4-5, 120–121		2	①				4	1	200		Quaternary
5-3, 84–85		16					10		200		
6-1, 26–27		4				2			200		
6-4, 55–56		2				1	2		200	?	
6-7, 50–51		3	①			7	2		200		
8-4, 121–122		2	①						110	*Neodenticula koizumii*	?
9, cc	①						2		185		
10-1, 40–41		8					2		200		upper Pliocene
11-1, 40–41		4		1			2		200	*Ne. koizumii*	
12-1, 41–42		2	2	3			1		200	*Ne. kamtschatica*	
12-7, 41–42		2	3				1		200		
14-1, 40–41		7	1	1			2		200		
14-5, 40–41		4							200		
15-1, 40–41		5		3			2		200		
15,cc		4	2	1			1		200		
16,cc		2							200		
17-1, 27–28		4	3	1					200	*Thalassiosira oestrupii*	lower Pliocene
17-5, 25–26		2					1		115		
18-3, 25–26		8	1	1			1		200		
19-1, 25–26		1	4	1			3		200		
19-4, 25–26		5			1		4		200		
20-2, 25–26		5		3			8		200		
21-1, 24–25		1		2		1	5		200		
21-5, 24–25		4		1			1		200		
22-3, 23–24		2	2		4		9	1	200		
23-1, 24–25			1				4		200		
23-5, 24–25									5	*Neodenticula kamtschatica*	upper Miocene
24-2, 23–22					7		4		200		
25-1, 24–25			1				1		200		

Table 4. Stratigraphic occurrences of Neogene diatoms in Hole 795A. Circle indicates reworked specimens.

Core, section, interval (cm)	Depth below seafloor (m)	Abundance (10^7 per g)	*Chaetoceros* spp.	*Achnanthes brevipes*	*Actinocyclus curvatulus*	*A. ingens*	*A. ochotensis*	*A. octonarius*	*A. oculatus*	*Actinoptychus senarius*	*A. splendens*	*Amphora ovalis*	*Asteromphalus darwinii*	*A. flabellatus*	*A. robustus*	*Aulacosira granulata*	*Azpeitia endoi*	*A. nodulifer*	*A. tabularis*	*Bacillaria paradoxa*	*Bacterosira fragilis*	*Caloneis bacillum*	*Cocconeis antiqua*	*C. californica*
1-1, 30–31	0.30	1.9	109					2		6	1				2				3					
1-5, 29–30	6.29	0.7	70		9		1	2								1								
2-3, 29–30	12.59	7.7	137		3										1									
3-1, 29–30	19.09	0.2	27		6			1								3		1						
3-5, 29–30	25.09	0.2	5		2			2	①															
4-3, 30–31	31.60	0.4	24		3					2														
5-1, 30–31	38.10		13							3		1												
5-5, 30–31	44.10	0.5	87					1		2						3								
6-2, 30–31	49.10	1.9	177						1	1					2			2						
6-6, 30–31	55.10	0.5	296		5					6					1	2					1			1
7-4, 29–30	61.59	15.4	76		7																			
8-2, 30–31	68.10	0.5	137	1	1			3	2							1					1			1
8-6, 30–31	74.10	0.1	13		1			1		3						1		1						
9-4, 30–31	80.60	0.1	7					1		3						3								
10-2, 30–31	87.10		5													1								
11-1, 30–31	95.10	0.1	6				1	1	1	2														
11-5, 30–31	101.10	0.2	43			①		1	5	1						1		1						
12-2, 29–30	106.09	0.3	75		2		6	3	12	2						1								
12-6, 29–30	112.09	1.5	118		3		12	3	5	3					1									1
13-4, 29–30	118.59	0.9	143		2	②	7			2					1	1								2
14-2, 79–80	125.59	0.7	98				3	2								4					1		1	
14-6, 29–30	131.09	5.1	91		5		1	1	1															1
15-4, 30–31	137.60	3.4	86		8			1	2	2						1								
16-2, 29–30	144.09	15	96				1																	
18-1, 29–30	153.19	1.5	42		1					1					4									
18-5, 29–30	159.19	2.1	54												1						1			1
19-3, 29–30	165.69	7.7	61																		1			1
19-7, 29–30	171.69	3.4	67		1	③				3														2
21-1, 29–30	181.89	7.7	35				1																	
21-5, 29–30	187.89	15.4	52				1			1							①							
22-3, 29–30	194.49	7.7	49		2										1						1			
22-7, 29–30	200.49	15.4	36		1					2			1											
25-2, 29–30	222.19	3.9	50							7														2
25-7, 29–30	228.60	1.7	42							10			1			1								1
26-4, 29–30	234.89	5.1	38		2		1			13														
27-1, 31–32	240.21	3.4	43				1			6														
27-5, 31–32	246.21	3.4	56			①				7			1	1										1
28, CC	259.50	1.7	70		1					11														1
29, CC	269.30	5.1	31				1			5				1										
30-1, 31–32	269.61	10.3	33							6														1
30-5, 31–32	275.61	7.7	37							11			1											
31-2, 29–30	280.89	7.7	54																	1				1
31-6, 15–16	286.75	3.9	65							8														2
34-1, 29–30	308.19	5.1	20							1										1				3
34-5, 29–30	314.19	7.7	22							6												1		
35-3, 29–30	320.89	15.4	39							1														

Table 4 (continued).

Core, section, interval (cm)	*C. costata*	*C. decipiens*	*C. disculus*	*C. placentula* var. *euglypta*	*C. pseudomarginata*	*C.* scutellum	*Cosinodiscus elegans*	*C. marginatus*	*C. obscurus*	*C.* oculus iridis	*C. stellaris*	*C. subtilis*	*C. symbolophorus*	*Cyclotella chaetoceras*	*C. kützingiana*	*C. striata*	*Cymatosira debyi*	*Delphineis angustata*	*D.* ischaboensis	*D. surirella*	*Denticulopsis dimorpha*	*D. hustedtii*	*D. hyalina*	*D. katayamae*	*Diploneis bombus*
1-1, 30–31	2							18		2	2					1									
1-5, 29–30	1					4		5												3					
2-3, 29–30								3																	
3-1, 29–30						1		2		1	1											①			1
3-5, 29–30	1							5						1		1				1					
4-3, 30–31								1												2				②	2
5-1, 30–31	1							1														①			
5-5, 30–31	1				1			7		1	2					1				3		①			5
6-2, 30–31			1			1										1									
6-6, 30–31	8		1	1		1		4		1	1											①			5
7-4, 29–30	1							1																	
8-2, 30–31	2			1				3								1							①		1
8-6, 30–31	2							5							2				1	1					
9-4, 30–31								4							2						③	①	①		
10-2, 30–31	2							4														①			1
11-1, 30–31								2												1	②				
11-5, 30–31						1		7		1					1	1					①	③			1
12-2, 29–30	2				1	1		5		1	1	1				1					③	④		④	3
12-6, 29–30	7					1		1														②			3
13-4, 29–30	16	1				4		6					1					1		2	①	⑤	①		
14-2, 79–80	14					3		15												2	①	①	①		
14-6, 29–30	1		2			1		13											2	2		①	①		
15-4, 30–31	1							27												3					
16-2, 29–30	2		1	1		3		3														①	①		
18-1, 29–30	7							42																	
18-5, 29–30	7					1		22														②			
19-3, 29–30	2					2		11																	
19-7, 29–30	5					1		44	1		1														
21-1, 29–30	5							22																	
21-5, 29–30	6							2																	
22-3, 29–30	3					1		8												2					
22-7, 29–30	5							9											1	1					
25-2, 29–30	2							22											5						
25-7, 29–30	2					1	1	19										1							
26-4, 29–30	2							7											2	3					
27-1, 31–32	4		1			2		13	1										1			①			
27-5, 31–32	3		1			4		15																	
28, CC	6							35			1						1		2		①	①			
29, CC								16										2			①	①			
30-1, 31–32	4					2		15																	
30-5, 31–32	5				1	1		6	1								1		1	2					
31-2, 29–30	4					1		15		1	2						1								
31-6, 15–16	8			1		1		14			1						1		2		①				
34-1, 29–30	2				1			8											2			①			
34-5, 29–30	6					2		7	1								1		3	2	①				
35-3, 29–30	1					1		3											2						

Table 4 (continued).

Core, section, interval (cm)	*D. coffeiformis*	*D. interrupta*	*D. oculata*	*D. smithii*	*D. suborbicularis*	*Epithemia argus*	*Fragilaria construens*	*Gomphonema angustatum*	*G. lanceolata*	*Goniothecium tenue*	*Grammatophora spp.*	*Hemidiscus cuneifomis*	*Lithodesmium unduatum*	*Mediaria splendida*	*Melosira albicans*	*M. polaris*	*Navicula directa*	*N. pymaea*	*N.* sp. 1	*Neodenticula kamtschatica*	*N. koizumii*	*N. seminae*	*Nitzschia cylindrica*	*N. extincta*	*N. fossilis*
1-1, 30–31			2		1							1								③		29			
1-5, 29–30		1																		39	④	17			
2-3, 29–30																				①		83			
3-1, 29–30					1										9					④		2			
3-5, 29–30					1															⑥	③	3			
4-3, 30–31																				②		4			
5-1, 30–31																				②		1			
5-5, 30–31					1						2									③	②	18			1
6-2, 30–31							1								1					④	③	8			
6-6, 30–31	1			1			1	1	1		4				3					⑦	⑥	17	3		
7-4, 29–30																						39			
8-2, 30–31											1									⑤		1			
8-6, 30–31											2									17					
9-4, 30–31						1									1					⑤					
10-2, 30–31										①										④					
11-1, 30–31																				⑦					
11-5, 30–31											1									⑩		1			
12-2, 29–30					1						5									24	13	5			
12-6, 29–30											2				1					⑥	24	6			
13-4, 29–30				1	1						1									⑦	13				
14-2, 79–80											2			1	1			1		⑧	24				
14-6, 29–30															2						87		1		
15-4, 30–31										②					1					2	50		1		
16-2, 29–30															2					2	107				
18-1, 29–30											1				1					24	41				
18-5, 29–30															4					18	34				
19-3, 29–30											2	3			1					57	21		2	1	
19-7, 29–30															5					17	12				
21-1, 29–30															2					43	10				
21-5, 29–30															3					46	8				
22-3, 29–30															3					64	19				
22-7, 29–30															1					77					
25-2, 29–30															5					77					
25-7, 29–30															1					75					
26-4, 29–30																				99					
27-1, 31–32											2									83					
27-5, 31–32											1				3					71					2
28, CC											2	1			4					83					
29, CC											1				1					120					
30-1, 31–32									1						2					93			4		
30-5, 31–32												1			1				1	108					
31-2, 29–30											1		1		2		1		1	108			1		
31-6, 15–16											2				1					111			1		
34-1, 29–30																				116					
34-5, 29–30															1	1			1	123					
35-3, 29–30											2				1					145					

Table 4 (continued).

Core, section, interval (cm)	*N. granulata*	*N. grunowii*	*N. marina*	*N. reinholdii*	*N. rolandii*	*N. sicula*	*N.* sp. 1	*Odontella aurita*	*Opephora martyi*	*Paralia sulcata*	*Plagiogramma staurophorum*	*Pinnularia alphina*	*P. borealis*	*Porosira glacialis*	*Pseudoeunotia doliolus*	*Pseudopodosira elegans*	*Rhabdonema japonicum*	*Rhaphoneis amphiceros*	*Rhizosolenia alata*	*R. barboi*	*R. bergonii*	*R. curvirostris*	*R. hebetata*	*R. imbricata*	*R. semispina*
1-1, 30–31			1			1				1					2								8	1	2
1-5, 29–30										3													33		
2-3, 29–30		2																			1		8		
3-1, 29–30										2					1					2		2	2		
3-5, 29–30										1												12	1		
4-3, 30–31										2						1				2		5	3		
5-1, 30–31		1						1														1			
5-5, 30–31			1							4					1			1			1	1			
6-2, 30–31																						14	2		
6-6, 30–31										7				7								1	1		
7-4, 29–30																						4	3		
8-2, 30–31										33		1								4		1			
8-6, 30–31										2											3		3		
9-4, 30–31										1									1	3					
10-2, 30–31										4										3					
11-1, 30–31										2										2					
11-5, 30–31										5										3					
12-2, 29–30	1									21				1		1							1		
12-6, 29–30				1						30				1						3					
13-4, 29–30				1				1		3	1			3		1				6					
14-2, 79–80	1								1	4	1					1				7					
14-6, 29–30										3										6					
15-4, 30–31							1			2						1				2			2		
16-2, 29–30																				1					
18-1, 29–30								1								1				19					
18-5, 29–30							1			1										9					
19-3, 29–30							2			2								1							
19-7, 29–30							2	1	1	1										10					
21-1, 29–30				1				1		1										3					
21-5, 29–30							4	1		1						3									
22-3, 29–30																				2					
22-7, 29–30								3	1	1															
25-2, 29–30					1		2		1											1			1		
25-7, 29–30							1	1		1						1				3					
26-4, 29–30																1				2					
27-1, 31–32																				5			1		
27-5, 31–32							1	2		2										2			1		
28, CC					1		2	1								2				2			1		
29, CC								1		1			1												
30-1, 31–32							5			1						3	3			11			2		
30-5, 31–32							3	2												4					
31-2, 29–30								1		2						1				10					
31-6, 15–16							2									1		1	1	5			1		
34-1, 29–30							2	1		2						1				5			3		
34-5, 29–30							1	4		2										3			1		
35-3, 29–30							3	3															1		

Table 4 (continued).

Core, section, interval (cm)	*R. setigera*	*R. styliformis*	*Rossiella tatsunokuchiensis*	*Rouxia californica*	*Stephanodiscus astrea*	*S. niagarae*	*Stephanophyxis turris*	*S.* spp.	*Synedra jouseana*	*S. ulna*	*Tetracyclus lacustris*	*Thalassionema bacillaris*	T. hirosakiensis	*T. nitzschioides*	*T. nitzschioides* vars.	*T. schraderi*	*Thalassiosira antiqua*	*T. eccentrica*	*T. glacilis*	*T. gravida*	*T. hyalina*	*T. jacksonii*	*T. lacustris*	*T. leptopus*	*T. lineata*
1-1, 30–31		6					4	3						49	2			4		2					
1-5, 29–30	2	4					8	2						26				3		7					
2-3, 29–30		1					27	2						24			③			2					
3-1, 29–30		1					43	6						10			①	2		2					
3-5, 29–30		2			1		37	12						3						1					
4-3, 30–31							104	36						3						11					
5-1, 30–31		1											3						1						
5-5, 30–31							83	12						16				2		5	1		1		
6-2, 30–31	1						118	24				1		10											
6-6, 30–31		2					29	3		1		2		31			①	1		9	2	①			5
7-4, 29–30		3					32	1						95											2
8-2, 30–31	11	3					55	5				6	①	43	3					2					1
8-6, 30–31		2		①			4							10			③	1				①			
9-4, 30–31	1	3		①			2	1			①			5			①								
10-2, 30–31		2		①			2	1						2											
11-1, 30–31		1					10	1						8								①	1		
11-5, 30–31	3	1					19	1						9							1				
12-2, 29–30	4	3		②			26	1						21						3					1
12-6, 29–30							40	7						15			1	2		3		②		2	
13-4, 29–30		5				1	44	2						23			4	1		9					
14-2, 79–80	2	1	1	①			45	6						19			1	1		5	4				1
14-6, 29–30		1	2					26	2					15						3		①			
15-4, 30–31	5	1					30	3						35			1			2	1				
16-2, 29–30		1					49	2						4			2			7	2				
18-1, 29–30	5						24	1	①					4			1		1	5				1	
18-5, 29–30	1	2					53	8						12			4			3	1				
19-3, 29–30							55	3						18			2				1				
19-7, 29–30	3						29	12	①					30											
21-1, 29–30	1						48	6						31			2			1	1				
21-5, 29–30							21	2						57			4			2				1	
22-3, 29–30		1		①			32							20			3			6	1				
22-7, 29–30							24							57						4	1				
25-2, 29–30		7					42	2						9	1					1					
25-7, 29–30	1	2					36							20			1								
26-4, 29–30		9					17	2						22			9								
27-1, 31–32		2		①			19	2						31		①	4			1		3			
27-5, 31–32		5	1				11	1						44			6			1	1	4			
28, CC	1	5					8	4						6			2		1	1		1			
29, CC		4	1				5	4						14			3			1		1			1
30-1, 31–32		1					5	2						15			1	1		1		2		2	
30-5, 31–32	1	13					12	5						7		①		1		1					
31-2, 29–30		12					6	1						7			2				2	3			
31-6, 15–16	1	8					3	2						10								1			
34-1, 29–30		7	1	①			4	5						13			1			2	1	3			
34-5, 29–30		4					2	4						5			2			3	1			1	
35-3, 29–30		6					2	1						9							1	2			

Table 4 (continued).

Core, section, interval (cm)	*T. manifesta*	*T. marujamica*	*T. nidulus*	*T. nordenskioldii*	*T. oestrupii*	*T. pacifica*	*T. plicata*	*T. temperei*	*T. trifulta*	*T. yabei*	*T. zabelinae*	*T.* sp. 1	*T.* sp.	*Thalassiothrix frauenfeldii*	*T. longissima*	*Trachyneis aspera*	Total number of valves	Diatom zone	Subseries
1-1, 30–31					4	2			19					9	5		200		
1-5, 29–30		①	①		3	2			14					1	1		200	*Neodenticula seminae*	
2-3, 29–30					2	1			24						3		200		
3-1, 29–30		①	1		6				5						2		115		
3-5, 29–30		①							3								100	*Rhizosolenia curvirostris*	
4-3, 30–31					7				8								20		
5-1, 30–31																	200		
5-5, 30–31		①			3				6		①				4		200		
6-2, 30–31									6						1		200		Quaternary
6-6, 30–31			1	1	5	2			2				2	1			200		
7-4, 29–30					4				2						6		120		
8-2, 30–31					3										1		70	*Actinocyclus oculatus*	
8-6, 30–31		1			1										1		50		
9-4, 30–31		1					1								2		30		
10-2, 30–31		1															50		
11-1, 30–31		4	1		1										1		85		
11-5, 30–31		2	1		1										1		200		
12-2, 29–30		1	2		1	2			2		①			1	2	1	200		
12-6, 29–30			4		4		1		2		①						200	*Neodenticula koizumii*	
13-4, 29–30		2	5	1	4			①	3						1		200		
14-2, 79–80	1		2		4				2						3	1	200		
14-6, 29–30	2	1	3		2				7	①	②				1		200		
15-4, 30–31					2				9						2		200		
16-2, 29–30		1	2						2		①				2		200	*Neodenticula*	upper
18-1, 29–30		3			4				7								200	*koizumii*	Pliocene
18-5, 29–30	1	1			6				4						2		200		
19-3, 29–30	1	1	2	3					2						3		200	———	
19-7, 29–30		2	2		2				1		4			1	3		200	*Neodenticula*	
21-1, 29–30	1	1	7	1	3				3		2	1			2		200	*kamtschatica*	
21-5, 29–30		1	4	1	7				14		2				7		200		
22-3, 29–30			3	1	6				3		15				2		200		
22-7, 29–30		1	1		3				3						3		200		
25-2, 29–30				1	3				2		5				1		200		
25-7, 29–30			2		5				1		11				1		200		
26-4, 29–30					1				1		2				5		200		
27-1, 31–32		1	1		6						4				3		200		
27-5, 31–32					4										3		200		
28, CC			2		2						4				4		200	*Thalassiosira*	lower
29, CC					3				3		1				3		200	*oestrupii*	Pliocene
30-1, 31–32	2		1		4			①			4				4		200		
30-5, 31–32			1		3	1									4		200		
31-2, 29–30	1	1	1	1	2				1						5		200		
31-6, 15–16			3		2						1				3		200		
34-1, 29–30	1	3	1		4						2				2		200		
34-5, 29–30		1	1		4				1		1				3		200		
35-3, 29–30					8				4		2				2		200		

Table 5. Diatom zonation of samples from ODP Leg 127.

Age	Diatom zone	Core, section, interval (cm)			
		Hole 797B	Hole 794A	Hole 796A	Hole 795A
Quaternary	*Neodenticula seminae*	1-1, 13–15 2-5, 44–45	1-1, 43–44 2-3,44–45	1-1, 13–14 2-6, 110–111	1-1, 30–31 2-3, 29–30
	Rhizosolenia curvirostris	3-3, 14–16	2-5, 44–45 5-3, 48–49	3-3, 74–75 5-3, 84–85	3-1, 29–30 5-5, 30–31
	Actinocyclus oculatus	9-5, 14–16	5-5, 45–46 7-5, 44–45	6-1, 26–27	6-2, 30–31 11-5, 30–31
Pliocene	*Neodenticula koizumii*	10-2, 109–111 11-4, 43–45	7-7, 44–45 9-1, 43–44	10-1, 40–41	12-2, 29–30 14-6, 29–30
	Neodenticula koizumii *Neodenticula kamtschatica*	12-1, 109–111 20-3, 38–39	9-3, 43–44 12-5, 43–44	11-1, 40–41 14-5, 40–41	15-4, 30–31 22-3, 29–30
	Thalassiosira oestrupii	21-1, 39–40 23-2, 40–41	13-1, 43–44 20-5, 43–44	15-1, 40–41 21-5, 24–25	22-7, 29–30
upper Miocene	*Neodenticula kamtschatica*	23-6, 40–41 26-5, 38–39	21-3, 44–45 26-3, 44–45	22-3, 23–24	
	Rouxia californica	27-1, 37–38 27-5, 38–39	27-1, 43–44 27-5, 43–44		
	Thalassionema schraderi	28-4, 38–39 31-4, 38–39	28-2, 44–45		
	Denticulopsis katayamae	32-2, 36–37			
	Denticulopsis dimorpha				
	Thalassiosira yabei				
middle Miocene	*Denticulopsis praedimorpha*	37X-2, 87 38X-1, 22			

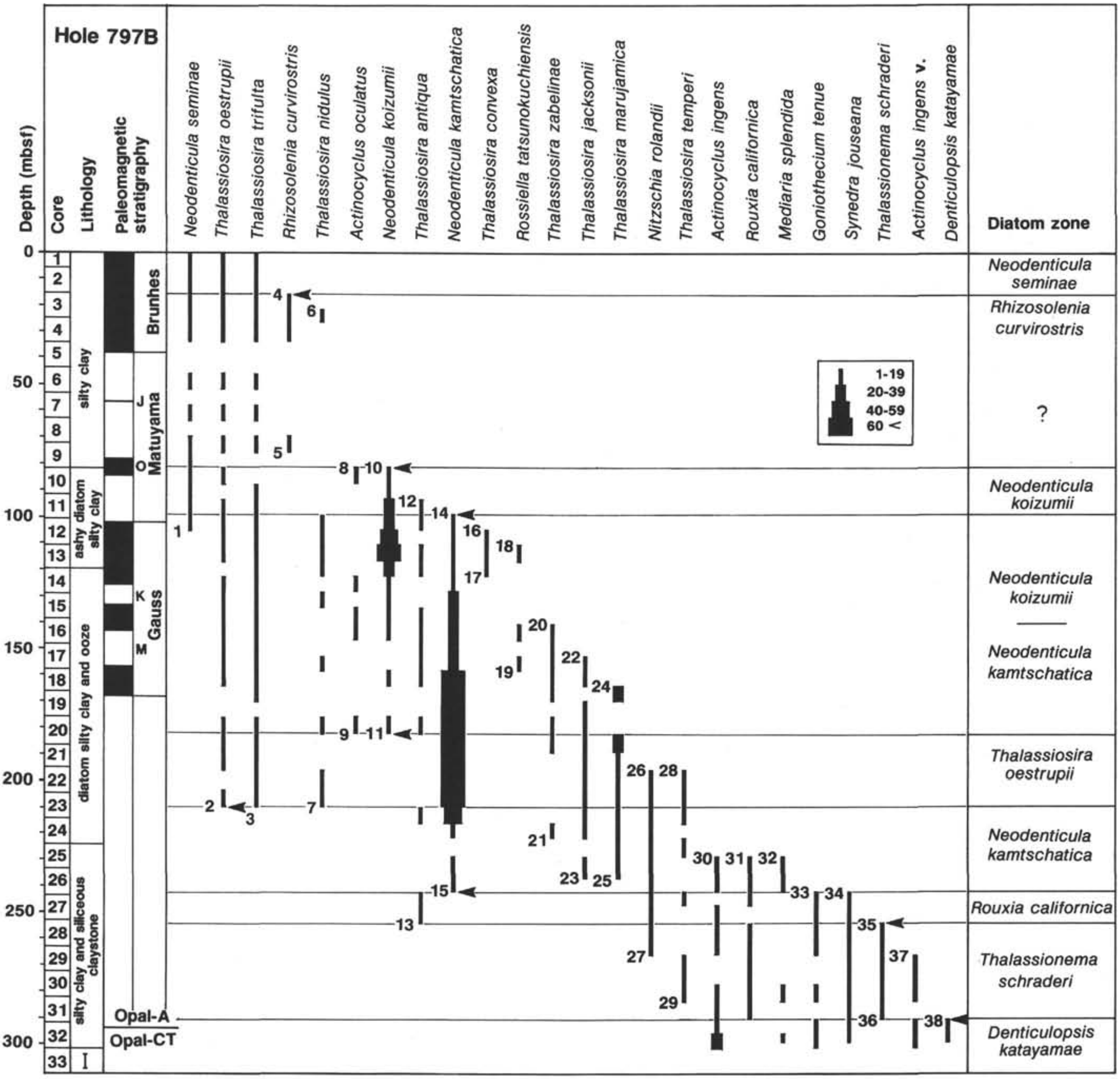

Figure 3. Ranges and abundances of stratigraphically important diatom species at Hole 797B. Arrows indicate the zonal boundaries. Numbers next to ranges indicate selected datum levels as specified in Table 6. I = silty clay and siliceous claystone.

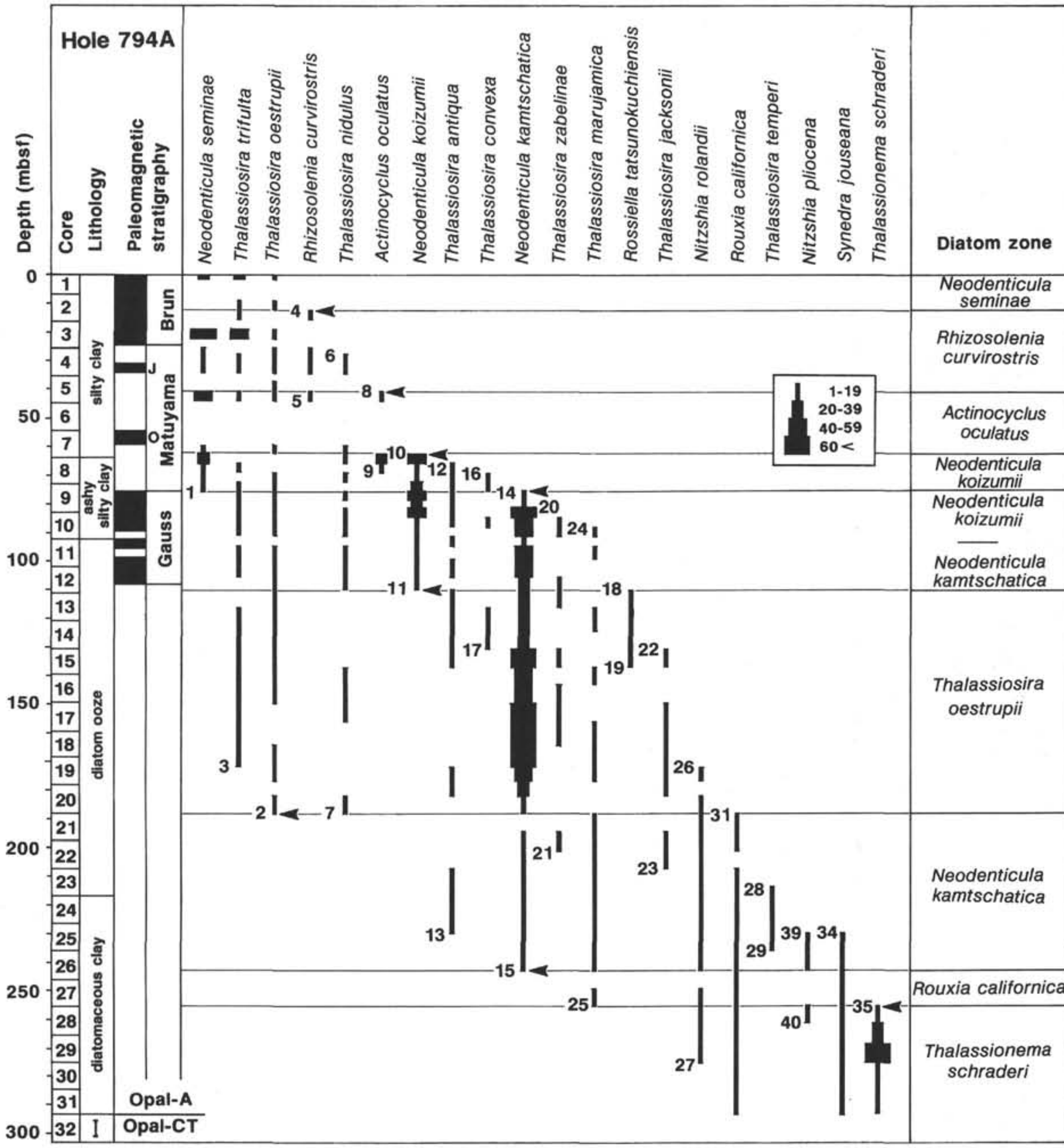

Figure 4. Ranges and abundances of stratigraphically important diatom species at Hole 794A. Arrows indicate the zonal boundaries. Numbers next to ranges indicate selected datum levels as specified in Table 6. I = siliceous claystone.

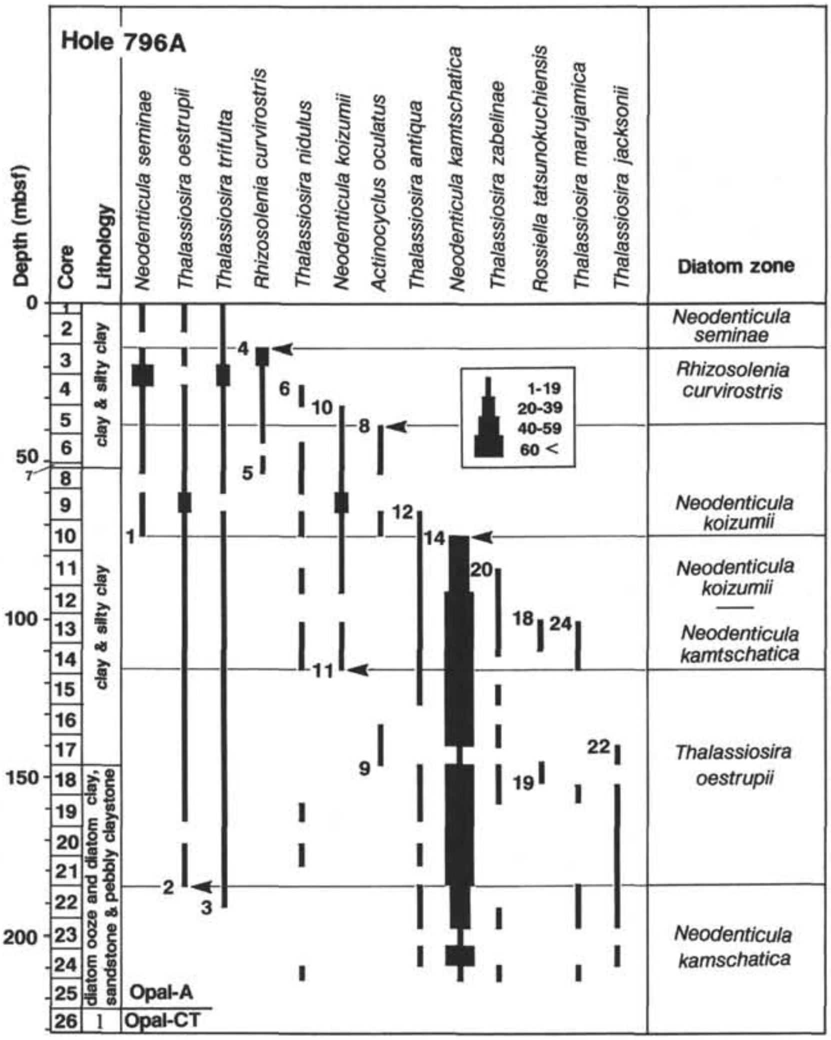

Figure 5. Ranges and abundances of stratigraphically important diatom species at Hole 796A. Arrows indicate the zonal boundaries. Numbers next to ranges indicate selected datum levels as specified in Table 6. I = siliceous claystone, sandstone, and siltstone.

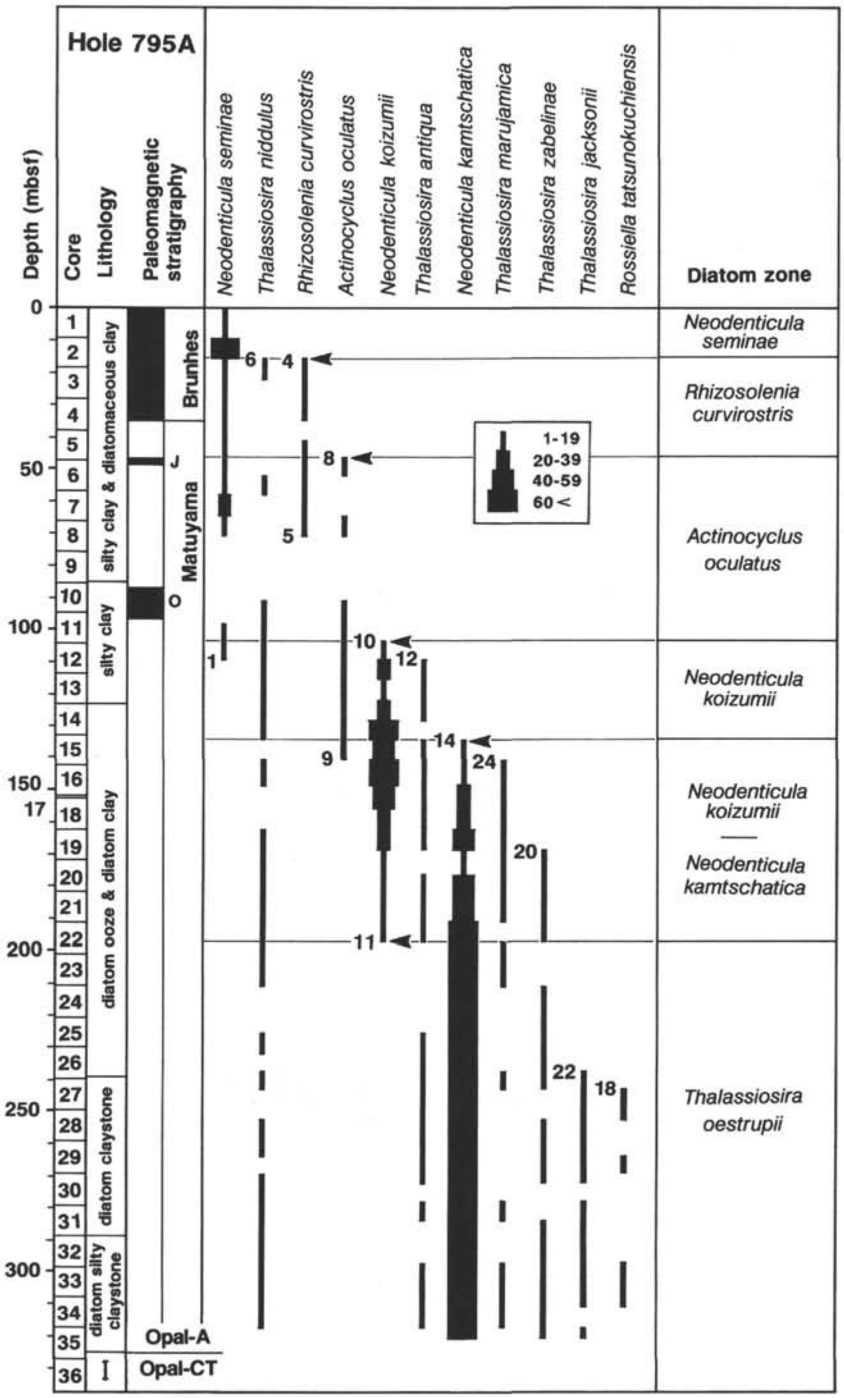

Figure 6. Ranges and abundances of stratigraphically important diatom species at Hole 795A. Arrows indicate the zonal boundaries. Numbers next to ranges indicate selected datum levels as specified in Table 6. I = siliceous silty claystone, porcellanite and chert.

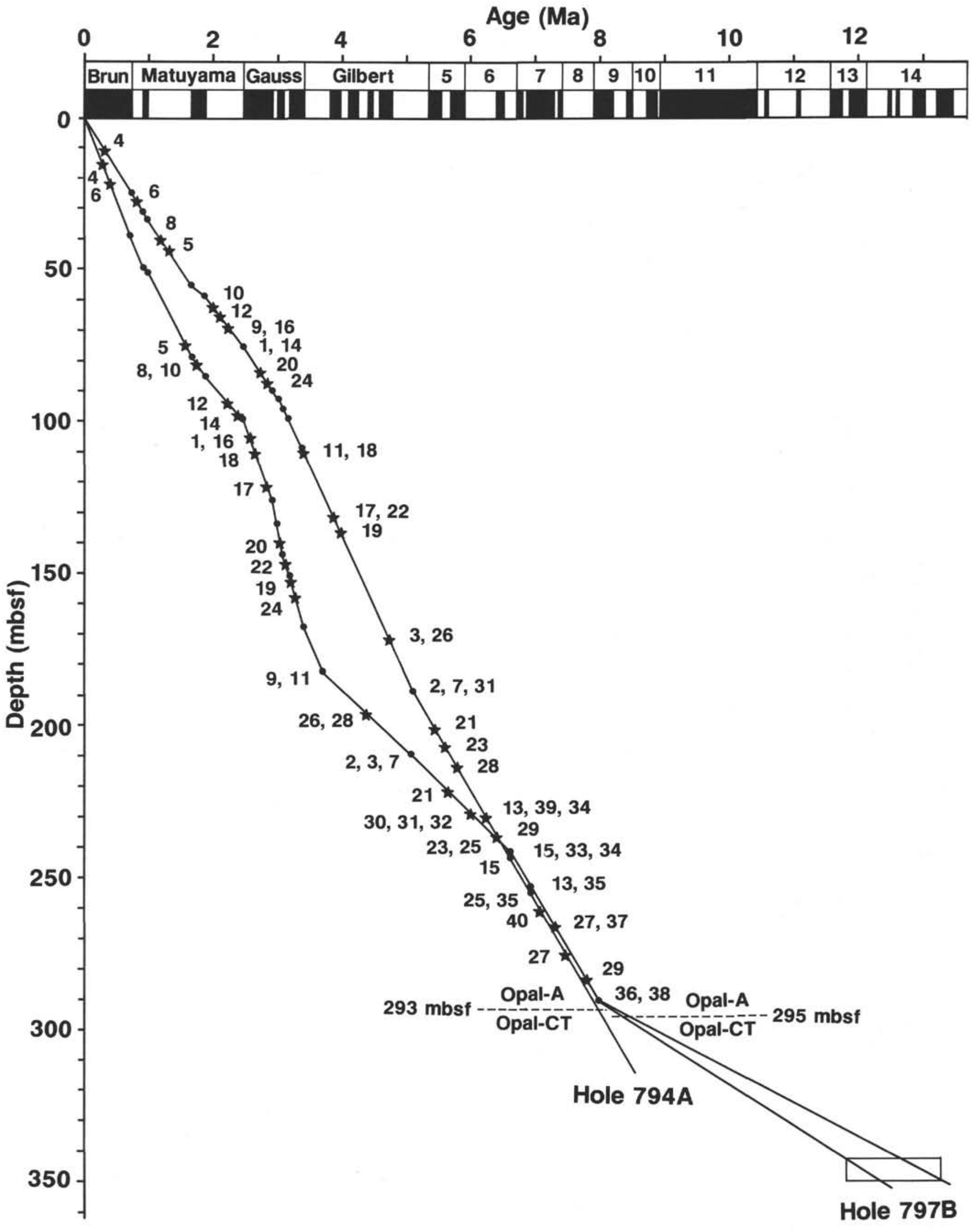

Figure 7. Sediment accumulation rate curve for Hole 797B and Hole 794A plotted from the paleomagnetic stratigraphy and the diatom zonal boundaries (dots). Numbers next to dots and stars indicate the selected datum levels as specified in Table 6.

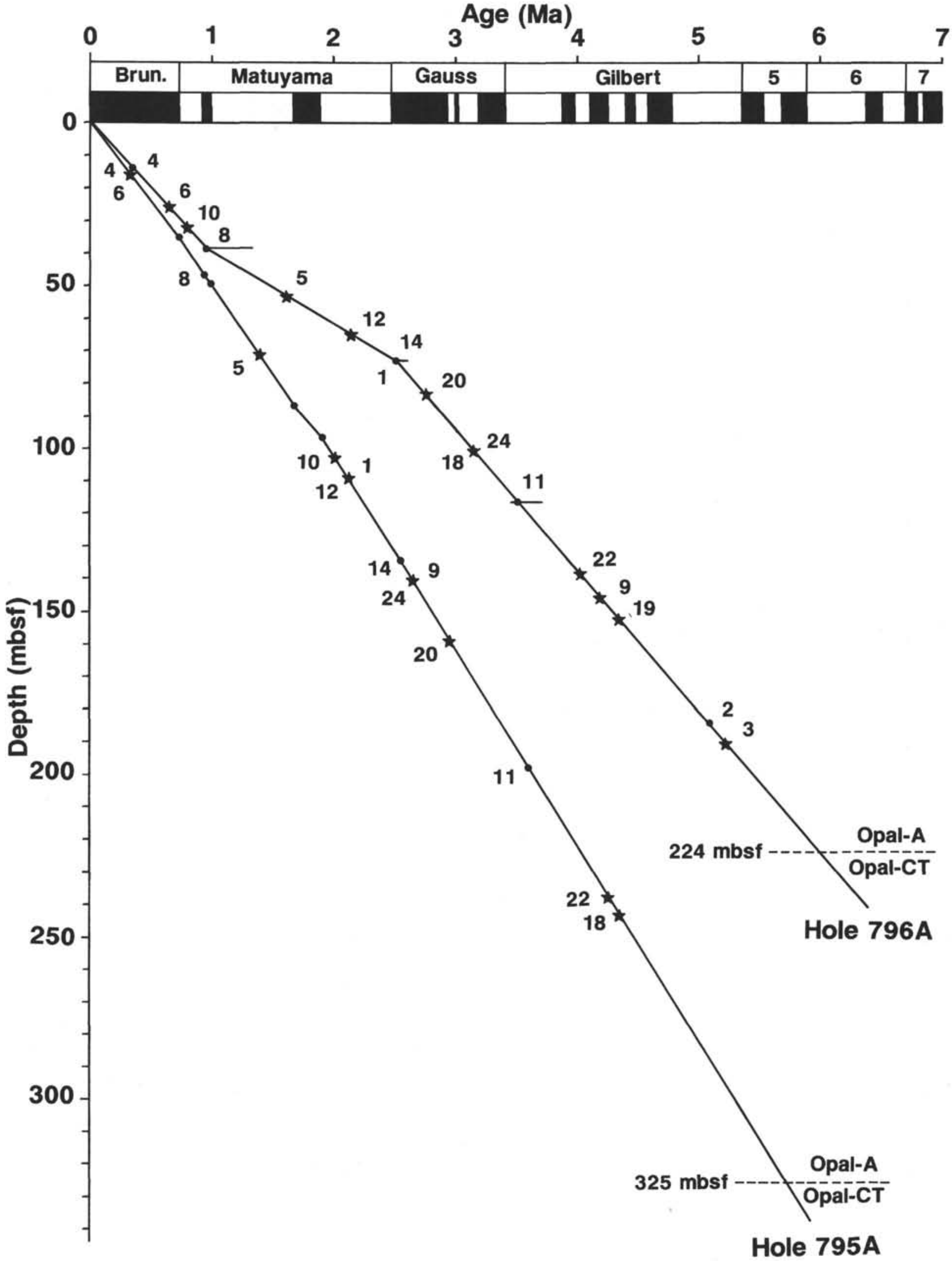

Figure 8. Sediment accumulation rate curve for Hole 796A and Hole 795A plotted from the paleomagnetic stratigraphy and the diatom zonal boundaries (dots). Numbers next to dots and stars indicate the selected datum levels as specified in Table 6.

Table 6. Stratigraphic occurrences and chronology of diatom datum levels in Holes 797B, 794A, 796A, and 795A.

			Hole 797B		Hole 794A		Hole 796A		Hole 795A	
		Datum level[a]	Stratigraphic level[b]	Age[c] (Ma)	Stratigraphic levelb	Age[c] (Ma)	Stratigraphic level[b]	Age[c] (Ma)	Stratigraphic level[b]	Age[c] (Ma)
1	B	*Neodenticula seminae*	12-1, 111/12-5, 109	2.6	9-1, 44/9-3, 43	2.5	10-1, 41/11-1, 40	2.6	12-6, 30/13-4, 29	2.1
2	B	*Thalassiosira oestrupii*	23-2, 41/23-6, 40	5.1	20-5, 44/21-3, 44	5.1	21-5, 25/22-3, 23	5.1		
3	B	*Thalassiosira trifulta*	23-2, 41/23-6, 40	5.1	19-1, 44/19-5, 43	4.8	22-3, 24/23-1, 24	5.3		
4	T	*Rhizosolenia curvirostris*	2-5, 104/3-3, 14	0.3	2-3, 45/2-5, 44	0.3	2-6, 111/3-3, 74	0.4	2-3, 30/3-1, 29	0.3
5	B	*Rhizosolenia curvirostris*	9-1, 16/9-5, 14	1.5	5-5, 46/5-7, 42	1.3	6-7, 51/8-4, 121	1.5	8-2, 31/8-6, 30	1.4
6	T	*Thalassiosira nidulus*	3-3, 16/3-7, 14	0.4	4-1, 45/4-3, 45	0.8	4-1, 121/5-3, 84	0.7	2-3, 30/3-1, 29	0.3
7	B	*Thalassiosira nidulus*	23-2, 41/23-6, 40	5.1	23-CC/25-1, 44	6			34-5, 31/6-2, 30	5.6
8	T	*Actinocyclus oculatus*	9-5, 16/10-2, 109	1.7	5-3, 49/5-5, 45	1.2	5-3, 85/6-1, 26	1.1	5-5, 31/6-2, 30	0.9
9	B	*Actinocyclus oculatus*	20-3, 39/21-1, 39	3.7	8-3, 45/8-5, 44	2.2	17-5, 26/18-3, 25	4.2	15-4, 31/16-2, 29	2.7
10	T	*Neodenticula koizumii*	9-5, 16/10-2, 109	1.8	7-5, 45/7-7, 44	2	11-5, 31/12-2, 29	1.9	11-5, 31/12-2, 29	2
11	B	*Neodenticula koizumii*	20-3, 39/21-1, 39	3.7	12-5, 44/13-1, 43	3.5	14-5, 41/15-1, 40	3.5	22-3, 30/22-7, 29	3.6
12	T	*Thalassiosira antiqua*	12-5, 111/13-3, 39	2.7	7-7, 45/8-3, 44	2.1	9-CC/10-1, 40	2.3	12-2, 30/12-6, 29	2.1
13	B	*Thalassiosira antiqua*	27-5, 39/28-4, 38	7	25-1, 45/25-5, 44	6.2	24-2, 24/25-1, 24	5.7	34-5, 30/35-3, 29	5.6
14	T	*Neodenticula kamtschatica*	11-4, 45/12-1, 109	2.6	9-1, 44/9-3, 43	2.5	10-1, 41/11-1, 40	2.6	14-6, 30/15-4, 30	2.6
15	B	*Neodenticula kamtschatica*	26-5, 39/27-1, 37	6.6	26-3, 45/27-1, 43	6.6				
16	T	*Thalassiosira convexa*	12-1, 111/12-5, 109	2.6	8-3, 45/8-5, 44	2.3				
17	B	*Thalassiosira convexa*	13-7, 41/14-4, 107	2.9	14-5, 45/15-3, 43	3.9				
18	T	*Rossiella tatsunokuchiensis*	12-5, 111/13-3, 39	2.7	12-5, 44/13-1, 43	3.4	12-7, 42/14-1, 40	3.1	13-4, 30/14-2, 79	2.3
19	B	*Rossiella tatsunokuchiensis*	17-7, 40/18-3, 39	3.3	15-3, 44/15-7, 43	4.2	18-3, 26/19-1, 25	4.3	34-1, 30/34-5, 29	5.5
20	T	*Thalassiosira zabelinae*	15-6, 41/16-4, 39	3	9-7, 44/10-3, 44	2.7	11-1, 41/12-1, 41	2.9	19-3, 30/19-7, 29	3
21	B	*Thalassiosira zabelinae*	24-4, 40/24-7, 39	5.6	22-1, 45/22-5, 44	5.5				
22	T	*Thalassiosira jacksonii*	17-2, 14/17-7, 39	3.1	14-5, 45/15-3, 43	3.9	17-1, 28/17-5, 25	4	26-4, 30/27-1, 31	4.3
23	B	*Thalassiosira jacksonii*	26-1, 39/26-5, 38	6.4	22-5, 45/23-3, 44	5.7	24-2, 24/25-1, 24	5.7		
24	T	*Thalassiosira marujamica*	18-3, 40/19-1, 39	3.3	10-3, 45/10-3, 45	2.9	12-7, 42/14-1, 40	4.3	8-2, 31/8-6, 30	2.7
25	B	*Thalassiosira marujamica*	26-1, 39/26-5, 38	6.4	27-5, 44/28-2, 44	7			34-5, 30/35-3, 29	5.6
26	T	*Nitzschia rolandii*	21-5, 40/22-4, 38	4.4	19-1, 44/19-5, 43	4.8				
27	B	*Nitzschia rolandii*	28-4, 39/30-2, 38	7.8	29-5, 45/30-3, 44	7.6				
28	T	*Thalassiosira temperei*	21-5, 40/22-4, 38	4.4	23-3, 45/23-CC	5.8				
29	B	*Thalassiosira temperei*	30-6, 39/31-4, 38	7.8	25-5, 45/26-3, 44	6.4				
30	T	*Actinocyclus ingens*	24-7, 40/26-1, 38	6						
31	T	*Rouxia californica*	24-7, 40/26-1, 38	6	20-5, 44/21-3, 44	5.1				
32	T	*Mediaria splendida*	24-7, 40/26-1, 38	6						
33	T	*Goniothecium tenue*	26-5, 39/27-1, 37	6.6						
34	T	*Synedra jouseana*	26-5, 39/27-1, 37	6.6	23-CC/25-1, 44	6				
35	T	*Thalassionema schraderi*	27-5, 39/28-4, 38	7	27-5, 44/28-2, 44	7				
36	B	*Thalassionema schraderi*	31-4, 39/32-2, 36	8						
37	T	*Actinocyclus ingens* var. *nodus*	28-4, 39/30-2, 38	8						
38	T	*Denticulopsis katayamae*	31-4, 39/32-2, 36	8						
39	T	*Nitzschia pliocena*			25-1, 45/25-5, 44	6.2				
40	B	*Nitzschia pliocena*			28-2, 45/29-1, 44	7.2				

[a] B = First occurrence, T = last occurrence.
[b] The highest and lowest stratigraphic levels at each hole for each datum level (core, section, level in cm) with a slash between them.
[c] Estimated from the sediment accumulation rate curve based on the paleomagnetic stratigraphy and diatom datum zonal boundaries.