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2. Data Report: Pliocene–Late Pleistocene Diatom Biostratigraphic Data from ODP Leg 185, Hole 1149A[1]

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ABSTRACT

We examined 75 samples from Unit I, Hole 1149A for diatoms. Fifty samples ranging from early Pliocene to late Pleistocene in age contained 139 diatom species and were attributable to the *Neodenticula kamtschatica* through *Neodenticula seminae* zones of the North Pacific diatom zonation and to the *Nitzschia jouseae* through *Pseudoeunotia doliolus* zones of the equatorial Pacific diatom zonation. Patterns of diatom abundance in Unit I correlate well with the diatom events of Barron. The data seem to show Barron's Events C and D and increases in diatom sedimentation in the late Pleistocene not specifically named by Barron but shown in his data. Inconsistencies of species ranges compared to published data suggest either extensive reworking or biogeographic control of first and last occurrences for some zonal indicator species. The presence of displaced Miocene, neritic, and benthic taxa strongly suggests aqueous or eolian transport of materials from coastal environments and/or land-based outcrops.

INTRODUCTION

Site 1149 is located at 31°20.519′N, 143°21.060′E in the northwestern Pacific. Cores 185-1149A-1H through 13H penetrated 118 m of ash and biogenic silica-bearing clay, designated Unit I, of late Miocene–late Pleistocene age (Shipboard Scientific Party, 2000). Unit I was found to contain diverse and abundant siliceous microfossils, including radiolarians, diatoms, and silicoflagellates. The purpose of this paper is to re-

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port on the Pliocene–late Pleistocene diatom biostratigraphy and the patterns of diatom abundance within Unit I and to illustrate the common and biostratigraphically significant diatom taxa observed. Recovery of Unit I in Hole 1149A was nearly 100%, permitting the development of a high-quality magnetostratigraphic framework for the upper Miocene–upper Pleistocene section. The detailed magnetostratigraphy (Shipboard Scientific Party, 2000) for Unit I allowed us to correlate to regional diatom biostratigraphy and global geochronology.

METHODS

A total of 157 samples were collected from lithologic Unit I in Cores 185-1149A-1H through 13H. The sampling interval was ~75 cm, beginning with Section 185-1149A-1H-1 at 00.61 meters below seafloor (mbsf) (Table T1). Approximately 1 g of air-dried sediment from each sample was cleaned and disaggregated in 15% hydrogen peroxide, followed by a 2% sodium hexametaphosphate (Calgon) solution and sonication in an ultrasonic bath for 5 s. When disaggregation was completed, each sample was washed five times by repeated decantations with deionized water to remove any suspended clays and sodium hexametaphosphate residue. Samples were allowed to stand undisturbed for 24 hr between decantations. A known quantity of *Lycopodium* sp. pollen grains and Rose Bengal dye were added to each sample to permit later estimations of diatom abundance (diatom number).

T1. Samples processed from Cores 185-1149A-1H through 13H, p. 16.

Strewn slides were prepared from the cleaned bulk sample using a settling method modified after Laws (1983). Prior to settling, some bulk wet samples were split to produce a concentration that would settle as a single layer on the coverslips. The 22 mm × 22 mm coverslips containing the settled sample were affixed to glass slides with Hyrax mounting medium. All diatoms were identified and counted at 1250× using the ribbon counting method (Laws, 1983) until at least 500 specimens were counted or 15 traverses (ribbons) were completed, whichever came first.

All samples collected, prepared, and analyzed for this report are shown in Table T1. The counts yield a raw data matrix of number of frustules for each species in each sample. The raw data for species present were converted to relative percents and are reported in Table T2 according to the following convention:

T2. Diatom abundance in Cores 185-1149A-1H through 11H, p. 18.

A = abundant, 15% or greater.
C = common, 4%–14.9%.
F = frequent, 1%–3.9%.
R = rare, <1%.
Barren = no diatoms encountered in three traverses.

Diatom abundance, as number of frustules per gram of sediment (diatom number), was calculated according to the following formula.

$$N_d = [L_t \times (D_c/L_c) \times 2^S]/M,$$

where

N_d = diatom number in valves per gram of sediment,
L_t = total number of *Lycopodium* spores added,
D_c = number of diatom frustules counted,

L_c = number of *Lycopodium* spores counted,
S = number of splits, and
M = dry weight in grams of sediment processed.

RESULTS

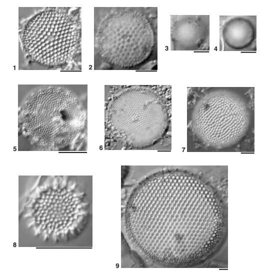
A total of 157 samples were collected, processed, and mounted onto microscope slides. Of those 157, 75 were examined for diatoms and 25 were barren (Table T1). All upper Miocene samples in Unit I were barren of diatoms. We identified 139 diatom species and varieties from 50 samples from lower Pliocene to upper Pleistocene strata. The complete list of diatom species identified in this study is shown in the floral list in the **Appendix,** p. 8. Illustrations of selected species are shown in Plates **P1, P2, P3, P4, P5, P6, P7, P8,** and **P9.**

Diatom Abundance

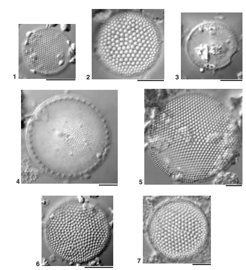
Figure F1 shows the pattern of diatom abundance (diatom number) with depth. Three peaks in abundance are noted: one at 91.6 mbsf, a second between 75 and 73 mbsf, and a third at 9.13 mbsf. The first peak (91.6 mbsf) correlates to the upper part of geomagnetic polarity Subchron C3n.1r at ~4.3 Ma. The second peak (between 75 and 73 mbsf) correlates to the interval between the base of Subchron C2An.2n and the top of Subchron C2An.1r between ~3.2 and 3.0 Ma. The third peak (9.1 mbsf) lies in the upper half of Chron C1n, which indicates an age between 260 and 265 ka. Diatom abundance remains relatively high between ~4.3 and 2.3 Ma, when it declines to its minimum value at ~2.2 Ma. This pattern seems to closely resemble the patterns of diatom sedimentation described by Barron (1998). The sudden increase in diatom abundance in Hole 1149A at ~4.3 Ma correlates well with the sudden increase in diatom accumulation rate noted by Barron (1998) at ~4.5 Ma, which he designated Event C. Barron (1998) also shows a continuously high diatom accumulation rate between 4.5 and 2.5 Ma. The significant decrease in diatom abundance in Hole 1149A between 2.3 and 2.15 Ma correlates well with Barron's (1998) Event D. The middle–late Pleistocene peak at ~265 ka also appears in Barron's (1998) data. Barron (1998) suggested that diatom Event C was related to the emergence of the Isthmus of Panama and Event D was related to fractionation of the North Atlantic and North Pacific Basins, concomitant adjustments in North Pacific circulation, and the expansion of Northern Hemisphere glaciation.

The diatom number (frustules per gram of sediment) is a conservative estimate of diatom abundance because broken pieces less than one-half the dimension of the valve are not counted. The diatom number would be affected by marked changes in nonbiogenic silica sediment input, and the patterns shown in Figure F1 might simply reflect abrupt changes in sediment accumulation rate. However, the sedimentation rate curve for Unit I shows a steadily increasing rate from ~12 m/m.y. in the early Pliocene to ~34 m/m.y. in the late Pleistocene (Shipboard Scientific Party, 2000), suggesting that the pattern shown in Figure F1 reflects actual changes in diatom accumulation. The diatom number is not directly comparable to Barron's (1998) data because the diatom number is not a rate of accumulation. Nevertheless, given these caveats, the similarity between the pattern shown in Figure F1 and Barron's (1998) data is striking.

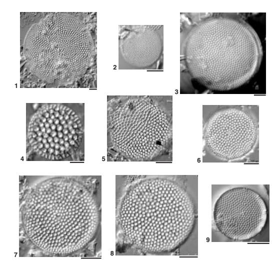
P1. *Thalassiosira* sp., p. 23.



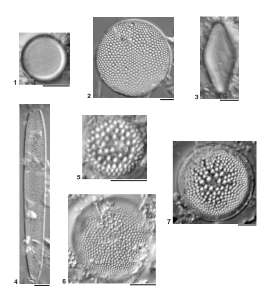
P2. *Thalassiosira* sp., p. 24.



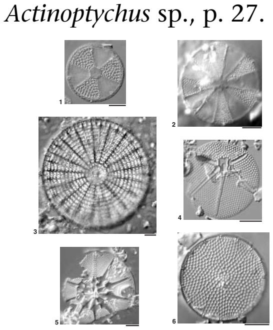
P3. *Coscinodiscus* sp. and *Azpeitia* sp., p. 25.



P4. *Actinocyclus* sp., p. 26.



P5. *Actinoptychus* sp., p. 27.



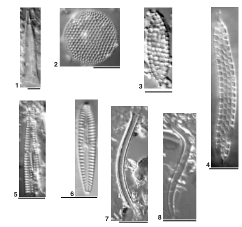
Biostratigraphy

Because of its location at 86.31°N, 144°E, the diatom flora from Unit I includes a variety of cold- and warm-water species and a significant number of neritic and benthic species, but their frustules are not numerically abundant. Table T2 shows the presence of all species identified within samples analyzed from Unit I. The most common and widespread taxa include *Azpeitia nodulifera, Coscinodiscus marginatus, Neodenticula koizumii, Nitzschia fossilis, Nitzschia interruptestriata, Nitzschia marina, Nitzschia reinholdii, Pseudoeunotia doliolis, Roperia tesselata, Thalassionema nitzschioides, Thalassiosira eccentrica, Thalassiosira lineata, Thalassiosira oestrupii, Thalassiosira tabulata,* and *Thalassiothrix longissima.* Neritic and benthic taxa encountered in Unit I include *Achnanthes, Amphora, Bacillaria, Biddulphia, Cyclotella, Delphineis, Diploneis, Epithemia, Gomphonema, Grammatophora, Lyrella, Navicula, Nitzschia, Odontella, Paralia, Pleurosigma, Rhaphoneis, T. nitzschioides,* and *Thalassiosira decipiens.*

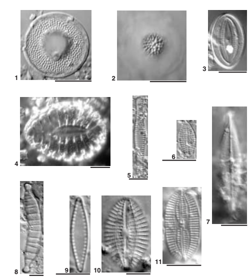
Figure F2 shows the presence within Unit I of some important biostratigraphic marker species and the correlation of strata in Unit I to North Pacific and equatorial Pacific diatom zonations based on those present and comparison to the magnetostratigraphic framework. It is interesting to note that zonal indicator species for all early Pliocene–late Pleistocene zones for both the equatorial Pacific and North Pacific zonations are present in Hole 1149A.

Stratigraphic ranges (tops and bases) of several important zonal markers are not consistent with ranges for those taxa reported by Barron and Gladenkov (1995), Akiba (1986), and Burckle and Opdyke (1985) based on comparison with the magnetostratigraphic framework. For example, *N. kamtschatica* is frequently present or commonly up into Subchron C1r.2r (~1.6 Ma) in Hole 1149A (Fig. F2), ~1 m.y. above the top of the last common occurrence reported by Barron and Gladenkov (1995) at ~2.6 Ma. This species continues to be present rarely and sporadically up into the upper Pleistocene in Hole 1149A (Fig. F2). The top of *N. koizumii* in Hole 1149A is present near the base of Subchron C1r.2r, which is slightly higher than reported by Akiba (1986) and Barron and Gladenkov (1995). The first occurrence (FO) of *N. koizumii* in Hole 1149A is slightly younger than the FO reported by Barron and Gladenkov (1995). The FO of *Actinocyclus oculatus* in Hole 1149A is in Subchron C2r.2r (~2.3 Ma) (Fig. F2), whereas the FO reported by Barron and Gladenkov (1995) is ~1 m.y. older. Likewise, the last occurrence (LO) of *A. oculatus* in Hole 1149A is ~0.5 m.y. higher than reported by Barron and Gladenkov (1995). Inconsistencies in first and LOs of diatom taxa in Hole 1149A with published ranges may be attributed to reworking of specimens through bioturbation and/or erosion and redeposition. Other evidence of reworking includes the presence of two species of *Denticulopsis,* which should have its LO in the upper Miocene as much as 20 m up into the Pliocene. Range inconsistencies may also be due to biogeographic distribution and dispersal patterns. Although the tops and bases for equatorial Pacific diatom zonation marker species show closer agreement to published data, the midlatitude location of Site 1149 may be out of the environmental optimum for both equatorial Pacific and North Pacific marker species even after attributing some amount of northwest plate motion since the early Pliocene. Also, assuming that these taxa have their evolutionary origins (FOs) in optimum equatorial Pacific or North Pacific environments, the FOs outside of those areas should be later owing to dispersal time. Therefore, it is

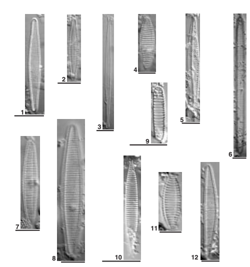
P6. Various diatom species, p. 28.



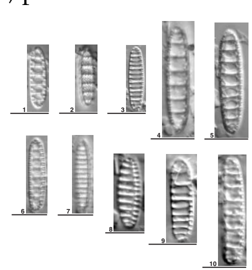
P7. Various diatom species, p. 29.



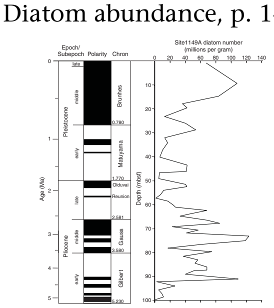
P8. *Nitzchia* sp. and *Pseudoeunotia* sp., p. 30.



P9. *Denticulopsis* sp. and *Neodenticula* sp., p. 31.



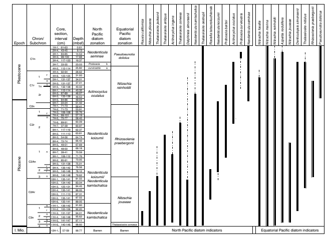
F1. Diatom abundance, p. 14.



not surprising that the bases and tops for some of these taxa are diachronous, especially the North Pacific taxa. Detailed comparison with the results of Legs 86 and 87 may shed light on these problems.

As many as 20 neritic, coastal, and benthic taxa are present in the diatom flora from Unit I, strongly suggesting some onshore to offshore transport of material to Site 1149 either by aqueous or eolian mechanisms. The presence of Miocene taxa (*Denticulopsis*) in Pliocene sediments suggests transport from land-based Miocene outcrops because the Miocene sediments from Site 1149 are barren of diatoms, precluding them as a source.

F2. Stratigraphic ranges, p. 15.



SUMMARY

We examined 75 samples from Unit I, Hole 1149A for diatoms. Fifty samples, ranging in age from early Pliocene to late Pleistocene, contained 139 diatom species and were attributable to the *N. kamtschatica* through *N. seminae* zones of the North Pacific zonation and to the *N. jouseae* through *P. doliolus* zones of the equatorial Pacific zonation. Patterns of diatom abundance in Unit I correlate well with the diatom events of Barron (1998). The data seems to show Barron's (1998) Events C and D and increases in diatom sedimentation in the late Pleistocene not specifically named by Barron (1998) but shown in his data. Inconsistencies of species ranges compared to published data suggest either extensive reworking or biogeographic control of first and LOs for some zonal indicator species. The presence of displaced Miocene, neritic, and benthic taxa strongly suggests aqueous or eolian transport of materials from coastal environments and/or land-based outcrops.

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APPENDIX

Floral List

Achnanthes groenlandica (Cleve) Grunow; Akiba, 1986, pl. 30, figs. 9, 10.

Achnanthes cf. *deliculata* (Kütz) Grunow; Desikachary and Prema, 1987, pl. 375, fig. 5.

Actinocyclus cubitus Hanna and Grant; Schrader, 1973, pl. 19, fig. 7 (Pl. **P4,** fig. 1).

Actinocyclus curvatulus Janisch; Schrader, 1973, pl. 19, fig. 2; Koizumi and Tanimura, 1985, pl. 3, fig. 9; Koizumi, 1986, pl. 3, fig. 4 (Pl. **P4,** fig. 2).

Actinocyclus ellipticus Grunow; Baldauf, 1984, pl. 6, fig. 4 (Pl. **P4,** fig. 3).

Actinocyclus ellipticus var. *elongatus* (Grunow) Kolbe; Akiba, 1986, pl. 16, fig. 10; Barron, 1985a, pl. 7, fig. 4. (Pl. **P4,** fig. 4).

Remarks: Also listed as *Actinocyclus ellipticus* Grunow in Van Huerck, 1883; Baldauf, 1984, pl. 6, fig. 7.

Actinocyclus ingens Rattray; Akiba, 1986, pl. 16, figs. 6, 9; Barron, 1985a, pl. 6, fig. 9; Baldauf, 1984, pl. 7, figs. 1, 2, 5, 7 (Pl. **P4,** fig. 5).

Actinocyclus ingens var. *nodus* Baldauf; Baldauf and Barron, 1980, pl. 1, fig. 7.

Actinocyclus octonarius Ehrenberg; Akiba, 1986.

Synonym: *Actinocyclus ehrenbergii* Ralphs in Pritchard; Schrader, 1973, pl. 19, fig. 1.

Actinocyclus oculatus Jousé; Koizumi and Tanimura, 1985, pl. 3, fig. 12; Koizumi, 1986, pl. 1, fig. 11 (Pl. **P4,** fig. 7).

Actinocyclus radiatus Rattray; Desikachary and Prema, 1987, pl. 223, fig. 2.

Actinoptychus senarius (Ehrenberg) Ehrenberg; Akiba, 1986, pl. 29, fig. 2.

Synonym: (1) *Actinocyclus senarius* Ehrenberg; (1) *Actinoptychus undulatus* (Bailey) Ralfs in Pritchard, Hustedt, 1929; Schrader, 1973, pl. 22, figs. 4, 12, 15, 17(?).

Actinoptychus splendens (Shädbolt) Ralfs in Pritchard; Schrader, 1973, pl. 22, figs. 10, 11, 13, 14, 16 (Pl. **P5,** fig. 2).

Amphora costata W. Smith; Akiba, 1986, pl. 30, fig. 7.

Arachnoidiscus schmidtii n. sp.; Hajos, 1976, pl. 8, figs. 1, 2 (Pl. **P5,** fig. 3).

Asterolampa acutiloba Forti in Tempère and Peragallo; Akiba, 1986, pl. 15, fig. 8; Koizumi and Tanimura, 1985, pl. 2, fig. 5; Koizumi, 1986, pl. 1, fig. 12.

Remarks: Listed as *Asterolampa acutiloba* Frenguelli; Barron, 1985a, pl. 6, fig. 6.

Asteromphalus arachne (Brébisson) Ralfs in Pritchard; Schrader, 1974, pl. 9, fig. 11; Barron, 1980, pl. 2, fig. 2 (Pl. **P5,** fig. 4).

Asteromphalus brookei Bailey; Koizumi and Tanimura, 1985, pl. 2, fig. 7.

Asteromphalus flabellatus (Brébisson) Grevielle; Schrader, 1974, pl. 8, fig. 3.

Asteromphalus hepatis (Brébisson) Ralfs in Pritchard; Schrader, 1974, pl. 8, fig. 1; Koizumi and Tanimura, 1985, pl. 2, fig. 1 (Pl. **P5,** fig. 5).

Asteromphalus hookerii Ehrenberg; Schrader, 1973, pl. 21, fig. 6; Schrader, 1974, pl. 8, fig. 7.

Asteromphalus robustus Castracane; Schrader, 1974, pl. 8, fig. 6.

Azpeitia neocrenulata VanLandingham; Hasle and Syvertsen, 1996, pl. 20 (Pl. **P5,** fig. 6).

Azpeitia nodulifera (A. Schmidt) G. Fryxell and P.A. Sims (Pl. **P3,** fig. 7).
Synonym: *Coscinodiscus nodulifer* A. Schmidt; Akiba, 1986, pl. 2, figs. 6, 7, pl. 3, fig. 6; Barron, 1985a, pl. 3, fig. 1; Koizumi and Tanimura, 1985, pl. 3, fig. 8; Koizumi, 1986, pl. 4, fig. 3.

Azpeitia nodulifera var. *cyclopus* (Jousé) G. Fryxell and P.A. Sims (Pl. **P3,** fig. 6).
Synonym: *Coscinodiscus nodulifer* var. *cyclopus* Jousé; Barron, 1980, pl. 4, fig. 3.

Bacillaria paxillifera (O.F. Muller) Hendey; Hendey, 1951, pl. 31, fig. 2.

Bacteriosira bathyomphala (Cleve) Syvertsen and Hasle (vide Hasle and Syvertsen). Hasle and Syvertsen, 1996 (Pl. **P7,** figs. 1, 2).

Bacteriostrum hyalinum Castracane; Desikachary and Prema, 1987, pl. 243, fig. 3.
Remarks: Positive identification is difficult because all specimens were broken with only central hyaline area observable.

Biddulphia cf. *moholensis* Schrader; Schrader, 1974, pl. 19, figs. 2, 3.

Cestodiscus species A Schrader, 1976, pl. 12, fig. 15.
Remarks: Only one fragment was found; therefore, no taxonomic study was made.

Chaetoceros species resting spores; Akiba, 1986, pl. 17, figs. 4–6, 13.

Cocconeis costata Gregory; Akiba, 1986, pl. 30, fig. 1.

Cocconeis cf. *pseudomarginata* Gregory; John, 1983, pl. 35, fig. 7 (Pl. **P7,** fig. 3).

Cocconeis cf. *scutellum* Ehrenberg; Akiba, 1986, pl. 30, fig. 2.
Remarks: Marine tychopelagic/benthic (Akiba, 1986).

Coscinodiscus asteromphalus Ehrenberg; Hasle and Syvertsen 1996, pl. 15 (Pl. **P3,** fig. 1).

Coscinodiscus curvatulus Grunow; Barron, 1980, pl. 3, fig. 7 (Pl. **P3,** fig. 2).

Coscinodiscus endoi Kanaya; Koizumi and Tanimura, 1985, pl. 4, fig. 12 (Pl. **P3,** fig. 3).

Coscinodiscus marginatus Ehrenberg; Koizumi, 1986, pl. 3, fig. 7 (Pl. **P3,** figs. 4, 5).

Coscinodiscus nitidus Gregory; Barron, 1975, pl. 7, fig. 3.

Coscinodiscus radiatus Ehrenberg; Barron, 1985a, pl. 3, fig. 7 (Pl. **P3,** fig. 8).

Coscinodiscus tabularis Akiba, 1986, pl. 2, figs. 3, 4; Barron, 1985a, pl. 3, fig. 4 (Pl. **P3,** fig. 9).

Coscinodiscus yabei Kanaya; Barron, 1985a, pl. 4, fig. 7; Koizumi and Tanimura, 1985, pl. 3, figs. 10, 11.

Craspedodiscus coscinodiscus Ehrenberg; Barron, 1985a, pl. 2, fig. 3.

Cyclotella striata (Kützing) Grunow; Akiba, 1986, pl. 4, figs. 8–10.
Remarks: Northern temperate region, littoral (Hasle and Syvertsen, 1996).

Delphineis cf. *angustata* (Pantocsek) Andrews; Akiba, 1986, pl. 20, figs. 4–7.

Delphineis simonsenii (Mertz) Akiba; Akiba, 1986, pl. 20, figs. 12–13 (Pl. **P7,** fig. 5).

Delphineis surirella (Ehrenberg) Andrews; Akiba, 1986, pl. 20, figs. 2, 3 (Pl. **P7,** fig. 6).
Synonym: *Rhaphoneis surirella* (Ehrenberg) Grunow

Denticulopsis hyalina (Schrader) Simonsen; Grunow; Akiba, 1986, pl. 29, figs. 16, 17; Koizumi and Tanimura, 1985, pl. 1, fig. 3 (Pl. **P9,** figs. 4, 5).

Denticulopsis simonsenii n. sp. Yanagisawa and Akiba, 1990, pl. 3, figs. 1–3, pl. 11, figs. 1, 5 (Pl. **P9,** figs. 1–3, 6, 7).

Synonym: *Denticulopsis hustedtii* (Simonsen and Kanaya) Simonsen; Akiba, 1986, pl. 28, figs. 5–18; Koizumi and Tanimura, 1985, pl. 1, figs. 7, 8.

Diploneis bombus Ehrenberg; Akiba, 1986, pl. 30, fig. 13.

Diploneis smithii (Brébisson) Cleve; Akiba, 1986, pl. 30, fig. 8 (Pl. **P7,** fig. 10).

Epithemia species A (Pl. **P7,** fig. 8).

Gomphonema cf. *affine;* Laws, 1988, pl. 29, fig. 10 (Pl. **P6,** fig. 6).

Gomphonema cf. *rhombicum;* Laws, 1988, pl. 29, fig. 8.

Grammatophora arcuata Ehrenberg; Akiba, 1986, pl. 29, fig. 11.

Grammatophora cf. *oceanica* (Ehrenberg) Grunow; Akiba, 1986, pl. 29, figs. 16, 17.

Hemidiscus cuneiformis Wallich; Akiba, 1986, pl. 16, figs. 3, 4; Barron, 1985a, pl. 9, fig. 12; Koizumi and Tanimura, 1985, pl. 5, fig. 12; Koizumi, 1986, pl. 4, fig. 4.

Ikebea tenuis (Brun) Akiba; Akiba, 1986, pl. 19, figs. 1–5.
Remarks: Only one fragment was found.

Kisseleviella ezoensis Akiba; Akiba, 1986, pl. 19, figs. 13–16.
Remarks: Only one fragment was found.

Lyrella species A.

Melosira albicans Sheshukova-Poretzkaya; Akiba, 1986, pl. 4, figs. 11, 12.

Melosira sol (Ehrenberg) Kützing; Sancetta, 1982, pl. 3, fig. 4.

Navicula cf. *digitoradiata* (Gregory) Ralfs; Desikachary and Prema, 1987, pl. 370, fig. 16.
Remarks: Only a few fragments were found.

Navicula cf. *flanatica* Grunow; Witowski, 1994, pl. 30, figs. 2, 3 (Pl. **P7,** fig. 7).

Navicula lyrella Ehrenberg; Desikachary et al., 1987, pl. 160, figs. 3, 4, 6 (Pl. **P7,** fig. 11).

Navicula cf. *oestrupii* Schulz; Witowski, 1994, pl. 32, figs. 2–6.

Neodenticula kamtschatica (Zabelina) Akiba and Yanagisawa, 1986; Akiba, 1986, pl. 25, figs. 7–27 (Pl. **P9,** fig. 8).

Neodenticula koizumii Akiba et Yanagisawa; Akiba and Yanagisawa, 1986, pl. 21, figs. 22–28, pl. 23, figs. 1–12, pl. 24, fig. 19; Yanagisawa and Akiba, 1990, pl. 7, figs. 38–41 (42–44) (Pl. **P9,** fig. 9).

Neodenticula seminae (Simonsen et Kanaya) Akiba et Yanagisawa; Yanagisawa and Akiba, 1990, pl. 7, figs. 45–49; Akiba, 1986, pl. 25, figs. 28–32 (Pl. **P9,** fig. 10).

Nitzschia fossilis (Frenguelli) Kanaya; Akiba, 1986, pl. 4, figs. 11, 12; Barron, 1985a, pl. 8, figs. 8, 9; Koizumi and Tanimura, 1985, pl. 1, fig. 18, pl. 6, fig. 12 (Pl. **P8,** fig. 1).

Nitzschia interruptestriata Simonsen; Akiba, 1986, pl. 24, fig. 2; Koizumi and Tanimura, 1985, pl. 6, fig. 8 (Pl. **P8,** figs. 2, 3).

Nitzschia jouseae Burckle; Akiba, 1986, pl. 23, figs. 4, 5, 11; Koizumi and Tanimura, 1985, pl. 1, fig. 12, pl. 6, fig. 12; Koizumi, 1986, pl. 1, fig. 4 (Pl. **P8,** fig. 4).

Nitzschia kolaczekii Grunow; Akiba, 1986, pl. 24, fig. 5 (Pl. **P8,** fig. 5).

Nitzschia marina Grunow; Akiba, 1986, pl. 22, fig. 12; Koizumi and Tanimura, 1985, pl. 6, figs. 1, 2; Koizumi, 1986, pl. 2, fig. 7 (Pl. **P8,** fig. 6).

Nitzschia panduriformis var. *minor* Grun; Desikachary et al., 1987, p. 7, pl. 166, fig. 7.
Remarks: Only one fragment was found.

Nitzschia pliocena (Brun) Mertz; Akiba, 1986, pl. 23, figs. 6–9 (Pl. **P8,** fig. 7).

Nitzschia reinholdii Kanaya and Koizumi; Barron, 1985a, pl. 8, fig. 22 (Pl. **P8,** fig. 8).
Synonym: (1) *N. reinholdii* Kanaya ex Schrader, 1973 in Akiba, 1986, pl. 22, figs. 4–5; (2) *N. reinholdii* Kanaya; Koizumi and Tanimura, 1985, pl. 6, figs. 3, 4; Koizumi, 1986, pl. 1, fig. 6.

Nitzschia rolandii Schrader; Akiba, 1986, pl. 24, fig. 13, pl. 25, figs. 1–6 (Pl. **P8,** fig. 9).

Nitzschia cf. *seriata* Cleve; Akiba, 1986, pl. 24, fig. 1.

Nitzschia cf. *sicula* (Castracane) Hustedt; Akiba, 1986, pl. 24, fig. 4 (Pl. **P7,** figs. 10, 11).

Odontella aurita (Lyngbye) Agardh; Akiba, 1986, pl. 17, figs. 2, 3.

Paralia sulcata (Ehrenberg) Cleve; Akiba, 1986, pl. 29, figs. 4, 5.
Synonym: *Melosira sulcata* (Ehrenberg).

Pleurosigma cf. n. sp. Schrader; Schrader and Fenner, 1976, pl. 5, fig. 25.

Podosira cf. *maxima* (Kützing) Grunow; Barron, 1975, pl. 11, fig. 15.
Remarks: Only one fragment was found.

Porosira glacialis (Grunow) Jørgensen; Koizumi, 1986, pl. 4, fig. 13.

Proboscia barboi (Brun) Jordan and Priddle; Akiba, 1986, pl. 18, fig. 2; Koizumi and Tanimura, 1985, pl. 6, fig. 16 (Pl. **P6,** fig. 7).
Synonym: (1) *Simonseniella barboi* Brun; (2) *Rhizosolenia barboi* Brun.

Proboscia curvirostris (Jousé) Jordan and Priddle; Akiba, 1986, pl. 18, fig. 3; Koizumi, 1986, pl. 1, fig. 8 (Pl. **P6,** fig. 8).
Synonym: (1) *Simonseniella curvirostris* Jousé; (2) *Rhizosolenia curvirostris* Jousé.

Pseudoeunotia doliolus (Wallich) Grunow; Akiba, 1986, pl. 22, figs. 1–2; Koizumi and Tanimura, 1985, pl. 1, fig. 17, pl. 6, fig. 5; Koizumi, 1986, pl. 1, fig. 3 (Pl. **P8,** fig. 12).
Remarks: Medlin and Sims (1993) proposed to synonymize *Pseudoeunotia* with *Fragilariopsis* and to conserve the junior synonym *Fragilariopsis* primarily because it contains numerous species, whereas *Pseudoeunotia* contains only one species, *P. doliolus*. That proposal has not been universally accepted or applied, especially in biostratigraphic literature (i.e., Barron and Gladenkov, 1995; Koç et al., 1999). Therefore, *Pseudoeunotia* is used in this report to conform to the common usage in biostratigraphic literature and the name of the equatorial Pacific diatom zonation proposed by Barron (1985a, 1985b).

Rhaphoneis amphiceros Ehrenberg; Akiba, 1986, pl. 20, fig. 19.

Rhaphoneis cf. *ischaboensis* (Grunow) Mertz; Akiba, 1986, pl. 20, figs. 8–11.

Rhizosolenia hebetata var. *hiemalis* Gran; Akiba, 1986, pl. 17, figs. 10, 11, pl. 18, figs. 9, 10.

Rhizosolenia praebergonii Mukhina; Koizumi, 1986, pl. 1, fig. 7; Koizumi and Tanimura, 1985, pl. 6, fig. 13 (Pl. **P6,** fig. 1).
Synonym: *Rhizosolenia bergonii* Pergallo; Koizumi and Tanimura, 1985, pl. 2, fig. 4; pl. 6, fig. 14.

Rhizosolenia styliformis (“A”) Brightwell; Schrader, 1973, pl. 10, fig. 21.

Rhizosolenia styliformis ("B") Brightwell; Akiba, 1986, pl. 18, fig. 4.

Rhizosolenia species A.
Remarks: Only one fragment was found; therefore, no taxonomic study was made.

Roperia tesselata (Roper) Grunow; Akiba, 1986, pl. 16, fig. 7; Koizumi and Tanimura, 1986, pl. 5, figs. 5, 6; Koizumi, 1986, pl. 2, fig. 8 (Pl. **P6,** fig. 2).

Rosiella tatsunokuchiensis (Koizumi) Gersonde and Schrader; Akiba, 1986, pl. 19, figs. 7–9; Koizumi, 1986, pl. 1, fig. 5 (Pl. **P6,** fig. 3).
Synonym: *Bogorovia tatsunokuchiensis* Koizumi; Koizumi and Tanimura, 1986, pl. 1, fig. 19.

Rosiella cf. *tatsunokuchiensis* Koizumi; Akiba, 1986, pl. 19, figs. 10–12 (Pl. **P6,** fig. 4).

Rouxia californica M. Peragallo; Akiba, 1986, pl. 21, figs. 5, 6; Koizumi and Tanimura, 1985, pl. 1, fig. 21 (Pl. **P6,** fig. 5).

Screptoneis species A.
Remarks: Only one fragment was found; therefore, no taxonomic study was made.

Stephanodiscus astreae var. *minutula* Grun; Schader, 1973, pl. 13, figs. 19, 20.

Stephanodiscus species A.

Stephanodiscus species B.

Stephanopyxis marginata Grunow; Schrader and Fenner, 1976, pl. 20, fig. 3.

Stephanopyxis turris (Greville and Arnott) Ralfs; Barron, 1975, pl. 13, figs. 1–3.

Surirella cf. *ovata*? (Pl. **P7,** fig. 4).

Synedra miocenica Schrader; Akiba, 1986, pl. 21, fig. 7.

Terpinsoe species A.
Remarks: Only one fragment was found; therefore, no taxonomic study was made.

Thalassionema nitzschioides (Grunow) H. and M. Pergallo; Akiba, 1986, pl. 21, fig. 11; Barron, 1985a, pl. 8, figs. 13, 15; Koizumi, 1986, pl. 2, fig. 5.

Thalassionema nitzschioides var. *lanceolata* (Grunow) H. and M. Pergallo; Desikachary et al., 1987, pl. 200, figs. 17–19.

Thalassiosira antiqua (Grunow) Cleve-Euler; Akiba, 1986, pl. 12, figs. 1, 3, 4; Koizumi and Tanimura, 1985, pl. 4, fig. 9 (Pl. **P1,** figs. 1, 2).

Thalassiosira burckliana Schrader; Akiba, 1986, pl. 10, fig. 5; Barron, 1985a, pl. 4, fig. 6.

Thalassiosira convexa Mukhina; Akiba, 1986, pl. 8, fig. 1; Koizumi, 1986, pl. 1, fig. 10 (Pl. **P1,** figs. 3, 4).
Remarks: Listed as *Thalassiosira convexa* var. *convexa* Mukhina; Barron, 1985a, pl. 5, fig. 9.

Thalassiosira decipiens (Grunow) Jørgensen; Koizumi and Tanimura, 1985, pl. 3, figs. 10, 11; Koizumi, 1986, pl. 4, fig. 2 (Pl. **P1,** fig. 5).

Thalassiosira eccentrica (Ehrenberg) Cleve; Akiba, 1986, pl. 14, fig. 13; Barron, 1985a, pl. 5, fig. 1; Koizumi, 1986, pl. 2, fig. 3 (Pl. **P1,** fig. 6).

Thalassiosira gravida Cleve; Akiba, 1986, pl. 10, figs. 1–4; Koizumi, 1986, pl. 3, fig. 5 (Pl. **P1,** fig. 7).

Thalassiosira grunowii Akiba and Yanagisawa, 1986, pl. 27, fig. 5.
Synonym: *Coscinodiscus plicatus* Grunow; Koizumi and Tanimura, 1985, pl. 3, figs. 3, 4.

Thalassiosira jacksonii Koizumi and Barron; Akiba, 1986, pl. 11, fig. 2; Koizumi and Tanimura, 1985, pl. 4, fig. 7.

Thalassiosira jouseae Akiba; Akiba, 1986, pl. 6, figs. 8–10 (Pl. **P1,** fig. 8).

Thalassiosira leptopus (Grunow) Hasle and Fryxell; Akiba, 1986, pl. 14, fig. 12; Barron, 1985a, pl. 5, fig. 5; Koizumi, 1986, pl. 2, fig. 4 (Pl. **P1,** fig. 9).

Thalassiosira lineata Jousé; Akiba, 1986, pl. 14, figs. 7, 9; Koizumi, 1986, pl. 4, fig. 6 (Pl. **P2,** fig. 1).

Thalassiosira marujamica Sheshukova-Poretzkaya; Akiba, 1986, pl. 13, figs. 1–7.

Thalassiosira nidulus (Tempère and Brun) Jousé; Akiba, 1986, pl. 6, figs. 4–7.

Thalassiosira nordenskioldi Cleve; Akiba, 1986, pl. 5, fig. 8.

Thalassiosira oestrupii (Ostenfeld) Proshkina-Lavrenko; Akiba, 1986, pl. 14, figs. 1–6; Barron, 1985a, pl. 4, fig. 5; Koizumi and Tanimura, 1985, pl. 4, figs. 4–6; pl. 5, figs. 1–4, 11; Koizumi, 1986, pl. 2, fig. 1 (Pl. **P2,** fig. 2).

Thalassiosira pacifica; Koizumi and Tanimura, 1985, pl. 4, fig. 13.

Thalassiosira plicata Schrader; Koizumi and Tanimura, 1985, pl. 3, fig. 13; pl. 5, figs. 7, 8 (Pl. **P2,** fig. 3).

Thalassiosira cf. *praeconvexa* (Burckle) Schrader; Akiba, 1986, pl. 8, fig. 5.

Thalassiosira punctata Jousé; Akiba, 1986, pl. 9, figs. 5, 6.

Thalassiosira symbolophora Grunow; Koizumi and Tanimura, 1985, pl. 5, figs. 9, 10 (Pl. **P2,** fig. 4).

Thalassiosira symmetrica (Ehrenberg) Cleve; Akiba, 1986, pl. 14, fig. 13 (Pl. **P2,** fig. 5).

Thalassiosira trifulta Fryxell; Akiba, 1986, pl. 10, figs. 5–7; Koizumi and Tanimura, 1985, pl. 3, fig. 7; Koizumi, 1986, pl. 3, fig. 9 (Pl. **P2,** fig. 6).

Thalassiosira zabelinae Jousé; Akiba, 1986, pl. 8, fig. 11.

Thalassiosira species A; Akiba, 1986, pl. 15, fig. 7 (Pl. **P2,** fig. 7).

Thalassiothrix longissima Cleve and Grunow; Akiba, 1986, pl. 21, fig. 18; Barron, 1985a, pl. 8, fig. 16.

Thalassiothrix robusta Schrader; Akiba, 1986, pl. 21, fig. 4.
Remarks: Only one fragment was found.

Triceratium alternans Bailey; Akiba, 1986, pl. 29, figs. 13, 14.

Triceratium cinnamomeum Greville; Schrader, 1974, pl. 20, figs. 10, 11.

Unknown species A (Pl. **P7,** fig. 9).
Remarks: Only one specimen was found; therefore, no taxonomic study was made.

Figure F1. Diatom abundance for Unit I, Hole 1149A plotted against a magnetostratigraphic framework. Depth = meters below seafloor (mbsf).

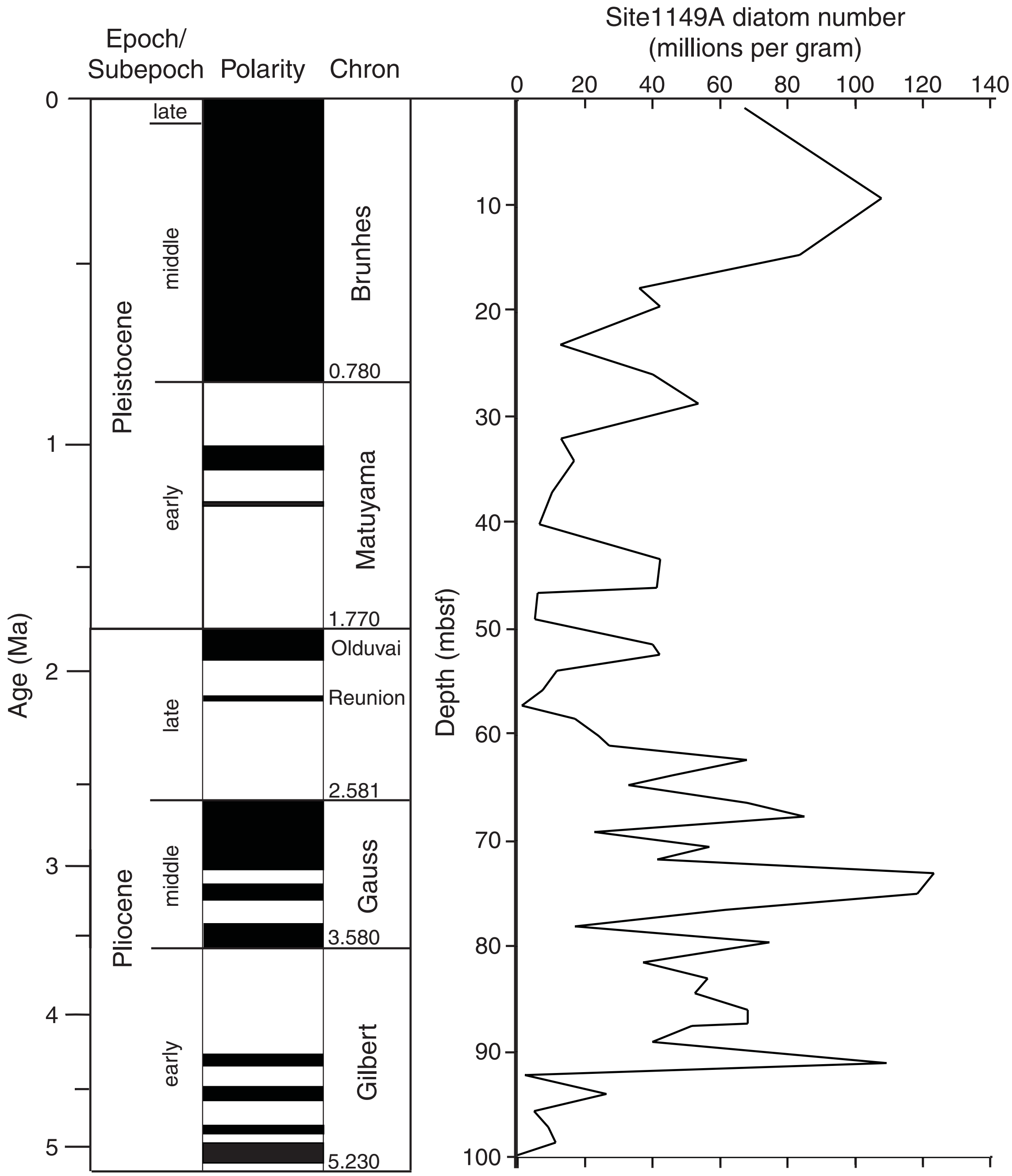

Figure F2. Stratigraphic ranges in Hole 1149A for some key zonal marker species. Solid lines = intervals where a particular species was abundant, common, or frequent (≥1%). Dashed lines = intervals where a species was rare or where an interval barren of a particular species were connected by two rare occurrences. Depths = the position of samples examined during the study.

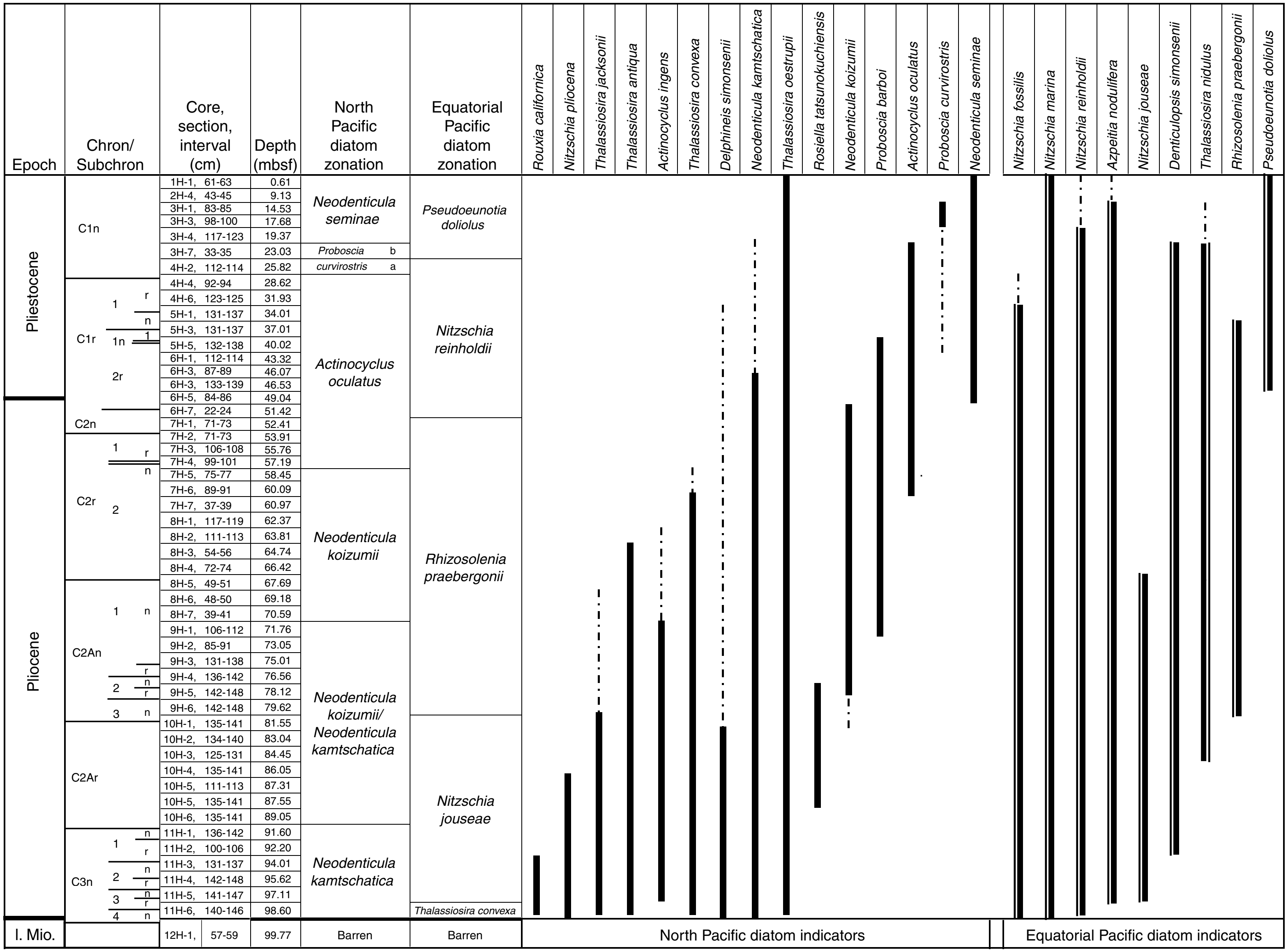

Table T1. A list of processed samples from Cores 185-1149A-1H through 13H. (Continued on next page.)

Core, section, interval (cm)	Actual depth (mbsf)	Microscope	Contains diatoms
185-1149A-			
1H-1, 61–63	0.61	X	X
1H-1, 112–118	1.12		
1H-2, 69–71	2.19		
1H-2, 112–118	2.62		
1H-3, 40–42	3.40		
2H-1, 45–47	4.65		
2H-1, 132–137	5.52		
2H-2, 31–33	6.01		
2H-2, 131–136	7.01		
2H-3, 122–124	8.42		
2H-3, 137–141	8.57		
2H-4, 43–45	9.13	X	X
2H-4, 133–138	10.03		
2H-5, 47–49	10.67		
2H-5, 132–138	11.52		
2H-6, 62–64	12.32		
2H-6, 132–138	13.02		
2H-7, 40–42	13.60		
3H-1, 83–85	14.53	X	X
3H-1, 114–120	14.84		
3H-2, 110–112	16.30		
3H-2, 133–139	16.53		
3H-3, 98–100	17.68	X	X
3H-3, 133–139	18.03		
3H-4, 76–78	18.96		
3H-4, 117–123	19.37	X	X
3H-5, 31–33	20.01		
3H-5, 125–131	20.95		
3H-6, 113–115	22.33		
3H-6, 128–134	22.48		
3H-7, 33–35	23.03	X	X
4H-1, 111–113	24.31		
4H-1, 134–141	24.54		
4H-2, 112–114	25.82	X	X
4H-2, 134–141	26.04		
4H-3, 114–116	27.34		
4H-3, 134–141	27.54		
4H-4, 92–94	28.62	X	X
4H-4, 103–109	28.73		
4H-5, 117–119	30.37		
4H-5, 131–138	30.51		
4H-6, 123–125	31.93	X	X
4H-6, 132–141	32.02		
4H-7, 52–54	32.72		
5H-1, 111–113	33.81		
5H-1, 131–137	34.01	X	X
5H-2, 119–121	35.39		
5H-2, 133–139	35.53		
5H-3, 22–24	35.92		
5H-3, 131–137	37.01	X	X
5H-4, 96–98	38.16		
5H-4, 133–139	38.53		
5H-5, 33–35	39.03		
5H-5, 132–138	40.02	X	X
5H-6, 97–99	41.17		
5H-6, 133–139	41.53		
5H-7, 36–38	42.06		
6H-1, 112–114	43.32	X	X
6H-1, 133–139	43.53		
6H-2, 78–80	44.48		
6H-2, 133–139	45.03		
6H-3, 87–89	46.07	X	X
6H-3, 133–139	46.53	X	X
6H-4, 111–113	47.81		
6H-4, 125–131	47.95		
6H-5, 84–86	49.04	X	X
6H-5, 133–139	49.53		
6H-6, 100–102	50.70		
6H-6, 133–139	51.03		
6H-7, 22–24	51.42	X	X
7H-1, 71–73	52.41	X	X
7H-1, 133–139	53.03		
7H-2, 71–73	53.91	X	X
7H-2, 133–139	54.53		
7H-3, 106–108	55.76	X	X
7H-3, 133–139	56.03		
7H-4, 99–101	57.19	X	X
7H-4, 133–139	57.53		
7H-5, 75–77	58.45	X	X
7H-5, 123–129	58.93		
7H-6, 89–91	60.09	X	X
7H-6, 124–130	60.44		
7H-7, 37–39	60.97	X	X
8H-1, 117–119	62.37	X	X
8H-1, 144–150	62.64		
8H-2, 111–113	63.81	X	X
8H-2, 132–138	64.02		
8H-3, 54–56	64.74	X	X
8H-3, 127–133	65.47		
8H-4, 72–74	66.42	X	X
8H-4, 135–140	67.05		
8H-5, 49–51	67.69	X	X
8H-5, 126–132	68.46		
8H-6, 48–50	69.18	X	X
8H-6, 130–135	70.00		
8H-7, 39–41	70.59	X	X
9H-1, 54–56	71.24		
9H-1, 106–112	71.76	X	X
9H-2, 59–61	72.79		
9H-2, 85–91	73.05	X	X
9H-3, 55–57	74.25		
9H-3, 131–138	75.01	X	X
9H-4, 72–74	75.92		
9H-4, 136–142	76.56	X	X
9H-5, 80–82	77.50		
9H-5, 142–148	78.12	X	X
9H-6, 62–64	78.82		
9H-6, 142–148	79.62	X	X
10H-1, 61–63	80.81		
10H-1, 135–141	81.55	X	X
10H-2, 52–54	82.22		
10H-2, 134–140	83.04	X	X
10H-3, 57–59	83.77		
10H-3, 125–131	84.45	X	X
10H-4, 91–93	85.61		
10H-4, 135–141	86.05	X	X
10H-5, 111–113	87.31	X	X
10H-5, 135–141	87.55	X	X
10H-6, 68–70	88.38		
10H-6, 135–141	89.05	X	X
11H-1, 61–63	90.31		
11H-1, 136–142	91.06	X	X
11H-2, 59–61	91.79		
11H-2, 100–106	92.20	X	X
11H-3, 54–56	93.24		
11H-3, 131–137	94.01	X	X
11H-4, 63–65	94.83		
11H-4, 142–148	95.62	X	X
11H-5, 53–55	96.23		
11H-5, 141–147	97.11	X	X
11H-6, 60–62	97.80		
11H-6, 140–146	98.60	X	X
12H-1, 57–59	99.77	X	
12H-1, 135–141	100.55	X	
12H-2, 70–72	101.40	X	

Table T1 (continued).

Core, section, interval (cm)	Actual depth (mbsf)	Microscope	Contains diatoms
12H-2, 135–141	102.05	X	
12H-3, 72–74	102.92	X	
12H-3, 125–131	103.45	X	
12H-4, 72–74	104.42	X	
12H-4, 136–142	105.06	X	
12H-5, 70–72	105.90	X	
12H-5, 136–142	106.56	X	
12H-6, 91–93	107.61	X	
12H-6, 108–110	107.78	X	
12H-7, 33–35	108.53	X	
13H-1, 67–69	109.37	X	
13H-1, 143–149	110.13	X	
13H-2, 70–72	110.90	X	
13H-2, 143–149	111.63	X	
13H-3, 70–72	112.40	X	
13H-3, 143–149	113.13	X	
13H-4, 70–72	113.90	X	
13H-4, 133–139	114.53	X	
13H-5, 78–80	115.48	X	
13H-6, 40–46	116.60	X	
13H-7, 63–65	117.11	X	
13H-7, 143–149	117.91	X	

Table T2. Diatom abundance for each species observed for Cores 185-1149A-1H through 11H. (Continued on next four pages.)

Age	Core, section, interval (cm)	Marine diatoms depth (mbsf)	*Achnanthes groenlandica*	*Achnanthes* cf. *deliculata*	*Actinocyclus cubitus*	*Actinocyclus curvatulus*	*Actinocyclus ellipticus*	*Actinocylcus ellipticus* var. *lanceolata*	*Actinocyclus ingens*	*Actinocyclus ingens* var. *nodus*	*Actinocyclus octonarius*	*Actinocyclus oculatus*	*Actinocyclus radiatus*	*Actynoptychus senarius*	*Actinoptychus splendens*	*Amphora costata*	*Arachnoidiscus scmidtii*	*Asterolampra acutiloba*	*Asteromphalus arachne*	*Asteromphalus brookei*	*Asteromphalus flabellatus*	*Asteromphalus hepactis*	*Asteromphalus hookerii*	*Asteromphalus robustus*	*Azpeitia neocrenulata*	*Azpeitia nodulifera*	*Bacillaria paxillifera*	*Bacteriosira bathyomphala*	*Bacteriostrum hyalinum*	*Biddulphia* cf. *moholensis*	*Cestodiscus* species A	*Cocconeis costata*
	185-1149A-																															
Pleistocene	1H-1, 61–63	0.61			F	R		R			R			R	R			R	R						F	R		R	R			R
	2H-4, 43–45	9.13			F	F					R	R			R								R		R	R						R
	3H-1, 83–85	14.53				R						R		R	R						R	R			F	F			R			R
	3H-3, 98–100	17.68			F	R					R	F		R	R							R			C	C						
	3H-4, 117–123	19.37			R	R					R	F		F	F				R			R	R		C	F			R			R
	3H-7, 33–35	23.03									F	F													F	F						
	4H-2, 112–114	25.82			R	R					R			F								R			F	F						R
	4H-4, 92–94	28.62												C											R							R
	4H-6, 123–125	31.93			F	R					R	R		R				R			R	R	R		F	F			R			R
	5H-1, 131–137	34.01			R	F					R			C		R							R		F	C						R
	5H-3, 131–137	37.01			R	R					R	R		F											F	F						R
	5H-5, 132–138	40.02										C		F																		
	6H-1, 112–114	43.32				R		R				R		R									R	R	F	F		R				
	6H-3, 87–89	46.07				R					R	R		F				R	R				R	R	R	F			R			R
	6H-3, 133–139	46.53				R					R	R		R	R		R	R						F	F	C						R
Pliocene	6H-5, 84–86	49.04			R	R						R		F				R							R	R						R
	6H-7, 22–24	51.42				F					R	R		F											F	F						
	7H-1, 71–73	52.41			R	F								F											R	F			R			
	7H-2, 71–73	53.91				R	R					F		R		R									R	F			R			
	7H-3, 106–108	55.76			R	F					R	F		R			R						R		R	F			R			R
	7H-4, 99–101	57.19										F		F																		
	7H-5, 75–77	58.45			R	F						R		F			R							R	R	F						R
	7H-6, 89–91	60.09				F		R			R	R		R			R								R	C			R			R
	7H-7, 37–39	60.97			R	F					R			R		R				R			R	R	R	C			F			
	8H-1, 117–119	62.37				F								F									R	R	R	C			F			
	8H-2, 111–113	63.81			R	R		R	R		F			F											R	F			F			
	8H-3, 54–56	64.74			R	R								R										R	R	F			R			R
	8H-4, 72–74	66.42			R	F		R			R			F		R							R	R	R	F			R			R
	8H-5, 49–51	67.69	R	R	F	R		R	R		R			F						R				R		F		R	R			R
	8H-6, 48–50	69.18			F						R		R	F											R	C						R
	8H-7, 39–41	70.59			F	F		R			R			F									R			C			R			R
	9H-1, 106–112	71.76	R		R	R		R	R					R												C						R
	9H-2, 85–91	73.05	R		R	F	R	R	R		R			F					R				R		R	F	R					
	9H-3, 131–138	75.01	R		R	R		R	R	R	R			F						R				R		F			R			
	9H-4, 136–142	76.56	R			F			R		R			C									R			F			R			
	9H-5, 142–148	78.12	R		R	R		R	R		R			F									R	R		F			R	R		R
	9H-6, 142–148	79.62	R			F			R		R			F									R	R	R	F			R	R		R
	10H-1, 135–141	81.55	R	R		R			R		F			F					R				R	R		F			F			R
	10H-2, 134–140	83.04	F			R	R	R	R		F			F									R			C						R
	10H-3, 125–131	84.45	F		R	R			R		F			F					R	R			R		R	C						F
	10H-4, 135–141	86.05	R			F		R	R		F			F		R								R	R	C			F			R
	10H-5, 111–113	87.31	R			R	R	F	R		F			F					R	R				R	R	F			R	R		R
	10H-5, 135–141	87.55	R			F	R	R	F		R			F					R						R	C			R		R	F
	10H-6, 135–141	89.05			F		R							F						R					R	C			F			F
	11H-1, 136–142	91.60	F			R					R			F										R		F			R			F
	11H-2, 100–106	92.20								F				C																		C
	11H-3, 131–137	94.01			F				F					F												F			R			F
	11H-4, 142–148	95.62			F	R	F				R			C						F				F		F			F			R
	11H-5, 141–147	97.11			F						R			F						F				R		R			F			
	11H-6, 140–146	98.60			F	R			R		R			C						R				R	R	F			R			R

Notes: A = abundant (15% or greater), C = common (4–14%), F= frequent (1–9%), and R = rare (less than 1%).

Table T2 (continued).

Age	Core, section, interval (cm)	Marine diatoms depth (mbsf)	*Cocconeis* cf. *pseudomarginata*	*Cocconeis* cf. *scutellum*	*Coscinodiscus asteromphalus*	*Coscinodiscus curvatulus*	*Coscinodiscus endoi*	*Coscinodiscus marginatus*	*Coscinodiscus nitidus*	*Coscinodiscus radiatus*	*Coscinodiscus tabularis*	*Coscinodiscus yabei*	*Craspedodiscus coscinodiscus*	*Cyclotella striata*	*Delphineis* cf. *angustata*	*Delphineis surirella*	*Denticulopsis hyalina*	*Denticulopsis simonsenii*	*Diploneis bombus*	*Diploneis smithii*	*Epithemia* species A	*Gomphonema* cf. *affine*	*Gomphonema* cf. *rhombicum*	*Grammatophora arcuata*	*Grammatophora* cf. *oceanica*	*Hemidiscus cuneiformis*	*Ikebea tenuis*	*Kisseleviella ezoensis*	*Lyrella* species A	*Mediaria spendida*	*Melosira albicans*	*Melosira sol*
	185-1149A-																															
Pleistocene	1H-1, 61–63	0.61				F				C	F			C		R							R			R						
	2H-4, 43–45	9.13				F		R		C	C		R	C		R			R		R		R		R	R						
	3H-1, 83–85	14.53				R		R		F	F			C					F							F						
	3H-3, 98–100	17.68				F				F	F		R	C	R				R							R						
	3H-4, 117–123	19.37			F	R				F	C			C					F							F						
	3H-7, 33–35	23.03								F				F				F	F													
	4H-2, 112–114	25.82			R		R			R	F			R					F							F						
	4H-4, 92–94	28.62				F				R	F							F	F							R						
	4H-6, 123–125	31.93				F	R	R		F	F			R					F							F						
	5H-1, 131–137	34.01			R	R		R		R	F			F	R			R	R						R	R					R	R
	5H-3, 131–137	37.01				F		F		R	F			R					F	R						R					R	
	5H-5, 132–138	40.02								C				C				F														F
	6H-1, 112–114	43.32	R			F				F	C			R				R	F						R	F			F			
	6H-3, 87–89	46.07			R	F	R			F	F		R	R	R				R	R						F						
	6H-3, 133–139	46.53			F	R		F		F	F		R	R					R							F						
Pliocene	6H-5, 84–86	49.04						F		R	F		R					F								F						R
	6H-7, 22–24	51.42				R				F	F							R								C						
	7H-1, 71–73	52.41			F	F		R		F	F			R					R							C						
	7H-2, 71–73	53.91				R		R		R	F		R	F				R	F						R	C						
	7H-3, 106–108	55.76			F	F	R	F		F	F		F	R					R							F						R
	7H-4, 99–101	57.19						F						C									F		F	F						
	7H-5, 75–77	58.45			R	F	R	F		F	F			R	R				F							C						R
	7H-6, 89–91	60.09			R	F		F		F	C			R					F							C						R
	7H-7, 37–39	60.97			R	R		F		R	F		R	R					R					R		C						
	8H-1, 117–119	62.37				F		F		R	F			R	R			R	R							F						R
	8H-2, 111–113	63.81				F		F		R	C			F	R									R		R						
	8H-3, 54–56	64.74			R	R	R	F			C			F	R											R						
	8H-4, 72–74	66.42		R	R	R	R	F		R	C			F	R			R	R							F						
	8H-5, 49–51	67.69		R		F	R	F		R	F			R	R			R	R				R			F						
	8H-6, 48–50	69.18					F	F			F			F									R			F						
	8H-7, 39–41	70.59				F		F	R	R	F					R										F						
	9H-1, 106–112	71.76			R	F	R	F		R	F			R	R			R	R				R			F						
	9H-2, 85–91	73.05		R	R		R	F	R	R	F			R	R			R	R							F						
	9H-3, 131–138	75.01			R		F	F	R	R	F							F	R							F						
	9H-4, 136–142	76.56						F			F			F	F			R	R							C						
	9H-5, 142–148	78.12						F			F			F	R			R								F						
	9H-6, 142–148	79.62						F	R	R	F			F	R				R				R			F						
	10H-1, 135–141	81.55						F			R			R		R		R					R			F						
	10H-2, 134–140	83.04					R	F	R		R			R	R	R		R	R							F						
	10H-3, 125–131	84.45			R		R	F			F							R	R							F						
	10H-4, 135–141	86.05			R			C	R		F			F				R	R							F						
	10H-5, 111–113	87.31			R			F	R	R	F					R		F	R							F						
	10H-5, 135–141	87.55			R			C	R	R	F					R		F	R							F						
	10H-6, 135–141	89.05			R			F			F							R	R							C				R		
	11H-1, 136–142	91.60						F		R	F			R		R	R		R							F						
	11H-2, 100–106	92.20												F				C								C						
	11H-3, 131–137	94.01						F			R			C	R	F	F	C						F		R				F		
	11H-4, 142–148	95.62			R					R	R	R				R										C				R		
	11H-5, 141–147	97.11			R					R	R			R		R	R	R								C	R					
	11H-6, 140–146	98.60			R						F			R			R	F	R			R				C		R				

Table T2 (continued).

Age	Core, section, interval (cm)	Marine diatoms depth (mbsf)	*Navicula* cf. *digitoradiata*	*Navicula* cf. *flanatica*	*Navicula lyrella*	*Navicula* cf. *oestrupii*	*Neodenticula kamtschatica*	*Neodenticula koizumii*	*Neodenticula seminae*	*Nitzschia bicapitata*	*Nitzschia fossilis*	*Nitzschia interruptestriata*	*Nitzschia jouseae*	*Nitzschia kolaczekii*	*Nitzschia marina*	*Nitzschia panduriformis* var. *minor*	*Nitzschia pliocena*	*Nitzschia reinholdii*	*Nitzschia rolandii*	*Nitzschia* cf. *seriata*	*Nitzschia* cf. *sicula*	*Odontella aurita*	*Paralia sulcata*	*Pleurosigma* cf. *planktonica*	*Podosira maxima*	*Porosira glacialis*	*Proboscia barboi*	*Proboscia curvirostris*	*Pseudoeunotia doliolus*	*Rhaphoneis amphiceros*	*Rhaphoneis* cf. *ischaboensis*	*Rhizosolenia hebetata* v. *hiemalis*
	185-1149A-																															
Pleistocene	1H-1, 61–63	0.61			R	R			F			C		F	F			R		F		R	C	R					F			R
	2H-4, 43–45	9.13			R				F			F		R	F			R			R		F						R			F
	3H-1, 83–85	14.53			R				F			C		R	F						R		R	R				R	C			F
	3H-3, 98–100	17.68										C		R	F			R					F					R	F		R	
	3H-4, 117–123	19.37		R					F			F		R	F			C			R		F						C	R		F
	3H-7, 33–35	23.03					F		C			C			F			C											C		F	
	4H-2, 112–114	25.82							R			C		R	F			C		R			F						C			F
	4H-4, 92–94	28.62							F		R	C		R	F			C					F	R					R			F
	4H-6, 123–125	31.93							F		R	C		R	F	R		C		R	R		R						C			F
	5H-1, 131–137	34.01					R		F		F	F		R	F			C		R			F	R			R		C		R	F
	5H-3, 131–137	37.01							F		F	C		R	R			C		R	R			R					F			C
	5H-5, 132–138	40.02	F				F		C		F	F						C									F					
	6H-1, 112–114	43.32					F		F		F	C		R	R			A		R	F						R	R	F			F
	6H-3, 87–89	46.07					R		F		F	C		R	F			A			F		F	R			R		C		R	R
	6H-3, 133–139	46.53							F		F	F		R	F			A					F						C			R
Pliocene	6H-5, 84–86	49.04					C		C		F	F		R				A					F								R	R
	6H-7, 22–24	51.42					R	F			C	C		R	R			C		R	R		F	R		R					R	R
	7H-1, 71–73	52.41					F	F			C	F		R	R			A		R	R		R							R	R	
	7H-2, 71–73	53.91					F	F			C	C		R	F			A		R	R		F								R	R
	7H-3, 106–108	55.76					R	R			C	F		R	R			C		R			F				R				R	R
	7H-4, 99–101	57.19					C	C				F						C													C	
	7H-5, 75–77	58.45					F	F			C	F		R	R			C		R	R		F								R	R
	7H-6, 89–91	60.09					F	C			C	F		R	R			C		R	F		R				R				R	R
	7H-7, 37–39	60.97					R	F			F	C		R	R			C	F	R	R		F								R	R
	8H-1, 117–119	62.37					F	F		R	C	F		R	R			C	R	F	R		R				R				F	R
	8H-2, 111–113	63.81					F	C			F	C		R	R			C	R	R	F		F	R							F	R
	8H-3, 54–56	64.74					C	C		R	C	C		R	F			C	R	R	R		R			R					R	F
	8H-4, 72–74	66.42					F	F		R	F	F		R	0.6			C	R	R	R		F				F				F	F
	8H-5, 49–51	67.69					F	F			F	F	R	R	0.6			C	R	F	R		F				R			R	R	F
	8H-6, 48–50	69.18					F	R			R	C	R	R	0.6			C			R		F				R				R	F
	8H-7, 39–41	70.59					C	F		R	F	F	F	R	R			C	R	R	R		F								R	F
	9H-1, 106–112	71.76					F	F		R	R	F	F	R	R			C		R	R	R	C	R			R				R	F
	9H-2, 85–91	73.05					C	F		R	R	F	R	R	R			C	R	F	R		R	R							R	F
	9H-3, 131–138	75.01					C	F		R	R	F	F	R	R			C	R	F	R		F								R	F
	9H-4, 136–142	76.56					A	F			R	F	C	R				C	R	R	R	R	F			R	R				R	F
	9H-5, 142–148	78.12					C	F			F	F	C	R	R			C		R			C									F
	9H-6, 142–148	79.62					C	R			R	F	F		R			C	R	R	R		F									F
	10H-1, 135–141	81.55					C	R		R	R	F	F	R	R			C	R	R	R		F			R						F
	10H-2, 134–140	83.04				R	C				R	C	F	R	R			C	R	R	R		F									F
	10H-3, 125–131	84.45					C				F	F	F	R	R			C	R	R	R										F	R
	10H-4, 135–141	86.05					C			R	R	F	F	R	R			C	R	R			R	R							F	R
	10H-5, 111–113	87.31					C			R	F	C	F		R		F	C	R	R	R		R	R		R						F
	10H-5, 135–141	87.55	R				C				R	F	R	R	F			C	R	R	F		R			R						F
	10H-6, 135–141	89.05					A			R	F	F			R		R	C	R				R	R	R					R		F
	11H-1, 136–142	91.60					C				F	F	F			R	F	F	R				F	R								R
	11H-2, 100–106	92.20					A					F																				F
	11H-3, 131–137	94.01					C				F	R					F	F	F			R	F									F
	11H-4, 142–148	95.62					C			R	F	F	R				F	C						R			R					F
	11H-5, 141–147	97.11					C			R	C	F	R		R		R	F	R					R			R				R	F
	11H-6, 140–146	98.60					C			R	F	F			F		F	C					F								R	R

Table T2 (continued).

Age	Core, section, interval (cm)	Marine diatoms depth (mbsf)	*Rhizosolenia praebergonii*	*Rhizosolenia styliformis* A	*Rhizosolenia styliformis* B	*Rhizosolenia* species A	*Roperia tesselata*	*Rosiella tatsunokuchiensis*	*Rosiella* cf. *tatsunokuchiensis*	*Rouxia californica*	*Rouxia naviculoides*	*Screptoneis* species A	*Stephanodiscus astreae* v. *minutula*	*Stephanodiscus* species A	*Stephanodiscus* species B	*Stephanopyxis marginata*	*Stephanopyxis turris*	*Surirella* cf. *ovata*	*Synedra miocenica*	*Terpinspoe* species A	*Thalassionema nitzschioides*	*Thalassionema nitzschioides* v. *lanceolata*	*Thalassiosira antiqua*	*Thalassiosira burckliana*	*Thalassiosira convexa*	*Thalassiosira decipiens*	*Thalassiosira eccentrica*	*Thalassiosira gravida*	*Thalassiosira grunowii*	*Thalassiosira jacksonii*	*Thalassiosira jouseae*	*Thalassiosira leptopus*
	185-1149A-																															
Pleistocene	1H-1, 61–63	0.61					F			R							R				A				R		C					
	2H-4, 43–45	9.13			R	R	R										R				A						F	R				
	3H-1, 83–85	14.53					F										R				A						C					
	3H-3, 98–100	17.68					F										R				C						C					F
	3H-4, 117–123	19.37					R										F				C						C					
	3H-7, 33–35	23.03					F														A						C					
	4H-2, 112–114	25.82					F										R				C			R			C					
	4H-4, 92–94	28.62					R						F								A			F			C					
	4H-6, 123–125	31.93					F										R				A						C					R
	5H-1, 131–137	34.01					F										R				A			R			C					R
	5H-3, 131–137	37.01	R				C						R								C			R		R	C					R
	5H-5, 132–138	40.02																			A						A					
	6H-1, 112–114	43.32	R				F						F		R						C			R			F					R
	6H-3, 87–89	46.07	R				C										R				C			R	R		C		R			F
	6H-3, 133–139	46.53	R				F										R				C			R			C					R
Pliocene	6H-5, 84–86	49.04					C						R								A			F			F		R			
	6H-7, 22–24	51.42	F				F								R		R				A						F					R
	7H-1, 71–73	52.41	R				F						R				R				C			R			F		R			F
	7H-2, 71–73	53.91	F				F										R				A			R			F		R			R
	7H-3, 106–108	55.76	F				C						R			R	F				A		R	R			C		R			R
	7H-4, 99–101	57.19	F				F						F				C				A			F			F				F	
	7H-5, 75–77	58.45	F				F						R				F				C				R		C					F
	7H-6, 89–91	60.09	F				F						R				F				A		R				C					R
	7H-7, 37–39	60.97	F				C		R				R				F				A		R		R		C		F		R	R
	8H-1, 117–119	62.37	R				C				R						R				A				R		F		R			F
	8H-2, 111–113	63.81	R				F						R				F				A				R	R	C					F
	8H-3, 54–56	64.74	R				F						R		R		R				A	R	R		F		F		R		R	F
	8H-4, 72–74	66.42					F		R								R			R	A		R		F		C		R			R
	8H-5, 49–51	67.69					F		R						R	R	F	R			A	R	R		F		C		R		R	F
	8H-6, 48–50	69.18					F										F				A	R			F		F			R	F	F
	8H-7, 39–41	70.59					F								R		F				A	R	F		F		C				R	F
	9H-1, 106–112	71.76												R			F				A	R	R		F	R	C		R			R
	9H-2, 85–91	73.05								R							C				A	F	R		F	R	F				R	F
	9H-3, 131–138	75.01			F			R					R		R		F				A	F	F		R	R	C				R	R
	9H-4, 136–142	76.56															F				A	F	F		F	R	F	R	R		R	F
	9H-5, 142–148	78.12						R	R								C				A	F	R		R		F		R	R	R	F
	9H-6, 142–148	79.62						R									F				A	F	R				F				R	F
	10H-1, 135–141	81.55						R	R								C				A		R		R		F			R	R	F
	10H-2, 134–140	83.04						R									F				A		R				F		R	R	F	F
	10H-3, 125–131	84.45				R		R	R								F				A		R		R		F		R		R	F
	10H-4, 135–141	86.05						F	R					R			F				A		R				F	R		R	F	F
	10H-5, 111–113	87.31			R			F	F								R				A		R		R		F		R	F	R	F
	10H-5, 135–141	87.55						F							R		R				A				R		F				R	F
	10H-6, 135–141	89.05							R					R			R				A						F			R	R	F
	11H-1, 136–142	91.60															R				A						F	R	R	R		F
	11H-2, 100–106	92.20																			A						F					C
	11H-3, 131–137	94.01								F	F						R				A						F		R	R		F
	11H-4, 142–148	95.62									R						R		R		A				R	F	F	R				F
	11H-5, 141–147	97.11		R						R		R					F		R		A						C	R	R	R		F
	11H-6, 140–146	98.60	R							R							R		R		A		R				F			R	R	F

Table T2 (continued).

Age	Core, section, interval (cm)	Marine diatoms depth (mbsf)	*Thalassiosira lineata*	*Thalassiosira marujamica*	*Thalassiosira nidulus*	*Thalassiosira nordenskioldi*	*Thalassiosira oestrupii*	*Thalassiosira pacifica*	*Thalassiosira plicata*	*Thalassiosira praeconvexa*	*Thalassiosira punctata*	*Thalassiosira symbolophora*	*Thalassiosira symmetrica*	*Thalassiosira trifulta*	*Thalassiosira zabelinae*	*Thalssiosira* species A	*Thalassiothrix longissima*	*Thalassiothrix robusta*	*Triceratium alternans*	*Triceratium cinnamomeum*	Unknown species A	Total diatoms counted	*Chaetoceros* spores	*Lycopodium* pollen	Number of transects	Diatom number
	185-1149A-																									
	1H-1, 61–63	0.61	F				C										F			R		424	204	2	15	67,312,117
	2H-4, 43–45	9.13	F				A										F				R	311	49	1	15	107,932,974
	3H-1, 83–85	14.53	F		R		A					R		R		R	F			R		500	193	2	11	83,683,025
	3H-3, 98–100	17.68	F		R		A										R					217	36	1	15	36,120,300
	3H-4, 117–123	19.37	F	R	R		A									R	F					204	43	2	15	42,250,007
	3H-7, 33–35	23.03	F		F		A					F				F						77	23	2	15	12,694,450
Pleistocene	4H-2, 112–114	25.82	C				A					F		R		F	R					238	44	2	15	40,135,839
	4H-4, 92–94	28.62	F		R		A							F								159	33	1	15	53,611,003
	4H-6, 123–125	31.93	F		R		C			R	R	F				R	R					460	146	6	15	12,874,274
	5H-1, 131–137	34.01	F		R		A				R						F					500	79	4	10	16,756,630
	5H-3, 131–137	37.01	F		R		A				R						F					282	32	5	15	10,236,594
	5H-5, 132–138	40.02					A				F											33	11	1	15	6,464,701
	6H-1, 112–114	43.32	R		R		A					R					F			R		500	106	2	12	42,318,209
	6H-3, 87–89	46.07	F				A					R		R		R	R			R		500	110	2	10	41,275,486
	6H-3, 133–139	46.53	R				A					F				R	F					500	39	5	5	5,969,257
	6H-5, 84–86	49.04	F				C							R		R	F					159	27	5	15	5,174,738
	6H-7, 22–24	51.42	F		R		A					F		R		R	R			R		500	81	2	10	40,093,861
	7H-1, 71–73	52.41	R		R		A		R			F		R		R	R					500	64	2	6	42,147,015
	7H-2, 71–73	53.91	F		R		C					R				R	R		R			500	90	7	7	11,692,442
	7H-3, 106–108	55.76	R		R		C					F		R		R	F			R		500	55	11	8	7,420,739
	7H-4, 99–101	57.19	F				F							F		F						55	6	7	15	1,269,746
	7H-5, 75–77	58.45	F		R		C					R		F		R	R		R	R		500	89	5	10	17,040,391
	7H-6, 89–91	60.09	R		F		C					R		R		R	F			R		500	78	7	13	24,062,641
	7H-7, 37–39	60.97	F		R		C							R		F	F					500	69	3	8	27,167,843
	8H-1, 117–119	62.37	F				F		R		R	R		R		R	F		R			500	83	5	9	68,005,572
	8H-2, 111–113	63.81	F		R		F		R			R		R		R	F		R			404	139	6	15	45,895,453
	8H-3, 54–56	64.74	F		R		F					R	R	R		R	F					241	25	5	15	32,893,239
	8H-4, 72–74	66.42	F				C					R		R		R	F					500	170	5	11	68,059,749
	8H-5, 49–51	67.69	F				F		R		R		R	R		R	F					500	95	4	13	85,074,686
	8H-6, 48–50	69.18				F	F				R					F	F					167	25	5	15	22,777,320
	8H-7, 39–41	70.59	R				C				R	R	R	R		R	F		R	R		500	123	6	12	56,880,722
	9H-1, 106–112	71.76	F				F					R	R	R		R	F					434	70	7	15	41,441,831
Pliocene	9H-2, 85–91	73.05	F		R		C							R		R	F					500	71	3	12	123,505,728
	9H-3, 131–138	75.01	R		R		C					R	R	R		R	F			R		500	44	3	12	118,556,758
	9H-4, 136–142	76.56	R				C			R	R	R	R	R		R	F					500	82	4	12	61,737,245
	9H-5, 142–148	78.12	F				F						R				F					500	35	10	14	17,004,777
	9H-6, 142–148	79.62	F	R	R		F						R	R			F	R	R			500	65	5	14	74,678,322
	10H-1, 135–141	81.55	R		R		F					R	R	R		R	F			R		500	47	6	11	37,220,407
	10H-2, 134–140	83.04	R				C				R		F	R			F					500	61	6	12	56,374,014
	10H-3, 125–131	84.45	F		R		C				R		R	R		R	F					500	81	4	7	52,573,538
	10H-4, 135–141	86.05	F				C				R		F				F			R		500	82	4	7	68,258,229
	10H-5, 111–113	87.31	R				C				R		F	R			F					500	67	5	8	68,290,967
	10H-5, 135–141	87.55	F				C			R			F	R			F					500	42	4	8	51,695,510
	10H-6, 135–141	89.05	R				F				R	R	F	F			F		F			500	53	5	7	39,977,539
	11H-1, 136–142	91.60	F											C			F					500	45	3	7	109,412,480
	11H-2, 100–106	92.20	C				F										C					70	8	10	15	2,185,361
	11H-3, 131–137	94.01	F				R					R	F	F			F					500	38	9	43	26,334,983
	11H-4, 142–148	95.62	F	R			F						C	F			C			R		500	33	22	6	4,874,809
	11H-5, 141–147	97.11	F	R			R		R		R		C	F	R		C		R			500	35	17	10	9,130,472
	11H-6, 140–146	98.60	R	R			F	R					F	R	R		C			R		500	32	15	12	11,305,015

Plate P1. 1, 2. *Thalassiosira antiqua* (Grunow) Cleve-Euler (Sample 185-1149A-10H-2, 134–140 cm). **3, 4.** *Thalassiosira convexa* Mukhina (Sample 185-1149A-10H-4, 135–141 cm). **5.** *Thalassiosira decipiens* Grunow (Sample 185-1149A-9-3, 131–138 cm). **6.** *T. eccentrica* (Ehrenberg) Cleve (Sample 185-1149A-8H-7, 39–41 cm). **7.** *Thalassiosira gravida* Cleve (Sample 185-1149A-2H-4, 43–45 cm). **8.** *Thalassiosira jouseae* Akiba (Sample 185-1149A-10H-1, 135–141 cm) **9.** *Thalssiosira leptopus* (Grunow) Hasle and Fryxell (Sample 185-1149A-8H-7, 39–41 cm). Scale bars = 10 µm.

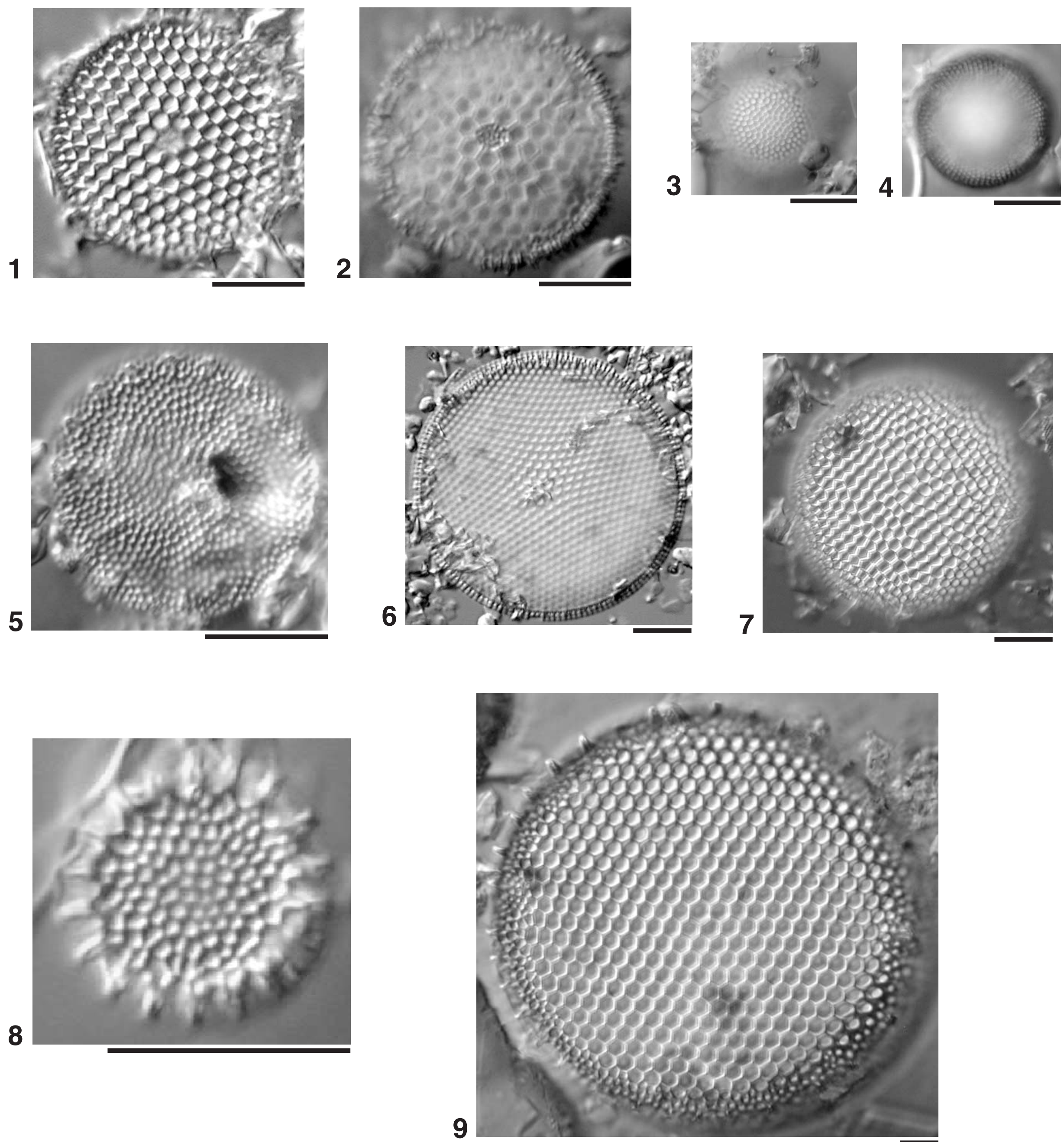

Plate P2. **1.** *Thalassiosira lineata* Jousé (Sample 185-1149A-1H-1, 61–63 cm) **2.** *Thalassiosira oestrupii* (Ostenfeld) Proshkina Lavrenko (Sample 185-1149A-10H-6, 135–141 cm). **3.** *Thalassiosira plicata* Schrader (Sample 185-1149A-10H-5, 111–113 cm). **4.** *Thalassiosira symbolophora* Koizumi and Tanimura (Sample 185-1149A-11H-6, 140–146 cm). **5.** *Thalassiosira symmetrica* (Sample 185-1149A-8H-3, 54–56 cm). **6.** *Thalassiosira trifulta* Fryxell (Sample 185-1149A-8H-3, 54–56 cm). **7.** *Thalassiosira* species A (Sample 185-1149A-8H-4, 72–74 cm). Scales bars = 10 µm.

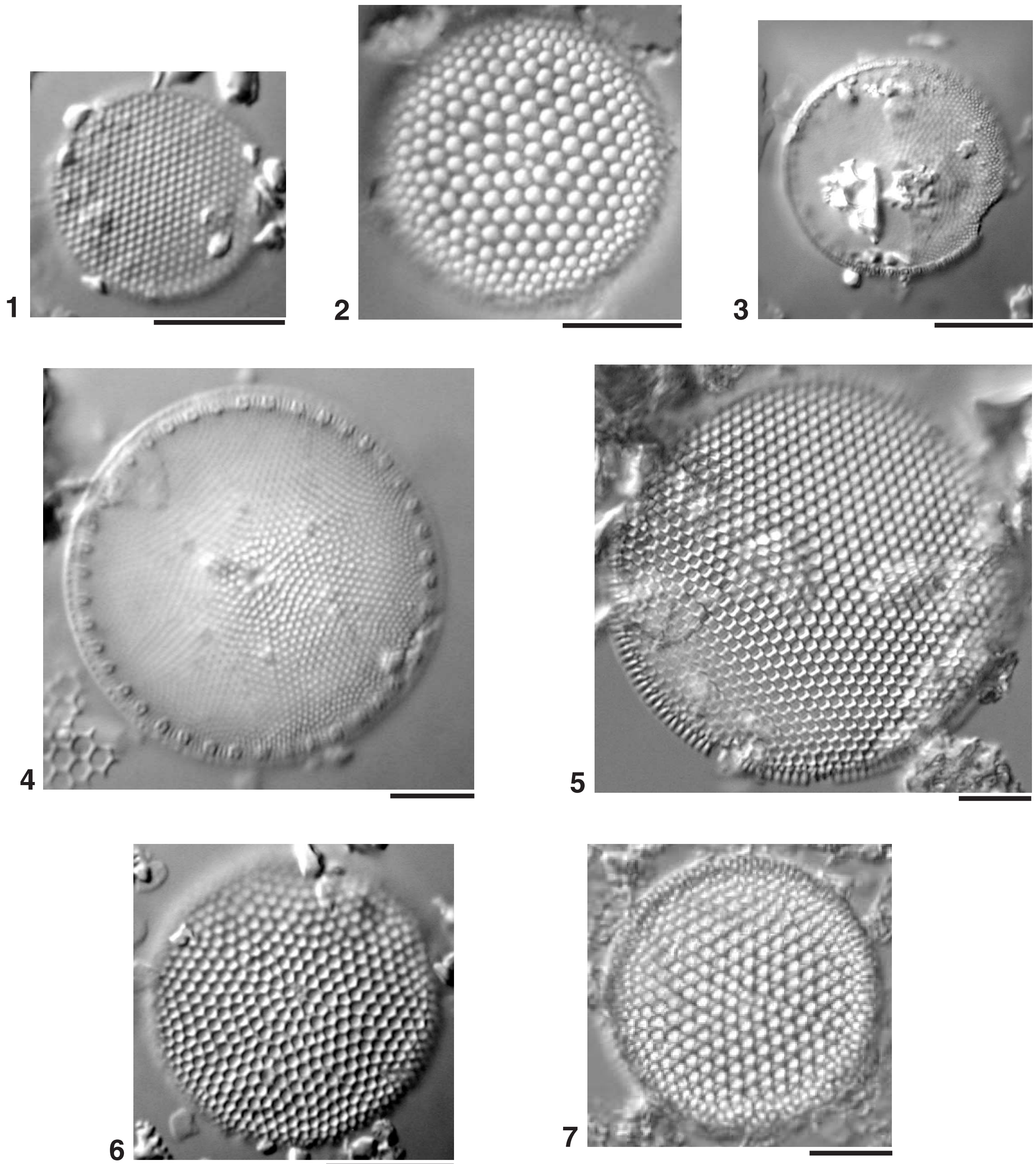

Plate P3. **1.** *Coscinodiscus asteromphalus* Ehrenberg (Sample 185-1149A-7H-6, 89–91 cm). **2.** *Coscinodiscus curvatulus* Grunow (Sample 185-1149A-8H-7, 39–41 cm). **3.** *Coscinodiscus endoi* Kanaya (Sample 185-1149A-7H-3, 106–108 cm). **4, 5.** *Coscinodiscus marginatus* Ehrenberg (Sample 185-1149A-10H-4, 135–141 cm). **6.** *Azpeitia nodulifera* var. *cyclopus* (Jousé) Fryxell and Sims (Sample 185-1149A-3H-4, 117–123 cm). **7.** *Azpeitia nodulifera* (A. Schmidt) Fryxell and Sims (Sample 185-1149A-3H-4, 117–123 cm). **8.** *Coscinodiscus radiatus* Ehrenberg (Sample 185-1149A-2H-4, 43–45 cm). **9.** *Coscinodiscus tabularis* Grunow (Sample 185-1149A-4H-2, 112–114 cm). Scale bars = 10 µm.

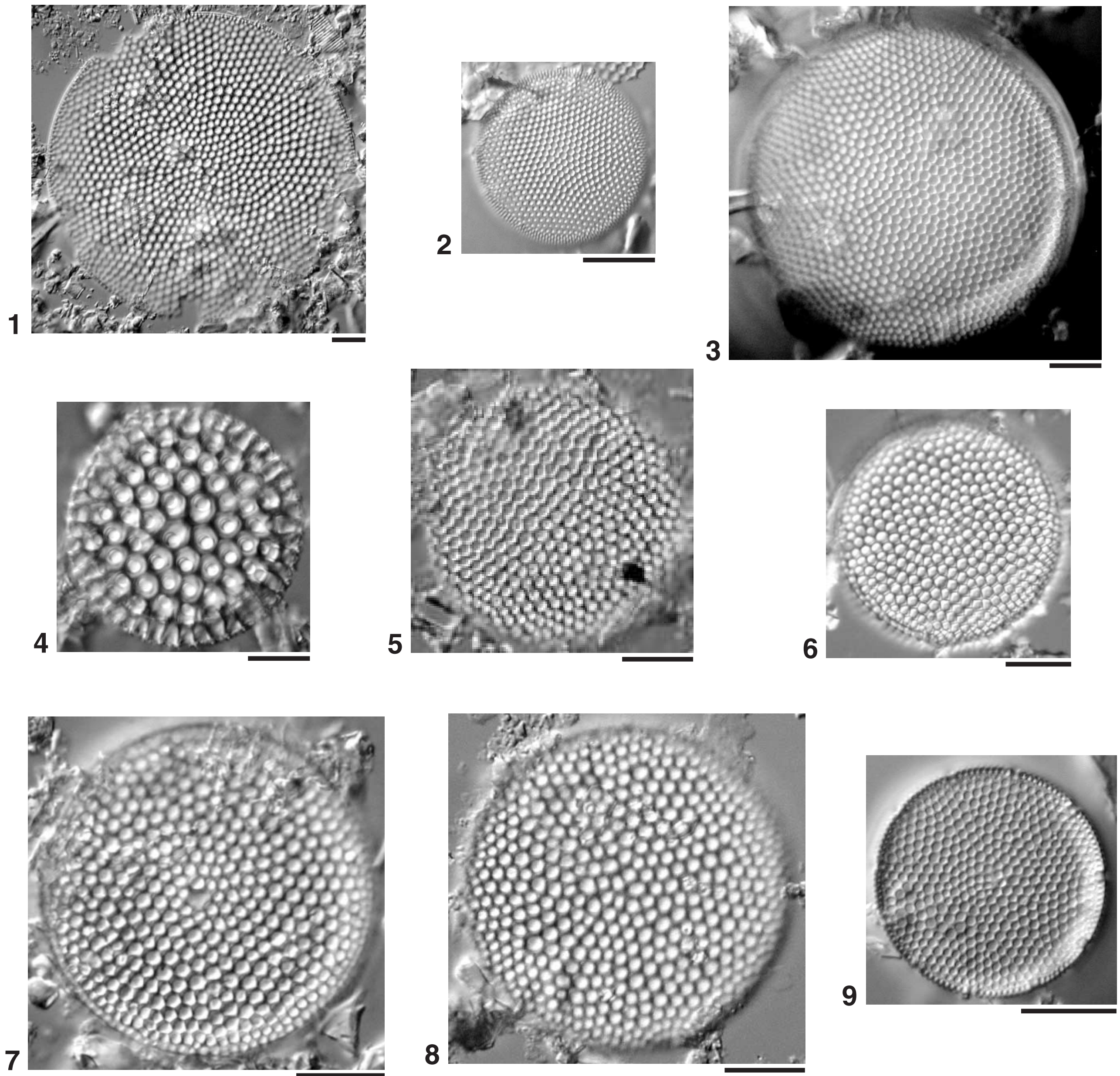

Plate P4. **1.** *Actinocyclus cubitus* Hanna and Grant (Sample 185-1149A-10H-4, 135–141 cm). **2.** *Actinocyclus curvatulus* Janisch (Sample 185-1149A-3H-2, 133–139 cm). **3.** *Actinocyclus ellipticus* Grunow (Sample 185-1149A-1H-4, 142–148 cm). **4.** *Actinocyclus ellipticus* var. *elongatus* (Grunow) Kolbe (Sample 185-1149A-1H-1, 61–63 cm). **5.** *Actinocyclus ingens* Ratray (Sample 185-11490A-11H-3, 131–137 cm). **6.** *Actinocyclus octonarius* Ralfs (Sample 185-1149A-2H-4, 43–45 cm). **7.** *A. oculatus* Jouse (Sample 185-1149A-6H-1, 112–114 cm). Scale bars = 10 µm.

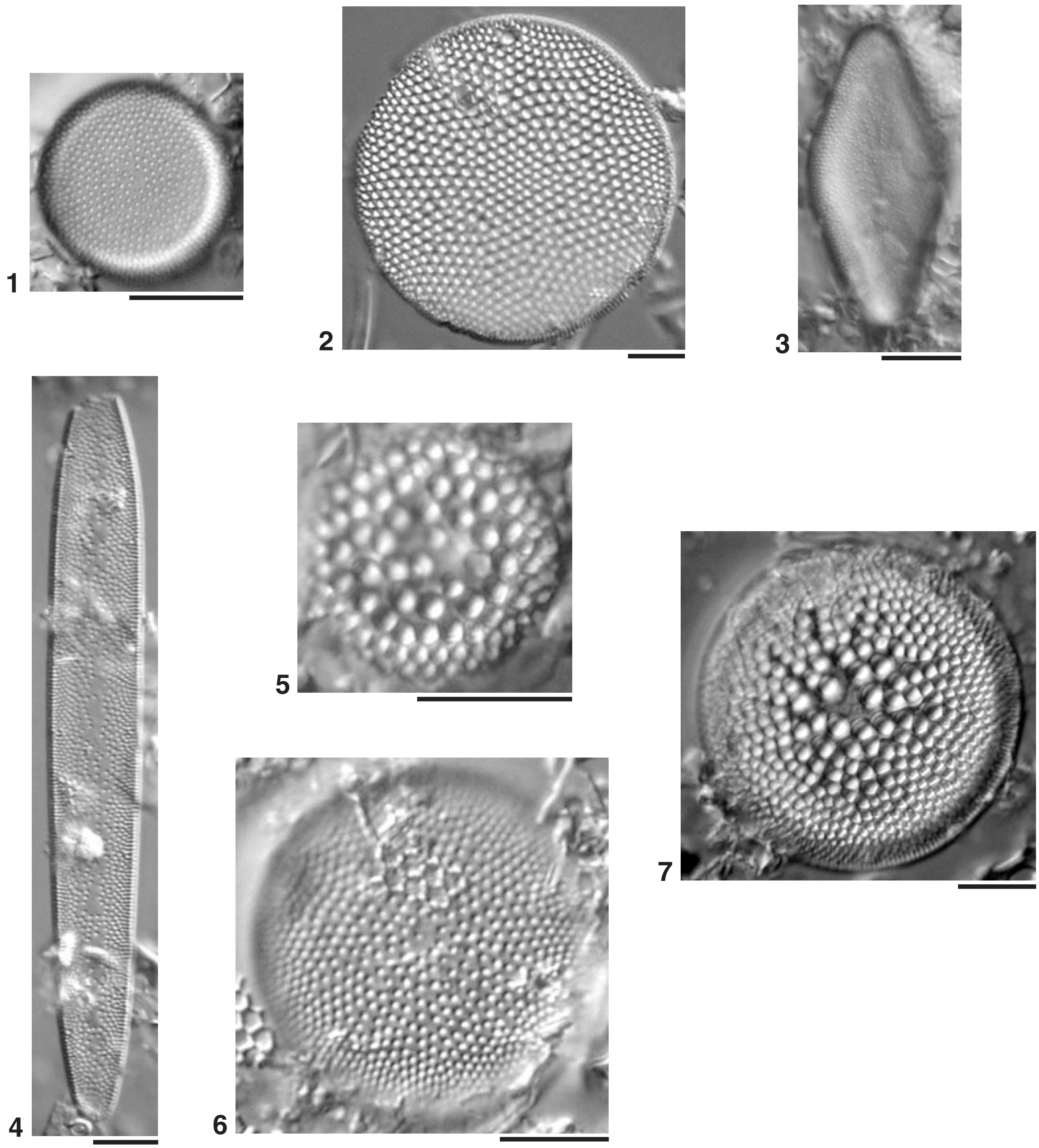

Plate P5. **1.** *Actinoptychus senarius* (Ehrenberg) Ehrenberg (Sample 185-1149A-2H-5, 47–49 cm). **2.** *Actinoptychus splendens* (Shädbolt) Ralfs (Sample 185-1149A-2H-4, 43–45 cm). **3.** *Arachnoidiscus schmidtii* n. sp. Hajos (Sample 185-1149A-7H-6, 89–91 cm). **4.** *Asteromphalus arachne* (Brébisson) Ralfs (Sample 185-1149A-10H-5, 111–113 cm). **5.** *Asteromphalus hepatis* (Brébisson) Ralfs (Sample 185-1149A-10H-1, 135–141 cm). **6.** *Azpeitia neocrenulata* Pergallo (Sample 185-1149-10H-4, 135–141 cm). Scale bars = 10 µm.

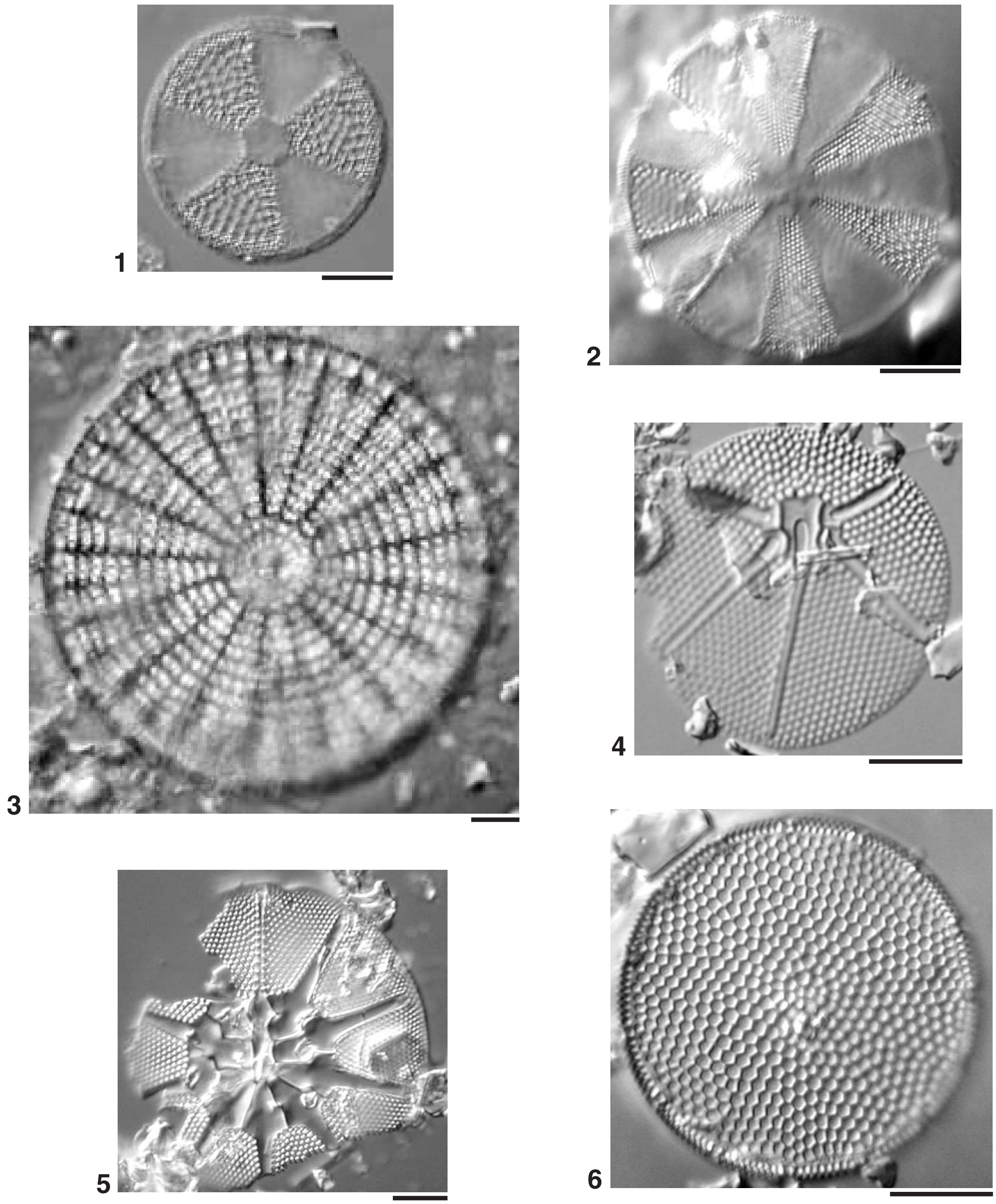

Plate P6. **1.** *Rhizosolenia praebergonii* Mukhina (Sample 185-1149A-7H-7, 37–39 cm). **2.** *Roperioa tesselate* Roper (Sample 185-1149A-8H-1, 117–119 cm). **3.** *Rosiella tatsunokuchiensis* Koizumi (Sample 185-1149A-10H-4, 135–141 cm). **4.** *Rosiella* cf. *tatsunokuchiensis* Koizumi (Sample 185-1149A-8H-1, 117–119 cm). **5.** *Rouxia californica* M. Pergallo (Sample 185-1149A-11H-3, 131–137 cm). **6.** *Gomphonema* cf. *affine* (Sample 185-1149A-10H-1, 135–141 cm). **7.** *Simonseniella barboi* Brun (Sample 185-1149A-6H-1, 112–114 cm). **8.** *Simonseniella curvirostris* Jousé (Sample 185-1149A-1H-1, 61–63 cm). Scale bars = 10 µm.

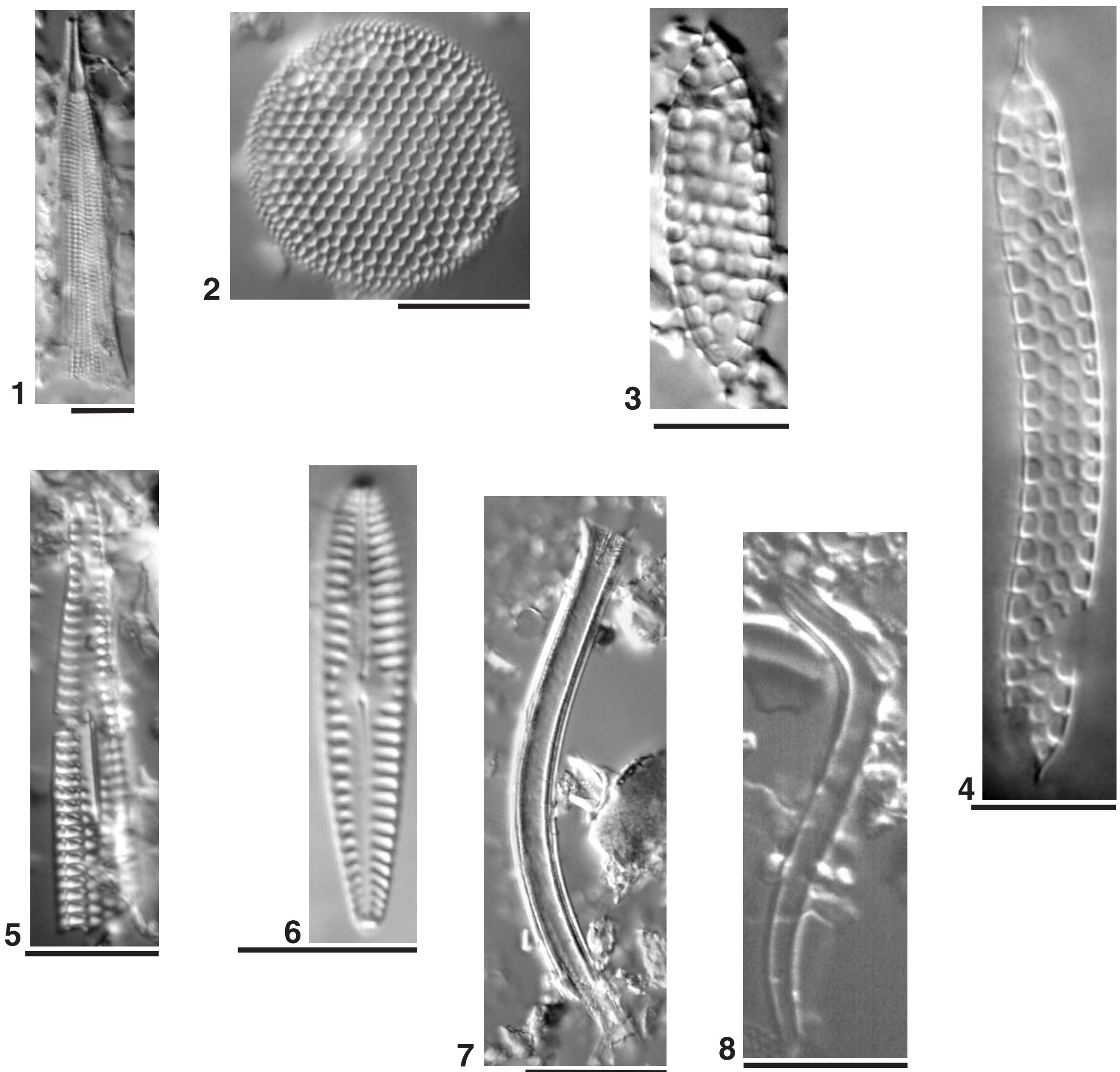

Plate P7. **1, 2.** *Bacteriosira bathyomphala* (Cleve) Syvertsen and Hasle (Sample 185-1149A-8H-5, 49–51 cm). **3.** *Cocconeis* cf. *pseudomarginata* Gregory (Sample 185-1149A-6H-1, 112–114 cm). **4.** *Surirella* cf. *ovada* (Sample 185-1149A-8H-5, 49–51 cm). **5.** *Delphineis simonsenii* (Simonsen and Kanaya) Simonsen (Sample 185-1149-10H-4, 135–141 cm) **6.** *Delphineis surirella* (Sample 185-1149A-1H-5, 141–147 cm). **7.** *Navicula* cf. *flanatica* Grunow (Sample 185-1149A-3H-4, 117–123 cm). **8.** *Epithemia* species A (Sample 185-1149A-2H-4, 43–45 cm). **9.** Unknown species A (Sample 185-1149A-2H-4, 43–45 cm). **10.** *Diploneis smithii* (Sample 185-1149A-6H-3, 87–89 cm). **11.** *Navicula lyrella* Ehrenberg (Sample 185-1149A-3H-2, 133–139 cm). Scale bars = 10 µm.

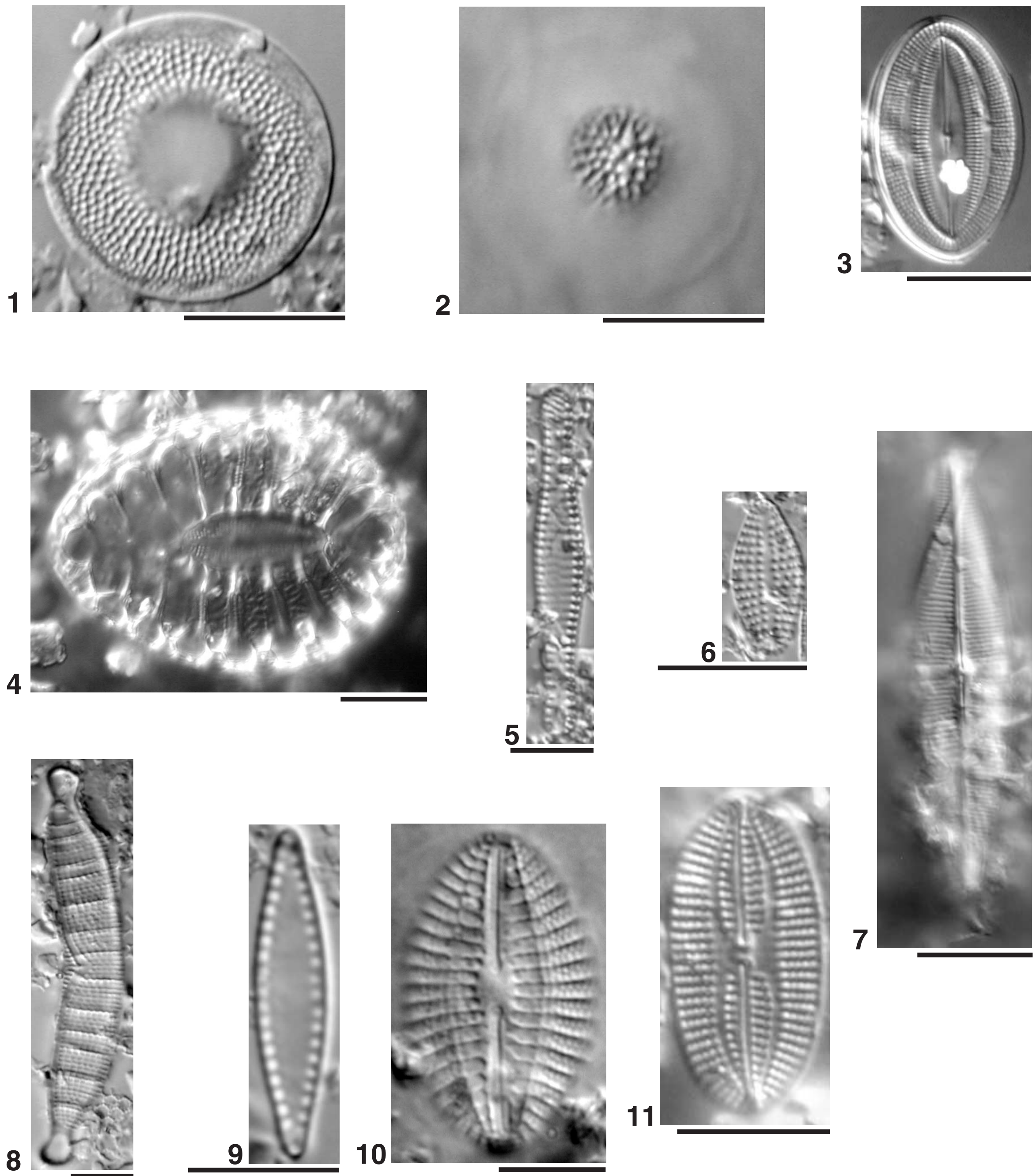

Plate P8. **1.** *Nitzschia fossilis* Frenguelli (Sample 185-1149A-11H-5, 141–147 cm). **2.** *Nitzschia interruptestriata* Simonsen (Sample 185-1149A-10H-6, 68–70 cm). **3.** *Nitzschia interruptestriata* Simonsen (Sample 185-1149A-10H-5, 111–113 cm). **4.** *Nitzschia jouseae* Burckle (Sample 185-1149A-10H-5, 111–113 cm). **5.** *Nitzschia kolackzeckii* Grunow (Sample 185-1149A-7H-6, 89–91 cm). **6.** *Nitzschia marina* Grunow (Sample 185-1149A-2H-5, 47–49 cm). **7.** *Nitzschia pliocena* (Brun) Mertz (Sample 185-1149A-11H-6, 140–146 cm). **8.** *Nitzschia reinholdii* Kanaya and Koizumi (Sample 185-1149A-8H-5, 49–51 cm). **9.** *Nitzschia rolandii* Schrader 8H-5, 49–51 cm). **10.** *Nitzschia* cf. *sicula* (Castracane) Hustedt (Sample 185-1149A-2H-4, 43–45 cm). **11.** *Nitschia* cf. *sisula* (Castracane) Hustedt (Sample 185-1149A-1H-1, 61–63 cm). **12.** *Pseudoeunotia doliolus* (Wallich) (Sample 185-1149A-4H-6, 123–125 cm). Scale bars = 10 µm.

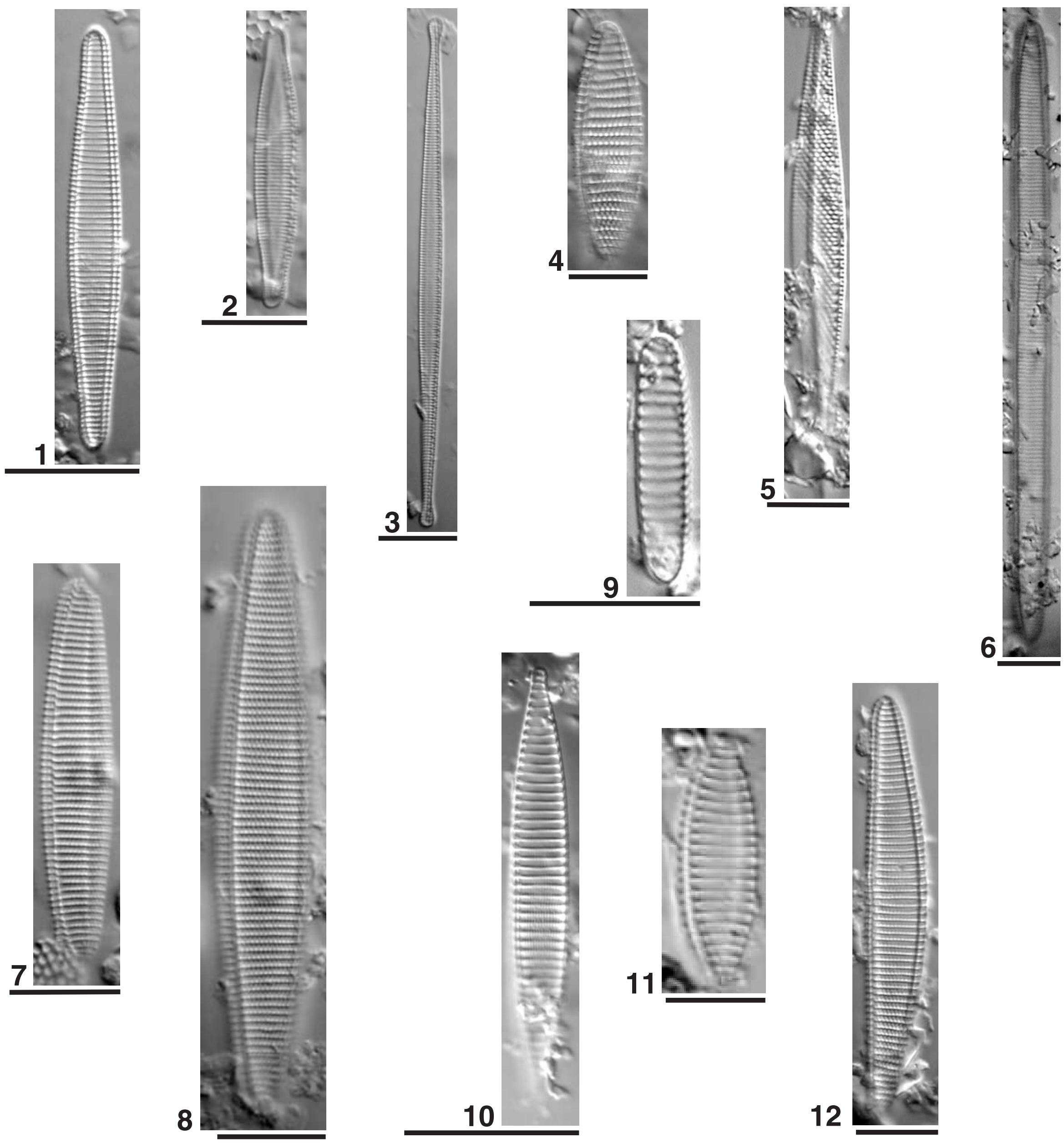

Plate P9. **1**, **2.** *Denticulopsis simonsenii* (Simonsen and Kanaya) Simonsen (Sample 185-1149A-8H-5, 49–51 cm). **3.** *Denticulopsis simonsenii* (Simonsen and Kanaya) Simonsen (Sample 185-1149A-4H4, 92–94 cm). **4**, **5.** *Denticulopsis hyalina* (Schrader) Simonsen (Sample 185-1149A-11H-1, 136–142 cm). **6**, **7.** *Denticulopsis simonsenii* (Simonsen and Kanaya) Simonsen (Sample 185-1149A-11H-3, 131–142 cm). **8.** *Neodenticula koizumii* Zabelina (Sample 185-1149A-11H-1, 136–142 cm). **9.** *Neodenticula koizumii* Akiba and Yanagisawa (Sample 185-1149A-8H-7, 39–41 cm). **10.** *Neodenticula seminae* (Simonsen and Kanaya) Akiba and Yanagisawa (Sample 185-1149A-2H-4, 43–45 cm). Scale bars = 10 µm.