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8. DATA REPORT: DIATOM BIOSTRATIGRAPHIC DATA AND PLATES FROM ODP LEG 172, HOLE 1063D, WITH BRIEF DISCUSSION OF PRESENT ECOLOGICAL AFFINITIES OF TAXA[1]

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ABSTRACT

During Leg 172, Site 1063 was unexpectedly found to contain intervals with rich assemblages of diatoms, both in species diversity and absolute abundance. These intervals correlated with well-defined gamma-ray attenuation bulk density lows. Sampling of the upper four cores at 10-cm spacing provided an in-depth examination of subtle changes in the diatom assemblages associated with these lows. The biostratigraphic data gathered in this study are presented here along with numerous illustrations of the common taxa observed. The modern ecological affinities, as reported in numerous literature sources, of many of these taxa are collated by species. The diatom species observed in this material presently occur in many different parts of the Atlantic as well as other areas of the globe. Some species are restricted to warm waters, and others are absent from warm waters. So, a brief discussion of specific environmental restrictions, and their bearing on indication of sediment transport, is included in this report.

INTRODUCTION

Diatoms were found to be an abundant part of the sedimentary composition of the well-defined bulk-density lows at Site 1063. The porous valve morphology of diatoms provides an open framework for the sediment, lowering the sediment density. Abundant terrigenous material

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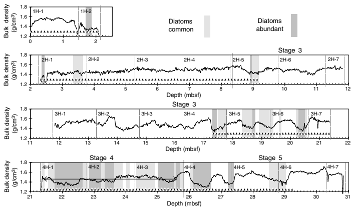
will also impart a low density signal, which is what accounts for the low observed at the top of Hole 1063D and at 1.4 meters below seafloor (mbsf) (see Fig. F1). This uppermost depth interval (0–1.7 mbsf) scarcely contains any diatoms or diatom fragments, so this density low results entirely from the high terrigenous component in the sediment. A nearly complete lack of diatoms is also noted in depth intervals 2.4–3.3 mbsf (Section 172-1063D-2H-1) and 3.6–8.9 mbsf (bottom of Section 172-1063D-2H-1 to the top of Section 172-1063D-2H-5). Because of the low diatom content in the upper 9 m of sediment, the following 8 m was not analyzed in order to focus on the lower depths of this study, which exhibit the largest changes in density. This study seeks to characterize the diatom assemblages, not only within the bulk-density lows but through entire density cycles.

F1. GRA bulk densities from Hole 1063D, p. 18.



Biogenic sedimentary material recovered from Site 1063 can either reflect in situ production and deposition or transport and redeposition of such material (or some of both). The presence of species restricted ecologically to coastal or littoral waters (*Delphineis surirella, Raphoneis amphiceros, Cocconies disculoides,* and *Cymatosira lorenziana*) indicates that some amount of transport is occurring. Currently, there is little diatom accumulation in this area of the Atlantic, whereas other regions with very different oceanographic regimes enjoy abundant diatom production and preservation (Jousé and Kazarina, 1974; Pokras and Molfino, 1986; Abrantes, 1991).

SAMPLE PREPARATION

Samples were collected every 10 cm from the first four cores of Hole 1063D. Three different types of slides were prepared from the unprocessed samples: smear, strewn, and sieved. Strewn slides were prepared by physically agitating 1–2 g of sediment in distilled water for 1 min and then withdrawing the suspended material with a pipette after allowing the coarse fraction to settle out for 30 s. This suspended material was dried on a coverslip through heating on a hot plate. The unprocessed material was also sieved at 25 µm, with slides of both the greater and lesser fraction produced in the same manner as for the strewn slides. The sieves were thoroughly cleaned by brushing under a steady flow of water, placed in an ultrasonic bath for 5 min, and finally blown dry with high-pressure air (from both directions) between each sample. All slides were permanently mounted with Norland optical adhesive No. 61. No chemical processing was performed on the sediment prior to slide preparation.

MICROSCOPIC ANALYSIS

All slides were examined for diatom biostratigraphic data on an Olympus CH-2 microscope at a magnification of 400×. Species identification was confirmed at 600× and 1000×. Each slide was scanned through four traverses across the cover glass (22 mm × 40 mm) to ascertain the presence or absence of diatoms. Observation of no identifiable diatoms or diatom fragments constituted a barren (B) assignment to the sample. Samples containing identifiable valves or fragments of valves were then further examined to document species occurrence and estimate the relative abundance (see Tables T1, T2, T3, T4). The following

T1. Biostratigraphic diatom data, Core 1H, p. 25.

T2. Biostratigraphic diatom data, Core 2H, p. 27.

T3. Biostratigraphic diatom data, Core 3H, p. 31.

T4. Biostratigraphic diatom data, Core 4H, p. 34.

convention was used to report the overall diatom abundance observed at 400× on each slide:

A = abundant; >1 specimen observed in every field of view.
C = common; 1 specimen observed in every field of view.
F = frequent; 1 specimen observed in every 5 fields of view.
R = rare; 1 specimen observed in 5–20 fields of view.
X = scarce; ≤1 specimen observed per traverse.
B = barren; no diatoms in sample.

Abundance estimates were derived from examination of the smear or strewn slides to achieve an unbiased analysis of the sediment. Ten transects were completed for each slide examined. Sieved slide examination allowed the inclusion of many rare species that statistically would have otherwise been likely to remain unobserved.

BIOSTRATIGRAPHY

The event indicative of the change from the *Pseudoeunotia doliolus* Zone (0–0.69 Ma) to the *Nitzschia reinholdii* Zone (0.69–1.88 Ma), the last occurrence of *N. reinholdii,* was not observed within this study. This species is present, but because of the rarity of the specimens within each sample and the sparsity of their occurrences biostratigraphically, these are thought to be reworked, placing the interval examined here entirely within the *P. doliolus* Zone. The biostratigraphy utilized during this cruise is presented in Keigwin, Rio, Acton, et al., 1998. All of the diatom data gathered from these four cores is presented in Tables **T1, T2, T3,** and **T4.**

BULK-DENSITY VALUES

Figure **F1** illustrates the pattern of changes in gamma-ray attenuation (GRA) bulk density downcore through Core 172-1063D-4H. Qualitative estimates of diatom abundances for the abundant and common categories are also illustrated in this figure; the dark gray bars represent periods with abundant diatoms, and the light gray bars show common occurrences. The interval between 1.75 and 9 mbsf stands apart from the rest of the record illustrated in that the density is slowly increasing over this interval. This is quite different from the large changes observed on either side of this period. In this interval, there are three periods with common or abundant diatoms in the sediment; all three occur in the upper portion of this depth interval between 1.75 and 3.6 mbsf. The decrease in density at 9 mbsf is again accompanied by a period of abundant diatoms.

DISCUSSION

Species-Specific Environmental Restrictions

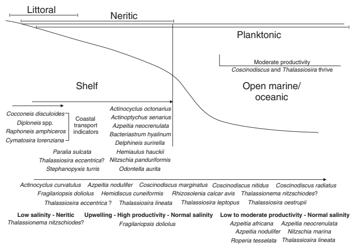
This section is not meant to solve all the questions that arose during study of this material, rather it presents the species observed in these cores and their present-day ecological restrictions and some inferences about the transported vs. in situ nature of the diatoms (see **"Taxonomy and Ecological Preferences,"** p. 7, for complete listing).

As was previously noted, present-day in situ sedimentation and preservation of diatoms at Site 1063 are quite rare (see Table **T1** for species observed in surface sediments). This trend extends downcore with a few periods of high diatom numbers to 9 mbsf (see Fig. **F1;** Tables **T2**). One species, *Hemiaulus hauckii,* was confined to occurrences within a restricted biostratigraphic range (Samples 172-1063D-2H-2, 23–24 cm, to 83–84 cm). This is an extant species that presently occurs in warm to temperate water regions. Apart from this species, all others occur throughout the entire study interval. Species not recorded for each sample will clearly have noncontinuous ranges.

Maynard (1976) discussed the correlation between phosphate values in the waters and the diatoms per gram of sediment in the underlying surface sediments. The correlation between areas with abundant phosphate and high primary productivity and subsequent deposition of diatoms in the sediment is great. Very little lateral transport occurs, with the biocoenoces differing very little from the underlying thanatocoenoces. As nutrient supply is the necessary ingredient for abundant diatom production, a nutrient source should be explained before the intervals of abundant diatoms at Site 1063 is inferred to be in situ. But the idea can not be ruled out solely because this situation does not currently exist in the area. The diversity and preservation of the assemblage supports the interpretation that previous conditions were favorable for periodic abundant diatom growth.

Several discernible patterns are recognized from the biostratigraphic data of this study, presented below in no particular order of importance.

F2. Environmental affinity of diatom species, p. 19.

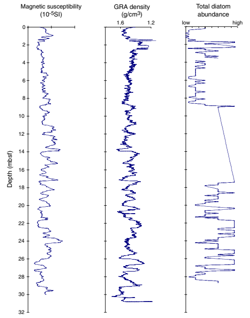


1. As is illustrated in Figure **F2** and listed in Table **T5,** the species observed in this study exist today in a variety of biological habitats. Some habitats, such as coastal and littoral settings, are more restrictive than neritic or planktonic habitats and offer more precise information than the latter. The known present ecological range of individual species can aid in the determination of the history of the material studied. Species that have been observed in either benthic habitats or have strong associations to continental coasts include *C. disculoides, C. lorenziana, D. surirella, Diploneis* spp., *Podosira stelliger, Suriella* spp., *Fragilariopsis doliolus, H. hauckii, R. amphiceros,* and *Thalassionema nitzschioides*.

   When the abundance data for these and other species are plotted against depth (Fig. **F3**), it is apparent that the above-mentioned species are more abundant in the lower samples of the study with fewer occurrences in samples from the upper part of the hole, whereas species with oceanic/planktonic habitat preferences are observed throughout the study interval. These data support the idea of a change in currents or sediment source between the periods of deposition for the lower and upper sections of the study interval. *Chaetoceros lascinosus* and *Thalassiosira nordenskoldii,* two species that are more commonly found today in colder waters, have a higher abundance in the lower samples (below 21 mbsf). *D. surirella,* common along coasts in colder climes, does not decrease towards the top of the hole but assumes a more sporadic pattern of appearance.

T5. Diatom species associated with specific habitats, p. 35.

F3. Depth vs. abundance for selected diatom species, p. 20.



2. The diatom assemblages in the low-density intervals are not uniform in character; all species do not experience the coincident increases and decreases in abundance. This would indicate that these intervals are not merely the result of a decrease in other sedimentary material (such as calcareous nannofossils or terrigenous material). Conversely, the periods with higher density can not have been created solely through dilution by terrigenous material. This is apparent when the sieved material for the high density intervals is examined. Some samples have abundant and rich diatom assemblages, whereas others are barren. Changes do occur in the accumulation patterns of other sedimentary material, but this can not entirely explain the diatom abundance changes observed.

   An example of the noncontinuous quality of the diatom assemblage can be found between 22.63 and 21.63 mbsf. Here, *Ethmodiscus rex* is observed in low numbers, whereas *T. nitzschioides* has a large abundance peak. Also, *Ditylum brightwellii* disappears almost completely from the sediment record over the interval 26.03–21.23 mbsf (Stage 4). Curiously, this last species is not presently observed in polar regions. This might seem to indicate a change in water temperature over this site or the source site for the sediment at this time, except that other species restricted from cold waters do not also decrease in numbers during this interval.

   Dilution is indeed occurring, because the species diversity of the assemblage does not change between the intervals with higher and lower abundances of diatoms. One does not find merely the very robust, corrosion-resistant species in the intervals with low total abundance. In addition, the valves observed in the sieved fraction do not show any more breakage or dissolution during these high-density intervals than those from the raw material with more abundant diatoms. In fact, there is very little dissolution of the fine features of the diatom valves at all. Abrantes (1991) uses several species as indicators of dissolution, two of them being *Bacteriastrium hyalinum* and *Thalassiosira* spp., because of the fragile nature of their valves. These species continue to be part of the assemblage, though decreased in number, throughout the study interval. Two of the species that she places in the resistant category are *P. sulcata* and *Actinocyclus nodulifer*. These species do experience gaps in their range during periods with low total diatom abundance, further supporting the idea of dilution with increased amounts of other sedimentary particles.

3. Five species (*B. hyalinum, C. lascinosus, Nitzschia marina, Paralia sulcata,* and *T. nitzschioides*) exhibit a pattern of abundance that increases throughout Stage 4. This pattern is not completely smooth, but the general trend is from lower abundances at the beginning of Stage 4 (~25.63 to ~23.63 mbsf) to higher near the end (~23.63 to ~21.33 mbsf). The species in which this pattern is the most pronounced is *T. nitzschioides*. *B. hyalinum, T. nitzschioides,* and *C. lascinosus* all occur today in temperate waters, *P. sulcata* is a cosmopolitan species, and *N. marina* is more common in warm waters. *B. hyalinum* and *N. marina* live in the pelagic realm, whereas the other three are associated with neritic envi-

ronments. The variety of present ecological and regional affinities does not assist in determining a cause for this observed increase. All five species also show a slight to pronounced decrease in abundance just prior to the onset of Stage 4.

Several other species (*D. surirella, F. doliolus, T. eccentrica, T. lineata,* and *T. oestrupii*) have a brief interval of high abundance in the upper part of Stage 4 but do not exhibit a general steplike increase throughout this period. One species that is obviously missing during most of Stage 4 is *D. brightwellii*. The only ecological affinity found in the literature for this species observes that it is a cosmopolitan species that is not recorded from the polar regions (Hasle and Syvertsen, 1996). For the rest of the species with abundance vs. depth data illustrated in Figure F3, there is no discernible pattern or noticeable peaks or lows during Stage 4.

SUMMARY

The diatoms present in the material from Site 1063 convey a complicated history for this site. The dominant species in the assemblage changes many times over the four cores examined. Assemblage dominance noted in the sieved samples varies between three groups: (1) *E. rex,* (2) *Coscinodiscus radiatus* and *A. nodulifer,* and (3) *Thalassionema* spp., *Thalassiothrix* spp., and *Bacteriastrium* spines. Species associated with littoral and coastal environments exhibit a greater abundance in the lower samples than those higher up. The species diversity of the entire assemblage does not change between intervals with more and less abundant diatoms, but the individual species do not experience uniform increases and decreases. Some few species were observed to either disappear from the sediment record or exist for a limited time only. Differences of these sorts would indicate some changes in currents and/or water masses between different depth intervals.

Whereas there are many patterns evident through comparing the presence and abundance of the diatom species observed in this study, data from other cores in the same region and in similar settings needs to be added before definite conclusions can be drawn.

ACKNOWLEDGMENTS

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TAXONOMY AND ECOLOGICAL PREFERENCES

Actinocyclus curvatulus Janisch in A. Schmidt; Schrader, 1973, pl. 19, fig. 2; Barron, 1980, pl. 1, fig. 1; Baldauf, 1984, pl. 1, fig. 9, pl. 2, fig. 8; Baldauf, 1987, pl. 2, figs. 2, 14; Hasle and Syvertsen, 1996, pl. 19 (Pl. **P1,** fig. 1).

Basionym: *Coscinodiscus curvatulus* Grunow; Hajós, 1973, pl. 4, figs. 8, 9; Barron, 1980, pl. 3, figs. 7, 11, 12.

Remarks: ecological affinities: (1) cosmopolitan, including diatoms common on arctic sea ice (Hasle and Syvertsen, 1996); (2) *C. curvatulus*—oceanic, warm-water (marine, oceanic, neritic, and planktonic) (Hajós, 1973).

Actinocyclus ellipticus var. *elongatus* (Grunow) Kolbe; Schrader, 1974, pl. 17, figs. 1, 3; Barron, 1980, pl. 1, figs. 3, 6; Barron, 1981, pl. 1, fig. 8; Desikachary et al., 1987, pl. 80, fig. 10 (Pl. **P9,** figs. 6, 7).

Actinocyclus ingens Rattray; Barron, 1981, pl. 1, fig. 1; Baldauf, 1984, pl. 7, figs. 1, 2, 5, 7.

Actinocyclus octonarius Ehrenberg; Hendey, 1964, pl. 24, fig. 3; Hajós, 1973, pl. 5, fig. 8 (Pl. **P1,** figs. 2, 3).

Synonym: *Actinocyclus ehrenbergii* Ralphs; Schrader, 1973, pl. 19, fig. 1; Barron, 1980, pl. 1, fig. 5; Baldauf, 1984, pl. 7, fig. 3.

Remarks: ecological affinities: (1) cosmopolitan (Hasle and Syvertsen, 1996); (2) sublittoral species (Jousé and Kazarina, 1974); (3) marine, brackish, neritic, littoral, and planktonic (Hajós, 1973); (4) meroplanktonic spp. (Abrantes, 1988).

Actinocyclus octonarius var. *tenella* (Brebisson) Hajós; Hajós, 1973, pl. 5, figs. 7, 9 (Pl. **P1,** fig. 4).

Synonym: *Actinocyclus ehrenbergii* var *tenella* Hustedt; Jousé and Kazarina, 1974, pl. 1, figs. 2, 3.

Remarks: ecological affinities: (1) marine, brackish, planktonic, littoral, and euryhaline (Hajós, 1973).

Actinoptychus senarius (Ehrenberg) Ehrenberg; Hendey, 1964, pl. 23, figs., 1, 2; Hajós, 1973, pl. 5, figs. 2, 3; Hasle and Syvertsen, 1996, pl. 22 (Pl. **P1,** fig. 5).

Remarks: ecological affinities: (1) cosmopolitan? (Hasle and Syvertsen, 1996); (2) Stenothermal, warm-water form, indicating a warm to temperate sedimentary environment (marine, neritic, littoral, planktonic, and stenothermal) (Hajós, 1973); (3) meroplanktonic spp. (Abrantes, 1988).

Actinoptychus splendens Ralphs; Hendey, 1964, pl. 22, fig. 1; Schrader, 1973, pl. 22, figs. 1, 10, 11, 13, 14, 16 (Pl. **P1,** fig. 6).

Asterolampra grevillei (Wallich) Greville; Schrader, 1973, pl. 21, fig. 3; Schrader, 1974, pl. 8, fig. 5; Desikachary, 1987, pl. 339, fig. 4; Desikachary et al., 1987, pl. 87, fig. 2 (Pl. **P2,** figs. 2, 3).

Asterolampra marylandica Ehrenberg; Schrader, 1973, pl. 21, fig. 2; Jousé and Kazarina, 1974, pl. 4, fig. 4; Barron, 1980, pl. 2, fig. 1; Baldauf, 1984, pl. 1, fig. 2; Hasle and Syvertsen, 1996, pl. 23 (Pl. **P4,** figs. 1, 2).

Remarks: ecological affinities: (1) warm-water region (e.g., Mediterranean Sea, Indian Ocean, and Gulf of California) (Hasle and Syvertsen, 1996); (2) Equatorial thanatocoenosis (Pacific) (Werner, 1977).

Asteromphalus arachne (Brebisson) Ralfs; Jousé and Kazarina, 1974, pl. 1, fig. 7, pl. 4, fig. 2; Barron, 1980, pl. 2, fig. 2; Hasle and Syvertsen, 1996, pl. 25 (Pl. **P3,** fig. 3).

Remarks: ecological affinities: (1) warm-water region (Hasle and Syvertsen from Simonsen, 1974); (2) oceanic species (Jousé and Kazarina, 1974).

Asteromphalus elegans Greville; Schrader, 1974, pl. 8, fig. 4; Barron, 1980, pl. 2, fig. 11; Baldauf, 1984, pl. 1, fig. 3; Hasle and Syvertsen, 1996, pl. 23 (Pl. **P3,** figs. 4, 5; Pl. **P4,** fig. 3).

Remarks: ecological affinities: (1) warm-water region (Hasle and Syvertsen from Simonsen, 1974).

Asteromphalus heptactis (de Brébisson) Ralfs in Pritchard; Hendey, 1964, pl. 24, fig. 5; Schrader, 1974, pl. 8, fig. 1, pl. 9, fig. 9; Hasle and Syvertsen, 1996, pl. 24 (Pl. **P4,** fig. 4).

Remarks: ecological affinities: (1) temperate (Hasle and Syvertsen, 1996, from Hendey, 1964); (2) planktonic species (Abrantes, 1988).

Asteromphalus sp. A (Pl. **P2,** fig. 1; Pl. **P3,** figs. 1, 2).

Remarks: This species is characterized by a nearly circular central hyaline area, taking up from one-half to one-third of the total radius of the valve face. The hyaline rays extend off of the central area in a regular placement. The separating lines between rays, within the central area, are straight. There appears to be a range of forms that relate this new species to *Asterolampra grevillei*. In *A*. sp. A, the narrow ray extends into the central area with a base the same width as the other hyaline rays but the central part of this narrow ray pinches and expands to a circular tip. Some examples were noted (Pl. **P2,** fig. 1; Pl. **P3,** fig. 2) that possess this narrow ray of *A*. sp. A, while also having a few rays that do not extend to the center of the hyaline area, as in *A. grevillei*.

Auliscus sculptus (Smith) Ralfs in Pritchard; Hendey, 1964, pl. 23, fig. 4 (Pl. **P14,** fig. 3).

Azpeitia africana (Janisch ex Schmidt) Fryxell & Watkins; Fryxell et al., 1986, figs. XXII, XXIII, XXXII-1, -2 (Pl. **P4,** fig. 5).

Basionym: *Coscinodiscus africanus* Janisch; Jousé and Kazarina, 1974, pl. 2, fig. 1, pl. 4, fig. 6; Barron, 1980, pl. 3, fig. 5.

Remarks: ecological affinities: (1) "*A. africana* was found in all Gulf Stream warm core rings we examined, as well as plankton tows from the central Pacific and Gulf of Mexico. It can be classified as a warm-water, planktonic species." (Fryxell et al., 1986); (2) Barron (1980) found *A. africana* in upper Pliocene to Holocene sediments from the tropical eastern Pacific; (3) Burckle (1978) correlates the first occurrence of *"C" africanus* with the late early Pliocene; (4) Monjanel and Baldauf (1989) found this species in the North Atlantic and Schrader (1974) in Indian Ocean sediments; (5) Equatorial thanatocoenosis (Pacific) (*C. africanus*) (Werner, 1977).

Azpeitia neocrenulata (Van Landingham) Fryxell & Watkins; Fryxell et al., 1986, figs. XVI, XXX-2; Desikachary et al., 1987, pl. 107, figs. 1–10 (Pl. **P4,** fig. 6; Pl. **P5,** fig. 1).

Synonyms: *Actinocyclus divisus* (Grunow) Hasle and Fryxell, Baldauf, 1984, pl. 2, fig. 7, pl. 9, fig. 3; *Coscinodiscus divisus* Grunow; Hasle, 1973, pl. 4, figs. 6, 7; *Coscinodiscus crenulatus* Grunow, Jousé and Kazarina, 1974, pl. 2, fig. 2; Barron, 1980, pl. 3, figs. 4, 6.

Remarks: ecological affinities: (1) "This species is a warm-water species, having been found in plankton tows from the Gulf of Mexico, the central Pacific, and the Indian Ocean as well as in Gulf Stream Warm Core Ring 81-D and Ring 82-E in the North Atlantic." (Fryxell et al., 1986); (2) *C. divisus*—oceanic warm-water form; marine, oceanic, neritic, littoral, and planktonic (Hajós, 1973); (3) northboreal thanatocoenosis (Pacific) (*A. divisicus*) (Werner, 1977); (4) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991); (5) "*C. crenulatus* is most common in an equatorial band west of 6°W. Numbers also somewhat higher off SW Africa, and along the SE African coast. Nearly absent from the region of depressed sea-surface salinities off the mouths of the Zaire and Niger rivers. Common component of tropical to sub-tropical diatom floras from all oceans." (Pokras and Molfino, 1986);

Azpeitia nodulifer (Schmidt) Fryxell & Sims; Fryxell et al., 1986, figs. XVII, XVIII-1, -2, -4, -5, XXX-3, -4 (Pl. **P5,** fig. 2).

Basionym: *Coscinodiscus nodulifer* Schmidt; Hendey, 1964, pl. 22, fig. 10; Jousé and Kazarina, 1974, pl. 2, figs. 4, 5, pl. 4, figs. 10–12; Barron, 1980, pl. 4, figs. 1–8, pl. 11, figs. 2–4; Barron, 1981, pl. 2, figs. 1–3; Baldauf, 1984, pl. 3, fig. 16, pl. 8, fig. 6; Baldauf, 1987, pl. 1, figs. 3, 7.

Remarks: ecological affinities: (1) *A. nodulifer* has been found in plankton tows from the central Pacific, Gulf of Mexico, and the northwest Atlantic Ocean in Gulf Stream warm core rings (Fryxell et al., 1986); (2) warm-water species (Hasle, 1976); (3) tropical thanatocoenosis (Pacific) (*C. nodulifer*) (Werner, 1977); (4) oceanic species (Jousé and Kazarina, 1974); (5) planktonic species (Abrantes, 1988, 1991); (6) "The equatorial band (of abundant *A. nodulifer*) corresponds geographically to the occurrence of the high-velocity Equatorial Undercurrent, which is characterized by high salinity and low nutrient content. Although several cores off southwest Africa also contain *C. nodulifer,* this species is nearly absent in cores close to shore. *C. nodulifer* thus appears best adapted to warm-waters of modest productivity and moderate to high salinity - widely distributed in tropical and subtropical waters - In the N. Atlantic, *C. nodulifer* is most common in waters south of 40°N, except near the continents." (Pokras and Molfino, 1986).

Bacteriastrum hyalinum Lander; Barron, 1980, pl. 2, fig. 10; Baldauf, 1984, pl. 1, fig. 5; Baldauf, 1987, pl. 6, fig. 10; Desikachary, 1988, pl. 461, figs. 1–4 (Pl. P6, figs. 1–3).

Remarks: ecological affinities: (1) marine and planktonic (Hajós, 1973); (2) neritic species (Abrantes, 1991); (3) common in temperate waters (Hasle and Syvertsen, 1996).

Biddulphia alternans (Bailey) van Heurck; Hendey, 1964, pl. 25, fig. 5; Barron, 1980, pl. 10, figs. 11, 12.

Remarks: ecological affinities: (1) *Biddulphia* spp.—benthic taxa (Abrantes, 1988, 1991).

Chaetoceros diadema (Ehrenberg) Gran; Hendey, 1964, pl. 10, fig. 1; Hasle and Syvertsen, 1996, pl. 46 (Pl. P6, fig. 4).

Remarks: ecological affinities: (1) cosmopolitan (Hasle and Syvertsen, 1996); (2) *Chaetoceros* spp.—meroplanktonic species (Abrantes, 1988).

Chaetoceros lacinosus Schütt; Hasle and Syvertsen, 1996, pl. 43 (Pl. P6, figs. 1, 5, 6).

Synonym: *Chaetoceros laciniosum* Schütt; Hendey, 1964, pl. 13, fig. 2.

Remarks: ecological affinities: (1) northern cold-water region to temperate? (Hasle and Syvertsen, 1996); (2) *Chaetoceros* spp.—meroplanktonic species (Abrantes, 1988).

Chaetoceros messanensis Castracane; Hasle and Syvertsen, 1996, pl. 45.

Synonym: *Chaeoteceros messanense* Castracane; Hendey, 1964, pl. 12, fig. 3.

Remarks: ecological affinities: (1) warm-water region (Hasle and Syvertsen, 1996); (2) *Chaetoceros* spp.—meroplanktonic species (Abrantes, 1988).

Chaetoceros mitra (Bailey) Cleve; Hendey, 1964, pl. 16, fig. 2; Hasle and Syvertsen, 1996, pl. 42 (Pl. P6, fig. 7).

Remarks: ecological affinities: (1) northern cold-water region (Hasle and Syvertsen, 1996); (2) *Chaetoceros* spp.—meroplanktonic species (Abrantes, 1988).

Cocconeis disculoides Hustedt; Hendey, 1964, pl. 28, figs. 21, 22 (Pl. P8, fig. 3).

Synonym: *Cocconeis disculus?* (Schumann) Cleve; Hustedt, 1985, fig. 799.

Remarks: ecological affinities: (1) *C. disculus*—distributed throughout Europe in the bottom mud of freshwater lakes but usually isolated in occurrence. Fairly common in the Baltic Sea area. (Hustedt, 1985); (2) epiphytic (Hajós, 1973); (3) *Cocconeis* spp.—benthic taxa (Abrantes, 1988, 1991).

Coscinodiscus marginatus Ehrenberg; Hendey, 1964, pl. 22, fig. 2; Schrader, 1973, pl. 20, figs. 7, 10; Baldauf, 1984, pl. 8, figs. 1–3; Baldauf, 1987, pl. 1, fig. 1.

Remarks: ecological affinities: (1) a wide distribution, according to literature, and may be cosmopolitan with a wide temperature tolerance; (2) northboreal thanatocoenosis (Pacific) (Werner, 1977); (3) oceanic, warm-water form (marine, oceanic, planktonic, and stenohaline) (Hajós, 1973); (4) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp. which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Coscinodiscus nitidus Gregory; Hendey, 1964, pl. 23, fig. 12; Hajós, 1973, pl. 3, fig. 6 (Pl. P5, fig. 3).

Remarks: ecological affinities: (1) oceanic, warm-water form (marine, oceanic, neritic, littoral, and planktonic) (Hajós, 1973); (2) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp. which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Coscinodiscus oculusiridus Ehrenberg; Hendey, 1964, pl. 24, fig. 1; Barron, 1980, pl. 5, fig. 1.

Remarks: ecological affinities: (1) marine, oceanic, stenohaline, and planktonic (Hajós, 1973); (2) planktonic species (Abrantes, 1988); (3) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp. which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Coscinodiscus radiatus Ehrenberg; Hendey, 1964, pl. 22, fig. 7; Barron, 1980, pl. 5, figs. 2, 5, 7 (Pl. P5, fig. 4).

Remarks: ecological affinities: (1) a wide distribution, according to the literature, and may be cosmopolitan with a wide temperature tolerance; (2) subtropical thanatocoenosis (Pacific) (Werner, 1977); (3) planktonic species (Abrantes, 1988, 1991); (4) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp. which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Coscinodiscus reniformis Castracane; Desikachary et al., 1987, pl. 362, figs. 1, 2, 4, 5; Desikachary, 1988, pl. 550, fig. 1 (Pl. P14, fig. 5).

Cymatosira lorenziana Grunow; Hustedt, 1985, fig. 648; Desikachary, 1987, pl. 6, fig. 4 (Pl. P8, fig. 4) (illustrated in Schrader, 1974, pl. 18, fig. 12 as *Cussia* sp. 1).

Remarks: ecological affinities: (1) "Littoral in the coastal areas of warm oceans; in general, not common" (Hustedt, 1985).

Delphineis surirella (Ehrenberg) Andrews; Hasle and Syvertsen, 1996, pl. 51 (Pl. P8, fig. 1).

Basionym: *Raphoneis surirella* (Ehrenberg) Grunow; Hendey, 1964, pl. 26, figs. 11–13; Schrader, 1973, pl. 25, figs. 4, 6, 12; Hustedt, 1985, fig. 679

Remarks: ecological affinities: (1) "cool to temp. seas" (Andrews, 1981); (2) North Sea (Drebs, 1974); (3) Chile (Andrews and Rivera, 1987); (4) distributed on all European coasts, also in harbors and river mouths with brackish water. Very common on the coasts of the southern North Sea to the Atlantic coasts of west Europe, rare in the Mediterranean (Hustedt, 1985); (5) *Raph. surirella*—marine, benthonic, littoral, rivermouth, epiphytic, and brackish (Hajós, 1973); (6) meroplanktonic species (Abrantes, 1988) and neritic species (Abrantes, 1991).

Diploneis bombus (Ehrenberg) Cleve; Hendey, 1964, pl. 32, fig. 2; Hustedt, 1985, fig. 1086.

Remarks: ecological affinities: (1) distributed and usually common on all ocean coasts (Hustedt, 1985); (2) marine, littoral, and benthic (Hajós, 1973); (3) sublittoral species (Jousé and Kazarina, 1974); (4) *Diploneis* spp.—benthic taxa (Abrantes, 1988, 1991).

Diploneis crabro Ehrenberg; Hendey, 1964, pl. 32, figs. 1, 3; Hustedt, 1985, figs. 1028–1037.

Remarks: ecological affinities: (1) distributed and common on most ocean coasts (Hustedt, 1985); (2) *Diploneis* spp.—benthic taxa (Abrantes, 1988, 1991).

Diploneis subovalis; Hustedt, 1985, fig. 1063.

Remarks: ecological affinities: (1) "One of the most common FW diatoms in tropical brooks and streams, on wet moss, also here and there in the littoral of lakes." (Hustedt, 1985); (2) *Diploneis* spp.—benthic taxa (Abrantes, 1988, 1991).

Diploneis spp. (Pl. P8, fig. 5).

Ditylum brightwellii (West) Grunow in Van Heurck; Hendey, 1964, pl. 5, fig. 1; Hasle and Syvertsen, 1996, pl 48 (Pl. P7, figs. 2–5)

Remarks: ecological affinities: (1) cosmopolitan—not recorded from polar regions (Hasle and Syvertsen, 1996).

Ethmodiscus rex (Rattray) Hendey; Barron, 1980, pl. 10, figs. 3, 6; Hasle and Syvertsen, 1996, pl. 18.

Remarks: ecological affinities: (1) warm-water to temperate region (Hasle and Syvertsen, 1996); (2) tropical thanatocoenosis (Pacific) (Werner, 1977).

Fragilariopsis doliolus (Wallich) Medlin & Sims; Hasle and Syvertsen, 1996, pl. 69 (Pl. P8, fig. 11).

Basionym: *Pseudoeunotia doliolus* (Wallich) Grunow Barron, 1980, pl. 6, figs. 1–3, 9; Baldauf, 1984, pl. 5, figs. 5–7; Baldauf, 1987, pl. 5, fig. 9.

Remarks: ecological affinities: (1) warm-water region (Hasle and Syvertsen, 1996); (2) predominantly in the littoral and in coastal plankton of warmer oceans; in the European area is found only in the Mediterranean (Hustedt 1985); (3) subtropical thanatocoenosis (Pacific) (Werner, 1977); (4) oceanic species (Jousé and Kazarina, 1974); (5) (*P. doliolus*) planktonic species (Abrantes, 1988, 1991); (6) "This species thrives in the eastern boundary current of the south Atlantic. It is most abundant in the upwelling area off southwest Africa and in the Benguela-South Equatorial Current System. Both regions experience strong upwelling and high levels of primary productivity, although SST differs greatly. *P. doliolus* evidently thrives in tropical to temperate regimes of high productivity. - in subtropical areas that correspond to the boundary between the pacific subtropical and subarctic gyres, where vertical mixing and high organic production occur, this species is important. In south Atlantic, high numbers of *P. doliolus* may reflect a seasonal plankton bloom. Maynard (1976) found this species important in her "gyre margin" factor in the south Atlantic. - this species is the dominant diatom of the offshore component of the Benguela and South Equatorial currents and may represent a productivity maximum during austral summer." (Pokras and Molfino, 1986).

Hemiaulus hauckii Grunow in Van Heurck; Hasle and Syvertsen, 1996, pl. 35 (Pl. P7, figs. 7–9).

Remarks: ecological affinities: (1) neritic species (Abrantes, 1991); (2) warm-water to temperate region (Hasle and Syvertsen, 1996).

Hemidiscus cuneiformis Wallich; Hendey, 1964, pl. 22, fig. 9; Schrader, 1973, pl. 24, fig. 14; Barron, 1980, pl. 1, figs. 8–10; Baldauf, 1984, pl. 1, figs. 6, 7; Baldauf, 1987, pl. 4, fig. 8 (Pl. P5, fig. 7).

Remarks: ecological affinities: (1) *H. cuneiformis* is a marine, warm-water species. In sediments, it is most likely warm-temperate, found in the North Pacific (Barron, 1981), the tropical eastern Pacific (Barron, 1980), the North Atlantic (Baldauf, 1984), and the tropical Indian Ocean (Schrader, 1974); (2) warm-water region (Hasle and Syvertsen, 1996); (3) tropical thanatocoenosis (Pacific) (Werner, 1977); (4) oceanic species (Jousé and Kazarina, 1974); (5) planktonic species (Abrantes, 1988).

Navicula lyroides Hendey; Hendey, 1964, pl. 33, figs. 3, 4 (Pl. P8, fig. 8).

Nitzschia marina Grunow; Barron, 1980, pl. 6, fig. 16; Hasle and Syvertsen, 1996, pl. 75, figs. e–h; Baldauf, 1984, pl. 4, figs. 1–4, pl. 5, figs, 1, 2; Baldauf, 1987, pl. 5, figs. 1, 4 (Pl. P8, fig. 13).

Remarks: ecological affinities: (1) warm-water region (Hasle and Syvertsen, 1996); (2) tropical thanatocoenosis (Pacific) (Werner, 1977); (3) oceanic species (Jousé and Kazarina, 1974); (4) planktonic species (Abrantes, 1988, 1991); (5) "This species is most important in two areas: north of the equator (though penetrating southward in the Guinea Basin) and in the extreme south eastern Atlantic and southwestern Indian Oceans. In the southeastern Atlantic, it is generally more prominent in cores farther from land. Our results show no obvious relationship between numbers of *N. marina* and productivity levels. N of

10°S its range suggests adaptation to warm-waters, particularly north of the equator." (Pokras and Molfino, 1986).

Nitzschia panduriformis Gregory; Baldauf, 1984, pl. 5, fig. 8 (Pl. P8, fig. 7).
Remarks: ecological affinities: (1) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991).

Nitzschia reinholdii Kanaya & Koizumi; Barron, 1980, pl. 6, figs. 10, 11; Barron, 1981, pl. 4, fig. 15; Baldauf, 1984, pl. 4, figs. 5–7, pl. 5, fig. 4; Baldauf, 1987, pl. 5, figs. 2, 3, 6 (Pl. P8, fig. 12).

Nitzschia sicula var. (Castracane) Hustedt; Hasle and Syvertsen, 1996, pl. 74, pl. 75, figs. a–d (Pl. P8, fig. 10).
Remarks: ecological affinities (1) probably warm-water to temperate region (Hasle and Syvertsen, 1996).

Odontella aurita (Lyngbye) C.A. Agardh; Hasle and Syvertsen, 1996, pl. 49 (Pl. P7, fig. 1).
Basionym: *Biddulphia aurita* (Lyngbye) de Brébisson; Hendey, 1964, pl. 24, fig. 6.
Remarks: ecological affinities: (1) cosmopolitan? (Hendey, 1964); (2) arcto-boreal thanatocoenosis (Pacific) (*Biddulphia*) (Werner, 1977); (3) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991).

Paralia sulcata (Ehrenberg) Cleve; Hendey, 1964, pl. 23, fig. 5; Hajós, 1973, pl. 1, figs. 20, 21; Hasle and Syvertsen, 1996, pl. 14 (Pl. P9, fig. 2).
Basionym: *Melosira sulcata* (Ehrenberg) Kutzing; Schrader, 1973, pl. 20, fig. 9; Baldauf, 1984, pl. 6, fig. 6.
Remarks: ecological affinities: (1) *P. sulcata* is a bottom form but fairly common in coastal plankton, probably cosmopolitan (Hasle and Syvertsen, 1996); (2) sublittoral species (Jousé and Kazarina, 1974); (3) marine, littoral, planktonic, neritic (Hajós, 1973); (4) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991).

Podosira stelliger (Bailey) Mann; Hendey, 1964, pl. 22, fig. 6; Hajós, 1973, pl. 2, figs. 2, 3; Desikachary, 1988, pl. 601, figs. 1–13, pl. 602, figs. 1–11 (Pl. P5, figs. 5, 6).
Remarks: ecological affinities: (1) *Podosira* spp.—marine, benthic (Hajós, 1973).

Porosira denticulata Simonsen; Hasle and Syvertsen, 1996, pg. 41 (Pl. P9, fig. 3).
Remarks: ecological affinities: (1) Indian Ocean, Equatorial Atlantic Ocean (?) (Simonsen, 1974, probably the only records) (Hasle and Syvertsen, 1996.

Pseudosolenia calcar-avis (Schultz) Sundström; Hasle and Syvertsen, 1996, pl. 30 (Pl. P7, figs. 10, 11).
Basionym: *Rhizosolenia calcar-avis* Schultz; Hendey, 1964, pl. 4, fig. 3.
Remarks: ecological affinities: (1) (*R. calcar-avis*) pelagic species (Abrantes, 1991); (2) warm-water region, occasionally in temperate waters (Hasle and Syvertsen, 1996).

Rhaphoneis amphiceros (Ehrenberg) Ehrenberg; Hendey, 1964, pl. 26, figs. 1–4; Schrader, 1973, pl. 25, figs. 2, 3; Hustedt; 1985, fig. 680; Hasle and Syvertsen, 1996, pl. 52 (Pl. P8, fig. 2).
Remarks: ecological affinities: (1) probably cosmopolitan (Hasle and Syvertsen, 1996); (2) "Distributed on all European coasts; common; likewise found in harbors and river mouths with brackish water. How much it actually prefers brackish water requires more research" (Hustedt, 1985); (3) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991).

Rhizosolenia curvirostris Jousé; Schrader, 1973, pl. 24, figs. 5, 6, 8, 9; Baldauf, 1984, pl. 1, fig. 10, pl. 2, fig. 6 (Pl. P7, fig. 13).

Roperia tesselata (Roper) Grunow; Hendey, 1964, pl. 22, fig. 3; Schrader, 1973, pl. 19, figs. 3, 4, 8, 9; Barron, 1980, pl. 3, figs. 8, 10, 13; Baldauf, 1984, pl. 6, figs. 5, 8; Baldauf, 1987, pl. 2, fig. 9 (Pl. P9, figs. 4, 5).

Remarks: Two distinct morphologies of this species were observed. One type, illustrated in Plate **P9**, figure 5 (var. 2), has a wide mantle band in the same plane as the valve face filled with distinctly smaller pores than those of the face in a decussiting pattern. The labiate extensions that mark the edge of the other morphotype (Pl. **P9**, fig. 4; var. 1) are still present but at the intersection between the larger and smaller pore sizes. The distinct fluting of the edge of the valve (var. 1) opposite the pseudonodulus is not present in var. 2. Both varieties have been grouped into one species for abundance estimates after it was noted that there was consistently no significant difference between the numbers of either in the assemblage.

Remarks: ecological affinities: (1) "*R. tesselata* is a warm-water, planktonic species in the modern oceans (Hasle 1976). In sediments, this species was recorded by Fenner et al. (1976) from the southern Pacific Ocean, but only in samples north of the Antarctic Convergence. Barron (1980) reports *R. tesselata* in tropical eastern Pacific sediments. Baldauf (1984) records this species from the North Atlantic Ocean." (Fryxell et al., 1986); (2) subtropical thanatocoenosis (Pacific) (Werner, 1977); (3) oceanic species (Jousé and Kazarina, 1974); (4) meroplanktonic species (Abrantes, 1988); (5) "This species is most abundant in western waters (between Africa and S. Am) north of 10°S. Its range shows a small W–E tongue extending almost to 0°W near 8°S. The southern tongue is similar to the southern part of the range of *A. neocrenulata*. *R. tesselata* is found across a wide range of latitudes in the Atlantic and in other oceans. It appears to be primarily a warm-water form, and was previously described as widespread and common in the equatorial Atlantic. Our results also indicate that it is primarily adapted to waters of moderate productivity." (Pokras and Molfino, 1986).

Stellarima stellaris (Roper) Hasle and Sims; Hasle and Syvertsen, 1996, pl. 19.

Remarks: ecological affinities: (1) warm-water to temperate region, planktonic (Hasle and Syvertsen, 1996); (2) planktonic species (Abrantes, 1988).

Stephanopyxis turris (Arnott in Greville) Ralfs in Pritchard; Baldauf, 1984, pl. 6, fig. 10; Hasle and Syvertsen, 1996, pl. 14.

Remarks: ecological affinities: (1) temperate to warm-water region? (Hasle and Syvertsen, 1996); (2) stenothermal, warm-water form (marine, neritic, planktonic, stenothermal) (Hajós, 1973); (3) meroplanktonic species (Abrantes, 1988), neritic species (Abrantes, 1991).

Surirella spp. Turpin; Hendey, 1964, pl. 40; Hustedt, 1985, figs. 831–869 (Pl. **P8**, fig. 6).

Remarks: ecological affinities: (1) littoral, brackish (Hajós, 1973); (2) *Surirella* spp.—benthic taxa (Abrantes, 1988, 1991).

Thalassionema nitzschiodes (Grunow) Mereschkowsky; Barron, 1980, pl. 6, figs. 15, 21; Baldauf, 1984, pl. 6, figs. 2, 3; Hasle and Syvertsen, 1996, pl. 57, figs. a, b (Pl. **P8**, fig. 9).

Remarks: ecological affinities: (1) cosmopolitan, but not in the high arctic and antarctic (Hasle and Syvertsen, 1996); (2) pelagic in coastal plankton of European oceans, very widely distributed and common; often massive blooms in the northern Atlantic area (Hustedt, 1985); (3) subtropical thanatocoenosis (Pacific) (Werner, 1977); (4) oceanic species (Jousé and Kazarina, 1974); (5) marine, neritic, littoral, euryhaline, planktonic (Hajós, 1973); (6) "This species is most abundant in relatively nearshore cores. It dominates the total flora between the Niger delta and ~7°S, just south of the Zaire River mouth. Its abundance decreases consistently with increasing distance from shore, suggesting that this species is adapted to nearshore conditions. It is common in the Peru-Chile current and in the Sea of Japan. In the north Atlantic, it is abundant relatively close to Europe. The abundance pattern bears a striking resemblance to maps of lowered sea surface salinity due to run off from the Niger and Zaire rivers. Zaire outflow is also high in nutrients. *T. nitzschiodes* is also common in low-salinity shelf areas of the Bering Sea. The dominance of *T. nitzschiodes* in the eastern equatorial Atlantic appears to reflect the particular salinity-nutrient conditions of river outflow—this species reflects the influx of low salinity run off from the Zaire and Niger rivers." (Pokras and Molfino, 1986).

Thalassiosira anguste-lineata (A. Schmidt) Fryxell & Hasle; Hasle and Syvertsen, 1996, pl. 9 (Pl. **P10,** figs. 1–3).

Remarks: ecological affinities: (1) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986); (2) pelagic species (Abrantes, 1991); (3) cosmopolitan (Hasle and Syvertsen, 1996).

Thalassiosira convexa var *aspinosa* Schrader, 1974, pl. 2, figs. 8, 9, 13a–21; Barron, 1980, pl. 8, fig. 1; Baldauf, 1984, pl. 7, figs. 4, 6, 8, 9; Baldauf, 1984, pl. 5, fig. 10, pl. 7, figs. 6, 9; Barron, 1985, pl. 5, figs. 8, 9; Baldauf, 1987, pl. 2, fig. 5 (Pl. **P10,** figs. 4, 5).

Remarks: ecological affinities: (1) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira eccentrica (Ehrenberg) Cleve; Barron, 1980, pl. 9, fig. 1, pl. 11, fig. 1; Baldauf, 1984, pl. 9, figs. 1, 4; Baldauf, 1987, pl. 2, fig. 7, pl. 4, fig. 3; Hasle and Syvertsen, 1996, pl. 6 (Pl. **P11,** figs. 1–3).

Synonyms: *Coscinodiscus eccentricus* Ehrenberg; Hendey, 1964, pl. 24, fig. 7; *Coscinodiscus excentricus* Ehrenberg; Hajós, 1973, pl. 4, figs. 1, 2, 4.

Remarks: ecological affinities: (1) cosmopolitan, exclusive polar regions (Hasle and Syvertsen, 1996); (2) northboreal thanatocoenosis (Pacific) (Werner, 1977); (3) *C. excentricus*—frequently occur in river mouths (brackish, plantonic, river mouths) (Hajós, 1973); (4) planktonic species (Abrantes, 1988, 1991); (5) "Relative abundances of this species exceed 5% in all cores. Maximum numbers are found in western equatorial waters, along the coast of equatorial Africa and off southwest Africa. With some exceptions, it is less common in the South Equatorial Current and in cores far from land off the southwest African coast. *T. eccentrica* is a very widespread species. It has been reported from the Subarctic Pacific, and Atlantic to the subantarctic Atlantic. This paper's data suggest that temperate to warm waters are optimal for this species." (Pokras and Molfino, 1986); (6) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira ferelineata Hasle and Fryxell; Barron, 1980, pl. 9, figs. 8, 11; Hasle and Fryxell, 1977, figs. 46–53.

Remarks: ecological affinities: (1) type locality–Pacific Ocean (off Australia), also found off Peru (Hasle and Fryxell, 1977); (2) mainly warm-water region (Hasle and Syvertsen, 1996); (3) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira leptopus (Grunow) Hasle and Fryxell; Hasle and Fryxell, 1977, figs. 1–14; Barron, 1980, pl. 9, fig. 6; Baldauf, 1984, pl. 1, fig. 8, pl. 9, fig. 5; Baldauf, 1987, pl. 1, fig. 2; Hasle and Syvertsen, 1996, pl. 10 (Pl. **P12,** figs. 1, 2).

Remarks: ecological affinities: (1) Indian Ocean, Atlantic and Pacific (mid lats), Monaco, Mejillones, Chile, and California. Although the records mentioned are few, they are from widespread localities and indicate a wide distribution and apparent absence from colder waters. (Hasle and Fyxell, 1977); (2) planktonic species (Abrantes, 1988, 1991); (3) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira lineata Jousé; Hasle and Fryxell, 1977, figs. 15–25; Hasle and Syvertsen, 1996, pl. 10 (Pl. **P11,** figs. 4, 5).

Synonym: *Coscinodiscus lineatus*; Hajós (1973)

Remarks: ecological affinities: (1) *T. lineata* was characterized by Jousé et al. (1971) among others as a subtropical species, and by Hasle (1976) as a warm-water species. (Hasle and Fryxell, 1977); (2) warm-water region (Hasle and Syvertsen, 1996); (3) subtropical thanatocoenosis (Pacific) (Werner, 1977); (4) *C. lineatus*—oceanic, warm-water form (Hajós, 1973); (5) "(including *T. leptopa*) While present in virtually the entire study area, *T. lineata* is particularly important in two areas. The Benguela upwelling region and along the equator, west of ~12°W and between 3°E and 7°W; this corresponds to the location of the Equatorial Undercurrent. *T. lineata* is found in almost all the world's oceans; it is particularly important in tropical and subtropical waters. The available evidence suggests that *T. lineata* has two preferences: warm but not especially productive waters (Equatorial Undercurrent) and cool, highly productive waters (Benguela Region)" (Pokras and Molfino, 1986); (6) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira nordenskioeldii Cleve; Sancetta, 1982, pl. 5, figs. 8, 9; Hasle and Syvertsen, 1996, pl. 5 (Pl. **P12,** figs. 3–5).

Remarks: ecological affinities: (1) northern cold-water region to temperate (Hasle and Syvertsen, 1996); (2) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira oestrupii (Ostenfeld) Proshkina-Lavrenko; Schrader, 1974, pl. 1, figs. 3–11, 13–16, 19, 20; Barron, 1980, pl. 9, figs. 2, 4, 5, 7; Barron, 1981, pl. 5, fig. 6; Baldauf, 1984, pl. 2, figs. 11, 12; Baldauf, 1987, pl. 2, figs. 4, 6; Hasle and Syvertsen, 1996, pl. 12 (Pl. **P12,** fig. 6).

Remarks: ecological affinities: (1) cosmopolitan?; warm-water to temperate region (Hasle and Syvertsen, 1996); (2) tropical thanatocoenosis (Pacific) (Werner, 1977); (3) oceanic species (Jousé and Kazarina, 1974); (4) marine, planktonic (Hajós, 1973); (5) planktonic species (Abrantes, 1988, 1991); (6) "subtropical waters of moderate productivity are dominated by a combination of *Coscinodiscus* and *Thalassiosira* spp., which also thrive in the Equatorial Undercurrent." (Pokras and Molfino, 1986).

Thalassiosira pacifica Gran and Angst; Barron, 1980, pl. 5, figs. 3, 4; Hasle and Syvertsen, 1996, pl. 5 (Pl. **P13,** fig. 3).

Remarks: ecological affinities: (1) cosmopolitan, exclusive polar regions (Hasle and Syvertsen, 1996).

Thalassiosira plicata Schrader, 1974, pl. 3, figs. 1, 2, 4–9; Barron, 1980, pl. 8, figs. 6, 9, 10; Baldauf, 1987, pl. 4, fig. 1 (Pl. **P13,** figs. 1, 2).

Triceratium spp. (Pl. **P14,** fig. 6).

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Figure F1. Chart with GRA bulk-density values for the upper four cores of Hole 1063D. Stages 3, 4, and 5 are indicated above their associated intervals of the record. Triangles = samples examined in this study (every 10 cm), dotted vertical lines = core breaks.

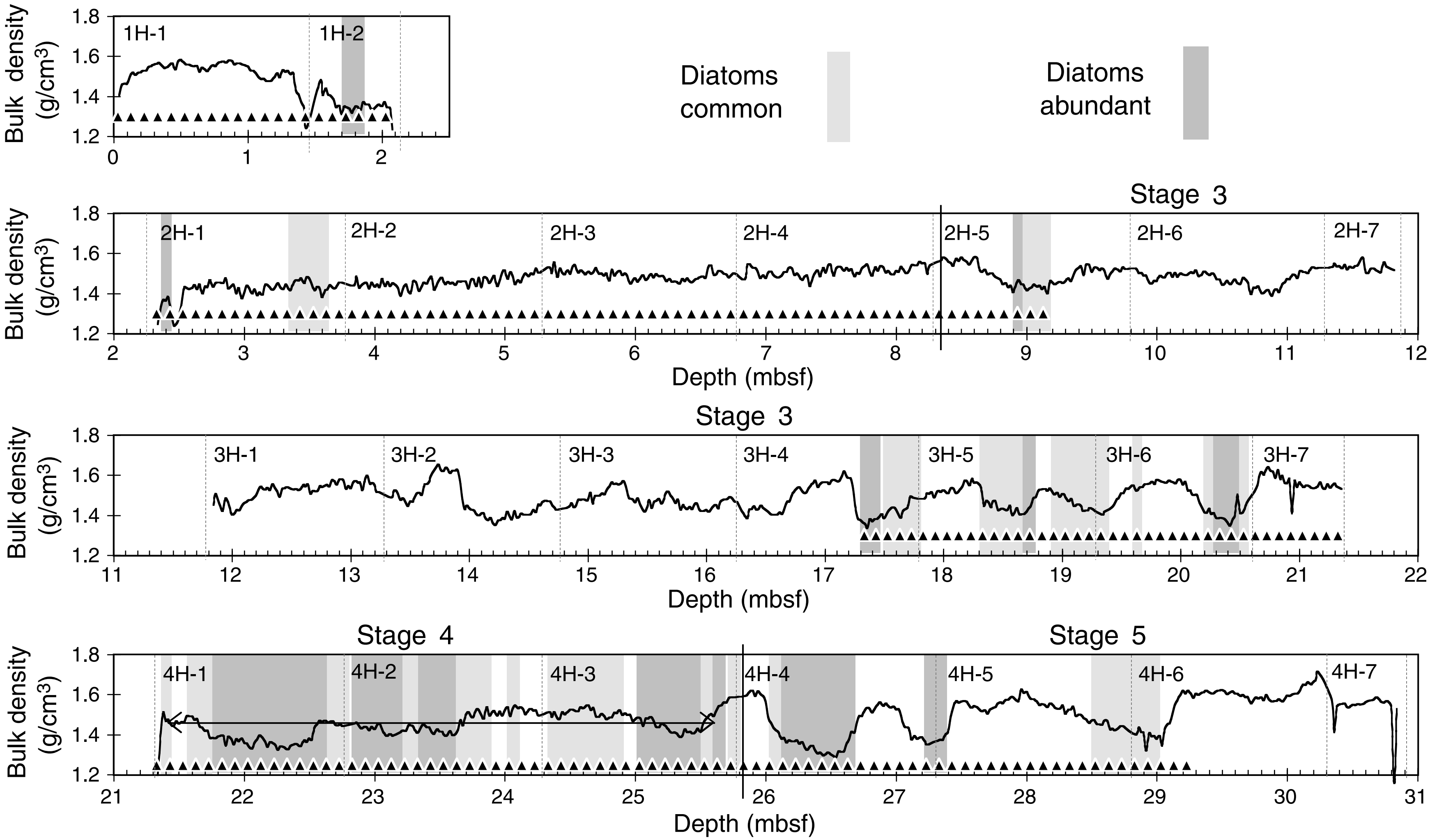


Figure F2. Illustration of the environmental affinity of some of the diatom species observed in this study (see "Taxonomy and Ecological Preferences," p. 7, for details and sources).

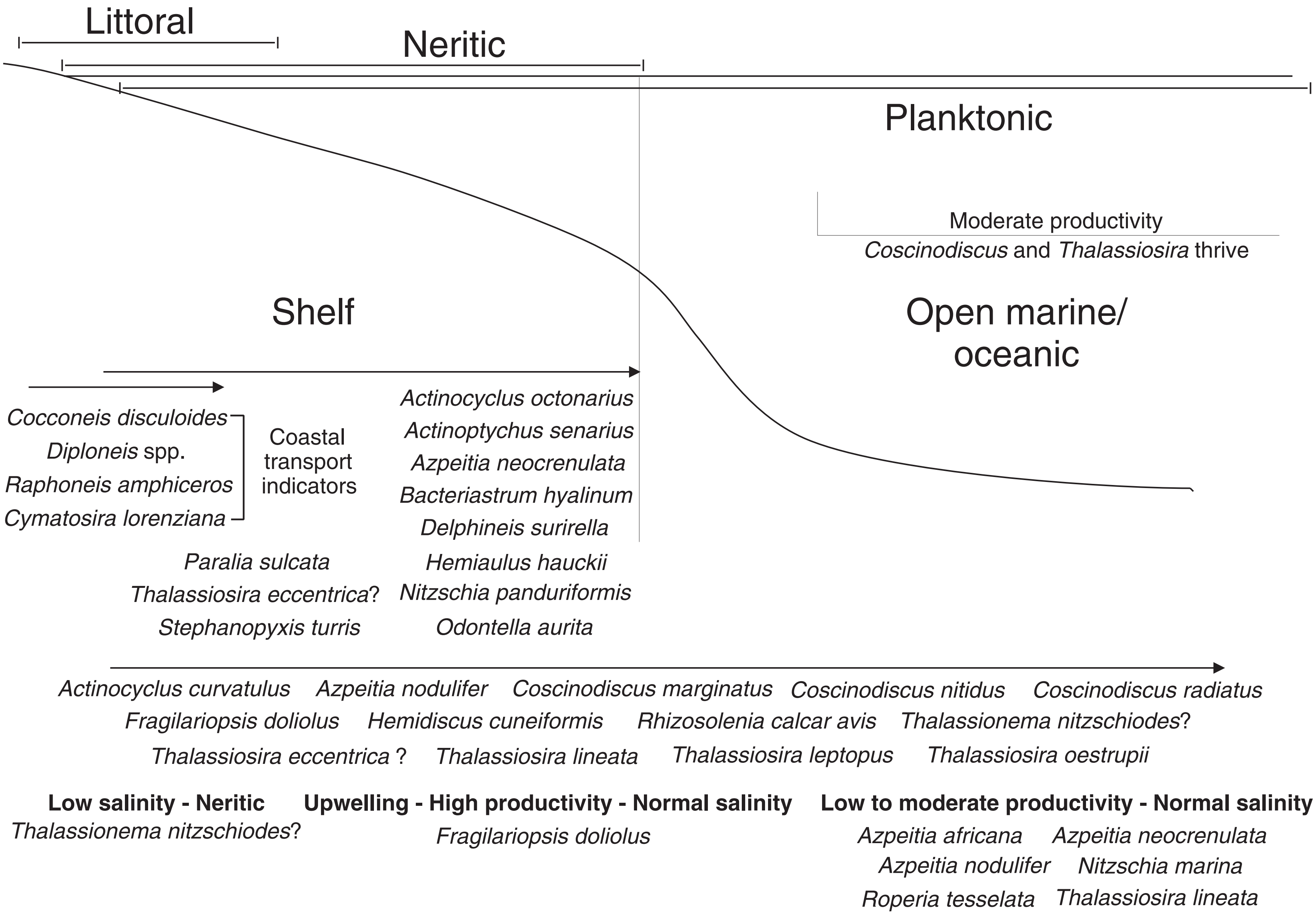


Figure F3. Comparison of depth vs. abundance for selected diatom species. Abundance increases to the right with quantitative assignments of 75 = A, 50 = C, 30 = F, 15 = R, and 5 = X. Magnetic susceptibility, GRA bulk density, and total diatom abundance are also illustrated. (Continued on next four pages.)

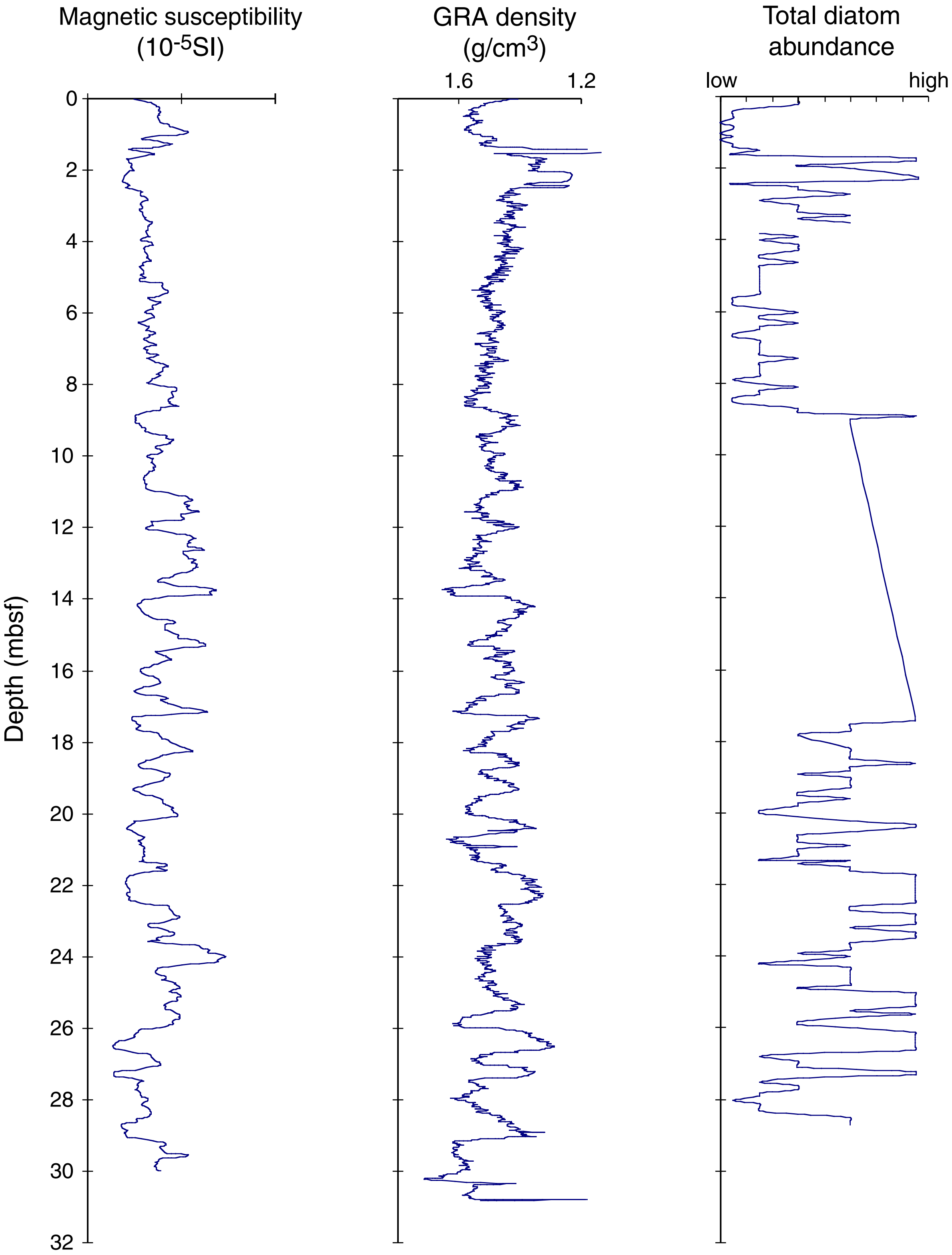


Figure F3 (continued).

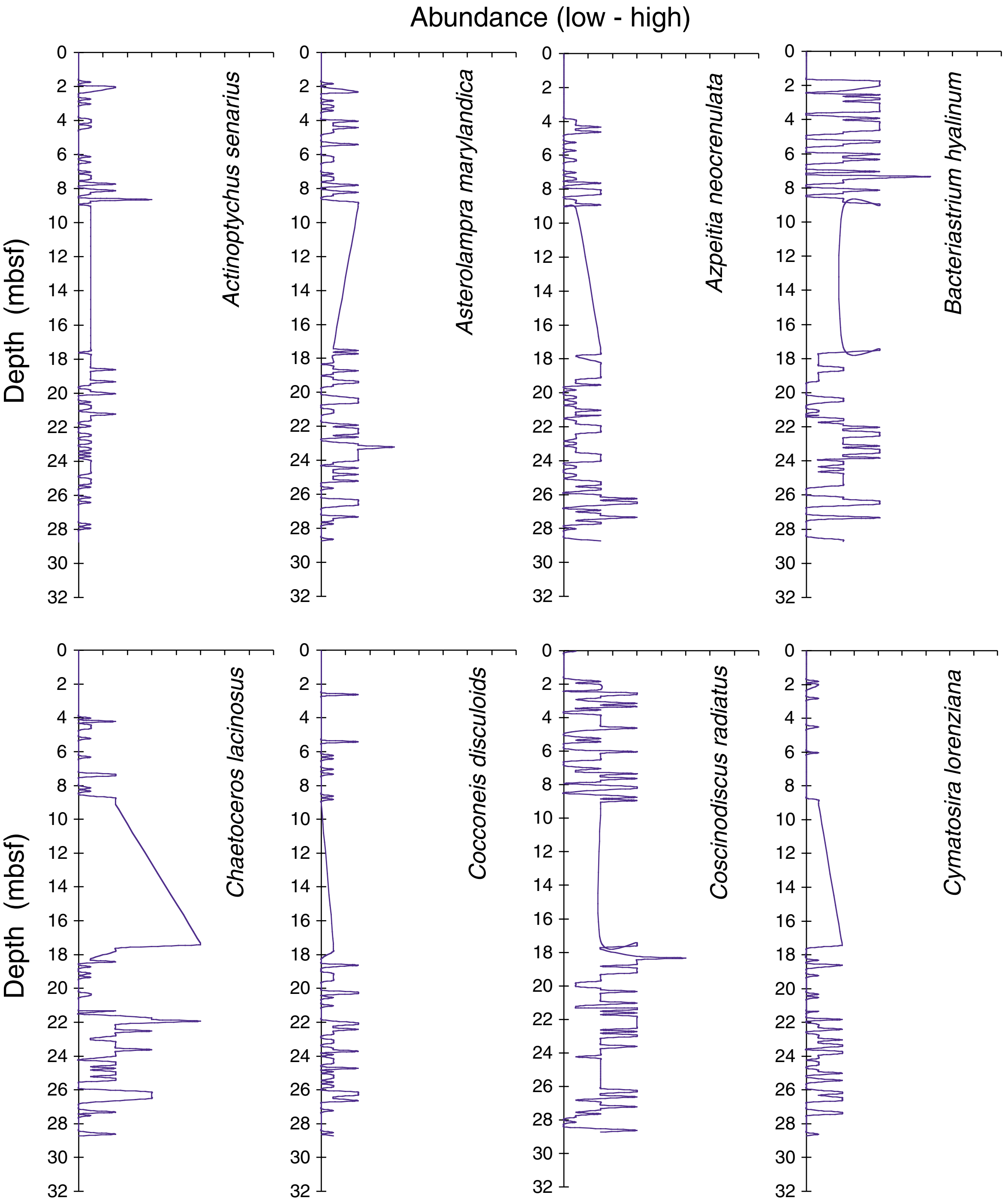


Figure F3 (continued).

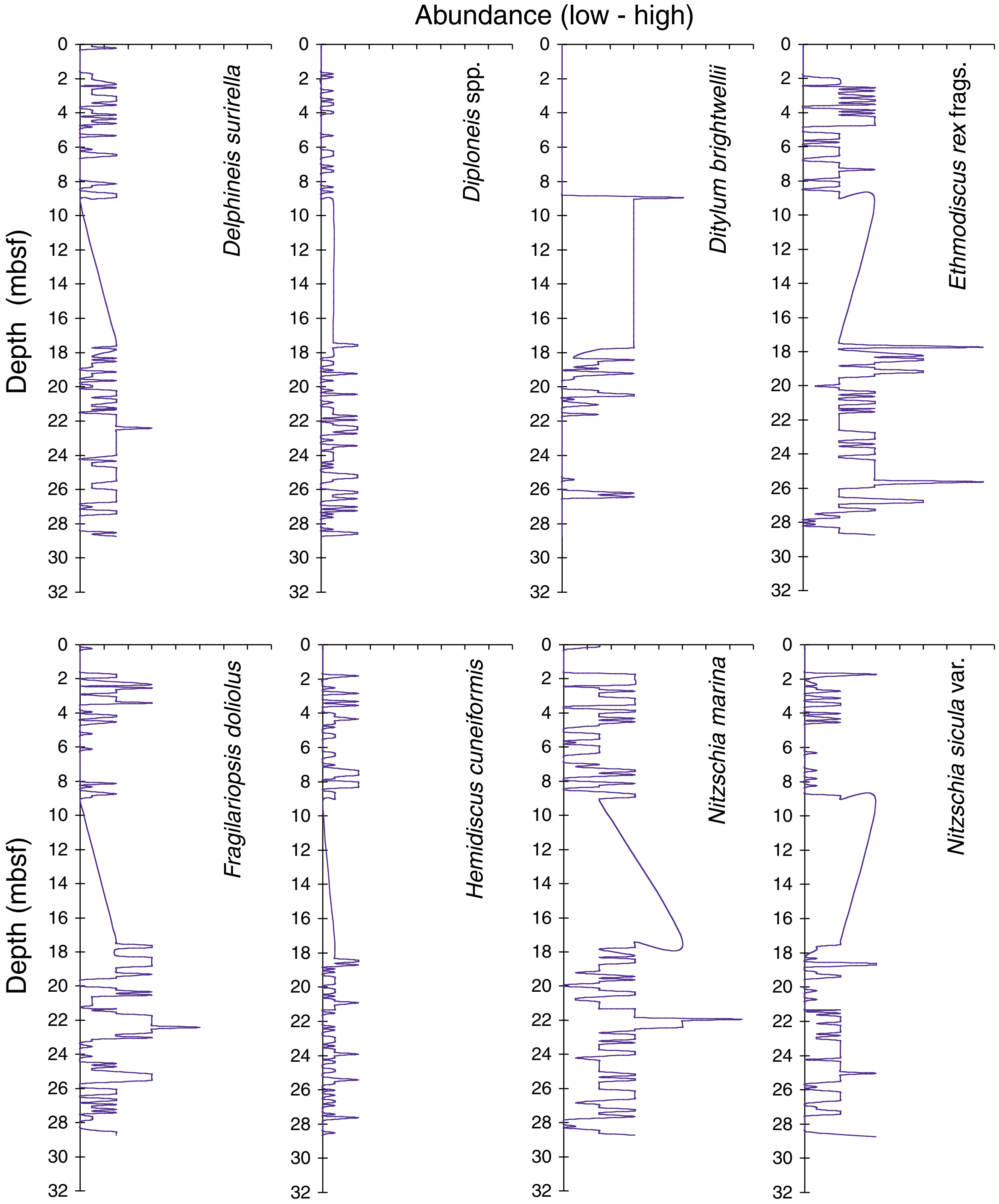


Figure F3 (continued).

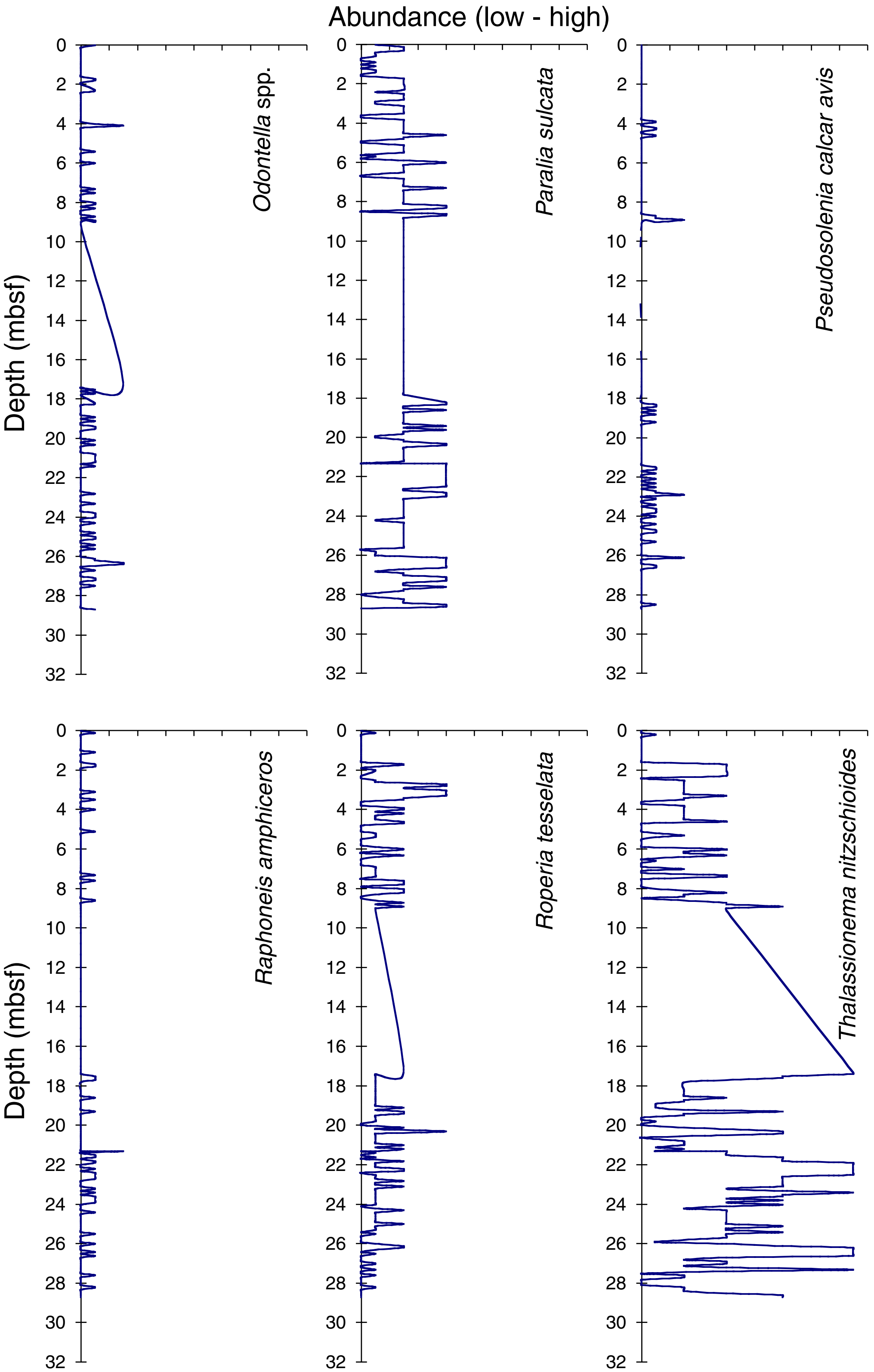


Figure F3 (continued).

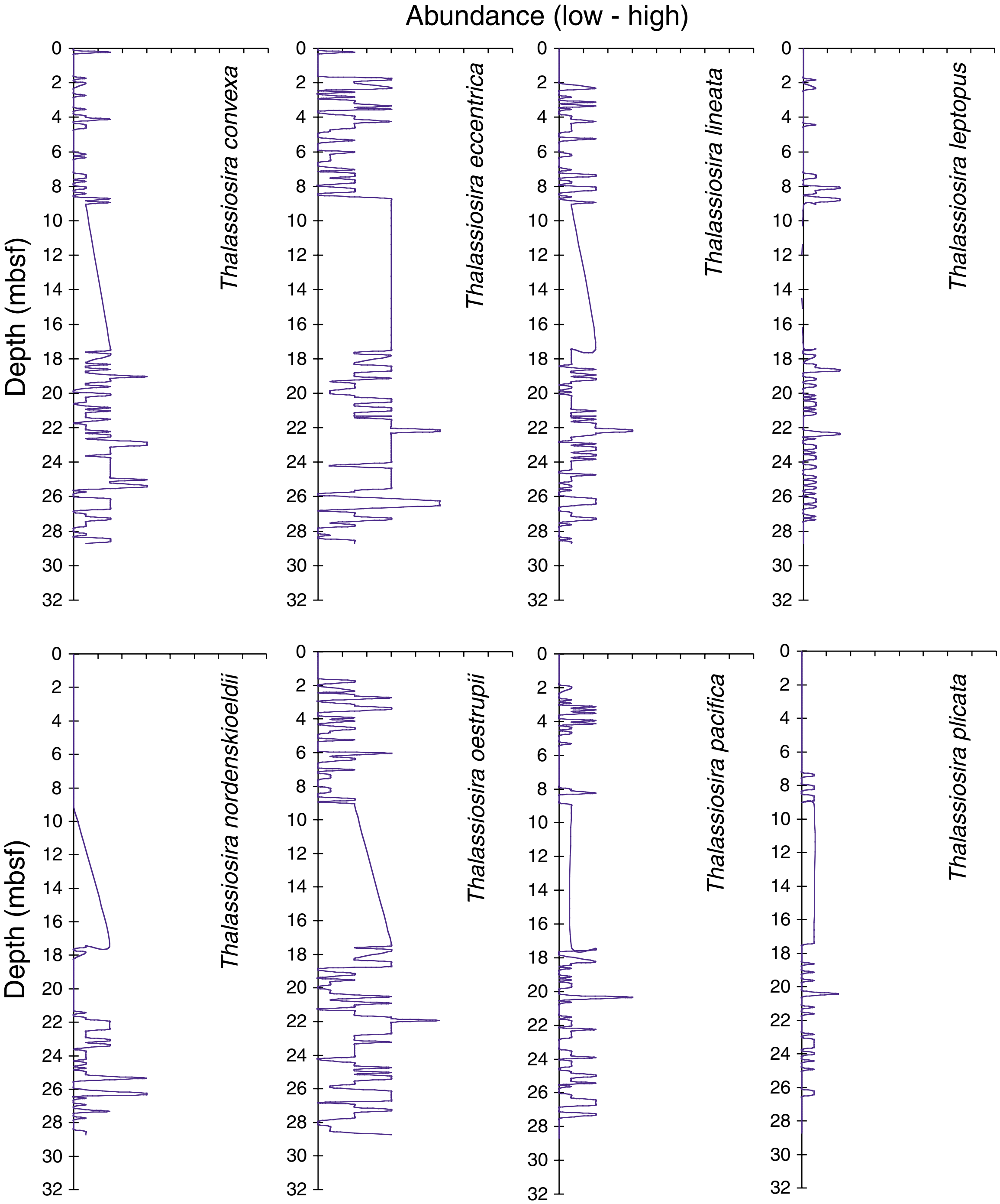


Table T1. Biostratigraphic diatom data for Core 172-1063D-1H. (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Actinocyclus curvatulus*	*Actinocyclus ellipticus* var. *elongatus*	*Actinocyclus ingens*	*Actinocyclus octonarius*	*Actinocyclus octonarius* var. *teniella*	*Actinoptychus senarius*	*Actinoptychus* spp.	*Amphora* cf. *robusta*	*Asterolampra grevillei*	*Asterolampra marylandicus*	*Asteromphalus arachne*	*Asteromphalus elegans*	*Asteromphalus heptactis*	*Asteromphalus* sp. A	*Asteromphalus* spp.	*Auliscus* spp.	*Azpeitia africana*	*Azpeitia neocrenulata*	*Azpeitia nodulifer*	*Bacteriastrum hyalinum*	*Biddulphia alternans*	*Biddulphia/Odontella* spp.	*Chaetoceros diadema*	*Chaetoceros lacinosus*	*Chaetoceros messanensis*	*Chaetoceros mitra*	*Chaetoceros* spp.	*Cocconeis disculoides*	*Cocconeis pinnata*	*Cocconeis* spp.	*Coscinodiscus marginatus*	*Coscinodiscus nitidus*	*Coscinodiscus oculusiridus*	*Coscinodiscus radiatus*	*Coscinodiscus reniformis*	*Cymatosira lorenziana*	*Delphineis surirella*	*Denticulopsis* spp.	*Diploneis bombus*	*Diploneis crabro*	*Diploneis subovalis*	*Diploneis* spp.	*Ditylum brightwellii*	*Ethmodiscus rex* frags.	*Fragilariopsis doliolus*
172-1063D-																																																
1H-1, 3-4	0.03	F	M												X																			R			X			X								
1H-1, 13-14	0.13	F	P																															X						X								
1H-1, 23-24	0.23	F	M	X																					X															R								X
1H-1, 33-34	0.33	R	P																																													
1H-1, 43-44	0.43	X	P																															X														
1H-1, 53-54	0.53	X	F																																													
1H-1, 63-64	0.63	X	F																																													
1H-1, 73-74	0.73	B																																														
1H-1, 83-84	0.83	X	F																																													
1H-1, 93-94	0.93	X	F																																													
1H-1, 103-104	1.03	B																																														
1H-1, 113-114	1.13	X	F																																													
1H-1, 123-124	1.23	B																																														
1H-1, 133-134	1.33	X	F																																													
1H-1, 143-144	1.43	X	F																																													
1H-2, 3-4	1.53	R	F																																													
1H-2, 13-14	1.63	X	F																																													
1H-2, 23-24	1.73	A	M	X					X				X	X						X		F	F	X		R			X								X			X			X					R
1H-2, 33-34	1.83	A	M	R					?				X							R		R	F														R		X	X								R
1H-2, 43-44	1.93	F	P	R						X	X		X							X			F			X											X			X				X			X	R
1H-2, 53-54	2.03	C	P						R	X	X		X									R	F														R		X	X							R	

Notes: Abundance: A = abundant, C = common, F = frequent, R = rare, X = scarce, B = barren. Preservation: G = good, M = moderate, P = poor, F = fragments.

Table T1 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Grammatophora* spp.	*Hemiaulus hauckii*	*Hemidiscus cuneiformis*	*Navicula lyroides*	*Navicula* spp.	*Nitschia panduriformis*	*Nitzschia sicula* var.	*Nitzschia fossils*	*Nitzschia marina*	*Nitzschia reinholdii*	*Odontella aurita*	*Opephora* spp.	*Paralia sulcata*	*Pinnularia* spp.	*Plagiogramma* spp.	*Pleurosigma* spp.	*Podosira stelliger*	*Porosira denticulata*	*Pseudonitzschia* spp.	*Pseudosolenia calcar avis*	*Pyxidicula* spp. *frags*	*Raphoneis amphiceros*	*Rhizosolenia curvirostris*	*Rhizosolenia* spp.	*Roperia tesselata*	*Stellarima stellaris*	*Stephanopyxis turris*	*Stephanopyxis* spp.	*Surirella* spp.	*Thalassionema nitzschioides*	*Thalassiosira aguste-lineata*	*Thalassiosira convexa*	*Thalassiosira eccentrica*	*Thalassiosira* cf. *ferelineata*	*Thalassiosira leptopus*	*Thalassiosira lineata*	*Thalassiosira nordenskioeldii*	*Thalassiosira oestrupii*	*Thalassiosira pacifica*	*Thalassiosira plicata*	*Trachyneis* spp.	*Triceratium* spp.
172-1063D-																																													
1H-1, 3-4	0.03	F	M				X	X				R		X		X																													
1H-1, 13-14	0.13	F	P									R				R									X			X																	
1H-1, 23-24	0.23	F	M									X				R																	X		R	R									
1H-1, 33-34	0.33	R	P													R																													
1H-1, 43-44	0.43	X	P													X																													
1H-1, 53-54	0.53	X	F													X																													
1H-1, 63-64	0.63	X	F													X																													
1H-1, 73-74	0.73	B																																													
1H-1, 83-84	0.83	X	F					X																																							
1H-1, 93-94	0.93	X	F													X																													
1H-1, 103-104	1.03	B																																													
1H-1, 113-114	1.13	X	F													X									X																				
1H-1, 123-124	1.23	B																																													
1H-1, 133-134	1.33	X	F													X																													
1H-1, 143-144	1.43	X	F													X																													
1H-2, 3-4	1.53	R	F																																										
1H-2, 13-14	1.63	X	F																																										
1H-2, 23-24	1.73	A	M							F		F				R									X			R					F		X	F					R				
1H-2, 33-34	1.83	A	M			R				R	?	F		X		R									X			X					F			F		X			R				
1H-2, 43-44	1.93	F	P			X		X		X		F				R						X											F			R						X			
1H-2, 53-54	2.03	C	P					X				F				R						X						X					F		X	R						X			

Table T2. Biostratigraphic diatom data for Core 172-1063D-2H. (See table notes. Continued on next three pages.)

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Actinocyclus curvatulus*	*Actinocyclus ellipticus* var. *elongatus*	*Actinocyclus ingens*	*Actinocyclus octonarius*	*Actinocyclus octonarius* var. *teniella*	*Actinoptychus senarius*	*Actinoptychus* spp.	*Amphora* cf. *robusta*	*Asterolampra grevillei*	*Asterolampra marylandicus*	*Asteromphalus arachne*	*Asteromphalus elegans*	*Asteromphalus heptactis*	*Asteromphalus* sp. A	*Asteromphalus* spp.	*Auliscus* spp.	*Azpeitia africana*	*Azpeitia neocrenulata*	*Azpeitia nodulifer*	*Bacteriastrum hyalinum*	*Biddulphia alternans*	*Biddulphia/Odontella* spp.	*Chaetoceros diadema*	*Chaetoceros lacinosus*	*Chaetoceros messanensis*	*Chaetoceros mitra*	*Chaetoceros* spp.	*Cocconeis disculoides*	*Cocconeis pinnata*	*Cocconeis* spp.	*Coscinodiscus marginatus*	*Coscinodiscus nitidus*	*Coscinodiscus oculusiridus*	*Coscinodiscus radiatus*	*Coscinodiscus reniformis*	*Cymatosira lorenziana*	*Delphineis surirella*	*Denticulopsis* spp.	*Diploneis bombus*	*Diploneis crabro*	*Diploneis subovalis*	*Diploneis* spp.	*Ditylum brightwellii*	*Ethmodiscus rex* frags.	*Fragilariopsis doliolus*	*Grammatophora* spp.	*Hemiaulus hauckii*
172-1063D-																																																		
2H-1, 3-4	2.33	A	M	R					X						X							R	R	X				X								X	R			R							R	F		
2H-1, 13-14	2.43	X	F																																															
2H-1, 23-24	2.53	F	P	X																		X	F														F			R							F	F		
2H-1, 33-34	2.63	F	M	X																			R								R			X			F			X							R	R	X	
2H-1, 43-44	2.73	C	M						X				X					X		R		X	F							X						X	R			X			X	X			F	R		
2H-1, 53-54	2.83	F	P	?																			F													X	R		X	X							R	R		
2H-1, 63-64	2.93	R	P							X													R														X			X							R			
2H-1, 73-74	3.03	F	M	X			X		X				X										F							X						X	R			R							F	R		
2H-1, 83-84	3.13	F	M				X						X							X			F							R				X			F			R							R	R		
2H-1, 93-94	3.23	F	M																				F														R			R			X				F	R		
2H-1, 103-104	3.33	C	M										X							R			F			X											F			R							F	R		
2H-1, 113-114	3.43	F	P																				F			X											X			X					X		R	F		
2H-1, 123-124	3.53	C	M	X											X					X		R	F							R						X	R			R					X		F			
2H-2, 3-4	3.63	R	F																				R														R			X							F		X	
2H-2, 13-14	3.73	F	M						X				R		X					X	X	X	F											X		X	R			X			X				R	X		
2H-2, 23-24	3.83	R	P	X			X		X				X		X	X				X	X	X	R	X		R	X	X	X	X						X	R			X			X		X		F			X
2H-2, 33-34	3.93	F	P	X					X				X			X				X	X		F			R				R						X	R			R							R	R		
2H-2, 43-44	4.03	F	P	X			X						X							X	X	X	F				R	X								X	R										F	R		X
2H-2, 53-54	4.13	F	M		X		X		X				R	R	X					X	R		F			X				R						X	R			R							F	X		X
2H-2, 63-64	4.23	R	M	X					X				X		X					X	X		F			X	X										R			X							F			
2H-2, 73-74	4.33	R	M		X								X	X	X					X	X	X	F			X	X			R						X	R		X	X							F	R		?
2H-2, 83-84	4.43	F	M	X							X		X	X	X					X	R		F		X	X	X					?				X	F			R							F	X		X
2H-2, 93-94	4.53	R	P																	X	X		R											X		X	R										F			
2H-2, 103-104	4.63	R	P																	X			R			X											X			X										
2H-2, 113-114	4.73	R	F																																															
2H-2, 123-124	4.83	R	F																																															
2H-2, 133-134	4.93	R	P	R																																	X													
2H-2, 143-144	5.03	R	M										X		X					X	X	X	F				X									X	R										R	X		
2H-3, 3-4	5.13	R	P				X						R				X					X	F													X	X			R				X			R			
2H-3, 13-14	5.23	R	M																				R	X							R						R										R			
2H-3, 23-24	5.33	R	P																				R											X													R			
2H-3, 33-34	5.43	X	F																															X																
2H-3, 43-44	5.53	X	F																		X																										R			
2H-3, 53-54	5.63	X	F																																															
2H-3, 63-64	5.73	R	P																																		X													
2H-3, 73-74	5.83	F	M	X									X										F														F		X								R			
2H-3, 83-84	5.93	R	P						X				X										R													X	R			X							R	X		
2H-3, 93-94	6.03	R	P										X				X			X	X		R								X					X	R						X				R			

Table T2 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Hemidiscus cuneiformis*	*Navicula lyroides*	*Navicula* spp.	*Nitschia panduriformis*	*Nitzschia sicula* var.	*Nitzschia fossils*	*Nitzschia marina*	*Nitzschia reinholdii*	*Odontella aurita*	*Opephora* spp.	*Paralia sulcata*	*Pinnularia* spp.	*Plagiogramma* spp.	*Pleurosigma* spp.	*Podosira stelliger*	*Porosira denticulata*	*Pseudonitzschia* spp.	*Pseudosolenia calcar avis*	*Pyxidicula* spp. frags	*Raphoneis amphiceros*	*Rhizosolenia curvirostris*	*Rhizosolenia* spp.	*Roperia tesselata*	*Stellarima stellaris*	*Stephanopyxis turris*	*Stephanopyxis* spp.	*Surirella* spp.	*Thalassionema nitzschioides*	*Thalassiosira aguste-lineata*	*Thalassiosira convexa*	*Thalassiosira eccentrica*	*Thalassiosira* cf. *ferelineata*	*Thalassiosira leptopus*	*Thalassiosira lineata*	*Thalassiosira nordenskioeldii*	*Thalassiosira oestrupii*	*Thalassiosira pacifica*	*Thalassiosira plicata*	*Trachyneis* spp.	*Triceratium* spp.
172-1063D-																																											
2H-1, 3-4	2.33	A	M					X		F				R											R			X			F			F		X	R		R				
2H-1, 13-14	2.43	X	F											X																							?						
2H-1, 23-24	2.53	F	P	X				X		R				R												X					R			R					R				
2H-1, 33-34	2.63	F	M					X		R				R											X	X					R				R				R				
2H-1, 43-44	2.73	C	M					R		F	?			R											X	F					R		X	X					F	X			
2H-1, 53-54	2.83	F	P	R						R				R												F					R			R			X		R				
2H-1, 63-64	2.93	R	P							R				X											X	R		X			R				?					X			
2H-1, 73-74	3.03	F	M					X		R				X						X						F					R			R					X				
2H-1, 83-84	3.13	F	M					R		F	?			R									X		X	F					R			R			R		R	R			
2H-1, 93-94	3.23	F	M						X	F				R	X											F					R			R					R	X		X	
2H-1, 103-104	3.33	C	M	R						F				R											X	F					F			F			R		F	R			
2H-1, 113-114	3.43	F	P					R	X	F				R						X						R					R			R					F	X			
2H-1, 123-124	3.53	C	M	R				R		F				R	X					X			X		R	R		X			R		X	F	R		X		R	R			
2H-2, 3-4	3.63	R	F							F				R																	R			X									
2H-2, 13-14	3.73	F	M							F				R						X	X			X		R					R		X	R			X		R	R		X	
2H-2, 23-24	3.83	R	P	X				R		R		X		R						X			X			R					R		X	R	X		X		X	X			
2H-2, 33-34	3.93	F	P	X						R		R		R				R		X					X	X		X			R		R	R	X		X		R	R			
2H-2, 43-44	4.03	F	P	X				X		R				R						X	X				R	R					R			F			R		X				
2H-2, 53-54	4.13	F	M	R				R		F				R			X			R	X				X	X		X			R			R	X		X			X		X	
2H-2, 63-64	4.23	R	M	X		X				R				R			X	X		X						X		X			R		X	R	X	X	X		X	X			
2H-2, 73-74	4.33	R	M	X	X	X		R		F				R			X	X							X	X		R			R		X	R	X		X		R				
2H-2, 83-84	4.43	F	M	X						R				F				X			X					R					F		X	R	R		X		R	X			
2H-2, 93-94	4.53	R	P		?	X				R				R											X	R			X					X	X		X		X	X			
2H-2, 103-104	4.63	R	P	X						X				R		X													X					X	?		X		X				
2H-2, 113-114	4.73	R	F																																								
2H-2, 123-124	4.83	R	F																																								
2H-2, 133-134	4.93	R	P											R									X																				
2H-2, 143-144	5.03	R	M	X		X				R				R												X			X		X			X	X		R		R				
2H-3, 3-4	5.13	R	P	X						R				R			X									X			X		R			R			X			X			
2H-3, 13-14	5.23	R	M	X						R				R						R						X					X			X								X	
2H-3, 23-24	5.33	R	P							R				R																													
2H-3, 33-34	5.43	X	F																																								
2H-3, 43-44	5.53	X	F							X				X																													
2H-3, 53-54	5.63	X	F																																								
2H-3, 63-64	5.73	R	P							R				R												X																	
2H-3, 73-74	5.83	F	M		X					R		X		F						X						R					F			R					F				
2H-3, 83-84	5.93	R	P							R	X			R												X			X		R		X	X			X		R				
2H-3, 93-94	6.03	R	P							R				R																	R			X			X		X				

Table T2 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Actinocyclus curvatulus*	*Actinocyclus ellipticus* var. *elongatus*	*Actinocyclus ingens*	*Actinocyclus octonarius*	*Actinocyclus octonarius* var. *teniella*	*Actinoptychus senarius*	*Actinoptychus* spp.	*Amphora* cf. *robusta*	*Asterolampra grevillei*	*Asterolampra marylandicus*	*Asteromphalus arachne*	*Asteromphalus elegans*	*Asteromphalus heptactis*	*Asteromphalus* sp. A	*Asteromphalus* spp.	*Auliscus* spp.	*Azpeitia africana*	*Azpeitia neocrenulata*	*Azpeitia nodulifer*	*Bacteriastrum hyalinum*	*Biddulphia alternans*	*Biddulphia/Odontella* spp.	*Chaetoceros diadema*	*Chaetoceros lacinosus*	*Chaetoceros messanensis*	*Chaetoceros mitra*	*Chaetoceros* spp.	*Cocconeis disculoides*	*Cocconeis pinnata*	*Cocconeis* spp.	*Coscinodiscus marginatus*	*Coscinodiscus nitidus*	*Coscinodiscus oculusiridus*	*Coscinodiscus radiatus*	*Coscinodiscus reniformis*	*Cymatosira lorenziana*	*Delphineis surirella*	*Denticulopsis* spp.	*Diploneis bombus*	*Diploneis crabro*	*Diploneis subovalis*	*Diploneis* spp.	*Ditylum brightwellii*	*Ethmodiscus rex* frags.	*Fragilariopsis doliolus*	*Grammatophora* spp.	*Hemiaulus hauckii*
2H-3, 103-104	6.13	F	M	X			X						X	X	X	X	X				X		F				X										R			X				X			R			
2H-3, 113-114	6.23	R	P						X													R	R							X	X					X	R			R			X	X			R			
2H-3, 123-124	6.33	R	P	X																		X	R														R			R			X				R			
2H-3, 133-134	6.43	X	F																																												X			
2H-3, 143-144	6.53	X	F																																															
2H-4, 3-4	6.63	R	F																																															
2H-4, 13-14	6.73	R	F																																		X										R			
2H-4, 23-24	6.83	R	P	R			X		X				X		X					X	X	X	F								X			X			R										R			
2H-4, 33-34	6.93	R	P				X	X																													X						X				R			
2H-4, 43-44	7.03	R	P	X					X				X		X		X			R		X															X										R			
2H-4, 58-59	7.13	F	M	X	X		X	X	X				X	X	X		X			R	X	R	C				R			R	X	X		X		R	F						X				F			
2H-4, 63-64	7.23	R	M	X			X		X				X	X	R	X	X			R	X	R	F		X		R								R	X	R						X				R			
2H-4, 73-74	7.33	R	P																			X	R												X		R										R			
2H-4, 83-84	7.43	R	P				X		X				X				X			X	R	R	R													R	F										R			
2H-4, 93-94	7.53	R	M	X			X		R				R		X		R			X	X	X	R													R	R										R			
2H-4, 103-104	7.63	R	P				X	X																										X	X		R										R			
2H-4, 113-114	7.73	X	F	X																																														
2H-4, 123-124	7.83	R	P	R		X	R		X			X	X		X		X			R	R	R	R							X					X	X	R			X							R	?		
2H-4, 133-134	7.93	F	M	R	X		R		R				R		X		R			R	R	R	F				X			R				X		X	F			R							R	R		
2H-4, 143-144	8.03	R	M	R	X		R		X				X		R		X			R	R	R	R												X		F			X							R			
2H-5, 3-4	8.13	R	M	X	X	X	X		X				X	X	X		X			X	R	X	R			X	X							X		X	R			X				X			R	X		
2H-5, 13-14	8.23	X	P																																		X										X			
2H-5, 23-24	8.33	X	F																																															
2H-5, 33-34	8.43	R	M	R			X		F			X	X	X	X		X			X	X	X	R				X				X					X	R			X					X		R	X	X	
2H-5, 43-44	8.53	F	M	R			R	X	X				R	X			X			X	X	X	R	X	X	X	R	F								X	F			R							R	R		
2H-5, 53-54	8.63	F	M	X	X		X		X				R	X	X		X			X	X	X	R			X	R				X						R		X	R							R	X		
2H-5, 63-64	8.73	A	M	X			R	X					R	X			X			R	R	R	F	X		R	R										F		X	R						C	R	X		
2H-5, 73-74	8.83	C	M	X			R	X	X				R	X	R					X		R	F			X	R										R		X	X						F	R			
2H-5, 83-84	8.93	C	M	X			X		X				X								X	X	R				R									X	R		X					X		F	F			

Notes: Abundance: A = abundant, C = common, F = frequent, R = rare, X = scarce, B = barren. Preservation: G = good, M = moderate, P = poor, F = fragments.

Table T2 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Hemidiscus cuneiformis*	*Navicula lyroides*	*Navicula* spp.	*Nitschia panduriformis*	*Nitzschia sicula* var.	*Nitzschia fossils*	*Nitzschia marina*	*Nitzschia reinholdii*	*Odontella aurita*	*Opephora* spp.	*Paralia sulcata*	*Pinnularia* spp.	*Plagiogramma* spp.	*Pleurosigma* spp.	*Podosira stelliger*	*Porosira denticulata*	*Pseudonitzschia* spp.	*Pseudosolenia calcar avis*	*Pyxidicula* spp. frags	*Raphoneis amphiceros*	*Rhizosolenia curvirostris*	*Rhizosolenia* spp.	*Roperia tesselata*	*Stellarima stellaris*	*Stephanopyxis turris*	*Stephanopyxis* spp.	*Surirella* spp.	*Thalassionema nitzschioides*	*Thalassiosira aguste-lineata*	*Thalassiosira convexa*	*Thalassiosira eccentrica*	*Thalassiosira* cf. *ferelineata*	*Thalassiosira leptopus*	*Thalassiosira lineata*	*Thalassiosira nordenskioeldii*	*Thalassiosira oestrupii*	*Thalassiosira pacifica*	*Thalassiosira plicata*	*Trachyneis* spp.	*Triceratium* spp.
2H-3, 103-104	6.13	F	M	X		X		X		R	R			R						X						R		X			F		X	X	X	?			R				
2H-3, 113-114	6.23	R	P	X	X	X				X				R											X	X			X		R			X					R				
2H-3, 123-124	6.33	R	P	X										R															X					X					X				
2H-3, 133-134	6.43	X	F											X																	X												
2H-3, 143-144	6.53	X	F																																								
2H-4, 3-4	6.63	R	F											R																													
2H-4, 13-14	6.73	R	F											R												X								X									
2H-4, 23-24	6.83	R	P	X		R				R	R			R											X	X		X			R			R	R		X		R				
2H-4, 33-34	6.93	R	P							X				R		X	X									X			R														
2H-4, 43-44	7.03	R	P	X						R	X			R												X								R	?								X
2H-4, 58-59	7.13	F	M	R		X		X		F	R	X		F					R	R			X		R	X	X	X			F		X	R	X	X	R		X		X		
2H-4, 63-64	7.23	R	M	R	X	X				F	R			R												X		X		X	F		X	R	X	X	R		X		X	X	
2H-4, 73-74	7.33	R	P	R						R		X		R												\		X		X			X	X	X	X			X				
2H-4, 83-84	7.43	R	P	R		X				F	\			R									X			R		X						R									
2H-4, 93-94	7.53	R	M	X						R	R			R			X			X					X	R		R					X	R	X		X						
2H-4, 103-104	7.63	R	P	X	?			X						R		X										R		R						R			X						
2H-4, 113-114	7.73	X	F											R																													
2H-4, 123-124	7.83	R	P	R					?	R	X	X		R			X			X						R		X	X		X		X	X		R	R			X	X		
2H-4, 133-134	7.93	F	M	R		X				F	R	X		R		X		X		R		X				R		X			R		X	R		R	R		X	X	X	X	
2H-4, 143-144	8.03	R	M	R	X			X		R	X			F				X							X	R		X			F			R	X	X	R		X	R	X		
2H-5, 3-4	8.13	R	M	R	X					R		X		F						X						X		X			R			R	X	X	X		X			X	
2H-5, 13-14	8.23	X	P											R																	R		X			X							
2H-5, 23-24	8.33	X	F																																								
2H-5, 33-34	8.43	R	M	X						R				F				X					X			X		X	X		R			R		X	X				X	X	
2H-5, 43-44	8.53	F	M	X						F		X		F	X					R	X					R	X				F		R	F	R	R			R		X	X	
2H-5, 53-54	8.63	F	M	X				R		F				R					X	R	X				X	X	X	X			F		X	F	R	R	X		R		X		
2H-5, 63-64	8.73	A	M	X			X	R		F	R	X		R	X					X	R					R	R		R		C		R	F		X	R			X	X		
2H-5, 73-74	8.83	C	M	X			X	R		R	R	X		R					X	X	X					X	X	X			F		X	F		X	X		R	X			
2H-5, 83-84	8.93	C	M				X	F		R	X			R												X					F		X	F			X		R	X	X		

Table T3. Biostratigraphic diatom data for Core 172-1063D-3H. (Continued on next two pages.).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Actinocyclus curvatulus*	*Actinocyclus ellipticus* var. *elongatus*	*Actinocyclus ingens*	*Actinocyclus octonarius*	*Actinocyclus octonarius* var. *teniella*	*Actinoptychus senarius*	*Actinoptychus* spp.	*Amphora* cf. *robusta*	*Asterolampra grevillei*	*Asterolampra marylandicus*	*Asteromphalus arachne*	*Asteromphalus elegans*	*Asteromphalus heptactis*	*Asteromphalus* sp. A	*Asteromphalus* spp.	*Auliscus* spp.	*Azpeitia africana*	*Azpeitia neocrenulata*	*Azpeitia nodulifer*	*Bacteriastrum hyalinum*	*Biddulphia alternans*	*Biddulphia/Odontella* spp.	*Chaetoceros diadema*	*Chaetoceros lacinosus*	*Chaetoceros messanensis*	*Chaetoceros mitra*	*Chaetoceros* spp.	*Cocconeis disculoides*	*Cocconeis pinnata*	*Cocconeis* spp.
172-1063D-																																	
3H-4, 103-104	17.33	A	G	X			X		X	X			X	R	X	X				R	R	R	R				C	R			X		
3H-4, 113-114	17.43	A	G	X	X		R	X	X			X	R	X			X	X		X	R	X	F		X		C	R			X		
3H-4, 123-124	17.53	C	M	X	X		R		X				X	X						X	R		F				F	R			X		
3H-4, 133-134	17.63	C	M	X			X					X	R				X				R		R				R	R			X		
3H-4, 143-144	17.73	C	M	X			R		X				X		X					X	R	X	X			X	R	R			X		
3H-5, 3-4	17.83	F	M	X			X		X			X	X		X					X	X	X	X				R	R			X		
3H-5, 13-14	17.93	C	M	X			R		X						X		X			X	X	X	X				R	R					
3H-5, 23-24	18.03	C	M	X			X		X				X		X					X	X	X	X				R	X			R		
3H-5, 33-34	18.13	F	M	X			X	X	X			X	X		X		X			X	X	X	X				R	R					
3H-5, 43-44	18.23	C	M						X											X	R	X	X				X	R					
3H-5, 53-54	18.33	C	M	X			X	?	R				X		R					X	R	X	X			X	X	R					
3H-5, 63-64	18.43	C	M	R			R	X	X			X	X		X					X	R	X	X			X	R	R					
3H-5, 73-74	18.53	C	M	R			X		X			X	X		X					X	R	X	R			R		X					
3H-5, 83-84	18.63	A	G	X	X		R		X				R	X	X		X			X	R	X	R			X		R			R		
3H-5, 93-94	18.73	C	M	X	R				X				X	X	X					X	R	X	R			X	X	X			X		
3H-5, 103-104	18.83	C	M	X			X		X				X		X		X			X	R	X	X										
3H-5, 113-114	18.93	F	P	R			X	X	X	X					X					X	R	X	X		X			X					
3H-5, 123-124	19.03	C	M	X			R		R				X							X	R		X			X		X					
3H-5, 133-134	19.13	C	M	R	X		X		X	X			X	X	X					X	R	X	X			R	X		X		X		
3H-5, 143-144	19.23	C	M	X	X			X	X	X		X	R	X	R					X	X		X			X		X			X		
3H-6, 3-4	19.33	C	M	X			R						R	X	X		X			X	X		X			X	X	X			X		
3H-6, 13-14	19.43	F	P				X						X		X					X	X			X				X			X		
3H-6, 23-24	19.53	F	P	X			X		X	X			X		X					X	R	X									X		
3H-6, 33-34	19.63	C	P	X			X		X	R					X					X		X											
3H-6, 43-44	19.73	F	P	X			X		R											X		F											
3H-6, 53-54	19.83	F	P	X			X														X	X						X					
3H-6, 63-64	19.93	R	P	X																													
3H-6, 73-74	20.03	R	P	X			X																										
3H-6, 83-84	20.13	F	M	X			R			X			X	X						X		X				X		R					
3H-6, 93-94	20.23	C	M	X			R		X				R	X			X			X	X	X	X					R			R		
3H-6, 103-104	20.33	A	M	X			R			X			R	X			X			X	X	X	R				X	F			R		
3H-6, 113-114	20.43	A	M				R		X	X			R							X		X	R				X	F					
3H-6, 123-124	20.53	C	M	X			R		X				R	X	X		X			X	X	X	R			X		F			X		
3H-7, 3-4	20.63	F	P	X			R		X						X					X	X		X					X					
3H-7, 13-14	20.73	F	P	X			R															X				X							
3H-7, 23-24	20.83	F	M	X			X		X						X					X	X	X		X		X		X					
3H-7, 33-34	20.93	C	M	X			X		R	X			X							X	X	X											
3H-7, 43-44	21.03	F	M	X			X		X				X	X	X					R	R	X	X					X			X		
3H-7, 53-54	21.13	F	P				X		X				X		X					X	X	X	X	X				X					
3H-7, 63-64	21.23	F	M	X			X		X	X					X					X	X	X						X					
3H-7, 73-74	21.33	R	P	X			X		X	X					X						X	X											

Notes: Abundance: A = abundant, C = common, F = frequent, R = rare, X = scarce, B = barren. Preservation: G = good, M = moderate, P = poor, F = fragments.

Table T3 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Coscinodiscus marginatus*	*Coscinodiscus nitidus*	*Coscinodiscus oculusiridus*	*Coscinodiscus radiatus*	*Coscinodiscus reniformis*	*Cymatosira lorenziana*	*Delphineis surirella*	*Denticulopsis* spp.	*Diploneis bombus*	*Diploneis crabro*	*Diploneis subovalis*	*Diploneis* spp.	*Ditylum brightwellii*	*Ethmodiscus rex* frags.	*Fragilariopsis doliolus*	*Grammatophora* spp.	*Hemiaulus hauckii*	*Hemidiscus cuneiformis*	*Navicula lyroides*	*Navicula* spp.	*Nitschia panduriformis*	*Nitzschia sicula* var.	*Nitzschia* fossils	*Nitzschia marina*	*Nitzschia reinholdii*	*Odontella aurita*	*Opephora* spp.	*Paralia sulcata*	*Pinnularia* spp.	*Plagiogramma* spp.
172-1063D-																																	
3H-4, 103-104	17.33	A	G				R		R	R					X	F	R	R			X				R		C	r	R		R		
3H-4, 113-114	17.43	A	G				F		R	R					X	F	R	R			X			X	R		F				R		
3H-4, 123-124	17.53	C	M		X		F		X	R				X	R	F	R	R			X			X	R		F		X		R		
3H-4, 133-134	17.63	C	M	X			F			R					R	F	F	F			X				X		F				R		
3H-4, 143-144	17.73	C	M				R			X					X	F	A	F			X			X	X		F		X		R		
3H-5, 3-4	17.83	F	M				R			R					X	R	R	R			X				X		R				R		
3H-5, 13-14	17.93	C	M	X	X		R		X	X					X	R	F	R			R		X	X	X		R				R		
3H-5, 23-24	18.03	C	M				R			R						R	F	R			X			R	X		R	X			X		
3H-5, 33-34	18.13	F	M	X			R			R					X	R	R	X			X			X			R	X	X		R		
3H-5, 43-44	18.23	C	M		X		F			X					X	X	C	R			X			X			F	X	X		F		
3H-5, 53-54	18.33	C	M			F	C	X	X	R		?	?			X	F	F			X			X	X		R	X			F		
3H-5, 63-64	18.43	C	M			X	F			X		?	?			F	C	F			R						F				R		
3H-5, 73-74	18.53	C	M			X	F			R					X	R	C	F			R						F	X			R		
3H-5, 83-84	18.63	A	G		X	X	F		R	X		?	?		X	R	F	F			X	X		X	F		F				F		
3H-5, 93-94	18.73	C	M			X	F	X	X	X				X		R	F	F			R				F		R			X	R		
3H-5, 103-104	18.83	C	M			X	R			X						X	R	F				X					R				R		
3H-5, 113-114	18.93	F	P			X	F									R	F	R			X	?					R	?	X		R		
3H-5, 123-124	19.03	C	M			X	F								X		F	R									R				R		
3H-5, 133-134	19.13	C	M			X	F			R						R	C	R			X			R	X		R	X	X		R		
3H-5, 143-144	19.23	C	M				F	X	X	X					R	F	C	R						X	X		X				R		
3H-6, 3-4	19.33	C	M		X		R			X					X	R	F	F						X	R		R	X	X		R		
3H-6, 13-14	19.43	F	P				R			X						X	F	R			X	X	X		R		F				F		
3H-6, 23-24	19.53	F	P			X	R							?		X	R	R			X	X					R		X		R	X	
3H-6, 33-34	19.63	C	P			X	R			R					X	X	R				X						F				F		
3H-6, 43-44	19.73	F	P		X	X	R										R				X						R				R		X
3H-6, 53-54	19.83	F	P				X										R				X		X				R				R		
3H-6, 63-64	19.93	R	P				X			X							R														X		
3H-6, 73-74	20.03	R	P				X			X							X														X		
3H-6, 83-84	20.13	F	M		X	X	R										R	R			X						R		X		R		
3H-6, 93-94	20.23	C	M		X		R			R					X	R	R	R			X				X		R				R		
3H-6, 103-104	20.33	A	M			X	F		X	R						R	F	F			X						F	X	X		F		
3H-6, 113-114	20.43	A	M		X	X	R			R				X	R	F	F	R				?					F	X			F		
3H-6, 123-124	20.53	C	M		X		R		X	R						F	R	F			X	?		X			F				R		
3H-7, 3-4	20.63	F	P		X		R			X		?					F	X									R				R		
3H-7, 13-14	20.73	F	P				R			R						X	R	X			X				X		X				R		
3H-7, 23-24	20.83	F	M	X			R			R		?					R	X			X						X		X		R		
3H-7, 33-34	20.93	C	M		X	X	R			R					X	X	F	X			R						R		X		R		
3H-7, 43-44	21.03	F	M				F			X						R	F	X			X						R		X		R		
3H-7, 53-54	21.13	F	P			X	R			X						X	R	X			X						R	X			R		
3H-7, 63-64	21.23	F	M			X	X			R		?			X		R				X						R	X	X		R		
3H-7, 73-74	21.33	R	P				X			X			X				R	X			X						R						

Table T3 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Pleurosigma* spp.	*Podosira stelliger*	*Porosira denticulata*	*Pseudonitzschia* spp.	*Pseudosolenia calcar avis*	*Pyxidicula* spp. frags	*Raphoneis amphiceros*	*Rhizosolenia curvirostris*	*Rhizosolenia* spp.	*Roperia tesselata*	*Stellarima stellaris*	*Stephanopyxis turris*	*Stephanopyxis* spp.	*Surirella* spp.	*Thalassionema nitzschioides*	*Thalassiosira aguste-lineata*	*Thalassiosira convexa*	*Thalassiosira eccentrica*	*Thalassiosira* cf. *ferelineata*	*Thalassiosira leptopus*	*Thalassiosira lineata*	*Thalassiosira nordenskioeldii*	*Thalassiosira oestrupii*	*Thalassiosira pacifica*	*Thalassiosira plicata*	*Trachyneis* spp.	*Triceratium* spp.	*Spines/thrix/nema* (sm/st)	Sieved dom by E/C/N	abun. (Ethmo/Cosc-Az/None)
172-1063D-																																	
3H-4, 103-104	17.33	A	G			X	X						R	X				A		R	F	R		R	R	F	X	X		X	D	N	A
3H-4, 113-114	17.43	A	G										X	X				A		R	F	R	X	X	X	F	R	X		X	D	N	A
3H-4, 123-124	17.53	C	M				X			X			X					C		R	F	R		X	X	F	R				A	N	A
3H-4, 133-134	17.63	C	M							X			X					C		X	R	X		X		R					A	N	A
3H-4, 143-144	17.73	C	M							X			X					F		R	R	X		X		F					C	E	A
3H-5, 3-4	17.83	F	M		X								X					R		R	F	X	X	X	X	F				X	R	N	A
3H-5, 13-14	17.93	C	M	X	X								X					F		R	R	X	X			F	X				C	N	A
3H-5, 23-24	18.03	C	M										R					F		X	R	X		X	X	R	R				F	N	A
3H-5, 33-34	18.13	F	M							X			R					F		X	R	X		X		X					F	E	A
3H-5, 43-44	18.23	C	M				X						X		X			R	X	X	R	X		X		R	R				R	E	A
3H-5, 53-54	18.33	C	M			X	X	X			X		X					R		R	R	X	X	X		R	X			X	R	C	A
3H-5, 63-64	18.43	C	M			X	X	X					X					R		X	F	X	X			F	X		X		F	C	A
3H-5, 73-74	18.53	C	M			X							X					R		X	F	X	X	X		F					F	E	A
3H-5, 83-84	18.63	A	G			X		X		X			X	X		X		F	X	R	F	R	R	R		F	X	X			F	N	A
3H-5, 93-94	18.73	C	M				X						X					R		X	F	X	R	X		F					F	E	A
3H-5, 103-104	18.83	C	M					X					X					R	X	X	R	X		X				X			R	E	A
3H-5, 113-114	18.93	F	P			X							X					X		R	R	X		R							F	C	A
3H-5, 123-124	19.03	C	M										X					X		F	R	X		X		X					F	C	A
3H-5, 133-134	19.13	C	M		X		X						R					X	R	R	F	R	X	R	X	R	X	X			R	E	A
3H-5, 143-144	19.23	C	M					X					X					R	X	R	R	R	X	R		R					F	N	A
3H-6, 3-4	19.33	C	M	X	X					X			R		X			C		R	X	R		X		X	X				F	E	A
3H-6, 13-14	19.43	F	P										R		X			R		X	R	X		X							R	E	A
3H-6, 23-24	19.53	F	P		X		X						X					R	X	X	R	X	X			R	X				X	N	A
3H-6, 33-34	19.63	C	P	X									X							R	R	X	X	X		X	X	X		X	R	N	A
3H-6, 43-44	19.73	F	P										X		X					X	R	X		X		X	X				X	N	F
3H-6, 53-54	19.83	F	P										X					X			X					X					X	N	R
3H-6, 63-64	19.93	R	P												X						X			X							X	N	R
3H-6, 73-74	20.03	R	P	X											X					R	X							?			X	N	R
3H-6, 83-84	20.13	F	M										R					R		R	R	X	X	X		X					R	N	F
3H-6, 93-94	20.23	C	M										X					F		X	R	R		X		X	X				A	N	A
3H-6, 103-104	20.33	A	M				X						F	X				C		X	F	R	X	X		X	F	X			D	N	A
3H-6, 113-114	20.43	A	M			X	X						X					C		X	F	F		X		R	R	R			D	N	A
3H-6, 123-124	20.53	C	M										X			X		F		X	F	X	X	X		F		X		X	D	N	A
3H-7, 3-4	20.63	F	P										X		X						R		X	X		R	X				F	E	A
3H-7, 13-14	20.73	F	P										X		X			X		X	R		X	X		X					F	E	A
3H-7, 23-24	20.83	F	M			X							X					R	?	R	F			X		R					F	E	A
3H-7, 33-34	20.93	C	M		X		X				X		X	X		X		R		X	F	X	X	X		F					F	E	A
3H-7, 43-44	21.03	F	M										R				X	R		R	F	X		R		R					F	E	A
3H-7, 53-54	21.13	F	P										X		X	X		X		X	R	X	X	X		R		?			F	E	A
3H-7, 63-64	21.23	F	M		X								R					R		X	R	X	X	X				X			F	N	A
3H-7, 73-74	21.33	R	P										X			X		X		X	R			X		X					R	N	A

Table T4. Biostratigraphic diatom data for Core 172-1063D-4H. This table is available in an **oversized format**.

Table T5. Diatom species associated with specific habitats.

Species environments				Specific associations		
Oceanic, planktonic	Neritic, littoral, planktonic	Benthic	Meroplanktonic	Cold/temperate waters	Warm-only waters	Coastal
Actinocyclus curavtulus	*Actinocyclus octonarius*	*Cocconeis disculoides*	*Chaetoceros diadema*	*Chaetoceros lacinosus*	*Asterlampra marylandica*	*Fragilariopsis doliolus*
Asteromphalus arachne	*Actinocyclus octonarius* var. *tenella*	*Cymatosira lorenziana*	*Chaetoceros lacinosus*	*Chaetoceros mitra*	*Ditylum brightwellii*	*Hemiaulus hauckii*
Asteromphalus heptactis	*Actinoptychus senarius*	*Delphineis surirella*	*Chaetoceros mesanensis*	*Delphineis surirella*	*Nitzschia marina*	*Raphoneis amphiceros*
Azpeitia africana	*Azpeitia neocrenulata*	*Diploneis* spp.	*Chaetoceros mitra*	*Thalassiosira nordenskioeldii*	*Thalassiosira eccentrica*	*Thalassionema nitzschioides*
Azpeitia nodulifer	*Coscinodiscus nitidus*	*Podosira stelliger*	*Nitzschia panduriformis*		*Thalassiosira leptopus*	
Bacteriastrium hyalinum	*Paralia sulcata*	*Surirella* spp.	*Odontella aurita*		*Thalassiosira lineata*	
Coscinodiscus marginatus	*Raphoneis amphiceros*		*Stephanopyxis turris*		*Thalassiosira pacifica*	
Coscinodiscus oculusiridus	*Thalassionema nitzschioides*					
Coscinodiscus radiatus						
Fragilariopsis doliolus						
Hemiaulus hauckii						
Hemidiscus cuneiformis						
Nitzschia marina						
Pseudosolenia calcar avis						
Roperia tesselata						
Thalassiosira auguste-lineata						
Thalassiosira eccentrica						
Thalassiosira leptopus						
Thalassiosira lineata						
Thalassiosira oestrupii						

Note: Environments and associations are drawn from various literature sources (see **"Taxonomy and Ecological Preferences,"** p. 7.).

Plate P1. **1.** *Actinocyclus curvatulus* Janisch, Sample 172-1063D-2H-2, 23–24 cm, >25. **2, 3.** *Actinocyclus octonarius* Ehrenberg, (2) Sample 172-1063D-4H-2, 8–9 cm, >25; (3) Sample 172-1061A-11H-CC, >20. **4.** *A. octonarius* var. *tenella* (Brebisson) Hajós, Sample 172-1063D-4H-2, 113–114 cm, >25. **5.** *Actinoptychus splendens* Ralphs, Sample 172-1063D-3H-6, 33–34 cm, >25. **6.** *Actinoptychus senarius* (Ehrenberg) Ehrenberg, Sample 172-1063D-2H-2, 28–29 cm, >25. Scale bars = 10 µm.

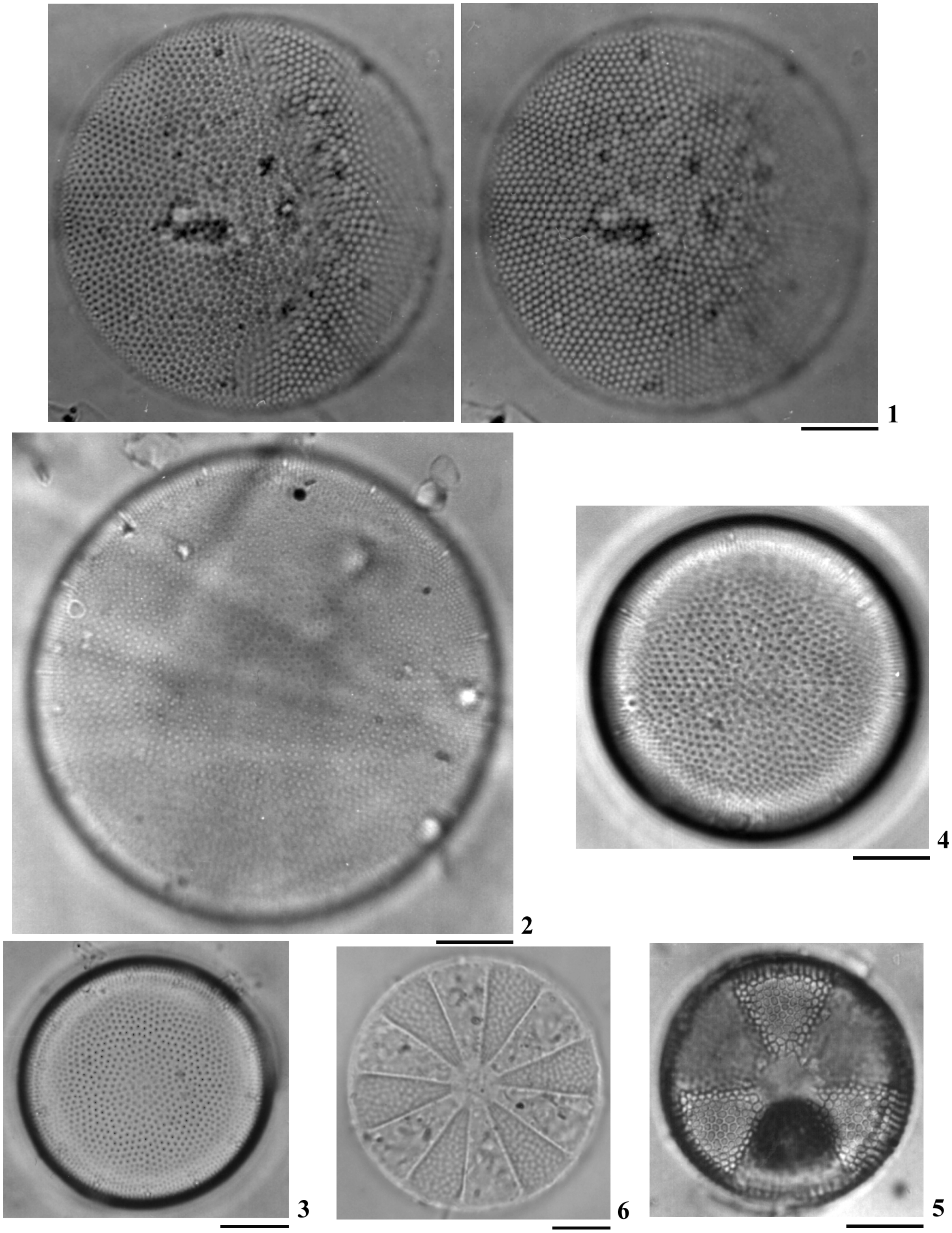


Plate P2. **1.** *Asteromphalus* sp. A?, Sample 172-1063D-4H-2, 53–54 cm, >25. **2**, **3.** *Asterolampra grevillei* (Wallich) Greville, Sample 172-1063D-4H-2, 53–54 cm, >25. Scale bars = 10 µm.

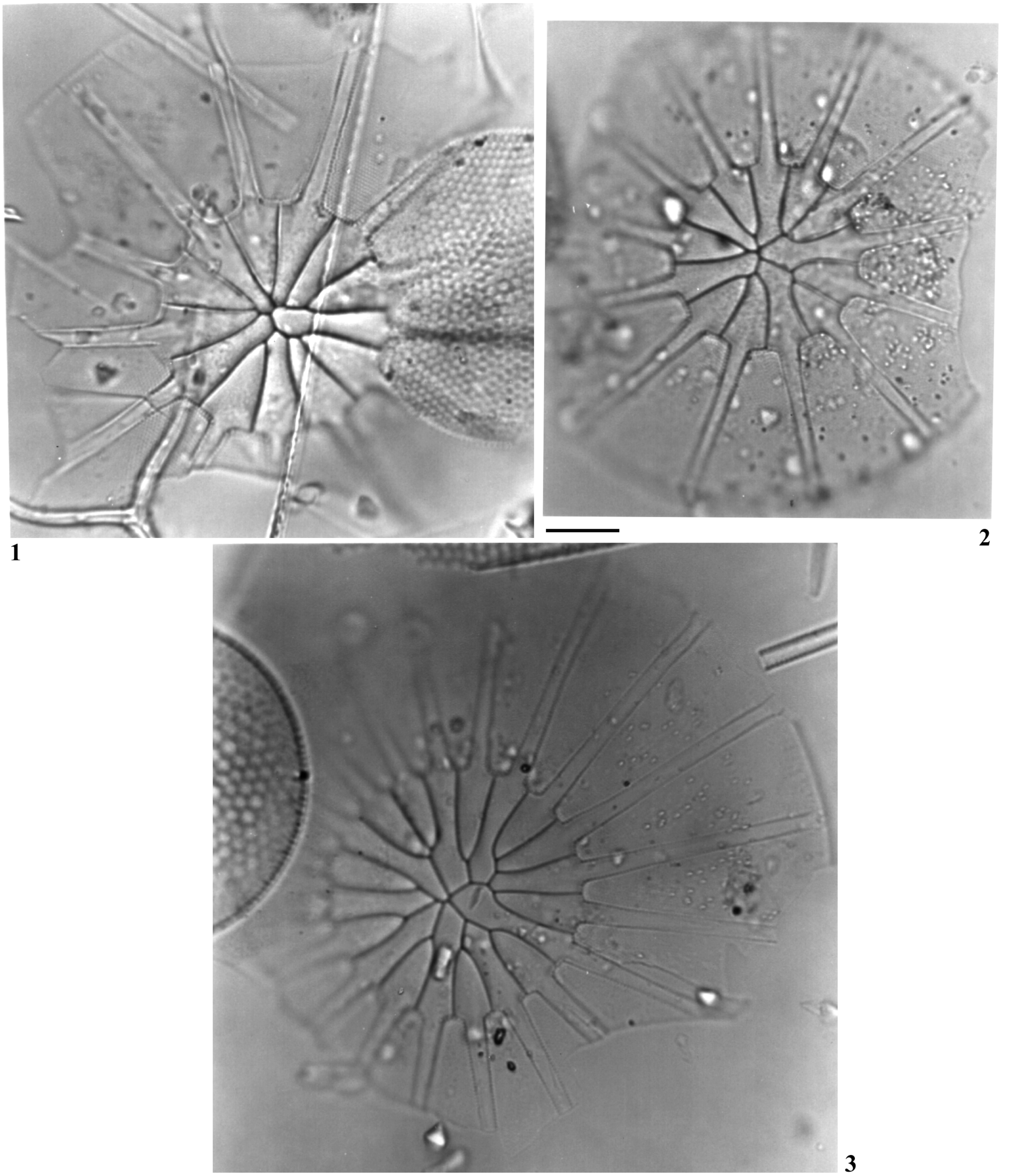
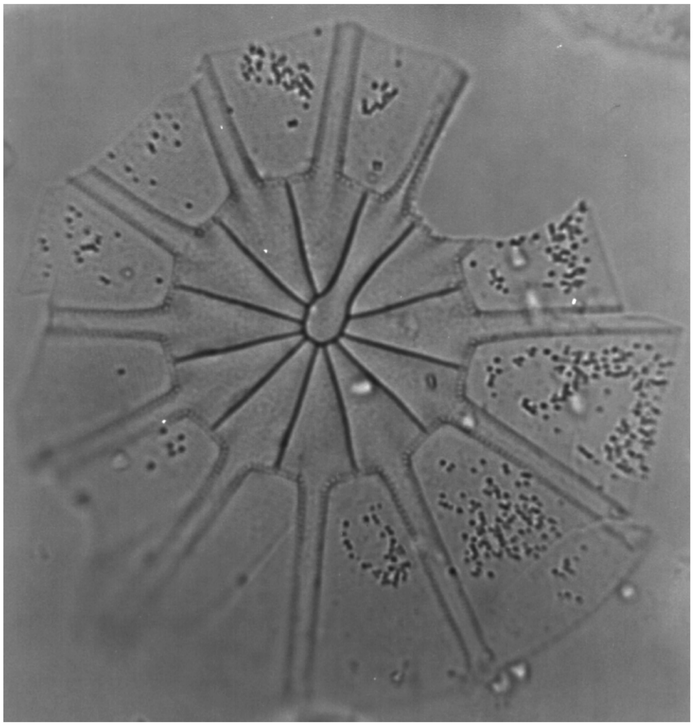


Plate P3. 1, 2. *Asteromphalus* sp. A, Sample 172-1063D-4H-2, 53–54 cm, >25. **3.** *Asteromphalus arachne* (Brebisson) Ralphs, Sample 172-1063D-4H-2, 53–54 cm, >25. **4, 5.** *Asteromphalus elegans* Greville, (4) Sample 172-1063D-4H-2, 53–54 cm, >25; (5) Sample 172-1063D-4H-2, 63–64 cm, >25. Scale bars = 10 µm.



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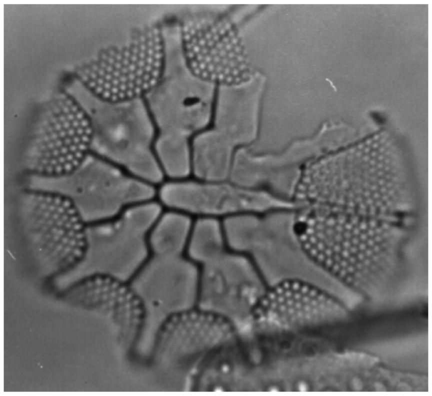

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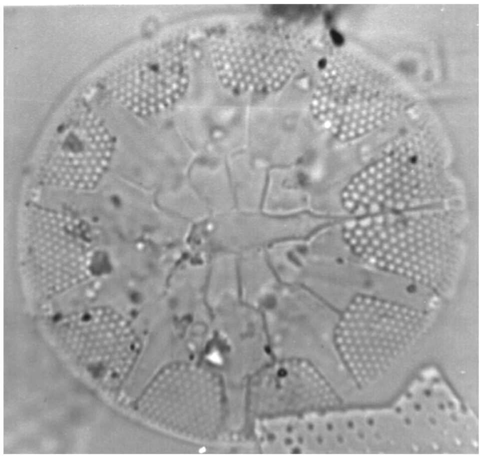

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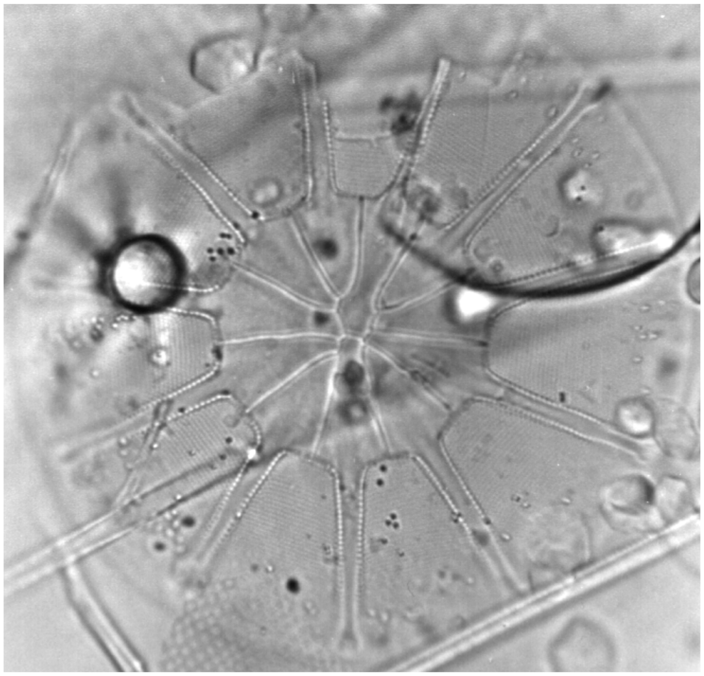

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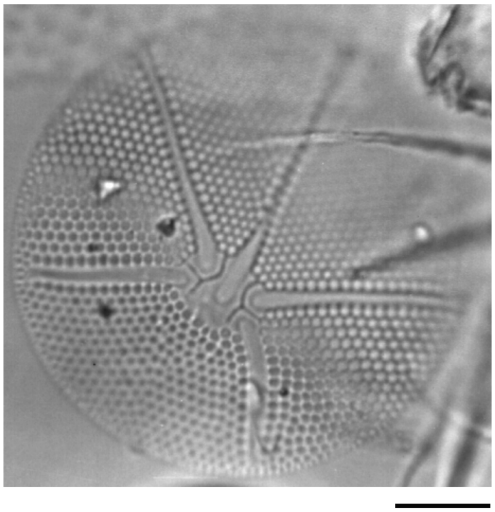

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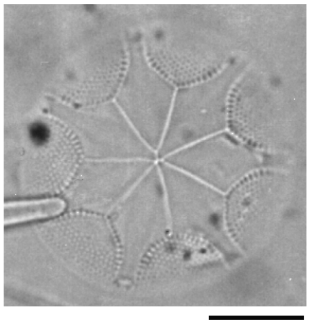
Plate P4. **1, 2.** *Asterolampra marylandica* Ehrenberg, (1) Sample 172-1063D-2H-2, 28–29 cm, >25; (2) Sample 172-1061A-1H-CC, >20. **3.** *Asteromphalus elegans* Greville, Sample 172-1061A-1H-CC, >20. **4.** *Asteromphalus heptactis* (de Brébisson) Ralphs, Sample 172-1061A-1H-CC, >20. **5.** *Azpeitia africana* (Janisch ex Schmidt) Fryxell & Watkins, Sample 172-1063D-3H-6, 33–34 cm, >25. **6.** *Azpeitia neocrenulata* (Van Landinham) Fryxell & Watkins, Sample 172-1063D-4H-2, 123–124 cm, >25. Scale bars = 10 µm.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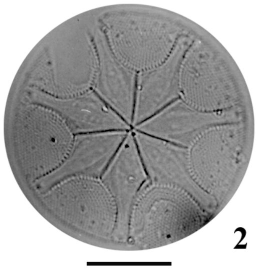
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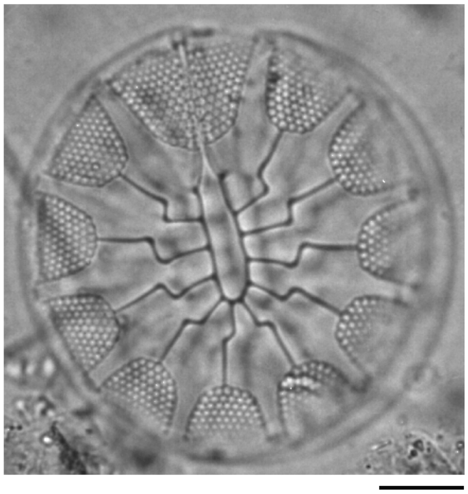
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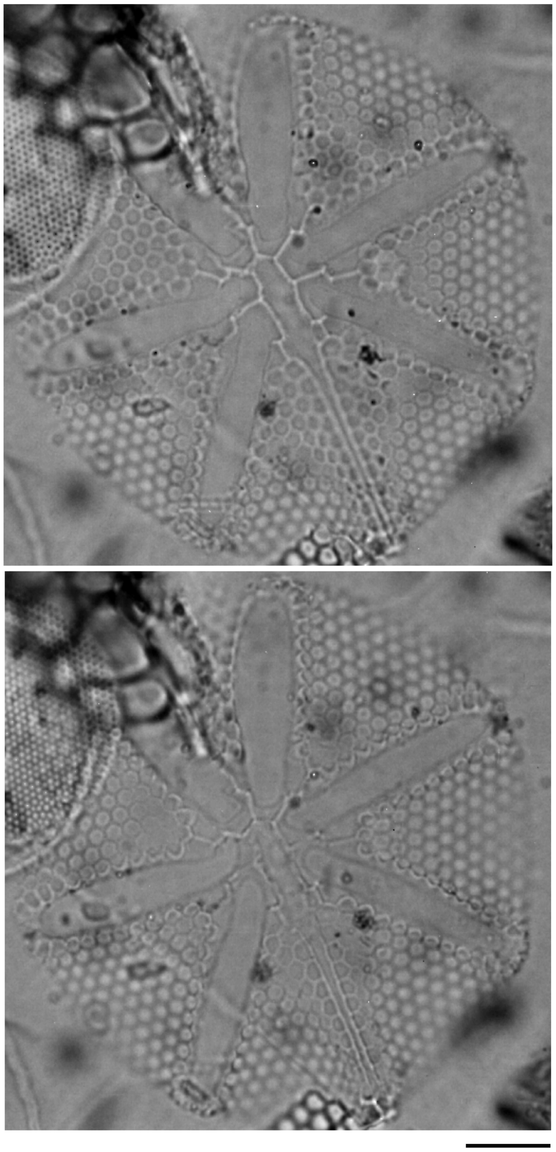
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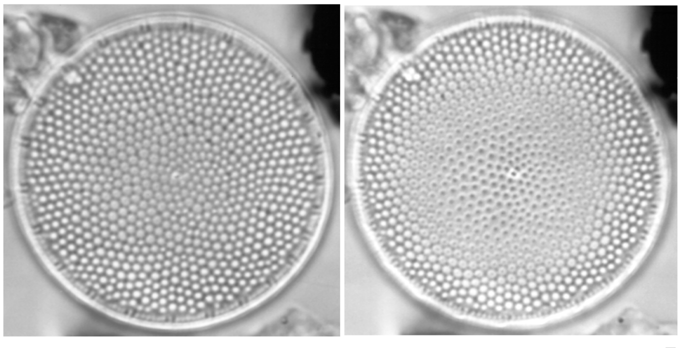
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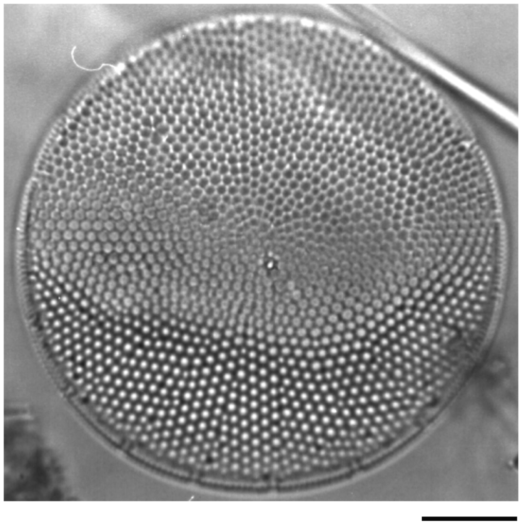
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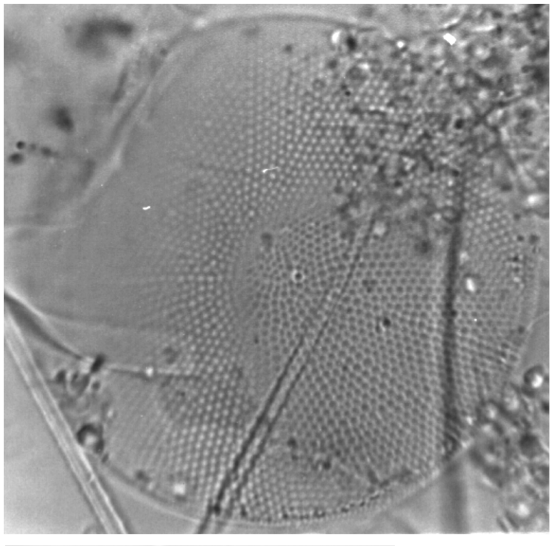
Plate P5. **1.** *Azpeitia neocrenulata* (Van Landinham) Fryxell & Watkins, Sample 172-1063D-4H-2, 123–124 cm, >25. **2.** *Azpeitia nodulifer* (Schmidt) Fryxell & Sims, Sample 172-1063D-2H-2, 48–49 cm, >25. **3.** *Coscinodiscus nitidis* Gregory, Sample 172-1063D-4H-4, 33–34 cm, st. **4.** *Coscinodiscus radiatus* Ehrenberg, Sample 172-1061A-1H-CC, >20. **5, 6.** *Podosira stelliger* (Bailey) Mann, (5) Sample 172-1063D-4H-2, 113–114 cm, >25; (6) Sample 172-1063D-2H-2, 33–34 cm, >25. **7.** *Hemidiscus cuniformis* Wallich, Sample 172-1063D-2H-2, 58–59 cm, >25. Scale bars = 10 µm.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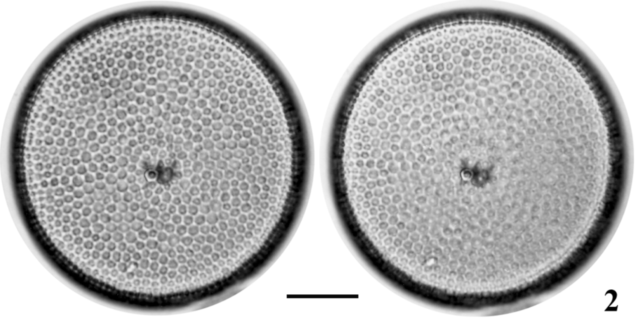
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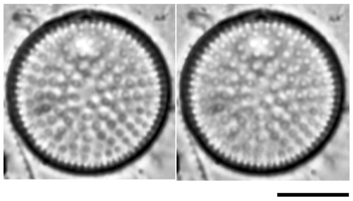
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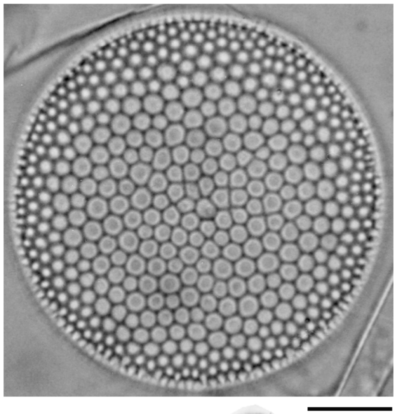
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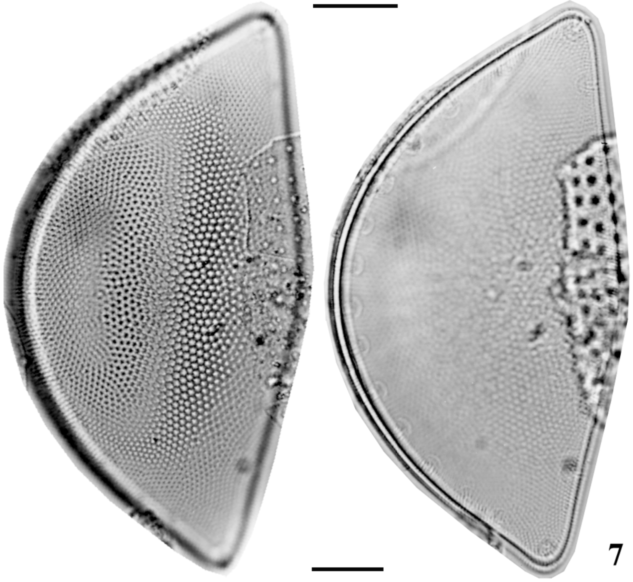
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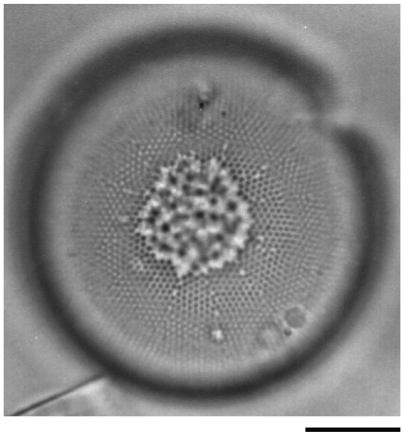
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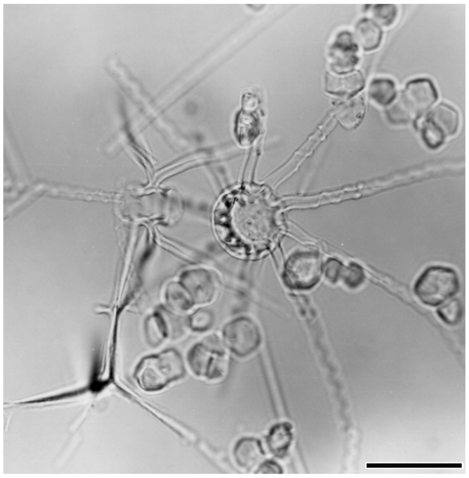
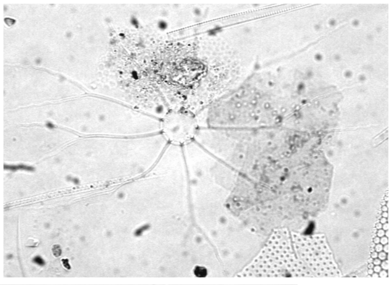
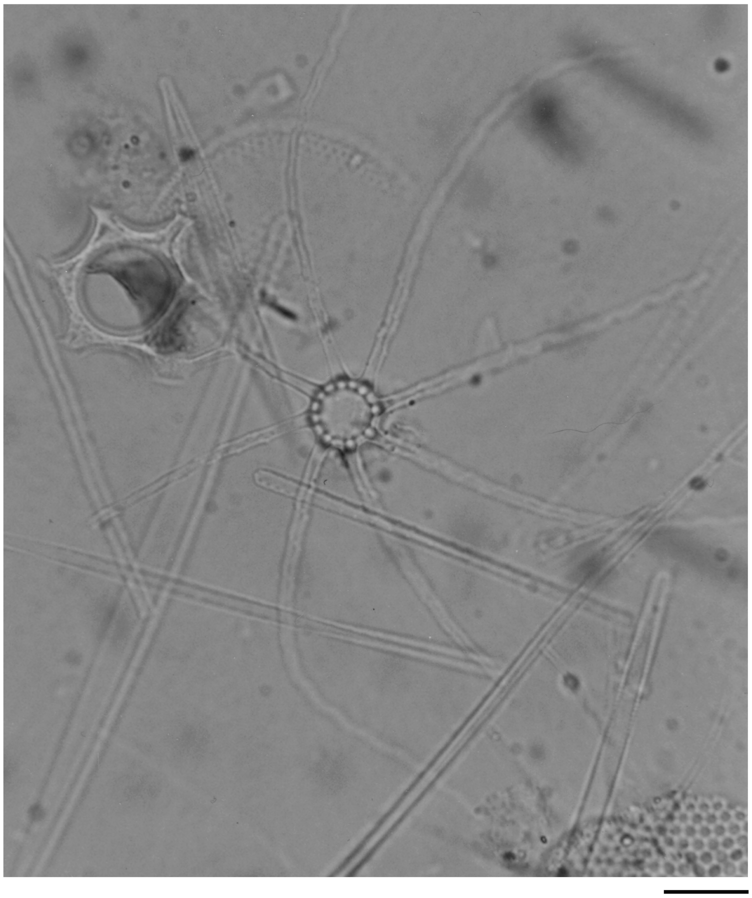
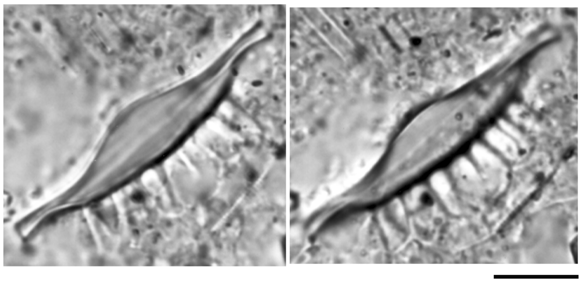
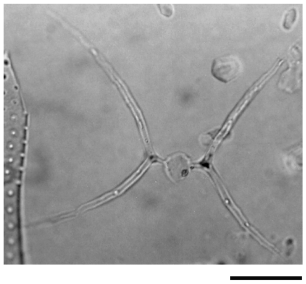
Plate P6. **1.** *Bacteriastrum hyalinum* Lander and *Chaetoceros lasinosus* Schütt, Sample 172-1063D-2H-5, 28–29 cm, >25. **2, 3.** *B. hyalinum* Lander, (2) Sample 172-1063D-2H-5, 58–59 cm, >25; (3) Sample 172-1061A-1H-CC, >20. **4.** *Chaetoceros diadema* (Ehrenberg) Gran, Sample 172-1063D-4H-4, 53–54 cm, st. **5, 6.** *Chaetoceros lasinosus* Schütt, Sample 172-1063D-2H-2, 23–24 cm, >25. **7.** *Chaetoceros mitra* (Bailey) Cleve, Sample 172-1063D-2H-2, 23–24 cm, >25. Scale bars = 10 µm.

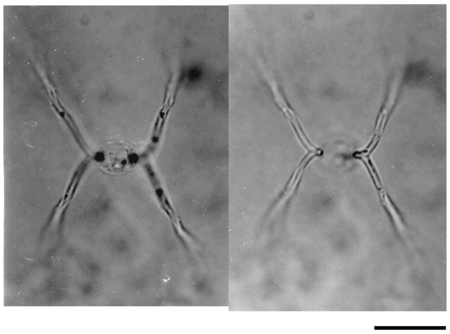












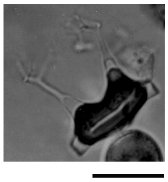


Plate P7. 1. *Odontella aurita* (Lyngbey) C.A. Agardh, Sample 172-1063D-2H-2, 23–24 cm, >25. **2–5.** *Ditylum brightwellii* (West) Grunow, (2–4) Sample 172-1063D-2H-5, 58–59 cm, >25; (5) Sample 172-1063D-3H-5, 143–144 cm, >25. **6.** *Ditylum* sp.?, Sample 172-1063D-3H-5, 43–44 cm, >25. **7–9.** *Hemiaulus hauckii* Grunow, Sample 172-1063D-2H-2, 28–29 cm, >25. **10.** *Pseudosolenia calcar avis* (Schultz) Sundström, Sample 172-1063D-4H-3, 43–44 cm, st. **11.** *Pseudosolenia calcar avis* (Schultz) Sundström, Sample 172-1063D-2H-2, 23–24 cm, >25. **12.** *Rhizosolenia* sp., Sample 172-1061A-18X-CC, >20. **13.** *Rhizosolenia curvirostris* Jousé, Sample 172-1063D-2H-2, 28–29 cm, >25. Scale bars = 10 µm.

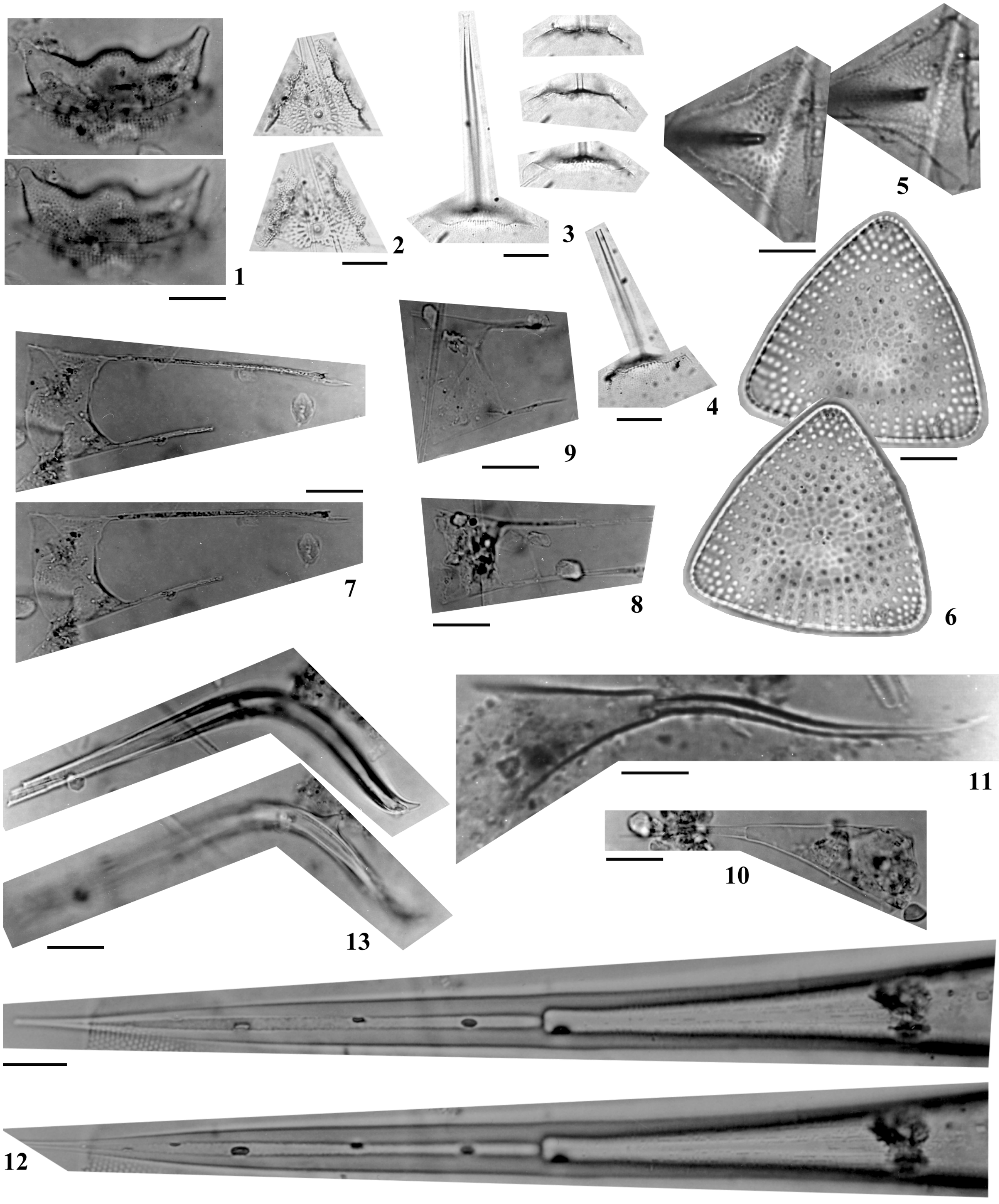


Plate P8. **1.** *Delphinius suriella* (Ehrenberg) Andrews, Sample 172-1063D-4H-2, 53–54 cm, st. **2.** *Rhaphoneis amphiceros* (Ehrenberg) Ehrenberg, Sample 172-1063D-4H-1, 63–64 cm, sm. **3.** *Cocconeis disculoides* Hustedt, Sample 172-1063D-4H-2, 83–84 cm, st. **4.** *Cymatosira lorenziana* Grunow, Sample 172-1063D-4H-4, 43–44 cm, st. **5.** *Diploneis* sp., Sample 172-1061A-1H-CC, >20. **6.** *Surriella* sp., Sample 172-1063D-4H-2, 53–54 cm, st. **7.** *Nitzschia panduriformis* Gregory, Sample 172-1063D-4H-2, 113–114 cm, >25. **8.** *Navicula lyroides* Hendey, Sample 172-1063D-2H-2, 28–29 cm, >25. **9.** *Thalassionema nitzschiodes* (Grunow) Mereschkowsky, Sample 172-1063D-4H-4, 53–54 cm, st. **10.** *Nitzschia sicula* var. (Castracane) Hustedt, Sample 172-1061A-11H-CC, >20. **11.** *Fragilariopsis dolious* (Wallich) Medlin & Sims, Sample 172-1061A-1H-CC, >20. **12.** *Nitzschia reinholdii* Kanaya & Koizumi, Sample 172-1063D-2H-2, 23–24 cm, >25. **13.** *Nitzschia marinia* Grunow, Sample 172-1061A-1H-CC, >20. **14.** Gen. sp. indet., Sample 172-1063D-4H-2, 93–94 cm, >25. Scale bars = 10 µm.

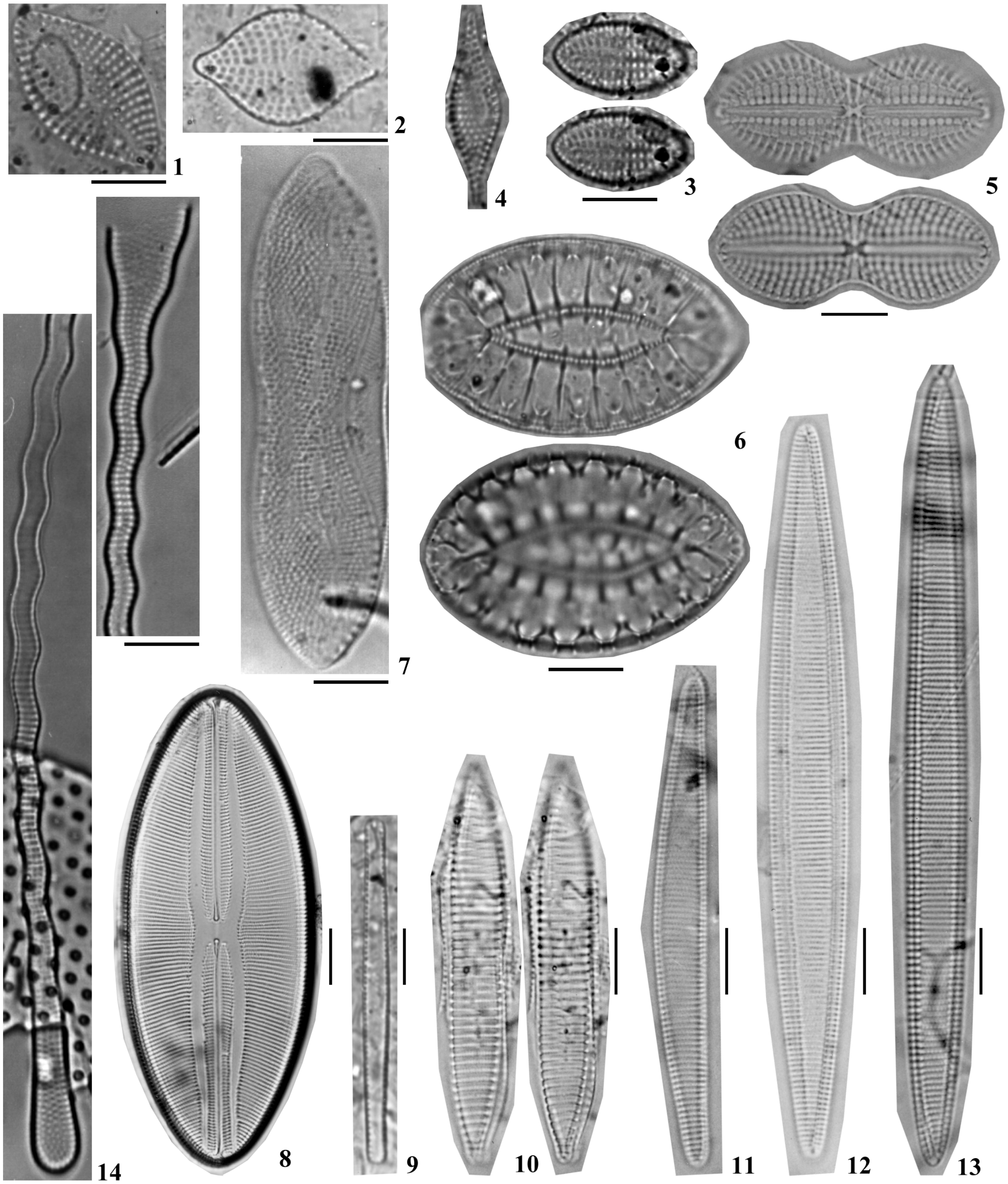
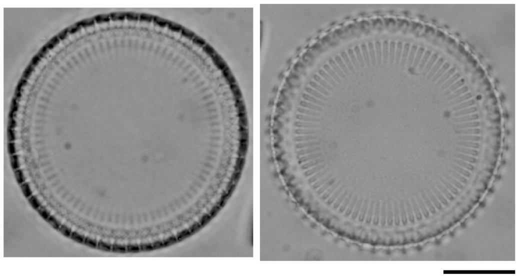


Plate P9. **1.** *Odontella* sp., Sample 172-1063D-4H-2, 123–124 cm, >25. **2.** *Paralia sulcata* (Ehrenberg) Cleve, Sample 172-1061A-11H-CC, >20. **3.** *Porosira denticulata* Simonsen, Sample 172-1063D-2H-5, 68–69 cm, >25. **4.** *Roperia tesselata* (Roper) Grunow (var 1), Sample 172-1063D-2H-2, 28–29 cm, >25. **5.** *R. tesselata* (Roper) Grunow (var 2), Sample 172-1063D-2H-2, 23–24 cm, >25. **6, 7.** *Actinocyclus ellipticus* var. *elongatus* (Grunow) Kolbe, (6) Sample 172-1063D-2H-2, 33–34 cm, >25; (7) Sample 172-1063D-3H-4, 123–4 cm, >25. Scale bars = 10 µm.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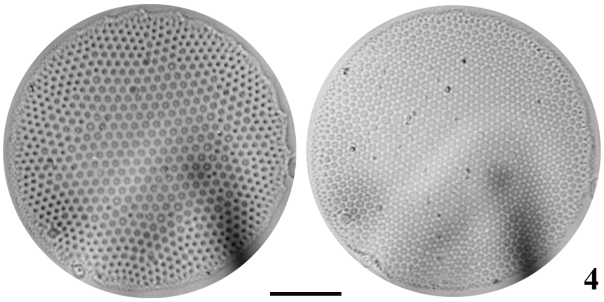
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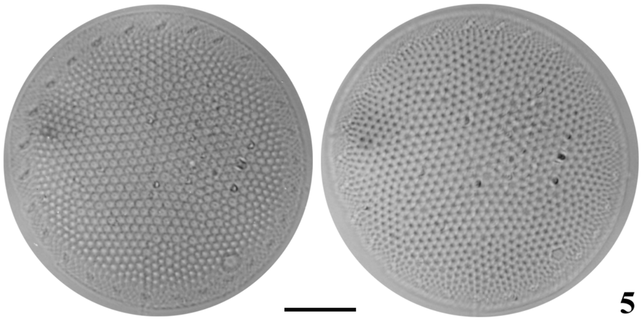
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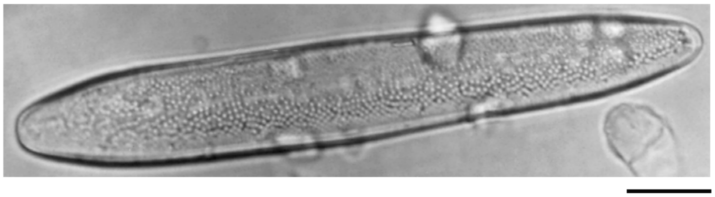
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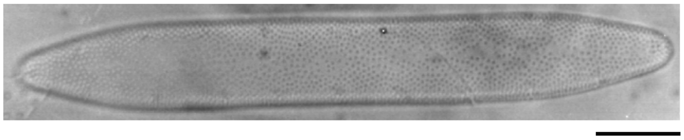
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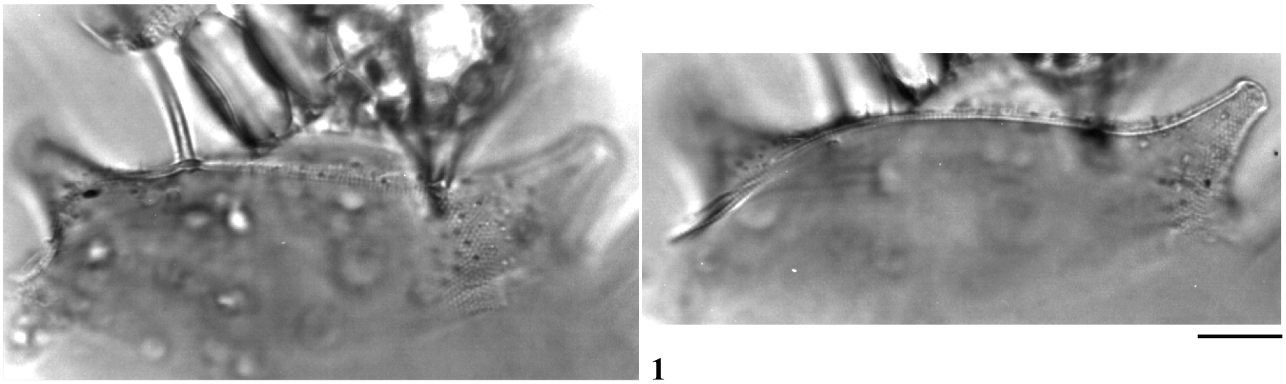
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Plate P10. 1–3. *Thalassiosira aguste-lineata* (A. Schmidt) Fryxell & Hasle, (1) Sample 172-1063D-3H-5, 143–144 cm, >25; (2) Sample 172-1063D-3H-5, 103–104 cm, >25; (3) Sample 172-1063D-3H-5, 133–134 cm, >25. **4, 5.** *Thalassiosira convexa* Mukhina, (4) Sample 172-1063D-3H-6, 33–34 cm, >25; (5) Sample 172-1063D-4H-2, 93–94 cm, >25. Scale bars = 10 µm.

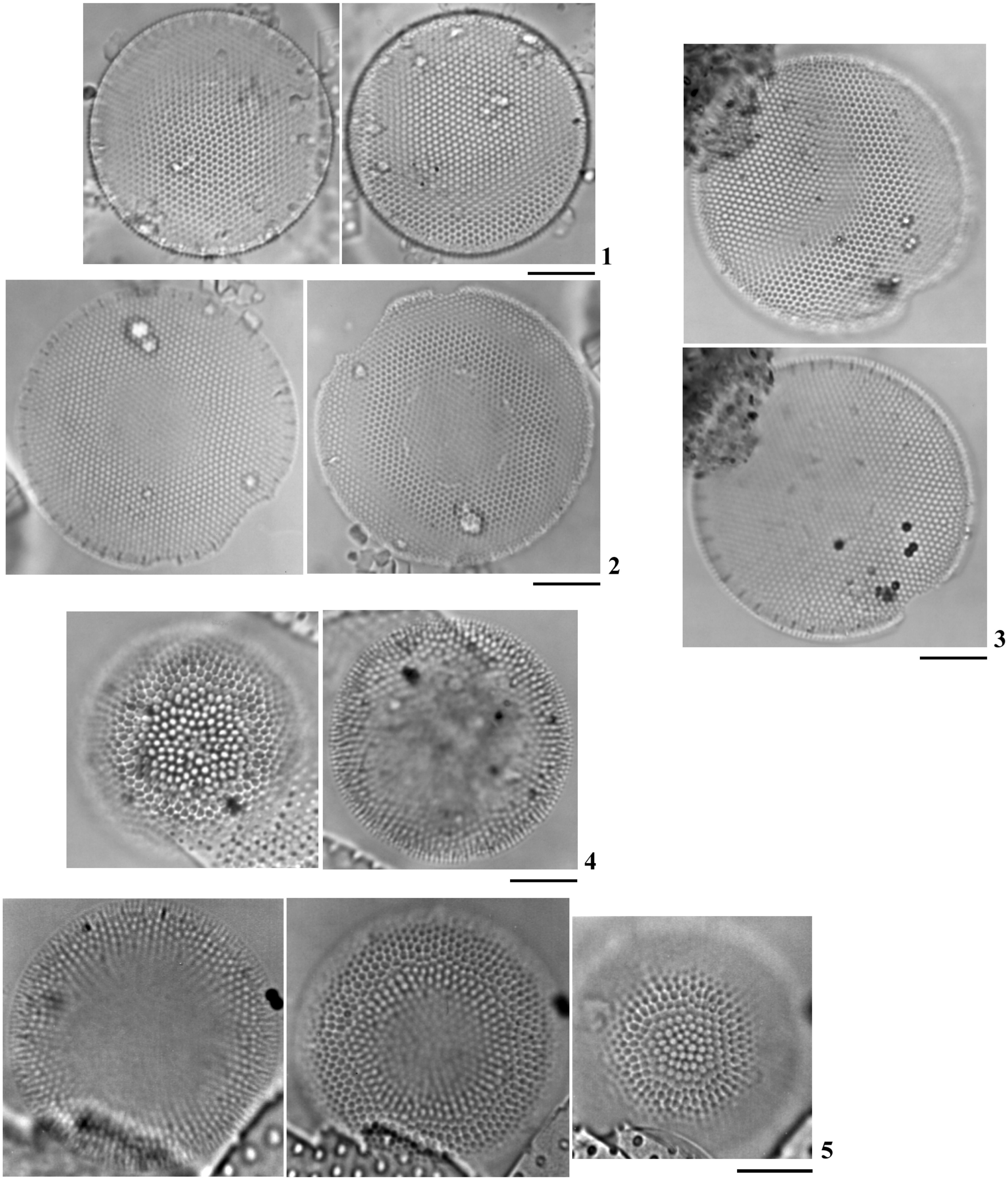
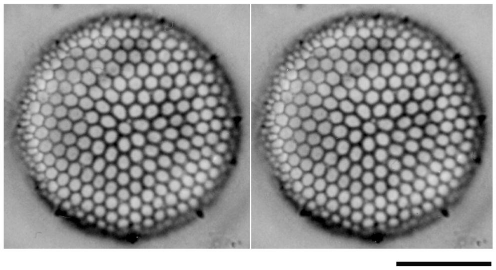


Plate P11. 1–3. *Thalassiosira eccentrica* (Ehrenberg) Cleve, (1) Sample 172-1061A-18X-CC, >20; (2) Sample 172-1063D-3H-5, 43–44 cm, >25; (3) Sample 172-1063D-4H-2, 8–9 cm, >25. **4, 5.** *Thalassiosira lineata* Jousé, (4) Sample 172-1063D-2H-2, 23–24 cm, st.; (5) Sample 172-1063D-4H-2, 113–114 cm, >25. Scale bars = 10 µm.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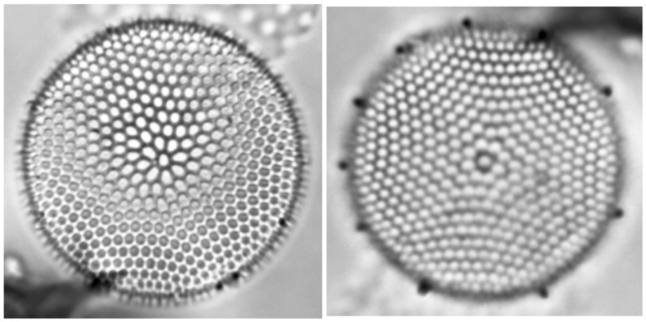
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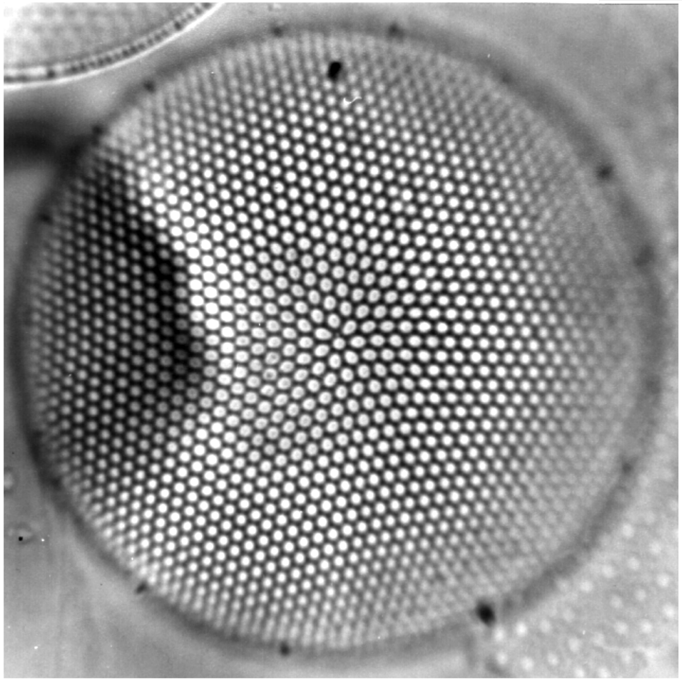
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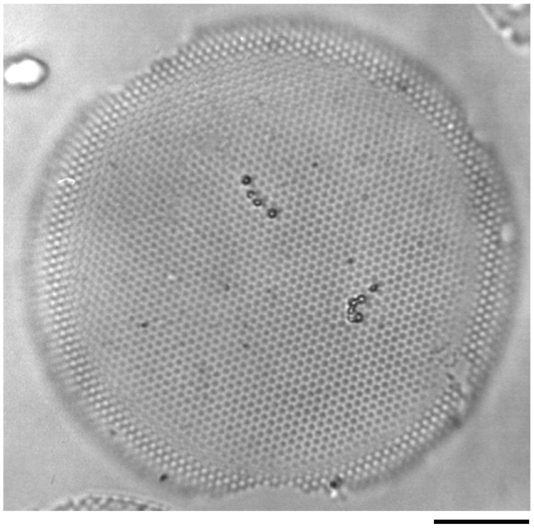
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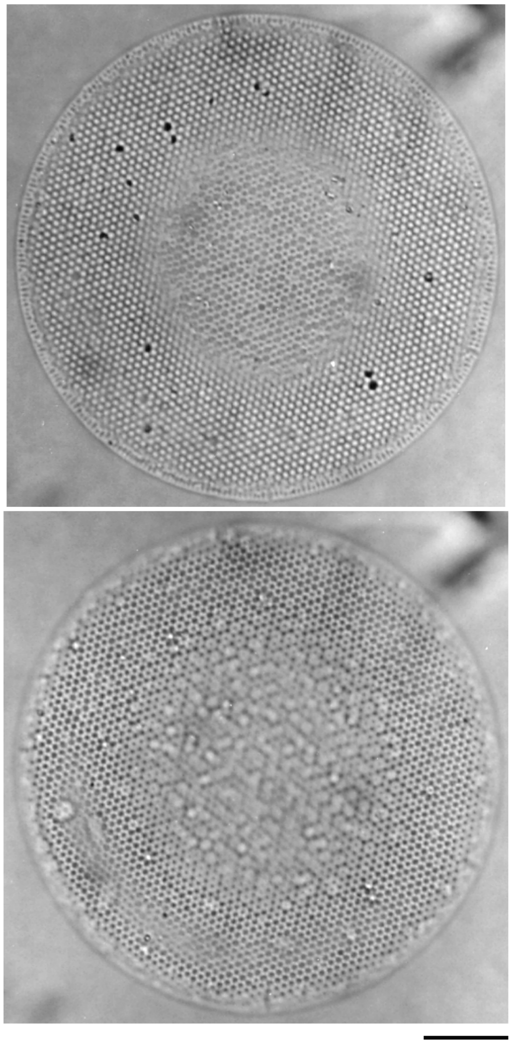
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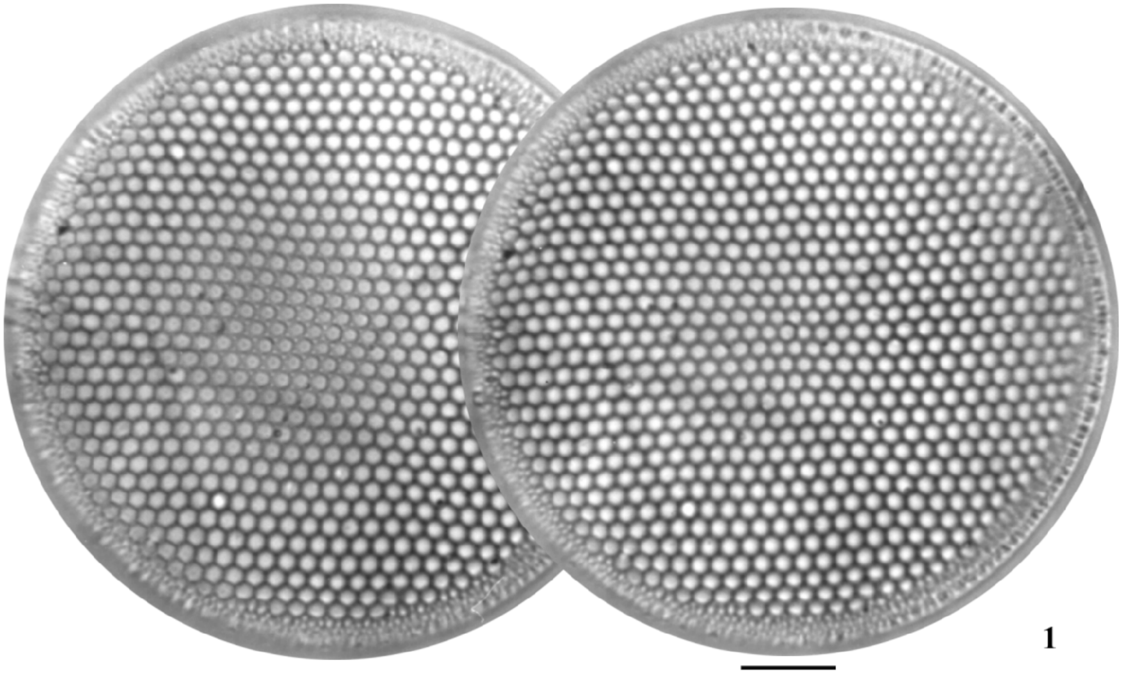
Plate P12. 1, 2. *Thalassiosira leptopus* (Grunow) Hasle and Fryxell, Sample 172-1063D-2H-4, 123–123 cm, >25. **3–5.** *Thalassiosira nordenskioeldii* Cleve, (3) Sample 172-1061A-1H-CC, >20; (4,5) Sample 172-1063D-4H-4, 53–54 cm, st. **6.** *Thalassiosira oestrupii* (Ostenfeld) Proshkina-Lavrenko, Sample 172-1063D-3H-4, 43–44 cm, >25. Scale bars = 10 µm.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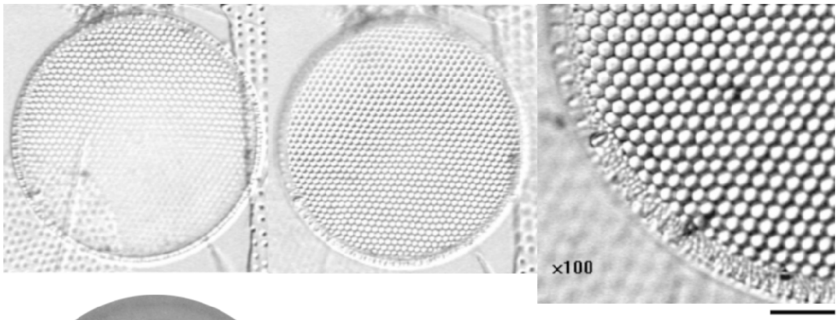

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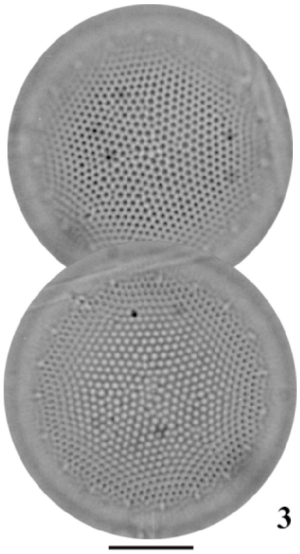
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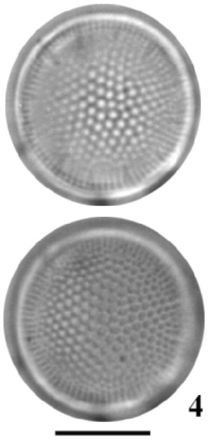
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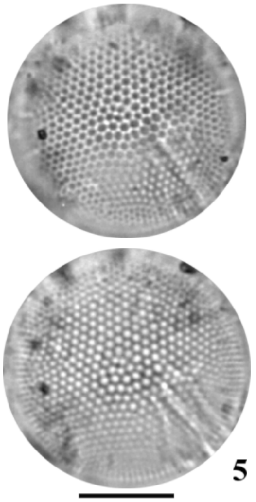
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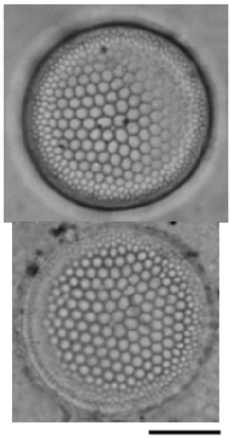
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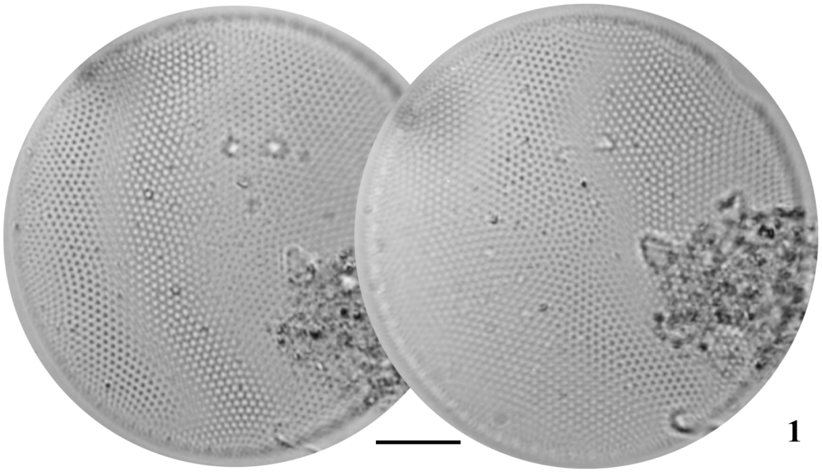
Plate P13. **1**, **2.** *Thalassiosira plicata* Schrader, (1) Sample 172-1063D-4H-2, 113–114 cm, >25; (2) Sample 172-1063D-4H-2, 113–114 cm, >25. **3.** *Thalassiosira pacifica* Gran and Angst, Sample 172-1063D-4H-4, 53–54 cm, st. **4.** *Thalassiosira* sp., Sample 172-1063D-2H-2, 73–74 cm, >25. Scale bars = 10 µm.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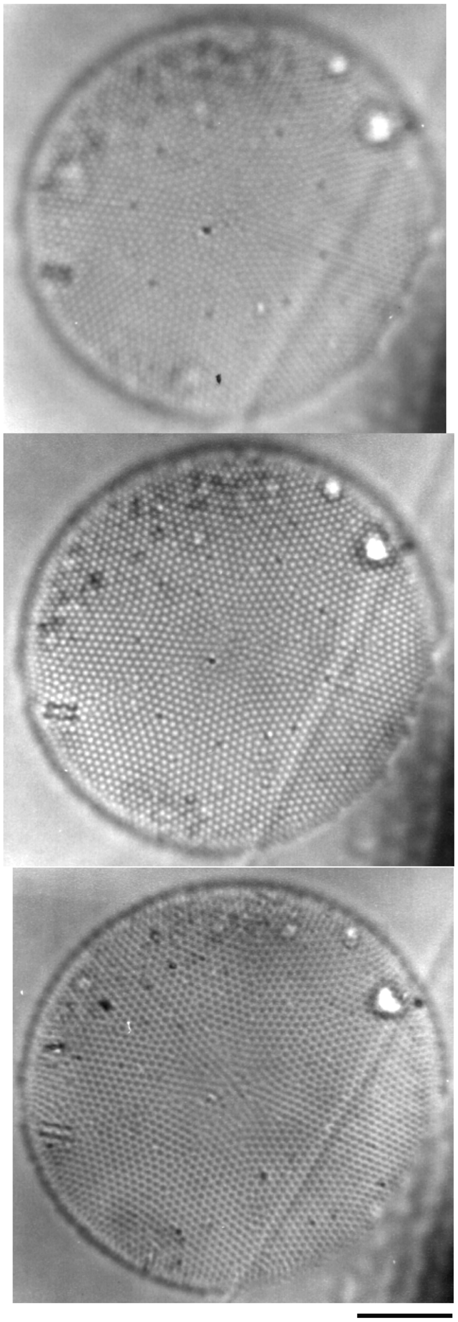
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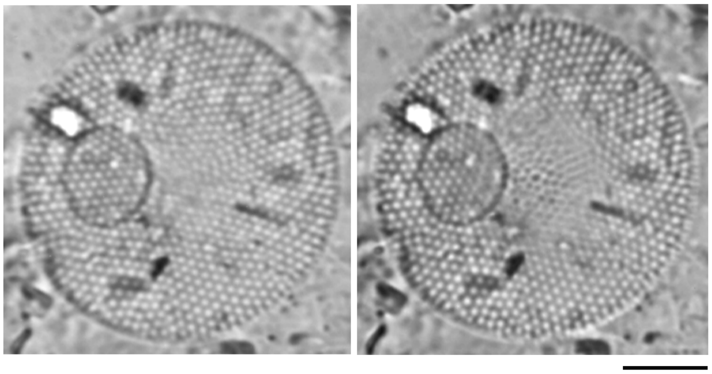
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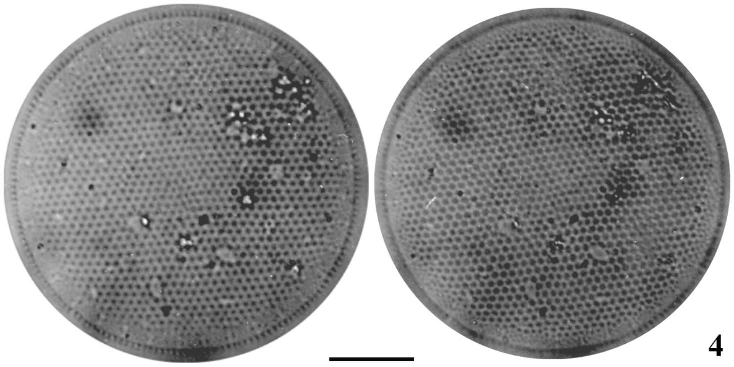
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Plate P14. **1.** Gen. sp. indet., Sample 172-1061A-1H-CC, >20. **2.** Gen. sp. indet., Sample 172-1061A-11H-CC, >20. **3.** *Auliscus sculptus* (Smith) Ralfs, Sample 172-1063D-3H-4, 43–44 cm, >25. **4.** Gen. sp. indet., Sample 172-1061A-11H-CC, >20. **5.** *Coscinodiscus reniformis* Castracane, Sample 172-1063D-2H-5, 68–69 cm, >25. **6.** *Triceratium* sp., Sample 172-1063D-4H-2, 93–94 cm, >25. Scale bars = 10 µm.