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35. Data Report: Taxonomic Notes of Neogene Diatoms from the Western Antarctic Peninsula: Ocean Drilling Program Leg 178[1]

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ABSTRACT

During Ocean Drilling Program Leg 178 we cored nine sites on the continental rise (Sites 1095, 1096, and 1101), continental shelf (Sites 1097, 1100, 1102, and 1103), and in an inner shelf basin, Palmer Deep (Sites 1098 and 1099), along the Pacific margin of the Antarctic Peninsula. Fossil diatoms are a key group that provides age constraint for these shelf site sediments to allow reconstruction of Antarctic Peninsula glacial history. This paper provides the systematic paleontology of diatoms applied in biostratigraphic and paleoceanographic studies and includes a total of 33 plates. Taxonomic confusion in previous reports, including biostratigraphically useful species such as *Thalassiosira inura* and *Thalassiosira complicata,* is discussed. These systematics and taxonomic discussions help to provide a reference for Neogene diatoms in the Southern Ocean.

INTRODUCTION

One of the strategies of Ocean Drilling Program (ODP) Leg 178 was to establish a biostratigraphic framework for the Antarctic continental rise that is also applicable to the shelf, in order to reconstruct the late Cenozoic Antarctic glacial history (Barker, Camerlenghi, Acton, et al., 1999). Fossil diatoms are one of the key microfossil groups that provide age constraints for the shelf basin sediments (Quilty, 1995; Barker and

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Camerlenghi, 1999). Many authors have published Neogene diatom biostratigraphies for the Southern Ocean (e.g., Weaver and Gombos, 1981; Gersonde and Burckle, 1990; Baldauf and Barron, 1991; Harwood and Maruyama, 1992; Gersonde and Bárcena, 1998; Winter and Iwai, Chap. 29, this volume). However, there are uncertainties in the isochroneity of individual biostratigraphic events (Ramsay and Baldauf, 1999). These uncertainties may result from biostratigraphic diachroneity, varied taxonomic concepts, or incorrect magnetostratigraphic correlation arising from a large number of apparent hiatuses. It is important to maintain a rigorous treatment of taxonomy for biostratigraphic and paleoceanographic studies (e.g., Iwai, 2000a, 2000b, 2001; Winter and Iwai, Chap. 29, this volume).

Biostratigraphic studies in the Pacific sector of the Southern Ocean have been completed by McCollum (1975) and Schrader (1976) using material cored during Deep Sea Drilling Project (DSDP) Legs 28, 29, and 35. Several additional biostratigraphic studies have also been completed (Akiba, 1982; Koizumi, 1982). However, most of the biostratigraphically useful species were described in the 1990s by Yanagisawa and Akiba (1990), Gersonde (1990, 1991), Baldauf and Barron (1991), Harwood and Maruyama (1992), Bodén (1993), and Gersonde and Bárcena (1998).

The purpose of this paper is to provide a taxonomic framework useful not only for biostratigraphic (Winter and Iwai, Chap. 29, this volume) and paleoceanographic (Iwai, 2000a, 2001) studies from ODP Leg 178, but for future research projects in the Southern Ocean as well.

MATERIAL AND METHOD

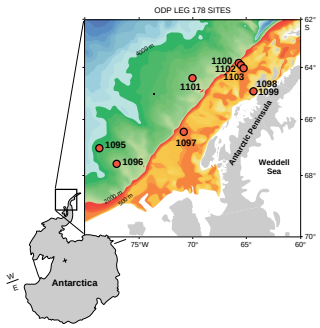
Leg 178 Samples

During Leg 178 we cored nine sites on the continental rise (Sites 1095, 1096, and 1101), continental shelf (Sites 1097, 1100, 1102, and 1103), and in Palmer Deep (Sites 1098 and 1099), along the Pacific margin of the Antarctic Peninsula (Fig. F1; Table T1). The samples used in this study were taken from Holes 1095A, 1095B, 1097A, 1100D, and 1103A. Sample preparation techniques are described in Winter and Iwai (Chap. 29, this volume). Observations and photomicroscopy of diatoms were carried out using a Zeiss Axioskope microscope with a differential interference contrast (DIC) condenser at magnifications of 400×, 630×, and 1000×. Diatom species occurrence in all holes at Site 1095 (where the major diatom occurrences were found) is given in table T3 of Winter and Iwai, Chap. 29, this volume. Occurrences at Sites 1097, 1101, and 1103 are given in Tables T2, T3, and T4, respectively, of this data report.

Digital Imaging

Photomicrographs of diatoms were taken using a digital camera system with the Zeiss DIC Axioskope microscope. A digital color camera, Fuji HC-300Z, was attached to the microscope with a Nikon relay lens (4×). The HC-300Z has a single 2/3-in square chip and 8-bit RGB color transfer method. The exposure time ranged between 1/2000 and 1/4 s. High-quality images at a resolution of 1280 × 1000 pixels were recorded directly onto Zip media as JPEG files. Pictures were processed with Adobe Photoshop and Microsoft Powerpoint. Brightness and contrast

F1. Locality of Leg 178 sites, p. 20.



T1. Summary of Leg 178 holes, p. 21.

T2. Stratigraphic occurrence of diatom species, Site 1097, p. 22.

T3. Stratigraphic occurrence of diatom species, Site 1100, p. 23.

T4. Stratigraphic occurrence of diatom species, Site 1103, p. 24

were adjusted in order to homogenize each image, but no special procedure was performed.

TAXONOMIC NOTES AND FLORAL REFERENCES

Taxonomic references for diatom species identified from Leg 178 sediments are listed below. The authority of each species is given as well as several good references that describe and illustrate the particular taxon. Plates P1–P23 show diatoms from a rise site (Holes 1095A and 1095B), and Plates P24–P33 show diatoms from the shelf sites (Holes 1097A and 1103A). The shelf site plates are arranged by seismic unit (Larter et al., 1997; Barker, Camerlenghi, Acton, et al., 1999) (i.e., Unit S1: Cores 178-1097A-1R through 9R and Cores 178-1103A-1R through 26R; Unit S2: Cores 178-1097A-10R through 18R; Unit S3: Cores 178-1097A-19R through 51R and Cores 178-1103A-27R through 38R).

Achnanthes spp. (not determined to species level) (Pl. **P6,** fig. 5).

Actinocyclus actinochilus (Ehrenberg) Simonsen, 1982, p. 101–116, pl. 1–4; Tanimura, 1992, p. 405, figs. 3–2, 5–3; Harwood and Maruyama, 1992, p. 699.

Synonym: *Charcotia actinochilus* (Ehrenberg) Hustedt, 1958; Fenner et al., 1976, pl. 5, fig. 5; Gombos, 1977, pl. 1, fig. 8; Akiba, 1982, pl. 3, figs. 7–10; Koizumi, 1982, pl. 2, fig. 9 (Pl. **P26,** fig. 2; Pl. **P33,** fig. 1).

Actinocyclus curvatulus Janisch in Schmidt et al., 1874–1959, pl. 57, fig. 31; Hustedt, 1930, p. 538, fig. 307; Akiba, 1982, pl. 5, figs. 5–6 (no illustration).

Actinocyclus ingens Rattray, 1890, p. 149, pl. 11, fig. 7; Schrader, 1976, pl. 13, fig. 8; Gombos, 1977, pl. 2, figs. 1, 2; Akiba, 1982, pl. 5, figs. 9–13; Gersonde, 1990, p. 791–192, pl. 1, figs. 1, 3–5, pl. 3, figs. 8, 9, pl. 4, fig. 1; Baldauf and Barron 1991, p. 58, pl. 5, fig. 2; Harwood and Maruyama, 1992, p. 700, pl. 8, fig. 10, pl. 11, figs. 4, 6, pl. 12, fig. 8; Mahood and Barron, 1996, p. 288, pl. 3, figs. 1a–4; pl. 7, figs. 20a, 20b, 21 (Pl. **P15,** fig. 3; Pl. **P29,** figs. 1, 4).

Actinocyclus ingens var. *ovalis* Gersonde, 1990, p. 792, pl. 1, fig. 7, pl. 3, figs. 1–3, pl. 5, figs. 4, 7, pl. 6, fig. 1 (oval), pl. 6, figs. 4, 5 (circular); Gersonde and Burckle, 1990, pl. 5, fig. 4; Baldauf and Barron, 1991, pl. 5, fig. 1 (circular).

Synonym: *Actinocyclus ingens* var. A of Harwood and Maruyama, 1992, p. 700, pl. 12, figs. 4, 5.

Remarks: Harwood and Maruyama (1992) distinguished asymmetric valves from circular valves and transferred the former from *Actinocyclus* to *Hemidiscus* and called the latter *Actinocyclus ingens* var. A. We included all the varieties into this species. The circular valve is more common and oval to slightly triangular valves are in the minority in Leg 178 materials (Pl. **P15,** fig. 5).

Actinocyclus karstenii Van Heurck, 1909; Harwood, 1986, pl. 8, figs. 8–10; Harwood and Maruyama, 1992, pl. 13, figs. 1, 2, 6–8, 10, 11, 13.

Synonym: *Actinocyclus fryxellae* Barron in Baldauf and Barron, 1991, p. 585, pl. 1, figs. 1, 2, 4.; *Cestodiscus* sp. of McCollum, 1975, pl. 3, figs. 1, 2; *Cestodiscus* sp. 1 of Schrader, 1976, pl. 12, fig. 6? (Pl. **P20,** figs. 5–8; Pl. **P24,** fig. 8; Pl. **P26,** fig. 1; Pl. **P27,** fig. 9).

Actinocyclus octonarius Ehrenberg, 1838; Hustedt, 1930, p. 525, fig. 298; Akiba, 1986, pl. 16, fig. 4 (Pl. **P20,** fig. 3).

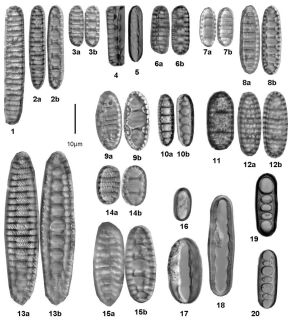
Actinocyclus cf. *octonarius* (Pl. **P21,** fig. 9; Pl. **P33,** fig. 2).

Amphora spp. (not determined to species level) (Pl. **P6,** figs. 6, 7).

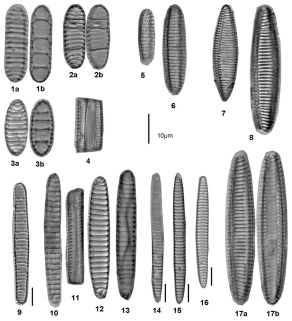
Arachnoidiscus ehrenbergii Ehrenberg, 1849; Hustedt, 1930, p. 471, fig. 262; Gombos, 1977, p. 592, pl. 6, fig. 1, pl. 26, fig. 4 (no illustration).

Asteromphalus spp. (not determined to species level) (no illustration).

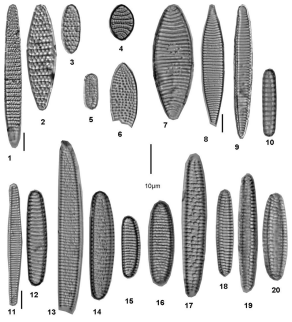
P1. Diatoms from rise site: *Denticulopsis* and *Crucidenticula*, p. 25.



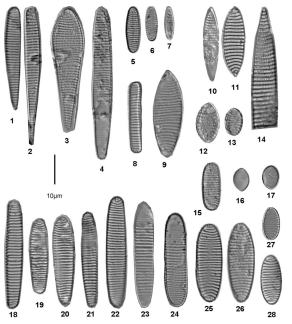
P2. Diatoms from rise site: *Denticulopsis* and *Nitzschia*, p. 26.



P3. Diatoms from rise site: *Fragilariopsis, Nitzschia,* and *Denticulopsis*, p. 27.



P4. Diatoms from rise site: *Nitzschia* and *Fragilariopsis*, p. 28.



Azpeitia endoi (Kanaya) Sims and Fryxell in Fryxell et al. of Baldauf and Barron, 1991, p. 586; Gladenkov and Barron, 1995, p. 31.

Synonym: *Coscinodiscus endoi* Kanaya, 1959; McCollum, 1975, pl. 4, figs. 5, 6; Schrader, 1976, pl. 11, figs. 8–10, 12; Gombos, 1977, pl. 2, figs. 6, 7; *Azpeitia tabularis* (Grunow) Fryxell and Sims in Fryxell et al., 1986; Harwood and Maruyama, 1992, p. 701, pl. 11, fig. 5 (figure caption shown as *Azpeitia endoi*).

Remarks: This species is referred to as *Azpeitia endoi* (Kanaya) by Sims and Fryxell in Fryxell et al. (1986) by Baldauf and Barron (1991), although Gladenkov and Barron (1995) regarded *A. endoi* as a variant of *A. tabularis*. Fryxell et al. (1986), however, did not discuss *A. endoi*. Future discussion based on scanning electron microscope observation is required (Pl. **P21,** figs. 6, 7).

Azpeitia gombosii? Harwood and Maruyama, 1992, p. 701, pl. 3, figs. 1, 2.

Remarks: *A. gombosii* is a late Oligocene taxon. A specimen was found in Sample 178-1097A-34R-CC of the upper Miocene *A. ingens* v. *ovalis* Zone and is considered to be reworked from the upper Oligocene (Pl. **P33,** fig. 6).

Azpeitia nodulifera (A. Schmidt) Fryxell and Sims in Fryxell et al., 1986, p. 19–20, figs. XVII, XVIII–1, 2, 4, 5 (SEM); XXX–3, 4 (LM).

Synonym: *Coscinodiscus nodulifer* Schmidt; McCollum, 1975, pl. 5, figs. 7, 8; Schrader, 1976, pl. 11, fig. 3; *Coscinodiscus vetustissimus* Pantocsek, 1886–1892; Schrader, 1976, pl. 11, fig. 11; *Coscinodiscus radiatus* Ehrenberg var. *nodulifer* Reinhold, 1937; Hajós, 1976, pl. 4, figs. 10, 11, pl. 6, figs. 3, 4 (Pl. **P21,** figs, 1, 3; Pl. **P29,** figs. 3a, 3b).

Azpeitia tabularis (Grunow) Fryxell and Sims in Fryxell et al., 1986, p. 16, figs. XIV, XV; XXX–I; Tanimura, 1992, figs. 3–10, 5–4.

Synonym: *Coscinodiscus tabularis* Grunow, 1884, p. 86; Schrader, 1976, pl. 11, fig. 5; Fenner et al., 1976, pl. 7, figs 10–13; Akiba, 1982, pl. 2, figs. 6–9; Koizumi, 1982, pl. 2, fig. 10 (Pl. **P21,** fig. 4).

Bacteriastrum spp. (not determined to species level) (no illustration).

Basilicostephanus? sp.

Remarks: Valve cylindrical. Pervalvar axis short, slightly curved. Valve face is circular and slightly convex, with radial punctate striae. Distinct central area. Possibly in the genus *Basilicostephanus,* as described by Gersonde and Harwood (1990, p. 371; type species is *B. ornatus* Gersonde and Harwood, 1990, p. 371, pl. 3, fig. 4, pl. 4, figs. 5–12, 15–17, pl. 5, figs. 1–8) from lower Cretaceous sediments. *Basilicostephanus*? sp. is found in Sample 178-1103A-34R-CC of the upper Miocene and is considered to be reworked (Pl. **P28,** fig. 21).

Chaetoceros sp. A of Harwood and Maruyama, 1992, p. 701, pl. 19, figs. 5–7 (Pl. **P5,** fig. 22).

Chaetoceros spp. (resting spores) (Pl. **P23,** figs. 6, 7; Pl. **P27,** fig. 10; Pl. **P28,** figs. 22–28).

Cocconeis californica (Grunow) Grunow in Van Heurck, 1909; Krebs, 1983, pl. 1, fig. 7 (Pl. **P6,** fig. 11).

Cocconeis sp. cf. *C. californica* (Pl. **P6,** fig. 12; Pl. **P27,** fig. 12).

Cocconeis costata Gregory, 1857; Akiba, 1982, pl. 7, fig. 12; Harwood et al., 2000, fig. 9h; *Cocconeis* sp. D of Harwood, 1986, pl. 6, fig. 9 (Pl. **P6,** fig. 16).

Cocconeis sp. aff. *C. costata*.

Remarks: This taxa group includes *Cocconeis* sp. of Gombos, 1977, pl. 5, figs. 6, 7 (Pl. **P6,** figs. 15, 19; Pl. **P29,** fig. 12).

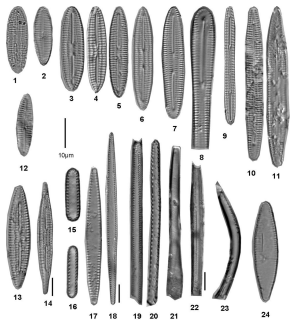
Cocconeis sp. aff. *Cocconeis fasciolata* (Ehrenberg) Brown, 1920, p. 232 (Pl. **P6,** fig. 20).

Cocconeis sp. (Pl. **P6,** figs. 13, 14).

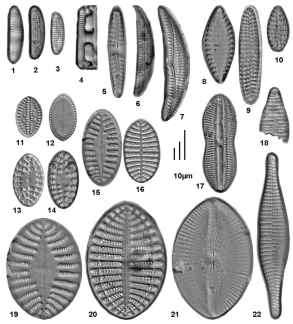
Cocconeis? sp. (Pl. **P6,** fig. 21).

Corethron spp. (not determined to species level).

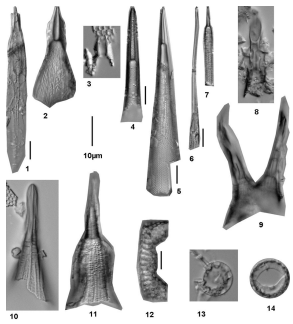
P5. Diatoms from rise site: *Rouxia* and others, p. 29.



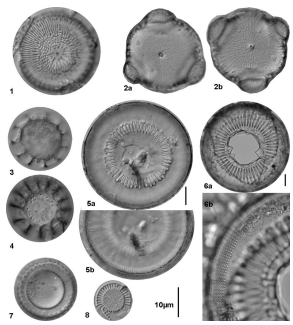
P6. Diatoms from rise site: *Cocconeis* and others, p. 30



P7. Diatoms from rise site: *Rhizosolenia* and others, p. 31.



P8. Diatoms from rise Site 1095, p. 32.



Remarks: This genus may be mainly composed of *Corethron criophilum* Castracane, 1886 (references: Fenner, et al., 1976, p. 771; Krebs, 1983, pl. 2, figs. 4a, 4b). Nearly monospecific ooze of *Corethron* spp. is present as pale brown-gray colored laminae in Palmer Deep Sites 1098 and 1099 (see the Leg 178 *Initial Reports* volume). Fragments are observed in upper Miocene and Pliocene sediments but never appear as a complete valve at the Leg 178 sites on the continental rise and shelf (Pl. **P7,** fig. 13; Pl. **P32,** figs. 6, 7).

Coscinodiscus asteromphalus Ehrenberg, 1844, p. 77; Hustedt, 1930, p. 452, fig. 250; Harwood, 1986, pl. 5, fig. 14 (no illustration).

Coscinodiscus elegans Greville, 1866; Kanaya, 1959, p. 75, pl. 3, figs. 6, 7 (Pl. **P22,** fig. 3).

Coscinodiscus marginatus Ehrenberg; Hustedt, 1930; McCollum, 1975, pl. 5, figs. 7, 8; Hajós, 1976, pl. 20, figs. 9, 10; Gombos, 1977, pl. 5, fig. 5; Akiba, 1982, pl. 1, fig. 8; Akiba, 1986, p. 442, pl. 1, figs. 1–4 (Pl. **P30,** figs. 2a, 2b; Pl. **P31,** fig. 5).

Coscinodiscus oculus-iridus Ehrenberg; Schmidt, 1928, in Schmidt et al., 1874–1959, pl. 113, fig. 1; Harwood, 1986, pl. 5, fig. 9; Harwood, 1989, pl. 1, fig. 1 (no illustration).

Coscinodiscus cf. *radiatus* Ehrenberg sensu Hajós, 1976, pl. 4, figs. 12–14; pl. 5, figs. 3–5 (Pl. **P22,** fig. 1).

Coscinodiscus sp. A sensu Akiba, 1986, p. 442, pl. 16, fig. 8 (Pl. **P22,** fig. 4).

Crucidenticula kanayae Akiba and Yanagisawa, 1986, p. 486, pl. 1, figs. 3–8, pl. 3, figs. 1–6, 9–11; Harwood and Maruyama, 1992, pl. 7, fig. 15 (no illustration).

Crucidenticula kanayae cf. var. *pacifica* Yanagisawa and Akiba, 1990, p. 229, pl. 1, figs. 36–38.
Synonym: *Denticulopsis lauta* (Bailey) Simonsen and Kanaya sensu Baldauf and Barron, 1991; *Denticulopsis hustedtii* var. *aspera* Maruyama in Harwood and Maruyama, 1992, p. 702, pl. 10, figs. 8–11, 15, 16 (Pl. **P1,** figs. 11–12).

Cyclotella spp. (not determined to species level).
Remarks: *Cyclotella* spp. includes *Cyclotella* sp. cf. *Cyclotella pantanelli* Castr. (Schmidt, et al., 1928, pl. 223, figs. 1–5).

Dactyliosolen antarcticus Castracane, 1886; Harwood and Maruyama, 1992, pl. 18, fig. 12.
Synonym: Genus et species indet (D) of Gombos, 1977, pl. 2, figs. 3, 4, pl. 10, figs. 1–3 (Pl. **P7,** fig. 14).

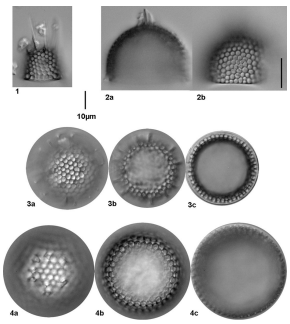
Delphineis spp. (not determined to species level) (Pl. **P6,** figs. 9, 10; Pl. **P29,** fig. 8).

Denticulopsis crassa Yanagisawa and Akiba, 1990, p. 248, pl. 3, figs. 21–27, pl. 12, figs. 1–8.
Synonym: *Denticulopsis hustedtii* (closed copula) of Harwood and Maruyama, 1992, pl. 9, figs. 19, 20, pl. 10, fig. 13 (Pl. **P1,** figs. 15 [valve view], 16–18 [closed copula]).

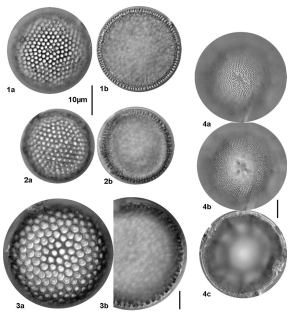
Denticulopsis delicata Yanagisawa and Akiba, 1990, p. 246, pl. 7, figs. 1–4.
Remarks: Valve delicate, linear, and slender. Valve face hyaline. Pseudosepta equally spaced. Poorly developed narrow basal ridge. Yanagisawa and Akiba (1990) mentioned that *Denticula* aff. *seminae* (no illustration) of Schrader (1976), which was present in the uppermost middle to lowermost upper Miocene sequence from the Southern Ocean, might be a synonym of this species. *D. delicata* was common in the upper Miocene *Actinocyclus kennetii* Zone and *Thalassiosira torokina* Zone of Site 1095 (Pl. **P2,** figs. 9–16; Pl. **P28,** figs. 3–5).

Denticulopsis sp. cf. *D. delicata*.
Remarks: This species is also similar to *Neodenticula* sp. A sensu Akiba and Yanagisawa, 1986 (p. 492, pl. 21, figs. 29–31, pl. 24, figs. 12–18, pl. 25, figs. 1–7).

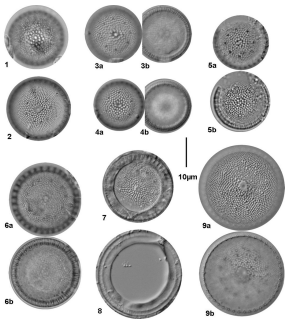
P9. Diatoms from rise site: *Stephanopyxis*, p. 33.



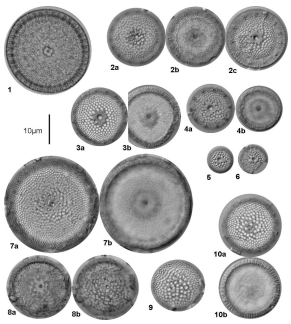
P10. Diatoms from Hole 1095B, p. 34.



P11. Diatoms from rise site: *Thalassiosira*, p. 35.



P12. Diatoms from Site 1095: *Thalassiosira*, p. 36.



However, *Neodenticula* sp. A has a more oval valve outline and is present in only the Quaternary section (Pl. **P2,** figs. 1–3 [valve view], 4 [girdle view]).

Denticulopsis dimorpha var. *areolata* Yanagisawa and Akiba, 1990, p. 257, pl. 4, figs. 40, 41, 50–54, pl. 5, figs. 13–17, pl. 6, figs. 1–5, 15–23, pl. 12, figs. 15, 16.
Synonym: *Denticula dimorpha* Schrader, 1973a; Schrader, 1976, pl. 4, figs. 29–32; *Denticula* cf. *dimorpha* Schrader; Gombos, 1977, pl. 8, figs. 9–12; *Denticulopsis lauta* (Bailey) Simonsen and Kanaya, 1961; Baldauf and Barron, 1991, pl. 7, fig. 3; *Denticulopsis dimorpha* (Schrader) Simonsen, 1979, p. 64; Akiba, 1982, pl. 11, fig. 8; Baldauf and Barron, 1991, pl. 7, fig. 4; *Denticulopsis ovata* (Schrader) Yanagisawa and Akiba, 1990, pl. 6, fig. 9; *Denticulopsis dimorpha* (Schrader) Simonsen emend. Akiba and Yanagisawa, 1986, of Harwood and Maruyama, 1992, pl. 6, figs. 5–7, pl. 9, figs. 5–9, 15–18, 22?, 23, pl. 10, figs. 5, 6, 12 (Pl. **P1,** fig. 19 [closed copula]).

Denticulopsis hustedtii (Simonsen and Kanaya) Simonsen emend. Yanagisawa and Akiba, 1990, p. 246–248, pl. 3, figs. 14–19, pl. 11, figs. 11–13.
Synonyms: *Denticula hustedtii* Simonsen and Kanaya, 1961; Schrader, 1976, pl. 4, figs. 2, 8 (Pl. **P1,** figs. 9, 13, 14).

Denticulopsis maccollumii Simonsen, 1979; Harwood and Maruyama, 1992, p. 702–703, pl. 6, fig. 22, pl. 7, fig. 17, pl. 9, fig. 27.
Synonyms: *Denticula* cf. *antarctica* McCollum, 1975; Gombos, 1977, pl. 12, figs. 9, 10 (Pl. **P3,** fig. 10).

Denticulopsis ovata (Schrader) Yanagisawa and Akiba, 1990, p. 257–258, pl. 6, figs. 6–8, 10–14, 24–32 (not including fig. 9).
Synonyms: *Denticula hustedtii*? Simonsen and Kanaya; Gombos, 1977, pl. 8, fig. 5; *Denticula hustedtii* var. *ovata* Schrader, 1976, pl. 4, figs. 12, 14, 15; *Denticula lauta* Bailey; Schrader, 1976, pl. 4, figs. 7, 10, 11, 13; *Denticula lauta* var. *ovata* Schrader, 1976, pl. 4, fig. 7; *Denticulopsis dimorpha* (Schrader) Simonsen; Gersonde and Burckle, 1990, pl. 4, figs. 10–12; *Denticulopsis* cf. *dimorpha* (Schrader) Simonsen sensu Akiba, 1982, pl. 10, figs. 12, 15; *Denticulopsis meridionalis* Maruyama in Harwood and Maruyama, 1992, p. 702–703, pl. 6, figs. 1–4, pl. 7, figs. 1–4, 6–9, 11–13, pl. 9, figs. 1–4, 10–14.
Remarks: The rare and sporadic occurrence of this species in upper Miocene sediment from the western Antarctic Peninsula leads to its consideration as a reworked specimen (Pl. **P1,** fig. 20 [closed copula]).

Denticulopsis praehyalina Tanimura emend. Yanagisawa and Akiba, 1990, p. 239, pl. 2, figs. 28–32, pl. 9, figs. 5–7 (Pl. **P1,** fig. 10a, 10b).

Denticulopsis simonsenii Yanagisawa and Akiba, 1990, p. 242–243, pl. 3, figs. 1–3, pl. 11, figs. 1, 5.
Synonym: *Denticulopsis hustedtii* (Simonsen and Kanaya) Simonsen, 1979; Gersonde and Burckle, 1990, pl. 54, figs. 10–13 (Pl. **P1,** figs. 1–6; Pl. **P28,** figs. 1a, 1b, 2].

Denticulopsis vulgaris (Okuno) Yanagisawa and Akiba, 1990, p. 243–244, pl. 3, figs. 4–8, pl. 11, figs. 2, 6–10 (Pl. **P1,** figs. 7a, 7b, 8a, 8b].

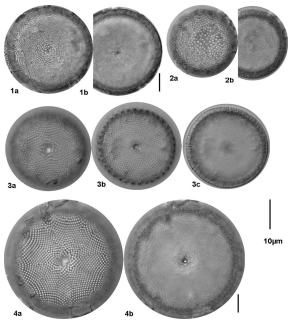
Diploneis spp. (not determined to species level) (Pl. **P6,** fig. 17).

Eucampia antarctica (Castracane) Mangin, 1914; Hasle and Syvertsen, 1990, pl. 16.1, figs. 7–13.
Synonym: *Eucampia balaustium* Castracane, 1886; Schrader, 1976, pl. 14, fig. 7; Fenner et al., 1976, p. 774, pl. 5, figs. 7–10; Gombos, 1977, pl. 1, figs. 1–5; Akiba, 1982, pl. 6, figs. 1–9; Koizumi, 1982, pl. 1, fig. 12; Webb et al., 1984, fig. 2.3; Tanimura, 1992, p. 407, figs. 3–13 (Pl. **P7,** fig. 12; Pl. **P27,** fig. 6].

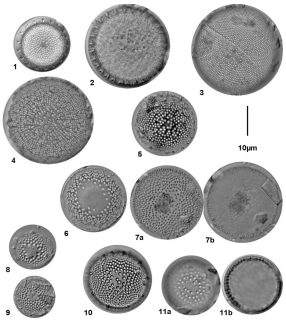
Fragilariopsis arcula (Gersonde) Gersonde and Bárcena, 1998, p. 92.
Synonym: *Nitzschia arcula* Gersonde, 1991, p. 143–144, pl. 2, fig. 4, pl. 4, fig. 4, pl. 5, figs. 1–6; Gersonde and Burckle, 1990, pl. 1, figs. 25, 26 (Pl. **P4,** figs. 25–28; Pl. **P4,** fig. 8 [cf.]).

Fragilariopsis aurica (Gersonde) Gersonde and Bárcena, 1998, p. 92.

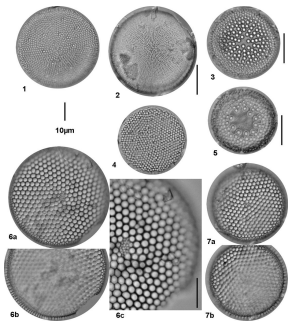
P13. Diatoms from Hole 1095B: *Thalassiosira*, p. 37.



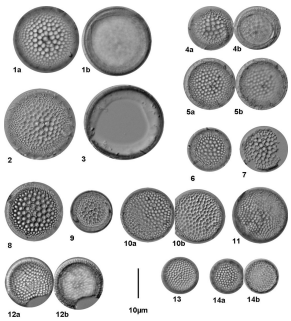
P14. Diatoms from rise site: *Thalassiosira*, p. 38.



P15. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*, p. 39.



P16. Diatoms from Hole 1095B: *Thalassiosira*, p. 40.



Synonym: *Nitzschia aurica* Gersonde, 1991, p. 144–146, pl. 1, figs. 18–25, pl. 3, fig. 5, pl. 4, figs. 5, 6, pl. 7, fig. 6; Gersonde and Burckle, 1990, pl. 2, figs. 10–12 (Pl. **P4,** figs. 24–28; Pl. **P25,** fig. 2; **P28,** fig. 7].

Fragilariopsis barronii (Gersonde) Gersonde and Bárcena, 1998, p. 92.
Synonym: *Nitzschia barronii* Gersonde, 1991, p. 146–147, pl. 3, fig. 6, pl. 4, figs. 1–3, pl. 5, figs. 7–17; Gersonde and Burckle, 1990, pl. 1, figs. 11, 12; Baldauf and Barron, 1991, pl. 7, fig. 14; Harwood and Maruyama, 1992, pl. 17, fig. 27 (Pl. **P25,** fig. 3).

Fragilariopsis aff. *barronii* 1.
Remarks: Including *Nitzschia barronii* Gersonde sensu Harwood and Maruyama, 1992, pl. 17, fig. 28 (Pl. **P3,** fig. 7).

Fragilariopsis aff. *barronii* 2 (Pl. **P4,** figs. 12, 13).

Fragilariopsis curta (Van Heurck) Hustedt, 1958, p. 160, pl. 11, figs. 140–144; Hasle, 1965, p. 32, pl. 6, fig. 6, pl. 12, figs. 2–5, pl. 13, figs. 1–6, pl. 16, fig. 6, pl. 17, fig. 5.
Synonym: *Nitzschia curta* (Van Heurck) Hasle, 1972, p.115; Akiba, 1982, pl. 10, figs. 1–2; Koizumi, 1982, pl. 1, figs. 1, 2; Gersonde, 1984, pl. 1, fig. 5; Tanimura, 1992, p. 407, figs. 4.17–4.23 (no illustration).

Fragilariopsis interfrigidaria (McCollum) Gersonde and Bárcena, 1998, p. 92.
Synonym: *Nitzschia interfrigidaria* McCollum, 1975, p. 535, pl. 9, fig. 9; Ciesielski, 1983, p. 655, pl. 1, figs. 11–18; Gersonde and Burckle, 1990, pl. 1, figs. 1–3; *Nitzschia praeinterfrigidaria* (transitional to *N. interfrigidaria*) of Ciesielski, 1983, pl. 2, figs. 15, 16.
Remarks: Transitional form of Ciesielski (1983) has been included herein into *F. interfrigidaria* (Pl. **P3,** figs. 16, 17).

Fragilariopsis kerguelensis (O'Meara) Hustedt, 1958, p. 162, pl. 10, figs. 121–127, pl. 12, fig. 158; Hasle, 1965, p. 14–18, pl. 3, figs. 4, 5, pl. 4, figs. 11–18, pl. 5, figs. 1–11, pl. 6, figs. 2–4, pl. 7, fig. 9, pl. 8, fig. 10, pl. 16, figs. 3–5.
Synonym: *Nitzschia kerguelensis* (O'Meara) Hasle, 1972; Fenner et al., 1976, p. 776, pl. 2, figs. 19–30; Gombos, 1977, pl. 8, figs, 13, 14; Akiba, 1982, pl. 9, figs. 1–4; Koizumi, 1982, pl. 1, figs. 7–11; Krebs, 1983, pl. 4, fig. 7a, 7b; Harwood, 1983, fig. 2.6 (Webb et al., 1984, fig. 2.4); Tanimura, 1992, p. 407, figs. 4.1–4.9; *Fragilariopsis antarctica* (Castracane) Hustedt sensu Hirano, 1983, pl. 6, fig. 8 (Pl. **P3,** figs. 1–3; Pl. **P24,** fig. 3; Pl. **P24**, fig. 1?).

Fragilariopsis sp. aff. *F. kerguelensis* (Pl. **P3,** fig. 4).

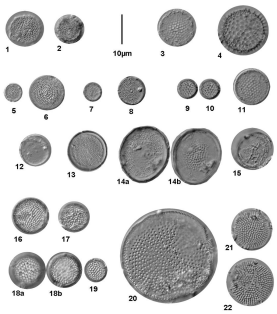
Fragilariopsis lacrima (Gersonde) Gersonde and Bárcena, 1998, p. 92.
Synonym: *Nitzschia lacrima* Gersonde, 1991, p. 148, pl. 1, figs. 1–6, 26, pl. 2, figs. 1–3; Gersonde and Burckle, 1990, pl. 1, figs. 14, 15 (Pl. **P4,** fig. 3).

Fragilariopsis praecurta (Gersonde) Gersonde and Bárcena, 1998, p. 92.
Synonym: *Nitzschia praecurta* Gersonde, 1991, p. 148–149, pl. 1, figs. 7–17, pl. 2, figs. 5, 6, pl. 3, figs. 3, 4, pl. 10, fig. 7; Gersonde and Burckle, 1990, pl. 1, figs. 21–24 (Pl. **P4,** figs. 19–23; Pl. **P28,** fig. 8).

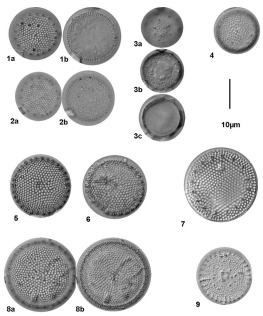
Fragilariopsis praeinterfrigidaria (McCollum) Gersonde and Bárcena, 1998, p. 92; *Nitzschia* cf. *praeinterfrigidaria,* Ciesielski, 1983, pl. 3, figs. 1–4; *Nitzschia interfrigidaria* McCollum, 1975, pl. 9, fig. 8.
Synonym: *Nitzschia praeinterfrigidaria* McCollum, 1975, p. 535, pl. 10, fig. 1; Ciesielski, 1983, p. 665, pl. 2, figs. 1–8, 13, 14, pl. 3, fig. 5; Gersonde and Burckle, 1990, pl. 1, figs. 4–10; Baldauf and Barron, 1991, pl. 7, fig. 12.
Remarks: Length = 20–60 µm, width = 6.5–9 µm. Transapical ribs = 10–11 in 10 µm. Transitional forms between *N. praeinterfrigidaria* and *N. interfrigidaria* sensu Ciesielski (1983) have been excluded from this taxon (Pl. **P3,** figs. 13–15).

Fragilariopsis sp. cf. *F. praeinterfrigidaria.*
Remarks: Length = 32–66 µm, width = 7–8 µm. Transapical ribs = 8–9 in 10 µm (Pl. **P3,** figs. 11, 12).

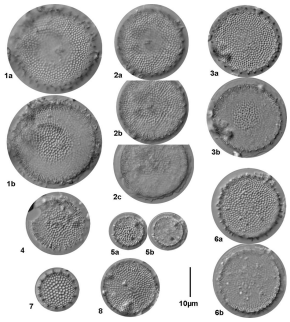
P17. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*, p. 41.



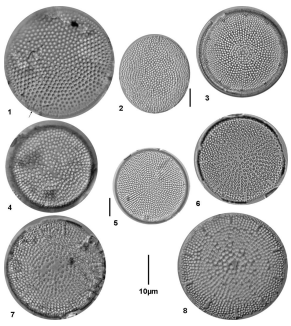
P18. Diatoms from rise site: *Thalassiosira* and *Porosira*?, p. 42.



P19. Diatoms from Hole 1095B: *Thalassiosira*, p. 43.



P20. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*, p. 44.



Fragilariopsis pseudonana Hasle, 1965, p. 22–24, pl. 1, figs. 7–14, pl. 4, figs. 20, 21, pl. 8, figs. 1–9, pl. 17, fig. 6.
Synonym: *Nitzschia pseudonana* Hasle, 1972; Fenner et al., 1976, p. 777, pl. 2, figs. 6–11 (Pl. **P4,** figs. 5–7).

Fragilariopsis ritscherii Hustedt, 1958, p. 164, pl. 11, figs. 133–136, pl. 12, fig. 153; Hasle, 1965, p. 20–21, pl. 1, fig. 20, pl. 3, fig. 3, pl. 4, figs 1–10, pl. 5, figs. 12, 13, pl. 6, fig. 1, pl. 7, fig. 8.
Synonym: *Nitzschia ritscherii* (Hustedt) Hasle, 1972; Fenner et al., 1976, p. 777, pl. 3, figs. 1–12; Akiba, 1982, pl. 9, figs. 5–10; Koizumi, 1982, pl. 1, fig. 6; Tanimura, 1992, p. 409, figs. 4–10~13; *Nitzschia* sp. A of Gombos, 1977, pl. 7, figs. 7, 8 (no illustration).

Fragilariopsis separanda Hustedt, 1958, p. 165, pl. 10, figs. 108–112.
Synonym: *Nitzschia separanda* (Hustedt) Hasle, 1972; Koizumi, 1982, pl. 1, figs. 3, 4; Tanimura, 1992, p. 409, figs. 4–27~29 (no illustration).

Fragilariopsis weaveri (Ciesielski) Gersonde and Bárcena, 1998, p. 93.
Synonym: *Nitzschia weaveri* Ciesielski, 1983, p. 625, pl. 1, figs. 1–10; Baldauf and Barron, 1991, pl. 7, fig. 5.
Remarks: Length = 28–38 µm, width = 6–8.5 µm. Transapical ribs = 9.5–11 in 10 µm, transapical parallel. There is one large circular to elliptical pore on the valve margin between distinct transapical ribs. Valves are elliptical–linear and strongly silicified. Ciesielski (1983) considered this species as the descendant of *N. interfrigidaria* and mentioned the gradual reduction in the abundance of punctae on the valve face. Barron (1996) used this species as a proxy of southward migration of the Polar Front. *N. weaveri* is observed from middle Pliocene samples in Hole 1095B but never dominated the assemblage (Iwai, 2000a, 2000b, 2001) (Pl. **P3,** figs. 18–20).

Gomphonema spp. (not determined to species level) (no illustration).

Grammatophora spp. (not determined to species level) (Pl. **P6,** figs. 1–3 [valve view], fig. 4 [girdle view]).

Hemidiscus cuneiformis Wallich; Fenner, et al., 1976, p. 774, pl. 11, fig. 17; Harwood and Maruyama, 1992, pl. 11, fig. 11 (Pl. **P21,** fig. 2).

Hemidiscus karstenii Jousé; Gombos, 1977, pl. 4, fig. 8; Akiba, 1982, pl. 5, figs. 1–4; Koizumi, 1982, pl. 2, fig. 6 (Pl. **P21,** fig. 5).

Hyalodiscus spp. (not determined to species level) (Pl. **P29,** fig. 7a, 7b).

Melosira omma Cleve; Schmidt, 1928, in Schmidt et al., 1874–1959, pl. 179, fig. 23.
Synonym: *Melosira arctica* (Ehrenberg) Dickie?; Hirano, 1983, pl. 7, figs. 6–9 (Pl. **P8,** figs. 5a, 5b, 6a, 6b; Pl. **P31,** fig. 6).

Melosira? sp. (Pl. **P8,** fig. 8).

Navicula spp. (not determined to species level) (Pl. **P27,** fig. 11).

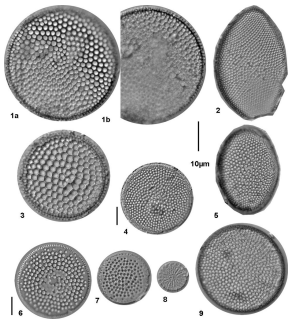
Nitzschia angulata (O'Meara) Hasle, 1972; Koizumi, 1982, pl. 1, fig. 5; Krebs, 1983, pl. 4, fig. 2; Tanimura, 1992, p. 407, figs. 4–24~26 (Pl. **P3,** fig. 6).

Nitzschia clementia Gombos, 1977, p. 595, pl. 8, figs. 18, 19; Gersonde and Burckle, 1990, pl. 2, figs. 22, 23; Harwood and Maruyama, 1992, pl. 17, fig. 18 (Pl. **P4,** figs. 1, 2).

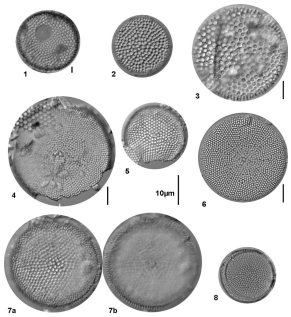
Nitzschia cylindrica Burckle, 1972, p. 239, pl. 2, figs. 1–6; Gombos, 1977, pl. 7, figs. 4, 5; Gersonde and Burckle, 1990, pl. 1, fig. 27; Baldauf and Barron, 1991, pl. 7, fig. 10 (Pl. **P2,** figs. 5, 6).

Nitzschia donahuensis Schrader, 1976, p. 633, pl. 2, fig. 30; Gersonde and Burckle, 1990, pl. 1, figs. 16–18; Baldauf and Barron, 1991, pl. 7, fig. 6 (no illustration).

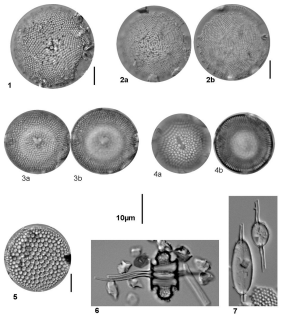
P21. Diatoms from rise site: *Azpeitia, Hemidiscus,* and *Actinocyclus,* p. 45.



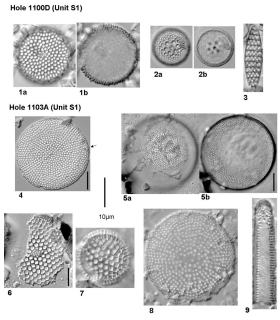
P22. Diatoms from rise site: *Coscinodiscus* and *Thalassiosira*, p. 46.



P23. Diatoms from rise site: *Chaetoceros* and others, p. 47.



P24. Diatoms from shelf sites: *Thalassiosira* and others, p. 48.



Nitzschia grossepunctata Schrader, 1976, p. 633, pl. 3, figs. 3, 4; Gersonde and Burckle, 1990, pl. 2, fig. 36; Harwood and Maruyama, 1992, pl. 10, fig. 2 (no illustration).

Nitzschia januaria Schrader, 1976, p. 634, pl. 2, figs. 25–29; Ciesielski 1986, pl. 3, fig. 5; Baldauf and Barron, 1991, pl. 5, fig. 10 (Pl. **P4,** fig. 18).

Nitzschia marina Grunow sensu Baldauf; Baldauf and Barron, 1991, pl. 7, fig. 11 (Pl. **P2,** fig. 17a, 17b).

Nitzschia pliocena (Brun) Mertz, 1966; Akiba, 1986, p. 443, pl. 23, figs. 6–9 (Pl. **P2,** fig. 7; cf. fig. 8).

Nitzschia pusilla Schrader, 1976; Gersonde and Burckle, 1990, pl. 2, figs. 17–19 (Pl. **P28,** fig. 9).

Nitzschia reinholdii Kanaya ex Schrader, 1973b; Akiba, 1986, pl. 22, figs. 4–5; Gersonde and Burckle, 1990, pl. 2, fig. 1 (Pl. **P28,** fig. 13).

Nitzschia sp. 17 sensu Harwood and Maruyama, 1992, pl. 7, fig. 16.
Remarks: This taxon should be included in the *N. interfrigidaria* coarse punctation form. This group is considered to be an intermediate form between *N. interfrigidaria* s.s. and *N. weaveri,* as mentioned in remarks of *N. interfrigidaria* coarse punctation form (no illustration).

Nitzschia sp. A sensu Gersonde, 1991 (Pl. **P3,** fig. 8).

Nitzschia spp. (Pl. **P3,** figs. 5, 9; Pl. **P4,** figs. 4, 9–11, 14–17).

Odontella spp. (not determined to species level).

Paralia sulcata (Ehrenberg) Cleve, 1873; Sancetta, 1982, p. 235, pl. 3, figs. 13–15.
Synonym: *Melosira sulcata* (Ehrenberg) Kützing; Hustedt, 1930, p. 276, fig. 119 (Pl. **P8,** fig. 7; Pl. **P25,** fig. 17; Pl. **P29,** fig. 9; Pl. **P32,** fig. 2).

Porosira pseudodenticulata (Hustedt) Jousé; Scherer, 1991, pl. III, fig. 5.
Synonym: *Thalassiosira* sp. 9 of Schrader, 1976, pl. 13, fig. 4a, 4b, pl. 15, figs. 11, 12 (no illustration).

Porosira spp. (not determined to species level) (Pl. **P29,** fig. 11; Pl. **P30,** figs. 5a, 5b, 10a, 10b).

Porosira? spp. (not determined to species level) (Pl. **P18,** figs. 3a–3c, 9).

Proboscia alata (Brightwell) Sündstrom; Harwood and Maruyama, 1992, pl. 18, figs. 15, 17).
Synonym: *Rhizosolenia alata* Brightwell, 1858; Schrader, 1976, pl. 9, fig. 10; Akiba, 1986, pl. 18, fig. 6; Tanimura, 1992, figs. 3–16; *Rhizosolenia alata* f. *inermis* (Castracane) Hustedt; Akiba, 1982, pl. 7, fig. 5 (Pl. **P5,** fig. 21).

Proboscia barboi (Brun) Jordan and Priddle, 1991, p. 56; Gersonde and Bárcena, 1998, p. 93.
Synonym: *Rhizosolenia barboi* (Brun) Tempère and Peragallo; McCollum, 1975, pl. 11, fig. 13; *Simonseniella barboi* (Brun) Fenner; Harwood and Maruyama, 1992, pl. 11, fig. 13 (no illustration).

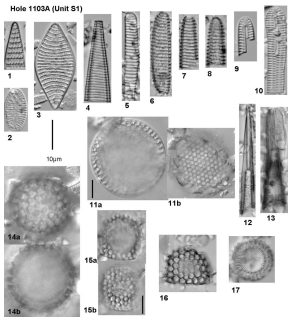
Proboscia praebarboi (Schrader) Jordan and Priddle, 1991, p. 56.
Synonym: *Rhizosolenia praebarboi* Schrader; Schrader, 1976, pl. 9, fig. 14; *Rhizosolenia barboi* Brun; Schrader, 1976, pl. 9, fig. 13 (Pl. **P5,** fig. 23).

Rhabdonema spp. (not determined to species level) (Pl. **P6,** figs. 18, 22).

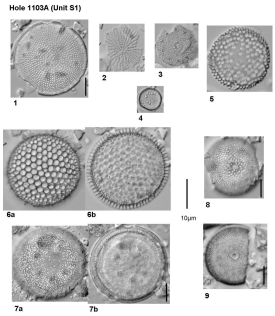
Rhizosolenia costata Gersonde, 1991, p. 149–150, pl. 9, figs. 1–6, pl. 10, figs. 1–6; Gersonde and Burckle, 1990, pl. 3, fig. 6; Harwood and Maruyama, 1992, pl. 18, figs. 1, 2 (Pl. **P7,** fig. 11).

Rhizosolenia costata var. A of Harwood and Maruyama, 1992, p. 705, pl. 18, figs. 3, 4 (Pl. **P7,** fig. 10).

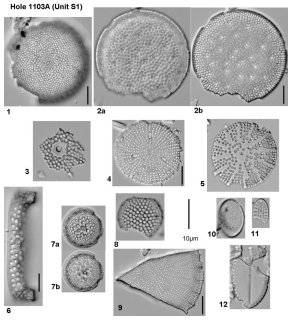
P25. Diatoms from shelf Site 1103, p. 49.



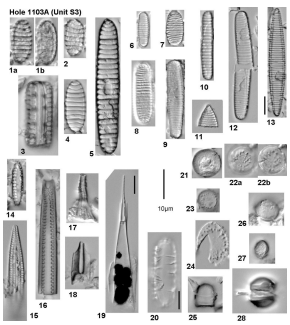
P26. Diatoms from shelf sites: *Actinocyclus* and *Thalassiosira,* p. 50.



P27. Diatoms from Sample 178-1103A-23R-CC, p. 51.



P28. Diatoms from rise Sites 1097 and 1103, p. 52.



Rhizosolenia hebetata f. *hiemalris* Gran.; Schrader, 1976, pl. 9, fig. 3; Baldauf and Barron, 1991, pl. 7, fig. 7 (Pl. **P7,** figs. 4, 5; Pl. **P25,** fig. 12; Pl. **P32,** fig. 4).

Rhizosolenia sp. aff. *R. hebetata* f. *bidens* Heiden.

Remarks: Similar to *Rhizosolenia hebetata* f. *bidens* Heiden (Fenner et al., 1976, p. 778, pl. 13, fig. 8; Akiba, 1982, pl. 7, fig. 20) by its twin apical structures. However, the apical portion of this species is strongly silicified like that of *Rhizosolenia* sp. D of Harwood and Maruyama (1992), although *R. hebetata* f. *bidens* has smoother apical spines (Pl. **P7,** fig. 9).

Rhizosolenia minima Schrader, 1976, p. 635, pl. 15, figs. 1–3; Akiba, 1982, pl. 7, fig. 6 (Pl. **P7,** fig. 7).

Rhizosolenia setigera Brightwell 1858; Akiba, 1986, pl. 18, fig. 5 (Pl. **P7,** fig. 6; Pl. **P32,** fig. 5).

Rhizosolenia styliformis Brightwell 1858; Schrader, 1976, pl. 9, fig. 4; Fenner, et al., 1976, p. 779, pl. 13, figs. 3–5, 9; Akiba, 1982, pl. 7, figs. 3, 4 (Pl. **P7,** figs. 1–3; Pl. **P28,** figs. 18, 19).

Rhizosolenia sp. C of Harwood and Maruyama, 1992, pl. 18, figs. 5, 6 (Pl. **P25,** fig. 13).

Rhizosolenia sp. D of Harwood and Maruyama, 1992, p. 705, pl. 18, figs. 7–10 (Pl. **P7,** fig. 8).

Rouxia californica Peragallo; Akiba, 1982, pl. 8, figs. 9, 10; Baldauf and Barron, 1991, pl., fig. 6 (Pl. **P5,** figs. 13, 14; Pl. **P28,** fig. 15).

Rouxia diploneides Schrader; McCollum, 1975, pl. 11, figs. 11, 12; Harwood and Maruyama, 1992, pl. 17, fig. 12 (Pl. **P5,** fig. 8).

Rouxia heteropolara Gombos, 1974; Gersonde and Burckle, 1990, pl. 5, fig. 2 (no illustration).

Rouxia heteropolara var. A of Harwood and Maruyama, 1992, p. 706, pl. 17, figs. 14–17 (no illustration).

Rouxia isopolica Schrader, 1976, p. 635, pl. 5, figs. 14, 15; Akiba, 1982, pl. 8, figs. 1–7 (Pl. **P5,** fig. 9).

Rouxia naviculoides Schrader, 1976, pl. 5, fig. 13; Gersonde and Burckle, 1990, pl. 4, fig. 16 (Pl. **P5,** figs. 1, 2).

Rouxia peragalli Brun and Héribaud; McCollum, 1975, pl. 12, figs. 1, 2; Baldauf and Barron, 1991, pl. 5, figs. 7, 8 (Pl. **P5,** figs. 3–7).

Rouxia sp. 2 of Gersonde and Burckle, 1990, pl. 5, fig. 3 (no illustration).

Schimperiella antarctica Karsten, 1905; Fenner et al., 1976, p. 779, pl. 14, figs. 1–5; Akiba, 1982, pl. 3, figs. 1–6; Koizumi, 1982, pl. 3, figs. 1–4; Tanimura, 1992, figs. 3–7a, b (Pl. **P23,** figs. 1, 2a, 2b).

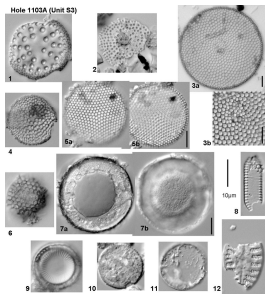
Stellarima spp. (not determined to species level).

Remarks: The species most probably observed in these samples is *Stellarima microtrias* (Ehrenberg) Hasle and Sims, 1986, which has the following synonym: *Coscinodiscus stellaris* var. *symbolophorus* (Grun.) Jörgensen, 1905; Hustedt, 1930, p. 396–398, fig. 208; McCollum, 1975, pl. 6, figs. 1–3; *Coscinodiscus symbolophorus* group 3 of Schrader, 1976, pl. 7, fig. 3; *Coscinodiscus symbolophorus* group 4 of Schrader, 1976, pl. 10 fig. 1 (Pl. **P10,** figs. 4a–4c; Pl. **P14,** fig. 3; Pl. **P23,** figs. 3, 4; Pl. **P24,** fig. 5a, 5b; Pl. **P31,** figs. 4a–4c).

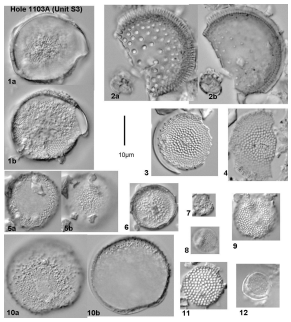
Stephanogonia spp. (not determined to species level).

Remarks: Some specimens can be identified as *Stephanogonia hanzawae* Kanaya, 1959, p. 118, pl. 11, figs. 3–7; McCollum, 1975, pl. 12, fig. 6 (Pl. **P8,** figs. 3, 4).

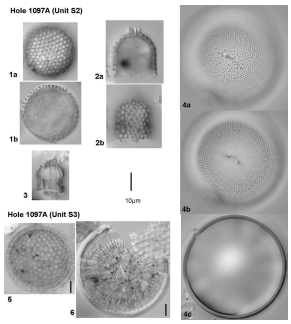
P29. Diatoms from rise site, Hole 1103A, p. 53.



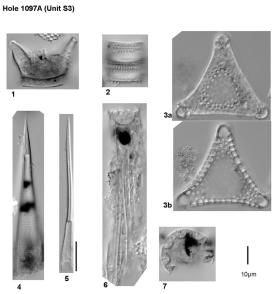
P30. Diatoms from rise Site 1103, p. 54.



P31. Diatoms from rise sites: *Stephanopyxis* and others, p. 55.



P32. Diatoms from Sample 178-1097A-34R-CC, p. 56.



Stephanopyxis barbadiensis (Greville) Grunow, 1884; McCollum, 1975, pl. 12, figs. 1–14 (= *Stephanopyxis turris* [Greville et Arnott] Ralfs Group of Harwood, 1986) (Pl. **P9,** fig. 1).

Stephanopyxis turris (Greville and Arnott) Ralfs in Pritchard, 1861, p. 826, pl. 5, fig. 74; Gombos, 1977, pl. 2, fig. 5; Sancetta, 1982, pl. 4, figs. 9–10; Akiba, 1982, pl. 1, fig. 9 (Pl. **P31,** fig. 2a, 2b).

Stephanopyxis superba (Greville) Grunow; Gombos, 1977, pl. 29, figs. 1–4; Harwood, 1989, pl. 2, figs. 14–20, 26 (Pl. **P9,** fig. 3a–3c).

Stephanopyxis grunowii Grove and Sturt in Schmidt et al., 1874–1959; Gombos, 1977, pl. 32, figs. 1–3; *Stephanopyxis* sp. 2.83 (St. "turris" of Schrader, 1976, pl. 13, fig. 7) (Pl. **P9,** fig. 2a, 2b).

Stephanopyxis sp. (Pl. **P9,** fig. 4a–4c).

Stictodiscus spp. (not determined to species level).

Remarks: Including *Stictodiscus hardmanianus* Greville, 1865; McCollum, 1975, pl. 13, figs. 1–4 (no illustration).

Synedra spp. (not determined to species level) (Pl. **P5,** fig. 17).

Thalassionema nitzschioides (Grunow) H.&M. Peragallo; Hasle and Mendiola, 1967, p. 111–112, figs. 5, 11–17, 27–34, 39–44; Akiba, 1982, pl. 8, figs. 15–18 (Pl. **P5,** fig. 18).

Thalassionema nitzschioides var. *parvum* Heiden; Hasle, 2001, figs. 4, 26 (Pl. **P5,** figs. 15, 16).

Thalassionema frauenfeldii (Grunow) Hallegraeff, 1986, p. 62, figs. 54–67; Hasle, 2001, p. 22–25, figs. 54–67.

Synonym: *Thalassiothrix frauenfeldii* (Grunow) Grunow in Cleve and Grunow; Schrader, 1976, pl. 1, figs. 7–10 (Pl. **P5,** fig. 20).

Thalassiosira antarctica Comber, 1896; Fryxell et al., 1981, figs. 1–33; Akiba, 1982, pl. 4, figs. 5–6; Krebs, 1983, pl. 5, fig. 4a–4f.

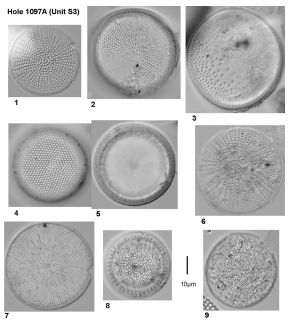
Synonym: *Thalassiosira* resting spore 1 of Gersonde, 1984, pl. 1, fig. 10 (Pl. **P24,** fig. 1a, 1b).

Thalassiosira baldaufii Bodén, 1993, p. 68, pl. 1, figs. R–V, pl. 2, figs. A–G, pl. 4, fig. A (Pl. **P17,** figs. 3, 11?).

Thalassiosira complicata Gersonde, 1991, p. 150–151, pl. 3, figs. 1, 2, pl. 5, figs. 18–20, pl. 6, figs. 1–6, pl. 7, figs. 1–5; Gersonde and Burckle, 1990, pl. 4, figs. 1, 2; Harwood and Maruyama, 1992, pl. 14, figs. 18–20.

Remarks: Valve disk-shaped, diameter = 17–30 µm, with small central depression. A ring of strutted processes, spaced 2–4 in 10 µm. Marginal strutted processes are regularly spaced, 5–6 in 10 µm (average = 2-µm interval). Gersonde (1991) remarked "*T. complicata* has some affinities to *T. opposita* Koizumi," which was described from upper Miocene sediments in the northwest Pacific Ocean (Koizumi, 1980, p. 39, pl. 1, figs. 15–17), "in the arrangement of areolae and the marginal and median rings of strutted processes." *T. opposita* differs by the presence of two central opposite processes that are surrounded by large and conspicuous areolae. A set of opposed central fultoportulae in the central hyaline field has been recognized by recent scanning electron microscope (SEM) observation (Shiono and Koizumi, pers. comm., 2000). *T. complicata* "early form" of Harwood and Maruyama (1992, pl. 14, fig. 21) is distinguished from *T. complicata* s.s. by the lack of middle processes and may be structurally close to *T. jacksonii*. *T. plicata* Schrader (1974) (Koizumi, 1980, pl. 3, figs. 22–25; = *Thalassiosira* cf. *jacksonii* of Akiba, 1986, p. 446, pl. 11, figs. 1, 5; *Thalassiosira* sp. E sensu Akiba, 1986, pl. 11, figs. 3, 4) is also similar to *T. complicata* by its arrangement of areolae and the ring of strutted processes in the middle of valve face. *T. complicata,* in general, is distinguished by a central hyaline area. However, it is not easy to distinguish completely between *T. complicata* and *T. plicata*

P33. Diatoms from rise Site 1097, p. 57.



with the optical microscope. Future SEM observation is required (Pl. **P11,** figs. 1–9; Pl. **P12,** fig. 1; cf. Pl. **P26,** fig. 3).

Thalassiosira elliptopora (Donahue) Fenner, 1991, p. 108, pl. 1, fig. 3, pl. 3, fig. 2; Harwood and Maruyama, 1992, p. 707, pl. 16, fig. 12.

Synonym: *Coscinodiscus elliptopora* Donahue, 1970; Gombos, 1977, p. 592, pl. 3, figs. 1–3, 6, pl. 9, fig. 3 (no illustration).

Thalassiosira fasciculata Harwood and Maruyama, 1992, p. 707, pl. 15, figs. 4–6 (no illustration).

Thalassiosira gersondei Barron in Baldauf and Barron, 1991, p. 585, pl. 2, figs. 1, 2, pl. 3, figs. 1, 3, 5, 6, pl. 5, fig. 4 (Pl. **P22,** figs. 6 (cf.) 7a, 7b).

Thalassiosira gracilis (Karsten) Hustedt, 1958; McCollum, 1975, pl. 14, fig. 3; Fenner et al., 1976, pl. 9, figs. 12–20; Akiba, 1982, pl. 4, figs. 11–12; Koizumi, 1982, pl. 2, figs. 4, 5; Gersonde, 1984, pl. 1, fig. 9; Tanimura, 1992, p. 409, figs. 3-3, 3-4, 3-5, 3-6 (Pl. **P24,** figs. 2a, 2b).

Thalassiosira sp. cf. *T. gracilis* (Pl. **P12,** figs. 4a, 4b).

Thalassiosira gravida Cleve, 1896; Fenner et al., 1976, p. 780, pl. 8, fig. 5; Akiba, 1986, p. 445, pl. 10, figs. 1–4 (no illustration).

Thalassiosira insigna (Jousé) Harwood and Maruyama, 1992, p. 707, pl. 14, figs. 3–5.

Synonym: *Cosmiodiscus insignis* Jousé, 1959; McCollum, 1975, pl. 8, fig. 5; Gombos, 1977, p. 593, pl. 4, fig. 4; Harwood, 1983, fig. 2.16 (= Webb et al., 1984, fig. 2.2) (no illustration).

Thalassiosira inura Gersonde, 1991, p. 151, pl. 6, figs. 7–14; pl. 8, figs. 1–6; Gersonde and Burckle, 1990, pl. 3, figs. 16, 17, pl. 5, fig. 14.

Remarks: Gersonde (1991) distinguished *T. inura* from *T. jacksonii* Koizumi and Barron in Koizumi (1980; p. 396, pl. 1, figs. 11–14) by its stronger areolation and by the absence of a strutted process located in the hyaline central area. However, according to the SEM observation of the type material of *T. jacksonii* by Shiono and Koizumi (pers. comm., 2000), a porelike structure of *T. jacksonii,* described as "a strutted process" in Koizumi (1980), is considered to be a central depression. The most distinguishable character should be the difference in density of marginal strutted processes (3–4 in 10 µm for *T. inura* [Gersonde, 1991] and 10–16 in 10 µm for *T. jacksonii* [Shiono and Koizumi, pers. comm., 2000]). Harwood and Maruyama (1992) noted the existence of *T. inura* in the uppermost Miocene sediments in Hole 747A. However, their *T. inura* Miocene form (Harwood and Maruyama, 1992, pl. 5, fig. 14) can be identified as *T. jacksonii*. The earliest appearance of *T. inura* in the Southern Ocean may be taxonomically confused with *T. jacksonii* (as already mentioned in Harwood and Maruyama, 1992) and other related species (Pl. **P12,** figs. 2, 3; Pl. **P26,** figs. 8, 9; Pl. **P27,** fig. 3).

Thalassiosira sp. 1 aff. *T. inura*.

Remarks: Diameter is almost always <10 µm. *Thalassiosira* sp. cf. *T. jacksonii* used during the Leg 178 cruise (Barker, Camerlenghi, Acton, et al., 1998) includes this taxon (Pl. **P12,** figs. 5, 6).

Thalassiosira sp. 2 aff. *T. inura*.

Remarks: This may include the species that has been previously described as *Coscinodiscus symbolophorus* group 4 of Schrader (1976, pl. 10, fig. 1) and *C. symbolophorus Grunow* v. *oamaruensis* Schmidt (Hajös, 1976, pl. 6, figs. 1, 2) (Pl. **P13,** fig. 1–4).

Thalassiosira kolbei (Jousé) Gersonde, 1990, p. 793, pl. 1, fig. 2, pl. 5, figs. 3, 5, 6; Gersonde and Burckle, 1990, pl. 3, fig. 1.

Synonym: *Coscinodiscus kolbei* Jousé, 1962; McCollum, 1975, pl. 4, figs. 7–9 (no illustration).

Thalassiosira sp. cf. *T. lambimarginata* Bodén, 1993, p. 68, pl. 1, figs. L–Q (Pl. **P16,** fig. 13); *Thalassiosira lentiginosa* (Janisch) Fryxell, 1977, p. 100; Harwood and Maruyama, 1992, p. 707, pl. 19, fig. 15; Tanimura, 1992, p. 409, figs. 3-1, 3-9; 5-1, 5-2.

Synonym: *Coscinodiscus lentiginosus* Janisch in Schmidt, 1878; McCollum, 1975, pl. 5, fig. 1; Fenner et al., 1976, pl. 7, figs. 4–6; Gombos, 1977, p. 593; pl. 3, figs. 5, 6; Akiba, 1982, pl. 2, figs. 1–5; Koizumi, 1982, pl. 2, figs. 7, 8; Harwood, 1983, fig. 2.18 (= Webb et al., 1984, fig. 2.1) (Pl. **P20,** figs. 1, 4; Pl. **P24,** fig. 4).

Thalassiosira lentiginosa var. *ovalis* (Castracane) Fryxell, 1977, p. 100; Harwood and Maruyama, 1992, p. 707.

Synonym: *Coscinodiscus obovatus* Castracane 1886; McCollum, 1975, pl. 5, fig. 6; *Coscinodiscus lentiginosus* f. *obovatus* Ciesielski, 1983, pl. 4, figs. 6–8 (Pl. **P20,** fig. 2).

Thalassiosira mahoodii Barron in Baldauf and Barron, 1991, p. 585, pl. 2, figs. 3–5, pl. 3, figs. 2, 4, pl. 4, figs. 1–5 (Pl. **P15,** fig. 2).

Thalassiosira sp. aff. *T. marujanica* Sheshukova-Poretzkaya sensu Akiba, 1986, p. 446, pl. 6, figs. 5–7 (Pl. **P18,** figs. 5, 6, 8?).

Thalassiosira sp. (Pl. **P8,** fig. 1).

Thalassiosira nativa Sheshukova-Poretzkaya, 1959, p. 41, pl. 1, fig. 8, pl. 4, fig. 5; Schrader, 1976, pl. 12, figs. 8–11 (Pl. **P19,** figs. 9, 10).

Thalassiosira oestrupii (Ostenfeld) Proshkina-Lavrenko, 1949; Akiba, 1982, pl. 4, figs. 2, 8–10; Koizumi, 1982, pl. 2, figs. 1–3; Gersonde and Burckle, 1990, pl. 3, figs. 13, 14 (Pl. **P16,** figs. 9a, 9b, 10).

Thalassiosira sp. aff. *T. oestrupii* (Pl. **P26,** figs. 6a, 6b).

Thalassiosira oliverana (O'Meara) Makarova and Nikolaev, 1984; Scherer, 1991, pl. III, fig. 6; Harwood and Maruyama, 1992, pl. 14, figs. 1, 2, 6 (Pl. **P14,** figs. 1, 2; Pl. **P33,** fig. 8, cf. Pl. **P14,** fig. 5).

Thalassiosira aff. *oliverana* (Pl. **P14,** fig. 10).

Thalassiosira oliverana var. *sparsa* Harwood and Maruyama, 1992, p. 708, pl. 16, fig. 13; Scherer, 1991, pl. II, fig. 9.

Synonym: *Cosmiodiscus intersectus* (Brun) Jousé; McCollum, 1975, pl. 8, fig. 4; Baldauf and Barron, 1991, pl. 6, figs. 3, 6; *Coscinodiscus insignis* Brady; Harwood, 1986, pl. 8, figs. 4, 6 (Pl. **P26,** fig. 4, cf. figs. 6, 7; Pl. **P33,** fig. 9).

Thalassiosira sp. aff. *T. oliverana* var. *sparsa* (Pl. **P14,** fig. 3).

Thalassiosira oliverana–T. inura group (Pl. **P12,** figs. 7–10).

Thalassiosira praenidulus Akiba, 1986, p. 440, pl. 5, fig. 7, pl. 6, figs. 1–3 (Pl. **P19,** fig. 7).

Thalassiosira striata Harwood and Maruyama, 1992, p. 708, pl. 15, figs. 7–9 (Pl. **P15,** fig. 4; Pl. **P27,** figs. 2a, 2b).

Thalassiosira tetraoestrupii Bodén, 1993, p. 63–67, pl. 1, figs. A–G (Pl. **P16,** figs. 1–8).

Thalassiosira torokina Brady, 1977, p. 122–123, figs. 1–5; Ciesielski, 1983, pl. 7, figs. 3–6; Harwood, 1983, fig. 2.17 (= Webb et al., 1984, fig. 2.6); Harwood, 1986, pl. 8, figs. 2–3; Scherer, 1991, pl. II, fig. 4.

Synonym: *Coscinodiscus excentricus* Ehrenberg; Hirano, 1983, pl. 8, fig. 4.

Remarks: Gersonde and Burckle (1990) included affinities to *Thalassiosira majuramica* Sheshukova-Poretzkaya and *T. torokina* into *T. majuramica–torokina* group for their analysis on Leg 113 materials (Pl. **P10,** figs. 1a, 1b; Pl. **P15,** figs. 6a–6c, 7a, 7b; Pl. **P24,** fig. 6).

Thalassiosira aff. *trifulta* group.

Remarks: This taxon is dominant in the upper Miocene section at Site 1095. No similar species has been reported from any previous DSDP or ODP sites in the Southern Ocean. Future detailed study is needed (Pl. **P19,** figs. 1–6, 8; Pl. **P30,** figs. 3, 4, 9).

Thalassiosira vulnifica (Gombos) Fenner, 1991; Harwood and Maruyama, 1992, pl. 15, fig. 1.

Synonym: *Coscinodiscus vulnificus* Gombos, 1977, p. 593, pl. 4, figs. 1–3; pl. 42, figs. 1, 2; Ciesielski, 1983, pl. 6, figs. 7, 8; Harwood, 1983, fig. 2.2 (= Webb et al., 1984, fig. 2.5); *Coscinodiscus* sp. 2 of McCollum, 1975, pl. 8, figs. 1, 2 (Pl. **P15,** fig. 1; Pl. **P27,** fig. 4).

Thalassiosira spp. (not determined to species level) (Pl. **P14,** fig. 11a, 11b; Pl. **P16,** fig. 14a, 14b; Pl. **P17,** figs. 21, 22; Pl. **P18,** figs. 1a, 1b, 2a, 2b, 4, 7, 8a, 8b; Pl. **P26,** fig. 4; Pl. **P30,** figs. 8, 11, 12).

Thalassiothrix antarctica Schimper ex Karsten, 1905, p. 124, pl. 17, fig. 12; Hasle and Syvertsen, 1990, pl. 17.1, figs. 46; Hasle, 2001, p. 39–40, figs. 104–106, 113–118.

Synonym: *Thalassiothrix longissima* sensu Schrader, 1976, pl. 1, figs. 5, 6, 17 (Pl. **P5,** fig. 19; Pl. **P24,** fig. 9; Pl. **P28,** fig. 16).

Thalassiothrix spp.

Remarks: Including *Thalassiothrix longissima* Cleve and Grunow; Akiba, 1982, pl. 8, fig. 19; Harwood and Maruyama, 1992, pl. 11, fig. 12; Hasle, 2001, p. 35–39, figs. 101–103, 107–112 (no illustration).

Trinacria spp. (not determined to species level).

Remarks: Including *Trinacria excavata* Heiberg, 1863; Schrader, 1976, pl. 14, fig. 15; Akiba, 1982, pl. 6, fig. 13 (Pl. **P32,** figs. 3a, 3b).

Gen. et sp. indet. B of Harwood et al., 2000, figs. 9s, 9t (Pl. **P6,** fig. 8).

Gen. et sp. indet. (Pl. **P5,** fig. 24; Pl. **P8,** fig. 2a, 2b).

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Figure F1. Locality of Leg 178 sites.

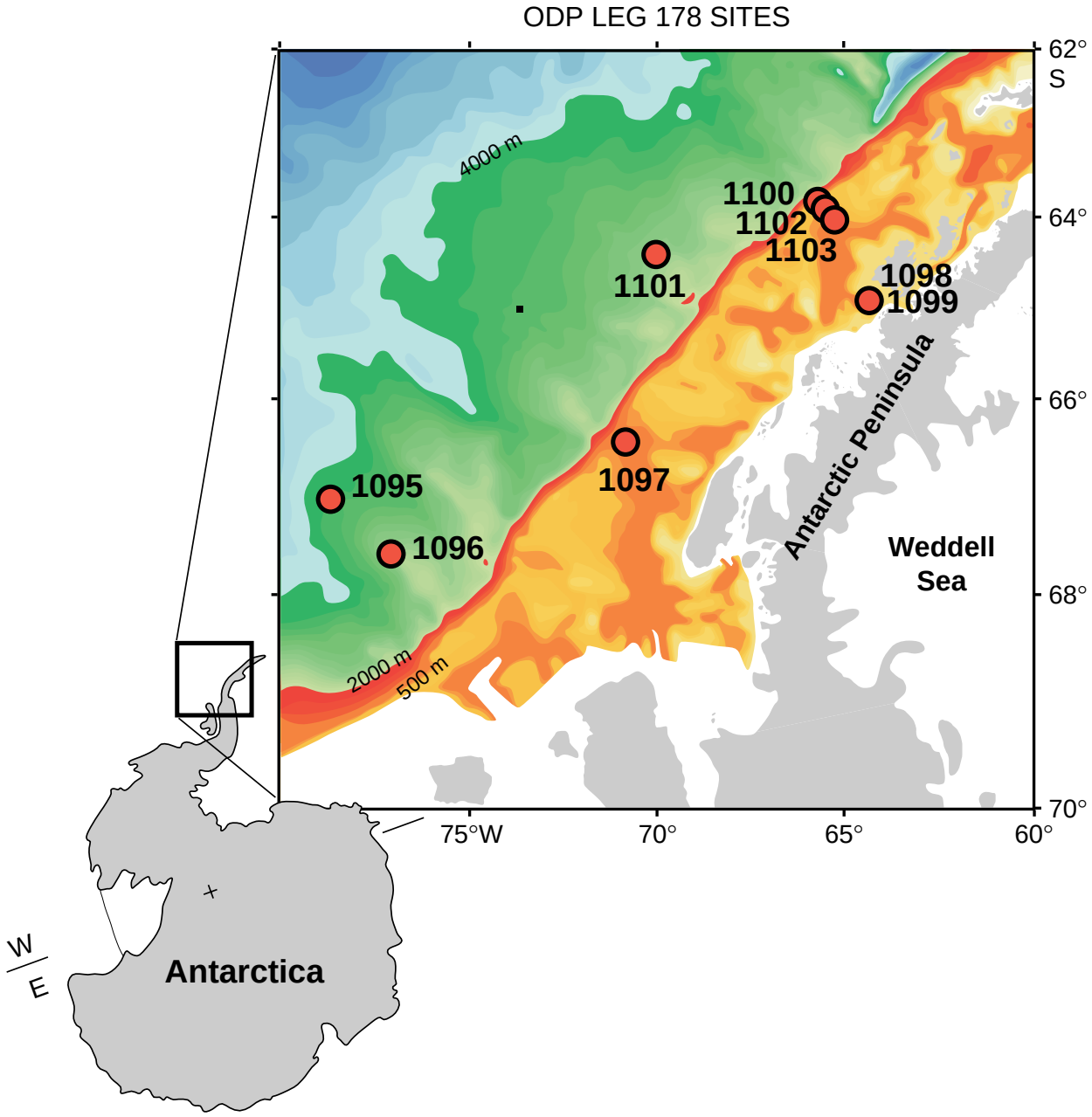

Table T1. Summary of holes cored during Leg 178.

Hole	Latitude	Longitude	Water Depth (m)
1095A	66°59.1′S	78°29.2′W	3841.6
1095B	66°59.1′S	78°29.3′W	3841.6
1095C	66°59.1′S	78°29.3′W	3841.6
1095D	67°34.0′S	78°29.3′W	3840.9
1096A	67°34.0′S	76°57.8′W	3152.0
1096B	67°34.0′S	76°57.8′W	3152.5
1096C	67°34.0′S	76°57.8′W	3152.5
1097A	66°23.6′S	70°45.4′W	551.7
1098A	64°51.7′S	64°12.5′W	1012.0
1098B	64°51.7′S	64°12.5′W	1010.6
1098C	64°51.7′S	64°12.5′W	1010.4
1099A	64°56.7′S	64°18.9′W	1399.8
1099B	64°56.7′S	64°18.9′W	1399.8
1100A	63°53.0′S	65°42.3′W	458.6
1100B	63°53.0′S	65°42.3′W	458.6
1100C	63°53.0′S	65°42.4′W	458.6
1101A	64°22.3′S	70°15.7′W	3279.7
1102A	63°48.2′S	65°51.5′W	430.5
1102B	63°48.2′S	65°51.5′W	430.5
1102C	63°48.1′S	65°51.5′W	430.5
1102D	63°48.1′S	65°51.4′W	430.5
1103A	63°60.0′S	65°27.9′W	493.5

Table T2. Stratigraphic occurrence of diatom species at Site 1097. This table is available in an **oversized format**.

Table T3. Stratigraphic occurrence of diatom species, Site 1100.

Seismic Unit	Diatom Zone	Observer	Depth (mbsf)	Core, section, interval (cm)	Slide preparation	Abundance of diatom fragments	Abundance of diatom frustules	Preservation	Planktonic diatoms:	*Actinocyclus karstenii*	*Azpeitia tabularis*	*Chaetoceros* spp. (resting spores)	*Coscinodiscus oculus-iridus*	*Eucampia antarctica*	*Fragilariopsis kerguelensis*	*Paralia sulcata*	*Rhizosolenia* spp.	*Stellarim* spp.	*Thalassiosira antarctica*	*Thalassiosira lentiginosa*	*Thalassiosira oestrupii*	*Thalassiosira oliverana*	*Thalassiosira striata*	*Thalassiosira torokina*	*Thalassiosira* spp.	*Thalassiothrix antarctica*	*Thalassionema and Thalassiothrix* fragments	Benthic diatoms:	*Cocconeis* spp.	Total diatoms counted	Remarks
S1		MI	4.00	178-1100C-1R-CC	H_2O_2	R	R	P				2	1		3		+		2	1		1		1	1		+		+	12	
	T. lentignosa Zone	DW	0.11	178-1100D-1R-CC	Smear	C	R	P						+	F																
		DW	14.68	2R-CC	Smear	F	R	P							1																
		MI	14.68	2R-CC	H_2O_2	R	R	P			+			10	6		3	1	23	1	1	2	1		3	0.5				51.5	
		DW	24.58	3R-CC	Smear	F	R	P		+					R	+						+		3							
		DW	33.94	4R-CC	Smear	F	B	P																							
		MI	33.94	4R-CC	H_2O_2	R	R	P						2	?+	1	+			+		1		+			+		+	4	
		DW	44.68	5R-CC	Smear	R	B	P																							
		DW	54.63	6R-CC	Smear	B	B	-																							
		MI	54.63	6R-CC	H_2O_2	B	B	-																							
		DW	62.76	7R-CC	Smear	B	B	-																							Mud on rock surface
		MI	76.97	9R-CC	Smear	B	B	-																							
	Barren	MI	76.97	9R-CC	H_2O_2	B	B	-																							
		MI	82.03	10R-CC	Smear	B	B	-																							Mud on rock surface
		MI	82.03	10R-CC	H_2O_2	B	B	-																							Mud on rock surface
		MI	91.55	11R-CC	Smear	B	B	-																							
		MI	100.90	12R-1, 0-5	H_2O_2	+	B	-																							
		MI	101.44	12R-CC	Smear	B	B	-																							Mud on rock surface

Note: Smear slides and hydrogen peroxide–processed slides were used. Abundance: A = abundant, C = common, F = few, R = rare, + = present, B = barren. Preservation: G = good, M = moderate, P = poor.

Table T4. Stratigraphic occurrence of diatom species at Site 1103. This table is available in an **oversized format**.

Plate P1. Diatoms from rise site: *Denticulopsis* and *Crucidenticula*. **1–6.** *Denticulopsis simonsenii (*Sample 178-1095B-45X-1, 41–42 cm). (1, 2a, 2b, 3a, 3b) valve view, (4) girdle view, (5) open copula, (6a, 6b) initial cell. **7, 8.** *Denticulopsis vulgaris*. (7a, 7b) Sample 178-1095B-30X-6, 25–26 cm, (8a, 8b) Sample 178-1095B-43X-2, 64–65 cm. **9, 13, 14.** *Denticulopsis hustedtii*. (9a, 9b) Sample 178-1095B-43X-2, 64–65 cm, (13a, 13b, 14a, 14b) Sample 178-1095B-45X-1, 41–42 cm. **10.** *Denticulopsis praehyalina* (Sample 178-1095B-10H-2, 60–61 cm). **11, 12.** *Crucidenticula* sp. cf. *Crucidenticula* var. *pacifica*. (11) Sample 178-1095B-12H-5, 30–31 cm, (12a, 12b) Sample 178-1095-36X-2, 52–54 cm. **15–18.** *Denticulopsis crassa*. (15a, 15b) valve view (Sample 178-1095B-43X-2, 64–65 cm), (16–18) closed copula (Sample 178-1095B-45X-1, 41–42 cm). **19.** *Denticulopsis dimorpha* var. *areolata,* closed copula (Sample 178-1095B-9H-4, 105–106 cm). **20.** *Denticulopsis ovata,* closed copula (Sample 178-1095B-21X-4, 128–130 cm).

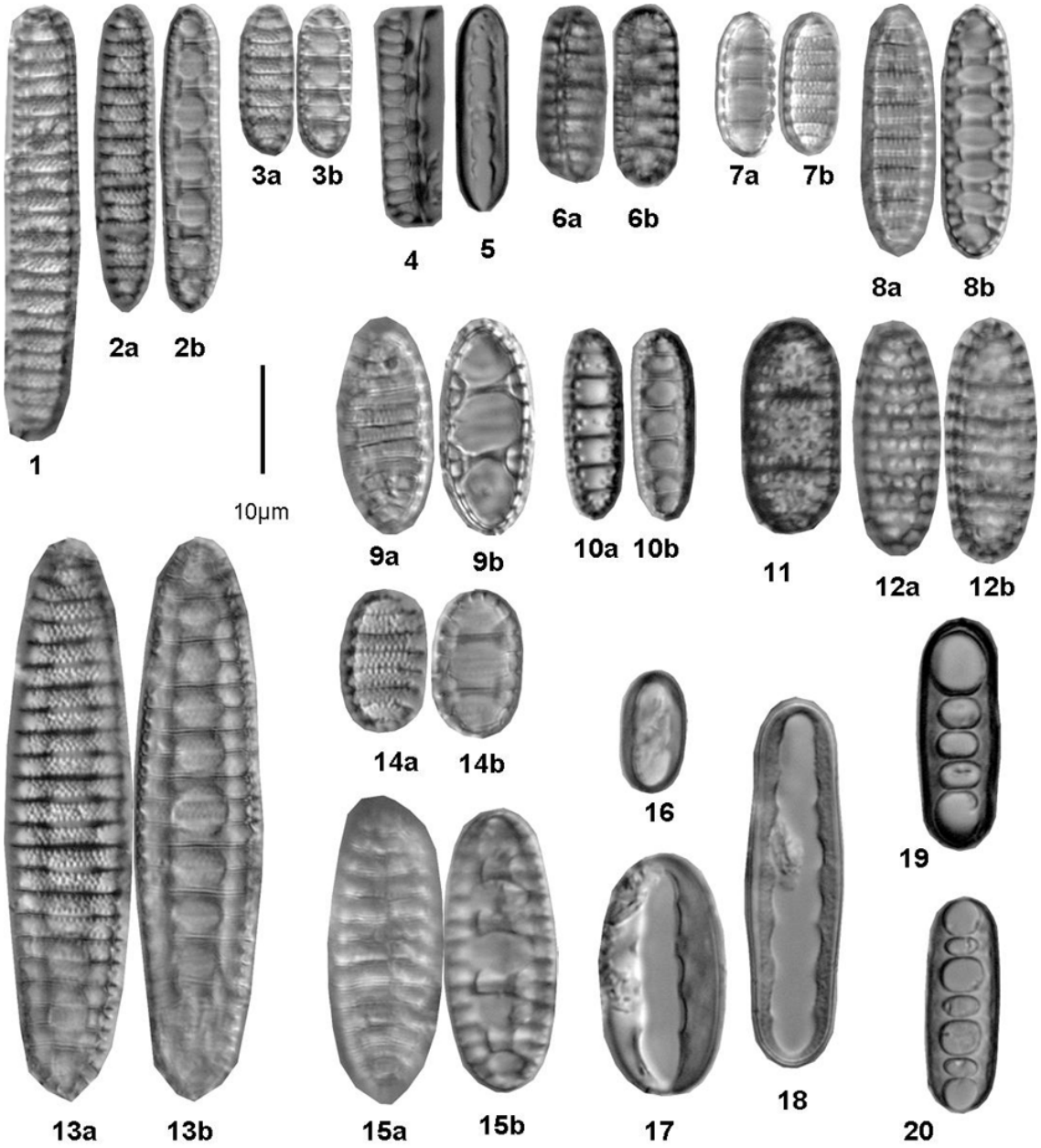

Plate P2. Diatoms from rise site: *Denticulopsis* and *Nitzschia*. **1–4.** *Denticulopsis* sp. cf. *Denticulopsis delicata*. (1a, 1b, 2a, 2b) Sample 178-1095B-45X-1, 41–42 cm, (3a, 3b) Sample 178-1095B-43X-2, 64–65 cm, (4) girdle view (Sample 178-1095B-7H-3, 35–36 cm). **5, 6.** *Nitzschia cylindrica*. (5) Sample 178-1095B-21X-2, 59–61 cm, (6) Sample 178-1095B-28X-5, 88–89 cm. **7.** *Nitzschia pliocena* (Sample 178-1095B-15X-2, 59–61 cm). **8.** *Nitzschia* sp. cf. *Nitzschia pliocena* (Sample 178-1095B-27X-5, 55–56 cm). **9–16.** *Denticulopsis delicata*. (9) Sample 178-1095B-12H-4, 41–42 cm, (10, 12) Sample 178-1095B-43X-2, 64–65 cm, (11) girdle view (Sample 178-1095B-43X-2, 64–65 cm), (13, 14) Sample 178-1095B-45X-1, 41–42 cm, (15, 16) Sample 178-1095B-15X-2, 59–61 cm. **17.** *Nitzschia* cf. *Nitzschia marina* (Sample 178-1095B-27X-5, 55–56 cm).

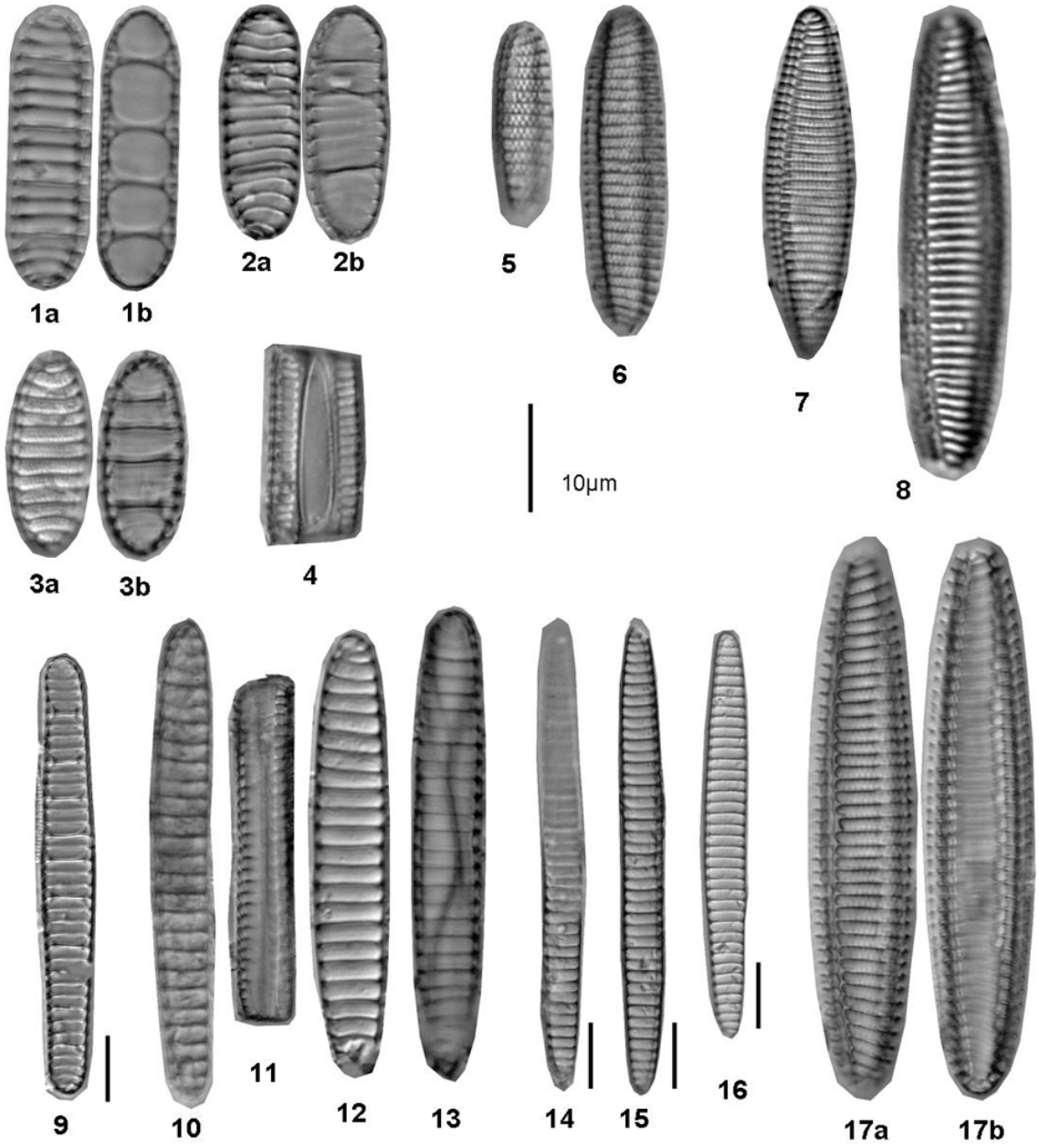

Plate P3. Diatoms from rise site: *Fragilariopsis, Nitzschia,* and *Denticulopsis*. **1–3.** *Fragilariopsis kerguelensis*. (1) Sample 178-1095A-1H-2, 78–79 cm. **4.** *Fragilariopsis* sp. aff. *Fragilariopsis kerguelensis* (Sample 178-1095A-8H-6, 24–25 cm). **5.** *Nitzschia* spp. (Sample 178-1095B-5H-3, 120–121 cm). **6.** *Nitzschia angulata* (Sample 178-1095A-1H-2, 78–79 cm). **7.** *Fragilariopsis* sp. aff. *Fragilariopsis barronii* (Sample 178-1095B-5H-3, 120–122 cm). **8.** *Nitzschia* sp. A sensu Gersonde, 1991 (Sample 178-1095B-3H-1, 37–38 cm). **9.** *Nitzschia* spp. (Sample 178-1095B-10H-4, 60–61 cm). **10.** *Denticulopsis maccollumii* (Sample 178-1095B-13H-4, 120–121 cm). **11, 12.** *Fragilariopsis* cf. *Fragilariopsis praeinterfrigidaria* (Sample 178-1095B-11H-4, 116–117 cm). **13–15.** *Fragilariopsis praeinterfrigidaria*. (13) Sample 178-1095B-3H-1, 37–38 cm, (14–15) Sample 178-1095A-10H-7, 14.5–15.5 cm. **16.** *Fragilariopsis interfrigidaria* s.s. (Sample 178-1095A-10H-7, 14.5–15.5 cm). **17.** *Fragilariopsis interfrigidaria* (coarse punctation) (Sample 178-1095B-2H-2, 57–58 cm). **18–20.** *Fragilariopsis weaveri*. (18) Sample 178-1095A-10H-7, 14.5–15.5 cm, (19) Sample 178-1095B-28X-5, 88–89 cm, (20) Sample 178-1095B-27X-5, 55–56 cm.

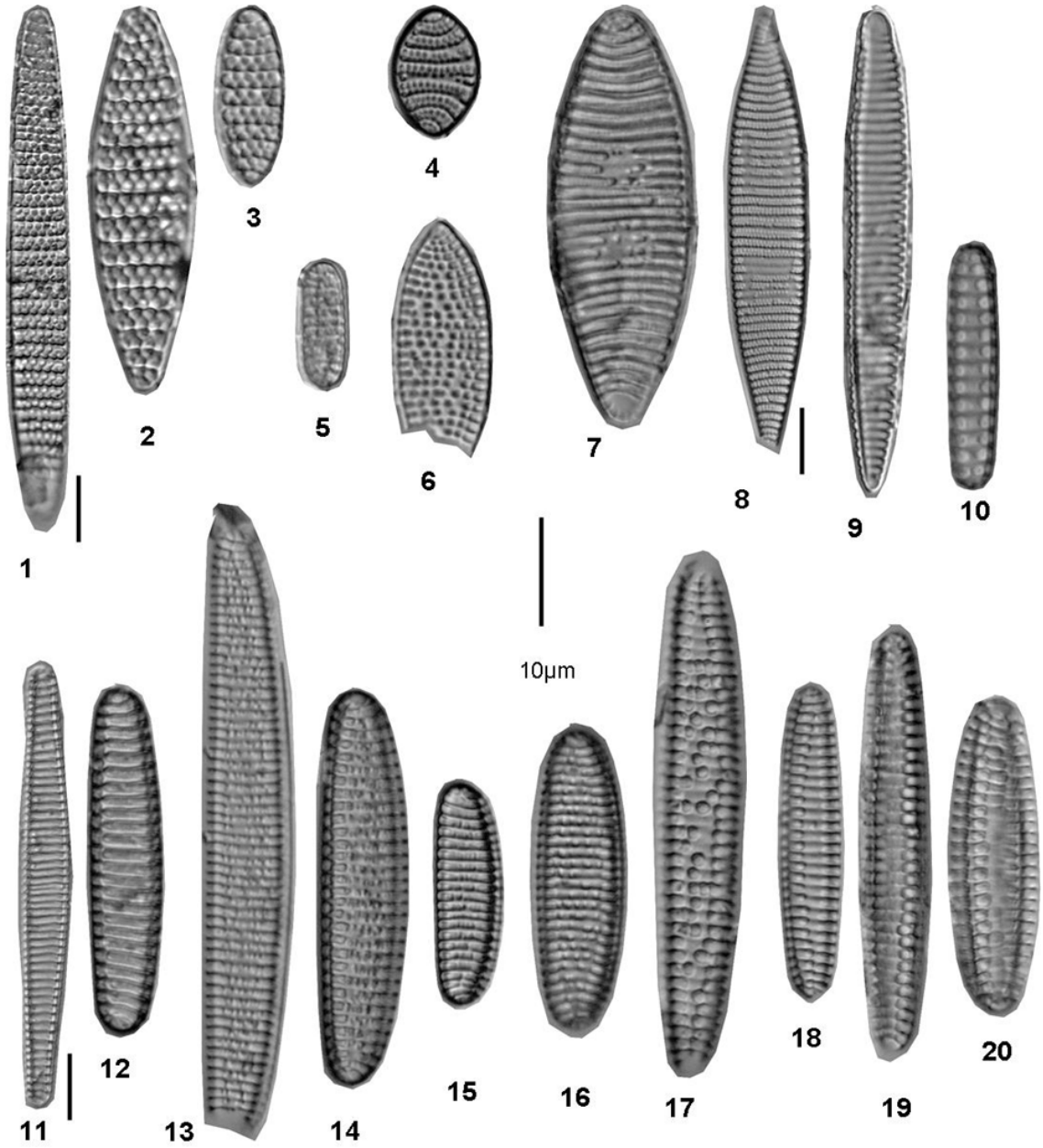

Plate P4. Diatoms from rise site: *Nitzschia* and *Fragilariopsis*. **1, 2.** *Nitzschia clementia*. (1) Sample 178-1095B-28X-5, 88–89 cm, (2) Sample 178-1095B-15X-2, 59–61 cm. **3.** *Fragilariopsis lacrima* (Sample 178-1095B-7H-3, 35–36 cm). **4.** *Nitzschia* spp. (Sample 178-1095B-45X-1, 41–42 cm). **5–7.** *Fragilariopsis pseudonana*. (5) Sample 178-1095B-29X-5, 117–119 cm, (6, 7) Sample 178-1095B-28X-5, 88–89 cm. **8.** *Nitzschia* cf. *Fragilariopsis arcula* (Sample 178-1095B-21X-4, 128–130 cm). **9–11.** *Nitzschia* spp. (9) Sample 178-1095B-7H-3, 35–36 cm, (10) Sample 178-1095B-36X-4, 8–10 cm, (11) Sample 1095B-33X-1, 43–44 cm. **12, 13.** *Fragilariopsis* sp. aff. *Fragilariopsis barronii* 2 (Sample 178-1095B-5H-3, 120–122 cm). **14–17.** *Nitzschia* spp. (14) Sample 178-1095B-45X-1, 41–42 cm, (15) Sample 178-1095B-29X-5, 117–119 cm, (16) Sample 178-1095B-9H-4, 105–106 cm, (17) Sample 178-1095B-4H-6, 75–76 cm. **18.** *Nitzschia januaria* (Sample 178-1095B-29X-5, 117–119 cm). **19–23.** *Fragilariopsis praecurta*. (19) Sample 178-1095B-42X-6, 115–116 cm, (20, 21) Sample 178-1095B-28X-5, 88–89 cm, (22) Sample 178-1095B-18X-6, 28–29 cm, (23) Sample 178-1095B-12H-5, 30–31 cm. **24.** *Fragilariopsis* cf. *Fragilariopsis praecurta* (Sample 178-1095B-9H-4, 105–106 cm). **25–28.** *Fragilariopsis aurica*. (25) Sample 178-1095B-9H-4, 105–106 cm, (26) Sample 178-1095B-7H-3, 35–36 cm, (27) Sample 178-1095B-8H-5, 75–76, (28) Sample 178-1095B-13H-4, 120–121 cm.

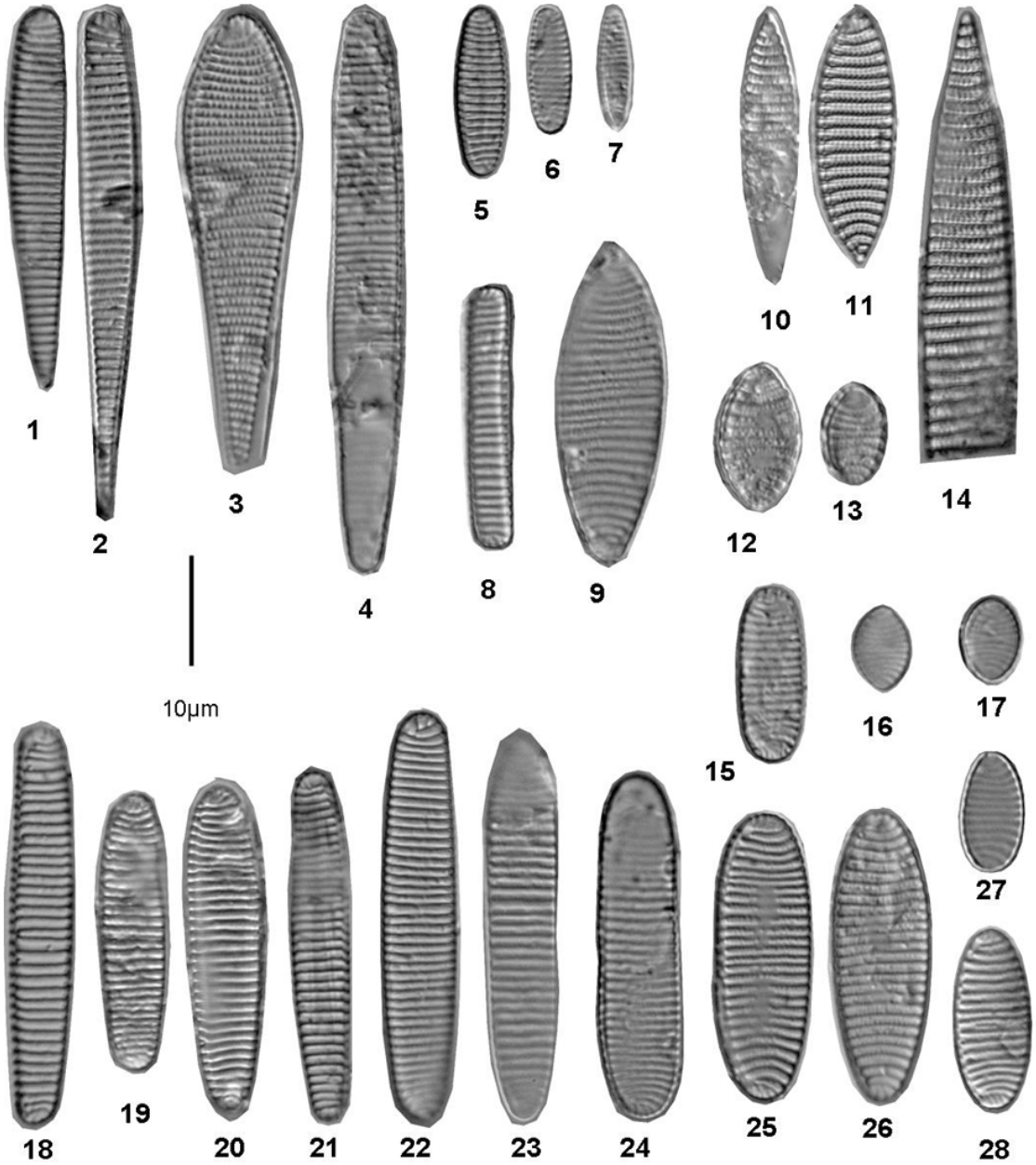

Plate P5. Diatoms from rise site: *Rouxia* and others. **1, 2.** *Rouxia naviculoides*. (1) Sample 178-1095B-13H-4, 120–121 cm, (2) Sample 178-1095B-30X-6, 25–26 cm. **3–7.** *Rouxia peragalli*. (3) Sample 178-1095B-12H-4, 41–42 cm, (4) Sample 178-1095B-13H-4, 120–121 cm. (5) Sample 178-1095B-7H-3, 35–36 cm, (6, 7) Sample 178-1095B-14H-3, 65–66 cm. **8.** *Rouxia diploneides* (Sample 178-1095B-9H-4, 105–106 cm). **9.** *Rouxia isopolica* (Sample 178-1095B-12H-4, 41–42 cm). **10, 11.** *Rouxia heteropolara* var. A of Harwood and Maruyama, 1992 (Sample 178-1095B-29X-5, 117–119 cm). **12.** *Rouxia naviculoides*? (Sample 178-1095B-30X-6, 25–26 cm) (244). **13, 14.** *Rouxia californica*. (13) Sample 178-1095B-23X-1, 65–66 cm, (14) Sample 178-1095B-30X-6, 25–26 cm. **15, 16.** *Thalassionema nitzschioides* var. *parvum*. (15) Sample 178-1095B-36X-4, 8–10 cm, (16) Sample 178-1095B-37X-3, 136–137 cm. **17.** *Synedra*? sp. (Sample 178-1095B-39X-6, 65–66 cm). **18.** *Thalassionema nitzschioides* (Sample 178-1095B-9H-4, 105–106 cm). **19.** *Thalassiothrix antarctica* (Sample 178-1095B-45X-1, 41–42 cm). **20.** *Thalassiothrix frauenfeldii* (Sample 178-1095B-45X-1, 41–42 cm). **21.** *Proboscia alata* (Sample 178-1095B-42X-6, 115–116 cm). **22.** *Chaetoceros* sp. A of Harwood and Maruyama, 1992 (spine) (Sample 178-1095B-45X-1, 41–42 cm). **23.** *Proboscia praebarboi* (Sample 178-1095B-9H-4, 105–106 cm). **24.** Gen. et sp. indet. 317 (Sample 178-1095B-29X-5, 117–119 cm).

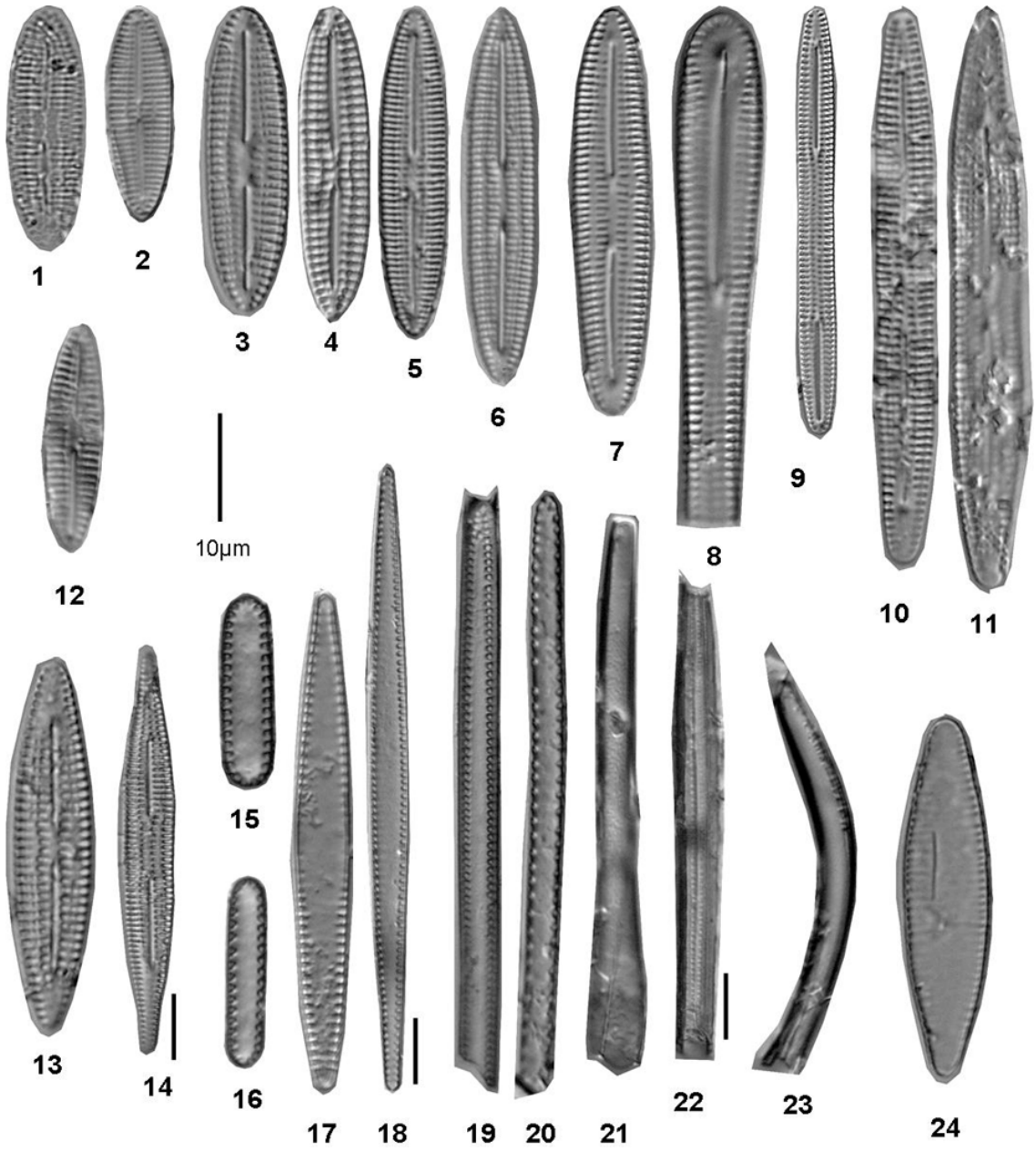

Plate P6. Diatoms from rise site: *Cocconeis* and others. **1–4.** *Grammatophora* sp. (1) Sample 178-1095B-17X-5, 31–33 cm, (2) Sample 178-1095B-32X-1, 129–131 cm, (3) Sample 178-1095B-28X-5, 88–89 cm, (4) girdle view (Sample 178-1095B-23X-2, 118–119 cm). **5.** *Achnanthes* sp. (Sample 178-1095B-34X-1, 44–45 cm). **6, 7.** *Amphora* sp. (6) Sample 178-1095B-23X-1, 65–66 cm, (7) Sample 178-1095B-34X-1, 44–45 cm. **8.** Gen. et sp. indet. B of Harwood et al., 2000 (Sample 178-1095B-29X-5, 117–119 cm). **9, 10.** *Delphineis* spp. (9) Sample 178-1095B-28X-5, 88–89 cm, (10) Sample 178-1095B-29X-5, 117–119 cm. **11.** *Cocconeis californica* (Sample 178-1095B-5H-4, 120–121 cm). **12.** *Cocconeis* sp. cf. *Cocconeis californica* (Sample 178-1095B-40X-5, 126–129 cm). **13, 14.** *Cocconeis* sp. (13) Sample 178-1095B-41X-6, 71–72 cm, (14) Sample 178-1095B-39X-6, 65–66 cm. **15, 19.** *Cocconeis* aff. *costata* (15) Sample 178-1095B-29X-5, 117–119 cm, (19) Sample 178-1095B-40X-5, 126–129 cm. **16.** *Cocconeis costata* (Sample 178-1095B-41X-6, 71–72 cm). **17.** *Diploneis* sp. (Sample 178-1095B-37X-3, 136–137 cm). **18, 21.** *Rhabdonema* spp. (18) Sample 178-1095B-39X-6, 65–66 cm, (21) Sample 178-1095B-41X-6, 71–72 cm. 19. *Cocconeis* aff. *fasciolata* (Sample 178-1095B-22X-1, 92–94 cm). **20.** *Cocconeis*? sp. (Sample 178-1095B-18X-6, 28–29 cm).

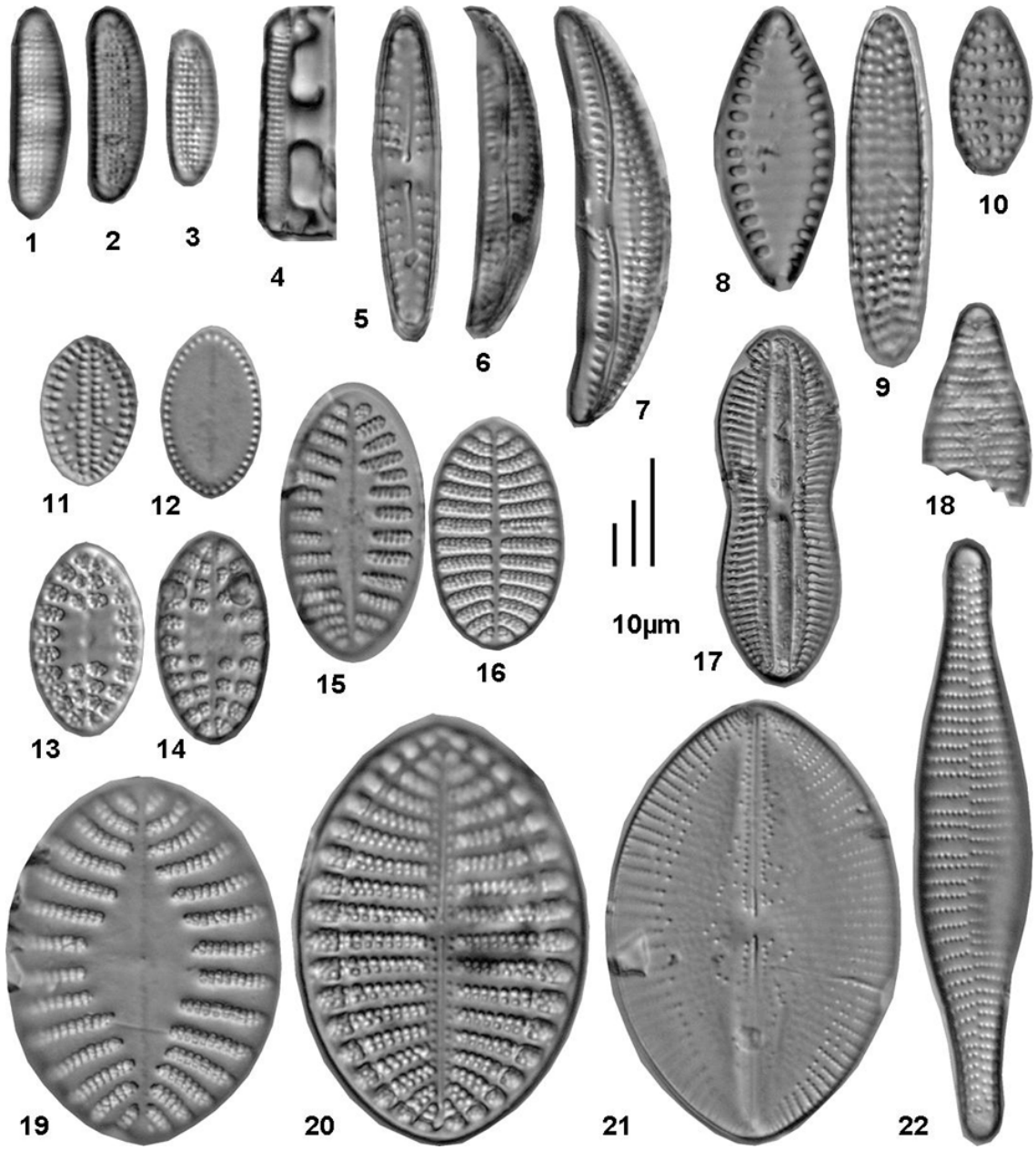

Plate P7. Diatoms from rise site: *Rhizosolenia* and others. **1–3.** *Rhizosolenia styliformis.* (1) good preservation (Sample 178-1095B-42X-6, 115–116 cm), (2) moderate preservation (Sample 178-1095B-45X-1, 41–42 cm), (3) poor preservation (Sample 178-1095B-15X-2, 59–61 cm). **4, 5.** *Rhizosolenia hebetata* f. *hiemalris.* (4) poor preservation (Sample 178-1095B-45X-1, 41–42 cm), (5) Sample 178-1095B-29X-5, 117–119 cm. **6.** *Rhizosolenia setigera* (Sample 178-1095B-45X-1, 41–42 cm). **7.** *Rhizosolenia minima* (Sample 178-1095B-43X-2, 64–65 cm). **8.** *Rhizosolenia* sp. D of Harwood and Maruyama, 1992 (Sample 178-1095B-45X-1, 41–42 cm). **9.** *Rhizosolenia* sp. aff. *Rhizosolenia hebetata* f. *bidens* (Sample 178-1095B-29X-5, 117–119 cm). **10.** *Rhizosolenia costata* var. A of Harwood and Maruyama, 1992 (Sample 178-1095B-15X-2, 59–61 cm). **11.** *Rhizosolenia costata* (Sample 178-1095B-7H-3, 35–36 cm). **12.** *Eucampia antarctica* (Sample 178-1095B-45X-1, 41–42 cm). **13.** *Corethron* sp., valve view (Sample 178-1095B-7H-3, 35–36 cm). **14.** *Dactyliosolen antarcticus* (Sample 178-1095B-7H-3, 35–36 cm).

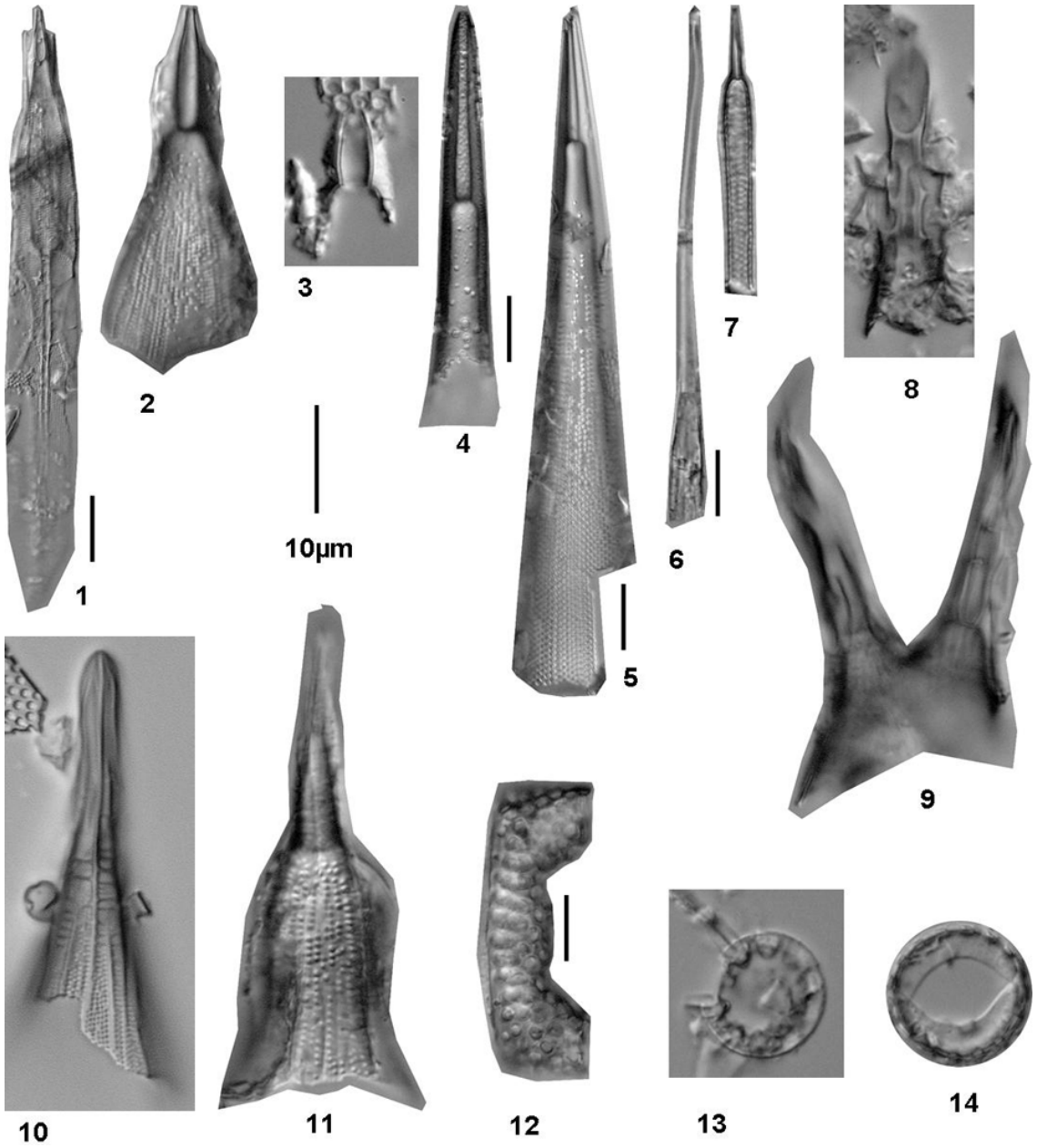

Plate P8. Diatoms from rise Site 1095. **1.** *Thalassiosira* sp. (Sample 178-1095B-6H-5, 40–41 cm). **2.** Gen. et sp. indet. (Sample 178-1095B-32X-1, 129–131 cm). **3, 4.** *Stephanogonia* spp. (3) Sample 178-1095B-8H-2, 74–75 cm, (4) Sample 178-1095B-8H-3, 5–6 cm. **5, 6.** *Melosira omma*. (5a, 5b) Sample 178-1095B-24X-1, 35–36 cm, (6a, 6b) Sample 178-1095B-11H-4, 116–117 cm. **7.** *Paralia sulcata* (Sample 178-1095B-22X-1, 92–94 cm). **8.** *Melosira*? sp. (Sample 178-1095A-1H-2, 78–79 cm).

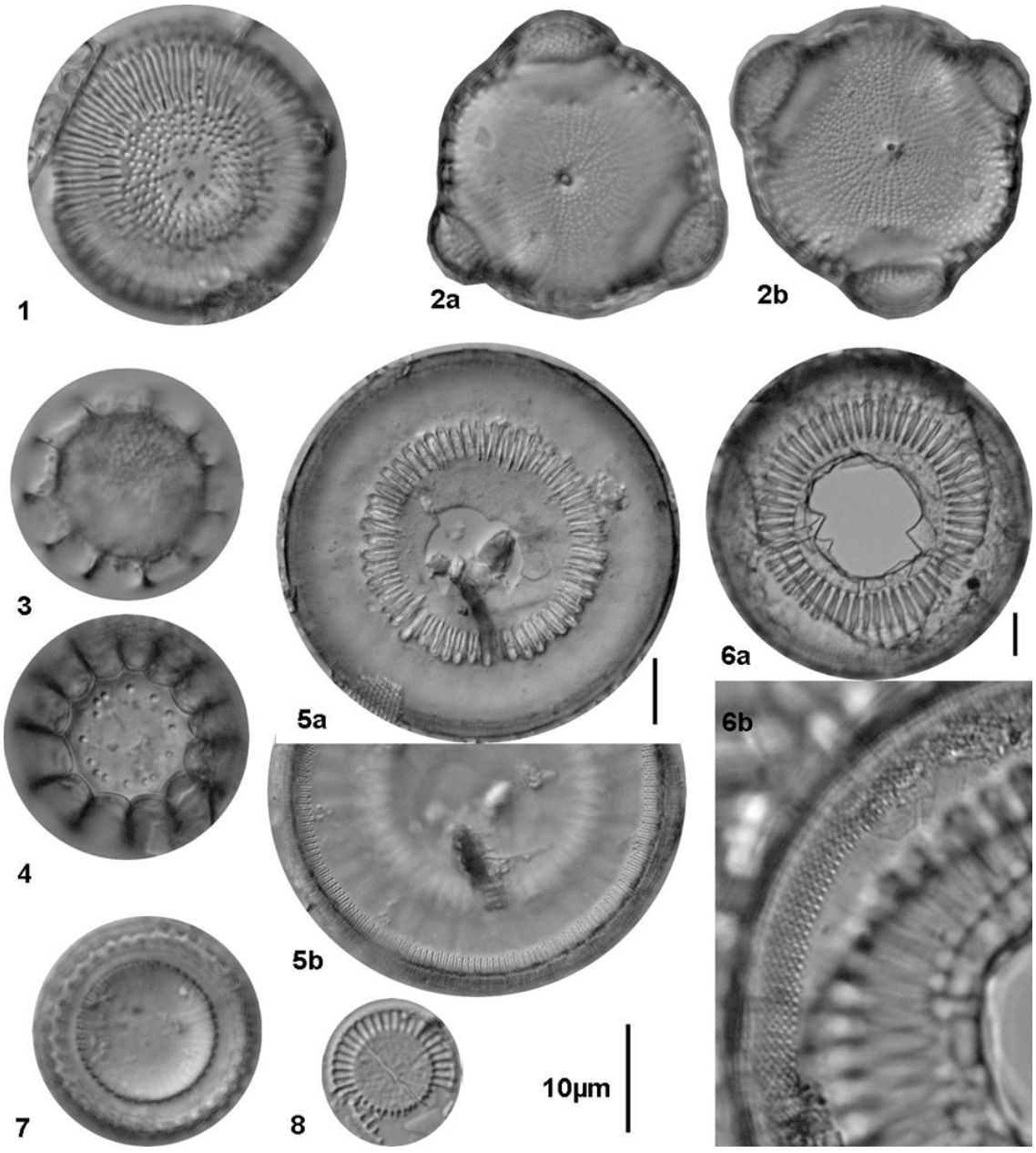

Plate P9. Diatoms from rise site: *Stephanopyxis*. **1.** *Stephanopyxis* spp. (Sample 178-1095B-3H-3, 108–109 cm). **2, 4.** *Stephanopyxis* spp. (Sample 178-1095B-9H-4, 105–106 cm). **3.** *Stephanopyxis superba* (Sample 178-1095A-10H-7, 14.5–15.5 cm).

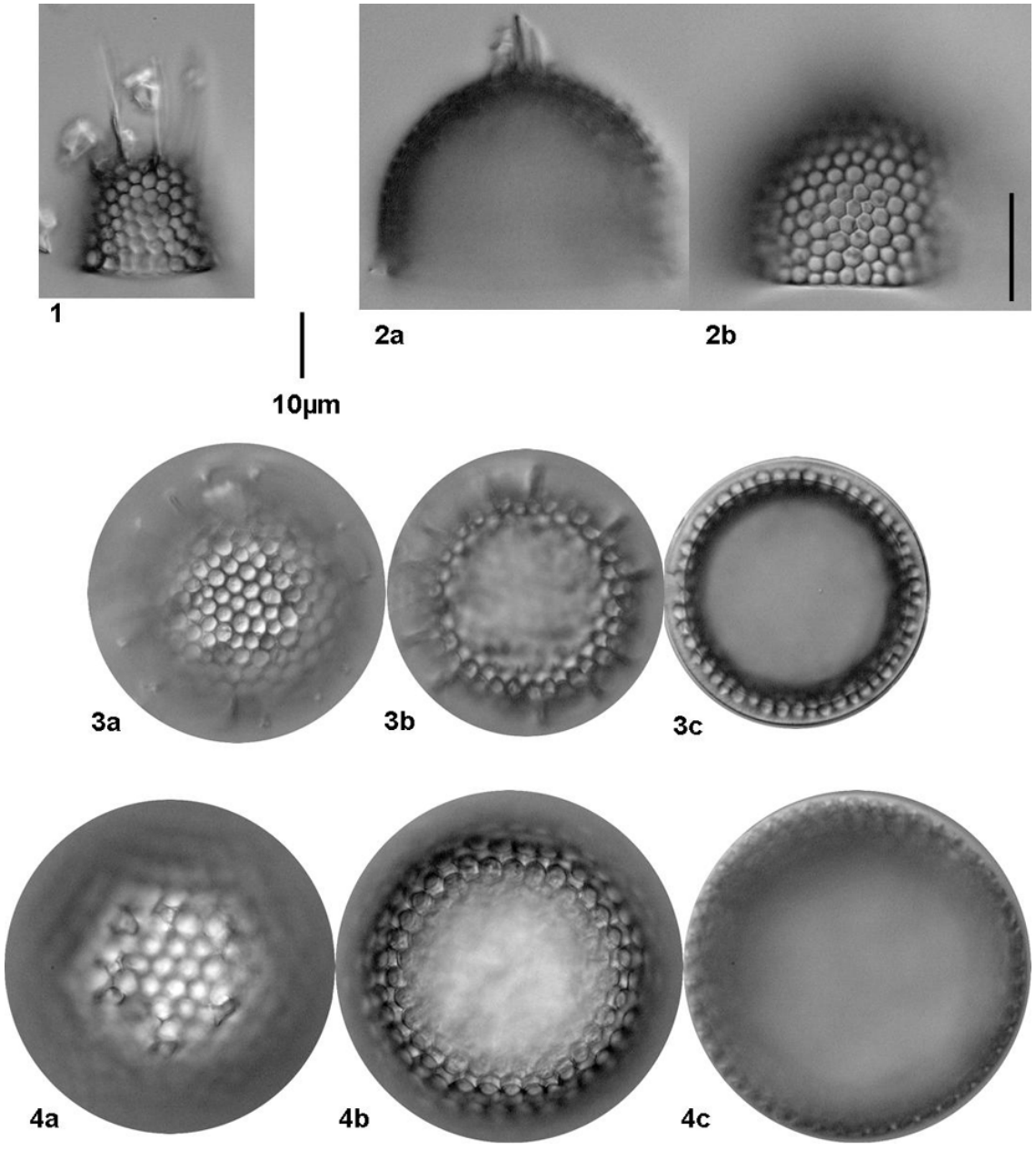

Plate P10. Diatoms from Hole 1095B. **1.** *Thalassiosira torokina* (Sample 178-1095B-8H-2, 74–75 cm). **2–4.** Sample 178-1095B-43X-2, 64–65 cm. (2) *Thalassiosira*? sp., (3) *Coscinodiscus*? sp., (4) *Stellarima microtrias*.

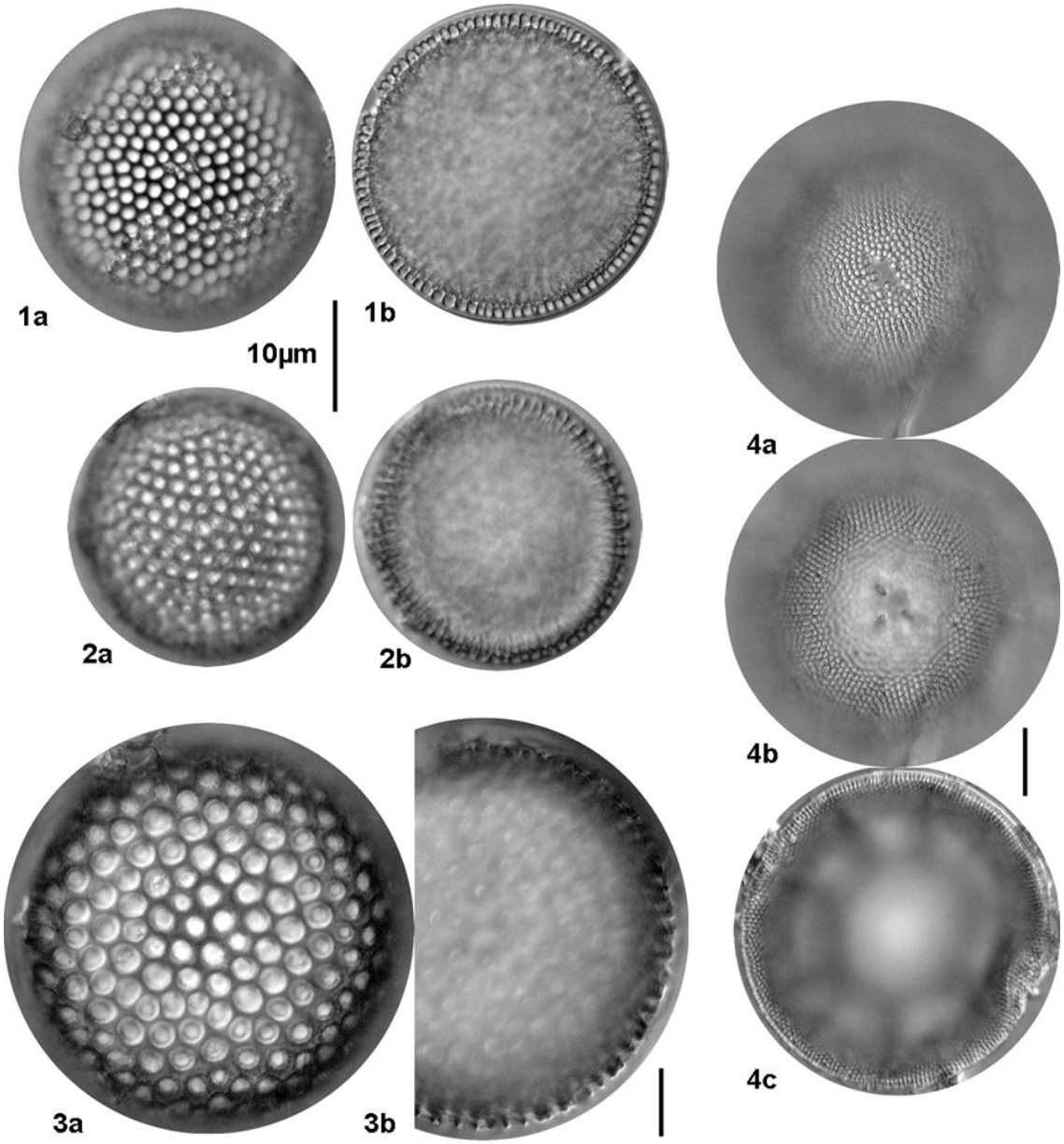

Plate P11. Diatoms from rise site: *Thalassiosira*. **1–4, 6–9.** *Thalassiosira complicata*. (1, 3a, 3b, 4a, 4b, 6a, 6b) Sample 178-1095A-10H-7, 14.5–15.5 cm, (2) Sample 178-1095B-8H-5, 75–76 cm, (7) valve with a girdle band (Sample 178-1095B-7H-3, 35–36 cm), (8) girdle band (Sample 178-1095B-7H-3, 35–36 cm), (9a, 9b) inner valve view (Sample 178-1095B-8H-1, 74–75 cm). **5.** *Thalassiosira* sp. cf. *Thalassiosira complicata* (Sample 178-1095B-5H-3, 120–122 cm).

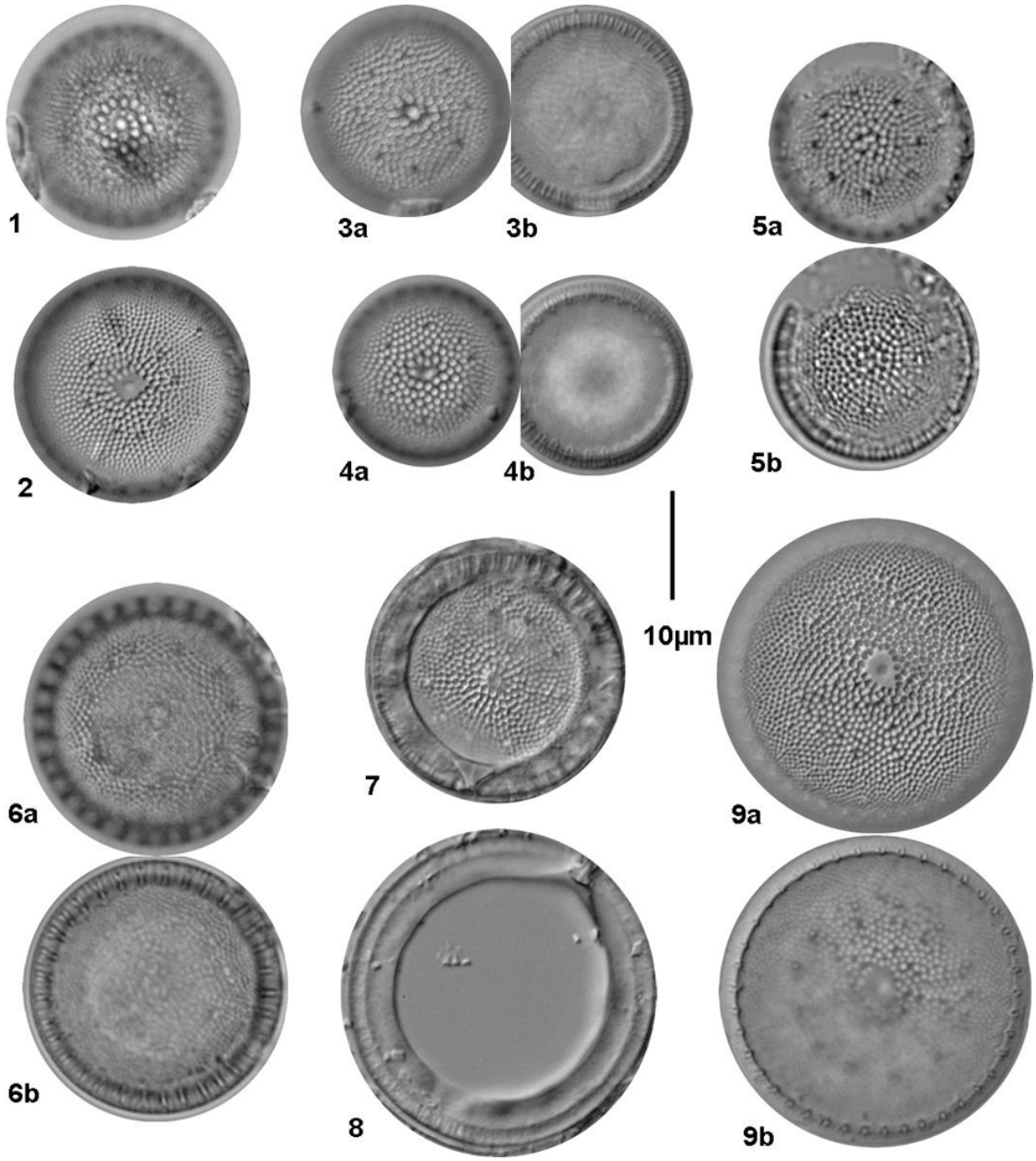

Plate P12. Diatoms from Site 1095: *Thalassiosira*. **1.** *Thalassiosira complicata* (Sample 178-1095B-3H-3, 108–109 cm). **2, 3.** *Thalassiosira inura* s.s. (2a–2c) Sample 178-1095A-10H-7, 14.5–15.5 cm, (3a, 3b) Sample 178-1095B-7H-3, 35–36 cm. **4.** *Thalassiosira* sp. cf. *Thalassiosira gracilis* (Sample 178-1095B-7H-3, 35–36 cm). **5, 6.** *Thalassiosira* sp. 1 aff. *Thalassiosira inura*. (5) Sample 178-1095B-10H-2, 60–61 cm, (6) Sample 178-1095B-7H-3, 35–36 cm. **7–10.** *Thalassiosira oliverana–Thalassiosira inura* group. (7a, 7b, 10a, 10b) Sample 178-1095B-7H-3, 35–36 cm, (8a, 8b) Sample 178-1095B-30X-6, 25–26 cm, (9) Sample 178-1095B-13H-4, 120–121 cm.

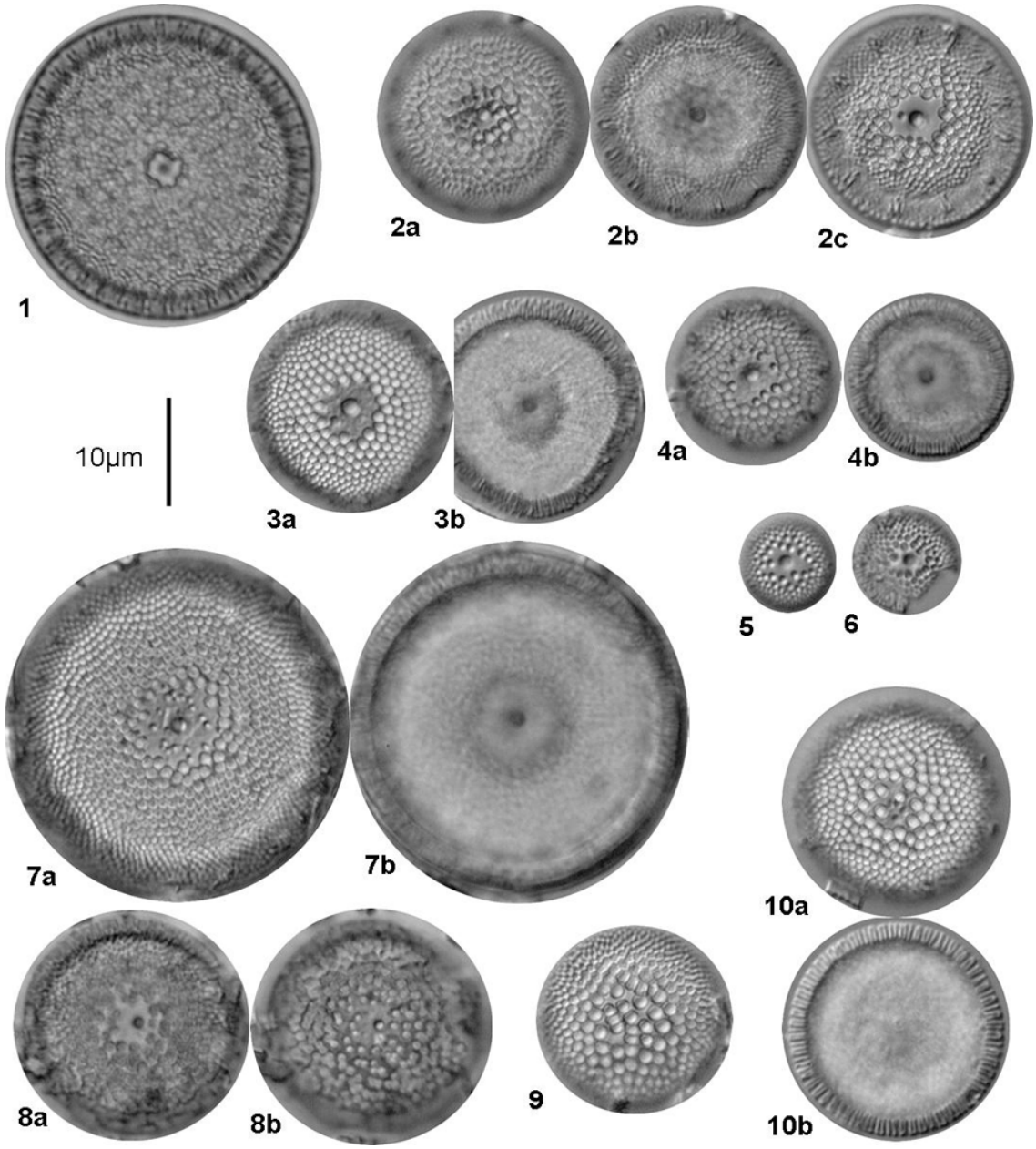

Plate P13. Diatoms from Hole 1095B: *Thalassiosira*. **1–4.** *Thalassiosira* sp. 2 aff. *Thalassiosira inura*. (1a, 1b) Sample 178-1095B-9H-4, 105–106 cm, (2a, 2b, 3a–3c) Sample 178-1095B-7H-3, 35–36 cm, (4a, 4b) Sample 178-1095B-2H-2, 57–58 cm.

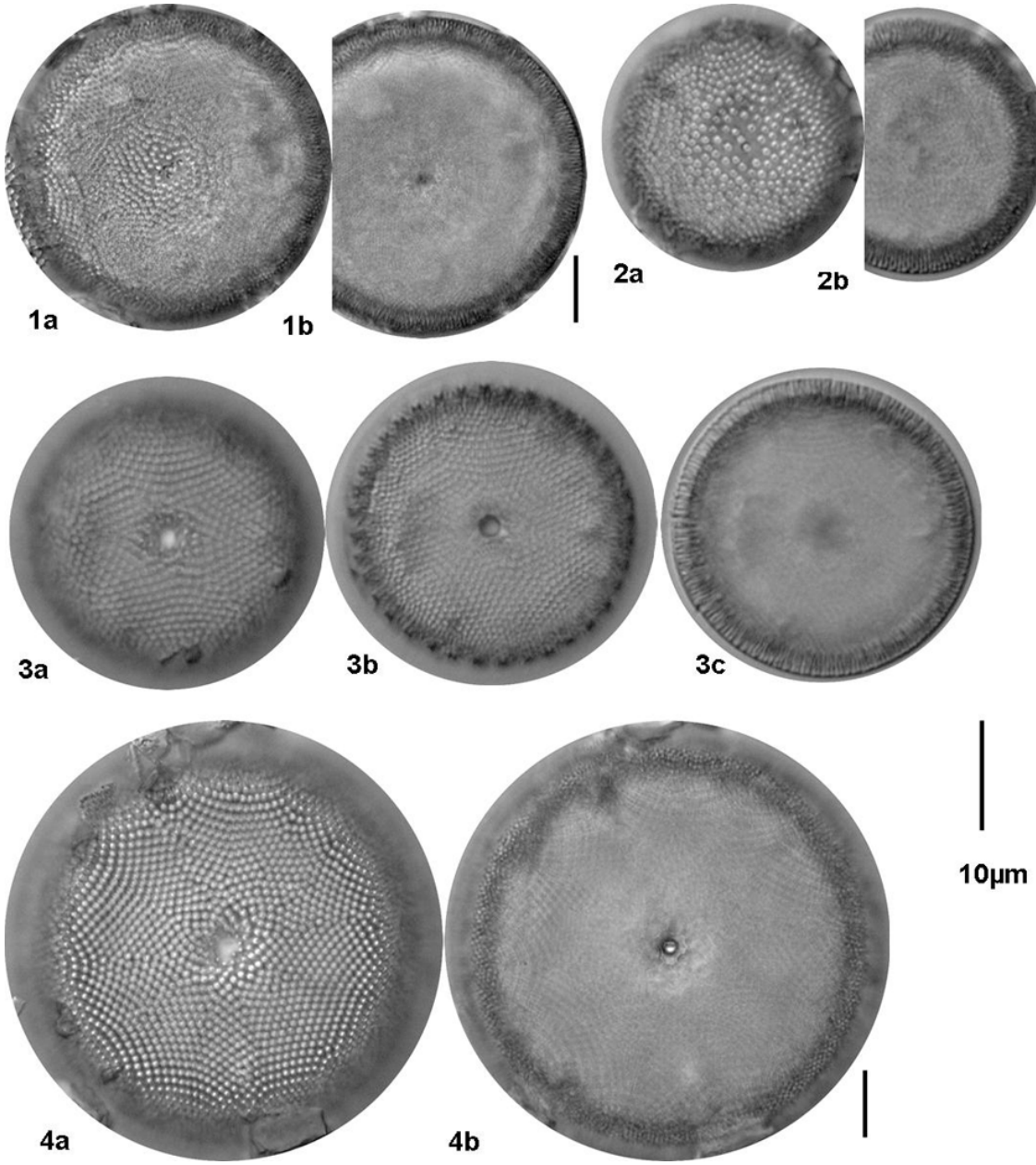

Plate P14. Diatoms from rise site: *Thalassiosira*. **1, 2.** *Thalassiosira oliverana* s.s. (1) Sample 178-1095B-27X-3, 139–140 cm, (2) Sample 178-1095B-27X-5, 55–56 cm. **3.** *Stellarima* spp. (Sample 178-1095B-45X-1, 41–42 cm). **4.** *Thalassiosira oliverana* var. *sparsa* (Sample 178-1095B-12H-5, 30–31 cm). **5.** *Thalassiosira* sp. cf. *Thalassiosira oliverana* (Sample 178-1095B-30X-6, 25–26 cm). **6, 7.** *Thalassiosira* sp. cf. *Thalassiosira oliverana* var. *sparsa*. (6) Sample 178-1095B-21X-2, 59–61 cm, (7) Sample 178-1095B-8H-5, 75–76 cm. **8, 9.** *Thalassiosira* sp. 1 aff. *Thalassiosira inura* (8) Sample 178-1095B-13H-4, 120–121 cm (#2.20), (9) Sample 178-1095B-7H-3, 35–36 cm. **10.** *Thalassiosira* sp. aff. *Thalassiosira oliverana* (Sample 178-1095B-9H-4, 105–106 cm). 11. *Thalassiosira*? sp. (Sample 178-1095B-21X-2, 59–61 cm).

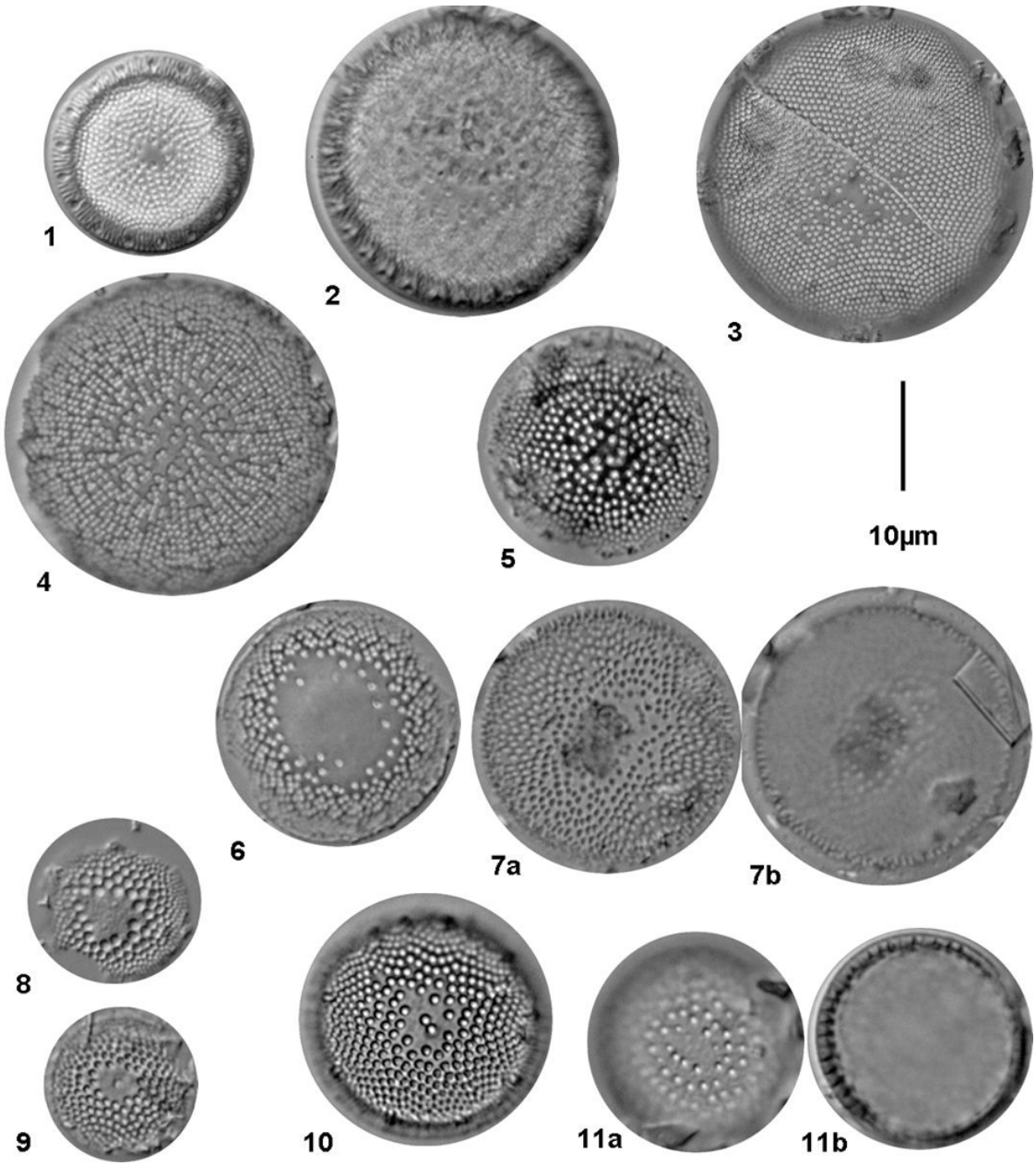

Plate P15. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*. **1.** *Thalassiosira vulnifica* (Sample 178-1095A-10H-7, 14.5–15.5 cm). **2.** *Thalassiosira mahoodii* (Sample 178-1095B-31X-3, 99–101 cm). **3.** *Actinocyclus ingens* s.s. (Sample 178-1095A-3H-6, 27–28 cm). **4.** *Thalassiosira striata* (Sample 178-1095A-10H-7, 14.5–15.5 cm). **5.** *Actinocyclus ingens* var. *ovalis* (Sample 178-1095B-28X-5, 88–89 cm). **6, 7.** *Thalassiosira torokina*. (6a–6c) Sample 178-1095B-14X-3, 65–66 cm, (7a, 7b) Sample 178-1095B-13H-4, 120–121 cm.

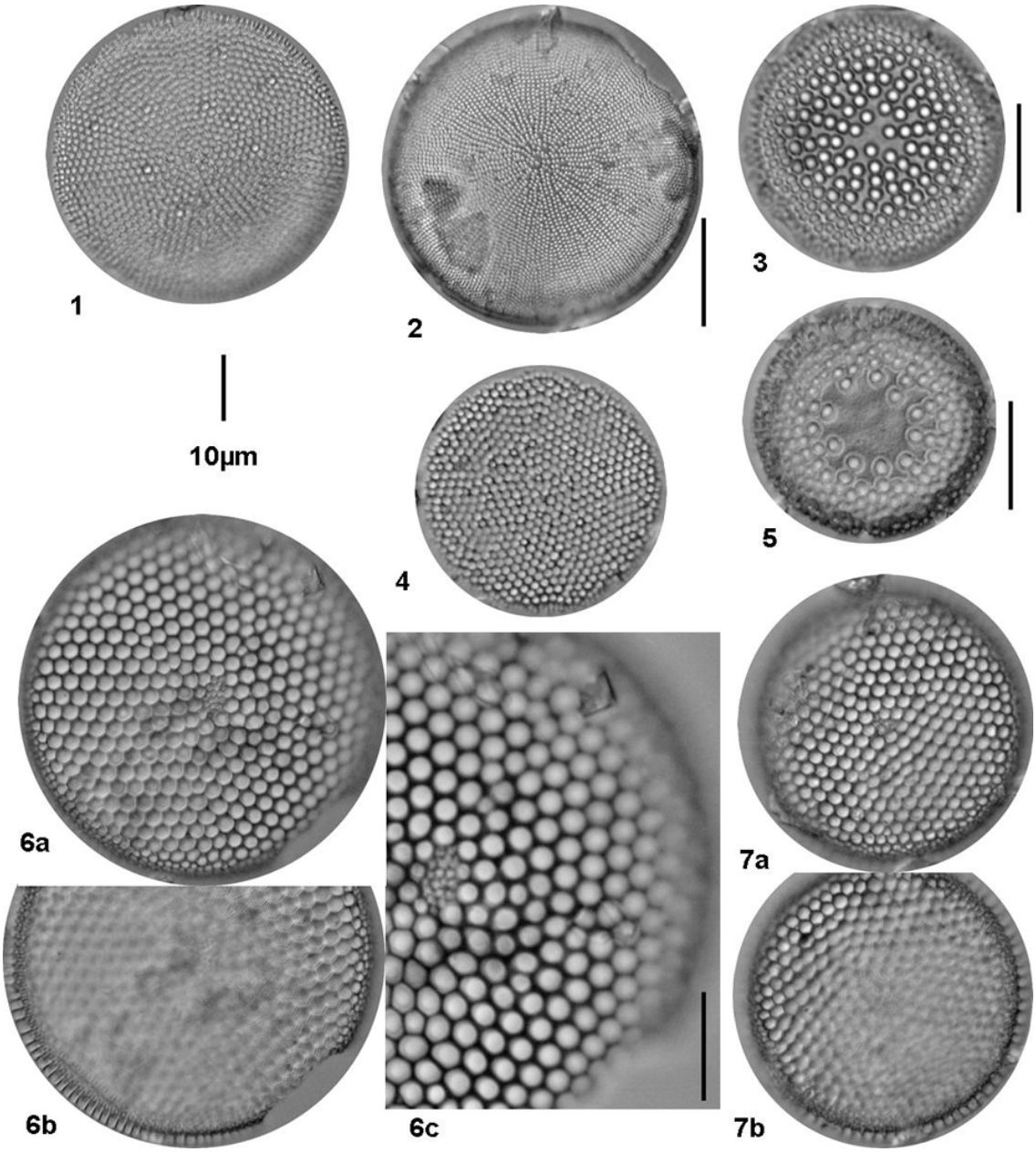

Plate P16. Diatoms from Hole 1095B: *Thalassiosira.* **1–7, 10.** *Thalassiosira oestrupii.* (1a, 1b) Sample 178-1095B-7H-3, 35–36 cm, (2) Sample 178-1095B-8H-1, 74–75 cm, (3) girdle band (Sample 178-1095B-7H-3, 35–36 cm), (4–6) Sample 178-1095B-6H-3, 101–102 cm, (7) Sample 178-1095B-15X-2, 59–61 cm, (10) Sample 178-1095B-8H-2, 74–75 cm. **8, 9.** *Thalassiosira tetraoestrupii* (Sample 178-1095B-7H-3, 35–36 cm. **11, 12, 14.** *Thalassiosira* spp. (11, 14) Sample 178-1095B-7H-3, 35–36 cm, (12) Sample 178-1095B-9H-5, 80–81 cm. **13.** *Thalassiosira* cf. *Thalassiosira lambimarginata* (Sample 178-1095B-22X-1, 92–94 cm).

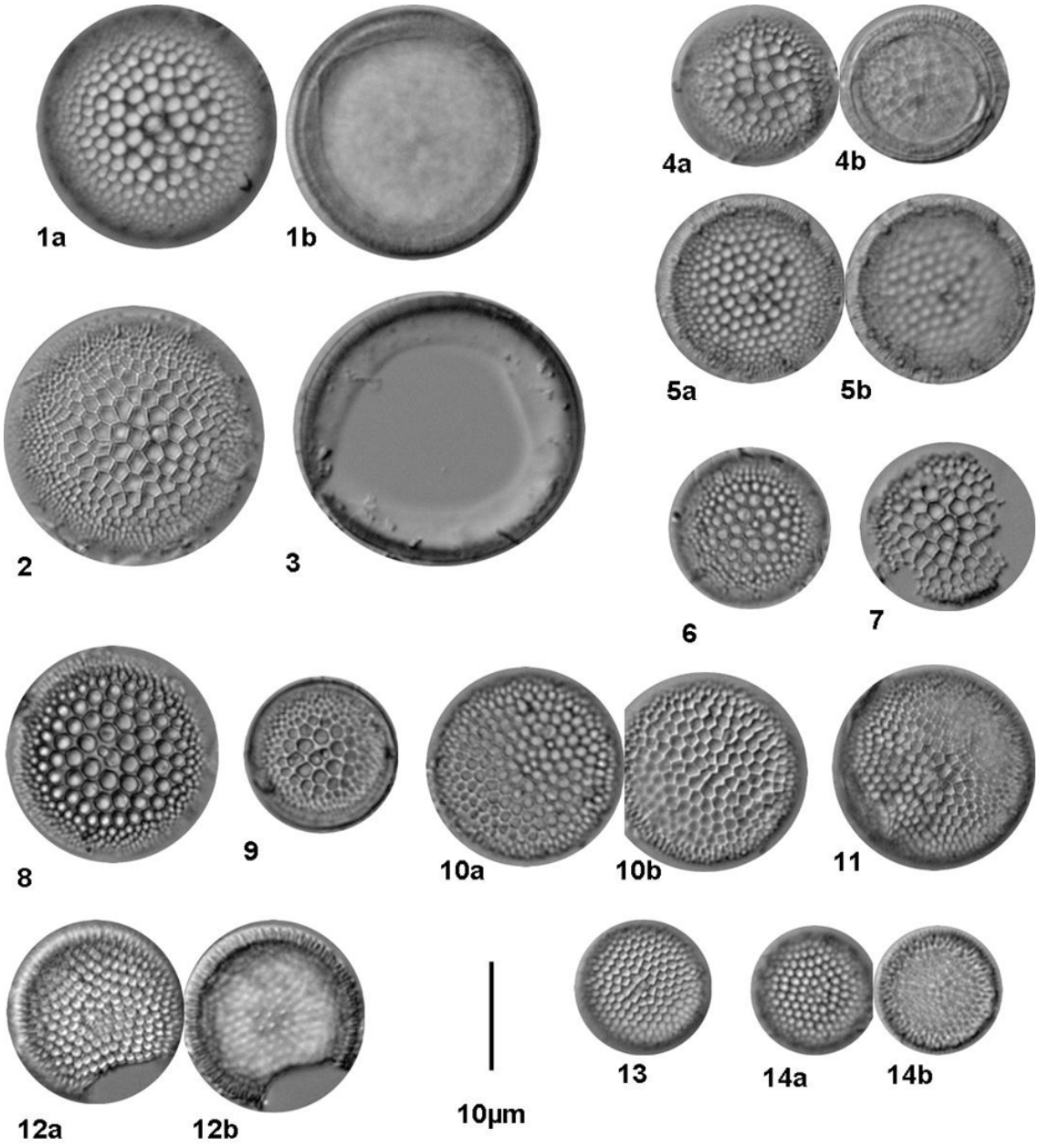

Plate P17. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*. **1, 2.** *Thalassiosira* aff. *trifulta*. (1, 2) Sample 178-1095B-45X-1, 41–42 cm. **3.** *Thalassiosira* spp. (Sample 178-1095B-7H-3, 35–36 cm). **4.** *Thalassiosira* spp. (Sample 178-1095B-8H-2, 74–75 cm). **5–8.** *Thalassiosira* spp. (5, 6) Sample 178-1095B-12H-6, 60–61 cm, (7) Sample 178-1095B-22X-1, 92–94 cm, (8) Sample 178-1095B-10H-2, 60–61 cm. **9, 10.** *Thalassiosira nativa* (Sample 178-1095B-45X-1, 41–42 cm). **11.** *Thalassiosira baldaufii*?, inner valve view (Sample 178-1095B-8H-2, 74–75 cm). **12, 13.** *Thalassiosira* aff. *trifulta* group. (12) Sample 178-1095B-34X-1, 44–45 cm, (13) Sample 178-1095B-43X-2, 64–65 cm. **14, 15.** *Thalassiosira* spp. (14a, 14b) Sample 178-1095B-34X-1, 44–45 cm, (15) Sample 178-1095B-29X-5, 117–119 cm. **16, 17.** *Thalassiosira* spp. (16) Sample 178-1095B-22X-2, 42–44 cm (#381), (17) Sample 178-1095B-27X-3, 139–140 cm. **18, 19.** *Thalassiosira* spp. (18a, 18b) Sample 178-1095B-45X-1, 41–42 cm (#225/224), (19) Sample 178-1095B-12H-6, 60–61 cm. **20.** *Actinocyclus* sp. (Sample 178-1095B-43X-2, 64–65 cm). **21, 22.** *Thalassiosira* sp. g of Fenner et al., 1976 (Sample 178-1095B-34X-1, 44–45 cm).

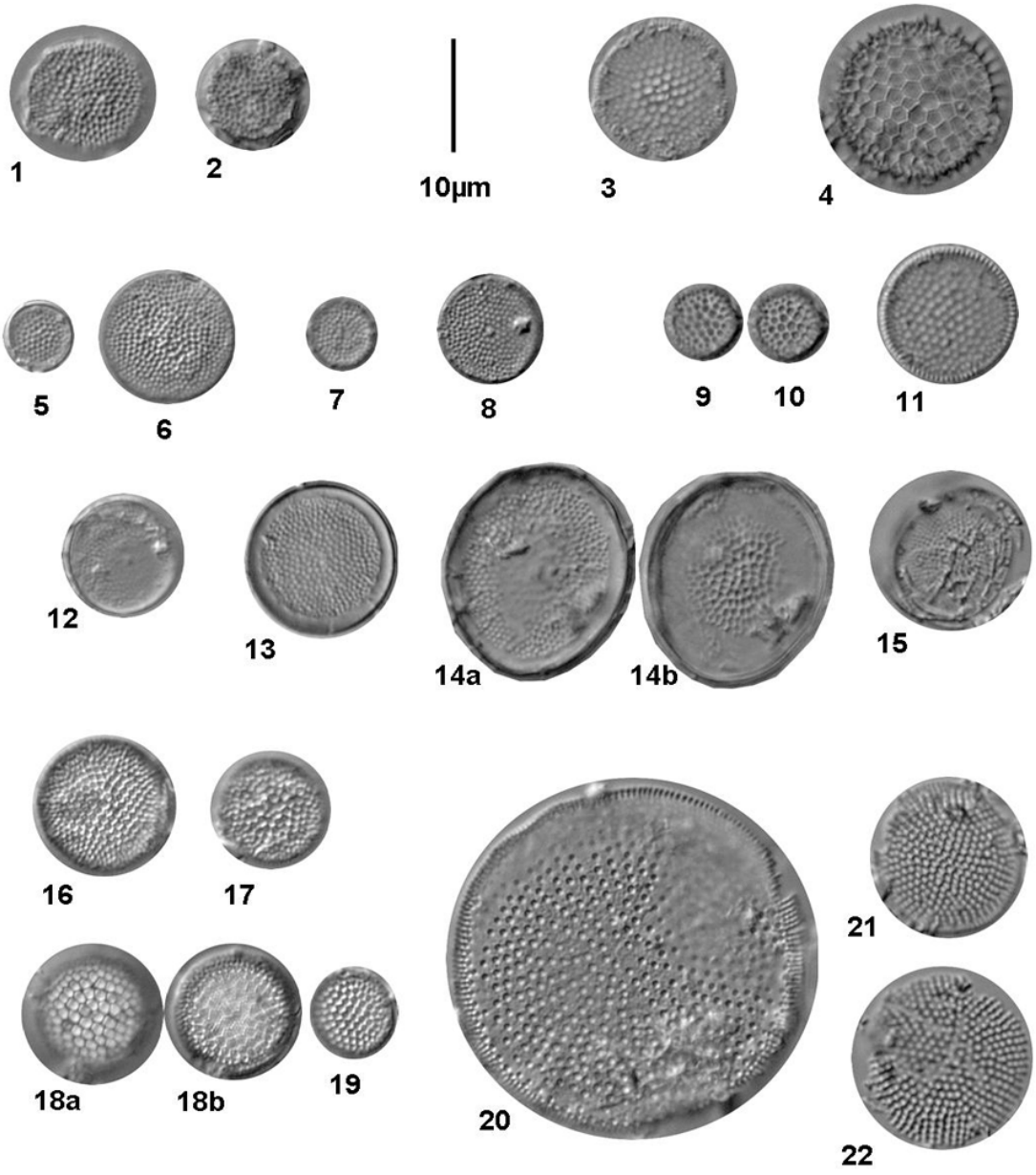

Plate P18. Diatoms from rise site: *Thalassiosira* and *Porosira*?. **1, 2.** *Thalassiosira* spp. (Sample 178-1095A-10H-7, 14.5–15.5 cm). **3.** *Porosira*? spp. (Sample 178-1095B-27X-3, 139–140 cm). **4.** *Thalassiosira* spp. (Sample 178-1095B-26X-1, 39–40 cm). **5, 6, 8.** *Thalassiosira* sp. aff *Thalassiosira marujanica* of Akiba, 1986. (5) Sample 178-1095B-24X-1, 35–36 cm, (6) Sample 178-1095B-29X-5, 117–119 cm, (8a, 8b) Sample 178-1095B-22X-1, 92–94 cm. **7.** *Thalassiosira* spp. (Sample 178-1095B-12H-4, 41–42 cm). **9.** *Porosira*? spp. (Sample 178-1095B-8H-1, 74–75 cm).

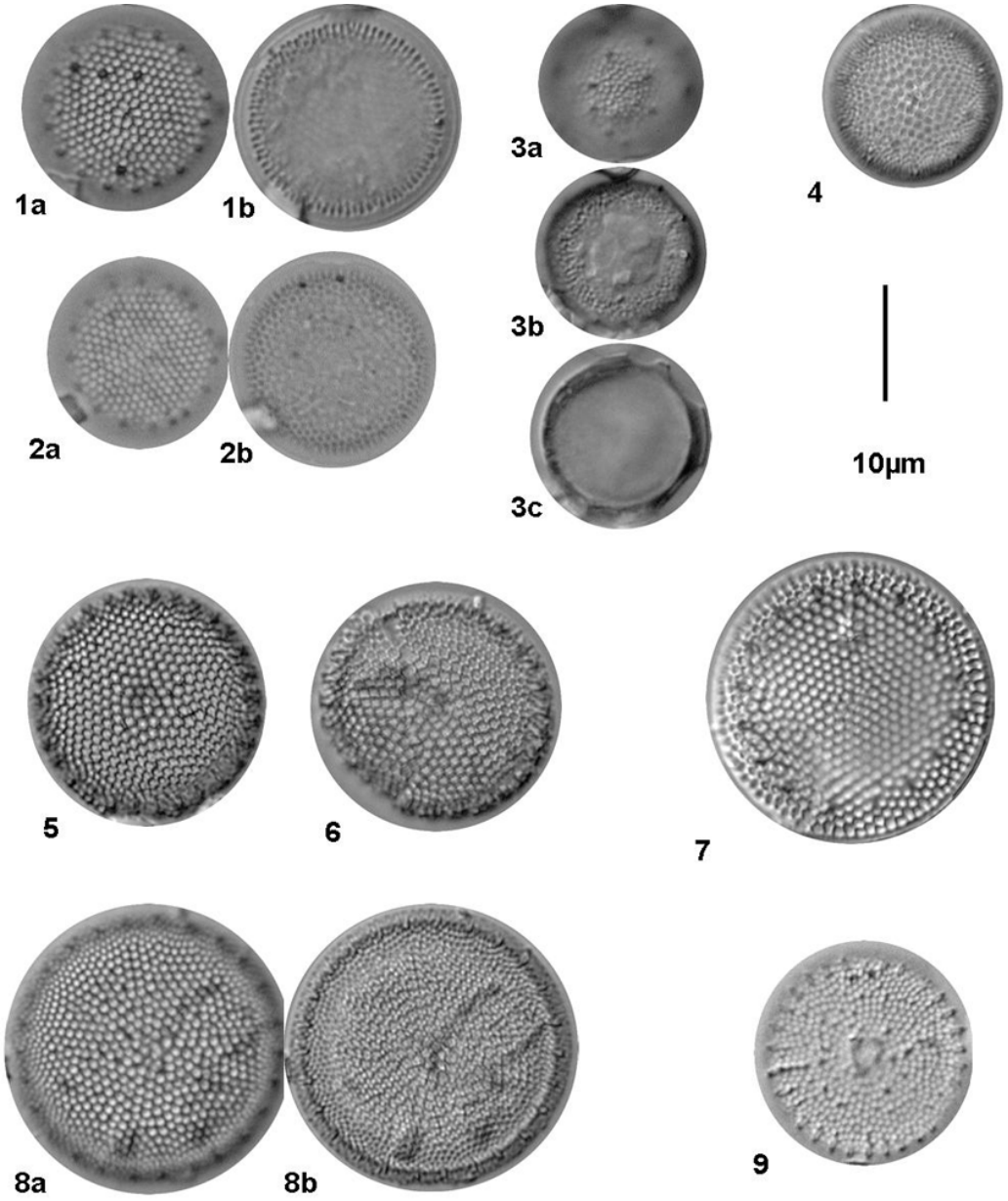

Plate P19. Diatoms from Hole 1095B: *Thalassiosira*. **1–6, 8.** *Thalassiosira* aff. *trifulta* group. (1a, 1b) Sample 178-1095B-39X-6, 65–66 cm, (2a–2c) Sample 178-1095B-36X-4, 8–10 cm, (3a, 3b) Sample 178-1098B-23X-2, 118–119 cm, (4) Sample 178-1095B-45X-1, 41–42 cm, (5a, 5b) Sample 178-1095B-39X-6, 65–66 cm, (6a, 6b) Sample 178-1095B-26X-1, 39–40 cm, (8) Sample 178-1095B-27X-3, 139–140 cm. **7.** *Thalassiosira praenidulus* (Sample 178-1095B-26X-1, 39–40 cm).

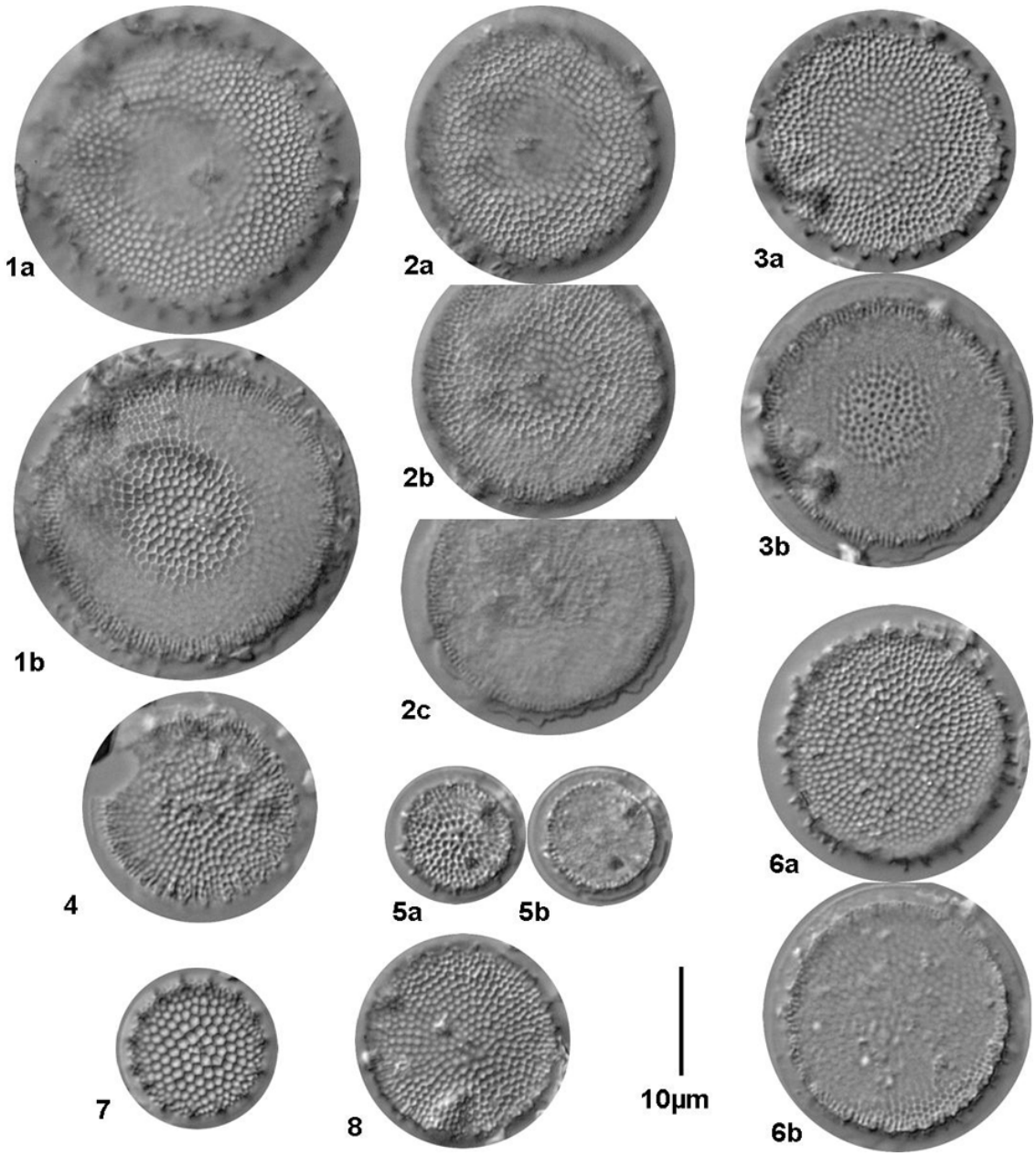

Plate P20. Diatoms from rise site: *Thalassiosira* and *Actinocyclus*. **1, 4.** *Thalassiosira lentiginosa*. (1) Sample 178-1095A-1H-4, 1–2 cm, (4) Sample 178-1095B-36X-4, 8–10 cm. **2.** *Thalassiosira lentiginosa* var. *ovalis* (Sample 178-1095A-8H-6, 24–25 cm). **3.** *Actinocyclus octonarius* (Sample 178-1095B-12H-4, 41–42 cm). **5–8.** *Actinocyclus karstenii*. (5) Sample 178-1095B-14X-3, 65–66 cm, (6) Sample 178-1095A-8H-3, 27–28 cm, (7) Sample 178-1095B-8H-2, 74–75 cm, (8) Sample 178-1095B-7H-3, 35–36 cm.

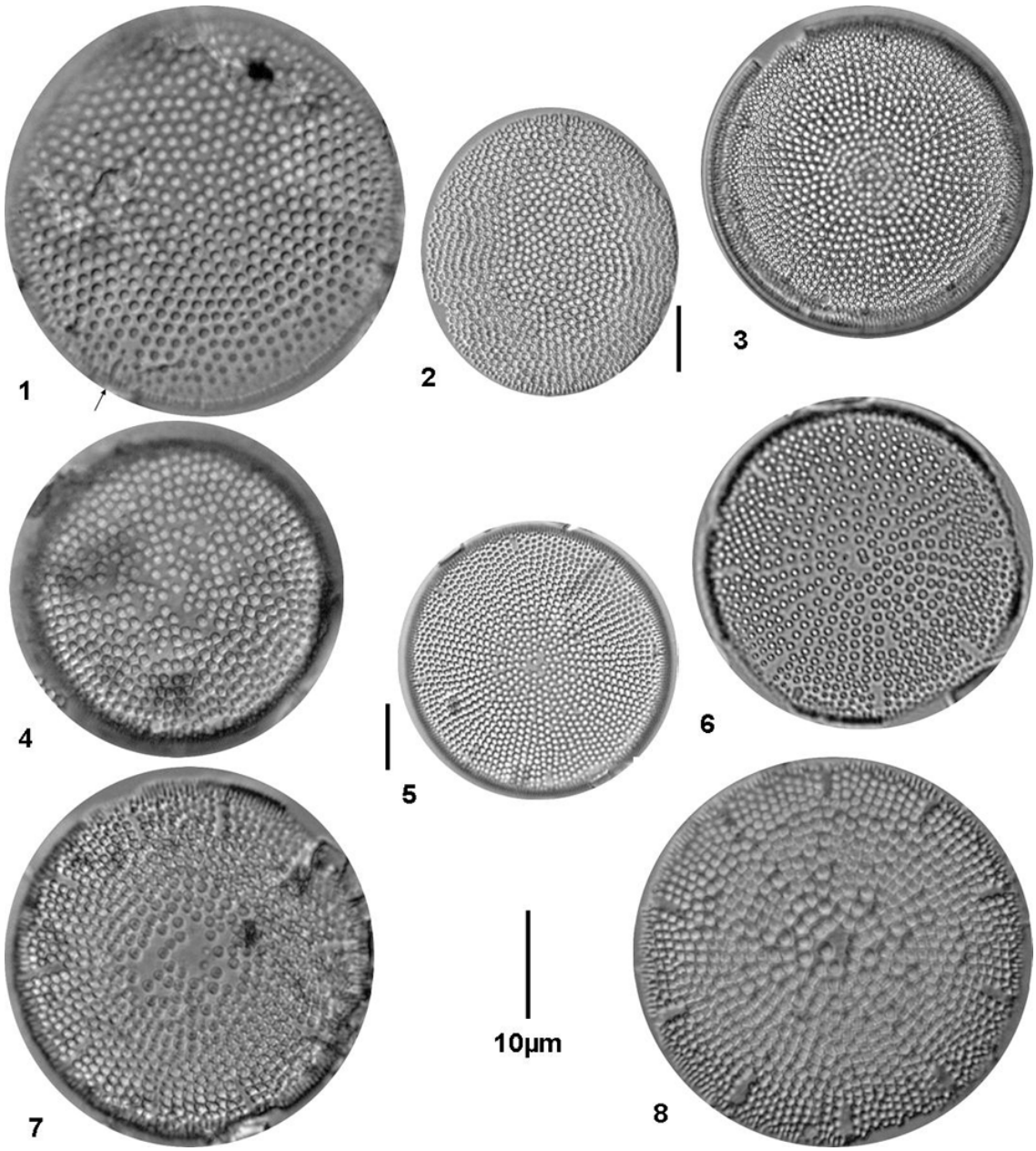

Plate P21. Diatoms from rise site: *Azpeitia, Hemidiscus,* and *Actinocyclus*. **1, 3.** *Azpeitia nodulifera*. (1a, 1b) Sample 178-1095B-12H-5, 30–31 cm, (3) Sample 178-1095B-6H-5, 40–41 cm. **2.** *Hemidiscus cuneiformis* (Sample 178-1095B-12H-6, 30–31 cm). **4.** *Azpeitia tabularis* (Sample 178-1095A-1H-4, 1–2 cm). **5.** *Hemidiscus karstenii* (Sample 178-1095B-21X-4, 128–130 cm). **6, 7.** *Azpeitia endoi*. (6) Sample 178-1095B-3H-1, 37–38 cm (#2.187), (7) Sample 178-1095B-20X-6, 79–80 cm. **8.** *Actinocyclus actinochilus* (Sample 178-1095B-4H-6, 75–76 cm). **9.** *Actinocyclus* sp. cf. *Actinocyclus octonarius* (Sample 178-1095B-12H-6, 60–61 cm).

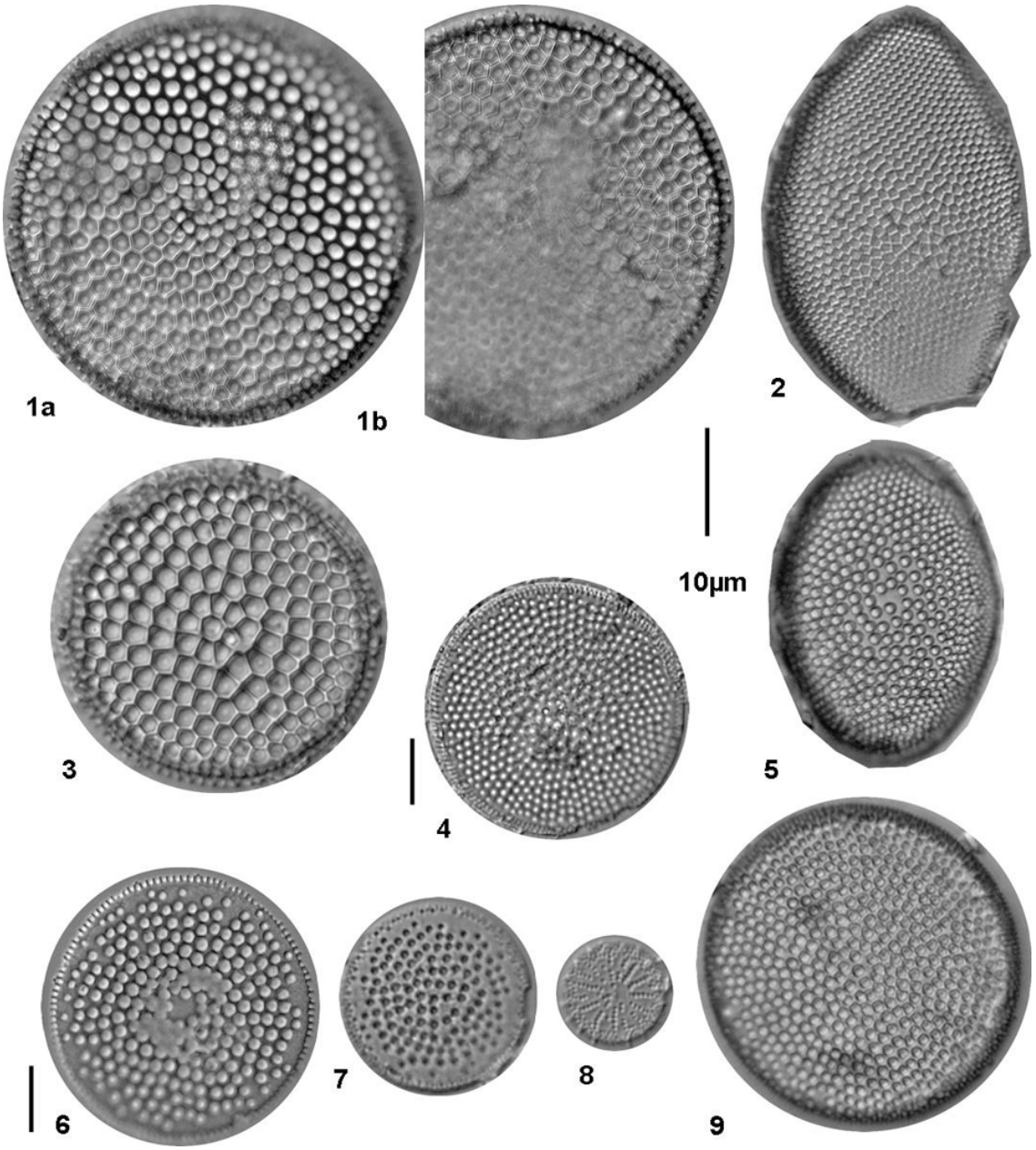

Plate P22. Diatoms from rise site: *Coscinodiscus* and *Thalassiosira*. **1.** *Coscinodiscus* sp. cf. *Coscinodiscus radiatus* (Sample 178-1095B-43X-2, 64–65 cm). **2.** *Thalassiosira* sp. 2.105 (Sample 178-1095B-12H-4, 41–42 cm). **3.** *Coscinodiscus elegans* (Sample 178-1095B-13H-4, 120–121 cm). **4.** *Coscinodiscus* sp. A sensu Akiba, 1986 (Sample 178-1095B-22X-1, 92–94 cm). **5.** *Thalassiosira* spp. (Sample 178-1095B-43X-2, 64–65 cm). **6.** *Thalassiosira* sp. cf. *Thalassiosira gersondei* (Sample 178-1095A-10H-7, 14.5–15.5 cm). **7.** *Thalassiosira gersondei* (Sample 178-1095B-36X-4, 8–10 cm). **8.** *Thalassiosira* spp. (Sample 178-1095B-30X-6, 25–26 cm).

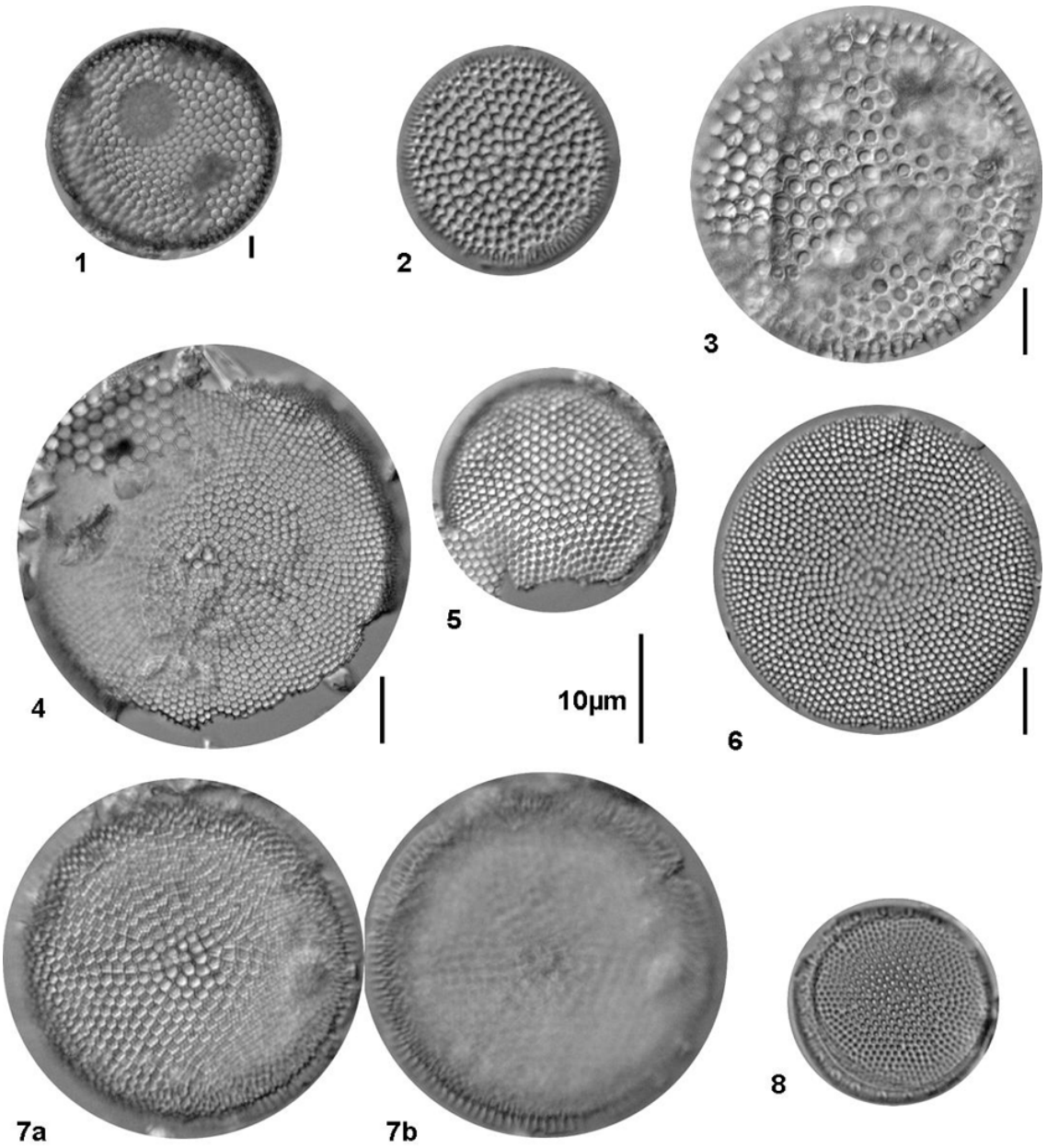

Plate P23. Diatoms from rise site: *Chaetoceros* and others. **1, 2.** *Schimperiella antarctica*. (1) Sample 178-1095A-1H-2, 78–79 cm, (2) Sample 178-1095B-7H-3, 35–36 cm. **3, 4.** *Stellarima* spp. (3a, 3b) Sample 178-1095B-22X-1, 92–94 cm, (4a, 4b) Sample 178-1095B-25X-3, 84–85 cm. **5.** *Coscinodiscus* spp. (Sample 178-1095A-1H-4, 1–2 cm). **6, 7.** *Chaetoceros* spp., resting spores (Sample 178-1095B-15X-2, 59–61 cm).

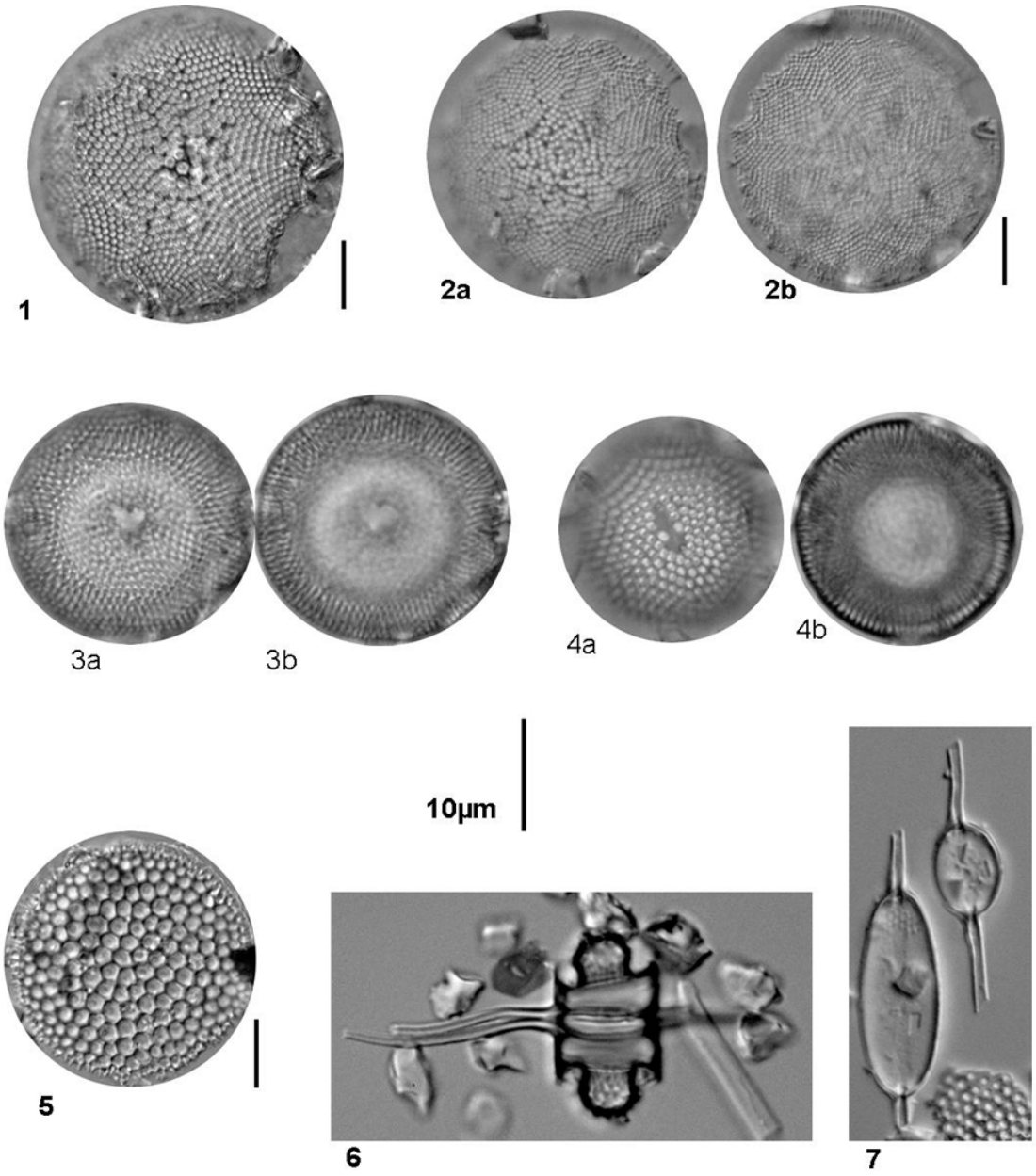

Plate P24. Diatoms from shelf sites: *Thalassiosira* and others. **1–3.** Sample 178-1100D-2R-CC. (1) *Thalassiosira antarctica*,(2) *Thalassiosira gracilis,* (3) *Fragilariopsis kerguelensis*. **4.** *Thalassiosira lentiginosa* (Sample 178-1103A-6R-CC). **5–9.** Sample 178-1103A-10R-CC. (5) *Stellarima* spp., (6) *Thalassiosira torokina,* (7) *Thalassiosira* spp. (8) *Actinocyclus karstenii*, (9) *Thalassiothrix antarctica*.

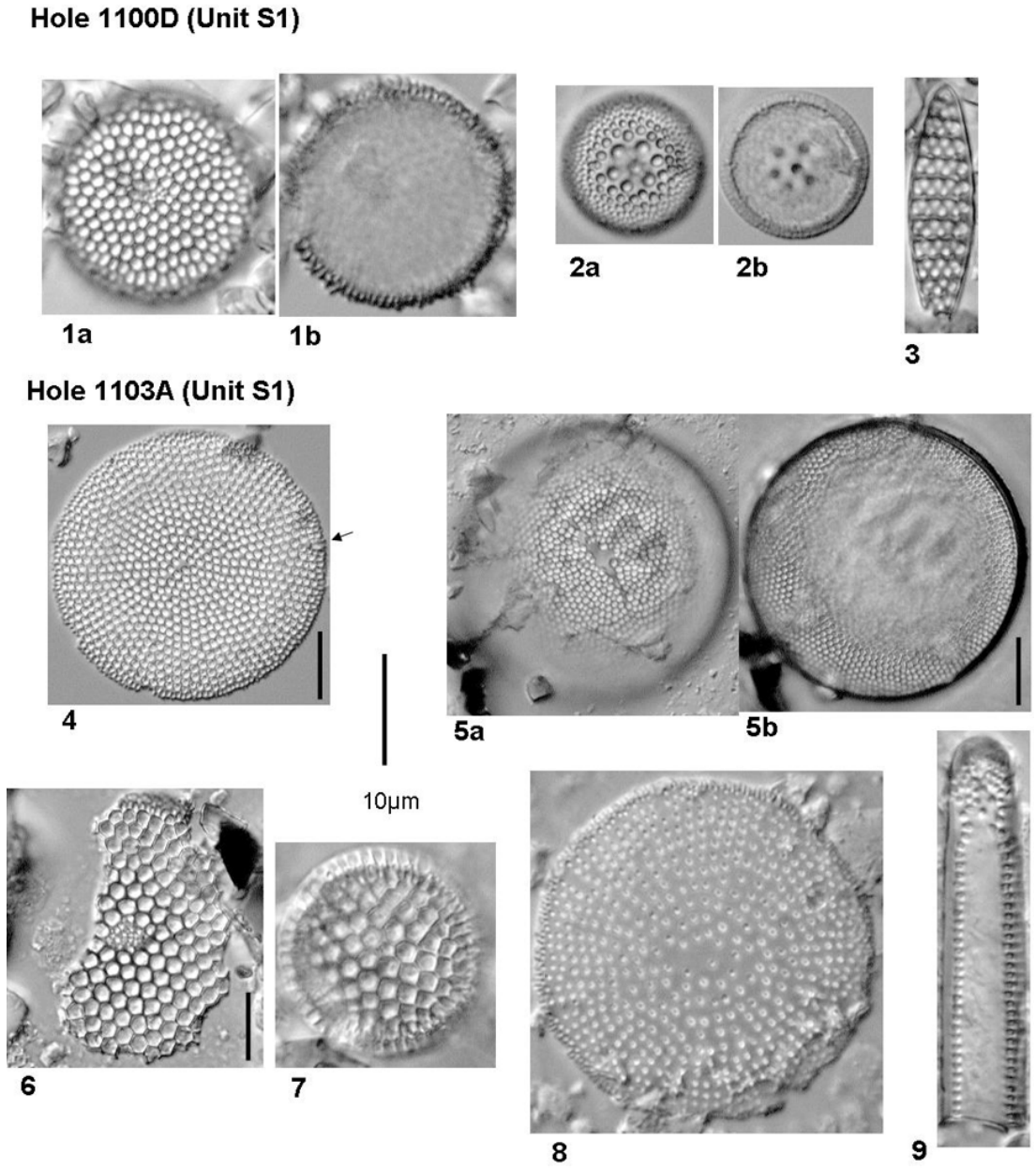

Plate P25. Diatoms from shelf Site 1103. **1–4.** Sample 178-1103A-13R-CC. (1) *Fragilariopsis kerguelensis*, (2) *Fragilariopsis aurica*, (3) *Fragilariopsis barronii*, (4) *Nitzschia* cf. *Nitzschia reinholdii*. **5.** *Nitzschia* spp. (Sample 178-1103A-14R-CC). **6–8.** *Fragilariopsis interfrigidaria*. (6) Sample 178-1103A-14R-CC, (7) Sample 178-1103A-13R-CC, (8) Sample 178-1103A-13R-CC. **9, 10.** *Rouxia* spp. (9) Sample 178-1103A-23R-CC, (10) Sample 178-1103A-13R-CC. **11.** *Stephanopyxis grunowii* (Sample 178-1103A-14R-CC). **12.** *Rhizosolenia hebetata* f. *hiemalris* (Sample 178-1103A-13R-CC). **13.** *Rhizosolenia* sp. C of Harwood and Maruyama, 1992 (Sample 178-1103A-14R-CC). **14–16.** *Stephanopyxis* spp. (14a, 14b) Section 178-1103A-10R-1, (15a, 15b) Sample 178-1103A-13R-CC, (16) Sample 178-1103A-15R-CC. **17.** *Paralia sulcata* (Sample 178-1103A-13R-CC).

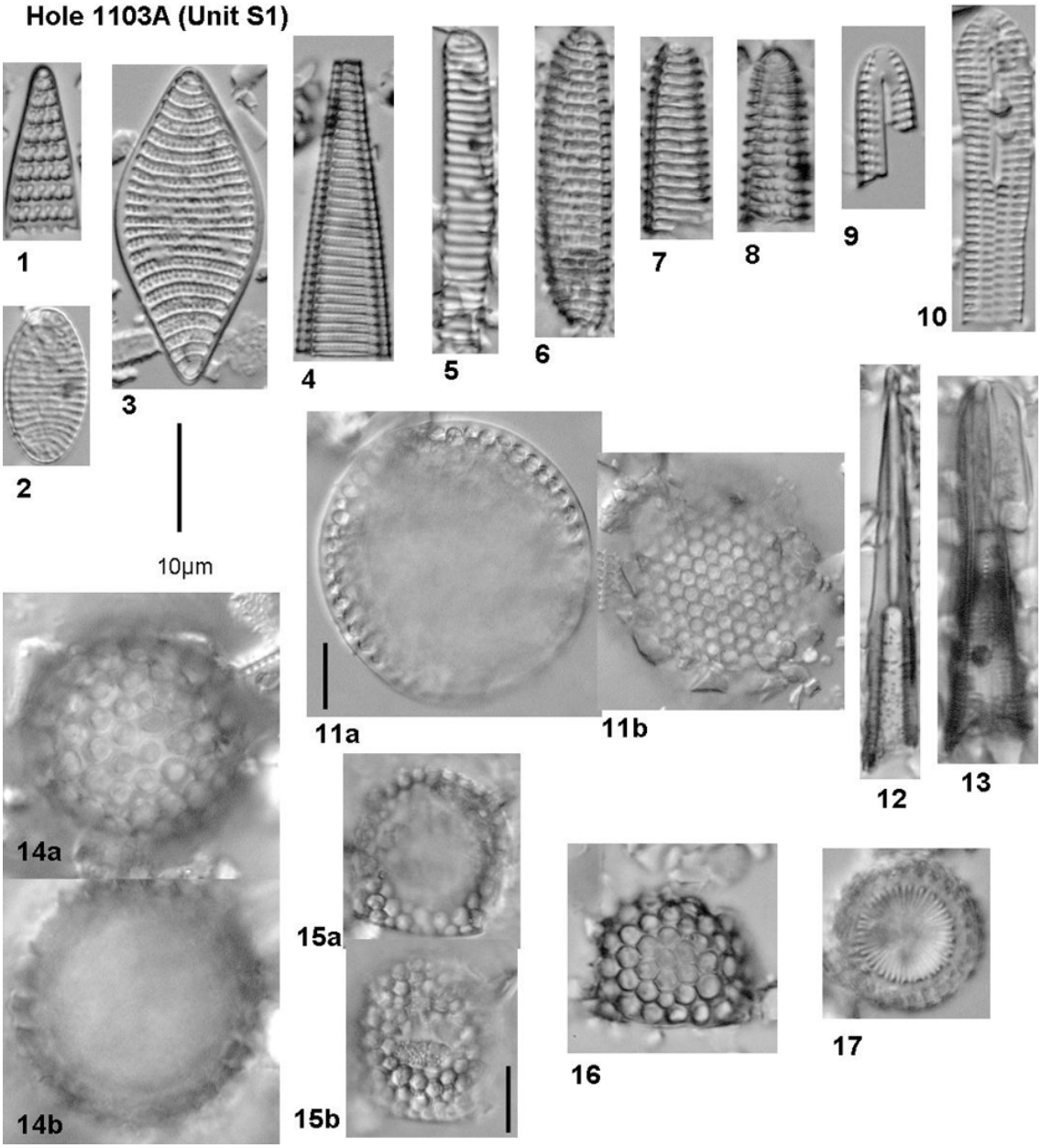

Plate P26. Diatoms from shelf sites: *Actinocyclus* and *Thalassiosira*. **1.** *Actinocyclus karstenii* (Sample 178-1103A-13R-CC). **2.** *Actinocyclus actinochilus* (Sample 178-1103A-14R-CC). **3.** *Thalassiosira* sp. cf. *Thalassiosira complicata* (Sample 178-1103A-14R-CC). **4.** *Thalassiosira* spp. (Sample 178-1103A-14R-CC). **5.** *Actinocyclus* spp. (Sample 178-1103A-15R-CC). **6.** *Thalassiosira* sp. aff. *Thalassiosira oestrupii* (Sample 178-1103A-13R-CC). **7.** *Thalassiosira oliverana* var. *sparsa* (Sample 178-1103A-18R-1, 4–5 cm). **8, 9.** *Thalassiosira inura*. (8) Sample 178-1103A-13R-CC, (9) Sample 178-1103A-15R-CC.

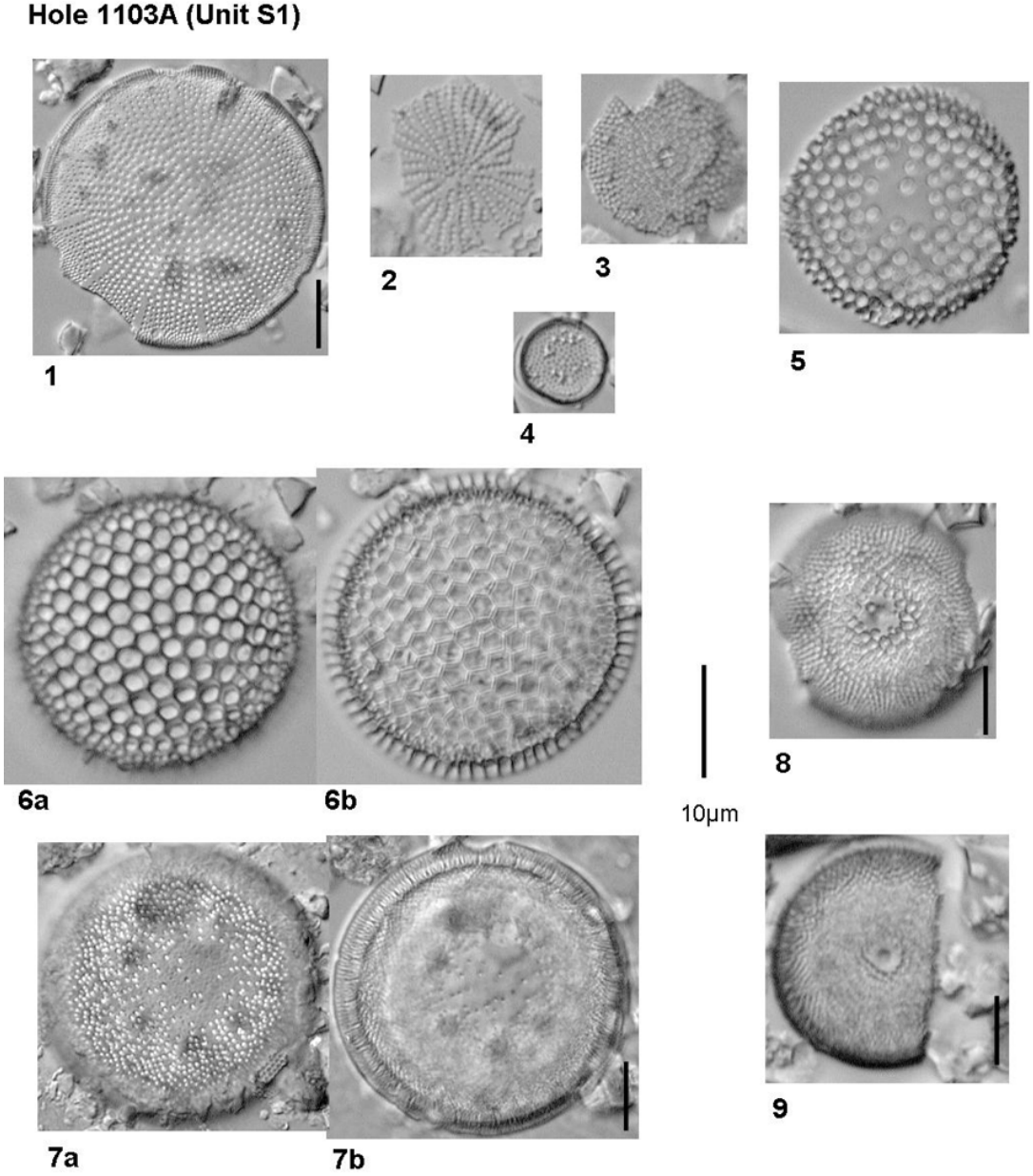

Plate P27. Diatoms from Sample 178-1103A-23R-CC. **1.** *Thalassiosira oliverana* group?. **2.** *Thalassiosira striata*. **3.** *Thalassiosira* cf. *Thalassiosira inura,* central part. **4.** *Thalassiosira vulnifica*. **5.** *Actinocyclus karstenii*. **6.** *Eucampia antarctica*. **7.** *Thalassiosira tetraoestrupii*. **8.** *Thalassiosira oestrupii*. **9.** *Actinocyclus karstenii*. **10.** *Chaetoceros* sp., resting spore. **11.** *Navicula* sp. **12.** *Cocconeis* sp. cf. *Cocconeis californica*.

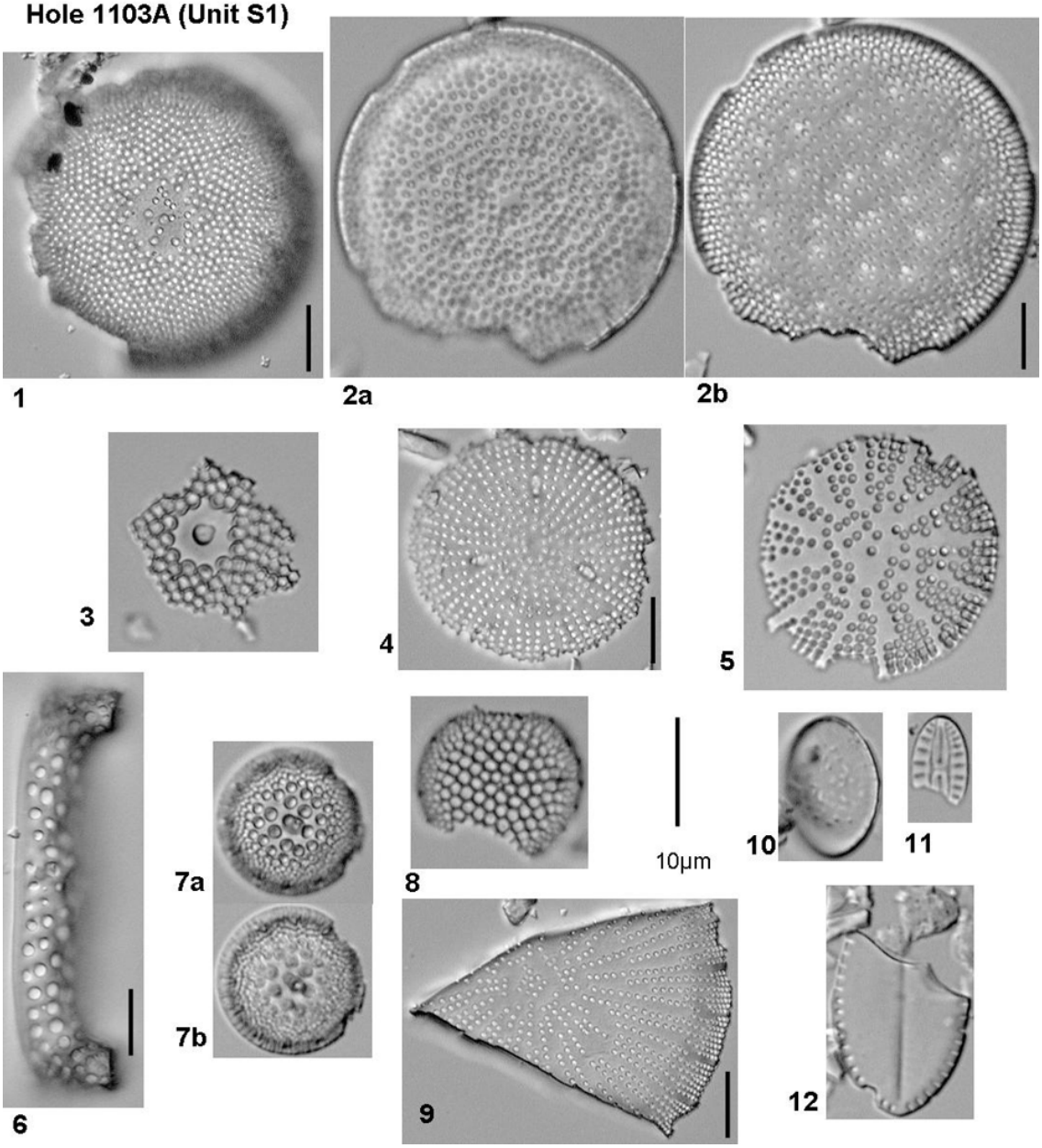

Plate P28. Diatoms from rise Sites 1097 and 1103. **1, 2.** *Denticulopsis simonsenii*. (1a, 1b) Sample 178-1103A-38R-CC, (2) Sample 178-1103A-31R-1, 39–40 cm. **3–5.** *Denticulopsis delicata* (Sample 178-1103A-31R-1, 39–40 cm). (3) girdle view, (4, 5) valve view. **6.** *Nitzschia* spp. (Sample 178-1103A-34R-CC). **7–14.** Sample 178-1103A-31R-1, 39–40 cm. (7) *Fragilariopsis aurica*, (8) *Fragilariopsis praecurta*, (9) *Nitzschia pusilla,* (10) *Fragilariopsis arcula*?, (11) *Nitzschia* aff. *angulata*, (12) *Nitzschia* sp., (13) *Nitzschia* sp. cf. *Nitzschia reinholdii*, (14) *Fragilariopsis* sp. cf. *Fragilariopsis grossepunctata*. **15.** *Rouxia californica* (Sample 178-1103A-34R-CC). **16.** *Thalassiothrix antarctica* (Sample 178-1103A-38R-CC). **17.** Gen. et sp. indet. (Sample 178-1103A-38R-CC). **18, 19.** *Rhizosolenia styliformis*. (18) Sample 178-1103A-38R-CC, (19) Sample 178-1097A-34R-CC. **20.** Gen. et. sp. indet. (Sample 178-1103A-34R-CC). **21.** *Basilicostephanus*? sp. (Sample 178-1103A-34R-CC). **22–28.** *Chaetoceros* spp., resting spores (Sample 178-1103A-34R-CC).

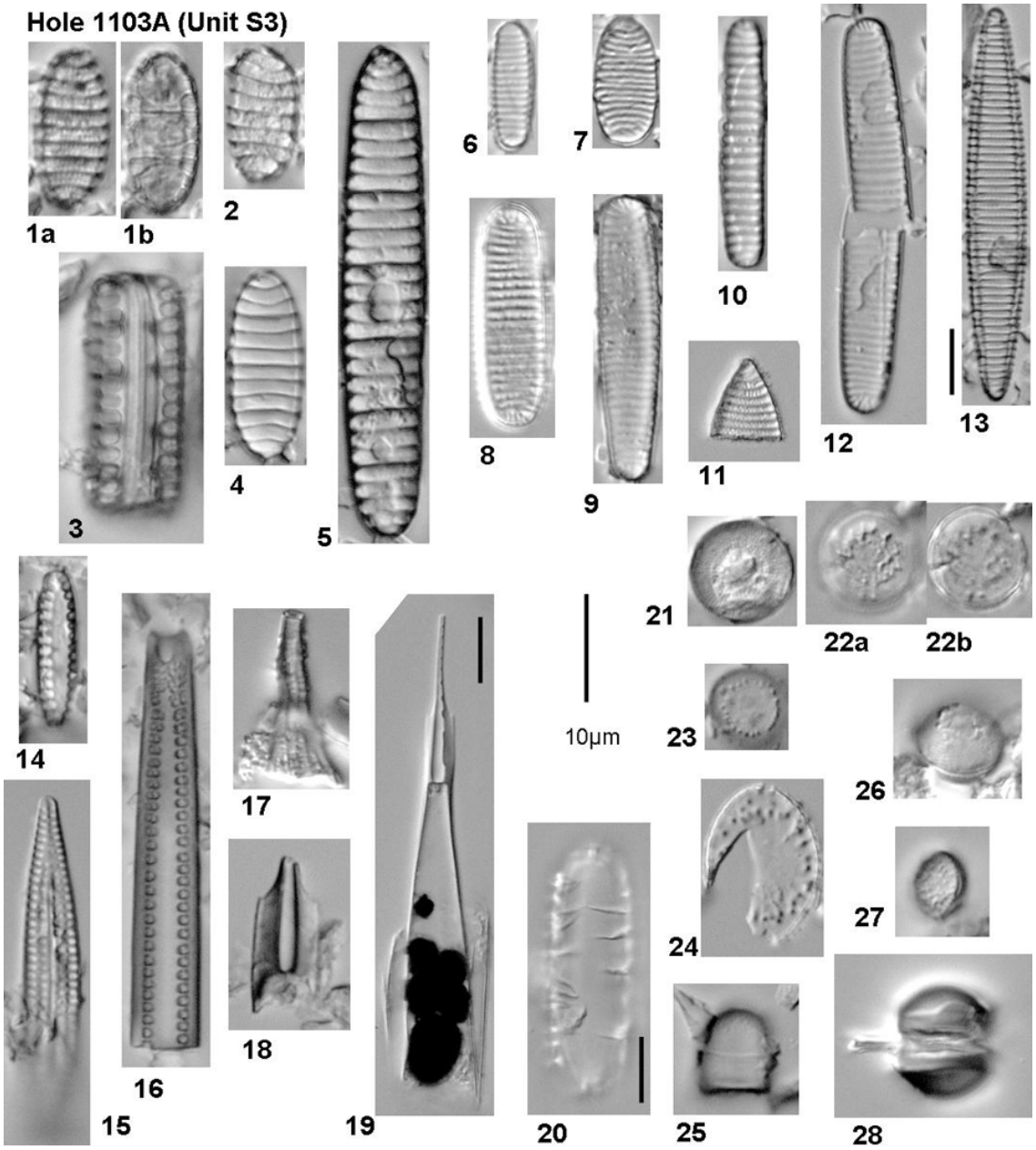

Plate P29. Diatoms from rise site, Hole 1103A. **1, 4.** *Actinocyclus ingens* s.s. (Sample 178-1103A-34R-CC). **2.** *Actinocyclus*? sp. (Sample 178-1103A-34R-CC). **3.** *Azpeitia nodulifera* (Sample 178-1103A-31R-1, 39–40 cm). **4.** *Actinocyclus* sp. (Sample 178-1103A-38R-CC). **5.** *Thalassiosira* spp. (Sample 178-1103A-31R-1, 39–40 cm). **6.** *Stephanopyxis* sp. (Sample 178-1103A-34R-CC). **7.** *Hyalodiscus* sp. (Sample 178-1103A-31R-1, 39–40 cm). **8.** *Delphineis* sp. (Sample 178-1103A-34R-CC). **9.** *Paralia sulcata* (Sample 178-1103A-37R-CC). 10. Gen. et sp. indet. (Sample 197-1103A-38R-CC). **11.** *Porosira* spp. (Sample 178-1103A-31R-1, 39–40 cm). **12.** *Cocconeis* sp. aff. *Cocconeis costata* (Sample 178-1103A-31R-1, 39–40 cm).

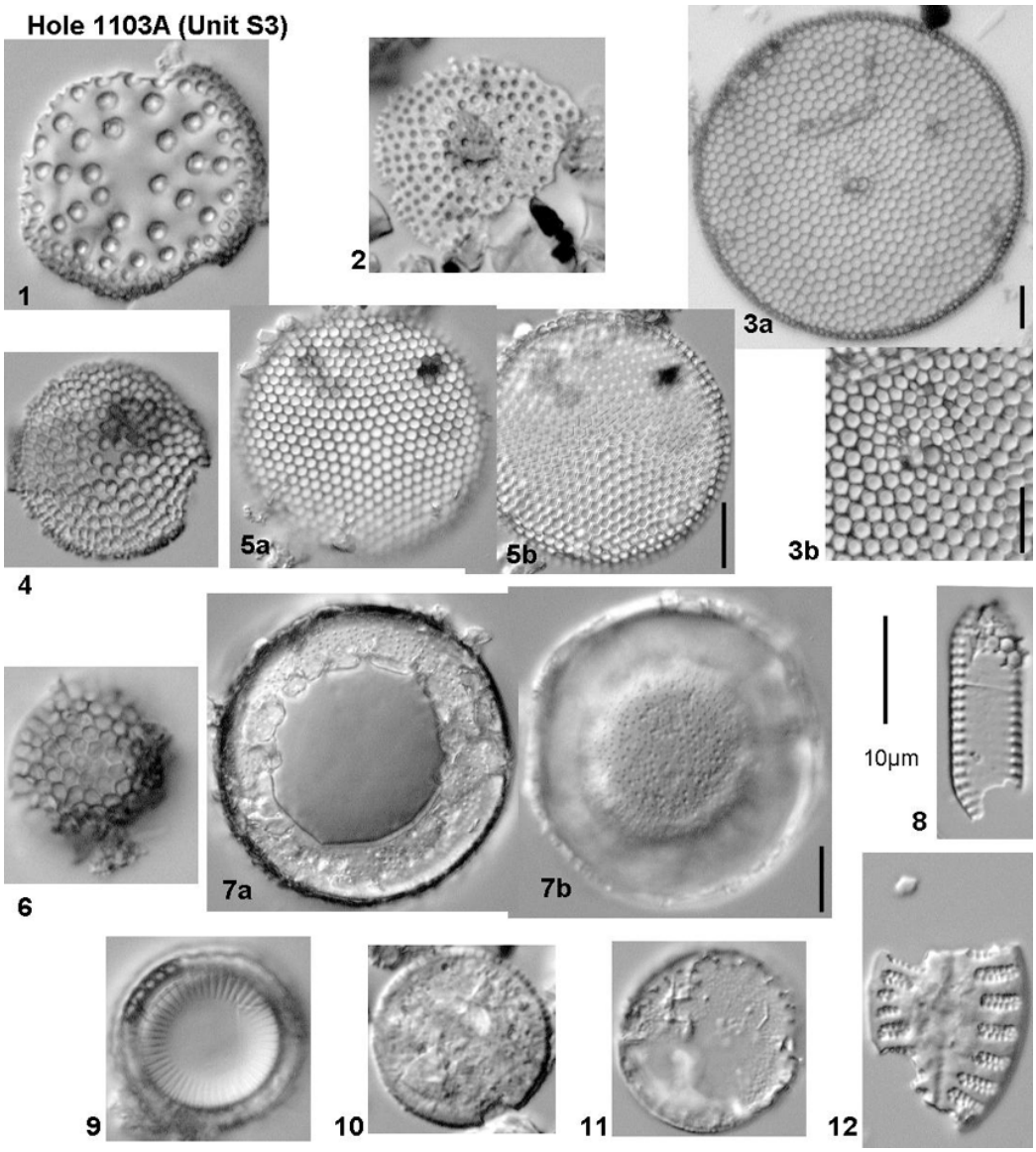

Plate P30. Diatoms from rise Site 1103. **1.** Gen. et sp. indet. (Sample 178-1103A-31R-1, 39–40 cm). **2.** *Coscinodiscus marginatus* (Sample 178-1103A-38R-CC). **3, 4, 9.** *Thalassiosira* aff. *trifulta* group (Sample 178-1103A-38R-CC). **5, 10.** *Porosira* sp. (Sample 178-1103A-31R-1, 39–40 cm). **6–8.** Sample 178-1103A-31R-1, 39–40 cm). (6) Gen. et sp. indet., (7) *Thalassiosira*? spp., (8). *Thalassiosira* spp. **11, 12.** *Thalassiosira* spp. (11) Sample 178-1103A-31R-1, 39–40 cm, (12) Sample 178-1103A-38R-CC.

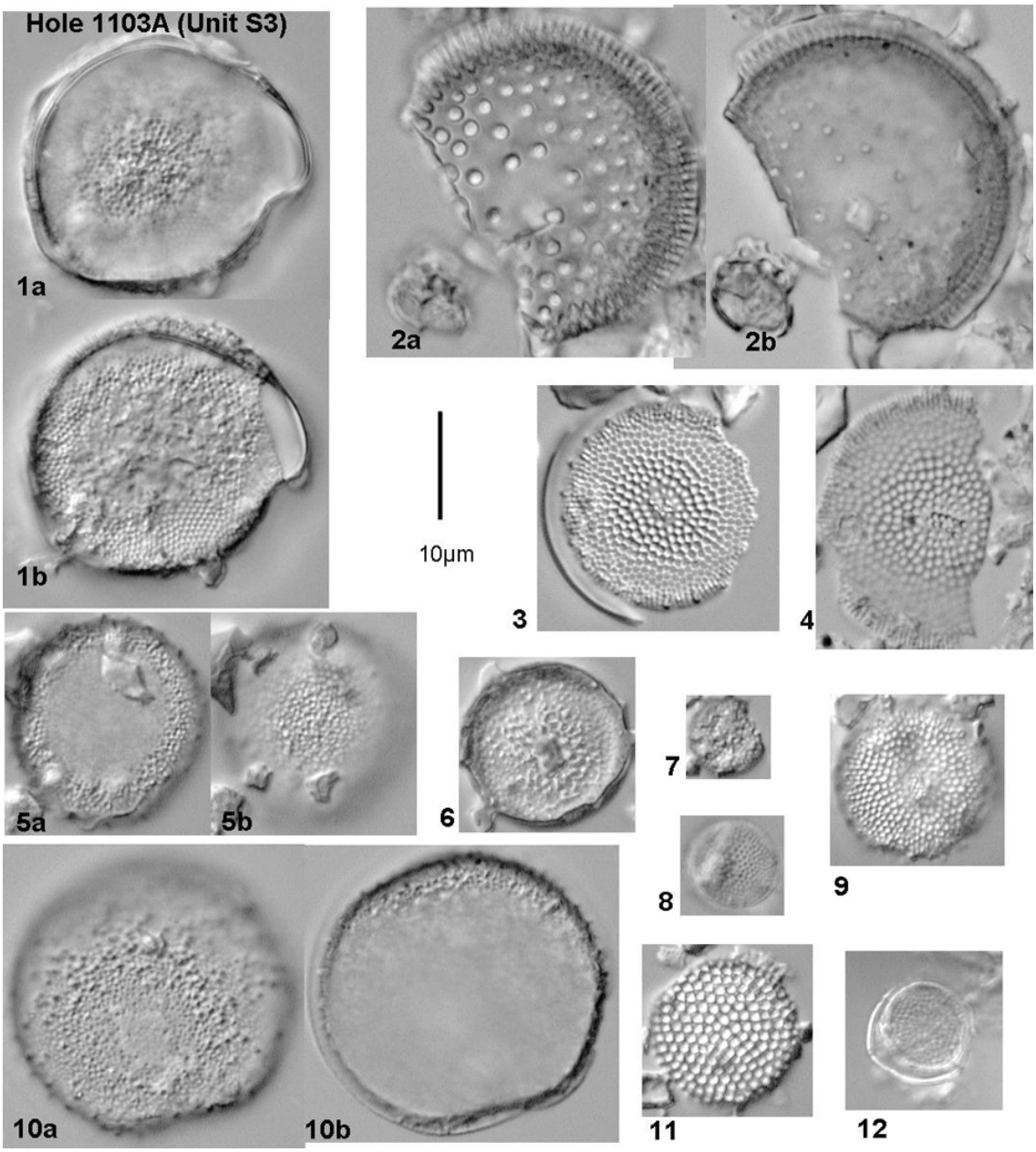

Plate P31. Diatoms from rise sites: *Stephanopyxis* and others. **1–4.** Sample 178-1097A-18R-1, 4–5 cm. (1) *Stephanopyxis* sp., (2a, 2b) *Stephanopyxis turris*, (3) *Stephanogonia* sp. (girdle view),(4) *Stellarima* spp. **5, 6.** Sample 178-1097A-35R-CC. (5) *Coscinodiscus marginatus*, (6) *Melosira omma*.

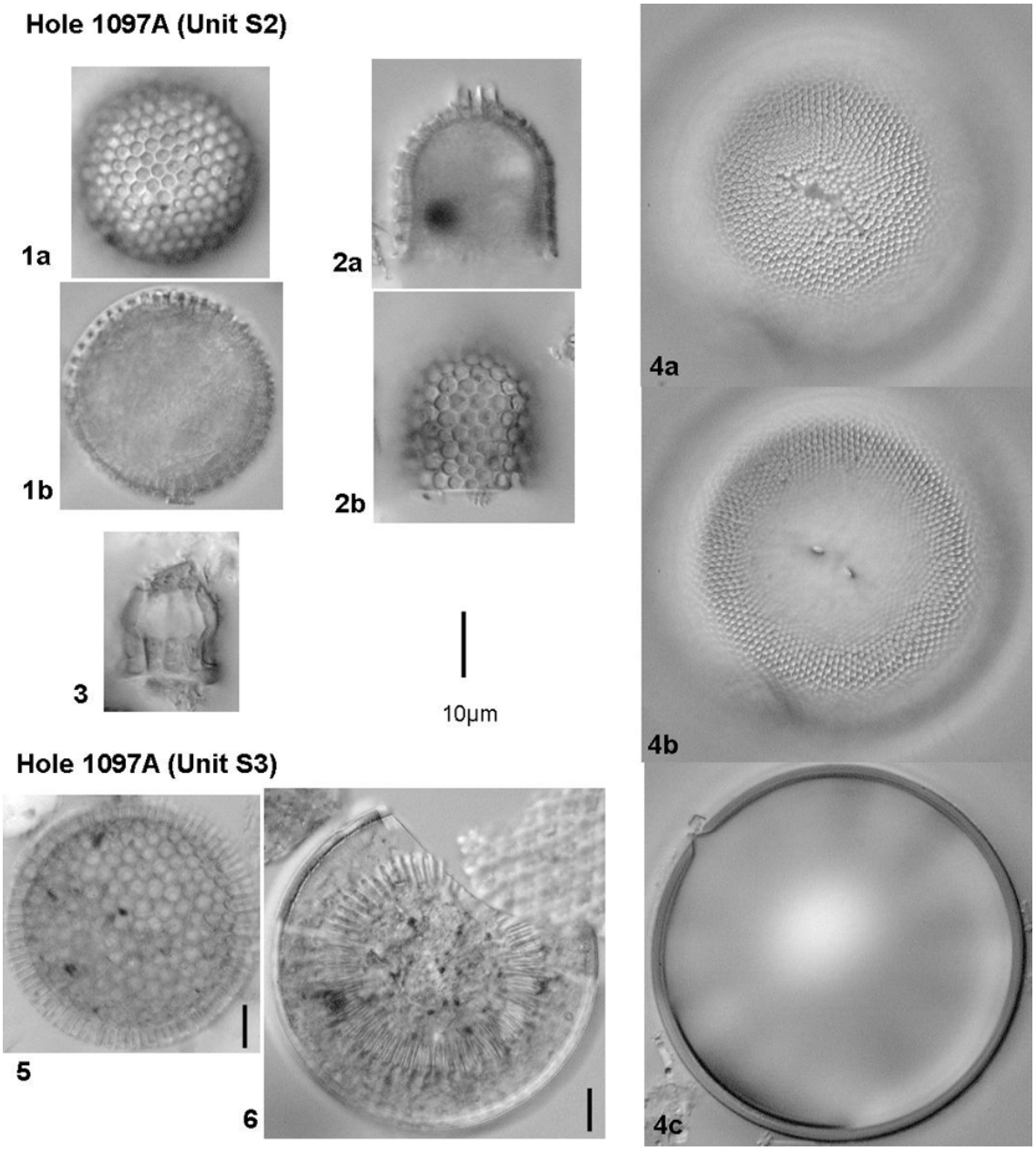

Plate P32. Diatoms from Sample 178-1097A-34R-CC. **1.** *Odontella* sp. **2.** *Paralia sulcata*. **3.** *Trinacria* sp. **4.** *Rhizosolenia hebetata* f. *hiemalris*. **5.** *Rhizosolenia setigera*. **6, 7.** *Corethron* sp. (6) girdle view, (7) valve view.

Hole 1097A (Unit S3)

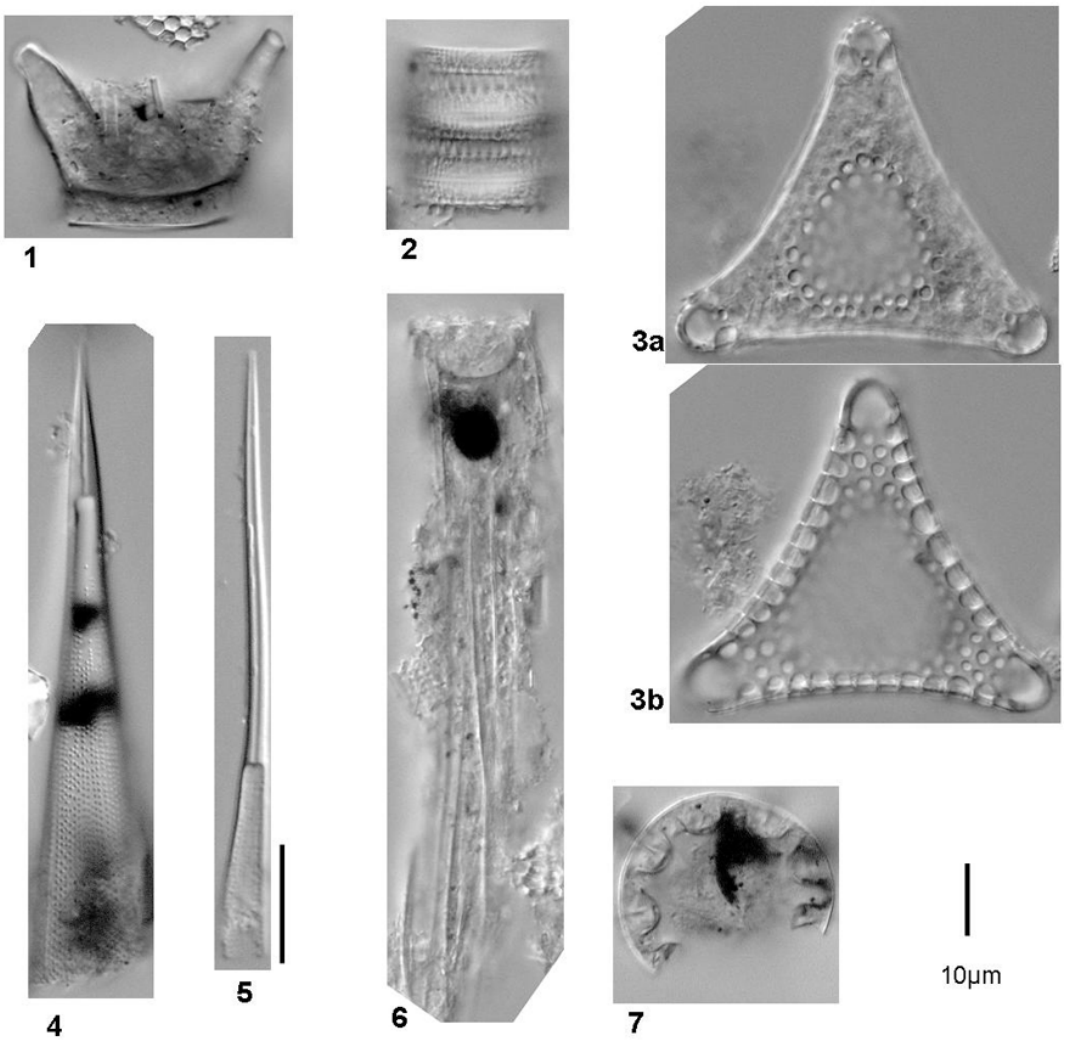

Plate P33. Diatoms from rise Site 1097. **1.** *Actinocyclus* sp. cf. *Actinocyclus actinochilus* (Sample 178-1097A-35R-CC). **2.** *Actinocyclus* sp. cf. *Actinocyclus octonarius* (Sample 178-1097A-34R-CC). **3.** *Hemidiscus*? sp. (Sample 1097A-35R-CC). **4, 5.** *Thalassiosira* spp. (Sample 178-1097A-35R-CC). **6.** *Azpeitia gombosii*? (Sample 178-1097A-34R-CC). **7.** *Actinocyclus* sp. aff. *octonarius* (Sample 178-1097A-35R-CC). ***8.*** *Thalassiosira oliverana* s.s. (Sample 178-1097A-34R-CC). **9.** *Thalassiosira* sp. cf. *Thalassiosira oliverana* var. *sparsa* (Sample 178-1097A-34R-CC).