# 6. NEOGENE AND QUATERNARY RADIOLARIANS FROM LEG 125[1]

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**ABSTRACT**

Radiolarians were recovered from three of the five holes investigated during Leg 125. Relative abundances are estimated at Holes 782A and 784A, where preservation is poor to good. Rare, poorly preserved radiolarians are present in Hole 786A. Seven radiolarian zones are recognized in the latest early- middle Miocene to early Pleistocene of Holes 782A and 784A. These zones are approximately correlated to the zones of Sanfilippo and others published in 1985.

## INTRODUCTION

Radiolarians were recovered from three of the five holes investigated during Leg 125. The localities of these Holes are: (Fig. 1):

Hole 782A: 30° 51.60′N, 141° 18.84′E,
Hole 784A: 30° 54.40′N, 140° 44.27′E, and
Hole 786A: 31° 55′N, 141° 13′E.

All holes were drilled at the abyssal depths in the Izu-Bonin Forearc in the western Pacific Ocean. A total of 97 samples were examined for this study, among which the following listed intervals are barren of radiolarians:

Hole 782A: 125-782A-3H-CC, -35X-CC, -36X-CC, -37X-CC, -39X-CC, -41X-CC, -42X-CC, and -43X-CC.
Hole 780C: 125-780C-1R-CC and -2R-CC.
Hole 780A: 125-780A-1H-CC.
Hole 786A: 125-786A-2H-CC, -4H-CC, -6H-CC, -7H-CC, -9X-CC, -10X-CC, -11X-CC, -12X-1, and -12X-CC.

In the following text and table, relative abundance of radiolarians in each sample is presented by using these symbols: A = abundant (over 50 individuals), C = common (20 to 50 individuals), F = few (5 to 20 individuals) and R = rare (1 to 5 individuals). The quality of preservation is classified as G (good), M (moderate), and P (poor).

## METHODS

1. Dry sample in an electric oven.
2. Place dried sample in a beaker and soak with water to cover the top surface of the sample.
3. Add hydrogen peroxide ($H_2O_2$). Wait for five to six days. If the sample is too viscous to disaggregate, boil it until disaggregated.
4. Wash the sample through a set of two sieves (20- and 250-mesh).
5. Dry the residue and place under a binocular microscope.

## BIOSTRATIGRAPHIC ANALYSIS

### Definition of Radiolarian Zones

We use the zones of Sanfilippo et al. (1985) in this study. The definitions of the zones are as follows:

*Calocycletta costata* Zone, Riedel and Sanfilippo, 1970.

Sample 125-782A-34X-CC is assigned to *Calocycletta costata* Zone by the presence of zonal index species together with forms such as *Dorcadospyris* cf. *dentata, Lychnocanoma elongata,* and *Stichocorys delmontensis.*

*Dorcadospyris alata* Zone, Riedel and Sanfilippo, 1970; emend. 1971.

The base of this zone is defined by the first appearance of *Dorcadospyris alata* and by the top of the *Diartus petterssoni* Zone.

*Diartus petterssoni* Zone, Riedel and Sanfilippo, 1970; emend. 1978.

The base is defined by the earliest morphotypic presence of *Diartus petterssoni* and the top by the base of the *Didymocyrtis antepenultima* Zone.

*Didymocyrtis antepenultima* Zone, Riedel and Sanfilippo, 1970; emend. 1978.

The base is defined by the earliest evolutionary appearance of the zonal marker species and the top by the base of the *Didymocyrtis penultima* Zone.

*Didymocyrtis penultima* Zone, Riedel and Sanfilippo, 1970.

The base is defined by the first appearance of *Didymocyrtis penultima* and the top by the base of the *Stichocorys peregrina* Zone.

*Stichocorys peregrina* Zone, Riedel and Sanfilippo, 1970.

The base and the top are defined by the earliest and last revolutionary appearance of *Stichocorys peregrina*, or the top by the base of the *Spongaster pentas* Zone.

*Spongaster pentas* Zone, Riedel and Sanfilippo, 1970; emend. 1978.

The base and the top are defined by the first presence and the extinction of *Spongaster pentas*.

*Amphirhopalum ypsilon* Zone, Nigrini, 1971.

The base and the top are defined by the first and last appearance of *Amphirhopalum ypsilon*.

### Radiolarians in Hole 782A

Pleistocene through early or middle Miocene radiolarian assemblages are present in Hole 782A (Table 1). A radiolarian assemblage questionably assigned to early Miocene is found in Sample 125-782A-34X-CC.

Abundant and well-preserved radiolarians of the *Calocycletta costata* Zone are characterized by the marker species of early Miocene age, *Calocycletta costata* in association with *Stichocorys delmontensis, Dorcadospyris* cf. *dentata*, as well as *Lychnocanoma elongata.* The middle Miocene radiolarian assemblages are present from Samples 125-782A-25X-CC to 125-782A-33X-CC. These samples contain two radiolarian zones: the *Dorcadospyris alata* and the *Diartus petterssoni.* Because the last occurrence of *Dorcadospyris alata* is in Samples 125-782A-28X-CC, the radiolarian assemblage from this sample to Sample 125-782A-33X-CC has been assigned to the *Dorcadospyris alata* Zone. The marker species *Diartus petterssoni* of the

[1] Fryer, P., Pearce, J. A., Stokking, L. B., et al., 1992. *Proc. ODP, Sci. Results,* 125: College Station, TX (Ocean Drilling Program).
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**Table 1. Radiolarians from Hole 782A.**

| Radiolarian zones in this study | Standard radiolarian zonation (after Sanfilippo et al., 1985) | Age | Sample (interval in cm) | Abundance | Preservation | *Amphirhopalum ypsilon* Haeckel | *Anthrocyrtidium ophirense* (Ehrenberg) | *Archipilium quasimacropus* Wang and Yang, n. sp. | *Astrophacus* sp. Ling | *Botryostrobus auritus* (Ehrenberg) group | *Botryostrobus bramlettei* Campbell and Clark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphirhopalum ypsilon Zone | *Buccinosphaera invaginata* Zone<br>*Collosphaera tubersoa* Zone<br>*Amphirhopalum ypsilon* Zone<br>*Anthrocyrtidium angulare* Zone | Quaternary | 1H-CC, 5-8 | A | G | F | • | • | • | • | • |
| | | | 2H-CC, 5-8 | R | P | F | • | • | • | • | • |
| | | | 4H-CC, 5-8 | R | P | • | • | • | • | • | • |
| | | | 5H-CC, 5-8 | F | P | F | • | • | • | • | • |
| *Stichocorys peregrina* Zone | *Pterocanium prismatium* Zone | Pliocene | 6H-CC, 5-8 | F | P | F | • | • | • | R | • |
| | | | 7H-CC, 5-8 | C | M | F | • | • | • | F | • |
| | | | 8H-CC, 2-5 | F | M | F | • | • | • | • | • |
| | | | 9H-CC, 5-8 | A | G | F | • | • | • | F | • |
| | *Spongaster pentas* Zone | | 10X-CC, 5-8 | A | G | R | • | R | • | • | • |
| | | | 11X-CC, 5-8 | A | G | R | F | • | • | F | • |
| | *Stichocorys peregrina* Zone | | 12X-CC, 5-8 | A | G | • | • | • | • | F | • |
| | | | 13X-CC, 1-4 | C | M | • | • | • | • | • | • |
| | | | 14X-CC, 6-9 | C | M | • | • | • | • | • | • |
| | | | 15X-CC, 6-9 | F | M | • | • | • | • | • | • |
| | | | 16X-CC, 4-7 | C | M | • | • | R | • | • | • |
| | | late Miocene | 17X-CC, 7-11 | F | P | • | • | • | • | • | • |
| | | | 18X-CC, 5-8 | F | P | • | • | • | • | • | • |
| | | | 19X-CC, 5-8 | C | P | • | • | • | • | • | • |
| | | | 20X-CC, 5-8 | A | G | • | F | • | • | • | • |
| | | | 21X-CC, 5-8 | C | M | • | • | • | • | • | • |
| *Didymocyr. penultima-D. antepenultima* Zone | *Didymocyrtis penultima* Zone | | 22X-CC, 5-8 | C | M | • | • | • | • | • | • |
| | *Didymocyrtis antepenultima* Zone | | 23X-CC, 5-8 | A | G | • | • | • | R | • | • |
| *Diartus petterssoni* Zone | *Diartus petterssoni* Zone | middle Miocene | 24X-2, 112-115 | A | G | • | F | • | F | • | • |
| | | | 25X-CC, 9-12 | A | G | • | F | • | F | • | • |
| *Dorcadospyris alata* Zone | *Dorcadospyris alata* Zone | | 27X-CC, 5-8 | E | G | • | • | • | F | • | • |
| | | | 28X-CC, 8-11 | C | P | • | F | • | F | • | • |
| | | | 30X-CC, 5-8 | F | P | • | F | • | F | • | • |
| | | | 31X-CC, 5-8 | A | G | • | F | • | • | • | • |
| | | | 32X-CC, 5-8 | F | M | • | • | • | F | • | • |
| | | | 33X-CC, 5-8 | F | M | • | F | • | • | • | • |
| *Calocycletta costata* Zone | *Calocycletta costata* Zone | early Miocene | 34X-CC, 5-8 | A | G | • | • | • | C | • | F |

*Diartus petterssoni* Zone of middle Miocene age is rather common in Samples 125-782A-27X-CC and -25X-CC.

*Didymocyrtis antepenultima* is in association with the zonal marker species *Didymocyrtis penultima* of the *D. penultima* Zone in Sample 125-782A-24X-2, thus, this sample has been assigned to a late Miocene age. The first and last appearances of *Stichocorys peregrina* are present in Samples 2365-782A-22X-CC to -10X-CC, respectively; this time interval represents the age range of the *Stichocorys peregrina* Zone from late late Miocene to early and middle Pliocene. The Miocene/Pliocene boundary passes through this zone and was placed at the bottom of Sample 125-782A-17X-CC, based on the last occurrence of the nannofossil *Discoaster quinqueramus* (5.66 Ma). However, note that the other two zonal species of the *Spongaster pentas* Zone and *Pterocanium prismatium* Zone of Pliocene age were not found in these samples. Only a few species of *Theocorythium vetulum, Botryostrobus auritus, Eucyrtidium matuyamai, Spongaster tetras tetras, Clathrocyclas bicornis* are present in this time-interval. The Pliocene/Pleistocene boundary has been placed at the bottom of Sample 125-782A-5H-2, based on nannofossil evidence and first occurrence of *Geophyrocapsa carribeanica.* Only one Quaternary radiolarian assemblage zone, the *Amphirhopalum ypsilon,* was identified. The other three radiolarian zones of Sanfilippo's standard radiolarian zonation (Sanfilippo at al., 1985) cannot be identified, although some important Quaternary radiolarian taxa, such as *Theocorythium trachelium trachelium* and *Lamprocyclas maritalis maritalis,* occur in these samples.

## Radiolarians in Hole 784A

Radiolarian assemblage zones in Hole 784A are similar to those in Holes 782A from middle Miocene to Quaternary in age (Table 2). In this hole, the middle Miocene radiolarian assemblages contain two zones: the lower, *Dorcadospyris alata* Zone evidenced by the appearance of *D. alata,* ranges from Samples 125-784A-31R-CC through -26R-CC; the upper zone, the *Diartus petterssoni,* ranges from Samples 125-784A-25R-CC through -23R-CC. The middle/late Miocene boundary was defined at the bottom of Sample 125-784A-23R-3 by the first occurrences of *Didymocyrtis antepenultima* and *D. penultima*. Therefore Sample 125-784A-23R-3, which yielded these zonal marker species of the *D. antepenultima* and *D. penultima* Zones, are regarded as late Miocene in age. The first and last appearances of *Stichocorys peregrina,* the zonal marker species of the *S. peregrina* Zone, were found in Samples 125-784A-22R-6 through -11R-CC. We considered this zone as late Miocene to early and middle Pliocene in age. Therefore, the Miocene/Pliocene boundary passes through this zone. Because a radiolarian-poor interval occurs in Samples 125-

**Table 1 (continued).**

| *Botryostrobus miralestensis* (Campbell and Clark) | *Calocycletta costata* (Riedel) | *Carpocanium kinugasense* Nishimura | *Clathrocyclas bicornis* Hays | *Cornutella bimarginata* Haeckel | *Cornutella profunda* Ehrenberg | *Cyrtocapsella cornuta* Haeckel | *Cyrtolagena aglaolampa* (Takahashi) | *Diartus pettersoni* (Riedel and Sanfilippo) | *Dictyocoryne profunda* (Ehrenberg) | *Dictyocoryne truncatum* (Ehrenberg) | *Dictyophimus crisiae* Ehrenberg | *Didymocyrtis antepenultima* (Riedel and Sanfilippo) | *Didymocyrtis laticonus* (Riedel) | *Didymocyrtis penultima* (Riedel) | *Didymocyrtis violina* (Haeckel) | *Dorcadospyris alata* (Riedel) | *Dorcadospyris* cf. *dentata* Haeckel | *Eucyrtidium calvertense* Martin | *Eucyrtidium hexagonatum* Haeckel | *Eucyrtidium hexastium* (Haeckel) | *Eucyrtidium matuyamai* Hays | *Eucyrtidium punctatum* Ehrenberg | *Lamprocyclas junonis* (Haeckel) | *Lamprocyclas margatensis* (Campbell and Clark) | *Lamprocyclas maritalis maritalis* Haeckel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | • | F | • | • | • | • | • | R | • | • | • | • | • | • | • | R | • | • | F | • | • | C |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • |
| • | • | • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | R | • | • | F |
| • | • | • | • | • | F | R | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • | F |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | F | • | F | • | F |
| • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F |
| • | • | • | R | • | F | • | • | • | C | • | • | • | • | • | • | • | • | • | • | • | F | R | • | • | F |
| • | • | • | • | F | • | • | • | • | F | F | F | • | • | • | • | • | • | • | • | • | F | • | • | R | F |
| • | • | • | F | C | • | • | • | • | C | • | • | • | • | • | • | • | • | • | • | • | C | F | • | • | F |
| • | • | • | F | F | • | • | • | • | F | • | F | • | • | • | • | • | • | • | • | • | F | • | F | • | F |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | F | F | • | R | R |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | F | R | • | R | R |
| • | • | • | • | • | R | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | F | • | • | R | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | R | • | • | • |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • |
| • | • | • | F | • | R | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | F | • |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • |
| • | • | • | • | F | R | • | • | • | F | • | • | • | R | F | • | • | • | F | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | • | F | • | • | F | C | C | • | • | • | • | • | • | • | • | • | C | • |
| • | • | • | • | • | • | • | • | F | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | F | F | • | • | • | C | • | • | • | • | F | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | • | F | • | • | • | C | • | • | F | • | • | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • |
| • | • | C | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | F | • | • | • | • | • | F | • |
| • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | R | • | • | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • |
| F | C | F | • | • | • | • | • | • | • | • | • | • | • | • | R | • | R | • | • | • | • | • | • | F | • |

784A-20R-6 through -18R-CC, while a new radiolarian fauna containing *Spongaster tetras tetras, Lamprocyclas maritalis maritalis, Amphirhopalum ypsilon, Clathrocyclas bicornis, Eucyrtidium matuyamai,* and *Pterocanium bicorne* reappears in Sample 125-784A-17R-CC. We have placed the Miocene/Pliocene boundary at the bottom of Sample 125-784A-17R-CC. The Pliocene/Pleistocene boundary was placed at the bottom of Sample 125-784A-4R-CC based on the last appearance of *Spongaster pentas* in Sample 125-784A-6R-CC. Only one of the Pleistocene radiolarian zones, the *Amphirhopalum ypsilon Zone, was found.*

## Radiolarians in Hole 786A

Rare, poorly preserved radiolarian assemblages are present in Hole 786A (Table 3). Zonal marker species of the standard radiolarian zonation were not found in these samples. Thus, age determination of this hole was approximated only by comparison with the assemblages present in Holes 782A and 784A.

Sample 125-786A-1H-CC has been dated as late Pliocene by the presence of *Saturnalis circularis, Spongaster tetras tetras, Lamprocyclas maritalis maritalis, Eucyrtidium matuyamai, Stichopilium bicorne, Clathrocyclas bicornis,* and *Cornutella profunda,* which correspond to the *Spongaster pentas* Zone– *Amphirhopalum ypsilon* Zone of Holes 782A and 784A.

Sample 125-784A-8X is middle Miocene in age, based on the presence of *Lamprocyclas margatensis, Theocorys spongoconum, Didymocyrtis* sp. and *Astrophacus* sp., which correspond to the *Dorcadospyris alata* Zone of Holes 784A and 782A.

### SYSTEMATIC DESCRIPTIONS

Subclass RADIOLARIA Müller, 1885
Superorder POLYCYSTINA Ehrenberg, 1838; emend. Riedel, 1967
Order SPUMELLARIA Ehrenberg, 1875
Family COLLOSPHAERIDAE Müller, 1858
Genus *OTOSPHAERA* Haeckel, 1887; emend. Nigrini, 1967

*Otosphaera auriculata* Haeckel, 1887, p. 116, Pl. 7, Fig. 5f; Ling, 1975, p. 717, Pl. 1, Fig. 5; Nishimura and Yamauchi, 1984, p. 18, Pl. 1, Fig. 10.

**Stratigraphic range**. Neogene to Holocene.

*Otosphaera* sp.
(Pl. 5, Fig. 15)

**Stratigraphic range.** Middle Miocene.

Genus *SIPHONOSPHAERA* Müller, 1858
*Siphonosphaera spinosa* (Haeckel)
(Pl. 2, Fig. 21)

*Collosphaera spinosa* Haeckel, 1862, p. 536.

**Table 1 (continued).**

| *Lychnocanoma elongata* (Vinassa) | *Otosphaera auriculata* (Haeckel) | *Otosphaera* sp. | *Perispyramis circumtexta* (Haeckel) | *Pterocanium korotnevi* (Dogiel) | *Pterocanium orcinum* (Haeckel) | *Pterocanium trilobum* (Haeckel) | *Saturnalis circularis* Haeckel | *Siphonospaera spinosa* (Haeckel) | *Siphostichoartus corona* (Haeckel) | *Spongaster tetras tetras* Ehrenberg | *Spongocore cylindrica* (Haeckel) | *Spongodiscus gigas* Campbell and Clark | *Stichocorys delmontensis (Campbell and Clark)* | *Stichocorys peregrina* (Riedel) | *Stichocorys* sp. B | *Stylacontarium acquilonium* (Hays) | *Stylotrochus (Stylotrochiscus) sol* Campbell and Clark | *Theocorys spongoconum* Kling | *Hexacontium arachnoidale Hollande and Enjumet* | *Theocorythium trachelium trachelium* (Ehrenberg) | *Theocyrtis* sp. A Nakaseko |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | F | • | • | • | R | • | • | F | • | • | • | • | • | • | • | • | F | • |
| • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | F | • |
| • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | F | • | • | F | R | • | • | • | C | • | • | • | • | • |
| • | • | • | • | • | • | • | • | R | • | • | F | • | • | • | • | C | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | F | • | • | F | R | • | • | F | F | • | • | R | • | • | • | • | R | • | • |
| • | • | • | F | • | • | • | • | • | • | • | F | • | • | R | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | R | F | • | • | F | • | • | R | • | F | • | • | • | • | • |
| • | • | • | C | • | • | • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | • |
| • | • | • | F | • | • | • | • | • | • | • | R | • | F | F | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | R | • | • | R | • | R | • | • | • | • | • |
| • | • | • | • | F | • | • | R | F | • | • | C | • | • | F | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | F | • | • | F | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | F | • | F | F | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | F | F | • | F | F | F | F | • | • | • | • | • |
| • | • | • | • | • | • | • | • | F | • | • | • | • | • | F | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | R | • | • | • | • | • | F | • | F | • | • | • | • | • |
| • | • | • | F | • | • | F | • | F | • | • | F | • | F | • | • | • | • | • | • | • | • |
| • | F | • | F | • | • | • | F | F | • | • | F | • | F | • | • | • | • | • | • | • | • |
| • | • | • | • | • | R | • | • | • | • | • | F | • | • | • | • | F | • | • | • | • | • |
| • | C | R | • | • | • | • | F | F | • | • | • | • | • | • | • | F | R | F | • | F | F |
| • | • | • | F | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • |
| • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • |
| • | • | • | • | • | • | • | R | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| C | • | • | • | • | • | • | • | • | F | • | • | • | C | • | • | • | • | • | • | • | • |

*Polysolenia spinosa* (Haeckel), Nigrini, 1967, pp. 14–15, Pl. 1, Fig. 1; Ling, 1975, p. 717, Pl. 1, Figs. 2–3.
*Acrosphaera spinosa* (Haeckel), Johnson and Nigrini, 1980, p. 119, Pl. 1, Fig. 3; Nishimura, 1987, pp. 718–719, Pl. 4, Fig. 1.
*Siphonosphaera spinosa* (Haeckel), Menshutkin and Petrushevskaya, 1989, p. 93, Fig. 7.

**Stratigraphic range.** Neogene to Quaternary.

Family ACTINOMMIDAE Haeckel 1862; emend. Riedel, 1967
Subfamily ACTINOMMINAE Haeckel, 1862; emend. Riedel 1967
Genus *ACTINOMMA* Haeckel, 1862
*Actinomma boreale* Cleve
(Pl. 4, Figs. 24, 25)

*Actinomma boreale* Cleve, 1899, p. 26, Pl.1, Fig. 5c; Nishimura and Yamauchi, 1984, p. 21, Pl. 8, Figs. 6, 8–10, 12; Pl. 43, Fig. 7; Pl. 47, Fig. 6.

**Stratigraphic range.** Quaternary to Holocene.

*Actinomma* sp.
(Pl. 5, Fig. 17)

**Stratigraphic range.** Pliocene to Holocene.

Genus *HEXACONTIUM* Haeckel, 1881
*Hexacontium arachnoidale* Hollande and Enjumet
(Pl. 2, Fig. 24; Pl. 5, Figs. 22, 23)

*Hexacontium arachnoidale* Hollande and Enjumet; 1960, p. 96, Pl. 53, Fig. 1; Nishimura and Yamauchi, 1984, p. 28, Pl. 3, Fig. 1; Pl. 45, Figs. 4a, 4b; Pl. 47, Fig. 2.

**Stratigraphic range.** Neogene to Holocene.

*Hexacontium axotrias* Haeckel
(Pl. 4, Fig. 26)

*Hexacontium axotrias* Haeckel, 1887, p. 192, Pl. 24, Fig. 3; Nishimura and Yamauchi, 1984, p. 29, Pl. 4, Fig. 11; Pl. 43, Fig. 9; Pl. 46, Fig. 3; Pl. 47, Fig. 3.

**Stratigraphic range.** Quaternary to Holocene.

Genus *STYLACONTARIUM* Popofsky, 1912
*Stylacontarium acquilonium* (Hays)
(Pl. 3, Figs. 3, 27; Pl. 4, Fig. 19)

*Druppatractus acquilonium* Hays, 1970, p. 214, Pl. 1, Figs. 4, 5; Kling, 1971, p.1086, Pl. 1, Figs. 5, 6; Ling, 1975, p. 717, Pl. 1, Figs. 17, 18.
*Stylacontariun acquilonium* (Hays), Kling, 1973b, p. 634, Pl. 1, Figs. 17–20; Pl. 14, Figs.1–4; Sakai, 1980, p. 704, Pl. 2, Figs. 2a, b; Sanfilippo et al., 1985, p. 651, Pl. 5, Fig. 3.

**Stratigraphic range.** Miocene to Quaternary.

Genus *HAECKELIELLA* Hollande and Enjumet, 1960
*Haeckeliella* sp.
(Pl. 5, Fig. 18)

**Stratigraphic range.** Neogene to Holocene.

Subfamily SATURNALINAE Deflandre, 1953
Genus *SATURNALIS* Haeckel, 1881

**Table 2. Radiolarians from Hole 784A.**

| Radiolarian zones in this study | Standard radiolarian zonation (after Sanfilippo et al., 1985) | Age | Sample (interval in cm) | Abundance | Preservation | *Actinomma boreale* (Cleve) | *Actinomma* sp. | *Amphirhopalum ypsilon* Haeckel | *Anthrocyrtidium ophirense* (Ehrenberg) | *Astrophacus* sp. Ling | *Axoprunium angelinum* Campbell and Clark | *Botryostrobus auritus* (Ehrenberg) group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Amphirhopalum ypsilon* Zone | *Buccinosphaera invaginata* Zone<br>*Collosphaera tubersoa* Zone<br>*Amphirhopalum ypsilon* Zone<br>*Anthrocyrtidium angulare* Zone | Quaternary | 1R-CC, 4-7 | A | G | • | • | F | • | • | • | • |
| | | | 2R-1, 5-8 | C | M | • | • | F | • | • | • | F |
| | | | 3R-CC, 5-8 | F | P | • | • | F | • | • | • | • |
| | | | 4R-CC, 5-8 | A | G | F | • | F | • | • | • | • |
| *Spongaster pentas* Zone | *Pterocanium prismatium* Zone | Pliocene | 6R-CC, 5-8 | A | G | F | • | R | • | • | • | F |
| | | | 7R-CC, 5-8 | C | G | • | • | • | • | • | • | R |
| | | | 8R-CC, 2-5 | A | G | • | • | R | • | • | • | R |
| | | | 9R-CC, 5-8 | C | M | • | • | • | • | • | • | • |
| | *Spongaster pentas* Zone | | 10R-CC, 5-8 | A | G | F | R | • | F | • | • | F |
| | | | 11R-CC, 5-8 | A | G | • | • | • | F | • | F | F |
| *Stichocorys peregrina* Zone | *Stichocorys peregrina* Zone | | 12R-CC, 5-8 | A | G | • | • | • | • | • | • | F |
| | | | 13R-CC, 5-8 | A | G | • | • | • | • | • | • | F |
| | | | 14R-CC, 3-6 | C | M | • | • | • | F | • | • | F |
| | | | 15R-CC, 5-8 | C | M | • | • | • | • | • | • | F |
| | | | 16R-CC, 5-8 | C | M | • | • | • | • | • | • | F |
| | | late Miocene | 17R-CC, 5-8 | C | M | • | • | • | F | • | • | F |
| | | | 18R-CC, 5-8 | F | M | • | • | • | F | • | • | • |
| | | | 19R-CC, 5-8 | C | M | • | • | • | F | • | • | • |
| | | | 20R-CC, 8-11 | A | G | • | • | • | • | • | • | • |
| | | | 21R-CC, 3-6 | E | M | • | • | • | F | • | • | • |
| *D. penultima* | *Didymocyrtis penultima* Zone | | 22R-6, 110-113 | F | M | • | • | • | • | • | • | • |
| *D. antepenultima* Zone | *Didymocyrtis antepenultima* Zone | | 23R-3, 80-83 | A | G | • | • | • | F | • | • | • |
| *Diartus petterssoni* Zone | *Diartus petterssoni* Zone | middle Miocene | 23R-CC | A | G | • | • | • | F | • | • | • |
| | | | 24R-CC, 4-7 | A | G | • | • | • | F | • | • | F |
| *Dorcadospyris alata* Zone | *Dorcadospyris alata* Zone | | 25R-CC, 5-8 | A | G | • | • | • | F | • | • | • |
| | | | 26R-CC, 5-8 | A | M | • | • | • | F | • | • | • |
| | | | 27R-CC, 5-8 | C | M | • | • | • | R | F | • | • |
| | | | 28R-CC, 5-8 | F | M | • | • | • | • | • | • | F |
| | | | 29R-CC, 5-8 | F | P | • | • | • | • | F | • | • |
| | | | 30R-5, 76-79 | F | P | • | • | • | F | • | • | • |
| | | | 31R-CC, 5-8 | F | M | • | • | • | • | • | • | • |
| | | | 39R-1, 5-8 | • | • | • | • | • | • | • | • | • |

*Saturnalis circularis* Haeckel
(Pl. 1, Figs. 14–16)

*Saturnalis circularis* Haeckel, 1887, p. 131; Nigrini, 1967, p. 25, Pl. 1, Fig. 9; Kling, 1973, p. 635, Pl.1, Figs. 21–25; Pl. 7, Figs. 1–5; Ling, 1973, p. 777, Pl. 1, Fig. 5; Chen, 1975, p. 454, Pl. 24, Fig. 2; Keany, 1979, p. 53, Pl. 1, Fig. 12; Pl. 5, Fig. 4; Nakaseko and Nishimura, 1982, p. 103, Pl.3, Figs. 1–6; Pl. 4, Figs. 1–4; Pl. 57, Fig.6; Nishimura and Yamauchi, 1984, p. 36, Pl. 5, Fig. 1; Riedel and Sanfilippo, 1977, Pl. 21, Fig. 11; Sakai, 1980, p. 709, Pl. 6, Fig. 14.

*Saturnalis planetes* Haeckel, 1887, p. 142, Pl. 16, Fig. 7; Hays, 1965, p. 167, Pl. 1, Fig. 5; Casey, 1977, Pl. 6, Fig. 5.

**Stratigraphic range.** Late Miocene to Holocene.

Family COCCODISCIDAE Haeckel, 1862; emend. Sanfilippo and Riedel, 1980
Subfamily ARTISCINAE Haeckel, 1881; emend. Riedel, 1967
Genus *DIARTUS* Sanfilippo and Riedel, 1980
*Diartus petterssoni* (Riedel and Sanfilippo)
(Pl. 1, Figs. 1, 2)

*Cannartus(?) petterssoni* Riedel and Sanfilippo, 1970, p. 520, Pl. 14, Fig. 3; Kling, 1971, p. 634, Pl. 7, Fig. 8.

*Cannartus petterssoni* Riedel and Sanfilippo, Riedel and Sanfilippo, 1978, p. 67, Pl. 4, Fig. 2; Sakai, 1980, p. 705, Pl. 4, Figs. 4, 6, 7.

*Diartus petterssoni* (Riedel and Sanfilippo), Sanfilippo and Riedel, 1980, p. 2020, text-Fig.1h; Sanfilippo et al., 1985, p. 657, Pl. 8, Figs. 10a, b; Nishimura, 1987, p. 725, Pl. 4, Figs. 10–13; Pl. 6, Figs. 2–6.

**Stratigraphic range.** Late middle Miocene (the *Diartus petterssoni* Zone).

*Diartus* cf. *petterssoni* (Riedel and Sanfilippo)
(Pl. 1, Fig. 6)

**Stratigraphic range.** Early late Miocene.

Genus *DIDYMOCYRTIS* Haeckel, 1860; emend. Sanfilippo and Riedel, 1980
*Didymocyrtis penultima* (Riedel)
(Pl. 1, Fig. 5)

*Panarium penultimum* Riedel, 1957, p. 76, Pl. 1, Fig. 1.

*Ommatartus penultimus* (Riedel), Westberg and Riedel, 1978, p. 22, Pl. 2, Figs. 6–8.

*Didymocyrtis penultima* (Riedel), Sanfilippo and Riedel, 1980, p. 1010, Fig. 1, f; Sanfilippo et al., 1985, p. 658, Pl. 8, Figs. 7a, 7b.

**Stratigraphic range.** Late late Miocene (base of *Didymocyrtis penultima* Zone) to early Pliocene, *Spongaster pentas* Zone.

*Didymocyrtis laticonus* (Riedel)
(Pl. 1, Figs. 3–4, 7–8)

*Cannartus laticonus* Riedel, 1959, p. 291, Pl. 1, Fig. 5; Riedel and Sanfilippo, p. 1971, Pl. 1c, Figs. 13–14; Moore, 1971, p. 736, Pl. 12, Fig. 6; Kling, 1973, p. 634, Pl. 7, Fig. 7; Westberg and Riedel, 1978, p. 22, Pl. 2, Figs. 1–3; Wolfart, 1981, p. 497, Pl. 5, Figs. 6–7.

*Didymocyrtis laticonus* (Riedel), Sanfilippo and Riedel, 1980, p. 1010, Fig. 1, e; Sanfilippo et al., 1985, p. 658, Pl. 8, Figs. 5a, 5b.

**Table 2 (continued).**

| *Calocycletta costata* (Riedel) | *Carpocanium kinugasense* Nishimura | *Clathrocyclas bicornis* Hays | *Cornutella bimarginata* Haeckel | *Cornutella profunda* Ehrenberg | *Diartus petterssoni* (Riedel and Sanfilippo) | *Diartus* cf. *petterssoni* (Riedel and Sanfilippo) | *Dictyocoryne profunda* (Ehrenberg) | *Dictyocoryne truncatum* (Ehrenberg) | *Dictyophimus crisiae* Ehrenberg | *Didymocyrtis antepenultima* (Riedel and Sanfilippo) | *Didymocyrtis laticonus* (Riedel) | *Didymocyrtis penultima* (Riedel) | *Didymocyrtis* sp. | *Didymocyrtis* sp. A | *Dorcadospyris alata* (Riedel) | *Eucyrtidium hexagonatum* Haeckel | *Eucyrtidium hexastium* (Haeckel) | *Eucyrtidium matuyamai* Hays | *Eucyrtidium punctatum* Ehrenberg | *Haeckeliella* sp. | *Heliodiscus asteriscus* Haeckel | *Hexacontium arachnoidale* Hollande and Enjumet | *Hexacontium axotrias* Haeckel | *Hexacontium heracliti* Haeckel | *Lamprocyclas junonis* (Haeckel) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | • | • | • | C | F | • | • | • | • | • | • | • | • | • | • | F | • | F | F | • | F | • |
| • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | R | • | • | • | • |
| • | • | • | • | • | • | • | C | • | • | • | • | • | • | • | • | • | • | • | F | • | F | • | • | C | F |
| • | • | • | • | F | • | • | F | • | R | • | • | • | • | • | • | F | • | F | F | • | • | • | • | • | • |
| • | • | R | F | • | • | • | F | F | • | • | • | • | • | • | • | • | • | F | F | • | • | • | • | • | • |
| • | • | R | F | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | F | • | F | • | • | • | • |
| • | • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | F | • | F | F | • | F | • | • | • | • |
| • | • | • | F | • | • | • | C | C | • | • | • | • | • | • | • | • | • | F | F | • | F | • | • | • | F |
| • | • | • | • | F | • | • | C | • | • | • | • | • | • | • | • | • | F | F | R | • | F | • | • | • | F |
| • | • | F | • | F | • | • | C | • | • | • | • | • | • | • | • | • | F | F | F | • | F | • | • | • | • |
| • | • | • | • | F | • | • | C | • | F | • | • | • | • | • | • | • | F | F | F | • | • | • | • | • | • |
| • | • | • | F | F | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | F | • | • | • | • |
| • | • | • | F | F | • | • | F | • | F | • | • | • | • | • | • | • | • | F | • | • | • | • | R | • | • |
| • | • | F | F | F | • | • | • | • | F | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | F |
| • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | F | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | F | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | R | F | • | • | • | • |
| • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | • | F | F | • | • | F | C | C | R | F | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | F | • | F | • | • | • | C | • | • | F | • | F | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | F | • | F | • | F | • | F | • | R | • | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | F | • | • | • | • | • | F | • | F | • | • | • | • | • | • | • | F | • | • | • | • |
| • | • | • | • | • | • | • | F | • | • | • | • | • | F | • | R | • | • | • | • | • | • | F | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • |
| • | F | • | • | • | • | • | R | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • |
| F | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| F | F | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |

**Stratigraphic range.** Late middle and early late Miocene.

*Didymocyrtis* sp.
(Pl. 1, Figs. 20–21)

**Stratigraphic range.** Middle and late Miocene.

Family PHACODISCIDAE Haeckel, 1881
Genus *ASTROPHACUS* Haeckel, 1881
*Astrophacus* sp. Ling
(Pl. 1, Fig. 176, Pl. 2, Fig. 9)

*Astrophacus* sp. Ling, 1975, p. 725, Pl. 2, Figs. 18–20.

**Remarks.** This indeterminate species may be a new species.

**Stratigraphic range.** Middle Miocene to early Pliocene.

Family PORODISCIDAE Haeckel, 1881, emend. Petrushevskaya and Kozlova, 1972
Genus *AMPHIRHOPALUM* Haeckel, 1887
*Amphirhopalum ypsilon* Haeckel
(Pl. 2, Figs. 26–29)

*Amphirhopalum ypsilon* Haeckel 1887, p. 522; Nigrini, 1967, p. 35, Pl. 3, Figs. 3a–d; 1971, p. 447, Pl. 34.1, Figs. 7a–c; Ling, 1975, p. 725, Pl. 4, Fig. 2; Riedel and Sanfilippo, 1977, Pl. 21, Fig. 14; Nishimura and Yamauchi, 1984, p. 37, Pl. 19, Fig. 16; Pl. 54, Figs. 8–9.

**Stratigraphic range.** Pleistocene to Holocene.

Family SPONGODISCIDAE Haeckel, 1986; emend. Riedel, 1967
Genus *SPONGASTER* Ehrenberg, 1860; emend. Riedel and Sanfilippo, 1981
*Spongaster tetras tetras* Ehrenberg
(Pl. 2, Fig. 22; Pl. 5, Fig. 14)

*Spongaster tetras* Ehrenberg, 1860, p. 833; 1872, p. 299, Pl. 6(3), Fig. 8.
*Spongaster tetras tetras* Ehrenberg, Nigrini, 1967, p. 41, Pl. 5, Figs. 1a–b; Riedel and Sanfilippo, 1971, Pl. 1D, Figs. 2–4; 1978, p. 74, Pl. 2, Figs. 2–3; Nishimura and Yamauchi, 1984, p. 39, Pl. 19, Figs. 14–15; Sanfilippo et al., 1985, p. 661, Pl. 9, Figs. 1a–c.

**Stratigraphic range.** Late Pliocene (upper part of the *Spongaster pentas* Zone) to Holocene.

*Spongaster pentas* Riedel and Sanfilippo
(Pl. 4, Figs, 20, 27)

*Spongaster pentas* Riedel and Sanfilippo, 1970, p. 523, Pl. 14, Fig. 3; 1971, p. 1589, Pl. 1D, Figs. 5–7; 1978. p. 74, Pl. 2, Figs 5–8; Sanfilippo et al., 1985, Pl. 661, Pl. 9, Figs. 2 a, b.

**Stratigraphic range.** Middle Pliocene.

Subgenus *STYLOTROCHISCUS* Haeckel, 1887

*Stylotrochus (Stylotrochiscus) sol* Campbell and Clark, 1944, p. 28, Pl. 4, Figs. 7, 9–11.

**Stratigraphic range.** Eocene to Holocene.

**Table 2 (continued).**

| *Lamprocyclas margatensis* (Campbell and Clark) | *Lamprocyclas maritalis maritalis* Haeckel | *Lamprocyclas maritalis polypora* Nigrini | *Lamprocyclas* sp. A | *Liriospyris mutuaria* Goll | *Lithomitra infundibulum* Haeckel | *Lithopera neotera* Sanfilippo and Riedel | *Lychnocanium nipponicum* Nakaseko | *Lychnocanoma elongata* (Vinassa) | *Otosphaera auriculata* (Haeckel) | *Perispyramis circumtexta* (Haeckel) | *Pterocanium bicorne* Haeckel | *Pterocanium korotnevi* (Dogiel) | *Pterocanium orcinum* (Haeckel) | *Pterocanium praetextum eucolpum* Haeckel | *Pterocanium* sp. | *Pterocanium sp. B* | *Saturnalis circularis* Haeckel | *Siphonospaera spinosa* (Haeckel) | *Siphostichoartus corona* (Haeckel) | *Spongaster tetras tetras* Ehrenberg | *Spongaster pentas* | *Spongocore cylindrica* (Haeckel) | *Stichocorys delmontensis* (Campbell and Clark) | *Stichocorys peregrina* (Riedel) | *Stichocorys* sp. B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | C | F | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | F | • | C | • | • | • |
| • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | F | • | F | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | F | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | F | • | F | • | C | • | • | • |
| • | F | • | • | • | • | • | • | • | • | F | • | F | • | R | • | • | F | • | • | F | R | F | • | • | • |
| • | F | • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | F | F | • | F | • | F | • | • | • |
| • | F | • | • | • | • | • | • | • | • | R | • | • | • | • | • | • | • | F | • | R | • | F | • | • | • |
| • | F | • | • | • | • | • | • | • | • | F | • | F | • | F | • | • | F | F | • | F | • | F | • | • | • |
| • | F | • | • | • | • | • | F | • | • | F | F | • | • | F | • | F | F | F | • | F | • | C | • | F | • |
| • | F | • | • | • | • | • | • | • | • | F | F | • | • | • | F | F | F | F | • | F | • | F | • | R | • |
| • | • | • | • | • | • | • | R | • | • | F | • | F | • | F | • | • | C | • | • | F | • | C | • | • | • |
| • | F | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | R | • |
| • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | F | • | R | • |
| • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • |
| • | • | • | • | • | • | • | • | • | • | F | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | R | • |
| F | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | F | • | • | • | • | • | F | • |
| F | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | F | F | • |
| F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | F | • |
| F | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | F | F | • |
| F | • | • | • | • | • | • | F | • | F | F | • | • | • | • | • | • | • | F | F | • | • | • | • | • | • |
| F | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | F | • | • | • | • | F | • | • |
| F | • | • | • | • | • | • | • | • | • | • | • | • | R | • | • | • | F | F | • | • | • | • | F | • | • |
| F | • | • | • | • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • |
| F | • | • | F | F | • | • | • | • | • | F | • | • | • | • | • | • | F | • | • | • | • | • | F | • | • |
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| F | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | F | F | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | F | • | • |
| • | • | • | • | • | • | F | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |

Genus *SPONGODISCUS* Ehrenberg, 1854
*Spongodiscus gigas* Campbell and Clark
(Pl. 5, Fig. 10)

*Spongodiscus gigas* Campbell and Clark, 1944, p. 27, Pl. 4, Figs. 1, 3.

**Stratigraphic range.** Miocene to Pleistocene.

Genus *DICTYOCORYNE* Ehrenberg, 1860
*Dictyocoryne profunda* Ehrenberg
(Pl. 2, Fig. 23; Pl. 5, Fig. 13)

*Dictyocoryne profunda* Ehrenberg, 1980, p. 767; 1872, p. 288, Pl. 7, Fig. 23; Nishimura and Yamauchi, 1984, p. 38, Pl. 19, Fig. 13; Pl. 20, Figs. 1–7, 9.
*Hymeniastrum eulidis* Haeckel, 1887, p. 531, Pl. 43, Fig. 13.

**Stratigraphic range.** Neogene to Holocene.

*Dictyocoryne truncatum* (Ehrenberg)
(Pl. 5, Fig. 12)

*Rhopalodictyum truncatum* Ehrenberg, 1861, P. 301.
*Dictyocoryne truncatum* (Ehrenberg), Nigrini and Moore, 1979, p. 89, Pl. 12, Figs. 2a, b; Nishimura and Yamauchi, 1984, p. 39, Pl. 20, Figs. 8, 10–12; Pl. 53, Figs. 3, 12.

**Stratigraphic range.** Neogene to Holocene.

Genus *SPONGOCORE* Haeckel, 1887
*Spongocore cylindrica* (Haeckel)
(Pl. 2, Figs. 12–14)

*Spongurus cylindricus* Haeckel, 1862, p. 465, Pl. 27, Fig. 1.
*Spongocore puella* Haeckel, 1887, p. 347, Pl. 48, Fig. 6; Nigrini, 1970, p. 168, Pl. 2, Fig. 3; Kling, 1973, p. 6356, Pl. 7, Figs. 18–122.
*Spongocore cylindrica* (Haeckel), Nishimura and Yamauchi, 1984, pp. 39–40, Pl. 16, Figs. 5, 6; Pl. 52, Figs. 8, 9.

**Stratigraphic range.** Neogene to Holocene.

Order NASSELLARIA Ehrenberg, 1875
Suborder SPYRIDA Ehrenberg, 1847; emend. Petrushevskaya, 1971
Family TRIASSOCYCLIDAE Haeckel, 1881; emend. Goll 1968.
Genus *LIRIOSPYRIS* Haeckel, 1881
*Liriospyris mutuaria* Goll
(Pl. 1, Fig. 18)

*Liriospyris mutuaria* Goll, 1968, pp. 1428–1429, Pl. 175, Figs. 6, 10, 11, 14, text-Fig. 9; Goll, 1972, p. 967, Pl. 71, Fig. 2; Riedel and Sanfilippo, 1977, pp. 868–9, Pl. 16, Fig. 15.

**Stratigraphic range.** Lower and middle Miocene.

*Liriospyris* sp.
(Pl. 1, Fig. 19)

**Stratigraphic range.** Middle Miocene.

**Table 2 (continued).**

| *Stichocorys* sp. A | *Stylacontarium acquilonium* (Hays) | *Stylotrochus (Stylotrochiscus) sol* Campbell and Clark | *Theocorys spongoconum* Kling | *Theocorythium vetulum* Nigrini | *Theocyrtis* sp. A Nakaseko |
|---|---|---|---|---|---|
| • | F | • | • | • | • |
| • | • | • | • | • | • |
| • | • | • | • | • | • |
| • | F | • | • | • | • |
| • | • | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | • | • | • | • | • |
| • | F | • | • | F | • |
| • | F | • | • | • | • |
| • | F | • | • | F | • |
| • | F | • | • | F | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | • | • |
| • | F | • | • | F | • |
| • | • | • | • | F | • |
| • | • | • | • | F | • |
| R | • | • | • | F | • |
| • | • | • | • | F | • |
| • | F | • | F | F | • |
| • | • | F | • | F | • |
| • | F | F | • | • | • |
| • | F | • | • | • | • |
| • | R | • | R | • | F |
| • | • | • | • | • | • |
| • | F | • | • | • | F |
| • | • | • | F | • | F |
| • | • | • | • | • | • |

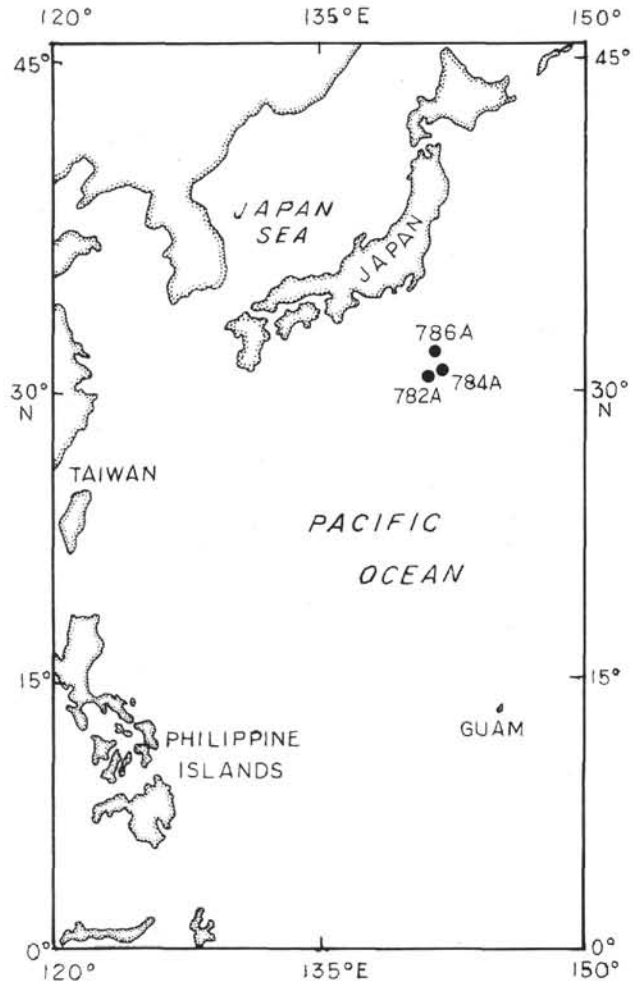


Figure 1. Map showing location of Holes 782A, 784A, and 786A.

Genus *DORCADOSPYRIS* Haeckel, 1881
*Dorcadospyris alata* (Riedel)
(Pl. 1, Fig. 22)

*Brachiospyris alata* (Riedel), Riedel and Sanfilippo, 1971, p. 1590. Pl. 2D, Fig. 1; Goll, 1972, Pl. 4, Figs. 1–3; Pl. 41, Figs. 1–3; Riedel and Sanfilippo, 1978, p. 68, Pl. 5, Fig. 2; Sanfilippo et al., 1985, p. 661, Pl. 10, Fig. 7; Nishimura, 1987, p. 725, Pl. 5, Fig. 20.

**Stratigraphic range**. Middle Miocene (the *Dorcadospyris alata* Zone).

*Dorcadospyris* sp. cf. *D. dentata* Haeckel
(Pl. 1, Figs. 23, 24)

*Dorcadospyris dentata* Haeckel, 1887, p. 1040, Pl. 85, Fig. 6; Riedel, 1957, p. 79, Pl. 1, Fig. 4; Riedel and Sanfilippo, 1971, p. 1590, Pl. 2D, Figs. 2, 3; Riedel and Sanfilippo, 1978, p. 68, Pl. 5, Fig. 4; Sakai, 1980, p. 712, Pl. 10, Figs. 9, 10.

**Remarks.** The illustrated forms are similar to Figures 9 and 10 reported by Sakai (1980) without an apical horn. These forms are probably transition for *D. dentata* to *D. alata*.

**Stratigraphic range.** Late early Miocene.

Superfamily EUCYRTIDOIDEA Ehrenberg, 1847; emend. Petrushevskaya, 1971
Family CARPOCANIIDAE Haeckel, 1881; emend. Riedel, 1967b
Subfamily CARPOCANIINAE Haeckel, 1881
Genus *CARPOCANIUM* Ehrenberg (s.s.), 1847

*Carpocanium kinugasense* Nishimura
(Pl. 2, Figs. 1, 2)

*Carpocanium kinugasense* Nishimura, 1990, pp.167–168, Pl. 41, Figs. 1, 3, 6–9; Pl. 42, Figs. 1, 2.
*Carpocanistrum* sp. c, Ling, 1975, p. 730, Pl. 21, Fig. 5; Ling, 1980. p. 367, Pl. 2, Fig. 19.
*Carpocanistrum* sp., Johnson, 1974, Pl. 8, Fig. 2.

**Stratigraphic range.** Middle Miocene.

Family ARTOSTRONIIDAE Riedel, 1967; emend. Foreman, 1973
Subfamily ARTOSTROBIINAE Petrushevskaya and Kozlova, 1972
Genus *SIPHOSTICHOARTUS* Nigrini, 1977
*Siphostichoartus corona* (Haeckel)
(Pl. 2, Fig. 10)

*Cyrophormis (Acanthocyrtis) corona* Haeckel, 1887, p. 1426, Pl. 77, Fig. 15.
*Lithostrobus* cf. *botryocyrtis* (Haeckel), Nakaseko, 1963, pp. 185–186, Pl. 3, Fig. 11.
*Phoromostichoartus corona* (Haeckel), Riedel and Sanfilippo, 1970, p. 1600, Pl. 11, Figs. 13–15; Pl. 2j, Figs. 1–5; 1977, p. 878, Pl. 20, Fig. 11; 1978, p. 71, Pl. 7, Fig. 12; Ling, 1975, p. 732, Pl. 13, Fig. 13.
*Siphostichoartus corona* (Haeckel), Nigrini, 1977, p. 257, Pl. 2, Figs. 5–7; Nishimura, 1987, p. 728, Pl. 5, Fig. 19.
*Theocamptra corona* (Haeckel) group, Petrushevskaya and Kozlova, 1972, p. 538, Pl. 23, Figs. 24, 25.

**Stratigraphic range.** Late early Miocene (the *Calocycletta costata* Zone) to early Pliocene (the *Stichocorys peregrina* Zone).

**Table 3. Radiolarians from Hole 786A.**

| Radiolarian zones in this study | Standard radiolarian zonation (after Sanfilippo et al., 1985) | Age | Sample (interval in cm) | Abundance | Preservation | *Amphirhopalum ypsilon* Haeckel | *Astrophacus* sp. | *Botryostrobus auritus* (Ehrenberg) group | *Clathrocyclas bicornis* Hays | *Cornutella bimarginata* Haeckel | *Cornutella profunda* Ehrenberg | *Dictyocoryne profunda* (Ehrenberg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Amphirhopalum ypsilon* Zone to *Spongaster pentas* Zone | *Pterocanium prismatium* Zone | Pliocene | 1H-6, 144-147 | F | P | R | • | • | • | • | • | • |
| | *Spongaster pentas* Zone | | 1H-CC, 5-8 | C | M | R | • | F | R | F | R | F |
| | *Stichocorys peregrina* Zone | | | | | | | | | | | |
| *Didymocyrtis penultima* Zone | *Didymocyrtis penultima* Zone / *Didymocyrtis antepenultima* Zone | late Miocene | 5X-CC, 5-8 | F | P | • | • | • | • | • | • | • |
| | *Diartus petterssoni* Zone | | | | | | | | | | | |
| *Dorcadospyris alata* Zone | *Dorcadospyris alata* Zone | middle Miocene | 8X-CC, 3-6 | F | P | • | R | • | • | • | • | • |

Genus *BOTRYOSTROBUS* Haeckel, 1887; emend. Nigrini, 1977
*Botryostrobus auritus* (Ehrenberg) group
(Pl. 2, Figs. 7, 8)

*Lithocampe aurita* Ehrenberg, 1844, p. 84; 1854, Pl. 22, Fig. 25.
*Artostrobium auritum* (Ehrenberg) group, Riedel and Sanfilippo, 1971, p. 1599, Pl. 1H, Figs. 5–8; Riedel et al., 1974, p. 713, Pl. 61, Fig. 7; Kling, 1973, p. 639, Pl. 5, Figs. 27–31; Pl. 12, Figs. 24–27; Pl. 23, Fig. 11; Riedel and Sanfilippo, 1977, p. 878, Pl. 23, Fig. 11; 1978, p. 122, Pl. 6, Figs. 10–12.
*Botryostrobus auritus* (Ehrenberg) group, Petrushevskaya and Kozlova, 1972, p. 539, Pl. 24, Figs. 15–18; Nigrini, 1977, pp. 246–248, Pl. 1, Figs. 2–5.

**Stratigraphic range.** Early middle Miocene (the *Dorcadospyris alata* Zone) to Quaternary.

*Botryostrobus bramlettei* (Campbell and Clark)
(Pl. 2, Fig. 6)

*Lithomitra bramlettei* Campbell and Clark, 1944, p. 53, Pl. 7, Figs. 10–14.
*Artostrobium auritum* (Ehrenberg) group, Riedel and Sanfilippo, 1971, p. 1599, Pl. 1H, Fig. 8.
*Botryostrobus bramlettei* (Campbell and Clark), Nigrini, 1977, pp. 248–249, Pl. 1, Figs. 7, 8.

**Stratigraphic range.** Middle and late Miocene.

*Botryostrobus miralestensis* (Campbell and Clark)
(Pl. 4, Figs. 1, 2)

*Dictyocephalus miralestensis* Campbell and Clark, 1944, p. 45, Pl. 6, Figs. 12–14.
*Artostrobium miralestense* (Campbell and Clark), Riedel and Sanfilippo, 1971, p. 1599, Pl. 1H, Figs. 14–17; Pl. 2I, Figs. 9, 10.
*Botryostrobus miralestensis* (Campbell and Clark), Petrushevskaya and Kozlova, 1972, p. 539, Pl. 24, Fig. 31; Nigrini, 1977, p. 249, Pl. 1, Fig. 9; Nishimura, 1987, p. 720, Pl. 5, Fig. 18.

**Stratigraphic range.** Middle Miocene.

Family SETHOPHORMIDIDAE Haeckel, 1881; emend. Petrushevskaya, 1971
Genus *CLATHROCYCLAS* Haeckel, 1887
*Clathrocyclas bicornis* Hays
(Pl. 3, Figs. 16, 17)

*Clathrocyclas bicornis* Hays, 1965, p. 179, Pl. 3, Fig. 3; Chen, 1983, p. 489, Pl. 12, Figs. 8, 9; Pl. 2, Fig. 5; Weaver, 1983, p. 675, Pl. 2, Fig. 5; Nishimura and Yamauchi, 1984, p. 49, Pl. 36, Figs. 8, 12.

**Stratigraphic range.** Late Miocene to early Pliocene.

Genus *THEOCYRTIS* Haeckel, 1887
*Theocyrtis* sp. A, Nakaseko
(Pl. 3, Figs. 14, 15)

Theocyrtis sp. A, Nakaseko, 1963, pp. 180–181, text-Fig. 13; Pl. 2, Figs. 6a-b, 9a-b.

**Stratigraphic range.** Miocene.

Family PTEROCORYIDAE Haeckel, emend. Riedel 1967
Genus *CALOCYCLETTA* Haeckel, 1887
*Calocycletta costata* (Riedel)
(Pl. 1, Figs. 9–11)

*Calocyclas costata* Riedel, 1959, p. 296, Pl. 2, Fig. 9.
*Calocycletta costata* (Riedel), Riedel and Sanfilippo, 1970, p. 1598, Pl. 2H, Figs. 12–14; Moore, 1972, p. 147, Pl. 1, Fig. 8; Petrushevskaya and Kozlova, 1972, p. 544, Pl. 35, Fig. 17; Johnson, 1974, p. 550, Pl. 8, Fig. 9; Wolfart, 1981, p. 497, Pl. 4, Fig. 6; Sanfilippo et al., 1985, p. 691, Pl. 28, Figs. 3a–b; Nishimura, 1987, p. 721, Pl. 5, Fig. 15.

**Stratigraphic range.** Latest early and early middle Miocene (the *Calocycletta costata* Zone).

Genus *THEOCORYTHIUM* Haeckel, 1887
*Theocorythium vetulum* Nigrini
(Pl. 2, Fig. 19)

*Theocorythium vetulum* Nigrini, 1971, p. 447, Pl. 34.1, Fig. 6; Kling, 1973, Pl. 5, Fig. 8; Sanfilippo and Riedel, 1974, Pl. 4, Figs. 6, 7; Riedel and Sanfilippo, 1978, p. 76, Pl. 9, Fig. 18; Sakai, 1980, p. 711, Pl. 10, Figs. 3a–b; Sanfilippo et al., 1985, p. 700, Pl. 31, Figs. 2a–c.

**Stratigraphic range.** Middle and late Pliocene (the *Spongaster pentas* Zone to the *Pterocanium prismatium* Zone).

*Theocorythium trachelium trachelium* (Ehrenberg)
(Pl. 4, Figs. 17, 18)

*Eucyrtidium trachelium* Ehrenberg, 1872a, p. 312; 1872b, p. 93, Pl. 7, Fig. 8.
*Calocyclas amicae* Haeckel, 1887, p. 1382, Pl. 74, Fig. 2.
*Calocyclas vestalis* Haeckel, 1887, p. 1382, p. 74, Fig. 3.
*Theocorythium trachelium trachelium* (Ehrenberg), Nigrini, 1967, p. 79, Pl. 8, Fig. 2; Pl. 9, Fig. 2; 1970, p. 172, Pl. 4, Fig. 10; Riedel and Sanfilippo, 1978, p. 76, Pl. 9, Fig. 17; Nishimura and Yamauchi, 1984, p. 64, Pl. 38, Figs. 9–12.

**Stratigraphic range.** Quaternary to Holocene.

Genus *LAMPROCYCLAS* Haeckel, 1881
*Lamprocyclas margatensis* (Campbell and Clark)
(Pl. 3, Figs. 22–24)

**Table 3 (continued).**

| *Didymocyrtis* sp. | *Eucyrtidium hexastium* (Haeckel) | *Eucyrtidium matuyamai* Hays | *Eucyrtidium punctatum* Ehrenberg | *Haeckeliella* sp. | *Hexacontium* sp. | *Lamprocyclas margatensis* (Campbell and Clark) | *Lamprocyclas maritalis maritalis* Haeckel | *Liriospyris* sp. | *Otosphaera auriculata* (Haeckel) | *Peripyramis circumtexta* Haeckel | *Pterocanium trilobum* (Haeckel) | *Saturnalis circumtexta* Haeckel | *Siphonospaera spinosa* (Haeckel) | *Spongaster tetras tetras* Ehrenberg | *Spongocore cylindrica* (Haeckel) | *Stichopilium bicorne* (Haeckel) | *Stylacontarium acquilonium* (Hays) | *Theocorys spongoconum* Kling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | R | • | R | • |
| • | F | F | F | F | • | • | F | • | • | F | R | F | • | F | • | R | F | • |
| • | • | • | • | • | R | • | • | • | • | • | • | • | • | • | • | • | R | • |
| | | | | | | | | | R | • | • | • | F | • | • | • | R | R |

*Calocyclas margatensis* Campbell and Clark, 1944, p. 47, Pl. 6, Figs. 17, 18; Nakaseko, 1963, p. 178, Pl. 2, Figs. 1, 2.
*Lamprocyclas margatensis* (Campbell and Clark), Caulet, 1986, p. 852, Pl. 4, Fig. 3.

**Stratigraphic range.** Miocene to Pleistocene.

*Lamprocyclas maritalis maritalis* Haeckel
(Pl. 3, Figs. 25, 26)

*Lamprocyclas maritalis* Haeckel, 1887, p. 1390, Pl. 74, Figs. 13, 14.
*Lamprocyclas maritalis maritalis* Haeckel, Nigrini, 1967, p. 74–76, Pl. 7, Fig. 5; Takahashi and Honjo, 1981, p. 154, Pl. 9, Fig. 26; Wolfart, 1981, p. 498, Pl. 2, Fig. 11; Nishimura and Yamauchi, 1984, p. 63, Pl. 37, Figs. 5, 7–11.
*Lamprocyclas nuptialis* Haeckel, 1887, p. 1390, Pl. 74, Fig. 15; Nishimura, 1990, p. 147, Pl. 31, Figs.1–4, 6.

**Stratigraphic range.** Pliocene to Holocene.

*Lamprocyclas maritalis polypora* Nigrini
(Pl. 2, Fig. 17)

*Lamprocyclas maritalis polypora* Nigrini, 1967, p. 76, Pl. 7, Fig. 6; Nigrini, 1970, pp. 171–72, Pl. 4, Fig. 9.

**Stratigraphic range.** Pliocene to Holocene.

*Lamprocyclas junonis* (Haeckel)
(Pl. 2, Fig. 25; Pl. 5, Figs. 1, 2)

*Theoconus junonis* Haeckel, 1887, p. 1401, Pl. 69, Fig. 7.
*Lamprocyclas junonis* (Haeckel), Petrushevskaya and Kozlova, 1972, p. 545, Pl. 36, Fig. 8; Caulet, 1986, p. 853, Pl. 4, Fig. 10.

**Stratigraphic range.** Pliocene to Quaternary.

*Lamprocyclas* sp. A
(Pl. 2, Fig. 18)

**Stratigraphic range.** Middle Miocene.

Genus *ANTHOCYRTIDIUM* Haeckel, 1881
*Anthocyrtidium ophirense* (Ehrenberg)
(Pl. 4, Figs. 10–12)

*Anthocorys ophirensis* Ehrenberg, 1872, p. 284, Pl. 9, Fig. 13.
*Anthocyrtidium ophirense* (Ehrenberg), Nigrini, 1967, p. 56, Pl. 6, Fig. 3; Takahashi and Honjo, 1981, p. 154, Pl. 9, Fig. 22; Nishimura and Yamauchi, 1984, p. 62, Pl. 37, Figs. 1–4.

**Stratigraphic range.** Pliocene to Holocene.

Family EUCYRTIDIIDAE Ehrenberg, 1847; emend. Petrushevskaya, 1971
Genus *CYRTOCAPSELLA* Haeckel
*Cyrtocapsella cornuta* Haeckel
(Pl. 2, Fig. 15)

*Cyrtocapsa (Cyrtocapsella) cornuta* Haeckel, 1887, p. 1513, Pl. 78, Fig. 9.
*Cyrtocapsa cornuta* Haeckel, Sanfilippo and Riedel, 1970, p. 453, Pl. 1, Figs. 19, 20; Sanfilippo et al., 1973, p. , Pl. 5, Figs. 1–2; Holdsworth, 1975, Pl. 2, Figs. 1–3, 5–8, 10; Sanfilippo et al., 1985, p. 670, Pl. 16, Figs. 2a, 2b.

**Stratigraphic range.** Late early and middle Miocene.

*Cyrtocapsella tetrapera* Haeckel
(Pl. 2, Fig. 16)

*Cyrtocapsa (Cyrtocapsella) tetrapera* Haeckel, 1887, p. 1512, Pl. 78, Fig. 5; Nishimura, 1990, p. 126, Pl. 40, Figs. 1, 2.
*Cyrtocapsella tetrapera* Haeckel, Sanfilippo and Riedel, 1970, p. 453, Pl. 1, Figs. 16–18; Riedel and Sanfilippo, 1971, p. 1594, Pl. 2E, Figs. 5–7; p. 68, Pl. 4, Fig. 18; Sanfilippo et al., 1973, Pl. 5, Figs. 4–6; Holdsworth, 1975, p. 530, Pl. 2, Figs. 9, 13–15; Chen, 1975, p. 460, Pl. 20, Fig. 1; Sakai, 1980, p. 709, Pl. 8, Figs. 5–6; Nishimura, 1987, p. 724, Pl. 5, Fig. 2.

**Stratigraphic range.** Late early and middle Miocene.

Genus *STICHOCORYS* Haeckel, 1881
*Stichocorys delmontensis* (Campbell and Clark)
(Pl. 2, Figs. 3–5; Pl. 4, Figs. 16, 23)

*Eucyrtidium delmontense* Campbell and Clark, 1944, p. 56, Pl. 7, Figs. 19, 20.
*Stichocorys delmontensis* (Campbell and Clark), Sanfilippo and Riedel, 1970, p. 451, Pl. 1, Fig. 9; Sanfilippo et al., 1973, Pl. 6, Fig. 3; Riedel and Sanfilippo, 1978 p. 74, Pl. 9, Fig. 10; Westberg and Riedel, 1978, Pl. 3, Figs. 1–5; Sanfilippo et al., 1985, p. 681, Pl. 23, Figs. 1a–b.

**Stratigraphic range.** Middle early through late Miocene.

*Stichocorys peregrina* (Riedel)
(Pl. 4, Figs. 13, 15)

*Eucyrtidium elongatum peregrina* Riedel, 1953, p. 812, Pl. 85, Fig. 2.
*Stichocorys peregrina* (Riedel), Sanfilippo and Riedel, 1970, p. 451, Pl. 1, Fig. 10; Kling, 1973, p. 638, Pl. 4, Fig. 27; Pl. 11, Fig. 29; Pl. 13, Figs. 9, 10; Riedel et al., 1974, p. 549, Pl. 8, Fig. 12; Riedel and Sanfilippo, 1978, p. 74, Pl. 9, Fig. 11; Westberg and Riedel, 1978, p. 22, Pl. 3, Figs. 6–9; Sakai, 1980, p. 711, Pl. 8, Figs. 1, 2; Wolfart, 1981, Pl. 1, Figs. 6–8; Sanfilippo et al., 1985, p. 682, Pl. 23, Fig. 2; Nishimura, 1987, pp. 728–729; Pl. 5, Figs. 8, 9.

**Stratigraphic range.** Late late Miocene (base of the *Stichocorys peregrina* Zone to middle Pliocene (Top to the *Spongaster pentas* Zone).

*Stichocorys* sp. A
(Pl. 4, Fig. 14)

**Stratigraphic range.** Middle Miocene.

*Stichocorys* sp. B
(Pl. 5, Figs. 19–21)

**Stratigraphic range.** Middle Miocene through early Pliocene.

Genus *EUCYRTIDIUM* Ehrenberg, 1847
*Eucyrtidium hexasticum* (Haeckel)
(Pl. 4, Fig. 6)

*Lithostrobus hexastichus* Haeckel, 1887, p. 1470, Pl. 80, Fig. 15.
*Eucyrtidium hexasticum* (Haeckel); Petrushevskaya, 1971, p. 221, Pl. 99, Figs. 3–10; Nishimura and Yamauchi, 1984, p. 57, Figs. 7, 9, 10.

**Stratigraphic range.** Pleistocene to Holocene.

*Eucyrtidium calvertense* Martin
(Pl. 4, Figs. 3, 4)

*Eucyrtidium calvertense* Martin, 1904, p. 450, Pl. 130, Fig. 5; Hays, 1965, p. 181, Pl. 3, Fig. 4; 1970, p. 231, Pl. 1, Fig. 6; Kling, 1973, p. 636, Pl. 4, Figs. 16, 18, 19; Pl. 11, Figs. 1–5; Sakai, 1980, p. 710, Pl. 7, Figs. 2a–b, 4a, b– 6a, b.

**Stratigraphic range.** Middle Miocene to Pleistocene.

*Eucyrtidium hexagonatum* Haeckel
(Pl. 3, Fig. 21)

*Eucyrtidium hexagonatum* Haeckel, 1887, p. 1489, Pl. 80, Fig. 11; Nigrini, 1967, p. 83, Pl. 8, Figs, 4a, b; 1970, p. 171, Pl. 4, Fig. 2; Nishimura and Yamauchi, 1984, p. 57, Pl. 39, Figs. 2, 11; Pl. 56, Fig. 4; Nishimura, 1987, p. 726, Pl. 5, Fig. 14; Pl. 6, Fig. 21.

**Stratigraphic range.** Middle Miocene to Holocene.

*Eucyrtidium matuyamai* Hays
(Pl. 4, Fig. 5)

*Eucyrtidium matuyamai* Hays, 1970, p. 213, Pl. 1, Figs. 7–9; Sakai, 1980, p. 710, Pl. 7, Figs. 1a–b.

**Stratigraphic range.** Miocene to early Pleistocene.

*Eucyrtidium punctatum* (Ehrenberg)
(Pl. 3, Figs. 1, 2)

Cf. *Lithocampe punctatum* Ehrenberg, 1844, p. 84.
Cf. *Eucyrtidium punctatum* (Ehrenberg), Ehrenberg, 1847, p. 43; 1854, Pl. 2, Fig. 24.
*Eucyrtidium punctatum* (Ehrenberg), Sanfilippo et al., 1973, p. 221, Pl. 5, Figs. 15, 16; Caulet, 1986, Pl. 5, Fig. 9; Nishimura, 197, p. 726, Pl. 5, Fig. 7.

**Stratigraphic range.** Late Miocene through Holocene.

Genus *LITHOPERA* Ehrenberg, 1847
*Lithopera neotera* Sanfilippo and Riedel
(Pl. 1, Fig. 25)

*Lithopera neotera* Sanfilippo and Riedel, 1970, p. 454, Pl. 1, Figs. 24–26, 28; Riedel and Sanfilippo, 1971, Pl. 1F, Figs. 14, 15; Pl. 2E, Fig. 19; 1978, p. 70. Pl. 6, Fig. 10; Sanfilippo et al., 1985, p. 675, Pl. 16, Figs. 5a, b.

**Stratigraphic range.** Late middle Miocene (uppermost of the *Dorcadospyris alata* Zone to the *Diartus petterssoni* Zone).

Family PLECTOPYRAMIDAE Haeckel, 1908; emend. Petrushevskaya, 1971
Genus *CORNUTELLA* Ehrenberg, 1838; emend. Petrushevskaya, 1971
*Cornutella bimarginata* (Haeckel)
(Pl. 3, Figs. 5–7)

*Sethoconus bimarginata* Haeckel, 1887, p. 1295, Pl. 54, Fig. 12.
*Cornutella bimarginata* (Haeckel), Nishimura and Yamauchi, 1984, p. 55, Pl. 25, Figs.1, 2; Nishimura, 1990, pp. 154–156, Pl. 33, Figs. 1a–b.

**Stratigraphic range.** Oligocene to Holocene.

*Cornutella profunda* Ehrenberg
(Pl. 3, Fig. 4)

*Cornutella profunda* Ehrenberg, 1854a m o. 241, 1854b, Pl. 4, Fig. 21; Kling, 1973, p. 635, Pl. 3, Figs. 1–4; Pl. 9, Figs. 8–17; Takahashi and Honjo, 1981, p. 152, Pl. 8, Fig. 9; Nishimura and Yamauchi, 1984, p. 56, Pl. 25, Figs. 3–7.

**Stratigraphic range.** Miocene to Holocene.

Genus *PERIPYRAMIS* Haeckel, 1881
*Peripyramis circumtexa* Haeckel
(Pl. 4, Figs. 7–9)

*Peripyramis circumtexa* Haeckel, 1887, p. 1162, Pl. 54, Fig. 5; Riedel, 1985, p. 231, Pl. 2, Figs. 8, 9; Petrushevskaya and Kozlova, 1972, p. 551, Pl. 31, Fig. 4; Kling, 1973, p. 637, Pl. 2, Figs. 15, 16; Pl. 9, Figs.1–3; Petrushevskaya, 1975, p. 587, Pl. 13, Fig. 29; Pl. 44, Figs. 5, 6; Casey, 1977, Pl. 2, Fig. 11; Riedel and Sanfilippo, 1977, Pl. 23, Fig. 6; Nakaseko and Yamauchi, 1984, p. 59, Pl. 25, Figs. 8–10.

**Stratigraphic range.** Miocene to Holocene.

Genus *PTEROCANIUM* Ehrenberg, 1854
*Pterocanium bicorne* Haeckel
(Pl. 3, Fig. 19)

*Pterocanium bicorne* Haeckel, 1887, p. 1332, Pl. 73, Fig. 5.

**Stratigraphic range.** Pleistocene to Holocene.

*Pterocanium korotnevi* (Dogiel)
(Pl. 5, Figs. 4, 5)

*Pterocorys korotnevi* Dogiel, 1952, p. 17, Fig. 11.
*Lychnocanium korotnevi* (Dogiel), Petrushevskaya and Kozlova, 1972, p. 553, Pl. 29, Fig. 16.
*Pterocanium korotnevi* (Dogiel), Nigrini, 1970. p. 170, Pl. 3, Figs. 10, 11; Kling, 1973, p. 638, Pl. 4, Figs. 1–4; Wolfart, 1981, p. 499, Pl. 4, Fig. 3.

**Stratigraphic range.** Pliocene to Quaternary.

*Pterocanium orcinum* Haeckel
(Pl. 3, Fig. 9; Pl. 5, Fig. 9)

*Pterocanium orcinum* Haeckel, 1887, p. 1329, Pl. 73, Fig. 2.

**Stratigraphic range.** Middle and late Miocene to Holocene.

*Pterocanium praetextum eucolpum* Haeckel
(Pl. 5, Fig. 6)

*Pterocanium eucolpum* Haeckel, 1887, p. 1322, Pl. 73, Fig. 4.
*Pterocanium* (Ehrenberg) *Praetextum eucolpum* Haeckel, Nigrini, 1967, p. 70, Pl. 7, Fig. 2; Nishimura and Yamauchi, 1984, p. 60, Pl. 30, Figs. 3, 5.

**Stratigraphic range.** Pliocene to Holocene.

*Pterocanium trilobum* (Haeckel)
(Pl. 3, Fig. 10; Pl. 5, Fig. 3)

*Dictyophodium trilobum* Haeckel, 1860, p. 839; 1862, p. 340, Pl. 8, Figs. 6–10.
*Pterocanium trilobum* (Haeckel, Nigrini, 1967, p. 67, Pl. 71, Figs. 3a–b; Hays, 1965, p. 177, Pl. 3, Fig. 10; Nishimura and Yamauchi, 1984, p. 61, Pl. 30, Figs. 9, 11, 12.

**Stratigraphic range.** Late Miocene to Holocene.

*Pterocanium* sp. B
(Pl. 3, Fig. 18)

**Stratigraphic range.** Pliocene to Holocene.

Genus *DICTYOPHIMUS* Ehrenberg, 1847
*Dictyophimus crisiae* Ehrenberg
(Pl. 3, Fig. 11; Pl. 4, Figs. 21, 22)

*Dictyophimus crisiae* Ehrenberg, 1854, p. 241; Nigrini, 1967, p. 66, Pl. 6, Figs. 7a–b; Kling, 1873, p. 636, Pl. 4, Figs.11–15; Pl. 10, Figs. 18–20; Takahashi and Honjo, 1982, p. 153, Pl. 9, Figs. 1, 2; Nishimura and Yamauchi, 1984, p. 56, Pl. 31, Figs. 1–3; Pl. 56, Fig. 11.
*Pterocorys hirundo* Haeckel, 1887, p. 1318, Pl. 71, Fig. 4; Nakaseko and Nishimura, 1982, p. 98, Pl. 47, Figs. 1, 2, 4, 9.
*Lychnocanium arabicum* Ehrenberg, 1854, p. 296, Pl. 10, Fig. 3.

**Stratigraphic range.** Miocene to Holocene.

Genus *ARCHIPILIUM* Haeckel, 1881
*Archipilium quasimacropum* Wang and Yang (sp. nov.)
(Pl. 3, Figs. 12, 13)

**Diagnosis.** Cephalus small without apical horn. Thorax semispherical, with fewer of pores. Three divergent feet originated from the lower part of thorax, very long, curved, thicker near their upper part and tapering distally. Thorax may not be distinctly separated from abdomen. Abdomen pores more numerous than those of thorax. Mouth open. Dimensions: Length and width of thorax: 45–50 μm; length and width of abdomen: 38–54 μm and 64–73 μm; length of feet: 140–172 μm; diameters of thoracic and abdominal pores: 7–10 and 4–7 μm.

**Remarks.** New species is closely similar to *Archipilium macropum* (Haeckel), but differs from the latter by having more thoracic and abdominal pores and longer feet, as well as having irregular abdominal pores of various sizes.

**Stratigraphic range.** Pliocene.

Genus *LYCHNOCANIUM* Ehrenberg, 1847
*Lychnocanium nipponicum* Nakaseko
(Pl. 3, Fig. 8; Pl. 5, Figs. 7, 8)

*Lychnocanium nipponicum* Nakaseko, 1963, pp. 168–170, Pl. 1, Fig. 1; Nakaseko and Sugano, 1973, p. 3, Fig. 1; Nishimura, 1990, pp. 133–134, Pl. 29, Figs. 4, 5, 9.
*Lychnocanoma nipponica magnacornuta* Sakai, 1980, p. 710, Pl. 9, Fig. 3.
*Lychnocanoma nipponica nipponica* (Nakaseko), Sakai, 1980, p. 710, Pl. 9, Fig. 2.

**Stratigraphic range.** Middle Miocene to Quaternary.

Genus *STICHOPILIUM* Haeckel, 1881
*Stichopilium bicorne* Haeckel
(Pl. 3, Fig. 20)

*Stichopilium bicorne* Haeckel, 1887, p. 1437, Pl. 77, Fig. 9; Nishimura and Yamauchi, 1984, p. 62, Pl. 35, Figs. 8–10.

**Stratigraphic range.** Pliocene to Holocene.

Genus *CYRTOLAGENA* Haeckel, 1887
*Cyrtolagena aglaolampa* (Takahashi)
(Pl. 2, Fig. 11).

*Cyrtopera aglaolampa* Takahashi, 1982, p. 255, Pl. 40, Figs. 7, 8.
*Cyrtolagena aglaolampa* (takahashi), Nishimura and Yamauchi, 1984, p. 55, Pl. 41, Fig. 7.
Theoperid., gen. et sp. indet., aff. *Stichopera pectinata* Haeckel or *Cyrtoopera laguncula* Haeckel, Sanfilippo and Riedel, 1970, p. 458, Pl. 1, Fig. 1.

**Stratigraphic range.** Neogene to Holocene.

Genus *LYCHNOCANOMA* Haeckel, 1887
*Lychnocanoma elongata* (Vinassa de Regny)
(Pl. 1, Figs. 12, 13)

*Tetrahedrina elongata* Vinassa de Regny, 1890, p. 243, Pl. 2, Fig. 31.
*Lychnocanoma elongata* (Vinassa de Regny), Sanfilippo et al., 1973, p. 221, Pl. 5, Figs. 19, 20; Ling, 1975, p. 729, Pl. 10, Fig. 11; Riedel and Sanfilippo, 1978, pp. 70–71, Pl. 7, Fig. 4; Ling, 1980, p.368, Pl. 2, Fig. 12; Sakai, 1980, p. 710, Pl. 9, Fig. 4; Poag, 1984, p. 122, Pl. 3, Fig. 12; Sanfilippo et al., 1985, p. 676, Pl. 19, Figs. 1a, b; Nishimura, 1990, p. 133, Pl. 27, Figs. 5, 6.
*Lychnocanium bipes* Riedel, 1959, pp. 294–295, Pl. 2, Figs. 5, 6.
*Lichnocanoma bipes* (Riedel), Foreman, 1973, p. 437.

**Stratigraphic range.** Early Miocene.

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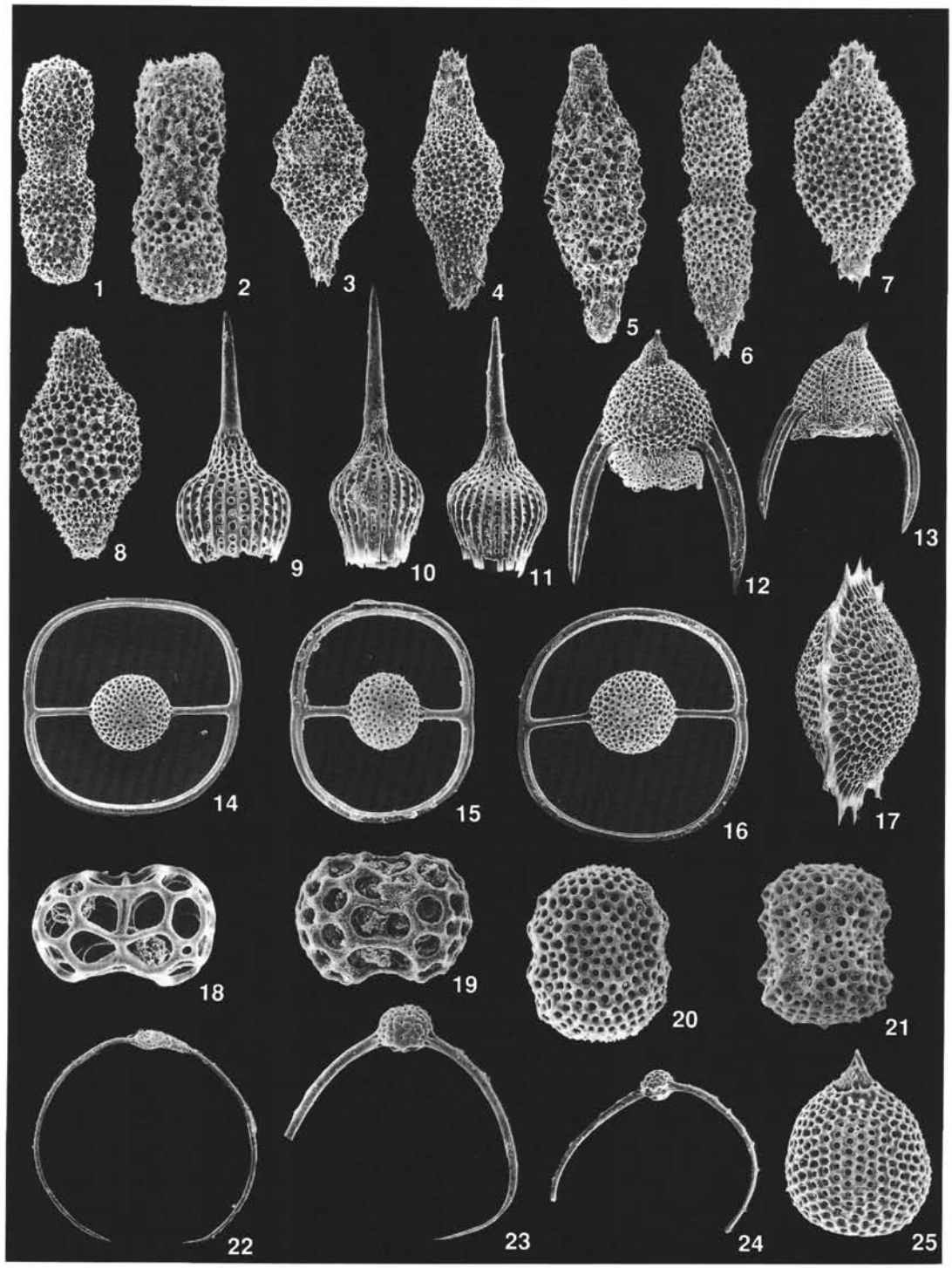


Plate 1. **1–2.** *Diartus petterssoni* (Riedel and Sanfilippo). **1.** Sample 125-782A-25X-CC, ×170. **2.** Sample 125-784A-23R-CC, ×205. **5.** *Didymocyrtis penultima* (Riedel), Sample 125-782A-24X-02, × 170. **6.** *Diartus* cf. *petterssoni* (Riedel and Sanfilippo), Sample 125-784A-23R, 3, × 155. **3–4, 7–8.** *Didymocyrtis laticonus* (Riedel). **3–4.** Sample 125-782A-27X-CC, ×155 and ×140. **7.** Sample 125-784A-24R-CC, ×170. **8.** Sample 125-782A-23X-CC, ×155. **9–11.** *Calocycletta costata* (Riedel), Sample 125-782A-34X-CC, ×170, ×130, and ×140. **12–13.** *Lychnocanoma elongata* (Vinassa de Regny), Sample 125-782A-34X-CC, ×140. **14–16.** *Saturnalis circularis* Haeckel. **14.** Sample 125-784A-6R-CC, ×140. **15.** Sample 125-786A-1H-CC, ×140. **16.** Sample 125-782A-16X-CC, ×155. **17.** *Astrophacus* sp. Ling., Sample 125-782A-34X-CC, ×140. **18.** *Liriospyris mutuaria* Goll Sample 125-784A-27R-CC, × 225. **19.** *Liriospyris* sp. Sample 125-786A-8X-CC, ×225. **20–21.** *Didymocyrtis* sp. **20.** Sample 125-784A-24R-CC, ×205; **21.** Sample 125-784A-23R-3, ×250. **22.** *Dorcadospyris alata* (Riedel), Sample 125-782A-28X-CC, ×70. **23–24.** *Dorcadospyris* sp. cf. *D. dentata* Haeckel, Sample 125-782A-34X-CC, ×140, and ×85. **25.** *Lithopera neotera* Sanfilippo and Riedel, Sample 125-784A-30R-5, ×225.

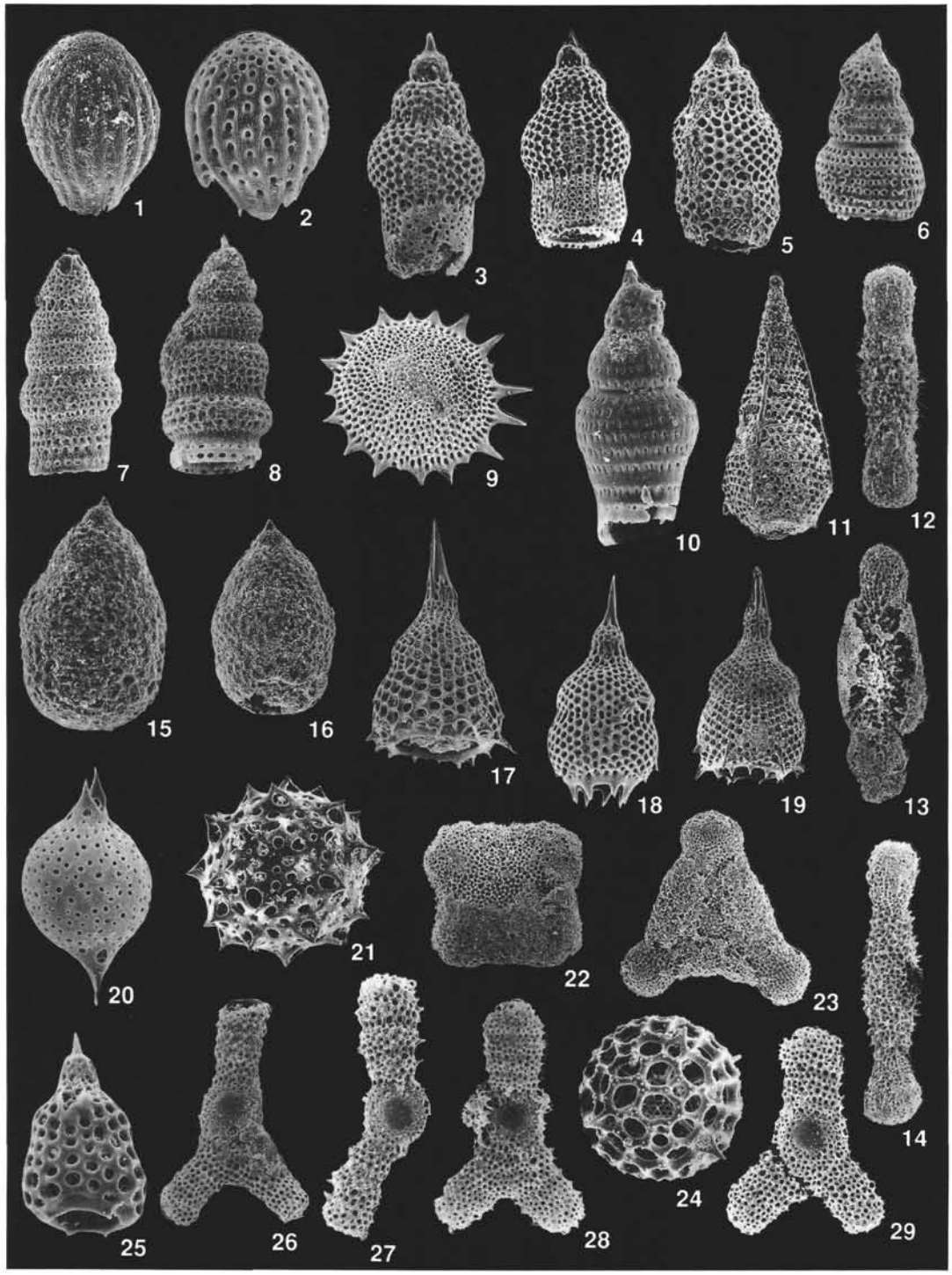


Plate 2. **1–2.** *Carpocanium kinugasense* Nishimura. **1.** Sample 125-782A-31X-CC, ×285; **2.** Sample 125-784A-30R-5, ×285. **3–5.** Stichocorys delmontensis (Campbell and Clark), Sample 125-782A-34X-CC, ×225, ×190, and ×190. **6.** *Botryostrobus bramlettei* (Campbell and Clark), Sample 125-782A-34X-CC, ×225. **7, 8.** *Botryostrobus auritus* (Ehrenberg) group. **7.** Sample 125-784A-8R-CC, ×225. **8.** Sample 125-784A-13R-CC, ×250. **9.** *Astrophacus* sp. Ling, Sample 125-784A-27R-CC, ×105. **10.** *Siphostichoartus corona* (Haeckel) Sample 125-784A-23R-03, ×225. **11.** *Cyrtolagena aglaogena* (Takahashi) Sample 125-782A-16X-CC, ×140. **12–14.** *Spongocore cylindrica* (Haeckel). **12.** Sample 125-782A-11X-CC, ×170. **13.** Sample 125-782A-16X-CC, ×140. **14.** Sample 125-784A-1R-CC, ×140. **15.** *Cyrtocapsella cornuta* Haeckel, Sample 125-782A-6H-CC, ×205. **16.** *Cyrtocapsella tetrapera* (Haeckel), Sample 125-782A-31X-CC, ×205. **17.** *Lamprocyclas maritalis polypora* Nigrini, Sample 125-784A-1R-CC, ×155. **18.** *Lamprocyclas* sp. A, Sample 125-784A-24R-CC, ×140. **19.** *Theocorythium vetulum* Nigrini, Sample 125-782A-10X-CC, ×140. **20.** *Otosphaera auriculata* (Haeckel), Sample 125-784A-23R-CC, ×155. **21.** *Siphonosphaera spinosa* (Haeckel), Sample 125-782A-24X-2, ×190. **22.** *Spongaster tetras tetras* Ehrenberg, Sample 125-782A-10X-CC, ×110. **23.** *Dictyocoryne profunda* (Ehrenberg), Sample 125-782A-10X-CC, ×110. **24.** *Hexacontium arachnoidale* Hollande and Enjumet, Sample 125-782A-10X-CC, ×170. **25.** *Lamprocyclas junonis* (Haeckel), Sample 125-784A-10R-CC, ×225. **26–29.** *Amphirhopalum ypsilon* Haeckel. **26.** Sample 125-784A-1R-CC, ×170; **27.** Sample 125-784A-8R-CC, ×205; **28.** Sample 125-784A-4R-CC, ×190; **29.** Sample 125-784A-6R-CC, ×170.

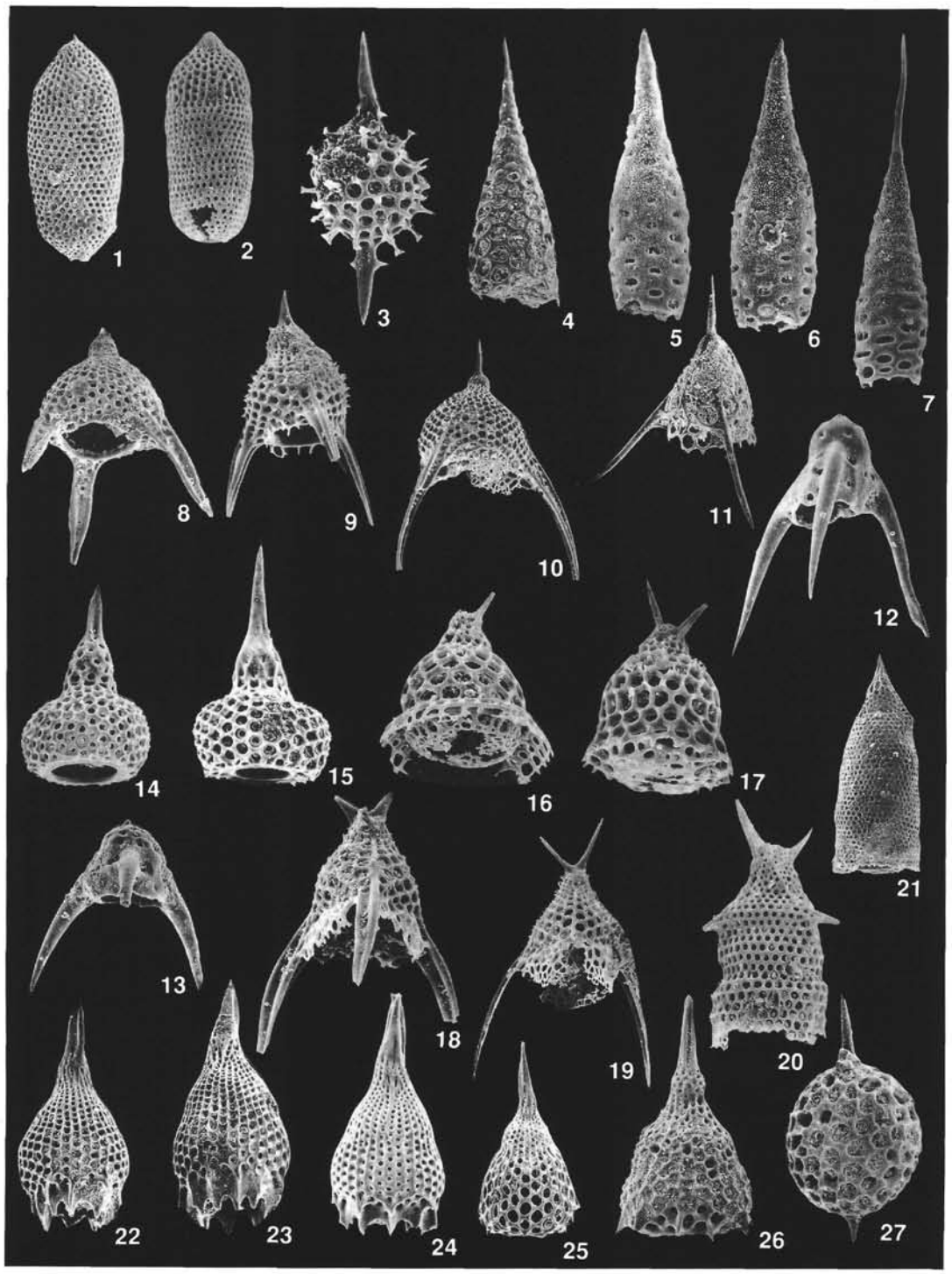


Plate 3. **1, 2.** *Eucyrtidium punctatum* (Ehrenberg). **1.** Sample 125-784A-1R-CC, × 225. **2.** Sample 125-784A-11R-CC, × 205. **3, 27.** *Stylacontarium acquilonium* (Hays). **3.** Sample 125-784A-11R-CC, × 225. **27.** Sample 125-782A-7H-CC, ×170. **4.** *Cornutella profunda* Ehrenberg, Sample 125-782A-1H-CC, ×205. **5–7.** *Cornutella bimarginata* Haeckel. **5.** Sample 125-782A-10X-CC, ×225. **6.** Sample 125-782A-16X-CC, ×225. **7.** Sample 125-784A-15R-CC, ×205. **8.** *Lychnocanium nipponicum* Nakaseko, Sample 125-784A-24R-CC, ×140. **9.** *Pterocanium orcinum* (Haeckel), Sample 125-784A-23R-CC, × 170. **10.** *Pterocanium trilobum* (Haeckel), Sample 125-784A-6R-CC, × 140. **11.** *Dictyophimus crisiae* Ehrenberg, Sample 125-782A-10X-CC, × 155. **12–13.** *Archipilium quasimacropus* Wang and Yang, n. sp. **12.** Sample 125-782A-10X-CC, × 190 (holotype). **13.** Sample 125-782A-16X-CC, × 170 (paratype). **14–15.** *Theocyrtis* sp. A Nakaseko, Sample 125-784A-30R-5, ×225. **16–17.** *Clathrocyclas bicornis* Hays. **16.** Sample 125-786A-1H-CC, ×245. **17.** Sample 125-784A-12X-CC, ×225. **18.** *Pterocanium* sp., Sample 125-784A-12R-CC, ×225. **19.** *Pterocanium bicorne* (Haeckel), Sample 125-784A-12R-CC, ×170. **20.** *Stichopilium bicorne* (Haeckel), Sample 125-786A-1H-CC, ×265. **21.** *Eucyrtidium hexagonatum* Haeckel, Sample 125-782A-1H-CC, ×170. **22–24.** *Lamprocyclas margatensis* (Campbell and Clark). **22.** Sample 782A-23X-CC, ×140. **23.** Sample 125-782A-33X-CC, ×140. **24.** Sample 125-784A-27R-CC, ×140. **25–26.** *Lamprocyclas maritalis maritalis* Haeckel. **25.** Sample 125-782A-11X-CC, ×105. **26.** Sample 125-782A-1H-CC, ×170.

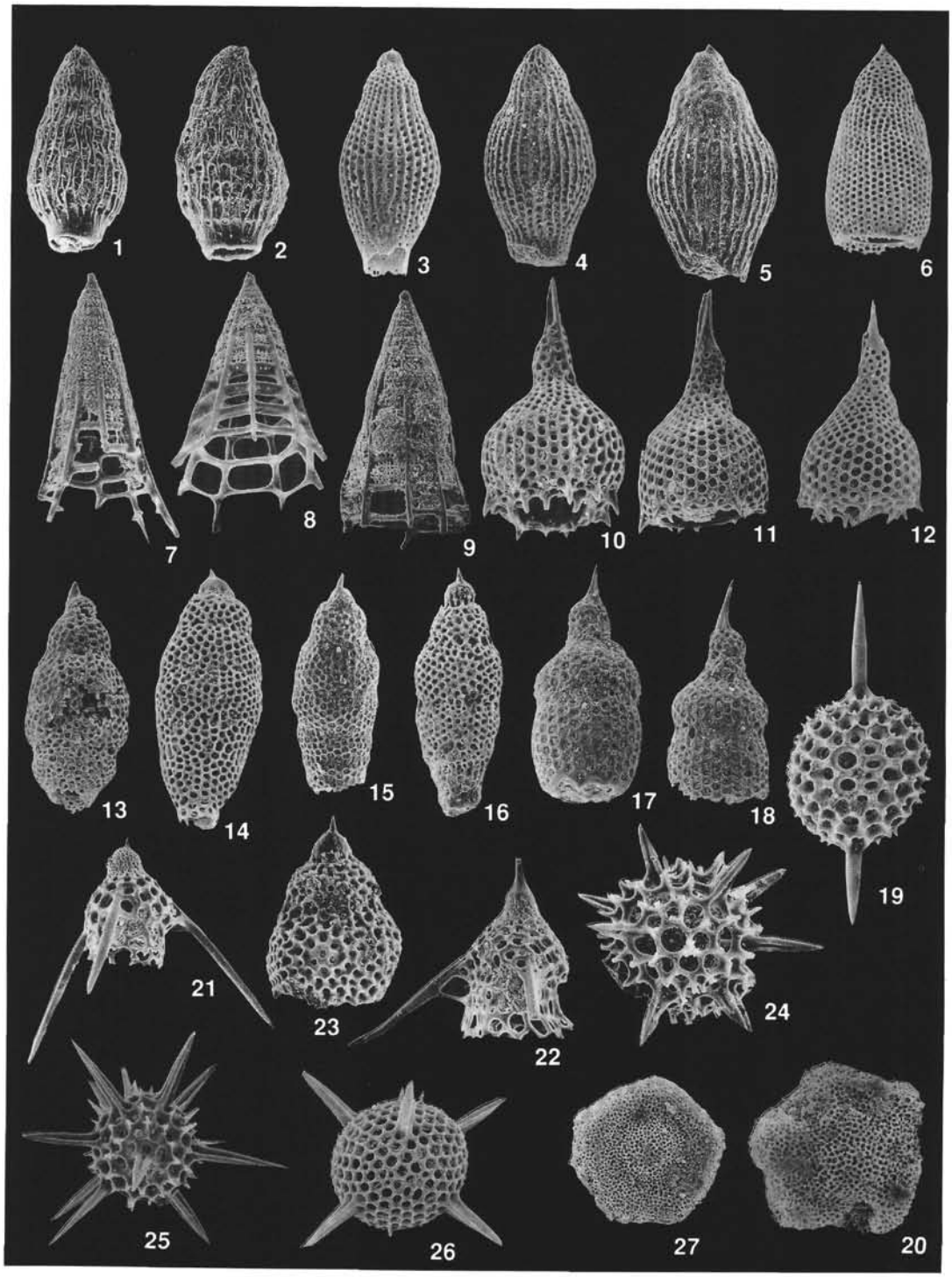


Plate 4. **1, 2.** *Botrostrobus miralestensis* (Campbell and Clark), Sample 125-782A-34X-CC, ×190 and 205. **3, 4.** *Eucyrtidium calvertense* Martin. **3.** Sample 125-784A-11R-CC, × 205. **4.** Sample 125-782A-6H-CC, ×205. **5.** *Eucyrtidium matuyamai* Hays, Sample 125-782A-11X-CC, × 205. **6.** *Eucyrtidium hexastium* (Haeckel), Sample 125-784A-27R-CC, × 205. **7–9.** *Peripyramis circumtexta* Haeckel. **7.** Sample 125-784A-23R-CC, × 105. **8.** Sample 125-784A-4R-CC,× 140. **9.** Sample 125-782A-6H-CC, ×155. 10–12. Anthocyrtidium ophirense (Ehrenberg). **10.** Sample 125-784A-23R-3, ×205. **11.** Sample 125-782A-11X-CC, × 205; **12.** Sample 125-784A-11R-CC, × 170. **13–15.** *Stichocorys peregrina* (Riedel). **13.** Sample 125-782A-10X-CC, × 205. **14.** Sample 125-784A-13R-CC, × 205. **15.** Sample 1245-782A-11X-CC, ×170. **16, 23.** *Stichocorys delmontensis* (Campbell and Clark). **16.** Sample 125-782A-14X-CC, ×170. **23.** Sample 125-782A-34X-CC, ×225. **17, 18.** *Theocorythium trachelium trachelium* (Ehrenberg). Sample 125-782A-1H-CC, ×225 and 205. **19.** *Stylacontarium acquilonium* (Hays). Sample 125-784A-20R-CC, × 155. **21, 22.** *Dictyophimus crisiae* Ehrenberg. **21.** Sample 125-784A-6R-CC, × 155. **22.** Sample 125-782A-10X-CC, × 140. **24, 25.** *Actinomma boreale* (Cleve) **24.** Sample 125-784A-4R-CC, × 205. **25.** Sample 125-784A-10R-CC, × 170. **26.** *Hexacontium axotrias* Haeckel. Sample 125-784A-15R-CC, × 190. **20, 27.** *Spongaster pentas* Riedel and Sanfilippo. **20.** Sample 125-784A-7R-CC, × 155; **27.** Sample 125-784A-6R-CC, × 120.

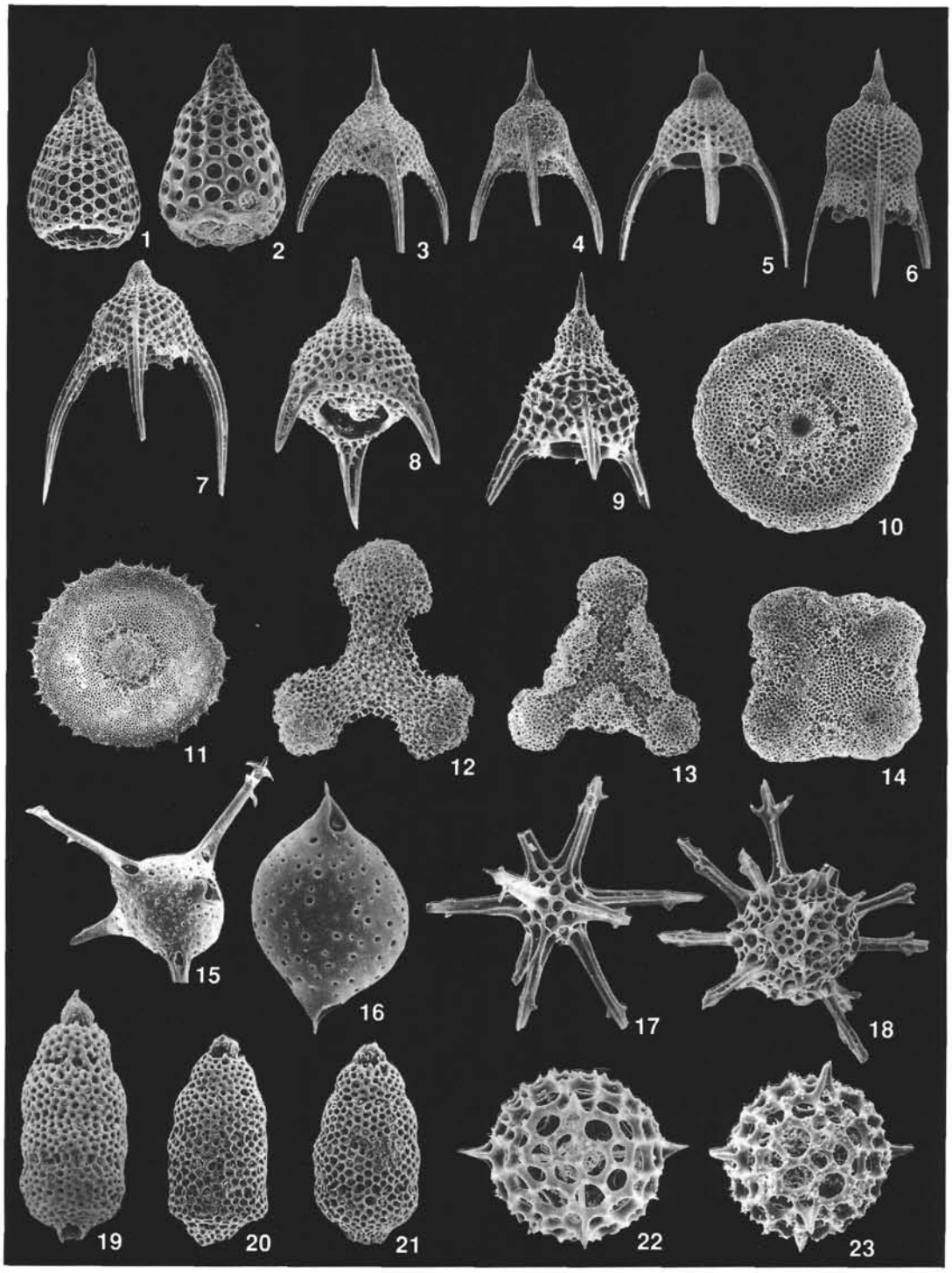


Plate 5. **1, 2.** *Lamprocyclas junonis* (Haeckel). **1.** Sample 125-782A-2H-CC, × 205. **2.** Sample 125-782A-7H-CC, × 225. **3.** *Pterocanium trilobum* (Haeckel), Sample 125-782A-10R-CC, × 140. **4, 5.** *Pterocanium korotnevi* (Dogiel). **4.** Sample 125-782A-1H-CC, × 155. **5.** Sample 125-784A-10R-CC, × 190. **6.** *Pterocanium praetextum eucolpum* Haeckel, Sample 125-784A-11R-CC, × 190. **7, 8.** *Lychnocanium nipponicum* Nakaseko. **7.** Sample 125-784A-13R-CC, ×140. **8.** Sample 125-784A-31R-CC, ×155. **9.** *Pterocanium orcinum* Haeckel, Sample 125-782A-25X-CC, ×205. **10.** *Spongodiscus gigas* Campbell and Clark, Sample 125-782A-7H-CC, × 120. **11.** *Stylotrochus (Stylotrodiscus) sol* Campbell and Clark. Sample 125-782A-27X-CC, ×85. **12.** *Dictyocoryne truncatum* (Ehrenberg), Sample 125-782A-10X-CC, ×155. **13.** *Dictyocoryne profunda* (Ehrenberg). Sample 125-782A-10X-CC, × 155. **14.** *Spongaster, tetras tetras* Ehrenberg, Sample 125-786A-1H-CC, × 105. **15.** *Otosphaera* sp. Sample 125-782A-27X-CC, × 105. **16.** *Otosphaera auriculata* Haeckel, Sample 125-784A-23R-3, × 205. **17.** *Actinomma* sp., Sample 125-784A-10R-CC, ×170. **18.** *Haeckeliella* sp., Sample 125-784A-20R-CC, × 140. **19–21.** *Stichocorys* sp. B. **19.** Sample 125-784A-24R-CC, × 225. **20–21.** Sample 125-782A-20X-CC, × 190. **22, 23.** *Hexacontium arachnoidale* Hollande and Enjumet. **22.** Sample 125-784A-26R-CC, ×155. **23.** Sample 125-784A-1R-CC, ×155.