14. PHYTOPLANKTON STRATIGRAPHY, DEEP SEA DRILLING PROJECT LEG 20, WESTERN PACIFIC OCEAN

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INTRODUCTION

Leg 20 of the Deep Sea Drilling Project, September to November 1971, in the western Pacific Ocean from Yokohama, Japan, to Suva, Fiji, recovered 57 cores at nine drilling sites (Figure 1). Light-microscope techniques were used to study the coccoliths and silicoflagellates of 75 samples from these cores.

Coccoliths are the most stratigraphically useful fossil group in Leg 20 sediment owing to their common occurrence in most samples and the similarity of their assemblages to those previously zoned in the eastern tropical Pacific (Bukry, 1973). Reworking and overgrowth characterize many of the coccolith assemblages examined. Samples from the shallowest site, DSDP 200, are dominated by foraminifers. Of the nine drilling sites, only DSDP 200 and DSDP 199 yielded biostratigraphically diagnostic assemblages to those previously zoned in the eastern tropical Pacific (Bukry, 1973). Reworking and overgrowth characterize many of the coccolith assemblages examined. Samples from the shallowest site, DSDP 200, are dominated by foraminifers. Of the nine drilling sites, only DSDP 200 and DSDP 199 yielded biostratigraphically diagnostic material in moderately complete sections.

Systematic paleontology and illustrations of coccoliths from Leg 20 are followed by stratigraphic summaries of the sites and some selected species lists.

SYSTEMATIC PALEONTOLOGY

Genus DISCOASTER Tan, 1927

Discoaster blackstockae n. sp.
(Plate 1, Figures 1-4)


Description: Discoaster blackstockae, a four-rayed species, has a small oblong central area. The four narrowly tapering, blade-like rays end in simple points. The rays form two large and two small angles. The two small angles are opposite each other and typically are identical at about 60 degrees. Variation from 52 degrees to 62 degrees has been observed for some specimens.

Remarks: Discoaster blackstockae is distinguished from D. tamalis by the arrangement of adjacent rays at about 60 or 120 degrees instead of all at 90 degrees, from Discoaster quadramus by its simply terminated rays and nonbirefringence in cross-polarized light in plan view. The angular relation between the rays and the ray morphology suggests that D. blackstockae was derived from D. brouweri through suppression of one set of rays.

Occurrence: As these four-rayed forms are never common and previously have been considered variants or broken specimens of D. pentaradiatus or D. brouweri, their full stratigraphic and paleogeographic ranges are not determined. Discoaster blackstockae has been noted most commonly in the Pliocene and latest Miocene of tropical sites from Legs 20, 21, and 23, at Sites DSDP 173, 199, 203, 219, 225, and 228. It may prove to be a useful ecological indicator for tropical assemblages that are dominated by discoasters for preservational reasons, such as strong dissolution.

Size: 8-20 microns

Holotype: USNM 188509 (Plate 1, Figure 1)

Paratypes: USNM 188510 to 188512

Type locality: Laccadive-Chagos Ridge (DSDP 219-6-5, 110-111 cm).

Discoaster quadramus n. sp.
(Plate 1, Figures 5-6)


Description: Discoaster quadramus is distinguished from D. tamalis and D. blackstockae by its bifurcate ray tips or faint cross-polarized light image, from D. pentaradiatus by its lack of pentameral symmetry.

Occurrence: This rare species has been reported in the Pliocene of Castell d'Arquato, Italy (Stradner and Papp, 1961; Takayama, 1967), Philippine Sea core V21-98 (Takayama, 1969) and in the Pliocene of the Laccadive-Chagos Ridge (DSDP 219). It is missing in the Pliocene samples of DSDP Leg 20.

Size: 10-20 microns

Holotype: USNM 188513 (Plate 1, Figures 5-6).

Type locality: Laccadive-Chagos Ridge (DSDP 219-6-5, 110-111 cm).

Genus FASCICULITHUS Bramlette and Sullivan, 1961

Fasciculithus pileatus n. sp.
(Plate 1, Figures 7-9; Plate 2, Figures 1-5)


Description: Fasciculithus pileatus is a medium-sized species with smooth straight walls that expand from the base to the apex. Therefore, the body is basically a truncated cone. A large, convex-topped, lens-shaped cap covers the entire top of the body and can extend beyond it. A central stud may connect the cap and body in some specimens. In cross-polarized light, side views have a straight dark line bisecting the body and a straight dark line separating the body and cap, forming three bright areas.

Remarks: Fasciculithus pileatus is unique among other species of the genus owing to its strong-reflect three-part division in side view. The only similar species, F. ulii, is distinguished by its concave body walls and small flat-topped apex that fails to cap the entire body and gives only weak optical relief in side view. Examination of samples from the type core of F. ulii, DSDP 119-25 (not DSDP 119-37) as was indicated in the captions of the type illustrations; Perch-Nielsen, 1971), confirms these distinctions. No wholly and brightly capped Fasciculithus specimens occur in DSDP 119-25-1, 133-134 cm or DSDP 119-25-2, 65-66 cm. F. pileatus is distinguished from potential overgrowth forms of F. ulii by the cap acting as a single crystallographic unit, instead of bilateral units in cross-polarized light. Its long stratigraphic range through the Paleocene is matched only by F. tympaniformis, a conservative, parallel-sided, cylindric form with no distinctive ornamentation.

1 Publication authorized by the Director, U. S. Geological Survey.
Occurrence: *Fasciculithus pileatus* is presently known from the Paleocene of tropical parts of the Pacific, Indian, Atlantic, and Caribbean. It occurs in DSDP 199-10-2, 34-35 cm; 199-9, CC; and 199-7, 76-77 cm, in the *Discoaster multiradiatus* Zone. It occurs in the *Heliolithus kleinpellii* Zone in DSDP 144A-3A-3, 114-115 cm and in the *Fasciculithus tympaniciformis* Zone in DSDP 237-50-1, 55-56 cm; 167-39-1, 115-116 cm; and 152-7-4, 105-106 cm; and reworked into the middle Eocene of DSDP 171-9-3, 90-91 cm.

Size: 5-12 microns.

Holotype: USNM 188514 (Plate 2, Figures 2-5).

Paratypes: USNM 188515 to 188517.

Type locality: Caroline Abyssal Plain (DSDP 199-10-2, 34-35 cm).

Genus *HAYASTER* n. gen.

Description: This compact species has a rounded quadrate to circular outline with no extensions. In cross-polarized light, four equant quadrants are bounded by two S-shaped black suture lines that intersect at the center. Focusing through the various levels in the fossil shows that the curvature of the sutures is more pronounced at one side of the fossil than on the other. All four quadrants become black together as the fossil is rotated relative to the direction of cross-polarization.

Remarks: *Tetralithus praemurus* is distinguished from *T. obscurus* and *T. ovalis* by its radial symmetric form and equant quadrants, from *T. pyramidus* by its rounded outline and S-shaped sutures, from *Micula mura* by the more subdued curvature of its sutures and its lack of peripheral extensions.

*Tetralithus praemurus*, unlike *M. mura*, shows little variation in form. *M. mura*, as presently constituted, may be a composite taxon. The abbreviated appendages and high relief of the *M. mura* holotype (Martini, 1961) is repeated in later scanning-electronmicrograph illustrations of *Micula* by Clocchiatti (1971). Yet hypotype illustrations by Bramlette and Martini (1964) do not suggest a *Micula* structure. Single specimens resembling both *M. decussata* and *M. mura* occur just below the appearance of *H. perplexus* at DSDP 47.2-13-3 and 199-10-2. Several explanations are possible: (1) Overgrown specimens of slightly evolved Maastrichtian *M. decussata* mimic *Tetralithus mura*; (2) *Micula decussata* of the Maastrichtian provides a template that patterns an overgrowth structure that may become separated and independently identified as *T. mura* of Bramlette and Martini; (3) *Micula conger* converges with *Tetralithus* in the Maastrichtian to form a similar structure. Electronmicroscopy of critical samples will be required to solve the problem.

Occurrences: *Tetralithus praemurus* occurs in the middle part of the Maastrichtian section of the Shatsky Rise and reworked into the Paleocene of Caroline Abyssal Plain in the western Pacific Ocean. It occurs just below the appearance of *M. mura*.

Size: 5-10 microns.

Holotype: USNM 188518 (Plate 2, Figures 7-9).

Paratypes: USNM 188519.

Type locality: Caroline Abyssal Plain (DSDP 199-10-2, 34-35 cm).
Diversity is generally low with no pentalithid or nanconid taxa present. Assemblages from the highest and lowest samples, at 278 meters and 392 meters, are similar, containing Cretarhabdus angustiforatus, Crucelliopsis cuvillieri, Cyclagelosphaera margereli, Diazonamotholithus lehmanni, Markalius circumradiatus, Parhabdolithus embergeri, Stephanolithia sp., Watznaueria barnesae, and W. britannica. The ranges of C. cuvillieri and M. circumradiatus indicate a Valanginian or Haueterivian age (Thierstein, 1971).

**TABLE 1**

<table>
<thead>
<tr>
<th>TABLE 1: Percentage and Total Count of Sparse Silicoflagellates in Single Smear Slides from DSDP 194</th>
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</thead>
<tbody>
<tr>
<td>Samples</td>
</tr>
<tr>
<td>Dietyocha aspera</td>
</tr>
<tr>
<td>D. epiodon</td>
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<tr>
<td>D. fibula</td>
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<tr>
<td>D. navicula</td>
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<tr>
<td>Distephanus sp. cf. D. crux</td>
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<tr>
<td>D. speculum</td>
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<tr>
<td>Mesocena elliptica</td>
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<tr>
<td>Total count</td>
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**SITE SUMMARIES**

**DSDP 194**
(lat 35°58.68'N, long 148°48.64'E, depth 5754 m)

Site DSDP 194 was drilled 630 km east of the Japan Trench in the abyssal northwestern Pacific to determine the age and composition of regional subbottom acoustic reflectors. Five cores were taken in the 256 meters penetrated. Two samples lacking coccoliths, but containing silicoflagellates, diatoms, and common volcanic ash were examined. Late Quaternary assemblages of the tropical Dietyocha epiodon Zone of silicoflagellates and the Roperia tessellata Zone of diatoms are present in the upper sample, DSDP 194-1-2, 73-75 cm (39 m). Volcanic ash is more abundant in the lower sample, DSDP 194-2-1, 127-129 cm (142 m), and the siliceous microfossil assemblage is less diagnostic, late Miocene or Pliocene in age. Silicoflagellates are sparse (Table 1); solution-thinned fragments of the diatom Ethmoch-discus rex are the most conspicuous siliceous microfossil.

**DSDP 195**
(lat 32°46.40'N, long 146°58.73'E, depth 5968 m)

Site DSDP 195 was drilled approximately 100 km southwest of DSDP 194 to penetrate the upper opaque acoustic-reflector layer. A sample above this horizon, 195-1-6, 75-77 cm (71 m), contains volcanic ash and an abundance of solution-thinned silicoflagellate and diatom species indicating a probable Pliocene age. A count of 300 silicoflagellates yields the following percentages: 77% Dietyocha fibula, 14% Dietyocha aspera, 5% Distephanus quinquangentialis, 2% Distephanus speculum, and <1% Dietyocha hexacantha. The large percentage of Dietyocha relative to Distephanus indicates a tropical depositional environment with a temperature of 27°C by the silicoflagellate paleotemperature curve (extrapolated) of Mandra (1969).

All deeper samples available from the site are Early Cretaceous coccolith-rich carbonates of the lower transparent layer, which is similar in age and lithology to the lower transparent layer at DSDP 49 and DSDP 50 on the western flank of Shatsky Rise (Bukry and others, 1971; Douglas and Moulade, 1972).

Upper Miocene
(Discoaster quinqueramus Zone, Discoaster berggrenii Subzone)

199-1-5, 5-6 cm (63 m):

Mixing of stratigraphically and preservationally discordant specimens is greatest at the top of Core 1. Discoasters in 199-1-2 range in preservation from specifically indeterminate specimens having dissolved centers and ray tips (preservation stage -4) to blocky and irregular overgrown forms (+4). But some specimens are practically pristine, the original camber, taper, and delicate ornamentation being preserved. Stratigraphic assignment of samples from Core 1 is facilitated by the abundant and diverse discoaster assemblages that can be identified. Key to the assignment in 196-1-2 is the occurrence of Discoaster quinqueramus and D. surculus with Ceratolithus primus and Triquetrorhabdulus rugosus. In 199-1-5 the occurrence of Discoaster berggrenii, D. quinqueramus, D. surculus, and Triquetrorhabdulus rugosus are considered diagnostic of the lower D. quinqueramus Zone. The only apparent reworking in this sample is some admixed discoasters characteristic of the zone directly below. Rare and sporadic Discoaster asymmetricus in this core is not considered biostratigraphically significant, as the species has been noted previously as a rare member of other upper Miocene tropical assemblages (Bukry, 1971). Although recorded as D. asymmetricus here, the species might be symmetric mutants of Discoaster bellus, which is common in the core. In any case, the acme of D. asymmetricus is middle Pliocene in age, at which time it was associated with Ceratolithus rugosus, which would be preserved in this tropical deposit if it were Pliocene.

Coccoliths are rare in the ash-rich sediment of Cores 2 and 3; assemblages have been severely restricted by etching to stage -4. A few resistant placolith rims and discoasters, some centerless, compose the trace assemblages. The sediment is probably upper Miocene down to 199-3-5, 35-36 cm (82 m), on the basis of the sporadic occurrence of Discoaster sp. cf. D. bellus, D. berggrenii, D. braarudii, D. sp. cf. D. neoabies, D. pseudovariabilis, and D. variabilis. Placoliths are relatively common only near the bottom of Core 3.

Middle Miocene
(Discoaster exilis Zone, Discoaster kugleri Subzone)

199-3-5, 35-36 cm (82 m):

Core 4 contains poorly representative assemblages of middle Miocene age. In 199-4-3, 35-36 cm (89 m), six-rayed discoasters resembling D. exilis or D. variabilis occur, but thick irregular overgrowths (+4) prevent any definite identifications. Associated placoliths such as Coccolithus miopelagicus, C. pelagicus, and Reticulofenestra pseudoumbilica are more moderately overgrown (+2). In 199-4-4, 34-35 cm (90 m), preservation is mixed with both etched and overgrown discoasters and placoliths. The assemblage is dominated by open and closed forms of Reticulofenestra pseudoumbilica. The rare occurrences of Cyclococcolithina macintyre s.s., Discoaster deflandrei, and Sphenolithus heteromorphus indicate a middle Miocene age for Core 4. Core 5 is largely barren of coccoliths. Rare specimens are recorded only in 199-5-3, 34-35 cm (146 m), where etched Coccolithus miopelagicus, C. pelagicus, Cyclaricolithus floridanus, overgrown Discoaster sp. cf. D. deflandrei, D. sp. cf. D. variabilis, Sphenolithus moriformis, and Triquetrorhabdulus carinatus suggest an early Miocene age. Assemblages are more common and diverse in Core 6 (200-210 m) owing to admixture by reworking. Species present indicate erosion of Upper Cretaceous and middle or upper Eocene deposits. The host assemblage is probably upper Oligocene or lower Miocene on the basis of the presence of Discoaster calculatus, D. sp. cf. D. variabilis, Helicopontosphaera intermedia, Sphenolithus belemnus, and S. conicus. Eocene taxa include Chiasmolithus grandis, Discoaster barbadiensis, and Triquetrorhabdulus inversus; Cretaceous taxa include Arkhangelskella cymbiformis, Cribrosphaera eilenbergi, Prediscosphaera cretacea, and Watznauera barnesae.

Samples available from Cores 7 to 9 (286-314 m) contain upper Paleocene assemblages and reworked Cretaceous. Diagnostic Paleocene species include Chiasmolithus bidorsus, C. californicus, C. conusfetus, Discoaster mohleri, D. multiradiatus, D. nobilis, Discosphaeroides megastypus, Fasciculithus tympaniciformis, and Toweus craticulus. Reworked Cretaceous species include Broinsonia parca, Cretarhabdulus eremolatus, Micaula mura, Prediscosphaera cretacea, and Watznauera barnesae. Most specimens are moderately overgrown, and fine calcareous debris is common in the samples.

The upper part of Core 10, down through Sample DSDP 199-10-2, 34-35 cm (372 m), is assigned to the Discoaster multiradiatus Zone of the upper Paleocene, as is the overlying interval of Cores 7 to 9. But a lower sample at 199-10-2, 112-113 cm (373 m), contains lower Paleocene species in a mixed assemblage that is most commonly Upper Cretaceous. This sample represents an early Paleocene deposit, probably near the Cretaceous-Tertiary boundary. Mixing within the Cretaceous assemblage is demonstrated.
by the discordant association of *Micula mura* of the upper Maastrichtian with *Broinsonia parca* and *Tetralithus trifidus* of the Campanian or lower Maastrichtian. Other Cretaceous species include *Arkhangelskiella cymbiformis*, *Cylindricalithus gallicus*, *Cretarhabdus schizobrachiatus*, *Eiffellithus turrissejelli*, and *Prediscosphaera cretacea*. Early Tertiary species include *Coccolithus* sp. [small] and *C. pelagicus*.

Late Cretaceous coccoliths are diverse and abundant in Cores 11 (400-409 m) and 12 (438-447 m), although diagenesis has produced moderate overgrowth and etching. Core 11 is late Maastrichtian on the basis of *Micula mura* and the associated assemblage. Core 12 is late Campanian or early Maastrichtian on the basis of *Cylindricalithus gallicus*, *Lucanorhabdus cayeuxi*, *Tetralithus trifidus*, and the associated assemblage.

**DSDP 200**

(lat 12°50.20'N, long. 156°46.96'E, depth 1479 m)

Site DSDP 200 was drilled on Ita Maitai Seamount in order to investigate the stratigraphy of its 150-meter sediment section. A total of 114 meters of early Eocene to Quaternary foraminiferal sand was drilled before mechanical difficulties forced discontinuation of the drilling. Tropical coccolith assemblages are diverse and abundant. Species in representative samples are listed below.

**Pleistocene or Holocene**

(\(\text{?Emiliania luxleyi Zone}\))

200-1-1, bottom (2 m):

*Ceratolithus cristatus* [large], *Cyclococcolithina leptopora*, *Emiliania annula*, \(\text{?E. luxleyi}\), *Gephyrocapsa oceanica*, *Helicopontosphaera kampferi*, *H. wallichii*, *Pontosphaera discopora*, *Rhabdosphaera stylifera* [common], *Scyphosphaera* sp. cf. *S. pulcherrima*, *Syracosphaera* sp., and *Thoracosphaera saxea*.

**Pleistocene**

(Lower *Gephyrocapsa oceanica* Zone)

200-1-5, bottom (8 m):

*Ceratolithus cristatus* cyclic, *Cyclococcolithina leptopora*, *Emiliania annula*, *E. ovata*, *Gephyrocapsa caribbeana*, *G. oceanica*, *Hayaster perplexus*, *Helicopontosphaera kampferi* [abundant], *Oolithotus antillarum*, *Pontosphaera discopora*, *Rhabdosphaera clavigera*, *R. stylifera*, *Syracosphaera* sp., and *Thoracosphaera saxea* [common]. *Reticulofenestra pseudoumbilica* and *Scyphosphaera globulata*.\n
**Pleistocene and Pliocene mixed**

200-2-1, bottom (11 m):

*Ceratolithus* rugosus, *Cyclococcolithina leptopora*, *C. macintyrei*, *Discocystera brouweri*, *D. pentaradiatus*, *D. tamalis*, *D. triradiatus*, *Discolithina japonica*, *Emiliania annula* [small, common], *Gephyrocapsa oceanica* [rare], *Hayaster perplexus*, *Helicopontosphaera kampferi*, *Rhabdosphaera stylifera*, *Scyphosphaera pulcherrima*, *Syracosphaera* sp. [common], and *Thoracosphaera saxea*.

**Upper Pliocene**

(\(\text{Discoaster brouweri Zone, Discoaster pentaradiatus Subzone}\))

200-2-2, bottom (12 m):


200-3-1, bottom (21 m):

*Ceratolithus* rugosus, *Coccolithus pelagicus*, *Cyclococcolithina leptopora*, *C. macintyrei*, *Discocystera asymmetricus*, *D. brouweri* [abundant], *D. challenger*, *D. pentaradiatus*, *D. tamalis* [common], *Helicopontosphaera kampferi*, *H. sellii* [small], *Reticulofenestra pseudoumbilica*, *Scyphosphaera globulata* [common], *S. recurvata*, *Sphenolithus abies*, *S. neoabies*, and *Thoracosphaera saxea*.

**Lower Pliocene**

(\(\text{Reticulofenestra pseudoumbilica Zone, Discoaster asymmetricus Subzone}\))

200-3-2, bottom (22 m):

*Ceratolithus* rugosus, *Cyclococcolithina leptopora*, *C. macintyrei*, *Discocystera asymmetricus*, *D. brouweri* [abundant], *D. challenger*, *D. pentaradiatus*, *D. tamalis* [common], *Helicopontosphaera kampferi*, *H. sellii* [small], *Reticulofenestra pseudoumbilica*, *Scyphosphaera globulata* [common], *S. recurvata*, *Sphenolithus abies*, *S. neoabies*, and *Thoracosphaera saxea*.

**Lower Pliocene**

(\(\text{Ceratolithus tricorniculatus Zone, Ceratolithus rugosus Subzone}\))

200-4-1, bottom (30 m):

*Angulolithina* arca*, *Ceratolithus bizzarus*, *C. primus*, *C. rugosus*, *Coccolithus pelagicus*, *Cyclococcolithina leptopora* [abundant], *Discocystera asymmetricus*, *D. blackstockiae*, *D. brouweri*, *D. pentaradiatus*, *D. surculus*, *Reticulofenestra pseudoumbilica*, and *Scyphosphaera globulata*. Taxa whose absence is unusual: *Helicopontosphaera kampferi*, and *Sphenolithus abies*.

*Mixed Oligocene to Pliocene, probably upper Miocene*  

200-5-1, bottom (39 m):

S. pulcherrima, Sphenolithus abies, S. neoabies [abundant], S. predistentus [rare], and Thracosphaera saxaea.

Middle Miocene
(upper Discoaster hamatus Zone)

200-6-1, bottom (49 m):

200-7, CC (57-67 m):

Middle Miocene
(lower Sphenolithus heteromorphus Zone)

200-9-1, bottom (87 m):

200-9-3, bottom (90 m):
Coccolithus miopelagicus, C. pelagicus, Coronocyclyus sp., Cyclicargolithus floridanus [abundant], Cyclococcolithina macintyre, Discoaster sp. cf. D. deflandrei [abundant, irregular overgrowth +4], D. sp. cf. D. exilis [abundant, irregular overgrowth +4], Discolithina sp. [large, imperforate], Helicopontosphaera granulata, Scyphosphaera recurvata, and Sphenolithus heteromorphus.

Lower Miocene
(Helicopontosphaera ampliaperta Zone)

200-9-6, bottom (95 m):
Braarudosphaera sp. cf. B. bigelowi [rare], Coccolithus miopelagicus, C. pelagicus, Coronocyclyus sp., Cyclicargolithus floridanus [abundant], Discoaster deflandrei s.a. [abundant], Discolithina sp. cf. D. segmenta, D. sp. [large, imperforate], Hayaster perplexus [rare, less overgrown than discoasters], Helicopontosphaera granulata, Sphenolithus heteromorphus [common; long apical spines], and Thracosphaera sp.

Lower Miocene
(Sphenolithus bemiuros Zone)

200-10, CC (105-114 m):

REFERENCES


PLATE 1
Coccolith Photomicrographs, 2000 X
(BF = Bright-field; XN = Cross-polarized)
(Scale bar equals 5 microns)

Figures 1-4  *Discoaster blackstockae* n. sp.
1. Holotype, USNM 188509, DSDP 71.0-4-5, 63-64 cm; BF.
2. USNM 188510, DSDP 199-1-5, 5-6 cm; BF.
3. USNM 188511, DSDP 72A-3A-5, 63-64 cm; BF, with a specimen of *Discoaster triradiatus*.
4. USNM 188512, DSDP 219-6-5, 110-111 cm; BF.

Figures 5-6  *Discoaster quadramus* n. sp.
5. Holotype, USNM 188513, DSDP 219-6-5, 110-111 cm; XN.
6. BF.

Figures 7-9  *Fasciculithus pileatus* n. sp.
7. USNM 188515, DSDP 199-10-2, 34-35 cm; BF, 45°.
8. XN, 45°, with specimen of *Coccolithus pelagicus* s. a.
9. USNM 188516, DSDP 199-10-2, 34-35 cm; BF, 82°.
PLATE 2
Coccolith Photomicrographs, 2000 X
(BF = Bright-field, PC = Phase-contrast; XN = Cross-polarized)
Scale bar equals 5 microns

Figures 1-5  *Fasciculithus pileatus* n. sp.
1. USNM 188517, DSDP 199-10-2, 34-35 cm; BF, 45°.
2. Holotype, USNM 188514, DSDP 199-10-2, 34-35 cm; BF, 0°.
3. XN, 45°.
4. XN, 25°.
5. PC, 45°.

Figures 6-9  *Tetralithus praemurus* n. sp.
6. USNM 188519, DSDP 47.2-13-3, 80-81 cm; XN.
7. Holotype, USNM 188518, DSDP 199-10-2, 34-35 cm; XN [suture inked for emphasis].
8. Partial XN.
9. BF.