

16. PRELIMINARY DATING BY FOSSIL CALCAREOUS NANNOPLANKTON, DEEP SEA DRILLING PROJECT: LEG 10

William W. Hay, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida;
Department of Geology, University of Illinois, Urbana, Illinois

INTRODUCTION

The zonation and ages used in this report correspond to those of Martini and Worsley (1970) for the Neogene, Martini (1970) for the Paleogene, and Cepek and Hay (1969) for the Late Cretaceous. The *Gephyrocapsa oceanica* Zone, defined by the first occurrence of the name species at the base and by the first occurrence of *Emiliana huxleyi* at the top, is used here instead of the *Pseudoemiliana lacunosa* Zone.

HOLE 85/85A

Samples: 85-1-1 (6-7 cm); 85-1-2 (6-7 cm); 85-1-3 (3-4 cm):

These samples contain generally poor assemblages; mostly reworked Late Cretaceous species, including *Micula staurophora*, *Watznaueria barnesae*, *Arkhangelskiella octoradiata*, *Cribrosphaera ehrenbergi*, *Cretadiscus colatus*, and *Eiffellithus turriseiffeli*. Some specimens of *Gephyrocapsa aperta* are present.

Age: Probably *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 85-1-4 (6-7cm):

Very poor assemblage with only *Micula staurophora* and a few corroded coccoliths.

Sample 85-1-5 (10-11 cm):

Poor assemblage with some reworked Late Cretaceous species, as in Sample 85-1-3 (3-4cm), but also including *Gephyrocapsa caribbeanica?* and *G. aperta*.

Age: Probably *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 85-1-6 (6-7 cm):

Very poor assemblage with only a few specimens of *Gephyrocapsa aperta* and *G. caribbeanica*.

Age: Probably *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 85-2-1 (6-7 cm); 85-2-2 (7-8 cm):

No calcareous nannofossils.

Sample 85-2-3 (14-15 cm):

Very poor assemblage with reworked species from Late Cretaceous, as in Sample 85-1-3 (3-4 cm), and ? *Gephyrocapsa caribbeanica*.

Age: Pleistocene.

Sample 85-3-1 (10-11 cm):

Very poor assemblage with rare coccoliths, including *Prediscosphaera cretacea* from the Late Cretaceous, and *Gephyrocapsa oceanica*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 85-3-2 (10-11 cm); 85-3-3 (7-8 cm); 85-3-4 (5-4 cm):

No calcareous nannofossils.

Samples: 85-3-6 (6-7 cm); 85-4-2 (10-11 cm); 85-5-1 (63-64 cm):

Very poor assemblages with *Gephyrocapsa aperta* and *G. caribbeanica*.

Age: Probably *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 85-5-2 (6-7 cm):

No calcareous nannofossils.

HOLE 86

Samples: 86-1-1 (7-8 cm); 86-1-2 (6-7 cm); 86-1-3 (6-7 cm):

These samples contain *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, *Rhabdosphaera stylifera*, and *Sphenolithus fossilis*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 86-2-1 (57-58 cm):

Moderately good assemblage with *Gephyrocapsa caribbeanica*, both elliptical and varieties of *Pseudoemiliana lacunosa*, *Helicopontosphaera kamptneri*, and *Rhabdosphaera clavigera*. Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Sample 86-3-1 (7-8 cm):

This sample contains *Gephyrocapsa caribbeanica*, *Cyclococcolithina leptopora*, *Pseudoemiliana lacunosa*, *Discoaster brouweri*, and *D. pentaradiatus*.

Age: Probably *Discoaster pentaradiatus* Zone or *Discoaster surculus* Zone; Late Pliocene.

Sample 86-3-2 (6-7 cm):

This sample contains the same assemblage as that immediately above, plus *Sphenolithus abies*.

Age: Early *Discoaster surculus* Zone; Late Pliocene.

Sample 86-3-3 (7-8 cm):

Assemblage like that above, but badly corroded.

Samples: 86-3-4 (5-6 cm); 86-3-5 (9-10 cm); 86-3-6 (7-8 cm):

Moderately good assemblages like Sample 86-3-2 (6-7 cm), but with *Discoaster extensus*.

Age: Early *Discoaster surculus* Zone; Late Pliocene.

Samples 86-4-1 (18-19 cm); 86-4-2 (6-7 cm):

Same assemblage as in Sample 86-3-6 (7-8 cm), but with *Discoaster asymmetricus* and *Reticulofenestra pseudoubilica*.

Age: *Reticulofenestra pseudoubilica* Zone; Early Pliocene.

Samples: 86-4-3 (6-7 cm); 86-4-4 (6-7 cm); 86-4-5 (9-10 cm):

As above but with *Discoaster variabilis* added.

Age: *Reticulofenestra pseudoubilica* Zone; Early Pliocene.

Samples: 86-5-1 (87-88 cm); 86-5-2 (6-7 cm):

Assemblage with *Discoaster nephados*, *D. saundersi*, *Coccolithus pelagicus*, *Sphenolithus distentus*, *S. predistentus*, and *Triquetrorhabdulus carinatus*.

Age: Probably *Sphenolithus distentus* Zone; Middle or Late Oligocene. The overlap of *Sphenolithus predistentus* and *Triquetrorhabdulus carinatus* should not occur and may be an indication of mixing of material of different ages.

Samples: 86-5-3 (11-12 cm); 86-5-4 (4-5 cm):

Sphenolithus predistentus is common in these samples and no *Triquetrorhabdulus carinatus* occur.

Age: *Sphenolithus predistentus* Zone; Middle Oligocene.

Samples: 86-7-2 (6-7 cm); 86-7-3 (6-7 cm); 86-7-4 (4-5 cm); 86-7-5 (6-7 cm):

Generally poor assemblages with *Coccolithus pelagicus*, *Chiasmolithus* sp., *Braarudosphaera bigelowi*, *B. undata*, and *Sphenolithus radians*.

Age: Uncertain, possibly Lower Eocene.

Sample 86-8-1 (101-102):

No calcareous nannofossils.

Sample 86-8-2 (7-8 cm):

Moderately good assemblage with *Zygodiscus adamas*, *Chiasmolithus bidens*, *Coccolithus cavus*, *Heliolithus kleinpellii*, *Fasciculithus tympaniformis*, and *Sphenolithus anarrhopus*.

Age: *Heliolithus kleinpellii* Zone; Middle Paleocene.

Samples: 86-8-3 (6-7 cm); 86-8-4 (6-7 cm); 86-9-1 (8-10 cm); 86-9-2 (6-7 cm):

Very poor assemblages; resembling that in Sample 86-8-2 (7-8 cm), but lacking *Heliolithus kleinpellii*.

Age: Probably *Fasciculithus tympaniformis* Zone; Early or Middle Paleocene.

HOLE 87

Sample 87-1-1 (6-7 cm):

Moderately good assemblage with *Gephyrocapsa oceanica*, *Cyclococcolithina leptopora*, *Cyclolithella annula*, *Helicopontosphaera kamptneri*, and *Scapholithus fossilis*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 87-1-1 (116-117 cm); 87-1-2 (6-7 cm):

No calcareous nannofossils.

HOLE 88

Samples: 88-1-2 (6-7 cm); 88-1-2 (145-146 cm); 88-1-3 (6-7 cm):

Good assemblage with *Gephyrocapsa oceanica*, *Helicopontosphaera kamptneri*, *Scapholithus fossilis*, *Rhabdosphaera clavigera*, *R. stylifera*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 88-1-4 (6-7 cm):

Same assemblage as above but with *Gephyrocapsa caribbeanica* and *G. aperta*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 88-2-1 (6-7 cm); 88-2-2 (6-7 cm); 88-2-3 (12-13 cm); 88-2-4 (8-9 cm); 88-2-5 (3-4 cm):

Good assemblages with *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, *Helicopontosphaera kamptneri*, and *Pseudoemiliana lacunosa*.

Age: Early *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 88-3-3 (69-70 cm); 88-3-4 (5-6 cm):

Good assemblage with *Discoaster brouweri rutellus*, *D. brouweri tridenus*, and *D. brouweri tamalis* accompanying a flood of *Pseudoemiliana lacunosa*.

Age: *Discoaster brouweri* Zone; Late Pliocene.

Samples: 88-3-5 (5-6 cm); 88-3-6 (27-28 cm):

Same assemblage as in the upper part of this barrel, but with *Discoaster pentaradiatus*.

Age: *Discoaster pentaradiatus* Zone; Late Pliocene.

Samples: 88-4-1 (6-7 cm); 88-4-2 (125-126 cm); 88-4-3 (19-20 cm); 88-4-4 (48-49 cm):

Assemblages with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus* (rare), and *Pseudoemiliana lacunosa*.

Age: *Discoaster surculus* Zone; Late Pliocene.

Samples: 88-4-5 (13-14 cm); 88-5-1 (2-3 cm); 88-5-6 (28-29 cm); 88-5-6 (18-19 cm):

Assemblages with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*, *Reticulofenestra pseudoumbilica*.

Age: *Reticulofenestra pseudoumbilica* Zone; Early Pliocene.

HOLE 89

Samples: 89-1-1 (100-101 cm); 89-1-2 (19-20 cm):

Assemblages of very small coccoliths, including *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, and *Cyclococcolithina leptopora*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 89-1-3 (12-13 cm):

Very poor assemblage with a few large specimens of *Gephyrocapsa oceanica*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 89-2-1 (122-123 cm):

Good assemblage with many *Gephyrocapsa caribbeanica* and *Pseudoemiliana lacunosa*, some *Cyclococcolithina leptopora* and *Helicopontosphaera kamptneri*.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Samples: 89-3-1 (4-5 cm); 89-3-2 (6-7 cm):

Moderately good assemblages with *Gephyrocapsa caribbeanica*, *Pseudoemiliana lacunosa*, *Rhabdosphaera clavigera*, and *Helicopontosphaera kamptneri*.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Sample 89-3-3 (10-11 cm):

Same assemblage as above, but with fragments of *Discoaster brouweri*.

Age: Earliest *Gephyrocapsa caribbeanica* Zone or latest *Discoaster brouweri* Zone; Earliest Pleistocene or latest Pliocene.

Sample 89-3-4 (6-7 cm):

Gephyrocapsa caribbeanica, *Pseudoemiliana lacunosa*, *Discoaster brouweri*, and *D. pentaradiatus*.

Age: *Discoaster pentaradiatus* Zone, Late Pliocene.

Sample 89-4-1 (6-7 cm):

Good assemblage with *Gephyrocapsa caribbeanica*, *Reticulofenestra pseudoumbilica*, *Sphenolithus abies*, *Discoaster brouweri*, *D. pentaradiatus*, *D. cf. surculus*, *D. cf. extensus*.

Age: Probably *Discoaster surculus* Zone; Late Pliocene.

Sample 89-4-2 (6-7 cm):

Same species as above are present, but the assemblage is very poor.

Sample 89-4-3 (7-8 cm):

Same assemblage as in Sample 89-4-1 (6-7 cm), but with typical specimens of *Discoaster surculus*.

Age: *Discoaster surculus* Zone; Late Pliocene.

Sample 89-4-4 (6-7 cm):

Same assemblage as in Sample 89-4-3 (7-8 cm), but with a reworked specimen of *Discoaster barbadiensis*.

Sample 89-4-5 (24-25 cm):

Good assemblage with *Reticulofenestra pseudoumbilica*, *Sphenolithus abies*, *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*, *Ceratolithus tricorniculatus*, and *C. rugosus*.

Age: *Ceratolithus rugosus* Zone; Early Pliocene.

Sample 89-4-6 (7-8 cm):

Same assemblage as in Sample 89-4-5 (24-25 cm), but with *Discoaster cf. quinqueramus*.

Age: *Ceratolithus rugosus* Zone; Early Pliocene.

Sample 89-5-1 (106-107 cm):

Very sandy sample with a few specimens of *Reticulofenestra pseudoumbilica*.

Age: Miocene or Pliocene.

Sample 89-6-1 (84-85 cm):

Very poor sample with only a few corroded unidentifiable coccoliths.

Age: Uncertain.

Sample 89-6-3 (6-7 cm):

Poor assemblage with *Discoaster brouweri*, *D. quinqueramus*, and *D. cf. neohamatus*.

Age: Probably *Discoaster quinqueramus* Zone; Late Miocene.

Sample: 89-6-4 (11-12 cm):

Poor assemblage with *Discoaster brouweri*, *D. pentaradiatus*, *D. quinqueramus*, and reworked specimens of *Micula staurophora*.

Age: *Discoaster quinqueramus* Zone; Late Miocene

Sample 89-6-5 (11-12 cm):

Poor assemblage with *Discoaster brouweri*, *D. pentaradiatus*, *D. quinqueramus*, *D. cf. neohamatus*, and reworked specimens of *Microrhabdulus decoratus* and *Micula staurophora*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

HOLE 90

Sample 90-1-1 (6-7 cm):

Good assemblage with *Gephyrocapsa oceanica*, *G. caribbeanica*, *Helicopontosphaera kamptneri*, *Discolithina sp.*, *Rhabdosphaera stylifera*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 90-1-2 (6-7 cm):

Sandy sample with very poor assemblage like that above.

Samples: 90-1-3 (6-7 cm); 90-1-4 (6-7 cm); 90-1-5 (6-7 cm); 90-1-6 (6-7 cm):

Good assemblages with *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, *Ceratolithus cristatus*, *Discolithina phaseola*, *Helicopontosphaera kamptneri*, *Cyclococcolithina leptopora*, and *Rhabdosphaera stylifera*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 90-2-1 (57-58); 90-2-2 (6-7 cm); 90-2-3 (15-16 cm); 90-2-4 (6-7 cm):

Same assemblage as in Sample 90-1-6 (6-7 cm), but with *Pseudoemiliania lacunosa*.

Age: Early *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 90-3-1 (60-61 cm); 90-3-2 (6-7 cm); 90-3-3 (14-15 cm):

Assemblages with *Discoaster brouweri rutellus*, *D. brouweri tridenus*, *D. brouweri tamalis*, and *D. pentaradiatus*.

Age: *Discoaster pentaradiatus* Zone; Late Pliocene.

Samples: 90-4-1 (86-87 cm); 90-4-2 (6-7 cm); 90-4-3 (13-14 cm):

Assemblages with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*, and *Sphenolithus abies*.

Age: Early *Discoaster surculus* Zone; Late Pliocene.

Sample 90-5-1 (6-7 cm):

Very poor assemblage with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*.

Age: Late Miocene or Pliocene.

Sample 90-5-2 (7-8 cm):

Very poor assemblage with only a few unidentifiable coccoliths.

Age: Uncertain.

Sample 90-5-3 (3-4 cm):

Very poor assemblage, but with *Discoaster quinqueramus*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

Samples: 90-5-4 (6-7 cm); 90-6-1 (19-20 cm); 90-6-2 (6-7 cm):

No calcareous nannofossils.

Samples 90-7-1 (32-33 cm); 90-7-2 (6-7 cm); 90-7-3 (6-7 cm):

Very poor assemblages with *Discoaster brouweri rutellus*, *D. brouweri tridenus*, *D. brouweri triradiatus*, *D. expansus*, and *D. quinqueramus*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

Samples: 90-9-1 (26-27 cm); 90-10-1 (3-4 cm):

No calcareous nannofossils.

Sample 90-11-2 (11-12 cm):

Sample almost barren, containing only a few coccolith and asterolith fragments.

Sample 90-11-3 (6-7 cm):

Very poor sample containing some heavily calcified asterolith fragments. Apparently only five- and six-rayed asteroliths are present.

Age: Probably Middle or Late Miocene.

Samples: 90-11-4 (6-7 cm); 90-11-5 (6-7 cm); 90-11-6 (6-7 cm); 90-13-1 (6-7 cm); 90-13-2 (6-7 cm); 90-13-3 (19-20 cm):

No calcareous nannofossils.

HOLE 91

Sample 91-1-1 (90-91 cm):

No calcareous nannofossils.

Sample 91-1-2 (6-7 cm):

Very poor assemblage with *Gephyrocapsa oceanica*, *G. caribbeanica*, and *Helicopontosphaera kamptneri*.

Age: *Gephyrocapsa caribbeanica* Zone; Late Pleistocene.

Samples: 91-1-3 (3-4 cm); 91-1-4 (14-15 cm); 91-1-5 (6-7 cm); 91-1-6 (6-7 cm); 91-2-1 (122-123 cm):

No calcareous nannofossils.

Samples: 91-2-2 (6-7 cm); 91-2-3 (6-7 cm); 91-2-4 (5-6 cm):

Very poor samples with a few specimens of *Gephyrocapsa oceanica*, *G. caribbeanica*, and *G. aperta*.

Age: *Gephyrocapsa caribbeanica* Zone; Late Pleistocene.

Sample 91-2-5 (6-7 cm):

No calcareous nannofossils.

Sample 91-3-1 (6-7 cm):

Very poor sample with *Helicopontosphaera kamptneri* and reworked Mesozoic *Watznaueria barnesae*.

Samples: 91-3-2 (4-5 cm); 91-3-6 (6-7 cm):

No calcareous nannofossils.

Sample 91-4-1 (6-7 cm):

A few reworked Cretaceous coccoliths occur: *Eiffellithus turriseiffeli*, *Watznaueria barnesae*, *Vekshinella* sp., *Micula staurophora*.

Samples: 91-4-2 (6-7 cm); 91-4-3 (6-7 cm):

Very poor samples with only a few specimens of reworked Mesozoic *Watznaueria barnesae*.

Samples: 91-4-4 (6-7 cm); 91-4-5 (6-7 cm); 91-4-6 (6-7 cm):

No calcareous nannofossils.

Sample 91-5-1 (5-6 cm):

Very poor assemblage with *Gephyrocapsa oceanica* and *G. aperta*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 91-5-2 (5-6 cm):

Very poor assemblage containing *Gephyrocapsa aperta*, *G. caribbeanica*, and *Helicopontosphaera kamptneri*.

Age: Probably *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 91-5-3 (6-7 cm); 91-5-4 (6-7 cm); 91-5-5 (6-7 cm):

No calcareous nannofossils.

Sample 91-5-6 (5-6 cm):

Poor assemblage with *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, and reworked Cretaceous *Watznaueria barnesae*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 91-6-1 (6-7 cm):

Moderately good assemblage with *Gephyrocapsa oceanica*, *G. aperta*, *G. caribbeanica*, *Cyclococcolithina leptopora*, *Scapholithus fossilis*, and *Rhabdosphaera stylifera*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 91-6-2 (6-7 cm):

Poor assemblage of reworked Cretaceous coccoliths: *Arkhangelskiella cymbiformis*, *Eiffellithus turriseiffeli*, *Prediscosphaera cretacea*, *Watznaueria barnesae*, *Micula staurophora*.

Sample 91-6-3 (6-7 cm):

Very poor assemblage with only a few rims of Cretaceous coccoliths.

Sample 91-6-4 (5-6 cm):

No calcareous nannofossils.

Sample 91-6-5 (5-6 cm):

Very poor assemblage with *Gephyrocapsa oceanica*, and some reworked Cretaceous specimens of *Watznaueria barnesae*, *Micula staurophora*, and *Cribrosphaera ehrenbergi*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 91-7-1 (45-46 cm); 91-7-2 (? cm); 91-7-3 (6-7 cm):

No calcareous nannofossils.

Sample 91-7-4 (6-7 cm):

Very poor assemblage with *Gephyrocapsa oceanica*, *Cyclococcolithina leptopora*, and reworked *Watznaueria barnesae*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Sample 91-7-5 (6-7 cm):

No calcareous nannofossils.

Samples: 91-8-1 (23-24 cm); 91-8-2 (6-7 cm):

Very poor assemblages with *Gephyrocapsa caribbeanica*, *Pseudoemiliana lacunosa*, and *Discoaster brouweri*.

Age: *Discoaster brouweri* Zone; Late Pleistocene.

Samples: 91-9-2 (7-8 cm); 91-9-3 (6-7 cm); 91-9-4 (6-7 cm):

No calcareous nannofossils.

Sample 91-9-5 (7-8 cm):

Moderately good assemblage with *Pseudoemiliana lacunosa*, *Gephyrocapsa caribbeanica*, *Discoaster brouweri*, *Discoaster rutellus*, *D. brouweri tridens*, *D. brouweri tamalis*, *D. pentaradiatus*, and *Ceratolithus cristatus*.

Age: *Discoaster pentaradiatus* Zone; Late Pliocene.

Sample 91-9-6 (12-13 cm):

Very poor sample with only a few specimens of *Pseudoemiliana lacunosa*.

Sample 91-10-2 (6-7 cm):

Very poor assemblage with *Discoaster brouweri* and *D. pentaradiatus*.

Age: *Discoaster pentaradiatus* Zone; Late Pliocene.

Samples: 91-10-3 (6-7 cm); 91-10-4 (6-7 cm):

No calcareous nannofossils.

Sample 91-11-2 (6-7 cm):

Very poor, with only a few coccolith rims present.

Samples: 91-11-3 (4-5 cm); 91-11-4 (6-7 cm); 91-12-2 (6-7 cm); 91-12-3 (8-9 cm); 91-13-1 (58-59 cm); 91-13-2 (6-7 cm); 91-13-3 (9-10 cm); 91-14-2 (6-7 cm); 19-15-1 (6-7 cm):

No calcareous nannofossils.

Samples: 91-15-2 (6-7 cm); 91-15-3 (6-7 cm):

Poor assemblage with *Discoaster brouweri*, *D. extensus*, *D. kugleri*, *D. bollii*.

Age: *Discoaster kugleri* Zone; Middle Miocene.

Sample 91-16-1 (3-4 cm):

No calcareous nannofossils.

Sample 91-16-2 (6-7 cm):

Poor assemblage with *Discoaster brouweri*, *D. bollii*, *D. kugleri*, and *Catinaster calyculus*.

Age: *Discoaster kugleri* Zone, Middle Miocene.

Samples: 91-16-3 (6-7 cm); 91-18-6 (73-74 cm); 91-20-2 (6-7 cm); 91-20-6 (7-8 cm); 91-22-1 (6-7 cm):

No calcareous nannofossils.

Sample 91-22-2 (5-6 cm):

Very poor assemblage with *Coccolithus* cf. *pelagicus*, and asterolith fragments.

Age: Uncertain.

Samples: 91-25-1 (89-90 cm); 91-25-2 (6-7 cm); 91-25-3 (13-14 cm); 91-25-4 (12-13 cm):

No calcareous nannofossils.

HOLE 92

Sample 92-2-1 (91-92 cm):

No calcareous nannofossils.

Sample 92-2-2 (6-7 cm):

Very poor assemblage of reworked Cretaceous coccoliths, with *Watznaueria barnesae* and *Micula staurophora*.

Sample 92-2-3 (6-7 cm):

Very poor assemblage with *Gephyrocapsa caribbeanica*, and reworked Cretaceous calcareous nannofossils: *Microrhabdulus decoratus*, *Arkhangelskiella* sp., *Micula staurophora*, *Prediscosphaera cretacea*.

Age: Probably *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Sample 92-2-4 (6-7 cm):

Few Cretaceous calcareous nannofossils present: *Microrhabdulus decoratus*, *Micula staurophora*.

Sample 92-2-5 (6-7 cm):

Poor assemblage of reworked Cretaceous calcareous nannofossils, with *Watznaueria barnesae*, *Arkhangelskiella cymbiformis*, and *Prediscosphaera cretacea*.

Sample 92-3-1 (101-102 cm):

Very poor assemblage with a few specimens of *Gephyrocapsa caribbeanica* and *G. aperta*.

Age: Probably *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Samples: 92-3-2 (6-7 cm); 92-3-3 (6-7 cm); 92-3-4 (6-7 cm); 92-3-5 (6-7 cm); 92-4-2 (6-7 cm); 92-4-3 (6-7 cm):

No calcareous nannofossils.

Sample 92-4-4 (6-7 cm):

Very poor sample with a few specimens of *Watznaueria barnesae* and *Gephyrocapsa* sp.

Sample 92-4-5 (9-10 cm):

No calcareous nannofossils.

Sample 92-5-1 (6-7 cm):

Very poor assemblage with *Gephyrocapsa* sp. and reworked Cretaceous coccoliths: *Arkhangelskiella cymbiformis*, *Watznaueria barnesae*, and *Prediscosphaera cretacea*.

Sample: 92-5-2 (6-7 cm):

Very rare, poorly preserved specimens of *Gephyrocapsa* cf. *caribbeanica*.

Age: ? *Gephyrocapsa caribbeanica* Zone; ? Early Pleistocene.

Samples: 92-5-3, (6-7 cm); 92-5-4, (6-7 cm):

Only a few coccolith remnants are present.

Sample 92-5-5, (6-7 cm):

Micula staurophora and *Watznaueria barnesae* from the Cretaceous occur with rare, poor specimens of *Gephyrocapsa* cf. *caribbeanica*.

Age: ? *Gephyrocapsa caribbeanica* Zone; ? Early Pleistocene.

Sample: 92-5-6 (8-9 cm):

Only a few reworked Cretaceous coccoliths are present: *Prediscosphaera cretacea*, *Arkhangelskiella parca*, *Eiffellithus turriseiffeli*, and *Watznaueria barnesae*.

Samples: 92-6-2 (6-7 cm); 92-7-1 (126-127 cm); 92-8-1 (34-35 cm); 92-11-2 (6-7 cm):

No calcareous nannofossils.

HOLE 93

Sample 93-1-1 (133-134 cm):

Mixed assemblage with *Gephyrocapsa oceanica*, *G. caribbeanica*, *Cyclococcolithina leptopora*, *Helicopontosphaera kamptneri*, and *Discoaster brouweri*.

Age: Mixed Late Pleistocene and Late Pliocene.

Sample 93-1-2 (6-7 cm):

Good assemblage with *Sphenolithus abies*, *Discoaster pentaradiatus*, *D. brouweri*, *D. extensus*, *Helicopontosphaera kamptneri*, and *Coccolithus pelagicus*.

Age: Probably *Discoaster surculus* Zone; Late Pliocene.

HOLE 94

Samples: 94-1-1 (103-104 cm); 94-1-2 (6-7 cm):

Good assemblage with *Gephyrocapsa oceanica*, *G. caribbeanica*, *G. aperta*, *Helicopontosphaera kamptneri*, and *Cyclococcolithina leptopora*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 94-2-1 (6-7 cm); 94-2-2 (6-7 cm):

Good assemblage with *Gephyrocapsa caribbeanica*, *G. aperta*, *Pseudoemiliana lacunosa*, *Helicopontosphaera kamptneri*, and *Cyclococcolithina leptopora*.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Samples: 94-2-3 (6-7 cm); 94-2-4 (6-7 cm); 94-2-5 (6-7 cm); 94-2-6 (6-7 cm):

Good assemblage with *Gephyrocapsa caribbeanica*, *Pseudoemiliana lacunosa*, *Discoaster brouweri*, and *D. pentaradiatus*.

Age: *Discoaster pentaradiatus* Zone; Late Pliocene.

Samples: 94-3-1 (33-34 cm); 94-3-2 (6-7 cm):

Good assemblage with *Gephyrocapsa caribbeanica*, *Pseudoemiliana lacunosa*, *Discoaster brouweri*, *D. pentaradiatus*, *D. cf. surculus*, *D. asymmetricus*, and *Sphenolithus abies*.

Age: Early *Discoaster surculus* Zone; Late Pliocene.

Sample 94-3-3 (6-7 cm):

Poor assemblage, but with the same species as immediately above.

Sample 94-3-4 (17-18 cm):

Moderately good assemblage like that of Sample 94-3-2 (6-7 cm)

Samples; 94-3-5 (6-7 cm); 94-3-6 (6-7 cm):

Assemblages like in Sample 94-3-2 (6-7 cm), but with typical *Discoaster surculus* present.

Age: Early *Discoaster surculus* Zone; Late Pliocene.

Sample 94-4-1 (6-7 cm):

Good assemblage with *Discoaster brouweri*, *D. surculus*, *D. pentaradiatus*, *D. asymmetricus*, *Reticulofenestra pseudumbilica*, and *Ceratolithus rugosus*.

Age: *Reticulofenestra pseudumbilica* Zone; Early Pliocene.

Sample 94-4-2 (6-7 cm):

Good assemblage with *Discoaster brouweri*, *D. surculus*, *D. pentaradiatus*, *D. perplexus*, *D. asymmetricus*, *Reticulofenestra pseudumbilica*, *Ceratolithus tricorniculatus*.

Age: *Discoaster asymmetricus* Zone; Early Pliocene.

Sample 94-4-3 (12-13 cm):

Assemblage as immediately above, but apparently lacking *Discoaster asymmetricus*.

Age: *Ceratolithus rugosus* Zone; Early Pliocene.

Samples: 94-4-4 (6-7 cm); 94-4-5 (6-7 cm):

Assemblages with the same species as in Sample 94-4-3 (12-13 cm), but dominated by a flood of minute coccoliths.

Age: *Ceratolithus rugosus* Zone; Early Pliocene.

Samples: 94-4-6 (6-7 cm); 94-5-1 (14-15 cm); 94-5-2 (6-7 cm); 94-5-3 (6-7 cm); 94-5-4 (14-15 cm):

Moderately good samples with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*, *Reticulofenestra pseudumbilica*, *Ceratolithus tricorniculatus* and *C. rugosus*.

Age: *Ceratolithus rugosus* Zone; Early Pliocene.

Samples: 94-5-5 (6-7 cm); 94-6-1 (6-7 cm); 94-6-2 (4-5 cm); 94-6-3 (6-7 cm); 94-6-4 (13-14 cm); 94-6-5 (4-5 cm); 94-6-6 (6-7 cm); 94-7-1 (108-109 cm); 94-7-2 (6-7 cm); 94-7-3 (6-7 cm); 94-7-4 (6-7 cm):

Poor to very poor assemblages with few asteroliths and very rare ceratoliths; species mostly as in Sample 94-5-4 (14-15 cm)

Age: Probably *Ceratolithus rugosus* Zone or *Ceratolithus tricorniculatus* Zone; Early Pliocene or Late Miocene.

Sample 94-7-5 (6-7 cm):

Moderately good assemblage with *Discoaster brouweri*, *D. surculus*, and *D. quinqueramus*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

Sample 94-8-1 (111-112 cm); 94-8-2 (6-7 cm):

Good assemblages with abundant *Discoaster quinqueramus*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

Samples: 94-8-3 (6-7 cm); 94-8-4 (6-7 cm); 94-8-5 (6-7 cm):

Good assemblages with *Discoaster quinqueramus*, *D. neohamatus*, *D. brouweri*, *D. extensus*, *D. surculus*, and *D. perclarus*.

Age: *Discoaster quinqueramus* Zone; Late Miocene.

Sample 94-9-1 (6-7 cm):

Poor assemblage with a few corroded coccoliths and asteroliths.

Samples: 94-9-2 (6-7 cm); 94-9-3 (6-7 cm); 94-9-4 (6-7 cm):

Good assemblages with *Discoaster aulakos*, *D. dilatus*, *D. nephados*, *D. cf. exilis*, *D. extensus*, *D. variabilis*, *Discolithina anisotrema*, and *Sphenolithus heteromorphus*.

Age: *Sphenolithus heteromorphus* Zone; Middle Miocene.

Sample 94-9-6 (6-7 cm):

Poor assemblage containing *Helicopontosphaera parallela*, *Sphenolithus ciperoensis*, and a few nondescript asteroliths.

Age: Probably *Discoaster druggi* Zone; Early Miocene.

Samples: 94-10-1 (69-70 cm); 94-10-2 (6-7 cm); 94-10-3 (6-7 cm):

Good assemblages with *Triquetrorhabdulus carinatus*, *Coronocyclus nitescens*, *Cyclococcolithina floridana*, *Discoaster aulakos*, *D. deflandrei*, *D. adamanteus*, *D. saundersi*, and *D. extensus*.

Age: Probably *Triquetrorhabdulus carinatus* Zone; Late Oligocene or Early Miocene.

Sample 94-11-1 (103-104 cm):

Assemblage similar to that above, but lacking *Triquetrorhabdulus carinatus*, and with *Sphenolithus distentus* and *Reticulofenestra bisecta*.

Age: *Sphenolithus distentus* Zone; Middle or Late Oligocene.

Samples: 94-11-2 (6-7 cm); 94-11-3 (14-15 cm); 94-11-4 (6-7 cm):

Good assemblage with *Reticulofenestra bisecta*, *Discoaster trinidadensis*, *D. saundersi*, *D. adamanteus*, *Cyclococcolithina floridana*, *Sphenolithus distentus* and *S. predistentus*.

Age: *Sphenolithus predistentus* Zone; Middle Oligocene.

Samples: 94-11-5 (6-7 cm); 94-11-6 (6-7 cm); 94-12-1 (19-20 cm); 94-12-2 (6-7 cm); 94-12-3 (6-7 cm); 94-12-4 (6-7 cm); 94-13-2 (22-23 cm); 94-13-3 (6-7 cm):

Good assemblages with the same species as in Sample 94-11-4, except that *Sphenolithus distentus* is absent, and rare specimens of *Discoaster tani ornatus* occur.

Age: *Sphenolithus predistentus* Zone; Middle Oligocene.

Samples: 94-14-1 (119-120 cm); 94-14-2 (5-6 cm); 94-14-3 (6-7 cm); 94-14-4 (4-5 cm); 94-15-4 (39-40 cm):

Moderately good assemblages with *Cyclococcolithina formosa*, *Reticulofenestra umbilica*, *Discoaster barbadiensis*, *D. saipanensis*, *D. tani ornatus*, and *Ericsonia subdisticha*.

Age: Probably *Isthmolithus recurvus* Zone or *Sphenolithus pseudoradians* Zone; Late Eocene.

Sample 94-16-1 (11-12 cm):

Very poor assemblage, lacking *Discoaster barbadiensis*.

Samples: 94-16-2 (6-7 cm); 94-16-3 (6-7 cm); 94-17-1 (16-17 cm); 94-17-2 (12-13 cm); 94-17-3 (7-8 cm):

Moderately good assemblages, with species as in Sample 94-15-4 (39-40 cm)

Sample 94-17-4 (6-7 cm):

Very poor sample with only a few small corroded coccoliths.

Samples: 94-18-1 (6-7 cm); 94-18-2 (6-7 cm):

Moderately good assemblage with *Reticulofenestra umbilica*, *Discoaster barbadiensis*, *D. saipanensis*, *Braarudosphaera undata*, and *B. discula*.

Age: Late Eocene.

Sample 94-18-3 (6-7 cm):

Poor assemblage with small coccoliths.

Samples: 94-18-4 (6-7 cm); 94-19-1 (7-8 cm); 94-19-2 (5-6 cm); 94-19-3 (5-6 cm); 94-19-4 (6-7 cm); 94-19-5 (5-6 cm); 94-20-1 (6-7 cm); 94-20-2 (6-7 cm); 94-20-3 (7-8 cm); 94-20-4 (6-7 cm):

Generally poor samples with species as in Sample 94-18-2 (6-7 cm).

Age: Probably Late Eocene.

Sample 94-21-2 (6-7 cm):

Moderately good sample with *Zygrhablithus bijugatus*, *Triquetrorhabdulus inversus*, *Micrantholithus procerus*, *Braarudosphaera discula*, *Discoaster barbadiensis*, and *D. saipanensis*.

Age: Probably Middle Eocene.

Samples: 94-22-1 (15-16 cm); 94-22-2 (6-7 cm); 94-22-3 (6-7 cm):

Moderately good assemblages with *Discoaster barbadiensis*, *D. saipanensis*, *Reticulofenestra umbilica*, *Zygrhablithus bijugatus*, *Micrantholithus procerus*, and *Heliorthus concinnus*.

Age: Probably Middle Eocene.

Samples: 94-22-4 (6-7 cm); 94-23-1 (89-90 cm); 94-23-2 (6-7 cm); 94-24-1 (115-116 cm); 94-24-2 (6-7 cm); 94-24-3 (7-8 cm):

Mediocre to poor samples with the same assemblage as Sample 94-22-3 (6-7 cm).

Sample 94-24-4 (6-7 cm):

Good assemblage with *Discoaster barbadiensis*, *D. deflandrei*, *Coccolithus eopelagicus*, *Triquetrorhabdulus inversus*, *Micrantholithus procerus*, *Campylosphaera dela*, *Chiasmolithus grandis*.

Age: Middle Eocene.

Samples: 94-25-1 (22-23 cm); 94-25-2 (6-7 cm):

Poor assemblages, but with the same species as immediately above.

Sample 94-25-3 (7-8 cm):

Good assemblage like that of Sample 94-24-4 (6-7 cm).

Age: Middle Eocene

Samples: 94-26-1 (103-104 cm); 94-26-2 (6-7 cm); 94-26-3 (6-7 cm); 94-26-4 (6-7 cm); 94-26-5 (6-7 cm); 94-28-1 (80-81 cm); 94-28-2 (6-7 cm); 94-28-3 (6-7 cm):

Moderately good assemblages with species as in Sample 94-24-4 (6-7 cm).

Age: Middle Eocene.

Samples: 94-28-4 (6-7 cm); 94-28-5 (6-7 cm):

Poor assemblages with species as in Sample 94-24-4 (6-7 cm).

Age: Probably Middle Eocene.

Samples: 94-30-1 (4-5 cm); 94-30-2 (1-2 cm):

Very poor assemblages with *Sphenolithus anarrhopus*, *Discolithina pectinata*, *Coccolithus cf. pelagicus*, *Discoaster*

barbadiensis, and *Lophodolichus reniformis*.

Age: Early Eocene.

Sample 94-33-1 (6-7 cm):

Discoaster barbadiensis is the only recognizable calcareous nannofossil.

Sample 94-33-2 (4-5 cm):

Very poor assemblage with *Discoaster multiradiatus* and *Neococcolithes protenus*.

Age: *Discoaster multiradiatus* Zone or *Marthasterites contortus* Zone; Late Paleocene or Early Eocene.

Samples: 94-34-1 (1-2 cm); 94-34-2 (4-5 cm); 94-34-3 (1-2 cm):

Poor assemblages with *Discoaster multiradiatus*, *Chiasmolithus consuetus*, and *Fasciculithus tympaniformis*.

Age: *Discoaster multiradiatus* Zone; Late Paleocene.

Samples: 94-35-1 (108-109 cm); 94-35-2 (117-119 cm):

Mediocre assemblages with *Sphenolithus anarrhopus*, *Discoaster multiradiatus*, *Fasciculithus tympaniformis*, *Ericsonia subpertusa*, and *Zygodiscus adamas*.

Age: *Discoaster multiradiatus* Zone; Late Paleocene.

Sample 94-36-1 (99-101 cm):

Very poor assemblage with *Ericsonia subpertusa*, *Coccolithus cavus*, and small nondescript coccoliths.

Age: Probably *Cruciplacolithus tenuis* Zone; Early Paleocene.

Sample 94-38-1 (23-24 cm):

No calcareous nannofossils.

HOLE 95

Samples: 95-1-1 (14-15 cm); 95-1-5 (6-7 cm):

Good assemblages with *Gephyrocapsa oceanica*, *G. caribbeanica*, *G. aperta*, and *Cyclococcolithina leptopora*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 95-2-1 (6-7 cm); 95-2-2 (24-25 cm); 95-2-3 (6-7 cm):

Good assemblages with *Triquetrorhabdulus carinatus*, *Cyclococcolithina floridana*, *Coccolithus pelagicus*, *Sphenolithus belemnus*, *Discoaster nephados*, *D. saundersi*, and *D. deflandrei*.

Age: Probably *Triquetrorhabdulus carinatus* Zone; Late Oligocene or Early Miocene.

Sample 95-2-6 (6-7 cm):

Poor assemblage with species as in Sample 95-2-3 (6-7 cm)

Samples: 95-3-1 (6-7 cm); 95-3-2 (28-29 cm); 95-3-3 (5-6 cm); 95-3-4 (8-9 cm); 95-3-5 (15-16 cm); 95-3-6 (6-7 cm); 95-4-2 (7-8 cm); 95-4-3 (6-7 cm); 95-4-4 (6-7 cm):

Good assemblages with *Cyclococcolithina floridana*, *Coccolithus eopelagicus*, *Sphenolithus predistentus* and *S. distentus*.

Age: Probably *Sphenolithus distentus* Zone; Middle or Late Oligocene.

Samples: 95-5-1 (2-3 cm); 95-5-2 (13-14 cm); 95-5-3 (6-7 cm); 95-5-4 (6-7 cm):

Good assemblages with *Cyclococcolithina floridana*, *Coccolithus eopelagicus* and *Sphenolithus predistentus*.

Age: Probably *Sphenolithus predistentus* Zone; Middle Oligocene.

Samples: 95-6-1 (6-7 cm); 95-6-2 (6-7 cm); 95-6-3 (6-7 cm); 95-6-4 (6-7 cm); 95-6-5 (6-7 cm); 95-6-6 (6-7 cm):

Good assemblages with *Cyclococcolithina floridana*, *Coccolithus eopelagicus*, *Sphenolithus predistentus*, *Reticulofenestra umbilica*, *Coronocyclus nitescens*, and *Quinquerhabdus colossicus*.

Age: *Sphenolithus predistentus* Zone; Middle Oligocene

Samples: 95-7-1 (5-6 cm); 95-7-2 (6-7 cm); 95-7-3 (6-7 cm); 95-7-4 (4-5 cm); 95-7-5 (5-6 cm); 95-7-6 (6-7 cm); 95-8-1 (6-7 cm):

Moderately good assemblages with *Coccolithus eopelagicus*, *Cyclococcolithina floridana*, and *Discoaster barbadiensis*.

Age: Probably Late Eocene.

Samples: 95-8-2 (6-7 cm); 95-8-3 (6-7 cm); 95-8-4 (6-7 cm); 95-8-5 (6-7 cm); 95-8-6 (6-7 cm):

Moderately good to poor assemblages with *Cyclococcolithina floridana*, *Coccolithus eopelagicus*, *Chiasmolithus grandis*, *Triquetrorhabdulus inversus*, and *Micrantholithus procerus*.

Age: Probably Middle Eocene.

Sample 95-10-1 (10-11 cm):

Moderately good assemblage with *Ericsonia subpertusa*, *Fasciculithus tympaniformis*, *Chiasmolithus bidens*, *Discoaster multiradiatus*, and *Braarudosphaera bigelowi*.

Age: Probably *Discoaster multiradiatus* Zone; Late Paleocene.

Samples: 95-11-1 (108-110 cm); 95-11-2 (6-7 cm); 95-11-3 (6-7 cm); 95-11-4 (1-2 cm):

Poor assemblages with *Fasciculithus tympaniformis*, *Chiasmolithus danicus*, *Braarudosphaera discula*, *B. bigelowi*, *Ericsonia subpertusa*, *Cruciplacolithus tenuis*, *Markalius astroporus*, *Zygodiscus adamus*, and *Coccolithus cavus*.

Age: *Fasciculithus tympaniformis* Zone; Middle Paleocene.

Samples: 95-12-1 (1-2 cm); 95-12-2 (6-7 cm); 95-12-3 (4-5 cm); 95-12-4 (1-2 cm):

Poor assemblages with *Ericsonia subpertusa*, *Markalius astroporus*, *Cruciplacolithus tenuis*, *Chiasmolithus danicus*, and *Coccolithus cavus*.

Age: *Chiasmolithus danicus* Zone; Early Paleocene.

Samples: 95-13-1 (26-27 cm); 95-13-2 (6-7 cm); 95-13-3 (5-6 cm):

These samples contain only coccolith fragments, no identifiable species.

Sample 95-13-4 (6-7 cm):

Moderately good assemblage of corroded coccoliths, with *Watznaueria barnesae*, *Prediscosphaera cretacea*, *Cribrosphaera* sp.

Age: Late Cretaceous.

Samples: 95-14-1 (42-43 cm); 95-15-1 (6-7 cm):

Moderately good assemblage with *Watznaueria barnesae*, *Prediscosphaera cretacea*, *Cribrosphaera ehrenbergi*, *Eiffellithus turriseiffeli*, *Microrhabdulus decoratus*, *Ahmuellerella octoradiata*, and *Lithastrinus grilli*.

Age: Probably Campanian.

Samples: 95-15-2 (8-9 cm); 95-15-3 (7-8 cm); 95-15-4 (7-8 cm); 95-15-5 (7-8 cm); 95-15-6 (6-7 cm); 95-16-1 (6-7 cm); 95-16-2 (6-7 cm); 95-16-3 (7-8 cm); 95-16-4 (6-7 cm); 95-16-5 (4-5 cm); 95-16-6 (6-7 cm):

Moderately good to mediocre to poor assemblages with the same species as in Sample 95-15-1 (6-7 cm).

Age: Probably Campanian.

Sample 95-17-1 (6-7 cm):

Very poor assemblage with only coccolith fragments.

Samples: 95-17-2 (6-7 cm); 95-17-3 (6-7 cm); 95-17-4 (5-6 cm); 95-17-5 (6-7 cm); 95-17-6 (5-6 cm):

Moderately good assemblages like Sample 95-16-6 (6-7 cm), but with abundant *Lithraphidites carniolensis*.

Age: Probably Santonian.

HOLE 96

Sample 96-1-2 (6-7 cm):

Very poor sample with a few reworked specimens of *Watznaueria barnesae*.

Sample 96-1-3 (6-7 cm):

No calcareous nannofossils.

Samples: 96-1-4 (6-7 cm); 96-1-5 (6-7 cm):

Very poor samples with a few reworked Cretaceous species, including *Watznaueria barnesae*, *Prediscosphaera cretacea*, and *Kamptnerius* sp.

Sample 96-1-6 (13-14 cm):

Poor assemblage of reworked Cretaceous coccoliths: *Micula staurophora*, *Watznaueria barnesae*, *Prediscosphaera cretacea*, and *Cribrosphaera* sp.

Samples: 96-2-1 (6-7 cm); 96-2-2 (6-7 cm):

Good assemblages with *Cyclococcolithina floridana*, *Coccolithus eopelagicus*, *Sphenolithus moriformis*, *S. heteromorphus*, *Helicopontosphaera parallelata*, *Reticulofenestra bisecta*, *Discoaster nephados*, *D. deflandrei*, and *Triquetrorhabdulus carinatus*.

Age: *Mixed Early Miocene*.

Samples: 96-2-3 (6-7 cm); 96-2-4 (6-7 cm); 96-2-5 (6-7 cm); 96-2-6 (6-7 cm):

Good assemblages with *Sphenolithus ciperoensis*, *Cyclococcolithina floridana*, *Coccolithus eopelagicus*, *Helicopontosphaera truncata*, *Triquetrorhabdulus carinatus*, and *Discoaster saundersi*.

Age: *Sphenolithus ciperoensis* Zone; Late Oligocene.

Samples: 96-3-1 (6-7 cm); 96-3-2 (6-7 cm); 96-3-3 (6-7 cm); 96-3-4 (6-7 cm):

Moderately good assemblages with *Ericsonia subpertusa*, *Discoaster multiradiatus*, *Sphenolithus anarrhopus*, *Coccolithus eopelagicus*.

Age: *Discoaster multiradiatus* Zone; Late Paleocene.

Samples: 96-3-5 (6-7 cm); 96-3-9 (6-7 cm):

Mediocre samples with species as in Sample 96-3-1 (6-7 cm)

Age: *Discoaster multiradiatus* Zone; Late Paleocene.

Sample 96-5-1 (44-45 cm):

Poor assemblage with *Ericsonia subpertusa*, *Coccolithus* cf. *pelagicus*, and *Fasciculithus tympaniformis*.

Age: Probably *Fasciculithus tympaniformis* Zone; Middle Paleocene.

HOLE 97

Samples: 97-1-1 (91-92 cm); 97-1-2 (6-7 cm); 97-1-2 (59-60 cm):

Good assemblages with *Gephyrocapsa oceanica*, *G. caribbeanica*, *G. aperta*, *Helicopontosphaera kamptneri*, and *Cyclococcolithina leptopora*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 97-1-3 (7-8 cm); 97-1-4 (6-7 cm):

Good assemblages with species as above, but with *Pseudoemiliania lacunosa*.

Age: *Gephyrocapsa oceanica* Zone; Late Pleistocene.

Samples: 97-2-1 (26-27 cm); 96-2-2 (6-7 cm); 96-2-3 (6-7 cm); 96-2-4 (13-14 cm):

Moderately good assemblages with *Gephyrocapsa caribbeanica*, *Sphenolithus abies*, *Discoaster brouweri*, *D. pentaradiatus*, and *D. surculus*.

Age: *Discoaster surculus* Zone; Late Pliocene.

Sample 97-3-2 (6-7 cm):

Rich asterolith assemblage, with *Discoaster brouweri*, *D. variabilis*, *D. cf. challengerii*, and *D. neohamatus*.

Age: *Discoaster calcaris* Zone; Late Miocene.

Sample 97-3-3 (12-13 cm):

Poor assemblage, but with species as immediately above.

Sample 97-4-2 (6-7 cm):

Mixed assemblage with *Discoaster brouweri*, *D. variabilis*, *Sphenolithus heteromorphus*, and *Cyclococcolithina floridana*.

Age: Mixed Early and Middle or Late Miocene.

Samples: 97-4-2 (58-59 cm); 97-4-3 (5-6 cm); 97-4-4 (5-6 cm); 97-4-5 (6-7 cm):

Good assemblage with *Cyclococcolithina floridana*, *Reticulo fenestra bisecta*, *Sphenolithus predistentus*, and *S. distentus*.

Age: *Sphenolithus predistentus* Zone; Middle Oligocene.

Sample 97-5-1 (123-124 cm):

Good assemblage with *Reticulofenestra umbilica*, *Coccolithus eopelagicus*, *Peritracelina joidesa*, and *Bramlettius serraculoides*.

Age: Late Eocene.

Sample 97-6-1 (49-50 cm):

Very poor assemblage with *Watznaueria barnesae*.

Sample 97-7-1 (108-109 cm):

No recognizable coccoliths.

Sample 97-7-2 (10-11 cm):

Very poor assemblage with *Watznaueria barnesae*.

Sample 97-8-1 (74-75 cm):

Poor assemblage with *Watznaueria barnesae* the only recognizable species.

Sample 97-8-2 (23-24 cm):

Moderately good assemblage with *Watznaueria barnesae*, *Eiffellithus turriseiffeli*, *Prediscosphaera cretacea*, *Ahmuellerella octoradiata*, *Glaukolithus diplogrammus* and *Staurolithites matalosus*.

Age: Probably Cenomanian.

Sample 97-8-3 (31-32 cm):

Poor assemblage, but with species as immediately above.

Sample 97-8-4 (11-12 cm):

No recognizable calcareous nannofossils.

Sample 97-12-1 (30-31 cm):

Good assemblage like that in Sample 97-8-2 (23-24 cm)
Age: Probably Cenomanian.

REFERENCES

- Cepek, P. and Hay, W.W., 1969. Calcareous nannoplankton and biostratigraphic subdivision of the Upper Cretaceous. Trans. Gulf Coast Assoc. Geol. Soc. **19**, 323.
Martini, E., 1970. Standard Paleogene calcareous nannoplankton zonation. Nature. **225**, 289.