

30. PRELIMINARY DATING BY FOSSIL CALCAREOUS NANNOPLANKTON DEEP SEA DRILLING PROJECT: LEG 6

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HOLE 44

Sample 44-1-1, 145-150 cm:

Sample 44-1-4, 145-150 cm:

These samples contain a rich assemblage with *Reticulofenestra umbilica*, *R. scissura*, *Sphenolithus predistinctus*, *Discoaster tani tani*, *Discoaster cf. nephados*.

Age: *Cyclococcolithus margaritae* or *Reticulofenestra laevis* Zones; Lower Oligocene.

HOLE 44.0

Sample 44.0-2-1, 145-150 cm:

Sample 44.0-2-2, 145-150 cm:

Sample 44.0-2-3, 145-150 cm:

Sample 44.0-2-4, 145-150 cm:

Sample 44.0-2-5, 145-150 cm:

Sample 44.0-2-6, 145-150 cm:

Samples from Core 2 all contain a rich assemblage with many specimens of *Discoaster tani*, *D. saipanensis*, and *Reticulofenestra umbilica*.

Age: An early Late Eocene age. Evolution of *D. saipanensis* from *D. ornatus* is suggested by the sample from Section 6.

Sample 44.0-3-2, 145-150 cm:

Sample 44.0-3-3, 145-150 cm:

These two samples contain *Discoaster barbadiensis*, *D. ornatus*, *Reticulofenestra umbilica*, *Coccolithus eopelagicus*, *Campylosphaera dela*.

Age: Late Middle Eocene.

Sample 44.0-3-4, 145-150 cm:

Sample 44.0-3-5, 145-150 cm:

Sample 44.0-4-2, 145-150 cm:

Sample 44.0-4-3, 145-150 cm:

Sample 44.0-4-4, 145-150 cm:

Sample 44.0-4-5, 145-150 cm:

These subsequent samples from Core 3, and all except the lowest sample from Core 4 contain *Discoaster ornatus*, *D. barbadiensis*, *Reticulofenestra umbilica*, *Campylosphaera dela*, *Chiasmolithus grandis* and *C. oamaruensis*.

Age: Late Middle Eocene.

Sample 44.0-4-6, 145-150 cm:

This basal sample contains the middle Eocene assemblage listed above, mixed with specimens of Late Miocene or Pliocene age (*Discoaster cf. surculus*, *D. brouweri*).

HOLE 45.1

Sample 45.1-1-5, 3 cm:

A very few, poorly preserved nannofossils are present, including *Discoaster cf. extensus* (Miocene or Pliocene) and *Watznaueria ?? sp.* (Cretaceous?).

HOLE 46.0

Sample 46.0-1-1, 145-150 cm:

Sample 46.0-1-2, 145-150 cm:

Sample 46.0-1-3, 145-150 cm:

Sample 46.0-1-4, 145-150 cm:

Sample 46.0-1-5, 145-150 cm:

Sample 46.0-1-6, 145-150 cm:

Barren.

HOLE 47.0

Sample 47.0-1-1, 2-3 cm:

Sample 47.0-1-2, 8-9 cm:

Sample 47.0-1-3, 9-10 cm:

Sample 47.0-1-4, 1-2 cm:

These samples contain *Gephyrocapsa oceanica*, *G. caribbeanica*, *Pseudoemiliania lacunosa*, and *Coccolithus pelagicus*.

Age: Lower part of the *Gephyrocapsa oceanica* Zone; Middle Pleistocene.

Sample 47.0-1-5, 9-10 cm:

Sample 47.0-1-6, 24-25 cm:

Contain *Pseudoemiliania lacunosa* and *Gephyrocapsa caribbeanica*, as well as *Coccolithus pelagicus*.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

HOLE 47.1

Sample 47.1-1, 145-150 cm:

Contains *Discoaster barbadiensis*, *D. ornatus*, *D. surculus*, *D. brouweri*, *D. quinqueramus*, *Chiasmolithus* sp., and *Coccolithus eopelagicus*.

Age: Mixed Upper Eocene and Miocene.

Sample 47.1-1-2, 26-27 cm:

This sample contains *Discoaster barbadiensis*, *D. multi-radiatus*, *D. brouweri*, *D. quinqueramus*, and *Chiasmolithus* spp.

Age: Mixed Paleocene, Eocene, and Miocene.

HOLE 47.2

Sample 47.2-1-1, 135-136 cm:

Sample 47.2-1-2, 29-30 cm:

Sample 47.2-1-3, 27-28 cm:

Sample 47.2-1-4, 19-20 cm:

Sample 47.2-2-2, 13-14 cm:

These samples contain *Gephyrocapsa oceanica*, *G. caribbeanica*, and *Pseudoemiliania lacunosa*.

Age: Lower part of the *Gephyrocapsa oceanica* Zone; Middle Pleistocene.

Sample 47.2-2-3, 14-15 cm:

Sample 47.2-2-4, 10-11 cm:

Sample 47.2-2-5, 20-21 cm:

Sample 47.2-2-6, 17-18 cm:

These contain *Gephyrocapsa caribbeanica* and *Pseudoemiliania lacunosa*.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Sample 47.2-3-2, 19-20 cm:

The sample contains *Discoaster brouweri* and *Pseudoemiliania lacunosa*.

Age: Upper part of the *Discoaster brouweri* Zone; Latest Pliocene.

Sample 47.2-3-3, 20-21 cm:

Contains *Discoaster brouweri rutellus*, *D. brouweri tamalis*, *D. surculus*, *D. pentaradiatus*, *D. asymmetricus*, and *Pseudoemiliania lacunosa*.

Age: Upper part of the *Discoaster surculus* Zone; Late Pliocene.

Sample 47.2-3-4, 10-11 cm:

Sample 47.2-4-1, 3-4 cm:

These samples contain the same assemblage as above, but lack *Pseudoemiliania lacunosa*.

Age: Lower part of the *Discoaster surculus* Zone; Late Pliocene.

Sample 47.2-4-2, 7-8 cm:

Sample 47.2-4-3, 4-5 cm:

Sample 47.2-4-4, 4-5 cm:

Sample 47.2-4-5, 29-30 cm:

Sample 47.2-4-6, 4-5 cm:

These contain *Discoaster brouweri rutellus*, *D. brouweri tamalis*, *D. surculus*, *D. pentaradiatus*, *D. asymmetricus*, and *Reticulofenestra pseudoumbilica*.

Age: *Reticulofenestra pseudoumbilica* Zone; Late Pliocene.

Sample 47.2-5-1, 29-30 cm:

Discoaster assymmetricus, *D. pentaradiatus*, *D. surculus?*, *D. brouweri rutellus*, *D. brouweri tamalis*, ceratoliths transitional between *C. tricorniculatus* and *C. rugosus*.

Age: *Discoaster assymmetricus* Zone; Early Pliocene.

Sample 47.2-5-2, 21-22 cm:

Sample 47.2-5-3, 20-21 cm:

Sample 47.2-5-3, 114-115 cm:

Sample 47.2-5-4, 21-22 cm:

Sample 47.2-5-5, 20-21 cm:

Sample 47.2-5-6, 19-20 cm:

Sample 47.2-6-2, 21-22 cm:

Sample 47.2-6-3, 28-29 cm:

Sample 47.2-7-1, 3.5-4.5 cm:

These samples contain *Discoaster brouweri rutellus*, *D. surculus*, *D. extensus*, *D. pentaradiatus*, and *Ceratolithus tricorniculatus*.

Age: *Ceratolithus tricorniculatus* Zone; Late Miocene.

Sample 47.2-7-2, 31-32 cm:

This sample contains a heavily calcified assemblage of calcareous nannofossils including most of the middle Eocene species listed below.

Sample 47.2-7-3, 19-20 cm:

Sample 47.2-7-4, 21-22 cm:

Sample 47.2-7-5, 12-13 cm:

Sample 47.2-7-6, 136-137 cm:

These samples contain *Discoaster barbadiensis*, *D. ornatus*, *Campylosphaera dela*, *Chiasmolithus* spp.

Age: Probably *Discoaster sublodoensis* Zone; Middle or Lower Eocene.

Sample 47.2-8-1, 33-34 cm:

Sample 47.2-8-2, 7-8 cm:

Same assemblage as above, but lacking *Discoaster ornatus*.

Age: Probably *Discoaster sublodoensis* Zone; Lower Eocene.

Sample 47.2-8-3, 21-22 cm:

Sample 47.2-8-4, 3-4 cm:

Sample 47.2-8-5, 4-5 cm:

These contain *Discoaster multiradiatus*, *D. barbadiensis*, *Campylosphaera dela*, *Chiasmolithus* spp.

Age: *Discoaster multiradiatus* Zone; Late Paleocene.

Sample 47.2-8-6, 4-5 cm:

Sample 47.2-9-1, 7-8 cm:

These two samples contain *Discoaster gemmeus*, *Fasciculithus tympaniformis*, and other species characteristic of the *Discoaster gemmeus* Zone.

Age: Late Paleocene.

Sample 47.2-9-2, 5-6 cm:

Sample 47.2-9-3, 26-27 cm:

Sample 47.2-9-4, 0-5 cm:

Sample 47.2-9-5, 4-5 cm:

Sample 47.2-9-6, 0-5 cm:

Sample 47.2-10-1, 6-7 cm:

Sample 47.2-10-2, 9-11 cm:

These samples contain *Fasciculithus tympaniformis* and *Heliolithus kleinelli* along with a rich and varied

assemblage of other species, constituting one of the best sections for this part of the Paleocene known to this investigator.

Age: *Heliolithus kleinpelli* Zone; Middle Paleocene.

Sample 47.2-10-3, 6-7 cm:

Sample 47.2-10-4, 5-6 cm:

Sample 47.2-10-5, 7-8 cm:

Sample 47.2-10-6, 26-27 cm:

These samples contain an abundance of *Fasciculithus tympaniformis* and other calcareous nannofossils characteristic of the *Fasciculithus tympaniformis* Zone.

Age: Early Paleocene.

Sample 47.2-11-1, 145-150 cm:

This sample contains a very poor corroded assemblage, probably from the *F. tympaniformis* Zone.

Sample 47.2-11-2, 145-150 cm:

Sample 47.2-11-3, 145-150 cm:

Sample 47.2-11-4, 145-150 cm:

Sample 47.2-11-5, 145-150 cm:

Sample 47.2-11-6, 145-150 cm:

Sample 47.2-12-1, 145-150 cm:

Sample 47.2-12-2, 25-26 cm:

Sample 47.2-12-3, 145-150 cm:

Sample 47.2-12-4, 145-150 cm:

Sample 47.2-13-1, 145-150 cm:

Sample 47.2-13-2, 145-150 cm:

Sample 47.2-13-3, 25-26 cm:

Sample 47.2-13-4, 145-150 cm:

Sample 47.2-13-5, 145-150 cm:

Sample 47.2-13-6, 145-150 cm:

Sample 47.2-14-1, 145-150 cm:

Sample 47.2-14-2, 145-150 cm:

All of these samples contain *Tetralithus murus*, *Microrhabdulus decoratus*, *Biscutum blacki*, *Wattnaueria barnesae*, *Prediscosphaera cretacea*, *Arkhangelskiella cymbiformis*, and *Cretarhabdus conicus*.

Age: Assignable to the *Tetralithus murus* Zone; Late Maestrichtian.

HOLE 48.2

Sample 48.2-1-3, 8-9 cm:

Sample 48.2-1-4, 25-26 cm:

Sample 48.2-1-5, 35-36 cm:

These samples contain *Discoaster extensus*, *D. brouweri*, *D. pentaradiatus*, *Coccolithus pelagicus*, *Gephyrocapsa caribbeanica*, and *G. oceanica*.

Age: Mixed Pliocene and Pleistocene.

Sample 48.2-1-5, 35-36 cm:

This sample contains a mixed assemblage with Pliocene and Pleistocene species (listed above) and Cretaceous species (listed below).

Sample 48.2-1-6, 33-35 cm:

Sample 48.2-2-1, 145-150 cm:

Sample 48.2-2-2, 24-25 cm:

Sample 48.2-2-2, 38-39 cm:

Sample 48.2-2-3, 145-150 cm:

Sample 48.2-2-5, 22-23 cm:

Sample 48.2-2-6, 36-37 cm:

Sample 48.2-3-2, 42-43 cm:

Sample 48.2-3-3, 64-65 cm:

These samples contain *Microrhabdulus decoratus*, *Wattnaueria barnesae*, *Cricolithus multiradiatus*, *Parhabdolithus angustus*, *Cribrosphaera ehrenbergi*, *Cylindralithus* sp., *Prediscosphaera cretacea*, *Arkhangelskiella cymbiformis*, and *Tetralithus murus*.

Age: *Tetralithus murus* Zone; Late Maestrichtian.

HOLE 49.0

Sample 49.0-1-1, 53-54 cm:

This is an assemblage with *Gephyrocapsa oceanica* and *Pseudoemiliania lacunosa*.

Age: *Gephyrocapsa oceanica* Zone; Middle Pleistocene.

Sample 49.0-1-2, 8-9 cm:

This is a reworked Pliocene assemblage with *Discoaster brouweri*, *D. pentaradiatus*, *D. cf. surculus*.

Sample 49.0-1-3, 8-9 cm:

Barren.

Sample 49.0-1-4, 9-10 cm:

This sample contains *Gephyrocapsa aperta*, *G. oceanica*, *Pseudoemiliania lacunosa*.

Age: Lower part of the *Gephyrocapsa oceanica* Zone; Middle Pleistocene.

Sample 49.0-1-5, 20-21 cm:

Sample 49.0-1-6, 20-21 cm:

Barren samples.

Sample 49.0-2-1, 84-85 cm:

This contains *Coccolithus pelagicus*, *Gephyrocapsa oceanica*, *Cyclococcolithus leptoporus*, *Discoaster extensus*.

Age: Mixed Pliocene and Pleistocene.

HOLE 49.1

Sample 49.1-1-1, 69-70 cm:

This sample contains *Gephyrocapsa oceanica*, *Coccolithus pelagicus*, *Discoaster extensus*.

Age: Mixed Pleistocene and Pliocene. Poorly preserved and corroded.

Sample 49.1-1-2, 27-28 cm:

Sample 49.1-1-3, 34-35 cm:

Sample 49.1-1-4, 19.5-21.5 cm:

Barren of calcareous nannoplankton.

Sample 49.1-1-5, 13-14 cm:

Sample 49.1-2-1, 145-150 cm:

Sample 49.1-2-2, 145-150 cm:

Sample 49.1-2-3, 145-150 cm:

These contain *Stephanolithion laffitei*, *Watznaueria barnesae*, *Cricolithus multiradiatus*, *Biscutum testudinarium*, *Parhabdolithus embergeri*, no nannoconids.

Age: Uncertain, possibly early Albian, but no younger than Late Albian.

HOLE 50.0

Sample 50.0-2-1, 145 cm:

Sample 50.0-2-2, 150 cm:

Sample 50.0-2-3, 145-150 cm:

Sample 50.0-2-4, 150 cm:

Sample 50.0-2-6, 150 cm:

These samples contain assemblages similar to those from the lower part of Hole 49.1, characterized by a floor of *Watznaueria*, with *W. barnesae*, *W. parvidentatus*, *Biscutum testudinarium*, *Cricolithus multiradiatus*, and *Stephanolithion laffitei*.

Age: Not certain, but no younger than Late Albian, probably Early Albian.

HOLE 50.1

Sample 50.1-1-1, 74-75 cm:

Contains few nannofossils, strongly corroded. Rims of *Gephyrocapsa* recognizable.

Age: Pleistocene.

Sample 50.1-1-2, 22-23 cm:

Contains a very poor, corroded assemblage like that in immediately lower samples.

Sample 50.1-1-3, 41-42 cm:

Contains a rich, well-preserved assemblage with *Gephyrocapsa oceanica*, *G. caribbeonica*, and *Pseudoemiliania lacunosa*; lower part of the *Gephyrocapsa oceanica* Zone.

Sample 50.1-1-4, 32-33 cm:

Sample 50.1-1-5, 6-7 cm:

Contain moderately well-preserved assemblages from the lower part of the *Gephyrocapsa oceanica* Zone.

Sample 50.1-1-6, 9-10 cm:

Contains a poor, corroded assemblage from the lower part of the *Gephyrocapsa oceanica* Zone.

Sample 50.1-2-1, 107-108 cm:

Sample 50.1-2-2, 23-24 cm:

Sample 50.1-2-3, 19-20 cm:

Sample 50.1-2-4, 20-21 cm:

Sample 50.1-2-5, 19-20 cm:

Sample 50.1-3-1, 145-150 cm:

Sample 50.1-3-2, 46-47 cm:

Sample 50.1-3-3, 22-23 cm:

Sample 50.1-3-4, 4-5 cm:

Sample 50.1-3-5, 8-9 cm:

Sample 50.1-3-6, 22-23 cm:

Sample 50.1-4-1, 75 cm:

All of these samples from the lower part of the hole are devoid of calcareous nannoplankton fossils.

HOLE 51.1

Sample 51.0-X-1, 145 cm:

Barren.

HOLE 52.0

Sample 52.0-2-6, 145-150 cm:

Sample 52.0-8-1, 145-150 cm:

Sample 52.0-8-2, 145-150 cm:

Sample 52.0-8-4, 145-150 cm:

Sample 52.0-8-5, 145-150 cm:

Sample 52.0-8-6, 145-150 cm:

All of the samples are barren, and contain no calcareous nannoplankton.

HOLE 53.0

Sample 53.0-1-1, 4-5 cm:

Contains a very poor, corroded assemblage with *Discoaster variabilis*, *D. kugleri*, *D. brouweri*, and *Sphenolithus heteromorphus*.

Age: *Discoaster kugleri* Zone?; Middle Miocene.

Sample 53.0-1-2, 2-3 cm:

This sample contains a poor assemblage with *Discoaster brouweri*, *D. variabilis*, *D. aulakos*.

Age: Middle Miocene.

Sample 53.0-1-3, 0-2 cm:

This contains a poor assemblage with *Discoaster brouweri* and *D. variabilis*.

Age: Middle Miocene.

Sample 53.0-3-1, 0-1 cm:

Sample 53.0-4-1, 0-2 cm:

No calcareous nannoplankton.

Sample 53.0-6-2, 0-1 cm:

Very poor sample with few specimens of *Discoaster deflandrei*.

Age: Probably Early Miocene.

Sample 53.0-7-1, 150 cm:

Barren.

HOLE 53.1

Sample 53.1-2-1, 145-150 cm:

This sample contains *Discoaster brouweri*, *D. extensus* and *D. pentaradiatus*.

Age: Probably lower part of the *Discoaster brouweri* Zone; Late Pliocene.

Sample 53.1-2-3, 81-82 cm:

Barren.

Sample 53.1-2-4, 24-25 cm:

This is a very poor, corroded assemblage containing only a few specimens of *Discoaster extensus*.

Age: Pliocene?

Sample 53.1-2-5, 24-25 cm:

Barren.

Sample 53.1-2-6, 30-31 cm:

Very poor sample containing only a few discoasters (*D. cf. dilatus*) with calcite overgrowths.

Sample 53.1-3-1, 150 cm:

Sample 53.1-3-2, 51-52 cm:

Sample 53.1-3-3, 11-12 cm:

Sample 53.1-3-4, 14-15 cm:

Devoid of calcareous nannoplankton fossils.

Sample 53.1-3-5, 3-4 cm:

Contains poor assemblage with *Discoaster variabilis*, *D. brouweri*, and *D. pentaradiatus*.

Age: Pliocene.

HOLE 53.2

Sample 53.2-1-1, 35-36 cm:

Barren.

Sample 53.2-1-2, 9-10 cm:

Sample 53.2-1-3, 4-5 cm:

Sample 53.2-1-4, 22-23 cm:

Sample 53.2-1-5, 15-16 cm:

These samples contain assemblages consisting exclusively of discoasters, including *Discoaster brouweri*, *D. variabilis*, *D. pentaradiatus*, and *D. quinqueramus*.

Age: Upper Miocene.

Sample 53.2-1-6, 17-18 cm:

Barren.

HOLE 54.0

Sample 54.0-1-1, 95-96 cm:

Sample 54.0-1-2, 40-41 cm:

Sample 54.0-1-3, 31-32 cm:

Sample 54.0-2-1, 36-37 cm:

Sample 54.0-2-2, 27-28 cm:

Sample 54.0-2-3, 5-6 cm:

Sample 54.0-2-4, 8-9 cm:

Sample 54.0-3-1, 140 cm:

These samples contain good assemblages with *Discoaster brouweri*, *D. extensus*, *D. variabilis*, and *D. exilis*.

Age: *Discoaster exilis* Zone; Middle Miocene.

Sample 54.0-4-2, 20+ cm:

Sample 54.0-5-Box # 1 of 7 unoriented cm:

Sample 54.0-6-1, 145-150 cm:

Sample 54.0-6-2, 25-26 cm:

These contain assemblages with *Discoaster brouweri*, *D. extensus*, *D. variabilis*, *D. deflandrei*, *D. cf. exilis*,

and *Sphenolithus heteromorphus*.

Age: *Sphenolithus heteromorphus* Zone; Middle Miocene.

Sample 54.0-6-3, 31-32 cm:

Sample 54.0-6-4, 26-27 cm:

Sample 54.0-6-5, 22-23 cm:

Sample 54.0-7-2, 20-21 cm:

Sample 54.0-7-3, 25-26 cm:

These samples contain *Discoaster brouweri*, *D. extensus*, *D. variabilis* and *D. aulakos*.

Age: Early Miocene.

HOLE 55.0

Sample 55.0-1-1, 17-18 cm:

This assemblage is dominated by *Gephyrocapsa oceanica*.

Age: *Gephyrocapsa oceanica* Zone; Middle Pleistocene.

Sample 55.0-1-2, 14-15 cm:

This sample contains a poor assemblage of the *Gephyrocapsa oceanica* Zone with reworked specimens of *Discoaster brouweri*.

Sample 55.0-1-3, 11-12 cm:

Sample 55.0-1-4, 11-12 cm:

Sample 55.0-1-5, 14-15 cm:

Sample 55.0-1-6, 13-14 cm:

These are typical assemblages of the upper part of the *Gephyrocapsa oceanica* Zone, with *G. oceanica*, *Ceratolithus cristatus*, *Cyclococcolithus leptoporus*, etc.

Age: Middle Pleistocene.

Sample 55.0-2-1, 0-1 cm:

Sample 55.0-2-2, 0-1 cm:

These contain assemblages with *Pseudoemiliania lacunosa*, *Gephyrocapsa caribbeanica*, and abundant *Ceratolithus cristatus* with calcite overgrowths.

Age: *Gephyrocapsa caribbeanica* Zone; Early Pleistocene.

Sample 55.0-2-3, 1-2 cm:

Sample 55.0-2-4, 27-28 cm:

Sample 55.0-2-5, 12-13 cm:

Sample 55.0-2-6, 14-15 cm:

Sample 55.0-3-1, 27-28 cm:

Sample 55.0-3-3, 1-2 cm:

These contain assemblages with *Discoaster brouweri*, *D. pentaradiatus*, *D. surculus*, and *Pseudoemiliania lacunosa*.

Age: *Discoaster surculus* Zone; Late Pliocene.

Sample 55.0-3-4, 145-150 cm:

Sample 55.0-3-5, 0-1 cm:

Sample 55.0-4-1, 1-2 cm:

Sample 55.0-4-2, 145-150 cm:

Sample 55.0-4-3, 0-1 cm:

Sample 55.0-4-4, 145-150 cm:
Sample 55.0-4-5, 0-1 cm:
These samples contain *Discoaster brouweri*, *D. extensus*, *D. cf. quinqueramus*.
Age: Upper Miocene.

Sample 55.0-4-6, 145-150 cm:
Sample 55.0-5-1, 0-1 cm:
Sample 55.0-5-2, 19-20 cm:
Sample 55.0-5-3, 0-1 cm:
Sample 55.0-5-5, 0-1 cm:
Sample 55.0-5-6, 26-27 cm:
These assemblages are rich in discoasters, with *D. brouweri*, *D. divaricatus*, and six-rayed specimens of *D. hamatus*.
Age: Upper part of the *Discoaster hamatus* Zone; Late Miocene.

Sample 55.0-6-1, 0-1 cm:
Sample 55.0-6-3, 0-1 cm:
Contain *Discoaster brouweri*, *D. challengerii*, *Reticulofenestra pseudoumbilica*.
Age: Early Late Miocene.

Sample 55.0-7-1, 8-9 cm:
Sample 55.0-7-3, 16-17 cm:
Sample 55.0-7-5, 0-1 cm:
These contain *Discoaster brouweri*, *D. exilis*.
Age: *D. exilis* Zone; Middle Miocene.

Sample 55.0-8-3, 29-30 cm:
Sample 55.0-8-5, 22-23 cm:
Sample 55.0-9-TOP cm:
These samples contain *Discoaster extensus*, *D. brouweri*, *D. nephados*, *D. cf. exilis*, *Sphenolithus heteromorphus*.
Age: *Sphenolithus heteromorphus* Zone; Middle Miocene.

Sample 55.0-10-2, 14-15 cm:
Sample 55.0-10-3, 15-16 cm:
Sample 55.0-10-5, 9-11 cm:
Sample 55.0-11-1, 28-29 cm:
Sample 55.0-11-3, 26-27 cm:
Sample 55.0-11-5, 24-25 cm:
Discoaster nephados, *Sphenolithus heteromorphus* dominate these assemblages.
Age: *Sphenolithus heteromorphus* Zone; Middle Miocene.

Sample 55.0-12-1, 17-18 cm:
Sample 55.0-12-2, 4-5 cm:
Sample 55.0-12-3, 11-12 cm:
Sample 55.0-12-5, 29-30 cm:
Sample 55.0-12-6, 11-12 cm:
Sample 55.0-13-1, 25-26 cm:
Sample 55.0-13-3, 30-31 cm:
Sample 55.0-13-5, 30-31 cm:

Sample 55.0-14-1, 145-150 cm:
Sample 55.0-14-2, 145-150 cm:
Sample 55.0-14-3, 145-150 cm:
Sample 55.0-14-4, 145-150 cm:
Sample 55.0-14-5, 145-150 cm:
Sample 55.0-14-6, 145-150 cm:
Assemblages with a flood of *Sphenolithus moriformis*, and *Sphenolithus belemnos* (transitional forms to *S. heteromorphus* occur in the upper part of Core 12), *Discoaster nephados*, *D. druggi*, and *Coronocyclus nitescens*.
Age: *Sphenolithus belemnos* and possibly *Helicopontosphaera ampliaperta* Zones; Lower Middle Miocene.

HOLE 56.2

Sample 56.2-1-1, 0-3 cm:
Sample 56.2-1-2, 0-3 cm:
Sample 56.2-1-2, 145-150 cm:
Sample 56.2-1-3, 0-3 cm:
Sample 56.2-1-4, 14-15 cm:
Sample 56.2-1-5, 0-3 cm:
Sample 56.2-1-6, 0-1 cm:
Sample 56.2-2-1, 0-3 cm:
Sample 56.2-2-2, 16-18 cm:
Sample 56.2-2-3, 0-3 cm:
Sample 56.2-2-4, 7-8 cm:
Sample 56.2-2-5, 0-3 cm:
Sample 56.2-2-6, 3-4 cm:
Assemblages in these upper two cores contain abundant discoasters, including *Discoaster brouweri*, *D. pentradiatus*, *D. cf. surculus*, *D. extensus*, *D. quinqueramus*, along with abundant specimens of *Sphenolithus abies*.
Age: Late Miocene.

Sample 56.2-3-1, 0-3 cm:
Sample 56.2-3-2, 145-150 cm:
Sample 56.2-3-3, 0-3 cm:
Sample 56.2-3-4, 145-150 cm:
Sample 56.2-3-5, 0-3 cm:
Sample 56.2-3-6, 145-150 cm:
These samples contain *Discoaster brouweri*, *D. pentradiatus*, *D. extensus*, six rayed specimens of *D. hamatus*, and *D. cf. quinqueramus*.
Age: Upper part of the *Discoaster hamatus* Zone; Late Miocene.

Sample 56.2-10-6, 20-21 cm:
This sample contains *Discoaster saundersi*, *D. nephados*, and *D. cf. druggi*.
Age: Probably belongs to the *Triquetrorhabdulus carinatus-Sphenolithus belemnos* Zone; Late Oligocene or Early Miocene.

HOLE 57.0

Sample 57.0-1-1, 11-12 cm:
Sample 57.0-1-2, 17-18 cm:
These contain poor assemblages with *Discoaster*

nephados, *D. deflandrei*, *Triquetrorhabdulus carinatus* and *Sphenolithus cf. belemnos*.

Age: *Triquetrorhabdulus carinatus-Sphenolithus belemnos* Zone; Late Oligocene or Early Miocene.

HOLE 57.1

Sample 57.1-1-1, 32-33 cm:

Sample 57.1-1-2, 6-7 cm:

Sample 57.1-1-3, 25-26 cm:

Sample 57.1-1-4, 24-25 cm:

Sample 57.1-1-5, 25-26 cm:

Sample 57.1-1-6, 24-25 cm:

These contain assemblages with *Discoaster brouweri*, *D. pentaradiatus*, *D. extensus*, *D. surculus*, six-rayed specimens of *D. hamatus*, *D. cf. quinqueramus*, and *Reticulofenestra pseudoumbilica*.

Age: Upper part of the *Discoaster hamatus* Zone; Late Miocene.

Sample 57.1-2-1, 57-58 cm:

Sample 57.1-2-2, 7-9 cm:

Sample 57.1-3-1, 33-34 cm:

Sample 57.1-3-2, 0-5 cm:

Sample 57.1-4-2, 33-34 cm:

Sample 57.1-4-3, 20-21 cm:

Sample 57.1-4-4, 0-3 cm:

Sample 57.1-4-4, 145 cm:

Sample 57.1-4-5, 0-3 cm:

These samples contain *Discoaster nephados*, *D. deflandrei*, *D. cf. druggi*, *D. saundersi*, *Triquetrorhabdulus carinatus*, *Sphenolithus belemnos*.

Age: *Triquetrorhabdulus carinatus-Sphenolithus belemnos* Zone; Late Oligocene or Early Miocene.

Sample 57.1-4-5, 145 cm:

Sphenoliths in this lowest sample are transitional between *S. belemnos* and *S. ciperoensis*.

HOLE 57.2

Sample 57.2-1-1, 36-37 cm:

Sample 57.2-1-2, 0-3 cm:

Sample 57.2-1-3, 0-3 cm:

Sample 57.2-1-4, 0-3 cm:

Sample 57.2-1-5, 0-3 cm:

Sample 57.2-1-6, 0-3 cm:

These contain assemblages with *Discoaster brouweri*, *D. surculus*, *D. pentaradiatus*, *D. asymmetricus*, *Ceratolithus rugosus*.

Age: *Discoaster surculus* Zone; Late Pliocene.

Sample 57.2-1-6, 0-3 cm:

This contains an assemblage like that above, but also including *Reticulofenestra pseudoumbilica*.

Age: *Reticulofenestra pseudoumbilica* Zone; Mid-Pliocene.

HOLE 58.1

Sample 58.1-1-2, 34-36 cm:

Sample 58.1-1-3, 0-4 cm:

Contain assemblages with *Discoaster brouweri*, *Gephyrocapsa caribbeana*, and *Pseudoemiliania lacunosa*.

Age: *Discoaster brouweri* Zone; Late Pliocene.

Sample 58.1-1-3, 145-150 cm:

Barren.

HOLE 58.2

Sample 58.2-1-1, 7-8 cm:

Sample 58.2-1-2, 0-1 cm:

Sample 58.2-1-3, 4-5 cm:

Sample 58.2-1-4, 14-15 cm:

Sample 58.2-1-5, 5-6 cm:

Sample 58.2-1-6, 5-6 cm:

These samples contain poor to fair assemblages with *Discoaster nephados*, *D. deflandrei*, *D. druggi*, and *Sphenolithus belemnos*.

Age: *Sphenolithus belemnos* Zone; Early Miocene.

HOLE 60.0

Sample 60.0-1-1, 1-2 cm:

Good assemblage with mostly asteroliths, including *Discoaster variabilis*, *D. extensus*, *D. challengerii*, *D. brouweri*, and five-rayed forms of *D. hamatus*.

Age: Lower part of the *Discoaster hamatus* Zone; Late Miocene.

Sample 60.0-1-2, 1-2 cm:

Sample 60.0-1-3, 4-5 cm:

Rich assemblages with *Discoaster variabilis*, *D. extensus*, *D. challengerii*, *D. brouweri*, *Catinaster coalitus*, and *C. calyculus* (Note: These samples contain the greatest abundance of *Catinaster* ever observed by this writer).

Age: Upper part of the *Catinaster coalitus* Zone; early Late Miocene or late Middle Miocene.

Sample 60.0-2-2, 4-5 cm:

Assemblage with *Discoaster variabilis*, *D. extensus*, *D. challengerii* and *Catinaster coalitus*.

Age: Lower part of the *Catinaster coalitus* Zone; Early Late Miocene or late Middle Miocene.

Sample 60.0-3-1, 140-141 cm:

Barren.

Sample 60.0-3-2, 15-16 cm:

Barren.

Sample 60.0-4-1, 145-150 cm:

Sample 60.0-4-2, 145-150 cm:

Assemblages consisting almost exclusively of asteroliths, including *Discoaster brouweri*, *D. extensus*, *D. variabilis* and *D. challengerii*.

Age: *Discoaster kugleri* Zone; late Middle Miocene.

Sample 60.0-5-1, 30-31 cm:

Sample 60.0-5-1, 41-42 cm:

Sample 60.0-5-2, 15-16 cm:

Assemblages dominated by asteroliths, including *Discoaster exilis*, *D. brouweri*, *D. extensus*, *D. challengerii* and *Sphenolithus heteromorphus*.

Age: Lower part of the *Discoaster exilis* Zone (Middle Miocene). Assemblages become progressively poor near top of core.

Sample 60.0-5-3, 17-20 cm:

Poor assemblage containing *Discoaster brouweri*, *D. woodringi*, *D. nephados*, *D. extensus*, *D. cf. deflandrei*.

Age: Early Middle Miocene.

Sample 60.0-6-1, 70-71 cm:

Sample 60.0-6-2, 22-23 cm:

Sample 60.0-6-3, 19-20 cm:

Sample 60.0-6-4, 30-31 cm:

Sample 60.0-6-6, 14-15 cm:

Moderate to good assemblages with *Discoaster exilis*, *D. brouweri*, *D. variabilis*, *D. deflandrei* and *Sphenolithus heteromorphus*.

Age: Lower part of the *Discoaster exilis* Zone; Middle Miocene.

Sample 60.0-8-1, 145 cm:

Barren.

Sample 60.0-8-3, 145 cm:

Sample 60.0-9-1, 145 cm:

Very poor assemblages with *Coccolithus cf. pelagicus*.

Age: Indeterminate.