

15. PRELIMINARY DATING BY FOSSIL CALCAREOUS NANNOPLANKTON, DEEP SEA DRILLING PROJECT, LEG 8

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INTRODUCTION

The zonation used here is that of Boudreaux and Hay (1969) for the Pleistocene, Martini and Worsley (1970) for the Neogene, and Hay *et al.* (1967), Bramlette and Wilcoxon (1967) and Hay (1970) for the Paleogene.

All samples were examined, although in most instances time permitted only a cursory inspection for this preliminary determination.

HOLE 69

Sample 69-1-1, 37 cm:

Discoaster argutus and a few poor coccoliths present.
Age: Probably Middle Miocene, but exact age assignment impossible.

Sample 69-2-1, 30-31 cm:

Very few, poorly preserved nannofossils; no age assignment possible.

Sample 69-2-2, 6-7 cm:

Discoaster argutus, *D. cf. exilis?*.
Age: Probably Middle Miocene.

Sample 69-2-3, 6-7 cm:

Indeterminate *Discoaster* spp. present.

Sample 69-2-4, 6-7 cm:

Barren.

Sample 69-2-5, 6-7 cm:

Discoaster argutus, *D. kugleri*, *D. cf. brouweri*, *Coccolithus pelagicus*.
Age: *D. kugleri* Zone (Middle Miocene).

Sample 69-2-6, 6-7 cm:

Discoaster brouweri, *D. extensus*, *D. deflandrei?*, *D. kugleri*, coccolith rims.
Age: *D. kugleri* Zone (Middle Miocene).

Sample 69-3-1, 6-7 cm:

Sample 69-3-2, 6-7 cm:

Discoaster brouweri, *D. extensus*, *D. kugleri*, poorly preserved coccoliths.

Sample 69-3-3, 6-7 cm:

Barren.

Sample 69-3-4, 6-7 cm:

Very poor, but like Sample 3-2, 6-7 cm.

Sample 69-3-5, 6-7 cm:

Sample 69-3-6, 6-7 cm:

Discoaster druggii, *D. nephados*, *D. obtusus*, very few coccoliths.

Age: Probably *Sphenolithus belemnus* Zone (Early Miocene).

Sample 69-4-1, 7-8 cm:

Sample 69-4-2, 6-7 cm:

Sample 69-4-3, 3-4 cm:

Sample 69-4-4, 6-7 cm:

Sample 69-4-5, 6-7 cm:

Sample 69-4-6, 6-7 cm:

Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. trinidadensis*, *Sphenolithus belemnus*.

Age: *T. carinatus* Zone (Early Miocene).

Sample 69-5-1, 6-7 cm:

Sample 69-5-2, 6-7 cm:

Reticulofenestra umbilica, *R. bisecta*, *Cyclcoccolithus floridanus*, many coccoliths.

Age: Early Oligocene.

Sample 69-5-3, 6-7 cm:

Sample 69-5-4, 6-7 cm:

As above, but very poor assemblage.

Sample 69-5-5, 6-7 cm:

Discoaster tani ornatus, *Reticulofenestra umbilica*, *R. bisecta*, *Cyclcoccolithus floridanus*, many coccoliths.

Age: Early Oligocene.

Sample 69-6-1, 6-7 cm:

Sample 69-6-2, 6-7 cm:

Sample 69-6-3, 6-7 cm:

Sample 69-6-4, 6-7 cm:

Sample 69-6-5, 6-7 cm:

Sample 69-6-6, 6-7 cm:

Barren.

HOLE 69A

Sample 69A-1-1, 4-5 cm:

Sample 69A-1-2, 6-7 cm:

Sample 69A-1-3, 6-7 cm:

Sample 69A-1-4, 6-7 cm:

Sample 69A-1-5, 6-7 cm:
Sample 69A-1-6, 6-7 cm:
Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. trinidadensis*, *D. cf. druggii*, many coccoliths.
Age: Lowermost *D. druggii* Zone or uppermost *T. carinatus* Zone (Early Miocene). Assemblages poorly preserved.

Sample 69A-2-1, 6-7 cm:
Very poor nannofossils.

Sample 69A-2-2, 6-7 cm:
Sample 69A-2-3, 6-7 cm:
Sample 69A-2-4, 6-7 cm:
Sample 69A-2-5, 6-7 cm:
Sample 69A-2-6, 6-7 cm:
Discoaster nephados, *D. trinidadensis*, *D. dilatus*, *Triquetrorhabdulus carinatus*.
Age: *T. carinatus* Zone (Early Miocene).

Sample 69A-3-1, 63-64 cm:
Sample 69A-3-2, 6-7 cm:
Sample 69A-3-3, 6-7 cm:
Sample 69A-3-4, 6-7 cm:
Sample 69A-3-5, 6-7 cm:
Sample 69A-4-1, 6-7 cm:
Sample 69A-4-2, 6-7 cm:
Sample 69A-4-3, Top:
Sample 69A-4-4, Top cm:
Sample 69A-4-5, 6-7 cm:
Sample 69A-4-6, 6-7 cm:
Sample 69A-5-1, 6-7 cm:
Discoaster nephados, *D. trinidadensis*, *D. cf. deflandrei*, few coccoliths.
Age: Late Oligocene.

Sample 69A-5-2, 6-7 cm:
Very poor assemblage.

Sample 69A-5-3, 6-7 cm:
Sample 69A-5-4, 6-7 cm:
Sample 69A-5-5, 6-7 cm:
Sample 69A-6-1, 6-7 cm:
Sample 69A-6-2, 6-7 cm:
Discoaster nephados, *D. cf. deflandrei*, *Reticulofenestra bisecta*, but generally poor assemblages.
Age: Late Oligocene.

Sample 69A-6-3, 6-7 cm:
As above, but with *Sphenolithus ciperoensis*.
Age: Probably *Sphenolithus distentus* Zone (Late Oligocene).

Sample 69A-6-5, Top:
Very poor assemblage.

Sample 69A-7-1, 30-31 cm:
Discoaster nephados, *D. cf. deflandrei*, *D. saundersi*.

Age: Probably *Sphenolithus distentus* or *S. predistentus* Zone (Late or Middle Oligocene).

Sample 69A-7-2, 30-31 cm:
Flood of *Sphenolithus pacificus*.

Sample 69A-7-3, 71-72 cm:
Very poor assemblage.

Sample 69A-8-1, 6-7 cm:
Poor assemblage with *Discoaster* spp., *Reticulofenestra umbilica*, and a few other poorly preserved coccoliths.
Age: Oligocene.

Sample 69A-8-2, 6-7 cm:
Sample 69A-8-3, 112-113 cm:
Very poor assemblages.

Sample 69A-8-4, 52-53 cm:
Poor assemblage like Sample 8-1, 6-7 cm.

Sample 69A-8-5, 6-7 cm:
Very poor assemblage.

Sample 69A-9-1, 6-7 cm:
Sample 69A-9-2, 6-7 cm:
Sample 69A-9-3, 6-7 cm:
Sample 69A-9-4, 6-7 cm:
Sample 69A-9-5, 6-7 cm:
Barren.

Sample 69A-10-1, 6-7 cm:
Very poor assemblage with only a few coccoliths present.

Sample 69A-10-2, 6-7 cm:
Reticulofenestra umbilica, *R. bisecta*, *Discoaster cf. deflandrei*.
Age: Probably Early Oligocene.

Sample 69A-10-3, 6-7 cm:
Sample 69A-10-4, 6-7 cm:
Sample 69A-10-5, 6-7 cm:
Sample 69A-10-6, 20-21 cm:
Sample 69A-11-1, 6-7 cm:
Sample 69A-11-2, 16-17 cm:
Sample 69A-11-3, 6-7 cm:
Sample 69A-11-4, 6-7 cm:
Sample 69A-11-5, 6-7 cm:
Sample 69A-11-6, 6-7 cm:
Barren.

Sample 69A-12-1, Top at 20:
Discoaster deflandrei, *D. cf. tani*, flood of *Ericsonia subdisticha* and many other small coccoliths.
Age: Probably *Ericsonia subdisticha* Zone (Early Oligocene).

HOLE 70

Sample 70-1-4, 6-7 cm:
Sample 70-2-1, 33-34 cm:
Barren.

Sample 70-2-2, 33-34 cm:
Discoaster challengerii, *D. variabilis*, *D. extensus*, *D. brouweri*, *D. quinqueramus*, few coccoliths.
Age: Mixed Early Pliocene and Late Miocene.

Sample 70-3-1, 6-7 cm:
Sample 70-3-2, 6-7 cm:
Barren.

Sample 70-3-3, 6-7 cm:
Poorly preserved assemblage with indeterminate astero-liths and coccoliths.

Sample 70-3-4, 6-7 cm:
Sample 70-3-5, 6-7 cm:
Discoaster argulus, *D. dilatus*, poorly preserved coccoliths.
Age: Probably Middle or Early Miocene.

Sample 70-4-1, 6-7 cm:
Sample 70-4-2, 12-13 cm:
Sample 70-4-3, 6-7 cm:
Sample 70-4-4, 14-15 cm:
Sample 70-4-4, 8-9 cm:
Discoaster trinidadensis, *D. cf. deflandrei*, *D. cf. saundersi*, *D. obtusus*, poorly preserved.
Age: Early Miocene, probably *Sphenolithus belemnus* Zone.

Sample 70-5-1, 7-8 cm:
Sample 70-5-2, 16-17 cm:
Discoaster trinidadensis, *D. deflandrei*, *D. argutus*, *D. dilatus*, *D. extensus*.
Age: Probably *Sphenolithus belemnus* Zone (Early Miocene).

Sample 70-5-3, 6-7 cm:
Sample 70-5-4, 6-7 cm:
Discoaster extensus, *D. dilatus*, *D. nephados*, *D. cf. druggii*.
Age: Probably *Sphenolithus belemnus* Zone (Early Miocene).

Sample 70-5-5, 6-7 cm:
Sample 70-5-6, 6-7 cm:
Barren.

Sample 70-6-1, 6-7 cm:
Sample 70-6-2, 6-7 cm:
Sample 70-6-3, 6-7 cm:
Sample 70-6-4, 6-7 cm:
Sample 70-6-5, 6-7 cm:

Sample 70-6-6, 6-7 cm:
Sample 70-7-1, 6-7 cm:
Sample 70-7-2, 6-7 cm:
Sample 70-7-3, 6-7 cm:
Sample 70-7-4, 6-7 cm:
Discoaster druggii, *D. nephados*, *D. dilatus*, *D. argutus*, *D. obtusus*.
Age: *Sphenolithus belemnus* Zone (Early Miocene).

Sample 70-7-5, 6-7 cm:
Sample 70-7-6, 6-7 cm:
Sample 70-8-1, 6-7 cm:
Sample 70-8-2, 6-7 cm:
Sample 70-8-3, 6-7 cm:
Sample 70-8-4, 6-7 cm:
Sample 70-8-5, 6-7 cm:
Sample 70-8-6, 6-7 cm:
Sample 70-9-4, Bottom:
Sample 70-9-5, 6-7 cm:
Sample 70-9-6, 6-7 cm:
Sample 70-9-6, 100-110 cm:
Sample 70-10-3, 6-7 cm:
Sample 70-10-4, 6-7 cm:
Sample 70-10-5, 6-7 cm:
Sample 70-10-6, 6-7 cm:
Triquetrorhabdulus carinatus, *Discoaster druggii*, *D. nephados*, *D. dilatus*, *D. argutus*, *D. obtusus*.
Age: *D. druggii* Zone (Early Miocene).

Sample 70-11-5, 6-7 cm:
Sample 70-11-5, 63-64 cm:
Sample 70-11-6, 6-7 cm:
Sample 70-12-1, Bottom:
Sample 70-12-2, 6-7 cm:
Sample 70-12-4, 6-7 cm:
Sample 70-12-5, 6-7 cm:
Triquetrorhabdulus carinatus, *Discoaster druggii*, *D. nephados*, *D. dilatus*, *D. argutus*, *D. obtusus*, *D. lidzi*.
Age: *D. druggii* Zone (Early Miocene).

HOLE 70A

Sample 70A-1-2, 6-7 cm:
Sample 70A-1-2, 63-64 cm:
Sample 70A-1-3, 6-7 cm:
Sample 70A-1-4, 6-7 cm:
Sample 70A-1-5, 6-7 cm:
Sample 70A-1-6, 6-7 cm:
Sample 70A-2-1, 6-7 cm:
Sample 70A-2-2, 6-7 cm:
Sample 70A-2-3, 6-7 cm:
Sample 70A-2-4, 6-7 cm:
Sample 70A-2-5, 6-7 cm:
Sample 70A-2-6, 6-7 cm:
Sample 70A-3-5, 12-13 cm:
Sample 70A-3-6, Bottom:
Sample 70A-4-2, 6-7 cm:
Sample 70A-4-3, 6-7 cm:

Sample 70A-4-4, 6-7 cm:
Sample 70A-4-5, 6-7 cm:
Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. dilatus*, *D. argutus*, *D. obtusus*, *D. lidzi*.
Age: *T. carinatus* Zone (Early Miocene).

Sample 70A-4-6, 6-7 cm:
Flood of coccoliths, very few astero-liths.

Sample 70A-5-4, Bottom:
Sample 70A-5-6, 6-7 cm:
Sample 70A-6-1, 6-7 cm:
Sample 70A-6-2, Bottom:
Sample 70A-6-3, Bottom:
Sphenolithus ciperoensis, *Discoaster argutus*, *D. dilatus*, *D. nephados*, *Coccolithus eopelagicus*.
Age: Probably *S. ciperoensis* Zone (Late Oligocene).

Sample 70A-6-4, 6-7 cm:
Sample 70A-6-5, Top:
Sample 70A-6-6, 6-7 cm:
Sample 70A-7-2, 1-10 cm:
Sample 70A-7-3, Bottom:
Sample 70A-7-4, 6-7 cm:
Sample 70A-7-5, 6-7 cm:
Sample 70A-8-1, Bottom:
Sample 70A-8-3, Top:
Sample 70A-8-4, 6-7 cm:
Flood of *Sphenolithus pacificus*, *S. ciperoensis*, *S. distentus*, *Coccolithus eopelagicus*, *Discoaster nephados*, *D. dilatus*.
Age: *S. ciperoensis* Zone (Late Oligocene).

Sample 70A-8-5, 6-7 cm:
Sample 70A-9-1, Top:
Sample 70A-9-2, 6-7 cm:
Sample 70A-9-4, 6-7 cm:
Sample 70A-9-4, 63-64 cm:
Sample 70A-10-1, 6-7 cm:
Sample 70A-10-2, 6-7 cm:
Sample 70A-10-3, 6-7 cm:
Sample 70A-10-4, 6-7 cm:
Sample 70A-10-5, 6-7 cm:
Sample 70A-11-2, 6-7 cm:
Sample 70A-11-3, 6-7 cm:
Sphenolithus distentus, *Discoaster nephados*, *D. dilatus*, *Coccolithus eopelagicus*, *C. pelagicus*.
Age: Probably *Sphenolithus distentus* Zone (Late Oligocene).

Sample 70A-11-4, 6-7 cm:
Sample 70A-11-5, 6-7 cm:
Sample 70A-12-1, 6-7 cm:
Sample 70A-12-2, 6-7 cm:
Sample 70A-12-3, 6-7 cm:
Sample 70A-12-4, 6-7 cm:
Sphenolithus distentus, *S. predistentus*, and intermediate forms.
Age: Probably *S. distentus* Zone (Late Oligocene).

Sample 70A-13-2, 6-7 cm:
Very poor assemblage.

Sample 70A-13-3, 6-7 cm:
Sample 70A-13-4, 6-7 cm:
Sample 70A-14-2, 6-7 cm:
Sample 70A-14-3, 6-7 cm:
Sample 70A-15-1, 134 cm:
Sample 70A-15-2, 6-7 cm:
Sample 70A-15-3, 6-7 cm:
Sample 70A-15-4, 6-7 cm:
Common *Sphenolithus predistentus*, and many coccoliths.
Age: Probably *S. predistentus* Zone (Middle Oligocene).

Sample 70A-16-1, 48-50 cm:
Sample 70A-16-2, 6-7 cm:
Sample 70A-16-3, 10-12 cm:
Sample 70A-17-1, 115-117 cm:
Sample 70A-17-2, 6-7 cm:
Sample 70A-17-3, 6-7 cm:
Sample 70A-17-4, 6-7 cm:
Sample 70A-18-1, 6-7 cm:
Sample 70A-18-2, 6-7 cm:
Sample 70A-19-1, 124-125 cm:
Sample 70A-19-2, 6-7 cm:
Sample 70A-19-3, 6-7 cm:
As above, but with fewer specimens of *Sphenolithus predistentus* and a flood of *S. pacificus*.

Sample 70A-21-1, 71-72 cm:
Sample 70A-21-2, 6-7 cm:
Sample 70A-22-2, 6-7 cm:
Sample 70A-23-2, 6-7 cm:
Sample 70A-24-1, 94-95 cm:
Sample 70A-24-2, 6-7 cm:
Sample 70A-24-3, 6-7 cm:
Sample 70A-25-1, 117-118 cm:
Sample 70A-25-2, 6-7 cm:
Sample 70A-25-3, 6-7 cm:
Sample 70A-26-2, ?:
Sample 70A-27-1, 115-116 cm:
Sample 70A-27-2, 6-7 cm:
Coccolithus pelagicus, *Reticulofenestra bisecta*, *Discoaster dilatus*, *D. nephados*.
Age: Early Oligocene.

Sample 70A-27-3, 6-7 cm:
Sample 70A-27-3, 6-7 cm:
Sample 70A-28-1, 6-7 cm:
Barren.

HOLE 71

Sample 71-1-1, 6-7 cm:
Gephyrocapsa oceanica, *Cyclococcolithus leptoporus*, *Ceratolithus cristatus*.

Age: Upper part of the *G. oceanica* Zone (Late Pleistocene).

Sample 71-1-2, 6-7 cm:

Gephyrocapsa oceanica, *G. caribbeanica*, *Pseudoemiliana lacunosa*, *Ceratolithus cristatus*.

Age: Lower part of *G. oceanica* Zone (Late Pleistocene).

Sample 71-1-3, 6-7 cm:

Gephyrocapsa caribbeanica, *Pseudoemiliana lacunosa*.
Age: *G. caribbeanica* Zone (Early Pleistocene).

Sample 71-1-4, 6-7 cm:

Sample 71-1-5, 6-7 cm:

Discoaster brouweri, *Gephyrocapsa caribbeanica*.

Age: *D. brouweri* Zone (Late Pliocene).

Sample 71-2-2, 6-7 cm:

Discoaster brouweri, *D. pentaradiatus*, *Ceratolithus cristatus*.

Age: *D. pentaradiatus* Zone (Late Pliocene).

Sample 71-2-3, 6-7 cm:

Sample 71-2-4, 6-7 cm:

Discoaster brouweri, *D. pentaradiatus*, *Ceratolithus rugosus*.

Age: *D. pentaradiatus* Zone (Late Pliocene).

Sample 71-2-5, 6-7 cm:

Sample 71-3-1, 6-7 cm:

Sample 71-3-3, 20-21 cm:

Discoaster extensus, *D. brouweri*, *D. pentaradiatus*, *Ceratolithus rugosus*.

Age: *D. extensus* Zone (Late Pliocene).

Sample 71-3-4, 6-7 cm:

Sample 71-3-5, 24-25 cm:

Sample 71-3-6, ?:

Discoaster surculus, *D. extensus*, *D. brouweri*, *Ceratolithus rugosus*.

Age: *D. surculus* Zone (Late Pliocene).

Sample 71-4-1, 6-7 cm:

Unusual assemblage consisting almost exclusively of asteroliths listed above, very few coccoliths, no ceratoliths.

Sample 71-4-2, 6-7 cm:

Sample 71-4-3, 10-11 cm:

D. surculus, *D. extensus*, *D. brouweri*, *Ceratolithus rugosus*, *C. tricorniculatus*.

Age: Probably *Discoaster asymmetricus* Zone (Early Pliocene).

Sample 71-4-4, 6-7 cm:

Sample 71-4-5, 6-7 cm:

Sample 71-5-4, 6-7 cm:

Discoaster asymmetricus, *D. surculus*, *D. extensus*,

D. brouweri, *Ceratolithus rugosus*, *C. tricorniculatus*.

Age: *D. asymmetricus* Zone (Early Pliocene).

Sample 71-5-5, 6-7 cm:

Sample 71-5-6, 6-7 cm:

Sample 71-6-1, 6-7 cm:

Discoaster surculus, *D. extensus*, *D. brouweri*, *Ceratolithus tricorniculatus*, very few *C. rugosus*.

Age: Probably *C. rugosus* Zone (Early Pliocene).

Sample 71-6-3, 6-7 cm:

Sample 71-6-4, 6-7 cm:

Sample 71-6-5, 6-7 cm:

Discoaster brouweri, *D. extensus*, *D. surculus*, many coccoliths.

Age: Probably *Ceratolithus tricorniculatus* Zone (Late Miocene).

Sample 71-7-1, 6-7 cm:

Sample 71-7-2, 6 cm:

Sample 71-7-3, 6 cm:

Sample 71-7-4, 6 cm:

Sample 71-7-5, 6 cm:

Discoaster quinquenarius, *D. brouweri*, *D. extensus*, many coccoliths.

Age: *D. quinquenarius* Zone (Late Miocene).

Sample 71-7-6, 6 cm:

Discoaster challengerii, *D. cf. hamatus*, *D. brouweri*, *D. extensus*.

Age: Late Miocene.

Sample 71-8-1, 6-7 cm:

Sample 71-8-2, 15-16 cm:

Sample 71-8-5, 15-16 cm:

Sample 71-9-1, 6-7 cm:

Sample 71-9-2, 6 cm:

Discoaster hamatus, *D. challengerii*, *D. brouweri*, *D. extensus*, many coccoliths.

Age: *D. hamatus* Zone (Late Miocene).

Sample 71-9-3, 6 cm:

Many five-rayed specimens of *Discoaster brouweri*.

Age: Late Miocene.

Sample 71-10-1, 6 cm:

Sample 71-10-2, 6 cm:

Sample 71-10-3, 6 cm:

Sample 71-10-4, 6 cm:

Sample 71-10-5, 6 cm:

Sample 71-10-6, 6 cm:

Unusual assemblages with many coccoliths and few asteroliths; asteroliths frequently overgrown with calcite. *Discoaster brouweri*, *D. extensus*, *D. kugleri*.
Age: *D. kugleri* Zone (Middle Miocene).

Sample 71-11-3, 6 cm:

Sample 71-11-5, 6 cm:

Sample 71-12-1, 6 cm:
Sample 71-12-2, 6 cm:
Discoaster cf. *exilis*, *D. extensus*, many coccoliths, but few and poorly preserved asteroliths.
Age: Probably *D. exilis* Zone (Middle Miocene).

Sample 71-12-4, 6 cm:
Sample 71-12-5, 6 cm:
Sample 71-13-1, 6 cm:
Sample 71-13-3, 6 cm:
Sample 71-14-1, 6 cm:
Sample 71-14-3, 6 cm:
Sample 71-14-5, 6 cm:

Sample 71-15-1, 6 cm:
Sample 71-15-5, 6 cm:
Discoaster cf. *trinidadensis*, *D. nephados*; assemblages with many coccoliths, but few and poorly preserved asteroliths.

Sample 71-16-1, 70-75 cm:
Discoaster brouweri, *D. extensus*, and other forms from higher in section.

Sample 71-16-2, 71-72 cm:
Sample 71-17-3, 6 cm:
Discoaster brouweri, *Sphenolithus heteromorphus*, *Discoaster deflandrei*, *D. extensus*, *Coccolithus pelagicus* Mixed assemblage of *S. heteromorphus* Zone and higher (Middle Miocene).

Sample 71-17-4, 6 cm:
Sample 71-17-5, 6 cm:
Discoaster deflandrei, *D. nephados*, *D. argutus*, rare *Sphenolithus heteromorphus*; probably *S. heteromorphus* Zone (Middle Miocene).

Sample 71-17-6, 13 cm:
Sample 71-18-2, 6 cm:
Sample 71-18-3, 6 cm:
Sample 71-18-4, 6 cm:
Sample 71-18-5, 6 cm:
Discoaster deflandrei, *D. nephados*, *D. lidzi*, *D. argutus*, *Sphenolithus heteromorphus*; *S. heteromorphus* Zone (Middle Miocene).

Sample 71-19-1, 6 cm:
Sample 71-19-2, 6 cm:
Sample 71-19-5, 6 cm:
Sample 71-20-2, 6 cm:
Sample 71-20-4, 6 cm:
Sample 71-20-6, 6 cm:
Sample 71-21-2, 71 cm:
Sample 71-21-4, 6 cm:
Sample 71-21-6, 6 cm:
Sample 71-22-4, 6 cm:
Sample 71-22-6, 6 cm:
Sample 71-23-3, 6 cm:

Sample 71-23-4, 6 cm:
Sample 71-23-6, 6 cm:
Sample 71-24-3, 6 cm:
Sample 71-24-4, 6 cm:
Sample 71-25-3, 9-10 cm:
Sample 71-25-5, 6 cm:
Discoaster deflandrei, *D. aulakos*, *D. nephados*, *D. cf. lidzi*, *D. argutus*, *Sphenolithus heteromorphus*; *S. heteromorphus* Zone (Middle Miocene).

Sample 71-26-2, 6 cm:
Sample 71-26-4, 6 cm:
Sample 71-26-6, 6 cm:
Sample 71-28-2, 6 cm:

Sample 71-29-1, 6 cm:
Sample 71-29-3, 6 cm:
Sample 71-29-5, 6 cm:
Sample 71-29-6, 6 cm:
Sample 71-30-2, 6 cm:
Sample 71-30-4, 6 cm:
Discoaster lidzi, *D. deflandrei*, *D. nephados*, *Sphenolithus belemnus*.
Age: *S. belemnus* Zone (Early Miocene).
Note: *Helicopontosphaera* does not occur in these samples so that recognition of the *H. ampliaperta* Zone is impossible.

Sample 71-30-6, 6 cm:
Sample 71-31-2, 6 cm:
Sample 71-31-4, 6 cm:
Sample 71-31-6, 6 cm:
Sample 71-32-2, 6 cm:
Sample 71-32-4, 6 cm:
Sample 71-32-6, 6 cm:
Sample 71-33-5, 6 cm:
Sample 71-33-6, 43 cm:
Sample 71-34-2, 6 cm:
Sample 71-34-4, 6 cm:
Sample 71-34-6, 6 cm:
Sample 71-35-2, 6 cm:
Sample 71-35-4, 6 cm:
Sample 71-35-6, 6 cm:
Assemblages almost entirely coccoliths, few asteroliths and no sphenoliths present.
Age: Probably *Sphenolithus belemnus* Zone, based on position above the highest occurrence of *Triquetrorhabdulus carinatus* (Early Miocene).

Sample 71-36-4, 6 cm:
Sample 71-36-6, 6 cm:
Sample 71-38-4, 6 cm:
Sample 71-38-6, 6 cm:
Sample 71-40-3, 10 cm:
Sample 71-40-5, 10 cm:
Sample 71-42-1, 6 cm:
Sample 71-42-4, 6 cm:
Sample 71-42-5, 6 cm:

Sample 71-42-6, 6 cm:
 Sample 71-43-2, 6 cm:
 Sample 71-43-3, 6 cm:
 Sample 71-44-1, 6 cm:
 Sample 71-44-3, 6 cm:
 Sample 71-44-4, 6 cm:
 Sample 71-44-6, 6 cm:
Triquetrorhabdulus carinatus, *Discoaster deflandrei*, *D. nephados*, many coccoliths.
 Age: Probably *T. carinatus* Zone, Early Miocene.

HOLE 72

Sample 72-1-1, 6 cm:
Gephyrocapsa oceanica, *Cyclococcolithus leptoporus*,
Helicopontosphaera kamptneri, *Ceratolithus cristatus*.
 Age: Upper part of the *G. oceanica* Zone, (Late Pleistocene).

Sample 72-1-2, 6 cm:
 Sample 72-1-3, 6 cm:
Gephyrocapsa oceanica, *Pseudoemiliana lacunosa*,
Ceratolithus cristatus.
 Age: Lower part of the *G. oceanica* Zone, (Late Pleistocene).

Sample 72-1-5, 6 cm:
 Sample 72-1-6, 6 cm:
Gephyrocapsa caribbeanica, *Pseudoemiliana lacunosa*.
 Age: *G. caribbeanica* Zone (Early Pleistocene).

Sample 72-2-1, 116 cm:
 Sample 72-2-2, 6 cm:
 Sample 72-2-3, 16 cm:
Discoaster brouweri, *D. calcaris*, *D. pentaradiatus*,
Ceratolithus rugosus.
 Age: *D. pentaradiatus* Zone (Late Pliocene).

Sample 72-2-4, 6 cm:
 Sample 72-2-5, 6 cm:
Discoaster extensus, *D. brouweri*, *D. pentaradiatus*, *D. cf. surculus*.
 Age: *D. extensus* Zone (Late Pliocene).

Sample 72-3-1, 6 cm:
Discoaster surculus, *D. extensus*, *D. brouweri*.
 Age: *D. surculus* Zone (Late Pliocene).

Sample 72-3-2, 6 cm:
 Sample 72-3-3, 6 cm:
 Sample 72-3-4, 6 cm:
 Sample 72-3-5, 6 cm:
 Poor assemblages with *Discoaster brouweri*, *D. extensus*, and coccoliths.
 Age: Late Miocene or Early Pliocene.

Sample 72-4-1, 6 cm:
Discoaster extensus, *D. dilatus*, *D. brouweri*, *D. kugleri*.
 Age: Probably *D. kugleri* Zone (Middle Miocene).

Sample 72-4-2, 6 cm:
 Sample 72-4-3, 6 cm:
 Sample 72-4-4, 6 cm:
 Assemblages with heavily calcified asteroliths; exact age assignment impossible.

Sample 72-4-5, 6 cm:
Discoaster argutus, *D. extensus*, *D. dilatus*, *D. nephados*.
 Age: Early Miocene.

Sample 72-5-1, 6 cm:
Discoaster extensus, *D. nephados*, *D. dilatus*, *Sphenolithus belemnus*.
 Age: *S. belemnus* Zone (Early Miocene).

Sample 72-5-5, 6 cm:
Discoaster quinquerramus, *D. brouweri*, *D. variabilis*, *D. extensus*, *D. nephados*; mixed assemblage from higher in hole.

Sample 72-5-6, 6 cm:
Discoaster brouweri, *D. nephados*, *D. dilatus*, *D. extensus*, *Sphenolithus distentus*.
 Age: Probably Early Miocene, with admixed material from higher in hole.

Sample 72-6-2, 6 cm:
 Sample 72-6-4, 6 cm:
 Sample 72-6-6, 6 cm:
Triquetrorhabdulus carinatus, *Discoaster lidzi*, *D. dilatus*, *D. extensus*, *D. nephados*.
 Age: *T. carinatus* Zone (Early Miocene).

Sample 72-7-1, 6 cm:
 Sample 72-7-2, 6 cm:
 Sample 72-7-3, 6 cm:
 Sample 72-7-4, 6 cm:
 Sample 72-7-5, 6 cm:
 Sample 72-7-6, 6 cm:
Discoaster lidzi, *D. nephados*, *Sphenolithus ciperoensis*.
 Age: Probably *Sphenolithus distentus* Zone (Late Oligocene).

Sample 72-8-5, 6 cm:
 Sample 72-8-6, 6-7 cm:
Sphenolithus predistentus, few asteroliths, many small coccoliths.
 Age: Probably *S. predistentus* Zone (Middle Oligocene).

Sample 72-9-2, 6 cm:
 Sample 72-9-3, 6 cm:
 Sample 72-9-4, 6 cm:
 Sample 72-9-5, 6 cm:
 Sample 72-9-6, 6 cm:
Reticulofenestra bisecta, *R. umbilica*, many small coccoliths, few asteroliths.
 Age: Early Oligocene.

Sample 72-10-3, 4 cm:
 Sample 72-10-5, 120-135 cm:
 Sample 72-11-1, 22-23 cm:
Discoaster barbadiensis, *D. saipanensis*, *D. tani*, *Reticulofenestra umbilica*.
 Age: Late Eocene.

HOLE 72A

Sample 72A-1-1, 110 cm:
 Sample 72A-1-2, 6 cm:
 Sample 72A-1-3, 6 cm:
 Sample 72A-1-4, 46 cm:
 Sample 72A-2-1, 6 cm:
 Sample 72A-2-2, 6 cm:
 Sample 72A-2-3, 6 cm:
Gephyrocapsa caribbeanica, *Pseudoemiliana lacunosa*, *Cyclococcolithus leptoporus*, *Helicopontosphaera kamptneri*, *Ceratolithus cristatus*.
 Age: *Gephyrocapsa caribbeanica* Zone (Early Pleistocene).

Sample 72A-2-4, 6 cm:
 Sample 72A-2-5, 6 cm:
 Sample 72A-3-2, 6 cm:
 Sample 72A-3-3, 6 cm:
 Sample 72A-3-4, 6 cm:
 Sample 72A-3-5, 6 cm:
 Sample 72A-4-2, 6 cm:
 Sample 72A-4-3, 6 cm:
 Sample 72A-4-6, 6 cm:
Discoaster brouweri calcaris, *Coccolithus pelagicus*.
 Age: *D. brouweri* Zone (Late Pliocene).

Sample 72A-5-2, 6 cm:
 Sample 72A-5-3, 6 cm:
Discoaster pentaradiatus, *D. brouweri*.
 Age: *D. pentaradiatus* Zone (Late Pliocene).

Sample 72A-5-4, 6 cm:
Discoaster extensus, *D. pentaradiatus*, *D. brouweri*, *Ceratolithus rugosus*, *C. tricorniculatus*.
 Age: *D. extensus* Zone (Late Pliocene).

Sample 72A-5-5, 6 cm:
 Sample 72A-5-6, 6 cm:
 Sample 72A-6-1, 6 cm:
 Sample 72A-6-2, 6 cm:
 Sample 72A-6-3, 6 cm:
Discoaster surculus, *D. extensus*, *D. brouweri*, *Ceratolithus rugosus*, *C. tricorniculatus*.
 Age: *D. surculus* Zone (Late Pliocene).

Sample 72A-6-4, 6 cm:
 Sample 72A-6-5, 6 cm:
 As above, but heavily calcified.

Sample 72A-6-6, 6 cm:
Reticulofenestra pseudumbilica, *Ceratolithus rugosus*,

C. tricorniculatus.
 Age: *R. pseudumbilica* Zone (Late Pliocene).

HOLE 73

Sample 73-1-1, 6 cm:
 Sample 73-1-2, 6 cm:
 Sample 73-2-1, 6 cm:
Gephyrocapsa oceanica, *Cyclococcolithus leptoporus*, *Ceratolithus cristatus*, *Helicopontosphaera kamptneri*.
 Age: Upper part of the *G. oceanica* Zone (Late Pleistocene).

Sample 73-2-2, 6 cm:
 Sample 73-2-3, 6 cm:
 Sample 73-2-4, 6 cm:
 Sample 73-2-5, 6 cm:
Gephyrocapsa oceanica, *G. caribbeanica*, *Cyclococcolithus leptoporus*, *Ceratolithus cristatus*, *Pseudoemiliana lacunosa*.
 Age: Lower part of the *G. oceanica* Zone (Late Pleistocene).

Sample 73-3-1, 96 cm:
 Sample 73-3-2, 6 cm:
 Sample 73-3-3, 6 cm:
 Sample 73-3-4, 6 cm:
 Sample 73-3-5, 6 cm:
 Sample 73-3-6, 6 cm:
Gephyrocapsa caribbeanica, *Pseudoemiliana lacunosa*, *Cyclococcolithus leptoporus*.
 Age: *G. caribbeanica* Zone (Early Pleistocene).

Sample 73-4-1, 6 cm:
 Sample 73-4-2, 6 cm:
 Sample 73-4-3, 6 cm:
 Sample 73-4-4, 6 cm:
Discoaster brouweri, *Gephyrocapsa caribbeanica*, *Pseudoemiliana lacunosa*.
 Age: *D. brouweri* Zone (Late Pliocene).

Sample 73-4-5, 6 cm:
 Sample 73-4-6, 6 cm:
 Sample 73-5-2, 7 cm:
 Sample 73-5-5, 6-7 cm:
 Sample 73-5-6, 6-7 cm:
 Sample 73-6-1, 6-7 cm:
Discoaster pentaradiatus, *D. brouweri*.
 Age: *D. pentaradiatus* Zone (Late Pliocene).

Sample 73-6-2, 6-7 cm:
Discoaster cf. *extensus*, *D. pentaradiatus*, *D. brouweri*, *D. extensus* Zone (Late Pliocene).

Sample 73-6-3, 6-7 cm:
 Sample 73-6-4, 6-7 cm:
 Sample 73-6-5, 6-7 cm:
 Sample 73-6-6, 6-7 cm:
Discoaster cf. *variabilis*, *D. extensus*, *D. pentaradiatus*,

D. brouweri, very few coccoliths.
Age: *D. extensus* Zone (Late Pliocene).

Sample 73-7-1, 6-7 cm:

Sample 73-7-3, 6-7 cm:

Sample 73-7-4, 6-7 cm:

Sample 73-7-5, 6-7 cm:

Discoaster cf. *surculus*, *D. extensus*, *D. brouweri*, *Ceratolithus rugosus*.

Age: Lowermost *D. extensus* Zone or uppermost *D. surculus* Zone (Late Pliocene).

Sample 73-7-6, 6-7 cm:

Sample contains abundant *Ceratolithus tricorniculatus*, but no *C. rugosus*.

Sample 73-8-1, 6-7 cm:

Sample 73-8-2, 6-7 cm:

Sample 73-8-4, 6-7 cm:

Sample 73-8-6, 6-7 cm:

Sample 73-9-2, 6 cm:

Discoaster surculus, *D. extensus*, *D. brouweri*, *Ceratolithus tricorniculatus*.

Age: Late Miocene or Early Pliocene.

Sample 73-9-6, 6 cm:

Reticulofenestra pseudumbilica, *Discoaster druggii*, *D. dilatus*, *D. brouweri*, *D. extensus*; mixed Miocene assemblage.

Sample 73-10-2, 6 cm:

Sample 73-10-4, 6 cm:

Sample 73-10-6, 6 cm:

Discoaster cf. *druggii*, *D. dilatus*, *D. nephados*, *D. extensus*.

Age: Early Miocene.

Sample 73-11-2, 6 cm:

Sample 73-11-4, 6 cm:

Sample 73-11-6, 6 cm:

Discoaster nephados, *D. dilatus*, *Sphenolithus heteromorphus*?

Age: Probably *Helicopontosphaera ampliaperta* Zone (Early Miocene).

Sample 73-12-2, 6 cm:

Discoaster nephados, *D. dilatus*, *Sphenolithus belemnus*.

Age: Probably *S. belemnus* Zone (Early Miocene).

Sample 73-12-4, 6 cm:

Sample 73-12-6, 6 cm:

Triquetrorhabdulus carinatus, *Discoaster dilatus*, *D. nephados*.

Age: *T. carinatus* Zone (Early Miocene).

Sample 73-13-2, 6 cm:

Triquetrorhabdulus carinatus, *Discoaster dilatus*, *D. nephados*, *Sphenolithus distentus*.

Age: Lowermost *T. carinatus* Zone or uppermost *Sphenolithus ciperoensis* Zone (Early Miocene or Late Oligocene).

Sample 73-13-4, 6-7 cm:

Sample 73-13-6, 6 cm:

Sample 73-14-2, 6 cm:

Sphenolithus predistentus, with nondescript asteroliths and many small coccoliths.

Age: *S. predistentus* Zone (Middle Oligocene).

Sample 73-14-3, 6 cm:

Sphenolithus predistentus, *Discoaster tani ornatus*, flood of small coccoliths and sphenoliths.

Age: *S. predistentus* Zone (Middle Oligocene).

Sample 73-14-4, 6 cm:

Sample 73-14-6, 6 cm:

Sample 73-15-2, 6-7 cm:

Sample 73-15-4, 6 cm:

Sample 73-15-6, 6 cm:

Sample 73-16-2, 6-7 cm:

Sample 73-16-4, 6 cm:

Sample 73-16-6, 6 cm:

Sample 73-17-2, 6-7 cm:

Sample 73-17-4, 6-7 cm:

Sample 73-17-6, 6-7 cm:

Flood of *Sphenolithus pacificus* and many coccoliths.

Age: Early Oligocene.

Sample 73-18-6, 16 cm:

Sample 73-19-2, 6 cm:

Many *Reticulofenestra bisecta*, *R. umbilica*.

Age: Early Oligocene.

Sample 73-19-4, 6 cm:

Very poor assemblage, with rims of *Reticulofenestra umbilica* only.

Sample 73-20-4, 6 cm:

Discoaster barbadiensis, *D. saipanensis*, *Reticulofenestra umbilica*.

Age: Late Eocene.

Sample 73-21-2, 6 cm:

Discoaster nephados, *D. extensus*, *D. barbadiensis*, *D. saipanensis*.

Age: Mixed Miocene and Eocene.

HOLE 74

Sample 74-1-2, 6 cm:

Barren.

Sample 74-3-4, 6 cm:

Sample 74-4-2, 6 cm:

Sample 74-4-4, 6 cm:

Sample 74-5-2, 6 cm:
Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. extensus*, *D. dilatus*.
Age: *T. carinatus* Zone (Early Miocene).

Sample 74-5-4, 6 cm:
Sample 74-5-6, 6 cm:
Sample 74-6-2, 6 cm:
Sample 74-6-4, 6 cm:
Sample 74-6-6, 6 cm:
Sample 74-7-2, 6 cm:
Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. dilatus*, *D. cf. deflandrei*, *Sphenolithus ciperoensis*.
Age: *T. carinatus* Zone (Early Miocene) or *S. ciperoensis* Zone (Late Oligocene).

Sample 74-7-4, 6 cm:
Sample 74-7-5, 6-7 cm:
Triquetrorhabdulus carinatus, *Sphenolithus ciperoensis*, *S. distentus*.
Age: Lowermost *S. ciperoensis* Zone or uppermost *S. distentus* Zone (Late Oligocene).

Sample 74-8-2, 6-7 cm:
Flood of *Sphenolithus pacificus*.

Sample 74-8-3, 6-7 cm:
Sphenolithus predistentus, *Discoaster deflandrei*, many coccoliths.
Age: *S. predistentus* Zone (Middle Oligocene).

Sample 74-9-1, 63-64 cm:
Sample 74-9-2, 6-7 cm:
Sample 74-9-4, 6-7 cm:
Sphenolithus predistentus, *Discoaster tani ornatus*, many coccoliths.
Age: *S. predistentus* Zone (Middle Oligocene).

Sample 74-9-5, 6-7 cm:
Sample 74-10-1, 12-13 cm:
Sample 74-11-1, 100 cm:
Very abundant *Sphenolithus pacificus*, *S. predistentus*, *Discoaster cf. tani ornatus*, *Reticulofenestra bisecta*.
Age: Probably *S. predistentus* Zone (Middle Oligocene).

Sample 74-12-3, 9 cm:
Sphenolithus belemnos??; sample rich in organic matter, with few poorly preserved coccoliths and sphenoliths, probably from higher in hole.

HOLE 75

Sample 75-1-4, 6 cm:
Sample 75-2-2, 6 cm:
Sample 75-2-5, 6 cm:
Discoaster nephados, *D. cf. druggii*, *D. dilatus*, *D. adamanteus*, *Coronocyclus nitescens*.
Age: Early Miocene.

Sample 75-3-3, 6 cm:
Sample 75-3-5, 6 cm:
Sample 75-4-2, 6-7 cm:
Sample 75-5-2, 6-7 cm:
Triquetrorhabdulus carinatus, *Discoaster nephados*, *D. cf. druggii*, *D. dilatus*.
Age: Lowermost *D. druggii* Zone or uppermost *T. carinatus* Zone (Early Miocene).

Sample 75-5-5, 6-7 cm:
Triquetrorhabdulus carinatus, *Sphenolithus ciperoensis*, *Discoaster nephados*.
Age: *T. carinatus* Zone or *S. ciperoensis* Zone (Early Miocene or Late Oligocene).

Sample 75-8-3, 6-7 cm:
Sample 75-8-5, 6-7 cm:
Sample 75-9-5, 6-7 cm:
Sphenolithus predistentus, *Discoaster tani ornatus*, *Coccolithus eopelagicus*, *Cyclococcolithus floridanus*.
Age: *S. predistentus* Zone (Middle Oligocene).

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