12. SOUTHEASTERN ATLANTIC LEG 40 CALCAREOUS NANNOFOSSILS

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INTRODUCTION

This report deals with the study of the calcareous nannofossil content of the six southeastern Atlantic Sites 360 to 365 drilled during DSDP Leg 40 (Figure 1).

Calcareous nannofossils were recovered from all sites; they range in age from Lower Cretaceous (Aptian) to Quaternary and represent an almost complete sequence of the biostratigraphic units for this time interval. All the stratigraphic stages, except for part of the Turonian and the Cenomanian, are represented in the sedimentary record of the investigated sites.

The light microscope was used to examine the 1329 smear slides of the cores sampled. Use of the scanning electron microscope was only made to check the structure of some problematic lower Eocene nannofossils from Site 361 and to illustrate some upper Cretaceous forms.

Of the three authors, F. Proto Decima studied Sites 361, 362, 362A, 363, and 365, F. Medizza Site 364, and L. Todesco Site 360. Discussions and conclusions on biostratigraphic and taxonomic problems were worked out jointly.

Table 1 lists in alphabetical order the nannofossil genera and species considered in this report.

BIOSTRATIGRAPHY

Cretaceous

The Lower Cretaceous zonation used in this report is that proposed by Thierstein (1971, 1973).

For the subdivision and age determination of the Upper Cretaceous the results of Cepek and Hay (1969), Martini (1969, 1976), Bukry and Bramlette (1970), Manivit (1971), Perch-Nielsen (1972, 1977), and Roth (1973) were considered.

The biostratigraphic distribution of the Cretaceous cores, the events used to fix the boundaries of the zones, and their correlation with the stratigraphic stages and absolute age are summarized in Table 2.

The recognized biozones and their definition are listed as follows in stratigraphic order from older to younger.

Chiastozygus litterarius Zone

Definition: Interval from the last occurrence of *Nannoconus colomii* and/or the first occurrence of *Chiastozygus litterarius* and/or *Rucinolithus irregularis* to the first occurrence of *Parhabdolithus angustus* and/or *Lithastrinus floralis*.



Figure 1. Location of Leg 40 Sites 360-365.

Author: Thierstein (1971, 1973).

Age: Lower Aptian.

The lower boundary of this zone was not recovered on Leg 40. The poorly preserved nannofossil associations of the lower part of Site 361 were referred to this zone on the concurrence of *Micrantholithus hoschulzii*, *M. obtusus*, and *Chiastozygus litterarius*. They represent the oldest nannofloras recovered in Leg 40.

Parhabdolithus angustus Zone

Definition: Interval from the first occurrence of *Parhabdolithus angustus* and/or *Lithastrinus floralis*, to the first occurrence of *Prediscosphaera cretacea*.

Author: Manivit (1971), modified Thierstein (1973). Age: Upper Aptian-lower Albian.

Prediscosphaera cretacea Zone

Definition: Interval from the first occurrence of *Prediscosphaera cretacea* to the first occurrence of *Eiffellithus turriseiffeli*.

Author: Thierstein (1971, 1973).

Age: Lower Albian to middle Albian.

Eiffellithus turriseiffeli Zone

Definition: Interval from the first occurrence of *Eiffellithus turriseiffeli* to the first occurrence of *Lithraphidites alatus.*

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TABLE 1 Selected Nannofossil Species Considered in This Report

CENOZOIC

Amaurolithus amplificus (Bukry and Percival, 1971) Gartner and Bukry, 1975 (Plate 5, Figure 8) Amaurolithus delicatus Gartner and Bukry, 1975 (Plate 5, Figures 3-7) Amaurolithus primus (Bukry and Bramlette, 1971) Gartner and Bukry, 1975 (Plate 5, Figures 7-11) Amaurolithus tricorniculatus (Gartner, 1967) Gartner and Bukry, 1975 (Plate 5, Figure 9) Angulolithina arca Bukry, 1973 (Plate 5, Figure 14) Aspidorhabdus stylifer (Lohmann, 1902) Boudreaux and Hay, 1969 Blackites spinulus (Levin, 1965) Roth, 1970 Braarudosphaera bigelowii (Gran and Braarud, 1935) Deflandre, 1947 Campylosphaera dela (Bramlette and Sullivan, 1961) Hay and Mohler, 1967 (Plate 10, Figure 3) Campylosphaera eodela Bukry and Percival, 1971 (Plate 10, Figure 2 Catinaster calyculus Martini and Bramlette, 1963 Catinaster coalitus Martini and Bramlette, 1963 Ceratolithus acutus Gartner and Bukry, 1974 (Plate 4, Figures 5, 8, 10, 11) Ceratolithus cristatus Kamptner, 1954 (Plate 4, Figure 12) Ceratolithus rugosus Bukry and Bramlette, 1968 (Plate 4, Figures 1-4, 6, 7, 9) Chiasmolithus altus Bukry and Percival, 1971 Chiasmolithus bidens (Bramlette and Sullivan, 1961) Hay and Mohler, 1967 Chiasmolithus californicus (Sullivan, 1964) Hay and Mohler, 1967 (Plate 10, Figure 7) Chiasmolithus consuetus (Bramlette and Sullivan, 1961) Hay and Mohler, 1967 Chiasmolithus danicus (Brotzen, 1959) Hay and Mohler, 1967 Chiasmolithus expansus (Bramlette and Sullivan, 1961) Gartner, 1970 Chiasmolithus gigas (Bramlette and Sullivan, 1961) Radomski, 1968 Chiasmolithus grandis (Bramlette and Riedel, 1954) Radomski, 1968 (Plate 11, Figure 7) Chiasmolithus oamaruensis (Deflandre, 1954) Hay, Mohler and Wade, 1966 Chiasmolithus solitus (Bramlette and Sullivan, 1961) Locker, 1968 Chiphragmalithus acanthodes Bramlette and Sullivan, 1961 Chiphragmalithus calathus Bramlette and Sullivan, 1961 Coccolithus crassus Bramlette and Sullivan, 1961 (Plate 10, Figure 9) Coccolithus cribellum (Bramlette and Sullivan, 1961) Stradner, 1962 (Plate 10, Figure 11) Coccolithus eopelagicus (Bramlette and Riedel, 1954) Bramlette and Sullivan, 1961 Coccolithus magnicrassus Bukry, 1971 (Plate 10, Figure 12) Coccolithus miopelagicus Bukry, 1971 Coccolithus pelagicus (Wallich, 1877) Schiller, 1930 Coronocyclus nitescens (Kamptner, 1964) Bramlette and Wilcoxon, 1967 (Plate 2, Figure 4) Cricolithus jonesii Cohen, 1965 (Plate 1, Figures 6, 7) Cruciplacolithus staurion (Bramlette and Sullivan, 1961) Gartner, 1971 Cruciplacolithus tenuis (Stradner, 1961) Hay and Mohler, 1967 (Plate 10, Figure 1) Cyclicargolithus abisectus (Müller, 1970) Bukry, 1973 (Plate 2, Figure 5) Cyclicargolithus floridanus (Roth and Hay, 1967) Bukry, 1971 (Plate 2, Figure 3) Cyclicargolithus pseudogammation (Bouche, 1962) Bukry, 1973 Cyclicargolithus reticulatus (Gartner and Smith, 1967) n. comb. Cyclococcolithus formosus Kamptner, 1963 Cyclococcolithus gammation (Bramlette and Sullivan, 1961) Sullivan, 1964 Cyclococcolithus kingii Roth, 1970

TABLE 1 - Continued Cyclococcolithus leptoporus (Murray and Blackmann, 1898) Kamptner, 1954 (Plate 1, Figure 22) Cyclococcolithus macintyrei Bukry and Bramlette, 1969 (Plate 2, Figure 6) Cyclolithella robusta (Bramlette and Sullivan, 1961) Stradner, 1969 (Plate 10, Figure 4) Dictyococcites bisectus (Hay, Mohler and Wade, 1966) Bukry and Percival, 1971 Dictyococcites scrippsae Bukry and Percival, 1971 Discoaster adamanteus Bramlette and Wilcoxon, 1967 Discoaster asymmetricus Gartner, 1969 (Plate 6, Figure 2; Plate 9, Figure 2) Discoaster barbadiensis Tan Sin Hok, 1927 Discoaster berggrenii Bukry, 1971 (Plate 7, Figures 1-3) Discoaster bifax Bukry, 1971 Discoaster binodosus Martini, 1958 Discoaster bollii Martini and Bramlette, 1963 (Plate 9, Figure 4) Discoaster braarudii Bukry, 1971 Discoaster brouweri Tan Sin Hok. 1927 (Plate 6, Figure 3) Discoaster calcaris Gartner, 1967 (Plate 6, Figures 4, 5) Discoaster challengeri Bramlette and Riedel, 1954 (Plate 9, Figure 5) Discoaster cruciformis Martini, 1958 Discoaster deflandrei Bramlette and Riedel, 1954 (Plate 9, Figures 3, 6) Discoaster delicatus Bramlette and Sullivan, 1961 Discoaster diastypus Bramlette and Sullivan, 1961 (Plate 11, Figures 5, 6) Discoaster distinctus Martini, 1958 Discoaster druggii Bramlette and Wilcoxon, 1967 (Plate 6, Figures 8, 9) Discoaster elegans Bramlette and Sullivan, 1961 Discoaster exilis Martini and Bramlette, 1963 (Plate 8, Figure 5) Discoaster formosus Martini and Worsley, 1971 Discoaster hamatus Martini and Bramlette, 1963 (Plate 6, Figure 6) Discoaster intercalaris Bukry, 1971 Discoaster kugleri Martini and Bramlette, 1963 Discoaster lautus Boudreaux and Hay, 1967 Discoaster lenticularis Bramlette and Sullivan, 1961 Discoaster lodoensis Bramlette and Riedel, 1954 Discoaster loeblichii Bukry, 1971 (Plate 9, Figures 7, 8) Discoaster mirus Deflandre, 1954 Discoaster mohleri Bukry and Percival, 1971 Discoaster moorei Bukry, 1971 (Plate 7, Figures 5-8) Discoaster multiradiatus Bramlette and Riedel, 1954 (Plate 11, Figure 4) Discoaster neorectus Bukry, 1971 (Plate 6, Figure 7; Plate 9, Figure 9) Discoaster nephados Hay, 1967 Discoaster nobilis Martini 1961 Discoaster nonaradiatus Bramlette and Sullivan, 1961 Discoaster pentaradiatus Tan Sin Hok, 1927 (Plate 8, Figure 4) Discoaster perplexus Bramlette and Riedel, 1954 Discoaster pseudovariabilis Martini and Worsley, 1971 (Plate 7, Figure 9); Plate 8, Figure 2) Discoaster quintueramus Gartner, 1969 (Plate 7, Figure 4) Discoaster saipanensis Bramlette and Riedel, 1954 Discoaster salisburgensis Stradner, 1961 Discoaster saundersii Hay, 1967 Discoaster septemradiatus (Klumpp, 1953) Martini, 1958 Discoaster signus Bukry, 1971 Discoaster sublodoensis Bramlette and Sullivan, 1961 Discoaster subsurculus Gartner, 1967 Discoaster surculus Martini and Bramlette, 1963 (Plate 8, Figure 1) Discoaster tamalis Kamptner, 1967 Discoaster tanii Bramlette and Riedel, 1954 Discoaster tanii nodifer Bramlette and Riedel, 1954 (Plate 12, Figure 12) Discoaster trinidadensis Hay, 1967 Discoaster variabilis Martini and Bramlette, 1963 (Plate 7, Figures 10-14)Discoaster variabilis decorus Bukry, 1971 (Plate 7, Figures 15-16; Plate 9, Figure 10)

- Discoaster wemmelensis Achutan and Stradner, 1969
- Discoaster sp. 1 (Plate 11, Figure 3; Plate 12, Figures 9-11)

TABLE 1 - Continued

Discoaster spp. (Plate 6, Figure 1; Plate 8, Figure 3; Plate 9, Figure 1) Discoasteroides kuepperi (Stradner, 1959) Bramlette and Sullivan, 1961 (Plate 11, Figures 1, 2) Discoasteroides megastypus Bramlette and Sullivan, 1961 Ellipsolithus distichus (Bramlette and Sullivan, 1961) Sullivan, 1964 Ellipsolithus macellus (Bramlette and Sullivan, 1961) Sullivan, 1964 (Plate 10, Figure 10) Emiliania annula (Cohen, 1964) Bukry, 1975 (Plate 1, Figures 14, 15) Emiliania ovata Bukry, 1973 (Plate 1, Figures 8, 9, 13) Ericsonia cava (Hay and Mohler, 1967) Perch-Nielsen, 1969 Ericsonia fenestrata (Deflandre and Fert, 1954) Stradner, 1968 Ericsonia obruta Perch-Nielsen, 1971 Ericsonia subdisticha (Roth and Hay, 1967) Roth, 1969 Ericsonia subpertusa Hay and Mohler, 1967 Fasciculithus involutus Bramlette and Sullivan, 1961 (Plate 12, Figure 7) Fasciculithus janii Perch-Nielsen, 1971 (Plate 12, Figure 1) Fasciculithus pileatus Bukry, 1973 (Plate 12, Figures 3, 6) Fasciculithus tympaniformis Hay and Mohler, 1967

Gephyrocapsa caribbeanica Boudreaux and Hay, 1967 (Plate 1, Figures 2, 5)

Gephyrocapsa oceanica Kamptner, 1943 (Plate 1, Figures 1, 3, 4)

Helicosphaera ampliaperta Bramlette and Wilcoxon, 1967 (Plate 2, Figure 1)

- Helicosphaera carteri (Wallich, 1877) Kamptner, 1954 (Plate 2, Figure 2)
- Helicosphaera compacta Bramlette and Wilcoxon, 1967
- Helicosphaera euphratis Haq, 1966
- Helicosphaera intermedia Martini, 1965 (Plate 1, Figure 25)
- Helicosphaera lophota (Bramlette and Sullivan, 1961) Jafar and Martini, 1975
- Helicosphaera obliqua Bramlette and Wilcoxon, 1967
- Helicosphaera perchnielsenae (Haq, 1971) Martini, 1975
- Helicosphaera recta (Haq, 1966) Jafar and Martini, 1975 Heliscosphaera reticulata Bramlette and Wilcoxon, 1967

- Helicosphaera sellii (Bukry and Bramlette, 1969) Jafar and Martini, 1975 (Plate 1, Figures 23, 24)
- Helicosphaera seminulum (Bramlette and Sullivan, 1961) Jafar and Martini, 1975
- Heliolithus kleinpellii Sullivan, 1964 (Plate 10, Figure 8)

Heliolithus riedelii Bramlette and Sullivan, 1961

- Isthmolithus recurvus Deflandre, 1954
- Lanternithus minutus Stradner, 1962
- Markalius inversus (Deflandre, 1954) Bramlette and Martini, 1964 (Plate 10, Figure 5)
- Micrantholithus attenuatus Bramlette and Sullivan, 1961

Minilitha convallis Bukry, 1973 (Plate 1, Figure 21)

- Nannotetrina cristata (Martini, 1958) Perch-Nielsen, 1971 (Plate 12, Figure 8)
- Nannotetrina fulgens (Stradner, 1960) Stradner 1969
- Nannotetrina pappii (Stradner, 1959) Perch-Nielsen, 1971

Neochiastozygus chiastus (Bramlette and Sullivan, 1961) Perch-Nielsen, 1971

- Neochiastozygus concinnus Martini, 1961) Perch-Nielsen, 1971 Neochiastozygus distentus (Bramlette and Sullivan, 1961) Perch-Nielsen, 1971
- Neochiastozygus junctus (Bramlette and Sullivan, 1961) Perch-Nielsen, 1971
- Neococcolithes dubius (Deflandre, 1954) Black, 1967

Neococcolithes protenus (Bramlette and Sullivan, 1961) Perch-Nielsen, 1971

Peritrachelina joidesa Bukry and Bramlette, 1968

Pontosphaera discopora Schiller, 1925

Pontosphaera japonica (Takayama, 1967) n. comb.

Pontosphaera multipora (Kamptner, 1948) Roth, 1970 (Plate 1, Figure 19)

Pontosphaera ovata (Levin and Joerger, 1967) n. comb.

Pontosphaera pectinata (Bramlette and Sullivan, 1961) Proto Decima, Roth and Rodesco, 1975

Pontosphaera plana (Bramlette and Sullivan, 1961) Hag, 1971 Pontosphaera vigintiforata (Kamptner, 1948) n. comb.

- Prinsius bisulcus (Stradner, 1963) Hay and Mohler, 1967
- Reticulofenestra coenura (Reinhardt, 1966) Roth, 1970
- Reticulofenestra hillae Bukry and Percival, 1971
- Reticulofenestra lockeri Müller, 1970 Reticulofenestra oamaruensis (Deflandre, 1954) Stradner, 1968
- Reticulofenestra pseudoumbilica (Gartner, 1967) Gartner, 1969 (Plate 2, Figure 8)
- Reticulofenestra umbilica (Levin, 1965) Martini and Ritzkowski, 1968
- Rhabdosphaera clavigera Murray and Blackman, 1898 (Plate 5, Figures 1, 2)
- Rhabdosphaera inflata Bramlette and Sullivan, 1961
- Rhabdosphaera perlonga (Deflandre, 1952) Bramlette and Sullivan, 1961
- Rhabdosphaera procera Martini, 1969
- Rhabdosphaera tenuis Bramlette and Sullivan, 1961
- Rhomboaster cuspis Bramlette and Sullivan, 1961 (Plate 12, Figures 13-15)
- Scapholithus fossilis Deflandre, 1954
- Scyphosphaera amphora Deflandre, 1942 (Plate 3, Figure 5)
- Scyphosphaera apsteinii Lohmann, 1902 (Plate 3, Figures 1, 8)
- Scyphosphaera globulosa Kamptner 1955 (Plate 3, Figures 3, 4)
- Scyphosphaera intermedia Deflandre, 1942 (Plate 3, Figures 6, 7)
- Scyphosphaera pulcherrima Deflandre, 1942 (Plate 3, Figure 2)
- Sphenolithus abies Deflandre, 1954 (Plate 1, Figure 17)
- Sphenolithus anarrhopus Bukry and Bramlette, 1969
- Sphenolithus belemnos Bramlette and Wilcoxon, 1967
- Sphenolithus capricornutus Bukry and Percival, 1971
- Sphenolithus ciperoensis Bramlette and Wilcoxon, 1967
- Sphenolithus delphyx Bukry, 1973
- Sphenolithus dissimilis Bukry and Percival, 1971
- Sphenolithus distentus (Martini, 1965) Bramlette and Wilcoxon, 1967

Sphenolithus heteromorphus Deflandre, 1953 (Plate 1, Figures 10-12)

- Sphenolithus moriformis (Brönnimann and Stradner, 1960) Bramlette and Wilcoxon, 1967 (Plate 1, Figure 16)
- Sphenolithus neoabies Bukry and Bramlette, 1969
- Sphenolithus orphanknollii Perch-Nielsen, 1971 (Plate 12, Figures 4, 5)
- Sphenolithus predistentus Bramlette and Wilcoxon, 1967
- Sphenolithus pseudoradians Bramlette and Wilcoxon, 1967 Sphenolithus radians Deflandre, 1952
- Sphenolithus spiniger Bukry, 1971 (Plate 12, Figure 2)
- Syracosphaera histrica Kamptner, 1941 (Plate 1, Figure 20)
- Thoracosphaera operculata Bramlette and Martini, 1964
- Thoracosphaera saxea Stradner, 1961 (Plate 2, Figure 7)
- Toweius craticulus Hay and Mohler, 1967 (Plate 10, Figure 5)
- Toweius eminens (Bramlette and Sullivan, 1961) Perch-Nielsen 1971

Transversopontis latus Müller, 1970

- Tribrachiatus contortus (Stradner, 1958) Bukry, 1972
- Tribrachiatus orthostylus Shamrai, 1963
- Triquetrorhabdulus carinatus Martini, 1965
- Triquetrorhabdulus inversus Bukry and Bramlette, 1969
- Triquetrorhabdulus rugosus Bramlette and Wilcoxon, 1967 (Plate 5, Figure 12)
- Umbilicosphaera mirabilis Lohmann, 1902 (Plate 1, Figure 18) Zvgodiscus sigmoides Bramlette and Sullivan, 1961
- Zygrhablithus bijugatus (Deflandre, 1954) Deflandre, 1959
- Zygrhablithus simplex Bramlette and Sullivan, 1961

MESOZOIC

- Ahmuellerella octoradiata (Gorka, 1957) Reinhardt, 1966 (Plate 15, Figure 14)
- Ahmuellerella sp. aff. octoradiata (Gorka, 1957) Reinhardt, 1966 (Plate 15, Figure 15)
- Arkhangelskiella cymbiformis Vershina, 1959
- Arkhangelskiella specillata Vershian, 1959
- Biscutum constans (Gorka, 1957) Black, 1959 (Plate 15, Figure 1) Braarudosphaera africana Stradner, 1961 (Plate 15, Figure 2)

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Braarudosphaera bigelowii (Gran and Braarud, 1935) Deflandre 1947
Braarudosphaera discula Bramlette and Riedel, 1954
Figure 4)
Broinsonia lata (Noel, 1969) Noel, 1970 (Plate 15, Figure 3)
Broinsonia parca (Stradner, 1963) Bukry, 1969 (Plate 14, Figure 10)
Chiastozygus cuneatus (Lyulyeva, 1967) Cepek and Hay, 1969
Chiastozygus litterarius (Gorka, 1957) Manivit, 1971
Corollithion achylosum (Stover, 1966) Thierstein, 1971
Corollithion signum Stradner, 1963 Crepidolithus thiersteinii Roth, 1973
Cretarhabdus conicus Bramlette and Martini, 1964
Cretarhabdus coronadventis Reinhardt, 1966 (Plate 14, Figure 8)
Cretarhabdus crenulatus Bramlette and Martini, 1964 emend. Thierstein, 1971 (Plate 16, Figure 2)
Cretarhabdus loriei Gartner, 1968
Cretarhabdus schizobrachiatus (Gartner, 1968) Bukry, 1969
Cretarhabdus surirellus (Deflandre, 1954) Reinhardt, 1970
1952 (Plate 14 Figure 1)
Cruciellipsis chiastia (Worsley, 1971) Thierstein, 1972 (Plate 14,
Figure 2)
Cylindralithus coronatus Bukry, 1969 Cylindralithus gallicus (Stradner, 1963) Bramlette and Martini
1964
Cylindralithus serratus Bramlette and Martini, 1964
Cyclagelosphaera margerellii Noel, 1965
Discorhabdus ignotus (Gorka, 1957) Perch-Nielsen, 1968
<i>Eiffellithus anceps</i> (Gorka, 1957) Reinhardt and Gorka, 1967 (Plate
Eiffellithus eximius (Stover, 1966) Perch-Nielsen, 1968
Eiffellithus trabeculatus (Gorka, 1957) Reinhardt and Gorka, 1967
Eiffellithus turriseiffeli (Deflandre, 1954) Reinhardt, 1965
Figure 11) Garmerago obliquum (Stradner, 1963) Reinnardt, 1970 (Plate 14,
Gartnerago striatum (Stradner, 1963) Forchheimer, 1972
Hayesites albiensis Manivit, 1971
<i>Kamptnerius magnificus</i> Deflandre, 1959 (Plate 14, Figure 12) <i>Lithastrinus grilli</i> Stradner, 1962 (Plate 16, Figure 1)
Lithastrinus floralis Stradner, 1962 (Plate 16, Figure 7, 9)
Lithraphidites carniolensis Deflandre, 1963
Lithraphidites quadratus Bramlette and Martini, 1964 (Plate 13,
Lucianorhabdus caveuxii Deflandre, 1959
Manivitella pemmatoidea (Deflandre, 1965) Thierstein, 1971
(Plate 14, Figure 7)
Markalius circumradiatus (Stover, 1966) Perch-Nielsen, 1968 Markalius inversus (Deflandre, 1954) Bramlette and Martini, 1964
Marthasterites furcatus (Deflandre, 1954) Deflandre, 1959
Micrantholithus hochschulzii (Reinhardt, 1966) Thierstein, 1971
Micrantholithus obtusus Stradner, 1963
Microrhabdulus accoratus Denandre, 1959 (Plate 15, Figure 1) Microrhabdulus stradneri Bramlette and Martini, 1964 (Plate 13,
Figure 2; Plate 14, Figure 9)
Micula mura (Martini, 1961) Bukry, 1973 (Plate 13, Figures 5, 11-13)
Micula pyramida (Gardet, 1955) Thierstein, 1974
Figures 7, 14)
Nannocomus truittii Broennimann, 1955 (Plate 16, Figures 3-6)
Maresch, 1968
Parhabdolithus asper (Stradner, 1963) Manivit, 1971 (Plate 14,
Parhabdolithus embergeri (Noel, 1958) Stradner, 1963 (Plate
16, Figure 10) Parhabdolithus splendens (Deflandra 1953) Noal 1960 (Plate 15
Figures 8, 16)
roaornabaus albianus Black, 1967

Podorhabdus decorus (Deflandre, 1954) Thierstein, 1972 Podorhabdus dietzmannii (Reinhardt, 1965) Reinhardt, 1967 Prediscosphaera cretacea (Arkhangelsky, 1912) Gartner, 1968 (Plate 15, Figures 5, 9) Prediscosphaera spinosa (Bramlette and Martini, 1964) Gartner, 1968 Reinhardtites anthoporus (Deflandre, 1959) Perch-Nielsen, 1968 Reinhardtites fenestratus (Worsley, 1971) Thierstein, 1972 (Plate 15, Figure 4) Rucinolithus hayi Stover, 1966 Rucinolithus irregularis Thierstein, 1972 Rucinolithus sp. aff. R. magnus Bukry, 1975 (Plate 16, Figures 11, 12) Stephanolithion laffittei Noel, 1970 Tegumentum stradneri Thierstein, 1972 (Plate 15, Figure 13) Tetralithus aculeus (Stradner, 1961) Gartner, 1968 Tetralithus gothicus Deflandre, 1959 (Plate 13, Figure 3) Tetralithus malticus Worsley, 1971 Tetralithus obscurus Deflandre, 1959 Tetralithus premurus Bukry, 1973 (Plate 13, Figures 4, 6) Tetralithus quadratus Stradner, 1961 Tetralithus trifidus (Stradner, 1961) Bukry, 1973 (Plate 15, Figures 10, 11) Tranolithus exiguus Stover, 1966 (Plate 14, Figure 5) Tranolithus gabalus Stover, 1966 Tranolithus orionatus Stover, 1966 (Plate 15, Figure 6) Vagalapilla matalosa (Stover, 1966) Thierstein, 1973 (Plate 15, Figure 7) Vagalapilla stradneri Thierstein, 1972 Watznaueria barnesae (Black, 1959) Perch-Nielsen, 1968 (Plate 16, Figure 8) Watznaueria biporta Bukry, 1969 Watznaueria britannica (Stradner, 1963) Reinhardt, 1964 Watznaueria oblonga Bukry, 1969 Watznaueria ovata Bukry, 1969 (Plate 15, Figure 12) Zygodiscus diplogrammus (Deflandre, 1954) Gartner, 1968 Zygodiscus elegans Gartner, 1968

Zygodiscus spiralis Bramlette and Martini, 1964

Author: Thierstein (1971), Roth (1973). Age: Upper Albian.

The upper limit of this zone was not detected in Leg 40. The Lithraphidites alatus and Corollithion exiguum zones, that should correspond to the Cenomanian and lower Turonian, were not recognized. Cenomanian and lower Turonian are therefore assumed to be absent at Sites 363 and 364. Another possibility would be the absence of Cenomanian and lower Turonian markers for ecological reasons.

Micula staurophora Zone

Definition: Interval from the first occurrence of Micula staurophora to the first occurrence of Marthasterites furcatus.

Author: Manivit (1971).

Age: Upper Turonian to lower Coniacian.

Marthasterites furcatus Zone

Definition: Interval from the first occurrence of Marthasterites furcatus to the first occurrence of Broinsonia parca.

Author: Cepek and Hay (1969), modified Perch-Nielsen (1977).

Age: Coniacian and Santonian.

This zone was recognized in Leg 40 at Sites 363 and 364, but a coring gap prevents establishing here the true ranges of M. furcatus and B. parca.

			ZONC	1	(a) - (4)	
STAGE	FIRST OCCURRENCE	11		361	363	364
	Micula mura		Micula mura		18/2 - 19cc	
MAASTRICHTIAN	Lithraphidites quadratus	_	Lithraphidites quadratus		20/1	
	Tetralithus trifidus		Arkhangelskiella cymbiformis		20/2 - 21/1	11/1 - 13/1
			Tetralithus trifidus		21/2 - 22cc	13/2 - 14cc
2	Tetralithus trifidus					
CAMPANIAN			Eiffellithus eximius		23/2 - 24cc	15/1 - 16cc
	Broinsonia parca	-				
SANTONIAN			Marthasterites furcatus		25	17/1 - 23/3
CONIACIAN	Marthasterites furcatus	-				
			Micula staurophora		1	23/4
	Micula staurophora	-	* 			
TURONIAN			Corollithion exiguum			
	Corollithion exiguum	-				
					8	
					- ×	
CENOMANIAN			Lithraphidites alatus			
	Lithraphidites alatus	-				
U		1	Eiffellithus turriseiffeli		26 - 34/3	24/2 - 33cc
ALBIAN	Eiffellithus turriseiffeli	-				
м			Prediscosphaera cretacea	26	34cc - 38/2	34/1 - 41/2
L	Prediscosphaera cretacea	-				
			P. L. L. M.	27/2 22/2	20.40	41/2 4200
			Farnabaotimus angustus	2113-32/2	39-40	-41/3 - 4200
_	Parhabdolithus angustus	-		-		
L	Chiastozyaw litterarius	-	Chiastozygus litterarius	32/6 - 49/3		
	amarox/gos minimiza					
	STAGE MAASTRICHTIAN CAMPANIAN SANTONIAN CONIACIAN TURONIAN CENOMANIAN U ALBIAN U ALBIAN U L U APTIAN L L	STAGE FIRST OCCURRENCE LAST OCCURRENCE MAASTRICHTIAN Micula mura Lithraphidites quadratus Tetralithus trifidus CAMPANIAN Tetralithus trifidus CAMPANIAN Broinsonia parca SANTONIAN Micula staurophora CONIACIAN Micula staurophora TURONIAN Corollithion exiguum CENOMANIAN Lithraphidites alotus U ALBIAN U Prediscosphaera cretacea U Prehabdoliithus angustus L Chiastozygus litterarius	STAGE FIRST OCCURRENCE MAASTRICHTIAN Micula mura MAASTRICHTIAN Lithraphidites quadratus CAMPANIAN Tetralithus trifidus CAMPANIAN Broinsonia parca SANTONIAN Micula staurophora CONIACIAN Micula staurophora TURONIAN Corollithion exiguum CENOMANIAN Lithraphidites alatus U Lithraphidites alatus U Prediscosphaera cretacea U APTIAN U Chiastozygus litterarius	STAGE L'RIST OCCURRENCE Micula mura Micula mura MAASTRICHTIAN Lithraphidites quadratus Tetralithus trifidus Arkhongelskiella cymbiformis Tetralithus trifidus Tetralithus trifidus CAMPANIAN Broinsonia parco SANTONIAN Broinsonia parco SANTONIAN Marthasterites furcatus CONIACIAN Marthasterites furcatus CENOMANIAN Lithraphidites alons CENOMANIAN Lithraphidites alons U Lithraphidites alons U Eiffellithus turiseiffeli ALBIAN Lithraphidites alons U Prediscophaera cretaceo L Prediscophaera cretaceo U Arthastorius iffeli L Chiatozygus litterarius	STAGE PRST OCCURRENCE Press 361 MAASTRICHTIAN Micula mura Micula mura Micula mura MAASTRICHTIAN Lithrophidites quadratus Lithrophidites quadratus Image: Comparison of the second secon	STAGE PIRST OCCURRENCE Image: Construction of the state of the sta

TARLE 3
TABLE 2
Crategoous Consolith Zonation Llead for Log 40 Sites 261 362 and 264
Cletaceous Coccondi Zonation Used for Leg 40 Sites 301, 303, and 304

Eiffellithus eximius Zone

Definition: Interval from the first occurrence of *Broinsonia parca* to the first occurrence of *Tetralithus trifidus.*

Author: Roth (1973), modified this paper.

Age: Campanian.

This stratigraphic interval was subdivided by Bukry (1973) and Roth (1973) in *Eiffellithus eximius* (= E. augustus of Bukry) Zone, from the first Broinsonia parca to the last Eiffellithus eximius, and Broinsonia parca Zone from the last Eiffellithus eximius to the first Tetralithus trifidus. At Sites 363 and 364 the last occurrence of Eiffellithus eximius is above the first occurrence of Tetralithus trifidus. Thus the zone defined by Bukry and Roth as Broinsonia parca Zone is not applicable.

Tetralithus trifidus Zone

Definition: Interval from the first to the last occurrence of *Tetralithus trifidus*.

Author: Bukry and Bramlette (1970).

Age: Upper Campanian to lower Maestrichtian.

Arkhangelskiella cymbiformis Zone

Definition: Interval from the last occurrence of *Tetralithus trifidus* to the first occurrence of *Lithraphidites quadratus*.

Author: Perch-Nielsen (1972), modified Martini (1976).

Age: Lower to middle Maestrichtian.

Lithraphidites quadratus Zone

Definition: Interval from the first occurrence of *Lithraphidites quadratus* to the first occurrence of *Nephrolithus frequens* in high latitudes or *Micula mura* in low latitudes.

Author: Cepek and Hay (1969). Age: Middle Maestrichtian.

Micula mura Zone

Definition: Interval from the first occurrence of *Micula mura* to the last occurrence of *Arkhangelskiella cymbiformis* and other Cretaceous species (Cretaceous extinction plane).

Author: Martini (1969).

Age: Upper Maestrichtian.

Tertiary-Quaternary

The subdivision of the Tertiary and Quaternary part of the stratigraphic sequences, the events on which they are based, and the age assignments of the cores sampled are reported in Tables 3A and 3B. The zonation used is very close to the standard zonation of Martini (1971). Where they seemed more reliable, some zones or subzones were replaced by those of Bukry (1973, 1975). Some minor changes in respect to Martini's zonation are also determined by the application of a different species nomenclature.

The correlations between Martini's standard zonation, the Bukry zones and subzones, and the zonation used in this report are shown in Tables 4A and 4B. In similar zonal correlations of the literature, the zones are often compared without consideration of their definitions which results in incorrect correlations. For instance, the Oligocene *Sphenolithus prdistentus*, *S. distentus*, and *S. ciperoensis* zones of Bukry have different definitions compared with the zones of the same names of Martini, and do not represent the same stratigraphic intervals.

Reference is made to Tables 3A and 3B for zonal sequences and boundaries used in this report. Some remarks on the major differences in comparison with the Martini and Bukry zonations are made in the following.

Lower Paleocene was recovered in Leg 40 at Sites 361, 363, and 364, but in none of them could the fine biostratigraphic subdivision of Martini be applied. It had to be replaced by a *Cruciplacolithus tenuis* Zone extending from the Cretaceous extinction plane to the first occurrence of *Fasciculithus tympaniformis*.

The use of the *Discoaster nobilis* Zone of Bukry instead of the *Heliolithus riedelii* Zone of Martini was preferred because the appearance of *H. riedelii* occurs in Site 363 before the first discoasters in the *Heliolithus kleinpellii* Zone. *H. riedelii* is very common in the *Discoaster nobilis* Zone at Site 363.

The lower Eocene nannofloras are characterized by the sudden appearance and rapid evolution of the "Tribrachiatus" group of which Rhomboaster cuspis Bramlette and Sullivan (= Marthasterites bramlettei Brönnimann and Stradner, 1960) represents the first stage. The Tribrachiatus contortus Zone as used here is thus the same as the Marthasterites contortus Zone of Martini. Bukry uses for the lower boundary of this zone the first occurrence of Discoaster diastypus. At Sites 361 and 363 Rhomboaster cuspis and Discoaster diastypus occur first at the same level. Instead at Site 364, and in some land sections such as the Lodo Formation (Bramlette and Sullivan, 1961), and the Pederobba and Possagno sections (Proto Decima, 1966; Proto Decima et al., 1975), the first Discoaster diastypus occur slightly above the Rhomboaster cuspis appearance.

Bukry's zonation was employed for the subdivision of the middle Eocene. The Nannotetrina fulgens Zone as used in this report is the same as the Nannotetrina quadrata Zone of Bukry and much more extended than the Chiphragmalithus alatus Zone of Martini. The absence of Rhabdosphaera gladius in the investigated sections prevents recognition of the Discoaster tanii nodifer Zone of Martini. The first appearance of Reticulofenestra umbilica is here considered more reliable than the last occurrence of Chiasmolithus solitus. The range of this latter species overlaps at Site 360 with Chiasmolithus oamaruensis.

For the upper Eocene, Oligocene, and Miocene the zonation used corresponds to the standard zonation of Martini. The Sphenolithus predistentus Zone as defined by Bukry (1973) is not present at Sites 362A and 363 and also not in some land sections, where the ranges of *Reticulofenestra umbilica* and Sphenolithus distentus are overlapping. In the upper Miocene the first occurrence of Amaurolithus primus and A. delicatus was considered as in Bukry's zonation to subdivide the Discoaster quinqueramus Zone.

For the Pliocene and Pleistocene the zonation used is a compromise between the zonations of Martini and Bukry. The *Emiliania ovata* Zone corresponds to the

	AGE		BIOHORIZONS		ONE			CITE		
M.Y.	EPOCH		FIRST		ONE	1 102220 11		300	0/0	244
-		-	DASI	Emiliania huxleyi,	/	360	361	362 362A	363	1/1 = 1/6
	PLEISTOCEN	E	Emiliania ovata 🦰	Gephyrocapsa acé	anica			2 - 5/4		1/1-1/0
		_	Discoaster brouweri	Emiliania ovata				5/6 - 10/3		lee
		υ	2	Discoaster brouwer	ri			10/6 - 11/2		2/2 - 2cc
		\vdash	Reticulofenestra pseudoumbilica	Reticulofenestra pr	reudoumbilica			11/3 - 13/6		3/1 - 3/2
	PLIOCENE		A. delicatus, A. tricorniculatus	Corntolithus sugge				11/0 10/0		3/3 - 3/6
		-	Ceratolithus rugosus		Caratalithur acutur	1/1 . 2/6		1300 - 14/6		3/3 - 3/0
5		-	Ceratolithus acutus	tricorniculatus	Triquetrorhabdulus	2cc - 3/3		14cc - 19/2		500
			Discoaster quinqueramus		Amaurolithus	3/4 - 10/3		19/3 - 24/3		
			Amourolithus primus		primus	3/4 - 10/3	1.01.041	11/0-240		
		U		Discoaster qu'inqueramus	Discoaster berggrenii	10cc - 12cc		24/4 - 26/3		4/2 - 4/4
10			Discouter berggrenii	Discoaster calcari	5	13/1 - 14/2		26/4 - 29/4		4/5
			Discouster hamatus	Discoaster hamatu		14/4 - 15cc		29/5 - 31/3	1/1 top - 1/1 (11 - 12)	4/6 - 4cc
			Discoaster hamatus 🖬 Catinaster coalitus	Catinaster coalitu	5	16/2 - 17cc		31/4 - 32/1		
	1012/22002		Discoutes husbari	Discoaster kugleri		18/2 - 20/4		32/2 - 33/5		
	MIOCENE	M		Discoaster exilis		20cc - 21/3		33/6 - 34	$\frac{1/2}{1/4} (9 - 10) - \frac{1}{4} (9 - 10)$	
15				Sphenolithus heter	omorphus			35 - 36/2		
			neiicosphaeta ampliaperta	Helicosphaera amp	oliaperta	1		36/3 - 37		5/3 - 5cc
			Sphenolithus belemnos Sphenolithus heteromorphus Sphenolithus heteromorphus Triquetrorhabdulus carinatus M	Sphenolithus beler	nnos	21/5 - 24cc		38		
- 20				Discoaster druggii				39 - 40	1/4 (101 - 103) - 1cc	۰
		\square	Discooster druggii 🛛 🛏	Triquetrorhabdulus	carinatus	25/1 - 28/2		41 - 43		
- 25			Sphenolithus ciperoensis Helicosphaera recta	Sphenolithus ciper	oensis	28/3 - 29		44	2/2 - 3/2	
		U	Sphenolithus distentus 🦰	-						
-30	OLIGOCENE	M		Sphenolithus diste	ntus	30/2 - 32/3		2 A - 3 A	3/5 - 5/2	
			Sphenolithus ciperoensis 🛏	Sphenolithus predi	stentus			4A - 5A/2	5/5 - 6/4	

 TABLE 3A

 Pleistocene-Middle Oligocene Coccolith Zonation Used for Leg 40 Sites 360, 361, 362, 362A, 363, and 364

NP 14 Pseudoemiliania lacunosa Zone of Martini. The name of the zone was changed because of the taxonomic revision by Bukry (1975). Because of the difficulty of recognizing Emiliania huxleyi in the light microscope, the Gephyrocapsa oceanica and Emiliania huxleyi zones were combined.

SITE 360 Cape Basin (lat 35°50.75'S, long 18°05.79'E, water depth 2949 m)

Abundant nannofossil assemblages ranging in age from the lower Pliocene Ceratolithus acutus Subzone to

	AGE		BIOHORIZONS		701/5				1.1	
M.Y.	EPOCH		FIRST	#	ZONE	240	241	3110	. 242	244
			e 1 111 1 1	1	Sphenolithus distentus		301	2A - 3A	3/5 - 5/2	304
		M	Sphenolimus ciperoensis	-	Sphenolithus predistentus	30/2 - 32/3		4A - 5A/2	5/5 - 6/4	
- 35	OLIGOCENE		Reticulatenestra umbilica Cyclococcolithus formosus	-+	Helicosphaera reticulata	32/4 - 32cc		5A/3 - 5Acc	6cc - 8/2	
			Discoaster saipanensis Discoaster barbadiensis	-	Ericsonia subdisticha	33 - 35/3		6A/1 - 6A/4	8cc - 9/2	
40		U			Sphenolithus pseudoradians	35cc - 37/2	1/1 - 2/2	64/5 - 8A	9/3	
			sphenolimus pseudorodians	-	Isthmolithus recurvus	37/3 - 39/2	1		9/4 - 10/2	
	1		Isthmolithus recurvus	-	Chiasmolithus aamaruensis	39/2 - 40cc	2cc		10/3	
					Reticulofenestra umbilica	41 - 47cc		9A - 10A/1	10/4 - 10cc	
	EOCENE	м	Keticulotenestra umbilica	4	Nannotetrina fulgens	48 - 50cç	4cc - 5cc	10A/2 - 11A	n	7cc
			Nannotetrina fulgens	÷	Discoaster sublodoensis	-	6/1 -	12A	12	8/1 - 8/3
			Discoaster sublodoensis	-	Discoaster ladaensis		8/0 top		13/1	8/4
50		L	Discoaster Indoensis	1	Tribrachiatus orthostylus		_		13/2 - 13cc	8/5 - 8cc
					Discoaster binodosus		8/0 (9 - 10)		14/1 - 14/2	
			Tribrachiatus contartus Rhombaaster cuspis	-	Tribrachiatus contortus		8/2 - 8cc		14/3 - 14cc	9/1 - 9cc
55		U	Discoaster multiradiatus		Discoaster multiradiatus		9/2		15/1 - 15/3	
10					Discoaster nobilis		9/3		15cc	
			Discouster nobilis	-	Discoaster mohleri					
			Discoaster mohleri	-	Heliolithus kleinpellii	-				10/1
	PALEOCENE		Heliolithus kleinpellii	-	Fasciculithus tympaniformis				16/1 - 17cc	10/2 - 10/5
60		L	Fasciculithus tymponiformis	4	Cruciplacolithus tenuis		10/2		18/1 - 18/2 (39 - 40)	10/6 - 10cc
65	CRETACEOUS		Cretaceous extinction plane	-	Minute and	_		-	18/2(42-44)-19	

 TABLE 3B

 Middle Oligocene-Paleocene Coccolith Zonation Used for Leg 40 Sites 360, 361, 362, 362A, 363, and 364

the middle Eocene Nannotetrina fulgens Zone were encountered at this site. The stratigraphic distribution of the calcareous nannofossils and some additional information on the abundance and preservation of the assemblages are shown in Tables 5A, 5B, and 5C. Discoasters are rare in the lower Pliocene and lower Oligocene, frequent in the remainder of the section, and particularly well preserved in the Miocene; the rosette *Discoaster barbadiensis*, however, is generally scarce in the upper Eocene. *Chiasmolithus oamaruensis* and

TABLE 4A Correlation of the Pleistocene-Middle Oligocene Coccolith Zonation Used in This Report with the Standard Nannoplankton Zonation of Martini (1971) and the Nannoplankton Zones and Subzones of Bukry (1973, 1975)

M.Y.	AGE EPOCH		ZONATION US	ed in Leg 40	STAND. ZONA	ARD NANNOPLANKTON TION OF MARTINI (1971)	NANNOPLANKTON OF BURK	ZONES AND SUBZONES (Y (1973, 1975)
		_	Emilionia huvlevi /		NN21	E. huxlevi	E. huxlevi	
	PLEISTOCEN	E	Gephyrocapsa ocea	nica	NN20	G. oceanica	G. oceanica	C. cristatus E. ovata
			Emiliania ovata		NN19	P. lacunosa	C. doronicoides	G. carribeanica
			Diana la ci		NN18 NN17	D. brouweri	D brouweri	C. macintyrei D. pentaradiatus
		0	Discoaster brouweri	1 1.00	NN16	D. surculus		D. surculus
	PLIOCENE		Keficulotenestra pse	udoumbilica	NN15	R. pseudoumbilica	R. pseudoumbilica	D. asymmetricus S. neoabies
-		L	Ceratolithus rugosus	1	NN13	C. rugosus		C. rugosus
	× -		Amourolithus	C. acutus	-		C. tricorniculatus	C. acutus
5			tricorniculatus	T. rugosus	NN12	C. tricorniculatus		T. rugosus
-				Amaurolithus				C. primus
-		U	Discoaster quinqueramus	Discoaster berggrenii	NNII	D. quinqueramus	D. quinqueramus	D. berggrenii
- 10								D. neorectus
10			Discoaster calcaris		NN10	D. calcaris	D, neohamatus	D. bellus
-								C coluculus
			Discoaster hamatus		NN 9	D. hamatus	D. hamatus	C. colycolog
			Catingstar coality		NIN 8	C coolibu	C coolitur	H. kamptneri
-							C. codrifus	D. kualari
	MIOCENE	M	Discoaster kugteri		NN 7	D, kugleri	D. exilis	D. Rogieri
	into certe		Discoaster exilis		NN 6	D. exilis		C. miopelagicus
- 15			Sphenolithus heteror	norphus	NN 5	S. heteromorphus	S. heteromorphus	
-			Helicosphaera ampli	aperta	NN 4	H. ampliaperta	H. ampliaperta	
			Sphenolithus belemn	05	NN 3	S. belemnos		
- 20		L	Discoaster druggii	(e NN 2	D. druggii	S. belemnos	1
								D. druggii
-			Triquetrorhabdulus c	arinatus	NN 1	I. carinatus	T. carinatus	D. deflandrei
					110000000			C. abisectus
- 25		υ	Sphenolithus ciperoe	nsis	NP25	S. ciperoensis		D. bisectus
- - 	OLIGOCENE	M	Sphenolithus distente	95	NP24	S. distentus	S. ciperoensis	C. floridanus
-			Sphenolithus prediste	entus	NP23	S. predistentus	S. distentus S. predistentus	

 TABLE 4B

 Correlation of the Middle Oligocene-Paleocene Coccolith Zonation Used in This Report with the Standard Nannoplankton Zonation of Martini (1971) and the Nannoplankton Zones and Subzones of Bukry (1973, 1975)

	AGE		ZONATION USED IN LEG 40	STANE	DARD NANNOPLANKTON		N ZONES AND SUBZONES
M.Y.	EPOCH		LONAHON USED IN LO IN	ZONA	(TON OF MARTINI (1971)		
-			Sphenolithus distentus	NP24	S. distentus	S. ciperoensis	C. floridanus
-		м	Sphenolithus predistentus	NP23	S. predistentus	S. distentus	
-		-		-			
- 35	OLIGOCENE		Helicosphaera reticulata	NP22	H. reticulata		R. hillae
-			Ericsonia subdisticha	NP21	E, subdisticha	H, reticulata	C. formosus
-							C, subdistichus
- 40		U	Sphenolithus pseudoradians	NP20	S, pseudoradians	D. barbadiensis	I, recurvus
			Isthmolithus recurvus	NP19	I, recurvus		
-			Chiasmolithus oamaruensis	NP18	C. camaruensis		C. oamaruensis
-			Reticulofenestra umbilica	NP17	D. saipanensis	R. umbilica	D. saipanensis
							D. bifax
43	EOCENE	м	Newstorf	NP16	D, tani nodifer		C. staurion
			Nannoferrina fulgens	NP15	C. alatus	N, quadrata	C. gigas
					5 U.1 1		R, inflata
-			Discoaster Jodoensis	NP14	D. sublodgens is	D, sublodoensis	D. kuepperi
- 50				14113	D, IOUDERAIS	D, lodoensis	
-		L	Tribrachiatus orthostylus	NP12	M. tribrachiatus	T. orthostylus	1
			Discoaster binodosus	NP11	D, binodosus	D. diastypus	D, binodosus
-			Tribrachiatus contortus	NP10	M. contortus		T, contortus
1		U	Discoaster multiradiatus	NP 9	D. multiradiatus	D. multiradiatus	C. eodela C. bidens
- 55			Discoaster nobilis	NP 8	H. riedelii	D. nobilis	
			Discoaster mohleri	NP 7	D, gemmeus	D. mohleri	
		M	Heliolithus kleinpellii	NP 6	H. kleinpellii	H. kleinpellii	
	PALEOCENE		Fasciculithus tympaniformis	NP 5	F. tympaniformis	F. tympaniformis	
- 60				NP 4	E. macellus		1
		L	Cruciplacolithus tenuis	NP 3	C. danicus	C, renuis	
				NP 2	C, tenuis		
				NP 1	M. inversus		
- 65	CRETACEOUS			1			

	LEG	40 360				lificus	cotus	5	erniculatus 		5	ogicus	leptoporut	efficus 		-		Peri				oria	Pin Pin	inter in the second sec		diatus	voriobilis	eromus		là	teri	eudoumbilice	ocera	steinii	bulota	ermeato Ichaetimo		100001							
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Amourolithus amp	Amouvolithus deli	Amourolithus prim	Catinoster calucu	Catinaster coality	Ceratalithus acut	Coccolithus sopel	Cyclococcolithus	Discoalter asymmetry	Disconter bollii	Discoater brouwer	Discouster calcori	Discoaster challer	Discouter decoru	Discourter exilis	Discouler homolu	Dicoater intercal	Disconster loahlic	Disconter neohor	Disconter neored	Disconter pentoro	Discouter preudo	Discoalter quinqu	Discouter surculu	Discouter voriabi	Helicosphaera car	Reticulatenestra ps	Rhabdosphaera pro	Scyphosphoera op	Scyphosphoera glo	Scurbonhoerd m	Schenolithue obje	Triquetrorhobdulus			ze	ONE			AGE
79,5- 89 89 - 98,5	1	2 5 CC 2	9-10 9-10 9-10 9-10	A A A A A	MAGM			Γ			1							I I		-							1			1				T					tricorniculatus		Ceratalithus	acutus		L	PLIOCENE
98,5-108	3	6 CC 1 3	9-10 35-36 9-10	AAAA	MGMM			I 			1									-												ł	1	ł					Amourolithus	,	ír iquetrarhab	dulus rugo	eve		
108 -117,5	4	4 6 CC 2 4	9-10 9-10 9-10 54-55	A A C C	M M M M		ł	I						Ľ			I									1						I		I											
117,5-127	5	2 4 6 CC	9-10 9-10 9-10	A A A A	GMMMG			F											_		-				1	1	-				I	I				1									
127 -136,5	7	2 4 6 CC 4	9-10 9-10 9-10 9-10	A A A A	MMGM	1											1		-	_				-		1						I	-	1	1		1		En un	,	umaurolithus	primus			
146 -155,5	8	5 6 CC 1	9-10 9-10 30-31	A A A	MMM	1										ł	ł										1				1		1						ooster quinquero						
155,5-165	9	3 CC 2 4 6	9-10 9-10 9-10 9-10	A A A C	M M M M	1											I									1	1					I I							Disc					U	MIOCENE
165 -174,5	10	1 3 CC	9-10 9-10	A C A	M M M	_	ł	I										ł									1					ł						ł							
174,5-184 184 -193,5	11	3 6 CC 1	9-10 9-10 56-57	C A A	M M M M		-										ł					I					1													D	îscoaster be	rggreņii			
193, 5-203	13	5 CC 1 3	9-10 9-10 31-32 9-10	AACC	M M M M		-	-									I		I	-	-							ł	1		I	I													
203 -212,5	14	6 CC 2 4	9-10 9-10 9-10	A A A A	MMM									-						I	I														-					D	iscoaster ca	lcaris			
212,5-222	15	5 CC 2 CC	9-10 9-10	AAAA	M M M M		-	-	1	-				-	1					I	I										1	I			-					D	iscoaster ha	matus			

 TABLE 5A

 Distribution of Pliocene-Upper Miocene Calcareous Nannofossils at Site 360

Isthmolithus recurvus are very abundant in Cores 34, 35, and 36 of upper Eocene and lower Oligocene age; Neococcolithes dubius is very frequent in the middle Eocene part of the sequence. The abundance here of these forms, which are extremely rare or absent in tropical waters, and the general scarcity of the genus Sphenolithus and Discoaster barbadiensis, furnish indications of temperate water conditions. The range of Chiasmolithus oamaruensis in this sequence differs from that of the Mediterranean regions and is the same as known for New Zealand. Characteristic is the total absence of near shore indicators such as Braarudosphaera, Micrantholithus, Pemma. In the middle/lower Oligocene the abundance of the holococcolith Zygrhablithus bijugatus seems to suggest a basin less than 1000 meters deep.

In the Oligocene the absence of Sphenolithus ciperoensis prevents separating the Sphenolithus distentus and Sphenolithus predistentus zones. A detailed zonation was not possible for the lower Miocene. Sphenolithus belemnos and S. heteromorphus have their last occurrence at the same level (Core 21, Section 6); the Helicosphaera ampliaperta and Sphenolithus heteromorphus zones cannot be recognized therefore and are probably missing. A sedimentary gap between the lower and middle Miocene is therefore possible.

The Miocene-Pliocene boundary by means of paleomagnetic correlations is dated at 5.2 m.y. (Ryan, Cita, et al., 1974), the first *Ceratolithus acutus* at 4.9 m.y. Thus the Miocene-Pliocene boundary at this site, according to nannoplankton is placed in Core 3. The

	LEG	40			T		SUB	4	ruensis	-	gicu	ourion	sidonus	noii	chus	posoe	nais		.5			arus ati	dietus	lifer	min	pperi	acta				to .	olus	enura	loe monteste	bilition -		rmia				5			
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Chicamolithus altur	Chicamolithus expo	Chicamolithua groun	Chicamolithus como	Chicsmolithus solity	Coccolithus eopelo	Cruciplocolithus at	Cyclicargolithus n	Cyclicoccolithus ki	Dicryococcites bise	Dictrococcites scri	Disconter barbodie	Disconter binodosu	Disconter deflandr	Discoaster distinctu	Discoatler mirus	Disconter nongrad	Discouter teptemro	Discoaster tani noc	Discoatter wemmels	Discoasteroides kue	Helicosphaera cam	Helicosphaera recio	lathmolithus recurvi	Markalius inversus	Nannotetrina crista	Neococcolithes du	Reticulofenestra co	Reticulatenestra hi	Reticulationeresta de	Phylochecking and and	Sobenolithus morito	Sub-andithe mande	Schenolithus adian	Toweius eminera	Transvenapontis la	ZONE		AGE
545 -554,5 564 -573,5	34	2 4 6 CC 1	9-10 9-10 9-10 59-60	A A A A A	M M G M													I	I																						ł	Ericsonia subdisticha	L	DLI GOCENE
172 5 102	-	2 3 3 CC	9-10 9-10 32-33	A A A	M M M		-				ł	-						T	I	-		1								-												-		
592,5-602	30	4 CC 2 CC	9-10 9-10 9-10	A A A A	MGM				I					1			I		T	1										1		-	+	+				1				Sphenolithus pseudoradio	• - U	
611,5-621 630,5-640	38 39	1 CC 2 3	37-33 9-10 9-10	A A A	MM									I	1			I		-									I	1		I					1			-		Isthmolithus recurvus		
649,5-659	40	2 2 CC	12-13	A C A C	MD		r	1	ł	T					1		1	1	-											T	-	1										Chiasmolithus aamaruens	-	
678 ~687,5	42	2 CC 2 4	9-10 9-10 9-10	C A A A	M M M												I	1		1											Ι	I	-	1			1							
697 -706,5	43	CC 1 2 CC	89-90 9-10	A F F A	M P P		+											1	I			-					1						-		-							-		EOCENE
735 -744,5	44	2 CC 1	9-10 9-10 29-30	A A A	G M M														•	I				l						t L	-	1		1								Reticulafenestra umbilica		
754 ~763,5	46	2 5 CC 1	9-10 9-10 9-10	A A A	M P M			ł				-				F		1	I	ł		1					ł	-		I I	-	1	1	1			1							
773 -782,5	47	2 4 CC 1	9-10 9-10 100-101	A A A	M M M													T					I		I		T			ł	1				1		1							
792 -801,5	48	2 CC 2 5	9-10 9-10 9-10	A A A	M M M													T						1			1			Ι		I		+						I				
811 -820,5	49	2 2 3 CC	9-10 9-10	A A A	M P M P													I	I	I I				I	ł	1				I												Nannotetrina fulgera		
830 -839,5	50	1 CC	9-10	A A	P	1	ľ			Ì	t	I	1			ŧ	1		Ì	I	1	Щ	H	I	1	I					t		1	1		t	-				F	1		

TABLE 5B Distribution of Middle Miocene-Lower Oligocene Calcareous Nannofossils at Site 360

Oligocene-Miocene boundary falls between the last occurrence of *Helicosphaera recta* in Core 28, Section 3 and the first occurrence of *Discoaster druggii* in Sample 24, CC. The Eocene-Oligocene boundary, marked by the last occurrence of *Discoaster saipanensis* is placed in Core 35 between Section 3 and the core catcher. Frequent *Nannotetrina cristata* and *Chiasmolithus gigas*, suggesting a middle Eocene age, characterize the assemblages at the bottom of the site. Typical *Nannotetrina fulgens* are not present at this site.

SITE 361 Cape Basin (lat 35°03.97'S, long 15°26.91'E, water depth 4549 m)

Nannofossil assemblages of upper Eocene to lower Paleocene and middle Albian to lower Aptian age occur at this site. The stratigraphic distribution of the nannofossils and information on abundance and preservation of the assemblages are shown on Tables 6 and 7.

Poorly preserved upper Eocene nannofossils are present in Cores 1 and 2. The absence of *Sphenolithus pseudoradians* does not allow us to distinguish between the *Isthmolithus recurvus* and *Sphenolithus pseudoradians* zones.

Cores 3 and 4 are barren. Sample 4, CC to Core 7 contain moderately preserved middle Eocene assemblages. In Sample 4, CC and Core 5 the presence of *Rhabdosphaera inflata* above the first *Nannotetrina fulgens* and *Chiasmolithus gigas* and the abundance of *Discoaster sublodoensis* suggest mixed assemblages between the *Nannotetrina fulgens* and *Discoaster sublodoensis* zones. The middle-lower Eocene *Discoaster sublodoensis* Zone is present in Core 7. The

	LI SI	EG TE 3	40 60					5	noruensis		ogicue		flucture.	formount	leptoporus	Hechan	rippeoe	nteus	-	ngeri	Śrei	2			difer	teri	month	denot in	emedia	ta a			villae	and a state of	A TILLE	and a second			unha unha		fumb.	stantu	doredione	corinatus	inversus	Ingent	ugetus									
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Catinater calycu	Catingster coolin	Chiaemolithus of	Chloamolithus oo	Chicamolithus sol	Coccelithu appe	Coronocyclus nite	Cultomodithe	Cyclococcolithus	Cyclococcolithus	Dictyococcite bi	Dictyococcites so	Discouter adama	Disconster brouws	Discouter challe	Discoaler deflan	Disconter distinc	Disconter avilia	Disconter kunler	Disconter toni re	Helicosphere co	Helicomboern co	Halicontohonen au	Helicombane in	Helicospore re	Isthmolishus recu	Morkolius inverse	Reticulatenetra		Reficultionering	Phylocological and a	Schendlicher hele	Cohenelister and	Soherolithue dish	Solution inter here	Cabandistin man	Solvenolithus credi	Sphenolithus paer	Triquetrorhobdulue	Triquetrorhobdulu	Triquettorhobdulu	Zygheeblithus bil				zor	NE			- 12-	AGE
222 -231,5	16	2 4 CC	9-10 9-10 89-90		M M M												+				-																									I		G	tinas	ter	coal	itus				
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260 -269,5	20	4	9-10 9-10 9-10		MMM	-													-	l		-	-				E																	I				Di	1001	ter	kugi	leri		ļ	4	
296 -307,5	21	1 3 6 CC	9-10 9-10 9-10	AAAA	MMM	-	+												-		T	-	-				E						-			+		¢		1								Di	coal	ler	exil	ia		-		MOCENE
317 -326,5 336 -345,5	23	2 6 CC 2 2 4	9-10 9-10 9-10 9-10	AACA	M M M													ł	-			-																									I	Spi	henol Icoas	lithu ter	a be drug	lemr gi	os /			
355 -364,5 374 -383,5	24	CC 2 CC 5 1	9-10 15-17	AAC	M M M					-																		1							+	+																		-	•	
393 -402,5	20	2 2 2 2 CC	7-8	A A A	M M M	-									1	I	I					-																						I				Tei	quetr	orhe	abdul	lus c	erinetu			
431 -440,5	28	4	9-10 79-80	AAAA	M M M	-		F		F							ł	t T				+																									ł									
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469 -478,5	30	CC 2 3 CC	9-10 7-9	AAAA	M M M P		-			I																									-								1		I		I		-							OLIGOCENE
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507 -516,5	32	2 4 CC	9-10	A	M	+	-		F	+		r			ŧ			_	-	+	ł	ł	ŧ	ŧ		t	h	+	t	þ	1	+	+	+	þ	q	Ħ	ŧ	+	+	1		F	F		-	-	He	licos	phoe	-	eticu	lata	T		
526 -535,5	33	4 5 CC	9-10 9-10 9-10	A A A A	M M M P								¢									I																										Fi	caoni		bdis	tiche			•	

TABLE 5C Distribution of Lower Oligocene-Middle Eocene Calcareous Nannofossils at Site 360

interval top of Core 8 to Core 9, Section 2 represents a complete but strongly condensed sequence of lower Eocene to upper Paleocene nannoplankton zones. A problematic oval-shaped nannofossil (Plate 2, Figures 9-12) is frequent in the Discoaster binodosus Zone and, from present observations, seems to be limited to it. It was also found at Site 362 in a Pleistocene-Pliocene. sample containing a reworked nannoflora of the Discoaster binodosus Zone. A very interesting evolution of the Tribrachiatus group is recorded in Core 8. A barren interval in the lower part of Core 9 separates the upper Paleocene from the lower Paleocene Cruciplacolithus tenuis Zone, present in Core 10, Section 2. Contamination from above and barren samples characterize the lower part of Core 10 and Core 11. Cores 12 to 25, which are not included in Table 7, contain very rare, small Watznaueria that only allow for a general Cretaceous dating. The Prediscosphaera cretacea, Parhabdolithus angustus, and Chiastozygus

litterarius zones of middle Albian to lower Aptian age have been recognized in the poor nannoflora associations from Core 26 to the bottom of the hole. The concurrence of *Chiastozygus litterarius* and *Micrantholithus hoschulzii* from Core 33 down is indicative of the lower Aptian *Chiastozygus litterarius* Zone.

From a paleoecological point of view, the abundance of *Isthmolithus recurvus* in the upper Eocene and *Neococcolithes dubius* in the middle and lower Eocene and in the upper Paleocene indicates temperate to cold water conditions for the Tertiary part of the section. The presence of barren intervals, heavily etched coccoliths, concentration of solution-resistant species, and the strong condensation of the lower Eocene sequence suggest deposition near the base of the carbonate compensation depth or a slow burying of organic remains. As far as the Cretaceous paleoecology of Site 361 is concerned, some conclusions can be drawn from the presence of *Micrantholithus hoschulzii*

	LE G SI TE	40 36	1				ifornicus	suetus	icus	ansus	05	ndis	naruensis	tus	calathus	agicus	taurion	tenuis	floridanus	formosus	kingii	usta	sectus	rippsae	iensis	sus	SO S	NS SU	tus		tus	Iaris	sis			diatus		diatus	ensis	rgensis	radiatus	oensis		odifer	Jepperi
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Blackites spinulus	Chiasmolithus cal	Chiasmolithus cor	Chiasmolithus dar	Chiasmolithus exp	Chiasmolithus gig	Chiasmolithus gra	Chiasmolithus oan	Chiasmolithus soli	Chiphragmalithus	Coccolithus eopel	Cruciplacolithus 3	Cruci placolithus	Cyclicargolithus 1	Cyclococcolithus	Cyclococcolithus	Cyclolithella robu	Dictyococcites bi	Dictyococcites sc	Discoaster barbad	Discoaster binodo	Discoaster delicat	Discoaster diastyp	Discoaster distinc	Discoaster elegan	Discoaster incomp	Discoaster lenticu	Discoaster lodoen	Discoaster mirus	Discoaster mohler	Discoaster multire	Discoaster nobilis	Discoaster nonara	Discoaster saipan	Discoaster salisbu	Discoaster septem	Discoaster sublode	Discoaster tanii	Discoaster tanii r	Discoasteroides ku
31,5- 41	1	1	9-10 9-10	A	P					_		_				I				I	-				I	1													ł			_			
60 - 69,5	2	2 CC	9-10	A	P								I	I		1		-	T			-		ł	I				Т		1		-				-		1	F			T	-	-
98 -107,5	3	1 CC	9-10																						-																				-
136 -145,5	4	1 CC	46-47	A	м							T		T	1	I			I	I					I				1 03	T			I					T	I		T	T			
174 -183,5	5	1 4 5	9-10 9-10 9-10	C A C	P M M					T		$\left \right $								I					I				ł	T		-	1		-			I T	T						
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202,5-212	6	1 2 3	108-109 9-10 9-10	AAA	M M M	T						ł		ł	T										ł					ł			1	T				1	ļ						1
231 -240,5	7		69-70	A A	M		_	1	_	I	_	ł										_					_		Ŧ	ł		_	ł	I			-	ł	_		1		3	_	_
250 -259,5	8	0	lop 9-10	A	M					I		1		I		1											1					-	ļ		•							-			_
	F	1 2 5	47-48 60-61 91-92	A A A	M		_	1			-	1					-		-			-				T	I					Γ					-								_
	E	6 CC	8-10	A A	P M							_		I												1	I	I				1			Ι		1			I					
259,5-269	9	2	top 9-10 12-13	A A A	P P P		I					_		_		-	-	-									ł		_			I			Ŧ	ł	L T		_						_
	E	4	9-10 9-10														F																												
269 -278,5	10	CC 2	9-10	A	м				I									T																											
		3 4 4	9-10 top 9-10	R	м		_				-						-									-						-				I		_		I		_			=
		5	9-10 9-10																																										-
278, 5-288	11	1 2	52-54 9-10	C	P												-																			1									-
		3	9-10 9-10															E																											
	F	5 6 CC	9-10 9-10	F	M											-						_					1									1	T								

 TABLE 6

 Distribution of Eocene-Paleocene Calcareous Nannofossils at Site 361

which is considered a temperate species. Unusual associations with floods of *Cyclagelosphaera margerelii* were found in Samples 33-3, 46 cm and in 37-1, 101 cm. According to Thierstein (1973) this species favored shallow water and platform conditions or a reducing marine environment. All the coccoliths present are solution-resistant species. This fact associated with the occurrence of many barren samples and the dark color (carbonaceous nature) of the sediments indicates

bottom conditions unfavorable for coccolith preservation.

HOLES 362 AND 362A Walvis Ridge (lat 19°45.45'S, long 10°31.95'E, water depth 1325 m)

Sites 362 and 362A, on the Abutment Plateau of the Walvis Ridge, together provide a stratigraphic sequence ranging from Pleistocene to lower Eocene. A

CALCAREOUS NANNOFOSSILS: SOUTHEASTERN ATLANTIC

TABLE 6 - Continued

Discoasteroides megastypus	Ellipsolithus distichus	Ericsonia cava	Fasciculithus involutus	Fasciculithus tympaniformis	Helicosphaera seminulum	Heliolithus riedelii	Isthmolithus recurvus	Markalius inversus	Nannotetrina cristata	Nannotetrina fulgens	Neochiastozygus chiastus	Neochiastozygus distentus	Neococcolithes dubius	Neococcolithes protenus	Peritrachelina joidesa	Pontosphaera multipora	Pontosphaera pectinata	Pontosphaera plana	Reticulafenestra coenura	Reticulofenestra hillae	Reticulofenestra oamaruensis	Reticulafenestra umbilica	Rhabdosphaera inflata	Rhabdosphaera tenuis	Rhomboaster cuspis	Sphenolithus moriformis	Sphenolithus radians	Thoracosphaera spp.	Toweius craticulus	Toweius eminens	Transversopontis obliquipons	Transversopontis pulcher	Tribrachiatus contortus	Tribrachiatus orthostylus	Zygodiscus sigmoides	Zygrhablithus bijugatus	ZONE		AGE
							ł	1											1	1		I															Sphenalithus pseudoradians/ Isthmolithus recurvus	U	
								I		1						I	I						I	I							1			1			Chiasmolithus oamaruensis Nannotetrina fulgens/ Discoaster sublodoensis mixed assemblages	м	EOCENE
	1							1			1	1		1			I	Ι					I	1		Т	T	1				ł				_	Discoaster subladaensis		
I I					I					1				1	I	Ι												I				1	I			1	Discoaster lodoensis Discoaster binodosus Tribrachiatus contortus	L	
-			I	I		1		I																					1	1					-	-	Discoaster multiradiatus Discoaster nobilis	U	
								1																				I						I			Cruciplacolithus tenuis down hole contamination	L	PALEOCENE
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total of 56 cores was obtained, of which 44 were drilled at Site 362 and 12 in the complementary Site 362A. Calcareous nannofossils are abundant throughout the section. Their stratigraphic distribution and additional data on the abundance and preservation of the assemblages are shown in Tables 8A, 8B, and 9.

The upper part of the section from Core 1 to Core 5, Section 4 is referred to the combined Pleistocene *Emiliania huxleyi/Gephyrocapsa oceanica* zones and the *Emiliania ovata* Zone. The age of the interval Core 5, Section 6 to Core 10, Section 3 is lower Pleistocene or upper Pliocene. Discoasters are rare or even absent in some samples, *Gephyrocapsa* spp. are generally present. Core Catcher 9 contains very frequent reworked lower Eocene coccoliths of the *Discoaster binodosus* Zone; the oval-shaped nannofossils (Plate 2, Figures 9-12) found

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TABLE 7	
Distribution of Albian-Aptian Calcareous Nannofossils at	Site 361

	LE SI 1	G 4 TE 3	40 361			S	africana	terarius	ricus	enulatus	iei	irellus		asta	margerelii	lehmanii	lotus	sis	lis	Irniolensis	matoidea	nradiatas	hoschulzii	obtusus	++11	ngustus	sper
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Biscutum constar	Braarudosphaera	Chiastozygus lit	Cretarhabdus coi	Cretarhabdus cre	Cretarhabdus lor	Cretarhabdus sur	Cretarhabdus sp.	Cruciellipsis chi	Cyclagelosphaero	Diazomatolithus	Discorhabdus igr	Hayesites albien	Lithastrinus flore	Lithraphidites co	Manivitella pem	Markalius circur	Micrantholithus	Micrantholithus	Nannoconus trui	Parhabdolithus a	Parhabdolithus a
905,5-915	26	2	9-10	С	Ρ								Т					T	T								
		5	9-10	A	Ρ																						T
		CC		С	м																						
953 -962,5	27	3	37-39	A	Ρ																						Т
1005,0-1010	28	cc		R	м																						
1029 -1038,5	29	6	9-10	A	м																						Т
1038, 5-1048	30	CC		С	м																						
1048 -1057,5	31	2	9-10	A	Р																						Π
		4	9-10	A	м																						
		CC		A	м																						
1057,5-1067	32	1	9-10	С	Ρ						_							6									
		2	50-51	A	м																						
		6	11-12	A	Ρ																						
		CC		С	Ρ																						
1067 -1076,5	33	2	35	С	Ρ																						
		3	27	A	м																						
			37-38	A	Ρ																						
			46	A	Ρ																						
1076,5-1086	34	2	40-41	С	Ρ																						
		СС		С	Ρ																						
1086 -1095,5	35	1	143-145	F	м																						
1095,6-1105	36	2	42-43	F	Ρ																		_				
1105 -1114,5	37	1	101	А	м																			_			
		CC		С	Ρ																						
1114,5-1124	38	2	75	С	Ρ																						
1124 -1133,5	39	2	8-9	С	Ρ																						
1143 -1152,5	40	3	60-61	С	Ρ																						
1162 -1171,5	41	1	91-92	С	Ρ											1											
1181 -1190,5	42	6	45-46	А	Ρ																	_					
1200 -1209,5	43	4	105-106	С	Р																						
1219 -1228,5	44	2	bottom	F	Ρ																						
1238 -1247,5	45	3	bottom	С	м																						
1257 -1266,5	46	CC	top	R	м																		_				
1266,5-1276	47	2	121-122	С	Ρ																				-		
1285,5-1295	48	CC		F	м																						
1304,5-1314	49	3	118-120	С	Р																						

CALCAREOUS NANNOFOSSILS: SOUTHEASTERN ATLANTIC

TABLE 7 – Continued

-		_		-			_	_	_	_				-	-		-	_		_	
Parhabdolithus embergeri	Parhabdolithus splendens	Podorhabdus albianus	Podorhabdus decorus	Podorhabdus dietzmannii	Prediscosphaera cretacea	Reinhardtites fenestratus	Rucinolithus irregularis	Stephanolithion laffittei	Vagalapilla matalosa	Vagalapilla stradneri	Watznaueria barnesae	Watznaueria biporta	Watznaueria britannica	Watznaueria oblonga	Watznaueria ovata	Zygodiscus diplogrammus	Zygodiscus elegans	Thoracosphaera sp.	ZONE		AGE
					1					I				I					Prediscosphaera cretacea	м	ALBIAN
I I		с	f	1					1							I				L	
				I		ł	I	I	l					J					Parhabdolithus angustus	U	
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H	1									Ι						1					ΔΡΤΙΔΝΙ
					•	1	1	1	1			1			I		I	I	Chiastozygus litterarius	Ĺ	arnan
	I								I	I				I							
						Ι															

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	LE SI	G 40 TE 36	1			atus	niculatus	fer	gelowii		cus gr.	oridanus	eptoporus	teus.	ricus	11		ner i	ei .	aris	diatus	ariabilis	romus				is decorut		ibeonico	anica		eri		pora	Dorg .		eudoumbilica			rucosus	irobilis								
3			Ê		Z	dello	Irice	a styl	ero bi		belagi	Hun R	inter inter	amon	ymme	rggrei		allen	flonds	fercol	ntaroc	endov	inque	rculus	-ile	riabil	riobil	ula -	0 001	a oce	dds a	a cort	a sell	disco	inulti	spp.	fra ps	dds o	opier	dollos	era m								
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TABLE 8A Distribution of Pleistocene-Upper Miocene Calcareous Nannofossils at Site 362

in the same zone of Site 361 are also present. The assemblages in Core 10, Section 6 to Core 11, Section 2 are typical of the lower part of the upper Pliocene Discoaster brouweri Zone, with common Discoaster asymmetricus and D. tamalis present. Part of the lower Pliocene seems to be missing. A continuous sedimentary sequence was recovered from the lowermost Pliocene Ceratolithus acutus Subzone down to the iower-middle Eocene Discoaster sublodoensis Zone. A sharp change in the nannoflora assemblages takes place in the middle and lower Oligocene Sphenolithus distentus, Sphenolithus predistentus, and Helicosphaera reticulata zones (Sample 3A, CC to Core 5A). Normal nannoplankton associations are here replaced by very rich Braarudosphaera horizons. Living braarudosphaeras are abundant in coastal waters and very rare in the open ocean. Their skeletal remains are absent from the deep oceanic sediments, and in many land sections their frequency increases toward the shallowing of the basins. Their significance from the ecological point of view therefore is that of a near-shore indicator. Nevertheless Braarudosphaera layers, as already known from the Oligocene of the South Atlantic and Indian oceans, are associated with open sea planktonic assemblages. In the Oligocene of Hole 362A, no indications are present for a shallowing of the basin. The ratio of planktonic to benthic foraminifers still remains very high, and no shallow-water forms are present among the rare benthic foraminifers. Thus the significance of these Braarudosphaera layers is not yet clearly understood: they are probably the result of periodic blooms connected with unusual oceanic conditions.

The last occurrence of Discoaster barbadiensis is in Core 7A, Section 3. Discoaster saipanensis ranges somewhat higher: it is present in all the sections of this core and particularly frequent in Sample 7A-2, 125-126 cm. It was also observed in Sample 6A-5, 119-120 cm, but none was found in the other examined samples of this core. The Eocene/Oligocene boundary is therefore placed in Core 6A between Sections 5 and 4. The Chiasmolithus oamaruensis Zone was not recognized. but it could be present in the uncored interval between Cores 8 and 9. A normal sequence of middle Eocene to uppermost lower Eocene nannoplankton assemblages was recovered from Core 9A down, but nannofossils there are poorly preserved, apparently because of diagenetic processes that affected the sediments. The presence of Discoaster sublodoensis in Core 12A, below the first Nannotetrina fulgens, indicates this nominal middle-lower Eocene zone.

Cool to temperate water conditions are suggested for the Pleistocene by the frequency of *Coccolithus pelagicus* and for the Pliocene and upper to middle Miocene by the general scarcity of discoasters. The fairly common sphenoliths in the lower/middle Miocene and Oligocene indicate more temperate conditions during this time. Discoasters are also more abundant in the lower Miocene. A great reduction in the frequency of chiasmoliths was observed in the Eocene and Oligocene of this site compared with the Cape Basin Site 360. This can indicate warmer water conditions connected with the lower latitude position of this site.

SITE 363 Walvis Ridge (lat 19°38.75'S, long 09°02.80'E, water depth 2248 m)

Nannofossil assemblages ranging from upper Miocene to Lower Cretaceous were encountered at this site.

The stratigraphic distribution of the nannofossils and additional data on the abundance and preservation of the assemblages are shown in Tables 10 and 11.

Breaks in the Miocene sedimentation are recorded in Core 1. Abundant, well to moderately preserved Oligocene coccoliths are present in a continuous sequence from Cores 2 to 8. Diagnostic species of Sphenolithus and other markers allow us to recognize almost all Oligocene biozones. Unusual ooze intervals, predominantly composed of Braarudosphaera, correlate well with identical horizons in Site 362A in the middle and lower Oligocene. The Eocene/Oligocene boundary based on the last occurrence of Discoaster saipanensis is placed in the upper part of Core 9 and is characterized by continuous sedimentation. In the fairly complete Eocene and Paleocene sequence the preservation is poorer in the Eocene because of recrystallization, becoming better in the Paleocene. The Cretaceous/Tertiary boundary is placed at Sample 18-2, 40 cm. The lowermost Paleocene contains abundant Thoracosphaera and common Braarudosphaera which are typical for Danian sediments. Cruciplacolithus tenuis, however, is present until the Cretaceous boundary; thus the oldest known Tertiary nannofossil associations are not present at this site.

Sample 18-2, 41 cm to Core 25 represent a continuous sequence of Upper Cretaceous nannofossil zones from upper Maestrichtian to Santonian/Coniacian. Preservation is good in the upper Maestrichtian *Micula mura* Zone, moderate to good in Cores 20 to 25 with some scattered only poorly preserved samples. Core 25 is referred to the Santonian/Coniacian Marthasterites furcatus Zone.

Below this core nannofloras become sparse and generally poorly preserved. Braarudosphaera and Nannoconus of the truitti group are present in this part of the sequence. An upper Albian age is inferred for Cores 26 to 34 based on the presence of Eiffellithus turriseiffeli and the absence of younger markers. The only specimen of Micula staurophora found in Sample 26-2, 94-95 cm, suggesting a Turonian age for this sample, is more likely the result of contamination from above. The Cenomanian marker Lithraphidites alatus was not observed at this site. It could, however, be absent for ecological reasons and the possibility for a younger age of the upper part of this interval cannot entirely be excluded. Nevertheless, an Albian age seems more probable, leaving a gap in the sedimentary sequence corresponding to the Cenomanian and Turonian.

Cores 35 to 38, situated below the first occurrence of *Eiffellithus turriseiffeli* and above that of *Predisco-sphaera cretacea*, are referred to the lower/middle Albian *Prediscosphaera cretacea* Zone.

Core 39 no longer contains *Prediscosphaera cretacea* and, based on some questionable specimens of *Parhabdolithus angustus*, is tentatively referred to the nominal zone of upper Aptian/lower Albian age.

Core 40 only contains Watznaueria and Parhabdolithus embergeri and cannot, therefore, be dated.

From a paleoecologic point of view, rather warmwater conditions are assumed for the Paleogene. This is based on the more abundant sphenoliths and more scarce chiasmoliths when compared with the Cape Basin Sites 360 and 361. The presence of *Braarudo*-

F. PROTO DECIMA, F. MEDIZZA, L. TODESCO

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 TABLE 8B

 Distribution of Upper Miocene-Upper Oligocene Calcareous Nannofossils at Site 362



sphaera and the abundance of *Thoracosphaera* in the lowermost Paleocene could indicate neritic or upper bathyal conditions. Warm-water conditions are also suggested for the upper Maestrichtian on the presence of *Micula mura*.

SITE 364 Angola Basin (lat 11°34.32'S, long 11°58.30'E, water depth 2248 m)

Coccolith assemblages ranging from Holocene to Lower Cretaceous occur in the section of this discontinuously cored site. The stratigraphic distribution of the calcareous nannofossils and the abundance and preservation of the assemblages are shown in Tables 12-14.

Good to moderately preserved Quaternary assemblages with abundant *Helicosphaera carteri* and *Gephyrocapsa oceanica* are present in Core 1 (7.5-17 m). The upper part of Core 1 contains many reworked Upper Cretaceous and Paleogene forms. A peculiar association composed almost exclusively of *Helicosphaera carteri* is present in the core catcher of Core 1. This species is characteristic of tropical to subtropical areas.

Samples from Core 2 (34-46.5 m) are barren except for Sample 364-2-2, 9-10 cm and the core catcher which contain a poorly preserved upper Pliocene assemblage of the *Discoaster brouweri* Zone. Nannofloras are common to rare and contain reworked Upper Cretaceous and Cenozoic specimens.

Moderately well preserved lower Pliocene assemblages occur through Core 3 (64.5-74 m). The great abundance of discoasters, such as *D. brouweri* and *D. pentaradiatus*, suggests warm-water conditions. Reworked specimens are common in Sample 3-6, 9-10 cm and in the core catcher.

Core 4 (102.5-112 m) contains upper Miocene coccolith assemblages. Preservation is moderate to good. Discoasters are abundant and sphenoliths are common. Based on the presence of the name-giving species, Sample 4-6, 9-10 cm and the core catcher are referred to the *Discoaster hamatus* Zone.

Coccoliths are very rare in Core 5 (150-159.5 m) except for Sample 5-4, 9-10 cm that contains an upper lower Miocene assemblage. The concurrence of rare *Helicosphaera ampliaperta*, abundant *Sphenolithus heteromorphus*, common *Cyclococcolithus macintyrei*, and *Discoaster deflandrei* allows the assignment of this sample to the upper part of the *Helicosphaera ampliaperta* Zone.

Samples of Cores 6 (197.5-207 m) and 7 (245-254.5 m) are barren of calcareous nannofossils except for Sample 7, CC that contains a moderately preserved middle Eocene assemblage of the *Nannotetrina fulgens* Zone.

The lower Eocene Discoaster sublodoensis, Discoaster lodoensis, and Tribrachiatus orthostylus zones are condensed in Core 8 (283-295.5 m). Coccoliths are abundant, but have only a moderate to poor preservation. Only the core catcher of Core 8 contains abundant Zygrhablithus bijugatus, a shallow water indicator which is frequent at Site 362.

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TABLE 9 Distribution of Middle Oligocene-Middle Eccene Calcareous Nannofossils at Site 362A

Lowermost Eocene and Paleocene assemblages are present in Cores 9 and 10 (321-359 m). The great abundance of discoasters and the poor preservation of placoliths suggest dissolution effects in this interval. The catcher of Core 9 contains nannofossils of the lower Paleocene Cruciplacolithus tenuis Zone.

Cores 11 and 12 (359-378 m) contain abundant but poorly preserved coccolith assemblages, which show

Helicosphaera intermedia	Helicosphaera perchnielseniae	Helicosphaera recta	Isthmolithus recurvus	Lanternithus minutus	Markalius inversus	Nannotetrina cristata	Nannotetrina fulgens	Nannotetrina pappii	Neochiastozygus concinnus	Neococcolithes dubius	Peritrachelina joidesa	Pontosphaera multipora	Pontosphaera ovata	Pontosphaera plana	Pontosphaera vigintiforata	Reticulofenestra coenura	Reticulofenestra lockeri	Reticulofenestra umbilica	Rhabdosphaera perlonga	Rhabdosphaera tenuis	Scyphosphaera spp.	Sphenolithus ciperoensis	Sphenolithus distentus	Sphenolithus moriformis	Sphenolithus predistentus	Sphenolithus pseudoradians	Sphenolithus radians	Thoracosphaera spp.	Tribrachiatus orthostylus	Triquetrorhabdulus inversus	Zygrablithus bijugatus	ZONE		AGE
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TABLE 9 - Continued

strong signs of dissolution. The species present suggest Upper Cretaceous Maestrichtian. Because of the absence of diagnostic species, an exact biostratigraphic assignment is difficult. However, the absence of *Micula* mura and Lithraphidites quadratus might suggest an Arkhangelskiella cymbiformis Zone age.

Cores 13 and 14 (397-435 m) are referred to the upper Campanian to lower Maestrichtian Tetralithus trifidus

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 TABLE 10

 Distribution of Miocene-Paleocene Calcareous Nannofossils at Site 363

Discoasteroides kuepperi	Discoasteroides megastypus Ellipsolithus distichus	Ellipsolithus macellus	Erictonia cava	Ericaonia subdisticha	Ericsonia subpertusa	Fasciculithus involutus	Fasciculithus tympaniformis	Helicosphaera carteri	Helicosphaera compacta	Helicosphaero euphratis	Halinoshara internatio	Helicomhnern Imhner	Helicotohoen rectn	Halfacehere contention	Heliolithus kleinpellii	Heliolithus riedelii	Isthmolithus recurvus	Lanternithus minutus	Markalius inversus	Micronthalithus attenuatus	Nannatetrina cristata	Nannatetrina fulgens	Nannotetrina pappii	Neochidstozygus concinnus	Postherehoare plane	Prinsing bisulcus	Reticulatemetra coenura	Reticulatenestra lackeri	Reticulatenestra pseudoumbilica	Reticulatenestra umbilica	Unabdasphaera tenuis	Chamboaster cuspis	Sphenolithus ciperoersis	Sphenolithus distentus	Sphenalithus mariformis	Sphenolithus predistentus	Sphenolithus pseudoradians	Sphenolithus radians	horachosphaera spp.	loweius eminens	Iribrachiatus contartus	Interachiatus orthoutylus	riquetrorhobdulus corinatus	Triquetrorhobdulus mensus	Zvenditcut tinnnidet	Zygrablithus bijugatus	ZONE			AGE
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TABLE 10 - Continued

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TABLE 11 Distribution of Maestrichtian-Aptian Calcareous Nannofossils at Site 363

Zone except for Sample 364-13-1, 40-41 cm that is assigned to the lower Maestrichtian Arkhangelskiella cymbiformis Zone based on the absence of Tetralithus trifidus.

Cores 15 and 16 (463.5-511 m) yield assemblages that include Broinsonia parca and Eiffellithus eximius typical

of the Campanian *Eiffellithus eximius* Zone. Nannofossils are generally abundant, their preservation is moderate to poor.

Cores 17 to 23, Sections 1-3 (530-648 m) recovered assemblages of the *Marthasterites furcatus* Zone which is considered Coniacian-Santonian. Based on the

TABLE 11 - Continued



absence of *Marthasterites furcatus*, Section 4A, 7-8 cm of Core 23 is assigned to the lower Coniacian-upper Turonian *Micula staurophora* Zone. The core catcher of Core 23 contains only rare nannofossils with *Eiffellithus turriseiffeli* and *Watznaueria barnesae* that do not allow for detailed biostratigraphic dating. In Cores 24 to 33 (672.5-853 m) richer nannofloras occur at different levels that could belong to the upper Albian *Eiffellithus turriseiffeli* Zone. Nannofossils are generally abundant, but are only moderately to poorly preserved. Overgrowth and fragmentation have affected some assemblages. The absence of

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 TABLE 12A

 Distribution of Pleistocene-Paleocene Calcareous Nannofossils at Site 364

TABLE 12A -Continued

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Discoaster berggrenii	Discoaster binodosus	Discoaster bollii	Discoaster brouweri	Discoaster calcaris	Discoaster challengeri	Discoaster cruciformis	Discoaster deflandrei	Discoaster diastypus	Discoaster druggii	Discoaster elegans	Discoaster exilis	Discoaster hamatus	Discoaster intercalaris	Discoaster lautus	Discoaster lenticularis	Discoaster lodoensis	Discoaster mirus	Discoaster mohleri	Discoaster moorei	Discoaster multiradiatus	Discoaster neorectus	Discoaster nobilis	Discoaster nonaradiatus	Discoaster pentaradiatus	Discoaster pseudovariabilis	Discoaster quinqueramus	Discoaster saipanensis	Discoaster salisburgensis	Discoaster sublodoensis	ZONE		AGE
																														Emiliania huxleyi to Gephyrocapsa oceanica		PLEISTOCENE
_																														Emiliania ovata	-	
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																			_											Fasciculithus tympaniformis	м	PALEOCENE
-													_																	Cruciplacolithus tenuis	L	

F. PROTO DECIMA, F. MEDIZZA, L. TODESCO

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DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Discoaster surculus	Discoaster tanii	Discoaster tanii no	Discoaster sp. 1	Discoaster variabilis	Discoaster variabilis	Discoasteroides kue	Discoasteroides meg	Ellipsolithus distichu	Ellipsolithus macellu	Emiliania annula	Emiliania ovata	Ericsonia cava	Fasciculithus involu	Fasciculithus janii	Fasciculithus pileate	Fasciculithus tympar	Gephyrocapsa ocear	Gephyrocapsa spp.	Helicosphaera ampli	Helicosphaera carte	Helicosphaera inter	Helicosphaera sellii	Heliolithus kleinpel	Markalius inversus	Minilitha convallis	Nannotetrina cristat	Nannotetrina fulger	Neochiastozygus ch	Neochiastozygus dis	Neochiastozygus jui	Neococcolithes dub	Neococcolithes prot	Pontosphaera discop
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283-292,5	8	1	9-10	A	M		1					L		_			_		_			_								_	-		-						L
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TABLE 12B Distribution of Pleistocene-Paleocene Calcareous Nannofossils at Site 364

CALCAREOUS NANNOFOSSILS: SOUTHEASTERN ATLANTIC

TABLE 12B - Continued

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Pontosphaera multipora	Pontosphaera spp.	Prinsius bisulcus	Reticulofenestra coenura	Reticulofenestra pseudoumbilica	Rhabdosphaera clavigera	Rhabdosphaera inflata	Rhomboaster-cuspis	Scapholithus fossilis	Scyphosphaera globulosa	Scyphosphaera spp.	Sphenolithus abies	Sphenolithus anarrhopus	Sphenolithus heteromorphus	Sphenolithus moriformis	Sphenolithus neoabies	Sphenolithus orphanknolli	Sphenolithus radians	Sphenolithus spiniger	Syracosphaera histrica	Thoracosphaera spp.	Toweius craticulus	Toweius eminens	Tribrachiatus contortus	Tribrachiatus orthostylus	Triquetrorhabdulus inversus	Umbilicosphaera mirabilis	Zygodiscus sigmoides	Zygrhablithus bijugatus	Zygrhablithus simplex	ZONE		AGE
								III												Ι						III				Emiliania huxleyi and Gephyrocapsa oceanica Emiliania ovata	Р	LEISTOCENE
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		1 I																		I		Ι					I			Fasciculithus tympaniformis	м	PALEOCENE
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	LE SI	G 40 TE 364	4			oradiata	symbiformis	pecillata				atus	rarius	rsteinii	cus	nadventis	ulatus	tobrachiatus	ellus	renbergii	onatus	licus	atus	tus		S	ulatus	iffeli	E S	ificus		s	iiolensis	euxii	atoidea	adiatus	11 62.0	catus
DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Ahmuellerella oct	Arkhangelskiella	Arkhangelskiella s	Biscutum constans	Broinsonia enormis	Broinsonia parca	Chiastozygus cune	Chiastozygus litte	Crepidolithus thie	Cretarhabdus coni	Cretarhabdus coro	Cretarhabdus cren	Cretarhabdus schiz	Cretarhabdus surir	Cribrospaerella eh	Cylindralithus con	Cylindralithus gal	Cylindralithus serr	Discorhabdus igno	Eiffellithus anceps	Eiffellithus eximiu	Eiffellithus trabec	Eiffellithus turrise	Gartnerago obliqu	Kamptnerius magn	Lithastrinus grillii	Lithastrinus florali	Lithraphidites carr	Licanorhabdus cay	Manivitella pemm	Markalius circumr	Markalius inversus	Marthasterites furc
359 -368,5	11	1	top	A	P	\vdash	Т														-	Т	-		1			-	-	1				•	-		T	_
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368,5-378	12	3	9-10	A	P		T										T			T		-	Т															
		CC		A	P																	T						T									T	
397 -406,5	13	1	40-41	A	P		T																		-									-				
		2	9-10	A	P																	-						T							Т			
425,5-435	14	1	95-96	A	P	T	T				Т						T	T				T			T	с	F	T						T				
		3	9-10	A	M	Ħ									T													T							Т			
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463,5-473	15	1	58-59	A	P	1		Т																											T			
		CC		A	P																														T	T		
501,5-511	16	3	9-10	A	P																								T						T			
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530 -539,5	17	1	9-10	A	M					T										T					Т				T	T					1			Т
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549 -558	18	3	9-10	A	P																																	
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568 -577,5	19	3	33-34	A	M	T																							Т						T			T
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596, 5-601	21	1	9-10	A	Ρ	T						1	51																							Т		T
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615,5-625	22	2	12-13	C	Ρ																					с	F											T
		4	8-9	С	P				T	T		T				I																			T	T		T
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644 -653,5	23	1	54-55	A	P	-						t								T	T				T						T				T	1	1	1
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		3	9-10	A	M																								T									T
		4.	7-8	A	M																														T			

TABLE 13 Distribution of Maestrichtian-Coniacian Calcareous Nannofossils at Site 364

Lithraphidites alatus does not permit to distinguish between upper Albian and Cenomanian. If this Cenomanian marker should be absent for ecological reasons, Cenomanian sediments could be present in the upper part of the interval.

Cores 34 to 41-2, 139-141 cm (872-1007 m) contain coccoliths of the lower to middle Albian *Prediscosphaera cretacea* Zone. The lower part of Core 41, Section 3-6 and core catcher, and Core 42 (1007-1033.5 m) yield only poorly preserved assemblages of the *Parhabdolithus angustus* Zone. This zone ranges from upper Aptian to lower Albian, but the presence in these cores of *Hayesites albiensis* suggests a lower Albian age for this interval.

Core 43 (1033.5-1043 m) is barren of calcareous nannofossils.

SITE 365 Angola Basin (lat 11°39.10'S, long 11°53.72'E, water depth 3018 m)

Only the first three cores of this site contain calcareous nannofossils

In Core 1 (225 to 234.5 m below sea floor) some samples are barren, some contain diatoms, silicoflagellates, Radiolaria, and Quaternary coccoliths which could represent down-hole contamination. In Core 1, Section 6 and in the core catcher the moderate to poorly preserved nannofossils with *Marthasterites furcatus* are of Santonian/Coniacian age.

Core 2, together with barren samples, contains assemblages of probably upper Albian age in Section 3, while those of the core catcher seem to be younger,

TABLE 13 - Continued

																					-							-				
Microrhabdulus decoratus	Micrornabautus stradneri	Micula pyramida	Micula staurophora	Parhabdolithus angustus	Parhabdolithus asper	Parhabdolithus embergeri	Parhabdolithus spendens	Podorhabdus decorus	Prediscosphaera cretacea	Prediscosphaera spinosa	Reinhardtites anthophorus	Rucinolithus sp. aff. R. ? magnus	Stephanolithion laffittei	Tegumentum stradneri	Tetralithus aculeus	Tetralithus gothicus	Tetralithus premurus	Tetralithus quadratus	Tetralithus trifidus	Tranolithus exiguus	Tranolithus gabalus	Tranolithus orionatus	Vagalapilla matalosa	Watznaveria barnesae	Watznaueria biporta	Watznaueria oblonga	Watznaueria ovata	Zygodiscus diplogrammus	Zygodiscus elegans	Zygodiscus spiralis	ZONE	AGE
										I	1						ł		1						I						Arkhangelskiella cymbiformis	MAASTRICHTIAN
				1	I					1			1												I		1			1	Tetralithus trifidus - Eiffellithus eximius	CAMPANIAN
								I			I			I						1	1				I	I					Marthasterites furcatus	SANTONIAN
				I	1		I	1			1	ł									I		1		1	1	I I			1	Micula staurophora	CONIACIAN

probably post-Santonian, by the presence of *Micula* staurophora and the absence of the solution-resistant *Lithastrinus floralis*.

Sections 1 to 3 of Core 3 are barren of calcareous nannofossils. Two core-catcher samples of this core were examined. The light colored one contains abundant, moderately preserved nannofloras of upper Albian age. The dark one contains abundant coccolith fragments which suggest strong dissolution effects.

Core 4 does not contain any preserved coccoliths, except for some rare *Watznaueria*, but small fragments are abundant in the core-catcher sample.

The remaining part of the section, Cores 5-7, are barren of calcareous nannofossils.

ACKNOWLEDGMENTS

The authors wish to thank H.E. Franz (Zürich) for the Scanning Electron Microscope micrographs and C. Brogiato (Padua) for the Light Microscope photographs and for the preparation of the plates. Gratitude is expressed to Padua University for having granted to one of the authors (FPD) the leave of absence necessary to participate in Leg 40.

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DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)	ABUNDANCE	PRESERVATION	Ahmuellerella sp.	Biscutum constans	Broarudosphaera af	Braarudasphaera bi	Broinsonia enormis	Broinsonia lata	Broinsonia signata	Chiastozygus litter	Corollithion achyle	Corollithion signun	Cretarhabdus conic	Cretarhabdus coror	Cretarhabdus crenu	Cretarhabdus loriei	Cretarhabdus surire	Cruciellipsis chiost	Cylindralithus core	Cyclagelosphaera 1	Discorhobdus ignotu	Eiffellithus trabecu	Eiffellithus turrisei	Gartnerago striatum	hoyesites albiensis	Lithostrinus floralis	Martingprintings com	Markalius circume	Microrhabdulus dec	Nannoconus truitti	Parhabdolithus ang	Parhabdolithus asp	Parhabdolithus emb	Parhabdolithus sple	Podorhabdus albiar	Podorhabdus decori	Prediscosphaera cri	Prediscosphaera sp	Reinhardtites fenes
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710,5-720	26	1	142-143	A	P	Π			_	I	_	_	Ł	-	-			_	_		_	_	_		H	I	-	_		μ		Π					H				_	
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 TABLE 14

 Distribution of Albian Calcareous Nannofossils at Site 364

Rucinolithus irregularis	Stephanolithion laffittei	Tegumentum stradneri	Tranolithus exiguus	Tranolithus gabalus	Tranolithus orionatus	Vagalapilla matalosa	Vagalapilla stradneri	Watznaueria barnesae	Watznaueria biporta	Watznaveria oblonga	Watznaueria ovata	Zygodiscus diplogrammus	Zygodiscus elegans	ZONE		AĢE
														Eiffellithus turriseiffeli	U	ALBIAN
														Prediscosphaera cretacea	M	
	I			I		I								Parhabdolithus angustus	L	

TABLE 14 - Continued

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PLATE I

Figures 1, 3, 4	Gephyrocapsa oceanica Kamptner. Sample 364-1 CC. 1a. Phase contrast. 1b, 3, 4. Cross-polarized light (×2800).
Figures 2, 5	Gephyrocapsa caribbeanica Boudreaux and Hay. Sample 364-1, CC. 2a, 5a. Phase contrast. 2b, 5b. Cross-polarized light (×2800).
Figures 6, 7	 Cricolithus jonesii Cohen. 6a. Phase contrast; 6b. Cross-polarized light (×2800). Sample 364-1, CC. 7a. Transmitted light; 7b. Cross-polarized light (×2800). Sample 364-3, CC.
Figures 8, 9, 13	 Emiliania ovata Bukry. 8a, 9a. Phase contrast; 8b, 9b. Cross-polarized light (×2800). Sample 364-1, CC. 13a. Phase contrast; 13b. Cross-polarized light (×2800). Sample 364-3-3, 9-10 cm.
Figures 10-12	Sphenolithus heteromorphus Deflandre. Sample 364-5-3, 9-10 cm. 10a- 12a. Transmitted light. 10b- 12b. Phase contrast. 10c- 12c. Long axis 0° to crossed nicols. 10d- 12d. Long axis 45° to crossed nicols (×2800).
Figures 14, 15	<i>Emiliania annula</i> (Cohen). Sample 364-3, CC. 14a, 15a. Phase contrast. 14b, 15b. Cross-polarized light (×2800).
Figure 16	Sphenolithus moriformis (Brönnimann and Stradner). Sample 364-5-3, 9- 10 cm. 16a. Transmitted light. 16b. Phase contrast. 16c. Cross-polarized light (×2800).
Figure 17	Sphenolithus abies Deflandre. Sample 364-5-3, 9-10 cm. 17a, 17b. Phase contrast. 17c. Long axis 0° to crossed nicols. 17d. Long axis 45° to crossed nicols (×2800).
Figure 18	Umbilicosphaera mirabilis Lohmann. Sample 364-1-2, 9-10 cm. 18a. Phase contrast. 18b. Cross-polarized light (×2800).
Figure 19	 Pontosphaera multipora (Kamptner). Sample 364-4-4, 9-10 cm. 19a. Transmitted light. 19b. Phase contrast. 19c. Long axis 0° to crossed nicols. 19d. Long axis 45° to crossed nicols (×2800).
Figure 20	Syracosphaera histrica Kamptner. Sample 364-1-2, 9-10 cm. 20a. Phase contrast. 20b. Cross-polarized light (×2800).
Figure 21	Minilitha convallis Bukry. Sample 364-4-6, 9-10 cm. 21a. Transmitted light. 21b. Cross-polarized light (×2800).
Figure 22	Cyclococcolithus leptoporus (Murray and Blackman). Sample 364-1-2, 9- 10 cm. 22a. Phase contrast. 22b. Cross-polarized light (×2800).
Figures 23, 24	Helicosphaera sellii (Bukry and Bramlette). Sample 364-2, CC. 23a, 24a. Phase contrast. 23b, 24b. Cross-polarized light (×2800).
Figure 25	Helicosphaera intermedia Martini. Sample 364-5-3, 9-10 cm. 25a. Phase contrast. 25b. Cross-polarized light (×2800).



24b

25b

Figure 1	Helicosphaera ampliaperta Bramlette and Wilcoxon. Sample 364-5-3, 9-10 cm. 1a. Phase contrast. 1b. Cross-polarized light (×2800).
Figure 2	Helicosphaera carteri (Wallich). Sample 364-4, CC. 2a. Phase contrast. 2b. Cross-polarized light (×2800).
Figure 3	Cyclicargolithus floridanus (Roth and Hay). Sample 364-5-3, 9-10 cm. 3a. Transmitted light. 3b. Phase contrast. 3c. Cross-polarized light (×2800).
Figure 4	Coronocyclus nitescens (Kamptner). Sample 364-5- 3, 9-10 cm. 4a. Phase contrast. 4b. Cross-polarized light (×2800).
Figure 5	Cyclicargolithus abisectus (Müller). Sample 364-5-3, 9-10 cm. 5a. Phase contrast. 5b. Cross-polarized light (×2800).
Figure 6	Cyclococcolithus macintyrei Bukry and Bramlette. Sample 364-4, CC. 6a. Phase contrast. 6b. Cross-polarized light (×2800).
Figure 7	Thoracosphaera saxea Stradner. Sample 364-1-3, 9-10 cm. 7a. Transmitted light. 7b. Cross-polarized light (×2800).
Figure 8	Reticulofenestra pseudoumbilica (Gartner). Sample 364-4, CC. 8a. Phase contrast. 8b. Cross-polarized light (×2800).
Figures 9-12	 Problematic calcareous nannofossil. Sample 361- 8-0, 9-10 cm. 9, 10. Scanning electron micrographs (×1500, ×6000). 11,12a. Transmitted light. 12b. Cross-polarized light (×1500, ×2800).

p





12b

Figures 1,8	 Scyphosphaera apsteinii Lohmann. 1a, 2a. Transmitted light. 1b, 2b. Cross-polarized light (×2800). 1. Sample 364-4-6, 9-10 cm. 2. Sample 364-4, CC.
Figure 2	Scyphosphaera pulcherrima Deflandre. Sample 364-4-6, 9-10 cm. 2a. Transmitted light. 2b. Cross-polarized light (×2800).
Figures 3, 4	 Scyphosphaera globulosa Kamptner. 3a, 4a. Transmitted light. 3b, 4b. Cross-polarized light (×2800). 3. Sample 364-3-1, 33-34 cm. 4. Sample 364-3, CC.
Figure 5	Scyphosphaera amphora Deflandre. Sample 364-3- 1, 33-34 cm. 5a. Transmitted light. 5b. Cross-polarized light (×2800).
Figures 6, 7	Scyphosphaera intermedia Deflandre. Sample 364- 3, CC. 6a, 7a. Transmitted light. 7b, 7c. Cross-polarized light.

PLATE 4

Figures 1-4, 6,	Ceratolithus rugosus Bukry and Bramlette.
7,9	la-4a, 6a, 7a, 9a, Transmitted light.
-	1b, 2b, 3b, 3c. Phase contrast.
	1c, 2c, 3d, 4b, 6b, 7b, 9b. Cross-polarized light (×2800).
	1- 3, 6, 7. Sample 364-3-5, 9-10 cm.
	4. Sample 364-3-1, 33-34 cm.
	9. Sample 364-3-2, 9-10 cm.
Figures 5, 8, 10,	Ceratolithus acutus Gartner and Bukry. Sample
11	59 89 109 119 Transmitted light
	8b Phase contrast
	5b, 8c, 10b, 11b. Cross-polarized light (×2800).
Figure 12	Ceratolithus cristatus Kamptner. Sample 364-1-3, 9-10 cm.

12a. Transmitted light.
12b. Phase contrast.
12c. Cross-polarized light (×2800).

(see p. 612)





Figures 1, 2	 Rhabdosphaera clavigera Murray and Blackman. 1a, 1b, 2a, 2b. Phase contrast. 1c. Cross-polarized light (×2800). 1. Sample 364-1-3, 9-10 cm. 2. Sample 364-1-2, 9-10 cm.
Figures 3-7	Amaurolithus delicatus Gartner and Bukry. Sample 364-3, CC. 3, 4a, 5a, 6, 7. Transmitted light. 4b, 5b. Phase contrast (×2800).
Figure 8	Amaurolithus amplificus (Bukry and Percival). Sample 360-7-4, 9-10 cm. 8a. Transmitted light. 8b. Phase contrast (×2800).
Figure 9	Amaurolithus tricorniculatus (Gartner). Sample 360-1-4, 9-10 cm. 9a. Transmitted light. 9b. Phase contrast (×2800).
Figures 10, 11	Amaurolithus primus (Bukry and Bramlette). Sample 360-7-4, 9-10 cm. 10a, 11a. Transmitted light. 10b, 11b. Phase contrast (×2800).
Figure 12	Triquetrorhabdulus rugosus Bramlette and Wilcoxon. Phase contrast ($\times 2800$). Sample 364-4-6, 9-10 cm.
Figure 13	Calcareous crystallites of unknown origin. Sample 364-8-1, 9-10 cm. 13a. Transmitted light. 13b. Cross-polarized light (×2800).
Figure 14	Angulolithina arca Bukry. Sample 364-3-5, 9-10 cm. 14a. Transmitted light. 14b. Cross-polarized light (×2800).

(see p. 614)



13a 614

13ь

14b

Figure 1	Discoaster sp.
	Transmitted light (×2800). Sample 364-4-4, 9-10
	cm.

- Figure 2 Discoaster asymmetricus Gartner. Transmitted light (×2800). Sample 364-4-6, 9-10 cm.
- Figure 3 Discoaster brouweri Tan Sin Hok. Transmitted light (×2800). Sample 364-3, CC.
- Figures 4, 5 Discoaster calcaris Gartner. Sample 364-4-6, 9-10 cm. 4a, 5. Transmitted light. 4b. Phase contrast (×2800).

Figure 6	Discoaster hamatus Martini and Bramlette.
	Sample 364-4, CC.
	6a. Transmitted light, low focus.
	6b. Transmitted light, high focus ($\times 2800$).

Figure 7 Discoaster neorectus Bukry. Transmitted light (×2800). Sample 364-4-6, 9-10 cm.

Figures 8, 9	Discoaster druggii Bramlette and Wilcoxon.	
	Sample 364-5-3, 9-10 cm.	
	9a. Transmitted light.	
	8, 9b. Phase contrast (\times 2800).	

(see p. 616)

PLATE 7

Figures 1-3	Discoaster berggrenii Bukry. Transmitted light (×2800). Sample 364-4-4, 9-10 cm.
Figure 4	Discoaster quinqueramus Gartner. Transmitted light (×2800). Sample 364-3-5, 9-10 cm.
Figures 5-8	 Discoaster moorei Bukry. 5. Phase contrast (×2800). 6- 8. Transmitted light (×2800). 5. Sample 364-5-3, 9-10 cm. 6- 8. Sample 364-4-6, 9-10 cm.
Figure 9	Discoaster pseudovariabilis Martini and Worsley. Sample 364-3-1, 33-34 cm. 9a, 9b. Phase contrast. 9c, 9d. Transmitted light (×2800).
Figures 10-14	Discoaster variabilis Martini and Bramlette. Transmitted light (×2800). 10, 13, 14. Sample 364-4-6, 9-10 cm. 11, 12. Sample 364-4-4, 9-10 cm.
Figures 15, 16	Discoaster variabilis decorus Bukry. Transmitted light (×2800). 15. Sample 364-3-5, 9-10 cm. 16. Sample 362-27-1, 62-63 cm.

(see p. 617)



9a

9b



Figure 1	Discoaster surculus Martini and Bramlette. Sample 364-3-1, 33-34 cm. 1a. Transmitted light. 1b. Phase contrast (×2800).
Figure 2	Discoaster pseudovariabilis Martini and Worsley. Sample 364-3-5, 9-10 cm. 2a. Transmitted light. 2b. Phase contrast (×2800).
Figure 3	Discoaster sp. Sample 364-3-3, 9-10 cm. 3a. Transmitted light. 3b. Phase contrast (×2800).
Figure 4	Discoaster pentaradiatus Tan Sin Hok. Sample 364-3-5, 9-10 cm. 4a. Transmitted light. 4b, 4c. Phase contrast (×2800).
Figure 5	Discoaster exilis Martini and Bramlette. Sample 364-5-3, 9-10 cm. 5a, 5b. Transmitted light. 5c. Phase contrast (×2800).
	PLATE 9
Figure 1	Discoaster sp. Sample 364-4, CC. 1a. Transmitted light. 1b. Phase contrast (×2800).
Figure 2	Discoaster asymmetricus Gartner. Sample 364-3-6, 9-10 cm. 2a. Transmitted light. 2b. Phase contrast (×2800).
Figures 3, 6	 Discoaster deflandrei Bramlette and Riedel. Sample 364-5-3, 9-10 cm. Transmitted light. Phase contrast (×2800).
Figure 4	Discoaster bollii Martini and Bramlette. Transmitted light (×2800). Sample 364-4-6, 9-10 cm.
Figure 5	Discoaster challengeri Bramlette and Riedel. Sample 364-4-4, 9-10 cm. 5a. Transmitted light. 5b. Phase contrast (×2800).
Figures 7, 8	Discoaster loeblichii Bukry. Transmitted light (×2800). Sample 362-27-1, 62-63 cm.
Figure 9	Discoaster neorectus Bukry. Transmitted light (×2800). Sample 360-5-6, 9-10 cm.
Figure 10	Discoaster variabilis decorus Bukry. Transmitted light (×2800). Sample 362-27-1, 62-63 cm.

(see p. 620)



5b

5a

619

5c



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Figure 1	Cruciplacolithus tenuis (Stradner). Sample 364-10- 5, 9-10 cm. 1a. Transmitted light. 1b. Cross-polarized light (×2800).
Figure 2	Campylosphaera eodela Bukry. Sample 364-9, CC. 2a. Phase contrast. 2b. Cross-polarized light (×2800).
Figure 3	Campylosphaera dela (Bramlette and Sullivan). Sample 364-8-1, 9-10 cm. 3a. Phase contrast. 3b. Cross-polarized light (×2800).
Figure 4	Cyclolithella robusta (Bramlette and Sullivan). Sample 364-10-1, 39-40 cm. 4a. Phase contrast. 4b. Cross-polarized light (×2800).
Figure 5	Markalius inversus (Deflandre). Cross-polarized light (×2800). Sample 364-10-2, 9- 10 cm.
Figure 6	<i>Toweius craticulus</i> Hay and Mohler. Cross-polarized light (×2800). Sample 364-9, CC.
Figure 7	Chiasmolithus californicus (Sullivan). Sample 364- 10-2, 9-10 cm. 7a. Phase contrast. 7b. Cross-polarized light (×2800).
Figure 8	 Heliolithus kleinpellii Sullivan. Sample 364-10-1, 39-40 cm. 8a. Phase contrast. 8b. Cross-polarized light (×2800).
Figure 9	Coccolithus crassus Bramlette and Sullivan. Sample 364-8-4, 9-10 cm. 9a. Phase contrast. 9b. Cross-polarized light (×2800).
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Figure 11	Coccolithus cribellum Bramlette and Sullivan. Sample 364-8-3, 9-10 cm. 11a. Transmitted light. 11b. Phase contrast. 11c. Cross-polarized light (×2800).
Figure 12	Coccolithus magnicrassus Bukry. Sample 364-8-4, 9-10 cm. 12a. Transmitted light. 12b. Phase contrast. 12c. Cross-polarized light (×2800).
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10a



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12a









11c



Figures 1, 2	Discoasteroides kuepperi (Stradner). 1a, 2a. Transmitted light. 1b, 2b. Cross-polarized light (×2800). 1. Sample 364-9-1, 17-18 cm. 2. Sample 364-9-2, 9-10 cm.
Figure 3	Discoaster sp. 1. Transmitted light (×2800). Sample 364-9, CC.
Figure 4	Discoaster multiradiatus Bramlette and Riedel. Sample 364-9-1, 17-18 cm. 4a. Transmitted light. 4b. Phase contrast (×2800).
Figures 5, 6	 Discoaster diastypus Bramlette and Sullivan. 5, 6a. Transmitted light. 6b. Phase contrast (×2800). 5. Sample 364-9-1, 17-18 cm. 6. Sample 364-9-2, 9-10 cm.
Figure 7	Chiasmolithus grandis (Bramlette and Riedel). Sample 364-8-4, 9-10 cm. 7a. Transmitted light. 7b. Cross-polarized light (×2800).

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Figure 1	 Fasciculithus janii Perch-Nielsen. Sample 364-10-2, 9-10 cm. 1a. Transmitted light. 1b, 1c. Cross-polarized light (×2800).
Figure 2	 Sphenolithus spiniger Bukry. Sample 364-8-1, 9-10 cm. 2a. Phase contrast. 2b. Long axis 0° to crossed nicols. 2c. Long axis 45° to crossed nicols (×2800).
Figures 3, 6	Fasciculithus pileatus Bukry. Sample 364-10-2, 9- 10 cm. 3a, 3b. Transmitted light. 3c, 6, Cross-polarized light (×2800).
Figures 4, 5	 Sphenolithus orphanknollii Perch-Nielsen. Sample 364-8-3, 9-10 cm. 5a. Transmitted light. 4a, 5b. Phase contrast. 4b, 5c. Long axis 45° to crossed nicols. 4c, 5d. Long axis 0° to crossed nicols (×2800).
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Figure 8	Nannotetrina cristata (Martini). Transmitted light (×2800). Sample 364-7, CC.
Figures 9-11	Discoaster sp. 1. Sample 364-9, CC. 9, 10. Transmitted light (×2800). 11. Transmitted light (×2400).
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Figures 13-15	 Rhomboaster cuspis Bramlette and Sullivan. Sample 364-9-1, 17-18 cm. 13, 14. Transmitted light (×2800). 15. Transmitted light (×2400).

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Figure 1	Microrhabdulus decoratus Deflandre. Sample 364- 14-1, 95-96 cm. 1a. Transmitted light. 1b, 1c. Cross-polarized light (×2800).
Figure 2	<i>Microrhabdulus stradneri</i> Bramlette and Martini. Cross-polarized light (×2800). Sample 363-19-2, 58-60 cm.
Figure 3	<i>Tetralithus gothicus</i> Deflandre. Cross-polarized light (×2800). Sample 364-14-3, 9- 10 cm.
Figures 4, 6	 Tetralithus premurus Bukry. Sample 364-11, CC. 6a. Transmitted light. 4, 6b. Cross-polarized light (×2800).
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Figures 7, 14	 Micula staurophora (Gardet). 7a. Transmitted light. 7b. Cross-polarized light (×2800). Sample 364-11, CC. 14. Scanning electron micrographs (×5000). Sample 363-18-2, 45-46 cm.
Figures 8, 15, 16	 Lithraphidites quadratus Bramlette and Martini. 8a. Phase contrast. 8b. Cross-polarized light (×2800). Sample 363-19-2, 58-60 cm.

Scanning electron micrographs (×5000).
 Sample 363-18-2, 45-48 cm.

Figures 9, 10 Distal part of the stem of *Prediscosphaera cretacea* (Arkhangelsky). Scanning electron micrograph (×6000). Sample 363-19-2, 58-60 cm.

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Figure 1	Cribrosphaerella ehrenbergii (Arkhangelsky). Sample 364-14-4, 9-10 cm. 1a. Transmitted light. 1b. Phase contrast. 1c. Cross-polarized light (×2800).
Figure 2	Cruciellipsis chiastia (Worsley). Cross-polarized light (×3500). Sample 364-40-2, 17-18 cm.
Figures 3, 6	 Parhabdolithus asper (Stradner). 3a. Phase contrast. 3b. Cross-polarized light (×2800). Sample 364-32, CC. 6a. Phase contrast. 6b. Cross-polarized light (×3500). Sample 364-39, CC.
Figure 4	 Broinsonia enormis (Shumenko). Sample 364-20-2, 9-10 cm. 4a. Phase contrast. 4b. Cross-polarized light (×2800).
Figure 5	Tranolithus exiguus Stover. Sample 364-23-2, 9-10 cm. 5a. Phase contrast. 5b. Cross-polarized light (×2800).
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Figure 9	<i>Microrhabdulus stradneri</i> Bramlette and Martini. Cross-polarized light (×2800). Sample 363-19-2, 58-60 cm.
Figure 10	Broinsonia parca (Stradner). Sample 364-14-1, 95- 96 cm. 10a. Phase contrast. 10b. Cross-polarized light (×2800).
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Figure 12	 Kamptnerius magnificus Deflandre. Sample 364-20-2, 9-10 cm. 12a. Transmitted light. 12b. Phase contrast. 12c. Cross-polarized light (×2800).

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12 a

12 b

12c

Figure 1	Biscutum constans (Gorka). Sample 364-35-2, 78-79 cm. 1a. Transmitted light. 1b. Phase contrast. 1c. Cross-polarized light (×2800).
Figure 2	 Braarudosphaera africana Stradner. Sample 364-34-3, 67-68 cm. 2a. Transmitted light. 2b. Phase contrast. 2c. Cross-polarized light (×2800).
Figure 3	Broinsonia lata (Noel). Sample 364-35-1, 16-17 cm. 3a. Phase contrast. 3b. Cross-polarized light (×3500).
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Figures 5, 9	 Prediscosphaera cretacea (Arkhangelsky). Sample 364-31-1, 60-61 cm. 5, 9c. Cross-polarized light. 9a. Transmitted light. 9b. Phase contrast (×3500).
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Figures 8, 16	 Parhabdolithus splendens (Deflandre). 8a. Phase contrast. 8b. Cross-polarized light (×3500). Sample 364-40-2, 30-31 cm. 16a. Transmitted light. 16b. Phase contrast. 16c. Cross-polarized light (×2800). Sample 364-31-1, 60-61 cm.
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Figure 13	<i>Tegumentum stradneri</i> Thierstein. Sample 364-40-2, 30-31 cm. 13a. Phase contrast. 13b, 13c. Cross-polarized light (×3500).
Figure 14	Ahmuellerella octoradiata (Gorka). Sample 364-14-3, 9-10 cm. 14a, 14b. Phase contrast. 14c. Cross-polarized light (×2800).
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17b

17c

Figure 1	Lithastrinus grillii Stradner. Sample 364-23-2, 9-10 cm.	
	the Phase contrast	
	1c. Cross-polarized light (×2800).	
Figure 2	Cretarhabdus crenulatus Bramlette and Martini.	
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	2a. Phase contrast.	
	2b. Cross-polarized light ($\times 2800$).	
Figures 3-6	Nannoconus truittii Brönnimann.	
	3, 4, 5a. Transmitted light.	
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	3-5. Sample 364-31-1, 60-61 cm.	
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Figures 7, 9	Lithastrinus floralis Stradner. Sample 364-34-3, 87-	
	88 cm.	
	7a, 9a. Transmitted light.	
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Figure 8	Watznaueria barnesae Black. Sample 364-39, CC.	
	8a. Phase contrast.	
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Figure 10	Parhabdolithus embergeri (Noel). Sample 364-34-3,	
	87-88 cm.	
	10a. Transmitted light.	
	10b. Phase contrast.	
	10c. Cross-polarized light (×2800).	
Figures 11, 12	Rucinolithus sp. aff. R. ? magnus Bukry. Sample	
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	11a, 12a. Transmitted light.	
	11b, 12b. Phase contrast ($\times 2800$).	
Figure 13	Microchabdulus stradneri Bramlette and Martini. Cross-	
	polarized light (X2800). Sample 364-14-1, 95-96 cm.	

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13b

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