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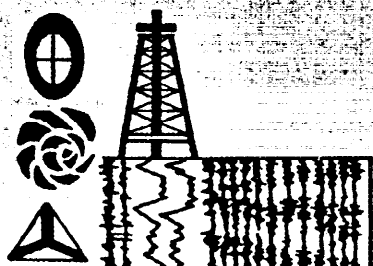
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**EXXON EXPLORATION COMPANY**

**Palynology, Biostratigraphic Zonation and  
Paleoenvironments of the Marlin A24 Well,  
Gippsland Basin, Australia**

**Thomas D. Davies**

TECHNOLOGY DEPARTMENT  
GLOBAL STUDIES - GEOLOGICAL SERVICES DIVISION  
BIOSTRATIGRAPHY SECTION  
EEC.13A.BIO.96  
MARCH, 1996



**BIOSTRATIGRAPHY  
REPORT**

**EXXON UNCLASSIFIED**

# EXXON EXPLORATION COMPANY

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TECHNOLOGY DEPARTMENT  
GLOBAL STUDIES/DATABASE DIVISION  
BIOSTRATIGRAPHY

April 2, 1996

Brodie Thomson  
Esso Australia Limited  
360 Elizabeth Street  
Melbourne, Victoria  
Australia 3000

Attn: Peter Glenton

Dear Brodie:

Attached are three copies of the biostratigraphy report "Palynology, Biostratigraphic Zonation and Paleoenvironments of the Marlin A24 Well, Gippsland Basin, Australia" (EEC.13A.BIO.96) by Thomas D. Davies. This report summarizes the results of examination of the palynologic assemblages and biofacies in ditch cuttings samples from the Marlin A24 well. This work was requested by Peter Glenton.

The purposes of this palynologic study focused on 1) stratigraphic control based on the age/stratigraphic position of sidewall core samples relative to Exxon's Gippsland Basin palynological zonation and 2) constrains on depositional environments. Fossils recovered in the section studied from 2575 to 3347 m (measured depth) range in age from basalmost lower Eocene to ?Upper Maastrichtian (Turrum zones Sz to probable Ma).

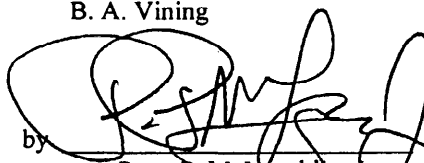
Eight zones and two subzones were recognized in this well. The section from 2575 to about 3011 m MD is considered to be mainly marginal marine to marine, based on abundance and type of dinoflagellate cysts and biofacies. From 3011 to 3203 m, the section is primarily nonmarine, except for sample 3017-24 m, which is probably marginal marine. Marine dinoflagellates reappear in samples in the basal part of the well from 3203 to 3347 m, which suggest some marine influences at these depths.

This report is unclassified, with all proprietary interpretations removed, so it can be distributed outside Exxon without further permission from EEC.

The Biostratigraphy Section appreciates this opportunity to work with you in ensuring the effective application of biostratigraphy to your project. If you have any questions regarding this work or require any further assistance, please contact Pete at 423-5988 or Tom at 423-5992.

Yours truly,

B. A. Vining

by   
Peter P. McLaughlin, Jr.

TDD



EXXON EXPLORATION COMPANY  
BIOSTRATIGRAPHY REPORT  
EEC.13A.BIO.96  
MARCH, 1996

**Palynology, Biostratigraphic Zonation and  
Paleoenvironments of the Marlin A24 Well, Gippsland  
Basin, Australia  
(Unclassified)**

**Thomas D. Davies**

## EXECUTIVE SUMMARY

- The palynostratigraphy of the Marlin A24 Well was studied to provide stratigraphic control based on age and stratigraphic position of cuttings samples from 2575 to 3347 m MD and environments of deposition from palynologic and biofacies evidence.
- Eight palynology zones and two subzone, ranging in age from basalmost lower Eocene to probable Upper Maastrichtian, were differentiated for this well and tied to the other Turrum field wells studied.
- Palynology demonstrates that Blue Grey SB occurs within probable Zone Rb, Bottle Green SB occurs between Rb and Rc, and MFS "E" falls within Zone Rc, as in the other Turrum field wells. Near Top L-200 sits within the base of Zone Rc, Naples Yellow SB occurs within subzone Rd2, MFS "B" SB is in Re, and Pink SB is between zones Re and Rf. In the base of the well, MFS "A" is found within Zone Rf and 450 Marker within Zone Rg.
- Most of the "shales" associated with the reservoir sandstone, particularly above the MFS "B" SB, contain common to abundant marine dinoflagellate cysts, three intervals were identified that contain relatively rich and diverse marine assemblages. These intervals correlate with the marine flooding events at about 2990 mMD associated with MFS "B" SB, and at 2850 and 2860 mMD associated with Near Top L-200.

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EXXON EXPLORATION COMPANY  
TECHNOLOGY DEPARTMENT  
GLOBAL STUDIES - GEOLOGICAL SERVICES DIVISION  
BIOSTRATIGRAPHY SECTION

29/02/96

**Biostratigraphy Report**  
**Spores, Pollen, and Dinoflagellates**

EEC.13A.BIO.96

ESSO AUSTRALIA, LTD  
Gippsland Basin, Australia

Marlin A24 Well

## INTRODUCTION

At the request of Esso Australia Limited (Peter Glenton), thirty-eight ditch cuttings samples were studied from the Marlin A24 Well, Gippsland Basin. Samples were analyzed for age and paleoenvironment, and the result of these analyses were integrated with Exxon's Turrum Field palynological zonation recently proposed by Davies (1995).

The main purposes of this palynologic study were to provide: 1) stratigraphic control based on the age/stratigraphic position of sidewall core samples relative to Exxon's Gippsland Basin palynological zonation, and 2) constrains on the depositional environments.

The age and paleoenvironmental interpretations are based on comparisons with materials from Askin, (1990); Besems (1993); Churchhill, (1973); Cookson and Eisenack (1965 and 1967); Damassa et al., (1994); Davies (1995 and 1996); Davey et al., (1966); Germeraad et al., (1968); (1987); Heilmann-Clausen (1985); Helby et al., (1987); Marshall, (1985); Muller, (1964); Partridge, (1973 and 1976); Powell (1992); Stover and Evans, (1973); Stover and Partridge, (1973 and 1984); Wilson, (1984 and 1988); and Wrenn and Hart, (1988).

Interpretations of paleoecology were made based on observed changes in the spore-pollen (S/P) assemblages and biofacies analyses from kerogen slides. Relative abundance abbreviations used below are: VA - very abundant; A - abundant; C - common; F - few; R - rare; and VR - very rare. Other abbreviations used are: SP - spores and pollen, D - dinoflagellates, F - foraminifera. Depths given are in meters, measured depth.

## DATABASE AND PRODUCTS

Approximately 120 microscope slides from thirty-eight Marlin A24 ditch cuttings samples were examined for palynology and paleoenvironments. These samples were processed by EEC's Biostratigraphic Lab in Houston.

Microscope slides: Palynology and kerogen microscope slides from thirty-eight cuttings samples (2575 to 3347 m MD) from the Marlin A24 well are stored at EEC's biostratigraphy laboratory in Houston. Unused sample will be returned to EAL.

## BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL SUMMARY

We studied approximately 120 microscope slide from thirty-eight Marlin A24 cuttings samples in the interval from 2575 to 3347 m. Marine dinoflagellate cysts are common to abundant in many of the samples from 2575 to about 3011 m, particularly at 2646, 2691, 2713, 2844\*, 2856\*, and 2981\* m. (Those depths annotated with an asterisk are interpreted as intervals of maximum marine incursions based on dinoflagellate cyst diversity and type.) The interval from 3011 to 3203 m is interpreted to be nonmarine, except for sample 3017 to 3024 m, as no indigenous marine forms were recovered. Marine dinocysts occur again, mainly in small numbers, in the basal part of this well from 3203 to 3347 m. Terrestrially derived spores and pollen are common to abundant in most of the samples, but often poorly preserved.

The palynostratigraphic subdivision, zone tops and ranges for the Marlin A24 well are listed below. Figure 1 gives the biostratigraphic subdivision and chronostratigraphy for this well, and shows the distribution of some of the important age diagnostic palynomorphs. Questioned depths shown in parenthesis, e.g. (?2960), denotes possible shallowest depth of the zone top.

2575-2594	Zone Sz (one sample)
2597-2615	Zone Sz/Ra? (weak evidence for Ra; one sample)
2633-2722	Zone Rb? (mixed assemblage; five samples)
2725-2758	Zone Rb (two samples)
2774-2810	Zone Rc (two samples)
2822-2838	Indeterminate (one samples)
2844-2868	Zone Rd1 (two samples)
2871-2899	Indeterminate (two samples)
2905-2944	Zone Rd2 (two samples)
(?2960) 2981-2993	Zone Re (subzones not differentiated; two samples)
3011-3100	Indeterminate (sample 3017-24 m ?Zone Re)
3103-3176	Zone Rf
3203-3225	Rg

3231-3261 Indeterminate  
3273-3347 Probably Upper Maastrichtian, Zone Ma

Intervals of maximum flooding occur in samples 2844, 2856, and 2981 mMD associated with Near Top L-200, and MFS "B" SB.

## DISCUSSION OF RESULTS

Zone Sz was tentatively identified in this well in cuttings sample 2575-2594 m (Appendix A).

The zonation of cuttings sample 2597 to 2615 m is not well established. Fossils from the overlying sample continue to be present in large numbers, together with very rare markers for top Zone Ra. This samples is tentatively assigned to zones Sz/Ra?. Appendix A, following the references, gives a sample-by-sample listing of the distribution of important species and kerogen types.

The five cuttings samples from 2633 to 2722 m are tentatively placed in Zone Rb. The zonation of samples 2691 to 2700, 2703 to 2713, and 2713 to 2722 m is less certain than 2699m, but their stratigraphic position and presence of rare *Glaphyrocysta retiintexta*, *Paleocystodinium golzowense*, and *Cerodinium* sp. S suggest they also are probably in Zone Rb.

The fossil assemblage at 2725 to 2740 and 2746 to 2758 m is characteristic of Turrum Zone Rb (Appendix A)

The two cuttings samples from 2774 to 2783 and 2801 to 2810 m are placed in Zone Rc (Appendix A).

The sample from 2822 to 2838 m is poorly fossiliferous and indeterminate for zonation.

Zone Rd is subdivided into two subzones. Subzone Rd1 is recorded in samples 2844 to 2850 and 2856 to 2868 m. The assemblage is characteristic of this subzone in the other Turrum wells. Samples 2871 to 2880 and 2889 to 2899 m are indeterminate. The two samples from 2905 to 2917 and 2929 to 2944 m are assigned to Subzone Rd2 (Appendix A).

The next sample studied from this well from 2960 to 2972 m contains an assemblage similar to that characteristic of Zone Re. It is tentatively assigned to Zone Re. The assemblage associated with this zone occurs certainly in the sample at 2981 to 2993 m and appears to represent the maximum flooding event associated with MFS "B" SB recognized in the other Turrum well studied (Davies, 1995).

Four of the five samples studied from 3011 to 3100 m, except for sample 3017 to 3024 m, are nonmarine, contain poorly preserved fossils, and are indeterminate for zonation. Sample 3017 to



3024 m however, contains a few marine dinoflagellate, and the fossil assemblage suggests that it may be in Zone Re. However, the confidence level is low.

The five samples in the interval from 3103 to 3176 m are placed in Zone Rf (Appendix A).

Samples 3203 to 3212 and 3216 to 3225 m are assigned to Zone Rg,

Samples 3231 to 3240 and 3246 to 3261 m are indeterminate.

The four basal samples from 3273 to 3286, 3298 to 3307, 3319 to 3331, and 3337 to 3347 m are probably within Zone Ma, however the confidence level is low. None of the typical markers for this zone were noted. Also, cavings and/or mud contamination of lower Eocene and Paleocene forms is severe and the preservation is poor. Fossils restricted to the Maastrichtian and lower occur very rarely at 3273 to 3286, and possibly at 3319 to 3331 and 3337 to 3347 m.

## PALYNOSTRATIGRAPHIC CORRELATION

The palynologic assemblages recovered from this well are similar to those reported for the other wells studied from the Turrum field (Davies, 1995 and 1996). Eight biozones and two subzones were recognized in this well, based on first, last, and peak occurrences, and concurrent ranges which were compared with ranges previously established in the area by Stover and Partridge (1973), Stover and Evans (1973), Helby, Morgan, and Partridge (1987), Wilson (1984, 1988), Wrenn and Hart (1988), and others.

The zonation of the upper samples from 2575 to 2725 m is not well established, so the designations for the tops of zones Ra and Rb are tentative. The top of Zone Rb is tentatively placed at sample 2633 to 2649 m. This level is approximately 30 m above the top of the massive sandstone at 2644 m. In relationship to the physical surface, the proposed Blue Grey Sequences Boundary at 2664m falls within probable Zone Rb. This zone was recognized by Davies (1995) in Turrum-4, Turrum-3, Turrum-2, and in Turrum-5. It typically occurs at or just below the Blue Grey SB in Turrum-4, -3, and -2, and Marlin-4 (Davies, 1995) and about 10 m beneath the MFS "M"/Blue Grey SB in Turrum-5 (Davies, 1996).

Bottle Green SB occurs between Rb and Rc. The top of Palynozone Rc, which occurs at or near the Bottle Green SB in the other Turrum wells, is placed within sample 2774 to 2783 m about 16 m below the Bottle Green SB. The Rc assemblage also is present in the sample from 2801 to 2810 m. MFS "E" falls within Zone Rc and Near Top L-200 sits within the base of this zone. This zone was recorded in most of the Turrum field wells (Davies, 1995; 1996).

The top of Subzone Rd1, which is usually occurs near the Near Top L-200 surface (Davies, 1995), was recorded in sample 2844 to 2849 m. This is about 2 m below the Near Top L-200

surface picked by EAL at 2842 m. Subzone Rd1 was recognized in most of the Turrum well, except Marlin-2.

Naples Yellow SB occurs within subzone Rd2, which was first recognized in sample 2905 to 2917 m.

The top of tentative Zone Re was first recognized in sample 2960 to 2872 m, but could be as high as 2944 m in the unsampled interval. Definitive Re occurs in the sample from 2981 to 2993 m. The physical surface at about 3001 m picked by EAL as a candidate for MFS "B" SB occurs within this zone, as it does in many of the other Turrum wells. This zone was recognized with certainty in Marlin-2, Turrum-4, Turrum-3, Turrum-5, and Turrum-2 (Davies, 1995 and 1996). Subzone Re2 was not differentiated in this well.

Pink SB picked at 3060 m occurs between zones Re and Rf. In the other Turrum wells, it typically sits within the top of Zone Rf. The top of the Rf was recognized in sample 3103 to 3112 m, but may go higher into the poorly fossiliferous, indeterminate section up to 3054 m. MFS "A" picked by EAL at 3145 m occurs within the basal part of Zone Rf.

The top of Zone Rg, which generally sits close to 450 Marker, probably occurs first in sample 3203 to 3212 m. It was identified with certainty in the four of the Turrum field wells, Turrum-4, Turrum-3, Turrum-2, Turrum-5, and Marlin-4 (Davies, 1995; 1996). The 450 Marker is placed at 3213 m within Rg.

The top of Upper Maastrichtian Palynozone Ma typically appears beneath the Oriental Blue SB at the base of the section. It is provisionally placed within sample 3273 to 3286 m based on the occurrences of very rare fossils that are restricted to the Maastrichtian or lower. The Oriental Blue SB was picked by EAL at 3299 m, but possibly may be as high as about 3275 or 3250 m.

## PALEOENVIRONMENTS

Results indicate that deposition of the interval studied from the Marlin A24 well took place in a non-marine to marginal marine environment with periodic and short-lived marine floods. The middle and upper portions of the reservoir sequence above about 3011 m appeared to have experienced more numerous and extensive flooding, whereas the basal part of the section contains fewer marine records. Although most of the shales associated with the reservoir sands, above sample 3011 to 3014 m, contain some fossils indicative of marine influence, three horizons were identified that contain rich, relatively diverse marine palynomorph assemblages. These occur near the Near Top L-200 and MFS "B" SB surfaces at 2844 to 2849, 2856 to 2868, and 2981 to 2993 m. These samples contain a more diverse dinoflagellate flora and a few *Spiniferites* spp., which are generally indicative of open marine conditions. These flooding events also were recognized near the Near Top L-200 surface in Turrum-1, Marlin-4, Turrum-3,

Turrum-5, and Turrum-6, and near the MFS "B" SB in Turrum-1, Turrum-3, and Turrum-4 (Davies, 1995; 1996). Appendix A gives the sample-by-sample interpretation of the paleoenvironments.

## **RECOMMENDATIONS**

Because of common cavings and/or mud contamination, we recommend studying a few SWC's, if they exist, in the upper part of the well to improve our confidence of the tops of zones Ra, Rb, Rc, and possibly Rd. If previously processed SWC microscope slides exist, they may provide some useful data, as well.

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**APPENDIX A**

**Sample-by-Sample Description**

## Appendix A

### MARLIN A24 BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL SUMMARY

#### Lower Eocene (Zone Sz) (2575-2594 m)

2575-2594

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C); amorphous (VA); biodegraded terr. (C); S/P (A);  
dinoflagellates (VA); pyrite (R-F)  
Spiniferites spp. (D)(VR)  
Achomosphaera spp. (D)(VR)  
?Spinidinium-type (D)(R)  
Senegalinium dilwynense (D)(F)  
?Apectodinium spp. (D)(A)  
Apectodinium quinquelatum (D)(R)  
Apectodinium parvum (D)(R)  
Apectodinium homomorphum (D)(F)  
Nothofagidites spp. (SP)(F)  
Nothofagidites emarcidus-heterus (SP)(R)  
Nothofagidites endurus (SP)(F)  
Nothofagidites goniatus (SP)(VR)  
Australopollis obscurus (SP)(F-R)  
Malvacipollis subtilis (SP)(VR)  
Proteacidites spp. (SP)(F)  
Ephedripites spp. (SP)(VR)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(F)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(A)  
Botryococcus spp. (R)

#### Lower Eocene-Upper Paleocene (Zone Sz/Ra?) (2597-2615 m)

2597-2615

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C-A); amorph. (C-A, decrease); biodegrad. terr. (C-A); S/P  
(A); dinoflagellates (VA); pyrite (F)  
Spiniferites spp. (D)(VR)  
Senegalinium dilwynense (D)(F)  
?Apectodinium spp. (D)(A)

Apectodinium quinquelatum (D)(R, caved?)  
 Apectodinium parvum (D)(R)  
 Apectodinium homomorphum (D)(R)  
 Eisenackia crassitabulata(D)(VR, ?reworked)  
 Turbiosphaera cf. galeata (D) (R)  
 Cordosphaeridium inodes (D) (R)  
 Cordosphaeridium cf. multispinosum (D)(R)  
 Diphyes colligerum (D)(VR)  
 Spinozonocolpites prominatus (SP)(R, caved?)  
 Nothofagidites spp. (SP)(R-F)  
 Australopollis obscurus (SP)(C-A, increase)  
 Intratriporopollenites notabilis (SP)(VR, caved?)  
 Proteacidites spp. (SP)(F)  
 Proteacidites dilwynensis (SP)(R, caved?)  
 ?Proteacidites angulatus (SP)(R)  
 Proteacidites adenanthoides (SP)(R)  
 Gambierina rudata (SP)(R)  
 Malvacipollis subtilis (SP)(VR)  
 Malvacipollis diversus (SP)(R)  
 Ephedripites spp. (SP)(VR)  
 Stereisorites antiquasporites (SP) (R)  
 Stereisorites (Tripunctisporis) (SP)(VR)  
 Phyllocladidites mawsonii (SP)(F)  
 Phyllocladidites microsaccatus (SP)(F-C)  
 Podosporites antarcticus (SP)(R)  
 Lygistipollenites balmei (SP)(F)  
 Lygistipollenites florinii (SP)(F)  
 Bisaccates (SP) (A)  
 Botryococcus spp. (algal)(R-F)

**Upper Paleocene (Probably Zone Rb)**  
 (2633-2722 m)

2633-2649

Paleoenvironment: marginal marine to marine  
 Kerogen: woody/coalay (C-A); amorph. (A-C); biodegrad. terr. (C-A); S/P (A);  
 dinoflagellates (VA); pyrite (F)  
 Spiniferites spp. (D)(VR)  
 Spiniferites septatus (D)(VR)  
 Senegalinium dilwynense (D)(F)  
 ?Apectodinium spp. (D)(A)  
 Apectodinium quinquelatum (D)(R, caved?)  
 Apectodinium parvum (D)(R)  
 Apectodinium homomorphum (D)(F)  
 Cerodinium sp. S (D)(VR-R)  
 Paleocystodinium golzowense (D)(R)  
 Glaphyrocysta spp. (D)(F)  
 Glaphyrocysta retiintexta (D)(F)  
 Cordosphaeridium cf. multispinosum (D)(R)  
 Gambierina rudata (SP)(R)  
 Gambierina edwardsii (SP)(VR)  
 Spinozonocolpites prominatus (SP)(F-R, caved?)  
 Cupanieidites orthoteichus (SP)(R, caved?)  
 Nothofagidites spp. (SP)(F)  
 Nothofagidites emarcidus-heterus (SP)(R)



Nothofagidites endurus (SP)(R)  
 Australopollis obscurus (SP)(C-A)  
 Triporopollenites ambiguus (SP)(VR, caved?)  
 Malvacipollis subtilis (SP)(R, caved?)  
 Anacolosidites acutullus (SP)(VR, caved?)  
 Proteacidites spp. (SP)(F)  
 Ephedripites spp. (SP)(VR)  
 Stereisorites antiquasporites (SP)(R)  
 Verrucatosporites usmensis (SP)(VR)  
 Verrucosporites kopukuensis (SP)(VR, caved?)  
 Phyllocladidites mawsonii (SP)(F)  
 Phyllocladidites microsaccatus (SP)(F-C)  
 Podosporites antarcticus (SP)(R)  
 Lygistipollenites balmei (SP)(R-F)  
 Lygistipollenites florinii (SP)(R)  
 Bisaccates (SP)(A)  
 Botryococcus spp. (algal)(R-F)

2649-2664

Paleoenvironment: marginal marine to marine  
 Kerogen: woody/coaly (C-A); amorph. (C); biodegrad. terr. (C-A); S/P (VA);  
 dinoflagellates (A-C); pyrite (C)  
 Spiniferites spp. (D)(VR)  
 Spiniferites septatus (D)(VR)  
 Senegalinium dilwynense (D)(R)  
 Spinidinium spp. (D)(VR)  
 ?Apectodinium spp. (D)(A)  
 Apectodinium cf. quinquelatum (D)(VR, caved?)  
 Apectodinium homomorphum (D)(F)  
 Cerodinium sp. S (D)(VR-R)  
 Paleocystodinium golzowense (D)(VR)  
 ?Alisocysta sp. (D) (R)  
 Glaphyrocysta spp. (D) (R)  
 Glaphyrocysta retiintexta (D)(F)  
 Diphyes colligerum (D)(VR)  
 Fibrocysta bipolaris (D)(VR)  
 Gambierina rudata (SP)(R)  
 Spinozonocolpites prominatus (SP)(R, caved?)  
 Nothofagidites spp. (SP)(F)  
 Nothofagidites cf. brachyspinulosus (SP)(VR)  
 Nothofagidites endurus (SP)(R)  
 Australopollis obscurus (SP)(C)  
 Malvacipollis subtilis (SP)(R, caved?)  
 Schizocolpus marlinensis (SP)(VR, caved?)  
 Proteacidites spp. (SP) (F-C)  
 Proteacidites grandis (SP) (R, caved?)  
 Proteacidites dilwyensis (SP)(R, caved?)  
 Proteacidites angulatus (SP)(VR-R)  
 Proteacidites adenanthoides (SP)(R)  
 Polycolpites esobalteus (SP)(VR, caved?)  
 Herkosporites elliotii (SP)(VR)  
 Verrucatosporites usmensis (SP) (VR)  
 Stereisorites antiquasporites (SP) (F)  
 Phyllocladidites mawsonii (SP) (F)  
 Phyllocladidites microsaccatus (SP) (F-C)

Lygistipollenites balmei (SP) (F)  
Bisaccates (SP) (A)  
Botryococcus spp. (algal) (VR)

2691-2700

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C-A); amorph. (F-C); biodegrad. terr. (C-A); S/P (VA);  
dinoflagellates (A); pyrite (C)  
Spiniferites spp. (D)(R)  
Senegalinium dilwynense (D)(F)  
Spinidinium spp. (D)(R)  
?Apectodinium spp. (D)(A)  
Apectodinium quinquelatum (D)(VR, caved?)  
Apectodinium parvum (D)(R)  
Apectodinium homomorphum (D)(F)  
Cerodinium spp. (D)(R)  
Cerodinium sp. S (D)(R)  
Paleocystodinium australinum (D)(R)  
Alisocysta sp. 2 (D)(R)  
Alisocysta cf. circumtabulata (D)(VR)  
Glaphyrocysta retiintexta (D)(VR)  
Cordosphaeridium gracile (D)(R)  
Spinozonocolpites prominatus (SP)(R, caved?)  
Nothofagidites spp. (SP)(F-R)  
Nothofagidites emarcidus-heterus (SP)(R)  
Nothofagidites cf. brachyspinulosus (SP)(R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(C)  
Proteacidites spp. (SP)(C)  
Proteacidites angulatus (SP)(R)  
Proteacidites dilwynensis (SP)(frag., caved?)  
Intratropipollenites notabilis (SP)(VR, caved?)  
Ephedripites spp. (SP)(R-F)  
Stereisporites antiquasporites (SP)(R-F)  
Stereisporites (Tripunctisporis) (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP) (F)  
Lygistipollenites balmei (SP)(R-F)  
Bisaccates (SP)(C)  
Botryococcus spp. (algal)(VR)

2703-2713

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (F); amorph. (A-C); biodegrad. terr. (C-A); S/P (VA);  
dinoflagellates (R-F); pyrite (C-A)  
Spiniferites spp. (D)(VR)  
Spiniferites septatus (D)(VR)  
Senegalinium dilwynense (D)(R)  
?Apectodinium spp. (D)(F-C)  
Apectodinium homomorphum (D)(R)  
Cerodinium spp. (D)(R)  
Glaphyrocysta pastielsii (D)(VR)  
Paleocystodinium golzowense (D)(R)  
Diphyes colligerum (D)(VR)  
Cordosphaeridium spp (D)(VR)  
Nothofagidites spp. (SP)(F-R)

Nothofagidites emarcidus-heterus (SP)(R)  
Nothofagidites endurus (SP)(R)  
Malvacipollis diversus (SP)(R, caved?)  
Australopollis obscurus (SP)(A)  
Proteacidites spp. (SP)(C)  
Proteacidites angulatus (SP)(F)  
Tricolpites gillii (SP)(R)  
Stereisporites antiquasporites (SP)(F)  
Stereisporites (Tripunctisporis) (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R-F)  
Bisaccates (SP)(C)  
Botryococcus spp. (algal)(R)

2713-2722

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C); amorph. (F-C); biodegrad. terr. (C-A); S/P (A);  
dinoflagellates (VA); pyrite (C-A); preservation, poor  
Senegalinium dilwynense (D)(C-A)  
Spinidium spp. (D)(R)  
?Apectodinium spp. (D)(A)  
Apectodinium quinquelatum (D)(VR, caved?)  
Apectodinium homomorphum (D)(F)  
Cerodinium spp. (D)(R)  
Cerodinium sp. S (D)(F-R)  
Deflandrea spp. (D)(R)  
Paleocystodinium golzowense (D)(R-F)  
Glaphyrocysta retiintexta (D)(VR)  
Turbiosphaera galeata (D)(VR)  
Spinizonocolpites prominatus (SP)(R, caved?)  
Nothofagidites spp. (SP)(R-F)  
Nothofagidites endurus (SP)(R)  
Nothofagidites emarcidus-heterus (SP)(R-F)  
Australopollis obscurus (SP)(C-A)  
Gambierina rudata (SP)(VR)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(R)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R-F)  
Bisaccates (SP)(C)

**Upper Paleocene (Zone Rb)**  
(2725-2758 m)

2725-2740

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (C); amorph. (F-C); biodegrad. terr. (C-A); S/P (A);  
dinoflagellates (A); pyrite (C)  
Appear to be fewer caving from this sample downwards  
Spiniferites spp. (D) (indicative of open marine) (VR)  
Senegalinium dilwynense (D) (C-A)

?Apectodinium spp. (D)(A)  
Apectodinium homomorphum (D)(F)  
Cerodinium spp. (D)(R)  
Cerodinium sp. S (D)(R)  
Paleocystodinium golzowense (D)(F-C)  
?Alisocysta sp. (D)(VR)  
Glaphyrocysta retiintexta (D)(F-C)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R-F)  
Bisaccates (SP)(C)  
Botryococcus spp. (algal)(R-F)

2746-2758

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C-A); amorphous (F); biodegraded terr. (A); S/P (C);  
dinoflagellates (C); pyrite (F-C)  
Spiniferites spp. (D)(VR)  
Senegalinium dilwynense (D)(C-F)  
?Apectodinium spp. (D)(C)  
Apectodinium homomorphum (D)(R)  
Cerodinium sp. S (D)(R)  
Paleocystodinium golzowense (D)(R)  
Glaphyrocysta. retiintexta (D)(F)  
Nothofagidites spp. (SP)(R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(F)  
Proteacidites spp. (SP) F  
?Tetracolporites verrucosus (SP)(VR)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Bisaccates (SP)(F)

**Upper Paleocene (Zone Rc)**  
(2774-2810 m)

2774-2783

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (A); amorphous (F-C); biodegraded terr. (A); S/P (A);  
dinoflagellates (VA); pyrite (F-C)  
Spiniferites spp. (D) (VR)  
?Spinidinium-type (D)(R)  
Senegalinium dilwynense (D)(A)  
?Apectodinium spp. (D)(C-A)  
Apectodinium parvum (D)(VR, caved)  
Apectodinium homomorphum (D)(R)  
Cerodinium sp. S (D) (F, increase)  
Paleocystodinium golzowense (D)(F-C)  
Glaphyrocysta retiintexta (D)(C-F)  
Gambierina edwardsii (SP) (R)  
Nothofagidites spp. (SP)(F)

Nothofagidites emarcidus-heterus (SP)(R)  
Nothofagidites endurus (SP) (R)  
Australopollis obscurus (SP)(C-A, increase)  
Proteacidites spp. (SP)(F-C)  
Proteacidites angulatus (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(R)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Bisaccates (SP)(C-A)

2801-2810

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (A); amorphous (F-C); biodegraded terr. (A); S/P (A);  
dinoflagellates (C-F, decrease); pyrite (F-C)  
Senegalinium dilwynense (D)(C-F)  
?Apectodinium spp. (D)(C-F)  
Apectodinium homomorphum (D)(R)  
Cerodinium spp. (D) (R)  
Cerodinium sp. S (D)(R)  
Paleocystodinium golzowense (D)(R-F)  
Glaphyrocysta retiintexta (D)(F-C)  
Nothofagidites spp. (SP)(F-R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(C-A)  
Proteacidites spp. (SP)(F)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(R)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Bisaccates (SP)(C-A)

**Indeterminate**  
(2822-2838 m)

2823.2-2838.4

Paleoenvironment: nonmarine to ?marginal marine  
Kerogen: woody/coaly (VA); amorphous (R-F); biodegraded terr. (F); S/P (F);  
dinoflagellates (VR, decrease); pyrite (F-C)  
?Apectodinium spp. (D) (VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(R-F)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podospirites antarcticus (SP)(R)  
Bisaccates (SP)(F-C)

**Lower Paleocene (Zone Rd1)**  
(2844-2868 m)

2844-2849

Paleoenvironment: marine to marginal marine  
Kerogen: woody/coaly (VA); amorph. (F-R); biodegraded terr. (F); S/P (C);  
dinoflagellates (VA, increase); pyrite (F-C)  
Spiniferites spp. (D)(R)  
Spiniferites septatus (D)(VR)  
?Spinidinium-type (D)(R)

Spinidinium cf. densispinatum (D)(A)  
Vozzhenikovia spp. (D)(F-C)  
Senegalinium dilwynense (D)(C-F)  
?Apectodinium spp. (D)(R)  
Cerodinium spp. (D)(R)  
Cerodinium sp. S (D)(R)  
Deflandrea-type spp. (D)(R)  
Glaphyrocysta retiintexta (D)(C)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(R-F)  
Proteacidites angulatus (SP)(R)  
Tricolpites sp. L (SP)(R)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Bisaccates (SP)(F-C)

2856-2868

Paleoenvironment: marine to marginal marine  
Kerogen: woody/coaly (C-A); amorphous (C); biodegraded terr. (C); S/P (A);  
dinoflagellates (VA); pyrite (C)  
Spiniferites spp. (D)(R)  
Spinidinium cf. densispinatum (D) (A)  
Vozzhenikovia spp. (D)(F-C)  
Senegalinium dilwynense (D) (C-F)  
?Apectodinium spp. (D) (F-C)  
Apectodinium homomorphum (D)(VR, caved?)  
Cerodinium sp. S (D)(R)  
Isabelidinium bakeri (D)(VR)  
Isabelidinium cingulatum (D)(R)  
Glaphyrocysta retiintexta (D)(C)  
?Turbiosphaera galeata (D)(R)  
Nothofagidites spp. (SP)(R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(F)  
Proteacidites spp. (SP)(F)  
Stereisporites antiquasporites (SP)(R)  
Stereisporites (Tripunctisporis) (SP)(R)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R-F)  
Bisaccates (SP)(F-C)

**Indeterminate**  
(2871-2899 m)

2871-2880

Paleoenvironment: nonmarine to marginal marine  
Kerogen: woody/coaly (VA); amorphous (F); biodegraded terr. (F); S/P (F-C);  
dinoflagellates (VR); pyrite (C)  
Senegalinium dilwynense (D)(R)  
?Apectodinium spp. (D)(VR)  
Nothofagidites spp. (SP)(VR)

Australopollis obscurus (SP)(F-R)  
Proteacidites spp. (SP)(F)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podosporites antarcticus (SP)(R)  
Bisaccates (SP)(F)

2889-2899

Paleoenvironment: nonmarine to marginal marine  
Kerogen: woody/coaly (VA); amorphous (R-F); biodegraded terr. (F); S/P (C);  
dinoflagellates (R); pyrite (A)  
Spinidinium cf. densispinatum (D)(R)  
Senegalinium dilwynense (D)(R)  
?Apectodinium spp. (D)(R)  
Nothofagidites spp. (SP)(VR)  
Australopollis obscurus (SP)(F-R)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(R)  
Stereisporites antiquasporites (SP)(R-F)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(R)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(F)

**Lower Paleocene (Zone Rd2)**

(2905-2944 m)

2905-2917

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (F); S/P (A);  
dinoflagellates (F-C); pyrite (C)  
Spiniferites spp. (D)(R)  
Spiniferites septatus (D)(VR)  
?Spinidinium-type (D)(R)  
Spinidinium cf. densispinatum (D)(F)  
Vozzhenikovia spp. (D)(F)  
Senegalinium dilwynense (D)(F)  
?Apectodinium spp. (D)(F-C)  
Apectodinium homomorphum (D)(VR, caved?)  
Alisocysta circumtabulata (D)(VR)  
Glaphyrocysta retiintexta (D)(R-F)  
Nothofagidites spp. (SP)(R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(F-R)  
Proteacidites spp. (SP)(F-C)  
Proteacidites angulatus (SP)(R)  
Tricolpites gillii (SP)(R)  
Stereisporites antiquasporites (SP)(R-F)  
Stereisporites (Tripunctisporis) (SP)(R)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

2929-2944

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (F); S/P (C);  
dinoflagellates (F); pyrite (C)  
Spinidium cf. densispinatum (D)(R)  
Senegalinium dilwynense (D)(R-F)  
?Apectodinium spp. (D)(F)  
Glaphyrocysta retiintexta (D)(VR)  
Nothofagidites spp. (SP)(R)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(R)  
Proteacidites adenanthoides (SP)(VR)  
Stereisporites antiquasporites (SP)(R-F)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

**Probably Lower Paleocene (Zone Re)**  
(2960-2972 m)

2960-2972

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (F); S/P (C);  
dinoflagellates (C); pyrite (C); preservation, poor  
Spiniferites septatus (D)(VR)  
Spinidium cf. densispinatum (D)(F-C)  
Vozzhenikovia spp. (D)(R-F)  
Senegalinium dilwynense (D)(R-F)  
?Apectodinium spp. (D)(C)  
Apectodinium quinquelatum (D)(R, caved?)  
Apectodinium homomorphum (D)(R-F, caved?)  
Cerodinium sp. S (D)(F)  
Glaphyrocysta retiintexta (D)(R-F)  
Paleocystodinium golzowense (D)(VR)  
Nothofagidites spp. (SP)(R)  
Nothofagidites endurus (SP)(R)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)  
Tricolpites gillii (SP)(R)  
Verrucatosporites usmensis (SP)(VR)  
Stereisporites antiquasporites (SP)(R-F)  
Stereisporites (Tripunctisporis) (SP)(VR)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(C)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

**Lower Paleocene (Zone Re)**  
(2981-2993 m)

2981-2993

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (F); S/P (A);  
dinoflagellates (C-A); pyrite (F); preservation, fair-poor



Spiniferites spp. (D)(F)  
 Spiniferites septatus (D)(R-F)  
 Spinidinium cf. densispinatum (D)(A)  
 Vozhenikovia spp. (D)(F)  
 Senegalinium dilwynense (D)(R-F)  
 ?Apectodinium spp. (D)(C)  
 Apectodinium quinquelatum (D)(R, caved)  
 Apectodinium parvum (D)(R, caved)  
 Apectodinium homomorphum (D)(R, caved)  
 Cerodinium sp. S (D)(F-C)  
 Alisocysta sp. 2 (D)(VR)  
 ?Glaphyrocysta retiintexta (D)(R)  
 Cordosphaeridium spp (D)(R)  
 Nothofagidites spp. (SP)(R)  
 Nothofagidites endurus (SP)(R)  
 Australopollis obscurus (SP)(R-F)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(VR)  
 Proteacidites dilwynensis (SP)(frag., caved)  
 Tricolpites gillii (SP)(VR)  
 Stereisorites antiquasporites (SP)(R-F)  
 Phyllocladidites mawsonii (SP)(R)  
 Phyllocladidites microsaccatus (SP)(C)  
 Lygistipollenites florinii (SP)(R)  
 Bisaccates (SP)(C)

**Indeterminate**  
 (3011-3014 m)

3011-3014

Paleoenvironment: prob. nonmarine  
 Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (R); S/P (VA);  
 dinoflagellates (VR-R); pyrite (C); preservation, poor  
 Spinidinium cf. densispinatum (D)(VR)  
 Apectodinium parvum (D)(R, caved)  
 Apectodinium homomorphum (D)(R, caved)  
 Nothofagidites spp. (SP)(R)  
 Nothofagidites brachyspinulosus (SP)(R)  
 Australopollis obscurus (SP)(R-F)  
 Proteacidites spp. (SP)(F)  
 Stereisorites antiquasporites (SP)(F)  
 Phyllocladidites mawsonii (SP)(R)  
 Phyllocladidites microsaccatus (SP)(C)  
 Lygistipollenites balmei (SP)(R-F)  
 Bisaccates (SP)(C)

**Possibly Lower Paleocene**  
 (3017-3024 m)

3017-3024

Paleoenvironment: nonmarine to marginal marine  
 Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F-C); S/P (VA);  
 dinoflagellates (F-R); pyrite (F-C); preservation, poor  
 Spiniferites spp. (D)(R)  
 Spiniferites septatus (D)(R)  
 Spinidinium cf. densispinatum (D)(F)

Vozzhenikovia spp. (D)(R)  
 Senegalinium dilwynense (D)(F)  
 ?Apectodinium spp. (D)(R)  
 Apectodinium quinquelatum (D)(R, caved?)  
 Apectodinium homomorphum (D)(VR, caved)  
 Cerodinium spp. (D)(VR)  
 Cordosphaeridium spp (D)(R)  
 Nothofagidites spp. (SP)(R)  
 Australopollis obscurus (SP)(C)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(VR)  
 Stereisorites antiquasporites (SP)(F)  
 Phyllocladidites mawsonii (SP)(R)  
 Phyllocladidites microsaccatus (SP)(C)  
 Lygistipollenites balmei (SP)(R-F)  
 Lygistipollenites florinii (SP)(R)  
 Bisaccates (SP)(C)

**Indeterminate**  
 (3054-3100 m)

3054-3060

Paleoenvironment: prob. nonmarine  
 Kerogen: woody/coaly (A); amorphous (C-A); biodegraded terr. (F-C); S/P (A);  
 dinoflagellates (VR); pyrite (F-C); preservation, poor  
 ?Apectodinium spp. (D)(VR)  
 Nothofagidites spp. (SP)(VR)  
 Nothofagidites endurus (SP)(VR)  
 Australopollis obscurus (SP)(C)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(R)  
 Tricolpites gillii (SP)(VR)  
 Stereisorites antiquasporites (SP)(F)  
 Phyllocladidites mawsonii (SP)(R)  
 Phyllocladidites microsaccatus (SP)(C)  
 Fern spores (SP)(C)  
 Bisaccates (SP)(C)  
 Botryococcus spp. (algal)(R)

3060-3069

Paleoenvironment: prob. nonmarine to marginal marine  
 Kerogen: woody/coaly (C-A); amorph. (C-A); biodegrad. terr. (F-C); S/P (A);  
 dinoflagellates (VR); pyrite (F-C); preservation, poor  
 Senegalinium dilwynense (D)(VR)  
 ?Apectodinium spp. (D)(VR)  
 Apectodinium homomorphum (D)(VR, caved)  
 ?Cordosphaeridium spp (D)(VR)  
 Isabelidinium cf. bakeri (D)(VR)  
 Gambierina rudata (SP)(R)  
 Australopollis obscurus (SP)(C)  
 Proteacidites spp. (SP)(F)  
 Tricolpites spp.(SP)(VR)  
 ?Tetracolporites verrucosus (SP)(VR)  
 Stereisorites antiquasporites (SP)(F)  
 Phyllocladidites mawsonii (SP)(R)  
 Phyllocladidites microsaccatus (SP)(C)

Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

3091-3100

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (F); S/P (A);  
dinoflagellates (VR); pyrite (F); preserv., fair-poor; cavings/mud contam (C)  
Senegalinium dilwynense (D)(VR)  
?Apectodinium spp. (D)(R)  
Apectodinium quinquelatum (D)(R, caved)  
Glaphyrocysta spp. (D)(VR)  
Gambierina rudata (SP)(R)  
Nothofagidites endurus (SP)(VR)  
Australopollis obscurus (SP)(F-R)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(R-F)  
Tetracolporites verrucosus (SP)(R-F)  
Tricolpites gillii (SP)(R)  
Ephedripites spp. (SP)(R)  
Stereisporites antiquasporites (SP)(R-F)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(C)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

**Lower Part of Lower Paleocene (Zone Rf)**  
(3103-3176 m)

3103-3112

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (R); S/P (VA);  
dinoflagellates (VR); pyrite (F); preserv., fair; cavings/mud contam (R)  
Senegalinium dilwynense (D)(VR)  
?Apectodinium spp. (D)(R)  
Gambierina rudata (SP)(R)  
Gambierina edwardsii (SP)(R)  
Nothofagidites spp. (SP)(R)  
Australopollis obscurus (SP)(R)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP) (F-C)  
Tetracolporites verrucosus (SP)(F)  
Tricolpites sp. L (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Ephedripites spp. (SP)(R-F)  
Herkosporites elliottii (SP)(VR)  
Stereisporites antiquasporites (SP)(F-C)  
Phyllocladidites mawsonii (SP)(R)  
Phyllocladidites microsaccatus (SP)(C)  
Podospores antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

3118-3124

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (R); S/P (VA);  
dinoflagellates (VR); pyrite (F); preserv., fair; cavings/mud contam (VR)  
Spinidinium cf. densispinatum (D)(VR)  
Senegalinium dilwynense (D)(VR)  
?Apectodinium spp. (D)(VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(F)  
Tetracolporites verrucosus (SP)(F)  
Tricolpites gillii (SP)(R)  
Tricolpites spp. (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Ephedripites spp. (SP)(R-F)  
Stereisporites antiquasporites (SP)(F-C)  
Phyllocladidites mawsonii (SP)(F-R)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(R)  
Bisaccates (SP)(C)

3133-3139

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (C); amorphous (VA-A); biodegraded terr. (R); S/P (A);  
dinoflagellates (F; caved?); pyrite (F); preserv., fair; cavings/mud contam (F-C)  
Senegalinium dilwynense (D)(R-F)  
?Apectodinium spp. (D)(R-F)  
Apectodinium quinquelatum (D)(VR, caved)  
Paleocystodinium golzowense (D)(VR, caved)  
Nothofagidites spp. (SP)(VR)  
Gephyrapollenites wahooensis (SP)(VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(F)  
Tetracolporites verrucosus (SP)(F-R)  
Tricolpites gillii (SP)(R)  
Tricolpites spp. (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Ephedripites spp. (SP)(R)  
Stereisporites antiquasporites (SP)(F)  
Phyllocladidites mawsonii (SP)(F-R)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Bisaccates (SP)(C)

3145- 3155

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (F); S/P (A);  
dinoflagellates (R; caved?); pyrite (F-C); preserv., fair; cavings/mud contam (F-C)  
Senegalinium dilwynense (D)(VR; caved?)  
?Apectodinium spp. (D)(R-F)  
Nothofagidites spp. (SP)(VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)

Proteacidites angulatus (SP)(F)  
Tetracolporites verrucosus (SP)(F)  
Tricolpites gillii (SP)(R)  
Tricolpites spp. (SP)(F)  
Tricolpites sp. L (SP)(R)  
Stereisporites antiquasporites (SP)(F)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(VR)  
Bisaccates (SP)(C)

3170- 3176

Paleoenvironment: prob. nonmarine  
Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (R); S/P (A);  
dinoflagellates (R-VR; caved?); pyrite (F-C); preserv., fair; cavings/mud contam (R)  
Senegalinium dilwynense (D)(R; caved?)  
?Apectodinium spp. (D)(R, caved?)  
Nothofagidites spp. (SP)(VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(F)  
Tetracolporites verrucosus (SP)(F)  
Tricolpites gillii (SP)(R)  
Tricolpites spp. (SP)(F)  
?Tricolpites cf. confessus (SP)(VR)  
Ephedripites spp. (SP)(R)  
Stereisporites antiquasporites (SP)(F)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podospirites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(VR)  
Bisaccates (SP)(C)

**Lowest Paleocene to Upper Maastrichtian (Zone Rg)**  
(3203-3225 m)

3203- 3212

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (A);  
dinoflagellates (F-C); pyrite (F-C); preserv., poor; cavings/mud contam (C-F)  
Spiniferites spp. (D)(VR)  
Senegalinium dilwynense (D)(R-F; caved?)  
?Apectodinium spp. (VD)(R-F, caved?)  
Apectodinium homomorphum (D)(R-F, caved)  
Cerodinium sp. S (D)(R, caved?)  
Paleocystodinium golzowense (D)(R)  
Glaphyrocysta spp. (D)(R)  
Glaphyrocysta retiintexta (D)(R, caved?)  
Hystrichosphaeridium sp. T (D)(R)  
Cordosphaeridium spp (D)(VR)  
Nothofagidites spp. (SP)(VR)  
Australopollis obscurus (SP)(R-F)  
Proteacidites spp. (SP)(F)

Proteacidites angulatus (SP)(R-F)  
Tetracolporites verrucosus (SP)(R)  
Tricolpites gillii (SP)(R-F)  
Tricolpites spp. (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Ephedripites spp. (SP)(R)  
Stereisporites antiquasporites (SP)(F)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Lygistipollenites florinii (SP)(VR)  
Bisaccates (SP)(C)

3216- 3225

Paleoenvironment: marginal marine  
Kerogen: woody/coaly (A-C); amorphous (C); biodegraded terr. (C); S/P (A);  
dinoflagellates (F); pyrite (C-A); preserv., poor; cavings/mud contam (C)  
Spiniferites spp. (D)(R)  
Spiniferites septatus (D)(VR)  
Spinidinium cf. densispinatum (D)(VR, caved?)  
Senegalinium dilwynense (D)(F; caved?)  
?Apectodinium spp. (VD)(R-F, caved?)  
Apectodinium quinquelatum (D)(R, caved)  
Apectodinium homomorphum (D)(R-F, caved)  
Cerodinium sp. S (D)(R, caved?)  
Isabelidinium cf. bakeri (D)(VR)  
Paleocystodinium golzowense (D)(R)  
Glaphyrocysta spp. (D)(R)  
Glaphyrocysta retiintexta (D)(R)  
Cordosphaeridium spp (D)(VR)  
Nothofagidites spp. (SP)(VR)  
Australopollis obscurus (SP)(F-C)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(F)  
Tetracolporites verrucosus (SP)(R)  
Tricolpites gillii (SP)(R-F)  
Tricolpites spp. (SP)(R)  
Tricolpites cf. confessus (SP)(VR)  
Stereisporites antiquasporites (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R-F)  
Lygistipollenites florinii (SP)(VR)  
Bisaccates (SP)(C)

**Indeterminate**  
(3231-3261 m)

3231- 3240

Paleoenvironment: nonmarine to marginal marine  
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (C); S/P (A);  
dinoflagellates (F); pyrite (C-A); preserv., poor; cavings/mud contam (C)  
Senegalinium dilwynense (D)(F; caved?)  
?Apectodinium spp. (VD)(R-F, caved?)

Apectodinium homomorphum (D)(R-F, caved)  
 Glaphyrocysta retiintexta (D)(R, caved?)  
 Gephyrapollenites wahooensis (SP)(VR)  
 Australopollis obscurus (SP)(F)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(R)  
 Tricolpites gillii (SP)(R-F)  
 Tricolpites spp. (SP)(R)  
 Ephedripites spp. (SP)(R)  
 Stereisorites antiquasporites (SP)(R)  
 Phyllocladidites mawsonii (SP)(F)  
 Phyllocladidites microsaccatus (SP)(F-C)  
 Podosporites antarcticus (SP)(R)  
 Lygistipollenites balmei (SP)(R-F)  
 Lygistipollenites florinii (SP)(R)  
 Bisaccates (SP)(C)

3246- 3261

Paleoenvironment: marginal marine to nonmarine  
 Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (C); S/P (A);  
 dinoflagellates (F); pyrite (VA); preserv., v. poor; cavings/mud contam (C)  
 Spinidinium cf. densispinatum (D)(VR, caved?)  
 Senegalinium dilwynense (D)(F-C; caved?)  
 ?Apectodinium spp. (VD)(R-F, caved?)  
 Apectodinium homomorphum (D)(R-F, caved)  
 Cerodinium sp. S (D)(R, caved?)  
 Paleocystodinium golzowense (D)(R)  
 Glaphyrocysta retiintexta (D)(R, caved?)  
 Cordosphaeridium spp (D)(VR)  
 Spinozonocolpites prominatus (SP)(R, caved)  
 Gambierina rudata (SP)(R)  
 Nothofagidites spp. (SP)(R)  
 Australopollis obscurus (SP)(R-F)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(R)  
 Tricolpites gillii (SP)(R)  
 Tricolpites spp. (SP)(R)  
 Stereisorites antiquasporites (SP)(R)  
 Stereisorites (Tripunctisporis) (SP)(R)  
 Phyllocladidites mawsonii (SP)(F)  
 Phyllocladidites microsaccatus (SP)(F-C)  
 Podosporites antarcticus (SP)(R)  
 Lygistipollenites balmei (SP)(R-F)  
 Lygistipollenites florinii (SP)(R)  
 Bisaccates (SP)(C)

**Probably Upper Maastrichtian (Zone Ma)**  
 (3273-3347 m)

3273- 3286

Paleoenvironment: marginal marine  
 Kerogen: woody/coaly (A); amorphous (C-A); biodegraded terr. (C); S/P (A);  
 dinoflagellates (F-C); pyrite (C-A); preserv., poor-fair; cavings/mud contam (A)  
 Spiniferites spp. (D)(R)  
 Senegalinium dilwynense (D)(F; caved?)  
 ?Apectodinium spp. (VD)(F-C, caved?)

Apectodinium quinquelatum (D)(R, caved)  
 Apectodinium homomorphum (D)(F, caved)  
 Paleocystodinium golzowense (D)(VR)  
 Glaphyrocysta retiintexta (D)(R)  
 Cordosphaeridium spp (D)(VR)  
 Spinozonocolpites prominatus (SP)(R, caved)  
 Intratriporopollenites notobilis (SP)(VR, caved)  
 Gambierina rudata (SP)(R)  
 Triporopollenites cf. sectilis (SP)(VR)  
 Nothofagidites spp. (SP)(F-R)  
 Australopollis obscurus (SP)(F)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(R)  
 Proteacidites amolosexinus (SP)(VR)  
 Tetracolporites verrucosus (SP)(R)  
 Tricolpites gillii (SP)(R)  
 Tricolpites spp. (SP)(F)  
 ?Tricolpites cf. confessus (SP)(VR)  
 Ornamentifera sentosa (SP)(VR)  
 Stereisorites antiquasporites (SP)(R)  
 Phyllocladidites mawsonii (SP)(F)  
 Phyllocladidites microsaccatus (SP)(F-C)  
 Podosporites antarcticus (SP)(R)  
 Lygistipollenites balmei (SP)(F)  
 Lygistipollenites florinii (SP)(R)  
 Latrobosporites spp. (SP)(R)  
 Bisaccates (SP)(C)

3258- 3317

Paleoenvironment: marginal marine  
 Kerogen: woody/coaly (A); amorphous (C-A); biodegraded terr. (C-A); S/P (A);  
 dinos. (A, caved?); pyrite (C-A); preserv., poor; cavings/mud contam (C)  
 Spiniferites spp. (D)(R)  
 Spinidinium cf. densispinatum (D)(VR, caved?)  
 Senegalinium dilwynense (D)(F-C; caved?)  
 ?Apectodinium spp. (VD)(F-C, caved?)  
 Apectodinium quinquelatum (D)(R, caved)  
 Apectodinium homomorphum (D)(F, caved)  
 Cerodinium sp. S (D)(R, caved?)  
 Paleocystodinium golzowense (D)(VR)  
 Glaphyrocysta retiintexta (D)(F, caved?)  
 Areoligera spp. (D)(R-F)  
 Spinozonocolpites prominatus (SP)(R, caved)  
 Intratriporopollenites notobilis (SP)(VR, caved)  
 Gambierina edwardsii (SP)(R)  
 Nothofagidites spp. (SP)(F-C)  
 Australopollis obscurus (SP)(F-C)  
 Proteacidites spp. (SP)(F)  
 Proteacidites angulatus (SP)(R)  
 Proteacidites adenanthoides (SP)(VR)  
 Proteacidites grandis (SP)(VR, caved)  
 Tetracolporites verrucosus (SP)(R)  
 Tricolpites spp. (SP)(R-F)  
 Tricolpites cf. confessus (SP)(R)  
 Stereisorites antiquasporites (SP)(R)



Stereisporites (Tripunctisporis) (SP)(R)  
Phyllocladidites mawsonii (SP)(F)  
Phyllocladidites microsaccatus (SP)(F-C)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(F)  
Lygistipollenites florinii (SP)(F)  
Bisaccates (SP)(C)  
Botryococcus spp. (algal) (R)

3319- 3331

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (C-A); amorphous (A); biodegraded terr. (C); S/P (A);  
dinoflagellates (A, caved); pyrite (C); preserv., v. poor; cavings/mud contam (C-A)  
Spiniferites spp. (D)(F, caved?)  
Spinidium cf. densispinatum (D)(VR, caved?)  
Senegalinium dilwynense (D)(C-A; caved?)  
?Apectodinium spp. (VD)(F-C, caved?)  
Apectodinium quinquelatum (D)(R, caved)  
Apectodinium homomorphum (D)(F, caved)  
Cerodinium sp. S (D)(F, caved?)  
Paleocystodinium golzowense (D)(VR, piece)  
Glaphyrocysta retiintexta (D)(F)  
Spinozonocolpites prominatus (SP)(R, caved)  
Gambierina edwardsii (SP)(VR)  
Amosopollis cruciformis (SP)(VR)  
Nothofagidites spp. (SP)(R-F)  
Australopollis obscurus (SP)(F)  
Proteacidites spp. (SP)(F)  
Proteacidites angulatus (SP)(VR)  
Tricolpites spp. (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Stereisporites antiquasporites (SP)(R-F)  
Phyllocladidites mawsonii (SP)(R-F)  
Phyllocladidites microsaccatus (SP)(F)  
Podosporites antarcticus (SP)(R)  
Lygistipollenites balmei (SP)(R)  
Latrobosporites spp. (SP)(R)  
Bisaccates (SP)(C)

3337- 3347

Paleoenvironment: marginal marine to marine  
Kerogen: woody/coaly (A); amorphous (F); biodegraded terr. (C); S/P (A);  
dinoflagellates (C); pyrite (C); preserv., v. poor; cavings/mud contam (C)  
Spiniferites spp. (D)(F, caved?)  
Senegalinium dilwynense (D)(C-A; caved?)  
?Apectodinium spp. (VD)(F-C, caved?)  
Apectodinium homomorphum (D)(F, caved)  
Glaphyrocysta retiintexta (D)(R, caved?)  
Areoligera spp. (D)(R-F)  
Nothofagidites spp. (SP)(R)  
Australopollis obscurus (SP)(R)  
Proteacidites spp. (SP)(R)  
Proteacidites angulatus (SP)(VR)  
Proteacidites adenanthoides (SP)(VR)  
Proteacidites cf. reticuloconcaus (SP)(VR)  
Tricolpites gillii (SP)(R)

Tricolpites spp. (SP)(R)  
?Tricolpites cf. confessus (SP)(VR)  
Stereisporites antiquasporites (SP)(F)  
Phyllocladidites mawsonii (SP)(VR)  
Phyllocladidites microsaccatus (SP)(F-C)  
Bisaccates (SP)(C)