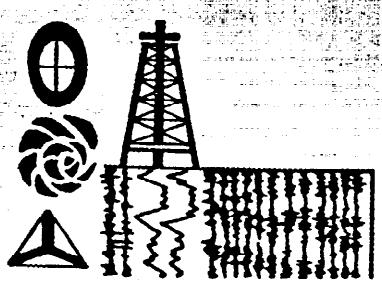
EXXON EXPLORATION COMPANY

Palynology, Paleoenvironments, and Biostratigraphic Zonation of the Marlin A6 Well, Gippsland Basin, Australia

Thomas D. Davies

TECHNOLOGY DEPARTMENT
GLOBAL STUDIES - GEOLOGICAL SERVICES DIVISION
BIOSTRATIGRAPHY SECTION

EEC.27A.BIO.96
JUNE, 1996



BIOSTRATIGRAPHY REPORT

UNCLASSIFIED

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EXECUTIVE SUMMARY

- The palynostratigraphy of the Marlin A6 well was studied to provide stratigraphic control based on age and stratigraphic position of cuttings and core samples from 2481 to 3289 m MD and environments of deposition from palynologic and biofacies evidence.

- Seven palynology zones and two subzones, ranging in age from early Eocene to early Paleocene, were differentiated for this well and tied to the other Turrum field wells studied. No definitive Late Cretaceous flora was observed. Very poor preservation, downhole cavings, abundant woody/coaly debris and mud additives, including walnut hulls, which dilute and mask index fossils, and limited marine palynomorphs, apparent due to the proximal position of this well, resulted in relatively low confidence in zonal assignments. Zonal bases are difficult to position, because of caving and poor preservation, and should be considered approximate.

- Palynology demonstrates that: 1) Blue Grey SB, picked by EAL at 2587 m, occurs just above the top of probable Zone Rb, 2) Bottle Green SB, at 2653 m, occurs within the base of Zone Rb, 3) MFS "E" SB, pick by EAL at 2716.5 m, falls within Zone Rc, as in the other Turrum field wells, 4) Near Top L-200, picked at 2750.5 m, sits within the top of the section tentatively assigned to subzone Rd1, 5) Naples Yellow SB, placed at 2844 m, occurs within subzone Rd2, 6) Zone Re contains a flooding event associated with the Pink sequence, 7) Pink SB, placed at 2992.5 m, is within the base Zones Re (in the other Turrum Field wells studied this surface occurs near the boundary between Re and Rf and frequently within the top of Rf), and 8) the 450 FS Marker, placed at 3155.5 m, falls about 30 m below speculative Rg recognized 3091-3106 m. Maastrichtian Zone Ma is not defined in this well.

- In contrast to the other Turrum wells studied, only four of the "shales" studied, which are associated with the Marlin A6 reservoir sandstones, contain relatively common marine dinoflagellate cysts. Three of the four 'marine' intervals are associated with minor marine flooding events of the MFS "E" SB sequence, whereas the fourth is associated with a flooding event of the Pink-MFS "B" sequence. Most of the other samples studied from this well are barren or nearly barren of marine forms, and are interpreted to be nonmarine to marginal marine.

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EEC.27A.BIO.96

ESSO AUSTRALIA, LTD **Marlin A6 Well**
Gippsland Basin, Australia

INTRODUCTION

At the request of Esso Australia Limited (Peter Glenton), thirty-four ditch cuttings and ten core samples were studied from the Marlin A6 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 cuttings and 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, 1996a, 1996b, 1996c, and 1996d); Davey et al., (1966); Esso Australia Ltd. (1988); Germeraad et al., (1968); Haq et al., (1987); Heilmann-Clausen (1985); Helby et al., (1987); Jolley (1992); Marshall, (1985); Muller, (1964); Partridge, (1976); Powell (1992); Stover and Evans, (1973); Stover and Partridge, (1973 and 1984); Strong et al. (1995); 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 140 microscope slides from thirty-five Marlin A6 ditch cuttings and ten core 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 forty-five cuttings and core samples (2481 to 3289 m MD) from the Marlin A6 well are stored at EEC's biðstratigraphy laboratory in Houston. Unused sample will be returned to EAL.

BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL SUMMARY

We studied approximately 140 microscope slide from thirty-five Marlin A6 cuttings and ten core samples in the interval from 2481 to 3289 m.

Marine dinoflagellate cysts are relatively common in two uppermost samples studied at 2481-2499 and 2508-2526 m. This section, which overlies the reservoir unit, is interpreted to be open marine to marginal marine. Compared with the other Turrum field wells studied (Davies, 1995, 1996a, 1996b), only four of the "shales" associated with the Marlin A6 reservoir sandstones contain relatively rich marine dinoflagellate cyst assemblages, which indicate marginal marine depositional settings. These occur at 2649-2661, 2688-2700, 2706-2728, and 2932-2941 m. Most of the other samples studied from this well are barren or nearly barren of marine forms, and are interpreted to be nonmarine to ?marginal marine. Marine dinocysts occur again, in small numbers, at the base of this well from 3267 to 3289 m.

The palynostratigraphic subdivision, zone tops and ranges for the Marlin A6 well are listed below. Questioned depths shown in parenthesis, e.g. (?2673), denotes possible shallowest depth of the zone top. Very poor preservation, downhole cavings, abundant woody/coaly debris and mud additives, including walnut hulls, which dilute and mask index fossils, and limited marine palynomorphs, apparent due to the proximal position of this well, resulted in relatively low confidence in zonal assignments. Zonal bases are difficult to position, because of caving and poor preservation, and should be considered approximate.

2481-2525	Zone Sz
2560-2600	Indeterminate
2600-2661	Prob. Zone Rb
(?2673) 2688-2728	Prob. Zone Rc
2728-2749	Indeterminate
2749-2783	Possible Zone Rd1
2795-?2883	Possible Zone Rd2
2899-?3002	Possible Zone Re

(?3027) 3045-3063	Zone Rf
3063-3289	Indeterminate (??Rg at 3091-3106)

Intervals of maximum flooding occur in samples 2649-2661, 2688-2700, 2706-2728, and 2932-2941 mMD associated with MFS "E" SB and Pink SB sequences.

DISCUSSION OF RESULTS

Zone Sz is assigned to the interval from 2481 to 2525 m. Six core samples were examined from 2509.9 to 2525.0 m. The palynological assemblage recovered in core samples 2518.7, 2521.2, and 2525.0 m suggest possible penetration of Zone Ra at this level. Since this is highly speculative, this interval is retained in Zone Sz. Appendix A, following the references, gives a sample-by-sample listing of the distribution of important species and kerogen types.

The zonation of the three cuttings samples from 2600 to 2661 m is not well established and fossils from the overlying section continue to be present. These three samples can only be tentatively assigned to Zone Rb, because of the absence of distinctive marker species (Appendix A).

The top of possible Zone Rc is first recognized in sample 2673-2682 m. The interval from 2688 to 2728 m is assigned to Zone Rc. Sample 2728-2749 m is poorly fossiliferous, contains a mixed assemblage, and is indeterminate for zonation.

Zone Rd is subdivided into two tentative subzones. Tentative subzone Rd1 is recorded in samples 2749-2761 and 2777-2783 m. This zonal assignment is based on weak evidence, but the stratigraphic position, biofacies and microfloral assemblage, suggest that they are possibly in Zone Rd1 (Appendix A). Caved marine dinocysts also occur, including *Tuberculodinium vancampoae* from the upper Oligocene to Recent. Biofacies and the microfloral assemblage suggest possible penetration of Zone Rd2 at 2795 m. This assemblage and biofacies continues down through 2883 m. Four core samples were studied in the interval from 2843.9 to 2850.9 m. The palynomorph assemblages and biofacies in these samples support this assignment (Appendix A). Marine dinoflagellates are very rare to rare in this section.

The top of ?Zone Re is picked at 2899-2917 m. This assemblage continue down to about 3002 m (Appendix A). Zonal bases are difficult to distinguish, because of cavings and poor preservation. Sample 2932-2941 m appears to represent the maximum flooding event associated with the Pink SB recognized in the other Turrum well studied (Davies, 1995).

Tentative Rf is picked in sample 3045-3063 m, based on the palynomorphs and biofacies. Rf may be as high as 3027-3045 m, but this is highly speculative.

The remainder of the samples studied from this well from 3063 to 3289 m are considered indeterminate. However, based on biofacies criteria mainly, the sample at 3091-3106 may possibly be in zone Rg. No definitive Upper Cretaceous forms were recovered.

PALYNOSTRATIGRAPHIC CORRELATION

Although preservation is poor and caving and/or mud contamination middle-lower Eocene and Paleocene forms are prevalent, there are recognizable similarities in the palynological assemblages between this well and those reported from the other wells studied from the Turrum field (Davies, 1995, 1996a, 1996b, and 1996c). These similarities allowed for recognition of seven biozones and two subzones, 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 2481 to 2682 m is not well established. The lower Eocene to upper Paleocene Turrum zone Sz (Upper *L. balmei* zone equivalent) is recognized in the interval from 2481 to 2525 m. Samples from 2560-2600 m are indeterminate. Zone Ra was not recognized and placement of Zone Rb from 2600 to ?2661 m is tentative. The base of Zone Rb, as well as the other zones, is difficult to place because of cavings and poor preservation. In relationship to the physical surface, Blue Grey SB occurs thirteen meters above the top of provisional Zone Rb. This zone was recognized in Turrum-4, Turrum-3, Turrum-2, and in Turrum-5, Turrum-6, and Marlin A24 (Davies, 1995, 1996a, 1996b, and 1996c) and it typically occurs at or just below the Blue Grey SB.

Bottle Green SB occurs within the base of the interval assigned to Rb. The top of Palynozone Rc, which typically is picked just beneath Bottle Green SB in the other Turrum wells, is very tentatively placed at 2673-2682 m about 20 m below the Bottle Green SB and definitively at 2688-2700 m. The Rc assemblage also is recognized in samples down to 2710-2728 m. MFS "E" SB, pick by EAL at 2716.5 m, falls within Zone Rc, as in the other Turrum field wells.

The top of Subzone Rd1, which usually occurs near the Near Top L-200 surface, is provisionally placed in sample 2749-2761 m. Near Top L-200 surface picked by EAL at 2750.5 m, falls within this sample. Subzone Rd1 was recognized in most of the Turrum well, except Marlin-2 (Davies, 1995, 1996a, 1996b). Naples Yellow SB, placed at 2844 m, occurs within subzone Rd2, which was first recognized tentatively in sample 2795 to 2798 m.

The top of tentative Zone Re was first recognized in sample 2899-2917 m and appears to continues down to about 3002 m. MFS" B" SB, which usually occurs within this zone in the other Turrum wells, is picked at 2892 m by EAL and is approximately 10 m above the biostratigraphic pick for top Re. The biostratigraphic top of this zone may occur somewhat higher and sit within the unsampled interval between 2883 and 2899 m. This zone also contains a flooding event at 2932-2941 m, which probably correlates with the maximum flooding event

recognized in the other Turrum wells between Pink SB and Naples Yellow SB (Davies, 1995, 1996a, 1996b, and 1996c). Subzones of this zone were not differentiated in this well.

Pink SB, picked by EAL at 2992.5 m, occurs within the base Zones Re. In the other Turrum Field wells, this surface typically occurs near the boundary of zones Re and Rf, and within the top of Zone Rf. The top of the probable Rf is placed in sample 3045-3063 m, but may go somewhat higher up to 3027-3045m . The base of Zone Re and top of Rf are difficult to place, because of cavings and poor preservation.

MFS "A" SB, picked by EAL at 3092.5 m, occurs within the indeterminate interval below probable Rf. However, based on the very rare re-occurrences of marine dinocysts and presence of abundant amorphous kerogen, this sample at 3091-3106 m may possibly be in Rg. This is consistent with the placement of MFS "A" SB in other Turrum wells, such as Turrum-5 and Turrum-6 (Davies 1996a and 1996c).

The 450 FS Marker, which typically sits within Rg, and the Oriental Blue SB, also fall within the Indeterminate zone at the base of the well. The only evidence for possible Upper Maastrichtian is the isolated occurrence of *Ornamentifera sentosa* at 3127-3136 m. This species, although typically is reported from the Maastrichtian to Upper Campanian *T. longus* to *T. lilliei* zones, is reported to extends up into the very basal part of the lower Paleocene. Since this an isolated specimen and the sample is from a predominantly sandstone section, it is likely that this fossil is reworked. *O. sentosa* also was recovered in Marlin A24 at 3273-3286 m just above Oriental Blue, in Turrum-6 at 2748-2750 and 2759 m above and below Oriental Blue, and in Flounder A2 at 3553.6 m within the Lower *T. longus* zone.

PALEOENVIRONMENTS

Results indicate that deposition of the interval studied from the Marlin A6 well took place in a non-marine to marginal marine environment with periodic and short-lived marine floods. Marine dinoflagellate cysts are relatively common in the two uppermost samples studied at 2481-2499 and 2508 to 2526 m, which are interpreted to be open marine to marginal marine. In contrast to the other Turrum wells, only four "shales" associated with the Marlin A6 reservoir sandstones contain relatively rich marine dinoflagellate cysts assemblages. The middle and upper portions of the reservoir sequence above about 2728 m appeared to have experienced more numerous flooding event than the basal part of the well. These occur at 2649-2661, 2688-2700, and 2706-2728 m. Most of the other samples studied from this well are barren or nearly barren of marine forms, and are interpreted to be nonmarine to ?marginal marine. Marine dinocysts occur again, in small numbers, at the base of this well from 3267 to 3289 m.

Three of the 'marine' intervals are associated with minor marine flooding events of the MFS "E" SB sequence, whereas the fourth is associated with a flooding event of the Pink-MFS" B" SB sequence. These flooding events also were recognized in other Turrum wells near the MFS "E" SB, including Turrum-3, Turrum -4, Turrum-6, and Marlin A24 and between Pink SB and Naples

Yellow in Turrum-3, Turrum -4, Turrum-5, Turrum-6, Marlin-2, Marlin-4, and Marlin A24 (Davies, 1995; 1996a, 1996b, 1996c). Appendix A gives the sample-by-sample interpretation of the paleoenvironments.

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APPENDIX A

Sample-by-Sample Description

Appendix A

MARLIN A6
SAMPLE-BY-SAMPLE DESCRIPTION

Lower Eocene (Zone Sz)
(2481–2525 m)

2481-2499

Paleoenvironment: marine to marginal marine
Kerogen: woody/coaly (C); amorphous (VA); biodegraded terr. (C); S/P (C); dinoflagellates (A); pyrite (F)
Spiniferites spp. (D) (R)
?Spinidinium-type (D) (R)
Senegalinium dilwynense (D) (F-R)
Ginginodinium spp. (D) (R)
?Apectodinium spp. (D) (F)
Apectodinium homomorphum (D) (F, caved?)
Apectodinium hyperacanthum (D) (R, caved?)
Nothofagidites spp. (SP) (R)
Nothofagidites endurus (SP) (R)
Australopollis obscurus (SP) (VR)
Malvacipollis diversus (SP) (VR)
Malvacipollis subtilis (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (F, caved?)
Proteacidites pachypolus (SP) (VR, caved)
Haloragacidites harrisii (SP) (R)
Anacolosidites acutullus (SP) (VR)
Cupanieidites orthoteichus (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Botryococcus spp. (algal) (R)

2508-2526

Paleoenvironment: marginal marine
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (C); S/P (C); dinoflagellates (F); pyrite (F)
Spiniferites cf. splendidus (D) (VR, caved)
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (VR)
Apectodinium parvum (D) (VR, caved?)
Apectodinium homomorphum (D) (R, caved?)
Apectodinium hyperacanthum (D) (R, caved?)
Nothofagidites spp. (SP) (R)
Proteacidites spp. (SP) (R-F)
Proteacidites cf. annularis (SP) (VR)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (F, caved?)
Haloragacidites harrisii (SP) (R-F)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (R)
Reinschospora spp. (SP) (VR, reworked)

2509.9

Paleoenvironment: marginal marine

2509.9

Paleoenvironment: marginal marine
Kerogen: woody/coaly (A); amorphous (R); biodegraded terr. (F); S/P (C); dinoflagellates (F); pyrite (F-R); poor-fair preservation.
Cyclopsiella spp. (algal) (R)
Senegalinium spp. (D) (R-F)
Senegalinium dilwynense (D) (R)
Ginginodinium spp. (D) (R)
Australopollis obscurus (SP) (R-F)
Nothofagidites spp. (SP) (VR)
Nothofagidites emarcidus-heterus (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites cf. annularis (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R-F)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (VR)

2510.8

Paleoenvironment: marginal marine-nonmarine
Kerogen: woody/coaly (A); amorphous (R); biodegraded terr. (F); S/P (A); dinoflagellates (R); pyrite (R); fair preservation.
Senegalinium spp. (D) (R)
Australopollis obscurus (SP) (R-F)
Nothofagidites spp. (SP) (R-F)
Nothofagidites emarcidus-heterus (SP) (R)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (F)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R-F)
Stereisporites antiquasporites (SP) (VR)

2514.7

Paleoenvironment: marginal marine-nonmarine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (C); S/P (C); dinoflagellates (C); pyrite (F); poor-fair preservation.
Senegalinium spp. (D) (R)
Senegalinium dilwynense (D) (F)
Ginginodinium spp. (D) (C)
Cordosphaeridium gracile (D) (VR)
Australopollis obscurus (SP) (R)
Nothofagidites spp. (SP) (R-F)
Proteacidites spp. (SP) (F)
Proteacidites pachypolus (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (R)
Podosporites antarcticus (SP) (R)
Lygistipollenites balmei (SP) (R-F)

2518.7

Paleoenvironment: marginal marine-nonmarine (possible Ra)
Kerogen: woody/coaly (C-A); amorphous (C); biodegraded terr. (C); S/P (); dinoflagellates (A); pyrite (F); fair-poor preservation.
Cyclopsiella spp. (algal) (R)
Senegalinium spp. (D) (F)
Senegalinium dilwynense (D) (F)
Ginginodinium spp. (D) (C)
Australopollis obscurus (SP) (R)
Nothofagidites spp. (SP) (R)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites cf. angulatus (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Podosporites antarcticus (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (F)
Stereisporites sp. (Tripunctisporis) (SP) (VR)

2521.2

Paleoenvironment: marginal marine-nonmarine
Kerogen: woody/coaly (R-F); amorphous (VA); biodegraded terr. (R); S/P (A); dinoflagellates (F-C); pyrite (C); fair-poor preservation, common pyrite scars
Cerodinium sp. S (D) (R)

Senegalinium spp. (D) (F)
Senegalinium dilwynense (D) (R)
Ginginodinium spp. (D) (R)
?Apectodinium spp. (D) (R-F)
Australopollis obscurus (SP) (F-C)
Polycolpites langstonii (SP) (VR)
Nothofagidites spp. (SP) (R-F)
Nothofagidites endurus (SP) (R)
Proteacidites spp. (SP) (F-C)
Proteacidites adenanthoides (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Podosporites antarcticus (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (F)
Lygistipollenites florinii (SP) (F)
Stereisporites antiquasporites (SP) (F)

2525.0

Paleoenvironment: prob. nonmarine
Kerogen: woody/coaly (A); amorphous (VR); biodegraded terr. (F); S/P (F); dinoflagellates (VR); pyrite (R); poor preservation
Senegalinium spp. (D) (VR-R)
Australopollis obscurus (SP) (F)
Nothofagidites spp. (SP) (R)
Proteacidites spp. (SP) (F)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R)
Stereisporites antiquasporites (SP) (F)

Indeterminate
(2560-2600 m)

2560-2582

Paleoenvironment: marginal marine
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (C); S/P (R); dinoflagellates (R); pyrite (F)
?Apectodinium spp. (D) (R)
Apectodinium homomorphum (D) (R, caved?)
Proteacidites spp. (SP) (R-F)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (R, caved?)
Proteacidites sp. L (SP) (VR)
Proteacidites pachypolus (SP) (VR, caved)
Haloragacidites harrisii (SP) (VR)
Phyllocladidites mawsonii (SP) (VR)

2582-2600

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (C); S/P (R-F); dinoflagellates (VR); pyrite (C); ?mud contam. from Ft Union, common
Apectodinium homomorphum (D) (VR, caved?)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (VR, caved?)
Cupanieidites orthoteichus/major (SP) (R, caved?)

Upper Paleocene (Prob. Zone Rb)
(2600-2682 m)

2600-2621

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (C); amorphous (A-C); biodegraded terr. (C); S/P (C); dinoflagellates (VR); pyrite (C); ?mud contam. from Ft Union?
Cyclopsiella spp. (D) (VR)
?Apectodinium spp. (D) (VR)
Apectodinium hyperacanthum (D) (VR, caved?)
Hystrichokolpoma spp. (D) (VR, caved?)
Nothofagidites spp. (SP) (R)
Malvacipollis diversus (SP) (VR, caved?)
Proteacidites spp. (SP) (R-F)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (VR, caved?)
Proteacidites pachypolus (SP) (VR, caved?)
Myrtaceidites tenuis (SP) (VR, caved?)
Australopollis obscurus (SP) (R)
Haloragacidites harrisii (SP) (F, caved?)
Tetracolporites cf. verrucosus (SP) (R)
Phyllocladidites mawsonii (SP) (VR)

Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites cf. balmei (SP) (R)
Lygistipollenites florinii (SP) (R)

2621-2630

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (VA); amorphous (F-C); biodegraded terr. (R); S/P (R); dinoflagellates (VR); pyrite (F); v. poor pres.
Apectodinium spp. (D) (R)
Nothofagidites spp. (SP) (R)
Malvacipollis diversus (SP) (VR, caved?)
Proteacidites spp. (SP) (R)
Proteacidites cf. annularis (SP) (VR, caved?)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (VR, caved?)
Proteacidites adenanthoides (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (VR)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites cf. balmei (SP) (R)

2630-2646

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (VA); amorphous (F); biodegraded terr. (R); S/P (R); dinoflagellates (R); pyrite (F); v. poor pres.
?Apectodinium spp. (D) (VR)
Apectodinium spp. (D) (R, caved?)
Polysphaeridium spp. (D) (VR, caved?)
Operculodinium spp. (D) (VR, caved?)
Nothofagidites spp. (SP) (VR)
Cupanieidites orthoteichus/major (SP) (VR, caved?)
Malvacipollis subtilis (SP) (VR, caved?)
Malvacipollis diversus (SP) (VR, caved?)
Proteacidites spp. (SP) (R)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (VR, caved?)
Haloragacidites harrisii (SP) (F, caved?)
Myrtaceidites spp. (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (VR)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites florinii (SP) (VR)

2649-2661

Paleoenvironment: marginal marine
Kerogen: woody/coaly (VA); amorphous (F); biodegraded terr. (R); S/P (R); dinoflagellates (F); pyrite (R-F), some cavings
Spiniferites spp. (D) (R)
?Spinidinium-type (D) (R)
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (R)
Apectodinium spp. (D) (R)
Nothofagidites spp. (SP) (R)
Nothofagidites brachyspinulosus (SP) (VR)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu Stover and Evans, 1973, (SP) (piece, caved?)
Myrtaceidites spp. (SP) (VR, caved?)
Malvacipollis subtilis (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (R-F)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Lygistipollenites cf. balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

Upper Paleocene (?Zone Rc)
(2673-2682 m)

2673-2682

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (R-F); amorphous (VA, increase); biodegraded terr. (R); S/P (R-F); dinoflagellates (VR); pyrite (C); some cavings; Ft. Union Flora mud contam.
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (R)
?Cerodinium sp. S (D) (VR)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (R)

Proteacidites spp. (SP) (R)
Tetracolporites cf. verrucosus (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)

Upper Paleocene (Zone Rc)
(2688-2728 m)

2688-2700

Paleoenvironment: marginal marine to marine
Kerogen: woody/coaly (C-A); amorphous (C); biodegraded terr. (R); S/P (R-F); dinoflagellates (F); pyrite (C); some cavings; poor pres.
Spiniferites spp. (D) (R)
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (R)
Apectodinium spp. (D) (R)
Apectodinium parvum (D) (VR, caved?)
Apectodinium homomorphum (D) (VR, caved?)
Polysphaeridium spp. (D) (VR, caved?)
Operculodinium spp. (D) (VR, caved?)
?Palaeocystodinium spp. (D) (VR) (piece)
Areosphaeridium cf. arcuatum (D) (VR, caved?)
Diphyes colligerum (D) (VR, caved?)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (no higher than basalmost Eocene) (F, slight increase)
Malvacipollis subtilis (SP) (VR, caved?)
Malvacipollis diversus (SP) (VR, caved?)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved?)
Proteacidites asperopolus (SP) (VR, caved?)
Haloragacidites harrisii (SP) (R)
Myrtaceidites spp. (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites verrucosus (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Stereisporites antiquasporites (SP) (R)

2706-2710

Paleoenvironment: marginal marine to marine
Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (R); S/P (R-F); dinoflagellates (F); pyrite (A);cavings; poor pres.
Spiniferites spp. (D) (R)
Senegalinium dilwynense (D) (R-F)
?Apectodinium spp. (D) (F)
Apectodinium spp. (D) (F, caved?)
Apectodinium homomorphum (D) (R, caved?)
Glaphyrocysta spp. (D) (VR)
Glaphyrocysta retiintexta (D) (VR-R)
Polysphaeridium spp. (D) (VR, caved?)
Operculodinium spp. (D) (VR, caved?)
Nothofagidites spp. (SP) (R)
Australopollis obscurus (SP) (F)
Malvacipollis subtilis (SP) (VR, caved?)
Tuberculodinium vancampoae (D) (VR, caved)
Proteacidites spp. (SP) (R)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (VR, caved?)
Proteacidites grandis sensu S. & E., 1973, (SP) (VR, caved?)
Haloragacidites harrisii (SP) (R)
Myrtaceidites spp. (SP) (VR, caved?)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Stereisporites antiquasporites (SP) (R)
Lygistipollenites cf. balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)

2710-2728

Paleoenvironment: marginal marine
Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (R); S/P (R-F); dinoflagellates (R-F); pyrite (A); some cavings; very poor pres.

Senegalinium dilwynense (D) (R)
?Apectodinium spp. (D) (VR)
Apectodinium homomorphum (D) (R, caved?)
?Cerodinium sp. S (D) (VR)
?Glaphyrocysta spp. (D) (VR)
Glaphyrocysta cf. retiintexta (D) (VR)
Nothofagidites spp. (SP) (R)
Australopollis obscurus (SP) (F-C, increase)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved?)
Haloragacidites harrisii (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (F)
Lygistipollenites cf. balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (F)
Stereisporites (Tripunctisporis) (SP) (R)

Indeterminate
(2728-2749 m)

2728-2749

Paleoenvironment: marginal marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (R); S/P (R-F); dinoflagellates (VR-R); pyrite (C-A); some cavings; very poor pres.
Spiniferites spp. (D) (VR)
Apectodinium homomorphum (D) (VR, caved?)
Glaphyrocysta cf. retiintexta (D) (VR)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (R-F)
Proteacidites spp. (SP) (R)
Haloragacidites harrisii (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)
Podosporites antarcticus (SP) (F)
Stereisporites antiquasporites (SP) (R)

Lower Paleocene (??Zone Rd1)
(2749-2783 m)

2749-2761

Paleoenvironment: marginal marine
Kerogen: woody/coaly (VA); amorphous (R); biodegraded terr. (VR); S/P (R-F); dinoflagellates (R); pyrite (C); some cavings; poor pres -SP
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (VR)
Cerodinium sp. S (D) (VR)
Glaphyrocysta cf. retiintexta (D) (VR)
Diphyes colligerum (D) (VR, caved)
Tuberculodinium vancampoae (D) (VR, caved)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved?)
Phyllocladidites mawsonii (SP) (R)

2777-2783

Paleoenvironment: marginal marine to nonmarine
Kerogen: woody/coaly (VA); amorphous (R); biodegraded terr. (R); S/P (R); dinoflagellates (R-VR); pyrite (C); some cavings; poor pres -SP
Spiniferites spp. (D) (VR)
Senegalinium dilwynense (D) (VR)
Apectodinium spp. (D) (VR, caved?)
Glaphyrocysta retiintexta (D) (R)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (VR)
Proteacidites angulatus (SP) (VR)
Haloragacidites harrisii (SP) (R)
Myrtaceidites spp. (SP) (VR, caved)
Cupanieidites orthoteichus/major (SP) (VR, caved)
Phyllocladidites mawsonii (SP) (R)
Stereisporites antiquasporites (SP) (R)

Lower Paleocene (??Zone Rd2)
(2795-2883 m)

2795-2798

Paleoenvironment: marginal marine to nonmarine
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (R); pyrite (C); some cavings; v poor pres
Spiniferites spp. (D) (R-F, caved?)
Senegalinium dilwynense (D) (VR)
Apectodinium spp. (D) (VR, caved?)
Apectodinium hyperacanthum (D) (VR, caved?)
Cerodinium sp. S (D) (VR)
Diphyes colligerum (D) (VR, caved)
Australopollis obscurus (SP) (F)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu Stover & Evans, 1973, (SP) (VR, caved?)
Haloragacidites harrisii (SP) (R)
Tetracolporites verrucosum (SP (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)

2819-2831

Paleoenvironment: marginal marine to nonmarine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (R); pyrite (C); some cavings; v poor pres
Spiniferites spp. (D) (R, caved?)
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (VR)
?Cerodinium sp. S (D) (VR)
?Glaphyrocysta spp. (D) (VR)
Australopollis obscurus (SP) (F-C)
Proteacidites spp. (SP) (R)
Haloragacidites harrisii (SP) (R, caved?)
Myrtaceidites spp. (SP) (VR, caved)
Tetracolporites verrucosum (SP) (R, slight increase)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (VR)

2843.9

Paleoenvironment: nonmarine
Kerogen: woody/coaly (C); amorphous (F-C); biodegraded terr. (C); S/P (F-C); dinoflagellates (barren); pyrite (F-C); v poor pres.
Australopollis obscurus (SP) (F-C)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (VR)
Gambierina edwardsii (SP) (VR)
Tetracolporites verrucosum (SP (R)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Stereisporites regium (SP) (VR)

2847-2862

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (R); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v poor pres
Spiniferites spp. (D) (R, caved?)
Apectodinium spp. (D) (VR, caved?)
Australopollis obscurus (SP) (F-C)
Proteacidites spp. (SP) (R)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved)
Haloragacidites harrisii (SP) (R, caved?)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (VR)

2848.5

Paleoenvironment: nonmarine to? marginal marine
Kerogen: woody/coaly (C); amorphous (F-C); biodegraded terr. (F); S/P (C-A); dinoflagellates (VR); pyrite (F); fair to poorr pres.
Senegalinium spp. (D) (VR)
Australopollis obscurus (SP) (A)
Proteacidites spp. (SP) (F-R)
Proteacidites angulatus (SP) (VR)
Tetracolporites verrucosum (SP) (R)
Tricolpites gillii (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (VR)
Stereisporites spp. (Tripunctisporis) (SP) (VR)
Stereisporites regium (SP) (VR)

2849.7

Paleoenvironment: nonmarine
Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (R); S/P (C-A); dinoflagellates (barren); pyrite (C); fair-poor pres.
Australopollis obscurus (SP) (C)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (R)
Tetracolporites verrucosum (SP) (R)
Tricolpites gillii (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F-C)
Podosporites spp. (SP) (F)
Lygistipollenites balmei (SP) (R)
Stereisporites antiquasporites (SP) (R)

2850.9

Paleoenvironment: nonmarine
Kerogen: woody/coaly (A); amorphous (R); biodegraded terr. (F); S/P (C); dinoflagellates (barren); pyrite (R); fair to poor preserv.
Australopollis obscurus (SP) (C-A)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (VR)
Gambierina edwardsii (SP) (VR)
Tetracolporites verrucosum (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (C)
Lygistipollenites balmei (SP) (R)
Stereisporites antiquasporites (SP) (R)

2868-2883

Paleoenvironment: nonmarine
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres.
Spiniferites spp. (D) (R, caved?)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (F-C)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved)
Haloragacidites harrisii (SP) (R, caved)
Tetracolporites verrucosum (SP) (VR)
Phyllocladidites mawsonii (SP) (R-F)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

Lower Paleocene (??Zone Re)
(2899-~3045 m)

2899-2917

Paleoenvironment: nonmarine
Kerogen: woody/coaly (A-C); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v poor pres
?Apectodinium spp. (D) (VR)
Australopollis obscurus (SP) (R)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (R)

Haloragacidites harrisii (SP) (R, caved?)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)

2920-2932

Paleoenvironment: nonmarine
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v poor pres
Spiniferites spp. (D) (R, caved?)
Apectodinium spp. (D) (VR, caved?)
Cerodinium sp. S (D) (VR)
Glaphyrocysta retiintexta (D) (VR, piece)
Operculodinium spp. (D) (VR)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (VR, caved)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)

2932-2941

Paleoenvironment: marginal marine
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (F); pyrite (C); some cavings; v. poor pres
Spiniferites spp. (D) (VR, appears to be in-place)
?Spinidinium-type (D) (VR)
Spinidinium cf. densispinatum (D) (F)
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (VR)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (R-F)
Proteacidites spp. (SP) (R)
Proteacidites pachypolus (SP) (VR, caved)
Tricolpites cf. confessus (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R-F)
Podosporites antarcticus (SP) (R)
Stereisporites antiquasporites (SP) (R)

2947-2972

Paleoenvironment: marginal to non marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (R); S/P (C); dinoflagellates (R); pyrite (C); some cavings; v. poor pres
?Spinidinium-type (D) (VR)
Spinidinium cf. densispinatum (D) (R-VR)
Senegalinium dilwynense (D) (VR)
Australopollis obscurus (SP) (F-R)
Proteacidites spp. (SP) (R)
Myrtaceidites spp. (SP) (VR, caved)
Phyllocladidites mawsonii (SP) (F-C)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (R)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)

2990-3002

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (A); amorphous (C); biodegraded terr. (F); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres
Spiniferites spp. (D) (VR, caved)
Spinidinium cf. densispinatum (D) (VR, caved?)
Senegalinium dilwynense (D) (VR)
Australopollis obscurus (SP) (R-F)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Tricolpites spp. (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (R)

Lower Paleocene (Possible Zone Rf)
(3027-3045 m)

3027-3045

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (C); dinoflagellates (VR-R); pyrite (C); some cavings; v. poor pres

Spinidinium cf. densispinatum (D) (VR)
Cerodinium sp. S (D) (VR, caved?)
Australopollis obscurus (SP) (R-F)
Proteacidites spp. (SP) (R-F, slight increase)
Proteacidites angulatus (SP) (VR)
Tricolpites spp. (SP) (VR)
Tricolpites gillii (SP) (VR-R)
?Tricolpites cf. confessus (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

Lower Paleocene (Probable Zone Rf)
(3045-3063 m)

3045-3063

Paleoenvironment: nonmarine to ?marginal marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (C); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres
Senegalinium dilwynense (D) (VR)
Australopollis obscurus (SP) (R-F)
?Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (F, increase)
Tricolpites spp. (SP) (R-F)
?Tetracolporites verrucosum (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

Indeterminate
(3063-3289 m)

3063-3072

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres
?Apectodinium spp. (D) (R)
Australopollis obscurus (SP) (VR)
Haloragacidites harrisii (SP) (VR, caved)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (VR, caved)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

3072-3084

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (F-C); amorphous (A); biodegraded terr. (F); S/P (C); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres
Senegalinium dilwynense (D) (VR)
?Apectodinium spp. (D) (R)
Apectodinium spp. (D) (VR, caved?)
Glaphyrocysta retiintexta (D) (VR, piece)
Australopollis obscurus (SP) (R)
Gambierina rudata (SP) (VR)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (VR, caved)
Tricolpites spp. (SP) (VR)
Tricolpites cf. confessus (SP) (VR)
Tricolpites gillii (SP) (VR)
?Tetracolporites verrucosus (SP) (VR)
Ephedripites spp. (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Stereisporites antiquasporites (SP) (R)

3091-3106

Paleoenvironment: nonmarine to marginal marine; (??Rg)
Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (F); S/P (C); dinoflagellates (VR-R); pyrite (C); some cavings; v. poor pres
Senegalinium dilwynense (D) (VR)
Cerodinium sp. S (D) (VR, caved?)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (R)
Tricolpites spp. (SP) (R)
Tricolpites gillii (SP) (VR)
Ephedripites spp. (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (R)

3118-3127

Paleoenvironment: nonmarine
Kerogen: woody/coaly (A); amorphous (F-R); biodegraded terr. (F); S/P (F); dinoflagellates (barren); pyrite (F); some cavings; v. poor pres
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (R)
Haloragacidites harrisii (SP) (VR)
Tricolpites spp. (SP) (R)
?Tricolpites cf. confessus (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Stereisporites antiquasporites (SP) (VR)

3127-3136

Paleoenvironment: nonmarine; (??Rg-??Ma)
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (F); S/P (F); dinoflagellates (barren); pyrite (C); minor cavings; v. poor pres
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (R)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved)
Tricolpites spp. (SP) (R)
Tetracolporites verrucosum (SP (R)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Ornamentifera sentosa (SP) (VR, reworked?)
Stereisporites antiquasporites (SP) (R)

3148-3158

Paleoenvironment: nonmarine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (F); S/P (F); dinoflagellates (barren); pyrite (C); minor cavings/mud contam.; poor pres
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (R)
Tetracolporites verrucosum (SP) (R)
Phyllocladidites mawsonii (SP) (F-R)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (VR)
Stereisporites antiquasporites (SP) (R)
Stereisporites spp. (Tripunctisporis) (SP) (VR)

3173-3182

Paleoenvironment: nonmarine to marginal marine
Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (F); dinoflagellates (VR); pyrite (C); common cavings; v. poor pres
Cerodinium sp. S (D) (R, caved?)
Polysphaeridium spp. (D) (VR, caved)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R)
Proteacidites angulatus (SP) (VR)
Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved)

	Proteacidites grandis sensu S. & E., 1973, (SP) (VR, caved) Tetracolporites verrucosum (SP) (R) Phyllocladidites mawsonii (SP) (F) Phyllocladidites microsaccatus (SP) (F) Lygistipollenites balmei (SP) (VR) Lygistipollenites florinii (SP) (VR) Stereisporites antiquasporites (SP) (R)
3188-3212	Paleoenvironment: nonmarine to ?marginal marine Kerogen: woody/coaly (C); amorphous (C); biodegraded terr. (F); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres ?Apectodinium spp. (D) (R, caved?) Australopollis obscurus (SP) (R-F) ?Gambierina rudata (SP) (VR) Proteacidites spp. (SP) (R) ?Tetracolporites verrucosum (SP) (VR) Phyllocladidites mawsonii (SP) (R) Phyllocladidites microsaccatus (SP) (F) ?Lygistipollenites balmei (SP) (VR) Lygistipollenites florinii (SP) (VR) Stereisporites antiquasporites (SP) (R)
3212-3231	Paleoenvironment: nonmarine to ?marginal marine Kerogen: woody/coaly (C-A); amorphous (C); biodegraded terr. (R); S/P (F); dinoflagellates (VR); pyrite (C); some cavings; v. poor pres Spiniferites spp. (D) (VR, caved) Apectodinium spp. (D) (VR, caved?) Apectodinium hyperacanthum (D) (VR, caved?) Australopollis obscurus (SP) (R-F) Proteacidites spp. (SP) (R) Myrtacidites spp. (SP) (VR, caved) Tricolpites cf. confessus (SP) (VR) Phyllocladidites mawsonii (SP) (F) Phyllocladidites microsaccatus (SP) (R) Lygistipollenites balmei (SP) (VR)
3267-3289	Paleoenvironment: nonmarine to marginal marine Kerogen: woody/coaly (F); amorphous (VA); biodegraded terr. (R); S/P (F); dinoflagellates (F); pyrite (A); freq. cavings; v. poor pres Spiniferites spp. (D) (R-F, caved?) ?Apectodinium spp. (D) (R, caved?) Apectodinium spp. (D) (R, caved?) Apectodinium homomorphum (D) (VR, caved?) Cerodinium sp. S (D) (VR, caved?) Glaphyrocysta retiintexta (D) (VR, piece) Paleocystodinium spp. (D) (VR) Australopollis obscurus (SP) (R) Proteacidites spp. (SP) (R) Proteacidites dilwyensis sensu S. & E., 1973, (SP) (R, caved) Tricolpites spp. (SP) (R) Tricolpites cf. confessus (SP) (VR) Phyllocladidites mawsonii (SP) (R) Phyllocladidites microsaccatus (SP) (F) Lygistipollenites florinii (SP) (VR) Stereisporites antiquasporites (SP) (R) Stereisporites (Tripunctisporis) (SP) (VR)