Palynological Analysis of samples from Burong-1, Dutson Downs-1, East Reeve-1, Golden Beach West-1, Merriman-1, North Seaspray-1, Rosedale-1 and Woodside-1 in Onshore Gippsland Basin.

by Alan D. Partridge
Biostrata Pty. Ltd.
A.C.N. 053 800 945

Petroleum Development Unpublished Report 1997/13

Palynological analysis of samples from Burong-1, Dutson Downs-1, East Reeve-1, Golden Beach West-1, Merriman-1, North Seaspray-1, Rosedale-1 and Woodside-1 in onshore Gippsland Basin.

by Alan D. Partridge

Table of Contents

INTERPRETATIVE DATA

BASIC DATA

INTERPRETATIVE DATA

Summary

Results of palynological analysis of 27 samples from nine wells used in a geochemical study of the Cretaceous and Tertiary sequence in the onshore Gippsland Basin are presented. The key findings of this study are:

- The samples range in age from Miocene to Early Albian and are from the Seaspray (1 sample), Latrobe (10 samples), Golden Beach (3 samples) and Strzelecki Groups (10 samples). The exceptions are one barren sidewall core sample, a cuttings sample indeterminate due to severe downhole cavings, and another cutting sample of Miocene age from the Latrobe Valley Coal Measures in the Latrobe Valley.
- Half of the cuttings analysed yielded residues in which there was a substantial component of downhole cavings. These cavings based on assemblage counts are estimated to comprised between 25% to >85% of the recorded palynomorph assemblages. The palynology therefore indicates that the geochemical analyses on these samples may not be wholly representative of the units sampled.
- The sample from the Seaspray Group contains an assemblage dominated by microplankton (72%) belonging to the *Operculodinium* microplankton Superzone. This microplankton assemblage is also well represented in the cavings present in the cutting analysed from the older groups.
- The samples from the Latrobe Group are from the Late Eocene (Middle *N. asperus* Zone), Paleocene (*L. balmei* Zone) and latest Maastrichtian (*T. longus* Zone). The Middle Eocene (Lower *N. asperus* Zone) and Early Eocene (*M. diversus* to *P. asperopolus* Zones) are not sampled but their presence is recognised in downhole cavings.
- The samples from the Golden Beach Group are from the Early Campanian (*N. senectus* Zone) and Turonian (*P. mawsonii* Zone) parts of the group. The intervening Santonian (*T. apoxyexinus* Zone) section was not recorded.
- The samples from the Strzelecki Group belong mainly to the *C. striatus* spore-pollen Zone of Early Albian age.

Introduction

This study reports on the age dating of samples from the Seaspray, Latrobe, Golden Beach and Strzelecki Groups in the onshore portion of the Gippsland Basin in conjunction with a geochemical evaluation of these sequences. It investigates 18 cuttings samples, 6 core and 3 sidewall core samples from nine wells. The samples were provided by Kourosh Mehin of Energy and Minerals Victoria and forwarded to Laola Pty Ltd in Perth for palynological processing. The report compliments and adds to an earlier study of 70 samples from 10 wells in the onshore Gippsland Basin by Partridge & Macphail (1996a & b). Ten of the new samples are from four of the wells previously studied.

The palynological zonation, ages of the samples and comparison between the wells are summarised in Table–1. Interpretative data on individual samples examined including key species and Confidence Ratings are recorded in Table–2. Basic data on residue yields, palynomorph concentration on the slides, preservation and species diversity are recorded in Table–3. Results of assemblage counts and the occurrences of other selected species recorded are provided in Tables–4 to 7.

Materials and Methods

The samples were processed and analysed as supplied even though it was realised from examination of the lithologies (Table–3) that most of the cuttings samples were moderately to severely contaminated by cavings from the Seaspray Group. This was confirmed upon analysis of the samples. It was also found that cavings from the Latrobe Group were also severely contaminating the assemblages from underlying Golden Beach and Strzelecki Groups. Estimates of amount of caved contamination in the samples is provided in Table–2 as a percentage of *caved* relative to *in situ* palynomorphs. Although these estimates provide a guide to amount of contamination possible in the geochemical analyses preformed on the samples they should be treated with caution as the extent of caved "kerogen" may not always be the same as the extent of caved "palynomorphs". In part this is because the assemblage counts were made on the oxidised slides in which the palynomorphs are more concentrated compared to those recorded in the kerogen slides. Also, in parts of the section, palynomorphs may occur in higher abundance relative to the kerogen. This is observed particularly in the *N. asperus* Zone where specimens of fossil *Nothofagidites* pollen can be exceptionally abundant and in certain Early Cretaceous samples where spores can be very abundant.

Table–1: Palynological Summary

Spore-Pollen Zone (Microplankton Zone and Age)	Burong-1,	Dutson Downs-1	East Reeve 1,	Golden Beach West-1,	Merriman-1	North Seaspray-1	Rosedale-1	Woodside-1
T. bellus (*Operculodinium* Sz) **Early Miocene**								678.2m
P.tuberculatus (*Operculodinium* Sz) **Oligocene-Miocene**	644m		1194.8m				374.9m	
Upper *N. asperus* **basal Oligocene**								
Middle *N. asperus* (*G. extensa*) **Late Eocene**			1322.8m 1396.0m 1408.2m		981.5m	655.3m		Present in deeper cuttings.
Lower *N. asperus* **Middle Eocene**			Probably present					
P. asperopolus to *M. diversus* **Early Eocene**						Present in deeper cuttings.		
L. balmei **Paleocene**		1295.4m				979.3m		
T. longus **Maastrichtian**				1225.3m Depth wrong!				
T. lilliei **Late Campanian**								
N. senectus **Early Campanian**		1499.5m						
T. apoxyexinus **Santonian**								
P. mawsonii **Turonian**				2209.8m	1722.1m			
C. striatus or younger **Albian**		1810.5m	1508.8m 1585.0m 1600.2m			1147.3m 1499.6m	1478.3m or older	1234.4m 1636.2m 1758.4m or younger

Stratigraphic Nomenclature.

In the following discussion the term Latrobe Group or Latrobe facies is applied to all fluviatile and coastal plain sands and coal measures facies underlying the open marine facies of the Seaspray Group and overlying the lacustrine to fluviatile facies of the Golden Beach Group. The Latrobe Group is distinguished from the Seaspray Group in being non-calcareous even though it may show evidence of marine influence particularly in the upper part of the section. Although the terms Latrobe Valley Group and Latrobe Valley Coal Measures (Hocking, 1976; Abele *et al.*, 1988) have legitimate priority over Latrobe Group the latter term is so entrenched in the petroleum industry literature it is unrealistic to expect the former names to gain ascendancy. Instead this report follows the recommendation and discussion in Partridge & Macphail (1996a & b) and restricts the term Latrobe Valley (Coal Measures) Group to the coal measures facies developed within the Latrobe Valley.

The Golden Beach Formation was originally proposed by Haskell (1972) and subsequently formally raised to the rank of a group and subdivided into two formations by Lowry & Longley (1991). Lithologically the sands within the group are characterised by more abundant lithic fragments and more kaolinitic cement (Sloan *et al.*, 1992, p.3), and overall there is less coal than found in the Latrobe Group. Both marine and lacustrine organic walled microplankton have been recorded from the Golden Beach Group (Marshall; 1988, 1989). The marine microplankton are found in the Chimera Sandstone which lies within the *T. apoxyexinus* to *N. senectus* Zones in its type locality in the Kipper-1 well (Lowry & Longley, 1991). The lacustrine microplankton are typical of the Kipper Shale and associated sands which all lie within the *P. mawsonii* Zone. Age equivalents of both formation are recognised in this reports, but as yet possible lithological distinctions between the two units onshore have not been established.

The Strzelecki Group is used for all Early Cretaceous sediments in the Gippsland Basin.

Geological and Biostratigraphic Comments

The basis for picking the zones and the stratigraphic relationships of the individual samples are discussed under the heading for individual wells as is also any previous palynological work on these wells.

Zone and age determinations are based on the spore-pollen zonation schemes proposed by Dettmann & Playford (1969) and Stover & Partridge (1973), subsequently modified by Stover & Partridge (1982) and Helby, Morgan & Partridge (1987). The Tertiary microplankton zones is based on the scheme

outlined by Partridge (1975, 1976) which has been modified and embellished in the many subsequent palynological reports prepared on well drilled in the Gippsland Basin. Unfortunately this work has not yet been collated or synthesised into a single report.

Author citations for most spore-pollen species can be sourced from Dettmann (1963), Helby, Morgan & Partridge (1987), Stover & Partridge (1973, 1982). Author citations for microplankton can be found in the indexes of Lentin & Williams (1993) and Fensome *et al.* (1990). Species names followed by "ms" are unpublished manuscript names.

Burong–1

The single sidewall core analysed from Burong–1 is in addition to the more comprehensive study by Partridge & Macphail (1996a). The new sample is from the basal part of the Seaspray Group and contains a mixed assemblage of abundant Oligocene microplankton associated with a reworked Late Eocene *N. asperus* Zone assemblage of spore-pollen and rare dinoflagellates. The *in situ* dinoflagellates comprise ~50% of the assemblage on the kerogen slide but <20% on the oxidised slides. The count data in Table–4 is a mixture of both slides. The key species, which indicate that a substantial part of the assemblage is reworked, are the distinctive pollen *Triorites magnificus* and the dinoflagellate *Gippslandica extensa* both of which are recorded from the underlying Latrobe section and are clearly out-of-place. A similar reworking event has been recorded in the Oligocene Lakes Entrance Formation in the Lakes Entrance Oil Shaft by Partridge (1971).

Dutson Downs–1

The core and two cuttings samples analysed from Dutson Downs-1 confirm and compliment the results of a more detailed study of this well by Partridge & Macphail (1996b).

The sample from core-3 at 1295.4m is assigned to the *L. balmei* Zone on the presence of *Lygistepollenites balmei* (~1%) and *Australopollis obscurus* (~1%) in an assemblage dominated by bisaccate pollen referred to *Podocarpidites* (34%). Unfortunately no diagnostic index species of the Upper or Lower subzones were recorded. Results from this new sample confirm that the previous sample collected from core-3 and assigned to the *N. senectus* Zone was out-of-place (Partridge & Macphail, 1996b).

The cuttings analysed at 1499.6m are confidently assigned to the *N. senectus* Zone on the presence of the two key index species *Nothofagidites senectus* (~4% of count) and *Forcipites sabulosus* (5%). The absence of *Gambierina rudata* suggests the sample belongs to the lower part of the zone.

The deepest cuttings at 1810.5m confirms the Early Albian *C. striatus* Zone age obtained from SWC-1 at 1834.9m by Partridge & Macphail (1996b). The results raise the shallowest confirmed occurrence of the Strzelecki Group by over 30 metres. The recording of the non-marine microplankton *Rimosicysta* sp and *Luxadinium* sp. as caved elements in these cutting for the first time confirms the presence of the *Rimosicysta* microplankton Superzone in the overlying Golden Beach Group in Dutson Downs-1. With this discovery all wells investigated in the onshore Gippsland Basin, which contain the Turonian *P. mawsonii* Zone, now also contain the distinctive lacustrine algae suite belonging to the *Rimosicysta* Superzone.

East Reeve-1

The seven cuttings samples analysed for this report appear to be the first palynological analyses performed on East Reeve-1. The samples confirm the presence of the Late Eocene Middle *N. asperus* Zone in the Latrobe Group and the Early Albian *C. striatus* Zone in the Strzelecki Group. Unfortunately the precise depth limits in the well for these zones must be treated with caution as all samples are badly contaminated with downhole cavings. The Latrobe Group has between 45% to 100% cavings from the overlying Seaspray Group (mostly Lakes Entrance Marl) while the samples from the Strzelecki Group are comprised of between 40% to 60% cavings from both the Seaspray and Latrobe Groups.

The shallowest cuttings at 1194.8m, which is below the log pick for the top of the Latrobe Group at 1182m, is probably the most severely caved sample as the assemblage recorded potentially could have been derived entirely from the overlying Seaspray Group. Only the occurrence of *Proteacidites stipplatus* is significance as it indicates the sample may belongs to the Upper *N. asperus* Zone. The next shallowest sample analysed at 1322.8m is no younger than the Middle *N. asperus* zone based on the youngest occurrence of *Santalumidites cainozoicus* while the deepest sample from the Latrobe Group at 1408.2 m may still lie within this zone based on the presence of *Triorites magnificus*. Limited data from Hollands Landing-1 located ~9 kilometres northwest of East Reeves-1 would suggest however that the base of the Latrobe Group ranges down into the Middle Eocene Lower *N. asperus* Zone

Notably absent in the cuttings were any species which could be considered caved from the Early Eocene, Paleocene or Late Cretaceous. This result supports the hypothesis advanced in Partridge & Macphail (1996b) that stratigraphic section equivalent to the lower part of the Latrobe Group (= *T. longus* to *P. asperopolus* Zones) and the Golden Beach Group (= *P. mawsonii* to *N. senectus* Zones) is absent north of the Rosedale Fault in the onshore Gippsland Basin.

All three samples from the Strzelecki Group contain Early Cretaceous spore-pollen which can be distinguished by higher maturation (greater carbonisation) from the caved palynomorphs. The *in situ* assemblages appear to be dominated by *Cyathidites* and *Podocarpidites*. The key index species present is *Crybelosporites striatus* which indicates the samples are no older than the Early Albian *C. striatus* Zone.

If additional palynological analysis is warranted on East Reeve-1 it is recommended that the 20 sidewall cores recovered from the Latrobe Group between 1188.7m to 1435m (3900-4708 ft) be found and analysed. It is considered unlikely that the age dating could be significantly improved by analysing additional cuttings samples because of the severe cavings problems.

The microplankton percentages given in Table–2 are all considered to be caved and therefore do not provide a reliable estimate of the possible marine influence within the Latrobe Group.

Golden Beach West–1

All three new samples analysed from Golden Beach West–1 are poor and provide little additional data to the study by Partridge & Macphail (1996b).

The core sample labelled as coming from 1225.3m (4020 ft) is clearly out-of-place as no conventional core was recovered at this depth. The good Upper *T. longus* Zone assemblage extracted in fact suggests the sample comes from core–5 between 1650.5-1653.5m (54315-5425 ft).

The sidewall core at 1777m was gave a minimal residue yield and was essentially barren of palynomorphs.

The sidewall core at 2209.8m gave a relatively low diversity assemblage which is assigned to the *P. mawsonii* Zone with low confidence based on comparison of the gross assemblage to other samples analysed in this zone from the onshore Gippsland Basin.

Merriman–1

The three new cuttings samples analysed in Merriman–1 provided mixed results.

The shallowest sample at 981.5m from the upper part of the Latrobe Group gave a diverse Late Eocene assemblage which could be confidently assigned to the Middle *N. asperus* spore-pollen and *G. extensa* microplankton Zones on the presence of the key index species and overall assemblage composition.

Of the two samples from the Golden Beach Group the shallowest at 1481.3m was dominated by caved palynomorphs and could not be confidently assigned to any zone. There is no convincing evidence from this sample that the well has penetrated the Golden Beach Group at this depth. The deeper cutting from 1722.1m in contrast contained a relatively good assemblage which could be confidently assigned to both the *P. mawsonii* Zone and *Rimosicysta* Superzone. The microplankton assemblage is of particular interest as it consists of *Rimosicysta concava*, *Wuroia corrugata* and *Micrhystridium* sp. A, all of which are where originally described from the core between 2480.7–2485m in the offshore Sunfish-1 well (Marshall, 1989).

North Seaspray-1

Known previous palynological work on North Seaspray-1 is restricted to two samples from cores 5 and 6 which were originally collected by geologists of Esso Australia Ltd and separately prepared and analysed by Dettmann (1966) and palynologists at EPRCo (Stover & Evans, 1969). The samples from both core-5 at 1061.9–1068m (3484-3504 ft) and core–6 at 1147.6–1149.4m (3765–3771 ft) gave assemblages which can be assigned to the Paleocene *L. balmei* Zone. Regrettably the early assemblage lists do not allow assignment of the samples to either the Upper or Lower subzones.

The four new samples analysed have given mixed results as they partially conflict with the earlier analyses.

The shallowest cuttings at 655.3m (2150 ft) gave a diverse Late Eocene assemblage which could be confidently assigned to the Middle *N. asperus* spore-pollen and *G. extensa* microplankton Zones on the presence of the key index species *Triorites magnificus* and *Gippslandica extensa* in an assemblage dominated by *Nothofagidites* (67%). The sample is ~137m below top of Latrobe pick in the well completion report at 518m.

The core sample analysed from 979.3m (3213ft) gave a moderately diverse assemblage dominated by tricolp(or)ate pollen (39%) and *Podocarpidites* pollen (23%) and contained index species *Lygistepollenites balmei*, *Australopollis obscurus* and *Gambierina rudata*. Like most other *L. balmei* Zone assemblages recorded from the onshore Gippsland Basin the sample lacks index species to distinguish either the Upper or Lower Subzones.

The two cuttings samples at 1147.3m (3764ft) and 1499.6m (4920ft) both contain Early Cretaceous assemblages which are badly contaminated by downhole cavings (>40%) from overlying Latrobe Group. Both samples are assigned to *C. striatus* Zone on presence of the eponymous species. The age dating of the

shallower sample is consistent with the pick from the top of the Strzelecki Group at 1104.3m (3623ft) in the well completion report. It is in conflict however with the *L. balmei* Zone assemblage recorded by Dettmann (1966) from core-6 at 1147.6–1149.4m. In her discussion of two samples examined Dettmann (1966b; p.2) states: "*...the upper one provides a meagre microflora composed of species that range from Jurassic to Tertiary...*" and "*...the lower sample contains a rich assemblage of spores and pollen grains*". Considering that core-6 is a sandstone and core-5 is a mudstone it seems likely the two samples have been switched and the reported occurrence of the *L. balmei* Zone from core-6 is invalid. This interpretation is supported by results of the duplicate samples analysed at EPRCo, as their core-5 sample contains a rich *L. balmei* Zone assemblage whilst their bottom sample was essentially barren (Stover & Evans, 1969).

Caved specimens of *Myrtaceidites tenuis* in cuttings at 1147.3m suggest presence of Upper *M. diversus* and/or *P. asperopolus* Zones in the Latrobe Group. The presence of this zone interval has previously been recorded as cavings in cutting from Burong-1, Dutson Downs-1, Merriman-1 and Wonga Binda-1 (Partridge & Macphail, 1996a & b).

Rosedale-1

Previous palynological work on Rosedale-1 is restricted to the Tertiary where ten core samples were analysed by Partridge (1971). Eight samples between 75.9–566m (249-1857 ft) gave Early Miocene to Early Oligocene ages and conform to the restricted usage of the "Latrobe Valley Coal Measures". The two deepest samples between 639.5–697.7m (2098–2289 ft) are Eocene in age and conform to the concept of the offshore Latrobe Group.

Only two new samples are analysed for this report. The shallowest a cuttings at 374.9m (1230 ft) gave a diverse spore-pollen assemblage assigned to the *P. tuberculatus* Zone on the presence of the eponymous species and the diagnostic spore *Cyatheacidites annulatus*. Further restriction to the Early Miocene Upper subzone is possible based on the presence of *Acaciapollenites myriosporites*. The limited microplankton suite recorded is dominated by *Systematophora placacantha* and is consistent with the other marine incursions documented in the "Latrobe Valley Coal Measures" by Holdgate & Sluiter (1991).

The deeper cutting sample from 1478.3m (4850 ft) gave a poorly preserved, carbonised and low diversity assemblage which was dominated by abundant *Cyathidites* spores (74%). Unfortunately key index species were not recorded from this sample which can only be assigned a broad Aptian to Albian age. Assignment to either the *F. wonthaggiensis* or *C. striatus* zones is considered equally possible with extremely low confidence.

Woodside-1

Three core samples from the Strzelecki Group and a cuttings from the Seaspray Group are analysed in Woodside-1. The only known previous work on the well is a study of three core samples by Dettmann (1959), of which only the deepest at 1813.6-1815m (5950-55 ft) yielded a workable microflora

The cuttings sample at 678.2m is from the base of the Gippsland Limestone directly above the lithological pick for the top of the Lakes Entrance Formation at ~683m. The sample is assigned to the *Triporopollenites bellus* Zone on the presence of *Haloragacidites haloragoides*. Although no other index species for this zone were recorded, the spores *Cyatheacidites annulatus* and *Cyathidites subtilis* and pollen *Chenoporopollis* sp. are indicative of a *P. tuberculatus* Zone or younger age and are thus consistent with the zone assignment while the presence of *Proteacidites rectomarginis* suggests an age no younger than the lower part of the *T. bellus* Zone. The assemblage contains abundant microplankton (>70%) which are indicative of a open marine environment.

The three core samples all gave rather poor Early Cretaceous assemblages dominated by spores of *Cyathidites* and bisaccate pollen referred to *Podocarpidites*. The only age diagnostic species recorded was *Crybelosporites striatus* which indicates the samples are *C. striatus* Zone or younger in age. Dettmann (1959) in her sample at 1813.6-1815m records *Coptospora* (al. *Cingulatisporites*) *paradoxa* which would suggest the whole section could belongs to the younger Late Albian *C. paradoxa* Zone. Unfortunately the latter species or other species diagnostic of this younger zone were not recorded in the new samples. Therefore, until the presence of younger index species are confirmed in the well the age is best expressed as *C. striatus* Zone or younger. Rare, low diversity non-marine algae indicate the presence of ephemeral lacustrine environments in a largely non-marine sequence.

The shallowest sample from the Strzelecki Group is further complicated by significant Middle to Late Eocene contamination estimated to represent ~50% of the total assemblage. Although labelled as a core the sample supplied consisted of clumped mudstone reminiscent of poorly washed cuttings. The caved component indicates the presence of the Late Eocene Middle *N. asperus* Zone in the well based on the presence of *Triorites magnificus* and *Tricolpites thomasii*.

References

ABELE, C., GLOE, C.S., HOCKING. J.B., HOLDGATE, G., KENLEY, P.R., LAWRENCE, C.R., RIPPER, D., THRELFALL, W.F. & BOLGER, P.F., 1988. Chapter 8. Tertiary. In *Geology of Victoria*, J.G. Douglas & J.A. Ferguson, eds. Victorian Division Geol. Soc. Aust. Inc., Melbourne. p.251–350

DETTMANN, M.E., 1959. Upper Mesozoic microfloras in well cores from Woodside and Hedley, Victoria. *Proc. R. Soc. Vict. 71*, pt.2, p.99–105.

DETTMANN, M.E., 1963. Upper Mesozoic microfloras from southeastern Australia. *Proc. R. Soc. Vict. 77*, p.1–148.

DETTMANN, M.E., 1966. Palynological report on core samples from wells sunk in the Gippsland Basin. 5p. 2 charts.(unpubl.).

DETTMANN, M.E. & PLAYFORD, G., 1969. Palynology of the Australian Cretaceous: a review. In *Stratigraphy and palaeontology. Essays in honour of Dorothy Hill*, K.S.W. Campbell, ed., A.N.U. Press, Canberra, 174–210.

FENSOME, R.A., WILLIAMS, G.L., BARSS, M.S., FREEMAN, J.M. & HILL, J.M., 1990. Acritarchs and fossil Prasinophytes: An index to genera, species and infraspecific taxa. *AASP Contribution Series No. 25*, p.1–771.

HASKELL, T.R., 1972. Hydrocarbon potential of the Mesozoic and Basal Tertiary of the Gippsland Basin: A Stratigraphic Analysis. *The APEA Journal 12*, p.138–172

HELBY, R., MORGAN, R. & PARTRIDGE, A.D., 1987. A palynological zonation of the Australian Mesozoic. *Mem. Ass. Australas. Palaeontols 4*, p.1–94.

HOCKING, J.B., 1976. Definition and revision of Tertiary stratigraphic units. onshore Gippsland Basin. *Rept. Geol. Surv. Vict. 1976/1*. p.1-40.

HOLDGATE, G.R. & SLUITER, I.R.K., 1991. Oligocene-Miocene marine incursions in the Latrobe Valley depression, onshore Gippsland Basin: evidence, facies relationships and chronology. *Spec. Publ. Geol. Soc. Aust. no.18*, p.137–180.

LENTIN, J.K. & WILLIAMS, G.L., 1993. Fossil Dinoflagellates: Index to genera and species, 1993 Edition. *AASP Contribution Series No. 28*, p.1–856.

LOWRY, D.C. & LONGLEY, I.M., 1991. a new model for Mid-Cretaceous structural history of the northern Gippsland Basin. *The APEA Journal 31*, p.143–153.

MARSHALL, N.G., 1988. A Santonian dinoflagellate assemblage from the Gippsland Basin, Southeastern Australia. *Mem. Ass. Australas. Palaeontols 5*, p.195-215.

MARSHALL, N.G., 1989. An unusual assemblage of algal cysts from the late Cretaceous, Gippsland Basin, Southeastern Australia. *Palynology 13*, p.21–56.

PARTRIDGE, A.D., 1971. Stratigraphic palynology of the onshore Tertiary sediments of the Gippsland Basin, Victoria. MSc thesis, University of NSW (unpubl.).

PARTRIDGE, A.D., 1975. Palynological zonal scheme for the Tertiary of the Bass Strait Basin (Introducing Paleogene Dinoflagellate Zones and Late Neogene Spore-Pollen Zones). *Geol. Soc. Aust. Symposium on the Geology of Bass Strait and Environs, Melbourne*, November, 1975. *Esso Aust. Ltd. Palaeo. Rept. 1975/17* (unpubl.).

PARTRIDGE, A.D., 1976. The geological expression of eustacy in the early Tertiary of the Gippsland Basin. *APEA Journal 16* (1), 73–79.

PARTRIDGE, A.D. & MACPHAIL, M.K., 1996a. Palynological age dating of the Latrobe Group in Avon–1, Burong–1, Comley–1, South West Bairnsdale–1, West Seacombe–1 and Wonga Binda–1 from the onshore Gippsland Basin. *Biostrata Report 1996/7*, p.1–37.

PARTRIDGE, A.D. & MACPHAIL, M.K., 1996b. New palynological analyses from the Latrobe and Golden Beach Groups in Colliers Hill–1, Dutson Downs–1, Golden Beach West–1, and Merriman–1 from onshore Gippsland Basin. *Biostrata Report 199687*, p.1–44.

SLOAN, M.W., MOORE, P.S. & MCCUTCHEON, A., 1992. Kipper—a unique oil and gas discovery Gippsland Basin, Australia. *The APEA Journal 32*, p.1–8.

STOVER, L.E. & EVANS, P. R., 1969. Early Tertiary and Late Cretaceous palynology of the Gippsland Basin and Bass Basin offshore southeastrn Australia. *Esso Production Research Company EPR69-ES16*, p.1-161, pl.1-31 (unpubl.).

STOVER, L.E. & PARTRIDGE, A.D., 1973. Tertiary and late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. *Proc. R. Soc. Vict. 85*, p.237–286.

STOVER, L.E. & PARTRIDGE, A.D., 1982. Eocene spore-pollen from the Werillup Formation, Western Australia. *Palynology 6*, p.69–95.

Table–2: Interpretative Palynological Data

Sample Type	Depth (f)	Depth (m)	Formations	Spore-Pollen Zone	*CR	Microplankton Zone	*CR	MP%	Comments and Key Species Present
Burong-1									
SWC-28	2113	644.0	Latrobe Group	*P. tuberculatus* and Middle *N. asperus*		*Operculodinium* Sz and *G. extensa*		21%	Mixed assemblage interpreted as Late Eocene reworked into Late Oligocene. *Triorites magnificus* and *Gippslandica extensa* present.
Dutson Downs–1									
Core-3	4250	1295.4	Latrobe Group	*L. balmei*	A2			NR	Rare *Lygistepollenites balmei* (<1%) recorded in gymnosperm dominated (>60% assemblage).
Cuttings	4920	1499.6	Golden Beach Group	*N. senectus*	D3			NR	*Forcipites sabulosus* common, *Nothofagidites senectus* frequent.
Cuttings	5940	1810.5	Strzelecki Group	*C. striatus*	D5			NR	LAD *Crybelosporites striatus* in assemblage with >25% caved palynomorphs including *Rimosicysta*.
East Reeve-1									
Cuttings	3920	1194.8	Latrobe Group	*P. tuberculatus*	D4	*Operculodinium* Superzone	D2	86%	Assemblage dominated by *Spiniferites* spp. ~60% (probalbly >95% caved).
Cuttings	4340	1322.8	Latrobe Group	Middle *N. asperus*	D4	Caved *Operculidinium* Sz.		41%	LAD *Santalumidites cainozoicus* in assemblage dominated by cavings from Lakes Entrance Formation (>45% caved).
Cuttings	4580	1396.0	Latrobe Group	*N. asperus*	D4	Caved *Operculidinium* Sz.		67%	Assemblage dominated by cavings from Lakes Entrance Formation (>70% caved).
Cuttings	4620	1408.2	Latrobe Group	Middle *N. asperus*	D3	Caved *Operculidinium* Sz.		42%	FAD *Triorites magnificus* in assemblage dominated by cavings from Lakes Entrance Formation (>45% caved).
Cuttings	4950	1508.8	Strzelecki Group	*C. striatus*	D5	Caved *Operculidinium* Sz.		21%	Shallowest occurrence of Early Cretaceous spore-pollen in assemblage which is >40% caved.
Cuttings	5200	1585.0	Strzelecki Group	*C. striatus*	D3	Caved *Operculidinium* Sz.		24%	LAD *Crybelosporites striatus* in assemblage which is >60% caved.
Cuttings	5250	1600.2	Strzelecki Group	*C. striatus*	D5	Caved *Operculidinium* Sz.		35%	Early Cretaceous spore-pollen in assemblage which is >65% caved.

Table-2: Interpretative Palynological Data

Sample Type	Depth (f)	Depth (m)	Formations	Spore-Pollen Zone	*CR	Microplankton Zone	*CR	MP%	Comments and Key Species Present
Golden Beach West-1									
Core	4020	1225.3	Latrobe Group	Upper *T. longus*	A2			NR	*Gambierina rudata* 53% with *Proteacidites reticuloconcavus* ms and *Battenispollis sectilis*. Core wrongly labelled probably from Core-5 5415-5425 ft.
SWC	5830	1777.0	Golden Beach Group	Indeterminate				NR	Sample barren.
SWC	7250	2209.8	Golden Beach Group	*P. mawsonii*	B5			NR	Limited assemblage dominated by *Podocarpidites* 34%. *Cyathidites* 20% and *Gleicheniidites* 15%.
Merriman-1									
Cuttings	3220	981.5	Latrobe Group	Middle *N. asperus*	D1	*G. extensa*	D3	<1%	*Triorites magnificus* and *Gippslandica extensa* present in assemblage dominated by *Nothofagidites* 69%.
Cuttings	4860	1481.3	Golden Beach Group	Indeterminate					Assemblage entirely dominated >85% by caved Oligocene-Eocene palynomorphs.
Cuttings	5650	1722.1	Golden Beach Group	*P. mawsonii*	D4	*Rimosicysta* Superzone	D3	10%	SP dominated by *Dilwynites* spp. 40%. MP dominated by *Rimosicysta* and *Micrhystridium* sp. A.
North Seaspray-1									
Cuttings	2150	655.3	Latrobe Group	Middle *N. asperus*	D1	*G. extensa*		<4%	*Triorites magnificus* and *Gippslandica extensa* present in assemblage dominated by *Nothofagidites* 67%.
Core-4	3213	979.3	Latrobe Group	*L. balmei*	D2			NR	Rare *Lygistepollenites balmei* and *Gambierina rudata* in assemblage dominated by *Tricolp(or)ites* pollen ~40%.
Cuttings	3764	1147.3	Strzelecki Group	*C. striatus*	D3			NR	LAD *Crybelosporites striatus* in assemblage which is >40% caved.
Cuttings	4920	1499.6	Strzelecki Group	*C. striatus*	D3			NR	*Crybelosporites striatus* present in assemblage with >50% caved palynomorphs.

Table–2: Interpretative Palynological Data

Sample Type	Depth (f)	Depth (m)	Formations	Spore-Pollen Zone	*CR	Microplankton Zone	*CR	MP%	Comments and Key Species Present
Rosedale–1									
Cuttings	1230	374.9	Latrobe Valley Coal Measures	Upper *P. tuberculatus*	D1	*Operculodinium* Superzone	D5	1.5%	*Nothofagidites* 43%. FAD *Acaciapollenites myriosporites.*
Cuttings	4850	1478.3	Strzelecki Group	*C. striatus* to *F. wonthaggiensis*				NR	Poorly preserved assemblage dominated by *Cyathidites* spp. at 74% without key index species.
Woodside–1									
Cuttings	2225	678.2	Seaspray Group	*T. bellus*	D2	*Operculodinium* Superzone	D	72%	*Cyathidites subtilis* and *Haloragacidites haloragoides* present in SP assemblage dominated by *Nothofagidites* 44%.
Core	4050	1234.4	Strzelecki Group	*C. striatus*	D3			NR	*Crybelosporites striatus* present in assemblage badly contaiminated ~50% by Tertiary spore-pollen.
Core	5368	1636.2	Strzelecki Group	*C. striatus*	D5			<2%	Key species not recorded in poor assemblage dominated by *Podocarpidites* spp. at 58%.
Core	5769	1758.4	Strzelecki Group	*C. striatus*	D2			<1%	Rare *C. striatus* present in assemblage dominated by *Cyathidites* spp. at 79%.

*CR = Confidence Ratings MP = Microplankton

NR = No microplankton recorded

Confidence Ratings

The Confidence Ratings assigned to the zone identifications on Table–2 are quality codes used in the STRATDAT relational database developed by the Australian Geological Survey Organisation (AGSO) as a National Database for interpretive biostratigraphic data. Their purpose is to provide a simple relative comparison of the quality of the zone assignments. The alpha and numeric components of the codes have been assigned the following meanings:

Alpha codes: Linked to sample type

- **A** Core
- **B** Sidewall core
- **C** Coal cuttings
- **D** Ditch cuttings
- **E** Junk basket
- **F** Miscellaneous/unknown
- **G** Outcrop

Numeric codes: Linked to fossil assemblage

1 **Excellent confidence:** High diversity assemblage recorded with key zone species.

2 **Good confidence:** Moderately diverse assemblage recorded with key zone species.

3 **Fair confidence:** Low diversity assemblage recorded with key zone species.

4 **Poor confidence:** Moderate to high diversity assemblage recorded without key zone species.

5 **Very low confidence:** Low diversity assemblage recorded without key zone species.

Diversity:

When diversity is used in the text it has the following numerical equivalence:

Very low	=	1–5	species
Low	=	6–10	species
Moderate	=	11–25	species
High	=	26–74	species
Very high	=	75+	species

Table–3: Basic Sample and Palynomorph Data

Sample Type	Depth (f)	Depth (m)	Lithology	Wt	Vom (cc)	O/Yield	Visual Yield	Palynomorph Concentration	Preservation	Number SP Species	Number MP Species
Burong-1											
SWC-28	2113	644.0	Calcareous LEM	3.4	0.3	0.088	Moderate	Moderate	Good	30+	7+
Dutson Downs–1											
Core-3	4250	1295.4	Medium grey mudstone with carbonaceous flecks	18.9	2.5	0.132	High	Moderate	Poor-fair	23+	NR
Cuttings	4920	1499.6	Coally shale 30%; medium grey shale 45%; qtz sand 25%	7.8	2.9	0.371	High	Low-moderate	Poor-fair	26+	1+
Cuttings	5940	1810.5	Fine sand 60%; coal 40%	12.4	2.9	0.233	High	Low	Poor	22+	3+
East Reeve-1											
Cuttings	3920	1194.8	100% LEM	18.2	1.2	0.065	Moderate	High	Fair-good	14+	14+
Cuttings	4340	1322.8	60% carbonaceous siltst; 40% caved LEM	13.7	8.0	0.583	High	Moderate	Poor-good	18+	11+
Cuttings	4580	1396.0	10% carbonaceous siltst; 90% caved LEM	20.8	2.8	0.134	High	Moderate	Poor-fair	20+	11+
Cuttings	4620	1408.2	80% qtz sand; 10% carbonaceous siltst; 10% caved LEM	26.2	1.8	0.068	High	Moderate	Poor-fair	29+	10+
Cuttings	4950	1508.8	10% qtz sand; 30% shale; 10% carbonaceous siltst; 50% caved LEM	12.9	1.8	0.139	High	Moderate	Poor-fair	25+	7+
Cuttings	5200	1585.0	70% grey shale; 10% carbonaceous siltst; 20% caved LEM	12.3	1.7	0.138	High	Low	Poor-fair	30+	11+
Cuttings	5250	1600.2	60% grey shale; 20% carbonaceous siltst; 20% caved LEM	11.7	2.8	0.239	High	Moderate-high	Poor-good	24+	6+
Golden Beach West–1											
Core	4020	1225.3	Medium grey shale	13.8	0.8	0.057	Low	Low	Poor-fair	16+	NR
SWC	5830	1777.0	Light grey siltstone to fine sandstone	7.8	0.1	0.120	Very low	Very low	Poor	1+	NR
SWC	7250	2209.8	Dark grey shale 40%; lithic cemented sandstone 60%	4.7	0.4	0.085	High	Low	Poor	13+	1+

Table-3: Basic Sample and Palynomorph Data

Sample Type	Depth (f)	Depth (m)	Lithology	Wt	Vom (cc)	O/Yield	Visual Yield	Palynomorph Concentration	Preservation	Number SP Species	Number MP Species
Merriman-1											
Cuttings	3220	981.5	Carbonaceous siltstone	13.5	2.8	0.207	High	High	Good	36+	3+
Cuttings	4860	1481.3	Light grey clumped mudstone and sand	13.8	0.9	0.065	High	Low	Good	22+	2+
Cuttings	5650	1722.1	Predominantly dark grey shale	11.9	1.4	0.117	High	Low	Poor-fair	23+	6+
North Seaspray-1											
Cuttings	2150	655.3	Carbonaceous sand with pieces of caved marl	10.9	2.8	0.256	High	High	Fair-good	37+	4+
Core-4	3213	979.3	Carbonaceous shale	13.1	5.8	0.442	High	Low	Poor	22+	1+
Cuttings	3764	1147.3	Mixed medium grey mudstone; carbonaceous shale and qtz sand	11.6	1.6	0.137	High	High	Poor-good	26+	3+
Cuttings	4920	1499.6	Clumped medium grey lithic sandsone	11.2	0.5	0.044	Moderate	Moderate	Poor-fair	39+	4+
Rosedale-1											
Cuttings	1230	374.9	Dark grey carbonaceous mudstone and qtz sand	12.0	1.0	0.083	High	Low	Good	31+	3+
Cuttings	4850	1478.3	Light grey shale	10.0	1.0	0.100	High	Low	Poor	14+	NR
Woodside-1											
Cuttings	2225	678.2	Large pieces of marl	7.9	0.4	0.050	Low	Moderate	Fair-good	25+	10+
Core	4050	1234.4	Cumped light-medium grey mudstone	11.0	0.3	0.027	Moderate	High	Fair-good	46+	NR
Core	5368	1636.2	Medium grey siltstone	12.8	0.3	0.023	Moderate	Moderate-high	Fair-good	16+	2+
Core	5769	1758.4	Medium grey shale with extensive slickensides	12.6	0.3	0.023	Moderate	Low-moderate	Poor-fair	18+	1+

Wt = Weight of samples in grams
Vol (cc) = Volume of aqueous suspension of kerogen residue recovered by Laola Pty Ltd
O/yield = Volume (cc) divided by Weight (grams)
LEM = Lakes Entrance Marl

Table–4: Selected Palynomorph Abundance Data for Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Ctgs	Ctgs	Ctgs	Ctgs	Core	Ctgs	Ctgs	Core-4	Ctgs	Ctgs
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
Palynomorphs												
TRILETE SPORES undiff.	2.1%		5.3%	3.0%	3.8%	1.0%	3.8%					
Baculatisporites spp.	2.1%						0.8%					1.8%
Cyathidites annulatus											0.7%	
Cyathidites spp. large >40μm	4.2%					1.9%				0.9%	3.5%	3.6%
Cyathidites spp. small <40μm		2.1%	21.1%		3.8%	1.9%	4.5%		0.7%	1.9%		
Dictyophyllidites	1.4%										2.8%	
Gleicheniidites/Clavifera spp.	2.1%	5.7%							1.5%			
Herkosporites elliottii					1.9%		1.5%					
Latrobosporites spp.							0.8%					
Retitriletes spp.							3.8%					
Stereisporites spp.	1.4%					1.0%	6.8%					
MONOLETES SPORES undiff:					1.9%					0.9%	0.7%	
Laevigatosporites spp.		2.1%		3.0%		1.9%	2.3%	0.9%			0.7%	
Total Spores:	**13%**	**10%**	**26%**	**6%**	**11%**	**8%**	**24%**	**1%**	**2%**	**4%**	**8%**	**5%**
GYMNOSPERMS undiff.												
Araucariacites australis		1.4%	10.5%	3.0%		1.0%		0.9%				5.5%
Dilwynites spp.	0.7%	6.4%		1.5%	5.7%	1.0%		0.9%	0.7%	4.7%		5.5%
Lygistepollenites balmei	2.8%	0.7%								0.9%		
Lygistepollenites florinii	4.2%	1.4%				4.8%		1.7%	4.4%	3.8%	4.2%	3.6%
Microalatidites spp.		2.1%								0.9%		
Microcachyridites antarticus		1.4%		1.5%					0.7%			
Phyllocladidites mawsonii	12.7%	13.5%		3.0%	1.9%	3.8%		7.8%	8.8%	2.8%	1.4%	3.6%
Podocarpidites spp.	7.7%	34.0%	5.3%	12.1%	1.9%	2.9%	3.0%	2.6%	5.1%	22.6%	9.1%	3.6%
Podosporites microsaccatus		4.3%					2.3%					
Total Gymnosperms:	**28%**	**65%**	**16%**	**21%**	**9%**	**13%**	**5%**	**14%**	**20%**	**36%**	**15%**	**22%**
ANGIOSPERM POLLEN undiff.	0.7%			1.5%		4.8%	0.8%	0.9%			2.1%	
Australopollis obscurus		0.7%								0.9%		
Battenipollis sectilis							0.8%					
Casuarina (H. harrisii)	8.5%		5.3%	18.2%	18.9%	13.5%		4.3%	16.8%	0.9%	21.0%	16.4%
Dicotetradites clavatus				4.5%						0.9%		
Gambierina rudata							52.6%			0.9%		
Ilexpollenites spp.			5.3%								0.7%	
Malvacipollis spp.						2.9%		2.6%				
Myrtaceidites spp.				1.5%							0.7%	
N. asperus/goniatus								0.9%	0.7%			1.8%
N. brachyspinulosus/flemingii	2.8%	0.7%		1.5%		1.9%		1.7%	1.5%		1.4%	
N. deminutus/vansteenisii	7.0%		5.3%	1.5%	7.5%	5.8%		10.3%	4.4%		5.6%	
N. emarcidus/heterus/falcatus	35%	0.7%	42%	23%	36%	36%	3.0%	56%	46%	2.8%	40%	44%
Periporopollenites spp.		1.4%				1.0%		0.9%		3.8%		1.8%
Proteacidites spp.	4.2%	17.7%		18.2%	17%	13.5%	13.5%	6.9%	4.4%	11.3%	1.4%	5.5%
Tricolp(or)ates spp.	0.7%	3.5%		3.0%				0.9%	4.4%	39%	4.2%	3.6%
Total Angiosperms:	**58%**	**25%**	**58%**	**73%**	**79%**	**79%**	**71%**	**85%**	**78%**	**60%**	**77%**	**73%**
Total Spore-Pollen Count:	**142**	**141**	**19**	**66**	**53**	**104**	**133**	**116**	**137**	**106**	**143**	**55**

Table–4: Selected Palynomorph Abundance Data for Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Ctgs	Ctgs	Ctgs	Ctgs	Core	Ctgs	Ctgs	Core-4	Ctgs	Ctgs
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
MICROPLANKTON												
Dinoflagellates undiff:	1.7%		3.7%	6.3%	9.4%	2.8%						1.0%
Dapsilidinium pseudocolligerum	1.2%		1.5%		1.3%	1.1%						
Gippslandica extensa								0.9%	0.7%			
Hystrichokolpoma rigaudiae	0.6%					1.1%						4.0%
Impagidinium spp.			0.7%									
Lingulodinium macharophorum			0.7%	0.9%	0.6%							
Nematosphaeropsis rhizoma ms			3.7%									
Operculodinium centrocarpum	0.6%		12.6%	5.4%	8.8%	9.6%						37.1%
Protoellipsodinium spp.	1.2%		3.7%	6.3%	1.9%	0.6%						3.0%
Pyxidmopsis pontus				0.9%								
Spiniferites spp.	12.2%		59.3%	20.7%	45.0%	26.4%			3.5%			27.7%
Total Microplankton:	**17%**		**86%**	**41%**	**67%**	**42%**		**1%**	**4%**			**73%**
Total SP & MP Count:	**172**	**141**	**135**	**111**	**160**	**178**	**133**	**117**	**143**	**106**	**143**	**202**
Reworked Spores & Pollen	0.6%					1.6%						
Fungal fruiting bodies											0.7%	
Fungal spores & hyphae		2.8%	0.7%	1.8%	1.2%			2.5%			4.6%	3.8%
Microforaminiferal liners	0.6%					1.6%						
Scolecodont												0.5%
TOTAL COUNT:	**174**	**145**	**136**	**113**	**162**	**184**	**133**	**120**	**143**	**106**	**151**	**211**

Table-5: Selected Species Distribution Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Cts	Cts	Cts	Cts	Core	Cts	Cts	Core-4	Cts	Cts
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
SPORE-POLLEN												
Acaciapollenites myriosporites											X	
Araucariacites australis		X	X	X	X	X			X			X
Australopollis obscurus		X								X		
Banksiaeidites arcuatus								X				
Banksieaeidites elongatus				X							X	
Battenipollis sectilis							X					
Beaupreaidites trigonalis ms									X			
Beaupreaidites verrucosus								X	X			
Chenopodopollis sp.												X
Cyatheacidites annulatus											X	X
Cyathidites australis	RW											
Cyathidites minor							X					
Cyathidites paleospora	X		X	X	X				X		X	
Cyathidites splendens	X			X	X	X				X		
Cyathidites subtilis												X
Dacrycarpites australiensis									X			
Dicotetradites clavatus				X						X		
Dilwynites granulatus	X	X		X	X	X		X	X	X		X
Dilwynites tuberculatus										X		
Dryptopollenites semilunatus	RW											
Ericipites crassiexinus/scabratus					X	X		X	X	X	X	
Foveotriletes palaequetrus												X
Gambierina rudata							A			X		
Gleicheniidites circinidites	X	X						X	X		X	
Haloragacidites haloragoides												X
Haloragacidites harrisii	X		X	X	C	C		X	X	X	X	X
Herkosporites elliottii					X		X					X
Ilexpollenites spp.			X								X	
Ischyosporites irregularis ms				X		X		X	X		X	
Laevigatosporites major			X					X				X
Laevigatosporites ovatus		X	X	X	X	X	X	X			X	
Latrobosporites marginis	X							X	X			
Lygistepollenites balmei	RW	X					X			C		
Lygistepollenites florinii	X	X				X		X	X	X	X	X
Malvacipollis diversus						X						
Malvacipollis robustus ms								X				
Malvacipollis subtilis			X			X		X	X		X	
Matonisporites ornamentalis					X	X		X			X	

Table–5: Selected Species Distribution Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Cts	Cts	Cts	Cts	Core	Cts	Cts	Core-4	Cts	Cts
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
Microalatidites paleogenicus		X								X		
Microcachyridites antarcticus		X		X			X		X			
Milfordia incerta											X	
Myrtaceidites parvus/mesonesus				X								
Myrtaceidites verrucosus									X			
Nothofagidites brachyspinulosus		X			X			X		X	X	
Nothofagidites emarcidus/heterus	X	X	X	X	X	A		X	X	X	X	X
Nothofagidites endurus		X										
Nothofagidites senectus							X					
Nothofagidites asperus					X			X	X			X
Nothofagidites deminutus	X		X	X	X	X		X	X		X	X
Nothofagidites falcatus	X		X		X	X			X		X	X
Nothofagidites flemingii	X	X		X	X	X		X	X			
Nothofagidites goniatus	X							X				
Nothofagidites vansteenisii	X		X		X	X		X	X		X	
Parasaccites catastus											X	
Periporopollenites demarcatus						X		X	X		X	
Periporopollenites polyoratus		X								X		
Phyllocladiidites mawsonii	X	X		X	X			X	X			X
Polypodiidites perverrucatus					X	X					X	X
Proteacidites adenanthoides		X						X	X			
Proteacidites angulatus	X											
Proteacidites annularis									X			X
Proteacidites obscurus	X							X	X			
Proteacidites prodigus ms										X		
Proteacidites pseudomoides						X						
Proteacidites recavus	X							X	X			
Proteacidites rectomarginis								X				X
Proteacidites reticulatus									X			
Proteacidites reticuloconcavus ms							X					
Proteacidites stipplatus	X		X									
Proteacidites tenuiexinus										X		
Proteacidites tuberculatus											X	
Pseudowinterapollis couperi								X				
Pseudowinterapollis wahooensis							X					
Rugulatispoites trophus								X				
Santalumidites cainozoicus				X								
Sapotaceoidaepollenites rotundus						X			X			
Stereisporites antiquisporites	X		X			X	X					

Table–5: Selected Species Distribution Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Cts	Cts	Cts	Cts	Core	Cts	Cts	Core-4	Cts	Cts
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
Stereisporites regium							X					
Trichotomosulcites subgranulatus		X										
Tricolpites paenestriatus									X			
Tricolpites phillipsii		X										
Tricolpites simatus								X				
Tricolporites adelaidensis	X					X		X	X		X	
Tricolporites leuros	X							X	X		X	
Tricolporites scabratus										X		
Tricolporites sphaerica								X				
Triorites magnificus	X							X	X			
Verrucatosporites attinatus ms											X	
Verrucatosporites speciosus		X								X		
Verrucosisporties kopukuensis	X							X	X			X
MICROPLANKTON												
Achomosphaera spp.									X			X
Apteodinium australiense			X	X		X						
Circulosporites parvus										X		
Cyclopsiella vieta			X	X					X			X
Dapsilidinium pseudocolligerum	X		X	X	CV	CV		X				
Deflandrea phosphoritia								X				
Gippslandica extensa	X							X	X			
Hystrichokolpoma rigaudae	X				CV	CV						X
Impagidinium spp.			X		CV							
Lejeunecysta sp.			X									
Lingulodinium machaerophorum			X	X	CV							X
Lingulodinium solarum	X											
Nematosphaeropsis rhizoma ms			X		CV	CV						
Nematosphaeropsis spp.						CV						
Operculodinium centrocarpum	X		X	X	CV	CV					X	X
Paralecaniella indentata				X								
Pentadinium laticinctum			X		CV							
Protoellipsodinium mamilatus ms				X								
Protoellipsodinium simplex ms	X		X	X	CV	CV						X
Pyxidiopsis pontus ms			X	X		CV						
Spinidinum spp.					CV							
Spiniferites spp.	X		X	X		CV			X		X	A
Systematophora placacanthum					CV						C	X
Tectatodinium ovum ms						CV						

Table-5: Selected Species Distribution Seaspray and Latrobe Groups.

Wells:	Burong-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1
Sample Type:	SWC	Core-3	Cts	Cts	Cts	Cts	Core	Cts	Cts	Core-4	Cts	Cts
Depth in metres:	644.0	1295.4	1194.8	1322.8	1396.0	1408.2	1225.3	981.5	655.3	979.3	374.9	678.2
Depth in feet:	2113	4250	3920	4340	4580	4620	4020	3220	2150	3213	1230	2225
Tectatodinium pellitum			X									
Tectatodinium scabroellipticus ms			X									X
OTHER PALYNOMORPHS												
Microforaminiferal liners	X		X		CV	CV						
Scolecodont												X
FUNGAL spores/hyphae		X	X	X	X	X		X		X	C	X
Persavis sp.											X	

ABBREVIATIONS:

A	=	Abundant
C	=	Common
F	=	Frequent
X	=	Present
CV	=	Caved
RW	=	Reworked

Table–6: Selected Palynomorph Abundance Data from Golden Beach and Strzelecki Groups

Well:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Ctgs	Ctgs	Ctgs	Ctgs	Ctgs	SWC	Ctgs	Ctgs	Ctgs	Ctgs	Ctgs	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
Palynomorphs														
TRILETE SPORES undiff.	2.0%	2.8%		2.8%		1.9%	1.9%	1.0%	1.6%	0.5%	4.6%	3.3%	9.0%	1.6%
Baculatisporites spp.	5.9%	3.7%	11%	12%		3.9%	0.9%	1.9%	2.6%	7.0%		1.7%	4.5%	3.9%
Callialasporites spp.													0.9%	
Ceratosporites equalis		0.9%	0.9%	0.9%							4.6%			0.8%
Cicatricosisporites spp.		2.8%		0.9%					7.8%	13%		5.8%		2.3%
Crybelosporites striatus		0.9%												
Cyathidites spp. large >40μm		3.7%	11%	10%	3.1%	4.9%		1.0%	8.3%	1.0%	61%	2.5%	3.6%	1.6%
Cyathidites spp. small <40μm	5.9%	7.3%	8.3%	8.4%	4.6%	15%	1.9%	3.9%	15%	7.0%	13%	12%	4.5%	78%
Cyclosporites													0.9%	
Dictyophyllidites										0.5%				0.8%
Dictyotosporites													0.9%	
Foraminisporites										1.5%				
Gleicheniidites/Clavifera spp.	2.9%			2.8%		15%	3.7%	1.0%	2.6%	2.0%			0.9%	
Herkosporites elliottii	1.0%							2.9%						
Leptolepidites verrucatus				0.9%	1.5%						2.8%			
Neoraistrickia spp.				0.9%				1.0%						
Osmundacidites spp.	3.9%	1.8%	5.6%	3.7%	3.1%			1.9%	2.6%	5.5%		5.8%	4.5%	0.8%
Retitriletes spp.		1.8%	8.3%	2.8%	6.2%	2.9%		1.0%	0.5%	0.5%	7.4%	5.0%	9.0%	2.3%
Stereisporites spp.	1.0%	2.8%	3.7%	3.7%	1.5%				6.2%	0.5%		1.7%	0.9%	
MONOLETES SPORES undiff:														0.8%
Crybelosporites spp.										1.0%				
Laevigatosporites spp.	2.9%	5.5%	0.9%	0.9%		5.8%	1.9%		0.5%			1.7%		
Marattisporites scabratus	2.9%													
HILATE														
Aequitriradites spp.					1.5%				0.5%	1.0%				
Triporoletes spp.										1.0%				
Total Spores:	**28%**	**34%**	**50%**	**51%**	**22%**	**49%**	**10%**	**16%**	**48%**	**42%**	**94%**	**39%**	**40%**	**92%**
GYMNOSPERMS undiff.														
Araucariacites australis	2.0%		0.9%	1.9%	1.5%		1.9%	14%	1.0%	3.0%		3.3%	1.8%	
Corollina spp.		0.9%			3.1%			1.0%	2.1%	1.0%		0.8%		2.3%
Cupressacites sp.		0.9%						4.9%	0.5%					
Dilwynites spp.	1.0%	4.6%		0.9%		6.8%		36%		1.0%		5.0%		
Dilwynites pusillus	3.9%	3.7%						2.9%						
Lygistepollenites balmei							3.7%							
Lygistepollenites florinii										2.0%				
Microcachyridites antarticus	2.0%	3.7%	2.8%	4.7%	1.5%	4.9%		1.0%	0.5%			1.7%	0.9%	
Phyllocladidites mawsonii	2.9%		3.7%	1.9%	1.5%		10%	1.0%	4.7%	8.5%		5.8%		
Podocarpidites spp.	30%	45%	21%	15%	32%	34%	7%	23%	11%	10%	6%	28%	58%	5%
Podosporites microsaccatus	8.8%	1.8%			3.1%	2.9%	1.9%		2.1%			0.8%		
Vitreisporites signatus		0.9%												
Total Gymnosperms:	**51%**	**61%**	**29%**	**24%**	**43%**	**49%**	**24%**	**83%**	**22%**	**25%**	**6%**	**45%**	**60%**	**8%**

Table–6: Selected Palynomorph Abundance Data from Golden Beach and Strzelecki Groups

Well:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Ctgs	Ctgs	Ctgs	Ctgs	Ctgs	SWC	Ctgs	Ctgs	Ctgs	Ctgs	Ctgs	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
ANGIOSPERM POLLEN undiff.									0.5%			1.7%		
Casuarina (H. harrisii)		0.9%	1.9%	3.7%	15%		21%		8.3%	12%		2.5%		
Forcipites sabulosus	4.9%													
Gambierina rudata							1.9%							
Malvacipollis spp.				0.9%			0.9%			2.5%				
Myrtaceidites spp.			0.9%	0.9%										
Nothofagidites spp									19%					
N. brachyspinulosus/flemingii										1.0%		1.7%		
N. deminutus/vansteenisii			1.9%	0.9%						1.0%				
N. emarcidus/heterus/falcatus	1.0%	1.8%	11%	8.4%	11%		25%			12%		9.1%		
Nothofagidites senectus	3.9%													
Peninsulapollis gillii	5.9%													
Proteacidites spp.	1.0%	0.9%	3.7%	6.5%	9.2%	1.0%	10%	1.0%	2.6%	2.0%		0.8%		
Tricolp(or)ates spp.	3.9%	0.9%	1.9%	2.8%		1.9%	5.6%		0.5%	1.0%				
Total Angiosperms:	**21%**	**5%**	**21%**	**24%**	**35%**	**3%**	**65%**	**1%**	**31%**	**32%**		**16%**		
Total Spore-Pollen Count:	**102**	**109**	**108**	**107**	**65**	**103**	**107**	**103**	**193**	**201**	**108**	**121**	**111**	**129**
MICROPLANKTON														
Dinoflagellates undiff:		0.9%	2.9%	1.7%	3.0%					0.5%				
Apectodinium australiense				4.1%										
Circulisporites parvus	2.9%	1.8%			1.0%	1.0%			0.5%				0.9%	
Dapsilidinium pseudocolligerum				0.6%										
Gippslandica extensa										1.0%				
Hystrichokolpoma rigaudae				0.6%										
Lingulodinium macharophorum			2.2%		2.0%									
Micrhystridium spp.								4.3%						
Operculodinium centrocarpum			3.6%	5.2%	7.9%									
Protoellipsodinium spp.				1.2%										
Rimosicysta spp.		0.9%						5.2%						
Sigmopollis carbonis								0.9%					0.9%	0.8%
Spiniferites spp.			14%	24%	22%					2.4%				
Total Microplankton:	**2.9%**	**3.5%**	**22%**	**38%**	**36%**	**1.0%**		**10%**	**0.5%**	**3.8%**			**1.8%**	**0.8%**
Total SP & MP Count:	**105**	**113**	**139**	**172**	**101**	**104**	**107**	**115**	**194**	**209**	**108**	**121**	**113**	**130**
Reworked Spores & Pollen													2.6%	
Fungal fruiting bodies								0.8%						
Fungal spores & hyphae		1.7%		1.1%	2.9%	5.5%	2.7%	4.9%	0.5%	0.9%				
TOTAL COUNT:	**105**	**115**	**139**	**174**	**104**	**110**	**110**	**122**	**195**	**211**	**108**	**121**	**116**	**130**

Table–7: Selected Species Distribution for Golden Beach and Strzelecki Groups.

Wells:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Cts	Cts	Cts	Cts	Cts	SWC	Cts	Cts	Cts	Cts	Cts	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
SPORE-POLLEN														
Aequitriradites verrucosus									X	X		X		
Aequitriradites spinulosus	X	X			X				X	X		X		
Alisporites grandis				X					X		X			X
Alisporites simplex			X											
Aratrisporites spp. RW								RW		RW		RW		
Araucariacites australis*	X		X	X	X	X	X	A	X			X	X	
Baculatisporites spp.	X	X	X	X	X	X	X	X	X	X		X	X	
Balmeisporites holodictyus												X		
Beaupreaidites trigonalis ms									CV					
Callialasporites dampieri													X	
Ceratosporites equalis	X		X	X	X			cf			X			X
Cicatricosisporites australiensis		X	X	X	X				X	X	X	X		X
Cicatricosisporites hughesii										X				
Cicatricosisporites pseudotripartitus								X						
Cingutriletes congruens										X				
Corollina simplex	X													
Corollina torosa			X		X			X	X	X		X		X
Crybelosporites nudum										X				
Crybelosporites striatus		X		X					X	X		X		X
Cupressacites sp.								F	X	X				
Cyathidites australis	X	X	X	A	C	X		X	X	X	X	X	X	
Cyathidites minor	C	C	X	X	X	X		X	X		X	X	X	X
Cyathidites paleospora												CV		
Cyathidites splendens					CV									
Cycadopites folliculosus												X		
Cyclosporites highesii													cf	
Dicotetradites clavatus					CV									
Dictyotosporites complex			X											
Dictyotosporites speciosus				X	X						X	X	X	
Dilwynites granulatus	X	C				X		A		X		CV		
Dilwynites pusillus ms (sm.var.)	F	F						F						
Ericipites scabratus					CV									
Foraminisporis asymmetricus										X		X		

Table–7: Selected Species Distribution for Golden Beach and Strzelecki Groups.

Wells:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Cts	Cts	Cts	Cts	Cts	SWC	Cts	Cts	Cts	Cts	Cts	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
Foraminisporis wonthaggiensis													X	
Forcipites sabulosus	X													
Gambierina rudata							CV			CV				
Gleicheniidites circinidites	X			X		C	X		X				X	
Haloragacidites harrisii	CV	CV	CV	CV	CV		CV	CV	CV	CV		CV		
Herkosporites elliottii	X	X						cf				CV		
Ischyosporites crateris														X
Januisporites spinulosus										X				
Klukisporites scaberis				X										
Laevigatosporites ovatus	F	X				X	X		X					
Leptolepidites major													X	
Leptolepidites verrucatus			X		X					X	X	X		X
Lygistepollenites balmei							CV			CV				
Lygistepollenites florinii							CV			CV		CV		
Malvacipollis subtilis	CV						CV		CV					
Microcachryidites antarticus	F	X	X	X		X	X	X	X			X	X	
Myrtaceidites tenuis									CV					
Neoraistrickia truncata			X	X				X			X			
Nevesisporites dailyi				X										
Nothofagidites asperus					CV				CV					
Nothofagidites deminutus							CV		CV	CV		CV		
Nothofagidites emarcidus/heterus	CV	CV		CV			CV	CV	CV	CV		CV		
Nothofagidites falcatus									CV					
Nothofagidites flemingii	CV									CV				
Nothofagidites senectus	F													
Nothofagidites vansteenisii										CV				
Osmundacidites wellmanii	X	F	F	X	X	X			X	X		X	C	X
Peninsulapollis gillii	X	X				CV								
Periporopollenites demarcatus	CV													
Phyllocladidites eunuchus ms												CV		
Phyllocladidites mawsonii	X		CV	CV	CV		F	X	CV	CV		CV		
Plicatipollenites spp. RW												RW		
Podocarpidites spp.	A	A	X	X	X	A	X	A	A	C	X	X	A	C
Podosporites microsaccatus	X	F	X	X	X	X	X		X		X	X		

Table–7: Selected Species Distribution for Golden Beach and Strzelecki Groups.

Wells:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Cts	Cts	Cts	Cts	Cts	SWC	Cts	Cts	Cts	Cts	Cts	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
Polycingulatisporites clavus														X
Proteacidites adenanthoides												CV		
Proteacidites annularis							CV		CV					
Proteacidites obscurus										CV				
Proteacidites pachypolus							CV		CV	CV				
Proteacidites spp.	X	CV	CV	CV	CV	X	CV	X	X	CV		CV		
Protohaploxypinus spp. RW								RW				RW	RW	RW
Retitriletes austroclavatidites			X		X				X	X	X			X
Retitriletes circolumenus			X								X			
Retitriletes eminulus					X						X			
Retitriletes nodosa													X	
Retitriletes spp.		X	X	X	X	F	X	X	X	CV	X	X	C	X
Stereisporites antiquisporites	X	F	F	F	X			X	X	X		X	X	
Tetracolporites verrucosus										CV				
Tricolp(or)ites spp.	X		X	X		X	X	X	X					
Tricolpites confessus							CV							
Tricolporites adelaidensis												CV		
Triorites magnificus										CV		CV		
Triporoletes reticulatus												X		
Velosporites triquetrus										X				
Verrucosisporties kopukuensis				CV										
Vitreisporites signatus	X	X												
MICROPLANKTON														
Apteodinium australiense			CV	CV										
Circulosporites parvus	F	F		X	X	X			X	X			X	
Cyclopsiella vieta				CV										
Dapsilidinium pseudocolligerum			CV	CV	CV									
Gippslandica extensa									CV	CV				
Lingulodinium machaerophorum				CV	CV									
Luxadinium sp.		X												
Micrhystridium sp. A. Marshall 1990								X				X		
Operculodinium centrocarpum			CV	CV	CV					CV				
Protoellipsodinium simplex ms			CV	CV										

Table–7: Selected Species Distribution for Golden Beach and Strzelecki Groups.

Wells:	Dutson Downs-1	Dutson Downs-1	East Reeve-1	East Reeve-1	East Reeve-1	Golden Beach West-1	Merriman-1	Merriman-1	North Seaspray-1	North Seaspray-1	Rosedale-1	Woodside-1	Woodside-1	Woodside-1
Sample Type:	Cts	Cts	Cts	Cts	Cts	SWC	Cts	Cts	Cts	Cts	Cts	Core	Core	Core
Depth in metres:	1499.6	1810.5	1508.8	1585.0	1600.2	2209.8	1481.3	1722.1	1147.3	1499.6	1478.3	1234.4	1636.2	1758.4
Depth in feet:	4920	5940	4950	5200	5250	7250	4860	5650	3764	4920	4850	4050	5368	5769
Rimosicysta concava								X						
Rimosicysta spp.		X						X						
Schizosporis reticulatus									X					
Sigmopollis carbonis													X	X
Spiniferites spp.			CV	CV	CV		CV	CV		CV				
Systematophora placacanthum				CV										
Wuroia corrugata								X						
OTHER PALYNOMORPHS														
Microforaminiferal liners			CV	CV										
Fungal spores & hypae	X	X	X		X	X		X	X	X		X		
Fungal fruiting bodies								X						

ABBREVIATIONS:

A = Abundant
C = Common
F = Frequent
X = Present
CV = Caved
RW = Reworked