Palynological Analysis of Blackback-3 Gippsland Basin

by

Alan D. Partridge

Biostrata Pty Ltd

A.C.N. 053 800 945

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INTERPRETATIVE DATA

Introduction

Thirty-one samples comprising 23 sidewall cores and 8 conventional core samples were analysed in Blackback-3. The author cleaned, split the selected sidewall cores and forwarded them to Laola Pty Ltd in Perth for processing to prepare the palynological slides. The eight core samples were sent directly to Laola Pty Ltd for initial urgent age dating.

An average of 22.3 grams of the conventional core samples and 13.2 grams of the sidewall cores were processed for palynological analysis (Table 2). Residue yields were mostly low to very low from both the conventional cores and sidewall cores. Palynomorph concentration on the slides was quite variable ranging from low to barren in the coarser grained sandstone samples to very high from some of the argillaceous sandstones and siltstones. The highest yielding sidewall cores, most of which had high palynomorph concentrations, were from the Late Cretaceous Upper *T. longus* Zone below 2971m. Preservation of palynomorphs varied from poor to very good. It is noticeable from the sandier lithologies that many of the larger dinoflagellate cysts are fragmented. This could have been caused either by initial post-depositional bioturbation of the sediments or later during the palynological preparations. Recorded spore-pollen diversity ranges up to 55 species/sample. Average diversity, excluding barren and very low yielding samples is 33+ species. Microplankton diversity in the same samples averages 12+ species and ranges from 3+ to 29+ species/sample. All productive samples contained microplankton.

Lithological units and palynological zones from the base of the Seaspray Group to Total Depth are given in the following summary. The interpretative data with zone identification and Confidence Ratings are recorded in Table-1 and basic data on residue yields, preservation and diversity are recorded on Tables-2 and 3. All species which have been identified with binomial names are tabulated on the palynomorph range charts. Relinquishment list for palynological slides and residues from samples analysed in Blackback-3 are provided at the end of the report.

Palynological Summary for Blackback-3

AGE	UNIT/FACIES	SPORE-POLLEN ZONES (DINOFLAGELLATE ZONES)	DEPTHS (mKB)
MIOCENE TO OLIGOCENE	SEASPRAY GROUP	*P. tuberculatus* (*F. leos*)	2772.4-2818 (2809-2818)
		Upper *N. asperus* (*F. leos*)	2823-2829 A (2823-2829 A)
LATE EOCENE	LATROBE GROUP "Blackback Channel Sands"	Upper *N. asperus*	2829 B
		Middle *N. asperus* (*C. incompositum*)	2835-2850 (2835-2850)
PALEOCENE	LATROBE GROUP "Hapuku Marine Sands"	*L. balmei* (*A. circumtabulata*)	2898.2-2902 (2898.2)
MAASTRICHTIAN	LATROBE GROUP "Terakihi Marine Sands"	Upper *T. longus* (*M. druggii*)	2971-3062 (2971-3004)
			T.D. 3125m

Geological Comments

1. The palynological analysis in Blackback-3 indicates that three marine sand units separated by unconformities can be recognised in the 296 metres of Latrobe Group penetrated, whilst in the basal 60 metres analysed from the overlying Seaspray Group, two deep marine claystone units can be distinguished which may also be separated by an unconformity.

2. The lithological pick for the Top of Latrobe Group is taken at 2829m where it was fortuitously sampled by SWC-40. This sidewall core consisted of a dark brown-grey calcareous claystone in sharp contact with a dark brown-grey, fine to medium grained, glauconitic sandstone. These two lithologies were processed separately to yield significantly different palynological assemblages. The claystone, which comprised less than 20% of the sidewall

core gave a very low yield in which microplankton comprised 87% of the palynomorphs recorded. The limited diversity of the spore-pollen and microplankton recorded from the sample is a direct consequence of the very low yield. The glauconitic sandstone, in contrast gave a high residue yield which was dominated by spores, pollen and fungal remains with microplankton a low 7% of the total count. This marked increase in microplankton abundance in the claystone lithology and subsequent decline in overlying samples from the Seaspray Group (Table-1) has the characteristics of a flooding surface. As both parts of SWC-40 gave the same age (within currently available resolution or understanding) it is uncertain whether the boundary may also represent a sequence boundary or simply reflect a downlap surface within a single depositional cycle.

3. The identification in Blackback-3 of the Upper *N. asperus* Zone, and the new *Fromea leos* Microplankton Zone, from a calcareous claystone facies typical of the basal Seaspray Group has potential significance to the identification of the seismic pick for the Top of Latrobe across the Blackback/Terakihi field. The Upper *N. asperus* Zone is recorded from the same facies in Hapuku-1 between 2804-2810.5m (9200-9221 ft) and in Blackback-1 Sidetrack-1 at 2884m MDRKB, but is apparently absent at the base of the Seaspray Group in both Blackback-2 and Terakihi-1. These latter wells are therefore interpreted as located higher on the original erosional palaeotopography over the Blackback/Terakihi field (but not necessarily higher on the current structure) because they do not contain any of the Middle to Late Eocene "Blackback Channel Sands" which fill the *N. asperus* Channel. Aside from the Blackback/Terakihi field the occurrence of an Upper *N. asperus* Zone section at the base of the Seaspray Group has a extremely restricted distribution in the offshore Gippsland Basin. Confident identification has only been made in a few nearshore wells extending in an arc from Tommyruff-1, through Perch-2, Blenny-1, Snook-1, Seahorse-2, Seahorse-1 to Harlequin-1A. Other wells along this arc are too poorly sampled or not analysed in sufficient detail. Very poor data suggests it may also be found in the wells lying between Athene-1 and Anemone-1. But again most wells to the south of the Blackback/Terakihi field are insufficiently sampled across the Top of Latrobe.

4. The Upper *N. asperus* Zone section may be part of what is informally referred to as the "Early Oligocene wedge", for that the basal part of the Seaspray Group between the seismic pick of the "Top of Latrobe" and a deeper lithological pick for the "Top of Latrobe". In most cases samples from the "Early Oligocene wedge" are assigned to the *P. tuberculatus* Zone

because they contain the distinctive spore *Cyatheacidites annulatus*. Given that the seismic pick for the "Top of Latrobe" in Blackback-3 may be taken as high as 2798m (J. Phillips pers comm. 9th May 1994) it would be consistent with present understanding to correlate all the interval 2798-2829m in Blackback-3 with the "Early Oligocene wedge".

5. The **new** *Fromea leos* Microplankton Zone is erected in Blackback-3 because of the potential of this microplankton assemblages to biostratigraphically characterise the "Early Oligocene wedge". The eponymous species is as yet undescribed. The specific name is an acronym for the Lakes Entrance Oil Shaft where the form was first recorded from the Lakes Entrance Greensand in 1969 during the study of onshore spore-pollen assemblages by Partridge (1971). In the subsequent 26 years the species has only rarely been recorded in the offshore Gippsland Basin even though the basal Seaspray Group has been routinely sampled and analysed by palynology. It is now suspected that *Fromea leos* ms characterises a part of the Early Oligocene which is not represented by sedimentary section over most of the offshore basin. By establishing a new zone it is hoped to better map the distribution of this unit.

6. The *Fromea leos* Microplankton Zone is considered to be younger than the *Phthanoperidinium comatum* Microplankton Zone and to straddle the boundary between the Upper *N. asperus* and *P. tuberculatus* Spore-Pollen Zones. Although of early Oligocene age precise correlation to the cycle charts of Haq *et al.* (1987, 1988) is uncertain.

7. The "*N. asperus* Channel-fill" originally recognised in Blackback-1 (Partridge & Hannah, 1990) and referred to as Eocene channel infill unit by Gross (1993) is here informally named the "Blackback Channel Sands". The base of the channel is confidently placed below the core sample at 2861m which contains a limited assemblage of fragmented dinoflagellate cysts, including the diagnostic form *Areosphaeridium capricornum*. With considerable less confidence the channel base can be considered to lie between the sidewall cores at 2867.5m and 2879.5m. Because these samples were virtually barren the few species that were recorded could very easily be contaminants introduced from the drilling mud or during the palynological processing. Notwithstanding this caveat the shallower sample at 2867.5m contains *Homotryblium tasmaniense* which is recorded consistently in the overlying samples whilst the deeper sample at 2879.5m contains *Peninsulapollis gillii* which is diagnostic of the underlying *L. balmei* Zone samples. The "Blackback Channel Sands" are therefore between 32 metres to a possible

maximum of 50 metres thick in Blackback-3 where they are all Late Eocene in age. In contrast it is 80+ metres thick (TVD) in Blackback-1 where it also contains the older Middle Eocene Lower *N. asperus* Zone (Partridge & Hannah, 1990).

8. The underlying "Hapuku Marine Sands" informally named in Blackback-2 by Partridge (1993b) gave poor results. Only two samples contained useful assemblages. Although they could only be assigned to the broad *L. balmei* Zone on the spore-pollen the associated microplankton indicate the assemblages would be equivalent to the Lower *L. balmei* Zone. Based on a few fragmented dinoflagellate cysts it is likely the samples at 2887m and 2913m also belong to the *L. balmei* Zone but the data is too limited to justify any zone assignment. Thus, the base of the Paleocene and position of the 63 Ma Sequence Boundary mapped by Gross (1993) can be fixed no more precisely in Blackback-3 on palynology than lying between samples at 2913m and 2971m.

9. The *Alisocysta circumtabulata* Microplankton Zone identified at 2898.2m is considered to be older than the more widely distributed *Elsenackia crassitabulata* Zone. It can be correlated into the better sampled Hapuku-1 sequence where it occurs over the interval 2840-2848.7m (9317-9346 ft) in cores 2 and 3. The *A. circumtabulata* Zone is also recorded in Whaleshark-1 at 2807m (Partridge, 1993a) and in Roundhead-1 at 2657.5-2678m (Partridge, 1989). In other earlier palynological reports on wells in the Gippsland Basin it is likely that some occurrences of the *A. circumtabulata* Zone have been incorrectly assigned to the *E. crassitabulata* Zone.

10. The Early Eocene unit identified as equivalent to The Flounder Formation in Blackback-2 (Partridge, 1993b) is not present in Blackback-3 where it has probably been removed by the erosive event which cut the *N. asperus* Channel.

11. The five samples between 2971-3062m are characterised by high diversity assemblages with a characteristic abundance of *Gambierina rudata* (average 14% of spore-pollen count) and frequent to abundant microplankton. The unit is informally referred to as the "Terakihi Marine Sands" after the similar but thicker (200+ metres) section intersected in Terakihi-1 (Partridge, 1990). The unit is considered to be nearshore marine because the samples consistently contain microplankton and the overall section lacks any coals.

12. All units analysed in Blackback-3 are marine and there is a progressive increase in marine character based on organic microplankton species abundance and diversity. In the "Terakihi Marine Sands" average microplankton abundance is <10%, whilst in the "Blackback Channel Sands" the average is <30%, increasing to >55% in the overlying basal Seaspray Group (Table-1). The count data from the "Hapuku Marine Sands" is too skewed to be meaningful, but eight samples counted in Hapuku-1 from this unit average 51% microplankton (Partridge, 1975a).

13. The "Blackback Channel Sands" and some of the samples from the Seaspray Group contain frequent to common reworking of Paleocene and Early Eocene spores, pollen and microplankton. The reworked palynomorphs may represent as much as 4% of the total count and 10% of the microplankton count. The commonest reworked species are *Homotryblium tasmaniense*, *Glaphrocysta retiintexta* and *Lygistepollenites balmei*. Similar reworking was recorded from Blackback-1 and Partridge & Hannah (1990) argued that the most likely source areas for the reworked sediments was to the south and south-west. The intersection in Blackback-2 of microplankton rich sediments of Early Eocene age, equivalent to the Flounder Formation, suggests that local reworking from the palaeotopographic highs on the Blackback/Terakihi field may also have been a sediment source for the "Blackback Channel Sands". The coarser grain size of this unit compared to the Turrum Formation makes it unlikely that these sands have been transported down the Marlin Channel.

    One particularly significant reworked species was the identification of the index dinoflagellate *Wilsonidinium ornatum* from the basal Seaspray Group at 2826.2m. This is the key index species of the stratigraphically next younger zone above the *D. waipawaense* Zone discovered at the top of the "Hapuku Marine Sands" in Blackback-2. It is tempting to suggest that it was derived locally and thus is indicative of the occurrence of younger zones in the latter unit.

    Rare reworked Permian and Early Cretaceous spores and pollen were also recorded, mainly from the Seaspray Group but they are not regarded as diagnostic of a particular provenance.

Biostratigraphy

Zone and age determinations are based on the spore-pollen zonation scheme proposed by Stover & Partridge (1973), partially modified by Stover & Partridge (1982) and Helby, Morgan & Partridge (1987), and a dinoflagellate zonation scheme which has only been published in outline by Partridge (1975b, 1976). Other modifications and embellishments to both zonation schemes can be found in the many palynological reports on the Gippsland Basin wells drilled by Esso Australia Ltd. Unfortunately this work is not collated or summarised in a single report.

Author citations for most spore-pollen species can be sourced from Stover & Partridge (1973, 1982), Helby, Morgan & Partridge (1987) or other references cited herein. Author citations for dinoflagellates can be found in the indexes of Lentin & Williams (1985, 1989), in the paper by Wilson (1988), or other references cited herein. Species names followed by "ms" are unpublished manuscript names.

Proteacidites tuberculatus Spore-Pollen Zone: 2772.4-2818.0 metres
Oligocene.

The four samples assigned to the zone contain the key index species *Cyatheacidites annulatus* and the deepest sample also contains *Proteacidites tuberculatus*. *Chenopodopollis* spp. recorded in the shallowest sample is the only other zone diagnostic species in moderate diversity assemblages dominated by long ranging spores and pollen. *Nothofagidites emaridus/heterus* dominate all the counts with *Araucariacites australis* and *Phyllocladidites mawsonii* the next most frequent types. The rare species *Droseridites tholus* ms (Partridge, 1973) was recorded at 2809m and 2818m.

Upper _Nothofagidites asperus_ Spore-Pollen Zone: 2823.0-2829.0 metres
Early Oligocene.

This zone was recorded over a 6 metre interval and samples are assigned to the zone on the presence of *Proteacidites stipplatus*, *P. rectomarginis* and *Aglaoreidia qualumis* and absence of spore *Cyatheacidites annulatus*. The spore-pollen assemblages are dominated by *Nothofagidites* spp. (average 61%) with *Phyllocladidites mawsonii* having a maximum abundance of only 7% at 2826.2m, which is similar to the abundance range of 2.2% to 8% from this zone in Blenny-1 (Partridge, 1992).

The low diversity spore-pollen assemblage from the low yield recovered from the very small 2.2 grams of calcareous claystone split from SWC-40 at 2829m is non-diagnostic. Although a single oxidised or "ghosted" specimen questionably referred to *Cyatheacidites annulatus* was found in the one kerogen slide recovered this was eventually dismissed as either drilling mud or laboratory contamination as this index species could not be found after an extensive search of the two overlying high diversity samples. The glauconitic sandstone fraction from the same sidewall core in contrast yielded a high diversity assemblage. Although *Proteacidites recavus* was recorded (which perhaps could be interpreted as a transition morphotype to *P. stipplatus*?) no other more typical Middle *N. asperus* Zone species were identified even after an extensive search of all available slides, and therefore the Upper *N. asperus* Zone assignment is preferred. Amongst the moderate diversity microplankton assemblage from the glauconitic sandstone sample only *Areosphaeridium capricornum* would support the older Middle *N. asperus* Zone assignment.

Unusual or rare species in the assemblages include *Malvacipollis grandis* ms and *Ricciaesporites boxatus* ms at 2826.2m and *Cyperaceae* pollen at 2829m (sample B). The latter species is a typical rare form in Upper *N. asperus* Zone in the Torquay Embayment.

Fromea leos Microplankton Zone: **2809.0-2826.2 metres**
Early Oligocene.

This is a new zone defined as the interval above the acme of *Phthanoperidinium comatum* to the Last Appearance Datum (LAD) of *Fromea leos* ms. The assemblages are characterised by abundant *Spiniferites* spp. (14%-39%), *Fromea* spp. (<1%-33%) or *Operculodinium centrocarpum* (5%-35%), with the frequent to common occurrences of *Hystrichokolpoma rigaudae* (13% at 2826.2m), *Phthanoperidinium* sp. cf. *P. eocenicum* (11% at 2823m) and *Thalassiphora pelagica* (6% at 2809m). The assemblages are distinguished from the more usual *Operculodinium* spp. Microplankton Association generally found in the basal Seaspray Group in lacking the consistent and often common occurrence of the species *Protoellipsodinium simplex* ms and *Pyxidinopsis pontus* ms. Additional taxonomic descriptive work needs to be done to fully document the microplankton assemblages in this zone.

The sample A at 2829m is not assigned to this zone as it lacks any of the *Fromea* species. This may be partly a preparation problem as the small *Fromea* species are hard to find in the kerogen slides of the overlying samples. This is because they are mostly filtered out of the filtered kerogen fractions and too dilute or obscured in the unfiltered kerogen fractions. The sample also contains morphotypes of *Protoellipsodinium simplex* ms more typical of the Miocene suggesting there may have been some mud contamination of the sample.

Middle *Nothofagidites asperus* Spore-Pollen Zone: 2835.0-2850.0 metres
Late Eocene.

The five spore-pollen assemblages within this interval are assigned to the upper part of the Middle *N. asperus* Zone based on the presence of *Proteacidites rectomarginis* and/or *Anacolosidites sectus* in most samples. Other species considered to range no older than this zone are rare but include *Tricolpites thomasii* and *Verrucosisporites cristatus* at 2837m, and *Aglaoreidia qualumis* at 2835m and 2841m. Most of the other species in these high diversity assemblages (which average >30 species/sample and have a combined diversity of 72+ species) can be considered long ranging. There is, however, a curious assortment of rare or unusual species mixed with rare species which have been interpreted as reworked. Included in the unusual category are *Bysmapollis emaciatus*, *Cupanieidites reticulatus* and *Proteacidites confragosus* at 2841m, and *Cyperaceae* pollen and *Tetrapollis campbellbrownii* Macphail & Truswell *in* Macphail *et al.* 1993 at 2850m, whilst *Proteacidites grandis* at 2835m and *Myrtaceidites tenuis* at 2850m are two of the most obvious reworked forms. *Proteacidites pachypolus* which occurs in four of the five samples may also be reworked as it is rarely found in upper part of the Middle *N. asperus* Zone in the coastal plain facies developed in the northwestern part of the basin. Notably absent from such rich assemblages was *Triorites magnificus* although this species was recorded from core-1 in the nearby Blackback-1 Sidetrack-1. All the samples are dominated by abundant *Nothofagidites emarcidus/heterus* (47%-53% of spore-pollen count) with *Haloragacidites harrisii* the next most common type (3%-11%).

The five core and single sidewall core sample between 2853-2870m contained too few spores and pollen to be assigned to any zone, but the associated microplankton in some of the samples suggests they are probably no older than this zone.

***Corrudinium incompositum* Microplankton Zone: 2835.0-2850.0 metres**
Late Eocene.

Three of the five samples in the interval contained the index species *Corrudinium incompositum*. Other diagnostic species are *Tritonites spinosus* at 2835m and 2841m (see Marshall & Partridge, 1988), *Deflandrea leptodermata* at 2847m and *Diphyes ariensis* ms at 2850m. The dominant forms in the assemblages are *Fromea* spp., *Spiniferites* spp. and the *Areosphaeridium capricornum* complex. This latter species displays considerable morphological variability and with more rigorous taxonomic treatment has the potential for subdivision into a number of morphotypes which may have stratigraphic significance. The occurrence of this species complex as a dominant element in the low yielding samples from core-2 suggests that the base of the Late Eocene may extend as deep as 2861m.

The samples from 2835m to 2867.5m all contain *Homotryblium tasmaniense* as a constant accessory and often frequent species. It has a maximum abundance of 6% of the microplankton in sample at 2837m and is considered to reflect the presence of considerable reworking from older Early Eocene zones, either from immediately adjacent Flounder Formation as identified in Blackback-2 (Partridge, 1992) or from areas to south and west of the Blackback/Terakihi field (see Partridge & Hannah, 1990). Other species considered reworked include *Tritonites pandus*, *Diphyes colligerum*, *Hystrichokolpoma truncatum*, *Apectodinium homomorphum* and *Glaphrocysta retiintexta*.

***Lygistepollenites balmei* Spore-Pollen Zone: 2898.2-2902.0 metres**
Paleocene.

Both samples clearly belong to the broader *L. balmei* Zone but lack definitive species to justify confident assignment of either sample to the Upper or Lower subzones, even though the associated microplankton would strongly support a Lower *L. balmei* Zone assignment. Key species recorded include the eponymous species *Lygistepollenites balmei*, *Gambierina rudata*, *G. edwardsii*, (including the *G. megaedwardsii* ms variety), *Australopollis obscurus* and common *Peninsulapollis gillii*. Total diversity is 36+ species and undoubtedly would be much higher had the recovery been better. As is typical of channel fill units in the basin some species reworked from the underlying Upper *T. longus* Zone were recorded.

The zone may extend as shallow as 2879.5m based on the occurrence of *Peninsulapollis gillii* and as deep as 2913m based on the associated microplankton.

***Alisocysta circumtabulata* Microplankton Zone:** **2898.2 metres**
Early Paleocene.

The *Alisocysta circumtabulata* Zone is recognised in the Gippsland Basin as the interval between the Last Appearance Datum (LAD) of *Palaeoperidinium pyrophorum* to the LAD of *A. circumtabulata*. The younger *Eisenackia crassitabulata* Zone can in turn be considered as the interval between the LAD of *A. circumtabulata* to the LAD of *E. crassitabulata*. In practice each of the above three species characterise discreet incursions (which may be condensed sections of individual Paleocene cycles) separated by packages of rock which are microplankton barren or lack diagnostic species. The *E. crassitabulata* Zone is the most widespread or at least most widely recognised incursion, although it is quite likely that some assignments to this zone need to be revised and reassigned to the *A. circumtabulata* Zone. In Blackback-3 this zone is dominated by *A. circumtabulata* and *A. margarita (senso lato)* which represent more than >50% of the assemblage whilst *Eisenackia crassitabulata* is quite rare. Other potentially diagnostic species in the zone are *Cladopyxidium facetus* ms and *Deflandrea speciosus*. All other recorded species have known longer ranges or are too rare in the basin to be of practical use.

***Glaphrocysta retiintexta* Microplankton Association:** **2902.0 metres.**

Although only a very small residue yield was obtained this was a highly unusual sample as it was overwhelmingly dominated by *Glaphrocysta retiintexta* which comprised 94% of the total assemblage and 98% of the total microplankton. Unfortunately the abundance of this species does not appear to have much significance for subdividing the Early Paleocene. In Whaleshark-1 for instance *G. retiintexta* comprised 92% of the lower sample assigned to the *E. crassitabulata* Zone.

Upper *Tricolpites longus* Zone: 2971.0-3062.0 metres **Maastrichtian.**

The five deepest recovered sidewall cores are all confidently assigned to the Upper. *T. longus* Zone based on the consistent abundance of *Gambierina rudata* (10%-17%) associated with *Stereisporites* (*Tripunctisporis*) spp. in four of the five samples. All samples contain high diversity assemblages with numerous other zone indicators, the most notable of which are *Forcipites* (al. *Tricolpites*) *longus*, *Proteacidites clinei* ms, *P. reticuloconcavus* ms, *P. otwayensis* ms and *Tricolporites lilliei*. The spore-pollen assemblages are dominated by *Proteacidites* spp. (22%-31%) with secondary abundances of *Phyllocladidites mawsonii* (7%-10%), *Podosporites microsaccatus* (6%-12%) and *Peninsulapollis gillii* (5%-10%).

Nothofagidites spp. varies from <1% to 7%. Total diversity in the zone is 75+ species.

A most interesting and unusual occurrence was the record of three specimens of the primitive angiosperm *Lactoripollenites africanus* Zavada & Benson 1987 at 3000.4m.

Manumiella druggii Zone 2971.0-3004.0 metres Maastrichtian.

Manumiella druggii and the closely related species *M. conorata*, which are conspicuous in the samples, are considered diagnostic of this zone. *Manumiella seelandica* is also recorded but most specimens are probably not *senso strictus*. Accessory species are few but include *Alterbidinium acutulum*, *Palaeostomocystis golzowense* and *Horologinella incurvata*. An undescribed *Micrhystridium* sp. dominates the high microplankton count in the shallowest sample where it comprises 56% of the microplankton count.

The two deepest sidewall cores lack specimens of *Manumiella* spp. but can be characterised by containing *Palaeostomacystis reticulata* and *Paralecaniella stoveri* ms of Marshall (1984). It is uncertain whether these samples should be considered as lying below the FAD for *M. druggii* and related species so no attempt is made to distinguish them as a separate zone.

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Table-1: Interpretative Palynological Data for Blackback-3.

Sample Type	Depth (m)	Spore-Pollen Zone	CR	Microplankton Zone (or Association)	CR	Comments or Key Species
SWC-46	2772.4	*P. tuberculatus*	B2	(*Operculodinium* spp.)		Microplankton 89%. Frequent specimens of *Cyatheacidites annulatus*.
SWC-45	2798.0	*P. tuberculatus*	B2	(*Operculodinium* spp.)		Microplankton 68%. Shallowest reworked *Homotryblium tasmaniense*.
SWC-44	2809.0	*P. tuberculatus*	B2	*F. leos*	B2	Microplankton 66%. LAD *Fromea leos* ms.
SWC-43	2818.0	*P. tuberculatus*	B2	*F. leos*	B4	Microplankton 38%. *Proteacidites tuberculatus* present.
SWC-42	2823.0	Upper *N. asperus*	B2	*F. leos*	B3	Microplankton 24%. *Proteacidites rectomarginis* and *P. stipplatus* present.
SWC-41	2826.2	Upper *N. asperus*	B1	*F. leos*	B2	Microplankton 40%. *Malvacepollis grandis* ms present.
SWC-40	2829.0 A	Upper *N. asperus*	B4	(*Operculodinium spp.*)		Microplankton 87%. Assemblage limited by low yield.
SWC-40	2829.0 B	Upper *N. asperus*	B1			Microplankton 7%. *Proteacidites recavus* present.
SWC-38	2835.0	Middle *N. asperus*	B1	*C. incompositum*	B2	Microplankton 21%. *Aglaoreidia qualumis* & *Proteacidites rectomarginis* present.
Core-1	2837.0	Middle *N. asperus*	B1	(*A. capricornum*)		Microplankton 33%. *Anacolosidites sectus* & *Tricolpites thomasii* present.
Core-1	2841.0	Middle *N. asperus*	B1	*C. incompositum*	B1	Microplankton 37%. *Proteacidites confragosus* present.
Core-1	2847.0	Middle *N. asperus*	B2	(*A. capricornum*)		
SWC-35	2850.0	Middle *N. asperus*	B4	*C. incompositum*	B2	Microplankton 45%.
Core-1	2853.0	Indeterminate		(*A. capricornum*)		Limited dinoflagellate assemblage.
Core-2	2857.0	Indeterminate		(*A. capricornum*)		Limited fragmented dinoflagellate assemblage.
Core-2	2861.0	Indeterminate		(*A. capricornum*)		Most dinoflagellates fragmented.
Core-2	2866.0	Indeterminate				Barren of palynomorphs.

Table-1: Interpretative Palynological Data for Blackback-3 cont...

Sample Type	Depth (m)	Spore-Pollen Zone	CR	Microplankton Zone (or Association)	CR	Comments or Key Species
SWC-32	2867.5	Indeterminate				*Homotryblium tasmaniense* fragment present.
Core-2	2870.0	Indeterminate				Barren of palynomorphs.
SWC-31	2875.0	Indeterminate				Barren of palynomorphs.
SWC-30	2879.5	Indeterminate				*Peninsulapollis gillii* present.
SWC-28	2887.0	Indeterminate				Single specimen of *Alisocysta margarita* present.
SWC-26	2898.2	*L. balmei*	B1	*A. circumtabulata*	B2	Microplankton 16% dominated by *Alisocysta* spp.
SWC-24	2902.0	*L. balmei*	B2	(*G. retiintexta*)		Microplankton 96%. *Graphrocysta retiintexta* 94%.
SWC-22	2913.0	Indeterminate		(*G. retiintexta*)		Rare fragmented specimens *G. retiintexta*.
SWC-19	2936.2	Indeterminate				Barren of palynomorphs.
SWC-18	2946.0	Indeterminate				Rare spore-pollen recorded not diagnostic.
SWC-14	2971.0	Upper *T. longus*	B1	*M. druggii*	B3	Microplankton 28%. *Gambierina* spp. 16%.
SWC-11	3000.4	Upper *T. longus*	B1	*M. druggii*	B3	Microplankton <1.5%. *Gambierina* spp. 17%.
SWC-10	3004.0	Upper *T. longus*	B1	*M. druggii*	B3	Microplankton 4%. *Gambierina* spp. 12%.
SWC- 8	3022.0	Upper *T. longus*	B1			Microplankton 6%. *Gambierina* spp. 15%.
SWC- 4	3062.0	Upper *T. longus*	B2			Microplankton 8%. *Gambierina* spp. 11%.

Confidence Ratings

The concept of Confidence Ratings applied to palaeontological zone picks was originally proposed by Dr. L.E. Stover in 1971 to aid the compilation of micropalaeontological and palynological data and to expedite the revision of the then rapidly evolving zonation concepts in the Gippsland Basin. The original scheme which mixed confidence in fossil species assemblage with confidence due to sample type gradually proved to be rather limiting as additional refinements to existing zonations were made. With the development of the STRATDAT computer database as a replacement for the increasingly unwieldy paper based Palaeontological Data Sheet files a new format for the Confidence Ratings was proposed. These are given for individual zone assignments on Table 1, and their meanings are summarised below:

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.

BASIC DATA

Table 2: Basic Sample Data

Table 3: Basic Palynomorph Data

Relinquishment Lists Of Palynological Slides & Residues

Spore-Pollen Range Chart

Microplankton Range Chart

Table 2: Basic Sample Data - Blackback-3.

Sample Type	Depth (metres)	Lithology	Sample Wt (g)	Residue Yield
SWC-46	2772.4	Med grey calc. claystone. Mud penetrated.	11.9	Moderate
SWC-45	2798.0	Lt gry micritic limestone. Hard & well cleaned.	13.4	Low
SWC-44	2809.0	Med. grey hard calc. claystone.	9.9	Low
SWC-43	2818.0	Brn-grey calcareous silty claystone.	13.4	Low
SWC-42	2823.0	Brn-gry calcareous claystone.	12.4	Moderate
SWC-41	2826.2	Brn-gry calcareous siltstone.	11.7	Moderate
SWC-40	2829.0	Sample A. Dk brn grey calcareous claystone.	2.2	Very low
SWC-40	2829.0	Sample B. Dk brn grey f.-med grn. glauconitic (<20%) sandstone.	12.9	Moderate
SWC-38	2835.0	Dk brn gry, f. grn. qtz sandstone - glauconite not obvious <5%. Sample firm and well cleaned.	14.6	High
Core-1	2837.0		25.3	Moderate
Core-1	2841.0		26.1	Moderate
Core-1	2847.0		20.6	Moderate
SWC-35	2850.0	Dk brn-gry, minor grn-gry fine grn. qtz glauconitic (<20%). sandstone with med. gry clay matrix. Sample not cleaned.	10.2	Low
Core-1	2853.0		21.2	Very low
Core-2	2857.0		23.2	Very low
Core-2	2861.0		20.2	Very low
Core-2	2866.0		20.5	Very low
SWC-32	2867.5	Med gry-grn med-fine qtz sandstone with v. f. glauc. in matrix. Sample firm - moderately clean.	16.2	Very low
Core-2	2870.0		21.3	Very low
SWC-31	2875.0	Med dk grn-gry f-med. qtz sandstone with <15% glauc. Sample firm and well cleaned.	15.0	Very low
SWC-30	2879.5	Med dk grn-gry crs grn glauc (<30%) & pyritic qtz sandstone, white clay matrix. Sample firm - fairly well cleaned.	18.9	Very low
SWC-28	2887.0	Off white & grn mottled crs qtz sandstone with accessory glauconite <20% & pyrite. Sample friable - not cleaned.	18.0	Very low
SWC-26	2898.2	Dk grn med-crs grn glauconitic (30%) & pyritic sandstone. Sample firm & well cleaned.	18.1	Low
SWC-24	2902.0	Gry-grn med-crs quartz sandstone with 10% glauconite. Sample friable, not cleaned.	13.6	Very low
SWC-22	2913.0	Lt grn-gry f.-crs grn sst with abund. argillaceous matrix. Sample broken & friable not cleaned.	12.5	Very low
SWC-19	2936.2	Lt gry-off white fine-crs sst with white clay matrix and tr. glauconite <2%. Poorly cleaned.	8.5	Very low
SWC-18	2946.0	Lt grn-gry fine grn qtz sst with kaolonitic and glauconitic matrix. Well cleaned.	10.5	Very low
SWC-14	2971.0	Dk gry f-med grn argillaceous sst with glauconite <20%. Sample firm, and well cleaned.	12.1	High
SWC-11	3000.4	Dk gry med-crs argillaceous sandst. Possibly pyritic. Minimal cleaning.	13.1	High
SWC-10	3004.0	Dk. gry poorly sorted argillaceous sst with qtz grn up to 3mm and shaly rock frags. Not cleaned.	13.0	High
SWC- 8	3022.0	Med gry f-med grn sandstone with micaceous matrix. Not cleaned.	11.9	High
SWC- 4	3062.0	Gry wh. crs qtz sandstone with minor matrix, with glauconite & pyrite. Processed because deepest sample but not cleaned.	9.6	Very low

Table-3: Basic Palynomorph Data for Blackback-3.

Sample Type	Depth (m)	Palynomorph Concentration	Palynomorph Preservation	Number S-P Species*	Microplankton Abundance	Number MP Species*
SWC-46	2772.4	High	Poor-fair	18+	Very Abundant	12+
SWC-45	2798.0	High	Fair-good	20+	Very Abundant	6+
SWC-44	2809.0	High	Poor-fair	26+	Very Abundant	12+
SWC-43	2818.0	High	Poor-fair	29+	Abundant	11+
SWC-42	2823.0	High	Poor	24+	Common	9+
SWC-41	2826.2	High	Poor-fair	44+	Abundant	16+
SWC-40	2829.0 A	High	Poor-fair	17+	Very Abundant	9+
SWC-40	2829.0 B	High	Fair-good	39+	Frequent	13+
SWC-38	2835.0	High	Poor-fair	38+	Common	24+
Core-1	2837.0	High	Poor-good	42+	Abundant	25+
Core-1	2841.0	High	Poor-good	41+	Abundant	29+
Core-1	2847.0	High	Poor-fair	20+	Abundant	11+
SWC-35	2850.0	High	Poor-good	23+	Abundant	15+
Core-1	2853.0	Low	Poor	NR	Abundant	8+
Core-2	2857.0	Low	Poor	NR	Abundant	5+
Core-2	2861.0	Low	Poor	NR	Abundant	3+
Core-2	2866.0	Barren				
SWC-32	2867.5	Very low	Poor	4+	Rare	1+
Core-2	2870.0	Very low	Very Poor	NR	Very Rare	2?
SWC-31	2875.0	Barren				
SWC-30	2879.5	Very low	Fair	3+	Very Rare	2?
SWC-28	2887.0	Very low	Poor-good	3+	Very Rare	1+
SWC-26	2898.2	High	Good	34+	Common	13+
SWC-24	2902.0	Very High	Excellent	11+	Very Abundant	5+
SWC-22	2913.0	Very low	Poor	1+	Rare	1+
SWC-19	2936.2	Barren				
SWC-18	2946.0	Very low	Good	3+	NR	
SWC-14	2971.0	High	Fair-good	49+	Common	10+
SWC-11	3000.4	High	Fair-good	55+	Rare	8+
SWC-10	3004.0	High	Fair-good	54+	Frequent	8+
SWC- 8	3022.0	Low	Poor-good	37+	Frequent	6+
SWC- 4	3062.0	High	Fair-good	29+	Frequent	5+

NR = Not recorded

Diversity:

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

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: BLACKBACK-3
PREPARED BY: A.D. PARTRIDGE
DATE: 3 May 1994 Sheet 1 of 2

SAMPLE TYPE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
SWC-46	2772.4	P196588	Kerogen slide sieved/unsieved fractions
SWC-46	2772.4	P196589	Oxidised slide 2
SWC-46	2772.4	P196590	Oxidised slide 3 (1/2 cover slip)
SWC-45	2798.0	P196591	Kerogen slide sieved/unsieved fractions
SWC-45	2798.0	P196592	Oxidised slide 2 (1/2 cover slip)
SWC-44	2809.0	P196593	Kerogen slide sieved/unsieved fractions
SWC-44	2809.0	P196594	Oxidised slide 2
SWC-43	2718.0	P196595	Kerogen slide sieved/unsieved fractions
SWC-43	2718.0	P196596	Oxidised slide 2
SWC-43	2718.0	P196597	Oxidised slide 3
SWC-42	2823.0	P196598	Kerogen slide sieved/unsieved fractions
SWC-42	2823.0	P196599	Oxidised slide 2
SWC-42	2823.0	P196600	Oxidised slide 3
SWC-42	2823.0	P196601	Oxidised slide 4 (1/2 cover slip)
SWC-41	2826.2	P196602	Kerogen slide sieved/unsieved fractions
SWC-41	2826.2	P196603	Oxidised slide 2
SWC-41	2826.2	P196604	Oxidised slide 3
SWC-41	2826.2	P196605	Oxidised slide 4 (18mm cover slip)
SWC-40A	2829.0	P196606	Kerogen slide sieved/unsieved fractions
SWC-40B	2829.0	P196607	Kerogen slide sieved/unsieved fractions
SWC-40B	2829.0	P196608	Oxidised slide 2
SWC-40B	2829.0	P196609	Oxidised slide 3
SWC-40B	2829.0	P196610	Oxidised slide 4 (1/2 cover slip)
SWC-38	2835.0	P196611	Kerogen slide sieved/unsieved fractions
SWC-38	2835.0	P196612	Oxidised slide 2
SWC-38	2835.0	P196613	Oxidised slide 3
SWC-38	2835.0	P196614	Oxidised slide 4
CORE-1	2837.0	P196615	Kerogen slide sieved fraction (1/2 cover slip)
CORE-1	2837.0	P196616	Oxidised slide 2
CORE-1	2837.0	P196617	Oxidised slide 3
CORE-1	2841.0	P196618	Kerogen slide sieved fraction (1/2 cover slip)
CORE-1	2841.0	P196619	Oxidised slide 2
CORE-1	2841.0	P196620	Oxidised slide 3 (1/2 cover slip)
CORE-1	2847.0	P196621	Kerogen slide sieved fraction (1/2 cover slip)
CORE-1	2847.0	P196622	Oxidised slide 2
CORE-1	2847.0	P196623	Oxidised slide 3

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: BLACKBACK-3
PREPARED BY: A.D. PARTRIDGE
DATE: 3 May 1994 Sheet 2 of 2

SAMPLE TYPE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
SWC-35	2850.0	P196624	Kerogen slide sieved/unsieved fractions
SWC-35	2850.0	P196625	Oxidised slide 2 (1/2 cover slip)
CORE-1	2853.0	P196626	Kerogen slide sieved (18mm cover slip)
CORE-2	2857.0	P196627	Kerogen slide sieved (1/2 cover slip)
CORE-2	2861.0	P196628	Kerogen slide sieved (18mm cover slip)
CORE-2	2866.0	P196629	Kerogen slide sieved fraction (1/2 cover slip)
SWC-32	2867.5	P196630	Kerogen slide sieved/unsieved fractions
CORE-2	2870.0	P196631	Kerogen slide sieved fraction (15mm cover slip)
SWC-31	2875.0	P196632	Kerogen slide sieved fraction (15mm cover slip)
SWC-30	2879.5	P196633	Kerogen slide sieved fraction (15mm cover slip)
SWC-28	2887.0	P196634	Kerogen slide sieved fraction (15mm cover slip)
SWC-26	2898.2	P196635	Kerogen slide sieved/unsieved fractions
SWC-26	2898.2	P196636	Oxidised slide 2
SWC-24	2902.0	P196637	Kerogen slide sieved fraction (18mm cover slip)
SWC-22	2913.0	P196638	Kerogen slide sieved fraction (15mm cover slip)
SWC-19	2936.2	P196639	Kerogen slide sieved fraction (15mm cover slip)
SWC-18	2946.0	P196640	Kerogen slide sieved fraction (15mm cover slip)
SWC-14	2971.0	P196641	Kerogen slide sieved/unsieved fractions
SWC-14	2971.0	P196642	Oxidised slide 2
SWC-14	2971.0	P196643	Oxidised slide 3
SWC-14	2971.0	P196644	Oxidised slide 4
SWC-11	3000.4	P196645	Kerogen slide sieved/unsieved fractions
SWC-11	3000.4	P196646	Oxidised slide 2
SWC-11	3000.4	P196647	Oxidised slide 3
SWC-11	3000.4	P196648	Oxidised slide 4
SWC-10	3004.0	P196649	Kerogen slide sieved/unsieved fractions
SWC-10	3004.0	P196650	Oxidised slide 2
SWC-10	3004.0	P196651	Oxidised slide 3
SWC-10	3004.0	P196652	Oxidised slide 4
SWC- 8	3022.0	P196653	Kerogen slide sieved/unsieved fractions
SWC- 8	3022.0	P196654	Oxidised slide 2
SWC- 8	3022.0	P196655	Oxidised slide 3
SWC- 8	3022.0	P196656	Oxidised slide 4
SWC- 4	3062.0	P196657	Kerogen slide sieved/unsieved fractions

RELINQUISHMENT LIST - PALYNOLOGY RESIDUES

WELL NAME & NO: BLACKBACK-3
PREPARED BY: A.D. PARTRIDGE
DATE: 17 MAY 1994

SAMPLE TYPE	DEPTH (M)	DESCRIPTION
SWC-14	2971.0	Oxidised residue.
SWC-11	3000.4	Oxidised residue.
SWC-10	3004.0	Oxidised residue.
SWC- 8	3022.0	Oxidised residue.