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APPENDIX-1

PALYNOLOGICAL ANALYSIS OF ADMIRAL-1
GIPPSLAND BASIN.

by

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INTERPRETED DATA

INTRODUCTION

Sixty-three samples comprising 47 sidewall core samples and 16 cuttings samples were processed from Admiral-1 and examined for spores, pollen and microplankton. Oxidized organic residue yields were mostly moderate to high except for the few samples from the marine Flounder and Gurnard Formations at the top of the Latrobe Group and the single sample from the overlying Seaspray Group which gave only very low to moderate yields. Palynomorph concentrations on the strew slides however were more variable but were mostly moderate to low. Preservation of palynomorphs overall was fair to good, and occasionally exceptional.

Analysis of the sequence in Admiral-1 can be divided between an "Upper" Latrobe Group section which was given routine examination and a "Lower" Latrobe Group section which was examined in more detail and partially quantitatively analysed with selective counting of samples.

Sixteen samples (including 14 SWCs) were analysed from the Maastrichtian to Eocene "Upper" Latrobe and Oligocene/Miocene Seaspray Group. Average spore-pollen diversity was 23.8 species per sample, with a maximum diversity of 63+ species. Microplankton, principally dinoflagellates cysts were present in 80% of the samples and exhibited their highest diversity in the marine Eocene samples.

The "Lower" Latrobe sequence below 1503m is Turonian to possibly Coniacian in age. Forty-seven samples (including 33 SWCs) were examined from this unit, and these had an average spore-pollen diversity of 18.7 species per sample, with a maximum diversity of 34+ species. Microplankton, which are chiefly represented by fresh water algae, including fresh water dinoflagellate cysts were recorded from nearly 90% of the samples. Diversity is very low ranging from 1 to 6+ species. Twelve of the sidewall cores were also counted and the results of this quantitative analysis is presented in Table-3.

Lithological units and palynological zones from base of the Seaspray Group to T.D. are given in the following summary. Interpretative data with identification of zones and confidence ratings are recorded in Table-1 and basic data on residue yields, preservation and diversity are recorded in Table-2. All species which can be identified with binomial names are tabulated on the two accompanying range charts.

PALYNOLOGICAL SUMMARY OF ADMIRAL-1

AGE	UNIT/FACIES	SPORE-POLLEN ZONES (Microplankton Zones)	DEPTH RANGE (mKB)
Oligocene-Early Miocene	Seaspray Group	*P. tuberculatus*	1234.5
UNCONFORMITY	1236.0m		
Middle Eocene	Gurnard Formation	Lower *N. asperus* (*A. australicum*)	1238.0-1241.4 (1241.4)
Early Eocene		*P. asperopolus*	1254.1
	1255.0m		
Early Eocene	Flounder Formation	*P. asperopolus* to Upper *M. diversus*	1268.7
UNCONFORMITY	1269.0m		
Paleocene	Upper Latrobe Group (coarse clastics)	Upper *L. balmei* (*A. homomorphum*)	1275.0-1285.8 (1275.0-1285.8)
Paleocene		Lower *L. balmei* (*T. evittii*)	1314.0-1430.8 (1427.0-1430.8)
Maastrichtian		Upper *T. longus*	1437.0-1477.5
	1492.0m		
Senonian	Unnamed Volcanics		
UNCONFORMITY	1503.0m		
Santonian?-Turonian	Lower Latrobe Gp. (Unnamed unit)	*P. mawsonii*	1518.3-1580.5
	1600.0m		
Santonian?-Turonian	Kipper Formation	*P. mawsonii* (*R. kipperii*)	1606.2-2071.3 (1606.2-2036.0)
	2073.0m		
Santonian?-Turonian	Lower Latrobe Gp. (Unnamed unit)	*P. mawsonii*	2103.5
	2117.0m		
Turonian?-Cenomanian?	Lower Latrobe Gp. (Arkosic sst.)	Not datable with palynology.	
	T.D. 2162.0m		

GEOLOGICAL COMMENTS

1. Admiral-1 was predicted to drill a 270 metres thick "Upper" Latrobe Group section of *T. apoxyexinus* to *N. senectus* Zones in age sandwiched between volcanics above (the seal) and Strzelecki Group sediments below (economic basement). Instead it found a 614 metres thick section of well dated *P. mawsonii* Zone age sediments referable to the "Lower" Latrobe Group, and then drilled 45 metres of indurated arkosic coarse grained sandstone to conglomerate before being plugged and abandoned.

2) The basal unit in Admiral-1 from 2117-2162m T.D. is not lithologically typical of the Strzelecki Group based on the petrographic description and fission track analysis (FTA) performed by Duddy *et al.* (1990). The most favoured interpretation is that at T.D. the well was still within the "Lower" Latrobe Group. The unit is nevertheless distinct from the overlying *P. mawsonii* Zone section, as it is much harder, based on slower drilling rate, higher sonic velocity and higher density. This is exemplified by the fact that although seven sidewall cores were programmed in this unit none were successfully recovered. SWC-2 at 2151.1m which was composed of floating rock fragments in a mud matrix was interpreted to be entirely downhole contamination and was not processed for palynology.

3) Palynological analysis of the cuttings sample at 2160m gave an assemblage grossly similar to those from the overlying *P. mawsonii* Zone and is therefore considered to be composed mostly of caved fossils. The only distinguishing feature of the assemblage is an increase in abundance of *Cyathidites australis s.l.* However this change is considered more likely to reflect a difference in environment of deposition rather than being a reliable indicator of a significant age difference.

4) The *P. mawsonii* Zone in Admiral-1 is one of the best sections of this age penetrated in the Gippsland Basin. The samples examined are in general characterised by better preserved and slightly more diverse palynomorph assemblages compared with other wells. The large number and good recovery of sidewall cores and the presence of a variety of depositional environments within the zone allowed the spore-pollen and microplankton assemblages to be better and more fully recorded. As a result a number of new spore-pollen species are recognised as stratigraphically significant and a better understanding of the effects of environment of deposition on assemblage composition was developed.

5) The 614 metres thick section referred to the *P. mawsonii* Zone between 1503-2117m can be lithologically subdivided into three units:-

UNIT	TOP	THICKNESS
"Upper unnamed unit"	1503m	197m
Kipper Formation	1600m	473m
"Lower unnamed unit"	2073m	44m

6) The most distinctive unit is the Kipper Formation which was first proposed as a discrete formation in the Kipper-1 well completion report (Marshall & Partridge, 1986). The environment of deposition of the bulk of the Kipper Formation is interpreted to be a large, and at times deep, fresh water lake. Evidence for this interpretation is derived from both lithology and palynology.

7) The Kipper Formation in Admiral-1 is dominantly a fine grained clastic unit composed of >85% siltstone to claystone with minor <15% fine to very fine grained sandstone and very minor <1% coal or carbonaceous beds which are all less than 1 metre thick. In Admiral-1 the cuttings descriptions suggest that the unit is predominantly siltstone but at least a third of the sidewall cores recovered from the unit are claystone and most of these are typically homogeneous. It is suggested that a lot of this clay has been washed out of the cuttings. This is supported by the palynological data which shows differences in the composition of assemblages comparing the cuttings and sidewall core preparations. On the electric logs the Kipper Formation is best characterised by a broad and consistent separation between the curves for the neutron porosity and bulk density logs. All logs suggest relatively thick homogeneous beds through the bulk of the unit and this implies a constant depositional environment, or rapid deposition, or both. Note for example, the thick beds at the top and bottom of the Kipper Formation at 1600-1681m and 2030-2073m. In contrast in the "Upper unnamed unit", and more especially in the Upper Latrobe Group, although there may be equivalent separation on some beds between neutron porosity/bulk density logs the bedding thickness is less (typically 1-5 metres) suggesting more frequent environmental changes (or slower average depositional rate?). Overall the dominance of fine grained clastics in the Kipper Formation suggests a more distal or offshore environment of deposition.

8) Another feature is the moderate but consistent carbonate content of the Kipper Formation which was determined as part of the geochemical analysis (Burns 1990, Table-1). The 27 SWC's analysed averaged 14%

CO_3 with a range of 2-36%. In contrast the "Upper unnamed unit" averaged 4% CO_3 with a range of 2-9%; and the Upper Latrobe Group averaged 3% with a range of 1-4%. The values below 5% can probably be mostly discounted allowing for some analytical error and diagenetic carbonate.

The higher carbonate content of the Kipper Formation suggested the possibility of biogenic carbonate so four SWCs were processed for microfossils. These were at 1789m (19% CO_3), 1843m (21%), 1873.2m (36%) and 1912m (21%). Except for a few obvious downhole contaminants from the drilling mud no calcareous microfossils were found.

The washed and sieved residues were also undistinguished except for the sample with the highest carbonate content at 1873.5m. The coarse sieved fraction of this sample was dominated by spheroidal grains which are either **oolites** or some type of **faecal pellets**. In case the idea of oolites is somewhat bizarre it is pointed out that oolitic limestone is recorded in trace amounts in the cuttings decription between 7930-40ft in Sunfish-1 over an interval now interpreted as Kipper Formation.

9) Traces of coal are recorded in the cuttings descriptions through the Kipper Formation at 1740-45m, 1815-20m, 1885-90m and 1985-90m. These confirm thin coals identified at 1883.5-84.5m and 1986-87m from the density log. Other possible coals identified on the density log such as at 1868-68.5m and 1901.5-02m, were not manifest in the cuttings descriptions. None of these coals are clearly expressed on the sonic log. Separation and palynological analysis of these coals are needed to determine their nature and perhaps their environment of deposition.

10) Low diversity assemblage of fresh water algae and microplankton are common throughout the *P. mawsonii* Zone and indicate that lacustrine environments are a characteristic feature of this time interval.

Algal and/or microplankton were recorded in 29 out of 33 (or 87%) of sidewall cores analysed from the *P. mawsonii* Zone. Diversity of these palynomorphs is typically 1 or 2 species in most samples but range to a high of 6+ species in the sample at 1606.2m from the top of the Kipper Formation (Table-2). This sample also had maximum algal and microplankton abundance of 29.7% (Table-3). Total diversity for entire zone is 19+ species.

The Kipper Formation contains most of the more diverse and abundant assemblages, and from this unit the *Rimosicysta kipperii* Microplankton Association (informally named in Partridge, 1990), has been identified between 1606.2-2036m. This association is based on the work of Marshall (1989) who described a highly unusual and mostly endemic group of algal cysts, from the Kipper Formation in Kipper-1, Sunfish-1 and from dredge samples from outcropping Latrobe Group sediments in the Bass Canyon.

11) The *R. kipperii* Association although widespread in the Gippsland Basin has not been recorded from known marine sections of equivalent age elsewhere around Australia. Conversely known marine dinoflagellate cyst of this age are not recorded from the Gippsland Basin. On this evidence, until demonstrated otherwise, the *R. kipperii* Association is interpreted as an exclusively lacustrine environmental association without evidence of esturine or marine environments originally suggested as possibilities by Marshall (1989, p.25).

12) The abundance of floral components within the spore-pollen assemblages also support an interpretation that the predominant environment of the Kipper Formation in Admiral-1 is the distal portion of a large lake or lake system.

The breakdown of the counts on the spore-pollen assemblages (Table-3) show an unusual dominance of gymnosperm pollen (51%-84%; average 65%). In particular there is a dominance of bisaccate pollen broadly referred to *Aliosporites/Podocarpidites*. and the alete *Araucariacites/Dilwynites* groups. The dominance of these types is interpreted to be a manifestation of the "Neves effect", which is the tendency, for bisaccate pollen, certain buoyant spores, and other pollen with "comparatively great transportability" to have greater relative abundance the further offshore you go in any depositional basin (Traverse, 1988; p.413). As the "Neves effect" is characteristic of majority of samples through the Kipper Formation it suggests stability of environment through a considerable period of geological time and this is a prerequisite only fulfilled by a large lake.

13) The "Neves effect" is also manifest in samples at 1518.3m and 1580.5m from above the Kipper Formation. However these, and the other samples from the "Upper unnamed unit", contain few algae of the *R. kipperii* Association and the counts show greater swings or changes in dominance of different species or groups (eg. note dominance of

Podosporites microsaccatus at 1518.3m). It is suggested that while lacustrine environments predominate through this unit the "lake system" is no longer as stable or persistent.

14) Another feature of assemblage from the *P. mawsonii* Zone is the consistent occurrence of reworked spores and pollen. In order of prominence most of the reworking is from Triassic sediments, then Permian and least frequent is Early Cretaceous (Strzelecki Group) reworking. In the counts the reworking reaches a maximum of 6% but this is probably a conservative value because of the problems of being able to confidently identify all reworked specimens. As an example of this problem many reworked specimens of the dominant Triassic bisaccate *Falcisporites australis* have probably been included in the counts under the broad category *Aliosporites/Podocarpidites* because of problems of confident identification of the former species when poorly preserved. The greater frequency of the Triassic species of *Aratrisporites* spp. on the range chart compared to *Falcisporites australis* is clear evidence that the latter species, which is orders of magnitude more abundant in the Triassic than *Aratrisporites* spp., is under-represented in the counts.

15) Reworking is notably more abundant in the Lower compared to the Upper Latrobe Group. This characteristic of the Lower part of the group may reflect a more extensive exposure of sediments of Permian and Triassic age to erosion, which subsequently have been either removed or buried. In general however, reworking tends to be a feature of distal rather than proximal environments. For example it tends to be ubiquitous in oceanic sediments sampled by the Deep Sea Drilling Projects. In deltaic or coastal plain sedimentary sequences the presence or absence and abundance of reworking tends to correlate to provenance of sediments being deposited.

The prominence of reworking in the Kipper Formation, relative to its near absence in the Upper Latrobe Group is here interpreted to support a more distal environment for the Kipper Formation and lends support to the large lake hypothesis.

16) In summary evidence that the Kipper Formation can be interpreted as a large lake is:-

i) Dominance of fine clastics.
ii) Mild to significant calcareous component of sediments.
iii) Rarity of coals or clean sands.

iv) Common fresh-water algae and microplankton.

v) "Neves effect" displayed by spore-pollen.

vi) Common occurrence of reworked Triassic, Permian and Early Cretaceous spores and pollen.

This Turonian to Senonian lake is considered to extend about 100 km east-west by 50 km north-south based on the known distribution of the algal cysts of the *Rimosicysta kipperii* Association (ie. from Sweetlips-1 to Kipper-1 to dredge sample in Bass Canyon examined by Marshall, 1989). Assuming, based on comparison to modern lakes, a conservative average water depth of 100 metres the lake would have a volume of 500 km^3. A lake of this size would rank 18th on the list of the largest modern lakes of the world by volume, and therefore could justifiably be called a large lake (see Herdendorf, 1982, table-8).

17) Only one sidewall core and a single cuttings sample were analysed from the "Lower unnamed unit" between 2073-2117m. A similar assemblage to the overlying Kipper Formation was recorded except for the absence of the key index species of the *R. kipperii* Association. However, in the counts on the sidewall core at 2103.5m water-transported elements in the assemblage, represented by both the total spores at 62.4% and reworked category at 5.6%, are significantly higher than the gymnosperm pollen category at 36.9% which is (at least initially) wind transported. It therefore may be argued that this "Lower unnamed unit" has a higher "fluviatile component" to its assemblages relative to samples from the overlying Kipper Formation.

18) The palynomorph assemblages from the "Upper unnamed unit" show the greatest variation in assemblage composition and abundances within the *P. mawsonii* Zone. This is interpreted to reflect variations from "lacustrine" to more "deltaic" or "fluviatile" environments.

Notable features are absence of significant counts of the algae *Amosopollis cruciformis* and high angiosperm pollen abundances (see Table-3). The spores *Crybelosporites brenneri, Cyathidites minor* and *Foraminisporis asymmetricus* and megaspores are conspicuous in most samples and also have their highest abundances in this unit. The algae and microplankton diversity is also significantly less than from the underlying Kipper Formation.

19) Definition of the *P. mawsonii* Zone and its correlation to the geological time scale is based on the synthesis of Helby *et al.* (1987). Analysis of the assemblages in Admiral-1 have highlighted

the lack of documentation of the complete spore-pollen assemblages in the zone in all sequences across Australia. At present the Admiral-1 assemblages cannot be compared readily with any other sequence of the same age outside of the Gippsland Basin. Further, it is likely that the complete zone has not yet been penetrated in the Gippsland Basin. Both Admiral-1 and Kipper-1 are still within the zone at the base of their dated sequences, while the top of the zone is definitely an unconformity in Admiral-1 and there is suspected to be a break at the top of the zone in Kipper-1. According to Helby *et al.* (1987) the *P. mawsonii* Zone extends from the base of the Turonian to just into the base of the Santonian, which is a time interval of 4 million years on the geochronometric scales of both Harland *et al.* (1982) and Haq *et al.* (1987, 1988). A rate of deposition greater than 154 m/m.y. (metres/million years) is therefore calculated for the sequence in Admiral-1. This rate is near the top of the range of maximum depositional rates for latest Cretaceous sections in the Gippsland Basin. For example, the thick Maastrichtian in Hermes-1 has a depositional rate of 207+ m/m.y. and in Volador-1 the equivalent section the rate is 168 m/m.y. In the Tertiary part of the Upper Latrobe Group depositional rates are typically lower. For example in the thickest Paleocene section located below the Marlin field the maximum depositional rate is about 75 m/m.y.

Considering the above deposition rates it is likely that the *P. mawsonii* Zone in Admiral-1 represents a considerable proportion of the time interval of the zone and probably represents a significant part of both the Turonian and Coniacian Stages.

20) The top of the Lower Latrobe Group in Admiral-1 is marked by the Late Cretaceous erosive unconformity described by Lowry (1987, 1988). For simplicity the unconformity is picked at 1503m at the base of the volcanics unit. It is noted however that the sidewall core recovered at 1508.1m is a conglomerate with quartz and lithic pebbles and was considered unsuitable for palynological age dating. As this lithology is quite distinct from all other sidewall cores recovered from the *P. mawsonii* Zone it is suggested the major unconformity may lie at 1509m immediately below the conglomerate and not directly at the base of the volcanic unit. Therefore there could be 6 metres of section of *T. apoxyexinus* or *N. senectus* Zone age below the volcanic unit. Because of severe cavings problems, at this level in the well, it would not be possible to confirm this interpretation by analysis of cuttings.

21) In the Upper Latrobe Group the sequence thins significantly from 570 metres in Kipper-1 to 267 metres in Admiral-1. All units thin and there is a loss of zones or parts of zones in Admiral-1 relative to Kipper-1.

22) Of particular interest and most difficult to explain is absence of the *M. druggii* Dinoflagellate Zone at the base of the marine shale and condensed section between 1423-1432m in Admiral-1 compared to its presence in the equivalent unit in Kipper-1 between 1723-1735m. The log character and thickness of this condensed section is very similar between the two wells.

23) The top of the Latrobe Group coarse clastic section in Admiral-1 is of Upper *L. balmei* Zone age. In Kipper-1 there is an additional 35+ metres of section referred to the Lower *M. diversus* Zone with the key *A. hyperacanthum* Dinoflagellate Zone occurring at the base of the section. It is considered these latter zones have been removed by erosion in Admiral-1 prior to deposition of the Flounder Formation. The unconformity is correlated to one of the erosive events which cut the Tuna-Flounder Channel.

24) The top of Flounder Formation between 1255-1268m is also considered to be an unconformity, this time correlated with the erosive event which cut the Marlin Channel. The presence of the *P. asperopolus* Zone at the base of the overlying Gurnard Formation is consistent with age dating of the Marlin Channel discussed in Marshall & Partridge (1988).

25) In both Admiral-1 and Kipper-1 the Gurnard Formation has not been demonstrated to contain section younger than the Lower *N. asperus* Zone. Elsewhere in the basin the Gurnard Formation frequently extends into the Middle *N. asperus* Zone and rarely into the Upper *N. asperus* Zone. The absence of these latter zones and the sharp log break at the Gurnard Formation in both wells suggest the top of the Latrobe Group is possibly an erosive unconformity. The consistent thickness of the Gurnard Formation between Admiral-1 and Kipper-1 would not however indicate the loss of any significant section.

BIOSTRATIGRAPHY

Zone and age-determinations have been made using criteria proposed by Stover & Partridge (1973), Helby *et al.* (1987) and unpublished observations made on Gippsland Basin wells drilled by Esso Australia Ltd. The description of the zones identified is presented in the order of oldest to youngest as in the formal definitions of the zones the first appearances of species are considered to be the most reliable criteria.

Author citations for most spore-pollen species can be sourced from Stover & Partridge (1973, 1982), Helby *et al.* (1987) and Dettmann & Jarzen (1988) or other references cited herein. Author citations for dinoflagellates can be found in Lentin & Williams (1985, 1989). Principal reference for other microplankton and algal cysts are Marshall (1989), Marshall & Partridge (1988) and Srivastava (1984). Species names followed by "ms" are unpublished manuscript names.

Phyllocladidites mawsonii Zone: **1518.3-2103.5 metres Santonian?-Turonian**

This zone is identified on the rare and infrequent presence of *Phyllocladidites mawsonii* and the absence of index species for the overlying *T. apoxyexinus* Zone or younger zones.

Phyllocladidites mawsonii was recorded in 17 out of the 33 sidewall cores examined which represents 52% of the samples. The species was also recorded from a majority of the cutting samples but these records are unreliable because of the probability of some down hole contamination. In the samples counted *P. mawsonii* abundance ranges from zero, or not recorded in count to a maximum of 1.8% (Table-3). As a comparison *P. mawsonii* in the *L. balmei* and *T. longus* Zones in Sweetlips-1 from which 18 samples were counted has an abundance range of 0 to 56.7% and an average abundance of 9.8% (Partridge, 1990; table-3).

The assemblages in Admiral-1 show several of the other key species shown as diagnostic or ranging through the zone on the range chart of Helby *et al.* (1987, fig.33). There is however almost an equal number of species which were either not recorded or found only extremely rarely. A third group consists of new or previously unrecorded species.

Diagnostic species recorded and their range in Admiral-1 are:-

Amosopollis cruciformis	Abundant	1518.3m-2160m*
Appendicisporites distocarinatus	Frequent	1518.3m-2160m*
Crybelosporites striatus	Rare	1555.6m-2056.0m
Cyatheacidites tectifera	Frequent	1640m*-2105m*
Foraminisporis asymmetricus	Frequent	1518.3m-1912.0m
Foraminisporis wonthaggiensis	Rare	1563.9m-1850m*
Interulobites intraverrucatus	Very Rare	1700m*-2056.0m

* Cuttings

Species considered diagnostic by Helby *et al.* (1987) either not recorded or recorded only extremely rarely in Admiral-1 are:-

Aequitriradites spinulosus	Not recorded.
Australopollis obscurus	Only caved specimens recorded.
Clavifera triplex	Single specimens at 1563.9m and 2103.5m
Contignisporites spp.	All specimens considered reworked.
Lygistepollenites florinii	Not recorded.
Phimopollenites pannosus	Not confidently recorded.
Trilobosporites trioreticulosus	Not recorded.

Previously described species either recorded for the first time in the *P. mawsonii* Zone in the Gippsland Basin or considered to have enhanced biostratigraphic significance because of their documentation in Admiral-1:-

Arcellites sp. cf. *A. disciformis* Miner 1935	1518.3m-1831.0m
Balmeisporites holodictyus Cookson & Dettmann 1958	1518.3m-2056.0m
Crybelosporites brenneri Playford 1971	1518.3m-2056.0m
Foveotricolpites robustus Singh 1983	1518.3m-1912.0m
Liliacidites peroreticulatus (Brenner)	1555.6m-1563.9m
Senectotetradites varireticulatus Dettmann 1973	1750m*-1930m*
Striatopollis paraneus (Norris)	1750m*-1930m*

* Cuttings

New species identified in Admiral-1 with considerable future potential for zone identification and subdivision are:-

Coptospora pileolus n.sp.	1555.6m-1930m*
Densoisporites muratus n.sp.	1620.1m-2060m*
Dilwynites echinatus n.sp.	1728.5m-2016.1m

Hoegisporis trinalis n.sp.	1912.0m-2103.5m
Laevigatosporites musa n.sp.	1563.9m-2056.0m
Phyllocladidites eunuchus n.sp.	1972.5m-2056.0m
Rugulatisporites admirabilis n.sp.	1518.3m-2160m*

* Cuttings

Assemblage counts sufficient for determination of meaningful percentages were made on about a quarter of the samples in the zone and these are given on Table-3. Partial counts were made on some other samples, but these counts were insufficient (<100 specimens) for calculation of meaningful percentages, but they are consistent with broad generalizations.

The counts show the *P. mawsonii* Zone spore-pollen assemblages are dominated by gymnosperm pollen (av. 60%) with secondary spores (av. 37%) and rare angiosperm pollen (<3%). The most characteristic aspect of the gymnosperm pollen is the dominance of a small sized variety of *Dilwynites granulatus*. This form probably needs a new specific epithet as its size range is significantly different from "topotypic" populations of *D. granulatus* from the Paleocene. Bisaccate gymnosperm pollen referred to the broad category *Aliosporites/Podocarpidites* are the next most abundant. Unfortunately no diagnostic species to be recognised in this broad group. The comparative rarity of angiosperm pollen is somewhat of a surprise. Most conspicuous is virtual absence of triporate grains particularly *Proteacidites* spp. Thus, the assemblages on initial impressions do not obviously belong to the *Proteacidites* Superzone of Helby *et al.* (1987, p.55).

Average spore-pollen diversity is 18+ species per sample through the zone. Range chart-2 which is solely for the *P. mawsonii* Zone shows a total *in situ* spore-pollen diversity of 63 species and about a third of these can be regarded as common species. In addition another 30 species of reworked spores and pollen were recorded, although this diversity is probably a gross under-estimation because only the common or highly distinctive reworked species were consistently recorded.

The relative high diversity through the zone and number of new species recorded suggests that there is significant potential for subdivision of and more detailed correlation within the *P. mawsonii* Zone. However to be able to do this it would be necessary to re-examine other sections of the *P. mawsonii* Zone in the Gippsland Basin. For example the thick section of the zone in Kipper-1 needs to be re-examined to either find or confirm the absence of the new and previously unrecorded species documented in Admiral-1.

Rimosicysta kipperii **Microplankton Zone: 1606.2-2036.0 metres.**

Algal microfossils including dinoflagellates are present in 30 out of 33 sidewall cores (91% of samples) in the *P. mawsonii* Zone interval. Total species diversity is moderate with 19 types identified. Most species recognised have been documented in Marshall (1989). Significant exceptions are small smooth or finely spinose spheres assigned respectively to *Sigmopollis carbonis* and *S. hispidus*. The description and environmental distribution of these species are best summarised in Srivastava (1984). The most consistently present form and overall most abundant is however *Amosopollis cruciformis*. Although originally described as a possible angiosperm pollen it's observed environmental distribution suggests strongly that it is some type of algae.

Species of *Rimosicysta* and *Wuroia* are distributed sporadically through the Kipper Formation. They are probably commoner than suggested by their occurrences on the range chart, because confident species identification is difficult where preservation is poor. This overall microplankton association is named the *Rimosicysta kipperii* Microplankton Zone or Association after the morphologically simplest species. A noted feature of the assemblages is the absence of the morphologically distinctive species *Limbicysta pediformis*, *L. guttularis*, *Rimosicysta cucullata* and *Tetrachacysta? keenei*. Their absence suggests that the complete time interval for the *P. mawsonii* Zone is probably not represented in Admiral-1.

Upper *Tricolpites longus* **Zone: 1437.0-1477.5 metres** **Maastrichtian**

The two sidewall cores samples are assigned to the zone with high confidence on the presence in both samples of *Stereisporites (Tripunctisporis)* spp. and common *Gambierina rudata*. The shallower sample also has the LADs of the important species *Quadraplanus brossus* and *Tricolporites lilliei*, while the deeper sample is characterised by common *Peninsulapollis gillii* and *Triporopollenites sectilis*.

The cuttings sample at 1495m from the volcanics interval referred to undifferentiated *T. longus* Zone is considered likely to contain only caved palynomorphs and is unlikely to be indicative of the age of the volcanics.

Lower *Lygistepollenites balmei* Zone: 1314.0-1430.8 metres Paleocene.
and
Trithyrodinium evittii Zone: 1427.0-1430.8 metres Paleocene.

This zone is represented by three sidewall cores from the condensed marine interval between 1423-1432m and two sidewall cores from the coastal plain facies above 1388m. The three lower samples contain mixed assemblages of both *T. longus* and *L. balmei* Zone spore-pollen species, but because of the frequent to abundant occurrence of the key dinoflagellate *Trithyrodinium evittii* assignment to the Lower *L. balmei* Zone is preferred. The following *T. longus* Zone index species are considered reworked: *Beaupreaidites orbiculatus* at 1430.8m, *Proteacidites clinei* at 1427.0m and 1430.8m; *P. reticuloconcavus* ms at 1430.8m, and *Triporopollenites sectilis* at 1427.0m and 1430.8m. Most of these records represent only single specimen occurrences. The only pollen species restricted to the Lower *L. balmei* Zone in the samples is *Proteacidites angulatus* at 1427.0m and 1428.9m. Of the two shallower samples, the lower at 1359.6m gave a limited assemblage but clearly belongs to the broader *L. balmei* Zone. Important oldest occurrences in the sample are *Australopollis obscurus* and *Milfordia homeopunctatus*. The higher sample at 1314.0m yielded a high diversity assemblage with presence of *Integricorpus antipodus* and FADs for *Haloragacidites harrisii* and *Myrtaceidites parvus/mesonesus*. The algae *Amosopollis cruciformis* is common in the sample which suggests a lacustrine environment, while the bed thickness (<3 metres) suggests the lake was ephemeral.

The *T. evittii* Zone is recognised in Admiral-1 on the acme of the eponymous species in accordance with the original definition of Helby *et al.* (1987). The associated microplankton although slightly more diverse than in other wells are all long ranging species and therefore are not very diagnostic.

Upper *Lygistepollenites balmei* Zone: 1275.0-1285.8 metres Paleocene.
and
Apectodinium homomorphum Zone: 1275.0-1285.8 metres Paleocene.

The two samples in this interval are both confidently assigned to the Upper *L. balmei* Zone on the FADs for *Proteacidites annularis* at 1285.8m, and *Cupanieidites orthoteichus* and *Cyathidites gigantis* at 1275.0m. Aside from *Lygistepollenites balmei* species with diagnostic LADs for the zone are rare. However, supporting the spore-pollen evidence for this age is the occurrence of the dinoflagellate *Apectodinium homomorphum* (short spined variety), which is abundant in the deeper sample and rare in the shallower.

Upper *Malvacipollis diversus* Zone
to
Proteacidites asperopolus Zone: 1268.7 metres Early Eocene.

Only a single sidewall core was recovered from the interval assigned to the Flounder Formation. Unfortunately the glauconitic sandstone from this core only gave an extremely meager residue. The palynomorph assemblage is dominated by the dinoflagellate cyst *Paralecaniella indentata* which has no zone significance. Other dinoflagellates and the spores-pollen are rare and not particularly diagnostic. An age no older than the Upper *M. diversus* Zone is suggested solely on the presence of the dinoflagellate cyst *Apectodinium longispinosum*. The lithology and electric log character support this age assignment as the marine glauconitic facies is more consistent with assignment to the Flounder Formation rather than being related to the lower coastal plains environment of the underlying Upper *L. balmei* Zone.

Proteacidites asperopolus Zone: 1254.1 metres Early Eocene.

This sample is assigned to the *P. asperopolus* Zone on the association of frequent *Conbaculites apiculatus* with *Proteacidites asperopolus* and the absence of any noticeable abundance of *brassii* type *Nothofagidites* pollen. *Nothofagidites flemingii* however is common, but this species is referred to the *fusca* group of *Nothofagidites* pollen and it can occur in some abundance in this zone. This sample also has the highest recorded spore-pollen diversity (63+ species) of all samples in Admiral-1. Whilst high diversity is also "typical" of samples from the *P. asperopolus* Zone it is noted that *Myrtaceidites tenuis* was not recorded. The LAD of this species is considered the most important criteria for picking the the top the *P. asperopolus* Zone and its absence (or extreme rarity?) suggest this assemblage is near the top of the zone. Because of this uncertainty only a Confidence Rating of 2 is given to the zone pick. The microplankton recorded from the sample are not diagnostic.

Lower *Nothofagidites asperus* Zone: 1238.0-1241.4 metres Middle Eocene.
and
Areosphaeridium australicum Zone: 1241.4 metres Middle Eocene.

The two samples are assigned to this zone on the common occurrence of *Nothofagidites* spp. of the *brassii* group. Key spore-pollen index species are rare but include the FAD for *Nothofagidites falcatus* and the LAD for

Proteacidites asperopolus both in the shallower sample at 1238.0m. The latter datum is indicative of an age no younger than the Lower subzone, although in the offshore marine environment represented in Admiral-1 it is possible that *P. asperopolus* could be reworked. A more definitive age is obtained by the microplankton in the deepest sample. The key species are the dinoflagellate *Areosphaeridium australicum* ms (= *Areosphaeridium* sp. cf. *A. diktyoplokus* of Marshall & Partridge 1988) and the acritarch *Tritonites tricornus* Marshall & Partridge 1988.

Proteacidites tuberculatus Zone: **1234.5 metres** **Miocene-Oligocene.**

This very low yield sample is assigned to the *P. tuberculatus* Zone on its microplankton content as the associated spores and pollen whilst supportive are not diagnostic. The key dinoflagellate species is *Protoellipsodinium simplex* ms which is abundant in the sample. Abundant occurrences of this species are typical of the younger part of this spore-pollen zone in the marine section in the offshore Gippsland Basin. An Early Miocene rather than Oligocene age is therefore favoured for the base of the marine Seaspray Group in Admiral-1. Equivalent ages are documented in Tuna field wells and in Sweep-1, while Hammerhead-1 has a thin section (<8 metres) of the Early Oligocene Zonule J-1 recorded immediately overlying the Latrobe Group. Other nearby well lack micropalaeontological data.

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PALYNOLOGY DATA SHEET

BASIN: Gippsland ELEVATION: KB: +21 m GL: -101 m

WELL NAME: Admiral-1 TOTAL DEPTH: 2162 m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA Preferred Depth	Rtg	HIGHEST DATA Alternate Depth	Rtg	LOWEST DATA Alternate Depth	Rtg	LOWEST DATA Preferred Depth	Rtg
NEOGENE	*T. pleistocenicus*								
	M. lipsis								
	C. bifurcatus								
	T. bellus								
	P. tuberculatus							1234.5	2
PALEOGENE	Upper *N. asperus*								
	Middle *N. asperus*								
	Lower *N. asperus*	1238	2					1241.4	0
	P. asperopolus							1254.1	2
	Upper *M. diversus*								
	Middle *M. diversus*								
	Lower *M. diversus*								
	Upper *L. balmei*	1275	0					1285.8	0
	Lower *L. balmei*	1314	2	1427	0	1428.9	0	1430.8	2
LATE CRETACEOUS	Upper *T. longus*	1437	1					1477.5	1
	Lower *T. longus*								
	T. lilliei								
	N. senectus								
	T. apoxyexinus								
	P. mawsonii	1518.3	2	1580.5	1	2071.3	1	2103.5	2
	A. distocarinatus								
EARLY CRET.	*P. pannosus*								
	C. paradoxa								
	C. striatus								
	C. hughesii								
	F. wonthaggiensis								
	C. australiensis								

COMMENTS: All depths in metres.

Dinoflagellate Zones: *A. australicum* 1241.4; *A. homomorphum* 1275-1285.8 m;

T. evittii 1427-1430.8 m.

CONFIDENCE RATING:

0: SWC or Core, Excellent Confidence, assemblage with zone species of spores, pollen and microplankton.
1: SWC or Core, Good Confidence, assemblage with zone species of spores andpollen or microplankton.
2: SWC or Core, Poor Confidence, assemblage with non-diagnostic spores, pollenand/or microplankton.
3: Cuttings, Fair Confidence, assemblage with zone species of either spores and pollen and/or microplankton.
4: Cuttings, No Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

NOTE:
If an entry is given a 3 or 4 confidence rating, an alternative depth with abetter confidence rating should be entered, if possible. If a sample cannot be assigned to one particular zone,then no entry should be made, unless a range of zones is given where the highest possible limit will appear in one zone and the lowest possible limit in another.

DATA RECORDED BY: A.D. Partridge DATE: June 1990

DATA REVISED BY: ______ DATE: ______

TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

Sheet 1 of 3

SAMPLE TYPE	DEPTH (metres)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE (OR ASSOCIATION)	CONFIDENCE RATING	COMMENT
SWC 60	1234.5	*P. tuberculatus*	*(P. simplex)*	2	Age based on dinoflagellates.
SWC 59	1238.0	Lower *N. asperus*		2	*Proteacidites asperopolus* present.
SWC 58	1241.4	Lower *N. asperus*	*A. australicum*	0	*Tritonites tricornus* present.
SWC 57	1254.1	*P. asperopolus*		2	*H. harrisii* > *Nothofagidites* spp.
SWC 56	1268.7	No older than Upper *M. diversus*	*(A. longispinosum)*	-	Dominated by *Paralecaniella indentata*.
SWC 55	1275.0	Upper *L. balmei*	*A. homomorphum*	0	FAD *Cyathidites gigantis*.
SWC 54	1285.8	Upper *L. balmei*	*A. homomorphum*	0	
SWC 53	1314.0	Lower *L. balmei*		2	Common *Amosopollis cruciformis*
SWC 52	1359.6	*L. balmei*		2	
SWC 51	1427.0	Lower *L. balmei*	*T. evittii*	0	
SWC 50	1428.9	Lower *L. balmei*	*T. evittii*	0	
SWC 49	1430.8	Lower *L. balmei*	*T. evittii*	2	
SWC 48	1437.0	Upper *T. longus*		1	LAD *Quadraplanus brossus*.
Cuttings	1445	*L. balmei/Upper T. longus*		3	Most palynomorphs caved.
SWC 47	1477.5	Upper *T. longus*		1	FAD *Stereisporites (Tripunctisporis)* spp.
Cuttings	1495	*T. longus*		3	Palynomorphs all caved.
SWC 45	1518.3	*P. mawsonii*		2	LADs for number of species.
Cuttings	1540	Indeterminate			Dominated by caved palynomorphs.
Cuttings	1545	Indeterminate			Dominated by caved palynomorphs.
SWC 43	1555.5	*P. mawsonii*		2	Dominated by fines.
SWC 42	1563.9	*P. mawsonii*		2	Rich assemblage, common megaspores.
SWC 41	1580.5	*P. mawsonii*		1	Dominated by gymnosperm pollen.
SWC 39	1606.2	*P. mawsonii*	*(R. kipperii)*	0	Abundant microplankton.
SWC 38	1620.1	*P. mawsonii*		2	
Cuttings	1640	*P. mawsonii*	*(R. kipperii)*	3	
SWC 37	1648.5	Indeterminate			
SWC 36	1680.5	*P. mawsonii*	*(R. kipperii)*	2	
SWC 35	1697.5	*P. mawsonii*	*(R. kipperii)*	1	*Amosopollis cruciformis* >18%

TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

Sheet 2 of 3

SAMPLE TYPE	DEPTH (metres)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE (OR ASSOCIATION)	CONFIDENCE RATING	COMMENT
Cuttings	1700	*P. mawsonii*	(*R. kipperii*)	3	LAD *Cyatheacidites tectifera*.
SWC 34	1728.4	Indeterminate	(*R. kipperii*)		*Wuroia corrugata* present.
SWC 33	1749.5	*P. mawsonii*		1	
Cuttings	1750	*P. mawsonii*		2	LAD *Senectotetradites varireticulatus*.
SWC 32	1768.8	*P. mawsonii*	(*R. kipperii*)	0	
SWC 31	1789.0	*P. mawsonii*	(*R. kipperii*)	0	*Amosopollis cruciformis* >20%
Cuttings	1790	Indeterminate			
SWC 30	1796.0	*P. mawsonii*		2	
SWC 29	1806.6	*P. mawsonii*		2	
SWC 28	1816.6	*P. mawsonii*		2	
SWC 27	1831.0	*P. mawsonii*		1	
SWC 26	1843.1	*P. mawsonii*	(*R. kipperii*)	2	*Amosopollis cruciformis* abundant >28%
Cuttings	1850	*P. mawsonii*	(*R. kipperii*)	3	
SWC 25	1858.1	Indeterminate			
Cuttings	1870	*P. mawsonii*		3	
SWC 24	1873.2	*P. mawsonii*		1	Abundant reworking.
SWC 23	1899.0	*P. mawsonii*	(*R. kipperii*)	2	FAD *Wuroia corrugata*.
Cuttings	1910	*P. mawsonii*		3	
SWC 22	1912.0	*P. mawsonii*		1	FAD *Coptospora pileolus* ms.
Cuttings	1930	*P. mawsonii*		3	*Coptospora pileolus* frequent.
SWC 21	1936.0	*P. mawsonii*		1	
SWC 20	1961.1	Indeterminate			
SWC 19	1972.5	*P. mawsonii*		1	
SWC 18	1988.0	*P. mawsonii*		2	
Cuttings	2010	Indeterminate			No older than *A. distocarinatus* Zone.
SWC 17	2016.1	*P. mawsonii*	(*R. kipperii*)	1	
SWC 16	2036.0	*P. mawsonii*	(*R. kipperii*)	2	FAD *Rimosicysta* spp.
SWC 15	2048.9	Indeterminate			
Cuttings	2060	Indeterminate			No older than *A. distocarinatus* Zone.
SWC 14	2056.0	*P. mawsonii*		1	FAD *Balmeisporites holodictyus*.

TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

SAMPLE TYPE	DEPTH (metres)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE (OR ASSOCIATION)	CONFIDENCE RATING	COMMENT
SWC 13	2061.5	*P. mawsonii*		1	
SWC 12	2071.3	*P. mawsonii*		1	FAD *Phyllocladidites mawsonii*.
SWC 9	2103.5	*P. mawsonii*		2	FAD *Cyatheacidites tectifera*.
Cuttings	2105	Indeterminate			No older than *A. distocarinatus* Zone.
Cuttings	2160	Indeterminate			

LAD - Last Appearance Datum
FAD - First Appearance Datum

BASIC DATA

TABLE-2: BASIC DATA

TABLE-3: PALYNOMORPH PERCENTAGES FOR

P. MAWSONII ZONE.

RANGE CHART FOR SAMPLES BETWEEN

1234.5m - 1495m

AND

1518.3m - 2160m

TABLE-2: BASIC PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

SP/P

Dino Sheet 1 of 3

SAMPLE TYPE	DEPTH (metres)	LAB. NO.	LITHOLOGY	RESIDUE YIELD	PALYNOMORPH CONCENTRATION	PRESERVATION	NO. OF S-P SPECIES*	MICROPLANKTON ABUNDANCE	NO. SPECIES*
SWC 60	1234.5	78290 H	Calcareous claystone	Very Low	Low	Fair-good	12+	High	7+
SWC 59	1238.0	78290 G	Brown glauconitic sandstone	Moderate	Moderate	Poor	22+	Low	4+
SWC 58	1241.4	78290 F	Brown glaucontic siltstone	Moderate	High	Low	41+	High	10+
SWC 57	1254.1	78290 E	Siltstone (trace glauconite)	Low	High	Good	63+	Moderate	9+
SWC 56	1268.7	78290 D	Glauconitic sandstone	Very Low	Low	Poor-fair	11+	High	5+
SWC 55	1275.0	78290 C	Homogeneous siltstone	High	Low	Fair	21+	Low	2
SWC 54	1285.8	78290 B	Claystone	High	High	Fair	21+	High	3
SWC 53	1314.0	78290 A	Claystone	High	High	Fair	31+	Low	2
SWC 52	1359.6	78289 Z	Claystone	Moderate	Low	Good	11+	Low	1
SWC 51	1427.0	78289 Y	Carbonaceous siltstone	Moderate	Moderate	Fair-good	22+	High	7+
SWC 50	1428.9	78289 X	Glauconitic sandstone/siltstone	Moderate	Low	Fair	15+	Low	3+
SWC 49	1430.8	78289 W	Glauconitic sandstone	Moderate	Low	Poor-good	23+	Low	5+
SWC 48	1437.0	78289 V	Carbonaceous siltstone	Moderate	Low	Poor-fair	22+		
Cuttings	1445	78281 J		Moderate	Moderate	Fair-good	15+	Low	1
SWC 47	1477.5	78289 U	Homogeneous claystone	High	High	Good	26+	Very Low	1
Cuttings	1495	78281 K	(Volcanic interval)	Moderate	Moderate	Fair-good	22+	Very Low	1
SWC 45	1518.3	78289 S	Homogeneous claystone	High	Low	Poor-fair	24+	Low	4
Cuttings	1540	78281 L		Moderate	Low	Poor-good	13+		
Cuttings	1545	78281 S		Very Low	Low	Poor-good	4+		
SWC 43	1555.5	78289 Q	Claystone	High	High	Poor-good	24+	Low-High	2
SWC 42	1563.9	78289 P	Homogeneous claystone	High	High	Good	29+	Low	4
SWC 41	1580.5	78289 O	Mottled siltstone	High	Moderate	Fair	33+	Low	3
SWC 39	1606.2	78289 M	Homogeneous claystone	High	Moderate	Fair	21+	High	6+
SWC 38	1620.1	78289 L	Siltstone	High	Moderate	Fair	23+	Low	5
Cuttings	1640	78281 N		High	Moderate	Good	13+	Low	2+
SWC 37	1648.5	78289 K	Siltstone	High	Low	Fair	12+	Low	1
SWC 36	1680.5	78289 J	Homogeneous claystone	High	Low	Fair	13+	Low	3
SWC 35	1697.5	78289 I	Homogeneous siltstone	High	Low	Fair	15+	Low	2

TABLE-2: BASIC PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

Sheet 2 of 3

SAMPLE TYPE	DEPTH (metres)	LAB. NO.	LITHOLOGY	RESIDUE YIELD	PALYNOMORPH CONCENTRATION	PRESERVATION	NO. OF S-P SPECIES*	MICROPLANKTON** ABUNDANCE	NO. SPECIES*
Cuttings	1700	78281 O		High	Moderate	Good	14+	Low	2
SWC 34	1728.4	78289 H	Siltstone with sandy laminae	High	Low	Fair	14+	Low	5+
SWC 33	1749.5	78289 G	Sandy siltstone	High	Low	Fair	16+	Low	3
Cuttings	1750	78281 P		High	High	Good	23+	Low	4+
SWC 32	1768.8	78289 F	Claystone with silty laminae	High	High	Good	28+	Low	4
SWC 31	1789.0	78289 E	Laminated siltstone	High	Moderate	Fair-good	24+	Low	3
Cuttings	1790	78281 Q		Moderate	Low	Good	11+	Low	1
SWC 30	1796.0	78289 D	Homogeneous claystone	High	Moderate	Fair	21+	Low	2
SWC 29	1806.5	78289 C	Homogeneous claystone	Moderate	High	Fair-good	9+	Low	3+
SWC 28	1816.6	78289 B	Homogeneous claystone	High	Low	Fair	7+	Low	2
SWC 27	1831.0	78289 A	Siltstone	High	High	Fair-good	29+	Low	2
SWC 26	1843.1	78288 Z	Laminated siltstone	High	Low	Fair	19+	High	2
Cuttings	1850	78281 R		High	Moderate	Fair-good	19+	Low	2
SWC 25	1858.1	78288 Y	Homogeneous claystone	High	Low	Fair	13+	Low	3
Cuttings	1870	78281 S		High	High	Fair	21+	Low	3
SWC 24	1873.2	78288 X	Homogeneous claystone	Low	Moderate	Poor-good	22+		
SWC 23	1899.0	78288 W	Siltstone	Moderate	Low	Fair-good	16+	Low	4
Cuttings	1910	78281 T		Moderate	High	Fair-good	20+	Low	4
SWC 22	1912.0	78288 V	Siltstone	High	High	Poor-good	34+	Low	3
Cuttings	1930	78281 U		High	High	Fair-good	19+	Low	2
SWC 21	1936.0	78288 U	Interlaminated claystone/sltst.	High	High	Good	29+	Low	4
SWC 20	1961.1	78288 T	Homogeneous siltstone	Moderate	Very Low	Poor	7+	Low	1
SWC 19	1972.5	78288 S	Carbonaceous siltstone	High	Low	Poor-fair	31+	Low	3
SWC 18	1988.0	78288 R	Sst/carbonaceous claystone	High	Low	Fair	16+	Low	1
Cuttings	2010	78281 V		Moderate	Low	Poor	7+	Low	1
SWC 17	2016.1	78288 Q	Carbonaceous siltstone	High	Low	Fair-good	30+	Low	4
SWC 16	2036.0	78288 P	Siltst. grading to claystone	Moderate	Low	Fair-good	17+	Low	2
SWC 15	2048.9	78288 O	Laminated carbonaceous siltstone	High	Low	Fair	11+	Low	2
Cuttings	2060	78281 W		Moderate	Very Low	Fair-good	10+	Low	2
SWC 14	2056.0	78288 N	Siltstone	High	Low	Fair	31+	Low	4

TABLE-2: BASIC PALYNOLOGICAL DATA ADMIRAL-1, GIPPSLAND BASIN

Sheet 3 of 3

SAMPLE TYPE	DEPTH (metres)	LAB. NO.	LITHOLOGY	RESIDUE YIELD	PALYNOMORPH CONCENTRATION	PRESERVATION	NO. OF S-P SPECIES*	MICROPLANKTON ABUNDANCE	MICROPLANKTON NO. SPECIES*
SWC 13	2061.5	78288 M	Sandy siltstone	High	Very Low	Fair	14+		
SWC 12	2071.3	78288 L	Homogeneous siltstone	Low	Low	Fair	21+		
SWC 9	2103.5	78288 I	Homogeneous siltstone	High	Low	Fair	30+	Low	3
Cuttings	2105	78281 X		Moderate	Low	Poor-fair	13+	Low	1
Cuttings	2160	78281 Y	Arkosic sandstone	Moderate	Low	Fair	11+	Low	1

* Diversity:
- Very Low - 1- 5 species
- Low - 6-10 species
- Moderate - 11-25 species
- High - 26-74 species
- Very High - 75+ species

** Note: Algal cysts including *Amosopollis cruciformis* included under Microplankton category.

TABLE 3: PALYNOMORPH PERCENTAGES FOR P. mawsonii Zone Page 1 of 2

	1518.3m SWC 45	1555.5m SWC 43	1563.9m SWC 42	1580.5m SWC 41	1606.2m SWC 39	1620.1m SWC 38
TRILETE SPORES undiff.	1.8%	2.7%	3.0%	6.1%	1.9%	3.8%
Appendicisporites spp.		1.6%				
Cicitricosisporites spp.	1.8%		0.5%			
Crybelosporites spp.	3.7%	2.2%	6.5%			
Cyatheacidites tectifera						
Cyathidites/Biretisporites (large)			0.3%	4.0%		0.3%
Cyathidites (small)	12.8%	14.6%	21.4%	1.4%	3.9%	1.9%
Dictyophyllidites spp.	0.9%					
Gleicheniidites spp.		3.2%	1.4%	1.4%		1.9%
Foraminisporis asymmetricus		9.7%	3.0%			1.3%
Osmundacidites/Baculatisporites spp.	2.7%	0.5%	0.8%	4.0%	2.9%	1.3%
Rugulatisporites spp.				4.0%		
Stereisporites antiquisporites		1.1%	0.5%	1.4%	1.9%	3.8%
MONOLETE SPORES						
Laevigatosporites spp.	5.5%	3.2%		1.4%	4.9%	4.4%
Marattisporites scabratus				0.7%		1.3%
HILATE SPORES						
Coptospora pileolus ms		0.5%	2.4%			
Triporoletes spp.		3.2%	3.5%		0.9%	0.3%
MEGASPORES	0.9%	0.5%	1.4%	0.7%		
TOTAL SPORES %	30.0%	48.6%	44.6%	25.0%	16.5%	20.6%
GYMNOSPERM POLLEN						
Aliosporites/Podocarpidites	17.4%	18.9%	11.1%	28.4%	16.5%	16.3%
Araucariacites australis	2.7%	2.2%	1.4%	6.1%	6.8%	6.9%
Cycadopites spp.			6.5%	0.7%		
Dilwynites spp.	21.1%	8.1%	19.5%	33.8%	57.3%	46.9%
Microcachryidites antarcticus	0.9%	5.4%	11.9%	4.0%	1.9%	2.4%
Phyllocladidites mawsonii				1.4%	0.9%	0.6%
Podosporites microsaccatus	23.8%	3.8%				4.4%
TOTAL GYMNOSPERM POLLEN %	65.5%	38.4%	50.3%	74.3%	83.5%	77.5%
ANGIOSPERM POLLEN						
"Monolete"		1.1%	1.9%			
"Tricolpates"	3.6%	11.4%	3.2%	0.7%		0.6%
"Triorates"	0.9%	0.5%				1.3%
TOTAL ANGIOSPERM POLLEN %	4.5%	13.0%	5.1%	0.7%	0.0%	1.9%
TOTAL SPORES & POLLEN COUNT	110	185	370	148	103	160
PERCENTAGES OF MAJOR CATEGORIES						
TOTAL SPORES & POLLEN %	86.6%	85.6%	94.6%	92.5%	67.8%	90.9%
FUNGAL SPORES & HYPHAE %	3.9%		0.5%	1.9%	2.6%	1.1%
REWORKED SPORES & POLLEN %		0.5%		5.6%		
TOTAL ALGAE & MICROPLANKTON	9.5%	13.9%	4.8%	0.6%	29.7%	8.0%
ALGAE & MICROPLANKTON Subcategories						
Amosopollis cruciformis					0.7%	4.5%
Circulisporites parvus	9.5%					0.6%
Micrhystridium spp.				0.6%		
Rimosicysta spp.					14.5%	1.1%
Sigmopollis carbonis		10.2%	1.0%		3.3%	1.7%
Sigmopollis hispidus		3.7%	3.8%			
Wuroia spp.					11.2%	
TOTAL COUNT	127	216	391	160	152	176

TABLE 3: PALYNOMORPH PERCENTAGES FOR P. mawsonii Zone Page 2 of 2

	1768.8m SWC 32	1831.0m SWC 27	1912.0m SWC 22	1972.5m SWC 19	2016.1m SWC 17	2103.5m SWC 9
TRILETE SPORES undiff.	3.0%	3.6%	2.5%	6.2%	5.9%	13.4%
Appendicisporites spp.		0.5%		0.9%		
Cicitricosisporites spp.	0.5%	0.9%	2.5%	0.9%	1.0%	
Crybelosporites spp.	0.5%	4.6%	2.5%		0.5%	
Cyatheacidites tectifera	0.5%	0.5%		0.9%		2.0%
Cyathidites/Biretisporites (large)	1.0%	4.1%	2.5%	0.9%	2.5%	
Cyathidites (small)	4.0%	9.6%	1.6%	4.0%	3.0%	12.8%
Dictyophyllidites spp.	0.5%	0.5%		5.8%	1.0%	0.7%
Gleicheniidites spp.	4.5%	1.8%	1.6%	9.3%	4.9%	4.7%
Foraminisporis asymmetricus			0.8%			
Osmundacidites/Baculatisporites spp.	1.5%	1.4%	4.1%	3.6%	3.9%	10.7%
Rugulatisporites spp.	0.5%	1.8%	4.9%	4.4%	6.9%	3.4%
Stereisporites antiquisporites	1.0%	0.9%	1.6%	3.6%	1.5%	8.7%
MONOLETE SPORES						
Laevigatosporites spp.	3.0%	2.3%	1.6%	3.1%	4.4%	5.4%
Marattisporites scabratus	1.5%			2.2%	0.5%	
HILATE SPORES						
Coptospora pileolus ms	1.5%	2.8%				
Triporoletes spp.	8.1%	8.7%	0.8%	0.4%	8.4%	0.7%
MEGASPORES	0.5%	3.2%		0.4%	1.0%	
TOTAL SPORES %	32.3%	47.2%	27.0%	46.7%	45.3%	62.4%
GYMNOSPERM POLLEN						
Aliosporites/Podocarpidites	14.1%	15.6%	45.1%	24.0%	23.6%	22.1%
Araucariacites australis	1.5%	4.1%	8.2%	3.1%	7.4%	6.0%
Cycadopites spp.	0.5%					
Dilwynites spp.	31.8%	27.5%	13.9%	14.6%	10.3%	4.7%
Microcachryidites antarcticus	16.7%	2.8%	2.5%	8.0%	9.8%	2.7%
Phyllocladidites mawsonii		0.5%		1.8%	0.5%	
Podosporites microsaccatus	2.5%	0.9%	0.8%	0.9%	1.5%	0.7%
TOTAL GYMNOSPERM POLLEN %	67.2%	51.4%	70.5%	52.4%	53.2%	36.9%
ANGIOSPERM POLLEN						
"Monolete"						
"Tricolpates"	0.5%	1.4%		0.4%	1.5%	0.7%
"Triorates"			2.5%	0.4%		
TOTAL ANGIOSPERM POLLEN %	0.5%	1.4%	2.5%	0.9%	1.5%	0.7%
TOTAL SPORES & POLLEN COUNT	198	218	122	225	203	149
PERCENTAGES OF MAJOR CATEGORIES						
TOTAL SPORES & POLLEN %	89.2%	90.5%	85.3%	94.9%	88.3%	92.0%
FUNGAL SPORES & HYPHAE %	0.9%			0.4%		0.6%
REWORKED SPORES & POLLEN %	1.4%	1.2%	0.7%	0.8%	4.8%	5.6%
TOTAL ALGAE & MICROPLANKTON	8.6%	8.3%	14.0%	3.8%	6.9%	1.9%
ALGAE & MICROPLANKTON Subcategories						
Amosopollis cruciformis	3.2%	7.1%	11.9%	3.0%	3.5%	0.6%
Circulisporites parvus						
Micrhystridium spp.			1.4%	0.4%	0.4%	1.2%
Rimosicysta spp.	0.9%				3.0%	
Sigmopollis carbonis	3.6%		0.7%	0.4%		
Sigmopollis hispidus	0.9%	1.2%				
Wuroia spp.						
TOTAL COUNT	222	241	143	237	230	162