APPENDIX

PALYNOLOGICAL ANALYSIS OF EAST KINGFISH-1
GIPPSLAND BASIN, VICTORIA

by

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April 1, 1985

Palaeontology Report 1985/13

1491L

CONTENTS

INTRODUCTION

Twenty-two sidewall core and eight conventional core samples were examined for palynomorphs in East Kingfish-1. Occurrences of spore-pollen and dinoflagellate species in each sample are recorded on the enclosed range chart. Tables 1 and 3 summarize interpretative and basic palynological data, and anomalous occurrences of spores and pollen are listed in Table 2.

SUMMARY TABLE

AGE	FORMATION	PALYNOLOGY ZONE	DEPTH (in metres from K.B.)
Early Miocene -Late Oligocene	Lakes Entrance Formation	*P. tuberculatus*	2440.01-2491.06
log break at 2493m			
Early Oligocene	Unnamed glauconitic sandstone	*P. tuberculatus*	2493.9-2495.1
Late Eocene	Gurnard Formation	Middle *N. asperus* and *C. incompositum* dinoflagellate Zone	2496.0
log break at 2497m *			
Early Eocene	Latrobe Group (coarse clastics)	Lower M. diversus	2497.0-2533.2
Late Paleocene	Latrobe Group (coarse clastics)	Upper *L. balmei* and *A. homomorpha* dinoflagellate Zone	2571.8-2617.6
			T.D. 2638m

* based on Rexilius (1985)

GEOLOGICAL COMMENTS

1. East Kingfish-1 was drilled to test for the presence of a marine progradational sand facies ranging from the Upper L. balmei Zone to the Lower M. diversus Zone. Palynological analyses confirm the occurrence of these zones. The consistent presence of dinoflagellates in the predominantly sand facies is consistent with deposition in a marine environment.

2. The A. hyperacanthum dinoflagellate Zone was not found within the transition from Upper L. balmei sediments to the Lower M. diversus sequence. This zone may be present in the section between 2571-2533m, but it has not been recognized due to the sparse palynomorph assemblages examined within the interval. Palaeogeographic mapping from other well control suggests it should be present. It could also be argued that the apparent absence of the dinoflagellate zone is due to erosion at a sequence boundary, possibly related to one of the regressive cycles associated with the major channel cutting events in the Early Eocene (e.g. Tuna-Flounder Channels). If the lower part of the Lower M. diversus Zone and the associated A. hyperacanthum Zone have been removed by erosion, the possibility exists that the upper part of the Upper L. balmei Zone has also been lost by this event. There is a distinct change in the characters of the sonic and gamma logs within this interval (at 2535m), which may be related to a sequence boundary.

3. The Latrobe Group coarse clastics are overlain by a thin (3-4m) sequence of glauconitic sandstone, and this was sampled by three sidewall cores at 2493.9, 2495.1 and 2496.0m. The lowest sidewall core at 2496.0m is referred to the Middle N. asperus Zone and is therefore consistent with the assemblages found in the Gurnard Formation. The higher two samples at 2493.9 and 2495.1m in contrast contain P. tuberculatus Zone palynofloras

which have not previously been recorded from the Gurnard Formation. These two samples have therefore been referred to an unnamed greensand unit. Possible interpretations for the development of this unit include:-

a) Reworking of sediments from the underlying Gurnard Formation during deposition of the basal P. tuberculatus Zone. Because of the absence of common reworked Middle N. asperus Zone or older taxa in the assemblages as typically seen in this situation elsewhere in the basin (e.g. Flounder 5 and 6), this explanation is not favoured. However, if the reworked Gurnard Formation was barren of fossils, this is a plausible interpretation.

b) Incorporation of P. tuberculatus Zone fossils into the greensand by burrowing at the hiatal surface at the top of the greensand unit (2493m). This is also unlikely because of a lack of mixed Eocene and Oligocene assemblages. As in case (a), however, it represents a possible explanation if the top of the greensand unit was barren of fossils.

c) Basal Lakes Entrance Formation greensand with the quartz component being derived from erosion of the palaeotopographically higher portions of the Kingfish structure.

d) Contamination of virtually barren Gurnard Formation with drilling mud containing material from the Lakes Entrance Formation. Although drilling mud contamination is evident in both the palynomorph (this report) and calcareous microfossil (Rexilius, 1985) assemblages, this possibility is discounted. This is because the basal sample of the P. tuberculatus Zone (2495.1m) contains a distinctive dinoflagellate assemblage that is replaced one metre up section by an assemblage more typical of the zone (see Biostratigraphic Section). If the presence of P. tuberculatus Zone assemblages in the greensand was entirely due to mud contamination, the composition of the palynoflora over this interval would be expected to remain fairly constant.

The foraminiferal and nannoplankton assemblages recorded by Rexilius (1985) in the two samples studied from the glauconitic sandstone unit (2493.9, 2495.1m) are suspected to be entirely due to downhole contamination through drilling mud of the Lakes Entrance Foramtion. The basal sample of Lakes Entrance Formation (2491.6m) studied by Rexilius (1985) consisted of recrystallized limestone that lacked age-diagnostic foraminiferal taxa.

BIOSTRATIGRAPHY

The spore-pollen zones have been identified following Stover & Partridge (1973). The dinoflagellate zones are modifications on the scheme of Partridge (1976). Discussions of the dinoflagellate assemblages and their zonal assignments are given with the descriptions of their associated spore-pollen zones.

Upper Lygistepollenites balmei Zone 2571-2617.6m

The five sidewall core samples placed in this interval are characterized by the consistent occurrence of L. balmei. Other taxa characteristic of the zone are Proteacidites adenanthoides, Polycolpites langstonii, Gambierina rudata, and Australopollis obscurus.

The dinoflagellate assemblage from this interval is placed in the Apectodinium homomorphum Zone due to the occurrence of A. homomorphum, Deflandrea medcalfii/dartmooria and Senegalinium dilwynense.

The spore-pollen assemblages are placed in the Upper L. balmei Zone because of the occurrences three taxa which first appear in this zone: Proteacidites annularis at 2610.59m, and Malvacipollis subtilis and Banksiaeidites cf. elongatus at 2617.55m. Taxa that characterize the Lower L. balmei Zone are absent, e.g. Tetracolporites verrucosus, Juxtacolpus peiratus and Proteacidites gemmatus. Furthermore, the A. homomorphum dinoflagellate Zone is mainly a stratigraphic equivalent of the Upper L. balmei Zone, and only extends into the uppermost portion of the Lower L. balmei Zone.

The three sidewall core samples (2549.1, 2537.1, 2535.1m) studied from directly above the top of the L. balmei Zone contain extremely low yield spore-pollen and dinoflagellate assemblages that lack taxa which can be used for zonal designation.

Lower Malvacipollis diversus Zone 2533.2-2497.0m

Samples assigned to this zone lack Lygistepollenites balmei, and are characterized by the presence of Malvacipollis duratus, M. diversus, Proteacidites grandis, and P. latrobensis, with infrequent to rare occurrences of Dryptopollenites semilunatus, Triporopollenites helosus and Ischyosporites gremius.

These samples contain dinoflagellate assemblages of low diversity, which include Apectodinium homomorphum, Deflandrea medcalfii/dartmooria, Glaphyrocysta retiintexta, numerous unnamed species of Spinidinium and unindentifiable, thin-walled peridiniacean taxa. The most stratigraphically significant element of this assemblage is Deflandrea medcalfii/dartmooria, which does not range above the top of the Middle M. diversus Zone.

It is suggested that only the upper part of the Lower M. diversus Zone is represented by the above samples. This is based on the apparent absence of dinoflagellates typical of the Apectodinium hyperacanthum Zone, which correlates with the lower part of the Lower M. diversus Zone

Middle Nothofagidites asperus Zone 2496.0m

The sidewall core sample assigned to this zone contains the diagnostic taxa Nothofagidites asperus, N. falcatus and Kuylisporites waterbolkii.

The sample contains a low diversity dinoflagellate assemblage which is correlated with the Corrudinium incompositum Zone. This is based on the rare presence of the zonal species.

Proteacidites tuberculatus Zone 2495.1-2440.0m

The eight sidewall core samples studied from the interval contain the diagnostic taxa Cyatheacidites annulatus, Cyathidites subtilus, Foveotriletes lacunosus, F. crater and Cingulatisporites (Foraminisporis) ozotus, which have their first occurrences within the zone.

The occurrences of the dinoflagellate species Nematosphaeropsis balcombiana, N. rhizoma ms, Dinospheara mammilatus ms, Protoellipsodinium simplex ms, Pyxidinopsis pontus ms, and frequent specimens of Spiniferites spp. and Operculodinium centrocarpum confirm the presence of the P. tuberculatus Zone.

The sample from 2495.1m contains a sparse microplankton assemblage of which the most age-diagnostic elements are Acritarch LEOS types 1 and 2. These taxa are restricted to the basal part of the P. tuberculatus Zone and are mostly associated with greensand facies.

Taxonomic Changes and New Taxa Identified

1. The dinoflagellate taxa Deflandrea medcalfii Stover 1973 and D. dartmooria Cookson & Eisenack 1965 are considered to be variants of a single species in this report, and are recorded as D. medcalfii/dartmooria in the Biostratigraphic Section (note: on the Data Sheets and Tables 1 and 3, they are recorded as D. medcalfii only).

2. An informally named, new species of Deflandrea is proposed. This is recorded as Deflandrea sp. 2530 N.M.

3. Two informally named, new species of acritarch are recorded as Acritarch LEOS types 1 and 2. LEOS is an abbreviation of Lakes Entrance oil shaft, from which these taxa have been recorded by A.D. Partridge (pers. comm.).

Specimens resembling Acritarch LEOS type 1 have been recorded as Forma P by Goodman & Ford (1983; p. 866, Pl. 5, figs 5-13) from the Upper Eocene-Lower Oligocene of DSDP Sites 511 and 513, southwest Atlantic Ocean.

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STOVER, L.E. & PARTRIDGE, A.D., 1973. Tertiary and Late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. Proc. Royal Soc. Victoria, 85, 237-286.

P A L Y N O L O G Y   D A T A   S H E E T

B A S I N: Gippsland   ELEVATION: KB: +21m   GL: -77m

WELL NAME: East Kingfish-1   TOTAL DEPTH: 2638m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	LOWEST DATA Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
	P. tuberculatus	2440.01	0				2495.08	1			
PALEOGENE	Upper *N. asperus*										
	Mid *N. asperus*	2496.02	0				2496.02	0			
	Lower *N. asperus*										
	P. asperopolus										
	Upper *M. diversus*										
	Mid *M. diversus*										
	Lower *M. diversus*	2497.01	0				2533.17	1			
	Upper *L. balmei*	2571.82	1				2617.55	2			
	Lower *L. balmei*										
LATE CRETACEOUS	*T. longus*										
	T. lilliei										
	N. senectus										
	U. *T. pachyexinus*										
	L. *T. pachyexinus*										
	C. triplex										
	A. distocarinatus										
EARLY CRET.	*C. paradoxus*										
	C. striatus										
	F. asymmetricus										
	F. wonthaggiensis										
	C. australiensis										
PRE-CRETACEOUS											

COMMENTS: 3 samples examined between 2549.09-2535.06m contained sparse palynomorph assemblages of indeterminate age.
Corrudinium incompositum Zone (2496.02m); Apectodinium homomorphum Zone (2617.55-2571.82m).

CONFIDENCE RATING:
- O: 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 and pollen or microplankton.
- 2: SWC or Core, Poor Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.
- 3: Cuttings, Fair Confidence, assemblage with zone species of either spores and pollen or microplankton, or both.
- 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 a better 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: Neil G. Marshall   DATE: 28/3/1985

DATA REVISED BY: ____________   DATE: ____________

TABLE I: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	CONFIDENCE RATING	COMMENTS
SWC 30	2440.01	P. tuberculatus	-	Oligocene-Eocene	0	C. annulatus, F. lucunosus, N. rhizoma, P. simplex
SWC 29	2445.09	Indet.	-	-		
SWC 28	2450.05	P. tuberculatus	-	Oligocene-Eocene	0	C. annulatus, N. rhizoma, N. balcombiana
SWC 25	2475.03	P. tuberculatus	-	Oligocene-Eocene	0	C. annulatus, F. crater, N. rhizoma, N. balcombiana
SWC 24	2480.08	P. tuberculatus	-	Oligocene-Eocene	0	C. annulatus, C. ozotus, N. rhizoma, D. mammilatus, N. balcombiana
SWC 19	2491.06	P. tuberculatus	-	Oligocene-Eocene	1	N. rhizoma, P. simplex, C. subtilis
SWC 16	2493.91	P. tuberculatus	-	Oligocene-Eocene	1	C. annulatus, N. rhizoma, P. simplex, D. mammilatus
SWC 15	2495.08	P. tuberculatus	-	Oligocene-Eocene	1	C. annulatus, N. rhizoma, Acritarch LEOS
SWC 14	2496.02	Middle N. asperus	C. incompositum	Middle-Late Eocene	0	N. asperus, N. falcatus, K. waterbolkii, C. incompositum
SWC 13	2497.01	Lower M. diversus	Indet.	Early Eocene	0	D. semilunatus, P. grandis, D. dartmooria
SWC 12	2516.11	Indet.	Indet.	-	-	
Core 2	2502.87	Lower M. diversus	Indet.	Early Eocene	1	M. diversus, P. grandis, D. dartmooria
Core 2	2503	Lower M. diversus	Indet.	Early Eocene	2	P. grandis, I. gremius, D. dartmooria
Core 2	2506.87	Lower M. diversus	Indet.	Early Eocene	1	P. grandis, D. dartmooria

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	CONFIDENCE RATING	COMMENTS
Core 2	2507	Indet.	Indet.	-	-	P. grandis, D. dartmooria
Core 2	2508.87	Lower M. diversus	Indet.	Early Eocene	I	B. elongatus, P. grandis, T. helosus, D. dartmooria
Core 4	2528.4	Indet.	Indet.	-	-	P. grandis
Core 4	2529	Lower M. diversus	Indet.	Early Eocene	2	P. grandis, T. helosus, G. retiintexta
Core 4	2530.4	Lower M. diversus	Indet.	Early Eocene	2	P. grandis, D. dartmooria
SWC 10	2531.17	Lower M. diversus	Indet.	Early Eocene	I	M. diversus, D. dartmooria
SWC 9	2533.17	Lower M. diversus	Indet.	Early Eocene	I	D. semilunatus, P. grandis, P. latrobensis, M. duratus, A. homomorphum, D. dartmooria
SWC 8	2535.06	Indet.	Indet.	-	-	D dartmooria
SWC 7	2537.07	Indet.	Indet.	-	-	L. balmei, P. grandis
SWC 6	2549.09	Indet.	Indet.	-	-	L. balmei, A. homomorphum, D. dartmooria
SWC 5	2571.82	Upper L. balmei	A. homomorphum	Paleocene	I	L. balmei, P. annularis, M. subtilis, A. homomorphum, D. dartmooria, S. dilwynense

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TABLE I: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	CONFIDENCE RATING	COMMENTS
SWC 4	2576.36	Upper L. balmei	A. homomorphum	Paleocene	2	L. balmei, P. langstonii, A. homomorphum, D. dartmooria, S. dilwynense
SWC 3	2590.54	Upper L. balmei	A. homomorphum	Paleocene	2	L. balmei, A. homomorphum
SWC 2	2610.59	Upper L. balmei	A. homomorphum	Paleocene	1	L. balmei, P. langstonii, P. annularis, A. homomorphum, S. dilwynense
SWC 1	2617.55	Upper L. balmei	A. homomorphum	Paleocene	2	L. balmei, G. rudata, A. obscurus, B. cf. elongatus, M. subtilis, A. homomorphum, S. dilwynense

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TABLE 2

ANOMALOUS AND UNUSUAL OCCURRENCES OF SPORE-POLLEN TAXA IN KINGFISH-1

SAMPLE NO.	DEPTH (m)	ZONE	TAXON	COMMENTS
SWC 1	2617.5	Upper L. balmei	P. tuberculotumulatus	1 specimen; not known below Middle M. diversus Zone
SWC 1	2617.5	Upper L. balmei	P. demarcatus	not known below M. diversus Zone
SWC 3	2590.54	Upper L. balmei	P. pseudomoides	not known below M. diversus Zone
SWC 6	2549.09	Indet.	C. orthoteichus	1 specimen in sample between Upper L. balmei-Lower M. diversus Zones; not known below M. diversus Zone
SWC 9	2533.17	Lower M. diversus	M. duratus	not known below Upper M. diversus Zone
Core 4	2529	Lower M. diversus	Gothanipollis sp.	1 specimen; not known below N. asperus Zone
Core 9	2533.17	Lower M. diversus	Gothanipollis sp.	1 specimen; not known below N. asperus Zone
Core 2	2502.87	Lower M. diversus	Gothanipollis sp.	1 specimen; not known below N. asperus Zone
SWC 24	2480.08	P. tuberculatus	Cingulatisporites ozotus	very rare ms sp. (A.D.P)

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TABLE 3: SUMMARY OF BASIC PALYNOLOGICAL DATA

DIVERSITY -	low	medium	high
S & P	10	10-50	50
D	1-3	3-10	10

SAMPLE NO.	DEPTH (m)	YIELD SPORE-POLLEN	YIELD DINOS	DIVERSITY SPORE-POLLEN	DIVERSITY DINOS	PRESERVATION	LITHOLOGY	COMMENTS
SWC 30	2440.01	low	high	med.	med.	good	calc. slst./clst.	
SWC 29	2445.09	very low	very low	low	low	good	calc. slst./clst.	
SWC 28	2450.05	medium	medium	medium	medium	good	calc. slst./clst.	
SWC 25	2475.03	medium	medium	medium	medium	good	calc. slst./clst.	
SWC 24	2480.08	low	low	medium	medium	good	calc. slst./clst.	
SWC 19	2491.06	low	medium	medium	medium	good	calc. slst./clst.	
SWC 16	2493.91	low	medium	medium	medium	good	glauc. s.st.	rare drilling mud contaminants
SWC 15	2495.08	low	low	low	low	good	glauc. s.st.	
SWC 14	2496.02	medium	low	medium	low	good	glauc. s.st.	
SWC 13	2497.01	medium	low	medium	low	good	s.st.	
SWC 12	2516.11	barren	-	-	-	-	s.st.	
Core 2	2502.87	medium	low	medium	low	good	s.st.	
Core 2	2503	low	low	medium	low	good	s.st.	
Core 2	2506.87	low	low	medium	low	good	s.st.	

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TABLE 3: SUMMARY OF BASIC PALYNOLOGICAL DATA

DIVERSITY -	low	medium	high
S & P	10	10-50	50
D	1-3	3-10	10

SAMPLE NO.	DEPTH (m)	YIELD SPORE-POLLEN	YIELD DINOS	DIVERSITY SPORE-POLLEN	DIVERSITY DINOS	PRESERVATION	LITHOLOGY	COMMENTS
Core 2	2507	medium	low	medium	low	good	s.st.	
Core 2	2508.87	medium	low	medium	low	good	s.st.	
Core 4	2528.4	medium	low	low	low	poor-good	s.st.	
Core 4	2529	medium	low	medium	low	good	s.st.	
Core 4	2530.4	medium	low	medium	low	good	s.st.	rare drilling mud contaminants
SWC 10	2531.17	high	low	medium	low	good	s.st.	
SWC 9	2533.17	high	medium	medium	low	good	s.st.	rare drilling mud contaminants
SWC 8	2535.06	low	low	low	low	good	s.st.	
SWC 7	2537.07	very low	none	low	-	good	s.st.	
SWC 6	2549.09	low	low	low	low	good	s.st.	
SWC 5	2571.82	low	low	medium	low	good	s.st	
SWC 4	2576.36	medium	low	medium	low	good	s.st.	rare drilling mud contaminants
SWC 3	2590.54	low	very low	low	low	good	s.st.	
SWC 2	2610.59	high	low	medium	low	good	s.st.	rare drilling mud contaminants
SWC 1	2617.55	medium	low	medium	low	good	s.st.	