APPENDIX

PALYNOLOGICAL ANALYSIS, PILOTFISH-1A

GIPPSLAND BASIN

by

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INTERPRETATIVE DATA

INTRODUCTION

Forty five (45) sidewall cores were processed and examined for spore-pollen and dinoflagellates. Recovery was usually good and preservation adequate to enable confident age-determinations for most samples (see Table 1). A feature of this well is the unusually good sample control for the *T. longus* Zone section.

Palynological zones and lithological facies divisions from the base of the Lakes Entrance Formation to the total depth of the well are given below. The occurrences of the more stratigraphically important species are tabulated in the accompanying range chart.

SUMMARY

UNIT FACIES	ZONE	DEPTH (m)
Lakes Entrance Formation	*P. tuberculatus*	2914.9
——— major unconformity ———		
Un-named unit	Lower *L. balmei* assemblage (reworked during Late Eocene to Early Oligocene)	2915.0-2925.0
——— unconformity ———		
Gurnard Equivalent	Lower *L. balmei* (*T. evittii* Zone)	2927.0-2935.0
	Lower *L. balmei*	2937.0-2949.0
Latrobe Group Coarse Clastics	Upper *T. longus* (*I. druggii* Zone)	2961.1-2963.0
	Upper *T. longus*	3014.5-3400.1
	Lower *T. longus*	3424.5
	T. lilliei	3455.5-3496.0
		3505 TD

GEOLOGICAL COMMENTS

1. The Pilotfish-1A well contains an apparently continuous sequence of sediments from the Late Cretaceous T. lilliei Zone to the Paleocene Lower L. balmei (T. evittii) Zone. Lower L. balmei Zone sediments of E. crassitabulata and W. homomorpha Zone ages and Upper L. balmei Zone sediments recorded in Hapuku-1 (Partridge 1975) were not recognised and are almost certainly absent.

2. The base of the Lakes Entrance Formation, picked on lithological and log characteristics as occurring at 2915.0m corresponds to the first occurrence of a P. tuberculatus Zone flora. Foraminiferal data demonstrate the horizon is Early Miocene in age (Hannah 1983). The sample at 2917.0m contains Late Eocene-Early Oligocene (Zone J2/K) forams, indicating a major unconformity or very condensed sequence occupies most of the Oligocene as in Hapuku-1.

3. Gamma-ray and resistivity logs for the glauconite-containing interval between 2915.0m and 2949.0m indicate three sedimentary units are present. The uppermost of these, 2915.0 to 2925.0m, contains only trace amounts of glauconite and is identified as possible Turrum Formation. Samples in this interval contain good dinoflagellate assemblages diagnostic of the Lower L. balmei Zone T. evittii marine transgression (this report) and Late Eocene-Early Oligocene forams (Hannah, ibid). Hence the glauconite and palynomorphs have been derived by redeposition, probably through erosion and bioturbation of the underlying massive greensands. The same formation may be represented by a unit of fine grained sandstone and siltstones containing good Upper N. asperus Zone palynofloras in Hapuku-1. This is equivalent in age to the J2/K forams detailed by Hannah (1983) in Pilotfish-1A from 2915.0 to 2925.0m.

4. The middle and lower units, 2927.0 to 2935.0m and 2937.0 to 2949.0m are characterised by large amounts of non-pelletal glauconite but lack forams. Accordingly these greensands are not Gurnard Formation (sensu stricto) and are termed here Gurnard Equivalent. The middle unit contains abundant Palaeoperidinium pyrophorum and is therfore the chronostratigraphic equivalent of the T. evittii Zone marine transgression. The lower unit lacks this dinoflagellate species and accordingly represents a marine sequence chronologically positioned between the T. evittii and I. druggii marine transgressions (see Partridge 1975, 1976).

Glauconitic sediments in Hapuku-1 extends from the Lower L. balmei Zone to the Upper N. asperus Zone. This strengthens the case for considering that erosion of the greensand facies in Pilofish-1A has occurred, removing sediments of Lower L. balmei (E. crassitabulata) to Upper L. balmei Zone ages.

5. The Maastrichtian I. druggii marine transgression is recorded in the uppermost two samples of the T. longus Zone (2961.1 and 2963.0m). This section is separated from the overlying Lower L. balmei Zone greensands by a stratum of barren sandstones, part of which is carbonaceous. It is unclear whether these sediments were deposited in a marine or deltaic environment. No biological indicators of marine deposition are recorded below 2963.0m but the first coal is considerably deeper, at 3028m.

6. The Pilotfish-1A well bottomed in T. lilliei Zone sediments.

BIOSTRATIGRAPHY

The zone boundaries for Tertiary sediments have been established using the criteria of Stover & Evans (1973), Stover & Partridge (1973) and Partridge (1976). The Cretaceous sediments have been zoned according to the criteria proposed in Macphail (1983).

Tricolporites lilliei Zone: 3495.0 to 3455.5m.
As is usually the case with the deeper samples within the Late Cretaceous sediments, samples from this zone contained poorly preserved palynofloras dominated by gymnosperm and Proteacidites pollen. The two samples assigned to this zone contain species which first appear in the T. lilliei Zone, eg. Tricolpites waiparensis, Triporopollenites sectilis and Proteacidites reticuloconcavus (see Partridge 1975) and lack species indicative of the T. longus Zone. The occurrence of Periporopollenites polyoratus at 3496.0m supports the conclusion (Table 1 in Stover & Evans 1973) that, unlike in Bass Basin wells, the species ranges lower than the T. longus Zone in the Gippsland Basin. Tricolporites lilliei is first recorded at 3455.5m.

Lower T. longus Zone: 3424.5m.
One sample is assigned to this zone, based on the occurrence of the nominate species in an assemblage lacking indicator species of the Upper T. longus Zone.

Upper T. longus Zone: 3400.1 to 2961.1m.

The base of the zone is defined by the first appearance of Stereisporites (Tripunctisporis) punctatus at 3400.1m. This sample contains abundant Gambierina as well as the first occurrence of Proteacidites otwayensis. Proteacidites gemmatus is first recorded at 3383.5m and Proteaciditites palisadus and Concolpites leptos at 3363.5m. Tetracolporites verrucosus occurs (with Proteacidites wahooensis) at 3263.1m and frequently thereafter within the section. Of interest is the occurrence, apparently in situ, of Beaupreadites elegansiformis/verrucosus at 3294m. This species complex is usually a reliable indicator of Middle M. diversus or younger sediments but may well be one of a small number of taxa with as yet unexplained disjunct age ranges. The sidewall core samples at 3039.0 and 3014.5m contained particularly rich palynofloras, including Grapnelispora evansii and Quadraplanus brossus as well as the typical T. longus indicator species. The latter (3014.5m) contained an undescribed Tricolporites species ca. 80 µ in diameter. This species has been previously recorded in T. longus Zone sediments in Wahoo-1 and may prove to be stratigraphically useful.

The uppermost two samples, at 2963.0m and 2961.1m contained well preserved dinoflagellates in addition to diverse spore-pollen assemblages including Tricolpites longus. The occurrence of Isabelidinium cf. druggii and Deflandrea coronata strongly suggest the section is the chrono stratigraphically equivalent of those recording the I. druggii marine transgression (Partridge 1976) in wells closer to shore.

The upper boundary is placed at the highest occurrence of Tricolpites longus in a rich spore-pollen assemblage including distinctive and large named and unnamed Proteacidites spp. (2961.1m). This is overlain by 10m of barren sandstones.

Lower Lygistepollenites balmei Zone: 2949.0 to 2919.0m.

The section is characterised by species-poor spore-pollen assemblages and diverse, well-preserved dinoflagellates. Age-determinations are based entirely on the latter since reworked Upper Cretaceous species including Proteacidites otwayensis and P. reticuloconcavus occur throughout the section. Nevertheless it is noted that the poor diversity of the palynofloras, abundance of small indeterminate Proteacidites spp. and sporadic occurrences of Lygistepollenites balmei, Tetracolporites verrucosus, Australopollis obscurus, Basopollis spp., Stereisporites regium, Proteacidites gemmatus and Tricolpites gillii are entirely consistent with a Lower L. balmei Zone age. The sole possible (see p. 5) anomaly noted is the occurrence of Beaupreadites verrucosus at 2925.0m. The presence of Parvisaccites catastus at 2921.0m and Tetracolporites multistrixus at 2941.0m demonstrate these samples are no older than Lower L. balmei Zone in age. The (?) algal species Amosopollis cruciformis is unusually infrequent within the zone. Excellent preservation suggests this sporomorph has been locally derived.

The base of the zone is provisionally placed at 2949.0m on the basis of a sparse Gambierina-Proteacidites assemblage in which a single specimen of Proteacidites reticuloconcavus is the sole Upper Cretaceous indicator species. It is noted that the sample immediately below (2951.0m) is lithologically part of the same glauconite unit and both samples contain the dinoflagellate Hystrichosphaeridium tubiferum, absent in the T. longus Zone interval.

The Lower L. balmei Zone indicator dinoflagellates Deflandrea medcalfii and Palaeoperidinium pyrophorum first occur at 2947.0m and 2935.0m respectively. The latter species occurs consistently from 2935.0 to 2919.0m indicating the section is chronostratigraphically equivalent to the T. evittii Zone. The highest occurrence of P. pyrophorum defines the top of the Lower L. balmei Zone in this well. As noted under Geological Comments, foraminiferal data indicate the interval 2917.0 to 2925.0m has been reworked during the Late Eocene to Early Oligocene.

REFERENCES

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MACPHAIL, M.K. 1983). Revision of the Maastrichtian *T. longus* Zone based on Palynological data from Hapuku-1 and Pilotfish-1A wells. Esso Australia Ltd. Palaeontological Report, 1983/19.

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PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: 21.0m GL: -205.6m

WELL NAME: PILOTFISH-1A TOTAL DEPTH: 3505m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
	P. tuberculatus	2911.1	0				2914.9	0			
PALEOGENE	Upper *N. asperus*										
	Mid *N. asperus*										
	Lower *N. asperus*										
	P. asperopolus										
	Upper *M. diversus*										
	Mid *M. diversus*										
	Lower *M. diversus*										
	Upper *L. balmei*										
	Lower *L. balmei*	2919.0	1				2949.0	2	2935.0	1	
LATE CRETACEOUS	*T. longus*	2961.1	0				3424.5	0			
	T. lilliei	3455.5	2				3496.0	2			
	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: Ages of Late Cretaceous samples have been determined using criteria proposed by Macphail, M.K. (1983) Palynological Analysis, Pilotfish-1A, Gippsland Basin. Esso Australia Ltd. Palaeontology Report 1983/20.

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 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: M.K. Macphail DATE: 8 March, 1983.

DATA REVISED BY: DATE:

TABLE 1.

SUMMARY OF PALYNOLOGICAL ANALYSIS, PILOTFISH-1A, GIPPSLAND BASIN.

INTERPRETATIVE CHART

SAMPLE	DEPTH(m)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
102	960.0	V. Low	Low	Lst., silty	Indeterminate		-	
76	2670.0	Good	Low	Slst.	Indeterminate		-	
52	2907.0	V. Low	Low	Slst.	Indeterminate		-	
50	2911.1	Good	Low	Slst.	P. tuberculatus		0	C. annulatus frequent.
48	2914.9	Good	Low	Slst.	P. tuberculatus		0	C. annulatus frequent, F. lacunosus.
47	2917.0	V. Low	Low	Ss.,Tr.glau.	Indeterminate		-	Reworked G. rudata, P. otwayensis.
46	2919.0	Good	Moderate	Ss.,Tr.glau.	Lower L. balmei	Paleocene	1	Palaeoperidinium pyrophormum, P.otwayensis.
45	2921.0	Fair	Low	Ss., glau	Lower L. balmei	Paleocene	1	P.pyrophormum, P.catastus, L.balmei, Allocysta circumtabulata, A.margarita
44	2923.0	Fair	Moderate	Ss., glau	Lower L. balmei	Paleocene	1	P.pyrophormum
43	2925.0	Good	Moderate	Ss., glau	Lower L. balmei	Paleocene	1	P.pyrophormum, S.regium, B.verrucosus
42	2927.0	Good	Low	Glau.	Lower L. balmei	Paleocene	1	P.pyrophormum
41	2929.0	Low	Low	Glau.	Lower L. balmei	Paleocene	1	P.pyrophormum, G.wahooensis
40	2931.0	Fair	High	Glau.	Lower L. balmei	Paleocene	1	L.balmei, T.verrucosus, C.leptos
39	2933.0	V. Low	Low	Glau.	Indeterminate	-	-	Ceratopsis diebelii
38	2935.0	Good	Moderate	Glau.	Lower L. balmei	Paleocene	1	P. pyrophormum
37	2937.0	Fair	Low	Ss., glau.	Lower L. balmei	Paleocene	2	Deflandrea medcalfi, frequent A. cruciformis P. otwayensis.
36	2939.0	V. Low	Low	Ss., glau.	Indeterminate	-	-	A. cruciformis
35	2941.0	Low	Low	Glau.	Lower L. balmei	Paleocene	2	T. multistrixus, L. balmei

TABLE 1.

SUMMARY OF PALYNOLOGICAL ANALYSIS, PILOTFISH-1A, GIPPSLAND BASIN.

INTERPRETATIVE CHART

SAMPLE	DEPTH(m)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
34	2943.1	V. Low	Low	Glau.	Indeterminate	-	-	
33	2944.9	Fair	Low	Glau.	Lower L. balmei	Paleocene	2	L. balmei. H. cf. harrisii, S. punctatus, D. medcalfii
32	2947.0	Low	Low	Glau.	Lower L. balmei	Paleocene	2	D. medcalfii, frequent H. tubiferum.
31	2949.0	Low	Moderate	Glau.	Lower L. balmei	Paleocene	2	S. regium, P. reticuloconcavus
30	2951.0	V. Low	V. Low	Ss., glau.	Indeterminate	-	-	H. tubiferum
29	2953.0	Nil	-	Ss., carb.	-	-	-	
28	2955.0	Nil	-	Ss.	-	-	-	
27	2957.0	Nil	-	Ss.	-	-	-	
26	2959.1	Nil	-	Ss.	-	-	-	
25	2961.1	Good	V. High	Ss., silty	Upper T. longus (I. druggii)	Maastrichtian	0	T. longus, T. securus, S. punctatus, Deflandrea coronata
24	2963.0	Low	V. High	Ss., silty	Upper T. longus	Maastrichtian	0	T. longus, T. waiparensis, P. palisadus, P. wahooensis, D. coronata, I.cf. druggii.
23	2965.0	Nil	-	Ss.	-	-	-	
22	3002.5	V. Low	V. Low	Slst.	Indeterminate	-	-	
21	3014.5	Good	Moderate	Ss., silty	Upper T. longus	Maastrichtian	0	T. longus, Q. brossus, T. securus.
20	3025.0	V. Low	V. Low	Slst.	Indeterminate	-	-	
19	3039.0	Good	High	Slst.	Upper T. longus	Maastrichtian	0	T. longus, Q. brossus, T. waiparensis, T. lilliei, Grapnelispora evansii.

TABLE I.

SUMMARY OF PALYNOLOGICAL ANALYSIS, PILOTFISH-IA, GIPPSLAND BASIN.

INTERPRETATIVE CHART

SAMPLE	DEPTH(m)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
16	3103.0	V. Low	V. Low	Slst.	Indeterminate	-	-	
15	3124.0	Fair	Moderate	Slst.	Upper T. longus	Maastrichtian	0	P. wahooensis, T. verrucosus
14	3148.5	V. Low	Low	Slst. carb.	Upper T. longus	Maastrichtian	1	T. verrucosus, E. notensis
13	3178.0	Fair	Moderate	Slst.	Upper T. longus	Maastrichtian	1	P. wahooensis, P. reticuloconcavus, P. otwayensis, T. securus, T. verrucosus.
12	3209.5	Low	Low	Slst. glau.	Indeterminate	-	-	Caved dinoflagellates
10	3253.0	Good	Low	Slst.	Upper T. longus	Maastrichtian	1	Abundant G.rudata, T. securus, T. verrucosus.
9	3263.1	Fair	Low	Slst.	Upper T. longus	Maastrichtian	1	Abundant G.rudata, T. verrucosus, P. wahooensis
8	3294.0	V. Low	Low	Slst.	Indeterminate	-	-	P. palyoratus, B. elegansiformis
7	3318.0	V. Low	Low	Slst., carb.	Upper T. longus	Maastrichtian	1	T. longus, T. sectilis
6	3363.5	Low	High	Ss.	Upper T. longus	Maastrichtian	1	P. palisadus, C. leptos, T. waiparensis
5	3383.5	V. Low	V. Low	Slst.	Upper T. longus	Maastrichtian	2	P. gemmatus
4	3400.1	Fair	Moderate	Slst., carb.	Upper T. longus	Maastrichtian	0	S. punctatus, abundant G. rudata, P. reticuloconcavus, P.otwayensis, T. sectilis.
3	3424.5	Good	Moderate	Slst., carb.	Lower T. longus	Maastrichtian	0	T. longus, abundant G. rudata, T. waiparensis
2	3455.5	V. Low	Moderate	Slst., carb.	T. lilliei	Maastrichtian	2	T. waiparensis, P. cliniei, T. lilliei
1	3496.0	Low	Low	Ss.	T. lilliei	Maastrichtian	2	T. waiparensis, P. polyoratus.

BASIC DATA

TABLE 2 : Palynological data.

RANGE CHART : Dinoflagellates.

RANGE CHART : Spore-Pollen.

TABLE 2.

BASIC DATA, PILOTFISH-1A, GIPPSLAND BASIN.

SAMPLE	DEPTH(m)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY
102	960.0	V. Low	Low	Lst. silty
76	2670.0	Good	Low	Slst.
52	2907.0	V. Low	Low	Slst.
50	2911.1	Good	Low	Slst.
48	2914.9	Good	Low	Slst.
47	2917.0	V. Low	Low	Ss.,Tr.glau
46	2919.0	Good	Moderate	Ss., tr.glau
45	2921.0	Fair	Low	Ss., glau
44	2923.0	Fair	Moderate	Ss., glau
43	2925.0	Good	Moderate	Ss., glau
42	2927.0	Good	Low	Glau.
41	2929.0	Low	Low	Glau.
40	2931.0	Fair	High	Glau.
39	2933.0	V. Low	Low	Glau.
38	2935.0	Good	Moderate	Glau.
37	2937.0	Fair	Low	Ss., glau.
36	2939.0	V. Low	Low	Ss., glau.
35	2941.0	Low	Low	Glau.
34	2943.1	V. Low	Low	Glau.
33	2944.9	Fair	Low	Glau.
32	2947.0	Low	Low	Glau.
31	2949.0	Low	Moderate	Glau
30	2951.0	V. Low	V. Low	Ss., glau
29	2953.0	Nil	-	Ss., carb.
28	2955.0	Nil	-	Ss.
27	2957.0	Nil	-	Ss.
26	2959.1	Nil	-	Ss.
25	2961.1	Good	V. High	Ss., silty
24	2963.0	Low	V. High	Ss., silty
23	2965.0	Nil	-	Ss.
22	3002.5	V. Low	V. Low	Slst.
21	3014.5	Good	Moderate	Ss., silty
20	3025.0	V. Low	V. Low	Slst.
19	3039.0	Good	High	Slst.
16	3103.0	V. Low	V. Low	Slst.
15	3124.0	Fair	Moderate	Slst.
14	3148.5	V. Low	Low	Slst.
13	3178.0	Fair	Moderate	Slst.
12	3209.5	Low	Low	Slst.
10	3253.0	Good	Low	Slst.
9	3263.1	Fair	Low	Slst.
8	3294.0	V. Low	Low	Slst.
7	3318.0	V. Low	Low	Slst.
6	3363.5	Low	High	Ss.
5	3383.5	V. Low	V. Low	Slst.
4	3400.1	Fair	Moderate	Slst.
3	3424.5	Good	Moderate	Slst.
2	3455.5	V. Low	Moderate	Slst.
1	3496.0	Low	Low	Ss.