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APPENDIX-2

PALYNOLOGICAL ANALYSIS, KAHAWAI-1,

GIPPSLAND BASIN

by

M.K. Macphail

Esso Australia Ltd.

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INTRODUCTION

Fifty eight (58) sidewall core and two cuttings samples were processed and examined for spore-pollen and dinoflagellates. The recovery of spore-pollen was usually poor to fair, with good yields separated by intervals with low diversity or barren. Preservation was usually poor but most samples contained marker species, enabling confident age-determinations. A feature of this well was the large number of samples containing caved or re-worked spore-pollen and dinoflagellates of post-Eocene or Paleocene/Late Cretaceous age. One sample, at 1508.0 metres, has been mislabelled.

Palynological zones and lithological facies divisions from the base of the Lakes Entrance Formation to the total depth of the well are given below. Table 1 represents a summary of the palynological analyses. The occurrence of the more stratigraphically important species is tabulated in the accompanying range chart.

SUMMARY

UNIT/FACIES	ZONE	DEPTH (Metres)
LAKES ENTRANCE FORMATION	<u>P. tuberculatus</u>	1389.0
"GURNARD FORMATION"	Middle <u>N. asperus</u>	1391.2 - 1393.0
	Lower <u>N. asperus</u>	1394.0 - 1396.1
LATROBE GROUP COARSE CLASTICS	<u>P. asperopolus</u>	1411.0 - 1426.2
	Upper <u>M. diversus</u>	1472.1
	Middle <u>M. diversus</u>	1495.2 - 1528.5
	Lower <u>M. diversus</u>	1572.2
	Upper <u>L. balmei</u>	1577.6 - 1687.8
	Lower <u>L. balmei</u>	1738.2 - 1932.7
	<u>T. longus</u>	1960.3 - 2307.5

GEOLOGICAL COMMENTS:

1. The Kahawai-1 well contains a continuous sequence of zones from the Late Cretaceous T. longus Zone to the Early Eocene P. asperopolus Zone. Despite the close sidewall core sampling, it has not been possible to demonstrate unequivocally the presence of Lower N. asperus Zone sediments. Upper N. asperus Zone sediments are absent, reflecting a period of erosion or non-deposition during the Late Eocene/Early Oligocene.
2. Samples at and above the log break at 1390.0m, picked as the base of the Lakes Entrance Formation (Hannah 1982), are P. tuberculatus Zone in age. The interval between 1390 and 1400m picked as the Gurnard Formation (Hannah ibid) is Middle- or Middle to Lower N. asperus Zone in age. This contrasts with a Lower N. asperus age for the Formation in the Tuna Field wells.
3. Most of the samples in the Gurnard Formation contained rare P. tuberculatus Zone and Paleocene to Late Cretaceous spore-pollen. Whilst the latter are almost certainly contaminants, the P. tuberculatus Zone species may be due to either contamination or reworking of the Gurnard Formation during the Oligocene. The latter is considered to be the less likely hypothesis for reasons given in the discussion of the palynological zones.
4. The Tuna-Flounder channel sediments are P. asperopolus Zone in age. Not all contained dinoflagellates, i.e. evidence of deposition in a marine environment, e.g. 1426.6m. This sample contained distinctive swollen pollen - considered to be indicative of having been at one time within the oil column, a feature consistent with the log character at this depth.

5. The sidewall core at 1472.1 metres, immediately below the log break at 1468 metres picked as the base of the channel, is brackish water/non-marine and contains an Upper M. diversus Zone spore-pollen assemblage. This sequence of P. asperopolus Zone channel sediments overlying Upper M. diversus Zone sediments differs from those in the Tuna Field where channel sediments of P. asperopolus Zone age overlie Lower M. diversus Zone sediments (Tuna-3) or Upper L. balmei Zone sediments (Tuna-1, Tuna A5). The presence of sediments of Upper M. diversus Zone age between 4820-5098 feet (1469.1-1553.9 metres) above the channel base in the Tuna-2 well is anomalous. This age-determination was made on one poor quality sample (5098 feet) and, based on an assemblage count (see attached Revision sheet for Tuna-2), the sample is reinterpreted as P. asperopolus Zone in age.
6. The occurrence of Upper and Middle M. diversus Zone sediments at Kahawai-1 is consistent with a location at the western edge of the channel in westward dipping sediments, as recorded by seismic stratigraphy. The data indicate channelling in this area occurred during or at end of Upper M. diversus Zone times although earlier episode(s) of channelling in the deeper (eastward) section of the basin remains a possibility. Mean sedimentation rates at Kahawai-1 changed from 22 metres per million years during the M. diversus Zone to 45 metres per million years during infilling of the Tuna-Flounder Channel in P. asperopolus Zone time.
7. Most of the samples within the M. diversus Zone contained frequent dinoflagellates. Since only three species were recorded, these are interpreted to represent transient brackish water conditions.

The sidewall core samples at 1572.2m and 1577.6m contained dinoflagellate assemblages diagnostic of the Apectodinium (Wetzeliella) hyperacantha marine transgression, described by Partridge (1976). The dinoflagellate and Lower M.diversus spore-pollen assemblage in the higher sample is virtually identical to that recovered from the Rivernook Bed of the onshore Princetown Section, Otway Basin. The lower sample contained a diverse Upper L.balmei Zone spore-pollen assemblage. Consequently the carbonaceous siltstone strata between ca 1578-1572 metres is likely to represent the Paleocene/Eocene boundary.

8. Four sidewall cores in the approximately 214 metre thick Lower L.balmei Zone section - between 1791.3 to 1820.0m and at 1932.7m - contained frequent to abundant dinoflagellates. None contained the marker dinoflagellate species for the Eisenackia crassitabulata or the Trithyrodinium evittii marine transgressions recognised by Partridge (ibid).
9. The well bottomed in T. longus Zone sediments as predicted by seismic stratigraphy.

DISCUSSION OF ZONES

Zone boundaries have been established using the criteria of Stover & Evans (1973), Stover & Partridge (1973), Partridge (1976) and subsequent unpublished revisions.

Tricolpites longus Zone: 2307.5 to 1960.3 metres

Samples from this section are dominated by Gambierina rudata and gymnosperm pollen but the majority contained species which first appear in this zone: Tetracolporites verrucosus, Tricolpites waiparensis, Tetradopollis securis, Proteacidites otwayensis and

P. reticuloconcavus. The age of the basal sample is equivocal since it contains abundant Nothofagidites pollen, a characteristic of the T. lilliei Zone. It has been included in the T. longus Zone on the basis of Tetracolporites verrucosus and Tricolpites waiparensis. The first occurrence of the Zone species Tricolpites longus is at 2294.2 metres. The top of the zone is placed at 1960.3 metres, based on the last appearance of abundant Gambierina rudata associated with Proteacidites otwayensis and P. reticuloconcavus.

Lower Lygistepollenites balmei Zone: 1932.7 to 1738.2 metres
The section is characterized by general L. balmei Zone markers such as abundant Lygistepollenites balmei and Polycolpites langstonii in association with Tetracolporites verrucosus, a species which ranges no higher than the Lower L. balmei Zone. Samples at 1791.3, 1820.0 and 1932.7 metres represent marine incursions and contain Deflandrea speciosus, a dinoflagellate restricted to this zone.

Upper Lygistepollenites balmei Zone: 1687.8 to 1577.6 metres
The base of the zone is defined by the first appearance of Verrucosisporites kopukuensis associated with abundant Lygistepollenites balmei. This sample (1687.8 metres) contains Eocene to Miocene spore-pollen as contaminants but the occurrence of a number of specimens of Phyllocladidites verrucosus shows the sample can be no younger than Upper L. balmei Zone in age. As with the Lower L. balmei Zone, the interval is characterized by barren samples and spore-pollen assemblages of low diversity. Cyathidites gigantis, which first appears in this zone occurs in the top three samples. The zone boundary (1577.6 metres) is placed at the last occurrence of abundant Lygistepollenites balmei associated with Cyathidites gigantis and Polycolpites langstonii.

This sample contains rare specimens of Malvacipollis diversus and Apectodinium hyperacantha, marker species for the M. diversus Zone, but not Spinizonocolpites prominatus which reaches its greatest abundance in those Lower M. diversus Zone assemblages which also record the A. hyperacantha Zone Marine transgression. This indicates sidewall core 49 lies close to or at the Upper L. balmei/Lower M. diversus Zone boundary.

Lower Malvacipollis diversus Zone: 1572.2 metres

This zone is represented by one sample, occurring below an interval with carbonaceous but barren sandstones. The zone is defined by the simultaneous first occurrence of abundant Malvacipollis diversus and Apectodinium hyperacantha with Proteacidites pachypolus, Spinizonocolpites prominatus, Crassiretitriletes vanraadshoovenii and Polypodiaceosporites varus and the dinoflagellate Cordosphaeridium bipolare.

Middle Malvacipollis diversus Zone 1495.2 to 1528.5 metres

The base of the zone is placed at the first occurrence of Proteacidites ornatus. This sample lacks Malvacipollis diversus and also contains Cyathidites gigantis, typically a good marker species for the Lower M. diversus Zone. The cuttings sample from 1505-1510m contains frequent Malvacipollis diversus and Polycopites esobalteus which first appears in the Middle M. diversus Zone. The age-determination for the interval is confirmed by the simultaneous first appearances of Proteacidites biornatus, P. delicatus, P. kopiensis, P. latrobensis, P. leightonii, P. plummelus and P. tuberculiformis in association with P. ornatus at 1498.7 metres. The majority of these species occur in the sample picked as the top of the zone (1495.2 metres) along with Banksieacidites elongatus and Polycopites esobalteus, as well as Integricorpus antipodus which ranges no higher than the Middle M. diversus Zone.

Upper Malvacipollis diversus Zone: 1472.1 metres

The zone is represented by one sample only. The occurrence of Proteacidites pachypolus with Myrtaceipollenites australis and Bysmapollis emaciatus confirm the age determination. The sample lacks dinoflagellates and is dominated by Nothofagidites spp. and Proteacidites spp. typical of the M. diversus Zone. It is unusual in that species which first appear in the Lower and Middle M. diversus Zone are first recorded here, e.g. Anacolosidites acutullus, Intratripoporopollenites notabilis and Tripoporopollenites ambiguus. As for samples in the Middle M. diversus Zone section, the sample contains reworked L. balmei Zone spore-pollen.

Proteacidites asperopolus Zone: 1411.0 to 1426.6 metres

Samples within this interval are dominated by Proteacidites spp., with common to abundant P. pachypolus and less than 5% Nothofagidites spp. except where caving has occurred (1411.0 metres). The base of the zone is placed at 1422.6 metres, the first appearance of the nominate species Proteacidites asperopolus, P. recavus and Liliacidites bainii. In addition, to P. asperopolus, the sample at 1424.6 metres contains P. rugulatus and Beaupreadites trigonalis, species which first appear in this zone, and Santalumidites cainozoicus and Diporites delicatus, which achieve their maximum abundance in the P. asperopolus Zone. The sample picked as the top of the zone (1411.0 metres) contains L. balmei Zone pollen indicators, relatively common Nothofagidites spp. and caved P. tuberculatus Zone spore-pollen and dinoflagellates. It is assigned to the P. asperopolus Zone on the basis of Myrtaceipollenites australis, Santalumidites cainozoicus, Proteacidites pachypolus (common) and a general absence of marker species for the Lower N. asperus Zone.

Nothofagidites asperus Zone: 1396.1 - 1391.2 metres

The interval corresponding to the Gurnard Formation (Hannah 1982) contained spore-pollen and dinoflagellate assemblages dominated by Nothofagidites spp (including N. falcatus) and Operculodinium centrocarpum respectively. Most samples contained 1-3 specimens of P. tuberculatus Zone spore-pollen, Foveotriletes crater, F. lacunosus, Cyathidites subtilis, as well as a diversity of Paleocene and Late Cretaceous pollen, e.g. Lygistepollenites balmei, Gambierina rudata, Australopollis obscurus, Tetracolporites verrucosus, Triporopollenites sectilis, Tricolporites lilliei, T. pachyexinus, Tricolpites waiparensis and Nothofagidites endurus. The sample at 1389.9 metres immediately below the base of the Lakes Entrance Formation contained a good T. longus Zone assemblage in which Malvacipollis subtilis and Matonosporites ornamentalis are the only identified post-Cretaceous elements. Cuttings from this interval (1385-1390 metres) contained a very sparse spore-pollen and dinoflagellate assemblage, lacking Paleocene and Late Cretaceous species. All occurrences of these taxa in the N. asperus Zone sediments are therefore considered to be contaminants.

The presence of P. tuberculatus Zone spore-pollen may be accounted for in one or more of 3 ways: (1) contamination (2) extension into the Eocene of the range of the Foveotriletes and Cyathidites species and (3) reworking of the interval from 1396.1 to 1389.9 metres during P. tuberculatus Zone times. The first is considered the most likely due to (i) extensive caving of the section immediately overl ng the Gurnard Formation (ii) the absence of the major indicator species for the P. tuberculatus Zone, Cyatheacidites annulatus, and (iii) the presence of an N. asperus Zone assemblage within these sediments similar to that found in the Gurnard Formation in the Tuna wells.

The interval has been tentatively subdivided into Lower N. asperus Zone and Middle N. asperus Zone sections on the basis of species which first appear in the Middle N. asperus Zone. The possibility remains that the entire interval from 1396.1 to 1389.9 metres is either wholly Lower N. asperus or Middle N. asperus Zone in age. The indicator species of the latter zone, Triorites magnificus, is absent.

Lower N. asperus Zone: 1396.1 to 1392.0 metres

The base of the zone is placed at the marked increase in Nothofagidites spp. abundance from less than 5% at 1424.6 metres to greater than 30% at 1396.1 metres. This sample contained Tricolpites simatus, a general marker species for the Middle N. asperus Zone but which first appears in the Lower N. asperus Zone. Samples at 1395.0 and 1394.0 metres contain Nothofagidites falcatus and Proteacidites scitus which ranges no higher than the Middle N. asperus Zone.

Middle N. asperus Zone 1391.2 to 1393.0 metres

The base of the zone is picked at 1393.0 metres on the occurrence of Cranwellia striatus, a rare species which is apparently restricted to the Middle N. asperus Zone, and the simultaneous presence of Proteacidites species typical of or ranging no higher than this zone: Proteacidites scitus, P. rugulatus and P. pachypolus. Aglaoreidia qualumis and Stereisporites (Tripunctisporis) punctatus are present at 1392.0 metres.

P. tuberculatus Zone: 1389.0 to 1369.0 metres

The regular occurrence of Cyatheacidites annulatus in these samples confirms a P. tuberculatus Zone age for these sediments.

TABLE 1

P.1.

SUMMARY OF PALYNOLOGICAL ANALYSIS, KAHAWAI-1, GIPPSLAND BASIN

INTERPRETATIVE DATA

SAMPLE NO.	DEPTH (Metres)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
79	1369.0	Good	Moderate	Mdst., calc.	<u>P. tuberculatus</u>	Miocene	0	<u>Cyatheacidites annulatus</u>
77	1376.2	Good	High	Slst., calc.	<u>P. tuberculatus</u>	Miocene	0	<u>C. annulatus</u> , Gyrostemonaceae
73	1386.0	Fair	High	Slst., glau, calc.	<u>P. tuberculatus</u>	Miocene	0	<u>C. annulatus</u> , reworked Late Eocene to Late Cretaceous spore-pollen
70	1389.0	Good	Low	Sst., glau, calc.	<u>P. tuberculatus</u>	Post-Eocene	0	<u>C. annulatus</u>
69	1389.9	Good	High	Slst., calc.	Indeterminate	-	-	<u>C. annulatus</u>
68	1391.2	Good	Moderate	Slst.	Middle <u>N. asperus</u>	Late Eocene	2	
110	1392.0	Good	High	Sst., glau.	Middle <u>N. asperus</u>	Late Eocene	2	mixed <u>P. tuberculatus</u> /Middle <u>N. asperus</u> assemblage
66	1393.0	Good	High	Sst., glau	Middle <u>N. asperus</u>	Late Eocene	2	<u>Cranwellia striatus</u> . Reworked Paleocene s-p.
65	1394.0	Low	Moderate	Sst., glau.	Lower <u>N. asperus</u>	Middle Eocene	2	
64	1395.0	Good	High	Sst., slightly calc., glau.	Lower <u>N. asperus</u>	Middle Eocene	2	<u>Proteacidites scitus</u> , <u>P. grandis</u> Caved <u>P. tuberculatus</u> s-p.
63	1396.1	Low	Moderate	Sst., slightly calc., glau.	Lower <u>N. asperus</u>	Middle Eocene	2	Caved <u>P. tuberculatus</u> s-p.
62	1405.0	Nil	-	Sst.	-	-	-	
61	1408.0	Nil	-	Sst.	-	-	-	
60	1411.0	Low	Moderate	Sst.	<u>P. asperopolus</u>	Early Eocene	2	<u>P. pachyopolus</u> , <u>S. cainozoicus</u> , <u>M. tenuis</u> caved <u>P. tuberculatus</u> dinos and s-p.
59	1413.6	Nil	-	Sst.	-	-	-	
109	1424.6	Low	High	Slst., carb.	<u>P. asperopolus</u>	Early Eocene	0	Less than 5% <u>Nothofagidites</u> pollen
58	1426.6	High	High	Slst., carb.	<u>P. asperopolus</u>	Early Eocene	0	<u>P. asperopolus</u> , <u>P. pachyopolus</u> (common)
56	1468.8	Very low	Poor	Sst., carb.	Indeterminate	-	-	

SAMPLE NO.	DEPTH (Metres)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
55	1472.1	Low	High	Slst., carb.	Upper <u>M. diversus</u>	Early Eocene	2	
54	1486.9	Nil	-	Sst., carb.	-	-	-	
107	1495.2	High	High	Slst., carb.	Middle <u>M. diversus</u>	Early Eocene	1	<u>Banksieacidites elongatus</u>
53	1498.7	High	High	Slst.	Middle <u>M. diversus</u>	Early Eocene	1	<u>P. tuberculiformis</u>
106	1508.0	High	High	Slst., carb.	Upper <u>L. balmei</u>	Paleocene	1	Mislabelled sample
ctg	1505-1510	High	Moderate	-	Middle <u>M. diversus</u>	Early Eocene	2	<u>Polycopites esobalteus</u>
52	1520.3	Nil	-	Sst., carb.	-	-	2	<u>P. ornatus</u> , <u>C. gigantis</u>
105	1531.0	Very low	Poor	Sst., carb.	Indeterminate	-	-	<u>T. waiparensis</u>
50	1572.2	High	High	Slst., carb.	Lower <u>M. diversus</u>	Early Eocene	0	<u>A. hyperacantha</u> transgression
49	1577.6	High	High	Slst., carb.	Upper <u>L. balmei</u>	Eocene/ Paleocene boundary	0	<u>A. hyperacantha</u> transgression
48	1585.3	Nil	-	Sst., carb.	-	-	-	
47	1596.1	High	High	Slst., carb.	Upper <u>L. balmei</u>	Paleocene	0	<u>V. kopukuensis</u> , <u>C. gigantis</u>
46	1604.2	High	Moderate	Coal	Upper <u>L. balmei</u>	Paleocene	1	<u>C. gigantis</u>
45	1611.2	High	Moderate	Slst. carb.	Upper <u>L. balmei</u>	Paleocene	0	<u>V. kopukuensis</u>
44	1626.4	Very Low	Poor	Sst., carb.	Indeterminate	-	-	
43	1639.8	Fair	Poor	Mdst; carb.	Upper <u>L. balmei</u>	Paleocene	0	<u>V. kopukuensis</u>
41	1671.8	Fair	Poor	Slst., carb.	Upper <u>L. balmei</u>	Paleocene	0	<u>V. kopukuensis</u>
40	1687.8	High	High	Sst., carb.	Upper <u>L. balmei</u>	Paleocene	1	<u>V. kopukuensis</u> Caved <u>P. tuberculatus</u> s-p
39	1701.1	Very low	Poor	Slst.	Indeterminate	-	-	
103	1719.5	Low	Moderate	Sst.	<u>L. balmei</u>	Paleocene		<u>L. balmei</u> , <u>P. langstonii</u>
38	1738.2	Very high	High	Slst., carb.	Lower <u>L. balmei</u>	Paleocene	0	<u>T. verrucosus</u> , <u>P. langstonii</u>
37	1749.2	Very low	Poor	Sst.	Lower <u>L. balmei</u>	Paleocene	1	<u>Parvisaccites catastus</u>

B A S I N : GIPPSLAND
 WELL NAME: KAHAWAI-1 REVISED

ELEVATION: KB: 21.0 GL: -81.0
 TOTAL DEPTH: 2321 metres

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA			
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg
NEOGENE	<i>T. pleistocenicus</i>									
	<i>M. lipsis</i>									
	<i>C. bifurcatus</i>									
	<i>T. bellus</i>									
	<i>P. tuberculatus</i>	1369.0	0				1389.0	0		
PALEOGENE	Upper <i>N. asperus</i>									
	Mid <i>N. asperus</i>	1391.2	2				1393.0	2		
	Lower <i>N. asperus</i>	1394.0	2				1396.1	2		
	<i>P. asperopolus</i>	1400.7	1				1426.6	0		
	Upper <i>M. diversus</i>	1472.1	2				1472.1	2		
	Mid <i>M. diversus</i>	1495.2	1				1528.5	2		
	Lower <i>M. diversus</i>	1554.6	1				1572.2	0		
	Upper <i>L. balmei</i>	1577.6	0				1687.8	1		
	Lower <i>L. balmei</i>	1738.2	0				1932.7	2	1895.6	1
	LATE CRETACEOUS	Upper <i>T. longus</i>	1960.3	1				2005.1		
Lower <i>T. longus</i>		2065.6	2	2271.4	1		2307.5	2	2294.2	1
<i>T. lilliei</i>										
<i>N. senectus</i>										
<i>T. apoxyexinus</i>										
<i>P. mawsonii</i>										
EARLY CRET.	<i>A. distocarinatus</i>									
	<i>P. pannosus</i>									
	<i>C. paradoxa</i>									
	<i>C. striatus</i>									
	<i>C. hughesi</i>									
	<i>F. wonthaggiensis</i>									
	<i>C. australiensis</i>									

COMMENTS: Depths in metres.

- CONFIDENCE RATING:
- 0: SWC or Core, Excellent Confidence, assemblage with zone species of spores, pollen and micropl
 - 1: SWC or Core, Good Confidence, assemblage with zone species of spores and pollen or micropl
 - 2: SWC or Core, Poor Confidence, assemblage with non-diagnostic spores, pollen and/or micropl
 - 3: Cuttings, Fair Confidence, assemblage with zone species of either spores and pollen or micropl 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 sh entered, if possible. If a sample cannot be assigned to one particular zone, then no entry should be r unless a range of zones is given where the highest possible limit will appear in one zone and the lowes limit in another.

M. K. Macphail 17 September 1995

limit in another.

DATA RECORDED BY: M.K. Macphail DATE: 17 September

DATA REVISED BY: DATE:

SAMPLE NO.	DEPTH (Metres)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY	ZONE	AGE	CONFIDENCE RATING	COMMENTS
35	1775.2	Fair	Poor	Sst., carb.	Lower <u>L. balmei</u>	Paleocene	1	<u>Australopollis obscurus</u>
34	1791.3	High	Poor	Slst., carb.	Lower <u>L. balmei</u>	Paleocene	1	<u>T. verrucosus</u>
33	1808.4	Fair	Poor	Slst., carb.	Lower <u>L. balmei</u>	Paleocene	2	
32	1820.0	High	Moderate	Slst., carb.	Lower <u>L. balmei</u>	Paleocene	1	<u>T. verrucosus</u> . Marine
31	1833.1	Very low	Poor	Slst.	<u>L. balmei</u>	Paleocene		Marine
27	1895.6	Fair	Moderate	Clyst., carb.	Lower <u>L. balmei</u>	Paleocene	1	<u>T. verrucosus</u> , <u>A. obscurus</u>
25	1918.3	Very Low	Poor	Slst.	<u>L. balmei</u>	Paleocene	-	
24	1932.7	High	Moderate	Slst., carb.	Lower <u>L. balmei</u>	Paleocene	2	Abundant <u>T. verrucosus</u> . Marine
22	1960.3	Low	Moderate	Slst., carb.	<u>T. longus</u>	Late Cretaceous	1	<u>P. otwayensis</u> , <u>P. reticuloconcavus</u> , <u>T. securus</u> , <u>G. rudata</u> (common)
21	2066.9	Low	Moderate	Sst., carb.	<u>T. longus</u>	Late Cretaceous	1	<u>P. otwayensis</u> , <u>P. reticuloconcavus</u>
20	1997.6	High	High	Sst., carb.	<u>T. longus</u>	Late Cretaceous	0	<u>T. longus</u> , <u>Quadraplanus brossus</u>
19	2005.1	High	High	Sst., carb.	<u>T. longus</u>	Late Cretaceous	0	<u>T. longus</u> , <u>Q. brossus</u>
17	2041.0	Very low	Poor	Sst., carb.	Indeterminate	-	-	<u>L. amplus</u> , <u>G. rudata</u>
15	2065.6	Fair	Poor	Sst., carb.	<u>T. longus</u>	Late Cretaceous	2	<u>T. verrucosus</u> (common), <u>T. lilliei</u>
8	2191.6	Fair	Moderate	Slst., carb.	<u>T. longus</u>	Late Cretaceous	0	<u>Jaxtacolpus pieratus</u> , <u>T. waiparensis</u> , <u>T. verrucosus</u> , <u>L. balmei</u>
4	2271.4	Fair	Moderate	Sst., carb.	<u>T. longus</u>	Late Cretaceous	0	<u>T. longus</u>
2	2294.2	Low	Moderate	Sst., carb.	<u>T. longus</u>	Late Cretaceous	0	<u>T. longus</u>
1	2307.5	High	High	Slst.	<u>T. longus</u>	Late Cretaceous	2	<u>T. verrucosus</u> , <u>P. otwayensis</u> , <u>P. reticuloconcavus</u> , <u>T. waiparensis</u>

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.
EXPLORATION DEPARTMENT PALYNOLOGY LABORATORY
PROVISIONAL REPORT

REPORTED TO:

D.A. Schwebel

WELL: TUNA-A2

PHONED TO:

REPORT NO: 1

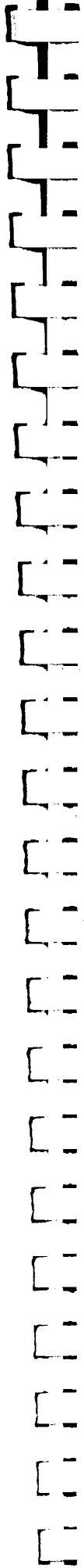
SEEN BY:

M.K. Macphail

DATE: 20 SEPTEMBER 1982

SAMPLE No.	DEPTH (in feet)	RECEIVED	AGE	ZONE	DIVISION
	5098		EARLY-MIDDLE EOCENE	<i>P. asperopolus</i>	

COMMENTS: This sample, at the base of the Tuna-Flounder channel sediments in the Tuna-A2 well, was originally dated as Upper *M. diversus* Zone in age. Although the sample contains a number of spore-pollen species which first appear in the Upper *M. diversus* Zone none are restricted to this zone. It is now considered to be *P. asperopolus* Zone in age (confidence rating 2), based on relatively frequent *Proteacidites pachypolus*, *P. asperopolus* and *Myrtacidites tenuis*.



BASIC DATA

Table - 2: Palynological Data

Range Chart - Dinoflagellates

Range Chart - Spore Pollen

TABLE 2

SUMMARY OF PALYNOLOGICAL ANALYSIS, KAHAWAI-1, GIPPSLAND BASIN

BASIC DATA

SAMPLE NO.	DEPTH (Metres)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY
79	1369.0	Good	Moderate	Mdst., calc.
77	1376.2	Good	High	Slst., calc.
73	1386.0	Fair	High	Slst., glau, calc.
70	1389.0	Good	Low	Sst., glau, calc.
69	1389.9	Good	High	Slst., calc.
68	1391.2	Good	Moderate	Slst.
110	1392.0	Good	High	Sst., glau.
66	1393.0	Good	High	Sst., glau
65	1394.0	Low	Moderate	Sst., glau.
64	1395.0	Good	High	Sst., slightly calc., glau.
63	1396.1	Low	Moderate	Sst., slightly calc., glau.
62	1405.0	Nil	-	Sst.
61	1408.0	Nil	-	Sst.
60	1411.0	Low	Moderate	Sst.
59	1413.6	Nil	-	Sst.
109	1424.6	Low	High	Slst., carb.
58	1426.6	High	High	Slst., carb.
56	1468.8	Very low	Poor	Sst., carb.
55	1472.1	Low	High	Slst., carb.
54	1486.9	Nil	-	Sst., carb.
107	1495.2	High	High	Slst., carb.
53	1498.7	High	High	Slst.
106	1508.0	High	High	Slst., carb.
ctg	1505-1510	High	Moderate	-
52	1520.3	Nil	-	Sst., carb.
105	1531.0	Very low	Poor	Sst., carb.
50	1572.2	High	High	Slst., carb.
49	1577.6	High	High	Slst., carb.

SAMPLE NO.	DEPTH (Metres)	YIELD	DIVERSITY SPORE-POLLEN	LITHOLOGY
48	1585.3	Nil	-	Sst., carb.
47	1596.1	High	High	Slst., carb.
46	1604.2	High	Moderate	Coal
45	1611.2	High	Moderate	Slst. carb.
44	1626.4	Very Low	Poor	Sst., carb.
43	1639.8	Fair	Poor	Mdst; carb.
41	1671.8	Fair	Poor	Slst., carb.
40	1687.8	High	High	Sst., carb.
39	1701.1	Very low	Poor	Slst.
103	1719.5	Low	Moderate	Sst.
38	1738.2	Very high	High	Slst., carb.
37	1749.2	Very low	Poor	Sst.
35	1775.2	Fair	Poor	Sst., carb.
34	1791.3	High	Poor	Slst., carb.
33	1808.4	Fair	Poor	Slst., carb.
32	1820.0	High	Moderate	Slst., carb.
31	1833.1	Very low	Poor	Slst.
27	1895.6	Fair	Moderate	Clyst., carb.
25	1918.3	Very Low	Poor	Slst.
24	1932.7	High	Moderate	Slst., carb.
22	1960.3	Low	Moderate	Slst., carb.
21	2966.9	Low	Moderate	Sst., carb.
20	1997.6	High	High	Sst., carb.
19	2005.1	High	High	Sst., carb.
17	2041.0	Very low	Poor	Sst., carb.
15	2065.6	Fair	Poor	Sst., carb.
8	2191.6	Fair	Moderate	Slst., carb.
4	2271.4	Fair	Moderate	Sst., carb.
2	2294.2	Low	Moderate	Sst., carb.
1	2307.5	High	High	Slst.

SAMPLE TYPE *	DEPTHS																											
	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S												
PALYNOMORPHS	1369.01	1376.2	1386.0	1389.0	1389.9	1391.2	1392.0	1393.0	1394.0	1395.0	1396.1	1411.0	1424.6	1426.6	1472.1	1495.2	1498.7	1505.10	1528.5	1531.0	1572.2	1577.6	1596.1	1604.2	1611.2	1626.4	1639.8	
<i>A. qualumis</i>																												
<i>A. acutullus</i>																												
<i>A. luteoides</i>																												
<i>A. oculatus</i>																												
<i>A. sectus</i>																												
<i>A. triplaxis</i>																												
<i>A. obscurus</i>			R		R			R				R			R													
<i>B. disconformis</i>																												
<i>B. arcuatus</i>		/					/																					
<i>B. elongatus</i>																												
<i>B. mutabilis</i>			R		R																							
<i>B. otwayensis</i>																												
<i>B. elegansiformis</i>																						R						
<i>B. trigonalis</i>																												
<i>B. verrucosus</i>																												
<i>B. Lombaxoides</i>																												
<i>B. emaciatus</i>																												
<i>C. bullatus</i>																												
<i>C. heskermensis</i>																												
<i>C. horrendus</i>																												
<i>C. meleosus</i>																												
<i>C. apiculatus</i>																												
<i>C. leptos</i>																												
<i>C. striatus</i>																												
<i>C. vanraadshoovenii</i>																												
<i>C. orthoteichus/major</i>		/					/					/			/			/				/						
<i>C. annulatus</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>C. gigantis</i>																												
<i>C. splendens</i>																												
<i>D. australiensis</i>																												
<i>D. granulatus</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>D. tuberculatus</i>																												
<i>D. delicatus</i>																												
<i>D. semilunatus</i>																												
<i>E. notensis</i>																												
<i>E. crassixinus</i>																												
<i>F. balteus</i>																												
<i>F. crater</i>																												
<i>F. lucinosus</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>F. palaequetrus</i>																												
<i>G. edwardsii</i>		R	R		R										R													
<i>G. rudata</i>	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
<i>G. divaricatus</i>																												
<i>G. gestus</i>																												
<i>G. catathus</i>																												
<i>G. cranwellae</i>																												
<i>G. wahooensis</i>					R																							
<i>G. bassensis</i>																												
<i>G. nebulosus</i>																												
<i>H. harrisii</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>H. astrus</i>																												
<i>H. elliotii</i>																												
<i>I. anguloclavatus</i>																												
<i>I. antipodus</i>																												
<i>I. notabilis</i>																												
<i>I. gremius</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>I. irregularis</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>J. peiratus</i>																												
<i>K. waterbolkii</i>																												
<i>L. amplus</i>					R																							
<i>L. crassus</i>																												
<i>L. ohaiensis</i>																												
<i>L. hainii</i>																												
<i>L. lanceolatus</i>																												
<i>L. balmei</i>			R		R																							
<i>L. florinii</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>M. diversus</i>	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
<i>M. duratus</i>																												
<i>M. grandis</i>																												
<i>M. perimagnus</i>																												

*C= core; S= sidewall core; T= cuttings.

R = contaminants or reworked specimens

□ = rare

⊗ = frequent

■ = common

■ = abundant/dominant

SAMPLE TYPE *	DEPTHS																												
	1369.01	1376.2	1385.0	1389.0	1389.9	1391.2	1392.0	1395.0	1395.0	1396.1	1411.0	1424.6	1426.6	1472.1	1495.2	1498.7	1505.10	1526.5	1531.0	1522.2	1522.2	1522.6	1526.1	1604.2	1611.2	1626.4	1639.8	1671.8	
<i>M. subtilis</i>																													
<i>M. ornamentalis</i>																													
<i>M. hypolaenoides</i>																													
<i>M. homeopunctatus</i>																													
<i>M. parvus/mesonesus</i>																													
<i>M. tenuis</i>																													
<i>M. verrucosus</i>																													
<i>M. australis</i>																													
<i>M. asperus</i>																													
<i>N. asperoides</i>																													
<i>N. brachyspinulosus</i>																													
<i>N. deminutus</i>																													
<i>N. emarcidus/heterus</i>																													
<i>N. endurus</i>		R		R	R		R					R																	
<i>N. falcatus</i>																													
<i>N. flemingii</i>																													
<i>N. goniatus</i>																													
<i>N. senectus</i>																													
<i>N. vansteenisii</i>																													
<i>O. sentosa</i>																													
<i>P. ochesis</i>																													
<i>P. catastus</i>																													
<i>P. demarcatus</i>																													
<i>P. magnus</i>																													
<i>P. polyoratus</i>																													
<i>P. vesicus</i>																													
<i>P. densus</i>																													
<i>P. velosus</i>																													
<i>P. morgani/jubatus</i>																													
<i>P. mawsonii</i>																													
<i>P. reticulosaccatus</i>																													
<i>P. verrucosus</i>																													
<i>P. crescentis</i>																													
<i>P. esobalteus</i>																													
<i>P. langstonii</i>																													
<i>P. reticulatus</i>																													
<i>P. simplex</i>																													
<i>P. varus</i>																													
<i>P. adenantoides (Prot.)</i>																													
<i>P. alveolatus</i>																													
<i>P. amolosexinus</i>																													
<i>P. angulatus</i>																													
<i>P. annularis</i>																													
<i>P. asperopolus</i>																													
<i>P. biornatus</i>																													
<i>P. clarus</i>																													
<i>P. cleinei</i>																													
<i>P. confragosus</i>																													
<i>P. crassus</i>																													
<i>P. delicatus</i>																													
<i>P. formosus</i>																													
<i>P. grandis</i>																													
<i>P. grevillaeensis</i>																													
<i>P. incurvatus</i>																													
<i>P. intricatus</i>																													
<i>P. kopiensis</i>																													
<i>P. lapis</i>																													
<i>P. latrobensis</i>																													
<i>P. leightonii</i>																													
<i>P. obesolabrus</i>																													
<i>P. obscurus</i>																													
<i>P. ornatus</i>																													
<i>P. otwayensis</i>																													
<i>P. pachyopolus</i>																													
<i>P. pallidus</i>																													
<i>P. parvus</i>																													
<i>P. plummelus</i>																													
<i>P. prodigus</i>																													
<i>P. pseudomoides</i>																													
<i>P. roccavus</i>																													

* C=core: S=sidewall core: T=cutting

SAMPLE TYPE *	DEPTHS																												
	1569.01	1576.2	1586.0	1589.0	1589.9	1591.2	1592.0	1593.0	1594.0	1595.0	1596.1	1411.0	1424.6	1426.6	1472.1	1495.2	1498.7	1505.10	1528.5	1531.0	1572.2	1577.6	1596.1	1604.2	1611.2	1626.4	1659.8	1671.8	
PALYNOFORMS																													
<i>P. rectomarginis</i>																													
<i>P. reflexus</i>																													
<i>P. reticulatus</i>																													
<i>P. reticuloconcavus</i>																													
<i>P. reticulosabratus</i>																													
<i>P. rugulatus</i>																													
<i>P. scitus</i>																													
<i>P. stipplatus</i>																													
<i>P. tenuixinus</i>																													
<i>P. truncatus</i>																													
<i>P. tuberculatus</i>																													
<i>P. tuberculiformis</i>																													
<i>P. tuberculotumulatus</i>																													
<i>P. xestoformis (Prot.)</i>																													
<i>O. brussus</i>																													
<i>R. boxatus</i>																													
<i>R. stellatus</i>																													
<i>R. mallatus</i>																													
<i>R. trophus</i>																													
<i>S. canozoicus</i>																													
<i>S. rotundus</i>																													
<i>S. digitoides</i>																													
<i>S. marlinensis</i>																													
<i>S. rarus</i>																													
<i>S. meridianus</i>																													
<i>S. prominatus</i>																													
<i>S. uvatus</i>																													
<i>S. punctatus</i>																													
<i>S. regium</i>																													
<i>T. multistrixis (CP4)</i>																													
<i>T. textus</i>																													
<i>T. verrucosus</i>																													
<i>T. securus</i>																													
<i>T. confessus (C3)</i>																													
<i>T. gillii</i>																													
<i>T. incisus</i>																													
<i>T. longus</i>																													
<i>T. phillipsii</i>																													
<i>T. renmarkensis</i>																													
<i>T. sabulosus</i>																													
<i>T. simatus</i>																													
<i>T. thomasii</i>																													
<i>T. waiparaensis</i>																													
<i>T. adelaidensis (CP3)</i>																													
<i>T. angurium</i>																													
<i>T. delicatus</i>																													
<i>T. geraniodes</i>																													
<i>T. leuros</i>																													
<i>T. lilliei</i>																													
<i>T. marginatus</i>																													
<i>T. moultonii</i>																													
<i>T. paenestriatus</i>																													
<i>T. reequetrus</i>																													
<i>T. scabratus</i>																													
<i>T. sphaerica</i>																													
<i>T. magnificus (P3)</i>																													
<i>T. spinosus</i>																													
<i>T. ambiguus</i>																													
<i>T. chnosus</i>																													
<i>T. helosus</i>																													
<i>T. scabratus</i>																													
<i>T. sectilis</i>																													
<i>V. attinatus</i>																													
<i>V. cristatus</i>																													
<i>V. kopukuensis</i>																													

*C=core; S= sidewall core; T= cuttings.

SAMPLE TYPE *	DEPTHS																						
	S	S	S	S	S	S	S	S	S	S	S												
DEPTH	1687.8	1719.5	1738.2	1749.2	1775.2	1791.3	1808.4	1820.0	1833.1	1895.6	1918.5	1932.7	1960.3	1966.9	1997.6	2005.1	2065.6	2096.1	2191.6	2271.4	2294.2	2307.5	
PALYNOMORPHS																							
<i>A. qualumis</i>																							
<i>A. acutullus</i>																							
<i>A. luteoides</i>																							
<i>A. oculatus</i>																							
<i>A. sectus</i>																							
<i>A. triplaxis</i>																							
<i>A. obscurus</i>																							
<i>B. disconformis</i>																							
<i>B. arcuatus</i>																							
<i>B. elongatus</i>																							
<i>B. mutabilis</i>																							
<i>B. otwayensis</i>																							
<i>B. elegansiformis</i>																							
<i>B. trigonalis</i>																							
<i>B. verrucosus</i>																							
<i>B. bombaxoides</i>																							
<i>B. emaciatu</i>																							
<i>C. bullatus</i>																							
<i>C. heskerniensis</i>																							
<i>C. horrendus</i>																							
<i>C. meleosus</i>																							
<i>C. apiculatus</i>																							
<i>C. leptos</i>																							
<i>C. striatus</i>																							
<i>C. vanraadshoovenii</i>																							
<i>C. orthoteichus/major</i>																							
<i>C. annulatus</i>	R																						
<i>C. gigantis</i>																							
<i>C. splendens</i>																							
<i>D. australiensis</i>																							
<i>D. granulatus</i>																							
<i>D. tuberculatus</i>																							
<i>D. delicatus</i>																							
<i>D. semilunatus</i>																							
<i>E. notensis</i>																							
<i>E. crassiexinus</i>																							
<i>F. balteus</i>																							
<i>F. crater</i>																							
<i>F. lucunosus</i>																							
<i>F. palaequetrus</i>																							
<i>G. edwardsii</i>																							
<i>G. rudata</i>																							
<i>G. divaricatus</i>																							
<i>G. gestus</i>																							
<i>G. catathus</i>																							
<i>G. cranwellae</i>																							
<i>G. wahoensis</i>																							
<i>G. bassensis</i>																							
<i>G. nebulosus</i>																							
<i>H. harrisii</i>																							
<i>H. astrus</i>																							
<i>H. elliotii</i>																							
<i>I. anguloclavatus</i>																							
<i>I. antipodus</i>																							
<i>I. notabilis</i>																							
<i>I. gremius</i>																							
<i>I. irregularis</i>																							
<i>J. peiratus</i>																							
<i>K. waterbolkii</i>																							
<i>L. amplus</i>																							
<i>L. crassus</i>																							
<i>L. ohaiensis</i>																							
<i>L. bainii</i>																							
<i>L. lanceolatus</i>																							
<i>L. balmei</i>																							
<i>L. florinii</i>																							
<i>M. diversus</i>																							
<i>M. duratus</i>																							
<i>M. grandis</i>																							
<i>M. perimagnus</i>																							

*C=core; S=sidewall core; T=cuttings.

R = contaminants or reworked specimens

☐ = rare

⊗ = frequent

▣ = common

■ = abundant/dominant

Well Name KAIHAWAI-1

Basin GIPPSLAND

Sheet No 5 of 6

SAMPLE TYPE *	DEPTHS																						
	1687.8	1719.5	1758.2	1749.2	1775.2	1791.3	1808.1	1820.0	1855.1	1895.6	1918.5	1932.7	1969.5	1966.9	1997.6	2005.1	2065.6	2096.1	2191.6	2271.4	2291.2	2507.5	
M. subtilis																							
M. ornamentalis																							
M. hypolaenoides																							
M. homeopunctatus																							
M. parvus/mesonesus																							
M. tenuis																							
N. verrucosus																							
N. australis																							
N. asperus																							
N. asperoides																							
N. brachyspinulosus																							
N. deminutus																							
N. emarcidus/heterus																							
N. endurus																							
N. falcatus																							
N. flemingii																							
N. goniatus																							
N. senectus																							
N. vansteenisii										R													
O. sentosa																							
P. ochesis																							
P. catastus																							
P. demarcatus																							
P. magnus																							
P. polyoratus																							
P. vesicus																							
P. densus																							
P. velosus																							
P. morgani/jubatus																							
P. mawsonii																							
P. reticulosaccatus																							
P. verrucosus																							
P. crescentis																							
P. esobalteus																							
P. langstonii																							
P. reticulatus																							
P. simplex																							
P. varus																							
P. adenanthoides (Prot.)																							
P. alveolatus																							
P. amolosexinus																							
P. angularatus																							
P. annularis																							
P. asperopolus																							
P. biornatus																							
P. clarus																							
P. cleinei																							
P. confragosus																							
P. crassus																							
P. delicatus																							
P. formosus																							
P. grandis																							
P. grevillaensis																							
P. incurvatus																							
P. intricatus																							
P. kopiensis																							
P. lapis																							
P. latrobensis																							
P. leightonii																							
P. obesolabrus																							
P. obscurus																							
P. ornatus																							
P. otwayensis																							
P. pachypolus																							
P. palisatus																							
P. parvus																							
P. plummelus																							
P. prodigus																							
P. pseudomoides																							
P. recavus																							

* C=core: S=sidewall core: T=cutting

MISC.PALY.DIST.CHART

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