APPENDIX-1

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PALYNOLOGICAL ANALYSIS OF TERAKIHI-1
GIPPSLAND BASIN.

by

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INTRODUCTION

Twenty-one sidewall core samples were processed from Terakihi-1 and examined for spores, pollen and microplankton. Palynomorph concentrations were mostly low to very low from the generally low quantities of oxidized organic residue extracted from the samples. As a consequence only moderate diversity spore-pollen assemblages (average 15.6 species per productive sample), and very low diversity microplankton assemblages (1 to 3 species per sample), were recorded from a majority of samples. Overall the preservation of the palynomorphs was fair to good, and in some cases very good.

Lithological units and palynological zones from base of Lakes Entrance Formation to T.D. are given in the following summary. Interpretative data with indentification 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 accompanying range chart.

PALYNOLOGICAL SUMMARY OF TERAKIHI-1

AGE	UNIT/FACIES	SPORE-POLLEN ZONES (Dinoflagellate Zones)	DEPTH RANGE (mKB)
Oligocene	Lakes Entrance	*P. tuberculatus*	2826.5
	2836.0m		
Maastrichtian	Latrobe Group (Coarse clastic facies)	Upper *T. longus* (*M. druggii*)	2837.0-3005.0 2872.0-3005.0
	T.D. 3040.0m		

GEOLOGICAL COMMENTS

1. The entire Latrobe Group section intersected in Terakihi-1 lies within the Upper *T. longus* Zone. Although the key dinoflagellates were not found in every sample it is considered that the section is entirely marine and lies wholly within the *M. druggii* Dinoflagellate Zone.

2. The Latrobe Group section in Terakihi-1 correlates with the sample intervals 3008-3142mMD (Measured Depth) in Blackback-1 Sidetrack-2 and 2937.7-3068.7m (9638-10068 ft) in Hapuku-1 (Partridge, 1975, 1990).

3. The above sections in all three wells are considered marine because they contain microplankton and lack the coals typical of the non-marine or coastal plain environments found in equivalent age sediments in wells to the west. The lithology of the section in Terakihi-1 differs however from the other two wells in lacking obvious glauconite, which is described as an accessory mineral in the sidewall core samples from both Hapuku-1 and Blackback-1 Sidetrack-2. From analogy with younger parts of the Latrobe Group, where glauconite is only found in the more condensed sections, it is suggested the depositional rate in Terakihi-1 is higher than in either of the other two wells. It is speculated therefore that the erosion at the top of the Latrobe may have cut well down into the Upper *T. longus* Zone at Terakihi-1.

4. No Gurnard Formation or section equivalent to the "*N. asperus*" Channel Fill in Blackback-1 and Hapuku-1 is present in Terakihi-1. The time break at the top of Latrobe unconformity at this location extends from the Maastrichtian to probably the late Oligocene an interval of 37+ million years.

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.

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

Upper *Tricolpites longus* Zone: 2837.0-3005.0 metres Maastrichtian.

Twelve of the eighteen sidewall cores analysed from the Latrobe Group could be confidently assigned to the Upper subdivision of the *T. longus* Zone because they contained either or both of *Stereisporites (Tripunctisporis)* sp. or/and an abundance of *Gambierina rudata*, in association with a variety of other *T. longus* Zone index species. These latter can be divided between species which are repesented in most samples and which may be either frequent or common, and those species which are present in only a few samples and are rare to very rare. Examples of species representing the former group and their ranges are: *Proteacidites clinei* ms (2839.5-3005m), *P. reticuloconcavus* ms (2886.2-3005m), *Tricolpites confessus* (2837.5-3005m). Examples of rare species which are restricted to the Upper and Lower subdivisions of the *T. longus* Zone, and the samples from which they are recorded are: *Forcipites* (al. *Tricolpites*) longus (2837.0m), *Grapnelispora evansii* (fragments of processes identified at 2837.0m and 2839.5m), *Proteacidites wahooensis* ms (2892.9m, 3005.0m), *Pseudowinterapollis* (al. *Gephrapollenites*) *wahooensis* (2839.5m), and *Quadraplanus brossus* (2892.9m). Examples of rare species which range no younger than the Upper *T. longus* Zone, and the samples from which they are recorded are: *Camarozonosporites horrendus* ms (2837.0m), *Proteacidites otwayensis* ms (2886.2), *P. palisadus* (2892.9m, 3005.0m), *P. retiformis* (3005.0m), *Tetradopollis securus* ms (2892.9m), *Tricolporites lilliei* (2875.5m, 3005.0m), and *Triporopollenites sectilis* (2839.5m, 3005.0m). Finally, *Tetracolporites verrucosus* (2839.5m, 2894.1m) is an example of a rare species that commences in the Lower *T. longus* Zone and ranges into the Paleocene *L. balmei* Zone. Overall the zone is of high diversity, even though average diversity in individual samples is only moderate because of the low residue yields recovered. In particular those

samples over this interval given as either indeterminate or just *T. longus* Zone reflect the situation where the yields were too low for reliable age determinations.

Manumiella druggii Dinoflagellate Zone: 2872.0-3005.0 metres Maastrichtian.

Twelve of the eighteen samples in the Latrobe Group also contained members of the *Manumiella druggii* species complex. *Manumiella conorata* was the most frequent type, followed by *M. druggii* with *M. seelandica* being the rarest of the indicator species for this zone. Although the entire section is obviously marine and the dinoflagellates are consistently present in low numbers the overall diversity of the section is surprisingly low. Other microplankton species present are restricted to *Micrhystridium* spp. in several samples, *Palaeocystidinium golzowense* at 2892.9m, and the *Alterbidinium acutulum* (Wilson) Lentin & Williams 1985 in the deepest sample at 3005.0m. This last species is an interesting occurrence as it is an important zone fossil in New Zealand for the interval below the *M. druggii* Zone, although it does range up into the latter zone (Wilson, 1984, Helby *et al.* 1987). It has previously been tentitatively identified in the Gippsland Basin in Pisces-1 and from a sea floor grab sample from the Bass Canyon (Marshall, 1990).

Proteacidites tuberculatus Zone: 2826.5 metres Oligocene.

The samples at 2826.5m is assigned to the *P. tuberculatus* Zone because of the common occurrence of simple spherical to ellipsoidal spinose dinoflagellates with a precingular (3'' only) archeopyle which has been called *Protoellipsodinium simplex* ms. This species is "typically" common from a stratigraphic position high within the Lakes Entrance Formation to somewhere in the Gippsland Limestone. The associated spore-pollen assemblage is not diagnostic and consists exclusively of long ranging species, but overall is conformable to this zone determination. The key spore *Cyatheacidites annulatus* was not found in the very low yield available from the sample, and consequently only a poor confidence rating can be given to the sample. The extremely low yields from the immediately underlying and overlying sidewall cores could not be confidently assigned to a zone, but the few species that were recorded are certainly consistent with a *P. tuberculatus* Zone age, and this is supported by the lithologies of the samples.

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

SAMPLE TYPE	DEPTH (metres)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	CONFIDENCE RATING	COMMENT
SWC 30	2820.5	Indeterminate			Probably Lakes Entrance Formation
SWC 29	2826.5	*P. tuberculatus*	*(P. simplex)*	2	
SWC 28	2834.0	Indeterminate			Virtually barren.
SWC 27	2837.0	Upper *T. longus*		1	LAD *Forcipites longus*, *Gambierina* spp. 8%
SWC 26	2839.5	Upper *T. longus*			*Proteacidites clinei*, *Triporopollenites sectilis* present.
SWC 24	2872.0	Indeterminate	*M. druggii*	1	*Manumiella conoratum* present.
SWC 23	2875.5	Upper *T. longus*	*M. druggii*	0	*Tricolporites lilliei* present.
SWC 22	2886.2	Upper *T. longus*	*M. druggii*	0	
SWC 21	2891.0	Upper *T. longus*	*M. druggii*	0	
SWC 20	2892.9	Upper *T. longus*	*M. druggii*	0	*Quadraplanus brossus* present.
SWC 19	2894.1	Upper *T. longus*		2	
SWC 15	2915.3	Upper *T. longus*		1	*Gambierina* spp. 15%
SWC 14	2942.8	Indeterminate			Barren.
SWC 13	2947.0	Indeterminate			
SWC 11	2954.5	Upper *T. longus*	*M. druggii*	1	
SWC 9	2959.0	Upper *T. longus*	*M. druggii*	0	
SWC 7	2971.5	*T. longus*	*M. druggii*	1	
SWC 5	2983.2	*T. longus*	*M. druggii*	1	
SWC 4	2990.5	Upper *T. longus*	*M. druggii*	1	
SWC 3	2994.0	*T. longus*	*M. druggii*	1	
SWC 2	3005.0	Upper *T. longus*	*M. druggii*	0	*Alterbidinium acutula* present.

LAD = Last Appearance Datum
FAD = First Appearance Datum

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: +21 m GL: -403 m

WELL NAME: TERAKIHI-1 TOTAL DEPTH: 3040 m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
		Preferred Depth	Rtg	Alternate Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg
NEOGENE	*T. pleistocenicus*								
	M. lipsis								
	C. bifurcatus								
	T. bellus								
	P. tuberculatus							2826.5	2
PALEOGENE	Upper *N. asperus*								
	Middle *N. asperus*								
	Lower *N. asperus*								
	P. asperopolus								
	Upper *M. diversus*								
	Middle *M. diversus*								
	Lower *M. diversus*								
	Upper *L. balmei*								
	Lower *L. balmei*								
LATE CRETACEOUS	Upper *T. longus*	2837	1	2875.5	0			3005	0
	Lower *T. longus*								
	T. lilliei								
	N. senectus								
	T. apoxyexinus								
	P. mawsonii								
	A. distocarinatus								
EARLY CRET.	*P. pannosus*								
	C. paradoxa								
	C. striatus								
	C. hughesii								
	F. wonthaggiensis								
	C. australiensis								

COMMENTS: Depths in metres.

Manumiella druggii Dinoflagellate Zone: 2872-3005 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 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 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: July 1990

DATA REVISED BY: _____ DATE: _____

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

SAMPLE TYPE	DEPTH (metres)	LAB. NO.	LITHOLOGY	RESIDUE YIELD	PALYNOMORPH CONCENTRATION	PRESERVATION	NO. OF S-P SPECIES*	MICROPLANKTON ABUNDANCE	NO. SPECIES*
SWC 30	2820.5	78314 D	Calcareous Claystone	Very Low	Very Low	Fair	2+	Very Low	2+
SWC 29	2826.5	78314 C	Calcareous Claystone	Very Low	Very Low	Fair-good	8+	Very Low	3+
SWC 28	2834.0	78314 B	Calcareous Claystone	Very Low	Very Low	Good	NR	Very Low	1
SWC 27	2837.0	78314 A	Cal. Siltstone, tr. glauconite	High	Low	Good	21+		
SWC 26	2839.5	78313 Z	Very fine pyritic sandstone	Moderate	Low	Poor-good	20+	Very Low	1
SWC 24	2872.0	78313 X	Medium grey sandstone	Very Low	Very Low	Fair	NR	Very Low	1
SWC 23	2875.5	78313 W	Dark grey siltstone	Moderate	Low	Good	19+	Low	2
SWC 22	2886.2	78313 V	Medium grey siltstone	Very Low	Very Low	Fair	7+	Very Low	1
SWC 21	2891.0	78313 U	Dark grey-brown sandstone	Moderate	Low	Fair-good	18+	Very Low	1
SWC 20	2892.9	78313 T	Dark grey siltstone	High	High	Poor-good	32+	Low	3
SWC 19	2894.1	78313 S	Medium grey sandstone	Moderate	Low	Fair-good	9+		
SWC 15	2915.3	78313 O	Dark grey-brown siltstone	Moderate	Low	Good	21+	Very Low	1
SWC 14	2942.8	78313 N	Grey sandstone	Very Low	Barren				
SWC 13	2947.0	78313 M	Sandstone grading to siltstone	Low	Low	Fair-good	7+		
SWC 11	2954.5	78313 K	Dark grey-brown siltstone	Low	Low	Fair-good	16+	Very Low	1
SWC 9	2959.0	78313 I	Dark grey-brown siltstone	Low	Moderate	Good	12+	Moderate	2
SWC 7	2971.5	78313 G	Very fine med. grey sandstone	Low	Low	Good	9+	Low	1
SWC 5	2983.2	78313 E	Dark brown pyritic siltstone	Moderate	Low	Good	11+	Low	2
SWC 4	2990.5	78313 D	Argillaceous sandstone	Moderate	Low	Good	20+	Very Low	1
SWC 3	2994.0	78313 C	Glauconitic siltstone	Low	Very Low	Fair-good	5+	Low	3
SWC 2	3005.0	78313 B	Grey-brown sst. with tr. glauc.	Low	Low-High	Good	43+	Low	3+

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

(ADP275)