



APPENDIX

FORAMINIFERAL ANALYSIS, TERAGLIN-1,
GIPPSLAND BASIN.

by

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(revised by

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INTRODUCTION

Fifty one (51) sidewall cores were examined for their foraminiferal content from 1780.0 to 2450.0m in Teraglin-1. Adequate planktonic foraminiferal assemblages were recovered from all samples of the marine carbonate section except the following: SWC 73 at 2420.5m, SWC 128 at 1870.1m and SWC 130 at 1830.0m. Only rare agglutinated foraminifera were found in the limonitized hardground unit (2421-2425m) in SWC 121 at 1423.0m. The undifferentiated clastic unit of the Latrobe Group (2425-2450.5m) was barren of foraminifera.

Tables 1 and 2 provide a summary (Basic and Interpretative) of the palaeontological analysis in Teraglin-1. A summary of the biostratigraphic breakdown of the stratigraphic units in Teraglin-1 is given below.

SUMMARY

AGE	UNIT	ZONE	DEPTH (m)
Late Miocene	Gippsland	(not sampled)	(seafloor to 1780)
-	Limestone	B-2	1780.0
Mid Miocene		Indeterminate	1830.0-1870.1
Mid Miocene		C	1810.0-1910.0
		D-2/D-1	1929.9-2110.0
log break at 2135m			
Mid Miocene	Lakes	D-2/D-1	2139.5-2170.0
Early Miocene	Entrance	G	2233.9-2321.0
Early Miocene	Formation	H-1	2349.0-2412.0
log break at 2412m			
Early Oligocene	unnamed	J-2	2415.0-2418.0
latest Late Eocene/ earliest Early Oligocene	carbonate unit	K	2419.0
log break at 2421m			
* Middle Eocene	Latrobe Group (unnamed limonitized unit)	Lower <u>N. asperus</u>	2423.0
log break at 2425m			
* Paleocene- Maastrichtian	Latrobe Group (coarse clastics)	Upper <u>L. balmei</u> Lower <u>L. balmei</u> Upper <u>T. longus</u> Lower <u>T. longus</u>	2428.0-2433.0 2440.0-2937.0 2947.0-3235.0 3282.0-3372.5

* age based on palynology (see Macphail, 1983)

T.D. 3373m.

GEOLOGICAL COMMENTS

1. The laminated clastic sequence near the top of the Latrobe Group (2425-2450.5m) is barren of foraminifera. The palynological assemblage in the sequence is dominated by Paleocene spore/pollen but contains younger elements of Eocene age. Contamination by Eocene palynomorphs is preferred to alternative interpretation that this section represents massive reworking of Paleocene sediments into an Eocene channel.
2. The laminated clastic sequence is overlain by a 5m thick limonitised hardground horizon. A sample from the middle of the unit (SWC 23 at 2423.0m) has been age dated as Middle Eocene and assigned to the Lower N. asperus palynological Zone (Macphail, 1983). On the basis of lithological character (the unit contains limonitised glauconite and minor fresh glauconite) and faunal content (the unit contains rare fish teeth), the unit is interpreted as having originally represented a greensand which was deposited very slowly. The top 2m of the unit (unsampled) may range up into the Late Eocene. The hardground probably formed during a period of non-deposition in the Late Eocene. The presence of minor fresh glauconite in the SWC sample at 2423m indicates that submarine diagenesis has only partially altered the original greensand.
3. The limonitized hardground horizon is disconformably overlain by a 9m thick unnamed carbonate unit. The unit is latest Late Eocene to earliest Early Oligocene (Zones K and J-2) in age. The hiatus between the unnamed carbonate unit and the limonitized hardground probably spans part of the Late Eocene. The unit has a higher bulk density and higher gamma log response than the overlying section of the Lakes Entrance Formation. The base of the unit consists of recrystallised limestone (2420.5m) and grades up into recrystallised marl (2419.0m) and finally into planktonic foraminiferal ooze at the top (2415.0-2418.0m). The unit contains minor coarse, well rounded quartz grains at the base (2420.5-2419.0m), and 2-5 percent pelletal glauconite and an unusually high proportion of fish teeth throughout. On the basis of lithological character and fossil content, the unit is interpreted as representing a condensed sequence deposited during a maximum rise in relative sea-level (transgression).
4. The condensed latest Late Eocene-earliest Early Oligocene unit is disconformably overlain by a thick section of calcareous shale (Lakes Entrance Formation), the basal part of which is Early Miocene (Zone H-1) in age. The hiatus between the units spans approximately 10 million

hiatus between the units spans approximately 10 million years. The two lowest samples of the calcareous shale (SWC 78 at 2412.0m and SWC 123 at 2409.0m) contain Early Oligocene planktonic foraminifera which have been reworked during Early Miocene (Zone H-1) time. Reworking of this nature has been documented in several wells in the Gippsland Basin including Cobia-2 (Rexilius, in prep.), Yellowtail-1 and Yellowtail-2 (Rexilius, 1982) and Opah-1 (Rexilius, 1983).

5. The boundary between the Gippsland Limestone and the Lakes Entrance Formation is difficult to delineate in the offshore Gippsland Basin but can be inferred from changes in lithological, faunal and log character. On the basis of log character, the boundary between the Gippsland Limestone and Lakes Entrance Formation in Teraglin-1 is selected at 2135m. The sidewall core sample immediately below this log break (SWC 95 at 2139.5m) is a planktonic foraminiferal ooze (pelagic sediment). The lowest sidewall core above the log break (SWC 96 at 2110.0m) is a calcareous shale comprising a moderate proportion of echinoid spines. The lithological character and fossil content of this sample indicates that it probably represents the distal edge of the prograding Gippsland Limestone. The prograding Gippsland Limestone reached the Teraglin-1 site during the Mid Miocene (Zones D-2/D-1 time). Typical fine grained shelfal calcarenite with abundant sponge spicules and echinoid spines makes its first appearance uphole at 1988.0m (SWC 100).

DISCUSSION OF ZONES

The Tertiary biostratigraphy in Teraglin-1 is based on the Gippsland Basin planktonic foraminiferal zonal scheme of Taylor (in prep).

Indeterminate Interval : 2420.5 - 2450.0m.

The laminated clastic sequence (2425.0-2450.5m) is barren of foraminifera. The palynological assemblage is dominated by Paleocene spore/pollen but contains younger elements of Eocene age. The limonitised hardground horizon (2421.0-2425.0m) is barren of planktonic foraminifera and only contains rare agglutinates. The unit cannot be age dated using foraminifera. Palynological analysis of SWC 121 at 2423.0m indicates that the middle portion of the unit is Middle Eocene in age and assignable to the Lower N. asperus Zone (Macphail, 1983). The lowest sample of the un-named carbonate unit (SWC 73 at 2420.5m) is strongly recrystallised and only contains a low yield of very poorly preserved, indeterminate planktonic foraminifera. The assemblage is not age diagnostic but is suspected to be Zone K (latest Late Eocene - earliest Early Oligocene) in age.

Zone K : 2419.0m.

The presence of Globigerina linaperta and G. brevis indicates that SWC 74 at 2419.0m is assignable to Zone K. The planktonic foraminiferal assemblage is moderately diverse but poorly preserved.

Zone J-2 : 2415.0 - 2418.0m.

The association of Globigerina angiporoides, G. brevis and Globorotalia postcretacea, and the absence of Globigerina linaperta, indicates that the interval is assignable to Zone J-2. The assemblage is dominated by Globigerina angiporoides, G. euapertura and specimens transitional between G. euapertura and G. ampliapertura. Other species in the assemblage include Globigerina ampliapertura, G. brevis, G. tripartita and Globorotalia postcretacea.

Zone H-1 : 2349.0 - 2412.0m.

The uphole appearance of Globigerina woodi connecta at 2412.0m defines the base of Zone H-1 in Teraglin-1. The preservation of the assemblages in the interval are moderate to poor.

Zone G : 2199.0 - 2321.0m.

The uphole appearance of Globigerinoides trilobus at 2321.0m defines the base of Zone G.

Zones D-2/D-1 : 1929.9 - 2170.0m.

The base of Zone D-2 is defined by the uphole entry of Orbulina universa at 2170.0m. Zones D-2 and D-1 have been grouped because the lower boundary defining species of Zone D-1, Globorotalia peripheroacuta, has not been recorded. The value of Globorotalia peripheroacuta for zonal designation is questionable because the species is itinerant and when present is generally rare.

Zone C : 1810.0 - 1910.0m.

The uphole first appearance of Globorotalia miotumida miotumida at 1910.0m defines the base of Zone C in Teraglin-1.

Zone B-2 : 1780.0m.

The base of Zone B-2 is defined by the uphole entry of Globorotalia acostaensis at 1780.0m.

REFERENCES

- MACPHAIL, M.K., 1983. Palynological analysis, Teraglin-1, Gippsland Basin. Esso Australia Ltd., Palaeontology Report, 1983/29.
- REXILIUS, J.P., 1982. Foraminiferal analysis, Yellowtail-2, Gippsland Basin. Esso Australia Ltd., Palaeontology Report 1982/45.
- REXILIUS, J.P., 1983. Revised Foraminiferal biostratigraphy, Opah-1, Gippsland Basin. Esso Australia Ltd., Palaeontology Report 1983/14.
- REXILIUS, J.P., (in prep). Revised foraminiferal biostratigraphy, Cobia-2, Gippsland Basin.
- TAYLOR, D.J. (in prep). Observed Gippsland biostratigraphic sequences of planktonic foraminiferal assemblages.

MICROPALAEONTOLOGICAL DATA SHEET

BASIN: GIPPSLAND

ELEVATION: KB: 21.0m GL: -79.3m

WELL NAME: TERAGLIN-1

TOTAL DEPTH: 3373m

AGE	FORAM. ZONULES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
PLEISTOCENE	A ₁										
	A ₂										
PLIOCENE	A ₃										
	A ₄										
MIOCENE	LATE	B ₁									
		B ₂	1780.0	1			1780.0	1			
		C	1810.0	1			1910.0	1			
	MIDDLE	D ₁	1929.9	1							
		D ₂					2170.0	0			
		E ₁									
		E ₂									
	EARLY	F									
		G	2199.0	1			2321.0	1			
		H ₁	2349.0	1			2412.0	1			
OLIGOCENE	LATE	H ₂									
		I ₁									
		I ₂									
	EARLY	J ₁									
		J ₂	2415.0	0			2418.0	0			
		K	2419.0	1			2419.0	1			
EOCENE	Pre-K										

COMMENTS: There is a substantial hiatus spanning most of the Oligocene (Zones J-1 to H-2 missing) in Teraglin-1. The 2 lowermost Early Miocene sample (SWC 78 at 2412.0m and SWC 123 to 2409.0m) contain reworked Early Oligocene (Zone J-2) assemblages. The absence of Zones F and E may be the result of a gap in sampling or may be the result of hiatus.

- CONFIDENCE RATING:
- 0: SWC or Core - Complete assemblage (very high confidence).
 - 1: SWC or Core - Almost complete assemblage (high confidence).
 - 2: SWC or Core - Close to zonule change but able to interpret (low confidence).
 - 3: Cuttings - Complete assemblage (low confidence).
 - 4: Cuttings - Incomplete assemblage, next to uninterpretable or SWC with depth suspicion (very low confidence).

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: J.P. Rexilius
 DATA REVISED BY: J.P. Rexilius

DATE: June 2, 1983.
 DATE: August 25, 1983.

TABLE 1
SUMMARY OF PALAEOONTOLOGICAL ANALYSIS, TERAGLIN-1, GIPPSLAND BASIN
INTERPRETATIVE DATA

NATURE OF SAMPLE	DEPTH (M)	PLANKTONIC FORAMINIFERAL YIELD	PRESERVATION	DIVERSITY	ZONE	AGE	COMMENTS
SWC 57	2450.0	Barren	-	-	-	-	-
SWC 58	2444.5	Barren	-	-	-	-	-
SWC 59	2447.0	Barren	-	-	-	-	-
SWC 60	2445.0	Barren	-	-	-	-	-
SWC 61	2444.0	Barren	-	-	-	-	-
SWC 62	2443.0	Barren	-	-	-	-	-
SWC 63	2440.0	Barren	-	-	-	-	-
SWC 64	2438.5	Barren	-	-	-	-	-
SWC 65	2435.5	Barren	-	-	-	-	-
SWC 66	2433.0	Barren	-	-	-	-	-
SWC 67	2430.5	Barren	-	-	-	-	Substantial downhole contamination.
SWC 68	2429.5	Barren	-	-	-	-	-
SWC 69	2428.0	Barren	-	-	-	-	-
SWC 70	2427.0	Barren	-	-	-	-	-
SWC 71	2425.5	Barren	-	-	-	-	-
SWC 121	2423.0	Barren	-	-	-	-	Agglutinate forams (rare) and fish teeth (rare).
SWC 73	2420.5	Low	Very poor	Very low	Indeterminate	-	Fish teeth.
SWC 74	2419.0	High	Poor	Moderate	K	latest Eocene/ earliest Oligocene.	Fish teeth.
SWC 75	2418.0	High	Poor	Moderate	J-2	Early Oligocene	Fish teeth.
SWC 77	2415.0	High	Moderate/poor	Moderate	J-2	Early Oligocene	Fish teeth.
SWC 78	2412.0	Low/moderate	Poor	Low	H-1	Early Miocene	Contains reworked Early Oligocene.
SWC 123	2409.0	High	Poor	Low	H-1	Early Miocene	Contains reworked Early Oligocene.

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INTERPRETATIVE DATA

NATURE OF SAMPLE	DEPTH (M)	PLANKTONIC FORAMINIFERAL YIELD	PRESERVATION	DIVERSITY	ZONE	AGE	COMMENTS
SWC 124	2406.0	High	Poor/moderate	Low	H-1	Early Miocene	
SWC 125	2404.1	Moderate	Poor/moderate	Low/moderate	H-1	Early Miocene	
SWC 82	2400.5	Moderate	Poor	Low/moderate	H-1	Early Miocene	
SWC 83	2397.5	Low/moderate	Poor	Low	H-1	Early Miocene	
SWC 84	2394.5	Low/moderate	Poor	Low	H-1	Early Miocene	
SWC 85	2390.0	Low	Poor	Low	H-1	Early Miocene	
SWC 86	2385.0	Moderate	Poor	Moderate	H-1	Early Miocene	
SWC 87	2379.9	High	Moderate	High	H-1	Early Miocene	
SWC 88	2349.0	Moderate/high	Poor	Moderate	H-1	Early Miocene	
SWC 89	2321.0	Moderate/low	Poor	Moderate/high	G	Early Miocene	
SWC 90	2290.0	Low	Poor/moderate	Moderate	G	Early Miocene	
SWC 91	2260.5	Very low	Poor	Low	G	Early Miocene	Shell fragments, bryozoa, echinoid spines.
SWC 92	2233.9	High	Moderate/good	Moderate/high	G	Early Miocene	
SWC 93	2199.0	Moderate	Poor/moderate	Low	G	Early Miocene	Opaline Ammodiscus common.
SWC 94	2170.0	High	Good	High	D-2/D-1	Mid Miocene	
SWC 95	2139.5	High	Moderate/good	High	D-2/D-1	Mid Miocene	
SWC 96	2110.0	Low/moderate	Poor	Moderate	D-2/D-1	Mid Miocene	
SWC 97	2079.9	High	Moderate/good	Moderate	D-2/D-1	Mid Miocene	
SWC 98	2049.9	High	Poor/moderate	Moderate/high	D-2/D-1	Mid Miocene	
SWC 99	2021.9	Moderate	Poor	Low/moderate	D-2/D-1	Mid Miocene	
SWC 100	1988.0	Low/moderate	Poor/moderate	Moderate	D-2/D-1	Mid Miocene	Sponge spicules, echinoid spines.

TABLE 1
SUMMARY OF PALAEOONTOLOGICAL ANALYSIS, TERAGLIN-1, GIPPSLAND BASIN
INTERPRETATIVE DATA

NATURE OF SAMPLE	DEPTH (M)	PLANKTONIC FORAMINIFERAL YIELD	PRESERVATION	DIVERSITY	ZONE	AGE	COMMENTS
SWC 101	1961.0	Moderate/high	Moderate	Moderate	D-2/D-1	Mid Miocene	Sponge spicules, echinoid spines.
SWC 102	1929.9	Low/moderate	Poor	Moderate	D-2/D-1	Mid Miocene	Echinoid spines.
SWC 126	1910.0	Moderate	Poor	Moderate	C	Mid Miocene	Sponge spicules (rare)
SWC 127	1890.0	Moderate	Poor	Moderate	C	Mid Miocene	Sponge spicules.
SWC 128	1870.1	Very low	Poor/moderate	Low	Indeterminate	-	Sponge spicules.
SWC 130	1830.0	Low	Poor	Low	Indeterminate	-	Sponge spicules (rare)
SWC 131	1810.0	High	Moderate	Moderate/high	C	Mid Miocene	Sponge spicules, high proportion of juvenile planktonics.
SWC 132	1780.0	Moderate	Poor/moderate	Moderate/high	B-2	Late Miocene	Echinoid spines, fish teeth (rare).

BASIC DATA.

TABLE 2 : FORAMINIFERAL DATA, TERAGLIN-1.
RANGE CHART : TERTIARY PLANKTONIC FORAMINIFERA.

TABLE 2
SUMMARY OF PALAEOONTOLOGICAL ANALYSIS, TERAGLIN-1, GIPPSLAND BASIN
BASIC DATA

NATURE OF SAMPLE	DEPTH (M)	PLANKTONIC FORAMINIFERAL YIELD	PRESERVATION	DIVERSITY	COMMENTS
SWC 57	2450.0	Barren	-	-	-
SWC 58	2444.5	Barren	-	-	-
SWC 59	2447.0	Barren	-	-	-
SWC 60	2445.0	Barren	-	-	-
SWC 61	2444.0	Barren	-	-	-
SWC 62	2443.0	Barren	-	-	-
SWC 63	2440.0	Barren	-	-	-
SWC 64	2438.5	Barren	-	-	-
SWC 65	2435.5	Barren	-	-	-
SWC 66	2433.0	Barren	-	-	-
SWC 67	2430.5	Barren	-	-	Substantial downhole contamination.
SWC 68	2429.5	Barren	-	-	-
SWC 69	2428.0	Barren	-	-	-
SWC 70	2427.0	Barren	-	-	-
SWC 71	2425.5	Barren	-	-	-
SWC 121	2423.0	Barren	-	-	Agglutinate forams (rare) and fish teeth (rare).
SWC 73	2420.5	Low	Very poor	Very low	Fish teeth.
SWC 74	2419.0	High	Poor	Moderate	Fish teeth.
SWC 75	2418.0	High	Poor	Moderate	Fish teeth.
SWC 77	2415.0	High	Moderate/poor	Moderate	Fish teeth.
SWC 78	2412.0	Low/moderate	Poor	Low	Contains reworked Early Oligocene.
SWC 123	2409.0	High	Poor	Low	Contains reworked Early Oligocene.
SWC 124	2406.0	High	Poor/moderate	Low	-
SWC 125	2404.1	Moderate	Poor/moderate	Low/moderate	-
SWC 82	2400.5	Moderate	Poor	Low/moderate	-
SWC 83	2397.5	Low/moderate	Poor	Low	-
SWC 84	2394.5	Low/moderate	Poor	Low	-
SWC 85	2390.0	Low	Poor	Low	-
SWC 86	2385.0	Moderate	Poor	Moderate	-
SWC 87	2379.9	High	Moderate	High	-
SWC 88	2349.0	Moderate/ high	Poor	Moderate	-
SWC 89	2321.0	Moderate/low	Poor	Moderate/high	-
SWC 90	2290.0	Low	Poor/moderate	Moderate	-

TABLE 2
SUMMARY OF PALAEOLOGICAL ANALYSIS, TERAGLIN-1, GIPPSLAND BASIN
BASIC DATA

NATURE OF SAMPLE	DEPTH (M)	PLANKTONIC FORAMINIFERAL YIELD	PRESERVATION	DIVERSITY	COMMENTS
SWC 91	2260.5	Very low	Poor	Low	Shell fragments, bryozoa, echinoid spines.
SWC 92	2233.9	High	Moderate/good	Moderate/high	-
SWC 93	2199.0	Moderate	Poor/moderate	Low	Opaline Ammodiscus common.
SWC 94	2170.0	High	Good	High	-
SWC 95	2139.5	High	Moderate/good	High	-
SWC 96	2110.0	Low/moderate	Poor	Moderate	-
SWC 97	2079.9	High	Moderate/good	Moderate	-
SWC 98	2049.9	High	Poor/moderate	Moderate/high	-
SWC 99	2021.9	Moderate	Poor	Low/moderate	-
SWC 100	1988.0	Low/moderate	Poor/moderate	Moderate	Sponge spicules, echinoid spines.
SWC 101	1961.0	Moderate/ high	Moderate	Moderate	Sponge spicules, echinoid spines.
SWC 102	1929.9	Low/moderate	Poor	Moderate	Echinoid spines.
SWC 126	1910.0	Moderate	Poor	Moderate	Sponge spicules (rare)
SWC 127	1890.0	Moderate	Poor	Moderate	Sponge spicules.
SWC 128	1870.1	Very low	Poor/moderate	Low	Sponge spicules.
SWC 130	1830.0	Low	Poor	Low	Sponge spicules (rare)
SWC 131	1810.0	High	Moderate	Moderate/high	Sponge spicules, high proportion of juvenile planktonics.
SWC 132	1780.0	Moderate	Poor/moderate	Moderate/high	Echinoid spines, fish teeth (rare).