C O N T E N T S

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Glossary of semiquantitative source rock parameters recorded using palynological techniques.

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TABLE 1
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Summary of the source rock and maturity data from Comley-1.

1. ABSTRACT

Comley-1 was drilled to 529m KB in Permit PEP 98, onshore Gippsland Basin. Sidewall core samples from 161.0 to 486.0m have been examined for calcareous nannoplankton, foraminifera and palynomorphs.

DEPTH (m)	UNIT	ZONE	AGE
161	Gippsland Limestone	T. bellus or younger	Middle Miocene or younger
178.3	Gippsland Limestone	D	Middle Miocene
347.5-379	Gippsland Limestone	NN4-NN5, G-F	Upper Early Miocene
412.5-438	Gippsland Limestone	NN2-NN3, H1-G	Early Miocene
447.5-465	Lakes Entrance Fm. ('upper member')	NN1, I1-H1	Lower Early Miocene
473	Lakes Entrance Fm. ('upper member')	NP25	Late Oligocene
478.5-480	Lakes Entrance Fm. ('lower member')	NP23-24, P. tuberculatus	Oligocene
486.5	Lakes Entrance Fm. ('lower member')	P. tuberculatus	Oligocene

The sequence from 161m to 478.5m was deposited in inner to middle neritic conditions. A marine environment is also indicated from 480m to 486.5m.

No significant source rocks were observed in the well. Spore colours of light yellow, white fluorescence and vitrinite reflectance of 0.24%-0.27% indicates the interval penetrated was immature.

11. INTRODUCTION

ECL Geological Laboratory was contracted by Ampol Exploration Ltd to undertake laboratory studies of sidewall core samples of the well Comley-1. The well is located in onshore exploration Permit PEP 98, Gippsland Basin, Victoria, and was drilled to a total depth of 529m KB.

Sidewall core samples from the interval 161.0 to 486.0m were analysed for calcareous nannoplankton, foraminifera, palynomorphs, source rock potential and maturity. The objective of this study was to provide biostratigraphic zonations, interpretation of depositional environment and information on hydrocarbon habitat for geological evaluation of the well section.

III. ROCK-STRATIGRAPHIC NOMENCLATURE

(A) Lakes Entrance Formation (Lower Member)

In this investigation Early-Late Oligocene glauconitic sandstone, oxidized glauconitic sandstone-siltstone and glauconitic marl, are referred to informally as the "lower member" of the Lakes Entrance Formation. The "lower member" includes the following formal onshore stratigraphic units : Colquhoun Sandstone Member, Cunninghame Greensand Member, Metung Marl Member, Giffard Sandstone Member and Seacombe Marl Member.

(B) Lakes Entrance Formation (Upper Member)

In this investigation Late Oligocene-Early Miocene marls are referred to informally as the "upper member" of the Lakes Entrance Formation.

(C) Gippsland Limestone

In Comley-1 Early-Middle Miocene clean skeletal limestone and calcarenites with common bryozoan fragments are referred to as the Gippsland Limestone.

IV. GEOLOGICAL COMMENTS

On the basis of wireline log character a disconformity is inferred at 481m (See Figure 2). The sonic kick between 481m and 482m is interpreted to represent an oxidized horizon. The interval 481-486.5m is definitely no older than Early Oligocene (no older than P. tuberculatus) and more likely to be Early Oligocene in age. The occurrence of common dinoflagellates at 486.5m indicates that the interval 481-486.5m represents part of the 'lower member' of the Lakes Entrance Formation. The section from 486.5m to basement (497m) was not examined palynologically but is tentatively interpreted to also represent 'lower member' of the Lakes Entrance Formation.

A mid-Oligocene hiatus is inferred at 481m although this cannot be demonstrated on palaeontological evidence. The oxidized horizon between 481m and 482m in Comley-1 is considered to correlate with oxidized horizons between 536-537m in Fairhope-1 and 576-577m in Paynesville-1 (See Figure 2). The oxidized horizon formed during Zone NP23-NP24 time (based on biostratigraphic evidence in Fairhope-1) and is interpreted to have formed during and after the major mid-Oligocene global fall in sea-level (30Ma event) proposed by Vail et. al. (1977). This event has certainly resulted in a widespread mid-Oligocene disconformity in offshore Gippsland Basin wells (unpublished data).

A 5m thick glauconitic sandy marl of Early/Late Oligocene (Zone NP23-NP24) age is inferred to rest on the mid-Oligocene disconformity surface in Comley-1. The top of this sequence is

defined by another oxidized horizon between 476-478m (defined by sonic kick). The sidewall core sample at 476.5m penetrated a highly oxidized siltstone. A second and younger intra-Lakes Entrance Formation disconformity is inferred at 476m with 'upper member' marls of Late Oligocene (Zone NP25) age resting on 'lower member' oxidized glauconitic facies of Zone NP23/24 age. The oxidized horizon has also been recorded in Fairhope-1 between 530.5m and 534m, and in Paynesville-1 between 569m and 570.5m (see Figure 2).

The boundary between the Gippsland Limestone and the Lakes Entrance Formation has been selected at the log break at 438.5m. The sidewall core sample immediately above the log break at 438.0m is a bryozoan rich calcarenite.

V. MICROPALAEONTOLOGY

A total of 14 sidewall core samples from the interval 161.0-486.5m were analysed for foraminifera and calcareous nannoplankton. Calcareous microfossil species identified in the well section, interpreted zonation and depositional environment subdivision have been plotted on the micropalaeotological distribution chart (Enclosure 1).

The planktonic foraminiferal letter zonal scheme of Taylor (in prep.) and the NP-NN calcareous nannoplankton letter scheme of Martini (1971) are used in this investigation. Foraminiferal studies by Carter (1964) and Jenkins (1971), and calcareous nannoplankton investigations by Edwards (1971) and Siesser (1979), have also been consulted.

(A) Calcareous Nannoplankton Biostratigraphy

i) 161.0m-178.3m : Indeterminate

The low yielding and poorly preserved calcareous nannofossil assemblages at 161.0m and 178.3m are not age diagnostic.

ii) 347.5m-379.0m : Zones NN4-NN5 (Upper Early Miocene-Lower Middle Miocene)

The occurrence of Sphenolithus heteromorphous in the interval indicates a Zone NN4 to NN5 age.

iii) 412.5m-438.0 : Zones NN2-NN3 (Early Miocene)

The downhole extinction of Sphenolithus heteromorphous at 412.5m and the uphole appearance of Discoaster druggii at 438.0 indicates that the interval is NN2 to NN3 in age.

iv) 447.5m-465.0m : Zone NN1 (basal Early Miocene)

The association of Helicosphaera cf. cartieri without Zygrhablithus bijugatus (extinction marker that approximates the top of the Oligocene in the Gippsland Basin and New Zealand) and Discoater druggii (defining event for base of Zone NN2) indicates that the rich nannofossil assemblage in the interval is assignable to the upper part of Zone NN1.

v) 473.0m : Zone NP25 (Late Oligocene)

The common occurrence of Dictyococcites bisectus without Chiasmolithus oamaruensis indicates that the sample at 473.0m is Zone NP25 in age. The nannofossil assemblage equates with the Discoaster deflandre Zone of Edwards (1971).

vi) 476.5m : Indeterminate

The moderate yielding nannofossil assemblage at 476.5m comprises mainly downhole contaminants from the Early Miocene section higher in the well. The absence of Oligocene marker species indicates that in situ nannofossils are absent or rare.

vii) 478.5m-480.0m : Zones NP23-NP24 (Early/Late Oligocene boundary).

The uphole extinction of Chiasmolithus oamaruensis at 478.5m defines the top of Zone NP24 in the well (= top of Syrocosphaera clathrata Zone of Edwards, 1971). The absence of Reticofenestra umbilica (= R. placomorpha of Edwards 1971) indicates that the nannofossil assemblage in the interval is no older than Zone NP23. The base of Zone NP23

correlates with the base of the Cyclococcolithus neogammation and the top of the Reticulofenestra placomorpha Zones of Edwards (1971).

B) Planktonic Foraminiferal Biostratigraphy

i) 161.0m : Indeterminate

The very low yielding planktonic foraminiferal assemblage at 161.0m is not age-diagnostic.

ii) 178.3m : Zone D (Middle Miocene)

The association of Orbulina universa and Globorotalia mayeri at 178.3m is indicative of Zone D.

iii) 347.5m : Zone F (Early Miocene)

The occurrence of Globigerinoides sicanus without the Orbulina-Praeorbulina group indicates that the sample at 347.5m is Zone F in age.

iv) 352.0m-424.0m : Zone G (Early Miocene)

The uphole appearance of Globigerinoides trilobus at 424.0m defines the base of Zone G in the well.

v) 438.0m : Zone H1 or younger (Early Miocene)

The moderately high yielding assemblage at 438.0m is dominated by Globigerina praebulloides. The occurrence of Globorotalia obesa indicates an age no older than Zone H1 (based on range of species in New Zealand as defined by Jenkins, 1971).

vi) 447.5m : Zone H1 (Early Miocene)

The occurrence of Globigerina woodi connecta without Globigerinoides trilobus at 447.5m indicates a Zone H1 age.

vii) 465.0m : No older than I1 (no older than Late Oligocene)

The presence of Globoquadrina dehiscens at 465.0m indicates an age no older than Zone I1. The high yielding planktonic foraminiferal assemblage is dominated by juveniles, turborotalids and globigerinids.

viii) 473.0m-478.5m : Indeterminate.

Samples at 473.0 and 476.5m contain planktonic foraminiferal assemblages which are not age-diagnostic while the sample at 478.5m is barren.

C) Environment of Deposition

i) 161.0m-178.3m : Inner neritic

An inner neritic benthonic foraminiferal assemblage comprising a moderately diverse calcareous benthonic fauna including common Elphidium crassatum is represented in the interval. The abundance of bryozoan fragments in the interval confirms an inner neritic environment of deposition.

ii) 347.5m : Inner/middle neritic

The common occurrence of bryozoan fragments, the very low yield of planktonic foraminifera, and the presence of moderate numbers of Cassidulina subglobosa and Brizalina spp, indicates that the sample at 347.5m was deposited in an inner to middle neritic environment.

iii) 352.0m : Middle Neritic

The sample at 352.0m comprises approximately 10% planktonic foraminifera with a rich calcareous benthonic foraminiferal assemblage including high numbers of Brizalina spp. and moderate numbers of Euvigerina spp. This foraminiferal assemblage is typical of a middle neritic environment.

iv) 379.0m - 424.0m : Inner neritic

An inner neritic environment of deposition for the interval is reflected by the low yield of planktonic foraminifera, very low numbers of Brizalina spp and Euvigerina spp. and the common occurrence of bryozoan fragments.

v) 438.0m : Inner/middle neritic

The sample at 438.0m comprises approximately 15% planktonic foraminifera, lacks Euvigerina spp. and Brizalina spp., but contains moderate numbers of Sphaeroidina bulloides. Bryozoan fragments represent a common constituent of the fossil assemblage in the sample. The foraminifera and associated macrofossil debris are indicative of an inner to middle neritic environment of deposition.

vi) 447.5-473.0m : Middle neritic

The interval contains moderately high numbers of planktonic foraminifera dominated by juveniles, turborotalids and globigerinids. The planktonic foraminiferal percentage ranges between 10 and 25%. The benthonic foraminiferal assemblage in the interval is very diverse with moderate to high numbers of Sphaeroidina bulloides and Euvigerina spp. Bryozoan fragments are lacking. The foraminiferal

assemblage in the interval is indicative of a middle neritic environment.

vii) 478.5m : Inner neritic

The common occurrence of Parrellina crespinae together with the lack or absence of Brizalina spp., Euvigerina spp., Sphaeroidina bulloides and planktonic foraminifera, indicate that the sample at 478.5m was deposited in an inner neritic environment.

viii) 480.0m : Marine

Only calcareous nannoplankton was scrutinized for the sample at 480.0m. The occurrence of common nannofossils in the sample indicates a marine environment of deposition.

VI. PALYNOLOGY

Four samples, three between 478.5m and 486.5m inclusive, and one at 161.0m, were palynologically analysed. The upper two samples were low to moderate in organic and palynomorph contents while the lower two were rich on both accounts. The following palynological zones are recognised:

A) Palynostratigraphy

i) 161.0m : Triporopollenites bellus Zone or younger (Miocene)

The sample is not older than the Triporopollenites bellus Zone of Early-Middle Miocene as indicated by Rugulatisporites micraulaxus which has its base occurrence in the zone. The dinoflagellate cyst Operculodiunium giganteum occurring in the sample is known to be restricted to the Miocene.

ii) 478.5m - 486.5m : Proteacidites tuberculatus Zone (Oligocene).

The interval is correlated with the Proteacidites tuberculatus Zone of Oligocene age on account of the following evidence: Cyathidites subtilis, Foveotriletes crater and Proteacidites symphyonemoides have their basal occurrences in the zone; and Nothofagidites asperus, Parvisaccites catastas and Proteacidites stipplatus have their top occurrences in the same zone. Also, the dinoflagellate cyst Hystrichokolpoma rigaudae occurring in all samples has its known top in the Oligocene.

B) Environment of Deposition

All samples examined contain abundant and diverse dinoflagellate cysts and common foraminiferal chamber-linings indicating deposition in a marine environment.

VII. SOURCE ROCK POTENTIAL AND MATURITY

Two samples at 480.0m and 486.5m were examined for source rock potential and organic maturity. The results are given in Tables 1A, 1B and 1C, and the methods and terms used are explained in Appendix No. 1.

Both samples yielded less than 0.5ml/10g organic matter suggesting a poor source-rock potential countered slightly by moderate liptinite and fluorescing liptinite percentages. The spore colours varied from light yellow through yellow to light orange and gave white and yellow fluorescence colours. These data are indicative of immaturity to early oil generating capabilities.

Vitrinite reflectance determinations were made on both the samples (Appendix 2). At 480m the 12 readings indicate a mean reflectance of 0.24% with a range of 0.19% to 0.32%. At 486.5m 27 readings gave a mean of 0.27% with a range of 0.19% to 0.34%. These confirm the immaturity of the section.

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FIGURE 1 : SUMMARY CHART, COMLEY-1

DEPTH (mKB)	LITHOLOGY *	UNIT	NANNOFOSSIL ZONE	PLANK FORAM ZONE	PALYNOLOGY ZONE	AGE		ENVIRONMENT
161.0	Calcarenite		Indeterm.	Indeterm.	T. bellus or or younger	Upper Early Miocene or younger		Inner neritic
178.3	Calcarenite		Indeterm.	D	Not studied	Middle Miocene		Inner neritic
347.5	Calcarenite		NN4-NN5	F	Not studied	Upper Early Miocene		Inner-middle neri
352.0	Calcisiltite	Gippsland	NN4-NN5	G	Not studied	Upper Early Miocene		Middle neritic
379.0	Calcarenite	Limestone	NN4-NN5	G	Not studied	Upper Early Miocene		Inner neritic
412.5	Calcarenite		NN2-NN3	G	Not studied	Early Miocene		Inner neritic
424.0	Calcarenite		NN2-NN3	G	Not studied	Early Miocene		Inner neritic
438.5	Calcarenite		NN2-NN3	H1 or younger	Not studied	Early Miocene		Inner/middle neri
				log break at 438.5m				
447.5	Marl	Lakes	NN1	H1	Not studied	Lower Early Miocene		Middle neritic
465.0	Marl	Entrance	NN1	No older than I1	Not studied	Lower Early Miocene		Middle neritic
473.0	Marl	Formation (upper member)	NP25	Indeterm.	Not studied	Late Oligocene		Middle neritic
				log break at 476.0m				
#476.5	Oxidized siltstone		Indeterm.	Indeterm.	Not studied			Indeterm.
478.5	Sandy glauconitic marl	Lakes Entrance	NP23-NP24	Indeterm.	P. tuberculatus	Early/Late Oligocene		Inner neritic
480.0	?	Formation (lower member)	NP23-NP24	Not studied	P. tuberculatus	Early/Late Oligocene	+	Marine
				log break at 481.0m				
486.5	?		Not studied	Not studied	P. tuberculatus	Early Oligocene	+	Marine

* Lithology based on washed residue

\# Downhole contamination noted.

\+ Environment based on palynomorph data.

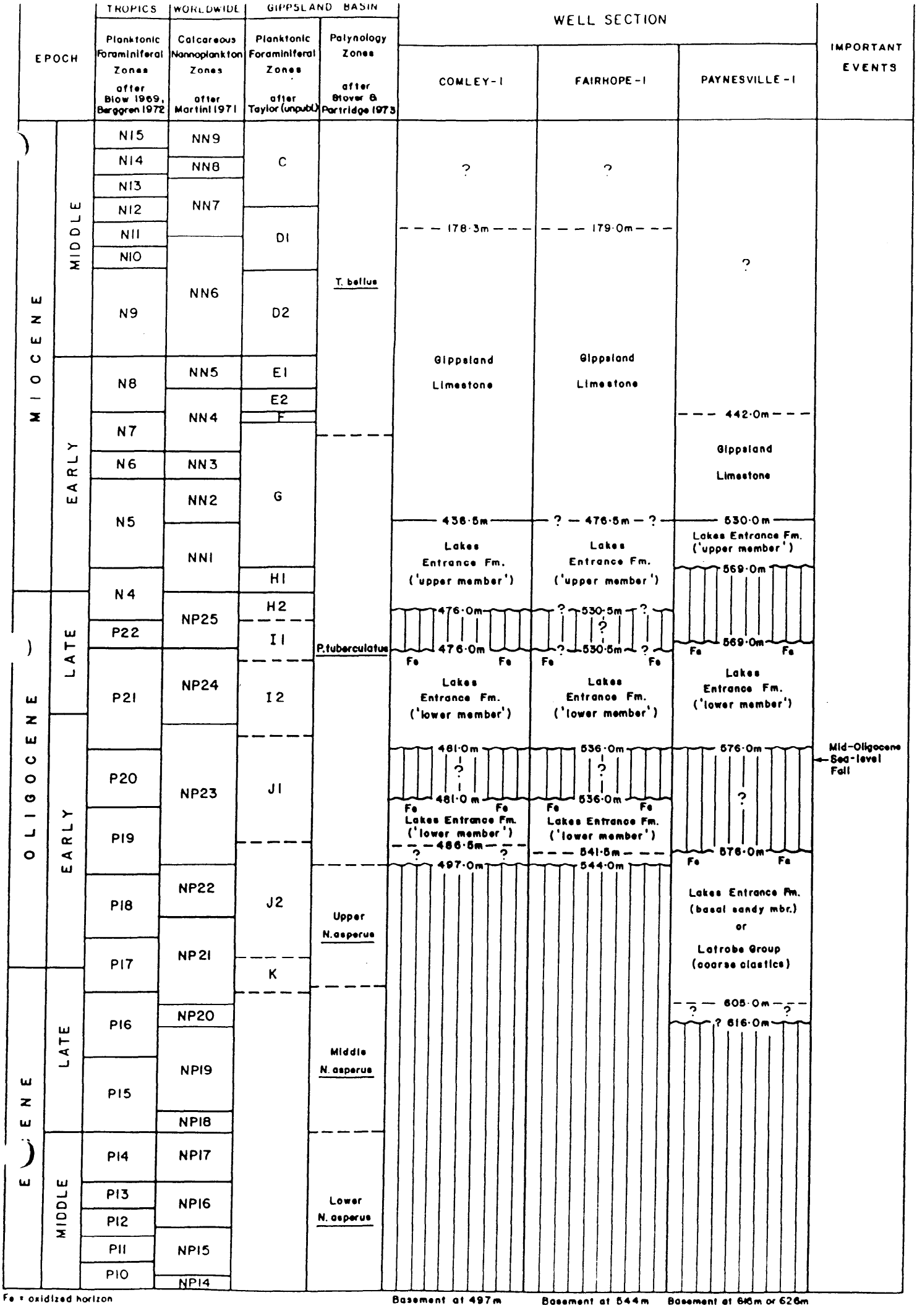

Fig 2 Tentative chronostratigraphic correlation between Comley-1, Fairhope-1, & Paynesville-1 wells, onshore Gippsland Basin

Tentative chronostratigraphic correlation between COMLEY 1, FAIRHOPE 1 & PAYNESVILLE 1 wells, onshore Gippsland Basin - revised by Ampol Exploration Ltd

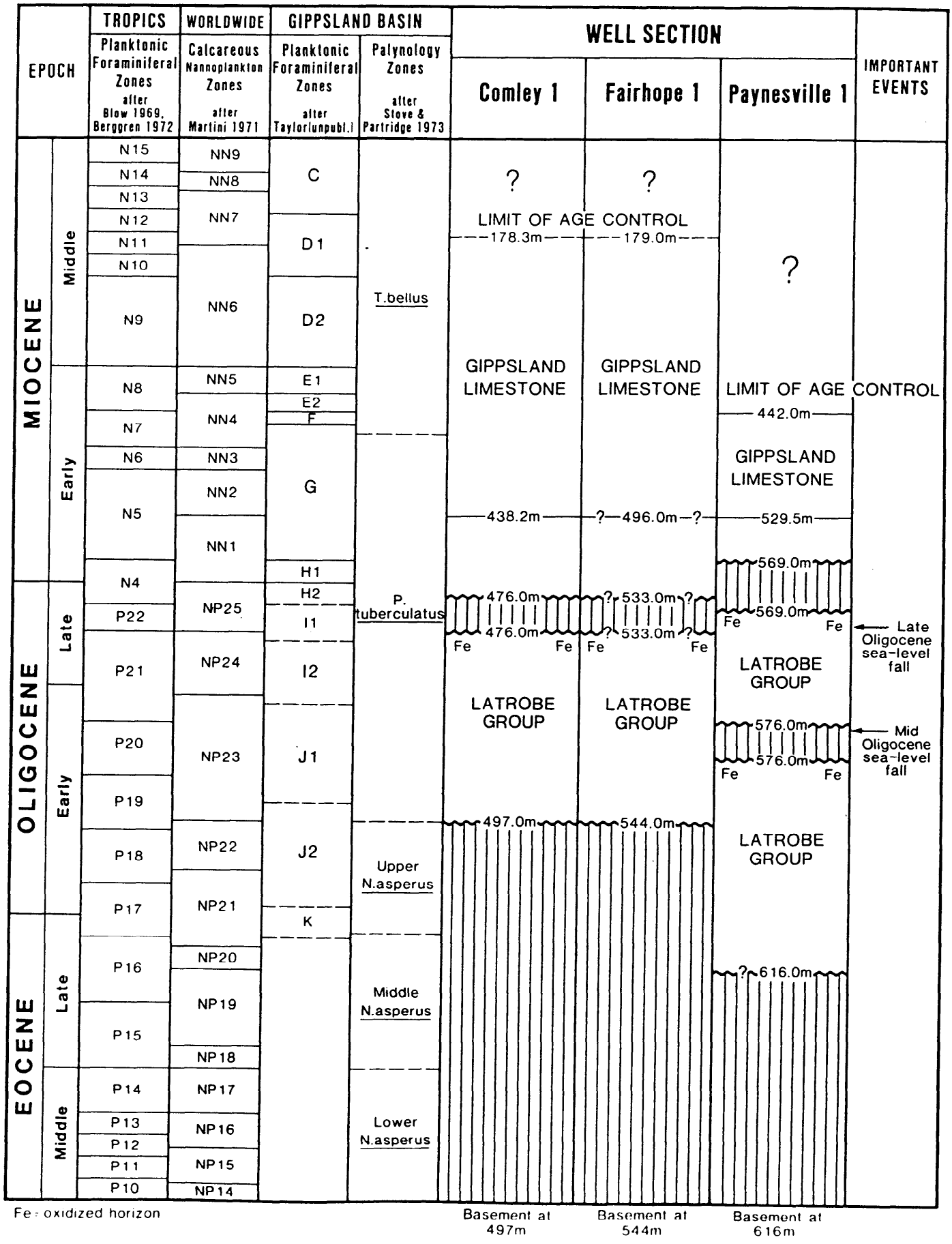

FIGURE 3

Spores and pollen recorded in Comley-1

KEY:

x - present
c - common
cf - compared with

	161.0m	468.5m	478.5m	480.0m
Alisporites varius	x			x
Araucariacites australis		x	x	x
Baculatisporites comaumensis		x	x	
Baculatisporites disconformis	x			
Cyathidites australis	x	x	x	x
Cyathidites minor	x	x	c	x
Cyathidites subtilis	x	x	x	x
Cycadopites follicularis	x		x	
Dacrycarpites australiensis	x	x	x	
Gleicheniidites senonicus		x		x
Haloragacidites harrisii	x	x	x	x
Herkosporites elliottii		x	x	x
Laevigatosporites major	x	x	x	x
Laevigatosporites ovatus	x	x	x	
Liliacidites lanceolatus	x			
Lygistepollenites florinii	x	x	x	x
Malvacipollis subtilis		x	x	x
Myrtaceidites eugenioides		x		
Myrtaceidites verrucosus				x
Nothofagiditee brachyspinulosus		x	x	
Nothofagidites asperus		x	x	
Nothofagidites deminutus		x		
Nothofagidites emarcidus	x	x	x	x
Nothofagidites falcatus		x		
Nothofagidites flemingii		x	x	
Nothofagidites goniatus		x		
Nothofagidites heterus		x	x	x
Nothofagidites incrassatus	x	x	x	
Nothofagidites vansteenisii		x	x	x
Osmundacidites wellmanii		x	x	
Parvisaccites catastus		x		x
Phyllocladidites verrucatus	x	x	x	x
Podocarpidites ellipticus	x	x	x	x
Propylipollis beddoesii		x		x
Proteacidites adenanthoides	x			
Proteacidites crassus			x	
Proteacidites granulatus	x	x		x
Proteacidites incurvatus		x		
Proteacidites obscurus		x		
Proteacidites stipplatus			x	x
Proteacidites symphyonemoides		x		
Proteacidites tenuiexinus			x	
Retitriletes austroclavatidites		x	x	
Rugulatisporites micraulaxus	x			
Tricolpites aspermarginis			x	
Tricolpites simatus		x	x	
Tricolporites paenestriatus		x		
Triletes tuberculiformis	x	x	x	x
Verrucatosporites confragosus		x		

FIGURE 4

Dinoflagellates and acritarchs recorded in Comley-1

KEY:

x = present
c = common
cf = compared with

	161.0m	468.5m	478.5m	480.0m
Chiropteridium sp.				x
Dapsilidinium pastielsii				x
Eatonicysta n.sp.				x
Hystrichokolpoma rigaudae		x	x	x
Kallosphaeridium biarmatum				x
Leiosphaeridia sp.	x	x	x	x
Lingulodinium siculum	x			
Micrhystridium sp.				x
Operculodinium bellulum		x	x	x
Operculodinium centrocarpum	x	x	x	x
Operculodinium giganteum	x			
Paucisphaeridium sp.			x	
Pentadinium taeniagerum				x
Polysphaeridium biformum				x
Pterodinium cingulatum		x		
Senoniasphaera n.sp.				x
Spiniferites bentorii	x			
Spiniferites membranaceous		x		
Spiniferites mirabilis	x		x	x
Spiniferites pachydermus	x		x	x
Spiniferites ramosus gracilis	x	x	x	x
Spiniferites ramosus granomembranaceous				x
Spiniferites ramosus multibrevis	x		x	x
Spiniferites ramosus ramosus	x	x	x	x
Spiniferites ramosus reticulatus				x
Spiniferites spp.	x	x	x	x
Tectatodinium pellitum			x	

TABLE 1

Summary of the source rock and maturity data from Comley-1

TABLE 1A

DEPTH (m)	PALYNOLOGICAL ZONE	AGE	ENVIRONMENT OF DEPOSITION	OIL POTENTIAL	MATURITY
480.0	P. tuberculatus	Early Oligocene	Marine	Poor	Immature
486.5	P. tuberculatus	Early Oligocene	Marine	? Moderate	Immature

TABLE 1B

DEPTH (m)	SAMPLE NO.	WEIGHT (g)	VOM (ml)	PRESERVATION (0-4)	% MICRO-PLANKTON	MICRO-PLANKTON DIVERSITY	SPORE-POLLEN DIVERSITY	PALYN YIELD (0-4)	CUT-ICLE (0-4)	HYL-OGEN (0-4)	MELAN-OGEN (0-4)	GRANULAR SAPROPEL (0-4)	AMORPHOUS SAPROPEL (0-4)
480.0	7	10	0.4	3	20	2	4	1	1	3	3	2	2
486.5	6	10	0.3	3	90	4	4	2	1	3	3	2	2

TABLE 1C

DEPTH (m)	VOM ml/10g	%SAPRO-PEL	%LIPTINITE	%FLUORESCENT LIPTINITES	VOL. FLUOR. LIPTINITES microlitres	OIL INDEX (0-4)	GAS INDEX (0-4)	SPORE COLOUR	UV LIPTINITE FLUORESCENCE COLOUR
480.0	0.40	60	10	8	32	1	2	Lt yell-Yell-Lt or	White - Yellow
486.5	0.30	60	10	8	24	2	2	Lt yell-Yell-Lt or	White - Yellow