PALYNOLOGY REPORT

Patricia No.1, 672m - 880m, Gippsland Basin

by

Mary E. Dettmann

Prepared for:

LASMO ENERGY AUSTRALIA LTD.

October, 1987

SAMPLE type	depth	lithol.	SOURCE POTENTIAL low	mod.	high	v.high	OIL SOURCE POTENTIAL poor	ltd.	fair	good	MATURATION IM	EM	M	LM	OM	BIOSTRAT.	AGE	DEPOSITIONAL ENVIRONMENT terr.	par.	m.mar.	mar.
swc	672	sst.		*						*	*					n.o.U. P. tuberc.	Mioc				*
swc	683	sst.	*							*	*					n.o. U N. asperus	n.o.Eoc.				*
swc	692	sst.			*					*	*					n.o. U N. asperus	n.o.Eoc.				*
core	705	slst.			*				*		*					M. N. asperus	m/l Eoc.			*	
core	720	slst.	*						*		*					L. N. asperus	m. Eoc.			*	
core	722	slst.		*					*		*					L. N. asperus	m. Eoc.			*	
core	739.8	slst.	*						*		*					L. N. asperus	m. Eoc.			*	
core	743.5	shl.			*				*		*					P. asperopolus	e/m Eoc.	*			
swc	769	shl	Not a source				rock									Not determined					
swc	786.5	sst.	Not a source				rock									Not determined					
swc	821	shl.		*					*			*				P. pannosus	l. Alb.	*			
swc	880	shl.	*				*					*				P. pannosus	l. Alb.	*			
			0.8 1.2 2.4 (ml/10gm) KEROGEN YIELD				20 60 80 %H-RICH KEROGEN				GY Y A Br Bl 1.8 2.2 2.5 3.0 SPORE COLOUR/ TAI VALUE										

TABLE 1. Summary of palynological results showing inferred hydrocarbon source potential, oil source potential, maturation, age, and palaeoenvironments of sediments between 672m and 880m in Patricia No.1.

SUMMARY

The following conclusions are drawn from a palynological examination of sediments between 672m and 880m in Patricia No.1, Gippsland Basin.

Depth(m)	Palynostratigraphy	Age	Environments
672	n.o. Upper P. tuberculatus	n.o.early Miocene	marine
683	n.o. Upper N. asperus	n.o.late Eocene	marine
692	n.o. Upper N. asperus	n.o.late Eocene	marine
705	Middle N. asperus/L. extensa	mid/late Eocene	marginal marine
720	Lower N. asperus/D. heterophylcta	mid Eocene	marginal marine
722	Lower N. asperus	mid Eocene	marginal marine
739.5	Lower N. asperus/D. heterophylcta	mid Eocene	marginal marine
743.5	P. asperopolus	early/mid Eocene	terrestrial
769	unassigned	-	-
786.5	unassigned	-	-
821	P. pannosus	late Albian	terrestrial
880	P. pannosus	late Albian	terrestrial

The palynological evidence indicates that the Latrobe Group includes sediments of early/mid to mid/late Eocene age; productive sediments investigated from the underlying Strzelecki Group are of late Albian age. Dating of the Lakes Entrance Formation is constrained by restricted palynofloras, but confirms that sediments at 672m are no older than early Miocene.

Source Rock Potential

Depth(m)	Kerogen Yield	Kerogen Type	Maturity	(TAI)
672	moderate	fair liquid potential	immature	(1.5)
683	low	fair liquid potential	immature	(1.5)
692	high	limited liquid potential	immature	(1.5)
705	high	limited liquid potential	immature	(1.6)
720	low	limited liquid potential	immature	(1.6)
722	moderate	limited liquid potential	immature	(1.6)
739.8	low	limited liquid potential	immature	(1.6)
743.5	high	limited liquid potential	immature	(1.6)
769	-	poor source rock	-	-
786.5	-	poor source rock	-	-
821	moderate	limited liquid pot.	early mature	(2.0)
880	low	gas prone	early mature	(2.0)

INTRODUCTION

Sidewall and conventional core samples from between 672m and 880m in Patricia No.1, Gippsland Basin have been palynologically analysed to ascertain the age and biostratigraphic relationships of the sediments and to assess the palaeoenvironmental significance and maturation levels of the enclosed organic matter.

Preparation of the samples follows Phipps and Playford (1984). Additionally kerogen slides were made from the unoxidised fractions of the residues and the volume of organic matter per 10 gm of sediment was assessed. Organic residues were recovered from all but two of the samples (769m, 786.5m); the remainder yielded low to high volumes of organic matter in which are represented spores, pollen and algal microfossils. Conclusions drawn from the study are summarised in Table 1. Species distributions are documented in Table 2 and source rock/maturation data as determined palynologically are shown in Table 3.

BIOSTRATIGRAPHY AND AGE

Productive samples examined contain palynomorph assemblages of late Early Cretaceous and early-mid Tertiary ages. Biostratigraphic evaluation of the sequence is in terms of the Cretaceous spore-pollen zones of Dettmann & Playford (1969, see also Helby, Morgan and Partridge 1987) and the Tertiary spore-

pollen zones of Stover & Evans (1973) and Stover & Partridge (1973). The Australian Tertiary dinoflagellate sequence awaits detailed documentation, but Partridge (1976) provided a summary account of zones delineable in the Gippsland Basin. These are employed herein.

1. 672m; n.o. Upper P. tuberculatus Zone, n.o. early Miocene

The sample yielded a sparse spore-pollen assemblage in which Acacia pollen (Acaciaepollenites myriosporites) and Foveosporites lacunosus are represented and which indicate assignment as designated above and an age no older than early Miocene.

Dinocysts occur more frequently than do land plant palynomorphs and comprise a restricted assemblage supportive of a Miocene dating. As discussed by Truswell, Sluiter & Harris (1985) Australian mid Tertiary dinocyst assemblages have received little attention in the literature subsequent to the work of Deflandre & Cookson (1955) and further work is necessary to resolve a detailed dinocyst-based biostratigraphy.

2. 683m, 692m; n.o. Upper N. asperus Zone, n.o. mid-late Eocene

The sparse spore-pollen assemblages include Nothofagidites asperus and Proteacidites tuberculatus (692m only), thereby indicating an age no older than mid-late Eocene. The dinocysts suites are similar to that from 672m and a Miocene dating appears likely.

3. 705m; Middle N. asperus Zone/ L. extensa Zone, mid-late Eocene

The moderately diverse spore-pollen assemblage is dominated by Nothofagidites and is consistent with those of the lower and middle portions of the N. asperus Zone as delineated in the Gippsland Basin. Stratigraphically significant species represented include Nothofagidites asperus and Proteacidites pachypolus. Dinocysts occur infrequently. Taxa represented include Lentonia extensa and Deflandrea heterophylcta, the former is the nominate species of the L. extensa Zone that Partridge (1976) equates to the Middle N. asperus Zone.

4. 720m - 739.5m; Lower N. asperus Zone/ D. heterophylcta Zone, middle Eocene

All three samples provided abundant and diverse spore pollen assemblages in which Nothofagidites occurs abundantly and Haloragacidites harrisii commonly. The presence of Nothofagidites asperus together with Proteacidites pachypolus, P. asperopolus, Tricolpites thomasii and Tricolpites simatus confirm reference to the Lower N. asperus Zone. Dinoflagellates and prasinophycean/chlorophycean microfossils occur in all samples. The dinocysts assemblages are comparable to those reported from the middle Eocene and referable to the D. heterophylcta Zone.

5. 743.5m; P. asperopolus Zone, early-middle Eocene

Taxonomically diverse spores and pollen together with abundant cuticular material occurs in the organic residue extracted from the sample. Amongst the spore-pollen palynomorphs are represented common Haloragacidites harrisii together with frequent Proteacidites pachypolus, P. asperopolus, and Sapotaceoidaepollenites rotundus suggesting attribution to the P. asperopolus Zone. Also represented are species indicative of older zones (e.g. T. longus and L. balmei) and it seems likely that these have been recycled from latest Cretaceous - Paleocene sequences. Species that fall into this category include Gambierina edwardsii, G. rudata, Triporopollenites sectilis and Lygistepollenites balmei.

6. 769m, 786.5m; unassigned

No palynomorphs or organic matter was extracted from the samples.

7. 821m, 880m; P. pannosus Zone, late Albian

Both samples provided moderately diverse palynomorph assemblages in which spores and pollen occur abundantly. The presence of Phimopollenites pannosus together with Interlobites intraverrucatus, Coptospora paradoxa, Perotriletes laceratus, and Foraminisporis asymmetricus clearly indicates attribution to the P. pannosus Zone.

Algal microfossils occur in the samples, but forms represented are not biostratigraphically definitive with respect to the Early and mid Cretaceous.

PALAEOENVIRONMENTAL INFERENCES

Observations from both the kerogen preparations and the palynological strew slides are discussed in terms of their palaeoenvironmental significance.

1. 672m - 692m; n.o. late Eocene (including Miocene)

Organic matter extracted from the samples is dominantly of algal origin and includes dinocysts together with sapropelic detritus. The character of the dinocyst assemblages, the low input of terrestrial detritus, and the representation of linings of foraminiferal tests suggest deposition in marine situations.

2. 705m - 739.5m; middle-late Eocene

Plentiful terrestrial organic matter occurs in the residues in which less abundant algal detritus is also represented. The land plant palynomorphs suggest a contemporaneous vegetation of temperate and subtropical rainforest and fringing communities including podocarpaceous gymnosperms, Nothofagus, Proteaceae, Myrtaceae and Casuarinaceae. Frequent fungal palynomorphs are represented by spores, hyphae, and fruiting bodies; these are relics of fungal attack of litter and other vegetable matter. Algal assemblages include both dinocysts and chlorophycean/

prasinophycean types and are consistent with close-to-land deposition in marine influenced environments.

3. 743.5m; early-middle Eocene

Abundant organic matter extracted from the sample is almost entirely of land plant origin. It includes significant proportions of leaf and other cuticles, many of which bear evidence of considerable fungal degradation. The spore pollen assemblage reflects a vegetation of rainforest and mangrove communities consistent with warm temperate to tropical habitats. Algal microfossils occur rarely; they include freshwater chlorophycean forms.

The presence of recycled palynomorphs of latest Cretaceous-Paleocene age suggest that sediments at 743.5m were sourced, at least in part, from latest Cretaxceous - Paleocene sequences.

4. 769m, 786.5m; unassigned

The absence of palynomorphs and other organic debris precludes environmental inferences to be drawn of palynological grounds.

5. 821m, 880m; late Albian

Organic matter extracted from both samples is dominantly of land plant origin. The source of this detritus included rainforest and swamp communities of gymnosperms, ferns, lycopods and bryophytes.

Represented in the upper sample (821m) is a varied assemblage of freshwater chlorophycean algal cysts together with derivatives of aquatic ferns and liverworts. Deposition in a low energy swamp situation is indicated. Palynomorphs in the lower sample (880m) suggest that organic matter was largely sourced from dry land vegetation communities and deposited in a fluvial/ lacustrine situation.

SOURCE ROCK POTENTIAL

1. 672m - 692m; n.o. late Eocene (including Miocene)

The low to high yields of organic matter extracted from the samples include high proportions of algal kerogens and have fair potential to source liquids when mature. Spore colouration, however, indicates that the sediments are immature with respect to the main oil generation zone.

2. 705m - 743.5m; early-late Eocene

The low to high yields of organic matter are dominantly of land plant detritus and include sufficient proportions of lipid-rich macerals for sourcing limited volumes of liquid hydrocarbons when mature. Organic matter is immature as revealed by the greenish yellow colouration of the spores (TAI 1.6).

3. 769m, 786.5m; unassigned

The two samples investigated failed to yield organic matter and are not considered likely source rocks.

4. 821m, 880m; late Albian

A moderate yield of organic matter was obtained from the upper sample; this includes sufficient proportions of hydrogen rich macerals to support limited petroleum generation. Organic matter of the lower sample consists mainly of opaque detritus that is gas prone. Organic matter of both samples is early mature as suggested by the yellowish amber colouration of the spore (TAI 2.0).

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Mary E. Dettmann
Department of Botany
University of Queensland
St. Lucia, Qld. 4067.

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TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: LASMO ENERGY AUSTRALIA LTD. Sheet 1 of 5

WELL: PATRICIA No.1 BASIN: GIPPSLAND

Palynomorph \ Depth (m)	880	821	786.5	769	743.5	739.8	722	720	705	692	683	672
Sample type	S	S	S	S	C	C	C	C	C	S	S	S
CRYPTOGAM MICROSPORES:												
Contignisporites glebulentus	+											
Dictyophyllidites pectinataeformis	+	+										
Perotrilites laceratus	+											
Dictyophyllidites crenatus	+											
Cicatricosisporites australiensis	+	+										
Crybelosporites striatus	+	+										
Interlobites intraverrucatus	+											
Biretisporites cf. potoniae	+											
Retitriletes austroclavatidites	+	+										
Retitriletes eminulus	+									+		
Retitriletes clavatoides	+											
Cyathidites australis/minor	+	+			+	+	+	+	+	+	+	+
Baculatisporites comaumensis	+	+							+	+		
Ceratosporites equalis	+											
Gleicheniidites circinidites	+	+				+		+	+	+		
Stereisporites antiquasporites	+	+				+	+	+		+		
Velosporites triquetrus	+											
Stereisporites pocockii	+	+										
Leptolepidites major	+											
Triporoletes reticulatus	+	+										
Triporoletes involucratus	+	+										
Aequitriradites verrucosus	+	+										
Foveosporites moretonensis	+	+										
Stoverisporites microverrucatus	+											
Laevigatosporites ovatus	+				+			+	+			+
Aequitriradites spinulosus		+										
Triporoletes radiatus		+										
Cyathidites punctatus		+										
Coptospora paradoxa		+										
Foraminisporis asymmetricus		+										
Foraminisporis dailyi		+										
Antulsporites varigranulatus		+										
Kuylisporites waterbolkii					+			+				
Rugulatisporites mallatus					+		+	+				

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: LASMO ENERGY AUSTRALIA LTD. Sheet 2 of 5

WELL: PATRICIA No.1 BASIN: GIPPSLAND

Sample type	S	S	S	S	C	C	C	C	C	S	S	S				
Palynomorph \ Depth (m)	880	821	786.5	769	743.5	739.8	722	720	705	692	683	672				
Laevigatosporites major					+	+	+									
Peromonolites vellosus					+	+										
Clavifera triplex						+										
Stereisporites (Tripunctisporis) sp.						+			+							
Verrucosisporites kopukiensis						+	+									
Verrucatosporites speciosus						+	+	+								
Polypodiaceoisporites tumulatus							+									
Ischyosporites gremius							+	+		+	+					
Peromonolites densus									+							
Microfoveolatosporis sp.									+							
Foveotriletes balteus									+							
Foveotriletes palaequetrus											+					
Foveosporites lacunosus												+				
CRYPTOGAM MEGASPORES:																
Balmeisporites holodictyus		+														
Arcellites reticulatus		+														
Minerisporites marginatus		+														
GYMNOSPERMOUS POLLEN:																
Classopollis chateaunovii	+	+														
Alisporites grandis	+	+														
Alisporites similis	+	+														
Araucariacites australis	+	+				+	+		+	+	+	+				
Cycadopites nitidus	+	+														
Trichotomosulcites subgranulatus	+	+						+	+	+						
Microcachryidites antarcticus	+	+				+		+	+	+						
Vitreisporites pallidus		+														
Podocarpidites ellipticus		+			+	+	+	+	+	+	+	+				
Lygistepollenites balmei					+											
Phyllocladidites mawsonii						+	+	+		+		+				
Lygistepollenites florinii						+	+		+	+	+					
Dilwynites granulatus						+	+	+	+							
Dacrycarpites australensis							+									
ANGIOSPERMOUS POLLEN:																
Clavatipollenites hughesii	+	+														
Phimopollenites pannosus	+	+														

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: LASMO ENERGY AUSTRALIA LTD. Sheet 4 of 5

WELL: PATRICIA No.1 BASIN: GIPPSLAND

Sample type	S	S	S	S	C	C	C	C	C	S	S	S				
Palynomorph \ Depth (m)	880	821	786.5	769	743.5	739.8	722	720	705	692	683	672				
Tricolpites simatus						+		+								
Ericipites crassiexinus						+	+	+								
Santalumidites cainozoicus						+	+	+								
Ilexpollenites anguloclavatus						+	+			+						
Myrtaceidites eugeniioides						+	+	+								
Nothofagidites incrassatus						+	+	+	+	+		+				
Nothofagidites deminutus						+	+	+	+	+						
Nothofagidites vansteenisii						+		+		+						
Periporollenites demarcatus						+	+	+	+	+						
Banksieaeidites arcuatus						+										
Proteacidites tuberculiformis						+										
Graminiidites sp.						?						+				
Proteacidites reflexus						+										
Proteacidites recavus							+									
Triorites psilatus							+	+								
Sparganiaceaepollenites sp.							+	+								
Malvacipollis subtilis							+	+								
Helciporites astrus							+									
Propylipollis crassipora							+		+							
Propylipollis reticuloscabratus							+		+	+						
Liliacidites lanceolatus							+									
Nothofagidites falcatus								+	+	+		+				
Tricolpites thomasii								+								
Concolpites leptos								+								
Proteacidites granoratus								+								
Proteacidites incurvatus								+	+							
Proteacidites crassus								+								
Proteacidites adenanthoides								+	+							
Tricolporites leuros									+							
Beaupreaidites elegansiformis									+							
Myrtaceidites parvus										+	+	+				
Proteacidites rectomarginus										+						
Proteacidites tuberculatus										+						
Periporopollenites vesicus											+					
Acaciaeopollenites myriosporites												+				

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: LASMO ENERGY AUSTRALIA LTD. Sheet 5 of 5

WELL: PATRICIA No.1 BASIN: GIPPSLAND

Sample type	S	S	S	S	C	C	C	C	C	S	S	S				
Palynomorph \ Depth (m)	880	821	786.5	769	743.5	739.8	722	720	705	692	683	672				
FUNGAL MICROFOSSILS:																
Spore, fruiting bodies and hyphae	+	+			+	+	+	+	+	+						
ALGAL MICROFOSSILS:																
Sigmopollis cf. carbonis	+	+														
Sigmopollis sp.	+															
Schizosporis reticulatus		+														
Schizophacus spriggii		+			+											
Schizophacus rugulatus		+														
Botryococcus sp.						+										
Spiniferites ramosus						+				+		+				
Deflandrea heterophylcta						+	+		+							
Eisenackia crassitabulata						+		+								
Spinidinium essoi						+										
Operculodinium sp.						+	+			+						
Oligosphaeridium sp.						+		+			+					
Paralecaniella indentata						+	+		+							
Impagidinium dispertitum							+	+								
Impagidinium victorianum								+								
Pallambages sp.								+								
Horologinella sp.								+								
Hemiplacaphora semilunifera								+								
Schematophora speciosa								+								
Deflandrea phosphoritica									+							
Lentina extensa									+							
Lecaniella sp.									+							
Areosphaeridium capricornum									+							
Systemophora ancryea									+							
Systemaphora placacantha										+	+					
Lingulodinium machaerophorum										+	+	+				
Spiniferites bulloidea										+	+	+				
Spiniferites cingulata											+					
Operculodinium centrocarpum											+	+				
Hystrichokolpoma stellatum												+				

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

SAMPLE	DEPTH (m)	LITHOLOGY	ORGANIC MATTER																
			AMOUNT (ml/ 10gm)	TYPE (% composition)													MATURITY		
				Alginite			Sporin./Cutin.				Woody tissue	Humic		Vitr.		Inertinite	Spore Colour	T.A.I. (after Staplin 1982)	Interpreted Maturity Level
				Dispersed	Dense	Algal cysts	Fine (<10µm)	Spores	Leaf tissue	Other		<20µm	>20µm	<20µm	>20µm				
swc	672	sst., f.gr med. grey	1.2	30	40	5	-	+	-	-	-	+	5	+-	10	10	greenish yellow	1.5	immature
swc	683	sst., f.gr med. grey	0.7	30	35	10	-	+	-	+	-	-	10	+	10	5	greenish yellow	1.5	immature
swc	692	sst. m. gr & slt.	1.5	30	10	5	-	+	+	5	-	-	20	5	20	5	greenish yellow	1.5	immature
core	705	slst., dk. grey	1.5	20	5	+	_	+	+	5	+	20	30	5	5	10	greenish yellow	1.6	immature
core	720	slst., dk. grey	0.8	15	-	+	10	5	+	15	+	10	20	5	20	+	greenish yellow	1.6	immature
core	722	slst., dk. grey	0.9	15	-	+	10	5	5	10	+	15	30	+	10	+	greenish yellow	1.6	immature
core	739.8	slst., dk. grey	0.5	5	5	+	10	5	+	10	+	+	50	5	10	+	greenish yellow	1.6	immature
core	743.5	shl., med. grey	2.0	-	-	+	10	5	10	30	+	+	30	5	5	5	greenish yellow	1.6	immature

TABLE 3. Organic matter, Patricia No.1, 672m - 880m. (contd.)

SAMPLE	DEPTH (m)	LITHOLOGY	ORGANIC MATTER																
			AMOUNT (ml/ 10gm)	TYPE (% composition)														MATURITY		
				Alginite			Sporin./Cutin.					Humic		Vitr.						
				Dispersed	Dense	Algal cysts	Fine (<10µm)	Spores	Leaf tissue	Other	Woody tissue	<20µm	>20µm	<20µm	>20µm	Inertinite	Spore Colour	T.A.I. (after Staplin 1982)	Interpreted Maturity Level
swc	769	white shl.	-	No recovery													-		
swc	786.5	sst., f.gr., white	-	No recovery													-		
swc	821	shl., dk. grey	1.0	-	-	+	10	20	10	10	+	-	25	5	10	10	yellowish amber	2.0	early mature
swc	880	shl., med. grey	0.6	-	-	+	-	15	-	-	-	-	-	30	45	10	yellowish amber	2.0	early mature

TABLE 3 (contd.). Organic matter, Patricia No.1, 672m - 880m.