EDINA NO. 1 WELL, GIPPSLAND BASIN

PALYNOLOGICAL EXAMINATION, SPORE COLOURATION AND KEROGEN TYPING.

by

W.K. Harris

PALYNOLOGICAL REPORT

Client : Australian Aquitaine Petroleum

Study : Edina No. 1 Well, Gippsland Basin.

Aims : Determination of age and distribution of kerogen types and spore colour.

INTRODUCTION

Twenty eight sidewall cores and two core samples from Edina No. 1 Well drilled in the Gippsland Basin at Lat. 38°36'22.4"S, Long. 147°52'42.1"E in Vic. P17 were processed by normal palynological procedures.

The basis for the biostratigraphy and consequent age determinations are based on Stover and Partridge (1973) and Partridge (1976).

OBSERVATIONS AND INTERPRETATION

A. Biostratigraphy

Table I summarises the biostratigraphy and age determinations of the samples studied. Tables II and III indicate the distribution of spore/pollen and dinoflagellate species respectively.

Most samples yielded reasonably well preserved and moderately diverse assemblages. These data are also documented on Table I. Two samples from a core at 2317.46 and 2318.78m were virtually barren of plant microfossils.

1. Lygistepollenites balmei zone: - 2528-2590m.
This zone is represented by only two samples with low diversity. In particular the presence of L. balmei with H. harrisii and S. punctatus supports their correlation. The absence of Gambierina edwardsii, G. rudata and the presence of M. diversus would suggest that the Upper L. balmei subdivision is represented.

   An alternative interpretaion is that L. Balmei is reworked and the samples are of M. diversus age. However the absence of any thin characteristic L.balmei or older species is evidence against this. No marine indicators were recorded and the sediments are of terrestrial origin. The age of this assemblage is Middle to Late Paleocene.

2. Malvacipollis diversus zone: - 2419-2514m
The onset of this zone is marked by the appearance of C. orthoteichus, S. prominatus and P. demarcatus. This assemblage at 2514.5m although not very diverse is consistent with an Upper M. diversus correlation. This is supported further by the inclusion in subsequent samples of H. astrus.

   Two incursions of dinoflagellates are recorded of 2514.5 and 2454m. The younger samples contains very few species but is consistent with assemblages of Upper M. diversus age. In particular D. pachyceros is commonly recorded from the M. diversus zone. The older sample contains two species of significance - A. homonorphum and K. leptocerata. These two support a correlation with the Upper M.

TABLE 1
EDINA NO. 1 WELL
SUMMARY OF PALYNOLOGICAL DATA

DEPTH	SWC	PRESERVATION	DIVERSITY	SPORE/POLLEN ZONE	CONFIDENCE LEVELS	ENVIRONMENT
2590	1	poor	very low	L. balmei (upper)	4	Non marine
2528	7	poor	low	L. balmei (upper)	4	Non marine
2574.5	8	fair	low	M. diversus (upper)	4	Marginal marine
2487.5	10	fair	very low	M. diversus (upper)	4	Non marine
2470	11	fair	very low	M. diversus (upper)	4	Non marine
2454	12	good	high	M. diversus (upper)	5	Marginal marine
2446.5	13	fair	very low	M. diversus (upper)	4	Non marine
2419	14	fair	very low	M. diversus (upper)	4	Non marine
2390.5	16	poor	moderate	P. asperopolus	5	Marginal marine
2372	18	fair	moderate	P. asperopolus	5	Marginal marine
2328.5	25	good	moderate	P. asperopolus	5	Near Shore marine
2318.78	Core	barren	-	-	-	-
2317.46	Core	barren	-	-	-	-
2304.5	26	poor	very low	un-named dino. unit	-	?Open Marine Shelf
2278	30	poor	very low	"	-	Open Marine Shelf
2276.5	31	poor	very low	"	-	Open Marine Shelf
2275	32	fair	very low	"	-	Open Marine Shelf
2270.5	33	good	very low	"	-	Open Marine Shelf
2220	67	good	very low	"	-	Open Marine Shelf
2211	68	good	very low	"	-	Open Marine Shelf
2204	69	good	very low	"	-	Open Marine Shelf
2197.4	70	fair	very low	"	-	Open Marine Shelf
2189	71	good	very low	"	-	Open Marine Shelf
1918.5	72	good	very low	"	-	Open Marine Shelf
1898.5	74	good	very low	"	-	Open Marine Shelf
1890	75	good	very low	"	-	Open Marine Shelf
1881.5	76	good	very low	"	-	Open Marine Shelf
1390	78	fair	very low	"	-	Open Marine Shelf
1370	79	good	very low	"	-	Open Marine Shelf
1343.5	81	good	very low	"	-	Open Marine Shelf

Confidence Levels.

1 cuttings sample, low diversity ± contaminants
2 cuttings sample, good assemblage
3 core or sidewall core, low diversity, ± contaminants
4 core or sidewall core, low diversity,
5 core or sidewall core, good assemblage.

TABLE II

EDINA NO. 1 WELL

DISTRIBUTION OF SPORES AND POLLEN

Spores/Pollen	2590	2528	2514.5	2487.5	2470	2454	2446.5	2419	2390	2372	2328.5	2318.5	2317	2304.5	2278	2276.5	2275	2270.5	2220	2211	2204	2197.4	2189	1918.5	1898.5	1890	1881.5	1390	1370	1343.5
Baculatisporites comaumensis	X	X							X													X								
Cyathidites splendens	X																													
Dictyophyllidites sp.	X	X					X																							
Gleicheniidites circinidites	X	X	X	X	X	X	X	X		X	X				X			X	X	X							X			X
Haloragacidites harrisii	X	X		X	X	X				X					X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lygistepollenites balmei	X	X																						X						
Laevigatosporites major	X																													
Nothofagidites senectus cf.	X																													
Podocarpidites sp.	X	X		X	X	X			X	X					X	X	X	X			X	X	X	X	X	X	X	X	X	X
Phyllocladidites mawsonii	X	X	X			X					X				X		X	X					X							
Proteacidites parvus	X	X	X			X			X		X			X	X													X		
Simplicepollis meridianus	X	X				X																				X				
Stereisporites antiquisporites	X	X	X			X													X	X						X				
S. (Tripunctisporis) punctatus	X	X																												
Tetracolporites verrucosus	X	X																												
Araucariacites australis		X				X									X			X			X									
Cyathidites australis		X				X									X	X			X	X		X		X	X	X	X	X		X
Lygopodiumsporites sp.		X																												
Malvacipollis diversus		X	X			X			X	X					X		X		X	X										
Myrtaceidites parvus/mesonesus		X		X	X						X						X		X	X		X	X	X				X	X	
Nothofagidites brachyspinulosus		X	X			X			X	X	X			X	X	X	X	X												
N. endurus		X																												
N. flemingii		X				X				X	X				X	X	X	X												
Microcachryities antarcticus		X			X	X													X	X										
Podosporites sp.		X		X	X	X									X		X													
Proteacidites spp.		X					X	X								X	X													
Proteacidites reticuloscabratus		X	X		X	X			X																					
Cupanieidites orthoteichus			X			X			X		X																			
Laevigatosporites sp.			X			X	X	X	X									X												

	2590	2528	2514.5	2487.5	2470	2454	2446.5	2419	2390	2372	2328.5	2318	2317	2304.5	2278	2276.5	2275	2270.5	2220	2211	2204	2197.4	2189	1918.5	1898.5	1890	1881.5	1390	1370	1343.5
Matonisporites gigantis			X																											
Nothofagidites emgradys heterus			X				X	X		X	X			X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Periporopollenites demarcatus			X			X									X		X	X	X	X										
Spinizonocolpites prominatus			X																											
Lygistepollenites florinii				X		X			X	X	X						X	X												
Proteacidites pseudomoides				X	X	X				X																				
Proteacidites incurvatus				X																										
Clavifera triplex					X	X																								
Proteacidites annularis					X				X	X																				
Tricolporites sp.					X					X																				
Cyathidites aff c. splendens						X																								
Dilwynites granulatus						X																								
Ilexpollenites anguloclavatus						X																								
Nothofagidites vansteenisii						X									X		X		X	X										
P. polyoratus						X																								
Proteacidites kopiensis						X			X																					
P. leightonii						X			X																					
P. incurvatus						X																								
P. pachypolus						X			X		X																			
Polypodiidites cf. speciosus						X																								
Rugulatisporites mallatus						X																								
Sapotaceoidaepollenites rotundus						X			X																					
Verrucosisporites kopukuensis						X					X																			
Camerozonosporites sp.							X																							
Ephedripites notensis									X								X													
Polycolpites esobalteus									X		X						X													
Cyathidities subtilis										X																				
Helciporites astrus							X			X																				
Myrtaceidites tenuis										X																				
Parvisaccites catastus										X																				
Proteacidites latrobensis										X																				
Schizocolpus marlinensis										X																				
Tricolporites mataurensis										X																				
Bysmapollis emaciatus aff.											X																			
Nothofagidites asperus cf.											X																			
Polypodiidites speciosus											X																			
Proteacidites asperopolus											X																			
Santalumidites cainozoicus											X																			
Nothofagidites asperus															X	X					X	X								
Tricolporites sphaerica cf.															X															

	Ischyosporites gremius	Nothofagidites deminutus	Graminidites sp.	Nothofagidites falcatus
343.5				
370				
390				
881.5				
890				
898.5				
918.5				
189				
197.4				
204				
211				
220				
270.5				
275			x	x
276.5		x		
278	x			
304.5				
317				
318				
328.5				
372				
390				
419				
446.5				
454				
470				
487.5				
514.5				
528				
590				

TABLE III

EDINA NO. 1 WELL

DINOFLAGELLATE DISTRIBUTION

Dinoflagellates	2590	2528	2514.5	2487.5	2470	2454	2446.5	2419	2390.5	2372	2328.5	2318	2317	2304.5	2278	2276.5	2275	2270.5	2220	2211	2204	2197.4	2189	1918.5	1898.5	1890	1881.5	1390	1370	1343.4
Muratodinium fimbriatus			X																											
Thalosisphara pelagica			X								X																			
Apectodinium homomorpha			X																											
Operculodinium sp.			X			X																								
Kenloyia leptocerata			X																											
Spiniferites ramosus			X						X						X	X	X	X			X	X	X	X	X	X	X	X	X	X
Cordosphaeridium inodes			X																											
Deflandrea pachyceros						X																								
Phthanoperidinium sp.						X					X																			
Glaphyrocysta retiintexta cf.									X																					
Apectodinium hyperacontha									X																					
Vozzhennikovia sp.									X	X																				
Wetzeliella longispinosa									X																					
Apteodinium australiense cf.									X																					
Spinidinium essoi cf.										X	X																			
Wetzeliella longispinosa										X																				
Operculodinium centrocarpum										X	X			X	X	X	X	X	X	X	X										
Areosphaeridium sp.											X						X		X	X										
Deflandrea darmooria											X																			
Cordosphaeridium fibrospinosum											X																			
C. gracile cf.											X																			
Tectatodinium sp.											X								X	X			X	X	X	X	X			
Cleistosphaeridium severinii											X										X		X							
Hystrichokolpoma rigaudae															X	X			X	X	X	X								
Deflandrea sp.															X															
Apteodinium australiense															X	X					X					X				
Impagidinium sp.															X	X			X	X			X			X			X	
Lingulodinium machaerophorum															X	X			X	X	X		X		X	X	X	X		

Depth	Systematophora placacantha	Hystrichokolpoma poculum	Hystrichosphaeridium sp.	Baltisphaeridium sp.	Baltisphaeridium nanum	Adnatosphaeridium sp.	Impagidinium cf. victorianum	?Pentadinium sp.	Corrudinium sp.	Achomosphaera ramulifera	Nematosphaeropsis balcombiana	Operculodinium acutulum (MS)	Hystrichostrogylon membranisphorum	Spiniferites adelaidensis (MS)	Tectatodinium sp.	Lophocysta sp.	Systematophora placacantha	Hystrichokolpoma rigaudae aff.	Spiniferites cingulatus	Polysphaeridium pseudocolligerum	Cyclopsiella sp.	Spiniferites pseudofurcatus	Operculodinum sp. nov.	cf. Tuberculodinium sp.	Impagidinium dispertitum cf.	Impagidinium dispertitum aff.	Melitaesphaeridium choanophorum	Batiacasphaera hirsuta
343						x				x	x												x					x
370							x			x	x												x	x		x		x
390						x	x			x		x											x			x	x	
881.5						x	x		x		x	x							x			x		x	x			
890						x			x	x	x	x							x				x	x				
89[illegible].5						x			x		x	x								x			x					
918.5						x					x	x										x	x					
189						x				x		x					x	x	x	x	x							
197.4						x			x		x	x	x				x											
204						x					x	x		x	x	x												
211						x				x	x	x	x															
220						x				x	x	x	x															
270.5			x			x	x	x	x																			
275																												
276.5			x		x	x																						
278	x	x	x	x																								
304.5																												
317																												
318																												
328.5																												
372																												
390																												
419																												
446.5																												
454																												
470																												
487.5																												
514.5																												
528																												
590																												

diversus zone but the dinoflagellate assemblage is not sufficiently diverse to permit a correlation with Partridge's (1976) zones. The presence of dinoflagellates in these two samples indicates deposition in near shore marginal marine environments. The age of this zone is Early Eocene.

3. Proteacidites asperopolus zone: 2328.5 - 2390.5m
The identification of this zone is based on an abundance of the pollen P. pachypolus and an associated dinoflagellate assemblage. Significant dinoflagellates include: Apectodinium hyperacantha, Wetzeliella longispina and Deflandrea dartmooria which are not inconsistent with this correlation.

Marine dinoflagellates were the dominant palynomorphs in the lowest sample in the zone and indicate deposition in a near shore marine environment. In the other samples dinoflagellates are less abundant but nevertheless indicate marginal marine conditions.

The age of the P. asperopolus zone is Early Eocene.

Mid Tertiary Assemblages 1343.5 - 2278m

Spores and pollen in this interval are very sparse and no correlation can be made on this basis with the onshore Gippsland Basin zones of this age. The assemblages although very sparse, are dominated by marine dinoflagellates. No formal or informal zones haave been proposed for these assemblages in Australia. There is some indication in the assemblages that subdivision of the sequence is possible that would need to be tested against other sections. The first appearance of aff. Tuberculodinium sp. and of M. choanosphorum with B. rirsuta may be of some significance. The other species recorded have long ranges from the Late Eocene through most of the remaining Tertiary and into the Holocene.

The palynomorphs in this section indicate an age no older than latest Eocene for the sample at 2278m but no further refinement is possible using palynomorphs.

Furthermore the dominance of dinoflagellates over terrestrial palynomorphs indicates deposition in an open marine environment.

B. Kerogen Types and Spore Colouration

During routine palynological processing of sidewall cores an unoxidised kerogen sample was taken and the nature of the kerogens and spore colouration are documented in Table V. Only those samples which yielded spore/pollen assemblages have been examined. Spore colour is expressed as the "Thermal Alteration Index" (TAI) of Staplin (1969) according to the scale in Table IV.

TABLE IV

Thermal - Alteration Index	Organic matter/spore colour
1 - none	fresh, yellow
2 - slight	brownish yellow
3 - moderate	brown
4 - strong	black
5 - severe	black and evidence of rock metamorphism.

Total organic matter (TOM) is expressed semi-quantitatively in the scale- abundant, moderate, low, very low, barren. Samples classed as having abundant or moderate amounts of TOM would be expected to have TOC's (total organic content) greater than 1%.

In this report four classes of organic matter are recognised - amorphogen, phyrogen, hylogen and melanogen and these terms are more or less synonymous with amorphous, herbaceous, woody and coaly. For reasons as outlined by Bujak et al. (1977) the former terms are preferred because they do not have a botanical connotation. The thermal alteration index scale follows that of Staplin (1969) and as outlined by Bujak et al. (1977): at a TAI of 2+ all four types of organic material contribute to hydrocarbon generation whereas at a TAI of 2, only amorphogen forms liquid hydrocarbons. The upper boundary defining the oil window is at a TAI of approximately 3 but varies acccording to the organic type. Above TAI 3+ all organic types only have a potential for thermal derived methane.

1. Early Tertiary Section
   Moderate to abundant TOM is present in most samples from T.D. up to the T. asperopolus zone. The two samples from the L. balmei zone are dominated by phyrogen and melanogen and these form the M. diversus zone show high melanogen with one sample showing high amorphogen. The latter sample at 2454m resulted from a marine incursion.

   The three samples from the P. asperopolus zone are characterised by high amorphogen and this also corresponds with another marine incursion. However these samples have low TOM values.

   TAI values from the Early Tertiary indicate immaturity with values barely reaching 2.

   Thus the Early Tertiary sequence at this location whilst it probably has adequate organic matter of a favourable nature, is immature for the generation of hydrocarbons.

2. Mid-Tertiary Sequence
   All samples from this sequence have low to very low TOM which is dominated by amorphogen. All TAI values are very low and these sediments therefore have low source potential for generating hydrocarbons.

TABLE V
EDINA WELL
SUMMARY OF MATURATION AND KEROGEN DATA

Depth	TOM	SWC No.	Phyr.	Amorpho	Hylogen	Melano	TAI
2590	mod	1	35	-	5	60	2
2528	mod	7	70	15	-	15	2
2514.5	low	8	50	10	Tr.	40	2-
2487.5	abund.	10	Tr.	-	10	90	2-
2470	abund.	11	10	80	Tr.	10	2-
2454	abund.	12	20	70	Tr.	10	2-
2446.5	abund.	13	Tr.	Tr.	15	85	2-
2419	abund.	14	Tr.	-	10	90	2-
2390.5	low	16	Tr.	80	-	10	2-
2372	low	18	50	40	Tr	10	2-
2328.5	v. low	25	20	60	Tr.	70	2-
2318.78	v. low	core	5	90	Tr.	5	ND
2317.46	v. low	core	5	90	Tr.	5	ND
2304.5	v. low	26	5	90	Tr.	5	1
2278	v. low	30	5	90	-	5	1
2276.5	v. low	31	Tr	95	-	5	1
2275	v. low	32	30	20	10	40	1
2270.5	v. low	33	30	30	10	30	1
2220	v. low	67	30	10	20	40	1
2211	low	68	40	20	10	30	1
2204	v. low	69	20	70	-	10	1
2197.4	v. low	70	10	80	5	5	1
2189	v. low	71	5	95	-	Tr	1
1918.5	v. low	72	5	90	Tr	5	1
1898.5	v. low	74	10	85	-	5	1
1890	v. low	75	10	90	-	Tr	1
1881.5	v. low	76	10	90	-	Tr	1
1390	v. low	78	10	85	-	5	1
1370	v. low	79	Tr	95	-	5	1
1343.5	v. low	81	Tr	95		5	1

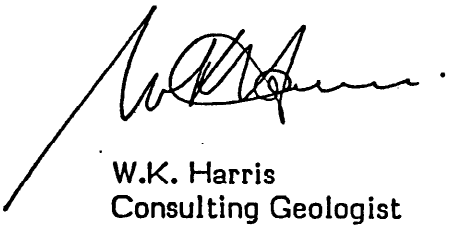
REFERENCES

Bujak, J.P., Barss, M.S., and Williams, G.L., 1977: Offshore East Canada's Organic Type and Colour and Hydrocarbon Potential. Oil Gas J., 45 (14): 198-202.

Partridge, A.D., 1976: The Geological Expression of Eustacy in the Early Tertiary of the Gippsland Basin. J. Aust. Petrol. Expl. Assoc., 16: 73-79.

Staplin, F.L., 1969: Sedimentary Organic Matter, Organic Metamorphism and Oi. and Gas Occurrence. Bull. Can. Pet. Geol., 17: 47-66.

Stover, L.E. & Partridge, A.D., 1973: Tertiary and Late Cretaceous spores and Pollen from the Gippsland Basin, southeastern Australia. Proc. R. Soc. Vict., 85: 237-286.



W.K. Harris
Consulting Geologist

10 January 1983