WHALE NO. 1 WELL

Palynological Examination and Kerogen Typing of Sidewall Cores

by

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PALYNOLOGICAL REPORT

Client : Hudbay Oil (Australia) Ltd.

Study : Whale No. 1 Well, Gippsland Basin.

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

INTRODUCTION

Fifty three sidewall cores from Whale No. 1 Well drilled in the Gippsland Basin at Lat. 38°01'17.18"S, Long. 148°34'44.17"E in Vic. P-11 were processed by normal palynological procedures.

The basis for the biostratigraphic and consequent age determinations are based on Stover and Partridge (1973) and Partridge (1976) for the Tertiary sediments and principally on Dettmann (1963), Dettmann and Playford (1969) with the modifications of Dettmann and Douglas (1976) and Burger (1973) for the Early Cretaceous sequence.

OBSERVATIONS AND INTERPRETATION

A. Biostratigraphy

Table 1 summarises the biostratigraphy and age determinations for the samples studied. Tables II and III indicate the distribution of species encountered in the Early Cretaceous and Tertiary sequences respectively.

Several samples from this well are barren of plant microfossils and this is mostly due to unfavourable lithologies. These are dominated by light grey to white argillaceous sandstone and claystones generally representing oxidising environments of deposition.

Where plant microfossils have been recovered they are well preserved but assemblages were often not very diverse limiting the biostratigraphic precision.

1. Early Cretaceous - 806-475m.

Assemblages from this section in the interval from 806m to 586.5m are poorly diversified but well preserved. These are of Early Cretaceous aspect but a finer subdivision is not possible. At 560 and 502m good assemblages were recovered and the presence of Dictyotosporites speciosus indicates a correlation with the zone of that name. The age is Aptian. Elsewhere in the Otway and Eromanga Basins it has been possible to subdivide this unit into two sub-zones but the indicative species have not been recognised in this well.

From 498 - 475m the assemblages are again poorly diversified and mostly lack key species. However considering the overall assemblages and the interval involved there is nothing to suggest that any younger Cretaceous units are present. All assemblages are non-

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TABLE I

SUMMARY OF BIOSTRATIGRAPHY AND AGE

Depth in Metres	Biostratigraphic Unit	Age
228	Un-named	Mid-Tertiary
239.9	Un-named	Mid-Tertiary
293.3	Un-named	Mid-Tertiary
334.8	Un-named	Mid-Tertiary
382.3	Un-named	Mid-Tertiary
425	Un-named	Mid-Tertiary
437	Indeterminate	?Mid-Tertiary
440	Late N. asperus	Late Eocene-Oligocene
442	Indeterminate	?Late Eocene
445	N. asperus	Late Eocene
453.2	Indeterminate	?Eocene
457	Indeterminate	?Eocene
460	No older than M. diversus	Eocene
462	No older than M. diversus	Eocene
463.5	Indeterminate	?Eocene
467	Barren	-
470.5	Barren	-
472	Barren	-
475	Indeterminate	Early Cretaceous
478.5	-	Early Cretaceous
480	-	Early Cretaceous
484	-	Early Cretaceous
490	Barren	-
498.0	Indeterminate	?Early Cretaceous
502	-	Early Cretaceous
504.5	Indeterminate	?Early Cretaceous
526.0	Barren	-
548	Barren	-
560	-	Early Cretaceous
571	Barren	-
586.5	Indeterminate	?Early Cretaceous
590	Barren	-
610	-	Early Cretaceous
620	Barren	-
630	Barren	-
640	Barren	-
650	Barren	-
660	Barren	-
669.5	Indeterminate	?Early Cretaceous
680	-	Early Cretaceous
690	Barren	-
715.0	Barren	-
720.0	Barren	-
732.0	Barren	-
740.0	Barren	-
755.0	-	Early Cretaceous

773.0	Barren	-
776.0	Indeterminate	?Early Cretaceous
780	Barren	-
785	-	Early Cretaceous
797.5	Barren	-
806	-	Early Cretaceous

2. Eocene - ?463.5 - 440m

The assemblages at 463.5m yielded very rare spores and pollen which included Proteacidites pachypolus and occasional acritarchs. Samples at 462 and 460m yielded slightly more diverse assemblages which included Nothofagidites spp., Haloragacidites harrisii, Malvacipollis diversus and rare dinoflagellates and acritarchs - Paralecaniella indentata and Vozzhennikovia cf. V. apertura. The assemblage has a general Eocene aspect and is not older than Upper Malvacipollis diversus assemblage. It is probably no younger than lower Nothofagidites asperus.

The next reasonable but still very sparse assemblage is from 445m. In particular the dinoflagellate Deflandrea phosphoritica which ranges through the N. asperus Zone in the Gippsland Basin is recorded.

The assemblage from 440m was a reasonably diverse assemblage dominated by Nothofagidites spp. associated with Matonisporites ornamentalis and common conifer pollen. Proteacidites sp. are uncommon. Dinoflagellates are common and are dominated by Spiniferites spp. indicating a pronounced marine influence.

The assemblage is best equated with the late N. asperus Zone. No index species of younger zones were recorded however because of low yields and poor diversity some caution is necessary in interpreting the data.

The age of the late N. asperus zone is Late Eocene and possibly Early Oligocene.

3. Mid-Tertiary - ?437 - 228m

This unit dominated by argillaceous calcareous sediments yielded very low amounts of organic matter and spores and pollen were generally rare. Nothofagidites spp. dominated the assemblages together with Haloragacidites harrisii and podocarpaceous pollen. Because of the sparse nature of the assemblages no precise assignment to a biostratigraphic unit is possible. Accompanying the spores and pollen is a not very diverse suite of dinoflagellates which dominate the palynomorphs. These comprise mostly of Spiniferites spp. together with Operculodinium spp. Lingulolodinium machaerophorum Nematosphaeropsis balcombiana, Impagidinium sp. Polysphaeridium sp. and Hystrichostrogylou membraniphorum. These species are long ranging from the Late Eocene through to the Recent. There appears to be little differentiation of the assmeblages from this interval. The assemblages are dominated by marine components.

The distribution of the few species recorded is not recorded on Table III.

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TABLE III

Distribution of Tertiary Species

	463.5	462	460	457.2	457	445	442	440
Proteacidites pachypolus	x							
Nothofagidites emarcidus	x	x		x		x	x	
Lygistepollenites florinii	x	x		x	x		x	x
Phyllocladidites mausonii	x	x	x		x	x	x	x
Malvacipollis diversus	x	x	x	x		x	x	
Baculatisporites comaumensis		x			x			x
Parvisaccites catastus		x						
Haloragacidites harrisii		x	x		x	x	x	x
Tricolporites adelaidensis		x						
Rhoipites sp.		x					x	
Proteacidites aff. P. obscurus		x				x		
Nothofagidites falcatus		x				x	x	x
N. deminutus		x		x		x	x	x
Vozzhennikovia cf V. apertura		x						
Camarozouosporites sp.			x					
Paralecaniella indentata			x					
Deflandrea phosphoritica						x		
Operculodinium centrocarpum							x	x
Nothofagidites asperus								x
Spiniferites sp.								x
Ilexipollenites angulolavatus								x
Proteacidites aff. P. truncatus								x
Matonisporites ornamentalis								x
Lingulodinium machaerophorum								x
Myrtaceidites parvus								x
Nematosphaeropsis sp.								x
Systematophora placacantha								x

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 connatation. 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 according to the organic type. Above TAI 3+ all organic types only have a potential for thermally derived methane.

1. Cretaceous Section

Kerogen types throughout this unit are characterised by high melanogen with only one or two exceptions (e.g. at 560m) where phyrogen becomes a significant component. If this section was mature for the generation of hydrocarbons it would yield dominantly gas with minor amounts of condensate.

Spore colour throughout is consistant at about 2 and cannot be considered to be mature especially when the kerogens are dominated by melanogen. These factors together with low to very low TOM values, imitigates agaist this section as a potential hydrocarbon source.

TABLE V

Distribution of Kerogen Types and Spore Colour in Selected Samples

Depth (m)	TAI	TOM	Amorpho %	Phyro %	Hylo %	Melano %
440	-	v. low	5	Tr	-	95
445	-	v. low	95	Tr	-	5
453.2	-	v. low	5	Tr	5	90
457	-	v. low	90	-	-	10
460	-	v. low	85	-	-	15
462	1+	v. low	5	10	5	80
463.5	-	v. low	-	Tr	5	95
475	1+	v. low	-	Tr	10	90
478.5	2	v. low	-	20	10	70
480	2	low	-	51	5	90
484	2^-	low	-	30	20	50
498	2	low	-	30	10	60
504.5	2^-	very low	-	Tr	5	95
560	2^-	low	-	60	10	30
586.5	2	very low	-	40	10	50
610	2	very low	-	15	30	55
660	2	very low	-	10	5	85
680	2	low	-	5	5	90
732.0	2	very low	-	10	-	90
755	2	very low	-	20	20	60
763	2	low	-	40	10	50
776	2^+	low	-	10	25	65
785	2^+	low	-	10	15	75
806	2^+	very low	-	10	-	90

2. Tertiary Section - Eocene

This section is characterised by very low TOM's and the dominant kerogen type is melanogen which appears to be mostly an inertinite-like maceral. Two samples have high amorphogen which is dominantly finely divided organic matter. In very low yielding sediments this is insignificant with regard to source rock potential.

Where spore colour was determined it is indicative of immaturity.

All of the evidence suggests that this section in the early Tertiary is immature and does not contain sufficient organic matter of a favourable nature to be considered as a potential source rock for the generation of hydrocarbons.

No kerogen analysis was undertaken on the mid-Tertiary sequence because of the extremely low organic yields.

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