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Palynological analysis of ten cuttings samples from the Eastern View Group in Barramundi-1, Bass Basin.

by

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INTERPRETATIVE DATA

Summary

Ten cuttings samples have been analysed in Barramundi-1 over 730 metres of the Eastern View Group between 1370 and 2100mTD. All samples contain diverse and diagnostic spore-pollen assemblages, but only rare and low diversity microplankton assemblages. The latter are not zone diagnostic but are consistent with the ages obtained from the spore-pollen. The shallowest four samples between 1370 and 1560 metres are assigned to the Lower *Nothofagidites asperus* spore-pollen Zone and are Middle Eocene in age. The next five samples between 1635 and 2010 metres are assigned to the *Proteacidites asperopolus* Zone and are mostly of Early Eocene age. The top of the zone is considered to lie within the Middle Eocene but a position for the Early/Middle Eocene boundary cannot be determined from the cuttings assemblages. The deepest sample at 2100mTD is no older than the Upper *Malvacipollis diversus* Zone and this indicates that the well at total depth is still within the upper part of the Early Eocene. These palynological ages indicate that Barramundi-1 has penetrated a similar age sequence to other wells in the Cormorant Trough, which are all characterised by thick Early Eocene spore-pollen zones.

Introduction

This study was undertaken for Minerals Resources Tasmania to provide a palynological age subdivision of the Eastern View Group penetrated in the Barramundi-1 well drilled in 1999 by GLOBEX Far East in permit T27/P. The well is located on the eastern side of the Cormorant Trough (Blevin, 2003; figure 2.1) in the northeastern part of the offshore Bass Basin. As no previous palynological studies were available on Open File from this well it was desirable to investigate the age of the Eastern View Group to assist in correlation with other wells and to aid the overall evaluation of the basin. A review of fracture analysis and seal integrity of the section penetrated by Barramundi-1 has been published by Crist *et al.* (2001).

The materials analysed consist of ten cuttings samples provided by Minerals Resources Tasmania, with the laboratory processing to extract the palynomorphs undertaken by Laola Pty Ltd in Perth. Initial results of the microscope analysis were provided in a Provisional Report submitted on 21st December 2003, while the final zone and age determinations are summarised in Table-1.

An average of 15 grams of cuttings were processed to give high organic residue yields containing low to moderate concentrations of moderately well preserved palynomorphs (Tables 2 & 3). The individual samples contain an average diversity of 47+ species of spore-pollen, but less than 2 species of microplankton. The distribution and abundances of the palynomorphs identified in the samples are shown on the accompanying StrataBugs™ range chart.

Author citations for spore-pollen species can be mostly sourced from Stover & Partridge (1973, 1982) and Partridge (1973), while those for the few microplankton recorded can be sourced from the indexes compiled by Fensome *et al.* (1990) and Williams *et al.* (1998). Manuscript species names and combinations are indicated by "sp. nov." or "comb. nov." on the range chart and "ms" or "†" after their binomials names in the text and tables.

Palynological Assemblages and Zones

All samples gave high yields of organic matter in which the initial concentration of palynomorphs was low, but this was improved by a second oxidation of the organic residues. Overall the diversity of the spore-pollen assemblages is high, however most of the species identified are long-ranging, while many of the most important zone index species are rare to very rare. Microplankton abundance in the assemblages are always low (<3%) with many of the specimens recorded thought to be caved from higher in the well. The assemblages discussed below are assigned to the Tertiary palynological zonation originally erected by Stover & Partridge (1973) and subsequently improved and modified by Partridge (1973, 1999).

Lower *Nothofagidites asperus* spore-pollen Zone
Interval: 1370 to 1560 metres
Age: Middle Eocene.

The four shallowest cuttings samples are assigned to the restricted concept of the Lower *N. asperus* Zone of Partridge (1973) and Stover & Partridge (1982), based on the abundant occurrence of *Nothofagidites* pollen (average 33%), which in all samples are more abundant than *Haloragacidites harrisii* pollen (average 14%). Supporting of this gross feature of the assemblages are the occurrences of the index species *Nothofagidites falcatus* in 3 of the 4 samples, *Tricolporites leuros* at 1480m, and *Proteacidites recavus* at 1480m and 1560m, which normally mark the base of the zone. In general, gymnosperm pollen are also more common in this zone (average 21%) relative to the deeper samples (average 13%), and this is best exemplified by the common occurrence of pollen of *Phyllocladidites mawsonii* (average 7.7%). No index species diagnostic of the overlying Middle *N. asperus* and younger zones were recorded from any of the samples. The few microplankton recorded are either caved or long ranging species and are not considered zone diagnostic.

***Proteacidites asperopolus* spore-pollen Zone**
Interval: 1635 to 2010 metres
Age: Early Eocene to basal Middle Eocene.

The next five samples are assigned to the *P. asperopolus* Zone following the modified definition proposed for the Bass Basin by Partridge (1973). The top is placed at 1635m based on the LADs (Last Appearance Datums) of *Intratriporopollenites notabilis* and *Conbaculatisporites apiculatus* ms, further supported by the LAD of *Myrtaceidites tenuis* in the next deepest sample at 1760m. In contrast, the index species defining the base of the zone display more staggered FADs (First Appearance Datums) with *Proteacidites asperopolus* occurring at 2010m, *Clavastephanocolporites meleosus* at 1910m, *Conbaculatisporites apiculatus* ms at 1890m, and *Sapotaceoidaepollenites rotundus* not until 1635m. The assemblages are dominated by angiosperm pollen (average 75%), with the abundance of *Haloragacidites harrisii* (average 25%) greater than or equal to the abundances of *Nothofagidites* pollen (average 15%). The next most common categories are species of *Proteacidites* (average 14.5%) and total tricolpate and tricolporate pollen (average 9%). No significant microplankton were recorded in any of the samples. Although the zone is considered to straddle the Early/Middle Eocene boundary there is no break observed in the assemblages recorded from Barramundi-1 that can be correlated with this boundary.

Upper *Malvacipollis diversus* spore-pollen Zone or younger
Sample at: 2100 metres
Age: Early Eocene.

The deepest sample at TD contains perhaps the poorest assemblage which is assigned an age no older than the Upper *M. diversus* Zone base on the presence of *Proteacidites pachypolus* and a poor

specimen of *Santalumidites cainozoicus*. The last, if not caved from higher, suggests a position near the top of the zone. Angiosperm pollen dominate the assemblage (76%), with tricolpate and tricolporate species next most abundant (23%), followed by *Haloragacidites harrisii* pollen (16%), then *Nothofagidites* pollen (13%), and *Proteacidites* pollen (7.5%). Fungal microfossils are also prominent in the sample making up 27% of the combined count. No microplankton were recorded. The age of the sample is Early Eocene, so therefore at TD the Barramundi-1 well had not fully penetrated the Early Eocene.

Geological Discussion

The paper by Crist *et al.* (2001) provides a review of the exploration results and stratigraphy encountered in Barramundi-1. The interval 1175 to 1300m is assigned to the Demons Bluff Formation (= Anglesea Formation following Partridge, 2002c), while the underlying section from 1300 to 2100mTD is assigned to undifferentiated Eastern View Coal Measures (Crist *et al.*, 2001; figure 8), with all samples analysed coming from the latter unit.

The palynological results from Barramundi-1 compare best with the Cormorant-1 and King-1 wells located ~20 km to the northwest in the middle of the Cormorant Trough. The thickness and distribution of zones in Barramundi-1 is very similar, but 100 metres deeper than found in those two wells in the recent reviews by Partridge (2002a-c) and Blevin (2003; figure 4.18). The closest other wells Bass-1 and Yolla-1 located respectively ~18 km and ~27 km to the south also appear to have similar zone thicknesses on the available palynology, however, in both these latter wells all the zones are about 600 metres deeper. Allowing for the varying vintages of the palynological data the most obvious difference in the assemblages recovered from all these wells is that both the microplankton abundances and diversity are higher in the northern wells Cormorant-1 and King-1 compared to more easterly Barramundi-1 and the more southerly Yolla-1. This is in keeping with the hypothesis in Partridge (2002c) that the early marine transgressions into the Bass Basin have entered from the northwest. In Bass-1 too few samples have been analysed to make meaningful comments about the presence of microplankton.

Over the intervals in Cormorant-1 and King-1 reviewed by Partridge (2002a-b), the Eastern View Group has also been subdivided into a number of informal stratigraphic units by Partridge (2002c), and these have also been illustrated in Blevin (2003; figures 4.3 & 4.18). Integrating the palynological results in this study with the gamma ray and sonic electric logs displayed on the accompanying range chart these informal stratigraphic units can also be tentatively identified in Barramundi-1. For example, the samples assigned to the Lower *N. asperus* Zone at 1370m and 1415m would lie within the Toolka lacustrine unit identified between 1356 and 1428m, while the deeper samples at 1480m and 1560m would lie within the Poonboon unit identified between 1428 and 1576m. Next, the samples between 1635 and 1910m assigned to the *P. asperopolus* Zone are interpreted to lie within the Cormorant unit between 1576m and 1970m. This last unit represents the interval of peak coal deposition in Barramundi-1 with approximately 12% coal in approximately 20 seams, according to the log interpretation in Crist *et al.* (2001; fig.7). A similar abundance of coal is found in this unit in Cormorant-1 and King-1 (Blevin, 2003; figure 4.18). Finally, the two deepest samples and the interval between 1970 and 2100mTD are assigned to the Narimba unit. All the boundaries picked for these informal stratigraphic units in Barramundi-1 should be regarded as tentative pending further study of larger scale and more detailed lithologic and electric logs across all the wells in the Bass Basin.

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Description of Range Chart.

The range chart accompanying this report was prepared using the StrataBugs™ program and displays the palynomorph species in the cuttings proportional to their depth in the well, and against selected electric logs, which were supplied to Mineral Resources Tasmania through the courtesy of Wiltshire Geological Services Pty Ltd. The palynomorphs recorded are split into different categories, with the spores, gymnosperm pollen and angiosperm pollen plotted in separate panels, and the abundance of individual species calculated as a percentage of the total Spore-Pollen sum. Microplankton and Other palynomorphs are next plotted as separate panels, with abundances expressed as a percentage of the total Spore-Pollen plus Microplankton sum, and Spore-Pollen plus Other sum. Within the panels the species are plotted according to their highest or youngest occurrence or alphabetically. The following codes or abbreviations apply to the individual species occurrences and abundances on the range chart:

Numbers	=	Abundance expressed as percentage
+	=	Species outside of count
C	=	Caved species
R	=	Reworked species
?	=	Questionable identification of species.

INTERPRETATIVE DATA

Table 1: Interpretative palynological data for Barramundi-1, Bass Basin.

Sample Type	Depth metres	Spore-Pollen Zones Age/Stage	CR*	Comments and Key Species Present
Cuttings	1370	Lower *N. asperus* **Middle Eocene**	D1	*Nothofagidites* 37% > *Haloragacidites harrisii* 14%. Rare dinocysts present may be caved.
Cuttings	1415	Lower *N. asperus* **Middle Eocene**	D1	*Nothofagidites* 38% > *Haloragacidites harrisii* 8%.
Cuttings	1480	Lower *N. asperus* **Middle Eocene**	D1	*Nothofagidites* 24% > *Haloragacidites harrisii* 19%. FAD of *Tricolporites leuros*.
Cuttings	1560	Lower *N. asperus* **Middle Eocene**	D1	*Nothofagidites* 33% > *Haloragacidites harrisii* 13%. FAD of *Nothofagidites falcatus*.
Cuttings	1635	*P. asperopolus* **Early Eocene**	D4	*Nothofagidites* 19% ≥ *Haloragacidites harrisii* 17%. LAD of *Intratriporopollenites notabilis*.
Cuttings	1760	*P. asperopolus* **Early Eocene**	D1	*Haloragacidites harrisii* 29% > *Nothofagidites* 12% LAD of *Myrtaceidites tenuis*.
Cuttings	1890	*P. asperopolus* **Early Eocene**	D1	*Haloragacidites harrisii* 33% > *Nothofagidites* 13% FAD of *Conbaculatisporites apiculatus* ms.
Cuttings	1910	*P. asperopolus* **Early Eocene**	D1	*Haloragacidites harrisii* 23% > *Nothofagidites* 13% FAD of *Clavastephanocolporites meleosus*.
Cuttings	2010	*P. asperopolus* **Early Eocene**	D1	*Haloragacidites harrisii* 22% ≥ *Nothofagidites* 20% FAD of *Proteacidites asperopolus*.
Cuttings	2100	Upper *M. diversus* or younger **Early Eocene**	D1	*Haloragacidites harrisii* 16% > *Nothofagidites* 13% FADs of *Proteacidites pachypolus* and *Santalumidites cainozoicus*.

FAD & LAD = First & Last Appearance Datums
ms = manuscript species
MP = Microplankton SP = Spore-pollen

***Confidence Ratings used in STRATDAT database and applied to Table 1.**

Alpha codes: Linked to sample		**Numeric codes:** Linked to fossil assemblage		
A	Core	**1**	**Excellent confidence:**	High diversity assemblage recorded with key zone species.
B	Sidewall core	**2**	**Good confidence:**	Moderately diverse assemblage with key zone species.
C	Coal cuttings	**3**	**Fair confidence:**	Low diversity assemblage recorded with key zone species.
D	Ditch cuttings	**4**	**Poor confidence:**	Moderate to high diversity assemblage without key zone species.
E	Junk basket	**5**	**Very low confidence:**	Low diversity assemblage without key zone species.

BASIC DATA

Table 2: Basic sample data for Barramundi-1, Bass Basin.

Sample Type	Depth	Lithology	Wt. (grams)
Cuttings	1370m	Medium grey mudstone (clumped)	15.8
Cuttings	1415m	Medium grey sandy mudstone (clumped)	15.4
Cuttings	1480m	Light-medium grey (dirty) sandstone >80%, and grey silty mudstone <20%, trace coal	15.6
Cuttings	1560m	Off-white fine-grained sandstone ~50%, and light grey mudstone ~50%	15.2
Cuttings	1635m	Medium brown-grey mudstone ~70%, and of-white fine-grained sandstone ~30%	15.0
Cuttings	1760m	Black carbonaceous shale to coal ~80%, and light grey fine-grained sandstone ~20% (clumped)	15.7
Cuttings	1890m	Black carbonaceous shale to coal ~60%, dark grey mudstone ~40%, trace sandstone (clumped)	15.0
Cuttings	1910m	Light grey sandstone >40%, light-medium grey mudstone >40%, and black carbonaceous shale to coal <20% (clumped & dirty)	15.1
Cuttings	2010m	Medium grey mudstone	15.5
Cuttings	2100m	Black carbonaceous shale to coal ~100%, trace sandstone	11.6
		Average:	**15.0**

Wt = Weight of sample processed in grams.

Table 3: Basic assemblage data for Barramundi-1, Bass Basin.

Sample Type	Depth	Visual Yield	Palynomorph Concentration	Preservation	No. SP Species	No. MP Species
Cuttings	1370m	High	Moderate	Fair	69+	6+
Cuttings	1415m	High	Moderate	Fair	44+	4+
Cuttings	1480m	High	Low	Fair	57+	2+
Cuttings	1560m	High	Low	Poor-Fair	46+	1?
Cuttings	1635m	High	Moderate	Poor-Fair	51+	5+
Cuttings	1760m	High	Very Low	Fair	40+	
Cuttings	1890m	High	Moderate	Poor-Good	40+	
Cuttings	1910m	High	High	Poor-Good	44+	
Cuttings	2010m	High	Low	Fair	40+	1?
Cuttings	2100m	High	Low-Moderate	Poor-Fair	40+	
				Averages:	**47+**	**1+**

Well Name : Barramundi-1
Operator : GLOBEX
Well Code : BARRAMUNDI-1
Interval : 1150m - 2150m
Scale : 1:3500
Chart date: 06 February 2004

Palynomorph Range Chart for Eocene.
Sample interval 1370 to 2100 metres.
Microscope analysis by Alan D. Partridge.

Barramundi-1

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AUSTRALIA

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