APPENDIX-1

PALYNOLOGICAL ANALYSIS OF SNOOK-1 GIPPSLAND BASIN.

by

A.D. PARTRIDGE
ESSO AUSTRALIA LTD.

Esso Australia Ltd.
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INTERPRETED DATA

INTRODUCTION

Twenty sidewall core samples were processed from Snook-1 and examined for spores, pollen and microplankton. Eight samples gave high yields, eight samples gave low to very low yields and the remainder moderate yields of oxidized organic residue. There were no obvious correlations between sample lithology and residue yield, or between residue yield and resultant palynomorph concentration and diversity, which could have been used to high-grade the samples (see Table-2). The only general observation that can be made is that the paler coloured lithologies tended to give the lower yields, and lowest palynomorph concentrations and diversity. All samples were thermally immature, a reflection of the shallow depth of the samples, and as a consequence preservation overall was good and sometimes exceptional. Because of the good preservation recorded diversity was generally high and the average diversity of spores and pollen in the productive samples was 30.8 species per sample. Microplankton diversity was low to very low, ranging from 1 to 8 species. Highest diversity of microplankton occurs near the top of the Latrobe Group and in the overlying Lakes Entrance Formation.

Lithological units and palynological zones from base of Lakes Entrance Formation to T.D. are given in the following summary. Interpretative data with indentification of zones and confidence ratings are recorded in Table-1 and basic data on residue yields, preservation and diversity are recorded in Table-2. All species which can be identified with binomial names are tabulated on the accompanying range chart.

PALYNOLOGICAL SUMMARY OF SNOOK-1

AGE	UNIT/FACIES	SPORE-POLLEN ZONES (Dinoflagellate Zones)	DEPTH RANGE (mKB)
Oligocene	Lakes Entrance Formation	Upper *N. asperus*	1120.0
	1125.0m		
Late Eocene	Latrobe Group (Gurnard Fm.)	Upper *N. asperus*	1137.0
	1155.0m		
Late Eocene	Latrobe Group (Undiff. coarse clastic facies)	Middle *N. asperus* (*G. extensa*)	1155.5-1206.5 (1155.5-1177.0)
Middle Eocene		Lower *N. asperus*	1263.5-1406.5
Early Eocene		*P. asperopolus*	1427.0-1444.5
	T.D. 1550.0m (Driller) T.D. 1553.5m (Schlumberger)		

GEOLOGICAL COMMENTS

1. The *P. asperopolus* Zone occurring between 1427-1444.5m is the oldest identifiable palynological zone in Snook-1. The 109 metres of section penetrated below this zone contained sidewall cores whose lithologies were unfavourable for palynology. Three samples were processed but only the sidewall core at 1470.5m gave a meager assemblage, which although suspected to be partially contaminated, indicated an age no older than the upper part of the Upper *M. diversus* Zone, based on the presence of *Santalumidites cainozoicus*.

2. The shallowest sidewall core sample in the *P. asperopolus* Zone at 1427m is unusual in being characterized by commom freshwater dinoflagellate cysts, the colonial algae *Botryococcus* and finely disseminated amorphous kerogen. A shallow freshwater lacustrine environment of deposition is envisaged. The gamma-ray and neutron/porosity logs indicate a maximum thickness of less than 1.5 metres, for the claystone unit sampled, suggesting that the lake had a maximum duration of about 50,000 years based on the average depositional rate for the Latrobe Group in Snook-1.

3. A notable feature of the assemblages from Snook-1 is the rarity of the distinctive species *Proteacidites pachypolus* and *P. asperopolus*. The former was recorded in only four samples and never in any numbers. *Proteacidites asperopolus* was only recorded in two samples. In the higher sample at 1353.0m the species is present in some numbers and this is regarded as an abundance acme even though the assemblage has not been counted. Abundances of *P. pachypolus* and *P. asperopolus* are obviously reflecting some environmental control on the parent plant because the peak abundance of the fossil form-species are not evenly distributed within the coastal plain environments in the Gippsland Basin. It is suggested that the abundances of these species are greatest in "lower coastal plain" close to the palaeoshorelines, whereas Snook-1 is on the "upper coastal plain" during the Early and Middle Eocene at a greater distance from the palaeoshoreline.

4. The base of the first abundance or Acme of *P. pachypolus* was use to initially define the base of the *P. asperopolus* Zone by Stover & Evans (1974). Later it realized that the first appearance of *P. asperopolus* was within the *P. pachypolus* Acme, and that all abundances of

P. asperopolus were not time equivalent to the *P. pachypolus* Acme. This resulted in the redefinition of the base of the *P. asperopolus* Zone as the FAD (First Appearance Datum) for the eponymous species, or other species whose FADs were coincident or nearly so (such as *Conbaculites apiculatus*, *Sapotaceoidaepollenites rotundus* etc.). Most abundances of *P. asperopolus* were indeed found to lie within the Lower *N. asperus* Zone, the most clear example of this being in Barracouta-4 (Partridge, 1977). This abundance or acme of the species *Proteacidites asperopolus* when associated with the rare but distinctive pollen species *Plicodiporties crescentus* ms Partridge 1971, is here recognised as a potential correlative time line within the Lower *N. asperus* Zone. Although it will need further testing this is an important observation as the Lower *N. asperus* Zone, which represents virtually the entire Middle Eocene, has proved difficult to subdivide using spores and pollen, even though the zone displays high diversity. This association is recognised in the following wells along the northern margin of the Central Deep in the Gippsland Basin:

WELL NAME	ACME OF *P. asperopolus*	OCCURRENCES OF *P. crescentus*
Barracouta-4	1168.6-1192.4m	1157.3m
Mulloway-1	1285.3-1369.5	1285.3m
Snapper-5	(Not obvious)	1332m
Snook-1	1353m	1353m
Whiptail-1A	1257.5-1344m	1278m

5. The top of the Gurnard Formation in Snook-1 is picked at the slight increase on the gamma-ray log at 1125m, and the base at 1155m where there is a corresponding reduction on the gamma-ray log. The base is also characterised by a reduction in the separation between the neutron porosity and bulk density logs. The only sidewall core recovered from this unit was a glauconitic claystone which gave a marine assemblage assignable to the Upper *N. asperus* Zone.

BIOSTRATIGRAPHY

Zone and age-determinations have been made using criteria proposed by Stover & Partridge (1973, 1982) and unpublished observations made on Gippsland Basin wells drilled by Esso Australia Ltd.

Author citations for most spore-pollen species can be sourced from Stover & Partridge (1973, 1982), or other references cited herein. Species names followed by "ms" are unpublished manuscript names. Author citations for dinoflagellates can be found in Lentin & Williams (1985, 1989).

Proteacidites asperopolus Zone: 1427.0-1444.5 metres Early Eocene.

The two samples assigned to this zone gave high residue yields and high palynomorph diversity in which the key zone indicator species were rare. From the deeper sample at 1444.5m only a single specimen each of the species *Proteacidites asperopolus* and *Clavastephanocolporites meleosus* ms were recorded. The frequent occurrence of *Santalumidites cainozoicus* in the sample encouraged searching of additional slides until the zone species were found. Although the FAD (First Appearance Datum) for *Santalumidites cainozoicus* is within the underlying Upper *M. diversus* Zone it is generally not frequent or common in that zone. The assemblage from 1444.5m is also characterized by common fungal spores, hypae and fruiting bodies.

The shallower sample at 1427.0m is dominated by finely disseminated amorphous material and is characterized by presence of the colonial algae *Botryococcus* and fresh-water dinoflagellate cysts referable to the genera *Saeptodinium* and *Morkallacysta*. Indicator species for the zone are slightly more frequent than in the underlying sample and include specimens of *Sapotaceoidaepollenites rotundus* and several specimens of both *Conbaculites apiculatus* ms and *Nothofagidites goniatus*. *Proteacidites asperopolus* was not found. This sample also is the LAD (Last Appearance Datum) for *Myrtaceidites tenuis* which ranges no higher than the *P. asperopolus* Zone.

Lower *Nothofagidites asperus* Zone: 1263.5-1406.5 metres Middle Eocene.

The base of the zone is picked at 1406.5m on the increase in abundance of *Nothofagidites* spp. above the LAD of *M. tenuis*. However, in the absence of key indicator species known to first occur in the Lower *N. asperus* Zone only a low confidence rating can be assigned to this sample. Higher confidence ratings are assigned to the overlying samples which contain the FADs for *Nothofagidites asperus*, *Tricolpites thomasii*, and *Matonisporites ornamentalis* (this is a disjunct younger datum as this species is also found in the *L. balmei* Zone) all from 1389.0m; *Tricolporites leuros* and *Proteacidites recavus* from 1353.0m; *Tricolpites simatus* and *Plicodiporites crescentus* ms Partridge 1971, from 1353.0m; and finally *Nothofagidites falcatus* and *Proteacidites reflexus* from 1263.5m.

The incoming of new species, rather than "local" species extinctions, are regarded as more reliable for separating the Middle from the Lower subdivision of the *N. asperus* Zone. A few LADs are of importance and in Snook-1 these are *Anacolosidites luteoides* and *Proteacidites asperopolus* at 1353.0m, and *Proteacidites reflexus* at 1263.5m.

Microplankton are rare in the Lower *N. asperus* Zone, but include non-marine dinoflagellate cysts at 1389.0m and 1406.5m, and the monospecific assemblage of the more typical "marine" dinoflagellate *Deflandrea antarctica* at 1283.0m.

Middle *Nothofagidites asperus* Zone: 1155.5-1206.5 metres Late Eocene.
and
Gippslandica extensa Zone: 1155.5-1177.0 metres Late Eocene.

The top and bottom of the Middle *N. asperus* Zone is picked respectively on the LAD and FAD of *Triorites magnificus* which unfortunately was only recorded from these two delimiting samples. The only other diagnostic pollen recorded are *Aglaoreidia qualumis* at 1177.0m and *Dryadopollis* (al. *Tricolporites*) *retequetrus* at 1155.5m.

The *G. extensa* Dinoflagellate Zone, which was informally proposed (as the *Deflandrea extensa* Zone)in Partridge (1976) is recognised in two samples based on the occurrence of the eponymous species. Associated dinoflagellates are not particularly diagnostic. The assemblages are undoubtedly much more diverse, but recording this diversity is not possible because of the low yields from the samples.

Upper *Nothofagidites asperus* Zone: 1120.0-1137.0 metres Oligocene-Late Eocene.

The two shallowest samples are assigned to the Upper *N. asperus* Zone with poor confidence ratings. Although high diversity assemblages were recorded it is felt that they are still only partial assemblages because of the low residue yields recovered. An Upper rather than Middle *N. asperus* Zone assignment for the deepest sample at 1137.0m is favoured by the FADs for *Foveotriletes crater* and *Proteacidites stipplatus*. Favouring an older age for this sample are the LADs for *Proteacidites crassus* and *Triporopollenites ambiguus* which are not considered to occur above the Middle subzone. The associated microplankton in the sample are dominated by abundant *Spiniferites* spp. and common *Operculodinium centrocarpum* without any index species typically found in the Middle *N. asperus* Zone, and this has significantly influenced the decision to assign the sample to the Upper subzone. The shallower sample at 1120.0m from the basal Lakes Entrance Formation is assigned to the Upper *N. asperus* Zone principally on the negative evidence of the absence of the distinctive spore *Cyatheacidites annulatus*. The presence of rare *Protoellipsodinium simplex* ms in a microplankton assemblage dominated by *Operculoidinium centrocarpum* does however suggest the sample could be younger.

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TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA SNOOK-1, GIPPSLAND BASIN

SAMPLE TYPE	DEPTH (metres)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE (OR ASSOCIATION)	CONFIDENCE RATING	COMMENT
SWC 30	1120.0	Upper *N. asperus*	*(O. centrocarpum)*	2	Could be younger.
SWC 29	1137.0	Upper *N. asperus*	*(O. centrocarpum)*	2	FAD *Foveotriletes crater.*
SWC 26	1155.5	Middle *N. asperus*	*G. extensa*	0	LAD *Triorites magnificus.*
SWC 25	1164.5	*N. asperus*		1	No middle subzone species recorded.
SWC 24	1177.0	Middle *N. asperus*	*G. extensa*	0	*Aglaoreidia qualumis* present.
SWC 23	1201.0	*N. asperus*		1	No middle subzone species recorded.
SWC 22	1206.5	Middle *N. asperus*		1	FAD *Triorites magnificus.*
SWC 21	1237.0	*N. asperus*		1	
SWC 20	1263.5	Lower *N. asperus*		1	*Proteacidites reflexus* present.
SWC 19	1283.0	*N. asperus*	*(D. antarctica)*	1	*Tricolpites simatus* present.
SWC 16	1353.0	Lower *N. asperus*		1	LAD *Proteacidites asperopolus*
SWC 15	1358.5	Lower *N. asperus*		1	
SWC 11	1389.0	Lower *N. asperus*		1	*Tricolpites thomasii* present.
SWC 9	1406.5	Lower *N. asperus*		2	*Nothofagidites >> H. harrisii.*
SWC 8	1420.0	Indeterminate			
SWC 7	1427.0	*P. asperopolus*	*(Saeptodinium)*	1	LAD *Myrtaceidites tenuis.*
SWC 6	1444.5	*P. asperopolus*		1	FAD *Proteacidites asperopolus.*
SWC 5	1453.0	Indeterminate			Barren of fossils.
SWC 4	1470.5	Indeterminate			No older than Upper *M. diversus* Zone.
SWC 2	1527.0	Indeterminate			Barren of fossils.

LAD = Last Appearance Datum
FAD = First Appearance Datum

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: +21 m GL: -28 m

WELL NAME: SNOOK-1 TOTAL DEPTH: 1553.5 m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
		Preferred Depth	Rtg	Alternate Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg
NEOGENE	*T. pleistocenicus*								
	M. lipsis								
	C. bifurcatus								
	T. bellus								
	P. tuberculatus								
PALEOGENE	Upper *N. asperus*	1120	2					1137	2
	Middle *N. asperus*	1155.5	0					1206.5	1
	Lower *N. asperus*	1263.5	1			1389	1	1406.5	2
	P. asperopolus	1427	1					1444.5	1
	Upper *M. diversus*								
	Middle *M. diversus*								
	Lower *M. diversus*								
	Upper *L. balmei*								
	Lower *L. balmei*								
LATE CRETACEOUS	Upper *T. longus*								
	Lower *T. longus*								
	T. lilliei								
	N. senectus								
	T. apoxyexinus								
	P. mawsonii								
	A. distocarinatus								
EARLY CRET.	*P. pannosus*								
	C. paradoxa								
	C. striatus								
	C. hughesii								
	F. wonthaggiensis								
	C. australiensis								

COMMENTS: Depths in metres.

Gippslandica extensa Dinoflagellate Zone: 1155.5-1177 m

CONFIDENCE RATING:

0: SWC or Core, Excellent Confidence, assemblage with zone species of spores pollen and microplankton.

1: SWC or Core, Good Confidence, assemblage with zone species of spores and pollen or microplankton.

2: SWC or Core, Poor Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

3: Cuttings, Fair Confidence, assemblage with zone species of either spores and pollen and/or microplankton.

4: Cuttings, No Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

NOTE:
If an entry is given a 3 or 4 confidence rating, an alternative depth with a better confidence rating should be entered, if possible. If a sample cannot be assigned to one particular zone, then no entry should be made, unless a range of zones is given where the highest possible limit will appear in one zone and the lowest possible limit in another.

DATA RECORDED BY: A.D. Partridge DATE: July 1990

DATA REVISED BY: _____ DATE: _____

BASIC DATA

TABLE-2: BASIC DATA

RANGE CHART

TABLE-2: BASIC PALYNOLOGICAL DATA SNOOK-1, GIPPSLAND BASIN

SAMPLE TYPE	DEPTH (metres)	LAB. NO.	LITHOLOGY	RESIDUE YIELD	PALYNOMORPH CONCENTRATION	PRESERVATION	NO. OF S-P SPECIES*	MICROPLANKTON ABUNDANCE	NO. SPECIES*
SWC 30	1120.0	78306 Z	Calcareous Claystone	Low	High	Good	29+	Moderate	7+
SWC 29	1137.0	78306 Y	Glauconitic Claystone	Moderate	High	Fair	41+	High	6+
SWC 26	1155.5	78306 X	Dark grey friable sandstone	Low	Moderate	Good	29+	Low	4+
SWC 25	1164.5	78306 W	Light grey sandstone	Low	Low	Good	12+	Very Low	1
SWC 24	1177.0	78306 V	Medium grey sandstone	Moderate	Low	Good	28+	Low	8+
SWC 23	1201.0	78306 U	Homogeneous siltstone	High	High	Good	35+		
SWC 22	1206.5	78306 T	Laminated siltstone	High	Moderate	Fair-good	32+		
SWC 21	1237.0	78306 S	Homogeneous siltstone	High	Moderate	Fair	34+		
SWC 20	1263.5	78306 R	Interlaminated sst./siltstone	High	High	Good	44+		
SWC 19	1283.0	78306 Q	Fine sandstone	Moderate	Low	Poor-good	16+	Very Low	1
SWC 16	1353.0	78306 O	Sst. with thin carb. laminae	High	High	Good	51+	(Very Low)	(1)
SWC 15	1358.5	78306 N	White sst. with carb. laminae	High	Low	Good	32+		
SWC 11	1389.0	78306 J	Light brown sandstone	Low	High	Good	43+	Very Low	1
SWC 9	1406.5	78306 H	Sst. (possible mud penetration)	Moderate	Moderate	Good	23+	Very Low	1
SWC 8	1420.0	78306 G	Pale siltstone	Very Low	Very Low	Fair-good	6+		
SWC 7	1427.0	78306 F	Dark carbonaceous? claystone	High	Moderate	Fair-good	49+	Moderate	1
SWC 6	1444.5	78306 E	Homogeneous carb. claystone	High	Moderate	Good	38+		
SWC 5	1453.0	78306 D	Very light grey claystone	Very Low	Barren				
SWC 4	1470.5	78306 C	Light brown sandstone	Very Low	Very Low	Good	12+	(Very Low)	(1)
SWC 2	1527.0	78306 B	Light brown sandstone	Very Low	Barren				

Microplankton in (brackets) = contamination

* Diversity:
- Very Low = 1- 5 species
- Low = 6-10 species
- Moderate = 11-25 species
- High = 26-74 species
- Very High = 75+ species

(ADP276)