PALYNOLOGICAL ANALYSIS OF ANGELFISH-1

GIPPSLAND BASIN, SOUTHEASTERN AUSTRALIA

by

Neil G. Marshall

Esso Australia Ltd.

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CONTENTS

INTRODUCTION

Fifty-six sidewall core samples were examined for palynomorphs from Angelfish-1. Occurrences of spore-pollen and dinoflagellate species in each sample are recorded on the enclosed range chart. Tables 1 and 3 summarize interpretative and basic palynological data, and anomalous occurrences of spores-pollen and dinoflagellates are listed in Table 2.

SUMMARY TABLE

AGE	FORMATION	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE
Early Miocene	Lakes Entrance Formation	*P. tuberculatus* 1638.5-1644.0m	-
	1648.0m		
	Flounder Formation	*P. asperopolus* 1649.0m	-
Early Eocene		Upper *M. diversus* to *P. asperopolus* 1665.5-1906.3m	-
		Upper *M. diversus* 1965.0-1988.7m	*R. waipawaense* 1965.0m
	2005.0m		
Late Paleocene	Latrobe Group (coarse clastics)	Upper *L. balmei* 2014.0-2033.3m	*A. homomorphum* 2033.3-2188.0m
Paleocene		Lower *L. balmei* 2050.5-2505.0m	*E. crassitabulata* 2259.0m
Early Paleocene			*T. evittii* 2496.5-2505.0m
Maastrichtian		Upper *T. longus* 2536.0-2880.4m	*M. druggii* 2536.0m
Maastrichtian		Lower *T. longus* 3038.4-3246.7m	-
Campanian		*T. lilliei* 3324.0-3403.0m	-
	T.D. 3421.0m		

GEOLOGICAL COMMENTS

1. Palynological analyses of the section of Latrobe Group (1648.0-3421.0m) penetrated in Angelfish-1 indicates that it ranges from the Late Cretaceous to Early Eocene (T. lilliei - P. asperopolus Zones). As predicted in the geological interpretations, the Flounder Formation in the well is of Early Eocene age (Upper M. diversus - P. asperopolus Zones), and the underlying coarse clastics of the Latrobe Group ranges in age from Campanian to Paleocene (T. lilliei - Upper L. balmei Zones).

2. As part of correlations of the palynological assemblages from Angelfish-1 with those in nearby wells, the material in the Late Cretaceous sections of Batfish-1 and Kahawai-1 have been reexamined and assessed in terms of present zonal concepts. As a result of this, the distribution of the Late Cretaceous zones in these wells have been altered slightly and revised summary data sheets are included in this report. Reasonably good correlations now exist between the spore and pollen zones identified in Angelfish-1 and surrounding wells such as Morwong-1, Tuna-4, Batfish-1 and Kahawai-1.

3) The top of the M. druggii/base of the T. evittii dinoflagellate Zones provides a good datum for correlations when integrated with electric log character. This corresponds to a transgressive marine shale at the Cretaceous-Tertiary boundary.

4) The E. crassitabulata dinoflagellate Zone has only a sporadic distribution in wells surrounding Angelfish-1 viz: Morwong-1 (7390-7704 ft), Batfish-1 (6309 ft), and Tuna-A5 (1802.0, 1932.5m). Hence, it cannot be used as a reliable datum for correlation.

5) Four "Wetzeliella" dinoflagellate Zones are recognized in the channel-fill sequence represented by the Flounder Formation over the Flounder Field. Only the oldest of these zones is identified in Angelfish-1. It is the Rhombodinium waipawaense Zone, which occurs at the same level as the Upper M. diversus spore-pollen Zone.

The Kisselovia thompsonae dinoflagellate Zone (second youngest "Wetzeliella" Zone) occurs in the channel sequence in Tuna-1 (4515.0-4621.0 ft), Tuna-A5 (1333.0-1487.0m), and Tuna-3 (4586 ft), but has not been recorded further west in Tuna-2, Tuna-4, Kahawai-1, Batfish-1, or Angelfish-1.

6) The patchy distribution of the zonal species Proteacidites asperopolus in the Flounder Formation of the Flounder Field makes it difficult to pick the boundary between the Upper M. diversus and P. asperopolus Zones on spore-pollen evidence alone. This problem is also thought to exist in the Flounder Formation penetrated in Angelfish-1. In the area of the Flounder Field, the "Wetzeliella" dinoflagellate Zones provide an independent means of dating the assemblages, with the Rhombodinium ornatum and R. waipawaense dinoflagellate Zones being associated with the Upper M. diversus Zone and the Kisselovia thompsonae and K. edwardsii dinoflagellate Zones corresponding to the P. asperopolus Zone.

In Angelfish-1, however, no dinoflagellate zones younger than the R. waipawaense Zone were observed. Above the level of this zone to near the top of the Flounder Formation (1665.5-1906.3m), samples contain an indistinct spore-pollen assemblage that can be only assigned to a generalized Upper M. diversus - P. asperopolus Zone. One sample studied from near the top of the Flounder Formation (1649.0m) contained rare specimens of P. asperopolus and could therefore be placed in the P. asperopolus Zone.

7) M. Hannah (pers. comm., March, 1986) has examined foraminiferal assemblages from two samples (1638.5, 1644.0m) near the base of the Lakes Entrance Formation in Angelfish-1, and these are dated as Early Miocene.

BIOSTRATIGRAPHY

The spore-pollen zones have been identified using the criteria proposed by Stover & Partridge (1973). The dinoflagellate zones are modifications on the scheme of Partridge (1976). Discussions of the dinoflagellate assemblages and their zonal assignments are given with the descriptions of their associated spore-pollen assemblages.

LATROBE GROUP COARSE CLASTICS: 2005.0-3421.0m

Tricolporites lilliei Zone: 3324.0-3403.0m

The four samples from the zone contain low yield, poorly preserved spore-pollen assemblages. The zonal species, Tricolporites lilliei, was only recorded in two samples (3403.0; 3324.0 m). Other significant species recorded within the interval are Dacrycarpites australiensis, Proteacidites otwayensis, Nothofagidites kaitangata, Tricolpites gillii, T. labrum ms., Gambierina rudata, and Aequitriradites spinulosus.

Palaeocystodinium sp. was the only dinoflagellate recorded and it occurred in the basal sample of the zone.

Lower Tricolpites longus Zone: 3038.4-3246.7m

The base of the zone was picked at the first occurrence of Tricolpites longus at 3246.7 m. Other important elements of the zone are Grapnelispora evansii, Proteacidites palisadus, P. otwayensis, P. gemmatus, Tricolpites waiparaensis, Nothofagidites kaitangata, Stereisporites regium, Camarozonosporites horrendus, and Quadraplanus brossus.

Upper Tricolpites longus Zone: 2526.0-2880.4m

The first occurrence of Stereisporites punctatus defines the base of the zone. Many distinctive taxa from the Lower T. longus Zone range into this subdivision, including Tricolpites longus, Proteacidites otwayensis, P. gemmatus, P. palisadus, Quadraplanus brossus, Grapnelispora evansii, and Camarozonosporites horrendus. Some other stratigraphically significant taxa within the zone are Lygistepollenites balmei, Proteacidites reticuloconcavus, P. wahoensis, Triporopollenites sectilis and Tetracolporites verrucosus.

Low yield dinoflagellate assemblages occur frequently, and these contain the following species: Apectodinium homomorphum, Palaeocystodinium sp., Areoligera sp., A. senonensis, Cribroperidinium sp., Manumiella druggii, Spiniferites sp., Trichodinium hirsutum, Eisenackia sp., and Paralecaniella sp. The most stratigraphically significant of these taxa is M. druggii and its occurrence is used to define the M. druggii Zone (2536.0m).

Lower Lygistepollenites balmei Zone: 2020.5-2505.0m

This zone is characterised by the absence of Tricolpites longus and the consistent and often frequent occurrence of L. balmei. Important taxa ranging into the zone from the underlying Upper T. longus Zone are Tetracolporites verrucosus, Stereisporites punctatus, S. regium, and Nothofagidites kaitangata. Some significant taxa restricted to the zone are Integricorpus antipodus, Juxtacolpus pieratus, and Polycolpites langstonii.

The sample at 2259.0m contained low records of Proteacidites annularis and P. incurvatus which appear anomalously early. These species are normally restricted to the Upper L. balmei Zone. The spore and pollen assemblage from this sample was unusually well-preserved for a Lower L. balmei Zone sample and of moderate diversity. A possible explanation of these early records is that these rare taxa are just not normally seen in the poorer quality material usually encountered in the Lower L. balmei Zone.

Three dinoflagellate zones were identified between 2050.5-2505.0m.

1. Trithyrodinium evittii Zone (2496.5-2505.0m): The zone is identified by the presence of T. evittii. The occurrence of Hystrichosphaeridium tubiferum and Deflandrea sp. at this level is consistent with the zone.

2. Eisenackia crassitabulata Zone (2259.0m): The rare occurrence of Alisocysta rugolirata is used to recognise the zone. Some other dinoflagellates recorded at this level are: Senegalinium dilwynense, Palaeocystodinium sp. P. australinium, Hystrichosphaeridium tubiferum, Glaphyrocysta retiintexta, Isabelidinium bakeri, and Apectodinium homomorphum.

3. Apectodinium homomorphum Zone (2033.3- 2188.0m): The zonal species was only recorded in the highest and lowest sample within this interval.

Upper Lygistepollenites balmei Zone: 2014.0-2033.3m

The base of the zone is marked by the occurrence of Proteacidites incurvatus at 2033.3 m. Other significant taxa recorded are Haloragacidites harrisii, Polycolpites langstonii, and frequent to common L. balmei.

Dinoflagellates recorded are Apectodinium homomorphum, and taxa of the Palaeoperidinium bassensis complex.

FLOUNDER FORMATION: 1648.0-2005.0m

The boundaries of the Upper M. diversus and P. asperopolus Zones within the section of Flounder Formation are difficult to identify reliably because of the sporadic occurrences of key species. This problem is also evident in equivalent sections of the Flounder Formation from the Flounder Field. Where dinoflagellate zones can be recognized, they provide an independent means of dating the sequence.

Upper Malvacipollis diversus Zone: 1965.0-1988.0m

Stratigraphically significant spore-pollen taxa recorded from this interval are Cupanieidites orthoteichus, Intratriporopollenites notabilis, Proteacidites grandis, P. leightonii, P. ornatus, P. pachypolus, P. tuberculiformis, and Tricolpites incisus.

The Rhombodinium waipawaense dinoflagellate Zone was identified at 1965.0m, based on the presence of the nominate species. This dinoflagellate zone is restricted to the Upper M. diversus spore pollen Zone. Some other dinoflagellates recorded from the interval are Homotryblium tasmaniense, Wetzeliella longispinosa and Glaphyrocysta velivolus ms.

Upper Malvacipollis diversus - Proteacidites asperopolus Zone: 1665.5-1906.3m

Important species ranging into this interval from the Upper M. diversus Zone are: Proteacidites leightonii, P. ornatus, P. pachypolus, P. tuberculiformis and Intratriporopollenites notabilis. Some other taxa recorded from the section are: Myrtaceidites tenuis, Anacolosidites acutullus, Triporopollenites ambiguus, T. spinosus, Beaupreaidites verrucosus, Kuylisporites waterbolkii, and Dryptopollenites semilunatus.

Dinoflagellates recorded include: Homotryblium tasmaniense, Wetzeliella longispinosa, Apectodinium homomorphum, Deflandrea flounderensis and D. truncata.

The Upper M. diversus - P. asperopolus Zones cannot be separated on the basis of the above palynological assemblage.

Proteacidites asperopolus Zone: 1649.0m

The zone is identified by the rare occurrence of the zonal species. Some other taxa recorded are: Proteacidites pachypolus, P. differentipolus, P. kopiensis, and P. tuberculiformis.

Proteacidites tuberculatus Zone: 1638.0-1644.5m

Two samples, containing low yield spore-pollen and dinoflagellate assemblages, were assigned to the zone. These are:

1) 1644.0m. This contained an indistinct spore and pollen assemblage. Diagnostic dinoflagellates recorded are: Nematosphaeropsis balcombiana and Pyxidinopsis pontus ms.

2) 1638.5m: The diagnostic spore Cyatheacidites annulatus was recorded at this level. Some dinoflagellates identified are: Nematosphaeropsis balcombiana, Pyxidinopsis pontus, P. simplex, and Tuberculodinium vancompoae

REFERENCES

PARTRIDGE, A.D., 1976. The Geological Expression of Eustacy in the Early Tertiary of the Gippsland Basin. APEA. J. 16, 73-79.

STOVER, L.E. & PARTRIDGE, A.D., 1973. Tertiary and Late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. Proc. R. Soc. Victoria 85, 237-286.

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND BASIN ELEVATION: KB: 21.0m GL: -70.1 m

WELL NAME: ANGELFISH-1 TOTAL DEPTH: 3413.5 m

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
PALEOGENE	*P. tuberculatus*	1638.5	0				1644.0	2			
	Upper *N. asperus*										
	Mid *N. asperus*										
	P. asperopolus	1649.0	0				1649.0	0			
	U.Md-P.asp	1665.5					1906.3				
	Upper *M. diversus*	1965.0	1				1988.7	2	1965.0	1	
	Mid *M. diversus*										
	Lower *M. diversus*										
	Upper *L. balmei*	2014.0	2				2033.3	1			
	Lower *L. balmei*	2050.5	2				2505.0	1			
LATE CRETACEOUS	Upper T. *longus*	2536.0	1				2880.4	0			
	Lower T. *longus*	3038.4	1				3246.7	1			
	T. lilliei	3324.0	2				3403.0	2			
	N. senectus										
	T. apoxyexinus										
	P. mawsonii										
	A. distocarinatus										
EARLY CRET.	*P. pannosus*										
	C. paradoxa										
	C. striatus										
	C. hughesi										
	F. wonthaggiensis										
	C. australiensis										

COMMENTS: Dino. zones: M. druggii Zone (2536.0m); T. evittii Zone (2505.0-2496.5m); E. crassitabulata Zone (2259.0m); A. homomorphum Zone (2188.0-2033.3m); R. waipawaense Zone (1965.0m)

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 or microplankton, or both.
- 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: NEIL G. MARSHALL DATE: 11/3/86

DATA REVISED BY: DATE:

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: +31 ft GL: 211 ft

WELL NAME: BATFISH-1 TOTAL DEPTH: 9761 feet

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
	P. tuberculatus	4765	1				4768	1			
PALEOGENE	Upper *N. asperus*										
	Mid *N. asperus*										
	Lower *N. asperus*										
	P. asperopolus	5004	1				5698	1			
	Upper *M. diversus*	5956	1				6102	1			
	Mid *M. diversus*										
	Lower *M. diversus*										
	Upper *L. balmei*										
	Lower *L. balmei*	6309	1				6740	2			
LATE CRETACEOUS	Upper *T. longus*	7332	1				8040	1			
	Lower *T. longus*	8100	2	8402	1		8562	1			
	T. lilliei	8604	2				9691	2			
	N. senectus										
	T. apoxyexinus										
	P. mawsonii										
	A. distocarinatus										
EARLY CRET.	*P. pannosus*										
	C. paradoxa										
	C. striatus										
	C. hughesi										
	F. wonthaggiensis										
	C. australiensis										

COMMENTS: Eisenackia crassitabulata Dinoflagellate Zone 6309' (2)

Depths in feet.

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 or microplankton, or both.

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: LES/ADP DATE: June 1971; Dec. 1971

DATA REVISED BY: ADP/N.G. Marshall DATE: Jan. 1975; March 1986

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: 21.0 GL: -81.0

WELL NAME: KAHAWAI-1 TOTAL DEPTH: 2321 metres

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
PALEOGENE	*P. tuberculatus*	1369.0	0				1389.0	0			
	Upper *N. asperus*										
	Mid *N. asperus*	1391.2	2				1393.0	2			
	Lower *N. asperus*	1394.0	2				1396.1	2			
	P. asperopolus	1400.7	1				1426.6	0			
	Upper *M. diversus*	1472.1	2				1472.1	2			
	Mid *M. diversus*	1495.2	1				1528.5	2			
	Lower *M. diversus*	1554.6	1				1572.2	0			
	Upper *L. balmei*	1577.6	0				1687.8	1			
	Lower *L. balmei*	1738.2	0				1932.7	2	1895.6	1	
LATE CRETACEOUS	Upper *T. longus*	1960.3	1				2005.1				
	Lower *T. longus*	2065.6	2	2271.4	1		2307.5	2	2294.2	1	
	T. lilliei										
	N. senectus										
	T. apoxyexinus										
	P. mawsonii										
	A. distocarinatus										
EARLY CRET.	*P. pannosus*										
	C. paradoxa										
	C. striatus										
	C. hughesi										
	F. wonthaggiensis										
	C. australiensis										

COMMENTS: Depths in metres.

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 or microplankton, or both.
- 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: M.K. Macphail DATE: 17 September, 1985

DATA REVISED BY: N.G. Marshall DATE: March, 1986

TABLE 1: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA FOR ANGELFISH-1

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	COMMENTS
SWC 60	1638.5	P. tuberculatus (o)	-		C. annulatus, P. simplex, N. balcombiana, T. vancompoae
SWC 59	1644.0	P. tuberculatus (2)	-		N. balcombiana
SWC 58	1649.0	P. asperopolus (o)	-	Early Eocene	P. asperopolus, P. pachypolus,
SWC 57	1665.5	U. M. diversus - P. asperopolus	-	Early Eocene	D. semilunatus, M. tenuis, P. tuberculiformis
SWC 56	1717.4	U. M. diversus - P. asperopolus	-	Early Eocene	I. notabilis, M. tenuis, P. pachypolus, H. tasmaniense
SWC 88	1752.2	U. M. diversus - P. asperopolus	-	Early Eocene	I. notabilis, M. tenuis, P. pachypolus, D. flounderense
SWC 55	1785.0	U. M. diversus - P. asperopolus	-	Early Eocene	M. tenuis, P. pachypolus, H. tasmaniense
SWC 87	1820.0	U. M. diversus - P. asperopolus	-	Early Eocene	M. tenuis, P. pachypolus, H. tasmaniense, P. ornatus, M. tenuis
SWC 54	1859.0	U. M. diversus - P. asperopolus	-	Early Eocene	I. notabilis, M. tenuis, P. pachypolus
SWC 53	1906.3	U. M. diversus - P. asperopolus	-	Early Eocene	P. pachypolus, H. tasmaniense
SWC 52	1933.0	U. M. diversus - P. asperopolus	-	Early Eocene	P. pachypolus, H. tasmaniense
SWC 51	1965.0	Upper M. diversus (1)	R. walpawaense (o)	Early Eocene	I. notabilis, R. walpawaense, H. tasmaniense
SWC 50	1988.7	Upper M. diversus		Early Eocene	I. notabilis, H. tasmaniense
SWC 49	2014.0	L. balmei	-	Paleocene	L. balmei
SWC 86	2033.3	Upper L. balmei(1)	A. homomorphum	Late Paleocene	L. balmei, P. incurvatus, P. langstonii
SWC 48	2050.5	L. balmei	-	Paleocene	L. balmei
SWC 46	2093.0	L. balmei	-	Paleocene	L. balmei, A. obscurus

NOTE: BRACKETED NUMBERS REFER TO CONFIDENCE RATINGS.

TABLE 1: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA FOR ANGELFISH-1

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	COMMENTS
SWC 85	2153.8	L. balmei	-	Paleocene	L. balmei, P. langstonii
SWC 84	2188.0	L. balmei	A. homomorphum (o)	Paleocene	L. balmei, A. obscurus, P. langstonii, I. antipodus
SWC 43	2232.4	L. balmei		Paleocene	A. obscurus
SWC 83	2259.0	Lower L. balmei (2)	E. crassitabulata (2)	Paleocene	L. balmei, J. pieratus, I. antipodus, I. bakeri, E. crassitabulata
SWC 42	2280.0	Lower L. balmei (2)	-	Paleocene	L. balmei, S. regium
SWC 82	2312.2	Lower L. balmei (1)	-	Paleocene	L. balmei, T. verrucosus, A. obscurus
SWC 40	2379.2	Lower L. balmei (2)	-	Paleocene	L. balmei, A. obscurus
SWC 39	2415.7	Lower L. balmei (2)	-	Paleocene	L. balmei, T. verrucosus,
SWC 81	2453.0	Lower L. balmei (1)	-	Paleocene	L. balmei, T. verrucosus,
SWC 37	2496.5	Lower L. balmei (2)	T. evittii (o)	Early Paleocene	L. balmei, H. tubiferum, T. evittii
SWC 80	2505.0	Lower L. balmei (1)	T. evittii (o)	Early Paleocene	L. balmei, T. verrucosus, T. evittii, H. tubiferum
SWC 79	2509.8	Indet	-	-	
SWC 34	2536.0	Upper T. longus (1)	M. druggii (o)	Maastrichtian	L. balmei, T. verrucosus, M. druggii
SWC 33	2541.6	T. longus	-	Maastrichtian	P. otwayensis, A. senonense
SWC 32	2548.0	T. longus	-	Maastrichtian	T. sectilis, Areoligera sp.
SWC 77	2575.2	Upper T. longus (1)	-	Maastrichtian	T. longus, S. punctatus

TABLE 1: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA FOR ANGELFISH-1

SAMPLE NO.	DEPTH (m)	SPORE-POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	COMMENTS
SWC 30	2586.0	Upper T. longus (2)	-	Maastrichtian	L. balmei, S. punctatus, P. gemmatus
SWC 29	2611.5	Upper T. longus (2)	-	Maastrichtian	G. evansii, P. otwayensis, P. pallsadus
SWC 76	2631.0	Upper T. longus (1)	-	Maastrichtian	C. horrendus, S. punctatus, P. gemmatus
SWC 28	2651.0	Indet	-		
SWC 75	2662.6	Upper T. longus (o)	-	Maastrichtian	S. punctatus, T. longus, Q. brossus
SWC 27	2680.3	Upper T. longus (1)	-	Maastrichtian	S. punctatus, P. gemmatus.
SWC 74	2706.5	Upper T. longus (1)	-	Maastrichtian	S. punctatus, T. verrucosus, P. pallsadus
SWC 26	2738.0	Upper T. longus (1)	-	Maastrichtian	S. punctatus, P. otwayensis, Q. brossus
SWC 73	2767.1	Indet			
SWC 12	2827.2	Indet			
SWC 23	2880.4	Upper T. longus (o)	-	Maastrichtian	S. punctatus, T. longus, T. lilliei
SWC 22	2904.5	Indet			
SWC 20	3038.4	Lower T. longus (1)	-	Maastrichtian	C. horrendus, T. longus, Q. brossus.
SWC 17	3104.4	Lower T. longus (2)	-	Maastrichtian	G. evansii, P. otwayensis, S. reglum.
SWC 13	3200.4	Indet	-		
SWC 9	3246.7	Lower T. longus (1)	-	Maastrichtian	T. longus,
SWC 8	3258.0	Indet	-		
SWC 7	3276.0	Indet	-		
SWC 3	3324.0	T. lilliei (2)	-	Campanian	T. lilliei, T. labrum
SWC 63	3357.5	Indet	-		
SWC 62	3382.2	Indet			
SWC 61	3403.0	T. lilliei (2)	-	Campanian	T. lilliei,

TABLE 2

ANOMALOUS AND UNUSUAL OCCURRENCES OF SPORE-POLLEN AND DINOFLAGELLATE TAXA IN ANGELFISH-1

SAMPLE NO.	DEPTH(m)	ZONE	TAXON	COMMENTS
SWC 29	2611.5	Upper *T. longus*	*Apectodinium homomorphum*	anomalously low record
SWC 34	2536.0	*M. druggii*	*Elsenackia* sp.	anomalously low record
SWC 80	2505.0	*T. evittii*	*Alisocysta rugolirata*	anomalously low record
SWC 39	2415.7	Lower *L. balmei*	*Apectodinium homomorphum*	anomalously low record
SWC 40	2379.2	Lower *L. balmei*	*Apectodinium homomorphum*	anomalously low record
SWC 83	2259.0	*E. crassitabulata*	*Proteacidites annularis*	anomalously low record
SWC 83	2259.0	*E. crassitabulata*	*Proteacidites incurvatus*	anomalously low record
SWC 83	2259.0	*E. crassitabulata*	*Juxtacolpus pleratus*	unusually high occurrence
SWC 83	2259.0	*E. crassitabulata*	*Apectodinium homomorphum*	anomalously low record
SWC 50	1988.7	Upper *M. diversus*	*Tricolpites inclsus*	unusually low occurrence
SWC 51	1965.0	Upper *M. diversus*	*Spinizonocolpites* sp.	unusual occurrence

TABLE 3: SUMMARY OF BASIC PALYNOLOGICAL DATA FOR ANGELFISH-1

DIVERSITY - low medium high
S & P less than 10 10-30 greater than 30
D 1-3 3-10 10

SAMPLE NO.	DEPTH (m)	YIELD		DIVERSITY		PRESERVATION	LITHOLOGY	PYRIZATION	COMMENTS
		SPORE-POLLEN	DINOS	SPORE-POLLEN	DINOS				
SWC 60	1638.5	v. low	low	mod	mod	good	clyst.		
SWC 59	1644.0	low	low	low	low	good	clyst.		
SWC 58	1649.0	mod	mod	mod	low	good	clyst.		
SWC 57	1665.5	mod	low	mod	low	exc.	sltst.	mod	
SWC 56	1717.4	mod	mod	mod	mod	good	sltst.		
SWC 88	1752.2	mod	mod	mod	mod	fair	clyst.	mod	
SWC 55	1785.0	mod	mod	mod	mod	fair	sh.	high	
SWC 87	1820.0	high	low	mod	mod	exc	sltst.		
SWC 54	1859.0	low	low	mod	low	good	sandy sltst.		
SWC 53	1906.3	mod	mod	low	mod	poor	sh.	high	
SWC 52	1933.0	mod	mod	mod	mod	good	sst.	mod	
SWC 51	1965.0	mod	mod	mod	mod	good	sltst.		
SWC 50	1988.7	low	low	mod	mod	good	slty sst.		
SWC 49	2014.0	low	low	low	-	fair	carb. sltst.		
SWC 86	2033.3	mod	mod	mod	low	fair	carb. sh.		
SWC 48	2050.5	mod	-	mod	-	poor	carb. sh.	high	
SWC 46	2093.0	mod	-	mod	-	poor	coal		
SWC 85	2153.9	low	low	low	low	poor	slty sst.		
SWC 84	2188.0	mod	low	mod	low	fair-good	sandy sltst.		

TABLE 3: SUMMARY OF BASIC PALYNOLOGICAL DATA FOR ANGELFISH-1

DIVERSITY - low medium high
S & P less than 10 10-30 greater than 30
D 1-3 3-10 10

SAMPLE NO.	DEPTH (m)	YIELD SPORE-POLLEN	YIELD DINOS	DIVERSITY SPORE-POLLEN	DIVERSITY DINOS	PRESERVATION	LITHOLOGY	PYRIZATION	COMMENTS
SWC 43	2232.4	mod	-	low	-	good	coal		
SWC 83	2259.0	mod	low	high	mod	exc.	carb. sh.		
SWC 42	2280.0	mod	-	mod	-	poor	siltst.		
SWC 82	2312.2	mod	-	mod	-	poor-fair	siltst.		
SWC 40	2379.2	mod	mod	mod	low	poor	siltst.	high	
SWC 39	2415.7	mod	low	mod	low	fair	sh.	mod	
SWC 81	2453.0	mod	mod	mod	low	poor-fair	carb. siltst.	mod	
SWC 37	2496.5	low	high	low	mod	good	siltst.		
SWC 80	2505.0	mod	mod	mod	mod	good	siltst.	mod	
SWC 79	2509.8	low	low	low	low	poor	siltst.		
SWC 34	2536.0	v. low	mod	low	mod	fair-good	silty sst.		
SWC 33	2541.6	v. low	v. low	low	low	fair	sandy siltst.		
SWC 32	2548.0	low	low	low	low	fair	sst.		
SWC 77	2575.5	low	low	low	low	poor	silty sst.		
SWC 30	2586.0	mod	v. low	mod	low	fair	carb. siltst.		
SWC 29	2611.5	mod	v. low	mod	low	fair	siltst.		
SWC 76	2631.0	mod	-	mod	-	fair	sst.		
SWC 28	2651.0	v. low	v. low	low	low	fair	siltst.		

TABLE 3: SUMMARY OF BASIC PALYNOLOGICAL DATA FOR ANGELFISH-1

DIVERSITY - low medium high
S & P less than 10 10-30 greater than 30
D 1-3 3-10 10

SAMPLE NO.	DEPTH (m)	YIELD SPORE-POLLEN	YIELD DINOS	DIVERSITY SPORE-POLLEN	DIVERSITY DINOS	PRESERVATION	LITHOLOGY	PYRIZATION	COMMENTS
SWC 75	2662.6	mod	-	mod	-	good	sh.		
SWC 27	2680.3	low	-	mod	-	fair	sltst.		
SWC 74	2706.5	low	-	low	-	fair	sst.		
SWC 26	2738.0	mod	-	mod	-	good	sh.		
SWC 73	2767.1	low	-	low	-	poor	sltst.		
SWC 25	2782.4	low	-	low	-	poor	sltst.		
SWC 72	2827.2	low	-	mod	-	fair	sltst.		
SWC 23	2880.4	mod	low	mod	low	fair	sltst.	mod	
SWC 22	2904.5	low	?low	low	?low	poor	slty coal		
SWC 20	3038.4	mod	-	mod	-	good	sltst.		
SWC 17	3104.4	low	-	low	-	fair	sltst.		
SWC 13	3200.4	low	-	mod	-	fair	sltst.		
SWC 9	3246.7	mod	v. low	mod	v. low	fair	sltst.		
SWC 8	3258.0	v. low	-	v. low	-	v. poor	sst.		
SWC 7	3276.0	low	-	low	-	poor	slst/sst.		
SWC 3	3324.0	low	-	low	-	poor	sltst.		
SWC 63	3357.5	low	-	mod	-	poor	sltst.		
SWC 62	3382.2	low	-	low	-	poor	sst/sltst.		
SWC 61	3403.0	low	v. low	mod	v. low	poor	sh.		