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APPENDIX 1

The Geochronology and Depositional Environments of Pisces No. 1 sediments over the interval from 1075.2 m. to 2564.5 m. (after Paltech Pty. Ltd.).

1.1. The Foraminiferal Sequence in Pisces No. 1.

1.2. The Palynological Sequence in Pisces No. 1.

1.1. THE FORAMINIFERAL SEQUENCE

in PISCES # 1.

Fifty sidewall cores were examined from PISCES # 1. The sequence is divisible into an upper, carbonate marine unit and an underlying series of non-carbonate, marginal marine to non-marine units. The absence of planktonic foraminifera in the non-carbonate series prohibits any comment regarding biostratigraphy or age in this report (refer Palynology). However, the carbonate unit contains a number of planktonic foraminiferal assemblages, thus permitting precise biostratigraphic designation as summarised below:-

Sidewall Cores Depth (m)	Approx. E-Log Unit Boundary	Age	Zone*	Paleoenvironment [¶]
1075.2 to 1155.0		Mid Miocene	D-1	Mid Shelf (≈100m)
----- ? -----				
1198.5 to 1464.0		Mid Miocene	D-1 to D-2	Outer Shelf Canyon (≈150m)
----- ? -----				
1475.0 to 1604.0		Mid Miocene	D-2 to E-1	Shelf Edge Canyon (≈200m)
----- ? -----				
1620.0 to 1681.5		Early Miocene	E-2	Shelf Edge Canyon (≈200m)
----- ? -----				
1684.5 to 1794.5		Early Miocene	F to G	Prograding Wedge at Shelf/Slope Break (≈200m)
~~~~~ 1796 ~~~~~				
1796.5 to 2320.5		? No planktonic foraminifera found	? 	Marginal marine non-carbonates

* Planktonic foraminiferal zonation after Taylor (in prep). This report includes distribution chart for Pisces on Table 1 with reliability of zonal determinations.

¶ Interpretation based on distribution of selected benthonic foraminiferal species and other sediment grains (<.075mm) as shown on Table 2 of this report. Paleobathymetric ranges are in parentheses.

The sidewall core at 1794.5 representing the base of the carbonate sequence, contains an "upper" Zone G assemblage, indicating an Early Miocene age at approximately 18 million years ago. The sequence continued, apparently uninterrupted, to at least the mid Miocene Zone D-1 at 1075. (The sidewall core at 1075.2m was the highest recovered in Pisces # 1.)

Faunal and other sediment grains in the basal part of the carbonate sequence (1794.5 to 1684.5) indicate a prograding wedge of the shelf edge. This wedge probably resulted from distal, carbonate sediment discharge from a submarine canyon which was apparent as canyon fill at and above 1681.5m.

The non-carbonate series between 1796.5 and 2320 contain at least three lithological units, with no planktonic foraminifera and only sporadic benthonic foraminifera and fish fragments. However, some sidewall cores were heavily contaminated with mid Miocene from the carbonate unit above (for example at 2097).

Directly below the carbonate unit were two "Greensand" units; each lithologically distinct from the other. The higher one, from 1796.5 to 1803.0 was a fine quartz, glauconitic clayey sandstone containing some coarse wind blown quartz grains. This unit may represent the "Lakes Entrance Greensand", but this cannot be confirmed either micropaleontologically or palynologically. The lower "Greensand", from 1808.5 to 1825, was coarser grained with distinct pellet glauconite which was oxidised to limonite in the top half of the unit (1808.5 to 1816.5).

Palynological examinations (see Palynology Report) revealed that dinoflagellates and spore/pollen were present only below this oxidised horizon (i.e. at and below 1820.5). These microfloras were of Late Cretaceous age and were dominated by low specific diversity dinoflagellate assemblages. The sporadic benthonic foraminiferal assemblages, between 1820.5 and 2320 were composed completely of arenaceous forms (refer Table 2 - this Report). These forms were euryhaline, tolerating fluctuating salinities; conditions also indicated by the low diversity nature of the dinoflagellate assemblages. Therefore we interpret that sedimentation between 1820.5 to at least 2320 took place in marginal marine situations such as lagoons, estuaries and delta fronts.



SELECTED BENTHONIC FORAMINIFERA IN ENVIRONMENTAL GROUPS			RESIDUE	LITHOLOGY		PALEO-ENVIRONMENT	CHARACTER CHANGES	PLANKTONIC FORAMINIFERAL ASSEMBLAGE	AGE	
LAGOON	SLOPE/SHELF BREAK → MID SHELF	MISPLACED INNER SHELF	MAJOR COMPONENTS	MINOR COMPONENTS						
	SHALLOW WATER EUVHIALINE PRIMITIVE AENEACEOUS	DEEP WATER PRIMITIVE AENEACEOUS								
	Osangularia sp. Martiniella communis Vulminina granulosa Cibicides medicocris Cibicides temperatus Discorbinaella berthelotti Bolivina spp. (smooth) Fuvvigerina spp. Stilostomella spp. Pleurastomella spp. Siphonvigerina proboscidea Gibbulinina pacifica Nonionella sp. Globocassidulina subglobosa Astronionon spp. Cibicides subbaldingeri Nodosarids Milloids Cibicides opaqueus Cibicides lobatulus		P: pyrite F: foraminifera M: micritic limestone B: limonite after glauc. G: glauc. pellets S: silt & clay Q: c-m. ang. qtz. Q: f. ang. qtz.	C. ang. qtz. pyrite limonite after pyrite qtz. pebbles glauc. pellets rock frags. mica frags. fish frags. bryozoa sponge spicules echinoid spines ostracodes	foram count plank foram %	DELTAIC-ESTUARINE INNER SHELF <100m MID SHELF >100m OUTER SHELF CANYON >150m SHELF EDGE CANYON >200m & PROGRADING WEDGE		Zone	Depth at Base	
1075.2+										
1155.0+										
1198.5+								D-1	1198.5	
1251.0+										
1293.0+										
1351.5+										
1398.0+										
1454.0+	INDET							D-2		MIDDLE MIOCENE
1464.0+	INDET									
1475.0+	INDET									
1489.0+	INDET									
1498.5+										
1514.0+										
1527.0+										
1541.0+										
1553.0+	INDET							?		
1564.5+								?		
1575.5+										
1589.5+										
1604.0+										
1620.0+								E-1	1604.0	
1633.0+										
1643.0+										
1660.5+										
1679.5+										
1681.5+										
1684.5+	INDET									
1687.5+										
1696.5+										
1722.5+										
1745.5+										
1769.5+										
1791.0+										
1792.5+										
1794.5+										
1796.5+										
1799.0+										
1803.0+										
1808.5+										
1812.5+	NO FORAMINIFERA FOUND									
1816.5+										
1820.5+										
1823.0+										
1825.0+										
1827.0+										
1834.0+										
2097.0+	DOWNHOLE MUD CONTAMINANTS									
2287.5+										
2295.5+										
2320.5+										

KEY: * = <20 specimens  
 x = >20 specimens  
 D = Dominant >60% of assemblage  
 W = Worn specimens

TABLE 2: SIGNIFICANT BENTHONIC FORAMINIFERAL DISTRIBUTION, RESIDUE LITHOLOGY & PALEOENVIRONMENTAL ASSESSMENT- PISCES # 1  
 PALTECH REPORT 1982/18

1.2. THE PALYNOLOGICAL SEQUENCE

IN PISCES # 1.

Fifty sidewall cores from Pisces # 1 were examined for palynological content. On the basis of that examination, the following breakdown of the sequence was noted:-

Depth (m)	Age	Dinoflagellate Zone	Spore-Pollen Zone	Paleoenvironment
1796.5 to 1812.5	Indet -barren	?	?	?
1816.5	Indet			
1820.5 to 2161.0	Maastrichtian	<i>I. druggii</i> Zone	<i>T. longus</i> Zone — 2081 — ?	marginal
2179 to 2490	Early Maastrichtian -Late Campanian	<i>I. korojonense</i> Zone — 2379.5 —	— 2320 — <i>T. lillei</i> Zone	marine
2509 to 2554.5	Campanian			Continental
2564.5	? Campanian		? <i>T. lillei</i> Zone	

The zonation scheme used is that established by Stover & Partridge (1973) and further updated in unpublished reports.

A list of the sidewall cores studied is shown on tables 1 and 2. The five shallowest sidewall cores, from 1796.5 to 1812.5, were barren and the sample at 1816.5 yielded insufficient information for dating purposes.

The section studied yielded an excellent well preserved Late Cretaceous marine dinoflagellate sequence. A detailed examination is beyond the scope of this report, but further examination is warranted as this sequence should provide valuable input into the clarification of a biostratigraphic Zonation

for the Late Cretaceous.

The preservation of the palynomorphs, particularly in the predominantly marine samples, is poor and the ranges of some of the species appear to be at variance with their known ranges. This may be the result of probable Oligocene/Miocene contamination, which was also mentioned in the foraminiferal report and is probably due to drilling mud contamination. Data provided by the spore-pollen assemblage allowed for zone determinations to be made, however the boundary between the *T. longus* and *T. lillei* Zones is rather indistinct, being somewhere between 2081m and 2320m.

The boundary at 2161m is based on the upper limit of the dinoflagellate *Isabelidium korojonense* which is known to have a limited vertical range in the late Campanian/early Maastrichtian. The correlation of the dinoflagellate Zones with the European Stages is based on unpublished ranges for Western Australian sequences. However the *I. korojonense* / *I. druggii* boundary in W.A. is marked by a major disconformity. There is no evidence for a disconformity at that horizon in PISCES # 1, which leaves open the question of the age of the *I. korojonense* / *I. druggii* boundary in PISCES # 1.

The occurrence of Late Cretaceous dinoflagellate assemblages older than the *I. druggii* Zone, in the Gippsland Basin has not been previously reported and makes this an important sequence for further study.

#### REFERENCES.

HELBY, et al, in prep: Palynologic Zonation of the Mesozoic.

STOVER, L.E. & PARTRIDGE A.D., 1973: Tertiary and Late Cretaceous Spores & Pollen from the Gippsland Basin, South Eastern Australia.  
*Proc. R. Soc. Vict. Vol. 85, Pt. 2.*

SIDEWALL CORE Depth in metres	DINOFLAGELLATES	KEY • <20 specimens x >20 specimens D Dominant >60% R Recycled	DIVERSITY L = low (1-7) M = moderate (8-14) H = high (15-19) VH = very high	YIELD VP 1-19 P 20-99 F 100-499 per 27mm coverlip	PRESERVATION VP = very poor P = poor F = fair G = good	ENVIRONMENTAL DATA														
						DINOFLAGELLATE ZONE HELBY et al	AGE	Total Count	% Marine	Preservation	Yield	Diversity	Maturation							
1796.5	<i>Heterosphaeridium</i> cf. <i>H. difficile</i> <i>Isabelidium</i> cf. <i>I. pellucidum</i> <i>Isabelidium</i> sp. ? <i>Alterbia</i> acutula ? <i>Amphiradema</i> rectangularis Canningia cf. <i>C. colliveri</i> <i>Isabelidium</i> cf. <i>I. bakeri</i> Cyclonephelium distinctum Cleistosphaeridium sp. <i>Isabelidium</i> cf. <i>I. beifastense</i> Nysticosphaeridium sp. <i>Isabelidium</i> cretaceum <i>Isabelidium</i> druggii Odontochitina sp. Spiniferites sp. ? <i>Ascodinium</i> acrophum Convalucyca sp. Odontochitina pacifica Leberidocysta chlangata Trichyrodinium vermiculatum Spiniferites ramosus Chatangiella tripartita Xenidion australis ? <i>Scrialodinium</i> sp. Cleistosphaeridium cf. <i>C. polytrichum</i> <i>Heterosphaeridium heterocanthum</i> ? <i>Operculodinium</i> hirsutum ? <i>Cribroridinium</i> edwardsii Paleosomocystis sp. <i>Oligosphaeridium</i> cf. <i>O. pulcherrimum</i> Canningia cf. <i>C. reticulata</i> Canningopsis denticulata ? <i>Kalypsea</i> sp. ? <i>Rensidium</i> vitillare ? <i>Baccharidium</i> polytes <i>Isabelidium</i> korojonense ? <i>Alterbia</i> sp. ? <i>Ceratopsis</i> pennucea Diconodinium cf. <i>D. glabrum</i> Mesourononchites sp. Nelsoniella semireticulata Microdinium sp.																			
1799.0	Barren																			
1803.0																				
1808.5																				
1812.5																				
1816.5																				
1820.5																				
1823.0																				
1825.0																				
1827.0																				
1834.0																				
1863.0																				
1881.0																				
1906.0																				
1919.3																				
1932.0																				
1940.0																				
1944.0																				
1968.5																				
1985.5																				
2053.5																				
2057.0																				
2060.0																				
2081.0																				
2097.0																				
2107.0																				
2112.5																				
2161.0																				
2179.0																				
2183.0																				
2249.0																				
2260.0																				
2274.5																				
2281.5																				
2287.5																				
2295.5																				
2305.5																				
2370.0																				
2360.5																				
2379.5																				
2388.0																				
2391.0																				
2432.5																				
2435.0																				
2466.5																				
2490.0																				
2509.0																				
2514.0																				
2554.5																				
2564.5																				

TABLE 2: DINOFLAGELLATE DISTRIBUTION CHART & ENVIRONMENTAL DATA - PISCES # 1.  
Paltech Report 1982/20

Katozona were not prepared but maturation for all samples did not exceed 1-3 i.e. marginally mature



SPORES/ POLLEN

KEY:

- <20 specimens
- x >20 specimens
- D Dominant >60%
- C Downhole contamination
- R Recycled

Depth in metres

- Proteacidites angulatus
- Pyxistopollenites florinii
- Podocarpidites ellipticus
- Tricolpites sectilis
- Gamblerina zudata
- Gamblerina edwardsii
- Periporopollenites polyretatus
- Pinuspollenites globosacatus
- Pinuspollenites parvisacatus
- Triarites minor
- Phyllocladites mawsonii
- Osmundacidites wellmanii
- Lycopodiumsporites spp.
- Tricolpites gilli
- Microcachyridites antarcticus
- Proteacidites scabratus
- Dictyophylloides sp.
- Kraeuselisporites tubatus
- Proteacidites palisadus
- Stereisporites antiquasporites
- Podosporites microsacatus
- Holoregacidites harrisi
- Nothofagidites senectus
- Nothofagidites endurus
- Simplicipollis meridianus
- Cymbidites australis
- Parvisaccites castatus
- Ceratoporesites equallis
- Densiporesites vellatus
- Kraeuselisporites majus
- Rouseisporites reticulatus
- Proteacidites amblosterfinus
- Ligistepollenites balmei
- Tricolpites confusus
- Tricolpites cf. T. fissilis
- Stereisporites (Triplexisporites) sp.
- Tricolpites pachyretus
- Proteacidites latrobensis
- Clavifera triplex
- Rouseisporites simplex
- Biretisporites spectabilis
- Tricolpites liliei
- Camerozanosporites obliensis
- Ornamentifera sentosa
- Lathosporites punctatus
- Rugulatisporites sp.
- Cicatricosisporites ludbrookii
- Latrobosporites crassus
- Foraminisporis cf. F. wonthaggiensis
- Peromonoletes vellosus
- Tricolpites pannosus
- Poveosporites cf. F. canalis
- Alisporites similis
- Dacrycarpites australiensis
- Tricolpites longus
- Dipwynites granulatus
- Tricolpites sabulosus

SPORE - POLLEN ZONES  
after  
STOVER & PARTRIDGE (1973)

AGE

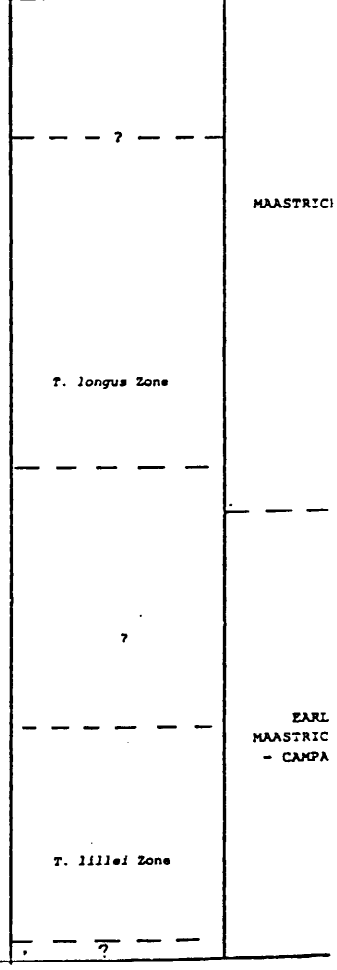
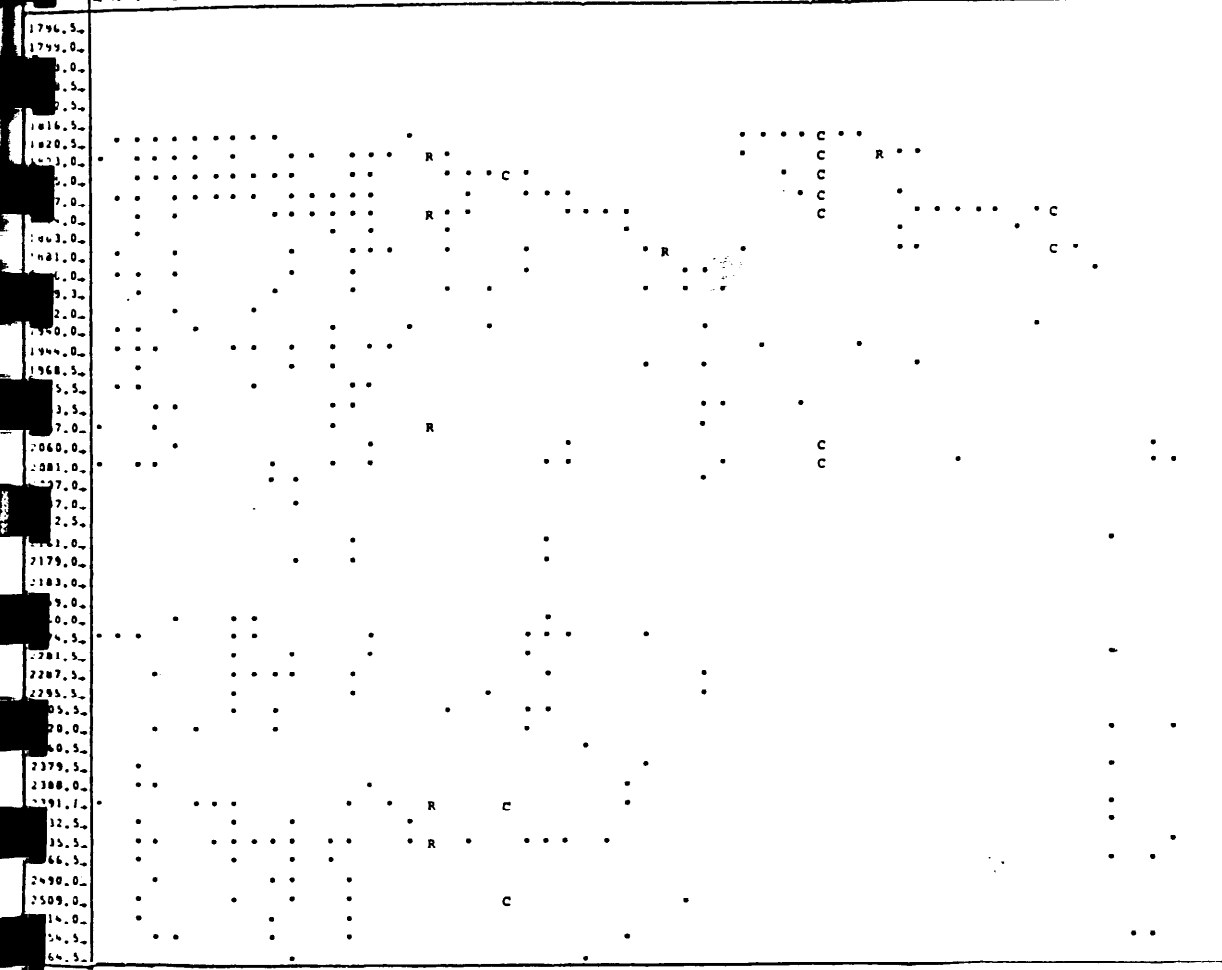


TABLE 1: SPORE/POLLEN DISTRIBUTION CHART - PISCES # 1.

Paltech Report 1982/20