PE990536

FORAMINIFERAL SEQUENCE

OPAH # 1

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Paleontology Report 1977/12

March 14, 1977

SUMMARY

The Opah # 1 well intersected a continuous marine sequence from early Oligocene or ?late Eocene to Pliocene without any evidence of depositional breaks. Canyon fill sedimentation occupied nearly 5000 feet of the 7000 feet sequence.

A possible early Eocene planktonic fauna comprising a single species, *Subbotina frontosa*, was found in the side wall core at 7970 feet.

INTRODUCTION

Ninety-nine samples were processed and examined from OPAH # 1 over the interval from 840 to 8070. Of these samples, seventy-five were side wall cores, with the remainder being rotary cuttings. Of the twelve side wall cores between 7895 and 8070, only that at 7970 contained foraminifera. All depths cited in this report and on accompanying sheets are in feet.

The following sheets accompany this report:-

Distribution Chart Sheet 1 - showing distribution of planktonic foraminifera and the basis of biostratigraphic breakdown.

Distribution Chart Sheet 2 - giving distribution of benthonic foraminifera.

Distribution Chart Sheet 3 - summarising the environmental analysis and presenting an environmental interpretation.

Biostratigraphic Data Sheet.

Three Sample Data Sheets.

BIOSTRATIGRAPHY

Depths of zonal boundaries are tabulated on the Distribution Chart Sheet 1 and the Biostratigraphic Data Sheet.

? EARLY EOCENE - 7970:- The side wall core at 7970 contained ten specimens of *Subbotina frontosa* which is referred to as *Globigerina frontosa* by Stainforth et al (1975, p.187-189) and as *Globigerina (Globigerina) boweri* by Jenkins (1971, p.138). On a worldwide basis, Stainforth et al (1975) give the range of this species as early to middle Eocene whilst Jenkins (1971) records it in the New Zealand *crater crater* and *primitiva* Zones, thus implying an identical early to mid Eocene range. McGowran (1973, fig.3) plots the range top of *S. frontosa* as being in the middle Eocene of the Gambier Embayment of the Otway Basin. In discussion, he (McGowran, l.c., p.50) states that "A junior synonym, *Globigerina boweri* Bolli, is identified by Jenkins (1971) but this older form may be *Subbotina patagonica* (Todd and Kniker).". However, *S. patagonica* from the Rivernook fauna (Paleocene/Eocene boundary in the Otway Basin), as illustrated by McGowran (1970, fig.3), are more highly spired than the form referred to as *S. frontosa* in Opah # 1 and as illustrated by Stainforth et al (1975, fig.51). Forms considered to be

S. frontosa are not present in the Rivernook fauna or its equivalent (= the *G. wilcoxensis* Zone of Jenkins, 1971) in New Zealand.
As no other planktonic foraminifera are associated with *S. frontosa* in Opah # 1, it is difficult to assess the exact age of the sample at 7970, but an Eocene, rather than Paleocene age is preferred on weighing up the scant evidence.

? LATE EOCENE - 7890 to 7885:- No foraminifera were found between 7970 and 7893 where there is a purely arenaceous fauna. In the side wall core at 7870, a sparse planktonic fauna contains *Subbotina angiporoides* and specimens probably assignable to *S. linaperta*. If the identification of *S. linaperta* is correct, then this fauna represents Zone K and the uppermost Eocene and is probably equivalent to the lower portion of the *G. brevis* Zone in New Zealand (Jenkins, 1974 and comment in Taylor, 1977).

EARLY OLIGOCENE - 7880 to 7850:- A typical J-2 fauna with *Globigerina brevis* and *Tenuitella gemma* was recorded in the side wall core at 7870 without *Subbotina linaperta*. This association is indicative of the early Oligocene. The side wall core at 7880, with *S. angiporoides* but without *S. linaperta*, is also considered to be within J-2. The highest appearance of *S. angiporoides* before the appearance of *Globorotalia opima opima* is considered to mark the top of the early Oligocene and Zone J-1 in the side wall core at 7850.

LATE OLIGOCENE - 7830 to 7590:- The top of the late Oligocene is placed immediately before the incoming of *Globigerina woodi connecta* in accordance with the views of Jenkins (1974). This event corresponds with the top of Zone H-2.

EARLY MIOCENE - 7540 to 6930:- The presence of *G. woodi connecta* at 7540 is taken as the base of the early Miocene and Zone H-1. This is confirmed by the occurrence of *Globorotalia kugleri* at 7490.
Zones G and F are present within this early Miocene interval. The top of the early Miocene is placed at 6930, where *Praeorbulina glomerosa curva* was present immediately before the evolutionary appearance of the "*Orbulina* form". The faunal association at 6930 represents Zone E-2. Zone E-2 is a very precise interval in Opah # 1, being represented at 6930 but not in the side wall cores at 6950 and 6915, thus it can be no more than 35 feet thick. It is easily recognisable and is now realized to be of immense correlateable value.

LATE MIOCENE - 6915 to between 2600 and 1800:- The base at 6915 (= Zone E-1) is clear because of the initial appearance of *Orbulina suturalis* but the top cannot be picked. It is impossible to recognise Zone B-2 (= late Miocene) from Zone B-1 (early Pliocene) because of the lack of side wall cores over the vital interval, the low diversity planktonic faunas present in the cuttings and the absence of such species as *Globorotalia conomiozea*. Because the late Miocene was represented as canyon fill sediment, planktonic diversity was low and specimen numbers fluctuated. As a result, the Zones D-2/D-1 boundary is vague and the Zones D-1/C boundary cannot be recognised. The top of Zone C is taken from the highest appearance of *Globorotalia mayeri* and cannot be considered as firm.

PLIOCENE - from between 2600 and 1800 to ? :- Only cuttings were available from the interval above 2600. The association of *Globorotalia puncticulata* and *G. crassaformis* at 1800 and 1700 is suggestive of Zone A-4. Such an association would represent the mid Pliocene according to Stainforth et al (1975). The association of *G. puncticulata* and *G. inflata* at 1400 indicates Zone A-3. Faunas above 1400 contain non-diagnostic species.

ENVIRONMENT

Data relating to this interpretation is shown on Distribution Chart Sheet 3, whilst benthonic foraminiferal distribution is plotted on Sheet 2.

The absence of any benthonic fauna over the interval between 8070 and 7895 indicates deleterious conditions such as low salinity and/or low oxygenation. The unique influx of the planktonic *Subbotina frontosa* at 7970 indicates a weak penetration of oceanic water into the Eocene marginal marine environment. The fact that only one planktonic species was represented portrays the lack of strength of this marine ingression.

The purely arenaceous Eocene fauna, in the fine quartz sandstone at 7893, is difficult to interpret. Such an assemblage could be representative of the extremes of either a lagoon or extremely deep water below the C.C.D.

The late Eocene to early Oligocene crystalline limestones at 7890, 7885 and 7880 were evidently deep water deposits as they contain mainly arenaceous benthonic foraminifera with numerically poor, low diversity planktonic faunas.

The Oligocene calcareous siltstones from 7760 to 7590 contain sparse benthonic faunaswhich were often dominated by *Bathysiphon* spp. Planktonic faunas fluctuated numerically, suggesting that there may have been fluctuations in the lysocline. A continental rise situation is envisaged but the paleodepth may not have been as extreme as today's continental rise (at 6000 feet). The worldwide depressed paleotemperatures in the late Oligocene (Savin et al, 1975) would have resulted in a considerable elevation of the C.C.D.

The early Miocene faunas were dominated by planktonic foraminifera with a sparse benthonic fauna which included such deep water species as *Planulina wullerstorfi* and *Karreriella bradyi*. The base of the slope is designated at 7267, because of tho lowest appearance of *Euuvigerina mayni* which was apparently restricted to the Gippsland continental slope during the Miocene. Also the presence of fine to coarse quartz between 6930 and 6891 could imply the influence of down slope currents.

There was a sharp numerical decline in the planktonic fauna at the base of the mid Miocene. This was accompanied by an almost total absence of benthonic forms and the lithological change from calcareous siltstone to fine-grained micritic limestone between 6870 and 6848. High energy conditions are evident and it is postulated that the sediment was canyon fill on the lower continental slope. There were sporadic dissipations of the high energy currents as some planktonic faunas were numerically rich in Zone D-2. The lower/upper continental shelf transition was indicated by the deepest presence of *Cassidulina carinata* at 4805. Decrease in the depth of the slope was evidenced by the sudden dominance of sponge spicules at and above 3982. The sponge spicules were detrital derivatives from the shelf/slope break. Canyon fill sedimentation continued to 2100 (= late Miocene or early Pliocene).

Pliocene sedimentation above 2100 was on the continental shelf, with water depth gradually decreasing upwards, as is evidenced by the dominance of *Cibicides* spp. succeeded by a co-dominance with *Parrellina imperatrix* at and above 1100. The sediment is rich in bryozoa above 1500. The common presence of such adherent forms as *Discoanomalina mitchelli* and *Cibicides cygnorum* suggests extensive seaweed banks in the vicinity.

REFERENCES

JENKINS, D.G., 1971 - New Zealand Cainozoic planktonic foraminifera. *N.Z. Geol. Surv., Paleont. Bull.* 42.

______________ 1974 - Paleogene planktonic foraminifera of New Zealand and the Austral region. *J. Foram. Res.*, 4(4); 155-170.

McGOWRAN, B., 1970 - Late Paleocene in the Otway Basin: biostratigraphy and the age of key microfossils. *Trans Roy. Soc. South Aust.*, 94; 1-14.

______________ 1973 - Observation Bore No. 2, Gambier Embayment of the Otway Basin: Tertiary micropalaeontology and stratigraphy. *South Aust. Min. Resources Rev.*, 135; 43-55.

SAVIN, S.M. et al, 1975 - Tertiary marine paleotemperatures. *Geol. Soc. Amer.*, 86; 1499-1510.

STAINFORTH, R.M. et al, 1975 - Cenozoic planktonic foraminiferal zonation and characteristics of index forms. *Univ. Kansas Paleont. Contrib.*, Art. 62.

TAYLOR, D., 1977 - Foraminiferal sequence - Swordfish # 1. *Esso Aust., Paleont. Rep.* 1977/5.

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: OPAH # 1

DATE: 6.4.77 ~~20x12x74~~

PREPARED BY: DAVID TAYLOR

SHEET NO: 1 of 3

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
840 to 860	RC		
1000 1020	RC		
1100 1120	RC		
1200 1220	RC		
1300 1320	RC		
1400 1420	RC		
1500 1520	RC		
1600 1620	RC		
1700 1720	RC		
1800 1820	RC		
1900 1920	RC		
2000 2020	RC		
2100 2120	RC		
2200 2220	RC		
2300 2320	RC		
2400 2420	RC		
2500 2520	RC		
2600 2620	RC		
2700 2720	RC		
2800 2820	RC		
2880 2900	RC		
2900	SWC 90		
3011	SWC 89		
3192	SWC 88		
3392	SWC 87		
3607	SWC 86		
3782	SWC 85		
3982	SWC 84		
4196	SWC 83		
4398	SWC 82		
4585	SWC 81		
4805	SWC 80		
5000	SWC 79		
5200	SWC 78		
5394	SWC 77		
5600	SWC 76		
5798	SWC 75		
6000	SWC 74		
6200	SWC 73		
6410	SWC 72		
6500	SWC 71		
6610	SWC 70		

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: OPAH # 1 — *DATE:* ~~20x12x74~~ 6.4.77

PREPARED BY: DAVID TAYLOR — *SHEET NO:* 2 of 3

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
6650	SWC 60		
6710	SWC 59		
6754	SWC 58		
6810	SWC 57		
6830	SWC 56		
6848	SWC 55		
6870	SWC 54		
6891	SWC 53		
6898	SWC 52		
6906	SWC 69		
6915	SWC 50		
6930	SWC 49		
6950	SWC 48		
7010	SWC 47		
7050	SWC 68		
7110	SWC 46		
7162	SWC 45		
7210	SWC 44		
7233	SWC 43		
7267	SWC 67		
7320	SWC 42		
7340	SWC 66		
7390	SWC 41		
7421	SWC 65		
7440	SWC 40		
7490	SWC 39		
7515	SWC 64		
7540	SWC 38		
7590	SWC 37		
7640	SWC 36		
7660	SWC 35		
7710	SWC 34		
7760	SWC 33		
7780	SWC 63		
7830	SWC 32		
7850	SWC 62		
7860	SWC 31		
7870	SWC 61		
7880	SWC 30		
7885	SWC 29		
7890	SWC 28		
7893	SWC 27		

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: OPAH # 1

DATE: 6.4.77

PREPARED BY: DAVID TAYLOR

SHEET NO: 3 of 3

DRAW:

DEPTH		*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
	7895	SWC 26		N.F.F.
	7897	SWC 25		N.F.F.
	7900	SWC 24		N.F.F.
	7907	SWC 21		N.F.F.
	7910	SWC 20		N.F.F.
	7925	SWC 17		N.F.F.
	7940	SWC 14		N.F.F.
	7950	SWC 12		N.F.F.
	7960	SWC 11		N.F.F.
7960	7970	RC		Downhole contamination
	7970	SWC 10		
7970	7980	RC		Downhole contamination
	7980	SWC 9		N.F.F.
7980	7990	RC		Downhole contamination
	8070	SWC 5		N.F.F.

N.F.F. = No foraminifera found

Form R193 3/71

BASIN GIPPSLAND BY David Taylor

WELL NAME OPAH # 1 DATE 6-4-77 ELEV. ______

Foram Zonules

Epoch	Zonule		Highest Data	Quality	2 Way Time	Lowest Data	Quality	2 Way Time
MIOCENE	A					1700	3	
		Alternate						
	B		1800	3		2600	3	
		Alternate						
	C		2900	2				
		Alternate						
	D_1					5600	2	
		Alternate				5000	0	
	D_2		5798	0		6870	1	
		Alternate						
	E		6891	2		6930	0	
		Alternate	6898	0				
	F		6950	1		7162	0	
		Alternate	7010	0				
	G		7210	0		7390	0	
		Alternate						
	H_1		7421	1		7540	1	
		Alternate	7440	0				
	H_2		7590	1		7710	1	
		Alternate						
OLIGOCENE	I_1		7760	0		7830	0	
		Alternate						
	I_2							
		Alternate						
	J_1		7850	1		7860	1	
		Alternate						
	J_2		7870	0		7880	1	
		Alternate						
EOC.	K		7885	2				
		Alternate						
	Pre K		7970*	2				

* Contains 10 specimens of *Subbotina frontosa* which has a range from early to mid Eocene.

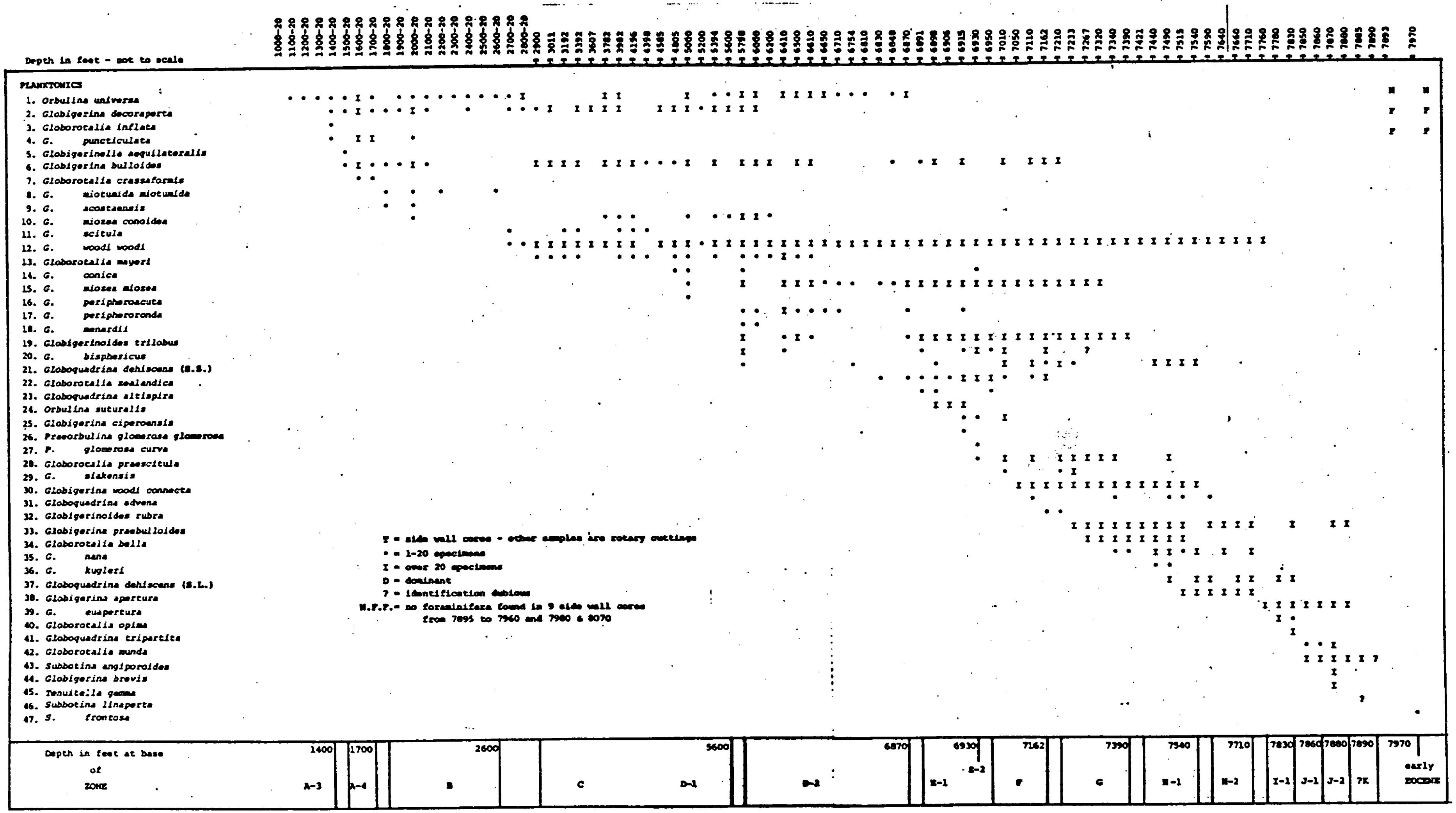
COMMENTS:

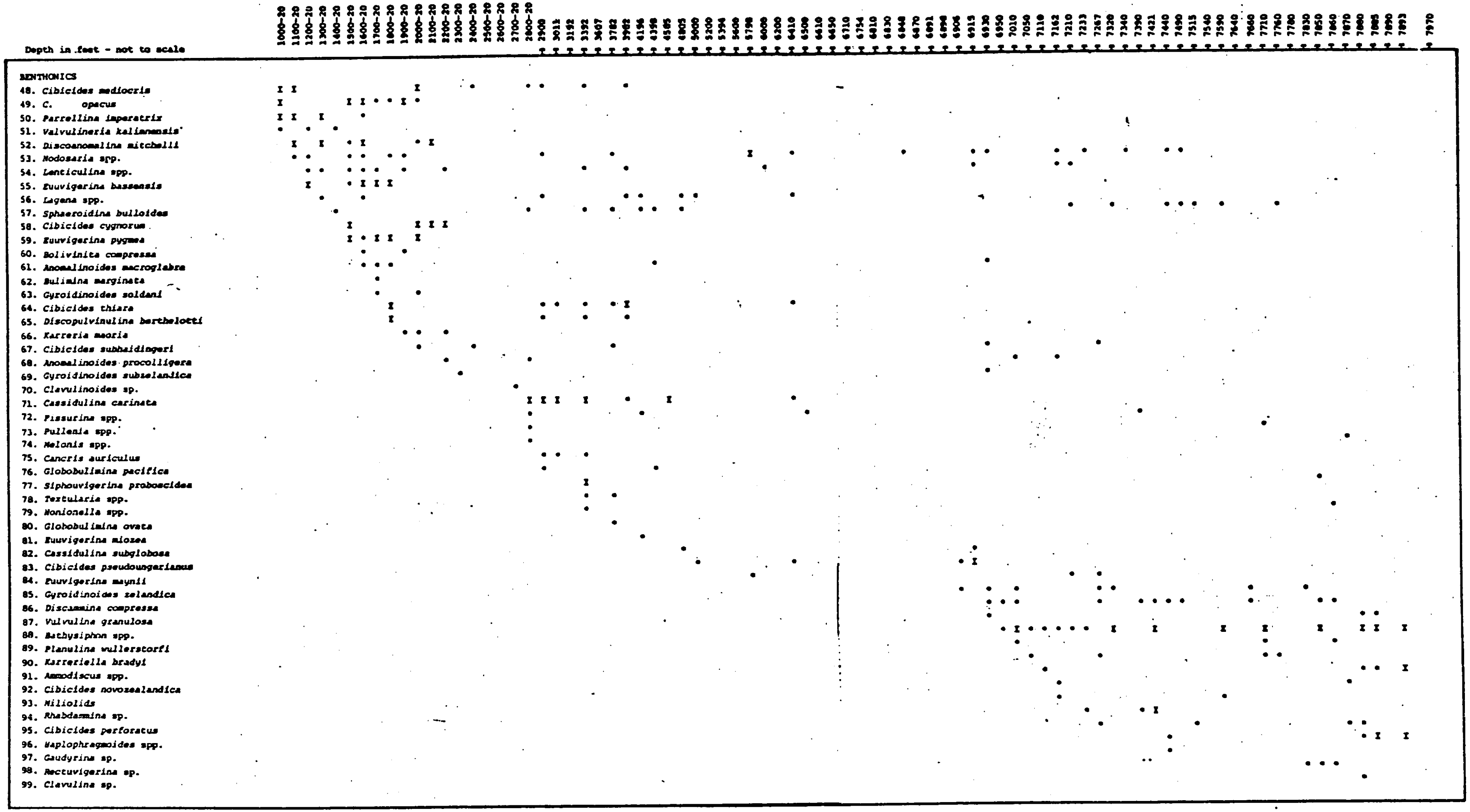
Note: If highest or lowest data is a 3 or 4, then an alternate 0, 1, 2 highest or lowest data will be filled in if control is available.

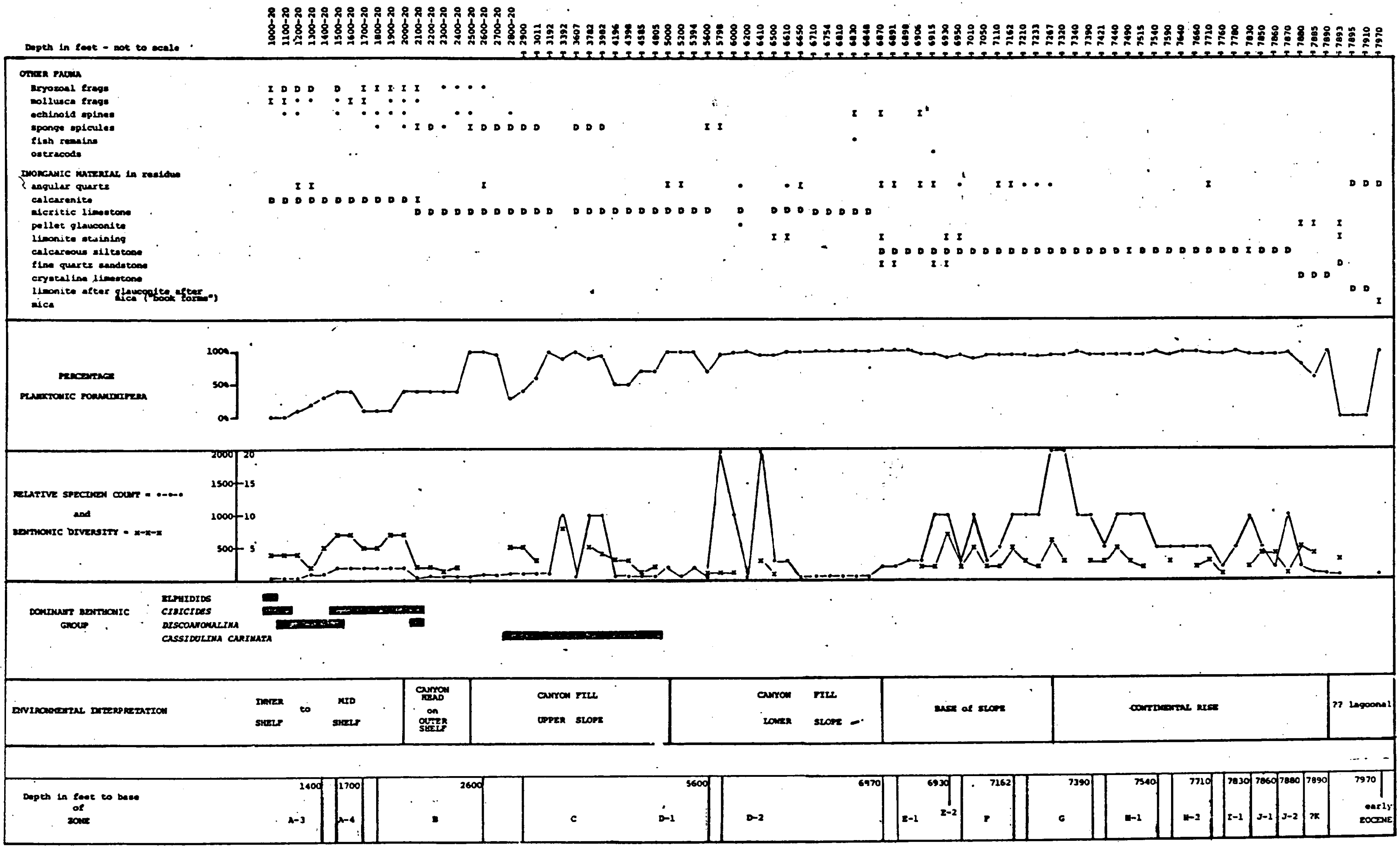
If a sample cannot be interpreted to be one zonule, as apart from the other, no entry should be made.

0 SWC or Core - Complete assemblage (very high confidence).
1 SWC or Core - Almost complete assemblage (high confidence).
2 SWC or Core - Close to zonule change but able to interpret (low confidence).
3 Cuttings - Complete assemblage (low confidence).
4 Cuttings - Incomplete assemblage, next to uninterpretable or SWC with depth suspicion (very low confidence).

Date Revised ______


Depth in feet - not to scale
PLANKTONICS
1. Orbulina universa
2. Globigerina decoraperta
3. Globorotalia inflata
4. G. puncticulata
5. Globigerinella aequilateralis
6. Globigerina bulloides
7. Globorotalia crassaformis
8. G. miotumida miotumida
9. G. acostaensis
10. G. miozea conoidea
11. G. scitula
12. G. woodi woodi
13. Globorotalia mayeri
14. G. conica
15. G. miozea miozea
16. G. peripheroacuta
17. G. peripheroronda
18. G. menardii
19. Globigerinoides trilobus
20. G. bispherícus
21. Globoquadrina dehiscens (S.S.)
22. Globorotalia zealandica
23. Globoquadrina altispira
24. Orbulina suturalis
25. Globigerina ciperoensis
26. Praeorbulina glomerosa glomerosa
27. P. glomerosa curva
28. Globorotalia praescitula
29. G. siakensis
30. Globigerina woodi connecta
31. Globoquadrina advena
32. Globigerinoides rubra
33. Globigerina praebulloides
34. Globorotalia bella
35. G. nana
36. G. kugleri
37. Globoquadrina dehiscens (S.L.)
38. Globigerina apertura
39. G. euapertura
40. Globorotalia opima
41. Globoquadrina tripartita
42. Globorotalia munda
43. Subbotina angiporoides
44. Globigerina brevis
45. Tenuitella gemma
46. Subbotina linaperta
47. S. frontosa
T = side wall cores - other samples are rotary cuttings
• = 1-20 specimens
I = over 20 specimens
D = dominant
? = identification dubious
N.F.F.= no foraminifera found in 9 side wall cores from 7895 to 7960 and 7980 & 8070
Depth in feet at base of ZONE
1400 A-3
1700 A-4
2600 B
C
5600 D-1
6870 D-2
6930 E-1
E-2
7162 F
7390 G
7540 H-1
7710 H-2
7830 I-1
7860 J-1
7880 J-2
7890 7K
7970 early EOCENE


Depth in feet - not to scale
1000-20
1100-20
1200-20
1300-20
1400-20
1500-20
1600-20
1700-20
1800-20
1900-20
2000-20
2100-20
2200-20
2300-20
2400-20
2500-20
2600-20
2700-20
2800-20
2900
3011
3192
3392
3607
3782
3982
4156
4398
4585
4805
5000
5200
5394
5600
5798
6000
6200
6410
6500
6610
6650
6710
6754
6810
6830
6848
6870
6891
6898
6906
6915
6930
6950
7010
7050
7110
7162
7210
7233
7267
7320
7340
7390
7421
7440
7490
7515
7540
7590
7640
7660
7710
7760
7780
7830
7850
7860
7870
7880
7885
7890
7893
7970
BENTHONICS
48. Cibicides mediocris
49. C. opacus
50. Parrellina imperatrix
51. Valvulineria kalimnensis
52. Discoanomalina mitchelli
53. Nodosaria spp.
54. Lenticulina spp.
55. Euuvigerina bassensis
56. Lagena spp.
57. Sphaeroidina bulloides
58. Cibicides cygnorum
59. Euuvigerina pygmea
60. Bolivinita compressa
61. Anomalinoides macroglabra
62. Bulimina marginata
63. Gyroidinoides soldani
64. Cibicides thiara
65. Discopulvinulina berthelotti
66. Karreria maoria
67. Cibicides subhaidingeri
68. Anomalinoides procolligera
69. Gyroidinoides subzelandica
70. Clavulinoides sp.
71. Cassidulina carinata
72. Fissurina spp.
73. Pullenia spp.
74. Melonis spp.
75. Cancris auriculus
76. Globobulimina pacifica
77. Siphouvigerina proboscidea
78. Textularia spp.
79. Nonionella spp.
80. Globobulimina ovata
81. Euuvigerina miozea
82. Cassidulina subglobosa
83. Cibicides pseudoungerianus
84. Euuvigerina maynii
85. Gyroidinoides zelandica
86. Discammina compressa
87. Vulvulina granulosa
88. Bathysiphon spp.
89. Planulina wullerstorfi
90. Karreriella bradyi
91. Ammodiscus spp.
92. Cibicides novozealandica
93. Miliolids
94. Rhabdammina sp.
95. Cibicides perforatus
96. Haplophragmoides spp.
97. Gaudyrina sp.
98. Rectuvigerina sp.
99. Clavulina sp.


Depth in feet - not to scale
OTHER FAUNA
Bryozoal frags
mollusca frags
echinoid spines
sponge spicules
fish remains
ostracods
INORGANIC MATERIAL in residue
angular quartz
calcarenite
micritic limestone
pellet glauconite
limonite staining
calcareous siltstone
fine quartz sandstone
crystaline limestone
limonite after glauconite after mica ("book forms")
mica
PERCENTAGE
PLANKTONIC FORAMINIFERA
100%
50%
0%
RELATIVE SPECIMEN COUNT = •-•-•
and
BENTHONIC DIVERSITY = x-x-x
2000
1500
1000
500
20
15
10
5
DOMINANT BENTHONIC GROUP
ELPHIDIDS
CIBICIDES
DISCOANOMALINA
CASSIDULINA CARINATA
ENVIRONMENTAL INTERPRETATION
INNER to MID SHELF
CANYON HEAD on OUTER SHELF
CANYON FILL UPPER SLOPE
CANYON FILL LOWER SLOPE
BASE of SLOPE
CONTINENTAL RISE
?? lagoonal
Depth in feet to base of ZONE
1400 A-3
1700 A-4
2600 B
C
5600 D-1
6970 D-2
E-1
6930 E-2
7162 F
7390 G
7540 H-1
7710 H-2
7830 I-1
7860 J-1
7880 J-2
7890 ?K
7970 early EOCENE