PE990880

WELL COMPLETION REPORT

SWORDFISH-1

APPENDIX 5

FORAMINIFERAL SEQUENCE - SWORDFISH-1

by

David Taylor

FORAMINIFERAL SEQUENCE

SWORDFISH # 1

by DAVID TAYLOR

Paleontology Report 1977/5 February 10, 1977

SUMMARY

The Swordfish # 1 well intersected a marine sequence from uppermost Eocene to Pliocene without any depositional breaks.

INTRODUCTION

Thirty nine side wall cores were examined between 3200 and 6698. No foraminifera were found in side wall cores at 3770, 4060, 6619, 6631, 6643, 6658, 6671, 6685, 6695 and 6698. Twenty nine rotary cutting samples were processed between 760 and 3040 and between 4100 and 4230 and the results incorporated in this report. Four rotary samples from 6490 to 6620 were examined also but as the depths were regarded as unreliable, the results have little significance. All depths cited in this report and listed in 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 the distribution of benthonic foraminifera.

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

Biostratigraphic Data Sheet

Two Sample Data Sheets

It is noted that the Salmon # 1 biostratigraphic data sheet has been revised.

BIOSTRATIGRAPHY

LATE EOCENE - 6604 to 6571:- Side wall cores contain a few specimens of *Globigerinatheka index* and *Subbotina linaperta* which are typical elements of the New Zealand late Eocene fauna. As this is the first report of *G. index* from Gippsland, it is difficult to place the fauna in the current zonal scheme. In Otway, the top of *G. index* was at the top of Zone L and preceded the top of *S. linaperta* which was at the top of Zone K. Jenkins (1974) disputes these observations as in New Zealand the tops of the ranges of both species were coeval. The fauna is definitely pre-J-2 and may represent Zone K if the sequence of faunal events was more akin to New Zealand than the Otway Basin. As there is no evidence of a depositional break between this late Eocene fauna and the overlying J-2 fauna, it is felt that the Swordfish # 1 late Eocene

assemblage represents Zone K of the Gippsland sequence, although it does not embrace the same biostratigraphic events as Zone K in the Otway Basin. Zone K in Swordfish # 1 can probably be equated with the lower part of the *G. brevis* Zone in New Zealand (Jenkins, l.c.) as it is succeeded almost immediately (= 7 feet between faunas) by Zone J-2 which contains a fauna identical to that in the upper part of the *G. brevis* Zone in New Zealand.

EARLY OLIGOCENE - 6564 to 6545:- Planktonic faunas in side wall cores of "greensand" at 6564 and 6560 include *Globigerina brevis* and *Tenuitella gemma* which are species which did not range above Zone J-2. The absence of *Globigerinatheka index* and *Subbotina linaperta* implies that this fauna can be equated with the upper part of the *G. brevis* Zone in New Zealand and was of early Oligocene age (Jenkins, l.c.).
The recrystallized limestone of the side wall core at 6545 bore a very poor fauna due probably to diagenetic obliteration. There were some recognisable specimens of *Subbotina angiporoides* which places the sample as being no younger than the top of Zone J.

LATE OLIGOCENE - ? to 6450:- Although the depth is disputed from evidence of E logs and side wall cores, rotary cuttings between 6490 and 6510 contain mixed faunas which include *Globigerina euapertura* and *Globorotalia opima opima*. The presence of these two species suggests that Zone I was within the section.
The side wall core at 6450 contains *Globoquadrina dehiscens* (s.l.), abundant *Globigerina woodi woodi* and rare *G. euapertura*. Such an association is now regarded as marking the very base of Zone H-2. This necessitates the revision of the Salmon # 1 section in that the base of Zone H-2 is now placed at the side wall core at 6236 so that the top of Zone I has been depressed.

EARLY MIOCENE - 6350 to 5750:- The fauna at 6350 has the lowest occurrence of *Globigerina woodi connecta* which places it at the base of Zone H-1. Jenkins (l.c.) assumes that the evolutionary appearance of *G. woodi connecta* marked the base of the early Miocene in the extra-tropical Austral region. This assumption is partially confirmed by the association of *G. woodi connecta* with *Globorotalia kugleri* in some off-shore Gippsland wells other than Swordfish # 1.
Zone G and Zone F faunas are present respectively at 5950 and 5850.

Zone E-2 and the top of the early Miocene is marked by the appearance of *Praeorbulina glomerosa curva* in the side wall core at 5750.

MID MIOCENE - 5650 to 2100:- Although the fauna is unrepresentative, the lowest Zone D-2 sample is probably at 5650. A more definite D-2 assemblage, with *Orbulina universa* and *Globorotalia peripheroronda* was present in side wall core at 5550. The top of Zone D-2 was placed at 4140 (= rotary cuttings) which suggests that there was a thicker development of the Zone in Swordfish # 1 than in Salmon # 1. Identical means of identifying the zonal top were used in both wells. Zone D-1 was consequently thinner in Swordfish than in Salmon. The top of Zone C and the top of the mid Miocene were placed at 2100 on the highest appearance of *Globorotalia mayeri* in rotary cuttings. This is approximately the same depth as in Salmon # 1.

LATE MIOCENE - 2000 to ? :- The association of *Globorotalia acostaensis* and *G. lenguaensis* in the absence of *G. mayeri* suggests that the rotary cutting sample at 2000 was at the base of Zone B-2 at the base of the late Miocene. Because of poor faunas it is impossible to fix the top of Zone B-2 and thus the top of the late Miocene, but this boundary was definitely below 1180.

PLIOCENE - ? to 1180 to ? :- *Globorotalia conomiozea* and *G. sphericomiozea* were present at 1180 (rotary cutting) indicating a position at the top of Zone B-1 within the early Pliocene.
At 1090 there was an unique association which was not represented in rotary cutting samples either above or below. This species association included *Globorotalia crassaformis* and *G. puncticulata* and may be an expression of the diversity peak seen in Flounder # 5 and Hapuku # 1 at the base of Zone A-4. Planktonic faunas above 1090 are much less diverse and contain neither of the above species.

ENVIRONMENT

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

It is very difficult to make an interpretation on the environment of the late Eocene as planktonic foraminifera were very rare and only one benthonic

specimen was recorded. This could mean the environmental extremes of either very deep conditions at or near the C.C.D. or that the planktonic forms were washed into a low salinity lagoonal or embayment environment.

The early Oligocene "greensands" bore a high percentage of planktonic foraminifera, although the faunas were relatively numerically sparse (planktonics = 80%, whilst total fauna approximated 100 specimens). The rare benthonic forms included *Cibicides brevoralis, C. perforatus* and *Vulvulina granulosa* which give the impression of a continental shelf situation. A transgressive invasion of oceanic waters may have been responsible for the high planktonic percentages. The diagenetic destruction of fauna in the limestone (6545) makes it impossible to speculate on the significance of the lithological change in the early Oligocene from "greensand" to limestone.

The late Oligocene and early Miocene sediments have a deep water aspect, not only in the dominance by planktonic forms, but by the presence of such benthonics as *Melonis pompiloides, Karreriella bradyi, Siphouvigerina proboscidae* and various morphologically simple arenaceous forms.

The mid Miocene Zone D-2 fauna (from 5650 to 4140) indicates deposition at the base of the continental slope with some evidence of sediment accumulation by down-slope slumping. One of the characteristic species of this interval is the large, costate *Euuvigerina maynii*.

The mid Miocene benthonic faunas between 4060 and 2820 have a low diversity and are probably the result of size and/or shape sorting. *Cassidulina carinata* dominates the benthonic fauna in some samples, with the flat *Cibicides thiara* almost ubiquitous. This sorting effect strongly suggests that the micritic limestone of this interval was a canyon fill.

Benthonic diversity increased at 2720 and faunas between there and 1700 (= Zone B) show a mixture of outer and inner continental shelf species including the seaweed adherent, *Cibicides cygnorum.* The faunal mixture and displacement of shallow water forms indicate that the sediment may have been deposited in a canyon head situation.

Above 1700 the fauna was dominated by *Cibicides* spp. and even higher (above 1000) by *Elphidium crassatum* and *Notorotalia clathrata*. This distribution pattern is evidence of gradual progradation from mid to

inner continental shelf during the latest Miocene and Pliocene. The benthonic faunal association between 1120 and 760 includes *Notorotalia clathrata, Parrellina imperatrix, Discoanomalina mitchelli* and *Valvulineria kalimnensis* and is a similar association to those described by Carter (1964) from the Tambo River and Jemmy Point Formations of the onshore Lakes Entrance region. However, the two onshore formations cannot be recognised in Swordfish # 1 either lithologically or on precise distribution of species; for instant, *V. kalimnensis* was confined to the Jemmy Point Formation whilst *Discoanomalina mitchelli* was restricted to the underlying Tambo River Formation, but both species were present in the same sample in Swordfish # 1. The richly bryozoal Pliocene calcarenites bearing this association in Swordfish were deposited in slightly deeper water than the marginal deposits around Lakes Entrance.

REFERENCES

CARTER, A.N., 1964 - Tertiary foraminifera from Gippsland, Victoria and their stratigraphic significance. *Geol. Surv. Vict., Mem.* 23.

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

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: SWORDFISH # 1 *DATE:* 20.1.77

PREPARED BY: DAVID TAYLOR *SHEET NO:* 1 of 2

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
3200	SWC 60		
3400	SWC 59		
3550	SWC 58		
3770	SWC 57		N.F.F.
4024	SWC 56		
4060	SWC 55		N.F.F.
4104	SWC 54		
4250	SWC 53		
4450	SWC 52		
4650	SWC 51		
4848	SWC 50		
5050	SWC 49		
5150	SWC 48		
5300	SWC 47		
5450	SWC 46		
5550	SWC 45		
5650	SWC 44		
5750	SWC 43		
5850	SWC 42		
5950	SWC 41		
6160	SWC 39		
6250	SWC 38		
6350	SWC 37		
6450	SWC 36		
6545	SWC 35		
6560	SWC 34		
6564	SWC 33		
6571	SWC 32		
6587	SWC 31		
6604	SWC 30		
6619	SWC 29		N.F.F.
6631	SWC 28		N.F.F.
6643	SWC 27		N.F.F.
6658	SWC 26		N.F.F.
6671	SWC 25		N.F.F.
6685	SWC 24		N.F.F.
6695	SWC 23		N.F.F.
6698	SWC 22		N.F.F.

N.F.F. = No foraminiferal fau

MICROPALEONTOLOGICAL MATERIAL

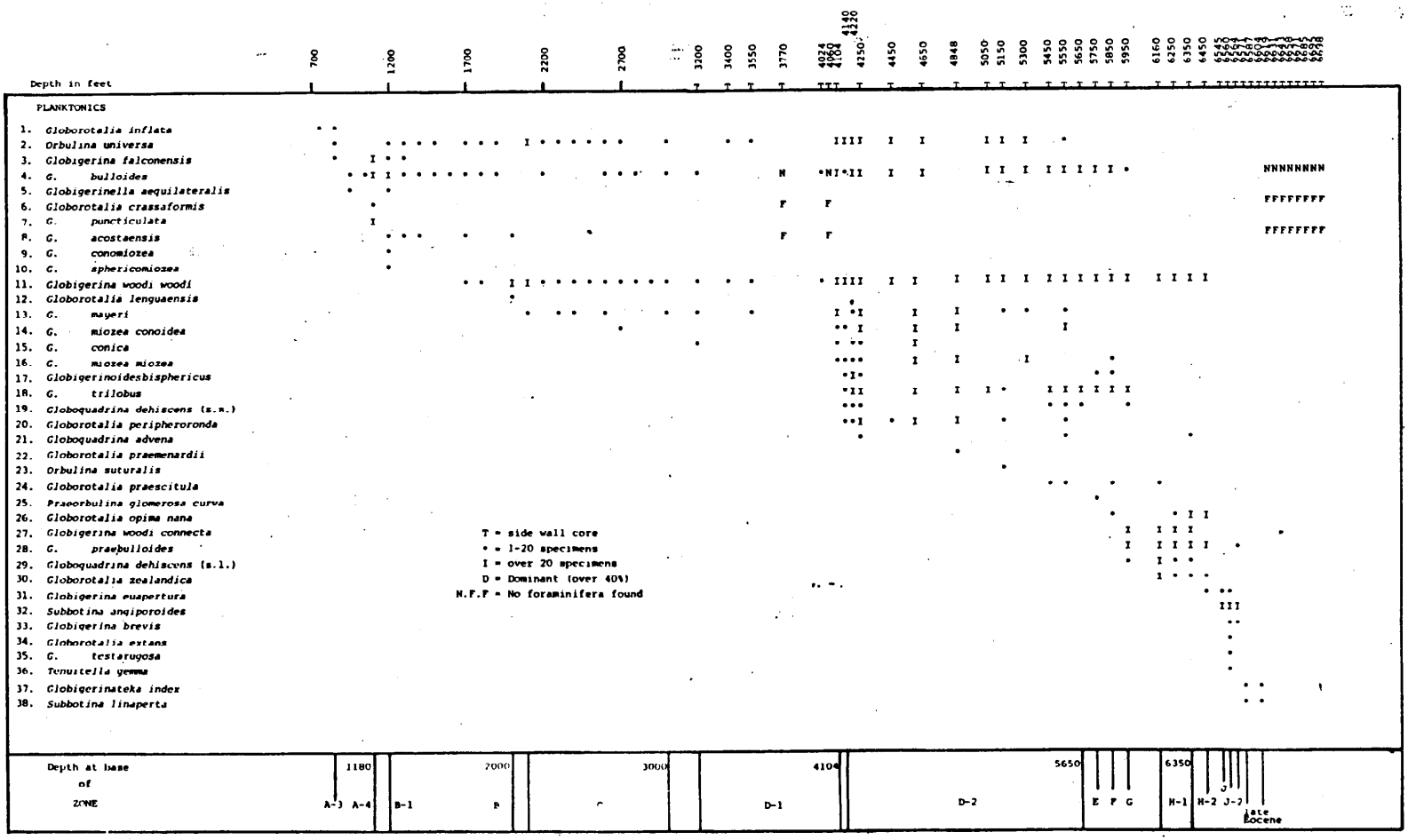
WELL NAME AND NO: SWORDFISH # 1 *DATE:* 20.12.74

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

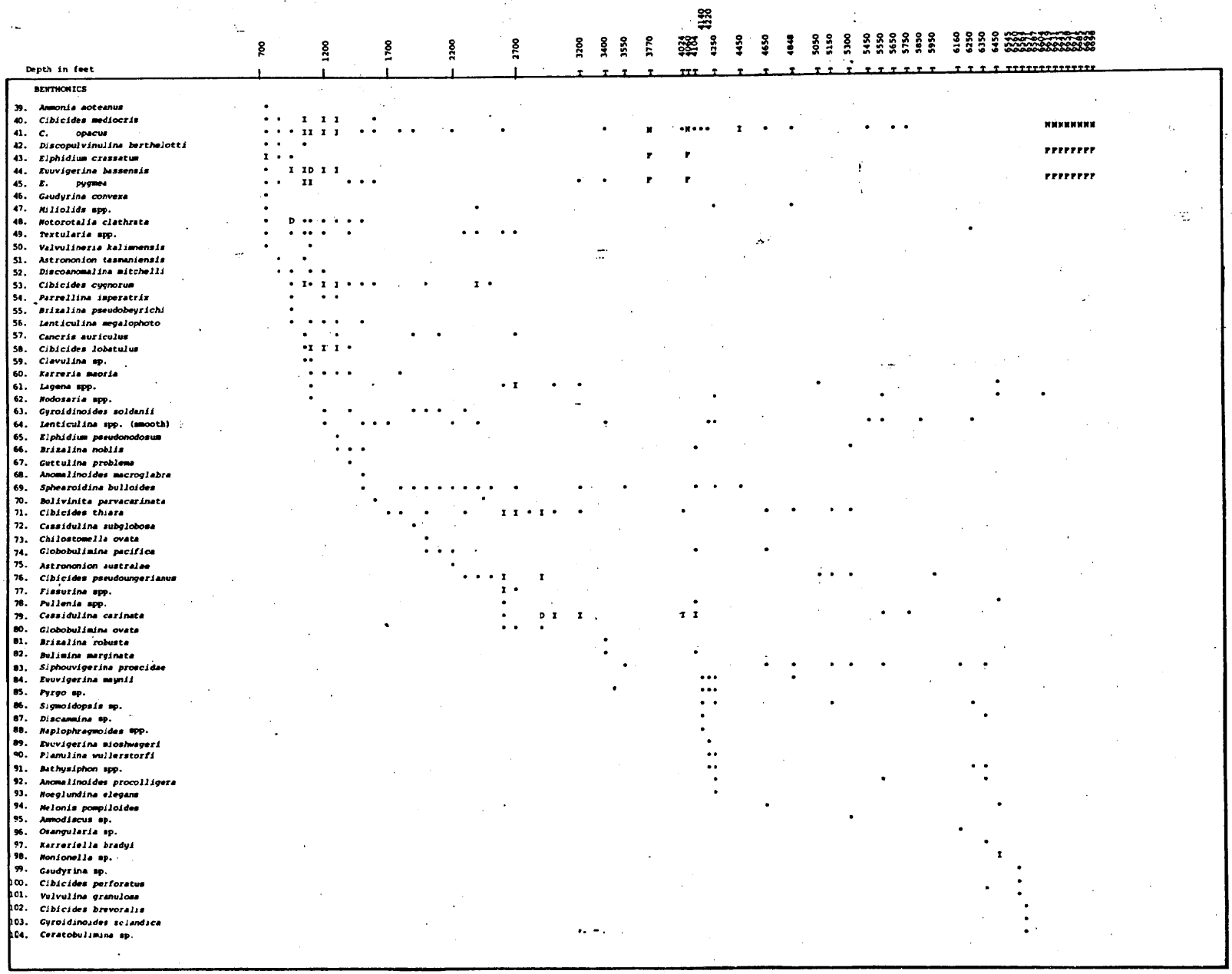
DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
760 to 790	RC		
850 880	RC		
970 1000	RC		
1030 1060	RC		
1090 1120	RC		
1180 1210	RC		
1300 1330	RC		
1390 1420	RC		
1480 1510	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		
2720 2740	RC		
2820 2840	RC		
2920 2940	RC		
3020 3040	RC		
4100 4110	RC		
4130 4140	RC		
4140 4150	RC		
4180 4190	RC		
4220 4230	RC		
6490 6500	RC		
6510 6520	RC		
6530 6540	RC		
6610 6620	RC		

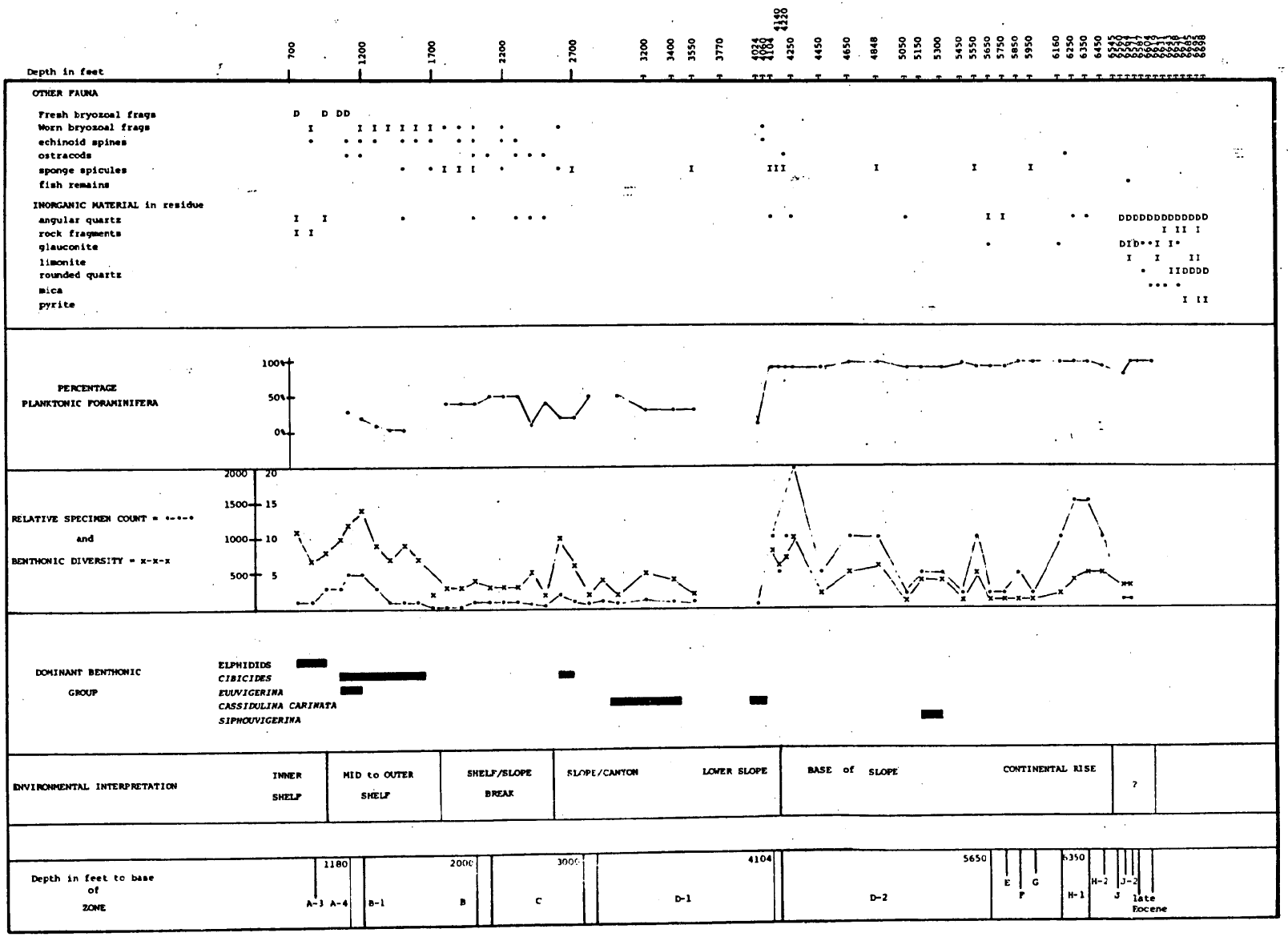
SWORDFISH # 1


Depth in feet
700
1200
1700
2200
2700
3200
3400
3550
3770
4024
4060
4104
4140
4220
4250
4450
4650
4848
5050
5150
5300
5450
5550
5650
5750
5850
5950
6160
6250
6350
6450
6545
6560
6570
6574
6584
6603
6611
6611
6613
6618
6618
6682
6685
6698
PLANKTONICS
1. Globorotalia inflata
2. Orbulina universa
3. Globigerina falconensis
4. G. bulloides
5. Globigerinella aequilateralis
6. Globorotalia crassaformis
7. G. puncticulata
8. G. acostaensis
9. G. conomiozea
10. G. sphericomiozea
11. Globigerina woodi woodi
12. Globorotalia lenguaensis
13. G. mayeri
14. G. miozea conoidea
15. G. conica
16. G. miozea miozea
17. Globigerinoidesbisphericus
18. G. trilobus
19. Globoquadrina dehiscens (s.s.)
20. Globorotalia peripheroronda
21. Globoquadrina advena
22. Globorotalia praemenardii
23. Orbulina suturalis
24. Globorotalia praescitula
25. Praeorbulina glomerosa curva
26. Globorotalia opima nana
27. Globigerina woodi connecta
28. G. praebulloides
29. Globoquadrina dehiscens (s.l.)
30. Globorotalia zealandica
31. Globigerina euapertura
32. Subbotina angiporoides
33. Globigerina brevis
34. Globorotalia extans
35. G. testarugosa
36. Tenuitella gemma
37. Globigerinateka index
38. Subbotina linaperta
T = side wall core
• = 1-20 specimens
I = over 20 specimens
D = Dominant (over 40%)
N.F.F = No foraminifera found
Depth at base of ZONE
1180
2000
3000
4104
5650
6350
A-3
A-4
B-1
B
C
D-1
D-2
E
F
G
H-1
H-2
J-2
J
Late Eocene

SWORDFISH # 1


Depth in feet
700
1200
1700
2200
2700
3200
3400
3550
3770
4024
4104
4150
4250
4450
4650
4848
5050
5150
5300
5450
5550
5650
5750
5850
5950
6160
6250
6350
6450
BENTHONICS
39. Ammonia aoteanus
40. Cibicides mediocris
41. C. opacus
42. Discopulvinulina berthelotti
43. Elphidium crassatum
44. Euuvigerina bassensis
45. E. pygmea
46. Gaudryina convexa
47. Miliolids spp.
48. Notorotalia clathrata
49. Textularia spp.
50. Valvulineria kalimnensis
51. Astrononion tasmaniensis
52. Discoanomalina mitchelli
53. Cibicides cygnorum
54. Parrellina imperatrix
55. Brizalina pseudobeyrichi
56. Lenticulina megalophoto
57. Cancris auriculus
58. Cibicides lobatulus
59. Clavulina sp.
60. Karreria maoria
61. Lagena spp.
62. Nodosaria spp.
63. Gyroidinoides soldanii
64. Lenticulina spp. (smooth)
65. Elphidium pseudonodosum
66. Brizalina neblis
67. Guttulina problema
68. Anomalinoides macroglabra
69. Sphaeroidina bulloides
70. Bolivinita pervacarinata
71. Cibicides thiara
72. Cassidulina subglobosa
73. Chilostomella ovata
74. Globobulimina pacifica
75. Astrononion australae
76. Cibicides pseudoungerianus
77. Fissurina spp.
78. Pullenia spp.
79. Cassidulina carinata
80. Globobulimina ovata
81. Brizalina robusta
82. Bulimina marginata
83. Siphouvigerina proscidae
84. Euuvigerina maynii
85. Pyrgo sp.
86. Sigmoidopsis sp.
87. Discammina sp.
88. Haplophragmoides spp.
89. Euuvigerina mioshwageri
90. Planulina wullerstorfi
91. Bathysiphon spp.
92. Anomalinoides procolligera
93. Hoeglundina elegans
94. Melonis pompiloides
95. Ammodiscus sp.
96. Osangularia sp.
97. Karreriella bradyi
98. Nonionella sp.
99. Gaudryina sp.
100. Cibicides perforatus
101. Vulvulina granulosa
102. Cibicides brevoralis
103. Gyroidinoides scandica
104. Ceratobulimina sp.

SWORDFISH # 1


Depth in feet
700
1200
1700
2200
2700
3200
3400
3550
3770
4024
4080
4104
4149
4220
4250
4450
4650
4848
5050
5150
5300
5450
5550
5650
5750
5850
5950
6160
6250
6350
6450
6545
6560
6611
6619
6631
6638
6685
6698
OTHER FAUNA
Fresh bryozoal frags
Worn bryozoal frags
echinoid spines
ostracods
sponge spicules
fish remains
INORGANIC MATERIAL in residue
angular quartz
rock fragments
glauconite
limonite
rounded quartz
mica
pyrite
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
EUUVIGERINA
CASSIDULINA CARINATA
SIPHOUVIGERINA
ENVIRONMENTAL INTERPRETATION
INNER SHELF
MID to OUTER SHELF
SHELF/SLOPE BREAK
SLOPE/CANYON
LOWER SLOPE
BASE of SLOPE
CONTINENTAL RISE
?
Depth in feet to base of ZONE
1180
2000
3000
4104
5650
6350
A-3
A-4
B-1
B
C
D-1
D-2
E
F
G
H-1
H-2
J
J-2
late Eocene

BASIN GIPPSLAND BY David Taylor

WELL NAME SWORDFISH # 1 DATE 1-2-77 ELEV.

Foram Zonules

		Highest Data	Quality	2 Way Time	Lowest Data	Quality	2 Way Time
	A				1120[1]	3	
	Alternate						
	B	1180[2]	3		2000	3	
MIOCENE	Alternate						
	C	2100	3		3020	3	
	Alternate						
	D_1	3200	1		4104	1	
	Alternate						
	D_2	4140	3		5650	2	
	Alternate	4250	0		5550	0	
	E	5750[3]	0		5750[3]	0	
	Alternate						
	F	5850	1		5850	1	
	Alternate						
	G	5950	1		5950	1	
	Alternate						
	H_1	6160	1		6350	0	
	Alternate						
	H_2	6450[4]	0		6450[4]	0	
	Alternate						
	I_1	6490	3		6510	3	
OLIGOCENE	Alternate						
	I_2						
	Alternate						
	J_1	6545	2		6545	2	
	Alternate						
	J_2	6560	0		6564	0	
	Alternate						
EOC.	K	6571	1		6604	1	
	Alternate						
	Pre K						

1. Good A-4 assemblage between 1090 and 1120

2. Good B-1 assemblage between 1180 and 1210

3. Fauna represents E-2

4. Right at base of H-2, immediately above I-1.

COMMENTS: The fauna designated K was definitely upper Eocene, but could be pre K, as it contained *G. index* not previously recorded in Gippsland.

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

Form R 193 3/71

BASIN GIPPSLAND BY David Taylor

WELL NAME SALMON # 1 DATE 20-4-71 ELEV.

Foram Zonules

		Highest Data	Quality	2 Way Time	Lowest Data	Quality	2 Way Time
	A				1150	3	
	Alternate						
	B	1300	3		2100	3	
	Alternate						
MIOCENE	C	2150			3100	2	
	Alternate						
	D_1	3200	3		5000	3	
	Alternate						
	D_2	5120	1		5500	3	
	Alternate						
	E	5602	0		5602	0	
	Alternate						
	F	5880	1		5880	1	
	Alternate						
	G						
	Alternate						
	H_1	6030	1		6150	3	
	Alternate						
	H_2	6200	3		6236	0	
	Alternate	6236	0				
	I_1						
	Alternate						
OLIGOCENE	I_2	6416	1		6416	1	
	Alternate						
	J_1	6496	1		6496	1	
	Alternate						
	J_2	6555	0		6555	2	
	Alternate						
EOC.	K						
	Alternate						
	Pre K						

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.

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4 Cuttings - Incomplete assemblage, next to uninterpretable or SWC with