PE990361

WELL COMPLETION REPORT

COBIA-2

APPENDIX 7

FORAMINIFERAL SEQUENCE - COBIA-2

by

David Taylor

FORAMINIFERAL SEQUENCE

COBIA # 2

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SUMMARY

The Cobia # 2 is a normal sequence in deeper water locations in the Gippsland Basin. However the sequence contained a proven hiatus within the Oligocene with Zone I-2 and part of I-1 missing. This is designated "The Cobia Event" and it is now realized it was present in many other Gippsland sequences. It corresponds to three linked events of worldwide significance which were the result of a drastic reorganization of the oceanic systems. The precise cause of "The Cobia Event" cannot be ascertained at present.

Once again it is interpreted that there was an environment shift in the early Oligocene from a shallow restricted sea to a deep water oceanic situation. This is controversial as it implies a sudden drop, of at least 1200 feet, of the sea floor.

INTRODUCTION

Seventy one side wall cores were examined between 7844 and 2912 in COBIA # 2. No foraminifera were found in samples at 7844, 7842, 7840 and 7838. The thirteen side wall cores at and above 5150 contained very small indeterminate planktonic foraminifera and very few benthonic foraminifera so the contents of these samples were omitted from the distribution charts. All depths cited in this report and accompanying data sheets are in feet as labelled on the side wall core jars.

The following data 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 and relative specimen count.
Three Sample Data Sheets -	listing all samples, giving zonal entity and quality and summarizing residue grain character.
Biostratigraphic Data Sheet	

BIOSTRATIGRAPHY

? LATE EOCENE to EARLY OLIGOCENE - 7836 to 7824:- The side wall cores contained only arenaceous foraminiferal faunas. Specifically these faunas are identical with those of the late Eocene to early Oligocene Demons Bluff Formation and similar lithofacies in the Bass and Otway Basins (Raggatt & Crespin, 1952, Crespin, 1950 and Taylor, 1965a).

EARLY OLIGOCENE - 7822 to 7810:- SWC 62 at 7822 (but not SWC 30) contained a numerically large planktonic fauna dominated by *Subbotina angiporoides* and containing *Globigerina brevis*, *Tenuitella gemma* and *T. munda*. This is the association of Zone J-2 and probably represents the upper portion of the *G. brevis* Zone in New Zealand (Jenkins, 1974), which would infer the Basal Oligocene.

The top of the early Oligocene is placed at the highest appearance of *Subbotina angiporoides* and *Globoquadrina tripartita tapuriensis* at 7810; this is Zone J-1 and equates with the *S. angiporoides* Zone in New Zealand (Jenkins, l.c.)

MID OLIGOCENE HIATUS "THE COBIA EVENT" - 7810 to 7808:- Two feet above the highest appearance of *Subbotina angiporoides* there was an abrupt faunal change with the range base of *Globoquadrina dehiscens* (S.L.) and *Globorotalia opima opima*. This fauna represents Zone I-1 and correlates with the *G. dehiscens* Zone in New Zealand (Jenkins, l.c.), if the initial cryptogenic appearance of the *G. dehiscens* Group was coeval across the Tasman. Taylor (1977, p. 29-30) summarizes the evidence and concludes that there were apparent dispersal delays due to oceanographic circulation during the mid Oligocene (Kennett et al, 1975). Be that as it may, there is evidence of a gap in the Cobia # 2 sequence as Zone I-2 (as defined by Taylor, 1977, p.28) was definitely absent and much, if not all, of the New Zealand *G. euapertura* Zone (Jenkins, 1974) cannot be equated into the Cobia sequence. This sequence of faunal events is apparent in numerous other deep water Oligocene sequences in Gippsland, but inadequacies of the sampling intervals and of faunal qualities made it inappropriate to propose a regional non-depositional or erosive event at this biostratigraphic level in Gippsland. However, now the evidence for a hiatus is regarded as equitable and is designated "THE COBIA EVENT".

The causal mechanisms of "The Cobia Event" are difficult to discern at this stage, but sub-aerial or sub-aqueous erosion is dismissed immediately because:-

(1) The faunas at both 7810 and 7808 accumulated in deep water situation on the continental slope or rise and certainly not on the continental shelf. By analogy with modern distribution of the primitive arenaceous benthonic faunas, the minimum depth limit was at least 1200 feet and probably more than 2000. (Refer to section on "Environment" in this report). Thus the requisite tectonic or eustatic sea level movements would have been too great to be accomodated in light of current geological evidence.

(2) The incoming of *Globoquadrina dehiscens* immediately succeeds the disappearance of *Subbotina angiporoides* in deep water sequences. No intermediate planktonic fauna has been recorded between the two events. The faunal events below and above the hiatus were always the same, and never appear to be older below or younger above. The consistency of the biostratigraphic span of the hiatus rules out sub-aqueous erosion which would have been haphazard, especially regarding the surface immediately below the hiatus.

The "Cobia Event" falls within the biostratigraphic time span of three events of considerable regional and worldwide significance, These are:-

(1) A deep sea unconformity in the Tasman and Coral Seas, attributed by Kennett et al (1975) to a major reorganization of the oceanographic systems in the Southern Ocean.

(2) A worldwide paleotemperature decline (Savin, in press) which is expressed clearly in the Southern Ocean (Kennett & Shackleton, 1976) and New Zealand (Jenkins, 1973) and apparently in the Gippsland Basin (Taylor, 1977, fig. 12).

(3) A profound eustatic event of low sea level, corresponding with the top of Zone J-1 (refer chart by Hardenbol, 1976).

Firstly, Kennett et al (1975) invoke an erosive western boundary current, flowing northwards and creating the regional unconformity. The time span of this unconformity varied (Kennett et al, l.c. fig. 4) and thus the effects were haphazard. They were not haphazard in Gippsland and an erosive mechanism is not accepted as the cause of "The Cobia Event". This also dismisses the possibility that the event was purely due to eustatic low sea level. The effects are inconsequential to the argument, but the cause was obviously linked with paleoceanographic reorganization which caused cool Antarctic waters to flow north and thus have a worldwide paleotemperature decline. At the same time there was a marked reduction in the water budget of the oceans expressed by the low sea level eustatic cycle. It is argued that all this was linked with the formation of Antarctic sea ice but a paleotemperature drop to a mere 5°C for Sub-Antarctic bottom water (Kennett & Shackleton, 1976) implies neither sea ice nor Antarctic Bottom Water Current analgous to the present day (less than 2°C).

The paleoceanographic reorganization, the stage of continental drift, the paleotemperature decline and reduction in the water budget were probably interrelated.

The simultaneous combination of the above events would have caused environmental consequences of considerable magnitude, especially to water chemistry. A strong possibility was that the Southern Ocean suddenly became undersaturated in calcium carbonate and silica dioxide which would result in a dramatic raising of various lysoclines. In the predominantly carbonate sedimentation of the Gippsland Basin Oligocene,this would result in complete sediment starvation, as even what little silica (biogenic or terrestial) was in the system would have been destroyed. Thus "The Cobia Event" could have marked a raising of the lysocline. The flaws in the argument are:-

(1) That a reduction in the water budget would increase and not decrease concentration of various chemicals.

(2) There was a sharp return to normal carbonate sedimentation and no evidence of a gradual readjustment of the system as would be expected from the fact that a paleotemperature rise was very gradual and by no means sudden (Savin, in press).

LATE OLIGOCENE - 7808 to 7595:- As explained above the sample at 7595 represents Zone I-1. The incoming of *Globerigina woodi woodi* marks the base of Zone H-2.

EARLY MIOCENE - 7560 to 7070:- The early Miocene sequence is normal for the Gippsland Basin in terms of Taylor's (1977). The top of the early Miocene can not be picked accurately as Zone E-2 was not recorded due to a sample gap between 7070 and 7025. Zone E-2 is a very thin sediment interval and extremely short time interval in Gippsland (Taylor, l.c., p.38).

MID MIOCENE - 7025 to 5350:- The base was picked on the *Orbulina* Datum, with the initial appearance of *O. suturalis*.

The fauna of 7008 appears to be on the Zone E/D boundary from the development stage of the *Orbulina* form and has been designated Zone E-1. Zone D-2 could only be positively identified in one sample at 6970, though because of sample gaps could extend from 7008 to just below 6870. Even so, the Zone D-2 interval was anomalously thin and it is noted that the quality of the lowest D-1 fauna at 6870 was high.

? MID to LATE MIOCENE - 5150 to 2912:- The majority of planktonic specimens in this interval are generally too small to identify whilst the occasional large specimens belong to such biostratigraphically non-diagnostic species as *Globigerina woodi woodi* and *G. decoraperta*. Taylor (1977, p.44 & fig. 12) has postulated a paleoclimatic down turn in Zone D-1 which corresponds to a marked worldwide oceanic paleotemperature decline (Savin, in press). This would no doubt explain the depauperate planktonic fauna. At this point in the Gippsland Basin, there is evidence that there was further changes in water chemistry with the sudden abundance of biogenic silica in the form of sponge spicules. These events may mark the development of the modern Antarctic Bottom Water and its penetration into the Gippsland Basin.

No samples were examined above 2912, so it cannot be ascertained if there were any depositional break between the basal mid Miocene and the Quaternary.

Despite the fact that there is a proven hiatus within the Oligocene, the Cobia # 2 sequence is regarded as normal for the deep water Gippsland Basin. The Oligocene hiatus is now apparent in other Gippsland deep water sequences due to the close side wall core spacing in Cobia # 2.

ENVIRONMENT

Although basically environmental, most of the discussion on Oligocene and mid Miocene paleoceanography was outlined in the Biostratigraphy section where it seemed more appropriate to immediately explain biostratigraphic problems.

The environmental interpretation for the late Eocene to early Oligocene is dependant on the precise classification of the architecturally primitive arenaceous foraminifera. A definite pattern emerges on Distribution Chart Sheet 2 over the interval between 7836 to 7810 in that the faunas fall into two groups. These groups are:-

GROUP A - 7836 to 7824 - NO PLANKTONICS
Ammodiscus parri, Bathysiphon angleseaensis, Ammosphaeroidina sphaeroidiniformis, Ammobaculites sp?, Haplophragmoides cf. paupera, H. cf. incisa and *H. rotundata*.

GROUP B - 7822 to 7810 - PLANKTONICS
Ammodiscus anguillae, A. mestayeri, Discammina compressa, Bathysiphon sp. *A* (= ? *B. filiformis*), *B.* sp. *B, Brachysiphon corbiformis, "Cyclammina" cf. paupera, "C". cf. incisa* and *Rhabdammina abyssorum*.

Specifically the two groups are distinct apart from the fact that exteriorally architecturally identical *Haplophragmoides* forms in Group A have developed internal aveloli in Group B. These avelolid forms should be classified in the genus *Cyclammina* although they differ from the accepted diagnosis of *Cyclammina*. The development of aveloli appears to be an adaption for deep water conditions (Taylor, 1965).

Comparing the paleogeographic distribution of the two groups it is apparent that Group A was endemic to Southern Australia whilst Group B was and is cosmopolitan in the ocean deeps and on continental slopes. Most species in Group A were first recorded in the Demons Bluff Formation or in the equivalent facies at Browns Creek (Crespin 1950, Raggatt & Crespin 1952, and Taylor 1965a & b). Some of these Group A species also occur in the early Eocene Dilwyn Formation of the Otway Basin. (Taylor, 1965a). Therefore, purely by geological comparison and not by analogy with modern distributions, Group A were shallow water forms and could have inhabited shallow "barred basin" conditions as were evident during Demons Bluff times in the Bass Basin (Taylor, 1965b). The absence of planktonics and the endemicity of the benthonic fauna supports the suggestion of both shallow water and of environmental stress and restriction. However this absence of planktonics and calcareous benthonics with the complete dominance of arenaceous forms can indicate a very deep water situation at or below the C.C.D. Deep water species of most benthonic organisms were and are cosmopolitan, but Group A species were endemically confined to shallow water sediments of Southern Australia. The conclusion must be that the sediment from 7836 to 7824 was a shallow water deposit in a restrictive environment. It is emphasized that this interpretation is a comparative one and not one using analogy by the thesis of uniformity between the present and the past.

It has already been stated that the arenaceous species of Group B (7822 to 7810) are and were distributed in deep water deposits and are seldom reported from continental shelf sediments. Off Gippsland these species were not found in depths less than 1200 feet and were concentrated below 2000 feet on the continental shelf and rise (Taylor & Mee, 1970). The few calcareous benthonic species present, especially *Cibicides wvellerstorfi* and *Melonis barleeanum,* support such water depths. The high percentage of planktonic specimens (above 95%) is indicative of sediment deposited beyond the continental rise. S.E.M. examination revealed that the side wall core at 7820 should be classified as a nannoplankton ooze. The sediment between 7822 and 7810 is thus believed to have been deposited in depths greater than 1200 feet by analogy with modern distribution.

It is realised that the sudden change from shallow water to deep water sedimentation between 7824 and 7822 is a controversial interpretation. A criticism of the argument is that comparative methods were used for the shallow water interpretation whilst analogy with the present had to be used for the deep water interpretation. But analogy with the modern Gippsland Lakes (Apthorpe, 1977) could be applied for the faunas at and below 7824 and an euryhaline situation similar to Lake Wellington would be envisaged. By comparison with early Oligocene faunas in wells in the vicinity of Cobia # 2, the sediment between 7822 to 7810 was certainly deep water. Another fact is there was a change in sediment grain character from quartz sand and silt at 7824 to a carbonate siltstone with some inorganic silica at 7822 to a nannoplankton ooze at 7820. Whether faunal or sediment characters are considered a dramatic environment shift was evident in the early Oligocene between 7824 and 7822.

The next question is whether this apparent shift was not a matter of dramatic deepening but one of sediment starvation and drastic changes in water chemistry. The complete absence of quartz, sand silt and clay at 7820 certainly indicates starvation of all sediment save biogenic pelagic carbonate. The inorganic silica and the siliceous replacement of planktonic specimens at 7822 (SWC 30 but not SWC 62) could indicate that the bottom water was silica rich and probably cold, though a minimal temperature of 5°C would follow from Kennett & Shackleton's (1976) reading on core from D.S.D.P. site 277 (sub-Antarctic). Kennett & Shackleton (l.c. fig. 1) graph a steep paleotemperature drop of 5°C in the early Oligocene. This rapid decline would have greatly influenced benthonic faunas and would have raised the C.C.D. A flaw is immediately apparent in that such a model would require abundant biogenic pelagic carbonate at and below 7824 and a complete absence of it at and above 7822. The reverse situation was true so an alternate proposition has to be proposed for Cobia # 2 and other Gippsland sequences.

The late Oligocene sediment above the hiatus of "The Cobia Event" (7810 to 7808) was a deep water biogenic pelagic carbonate with similar faunas to those below the hiatus. Planktonic percentages were greater than 95%.

This situation continued into Zone H-1 (early Miocene), but at 7454 there was a sudden decline in planktonic percentage from 98% to 20%. The sample at 7454 marks the upper limit in the section of many deep water benthonic species such as *Bathysiphon sp. B, Eggerella bradyi, Karreriella bradyi* and *Epistiminella exigua*. An environmental disruption is evident as planktonic percentages return to 98% in the next sample at 7830. The benthonic component in 7454 would today inhabit depth greater than 1200 feet on the Gippsland continental slope (Taylor & Mee, 1970). So with the gradual filling a particular point, analagous to 1200 feet water depth was reached at 7454. It may be significant that Pflum & Frerichs (1976) report that *Eggerella bradyi* and *Kareriella bradyi* are "delta depressed" on the slope of the Gulf of Mexico immediately off the Mississipi River. What is implied is that stream discharge depressed the upper depth limit of these two species. Stream discharge with resultant decline in salinity and clouding of the water would inhibit planktonic foraminifera. Therefore the environmental disruption at 7370 may have been the result of a short period of stream discharge. A similar happening at this biostratigraphic level was probable in other wells in the vicinity.

Early Miocene sedimentation at and above 7370 was evidently on the upper slope and a paleobathymetric estimate of between 1200 and 700 feet is proposed.

The base of the mid Miocene (Zone E-1) appears to have been deposited at the very top of the slope (= 800 to 700 feet) as this is the cut off point of all arenaceous species. The mid Miocene between 6970 and 5350 (Zones D-2 and D-1) maintains the high percentage of planktonics and contains a fairly sparse calcarcous benthonic assemblage which could have inhabited the upper slope, and shelf edge at approximately 700 feet. The sediment at and above 6870 is a micritic limestone in contrast with the calcarcous shales and pelagic sediments below. Above 5350 the pelagic elements were obviously size sorted as most planktonic foraminiferal specimens were of very small size. This size sorting in the absence of benthonic foraminifera points to high energy conditions, so that sediment above 5350 is thought to have been deposited as a canyon fill on the upper slope break. The high proportion of siliceous sponge spicules in samples between 3750 and 2912 is another characteristic of Gippsland canyon sedimentation below the shelf edge (Taylor & Mee, 1970).

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Form R 193 3/71

BASIN GIPPSLAND

BY David Taylor

WELL NAME COBIA # 2

DATE August 17, 1977

ELEV.

Foram Zonules

		Highest Data	Quality	2 Way Time	Lowest Data	Quality	2 Way Time
MIOCENE	A						
	Alternate						
	B						
	Alternate						
	C						
	Alternate						
	D_1	5350*	1		6870	1	
	Alternate						
	D_2	6970	1		6970	1	
	Alternate						
	E	7008	1		7025	0	
	Alternate						
	F	7070	0		7110	1	
	Alternate				7090	0	
	G	7130	1		7225	1	
	Alternate				7170	0	
	H_1	7270	1		7560	0	
	Alternate						
	H_2	7595	1		7698	1	
	Alternate						
OLIGOCENE	I_1	7736	1		7808	0	
	Alternate						
	I_2						
	Alternate						
	J_1	7810	1		7816	0	
	Alternate						
	J_2	7820	1		7822	0	
	Alternate						
EOC.	K						
	Alternate						
	Pre K						

*Thirteen SWCs between 5150 and 2912 contained biostratigraphically non diagnostic planktonic fauna.

COMMENTS: Non depostional event between 7810 & 7808.
Zone I-2 and early portion of I-1 definitely absent.

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

By

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: COBIA # 2 — *DATE:* 17.8.77

PREPARED BY: DAVID TAYLOR — *SHEET NO:* 1 of 3

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
7844	SWC 19	U.C. - N.F.F.	Dom f ang qtz sdst, r pellet glauc
7842	SWC 20	U.C. - N.F.F.	Dom f ang qtz sdst, r pellet glauc
7840	SWC 21	U.C. - N.F.F.	Dom f-m ang qtz, c pellet glauc
7838	SWC 22	N.F.F.	Dom f-m ang qtz, c pellet glauc
7836	SWC 23	aren only,	residue *ibid*
7834	SWC 24	*ibid*	
7832	SWC 25	aren only.	Dom f ang qtz sdst
7830	SWC 26	*ibid*	
7827	SWC 27	aren only.	Dom f-c ang qtz sdst, r glauc
7826	SWC 28	*ibid*	
7824	SWC 61	aren only.	50-50 siltst & f ang qtz sdst
7824	SWC 29	aren only.	Dom f ang qtz sdst, lim
7822	SWC 30	? indet planks -	totally replaced by silica
7822	SWC 62	J-2 (0)	Dom plank replaced by silica all texture destroyed
7820	SWC 31	J-2 (1)	Dom calc sh - plank somewhat corroded
7818	SWC 32	J (2)	Dom ?mic
7816	SWC 33	J-1 (0)	Dom calc sh, r ang qtz.
7814	SWC 34	J-1 (1)	Dom planks
7812	SWC 35	J-1 (1)	Dom planks
7810	SWC 36	J-1 (1)	Dom planks
7808	SWC 37	I-1 (0)	Dom planks ang qtz
7806	SWC 38	I-1 (0)	Dom planks 20% calc sh
7804	SWC 39	I-1 (1)	Dom calc sh
7802	SWC 40	U.C. I-1 (1)	Dom calc sh, r c ang qtz
7800	SWC 41	I-1 (0)	50-50 planks & calc sh, r c ang qtz
7795	SWC 42	I-1 (1)	Dom calc sh, r c ang qtz

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: COBIA # 2 *DATE:* 17.8.77

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

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
7790	SWC 43	I-1 (1)	Dom calc sh, lim
7784	SWC 44	I-1 (2)	Dom calc sh
7776	SWC 45	I-1 (1)	70-30 planks calc sh, r c ang qtz
7768	SWC 46	I-1 (1)	Dom calc sh
7736	SWC 47	I-1 (1)	Dom planks
7698	SWC 48	H-2 (1)	Dom planks
7662	SWC 49	H-2 (1)	Dom calc sh
7631	SWC 50	H-2 (1)	80-20 planks & calc sh
7595	SWC 51	H-2 (1)	Dom calc sh
7560	SWC 52	H-1 (O)	Dom planks
7540	SWC 53	H-1 (O)	70-30 planks & calc sh, lim, r c ang qtz
7454	SWC 54	H-1 (2)	Dom calc sh, r c ang qtz
7370	SWC 55	H-1 (1)	50-50 planks & calc sh
7270	SWC 56	H-1 (1)	Dom calc sh, r c ang qtz
7225	SWC 57	G (1)	calc sh & planks
7170	SWC 58	G (O)	80-20 planks & calc sh, r c ang qtz
7130	SWC 59	G (1)	Dom calc sh, r c ang qtz
7110	SWC 60	F (1)	Dom planks
7090	SWC 63	F (O)	Dom planks, r c ang qtz
7070	SWC 64	F (O)	Dom planks, r c ang qtz
7025	SWC 65	E-1 (O)	60-40 planks & calc sh + r c ang qtz
7008	SWC 66	E-1 (1)	Dom calc sh
6970	SWC 67	D-2 (1)	Dom planks, lim, r c ang qtz
6870	SWC 68	D-1 (1)	Dom mic, r c ang qtz
6760	SWC 69	D-1 (2)	Dom mic, r c ang qtz
6550	SWC 70	D-1 (O)	Dom mic
6350	SWC 71	D-1 (2)	Dom mic
6150	SWC 72	D-1 (2)	Dom mic, r c ang qtz

MICROPALEONTOLOGICAL MATERIAL

WELL NAME AND NO: COBIA # 2

DATE: 17.8.77 ~~20x12x74~~

PREPARED BY: DAVID TAYLOR

SHEET NO: 3 of 3

DRAW:

DEPTH	*SAMPLE TYPE*	*SLIDES*	*ADDITIONAL INFORMATION*
5950	SWC 73	U.C. D-1 (1) Dom mic	
5750	SWC 74	U.C. D-1 (O) Dom planks & mic, r c ang qtz, py	
5550	SWC 75	U.C. D-1 (2) Dom mic, r c ang qtz	
5350	SWC 76	D-1 (1) Dom mic, r c ang qtz	
5150	SWC 77	U.C. indet planks Dom mic	
4950	SWC 78	U.C. indet small planks, Dom mic	
4750	SWC 79	U.C. Small indet planks, Dom mic,r c ang qtz	
4550	SWC 80	U.C. small indet planks, Dom mic,r c ang qtz	
4360	SWC 81	U.C. small indet planks, Dom mic	
4340	SWC 82	U.C. small indet planks, Dom mic,r c ang qtz	
4150	SWC 83	U.C. small indet planks, Dom mic	
3950	SWC 84	U.C. small indet planks, Dom mic, r c ang qtz	
3750	SWC 85	small indet planks, Dom mic, 20% spic, r c ang qtz	
3550	SWC 86	small indet planks, Dom mic, 10% spic	
3350	SWC 87	small indet planks, Dom mic, 10% spic	
3190	SWC 88	washed in "Quaternary O" small indet planks Dom mic, 20% spic	
2912	SWC 90	small indet planks, Dom mic, 20% spic	

ABBREVIATION KEY used by David Taylor on summary date sheets.

R.C.	= rotary cuttings
S.W.C.	= side wall core
C.C.	= conventional core
U.C.	= unable to clean sample of drilling mud before washing, thus result may be spurious.
N.F.F.	= no fauna found
indet	= specifically indeterminate and/or biostratigraphically non diagnostic
J-2 (O)	= Zone J-2 planktonic fauna present and identification is of highest level of confidence.
B-1 (4)	= Zone B-1 suspected but lowest confidence indicated
Dom	= Dominant grain type - at least 90% of washed sample
r	= rare - less than 10 grains
60-40	= proportion of components
qtz	= quartz
py	= pyrite
glauc	= glauconite
lim	= limonite
sdst	= sandstone
siltst	= siltstone
mdst	= mudstone
calc sh	- calcareous shale
lst	= limestone
mic	= micritic limestone
calcar	= calcarenite
bio	= biogenic
bry	= bryozoa
moll	= molluscan fragments
plank	= planktonic foraminifera
calc benth	= calcarcous benthonic foraminifera
aren	= arenaceous foraminifera
ost	= ostracods
spic	= siliceous sponge spicules
ech	= echnioid spines

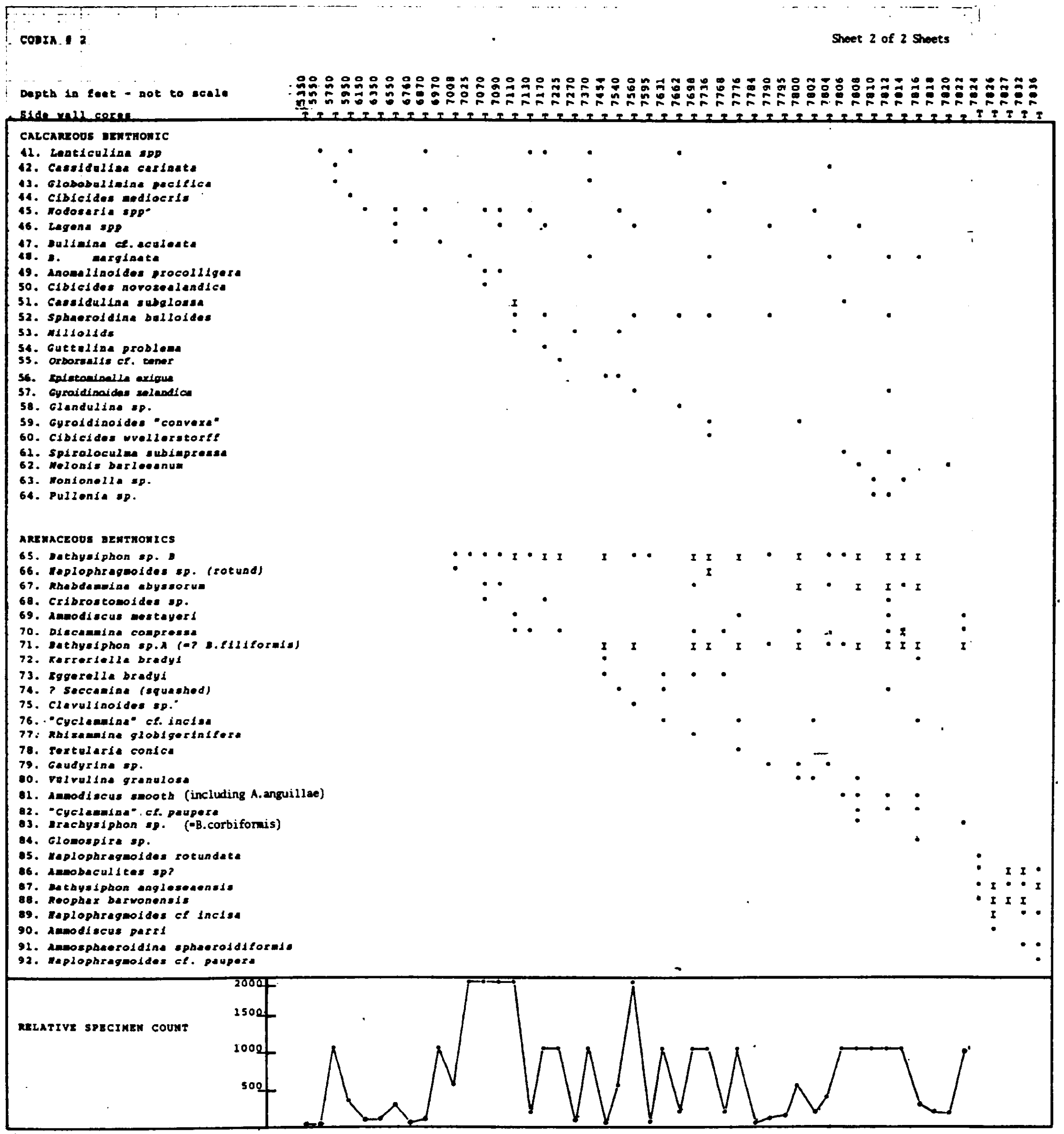
...2/

f	= fine grade
m	= medium grade
c	= coarse grade
f-c	= whole spectrum of grades
ang	= angular shape
subrd	= subround shape
rd	= round shape
ibid	= sample identical to that listed immediately above.

COBIA # 2

Depth in feet - not to scale	5350	5550	5750	5950	6160	6350	6550	6760	6870	6970	7008	7025	7070	7090	7110	7130	7170	7225	7270	7370	7454	7540	7560	7595	7631	7662	7698	7736	7768	7776	7784	7790	7795	7800	7802	7804	7806	7808	7810	7812	7814	7816	7818	7820	7822	7824
Side wall cores	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
PLANKTONICS																																														
1. *Orbulina universa*	•	I	I	I	•	I	I	I	I	I																																				
2. *Globorotalia conica*	•		•				•		•		•	•																																		
3. *G. miozea conoidea*	•	•	I	•	•		•		I																																					
4. *Globigerina woodi woodi*		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	•	I	I	I	I	I	I																			
5. *G. decoraperta*		•	I	I																																										
6. *G. bulloides*			I		I	I				I	I	I																																		
7. *Globorotalia mayeri*			I	•		•	•																																							
8. *G. miozea miozea*			•				•		•	I	I	I	I	I	I	I	I																													
9. *Globigerinoides trilobus*									•		I	I	I	I	I	I	I	I																												
10. *Globorotalia peripheroronda*										•																																				
11. *Orbulina Suturalis*											I	I																																		
12. *Globigerinoides bisphericus*											I	I																																		
13. *Praeorbulina glomerosa glomerosa*											I	I	I	I	I																															
14. *P. glomerosa curva*												•																																		
15. *Globorotalia praemenardii*												•																																		
16. *G. praescitula*												I	I	I	I		I		I	I		I	I																							
17. *Globoquadrina advena*												I													I		I	•		I																
18. *Globigerina ciperoensis*													I	I																																
19. *G. woodi connecta*													I	I	I	I	I	I		I		I	I																							
20. *G. praebulloides*													I	I	I	I	I	I	I	I		I	I			I				I	•	I	I	I	I	I	I	I			I					
21. *Globigerinoides trilobus elongate*													I	I																																
22. *Globorotalia bella*													I		I			I	•																											
23. *Globoquadrina dehiscens (S.S.)*																I	I																													
24. *Globorotalia zealandira*																				I																										
25. *G. kugleri*																						•																								
26. *Globoquadrina dehiscens (S.L.)*																						I	I		I	I	I	I	•	I		I		I		I	I	I								
27. *Globigerina angisuturalis*																						I	I	•		I	I	I	•									I								
28. *G. apertura*																							I	•	I	I	I	I																		
29. *Globorotalia opima nana*																							•			•			•																	
30. *Globigerina evapertura*																												I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	
31. *Catapsydrax unicavus*																													•		•									•						
32. *Globorotalia opima opima*																																	•	•			•	•								
33. *G. obesa*																																						•								
34. *Globoquadrina tripartita tripartita*																																						I				I				
35. *G. tripartita tapuriensis*																																							•	•	I	I				
36. *Subbotina angiporoides*																																							I	I	I	I	I	I	I	
37. *Globorotalia testarugosa*																																										•				
38. *Globigerina brevis*																																												I	I	
39. *Tenuitella gemma*																																													•	
40. *T. munda*																																													•	

Depth in feet to base of ZONE	6870	6970	7025	7110	7225	7560	7698	7808		7816		7820	
?	D - 1	D-2	E	F	G	H-1	H-2	I-1		J-1		J-2	[illegible]


COBIA # 2
Sheet 2 of 2 Sheets
Depth in feet - not to scale
5350 5550 5750 5950 6150 6350 6550 6760 6870 6970 7008 7025 7070 7090 7110 7130 7170 7225 7270 7370 7454 7540 7560 7595 7631 7662 7698 7736 7768 7776 7784 7790 7795 7800 7802 7804 7806 7808 7810 7812 7814 7816 7818 7820 7822 7824 7826 7827 7832 7836
Side wall cores
CALCAREOUS BENTHONIC
41. Lenticulina spp
42. Cassidulina carinata
43. Globobulimina pacifica
44. Cibicides mediocris
45. Nodosaria spp
46. Lagena spp
47. Bulimina cf. aculeata
48. B. marginata
49. Anomalinoides procolligera
50. Cibicides novozealandica
51. Cassidulina subglossa
52. Sphaeroidina bulloides
53. Miliolids
54. Guttulina problema
55. Orbonalis cf. tener
56. Epistominella exigua
57. Gyroidinoides zelandica
58. Glandulina sp.
59. Gyroidinoides "convexa"
60. Cibicides wuellerstorffi
61. Spiroloculina subimpressa
62. Melonis barleeanum
63. Nonionella sp.
64. Pullenia sp.
ARENACEOUS BENTHONICS
65. Bathysiphon sp. B
66. Haplophragmoides sp. (rotund)
67. Rhabdammina abyssorum
68. Cribrostomoides sp.
69. Ammodiscus mestayeri
70. Discammina compressa
71. Bathysiphon sp.A (=? B.filiformis)
72. Karreriella bradyi
73. Eggerella bradyi
74. ? Saccamina (squashed)
75. Clavulinoides sp.
76. "Cyclammina" cf. incisa
77. Rhizammina globigerinifera
78. Textularia conica
79. Gaudryina sp.
80. Vulvulina granulosa
81. Ammodiscus smooth (including A.anguillae)
82. "Cyclammina" cf. paupera
83. Brachysiphon sp. (=B.corbiformis)
84. Glomospira sp.
85. Haplophragmoides rotundata
86. Ammobaculites sp?
87. Bathysiphon angleseaensis
88. Reophax barwonensis
89. Haplophragmoides cf incisa
90. Ammodiscus parri
91. Ammosphaeroidina sphaeroidiformis
92. Haplophragmoides cf. paupera
RELATIVE SPECIMEN COUNT
2000
1500
1000
500