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FORMAINIFERAL SEQUENCE - ESSO GIPPSLAND SHELF NO. 4 WELL

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SUMMARY OF SEQUENCE

Depth in Feet	Biostrat. Unit	Age
- 850	A	UPPER MIOCENE
850-1200	B	" "
1200-1800	C	MIDDLE MIOCENE
1800-2300	D	" "
2300-2700	E	" "
2700-3000	F	LOWER MIOCENE
3000-3700	G	" "
3700-4300	H	" "
4300-4510	I	OLIGOCENE
4510-4800	J	LOWER OLIGOCENE
4800 (approx.)	K	UPPER EOCENE
?4800-6500		? PALEOCENE ?
6500-7267		UPPERMOST CRETACEOUS
7267-8485 (T.D.)	No new fauna in cuttings of fauna in cores found.	Probable UPPER CRETACEOUS

INTRODUCTION:

Esso Gippsland Shelf No.4 Well was drilled in 197 feet of water, 27 miles south-east of Lakes Entrance, on a structure separate from the "Gippsland Shelf Structure" and some 29 miles east of the No.1 well.

All depths, discussed here, were those shown on submitted samples. The datum for all samples was taken from the rotary table at +31 feet M.S.L.

Cutting samples and 15 cores were examined between 758 feet (first returns) and 8485 feet (total depth). The 20" casing shoe was at 728 feet; the $13\frac{3}{8}$" casing shoe was at 2252 feet; and the $9\frac{5}{8}$" casing shoe at 6289 feet. Rotary cutting contamination is present throughout but decreases considerably below the $9\frac{5}{8}$" casing shoe (at 6289 feet).

THE FORAMINIFERAL SEQUENCE:

The sequence is summarised on the title page. An uninterrupted mid-Tertiary sequence extends from the upper Miocene (from 758 feet or higher) to uppermost Eocene at approximately 4800 feet. Possible upper Paleocene planktonic species are present in core 6 (4891 to 4921 feet). A sparse arenaceous fauna with rare calcareous forms was found below 6500 feet. This fauna has Upper Cretaceous affinities to the Upper Cretaceous to Lower Tertiary faunas of western Victoria as described by Taylor (1964 and 1965a).

BIOSTRATIGRAPHIC CORRELATION:

(i) MID TERTIARY:

The mid-Tertiary sequence is correlation with the zonule scheme established by Taylor (1965b) for Esso Gippsland Shelf No.1 well.

(a) Upper Miocene: ? to 1200 feet.

A fairly nondescript benthonic fauna is present down to 850 feet. This fauna includes Cancris auriculus, Elphidium imperatrix, Notorotalia clathrata, Rosalina mitchelli and Uvigerina sp.1 which is typical of Zonule A as well as of the Mitchellian (upper Miocene) and Kalimnan (lower Pliocene) faunas of Carter (1964). Taylor (1965b) regarded Zonule A as being upper Miocene because of its close association with

the definite upper Miocene Zonule B. But Zonule A is an expression of environmental change, thus can not be considered as a laterally consistant biostratigraphic unit.

The highest appearance of Globorotalia menardii Group is at 850 feet marking the top of Zonule B.

(b) Middle Miocene: 1200 to 2700 feet.

The top of the middle Miocene is marked by the highest appearance of Globorotalia mayeri and benthonic species which do not extend above Zonule C. The top of the middle Miocene appears to form a horizontal surface at 1700 feet on the crest and southeast flank of the "Gippsland Shelf/No.1 Structure" (No.1 to 3 wells). This surface is 500 foot higher in the No.4 well, suggesting that the No.4 structure moved independently to the No.1 structure. The total thickness of the middle Miocene is similar to that in the No.1 well, though both are considerably less than that in the No.3 well which was drilled on the flank of the No.1 structure.

The complete middle Miocene sequence is represented with Zonules C, D and E present. The top of Zonule E is marked by the highest appearance of Globigerinoides triloba, G. rubra and G. bispherica and the restricted presence of Plectofrondicularia australis. Although the vertical range of Globigerinoides spp. extends higher, its extinction at this level appears to be a consistent feature on the Gippsland Shelf and in cores is seldom associated with Orbulina universa.

(c) Lower Miocene: 2700 to 4300 feet.

Unlike the No.1 well, the No.4 well contains a complete sequence of lower Miocene. Zonules F and G, missing in the No.1 well, are present. There is an abrupt change in the benthonic fauna at 2700 feet with the highest appearance of Cibicides perforatus, Anomalinoides procilligera, Astrononion centroplax, Gyroidinoides sp.4 and the arenaceous form Vulvulina sp. Larger foraminifera, including Lepidocyclina sp. were not reported. The large costate "Uvigerina" sp.9 and Uvigerina sp.10 were first reported at 3000 feet. There is a gradual increase in arenaceous forms down the section. Haplophragmoides spp. (including H. rotundata) are common below 3300 feet. For the above reasons the top of Zonule G. was placed at 3000 feet.

Below 3700 feet, there is a marked decline in Globigerinoides spp. and a predominance of Globigerina woodi. Globorotalia cf. miozea is present below 3700 feet. These factors strongly indicate Zonule H.

(d) Oligocene: 4300 to 4510 feet.

A thin development of Zonule I is present between 4300 and 4510 feet. Such Oligocene planktonic species as Globigerina euapertura, Globorotalia opima and G. extans are present.

(e) Lower Oligocene - Uppermost Eocene: 4510 to 4800 feet.

The highest appearance of Globorotalia testarugosa is recorded at 4510 feet which is within the calcareous section, some 30 feet above the incoming of sand in the cuttings. G. testarugosa is the index species of Zonule J and its upper range is very consistent. Jenkins (1960) first reported it from the basal 30 feet of the Lakes Entrance Formation marls (i.e. 30 ft. above the "Greensand"). I have shown a similar range in other wells.

At 4800 feet Glogigerina linaperta and G. angipora suggest an upper Eocene age and the presence of Zonule K.

(ii) LOWER TERTIARY (? PALEOCENE): 4800 to 6500 feet.

The upper Eocene fauna, Zonule K is probably at the Eocene/Oligocene boundary and is equivalent to Carter's (1964) Faunal Unit 3. Globigerapsis faunas were not found in this section and thus Carter's upper Eocene Faunal Units 1 and 2 are absent, as they are in every Gippsland section (on and off shore) I've examined. This strongly suggests that there was very little marine influence in upper Eocene sedimentation in the Gippsland Basin. There is no evidence of marine sedimentation during the lower and middle Eocene.

Core No.6 (4891-4921 feet) contains a sparse fauna of small planktonic specimens. Poor preservation makes this fauna perplexing. One species could be poorly preserved juvenile Globorotalia cf. miozea and thus the result of mud contamination penetrating the porous sandstone core. G. cf. miozea does not range below Zonule I. On the other hand, this species could be Globorotalia pseudomenardii and specimens compare closely with my western Victorian material. McGowran (1965) regards G. pseudomenardii as being an upper Paleocene

species in western Victoria, whilst Berggren (1965) and others demonstrate that this species is restricted to, but does not reach the top of, the upper Paleocene of the Gulf Coast (U.S.A.) and the Caucasus (U.S.S.R.). Other species present in core 6 are stratigraphically nondescript. On the whole, the material cannot be taken as concrete evidence of a Paleocene age, especially as morphologically convergent forms to G. pseudomenardii (e.g. G. cf. miozea and G. menardii) are present higher in the well and are noted as rotary cutting contaminants.

(iii) UPPER CRETACEOUS: 6500 to 7267 feet.

Core No.12 (7237 to 7267 feet) contains sporadic and sparse faunas of arenaceous foraminifera, including Ammobaculites goodlandensis, A. fragmentaria, A. subcretacea, Ammodiscus sp. (non A. parri), Bathysiphon sp., Haplophragmoides paupera, H. sp. B of Taylor 1964 and Reophax sp. Calcareous species are extremely rare, consisting of single specimens of Nodosaria alternistriata, Lenticulina navarroensis, Nonionella sp. and a buliminid. Most of these species make their first appearance at 6500 feet.

Specifically the fauna contains elements of the Upper Cretaceous faunas of western Victoria described by Taylor (1964). Detailed work on the western Victorian Paleocene arenaceous faunas by Taylor (1965a and manuscript) shows subtle differences between the Upper Cretaceous and Paleocene arenaceous faunas, in that:

UPPER CRETACEOUS (Senonian)		PALEOCENE (mid to upper)
Ammobaculites goodlandensis	replaced by	- A. expandus
A. subcretacea	" "	- A. midwayensis
Ammodiscus sp.	" "	- A. parri
Haplophragmoides spB. becomes very rare	and is replaced by	- H. complanata

Fig.1 shows the distribution of Haplophragmoides faunas in western Victoria and their distributions are related to diagnostic planktonic species. The above data certainly indicates an Upper Cretaceous age for core 12 faunas and suggests that they represent the uppermost Cretaceous (i.e. Senonian to ? Maastrichtian). The presence of Haplophragmoides paupera (= H. sp.A of Taylor 1964) and Ammobaculites subcretacea precludes a Turonian age.

The rare calcareous species confirm the age determination, as neither Nodosaria alternistriata and Lenticulina navarroensis are reported in the western Victorian Paleocene by McGowran (1965) or Taylor (manuscript).

? UPPER CRETACEOUS: 7267 to 8485 feet (T.D.)

No new faunas were reported below 7267 feet, but in all probability this is within the Upper Cretaceous.

DEPOSITIONAL HISTORY:

The oldest fauna in this section is designated as uppermost Cretaceous. This predominately arenaceous fauna is sparse. Analagous faunas are euryhaline, living today in lagoons and estuaries where there is a high coastal run-off, resulting in diluted, muddy sea water, which is deleterious to most calcareous foraminifera. Taylor (1964) discusses a similar environment in the Upper Cretaceous Paaratte Formation of western Victoria. Coal deposits associated with these Upper Cretaceous sediments support the contended lagoonal and estuarine environment. Ingressions of sea water are obviously sporadic. The sedimentary sequence could be best defined as paralic.

At this stage no comment can be made on Paleocene deposition.

Both the Upper Cretaceous and the ? Paleocene faunas would have been the result of sporadic ingressions onto coastal lowlands from the continental shelf. These ingressions can not be regarded as transgressions as they are short-lived and are by no means wide-spread. However a definite transgression was initiated in the uppermost Eocene and deposition continued to at least the upper Miocene. The facies sequence is broadly similar to that described for the Gippsland Shelf No.1 sequence by Taylor (1965b), with the exception that there is no hiatus in the lower Miocene of the No.4 sequence. During the lower Miocene there was gradual deepening and the early middle Miocene deposition (Zonule E) was in deeper water than the No.1 sequence, where deposition had just recommenced after the lower Miocene hiatus.

GEOLOGICAL SETTING:

When comparing the Mid-Tertiary sequence of Gippsland Shelf No.1, No.2 with Gippsland Shelf No.4, it is apparent that the No.4 well is structurally unrelated from the former two wells in that:

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(i) There is no hiatus in the lower Miocene in No.4.

(ii) The top of the middle Miocene appears to form a horizontal surface between No.1 and No.2 at the 1700 foot level. This surface is some 500 feet higher in No.4.

In none of the wells does there appear to be a hiatus between the calcareous sequence and the underlying sandy sequence. In No.2, No.3 and No.4 wells the lowermost Oligocene Zonule J fauna is present in the basal 30 feet of the Calcareous sequence as well as in the top of the sand. This situation can be directly correlated with the Lakes Entrance area where Zonule J is in the basal 30 feet of the Micaceous Marl Member of the Lakes Entrance Formation and the top of the Greensand Member of the Lakes Entrance Formation.

The possibility of upper Paleocene sediments below 4800 feet is of particular interest, as above 4800 feet to 4510 feet uppermost Eocene to lower Oligocene faunas are present. If this Paleocene age is substantiated, then there must have been a depositional break at 4800 feet.

I have already reported a sparse Cretaceous foraminiferal fauna in Holland's Landing bore (Bengworden South No.1), although this determination was disputed on palyonological grounds (refer also Hocking and Taylor, 1964). The faunas in Gippsland Shelf No.4 are also sparse but do provide concrete evidence of marine influence during the Upper Cretaceous in the Gippsland Basin. In terms of Hocking and Taylor's (l.c) structural division of the Gippsland Basin, Holland's Landing bore is within the Lake Wellington Trough of marine Tertiary deposition. This trough trends south east and Gippsland Shelf No.4 is within this trend. Taylor (1964) found that the Upper Cretaceous marine sedimentation trended from the south east in western Victoria. Thus it is suspected that the Lake Wellington Trough may well have been effective during the Upper Cretaceous as well as during the mid-Tertiary, the magnitude of the Upper Cretaceous "down-warping" may have been minute as only marine ingressions in two localities have as yet been noted.

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REFERENCES:

BERGGREN, W.A., 1965. Some problems of Paleocene-Lower Eocene planktonic foraminiferal correlation. Micropaleontology, 11 (3) : 278-300.

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

HOCKING, J.B., and TAYLOR, D.J., 1964. Initial marine transgression in the Gippsland Basin, Victoria. A.P.E.A. J., 1964 : 125-132.

JENKINS, D.G., 1960. Planktonic foraminifera from the Lakes Entrance Oil Shaft, Victoria. Micropaleontology, 6 (4) : 345-371.

McGOWRAN, B., 1965. Two Paleocene foraminiferal faunas from the Wangerrip Group, Pebble Point coastal section, western Victoria. Proc. Roy. Soc. Vict., 79(1) : 9-74.

TAYLOR, D.J., 1964. Foraminifera and the stratigraphy of the western Victorian Cretaceous sediments. ibid, 77(2) : 535-602.

TAYLOR, D.J., 1965a. Preservation, composition and significance of Victorian lower Tertiary "Cyclammina faunas". ibid, 78(2) : 143-160.

TAYLOR, D.J., 1965b. The mid-Tertiary foraminiferal sequence Esso Gippsland Shelf No.1 Well. Appendix to Comm. Petrol. Search Subsidary Acts Publ. (in press).

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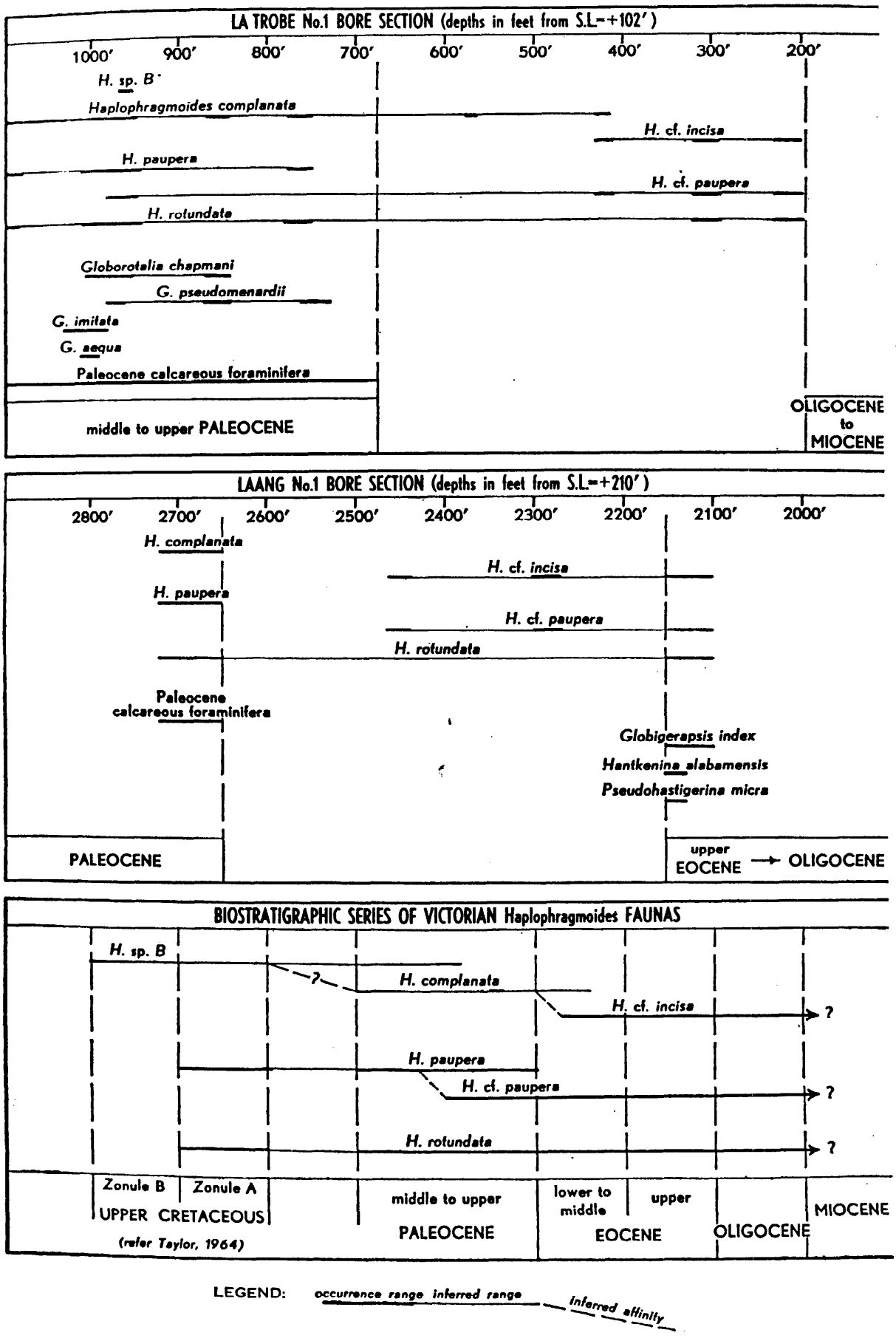

FIG. 1 – Stratigraphic distribution of Upper Cretaceous and Lower Tertiary Haplophragmoides faunas in relation to diagnostic planktonic faunas. Figure copied from Taylor (1965a).