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THE STRATIGRAPHIC PALYNOLOGY
of
HELIOS # 1,
GIPPSLAND BASIN.

for: PHILLIPS AUSTRALIAN OIL COMPANY,

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HELIOS # 1
STRATIGRAPHIC PALYNOLOGY SUMMARY

Depth (m)	Spore/Pollen Zone	Dinoflagellate Zone	Age	Palaeoenvironment
2596 to 2602	Lower *N. asperus*	? [1.]	Mid Eocene	Marginal marine
2608		*A. diktyoplokus*		
2630 to 2670	*M. diversus*	?	Early Eocene	Marine to Marginal marine
2688		none		Non marine
2702	*L. balmei*	?	Paleocene	Marginal marine
2727		*E. crassitabulata*		
2746 to 2782	*T. longus*	?	Maastrichtian	
2803 to 2855		none		Non marine
2873		?		Marginal marine
2889 to 2900		*I. druggii*		
2917		?		
2933 to 2966.3		none		Non marine
2998	SAMPLE MIX-UP		EOCENE	
3045 to 3195	*T. longus*	none	Maastrichtian	Non marine
3214 to 3465.5	*T. lilliei*	none	Campanian	Non marine

1. Dinoflagellates present but they do not constitute any of the named zones.

Helene A Martin, May 1983.

SPORES and POLLEN

The spores and pollen identified are listed in Table 1 and the ranges of diagnostic species are shown on Figure 1 with species in Table 1 grouped into three categories:-

1) Spores, mostly from ferns and their allies.
2) Gymnosperm pollen: pines e.g. hoop pine, Huon pine etc. These would have been mostly forest trees. Their relatives are found today in forests of Tasmania, New Zealand, New Caledonia and New Guinea. Only a few grow on the Australian Mainland and they are restricted to rainforests and the wetter climates.
3) Angiosperm pollen: flowering plants. These may have been trees or shrubs.

The ranges of diagnostic species and zonation follows Stover & Partridge (1973) as ammended by Partridge (1976). Experience has shown that subsequent publications on the same period extend the ranges of some diagnostic species. This is seen especially for the Early and Middle Cretaceous where three groups of authors have published on this time range. For this reason, if the ranges of some species fall slightly outside of those given in the references, then it is not considered serious. Sometimes there is conflicting evidence, and the method adopted then is to add up all the pros and cons before making a decision.

1. *T. lilliei* Zone - Campanian, 3465.5 to 3214m.

In the two deepest samples, species which first appear at the base of the *T. lilliei* Zone, viz. *Latrobosporites amplus, L. ohaiensis, Nothofagidites endurus, Proteacidites scaboratus, Tricolporites lilliei* and *Tricolporopollenites sectilis* are present. *Lygistepollites florinii* (in 3450m) and *Tricolpites longus* (in 3446m) both first appear within the *T. lilliei* Zone and suggest the upper part of this zone (see Table 1 and Figure 1). There is variation in presence and abundance of some species but no trends, i.e. the overall aspects of the assemblages remain much the same up to 3214m.

Wood, cuticles and other plant tissue fragments occur throughout in variable quantities. Abundant plant tissue fragments is thought to indicate a swamp environment. Where wood is conspicuous, the gymnosperm pollen is usually more abundant, particularly *Phyllocladidites mawsonii* (living relative, Huon Pine) and this could indicate a swamp-forest environment. There is an exceptional abundance of pollen at 3390.5m and most of it is *Ph. mawsonii*.

There are some reworked Early Cretaceous and one Permian species in both this zone and the one directly above it (see Table 1). Most of the species are large, thick walled and tough and are able to survive reworking. Usually, only one or two specimens are seen in a sample and they are quite distinctive.

2. *T. longus* Zone - Maastrichtian, 3195 to 2746m.

The overall characteristics of the assemblages here are much the same as those of the *T. lilliei* Zone. Stover & Partridge designated the top of the older zone by the introduction of some five diagnostic species which mark the base of the younger zone, i.e. negative evidence. Of these five species, only two have been seen in Helios, viz. *Tetracolporites verrucosus* and *Proteacidites angulatus*, and they only occur sporadically. Stover & Partridge show *Australopollis obscurus* appearing about half way through the zone, but it is found here below *T. verrucosus*, in the deepest of the *T. longus* Zone (see Table 1 and Figure 1).

Wood, cuticles and other plant tissue occur throughout, just the same as in the *T. lilliei* Zone. *Ph. mawsonii* is common in some of the samples but not as abundant as at 3390.5m in the *T. lilliei* Zone.

A puzzling feature is the extension of the *T. longus* Zone above the dinoflagellate *Isabelidinium druggii* Zone top at 2889m (discussed further below). According to Stover, Helby and Partridge (1979), the *I. druggii* Zone occurs at the top of the *T. longus* Zone and the top of the Maastrichtian (see Figure 2). There is no doubt that the *T. longus* Zone extends above the *I. druggii* Zone for three reasons, viz. (1) the overall aspects of the assemblages above the *I. druggii* Zone are much the same as those below; (2) species whose ranges terminate at the top of the *T. longus* Zone are found above the *I. druggii* Zone and (3) None of the species which first appear in the overlying *Lygistepollenites balmei* Zone are found here.

3. *L. balmei* Zone - Palaeocene, 2727 to 2702m.

Species found here which define the base of this zone are *Lygistepollenites allipticus, Nothofagidites brachyspinulosus.* *Nothofagidites flemingii* and *Proteacidites adenanthoides* first appear within the zone (see Table 1 and Figure 1). None of the species which terminate their range at the end of the *T. longus* Zone are found here. As well, the overall characteristics of the assemblages are quite different to those of the *T. longus* Zone. Here, *L. balmei* is common. Plant tissue is present also.

The *L. balmei* Zone has been divided into Lower and Upper by Partridge (1976) and Stover et al (1979) but they have not defined the basis of this sub-division. Consequently, this zone is not sub-divided here.

4. *M. diversus* Zone - Early Eocene, 2688 to 2630m.

The appearance of *Banksieaeidites arcuatus, Proteacidites grandis* and *P. latrobensis* at 2688m mark the *M. diversus* Zone. Other samples of this zone contain *Proteacidites leightonii, P. reticuloscabratus, P. pachypolus* and *Cupanieidites orthoteichus* which all first appear within this zone (see Figure 1 and Table 1). The overall aspects are quite distinctive with *Dilwynites granulatus* the most common species. *Myrtaceidites parvus* is sometimes common as well.

The pollen content and abundance of plant tissue debris decrease up the section within this zone and dinoflagellate abundance increases (discussed further below).

Stover, Helby and Partridge (1979) have divided the *M. diversus* Zone into Lower, Middle and Upper, but they have not described the diagnosis of this subdivision. Consequently, this zone is not subdivided here.

5. Lower *N. asperus* Zone - Mid Eocene, 2608 to 2596m.

The introduction of *Nothofagidites vansteenisii* and *Tricolporites angurium* denote the Lower *N. asperus* Zone. The overall characteristics of the assemblages are quite different to those of the *M. diversus* Zone. Here, species of *Nothofagidites* are abundant and this is also one of the diagnostic features of the zone (Stover & Partridge, 1973).

Stover and Partridge (1973) define both Lower and Upper *N. asperus* Zones. At a conference in July, 1975, Partridge (unpublished) had interposed a *Triorites magnificus* Subzone between the Upper and Lower. The subsequent publication (Partridge, 1976) has the Middle *N. asperus* Zone between the Upper and Lower, without any description or diagnosis of the middle zone. However, it is thought that the middle zone may be diagnosed on the presence of *T. magnificus*, and if this is so, then these assemblages, lacking *T. magnificus,* fit the modified Lower *N. asperus* Zone shown on Figures 1 and 2.

DINOFLAGELLATES.

Dinoflagellate distribution in Helios is shown on Table 1 with ranges tabulated on Figure 2.

Dinoflagellate zones have been named in Partridge (1976) and Stover et al (1979) but they have not been described, so the diagnostic features of the zones are not known. For the present purpose, it is assumed that the species after which the zone is named is common therein. It should be noted that the ranges of these species usually extend beyond the zone. As with the spores and pollen, experience may show that the ranges require modification.

1. *I. druggii* Zone - Maastrichtian, 2889 to 2900m.

Here *I. druggii* is the most common dinoflagellate. The samples immediately above and below this zone, viz. 2873 and 2917 contain some dinoflagellates but *I. druggii* is not present. One specimen of *I. druggii* was seen at 2835m, but as it was the only dinoflagellate seen, it is regarded as a trace and not sufficient evidence of the zone. *Apectodinium homomorphum* occurs at 2917m, below the *I. druggii* Zone and this is outside of its range given by Stover et al (1979). See Figure 2.

2. 2746 to 2782m.

Here, there are some dinoflagellates which do not fit any named zone. These samples occur at the top of the *T. longus* Zone. As discussed previously, Stover et al (1979) place the *I. druggii* Zone at the top of the *T. longus* Zone but here it occurs well within this zone.

3. *E. crassitabulata* Zone, Paleocene, 2727m.

Here, *E. crassitabulata* is the most common. The other species identified are consistent with the Paleocene age.

4. 2702m - Paleocene

This sample, immediately above the *E. crassitabulata* Zone and still within the *L. balmei* Zone contains *Achomosphaera septata* as the most common dinoflagellate. *E. crassitabulata* was not found here and this assemblage does not fit any of the named zones.

5. 2630 to 2670m - Early Eocene.

These samples all fall within the *M. diversus* Zone. The pollen content decreases up the section as dinoflagellate abundance and diversity increases. Both *Apectodinium homomorphum* and *Spiniferites ramosus* are abundant in 2659m, but this early Eocene assemblage in the *M. diversus* Zone cannot be put in the *A. homomorphum* Zone of Stover et al (1979) which is placed in the Paleocene Upper *L. balmei* Zone. At 2652m, *Spiniferites ramosus* is the most abundant. Two species of *Hystrichosphaeridium* are abundant in the assemblages at 2643m and 2630m. *Glaphrocysta retiintexta* is also common in the latter. None of the assemblages found here can be placed in a named dinoflagellate zone.

6. *A. diktyoplokus* Zone - Mid Eocene, 2608m.

The assemblage here has a low content of dinoflagellates and *Areosphaeridium diktyoplokus* is most abundant. A few dinoflagellates are found above this level at 2602m and 2596m, and although *A. diktyoplokus* does not occur in these assemblages, they conform to a mid Eocene age.

PALAEOECOLOGY.

Late Cretaceous deposition was completely non marine up to 2933m. The low content of dinoflagellates and good pollen assemblages at 2917m to 2873m indicate only a slight marine influence. Marginal marine conditions reappeared at 2702m to 2782m. The lowermost assemblage of the Early Eocene *M. diversus* Zone, 2688m was non marine. The assemblage above it, at 2670m has a few dinoflagellates which increase in frequency up-section. This, coupled with the frequency decline of pollen and plant tissue indicate increasing marine conditions throughout the *M. diversus* Zone. In the Mid Eocene Lower *N. asperus* Zone, there were good pollen assemblages with only a few dinoflagellates, indicating a return to marginal marine conditions.

RECONCILIATION with FORAMINIFERAL SEQUENCE

Comments by David Taylor.

CRETACEOUS - TERTIARY BOUNDARY.

Although no Cretaceous or Paleocene foraminifera were found in Helios, comment is made regarding the placement of this boundary on palynological criteria and correlation with planktonic foraminiferal biostratigraphy. Dr. Martin demonstrates that the impression given by Partridge (1976) and Stover et al (1979) is misleading in that the top of the *T. longus* spore/ pollen Zone and the *I. druggii* dinoflagellate Zone were not coeval. In Helios # 1, the *T. longus* Zone extends some 140m above the top of the *I. druggii* Zone. Stover et al (1979) tabulate the coeval zonal tops as corresponding with "Top Cretaceous", yet in earlier publications (e.g. Stover & Partridge, 1973) the *T. longus* zone was placed entirely within the Paleocene.

Another assumption has been that the *I. druggii* Zone was the expression of the marine transgression in late Maastrichtian and its top corresponds with the regressive event in the basal Paleocene. However, in New Zealand *I. druggii* has been reported both below and above unconformable contact between late Maastrichtian and early/mid Paleocene in a single, well documented outcrop section (refer Strong, 1977 re. planktonic foraminifera and Wilson, 1978 re, dinoflagellates). Moreover, *I. druggii* occurs in the type Danian of Denmark (Wilson, l.c.).

In Helios, the *T. longus* interval (from 2873 to 2764m) above the *I. druggii* Zone may well be of early Paleocene age. This infers that non-marine sedimentation persisted in some deltaic situations during an early Paleocene hiatus effecting more marine situations; such as the carbonate shelf environments in New Zealand. Much more data is therefore required regarding the whole question of the stratigraphic relationships of the *T. longus* and *I. druggii* Zonal tops, and the Cretaceous/Tertiary boundary. For the time being, in search of both convenience and consistency, the *T. longus/L. balmei* boundary should be accepted as approximating the Cretaceous/Tertiary boundary. But the possibility of diachronuity of this "Top Cretaceous"; over some 5 million years, should not be overlooked in regional geological assessment in the Gippsland Basin.

EOCENE.

One slight discrepancy is that palynological determinations suggest that 2630m was at the top of early Eocene, whilst planktonic foraminiferal evidence indicates a mid Eocene age. A similar discrepancy is discussed in the Selene # 1 palynology report.

Probably a more significant discrepancy is that relative frequency of plant debris suggests a decline in marine influence from early to mid Eocene, whilst distribution of planktonic foraminifera demonstrates the reverse trend with marine influence increasing up-section. Increase in plant debris may have been due to rejuvenation of supply of terrigenous material, caused by tectonic uplift and/or increased precipitation in the hinterland, rather than because of a marine regression.

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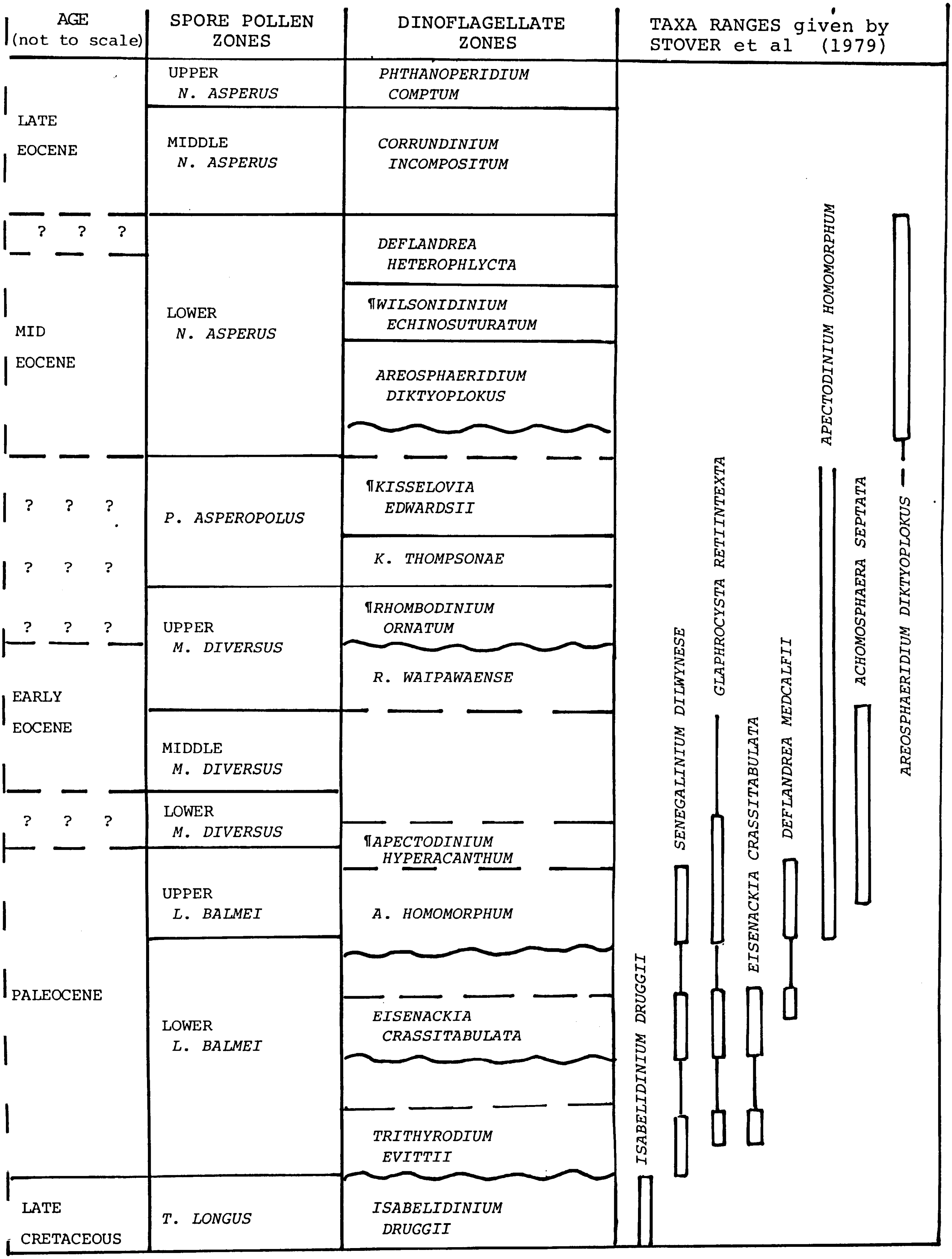

¶ FORMER GENERIC DESIGNATION - *WETZELIELLA*

* former *Deflandrea*

Helene A. Martin, May 1983.

FIGURE 2: HELIOS # 1 - DINOFLAGELLATE RANGES.