THE STRATIGRAPHIC PALYNOLOGY
of
HERMES # 1,
GIPPSLAND BASIN.

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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). Some modification has been made in the light of experience and they are explained in the text.

Experience has shown that subsequent publications on the smae 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. Even with this approach, some assemblages remain problematical and it requires independant evidence to resolve these difficulties.

1. *T. lilliei* Zone, Campanian, 3587-4558m.

The lower-most assemblage is extremely poorly preserved, limiting identifications, but it does contain *Triporopollenites sectilis* and a doubtful specimen of *Lygistepollenites balmei*. Both of these species first appear at the base of the *T. lilliei* Zone. *Nothofagidites endurus* and *Proteacidites palisadus* also first appear at the base of the *T. lilliei* zones and they are found in the assemblages above.

Wood, cuticles and other plant tissue are found in most samples in variable quantities. The gymnosperm pollen frequency is lower than usually encountered, with *Nothofagidites* spp. being more common.

2. *T. longus* Zone, Maastrichtian into Paleocene, 2700-3568m.

The overall characteristics of the assemblages here are much the same as those of the *T. lilliei* Zone. The top of the older zone is defined by the introduction of species of the younger zone, i.e. negative evidence. Here, *Australopollis obscurus, Dilwynites granulatus* and *Tetracolporites verrucosus,* which first appear at the base of the *T. longus* Zone, are found at 3382m to 3568m. As with the *T. lilliei* Zone, plant tissue is common throughout and gymnosperm pollen is lower than usual with *Nothofagidites* more abundant than previously encountered.

As in Helios # 1, dating the top of the *T. longus* Zone is problematical. The following modifications are adopted here, for the following reasons.

Originally, Stover & Partridge (1973) placed the whole of the *T. longus* Zone in the Paleocene. Partridge (1976) relocated it into the Maastrichtian, with the top of zone coeval with the top of the dinoflagellate *Isabelidinium* (= *Deflandrea*) *druggii* Zone. According to this latter reference, both zones terminated at the Creteacous - Paleocene boundary. Subsequently, *I. druggii* has been reported from both below and above unconformable contact between late Maastrichtian and early/mid Paleocene in a single, thoroughly documented outcrop in New Zealand (Strong, 1977 and Wilson, 1978). Moreover, *I. druggii* occurs in the type Danian of Denmark (Wilson, 1978). Hence the modification adopted here is that the *I. druggii* Zone occurs both above and below the Cretaceous - Paleocene boundary. Helios # 1 showed that the *I. druggii* Zone occurs within the *T. longus* Zone. Consequently, the modification adopted here is that the *T. longus* Zone terminated within the Paleocene.

3. *L. balmei* Zone, Paleocene, 2567-2583m.

The basal assemblage lacks any of the species whose ranges end at the top of the *T. longus* Zone. It also lacks species which first appear in the *L. balmei* Zone, however the overall characteristics are more like the *L. balmei* assemblages above than in the zone below. Species which first appear in the *L. balmei* Zone are found in other assemblages above the base, include *Lygistepollenites ellipticus, Rugulatisporites mallatus* and *Nothofagidites flemingii* (Stover & Partridge, 1973). *Proteacidites reticuloscabratus* first appears in the *M. diversus* Zone, but is present at 2575m. This species has been found in assemblages older than the *M. diversus* Zone before, so it's published restricted range is now considered unreliable.

4. Transitional *M. diversus-L. balmei,* Age Problematical, 2525-2562m.

These spore-pollen assemblages are problematical in that *L. balmei* Zone indicators (species which terminate at the top of the *L. balmei* Zone) and *M. diversus* Zone indicators (those which first appear at the base of this zone) co-exist throughout this interval. The number of each indicator is scored on Table 1, and overall, each sample has more of the *L. balmei* Zone indicators than those of the *M. diversus* Zone. Moreover, the overall characteristics of the assemblages show very little change from those of the underlying *L. balmei* Zone.

A further problem is encountered with the presence of the dinoflagellate *Schematophora speciosa* at 2550m. *S. speciosa* has a recorded range from the top part of the Lower *N. asperus* into the bottom of the Middle *N. asperus* Zones (Stover et al, 1979). Therefore the spore pollen evidence is inclusive regarding age (refer page 7 this report).

Two questions should be considered in conjunction with these problematical assemblages:

1) How much variation is there between assemblages within the same spore-pollen zone?

   The spore-pollen zone is an artifact of the vegetation, of course. One does not have to traverse far to appreciate that today, vegetation is by no means uniform. For instance a traverse of several kilometres in the Royal National Park, south of Sydney, will reveal *floral lateral facies* changes from moist eucalypt forest to stunted, coastal heath, to rain forest. Therefore, spore-pollen deposited today will reflect these ecological changes and the characteristics of the *present day* Zone will not be uniform.

Variation should be expected of spore-pollen zones in past ages. The following example of variation in Late Eocene-Early Oligocene assemblages in the Murray Basin illustrates this point.

Only one assemblage of the Upper *N. asperus* Zone (Late Eocene into Early Oligocene) has been found in the non-marine part of the Murray Basin. It is missing from numerous other bores which simply show a gradation from the underlying Middle *N. asperus* Zone into the overlying *P.tuberculatus* Zone. It is thought that the vegetation which laid down the Upper *N. asperus* Zone required a special environment, possibly coastal dunes and the swampy interdunes. This environment would not have existed in the non-marine part of the Murray Basin. Indeed, the only occurrence of the Upper *N. asperus* Zone here occurs in the bore closest to the limits of the marine transgression. Thus it is possible for whole zones not to be recognised, even deposition was almost continuous.

2) Is it possible for spore-pollen zones to be time-transgressive?

Obviously, in the example given above, the top of the Middle *N. asperus* Zone and/or the bottom of the *P. tuberculatus* Zone must be diachronous for them to intergrade. A further example may be given.

Assemblages which on general characteristics resemble those of the Pliocene in the Gippsland Basin are found in numerous places in inland New South Wales. In the Warrumbungle Mountains, they are found in association with basalt flows of Mid Miocene age. The Miocene-Pliocene spore-pollen zones reflect an increasingly drier climate. Inland areas are drier than those of coastal regions, hence it is not surprising that a specific spore-pollen zone appears earlier in inland areas than on the coast (Holmes et al, 1983). Thus the spore-pollen assemblages were time transgressive, reflecting encroachment of dry conditions from the inland to the coast.

Thus there may be considerable variation in the spore-pollen zones; whole zones may be missing in almost continuous deposition and zones may be time transgressive. In Hermes # 1, the assemblages between 2525m and 2562m fit the palynological definition of a transitional *M. diversus - L. balmei* Zone, but dating them on this evidence alone is suspect. A satisfactory interpretation requires independant evidence.

5. 2505 - 2145m.

The spore-pollen assemblage is extremely restricted and insufficient for zone determination. There is practically no plant debris, indicating a marine environment.

DINOFLAGELLATES

The dinoflagellates identified are listed on Table 1 and the ranges of diagnostic species shown 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. Some modifications have been adopted in this report and they are explained below.

1. 3851.5m?

Broken pieces of a possible *Deflandrea* type dinoflagellate and one other poorly preserved species is present in trace quantities. It is impossible to reliably identify these specimens in such poor condition. The spore-pollen assemblage is equally poorly preserved. However, there is very little plant debris in this sample which suggests the possibility of marine conditions. The poor state of this evidence should be borne in mind and it is impossible to interpret it further.

2. 3027m.

One unidentifiable dinoflagellate specimen occurs here. The spore-pollen assemblage is fairly normal and there is the usual quantity of plant debris. This one specimen can be disregarded.

3. "*Apectodinium* spp. Assemblage", 2924-2943m.

A most variable dinoflagellate is found here, and in 2934, it is very abundant. One form resembles *Apectodinium homomorphum* but others clearly fall well outside of the morphology of this species.

Apectodinium homomorphum occurs in Helios at 2917m, beneath the *I. druggii* Zone. The low content of dinoflagellates did not show the morphological variation seen in Hermes. It is thought that the same event is represented in both wells, although the *I. druggii* Zone, if present, is very poorly expressed in Hermes (discussed further below). *A. homomorphum* was also recorded above the *I. druggii* Zone, within the *T. longus* Zone of Helios. It is also present here in the same relative position in 2786m. There is no documentation of this event in the literature and it is informally named the "*Apectodinium* spp. Assemblage" here.

4. ?2854-2881m.

A few specimens of broken *Deflandrea*-type dinoflagellates are found here. They might be *I. druggii,* but the diagnostic features for positive identification are lacking, so they might be other species of the *Deflandrea* group. However, they are found in a more or less equivalent stratigraphic position to the *I. druggii* Zone in Helios. The tenuous nature of the evidence here should be borne in mind.

5. 2583-2700m.

A few dinoflagellates occur here. *Isabelidinium pellucidum* is found in the *T. longus* Zone (2575m). Stover (1973) records this species from the *L. balmei* Zone and Evans (1966) gives the range of this species as late Cretaceous into Tertiary.

6. *E. crassitabulata* Zone, 2573-2575m.

This species is present here in low to trace numbers. It is not very well preserved.

7. 2573-2505m.

Dinoflagellates are present in low to trace numbers in all of the assemblages here, from the top of the *L. balmei* through the transitional *M. diversus* - *L. balmei* Zone and into the marine. Most are long ranging and not diagnostic for dating with the following exceptions.

Senegalinium dilwynense is found at 2552m, within the transitional

M. diversus - L. balmei Zone, whereas according to Stover et al (1979), its range does not extend above the top of the *L. balmei* Zone. See Figure 2.

Glaphrocysta retiintexta is found within the range reported by Stover et al (1979). See Figure 2.

The presence of *Schematsphora speciosa* at 2550m and its range, mid into late Eocene (Stover et al, 1979) is problematical here. See Figure 2. However, Taylor reports Mid Eocene planktonic foraminifera at 2541 and 2525m in Hermes # 1.

PALEOECOLOGY.

Late Cretaceous deposition was non-marine up to 2983m, with the possible exception of a marine environment at 3851.5m. (figure 3) However, the evidence for this is not conclusive. Marginal marine conditions are found at 2854-2943m, the latest Cretaceous into earliest Paleocene. Non marine conditions return, 2700-2787m, with marginal marine deposition again at 2573-2583m in the Paleocene, where Taylor reported mid Paleocene planktonic foraminifera. This is followed by non marine, 2567-2568.5m, then marginal marine, 2525-2562m, (confirmed by the foraminifera) possibly in the Eocene, although the palynological evidence of the age is problematical. Finally, marine deposition commences at 2514.5m and continues to 2505m.

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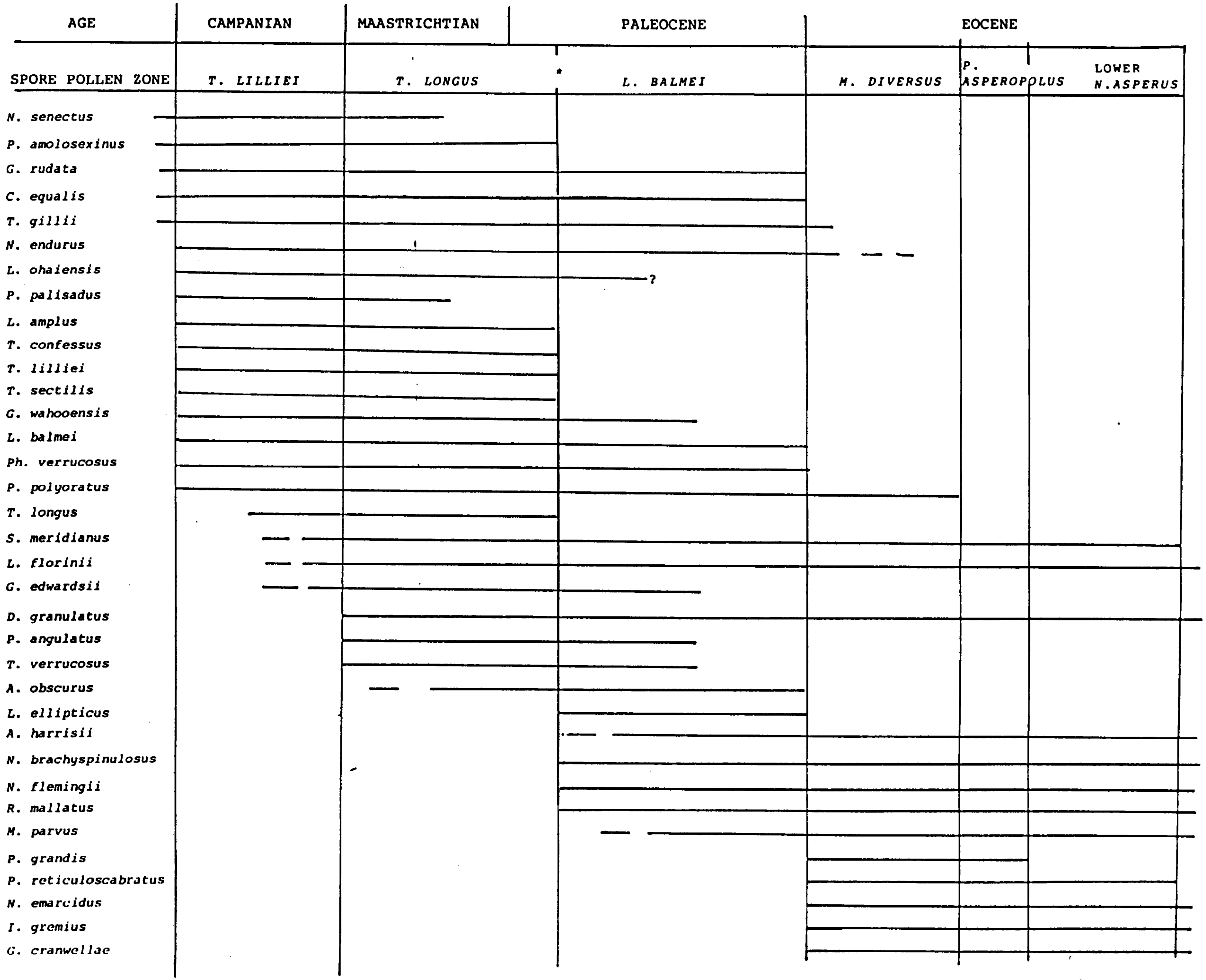

FIGURE 1: HERMES # 1 SPORE POLLEN RANGE CHART BASED ON STOVER & PARTRIDGE, 1973 and PARTRIDGE, 1976, with modifications.*
For further explanation, see text.

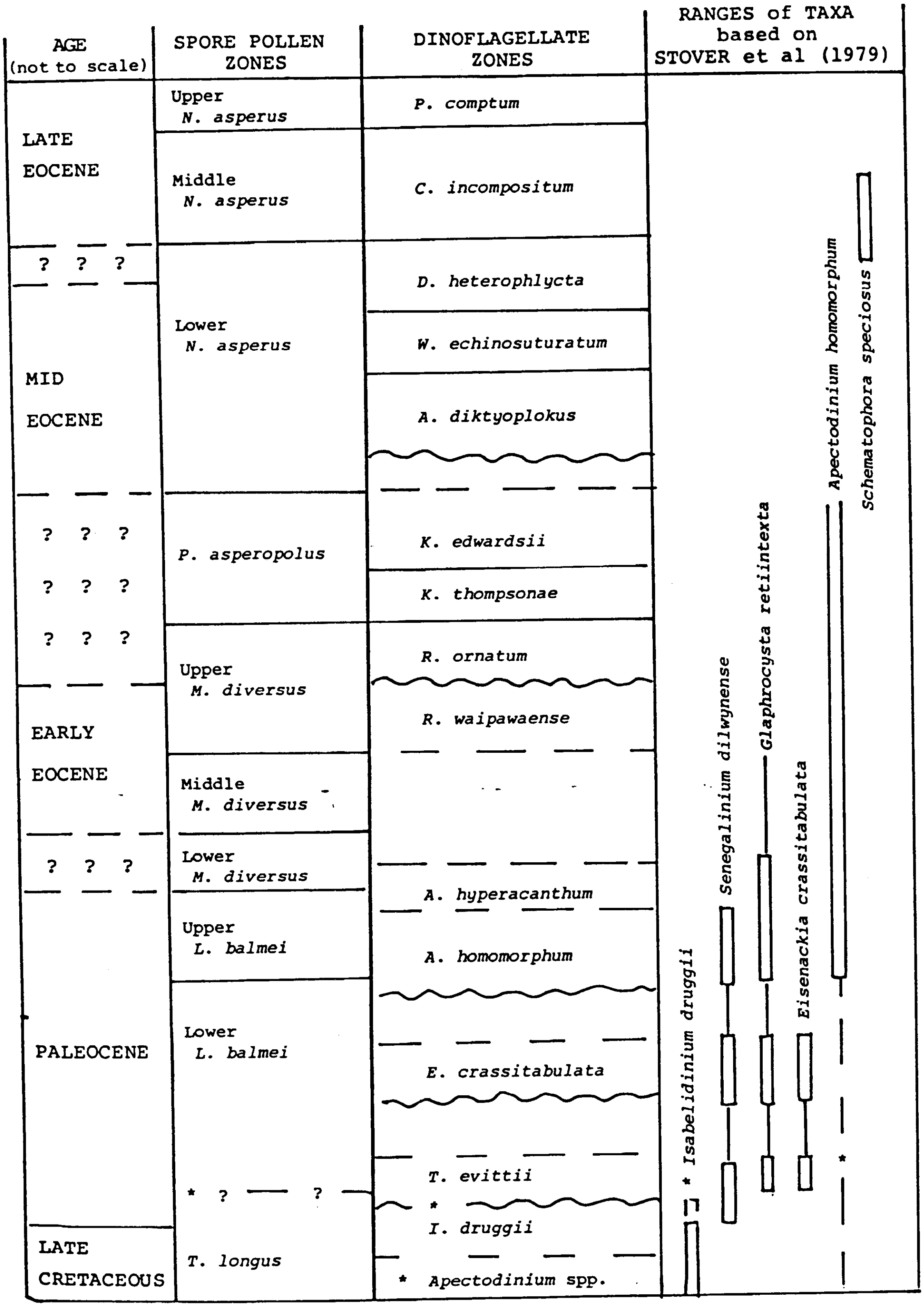

FIGURE 2: HERMES # 1 - DINOFLAGELLATE RANGES.

*Modifications from Stover et al (1979). See text for explanation.

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HERMES # 1

FIGURE 3 : STRATIGRAPHIC PALYNOLOGY SUMMARY

DEPTH (m)	SPORE/POLLEN ZONE	DINOFLAGELLATE ZONE	AGE	PALEOENVIRONMENT
2505 - 2514.5	?	?	?	marine
2525 - 2562	? *M. diversus* - *L. balmei* transitional ?	?	?	marginal marine to non marine
2567 - 2568.5				non marine
2573 - 2575	*L. balmei*	*E. crassitabulata*	PALEOCENE	marginal marine to non marine
2583		?		
2700 - 2787			PALEOCENE	non marine
2854 - 2881	*T. longus*	?		marginal marine to non marine
2924 - 2943		"*Apectodinium* spp"	MAASTRICHTIAN	
2983 - 3568				non marine
3587 - 3800				
3851.5		?		? marine ?
3895 - 4558	*T. lilliei*		CAMPANIAN	non marine