PALYNOLOGICAL DETERMINATIONS FOR TURRUM-2, GIPPSLAND BASIN, AUSTRALIA

by

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SUMMARY

Based on the spore-pollen and dinoflagellates recovered from 36 sidewall cores and one conventional core, the following palynological zones are recognized in Turrum-2.

5030'-5073'	*P. tuberculatus*	Post-Latrobe
5078'-5084'	Lower *N. asperus* "A"	Middle Eocene
5140'-5344'	Lower *M. diversus*	Early Eocene
5637'-6156'	Upper *L. balmei*	Paleocene
6282'-8089'	Lower *L. balmei*	Paleocene
8302'-8745'	*T. longus*	Paleocene

Spore-pollen occur throughout the sampled interval and dinoflagellates are present in the post-Latrobe, in the Middle Eocene, and in the Paleocene down to a depth of 7520 feet. Significant palynological occurrences in Turrum-2 are summarized below.

Turrum-2 well
Significant Palynological Data

Depth		Event
5040'	-	highest occurrence of *Cyathaeidites annulatus.*
5073'	-	lowest occurrence of *Cyathaeidites annulatus.*
5078'	-	highest occurrences of *Intratriporopollenites notabilis* and *Areosphaeridium dictyoplokus.*
5084'	-	presence of *Proteacidites asperopolus* and *P. pachypolus;* lowest occurrence of *Areosphaeridium dictyoplokus.*
5140'	-	highest occurrence of *Proteacidites grandis;* lowest occurrence of *Intratriporopollenites notabilis.*
5344'	-	lowest occurrence of *Proteacidites grandis* and *P. lapis.*

5637' - highest occurrences of *Gambierina nudata, Lygistepollenites balmei, L. ellipticus, Nothofagidites endurus* and *Wetzeliella homomorpha* (short spines).

5687' - highest occurrence of *Australopollis obscurus* and *Polycolpites langstonii.*

6156' - lowest sample within Upper *L. balmei* zone.

7052' - highest occurrence of *Proteacidites angulatus.*

7211' - lowest occurrence of *Wetzeliella homomorph* (short spines) and highest occurrence of *Adnatosphaeridium retiintextum.*

7520' - presence of *Deflandrea bakerii* and *Eisenackia crassitabulata;* lowest occurrence of *Adnatosphaeridium retiintextum.* Deepest dinoflagellate assemblage in Turrum-2.

8302' - highest occurrences of *Nothofagidites senectus, Proteacidites amolosexinus, P. reticuloconcavus,* and *Tricolpites confessus;* lowest occurrences of *Australopollis obscurus, Herkosporites elliottii,* and *Lygistepollenites balmei.*

8745' - highest occurrences of *Tricolpites waiparaensis* and *Tricolporites lillieri.*

ANALYSES

Samples from the *Proteacidites tuberculatus* zone. (SWC 12-9, 5030 to 5078 feet)

Residue from SWC 12 at 5030 feet has abundant dinoflagellates and very rare spore-pollen. Specimens of *Operculodinium centrocarpum* and *Spiniferites ramosus* dominate the assemblage and several undescribed forms of dinospheres exhibiting various types of ornamentation are also common. No age diagnostic palynomorphs were identified, and the assemblage is assigned to the *Proteacidites tuberculatus* zone because of its general character and the absence of species indicative of an older zone. Rare specimens of *Hystrichosphaeropsis borussica* and *Nematosphaeropsis sp.* are present.

The sample from SWC 11 at 5040 feet also contains abundant dinoflagellates and sparse spore-pollen. The palynomorphs are more diverse than the assemblage from 5030 feet although the preservation is about the same in both samples. Forms present at 5040 feet include:

Spore-Pollen

Cyathaeidites annulatus
Cyathidites spp.
Haloragacidites harrisii
Ischyosporites irregularis
Myrtaceidites eucalyptoides

Myrtaceidites parvus
Nothofagidites deminutus
Nothofagidites emarcidus
Nothofagidites falcatus
Proteacidites pachypolus (recycled)
Simplicepollis meridianus

Microplankton

Leptodinium sp.
Lingulodinium machaerophorum
Nematosphaeropsis (type 2)
Operculodinium centrocarpum
Pterodinium sp.

Spiniferites ramosus
Systematophora placacantha
Tuberculodinium rossignolae
numerous dinospheres

Of note is the presence of reworked forms as indicated by the Eocene species *P. pachypolus* and of the dinoflagellate species *T. rossignolae*. *Tuberculodinium rossignolae* has not been recorded previously from Australia and the genus, up to now, has been reported only from Early Miocene or younger sections. The occurrence of *T. rossignolae* in the Oligocene *P. tuberculatus* assemblage is anomalous. Assignment to the *P. tuberculatus* zone is based principally on the presence of *C. annulatus*.

Dinoflagellates dominate the assemblage from SWC 10 at 5060 feet and spore-pollen are rare to sparse. Among the dinoflagellates, the forms marked with an asterisk were not observed in the overlying assemblages. Species from 5060 feet include:

Spore-Pollen

Cyathaeidites annulatus
Dilwynites granulatus
Foveotriletes palaequetrus
Haloragacidites harrisii
Lygistepollenites florinii
Malvacipollis diversus
Nothofagidites emarcidus
Periporopollenites demarcatus
Simplicepollis meridianus

Microplankton

**Achomosphaera alcicornu*
**Adnatosphaeridium sp.*
**Cyclopsiella vieta*
Leptodinium sp.

Nematosphaeropsis (type 2)
Operculodinium centrocarpum
**Polysphaeridium fibrosum*
Pterodinium sp.

Spiniferites ranosus
Systematophora placacantha
numerous dinospheres

Assignment to the *Proteacidites tuberculatus* zone is based on the presence of *C. annulatus, F. palaequetrus* and the introduction of *C. vieta* and *P. fibrosum.*

The deepest sample from the *P. tuberculatus* zone is SWC 9 at 5073. The assemblage is dominated overwhelmingly by dinoflagellates represented mainly by several species of *Spiniferites* and dinospheres. Assignment to the *P. tuberculatus* zone is based on the continued occurrence of *C. annulatus.* Palynomorphs present at 5073 feet include:

Spore-Pollen

Cyatheacidites annulatus
Dacrydiumites australiense
Kuylisporites waterbolkii
Nothofagidites asperus
Nothofagidites deminutus
Nothofagidites emarcidus
Nothofagidites falcatus

Microplankton

Cyclopsiella vieta
Leptodinium sp.
Lingulodinium machaerophorum
Nematosphaeropsis (type 1)
Nematosphaeropsis (type 2)
Operculodinium centrocarpum
Spiniferites spp.
numerous dinospheres

Samples from the Lower *Nothofagidites asperus* zone. (SWC 8 and 7 at 5078 and 5084 feet, respectively)

In contrast to the assemblages from 5030 to 5073 feet which are dominated by microplankton, the assemblage from 5078 feet consists mostly of spore-pollen and dinoflagellates as well as acritarchs. The microplankton, however, are rather sparse and not well preserved. Very few proteaceous pollen are present; specimens of *nothofagidites* and *H. harrisii* are frequent and neither pollen type dominates the assemblage.

The occurrences of *Intratiporopollenites notabilis* and *Schizocolpus marlinensis* among the spore-pollen and of *Areosphaeridium dictyoplokus,*

Corrudinium corrudatum, and *"Horologinella biloba"* among the microplankton are the basis for assigning the assemblage to the "A" subzone of the Lower *N. asperus* zone. Forms identified from 5078 feet include:

Spore-Pollen

Baculatusporites disconformis
Cupaneidites orthoteichus
Dilwynites granulatus
Ephedripites notensis
Haloragacidites harrisii
Ischyosporites gremius
Intratriporopollenites notabilis
Lygistepollenites florinii
Malvacipollis diversus
Malvacipollis subtilis
Nothofagidites deminutus
Nothofagidites emarcidus
Nothofagidites falcatus
Nothofagidites flemingii
Nothofagidites goniatus
Nothofagidites heterus
Phyllocladidites mawsonii
Polycolpites esobalteus
Proteacidites annularis
?Proteacidites grandis (poor specimen)
Proteacidites latrobensis
Proteacidites obscurus
Proteacidites pœrvus
Rugulatisporites mallatus
Schizocolpus marlinensis
Simplicepollis meridianus
Tricolpites paenestriatus

Microplankton

Aerosphaeridium dictyoplokus
Corrudinium corrugatum
Deflandre sp. (probably *D. phosphoritica*)
"Horologinella biloba"
Spiniferites sp.
Wetzeliella homomorpha

The assemblage from 5084 feet has a fair association of moderately diverse, well preserved spore-pollen; microplankton are sparse. Among pollen, microplankton are sparse. Among the spore-pollen, specimens of *Nothofagidites* are common (but not dominant) and those of *H. harrisii* are frequent. *Proteacidites grandis* is the most common proteaceous pollen and examples of *P. asperopolus* and *P. pachypolus* are very rare. *Areosphaeridium dictyoplokus* is the most commonly occurring dinoflagellate; other forms are rare or very rare.

At 5084 feet recycled spore-pollen, most likely from the *L. balmei* zone, are *Basopollis otwayensis*, *Lygistepollenites balmei* and *Tricolpites gillii*.

Other forms identified from SWC 7 include:

Spore-Pollen

Banksieacidites arcuatus
Clavifera triplex
Cyathidites splendens
Dilwynites granulatus
Ephedripes notensis
Haloragacidites harrisii
Lygistepollenites florinii
Malvacipollis diversus
Malvacipollis perimagnus
Nothofagidites asperus
Nothofagidites deminutus
Nothofagidites emarcidus
Nothofagidites flemingii
Nothofagidites goniatus
Periporopollenites demarcatus
Phyllocladidites mawsonii
Polycolpites esobalteus
Proteacidites adenanthoides
Proteacidites annularis
Proteacidites asperopolus
Proteacidites grandis
Proteacidites obscurus
Proteacidites leightonii
Proteacidites pachypolus
Proteacidites parvus
Simplicepollis meridianus
Tetracolpites sp.
Verrucosisporites kopukuensis

Microplankton

Areosphaeridium dictyoplokus
Baltisphaeridium nanum (type 1)
Baltisphaeridium nanum (type 2)
Deflandrea phosphoritica
Histiocysta variata
"Horologinella triloba"
Hystrichokolpoma sp.
Pterodinium sp.
Tectatodinium sp.
Wetzeliella homomorpha

Samples from the Lower *Malvacipollis diversus* zone (SWC 6-2, 5140 to 5344 feet).

The assemblage from 5140 feet is composed exclusively of spore-pollen, with long ranging species being considerably more common than those listed

below. No typical Upper *M. diversus* species were identified among those at 5140 feet which include:

Spore-Pollen

Anacolosidites sp. cf. A. acutullus
Baculatisporites disconformis
Banksieaeidites arcuatus
Basopollis otwayensis
Clavifera triplex
Dilwynites granulatus
Haloragacidites harrisii
Integricorpus antipodus
Intratriporopollenites notabilis
Malvacipollis diversus
?Matonisporites ornamentalis
Nothofagidites emarcidus
Nothofagidites flemingii
Periporopollenites polyoratus
Phyllocladidites mawsonii
Proteacidites annularis
Proteacidites grandis
Proteacidites lapis
Proteacidites parvus
Proteacidites pseudomoides
Proteacidites reticuloscabratus
Rugulatisporites mallatus
Stereisporites punctatus
Tricolpites paenestriatus
Tricolporites adelaidensis
Verrucosisporites kopukuensis

No microplankton

SWC 5 at 5190 feet is very poorly fossiliferous and the residue is composed of mostly carbonaceous debris, woody fragments, some cuticular material and spore-pollen. The latter are rare, about 1 or 2 specimens for each of the types listed below. Assignment to the Lower *M. diversus* zone is based more on the stratigraphic position of the sample (in between two rather good Lower *M. diversus* assemblages) rather than its palynological content. Palynomorphs from 5190 feet include:

Spore-Pollen

Clavifera triplex
Dilwynites granulatus
Ephedripites notensis
Haloragacidites harrisii
Malvacipollis diversus
Nothofagidites brachyspinulosus
Nothofagidites flemingii

Periporopollenites polyoratus
Phyllocladidites mawsonii
Proteacidites grandis
Stereisporites regium (anomalous occurrence)

No microplankton

The residue from SWC 4 at 5240 feet contains abundant, moderately diverse and well preserved spore-pollen of which the most commonly occurring species are long ranging forms. Present are numerous small, relatively simple proteaceous pollen and specimens of *Nothofagidites* and *H. harrisii* are rare.

Species identified from 5240 feet include:

Spore-Pollen

Baculatisporites disconformis
Basopollis otwayensis
Clavifera triplex
Cyathidites splendens
Dilwynites granulatus
Ericipites scabratus
Haloragacidites harrisii
Ilexpollenites anguloclavatus
Latrobosporites crassus
Lygistepollenites florinii
Malvacipollis diversus
Nothofagidites emarcidus
Periporopollenites polyoratus
Phyllocladidites mawsonii
Proteacidites annularis
Proteacidites grandis
Proteacidites lapis
Rugulatisporites mallatus
Simplicepollis meridianus
Stereisporites punctatus
Tricolpites gillii
Tricolpites phillipsii

Microplankton - 2 broken specimens

Sample from SWC 2 at 5344 feet is very poorly fossiliferous. It is assigned to Lower *M. diversus* zone because of the absence of *L. balmei* forms rather than the presence of definitive Lower *M. diversus* species. Forms present are:

Spore-Pollen

Baculatisporites comaumensis
Basopollis sp. cf. B. otwayensis
Nothofagidites emarcidus
Periporopollenites polyoratus
Proteacidites annularis
Proteacidites grandis
Proteacidites lapis
Proteacidites parvus

Samples from the Upper *Lygistepollenites balmei* zone (SWC 29-25, 5637 to 6156 feet).

The samples from the Upper *L. balmei* zone are sparsely to moderately fossiliferous. These assemblages are composed mainly of spore-pollen and either lack dinoflagellates or they are rare and generally not well preserved. Assignment to the Upper *L. balmei* zone is based on the presence of the nominate species and *Gambierina rudata, Australopollis obscurus, Polycolpites langstonii, Lygistepollenites ellipticus.* These species, in conjunction with the continued occurrence of *Basopollis mutabilis, B. otwayensis, Haloragacidites harrisii, Malvacipollis diversus* and *Nothofagidites flemingii,* indicate the appropriateness of assigning the samples between 5637 and 6156 feet to the Upper *L. balmei* zone.

Specimens of *Wetzeliella homomorpha* (short spined variety) and an unnamed peridiniacean form with an autophragm occur at 5637, 5897 and 6156 feet. The occurrences of associated spore-pollen from the Upper *L. balmei* zone are plotted on the accompanying distribution charts.

Samples from the Lower *Lygistepollenites balmei* zone (SWC 24-9, 6282 to 8089 feet and core 3 at 7653 feet).

In Turrum-2, the Lower *L. balmei* zone has a dinoflagellate bearing interval that extends from 6282 to 7520 feet. The upper part of this interval (6282 to 7052 feet) is characterized by the consistent but rare occurrence of *Wetzeliella homomorpha* and *Deflandrea* sp. (the same forms that are present in the Upper *L. balmei* zone). From 7211 to 7520 feet the relative abundance of dinoflagellates increases as does the number of species. For example, the sample at 7211 feet contains numerous specimens of *Adnatosphaeridium retiintextum;* at 7310 feet *A. retiintextum* is the dominant form and associated with it are specimens of *Cleistosphaeridium sp., Deflandrea bakerii* (frequent), *Fibrocysta sp., Spiniferites sp.* and *Epicephalopyxis indentata.* The same association, with the addition of *Eisenackia crassitabulata* and common specimens of *Spinidinium sp.,* is present at 7520 feet.

Spore-pollen assemblages from 6282 to 7520 feet are generally poor, both in the number of specimens and in the number of species. The majority of forms are long ranging and key species, for the most part, are sparse and

occur sporadically. The exception is the consistent occurrence of *L. balmei*. Also important is the presence of *Proteacidites angulatus* at 7052 feet.

Samples below 7520 feet and assigned to the Lower *L. balmei* zone lack dinoflagellates. Spore-pollen assemblages vary from poor to fair and preservation becomes increasingly less favorable with greater depth. Some samples contain relatively numerous specimens of small proteaceous pollen (7762 and 7874 feet); *Australopollis obscurus* is frequent at 7874 feet; specimens of *Nothofagidites spp.* are essentially absent (recorded only at 7666 feet); and *Proteacidites angulatus* occurs in nearly every sample.

Samples from the *Tricolpites longus* zone (SWC 7 and 1 at 8302 and 8745 feet).

Assignment of these samples to the *T. longus* zone is based on the presence of *Tricolpites confessus, Proteacidites amolosexinus, P. reticuloconcavus* and *Nothofagidites senectus* at 8302 feet plus the introduction of *Tricolpites waiparaensis* and *Tricolporites lilliei* at 8745 feet. The intervening sidewall cores yielded very poor spore-pollen assemblages.