Appendix 7

PE990150

PALYNOLOGY OF HARTOGEN TIRRENGOWA-1,

OTWAY BASIN, AUSTRALIA

BY

ROGER MORGAN

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I SUMMARY

1106 ft. (swc) : middle N. asperus Zone : late Eocene : slightly brackish : immature

lower N. asperus (late Eocene) to C. striatus (Albian) Zones not seen

1965 ft. (swc)-3600 ft. (swc) : upper C. hughesi Zone : late Aptian : non-marine : marginally mature except early mature at 3600 ft.

3885 ft. (swc) : lower C. hughesi Zone : early Aptian : non-marine : early mature

4014 ft. (swc) : F. wonthaggiensis Zone : late Neocomian : non-marine with lacustrine influence : early mature

II INTRODUCTION

Seven sidewall cores were examined from Hartogen Tirrengowa-1 for biostratigraphy and spore colour. All yielded excellent microfloras. These are assigned to four palynological zones based on the supporting data presented here as Appendix I. The Mesozoic zonation used is basically that of Helby, Morgan and Partridge (1987), which draws on all previous work and is designed for pan-Australian use. Minor modification for Otway Basin use has been necessary The zones of Dettmann and Douglas (1976) have proved very difficult to use due to scarcity of some zone fossils. Zone equivalents are given in the CSR zonation of Price et al. (1985) which was essentially designed for Eromanga Basin use. The Tertiary zonation is that of Stover and Partridge (1973) and Stover and Evans (1973) as modified by Partridge (1976).

Maturity data was generated on the Thermal Alteration Index (TAI) Scale of Staplin and plotted on Figure 2 as a Maturity Profile. The oil and gas windows on Figure 2 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (2.7) to dark brown (3.6) and would correspond to Vitrinite Reflectances of 0.6% to 1.3%. Geochemists, however, have not reached universal agreement on these values and argue variations based on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and would probably not move the oil window by more than 500 feet. Instrumental geochemistry offers quantitative and repeatable raw data.

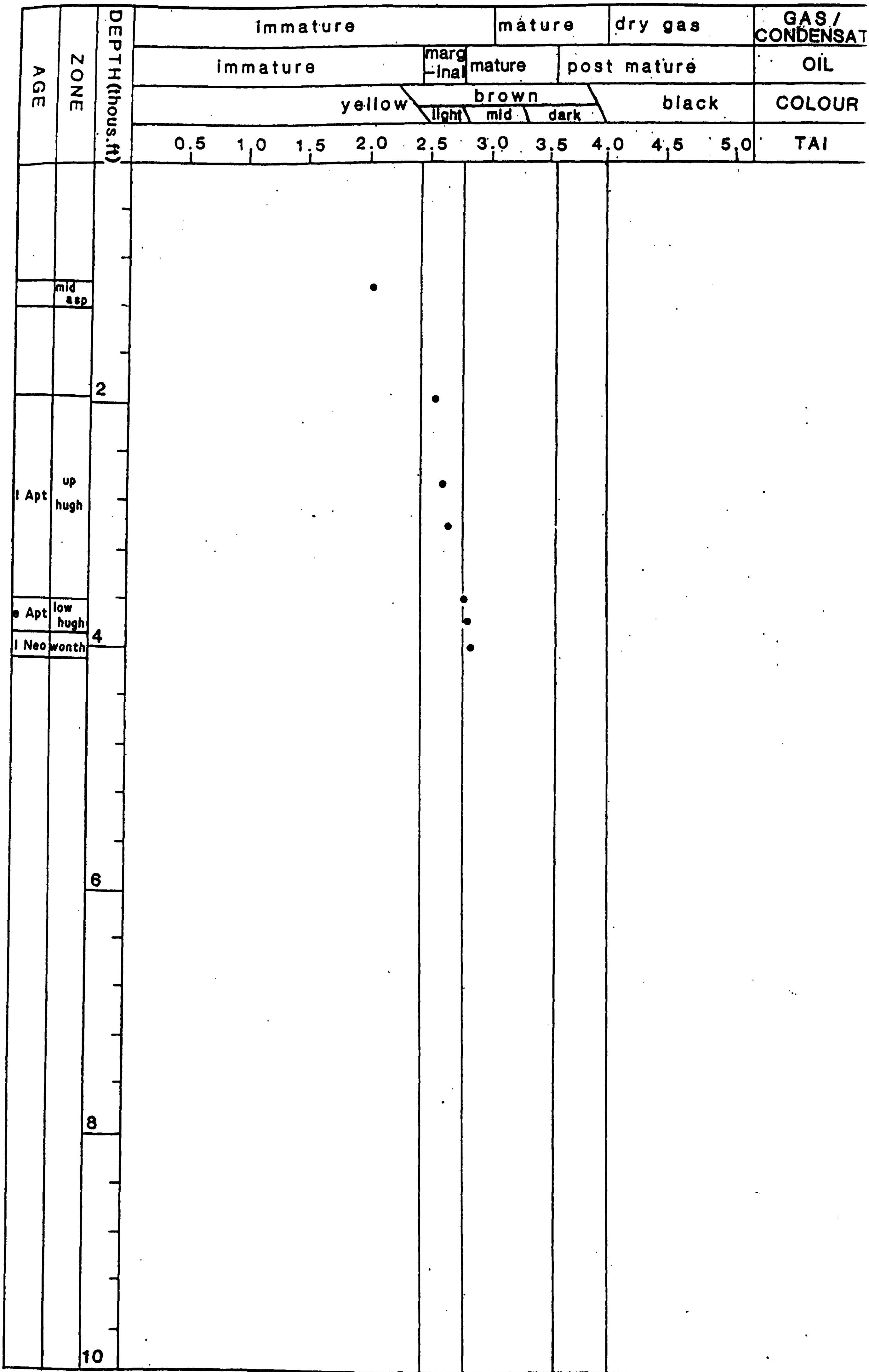

FIGURE 2 MATURITY PROFILE, TIRRENGOWA-1

III PALYNOSTRATIGRAPHY

A. 1106 ft. (swc) : middle N. asperus Zone

Assignment to the middle Nothofagidites asperus Zone is indicated at the base by oldest Triorites magnificus, supported by oldest Aglaoreidia qualamus and Riccia "boxatus". At the top, assignment is indicated by youngest Triorites magnificus, supported by youngest Beaupreadites elegansiformis, Periporopollenites demarcatus, Proteacidites crassus, P. leightonii, P. incurvatus, Santalumidites cainozoicus, Tricolpites thomasii and consistent Proteacidites pachypolus.

Slightly brackish environments are suggest by the presence of a single dinoflagellate amongst diverse and abundant spore-pollen.

This zone is normally associated with the topmost Dilwyn Formation or lowermost Nirranda Group. In such restricted marine environments, the Dilwyn Formation is indicated.

Yellow spore colours indicate immaturity for hydrocarbon generation.

B. lower N. asperus to C. striatus Zones not seen

None of the late Eocene to early Albian zones were seen, and are probably largely absent by hiatus at 1252 ft. (log evidence).

C. 1965 ft. (swc) - 3600 ft. (swc) : upper C. hughesi Zone

Assignment to the upper Cyclosporites hughesi Zone is indicated at the top by the absence of the younger indicator Crybelosporites striatus and at the base by the absence of the older indicator Cooksonites variabilis. The presence of consistent Pilosisporites spp. and Cyclosporites hughesi confirm the assignment. Foraminisporis asymmetricus occurs down to the base of the interval but not beyond it. A single specimen of Crybelosporites stylosus occurs at 1965 ft. only.

Non-marine environments are indicated by the abundant and diverse spores and pollen and lack of brackish or marine indicators. Freshwater algal indicators include Botryococcus and Schizosporis spp. and suggest lacustrine influence.

This zone is usually associated with the lower part of the Eumeralla Formation, and often with coaly facies developments.

Spore colours of light brown at the top, grading to light-mid brown at 3600 ft. indicate marginal maturity for oil in the interval 1965-2940 ft., and early maturity for oil at 3600 ft. For gas/condensate, the interval is immature to 2940 ft., and marginally mature at 3600 ft.

D. 3885 ft. (swc) : lower C. hughesi Zone

Assignment to the lower Cyclosporites hughesi Zone is indicated at the top by youngest Cooksonites variabilis and at the base by oldest Pilosisporites notensis and P. parvispinosus. This interval is approximately equivalent to the middle C. hughesi Zone of Dettmann and Douglas (1976).

Non-marine, possibly lacustrine environments are indicated by the abundant and diverse spores and pollen, and presence of algal acritarchs (Schizosporis spp.).

This zone is usually associated with the basal Eumeralla Formation or uppermost Pretty Hill Formation.

Spore colours of mid to light brown indicate early maturity for oil, and marginal maturity for gas/condensate.

E. 4014 ft. (swc) : F. wonthaggiensis Zone

Assignment to the Foraminisporis wonthaggiensis Zone is indicated at the top by the absence of the younger indicator P. notensis, and confirmed by youngest Murospora florida in this sample. At the base, assignment is indicated by oldest Dictyotosporites speciosus, and confirmed by oldest Foraminisporis wonthaggiensis. Cicatricosisporites spp. are present but very rare. This interval is approximately equivalent to the lower C. hughesi Zone of Dettmann and Douglas (1976).

Non-marine lacustrine environments are indicated by abundant cuticle, common and diverse spores and pollen, and rare presence of the algal acritarch Microfasta evansii.

These features are normally seen in the topmost Pretty Hill Formation.

Mid brown spore colours indicate early maturity for oil, and marginal maturity for gas/condensate.

IV CONCLUSIONS

A. The log picks show good agreement with the regional geological framework.

The Pretty Hill Formation is here associated with the *F. wonthaggiensis* and lower *C. hughesi* Zones (log top at 3610 ft.). This is seen elsewhere although the lithological boundary can also coincide with the *F. wonthaggiensis*/*C. hughesi* boundary. The actual erosional event producing the angular unconformity probably occurs within the lower *C. hughesi* Zone, but, if sufficient erosion occurs, may remove all of the underlying lower *C. hughesi* Zone, so that the unconformity lies at the top, or is eroded down into, the *F. wonthaggiensis* Zone. The top good sand (4027 ft.) is well below the top Pretty Hill Formation, again consistent with the regional pattern of the best sand being located in the middle part of the Formation.

The Eumeralla Formation is Aptian at the base, as is usual. The upper 500 ft. is undated however, as no samples were studied from that interval. The age extent of erosional truncation of the Eumeralla is therefore unknown.

The logs suggest the absence of the late Cretaceous on an unconformity at 1252 ft., but no palynological control exists.

The logs suggest a Pebble Point Formation at 1209-1252 ft., and so imply the presence of at least part of the Paleocene. No palynology samples were studied in the interval.

The Dilwyn Formation is identified from logs at 1101-1209 ft.

Usually, the lower Eocene (M. diversus Zone) and late Eocene (N. asperus) intervals are the most laterally persistent. The single sample studied confirms a late Eocene top, but the age extent of the rest of the Formation is unknown.

B. Environmental data are consistent with the regional picture. The Pretty Hill and Eumeralla intervals are non-marine with lacustrine influence. Very rare brackish influence seen in some other localities was not seen here. The Dilwyn Formation is seen to be slightly brackish, although elsewhere the formation top is often rather more marine.

C. Maturity data indicate that the base of the section, although only early mature, could have sourced some hydrocarbons. Deeper burial offstructure could have taken the section to peak maturity and produced much more liquid hydrocarbons. However, burial to depths of about 7000 ft. would be necessary.

V REFERENCES

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TIRRENGOWA #1

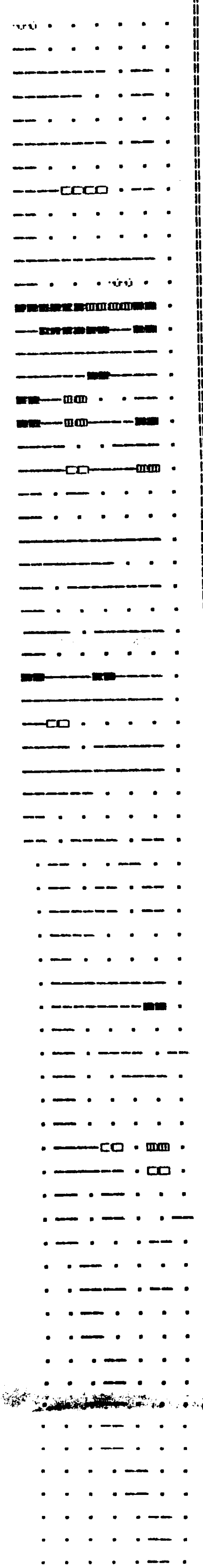
DESCRIPTION:

ALL SAMFLE DEPTHS ARE IN FEET
* INDICATES NON SPORE FOLLEN
FALYNOLOGICAL INTERPRETATION DONE BY ROGER MORGAN - JUNE 1987

CHECKLIST OF GRAPHIC ABUNDANCE BY LOWEST APPEARANCE

= Abundant
= Common
= Few
= Rare
= Very Rare
? = Questionably Fresent
. = Not Fresent

1106.0 SWC
1965.0 SWC
2350.0 SWC
2940.0 SWC
3600.0 SWC
3885.0 SWC
4014.0 SWC



1 * BATIACASPHAERA MACROGRANULATA *
2 * MICROFASTA EVANSII *
3 AEQUITRIRADITES SPINULOSUS
4 ARAUCARIACITES AUSTRALIS
5 BIRETRISPORITES SPECTABILIS
6 CALLIALASPORITES DAMPIERI
7 CALLIALASPORITES TURBATUS
8 CICATRICOSISPORITES AUSTRALIENSIS
9 CICATRICOSISPORITES LUDBROOKIAE
10 CINGUTRILETES CLAVUS
11 COROLLINA TOROSUS
12 COUPERISPORITES TABULATUS
13 CYATHIDITES AUSTRALIS
14 CYATHIDITES MINOR
15 CYCADOPITES FOLLICULARIS
16 DICTYOTOSPORITES SPECIOSUS
17 FALCISPORITES GRANDIS
18 FALCISPORITES SIMILIS
19 FORAMINISPORIS DAILYI
20 FORAMINISPORIS WONTHAGGIENSIS
21 ISCHYOSPORITES PUNCTATUS
22 JANUASPORITES SPINULOSUS
23 LEPTOLEPIDITES MAJOR
24 LEPTOLEPIDITES VERRUCATUS
25 MICROCACHRYIDITES ANTARCTICUS
26 MUROSPORA FLORIDA
27 NEORAISTRICKIA TRUNCATA
28 NEVESISPORITES VALLATUS
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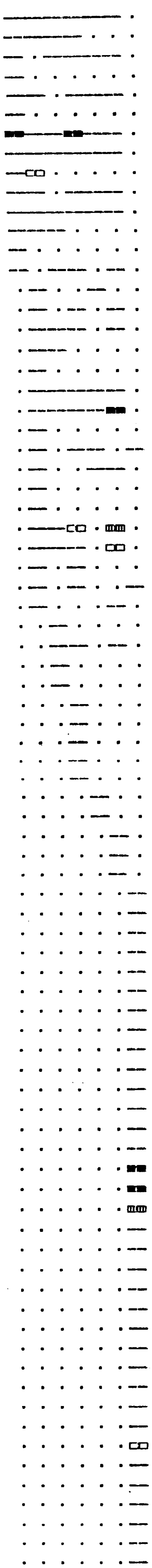
33 RETITRILETES FACETUS
34 RETITRILETES WATHEROOENSIS
35 TRILOBOSPORITES PURVERULENTUS
36 VELOSPORITES TRIQUETRUS
37 * SCHIZOSPORIS PSILATA *
38 AEQUITRIRADITES VERRUCOSUS
39 CERATOSPORITES EQUALIS
40 CONTIGNISPORITES COOKSONIAE
41 COOKSONITES VARIABILIS
42 CYCLOSPORITES HUGHESI
43 DICTYOTOSPORITES COMPLEX
44 FORAMINISPORIS CAELATUS
45 GLEICHENIIDITES
46 KLUKISPORITES SCABERIS
47 LYCOPODIACIDITES ASPERATUS
48 MATONISPORITES COOKSONIAE
49 PILOSISPORITES NOTENSIS
50 PILOSISPORITES PARVISPINOSUS
51 RETITRILETES NODOSUS
52 STEREISPORITES ANTIQUASPORITES
53 VITREISPORITES PALLIDUS
54 * SUBTILOSPHAERA SP. *
55 FORAMINISPORIS ASYMMETRICUS
56 NEORAISTRICKIA TAYLORI
57 PEROTRILETES WHITFADENSIS
58 * BOTRYOCOCCUS *
59 CRYBELOSPORITES BERBEROIDES
60 FOVEOTRILETAS PARVIRETUS
61 POLYCINGULATISPORITES CRENULATUS
62 ROGALSKISPORITES CICATRICOSUS
63 * SCHIZOSPORIS RETICULATA *
64 DICTYOTOSPORITES FILOSUS
65 ANNULISPORITES FOLLICULOSA
66 CRYBELOSPORITES STYLOSUS
67 RETICULATISPORITES PUDENS



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71 CUPANIEIDITES ORTHOTEICHUS
72 DACRYCARPITES AUSTRALIENSIS
73 ERICIPITES SCABRATUS
74 HALORAGACIDITES HARRISII
75 ISCHYOSPORITES GREMIUS
76 KUYLISPORITES WATERBOLKII
77 LILIACIDITES LANCEOLATUS
78 LYGISTEPOLLENITES FLORINII
79 MALVACIPOLLIS SUBTILIS
80 MILFORDIA HOMEOPUNCTA
81 NOTHOFAGIDITES ASPERUS
82 NOTHOFAGIDITES BRACHYSPINULOSUS
83 NOTHOFAGIDITES EMARCIDUS
84 NOTHOFAGIDITES FALCATUS
85 NOTHOFAGIDITES FLEMINGII
86 NOTHOFAGIDITES VANSTEENISII
87 PERIPOROPOLLENITES DEMARCATUS
88 PERIPOROPOLLENITES VESICUS
89 PHYLOCLADIDITES MAWSONII
90 PODOSPORITES MICROSACCATUS
91 PROTEACIDITES ANNULARIS
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93 PROTEACIDITES GRANDIS
94 PROTEACIDITES INCURVATUS
95 PROTEACIDITES LEIGHTONII
96 PROTEACIDITES PACHYPOLUS
97 RICCIA BOXATUS
98 SANTALUMIDITES CAINOZOICUS
99 TRICOLPITES PHILLIPSII
100 TRICOLPITES THOMASII
101 TRIORITES MAGNIFICUS
102 VERRUCOSISPORITES KOPUKUENSIS

SPECIES LOCATION INDEX

Index numbers are the columns in which species appear.

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1	* BATIACASPHAERA MACROGRANULATA *
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