PE990893

PALYNOLOGY OF 13 SELECTED CORES FROM TULLICH-1, CASTERTON-1 AND HEATHFIELD-1, OTWAY BASIN, VICTORIA

BY

ROGER MORGAN
BOX 161
MAITLAND SA 5573

PHONE (088) 322795
FAX (088) 322658

for GAS AND FUEL CORPORATION SEPTEMBER, 1989.

PALYNOLOGY OF 13 SELECTED CORES FROM TULLICH-1, CASTERTON-1 AND HEATHFIELD-1, OTWAY BASIN, VICTORIA

BY

ROGER MORGAN

CONTENTS PAGE

I SUMMARY

Tullich-1

2928-92 ft. (core 7) : C. striatus Zone : early Albian : non-marine : early marginal mature : usually mid Eumeralla Formation

3479-89 ft. (core 8) : C. hughesi Zone : Aptian : non-marine : early marginal mature : usually lower Eumeralla Formation

3994 (core 10)-5463 ft. (core 15) : F. wonthaggiensis Zone : late Neocomian : non-marine except slightly brackish at 4841-55 ft. : marginally mature to 4855 ft., mature at 5460 ft. : usually upper Pretty Hill Formation or correlatives

Casterton-1

4507-12 ft. (core 8) : F. wonthaggiensis Zone : Late Neocomian : non-marine : marginally mature : usually upper Pretty Hill Formation or correlatives

Heathfield-1

4144-54 ft. (core 10) : C. striatus Zone : early Albian : non-marine : marginally mature : usually mid Eumeralla Formation

4620 ft. (core 12)-5703 ft. (core 15) : C. hughesi Zone : Aptian : non-marine : marginally mature at 4620 ft., early mature 5026-5703 ft. : usually lower Eumeralla Formation

5990-6000 ft. (core 16) : F. wonthaggiensis Zone : late Neocomian : non-marine : mature : usually Pretty Hill Formation or correlatives

Study of the other cores from these wells would permit a more complete understanding of the whole Early Cretaceous in this permit.

II INTRODUCTION

Steve Guba of Gas and Fuel Corporation submitted thirteen core samples for palynology, particularly age dating. Results were faxed as samples were studied, but this report documents the detailed work.

Palynomorph occurrence data are shown as Appendix I and form the basis for assignment of the samples to three spore pollen zones of Late Neocomian to early Albian age. The zonation is esssentially that of Dettmann and Playford (1969) but has been significantly modified and improved by various authors since and most recently discussed in Helby et al. (1987), as shown on figure 1 and modified by Morgan (1985) for application in the Otway Basin. The zonation continues to improve as more detailed data becomes available.

Maturity data was generated in the form of Spore Colour Index, as discussed in the text. The oil and gas windows follow the general concensus of geochemical literature. The oil window corresponds to spore colours of light to mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These correspond to Vitrinite Reflectances of 0.6% and 1.3% respectively.

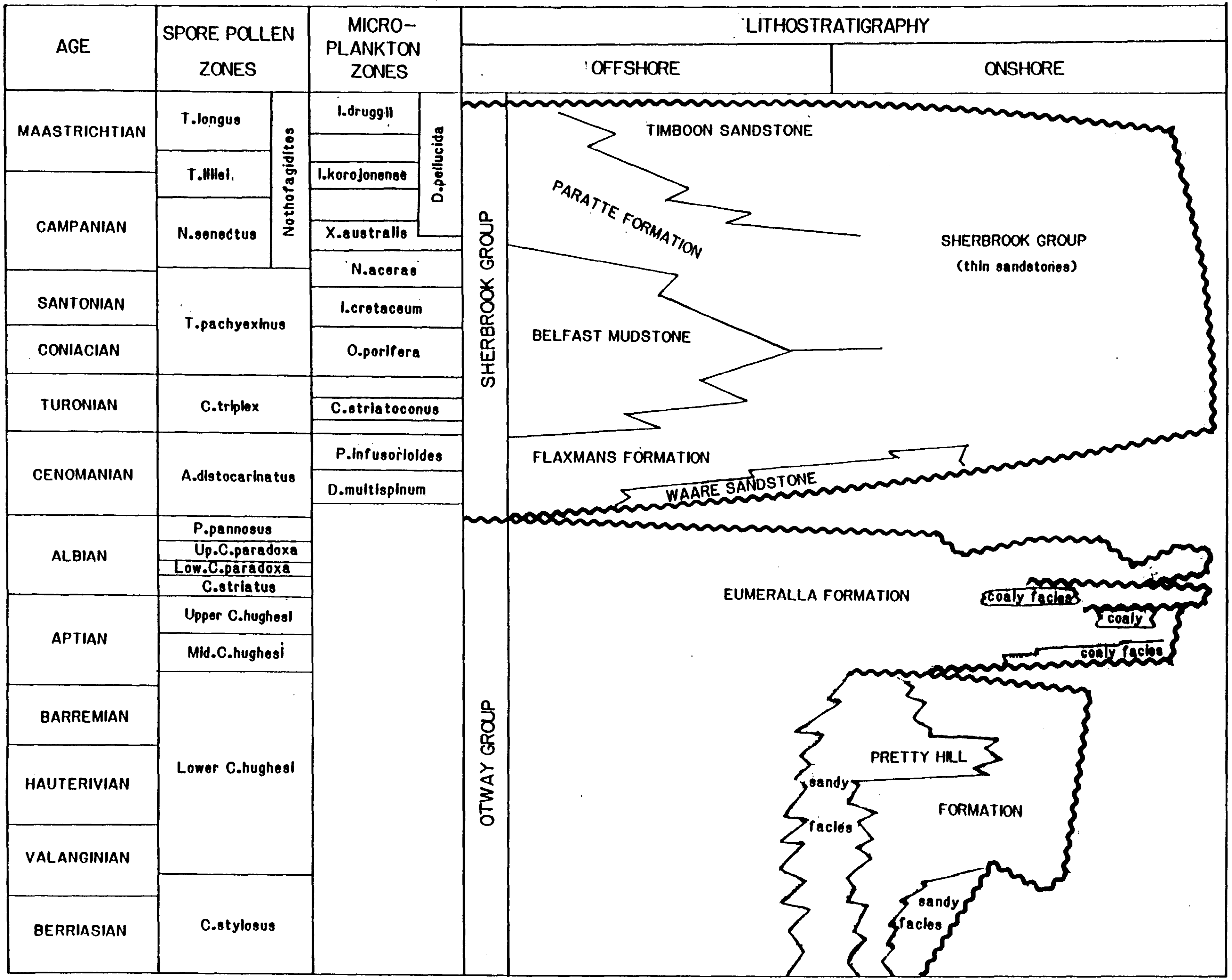


FIGURE 1 CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

III PALYNOSTRATIGRAPHY

A. TULLICH-1

1. 2982-92 ft. (core) : C. striatus Zone

Assignment to the Crybelosporites striatus Zone is indicated by oldest C. striatus without younger indicators. The presence of Pilosisporites notensis indicates a lower C. paradoxa or older assignment. Cyathidites, Falcisporites and Microcachryidites dominate the assemblage. Stereisporites antiquasporites is frequent, and is usually seen in the Albian.

Non-marine environments are indicated by the abundant tracheid fragments, diverse and abundant spores and pollen, and lack of marine indicators. The very rare presence of the freshwater algal acritarch Schizosporis reticulatus is consistent with minor lacustrine influence.

Yellow-brown to light brown spore colours indicate early marginal maturity for oil generation, and immaturity for gas/condensate generation.

2. 3479 ft. (core)-3489 ft. (core) : C. hughesi Zone

Assignment to the Cyclosporites hughesi Spore-Pollen Zone is indicated by oldest P. notensis without younger indicators. Neither Foraminisporis asymmetricus nor Cooksonites variabilis were seen, and so subzone assignment is not possible. Cyathidites minor dominates the assemblage, with frequent C. australis, Osmundacidites wellmanii and Retitriletes austroclavatidites. Dictyotosporites speciosus and

Pilosisporites notensis are consistent components. Cicatricosisporites australiensis does not occur below this point.

Non-marine environments are indicated by the common and diverse spores and pollen and lack of marine indicators. Rare algal acritarchs (Schizosporis spp.) indicate lacustrine influence.

Yellow/brown to light brown spore colours indicate early marginal maturity for oil generation.

3. 3994 (core)-5463 ft. (core) : F. wonthaggiensis Zone

Assignment to the Foraminisporis wonthaggiensis Zone is indicated at the top by the absence of younger indicators and confirmed by more consistent Retitriletes watherooensis and Contignisporites cooksoniae. At the base, oldest Dictyotosporites speciosus indicates the assignment. Within the interval, Cyathidites dominate to 4855 ft. with subordinate Retitriletes austroclavatidites and Osmundacidites wellmannii. Murospora florida occurs at 4841-55 (core). At 5460-63 ft., Falcisporites dominates.

Mostly non-marine environments are indicated by the common and abundant spores and pollen, common cuticle, and usual absence of marine indicators. At 4841-55 ft. however, rare spiny acritarchs (Micrhystridium spp.) indicate slightly brackish influence. Minor lacustrine influence is also seen in the algal acritarchs Schizosporis (3994-99 ft. and 4500-05 ft.) and Microfasta evansii (4841-55 ft.)

Light brown spore colours at 3994-99 ft., 4500-05 ft., and 4841-55 ft. indicate marginal maturity for oil and immaturity for gas/condensate. At 5460-63 ft., mid to light brown spore colours indicate maturity for oil and marginal maturity for gas/condensate.

B. CASTERTON-1

1. 4507-12 ft. (core) : F. wonthaggiensis Zone

Assignment is indicated by the presence of D. speciosus without younger indicators and is confirmed by the presence of the algal acritarch M. evansii (not normally seen above this zone). The assemblage is dominated by Cyathidites and O. wellmannii.

Non-marine environments are indicated by the abundant and diverse spores and pollen and absence of marine indicators. Slight lacustrine influence is suggested by the algal acritarch M. evansii.

Light brown spore colours indicate marginal maturity for oil generation, and immaturity for gas/condensate.

C. HEATHFIELD-1

1. 4144-54 ft. (core)

Assignment to the C. striatus Zone is indicated by oldest Crybelosporites striatus without younger indicators. The presence of P. notensis indicates a lower C. paradoxa or older assignment. Consistent F. asymmetricus and C. australiensis are usually seen in the Albian and so generally confirm the assignment. Cyathidites spp. however, dominate the assemblage.

Non-marine environments are indicated by the abundant and diverse spores and pollen and absence of marine indicators. The rare presence of algal acritarchs (Schizosporis spp.) indicate some lacustrine influence.

Light brown spore colours indicate marginal maturity for oil generation, but immaturity for gas/condensate.

2. 4620 ft. (core)-5703 ft. (core) : C. hughesi Zone

These four cores are assigned to the Cyclosporites hughesi Zone by containing oldest P. notensis without younger indicators. C. hughesi, D. speciosus and C. australiensis all occur throughout and below the interval. F. asymmetricus is consistent at 5026-36 ft. (core) and indicates that the interval 4620-5036 ft. belongs to the upper C. hughesi Zone and 5406-5703 ft. belongs to the lower C. hughesi Zone. Within the interval, Cyathidites spp. dominate the assemblages. A single F. asymmetricus at 5693-5703 ft. occurs, and is consistent with previous observations. Rare M. evansii at 5693-5703 ft. are considered reworked.

Non-marine environments are indicated by the common and diverse spores and pollen, and lack of marine indicators. Minor lacustrine influence is suggested by rare algal acritarchs at 5026-36 ft. and 5693-5703 ft. At 5406-16 ft., amorphous sapropel is abundant suggesting anoxic bottom environments and potentially excellent source rocks.

At 4620-26 ft., light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate. At 5026-5703 ft., light to mid brown spore colours indicate early maturity for oil, and early marginal maturity for gas/condensate.

3. 5990-6000 ft. (core) : F. wonthaggiensis Zone

Assignment to the Foraminisporis wonthaggiensis Zone is indicated by oldest D. speciosus in the absence of younger indicators. Youngest R. watherooensis confirms the assignment. The presence of consistent C. australiensis and very rare F. asymmetricus suggests that the upper part of the F. wonthaggiensis Zone is present. The assemblage is dominated by Cyathidites spp. and O. wellmannii.

Non-marine environments are indicated by the common and diverse spores and pollen and absence of marine indicators. Minor lacustrine influence is suggested by rare algal acritarchs (Schizosporis spp.). Common amorphous sapropel suggests anoxic bottom environments and potentially excellent source rocks.

IV CONCLUSIONS AND RECOMMENDATIONS

A. These data span the early Albian to late Neocomian interval, normally the mid Eumeralla to upper Pretty Hill Formation.

Experience in this basin has shown that the top Pretty Hill unconformity normally occurs at or near the C. hughesi/F. wonthaggiensis boundary, although top sand may occur above or well bellow this boundary.

Sequence stratigraphy in continental basins of this type indicates that sequence boundaries at lowstands are frequently marked by high energy braided stream sands with highstands being marked by fine-grained lacustrine shales or coals. Of course, point bar sands can occur anywhere in the section and confuse the picture. Major lowstands occur at 112 m.y. base Aptian (base C. hughesi Zone) and at 107.5 m.y. base Albian (base C. striatus Zone). Minor lowstands occur at 109.5 m.y. intra Aptian (intra C. hughesi Zone), 106 m.y. early Albian (base C. paradoxa Zone) and 103 m.y. (intra C. paradoxa Zone). The 112 m.y. base Aptian (base C. hughesi Zone) lowstand therefore coincides with the top Pretty Hill unconformity and may represent eustatic enhancement of a tectonic unconformity.

B. In Tullich-1, the top Pretty Hill unconformity may therefore lie in the palynological sample gap 3489 ft. to 3994 ft. The base of the sand at 3814 ft. may be a candidate for the 112 m.y. sequence boundary and therefore be a basal Eumeralla sand. The sand at 3094 ft. (? Heathfield Sand) may mark the 107.5 m.y. base Albian (base C. striatus Zone) lowstand. The upper Pretty Hill equivalent appears to be all shale, with top sand at 4770 ft. well below the unconformity.

C. In Casterton-1, this new data also suggests that the upper Pretty Hill equivalent is all shale, with the top Pretty Hill unconformity expected in the gap 3596 ft. to 4507 ft. No sands are developed, but dipmeter records might be useful to locate it.

D. In Heathfield-1, this data again suggests that the upper Pretty Hill equivalent is all shale, with the top Pretty Hill unconformity expected in the gap 5703 ft. to 5990 ft. No sands are developed, but the dipmeter might be useful. The sands near 4620 ft. may represent the 107.5 m.y. base Albian (base C. striatus Zone) sequence boundary while the "Heathfield Sand" at 4144 ft. may mark the 106 m.y. early Albian (base C. paradoxa Zone) sequence boundary. The dipmeter break near 4290 ft. may mark the change from Transgressive deposits to Highstand deposits, or may itself be a candidate for the 107.5 m.y. sequence boundary.

E. I recommend study of the balance of the Early Cretaceous cores in Tullich-1 and Heathfield-1 to more fully understand whole section, particularly in sequence stratigraphic terms. I also recommend new multiple sampling and restudy of cores 1, 2 and 3 from Casterton-1 to resolve different zonal assignments by Evans and myself.

V REFERENCES

Dettmann, M.E. and Playford, G. (1969) Palynology of the Australian Cretaceous : a review In Stratigraphy and Palaeontology. Essays in honour of Dorothy Hill, KSW Campbell Ed. ANU Press, Canberra 174-210

Helby, R.J., Morgan, R.P. and Partridge, A.D. (1987) A palynological zonation of the Australian Mesozoic In Studies in Australian Mesozoic Palynology Assoc. Australas. Palaeontols. Mem 4 1-94

Morgan, R.P. (1985) Palynology review of selected oil drilling, Otway Basin, South Australia unpubl. rept. for Ultramar Australia

APPENDIX I

PALYNOMORPH RANGE DATA

PALYNOLOGY OF OTWAY BASIN SAMPLES

Roger Morgan, PETROLEUM GEOLOGIST CONSULTANT,
Box 161, Maitland, S.A., 5573.
fax (088) 32 2658 ... ph. (088) 32 2795

C L I E N T: Gas & Fuel Exploration

W E L L: Tulloch #1, Casterton #1, Heathfield #1

F I E L D / A R E A: Otway Basin

A N A L Y S T: Roger Morgan Ph.D. D A T E : September '89

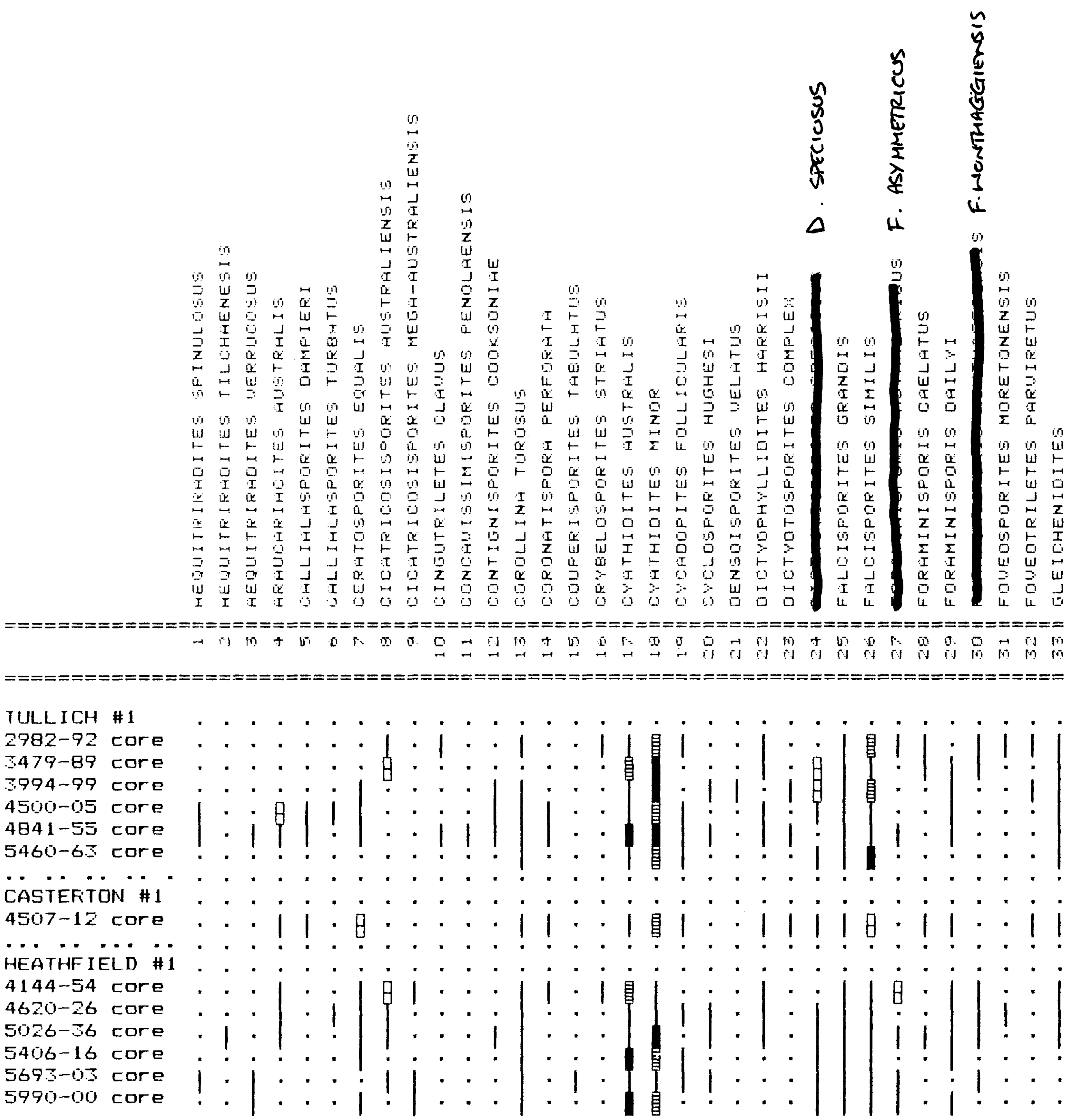
N O T E S: all sample depths are in feet

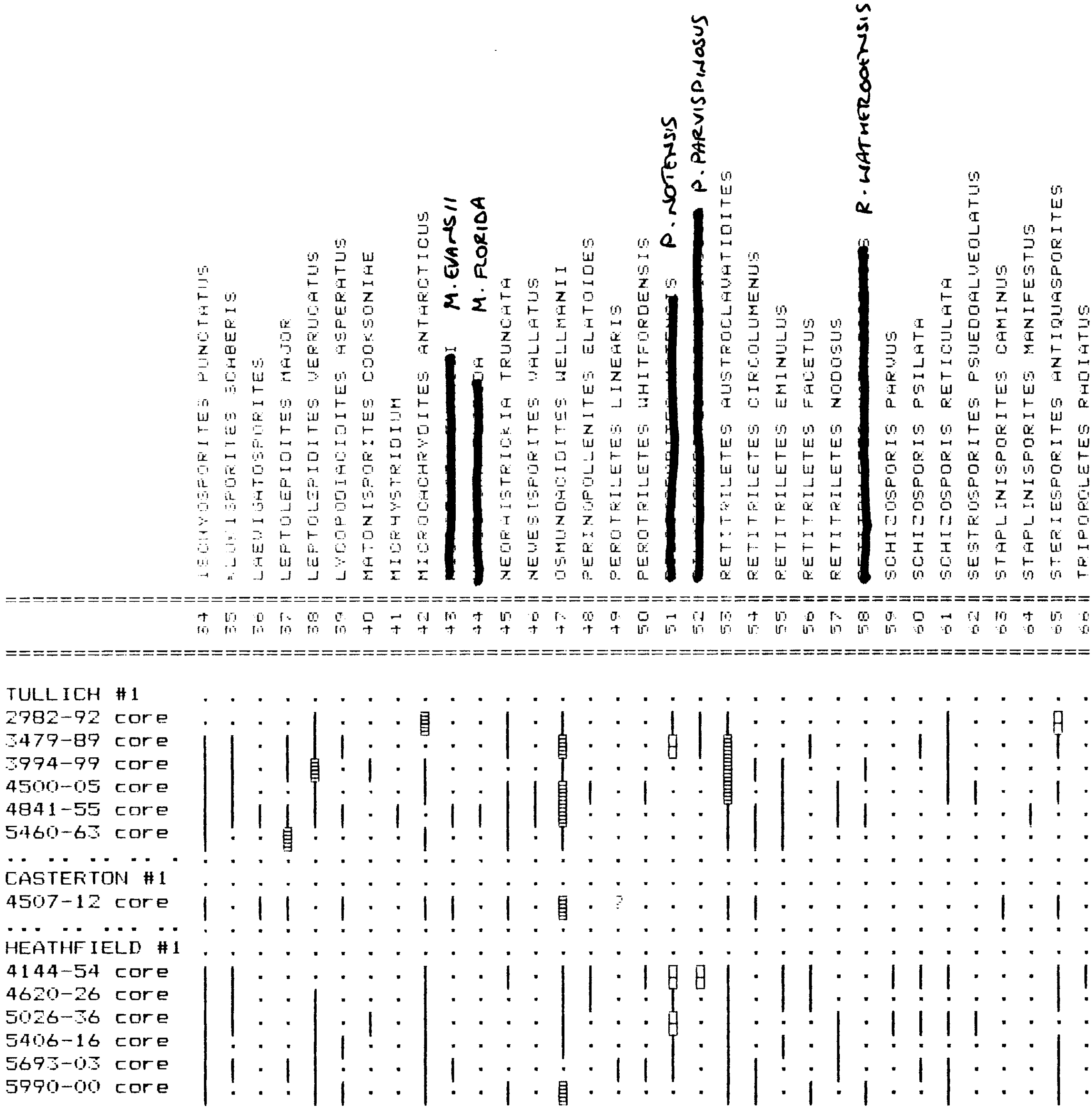
RANGE CHART OF GRAPHIC ABUNDANCES BY ALPHABETICAL ORDER

Key to Symbols

= Very Rare
= Rare
= Few
= Common
= Abundant

? = Questionably Present
. = Not Present


1 AEQUITRIRADITES SPINULOSUS
2 AEQUITRIRADITES TILCHAENSIS
3 AEQUITRIRADITES VERRUCOSUS
4 ARAUCARIACITES AUSTRALIS
5 CALLIALASPORITES DAMPIERI
6 CALLIALASPORITES TURBATUS
7 CERATOSPORITES EQUALIS
8 CICATRICOSISPORITES AUSTRALIENSIS
9 CICATRICOSISPORITES MEGA-AUSTRALIENSIS
10 CINGUTRILETES CLAVUS
11 CONCAVISSIMISPORITES PENOLAENSIS
12 CONTIGNISPORITES COOKSONIAE
13 COROLLINA TOROSUS
14 CORONATISPORA PERFORATA
15 COUPERISPORITES TABULATUS
16 CRYBELOSPORITES STRIATUS
17 CYATHIDITES AUSTRALIS
18 CYATHIDITES MINOR
19 CYCADOPITES FOLLICULARIS
20 CYCLOSPORITES HUGHESI
21 DENSOISPORITES VELATUS
22 DICTYOPHYLLIDITES HARRISII
23 DICTYOTOSPORITES COMPLEX
24 [redacted] D. SPECIOSUS
25 FALCISPORITES GRANDIS
26 FALCISPORITES SIMILIS
27 [redacted] F. ASYMMETRICUS
28 FORAMINISPORIS CAELATUS
29 FORAMINISPORIS DAILYI
30 [redacted] F. WONTHAGGIENSIS
31 FOVEOSPORITES MORETONENSIS
32 FOVEOTRILETES PARVIRETUS
33 GLEICHENIIDITES
TULLICH #1
2982-92 core
3479-89 core
3994-99 core
4500-05 core
4841-55 core
5460-63 core
CASTERTON #1
4507-12 core
HEATHFIELD #1
4144-54 core
4620-26 core
5026-36 core
5406-16 core
5693-03 core
5990-00 core



ISCHYOSPORITES PUNCTATUS
KLUKISPORITES SCABERIS
LAEVIGATOSPORITES
LEPTOLEPIDITES MAJOR
LEPTOLEPIDITES VERRUCATUS
LYCOPODIACIDITES ASPERATUS
MATONISPORITES COOKSONIAE
MICRHYSTRIDIUM
MICROCACHRYIDITES ANTARCTICUS
[redacted] M. EVANSII
[redacted] M. FLORIDA
NEORAISTRICKIA TRUNCATA
NEVESISPORITES VALLATUS
OSMUNDACIDITES WELLMANII
PERINOPOLLENITES ELATOIDES
PEROTRILETES LINEARIS
PEROTRILETES WHITFORDENSIS
[redacted] P. NOTENSIS
[redacted] P. PARVISPINOSUS
RETITRILETES AUSTROCLAVATIDITES
RETITRILETES CIRCOLUMENUS
RETITRILETES EMINULUS
RETITRILETES FACETUS
RETITRILETES NODOSUS
[redacted] R. WATHEROOENSIS
SCHIZOSPORIS PARVUS
SCHIZOSPORIS PSILATA
SCHIZOSPORIS RETICULATA
SESTROSPORITES PSUEDOALVEOLATUS
STAPLINISPORITES CAMINUS
STAPLINISPORITES MANIFESTUS
STERIESPORITES ANTIQUASPORITES
TRIPOROLETES RADIATUS
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66
TULLICH #1
2982-92 core
3479-89 core
3994-99 core
4500-05 core
4841-55 core
5460-63 core
CASTERTON #1
4507-12 core
?
HEATHFIELD #1
4144-54 core
4620-26 core
5026-36 core
5406-16 core
5693-03 core
5990-00 core

	TRIPOROLETES SIMPLEX	VELOSPORITES TRIQUETRUS	VITREISPORITES PALLIDUS	
	67	68	69	
TULLICH #1	.	.	.	TULLICH #1
2982-92 core	.	.	.	2982-92 core
3479-89 core	.	.	|	3479-89 core
3994-99 core	.	.	|	3994-99 core
4500-05 core	|	.	.	4500-05 core
4841-55 core	.	|	|	4841-55 core
5460-63 core	.	|	.	5460-63 core
.. ..	.	.	.	.. ..
CASTERTON #1	.	.	.	CASTERTON #1
4507-12 core	.	.	.	4507-12 core
... .	.	.	.	... .
HEATHFIELD #1	.	.	.	HEATHFIELD #1
4144-54 core	|	.	|	4144-54 core
4620-26 core	.	.	.	4620-26 core
5026-36 core	|	.	.	5026-36 core
5406-16 core	.	.	.	5406-16 core
5693-03 core	.	.	.	5693-03 core
5990-00 core	.	|	.	5990-00 core