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PALYNOLOGY OF GAS AND FUEL McEACHERN-1,

OTWAY BASIN, AUSTRALIA

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for GAS AND FUEL

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I SUMMARY

Final study of 14 new swcs plus the existing 6 cuttings samples yielded the following results.

504.6m (swc) : lower C. paradoxa Zone : mid Albian : immature : slightly brackish : usually mid Eumeralla

699.6m (swc) : C. striatus Zone : early Albian : non-marine : immature : usually mid Eumeralla

905.6m (swc)-1048.6m (swc) : C. hughesi Zone : Aptian : non-marine : marginally mature : usually lower Eumeralla

1174.5m (swc)-1946.1m (swc) : F. wonthaggiensis zone : late Neocomian : non-marine with minor lacustrine influence especially near the top : marginally mature to early mature : usually Pretty Hill

2070m (cutts)-2354m (cutts) : upper C. australiensis Zone : early Neocomian : non-marine : mature : usually lower Pretty Hill : note that cuttings may have made this base too low through caving

2364m (cutts)-2384m (cutts) : lower C. australiensis-?R. watherooensis Zones : earliest Neocomian to ?Latest Jurassic : non-marine : mature : usually Casterton Beds

II INTRODUCTION

Fourteen sidewall cores and 6 cuttings of favourable lithology were processed, to provide information on age, encironment and maturity for the completion report.

Palynomorph occurence data are shown as Appendix I and form the basis for the assignment of the samples to sixe spore-pollen units of early Neocomian to mid Albian age. The Cretaceous spore-pollen zonation is essentially 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.

Maturity data was generated in the form of Spore Colour Index, and is plotted on figure 2 Maturity profile of Ultramar McEachern-1. The oil and gas windows in figure 2 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These correspond to citrinite reflectance values of 0.6% to 1.3%.

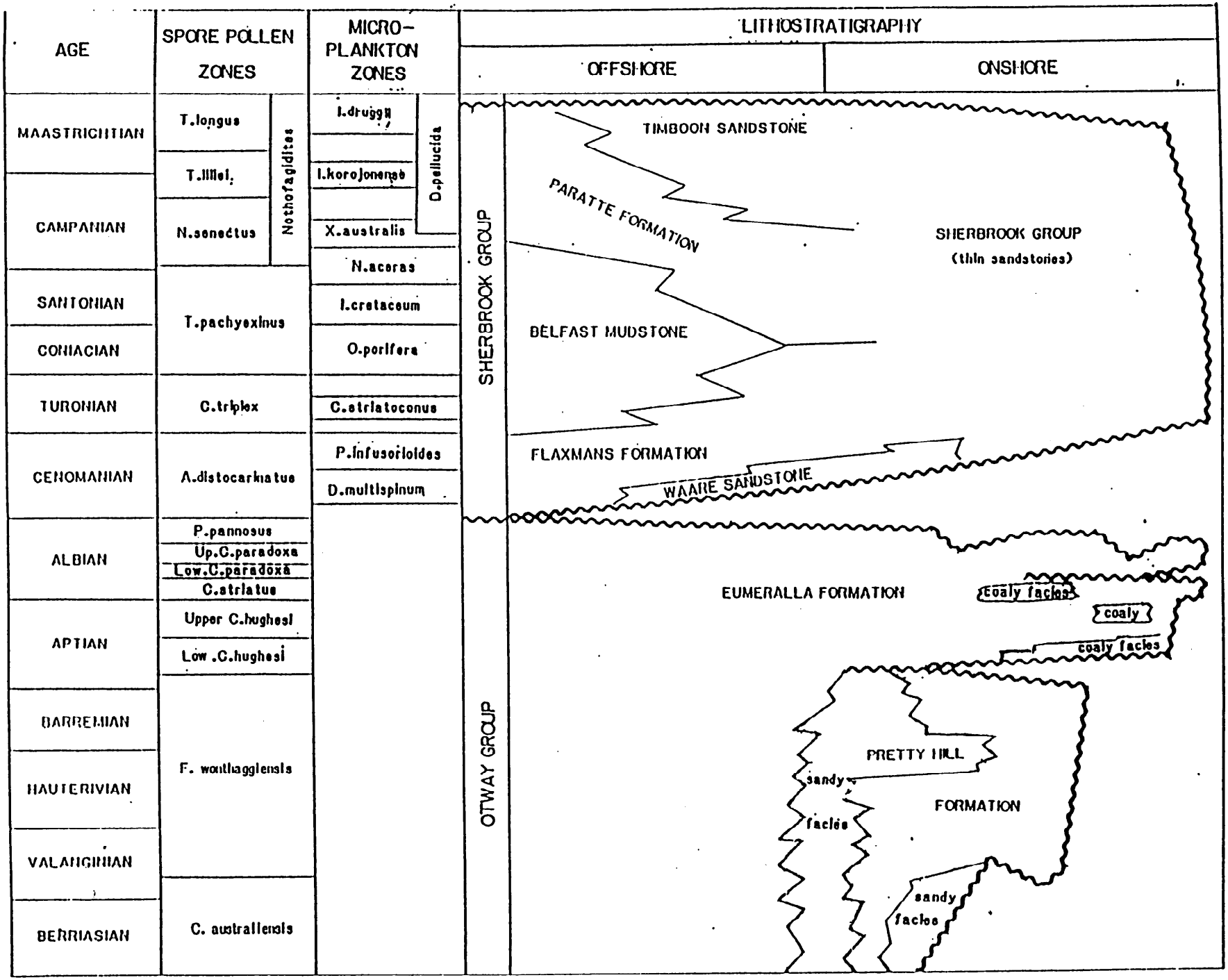

FIGURE 1 CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

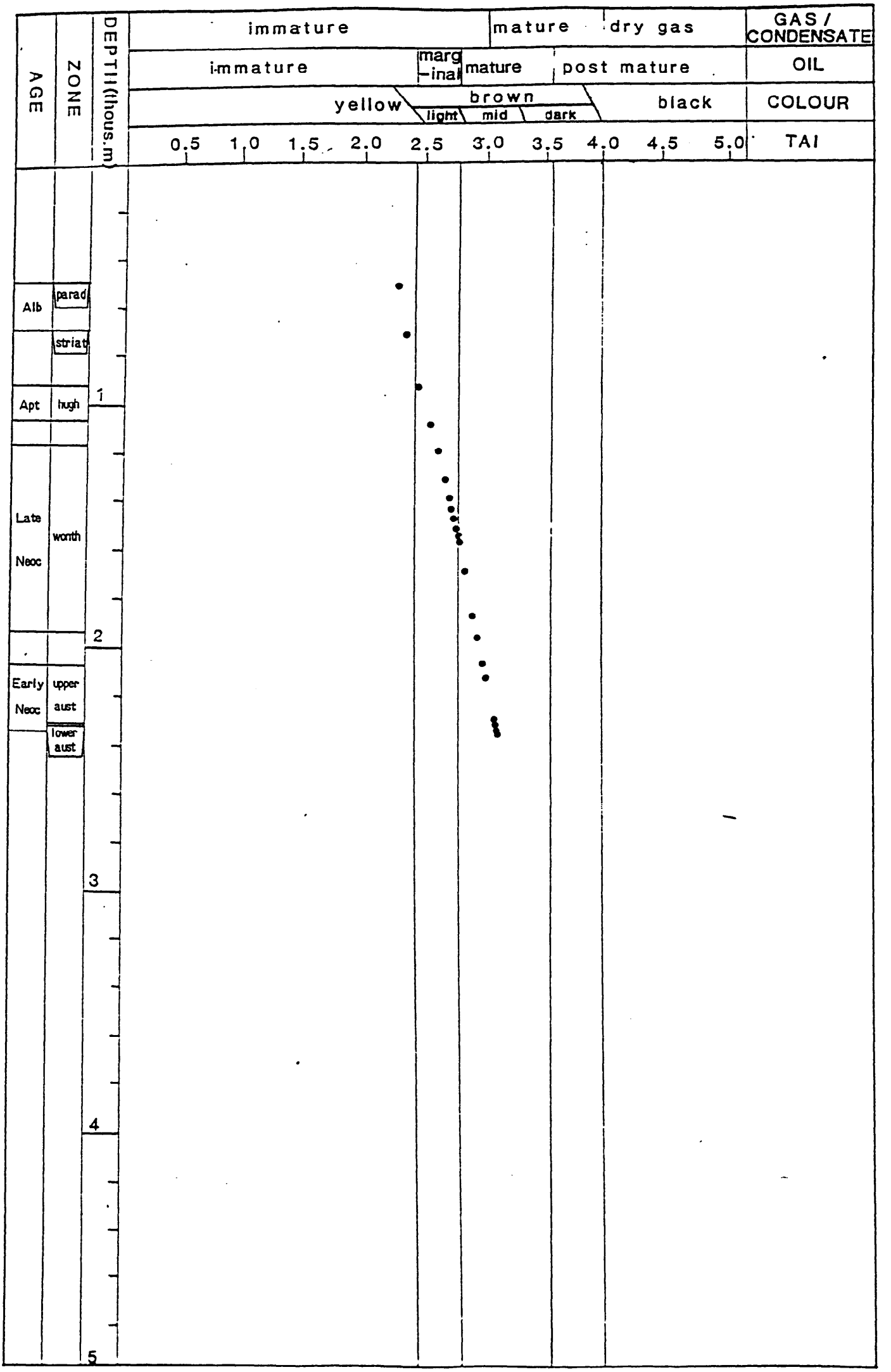

FIGURE 2 MATURITY PROFILE McEACHERN 1

III PALYNOSTRATGRAPHY

A. 504.6m (swc) : lower C. paradoxa Zone

Assignment to the lower Coptospora paradoxa Zone of mid Albian age is indicated by youngest Dictyotosporites speciosus and oldest Coptospora paradoxa. The absence of younger indicators, and the presence of oldest Perotriletes majus confirms the assignment. Falcisporites similis dominates the assemblage, with frequent Microcachryidites antarcticus and consistent Cicatricosisporites australiensis.

Slightly brackish environments are indicated by the very rare presence of spiny acritarchs (Micrhystridium) and dominance of diverse and abundant spores and pollen

These features are normally seen in the mid Eumeralla Formation.

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

B. 699.6m (swc) : C. striatus Zone

Assignment to the early Albian Crybelosporites striatus Zone is indicated by oldest C. striatus without younger indicators. Youngest Pilosisporites notensis occurs in this sample and confirms the assignment. Common taxa are C. australiensis, F. similis, Osmundacidites wellmanii and Retitriletes austroclavatidites.

Non-marine environments are indicated by the common and diverse spores and pollen, and absence of saline

indicators. Rare algal acritarchs (Schizosporis spp.) indicate minor lacustrine influence.

These features are normally seen in the mid Eumeralla Formation, often in coaly facies.

Yellow to light brown spore colours indicate immaturity for oil, but approaching early marginal maturity. The sample is clearly immature for gas/condensate.

C. 905.6m (swc)-1048.6m (swc) C. hughesi Zone

Assignment to the Aptian Cyclosporite hughesi Zone is indicated at the top by the absence of younger markers, and at the base by oldest Pilosisporites notensis. Cyathidites, Falcisporites and Retitriletes are common in both samples, while P. notensis and D. speciosus and prominent at 905.6m.

Non-marine environments are indicated by the common and diverse spores and pollen, and absence of saline indicators. Amorphous sapropel and cuticle are common at 905.6m, suggesting anoxic swamp conditions.

These features are normally seen in the lower Eumeralla Formation, often associated with coaly lithologies.

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

D. 1174.5m (swc)-1946.1m (swc) : F. wonthaggiensis Zone

Assignment to the late Neocomian Foraminisporis wonthaggiensis Zone is indicated at the top by youngest Microfasta evansii and the absence of younger markers.

At the base, oldest D. speciosus indicates the assignment. Within the unit, oldest C. australiensis at 1174.5m suggests its assignment to an upper subunit, and the interval 1289.5-1946.1m to a lower subunit. A minor influx of Contignisporites cooksoniae occurs at 1174.5m. Within the interval, M. evansii is rare down to 1289.5m, and extremely scarce beneath, being seen only at 1523.6m. Cyathidites, Falcisporites, O. wellmanii and Retitriletes are the most common forms. Callialasporites dampieri is consistently present beneath 1946.1m.

Non-marine environments are indicated by the common and diverse spores and pollen, abundant plant debris, and absence of saline indicators. Minor lacustrine influence is shown by the presence of algal acritarchs including M. evansii at the top of the interval. Common cuticle and amorphous sapropel at 1365m suggests swampy conditions.

These features are normally seen in the Pretty Hill Formation and its shaley equivalents, and therefore normally underlie the "top Pretty Hill unconformity".

Spore colours of light brown at 1174.5m to 1461.1m indicate marginal maturity for oil, but immaturity for gas condensate. Light to mid brown spore colours at 1504.6m to 1649.1m indicate early maturity for oil, and early marginal maturity for gas/condensate. Mid brown spore colours at 1857.6m and 1946.1m indicate maturity for oil, and marginal maturity for gas/condensate.

E. 2070m (cutts)-2354m (cutts) : upper C. australiensis Zone

Assignment to the upper part of the early Neocomian

Cicatricosisporites australiensis Zone is indicated at the top by the absence of younger indicators, and confirmed by youngest consistent C. dampieri. At the base, oldest Cyclosporites hughesi indicates the assignment. Unfortunately, swcs were not studied for palynology in this interval, and it is possible that oldest C. hughesi may be caved somewhat, causing this boundary to be picked low. Diversity is low, with Cyathidites and Falcisporites usually dominant. Minor Permian reworking was noted in some samples.

Non-marine environments are indicated by the common and diverse spores and pollen and absence of saline indicators.

These features are normally seen in the lower part of the Pretty Hill Formation.

Mid brown spore colours indicate maturity for oil, but only marginal maturity for gas/condensate.

F. 2364m (cutts)-2384m (cutts) : lower C. australiensis -?R. watherooensis

Assignment of this interval to the earliest Neocomian to late Jurassic lower Cicatricosisporites australiensis Zone to R. watherooensis Zone is indicated at the top by the absence of younger indicators and at the base by oldest Retitriletes watherooensis and Ceratosporites equalis. The base of the C. australiensis is usually picked on oldest C. australiensis, but this species is extremely rare at this level in the Otway Basin and is not a reliable indicator. A downhole influx of C. dampieri at 2384m is distinctive, and may have correlative value in the future. Above that sample, Cyathidites, O. wellmanii

and Retitriletes dominate. Caving is noted in all samples and included M. evansii and some Aptian forms.

Environments are probably non-marine, as the spores and pollen are dominant and diverse. Very rare Micrhystridium spp. at 2374 and 2384m suggest brackish influence, but could be caved in these cuttings samples.

These features are normally seen in the Casterton Beds in the Otway Basin.

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

IV CONCLUSIONS

A. Sparse sampling has precluded tight resolution of the zone boundaries and the available subzones, especially at top Pretty Hill unconformity leval. Correlation to better sampled sections will rely on logs. The study of cuttings only in the bottom hole section has further limited the data, precluding crisp resolution of the age relationships of the Casterton Beds.

B. Nevertheless, the sampled section comprises correlatives of the Casterton Beds, Pretty Hill Formation and Eumeralla Formation, mature below about 1800m, and almost all non-marine. Minor brackish influence is seen in the mid Albian Eumeralla Formation, and possible also in the Casterton Beds.

V REFERENCES

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McEACHERN #1 composite palynological data a) dino b) S/P

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C L I E N T: Gas & Fuel Exploration

W E L L: McEachern #1

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

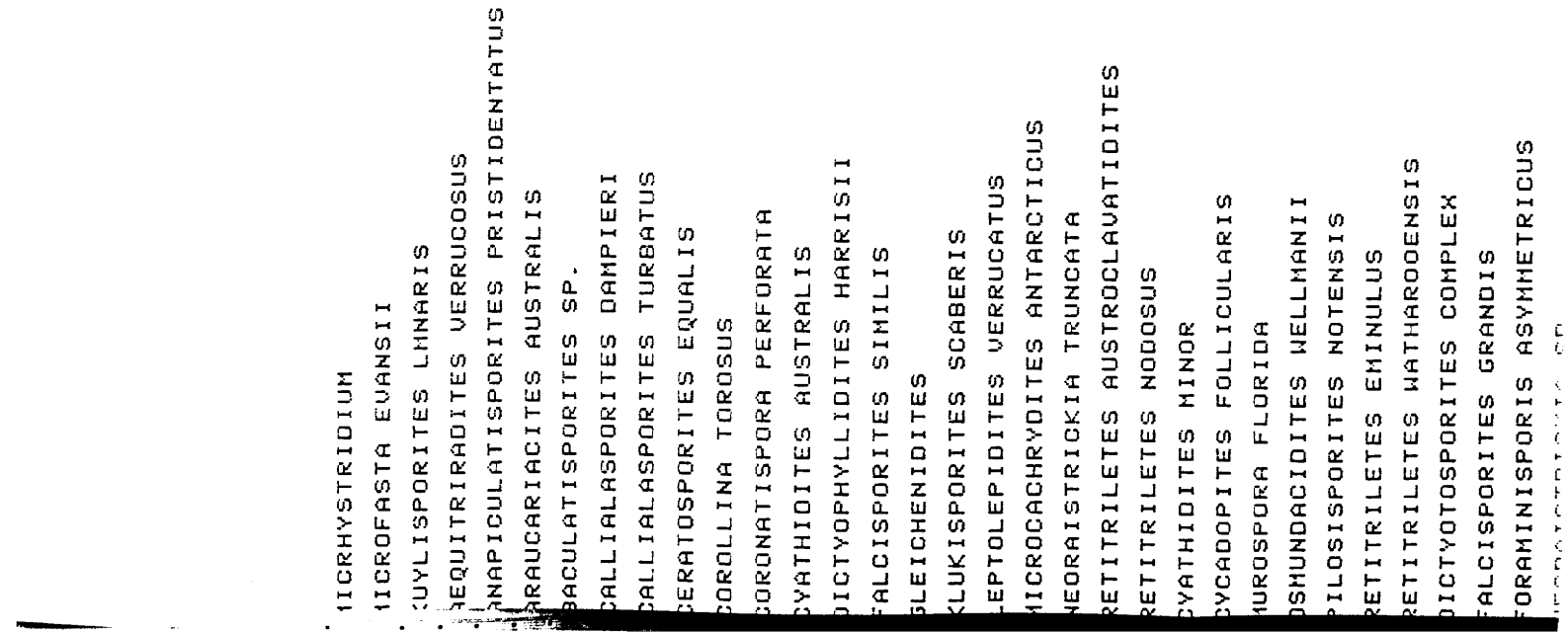
A N A L Y S T: Roger Morgan D A T E : April '90

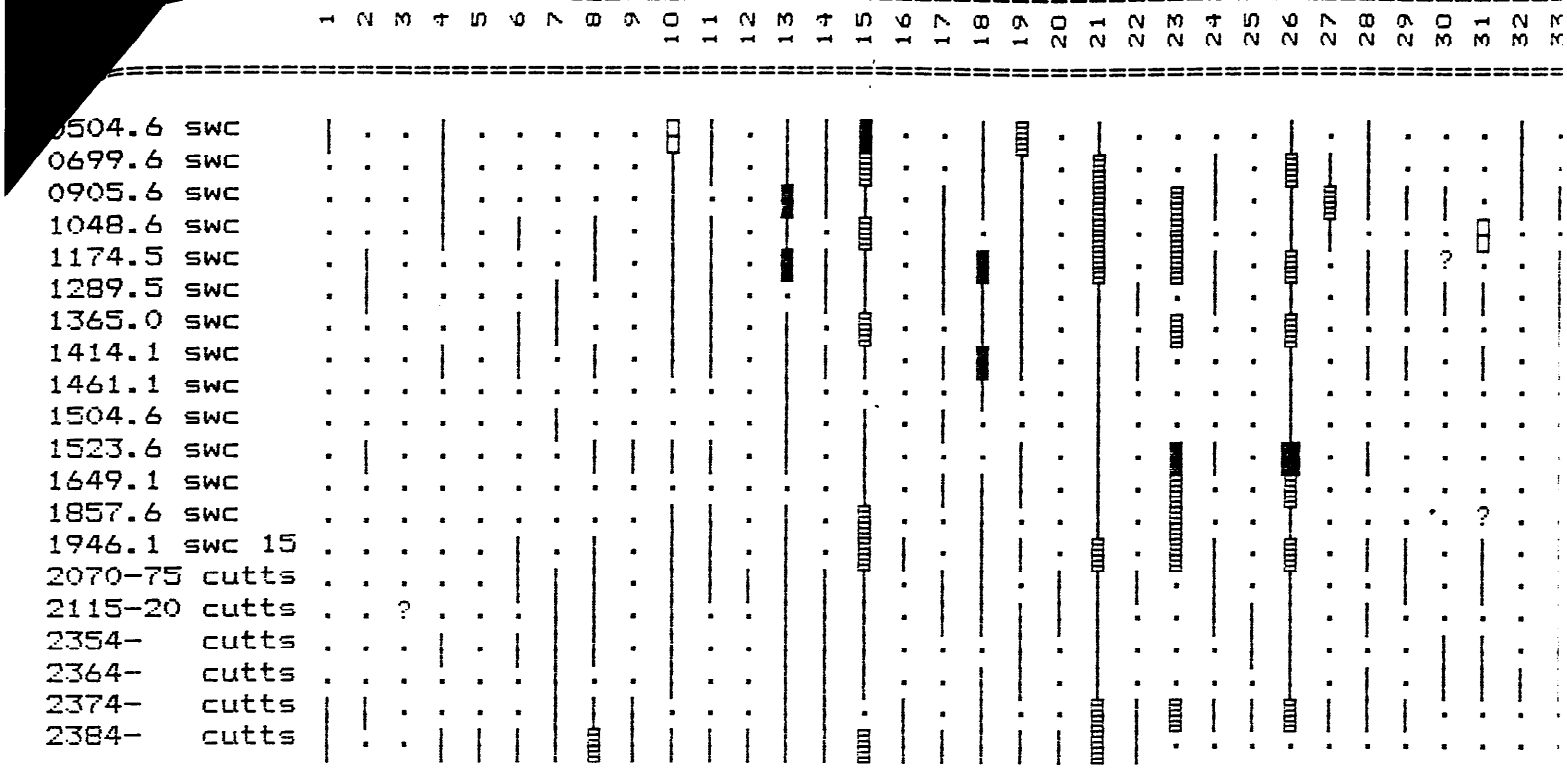
N O T E S: all sample depths are in metres

RANGE CHART OF GRAPHIC ABUNDANCES BY LOWEST APPEARANCE

Key to Symbols

| = Very Rare
▒ = Rare
▓ = Few
▓ = Common
▓ = Abundant
? = Questionably Present
. = Not Present

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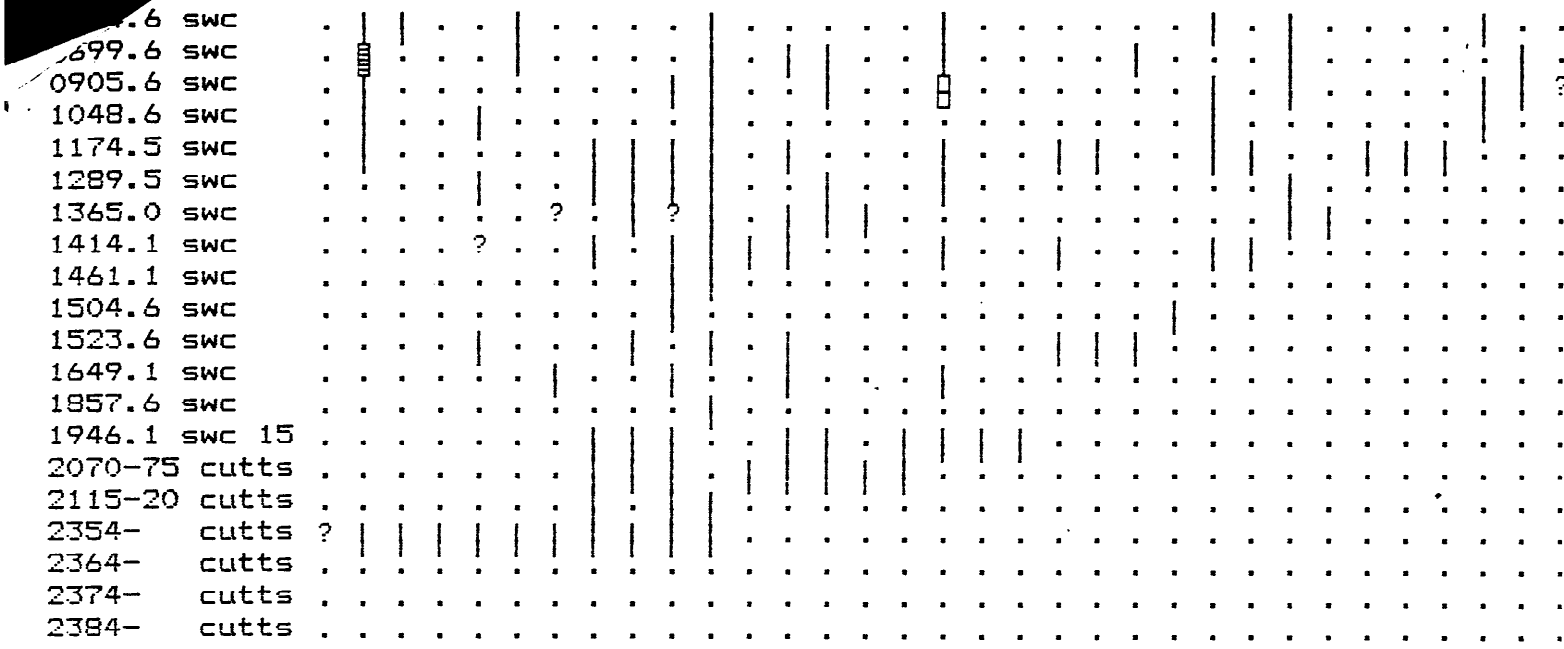
0504.6 swc
0699.6 swc
0905.6 swc
1048.6 swc
1174.5 swc
1289.5 swc
1365.0 swc
1414.1 swc
1461.1 swc
1504.6 swc
1523.6 swc
1649.1 swc
1857.6 swc
1946.1 swc 15
2070-75 cutts
2115-20 cutts
2354- cutts
2364- cutts
2374- cutts
2384- cutts

34 AEQUITRIRADITES ACUSUS
35 CICATRICOSISPORITES AUSTRALIENSIS
36 CONCAVISSIMISPORITES PENOLAENSIS
37 CONCAVISSIMISPORITES VARIVERRUCATUS
38 COROLLINA SIMPLEX
39 CRYBELOSPORITES STRIATUS
40 CYATHIDITES ASPER
41 CYCLOSPORITES HUGHESI
42 FOVEOTRILETES PARVIRETUS
43 LEPTOLEPIDITES MAJOR
44 STERIESPORITES ANTIQUASPORITES
45 LAEVIGATOSPORITES BELFORDI
46 RETITRILETES CIRCOLUMENUS
47 RETITRILETES FACETUS
48 SESTROSPORITES PSUEDOALVEOLATUS
49 VELOSPORITES TRIQUETRUS
50 DICTYOTOSPORITES SPECIOSUS
51 PERINOPOLLENITES ELATOIDES
52 STAPLINISPORITES CAMINUS
53 CONTIGNISPORITES COOKSONIAE
54 ISCHYOSPORITES PUNCTATUS
55 LYCOPODIACIDITES ASPERATUS
56 CIRCULISPORITES PARVUS
57 AEQUITRIRADITES SPINULOSUS
58 VITREISPORITES PALLIDUS
59 FORAMINISPORIS DAILYI
60 STAPLINISPORITES MANIFESTUS
61 ANNULISPORITES FOLLICULOSA
62 CONTIGNISPORITES FORNICATUS
63 PEROTRILETES LINEARIS
64 AEQUITRIRADITES TILCHAENESIS
65 FORAMINISPORIS WONTHAGGIENSIS
66 DILASICPORITES PAPILIFERINOSUS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1504.6 swc
1523.6 swc
1649.1 swc
1857.6 swc
1946.1 swc 15
2070-75 cutts
2115-20 cutts
2354- cutts
2364- cutts
2374- cutts
2384- cutts

67	TRIPOROLETES RADIATUS
68	TRIPOROLETES RETICULATUS
69	FOVEOSPORITES CANALIS
70	CINGUTRILETES CLAVUS
71	COPTOSPORA PARADOXA
72	MATONISPORITES COOKSONIAE
73	PEROTRILETES MAJUS
74	TRIPOROLETES SIMPLEX
75	SCHIZOSPORIS RETICULATA
76	SCHIZOSPORIS PSILATA
77	SCHIZOSPORIS PARVUS

0504.6 swc

0504.6 swc

[illegible] swc	0905.6 swc
[illegible].6 swc	1048.6 swc
1174.5 swc	1174.5 swc
1289.5 swc	1289.5 swc
1365.0 swc	1365.0 swc
1414.1 swc	1414.1 swc
1461.1 swc	1461.1 swc
1504.6 swc	1504.6 swc
1523.6 swc	1523.6 swc
1649.1 swc	1649.1 swc
1857.6 swc	1857.6 swc
1946.1 swc 15	1946.1 swc 15
2070-75 cutts	2070-75 cutts
2115-20 cutts	2115-20 cutts
2354- cutts	2354- cutts
2364- cutts	2364- cutts
2374- cutts	2374- cutts
2384- cutts	2384- cutts

SPECIES LOCATION INDEX

x numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
34	AEQUITRIRADITES ACUSUS
57	AEQUITRIRADITES SPINULOSUS
64	AEQUITRIRADITES TILCHAENESIS
4	AEQUITRIRADITES VERRUCOSUS
5	ANAPICULATISPORITES PRISTIDENTATUS
61	ANNULISPORITES FOLLICULOSA
6	ARAUCARIACITES AUSTRALIS
7	BACULATISPORITES SP.
8	CALLIALASPORITES DAMPIERI
9	CALLIALASPORITES TURBATUS
10	CERATOSPORITES EQUALIS
35	CICATRICOSISPORITES AUSTRALIENSIS
70	CINGUTRILETES CLAVUS
56	CIRCULISPORITES PARVUS
36	CONCAVISSIMISPORITES PENOLAENSIS
37	CONCAVISSIMISPORITES VARIVERRUCATUS
53	CONTIGNISPORITES COOKSONIAE
62	CONTIGNISPORITES FORNICATUS
71	COPTOSPORA PARADOXA
38	COROLLINA SIMPLEX
11	COROLLINA TOROSUS
12	CORONATISPORA PERFORATA
39	CRYBELOSPORITES STRIATUS
40	CYATHIDITES ASPER
13	CYATHIDITES AUSTRALIS
23	CYATHIDITES MINOR
24	CYCADOPITES FOLLICULARIS
41	CYCLOSPORITES HUGHESI
14	DICTYOPHYLLIDITES HARRISII
30	DICTYOTOSPORITES COMPLEX
50	DICTYOTOSPORITES SPECIOSUS
31	FALCISPORITES GRANDIS
15	FALCISPORITES SIMILIS
32	FORAMINISPORIS ASYMMETRICUS
59	FORAMINISPORIS DAILYI
65	FORAMINISPORIS WONTHAGGIENSIS
69	FOVEOSPORITES CANALIS
42	FOVEOTRILETES PARVIRETUS
16	GLEICHENIDITES
54	ISCHYOSPORITES PUNCTATUS
17	KLUKISPORITES SCABERIS
3	KUYLISPORITES LMNARIS
45	LAEVIGATOSPORITES BELFORDI
43	LEPTOLEPIDITES MAJOR
18	LEPTOLEPIDITES VERRUCATUS
55	LYCOPODIACIDITES ASPERATUS
72	MATONISPORITES COOKSONIAE
1	MICRHYSTRIDIUM
19	MICROCACHRYDITES ANTARCTICUS
2	MICROFASTA EVANSII
25	MUROSPORA FLORIDA
33	NEORAISTRICKIA SP.
20	NEORAISTRICKIA TRUNCATA
26	OSMUNDACIDITES WELLMANII
51	PERINOPOLLENITES ELATOIDES
63	PEROTRILETES LINEARIS
73	PEROTRILETES MAJUS
27	PILOSISPORITES NOTENSIS
66	PILOSISPORITES PARVISPINOSUS
21	RETITRILETES AUSTROCLAVATIDITES
46	RETITRILETES CIRCOLUMENUS
28	RETITRILETES EMINULUS
47	RETITRILETES FACETUS

29 RETITRILETES WATHAROOENSIS
77 SCHIZOSPORIS PARVUS
76 SCHIZOSPORIS PSILATA
75 SCHIZOSPORIS RETICULATA
48 SESTROSPORITES PSUEDOALVEOLATUS
52 STAPLINISPORITES CAMINUS
60 STAPLINISPORITES MANIFESTUS
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