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NEW PALYNOLOGY OF ROSS CREEK-1

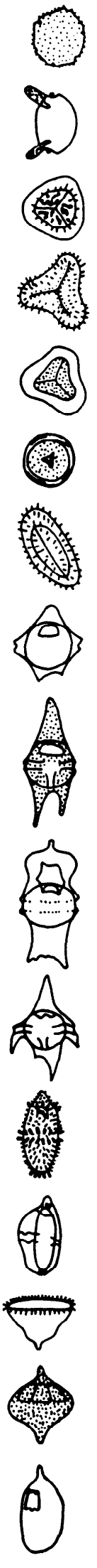
ONSHORE OTWAY BASIN, AUSTRALIA

BY

ROGER MORGAN

for BHP Australia

August 1992
REF:OTW.ROSSCREK



NEW PALYNOLOGY OF ROSS CREEK-1

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CONTENTS

I SUMMARY

Twelve new cuttings from the early Cretaceous have been studied as reported herein. No previous raw data is available, nor are the original microscope slides, perhaps lost in the Brisbane flood. The text of the original report by Wilschut (undated) has been used in conjunction with the new samples to produce the breakdown herein. Confidence is low however, in the absence of good swc based data.

670m(swc)-764m(swc) : apoxyexinus Zone (aceras dino Zone) according to Wilschut data : Santonian : marine

814m(swc)-978m(swc) : ?pannosus Zone according to Wilschut : ?latest Albian marginal marine

1009m(swc)-1093m(swc) : ?paradoxa Zone according to Wilschut : ? Albian : non-marine

1101m(swc)-1769m(swc) : upper paradoxa Zone in my interpretation of Wilschut : Albian : non-marine

1900m(swc)-1997m(swc) : paradoxa Zone, subzone uncertain on my interpretation of Wilschut : Albian : non-marine

2057m(swc)-2181m(swc) : lower paradoxa Zone on my interpretation of Wilschut : Albian : non-marine

2213m(swc)-2249m(new cutts and Wilschut swc) : striatus Zone : early Albian : non-marine

2282m(swc)-2399m(new cutts) upper hughesi Zone (to partly striatus Zone) : Aptian : non-marine

2530m(new cutts)-3287m(swc) : lower hughesi Zone : Aptian : non-marine

3289m(new cutts)-3659m(cutts) : apparently all lower hughesi but possibly partly wonthaggiensis Zone : apparently Aptian with possibly some Neocomian : non-marine

II INTRODUCTION

Ross Creek-1 was drilled by Shell and palynologically studied by Wilschut (undated) for the completion report using an extensive suite of 95 swcs, 2 cuttings and 1 grab sample. Neither the raw data nor the original microscope slides are available and so the interpretation cannot be assessed in the light of modern knowledge. Wilschut's running text does mention some important datums, and these are used herein to assign the section. Twelve new cuttings from the Early Cretaceous were submitted for study by Paul Carroll and David Pickavance of BHP Petroleum, but these were never intended to be exhaustive for biostratigraphy. The total data set enables assignment to the Cretaceous zonation as most recently summarized in Helby, Morgan and Partridge (1987). Raw data are presented as Appendix 1.

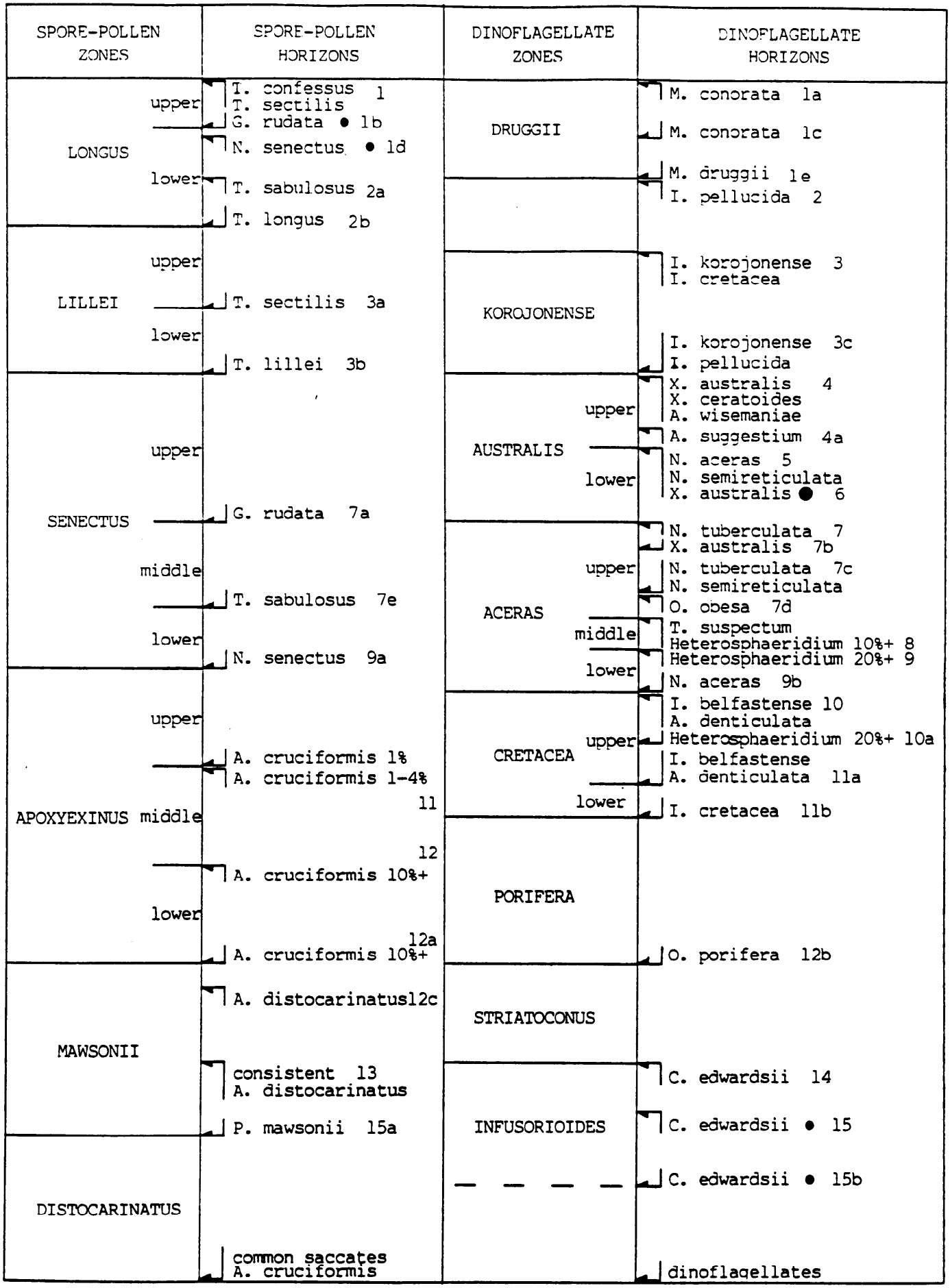

FIGURE 1 ZONATION USED HEREIN SHOWING THE NUMBERED HORIZONS AGAINST THE EXISTING FORMAL ZONATION.

• =frequent (4-10%) ● =common (11-30%)

III PALYNOSTRATIGRAPHY

A 670m(swc) - 764m(swc) : apoxyexinus Zone (aceras dino Zone) according to Wilschut

No raw data exists for this interval, but Wilschut indicates the apoxyexinus Zone (Tricolporites apoxyexinus without Nothofagidites senectus) and the aceras dinoflagellate zone (Nelsoniella aceras without younger markers). A late Santonian age is thus indicated, probably including the marine maximum associated with horizons 8,9 and 9b. In the current study, N. senectus has proven very scarce near its base range, and so its absence is not definitive and a senectus spore-pollen zone is possible.

Wilschut assigns a nearshore environment, but I cannot assess this in the absence of raw data. The apoxyexinus Zone occurs usually in shaley facies of the Sherbrook Group.

B 814m(swc) - 978m(swc) : ?pannosus Zone according to Wilschut

Wilschut indicates the Phimopollenites pannosus Zone of latest Albian age on oldest P. pannosus to the base. However, he also describes dinoflagellates Ascodinium parvum, Odontochitina operculata and Veryhachium to the interval base. In my extensive Otway Basin experience, these dinoflagellates are almost without exception restricted to the distocarinatus Zone and younger. Thus I suspect either the distocarinatus Zone or downhole contamination of these swcs. In the absence of raw data, other evidence cannot be assessed.

Wilschut indicates possible marginal marine environments.

The pannosus Zone occurs at the top Eumeralla Formation, while the distocarinatus Zone occurs in the basal Sherbrook Group.

C 1009m(swc) - 1093m(swc) : ?paradoxa Zone according to Wilschut

Wilschut only questionably assigns this interval to the paradoxa Zone of Albian age and I cannot assess it in the absence of detailed discussion or raw data. He assigns continental environments.

D 1101m(swc) -1769m(swc) : upper paradoxa Zone on my interpretation of Wilschut

Wilschut assigns this interval confidently to the mid to late Albian paradoxa Zone without subdivision. His discussion however indicates that Pilosisporites grandis occurs 1604-1769m and I consider this to be upper paradoxa-pannosus Zones restricted. He also notes Trilobosporites trioreticulosus down to 1664m, reinforcing the upper paradoxa assignment. Thus my interpretation of Wilschut's data indicates the assignment.

Wilschut indicates continental environments.

The upper paradoxa Zone occurs in the upper Eumeralla Formation of Kopsen and Scholefield.

E 1900m(swc)-1997m(swc) : paradoxa Zone, subzone uncertain

Wilschut indicates Coptospora paradoxa down to 2181m and so all this interval is assigned to the paradoxa Zone. The absence of younger markers above and older ones beneath means that subzonal assignment is not possible.

Wilschut indicates continental environments.

F 2057m(swc) - 2181m(swc) : lower paradoxa Zone on my interpretation of Wilschut

Wilschut's running text indicates youngest Pilosisporites notensis at 2057m, youngest Dictyotosporites speciosus at 2122, and oldest C. paradoxa at 2181m. These datums indicate the lower paradoxa Zone of mid Albian age. Wilschut assigns the interval to the paradoxa Zone without subdivision. Wilschut indicates continental environments.

The lower paradoxa Zone occurs in the upper Eumeralla Formation.

G 2213m(swc)-2249m(new cutts and Wilschut swc) striatus Zone

Assignment to the Crybelosporites striatus Zone of early Albian age is indicated by Wilschut although he clearly states that C. striatus occurs a short distance beneath, overlapping with Cyclosporites hughesi.

I would pick the base of the striatus Zone on oldest C. striatus, but in the absence of raw data am unable to do so. The one new cuttings sample in this interval contains C. striatus but lacks C. hughesi. Osmundacidites wellmannii is very common, with Falcisporites, Cyathidites and Cicatricosisporites australiensis common. Pilosisporites spp are consistent.

Wilschut indicates continental environments. I concur, given the absence of saline indicators and the abundant and diverse spore-pollen. Rare algal acritarchs (Schizosporis spp) indicate that lacustrine influence is minor.

Light brown spore colours indicate immaturity to marginal maturity for oil generation.

H 2282m(swc) - 2399m(new cutts) : upper hughesi Zone (top striatus Zone)

Wilschut assigns this interval and that below to the Cyclosporites hughesi Zone of Aptian age without subdivision, on youngest C. hughesi at the top and apparently on the absence of Murospora florida at the base. At the top, however, C. striatus was seen in swcs, as discussed above. Four new cuttings were studied herein from this interval but all contain C. striatus (which may be caved) and lack C. hughesi (which can be rare). Common taxa are Cyathidites spp, Falcisporites, Osmundacidites and Microcachryidites. Frequent taxa include C. australiensis and Retitriletes austroclavatidites. P. notensis and F. asymmetricus are consistent and have spore colours consistent with being "in place" and not caved.

Wilschut indicates continental environments. I concur, with abundant and diverse spore dominated microfloras, absence of marine indicators, common cuticle and only rare algal acritarchs (Schizosporis).

Light brown spore colours indicate immaturity to marginal maturity for oil generation.

I 2530m(new cutts) - 3287m(swc) : lower hughesi Zone

Assignment to the lower Cyclosporites hughesi Zone of Aptian age is indicated at the top by youngest Cooksonites variabilis (in new cutts herein - Wilschut data not available) and at the base by oldest P. notensis in swcs (Wilschut data). Wilschut assigns the

entire interval to the hughesi Zone. Within the interval, two new cuttings contain dominant Cyathidites with common Osmundacidites, R. austroclavatidites and Falcisporites. Rare but age significant forms include C. variabilis, F. asymmetricus (down to 2548m cutts), C. hughesi and P. notensis. This interval is firmly assigned to the hughesi Zone and the correlative Eumeralla Formation. Below this point, assignment is less certain.

Wilschut indicates continental environments and I concur with abundant and diverse spore-pollen, absent dinoflagellates, and very rare algal acritarchs.

Mid brown to dark brown spore colours indicate maturity to full maturity in this interval.

The lower hughesi Zone occurs in the lower part of the Barikewa Formation above the "top Pretty Hill unconformity."

J 3289m(new cutts) - 3659m(cutts) : lower hughesi to ?upper wonthaggiensis Zone

Assignment of this interval is much less certain. Wilschut assigned it all to the hughesi Zone on the absence of M. florida at the base. I saw P. notensis with spore colours suggesting "in place" down to 3557m (new cuttings) but it could be caved. If in place, it indicates hughesi Zone and correlation with the Eumeralla Formation. C. australiensis was seen by me in new cuttings down to 3557m and by Wilschut to 3547m in swc and 3659m in cuttings and is very rare below the hughesi Zone and hardly ever seen below upper wonthaggiensis Zone. It too, suggests that Pretty Hill equivalents may not have been penetrated. The absence of Microfasta evansii from my new cuttings further suggests that the

wonthaggiensis Zone (and Pretty Hill equivalents) have not been penetrated. In the new cuttings, Cyathidites are totally dominant (40-50% of palynomorphs) while Osmundacidites, and Falcisporites are also common. Rare but consistent are C. australiensis, D. speciosus and P. notensis. However, given the high organic maturity, it is possible that the "in situ" assemblages may be largely destroyed by carbonization and the specimens seen may be partly or largely caved. In all, confidence is low without the raw data or swc preparations.

Wilschut indicates continental environments and I concur, given the common and diverse spore-pollen, absence of dinoflagellates and only very rare algal acritarchs.

Dark brown to black spore colours indicate full maturity to post maturity for this section for oil and full maturity for gas/condensate.

IV CONCLUSIONS

A Little can be added to the existing breakdown of Wilschut in the absence of the original data or microscope slides. New cuttings might better define the thin late Cretaceous, but the early Cretaceous zonation is difficult to work on cuttings alone.

B The Cretaceous section comprises a thick Eumeralla Formation equivalent, but there is no positive or definitive evidence that the "top Pretty Hill unconformity" has been penetrated, and Pretty Hill Formation equivalents drilled. The late Cretaceous is apparently thin and sandy and few data are available. I have not seen logs for this well.

V REFERENCES

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Helby RJ, Morgan RP and Partridge AD (1987) A palynological zonation of the Australian Mesozoic Mem. Ass. Australas. Palaeontols. Mem 4, 1-94

Lowry DC, and Longley IM (1991) A new model for the mid-Cretaceous structural history of the northern Gippsland Basin APEA J 31(1) 143-153

Wilschut JG (undated) Palynological report Shell Ross Creek-1 unpubl. rept.

ROSS CREEK #1

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C L I E N T: BHP PETROLEUM

W E L L: ROSS CREEK #1

F I E L D / A R E A: ONSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

A N A L Y S T: ROGER MORGAN D A T E : FEBRUARY 1992

N O T E S: ALL DEPTHS IN METRES
FIGURES ARE PERCENTAGES

RANGE CHART OF OCCURRENCES BY HIGHEST APPEARANCE, IN GROUPS

1	SCHIZOSPORIS PARVUS
2	SCHIZOSPORIS PSILATUS
3	SCHIZOSPORIS RETICULATUS
4	AEQUITRIRADITES SPINULOSUS
5	ARAUCARIACITES AUSTRALIS
6	CALLIALASPORITES TURBATUS
7	CERATOSPORITES EQUALIS
8	CICATRICOSISPORITES AUSTRALIENSIS
9	COPTOSPORA PARADOXA
10	COROLLINA TOROSUS
11	CRYBELOSPORITES STRIATUS
12	CYATHIDITES AUSTRALIS
13	CYATHIDITES MINOR
14	FALCISPORITES GRANDIS
15	FALCISPORITES SIMILIS
16	FORAMINISPORIS ASYMMETRICUS
17	FORAMINISPORIS DAILYI
18	FORAMINISPORIS WONTHAGGIENSIS
19	FOVEOTRILETES PARVIRETUS
20	JANUASPORITES SPINULOSUS
21	MICROCACHRYIDITES ANTARCTICUS
22	OSMUNDACIDITES WELLMANII

2249	CUTTS	X	X	.	X	3	4	1	9	?	3	X	16	11	3	21	X	X	X	X	X	2	25
2301	CUTTS	.	.	X	.	.	1	X	7	.	.	2	28	5	2	25	4	2	2	.	.	5	10
2326	CUTTS	.	.	X	.	5	.	.	5	.	3	2	20	10	1	25	X	1	.	.	1	13	7
2362	CUTTS	.	1	.	1	4	1	2	7	.	1	1	27	13	4	14	X	.	X	.	.	5	14
2399	CUTTS	.	.	.	1	3	.	3	4	.	3	1	16	10	7	22	2	1	2	.	.	6	13
2530	CUTTS	.	.	.	X	2	.	1	3	.	.	X	31	12	7	11	1	X	.	1	X	2	11
2548	CUTTS	X	.	.	X	6	1	1	1	.	1	X	25	21	.	19	X	1	.	.	.	5	9
3261	CUTTS	.	.	.	.	2	.	2	2	.	5	.	32	6	1	8	.	.	.	.	.	9	9
3289	CUTTS	.	.	X	.	3	4	.	X	.	1	.	47	8	1	7	.	.	.	.	.	3	13
3325	CUTTS	.	.	.	.	1	3	.	2	.	3	.	30	18	1	4	.	.	2	.	.	2	12
3356	CUTTS	.	.	.	.	4	.	.	.	.	2	.	27	13	3	16	.	.	.	.	.	2	15
3557	CUTTS	.	.	X	X	4	.	2	3	.	.	.	27	12	3	13	.	.	1	.	.	1	23

7249 CUTTS	7301 CUTTS	2326 CUTTS	2362 CUTTS	1399 CUTTS	1530 CUTTS	2548 CUTTS	7261 CUTTS	7289 CUTTS	3325 CUTTS	7254 CUTTS		
X	X	X	X	X	X	X	X	X	X	X	23	PILOSISPORITES NOTENSIS
.	X	.	X	.	.	X	.	.	.	.	24	PILOSISPORITES PARVISPINOSUS
3	3	2	5	5	10	8	13	5	13	7	25	RETITRILETES AUSTROCLAVATIDITES
X	X	X	X	X	X	X	.	.	.	.	26	RETITRILETES FACETUS
X	.	X	1	.	.	.	1	.	.	.	27	STEREISPORITES ANTIQUASPORITES
X	.	X	X	.	.	.	.	.	.	.	28	TRIPOROLETES RADIATUS
X	X	X	X	.	.	.	.	.	.	.	29	TRIPOROLETES RETICULATUS
.	X	X	.	X	1	X	3	.	1	.	30	DICTYOTOSPORITES SPECIOSUS
1	.	1	.	1	1	1	.	.	1	.	31	GLEICHENIIDITES
2	X	X	.	.	1	X	X	.	.	.	32	KLUKISPORITES SCABERIS
2	X	X	.	.	2	X	4	1	2	.	33	LEPTOLEPIDITES VERRUCATUS
X	X	X	X	X	X	.	.	1	X	.	34	AEQUITRIRADITES VERRUCOSUS
.	.	X	.	.	X	X	.	.	.	.	35	COOKSONITES VARIABILIS
.	.	1	.	.	.	.	.	.	.	.	36	COUPERISPORITES TABULATUS
.	.	1	.	.	1	.	.	.	.	.	37	CYCADOPITES FOLLICULARIS
.	.	X	.	.	.	.	.	.	.	.	38	SESTROSPORITES PSEUDOALVEOLATUS
.	.	1	.	.	.	.	.	.	.	.	39	TRIPOROLETES SIMPLEX
.	.	.	X	X	.	2	.	.	.	1	40	CINGUTRILETES CLAVUS
.	.	X	.	.	.	.	.	.	.	.	41	CONCAVISSIMISPORITES PENOLAENSIS
.	.	X	.	.	.	.	.	.	.	.	42	PILOSISPORITES GRANDIS
.	.	.	X	.	.	.	.	.	.	.	43	AEQUITRIRADITES TILCHAENSIS
.	.	.	X	X	X	.	.	.	.	.	44	FORAMINISPORIS RETICULOWONTHAGGIENSIS

3557	CUTTS		X	.	8	.	.	.	.	X	.	.	1	1	X	.	.	.	.	.	.	.	.	.	.

		TRILOBOSPORITES TRIBOTRYS	CALLIALASPORITES DAMPIERI	CYCLOSPORITES HUGHESI	DICTYOTOSPORITES COMPLEX	RETITRILETES CIRCOLUMENUS	RETITRILETES NODOSUS	ISCHYOSPORITES PUNCTATUS	LEPTOLEPIDITES MAJOR	NEORAISTRICKIA	PEROTRILETES WHITFORDENSIS	RETITRILETES WATHAROOENSIS	TRILOBOSPORITES PURVERULENTUS	
		45	46	47	48	49	50	51	52	53	54	55	56	
2249	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	2249 CUTTS
2301	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	2301 CUTTS
2326	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	2326 CUTTS
2362	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	2362 CUTTS
2399	CUTTS	X	.	.	.	.	.	.	.	.	.	.	.	2399 CUTTS
2530	CUTTS	.	1	X	X	X	X	.	.	.	.	.	.	2530 CUTTS
2548	CUTTS	.	.	.	.	X	.	X	X	X	X	X	.	2548 CUTTS
3261	CUTTS	.	.	.	.	X	.	X	.	1	.	1	.	3261 CUTTS
3289	CUTTS	.	4	.	.	.	.	.	.	1	.	.	X	3289 CUTTS
3325	CUTTS	.	5	.	.	.	.	.	.	.	.	.	.	3325 CUTTS
3356	CUTTS	.	6	.	.	.	.	X	.	.	.	.	.	3356 CUTTS
3557	CUTTS	.	.	.	.	X	.	.	.	.	.	.	.	3557 CUTTS

SPECIES LOCATION INDEX

Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
4	AEQUITRIRADITES SPINULOSUS
43	AEQUITRIRADITES TILCHAENSIS
34	AEQUITRIRADITES VERRUCOSUS
5	ARAUCARIACITES AUSTRALIS
46	CALLIALASPORITES DAMPIERI
6	CALLIALASPORITES TURBATUS
7	CERATOSPORITES EQUALIS
8	CICATRICOSISPORITES AUSTRALIENSIS
40	CINGUTRILETES CLAVUS
41	CONCAVISSIMISPORITES PENOLAENSIS
35	COOKSONITES VARIABILIS
9	COPTOSPORA PARADOXA
10	COROLLINA TOROSUS

58	COOPERISPORITES TABULATUS
11	CRYBELOSPORITES STRIATUS
12	CYATHIDITES AUSTRALIS
13	CYATHIDITES MINOR
37	CYCADOPITES FOLLICULARIS
47	CYCLOSPORITES HUGHESI
48	DICTYOTOSPORITES COMPLEX
30	DICTYOTOSPORITES SPECIOSUS
14	FALCISPORITES GRANDIS
15	FALCISPORITES SIMILIS
16	FORAMINISPORIS ASYMMETRICUS
17	FORAMINISPORIS DAILYI
44	FORAMINISPORIS RETICULOWONTHAGGIENSIS
18	FORAMINISPORIS WONTHAGGIENSIS
19	FOVEOTRILETES PARVIRETUS
31	GLEICHENIIDITES
51	ISCHYOSPORITES PUNCTATUS
20	JANUASPORITES SPINULOSUS
32	KLUKISPORITES SCABERIS
52	LEPTOLEPIDITES MAJOR
33	LEPTOLEPIDITES VERRUCATUS
21	MICROCACHRYIDITES ANTARCTICUS
53	NEORAISTRICKIA
22	OSMUNDACIDITES WELLMANII
54	PEROTRILETES WHITFORDENSIS
42	PILOSISPORITES GRANDIS
23	PILOSISPORITES NOTENSIS
24	PILOSISPORITES PARVISPINOSUS
25	RETITRILETES AUSTROCLAVATIDITES
49	RETITRILETES CIRCOLUMENUS
26	RETITRILETES FACETUS
50	RETITRILETES NODOSUS
55	RETITRILETES WATHAROOENSIS
1	SCHIZOSPORIS PARVUS
2	SCHIZOSPORIS PSILATUS
3	SCHIZOSPORIS RETICULATUS
38	SESTROSPORITES PSEUDOALVEOLATUS
27	STEREISPORITES ANTIQUASPORITES
56	TRILOBOSPORITES PURVERULENTUS
45	TRILOBOSPORITES TRIBOTRYS
28	TRIPOROLETES RADIATUS
29	TRIPOROLETES RETICULATUS
39	TRIPOROLETES SIMPLEX

PALYNOLOGICAL DATA SHEET

BASIN: OTWAY SPORE-POLLEN ZONES ELEVATION: KB: _____ GL: _____

WELL NAME: ROSS CREEK-1 TOTAL DEPTH: _____

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
			Preferred Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg	Alternate Depth	Rtg
NEOGENE	Plei	T. pleistocenicus								
	Plio	M. lipsus								
	Mio	C. bifurcatus								
		T. bellus								
		P. tuberculatus								
	Olig	upper N. asperus								
PALEOGENE	L.Eo	mid N. asperus								
	Mid Eo	lower N. asperus								
		P. asperopolus								
	Earl Eo	upper M. diversus								
		mid M. diversus								
		lower M. diversus								
	Pale	upper L. balmei								
		lower L. balmei								
LATE CRETACEOUS	Maas	upper T. longus								
		lower T. longus								
		T. lillei								
	Camp	N. senectus								
	Sant	up T. apoxyexinus	670	1						
		mid T. apoxyexinus								
	Con	low T. apoxyexinus					764	1		
	Tur	P. mawsonii								
	Ceno	A. distocarinatus								
EARLY CRETACEOUS	Alb	P. pannosus ✲/	814	?			978	?		
		upper C. paradoxa	1101	1			1769	0		
		lower C. paradoxa	2057	1			2181	1		
		C. striatus	2213	2			2249	?		
	Apt	upper C. hughesi	2282	2			2399	5		
		lower C. hughesi	2530	3			3287	0	3659	?
	l.Ne	F. wonthaggiensis								
	e.Ne	up C. australiensis								

Environments :

- o lacustrine (algal acritarchs).
- non-marine (no or very few 5% algal acritarchs).
- ✲ brackish (spiny acritarch, no or very few dinoflagellates 1%).
- ✲/ marginal marine (1-5% very low diversity dinoflagellates).
- nearshore marine (6-30% low to medium diversity dinoflagellates).
- / intermediate marine (31-60% medium diversity dinoflagellates).
- offshore marine (61%-80% medium to high diversity dinoflagellates).
- far offshore marine/oceanic (81%-100% high diversity dinoflagellates and/or planktonic forams).

Confidence Ratings :

0 : good to excellent with numerous zone fossils in core/swc.
1 : fair with rare zone fossils in core/swc.
2 : poor with non-diagnostic assemblage in core/swc. Often occurs next to a distinctive 0 to 1 rating, lacking the zone fossil seen adjacent.
3 : good with extinction event (top range) in cuttings.
4 : poor to fair with inception event (base range) in cuttings and therefore may be picked too low if caved or too high if swamped by cavings.
5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.
? : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan Feb 1992, Wilschut undated

Data revised by : Roger Morgan Feb 1992

PALYNOLOGICAL DATA SHEET

BASIN: OTWAY DINOFLAGELLATE ZONES ELEVATION: KB: ________ GL: ________

WELL NAME: ROSS CREEK-1 TOTAL DEPTH: ________

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA Preferred Depth	Rtg	HIGHEST DATA Alternate Depth	Rtg	LOWEST DATA Preferred Depth	Rtg	LOWEST DATA Alternate Depth	Rtg
LATE CRETACEOUS	Maas	M. druggii								
	Camp	I. korojonense								
		upper X. australis								
		lower X. australis								
	Sant	N. aceras ♁	670	2			764	0		
		I. cretaceum								
	Con	O. porifera								
	Turo	C. striatoconus								
	Ceno	P. infusorioides								

Environments :

- ○ lacustrine (algal acritarchs).
- ∅ non-marine (no or very few 5% algal acritarchs).
- ✡ brackish (spiny acritarch, no or very few dinoflagellates 1%).
- ✡/♁ marginal marine (1-5% very low diversity dinoflagellates).
- ♁ nearshore marine (6-30% low to medium diversity dinoflagellates).
- ♁/♁♁ intermediate marine (31-60% medium diversity dinoflagellates).
- ♁♁ offshore marine (61%-80% medium to high diversity dinoflagellates).
- ⊖ far offshore marine/oceanic (81%-100% high diversity dinoflagellates and/or planktonic forams).

Confidence Ratings :

0 : good to excellent with numerous zone fossils in core/swc.
1 : fair with rare zone fossils in core/swc.
2 : poor with non-diagnostic assemblage in core/swc. Often occurs next to a distinctive 0 to 1 rating, lacking the zone fossil seen adjacent.
3 : good with extinction event (top range) in cuttings.
4 : poor to fair with inception event (base range) in cuttings and therefore may be picked too low if caved or too high if swamped by cavings.
5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.
? : no confidence, Picked as a best guess in very poor data.

Data recorded by : Roger Morgan Feb 1992, Wilschut undated

Data revised by : Roger Morgan Feb 1992