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PALYNOLOGY OF 6 NEW SAMPLES FROM MINERVA-1

OTWAY BASIN, AUSTRALIA

BY

ROGER MORGAN

APRIL 1994

I SUMMARY

860-70m(cutts) : apparently *longus* Zone but may be caved (*balmei* and *longus* elements caving to mask *lillei* Zone) : apparently Maastrichtian : very nearshore : immature.

2089.0m(swc) : *mawsonii* Zone (*infusorioides* dino Zone) : Coniacian-Turonian : very nearshore : marginally mature.

2215.0m(swc) : almost barren and indeterminate.

2273-79m(cutts) : *distocarinatus* Zone : Cenomanian : non-marine lacustrine : marginally mature.

2319.0m(swc), 2359.5m(swc) : possibly *paradoxa* Zone but not typically so (identical to earlier samples) : possibly Albian : slightly brackish : early mature for oil.

II INTRODUCTION

These samples were submitted by Simon Horan to clarify aspects of the palynology as reported at well completion. The zonation used is that for Minerva-1 (Morgan and Hooker 1994). Raw data is presented in Appendix I.

D 2273-79m(cutts) : *distocarinatus* Zone

Assignment to the *A. distocarinatus* Spore Pollen Zone is indicated by the presence of *A. distocarinatus* without younger or older markers. *Falcisporites* spp. are abundant with *Cyathidites* and *Microcachryidites* frequent. Minor Permian reworking was seen.

Non-marine environments are indicated by the total lack of dinoflagellates and the abundant and diverse spore pollen. Common freshwater algae (13% *Botryococcus*) suggest a lake environment.

Light brown spore colour indicates marginal maturity for oil and immaturity for gas/condensate.

E 2319.0m(swc), 2359.5m(swc) : possibly *paradoxa* Zone

Both assemblages are rather bland, dominated by common to abundant *Falcisporites* with common *Cyathidites* and *Microcachryidites*. A *distocarinatus* was absent, *C. paradoxa* extremely rare at 2319m only, and *F. asymmetricus* very rare in both samples. *Cicatricosisporites australiensis* was consistent in both (4% and 2% downhole). Overall, the assemblage is identical to those already described from Minerva-1 but lacks the spore diversity and frequency of *C. paradoxa* normally seen in the Eumeralla Formation. As previously discussed this may be due to the sandy lithofacies. The samples are therefore considered "?possibly *paradoxa* Zone, but not typically so."

Extremely rare spiny acritarchs (<1% and 2% downhole) and diverse and abundant spore pollen indicate brackish environments.

Mid to light brown spore colours indicate early maturity for oil but early marginal maturity for gas/condensate.

IV CONCLUSIONS

The 870m sample suggests that the *lillei* Zone is extremely or faulted out in the sample gap 870m to 897m. The logs also suggest some lost section at this point, relative to Minerva-2A.

The 2087m sample extends the base of the *mawsonii* Zone down the well by 3m and places it within the distinctive basal *mawsonii* claystone marker.

The 2215.0m swc was intended to document the *distocarinatus* Zone but was too lean to provide definitive data. The cuttings at 2279m extends the *distocarinatus* Zone down to close to the top of the "Eumeralla Sands."

The two basal swcs were intended to document the assemblage in the "Eumeralla Sands" and hopefully provide an undisputed *paradoxa* assignment. The assemblages were not significantly different from those described earlier.

V REFERENCES

Morgan R and Hooker N (1993) Final palynology of BHPP Minerva-1, offshore Otway Basin, Victotria, Australia **unpubl. rept. for BHPP**.

OTW.MINERV6

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

WELL NAME: MINERVA-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								
NEOGENE	Plio	M. lipsus								
NEOGENE	Mio	C. bifurcatus								
NEOGENE	Mio	T. bellus								
NEOGENE	Mio	P. tuberculatus								
PALEOGENE	Olig	upper N. asperus								
PALEOGENE	L.Eo	mid N. asperus								
PALEOGENE	Mid Eo	lower N. asperus								
PALEOGENE	Mid Eo	P. asperopolus								
PALEOGENE	Earl Eo	upper M. diversus								
PALEOGENE	Earl Eo	mid M. diversus ♀/☼	563	2			594	0		
PALEOGENE	Earl Eo	lower M. diversus ♀/☼	617	2			617	0		
PALEOGENE	Pale	upper L. balmei ♀	627	0			651	0		
PALEOGENE	Pale	lower L. balmei ♀/☼	760	2			760	0		
LATE CRETACEOUS	Maas	upper T. longus Ø/	783	0						
LATE CRETACEOUS	Maas	lower T. longus /♀					839	0	870	?
LATE CRETACEOUS		T. lillei								
LATE CRETACEOUS	Camp	N. senectus ☼/♀	897	2			1166	0		
LATE CRETACEOUS	Sant	up T. apoxyexinus ♀	1179	2			1453	2		
LATE CRETACEOUS	Sant	mid T. apoxyexinus ♀	1502	1			1597	2		
LATE CRETACEOUS	Con	low T. apoxyexinus ♀	1616	3			1805	1		
LATE CRETACEOUS	Tur	P. mawsonii Ø/♀	1820	3			2089	0		
LATE CRETACEOUS	Ceno	A. distocarinatus ☼/♀	2098	2			2142	0	2279	4
EARLY CRETACEOUS	Alb	P. pannosus								
EARLY CRETACEOUS	Alb	upper C. paradoxa ☼	?2294							
EARLY CRETACEOUS	Alb	lower C. paradoxa ☼					?2425			
EARLY CRETACEOUS	Alb	C. striatus								
EARLY CRETACEOUS	Apt	upper C. hughesi								
EARLY CRETACEOUS	Apt	lower C. hughesi								
EARLY CRETACEOUS	l.Neo	F. wonthaggiensis								
EARLY CRETACEOUS	e.Neo	up C. australiensis								

Environments :

- o lacustrine (algal acritarchs).
- Ø 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).
- θ 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 and Nigel Hooker Sept 83

Data revised by : Roger Morgan April 94

PALYNOLOGICAL DATA SHEET

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

WELL NAME: MINERVA-1 TOTAL DEPTH: ______

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA Preferred Depth	Rtg	Alternate Depth	Rtg	LOWEST DATA Preferred Depth	Rtg	Alternate Depth	Rtg
LATE CRETACEOUS	Maas	M. druggii ♀	783	0			783	0		
	Camp	I. korojonense								
	Camp	upper X. australis ♀/☆	897	0			897	2		
	Camp	lower X. australis ♀/☆	954	1			991	0		
	Sant	N. aceras ♀	1054	1			1298	0		
	Sant	I. cretaceum ♀	1325	3			1453	0		
	Con	O. porifera ♀	1502	2			1510	4		
	Turo	C. striatoconus								
	Ceno	P. infusorioides ☆/♀	2084	0			2105	4	2101	0

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).
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5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.
7 : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan and Nigel Hooker Sept 83

Data revised by : Roger Morgan April 94

26th May, 1994

NOTE TO: FILE

FROM: SIMON HORAN

OUR REF: sth.012:tt

COPIES:

PALYNOLOGICAL SAMPLES PROCESSING AND SAMPLE EXAMINATION METHODOLOGY

Following discussion with Roger Morgan, the sample processing techniques and sample examination methodology used in palynological studies of the Fergusons Hill-1, Ross Creek-1, Mussel-1, Pecten-1A, Triten-1ST, La Bella-1, Eric the Red-1, Minerva-1, Minerva-2A and Loch Ard-1 is listed below.

Sample processing usually involves the following steps. Extra techniques are only used if required:

a) digest about 10gm of crushed rock in 50% HF overnight
b) wash out several times over 10 micron polyester sieve. Acidify with conc HCI if fluorosilicate gel forms
c) heavy liquid separation used concentrate $ZnBr_2$ with SG of 2.0
d) wash out float fraction over 10 micron polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
e) mount a sieved kerogen slide
f) oxidise in Schutze Solution (conc 30% HNO_3 with crystalline $KCIO_3$)
g) wash out over 10 micron polyester sieve
h) add 5% KOH to dissolve humic acids
i) wash out over 10 micron polyester sieve
j) examine under microscope for satisfactory oxidation. Repeat steps (f) to (g) if required
k) heavy liquid separation using $ZnBr_2$ solution (SG of 20.)
l) wash out float fraction using polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
m) dehydrate onto coverslip
n) mount microscope slides using Eukitt medium

Sample examination usually involved the following steps:

a) scan two traverses at a x10 to log the bulk of the assemblage and get some idea of age
b) scan at x40 and count the first 100 specimens to get percentage contents for each species. From this, saline "Microplankton Content" (%) can be developed to provide an index of marine influence. Where the sample is too lean to provide 100 specimens, frequency is estimated from the specimens

seen with A = abundant, C = common, F = frequent, R = rare

c) return to x10 to scan at least two large coverslips to log rare species, and finalise age conclusions. Log more slides if required

d) develop "Salines Microplankton Diversity" by counting up total species identified of dinoflagellates plus spiny acritarchs, as a second index of marine influence. This count includes species seen both inside and outside the court

e) develop "Freshwater Microplankton Content" by totally all freshwater algal elements (*Botryococcus, Schizosporis, Paralecaniella, Leiosphaeridia, Nummus*)

f) examine sieved kerogen slide for specimens of *Cyathidites* to establish spore colour for Spore colour Maturity Index

MINERVA #1 .. 6 infill samples ..

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C L I E N T: BHPP
W E L L: MINERVA #1: 6 INFILL SAMPLES
F I E L D / A R E A: OFFSHORE OTWAY BASIN
A N A L Y S T: Roger Morgan Ph.D. D A T E: February '94
N O T E S: all sample depths are in metres
all figures are percentages in a 100 specimen count
"X" indicates rare presence outside the grain count
in uncounted samples "A" = Abundant "C" = Common
"F" = Frequent "R" = Rare

RANGE CHART OF OCCURRENCES BY HIGHEST APPEARANCE: by groups

	BOTRYOCOCCUS	APTEA SP	DEFLANDREA SPECIOSUS	MANUMIELLA CORONATA	MICHRYSTIDIUM SP	NUMMUS	OLIGOSPHAERIDIUM COMPLEX	SPINIFERITES FURCATUS/RAMOSUS	TRICOLPITES CONFESSUS	CRIBROPERIDINIUM EDWARDSII	HETEROSPHAERIDIUM HETEROCANTHUM	VERYHACHIUM	AEQUITRIRADITES VERRUCOSUS	AMOSOPOLLIS CRUCIFORMIS	CAMEROZONOSPORITES OHAIENSIS	CAMEROZONOSPORITES ROBUSTA	CERATOSPORITES EQUALIS	CICATRICOSISPORITES AUSTRALIENSIS	CLAVIFERA TRIPLEX	CYATHIDITES AUSTRALIS	CYATHIDITES MINOR	DILWYNITES GRANULATUS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
)860-70 CUTTS	1	X	X	1	3	1	X	X	1	.	.	.	X	X	1	X	3	1	0	1	2	10
2089.0 SWC	.	.	.	.	.	2	1	1	.	X	2	.	.	.	.	.	1	1	.	7	18	10
2215.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	R	.
2273-79 CUTTS	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	6	.	.
2319.0 SWC	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	4	.	7	18	2
2359.5 SWC	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2	2	.	6	17	.

	23 ERICIPITES SCABRATUS	24 FALCISPORITES GRANDIS	25 FALCISPORITES SIMILIS	26 GAMBIERINA EDWARDSII	27 GAMBIERINA RUDATA	28 GLEICHENIIDITES	29 HALORAGACIDITES HARRISII	30 ISABELIDINIUM PELLUCIDA	31 LAEVIGATOSPORITES OVATUS	32 LYGISTIPOLLENITES BALMEI	33 LYGISTIPOLLENITES FLORINII	34 MICROCACHRYIDITES ANTARCTICUS	35 NOTHOFAGUS ENDURUS	36 OSMUNDACIDITES WELLMANII	37 PHYLLOCLADIDITES MAWSONII	38 PODOSPORITES MICROSACCATUS	39 POLYPOROPOLLENITES POLYORATUS	40 PROTEACIDITES	41 RETITRILETES AUSTROCLAVATIDITES	42 STEREISPORITES ANTIQUISPORITES	43 TRICOLPITES GILLII	44 TRICOLPITES LONGUS
860-70 CUTTS	1	1	9	X	1	5	X	X	1	X	1	10	3	1	6	5	5	18	1	2	1	X
089.0 SWC	.	9	22	.	.	3	X	.	.	.	.	16	.	.	X	3	.	.	1	X	.	.
215.0 SWC	.	R	R	.	.	.	.	.	.	.	.	.	.	R	.	.	.	.	.	.	.	.
273-79 CUTTS	.	7	28	.	.	2	.	.	.	.	.	6	.	2	.	.	.	.	1	3	.	.
319.0 SWC	.	4	18	.	.	1	.	.	1	.	.	13	.	4	.	2	.	.	4	.	.	.
2359.5 SWC	.	9	33	.	.	2	.	.	1	.	.	7	.	3	.	1	.	.	2	.	.	.

	45 TRICOLPITES SABULOSUS	46 TRICOLPITES WAIPAWAENSIS	47 TRICOLPORITES APOXYEXINUS	48 TRICOLPORITES LILLIEI	49 TRIPOROLETES RETICULATUS	50 TRIPOROPOLLENITES SECTILIS	51 ARAUCARIACITES AUSTRALIS	52 BALMEISPORITES HOLODICTYUS	53 VITREISPORITES PALLIDUS	54 APPENDICISPORITES DISTOCARINATUS	55 CALLIALASPORITES DAMPIERI	56 CALLIALASPORITES TURBATUS	57 COPTOSPORA PILEOSA	58 COROLLINA TOROSUS	59 CYATHIDITES GIGANTIS	60 ISCHYOSPORITES PUNCTATUS	61 CICATRICOSISPORITES LUDBROOKIAE	62 COPTOSPORA PARADOXA	63 CRYBELOSPORITES STRIATUS	64 FORAMINISPORIS ASYMMETRICUS	65 FORAMINISPORIS DAILYI	66 LEPTOLEPIDITES VERRUCATUS
)860-70 CUTTS	1	1	X	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
:089.0 SWC	.	.	.	.	.	.	3	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.
:215.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
:273-79 CUTTS	.	.	.	.	.	.	4	.	2	1	2	5	1	1	13	1	.	.	.	.	.	.
:319.0 SWC	.	.	.	.	2	.	5	.	2	.	1	2	.	2	.	1	1	X	1	1	X	1
:359.5 SWC	.	.	.	.	.	.	5	.	1	.	X	1	.	2	.	.	.	.	.	1	.	.

	67 PEROTRILETES JUBATUS/MORGANII	68 TRIPOROLETES RADIATUS	69 CYCADOPITES FOLLICULARIS	70 REWORKING: TRIASSIC	
0860-70 CUTTS	.	.	.	.	0860-70 CUTTS
2089.0 SWC	.	.	.	.	2089.0 SWC
2215.0 SWC	.	.	.	.	2215.0 SWC
2273-79 CUTTS	.	.	.	.	2273-79 CUTTS
2319.0 SWC	X	1	.	2	2319.0 SWC
2359.5 SWC	.	.	3	.	2359.5 SWC

SPECIES LOCATION INDEX

nd(numbers are the columns in which species appear.

NDEX UMBER	SPECIES
13	AEQUITRIRADITES VERRUCOSUS
14	AMOSOPOLLIS CRUCIFORMIS
54	APPENDICISPORITES DISTOCARINATUS
2	APTEA SP
51	ARAUCARIACITES AUSTRALIS
52	BALMEISPORITES HOLODICTYUS
1	BOTRYOCOCCUS
55	CALLIALASPORITES DAMPIERI
56	CALLIALASPORITES TURBATUS
15	CAMEROZONOSPORITES OHAIENSIS
16	CAMEROZONOSPORITES ROBUSTA
17	CERATOSPORITES EQUALIS
18	CICATRICOSISPORITES AUSTRALIENSIS
61	CICATRICOSISPORITES LUDBROOKIAE
19	CLAVIFERA TRIPLEX
62	COPTOSPORA PARADOXA
57	COPTOSPORA PILEOSA
58	COROLLINA TOROSUS
10	CRIBROPERIDINIUM EDWARDSII
63	CRYBELOSPORITES STRIATUS
2[illegible]	CYATHIDITES AUSTRALIS
5[illegible]	CYATHIDITES GIGANTIS
21	CYATHIDITES MINOR
69	CYCADOPITES FOLLICULARIS
3	DEFLANDREA SPECIOSUS
22	DILWYNITES GRANULATUS
23	ERICIPITES SCABRATUS
24	FALCISPORITES GRANDIS
25	FALCISPORITES SIMILIS
64	FORAMINISPORIS ASYMMETRICUS

26 GAMBIERINA EDWARDSII
27 GAMBIERINA RUDATA
28 GLEICHENIIDITES
29 HALORAGACIDITES HARRISII
11 HETEROSPHAERIDIUM HETEROCANTHUM
30 ISABELIDINIUM PELLUCIDA
60 ISCHYOSPORITES PUNCTATUS
31 LAEVIGATOSPORITES OVATUS
66 LEPTOLEPIDITES VERRUCATUS
32 LYGISTIPOLLENITES BALMEI
33 LYGISTIPOLLENITES FLORINII
4 MANUMIELLA CORONATA
5 MICHRYSTIIDIUM SP
34 MICROCACHRYIDITES ANTARCTICUS
35 NOTHOFAGUS ENDURUS
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9 TRICOLPITES CONFESSUS
43 TRICOLPITES GILLII
44 TRICOLPITES LONGUS
45 TRICOLPITES SABULOSUS
46 TRICOLPITES WAIPAWAENSIS
47 TRICOLPORITES APOXYEXINUS
48 TRICOLPORITES LILLIEI
68 TRIPOROLETES RADIATUS
49 TRIPOROLETES RETICULATUS
50 TRIPOROPOLLENITES SECTILIS
12 VERYHACHIUM
53 VITREISPORITES PALLIDUS