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PALYNOLOGY OF UPPER PROTEROZOIC AND CAMBRIAN SAMPLES FROM 11 WELLS IN SOUTH AUSTRALIA

by

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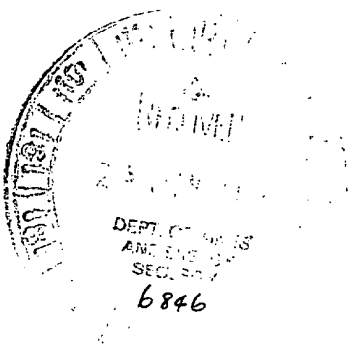

Keywords: Birksgate, Byilkaoora, Cootanoorina, Emu, Marla, Munyarai, Murnaroo, Wallira West, Weedina, Wilkatana, Wilkinson, fluorescence, Observatory Hill Beds

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INTRODUCTION

In June 1984 a total of 145 core samples from 11 wells covering the "Late Proterozoic" and "Cambrian" intervals were collected from the Core Library of the South Australian Department of Mines and Energy, Glenside, S.A. and from the BMR Core Library, Fyshwick, A.C.T.

The samples were selected on lithology and apparent presence of organic matter. Preparations followed the standard routine of hydrochloric acid - hydrofluoric acid - hydrochloric acid. Residues were left untreated in most cases, i.e. no oxidation was given. Only in a few cases, where a rich organic fraction was obtained, the residues were sieved to get rid of the very fine fraction (less than 10 micrometers), thus concentrating the macerals and fossils. If enough material remained an oxidation with nitric acid was given to further concentrate the residue. Microscope slides were prepared using Elvacite as an embedding medium.

The residues were examined under transmitted (white) light. Incident ultraviolet light was used on the palynomacerals to aid identification and to judge levels of organic maturity.

Most samples proved to be barren of organic microfossils and the amount of organic matter present rarely reached source-rock levels. Details follow.

BIRKSGATE-1

964.69 - 1877.26 m (6 core samples):

Although microfossils were found in all samples but one (1680.06m) only two types were present:

Featureless sphaeromorphs ranging in size from 35 to more than 500 micrometer; and (at 1099-26m) acritarchs, about 100 micrometer in diameter, with branched processes. A single specimen of a ribbed or transversely striated "tube" was present at 971.70m. Age-wise, nothing much can be deduced from the microfossils. The ornamented acritarchs would suggest a Cambrian age from 1099.24m up. But very large sphaeromorphs (350 - more than 500 micrometers) are more indicative of the Late Proterozoic. Ribbed tubes of the type found at 971.70m have been described from the Late Proterozoic (Knoll, 1984; Peat, 1984; Peat, et.al., 1978, a.o.).

A dull-brown fluorescence was noted with some of the larger sphaeromorphs in the top samples (964.69m - 1099.26m) but it was very weak. Colour in transmitted light : deep greyish-brown. Both indicate an advanced maturity, perhaps base oil-window or more. The organic fraction obtained after palynological preparation was very small, 0.05 millilitre or less per 10 grams of sample. None of the 6 core samples is therefore considered to be a source rock.

BYILKAOORA-1

200.70 - 407.25m (34 core samples):

Apart from rare filamentous tubes at 298.0m and 309.7m no microfossils were found in any of the samples. Organic matter was poor in most samples and, where more common, did not show any cell-structure or other morphology except mineral imprints. Most organic matter was of the granular type but solid sheets of material were present at several depths (a.o. 204.25m, 214.1m and 268.95m). It looked almost gel-like, and dull golden/brown fluorescence was noted in this material down to 313.35m.

110.45 - 111.75m (2 core samples). Early to Mid APTIAN, Odontochitina operculata dinoflagellate zone.

Rich, diverse and well-preserved palynofloras, a mixture of spores, pollen and dinoflagellates. Near shore but open marine environment of deposition. Both samples rich in organic matter, potential source rocks, but of low maturity.

194.60 - 633.29m (4 core samples). Early Permian.

Well-preserved sporomorphs, rich but not diverse. No marine indicators seen. Abundant plant tissues and fibres. Rich in organic matter, potential source for hydrocarbons (gas mainly) but lacking sufficient maturity.

873.10 - 948.83m

Barren of organic microfossils. Little or no organic matter.

EMU-1

63.90 - 248.0m (10 core samples)

Barren of organic microfossils. At 247.40m clusters of thin, filamentous tubes, up to 10 micrometers wide, were common. Organic matter was virtually absent from most samples except at 63.90m where large but thin sheets with mineral imprints gave a faint, dull-brown fluorescence.

95.90 - 377.80m (17 core samples)

Barren of organic microfossils. Most samples did not yield much organic residue. Spongy, structureless organic matter was present in two intervals, 126.50 - 138.60m and 268.70 - 286.40m. More solid angular material (gel-like), dark brown in colour, was present at 126.50m. Neither of the two types showed fluorescence.

MUNYARAI-1

1692.86 - 2896.82m (9 core samples)

Sphaeromorphs up to 180 micrometer in diameter, were present in the top three samples (1692.86 - 2136.04m). In addition, a few acritarchs about 350 micrometer in diameter and with short, simple processes, were present at 2136.04m. They are perhaps referable to the genus MICRHYSTRIDIUM, although their large size is against this. Microfossils with such sculpture are not supposed to occur before the Early Cambrian (see Vidal, 1984; Vidal and Knoll, 1983). Recently cases have come to light where "Upper Proterozoic" assemblages contained sculptured "Cambrian" types (M. Walter, pers.comm.). Taking also into account the very poor assemblages of Munyarai-1 it would seem better to defer labelling them either way.

Little or no organic matter was recovered from the samples. A few thin tissues were present at 2136.04m. No fluorescence visible.

MURNAROO-1

55.90 - 297.20m (21 core samples)

The top three samples (55.90 - 57.25m) were barren and did not contain organic matter. Between 61.75 - 95.55m algal filaments and thin, structureless tissue were present. No fluorescence was visible. Algal remains (filaments) and sphaeromorphs, ranging in diameter from 30 to 750 micrometer were found between 158.75 and 229.5m. Some of the very large, thick-walled sphaeromorphs may be CHUARIA CIRCULARIS, of Upper Proterozoic age (Upper Riphean to Varangerian, see Vidal and Knoll, 1983). They showed faint, yellow-brown fluorescence colours. At 213.15m a few transversely-striated tubes were present and also an acritarch, about 500 micrometers in diameter with short, simple processes of about 20 micrometers, and not unlike the acritarch of Munyarai-1 at 2136.04m. Finally, at 229.5m, a single specimen of an acritarch with branched processes, similar to the one in Birksgate-1 at 1099.26m.

Again, there seems to be a conflict between "Upper Proterozoic" types such as CHUARIA CIRCULALIS and "Cambrian" acritarchs with processes. And again, as assemblages are very poor, no firm interpretation can be given.

Organic matter, where present (mainly at 92.90, 158.75, 161.80, and 182.40 - 191.35m) consisted mostly of large, thin structureless sheets of tissue, without fluorescence.

WALLIRA WEST-1

330.35 - 367.03m (7 core samples)

All barren of organic microfossils. Most samples except the two deepest (365.05 - 367.03m) contained organic matter of the granular, structureless, spongy type, not showing fluorescence. The few solid pieces present had clear mineral imprints only and no evidence of a cellular structure.

WEEDINA-1

902.65 - 1515.65m (7 core samples)

Barren of microfossils, no organic matter.

WILKATANA-1

234.70 - 556.31m (15 core samples)

Barren of organic microfossils. Very little organic matter, mostly of the granular/spongy type. At 320.70m solid, angular, gel-like fragments are common, no fluorescence colours observed.

WILKINSON-1

314.45 - 669.93m (17 core samples)

No microfossils were found. This is very surprising because 5 samples over the interval 314.47 - 512.15m examined by Muir (1979), yielded impoverished assemblages in all of them. No explanation can be offered. Preparation - techniques were similar. There are slight differences in sampled depths but this hardly explains the total absence of fossils from "our" samples. Organic matter is fairly common in most samples except the two deepest (666.65m and 669.93m). Most of it is granular/spongy, structureless, and with mineral imprints. More solid, sheet-like tissues were present also but again without structure. Colour in transmitted light ranges from greyish to dark brown (Muir: pale to mid yellow). Faint fluorescence was noted at 344.35m. Interestingly, the rather dull colours became bright golden-yellow to yellowish-brown after one hour exposure to U.V. light. From about 462.10m down no fluoroscence was visible anymore.

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APPENDIX

LIST OF SAMPLES EXAMINED

BIRKSGATE-1 (CONOCO)

964.69m	a few sphaeromorphs
971.70m	sphaeromorphs (up to 350 micrometer), transversely-striated tubes
1099.26m	acritarchs (branched processes) sphaeromorphs (to 500 micrometer).
1382.33m	sphaeromorphs rare, up to 150 micrometer
1680.06m	barren
1877.26m	sphaeromorphs

(964.69 - 1099.26m: Observatory Hill Formation equivalent;
1382.33 - 1877.26m: ?Punkerri Beds)

BYILKAOORA-1 (SADME)

200.7m	barren
202.29m	"
204.25m	"
209.59m	"
214.1m	"
225.5m	"
241.10m (B)	"
241.10m (A)	"
248.35m	"
254.9m	"
259.35m	"
268.95m	"
277.3m	"
278.25m	"
286.5m	"
289.8m	"
292.55m	"
293.2m	"
295.65m	"
298.0m	"

(Byilkaoora-1, continued)

298.7m	Barren
303.3m	"
306.1m	"
309.7m	"
312.3m	"
313.35m	"
319.05m	"
324.95m	"
327.1m	"
333.5m	"
377.1m	"
382.5m	"
394.2m	"
407.25m	"

(200.70 - 377.1m: Observatory Hill Beds;
382.50 - 407.25m: Davies Bore conglomerate)

COOTANOORINA-1 (SADME)

110.45m	Early to Mid Aptian, Odontochitina operculata Zone
111.75m	" "
194.60m	Permian
379.05m	"
530.70m	"
633.29m	"
873.10m	Barren
873.60m	"
889.10m	"
889.29m	"
927.8m	"
943.35m	"
944.26m	"
945.25m	"
945.85m	"
948.35m	"
948.83m	"

Cootanoorina-1 (continued)

(110.45 - 111.75m: Bulldog Shale;
194.60 - 379.05m: Mount Toondina Beds;
530.70 - 633.29m: Lower Permian, Unit 1;
873.10 - 889.29m: ?Permo-Carboniferous, Unit 2;
927.80 - 948.83m: ?Devonian, Unit 3)

EMU-1 (EXOIL)

63.90m	Barren
64.15m	"
65.06m	"
153.65m	"
154.10m	"
155.30m	"
246.50m	"
247.40m	"
248.0m	"

(63.90 - 248.0m: Observatory Hill Beds)

MARLA-1B (SADME)

95.9m	Barren
106.3m	"
113.0m	"
126.5m	"
136.7m	"
138.6m	"
152.6m	"
193.3m	"
198.6m	"
227.4m	"
268.7m	"
277.6m	"
286.4m	"
325.7m	"
331.6m	"
364.6m	"
377.8m	"

(95.90 - 377.80m: Observatory Hill Beds)

MUNYARAI-1 (CONOCO)

1692.86m	some sphaeromorphs
1693.47m	a few sphaeromorphs
2136.04m	acritarchs with simple processes (350 micrometers), sphaeromorphs
2289.35m	barren
2438.40m	"
2534.11m	"
2610.31m	"
2753.56m	"
2896.82m	"

(1692.86 - 2896.82m: Tapley Hill Formation equivalent)

MURNAROO-1 (SADME)

55.90m	Barren
56.80m	"
57.25m	"
61.75m	some algal remains ("sheaths", "ribbons")
68.55m	"
92.90m	"
95.35m	"
124.40m	"
131.80m	"
158.75m	a few sphaeromorphs and algal remains
161.80m	barren
164.70m	"
182.40m	a few large (to 400 micrometer) sphaeromorphs
185.30m	" " "
191.35m	very large sphaeromorphs (?Chuaria, to 750 micrometer)
213.15m	sphaeromorphs, transversely-striated tube and algal "ribbons"
215.15m	barren
229.5m	a few sphaeromorphs, acritarch with branched processes
266.15m	barren
271.15m	"
297.20m	"

(55.90 - 297.20m: Observatory Hill Beds)

WALLIRA WEST-1 (SADME)

330.35m	Barren
331.40m	"
332.10m	"
343.05m	"
343.50m	"
365.05m	"
367.03m	"

(330.35 - 367.03m: Observatory Hill Beds)

WEEDINA-1 (PEXA)

902.65m	barren
903.35m	"
1025.70m	"
1152.20m	"
1153.55m	"
1514.40m	"
1515.65m	"

WILKATANA-1 (SANTOS)

234.70m	barren
236.37m	"
238.74m	"
244.32m	"
275.84m	"
303.02m	"
320.70m	"
335.10m	"
341.0m	"
349.30m	"
380.62m	"
404.62m	"
409.85m	"
469.62m	"
556.31m	"

314.45m	barren
344.35m	"
344.65m	"
389.33m	"
389.90m	"
390.45m	"
461.12m	"
462.10m	"
463.0m	"
480.85m	"
493.23m	"
511.10m	"
529.35m	"
534.28m	"
553.20m	"
666.65m	"
669.93m	"

(314.45 - 669.93m: Observatory Hill Beds)