PE990881

TARRA NO. 1 WELL
GIPPSLAND BASIN

Palynological examination and kerogen typing of sidewall cores.

by

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TABLE I

TARRA NO. 1 WELL

SUMMARY OF PALYNOLOGICAL DATA

DEPTH (m)	SWC	PRESERVATION	DIVERSITY	SPORE POLLEN ZONE	DINOFLAGELLATE ZONE	CONFIDENCE LEVEL	ENVIRONMENT
2085	39	good	low	P. tuberculatus	unnamed	4	Open marine
2105	30	good	low	P. tuberculatus	unnamed	4	Open marine
2113	29	fair	low	P. tuberculatus	unnamed	4	Open marine
2122	28	fair	low	P. tuberculatus	unnamed	4	Open marine
2135	35	fair	low	P. tuberculatus	unnamed	4	Open marine
2145	27	good	low	Upper N. asperus	?P. coreoideum	5	Open marine
2160	34	good	low	Upper N. asperus	?P. coreoideum	5	Open marine
2177.5	26	fair	low	Upper N. asperus	?P. coreoideum	5	Open marine
2192.1	33	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2208.1	25	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2220.9	24	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2232.5	23	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2237	22	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2241	21	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2257	32	fair	low	Upper N. asperus	?P. coreoideum	5	Marginal marine
2274	18	fair	low	L. balmei	-	4	-
2305.5	17	fair	low	L. balmei	-	5	Non marine
2362.1	15	fair	low	L. balmei	-	5	Marginal marine
2382	14	fair	moderate	L. balmei	-	5	Non marine
2411.9	13	fair	moderate	L. balmei	-	5	Non marine
2446	11	fair	moderate	L. balmei	-	5	Non marine
2468	10	poor	very low	Indeterminate	-	-	-
2474	9	poor	low	T. longus	-	5	Non marine
2501	8	fair	low	T. longus	-	4	Non marine
2511.5	7	fair	very low	Indeterminate	-	-	Marginal marine
2533	6	fair	low	T. longus	-	4	Non marine
2543	4	fair	low	T. longus	-	4	Non marine
2556	3	fair	very low	Indeterminate	-	-	Non marine
2579	85	fair	low	T. longus	-	4	Non marine
2582.5	83	barren	-	-	-	-	-
2599	77	fair	low	undiff. E. Cretaceous	-	-	Non marine
2622.9	73	fair	very low	undiff. E. Cretaceous	-	-	Non marine
2644	71	poor	very low	undiff. E. Cretaceous	-	-	Non marine
2676.2	69	fair	very low	undiff. E. Cretaceous	-	-	Non marine
2751	65	fair	very low	undiff. E. Cretaceous	-	-	Non marine
2820	65	fair	moderate	C. striatus	-	4	Non marine
2879.9	60	fair	moderate	C. striatus	-	4	Non marine

Confidence Levels:

1 cuttings sample, low diversity + contaminants
2 cuttings sample, good assemblage
3 core or sidewall core, low diversity, + contaminants
4 core or sidewall core, low diversity
5 core or sidewall core, good assemblage.

Palynological Report

Client: Australian Aquitaine Petroleum

Study: Tarra No. 1 Well, Gippsland Basin

Aims: Determination of age and distribution of kerogen types

INTRODUCTION

Thirty seven sidewall cores from Tarra No. 1 well drilled in the Gippsland Basin at Lat 38°38'37.4"S, Long 147°42'9.8"E in Vic P17 were processed by normal palynological procedures.

The biostratigraphy and consequent age determinations are based on Stover & Partridge (1973) and Partridge (1976) for the Tertiary sediments; and principally on Dettmann (1963), Dettmann & Playford (1969), with the modifications of Dettmann & Douglas (1976) and Burger (1973), for the Cretaceous sequence.

OBSERVATIONS AND INTERPRETATION

A. Biostratigraphy

Table I summarises the biostratigraphy and age determinations for the samples studied. Tables II to IV indicate the distribution of species identified in the Cretaceous and Tertiary sequences.

Preservation, and diversity data are indicated on Table 1. Most samples yielded reasonably well preserved and moderately diverse assemblages. One sample was barren of plant microfossils.

1. Early Cretaceous, undifferentiated: 2879.9-2599 m

In keeping with Early Cretaceous assemblages elsewhere in the Gippsland Basin, most samples lack sufficient index forms to permit a confident correlation with accepted zonal schemes of this age. However the bottom two samples at 2879.9 m and 2820 m contain in particular *Crybelosporites striatus* which indicates a correlation with *C. striatus* sub zone of the *Dictyotosporites speciosus* zone. The absence of forms characteristic of the *Coptospora paradoxa* zone supports this correlation. The age of the sub-zone is Late Aptian to Early Albian.

Samples higher in the well lack zonal species and are simply dated as undifferentiated Early Cretaceous.

No marine palynomorphs were recovered over the interval and deposition took place in a non-marine environment.

2. *Tricolpites longus* zone: - 2579 - 2474 m

Assemblages from this interval are characterised by low diversity. Nevertheless, important species such as *Stereisporites punctatus* and *Australopollis obscurus* make their appearance at 2579 m and thus indicate the commencement of *T. longus* zone. The zone is also characterised by very common *Gambierina* spp. and rare *Nothofagidites* spp.

Most samples contain only terrestrially derived palynomorphs and were deposited in a non-marine environment. However one sample at 2511.5 m contained several dinoflagellates related to Areoligera sp. and thus a marginal marine environment is envisaged.

3. Lygistepollenites balmei zone: 2446 - 2274 m

The presence of Haloragacidites harrisii together with Phyllocladidites reticulosaccatus at 2446 m indicate the commencement of the L. balmei zone. The appearance of Nothofagidites flemingii at 2305.5 m would suggest that the Upper L. balmei zone is present at that level. Because diversities are generally low a firm subdivision of the L. balmei zone in this well, is not possible.

One sample at 2362.1 m contained rare dinoflagellates and possibly indicates marginal marine conditions. However there is a possibility of contamination by mud invasion.

All other samples indicate deposition in a non-marine environment.

4. Upper Nothofagidites asperus zone:- 2257-2145 m

Again samples in this interval have low diversity but assemblages are dominated by Nothofagidites spp. This feature alone is characteristic of the zone. Importantly Proteacidites spp. show very low diversity in this interval.

Corroborative evidence is afforded by the dinoflagellate assemblages which are clearly younger than the Vozzennikovia extensa zone and are probably equated with Partridge's (1976) Phthanoperidinium coreoideum zone. The zone has not been described in detail but the lack of V. extensa would support the younger age.

All samples recorded marine phytoplankton and from 2257 to 2192.1 m the dinoflagellates are subordinate to the terrestrially derived spores and pollen and a near shore marine environment is indicated. From 2177.5 to 2145 m dinoflagellates become more prominent and indicate deepening water conditions and a more open marine environment.

5. Proteacidites tuberculatus zone: 2135 - 2085 m

The appearance of Cyatheacidites annulata at 2135 m and the lack of younger index forms indicates the presence of the P. tuberculatus zone. Again the spore/pollen assemblages are of low diversity and are dominated by marine dinoflagellates indicating open marine environments.

The age of the P. tuberculatus zone is Late Oligocene or Early Miocene.

B. Kerogen Types and Spore Colouration

During routine palynological processing of sidewall cores an unoxidised kerogen sample was taken and the nature of the kerogens and spore colouration are documented in Table VI. Spore colour is expressed as the "Thermal Alteration Index" (TAI) of Staplin (1969) according to the scale in Table V.

Total organic matter (TOM) is expressed semi-quantitatively in the scale-

Table II

TARRA # 1

DESCRIPTION:

GIPPSLAND BASIN EARLY CRETACEOUS SPORES AND POLLEN

CHECKLIST OF PRESENCE/ABSENCE BY LOWEST APPEARANCE

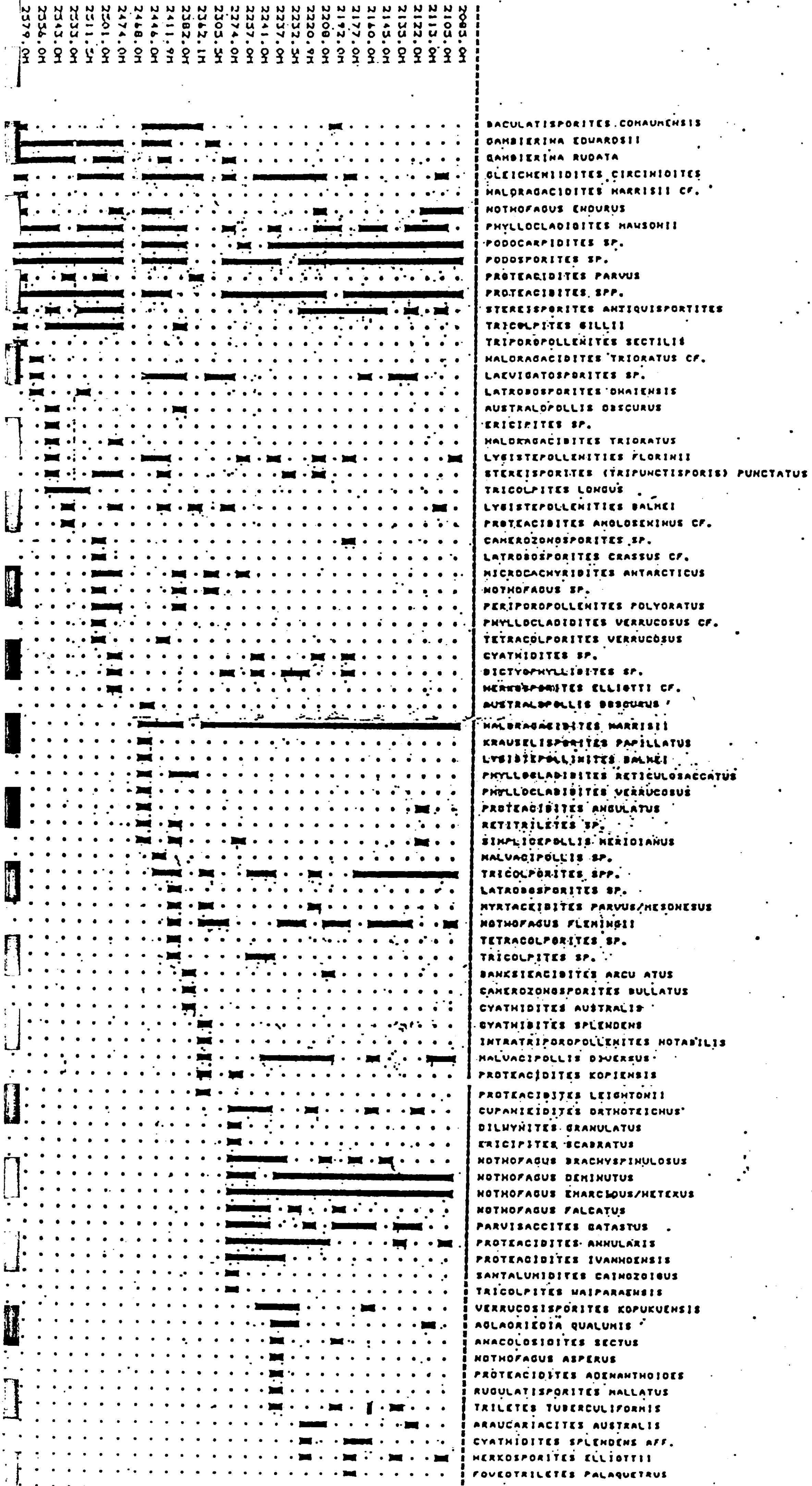
	2879.9M	2820.0M	2751.0M	2676.2M	2644.0M	2622.9M	2599.0M
AEQUITRIRADITES SPINULOSIS	■	■	·	·	·	·	·
BACULATISPORITES COMAUMENSIS	■	■	■	■	■	■	■
CERATOSPORITES EQUALIS	■	■	·	·	·	·	■
CICATRICOSISPORITES AUSTRALIENSIS	■	■	■	■	■	■	·
CINGUTRILETES CLAVUS	■	·	·	·	·	·	·
CRYBELOSPORITES STRIATUS	■	■	·	·	·	·	·
CYATHIDITES AUSTRALIS	■	■	■	■	■	■	■
CYCADOPITES SP.	■	·	·	·	·	·	·
DICTYOPHYLLIDITES MORTONI	■	■	·	·	·	·	■
FALCISPORITES GRANDIS	■	■	■	·	■	■	■
FALCISPORITES SIMILIS	■	■	■	·	■	■	■
FORAMINISPORIS WONTHAGGIENSIS	■	·	·	·	·	·	·
KUYLISPORITES LUNARIS	■	·	·	·	·	·	·
LYCOPODIUMSPORITES AUSTROCLAVATIDITES	■	·	■	·	·	·	■
MICROCACHYRIDITES ANTARCTICUS	■	■	·	■	·	■	■
NEORAISTRICKIA TRUNCATA	■	·	■	·	·	·	■
PODOCARPIDITES SP.	■	■	■	■	■	■	■
PODOSPORITES SP.	■	■	■	■	■	■	■
POLYCINGULATISPORITES CRENNULATUS	■	·	·	·	·	·	·
ROUSEISPORITES RETICULATUS	■	■	·	·	·	·	·
STEREISPORITES ANTIQUASPORITES	■	■	■	·	■	■	■
AEQUITRIRADITES VERRUCOSUS	·	■	·	·	·	·	·
BALMEISPORITES HOLODICTYUS	·	■	·	·	·	·	·
CICATRICOSISPORITES CUNEIFORMIS	·	■	·	·	·	·	·
CICATRICOSISPORITES HUGHESI	·	■	·	·	·	·	■
CICATRICOSISPORITES LUDBROOKI	·	■	·	·	·	·	·
CRYBELOSPORITES STYLOSUS	·	■	·	·	·	·	·
CYCLOSPORITES HUGHESI	·	■	·	·	·	·	·
FORAMINISPORIS ASSYMETRICUS	·	■	·	·	·	·	·
ROUSEISPORITES SIMPLEX	·	■	·	·	·	·	·
CAMEROZONOSPORITES RUDIS	·	·	■	·	·	·	·
PILOSISPORITES NOTENSIS	·	·	■	·	·	·	·
DICTYOTOSPORITES SPECIOSUS	·	·	·	■	·	·	■
MATONISPORITES COOKSONIAE	·	·	·	·	·	■	·
ANNULISPORA FOLLICULOSA	·	·	·	·	·	·	■
COROLLINA SP.	·	·	·	·	·	·	■
CYCADOPITES FOLLICULARIS	·	·	·	·	·	·	■
RETICULATISPORITES PUDENS	·	·	·	·	·	·	■

TARRA # 1 TABLE XXI

DESCRIPTION:

LATE CRETACEOUS - TERTIARY SPORE POLLEN

CHECKLIST OF PRESENCE/ABSENCE BY LOWEST APPEARANCE



TARRA 1 DINOFLAGELLATES

DESCRIPTION:

TABLE IV

CHECKLIST OF PRESENCE/ABSENCE BY LOWEST APPEARANCE

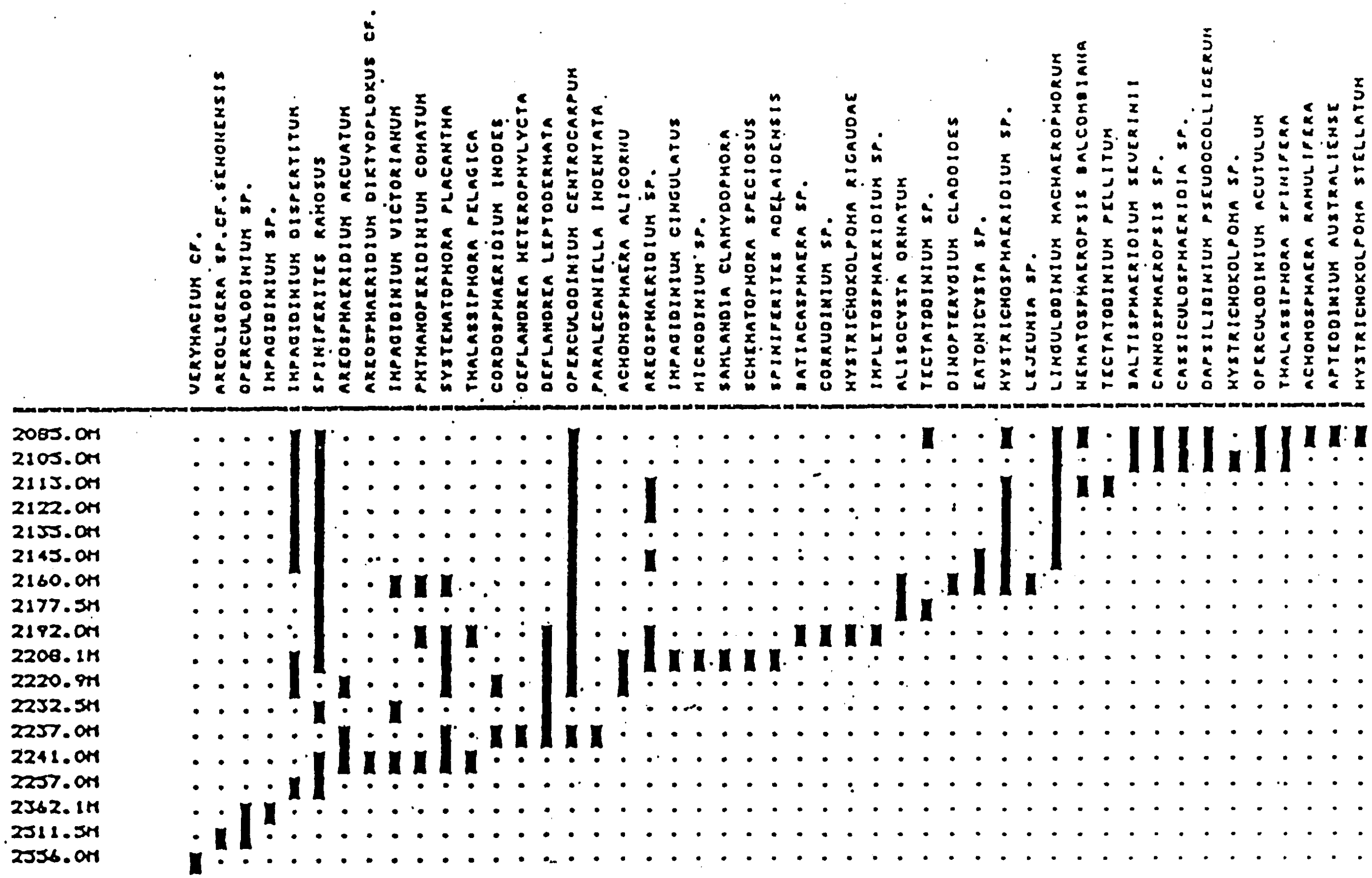


Table V

MATURATION LEVELS, Bujak et al. 1977

CATEGORIES	ORGANIC COMPONENTS		OIL	GAS CONDENSATE	THERMALLY DERIVED METHANE
			TAI	TAI	TAI
HYLOGEN	NON-OPAQUE FIBROUS PLANT MATERIAL OF WOODY ORIGIN	} TRACHEIDS VESSELS	>2→3 (2.5-2.9)	>2→≥3 (2.3-3.2)	2→4
PHYROGEN	NON-OPAQUE NON-WOODY ORIGIN	} SPORES POLLEN ALGAE ACRITARCHS CUTICLES	>2→3 (2.2→3)	2→<3+	>2⁻→4
AMORPHOGEN	STRUCTURELESS ORGANIC MATTER	} FINELY DISSEMINATED or COAGULATED FLUFFY MASSES	2→<3+	2→3+	3+→5
MELANOGEN	OPAQUE ORGANIC DEBRIS		-	2+→<3	2.5-4

Notes: (1) Hylogen, Phyrogen, Melanogen 4→5: Traces of Dry Gas and Co_2

(2) Hylogen, Phyrogen, Melanogen 1→2: Biogenic methane (Marsh gas).

TAI (Thermal Alteration Index):

1+, 2-, 2 - YELLOWS
2, 2+, 3, 4 - BROWNS
4-, 5 - BLACK

TABLE VI

TARRA NO. 1 WELL

SUMMARY OF MATURATION AND KEROGEN DATA

Depth (m)	TAI	TOM	Phyr. %	Amorph %	Hylo %	Melano %
2085	1+	very low	20	40	-	40
2105	1+	very low	20	50	-	30
2113	1+	very low	20	70	-	10
2122	1+	very low	5	85	-	10
2135	N.D.	very low	5	80	-	15
2145	1+	very low	30	60	-	10
2160	1+	very low	10	70	-	20
2177.5	1+	very low	20	70	-	10
2192.1	N.D.	very low	Tr.	90	-	15
2208.1	N.D.	very low	-	90	-	10
2220.9	N.D.	very low	Tr.	85	-	15
2232.5	N.D.	very low	Tr.	90	-	10
2237	N.D.	very low	10	80	-	10
2241	1+	low	20	60	10	10
2257	1+	moderate	30	40	10	20
2274	N.D.	very low	10	60	-	30
2305.5	1+	low	10	90	-	10
2362.1	N.D.	very low	Tr.	90	-	10
2382	1+	low	30	40	10	20
2411.9	1+	low	20	60	-	20
2446	1+	low	-	-	20	80
2468	N.D.	low	Tr.	-	10	90
2474	1+	low	30	10	10	50
2501	1+	low	5	80	-	15
2511.5	1+	moderate	30	10	10	50
2533	1+	low	30	-	10	60
2543	1+	moderate	30	-	20	50
2556	2	low	30	20	20	30
2579	1+-2	low	30	-	10	60
2582.5	N.D.	very low	30	30	10	30
2599	2	low	15	20	5	60
2622.9	2	very low	5	50	5	40
2644	2	low	20	20	10	50
2676.2	2	low	15	-	10	75
2751	2	low	30	20	20	30
2820	2	low	40	10	20	30
2879.9	2	low	25	-	15	60

abundant, moderate, low, very low, barren. Samples classed as having abundant or moderate amounts of TOM would be expected to have TOC's (total organic content) greater than 1%.

In this report four classes of organic matter are recognised - amorphogen, phyrogen, hylogen and melanogen and these terms are more or less synonymous with amorphous, herbaceous, woody, and coaly. For reasons as outlined by Bujak et al (1977) the former terms are preferred because they do not have a botanical connotation. The thermal alteration index scale follows that of Staplin (1969) and as outlined by Bujak et al. (1977). At a TAI of 2+ all four types of organic material contributed to hydrocarbon generation whereas at a TAI of 2, only amorphogen forms liquid hydrocarbons. The upper boundary defining the oil window is at a TAI of approximately 3 but varies according to the organic type. Above TAI 3+ all organic types only have a potential for thermally derived methane.

Spore colouration in Tarra No. 1 well ranges from values of 1 to 2 at T.D. The Tertiary sequence shows very little evidence of alteration and below the Tertiary - Cretaceous unconformity there is a very gradual increase in maturity. However all values indicate that the entire section is immature for the generation of hydrocarbons.

Kerogen is dominated in the Early Tertiary sequence by amorphogen which is a potential source for liquid hydrocarbons whereas the Early and Late Cretaceous section is mainly dominated by melanogen. The potential in this section is for the generation of gaseous hydrocarbons with some liquid fraction.

Kerogens from the Oligocene-Miocene section are characterised by amorphous kerogen and the organic yields are very low.

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