PALYNOLOGY REPORT

BIOSTRATIGRAPHY, PALAEOENVIRONMENTS, AND HYDROCARBON SOURCE POTENTIAL OF NAJABA NO.1, 1311m - 3400m (EARLY CRETACEOUS - EARLY TERTIARY) OTWAY BASIN

by

MARY E. DETTMANN

Prepared for
BEACH PETROLEUM N.L.

August, 1986.

SAMPLE type	depth	lithol.	SOURCE POTENTIAL low	mod.	high	v.high	OIL SOURCE POTENTIAL poor	ltd.	fair	good	MATURATION IM	EM	M	LM	OM	BIOSTRAT.	AGE	DEPOSITIONAL ENVIRONMENT terr.	par.	m.mar.	mar.
SWC	1311	cly			*			*			*					M. diversus	Pal./Eoc.			*	
SWC	1382	cly			*			*			*					M. diversus	Pal./Eoc.			*	
SWC	1460.5	cly			*		*				*					L. balmei	Pal.			*	
SWC	1496	cly/sand		*			*				*					T. longus	Maastr.			*	
SWC	2186.5	cly	*				*					*				T. pachyexinus	Santon.			*	
SWC	2520	cly/sand	*				*					*				C. triplex	Tur.			*	
SWC	2651	cly/st		*			*					*				C. triplex	Tur.		*		
SWC	2805	slst.			*		*						*			C. triplex	Tur.			*	
SWC	2887	slst.	*				*						*			C. paradoxa	m. Albian	*			
SWC	2997	slst.	*				*						*			no. C. striatus	n.o. Albian	*			
SWC	3400	slst.	*				*							*		no. C. striatus	no. Albian	*			
			0.8	1.2	2.4		20	60	80		GY	Y	A	Br	Bl						
			(ml OM/10gm) KEROGEN YIELD				% H-RICH KEROGEN				1.8	2.2	2.5	3.0	SPORE COLOUR/ TAI VALUE						

TABLE 1. Summary of palynological results showing inferred hydrocarbon source potential, oil source potential, maturation, age, and palaeoenvironments of sediments between 1311m and 3400m in Najaba No.1

SUMMARY

Palynomorphs extracted from Najaba No.1 between 1331m and 3400m indicate that the section ranges in age from Albian to late Paleocene or early Eocene. An hiatus, spanning the late Albian to Cenomanian is located within the sequence between 2805m and 2887m. The Late Cretaceous - Early Tertiary sediments examined were deposited in close-to-land, marginal marine to paralic situations. Deposition of the underlying Early Cretaceous (Albian) sequence occurred in terrestrial environments. The organic component of the sediments is predominantly of land plant origin and is dominated by hydrogen-lean macerals that are gas prone when mature. High yields of organic matter from sediments between 1311m - 1496m and 2651m - 2805m indicate good potential for hydrocarbon generation. Spore colour suggests that the section is mature at and below 2805m.

INTRODUCTION

Eleven sidewall cores and a cutting sample from between 1311m and 3400m in Najaba No.1, Otway Basin have been palynologically examined to ascertain the age and biostratigraphic relationships of the sediments, the palaeoenvironments at and around the depositional site, and the hydrocarbon source potential and maturation levels of the enclosed organic matter. Table 1 summarises these results. Species distributions are shown on Table 2 and source rock/maturation data, as determined palynologically, are incorporated in Table 3.

Sample processing and analyses follows procedures outlined in a previous report (Dettmann 1986).

BIOSTRATIGRAPHY AND AGE

All samples proved to be palynologically productive and the contained assemblages indicate an age range of Early Cretaceous to Early Tertiary. The separate spore-pollen and dinoflagellate constituents of the assemblages enable biostratigraphic zonation of the sediments in terms of the palyno-zones established for southern Australian Cretaceous and Tertiary sequences by Dettmann and Playford (1969), Harris (1965) Stover & Evans (1973), Stover & Partridge (1973), Partridge (1976) and Helby et al. (in press).

1. 1311m - 1382m ; M. diversus Zone, late Paleocene - early Eocene.
The presence of common Malvacipollis diversus in association with Spinozonocolpites prominatus, Cupanieidites orthoteichus, and Proteacidites grandis indicate attribution to the M. diversus Zone of Stover & Evans (1973) and the C. orthoteichus Zone of Harris (1965). The latter was delineated with the Dilwyn Formation in the Princetown region of western Victoria.

The taxonomically restricted dinoflagellate associations contained in the samples provide general support for a late Paleocene - early Eocene age, but lack indices of Partridge's (1976) Early Tertiary Zones.

2. 1460.5m ; L. balmei/E. crassitabulata Zones, Paleocene.

The spore-pollen assemblage contains Gambierina edwardsii and Lygistepollenites balmei and is comparable to those of the L. balmei Zone of Stover & Evans (1973) and equivalent G. edwardsii Zone of Harris (1965). The Paleocene age thus indicated is supported by the dinoflagellates.

The latter indicate reference to the E. crassitabulata Zone of mid Paleocene age (Partridge 1976).

3. 1496m ; T. longus/M. druggii Zones, Maastrichtian.

The diverse spore-pollen assemblage contains common Gambierina, diverse proteaceous pollen together with Tricolpites longus and is referable to the T. longus Zone. The dinocyst microflora indicates reference to the M. druggii Zone of Maastrichtian age (Partridge 1976, Helby et al., in press).

4. 2186.5m ; T. pachyexinus/C. porifera Zones; Santonian.

The sample provided a moderately diverse assemblage dominated by saccate pollen. The association of Tricolpites pachyexinus, Phyllocladidites mawsonii and Ornamentifera sentosa confirms attribution to the T. pachyexinus Zone of Dettmann & Playford (1969). Associated dinocysts include Chatangiella tripartita and Odontochitina porifera, the combined occurrence of which defines the O. porifera Zone (Helby et al. in press). The sediments are thus of Santonian age.

5. 2520m - 2805m ; C. triplex Zone, Turonian.

Samples examined contain Phyllocladidites mawsonii, Clavifera triplex and Triorites minor in saccate dominated assemblages. They are referred to the C. triplex Zone of Turonian age.

Dinoflagellates occur in all samples and the assemblages are comparable to those of early Late Cretaceous age reported from the Flaxmans Formation and basal Belfast Mudstone in the Otway Basin. However, they are insufficiently diagnostic for precise zonal attribution.

6. 2887m ; C. paradoxa, middle Albian.

The moderately diverse, but poorly preserved palynomorph assemblage contains Coptospora paradoxa, Balmeisporites spp. and Pilosisporites grandis. The presence of this association and absence of Phimopollenites pannosus indicates attribution to the C. paradoxa Zone (Dettmann & Playford 1969).

7. 2997m - 3400m ; n.o. C. striatus Subzone, n.o. early Albian.

Sidewall cores from 2997m and 3400m provided low yields of poorly preserved palynomorphs. The assemblages are clearly of Early Cretaceous age and the presence of Crybelosporites striatus in the lower sample indicates an age no older than the early Albian C. striatus Subzone of Dettmann & Playford 1969. Cuttings from 3023m were also investigated; from these were picked dark shaly and green-grey silty to sandy lithotopes that were separately prepared for palynological examination. The sandstone/siltstone fragments were found to be devoid of palynomorphs. The shale cuttings yielded a moderately well preserved spore pollen - dinoflagellate assemblage comparable to those of the C. triplex Zone. In view of results obtained from the sidewall cores, it is concluded that the productive (shaly) cuttings include substantial down-hole contamination from the early Late Cretaceous sequence identified at higher levels (2520m - 2805m) in the well.

PALAEOENVIRONMENTS

Organic matter extracted from the samples is dominantly of land plant derivation, with minor contributions of algal and fungal material. Additionally, recycled palynomorphs occur in several of the samples.

Late Cretaceous and Early Tertiary sediments between 1311m and 2805m are interpreted to have accumulated in close-to-land situations subjected to marine influence. The Albian sequence was deposited in terrestrial environments. Further discussion of the palaeoenvironments is given below.

1. 1311m - 1496m ; Maastrichtian - late Paleocene/early Eocene.
All samples provided high volumes of organic matter mostly derived from terrestrial sources. The presence of dinoflagellates are suggestive of brackish to marine environments. Deposition occurred in a close-to-land marginal marine situation and source sediments were derived, in part, from erosion products of Permian and Early-mid Cretaceous sequences.

2. 2186.5m ; Santonian.
A close-to-land depositional situation subjected to marine influence is indicated for the sample from its content of land-plant and algal detritus. The latter includes chlorphycean microfossils of fresh to brackish habitats as well as dinoflagellates that are indicative of marine influence. As in the overlying samples recycled Permian and Early Cretaceous palynomorphs indicate that the sediment source included Permian and Early Cretaceous sequences.

3. 2520m - 2887m ; Turonian.
Low to high volumes of organic matter extracted from the samples is dominated by land-plant material derived from a rainforest vegetation. This was deposited in close-to-land situations subjected to marine influence. All three samples contain recycled Permian palynomorphs. Additionally, Early Cretaceous forms are represented in that from 2520m, and profuse representation of the Late Devonian - Early Carboniferous Granulatisporites frustulensis (Playford 1985) was recorded from the sample at 2651m. Thus the palynological evidence indicates that the sediment source of the Turonian section in Najaba No.1 included Late Devonion - Early Carboniferous, Permian, and Early Cretaceous sequences.

4. 2887m - 3400m ; Albian.

Low volumes of organic matter were recovered from the sample. This is dominantly of land plant origin derived from a flood plain vegetation that included dry-zone and mesic elements. Algal microfossils, which occur rarely, appear to be affiliated with fresh water forms. Deposition in terrestrial environments (paludal/fluvial) is indicated. Source sediments were, in part, derived from Triassic and Permian sequences.

SOURCE ROCK POTENTIAL AND MATURATION

Source rock and maturation assessments are based on methods outlined in a previous report (Dettmann 1986).

The majority of samples from the Late Cretaceous - Early Tertiary section (1311m - 2805m) provided high yields of organic matter and have potential to support significant hydrocarbon generation when mature (Table 1, 3). Organic matter is chiefly of opaque land plant detritus and is gas prone. However, samples at 1311m and 1382m have sufficiently high proportions of hydrogen-rich macerals (spores, cuticles etc.) to support limited liquid generation. These and underlying sediments to a depth of 1496m are immature. Below 2186.5m, the Late Cretaceous section is early mature to mature.

Samples studied from the Early Cretaceous sequence (2887m - 3400m) yielded low volumes of organic matter and thus have limited hydrocarbon source potential (Tables 1, 3). Organic matter is gas prone and is mature to late mature with respect to the main oil generation zone.

REFERENCES

DETTMANN, M.E. 1986. Biostratigraphy, palaeoenvironments, and hydrocarbon source potential of Westgate No. 1A, 1754m - 1909m (Cretaceous) Otway Basin. Palynology Rept. for Beach Petroleum N.L. (unpubl.)

DETTMANN, M.E. & PLAYFORD, G. 1969. Palynology of The Australian Cretaceous : a review. In: Stratigraphy and Palaeontology ; essays in honour of Dorothy Hill (ed. K.S.W. Campbell), A.N.V. Press Canberra, 174 - 210.

HARRIS, W.K. 1965. Basal Tertiary microfloras from the Princetown area, Victoria, Australia. Palaeontographica 115B, 75 - 106.

HELBY, R.J., MORGAN, R., & PARTRIDGE, A.D. in press. A palynological zonation for the Australian Mesozoic. Mem. Assoc. Australas. Palaeontols.

PARTRIDGE, A.D. 1976. The geological expression of eustacy in the Early Tertiary of the Gippsland Basin. APEA J. 16, 73 - 79.

PLAYFORD, G. 1985. Palynology of the Australian Lower Carboniferous : a review. Compte Rendu Dixième Congrès International de Stratigraphie et de Gèologie du Carbonifère, Madrid 1983, 4, 247 - 265.

STOVER, L.E. & EVANS, P.R. 1973. Upper Cretaceous - Eocene spore-pollen zonation, offshore Gippsland Basin, Australia. Geol. Soc. Aust. Spec. Publ. 4, 55 - 72.

STOVER, L.E. & PARTRIDGE, A.D. 1973. Tertiary and Late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. Proc. Roy. Soc. Vict. 85, 237 - 286.

Mary E. Dettmann
c/o Department of Geology & Mineralogy
University of Queensland
St. Lucia, Qld. 4067

1 August, 1986.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: BEACH PETROLEUM N.L. Sheet 1 of 5

WELL: NAJABA No.1 BASIN: OTWAY

Sample type	S	S	S	S	S	S	S	S	S	S	S			D		
Palynomorph \ Depth (m)	3400	2997	2887	2805	2651	2520	2186.5	1496	1460.5	1382	1311			3023		
CRYPTOGAM SPORES:																
Aequitriradites spinulosus	+	+														
Klukisporites scaberis	+	·		+												
Foraminisporis dailyi	+		+				+									
Pilosisporites notensis	+															
Velosporites triquetrus	+															
Foraminisporis asymmetricus	+	+	+													
Triporoletes reticulatus	+		+													
Cicatricosisporites australiensis	+	+	+	+												
Crybelosporites striatus	+															
Ceratosporites equalis	+	+		+	+	+	+									
Neoraistrickia truncata	+	+														
Cyathidites australis/minor	+		+	+	+	+	+	+	+	+						
Cyathidites punctatus	+		+				+									
Baculatisporites comaumensis	+	+		+	+	+	+		+					+		
Retitriletes austroclavatidites	+	+	+			+	+		+	+						
Stereisporites antiquasporites	+	+	+	+	+	+	+	+	+	+	+			+		
Foraminisporis wonthaggiensis		+	+													
Antulsporites clavus		+														
Stereisporites pocockii		+	+			+										
Retitriletes circolumenus		+														
Pilosisporites grandis			+													
Coptospora paradoxa			+													
Retitriletes nodosus			+													
Reticulatisporites pudens			+		+											
Cyathidites asper			+													
Gleicheniidites circinidites			+	+	+	+	+	+	+	+	+			+		
Balmeisporites holodictyus			+													
Arcellites reticulata			+													
Triporoletes simplex			+													
Laevigatosporites ovatus			+			+	+	+	+	+				+		
Leptolepidites verrucatus			+													
Cicatricosisporites cuneiformis				+												
Clavifera triplex				+	+	+	+		+					+		
Dictyophyllidites crenatus				+												

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: BEACH PETROLEUM N.L. Sheet 2 Of 5

WELL: NAJABA No.1 BASIN: OTWAY

Sample type	S	S	S	S	S	S	S	S	S	S	S			D		
Palynomorph \ Depth (m)	3400	2997	2887	2805	2651	2520	2186.5	1496	1460.5	1382	1311			3023		
Trilobosporites trioreticulosus				+												
Lycopodiacidites cf. asperus					+	+	+									
Cicatricosisporites sp.					+											
Perotriletes oepikii					+	+								+		
Ornamentifera sp.					+									+		
Balmeisporites glenelgensis					+											
Cicatricosisporites hughesii						+										
Rugulatisporites cf. mallatus						+	+									
Perotrilites jubatus						+	+									
Microfoveolatosporis canaliculatus						+										
Biretisporites sp.						+				+	+					
Foveogleicheniidites confossus							+									
Ornamentifera sentosa							+	+	+							
Punctatosporites sp.							+									
Camarazonosporites ohaiensis									+		+					
Laevigatosporites major								+	+	+						
Triporoletes sp.								+		+	+					
Camarazonosporites bullatus									+							
Latrobosporites crassus									+							
Camarazonosporites amplus									+	+	+					
Cyathidites splendens										+						
Polypodiaceoisporites tumulatus										+	+					
Osmundacidites wellmanii											+					
GYMNOSPERMOUS POLLEN:																
Alisporites grandis	+	+	+		+											
Araucariacites australis	+	+	+	+	+	+	+				+			+		
Podocarpidites ellipticus	+	+	+	+	+	+	+	+	+	+	+			+		
Classopollis chateaunovii	+	+	+													
Cycadopites nitidus	+	+	+				+									
Microcachryidites antarcticus	+		+	+	+	+	+	+	+	+	+			+		
Alisporites similis		+														
Trisaccites microsaccatus			+	+	+	+	+	+	+	+				+		
Phyllocladidites mawsonii				+	+	+	+	+	+	+	+			+		
Inaperturopollenites sp.					+											
Lygistepollenites florinii								+	+	+	+					

Sample type: S = Sidewall core; C = Conventional core; D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: BEACH PETROLEUM N.L. Sheet 3 of 5

WELL: NAJABA No.1 BASIN: OTWAY

Sample type	S	S	S	S	S	S	S	S	S	S	S			D		
Palynomorph \ Depth (m)	3400	2997	2887	2805	2651	2520	2186.5	1496	1460.5	1382	1311			3023		
Lygistepollenites balmei								+	+							
Dilwynites granulatus										+	+					
Dilwynites tuberculatus										+	+					
ANGIOSPERMOUS POLLEN:																
Rousea sp.				+												
Nyssapollenites cf. lanosus				+												
Triorites minor				+	+	+	+							+		
Cupuliferoidopollenites sp.						+										
cf Proteacidites sp.						+										
Tricolpites sp.						+								+		
Liliacidites cf. intermedius						+		+								
Phimopollenites pannosus						+										
Tricolporites sp.							+									
Australopollis obscurus							+	+	+	+	+					
Tricolpites gillii							+	+	+							
Tricolpites pachyexinus							+									
Asteropollis asteroides							+									
Tricolpites longus								+								
Triporopollenites sectilis								+								
Nothofagidites endurus								+	+							
Gambierina rudata								+								
Gambierina edwardsii								+	+							
Cranwellipollis subpalisadus								+								
Gephyrapollenites wahooensis								+								
'Proteacidites latrobensis								+								
Nothofagidites senectus								+								
Tricolporites microreticulatus								+								
Proteacidites amolosexinous								+								
Ericipites scabratus								+	+	+						
Periporopollenites polyoratus								+		+	+					
Tricolpites sabulosus								+								
Propylipollis angulatus								+								
Tricolpites confessus								+	+	+						
Proteacidites cf. crassipora									+							
Tricolporites lilliei								+								

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: BEACH PETROLEUM N.L.

WELL: NAJABA No.1 BASIN: OTWAY

Sample type	S	S	S	S	S	S	S	S	S	S	S			D		
Palynomorph \ Depth (m)	3400	2997	2887	2805	2651	2520	2186.5	1496	1460.5	1382	1311			3023		
Proteacidites subscabratus									+		+					
Proteacidites parvus									+	+						
Proteacidites adenanthoides									+		+					
Haloragicidites harrisii									+	+	+					
Triporopollenites cf ambiguus									+							
Tetracolporites verrucosus									+							
Tricolpites waiparaensis									+							
Tricolporites prolata									+	+	+					
Malvacipollis diversus										+	+					
Proteacidites pachypolus										+	+					
Proteacidites grandis										+	+					
Myrtaceidites eugenioides										+	+					
Proteacidites reticuloscabratus										+	+					
Spinozonocolpites prominatus										+	+					
Tricolporites scabratus										+						
Cupanieidites orthoteichus										+	+					
Anacolosidites luteoides										+						
Proteacidites scaboratus											+					
Tiliaepollenites notabilis											+					
Proteacidites stiplatus											+					
Proteacidites crassus											+					
ALGAL MICROFOSSILS:																
Sigmopollis spp.	+	+	+			+										
Schizosporis reticulatus	+															
Amosopollis cruciformis				+	+	+	+							+		
Oligosphaeridium complex				+	+		+							+		
Heterosphaeridium heteracanthum				+		+	+							+		
Cyclonephelium distinctum				+												
Palaeohystrichophora infusorioides				+			+									
Palaeoperidinium sp.						+										
Oligosphaeridium pulcherinum						+										
Spiniferites sp						+										
Cribroperidinium edwardsii						+										
Botryococcus sp.							+	+	+	+						
Pallambages sp.							+									

Sample type: S = Sidewall core; C = Conventional core; D = Cuttings.

TABLE 2 PALYNOMORPH DISTRIBUTION

COMPANY: BEACH PETROLEUM N.L. Sheet 5 of 5

WELL: NAJABA No.1 BASIN: OTWAY

Sample type	S	S	S	S	S	S	S	S	S	S	S			D		
Palynomorph \ Depth (m)	3400	2997	2887	2805	2651	2520	2186.5	1496	1460.5	1382	1311			3023		
Chatangiella tripartita							+									
Odontochitina porifera							+									
Manumiella druggii								+								
Isabelidinium bakeri								+	+							
Cymatiosphaera sp.								+								
Pterospermella sp.								+								
Ceratiopsis dartmoria									+							
Eisenackia crassitabulata									+							
Cordosphaeridium inodes									+							
Fibrocysta bipolare									+	+	+					
Ceratiopsis obliquipes										+	+					
Deflandrea pachyceras											+					
RECYCLED PALYNOMORPHS:																
Playfordiaspora crenulata	+															
Lundbladispora denmeadii		+														
Aratrisporites spp.		+														
Striatoabieites sp.			+													
Plicatipollenites spp.				+		+	+	+	+							
Granulatisporites frustulensis					+											
Cyclosporites hughesii						+			+	+	+					
Cicatricosisporites ludbrookiae							+									
Didecitriletes ericianus								+								
Pseudoreticulatispora pseudoretic.								+								
Classopollis chateaunovii											+					
Contignisporites spp.											+					
Pilosisporites notensis											+					
Dictyotosporites complex											+					

Sample type: S = Sidewall core; C = Conventional core;
D = Cuttings.

SAMPLE	DEPTH (m)	LITHOLOGY	ORGANIC MATTER																
			AMOUNT (ml/ 10gm)	TYPE (% composition)													MATURITY		
				Alginite			Sporin./Cutin.				Woody tissue	Humic		Vitr.		Inertinite			
				Dispersed	Dense	Algal cysts	Fine (<10µm)	Spores	Leaf tissue	Other		<20µm	>20µm	<20µm	>20µm		Spore Colour	T.A.I. (after Staplin 1982)	Interpreted Maturity Level
SWC 15	1311	Claystone, dk. grey	1.7	5	-	+	-	5	+	25	-	15	30	5	15	+	greenish yellow	1.4	immature
SWC 11	1382	Claystone, dk. grey	1.6	5	-	+	-	5	5	15	+	15	35	5	15	-	greenish yellow	1.4	immature
SWC 6	1460.5	Claystone, dk. grey - brown	2.1	+	5	+	-	+	+	+	-	25	40	5	25	-	greenish yellow	1.4	immature
SWC 1	1496	Sandstone, f.gr.& clay dk. grey-brown	1.1	-	-	+	-	5	-	-	-	5	10	30	50	+	greenish yellow	1.6	immature
SWC 29	2186.5	Claystone, dk.grey-brown white lam.	0.6	+	-	+	-	5	+	5	-	10	10	20	50	+	greenish yellow	1.8	immature - early mature

TABLE 3. Organic matter Najaba No.1, sidewall cores 1311m - 3400m

SAMPLE	DEPTH (m)	LITHOLOGY	ORGANIC MATTER															
			AMOUNT (ml/ 10gm)	TYPE (% composition)													MATURITY		
				Alginite			Sporin./Cutin.				Woody tissue	Humic		Vitr.		Inertinite	Spore Colour	T.A.I. (after Staplin 1982)	Interpreted Maturity Level
				Dispersed	Dense	Algal cysts	Fine (<10µm)	Spores	Leaf tissue	Other		<20µm	>20µm	<20µm	>20µm				
SWC 25	2520	Claystone & sand, f.gr.dk. grey-brown	0.5	+	-	+	-	+	+	10	-	10	30	20	30	-	yellow	2.0	early mature
SWC 23	2651	Claystone & f.gr.sand, dk.grey-brown	1.2	+	-	+	5	+	-	10	+	10	15	20	40	+	yellowish amber	2.2	early mature
SWC 19	2805	Siltstone, grey-brown	2.0	-	-	+	-	+	+	15	+	5	10	30	40	+	amber	2.3	mature
SWC 16	2887	Siltstone med.grey	0.5	-	-	-	-	5	-	5	-	20	10	20	40	+	amber-brown	2.5	mature
SWC14	2997	Siltstone dk.grey	0.6	-	-	-	-	+	-	10	-	25	5	20	40	+	amber-brown	2.5	mature
SWC 1	3400	Siltstone grey-green	0.4	-	-	-	-	5	-	15	-	15	5	20	40	+	brown	2.5+	mature-late mature

TABLE 3 (contd.) Organic matter Najaba No.1, sidewall cores 1311m - 3400m