SUMMARY

Palynomorphs extracted from Westgate No.1A between 1754m and 1909m demonstrate an age range of late Albian to Turonian. During late Albian - Cenomanian sediments between 1867m and 1909m were deposited in terrestrial situations. Encroachment of the sea occurred during the Cenomanian and Turonian when sediments between 1832.5m and 1848.5m accumulated in close-to-land marginal marine situations; the sandstone at 1754m is clearly of Late Cretaceous age but yielded insufficient palynomorphs from which to draw precise age, biostratigraphic and palaeoenvironmental inferences.

Sediments at 1832.5m and 1848.5m provided high yields of organic matter and have good hydrocarbon source potential; OM is predominantly gas prone and the section is early mature with respect to the main oil generation zone. Underlying terrestrial sediments at 1867m and 1909m contain low quantities of OM and have limited source potential; spore colouration indicates that the section is mature, lying within the main oil generation zone.

INTRODUCTION

Five sidewall cores from between 1754m and 1909m in Westgate No.1A, Otway Basin have been palynologically analysed to ascertain the age and biostratigraphic relationships of the sediments, the palaeo-environments 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 followed conventional physico-chemical techniques for recovery and concentration of the palynological microfossils (see Phipps & Playford 1984). Kerogen slides of unoxidised residue were also prepared and form the basis of the source rock/maturation analyses.

BIOSTRATIGRAPHY AND AGE

All samples were palynologically productive, although that from 1754m provided only a low yield of palynomorphs. Biostratigraphic evaluation of the sequence is in terms of the spore-pollen zones introduced by Dettmann & Playford (1969), and, where applicable, the dinoflagellate zones of Helby *et al.* (in prep.) as detailed in Fig.1 (from Frakes *et al.* in press). Relationships of the palynozones to the litho-stratigraphic sequence in the Otway Basin are displayed in Fig.2.

1. 1754m; n.o. *C. triplex* Zone, n.o. Turonian

The sparse assemblage is compatible with an early Late Cretaceous age. The sample is stratigraphically above sediments at 1832.5m that contain *C. triplex* Zone indices; a Turonian or younger age is indicated.

2. 1832.5m; C. triplex Zone, Turonian

The presence of Phyllocladidites mawsonii together with Clavifera triplex, Amosopollis cruciformis and Balmeisporites glenelgensis indicates reference of the sample to the C. triplex Zone. The dinoflagellate assemblage is taxonomically restricted and insufficiently diagnostic for precise attribution in terms of the Helby et al. zones. However it is consistent with those reported from the lower part of the Upper Cretaceous sequence in the Otway Basin; here, initial appearances of Palaeohystrichophora infusioroides are usually associated with the C. triplex Zone.

3. 1848.5m; A. distocarinatus Zone, Cenomanian/Turonian

The diverse spore-pollen assemblage contains first appearances (up section) of A. distocarinatus & Amosopollis cruciformis and lacks indices of the of the succeeding C. triplex Zone. Accordingly the sediments are assigned to the A. distocarinatus Zone. Dinoflagellates comprise species that are long ranging in Australian Early and mid Cretaceous sediments.

4. 1867m, 1909m; P. pannosus Zone, late Albian-Cenomanian

Both samples yielded Phimopollenites pannosus in diverse spore-pollen assemblages that are indicative of the P. pannosus Zone.

PALAEOENVIRONMENTS

Land plant organic matter dominates the kerogens although algal microfossils occur in four of the samples. Additionally represented in all samples are fungal and recycled palynomorphs. The palaeoenvironmental significance of the individual palynomorph assemblages is discussed below.

SUMMARY

Westgate No. 1A was drilled as a wildcat exploration well in PEP 108, Otway Basin, Victoria, approximately 12 km northwest of the Paaratte gas field.

Participants in the well were Beach Petroleum N.L. (Operator) and Bridge Oil Ltd.

The structure is a fault controlled culmination with laterally offset Waarre and Pebble Point Formations as the primary targets. The borehole was deviated to intersect these targets at their highest structural points.

Drilling commenced on the 23rd February 1986 and reached a total measured depth of 1918m. At 972m MD mechanical problems necessitated the hole being plugged back to 554m MD and redrilled. At 1414m the drill string became stuck, but was freed after displacing the drilling mud with water.

A total of three wireline logging suites were performed as follows; at 456m, Induction/Sonic; at 1144m Induction/Sonic, at 1918m Dual Laterolog/Micro-spherically focused, Litho Density/Compensated Neutron, Sonic, Stratigraphic High Resolution Dipmeter, Natural Gamma Ray Spectrometry, Microlog, Well Velocity Survey (standard and offset), Sidewall Cores (29 recovered) and a Repeat Formation Tester. No conventional cores were cut.

All the prognosed target formations were intersected but proved to be water saturated. A good gas show was however, recorded within the Flaxmans Formation.

A cased hole test was performed over the most promising zone and produced a small amount of gas cut water.

Westgate No. 1A was plugged and abandoned as a dry hole on the 24th March 1986.

1. INTRODUCTION

Westgate No. 1A was drilled in the Port Campbell Embayment of the Otway Basin.

The Otway Basin is an east-west trending trough, extending from Cape Jaffa in South Australia, east to the King Island - Mornington Peninsula Ridge. The basin contains up to 8000 metres of Lower Cretaceous to recent sediments and has an areal extent of some 105,000 square kms.

The trough was initiated in the late Jurassic in response to a major tensional regime associated with the separation of Australia and Antartica. By Upper Cretaceous times a series of north trending, sub-parallel embayments had developed. Within each embayment the structural framework is dominated by a few major down-to-basin normal faults which form large tilted fault blocks. The platform areas are generally heavily modified by many smaller "compensating" fault systems, some of which have a reverse component.

In the central region of PEP 108, a major down-to-basin normal fault, the Timboon Fault, splinters into two prominent faults separated by a fault dissected platform. Westgate No. 1 was drilled on this platform, close to the bifurcation point of the Timboon Fault.

The prospect was delineated by the 1984 Beach/Bridge Timboon (TM) Seismic Survey and refined by the 1985 Beach/Bridge Timboon Extension (TME) Seismic Survey.

The primary targets were the basal Upper Cretaceous Waarre Formation and the basal Tertiary Pebble Point Formation.

At Waarre Formation level the structure is an asymmetric horst block bounded by northeast - southwest trending normal faults. The south bounding fault terminates within the Upper Cretaceous but closure is inferred against the north bounding fault up to the basal Tertiary.

As the highest points of the Waarre Formation and the Pebble Point Formation over this structure are laterally offset by some 390m (the Waarre Formation being further north) the borehole was deviated by the appropriate amount in order to maximise the potential of this exploration well.

1. 1754m; n.o Turonian

The sandstone sample yielded a low volume of organic matter derived largely from terrestrial sources. Deposition occurred under moderate energy conditions with source sediments derived, at least in part, from Triassic sequences.

2. 1832.5m, 1848.5m; Cenomanian - Turonian

Both samples are rich in organic matter that is chiefly of land plant origin. This was deposited under low energy conditions in a close-to-land situation subjected to marine influence. Source sediments include erosion products of Permian, Triassic, and possibly Lower Cretaceous sequences.

3. 1867m, 1909m; late Albian - Cenomanian

The low volumes of organic matter extracted from the samples include products of land plants and freshwater algae. Deposition in terrestrial situations is indicated. Infrequent recycled palynomorphs of Triassic and Early Cretaceous age indicate that some of the source sediments may have derived from Triassic and Lower Cretaceous sequences.

SOURCE ROCK POTENTIAL

The source richness of the samples was determined from the volume of organic matter extracted from 10 gm of sample; this provides a guide to TOC values (Tissot & Welte 1978). Source quality was determined using transmitted and blue fluorescent microscopy methods, and maturation levels were determined from spore colouration and expressed in terms of T.A.I. values of Staplin (1982).

Samples from 1848.5m and 1832.5m provided high yields of OM and could thus be expected to support significant hydrocarbon generation when mature. Samples from 1867m and 1909m provided low volumes of OM and have limited source potential. The sandstone from 1754m is not considered a likely source rock.

OM present in the potential source rocks (1832.5m, 1848.5m) is chiefly of opaque land plant detritus that is predominantly gas prone. However, liptinitic (oil generating) macerals comprising land plant exines/ cuticles and minor alginites account for sufficiently high proportions to indicate limited potential for oil. Kerogens from underlying samples at 1867m and 1909m are predominantly gas prone and the sediments have poor oil source potential.

Based upon spore colouration, the sequence 1754m - 1848.5m is early mature; that between 1867m and 1909m is mature, lying within the main oil generation zone.

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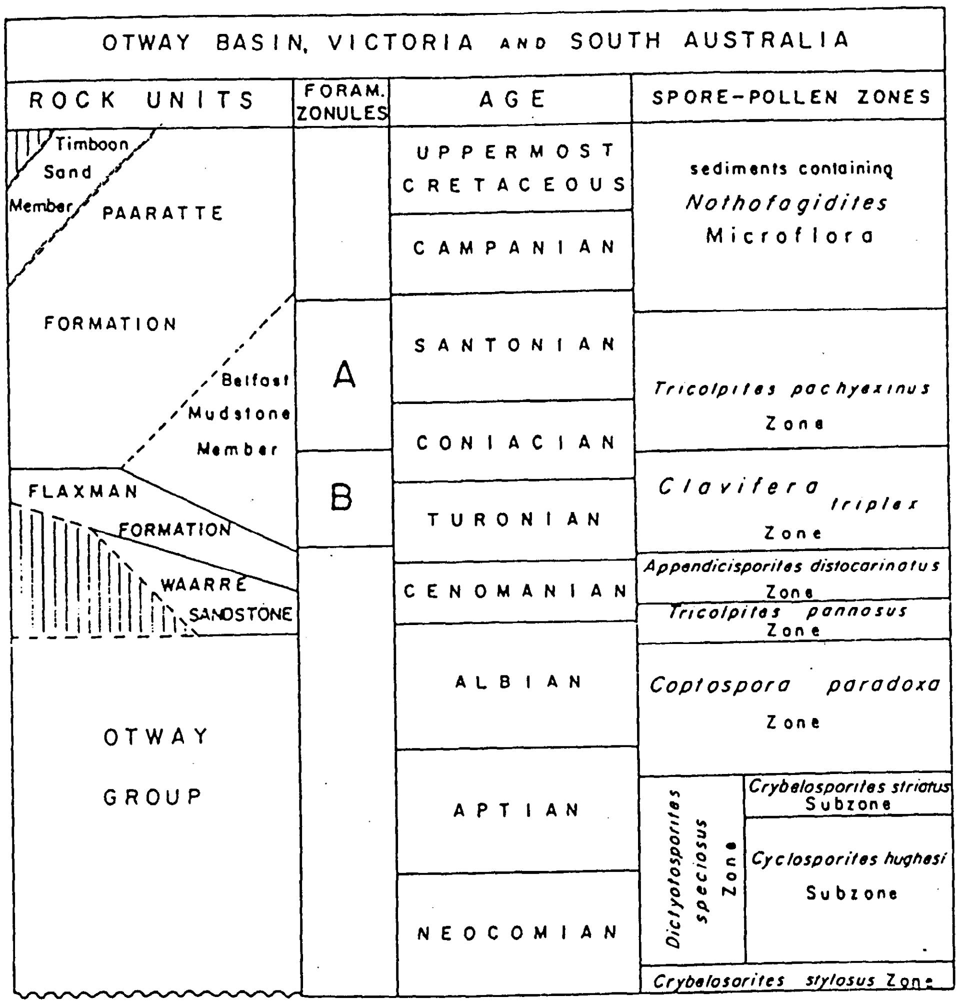

FIG. 1. Lithostratigraphic/biostratigraphic relationships in the Cretaceous sequence, Otway Basin (from Dettmann & Playford 1969).

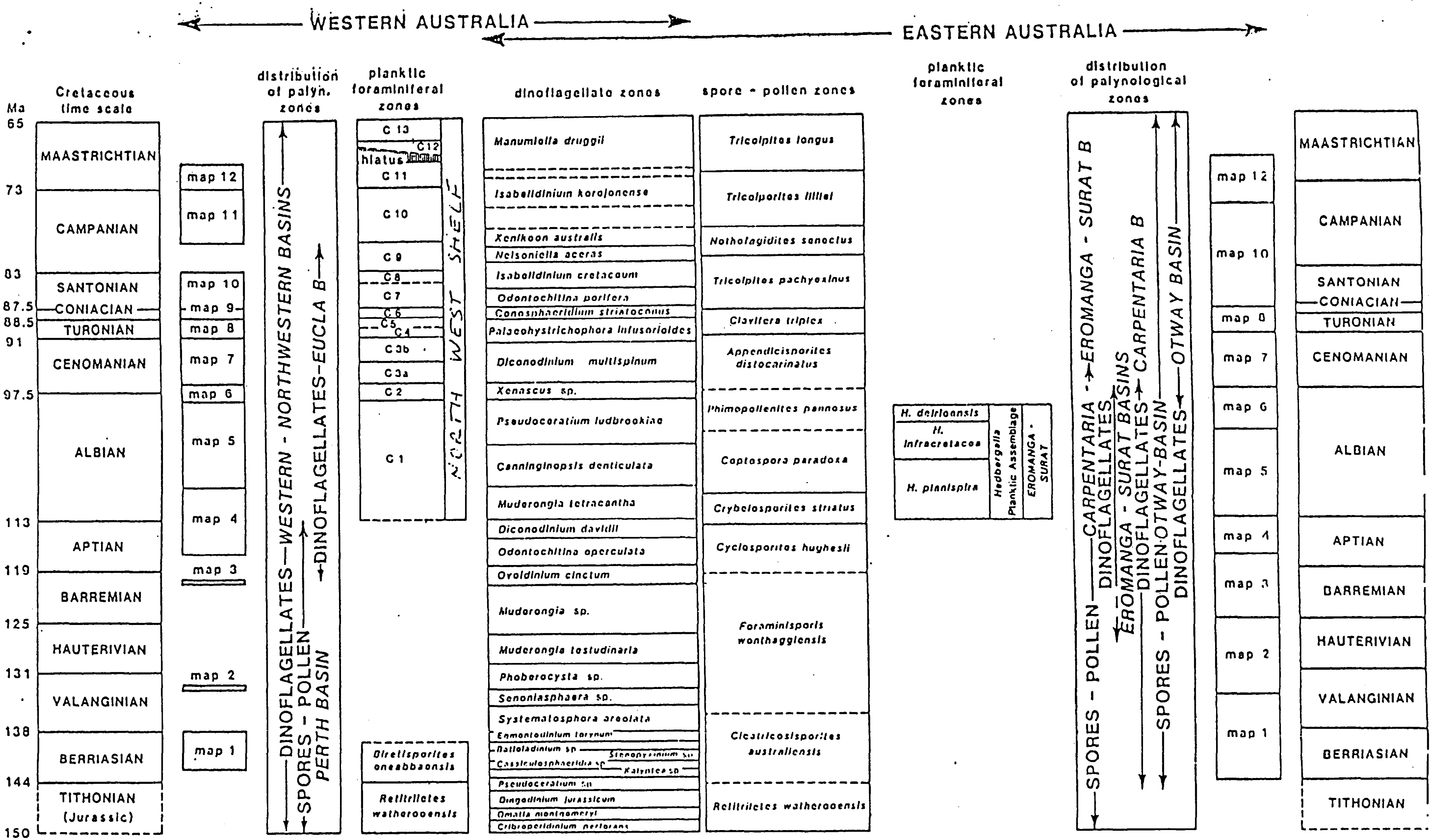

FIG. 2. Biostratigraphic units for the Australian Cretaceous (from Frakes et al. in press)

COMPANY: BEACH PETROLEUM N.L.

WELL: WESTGATE No. 1A BASIN: OTWAY

Sample type	S	S	S	S	S
Palynomorph / Depth (m)	1909	1867	1848.5	1832.5	1754
CRYPTOGAM MICROSPORES:					
Trilobosporites trioreticulosus	+			+	
Trilites cf. tuberculiformis	+		+		+
Stereisporites antiquasporites	+	+	+	+	+
Stereisporites pocockii	+	+	+		
Cyathidites australis/minor	+	+	+	+	+
Baculatisporites comaumensis	+	+	+	+	+
Triporoletes reticulatus	+	+	+		+
Foraminisporis wonthaggiensis	+	+	+		
Foraminisporis asymmetricus	+	+	+		
Foraminisporis dailyi	+				+
Retitriletes austroclavatidites	+	+	+		
Retitriletes nodosus	+		+		
Retitriletes eminulus	+	+	+	+	
Perinomonoletes sp.	+		+		
Crybelosporites striatus	+	+			
Aequitriradites spinulosus	+	+	+		
Aequitriradites verrucosus	+	+			
Leptolepidites verrucatus	+	+	+	+	
Cicatricosisporites australiensis	+	+	+	+	
Cicatricosisporites cuneiformis	+			+	
Cicatricosisporites hughesii	+	+	+		
Cyathidites punctatus	+		+		
Neoraistrickia truncata	+	+	+		
Gleicheniidites circinidites	+	+	+	+	+
Velosporites triquetrus	+				
Punctatosporites sp.	+			+	
Matonisporites cooksoniae	+				
Ceratosporites equalis	+	+	+	+	
Dictyophyllidites crenatus	+	+			
Klukisporites scaberis	+		+	+	
Microfoveolatosporis canaliculatus	+		+	+	
Coptospora paradoxa		+			
Osmundacidites wellmanii		+			
Densoisporites velatus		+	+		

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

COMPANY: BEACH PETROLEUM N.L.

WELL: WESTGATE NO.1A

BASIN: OTWAY

Sample type	S	S	S	S	S
Palynomorph / Depth (m)	1909	1867	1848.5	1832.5	1754
Retitriletes clavatoides		+			
Laevigatosporites ovatus		+	+	+	+
Biretisporites cf. potoniaei		+	+	+	
Triporoletes radiatus		+			
Perotrilites granulatus			+		
Perotrilites major			+		
Perotrilites jubatus			+	+	
Concavissimisporites penolaensis			+		
Stoverisporites microverrucatus			+	+	
Appendicisporites distocarinatus			+	+	
Cicatricosisporites pseudotripartitus			+	+	
Foveogleicheniidites confossus			+	+	
Leptolepidites major			+		
Retitriletes facetus			+		
Contignisporites glebulentus			+		
Camarazonosporites australis				+	
Lycopodiacidites cf. asperus				+	
Laevigatosporites major				+	
Clavifera triplex				+	
Interlobites intraverrucatus				+	
CRYPTOGAM MEGASPORES:					
Balmeisporites glenelgensis				+	+
GYMNOSPERMOUS POLLEN:					
Alisporites grandis	+	+			
Alisporites similis	+	+	+	+	
Araucariacites australis	+	+	+	+	+
Classopollis chateaunovii	+	+	+	+	
Classopollis sp.	+	+			
Microcachryidites antarcticus	+	+	+	+	+
Podocarpidites cf. ellipticus	+	+	+	+	+
Trisaccites microsaccatus	+	+	+	+	
Vitreisporites pallidus	+		+		
Cycadopites nitidus			+	+	
Hoegisporis sp.				+	
Phyllocladidites mawsonii				+	

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

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	1754	sst.	*				*					*				n.o. C. triplex	n.o. Tur.				
swc	1832.5	shl.			*			*				*				C. triplex	Tur.			*	
swc	1848.5	shl.		*				*				*				A. distocar.	Cen/Tur			*	
swc	1867	slst.	*				*						*			P. pannosus	Alb/Cen	*			
swc	1909	slst.	*				*						*			P. pannosus	Alb/Cen	*			
			0.8	1.2	2.4		20	60	80		GY 1.8	Y 2.2	A 2.5	Br 3.0	Bl						
			(ml OM/10gm) KEROGEN YIELD				% H-RICH KEROGEN				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 1754m and 1909m in Westgate No.1A.