

926C

DEPT. NAT. RES & ENV



PE907699

LINDON NO. 1

Source Rock Evaluation
Oil Correlation Analysis

Amoco Production Company - Research Center
1985

LINDON-1
OIL CORRELATION ANALYSIS
(W841)

OB277d

105. Lindon

85179ART0182

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

SOURCE ROCK EVALUATION
OIL CORRELATION ANALYSIS

Cuttings, Core, and Oil from the Beach Petroleum Lindon
No. 1 Well Otway Basin, Australia

Geochemistry Services

R. K. Olson

Technical Service 859062CF

Requested by M. Toll

CSA/FE, HOUSTON

R. K. Olson (7/2/85)
R. K. Olson

Distribution: D. B. Felio, Attn: M. Toll, CSA/FE, Houston
K. B. Knowlton, CSA/FE, Houston

Proprietary - for the exclusive use of Amoco Production Company and
other wholly owned subsidiaries of Amoco Corporation.

Subject: Source Rock and Oil Correlation Analysis of Cuttings, Sidewall Core and Oil Samples from the Beach Petroleum Lindon No. 1 Well, Otway Basin, Australia (Figure 1)

INTRODUCTION

Cuttings, sidewall cores and an oil sample from the subject well were submitted to Tulsa Research for source rock evaluation and oil correlation analysis. One rock extract and oils from the Lindon and Port Campbell wells were sent to Brown & Ruth laboratory in Houston for GC-MS analysis. This report transmits results of those analyses.

CONCLUSIONS

1. Three intervals, one at approximately 873 meters, the second between 2100 and 2200 meters, and the third between 2660 and 2940 meters are rated as having marginal to good hydrocarbon source potential. One sample from 2840 meters was found to contain in excess of 6% organic carbon and is rated as being an excellent source. All other samples are rated as having no significant hydrocarbon generating capabilities (Figure 2).
2. Visual kerogen analysis (Table 4) and pyrolysis convertibilities (Figure 2) suggests these intervals will generate primarily gas. However, the oil-like character of the bitumens extracted from three samples between 2760 meters and 2940 meters (Figure 4) suggests they may have some minor oil generating capabilities. Elemental kerogen analyses support this interpretation.

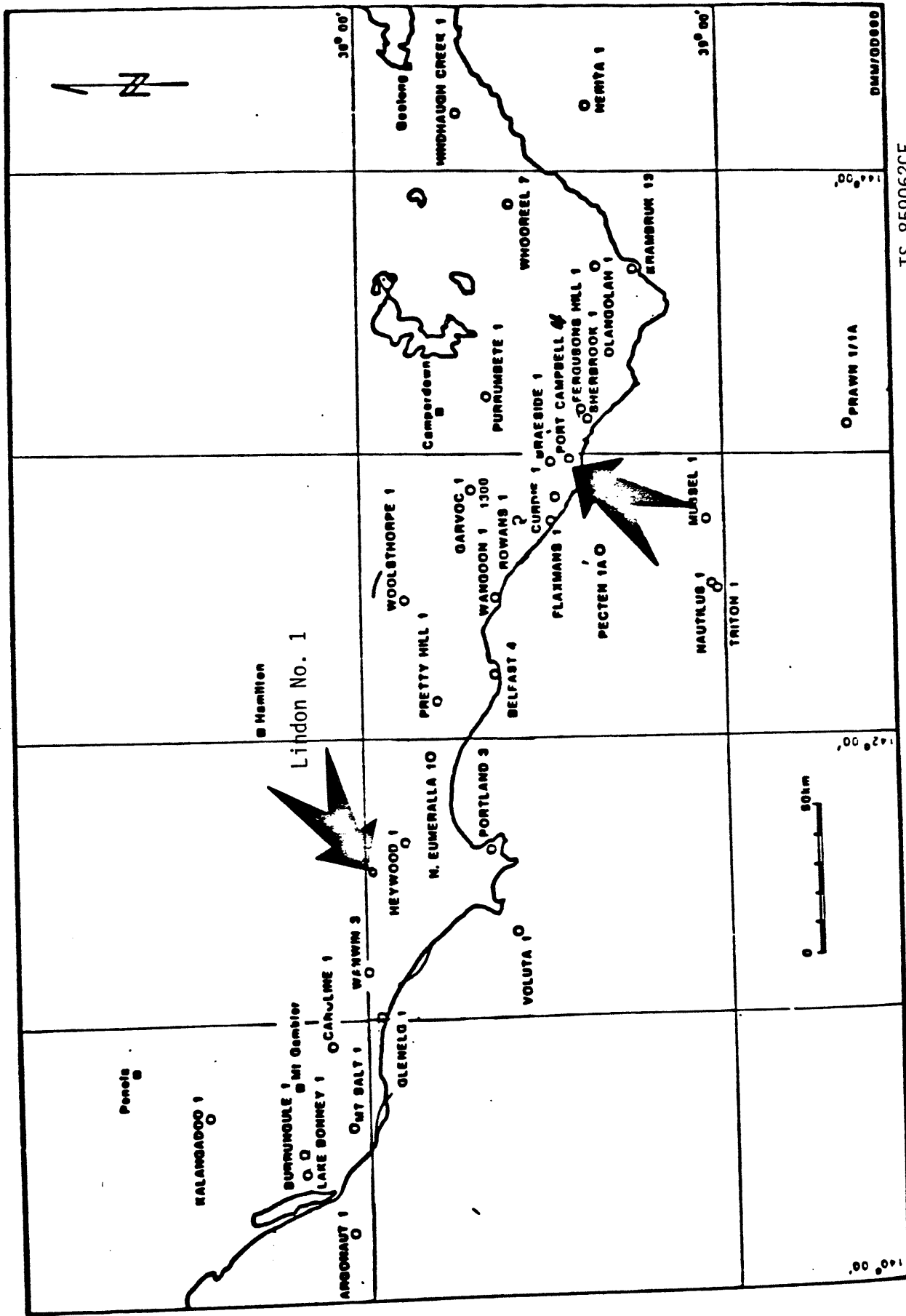
3. The level of thermal maturity was found to increase from 0.43% R_o at 873 meters to 0.88% R_o at 2940 meters. These data suggest the top of the oil window occurs at approximately 2600 meters. Vitrinite reflectance data generated by Amoco are in good agreement with vitrinite measurements obtained from Beach Petroleum (Figure 5).
4. Oil recovered from a drill-stem test at approximately 912 meters in this well is partially biodegraded. This is suggested by the loss of low molecular weight normal alkanes seen on the gas chromatogram (Figure 6a).
5. The extract from the 910 m cuttings sample has a molecular distribution very similar to the oil recovered from the DST near this depth. This bitumen represents migrated oil not bitumen generated from kerogen indigenous to this shale section.
6. Oil recovered from the Lindon No. 1 is correlated with oil recovered from the Port Campbell No. ⁴X (see TS 845419CF). Differences between them are attributed to partial degradation of the Lindon No. 1 oil (Figures 6a and b).
7. Extracts from the 2760 meter to 2940 meter interval of the Lindon well were compared to the oils recovered from both the Lindon and the Campbell wells. Although there are isotopic similarities between these oils and the saturated fraction GC-MS ion chromatograms appear similar (Figures 7a and b) the lack of waxes in the extracts precludes correlation with these oils.

8. No data to support or refute the possibility of a lacustrine source having generated either the Port Campbell or Lindon oils was found. The high pristane/phytane ratio and abundance of waxes in both oils suggest the source horizon for this oil type contains a large amount of terrestrially derived organic matter that accumulated under somewhat oxidizing conditions. However, these conditions could be met in either a lacustrine or marine depositional environment.

9. GC-MS data, gas chromatograms and carbon isotope data generated for the oils and bitumens analyzed here were compared to McKirdy's data (reprint supplied by M. Toll). The Lindon and Port Campbell oils are isotopically most similar to McKirdy's Type I family of coastal bitumens but botryococcane was not found in this oil and the Pristane/Phytane ratios are much higher for Lindon and Port Campbell oils. McKirdy's Family I oils are most likely generated and expelled from a different source horizon than the oils reported here. This conclusion is supported by comparison of sterane ion chromatograms found here and in McKirdy's report.

R. K. Olson
R. K. Olson

RKO:jdb/bl



TS 859062CF

Figure 1

Approximate location of the Port Campbell #4 and Lindon No. 1 Wells.

Proprietary - To Be Maintained In Confidence
Amoco Production Company

OFFICE APC(I) DISTRICT CSA & FE
AUTHORIZED BY MICHAEL TOLL
TECHNICAL SERVICE NUMBER 859062

SOURCE ROCK SUMMARY
TABLE 1.
DATE 06/25/85

SAMPLE NUMBER	SMPL TYPE	FORMATION	AGE	LITHOLOGY	FIELD NO. OR DEPTH METERS TOP***BOTTOM	PETROLEUM GENERATION			
						CAPABILITY	TYPE	STAGE	
	STATE FOREIGN OPERATOR	BEACH PETROLEUM	COUNTY	AUSTRALIA LEASE	LONDON #1	WELL LOCATION			
F-1935	CT			SS & SH	770.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1925	CR			SHALE	873.0		GOOD	OIL & GAS ?	EARLY PEAK OIL-EARLY GAS
F-1936*	CT			SS & SH	910.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1926	CR			SANDSTONE	931.6		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1927	CR			SHALE	1216.5		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1937	CT			SS & SH	1300.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1938	CT			SS & SH	1460.0 - 1470.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1939	CT			SS & SH	1610.0 - 1620.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1940	CT			SS & SH	1700.0 - 1710.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1941	CT			SS & SH	1810.0 - 1820.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1942	CT			SS & SH	1900.0 - 1910.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1943	CT			SS & SH	2000.0 - 2010.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1944	CT			SS & SH	2100.0 - 2110.0		MARGINAL	OIL & GAS ?	EARLY PEAK OIL-EARLY GAS
F-1945	CT			SS & SH	2200.0 - 2210.0		MARGINAL	OIL & GAS ?	EARLY PEAK OIL-EARLY GAS
F-1928	CR			SHALE	2253.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1946	CT			SS & SH	2300.0		NON SOURCE		EARLY PEAK OIL-EARLY GAS
F-1929	CT			SHALE	2660.0		GOOD	OIL & GAS ?	PEAK OIL-EARLY PEAK GAS
F-1930	CT			SHALE	2760.0		GOOD	OIL & GAS	PEAK OIL-EARLY PEAK GAS
F-1931	CT			SHALE	2840.0		EXCELLENT	OIL & GAS	PEAK OIL-EARLY PEAK GAS
F-1932	CR			SHALE	2902.0		MARGINAL	GAS	PEAK OIL-EARLY PEAK GAS

* CONTAINS MIGRATED OIL.

Proprietary - To Be Maintained In Confidence
Amoco Production Company

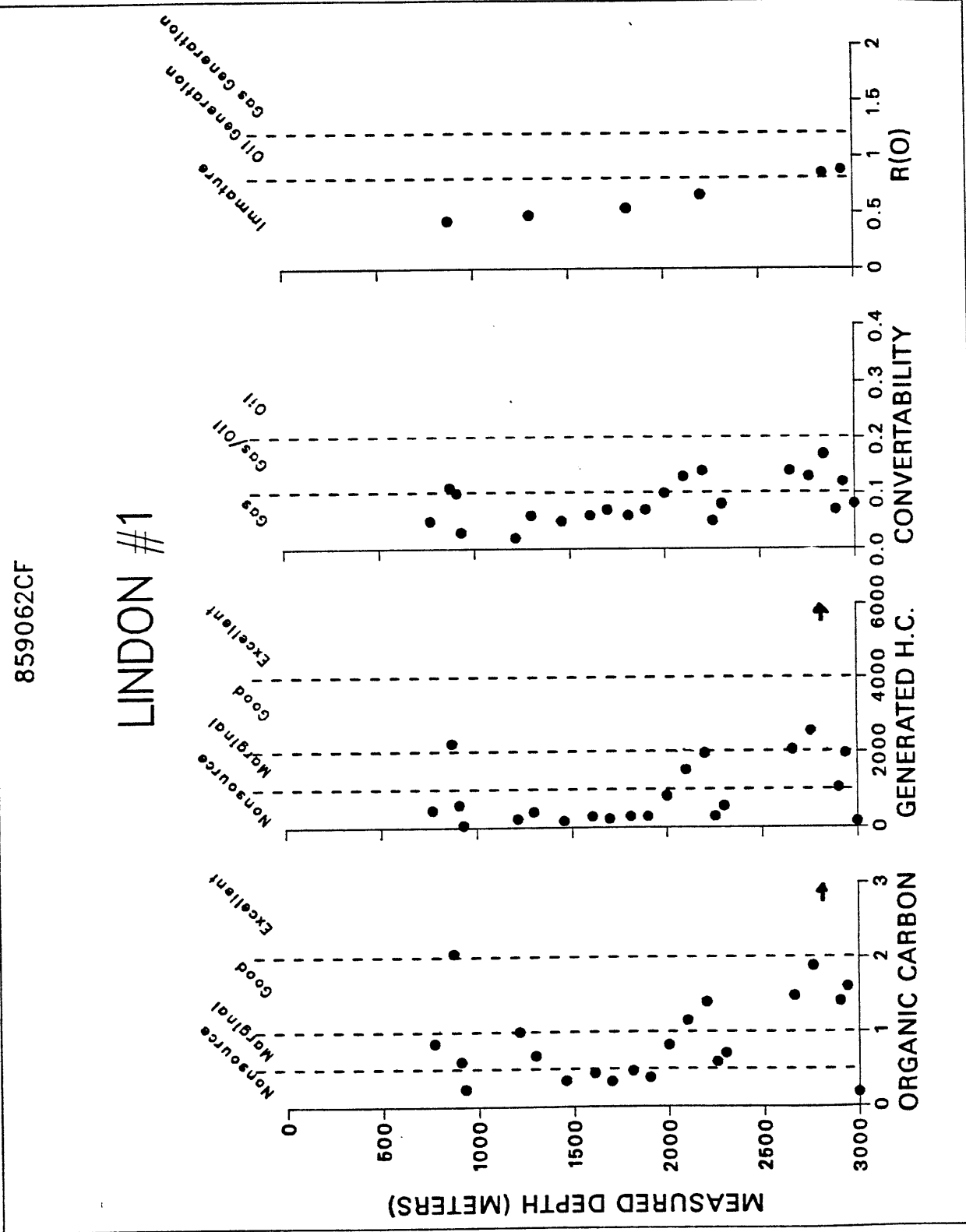
OFFICE APC(1) DISTRICT CSA & FE
 AUTHORIZED BY MICHAEL TOLL
 TECHNICAL SERVICE NUMBER 859062

SOURCE ROCK SUMMARY
 TABLE 1.
 DATE 06/25/85

SAMPLE NUMBER	SMPL TYPE	FORMATION	AGE	LITHOLOGY	FIELD NO. OR DEPTH METERS TOP***BOTTOM	PETROLEUM GENERATION		
						CAPABILITY	TYPE	STAGE
F-1933	CT			SHALE	2940.0	MARGINAL	OIL & GAS	PEAK OIL-EARLY PEAK GAS
F-1934	CT			SHALE	3000.0	NON SOURCE		PEAK OIL-EARLY PEAK GAS

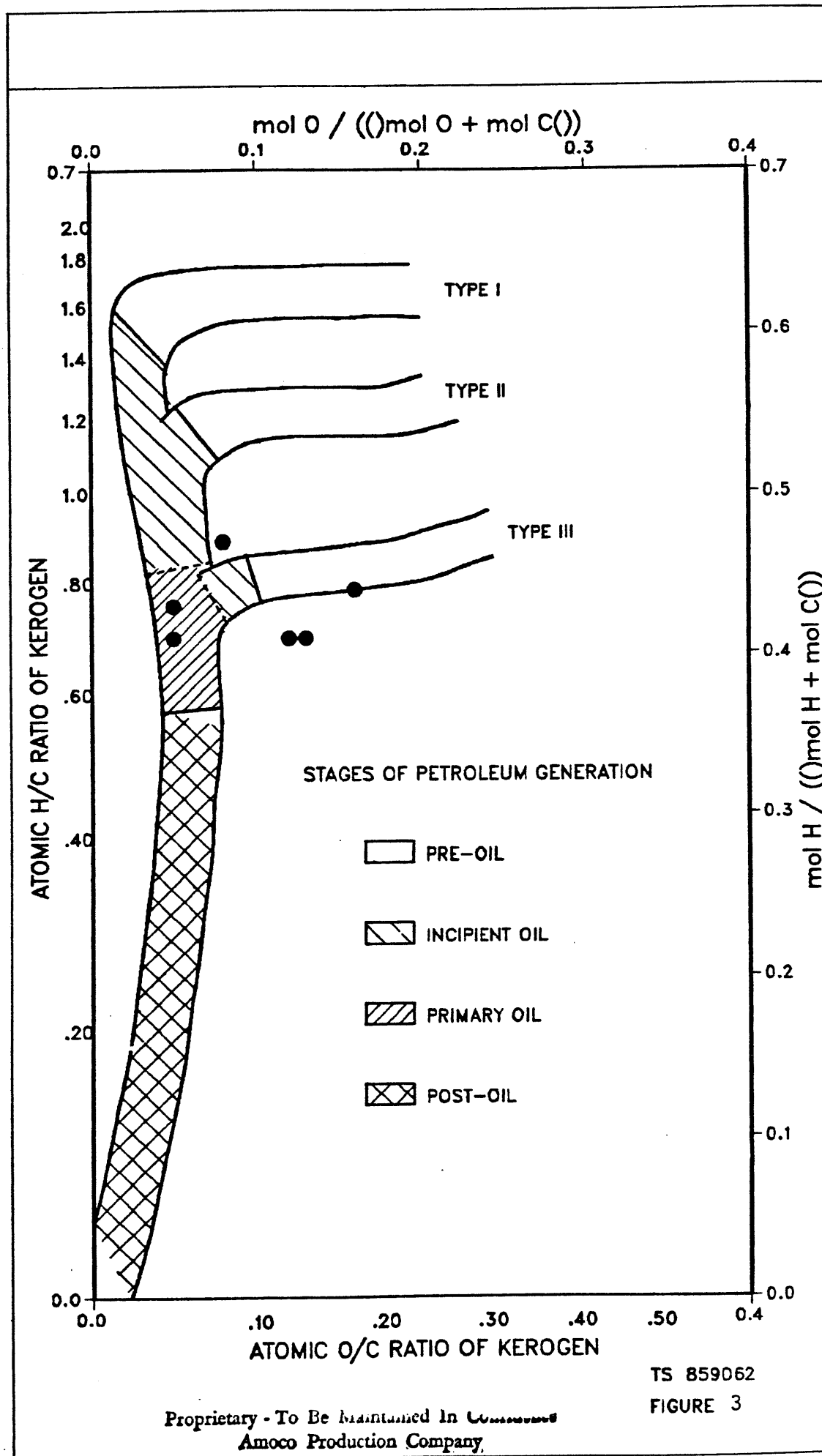
859062CF

LINDON #1



TS 859062CF
Figure 2

Proprietary - To Be Maintained In Confidence
Amoco Production Company



Proprietary - To Be Maintained In Confidence
Amoco Production Company

910m

2760m

2840m

Bitumen Gas Chromatograms

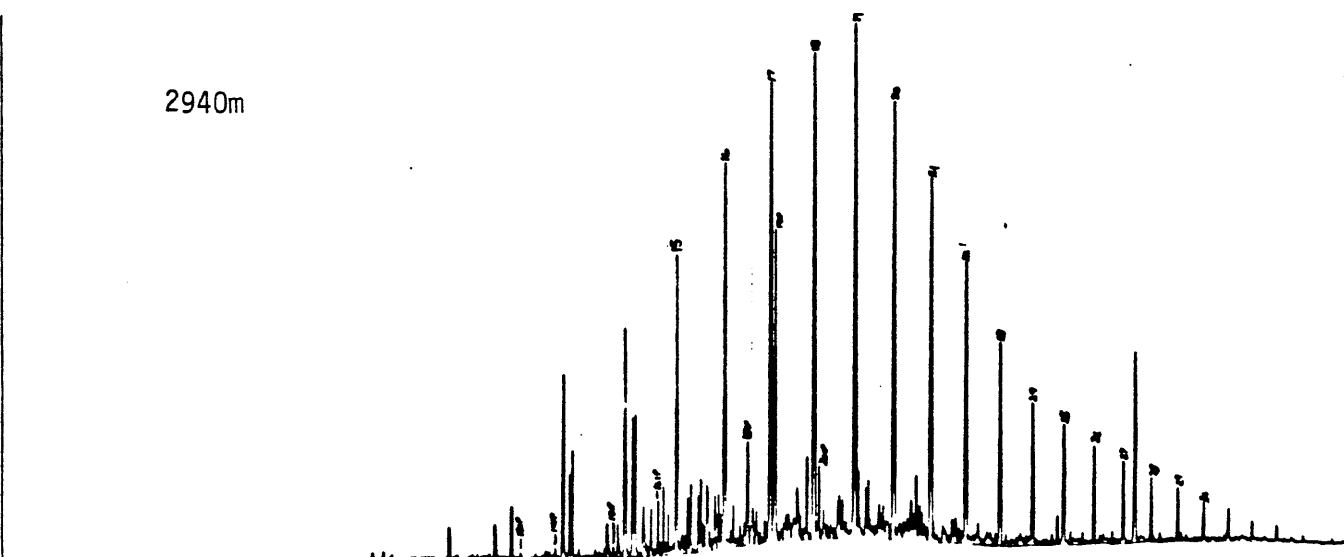
Proprietary - To Be Maintained In Confidence
Amoco Production Company

TS 859062CF
Figure 4a

2902m

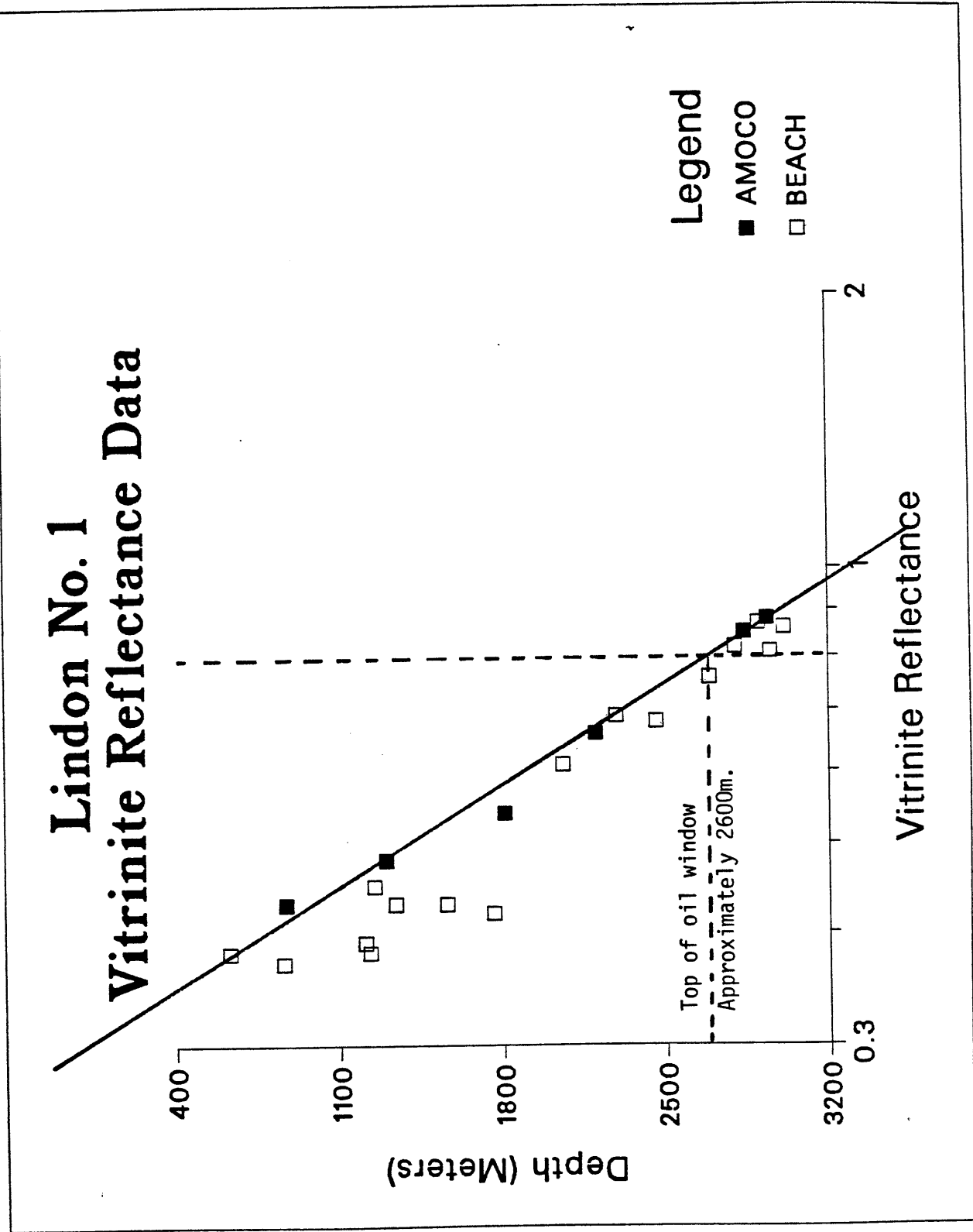


2940m



Bitumen Gas Chromatograms (cont'd)

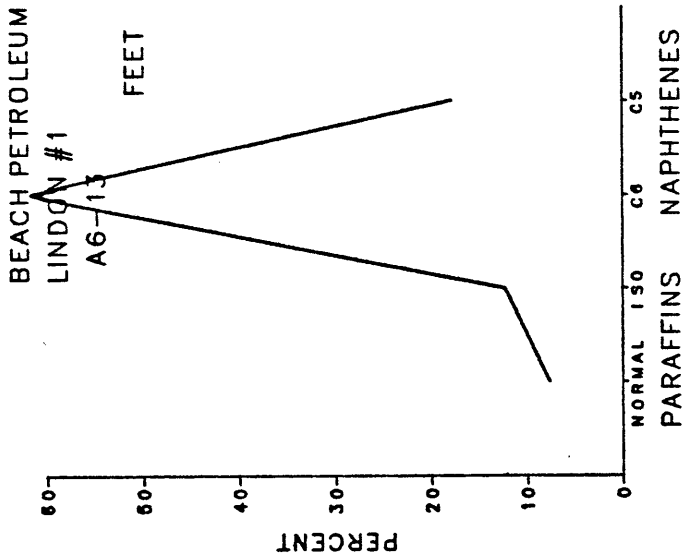
Lindon No. 1 Vitrinite Reflectance Data



Proprietary - To Be Maintained In Confidence
Amoco Production Company

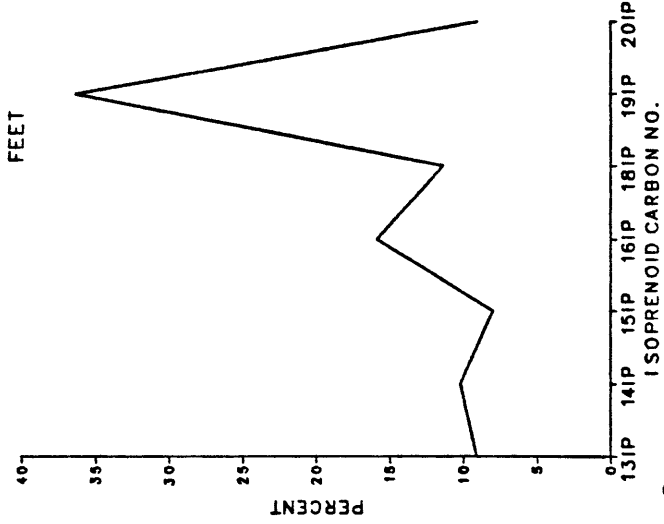
Beach Petroleum
 Lindon No. 1
 Otway Basin Australia

API Gravity = 33.2
 $\delta^{13}C_{oil}$ = 24.2
 $\delta^{13}C_{sat}$ = 25.0
 % S = 0.10
 O. R. = 0.73



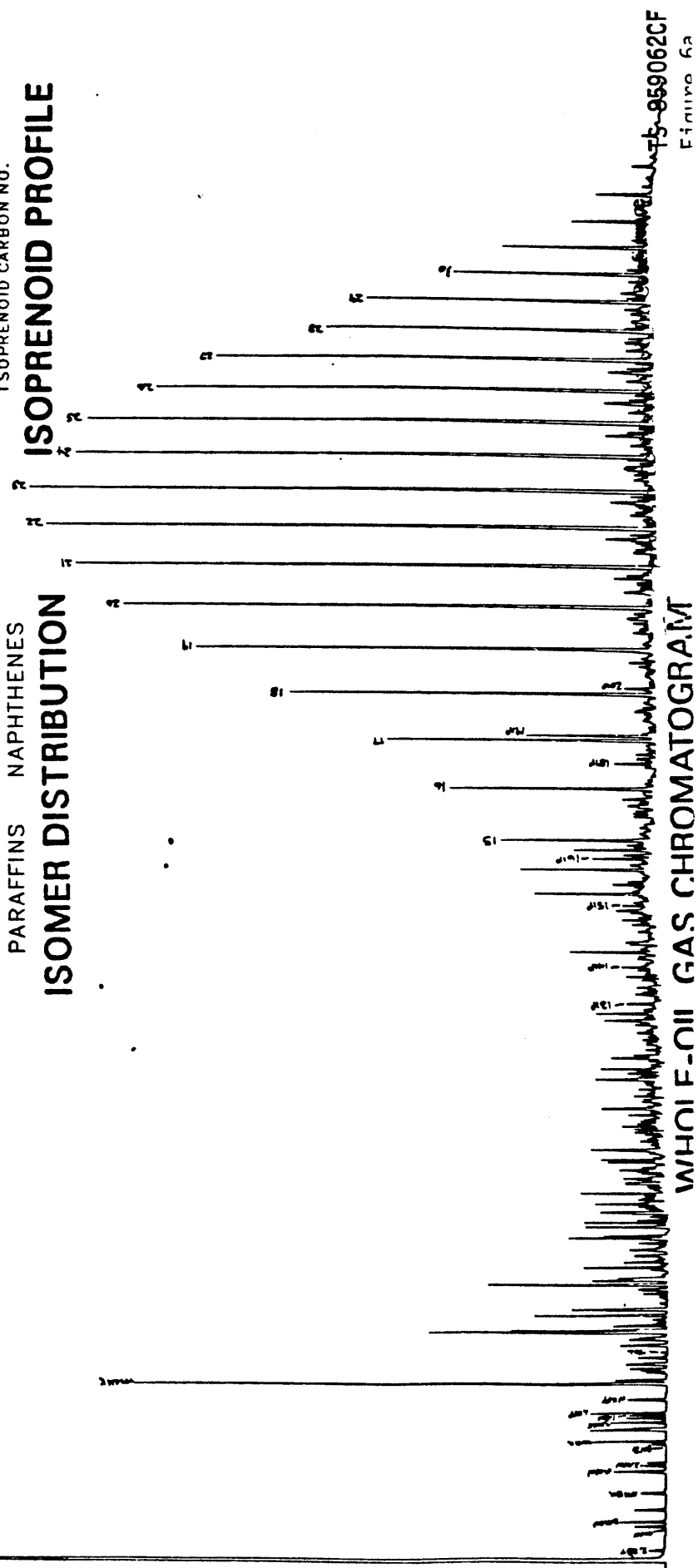
ISOMER DISTRIBUTION

PARAFFINS NAPHTHENES



ISOPRENOID PROFILE

ISOPRENOID CARBON NO.



Proprietary - To Be Maintained In Confidence
 Amoco Production Company

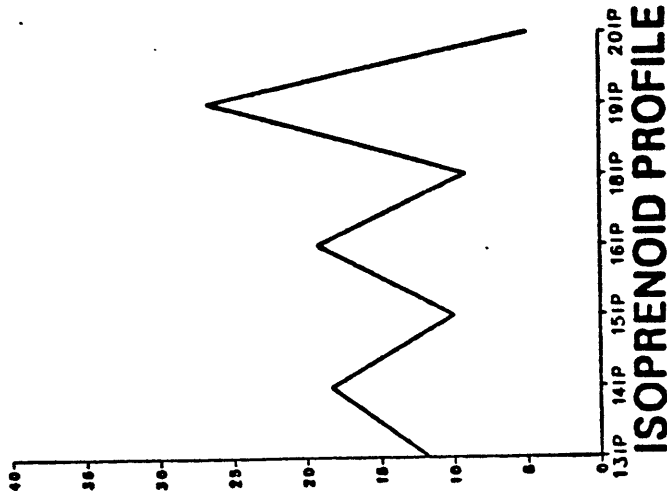
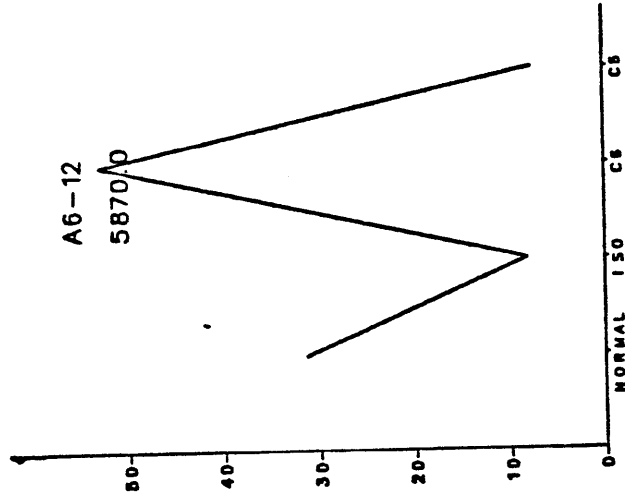
WHOLE F-OIL GAS CHROMATOGRAM

Figure 6a
 859062CF

Port Cambell No. 4
 Otway Basin Australia

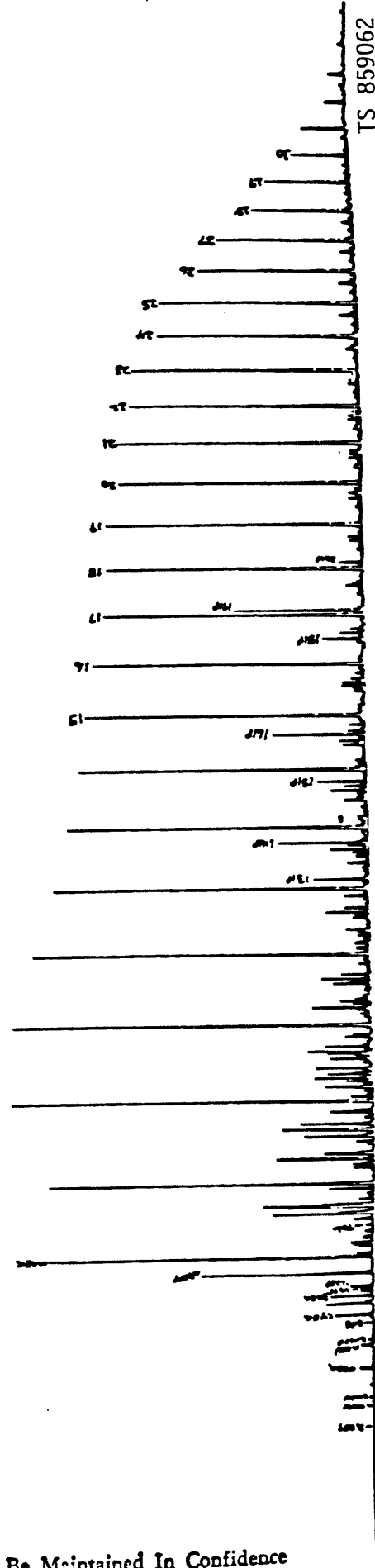
API Gravity = *
 $\delta^{13}C_{oil}$ = -25.6
 $\delta^{13}C_{sat}$ = -25.7
 % S = 0.05
 O R = 0.59

* could not be accurately measured



ISOMER DISTRIBUTION

ISOPRENOID PROFILE



TS 859062

Figure 6h

VALUOL E-OIL GAS CHROMATOGRAM

GC-MS Ion Chromatograms
Saturate Fraction

M/Z 191: TERPANES

A6-12

20.81
Blanchopane

20.81
Moretane

A6-13

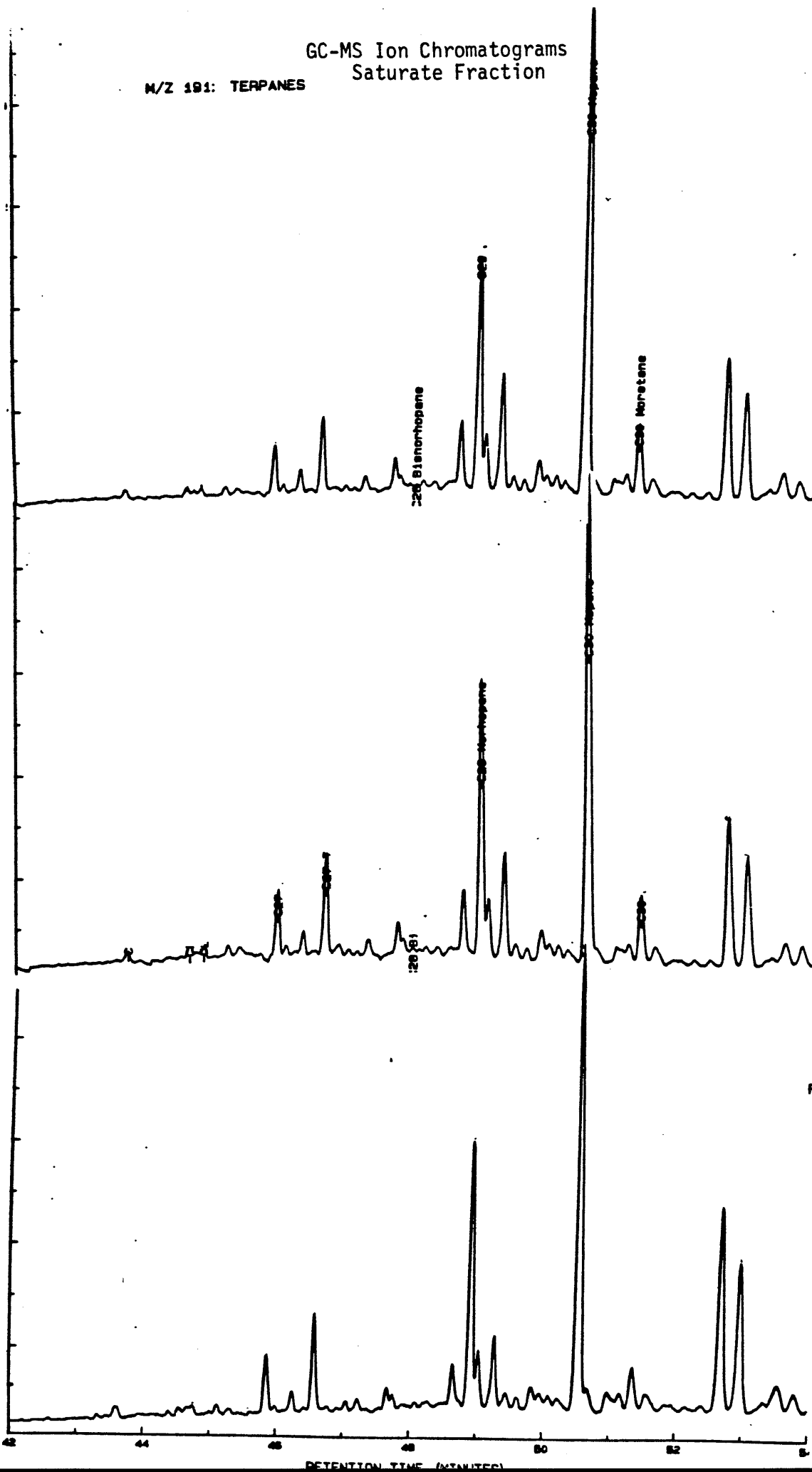
20.81

F-1931

Proprietary - To Be Maintained In Confidence
Amoco Production Company

Proprietary - To Be Maintained In Confidence
Amoco Production Company

TS 859062CF
Figure 7a



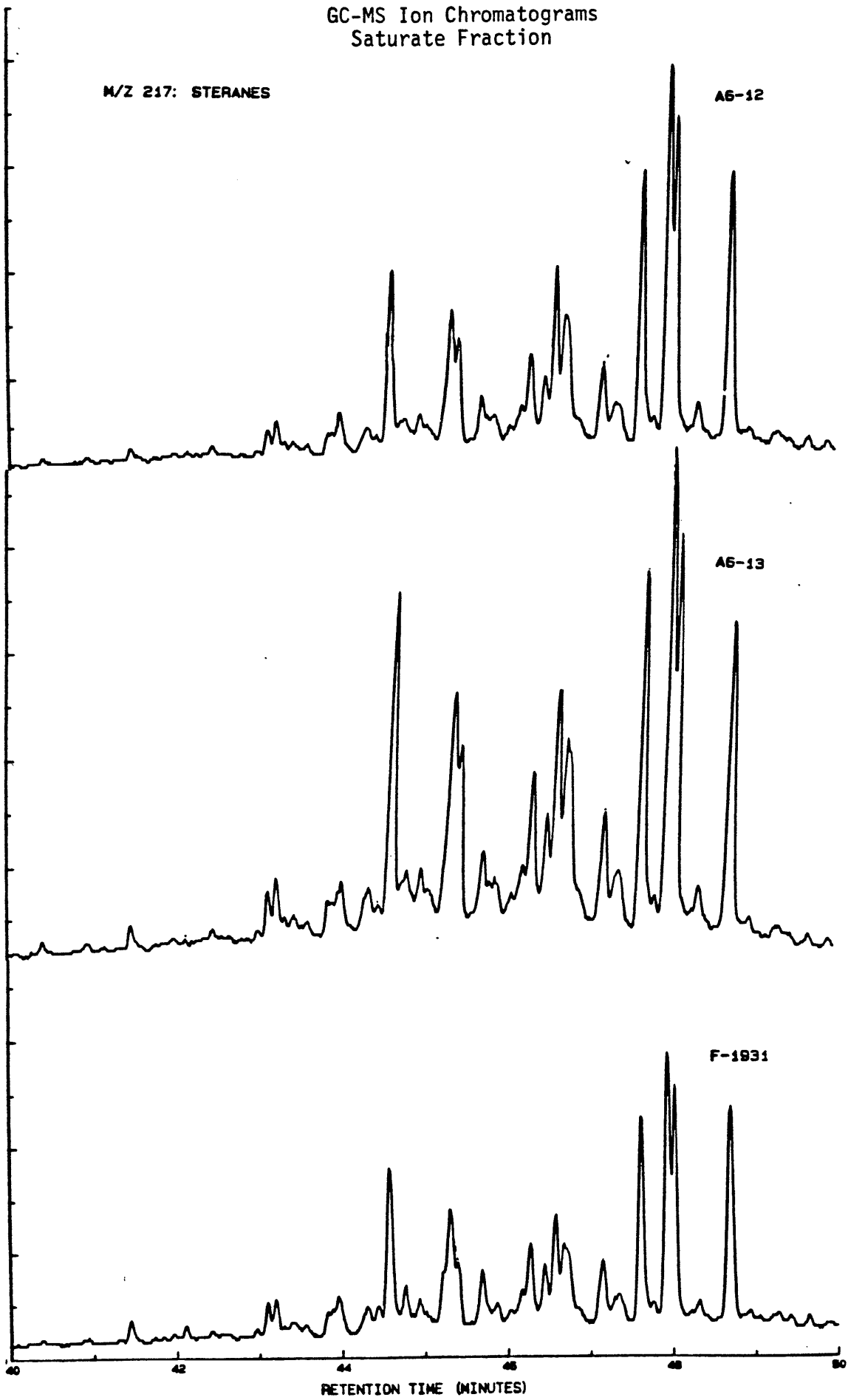
GC-MS Ion Chromatograms
Saturate Fraction

M/Z 217: STERANES

A6-12

A6-13

F-1931



Proprietary - To Be Maintained In Confidence
Amoco Production Company

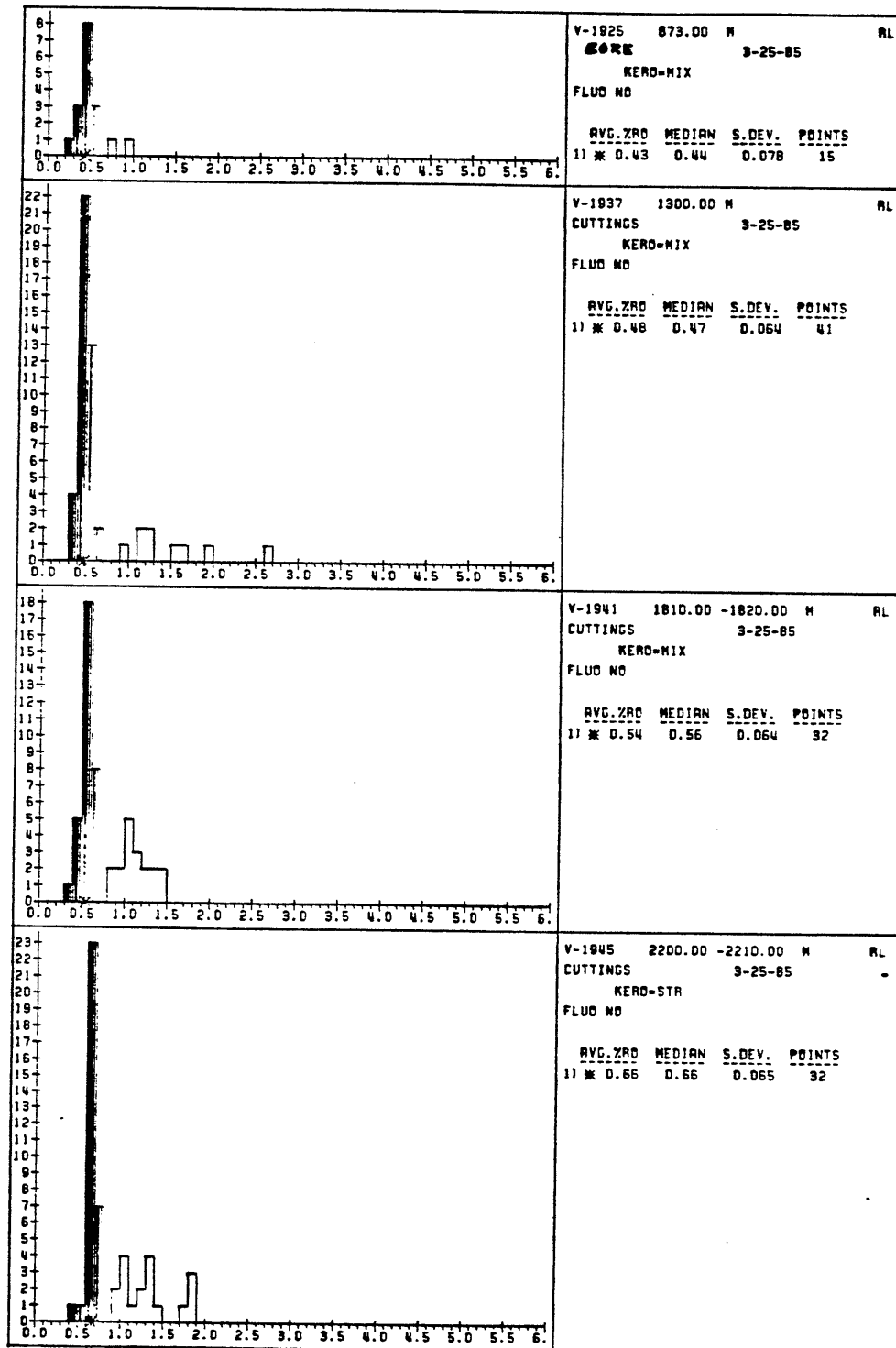
TS 859062
Figure 7b

VITRINITE REFLECTANCE ANALYSIS

LINDON NO.1: VICTORIA, AUSTRALIA

LOCALITY 9062

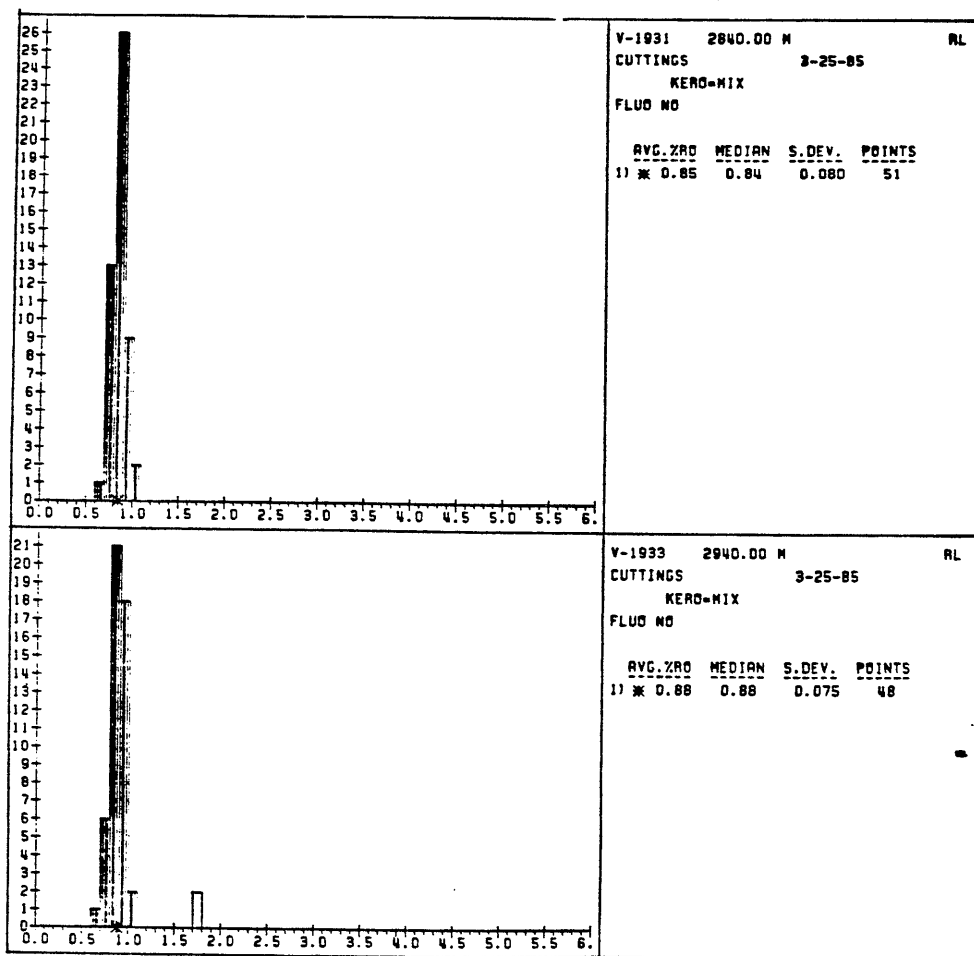
TECH SVC NO.9062



Proprietary - To Be Maintained In Confidence
Amoco Production Company.

Figure 8
T.S. 859062CF

Vitrinite Reflectance Histograms (cont.)



X-AXIS = PERCENT REFLECTANCE OF VITRINITE (ZRO)

Y-AXIS = FREQUENCY

AVERAGE ZRO FOR POP. 1 = 0.64

Figure 8b.
T.S. 859062CF

OFFICE APC(I) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

ROCKEVAL PYROLYSIS DATA
TABLE 2.
DATE 06/25/85

SAMPLE NUMBER	TOP OF INTERVAL METERS	FORMATION	TOTAL ORGANIC CARBON WT% ROCKEVAL TOC	PPM VOLATILE HYDROCARBONS (S1 X 1000)	VOL/ TOC	PPM GENERATED HYDROCARBONS (S2 X 1000)	GEN/ TOC	TEMP OF MAX GEN	VOL/ VOL + GEN	
	STATE FOREIGN OPERATOR	BEACH PETROLEUM	COUNTY	AUSTRALIA LEASE	LINDON #1	WELL LOCATION				
F-1935	770.0			0.9	40	< 0.01	470	0.05	NR	0.08
F-1925	873.0			2.1	90	< 0.01	2240	0.11	430	0.04
F-1936	910.0			0.6	490	0.08	610	0.10	420	0.45
F-1926	931.6			0.2	50	0.02	60	0.03	NR	0.45
F-1927	1216.5			1.0	30	< 0.01	230	0.02	NR	0.12
F-1937	1300.0			0.7	60	0.01	420	0.06	NR	0.13
F-1938	1460.0			0.4	50	0.01	170	0.05	NR	0.23
F-1939	1610.0			0.5	40	0.01	290	0.06	NR	0.12
F-1940	1700.0			0.3	40	0.01	230	0.07	NR	0.15
F-1941	1810.0			0.5	50	0.01	290	0.06	NR	0.15
F-1942	1900.0			0.4	50	0.01	290	0.07	NR	0.15
F-1943	2000.0			0.8	90	0.01	840	0.10	439	0.10
F-1944	2100.0			1.2	120	0.01	1530	0.13	439	0.07
F-1945	2200.0			1.4	130	0.01	1970	0.14	443	0.06
F-1928	2253.0			0.6	80	0.01	290	0.05	NR	0.22
F-1946	2300.0			0.7	110	0.02	570	0.08	433	0.16
F-1929	2660.0			1.5	270	0.02	2060	0.14	448	0.12
F-1930	2760.0			1.9	1220	0.06	2550	0.13	450	0.32
F-1931	2840.0			6.6	2120	0.03	11350	0.17	444	0.16
F-1932	2902.0			1.4	360	0.03	1050	0.07	453	0.26

NR indicates "not reliable"

OFFICE APC(I) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

ROCKEVAL PYROLYSIS DATA
TABLE 2.
DATE 06/25/85

SAMPLE NUMBER	TOP OF INTERVAL METERS	FORMATION	TOTAL ORGANIC CARBON WT% ROCKEVAL TOC	PPM VOLATILE HYDROCARBONS (S1 X 1000)	VOL/ TOC	PPM GENERATED HYDROCARBONS (S2 X 1000)	GEN/ TOC	TEMP OF MAX GEN	VOL/ VOL + GEN
F-1933	2940.0		1.6	620	0.04	1960	0.12	455	0.24
F-1934	3000.0		0.2	140	0.07	150	0.08	NR	0.48

NR indicates "not reliable"

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

OFFICE APC(1) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

SOURCE ROCK DATA
TABLE 3.
DATE 06/25/85

SAMPLE NUMBER	FIELD NO. OR DEPTH METERS -TOP***BOTTOM	FORMATION	INSOL RESID%	TOTAL ORG C WT%	BITUMEN		SAT HC		BIT/ TOC	NC17/ PR	NC18/ PH	CPI BITUMEN
					BBL/AF	PPM	BBL/AF	PPM				
	STATE FOREIGN OPERATOR BEACH PETROLEUM	COUNTY AUSTRALIA										
		LEASE LINDON #1										
F-1936	910.0		NA	0.6	25	1391			0.23	2.00	9.00	1.11
F-1930	2760.0		NA	1.9	40	2221			0.12	1.19	5.07	1.10
F-1931	2840.0		NA	6.6	50	2789			0.04	1.32	6.37	1.11
F-1932	2902.0		NA	1.4	38	2124			0.15	1.75	4.33	1.10
F-1933	2940.0		NA	1.6	20	1122			0.07	1.48	6.95	1.06

Proprietary - To Be Maintained In Confidence
Amoco Production Company

OFFICE APC(I) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

VISUAL AND VITRINITE REFLECTANCE
TABLE 4.
DATE 06/25/85

SAMPLE NUMBER	FIELD NO. OR DEPTH METERS -TOP***BOTTOM	FORMATION	VIT REFLECTANCE		VISUAL SCALE	KEROGEN DESCRIPTION
			%RO	COUNTS		
		COUNTY AUSTRALIA				
		LEASE LINDON #1				
F-1925	873.0		0.43	15		MIXED
F-1937	1300.0		0.48	41		MIXED
F-1941	1810.0 - 1820.0		0.54	32		MIXED
F-1945	2200.0 - 2210.0		0.66	32		STRUCTURED
F-1931	2840.0		0.85	51		MIXED
F-1933	2940.0		0.88	48		MIXED

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

OFFICE APC(I) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

KEROGEN DATA
TABLE 5.
DATE 06/25/85

LAB SAMPLE NUMBER	FIELD NO. OR DEPTH METERS TOP***BOTTOM	FORMATION	NORM. ELEMENTAL ANALYSIS, WT. %				% REC	SULFUR WT. %	ASH WT. %	ATOMIC RATIO O/C	ATOMIC RATIO H/C	CARBON ISOTOPE KEROGEN
			CARBON	HYDROGEN	OXYGEN	NITROGEN						
	STATE FOREIGN OPERATOR BEACH PETROLEUM	COUNTY	AUSTRALIA LEASE	LINDON #1	WELL LOCATION							
F-1925	873.0		74	4.8	19.0	2.5	69			0.19	0.78	
F-1937	1300.0		78	4.6	16.1	1.7	70			0.16	0.70	
F-1941	1810.0 - 1820.0		79	4.7	14.4	1.6	88			0.14	0.70	
F-1945	2200.0 - 2210.0		83	6.2	9.4	1.4	92			0.09	0.90	
F-1931	2840.0		86	5.4	6.2	2.1	89			0.05	0.75	
F-1933	2940.0		87	5.1	5.9	1.7	94			0.05	0.69	

Proprietary - To Be Maintained In Confidence
Amoco Production Company

OFFICE APC(I) DISTRICT CSA & FE
TECHNICAL SERVICE NUMBER 859062

ROCK-TO-OIL CORRELATION
TABLE 6.
DATE 06/25/85

SAMPLE NUMBER	FIELD NO. OR DEPTH METERS -TOP***BOTTOM	FORMATION	CARBON ISOTOPES OF EXTRACT			OPT ROT	IR	PR/PH	SULFUR WT. %
			SAT	AROM	BIT				
	STATE FOREIGN OPERATOR BEACH PETROLEUM	COUNTY	AUSTRALIA LEASE	LINDON #1	WELL LOCATION				
F-1936	910.0							3.00	
F-1930	2760.0		-26.4		-26.1			4.00	
F-1931	2840.0							4.89	
F-1932	2902.0							2.67	
F-1933	2940.0		-26.0		-25.2			4.42	

Proprietary - To Be Maintained In Confidence
Amoco Production Company

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

OFFICE APC(I) DISTRICT CSA/FE
TECHNICAL SERVICE NUMBER 859062

OIL CORRELATION SUMMARY
TABLE 1.
DATE 01/18/85

SAMPLE NUMBER	GEOLOGICAL FORMATION	GEOLOGICAL AGE	DEPTH FEET TOP***BOTTOM	API GRAV	CARBON ISOTOPES			OPT ROT	IR TYPE	PRIS/ PHVT	WT% SULFUR	OIL TYPE
					SAT	AROM	OIL					
STATE FOREIGN COUNTY AUSTRALIA WELL LOCATION FIELD												
OPERATOR FROME-BROKEN HILL LEASE PORT CAMPBELL #4												
A6-12	U. OTWAY	L. CRETACEOUS	5870.0	*	-25.7	-25.6	0.59	5.33	0.05			

* API GRAVITY COULD NOT BE ACCURATELY DETERMINED.

STATE FOREIGN COUNTY AUSTRALIA WELL LOCATION FIELD												
OPERATOR BEACH PETROLEUM LEASE LINDON #1												
A6-13	PEBBLE POINT		912.5		33.2	-25.0	-24.2	0.73	4.00	0.10		

OFFICE APC(1)
 TECHNICAL SERVICE NUMBER

DISTRICT CSA
 859062

OIL DATA
 TABLE 2.
 DATE 01/18/85

SAMPLE NUMBER	FORMATION	FIELD NO. OR DEPTH FEET TOP***BOTTOM	COLLECTION POINT	WT% SAT	WT% AROM	WT% NSO	WT% NOT RECOV	WT% ASPH	SAT/ AROM	C17/ PRIS	C18/ PHYT	CPI
---------------	-----------	--------------------------------------	------------------	---------	----------	---------	---------------	----------	-----------	-----------	-----------	-----

STATE	FOREIGN	COUNTY	AUSTRALIA	WELL LOCATION	FM TEMP(S):
OPERATOR	FROME-BROKEN HILL		LEASE	PORT CAMPBELL #4	
A6-12	U. OTWAY	5870.0	DST	49.8 8.5	41.7 5.9 2.03 0.67 1.13

STATE	FOREIGN	COUNTY	AUSTRALIA	WELL LOCATION	FM TEMP(S):
OPERATOR	BEACH PETROLEUM		LEASE	LINDON #1	
A6-13	PEBBLE POINT	912.5	DST #1	62.6 13.0	24.4 4.8 2.06 11.25 1.09

REP 926C
OT BASIN