APPENDIX L

**TOC, Rock Eval Results and Geochemistry
Permian Samples
Amdel Limited**

Diane Cass
Operations Manager
Petroleum Services
Amdel Limited PO Box 338
Torrensville Plaza
SA 5031

30th August 2002

Please find enclosed thirteen rock samples for TOC, and Rock Eval analysis if TOC is appropriate.

Sample numbers

S3
S4
S5
Q1   146.6m
Q2   158.66m
Q3   126.4m
Q4   120m
Q5   110m
Q6   100m
H1   859.2m
H2   874.4m
H3   940m
H4   964.9m

The University of Tasmania holds an account with AMDEL, and a purchase order no of 38424 is allocated to this order.
If there are any problems please contact me on (03) 6226 2468 or C.Reid@utas.edu.au

Thank-you

Catherine Reid

School of Earth Sciences
University of Tasmania
GPO Box 252-79
Hobart
TAS 7001

16 September 2002

University of Tasmania
School of Earth Sciences
Locked Bag 1-353
LAUNCESTON TAS 7250

Attention: Catherine Reid

REPORT LQ12012

CLIENT REFERENCE: 38424

WELL NAME/RE:

MATERIAL: Rock

WORK REQUIRED: TOC & Rock Eval analysis

AUTHOR'S NAME: Carmelina Valente

Please direct technical enquiries regarding this work, to the signatory below, under whose supervision the work was carried out. This report relates specifically to the sample or samples submitted for testing.

Diane Cass
Operations Manager
Petroleum Services

dc.cm

G:\Secretary\petroleum\Docs-02\12012.doc

PETROLEUM SERVICES

TABLE 1

amdel
www.amdel.com

Rock-Eval Pyrolysis

Report #   LQ12012

Client: University of Tasmania

Well: -

Depth (m)	T Max	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
S3	449	1.01	1.47	0.18	1.19	0.41	8.16	0.2	0.99	148	18
S4	388	0.28	0.62	0.22	0.90	0.31	2.81	0.07	0.39	158	56
S5	515	0.50	0.95	0.07	1.45	0.35	13.57	0.12	1.00	95	7
Q1									0.22		
Q2									0.13		
Q3	542	0.07	0.20	0.22	0.27	0.27	0.90	0.02	1.26	15	17
Q4	418	0.06	0.08	0.20	0.14	0.43	0.40	0.01	1.37	5	14
Q5	443	0.09	0.17	0.20	0.26	0.35	0.85	0.02	1.11	15	18
Q6	486	0.11	0.50	0.21	0.61	0.18	2.38	0.05	0.79	63	326
H1	458	0.41	1.49	0.10	1.90	0.22	14.90	0.15	2.24	66	4
H2	447	0.36	1.01	0.20	1.37	0.26	5.05	0.11	1.26	80	15
H3	457	0.48	0.95	0.36	1.43	0.34	2.63	0.11	0.97	97	37
H4	453	2.61	24.97	0.73	27.58	0.09	34.20	2.29	8.10	308	9

6 December 2002

University of Tasmania
School of Earth Sciences
Locked Bag 1-353
LAUNCESTON TAS 7250
Australia

Attention: Catherine Reid

Project   **02PEAD05369**
Client Ref: letter 14/11/02

Customer Sample ID   S8

Test/Reference	Unit	
Rock-Eval Pyrolysis		
Depth	m	0
T Max		466
S1- Hydrocarbon per Rock		0.35
S2- Hydrocarbon per Rock		0.76
S3- Carbon Dioxide per Rock		0.22
S1 + S2- Hydrocarbon per Rock		1.11
PI		0.32
S2/S3		3.45
PC- Hydrocarbon per Rock		0.09
TOC	%	0.60
HI- Hydrocarbon per Rock		126
OI- Carbon Dioxide per Rock		36

amdel

University of Tasmania
School of Earth Sciences
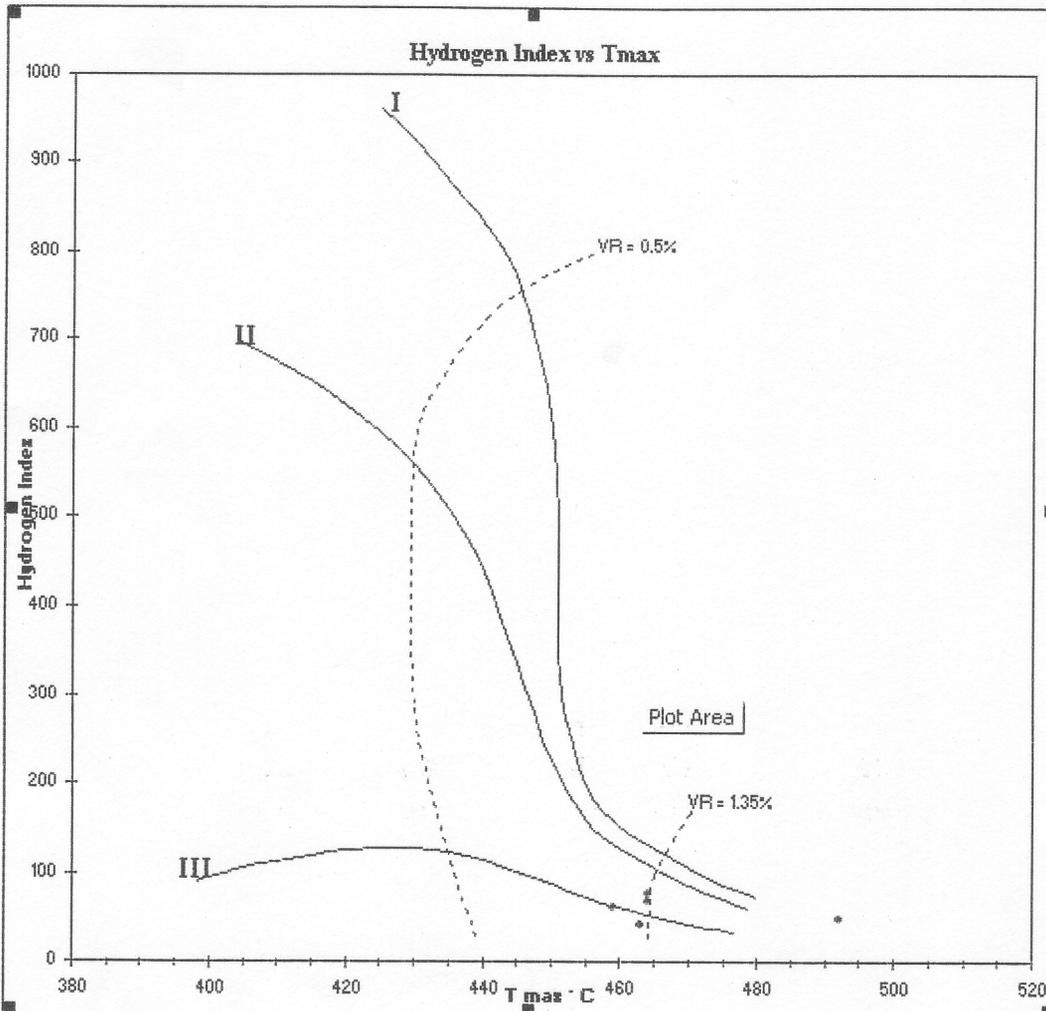Locked Bag 1-353
LAUNCESTON TAS 7250
Australia
Attention: Catherine Reid

Project   **03PEAD00681**
Client Ref: Letter 21/01/03

Customer Sample ID		H5	H6	H7
Test/Reference	Unit			
Rock-Eval Pyrolysis				
T Max	°C	459	-	463
S1- Volatile Hydrocarbons	mg/g	0.54	-	0.46
S2- HC Generating Potential	mg/g	1.90	-	1.24
S3- Organinc Carbon Dioxide	mg/g	0.34	-	0.26
S1 + S2- Potential Yield	mg/g	2.44	-	1.70
PI - Production Index		0.22	-	0.27
S2/S3		5.58	-	4.76
PC- Pyrolysized Carbon	mg/g	0.20	-	0.14
TOC - Total Organic Carbon	Weight %	3.10	-	2.90
HI- Hydrogen Index		61	-	42
OI- Oxygen Index		10	-	8
Total Organic Carbon				
Total Organic Carbon	Weight %	3.10	0.22	2.90

Customer Sample ID		H8	H9	H10
Test/Reference	Unit			
Rock-Eval Pyrolysis				
T Max	°C	464	464	492
S1- Volatile Hydrocarbons	mg/g	0.38	0.55	0.06
S2- HC Generating Potential	mg/g	1.84	1.51	0.61
S3- Organinc Carbon Dioxide	mg/g	0.09	0.05	0.38
S1 + S2- Potential Yield	mg/g	2.22	2.06	0.67
PI - Production Index		0.17	0.27	0.09
S2/S3		20.44	30.20	1.60
PC- Pyrolysized Carbon	mg/g	0.18	0.17	0.05
TOC - Total Organic Carbon	Weight %	2.35	2.20	1.25
HI- Hydrogen Index		78	68	48
OI- Oxygen Index		3	2	30
Total Organic Carbon				
Total Organic Carbon	Weight %	2.35	2.20	1.25

Graph

Hydrogen Index vs Tmax

Authorised By: Carmelina Valente
Petroleum Chemist

Signature:

Final Report

Diane Cass
Operations Manager
Petroleum Services
Amdel Limited PO Box 338
Torrensville Plaza
SA 5031

21st January 2003

Please find enclosed six rock samples for TOC, and Rock Eval analysis if TOC is appropriate.

Sample numbers

H5   850.15m
H6   850.5m
H7   845.6m
H8   856.5m
H9   869.5m
H10   828.5m

The University of Tasmania holds an account with AMDEL, and a purchase order number of 40773 is allocated to this order.
If there are any problems please contact me on (03) 6226 2468 or C.Reid@utas.edu.au

Thank-you

Catherine Reid

School of Earth Sciences
University of Tasmania
GPO Box 252-79
Hobart
TAS 7001

TABLE I

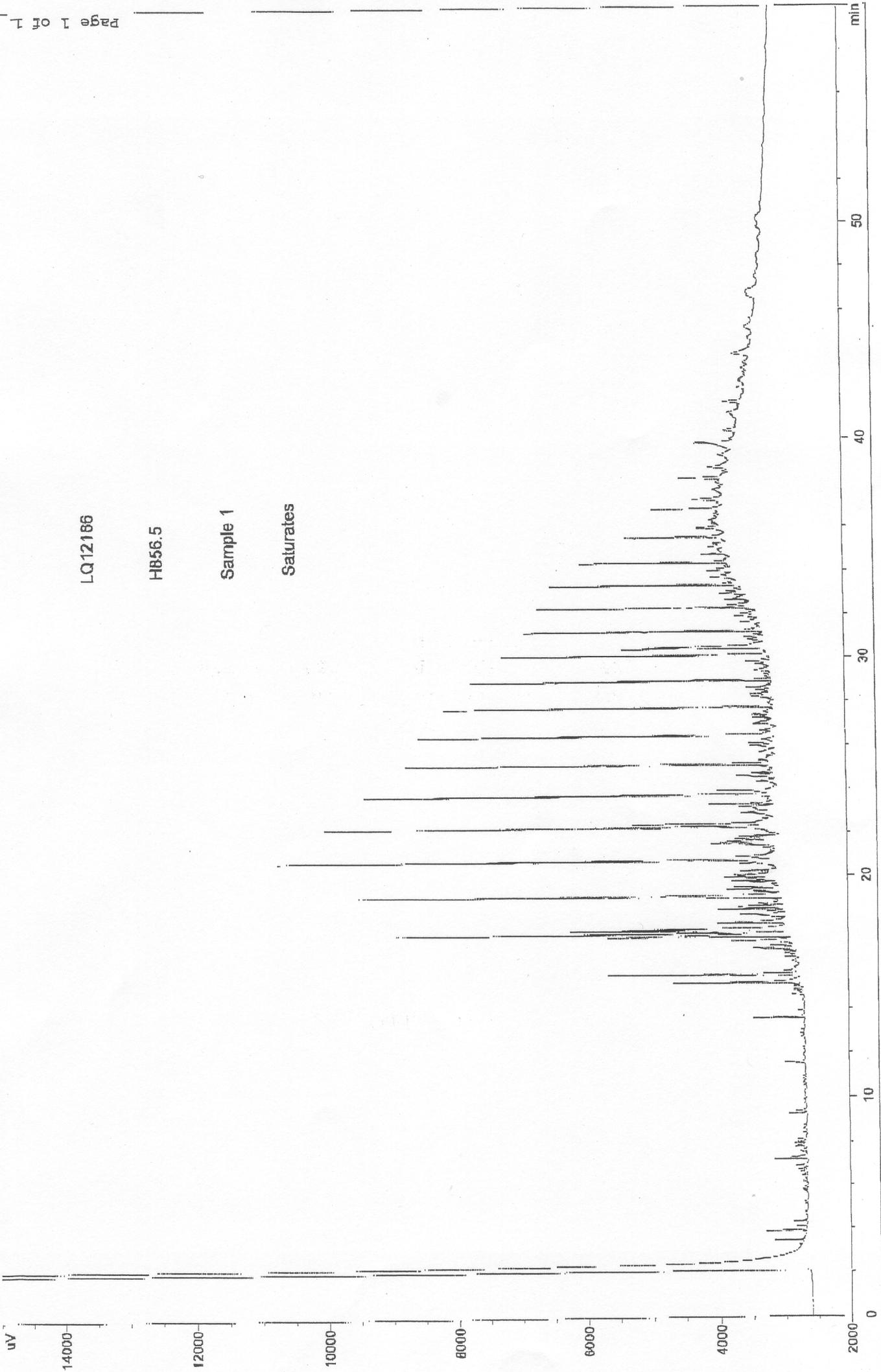## C_{12+} BULK COMPOSITION AND ALKANE RATIOS

Sample	EOM (ppm)	Composition (%)			Alkane Ratios			
		Sats	Arom	NSO	Np/Pr	Pr/Ph	Pr/n-C_{17}	Ph/n-C_{18}
H856.5	236	44	17	39	0.47	2.50	0.32	0.14
H859.2	322	34	26	40	0.45	2.20	0.22	0.11
H874.4	416	55	19	26	0.60	2.14	0.29	0.14
S3	1025	78	14	8	0.77	1.56	0.40	0.29

EOM	=	extractable organic matter
Sats	=	saturated hydrocarbons
Arom	=	aromatic hydrocarbons
NSO	=	compounds containing nitrogen, sulphur and oxygen

Np	=	norpristane
Pr	=	pristane
Ph	=	phytane
n-C_{17}	=	n-heptadecane
n-C_{18}	=	n-octadecane

ADC1 A, PE 8500 (02NOV\12186SA1.D)

LQ12186

HB56.5

Sample 1

Saturates

uV

14000

12000

10000

8000

6000

4000

2000

0   10   20   30   40   50   min

ADC1 A, PE 8500 (02NOV12186SA2.D)

LQ12186

H859.2

Sample 2

Saturates

LQ12186

H874.4

Sample 3

Saturates

ADC1 A, PE 8500 (02NOV12186SR3.D)

LQ12186

S3

Sample 4

Saturates
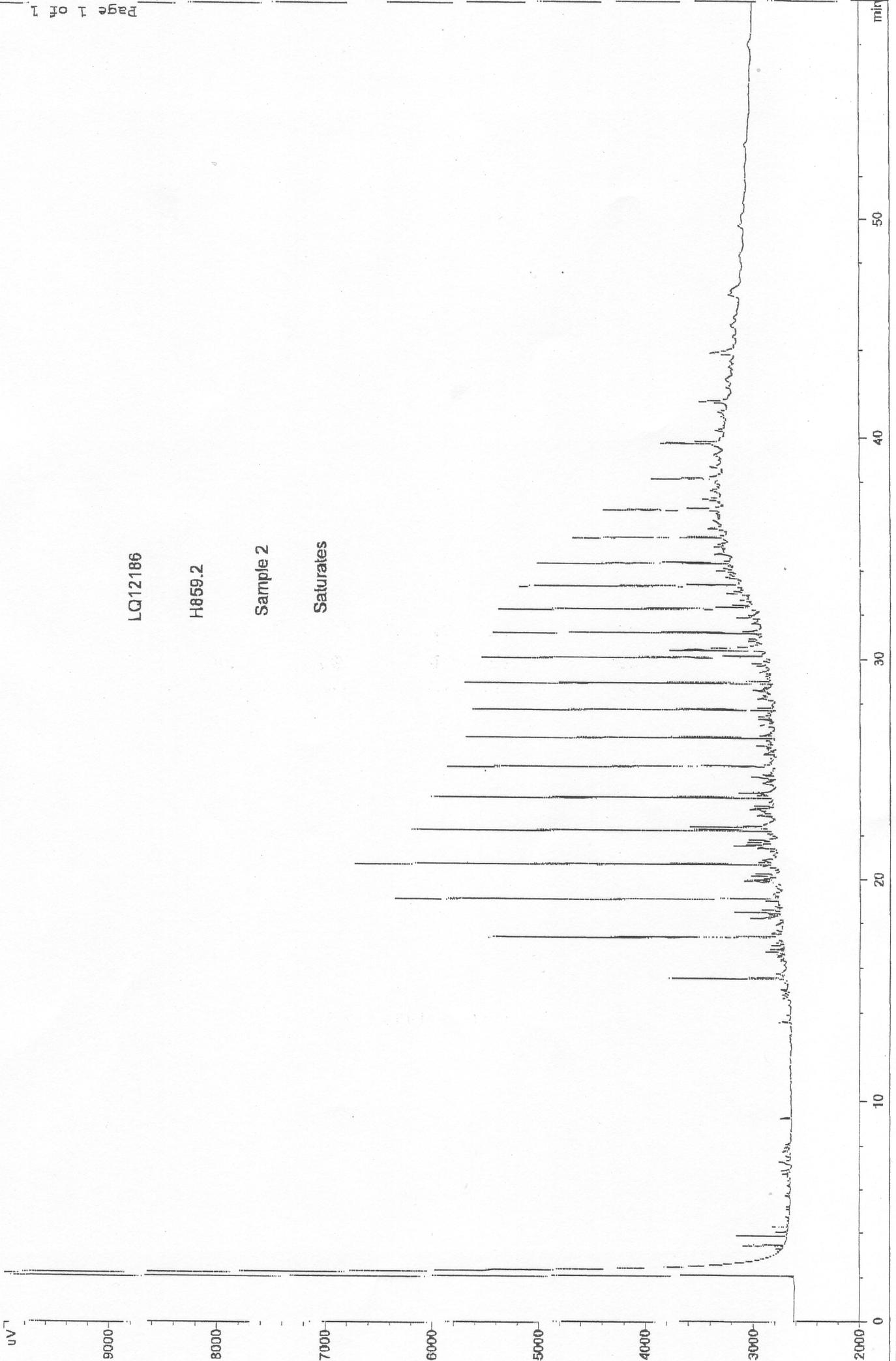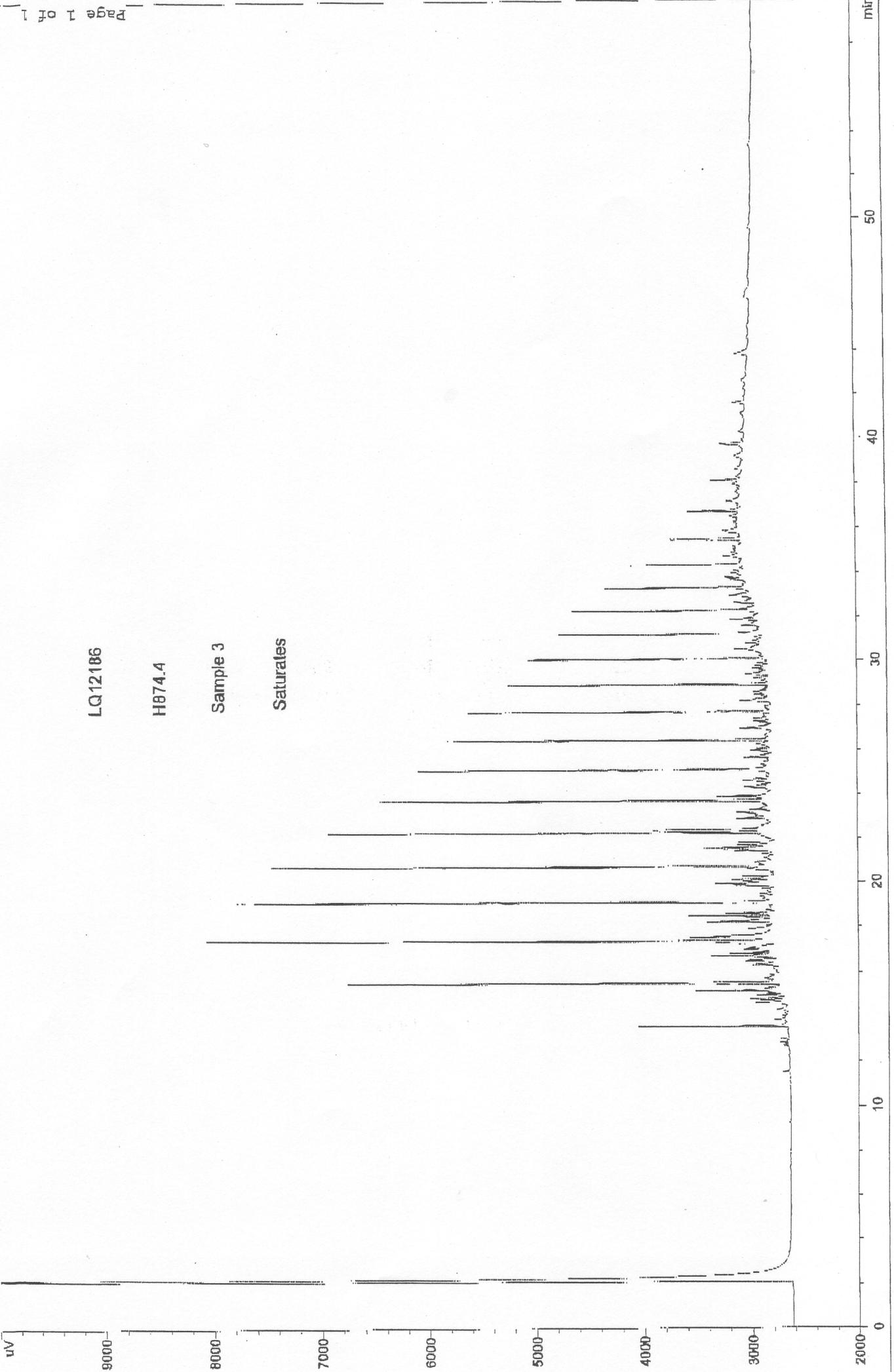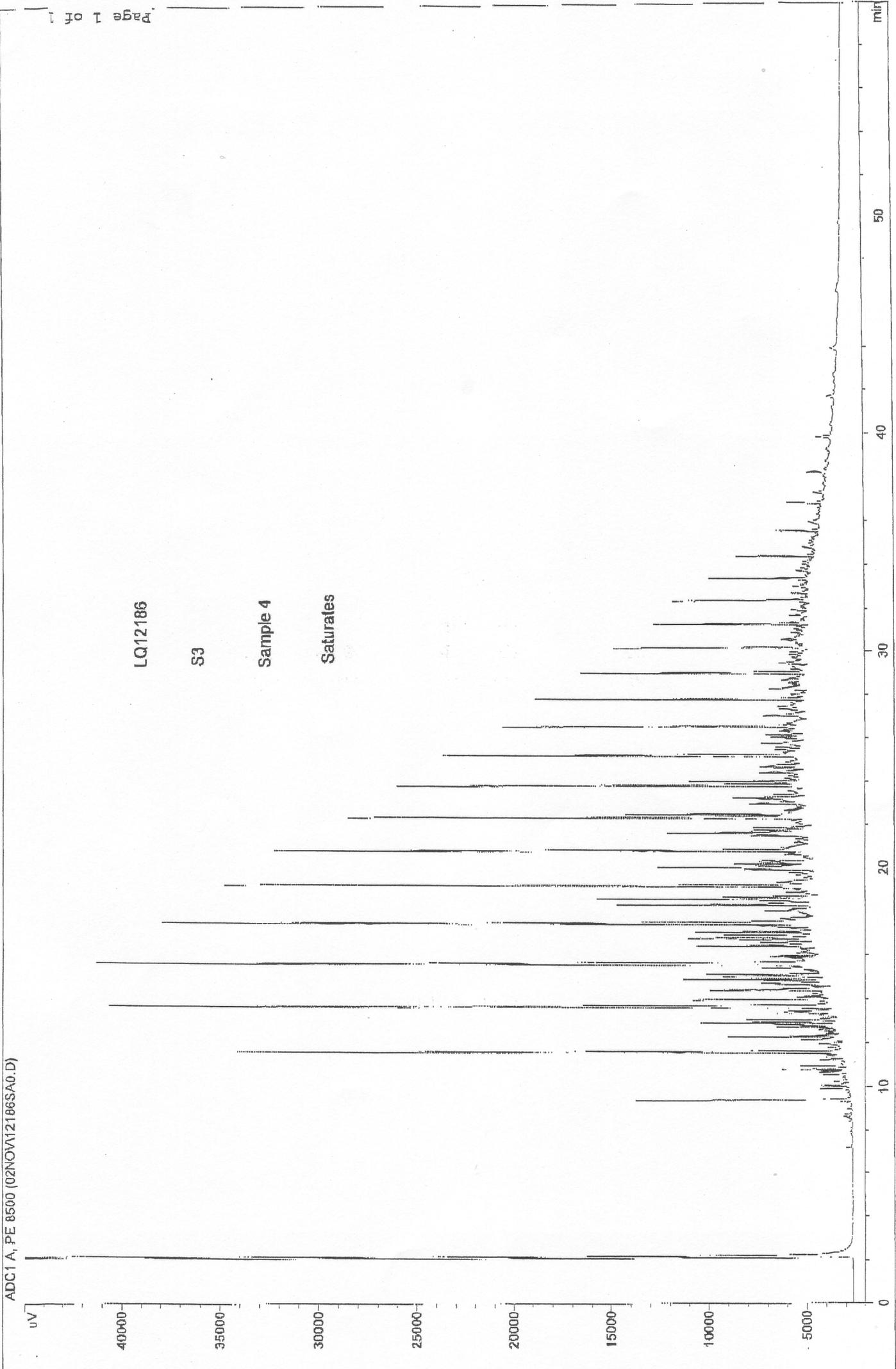
ADC1 A, PE 8500 (02NOV\12186SA0.D)

TABLE 2

BIOMARKER PARAMETERS OF SOURCE, MATURITY, MIGRATION AND BIODEGRADATION, ATP-269-P(1) OILS

Sample		Steranes					Terpanes							Acyclic Alkanes		
	Parameter															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H856.5	20	3.11	1.66	0.64	0.64	0.66	0.33	0.14	0.83	0.27	0.11	1.37	0.19	2.50	0.32	0.14
H859.2	26	1.91	2.47	1.03	1.44	1.04	0.35	0.25	0.49	0.64	0.15	1.33	0.13	0.22	0.22	0.11
H874.4	21	2.68	1.75	0.80	1.33	0.87	0.29	0.25	0.54	0.56	0.18	1.42	0.16	0.29	0.29	0.14
S3	23	2.58	1.33	0.59	1.23	0.79	0.60	0.15	1.38	0.32	0.11	1.30	0.21	0.40	0.40	0.29

- = not determined

KEY TO BIOMARKER PARAMETERS OF SOURCE, MIGRATION AND BIODEGRADATION

Parameter	Derivation*	Specificity
1	C_{27}:C_{28}-C_{29} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20R steranes	Source
2	C_{29} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20R sterane/C_{27} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20R sterane	Source
3	C_{29} $13\beta(H)17\alpha(H)$ 20R diasterane/C_{27} $13\beta(H)17\alpha(H)$ 20R diasterane	Source
4	C_{29} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20S sterane/C_{29} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20R sterane	Maturity, Biodegradation
5	C_{27} $13\beta(H)17\alpha(H)$ 20S diasterane/C_{27} $13\beta(H)17\alpha(H)$ 20R diasterane	Maturity
6	C_{29} $5\alpha(H)14\beta(H)17\beta(H)$ 20R sterane/C_{29} $5\alpha(H)14\alpha(H)17\alpha(H)$ 20R sterane	Maturity, Migration
7	C_{29} $13\beta(H)17\alpha(H)$ 20R+20S diasteranes/C_{29} $5\alpha(H)$ steranes	Migration, Source
8	$18\alpha(H)$-30-norneohopane (C_{29}Ts)/C_{29} $17\alpha(H)$ hopane + C_{29}Ts	Maturity, Source
9	$17\alpha(H)$ diahopane/$18\alpha(H)$-30-norneohopane (C_{30}*/C_{29} TS)	Source, Maturity
10	C_{27} $18\alpha(H)$-22,29,30-trisnorhopane (Ts)/C_{27} $17\alpha(H)$-22,29,30-trisnorhopane (Tm)+ Ts	Maturity, Source
11	Ts/C_{30} $17\alpha(H)21\beta(H)$ hopane	Maturity
12	C_{32} $17\alpha(H)21\beta(H)$ 22S homohopane/C_{32} $17\alpha(H)21\beta(H)$ 22R homohopane	Maturity
13	C_{30} $17\beta(H)21\alpha(H)$ moretane/C_{30} $17\alpha(H)21\beta(H)$ hopane	Maturity
14	pristane/phytane	Source
15	pristane/n-heptadecane	Source, Biodegradation, Maturity
16	phytane/n-octadecane	Source, Biodegradation, Maturity

* Ratios calculated from peak areas as follows:

Parameters	1-7	m/z = 217, 218, 259	mass fragmentograms
Parameters	8 - 13	m/z = 191	mass fragmentogram
Parameters	14 - 16		capillary gas chromatogram of alkanes or whole oil/extract

TABLE

AROMATIC MATURITY DATA

Depth (m)	MPI	MPR	DNR	MPDF	VR CALC (%)					
					A	B	C	D	E	F
H856.5	0.994	1.875	-	0.596	1.00	1.70	1.21	-	0.92	1.17
H859.2	0.894	1.908	-	0.591	0.94	1.76	1.22	-	0.85	1.16
H874.4	0.952	1.510	-	0.553	0.97	1.73	1.12	-	0.89	1.07
S3	0.934	1.352	-	0.471	0.96	1.74	1.07	-	0.87	0.89

KEY TO AROMATIC MATURITY INDICATORS

Methylphenanthrene index (MPI), methylphenanthrene ratio (MPR), dimethylnaphthalene ratio (DNR) and calculated vitrinite reflectance (VR_{calc}) are derived from the following equations (after Radke and Welte, 1983; Radke *et al*, (1984):

$$MPI = \frac{1.5(2\text{-}MP + 3\text{-}MP)}{P + 1\text{-}MP + 9\text{-}MP}$$

$$VR_{calc} (a) = 0.6 \, MPI + 0.4 \ (\text{for } VR < 1.35\%)$$

$$VR_{calc} (b) = -0.6 \, MPI + 2.3 \ (\text{for } VR > 1.35\%)$$

$$MPR = \frac{2\text{-}MP}{1\text{-}MP}$$

$$VR_{calc} (c) = 0.99 \log_{10} MPR + 0.94 (VR = 0.5\text{-}1.7\%)$$

$$DNR = \frac{2,6\text{-}DMN + 2,7\text{-}DMN}{1,5\text{-}DMN}$$

$$VR_{calc} (d) = 0.46 \, DNR + 0.89 \ (\text{for } VR = 0.9\text{-}1.5\%)$$

Where
P	=	phenanthrene
1-MP	=	1-methylphenanthrene
2-MP	=	2-methylphenanthrene
3-MP	=	3-methylphenanthrene
9-MP	=	9-methylphenanthrene
1,5-DMN	=	1,5-dimethylnaphthalene
2,6-DMN	=	2,6-dimethylnaphthalene
2,7-DMN	=	2,7-dimethylnaphthalene

Peak areas measured from m/z 156 (dimethylnaphthalene), m/z 178 (phenanthrene) and m/z 192 (methylphenanthrene) mass fragmentograms of diaromatic and triaromatic hydrocarbon fraction isolated by thin layer chromatography.
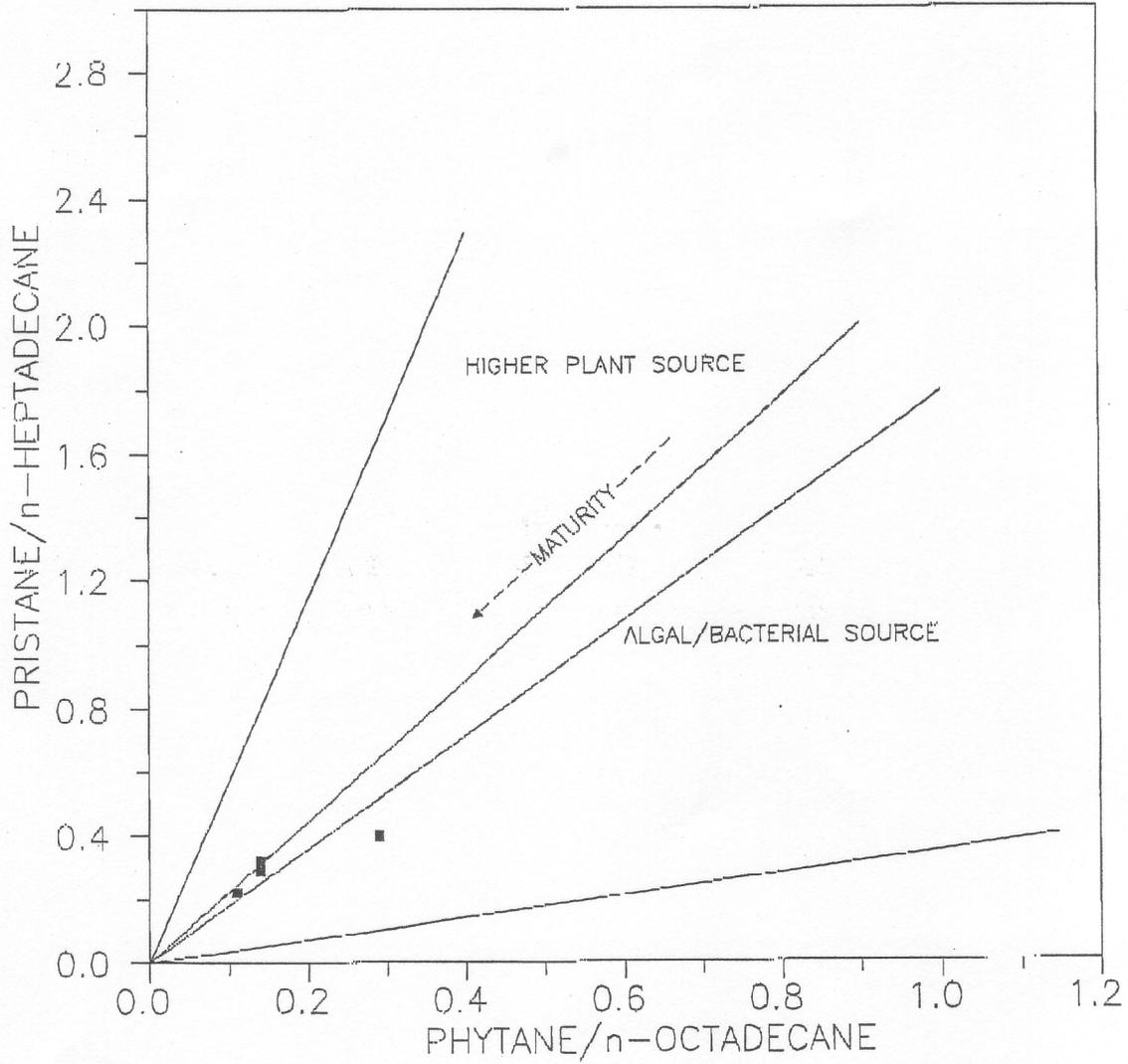
Recalibration of the methylphenanthrene index using data from a suite of Australian coals has given rise to another equation for calculated vitrinite reflectance (after Boreham *et al*, 1988):

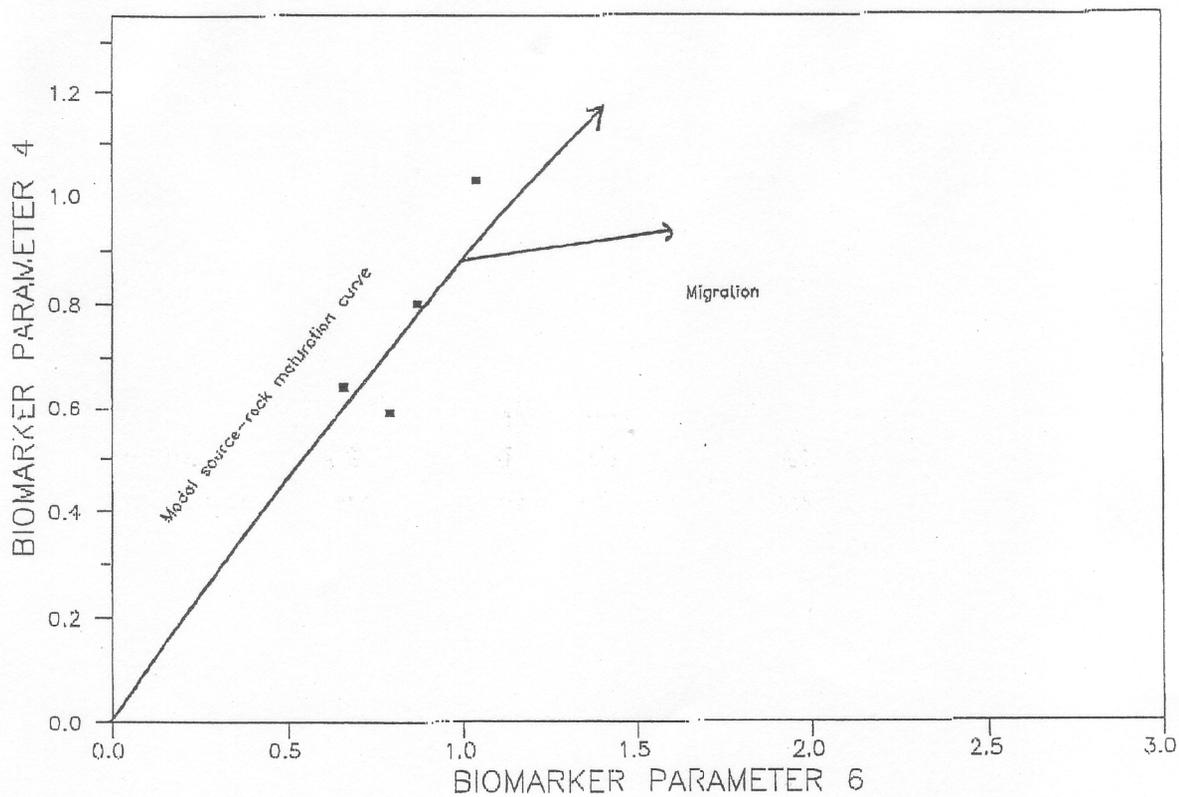$$VR_{calc} (e) = 0.7 \, MPI + 0.22 \ (\text{for } VR < 1.7\%)$$

The methylphenanthrene distribution ratio (MPDF) and calculated vitrinite reflectance VR_{calc} (f) is derived from the following equation (after Kvalheim *et al*, 1987):

$$MPDF = \frac{(2\text{-}MP + 3\text{-}MP)}{(2\text{-}MP + 3\text{-}MP + 1\text{-}MP + 9\text{-}MP)}$$

$$VR_{calc} (f) = -0.166 + 2.242 \, MPDF$$

BEYAZKOY−1
GENETIC AFFINITY AND MATURITY

C$_{29}$ STERANE MATURITY — MIGRATION PLOT

1001
OIL SOURCE AFFINITY

A scatter plot titled "OIL SOURCE AFFINITY" with y-axis labeled "Pristane/Phytane" (0 to 8) and x-axis labeled "C29/C27 Diasterane" (0 to 16). Regions labeled OXIC, ANOXIC, ALGAL, and LAND PLANT. Several data points clustered near the lower-left region around C29/C27 = 1.5–2.5 and Pristane/Phytane ≈ 2.