BHP Petroleum

VIC/P30
LA BELLA-1
WELL COMPLETION REPORT
INTERPRETATIVE

OTWAY BASIN, VIC/P30

LA BELLA-1

WELL COMPLETION REPORT
INTERPRETATIVE DATA

COMPILED BY: A. Locke
Petroleum Geologist

70285.WCR

DATE: March 1994

BHP PETROLEUM PTY. LTD.

TABLE OF CONTENTS

1 WELL INDEX SHEET

COMPANY: BHP Petroleum Pty Ltd
SPUDDED: 0200 hrs 22nd January 1993
COMPLETED: 1530 hrs 15th February 1993
TD: 2735 mRT

STATUS: P & A (Gas Discovery)

WELL: La Bella 1
BASIN: Otway
ELEV. W.D.:94.2m
R.T.: 25.3 m

TYPE:W/cat
TENEMENT: VIC/P30
Lat: 39⁰ 00' 14.19" South
Long. 142⁰ 41' 42.30" East
1st FLANGE: 30" @ 156m

FORMATION/ MARKER	TOPS (m)		SEISMIC TWT	LITHOLOGICAL SUMMARY/ REMARKS
	DRILL	SUB SEA		
No Returns	119-628	94		No returns until 628m
Heytesbury Group	?	?		
Port Cambell Limestone	?	?		Not sampled
Gellibrand Marl	?	?		Bioclastic marl
Nirranda Group	628	603		First returns in Nirranda Gp.
Narrawaturk Marl	628	603	-	Narrawaturk Marl
Mepunga Formation	1195	1170	1.034	Medium to very coarse iron stained sandstone
Wangerrip Group	Not Present			
Sherbrook Group	1559	1534	1.188	Claystone with trace sandstone and minor dolomite increasing towards the base
Upper Shipwreck Group	2007	1982	1.467	Sandstone interbedded with silty claystone
Lower Shipwreck Group	2283	2258	1.614	Interbedded sandstone, siltstone and claystone
Otway Group	2592	2567	1.775	Argillaceous sandstone interbedded with claystone

LOGS:

SUITE 1
DLL-MSFL-AS-GR-AMS-SP
CST (60 SHOT)
CSI (VSP)

SUITE 2
DLL-MSFL-GR-AMS-SP
SDT-LDL-CNL-GR-AMS
FMS
CST (2 Runs)
RFT-HP
CSI (VSP)

SWC: SHOT 150 REC 136
STORED: KESTREL Management,
Mt Waverley, VIC

DITCH SAMPLES: 635-2735m
CORES: Core-1 2071-2098.65m
100% Recovery

CASING/TUBING SIZE	30"	13.375"	9.625"
LANDED AT (m)	156	618	1785
CEMENT (sacks)	500	583	234

TEST RESULTS, FLUID ANALYSIS, LOST CIRCULATION, (INTERVAL, CAUSES) PLUGS , REMARKS

Plug No 1 was set from 1700 - 2200 m; 769 sacks cement
Plug No 2 was set from 142 - 192 m; 120 sacks cement

RFT: Two RFT runs; 33 pretests attempted; 28 successful
Two segregated samples were taken
Results:
Two hydraulically isolated sands in the Upper Shipwreck Group over the intervals 2060-2075mRT and 2100-2168mRT
Sand 1 has a probable GWC at 2119.6mSS
Sand 2 has a GWC at 2142.9mSS

2 WELL SUMMARY

La Bella-1 was drilled as an exploration well designed to test the hydrocarbon potential of the La Bella structure. The well was spudded on the 22nd January 1993 in 94m of water. It is located in the southeast corner of permit VIC/P30 in the eastern offshore Otway Basin (Figure 1).

The La Bella structure is a northeast-southwest trending faulted anticline which has been broken up into four fault blocks. The La Bella-1 well was located to test the southwestern most fault block in a crestal position.

The primary objective of the well was to test the hydrocarbon potential of sands contained within the Late Cretaceous Shipwreck Group. The overlying claystones and siltstones of the Late Cretaceous Sherbrook Group were expected to act as both a vertical and lateral seal. No secondary targets were mapped.

The well discovered two gas bearing sands within the Shipwreck Group. The upper sand consisted of 4.1m of net gas bearing sand over a 15m gross interval (2060 - 2075m), with an average porosity of 14% and an average water saturation of 46%.The lower sand is interpreted to contain 28.6m of net gas sand over a 68m interval (2100 - 2168m), with an average porosity of 20% and an average water saturation of 31%.

The well was plugged and abandoned on the 15th February 1993.

3 HYDROCARBONS

There were no hydrocarbon shows recorded in the Tertiary section. Ditch gas readings were not recorded until part way through the Cretaceous at 1680mRT, where background readings, consisting dominantly of C1 with minor amounts of C2, were recorded up to 0.7%.

Minor gas only was recorded until 2060m RT where gas was recorded up to 7% in sands of the Upper Shipwreck Group. No direct fluorescence was recorded throughout these sands which were cored from 2071 - 2098.65mRT.

Log interpretation (Appendix 1) indicates two gas bearing intervals. The upper sand consists of 4.1m of net gas sand over a 15m gross interval (27% N/G) with an average porosity of 14% and an average water saturation of 46%.

A further gas bearing sand was intersected, lower in the Upper Shipwreck Group from 2100-2168mRT. Log interpretation indicates a total of 28.6m of net gas sand over a gross interval of 68m (42% N/G), with an average porosity of 20% and an average water saturation of 31%.

Interpretation of the RFT pretest measurements indicate that the two gas bearing intervals are in different pressure regimes (Appendix 2). No gas/water contacts could be determined from wireline logs due to the increase in shale content, however interpretation of the RFT, indicates gas/water contacts at 2145mRT for the upper sand and 2168mRT for the lower sand. As both gas bearing sands are overpressured, the sands are not in pressure communication with those seen in nearby wells (ie Pecten-1A, Eric The Red-1)

Two fluid samples were taken from the gas bearing intervals in La Bella-1. One segregated sample was taken at 2160.5m RT, and recovered 134 Ft^3 of gas, approximately 75cc of condensate and 575cc of filtrate, in the six gallon chamber. The second sample was recovered from 2072.8mRT and recovered 124 ft^3 of gas and approximately 35cc of condensate and 315cc of filtrate, in the six gallon chamber.

Below 2168mRT the gas decreased to between 0.06 - 0.6% and the section is interpreted to be entirely water saturated.

4 STRUCTURE

The La Bella structure is a northeast-southwest trending faulted anticline which has been broken up into four rotated fault blocks by northwest-southeast trending normal faults. Each of the fault blocks has three way dip closure to the in combination with fault closure to the southeast.

An east-west compressional event after the deposition of the Upper Shipwreck Group appears to have created the majority of the structural relief in the strike direction. Faults have been active throughout the Cretaceous with a major period of movement after deposition of the Shipwreck Group. The faults do not extend into the Tertiary around the La Bella-1 well. They are downthrown to the southwest and the Shipwreck and Otway Group sediments have been tilted back to provide dip closure towards the northeast.

5 STRATIGRAPHY

The stratigraphic sequence penetrated at La Bella-1 has significant differences to the anticipated section (Figure 3), as the Wangerrip Group sediments were absent in this well. La Bella-1 reached a total depth of 2735mRT, terminating in the Albian aged Otway Group. Delineation of age units is based primarily on log correlation with nearby wells, together with palynology (Appendix 3) and micropaleontology (Appendix 4) to further define the formations.

The stratigraphic section is shown in Figure 3 and Enclosure 1. Age, lithology, and drilling data are marked on the composite well log accompanying this report. No ditch cuttings were obtained above 628m.

Otway Group (2735 - 2592 mRT)

The top 143m of the Albian aged Otway Group was penetrated by the La Bella-1 well and consists dominantly of an argillaceous lithic quartzose sandstone, interbedded with minor claystone. The sands are generally light grey, fine to medium grained, subangular to subrounded and moderately to well sorted. The sands contain common altered feldspar, traces of carbonaceous flecks and coal particles. The sand has poor visible porosity.

Lower Shipwreck Group (2592 - 2283mRT)

The Shipwreck Group was deposited as a vast delta system and changes regionally from non-marine/fluvial facies onshore in the north to nearshore and offshore/deltaic in the southern permit areas. The base of the Lower Shipwreck Group is marked by an unconformity which was formed in response to reactivation of rift activity in the Cenomanian.

In the La Bella-1 well 309m of Lower Shipwreck Group sediments were intersected. The sequence consists of sandstones interbedded with argillaceous sandstone and silty claystone. The sands are generally clear to very light grey, friable with abundant loose grains, subangular and moderately sorted.

Upper Shipwreck Group (2283 - 2007mRT)

The base of the Upper Shipwreck Group is marked by a Turonian unconformity.

A 276m section of Upper Shipwreck sediments were intersected in the La Bella-1 well, which consist of silty claystones towards the top, with interbedded sandstones increasing in abundance towards the base. A core was cut over the interval 2071-2098.65mRT with 100% recovery. The core consisted of interbedded sandstone, argillaceous sandstone and claystone. The sands are medium grey, medium to coarse grained, angular to subangular, poorly sorted with common grey argillaceous matrix. Although towards the top of the section the sands are thin and of poor reservoir quality, the sands towards the lower part generally have good reservoir characteristics.

Sherbrook Group (2007 - 1559mRT)

The base of the Sherbrook Group is marked by a regional, angular to occasionally parallel unconformity which formed in response to the breakup and onset of seafloor spreading, at around 85 Ma.

In La Bella-1 a 448m section of medium to dark grey claystones were intersected with traces of sandstone, dolomite and calcarenite bands. The claystones of the Sherbrook Group act as the seal for the underlying Shipwreck Group.

Wangerrip Group - Not Present

The Wangerrip Group was not intersected in the La Bella-1 well, due to non deposition of the prograding deltaic sediments at this location.

Nirranda Group (1559 - 1195mRT)

Mepunga Formation (1559 - 1195mRT)
Narrawaturk Marl - (1195-628mRT, first returns)

The base of the Nirranda Group is marked by a regional unconformity which may represent a starvation of sediment in combination with a relative fall in sea level. The sequence consists of the shoreface sands of the Mepunga Sandstone overlain by Narrawaturk Marls.

In La Bella-1 a 364m sequence of Mepunga sands were intersected which consisted of medium to very coarse sandstones, which were iron-stained near the top and become dolomitic towards the base. This unit was overlain by 567m of Narrawaturk Marl which is fossiliferous and light to dary drey in colour.

6 GEOPHYSICAL DISCUSSION

6.1 Seismic Coverage

The La Bella structure is defined by a 1 by 1 kilometre grid of seismic data acquired in 1991. In addition to the 1991 acquired data several 1980 and 1981 acquired seismiclies that were reprocessed in 1991 aided the interpretation around the La Bella structure. The data are of good quality and are correctly located in order to give optimum imaging of the numerous faults in the area. The closeness of the faults (less than one kilometre in many cases) requires a closer seismic line spacing in order to more accurately map horizons and correlate faults.

6.2 Post-Drill Mapping

La Bella-1 came in very close to prognosis with the top of the main gas zone only 20 metres deeper than that predicted. No immediate post-drill mapping was therefore warranted. The extent of the hydrocarbon column encountered in La Bella-1 is being investigated.

6.3 Velocities

A smoothed seismic velocity model was created to be used for pre-drill depth conversion. The velocity model was then intersected with seismic times for the five horizons interpreted. This enabled the calculation of smoothed average and interval velocities. The interval velocities were then used to convert time to depth and a correction factor applied to each horizon to enable a depth tie at the nearby Mussel-1 well location.

The resulting prognosed depths were very close to the actual depths encountered in La Bella-1, indicating that the velocity model was accurate.

The following table compares the prognosed depth for four of the horizons with the actual depth taken from the VSP for the SAME TWO-WAY TIME.

TWT (ms)	PROGNOSED DEPTH (metres SS)	VSP DEPTH (metres SS)	DIFF (metres)	DIFF (%)
1164	1490 (3492 m/s Vint	1496 3238 m/s)	6	0.4
1487	2054 (4385 m/s Vint	2019 3667 m/s)	35	1.7
1565	2225 (3004 m/s Vint	2162 3865 m/s)	37	1.7
1788	2560	2593	33	1.3

7 GEOLOGICAL DISCUSSION

7.1 Previous Work

In the permit VIC/P30 (granted to BHPP on 22nd February 1991) three wells had been drilled prior to La Bella-1, Pecten-1A (Shell, 1967), Nautilus-1 (Esso, 1968) and Triton-1 (Esso, 1982).

Pecten-1A tested 320 MSCF/d gas from a thin Late Cretaceous sandstone but intersected only an abbreviated Late Cretaceous reservoir section as a result of considerable onlap on the flanks of the Pecten structure.

Nautilus-1 targeted a Tertiary 'clastic wedge' stratigraphic play that turned out to be composed entirely of marl.

Triton-1 appears to have been a crestal well based on the available 4x4 km seismic grid although this is complicated by faults intersecting the well bore at TD. It now appears that Triton-1 encountered only the distal equivalent of sands penetrated in nearby wells in the Shipwreck Group.

7.2 Regional Geology

The Otway Basin, situated on the southeastern margin of Australia, is one of a series of basins formed in association with the breakup of Gondwana and Australia's separation from Antarctica.

Rifting within Gondwana was initiated at Late Jurassic to very Early Cretaceous time. Early Cretaceous sediments have only been penetrated in Pecten-1A in the permit area, however are known directly onshore from the permit area and to the west. Rifting produced northwest-southeast oriented normal faulting which controlled the major structural style of the area. Sediments deposited within the Early Cretaceous rift and post-rift sequences thicken southwestwards across faults towards the basin centre.

From Valanginian to Barremian times, it is interpreted that the Pretty Hill Formation was deposited in the permit as alluvial fan sands, silts and clays in tilted half-graben settings. An ensuing sag phase due to thermal cooling and contraction of the crust led to a regional unconformity above the Pretty Hill Formation. The Eumeralla Formation was deposited from the Aptian to the latest Albian during the sag, comprising of both fluvial and lacustrine sands, silts and clays, with common coals deposited in a lake margin coal-swamp environment.

Reactivation of rift activity is interpreted at the earliest Cenomanian, which created a regional unconformity above the Eumeralla Formation. The rifting enhanced the structural style of the previous rifting episode, generating a series of northwest-southeast trending terraces, such as the Mussel Terrace, stepping down into the basin.

Rifting continued from the Cenomanian to the Santonian. During this time sediments of the Upper and Lower Shipwreck Groups were deposited, with the two separated by an unconformity dated approximately at 90 Ma. The sediments were deposited as a vast delta system changing regionally from non-marine/fluvial facies onshore in the north to nearshore and offshore/deltaic in the south.

The end of the second rifting episode, and the inception of sea-floor spreading, is suggested to occur in the permit area at 85Ma, which resulted in a compressive episode which gently folded the Shipwreck Group sediments. This resulted in a regional to occasionally parallel unconformity.

The Sherbrook Group sediments onlap and downlap the breakup unconformity. The sediments consist predominantly of distal clays and silts which grade vertically to more proximal delta sand/silt facies. During the deposition of the Sherbrook Group the basin underwent continued northeast-southwest extension along pre-existing normal faults, coincident with periods of northwest-southeast compression. The compression overprinted the previous minor regional folding.

Overlying the regional unconformity above the Sherbrook Group are Paleocene to Middle Eocene Wangerrip Group sediments. After a rapid marine transgression, which is often represented by a basal sand of the Pebble Point Formation, the Wangerrip Group prograded basinward, being deposited as a regressive sequence in deltaic settings represented by sands and silts of the Pember Mudstone and Dilwyn Formation.

The Nirranda Group, comprising of the Mepunga Formation shoreface sands overlain by marls and limestones of the Narrawaturk Marl, unconformably overlies the Wangerip Group. The Nirranda Group represents a large marine transgression at Late Eocene time.

Northwest-southeast compressional tectonism was reactivated at earliest Oligocene time, with partial inversion of some faults, folding of strata and formation of a regional unconformity.

Open marine conditions since the Oligocene have produced the prograding, bioclastic carbonate sequence of the Heytesbury Group. Minor extension and some compressional tectonism have continued until present day, particularly in the northeast of the permit area, resulting in the partial erosion of the Heytesbury and Nirranda Group sediments.

7.3 Contribution to Geological Concepts and Conclusions

La Bella-1 was drilled as an exploration well on the La Bella structure in order to test the hydrocarbon potential of the La Bella structure.

The Tertiary section intersected did not entirely agree with the prognosed section, as the prograding Mid Eocene sediments of the Wangerrip Group were not present in this well. This is interpreted to be due to the well location being distal to the sediment source for the Mid Eocene sediments and that the prograding sediments did not reach this location.

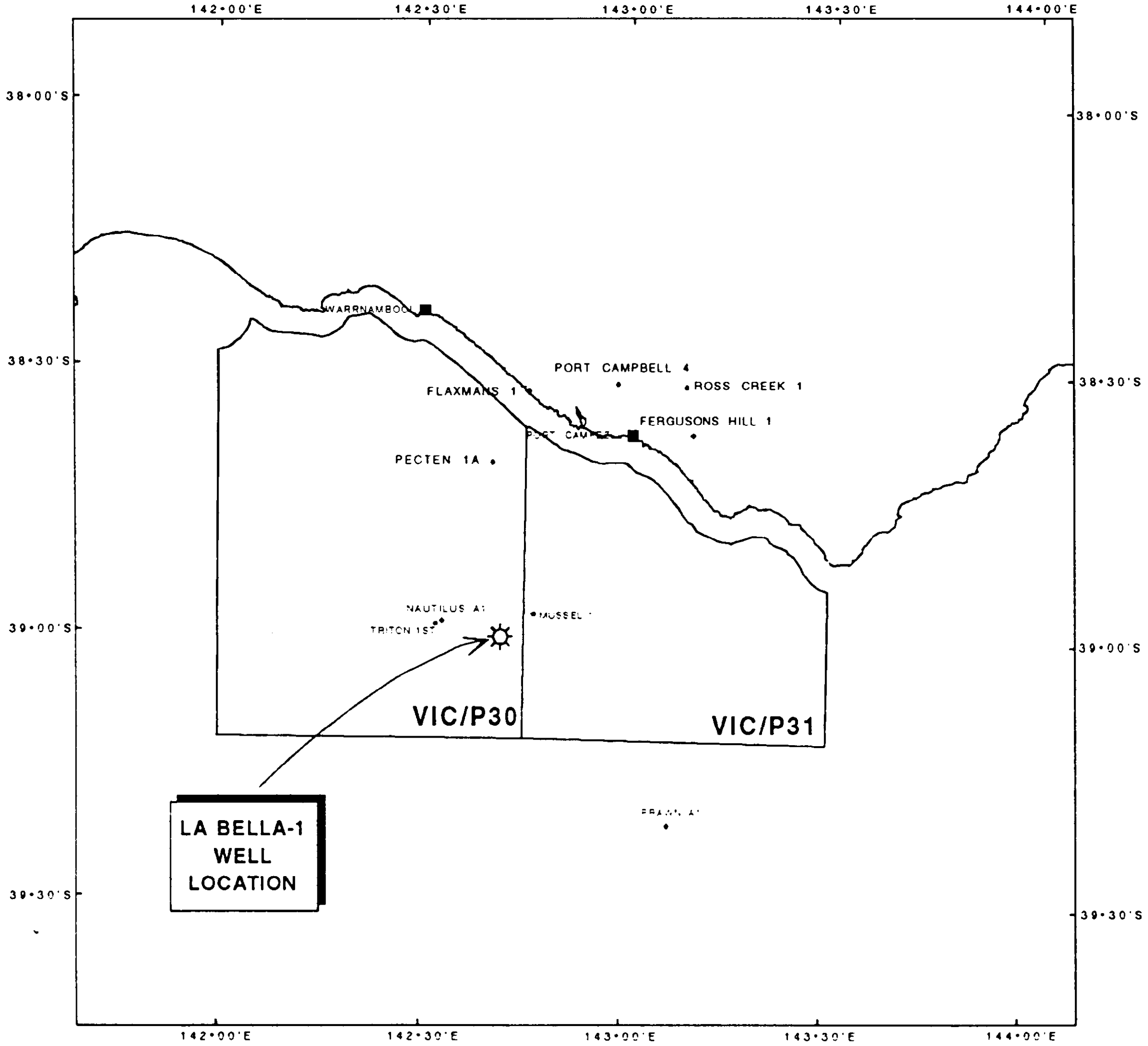
A 15m gas interval was intersected in the Upper Shipwreck Group at 2060m with 4.1m of net reservoir and with an average porosity of 14% and an average water saturation of 46%. No hydrocarbon contacts could be identified from wireline logs, however interpretation of the RFT pretests suggest a probable gas/water contact at 2119.6mSS.

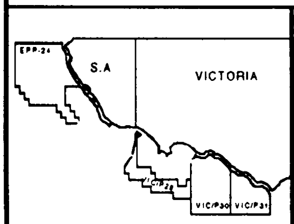
Lower in the Upper Shipwreck Group a second gas column was intersected at 2100mRT, with 28.6m of net gas sand over a 68m gross interval and with an average porosity of 20% and an average water saturation of 31%. A gas/water contact could not be identified from wireline logs, however interpretation of RFT pretests suggest a gas/water contact at 2142.9mSS (2168mRT).

RFT pressure measurements show that the two gas bearing intervals are not in communication with each other, with the upper sand being 33.1psi underpressured with respect to the lower sand. This would suggest that the claystones in the Upper Shipwreck Group have excellent sealing properties at this location, and hence good potential for intraformational seals for structural and stratigraphic traps exist.

The Lower Shipwreck is overpressured with respect to the two Upper Shipwreck Group sands and the Shipwreck Group sediments seen in Eric The Red-1 and Pecten-1A.

An investigation of the source rock potential of the Late Cretaceous Sherbrook and Shipwreck Groups has been carried out and a copy of the report is presented in Appendix 5. Nine SWC samples and a core sample were analysed which revealed a predominance of Type II/III to Type III organic matter. HI values were generally less than 200 and the S1+S2 yields indicate that expulsion from these samples would be possible only at relatively advanced levels of thermal maturity. As secondary cracking of liquids to gas is likely to occur at relatively advanced levels of thermal maturity, the source rocks are likely to be more gas prone than is indicated by the source rock data.





BHP Petroleum

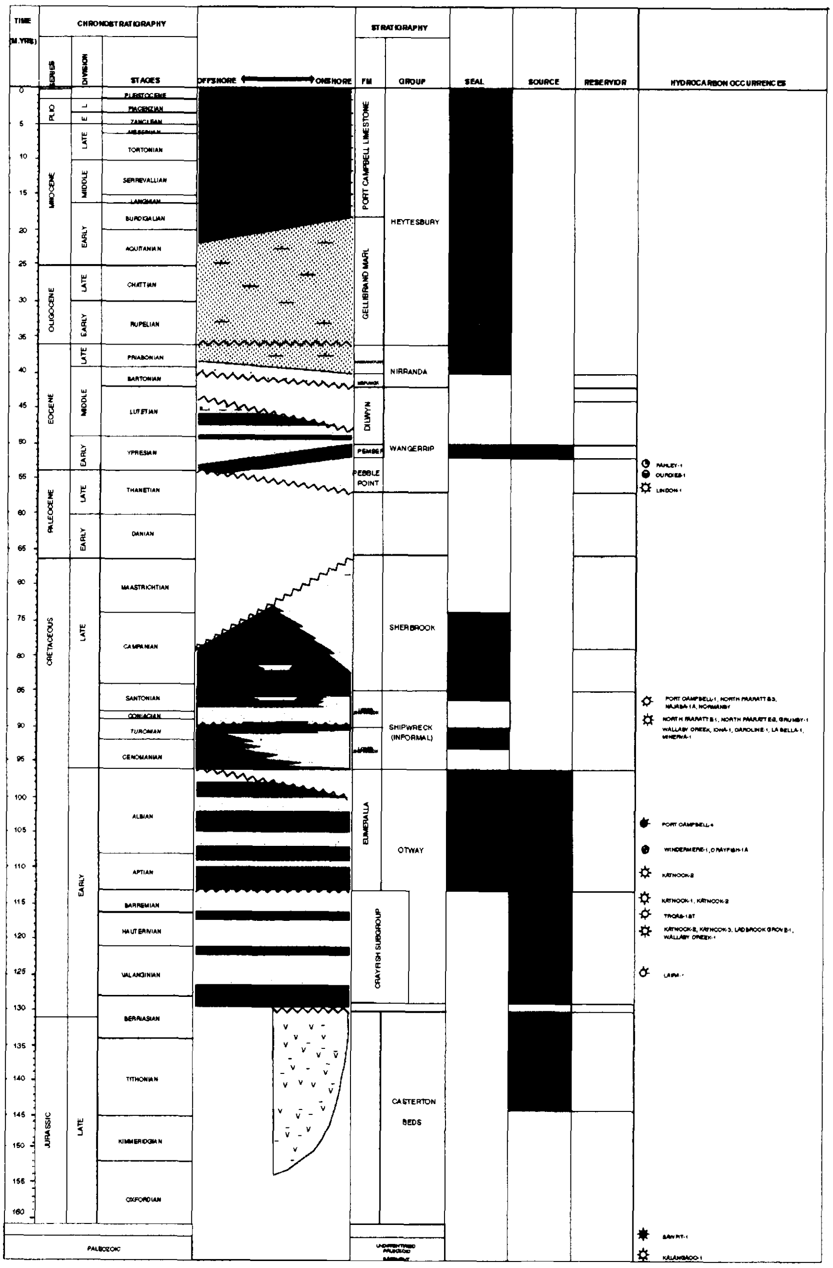
OTWAY BASIN
FIGURE 1.0
LA BELLA-1
LOCATION MAP

AUTHOR:		DATE	APR 93
DRAWN BY	TD	DWG NO	060_V4_HG3

BHP
Petroleum

OTWAY BASIN

STRATIGRAPHIC COLUMN - JUNE 1993



BHP

La Bella-1

PERMIT: VIC/P30

PREDICTED v ACTUAL

LINE : OH91-149
SP : 1274

LAT :39°00'14.194"S
LONG : 142°41'42.927"E

ELEV : Rt : 25m
WATER DEPTH : 94M

SPUD : 22/1/93
RIG RELEASE : 15/2/93

STATUS : Gas discovery- Plugged & abandoned
RIG :Byford Dolphin

Depth ss VD)	T.W.T. msec	Tops mss (TVD)	STRATIGRAPHY System / Series	STRATIGRAPHY FM	PREDICTED LITHOLOGY	OBJECTIVES
0						
	0.125	95				
1000	0.884	1064	Oligocene to Recent	Heyesbury Group	Calcarenite: light grey and fossiliferous Interbedded marl and calcarenite Fossiliferous marl: light to dark grey	
	0.986	1220	Late Eocene	Narrawaturk Marl	Limestone to top Marl	
	1.104	1403		Mepunga	Medium to v.coarse sst iron stained at top, dolomitic to base	
	1.164	1490	Mid Eocene	Wangerrip Group	Sandstone with minor siltstone	
2000	1.487	2054	Maastrictian to Santonian	Sherbrook Group	Siltstone with minor sandstone Siltstone with minor shale	
	1.585	2225	Late Turonian to Santonian	Upper Shipwreck Group	Sandstone with minor siltstone	
	1.718	2455	Late Turonian to Cenomanian	Lower Shipwreck Group	Interbedded sandstone, siltstone and shale FAULT	1°
	1.788	2560				
		2710	Albian	Otway Group	Interbedded sandstone, siltstone and claystone	
3000						
4000						

ACTUAL LITHOLOGY	STRATIGRAPHY FM	STRATIGRAPHY System / Series	Tops mss (TVD)	Thick-ness m	CSG mss
Sea level					
Sea bed			94		
Light to dark grey fossiliferous marl	Port Campbell limestone/ Gellibrand Marl	Oligocene to Recent	603	509	30" 131m
Fossiliferous marl	Narrawaturk Marl	Late Eocene	1170	567	13 3/8" 618m
Medium to v.coarse sst iron stained at top, dolomitic to base	Mepunga	Late Eocene	1534	364	
Claystone with trace sandstone Claystone with trace sandstone, dolomite and calcareous bands	Sherbrook Group	Maastrictian to Santonian	1982	448	9 5/8" 1761m
Sandstone with silty claystone	Upper Shipwreck Group	Late Turonian to Santonian	2258	276	
Interbedded sandstone siltstone and claystone	Lower Shipwreck Group	Late Turonian to Cenomanian	2567	309	
Argillaceous sandstone interbedded with claystone	Otway Group	Albian	2708.8		

MICROPALAEONTOLOGICAL ANALYSIS
LA BELLA-1, PERMIT VIC-P-30
OTWAY BASIN

FOR
BHP PETROLEUM PTY LTD

J.P. REXILIUS
S.L. POWELL

SEPTEMBER, 1993

BHP PETROLEUM PTY. LTD.
DO NOT RETAIN IN PERSONAL FILES
FILE COPY
PLEASE RETURN TO
EXPLORATION INFORMATION
CENTRE

INTERNATIONAL STRATIGRAPHIC CONSULTANTS PTY LTD
A.C.N. 009 183 555

UNIT 2, 10 STATION STREET
P.O. BOX 26
COTTESLOE 6011
WESTERN AUSTRALIA
PHONE 3852571 FAX 3843257

CONTENTS

I. SUMMARY

La Bella-1 was drilled in offshore petroleum permit Vic-P-30, Otway Basin to a depth of 2735mKB. A total of 15 sidewall core samples from the Tertiary section have been examined for foraminifera and calcareous nannoplankton. A summary of the biostratigraphic and environmental sub-division for these samples is given below:-

Planktonic Foraminiferal Sub-division

635m-1115m	Zone H1	early Early Miocene
1151m-1364m	indeterminate	indeterminate

Calcareous Nannoplankton Sub-division

635m-832m	Zone NN1	early Early Miocene
896.5m	Zones NN1 & NP25/24	early Early Miocene-late Late Oligocene
997m-1151m	Zones NP25/24	late Late Oligocene
1200.5m-1364m	indeterminate	indeterminate

Integrated Biostratigraphic Sub-division

635m-832m	Zones H1, NN1	early Early Miocene
896.5m	Zones H1, NN1 to NP24	early Early Miocene-late Late Oligocene
997m-1115m	Zones H1, NP25/24	late Late Oligocene
1151m	Zones NP25/24	late Late Oligocene
1200.5m-1364m	indeterminate	indeterminate

Environment of Deposition

Samples 635m to 1027m inclusive	middle-outer neritic
1040m	outer neritic
1064m & 1115m	middle-outer neritic
1151m	middle neritic
1200.5m	indeterminate
1255m & 1264m	undifferentiated marine
1340m & 1364m	indeterminate

II. INTRODUCTION

A total of 15 sidewall core samples from the interval 635m to 1364m have been examined for foraminifera and calcareous nannoplankton.

Fossil assemblages identified in the well section have been plotted on the distribution chart (Appendix No 2).

III. BIOSTRATIGRAPHIC ANALYSIS

The planktonic foraminiferal letter scheme of Taylor (in prep.) and the nannoplankton letter scheme of Martini (1971) are used for biostratigraphic subdivision.

A. Planktonic Foraminiferal Sub-division

1. 635m–1115m : Zone H1 (early Early Miocene)

Assignment to Zone H1 is based on the occurrence of *Globigerina woodi connecta* and the lack of *Globigerinoides trilobus*.

2. 1151m–1364m : Indeterminate

The sidewall core sample at 1151m contains a single specimen of *Globigerina* while the other sidewall cores lower in the interval are barren of planktonic foraminifera.

B. Calcareous Nannoplankton Sub-division

1. 635m–832m : Zone NN1 (early Early Miocene)

The occurrence of *Cyclicargolithus abisectus* and lack of pre–Zone NN1 index species indicates assignment to Zone NN1.

2. 896.5m : Zones NN1 & NP25/24 (early Early Miocene–late Late Oligocene)

Assignment to Zones NN1 to NP24 inclusive is based on the association of a single specimen of *Dictyococcites bisectus* together with *Cyclicargolithus abisectus*.

3. 997m–1151m : Zones NP25/24 (late Late Oligocene)

Assignment to Zones NP25 and NP24 is based on the association of *Dictyococcites bisectus, Cyclicargolithus abisectus* and *Zygrhablithus bijugatus*.

4. 1200.5m–1364m : Indeterminate

The sidewall core samples in the interval are barren of calcareous nannoplankton.

IV. ENVIRONMENT OF DEPOSITION

1. Samples 635m to 1027m inclusive : Middle–outer neritic

The benthonic foraminiferal fauna includes the following bathymetrically important taxa: *Sphaeroidina bulloides* (rare–frequent), *Pullenia bulloides* (single–rare), *Globocassidulina subglobosa* (frequent–abundant), *Siphouvigerina canariensis* (rare) and *Cassidulina delicata* (rare–common). Deposition in a middle to outer neritic setting is envisaged.

2. 1040m : Outer neritic

The foraminiferal fauna at 1040m is dominated by benthonics with the following important taxa represented: *Globocassidulina subglobosa* (abundant), smooth *Hyperammina* (rare) and smooth *Bathysiphon* (single). Deposition in an outer neritic environment is envisaged.

3. 1064m & 1115m : Middle–outer neritic

The samples are interpreted to have been deposited in a middle to outer neritic setting on the basis of containing a similar benthonic foraminiferal fauna to that recorded in the overlying sample but without the flysch taxa, smooth *Hyperammina* and *Bathysiphon.*

4. 1151m : Middle neritic

The sidewall core sample at 1151m contains a benthonic foraminiferal assemblage that lacks outer neritic taxa and is dominated by *Eponides subhaidingeri* (common) and *Globocassidulina subglobosa* (common). Deposition in a middle neritic environment is envisaged.

5. 1200.5m : Indeterminate

The sandstone sidewall core sample is barren of foraminifera, nannoplankton and other skeletal material.

6. 1255m & 1264m : Undifferentiated marine

The sandstone samples in the interval are barren of foraminifera, nannoplankton and other skeletal material but do contain minor glauconite suggesting deposition in a marine setting.

7. 1340m & 1364m : Indeterminate

The sandstone sidewall core samples are barren of foraminifera, nannoplankton and other skeletal material.

V. REFERENCES

MARTINI, E., 1971. Standard Tertiary and Quaternary calcareous nannoplankton zonation, in Farinacci, A., (ed), *Proc. Second Plank. Conf*, Roma, 1970, 1: 739–785.

TAYLOR. D.J., (in prep.). Observed Gippsland biostratigraphic sequences of planktonic foraminiferal assemblages.

APPENDIX NO. 1 : SUMMARY OF MICROPALAEONTOLOGICAL DATA, LA BELLA-1

DEPTH (mKB)	FORAM YIELD	FORAM PRESERV.	FORAM DIVERSITY	NANNO YIELD	NANNO PRESERV.	NANNO DIVERSITY
SWC60, 635	high	moderate	high	high	moderate	moderate-low
SWC59, 695	high	moderate	high	high	moderate	moderate
SWC57, 832	moderate	moderate	moderate	low	moderate	low
SWC55, 896.5	high	moderate	mod-high	high	moderate	moderate
SWC52, 997	moderate	moderate	mod-low	high	moderate	low
SWC51, 1027	high	moderate	high	high	moderate	moderate-high
SWC50, 1040	high	mod-good	mod-high	high	mod-good	moderate
SWC47, 1064	high	mod-good	mod-high	mod-low	poor	low
SWC45, 1115	high	mod-good	high	high	moderate	moderate
SWC44, 1151	mod-low	moderate	moderate	low-v. low	poor	low
SWC41, 1200.5	barren	-	-	barren	-	-
SWC38, 1255	barren	-	-	barren	-	-
SWC37, 1264	barrren	-	-	barren	-	-
SWC34, 1340	barren	-	-	barren	-	-
SWC33, 1364	barren	-	-	barren	-	-

APPENDIX NO. 2: DISTRIBUTION FORAMINIFERA AND NANNOPLANKTON, LA BELLA-1

SPECIES /SAMPLES	SWC, 635m	SWC, 695m	SWC, 832m	SWC, 896.5m	SWC, 997m	SWC, 1027m	SWC, 1040m	SWC, 1064m	SWC, 1115m	SWC, 1151m	SWC, 1200.5m	SWC, 1255m	SWC, 1264m	SWC, 1340m	SWC, 1364m
BENTHONIC FORAMINIFERA															
Lenticulina spp.	f	f	f	s	r	f	f		r	f					
Globocassidulina subglobosa	c	c		f	c	a	a	a	c	c					
Sphaeroidina bulloides	f	r	r	r		f		r	f	r					
Eponides subhaidingeri	c	c	c	a	c		f	r	c	c					
Stilostomella spp.	s			f		c	c	r							
Cibicides vortex	c	f	f						r						
Lagena spp.	f	f	f	f	r	c	s	c	f						
Fissurina spp.	a	r	s	r		c		f	s						
Dentalina spp.	s	s					r		f	r					
Loxostomum spp.	r														
Pullenia bulloides	r	r		s	r	s		s	r	s					
Protoglobobulimina spp.	s								r						
Anomalinoides glabrata	s			f											
Triloculina spp.	s					r									
Pseudonodosaria laevigata	r					r	r								
Nodosaria spp.	f	f	r	r	r	c	f	f	r						
Euuvigerina peregrina	f	r		f											
Euuvigerina schwageri	r														
Lagenonodosaria scalaris	s			r	s	s	s		s						
Cibicides thiara	c	f	f	r		f		r		r					
Trifarina bradyi	r	r	s	r			r	s	c	s					
Astrononion spp.	f	r	f	r	r	r	f		r	r					
Cibicides spp. (small)	a					c	c	c							
Siphonina spp.	r														
Brizalina robusta	f	r		f	r	f	f		r						
Cassidulina delicata	f	f	r	c		c		r	s						
Siphouvigerina canariensis	r	r	r	r	r			s							
Anomalina inversa	r		s		s	r									
Textularia spp.	r		r			r			s						
Haplophragmoides spp. (smooth)		r													
Euuvigerina flintii		r													
Ramulina spp.		s				s		s							
Pyrgo spp.		s				s									
Hanzawaia spp.		r	s	s	r	s	s								
Cibicides mediocris		r													
Sigmoidella elegantissima		s	s												
Nodosaria longiscata		r				r									
Neoeponides parantillarium		s													
Clavulina spp.		r				s	s								
Guttelina problema		s					s	s	s						
Pullenia quinqueloba		s													
Anomalina glabrata		r													
Bueningia creeki		s													
Bolivina mahoenica		r													
Heronallenia spp.		s				s									
Cibicides spp.		c	c	a	c				a	f					
Cibicides lobulatus			r	s		s									
Gyroidina spp.			r						r						
Gyroidina subzealandica			r			r									
Bolivina spp.			s		s	r									
Discorbis spp.				s											
Siphonina tubulosa				f	s	f		s	f						
Glandulina spp.				s	s	r		s							
Brizalina spp.				f	r	c		f	r						
Vaginulinopsis spp.				s											
Cassidulina bradyi					r										
Pleurostomella spp.					s										
Arenodosaria antipoda						r									
Gyroidina zealandica						c	r		s	r					
Pyrulina cylindroides						r									
Gaudryina spp.						r		s							
Baggina ampla						s									
Bulimina striata						r									
Dorothia spp.						s	s								
Cassidulina oblonga						f		f	s						
Quinqueloculina spp.						r									
Haplophragmoides spp.							r								
Hyperammina spp. (smooth)							s								
Reussella simplex							s								
Bathysiphon spp. (smooth)							s								

s = single, r = rare, f = frequent, c = common, a = abundant.

APPENDIX NO. 2: DISTRIBUTION FORAMINIFERA AND NANNOPLANKTON, LA BELLA-1

SPECIES /SAMPLES	SWC, 635m	SWC, 695m	SWC, 832m	SWC, 896.5m	SWC, 997m	SWC, 1027m	SWC, 1040m	SWC, 1064m	SWC, 1115m	SWC, 1151m	SWC, 1200.5m	SWC, 1255m	SWC, 1264m	SWC, 1340m	SWC, 1364m
Protoglobobulimina affinis								r							
Marginulina spp.								s	s						
Discorotalia tenuissima								s	r						
Cibicides semiperforatus								s		s					
Melonis affinis								r							
Cyclammina spp.									r						
Anomalina spp.									r	s					
Notorotalia stachei									s						
Protoglobobulimina ovata									r	s					
Lamarckina spp.									s						
Alabamina spp.									r						
Anomalinoides evolutus									s						
Bolivinopsis cubensis									r						
Epistominella cassidulinoides										r					
PLANKTONIC FORAMINIFERA															
Globigerina praebulloides	f	f	r			f		f	f						
Globigerinoides spp.	c	f	f												
Globoquadrina dehiscens s.s.	s	r	r												
Globigerina brazieri	c							r							
Globigerina woodi woodi	c					s	r	r	s						
Globigerinoides altiaperturus	r		r												
Globigerina woodi connecta	f	r	s	s		r		f	r						
Turborotalia continuosa	r														
Globigerina aff. angustiumbilicata	s	f		s											
Catapsydrax aff. dissimilis			s					r							
Turborotalia cf. kugleri				r											
Globigerina obesa				r		f									
Globigerinoides aff. primordius				s											
Globigerina spp.				f	f		r			s					
Globigerina euapertura						r		r	r						
Globigerina aff. woodi connecta							s								
Turborotalia opima nana								s							
Catapsydrax aff. unicavus									s						
CALCAREOUS NANNOPLANKTON															
Cyclicargolithus floridanus	a	a	f	a	a	a	a	c	a	f					
Cyclicargolithus abisectus	f	f	f	r	f	c	f	s	f	s					
Dictyococcites productus	c	r		f		r	r	s	f	r					
Sphenolithus moriformis	f	c	f	c	f	f	s	r	r	s					
Discoaster deflandre	s	r							r						
Coronocyclus nitescens	s														
Coccolithus miopelagicus	r	f	s	s	f	c	r	f	r	r					
Reticulofenestra haqii	r	r													
Helicosphaera kamptneri	s														
Sphenolithus abies	r	r							s						
Braarudosphaera bigelowii		r	f	r	f	f	f		r						
Helicosphaera spp.		r		r		s	s								
Micrantholithus attenuatus		r	r	s			r								
Pontosphaera aff. discopora		s													
Micrantholithus spp.				s					s						
Pontosphaera multipora				f		r	r		r						
Helicosphaera euphratis				s		r									
Dictyococcites bisectus				s	r	f	r	f	c						
Zygrhablithus bijugatus					f	f	f		r	s					
Micrantholithus fornicatus					s	s									
Helicosphaera kamptneri						s									
Pontosphaera spp.						r	r								
Helicosphaera aff. recta								s							
Helicosphaera recta									f						
OTHER SKELETAL MATERIAL															
Bryozoan debris	f	f	c					s	f	f					
Ostracods	f	f	r	s	s	f		r	r	r					
Echinoid debris	f	r	c	f					r	f					
Gastropods		r													
Bivalve fragments		r													

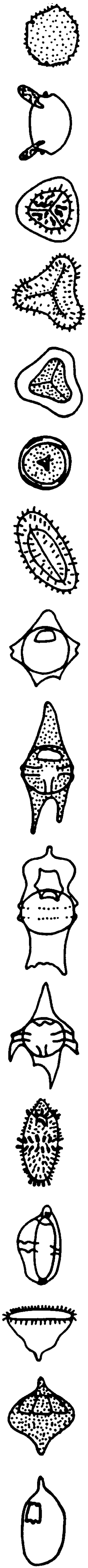
s = single, r = rare, f = frequent, c = common, a = abundant.

2

MORGAN PALAEO ASSOCIATES

PALYNOLOGICAL/PETROLEUM GEOLOGICAL CONSULTANTS

POSTAL ADDRESS: Box 161, Maitland, South Australia 5573
DELIVERIES: 1 Shannon Tce, Maitland, South Australia 5573
Phone (088) 32 2795 Fax (088) 32 2798



FINAL PALYNOLOGY OF BHPP LA BELLA #1, OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN AND NIGEL HOOKER

BHP PETROLEUM PTY. LTD.
DO NOT RETAIN IN PERSONAL FILES
FILE COPY
PLEASE RETURN TO
EXPLORATION INFORMATION
CENTRE

for BHP PETROLEUM

June 1993

REF:W.OTW.RPBELLA1

FINAL PALYNOLOGY OF BHPP LA BELLA #1

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN AND NIGEL HOOKER

CONTENTS **PAGE**

I SUMMARY

635.0m(swc), 695.0m(swc) : *bellus* Zone or older : Miocene or older : offshore marine : immature

832.0m(swc) : extremely lean and indeterminate

896.5m(swc), 997.0m(swc), 1027.0m(swc), 1040.0m(swc), 1064.0m(swc) : lower to mid *tuberculatus* Zone : Oligocene : offshore marine : immature

1115.0m(swc), 1151.0m(swc), 1200.5(swc) : probably Oligocene : lean with heavy reworked Cretaceous (lower *X. australis* dinoflagellate Zone) at 1151m : offshore marine : immature

1255.0m(swc), 1264.0m(swc) : upper *asperus* Zone (*comatum* dinoflagellate Zone) : Late Eocene : offshore marine : immature

1340.0m(swc), 1364.0m(swc) : lower *asperus* Zone : Middle Eocene : intermediate to nearshore marine : immature

1489.0m(swc), 1491.0m(swc), 1494.0m(swc) : *asperopolus* Zone (1489.0 *edwardsii* dinoflagellate Zone, 1491.0m *thompsonae* dinoflagellate Zone) : Early Eocene : marginally marine at the base, passing to intermediate marine at the top : immature

1517.0m(swc), 1523.0m(swc) : upper *diversus* Zone (1523.0 *ornatum* dinoflagellate Zone) : Early Eocene : nearshore marine : immature

1544.0m(swc) : lower *diversus* Zone : Early Eocene : marginally marine : immature

1563.0m(swc), 1580.0m(swc), 1640.0m(swc), 1663.0m(swc) : upper *senectus* Zone (upper *australis* dinoflagellate Zone 1580-1663m) : early Campanian : nearshore marine : immature

1721.0m(swc), 1765.0m(swc) : upper *senectus* Zone (lower *australis* dinoflagellate Zone) : early Campanian : nearshore marine : immature

1823m(cutts), 1865.0m(swc) : middle *senectus* Zone (upper *acerus* dinoflagellate Zone : early Campanian : nearshore marine : immature

1891.0m (swc), 1949.0m(swc), 1979.0m(swc) : apparently upper *apoxyexinus* Zone (*aceras* dinoflagellate Zone ?middle subzone but unclear in swcs) : early Campanian : nearshore marine : marginally mature

2004.0m(swc) : upper *apoxyexinus* Zone (upper *cretacea* dinoflagellate Zone) : Santonian : intermediate marine : marginally mature

2020.0m(swc) : middle *apoxyexinus* Zone : Santonian : intermediate marine : marginally mature

2028.0m(swc) 2043.0m(swc), 2054.0m(swc), 2059.0m(swc), 2066.0m(swc), 2076.0m(core) : lower *apoxyexinus* Zone : Santonian : intermediate marine to very nearshore marine : marginally mature

2086.1m(core), 2096.0m(core), 2111.5m(swc), 2118.0(swc), 2145.0m(swc), 2159.0m(swc), 2164.0m(swc), 2166.0m(swc), 2179.0m(swc), 2199.0m(swc), 2232.0(swc), 2252.0m(swc), 2270.0m(swc) : *mawsoni* Zone (2252.0 - 2270.0m *infusorioides* dinoflagellate Zone) : Coniacian-Turonian : mostly very nearshore with one intermediate marine exception at 2118m and nearshore below 2232m : marginally mature

2275.5m(swc), 2284.0m(swc), 2286.0m(swc), 2309.0m(swc), 2330.0m(swc), 2398.0m(swc), 2402.0m(swc), 2454.0m(swc), 2489.0m(cutts), 2497.0m(swc), 2500.0m(swc), 2528.0m(swc), 2540.5m(swc), 2544.5m(swc), 2550m(cutts), 2567.0m(swc), 2573m(cutts), 2593.0m(swc) : *distocarinatus* Zone (2277.5, 2284, 2286, 2309, 2402 *infusorioides* Zone) : Cenomanian : above 2402m mostly nearshore marine with marginal marine (2286m), non-marine (2330m) and intermediate marine (2309m) exceptions. Section below 2454m may all be non-marine with the observed dinoflagellates being caved as they are only seen in the cuttings, not the swcs : marginally mature to 2330, early mature below 2398m.

2605.0m(swc), 2624.0m(swc), 2640m(cutts), 2671.0m(swc), 2683.0m(swc), 2690m(cutts), 2705.0m(swc), 2715(cutts), 2730.0m(swc), 2735m(cutts) : Indeterminate (all except 2646.5m are extremely lean with percentage counts invalid. At 2646.5m(swc), an abundant and diverse assemblage lacks zonal markers of Sherbrook or Otway Group sequences with rare Permian and Aptian reworking) : non-marine.

II INTRODUCTION

During drilling seven cuttings samples were studied on an urgent basis at BHPP's Portland Base and were reported in 2 faxed reports. After well completion, a further seventy four samples (70 swcs, 3 from core, 1 cutts) were submitted for detailed study. All results are summarised herein.

Palynomorph occurrence data are shown as Appendix I and include the urgent and followup samples and form the basis for the assignment of the samples to sixteen spore-pollen and dinoflagellate units of Miocene to Cenomanian age. The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al (1987), as shown on Figure 1. The Late Cretaceous zonation has been modified by Morgan (1992) in project work for BHPP (Figure 2). Tertiary zones are essentially those of Partridge (1976).

Maturity data was generated in the form of Spore Colour Index, and is plotted on Figure 3 Maturity Profile of La Bella #1. The oil and gas windows on Figure 3 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These correspond to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 metres.

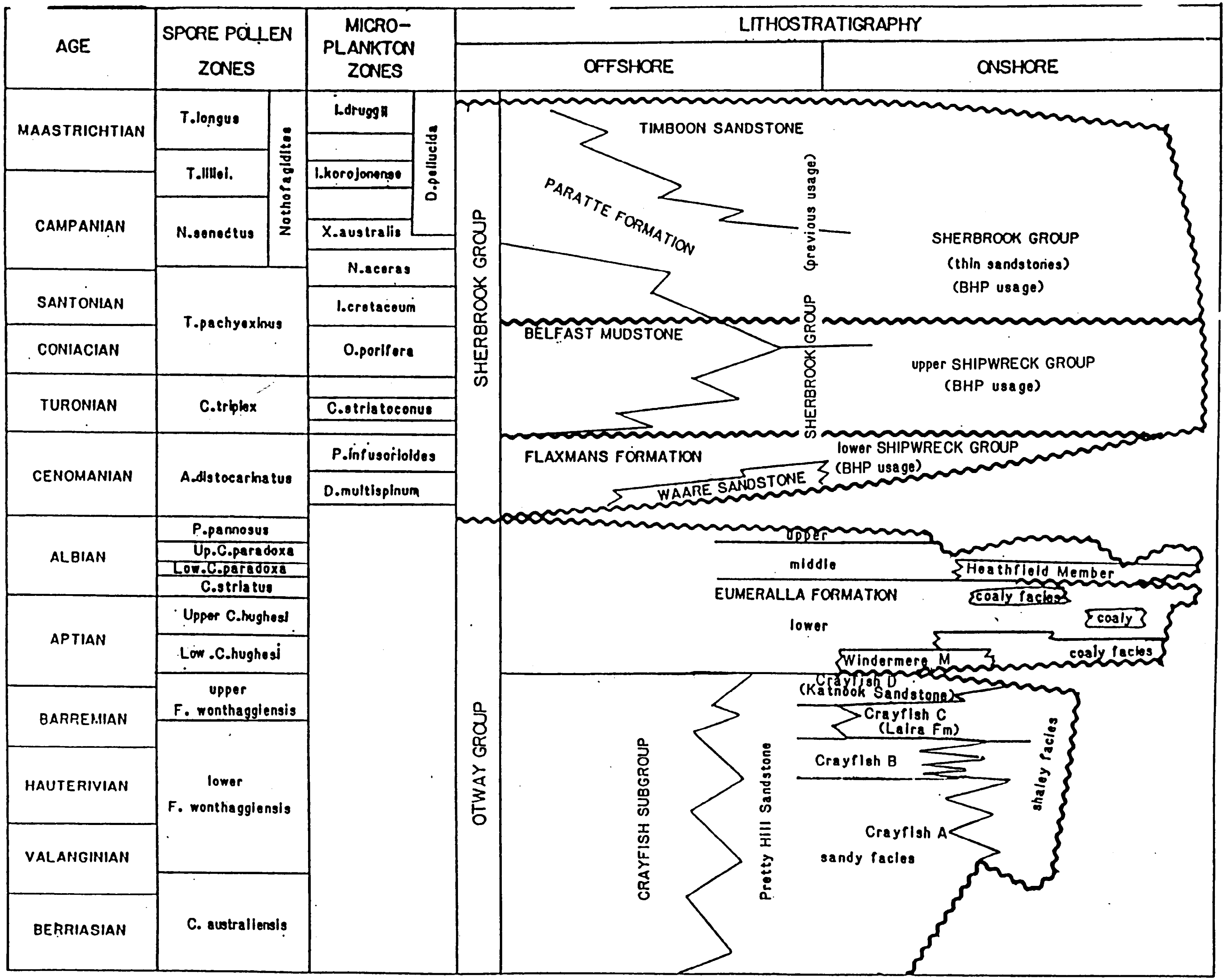


FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

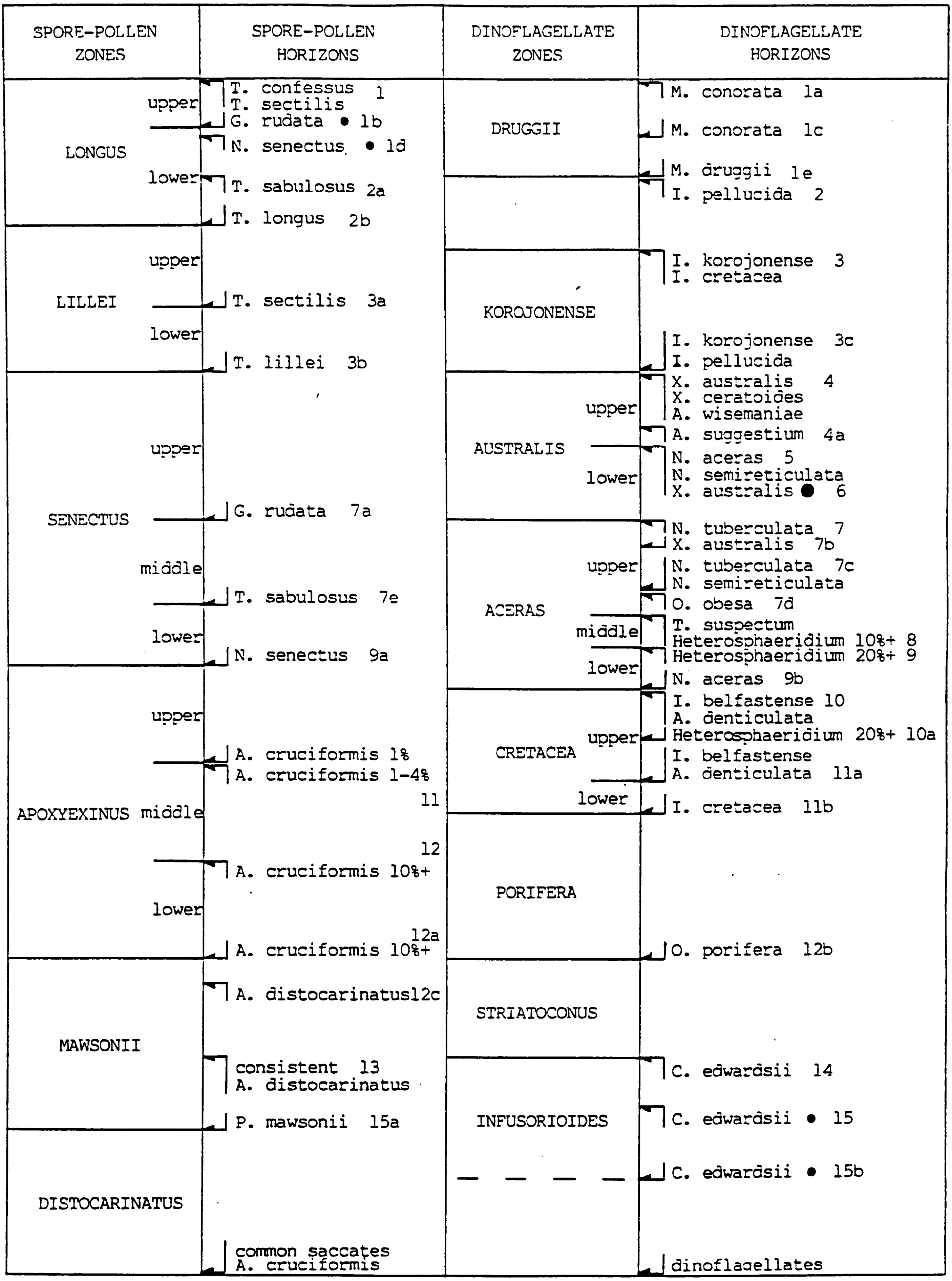


FIGURE 2 ZONATION USED HEREIN SHOWING THE NUMBERED HORIZONS AGAINST THE EXISTING FORMAL ZONATION.

● = frequent (4-10%) ● = common (11-30%)

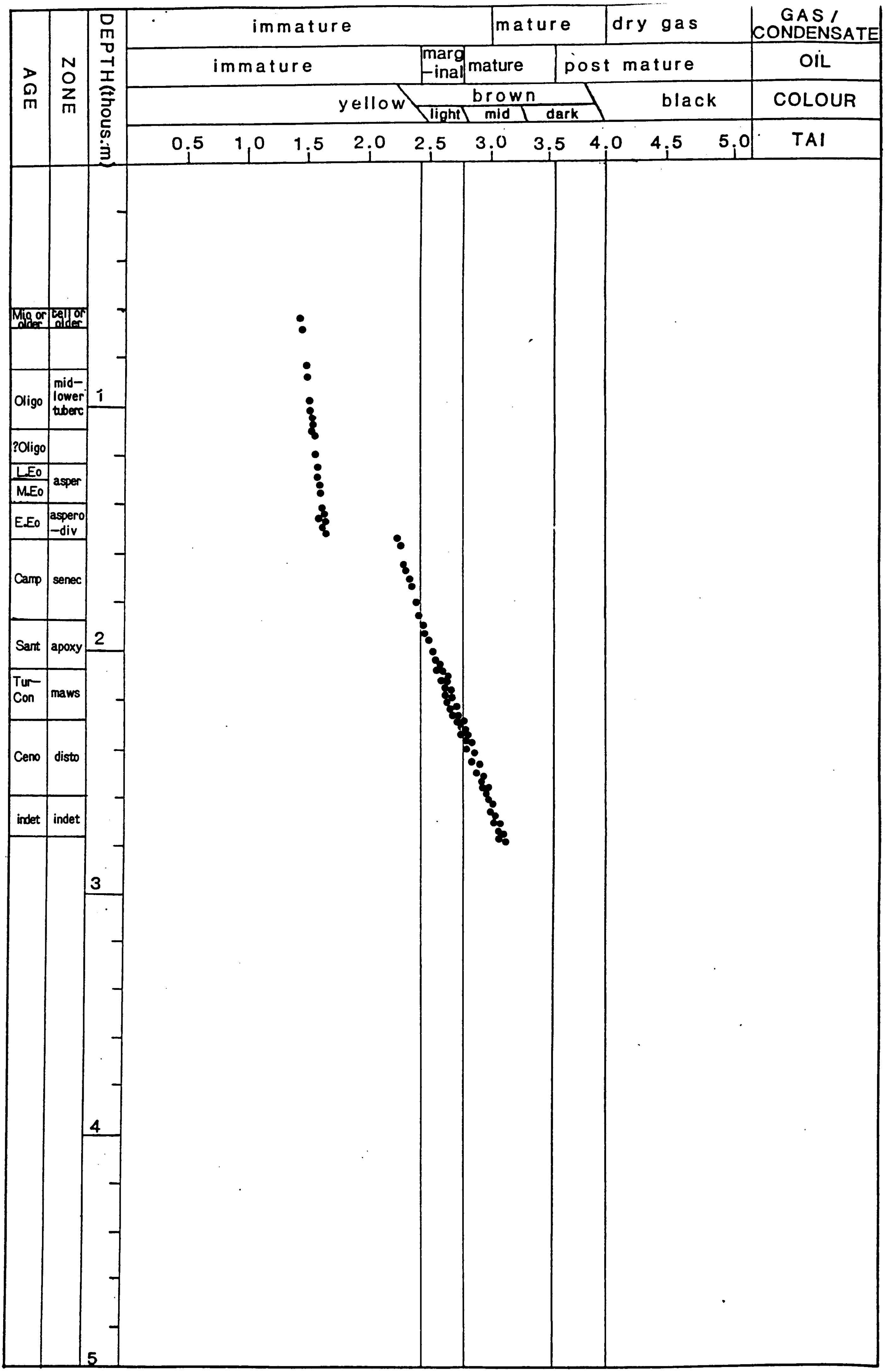


FIGURE 3 MATURITY PROFILE – LA BELLA # 1

III PALYNOSTRATIGRAPHY

A 635.0m(swc), 695.0m(swc) : *bellus* Zone or older

Assignment of these lean samples to the *Triporopollenites bellus* Zone of Miocene age or older is indicated by youngest *Nothofagidites asperus* and *Myrtaceidites verrucosus* and confirmed by the dinoflagellates. Of the spore-pollen, *Cyathidites*, *Dilwynites*, *Falcisporites* and *Haloragacidites harrisii* are frequent to common.

Of the dinoflagellates, *Spiniferites ramosus* and *Achomosphaera alicornu* are common in low diversity assemblages. The presence of *Impletosphaeridium* sp1 Manum suggests a late Oligocene to late Miocene age from its European range. Australian records in this part of the section are inconclusive, as this section has rarely been studied.

Offshore marine environments are suggested by high dinoflagellate content despite low diversity, and low organic yields, apparently starved.

Colourless palynomorphs indicate immaturity for hydrocarbon generation.

B 832.0(swc) : extremely lean and indeterminte

This sample yielded very few palynomorphs (about 30) with *Cyathidites*, *Dilwynites*, *Spiniferites* and *Operculodinium* frequent. Age diagnostic taxa were absent.

Offshore marine environments were indicated by the equal proportions of dinoflagellates and spore-pollen in an organically lean assemblage.

Immaturity for hydrocarbons is indicated by colourless palynomorphs.

C 896.5m(swc), 997.0m(swc), 1027.0m(swc), 1040.0m(swc), 1064.0(swc) : lower to mid *tuberculatus* Zone

Assignment to the lower to middle *Proteacidites tuberculatus* Zone of Oligocene age is indicated by the dinoflagellates at the top, supported by youngest *Nothofagidites flemingii* at 1027.0m. The base is indicated by oldest *Cyatheacidites annulatus*. Amongst the spore-pollen, *Cyathidites*, *Dilwynites*, *Falcisporites*, *H. harrisii* and *Nothofagidites* are frequent to common, with *Nothofagidites flemingii*, *N. falcata* and *C. annulatus* rare and intermittent. Minor

Permian reworking was noted.

Dinoflagellates are frequent to abundant with *Spiniferites* and *Operculodinium* frequent to common in all samples. The *Chiropterygium* group occur 896.5-1027.0m (abundant at 896.5m) and are Oligocene restricted worldwide with their common occurrence in the Late Oligocene. *Impletosphaeridium* sp1 Manum also occurs 896.5-1040.0m and is late Oligocene to Late Miocene worldwide. A Late rather than Early Oligocene age is therefore favoured, but ranges of these taxa have not yet been well established in Australia.

Offshore marine environments appear likely with generally moderate to high dinoflagellate content despite low moderate diversity, combined with low organic yields.

Immaturity for hydrocarbon generation is indicated by the colourless palynomorphs.

D 1115.0m(swc), 1151.0m(swc), 1200.5m(swc) : probably Oligocene

These three samples are all very lean and 1200.5m is almost barren. They can thus not be assigned to any spore-pollen zone. Of the pollen considered in place, *Nothofagidities* spp and *Haloragacidites harrisii* dominate and indicate an early Miocene or older age. Given the Late Eocene ages seen beneath, these samples probably belong to the Oligocene, and this is supported by the dinoflagellates. Significant Cretaceous reworking is present, especially at 1151m.

Dinoflagellates are very common in these samples but are mostly long ranging. Common to abundant are *Operculodinium* spp, *Hemicystodinium zoharyi* and *Spiniferites ramosus*. *Operculodinium* is usually abundant in the lower to middle *P. tuberculatus* spore-pollen zone. At 1151m, reworked Cretaceous dinoflagellates are frequent including *Odontochitina porifera*, *Nelsoniella aceras*, *N. semireticulata* and frequent *Xenikoon australis*, suggesting the lower *australis* dinoflagellate zone of early Campanian age.

Environments are offshore marine, with dinoflagellates dominant (72%, 71% and barren downhole), but of low diversity. The limited diversity spore-pollen are consistent with an offshore location.

Colourless spores and pollen indicate immaturity for hydrocarbon generation.

E 1255.0m(swc), 1264.0m(swc) : upper *asperus* zone

Assignment to the upper *Nothofagidites asperus* Zone of Late Eocene age is based on the dinoflagellates, as the pollen are scarce and non-diagnostic in these very lean assemblages. Amongst the pollen, *Nothofagidites* (including *N. falcata*), *Haloragacidites* and *Proteacidites* are the most frequent. Inertinite dominates the lean yield.

Dinoflagellates are relatively common in these very lean assemblages and include frequent *Phthanoperidinium comatum* and *Systematophora placacantha*, indicating the *P. comatum* dinoflagellate zone, correlative with the upper *N. asperus* spore-pollen zone.

Offshore marine environments are indicated by the dinoflagellate content (~60% and ~30% downhole) and their relatively high diversity in such a lean assemblage.

Colourless pollen indicate immaturity for hydrocarbon generation.

F 1340.0m(swc), 1364.0m(swc) : lower *asperus* Zone

These assemblages are extremely lean but assignment to the lower *Nothofagidites asperus* Zone of Middle Eocene age is indicated at the top by youngest *Dryptopollenites semilunatus* and *Intratriporopollenites notabilis*, supported by youngest *Proteacidites pachypolus* and *P. leightonii* and the dinoflagellate data. At the base, dinoflagellate data indicate assignment. Amongst the very rare pollen, *H. harrisii*, *Nothofagidites* and *Proteacidites* are the most common.

Amongst the dinoflagellates, youngest *Homotriblium tasmaniense*, consistent *Impagidinium maculatum* and oldest *S. placacantha* and *Deflandrea phosphoritica* indicates the *heterophlycta* dinoflagellate zone, correlative with the lower *asperus* spore-pollen zone. *Microdinium* spp and *Operculodinium* spp are frequent.

Intermediate marine to nearshore marine environments are indicated by the dinoflagellate content (~35% and ~30%) and moderate diversity. Spores and pollen are clearly dominant in very lean assemblages.

Colourless palynomorphs indicate immaturity for hydrocarbons.

G 1489.0m(swc), 1491.0m(swc), 1494.0m(swc) : *asperopolus* Zone

Assignment to the *Proteacidites asperopolus* Zone of latest Early Eocene to earliest Middle Eocene is indicated at the top by youngest *Proteacidites ornatus*, *P. grandis*, *Malvacipollis diversus* (at 1489.0m) and *Myrtaceidites tenuis* (at 1491.0m). At the base, oldest *P. asperopolus* is definitive. *H. harrisii* and *Proteacidites* spp are common with *Nothofagidites* very rare. Other distinctive species include *Beaupreadites verrucosus*, *Cupanieidites orthoteichus*, *Proteacidites pachypolus* and *Santalumidites cainozoicus*.

Dinoflagellates include *Kisselovia edwardsii* and common *H. tasmaniense* at 1489.0m indicating the *edwardsii* dinoflagellate zone and *Kisselovia thompsonae* without *K. edwardsii* at 1491.0m, indicating the *thompsonae* dinoflagellate zone. Both zones are correlative with the lower half (Early Eocene part) of the *asperopolus* spore-pollen zone.

Environments are marginally marine at the base (2% low diversity dinoflagellates with 16% freshwater algae at 1494.0m) passing to nearshore (18% moderate diversity dinoflagellates and 5% freshwater algae at 1491.0m) passing to intermediate marine (55% diverse dinoflagellates with 7% freshwater algae at 1489.0m).

Colourless palynomorphs indicate immaturity for hydrocarbons.

H 1517.0m(swc), 1523.0m(swc) : upper *diversus* Zone

Assignment to the upper *Malvacipollis diversus* Zone of Early Eocene age is indicated at the top by the absence of younger markers and at the base by oldest *Santalumidites cainozoicus* (1517.0m) *Proteacidites pachypolus* (1523.0m) and *Myrtaceidites tenuis* (1517.0m). *H. harrisii*, *Malvacipollis* spp and *Proteacidites* are the most common taxa in diverse assemblages that include *C. orthoteichus*, *Periporopollenites demarcatus*, *Proteacidites tuberculiformis*, *Polycolpites esobalteus*, *I. notabilis* and *Triporopollenites ambiguus*.

Dinoflagellates are also age diagnostic and include oldest *H. tasmaniense* and *Wetzeliella ornatum* without younger markers and indicate the *ornatum* dinoflagellate zone, correlative with the upper half of the upper *diversus* spore-pollen zone. The deeper sample contains common *Operculodinium* and *H. tasmaniense* while the shallower one contains few dinoflagellates with frequent

Operculodinium.

Environments are nearshore marine with dinoflagellate contents of 11% and 35% downhole. The freshwater alga *Botryococcus* is also common (14% and 21% downhole), indicating a strong lacustrine influence. Tidal lakes or estuaries seem likely environments. Pollen and spores dominate and are of high diversity.

Colourless palynomorphs indicate immaturity for hydrocarbons.

I 1544.0m(swc) : lower *diversus* Zone

Assignment to the lower *Malvacipollis diversus* spore-pollen zone is indicated at the top by the absence of younger indicators and at the base by oldest *Malvacipollis diversus* and *Periporopollenites demarcatus*. Common taxa are *Cyathidites minor*, *Dilwynites granulatus* and *Falcisporites similis*, and *Proteacidites* are frequent.

Dinoflagellates are rare but include *Deflandrea pachyceros*, usually restricted to the Early Eocene.

Marginally marine environments are indicated by the very low dinoflagellate content (<1%) and low diversity. Significant lacustrine influence is suggested by frequent freshwater *Botryococcus* (6%). Common cuticle and common and diverse spores and pollen indicate major terrestrial influence.

Colourless palynomorphs indicate immaturity for hydrocarbons.

J 1563.0m(swc), 1580.0m(swc), 1640.0m(swc), 1663.0m(swc) : upper *senectus* Zone (upper *australis* dino Zone)

Assignment to the upper *Nothofagidites senectus* Zone of early Campanian age is indicated at the top by the absence of younger markers and confirmed by dinoflagellate data and indicated at the base by oldest *Gambierina rudata*. This shows the total absences of the *lillei* to *balmei* Zones (mid Campanian to Paleocene) representing a major unconformity. Other significant top ranges related to this truncation include *Tricolpites confessus*, *G. rudata* and *Tricolpites sabulosus*. Within the interval, *Proteacidites* spp, *Cyathidites* spp and *Falcisporites* spp are all common with *Cicatricosisporites australiensis*, *Gleicheniidites* and *Nothofagidites senectus* all frequent. Minor Permian and Triassic reworking was seen in all samples.

Amongst the dinoflagellates, youngest *Xenascus ceratoides* (1580.0m) and *Xenikoon australis* (1640.0m) at the top and the absence of older markers at the base indicates the upper *X. australis* dinoflagellate zone. Youngest *Odontochitina porifera* (1580.0m), *Areosphaeridium suggestium* (1640.0m) and *Anthosphaeridium wisemaniae* (1663.0m) confirm the assignment. A single specimen of *Nelsoniella aceras* at 1640.0m is considered reworked. Amongst the rare dinoflagellates, *X. australis* and *X. ceratoides* are the most frequent.

Nearshore marine environments are indicated by the low dinoflagellate content (6%, 5%, 11% and 13% downhole) and their low diversity. The abundant and diverse pollen and spores indicate very strong terrestrial influence.

Yellow spore colours indicate immaturity for hydrocarbons.

K 1721.0m(swc), 1765.0m(swc), upper *senectus* Zone (lower *australis* dino zone)

Assignment to the upper *N. senectus* Zone of early Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *G. rudata T. confessus* and *T. sabulosus* occur consistently. *Proteacidites* spp, *Cyathidites* spp and *Falcisporites* spp are common. Minor Permian reworking was also seen.

Amongst the dinoflagellates, youngest *Nelsoniella aceras* and the major downhole influx of *X. australis* at the top indicate the lower *australis* dinoflagellate zone. *X. australis* is common in both samples with few or no other taxa.

Environments are nearshore marine with 24% and 25% dinoflagellates downhole, but very low diversity (3 and 1 species downhole). Pollen and spores are dominant and diverse.

Yellow palynomorphs indicate immaturity for hydrocarbon generation.

L 1823.0m(cutts), 1865.0m(swc) : middle *senectus* Zone (upper *aceras* dino zone)

Assignment to the middle *N. senectus* Zone of early Campanian age is indicated at the top by the absence of younger markers confirmed by dinoflagellate data and at the base by oldest *Tricolpites sabulosus*. *Falcisporites* are common, with *Cyathidites* and *Microcachryidites antarcticus* very frequent and *Proteacidites* frequent.

Amongst the dinoflagellates, *Nelsoniella tuberculata* to the top and base indicates the upper *aceras* dinoflagellate zone. Youngest *Odontochitina obesa* at 1865m indicates a point close to the base of the upper *aceras* Zone. Common is *X. australis* in both samples, as above. *Spiniferites* and *Heterosphaeridium* are frequent.

Nearshore marine environments are indicated by the low dinoflagellate content (28% and 33%) and low to moderate diversity.

Yellow spore colours indicate immaturity for hydrocarbons.

M 1891.0m(swc), 1949.0m(swc), 1979.0m(swc) : apparently upper *apoxyexinus* Zone

Assignment to the upper *Tricolporites apoxyexinus* Zone is suggested at the top by the absence of *N. senectus* and at the base by very rare *Amosopollis cruciformis*. However, *N. senectus* can be very rare near its oldest occurrence and study of a few extra swcs in this vicinity would be useful. The dinoflagellate data suggest that these samples might be lower *N. senectus* Zone. *Falcisporites* and *Cyathidites* are common while *Dilwynites granulatus* is very frequent (8-10%) in contrast with very rare (0-3%) above. *Proteacidites* are very frequent at 1891.0m (9%), but very rare (1%) below.

Amongst the dinoflagellates, consistent *N. aceras* and frequent to common *Heterosphaeridium* (8-16%) without *X. australis* indicates the *aceras* dinoflagellate zone and suggests the middle subzone. *Heterosphaeridium* spp are the common forms in all samples, with *N. aceras* frequent at 1891.0m and 1979.0m. *Heterosphaeridium* 20%+ is the marker for lower *aceras* zone but may be present between the swcs, missed by the absence of cuttings samples.

Nearshore marine environments are indicated by the low dinoflagellate content (22%, 12%, 25% downhole) and low to moderate diversity. *Botryococcus* is prominent at 1949.0m (3%) indicating significant lacustrine influence. Abundant mixed plant debris plus the abundant and diverse spores and pollen indicate the major terrestrial influence.

Light brown spore colours indicate early marginal maturity for hydrocarbons.

N 2004.0m(swc) : upper *apoxyexinus* Zone (upper *cretacea* dino zone)

Assignment to the upper *Tricolporites apoxyexinus* Zone of Santonian age is indicated at the top and base by the absence of younger and older markers respectively and confirmed by the dinoflagellates. Within the interval, spores and pollen are rare but *Falcisporites* and *Proteacidites* are the most frequent. *Amosopollis cruciformis* was not seen.

Of the dinoflagellates, youngest *Chatangiella victoriensis* and *Isabelidinium belfastense* and oldest *Isabelidinium cretacea* and *I. belfastense* indicate the upper *I. cretacea* dinoflagellate zone. Common taxa are *Heterosphaeridium* spp, *Cassidium* sp and *Trithyrodinium* spp. *Chatangiella tripartita* and *Odontochitina porifera* are prominent.

Intermediate marine environments are indicated by the high dinoflagellate content (84%) tempered by only moderate diversity.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

O 2020.0m(swc) : middle *apoxyexinus* Zone

Assignment to the middle *T. apoxyexinus* Zone of Santonian age is indicated at the top by the downhole influx of *A. cruciformis* (2% in contrast to absent in the sample above) and at the base by the absence of older markers. Common taxa are *Cyathidites minor*, *Dilwynites granulatus* and *Falcisporites similis*. A single *Appendicisporites distocarinatus* is considered reworked. Dinoflagellates are mostly nondescript and longranging and assignment to any zone is not possible.

Environments are intermediate marine with moderate dinoflagellate content (32%) but moderate diversity. Abundant cuticle and common and diverse spores and pollen reflect the strong terrestrial influence.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

P 2028.0m(swc), 2043.0m(swc), 2054.0m(swc), 2059.0m(swc), 2066.0m(swc), 2076.0m(core) : lower *apoxyexinus* Zone

Assignment to the lower *T. apoxyexinus* Zone of Santonian age is indicated at the top by the major downhole influx of *A. cruciformis* (18%, 14%, 14%, 3%, absent, 19% downhole compared with 2% above) and at the base by the base of this acme and absence of older indicators. Within the interval, *A. cruciformis* is the most common taxon, with *D. granulatus*, *Falcisporites* and *Cyathidites* also common. A single specimen of *A. distocarinatus* at 2059.0m(swc) may be reworked but single specimens of *A. distocarinatus* and *A. tricornitatus* at 2076.0m may represent the true top range. Dinoflagellates are not age diagnostic.

Environments are mostly nearshore marine (35%, 17%, 18%, 32%, 18% dinoflagellates downhole with moderate diversity) with a single very nearshore marine sample at the base (7% dinoflagellates with very low diversity). Common cuticle and dominant and diverse spores and pollen indicate strong terrestrial influence.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

Q **2086.1m(core), 2096.0m(core), 2111.5m(swc), 2118.0m(swc), 2145.0m(swc), 2159.0m(swc), 2164.0m(swc), 2166.0m(swc), 2179.0m(swc), 2199.0m(swc), 2232.0m(swc), 2252.0m(swc), 2270.0m(swc) : *mawsonii* Zone**

Assignment to the *Phyllocladidites mawsonii* Zone of Coniacian-Turonian age is indicated at the top by youngest consistent *A. distocarinatus* and at the base by oldest *P. mawsonii* supported by oldest *C. triplex*. Within the interval, common taxa are *Cyathidites* spp, *D. granulatus*, *Falcisporites* and *Microcachryidites*. *A. cruciformis* is frequent at the top (6% at 2086.1m, 5% at 2096.0m) but rare or absent beneath. *A. distocarinatus* is consistently present and is frequent at the base (5% at 2270.0m).

Dinoflagellates are mostly scarce but include youngest *Cribroperidinium edwardsii* consistent at 2252.0m and frequent at 2270.0m, indicating the *Palaeohystrichophora infusorioides* dinoflagellate zone. At 2118m a high diversity assemblage occurs and towards the base of the interval, (2230m and deeper), *Heterosphaeridium* are frequent to common.

Environments are mostly very nearshore at the top (7%, 3%, 6%, 56%, 9%, 1%, 6%, 4%, 8%, 6% low diversity dinoflagellates downhole with a single intermediate marine exception at 2118m) and nearshore at the base (49%, 19% and 29% moderate diversity dinoflagellates). Abundant cuticle and inertinite and dominant and diverse spores and pollen indicate dominant terrestrial influence.

Light brown spore colours indicate marginal maturity for oil and immaturity for gas/condensate.

R **2277.5(swc), 2284.0m(swc), 2286.0m(swc), 2309.0(swc), 2330.0m(swc), 2398.0m(swc), 2402.0m(swc), 2454.0m(swc), 2489.0m(swc), 2497.0m(swc), 2500.0m(swc), 2528.0m(swc), 2540.5m(swc), 2544.5m(swc), 2550m(cutts), 2567.0(swc), 2573m(cutts), 2593.0m(swc) : *distocarinatus* Zone**

Assignment to the *Appendicisporites distocarinatus* Zone of Cenomanian age is indicated at the top and base by the presence of *A. distocarinatus* in the absence of younger or older markers respectively. Within the interval, yields are variable with most samples rich and diverse but with lean and indeterminate assemblages at 2497.0m and 2540.5m. Saccate pollen dominate (*Falcisporites* spp and *Microcachryidites* common) with subordinate spores (*Cyathidites* and *Osmundacidites* frequent). *A. cruciformis* is extremely rare and inconsistent, being seen only at 2398.0m. *D. granulatus* is rare to frequent (1-6%) and *Cicatricosisporites australiensis* rare to absent (0-2%) in the upper half of the section (2277.5m-2528.0m), but *D. granulatus* is extremely rare to absent and *C. australiensis* consistent to frequent (1-7%) in the lower half of the section (2544.5m-2593.0m).

Dinoflagellates are rare and inconsistent but include *C. edwardsii* at 2277.5m, 2284.0m, 2286.0m, 2309.0m and 2402.0m indicating the *P. infusorioides* dinoflagellate zone. *C. edwardsii* and *C. deflandrei* are the most consistent taxa.

The upper part of the section (2277.5-2402m) is mostly nearshore marine with a marginal marine sample at 2286m (1% dinoflagellates), a non-marine one at 2330m and an intermediate marine one (57%) at 2309m. Dinoflagellate percentage contents from the top are 11%, 20%, 1%, 57%, absent, 22%, 22%. The lower part of the section (2454m-2593m) may all be non-marine, as almost all the dinoflagellates seen are in cuttings and are absent from the swcs. Dinoflagellate percentage contents from the top are absent, ?5% (cutts), extremely lean, ?1% (single specimen in swc), absent, barren, absent, ?3% (cutts), absent, ?3% (cutts), absent. *Botryococcus* is a minor component of most assemblages indicating minor lacustrine influence.

Light brown to mid brown spore colours at 2277.5-2330m indicate marginal maturity for oil but immaturity for gas/condensate. Mid brown to light brown spore colours at 2398-2593m indicate early maturity for oil and early marginal maturity for gas/condensate.

S **2605.0m(swc), 2624.0m(swc), 2640m(cutts), 2671.0m(swc), 2683.0m(swc), 2690m(cutts), 2705.0m(swc), 2715m(cutts), 2730.0m(swc), 2735m(cutts) : extremely lean and indeterminate : 2646.5m(swc) rich but zonally indeterminate.**

These assemblages (except 2646.5m) all come from sandy lithologies and are extremely lean of palynomorphs, although several contain frequent inertinite. Of the swcs, only 2683.0m contained sufficient specimens for a valid count of 100 speciments with saccate pollen (*Falcisporites*, *Microcachyidites*) being dominant. The cuttings contain richer assemblages including very rare dinoflagellates but are almost certainly caved. *A. distocarinatus* occurs only at 2624.0m in swc. The only suggestion of an older assemblage is that at 2715m (cutts) where a richer spore flora occurs including *C. australiensis* (5%), *Concavissimisporites penolaensis*, *Crybelosporites striatus*, *Foraminisporis asymmetricus*, *Triporoletes radiatus*, *T. reticulatus* and *T. simplex*. Key age diagnostic taxa such as *Pilosisporites grandis* and *Coptospora paradoxa* were not seen and so assignment to older zones is not possible. At 2646.5m(swc), a rich assemblage lacks markers for the basal Sherbrook or upper Otway groups, but includes the Aptian *Pilosisporites notensis* (considered reworked) and rare Permian taxa (reworked).

Environments are probably non-marine although very rare dinoflagellates were seen at 2605.0m(swc), 2715m(cutts) and 2735m(cutts) but these may be caved.

Spore colours are variable possibly due to caving and are considered unreliable for maturity determination.

IV CONCLUSIONS

At the top, the sampled section is Tertiary (Eocene to Oligocene and possibly Miocene), nearshore at the base and offshore at the top. Beneath a Maastrichtian to Paleocene unconformity a Cenomanian to Campanian mostly nearshore and partly non-marine sequence occurs. At the base, an undated sequence of argillaceous sandstones may belong to the Otway Group, but this cannot be confirmed by the palynology.

For generation of hydrocarbons, the section is early mature for oil at the base (below 3400m), marginally mature in the middle (below 1900m) and immature above.

V REFERENCES

Dettmann ME and Playford G (1969) Palynology of the Australian Cretaceous : a review **In** Stratigraphy and Palaeontology. Essays in honour of Dorothy Hill, **KSW Campbell ED.** ANU Press, Canberra 174-210

Helby RJ, Morgan RP and Partridge AD (1987) A palynological zonation of the Australian Mesozoic **In** Studies in Australian Mesozoic Palynology **Assoc. Australas. Palaeontols. Mem 4** 1-94

Morgan RP (1992) Overview of new cuttings based Late Cretaceous correlations, Otway Basin, Australia **unpubl. rept. for BHPP**

Partridge AD (1976) The geological expression of eustacy in the early Tertiary of the Gippsland Basin **APEA J 16(1)** 73-79.

LA BELLA # 1

MORGAN PALAEO ASSOCIATES . . . Palynological Consultants
Box 161, Maitland, South Australia, 5573.
Phone (088) 32 2795 . Fax (088) 32 2798

CLIENT: BHP PETROLEUM
WELL: LA BELLA #1
FIELD/AREA: OFF SHORE OTWAY BASIN

ANALYST: ROGER MORGAN
DATE : AUGUST '93
NOTES: ALL DEPTHS IN METRES
FIGURES ARE PERCENTAGES FROM 100 SPECIMEN COUNT
"X" = SEEN OUTSIDE COUNT
"XX" = COMMON OCCURENCE OUTSIDE COUNT "*" = REWORKED

RANGE CHART OF OCCURRENCES BY LOWEST APPEARANCE - by group -

	1 CIRCULODINIUM DEFLANDREI	2 EXOCHOSPHAERIDIUM PHRAGMITI	3 CHLAMYDOPHORELLA NYEI	4 CRIBROPERIDINIUM EDWARDSII	5 CRIBROPERIDINIUM sp	6 HETEROSPHAERIDIUM HETEROCA	7 CYCLONEPHELIUM MEMBRANIPHO	8 HETEROSPHAERIDIUM SOLIDA	9 OLIGOSPHAERIDIUM COMPLEX	10 PALAEOPERIDINIUM CRETACEUM	11 SPINIFERITES FURCATUS RAMO	12 TRICHODINIUM	13 CYCLONEPHELIUM COMPACTUM	14 HETEROSPHAERIDIUM CONJUNCTI	15 CALLAIOSPHAERIDIUM ASYMMETI	16 CLEISTOSPHAERIDIUM SP.	17 ODONTOCHITINA OPERCULATA	18 OLIGOSPHAERIDIUM PULCHERRI	19 VERYHACHIUM	20 NUMUS MONOCULATUS	21 XIPHOPHORIDIUM ALATUM	22 APECTODINIUM SUMMISIMUM	23 FLORENTINIA LACINIATA	24 HYSTRICHODINIUM PULCHRUM	25 KIOKANSIUM POLYPES	26 PTEROSPERMELLA AUSTRALIENSI	27 CHLAMYDOPHORELLA SP	28 ODONTOCHITINA COSTATA	29 APTEODINIUM SP.
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	.	.	32	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	.	.	.	.	.	10	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
1027.0 SWC	.	2	.	.	.	.	.	.	.	.	40	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	.	.	.	.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
1064.0 SWC	.	.	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	.	.	.	.	.	.	.	41	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	.	.	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1489.0 SWC	.	.	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1491.0 SWC	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1494.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1523.0 SWC	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	X	.	.	.	.	.	.	.
1544.0 SWC	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1563.0 SWC	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	2	1	.	.	.	X	.	.	.	.	.
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1640.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	.	.	.	.	.	1	.	.	2	.	4	1	.	X	.	.	X	.	.	.	.	.	.	.	1	.	.	.	.
1865.0 SWC	.	.	.	.	.	6	.	.	.	.	3	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
1891.0 SWC	.	.	.	.	.	16	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	.	1	.	.	.	.	.	3	.	.	X	.	.	.	.	1	X	.	.	.	.	.	.	.	X	.	.	.	.
1979.0 SWC	.	.	.	.	.	16	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2004.0 SWC	.	.	.	.	.	4	.	15	.	.	2	.	.	.	1	.	2	.	.	.	X	.	.	.	.	.	.	2	.
2020.0 SWC	.	1	.	.	1	11	.	.	3	.	7	.	.	1	1	.	1	2	1	.	.	.	.	X	1	.	.	.	.
2028.0 SWC	.	4	.	.	2	27	.	.	2	.	3	.	1	.	.	.	.	4	.	.	.	.	.	.	.	.	.	1	.
2028.0 swc	.	4	.	.	.	4	.	.	1	.	7	.	.	.	2	.	.	1	.	1	.	.	.	.	2	.	.	.	2
2043.0 SWC	.	.	.	.	.	6	.	2	.	.	3	.	.	.	.	.	1	.	.	2	.	.	.	.	.	.	.	.	3
2054.0 SWC	1	2	.	.	.	6	.	.	1	.	2	.	.	.	.	.	.	X	3	X	.	.	.	.	2	.	.	.	X
2059.0 SWC	2	4	.	.	.	6	.	.	1	.	1	1	.	.	.	.	3	.	1	3	.	.	.	.	2	.	.	.	3
2066.0 SWC	.	3	.	.	.	3	.	.	3	.	3	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	.	.	.	X	6	.	.	X	.	1	.	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.
2086.1 CORE	1	2	.	.	X	4	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	X	X	.	.	.	X	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	2	.	.	2	.	1	.	.	.	.	1	.	.	.	6	.	.	.	.	.	.	.	.	.
2118.0 SWC	5	6	1	X	.	3	.	.	6	.	3	1	.	1	.	2	3	2	.	6	.	.	.	.	6	.	.	.	.
2145.0 SWC	X	2	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	3	.	.	1	.	3	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	1	X	.	.	4	.	.	1	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
2179.0 SWC	4	.	.	.	1	X	.	.	.	.	1	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	X	3	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	X	.
2232.0 SWC	1	.	.	.	1	24	X	.	11	2	2	.	.	2	.	.	X	.	.	X	X	.	.	.	1	.	.	.	3
2252.0 SWC	.	1	1	.	1	10	.	.	X	2	1	.	.	1	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.
2270.0 SWC	5	.	.	4	X	5	.	.	2	XX	2	.	.	.	.	.	.	5	.	.	X	.	.	.	5	.	1	X	.
2277.5 SWC	1	X	.	1	1	1	X	.	1	1	1	.	X	.	.	.	X	.	.	1	1	.	1	1	1	X	.	.	.
2284.0 SWC	3	2	.	3	.	1	.	.	2	1	1	.	1	1	.	1	.	3	.	.	.	X	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	1	.	X	5	.	X	.	.	1	38	1	.	1	.	.	.	10	X	.	X	X	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	5	X	.	.	.	3	.	.	2	.	5	.	3	.	X	1	1	1	1	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	11	.	.	3	X	X	.	.	.	.	4	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	3	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	X	1	.	X	.	1	X	X	X	X	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	1	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	1	?	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	PALAEOHYSTRICHOSPHORA INFUSORIOIDES 30	SCHIZOSPORIS PARVUS 31	CANNINGIA SPINY 32	ISABELIDINIUM COOKSONIAE 33	MILLIOUDIDINIUM SP. 34	PARALECANIELLA INDENTATA 35	ISABELIDINIUM SP. 36	CIRCULODINIUM SOLIDA 37	MICRODINIUM SP 38	ALTERBIA ACUMINATUM 39	DICONODINIUM PUSILLUM 40	CORONIFERA OCEANICA 41	AREOSPHAERIDIUM SUGGESTIUM 42	APTEA SP 43	APTEODINIUM GRANULATUM 44	CASSIDIUM SP 45	CHATANGIELLA TRIPARTITA 46	CHATANGIELLA VICTORIENSIS 47	ISABELIDINIUM BELFASTENSE 48	ISABELIDINIUM CRETACEUM 49	ODONTOCHITINA PORIFERA 50	TRITHYRODINIUM SUSPECTUM 51	TRITHYRODINIUM THICK SCABRATE 52	TRITHYRODINIUM THICK VERMICULATE 53	TRITHYRODINIUM THICK VERRUCATE 54	TRITHYRODINIUM THIN PSILATE 55	CHATANGIELLA MICROCANTHA 56	EUCLADINIUM MADURENSUS 57	FROMEA FRAGILIS 58
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1027.0 SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1064.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1489.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
1491.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
1494.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
1523.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1544.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1563.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
1640.0 SWC	2	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	*	.	.	.	.	.	.	.	.
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	5	.	.	X	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	1	.	.	.	.	.	.	X	.
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.
1891.0 SWC	X	.	.	.	.	.	1	.	.	.	X	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	2	.	.	.
1979.0 SWC	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	X	X	1
2004.0 SWC	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	32	4	3	X	3	X	X	X	X	4	11	.	.	.
2020.0 SWC	.	.	.	.	.	.	.	X	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	2	.	X	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2043.0 SWC	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2054.0 SWC	.	.	.	X	.	.	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2059.0 SWC	.	.	.	4	1	.	.	X	.	3	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2118.0 SWC	.	.	X	9	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	NELSONIELLA ACERAS 59	ODONTOCHITINA CRIBROPODA 60	TRITHYRODINIUM THICK RETICULATE 61	HESLERTONIA STRIATA 62	MADURADINIUM PENTAGONUM 63	HETEROSPHAERIDIUM LATEROBRACHIUS 64	NELSONIELLA TUBERCULATA 65	ODONTOCHITINA OBESA 66	XENIKOON AUSTRALIS 67	ANTHOSPHAERIDIUM CONVOLVULOIDES 68	PTEROSPERMELLA AUREOLATA 69	FROMEA CHYTRA 70	ANTHOSPHAERIDIUM WISEMANIAE 71	DEFLANDREA SP. 72	XENASCUS CERATOIDES 73	TANYOSPHAERIDIUM SALPINX 74	CHATANGIELLA CF CRETACEA 75	CHATANGIELLA SP. 76	ISABELIDINIUM KOROJONENSE 77	ACHOMOSPHAERA RAMULIFERUM 78	DEFLANDREA PACHYCEROS 79	DIPHYES COLLIFERUM 80	OPERCULODINIUM 81	SYSTEMATOPHORA PLACACANTHUM 82	ACHOMOSPHAERA CRASSIPELLIS 83	APECTODINIUM HOMOMORPHUM 84	APECTODINIUM QUINQUILATUM 85	APTEODINIUM AUSTRALIENSE 86	CEREBROCYSTA SP 87
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	3	.	.	.	2	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	11	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.
1027.0 SWC	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	10	1	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1064.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	20	1	.	.	.	.	.
1151.0 SWC	X	.	.	.	1	.	.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	1	18	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	.
1264.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.
1364.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	.	.	.	.	.
1489.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	X
1491.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	X	.	.	.	.
1494.0 SWC	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	1	.	.	X	.	.	.	.	.	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.
1523.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	14	?	X	1	X	X	X
1544.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	X	?	.	.	.	.	.
1563.0 SWC	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	X	1	?	.	.	.	.	.	.	.	.	.	.
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1640.0 SWC	*	.	.	.	.	.	.	.	4	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.
1663.0 SWC	.	.	.	.	.	.	.	.	3	.	.	X	X	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1721.0 SWC	X	.	.	.	.	.	.	.	23	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	X	.	.	.	.	.	1	.	10	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1865.0 SWC	.	.	.	.	.	1	2	X	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1891.0 SWC	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	X	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1979.0 SWC	3	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2004.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2020.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2043.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	CORDOSPHAERIDIUM INODES 88	CYCLOPSIELLA 89	DEFLANDREA PHOSPHORITICA 90	DEFLANDREA TRUNCATA 91	HEMICYSTODINIUM ZOHARYI 92	HOMOTRYBLIUM TASMANIENSE 93	HYSTRICHOKOLPOMA EISENACKI 94	HYSTRICHOKOLPOMA RIGAUDIAE 95	IMPAGIDINIUM VICTORIANUM 96	MILLIOUDIDINIUM TENUITABULATUS 97	MURATODINIUM FIMBRIATUM 98	RHOMBODINIUM GLABRUM 99	SAMLANDIA CHLAMYDOPHORIDITES 100	SENONIASPHAERA SP 101	WETZELIELLA HAMPDENENSIS 102	WETZELIELLA ORNATUM 103	WETZELIELLA WAIPAWAENSIS 104	DAPSILIDINIUM PSEUDOCOLLIGERUM 105	IMPAGIDINIUM MACULATUM 106	GLAPHYRODINIUM VICINUM 107	KISSELOVIA THOMPSONAE 108	WETZELIELLA SP 109	ACHILLEODINIUM BIFORMOIDES 110	CORDOSPHAERIDIUM FIBROSPINOSUM 111	DAPSILIDINIUM PASTIELSI 112	DRACODINIUM SPONGY 113	HOMOTRIBLIUM BREVIRADIATUM 114	KISSELOVIA EDWARDSII 115	THALASSIPHORA PELAGICA 116
0635.0 SWC	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
0997.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1027.0 SWC	3	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
1040.0 SWC	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1064.0 SWC	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	.	5	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	X	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	X	X	.	.	.	.	.	.	.	.	.
1489.0 SWC	.	.	?	.	10	15	X	.	X	X	2	.	X	.	.	1	.	.	X	2	X	.	1	X	1	X	2	X	X
1491.0 SWC	.	.	?	2	7	.	1	.	.	.	.	.	.	.	.	X	.	.	.	X	X	?	.	.	.	.	.	.	.
1494.0 SWC	1	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1517.0 SWC	2	.	.	X	.	X	2	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	.	.
1523.0 SWC	4	X	?	X	1	9	X	X	X	1	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.
1544.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1563.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1640.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1891.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1979.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2004.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2020.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2043.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	WETZELIELLA PENTAGONAL 117	CHIROPTERIDIUM TABULATE 118	HYSTRICHOSPHAERIDIUM TUBIFERUM 119	IMPAGIDINIUM MARGINATA 120	IMPAGIDINIUM SP 121	TECTATODINIUM 122	PHTANOPENIDINIUM COMATUM 123	CORRUDINIUM INCOMPOSITUM 124	LINGULODINIUM MACHAEROPHORUM 125	NELSONIELLA SEMIRETICULATA 126	PALAEOCYSTIDINIUM AUSTRALINIUM 127	AREOLIGERA SP 128	OPERCULODINIUM CENTROCARPUM 129	CRASSOSPHAERA CONCINNIA 130	IMPLETOSPHAERIDIUM SP.1 131	ACHOMOSPHAERA ALCICORNU 132	CHIROPTERIDIUM ASPINATUM 133	CHIROPTERIDIUM DISPERSUM GP. 134	COMPOSITOSPHAERIDIUM SP. 135	HYSTRICHOKOLPOMA SP. 136	SCHEMATOPHORA SPECIOSUS 137	BATIACASPAERA SP. 138	CASSICULOSPHAERIDIA SP. 139	AEQUITRIRADITES TILCHAENESIS 140	ARAUCARIACITES AUSTRALIS 141	ARAUCARIACITES FISSUS 142	CALLIALASPORITES DAMPIERI 143	CALLIALASPORITES TURBATUS 144	CICATRICOSISPORITES AUSTRALIENSIS 145
0635.0 SWC	.	.	.	.	.	5	.	.	.	.	.	.	8	X	X	2	.	.	.	.	.	.	1	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	3	.	.	.	.	.	.	12	.	.	40	.	.	.	.	3	12	8	.	.	.	X	.	.
0832.0 SWC	.	.	.	.	.	X	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	4	.	.	1	.	.	.	9	.	6	2	2	21	.	X	1	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	1	.	.	.	.	.	.	3	.	.	2	.	.	.	.	.	.	.	.	3	.	.	.	.
1027.0 SWC	.	.	.	.	.	.	.	.	1	.	.	2	9	.	.	4	X	2	5	4	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	7	.	.	.	.	.	X	.	X	1	.	.	.	.	.	.	.	.	.	X	.	.	.	.
1064.0 SWC	.	.	.	.	.	.	1	.	1	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
1115.0 SWC	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	1	.	.	.	X	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.
1264.0 SWC	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.
1489.0 SWC	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1491.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1494.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
1523.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1544.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	X
1563.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	X	.	X
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
1640.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	4
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	4
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	1
1823 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
1891.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	1
1979.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2
2004.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2020.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
2043.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	X
2066.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	3	.	.
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	3
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	1	.	1
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	2
2166.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	X	1	2
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	X
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	2	4	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	X
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	3	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	1	2	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	3
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	1	1	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	8	2	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	3	X
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	1	3	7
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	3	.	5	1	1
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	5	.	2	1	6
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	4	3	1
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	5	1	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	8	5	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	1	2
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	4	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	4	2	3
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	X	.	X
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	1	3	5
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	L	4	1	4	10	2

	COROLLINA TOROSUS 146	CYATHIDITES AUSTRALIS 147	CYATHIDITES MINOR 148	CYCADOPITES FOLLICULARIS 149	FALCISPORITES GRANDIS 150	FALCISPORITES SIMILIS 151	KLUKISPORITES SCABERIS 152	MICROCACHRYIDITES ANTARCTICUS 153	OSMUNDACIDITES WELLMANII 154	PEROTRILETES JUBATUS/MORGANII 155	RETITRILETES AUSTROCLAVATIDITES 156	STERIESPORITES ANTIQUASPORITES 157	AEQUITRIRADITES VERRUCOSUS 158	CINGUTRILETES CLAVUS 159	CONCAVISSIMISPORITES PENOLAENSIS 160	CRYBELOSPORITES STRIATUS 161	FORAMINISPORIS ASYMMETRICUS 162	FOVEOTRILETES PARVIRETUS 163	ISCHYOSPORITES PUNCTATUS 164	TRIPOROLETES RADIATUS 165	TRIPOROLETES RETICULATUS 166	TRIPOROLETES SIMPLEX 167	APPENDICISPORITES DISTOCARINATUS 168	CERATOSPORITES EQUALIS 169	CONTIGNISPORITES GLEBULENTUS 170	GLEICHENIIDITES 171	PODOSPORITES MICROSACCATUS 172	CICATRICOSISPORITES CUNEIFORMIS 173	FOVEOGLEICHENIIDITES 174
0635.0 SWC	.	.	9	.	7	.	.	2	1	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
0695.0 SWC	.	.	10	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	15	.	.	13	.	4	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.
1027.0 SWC	.	.	3	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	7	.	.	2	.	.	8	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
1064.0 SWC	.	1	9	.	.	15	.	6	1	.	3	.	.	.	.	.	.	.	.	.	.	.	.	3	.	1	.	.	.
1115.0 SWC	.	1	1	.	.	.	.	1	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	X	3	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.	.
1200.5 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	X	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	X	X	.	.	X	.	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	X	X	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	X	X	.	X	X	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.
1489.0 SWC	.	1	3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.
1491.0 SWC	.	4	2	.	1	2	.	X	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.
1494.0 SWC	.	4	3	.	2	8	.	2	.	.	2	.	.	X	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.
1517.0 SWC	X	2	7	.	3	1	.	2	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1523.0 SWC	1	.	2	.	2	2	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1544.0 SWC	.	5	11	.	5	17	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	1	.	X
1563.0 SWC	1	6	6	.	3	20	.	5	1	.	6	.	.	X	.	.	.	.	.	.	1	.	.	3	.	3	5	.	.
1580.0 SWC	1	18	.	.	.	24	.	5	2	.	3	.	.	.	.	.	R/W	.	.	.	X	.	.	2	.	2	.	.	.
1640.0 SWC	.	17	.	.	.	14	.	2	2	.	6	.	.	.	.	.	.	.	.	2	2	.	.	8	.	3	.	.	.
1663.0 SWC	1	13	.	.	.	18	.	3	5	.	3	.	.	.	.	.	.	.	.	1	2	.	.	2	.	5	.	.	.
1721.0 SWC	1	18	.	.	.	17	.	1	3	.	2	.	.	.	.	.	.	.	.	1	.	.	.	2	.	5	.	.	.
1765.0 SWC	.	20	.	.	.	18	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	1	.	.	.
1823 CUTTS	1	6	3	.	5	25	.	1	2	.	2	1	.	1	.	.	1	.	.	.	.	.	.	.	.	3	3	.	.
1865.0 SWC	X	4	6	X	1	22	.	8	3	.	3	X	.	X	.	.	.	.	.	.	X	.	.	1	.	3	1	.	.
1891.0 SWC	.	21	.	.	23	.	.	2	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	1	5	8	1	13	11	.	6	6	.	3	1	.	.	.	.	.	.	.	.	.	.	.	5	.	4	1	.	.
1979.0 SWC	.	3	6	.	4	16	.	15	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	.
2004.0 SWC	.	2	1	.	1	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.
2020.0 SWC	4	1	10	1	1	15	.	6	X	.	X	X	.	X	.	.	.	.	.	.	.	.	X	.	.	4	2	.	.
2028.0 SWC	.	11	.	.	.	16	.	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
2028.0 swc	1	1	4	1	4	12	.	10	1	.	1	1	.	1	.	.	.	.	.	.	.	.	.	1	.	2	5	.	.
2043.0 SWC	.	3	6	1	3	17	.	5	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3	.	.
2054.0 SWC	1	2	5	.	2	16	.	6	3	.	1	.	.	1	.	.	.	.	.	X	.	.	.	1	.	2	1	.	.
2059.0 SWC	3	1	8	1	3	13	.	3	1	.	1	.	.	X	.	.	.	.	.	.	.	.	X	1	.	1	4	.	.
2066.0 SWC	1	7	15	.	2	20	.	9	6	.	1	2	.	X	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
2076.0 CORE	1	8	7	.	5	11	.	12	1	X	.	.	.	.	.	.	.	.	.	.	.	.	:	1	.	3	8	.	.
2086.1 CORE	2	7	11	.	6	12	.	22	X	X	1	1	.	.	.	.	X	.	X	.	.	.	X	.	.	5	5	.	.
2096.0 CORE	1	2	19	.	.	23	.	8	1	.	2	.	.	.	.	.	.	.	.	.	.	.	2	.	.	5	.	.	.
2111.5 SWC	1	6	7	.	7	24	.	9	9	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	5	5	.	.
2118.0 SWC	3	2	3	1	5	12	.	4	1	.	1	.	.	.	.	.	.	.	.	.	.	.	X	.	.	3	.	.	.
2145.0 SWC	.	5	7	.	3	15	.	7	3	.	1	2	.	.	.	.	.	.	.	.	.	.	2	.	.	5	2	.	.
2159.0 SWC	1	6	12	1	6	23	.	10	17	.	1	1	.	1	.	.	.	.	.	.	.	.	.	2	.	4	.	.	.
2164.0 SWC	4	7	16	.	5	22	.	11	8	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	3	3	.	.
2166.0 SWC	2	3	13	1	6	25	.	13	5	.	1	.	.	.	.	.	1	.	.	.	.	.	X	.	.	4	1	.	.
2179.0 SWC	1	5	3	.	5	18	.	18	6	.	X	X	.	.	.	.	.	.	.	.	.	.	X	.	.	1	.	.	.
2199.0 SWC	.	43	.	.	.	26	.	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	X	2	.	3	.	.	.
2232.0 SWC	.	2	10	.	4	7	1	5	1	.	1	.	.	1	.	.	.	.	.	.	.	.	1	1	.	1	3	.	.
2252.0 SWC	3	4	10	1	8	15	.	6	1	.	1	1	.	.	.	.	.	.	.	.	.	.	X	.	.	8	.	.	.
2270.0 SWC	1	28	.	.	.	17	.	4	.	.	.	.	.	.	.	.	.	.	.	.	X	.	5	.	.	.	.	.	.
2277.5 SWC	1	4	19	1	2	12	.	14	3	.	1	1	X	1	.	.	.	.	.	.	X	.	1	1	.	4	4	.	.
2284.0 SWC	2	4	12	.	4	19	.	14	1	.	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.
2286.0 SWC	1	12	12	.	9	17	.	9	11	.	6	1	.	.	.	.	.	.	X	X	.	.	X	1	.	4	3	.	.
2309.0 SWC	1	1	3	1	1	10	.	6	1	.	1	3	.	.	X	.	.	.	.	.	X	.	.	1	.	1	2	.	.
2330.0 SWC	4	7	6	1	11	21	1	18	5	X	6	.	X	1	.	.	.	.	.	.	.	.	1	1	.	2	2	.	.
2398.0 SWC	X	4	6	.	11	22	.	16	1	.	3	1	.	.	.	.	.	X	X	.	X	.	X	.	.	4	1	.	.
2402.0 SWC	2	5	7	1	9	10	.	8	7	X	2	.	.	.	.	.	.	.	.	.	.	.	2	1	.	3	.	.	.
2454.0 SWC	3	3	11	2	7	26	.	10	7	1	6	1	.	.	.	.	X	.	3	.	.	.	X	.	.	2	2	.	.
2489 CUTTS	3	8	4	.	13	25	3	.	12	.	3	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	.	.	.
2497.0 SWC	X	X	X	.	X	X	.	XX	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	9	11	X	18	15	.	10	6	.	4	2	X	.	.	.	1	.	2	.	.	.	1	6	X	2	.	.	.
2528.0 SWC	1	6	6	1	7	47	.	7	2	.	4	X	.	.	1	.	.	.	.	.	.	.	X	1	.	4	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	4	3	.	6	12	.	30	4	.	.	.	.	.	.	.	.	.	.	1	3	.	1	2	.	1	11	.	.
2550 CUTTS	.	10	3	1	15	28	2	14	2	1	6	.	.	.	.	.	1	.	.	X	1	.	1	1	.	.	.	.	.
2567.0 SWC	1	9	11	.	13	11	.	16	9	.	6	2	X	.	.	.	X	.	X	.	.	.	.	1	.	1	1	1	.
2573 CUTTS	1	17	6	2	10	25	2	11	5	.	4	1	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.
2593 CUTTS	4	8	13	.	22	25	X	6	4	.	3	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.
2605.0 SWC	X	XX	XX	.	XX	XX	.	X	XX	.	X	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.
2624.0 SWC	.	XX	X	.	XX	X	.	X	X	.	X	X	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	.
2640 CUTTS	3	9	4	.	15	20	.	13	7	.	3	.	.	.	.	.	.	.	.	1	.	.	.	1	.	1	.	.	.
2646.5 SWC	1	4	10	1	11	38	1	7	6	.	3	.	.	1	.	.	.	.	1	.	.	.	.	2	.	1	.	X	.
2671.0 SWC	X	X	XX	.	XX	XX	.	X	X	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.
2683.0 SWC	2	9	14	1	20	22	.	4	6	.	3	.	.	1	.	.	.	.	.	.	.	.	.	2	.	5	1	.	.
2690 CUTTS	3	9	6	.	30	17	.	3	7	.	2	2	.	.	.	.	.	.	.	.	2	.	.	.	.	2	.	X	2
2705.0 SWC	X	X	X	.	XX	XX	.	XX	XX	.	X	.	.	.	.	.	.	.	.	.	.	.	?	X	X	X	X	.	.
2715 CUTTS	3	12	6	2	17	18	1	10	1	.	1	.	X	X	X	2	X	1	X	1	4	1	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	1	9	11	3	6	24	1	8	5	1	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	175 CYCLOSPORITES HUGHESI	176 DICTYOTOSPORITES SPECIOSUS	177 FORAMINISPORIS DAILYI	178 LYCOPODIACIDITES ASPERATUS	179 PILOSISPORITES NOTENSIS	180 VITREISPORITES PALLIDUS	181 DICTYOPHYLLIDITES	182 LEPTOLEPIDITES VERRUCATUS	183 SESTROSPORITES PSEUDOALVEOLATUS	184 PROTEACIDITES SP.	185 TRIPOROLETES BIRETICULATUS	186 RETITRILETES CIRCOLUMENUS	187 PHYLLOCLADIDITES MAWSONII	188 CICATRICOSISPORITES LUDBROOKIAE	189 COPTOSPORA PILEOSA	190 AEQUITRIRADITES SPINULOSUS	191 CAMEROZONOSPORITES LATROBENSIS	192 DILWYNITES GRANULATUS	193 PHYLLOCLADIDITES EUNUCHUS	194 RETITRILETES FACETUS	195 RETITRILETES NODOSUS	196 FORAMINISPORIS WONTHAGGIENSIS	197 DICTYOTOSPORITES COMPLEX	198 DILWYNITES TUBERCULATUS	199 VELOSPORITES TRIQUETRUS	200 AMOSOPOLLIS CRUCIFORMIS	201 ANTULSPORITES VARIGRANNULATUS	202 LAEVIGATOSPORITES OVATUS	203 CONTIGNISPORITES COOKSONIAE
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	10	.	.	.	.	.	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.
1027.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	17	.	.	.	X	.	.	.	.	.	3	.
1064.0 SWC	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	8	.	.	.	.	.	2	.	.	.	2	.
1115.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	1	.	.	.	3	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1489.0 SWC	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	10	.	.	.	.	.	.	.	.	.	2	.
1491.0 SWC	.	.	.	1	.	1	.	.	.	11	.	.	1	.	.	.	.	13	.	.	.	.	.	.	.	.	.	.	.
1494.0 SWC	.	.	.	.	.	.	.	.	.	15	.	.	1	.	.	.	.	10	.	.	.	.	.	.	.	.	.	X	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	13	.	.	1	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
1523.0 SWC	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.
1544.0 SWC	.	.	.	.	.	.	.	X	.	8	.	.	X	.	.	.	.	17	.	.	.	.	.	.	.	.	.	X	.
1563.0 SWC	.	1	1	.	.	1	.	.	.	6	.	.	1	.	.	1	.	3	.	.	.	.	.	.	.	3	.	X	.
1580.0 SWC	.	.	.	.	.	.	2	.	.	23	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
1640.0 SWC	.	.	.	.	*	.	4	1	.	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*
1663.0 SWC	*	*	.	.	.	.	2	.	.	16	.	.	X	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	X
1721.0 SWC	.	.	.	.	.	.	.	X	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	X	.	21	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	.	X	.	.	.	.	.	.	.	1	.	.	X	.	.	.	.	6	.	.	.	.	.	.	.	1	.	1	.
1865.0 SWC	.	.	2	.	.	X	.	.	.	.	.	.	2	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.
1891.0 SWC	.	.	.	.	.	.	.	X	.	9	.	.	.	.	.	.	.	10	.	.	.	.	.	.	.	1	.	.	.
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	8	.	.	.	.	.	.	.	2	1	.	.
1979.0 SWC	.	.	.	.	.	1	.	.	.	1	.	.	2	1	.	.	.	9	1	.	.	.	.	.	.	X	.	.	.
2004.0 SWC	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
2020.0 SWC	.	.	.	X	.	1	.	X	.	.	.	X	.	X	.	.	.	17	.	X	.	.	.	.	.	2	X	.	.
2028.0 SWC	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	18	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	.	.	.	.	.	10	.	.	1
2043.0 SWC	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.	.	14	.	.	.
2054.0 SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	22	.	.	.	.	.	.	.	14	.	.	.
2059.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	21	.	.	.	.	.	.	.	3	.	.	.
2066.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	1	.	.	.	.	5	1	.	.	.	.	.	.	.	.	1	.
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	13	.	.	.	.	.	.	.	19	.	.	.
2086.1 CORE	.	.	X	X	.	.	.	.	.	.	.	.	.	X	.	.	.	13	.	.	.	X	.	.	.	6	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	15	.	.	.	.	.	.	.	5	2	1	.
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	2	.
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	.	3	.	.	.	.	.	.	.	.	1	1	.	.	.	15	.	.	.	.	.	.	.	1	.	4	.
2159.0 SWC	.	.	.	2	.	.	.	2	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	3	.	1	1	.	.	.	.	.	1	.	.	.	.	4	2	.	.	.	.	.	.	X	.	X	1
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	23	X	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	6	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	.	.	.	1	.	2	.	.	.	.	.	.	1	X	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	*	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	10	.	.	.	.	.	.	.	1	.	.	1
2277.5 SWC	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	11	1	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	?	.	.	.	.	6	1	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3	.	.	.	.	.	.	.	.	.	1
2330.0 SWC	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	5	X	1	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	X	.	X	.
2402.0 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	1	.	.
2454.0 SWC	.	.	.	X	.	X	.	1	.	.	.	.	.	.	X	.	.	.	1	.	.	.	X	4	X	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	X	.	X	.	.	.	.	X	1	.	.	.	.	.	.	.	.	4	?	.	.	1	.	.	.	.	.	.	.
2528.0 SWC	1	.	.	.	X	X	.	.	.	.	.	.	.	.	.	1	5	6	X	X	X	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	1	.	?	.	.	.	.	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	1	.	2	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	X	.	.	.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	1	1	X	X	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	CICATRICOSISPORITES RADIATUS 204	APPENDICISPORITES TRICORNITATUS 205	CLAVIFERA TRIPLEX 206	TRICOLPITES 207	AUSTRALOPOLLIS OBSCURUS 208	CORONATISPORA PERFORATA 209	LILIACIDITES SP. 210	TRILOBOSPORITES TRIORETICULOSUS 211	INTERULOBITES INTRAVERRUCATUS 212	BALMEISPORITES HOLODICTYUS 213	PEROTRILETES MAJUS 214	CAMEROZONOSPORITES SP 215	TRICOLPITES VARIVERRUCATUS 216	COPTOSPORA PARADOXA 217	PROTEACIDITES SP. LARGE 218	CAMEROZONOSPORITES OHAIENSIS 219	CICATRICOSISPORITES HUGHESI 220	LYGISTIPOLLENITES FLORINII 221	TRICOLPITES CONFESSUS 222	TRICOLPITES SABULOSUS 223	TRICOLPORITES GILLI 224	GAMBIERINA RUDATA 225	NEORAISTRICKIA 226	NOTHOFAGIDITES SENECTUS 227	PEROTRILETES SP 228	BEAUPREADITES VERRUCOSUS 229	GAMBIERINA EDWARDSI 230	LYGISTIPOLLENITES BALMEI 231	NOTHOFAGIDITES ENDURUS 232
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	7	.	.	.	.	.	.	.	.	.	.	.
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	3	.	.	.	.	.	.	.	.	.	.	.
1027.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
1064.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1340.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1489.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	X	.	.	.
1491.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
1494.0 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
1517.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1523.0 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
1544.0 SWC	.	.	2	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1563.0 SWC	.	.	2	.	X	.	.	.	.	1	.	.	.	.	4	1	.	X	.	2	X	X	.	1	.	.	X	.	X
1580.0 SWC	.	.	2	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	4	.	.	.	.	.
1640.0 SWC	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	1	1	3	.	.	.	1	.
1663.0 SWC	.	.	3	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	?	.	X	1	6	.	X	?	1	.
1721.0 SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	?	.	X	1	5	X	.	.	.	.
1765.0 SWC	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.
1823 CUTTS	.	.	.	.	1	.	.	.	.	.	.	.	.	X	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	X	.	.	1	.	.	.	.	.	.	.	.	.
1891.0 SWC	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	.	.	2	.	X	.	.	.	.	.	.	.	.	.	1	X	X	1	?	.	.	.	.	.	.	.	.	.	.
1979.0 SWC	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2004.0 SWC	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2020.0 SWC	.	.	X	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2043.0 SWC	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0 SWC	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	X	1	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2086.1 CORE	X	.	.	.	X	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2118.0 SWC	.	.	1	.	.	.	X	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	1	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2179.0 SWC	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2277.5 SWC	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	PERIPOROPOLLENITES POLYORATUS 233	TRICOLPORITES LONGUS 234	ERICIPITES SCABRATUS 235	HALORAGACIDITES HARRISII 236	MALVACIPOLLIS DIVERSUS 237	MALVACIPOLLIS SUBTILIS 238	NOTHOFAGIDITES BRACHYSPINULOSUS 239	NOTHOFAGIDITES FLEMINGII 240	PERIPOROPOLLENITES DEMARCATUS 241	PROTEACIDITES BUN GRANDIS 242	PROTEACIDITES GRANDIS 243	PROTEACIDITES INCURVATUS 244	PROTEACIDITES SCABORATUS 245	STERIESPORITES PUNCTATUS 246	TETRACOLPORITES VERRUCOSUS 247	TRICOLPORITES ESTOUTUS 248	TRILETES TUBERCULIFORMIS 249	ANACOLOSIDITES LUTEOIDES 250	CUPANEIDITES ORTHOTEICHUS 251	INTRATRIPOROPOLLENITES NOTABILIS 252	PROTEACIDITES ASPEROPOLUS 253	PROTEACIDITES ORNATUM 254	PROTEACIDITES PACHYPOLUS 255	PROTEACIDITES TUBERCULIFORMIS 256	TRIPOROPOLLENITES AMBIGUUS 257	MYRTACEIDITES PARVUS 258	MYRTACEIDITES TENUIS 259	NOTHOFAGIDITES DEMINUTUS 260	NOTHOFAGIDITES EMARCIDUS 261
0635.0 SWC	.	.	.	11	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
0695.0 SWC	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0832.0 SWC	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0896.5 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
0997.0 SWC	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1027.0 SWC	.	.	.	X	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040.0 SWC	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	9
1064.0 SWC	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.
1115.0 SWC	.	.	.	7	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	7
1151.0 SWC	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1255.0 SWC	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
1264.0 SWC	.	.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	X
1340.0 SWC	.	.	.	X	.	.	X	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	X	.	.	.	.	.	X
1364.0 SWC	X	.	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1489.0 SWC	.	.	.	8	1	5	.	.	.	.	X	.	.	1	.	.	.	.	1	.	1	X	1	.	.	X	.	.	.
1491.0 SWC	.	.	1	21	1	5	.	.	.	.	X	X	.	.	.	.	1	.	.	.	X	X	3	.	.	11	1	.	1
1494.0 SWC	.	.	X	10	1	7	.	X	1	.	X	.	.	.	.	.	2	.	X	.	X	X	2	.	.	1	1	2	X
1517.0 SWC	.	.	.	16	3	5	1	.	X	.	.	X	.	.	.	.	1	.	1	X	.	1	2	1	.	3	X	1	1
1523.0 SWC	.	.	.	4	2	7	.	.	.	.	?	.	.	.	.	.	.	X	1	X	.	1	X	X	1	.	.	.	.
1544.0 SWC	X	.	2	1	2	1	2	1	X	1	X	X	X	2	?	X	X	.	.	.	.	.	.	.	.	.	.	.	.
1563.0 SWC	1	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1640.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1823 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1891.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1979.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2004.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2020.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2043.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2096.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2166.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	POLYCOLPITES ESOBALTEUS	SANTALUM CAINOZOICUS	TRICOLPORITES	MALVACIPOLLIS GRANDIS	PROTEACIDITES ANNULARIS	VERRUCOSISPORITES KOPUKUENSIS	PROTEACIDITES LEIGHTONI	TRIORITES MAGNIFICUS	DRYPTOPOLLENITES SEMILUNATUS	NOTHOFAGIDITES FALCATA	PROTEACIDITES RECTOMARGINUS	CYATHEACIDITES ANNULATUS	HERKOSPORITES ELLIOTTII	BANKSIEACIDITES ARCUATUS	MYRTACEIDITES VERRUCOSUS	NOTHOFAGIDITES ASPERUS	BOTRYOCOCCUS	CAUCA SP	NUMMUS MONOCULATUS	NUMMUS SP	REWORKING - TRIASSIC	REWORKING - PERMIAN	REWORKING - JURASSIC	REWORKING - CRETACEOUS	
	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	
0635.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	0635.0 SWC
0695.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0695.0 SWC
0832.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0832.0 SWC
0896.5 SWC	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0896.5 SWC
0997.0 SWC	.	.	.	.	.	.	.	.	.	1	2	X	1	3	.	.	.	.	.	.	.	.	.	.	0997.0 SWC
1027.0 SWC	.	.	.	X	.	.	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	1027.0 SWC
1040.0 SWC	.	.	.	.	.	.	.	.	.	3	.	.	.	X	.	.	6	.	.	.	.	.	.	.	1040.0 SWC
1064.0 SWC	.	.	.	.	.	.	.	.	.	1	1	1	1	.	.	.	9	.	.	.	.	1	.	.	1064.0 SWC
1115.0 SWC	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	1115.0 SWC
1151.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	1151.0 SWC
1200.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1200.5 SWC
1255.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1255.0 SWC
1264.0 SWC	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1264.0 SWC
1340.0 SWC	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1340.0 SWC
1364.0 SWC	.	.	.	.	.	.	X	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1364.0 SWC
1489.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	1489.0 SWC
1491.0 SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	1491.0 SWC
1494.0 SWC	.	2	.	1	X	.	.	.	.	.	.	.	.	.	.	.	16	.	.	.	.	.	.	.	1494.0 SWC
1517.0 SWC	X	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	1517.0 SWC
1523.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	21	.	.	.	.	.	.	.	1523.0 SWC
1544.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	1544.0 SWC
1563.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	X	X	.	X	1563.0 SWC
1580.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	.	1580.0 SWC
1640.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1640.0 SWC
1663.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	1663.0 SWC
1721.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1721.0 SWC
1765.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1765.0 SWC
1823 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	1823 CUTTS
1865.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	1865.0 SWC
1891.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1891.0 SWC
1949.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	1949.0 SWC
1979.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	1979.0 SWC
2004.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2004.0 SWC
2020.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	2020.0 SWC
2028.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2028.0 SWC
2028.0 swc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2028.0 swc
2043.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	2043.0 SWC
2054.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2054.0 SWC
2059.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2059.0 SWC
2066.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2066.0 SWC
2076.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2076.0 CORE
2086.1 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2086.1 CORE
2096.0 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	1	.	.	.	.	2096.0 CORE
2111.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2111.5 SWC
2118.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2118.0 SWC
2145.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2145.0 SWC
2159.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2159.0 SWC
2164.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2164.0 SWC
2166.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2166.0 SWC
2179.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	1	X	.	.	.	.	2179.0 SWC
2199.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2199.0 SWC
2232.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2232.0 SWC
2252.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2252.0 SWC
2270.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2270.0 SWC
2277.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2277.5 SWC
2284.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	2284.0 SWC
2286.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2286.0 SWC
2309.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2309.0 SWC
2330.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	2330.0 SWC
2398.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2398.0 SWC
2402.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	X	.	*	*	.	.	2402.0 SWC
2454.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	X	.	.	.	2454.0 SWC
2489 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2489 CUTTS
2497.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2497.0 SWC
2500.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2500.0 SWC
2528.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	2528.0 SWC
2540.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2540.5 SWC
2544.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2544.5 SWC
2550 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.	2550 CUTTS
2567.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	X	.	.	.	.	.	.	2567.0 SWC
2573 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2573 CUTTS
2593 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	X	.	.	2593 CUTTS
2605.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	2605.0 SWC
2624.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	2624.0 SWC
2640 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	2640 CUTTS
2646.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	1	.	.	2646.5 SWC
2671.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2671.0 SWC
2683.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	.	.	.	2683.0 SWC
2690 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2690 CUTTS
2705.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	2705.0 SWC
2715 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2715 CUTTS
2730.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2730.0 SWC
2735 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2735 CUTTS

SPECIES LOCATION INDEX

Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
.0	ACHILLEODINIUM BIFORMOIDES
.32	ACHOMOSPHAERA ALCICORNU
83	ACHOMOSPHAERA CRASSIPELLIS
78	ACHOMOSPHAERA RAMULIFERUM
190	AEQUITRIRADITES SPINULOSUS
140	AEQUITRIRADITES TILCHAENESIS
158	AEQUITRIRADITES VERRUCOSUS
39	ALTERBIA ACUMINATUM
200	AMOSOPOLLIS CRUCIFORMIS
250	ANACOLOSIDITES LUTEOIDES
68	ANTHOSPHAERIDIUM CONVOLVULOIDES
71	ANTHOSPHAERIDIUM WISEMANIAE
201	ANTULSPORITES VARIGRANNULATUS
84	APECTODINIUM HOMOMORPHUM
85	APECTODINIUM QUINQUILATUM
22	APECTODINIUM SUMMISIMUM
168	APPENDICISPORITES DISTOCARINATUS
205	APPENDICISPORITES TRICORNITATUS
43	APTEA SP
86	APTEODINIUM AUSTRALIENSE
44	APTEODINIUM GRANULATUM
29	APTEODINIUM SP.
141	ARAUCARIACITES AUSTRALIS
142	ARAUCARIACITES FISSUS
128	AREOLIGERA SP
42	AREOSPHAERIDIUM SUGGESTIUM
208	AUSTRALOPOLLIS OBSCURIS
213	BALMEISPORITES HOLODICTYUS
275	BANKSIEACIDITES ARCUATUS
138	BATIACASPAERA SP.
229	BEAUPREADITES VERRUCOSUS
278	BOTRYOCOCCUS
15	CALLAOISPHAERIDIUM ASYMMETRICUM
143	CALLIALASPORITES DAMPIERI
144	CALLIALASPORITES TURBATUS
191	CAMEROZONOSPORITES LATROBENSIS
219	CAMEROZONOSPORITES OHAIENSIS
215	CAMEROZONOSPORITES SP
32	CANNINGIA SPINY
139	CASSICULOSPHAERIDIA SP.
45	CASSIDIUM SP
279	CAUCA SP
169	CERATOSPORITES EQUALIS
87	CEREBROCYSTA SP
75	CHATANGIELLA CF CRETACEA
56	CHATANGIELLA MICROCANTHA
76	CHATANGIELLA SP.
46	CHATANGIELLA TRIPARTITA
47	CHATANGIELLA VICTORIENSIS
33	CHIROPTERIDIUM ASPINATUM
.34	CHIROPTERIDIUM DISPERSUM GP.
118	CHIROPTERIDIUM TABULATE
3	CHLAMYDOPHORELLA NYEI
27	CHLAMYDOPHORELLA SP
145	CICATRICOSISPORITES AUSTRALIENSIS
173	CICATRICOSISPORITES CUNEIFORMIS
220	CICATRICOSISPORITES HUGHESI
188	CICATRICOSISPORITES LUDBROOKIAE
204	CICATRICOSISPORITES RADIATUS
159	CINGUTRILETES CLAVUS
1	CIRCULODINIUM DEFLANDREI
37	CIRCULODINIUM SOLIDA
206	CLAVIFERA TRIPLEX
16	CLEISTOSPHAERIDIUM SP.
135	COMPOSITOSPHAERIDIUM SP.
160	CONCAVISSIMISPORITES PENOLAENSIS
203	CONTIGNISPORITES COOKSONIAE
170	CONTIGNISPORITES GLEBULENTUS
217	COPTOSPORA PARADOXA
189	COPTOSPORA PILEOSA
111	CORDOSPHAERIDIUM FIBROSPINOSUM
88	CORDOSPHAERIDIUM INODES
146	COROLLINA TOROSUS
209	CORONATISPORA PERFORATA
41	CORONIFERA OCEANICA
124	CORRUDIMUM INCOMPOSITUM
130	CRASSOSPHAERA CONCINNIA
4	CRIBROPERIDINIUM EDWARDSII
5	CRIBROPERIDINIUM sp
161	CRYBELOSPORITES STRIATUS
251	CUPANEIDITES ORTHOTEICHUS
273	CYATHEACIDITES ANNULATUS
147	CYATHIDITES AUSTRALIS
148	CYATHIDITES MINOR
149	CYCADOPITES FOLLICULARIS
13	CYCLONEPHELIUM COMPACTUM
7	CYCLONEPHELIUM MEMBRANIPHORUM
89	CYCLOPSIELLA
175	CYCLOSPORITES HUGHESI
112	DAPSILIDINIUM PASTIELSI
105	DAPSILIDINIUM PSEUDOCOLLIGERUM
79	DEFLANDREA PACHYCEROS
90	DEFLANDREA PHOSPHORITICA
72	DEFLANDREA SP.
91	DEFLANDREA TRUNCATA
40	DICONODINIUM PUSILLUM
181	DICTYOPHYLLIDITES
197	DICTYOTOSPORITES COMPLEX
176	DICTYOTOSPORITES SPECIOSUS
192	DILWYNITES GRANULATUS
198	DILWYNITES TUBERCULATUS
80	DIPHYES COLLIFERUM
113	DRACODINIUM SPONGY
270	DRYPTOPOLLENITES SEMILUNATUS
235	ERICIPITES SCABRATUS
57	EUCLADINIUM MADURENSUS
2	EXOCHOSPHAERIDIUM PHRAGMITES
150	FALCISPORITES GRANDIS
151	FALCISPORITES SIMILIS
23	FLORENTINIA LACINIATA
162	FORAMINISPORIS ASYMMETRICUS
177	FORAMINISPORIS DAILYI
196	FORAMINISPORIS WONTHAGGIENSIS
174	FOVEOGLEICHENIIDITES
163	FOVEOTRILETES PARVIRETUS
70	FROMEA CHYTRA
58	FROMEA FRAGILIS
230	GAMBIERINA EDWARDSI
225	GAMBIERINA RUDATA
107	GLAPHYRODINIUM VICINUM
171	GLEICHENIIDITES
236	HALORAGACIDITES HARRISII
92	HEMICYSTODINIUM ZOHARYI
274	HERKOSPORITES ELLIOTTII
62	HESLERTONIA STRIATA
14	HETEROSPHAERIDIUM CONJUNCTUM
6	HETEROSPHAERIDIUM HETEROCANTHUM
64	HETEROSPHAERIDIUM LATEROBRACHIUS
8	HETEROSPHAERIDIUM SOLIDA
114	HOMOTRIBLIUM BREVIRADIATUM
93	HOMOTRYBLIUM TASMANIENSE
24	HYSTRICHODINIUM PULCHRUM
94	HYSTRICHOKOLPOMA EISENACKI
95	HYSTRICHOKOLPOMA RIGAUDIAE
136	HYSTRICHOKOLPOMA SP.
119	HYSTRICHOSPHAERIDIUM TUBIFERUM
106	IMPAGIDINIUM MACULATUM
120	IMPAGIDINIUM MARGINATA
121	IMPAGIDINIUM SP
96	IMPAGIDINIUM VICTORIANUM
131	IMPLETOSPHAERIDIUM SP.1
212	INTERULOBITES INTRAVERRUCATUS
252	INTRATRIPOROPOLLENITES NOTABILIS
48	ISABELIDINIUM BELFASTENSE
33	ISABELIDINIUM COOKSONIAE
49	ISABELIDINIUM CRETACEUM
77	ISABELIDINIUM KOROJONENSE
36	ISABELIDINIUM SP.
164	ISCHYOSPORITES PUNCTATUS
25	KIOKANSIUM POLYPES
115	KISSELOVIA EDWARDSII
108	KISSELOVIA THOMPSONAE
152	KLUKISPORITES SCABERIS
202	LAEVIGATOSPORITES OVATUS
182	LEPTOLEPIDITES VERRUCATUS
210	LILIACIDITES SP.
125	LINGULODINIUM MACHAEROPHORUM
178	LYCOPODIACIDITES ASPERATUS
231	LYGISTIPOLLENITES BALMEI
221	LYGISTIPOLLENITES FLORINII
63	MADURADINIUM PENTAGONUM
237	MALVACIPOLLIS DIVERSUS
265	MALVACIPOLLIS GRANDIS
238	MALVACIPOLLIS SUBTILIS
153	MICROCACHRYIDITES ANTARCTICUS
38	MICRODINIUM SP
34	MILLIOUDIDINIUM SP.
97	MILLIOUDIDINIUM TENUITABULATUS
98	MURATODINIUM FIMBRIATUM
258	MYRTACEIDITES PARVUS
259	MYRTACEIDITES TENUIS
276	MYRTACEIDITES VERRUCOSUS
59	NELSONIELLA ACERAS
126	NELSONIELLA SEMIRETICULATA
65	NELSONIELLA TUBERCULATA
226	NEORAISTRICKIA
277	NOTHOFAGIDITES ASPERUS
239	NOTHOFAGIDITES BRACHYSPINULOSUS
260	NOTROFAGIDITES DEMINUTUS
261	NOTHOFAGIDITES EMARICIDUS
232	NOTHOFAGIDITES ENDURUS
271	NOTHOFAGIDITES FALCATA
240	NOTHOFAGIDITES FLEMINGII
227	NOTHOFAGIDITES SENECTUS
280	NUMMUS MONOCULATUS
281	NUMMUS SP
20	NUMUS MONOCULATUS
28	ODONTOCHITINA COSTATA
60	ODONTOCHITINA CRIBROPODA
66	ODONTOCHITINA OBESA
17	ODONTOCHITINA OPERCULATA
50	ODONTOCHITINA PORIFERA
9	OLIGOSPHAERIDIUM COMPLEX
18	OLIGOSPHAERIDIUM PULCHERRIMUM
81	OPERCULODINIUM
129	OPERCULODINIUM CENTROCARPUM
154	OSMUNDACIDITES WELLMANII
127	PALAEOCYSTIDINIUM AUSTRALINIUM
30	PALAEOHYSTRICHOSPHORA INFUSORIOIDES
10	PALAEOPERIDINIUM CRETACEUM
35	PARALECANIELLA INDENTATA
241	PERIPOROPOLLENITES DEMARCATUS
233	PERIPOROPOLLENITES POLYORATUS
155	PEROTRILETES JUBATUS/MORGANII
214	PEROTRILETES MAJUS
228	PEROTRILETES SP
123	PHTANOPENIDINIUM COMATUM
193	PHYLLOCLADIDITES EUNUCHUS
187	PHYLLOCLADIDITES MAWSONII
179	PILOSISPORITES NOTENSIS
172	PODOSPORITES MICROSACCATUS
262	POLYCOLPITES ESOBALTEUS
266	PROTEACIDITES ANNULARIS
253	PROTEACIDITES ASPEROPOLUS
242	PROTEACIDITES BUN GRANDIS
243	PROTEACIDITES GRANDIS
244	PROTEACIDITES INCURVATUS
268	PROTEACIDITES LEIGHTONI
254	PROTEACIDITES ORNATUM
255	PROTEACIDITES PACHYPOLUS
272	PROTEACIDITES RECTOMARGINUS
245	PROTEACIDITES SCABORATUS
184	PROTEACIDITES SP.
218	PROTEACIDITES SP. LARGE
256	PROTEACIDITES TUBERCULIFORMIS
69	PTEROSPERMELLA AUREOLATA
26	PTEROSPERMELLA AUSTRALIENSIS
156	RETITRILETES AUSTROCLAVATIDITES
186	RETITRILETES CIRCOLUMENUS
194	RETITRILETES FACETUS
195	RETITRILETES NODOSUS
285	REWORKING - CRETACEOUS
284	REWORKING - JURASSIC
283	REWORKING - PERMIAN
282	REWORKING - TRIASSIC
99	RHOMBODINIUM GLABRUM
100	SAMLANDIA CHLAMYDOPHORIDITES
263	SANTALUM CAINOZOICUS
137	SCHEMATOPHORA SPECIOSUS
31	SCHIZOSPORIS PARVUS
101	SENONIASPHAERA SP
183	SESTROSPORITES PSEUDOALVEOLATUS
11	SPINIFERITES FURCATUS/RAMOSUS
157	STERIESPORITES ANTIQUASPORITES
246	STERIESPORITES PUNCTATUS
82	SYSTEMATOPHORA PLACACANTHUM
74	TANYOSPHAERIDIUM SALPINX
122	TECTATODINIUM
247	TETRACOLPORITES VERRUCOSUS
116	THALASSIPHORA PELAGICA
12	TRICHODINIUM
207	TRICOLPITES
222	TRICOLPITES CONFESSUS
223	TRICOLPITES SABULOSUS
216	TRICOLPITES VARIVERRUCATUS
264	TRICOLPORITES
248	TRICOLPORITES ESTOUTUS
224	TRICOLPORITES GILLI
234	TRICOLPORITES LONGUS
249	TRILETES TUBERCULIFORMIS
211	TRILOBOSPORITES TRIORETICULOSUS
269	TRIORITES MAGNIFICUS
185	TRIPOROLETES BIRETICULATUS
165	TRIPOROLETES RADIATUS
166	TRIPOROLETES RETICULATUS
167	TRIPOROLETES SIMPLEX
257	TRIPOROPOLLENITES AMBIGUUS
51	TRITHYRODINIUM SUSPECTUM
61	TRITHYRODINIUM THICK RETICULATE
52	TRITHYRODINIUM THICK SCABRATE
53	TRITHYRODINIUM THICK VERMICULATE
54	TRITHYRODINIUM THICK VERRUCATE
55	TRITHYRODINIUM THIN PSILATE
199	VELOSPORITES TRIQUETRUS
267	VERRUCOSISPORITES KOPUKUENSIS
19	VERYHACHIUM
180	VITREISPORITES PALLIDUS
102	WETZELIELLA HAMPDENENSIS
103	WETZELIELLA ORNATUM
117	WETZELIELLA PENTAGONAL
109	WETZELIELLA SP
104	WETZELIELLA WAIPAWAENSIS
73	XENASCUS CERATOIDES
67	XENIKOON AUSTRALIS
21	XIPHOPHORIDIUM ALATUM

3

ACS
LABORATORIES
AUSTRALIA

PETROLOGY REPORT

LA BELLA #1

OTWAY BASIN

Report prepared for BHP Petroleum Pty Ltd

by

Dr S E PHILLIPS

&

Mr A THOMAS

on behalf of

ACS LABORATORIES PTY LTD
ACN 008 273 005
31 Flemington St
Frewville SA 5063

August 1993

BHP PETROLEUM PTY. LTD.
DO NOT RETAIN IN PERSONAL FILES
FILE COPY
PLEASE RETURN TO
EXPLORATION INFORMATION
CENTRE

CONTENTS

1. SUMMARY

BHP Petroleum submitted 12 sidewall cores and two core segments from La Bella #1 in the Otway Basin for petrological examination. The study was designed to ascertain the mineralogy, diagenetic alteration and depositional environment of the samples. Specific aims were to resolve problems with electric log responses from immediately beneath the hydrocarbon-water contact at approximately 2156m; compare sands from sample 140 (2009.0m) and sands from the Upper Shipwreck Group; determine the nature of material filling cracks in the siderite nodule at 2094.4m; to ascertain whether the clay in the main reservoir (2100m to 2164m) is detrital or authigenic and to note the presence of fluid inclusions in authigenic cements for future work.

Lithologically the samples show a distinct break between the Upper and Lower Shipwreck Group (Table 1). The Upper Shipwreck Group is dominated by quartzarenites and the Lower Shipwreck by litharenites. There are no significant changes in mineralogy apparent from these samples immediately above and below the hydrocarbon-water contact at approximately 2156m. It is possible that high gamma responses over this interval could be caused by concentrations of heavy minerals in thin lags that have not been intersected by the present samples.

Comparison of the Sherbrook Group sample from 2009.0m with the thin sand in the Upper Shipwreck Group at 2071.5m shows distinct differences in the lithology and mineralogy. The Sherbrook sample is finer grained, more poorly sorted, bioturbated and contains higher proportions of lithics, detrital clay and authigenic minerals (glaucony and carbonate). Similarities between the Sherbrook Group sample and any of the other Upper Shipwreck Group samples are not pronounced. Even samples with a similar fine grain size at 2102.5m, 2121.0m, 2153.0m, 2168.5m and 2205.0m do not have the same sorting and hence high percentage of detrital clay. This suggests that there are differences in the depositional environment. The higher percentage of glaucony in the Sherbrook Group sample tends to support this hypothesis.

Porosity and permeability have been controlled by grain size, sorting, and the presence of ductile lithics and authigenic cements. Good reservoir quality has been retained in the thin sand of the Upper Shipwreck Group at 2071.5m due to coarse grain size and good sorting. Within the main hydrocarbon zone there are minimal authigenic cements and detrital clays that would limit reservoir quality. However, the presence of bedding with alignment of grains may have slightly reduced porosity and permeability. Where bedding is absent in the water zone at 2168.5m reservoir quality is again interpreted as good. Primary intergranular pores are dominant in all these samples and it is highly likely that pores are interconnected. In the sample from the Sherbrook Group (depth 2009.0m), porosity has been reduced by poor sorting and carbonate cement. Similar controls operated in the Upper Shipwreck carbonate cemented nodule (2094.4m) and very fine grained quartzarenite (2102.5m) which could also represent a nodule. Reservoir quality is significantly reduced in the Lower Shipwreck samples due to deformation of ductile lithics, bedding and an increase in the proportion of authigenic cements.

TABLE 1 SUMMARY OF TEXTURE, LITHOLOGY AND MINERALOGY FOR LA BELLA #1

GROUP	SHERBROOK	UPPER SHIPWRECK (hydrocarbon zone)					
Sample	140	-	-	129	125	122	118
Depth (m RT)	2009.0	2071.5	2094.4	2102.5	2121.0	2134.0	2153.0
Lithology	sublitharenite	quartzarenite	ca-cmt nodule	ca-cmt qtzarenite	quartzarenite	quartzarenite	quartzarenite
Grain size	fine	coarse	v-fine	v-fine	fine	medium	f-vc
Sorting	poor	well	poor	moderate	well	moderate	poor
Structures	laminae burrow	?beds	laminae channels septaria	laminae burrows	laminae	?lamina	laminae
Framework grains							
Quartz	65	67	48	53	72	80	72
Feldspar	1	1	tr	1	tr	-	tr
Lithics	3	tr	-	1	1	tr	tr
Mica	3	-	2	2	1	tr	tr
Accessory	tr	tr	tr	tr	1	tr	tr
Matrix							
Clay	8	1 (dm)	5	tr	3	2	tr
Opaque material	3	-	1	tr	1	-	4
Authigenic minerals & cements							
Quartz	-	4	-	-	2	2	3
Carbonate	10	tr	40	40	1	tr	-
Pyrite	1	1	2	1	tr	1	tr
Kaolin	tr	tr	1	tr	tr	tr	2
Glaucony	5	tr	-	tr	-	-	-
Barite	-	-	-	-	-	-	-
Porosity							
Intergranular	tr	20	-	-	14	?14	?15
Dissolution	tr	5	tr	1	3	-	?3

GROUP	UPPER SHIPWRECK (water zone)			LOWER SHIPWRECK (water zone)			?OTWAY
Sample	112	106	97	91	82	76	63
Depth (m RT)	2168.5	2205.0	2281.5	2345.0	2451.5	2522.0	2683.0
Lithology	quartzarenite	quartzarenite	quartzarenite	lith arenite	lith arenite	lith arenite	lith arenite
Grain size	fine	fine	medium	medium	coarse	coarse	fine
Sorting	well	mod	mod	m-well	poor	poor	mod
Structures	-	dissolution seam	-	-	?beds ?burrows	?beds	?beds
Framework grains							
Quartz	70	78	71	45	48	45	35
Feldspar	tr	tr	tr	6	6	8	10
Lithics	tr	1	1	18	30	25	33
Mica	tr	1	tr	tr	1	tr	tr
Accessory	tr	tr	tr	tr	tr	tr	tr
Matrix							
Clay	-	2	-	tr	-	-	5
Opaque material	-	1	-	1	-	-	1
Authigenic minerals & cements							
Quartz	3	1	3	2	2	tr	1
Carbonate	-	5	4	6	7	10	10
Pyrite	tr	tr	tr	1	-	tr	tr
Kaolin	3	tr	7	10	3	5	1
Glaucony	tr	tr	3	4	tr	tr	tr
Barite	-	-	tr	-	-	-	-
Porosity							
Intergranular	18	7	?10	5	2	5	3
Dissolution	5	3	-	1	tr	1	tr

bioturb = bioturbation, ca-cmt = carbonate cemented, dm = drilling mud,
f = fine, c = coarse, m-well = moderately well, qtzarenite= quartzarenite,
tr = trace, v = very

During the depositional history of this suite of samples there have been significant changes in sediment provenance. For the Sherbrook Group sample (2009.0m) sediments were probably derived from a volcanic/plutonic craton with minor metamorphic and sedimentary input. Upper Shipwreck Group sediments were either derived from a stable craton or have been extensively reworked. The source rocks may have been granitic, as potassic feldspars are present. However, there has also been sediment input from sedimentary and metamorphic terranes. Rare volcanic lithics at the base of the Upper Shipwreck Group (depth 2281.5m) reflect a gradual change in sediment provenance or confirm that there has been reworking. During the time of deposition of Lower Shipwreck and ?Otway sediments, the dominant provenance was a metamorphic/ volcanic terrane. This is apparent from the abundance of lithics and plagioclase feldspar, and nature of quartz grains. The presence of fresh feldspars and soft lithics suggests that distances of transport were relatively short, and/or that there was uplift in the source area.

Samples from the Sherbrook, Upper and Lower Shipwreck and ?Otway Groups all appear to have been deposited in a variety of shallow marine environments. The Sherbrook sample was deposited in a low energy marine phreatic environment (?subtidal) that had a relatively low sedimentation rate. Upper Shipwreck Group sediments may have been deposited during deltaic progradation and facies variations within this sequence are apparent. The sand at 2071.5m is probably a channel or distal bar within the bioturbated silts and muds of either a flood plain / marsh on a delta plain or deeper water prodelta deposits. Siderite nodules (eg at 2094.4m) in the bioturbated sediments probably formed at shallow burial depths (less than 10m) where there was mixing of fresh and marine waters. Preservation of organic matter in the nodules suggests high rates of sediment deposition which is consistent with the lack of glaucony. The presence of filamentous structures in the associated sediments and nodules may indicate the influence of micro-organisms (?algae) in the precipitation of carbonate. Septaria in the nodule are filled with spar and kaolin. Isopachous rims on micas in the nodule show that this was a marine phreatic zone. A similar depositional environment is envisaged for the carbonate cemented quartzarenite at 2102.5m. The fine to medium grained, moderately to well sorted quartzarenites at depths of 2121.0m, 2134.0m, 2168.5m, 2205.0m and 2281.5m may have been deposited on the delta front rather than the delta plain. This hypothesis is based on the cleaner nature of these sediments and the lack of obvious bioturbation. The poorly sorted quartzarenite from 2153.0m has a bimodal grain size that may indicate sediment mixing in a slightly different facies to that of the delta front. It is possible that this sample represents a channel which has reworked sediment from a coarser sand ridge.

Lower Shipwreck and ?Otway Group samples (depths of 2345.0m, 2451.5m, 2522.0m and 2683.0m) typically are coarser sands with higher percentages of labile grains than the Upper Shipwreck Group. These characteristics suggest that rapid deposition occurred closer to the sediment source and possibly in shallower water or higher energy channels than the Upper Shipwreck Group. High concentrations of altered lithics have probably influenced the gamma log over this interval.

Typically sediments have been diagenetically altered by similar processes but to varying degrees. There have been early authigenic minerals of glaucony, siderite and pyrite, a phase of compaction and later authigenic cements and minerals of quartz, carbonate, kaolin and barite. Fluid inclusions are trapped within quartz overgrowths in samples from 2071.5m, 2345.0m and 2451.5m. The diagenetic sequence also included a phase of dissolution to produce secondary pores and was followed by the emplacement of hydrocarbons. Vague trends within the suite of samples can be identified:

1. Where early siderite cements are abundant either silicification has been inhibited or overgrowths were replaced (depths 2009.0m, 2094.4m and 2102.5m).

2. There are multiple phases of carbonate apparent, but the later phases of spar that are interpreted as burial cements, appear to increase in abundance with depth from the basal Upper Shipwreck (2205.0m) into the Lower Shipwreck and ?Otway Group samples.

3. There is no significant change in diagenetic alteration immediately above or below the current hydrocarbon-water contact at 2156m.

4. Samples either side of the boundary between the Upper and Lower Shipwreck Groups (depths 2281.5m and 2345.0m) have a relatively high concentration of kaolin.

5. Barite is restricted to one sample at a depth of 2281.5m.

Although the paragenetic sequence is not certain and all samples do not show each phase, the following diagenetic events have been recognised (Table 2).

TABLE 2. SUMMARY OF DIAGENETIC ALTERATION

Event	Early	Middle	Late
		Diagenetic Stage	
Glauconite	---		
Pyrite	---		---
Carbonate	----		----
Compaction		--------------------	
Dissolution	-------		----
Quartz		----	
Barite		----	
Kaolin		-----	----
Hydrocarbons			-------

2. INTRODUCTION

BHP Petroleum submitted 12 sidewall cores and two core portions from La Bella #1 in the Otway Basin for petrological examination. The study was designed to ascertain the mineralogy, diagenetic alteration and depositional environment of the samples. Specific aims were identified as:

1. To resolve problems with electric log responses from immediately beneath the hydrocarbon-water contact at approximately 2156m RT, which was thought could be due to the mineralogy.
2. A comparison of sands from sample 140 (2009.0m) and sands from the Upper Shipwreck Group.
3. To determine the nature of material filling cracks in the siderite nodule at 2094.4m.
4. To ascertain whether the clay in the main reservoir (2100m to 2164m) is detrital or authigenic.
5. To note the presence of fluid inclusions in authigenic cements for future work.

Electric logs (gamma, SP, resistivity and sonic) and core photographs from the relevant intervals were provided to assist with this study.

The following samples were examined:

Well	Depth (m RT)	Group (Zone)	Sample	Description
La Bella #1	2009.0	Sherbrook	140	Detailed
	2071.5	U Shipwreck	-	Detailed
	2094.4	U Shipwreck	-	Brief
	2102.5	U Shipwreck (H/C)	129	Detailed
	2121.0	U Shipwreck (H/C)	125	Brief
	2134.0	U Shipwreck (H/C)	122	Brief
	2153.0	U Shipwreck (H/C)	118	Detailed
	2168.5	U Shipwreck (water)	112	Detailed
	2205.0	U Shipwreck (water)	106	Brief
	2281.5	U Shipwreck (water)	97	Brief
	2345.0	L Shipwreck (water)	91	Detailed
	2451.5	L Shipwreck (water)	82	Brief
	2522.0	L Shipwreck (water)	76	Detailed
	2683.0	?Otway	63	Brief

3. METHODS

Sidewall core samples and core portions were impregnated with blue-dyed araldite prior to thin section preparation. Thin sections were systematically scanned to determine lithology, composition, porosity and textural relationships. All percentages given in thin section descriptions are based on visual estimates, not point counts.

4. PETROLOGY

4.1 La Bella #1, sample 140, depth 2009.0m RT, Sherbrook Group

Rock Name Sublitharenite

Thin section description

Texture:

The margins of the sample have been moderately disrupted by sidewall coring, whereas the central portions are relatively intact. The sublitharenite is fine grained, texturally immature and mineralogically submature. Framework grains range in diameter from 0.04mm (coarse silt) to 0.3mm (medium sand), they are well sorted, angular to subrounded and of low to moderate sphericity (Fig. 1). The sublitharenite is poorly sorted overall due to the presence of matrix. Texturally, the sample is supported by framework grains that typically have tangential contacts, with minor concavo-convex examples. Bent micas, deformed glaucony and crenulated opaque stringers indicate moderate compaction. Discontinuous clay and carbonate rich laminae up to 2mm thick are irregularly distributed in the section. This distribution is probably the result of bioturbation. This hypothesis is supported by the presence of a U-shaped burrow rimmed by micrite and filled with clay and framework grains. The burrow is approximately 1.5cm long and 1cm wide.

Porosity:

Porosity consists of isolated primary intergranular pores and grain sized voids. The latter are interpreted to have resulted from dissolution of labile minerals. The isolated distribution of pores indicates that permeability will be very low.

Visual Estimate of Composition		%
Framework grains	Quartz	65
	Feldspars	1
	Lithics	3
	Mica	3
	Accessory minerals	tr
Matrix	Clays	8
	Opaque material	3
Authigenic minerals and cements	Carbonate	10
	Pyrite	1
	Kaolin	tr
	Glaucony	5
Porosity	Intergranular	tr
	Dissolution	tr

Framework grains:

Monocrystalline and minor polycrystalline quartz have straight to slightly undulose extinction and rarely display vacuoles or mineral (rutile needles) inclusions. Boundaries within polycrystalline quartz grains are straight. Feldspars range from fresh examples of plagioclase and lesser amounts of K-feldspar, to highly kaolinised grains of uncertain type. Lithics of chert, quartz-mica schist and mudstone are evident. Mica flakes up to 0.2mm long are composed of muscovite and chloritised biotite. Accessory minerals of dusty sphene, silt sized zircon and brown tourmaline are evident.

Matrix:
Framework grains are rimmed by light brown illitic clays, particularly within the irregular laminae. Stringers of opaque material throughout the sample are probably composed of organic matter.

Authigenic minerals and cements:
At least three phases of carbonate are evident. Dark red anhedral Fe rich micrite (?siderite or ankerite) and microspar concentrates in laminae and is scattered throughout the sample. Framework grains in the laminae have been embayed and replaced by the carbonate. A second phase of carbonate is suggested by the presence of dusty anhedral crystals of spar. These crystals are up to 50 microns in diameter and commonly have a darker core which is indicative of neomorphism. This phase of spar concentrates in a large patch approximately 1.5cm long and 1 cm wide. Framework grains are very rare in this zone and highly embayed. A third phase of carbonate forms circumgranular or isopachous cements on framework grains. These cements characterise deposition in a marine phreatic environment. The circumgranular cement is associated with the patches of dusty anhedral crystals and therefore precipitated prior to the second phase of carbonate. Pyrite cubes are associated with altered biotite, glaucony and opaque stringers. Rare patches of kaolin are vermiform in habit and verms are up to 40 microns in diameter. The kaolin has probably formed due to alteration of micas. Grains of glaucony are bright green in colour and composed of glauconite with minor quantities of illite.

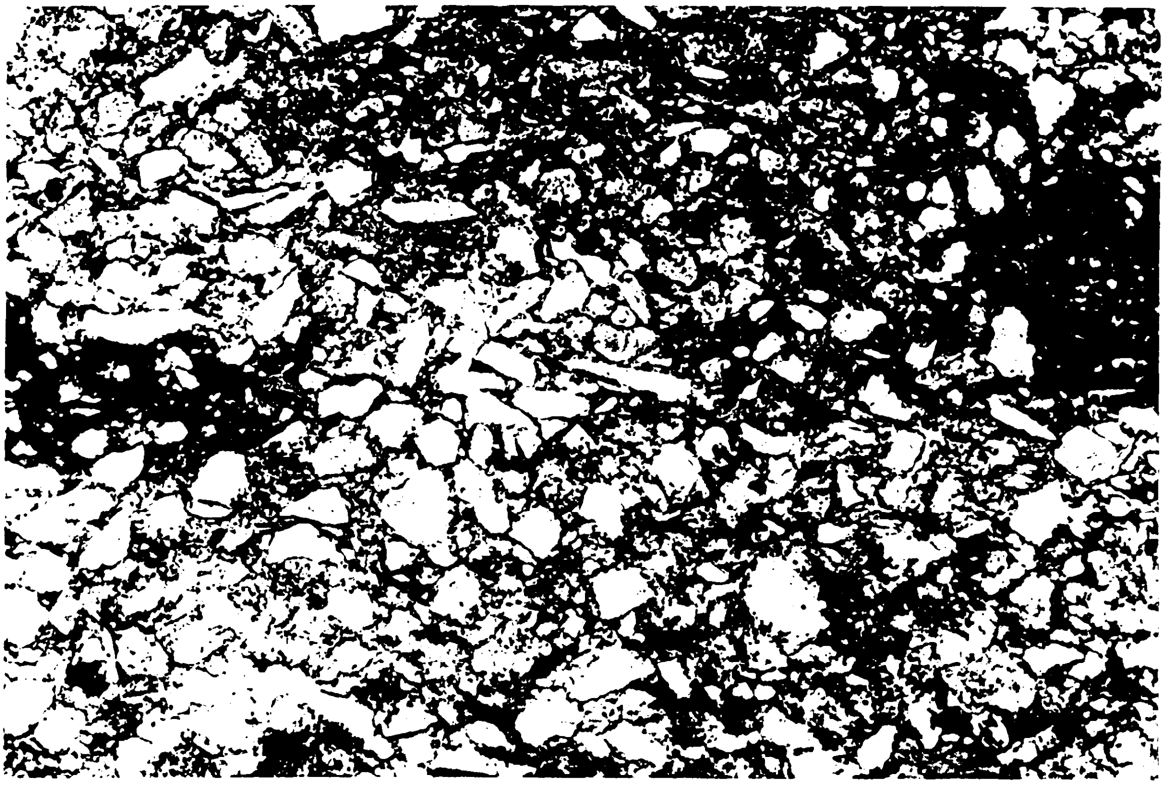


Figure 1. Angular to subrounded framework grains with low to moderate sphericity are evident in this sublitharenite. Note the distorted grains of green glaucony, and discontinuous clay plus carbonate rich laminae (dark areas). Porosity (blue) is an artefact of sidewall coring. La Bella #1, sample 140, depth 2009.0m. Plane light. Field of view 2.6mm

4.2 La Bella #1, depth 2071.5m RT, Upper Shipwreck Group

Rock Name Quartzarenite

Thin section description

Texture:

The sample is a mineralogically and texturally mature, coarse grained quartzarenite. Well sorted framework grains (Fig. 2) range in diameter from approximately 0.13mm (fine sand) to 1.3mm (very coarse sand), and are rounded and of moderate to high sphericity. Rarely grains have distinct embayments that could be attributed to either dissolution of a labile component in the grain or embayment by a carbonate cement that was later removed. Texturally the quartzarenite is supported by framework grains that have dominantly tangential and point contacts. Concavo-convex grain contacts are minor and reflect moderate compaction. The parallel alignment of elongate grains could be attributed to either grain rotation during compaction or primary bedding.

Porosity:

Primary intergranular pores are abundant and commonly interconnected by unobstructed pore throats. Typically these pores are angular due to the presence of quartz overgrowths. Secondary dissolution porosity is apparent from grain sized to oversized pores and highly corroded feldspars (Fig. 2). Permeability is likely to be high at this depth due to the good primary porosity and the open pore throats. The presence of drilling mud contamination supports this view.

Visual Estimate of Composition		%
Framework grains	Quartz	67
	Feldspars	1
	Lithics	tr
	Accessory	tr
Drilling mud		1
Authigenic minerals and cements	Quartz	4
	Carbonate	tr
	Pyrite	1
	Kaolin	tr
	Glaucony	tr
Porosity	Intergranular	20
	Dissolution	5

Framework grains:

Monocrystalline quartz has straight extinction, minor Boehm lamellae and rare mineral inclusions of muscovite, apatite, zircon, biotite and tourmaline. Polycrystalline quartz is a minor component, this has straight and lesser sutured boundaries, and straight to slightly undulose extinction. Feldspars are highly corroded, sericitised and kaolinised examples of untwinned K-feldspar (possibly orthoclase). Dusty examples of banded chert, granite and rare quartzite comprise the lithic fraction. The granite is composed of quartz, corroded feldspar and muscovite. One well rounded very fine sand size zircon represents the accessory minerals.

Matrix:

Drilling mud has invaded the sample, coating grains and forming meniscus shaped bridges between grains.

Authigenic minerals and cements:
Silica in the form of syntaxial quartz overgrowths is the dominant cement throughout this quartzarenite. Quartz overgrowths have formed euhedral rhombohedral terminations and rare triple point junctions. Fluid inclusions are trapped in the overgrowths. Rhombs of clear carbonate spar have crystallised in isolated corroded feldspars. Pyrite framboids and cubes concentrate along and have embayed grain margins. There is one grain that has been partially replaced by pyrite. Anhedral kaolin is present in patches and it appears to have formed by complete alteration of feldspar. Other kaolin is more highly crystalline and composed of subhedral to euhedral booklets and verms. The vermiform habit is up to 50 microns in diameter and probably formed as an alteration product of micas. Rounded grains of bright green glaucony are up to 0.2mm in diameter and are composed of glauconite with traces of illite. The latter mineral is concentrated near the margins of glaucony grains.

Figure 2. A general view of this quartzarenite shows well sorted framework grains and abundant porosity (blue). Euhedral terminations on grains indicate quartz overgrowths. Note that the dusty feldspar in the centre of the photomicrograph is highly corroded. Brown stain on the margins of some grains is contamination by drilling mud. La Bella #1, depth 2071.5m. Plane light. Field of view 2.6mm.

4.3 La Bella #1, depth 2094.4m RT, Upper Shipwreck Group

Rock Name: Carbonate cemented nodule

Thin section description

The sample was taken from a siderite nodule and represents a cross section from the dense core into underlying laminae of bioturbated sandy (very fine) mudstone. The core is composed of dense micrite with numerous discontinuous opaque stringers and fragments that indicate the presence of organic matter. Minor silt size terrigenous grains float within the micrite. The core is cross cut by a number of channels and cracks or fractures (septaria) of variable diameter and orientation. Finer channels are sinuous, up to 0.25mm in width and are filled by bladed and scalenohedral clear spar followed by a phase of kaolin. Traces of opaque material found in one channel may be composed of organic matter. The larger cracks or fractures are straighter, up to 1.5mm wide and at least 2cm long. These septaria taper in width away from the core and display Y shaped branching into the underlying laminae. Traces of carbonate spar line these septaria but the dominant material filling the structures is anhedral kaolin booklets.

Sandy mudstone laminae which enclose the core are variable in composition and typically discontinuous. Grains of quartz, feldspar and mica can be recognised floating in the micrite but quartz is the dominant component. Rare mica flakes have a rim of isopachous cement. Selected laminae contain concentrations of micritic ?intraclasts that are aligned parallel to the laminae. The ?intraclasts are composed of dense micrite with cellular and filamentous structures evident. The filaments are commonly up to 5 microns in diameter with a rim of fibrous calcite. They probably represent calcified organic filaments of possible fungal or algal origin. Rarely similar filamentous structures are evident in the nodule core. Other laminae contain minor amounts of detrital clay.

4.4 La Bella #1, sample 129, depth 2102.5m RT, Upper Shipwreck Group, hydrocarbon zone

Rock Name: Carbonate cemented quartzarenite

Thin section description

Texture:

The sample consists of 5 separate fragments that show disruption due to sidewall coring. Texturally and mineralogically the sample is very similar to the siderite nodule described from 2094.4m. It is a mineralogically and texturally submature quartzarenite. Moderately sorted framework grains that range in diameter from approximately 0.03mm (medium silt) to 0.6mm (coarse sand) are angular and of low to moderate sphericity. Framework grains typically float in the carbonate cement (Fig. 3), and grain to grain contacts are uncommon. These contacts are generally at points and tangents. Flakes of mica are bent to a minor degree indicating slight mechanical compaction. The weak alignment of elongate grains could indicate the presence of laminae. The largest fragment contains a channel like feature up to 1mm wide and at least 2 cm long. A second narrower channel appears to branch from the main feature. Both are filled with carbonate, kaolin and framework grains, and contain a minor proportion of pyritised opaque material. These features are interpreted as channels caused by burrowing organisms.

Porosity:

Most porosity apparent in the quartzarenite has probably been induced by sidewall coring. However, minor pores that are grain sized and oversized may be the result of dissolution of labile minerals and cement. If this is the case, permeability will be very low due to the isolated distribution of these pores.

Visual Estimate of Composition		%
Framework grains	Quartz	53
	Feldspars	1
	Lithics	1
	Mica	2
	Accessory minerals	tr
Matrix	Clays	tr
	Opaque material	tr
Authigenic minerals and cements	Carbonate	40
	Pyrite	1
	Kaolin	tr
	Glaucony	tr
Porosity	Dissolution	1

Framework grains:

Quartz is commonly monocrystalline, with straight extinction, few vacuoles and rare mineral inclusions of tourmaline, apatite and mica. Polycrystalline quartz is rare, and exhibits straight to sutured crystal boundaries and slightly undulose extinction. Feldspars are untwinned potassic varieties and of dusty to kaolinised appearance. Lithic fragments include chert and micaceous quartzite. Flakes of muscovite are up to 0.2mm long. Accessory minerals of rounded tourmaline and silt sized zircon are present.

Matrix:

Opaque material noted in channels may be composed of organic matter and there are traces of clay rimming grains.

Authigenic minerals and cements:
Grains are typically coated and pores bridged by anhedral Fe stained micrite and microspar. This form of cement is typical of a marine phreatic environment. The remaining pore space is filled with rhombs and anhedral crystals of carbonate that are reddish brown and average 30 microns in diameter. Most carbonate is dusty and there are lesser amounts of clearer spar that display dusty cores. Carbonate typically embays framework grains. Rare ghosts of cellular structures in the carbonate cement could represent remnants of the ?intraclasts noted in the siderite nodule from 2094.4m. Minute cubes and framboids of pyrite have partially replaced framework grains, whilst ?organic matter has been replaced by massive pyrite. Kaolin booklets that fill channels and have replaced grains are subhedral and up to 50 microns in diameter. Glaucony grains are pale green and have a wormy texture typical of glauconite.

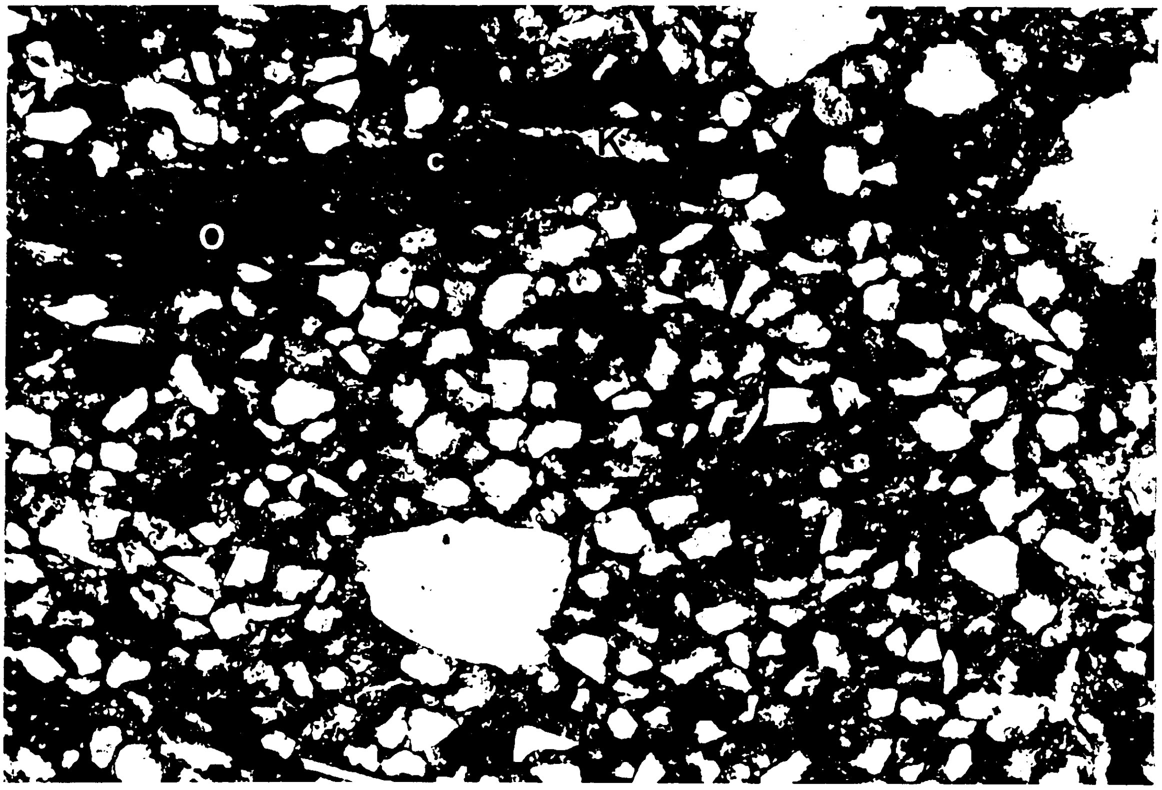


Figure 3. Framework grains appear to float in dark carbonate in this quartzarenite. Note the channel which traverses the upper portion of the photomicrograph and is filled with opaque material (O), carbonate (C) and minor clear kaolin (K). La Bella #1, sample 129, depth 2102.5m. Plane light. Field of view 2.6mm.

4.5 La Bella #1, sample 125, depth 2121.0m RT, Upper Shipwreck Group, hydrocarbon zone

Rock Name: Quartzarenite

Thin section description

The sample has been extensively disrupted by sidewall coring and only a minor proportion has retained textural integrity. It is a texturally submature and mineralogically mature, fine grained quartzarenite. Framework grains range in diameter from approximately 0.05mm (coarse silt) to 0.49mm (medium sand) are subrounded, well sorted and of moderate to high sphericity. The quartzarenite is supported by framework grains that show tangential and minor concavo-convex contacts. The latter contacts are due to moderate compaction. Crenulated discontinuous laminae consist of stringers of opaque material and detrital clays. These laminae form a dissolution seam of fitted nodule form. Porosity is difficult to assess owing to the intense disruption. Primary intergranular porosity is evident where grains have remained in situ, and pores are interconnected in these areas. Pore throats are unobstructed and permeability should be moderate in this lithology. Grain sized and oversized pores are also apparent, indicating dissolution of labile minerals. Rare dissolution pores are rimmed by opaque material that could represent reservoir bitumen.

The common variety of volcanic/plutonic quartz dominates the framework components. Rare feldspars are highly kaolinised, whilst quartz-mica schist and chert comprise the lithic grains. Flakes of muscovite are present in minor amounts. Accessory minerals of rounded, green tourmaline and zircon are evident. Brown detrital clays rim rare grains whilst stringers of opaque material probably represent organic matter. Authigenic minerals of quartz (overgrowths), carbonate, kaolin and pyrite are present in minor amounts. Rhombs of brown spar and pyrite cubes have replaced detrital clays and organic matter respectively.

4.6 La Bella #1, sample 122, depth 2134.0m RT, Upper Shipwreck Group, hydrocarbon zone

Rock Name: Quartzarenite

Thin section description

The sample has been extensively disrupted by sidewall coring, and consists of a number of shattered rock fragments. One fragment contains rounded grains and a brown clay rich matrix which may reflect a silty layer, whilst another chip that has fractured grains but very little matrix suggests a clean sand lithology. The majority of the sample was probably a medium grained, mineralogically mature and texturally submature quartzarenite. Sorting overall may be moderate. The other portions display fractured framework grains embedded in silty material that probably represents powdered grains. Grain sizes from 0.17mm (fine sand) up to at least 1.0mm (very coarse sand) are evident, but these figures may not reflect the true range. Porosity and permeability are very difficult to assess with any confidence. If the clean chip represents the lithology then reservoir quality is at least moderate.

Monocrystalline quartz dominates the framework components. Chert lithics, muscovite flakes and rare tourmaline are also apparent. Brown illitic clays that fill pores and coat grains in one portion of the sample may be detrital rather than contamination. Authigenic minerals of quartz (overgrowths), carbonate, kaolin and pyrite are evident in some portions of the sample. Carbonate spar cements framework grains whilst framboids of pyrite embay quartz. Rare grains have been replaced by kaolin.

4.7 La Bella #1, sample 118, depth 2153.0m RT, Upper Shipwreck Group, hydrocarbon zone

Rock Name Quartzarenite

Thin section description

Texture:

The sample has been disrupted by sidewall coring, and framework grains are typically fractured and displaced. A silt sized matrix of crushed framework grains occupies most intergranular spaces and textural relationships are uncertain except for minor areas. The sample is a fine to very coarse grained, mineralogically and texturally submature quartzarenite. Laminae are indicated by stringers of opaque material and changes in grain size from very coarse to fine sand but contacts between laminae are gradational. In the very coarse laminae grain size is bimodal (both fine and very coarse sand), sorting is very poor and grains are subrounded to rounded and of moderate to high sphericity. The fine grained sands are angular to subrounded, with moderate sphericity. Overall the quartzarenite is poorly sorted, and grain size ranges from 0.05 (coarse silt) to 4.5mm (pebbles) in diameter. The quartzarenite is supported by framework grains that exhibit mainly tangential contacts. The crenulated nature of opaque stringers is probably the result of moderate compaction.

Porosity:

Porosity is difficult to quantify due to the degree of disruption, and figures given reflect estimates from intact areas. In the latter regions, primary intergranular pores are apparent between quartz grains with overgrowths (Fig. 4), whilst rare corroded grains and grain sized pores indicate minor secondary dissolution porosity. The presence of laminae and poor sorting may limit permeability.

Visual Estimate of Composition		%
Framework grains	Quartz	72
	Feldspars	tr
	Lithics	tr
	Mica	tr
	Accessory minerals	tr
Matrix	Clays	tr
	Opaque material	4
Authigenic minerals and cements	Quartz	3
	Pyrite	tr
	Kaolin	2
Porosity	Intergranular	?15
	Dissolution	?3

Framework grains:

Quartz is typically monocrystalline, with straight extinction, scarce vacuoles and mineral inclusions of muscovite and tourmaline. Rare examples of quartz with Boehm lamellae are evident. Polycrystalline quartz represents a relatively high proportion (30%) of the coarse fraction. Typically these grains display straight crystal boundaries and slightly undulose extinction. Rare examples of polycrystalline quartz show sutured boundaries and highly undulose extinction. Dusty examples of K-feldspar are evident. Lithics include rounded examples of fine grained micaceous schist and chert. Flakes of muscovite are up to 0.4mm long, relatively straight and fresh. Flakes of biotite are highly altered. Accessory minerals of brown to green tourmaline, epidote and silt sized zircon are present.

Matrix:
Traces of brown illitic clay coat grains and rarely fill intergranular pores. Opaque stringers are indicated by fragments of angular opaque material that probably represent organic matter. This opaque material has completely filled intergranular pores.

Authigenic minerals and cements:
Quartz overgrowths are evident due to euhedral terminations and straight grain boundaries. Dust rims that outline detrital grains are rarely apparent. Minute cubes and framboids of pyrite embay framework grains in the clay rich laminae. In addition, pyrite has replaced a minor amount of the opaque material. Subhedral booklets of kaolin up to 20 microns in diameter have crystallised in intergranular pores and coarse grains have been replaced by kaolin. There are examples of micas that have been partially replaced by kaolin.

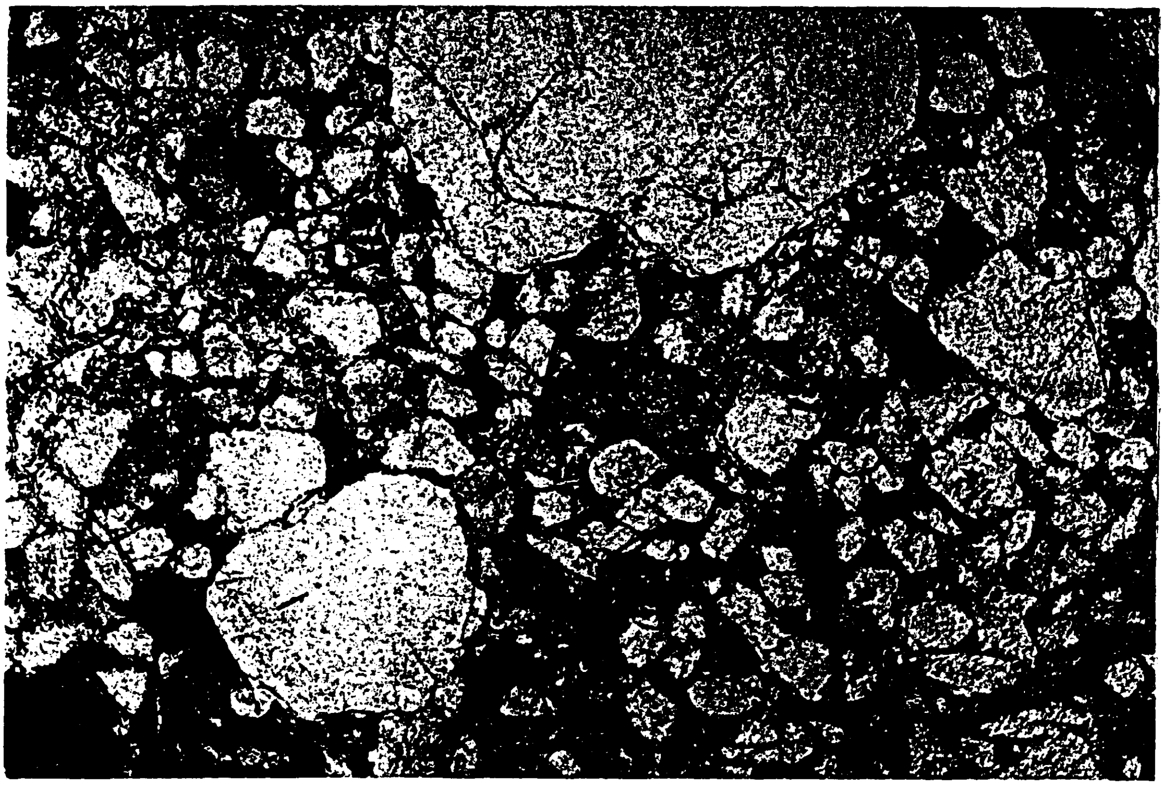


Figure 4. Primary intergranular porosity (P) is evident between finer grains in an area of this quartzarenite where disruption is less noticeable. Some grain sized pores may be the result of dissolution, although displacement during sidewall coring has exaggerated this effect. La Bella #1, sample 118, depth 2153.0m. Plane light. Field of view 2.6mm.

4.8 La Bella #1, sample 112, depth 2168.5m RT, Upper Shipwreck Group, water zone

Rock Name Quartzarenite

Thin section description

Texture:

The quartzarenite has been disrupted and grains displaced during sidewall coring. Minor areas have retained textural integrity. The sample is a fine grained, texturally and mineralogically mature quartzarenite. Well sorted framework grains range in diameter from approximately 0.05mm (coarse silt) to 0.28mm (medium sand), are subangular to subrounded and of moderate sphericity. Typically these grains have embayed margins which could suggest that an earlier cement has been removed. Texturally, the quartzarenite is framework grain supported, with contacts that are dominantly tangential. Minor concavo-convex contacts and bent micas indicate that compaction has been moderate. No sedimentary features are apparent.

Porosity:

Abundant porosity is evident in regions where textural integrity has been preserved (Fig. 5). Pore throats connecting primary intergranular pores are unobstructed and permeability is anticipated to be high as a result. Dissolution of labile minerals has resulted in grain sized to oversized pores.

Visual Estimate of Composition		%
Framework grains	Quartz	70
	Feldspars	tr
	Lithics	tr
	Mica	tr
	Accessory minerals	tr
Matrix		nd
Authigenic minerals and cements	Quartz	3
	Pyrite	tr
	Kaolin	3
	Glaucony	tr
Porosity	Intergranular	18
	Dissolution	5

Framework grains:

Quartz is present dominantly as the monocrystalline variety, with minor polycrystalline examples. Monocrystalline quartz has straight extinction, few vacuoles and mineral inclusions of tourmaline, rutile needles and apatite. Polycrystalline quartz reveals straight and minor sutured boundaries, slightly undulose extinction and rare mineral inclusions of mica. Feldspars are dusty to highly sericitised examples of untwinned potassic varieties. Micaceous grains may represent metamorphic (schist or phyllite) lithics and there is at least one example of quartzite. Dusty chert is also apparent. Flakes of mica up to 0.3mm long are slightly bent and have partially split along the cleavage direction. Well rounded accessory grains of zircon are very fine sand sized.

Authigenic minerals and cements:

Euhedral terminations and rare dust rims around detrital grains indicate quartz overgrowths. In addition, there are scarce instances of druse overgrowths. Minute framboids of pyrite embay framework minerals along grain margins. Kaolin booklets that are up to 15 microns in diameter are subhedral to euhedral and fill intergranular pores (Fig. 5). Where kaolin occurs in a vermiform habit which is 50 microns in diameter it has probably replaced micas. Kaolin is intergrown with quartz overgrowths in minor cases.

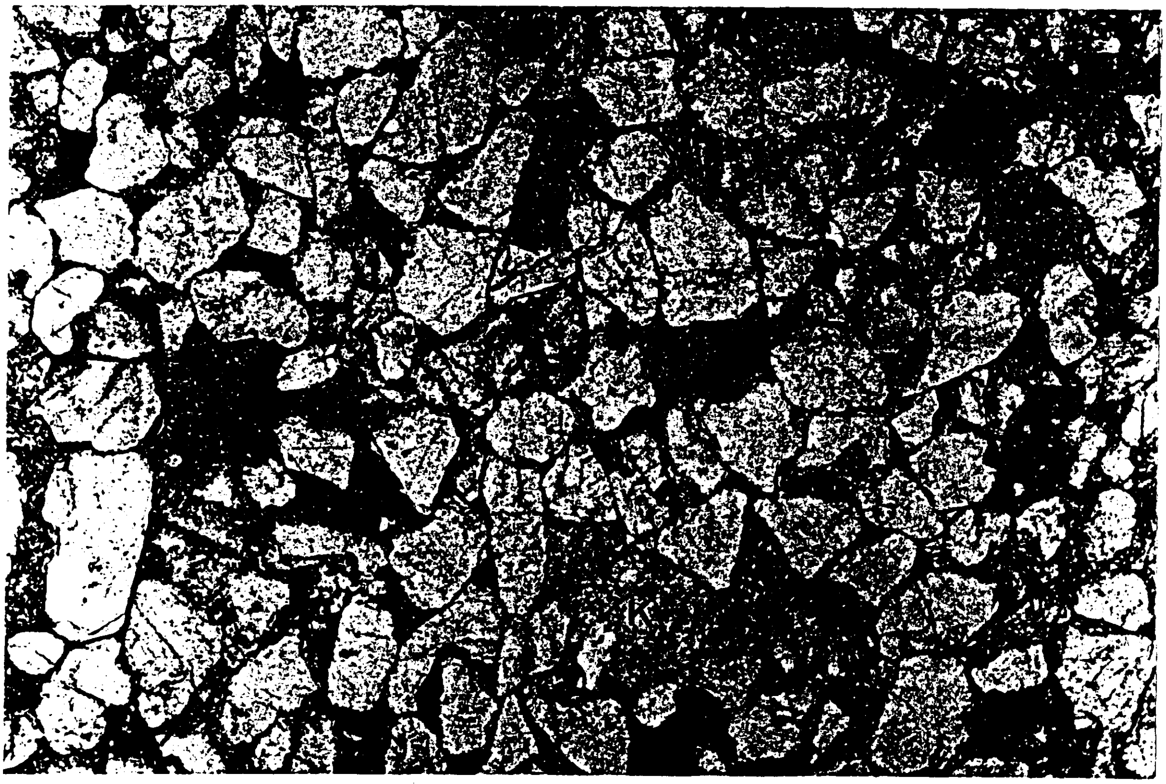


Figure 5. Some of the abundant porosity (blue) evident in this quartzarenite consists of oversized pores due to secondary dissolution (S). Kaolin (K) has precipitated in other pores. La Bella #1, sample 112, depth 2168.5m. Plane light. Field of view 2.6mm.

4.9 La Bella #1, sample 106, depth 2205.0m RT, Upper Shipwreck Group, water zone

Rock Name Quartzarenite

Thin section description

The quartzarenite is fine grained, texturally submature and mineralogically mature. Grains are moderately sorted, subrounded and moderately spherical, they range in diameter from approximately 0.03mm (coarse silt) to 0.4mm (medium sand). A dissolution seam up to 0.5mm thick cross cuts the sample. Adjacent to this seam there are numerous discontinuous crenulated opaque stringers. Contacts between grains are dominantly at tangents, and moderate compaction has resulted in minor concavo-convex contacts. Disruption of the quartzarenite due to sidewall coring has generally obscured porosity, but primary intergranular pores are evident in minor areas of coherent sample. The latter areas are free of detrital clays, and unobstructed pore throats are apparent. Minor grain sized and oversized pores indicate dissolution porosity.

Monocrystalline quartz of the common volcanic/plutonic variety dominates the framework grains. Other components are in trace to minor amounts. They include dusty to sericitised feldspars (K-feldspar dominant), lithics of chert, micaceous schist and quartzite, and bent muscovite flakes. Rounded zircon and green tourmaline are present as accessory minerals. Laminae contain opaque stringers probably composed of organic matter and brown detrital clays. The latter are illitic, rim grains and fill pores. Authigenic minerals of quartz, carbonate (clear spar and dusty red micrite), pyrite (framboids that partially replace ?organic matter), glaucony (highly altered) and kaolin (replacing mica) are evident in minor amounts.

4.10 La Bella #1, sample 97, depth 2281.5m RT, Upper Shipwreck Group, water zone

Rock Name Quartzarenite

Thin section description

There has been extensive disruption of the sample due to sidewall coring. Grains are typically fractured and displaced. In those areas where some textural integrity has been retained the sample appears to be a medium grained, texturally and mineralogically mature quartzarenite. Grains may range in diameter from 0.20mm (fine sand) to 1.7mm (very coarse sand), they are moderately sorted, subrounded to rounded and of moderate to high sphericity. Grain contacts are dominantly at tangents, with minor concavo-convex examples. No sedimentary features are evident. Porosity is difficult to assess overall, although there are abundant primary intergranular pores in regions where grains have been only slightly displaced. The latter patches show unobstructed pore throats and permeability may be moderate. This hypothesis is supported by the lack of detrital clays and paucity of deformed lithics that could block pore throats. Dissolution pores cannot be identified with any certainty.

Quartz is the common volcanic/plutonic variety and dominates the mineral assemblage. Dusty to fresh K-feldspar, chert, quartzite, micaceous schist, volcanic and mudstone lithics, and muscovite flakes are present in trace to minor amounts. Accessory grains of zircon and brown tourmaline are apparent. Authigenic minerals of quartz (overgrowths), clear carbonate spar, rounded grains of bright green glaucony (glauconite) and kaolin booklets are evident in minor amounts, whilst traces of blocky barite and minute pyrite framboids are also present. Carbonate has embayed framework grains, whilst carbonate, kaolin and barite fill intergranular pores.

4.11 La Bella #1, sample 91, depth 2345.0m RT, Lower Shipwreck Group, water zone

Rock Name Litharenite

Thin section description

Texture:

The sample has been moderately disrupted by sidewall coring. It is a medium grained, texturally submature and mineralogically immature litharenite. Regions that have retained textural integrity illustrate that framework grains are moderately well sorted, subrounded to rounded and of moderate sphericity. Grain size ranges in diameter from approximately 0.07mm (very fine sand) to 0.35mm (medium sand). Texturally the litharenite is framework grain supported, with contacts between harder minerals typically at tangents. Moderate compaction has resulted in squashing and distortion of soft lithic grains. No sedimentary structures are apparent.

Porosity:

Deformation of soft lithics into pores has reduced porosity. Fracturing and displacement of grains during sampling has caused most of the porosity that is evident. Nevertheless, primary intergranular pores are apparent between quartz overgrowths (Fig. 6), and unobstructed pore throats are noted in minor instances. Permeability may be moderate at this depth. Dissolution of feldspars along crystallographic axes has resulted in honeycomb porosity, and a minor proportion of grain sized and oversized pores may indicate complete dissolution of labile minerals.

Visual Estimate of Composition		%
Framework grains	Quartz	45
	Feldspars	6
	Lithics	18
	Mica	tr
	Accessory minerals	tr
Matrix	Clays	tr
	Opaque material	1
Authigenic minerals and cements	Quartz	2
	Carbonate	6
	Pyrite	1
	Kaolin	10
	Glaucony	4
Porosity	Intergranular	5
	Dissolution	1

Framework grains:

Quartz is dominantly monocrystalline, with straight extinction, mineral inclusions of rutile needles, muscovite, biotite and scarce fluid vacuoles. Polycrystalline quartz is a minor component, this commonly has straight crystal boundaries and slightly undulose extinction. Kaolinised K-feldspars (some with microcline twinning) and a lesser quantity of fresh to dusty plagioclase are present. The dominant lithic component is a very fine grained, argillaceous rock in which the illite is commonly aligned. The latter suggests the lithics are either shale or phyllite. The next most abundant lithics do not show alignment of the clays and contain distinct grains of quartz or feldspar. These lithics are probably of volcanic origin. Other lithics include devitrified glass, chert which is streaked with minute opaques (?haematite), chalcedonic chert and micaceous quartzite. One grain of chalcedony has a distinctive iron staining. Flakes of muscovite are up to 0.5mm long and show splayed terminations. Rarely rounded grains appear to have been replaced by muscovite. The only accessory mineral is rounded, very fine sand sized grains of zircon.

Matrix:
Rare patches of brown, illitic detrital clays are associated with minute flecks of opaque material (?organic matter).

Authigenic minerals and cements:
Carbonate has a patchy distribution throughout the sample. Clear poikilotopic blocky carbonate spar has filled intergranular pores, crystallised along cleavage planes of mica flakes and partially replaced framework grains. Micrite and subhedral rhombs of reddish brown carbonate have partially replaced lithics. Massive pyrite has filled pores after development of quartz overgrowths, which are embayed by pyrite. Quartz overgrowths are outlined by druse and dust rims containing fluid inclusions. Rare grains have at least two dust rims indicating that there has been more than one phase of silicification. Jagged contacts are apparent between quartz overgrowths and pores filled with kaolin. Booklets of subhedral to anhedral kaolin up to 50 microns in diameter have crystallised in pores and replaced mica flakes. Typically the finer kaolin is anhedral and pore filling. Deformed grains of glaucony show remnants of the wormy texture typical of glauconite but have been extensively replaced by illite making recognition difficult. Other grains have only been partially replaced by glaucony.

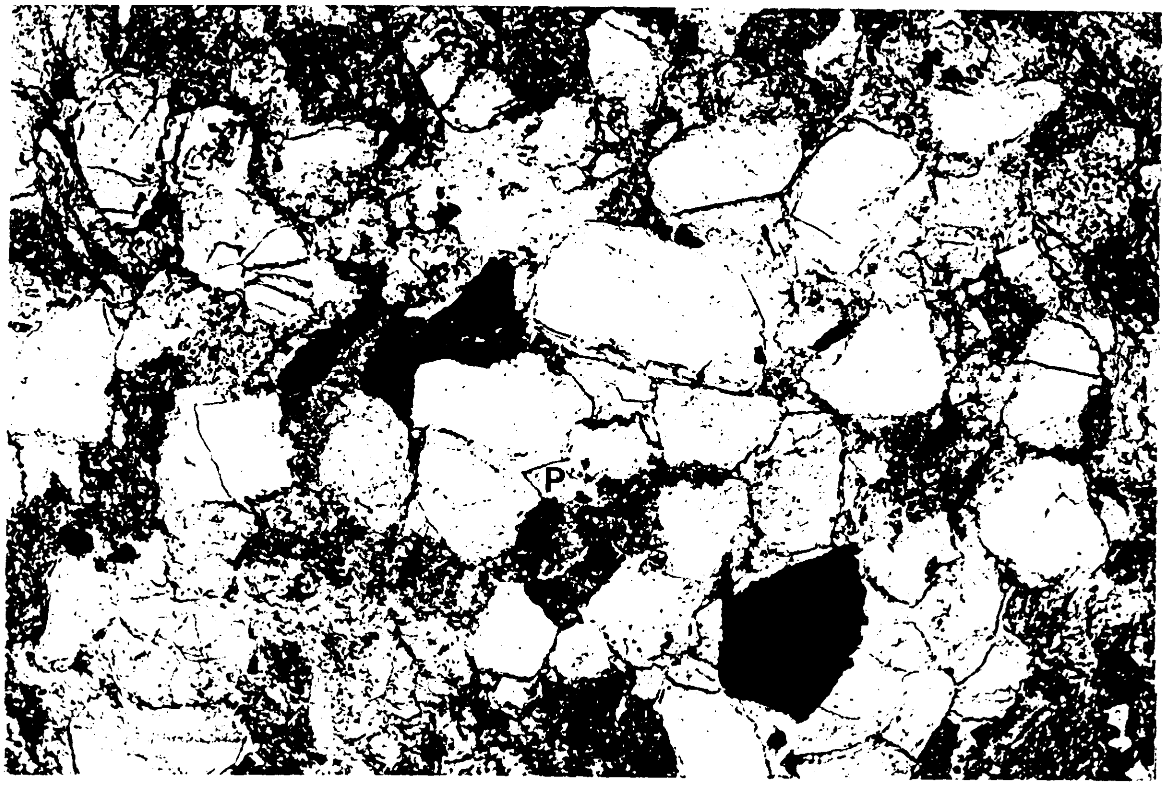


Figure 6. Primary intergranular pores (P) are evident in this litharenite. Note distortion of brown lithics which has resulted from moderate compaction. Pale yellow kaolin has crystallised in minor pores. La Bella #1, sample 91, depth 2345.0m. Plane light. Field of view 2.6mm.

4.12 La Bella #1, sample 82, depth 2451.5m RT, Lower Shipwreck Group, water zone

Rock Name Litharenite

Thin section description

The sample is a coarse grained, mineralogically immature and texturally submature litharenite. Subangular to rounded, poorly sorted, moderately spherical framework grains range in diameter from approximately 0.15mm (fine sand) to 4.2mm (pebbles). Coarser grains tend to be better rounded. The grain supported litharenite has mainly tangential contacts between quartz grains, and compaction has deformed soft lithic fragments. A vague alignment of elongate grains is evident and may indicate the direction of bedding. Three features outlined by reddish brown carbonate lie parallel to this direction. They range from 1mm to 5mm in diameter, are irregular to elliptical in shape and one is filled with kaolin. It is possible that these features are cross sections of channels caused by burrowing organisms. Most porosity is considered to be an artefact of sample disruption, but there are minor examples of primary intergranular pores. These are isolated and permeability will be very low. Honeycombed feldspars indicate porosity gains caused by secondary dissolution.

The common volcanic/plutonic variety of quartz is dominant. Lithics are similar to those described from 2345.0m and include shale/phyllite, volcanics, chert and quartzite. Plagioclase and K-feldspar, muscovite and altered biotite are minor components and there are rare rounded zircons. Authigenic minerals of carbonate, kaolin, quartz and glaucony are evident. Rhombs of spar that commonly have dark cores rim grains, whilst clear spar fills pores. Kaolin booklets fill pores and have replaced grains. Syntaxial quartz overgrowths contain fluid inclusions but these overgrowths are isolated in distribution. Distorted glaucony (glauconite) grains are rare.

4.13 La Bella #1, sample 76, depth 2522.0m RT, Lower Shipwreck Group, water zone

Rock Name Litharenite

Thin section description

Texture:

The sample has been moderately to extensively disturbed by sidewall coring, with patches that illustrate displacement and fracturing of grains. Elsewhere, grains show little disruption and texture can be reliably assessed. The sample is a coarse grained, mineralogically and texturally submature litharenite. Framework grains range from 0.15mm (fine sand) to 2.1mm (granule) in diameter, they are poorly sorted, subrounded to rounded and of moderate sphericity. Texturally, the litharenite is supported by grains that have dominantly tangential contacts. Compaction has resulted in distortion of most lithic fragments (Fig. 7). Weak alignment of grains could be due to grain rotation during compaction or bedding.

Porosity:

Primary intergranular pores are rarely evident due to occlusion by deformed grains and precipitation of authigenic cements. Permeability is limited to low values for similar reasons. However, examples of primary pores are noted between quartz overgrowths and minor lithics (Fig. 7). In addition, honeycombed felspars indicate partial dissolution along crystallographic axes and secondary porosity.

Visual Estimate of Composition		%
Framework grains	Quartz	45
	Feldspars	8
	Lithics	25
	Mica	tr
	Accessory minerals	tr
Matrix		nd
Authigenic minerals and cements	Quartz	tr
	Carbonate	10
	Pyrite	tr
	Kaolin	5
	Glaucony	tr
Porosity	Intergranular	5
	Dissolution	1

Framework grains:

Quartz is dominantly monocrystalline, with straight extinction and mineral inclusions of tourmaline, muscovite and apatite. Polycrystalline quartz displays either sutured or straight crystal boundaries and has undulose extinction. Feldspars range from slightly dusty to extensively sericitised examples of plagioclase and lesser amounts of K-feldspar (microcline). A minor amount of plagioclase contains mineral inclusions of muscovite and apatite. Lithics are interpreted to be dominantly of metamorphic and volcanic derivation. Metamorphic lithics of shale/phyllite and quartzite are evident. Inequigranular, trachytic, granophyric and glassy textures represent the volcanic lithics. Non volcanic lithologies are represented by chert. Flakes of biotite are typically partially chloritised. Green tourmaline and rounded grains of silt to fine sand sized zircon are evident as accessory minerals.

Authigenic minerals and cements:

Rare quartz overgrowths are apparent due to euhedral terminations and rounded dust rims that outline detrital grains. Where two dust rims are present, this indicates an earlier inherited overgrowth. At least two phases of carbonate are evident. Coarse, poikilotopic clear spar has precipitated between and embayed framework grains. Lesser amounts of yellowish cereal grain shaped crystals of carbonate spar (scalenohedra approximately 0.05mm in diameter) have crystallised at grain margins and partially replaced lithics. In addition there is a phase of reddish brown micrite that has a very patchy distribution. Pyrite is associated with chloritised biotite and has precipitated within chert lithics. Kaolin booklets, up to 20 microns in diameter, have precipitated in pores. Rounded and deformed grains of bright green glaucony are composed of glauconite and traces of illite. Some framework grains are partially replaced by glaucony.

Figure 7. Compaction has distorted brown to dusty lithics but has not affected quartz (clear) and feldspar (F). Note that carbonate is present as cereal grains (arrows) and spar (S). Primary intergranular porosity (blue) is evident between framework grains. La Bella #1, sample 76, depth 2522.0m. Plane light. Field of view 1.0mm.

4.14 La Bella #1, sample 63, depth 2683.0m RT, ?Otway Group

Rock Name Litharenite

Thin section description

The sample is a fine grained, mineralogically and texturally submature litharenite. There has been minor disruption due to sampling. Framework grains range in diameter from approximately 0.5mm (coarse silt) to 0.55mm (coarse sand), are moderately sorted, subangular to subrounded and of low to moderate sphericity. Framework grains support the litharenite with contacts at points and tangents. Moderate compaction has distorted soft lithic grains whereas quartz and feldspar are relatively unaffected. Alignment of framework grains could be due to rotation during compaction or indicates the presence of bedding. Primary intergranular pores are present in minor patches, but these are isolated and permeability is likely to be low. Rare honeycombed feldspars indicate dissolution porosity.

Quartz and lithics (metamorphic and volcanic) are co-dominant. Quartz is monocrystalline and polycrystalline with mainly straight extinction. Dusty to sericitised plagioclase and K-feldspar is minor, whilst muscovite, chloritised biotite, and zircon occur in trace to minor amounts. Detrital clays that rim grains are illitic or chloritic in composition. There are patches where the clay appears to have been oxidised. Stringers of opaque material are present and probably composed of organic matter. Authigenic minerals of quartz (overgrowths), carbonate, pyrite, kaolin and glaucony are evident. Slightly dusty spar cements and partially replaces framework grains, whilst light brown rhombic carbonate (with dark cores) is concentrated in irregular patches associated with reddish micrite. Subhedral booklets of kaolin occur in pores. Glaucony occurs as deformed and rounded bright green grains and has partially replaced framework grains.

5. DISCUSSION

a) Reservoir quality

Samples from La Bella #1 have variable reservoir quality that ranges from very poor to good. Grain size, sorting, and the presence of ductile lithics and authigenic cements have controlled porosity and permeability. It is important to note that the accuracy of visual estimates of reservoir quality in this report are limited by the disrupted nature of the sidewall cores.

Good reservoir quality has been retained in the thin sand of the Upper Shipwreck Group at 2071.5m due to coarse grain size and good sorting. Within the main hydrocarbon zone there are minimal authigenic cements and detrital clays that would limit reservoir quality. However, the presence of bedding with alignment of grains may have slightly reduced porosity and permeability. Where bedding is absent in the water zone at 2168.5m reservoir quality is again interpreted as good. Primary intergranular pores are dominant in all these samples and it is highly likely that pores are interconnected.

In the sample from the Sherbrook Group (depth 2009.0m), porosity has been reduced by poor sorting and carbonate cement. Similar controls operated in the Upper Shipwreck carbonate cemented nodule (2094.4m) and very fine grained quartzarenite (2102.5m) which could also represent a nodule. Reservoir quality is significantly reduced in the Lower Shipwreck samples due to deformation of ductile lithics, bedding and an increase in the proportion of authigenic cements.

b) Lithology and mineralogy

Lithologically the samples show a distinct break between the Upper and Lower Shipwreck Group. The Upper Shipwreck Group is dominated by quartzarenites and the Lower Shipwreck by litharenites. There are no significant changes in mineralogy apparent from these samples immediately above and below the hydrocarbon-water contact at approximately 2156m. It is possible that high gamma responses over this interval could be caused by concentrations of heavy minerals in thin lags that have not been intersected by the present samples. Furthermore, permeability in the hydrocarbon reservoir has not been limited by detrital or authigenic clays since these represent less than 4% of the total rock volume.

Sherbrook Group

The Sherbrook Group sample from 2009.0m is a texturally immature and mineralogically submature sublitharenite which contains 5% glaucony. Comparison of this fine grained, poorly sorted sublitharenite with the thin sand in the Upper Shipwreck Group at 2071.5m shows distinct differences in the lithology and mineralogy. The Sherbrook sample is finer grained, more poorly sorted, bioturbated and contains higher proportions of lithics, detrital clay and authigenic minerals (glaucony and carbonate).

Similarities between the Sherbrook Group sample and any of the other Upper Shipwreck Group samples are not pronounced. Even samples with a similar fine grain size at 2102.5m, 2121.0m, 2153.0m, 2168.5m and 2205.0m do not have the same sorting and hence high percentage of detrital clay. This suggests that there are differences in the depositional environment. The higher percentage of glaucony in the Sherbrook Group sample tends to support this hypothesis. Furthermore, differences in the mineralogy may reflect subtle variations in sediment provenance. The maximum percentage of lithics in the Upper Shipwreck Group is 1% and that contrasts with the Sherbrook Group where 3% lithics were detected. Detrital feldspars in the Sherbrook Group consist of plagioclase and K-feldspars whereas in the Upper Shipwreck Group only K-feldspars were recognised.

Upper Shipwreck Group
Samples from the hydrocarbon and water zones are all very fine to medium grained, poor to well sorted quartzarenites. Framework grains are comprised of quartz, K-feldspars (except at 2134.0m), lithics, mica (muscovite and biotite) and accessory minerals (zircon, tourmaline and rare epidote). Quartz is dominantly monocrystalline with rare examples of polycrystalline quartz. Lithics of chert, schist and quartzite are common. Rare volcanics at the base of the Upper Shipwreck Group (2281.5m) are remnants of the change from the Lower Shipwreck Group.

Authigenic minerals of quartz, carbonate, pyrite, kaolin, glaucony and barite are present. Barite is restricted to trace amounts of blocky cement at a depth of 2281.5m. Multiple phases of carbonate cement are apparent including Fe stained micrite, dusty spar and clear spar. High proportions (40%) of carbonate are evident in the siderite nodule at 2071.5m and the quartzarenite from 2102.5m. Kaolin has filled pores, channels and replaced grains and is most abundant at the boundary with the Lower Shipwreck Group.

Lower Shipwreck Group
Three samples from this group illustrate the marked change in lithology from quartzarenites to litharenites. The litharenites are medium to coarse grained and moderately well to poorly sorted. Quartz is similar to that described for the Upper Shipwreck Group, whereas feldspars are dominated by plagioclase rather than K-feldspar. Lithics are dominated by metamorphic and volcanic fragments with rare chert and represent up to 33% of the total volume. The high illite content of these lithics could have influenced the gamma log in this interval. Other framework grains of mica and zircon are apparent. Detrital illite and opaque stringers are described from 2345.0m, and authigenic minerals of quartz, carbonate, pyrite and kaolin occur in varying amounts. Carbonate spar is the dominant cement and the proportion of kaolin is greatest adjacent to the contact with Upper Shipwreck Group.

?Otway Group
The ?Otway Group is represented by a fine grained, moderately sorted litharenite taken from 2683.0m. It is mineralogically similar to litharenites from the Lower Shipwreck Group, but has more detrital illitic/ chloritic clay. Lithics are similar in composition and show a slight increase in the proportion of volcanic fragments.

c) Sediment provenance and depositional environments
During the depositional history of this suite of samples there have been significant changes in sediment provenance. For the Sherbrook Group sample at 2009.0m sediments were probably derived from a volcanic/plutonic craton. This hypothesis is based on the nature of quartz and presence of minor plagioclase feldspar. However, there are metamorphic and sedimentary lithics which indicate some input from these rocks. Distances of transport may have been moderate, and the fine grain size and presence of detrital clays indicates that deposition was from currents of low strength.

Upper Shipwreck Group sediments were either derived from a stable craton or have been extensively reworked. The source rocks may have been granitic, as potassic feldspars are present. However, there has also been sediment input from sedimentary and metamorphic terranes as suggested by the schist, chert and mudstone lithics, and rare polycrystalline quartz with sutured crystal boundaries. Rare volcanic lithics at the base of the Upper Shipwreck Group (depth 2281.5m) reflect a gradual change in sediment provenance or confirm that there has been reworking. The sample from 2153.0m has a bimodal grain size which indicates mixing of sediments from two sources. Furthermore, the polycrystalline nature of coarse quartz crystals in this sample indicates relatively short distances of sediment transport and rapid deposition.

During the time of deposition of Lower Shipwreck and ?Otway sediments, the dominant provenance was a metamorphic/ volcanic terrane. This is apparent from the abundance of lithics and plagioclase feldspar, and nature of quartz grains. However, there are chert and inherited quartz overgrowths at 2522.0m which suggest some input from a sedimentary source. The presence of fresh feldspars and soft lithics suggests that distances of transport were relatively short, and/or that there was uplift in the source area. The fine grain size and presence of detrital clays in the ?Otway Group sample (2683.0m) may indicate that current strength was relatively low, whereas cleaner and coarser sands are evident in samples from the Lower Shipwreck Group, which exemplify deposition from currents of moderate strength.

Samples from the Sherbrook, Upper and Lower Shipwreck and ?Otway Groups all appear to have been deposited in a variety of shallow marine environments. The Sherbrook sample contains a slightly higher percentage of glaucony than the other sediments and this suggests that deposition occurred in a zone of relatively low sedimentation. The fine grain size, presence of muddy laminae and burrows confirm the low energy environment. Circumgranular/ isopachous cements in the sublitharenite are indicative of a marine phreatic zone (eg low intertidal and subtidal environments). The GR trace suggests deposition in a channel or tidal sand ridge. Given that the glaucony is fresh there would appear to have been no exposure and this supports the hypothesised subtidal depositional environment.

Upper Shipwreck Group sediments may have been deposited during deltaic progradation, as the GR trace illustrates a series of coarsening upwards cycles. Facies variations within this sequence are apparent. The sand at 2071.5m is probably a channel or distal bar within the bioturbated silts and muds of either a flood plain / marsh on a delta plain or deeper water prodelta deposits. Coarse grain size tends to favour the delta plain depositional environment near to the sediment source. Siderite nodules (eg at 2094.4m) in the bioturbated sediments probably formed at shallow burial depths (less than 10m) where there was mixing of fresh and marine waters. Preservation of organic matter in the nodules suggests high rates of sediment deposition combined with rapid cementation which is consistent with the lack of glaucony. The presence of filamentous structures in the associated sediments and nodules may indicate the influence of micro-organisms (?algae) in the precipitation of carbonate. Isopachous rims on micas in the nodules show that this was a marine phreatic zone. A similar depositional environment is envisaged for the carbonate cemented quartzarenite at 2102.5m. The fine to medium grained, moderately to well sorted quartzarenites at depths of 2121.0m, 2134.0m, 2168.5m, 2205.0m and 2281.5m may have been deposited on the delta front rather than the delta plain. This hypothesis is based on the cleaner nature of these sediments and the lack of obvious bioturbation. The poorly sorted quartzarenite from 2153.0m has a bimodal grain size that may indicate sediment mixing in a slightly different facies to that of the delta front. It is possible that this sample represents a channel which has reworked sediment from a coarser sand ridge.

Lower Shipwreck and ?Otway Group samples (depths 2345.0m, 2451.5m, 2522.0m and 2683.0m) typically are coarser sands with higher percentages of labile grains than the Upper Shipwreck Group. These characteristics suggest that rapid deposition occurred closer to the sediment source and possibly in shallower water or higher energy channels than the Upper Shipwreck Group. High concentrations of altered lithics have probably influenced the gamma log over this interval.

d) Diagenetic alteration

Typically sediments have been diagenetically altered by similar processes but to varying degrees. There have been early authigenic minerals of glaucony, siderite and pyrite, a phase of compaction and later authigenic cements and minerals of quartz, carbonate, kaolin and barite. This sequence also included a phase of dissolution and was followed by the emplacement of hydrocarbons. Vague trends within the suite of samples can be identified:

1. Where early siderite cements are abundant either silicification has been inhibited or overgrowths were replaced (depths 2009.0m, 2094.4m and 2102.5m).

2. There are multiple phases of carbonate apparent, but the later phases of spar that are interpreted as burial cements, appear to increase in abundance with depth from the basal Upper Shipwreck (2205.0m) into the Lower Shipwreck and ?Otway Group samples.

3. There is no significant change in diagenetic alteration immediately above or below the current hydrocarbon-water contact at 2156m.

4. Samples either side of the boundary between the Upper and Lower Shipwreck Groups (depths 2281.5m and 2345.0m) have a relatively high concentration of kaolin.

5. Barite is restricted to one sample at a depth of 2281.5m.

In this suite of samples glauconite was probably the first diagenetic mineral to precipitate as it forms at the sediment-water interface when pH is near 8, Eh is at the oxidation - reduction boundary and there is sufficient Fe^{2+} and Fe^{3+} available. Those samples which lack glauconite (2121.0m, 2134.0m and 2153.0m) probably had higher sedimentation rates or a stronger terrestrial influence. Later alteration of glauconite to illite probably occurred after burial when Fe was substituted by Al in the glauconite lattice. Intense alteration of glaucony noted in the litharenite from 2345.0m maybe related to flushing by meteoric waters or exposure when kaolin was precipitated.

Siderite nodules and cements (depths 2009.0m, 2094.4m and 2102.5m) were also early diagenetic, probably precipitating after shallow burial (less than 10m). This is suggested by muddy discontinuous laminae draped around the concretions and the presence of possible burrows in the nodules. Siderite precipitation is favoured by waters of high bicarbonate activity, low oxidation potential and extremely low concentrations of dissolved sulphide. These conditions prevail where there is a mixing of marine and fresh waters and abundant bacterial activity. Rapid deposition would have preserved the organic matter noted in the nodule. Septaria (fractures) in siderite nodules are thought by some workers to only develop in uncompacted water laden sediments. Those nodules which lack septaria could have precipitated later in the diagenetic sequence when compaction had reduced pore space available for carbonate precipitation. Carbonate spar and kaolin which fill the fractures in nodules may be related to deeper burial.

As the sediment was buried and conditions became more anoxic, an early phase of pyrite probably formed due to alteration of organic matter by sulphate reducing bacteria. Pyritisation is minimal in these samples and may reflect the low sulphide concentrations that favoured siderite precipitation. Later minor phases of pyrite have resulted from the alteration of biotite (2522.0m) and possible pyritisation of pore filling bitumen (2345.0m).

The isopachous and circumgranular cements formed when the sediment was buried below the water table so that pores were constantly filled with water. These cements are probably calcitic in composition and reflect alkaline pore waters.

After burial primary porosity would have been reduced by gradual grain rotation, followed by the deformation of soft lithics and bending of micas. Alteration and corrosion of lithics and feldspars was probably initiated during weathering prior to erosion and transport, but continued after deposition. Flushing by slightly acidic ground water with low K^+ would have dissolved some feldspars to produce secondary pores and released Si and Al for the precipitation of kaolin. Kaolin has also formed due to the alteration of micas. The high concentration of kaolin in samples adjacent to the boundary between the Upper and Lower Shipwreck Group could be related to either the abundance of lithics and feldspars, or flushing by meteoric waters during uplift or exposure. Dissolution of feldspars typically produces an excess of silica which could have contributed to the development of quartz overgrowths. Fluid inclusions are trapped within these overgrowths in samples from 2071.5m, 2345.0m and 2451.5m.

No petrographic relationships are apparent to indicate the relative timing for the precipitation of barite cement in the sample from 2281.5m If the barite was early it could be related to the depositional environment when evaporitic conditions prevailed in the deltaic setting. Alternatively barite could have precipitated from sulphate rich fluids circulating in the reservoir after deep burial.

Later burial carbonate phases were precipitated in pores and channels as clear spar and spar with dusty cores. The latter have probably recrystallised from micrite (neomorphism) and the former precipitated from solution when alkaline pore waters had high bicarbonate levels. The concentration of carbonate in the water zone of the Upper Shipwreck and Lower Shipwreck Groups may indicate either a closed circulation system within this section or that carbonate was removed from the hydrocarbon zone. Embayed margins of grains in samples from 2168.5m and 2071.5m may provide evidence of this dissolution. Removal of carbonate cement could be related to decarboxylation and the increase in pCO_2 prior to hydrocarbon migration. Emplacement of hydrocarbons has effectively prevented further diagenetic alteration, as is evident from the presence of ?reservoir bitumen filling pores in the sample from 2121.0m.

6. GLOSSARY

Boehm lamellae
Parallel trails of vacuoles in quartz which are thought to form during deformation (metamorphism) of grains.

Honeycomb Porosity
Secondary porosity produced by the corrosion (etching) of detrital grains.

Granophyric texture
Intergrowth of feldspar and quartz.

Inequigranular texture
A volcanic igneous texture where laths of feldspar are randomly arranged in a fine grained groundmass.

Isopachous cement
Carbonate cement of equal thickness that rims grains indicating marine phreatic (below the water table) conditions where pores were constantly filled with water.

nd
Abbreviation meaning not detected.

Neomorphism
All transformations between a mineral and the same mineral, or another of the same general composition.

Trachytic texture
A volcanic igneous texture where sub-parallel laths of feldspar occur in a fine grained groundmass.

Vacuole
Gas or liquid filled inclusion.

4.

BHP
Petroleum

BHP PETROLEUM PTY. LTD.

A.C.N. 006 918 832

GEOCHEMICAL EVALUATION OF LA BELLA-1

OTWAY BASIN

OFFSHORE VICTORIA AUSTRALIA

PREPARED BY: J. PRESTON
SENIOR GEOCHEMIST

0392.rep

DATE: March, 1994

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ENCLOSURES

1 INTRODUCTION

Following completion of the La Bella-1 well, a programme was undertaken to evaluate the source rock character and thermal maturity of the drilled sequence, and the fluids recovered from it.

The evaluation of source rock character firstly involved analysis of nine sidewall cores for total organic carbon (TOC) content by Geotech, Perth. All the samples analysed yielded a TOC greater than 1.0%, and were accordingly pyrolysed by the Rock-Eval method.

In an attempt to evaluate the thermal maturity of the La Bella-1 section, vitrinite reflectance measurements were made on nine SWCs from the wells.

During petrographic analysis of a core sample (from 2095.15-2095.20m), Amdel, Adelaide, reported a trace of hydrocarbon. The sample was sent to Geotech, Perth, for solvent-extraction and whole-extract GC analysis to determine the nature of this trace. TOC/Rock-Eval pyrolysis was also performed on this sample.

A further seven samples (two core fragments, four SWCs and one cuttings sample), from four separate reservoir units and an intra-formational claystone, were solvent-extracted in an attempt to establish the presence of residual hydrocarbons. All of the resulting extracts were analysed by the whole-extract GC method; five extracts (from one core, three SWCs and one cuttings sample) were then separated by liquid chromatography, and analysed by saturate-fraction GC, SIR GC-MS (branched/cyclics), and SIR GC-MS (aromatics) techniques.

Two gas samples, recovered by RFT from 2072.8m and 2160.5m, were analysed by CSIRO, North Ryde, for their chemical and stable carbon isotopic compositions. Finally, in an attempt to gain more information relating to the source of the gases and their associated fluids, the RFT gas samples were subjected to cold-trapping by Petrolab, Adelaide, and two condensate samples isolated. These liquids were then analysed by whole-oil GC, separated, and analysed by the saturate fraction GC, GC-MS (branched/cyclics) and GC-MS (aromatics) techniques.

This report provides a compilation of the petroleum geochemistry data obtained from the La Bella-1 well, together with an interpretation of these data.

2 SOURCE ROCK CHARACTERISATION

2.1 Screening Analyses

2.1.1 Total Organic Carbon (TOC)

As indicated in Table 1-1, the ten samples analysed for total organic content (TOC) originated in the Late Cretaceous Sherbrook and Shipwreck Groups. Although 0.5% TOC is commonly used as the minimum requirement for a petroleum source rock, it is uncommon for sediments from the southern margin of Australia with less than 1.0% TOC to be significant petroleum sources. On the basis of ten samples, it is clear that the Late Cretaceous section in La Bella-1 contains significant potential petroleum source rocks, their TOC values ranging from 1.10-2.35% (Table 2, Figure 1 and Enclosure 1). Note that one sample, from 2540.5m, consisted of coal (TOC=73.30%).

2.1.2 Rock-Eval Pyrolysis

All ten samples (in which the TOC was found to exceed 1.0%) were pyrolysed using the Rock-Eval method. Nine of these samples from 1563-2528m, gave HI values of 94-183 and S1+S2 yields of 1.62-4.61 mg/g TOC (Figures 2 and 3), indicating fair to moderate generative potential for gas and condensate, with perhaps minor amounts of light oil. The data from the 2540.5m sample (HI=258) suggest that there is greater potential for liquids generation in the coals.

It is clear from the S1+S2 yields of the La Bella-1 samples that expulsion, if any, would be possible only at relatively high levels of thermal maturity. At such levels of thermal maturity, considerable secondary cracking of liquids to gas would occur, such that these source rocks would perhaps be more "gas prone" than indicated by the source character data.

The Rock-Eval pyrolysis data listed in Table 2 are summarised in the form of crossplots in Figures 4 and 5. Figure 4 reflects the overall quality of the kerogen in the samples analysed, in terms of their oil-prone or gas-prone character: most samples plot in the gas/condensate-prone Type II/III and Type III areas of the diagram (HI < 200). The more liquids-prone character of the coal sample is reflected in its more obvious Type II affinity. Figure 5 reflects the generative capacity of the samples, in terms of their overall quantitative potential; only the coal sample approaches the threshold of significant hydrocarbon generation and expulsion, the remainder failing due to thermal immaturity (the Tmax of the 2232m sample is regarded as anomalously high).

Maceral petrography associated with the vitrinite reflectance determinations shows that the organic matter in most of the samples is dominated by inertinite, followed by vitrinite (Figure 6). However, liptinitic/exinitic (Type II) macerals are identified in all samples except the 2540.5m coal (described as 100% vitrinite), confirming the presence of some liquids-prone components. In the Sherbrook Group, the Type II macerals are supplemented by oil-prone alginitic (Type I) macerals, a reflection of the perhaps marginal-marine affinity of these sediments.

2.2 Thermal Maturity

Rock-Eval parameters which are often used for maturity assessment are Tmax and Production Index (PI). A Tmax value of 435°C, and a PI value of 0.10, are regarded as marking the entrance to the oil-generative window.

As Table 2 and Figure 7 show, values of Tmax range from 423-440°C, with one anomalous value of 449°C. Values of PI (Figure 8) are less than 0.10 in the Shipwreck interval (below 2095m), but range from 0.13-0.21 in the overlying Sherbrook Group. There is therefore an agreement between the maturity estimates based on the PI and Tmax data in the Shipwreck Group, namely that this section is thermally immature to marginally mature.

Vitrinite reflectance measurements on nine samples from the 1563-2646.5m interval do not exceed 0.70% (see Table 3/ 3A and Figures 9 and 10). Values for five samples in the Shipwreck Group (2232-2646.5m) occupy the 0.62-0.67% range, concurring with the marginally mature estimate based on Rock-Eval data. With the exception of a value of 0.68% at 1979m, the Sherbrook Group can be considered to be thermally immature.

Because kerogens will generate products with markedly different compositions as thermal maturity progresses (Horsfield, 1989), it follows that certain analyses and the interpretation of their results will be fundamentally affected by maturity, in particular Rock-Eval pyrolysis data. The observation that the drilled interval has not attained thermal maturity means that this need not be a consideration in the interpretation of geochemical data from the La Bella-1 well. The poor source quality of parts of the drilled sequence cannot be attributed to advanced thermal maturity.

3 FLUIDS CHARACTERISATION

3.1 Whole-Oil GC Analysis

Two condensate samples from the La Bella-1 well were analysed by the whole-oil GC method. These samples were obtained by the cold-trapping of gas samples from 2072.8m and 2160.5m.

The whole-oil GC data for these two samples are presented in Tables 4 and 5; the corresponding whole-oil GC traces are shown in Figure 11 (C_1 -C_{33} range), Figure 12 (C_1-C_8 gasoline range), and Figure 13 (normalised plots). Compound abundances normalised from the whole-oil GC data are compared in Figure 14.

Paraffin Index data from the two condensates are plotted in Figure 15, and suggest (if taken at face value) that the condensates were expelled from their source rocks at about 135°C.

3.2 Whole-Extract GC Analysis

During petrographic analysis of a core sample (2095.15 - 2095.20m), Amdel Laboratories, Adelaide, reported a trace of hydrocarbon. The sample was sent to Geotech, Perth, for solvent-extraction and whole-extract GC analysis to determine the nature of this trace. A further seven samples (two core fragments, four SWCs and one cuttings sample), from four separate reservoir units and an intra-formational claystone, were solvent-extracted in an attempt to establish the presence of residual hydrocarbons. The resulting extract yields are listed in Table 6, and summarised in Figure 16. All the extracts were analysed by the whole-extract GC method, the GC traces being shown in Figures 17a-d.

As Figure 16 shows, the extract yields ranged from 244-784 ppm. These results, combined with the character of the whole-extract GC traces, suggest that the extracts are unlikely to represent residual saturations of mature migrated hydrocarbons, but instead appear to represent small amounts of indigenous, or very locally migrated, immature hydrocarbons. However, a more detailed evaluation of the extracts was warranted to confirm their character, and to determine any similarities between the compositions of the extracts and those of known migrated fluids (see below).

3.3 Saturate Fraction GC Analyses

Both condensate samples, and five of the eight sediment extracts, were separated into their constituent fractions by liquid chromatography, the separation data being listed in Tables 6 and 7, and summarised in Figure 18.

The saturate fraction of each condensate, and of each of the five extracts, was analysed by the saturate fraction GC method. The resulting saturate GC traces of the condensates are shown in Figure 19; the n-alkane distribution data are reported in Table 8, normalised in Figure 20, and compared in Figure 21. The saturate GC traces for the five sediment-extracts are shown in Figure 22a-c; the n-alkane distribution data are reported in Table 9, normalised in Figure 23, and compared in Figure 24.

The n-alkane compositional data for the condensates and sediment-extracts are listed in Tables 10 and 11 respectively, and summarised in Figures 25 and 26. The condensates and extracts alike contain Pr/Ph ratios over 4.0, and ratios of Pr/nC_{17} to Ph/nC_{18} greater than 2.3, suggesting that the extracts were derived from higher land-plant-derived organic material within source sediments deposited in oxic, terrestrial environments.

While the 2070m, 2097.7m and 2159m extracts each contain high molecular weight, odd-preferenced waxy components within their n-alkane distributions, the 2100-2110m and 2121m extracts show different characters. The 2100-2110m extract displays a conical hump of unresolved compounds in its higher molecular weight range, characteristic of a component of contamination in the extract. The 2121m extract contains proportionally few higher molecular weight compounds, though a subtle waxy hump is evident.

3.4 GC-MS (Branched/Cyclics) Analysis

The branched and cyclic compounds were isolated from the saturate fractions of the two condensates and five extracts and analysed by the SIR GC-MS technique. Selected m/z 191 (triterpane) and m/z 217 (sterane) biomarker distributions are given in Figures 27-33; full suites of mass fragmentograms are provided in this report as Appendices 1 and 3.

Detailed compound abundances and calculated parameters are listed in Tables 12 to 18; normalised compound abundances and values for calculated parameters for the m/z 191 ions (terpanes) are summarised in Figures 34a-40a, and for the m/z 217 ions (steranes) in Figures 34b-40b. Figures 41 and 42 compare normalised compound abundances and values of calculated parameters for the condensates and extracts.

3.4.1 Terpane Parameters

The relative abundance of C_{27} triterpanes, 18α(H)-hopane (Ts) and 17α(H)-hopane (Tm), is theoretically useful for the maturity assessment of medium to high maturity oils. With increasing maturity, more of the maturable C_{27} triterpane (Tm) is converted to the stable C_{27} triterpane (Ts). The relative amounts of Ts and Tm in the extracts show a strong predominance of maturable (Tm) over stable (Ts) (Ts/Ts+Tm = 5-17%), suggesting that they are thermally immature. By contrast, there is only a slight predominance of Tm in the condensates, implying greater thermal maturity. However, the Ts/Ts+Tm parameter is lithofacies-dependent, and should be used with some caution as an absolute indicator of thermal maturity (it is best used as a maturity indicator of oils from a common source of consistent organic facies).

Moretanes are diastereomers of the hopanes, and, being less stable than the latter, are destroyed more rapidly with increasing maturity. The moretane/hopane ratio decreases from about 0.80 in immature bitumens to values of 0.15-0.05 in mature source rocks and oils. The relative abundances of the C_{29} and C_{30} moretanes and hopanes in the extracts revealed a predominance of hopanes (moretane/hopane = 0.16-0.24), implying that they are perhaps marginally mature. Values of 0.06-0.12 in the condensates reflect their greater maturity. (Note that, like Ts/Ts+Tm, the moretane/hopane parameter is to some extent lithofacies-dependent, its value, for example, being higher in Tertiary source rocks.)

The C_{31}22S-hopane/C_{31}22R-hopane ratio can be used to assess thermal maturity. As maturity increases, the proportion of the 22S isomer increases at the expense of the biologically produced 22R isomer, until equilibrium is reached, at which point the 22S isomer accounts for about 60% of the mixture. This is achieved soon after the onset of oil generation (at about 0.60% VR, before significant oil generation has occurred), limiting the use of this parameter at higher levels of maturity. In the extracts and condensates, the 22S isomer accounts for 55-59% of the mixture, implying that isomeric equilibrium has been reached, and that the source rocks in both cases were thermally matured at least to the point of initial oil-generation. Note that the 22S isomer of the C_{32} hopanes forms 55-60% of the isomeric mixture, concurring with the C_{31} hopane data.

C_{28} 25,30 and 28,30-bisnorhopanes (BNH) are present in the extracts (Tables 14-1 to 18-1, and Figures 29-33), but are not reported for the condensates. While high concentrations of BNH are typical of petroleum from highly reducing to anoxic depositional environments (Peters and Moldowan, 1993), its presence in the La Bella-1 extracts is more likely the result of its derivation from the original (post-digenetic) free bitumen (S_0) in the source claystones. Concentrations of BNH from such a source are likely to fall during thermal maturation, which may explain the absence of BNH in the more mature condensates.

3.4.2 Sterane Parameters

The relative proportion of the geological 20S and biological 20R isomers of the C_{28} and $C_{29}\alpha\alpha\alpha$ (normal) steranes, expressed as the 20S/20S+20R ratios, is perhaps the most reliable biomarker maturity parameter (it is not greatly influenced by lithofacies variations). Equilibrium, when the 20S isomer forms about 52-55% of the mixture, is reached at, or around, 0.80% vitrinite reflectance. In the La-Bella-1 condensates the 20S isomer forms 51-53% of the C_{29} mixture, suggesting expulsion of the oil from its source sediment at, or beyond, 0.80% vitrinite reflectance, in contrast to the extracts in which the 20S isomer forms only 27-38% of the C_{29} mixture (reflecting their relative immaturity).

The relative proportions of C_{29} normal ($\alpha\alpha\alpha$) and iso-($\beta\beta\alpha$) steranes can be effective in assessing the thermal maturity of source rocks and oils. The normal ($\alpha\alpha\alpha$) steranes, produced biologically, become less dominant relative to the iso-steranes ($\beta\beta\alpha$) with increasing maturity, until equilibrium is reached at a value of $\beta\beta\alpha/(\beta\beta\alpha+\alpha\alpha\alpha)$ of about 67-71% (VR=0.90%). In the La Bella-1 condensates, the iso-steranes dominate the normal steranes ($\beta\beta\alpha/\alpha\alpha\alpha+\beta\beta\alpha$ = 58-60%), suggesting that the source rock was matured to 0.8-0.9% VR at the time they were expelled. The lower values of 37-40% in the extracts is a further reflection of their relative immaturity.

Diasterane/sterane ratios are affected by both thermal maturity and inorganic (lithological) characteristics of the source rock. Conversion of steranes to diasteranes is catalysed by clay minerals, so that diasterane/sterane ratios are typically low (less than 0.30) in carbonate source rocks and derived oils. A high-Eh (oxidising) depositional environment and increasing thermal maturity can each result in a high diasterane/sterane ratio. C_{29} diasteranes constitute 36-41% of the C_{29} normal/iso-/diasterane mixture in the La Bella-1 condensates, compared with 22-28% in the extracts, further reflecting the greater maturity of the condensates. It is difficult to make a better estimate of the absolute level of thermal maturity at which the condensates and extracts were expelled from their respective sources (the proportion of diasteranes in the extracts being partly dependent on lithofacies).

The general assumption about triterpane/sterane ratios is that steranes are derived mainly from algae and higher plants, whereas triterpanes come mainly from bacteria. However, the relationship between organic facies and triterpane/sterane ratio is complex, and cannot always be used with confidence. When absolute concentrations of biomarkers are high, high triterpane/sterane ratios are taken to indicate a high degree of microbial input; where concentrations are low, high ratios are taken to indicate greater contribution from land-plants than from algae. Low triterpane/sterane ratios together with high absolute biomarker concentrations, are associated with coals, shales and oils (eg. South East Asia and New Zealand); low ratios in conjunction with low absolute abundances may indicate a dominance of higher-plant and fungal material (Waples et al., 1991). Triterpane/sterane ratios as expressed by Ratio C in Figures 41b, 42b and 44b are low in the La Bella-1 condensates (0.34-0.62), and higher in the extracts (2.5-3.5), suggesting a dominance of higher land-plant material in the source sediments of the extracts.

Figures 43a and 43b, triangular plots of C_{27}, C_{28} and C_{29} normal steranes, show a dominance of C_{27} compounds, the data plotting within the marginal marine field. Note that S isomers of the normal steranes were reported for four of the extracts, and neither of the condensates, so that Figures 43a and 43b are constructed accordingly.

Figure 44a shows a crossplot of Pr/Ph ratios versus $C_{29}R/C_{27}R$ sterane ratios for the condensates and extracts, confirming the relatively oxic environment of deposition of the source sediments, but again reflecting lower-than-expected values for the sterane ratio.

Plots of $\beta\beta/(\beta\beta+\alpha\alpha)$ versus 20S/(20S+20R) for the C_{29} steranes are effective in describing and comparing the thermal maturity of source rocks or oils; data for any oils which plot away from the maturity trend-line in such plots should be re-examined in the light of the disagreement between the two parameters (Peters and Moldowan, 1993). As Figure 45 shows, data for the condensates plot together, high on a maturity trend-line which passes close to the 2097.7m extract to the origin; the other extract data, while confirming the relative immaturity of the extracts, are somewhat scattered (notably the 2070m and 2100-2110m samples), though this, in the light of the extract yield data, may be as much a function of analytical error and/or poor sample quality as true geochemical character.

A note of caution should be made regarding the use of biomarker data from condensates. Condensates are formed either from source rocks under high thermal stress or by phase-separation from an oil, and exist in the subsurface in the gas phase. These processes usually result in a significant variation in the values of important biomarker ratios and parameters in condensates compared with co-genetic oils. Although it is possible to compensate for the effect of maturity by selecting parameters which are relatively insensitive to maturity, it is very difficult to compensate for phase-change effects (Woodhouse, 1991). However, the biomarker data for the La Bella-1 condensates, notwithstanding these effects, differ from the biomarker data from the extracts to such a degree that it is unlikely that the two sets of fluids are co-genetic.

3.5 GC-MS(Aromatics) Analysis

The aromatics fractions from the 2072.8m and 2160.5m condensates from La Bella-1, together with those from five extracts, were analysed by the SIR GC-MS technique. Full suites of mass fragmentograms are provided in this report as Appendices 2 and 4. Detailed compound abundances, and parameters calculated from them, are listed in Tables 19-25.

The primary application of these data is for maturity assessment. Perhaps the most widely used parameter is the Methylphenanthrene Index (MPI-1), due to its better calibration against the vitrinite reflectance scale, equivalent values of which can be calculated (Radke et al, 1982). Figure 46a shows a plot of MPI-derived vitrinite reflectance values, $R_c(a)\%$, versus depth for the La Bella-1 condensates and extracts. The condensates give disparate values, the 2160m value (0.96%) being considered the more reliable in the context of other parameters. The extracts give values in the 0.71-0.80% early mature range; however, if MPI-1 values are converted according to a formula more consistent with Australian coals (Boreham et al, 1988), the $R_c(a)$ values fall within the 0.58-0.69% marginally mature range (Figure 46b), consistent with the measured vitrinite reflectance values over the same depth interval (see Figure 10). Note that this approach has the concomitant effect of reducing the R_c (a) values for the condensates to maturity levels inconsistent with other observations (see Gas Analysis Data).

Maturity estimates based on the TNR-1 (Trimethylnaphthalene Ratio) lie in the marginal-to-early mature range in the extracts (consistent with the MPI-1 and other data), and also in the condensates (inconsistent with other data). The MPR-1 (methylphenanthene ratio) parameter gives a late-oil mature estimate for the condensates and extracts alike (inconsistent with other maturity estimates for the extracts).

The relative abundances of certain aromatic compounds can be applied to source input assessment, particularly the degraded diterpanes, such as 1,2,5-TMN, 1,7-DMP, 1-MP and retene, which are thought to be derived from resin precursors in conifers (such as Araucariaceae, Cupressaceae and Podocarpaceae in the Jurassic to Lower Cretaceous of Australia). Source sediments which pre-date the appearance of such conifers in the Late Triassic will display different distributions of degraded aromatic compounds, so that the data provide a useful correlation tool. Figures 47a and 47b show crossplots of ratios involving these compounds, and show separate groupings of the condensates and extracts, implying different sources. This is consistent with the earlier inference that the extracts are indigenous to their depth interval, whereas the condensates represent migrated fluids.

3.6 Gas Analysis

Two gas samples, recovered by RFT from 2072.8m and 2160.5m in La Bella-1 were analysed by CSIRO, North Ryde for their chemical and stable carbon isotopic compositions. (Condensates isolated by cold-trapping these gases were analysed separately, the results of this work having already been discussed.)

3.6.1 Chemical Composition

The chemical compositions of the RFT gases are summarised in Tables 26 and 27, normalised in Figure 48a, and compared in Figure 48b. As expected, the gases are chemically very similar, containing 76-77% methane and 4.5-4.8% ethane by volume, together with 12-13% carbon-dioxide and 3.4-3.9% nitrogen.

3.6.2 Stable Carbon Isotopic Composition

The stable carbon isotope data for the two gases are listed in Table 28, and values for individual hydrocarbon species cross-plotted in Figures 49a and 49b. As these figures show, the carbon isotope compositions of the gases are very similar, leaving their co-genetic origin in little doubt. In addition, these figures indicate that the gases were expelled from their source rocks at thermal maturities equivalent to about 1.30-1.35% VR, early in the wet-gas-generative window.

Figure 50 is an attempt to characterise the gases in terms of the isotopic compositions of their methane components and the relative amounts of their C_2+ components. This plot suggests that the gases are non-associated (ie. they were not generated along with oil, but produced by the thermal cracking of oils) and that they were migrated from moderate depth. The plot also infers that their source may have been marine rather than humic.

4 CONCLUSIONS

Nine SWC samples, from the Late Cretaceous Sherbrook and Shipwreck Groups, were analysed for their TOC content. All these samples yielded values greater than 1.0%, and were accordingly analysed by Rock-Eval pyrolysis. A core sample from 2095.15-2095.20m was similarly analysed. The resulting data revealed a predominance of Type II/III to Type III, mainly gas/condensate-prone organic matter with HI values less than 200, with the exception of one coal sample (2540.5m) characterised by a more strongly Type II, liquids-prone organic facies. While liptinitic/exinitic (Type II) macerals were identified in most samples (supplemented by a sparse alginitic component in the Sherbrook Group), suggesting some liquids potential, it is clear from the S1+S2 yields that expulsion from these samples would be possible only at relatively advanced levels of thermal maturity; at such levels, secondary cracking of liquids to gas would occur, such that these source rocks would, in the event, become more gas-prone than indicated by the source character data.

Thermal maturity data, namely Tmax, PI and vitrinite reflectance measurements, suggest that the Sherbrook Group is thermally immature and the Shipwreck Group marginally mature. The generative potential of the source rocks discussed above has therefore not been realised at the La Bella-1 location. A further inference is that the quality of these source rocks can in no way be linked to advanced maturity, their relative leanness being more a function of the preservation state of their contained organic matter.

A trace of hydrocarbon was reported during petrographic analysis of the 2095.15-2095.20m core sample. The sample was therefore solvent-extracted to determine the character of any contained hydrocarbons. A further seven samples (two core fragments, four SWCs, and one cuttings sample), from four separate reservoir units and one intra-formational claystone, were solvent-extracted in an attempt to identify any residual hydrocarbons (namely, any hydrocarbons which represent the remains of an earlier saturation displaced by the existing gas accumulation).

The resulting extract yields were low (less than 800ppm). Each was analysed by the whole-extract GC method, and the nature of the GC traces, taken together with the low extract yields, did not offer any strong indication that the extracts represented residual hydrocarbon saturations. However, to be certain of this, five of the extracts were subjected to more detailed analysis, namely saturate-GC, GC-MS (branched/cyclics) and GC-MS (aromatics). Two condensates, acquired from the cold-trapping of the 2072.8m and 2160.5m RFT gases, were subjected to the same analytical sequence to determine any similarity between the compositions of the extracts and those of known migrated fluids.

The condensates and extracts alike revealed Pr/Ph ratios, and ratios of Pr/nC_{17} to Ph/nC_{18}, typical of land-plant derived organic matter in sediments deposited under relatively oxic conditions. However, the saturate-GC traces of the extracts showed significant variation. Three of the extracts contained high molecular-weight, odd-preferenced, waxy components within their alkane distributions (consistent with derivation from land-plants), while in a fourth only a subtle waxy hump was evident; the fifth showed a symmetrical hump of unresolved compounds typical of contamination.

The characters of the saturates-GC traces of the extracts compared with those of the condensates support the view that the extracts do not represent thermally mature, migrated hydrocarbons. GC-MS analysis of the branched/cyclic alkanes revealed fundamental differences in the biomarker distributions of the extracts and condensates which appear to be due more to differences in maturity than to differences in organic facies (though these may exist). In particular, C_{28}-bisnorhopanes, thought to be derived from post-diagenetic free bitumens in thermally immature claystones, are present in the extracts but not the condensates. Maturity estimates based on MPI-1 values from GC-MS analysis of the aromatic fractions of the extracts appear to concur with other maturity indicators from the interval, indicating the marginal maturity of the Shipwreck Group.

The analytical data, taken together, therefore suggest that the La Bella-1 extracts do not represent a residuum of thermally mature migrated fluids, but are instead indigenous to, or very locally migrated within, the marginally mature Shipwreck Group.

Two gas samples were recovered by RFT from 2072.8m and 2160.5m, consisting of 76-77% methane, 4.5-4.8% ethane, 12-13% carbon-dioxide, and 3.4-3.9% nitrogen. Interpretation of stable carbon isotope data from the gases suggests that they were expelled from their source rocks at thermal maturities equivalent to about 1.30-1.35% VR, early in the wet-gas-generative window, having been generated by the thermal cracking of liquids rather than in association with them.

REFERENCES

BOREHAM, C.J., CRICK, I.H., and POWELL, T.G., 1988, "**Alternative Calibration of the Methylphenanthrene Index Against Vitrinite Reflectance: Application to Maturity Measurements on Oils and Sediments**" Org. Geochem., 12, 289-294.

PETERS, K.E., and MOLDOWAN, J.M., 1993, "**The Biomarker Guide**" (Prentice Hall, 363pp).

RADKE, M., WELTE, D.H., and WILLSCH, H., 1982, "**Geochemical Study on a Well in the Western Canada Basin: Relation of the Aromatic Distribution Pattern to Maturity of Organic Matter**" Geoch. Cosomochim. Acta, 46, 1-10.

WAPLES, D.W., and MACHIHARA, T., 1991, "**Biomarkers for Geologists : A Practical Guide to the Application of Steranes and Triterpanes in Petroleum Geology**" (AAPG Mettrods in Exploration, No. 9, 91pp).

TABLE 1-1

GEOLOGIC & GENERAL DATA - SEDIMENTS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	GEOLOGIC PERIOD/EPOCH	GEOLOGIC AGE	FORMATION	PRIMARY LITHOLOGY	PERCENT PRIMARY	SECONDARY LITHOLOGY	PERCENT SECONDARY	SAMPLE TYPE	SAMP QUAL
1563.00	1563.00	L.CRET	-	SHERGP	-	-	-	-	SWC	-
1692.00	1692.00	L.CRET	-	SHERGP	-	-	-	-	SWC	-
1865.00	1865.00	L.CRET	-	SHERGP	-	-	-	-	SWC	-
1979.00	1979.00	L.CRET	-	SHERGP	-	-	-	-	SWC	-
2070.00	2070.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2071.20	2071.20	L.CRET	-	SHIPGP	-	-	-	-	COR	-
2095.15	2095.20	L.CRET	-	SHIPGP	-	-	-	-	COR	-
2097.70	2097.70	L.CRET	-	SHIPGP	-	-	-	-	COR	-
2100.00	2110.00	L.CRET	-	SHIPGP	-	-	-	-	CUT	-
2102.50	2102.50	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2121.00	2121.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2159.00	2159.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2232.00	2232.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2309.00	2309.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2454.00	2454.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2528.00	2528.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2540.50	2540.50	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
2646.50	2646.50	L.CRET	-	SHIPGP	-	-	-	-	SWC	-

N.B. Code definitions at end of table
- = No data

CODE DEFINITIONS FOR TABLE 1

GEOLOGICAL PERIOD CODES

L.CRET = Late Cretaceous

GEOLOGICAL AGE CODES

FORMATION CODES

SHERGP = Sherbrook Group
SHIPGP = Shipwreck Group

SAMPLE TYPE CODES

COR = Conventional Core
CUT = Cuttings
SWC = Sidewall Core

SAMPLE QUALITY CODES

CONTRA

GTS = Geote

TABLE 1-2

GEOLOGIC & GENERAL DATA - FLUIDS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	SAMPLE DESCRIPTION	GEOLOGIC PERIOD/EPOCH	GEOLOGIC AGE	FORMATION	SAMPLE TYPE	SAMPLE
2072.80	2072.80	GAS	L.CRET	-	SHIPGP	GAS	
2072.80	2072.80	RFT SAMPLE	L.CRET	-	SHIPGP	CON	
2160.50	2160.50	GAS	L.CRET	-	SHIPGP	GAS	
2160.50	2160.50	RFT SAMPLE	L.CRET	-	SHIPGP	CON	

N.B. Code definitions at end of table
- = No data

CODE DEFINITIONS FOR TABLE 1

GEOLOGICAL PERIOD CODES

L.CRET = Late Cretaceous

GEOLOGICAL AGE CODES

FORMATION CODES

SHIPGP = Shipwreck Group

SAMPLE TYPE CODES

CON = Condensate
GAS = Gas

SAMPLE QUALITY CODES

CONTRACTOR CODES

CSI = C.S.I.R.O
GTS = Geotechnical Servics

TABLE 2

TOC AND ROCK-EVAL PYROLYSIS DATA - SEDIMENTS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	TOC	TMAX	S0	S1	S2	S3	S1+S2	S2/S3	PI	PC	HI	OI
1563.00	1563.00	1.90	423	-	.73	2.82	.33	3.55	8.55	.21	.29	148	1
1692.00	1692.00	1.50	424	-	.50	2.21	.28	2.71	7.89	.18	.22	147	1
1865.00	1865.00	1.55	433	-	.30	1.85	.57	2.15	3.25	.14	.18	119	3
1979.00	1979.00	1.45	438	-	.23	1.56	.63	1.79	2.48	.13	.15	108	4
2095.15	2095.20	2.05	440	-	.18	1.92	.77	2.10	2.49	.09	.17	94	3
2232.00	2232.00	1.25	449	-	.18	1.90	2.01	2.08	.95	.09	.17	152	16
2309.00	2309.00	2.35	434	-	.31	4.30	3.27	4.61	1.31	.07	.38	183	13
2454.00	2454.00	1.60	440	-	.20	2.27	3.41	2.47	.67	.08	.21	142	21
2528.00	2528.00	1.10	440	-	.12	1.50	1.88	1.62	.80	.07	.13	136	17
2540.50	2540.50	73.30	428	-	7.00	188.97	2.61	195.97	72.40	.04	16.27	258	

TOC = Total organic carbon
S2 = HC generating potential
HI = Hydrogen index
TMAX = Max. temperature S2
S3 = Organic carbon dioxide
OI = Oxygen index
S0 = Volatile gaseous HC's
PI = Production index
\- = no data

CODE DEFINITIONS FOR TABLE 2

INSTRUMENT CODES

RE2 = Rock-Eval II

SAMPLE TYPE CODES

COR = Conventional Core
CUT = Cuttings
SWC = Sidewall Core

CONTRACTOR CODES

GTS = Geotechnical Servics

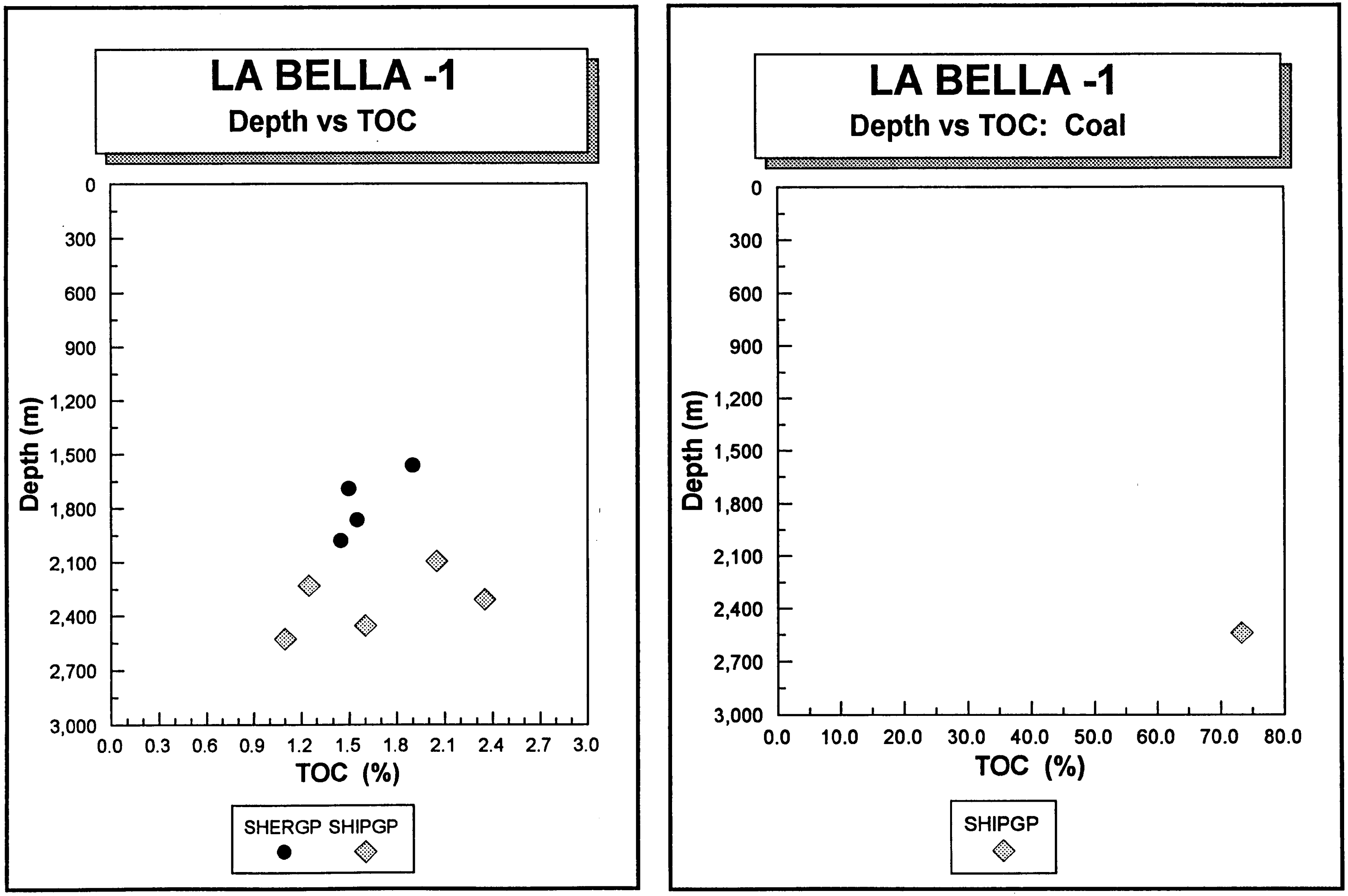

LA BELLA -1
Depth vs TOC
Depth (m)
0
300
600
900
1,200
1,500
1,800
2,100
2,400
2,700
3,000
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
TOC (%)
SHERGP
SHIPGP
LA BELLA -1
Depth vs TOC: Coal
Depth (m)
0
300
600
900
1,200
1,500
1,800
2,100
2,400
2,700
3,000
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
TOC (%)
SHIPGP

Figure 1

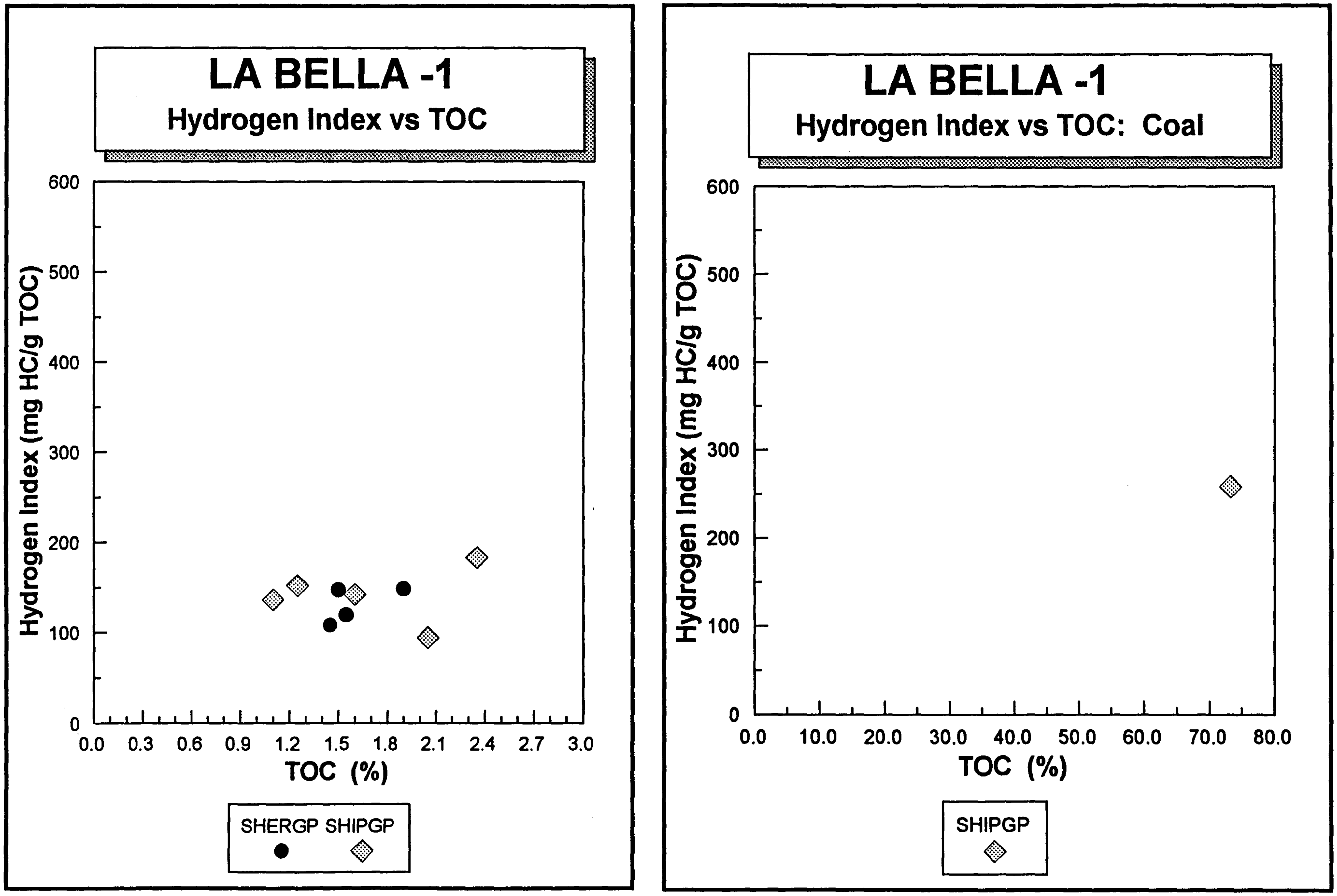

LA BELLA -1
Hydrogen Index vs TOC
Hydrogen Index (mg HC/g TOC)
0
100
200
300
400
500
600
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
TOC (%)
SHERGP
SHIPGP
LA BELLA -1
Hydrogen Index vs TOC: Coal
Hydrogen Index (mg HC/g TOC)
0
100
200
300
400
500
600
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
TOC (%)
SHIPGP

Figure 2

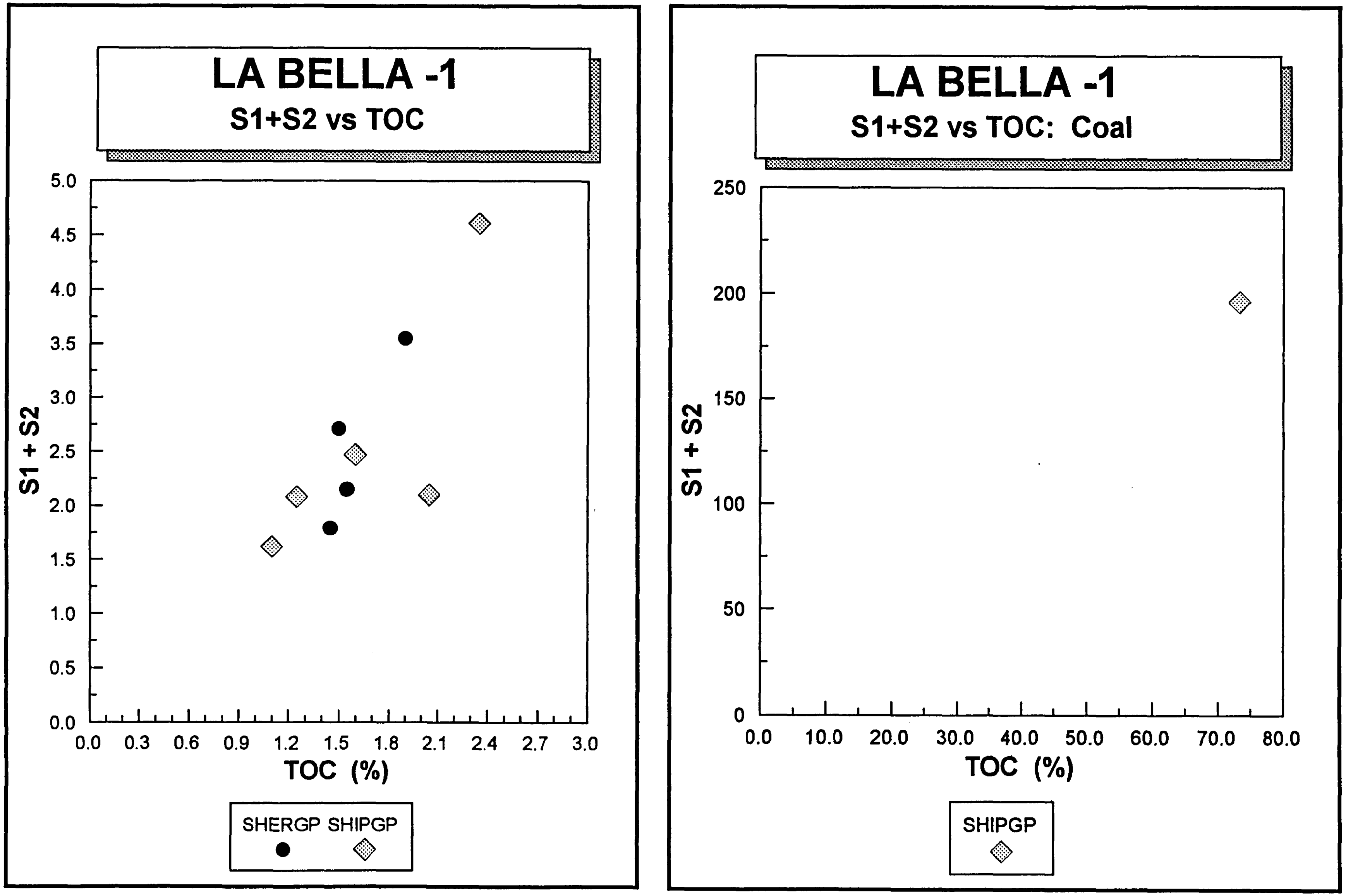
LA BELLA -1
S1+S2 vs TOC
S1 + S2
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
TOC (%)
SHERGP
SHIPGP
LA BELLA -1
S1+S2 vs TOC: Coal
S1 + S2
250
200
150
100
50
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
TOC (%)
SHIPGP

Figure 3

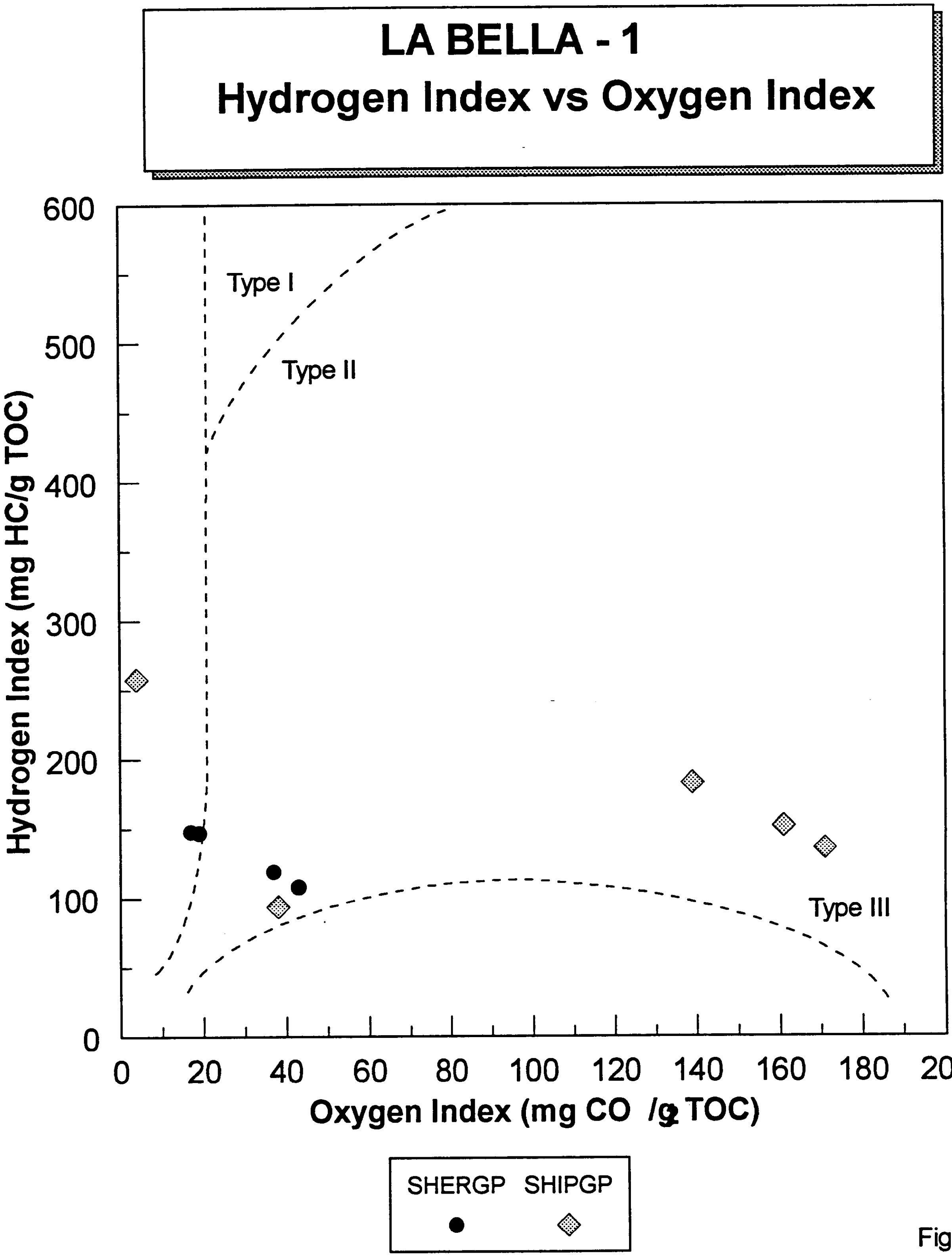

LA BELLA - 1
Hydrogen Index vs Oxygen Index
600
500
400
300
200
100
0
Hydrogen Index (mg HC/g TOC)
0
20
40
60
80
100
120
140
160
180
200
Oxygen Index (mg CO2 /g TOC)
Type I
Type II
Type III
SHERGP ●
SHIPGP ◈

Figure 4

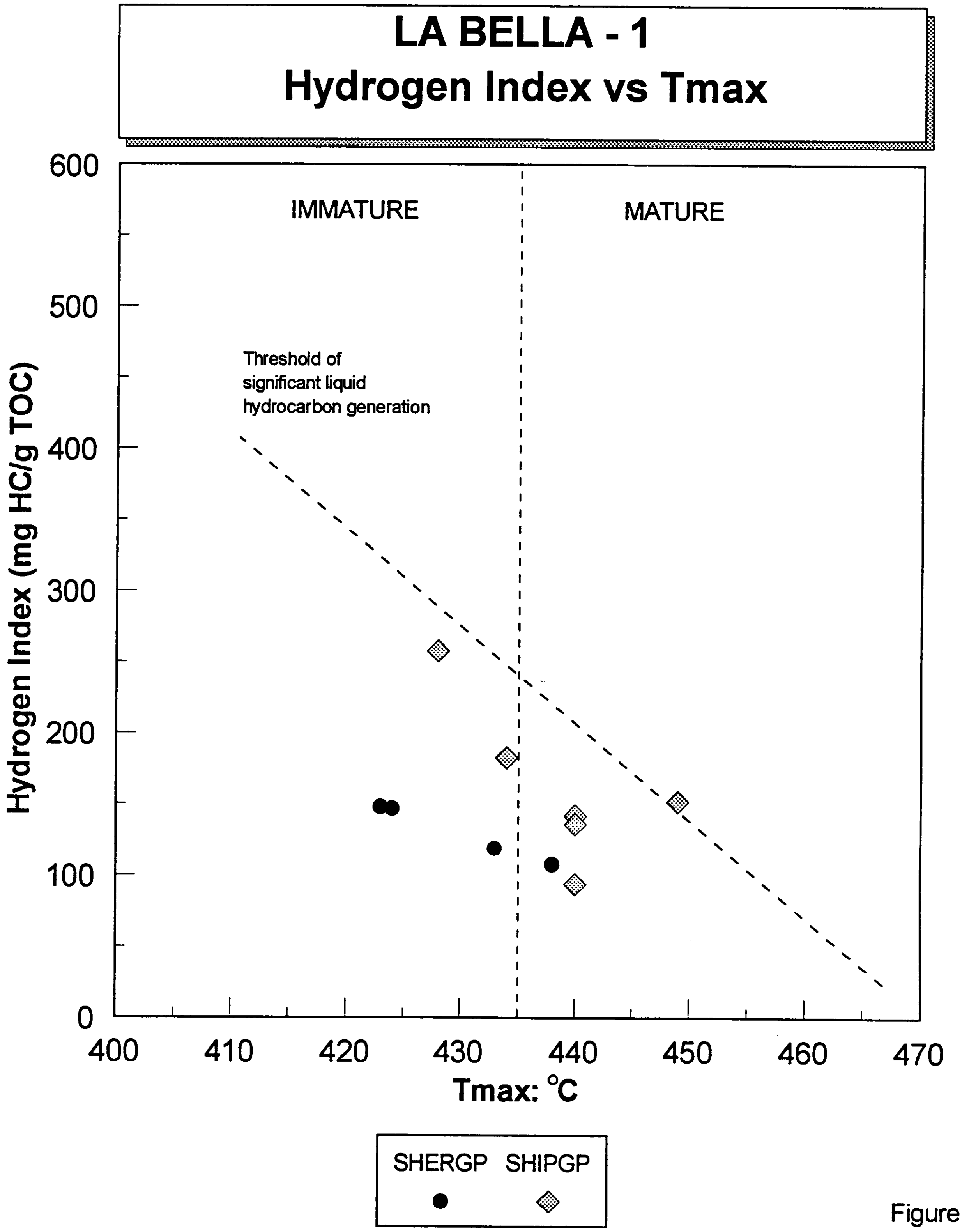

LA BELLA - 1
Hydrogen Index vs Tmax
IMMATURE
MATURE
Threshold of
significant liquid
hydrocarbon generation
Hydrogen Index (mg HC/g TOC)
600
500
400
300
200
100
0
400
410
420
430
440
450
460
470
Tmax: °C
SHERGP
SHIPGP
●
◈

Figure 5

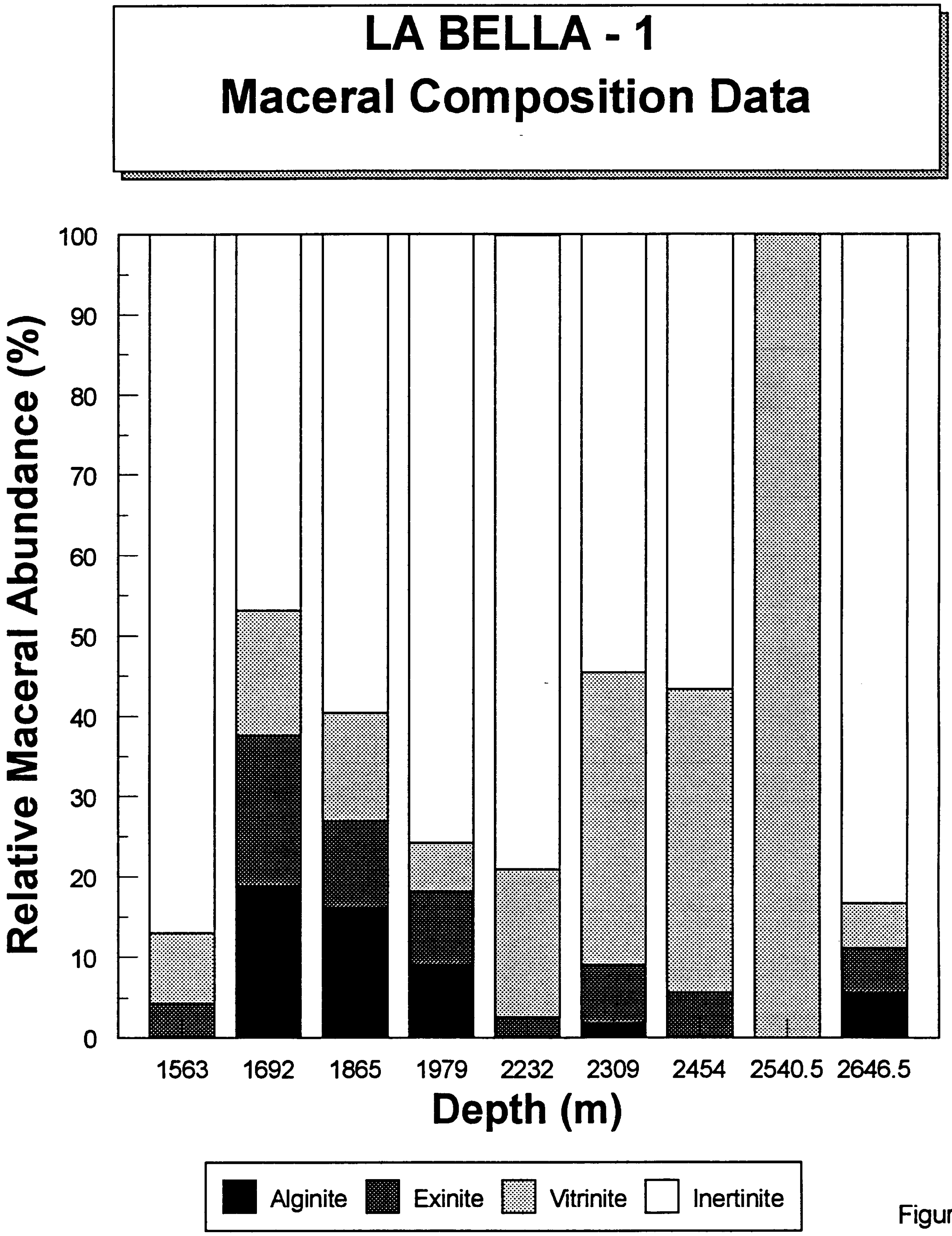

LA BELLA - 1
Maceral Composition Data
Relative Maceral Abundance (%)
100
90
80
70
60
50
40
30
20
10
0
1563
1692
1865
1979
2232
2309
2454
2540.5
2646.5
Depth (m)
■ Alginite
▨ Exinite
░ Vitrinite
☐ Inertinite

Figure 6

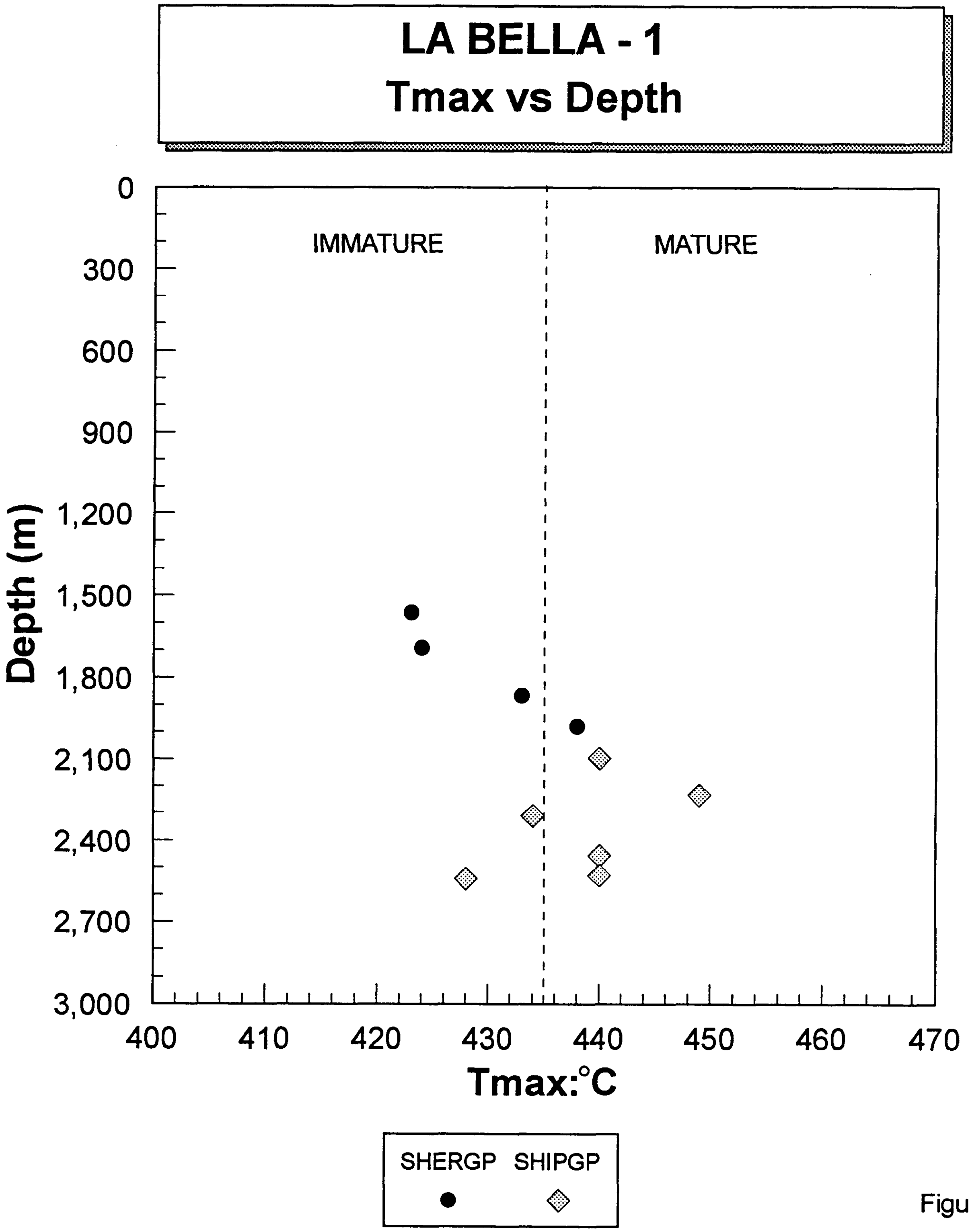

LA BELLA - 1
Tmax vs Depth
IMMATURE
MATURE
Depth (m)
0
300
600
900
1,200
1,500
1,800
2,100
2,400
2,700
3,000
400
410
420
430
440
450
460
470
Tmax:°C
SHERGP
SHIPGP

Figure 7

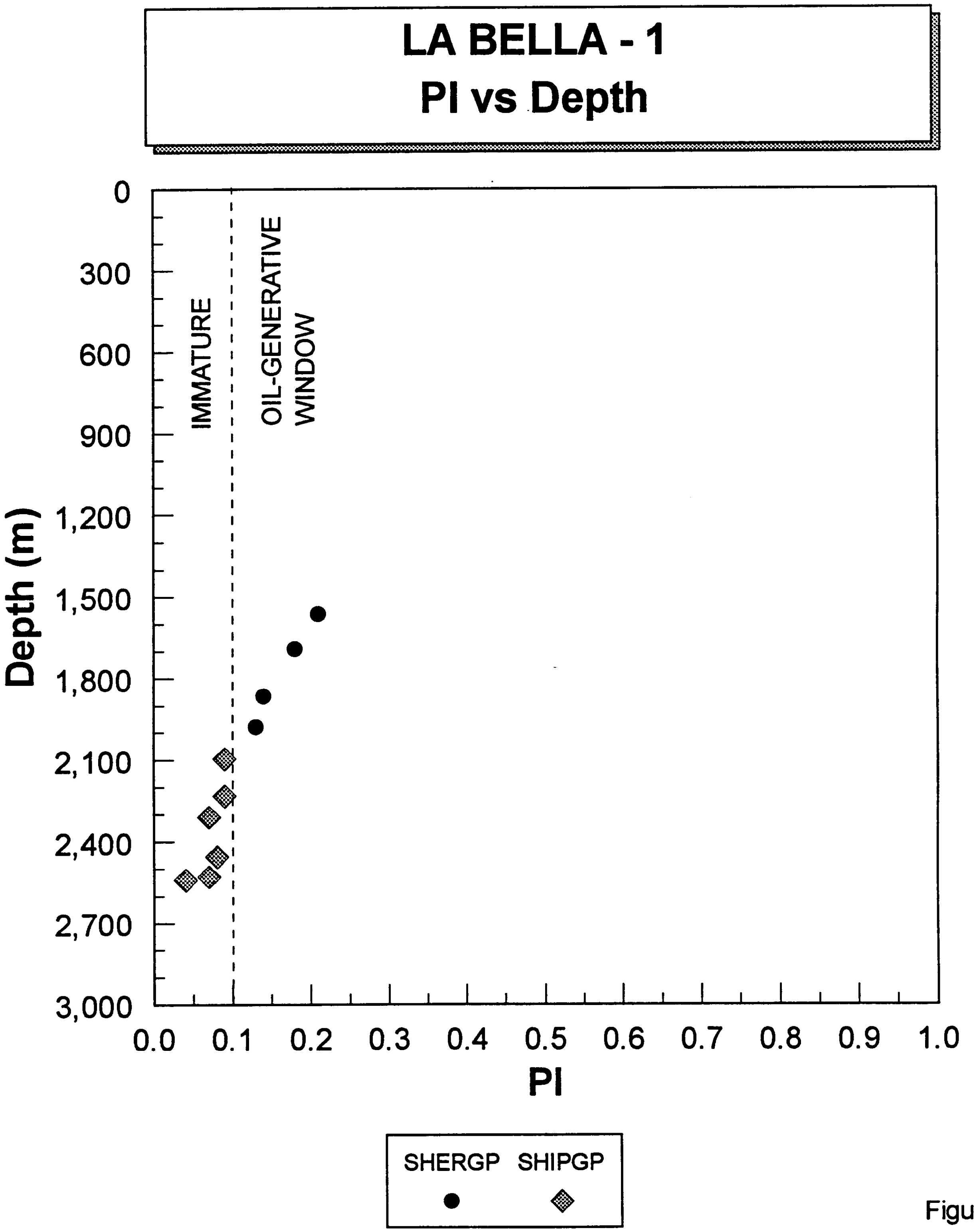

LA BELLA - 1
PI vs Depth
Depth (m)
0
300
600
900
1,200
1,500
1,800
2,100
2,400
2,700
3,000
IMMATURE
OIL-GENERATIVE WINDOW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
PI
SHERGP
SHIPGP

Figure 8

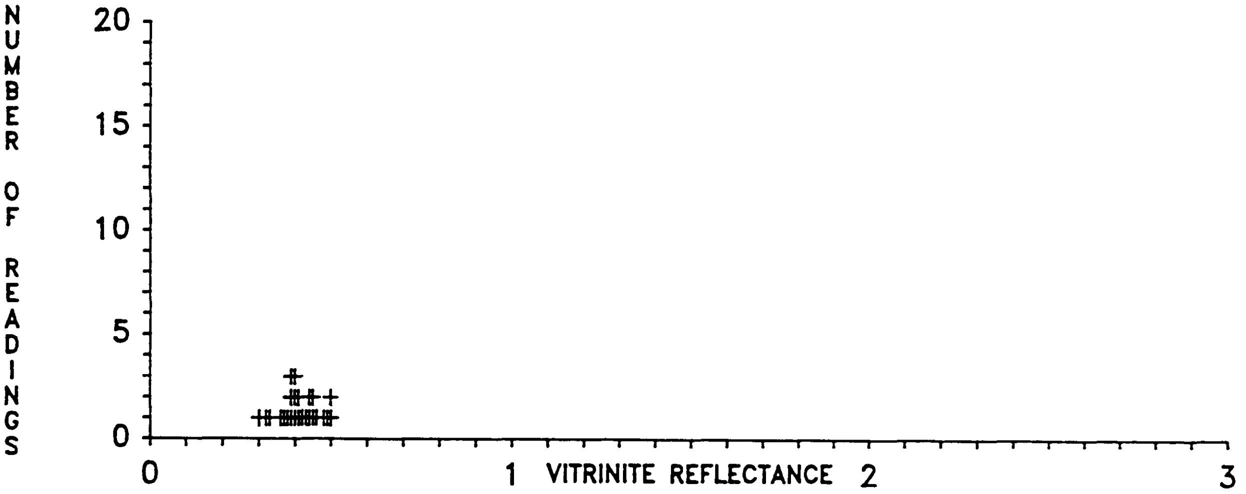
FIGURE 9

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LA BELLA-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 1563.0 METRES DATE: MAY 1993

(Total No. of Readings=25) 0.30 0.32 0.33 0.36 0.37 0.38 0.39 0.39 0.39 0.40 0.40 0.40 0.41 0.41 0.42 0.43 0.44 0.44 0.45 0.45 0.46 0.48 0.49 0.50 0.50

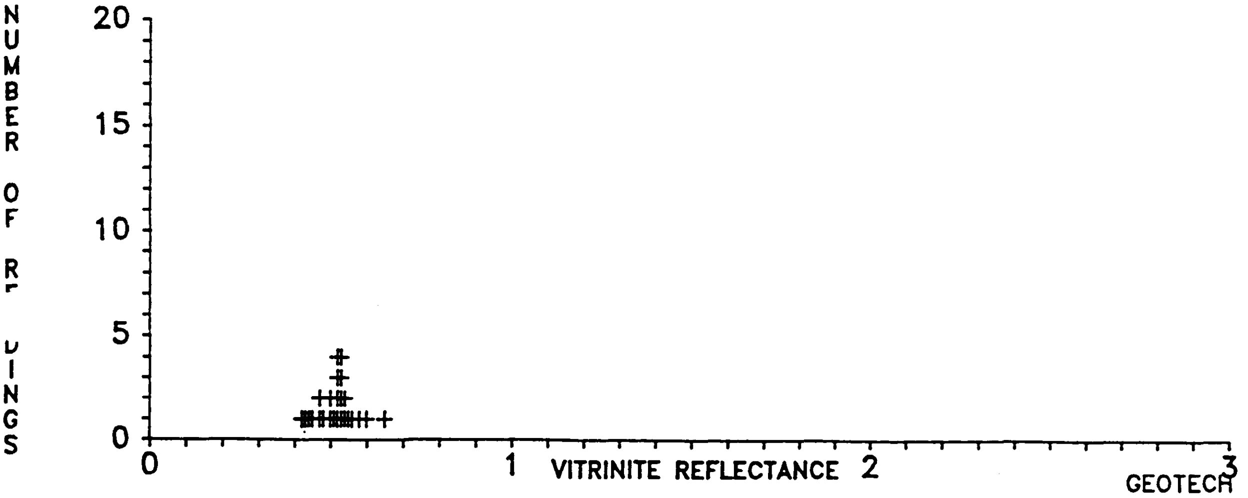
VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	25	0.41	0.30	0.50	0.05	INDIGENOUS(+)	8.70	87.00	4.30	0.00



SAMPLE ID: 1692.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=25) 0.42 0.43 0.44 0.45 0.47 0.47 0.48 0.50 0.50 0.51 0.52 0.52 0.52 0.52 0.53 0.53 0.53 0.53 0.54 0.54 0.55 0.56 0.58 0.60 0.65

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	25	0.52	0.42	0.65	0.05	INDIGENOUS(+)	15.20	45.50	36.40	2.90



GEOTECH

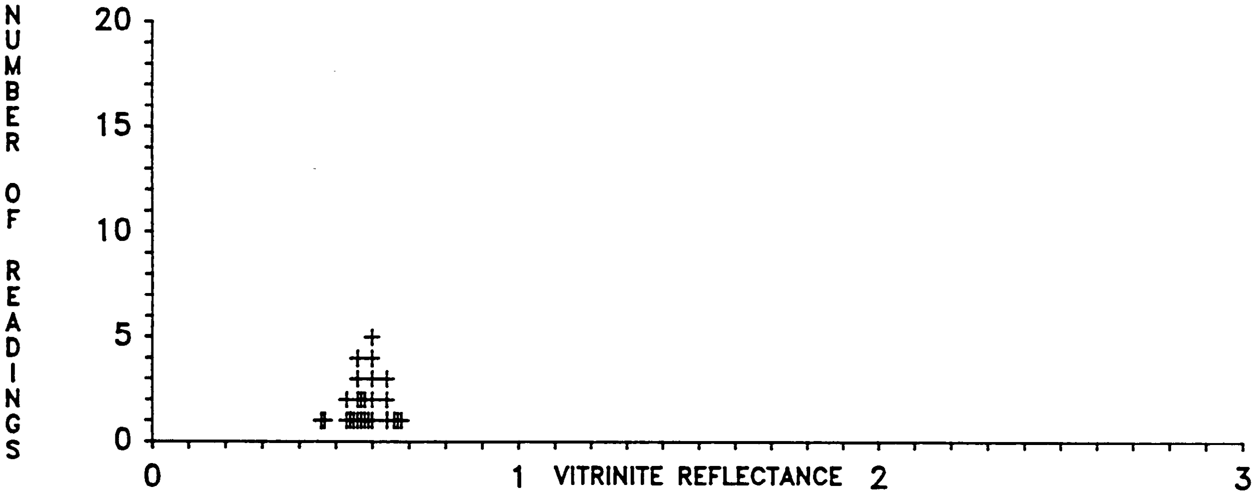
FIGURE 9 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LA BELLA-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 1865.0 METRES DATE: MAY 1993

(Total No. of Readings=26) 0.46 0.47 0.53 0.53 0.54 0.55 0.56 0.56 0.56 0.56 0.57 0.57 0.58 0.58 0.59 0.60 0.60 0.60 0.60 0.60 0.64 0.64 0.64 0.66 0.67 0.68

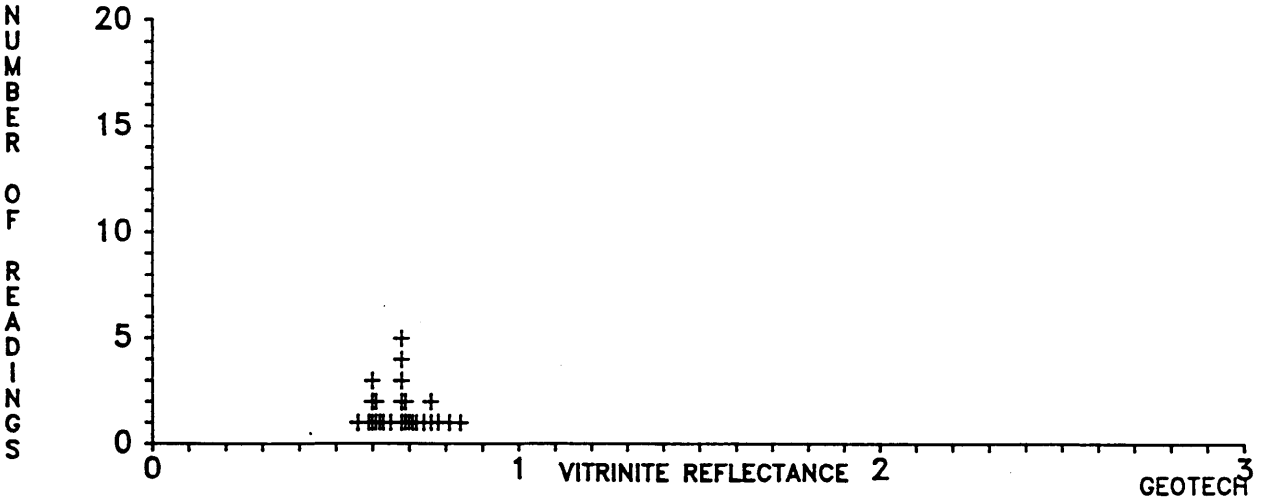
VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.58	0.46	0.68	0.05	INDIGENOUS(+)	13.20	57.90	26.30	2.60



SAMPLE ID: 1979.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.56 0.59 0.60 0.60 0.60 0.61 0.61 0.62 0.63 0.65 0.68 0.68 0.68 0.68 0.68 0.69 0.69 0.70 0.71 0.72 0.74 0.76 0.76 0.78 0.81 0.84

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.68	0.56	0.84	0.07	INDIGENOUS(+)	5.90	73.60	17.60	2.90



GEOTECH

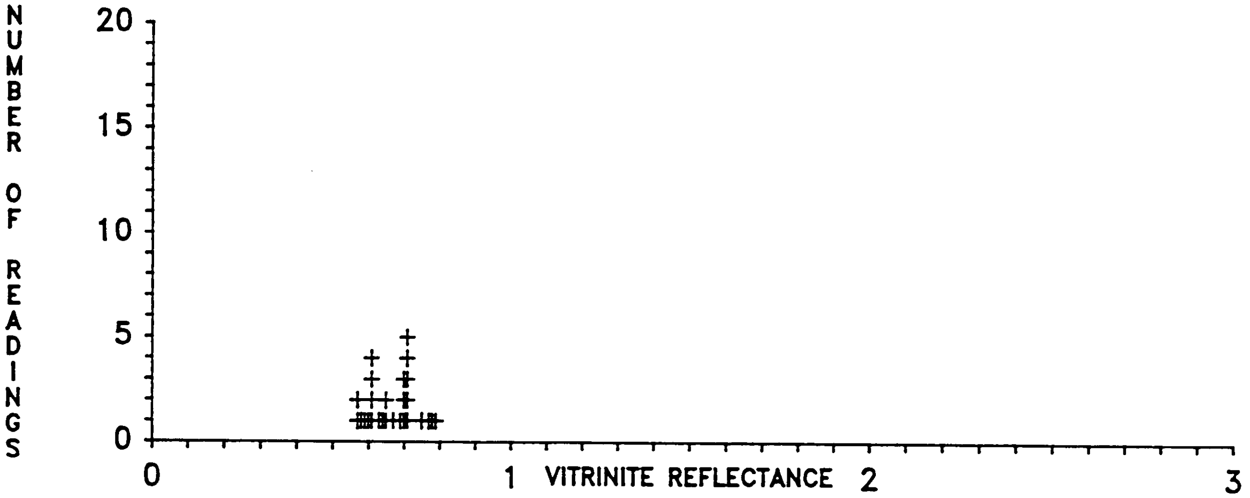
FIGURE 9 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LA BELLA-1
CLIENT: BHP PETROLEUM
SAMPLE TYPE: SWC
SAMPLE ID: 2232.0 METRES
DATE: MAY 1993

(Total No. of Readings=27) 0.57 0.57 0.58 0.59 0.60 0.61 0.61 0.61 0.61 0.63 0.64 0.65 0.65 0.67 0.69 0.70 0.70 0.70 0.71 0.71 0.71 0.71 0.71 0.75 0.77 0.78 0.79

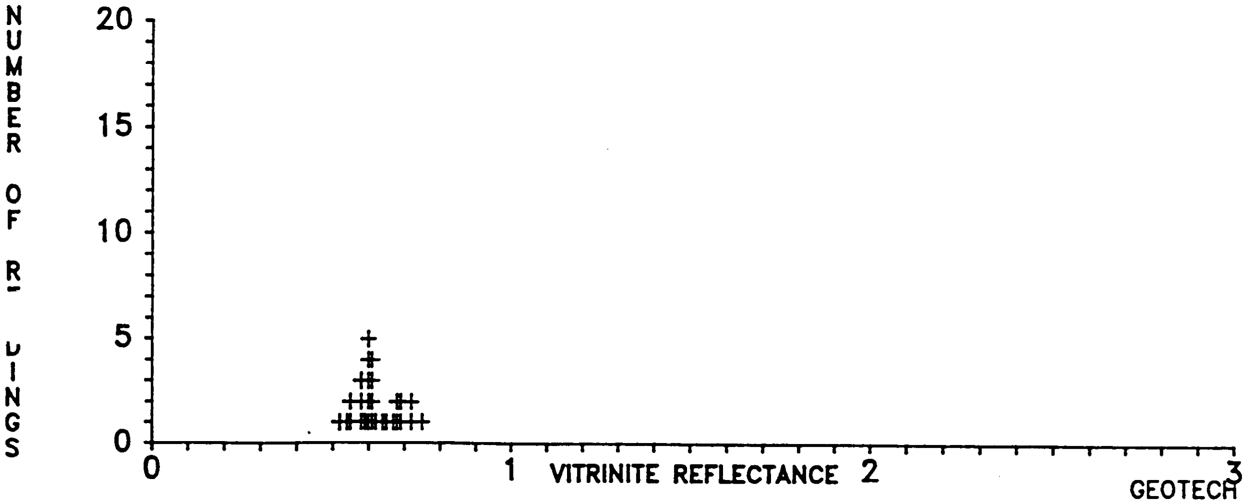
VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	27	0.67	0.57	0.79	0.06	INDIGENOUS(+)	17.90	76.90	2.60	2.60



SAMPLE ID: 2309.0 METRES
SAMPLE TYPE: SWC

(Total No. of Readings=28) 0.52 0.54 0.55 0.55 0.58 0.58 0.58 0.59 0.60 0.60 0.60 0.60 0.60 0.61 0.61 0.61 0.61 0.62 0.64 0.65 0.67 0.68 0.68 0.69 0.69 0.72 0.72 0.75

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	28	0.62	0.52	0.75	0.06	INDIGENOUS(+)	35.70	53.60	8.90	1.80



GEOTECH

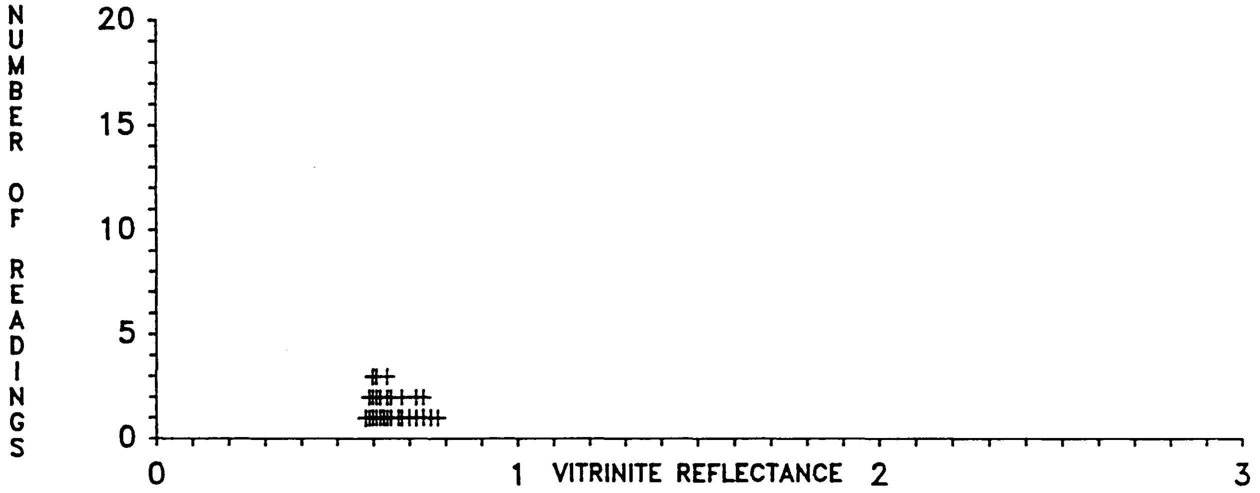
FIGURE 9 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LA BELLA-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 2454.0 METRES DATE: MAY 1993

(Total No. of Readings=27) 0.58 0.59 0.59 0.60 0.60 0.60 0.61 0.61 0.61 0.62 0.62 0.63 0.64 0.64 0.64 0.65 0.65 0.67 0.68 0.68 0.70 0.72 0.72 0.74 0.74 0.76 0.78

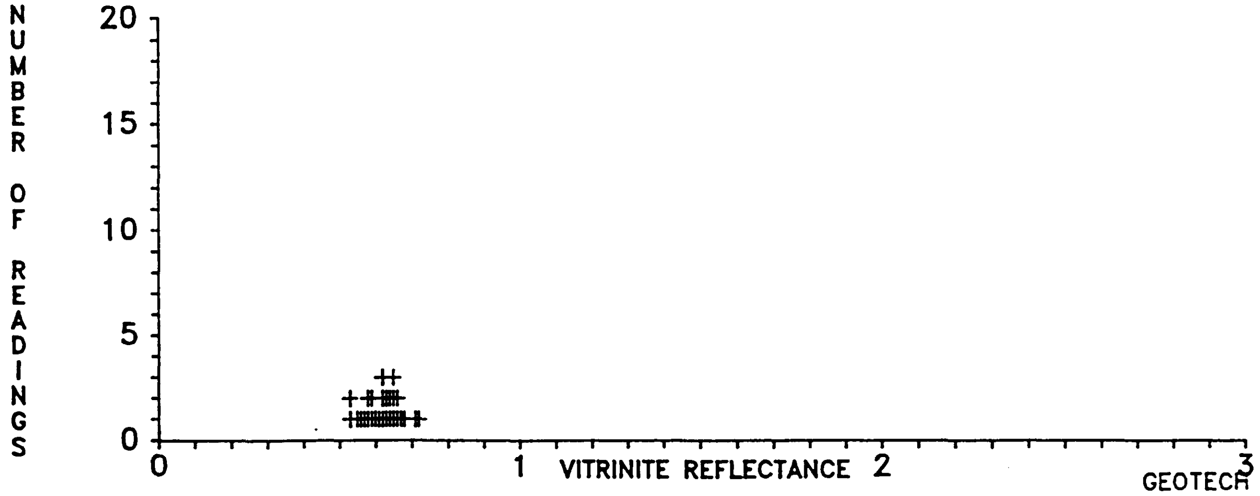
VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	27	0.65	0.58	0.78	0.06	INDIGENOUS(+)	37.70	56.60	5.70	0.00



SAMPLE ID: 2540.5 METRES SAMPLE TYPE: SWC

(Total No. of Readings=27) 0.53 0.53 0.55 0.56 0.57 0.58 0.58 0.59 0.59 0.60 0.61 0.62 0.62 0.62 0.63 0.63 0.64 0.64 0.65 0.65 0.65 0.66 0.66 0.67 0.68 0.71 0.72

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	27	0.62	0.53	0.72	0.05	INDIGENOUS(+)	99.90	0.10	0.00	0.00



GEOTECH

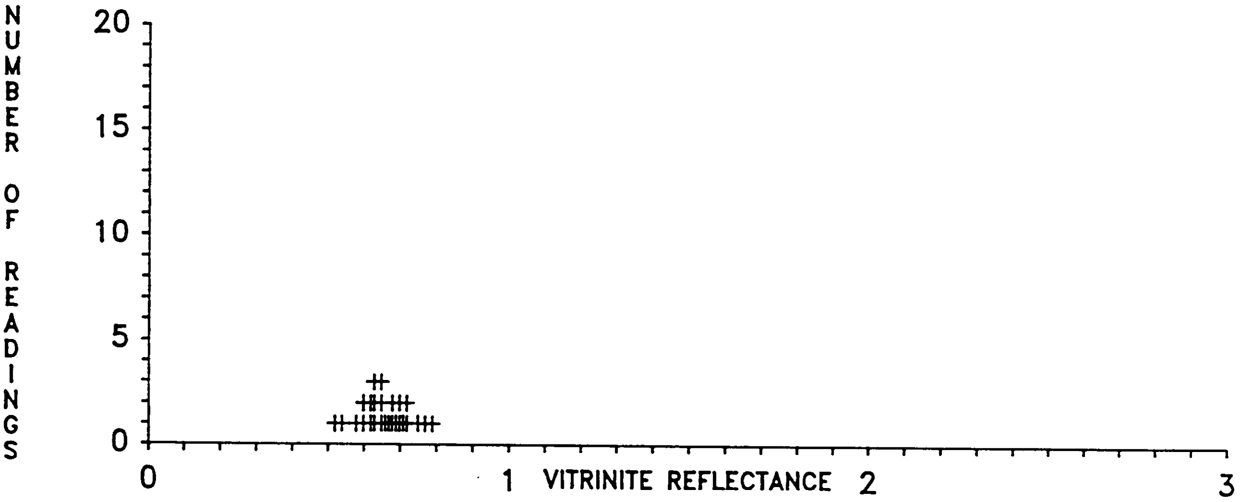
FIGURE 9 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LA BELLA-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 2646.5 METRES DATE: MAY 1993

(Total No. of Readings=26) 0.52 0.54 0.58 0.60 0.60 0.62 0.62 0.63 0.63 0.63 0.65 0.65 0.65 0.66 0.67 0.68 0.68 0.69 0.70 0.70 0.71 0.72 0.72 0.75 0.77 0.79

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.66	0.52	0.79	0.06	INDIGENOUS(+)	5.30	79.00	10.50	5.20



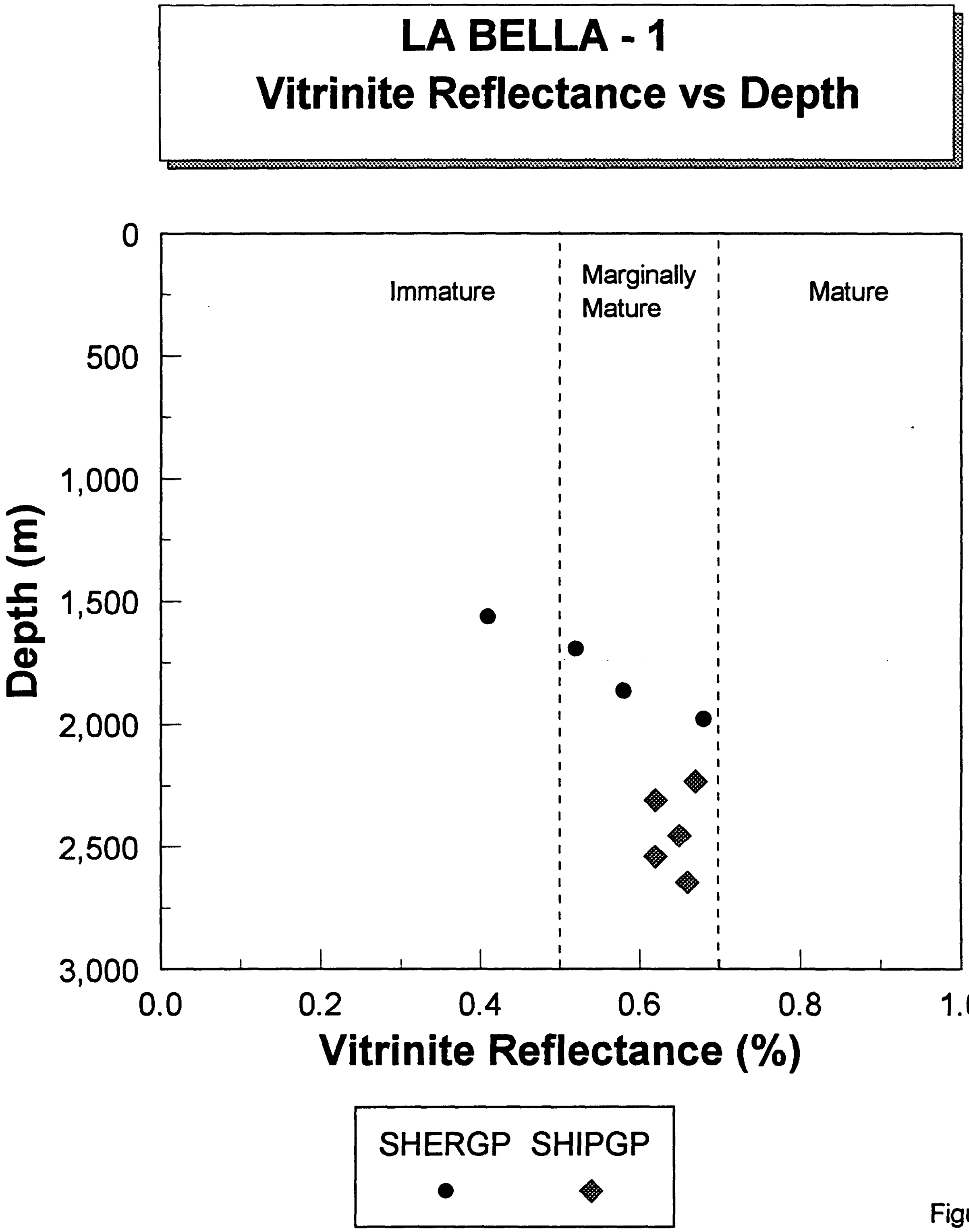

LA BELLA - 1
Vitrinite Reflectance vs Depth
Immature
Marginally Mature
Mature
Depth (m)
0
500
1,000
1,500
2,000
2,500
3,000
0.0
0.2
0.4
0.6
0.8
1.0
Vitrinite Reflectance (%)
SHERGP
SHIPGP

Figure 10

TABLE 3

VITRINITE REFLECTANCE AND COAL MACERAL DATA - SEDIMENTS
ALL MACERAL POPULATIONS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

								MACERAL C	
DEPTH 1	DEPTH 2	POPULATION TYPE	MEAN % REFL.	MINIMUM % REFL.	MAXIMUM % REFL.	NUMBER READINGS	STANDARD DEVIATION	% ALGINITE	% EXINITE
1563.00	1563.00	V	.41	.30	.50	25	.05	0.00	4.30
1692.00	1692.00	V	.52	.42	.65	25	.05	18.80	18.80
1865.00	1865.00	V	.58	.46	.68	26	.05	16.20	10.80
1979.00	1979.00	V	.68	.56	.84	26	.07	9.10	9.10
2232.00	2232.00	V	.67	.57	.79	27	.07	0.00	2.60
2309.00	2309.00	V	.62	.52	.75	28	.06	1.80	7.30
2454.00	2454.00	V	.65	.58	.78	27	.06	0.00	5.70
2540.50	2540.50	V	.62	.53	.72	27	.05	0.00	0.00
2646.50	2646.50	V	.66	.52	.79	26	.06	5.60	5.60

N.B. Code definitions at end of table
- = no data

CODE DEFINITIONS FOR TABLE 3

POPULATION TYPE CODES

V = VITRINITE

CONTRACTOR CODES

GTS = Geotechnical Servics

JOB NO. 1916A, LA BELLA - 1 OTWAY BASIN

Sample No(s)	Depth(m)/ Sample type	$\bar{R}_v$ max (%)	Range (%)	N	Description Including Liptinite Fluorescence Characteristics
v7733	1563 SWC8	0.41	0.30-0.50	25	Rare cutinite and liptodetrinite, yellow to orange, rare sporinite, bright yellow to orange, rare telalginite, bright yellow. (Silty claystone. Dom abundant, I>>V>L. Inertinite abundant, vitrinite and liptinite sparse. Oil drops rare, greenish yellow. Mineral fluorescence pervasive, faint green. Iron oxides sparse. Pyrite abundant.)
v7734	1692 SWC4	0.52	0.42-0.65	25	Common lamalginite and liptodetrinite, greenish yellow to orange. (Calcareous claystone. Dom common, I>L>V. Inertinite and liptinite common, vitrinite sparse. Bitumen rare, yellow. Mineral fluorescence pervasive, moderate green to yellowish orange. Iron oxides sparse. Glauconite sparse. Pyrite abundant.)
v7735	1865 SWC147	0.58	0.46-0.68	26	Common lamalginite, greenish yellow to orange. Sparse liptodetrinite, greenish yellow to orange. (Calcareous silty claystone. Dom abundant, I>L>V. Inertinite abundant, liptinite common, vitrinite sparse. Bitumen rare, yellow. Mineral fluorescence pervasive, moderate green to greenish yellow. Iron oxides sparse. Glauconite rare. Pyrite abundant.)
v7736	1979 SWC143	0.68	0.56-0.84	26	Sparse lamalginite and liptodetrinite, yellow to orange, rare sporinite, orange to dull orange. Clayey siltstone>>sandstone. Dom abundant, I>L>V. Inertinite abundant, liptinite common, vitrinite sparse. Bitumen rare, yellow. Mineral fluorescence pervasive, moderate green to greenish yellow. Iron oxides sparse. Glauconite rare. Pyrite abundant.)
v7737	2232 SWC103	0.66	0.57-0.79	27	Rare cutinite, lamalginite and liptodetrinite, yellow to orange, rare resinite, yellow orange. (Siltstone. Dom abundant, I>V>L. Inertinite abundant, vitrinite common, liptinite sparse. Oil drops rare, greenish yellow. Mineral fluorescence pervasive, yellow to dull orange. Iron oxides sparse. Pyrite common.)
v7738	2309 SWC93	0.62	0.52-0.75	28	Sparse cutinite, yellow to orange, sparse lamalginite bright yellow to orange, rare resinite greenish yellow to orange, rare liptodetrinite and sporinite, yellow to orange. (Siltstone>sandstone. Dom abundant, I>V>L. Inertinite and, vitrinite abundant, liptinite common. Bitumen rare, greenish yellow to orange. Oil drops rare, greenish yellow. Mineral fluorescence pervasive, faint green to dull orange. Iron oxides abundant. Pyrite common.)
v7739	2454 SWC81	0.65	0.58-0.78	27	Sparse cutinite, yellow to orange, rare lamalginite, sporinite and liptodetrinite, yellow to orange. (Siltstone. Dom abundant, I>V>L. Inertinite and vitrinite abundant, liptinite sparse. Bitumen rare, orange. Mineral fluorescence pervasive, faint green to dull orange. Iron oxides common. Pyrite sparse.)

JOB NO. 1916A, LA BELLA - 1 OTWAY BASIN

Sample No(s)	Depth(m)/ Sample type	$\bar{R}_v$max (%)	Range (%)	N	Description Including Liptinite Fluorescence Characteristics
v7740	2540.5 SWC-74	0.62	0.53-0.72	27	Fluorescing liptinite absent. Coal, V>>I. Vitrite only. Mineral-free maceral group composition of the coal: vitrinite - 100%, inertinite - <<0.1%, liptinite - absent. Iron oxides rare. Pyrite rare.)
v7741	2646.5 SWC-65	0.66	0.52-0.79	26	Sparse cutinite, yellow to orange, rare telalginite and lamalginite, bright yellow to orange, rare sporinite and liptodetrinite, yellow to orange. (Carbonate>calcareous sandstone>claystone. Dom common, I>L>V. Inertinite common, liptinite and vitrinite sparse. Bitumen rare, yellow to orange. Mineral fluorescence pervasive, faint green to orange. Iron oxides common. Pyrite sparse.)

TABLE 4

SUMMARY OF WHOLE OIL ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1 = 2072.80
DEPTH 2 = 2072.80

DEPTH UNIT = Metres
DATE OF JOB = Sept 93

DESCRIPTION : RFT SAMPLE

COMPOSITION BY CARBON NUMBER

Data Type = ALL CMPDS

Carbon Number	Rel. Wt %
1 - 3	0.02
4	0.50
5	6.34
6	24.70
7	30.05
8	11.57
9	6.51
10	7.51
11	4.22
12	2.87
13	1.88
14	1.37
15	0.88
16	0.36
17	0.65
18	0.15
19	0.08
20	0.04
21	0.02
22	0.07
23	0.14
24	0.01
25	0.01
26	0.02
27	0.00
28	0.01
29	0.00
30	0.01
31	0.01
32	0.00
33	-

COMPOSITION OF C4-C8 FRACTION

Compound	Rel. Wt %
isobutane (A)	0.10
n-butane (B)	0.40
isopentane (C)	2.70
n-pentane (D)	3.13
2,2-dimethylbutane (E)	0.42
cyclopentane (F)	0.51
2,3-dimethylbutane (G)	0.87
2-methylpentane (H)	4.25
3-methylpentane (I)	2.40
n-hexane (J)	5.27
methylcyclopentane (K)	4.77
2,4-dimethylpentane (L)	0.58
benzene (M)	0.39
cyclohexane (N)	6.33
1,1-dimethylcyclopentane (O)	0.81
2-methylhexane (P)	2.04
3-methylhexane (Q)	3.16
1 cis-3-dimethylcyclopentane (R)	1.00
1 trans-3-dimethylcyclopentane (S)	1.68
1 trans-2-dimethylcyclopentane (T)	0.13
n-heptane (U)	4.34
methylcyclohexane (V)	14.79
1 cis-2-dimethylcyclopentane (W)	0.34
n-toluene (X)	1.19
n-octane (Y)	3.16
ethylbenzene (Z)	0.51
M+P-xylene (AA)	0.69
O_xylene (BB)	0.25

CALCULATED DATA - C12+ FRACTION

Pristane/Phytane	8.38
Pristane/n-C17	2.66
Phytane/n-C18	0.52
TMTD/Pristane	0.78
(C21+C22)/(C28+C29)	7.33

CALCULATED DATA - C4-C8 FRACTION

Paraffin Index I	1.85
Paraffin Index II	12.65
N/K (Maturity)	1.33
C/D (Maturity)	0.86
J/K (Maturity)	1.10
I/M (Water Washing)	6.18
I/J (Biodegradation)	0.45

TMTD = Trimethyltridecane
- = Below detection limit or not measured

Paraffin Index I = (P+Q) / (R+S+T)
Paraffin Index II = %U in all compounds N to V and including 2,2-DiMeC6 and 2,3-DiMeC5

TABLE 5

SUMMARY OF WHOLE OIL ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway
DEPTH 1 = 2160.50
DEPTH 2 = 2160.50
DEPTH UNIT = Metres
DATE OF JOB = Sept 93

DESCRIPTION : RFT SAMPLE

COMPOSITION BY CARBON NUMBER

Data Type = ALL CMPDS

Carbon Number	Rel. Wt %
1 - 3	0.13
4	1.87
5	10.78
6	30.57
7	38.41
8	8.05
9	3.30
10	2.98
11	1.25
12	0.89
13	0.48
14	0.37
15	0.22
16	0.12
17	0.18
18	0.08
19	0.06
20	0.05
21	0.04
22	0.03
23	0.02
24	0.06
25	0.02
26	0.01
27	0.01
28	0.01
29	0.00
30	0.00
31	0.00
32	0.00
33	-

COMPOSITION OF C4-C8 FRACTION

Compound	Rel. Wt %
isobutane (A)	0.45
n-butane (B)	1.42
isopentane (C)	4.21
n-pentane (D)	5.55
2,2-dimethylbutane (E)	0.57
cyclopentane (F)	1.03
2,3-dimethylbutane (G)	0.44
2-methylpentane (H)	4.64
3-methylpentane (I)	2.53
n-hexane (J)	5.47
methylcyclopentane (K)	5.84
2,4-dimethylpentane (L)	9.42
benzene (M)	1.26
cyclohexane (N)	9.82
1,1-dimethylcyclopentane (O)	0.60
2-methylhexane (P)	1.72
3-methylhexane (Q)	2.45
1 cis-3-dimethylcyclopentane (R)	0.80
1 trans-3-dimethylcyclopentane (S)	1.39
1 trans-2-dimethylcyclopentane (T)	0.10
n-heptane (U)	3.09
methylcyclohexane (V)	14.86
1 cis-2-dimethylcyclopentane (W)	0.22
n-toluene (X)	3.76
n-octane (Y)	1.66
ethylbenzene (Z)	0.51
M+P-xylene (AA)	1.85
O_xylene (BB)	0.44

CALCULATED DATA - C12+ FRACTION

Pristane/Phytane	4.91
Pristane/n-C17	0.83
Phytane/n-C18	0.21
TMTD/Pristane	0.85
(C21+C22)/(C28+C29)	7.50

CALCULATED DATA - C4-C8 FRACTION

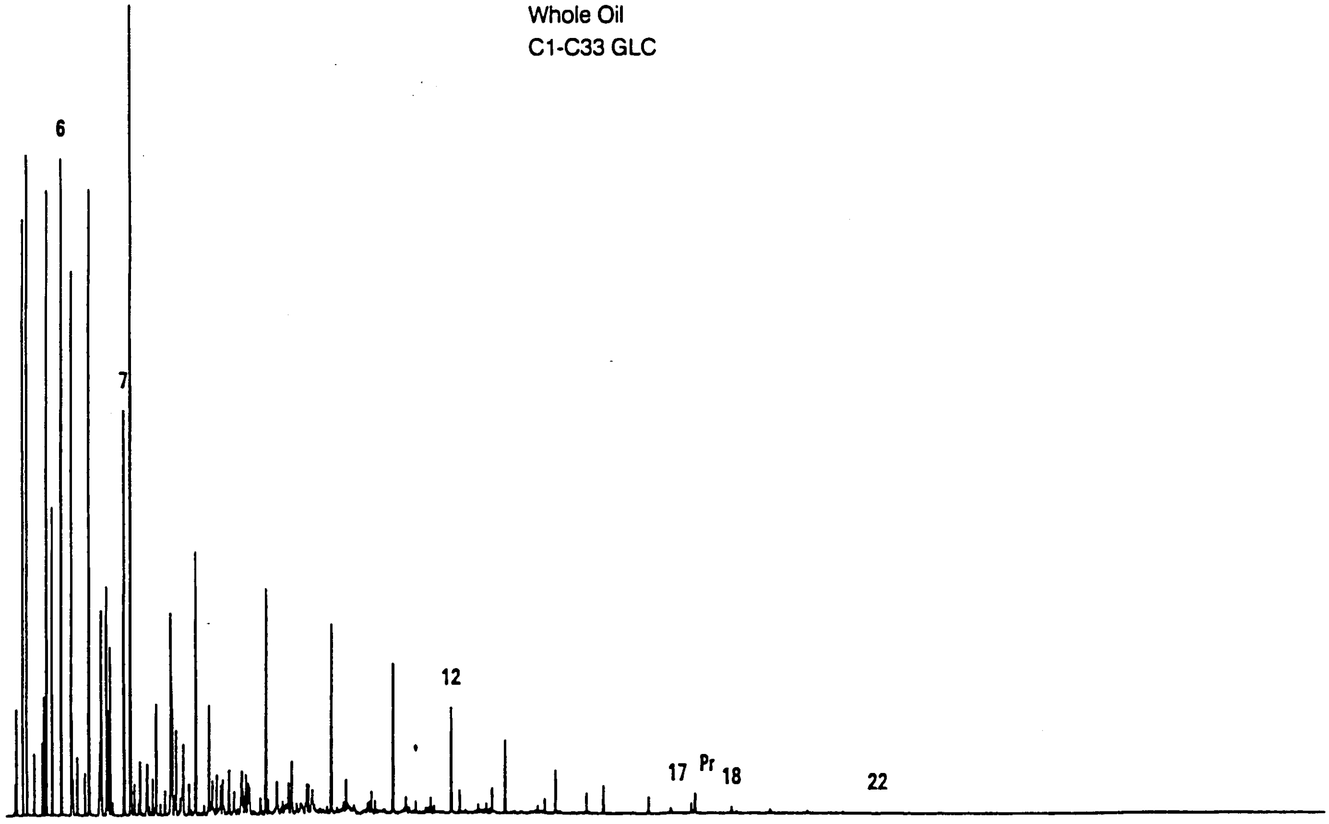
Paraffin Index I	1.82
Paraffin Index II	8.88
N/K (Maturity)	1.68
C/D (Maturity)	0.76
J/K (Maturity)	0.94
I/M (Water Washing)	2.00
I/J (Biodegradation)	0.46

TMTD = Trimethyltridecane
- = Below detection limit or not measured

Paraffin Index I = (P+Q) / (R+S+T)
Paraffin Index II = %U in all compounds N to V and including 2,2-DiMeC6 and 2,3-DiMeC5

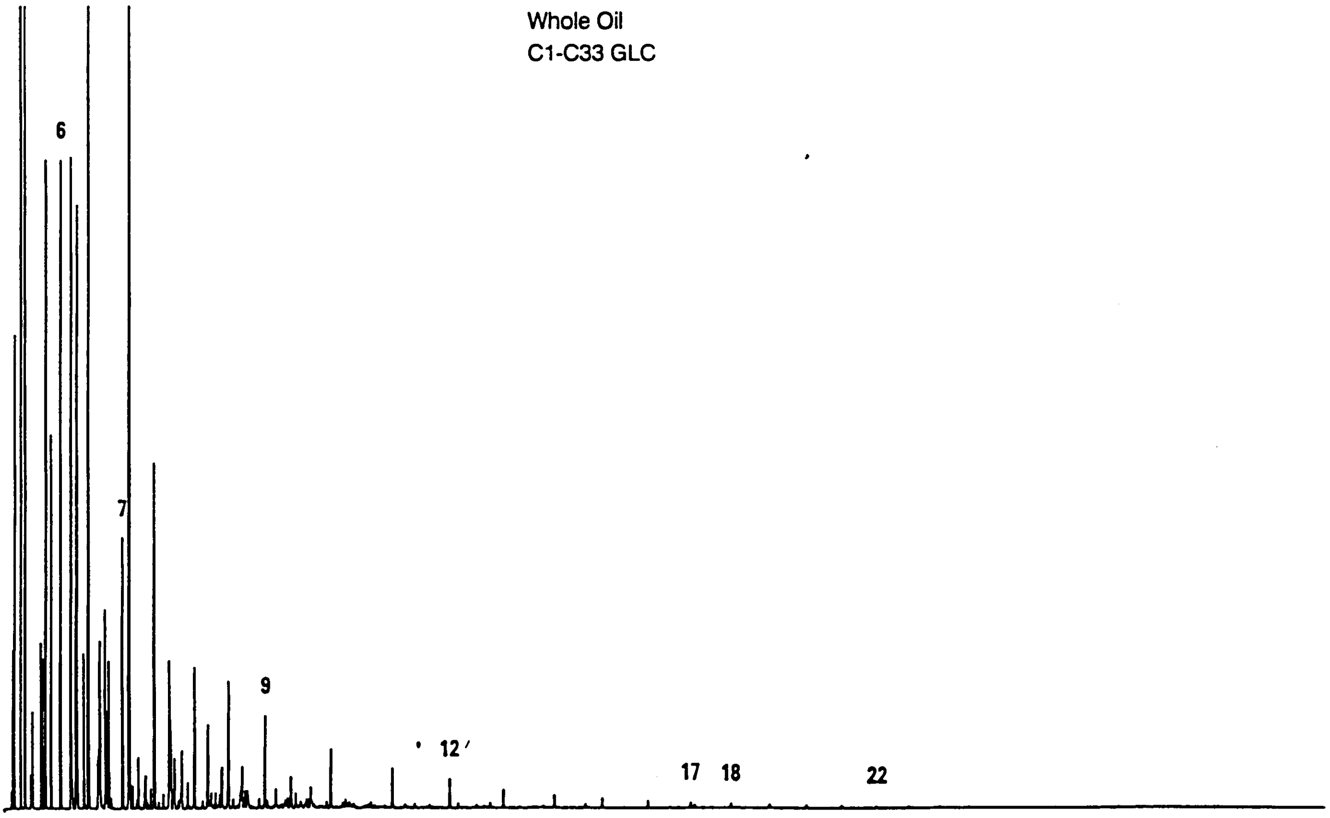
FIGURE 11

LA BELLA 1, 2072.8m, RFT
Whole Oil
C1-C33 GLC



GEOTECHNICAL SERVICES PTY LTD

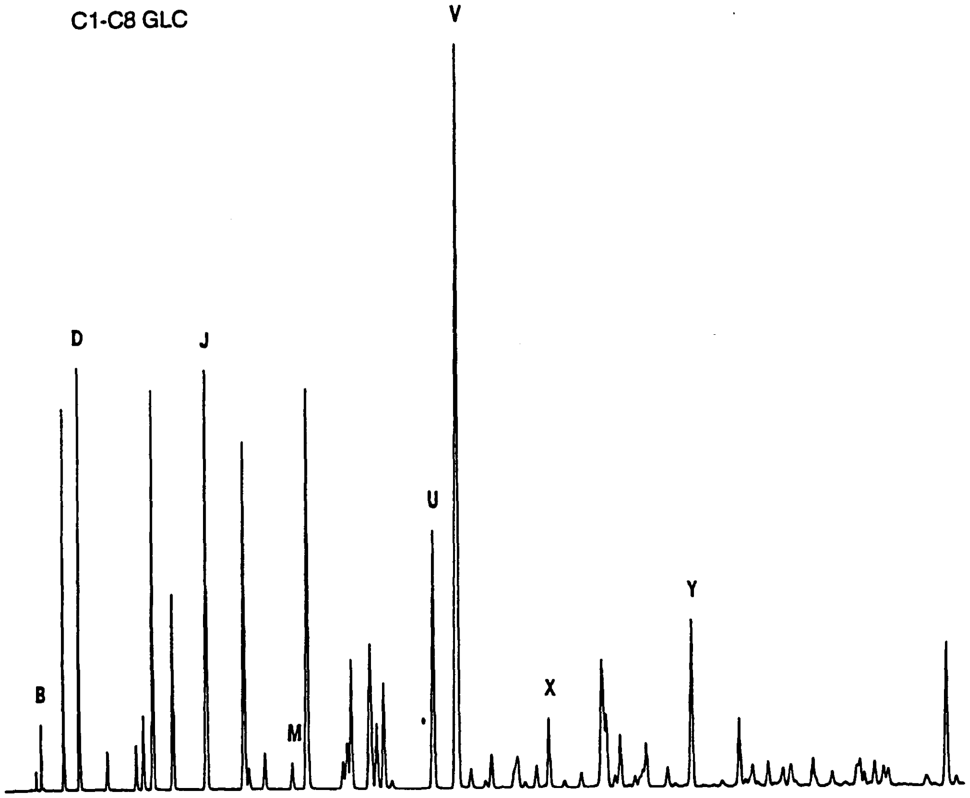
LA BELLA 1, 2160.5m, RFT
Whole Oil
C1-C33 GLC



GEOTECHNICAL SERVICES PTY LTD

FIGURE 12

LA BELLA 1, 2072.8m, RFT
Gasoline Range Whole Oil
C1-C8 GLC

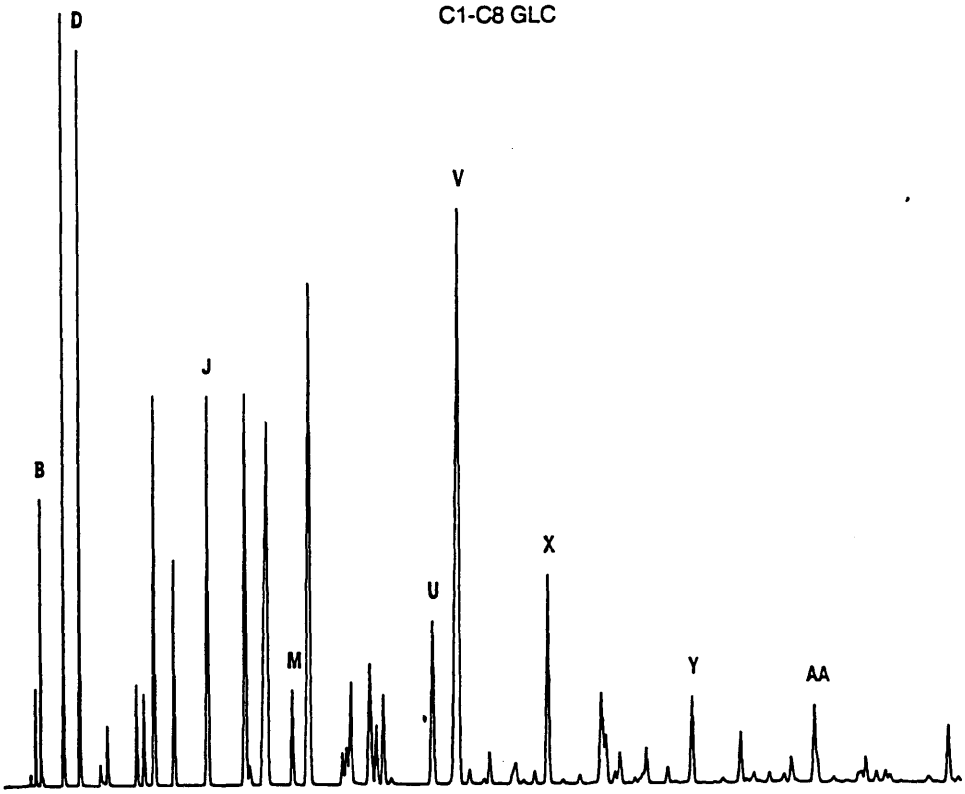


C4-C8 Compounds

A	isobutane
B	n-butane
C	isopentane
D	n-pentane
E	2,2-dimethylbutane
F	cyclopentane
G	2,3-dimethylbutane
H	2-methylpentane
I	3-methylpentane
J	n-hexane
K	methylcyclopentane
L	2,4-dimethylpentane
M	benzene
N	cyclohexane
O	1,1-dimethylcyclopentane
P	2-methylhexane
Q	3-methylhexane
R	1 cis-3-dimethylcyclopentane
S	1 trans-3-dimethylcyclopentane
T	1 trans-2-dimethylcyclopentane
U	n-heptane
V	methylcyclohexane
W	1 cis-2-dimethylcyclopentane
X	toluene
Y	n-octane
Z	ethylbenzene
AA	M+P-xylene
BB	O-xylene

GEOTECHNICAL SERVICES PTY LTD

LA BELLA 1, 2160.5m, RFT
Gasoline Range Whole Oil
C1-C8 GLC

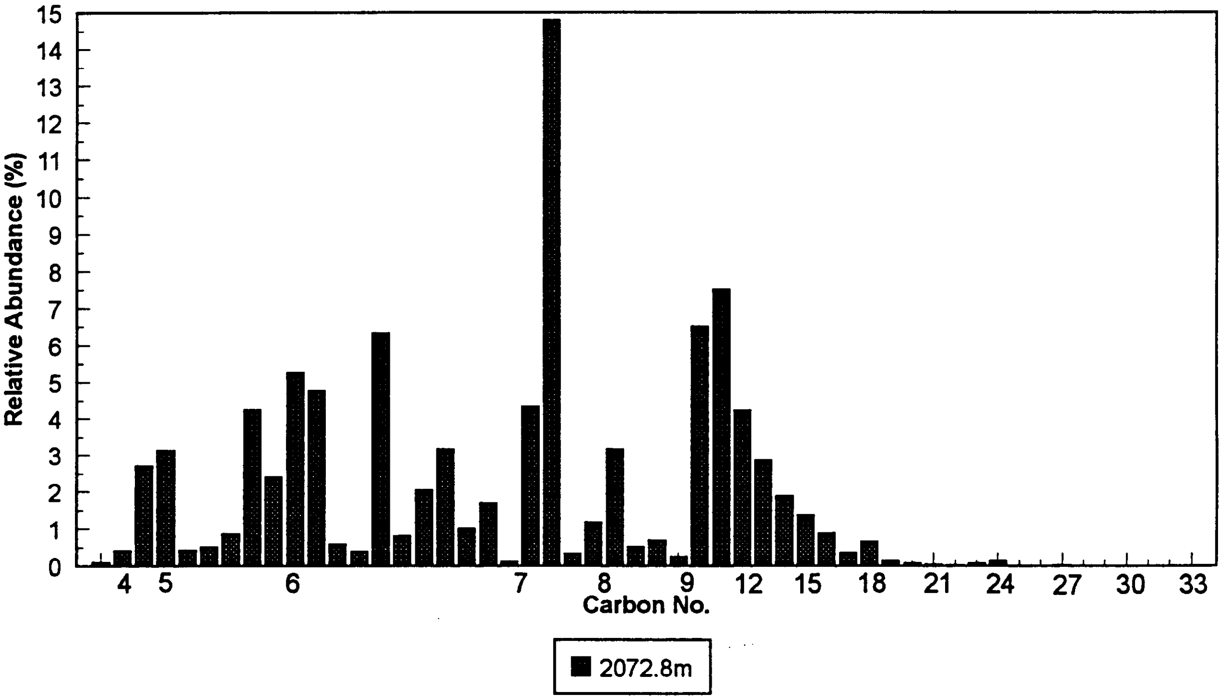


C4-C8 Compounds

A	isobutane
B	n-butane
C	isopentane
D	n-pentane
E	2,2-dimethylbutane
F	cyclopentane
G	2,3-dimethylbutane
H	2-methylpentane
I	3-methylpentane
J	n-hexane
K	methylcyclopentane
L	2,4-dimethylpentane
M	benzene
N	cyclohexane
O	1,1-dimethylcyclopentane
P	2-methylhexane
Q	3-methylhexane
R	1 cis-3-dimethylcyclopentane
S	1 trans-3-dimethylcyclopentane
T	1 trans-2-dimethylcyclopentane
U	n-heptane
V	methylcyclohexane
W	1 cis-2-dimethylcyclopentane
X	toluene
Y	n-octane
Z	ethylbenzene
AA	M+P-xylene
BB	O-xylene

GEOTECHNICAL SERVICES PTY LTD

LA BELLA - 1
Whole Oil GC Data
Normalised Compound Abundances



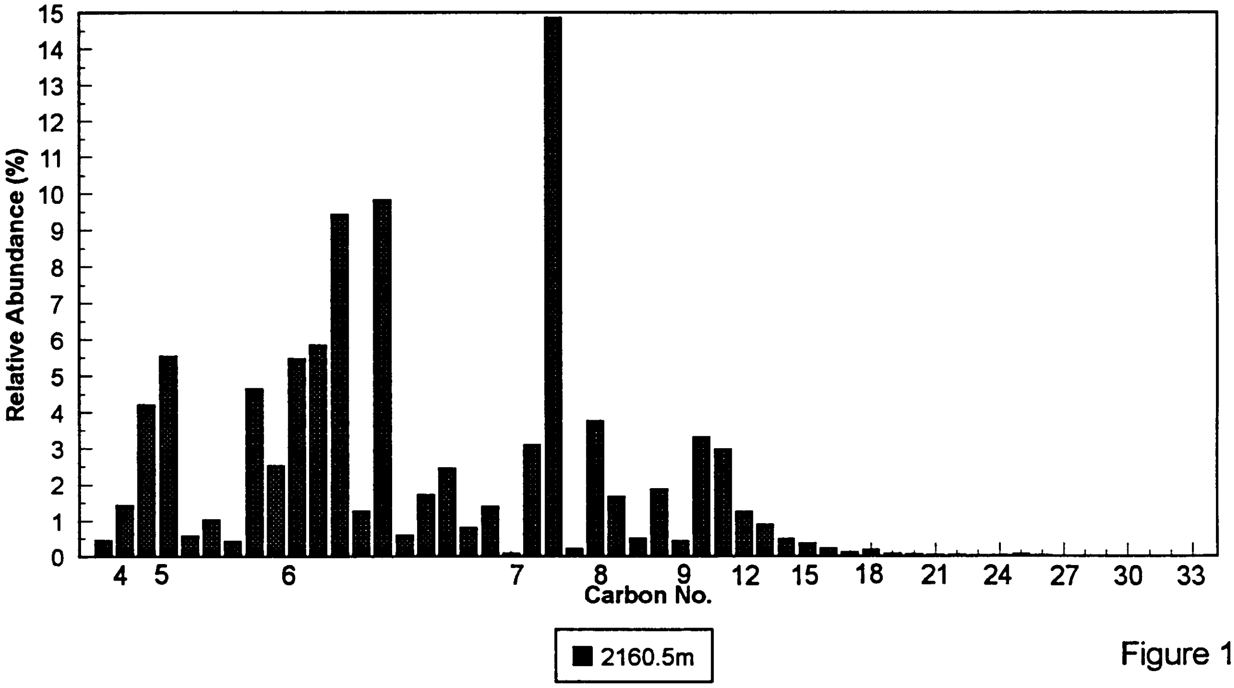


Figure 13

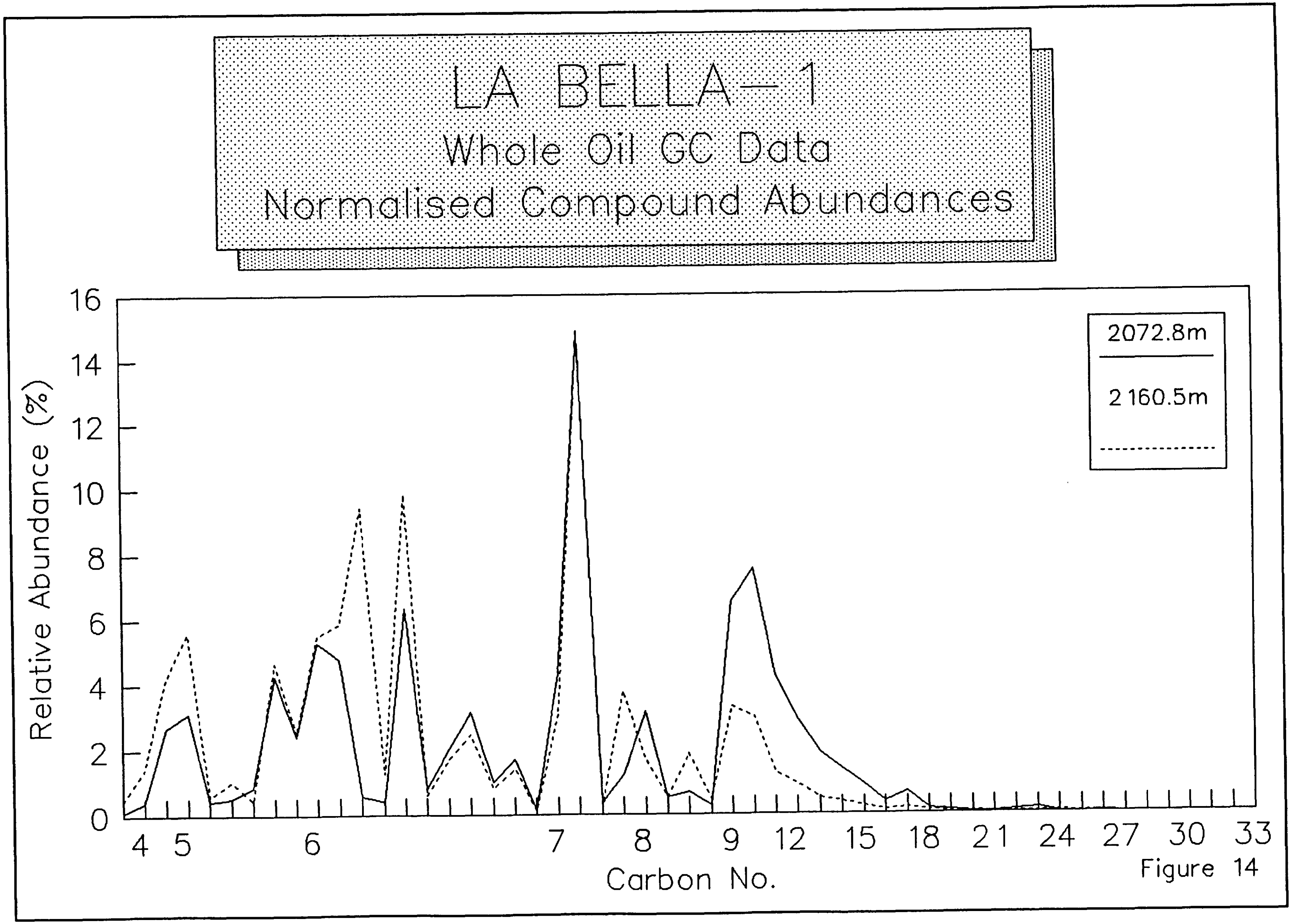

LA BELLA-1
Whole Oil GC Data
Normalised Compound Abundances
Relative Abundance (%)
0
2
4
6
8
10
12
14
16
2072.8m
2160.5m
4
5
6
7
8
9
12
15
18
21
24
27
30
33
Carbon No.

Figure 14

LA BELLA - 1

Whole Oil GC Data

Paraffin Index I vs Paraffin Index II

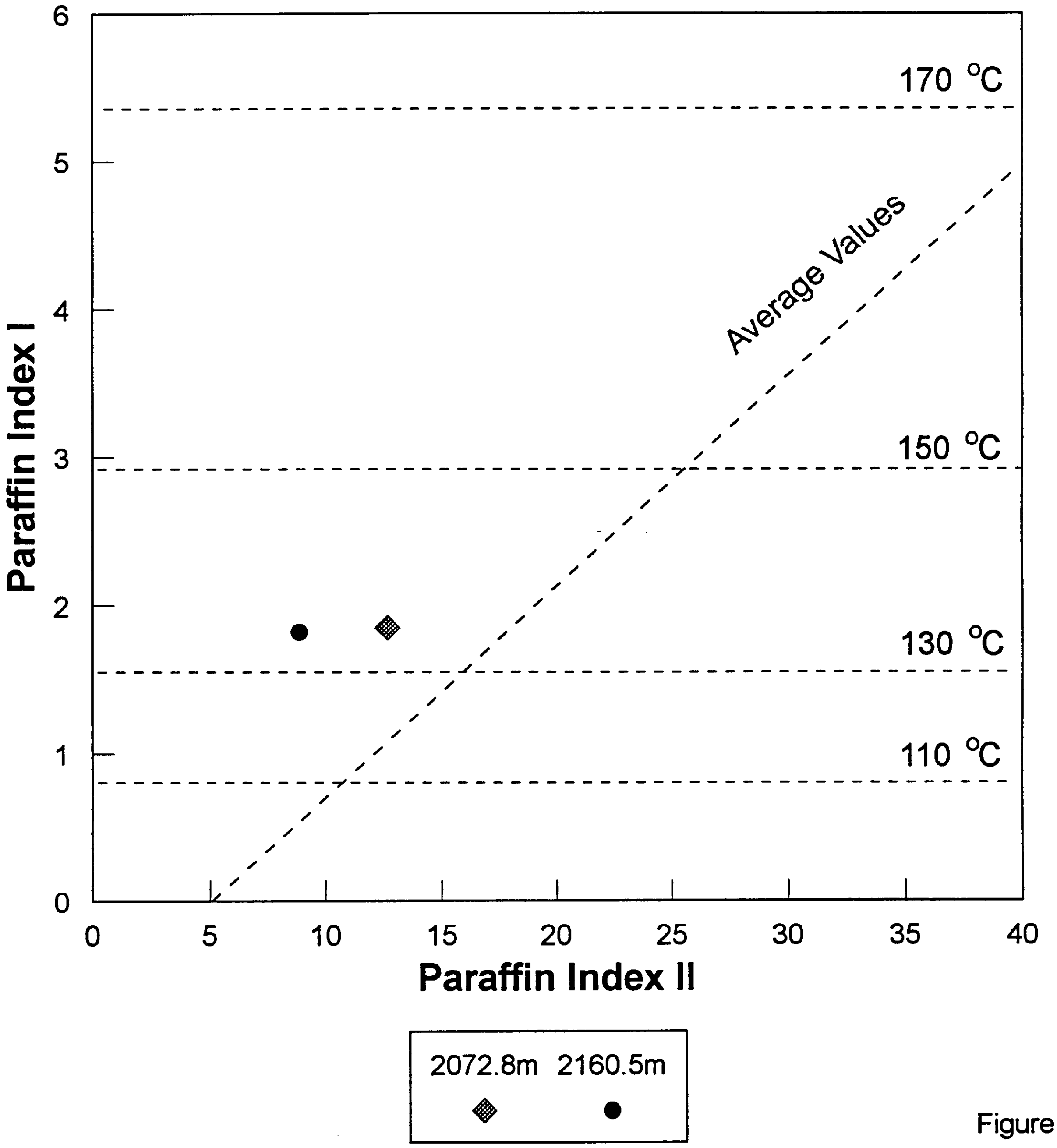


Figure 15

TABLE 6

SUMMARY OF EXTRACTION AND LIQUID CHROMATOGRAPHY - SEDIMENTS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1	DEPTH 2	WEIGHT OF ROCK EXTD (grams)	TOTAL EXTRACT (ppm)	LOSS ON COLUMN (ppm)	% REC.	SATURATES (ppm)	AROMATICS (ppm)	POLARS (ppm)	SATURATES (rel %)	AROMATICS (rel %)	POLARS (rel %)	EOM(mg)/ TOC(g)	SAT(mg)/ TOC(g)	SAT/ AROM	HC/ non-HC
2070.00	2070.00	18.70	332.4	-	-	-	-	-	-	-	-	-	-	-	-
2071.20	2071.20	49.70	376.0	-	-	-	-	-	-	-	-	-	-	-	-
2095.15	2095.20	97.10	244.0	-	-	-	-	-	-	-	-	11.9	-	-	-
2097.70	2097.70	81.40	443.4	-	-	-	-	-	-	-	-	-	-	-	-
2100.00	2110.00	74.80	344.8	37.4	89.2	116.3	96.2	94.9	37.8	31.3	30.9	-	-	1.21	2.24
2102.50	2102.50	10.60	783.8	-	-	-	-	-	-	-	-	-	-	-	-
2121.00	2121.00	13.50	665.2	-	-	-	-	-	-	-	-	-	-	-	-
2159.00	2159.00	10.60	511.4	-	-	-	-	-	-	-	-	-	-	-	-

EOM = Extractable organic matter
AROM = matic compounds
POLARS = Polar (Asphaltenes + resi)
HC = Hydrocarbon
TOC = Total organic carbon
REC. = Recovered
SAT = Saturated compounds
\- = no data

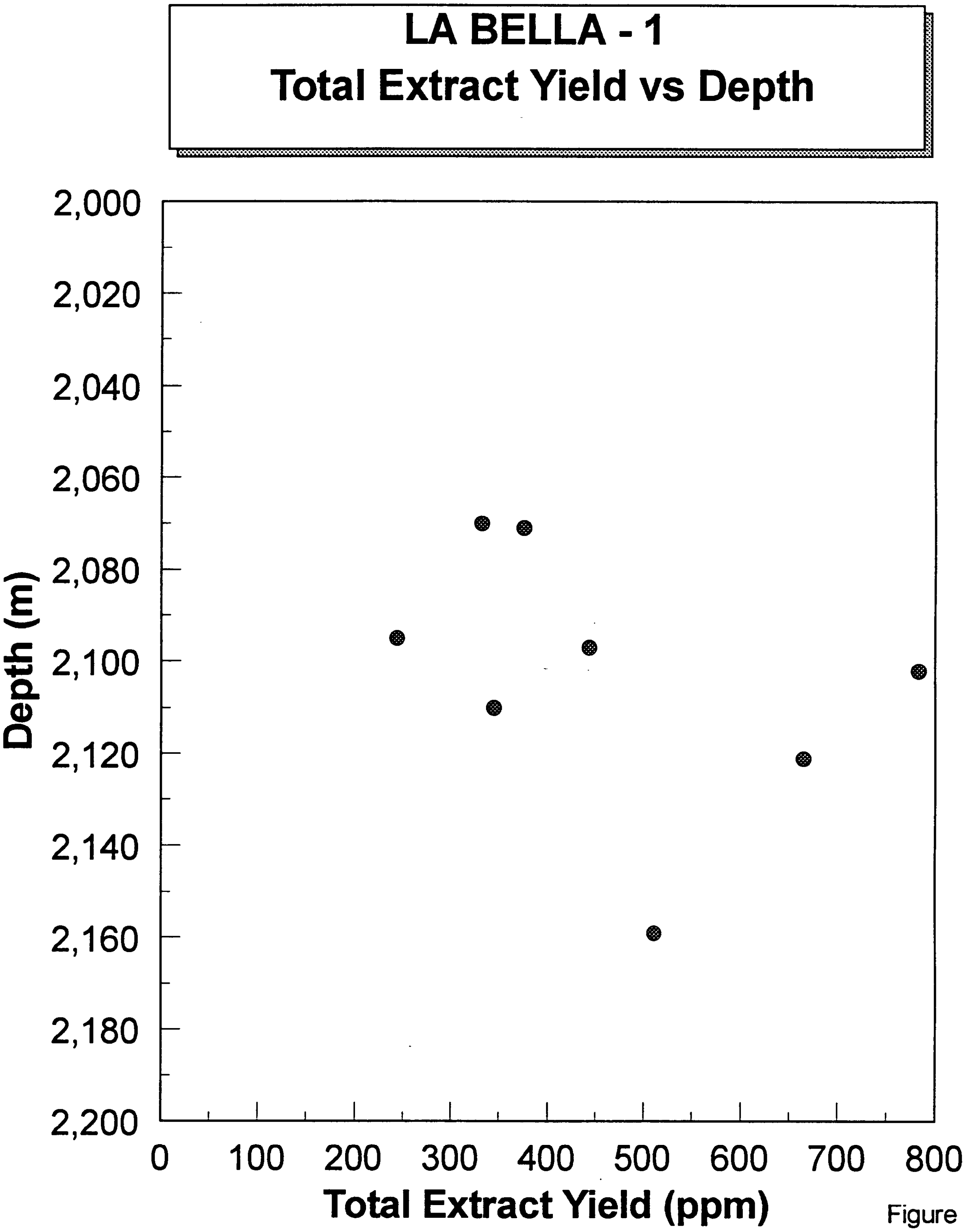
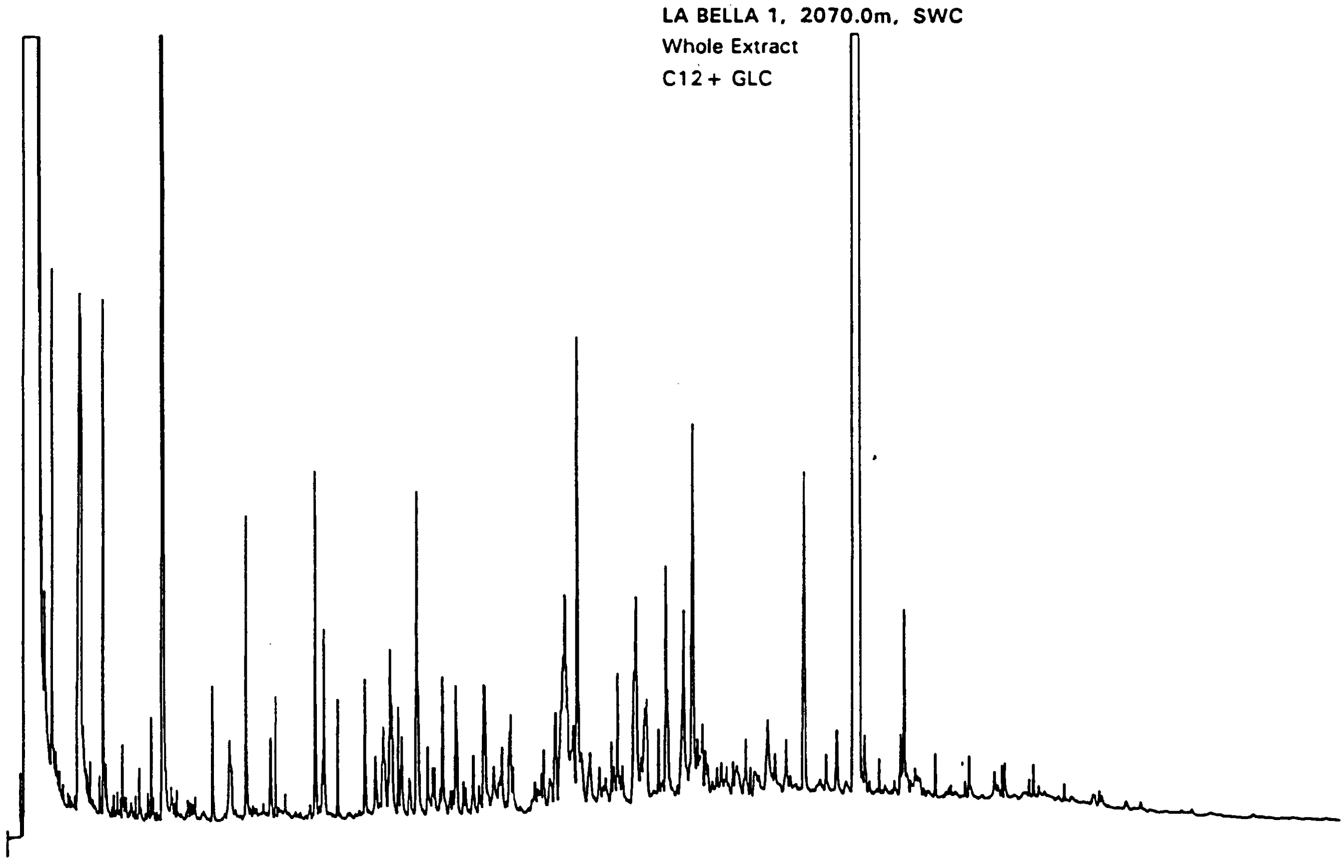

LA BELLA - 1
Total Extract Yield vs Depth
Depth (m)
2,000
2,020
2,040
2,060
2,080
2,100
2,120
2,140
2,160
2,180
2,200
0
100
200
300
400
500
600
700
800
Total Extract Yield (ppm)

Figure 16

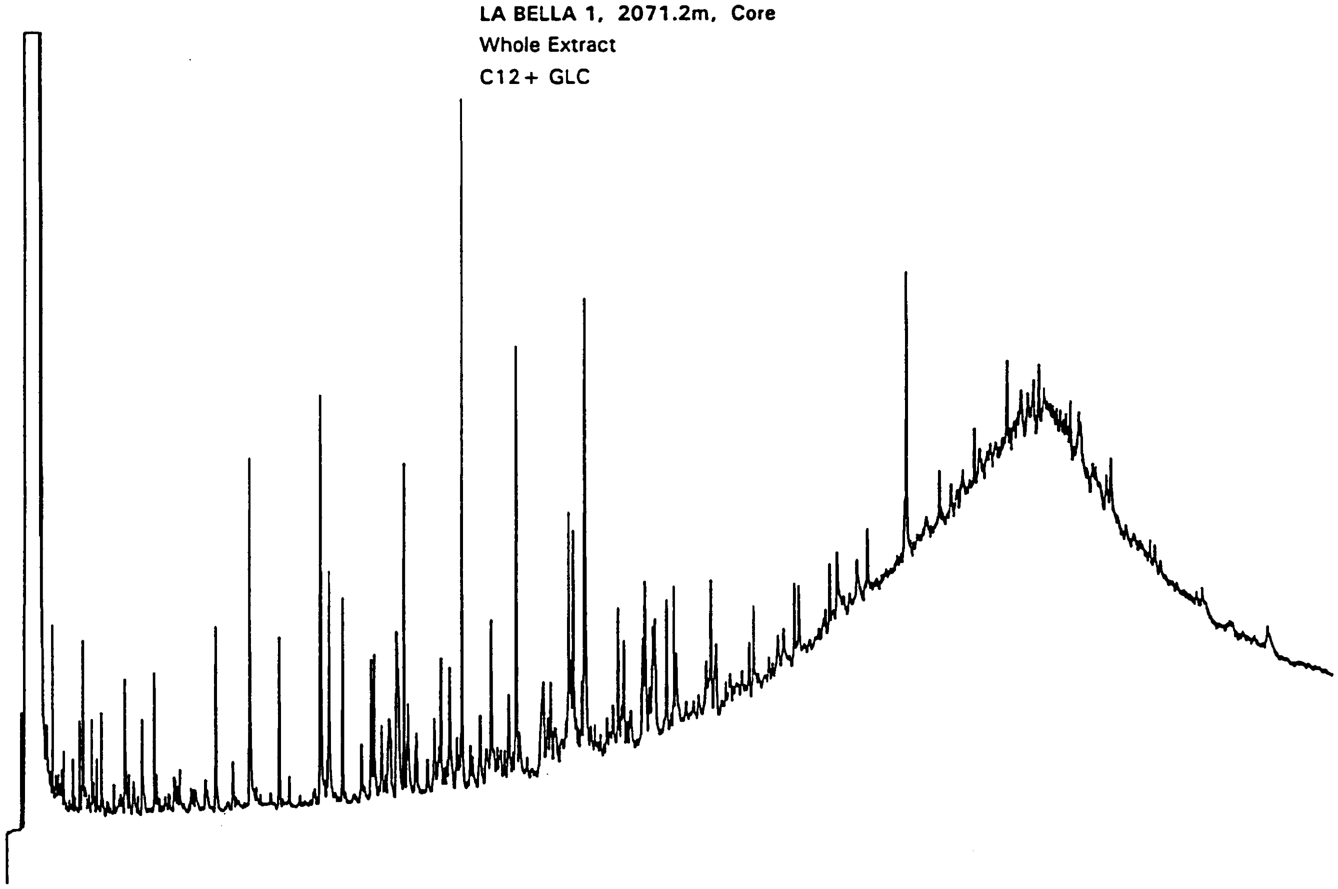
FIGURE 17a



LA BELLA 1, 2070.0m, SWC
Whole Extract
C12+ GLC

GEOTECHNICAL SERVICES PTY LTD

1994ED7

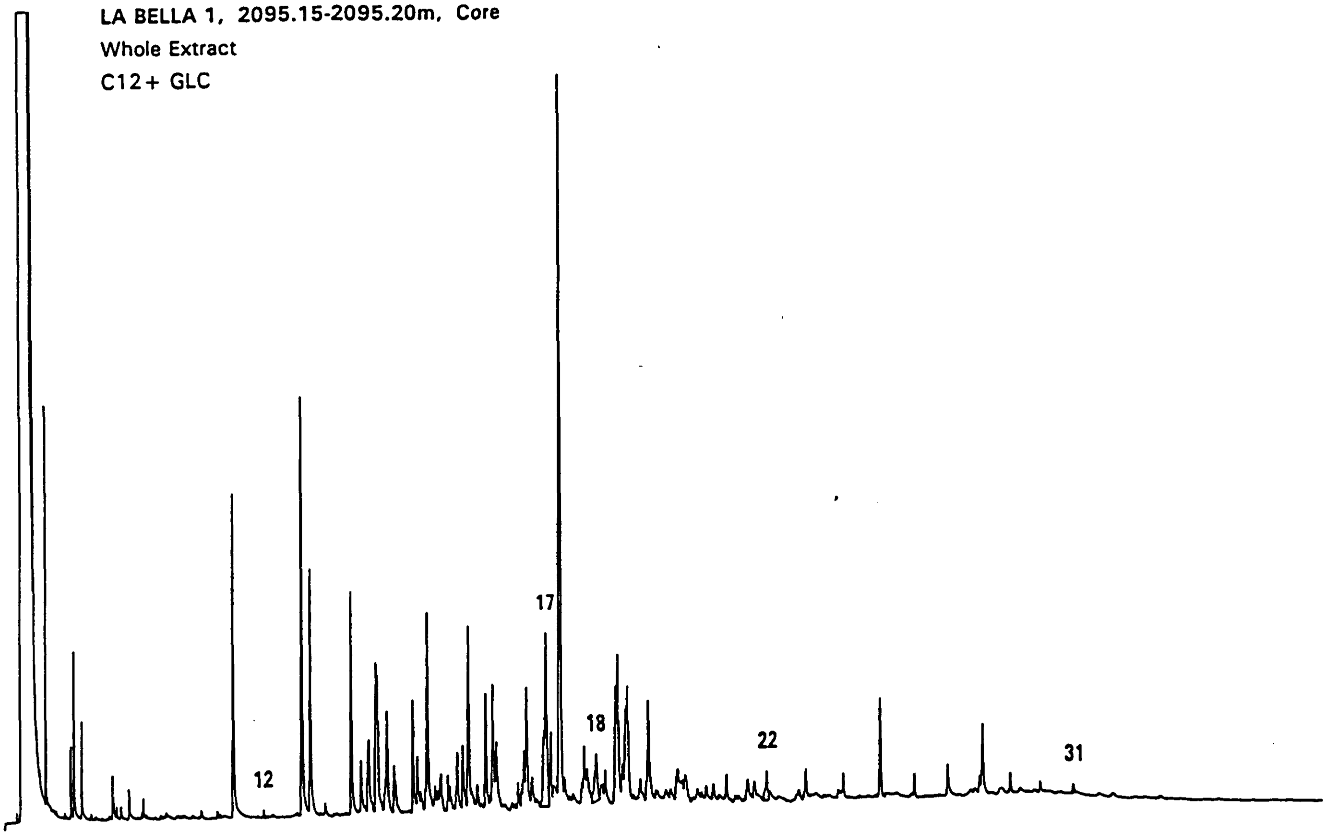


LA BELLA 1, 2071.2m, Core
Whole Extract
C12+ GLC

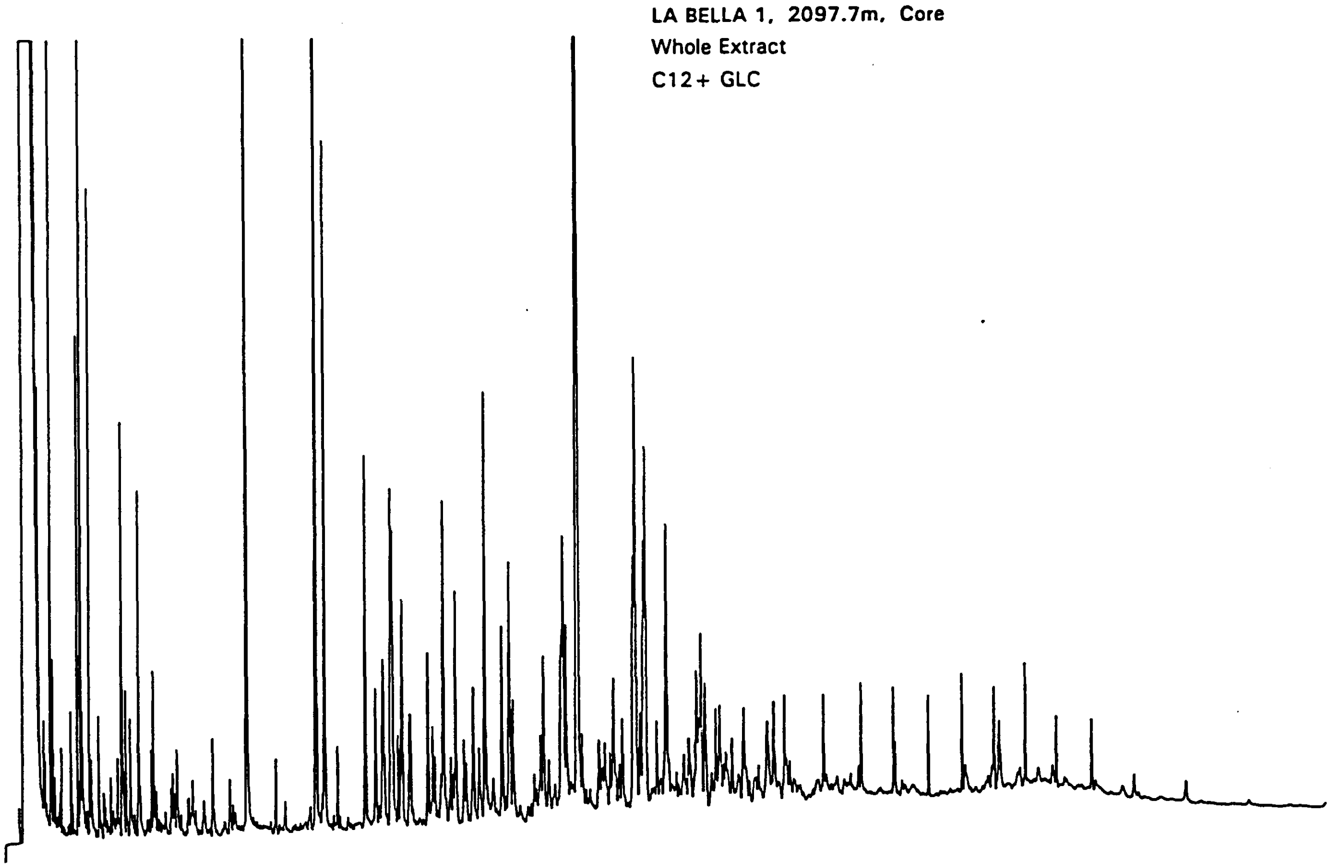
GEOTECHNICAL SERVICES PTY LTD

1994ED4

FIGURE 17b


LA BELLA 1, 2095.15-2095.20m, Core
Whole Extract
C12+ GLC

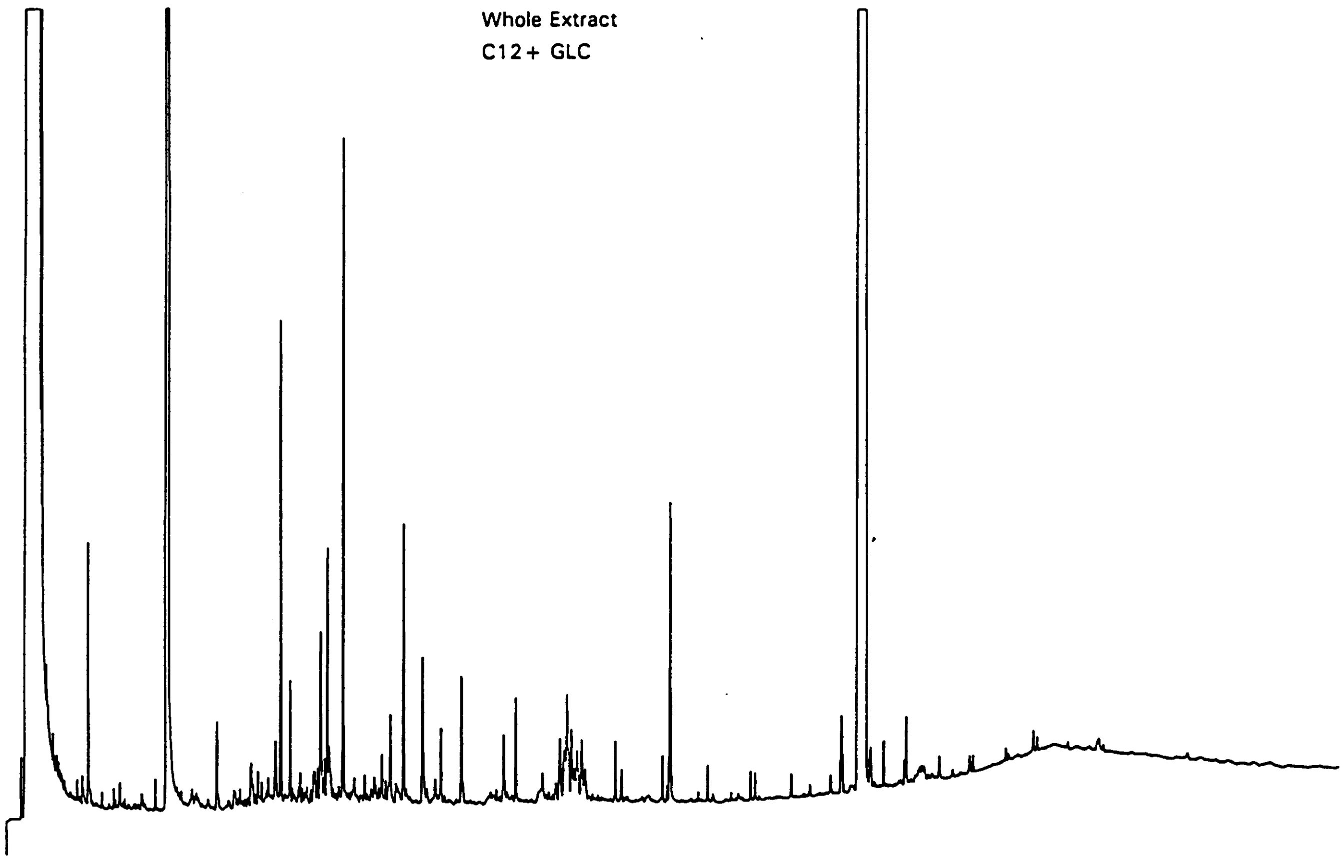
GEOTECHNICAL SERVICES PTY LTD


LA BELLA 1, 2097.7m, Core
Whole Extract
C12+ GLC

GEOTECHNICAL SERVICES PTY LTD

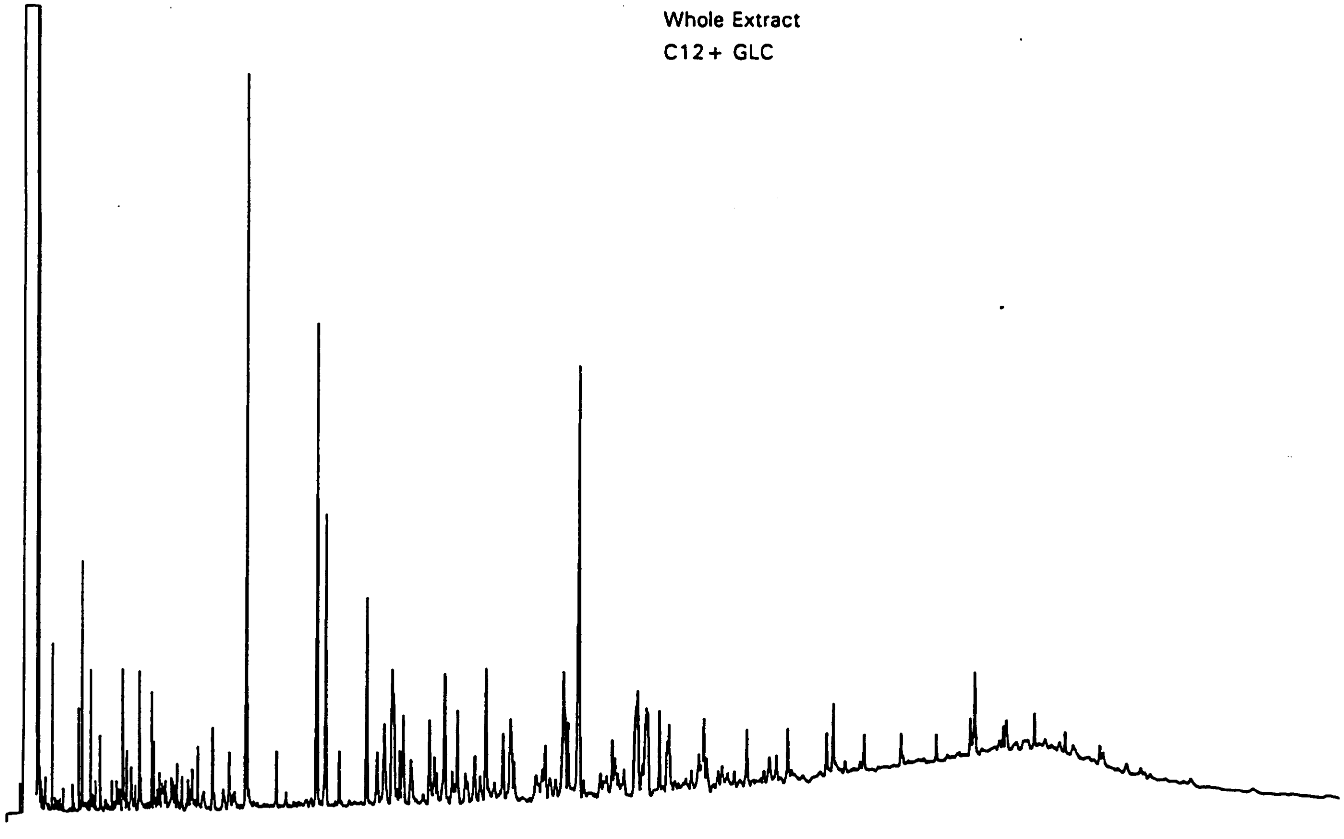
FIGURE 17c

LA BELLA 1, 2102.5m, SWC
Whole Extract
C12+ GLC



GEOTECHNICAL SERVICES PTY LTD

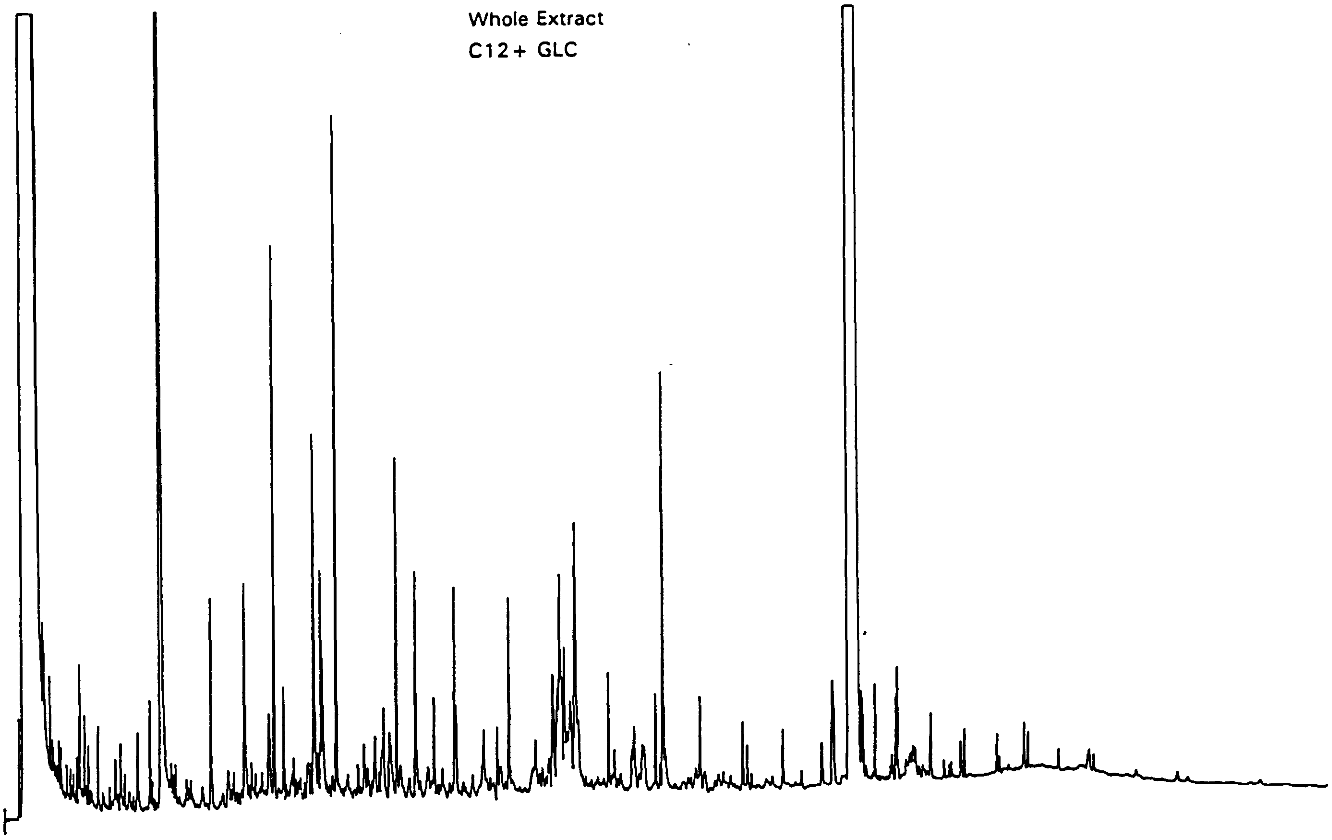
LA BELLA 1, 2100-2110m, Cuttings
Whole Extract
C12+ GLC



GEOTECHNICAL SERVICES PTY LTD

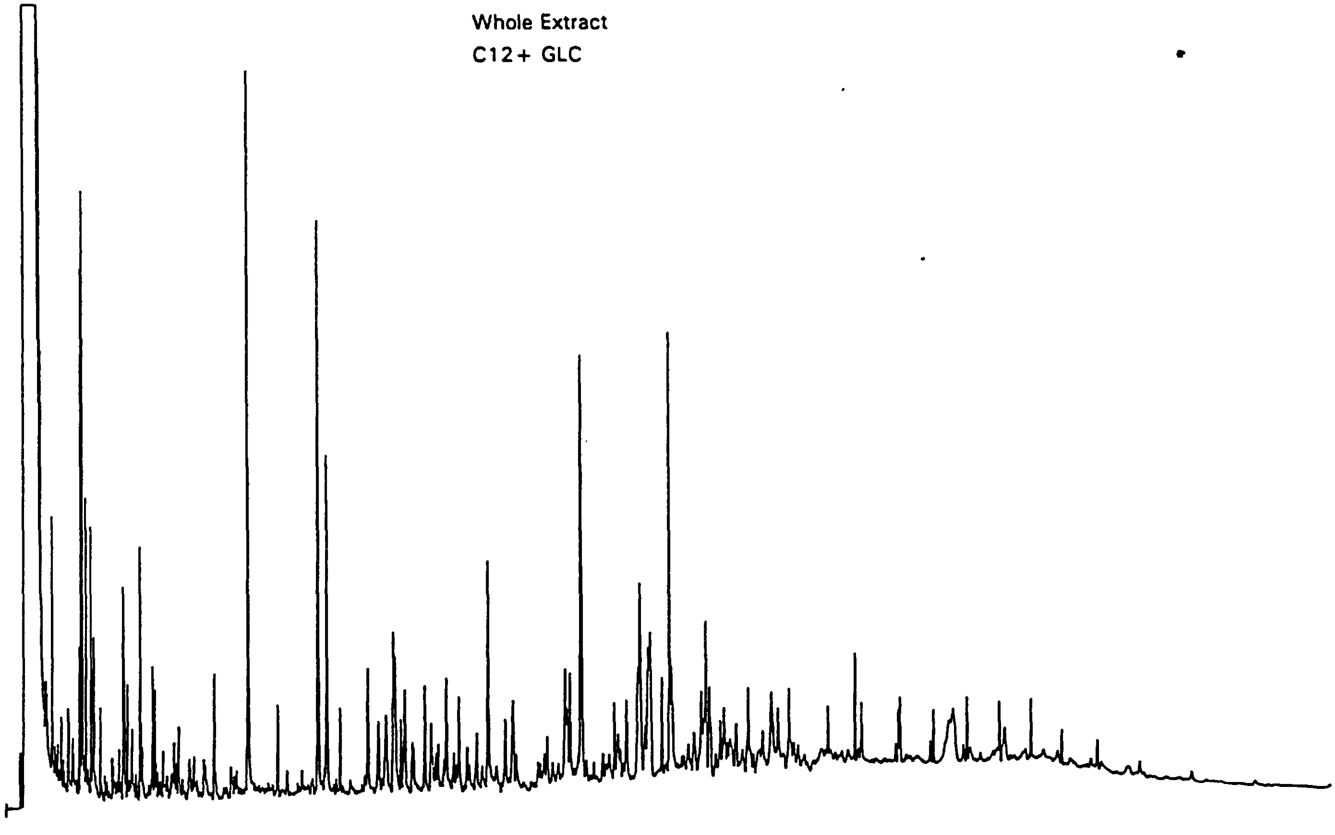
FIGURE 17d

LA BELLA 1, 2121.0m, SWC
Whole Extract
C12+ GLC



GEOTECHNICAL SERVICES PTY LTD

LA BELLA 1, 2159.0m, SWC
Whole Extract
C12+ GLC



GEOTECHNICAL SERVICES PTY LTD

TABLE 7

SUMMARY OF LIQUID CHROMATOGRAPHY - CONDENSATES

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1	DEPTH 2	SATURATES (REL %)	AROMATICS (REL %)	POLARS (REL %)	SAT/ AROM	HC/ non-HC
2072.80	2072.80	-	-	-	-	-
2160.50	2160.50	-	-	-	-	-

SAT = Saturated compounds
AROM = Aromatic compounds
HC = Hydrocarbon
- = no data

LA BELLA - 1
LC Separation Data

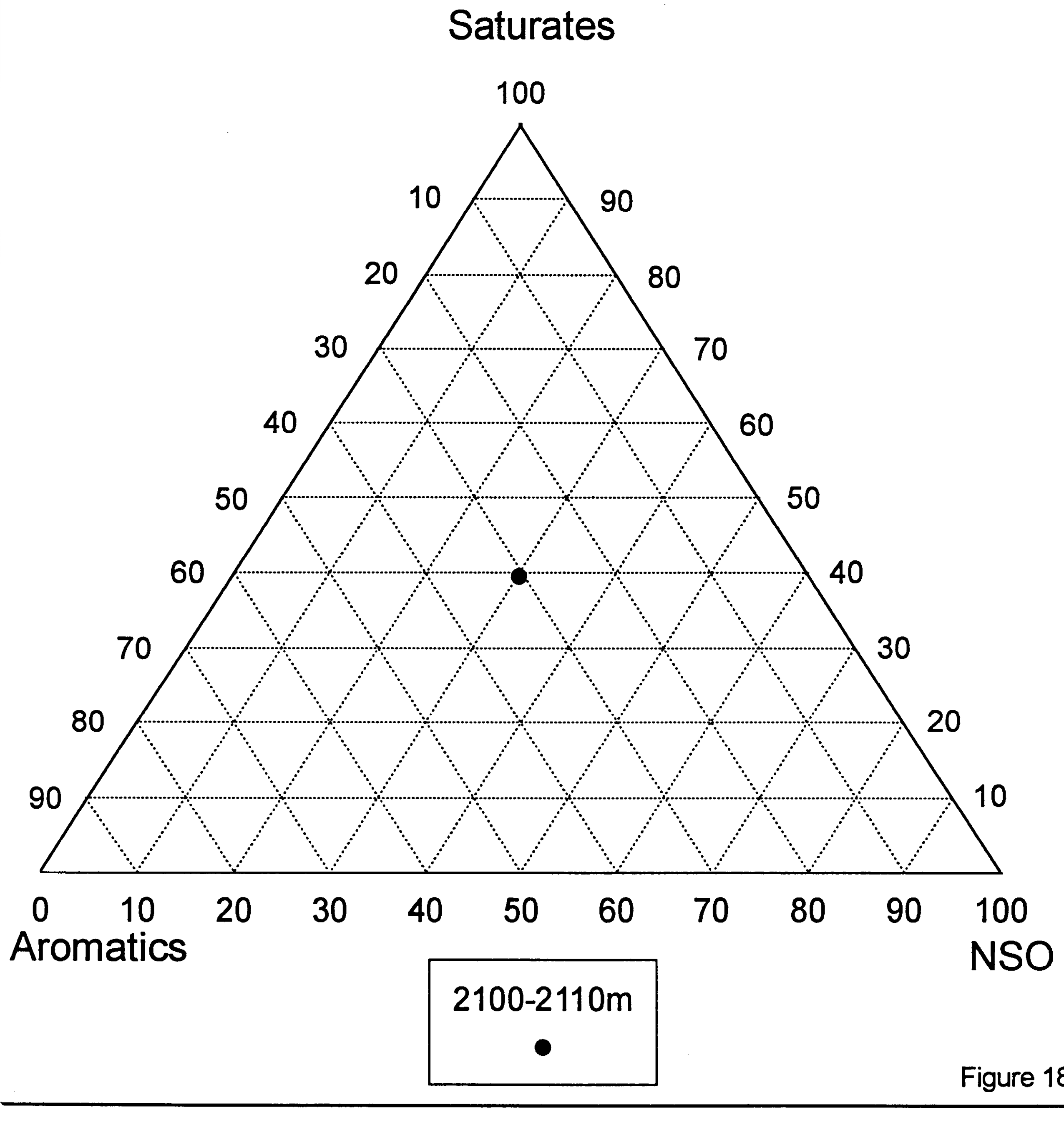
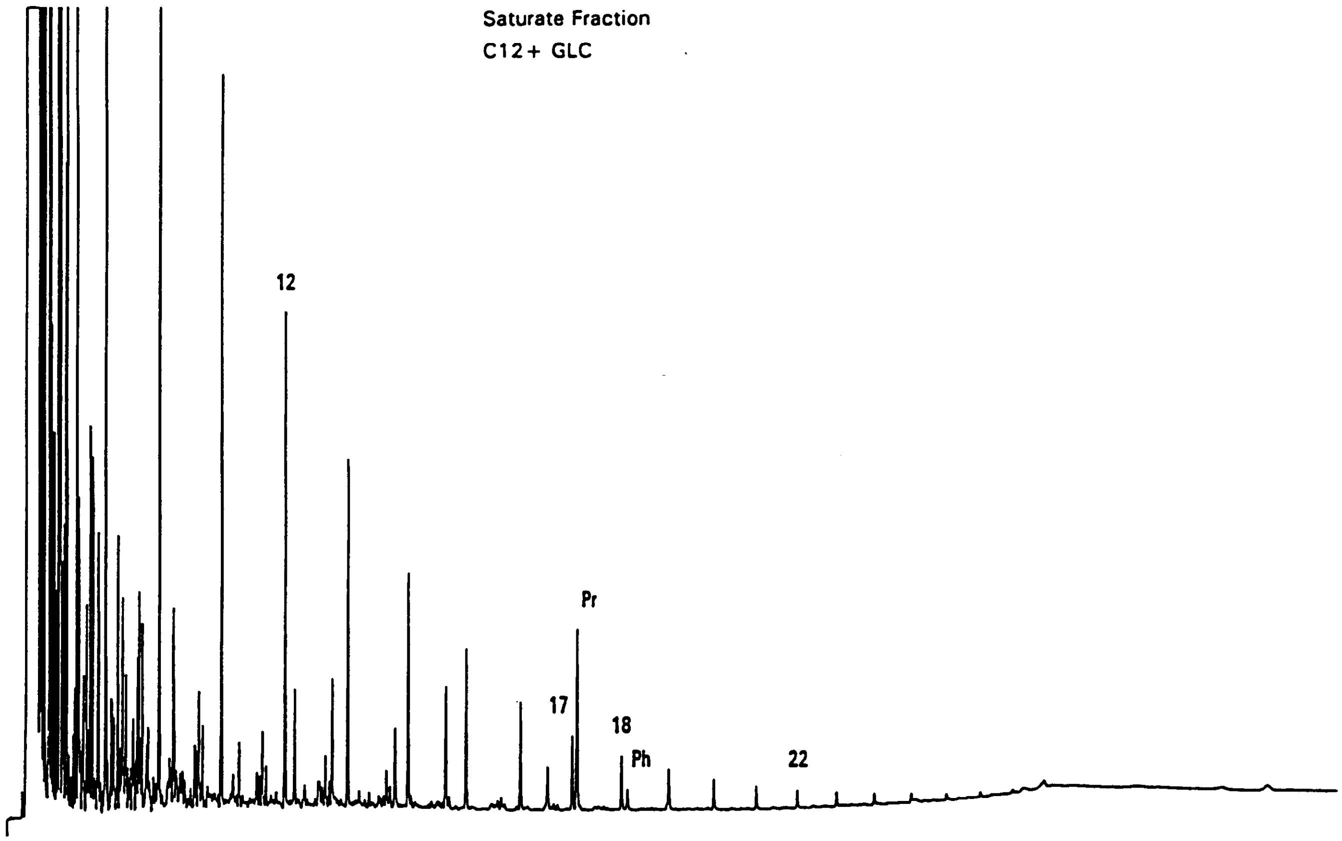
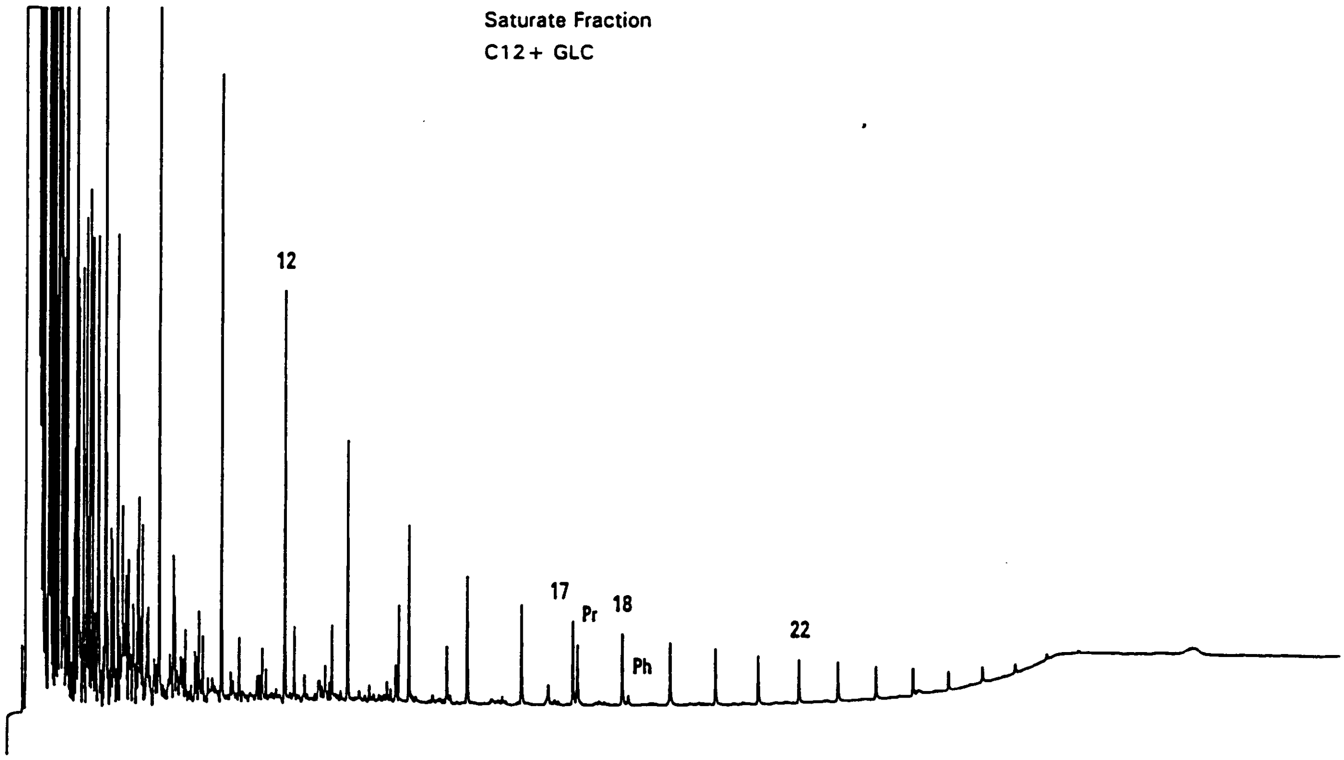


Figure 18

FIGURE 19



LA BELLA 1, 2072.8 m
Saturate Fraction
C12+ GLC



LA BELLA 1, 2160.5 m
Saturate Fraction
C12+ GLC

TABLE 8

SUMMARY OF GAS CHROMATOGRAPHY DATA - CONDENSATES
ALKANE DISTRIBUTIONS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1	DEPTH 2	nC12	nC13	nC14	TMTD	nC15	nC16	iC18	nC17	iC19	nC18	iC20	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33
2072.80	2072.80	21.6	16.1	11.2	6.1	8.2	5.4	3.1	4.2	10.7	2.9	1.3	2.6	1.7	1.3	1.0	.8	.6	.5	.4	.3	.2	0.0	0.0	0.0	0.0	0.0
2160.50	2160.50	19.5	13.3	9.7	3.0	7.3	5.8	1.8	5.1	4.1	4.7	.7	4.4	3.8	3.2	2.9	2.5	2.2	2.0	1.3	1.1	.6	.4	.2	.2	0.0	0.0

---

i = iso
- = no data
n = normal
TMTD = Trimethyltridecane

N.B. Values are relative %

LA BELLA - 1: Condensates

GC (Sats) Normalised Relative Abundance

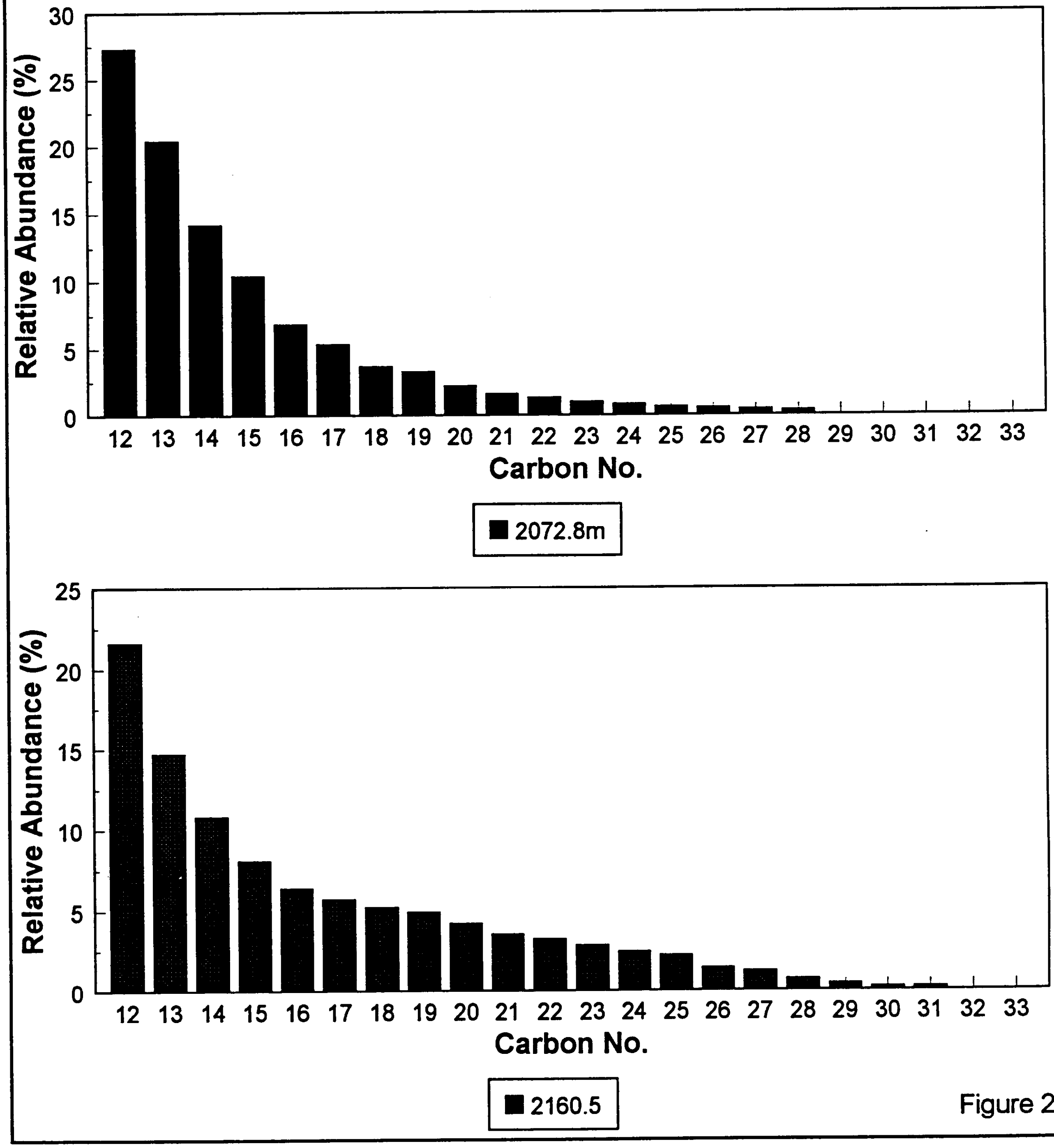


Figure 20

LA BELLA - 1: Condensates
GC (Sats) Normalised Relative Abundance

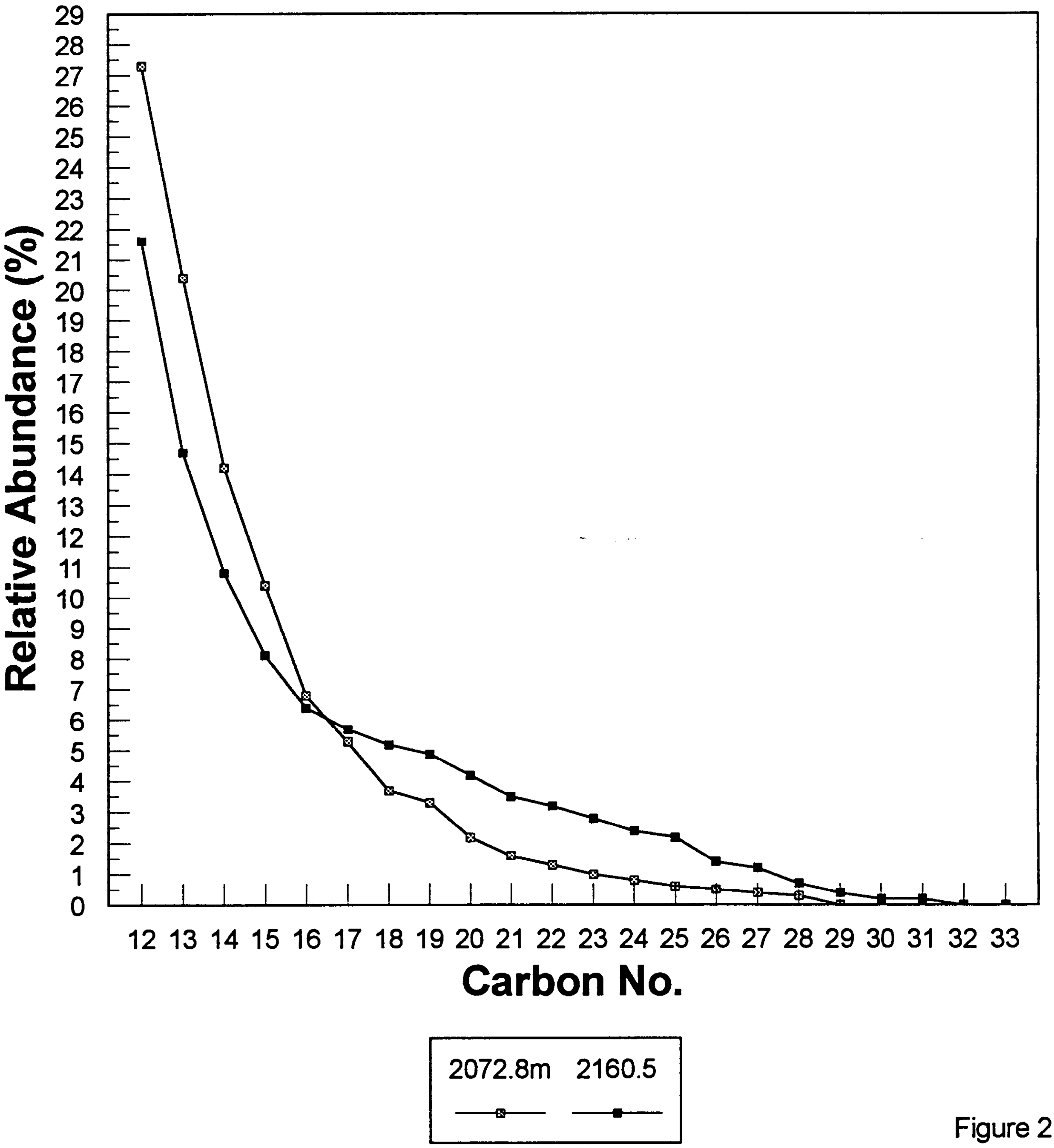
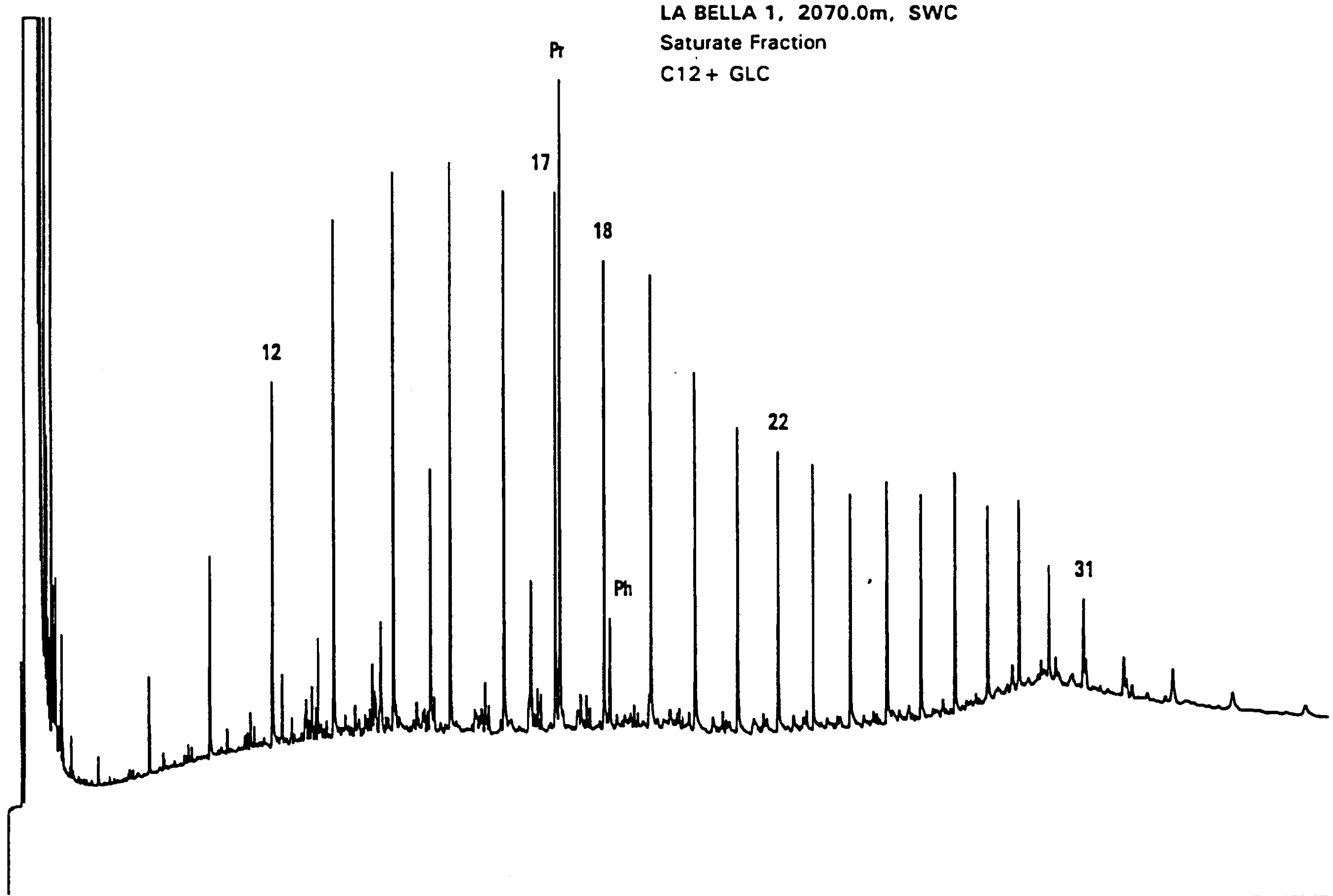


Figure 21

FIGURE 22a

LA BELLA 1, 2070.0m, SWC
Saturate Fraction
C12+ GLC



LA BELLA 1, 2097.7m, Core
Saturate Fraction
C12+ GLC

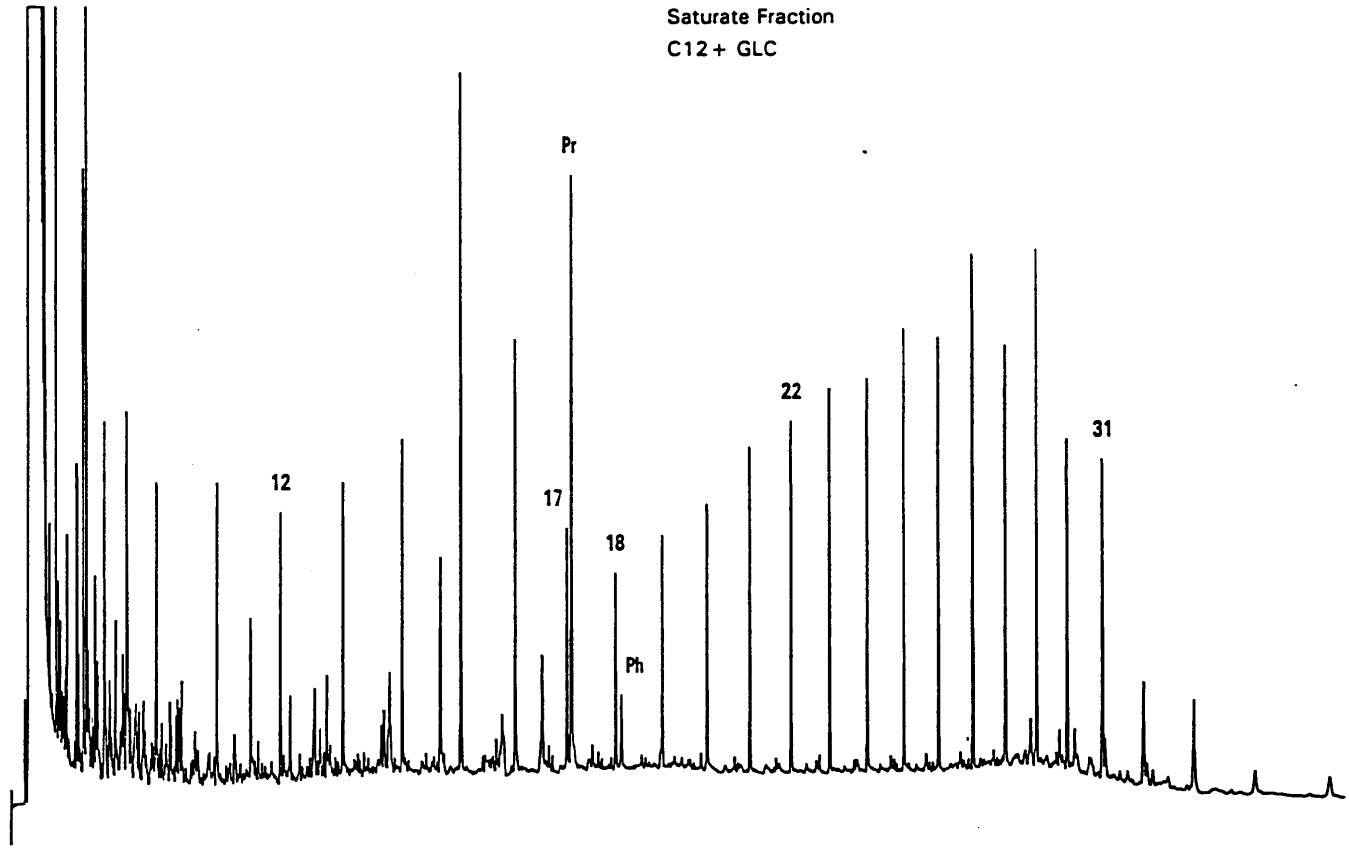
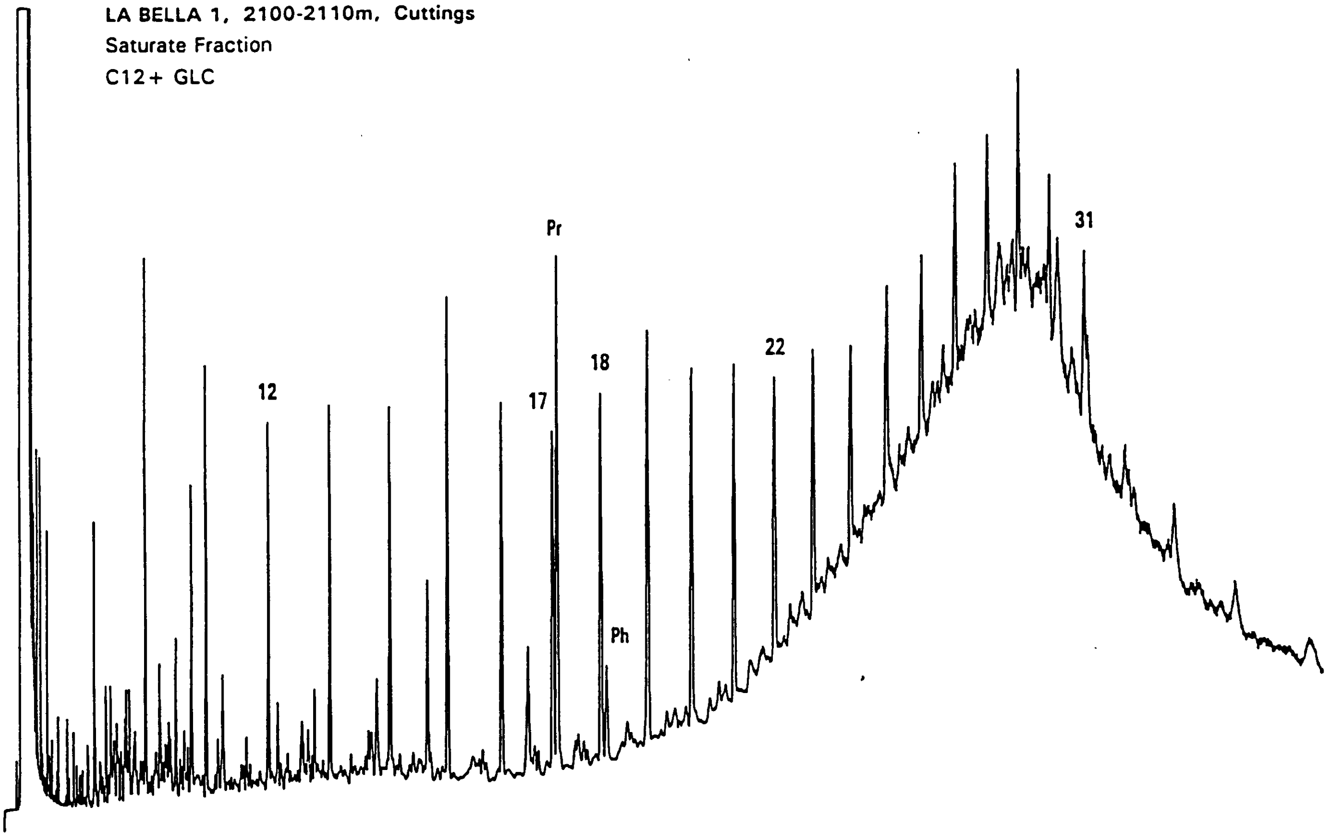


FIGURE 22b


LA BELLA 1, 2100-2110m, Cuttings
Saturate Fraction
C12+ GLC

GEOTECHNICAL SERVICES PTY LTD

LA BELLA 1, 2121.0m, SWC
Saturate Fraction
C12+ GLC

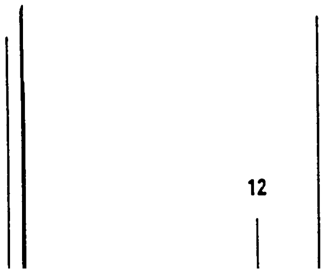
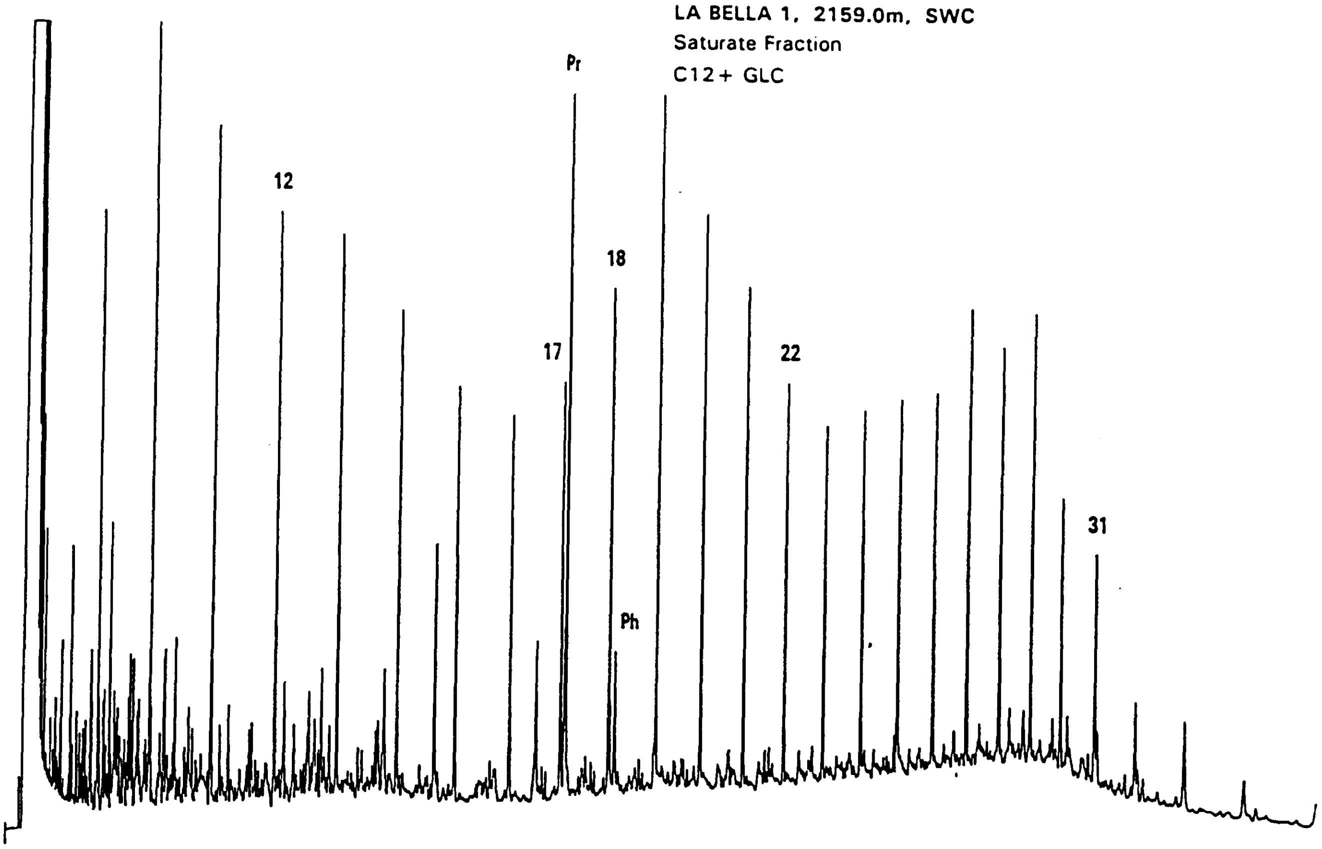


FIGURE 22c



1994ED9

GEOTECHNICAL SERVICES PTY LTD

TABLE 9

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE DISTRIBUTIONS

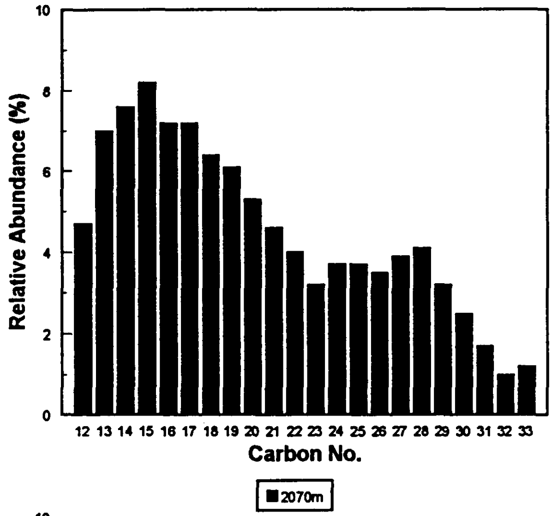
WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

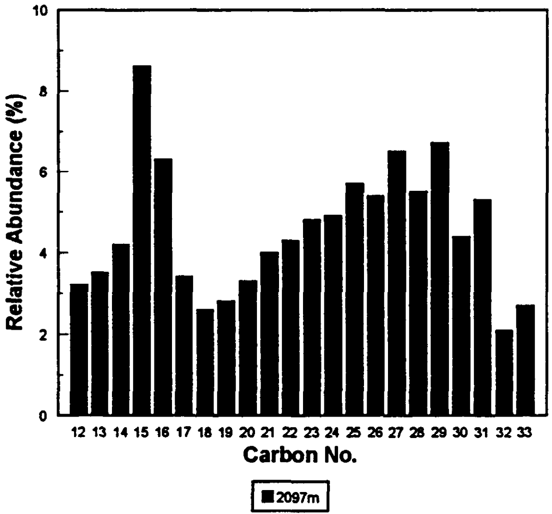
DEPTH UNIT = Metres
DATE OF JOB = Oct 93

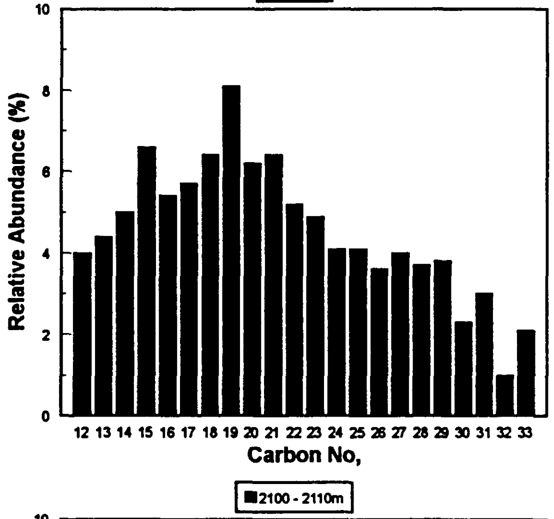
DEPTH 1	DEPTH 2	nC12	nC13	nC14	TMTD	nC15	nC16	iC18	nC17	iC19	nC18	iC20	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33
2070.00	2070.00	3.9	5.8	6.3	3.0	6.8	6.0	3.0	6.0	9.2	5.3	1.6	5.1	4.4	3.8	3.3	2.7	3.1	3.1	2.9	3.2	3.4	2.7	2.1	1.4	.8	1.0
2071.20	2071.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2095.15	2095.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2097.70	2097.70	2.7	3.0	3.6	2.6	7.4	5.4	2.3	2.9	8.1	2.2	1.1	2.4	2.8	3.4	3.7	4.1	4.2	4.9	4.6	5.6	4.7	5.7	3.8	4.5	1.8	2.3
2100.00	2110.00	3.5	3.8	4.4	2.3	5.8	4.7	2.4	5.0	6.6	5.6	1.3	7.1	5.4	5.6	4.5	4.3	3.6	3.6	3.1	3.5	3.2	3.3	2.0	2.6	.9	1.8
2102.50	2102.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2121.00	2121.00	13.1	18.3	9.9	3.0	6.4	6.2	3.1	5.6	5.5	4.2	1.3	3.2	2.6	2.2	2.1	2.0	1.8	1.8	1.5	1.5	1.4	1.1	.8	.7	.3	.4
2159.00	2159.00	4.9	4.7	4.2	2.6	3.8	3.8	2.5	4.4	8.3	5.3	1.5	5.6	5.2	4.4	3.9	3.3	3.5	3.6	3.8	4.4	4.1	4.2	2.6	2.6	1.2	1.5

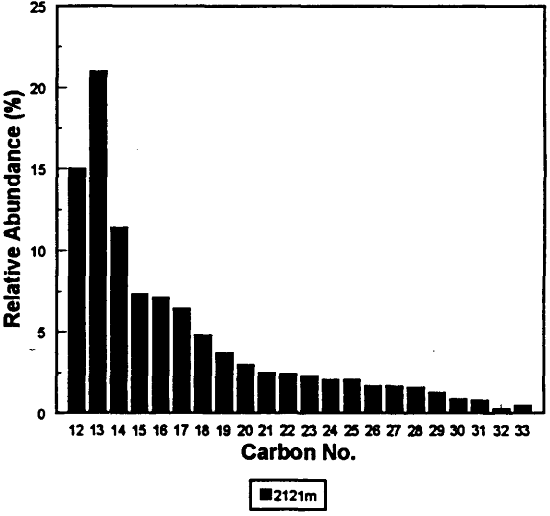
---

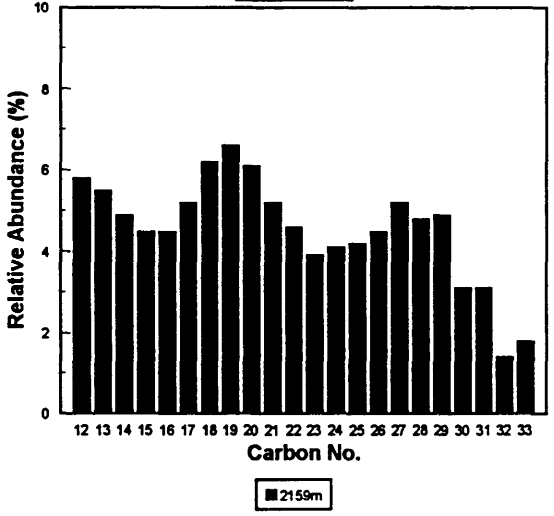
i = iso n = normal N.B. Values are relative %
- = no data TMTD = Trimethyltridecane











LA BELLA - 1: Extracts

GC (Sats) Normalised Relative Abundance

Figure 23

LA BELLA - 1: Extracts
GC (Sats) Normalised Relative Abundance

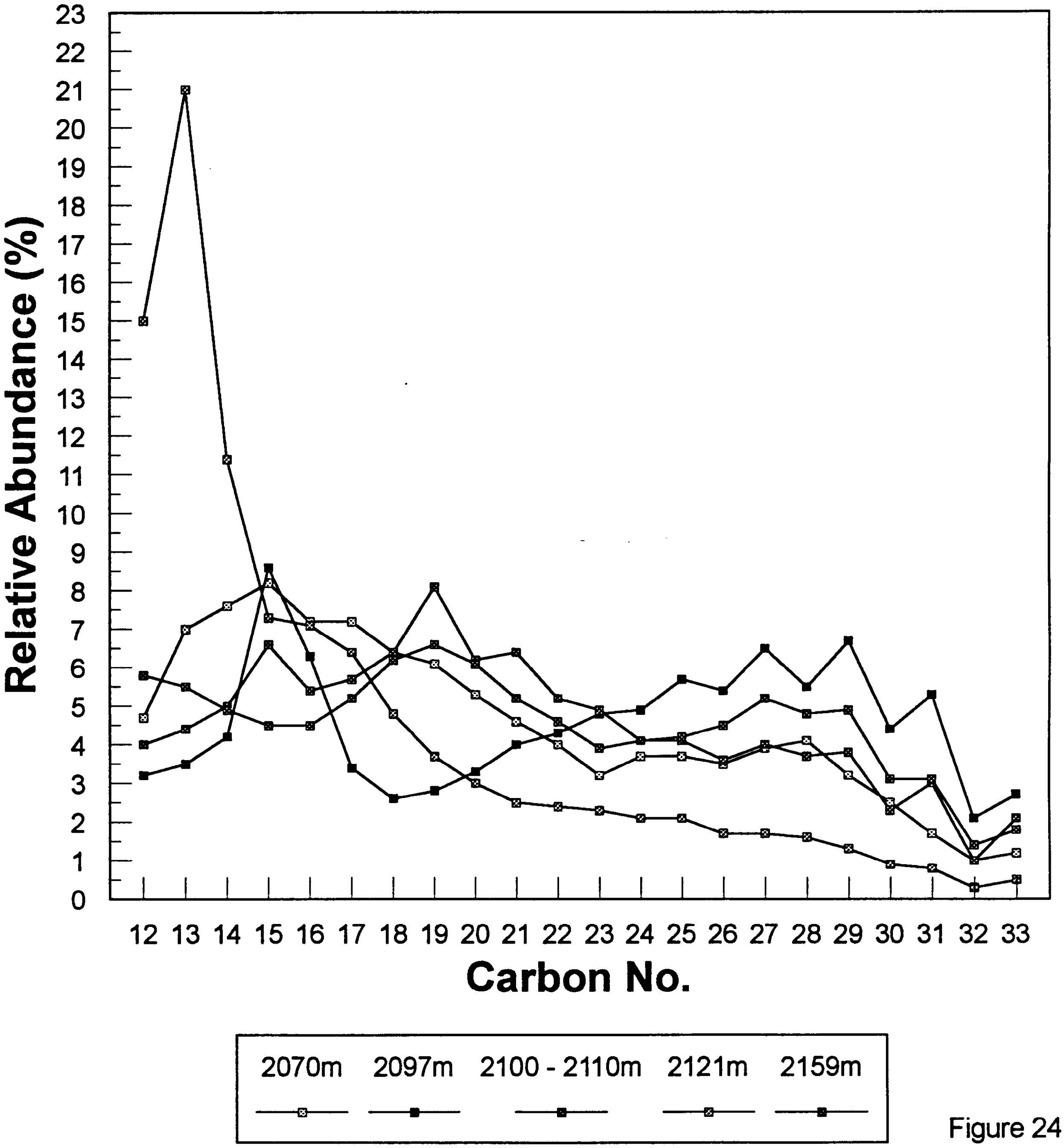


Figure 24

TABLE 10

SUMMARY OF GAS CHROMATOGRAPHY DATA - CONDENSATES
ALKANE COMPOSITIONAL DATA

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1	DEPTH 2	ANALYSIS TYPE	PRISTANE/PHYTANE	PRISTANE/n-C17	PHYTANE/n-C18	TMTD/PRISTANE	CPI(I)	CPI(II)	(C21+C22)/(C28+C29)
2072.80	2072.80	SF	8.26	2.54	0.44	0.57	0.95	0.95	13.49
2160.50	2160.50	SF	5.56	0.82	0.16	0.72	1.12	1.11	6.32

CPI = Carbon preference index TMTD = Trimethyltridecane - = [illegible] data
SF = Saturate fraction WE = Whole extract

TABLE 11

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE COMPOSITIONAL DATA

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	ANALYSIS TYPE	PRISTANE/PHYTANE	PRISTANE/n-C17	PHYTANE/n-C18	TMTD/PRISTANE	C
2070.00	2070.00	SF	5.70	1.53	0.30	0.33	
2071.20	2071.20	WE	-	-	-	-	
2095.15	2095.20	WE	-	-	-	-	
2097.70	2097.70	SF	7.54	2.78	0.48	0.32	
2100.00	2110.00	SF	4.93	1.31	0.24	0.35	
2102.50	2102.50	WE	-	-	-	-	
2121.00	2121.00	SF	4.38	0.97	0.30	0.55	
2159.00	2159.00	SF	5.56	1.91	0.28	0.31	

CPI = Carbon preference index   TMTD = Trimethyltridecane   - = no data
SF = Saturate fraction   WE = Whole extract

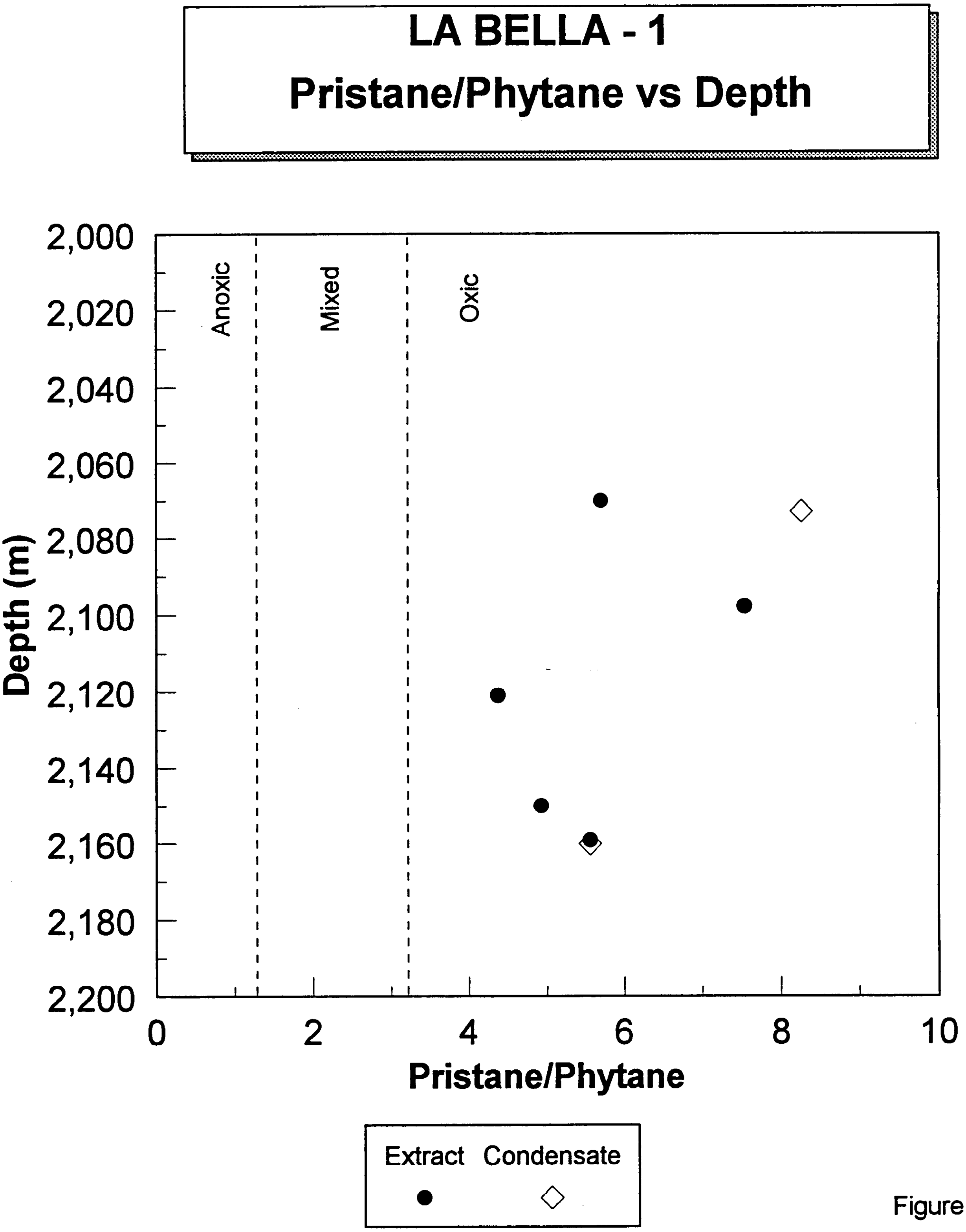

LA BELLA - 1
Pristane/Phytane vs Depth
Depth (m)
2,000
2,020
2,040
2,060
2,080
2,100
2,120
2,140
2,160
2,180
2,200
0
2
4
6
8
10
Pristane/Phytane
Anoxic
Mixed
Oxic
Extract ●
Condensate ◇

Figure 25

LA BELLA - 1
Pristane/n-C17 vs Phytane/n-C18

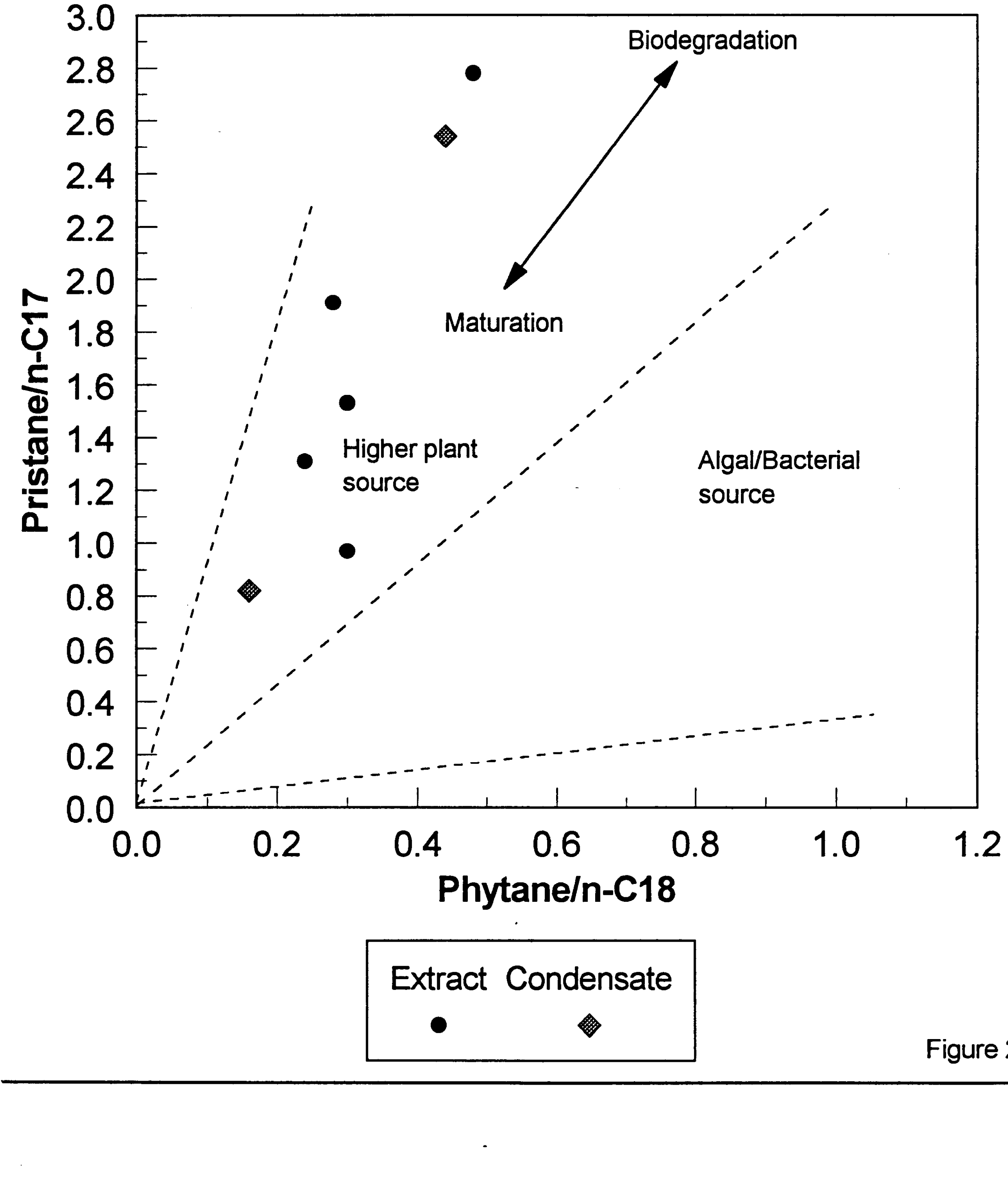
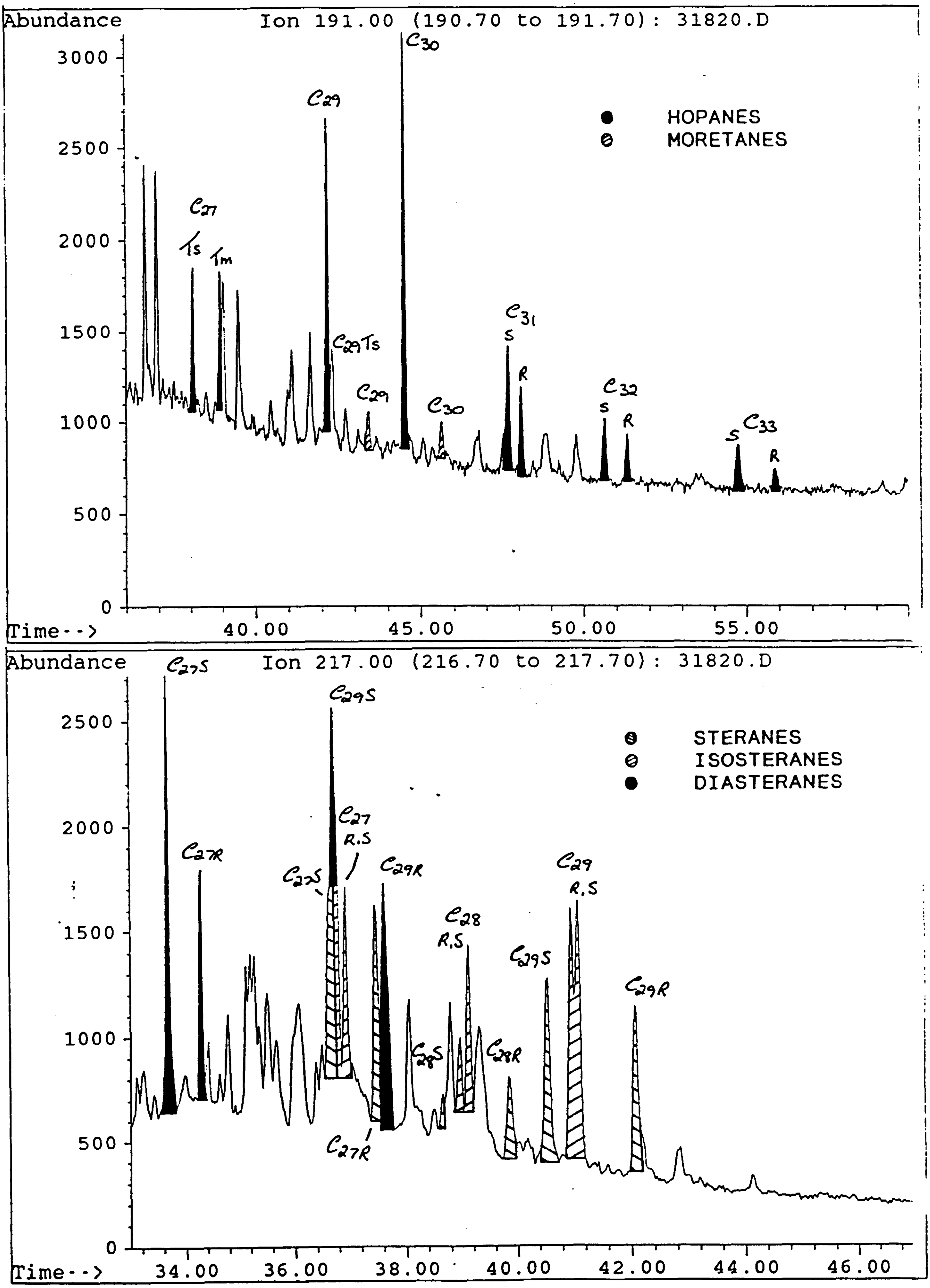
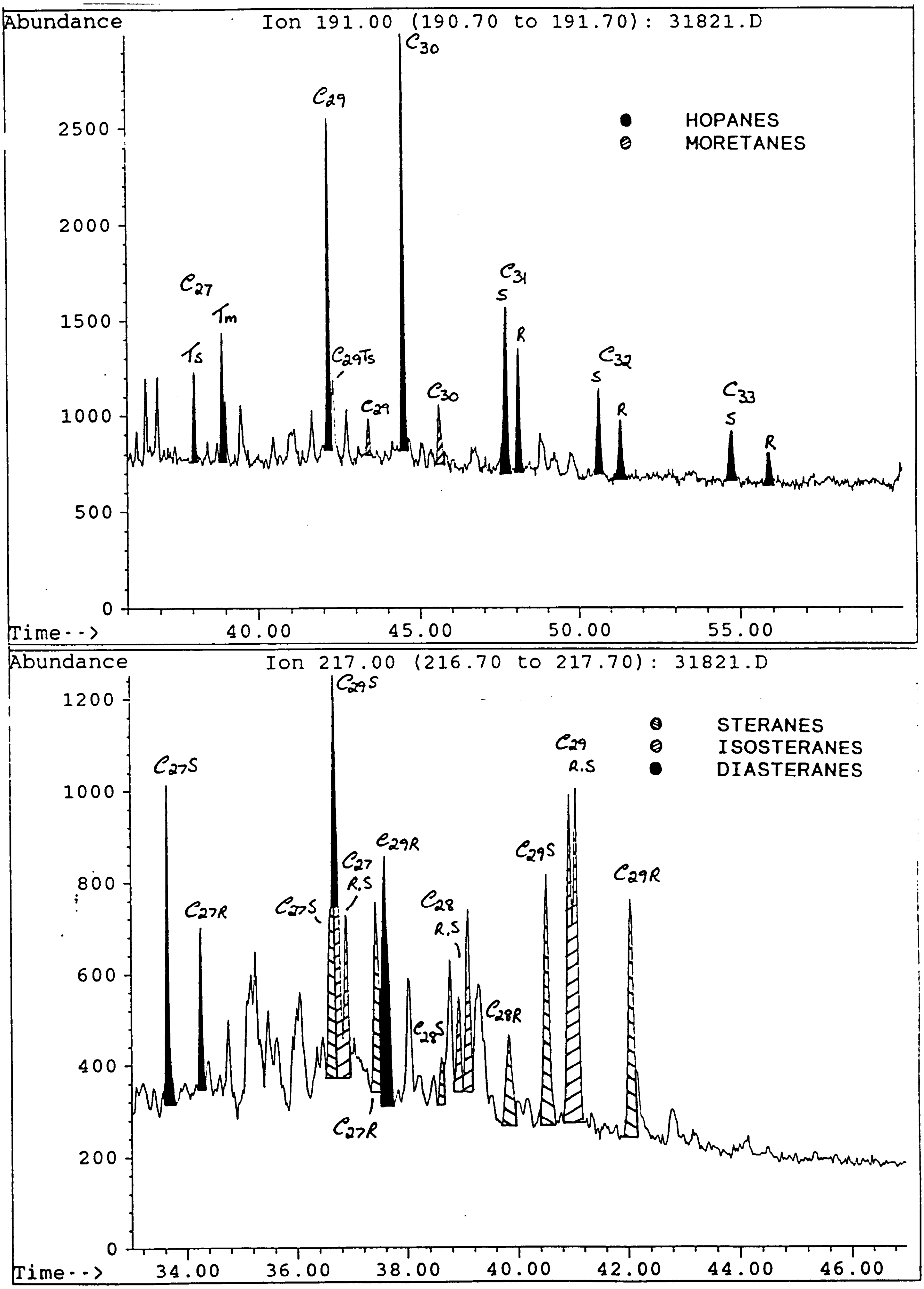


Figure 26

m/z 191 and m/z 217 biomarker traces: 2072.8m condensate



m/z 191 and m/z 217 biomarker traces: 2160.5m condensate



m/z 191 and m/z 217 biomarker traces: 2070m extract

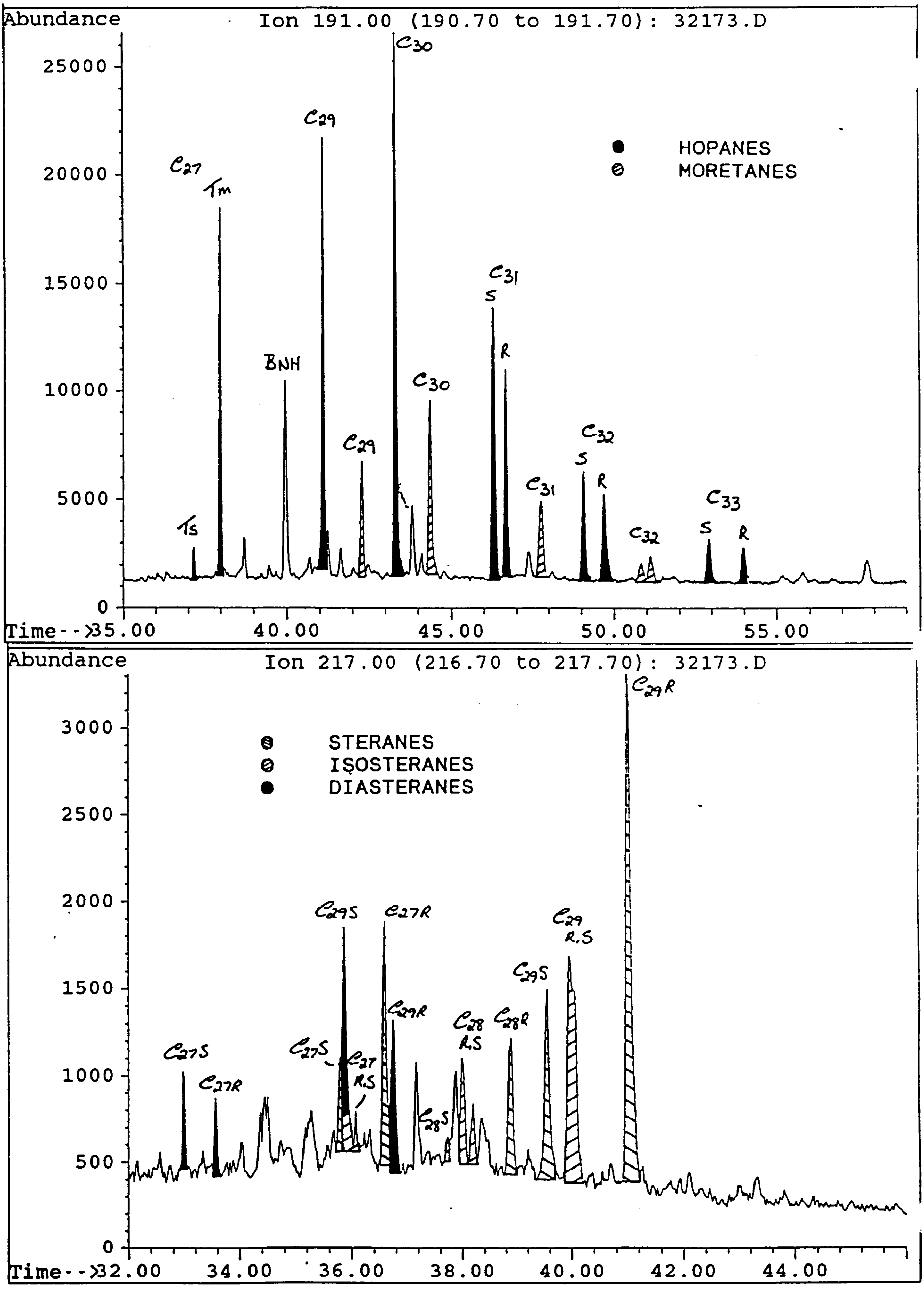


FIGURE 30

m/z 191 and m/z 217 biomarker traces: 2097.7m extract

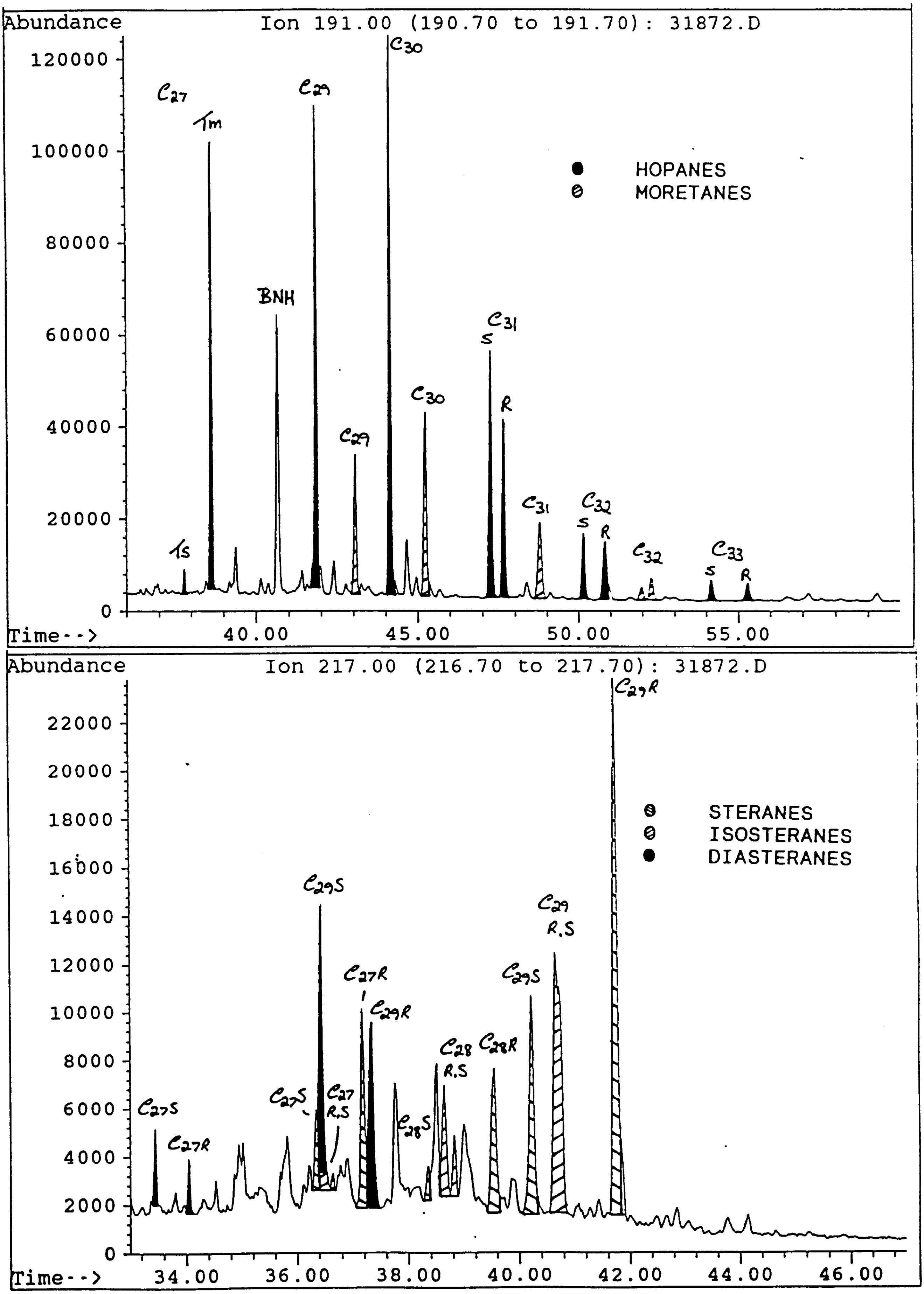


FIGURE 31

m/z 191 and m/z 217 biomarker traces: 2100-2110m extract

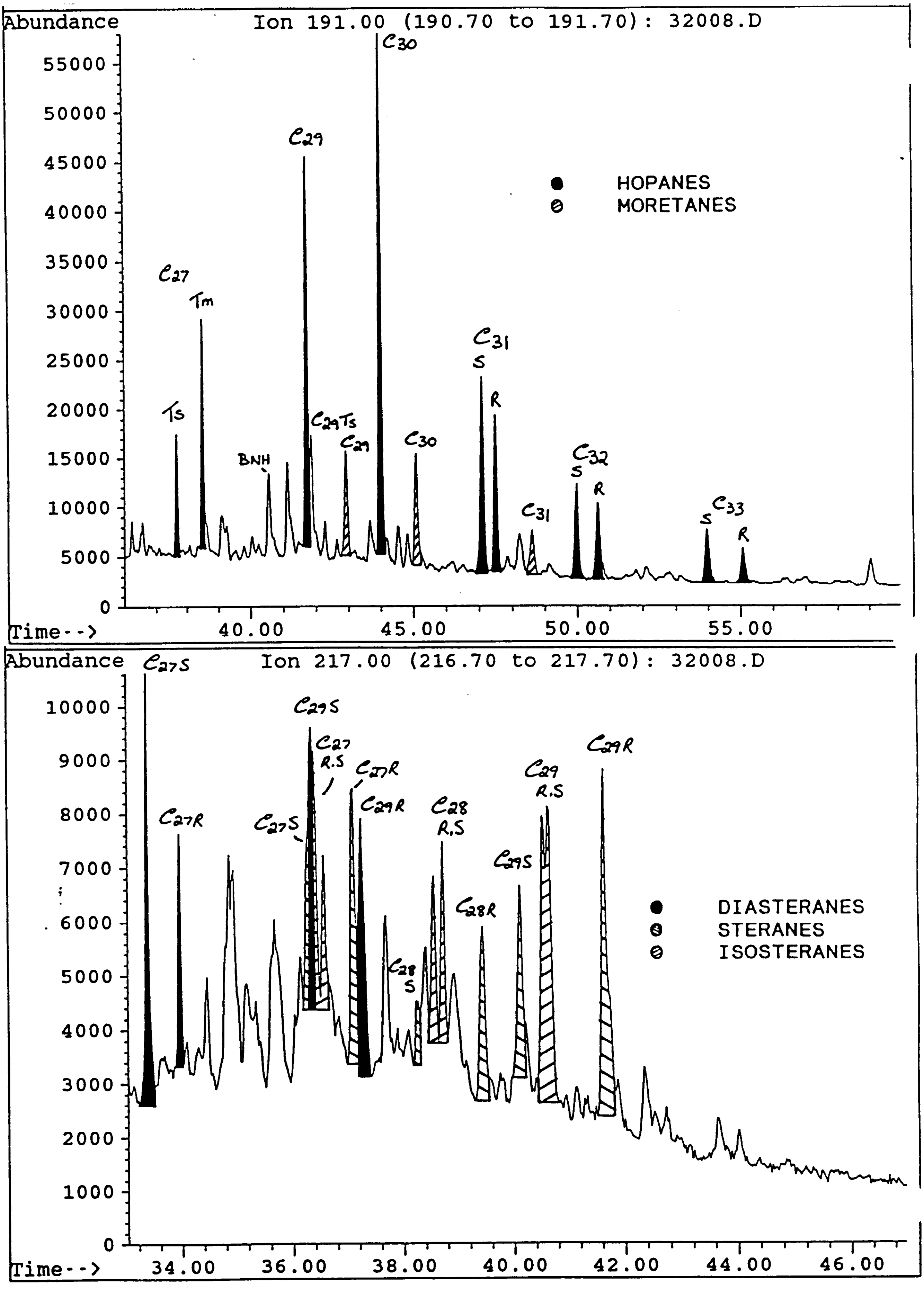


FIGURE 32

m/z 191 and m/z 217 biomarker traces: 2121m extract

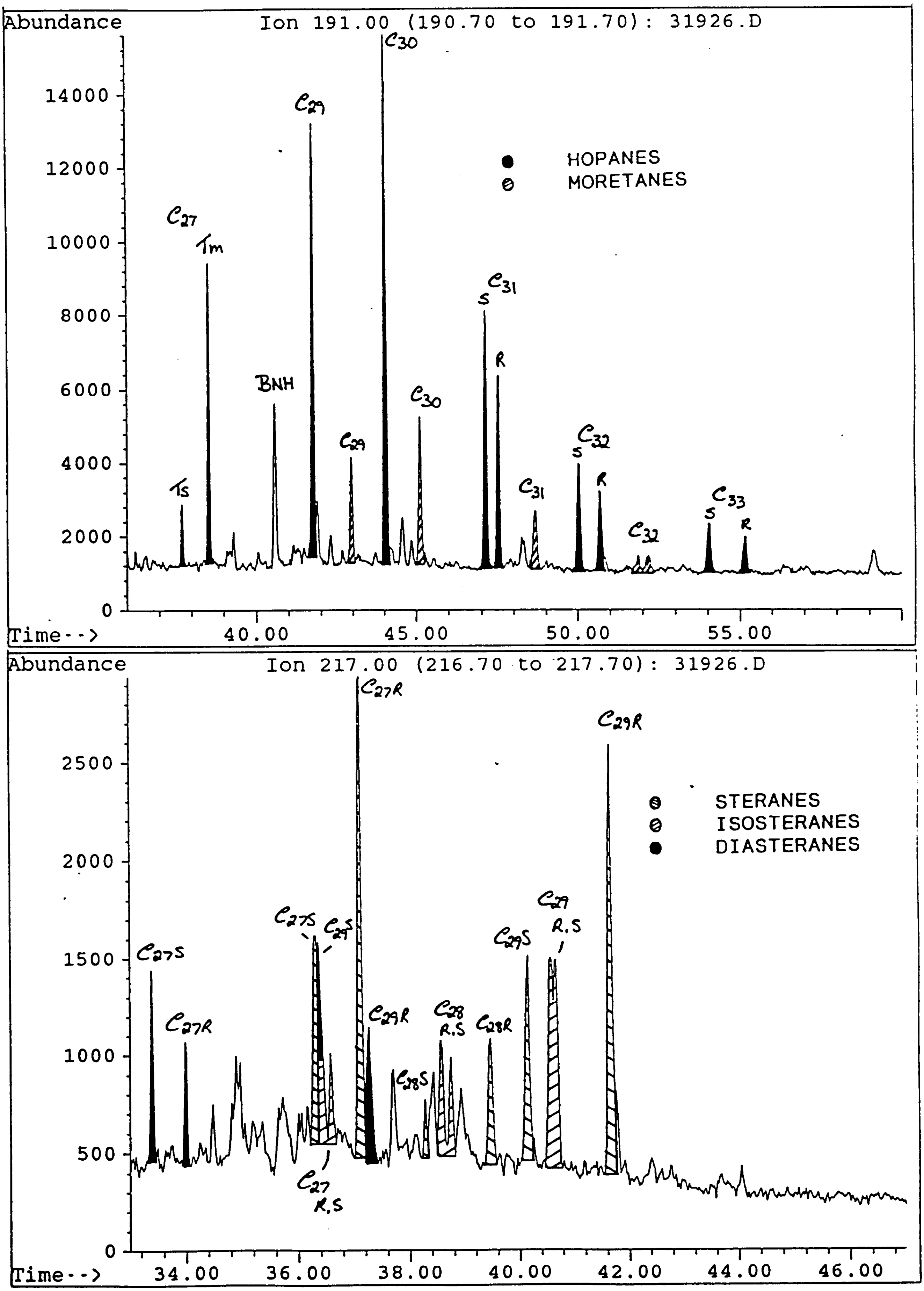


FIGURE 33

m/z 191 and m/z 217 biomarker traces: 2159m extract

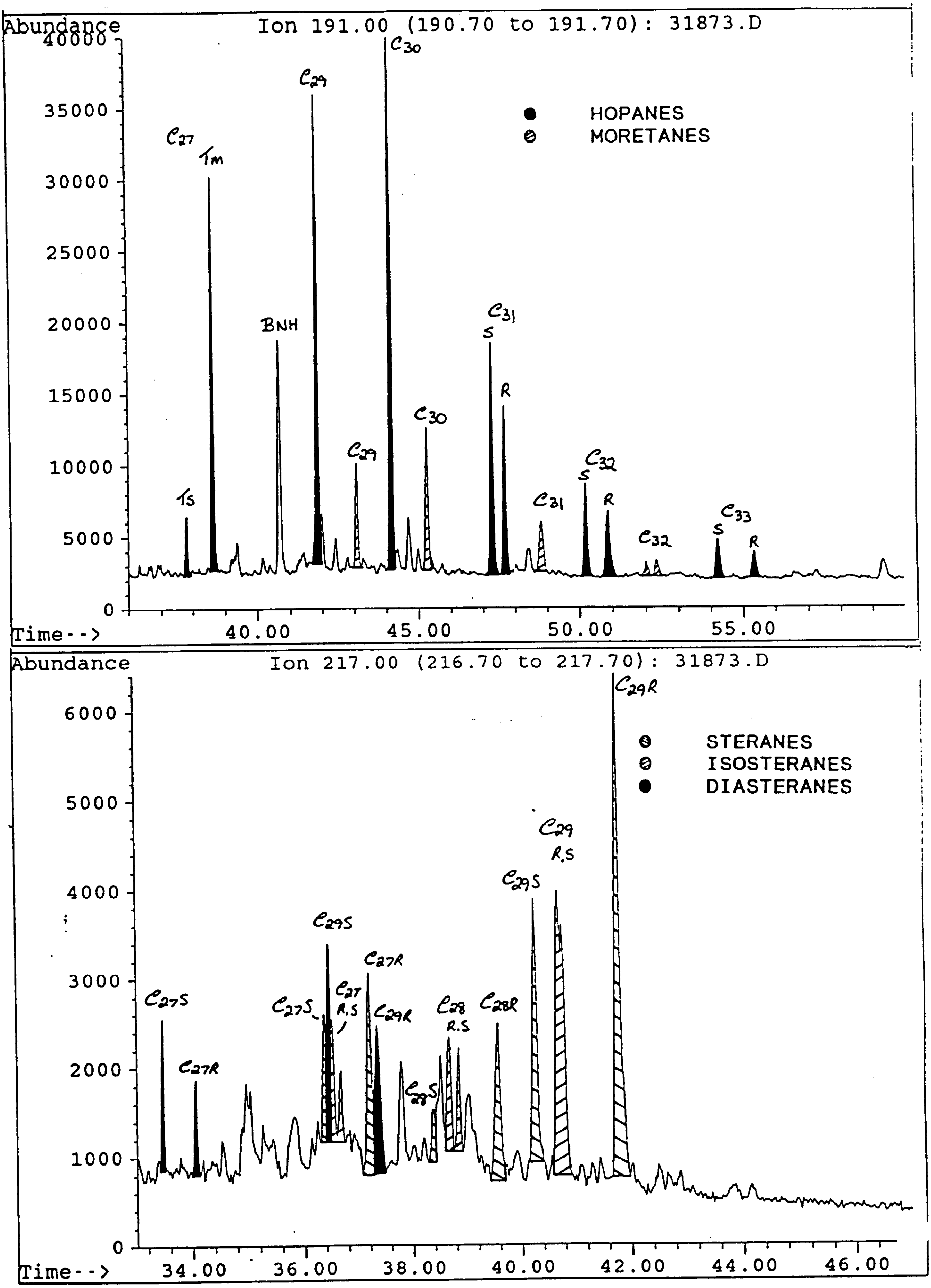


TABLE 12-1

SATURATE FRACTION SIR GC/MS DATA - OILS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DETAILED COMPOUND ANALYSIS
DESCRIPTION : RFT SAMPLE
DEPTH 1 = 2072.80 DEPTH 2 = 2072.80

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	1953.0	C24 Tricyclic	191	1336.0
C25 Tricyclic	191	814.0	C26 Tricyclic	191	1122.0
C28 Tricyclic	191	1268.0	C29 Tricyclic	191	1073.0
C24 Tetracyclic	191	803.0			
C27 Hopane (Ts)	191	766.0	C27 Hopane (Tm)	191	834.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	-	C28 Hopane (28,30)	191	-
C29 Hopane	191	1686.0	C29 Moretane	191	217.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	-
C30 Hopane	191	2284.0	C30 Moretane	191	151.0
C30 Hopane (BB)	191	-			
C31S Hopane	191	715.0	C31R Hopane	191	496.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	-
C32S Hopane	191	342.0	C32R Hopane	191	267.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	-
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	151.0
Unknown 3	191	461.0	Unknown 4	191	239.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	-	C27R Normal Sterane	217	1034.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	168.0	C28R Normal Sterane	217	394.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	880.0	C29R Normal Sterane	217	792.0
C29S Isosterane	217	1281.0	C29R Isosterane	217	1231.0
C29S Diasterane	217	1770.0	C29R Diasterane	217	1176.0
C27S+R Isosterane	218	3773.0	C28S+R Isosterane	218	1856.0
C29S+R Isosterane	218	4153.0			
C27S Diasterane	259	1101.0	C27R Diasterane	259	581.0
C28S Diasterane	259	672.0	C28R Diasterane	259	486.0
C29S Diasterane	259	920.0	C29R Diasterane	259	645.0
16a Phyllocladane	123	-	16B Phyllocladane	123	717.0
Beyerene	123	354.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	434.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	-
Norisopimerane	123	657.0	Unknown 1	123	-
Drimane	123	4493.0	Homodrimane	123	7358.0
Rearranged Drimane 1	123	6985.0	Rearranged Drimane 2	123	3201.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 12-2

SATURATE FRACTION SIR GC/MS DATA - OILS

CALCULATED DATA

DESCRIPTION : RFT SAMPLE

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1(m) = 2072.80
DEPTH 2(m) = 2072.80

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	47.88
% C29 M / (C29 H + C29 M)	191	11.40
% C30 M / (C30 H + C30 M)	191	6.20
% C31S H / (C31S H + C31R H)	191	59.04
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	56.16
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	6.20
% U3 / (U3 + C30 H)	191	16.79
% U4 / (U4 + C30 H)	191	9.47
% C29 H / (C29 H + C30 H)	191	42.47
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	-
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	-
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	-
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	61.06
% Rea. Drimanes / (Drimane + Homodrimane)	123	85.95
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	331.26
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	34.15

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	-
% C28S NS / (C28S NS + C28R NS)	217	29.89
% C29S NS / (C29S NS + C29R NS)	217	52.63
% C27 NS's / C29 NS's	217	-
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	41.32
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	60.04

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
\- = no data available

TABLE 13-1

SATURATE FRACTION SIR GC/MS DATA - OILS

WELL = LA BELLA-1 DETAILED COMPOUND ANALYSIS DEPTH UNIT = Metres
COUNTRY = Australia DESCRIPTION : RFT SAMPLE DATE OF JOB = Oct 93
BASIN = Otway DEPTH 1 = 2160.50 DEPTH 2 = 2160.50

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	872.0	C24 Tricyclic	191	541.0
C25 Tricyclic	191	329.0	C26 Tricyclic	191	5698.0
C28 Tricyclic	191	604.0	C29 Tricyclic	191	495.0
C24 Tetracyclic	191	373.0			
C27 Hopane (Ts)	191	479.0	C27 Hopane (Tm)	191	684.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	-	C28 Hopane (28,30)	191	-
C29 Hopane	191	1738.0	C29 Moretane	191	190.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	-
C30 Hopane	191	2184.0	C30 Moretane	191	308.0
C30 Hopane (BB)	191	-			
C31S Hopane	191	877.0	C31R Hopane	191	648.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	-
C32S Hopane	191	470.0	C32R Hopane	191	319.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	-
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	169.0
Unknown 3	191	374.0	Unknown 4	191	301.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	-	C27R Normal Sterane	217	418.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	107.0	C28R Normal Sterane	217	201.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	559.0	C29R Normal Sterane	217	527.0
C29S Isosterane	217	753.0	C29R Isosterane	217	737.0
C29S Diasterane	217	886.0	C29R Diasterane	217	550.0
C27S+R Isosterane	218	1323.0	C28S+R Isosterane	218	926.0
C29S+R Isosterane	218	2438.0			
C27S Diasterane	259	350.0	C27R Diasterane	259	202.0
C28S Diasterane	259	255.0	C28R Diasterane	259	219.0
C29S Diasterane	259	417.0	C29R Diasterane	259	263.0
16a Phyllocladane	123	-	16B Phyllocladane	123	1860.0
Beyerene	123	1099.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	994.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	-
Norisopimerane	123	1357.0	Unknown 1	123	-
Drimane	123	14592.0	Homodrimane	123	26253.0
Rearranged Drimane 1	123	18008.0	Rearranged Drimane 2	123	10134.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 13-2

SATURATE FRACTION SIR GC/MS DATA - OILS

CALCULATED DATA

DESCRIPTION : RFT SAMPLE

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1(m) = 2160.50
DEPTH 2(m) = 2160.50

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	41.19
% C29 M / (C29 H + C29 M)	191	9.85
% C30 M / (C30 H + C30 M)	191	12.36
% C31S H / (C31S H + C31R H)	191	57.51
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	59.57
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	7.18
% U3 / (U3 + C30 H)	191	14.62
% U4 / (U4 + C30 H)	191	12.11
% C29 H / (C29 H + C30 H)	191	44.31
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	-
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	-
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	-
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	55.58
% Rea. Drimanes / (Drimane + Homodrimane)	123	68.90
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	390.98
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	62.11

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	-
% C28S NS / (C28S NS + C28R NS)	217	34.74
% C29S NS / (C29S NS + C29R NS)	217	51.47
% C27 NS's / C29 NS's	217	-
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	35.79
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	57.84

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available

TABLE 14-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

DETAILED COMPOUND ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway
DEPTH 1 = 2070.00
DEPTH 2 = 2070.00
DEPTH UNIT = Metres
DATE OF JOB = Oct 93

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	1225.0	C24 Tricyclic	191	788.0
C25 Tricyclic	191	-	C26 Tricyclic	191	-
C28 Tricyclic	191	-	C29 Tricyclic	191	-
C24 Tetracyclic	191	2854.0			
C27 Hopane (Ts)	191	1545.0	C27 Hopane (Tm)	191	17000.0
C27 Hopane (17B)	191	1871.0			
C28 Hopane (25,30)	191	-	C28 Hopane (28,30)	191	9187.0
C29 Hopane	191	20220.0	C29 Moretane	191	5353.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	1118.0
C30 Hopane	191	25141.0	C30 Moretane	191	8218.0
C30 Hopane (BB)	191	1315.0			
C31S Hopane	191	12576.0	C31R Hopane	191	9608.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	3591.0
C32S Hopane	191	4974.0	C32R Hopane	191	4004.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	2048.0
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	2121.0	Unknown 4	191	1413.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	668.0	C27R Normal Sterane	217	1424.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	132.0	C28R Normal Sterane	217	784.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	1094.0	C29R Normal Sterane	217	2985.0
C29S Isosterane	217	1107.0	C29R Isosterane	217	1276.0
C29S Diasterane	217	1420.0	C29R Diasterane	217	887.0
C27S+R Isosterane	218	1059.0	C28S+R Isosterane	218	1101.0
C29S+R Isosterane	218	2927.0			
C27S Diasterane	259	374.0	C27R Diasterane	259	286.0
C28S Diasterane	259	477.0	C28R Diasterane	259	344.0
C29S Diasterane	259	660.0	C29R Diasterane	259	445.0
16a Phyllocladane	123	-	16B Phyllocladane	123	3482.0
Beyerene	123	2062.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	2923.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	1617.0
Norisopimerane	123	3323.0	Unknown 1	123	-
Drimane	123	4908.0	Homodrimane	123	12849.0
Rearranged Drimane 1	123	4892.0	Rearranged Drimane 2	123	2730.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data   IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 14-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = LA BELLA-1 DEPTH 1(m) = 2070.00 DEPTH UNIT = Metres
COUNTRY = Australia DEPTH 2(m) = 2070.00 DATE OF JOB = Oct 93
BASIN = Otway

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	8.33
% C29 M / (C29 H + C29 M)	191	20.93
% C30 M / (C30 H + C30 M)	191	24.64
% C31S H / (C31S H + C31R H)	191	56.69
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	55.40
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	7.78
% U4 / (U4 + C30 H)	191	5.32
% C29 H / (C29 H + C30 H)	191	44.58
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	4.19
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	-
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	-
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	38.20
% Rea. Drimanes / (Drimane + Homodrimane)	123	42.92
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	-
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	380.42

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	31.93
% C28S NS / (C28S NS + C28R NS)	217	14.41
% C29S NS / (C29S NS + C29R NS)	217	26.82
% C27 NS's / C29 NS's	217	51.29
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	26.31
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	36.88

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available

TABLE 15-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS
DETAILED COMPOUND ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2097.70 DEPTH 2 = 2097.70

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	4129.0	C24 Tricyclic	191	3441.0
C25 Tricyclic	191	-	C26 Tricyclic	191	-
C28 Tricyclic	191	-	C29 Tricyclic	191	-
C24 Tetracyclic	191	23829.0			
C27 Hopane (Ts)	191	5432.0	C27 Hopane (Tm)	191	97739.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	10292.0	C28 Hopane (28,30)	191	60394.0
C29 Hopane	191	106276.0	C29 Moretane	191	30551.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	4249.0
C30 Hopane	191	212896.0	C30 Moretane	191	40210.0
C30 Hopane (BB)	191	3710.0			
C31S Hopane	191	53915.0	C31R Hopane	191	38899.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	16678.0
C32S Hopane	191	14831.0	C32R Hopane	191	12292.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	7596.0
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	6217.0	Unknown 4	191	7235.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	3882.0	C27R Normal Sterane	217	8136.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	1403.0	C28R Normal Sterane	217	6043.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	9118.0	C29R Normal Sterane	217	22714.0
C29S Isosterane	217	9383.0	C29R Isosterane	217	10811.0
C29S Diasterane	217	12370.0	C29R Diasterane	217	7715.0
C27S+R Isosterane	218	3552.0	C28S+R Isosterane	218	7523.0
C29S+R Isosterane	218	21162.0			
C27S Diasterane	259	2191.0	C27R Diasterane	259	1448.0
C28S Diasterane	259	3034.0	C28R Diasterane	259	2679.0
C29S Diasterane	259	8457.0	C29R Diasterane	259	5293.0
16a Phyllocladane	123	-	16B Phyllocladane	123	28328.0
Beyerene	123	11362.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	17431.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	10422.0
Norisopimerane	123	-	Unknown 1	123	-
Drimane	123	27275.0	Homodrimane	123	69435.0
Rearranged Drimane 1	123	19361.0	Rearranged Drimane 2	123	9839.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 15-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = LA BELLA-1
DEPTH 1(m) = 2097.70
DEPTH UNIT = Metres
COUNTRY = Australia
DEPTH 2(m) = 2097.70
DATE OF JOB = Oct 93
BASIN = Otway

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	5.27
% C29 M / (C29 H + C29 M)	191	22.33
% C30 M / (C30 H + C30 M)	191	15.89
% C31S H / (C31S H + C31R H)	191	58.09
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	54.68
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	2.84
% U4 / (U4 + C30 H)	191	3.29
% C29 H / (C29 H + C30 H)	191	33.30
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	3.01
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	24.93
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	44.59
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	39.28
% Rea. Drimanes / (Drimane + Homodrimane)	123	30.19
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	-
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	350.99

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	32.30
% C28S NS / (C28S NS + C28R NS)	217	18.84
% C29S NS / (C29S NS + C29R NS)	217	28.64
% C27 NS's / C29 NS's	217	37.75
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	27.85
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	38.82

NOTES :
H = Hopane
M = Moretane
Me = Methyl
NS = Normal Sterane
IS = Iso Sterane
DS = Dia Sterane
ST = NS + IS + DS
U = Unknown
- = no data available

TABLE 16-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

DETAILED COMPOUND ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2100.00   DEPTH 2 = 2110.00

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	6907.0	C24 Tricyclic	191	4137.0
C25 Tricyclic	191	3003.0	C26 Tricyclic	191	39197.0
C28 Tricyclic	191	7757.0	C29 Tricyclic	191	6800.0
C24 Tetracyclic	191	7996.0			
C27 Hopane (Ts)	191	12288.0	C27 Hopane (Tm)	191	23783.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	4117.0	C28 Hopane (28,30)	191	8372.0
C29 Hopane	191	39526.0	C29 Moretane	191	10634.0
C29 Demeth. Hopane	191	9274.0	C29 Hopane (BB)	191	3448.0
C30 Hopane	191	52839.0	C30 Moretane	191	11603.0
C30 Hopane (BB)	191	3999.0			
C31S Hopane	191	19836.0	C31R Hopane	191	16027.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	4484.0
C32S Hopane	191	9758.0	C32R Hopane	191	7717.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	-
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	9956.0	Unknown 4	191	3967.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	-	C27R Normal Sterane	217	5150.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	1185.0	C28R Normal Sterane	217	3217.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	4043.0	C29R Normal Sterane	217	6468.0
C29S Isosterane	217	5528.0	C29R Isosterane	217	5303.0
C29S Diasterane	217	6004.0	C29R Diasterane	217	4796.0
C27S+R Isosterane	218	11559.0	C28S+R Isosterane	218	10116.0
C29S+R Isosterane	218	15060.0			
C27S Diasterane	259	4067.0	C27R Diasterane	259	2587.0
C28S Diasterane	259	4102.0	C28R Diasterane	259	2814.0
C29S Diasterane	259	3516.0	C29R Diasterane	259	2474.0
16a Phyllocladane	123	-	16B Phyllocladane	123	7075.0
Beyerene	123	2815.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	4104.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	-
Norisopimerane	123	-	Unknown 1	123	-
Drimane	123	6384.0	Homodrimane	123	17699.0
Rearranged Drimane 1	123	4154.0	Rearranged Drimane 2	123	2615.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data   IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 16-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1(m) = 2100.00
DEPTH 2(m) = 2110.00

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	34.07
% C29 M / (C29 H + C29 M)	191	21.20
% C30 M / (C30 H + C30 M)	191	18.01
% C31S H / (C31S H + C31R H)	191	55.31
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	55.84
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	15.85
% U4 / (U4 + C30 H)	191	6.98
% C29 H / (C29 H + C30 H)	191	42.79
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	6.43
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	19.12
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	42.37
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	36.07
% Rea. Drimanes / (Drimane + Homodrimane)	123	28.11
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	128.32
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	200.49

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	-
% C28S NS / (C28S NS + C28R NS)	217	26.92
% C29S NS / (C29S NS + C29R NS)	217	38.46
% C27 NS's / C29 NS's	217	-
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	33.60
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	50.75

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available

TABLE 17-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS
DETAILED COMPOUND ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway
DEPTH 1 = 2121.00
DEPTH 2 = 2121.00
DEPTH UNIT = Metres
DATE OF JOB = Oct 93

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	1807.0	C24 Tricyclic	191	1037.0
C25 Tricyclic	191	3857.0	C26 Tricyclic	191	-
C28 Tricyclic	191	-	C29 Tricyclic	191	-
C24 Tetracyclic	191	2319.0			
C27 Hopane (Ts)	191	1712.0	C27 Hopane (Tm)	191	8361.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	1048.0	C28 Hopane (28,30)	191	4492.0
C29 Hopane	191	12019.0	C29 Moretane	191	2895.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	697.0
C30 Hopane	191	14411.0	C30 Moretane	191	4011.0
C30 Hopane (BB)	191	744.0			
C31S Hopane	191	6998.0	C31R Hopane	191	5210.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	1631.0
C32S Hopane	191	2986.0	C32R Hopane	191	2184.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	927.0
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	1773.0	Unknown 4	191	855.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	1149.0	C27R Normal Sterane	217	2476.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	288.0	C28R Normal Sterane	217	671.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	1117.0	C29R Normal Sterane	217	2216.0
C29S Isosterane	217	1101.0	C29R Isosterane	217	1111.0
C29S Diasterane	217	1149.0	C29R Diasterane	217	702.0
C27S+R Isosterane	218	1606.0	C28S+R Isosterane	218	1531.0
C29S+R Isosterane	218	2787.0			
C27S Diasterane	259	500.0	C27R Diasterane	259	302.0
C28S Diasterane	259	602.0	C28R Diasterane	259	376.0
C29S Diasterane	259	576.0	C29R Diasterane	259	385.0
16a Phyllocladane	123	-	16B Phyllocladane	123	2368.0
Beyerene	123	1941.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	1989.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	-
Norisopimerane	123	-	Unknown 1	123	-
Drimane	123	10405.0	Homodrimane	123	28997.0
Rearranged Drimane 1	123	11043.0	Rearranged Drimane 2	123	6958.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data   IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 17-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = LA BELLA-1	DEPTH 1(m) = 2121.00	DEPTH UNIT = Metres
COUNTRY = Australia	DEPTH 2(m) = 2121.00	DATE OF JOB = Oct 93
BASIN = Otway		

------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	17.00
% C29 M / (C29 H + C29 M)	191	19.41
% C30 M / (C30 H + C30 M)	191	21.77
% C31S H / (C31S H + C31R H)	191	57.32
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	57.76
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	10.96
% U4 / (U4 + C30 H)	191	5.60
% C29 H / (C29 H + C30 H)	191	45.47
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	4.46
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	27.77
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	46.84
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	35.88
% Rea. Drimanes / (Drimane + Homodrimane)	123	45.69
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	-
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	249.08

------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	31.70
% C28S NS / (C28S NS + C28R NS)	217	30.03
% C29S NS / (C29S NS + C29R NS)	217	33.51
% C27 NS's / C29 NS's	217	108.76
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	25.03
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	39.89

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available

TABLE 18-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS
DETAILED COMPOUND ANALYSIS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2159.00 DEPTH 2 = 2159.00

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	3610.0	C24 Tricyclic	191	1628.0
C25 Tricyclic	191	-	C26 Tricyclic	191	-
C28 Tricyclic	191	-	C29 Tricyclic	191	-
C24 Tetracyclic	191	5313.0			
C27 Hopane (Ts)	191	4224.0	C27 Hopane (Tm)	191	27697.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	2324.0	C28 Hopane (28,30)	191	16309.0
C29 Hopane	191	33200.0	C29 Moretane	191	7406.0
C29 Demeth. Hopane	191	-	C29 Hopane (BB)	191	1770.0
C30 Hopane	191	37631.0	C30 Moretane	191	10221.0
C30 Hopane (BB)	191	1606.0			
C31S Hopane	191	16332.0	C31R Hopane	191	11850.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	3773.0
C32S Hopane	191	6637.0	C32R Hopane	191	4842.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	2226.0
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	3860.0	Unknown 4	191	2368.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	1729.0	C27R Normal Sterane	217	2280.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	589.0	C28R Normal Sterane	217	1778.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	3181.0	C29R Normal Sterane	217	5740.0
C29S Isosterane	217	2828.0	C29R Isosterane	217	3122.0
C29S Diasterane	217	2504.0	C29R Diasterane	217	1654.0
C27S+R Isosterane	218	3826.0	C28S+R Isosterane	218	3147.0
C29S+R Isosterane	218	7063.0			
C27S Diasterane	259	1108.0	C27R Diasterane	259	754.0
C28S Diasterane	259	1002.0	C28R Diasterane	259	980.0
C29S Diasterane	259	1507.0	C29R Diasterane	259	1069.0
16a Phyllocladane	123	-	16B Phyllocladane	123	4837.0
Beyerene	123	2334.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	3241.0	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	1832.0
Norisopimerane	123	-	Unknown 1	123	-
Drimane	123	10082.0	Homodrimane	123	23234.0
Rearranged Drimane 1	123	8163.0	Rearranged Drimane 2	123	4610.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 18-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1(m) = 2159.00
DEPTH 2(m) = 2159.00

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

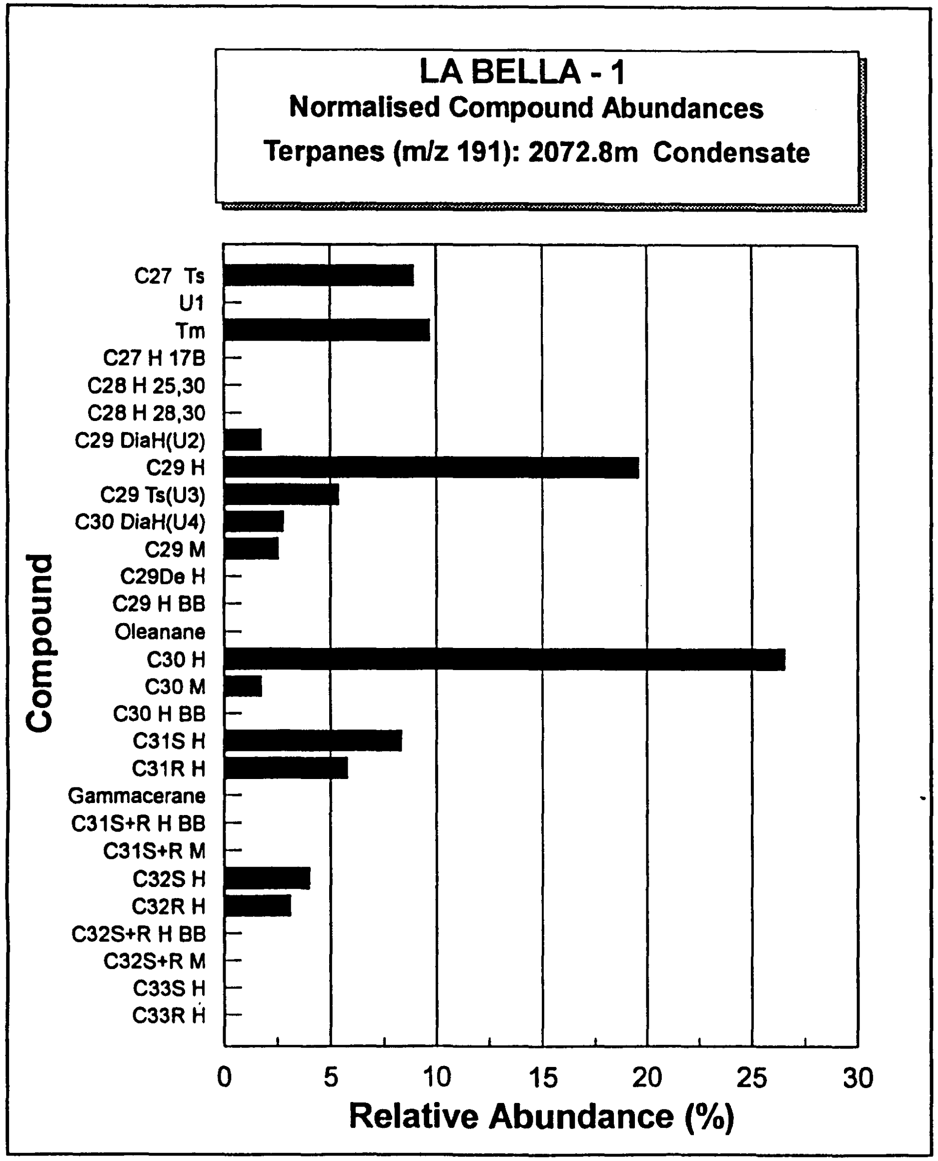
------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	13.23
% C29 M / (C29 H + C29 M)	191	18.24
% C30 M / (C30 H + C30 M)	191	21.36
% C31S H / (C31S H + C31R H)	191	57.95
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	57.82
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	9.30
% U4 / (U4 + C30 H)	191	5.92
% C29 H / (C29 H + C30 H)	191	46.87
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	4.18
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	33.12
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	57.15
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	43.39
% Rea. Drimanes / (Drimane + Homodrimane)	123	38.34
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	-
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	251.47

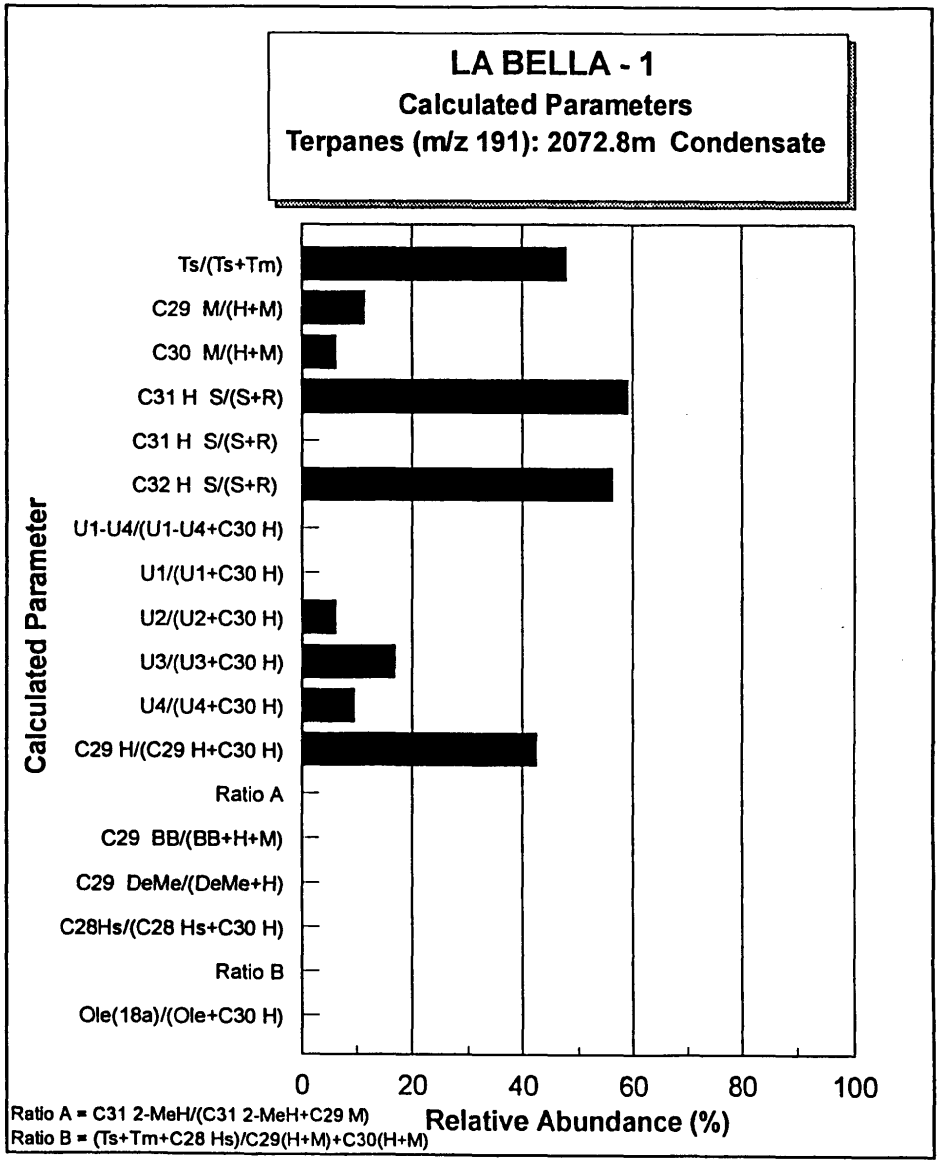
------ STERANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	43.13
% C28S NS / (C28S NS + C28R NS)	217	24.88
% C29S NS / (C29S NS + C29R NS)	217	35.66
% C27 NS's / C29 NS's	217	44.94
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	21.85
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	40.01

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available



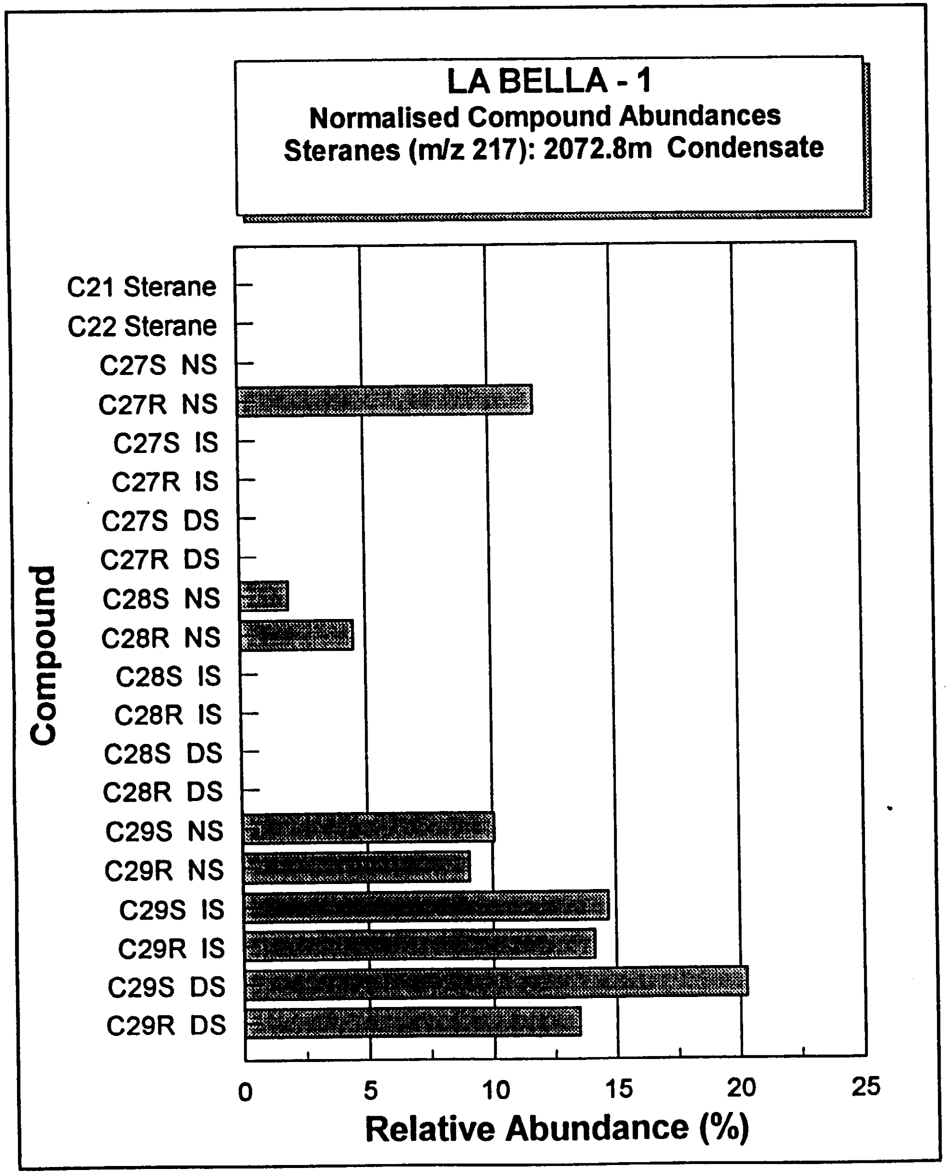
LA BELLA - 1
Normalised Compound Abundances
Terpanes (m/z 191): 2072.8m Condensate

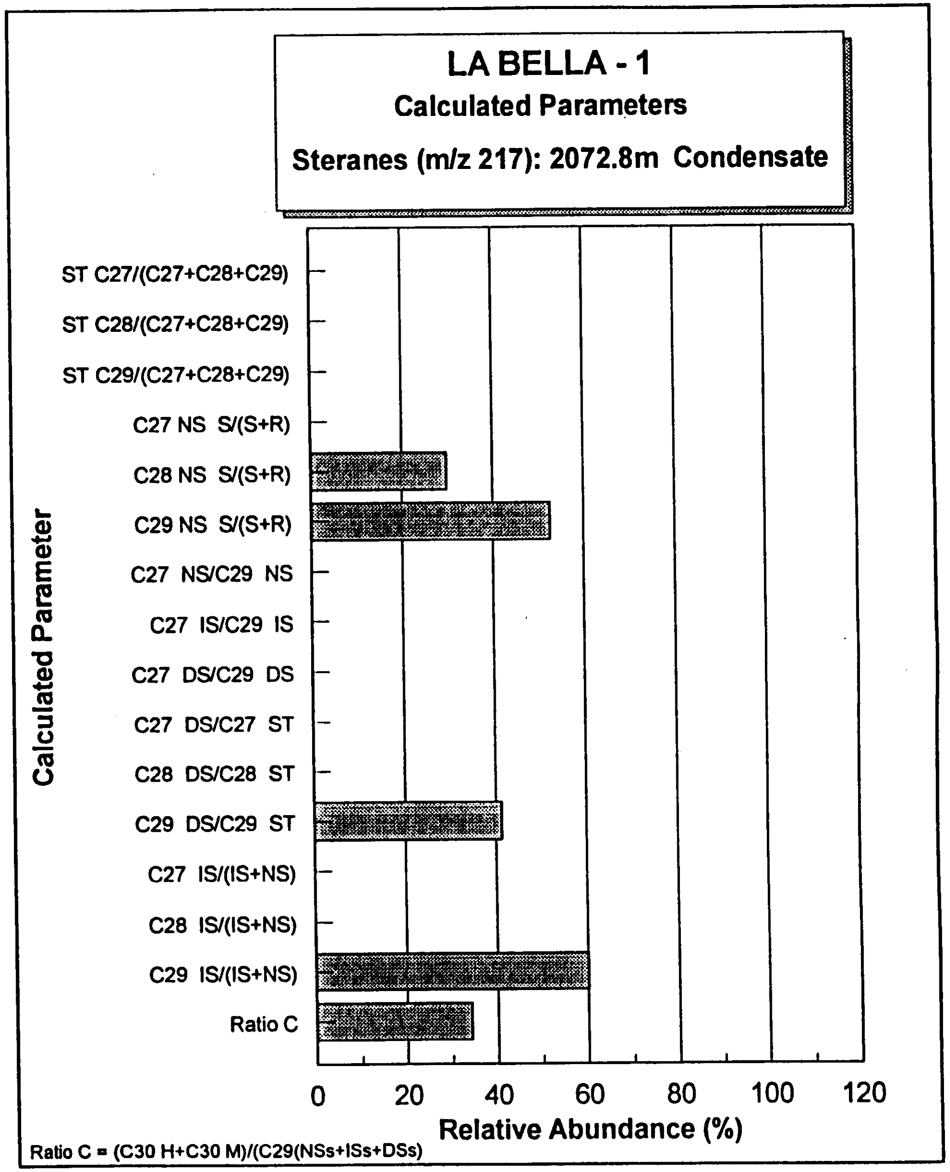


LA BELLA - 1
Calculated Parameters
Terpanes (m/z 191): 2072.8m Condensate

Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

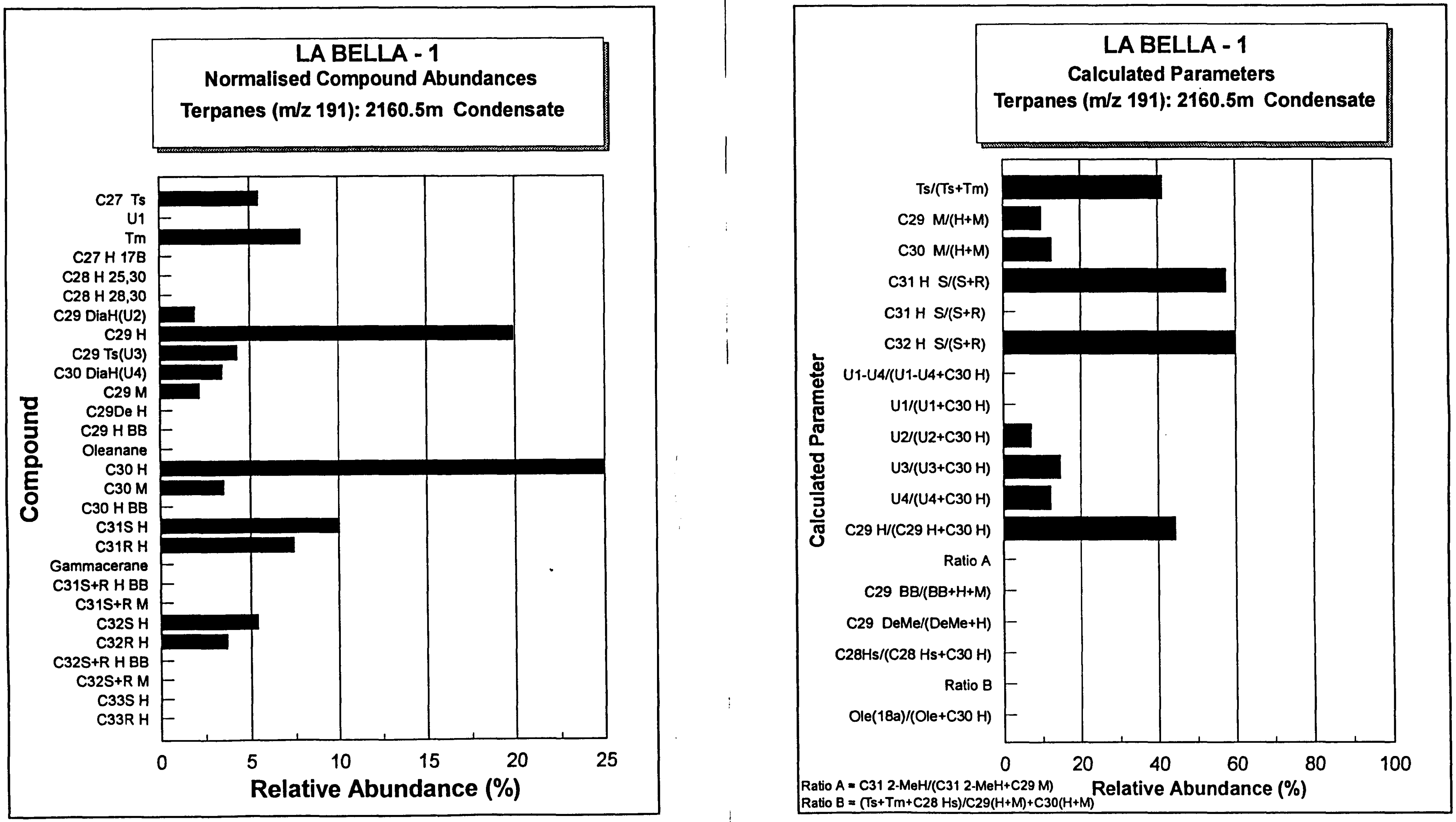
FIGURE 34a





Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 34b



Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 35a

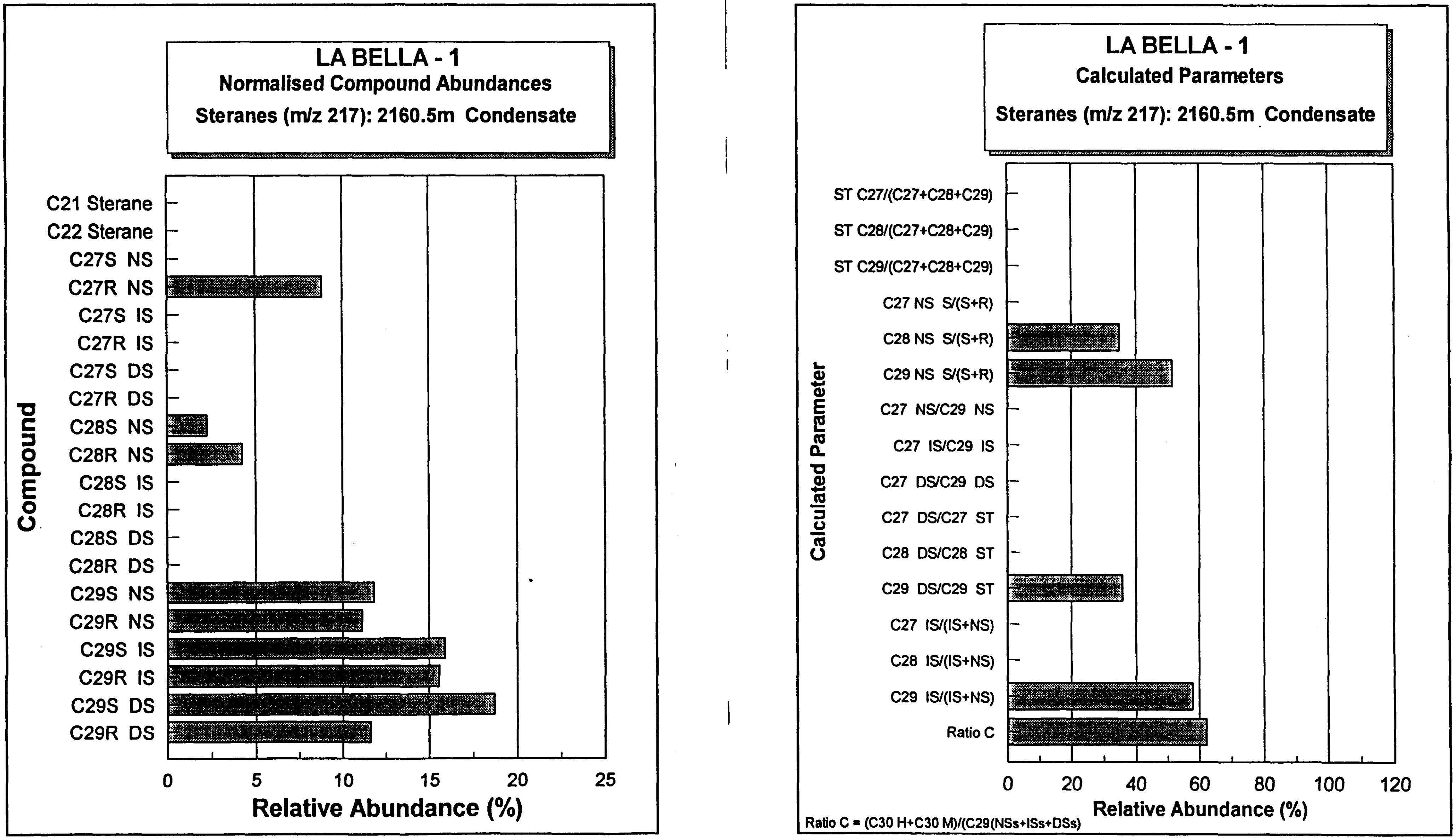
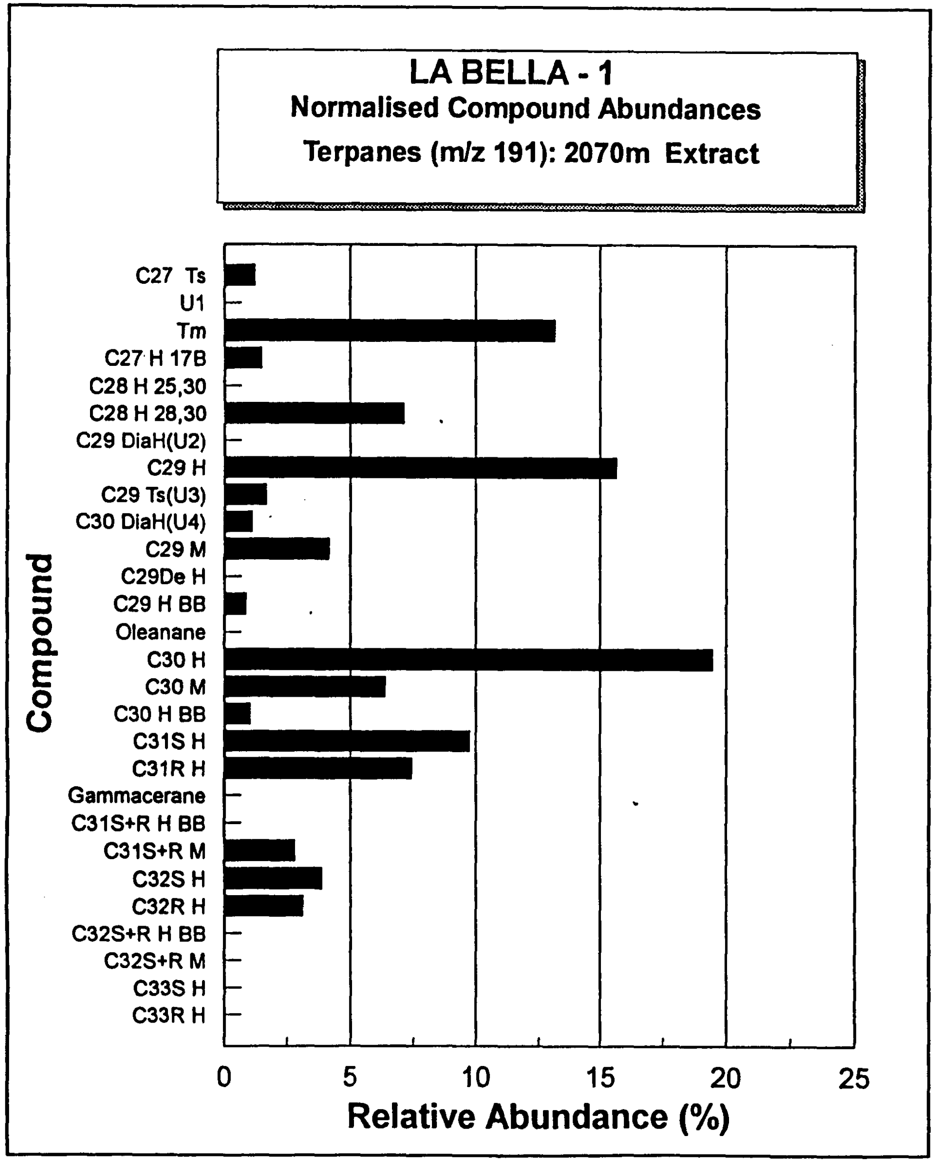
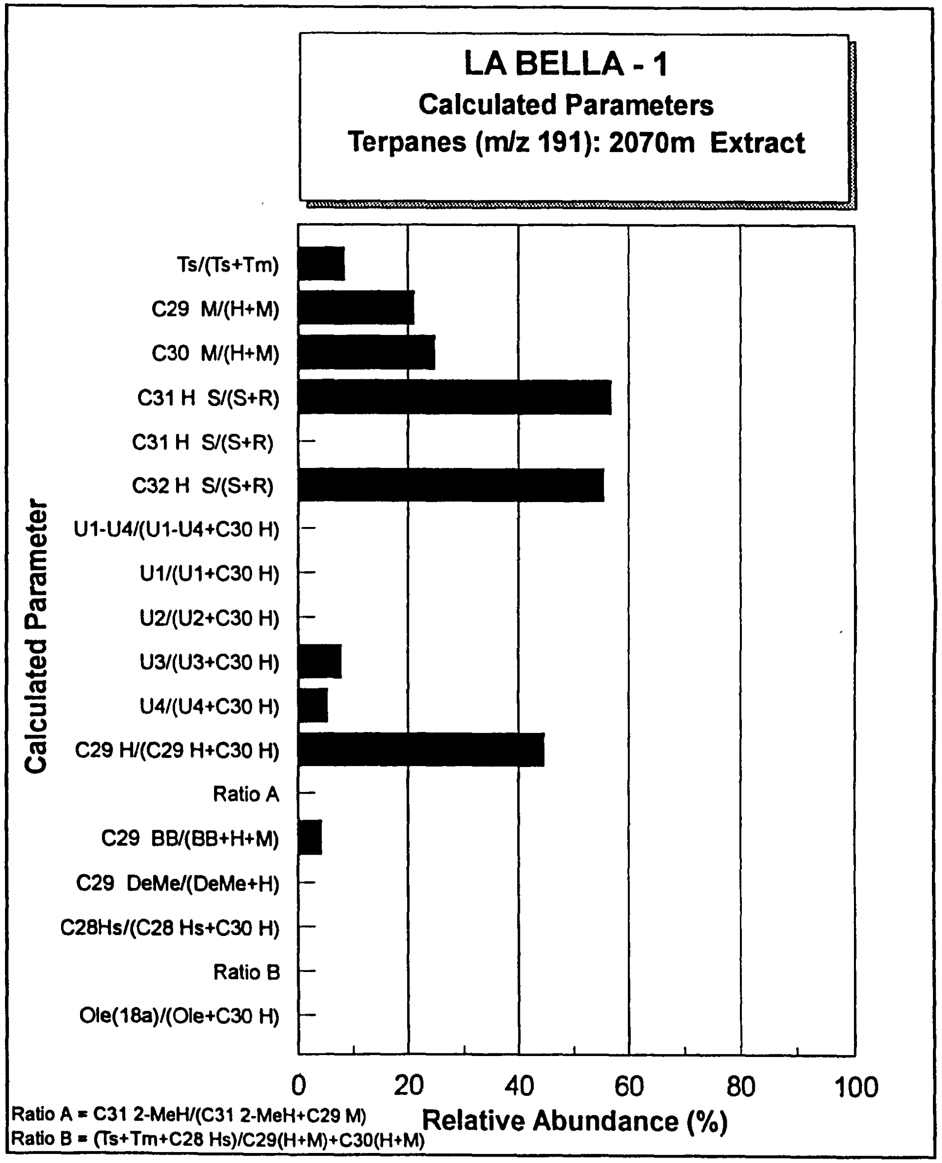

LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2160.5m Condensate
Compound
C21 Sterane
C22 Sterane
C27S NS
C27R NS
C27S IS
C27R IS
C27S DS
C27R DS
C28S NS
C28R NS
C28S IS
C28R IS
C28S DS
C28R DS
C29S NS
C29R NS
C29S IS
C29R IS
C29S DS
C29R DS
0
5
10
15
20
25
Relative Abundance (%)
LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): 2160.5m Condensate
Calculated Parameter
ST C27/(C27+C28+C29)
ST C28/(C27+C28+C29)
ST C29/(C27+C28+C29)
C27 NS S/(S+R)
C28 NS S/(S+R)
C29 NS S/(S+R)
C27 NS/C29 NS
C27 IS/C29 IS
C27 DS/C29 DS
C27 DS/C27 ST
C28 DS/C28 ST
C29 DS/C29 ST
C27 IS/(IS+NS)
C28 IS/(IS+NS)
C29 IS/(IS+NS)
Ratio C
0
20
40
60
80
100
120
Relative Abundance (%)
Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 35b



LA BELLA - 1
Normalised Compound Abundances
Terpanes (m/z 191): 2070m Extract



LA BELLA - 1
Calculated Parameters
Terpanes (m/z 191): 2070m Extract

Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 36a

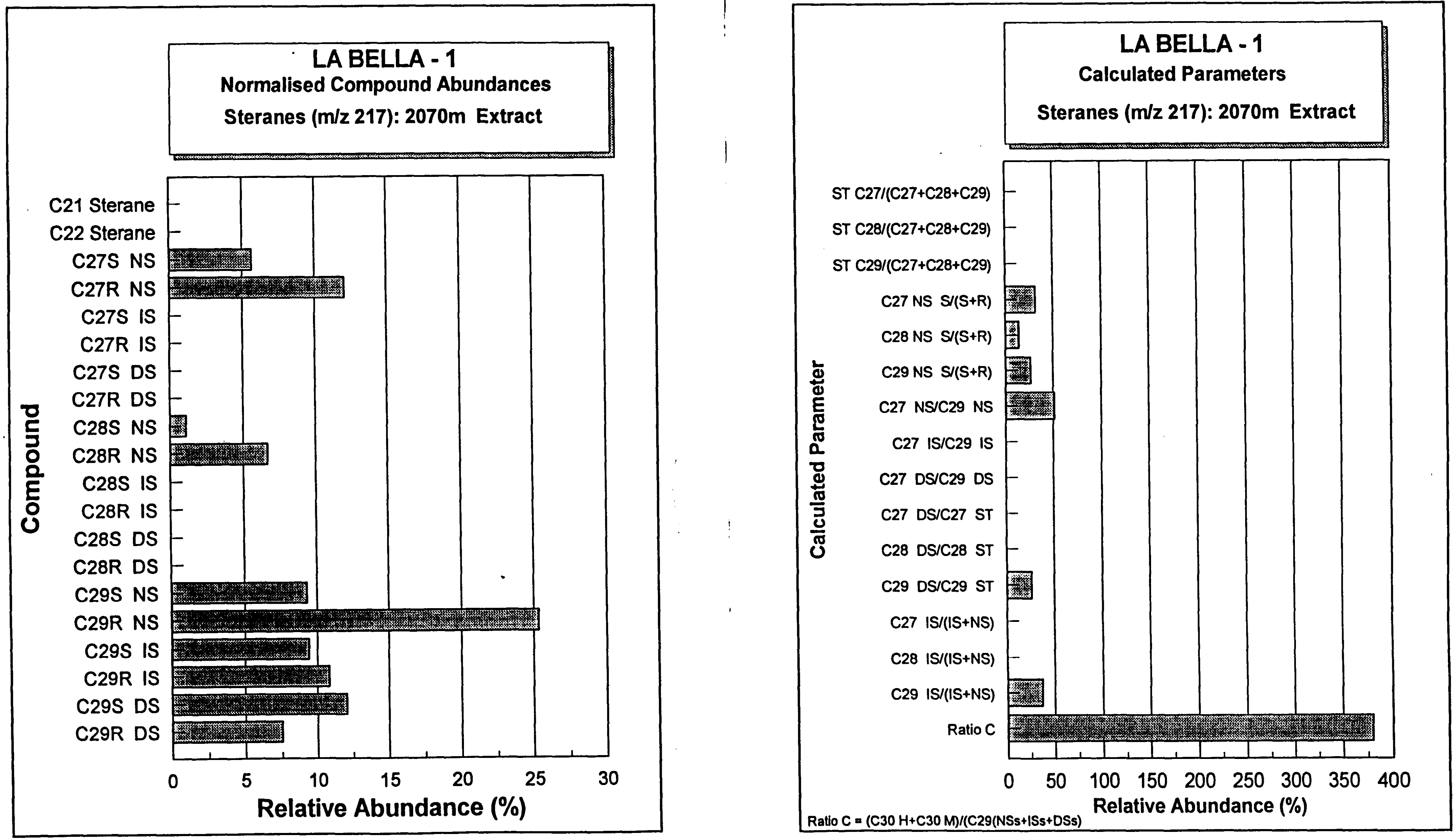
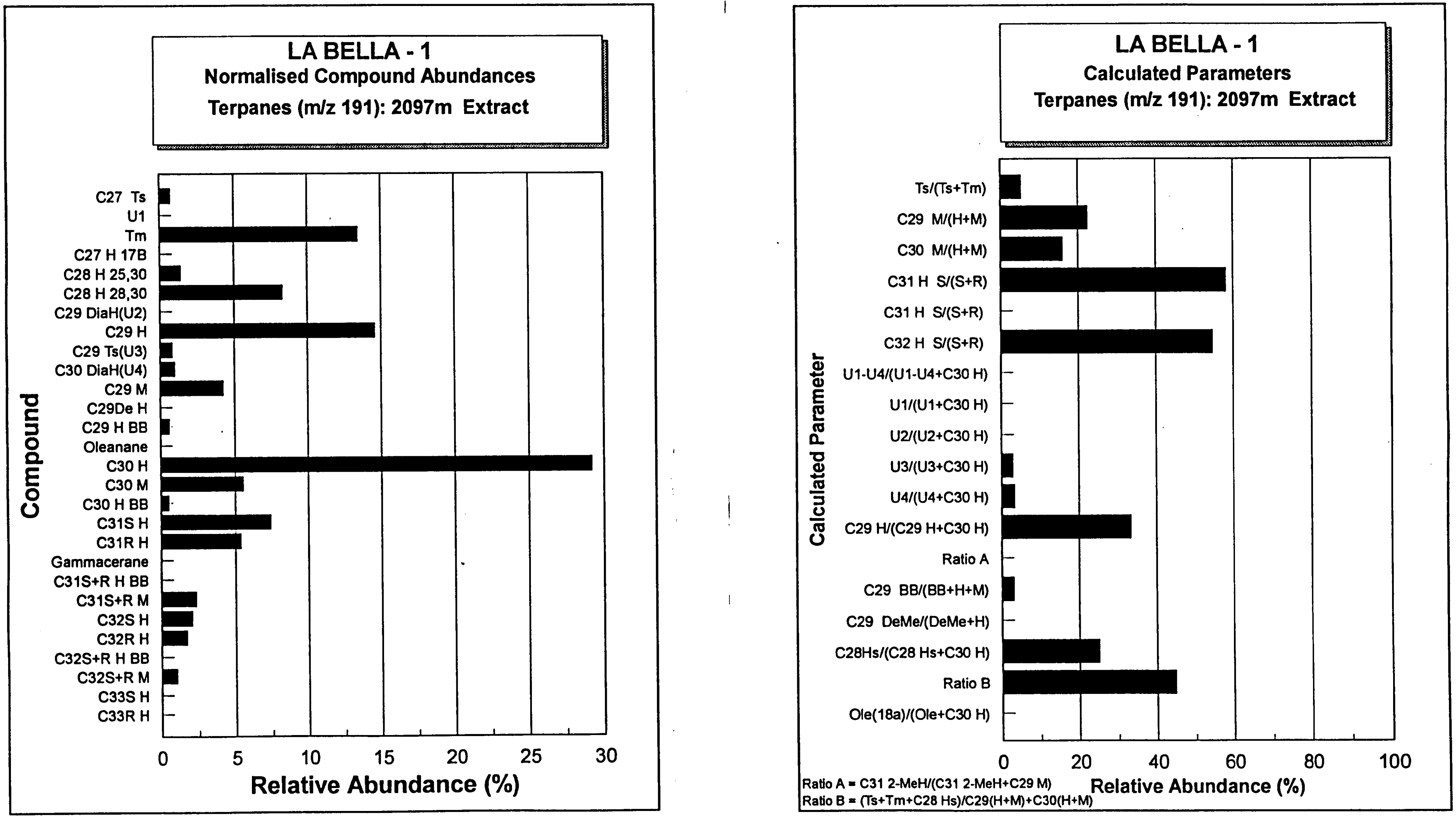

LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2070m Extract
Compound
C21 Sterane
C22 Sterane
C27S NS
C27R NS
C27S IS
C27R IS
C27S DS
C27R DS
C28S NS
C28R NS
C28S IS
C28R IS
C28S DS
C28R DS
C29S NS
C29R NS
C29S IS
C29R IS
C29S DS
C29R DS
0
5
10
15
20
25
30
Relative Abundance (%)
LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): 2070m Extract
Calculated Parameter
ST C27/(C27+C28+C29)
ST C28/(C27+C28+C29)
ST C29/(C27+C28+C29)
C27 NS S/(S+R)
C28 NS S/(S+R)
C29 NS S/(S+R)
C27 NS/C29 NS
C27 IS/C29 IS
C27 DS/C29 DS
C27 DS/C27 ST
C28 DS/C28 ST
C29 DS/C29 ST
C27 IS/(IS+NS)
C28 IS/(IS+NS)
C29 IS/(IS+NS)
Ratio C
0
50
100
150
200
250
300
350
400
Relative Abundance (%)
Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 36b


LA BELLA - 1
Normalised Compound Abundances
Terpanes (m/z 191): 2097m Extract

LA BELLA - 1
Calculated Parameters
Terpanes (m/z 191): 2097m Extract

Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 37a

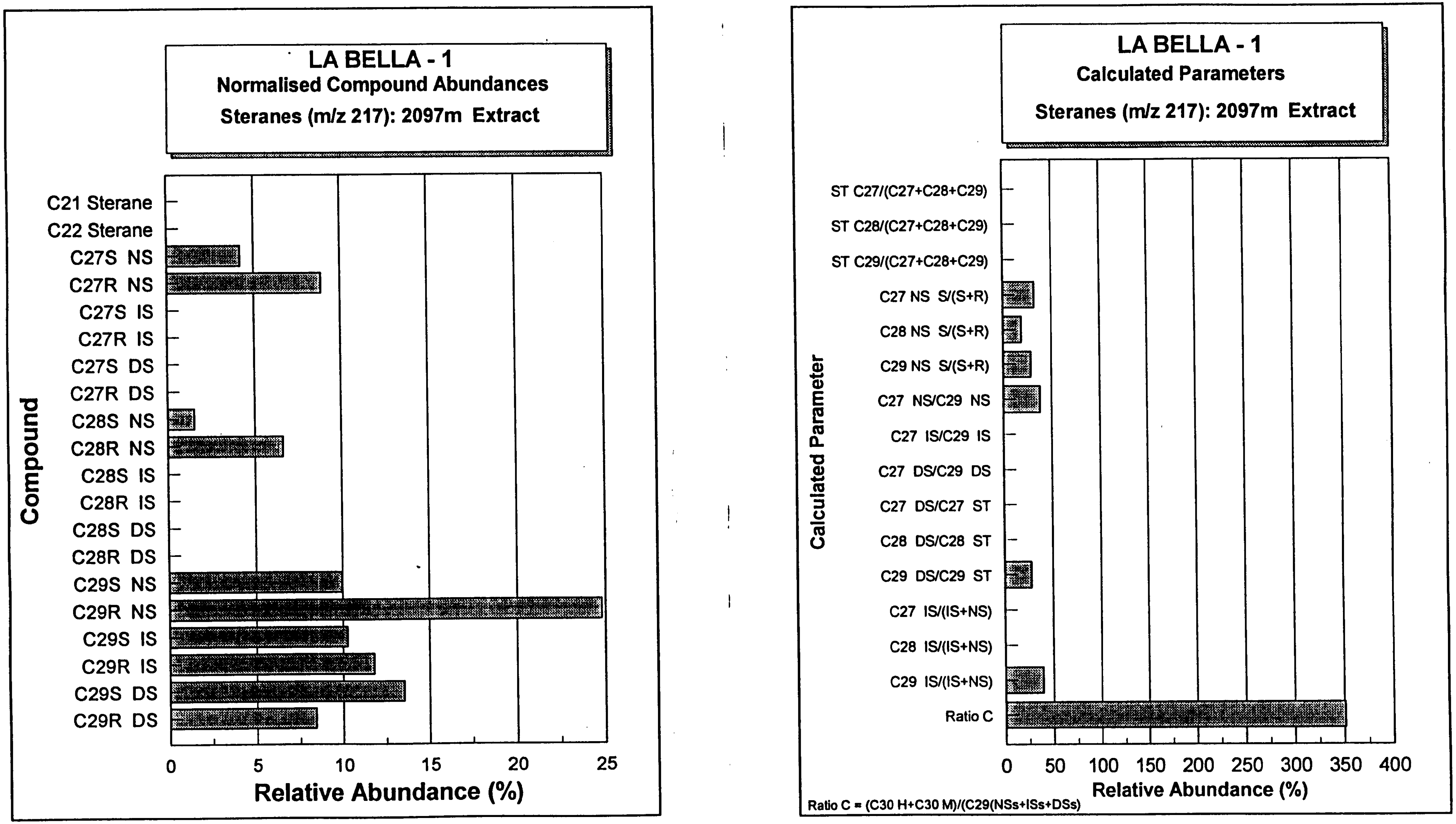
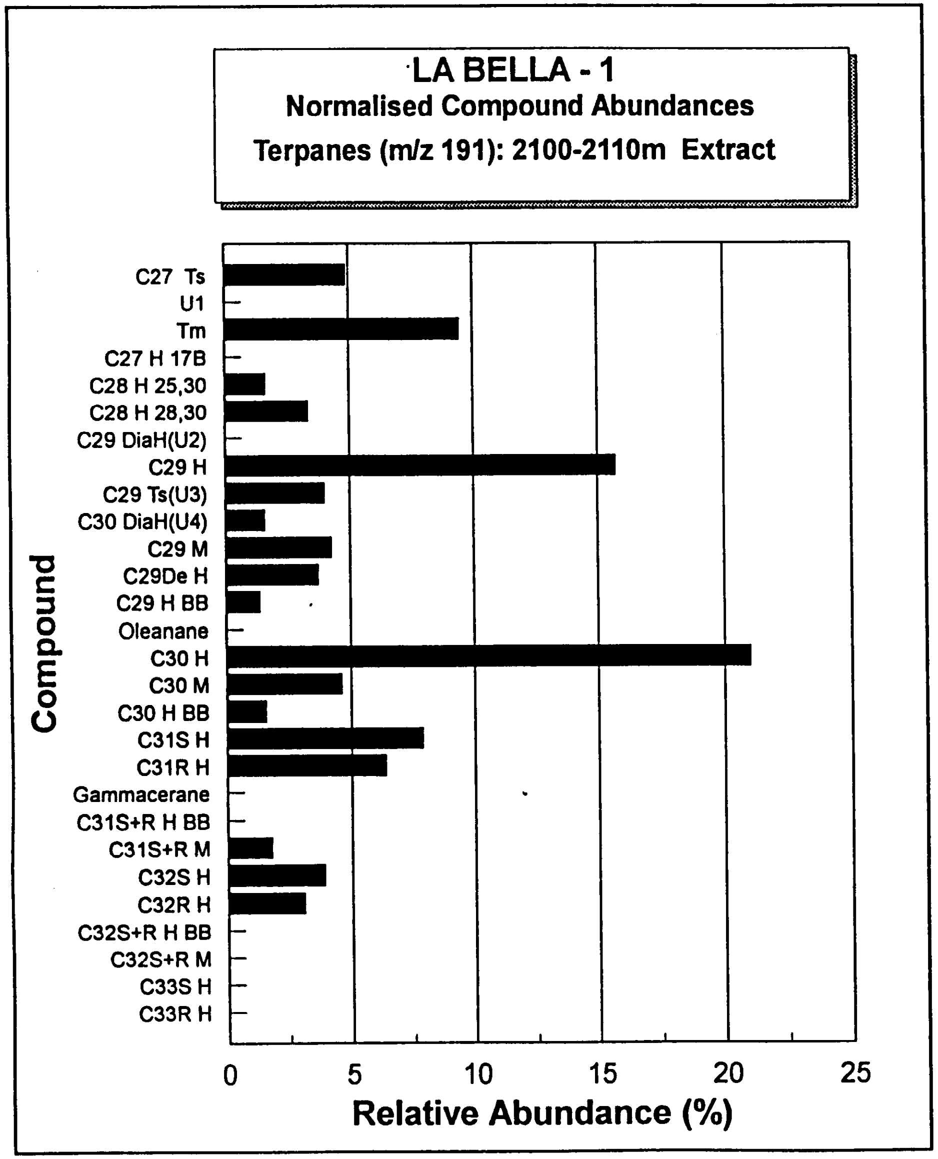
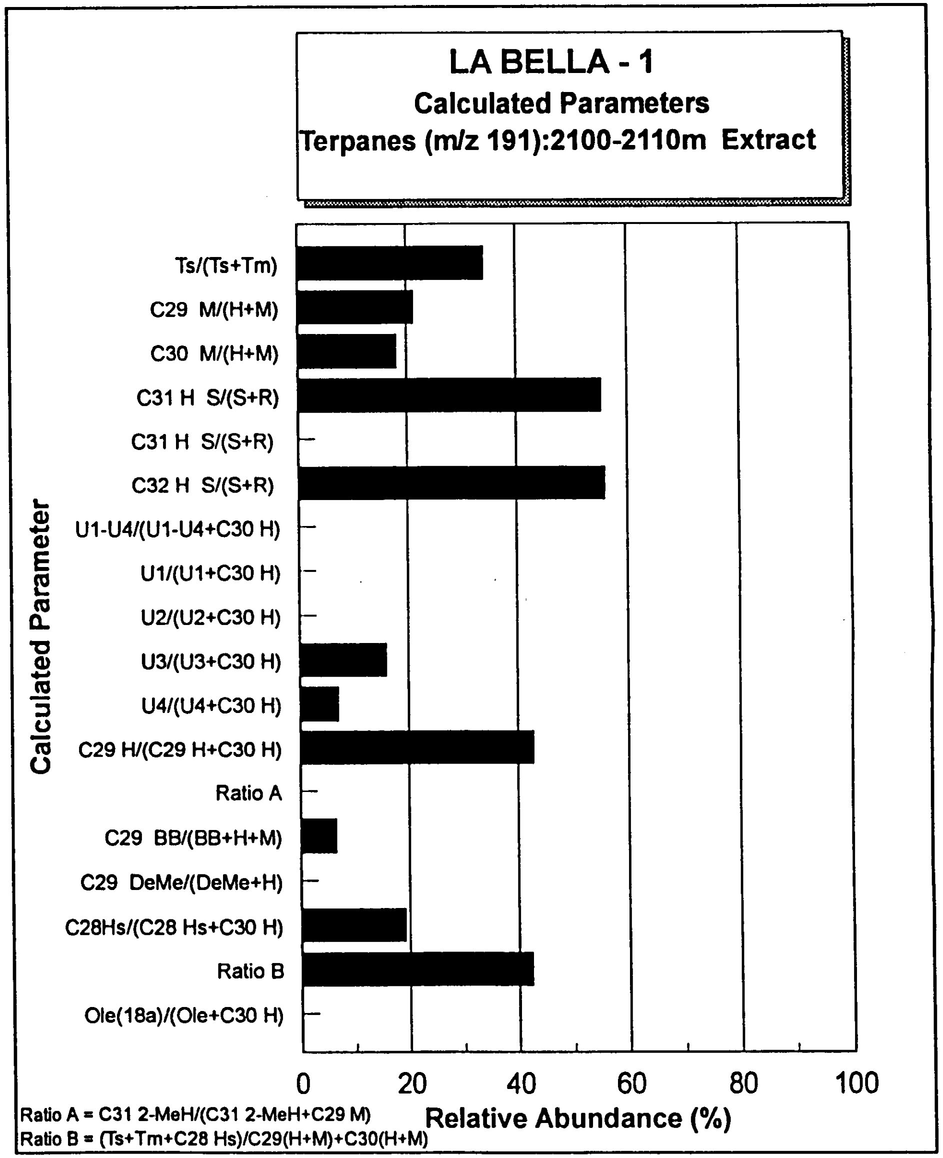

LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2097m Extract
Compound
C21 Sterane
C22 Sterane
C27S NS
C27R NS
C27S IS
C27R IS
C27S DS
C27R DS
C28S NS
C28R NS
C28S IS
C28R IS
C28S DS
C28R DS
C29S NS
C29R NS
C29S IS
C29R IS
C29S DS
C29R DS
0
5
10
15
20
25
Relative Abundance (%)
LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): 2097m Extract
Calculated Parameter
ST C27/(C27+C28+C29)
ST C28/(C27+C28+C29)
ST C29/(C27+C28+C29)
C27 NS S/(S+R)
C28 NS S/(S+R)
C29 NS S/(S+R)
C27 NS/C29 NS
C27 IS/C29 IS
C27 DS/C29 DS
C27 DS/C27 ST
C28 DS/C28 ST
C29 DS/C29 ST
C27 IS/(IS+NS)
C28 IS/(IS+NS)
C29 IS/(IS+NS)
Ratio C
0
50
100
150
200
250
300
350
400
Relative Abundance (%)
Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

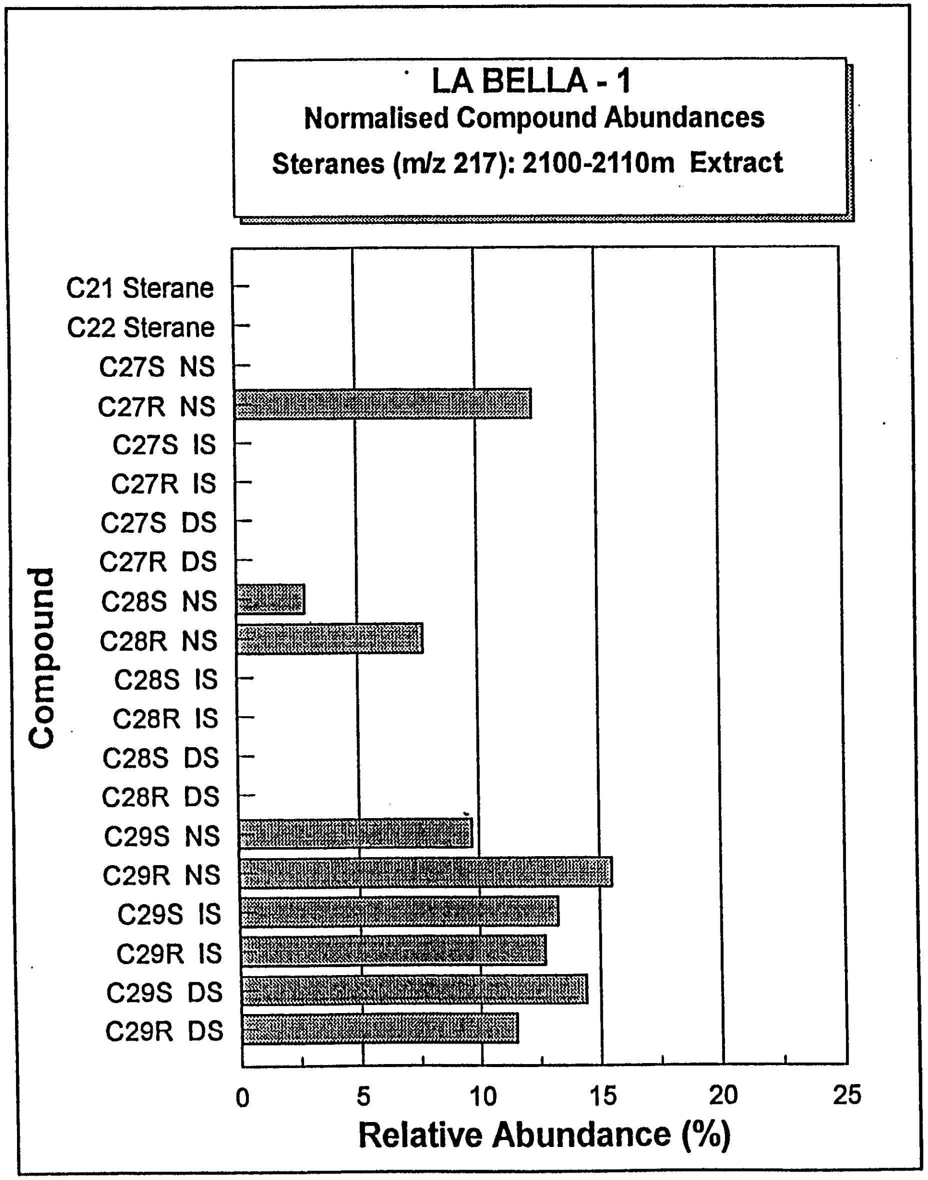
FIGURE 37b

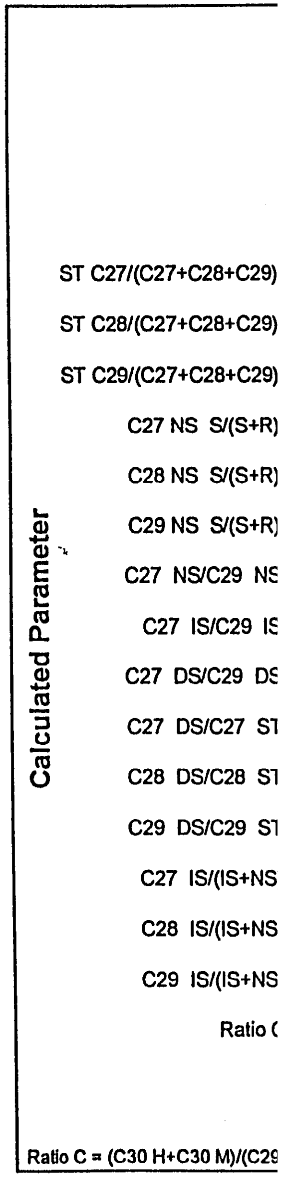


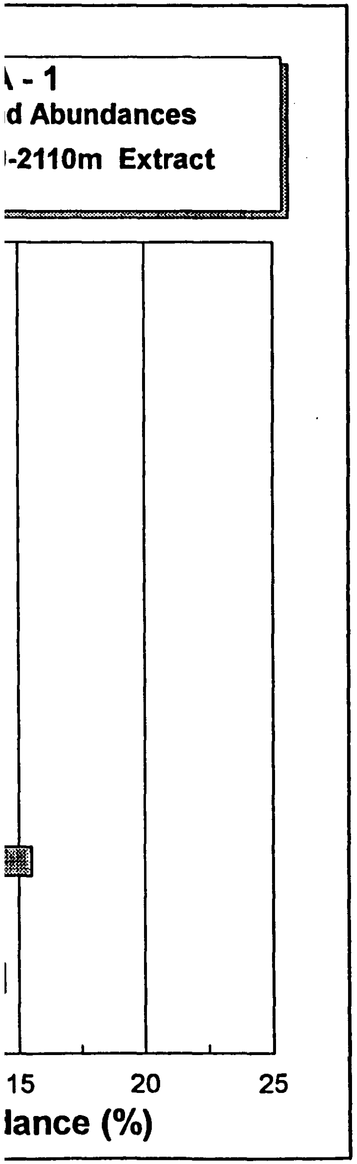


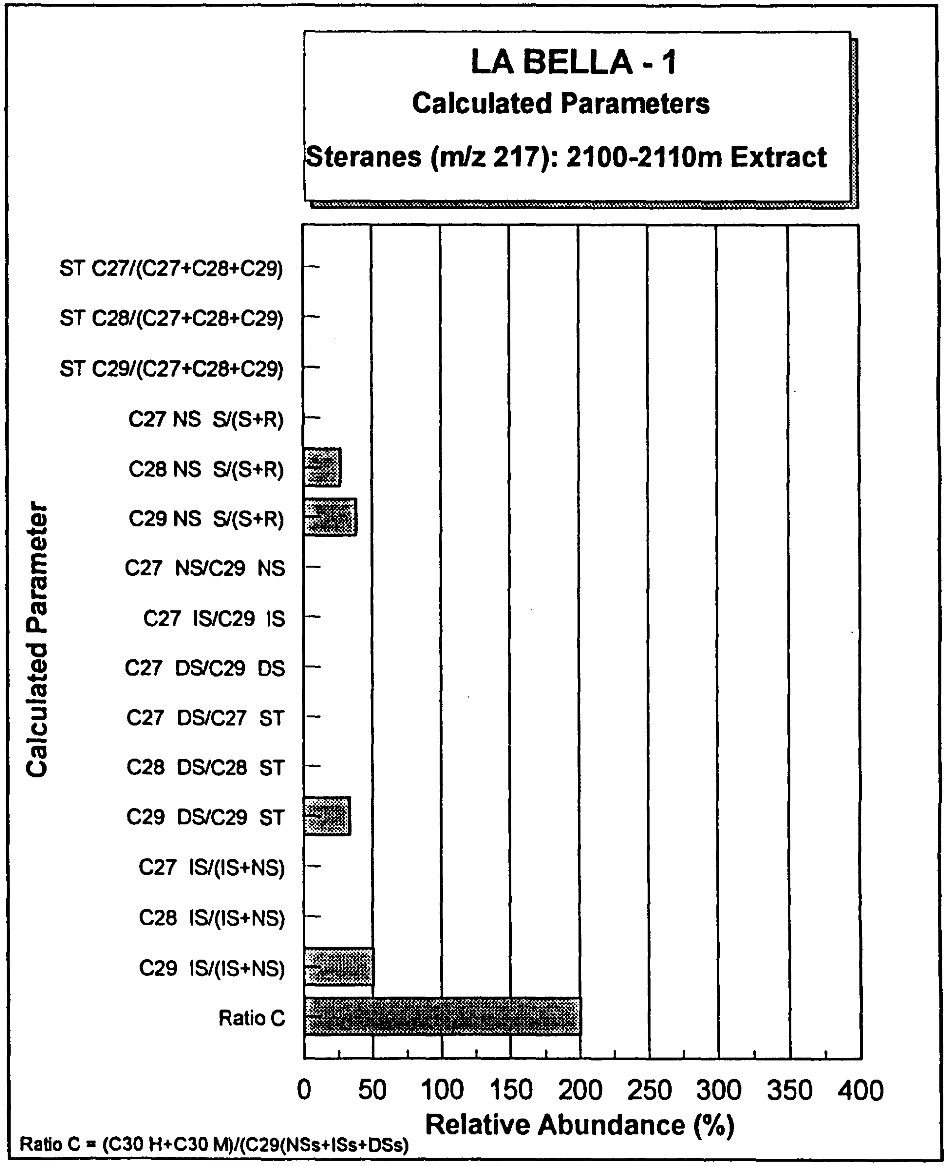
Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 38a


LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2100-2110m Extract
Compound
C21 Sterane
C22 Sterane
C27S NS
C27R NS
C27S IS
C27R IS
C27S DS
C27R DS
C28S NS
C28R NS
C28S IS
C28R IS
C28S DS
C28R DS
C29S NS
C29R NS
C29S IS
C29R IS
C29S DS
C29R DS
0
5
10
15
20
25
Relative Abundance (%)

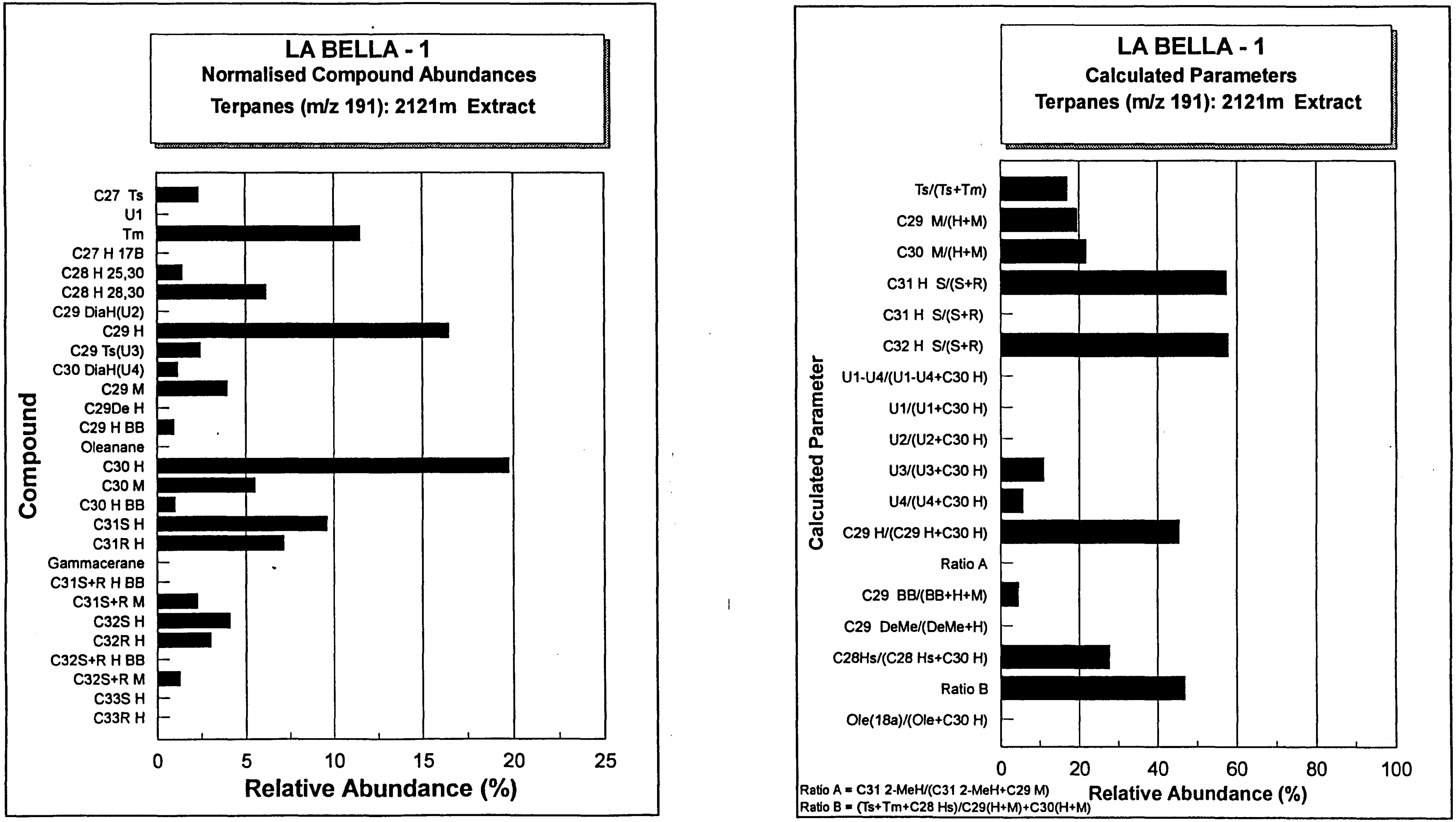

Calculated Parameter
ST C27/(C27+C28+C29)
ST C28/(C27+C28+C29)
ST C29/(C27+C28+C29)
C27 NS S/(S+R)
C28 NS S/(S+R)
C29 NS S/(S+R)
C27 NS/C29 NS
C27 IS/C29 IS
C27 DS/C29 DS
C27 DS/C27 ST
C28 DS/C28 ST
C29 DS/C29 ST
C27 IS/(IS+NS
C28 IS/(IS+NS
C29 IS/(IS+NS
Ratio (
Ratio C = (C30 H+C30 M)/(C29





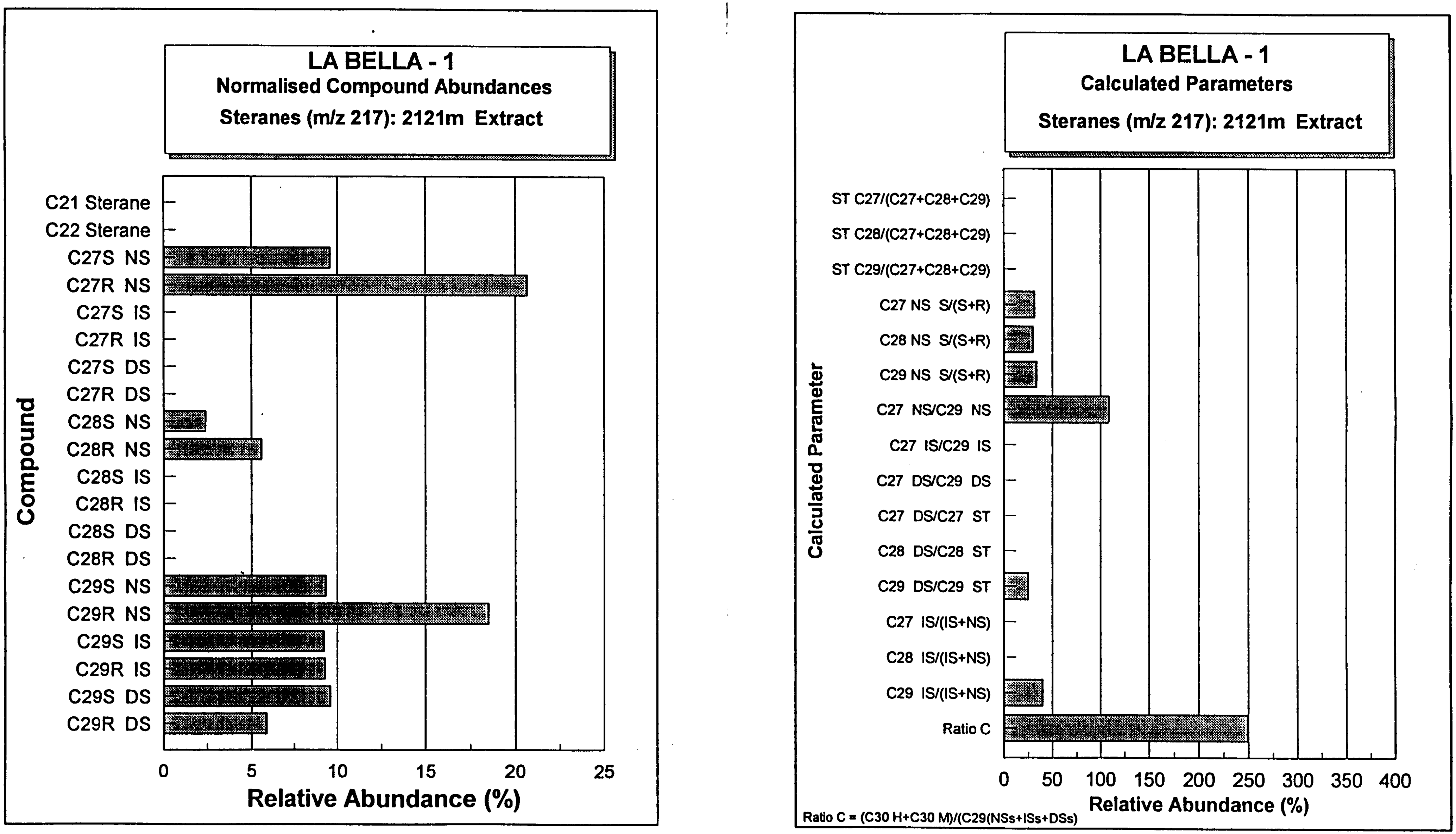
Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 38b



Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 39a

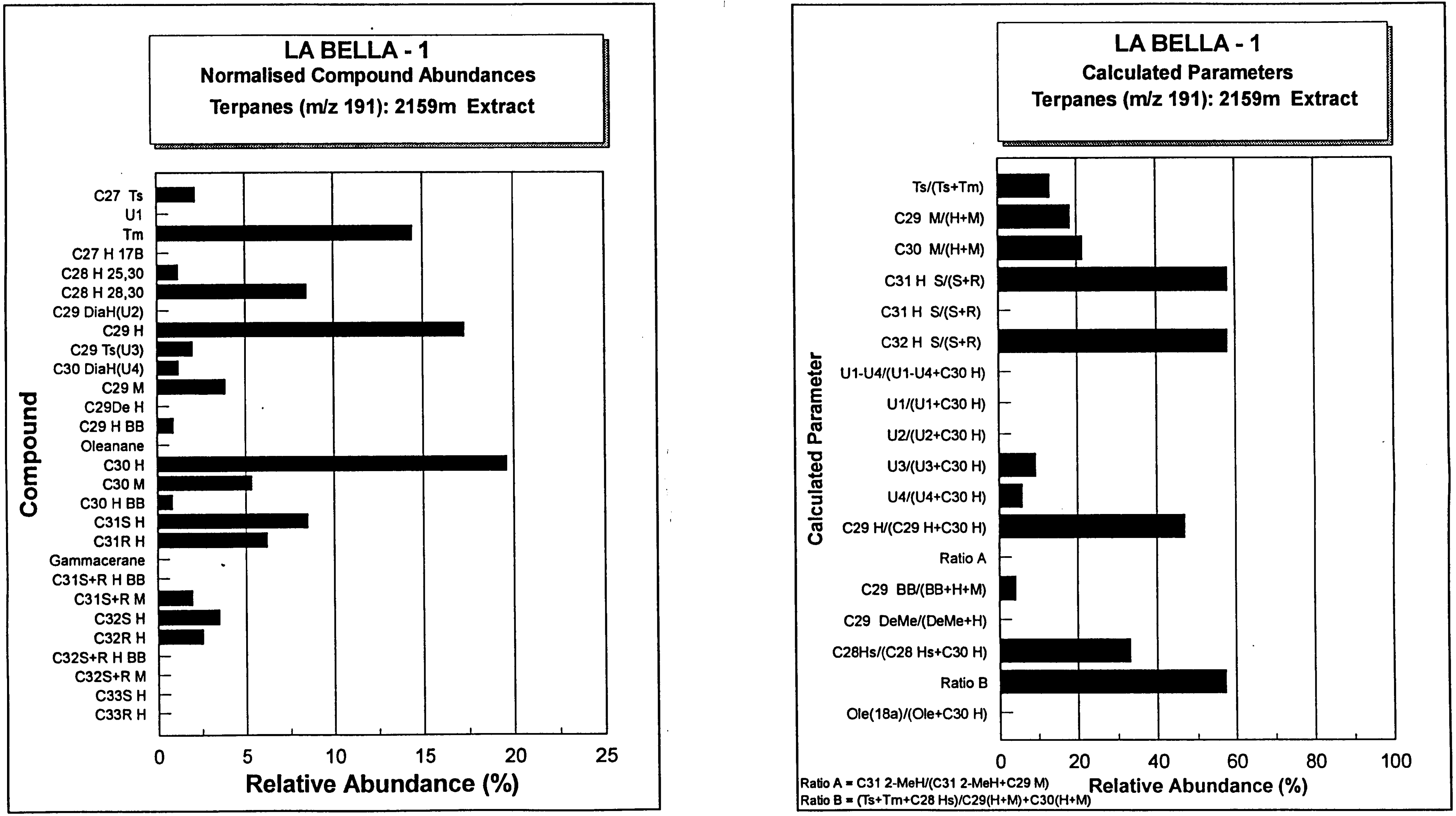


LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2121m Extract

LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): 2121m Extract

Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 39b



LA BELLA - 1
Normalised Compound Abundances
Terpanes (m/z 191): 2159m Extract

LA BELLA - 1
Calculated Parameters
Terpanes (m/z 191): 2159m Extract

Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 40a

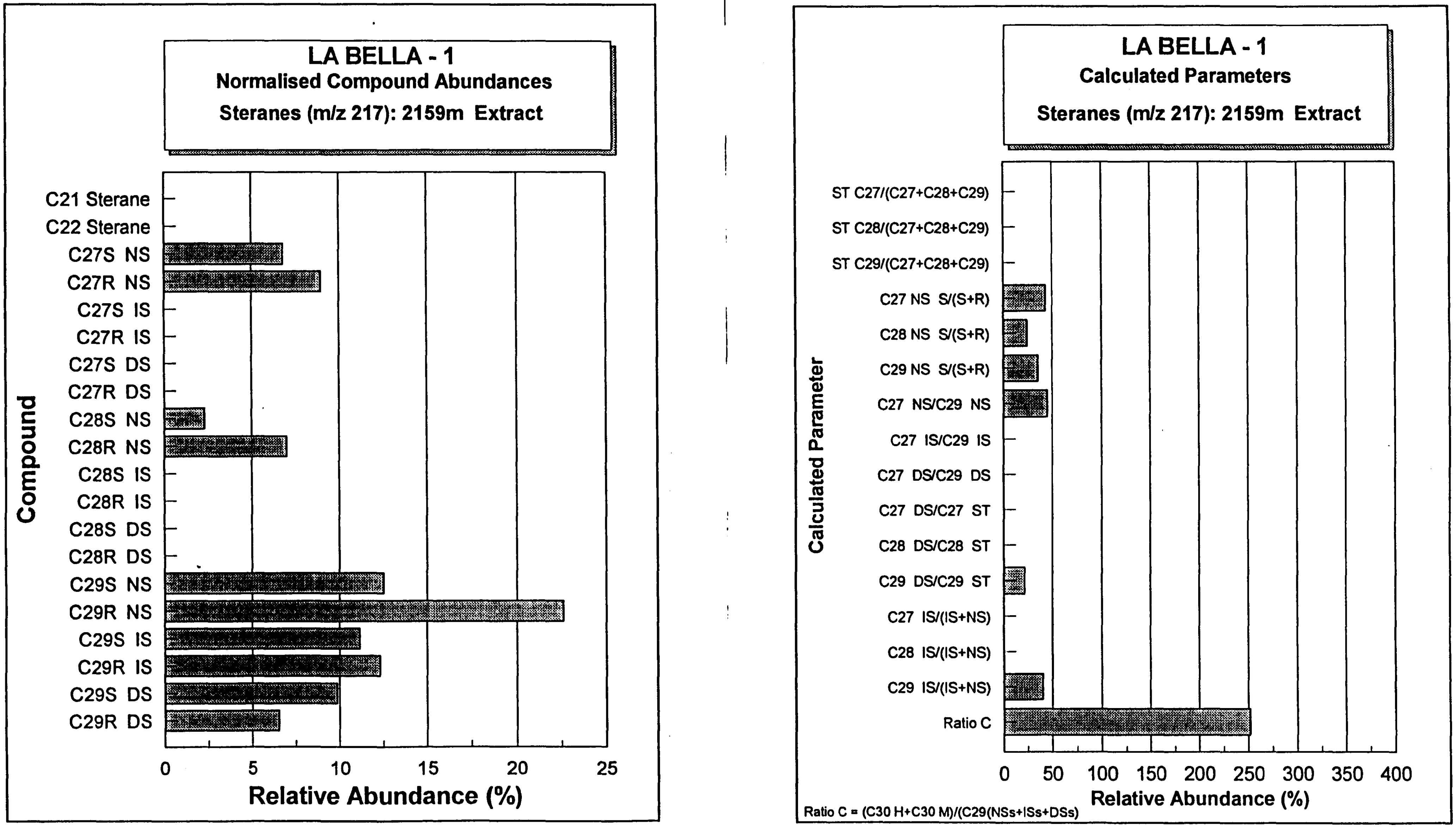
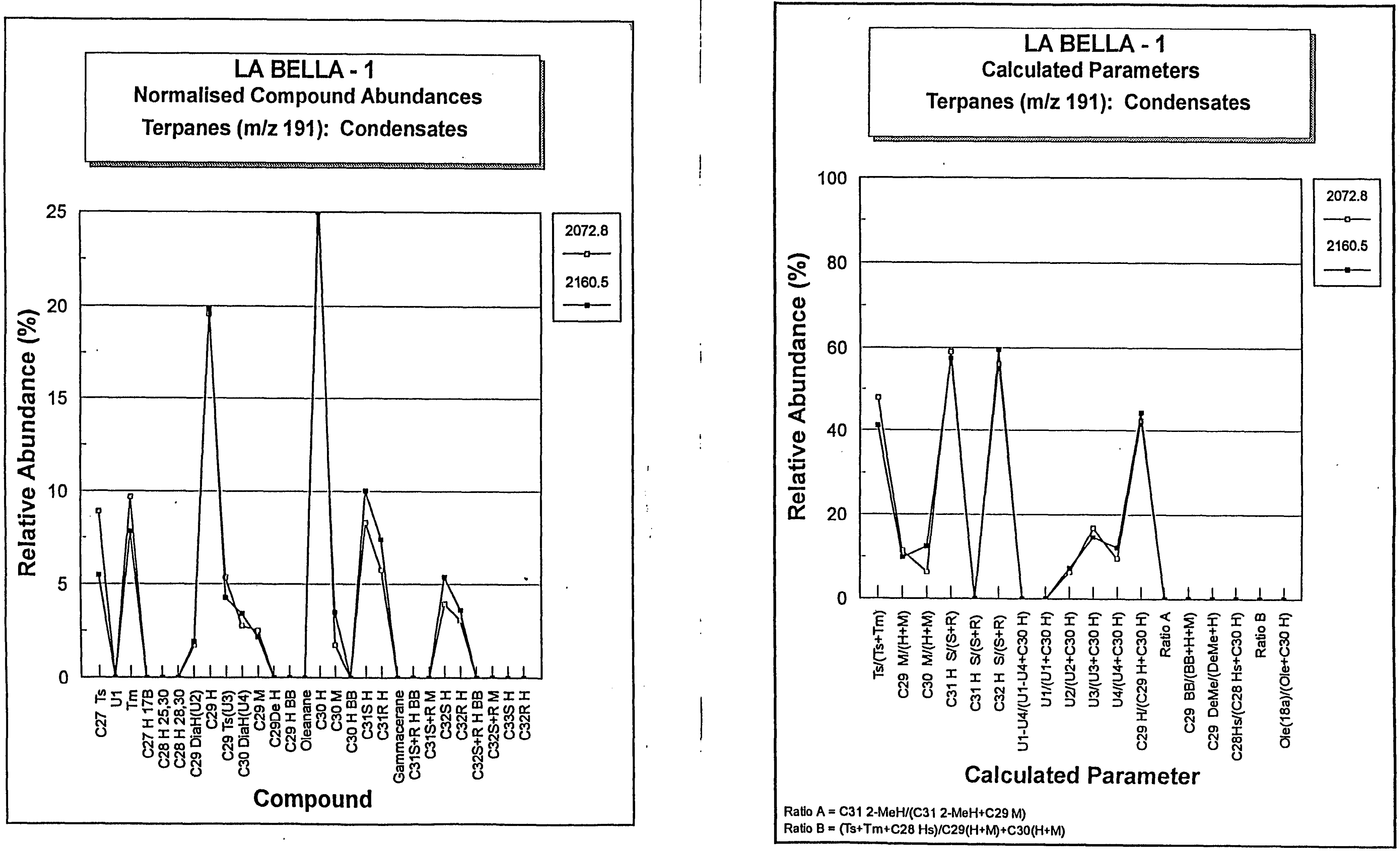

LA BELLA - 1
Normalised Compound Abundances
Steranes (m/z 217): 2159m Extract
Compound
C21 Sterane
C22 Sterane
C27S NS
C27R NS
C27S IS
C27R IS
C27S DS
C27R DS
C28S NS
C28R NS
C28S IS
C28R IS
C28S DS
C28R DS
C29S NS
C29R NS
C29S IS
C29R IS
C29S DS
C29R DS
0
5
10
15
20
25
Relative Abundance (%)
LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): 2159m Extract
Calculated Parameter
ST C27/(C27+C28+C29)
ST C28/(C27+C28+C29)
ST C29/(C27+C28+C29)
C27 NS S/(S+R)
C28 NS S/(S+R)
C29 NS S/(S+R)
C27 NS/C29 NS
C27 IS/C29 IS
C27 DS/C29 DS
C27 DS/C27 ST
C28 DS/C28 ST
C29 DS/C29 ST
C27 IS/(IS+NS)
C28 IS/(IS+NS)
C29 IS/(IS+NS)
Ratio C
0
50
100
150
200
250
300
350
400
Relative Abundance (%)
Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

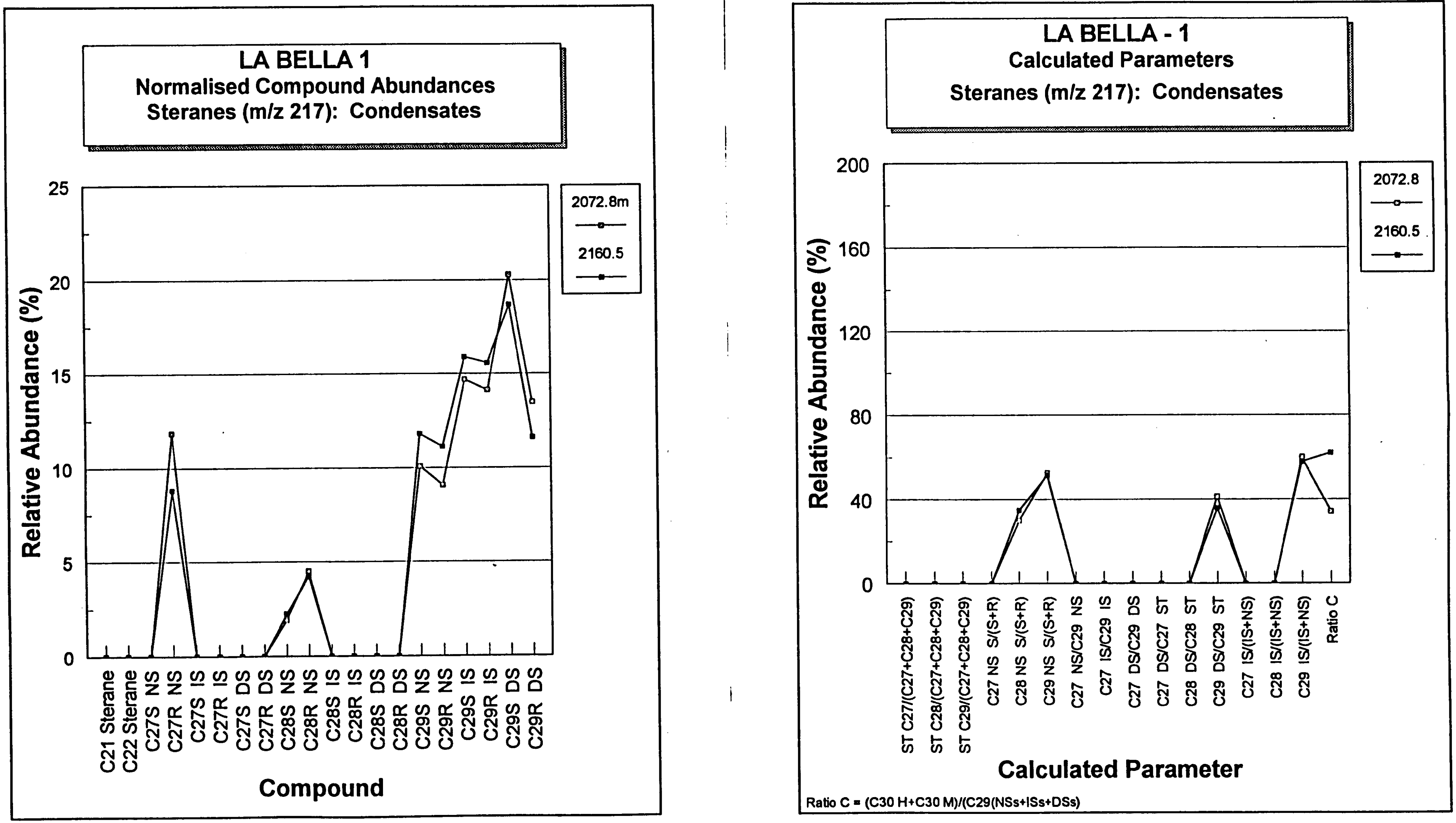
FIGURE 40b



Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

LABL 1/PE900368/P206.

FIGURE 41a

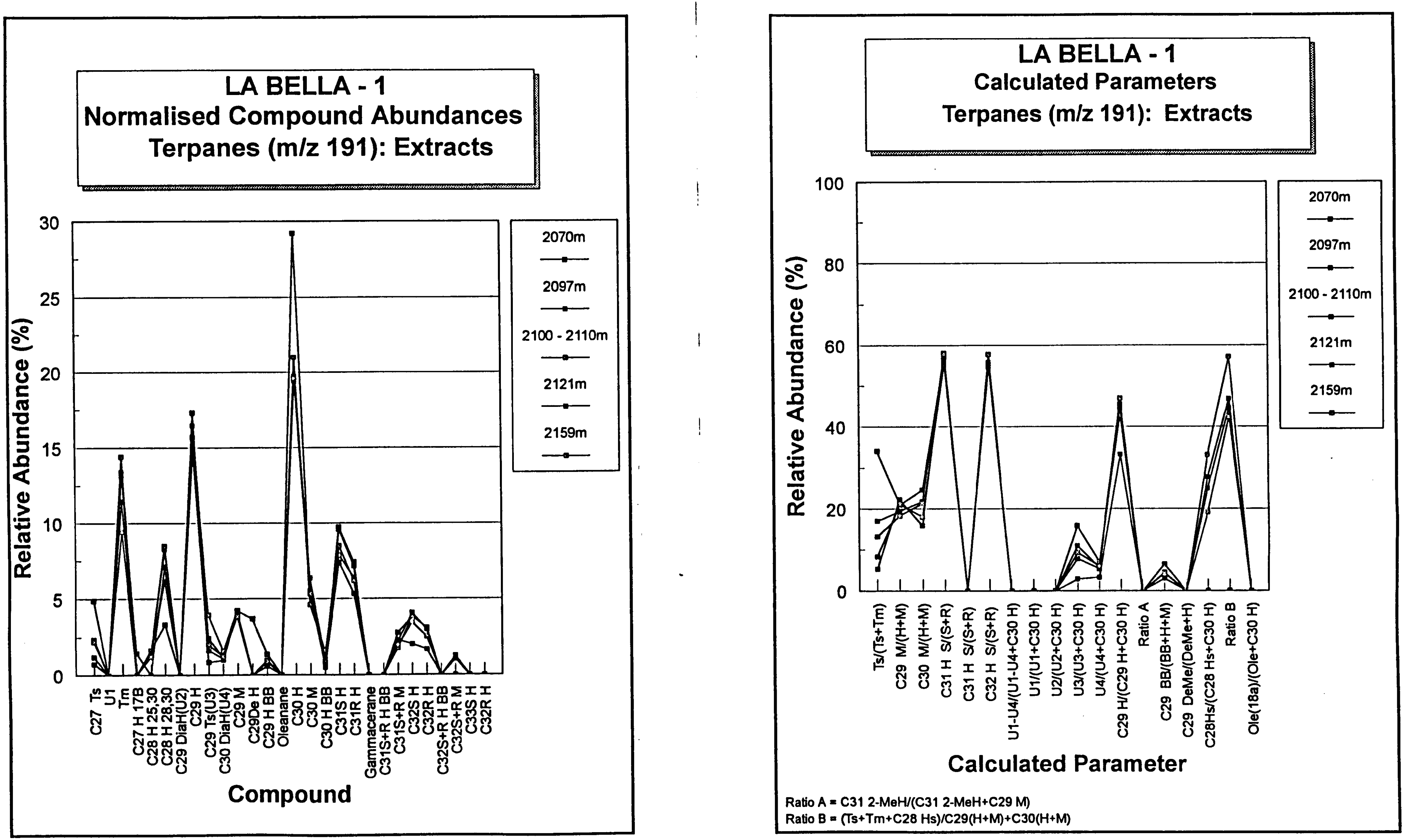


LA BELLA 1
Normalised Compound Abundances
Steranes (m/z 217): Condensates

LA BELLA - 1
Calculated Parameters
Steranes (m/z 217): Condensates

Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

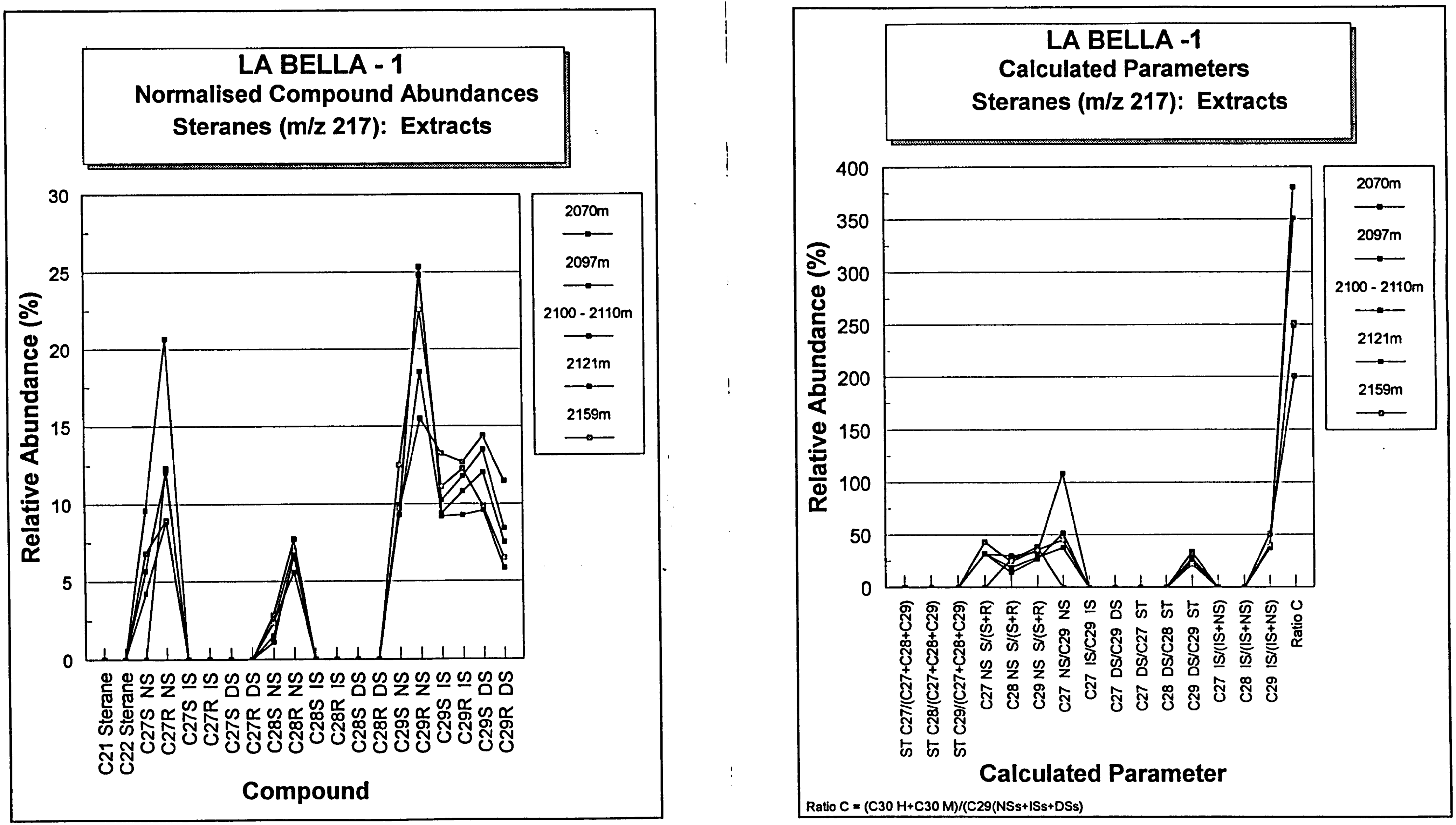
FIGURE 41b


LA BELLA - 1
Normalised Compound Abundances
Terpanes (m/z 191): Extracts

LA BELLA - 1
Calculated Parameters
Terpanes (m/z 191): Extracts

Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 42a



Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 42b

LA BELLA - 1

Facies Interpretation based on Sterane Abundances (R Isomers Only)

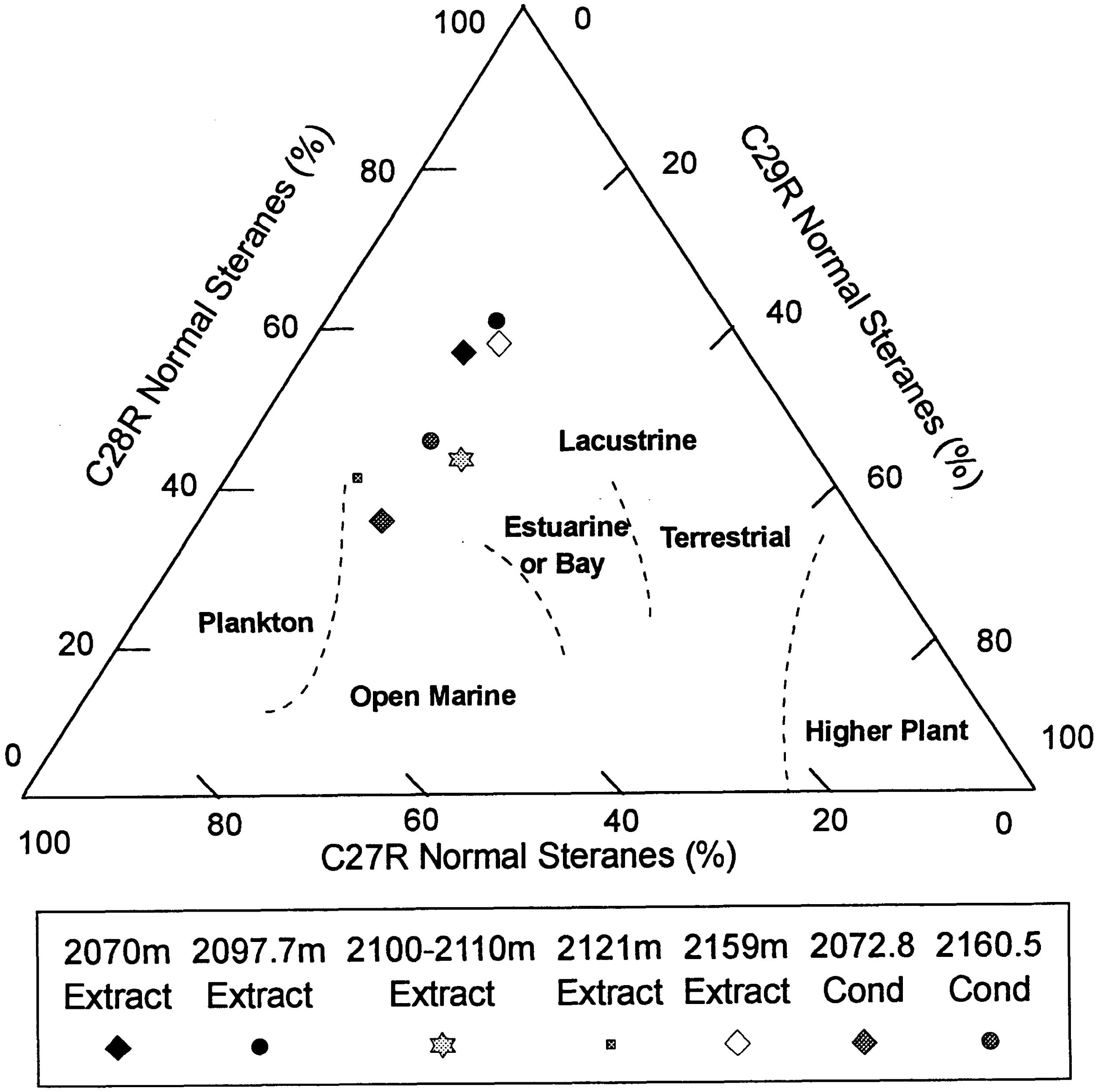


Figure 43a

LA BELLA - 1

Facies Interpretation based on Sterane Abundances (S+R Isomers)

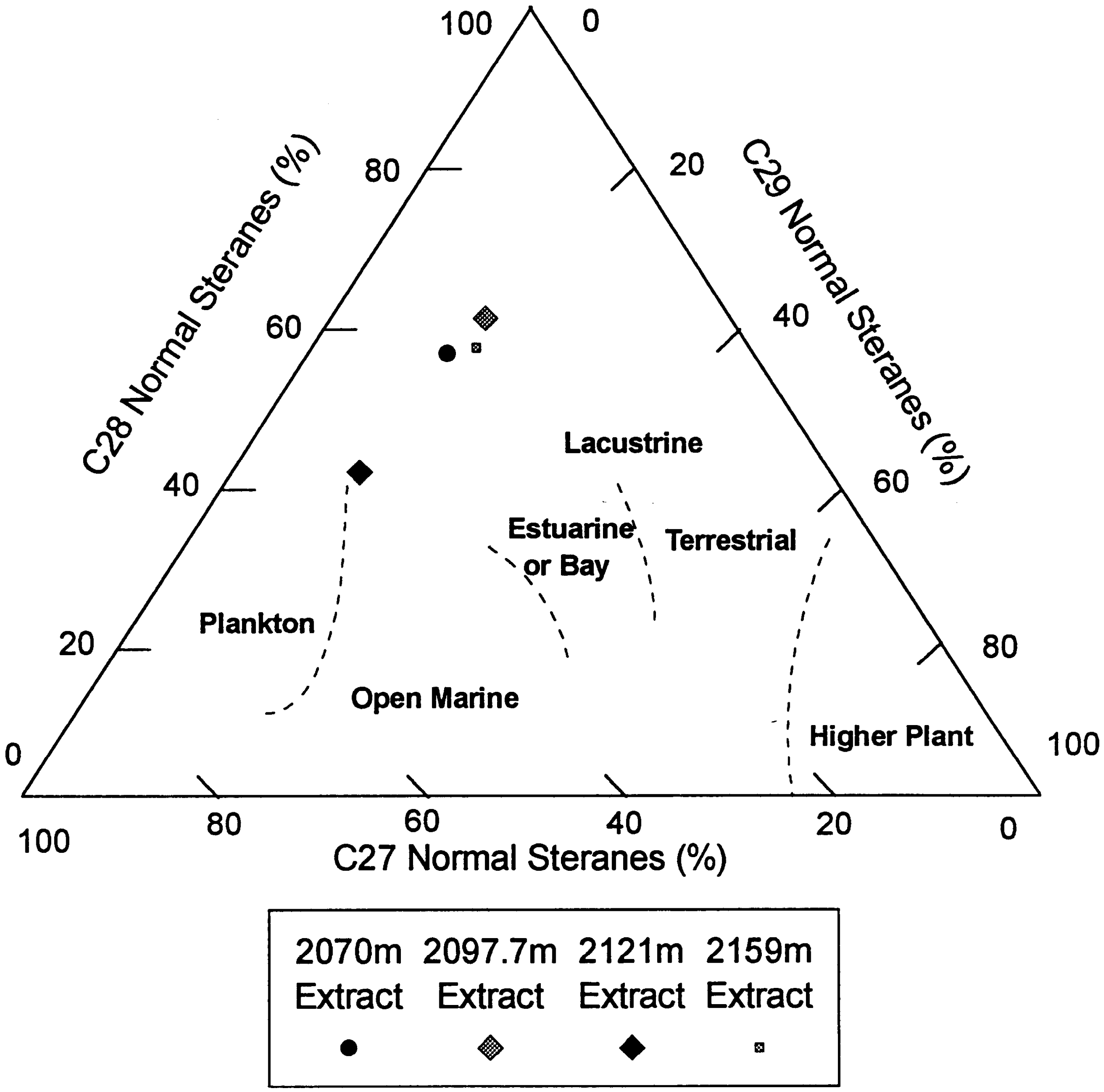
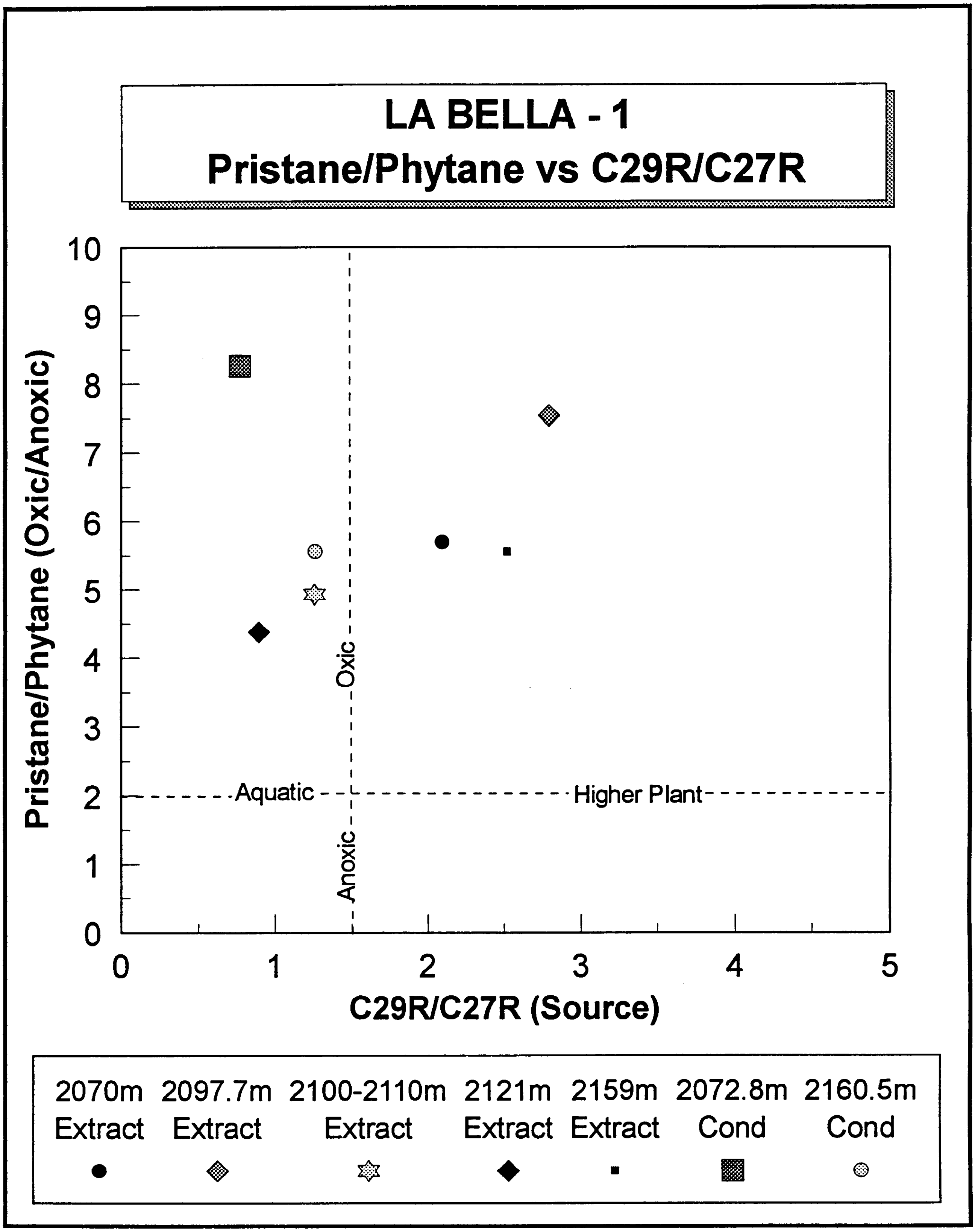


Figure 43b

Figure 44a



LA BELLA - 1
Pristane/Phytane vs C29R/C27R
Pristane/Phytane (Oxic/Anoxic)
0
1
2
3
4
5
6
7
8
9
10
C29R/C27R (Source)
0
1
2
3
4
5
Oxic
Anoxic
Aquatic
Higher Plant
2070m Extract ●
2097.7m Extract
2100-2110m Extract
2121m Extract ◆
2159m Extract ▪
2072.8m Cond ▨
2160.5m Cond

LA BELLA - 1
Pristane/Phytane vs Hopane/Sterane Ratio

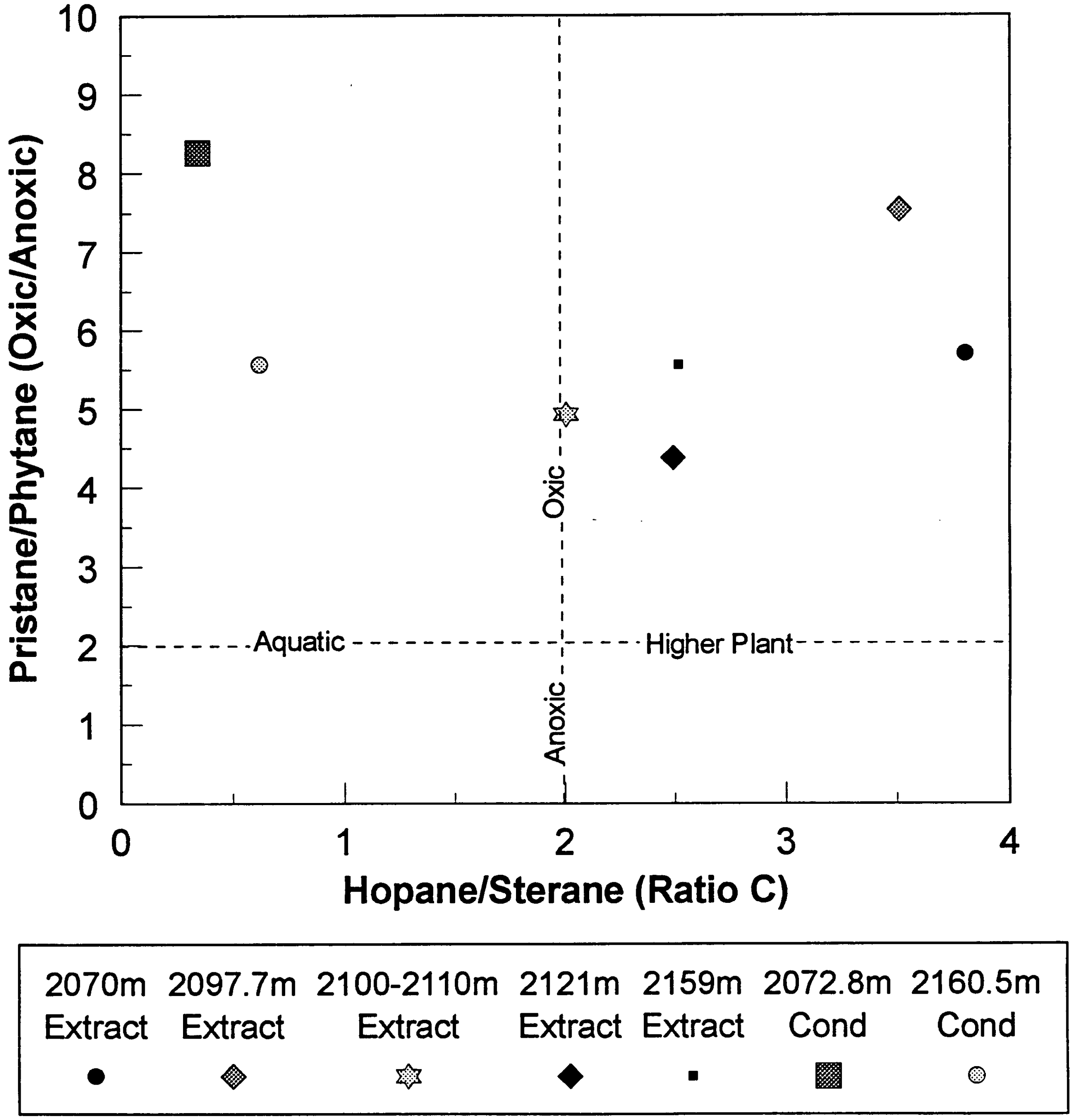
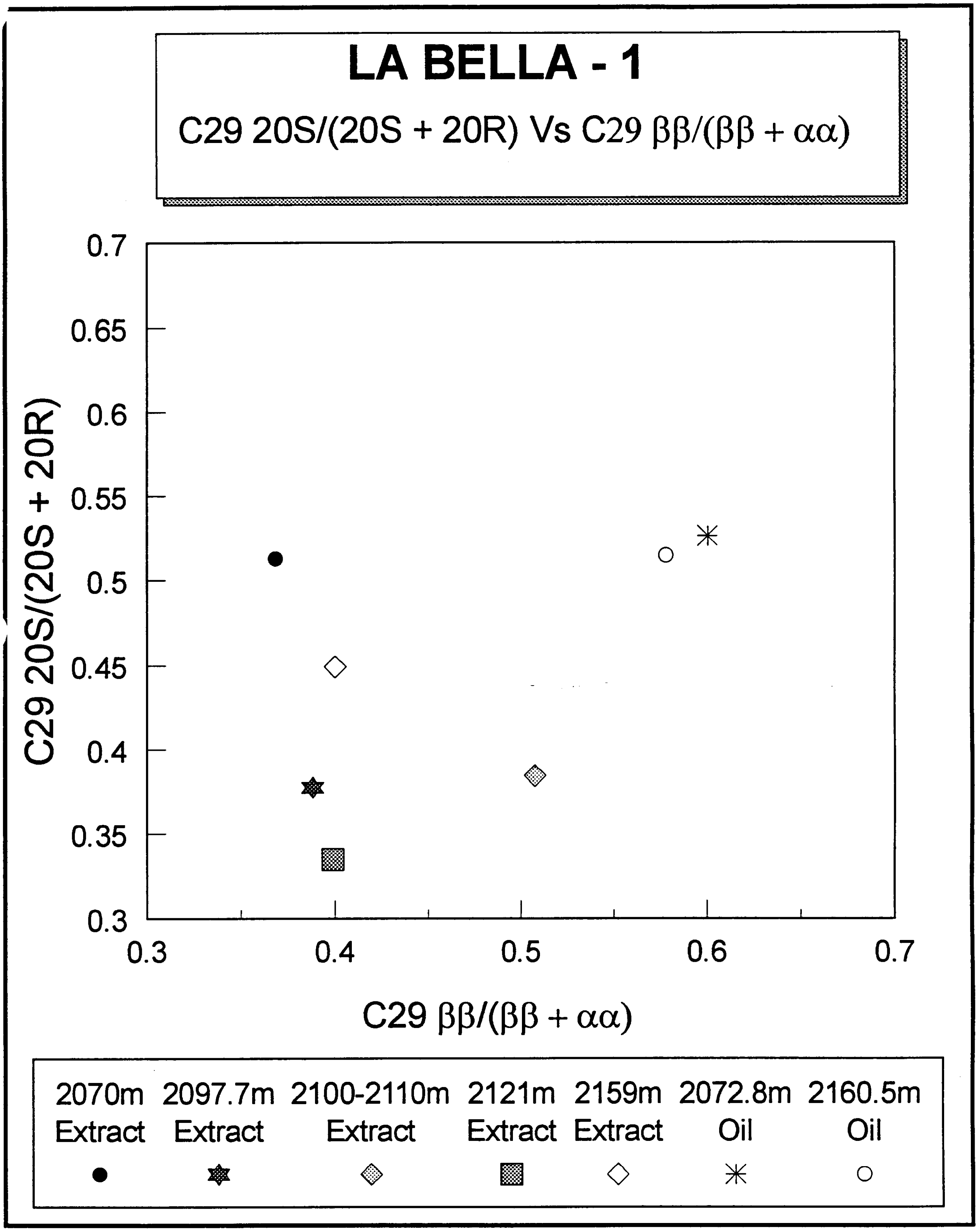


Figure 45



LA BELLA - 1

C29 20S/(20S + 20R) Vs C29 ββ/(ββ + αα)

TABLE 19

DI & TRI NUCLEAR AROMATIC GC/MS DATA - OILS

DESCRIPTION : RFT SAMPLE

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2072.80 DEPTH 2 = 2072.80

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	302133.0
1,6-Dimethylnaphthalene	156	1339397.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	1583932.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	797040.0
1,2,5-Trimethylnaphthalene	170	846495.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	568754.0
1,3,7-Trimethylnaphthalene	170	454682.0
2,3,6-Trimethylnaphthalene	170	370439.0
1,3,5+1,4,6-Trimethylnaphthalene	170	488349.0
Phenanthrene	178	720813.0
1-Methylphenanthrene	192	112514.0
2-Methylphenanthrene	192	167823.0
3-Methylphenanthrene	192	148815.0
9-Methylphenanthrene	192	146469.0
1,7-Dimethylphenanthrene	206	51699.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	98442.0
Retene	219	33205.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.62
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	1.12
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.81
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.64
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.68
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.78
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.92
1,7-Dimethylphenantrene / Compound X	206	0.53
Retene / 9-Methylphenantrene	192,219	0.23
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.77

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 20

DI & TRI NUCLEAR AROMATIC GC/MS DATA - OILS

DESCRIPTION : RFT SAMPLE

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2160.50 DEPTH 2 = 2160.50

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	426542.0
1,6-Dimethylnaphthalene	156	1918194.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	2637244.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	947912.0
1,2,5-Trimethylnaphthalene	170	991316.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	801792.0
1,3,7-Trimethylnaphthalene	170	658611.0
2,3,6-Trimethylnaphthalene	170	521846.0
1,3,5+1,4,6-Trimethylnaphthalene	170	672860.0
Phenanthrene	178	612065.0
1-Methylphenanthrene	192	188200.0
2-Methylphenanthrene	192	274914.0
3-Methylphenanthrene	192	227624.0
9-Methylphenanthrene	192	215570.0
1,7-Dimethylphenanthrene	206	150174.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	215928.0
Retene	219	57243.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.64
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	0.93
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.67
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.93
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	1.02
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.96
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.74
1,7-Dimethylphenantrene / Compound X	206	0.70
Retene / 9-Methylphenantrene	192,219	0.27
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.87

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 21

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2070.00 DEPTH 2 = 2070.00

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	45478.0
1,6-Dimethylnaphthalene	156	196868.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	212318.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	143772.0
1,2,5-Trimethylnaphthalene	170	202302.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	73654.0
1,3,7-Trimethylnaphthalene	170	46669.0
2,3,6-Trimethylnaphthalene	170	62410.0
1,3,5+1,4,6-Trimethylnaphthalene	170	61120.0
Phenanthrene	178	1939544.0
1-Methylphenanthrene	192	267460.0
2-Methylphenanthrene	192	424921.0
3-Methylphenanthrene	192	286048.0
9-Methylphenanthrene	192	334884.0
1,7-Dimethylphenanthrene	206	94722.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	138490.0
Retene	219	44049.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.84
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	2.06
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.66
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.56
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.67
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.74
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.96
1,7-Dimethylphenantrene / Compound X	206	0.68
Retene / 9-Methylphenantrene	192,219	0.13
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.80

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 22

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2097.70 DEPTH 2 = 2097.70

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	54693.0
1,6-Dimethylnaphthalene	156	193238.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	199834.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	147645.0
1,2,5-Trimethylnaphthalene	170	286469.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	59786.0
1,3,7-Trimethylnaphthalene	170	34132.0
2,3,6-Trimethylnaphthalene	170	43655.0
1,3,5+1,4,6-Trimethylnaphthalene	170	55547.0
Phenanthrene	178	2812541.0
1-Methylphenanthrene	192	314650.0
2-Methylphenanthrene	192	513940.0
3-Methylphenanthrene	192	365237.0
9-Methylphenanthrene	192	373188.0
1,7-Dimethylphenanthrene	206	92128.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	137357.0
Retene	219	48435.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.64
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	3.59
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.79
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.51
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.60
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.71
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.99
1,7-Dimethylphenantrene / Compound X	206	0.67
Retene / 9-Methylphenantrene	192,219	0.13
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.84

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 23

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2100.00 DEPTH 2 = 2110.00

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	186383.0
1,6-Dimethylnaphthalene	156	694738.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	741372.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	499720.0
1,2,5-Trimethylnaphthalene	170	803246.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	206484.0
1,3,7-Trimethylnaphthalene	170	131183.0
2,3,6-Trimethylnaphthalene	170	152578.0
1,3,5+1,4,6-Trimethylnaphthalene	170	187535.0
Phenanthrene	178	6977850.0
1-Methylphenanthrene	192	797780.0
2-Methylphenanthrene	192	1286611.0
3-Methylphenanthrene	192	939844.0
9-Methylphenanthrene	192	981828.0
1,7-Dimethylphenanthrene	206	232311.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	351441.0
Retene	219	114034.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.67
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	2.92
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.79
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.52
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.60
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.71
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.99
1,7-Dimethylphenantrene / Compound X	206	0.66
Retene / 9-Methylphenantrene	192,219	0.12
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.81

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 24

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2121.00 DEPTH 2 = 2121.00

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	31870.0
1,6-Dimethylnaphthalene	156	144307.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	208309.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	85659.0
1,2,5-Trimethylnaphthalene	170	172092.0
1,2,7-Trimethylnaphthalene	170	-
1,3,6-Trimethylnaphthalene	170	57697.0
1,3,7-Trimethylnaphthalene	170	36897.0
2,3,6-Trimethylnaphthalene	170	43224.0
1,3,5+1,4,6-Trimethylnaphthalene	170	45758.0
Phenanthrene	178	1836398.0
1-Methylphenanthrene	192	294102.0
2-Methylphenanthrene	192	485813.0
3-Methylphenanthrene	192	320017.0
9-Methylphenanthrene	192	331511.0
1,7-Dimethylphenanthrene	206	107813.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	157359.0
Retene	219	44941.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.77
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	2.24
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	-
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.74
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.65
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.79
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.79
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.91
1,7-Dimethylphenantrene / Compound X	206	0.69
Retene / 9-Methylphenantrene	192,219	0.14
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.89

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

TABLE 25

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DEPTH 1 = 2159.00 DEPTH 2 = 2159.00

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	65169.0
1,6-Dimethylnaphthalene	156	222579.0
1,8-Dimethylnaphthalene	156	-
2,6-Dimethylnaphthalene	156	214085.0
2,7-Dimethylnaphthalene	156	-
1,4+2,3-Dimethylnaphthalene	156	159479.0
1,2,5-Trimethylnaphthalene	170	382812.0
1,2,7-Trimethylnaphthalene	170	26325.0
1,3,6-Trimethylnaphthalene	170	74897.0
1,3,7-Trimethylnaphthalene	170	38606.0
2,3,6-Trimethylnaphthalene	170	56571.0
1,3,5+1,4,6-Trimethylnaphthalene	170	74529.0
Phenanthrene	178	2114964.0
1-Methylphenanthrene	192	374004.0
2-Methylphenanthrene	192	623551.0
3-Methylphenanthrene	192	396093.0
9-Methylphenanthrene	192	481887.0
1,7-Dimethylphenanthrene	206	175463.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	219856.0
Retene	219	71339.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	-
DNR-2 = 2,7-DMN / 1,8-DMN	156	-
DNR-5 = 1,6-DMN / 1,8-DMN	156	-
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	-
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.62
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	3.83
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	0.68
MPR-1 = (2-MP + 3-MP) / 1-MP	192	2.73
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.67
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.83
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.80
Rc(b) = (-0.6 x MPI-1) + 2.3	na	1.90
1,7-Dimethylphenantrene / Compound X	206	0.80
Retene / 9-Methylphenantrene	192,219	0.15
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.78

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

LA BELLA - 1
MPI-1-derived Rc(a) vs Depth

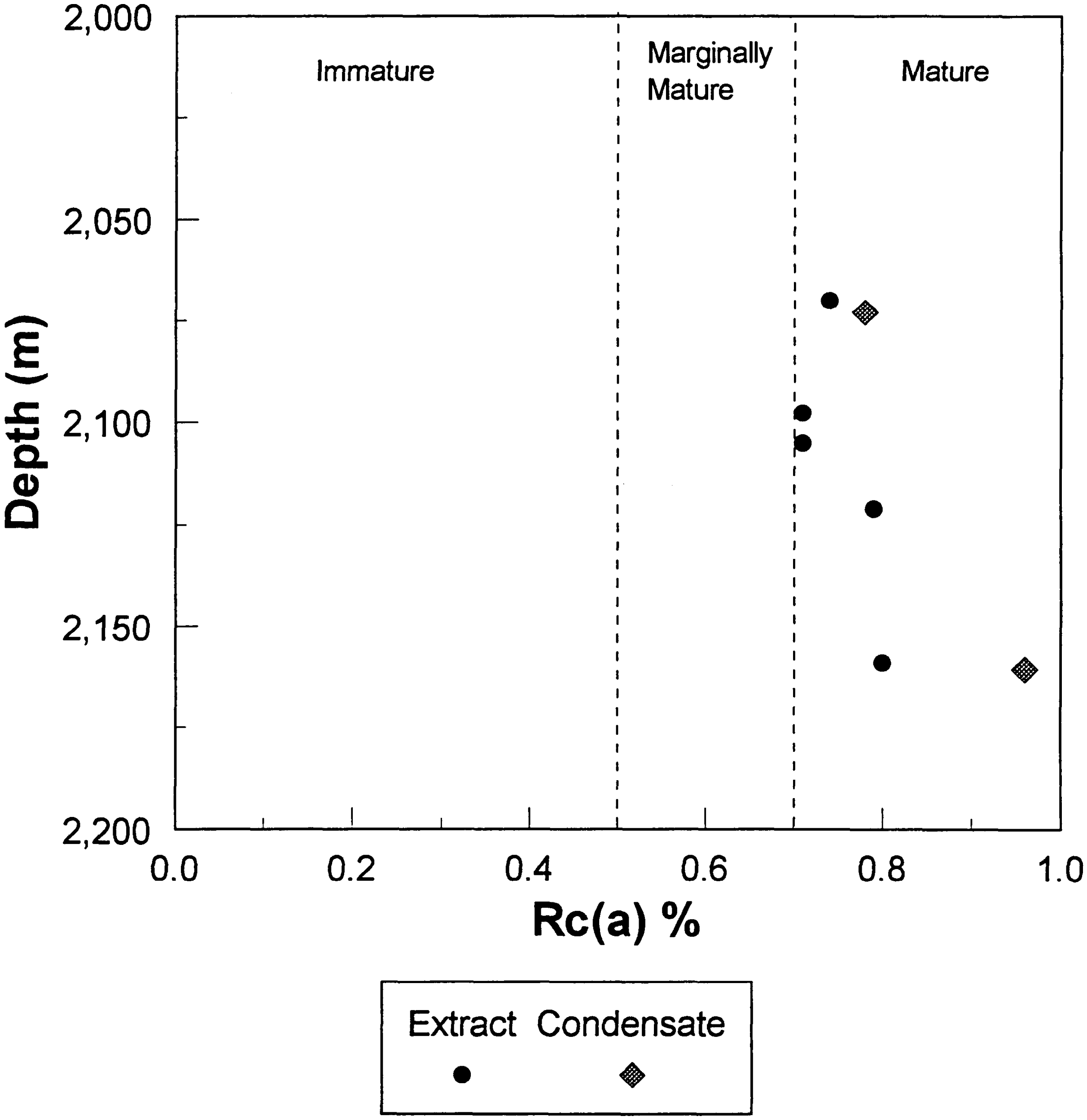
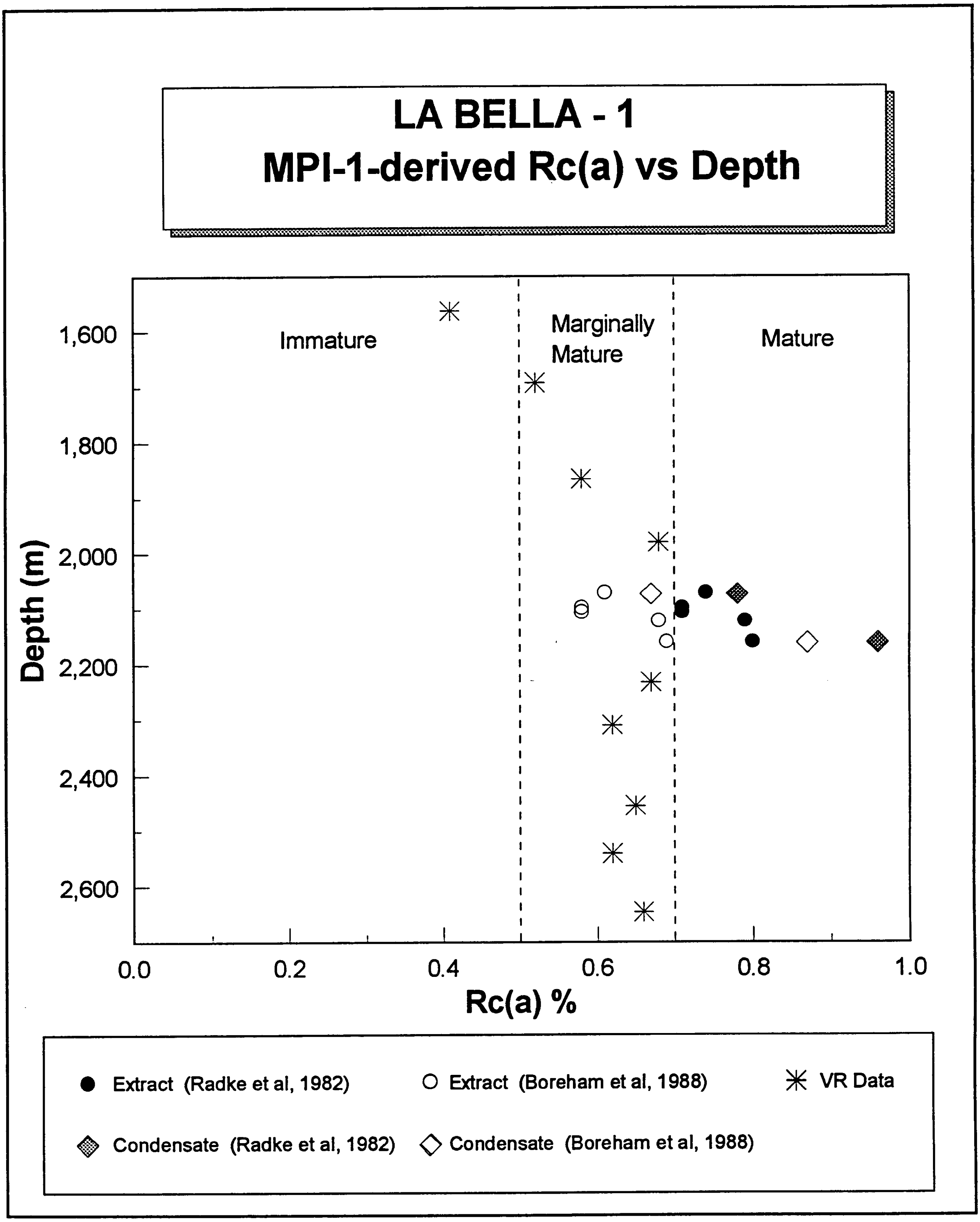


Figure 46b


LA BELLA - 1
MPI-1-derived Rc(a) vs Depth
Immature
Marginally Mature
Mature
Depth (m)
1,600
1,800
2,000
2,200
2,400
2,600
0.0
0.2
0.4
0.6
0.8
1.0
Rc(a) %
● Extract (Radke et al, 1982)
○ Extract (Boreham et al, 1988)
✳ VR Data
◈ Condensate (Radke et al, 1982)
◇ Condensate (Boreham et al, 1988)

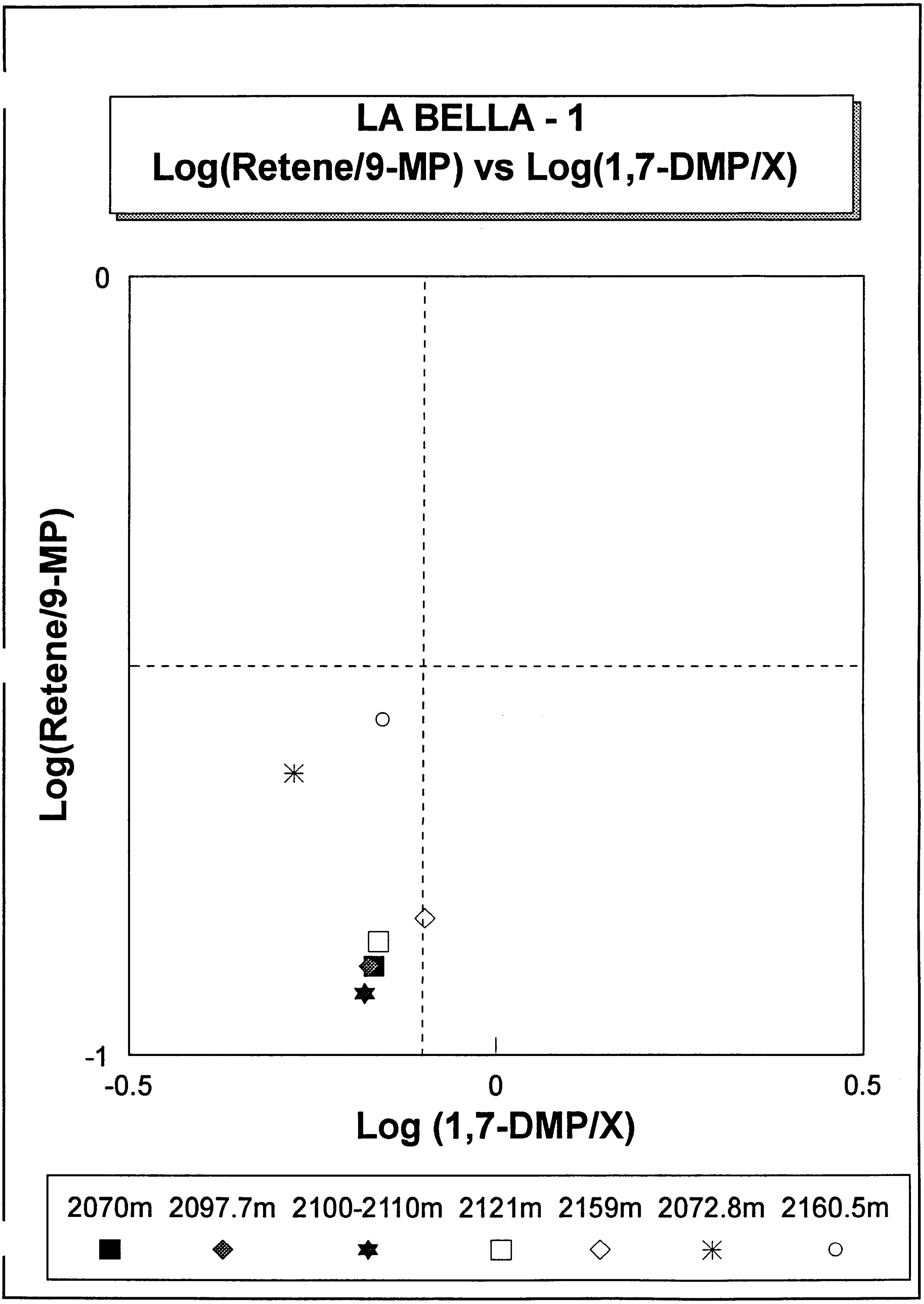

LA BELLA - 1
Log(Retene/9-MP) vs Log(1,7-DMP/X)
0
-1
-0.5
0
0.5
Log(Retene/9-MP)
Log (1,7-DMP/X)
2070m ■
2097.7m ◈
2100-2110m ✡
2121m □
2159m ◇
2072.8m ✳
2160.5m ○

Figure 47a

FIGURE 47b

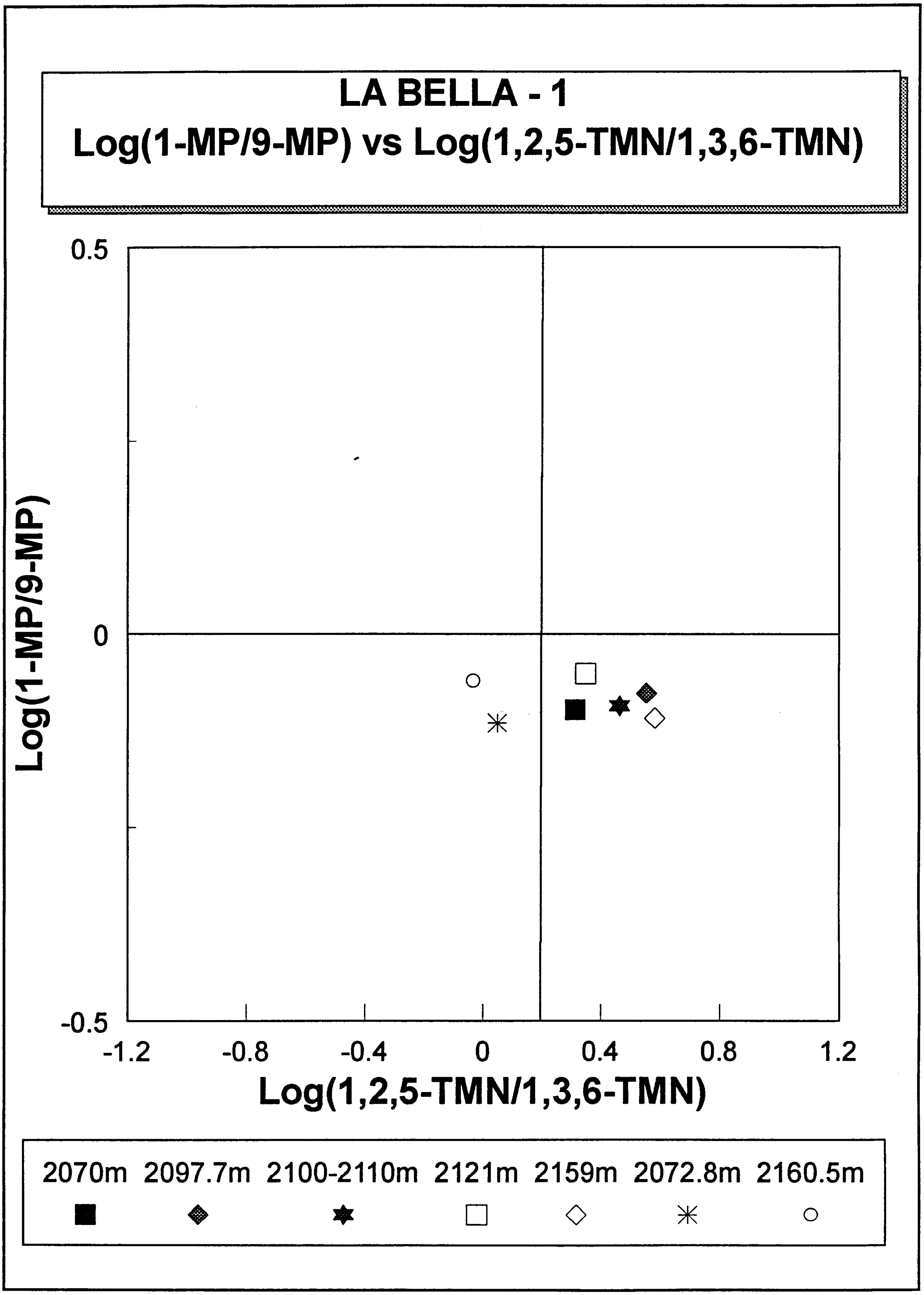

LA BELLA - 1
Log(1-MP/9-MP) vs Log(1,2,5-TMN/1,3,6-TMN)
0.5
0
-0.5
Log(1-MP/9-MP)
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
Log(1,2,5-TMN/1,3,6-TMN)
2070m ■
2097.7m ◈
2100-2110m ✡
2121m □
2159m ◇
2072.8m ✳
2160.5m ○

TABLE 26

GAS ANALYSIS DATA

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DESCRIPTION : RFT SAMPLE

DEPTH 1(m) = 2072.80

DEPTH 2(m) = 2072.80

COMPOUND	% by VOLUME
Methane	77.10
Ethane	4.52
Propane	1.61
IsoButane	.27
n-Butane	.26
IsoPentane	.08
n-Pentane	.07
C6+	.05
Carbon Dioxide	12.04
Nitrogen	3.89
Hydrogen Sulphide	-
Oxygen	.10
Hydrogen	-
Helium	-
Argon	-

NOTES : - = not reported

TABLE 27

GAS ANALYSIS DATA

WELL = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

DESCRIPTION : RFT SAMPLE

DEPTH 1(m) = 2160.50

DEPTH 2(m) = 2160.50

COMPOUND	% by VOLUME
Methane	76.39
Ethane	4.78
Propane	1.74
IsoButane	.28
n-Butane	.30
IsoPentane	.09
n-Pentane	.08
C6+	.07
Carbon Dioxide	12.79
Nitrogen	3.37
Hydrogen Sulphide	-
Oxygen	.11
Hydrogen	-
Helium	-
Argon	-

NOTES : - = not reported

FIGURE 48a

LA BELLA - 1
Gas Analysis Data
Normalised Relative Abundances

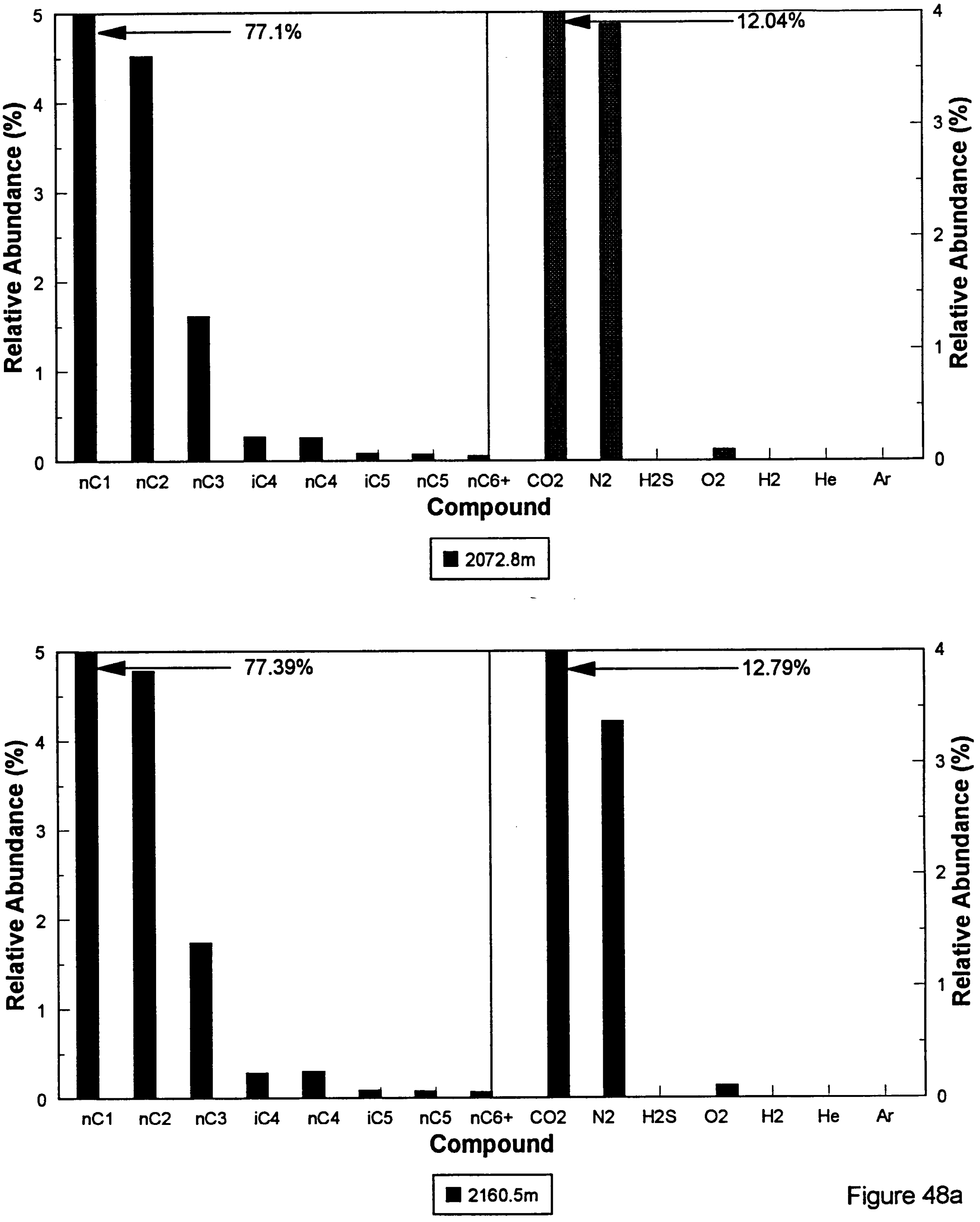


Figure 48a

LA BELLA - 1
Gas Analysis Data
Normalised Relative Abundances

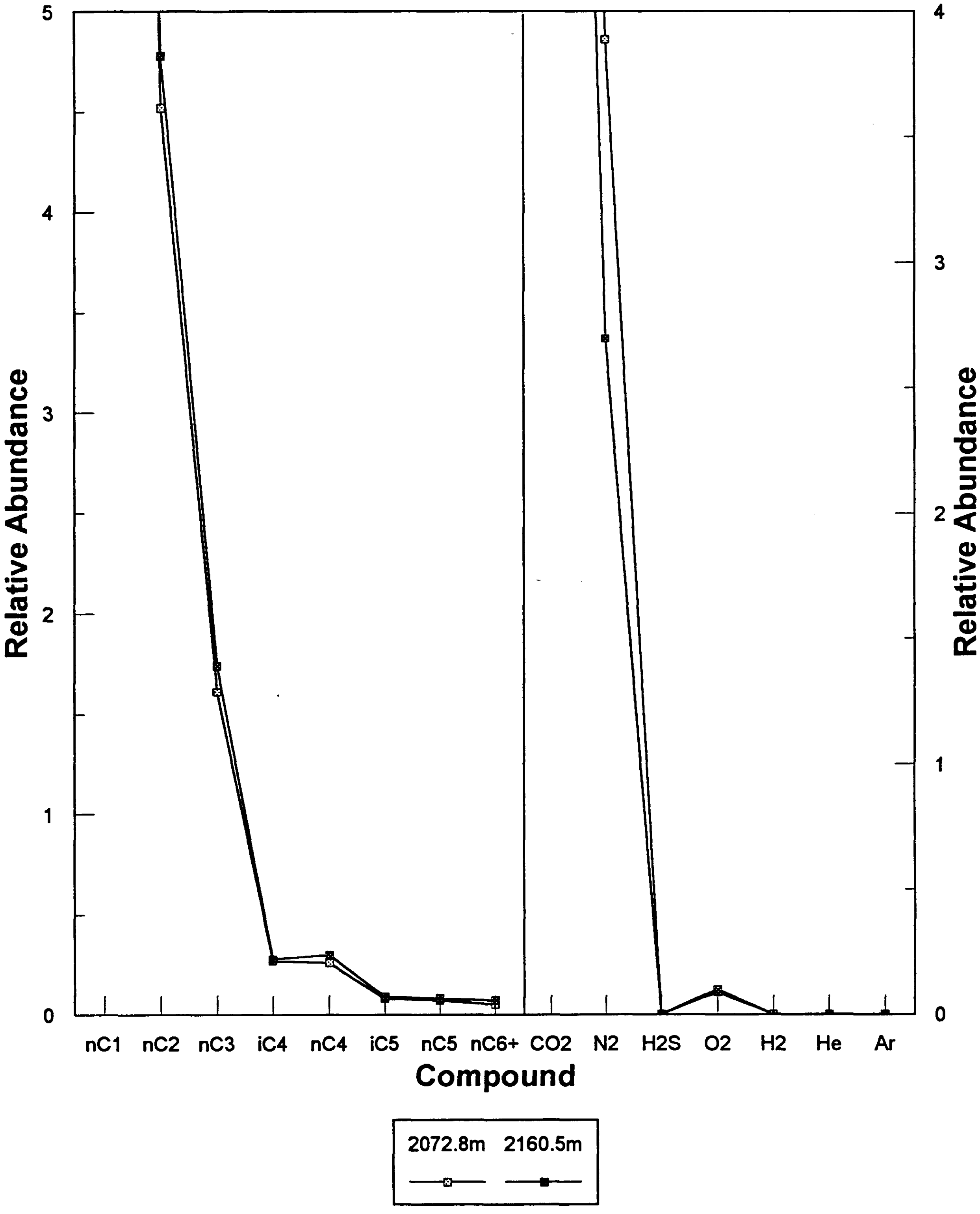


TABLE 26

CARBON ISOTOPE ANALYSIS DATA - GAS

WELL NAME = LA BELLA-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB = Oct 93

		delta C VALUES							
DEPTH 1	DEPTH 2	METHANE	ETHANE	PROPANE	ISO-BUTANE	n-BUTANE	ISO-PENTANE	n-PENTANE	CARBON DIOXIDE
2072.80	2072.80	-40.70	-29.20	-27.10	-	-27.20	-	-26.20	-9.70
2160.50	2160.50	-40.90	-28.90	-26.90	-	-26.80	-	-26.30	-8.80

All values permil relative to PDB
- = no data

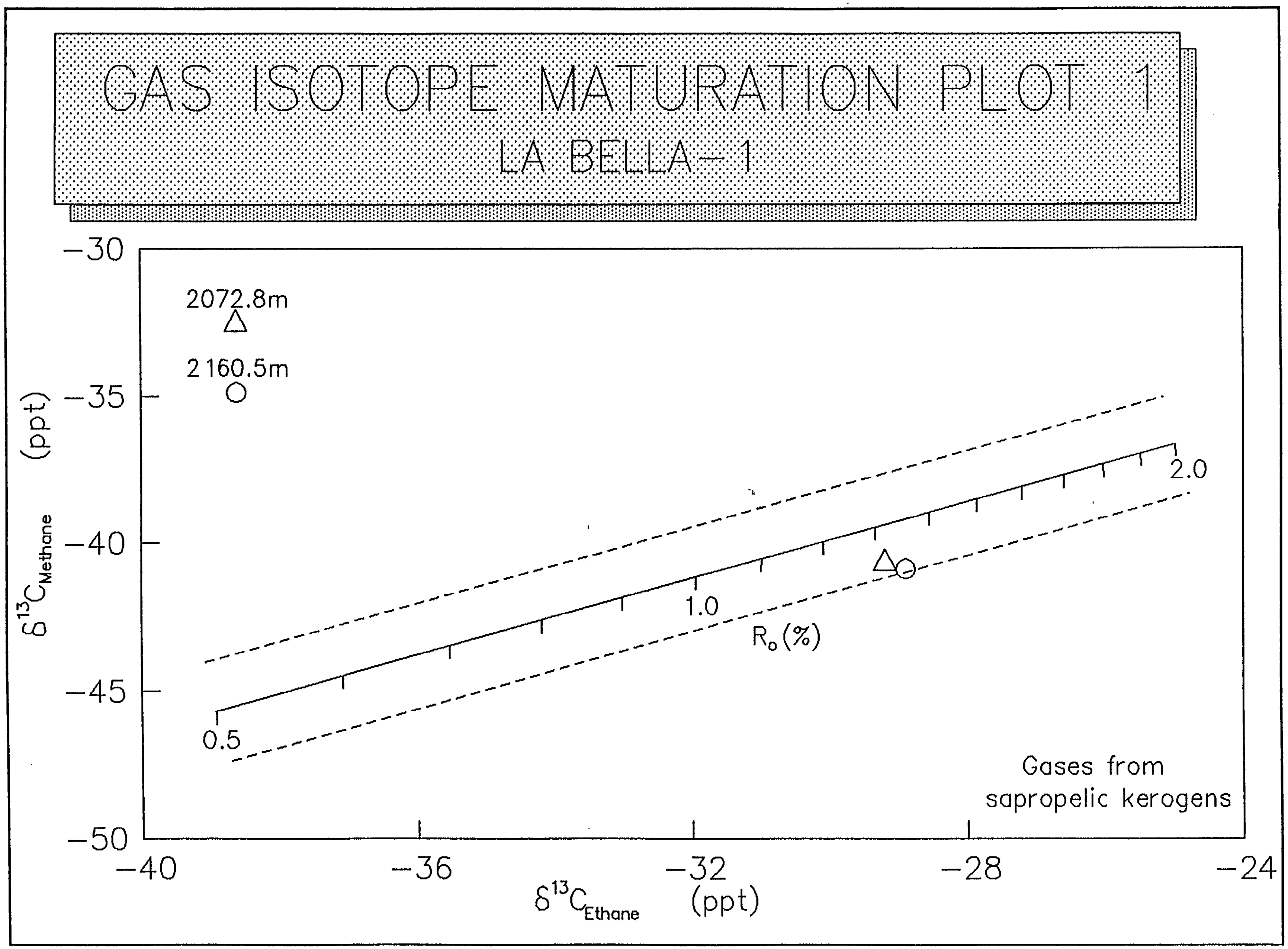

GAS ISOTOPE MATURATION PLOT 1
LA BELLA-1
2072.8m
2160.5m
0.5
1.0
2.0
R_o(%)
Gases from
sapropelic kerogens
−30
−35
−40
−45
−50
$\delta^{13}C_{Methane}$ (ppt)
−40
−36
−32
−28
−24
$\delta^{13}C_{Ethane}$ (ppt)

FIGURE 49a

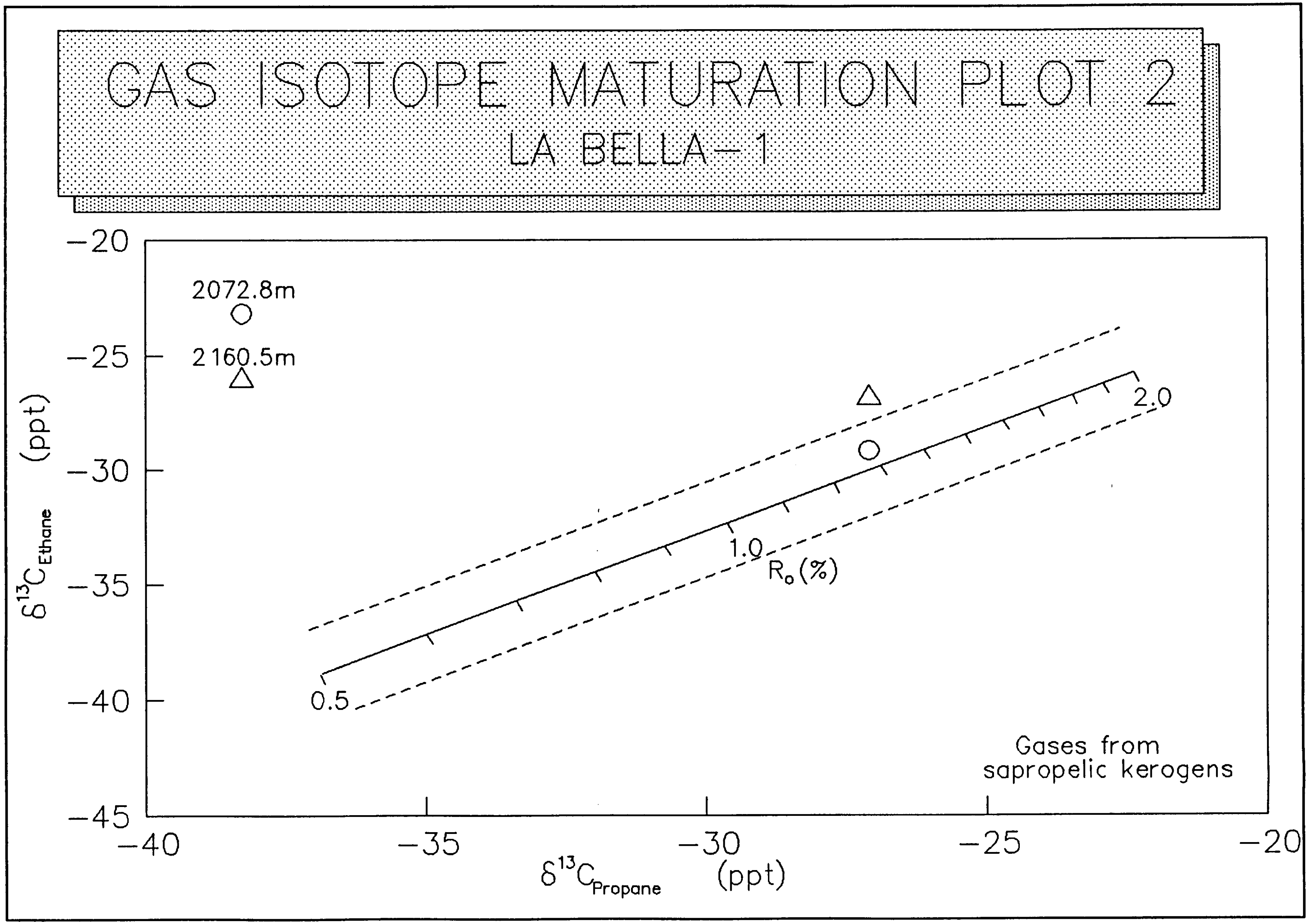
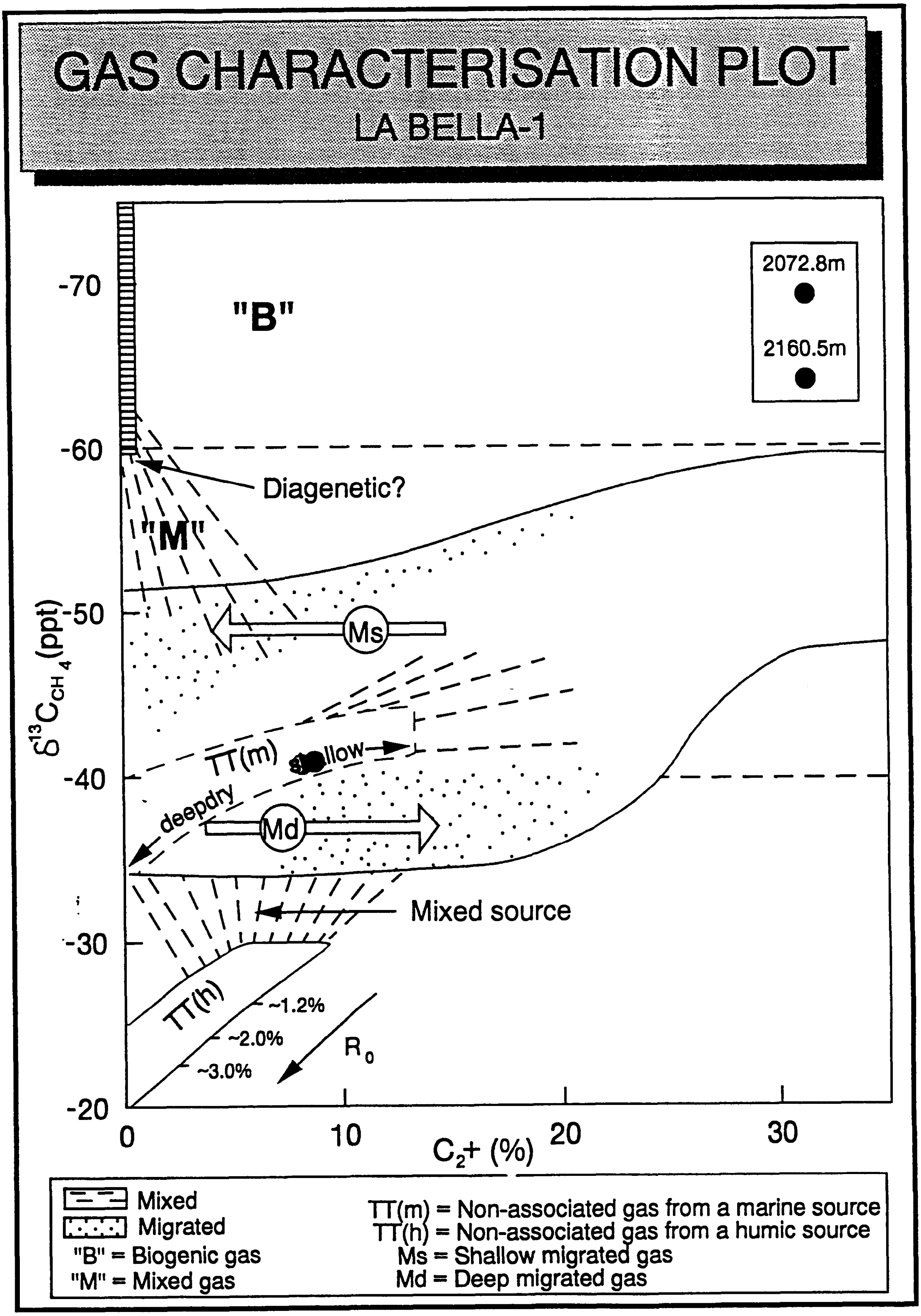

GAS ISOTOPE MATURATION PLOT 2
LA BELLA-1
2072.8m
2160.5m
2.0
1.0
R_o(%)
0.5
Gases from
sapropelic kerogens
−20
−25
−30
−35
−40
−45
−40
−35
−30
−25
−20
$\delta^{13}C_{Ethane}$ (ppt)
$\delta^{13}C_{Propane}$ (ppt)

FIGURE 49b

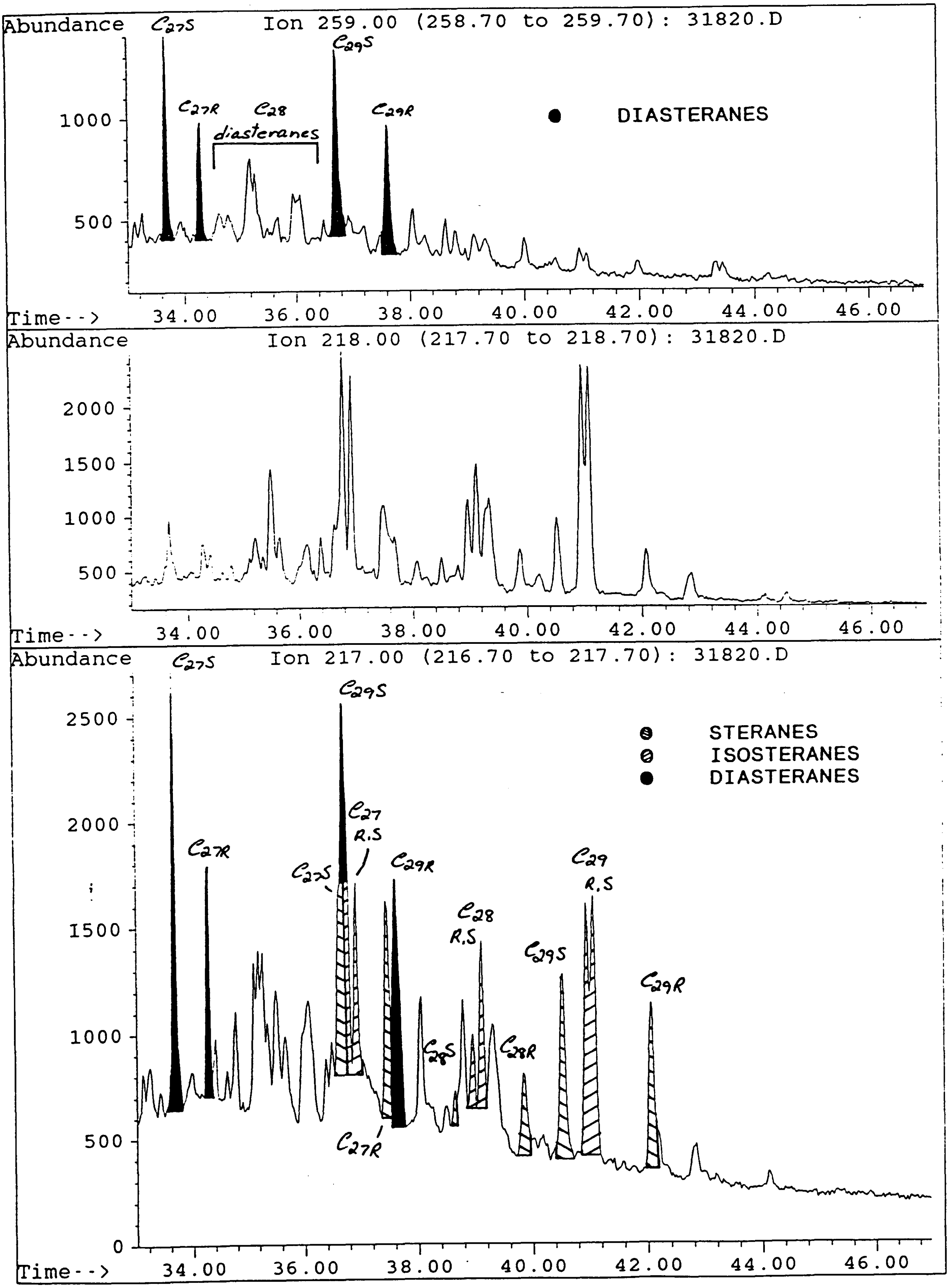
FIGURE 50


GAS CHARACTERISATION PLOT
LA BELLA-1
2072.8m ●
2160.5m ●
"B"
"M"
Diagenetic?
Ms
TT(m)
shallow
deepdry
Md
Mixed source
TT(h)
~1.2%
~2.0%
~3.0%
R_0
$\delta^{13}C_{CH_4}$ (ppt)
-70
-60
-50
-40
-30
-20
0
10
20
30
C_2+ (%)
Mixed
Migrated
"B" = Biogenic gas
"M" = Mixed gas
TT(m) = Non-associated gas from a marine source
TT(h) = Non-associated gas from a humic source
Ms = Shallow migrated gas
Md = Deep migrated gas

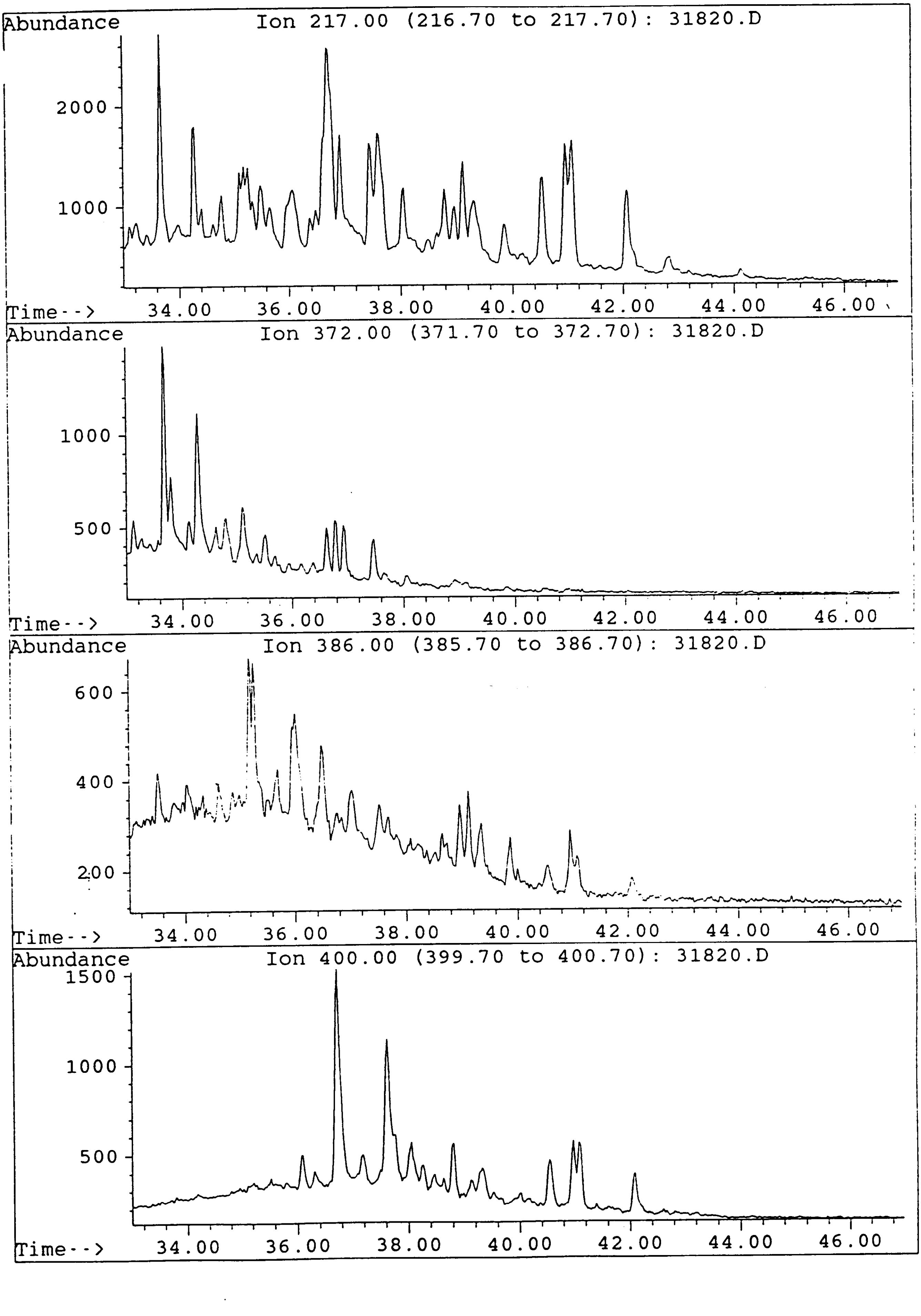
APPENDIX 1

SIR GC-MS (B/C) MASS FRAGMENTOGRAMS : CONDENSATES

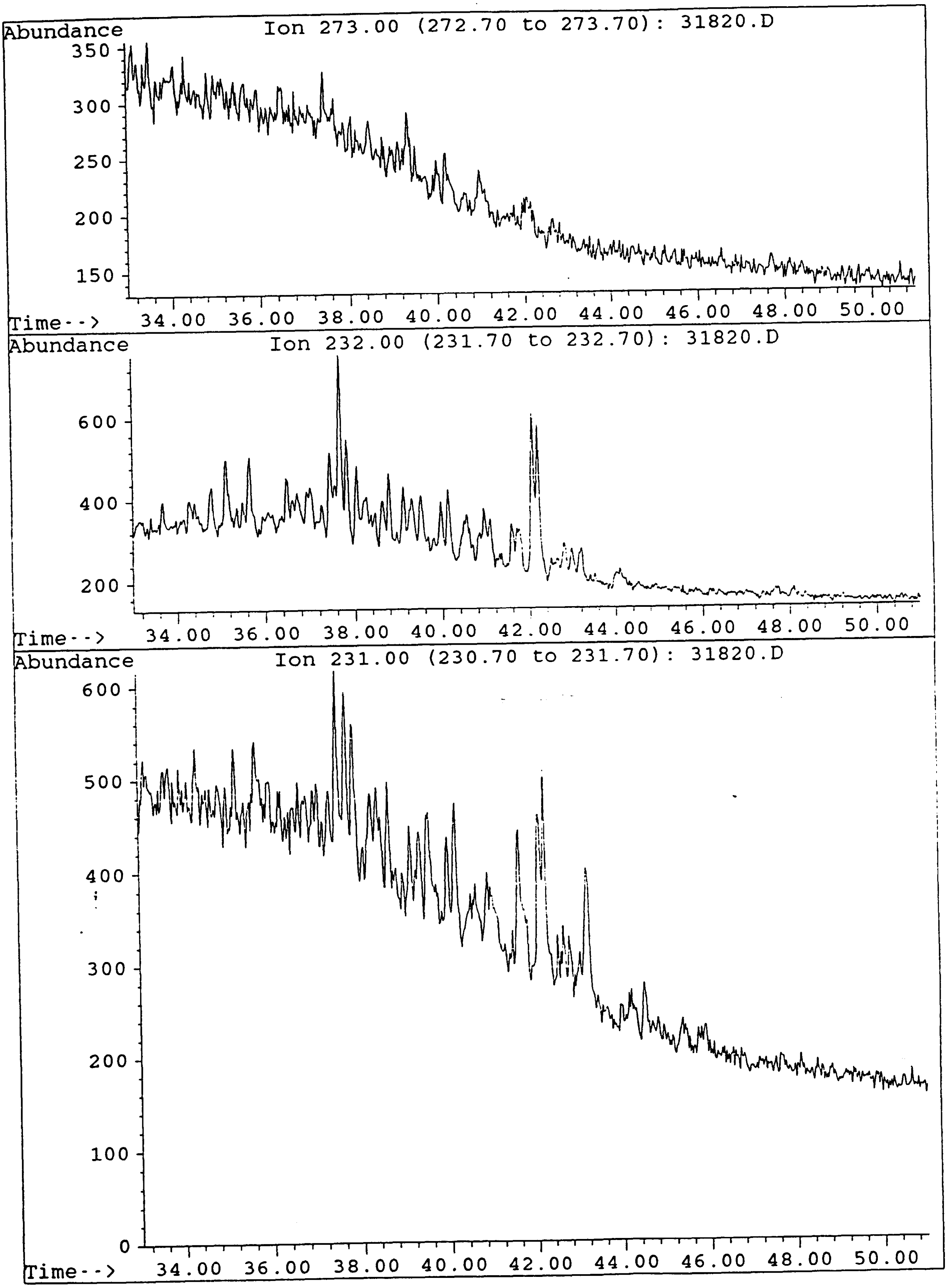
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



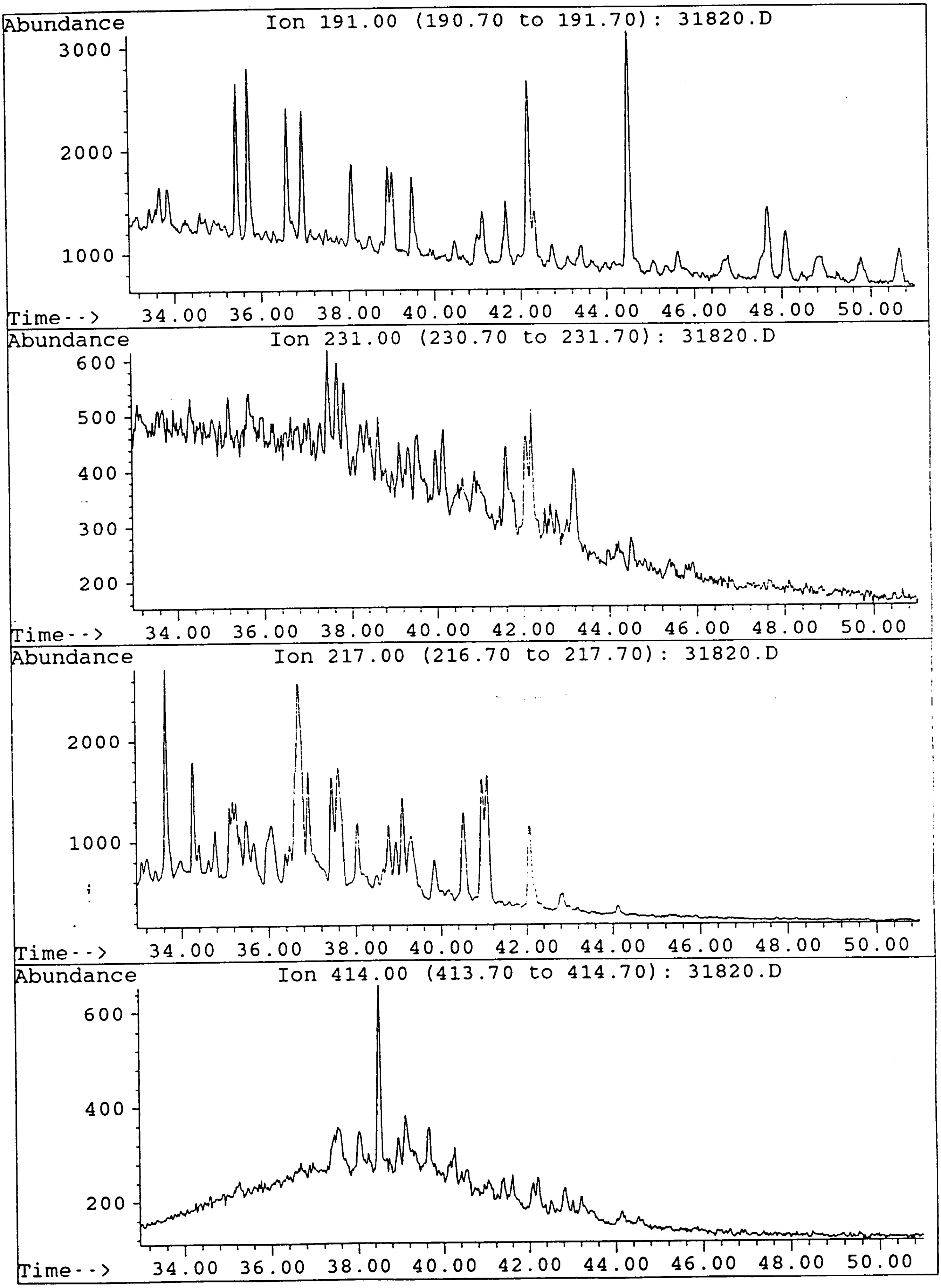
File :   31820.D
Sample :   LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info :   COL#143. 1/150uL. 28-10-93. GEC



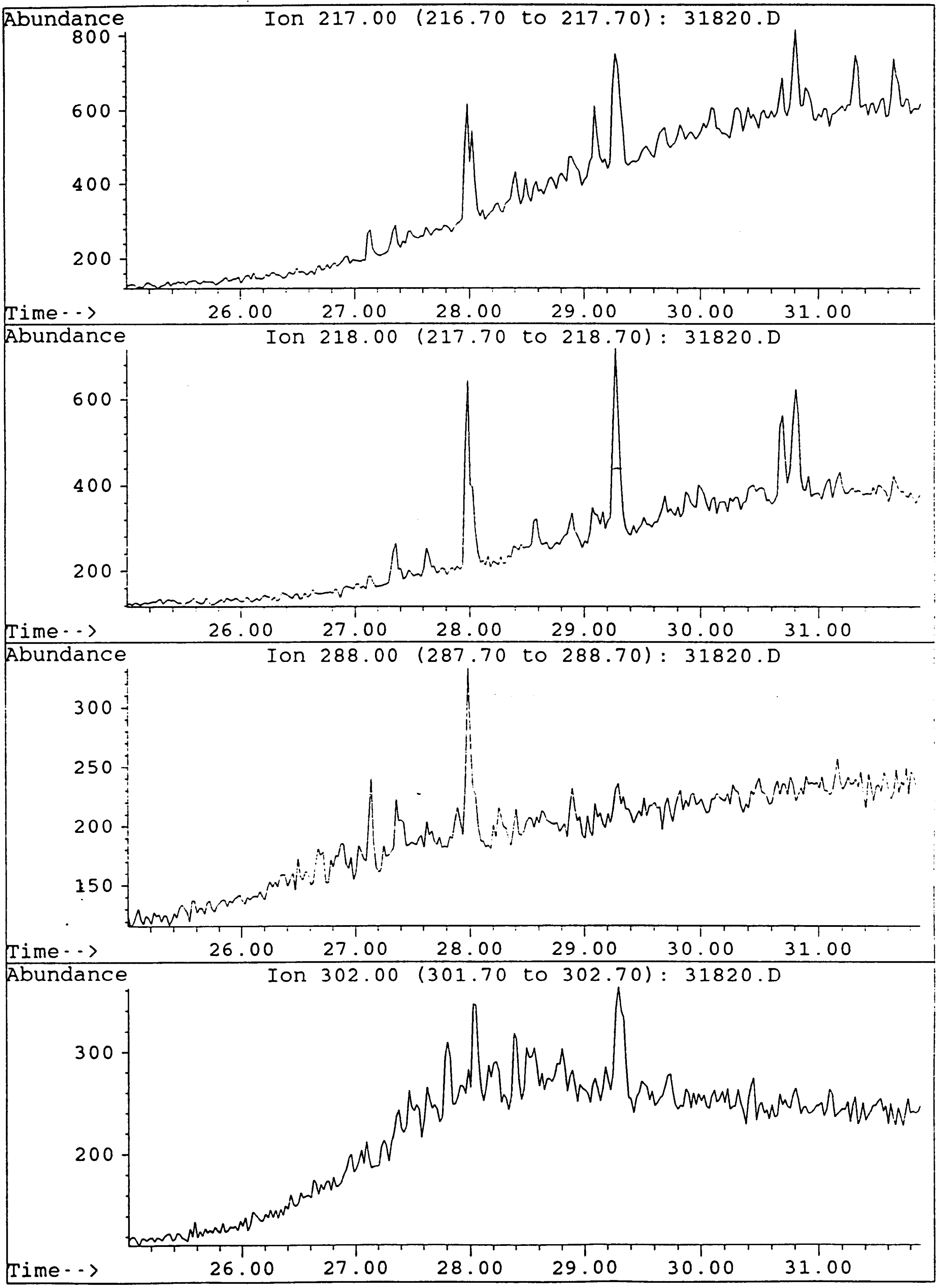
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



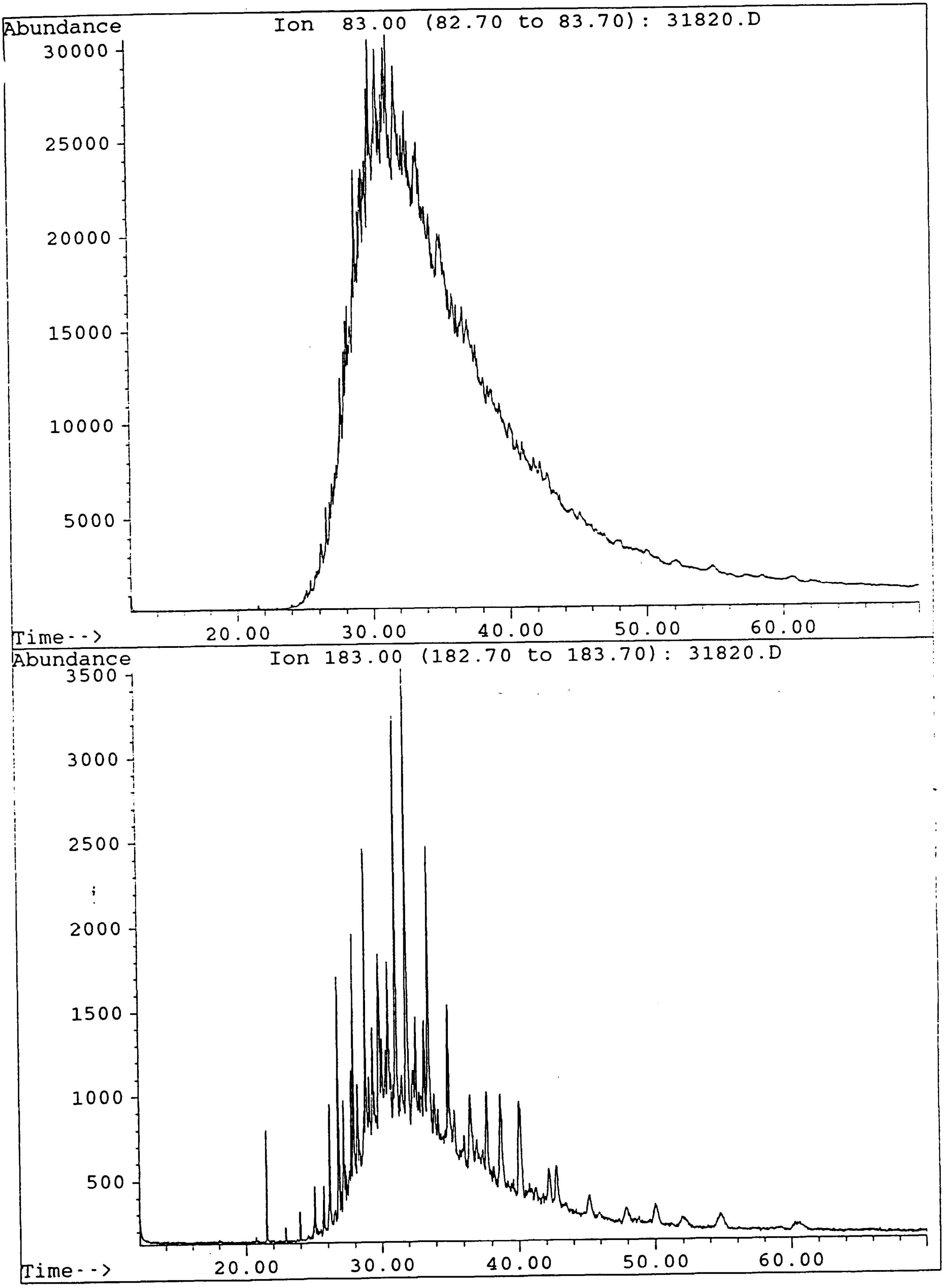
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



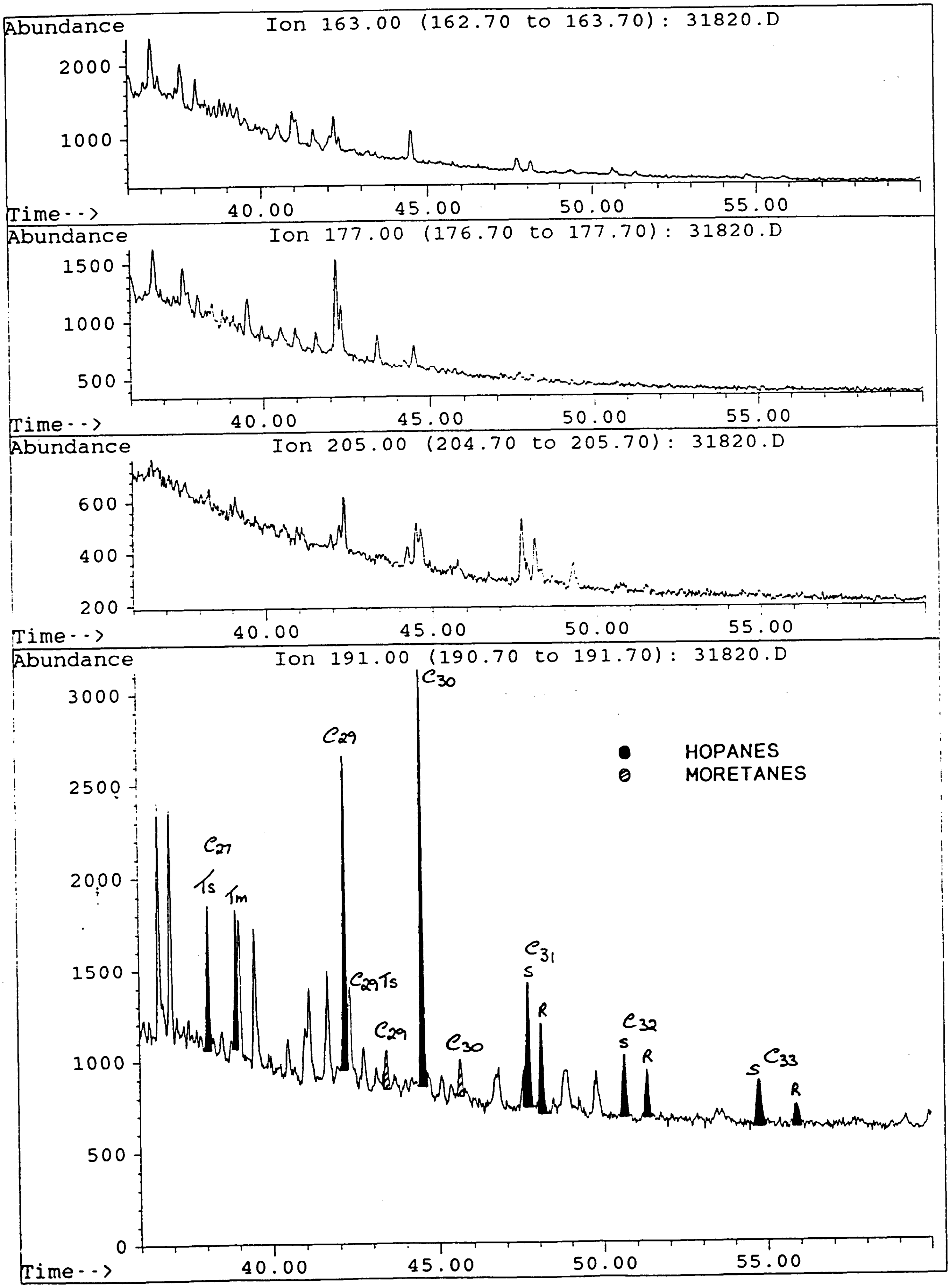
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



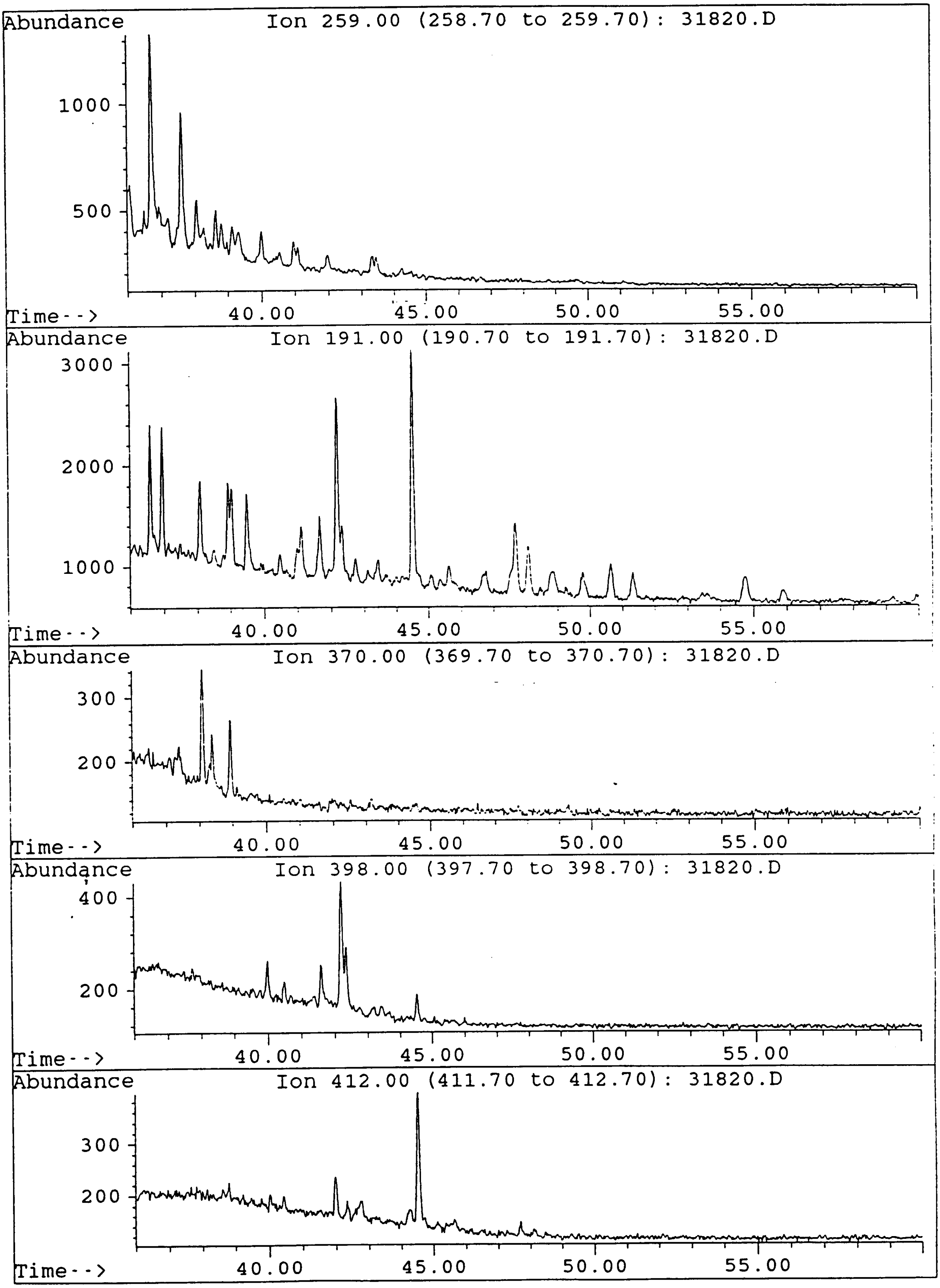
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



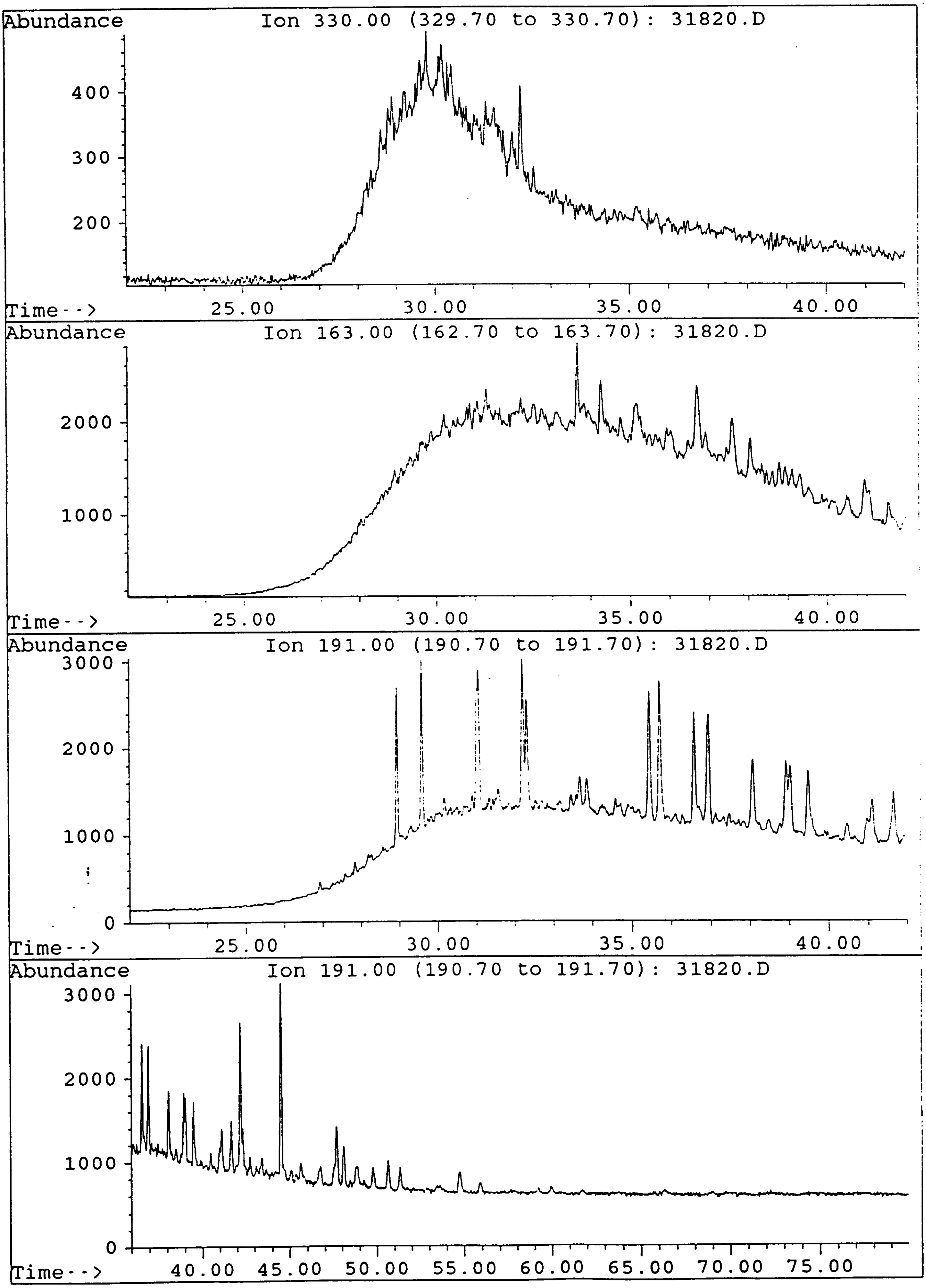
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



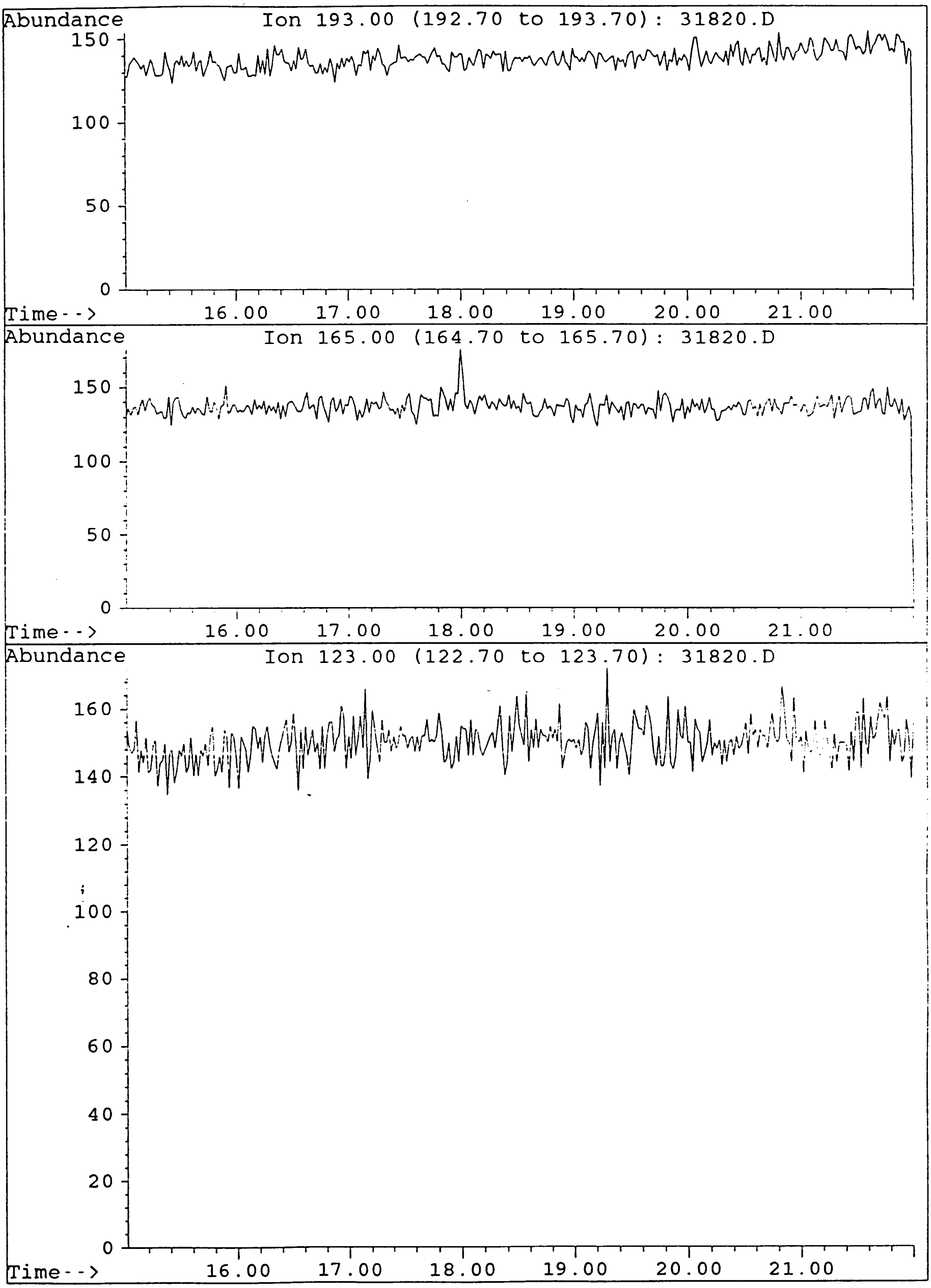
File :   31820.D
Sample :   LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info :   COL#143. 1/150uL. 28-10-93. GEC



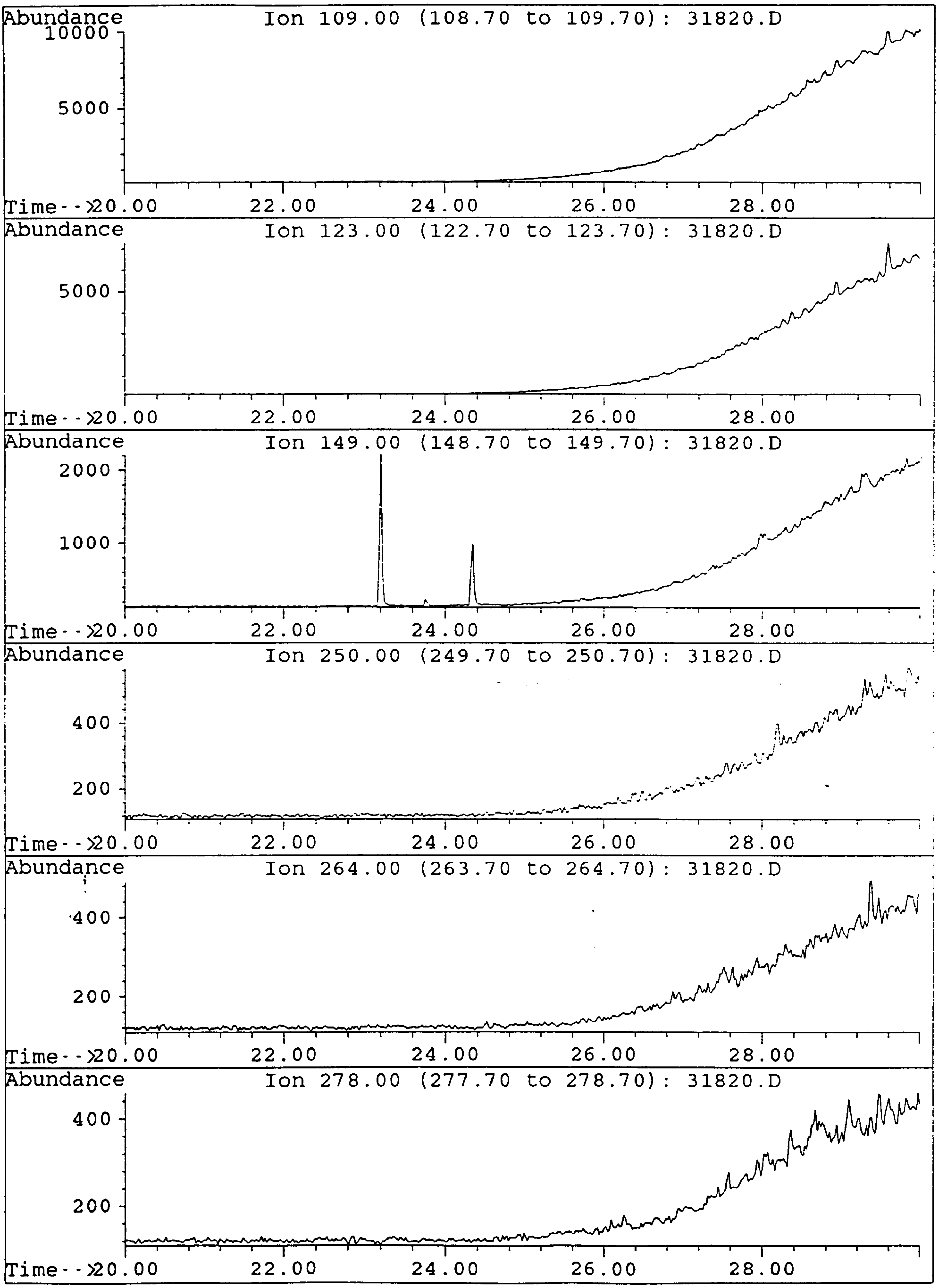
File :   31820.D
Sample :   LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info :   COL#143. 1/150uL. 28-10-93. GEC



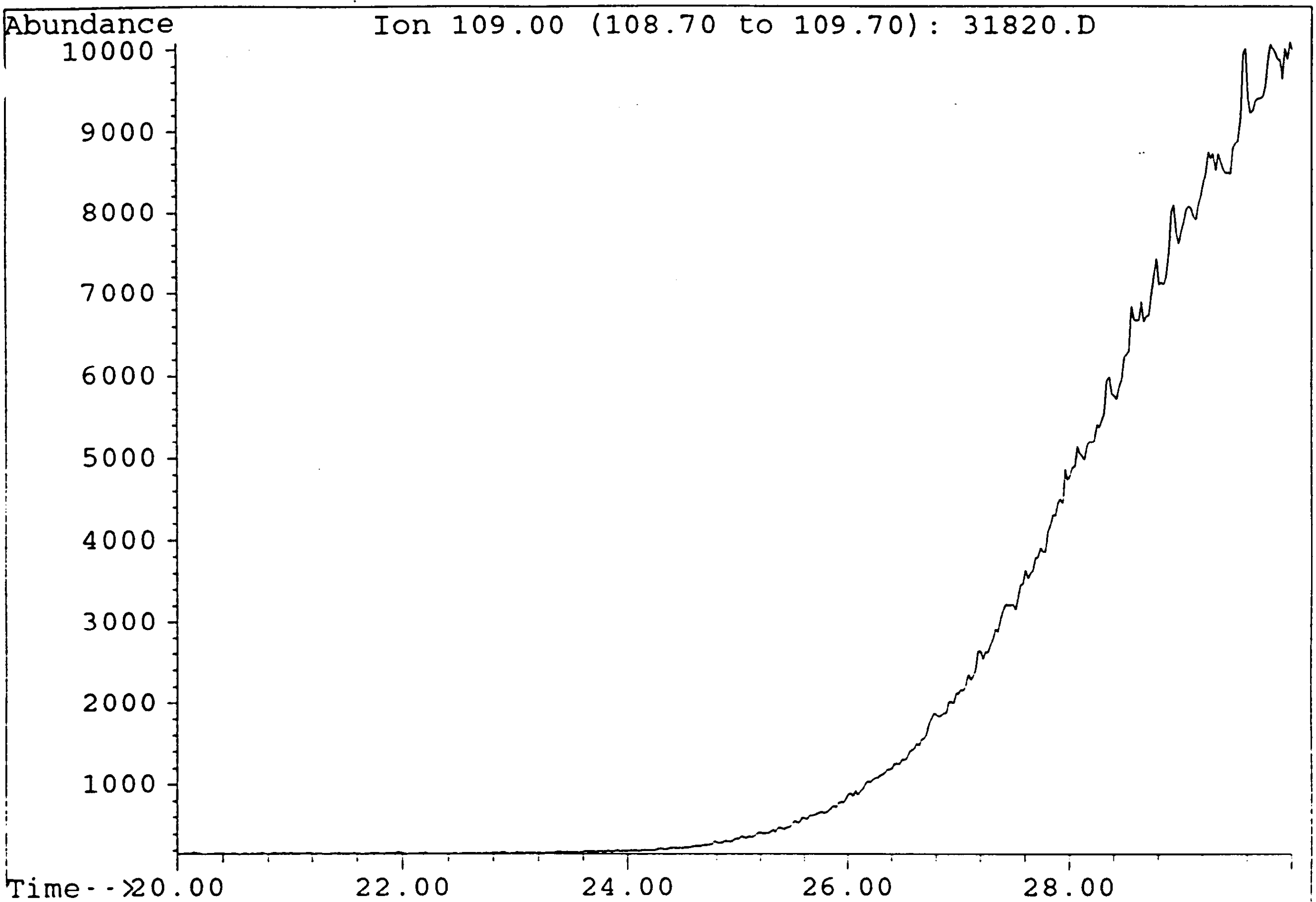
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC

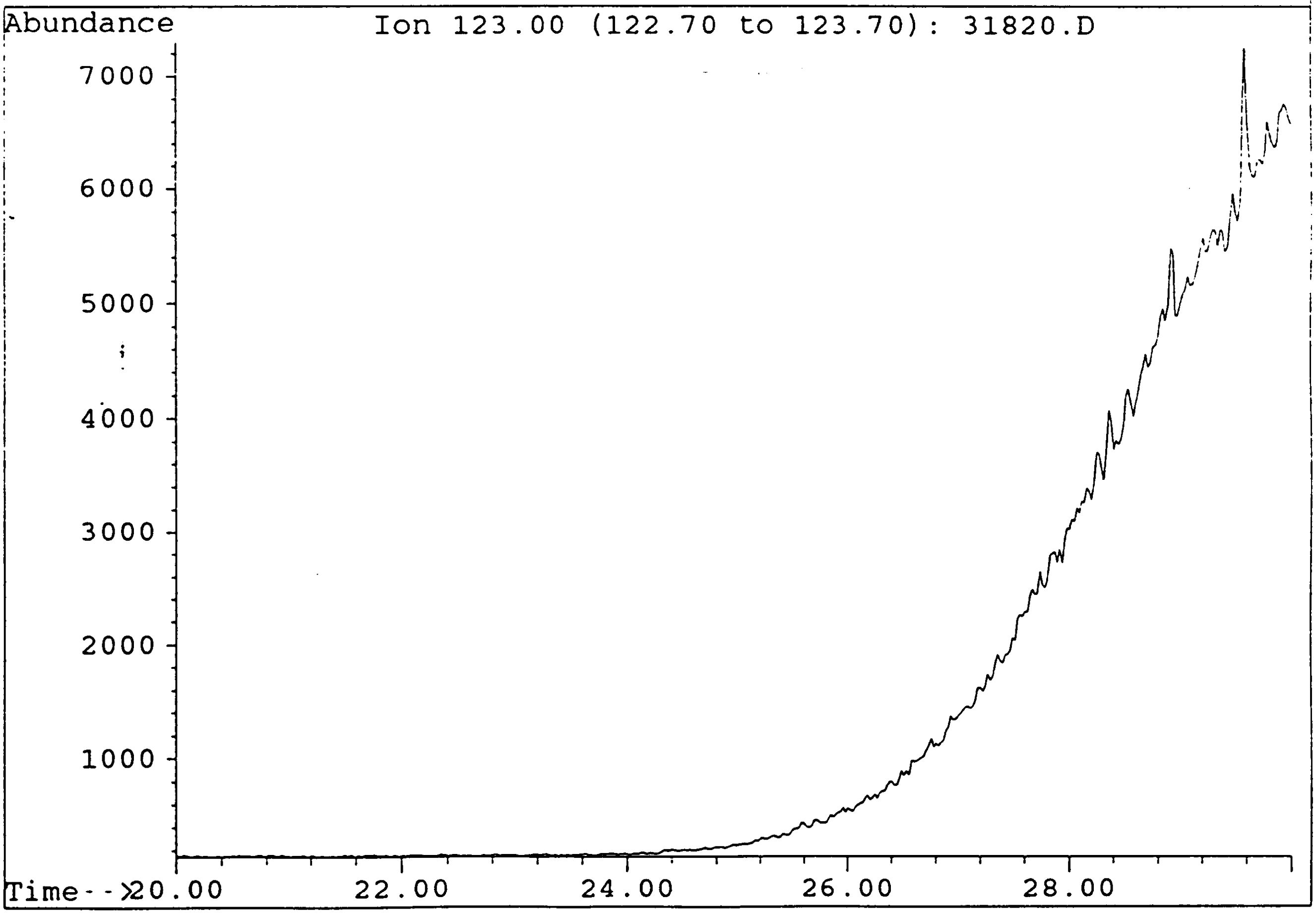


File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC

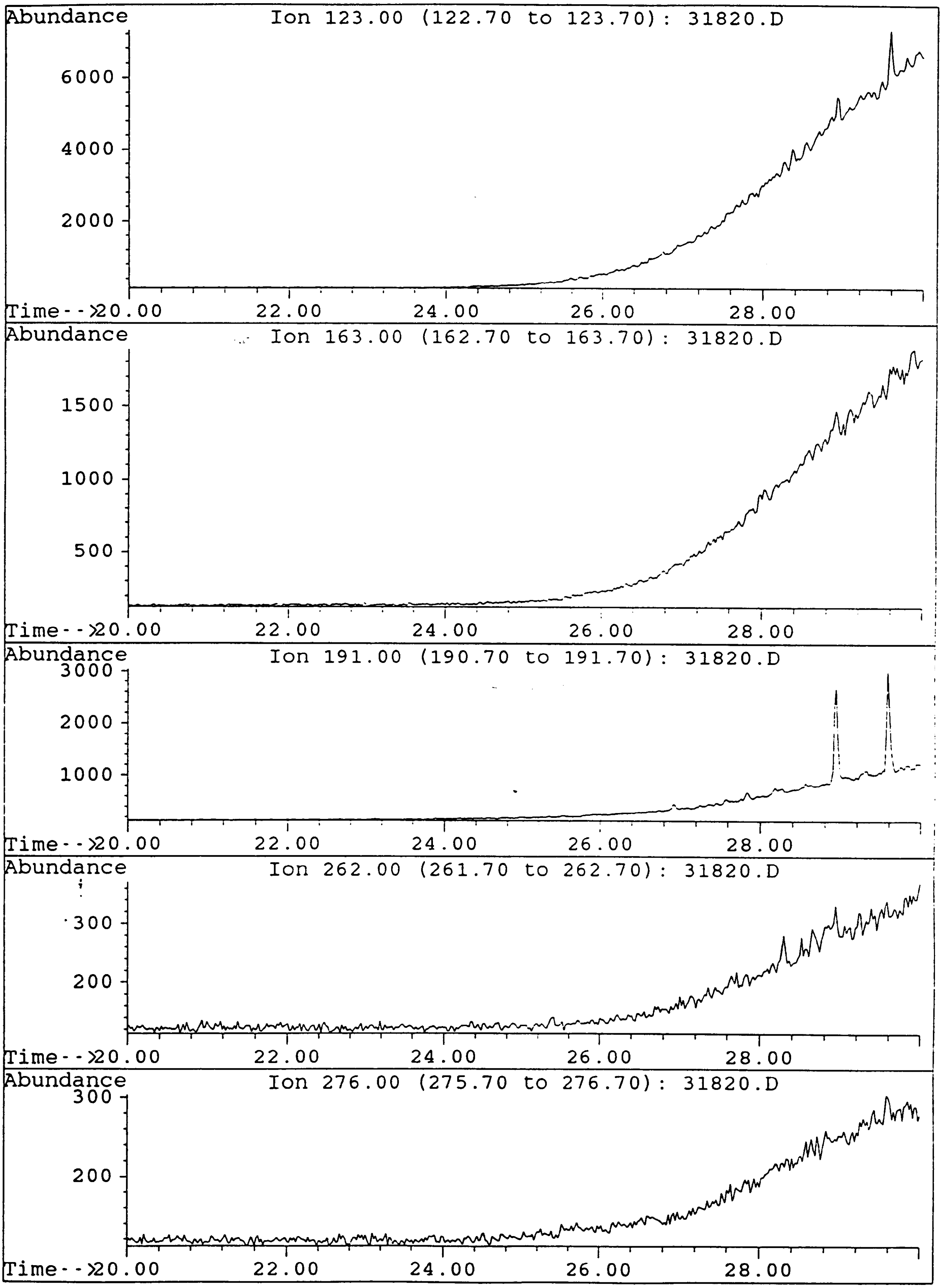


File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC

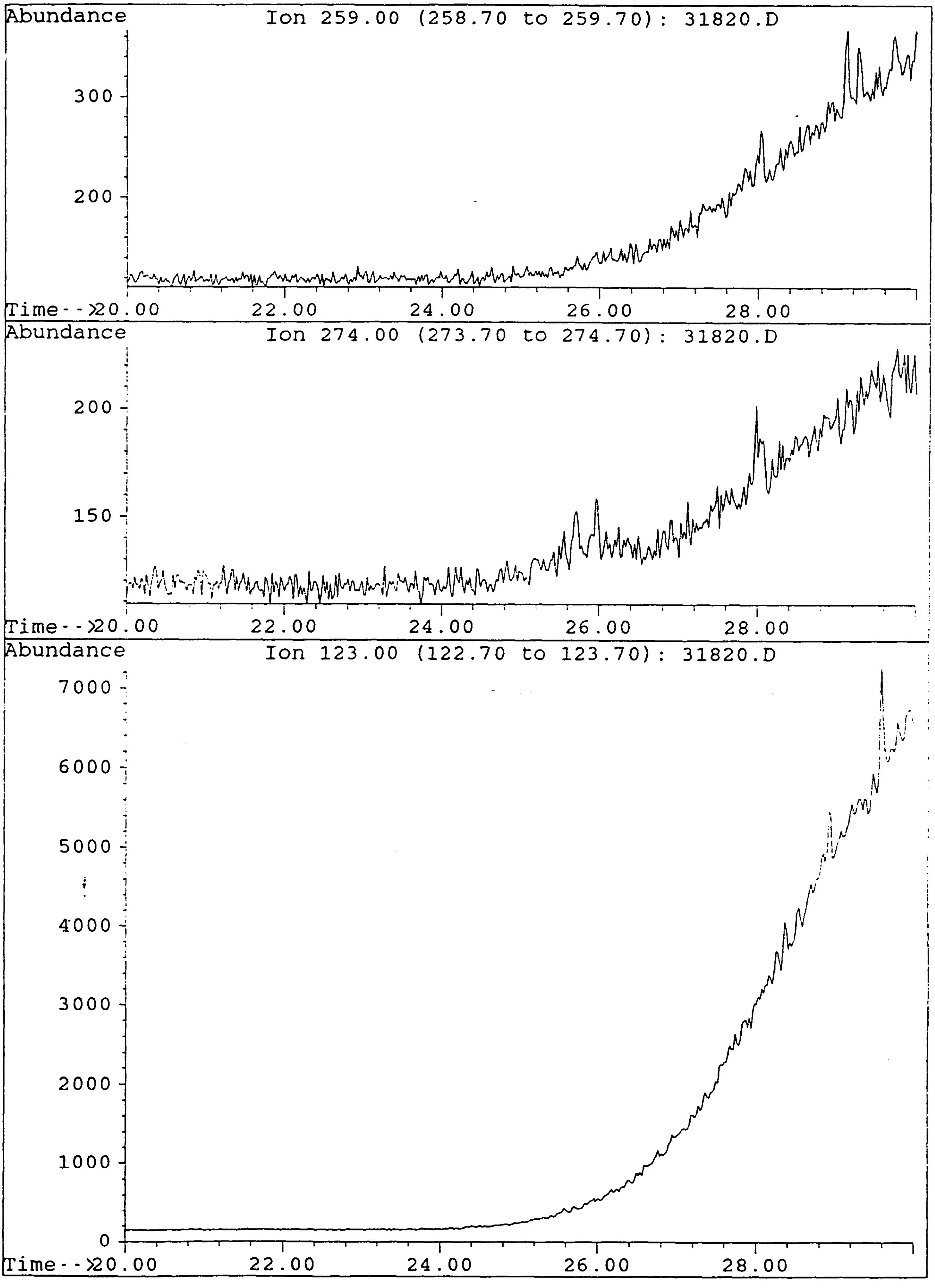




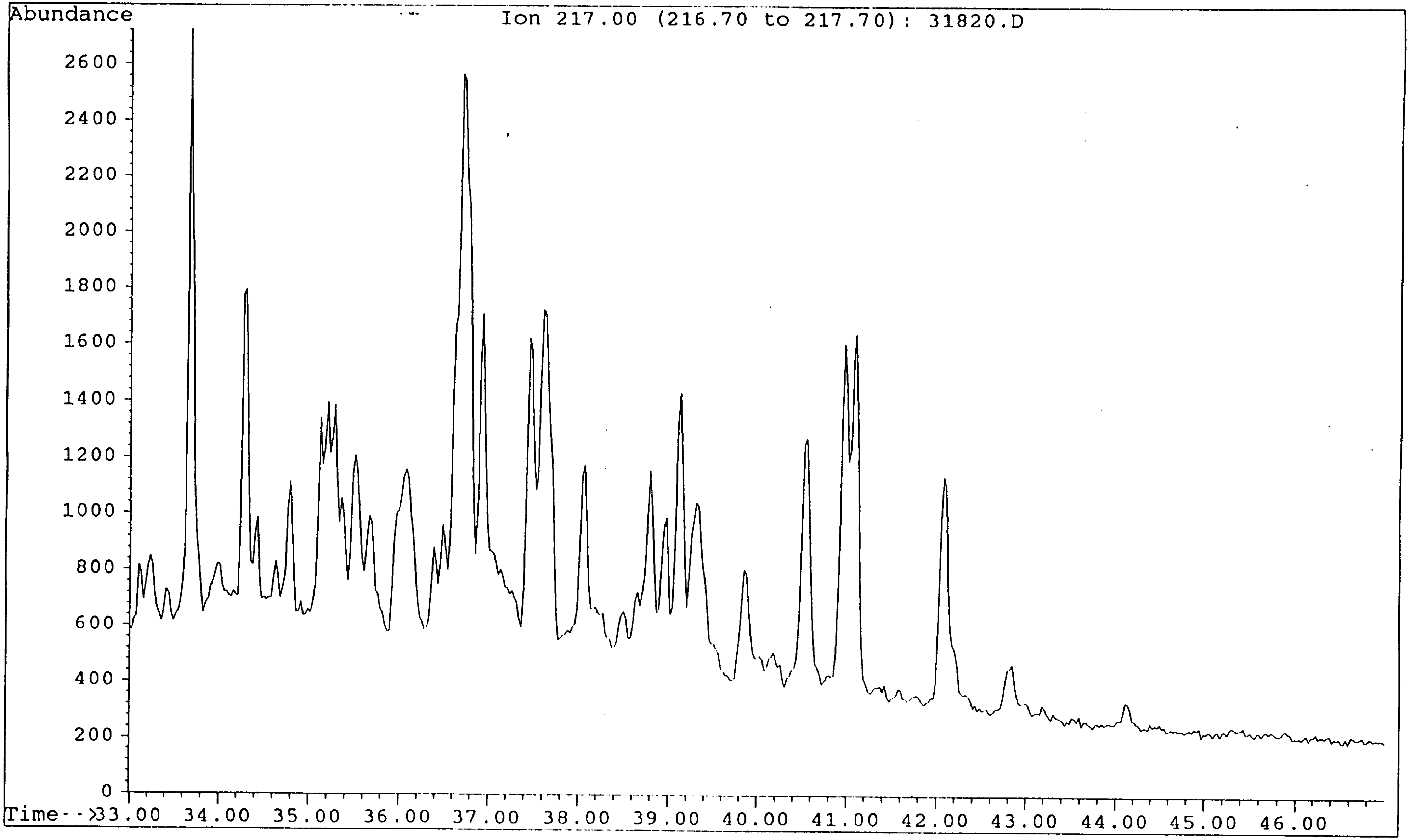
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



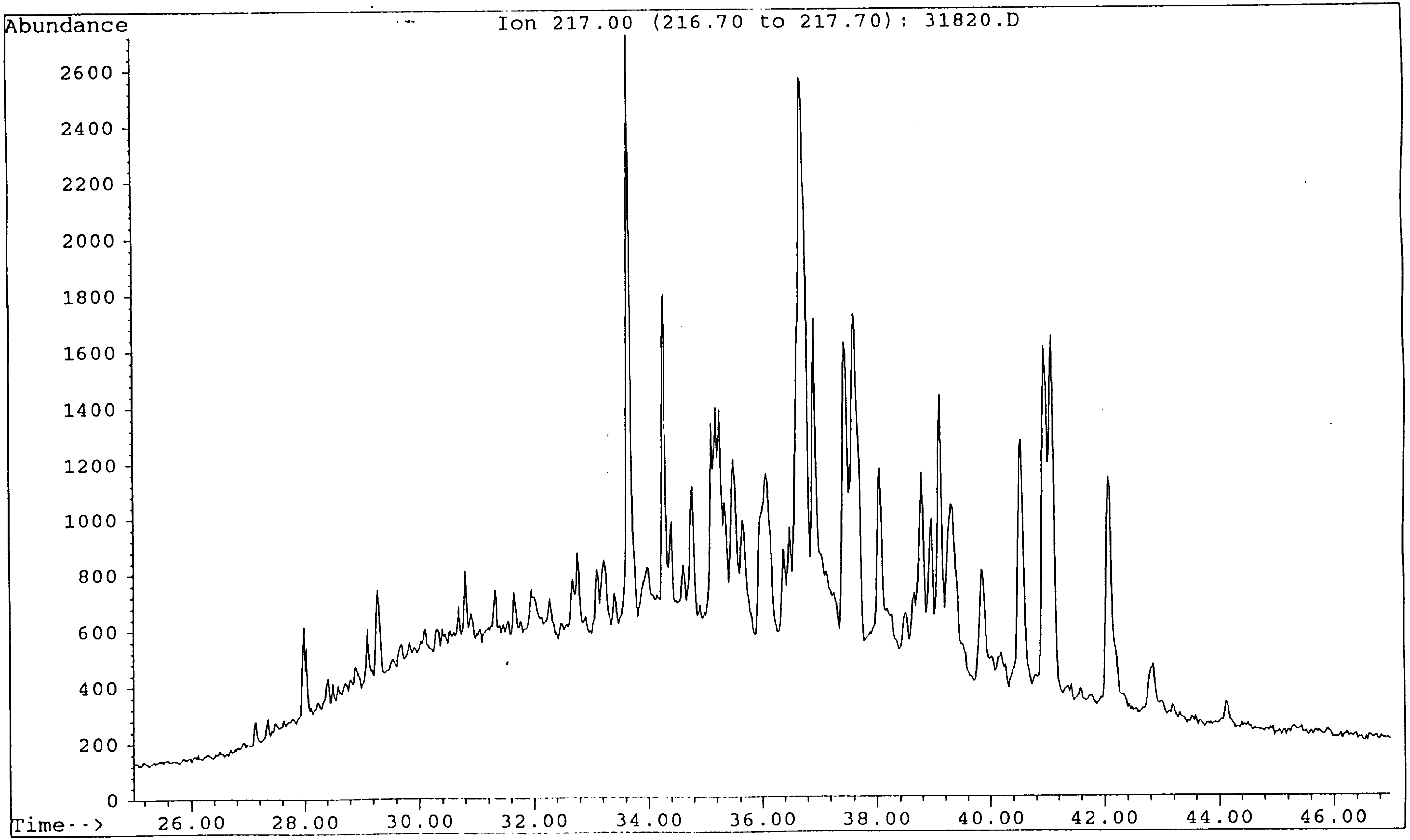
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



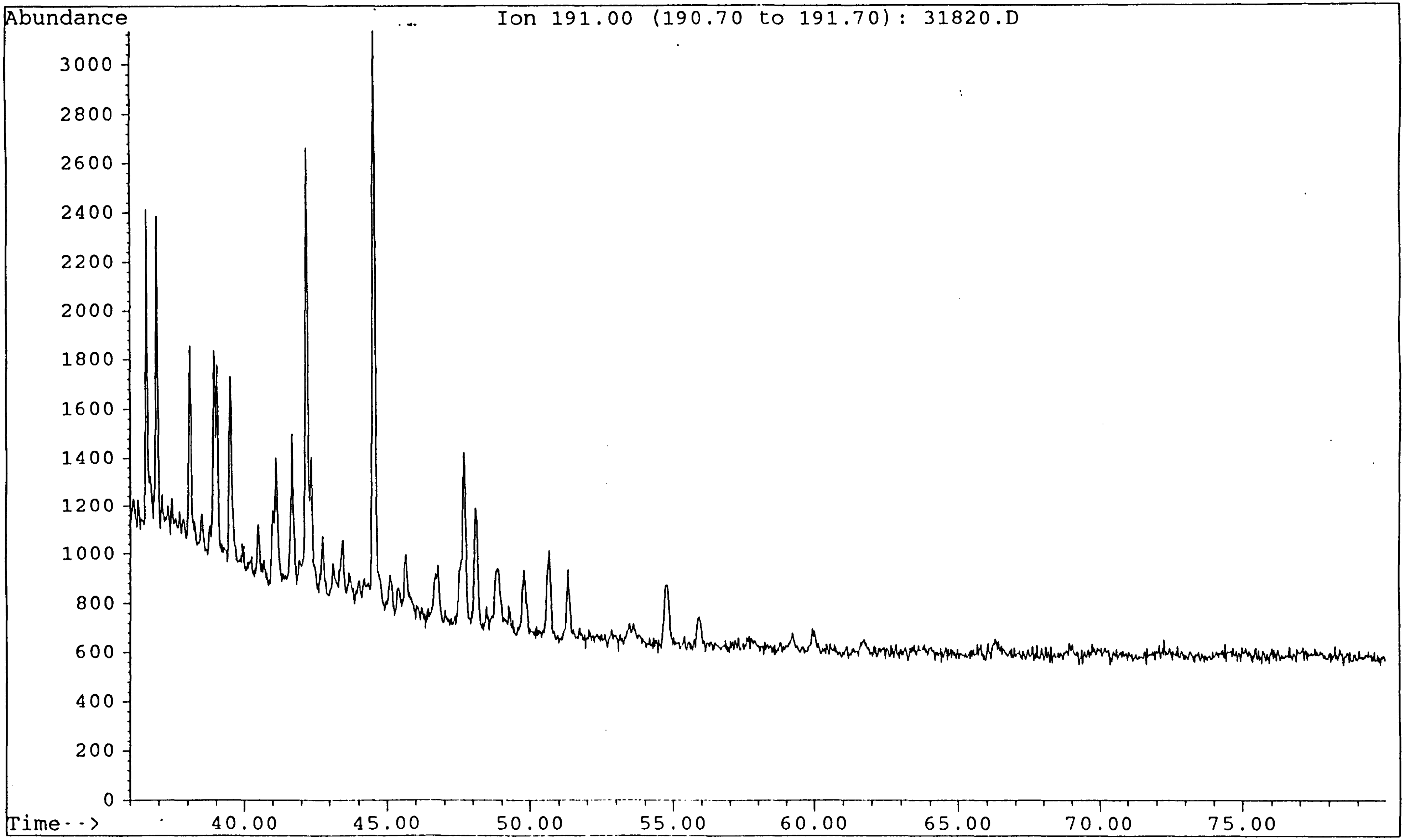
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



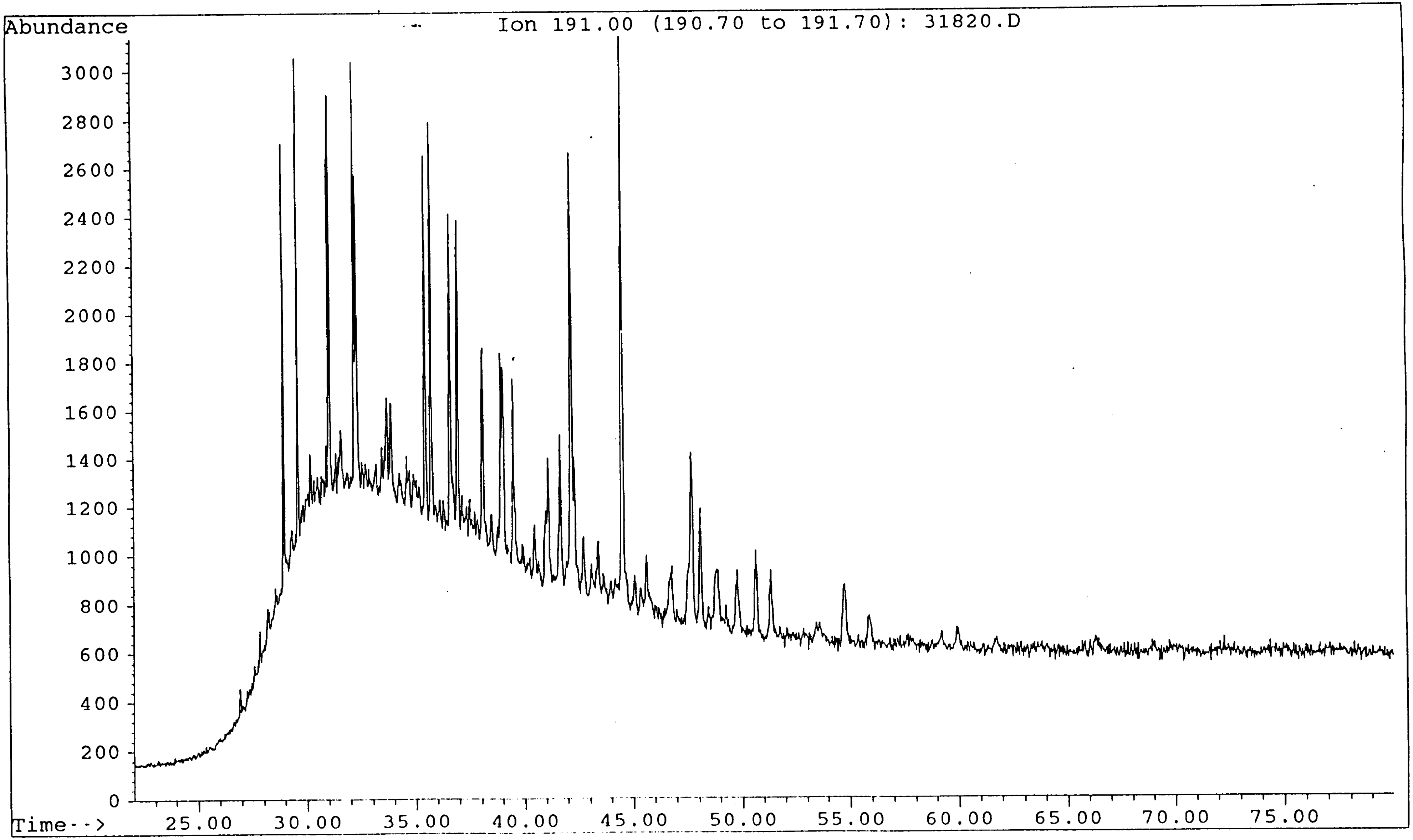
File 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPEL
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



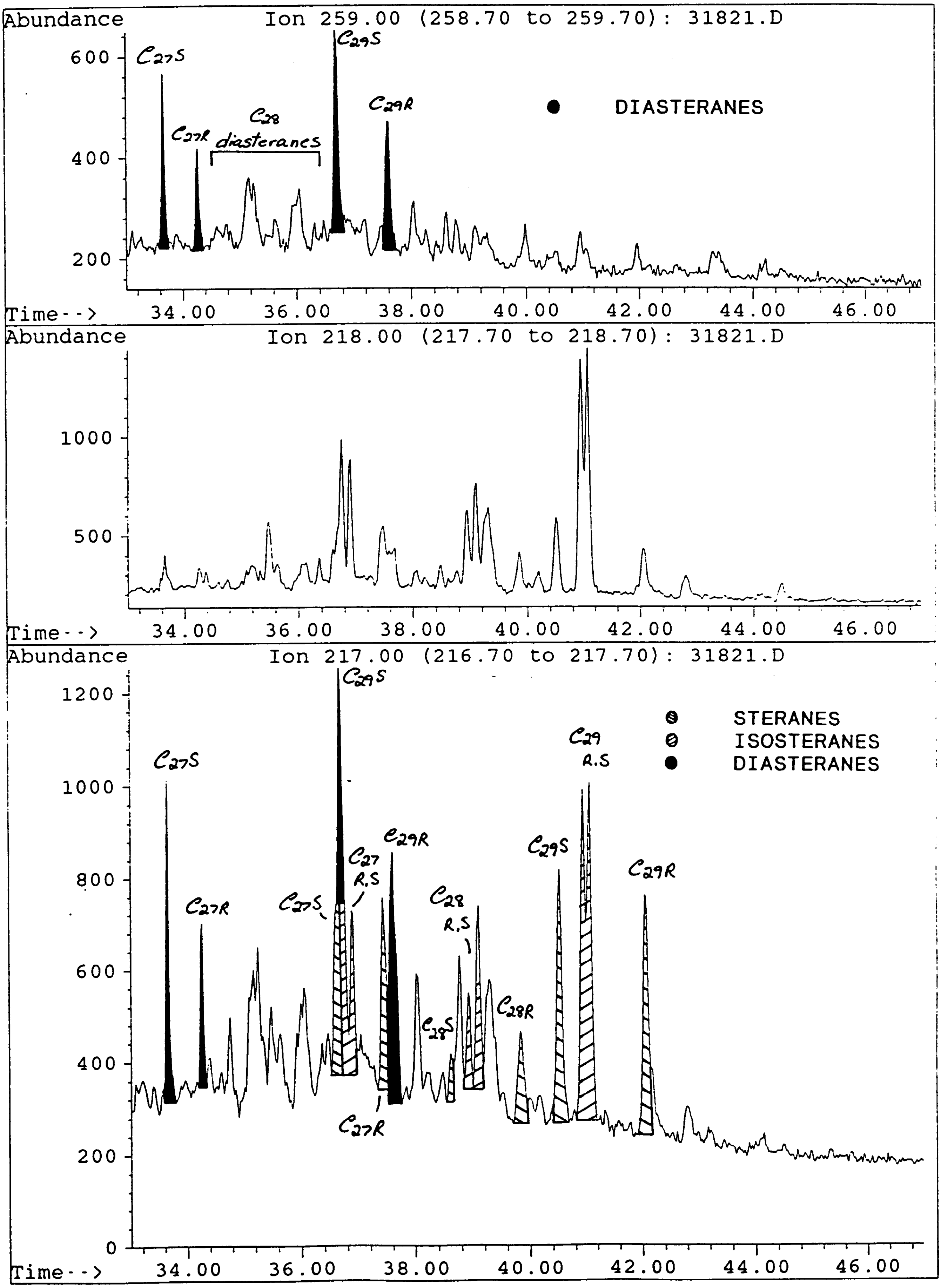
File : 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC



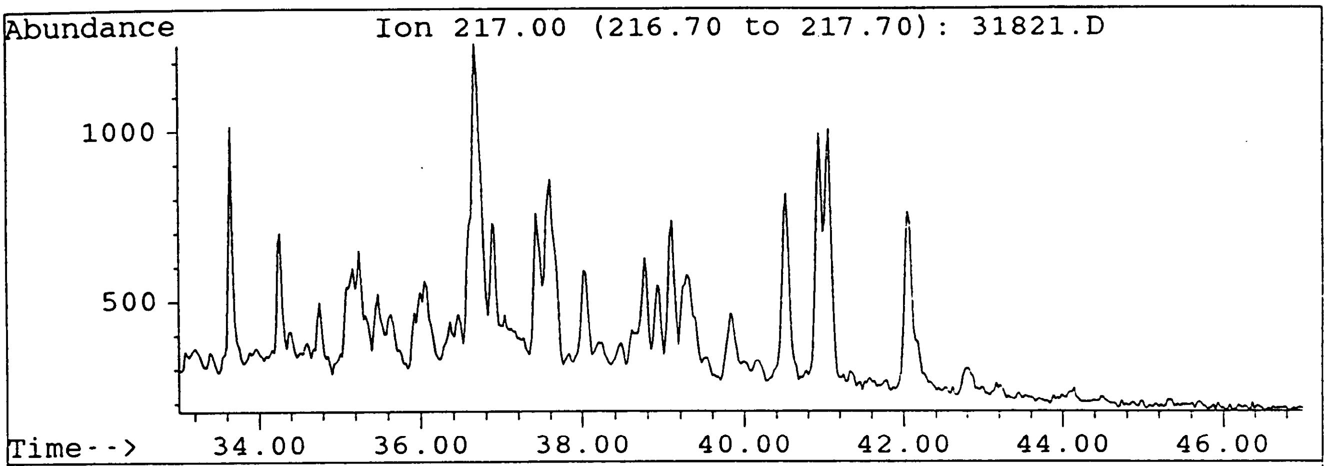
File 31820.D
Sample : LA BELLA#1, 2072.8m, B/C. TOPPED
Misc. Info : COL#143. 1/150uL. 28-10-93. GEC

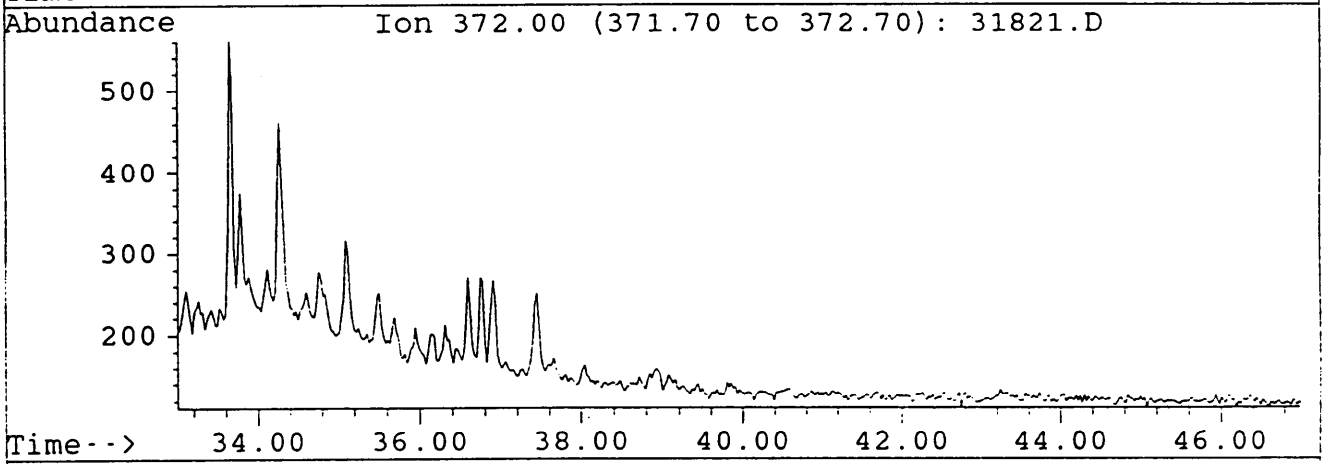


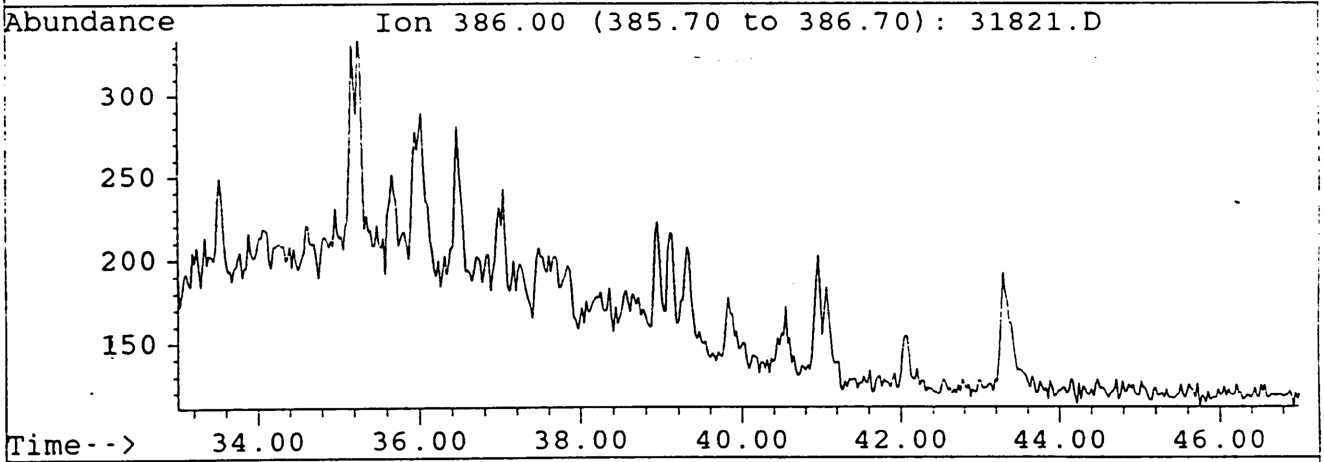
File :   31821.D
Sample :   LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info :   COL#143. 1/20uL. 29-10-93. GEC

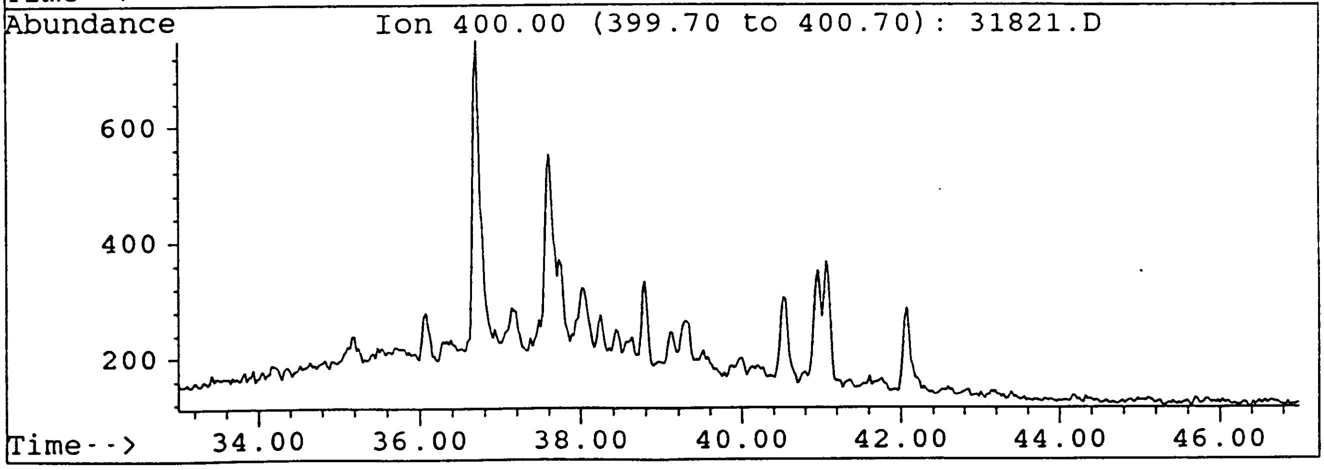


File :   31821.D
Sample :   LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info :   COL#143. 1/20uL. 29-10-93. GEC

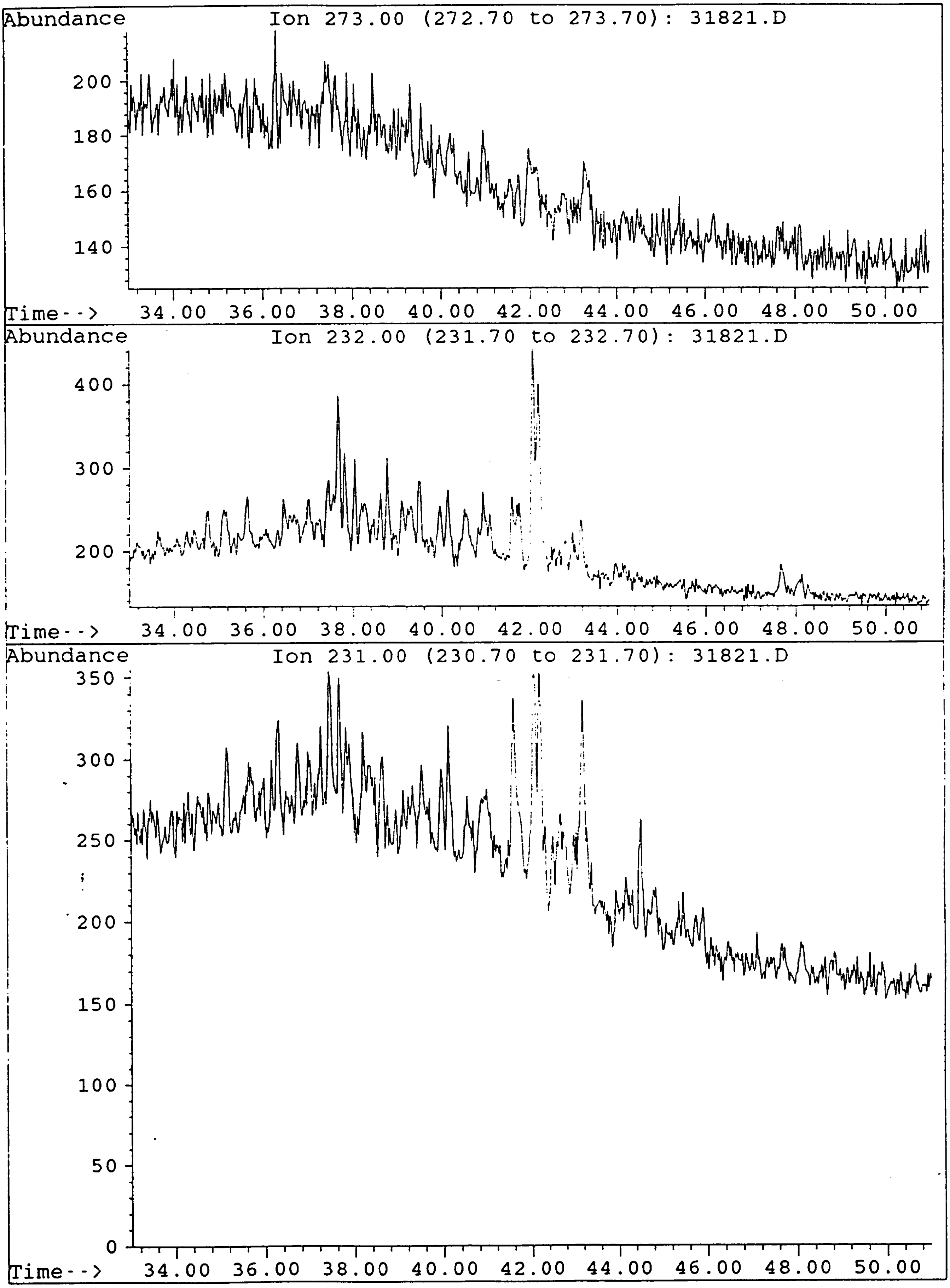




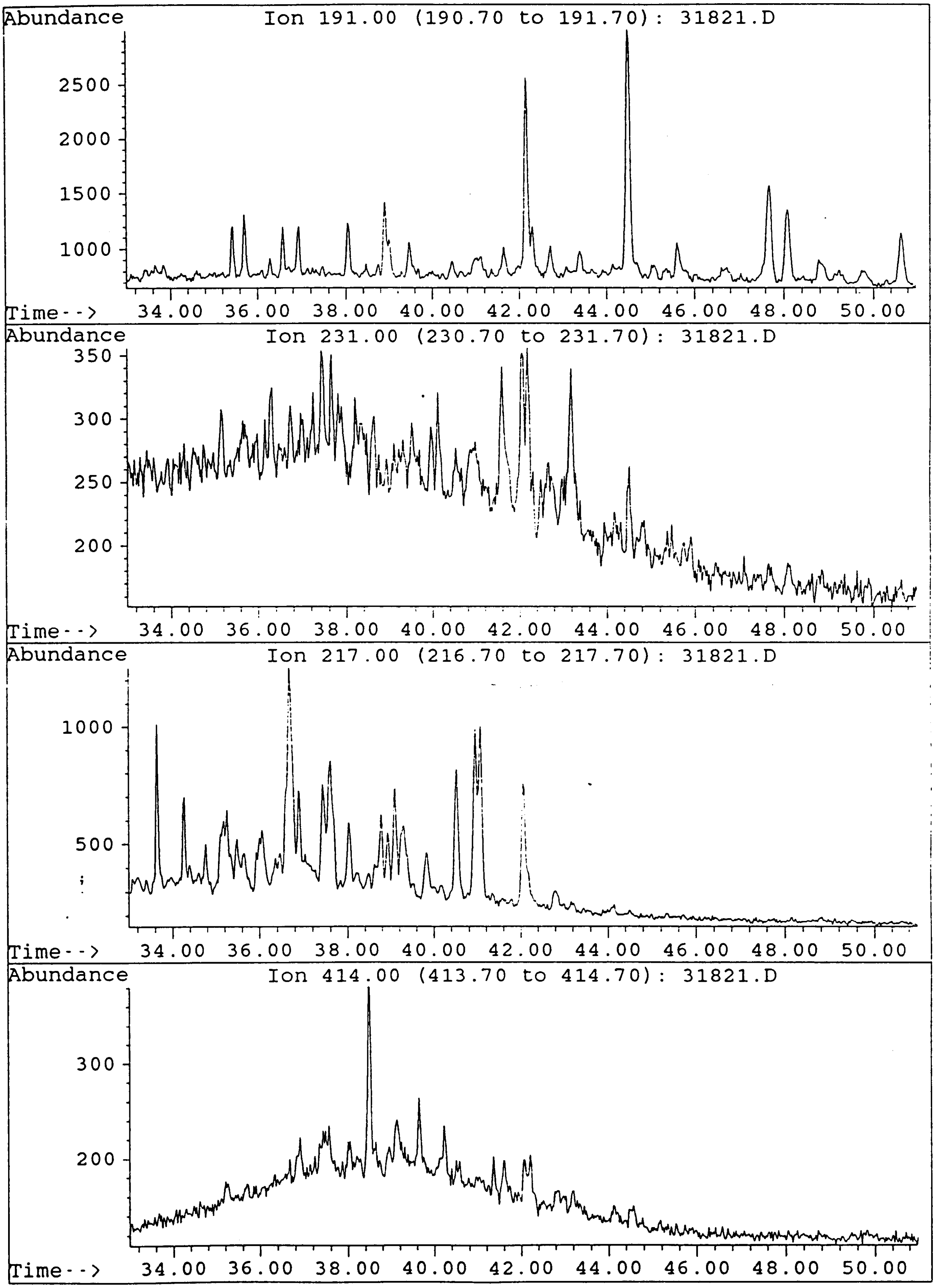




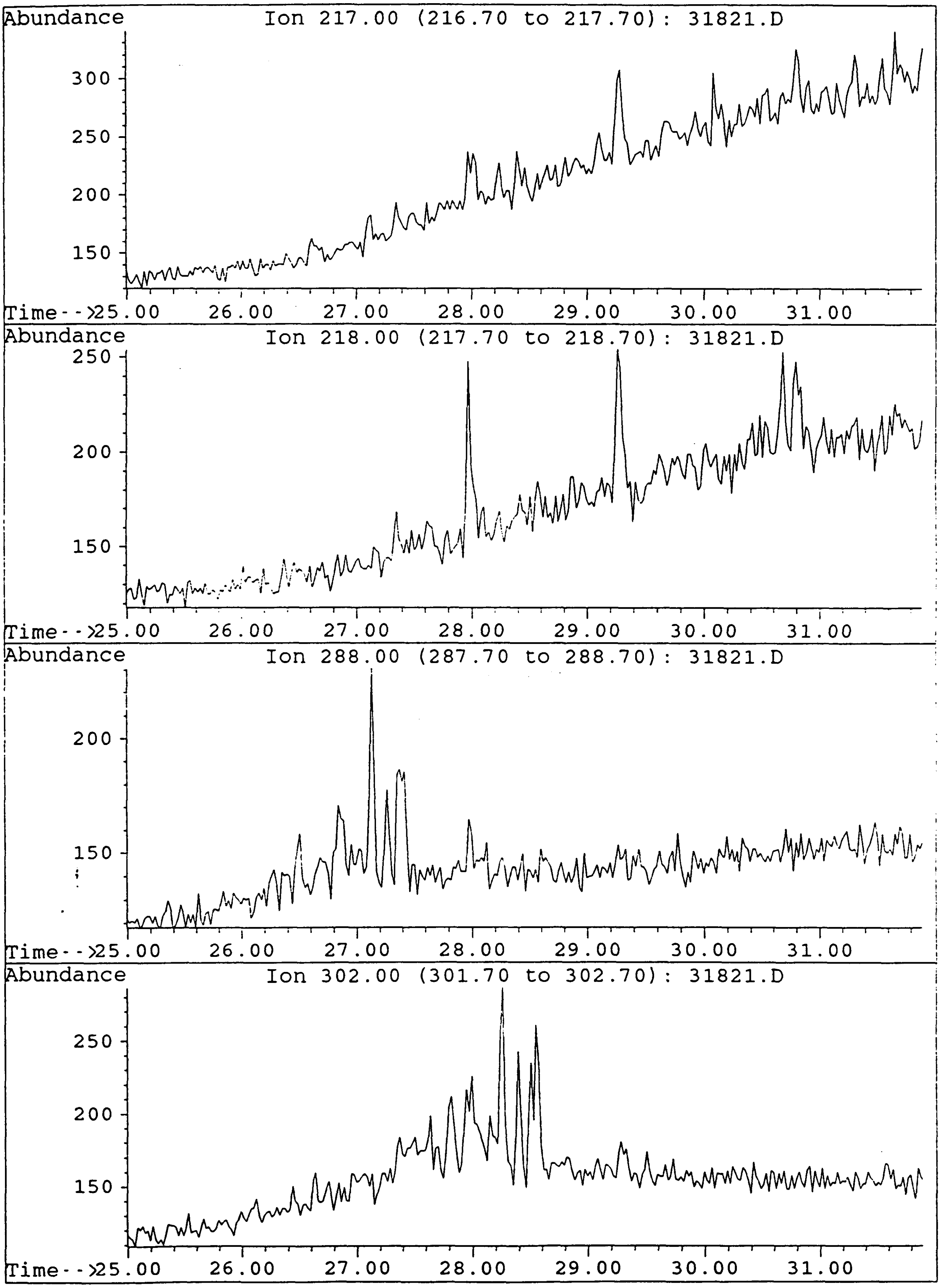
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



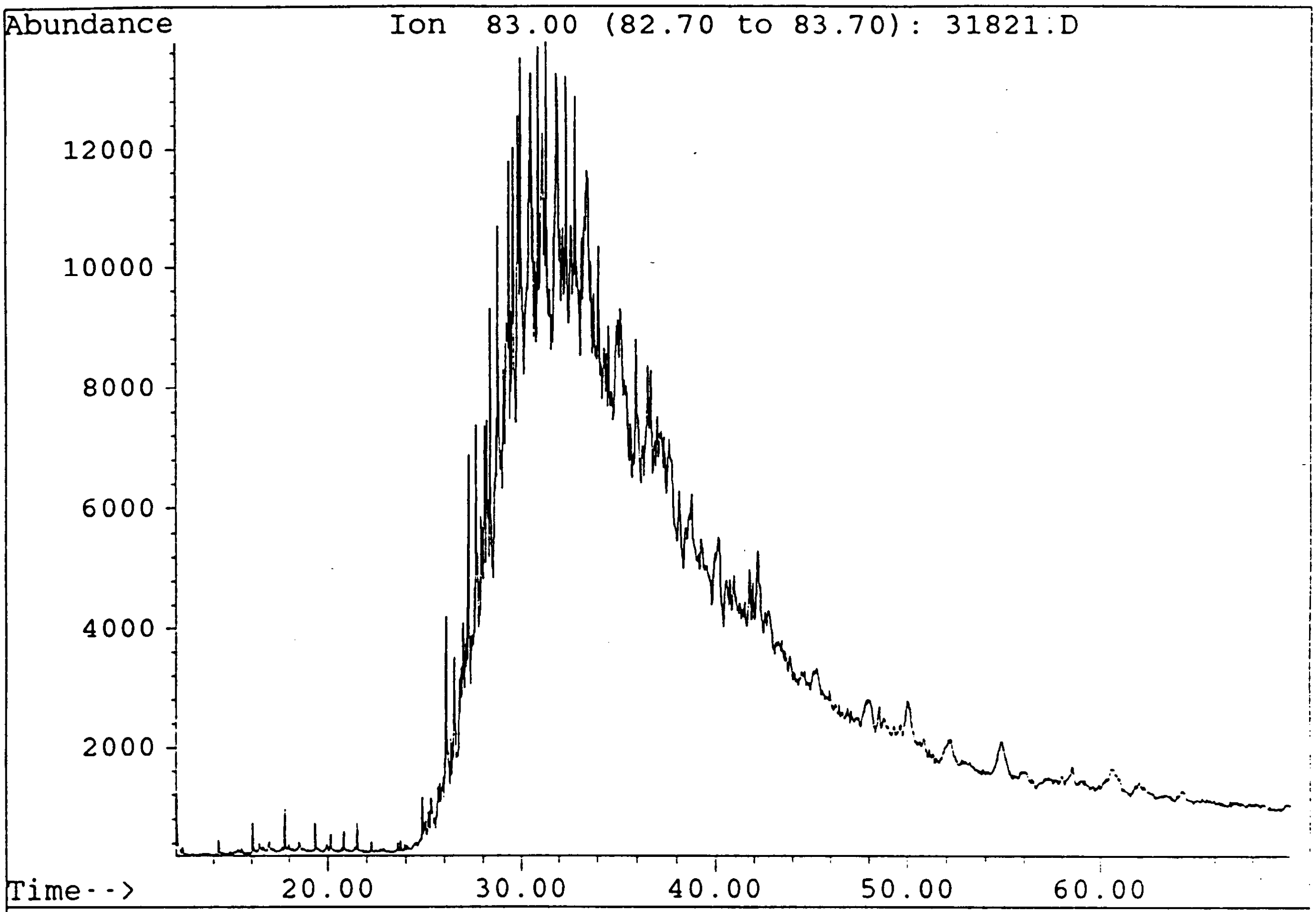
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

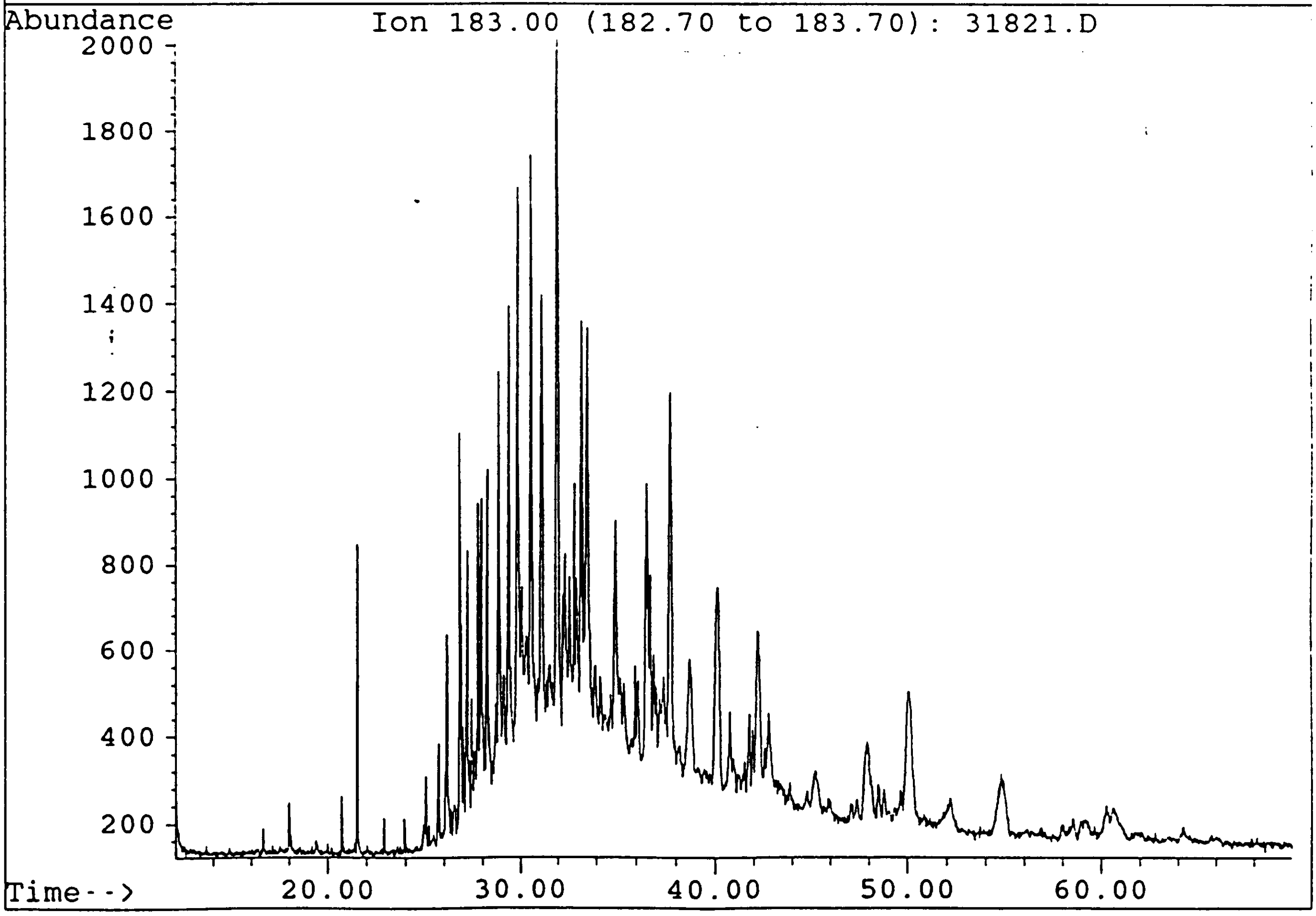


File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

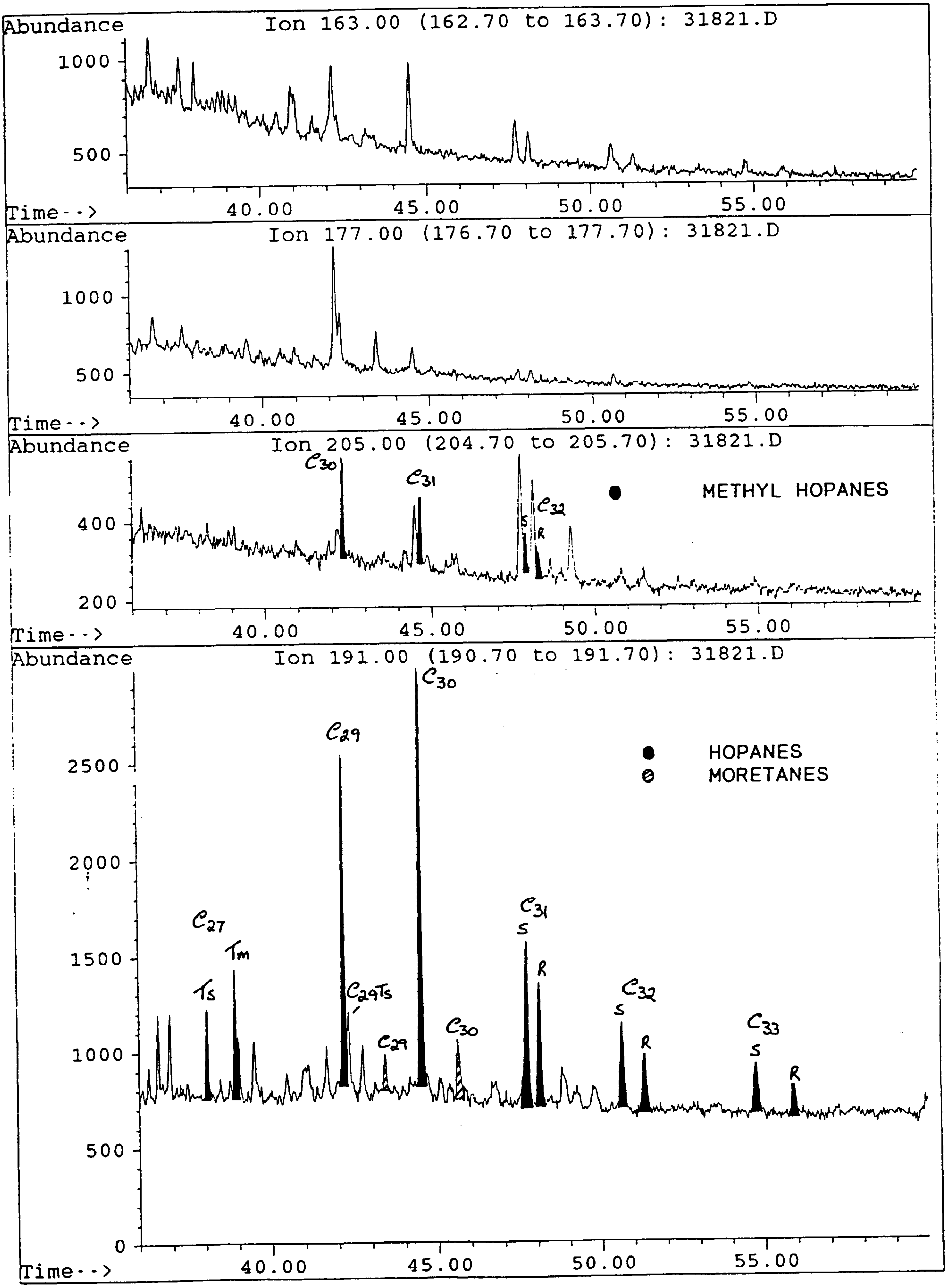


File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

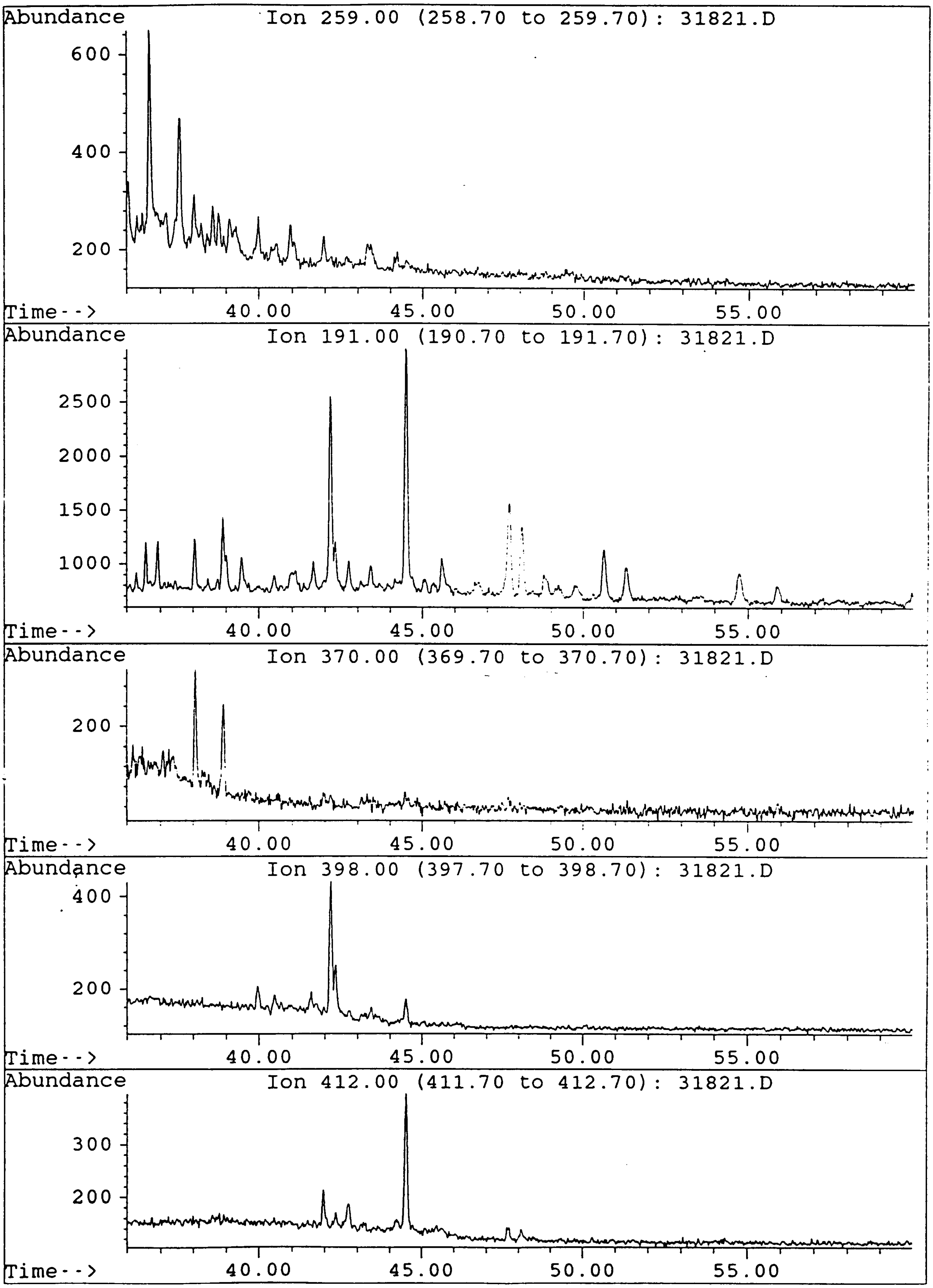




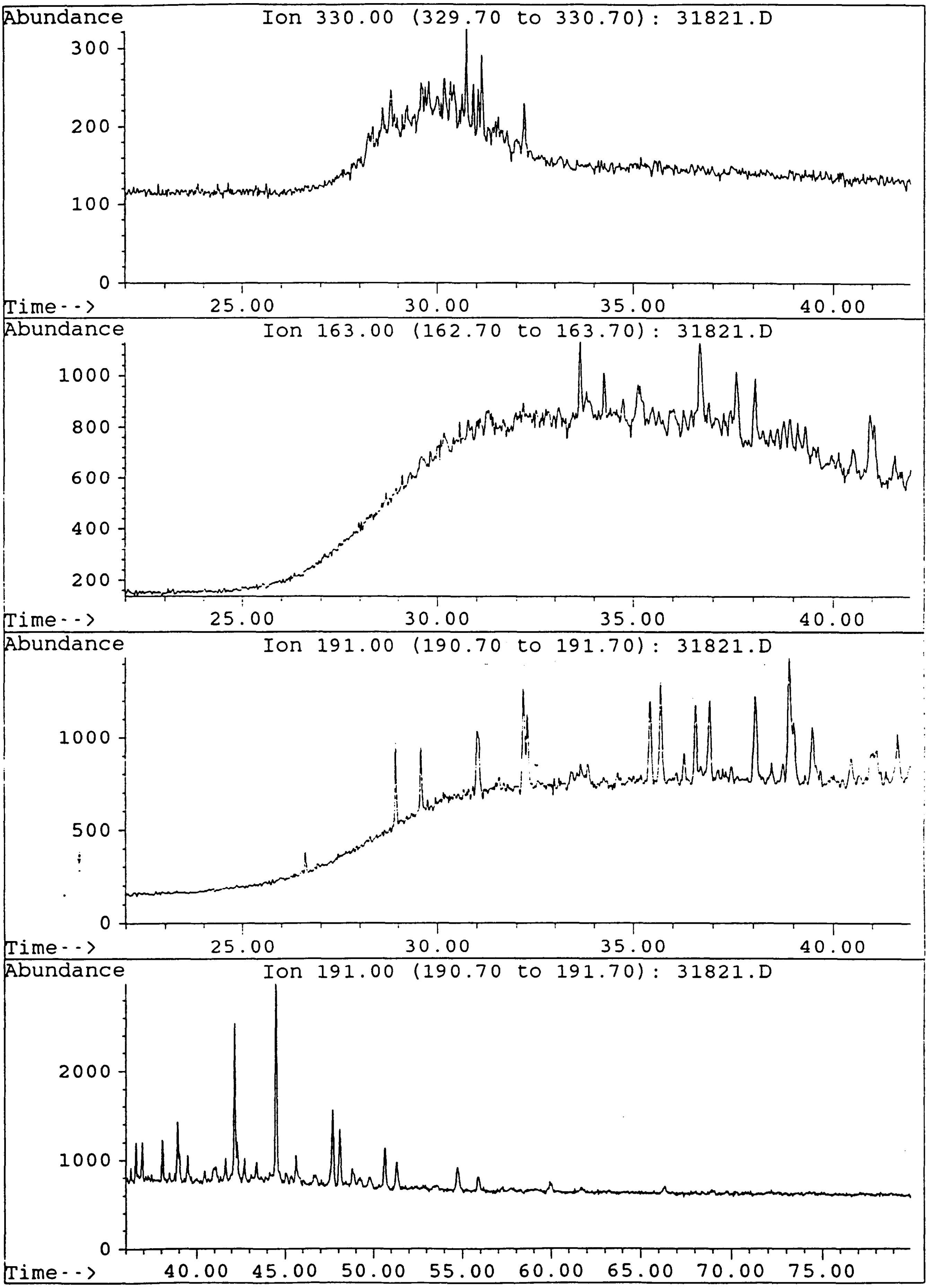
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



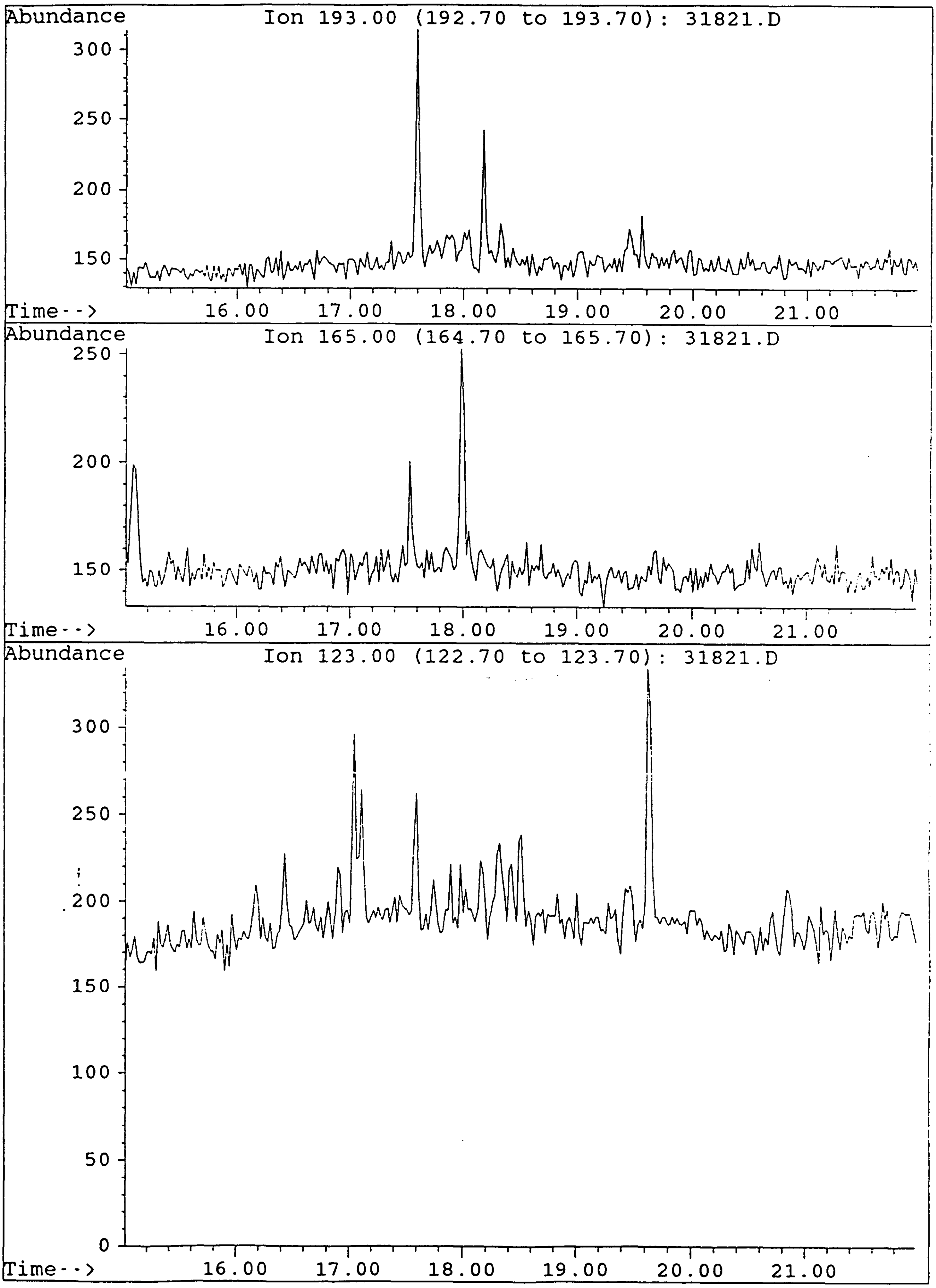
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



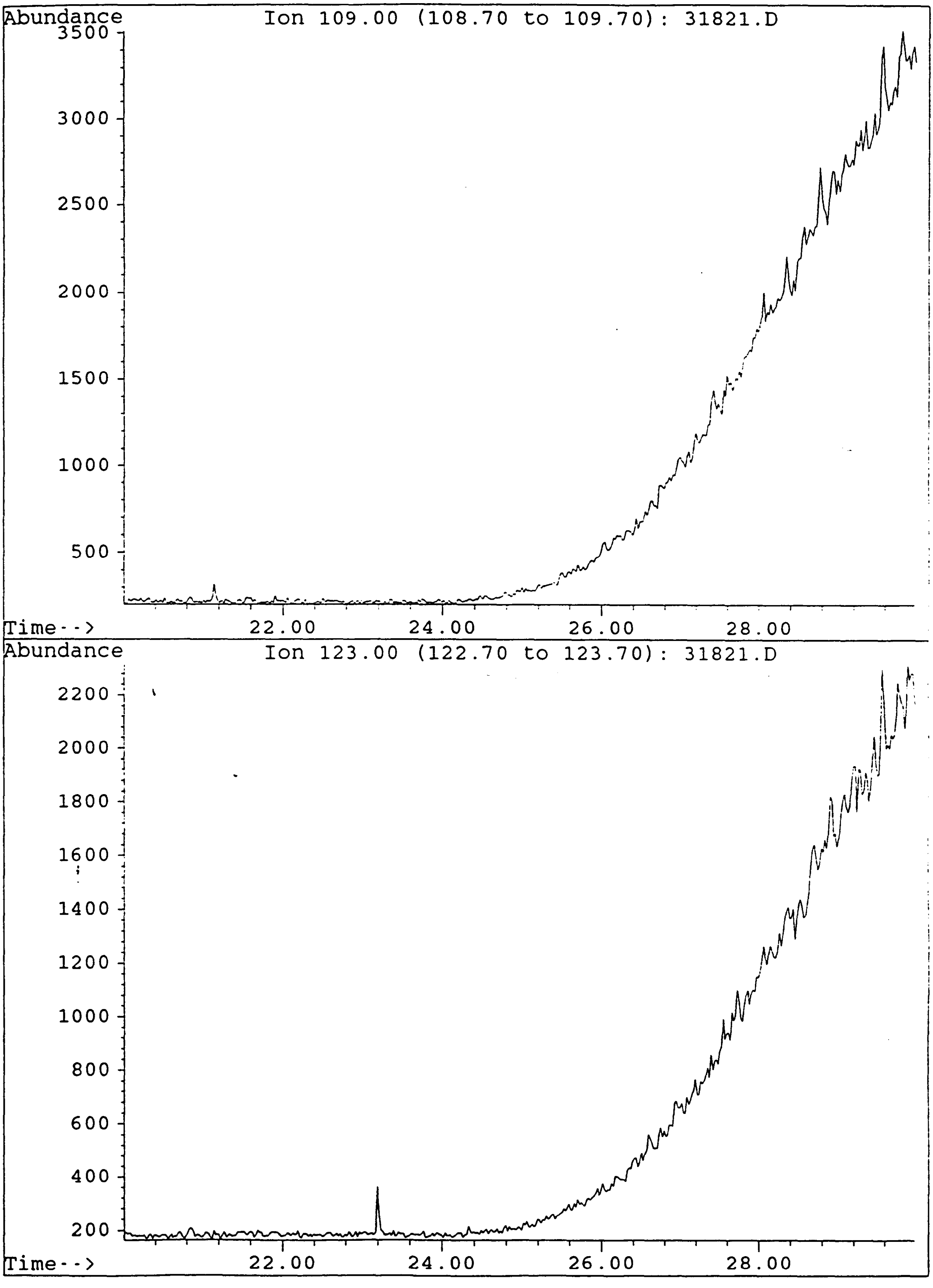
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



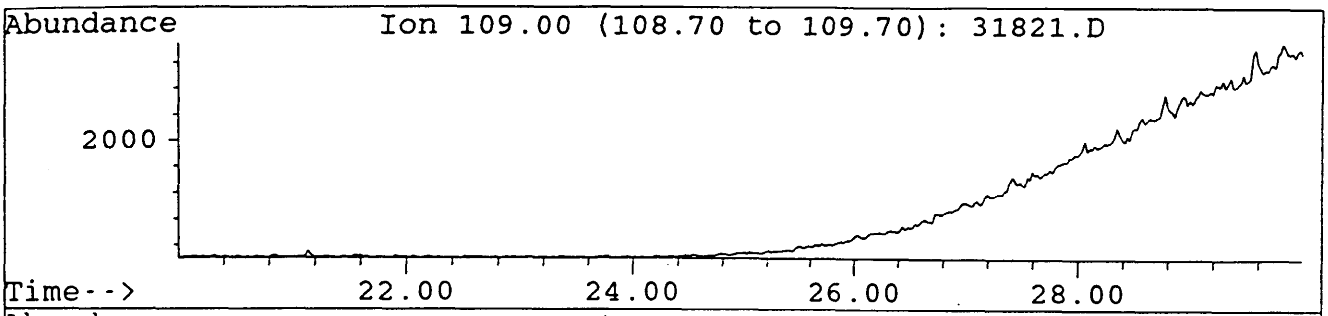
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

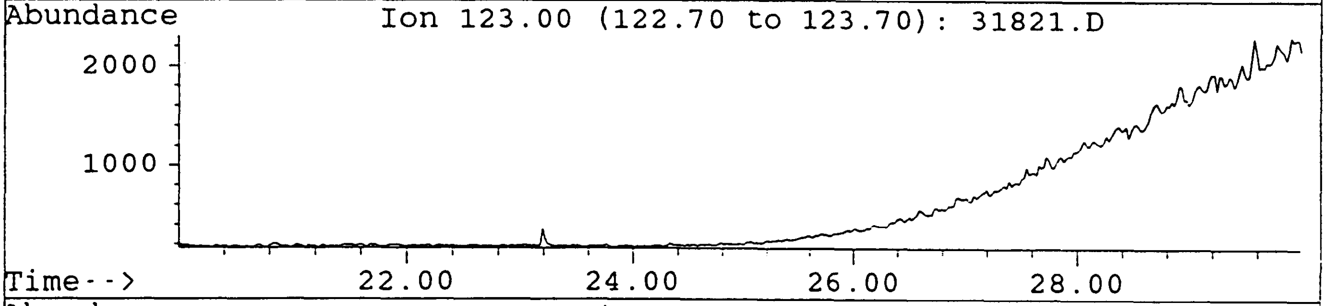


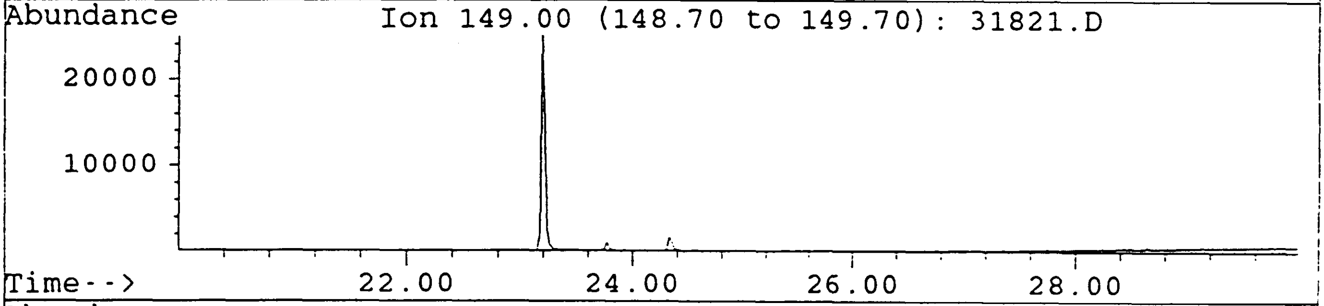
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

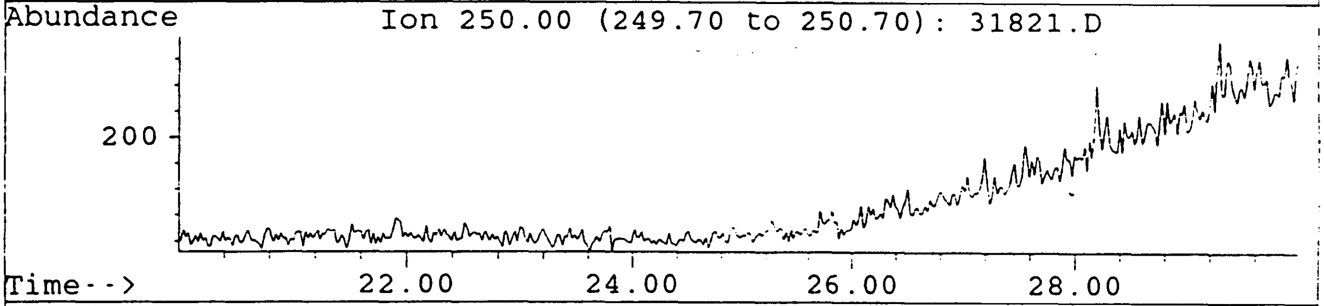


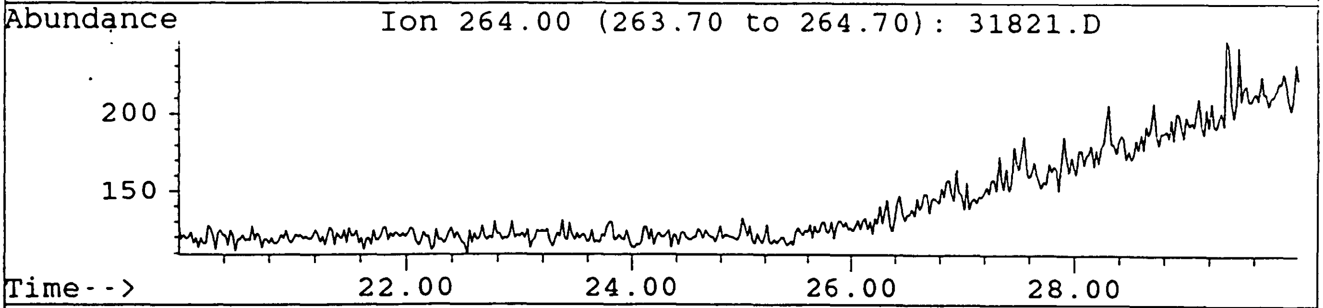
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC

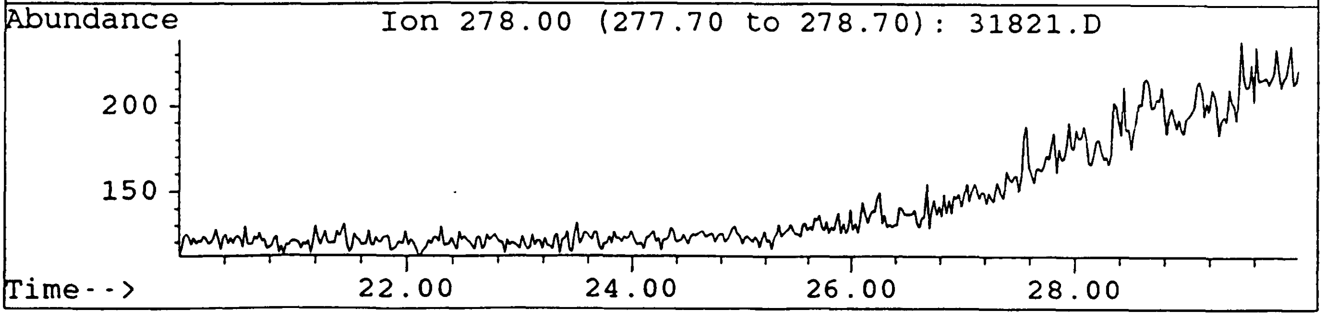




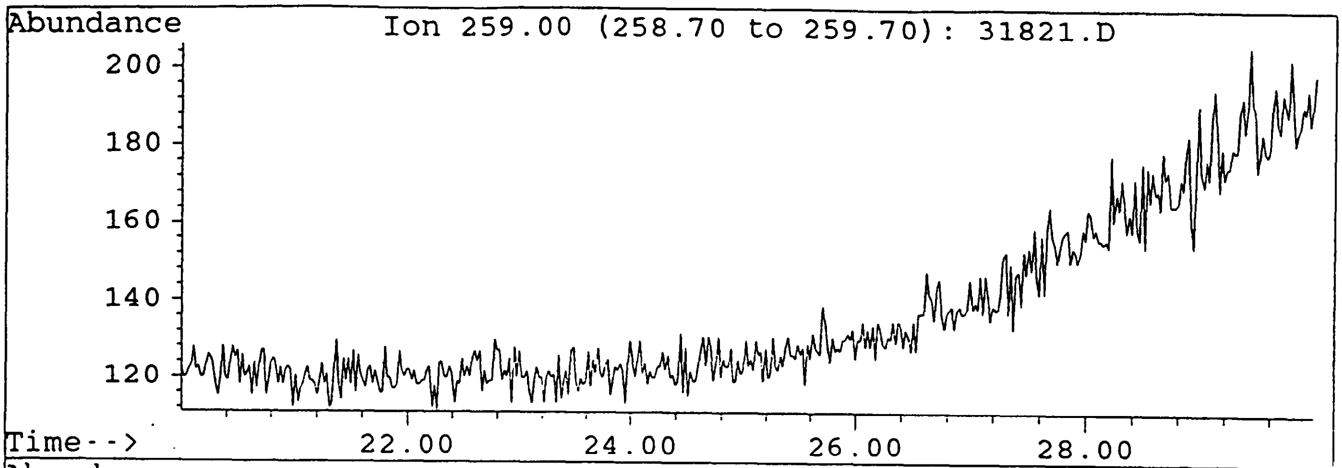


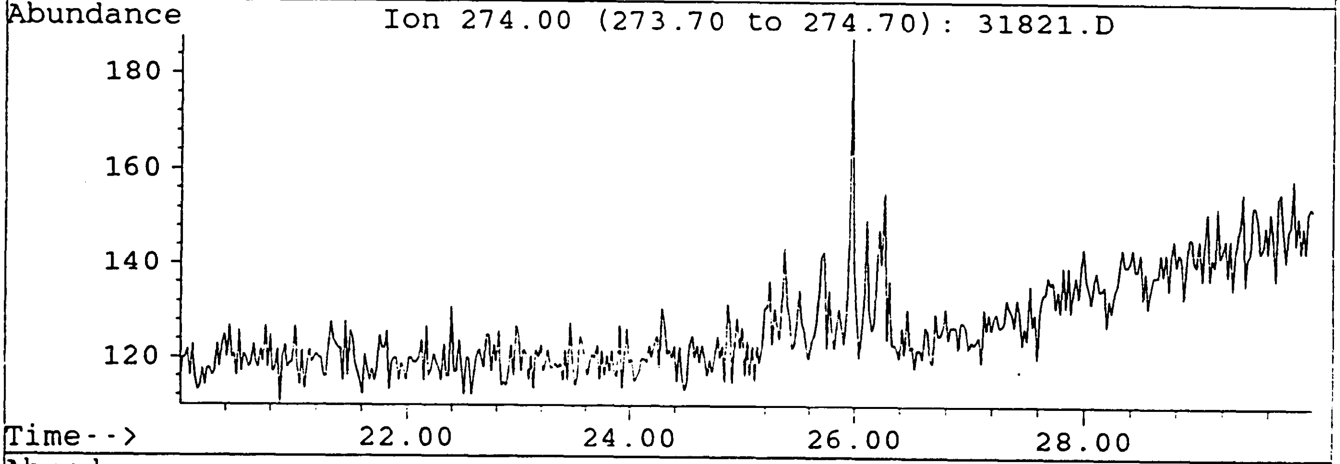


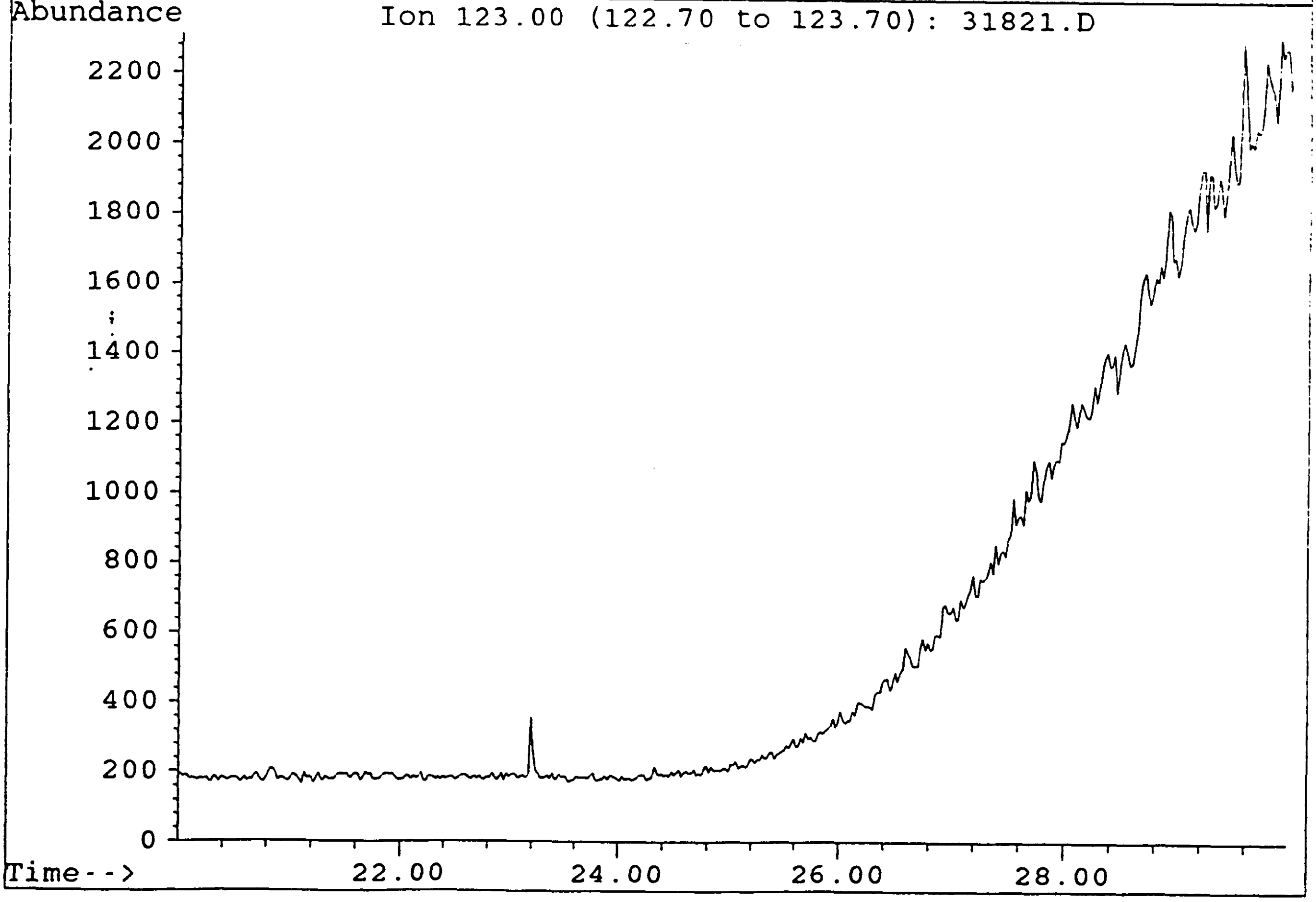




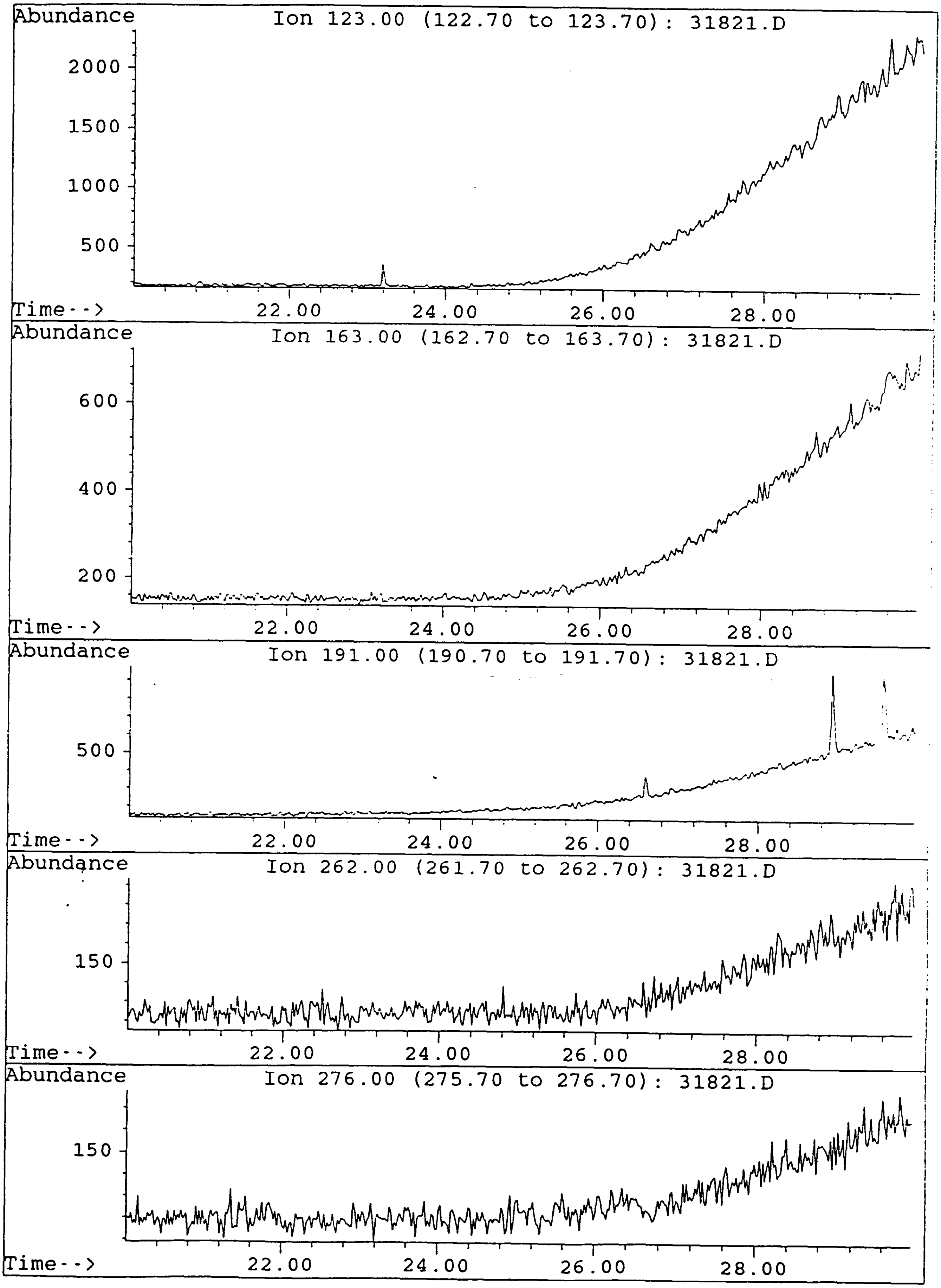
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



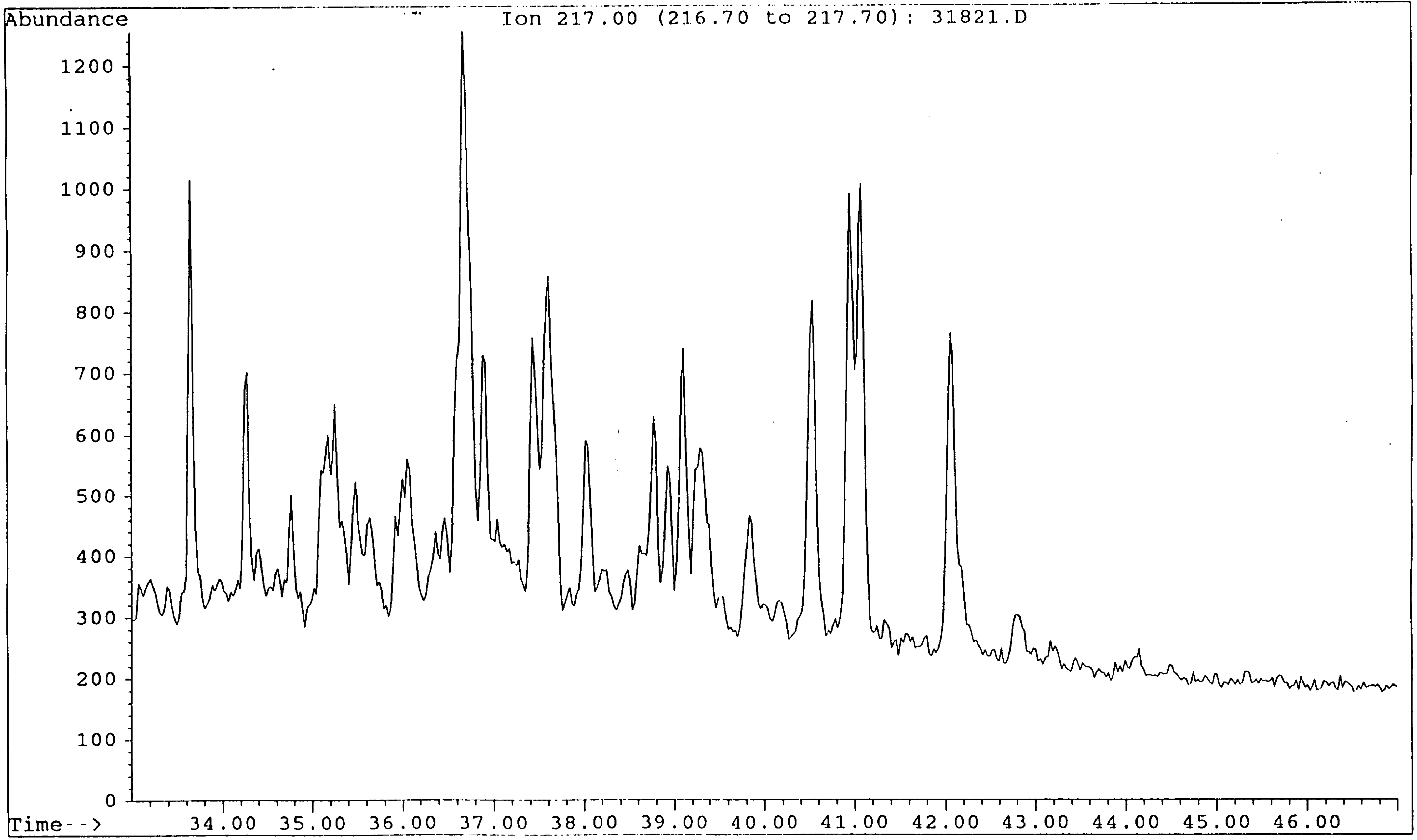




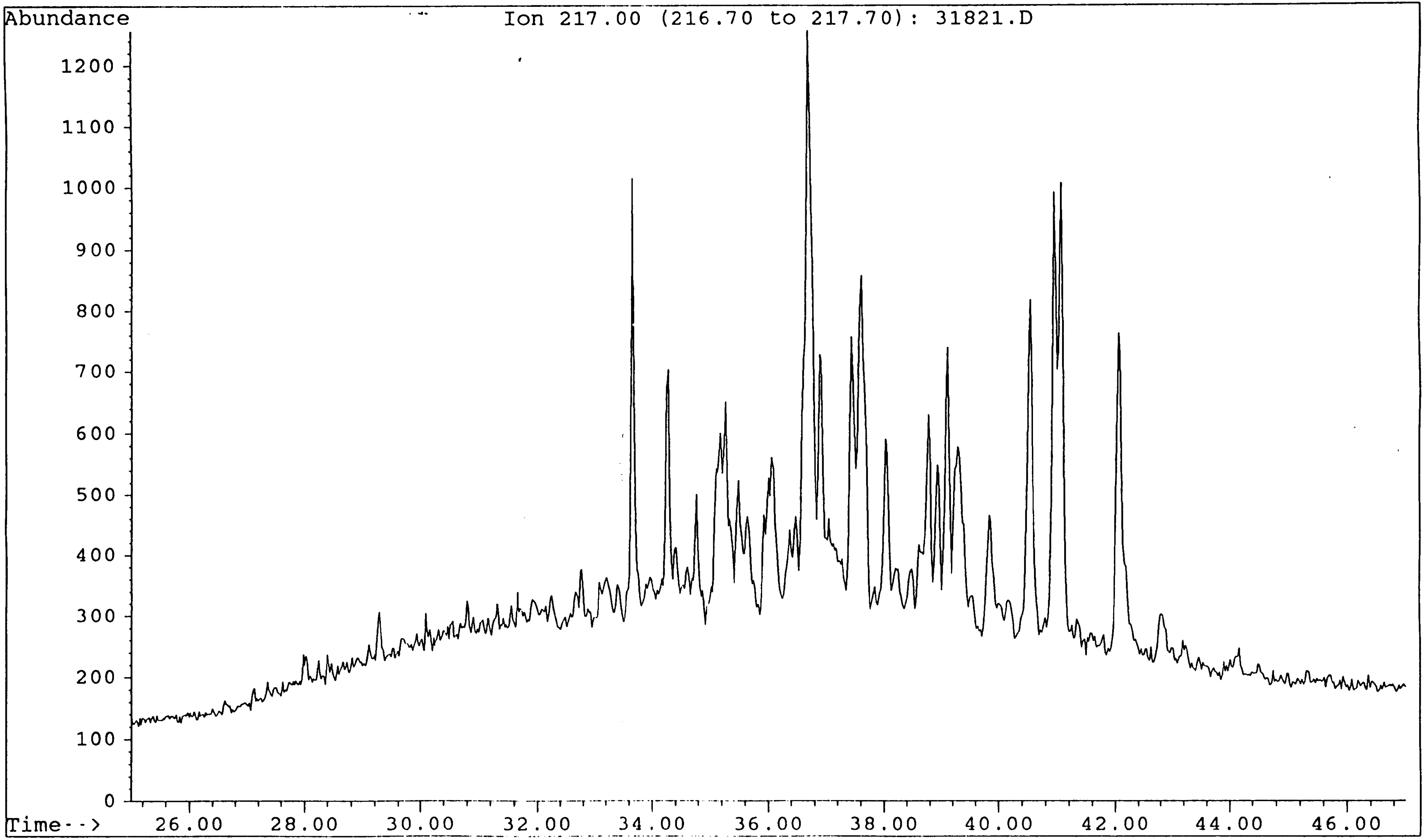
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



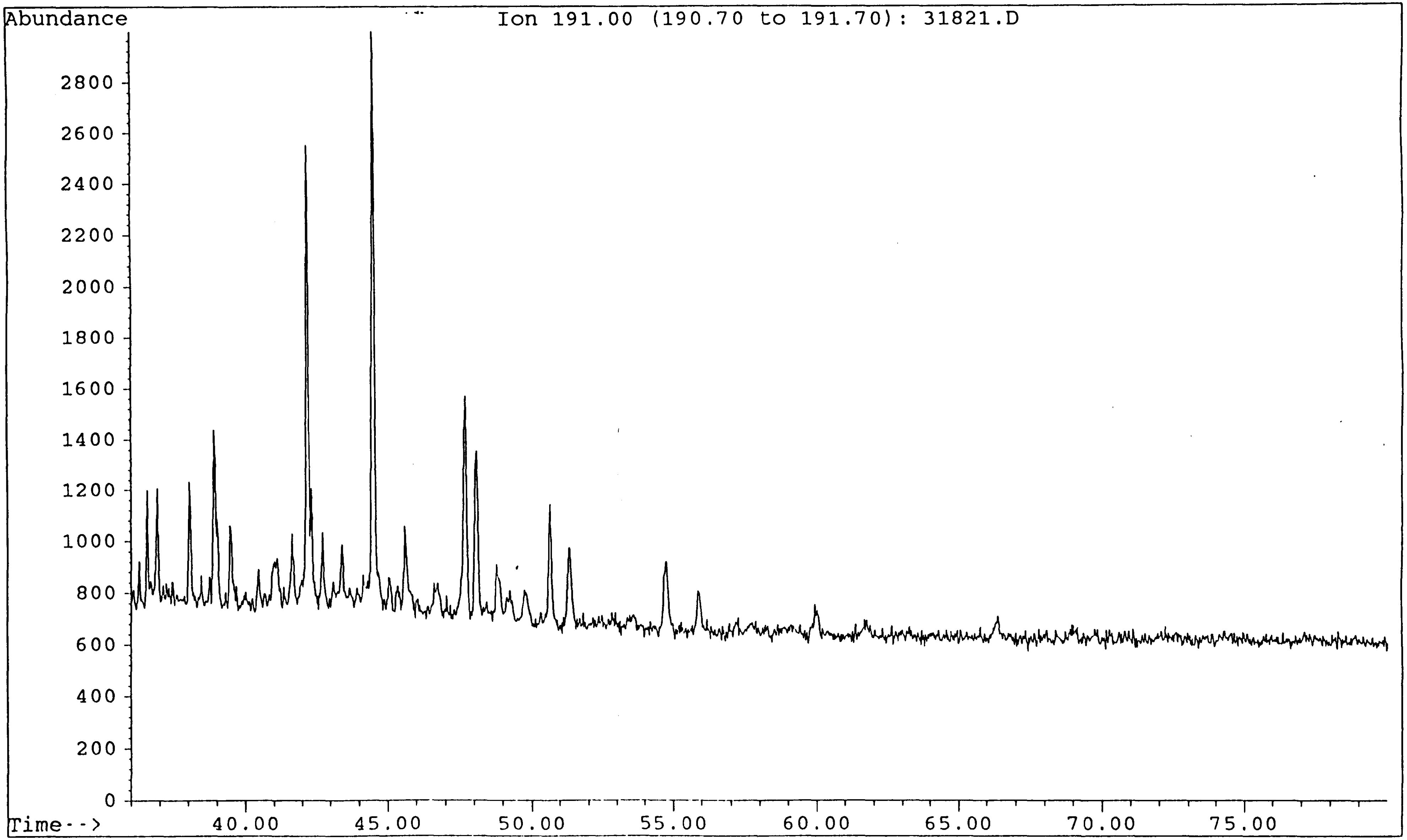
File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



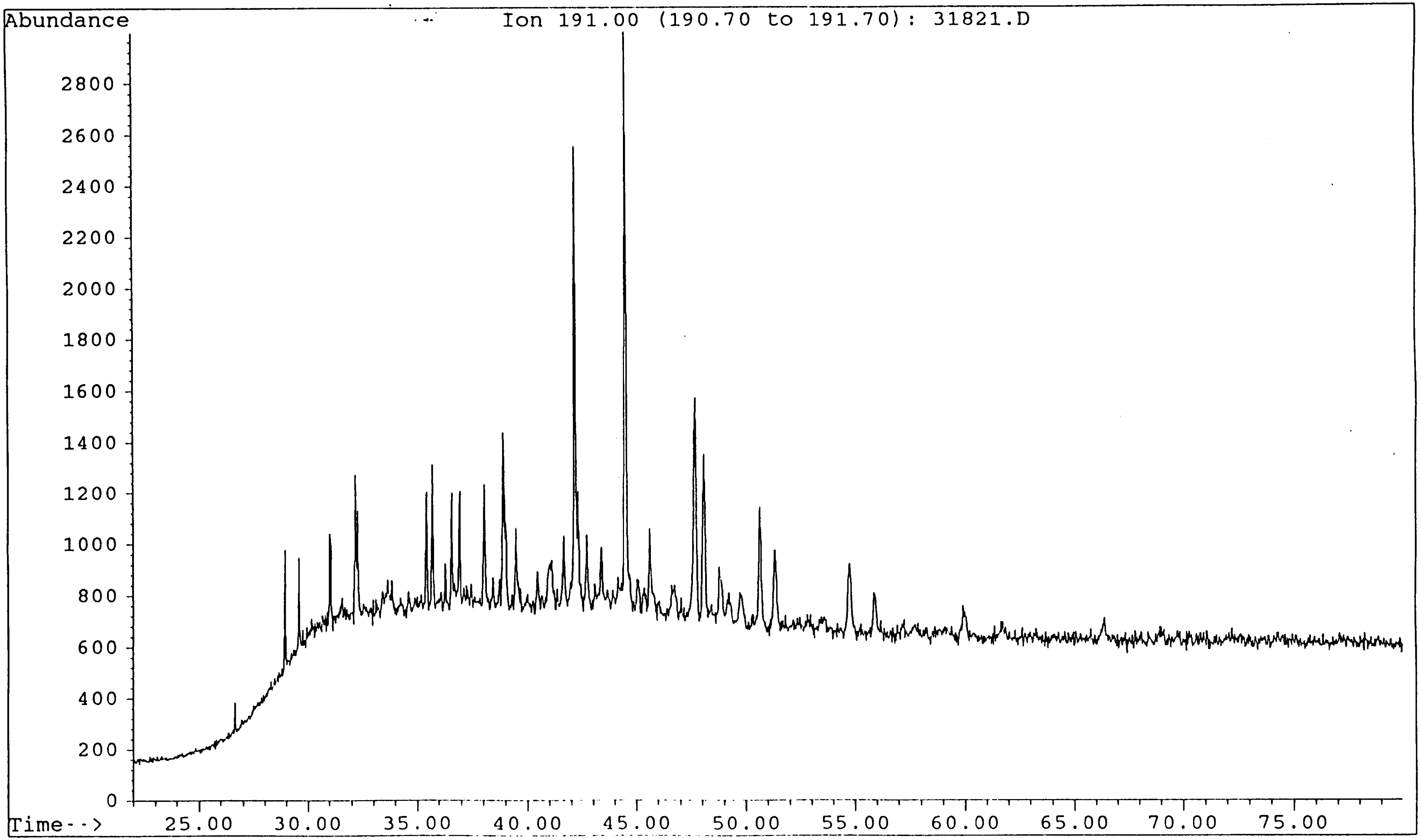
File   31821.D
Sample :   LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info :   COL#143. 1/20uL. 29-10-93. GEC



File : 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED.
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



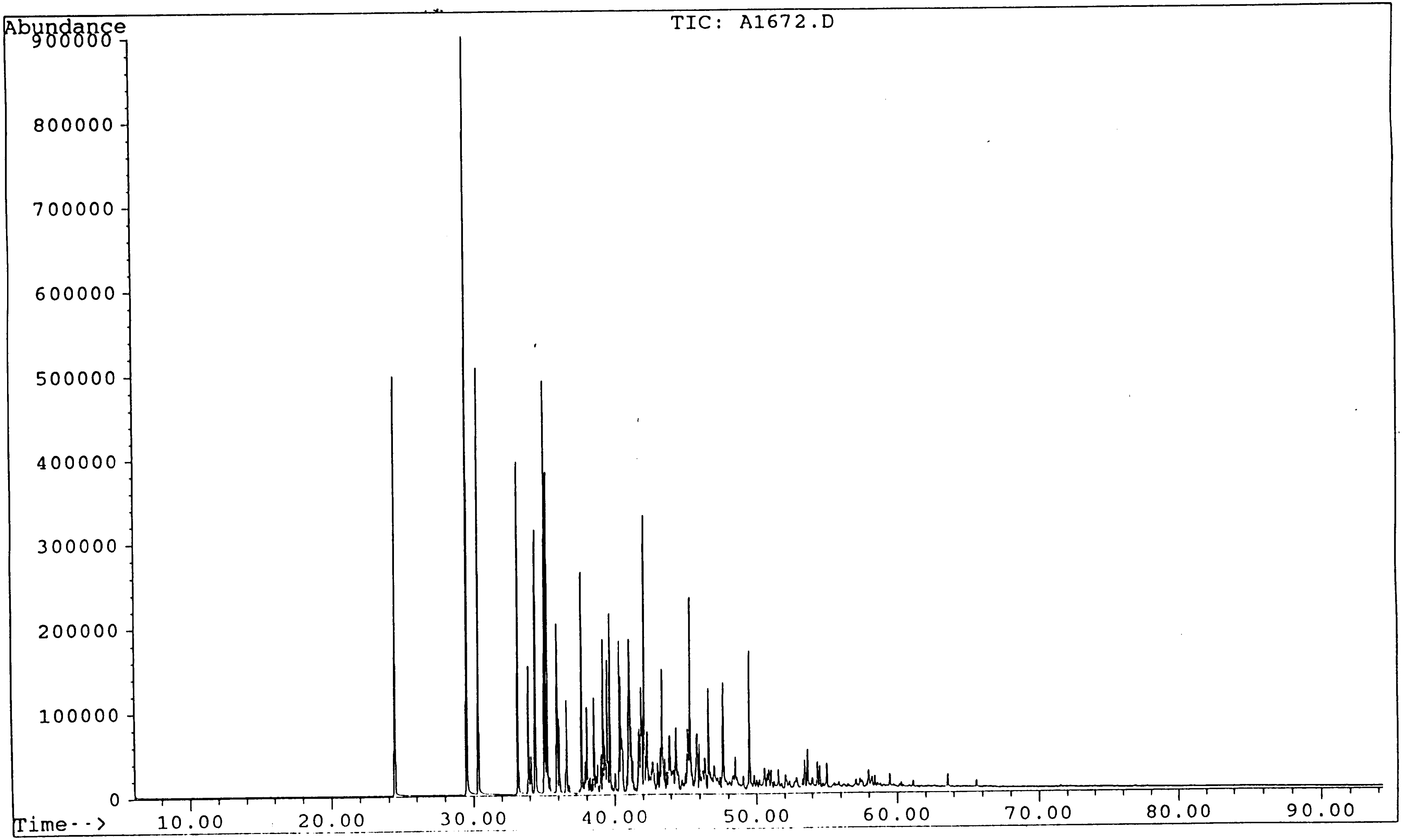
File 31821.D
Sample : LA BELLA#1, 2160.5m, B/C. TOPPED
Misc. Info : COL#143. 1/20uL. 29-10-93. GEC



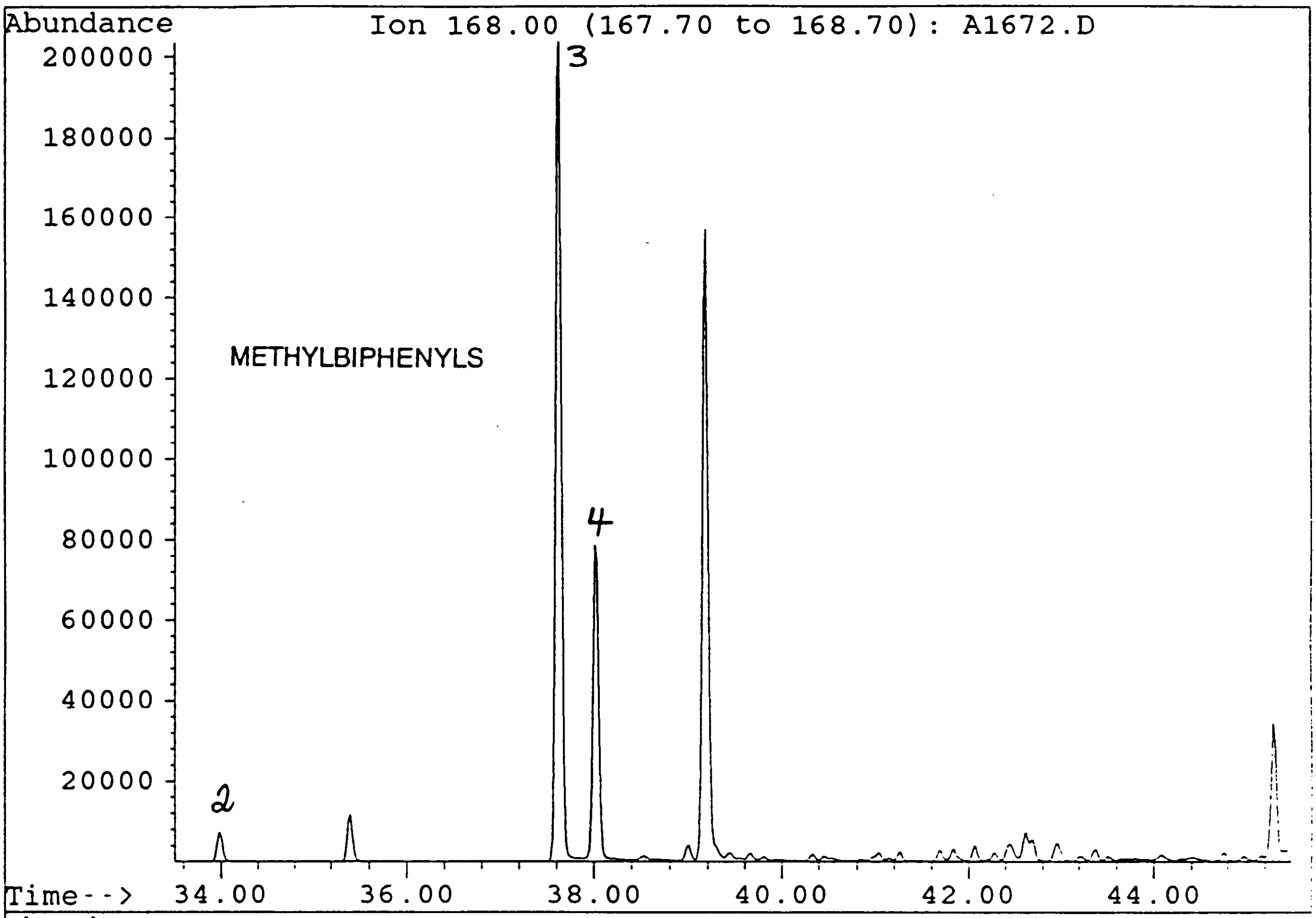
APPENDIX 2

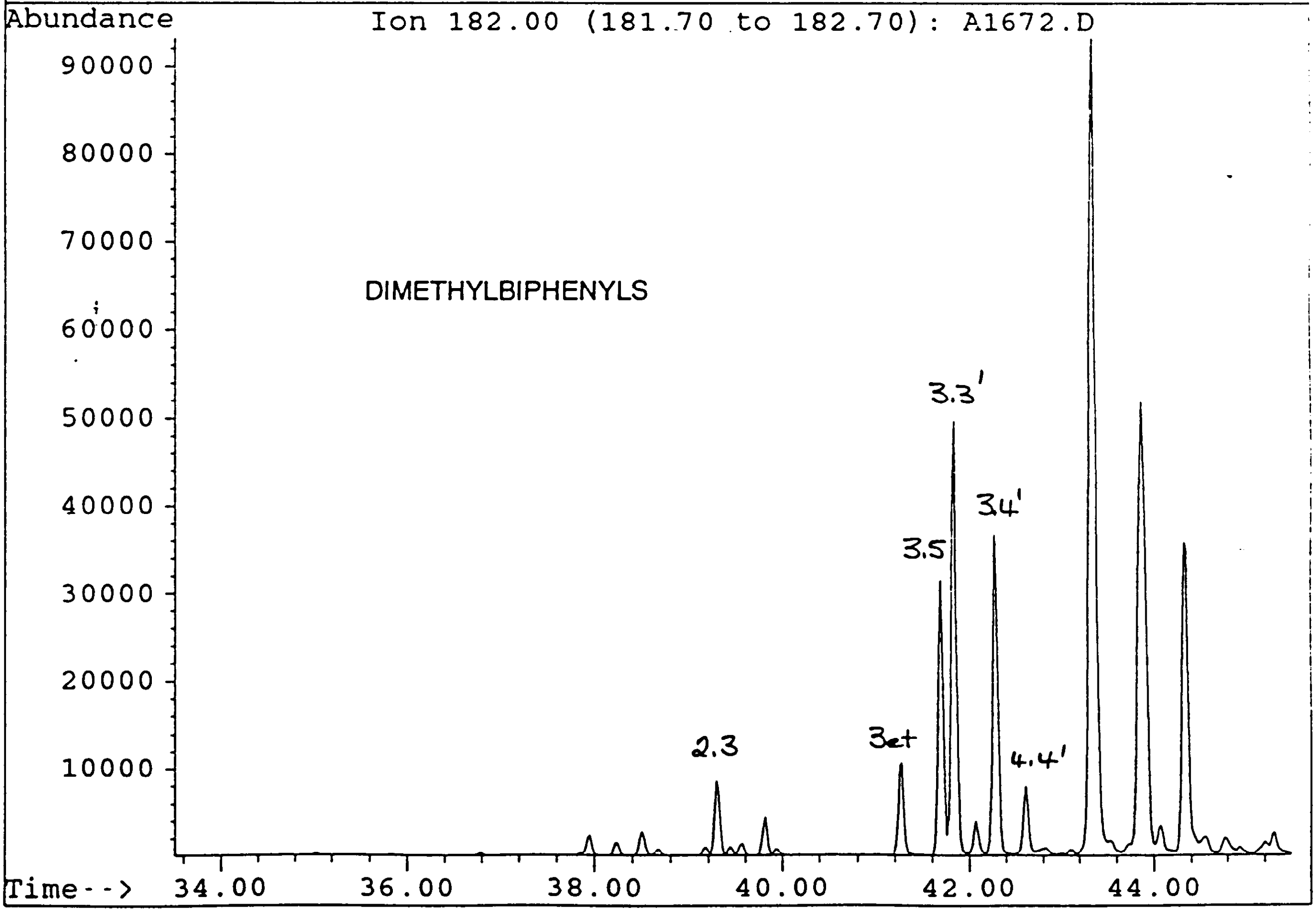
SIR GC-MS (AROMS) MASS FRAGMENTOGRAMS : CONDENSATES

File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.

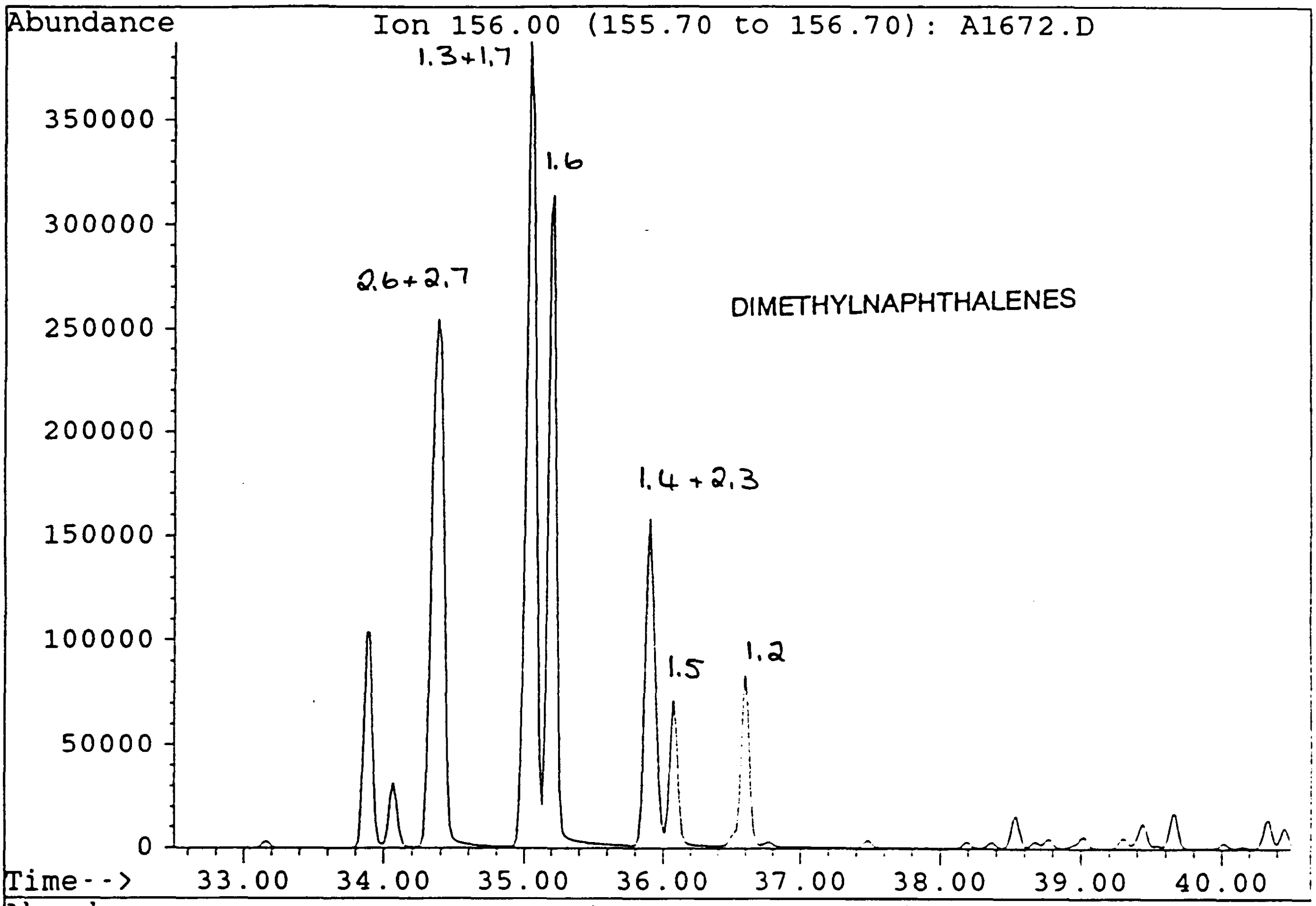


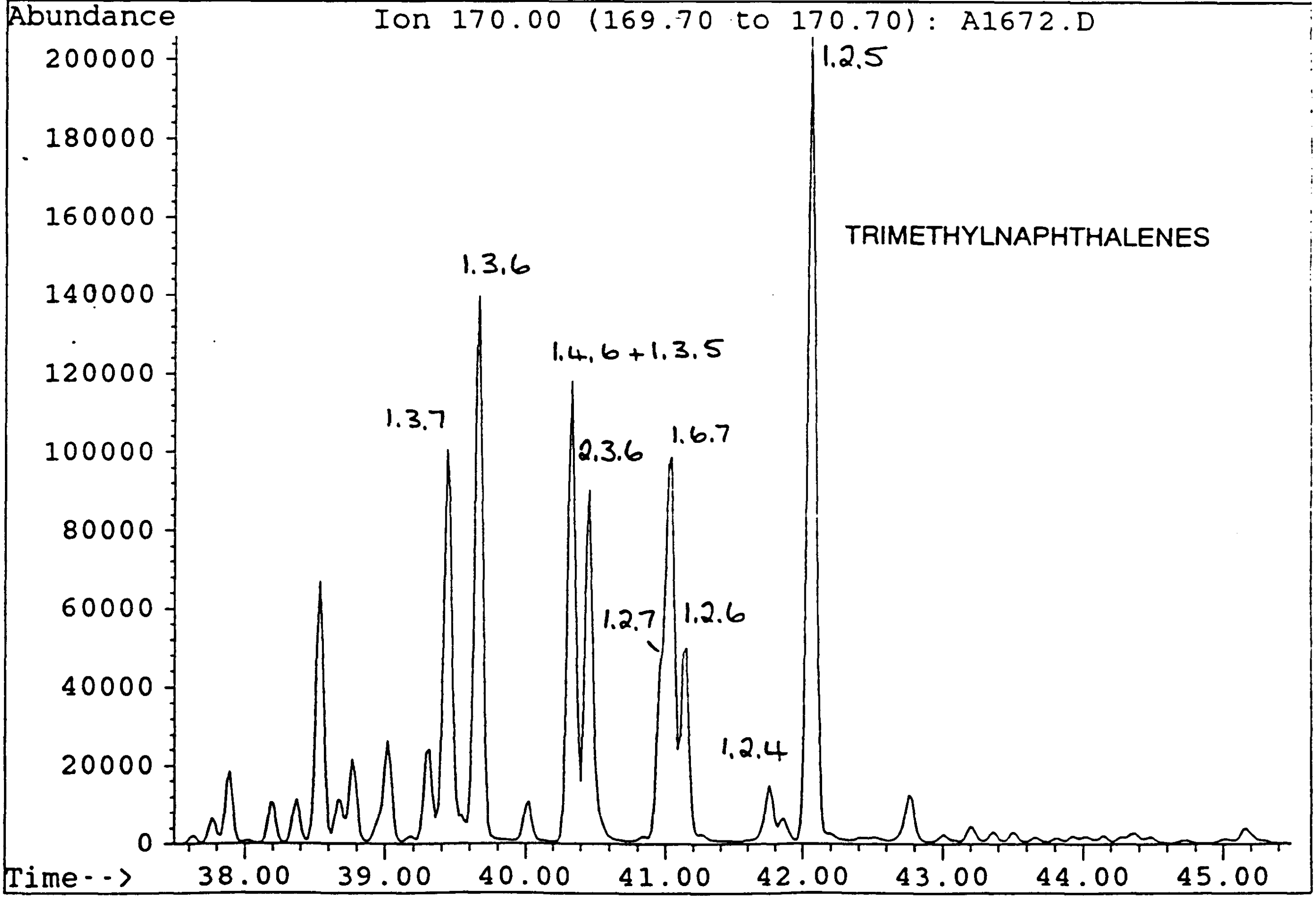
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.





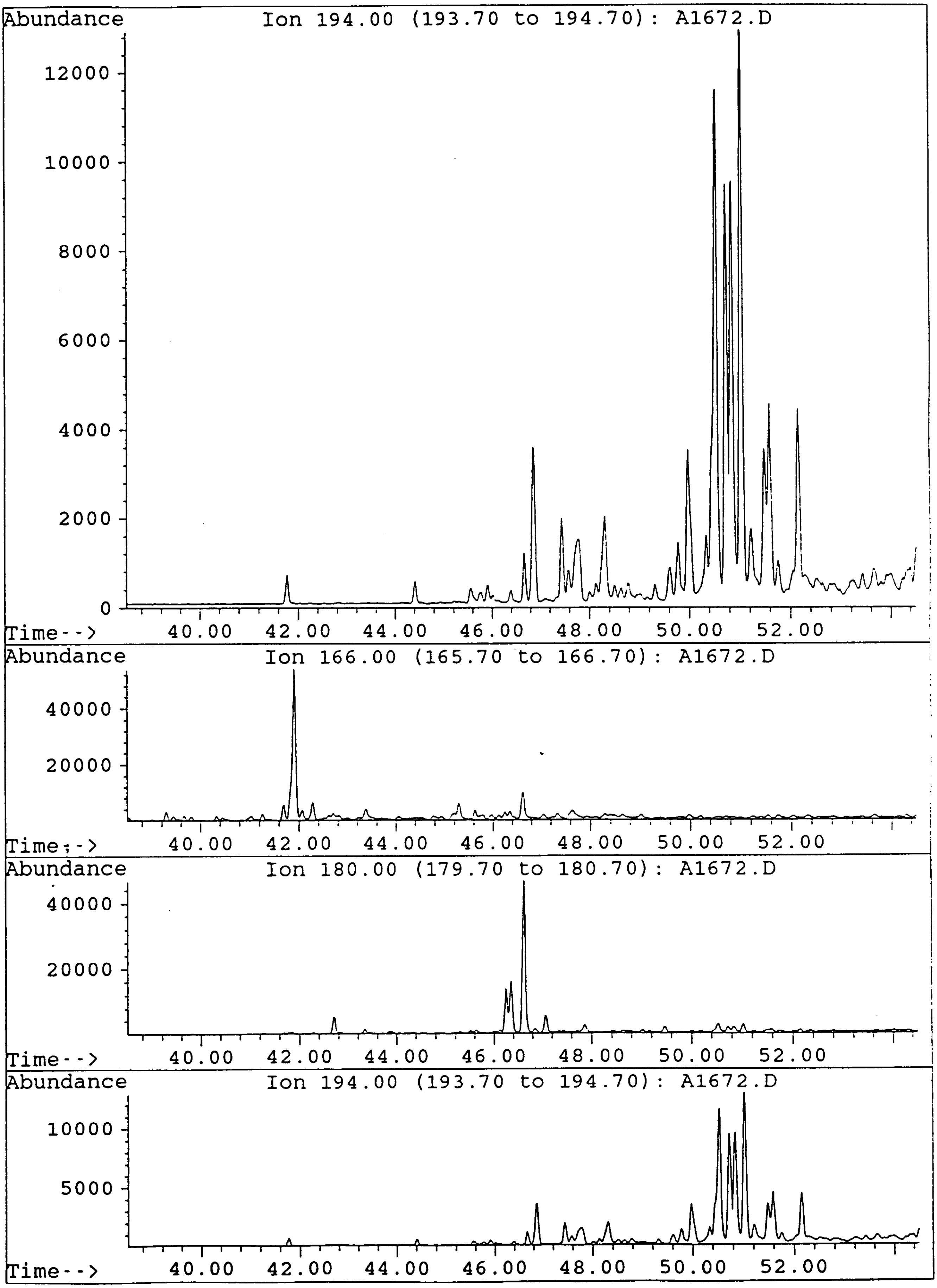
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.



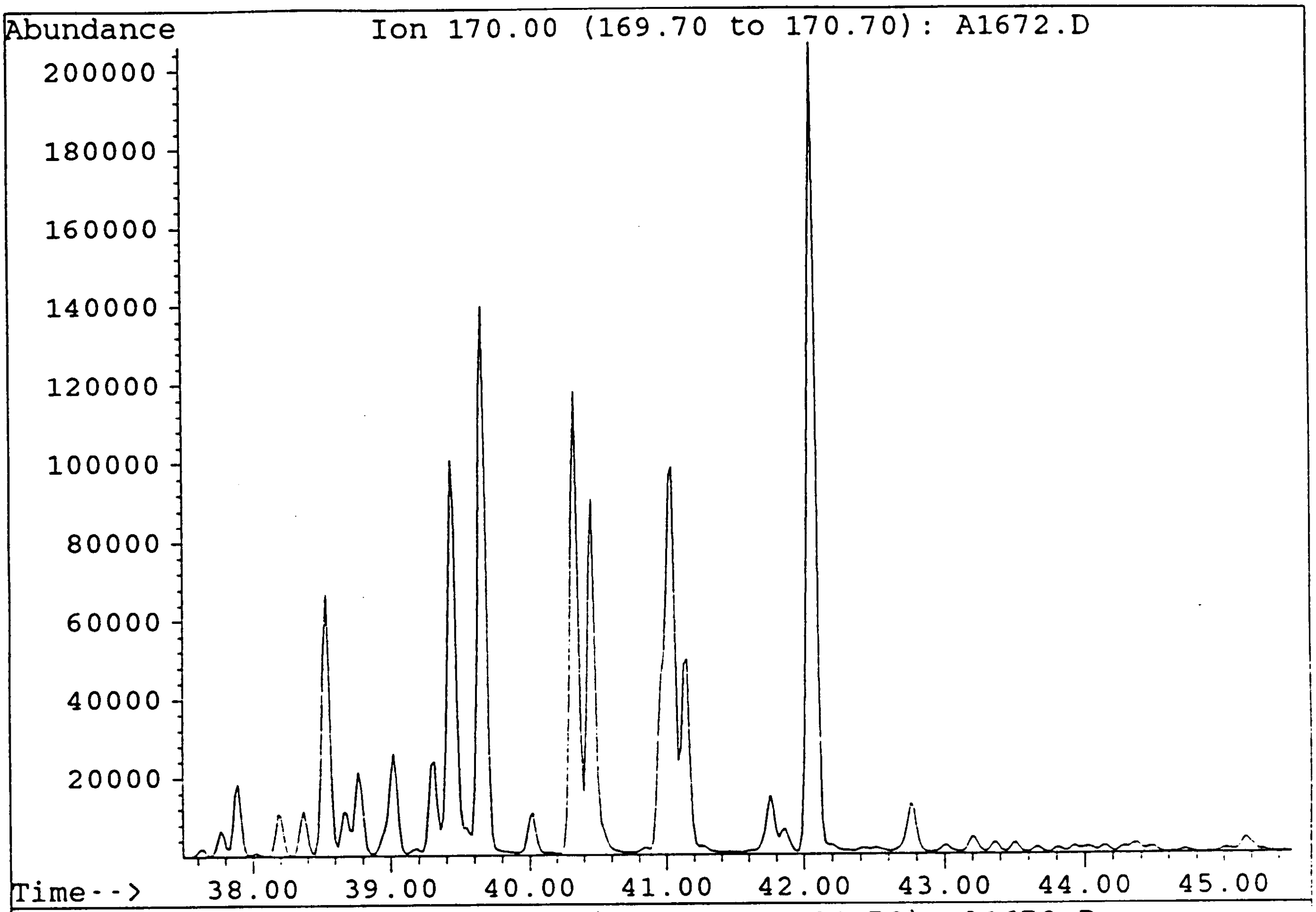


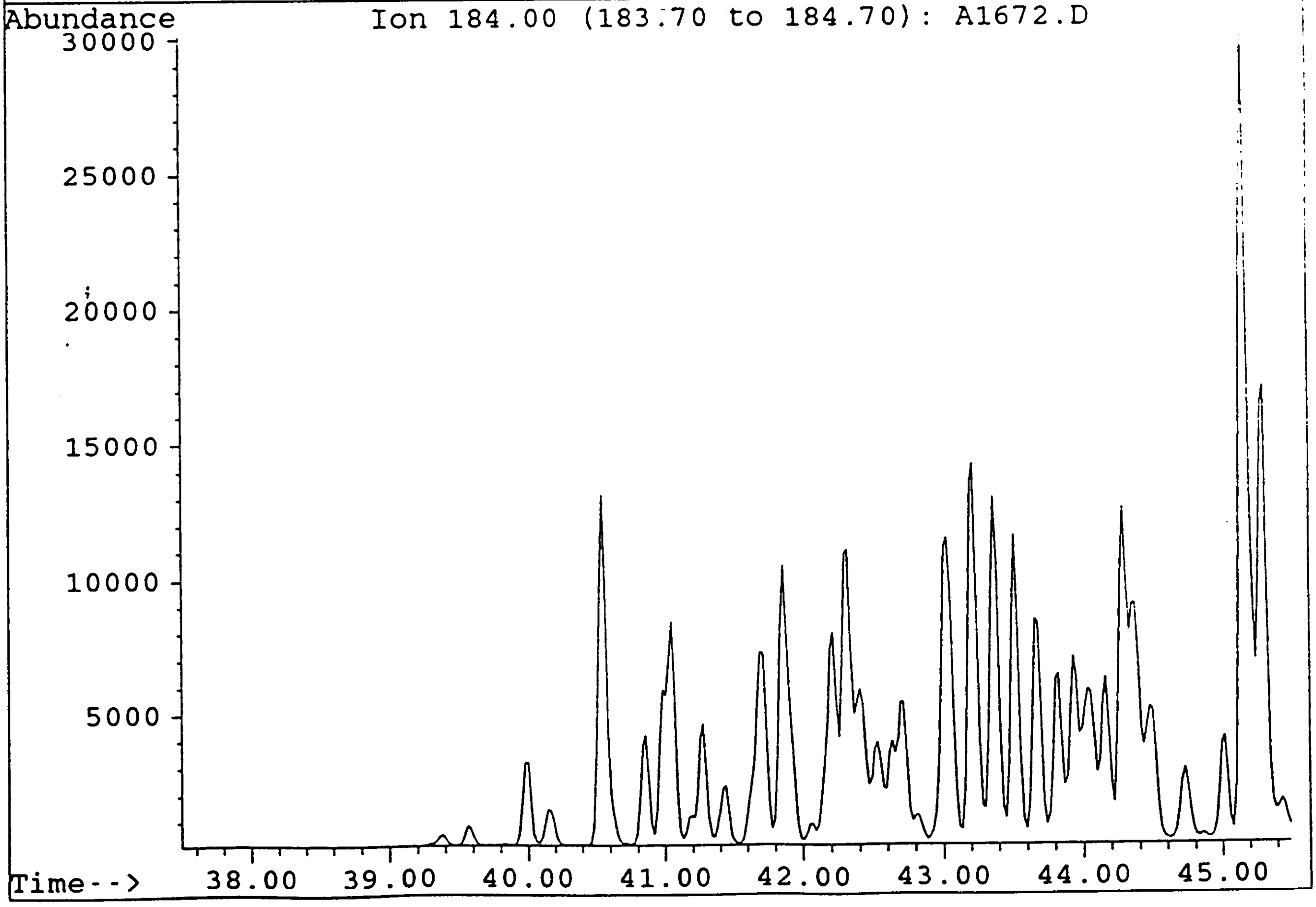
File :   A1672.D
Sample :   LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info :   COL#155. 1/140uL. 26-10-93. GEC.

FLUORENES

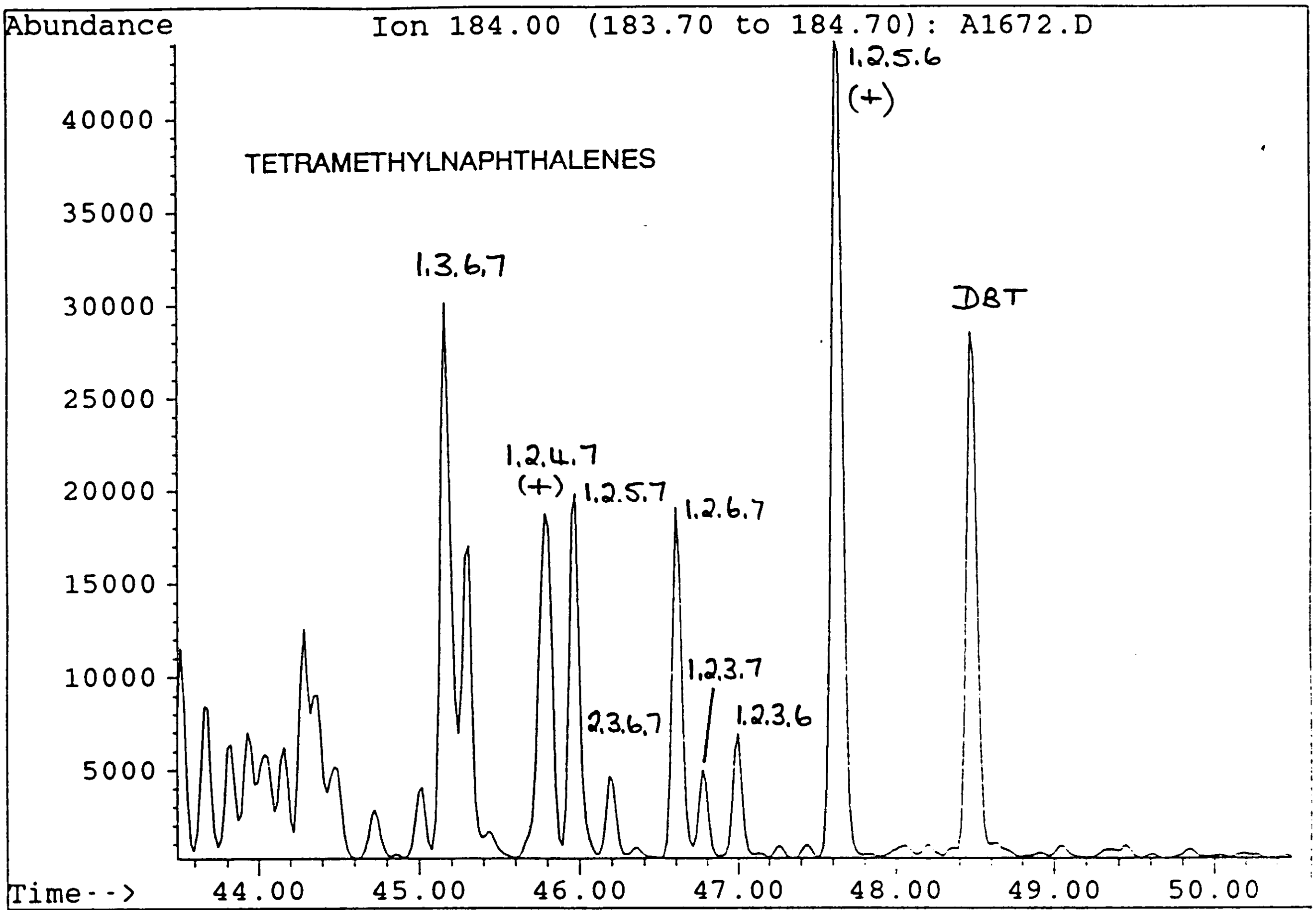


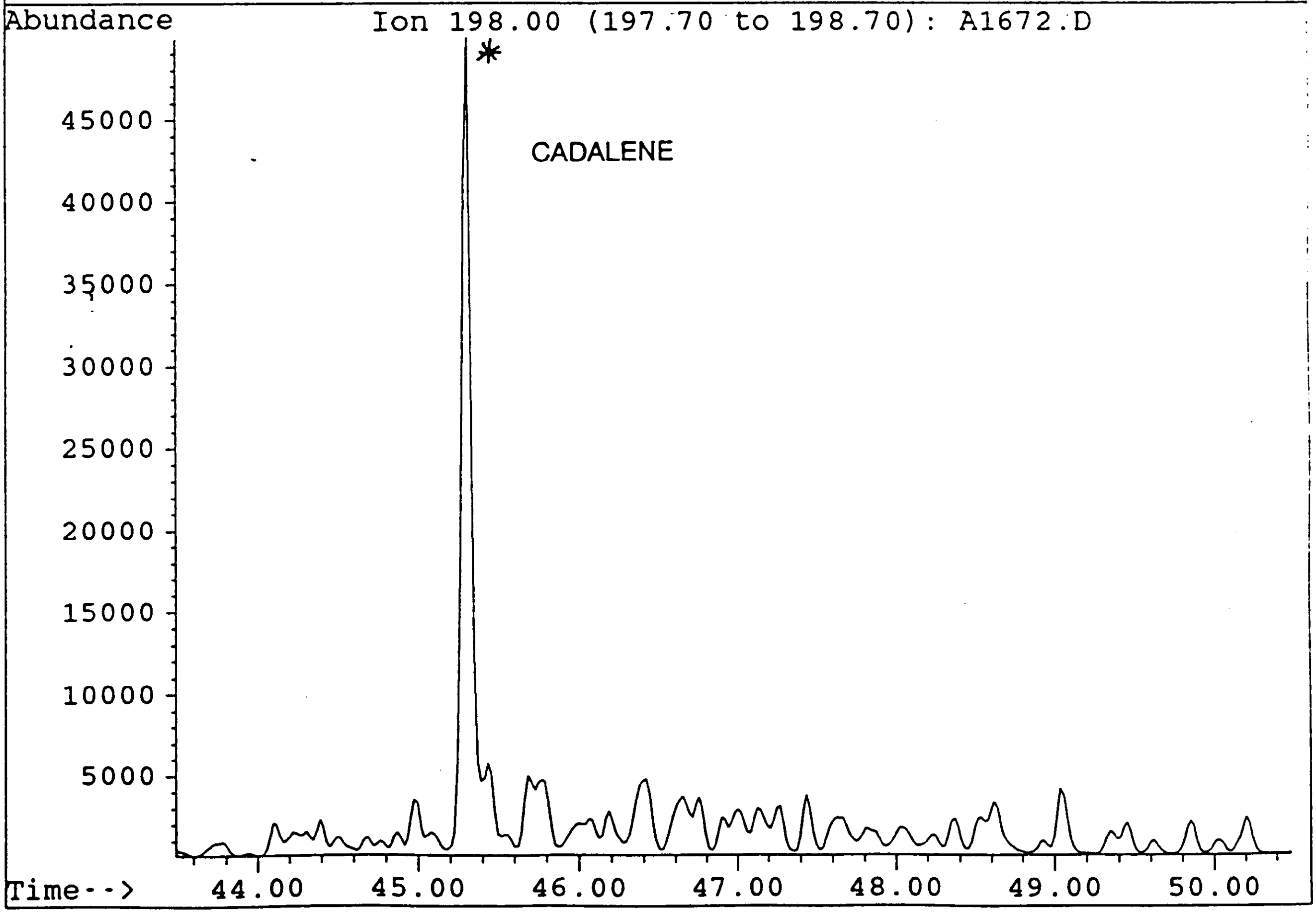
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.



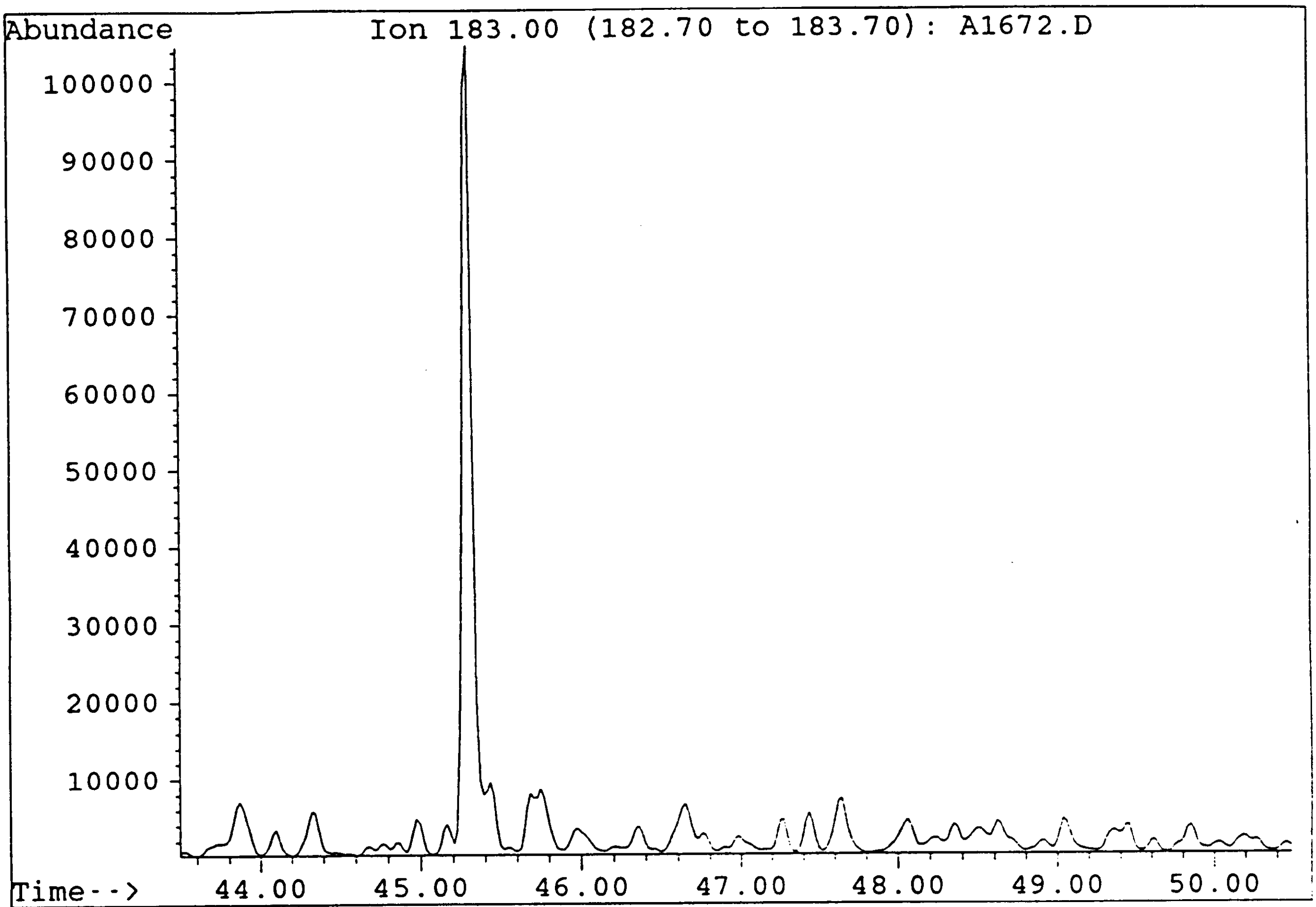


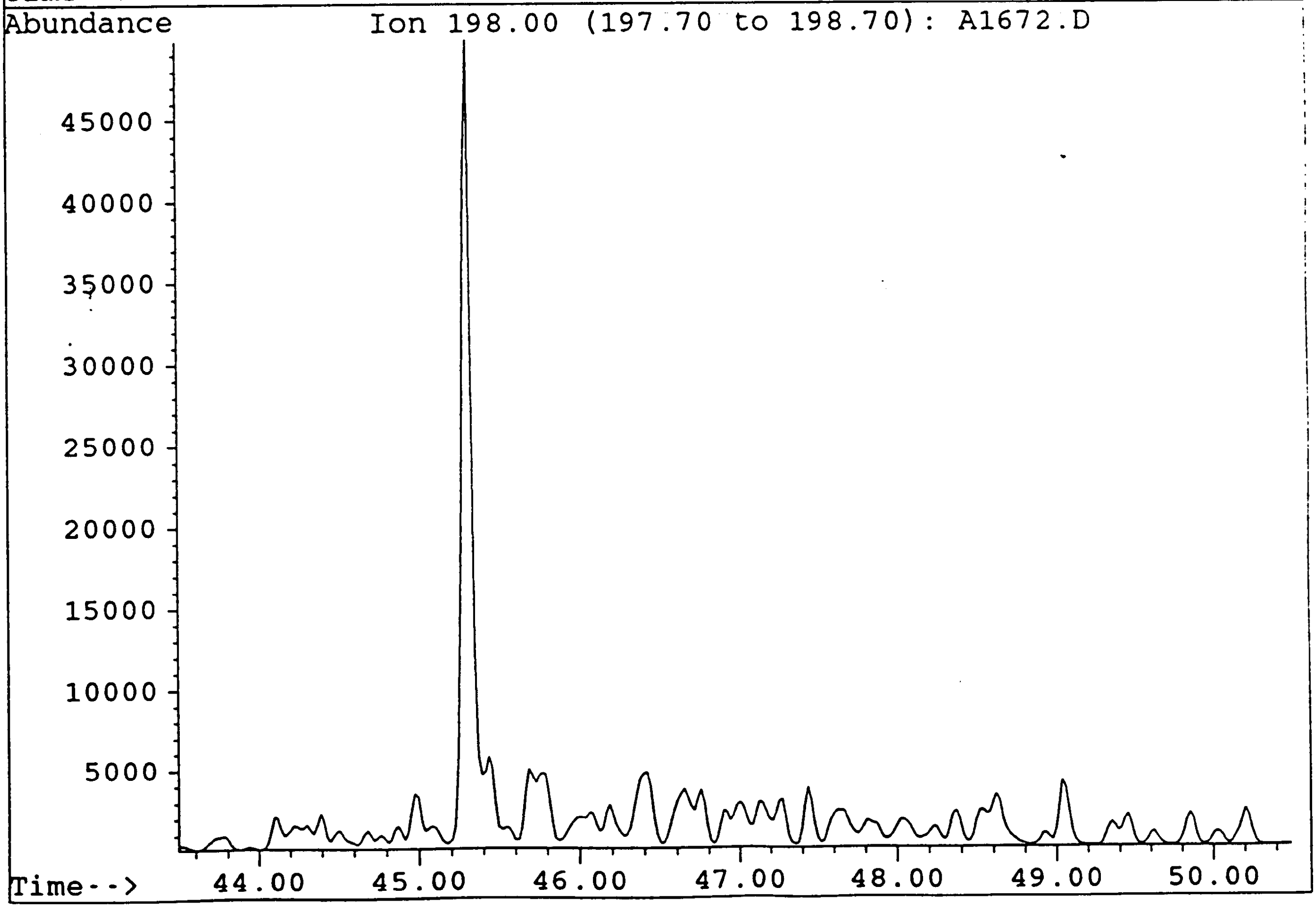
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.



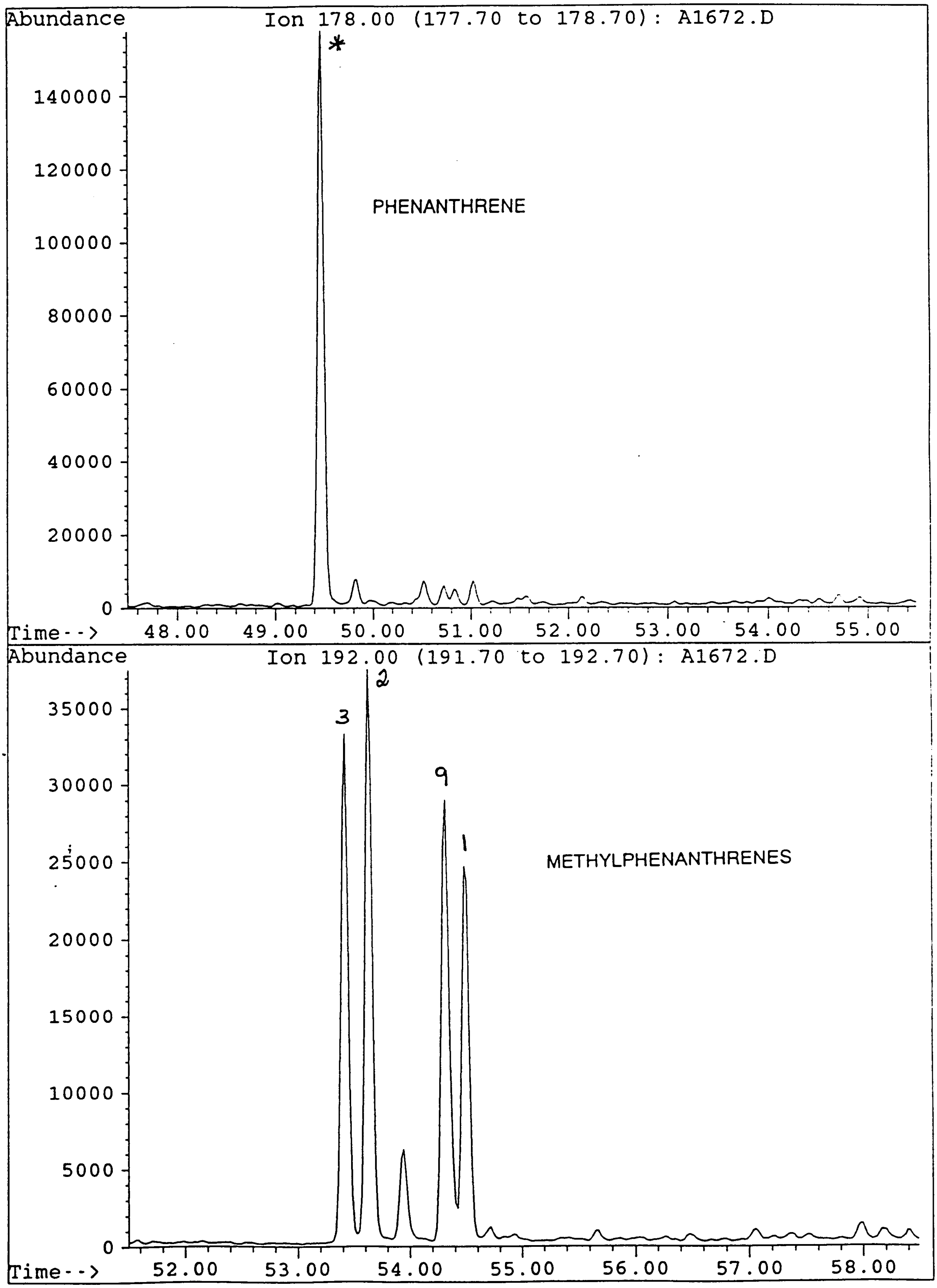


File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.

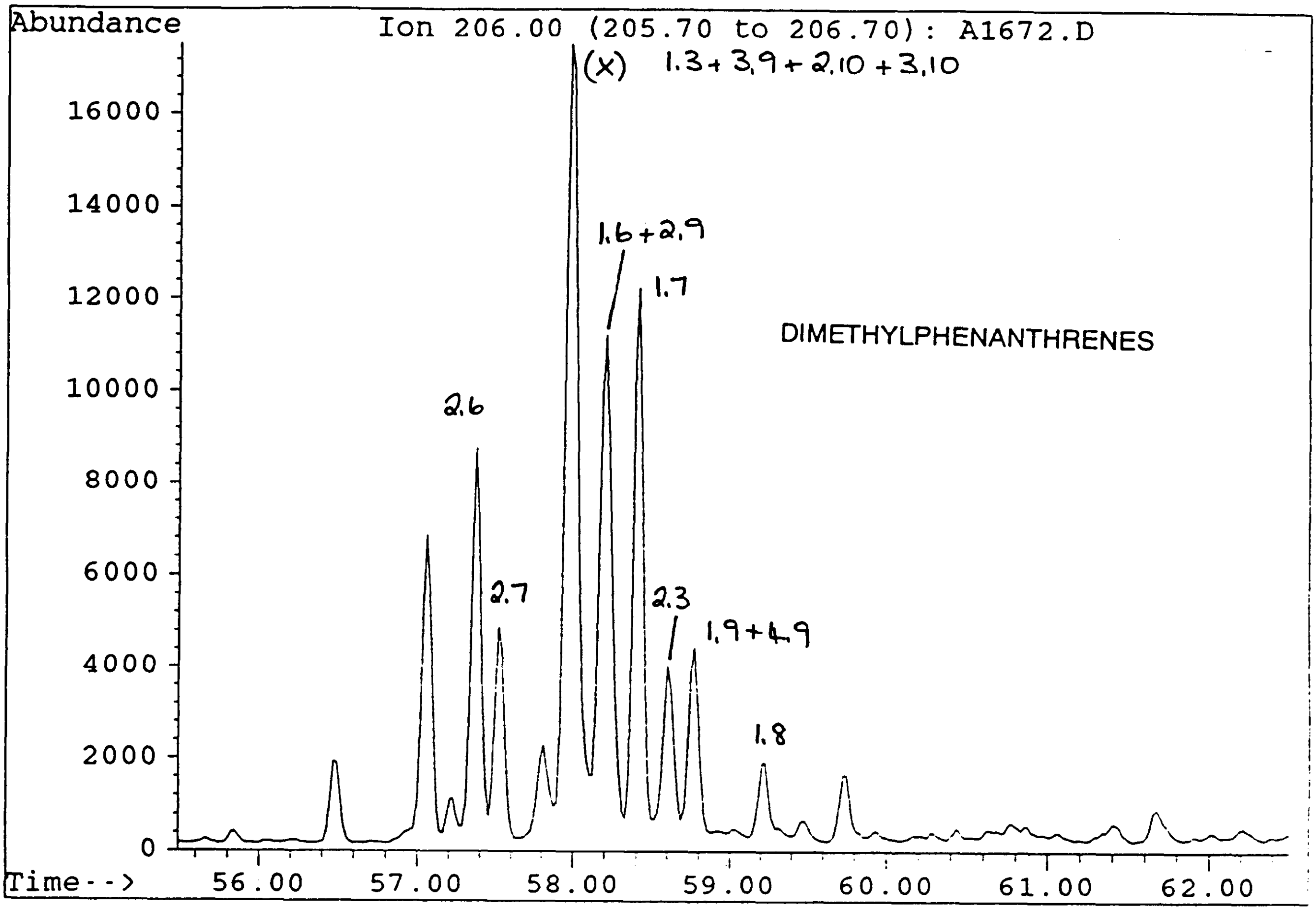




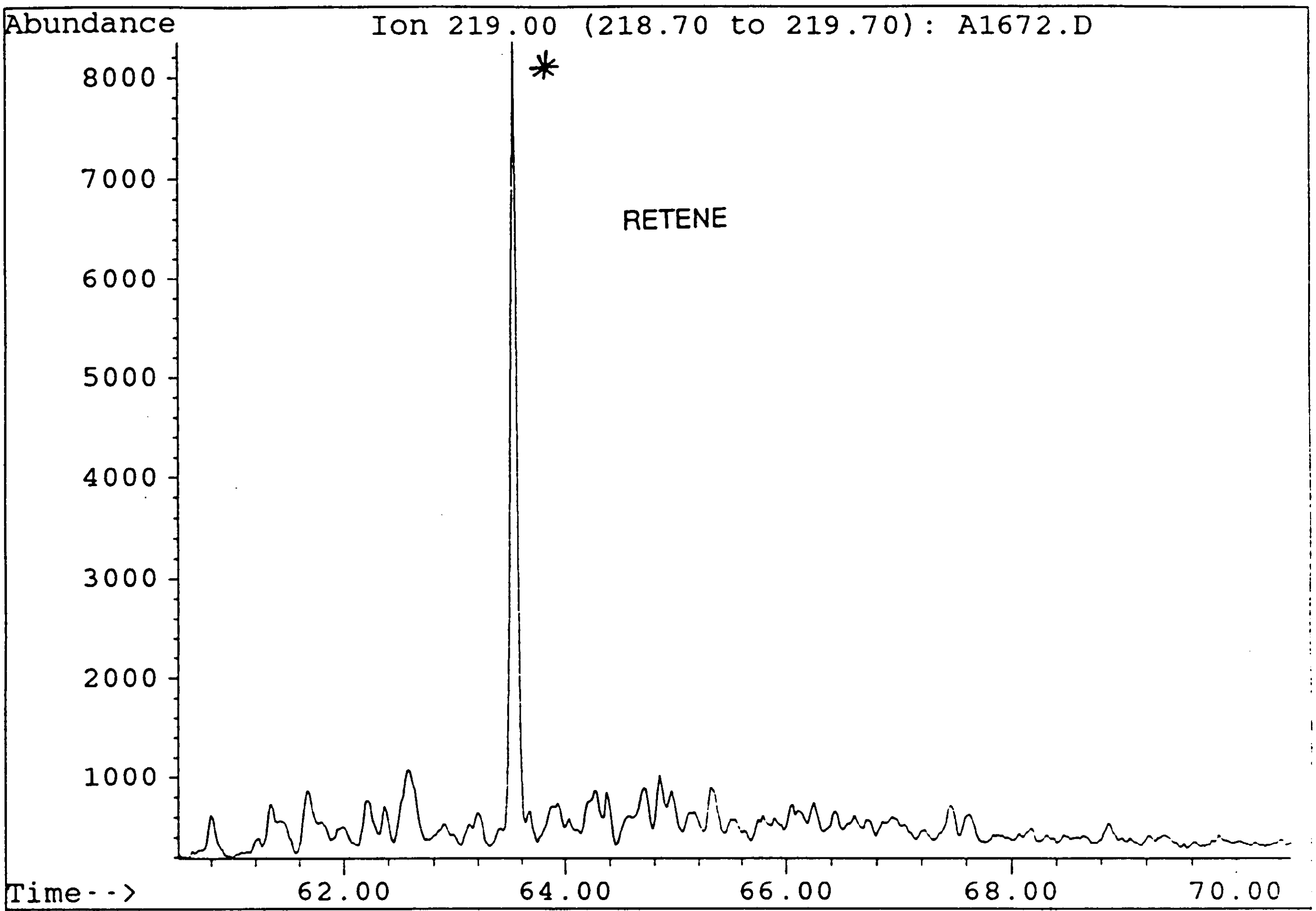
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.

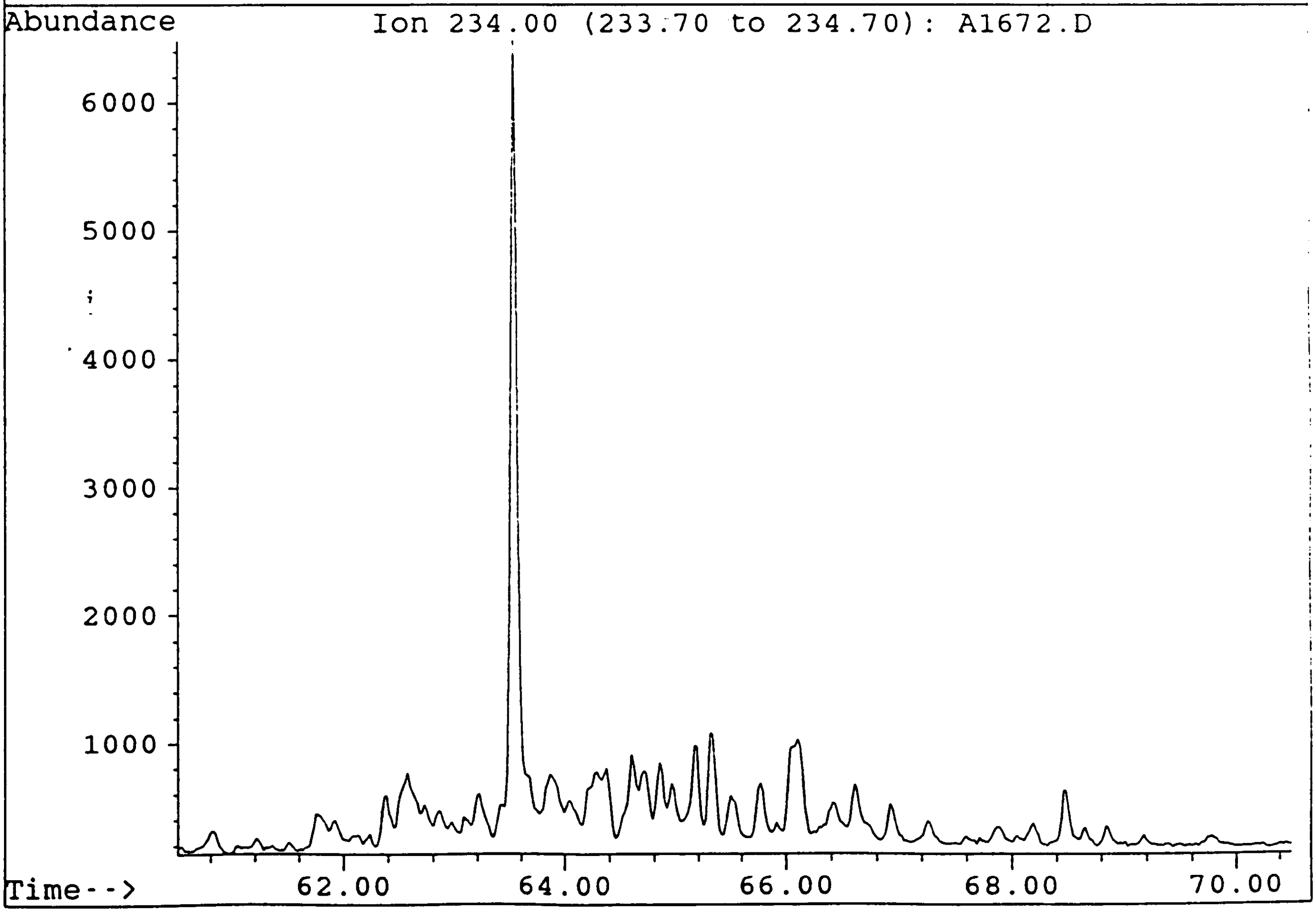


File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.

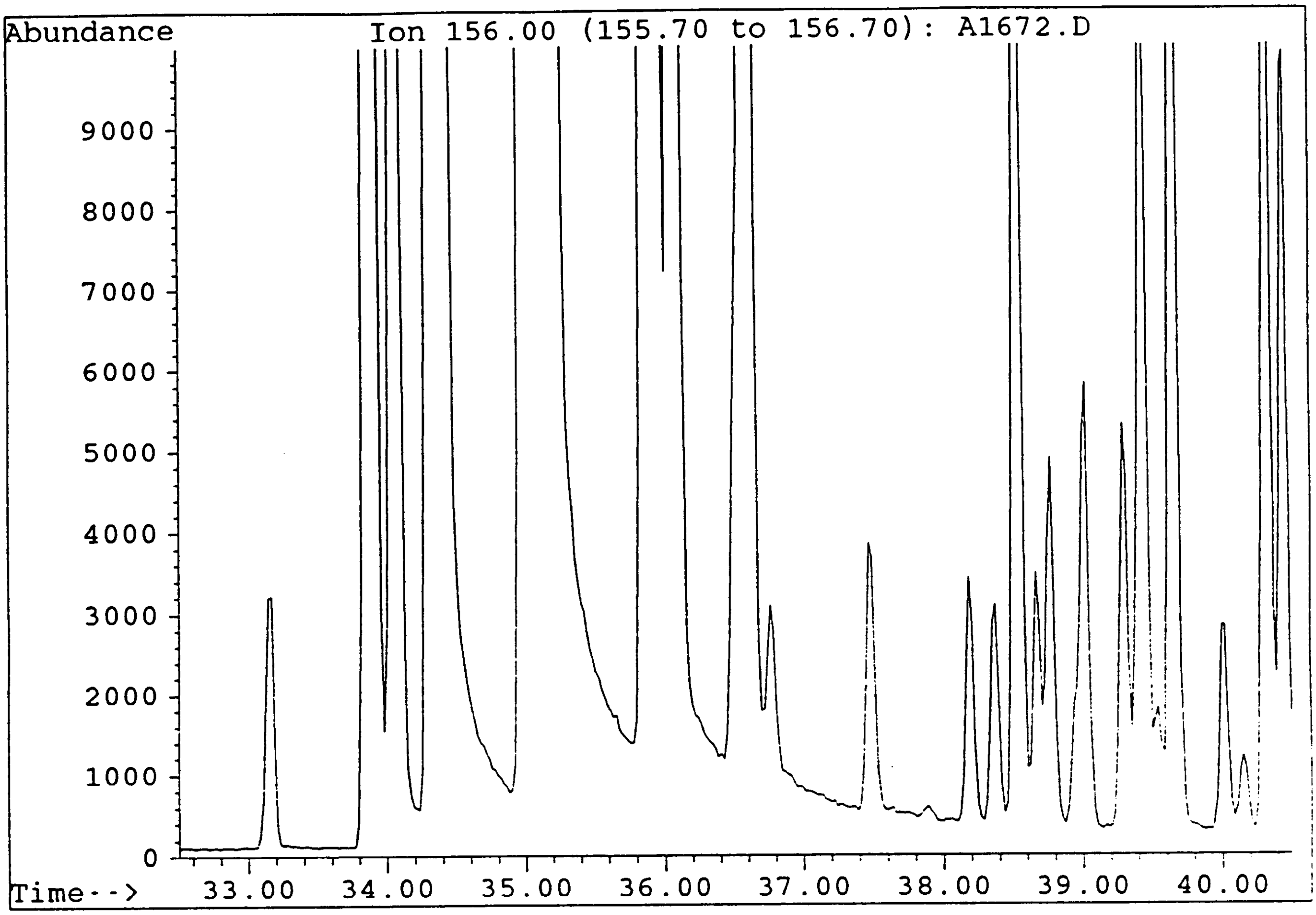


File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.

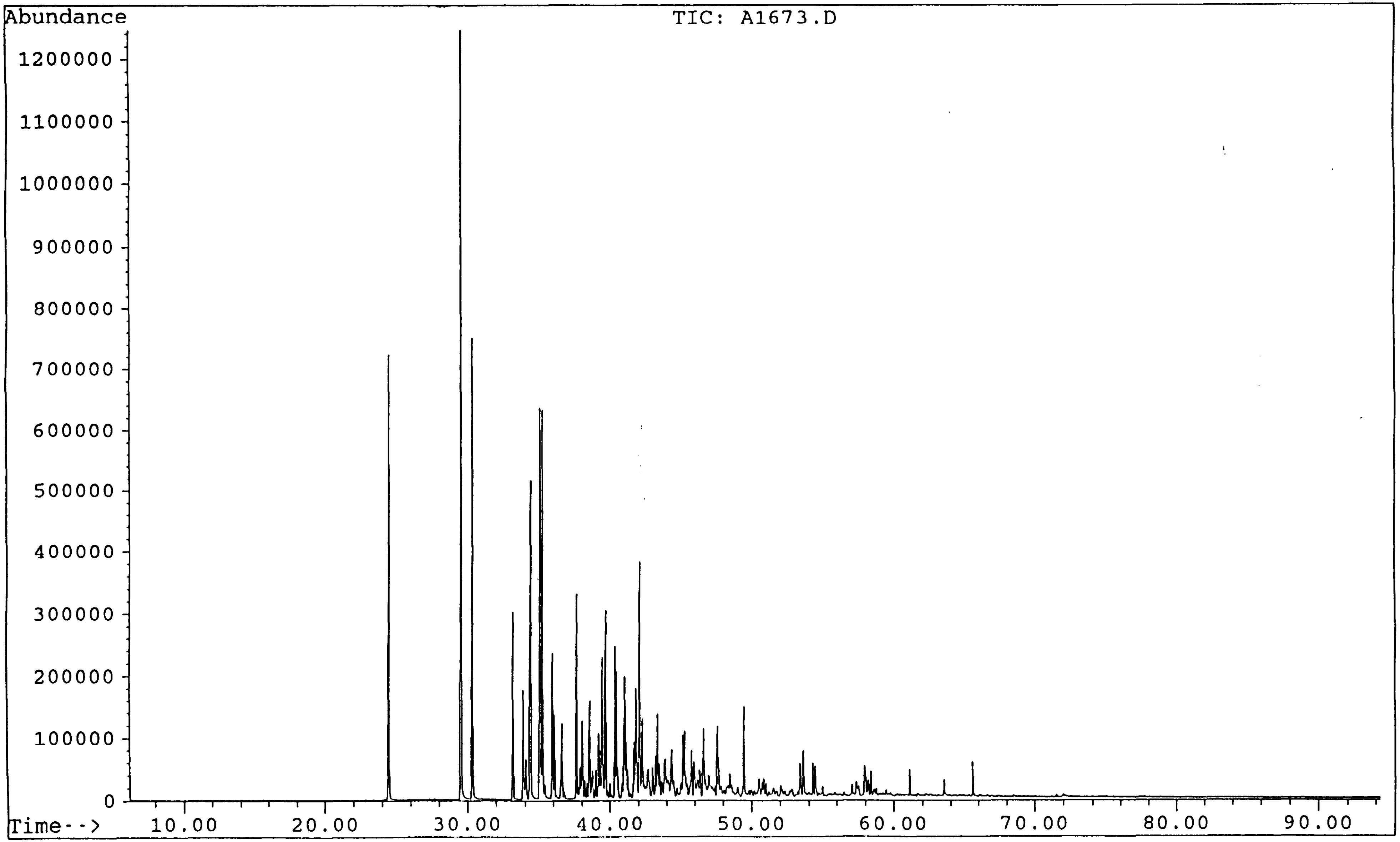




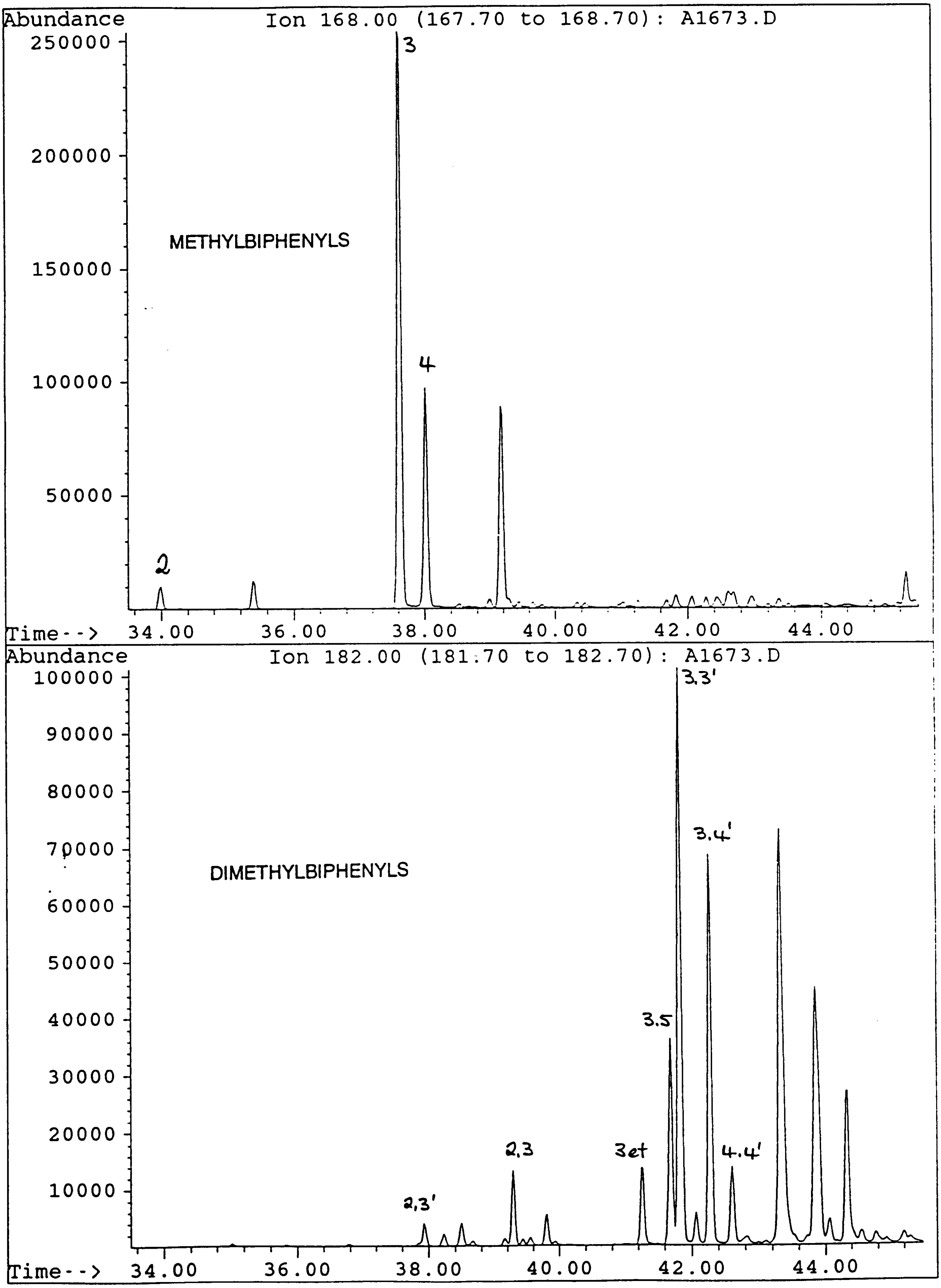
File : A1672.D
Sample : LA BELLA#1, 2072.8m, TLC ARO.
Misc. Info : COL#155. 1/140uL. 26-10-93. GEC.



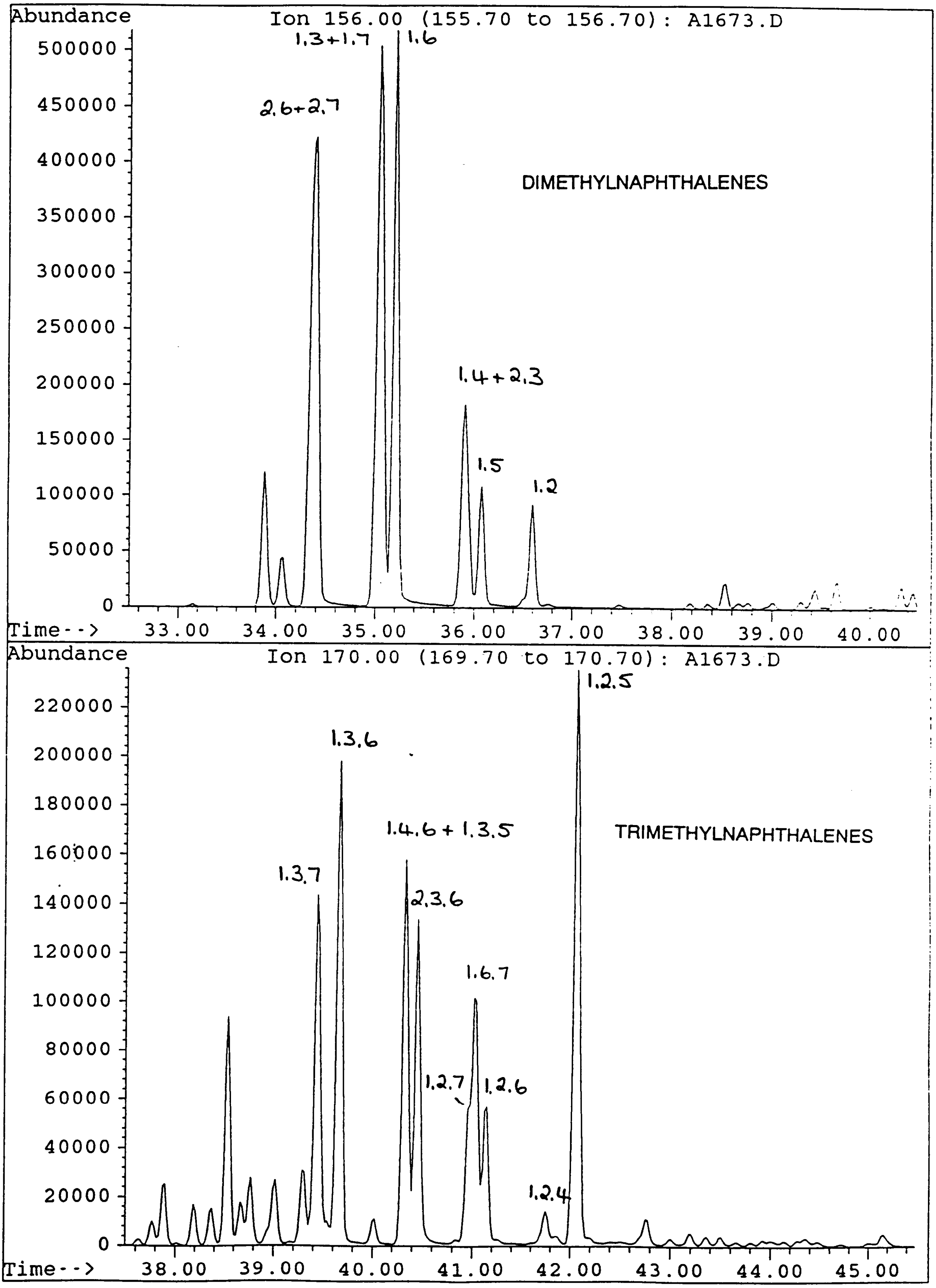
File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.



File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

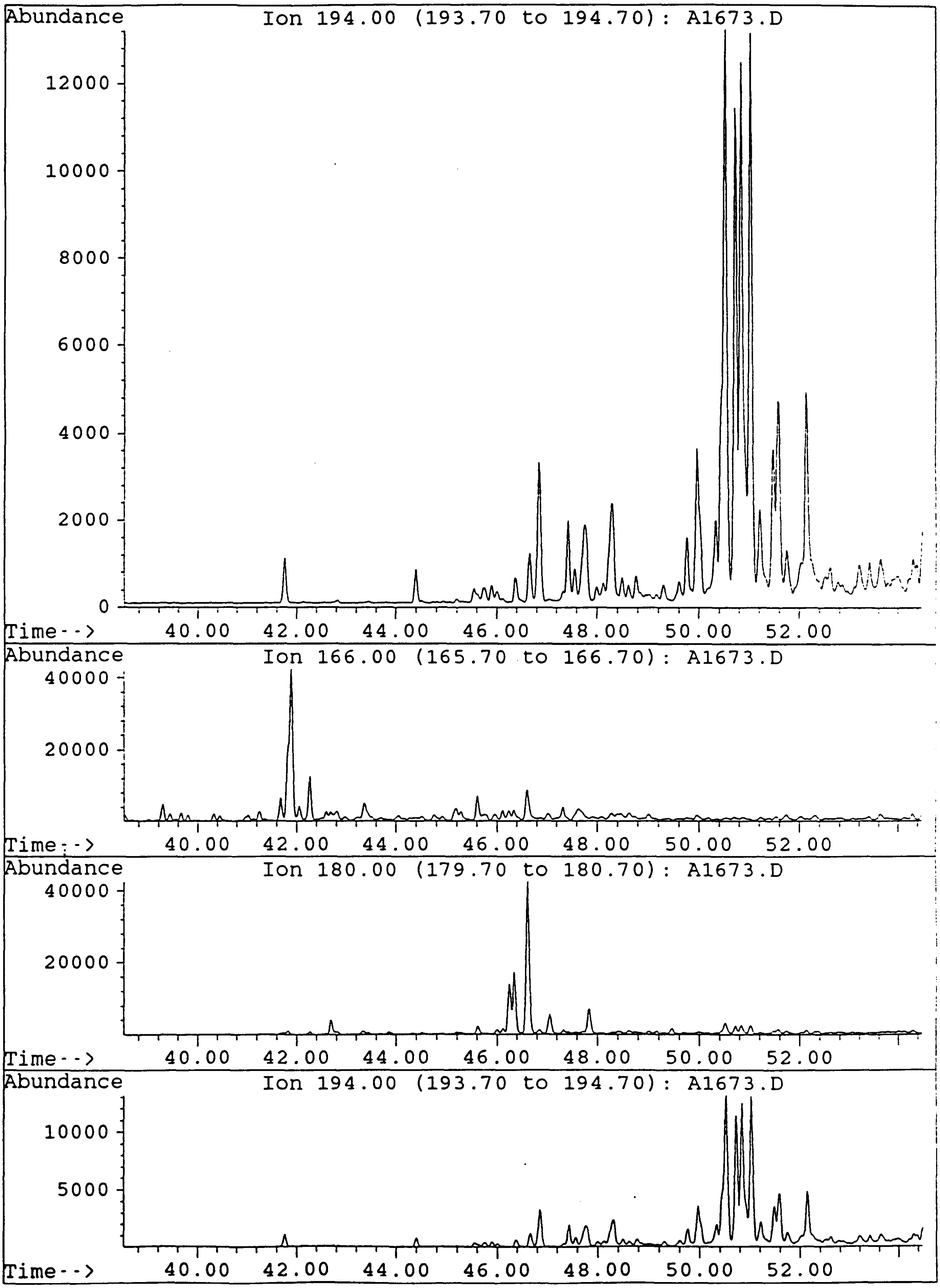


File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

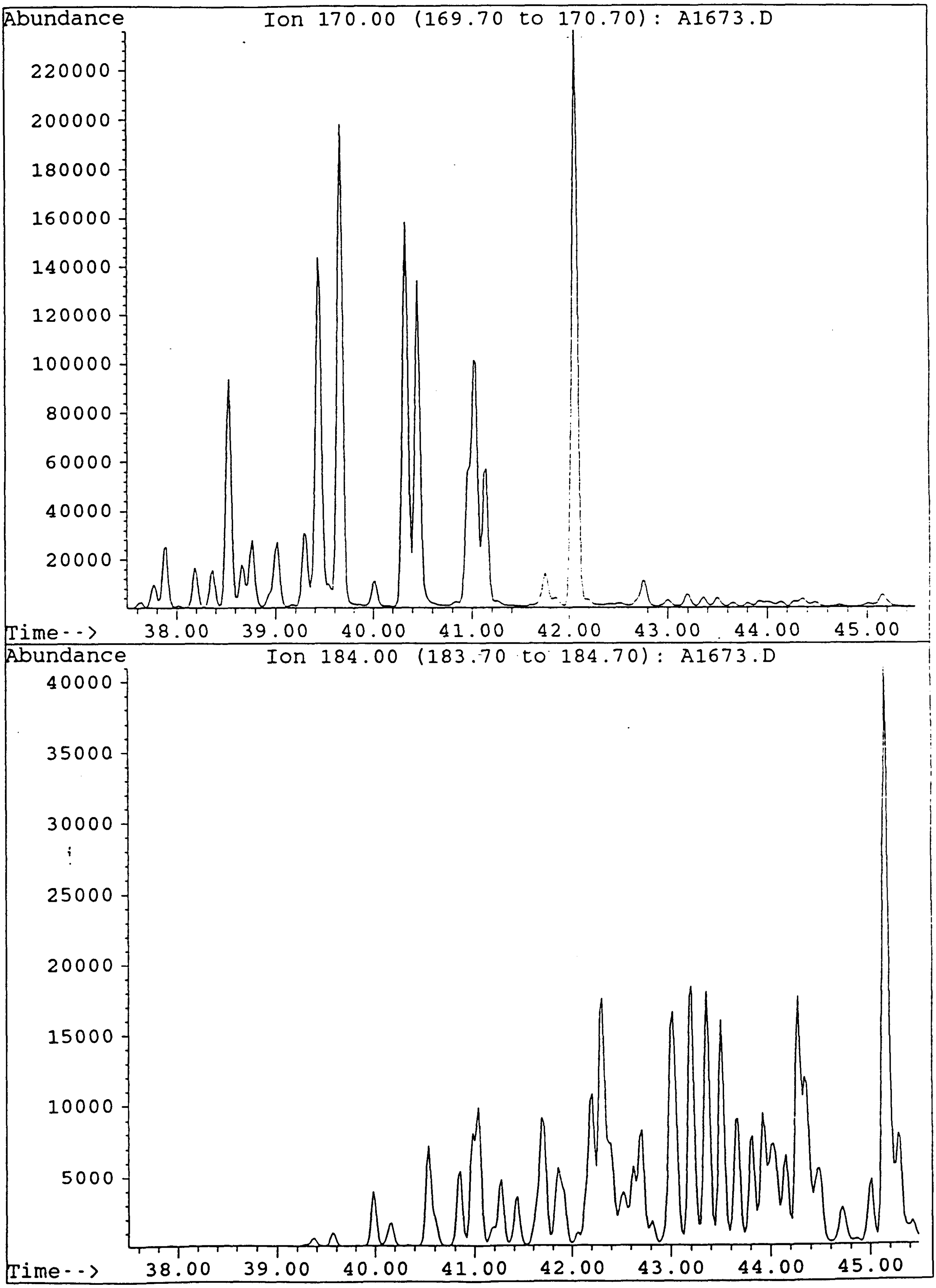


File :   A1673.D
Sample :   LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info :   COL#155. 1/70uL. 26-10-93. GEC.

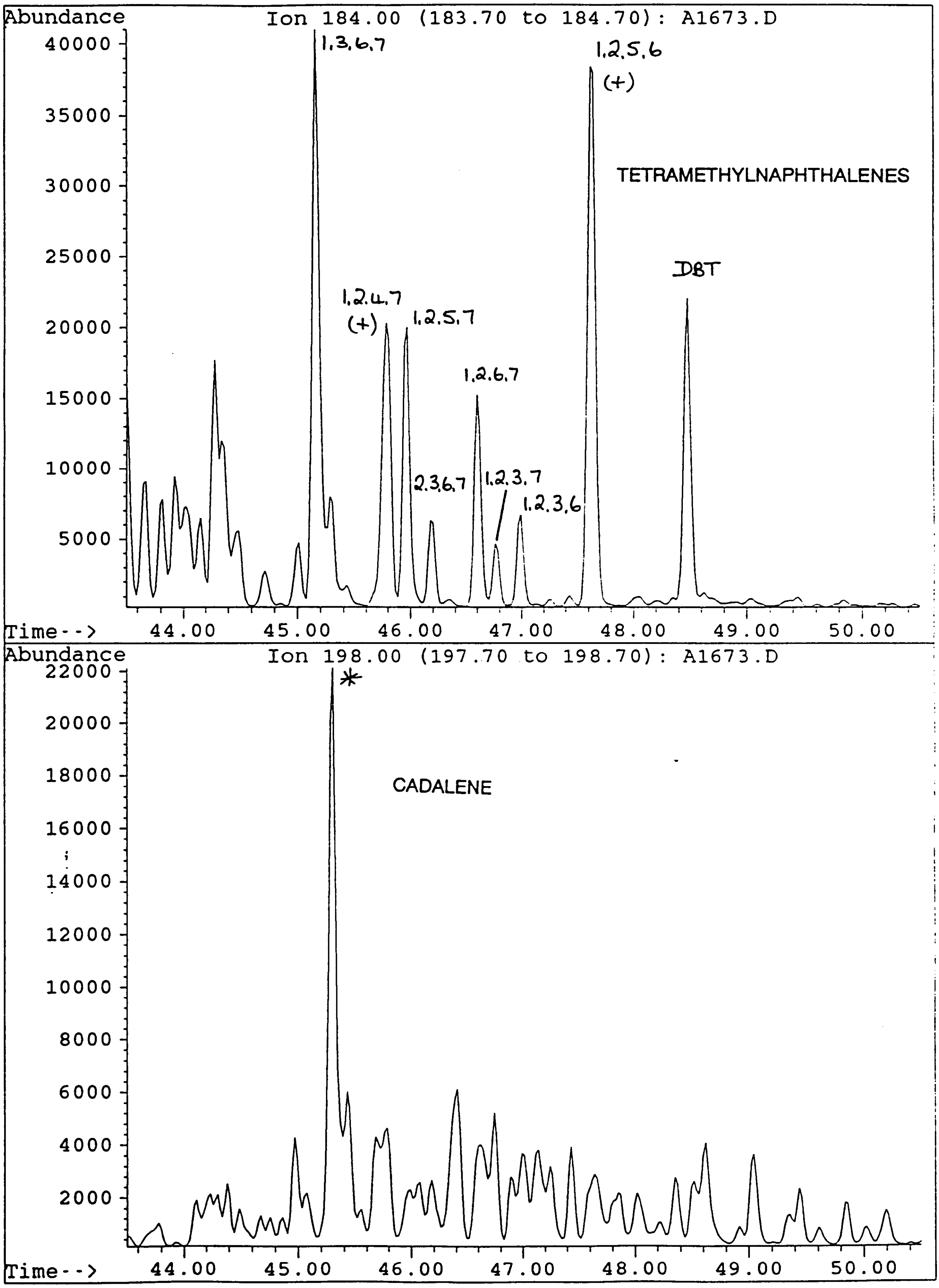
FLUORENES



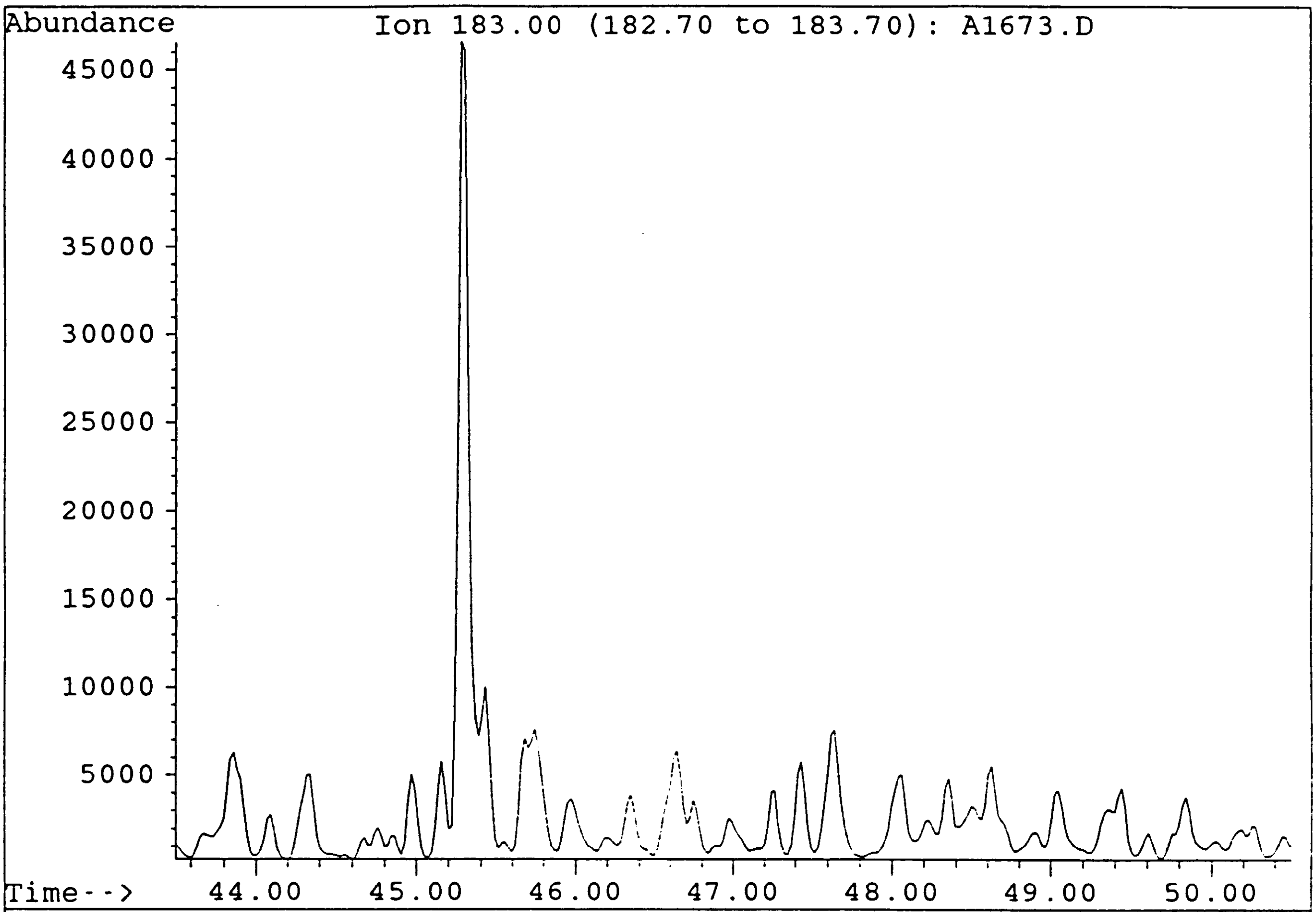
File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

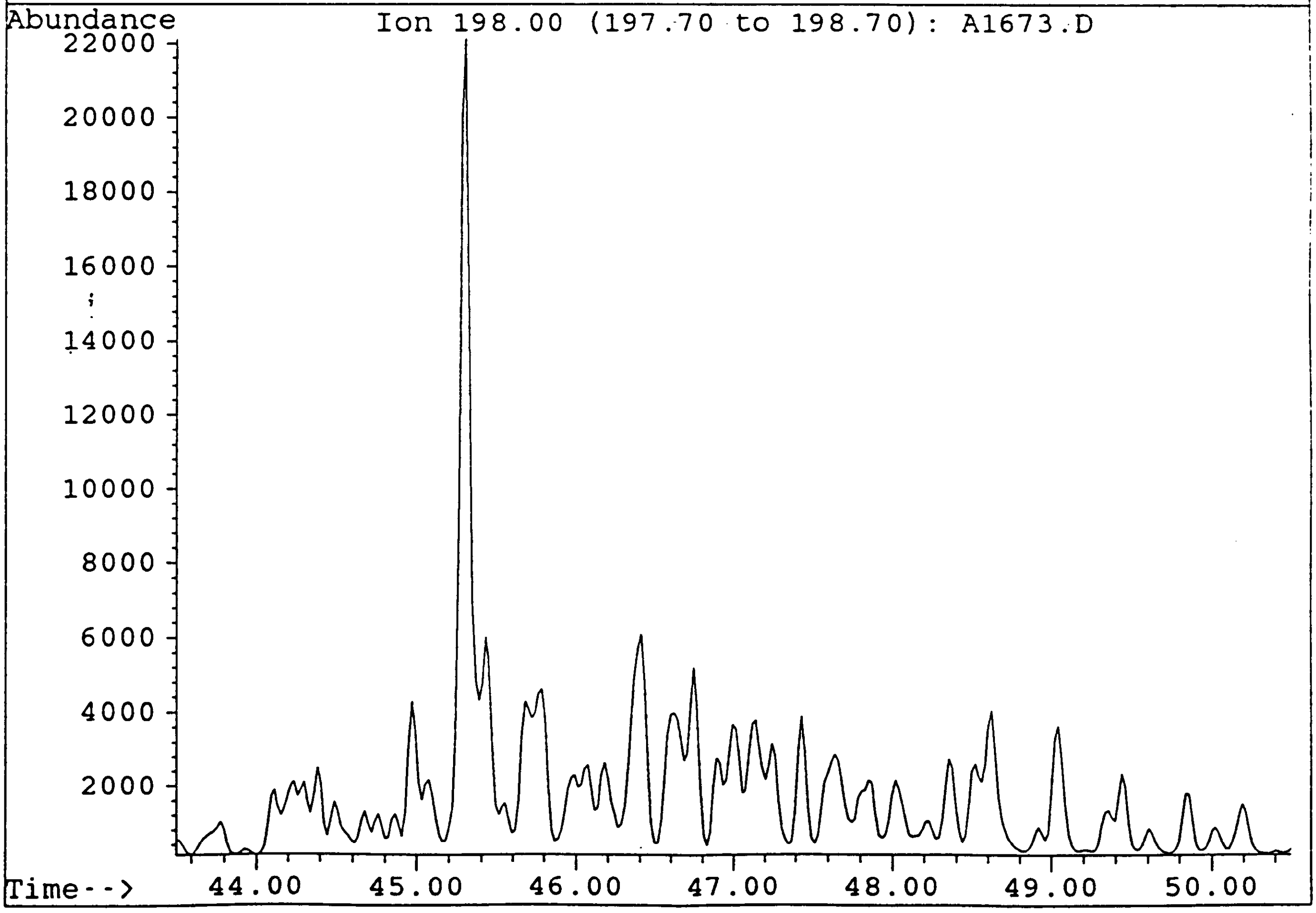


File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

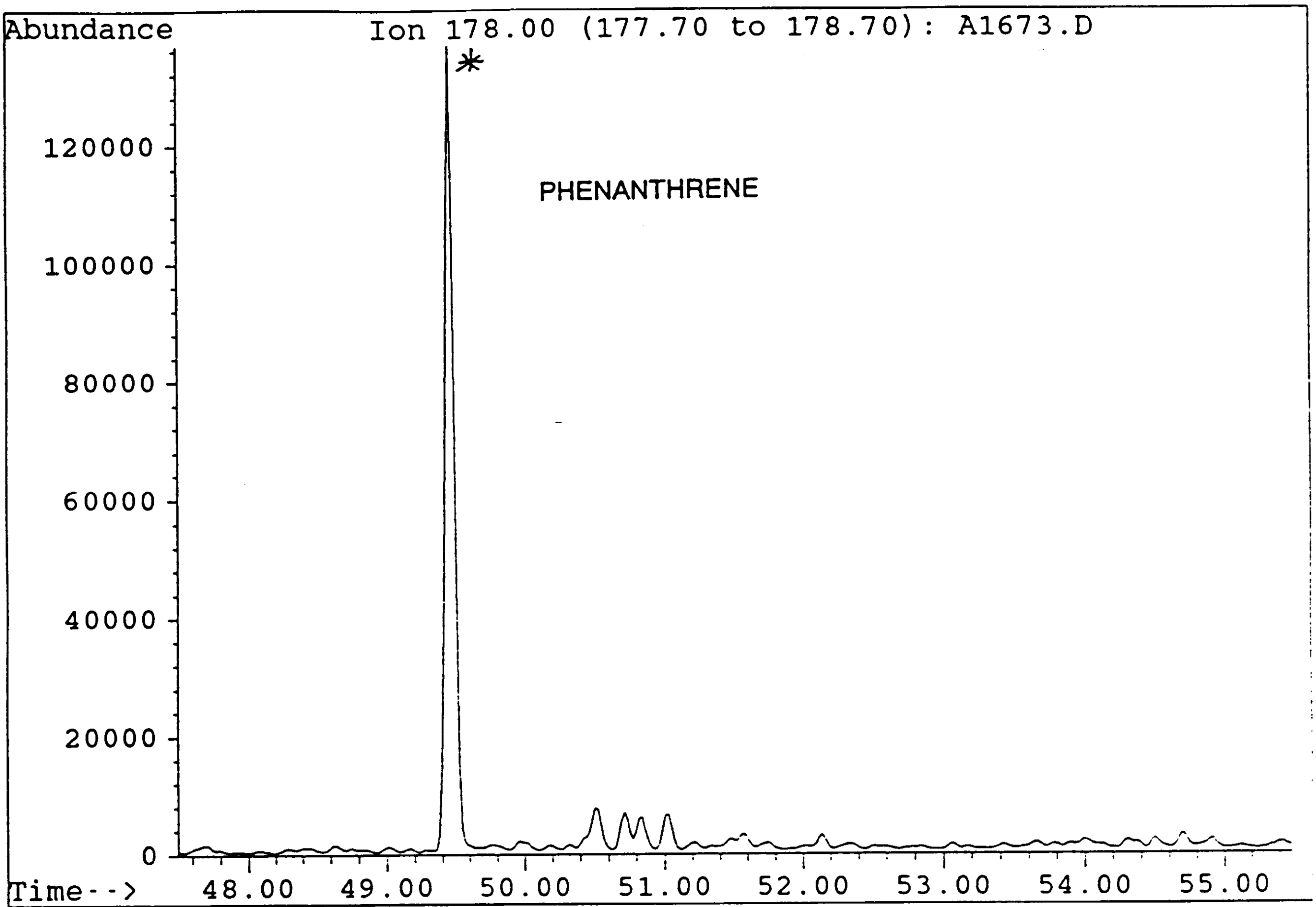


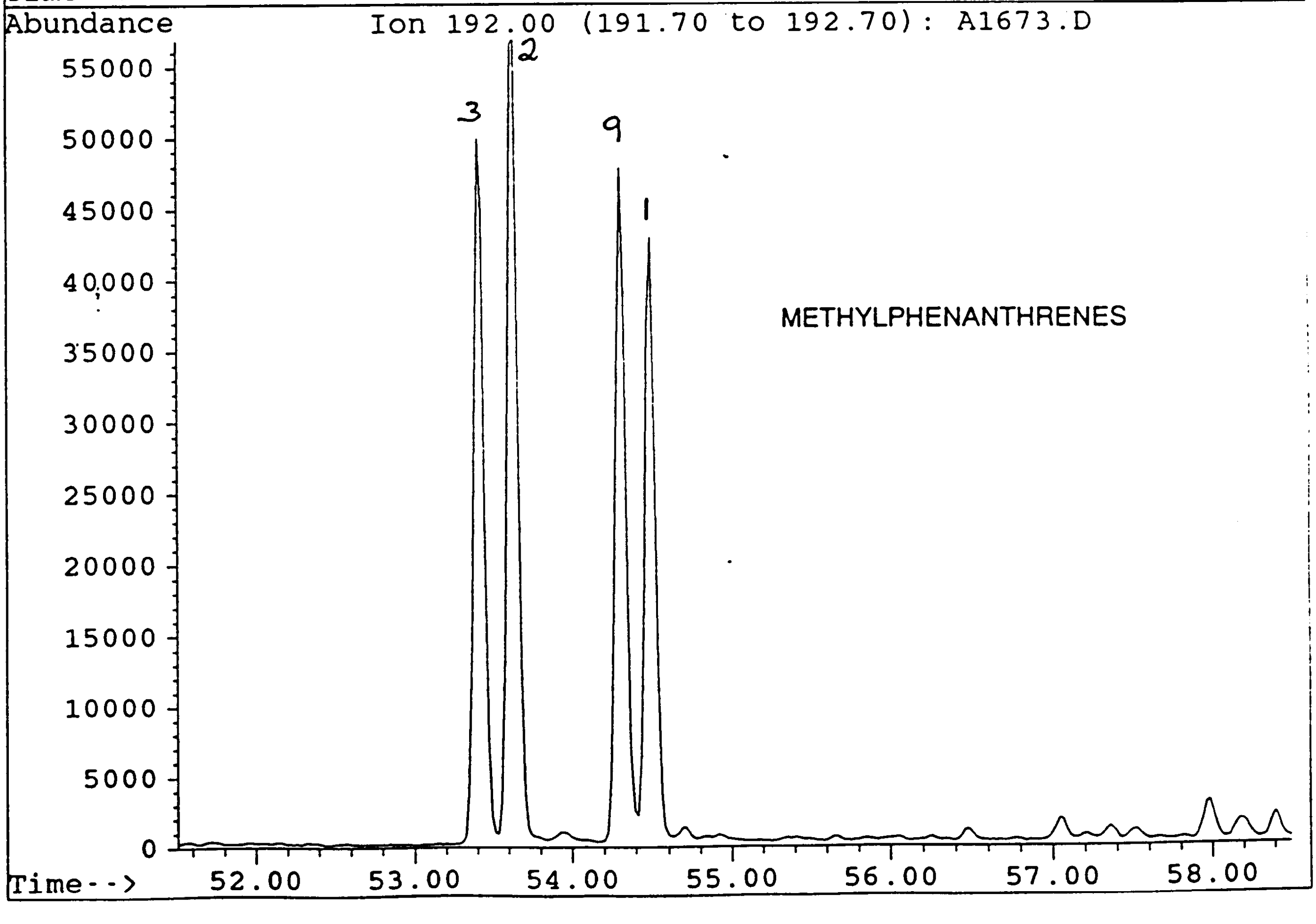
File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.



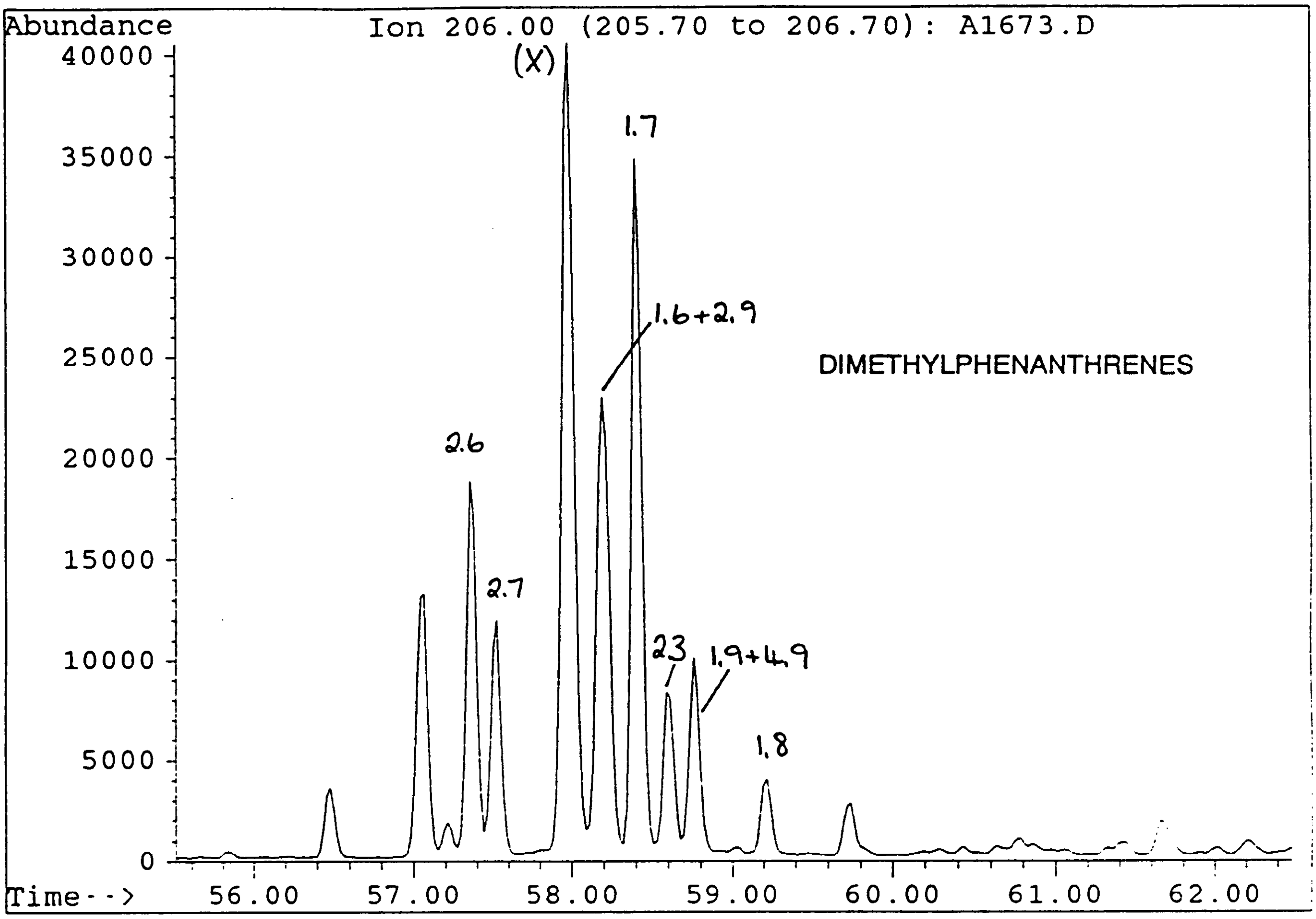


File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

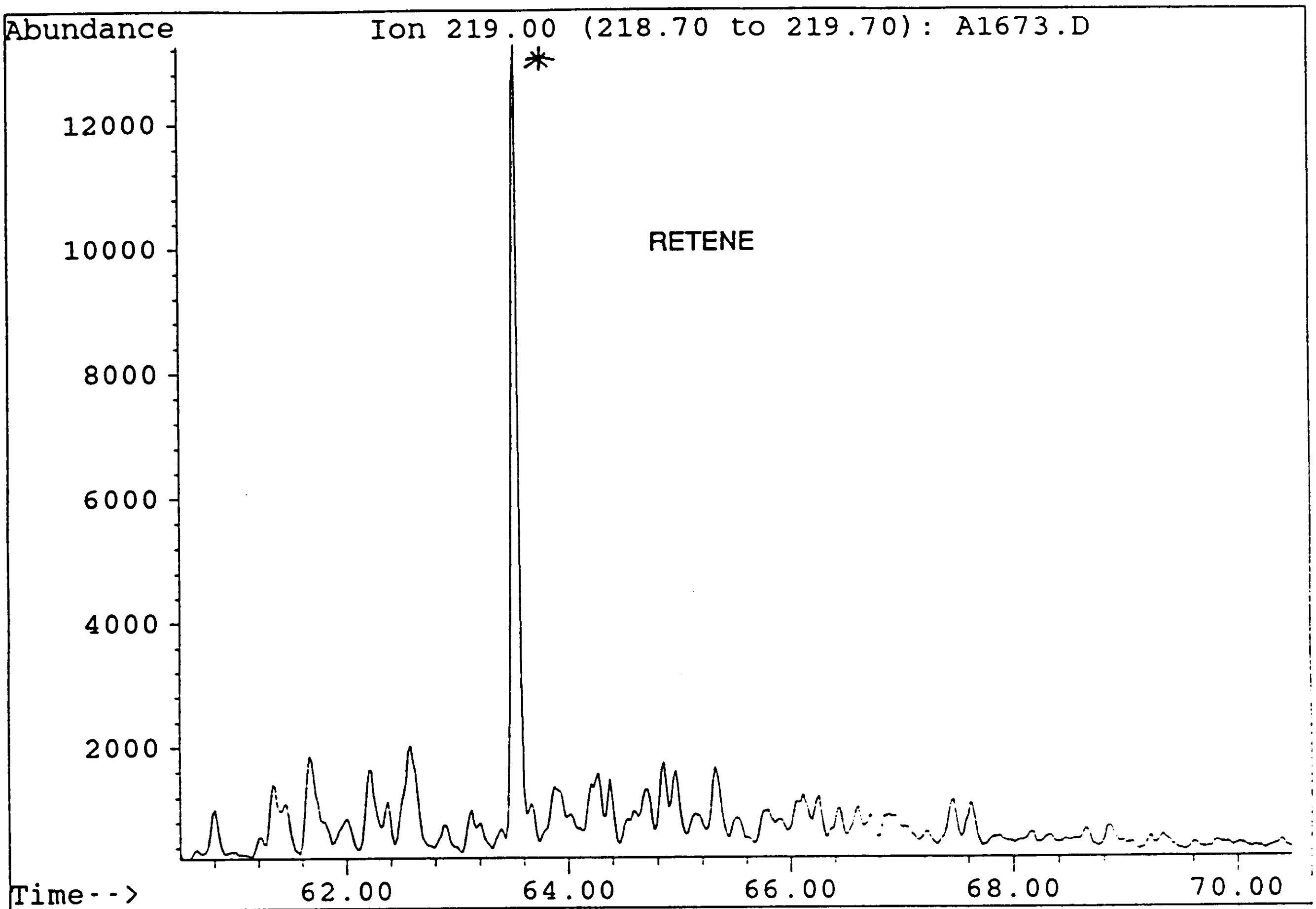


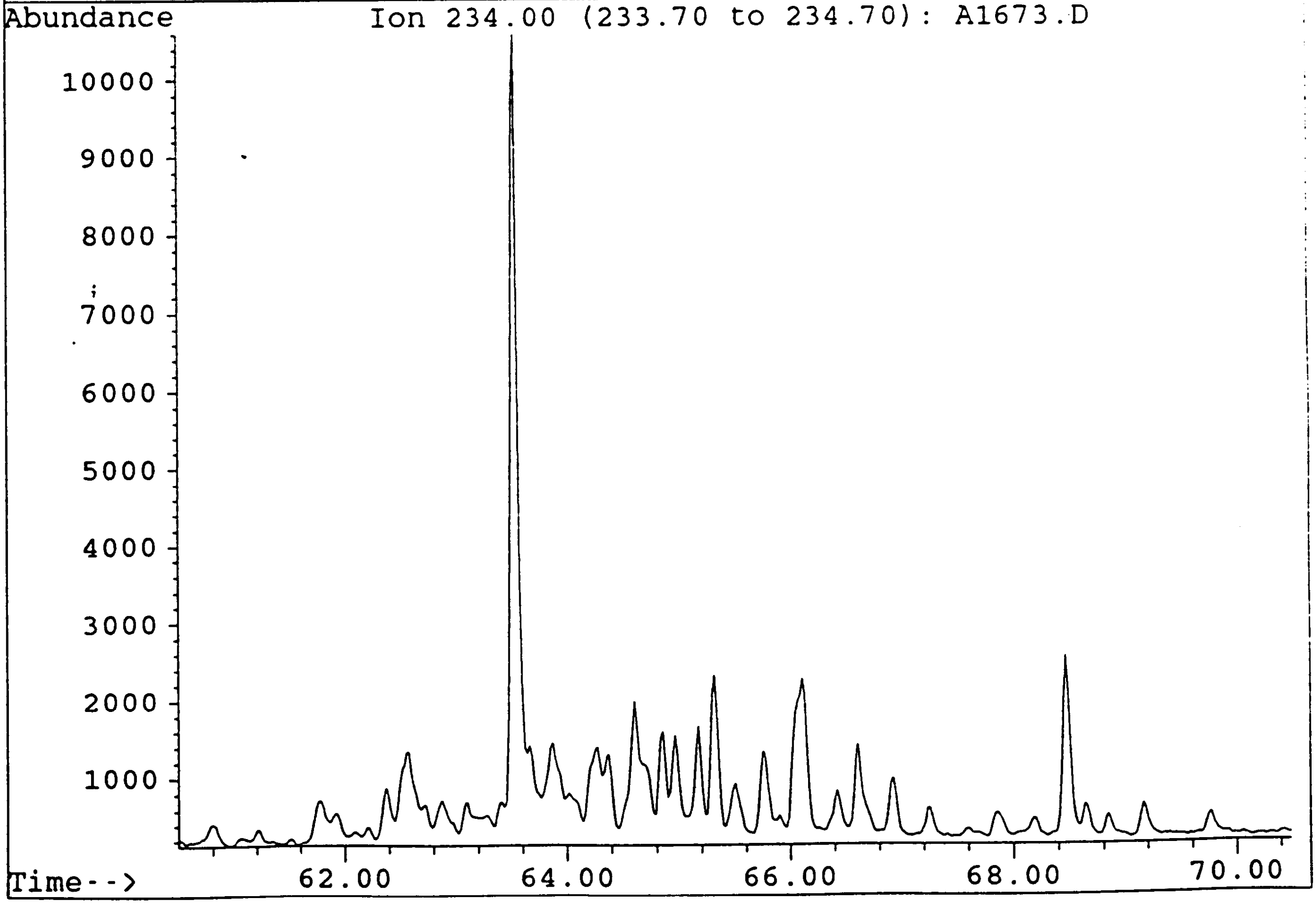


File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.

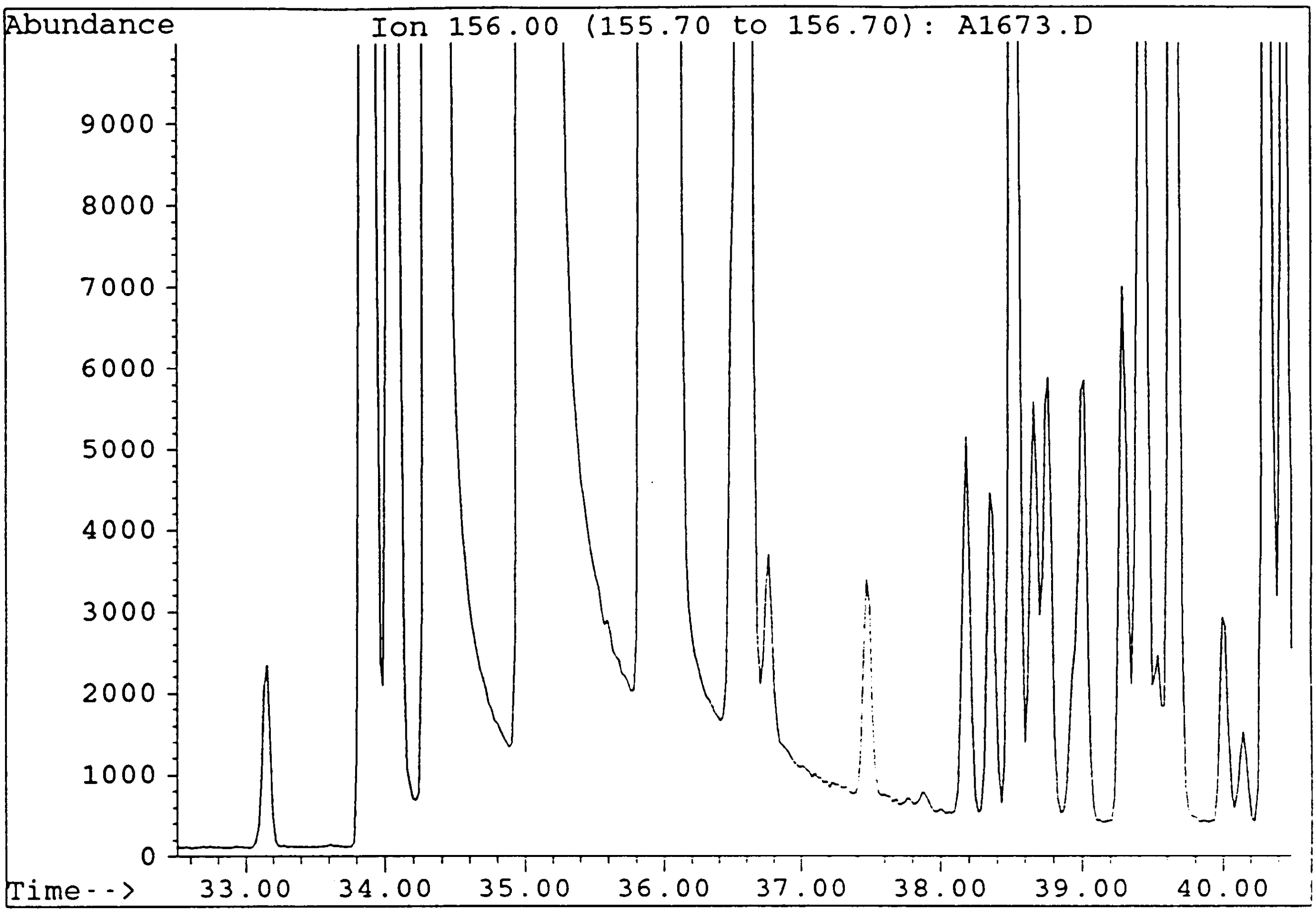


File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.





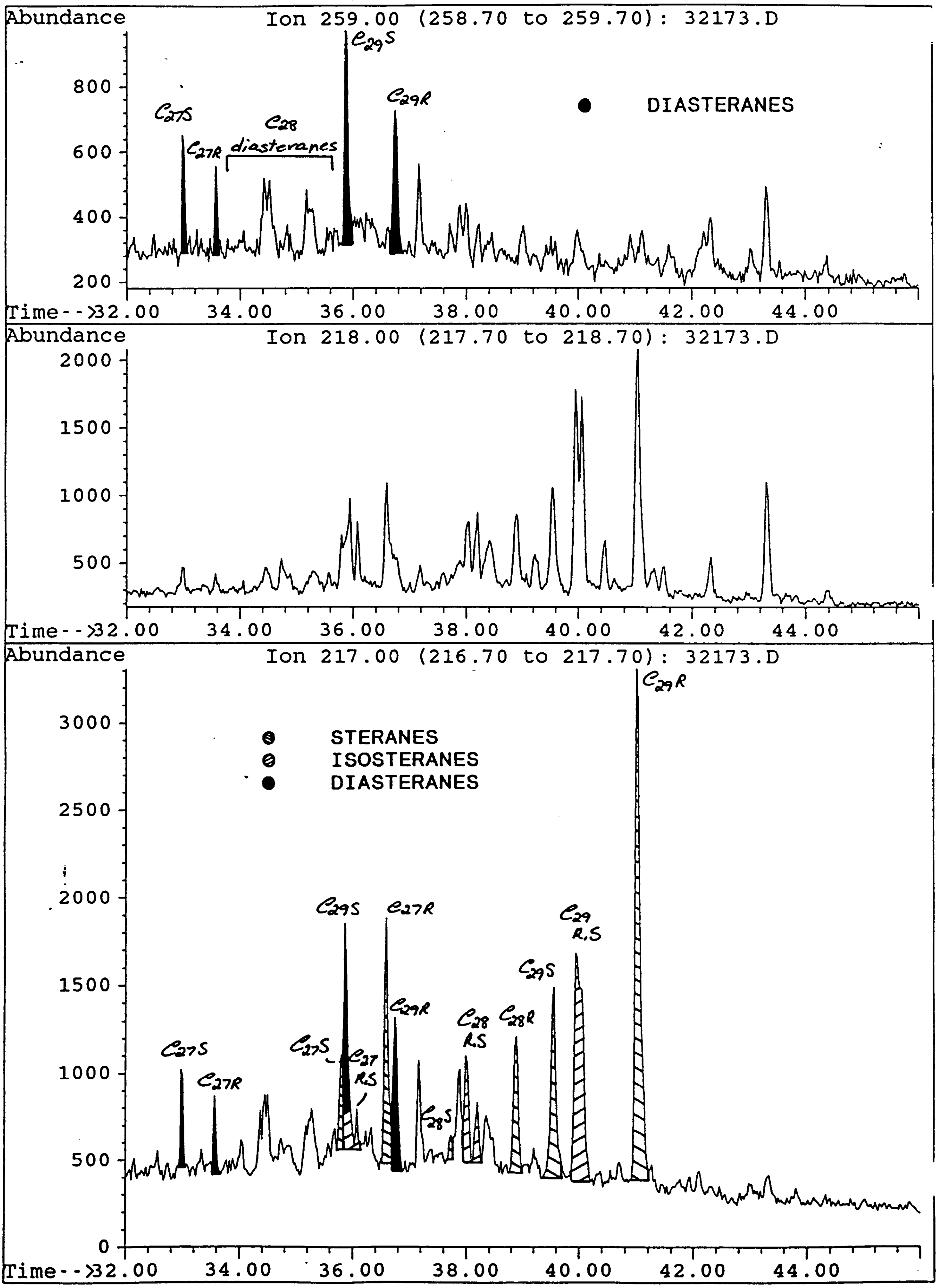
File : A1673.D
Sample : LA BELLA#1, 2160.5m, TLC ARO.
Misc. Info : COL#155. 1/70uL. 26-10-93. GEC.



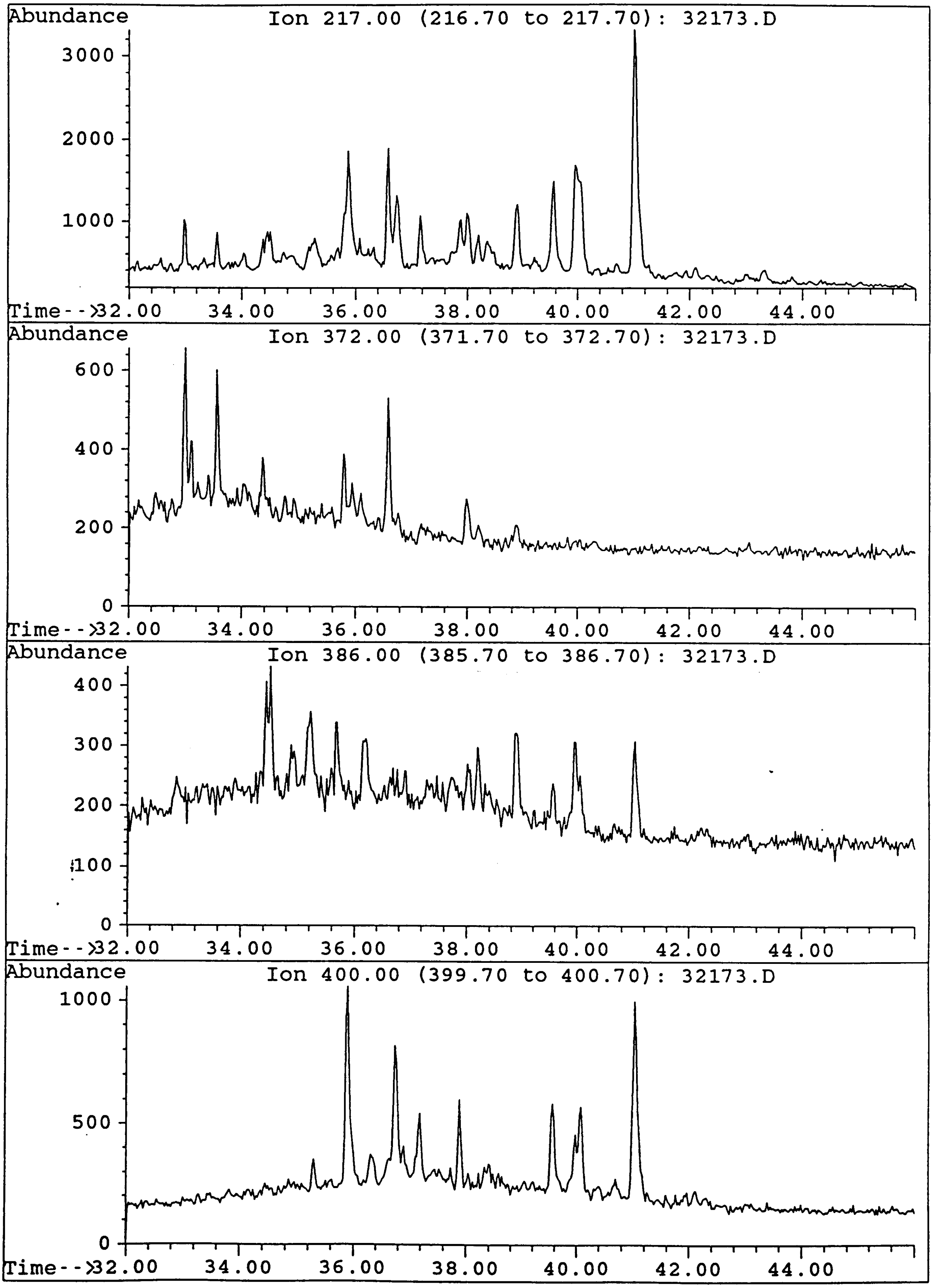
APPENDIX 3

SIR GC-MS (B/C) MASS FRAGMENTOGRAMS : EXTRACTS

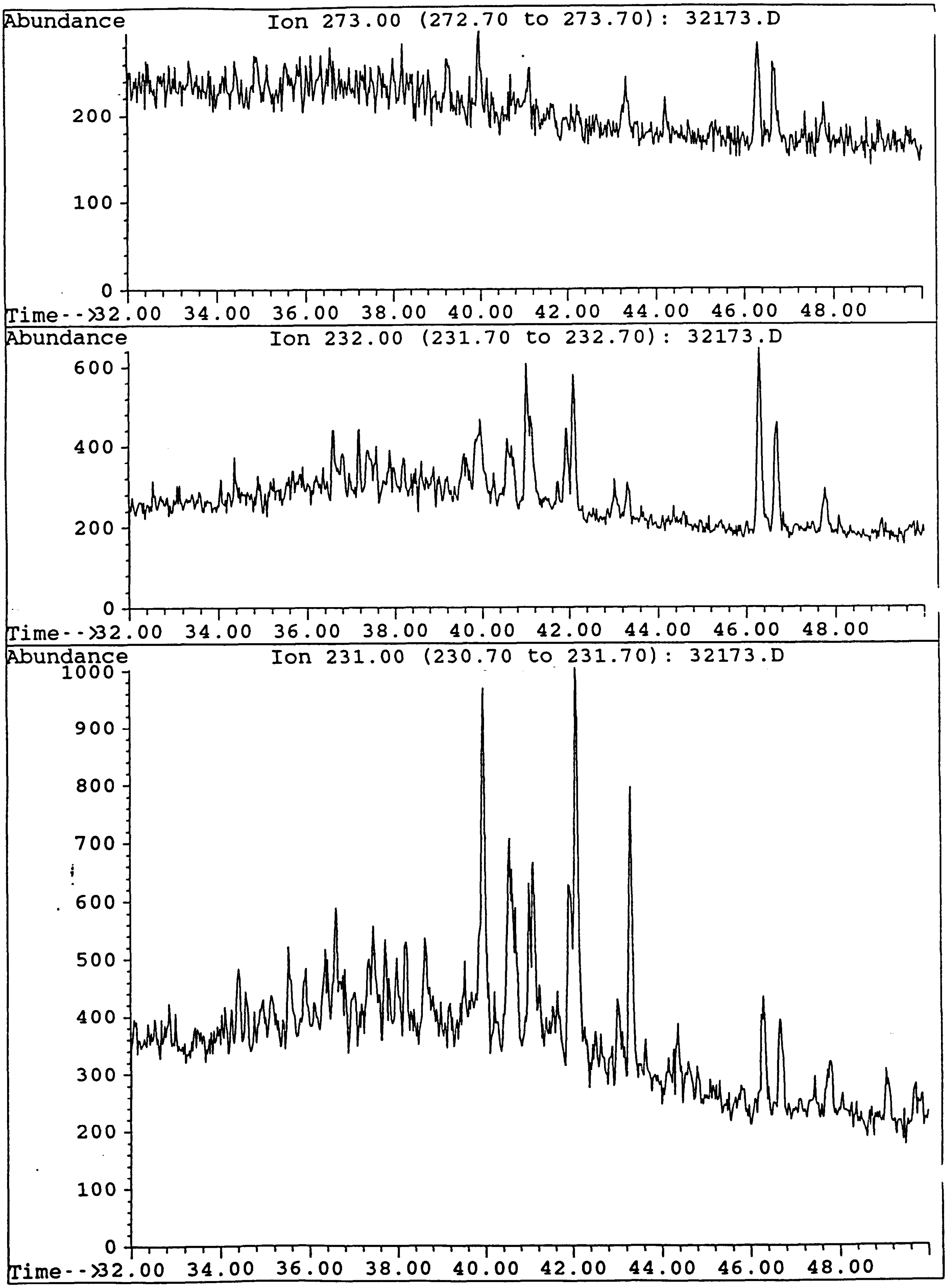
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



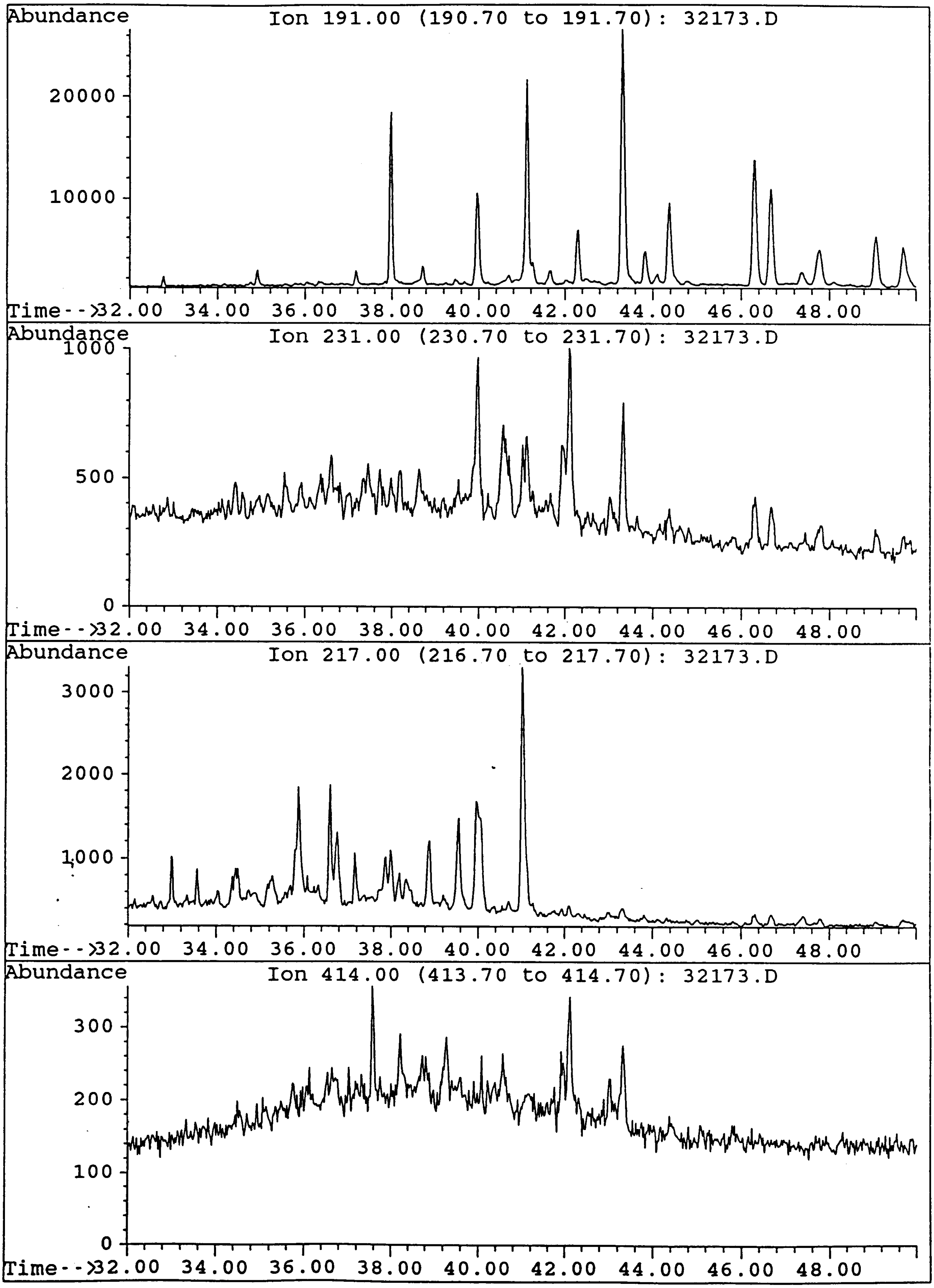
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



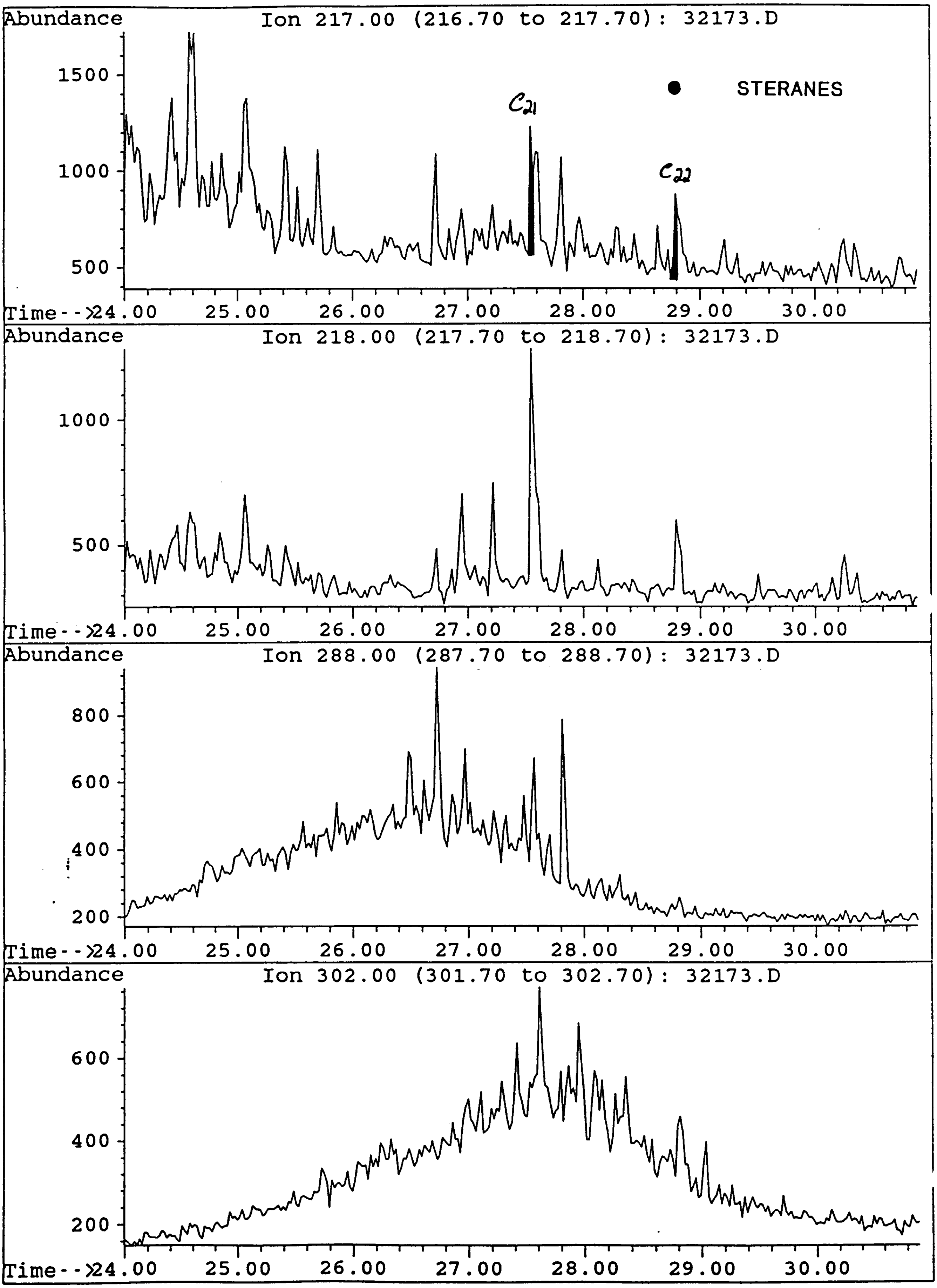
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



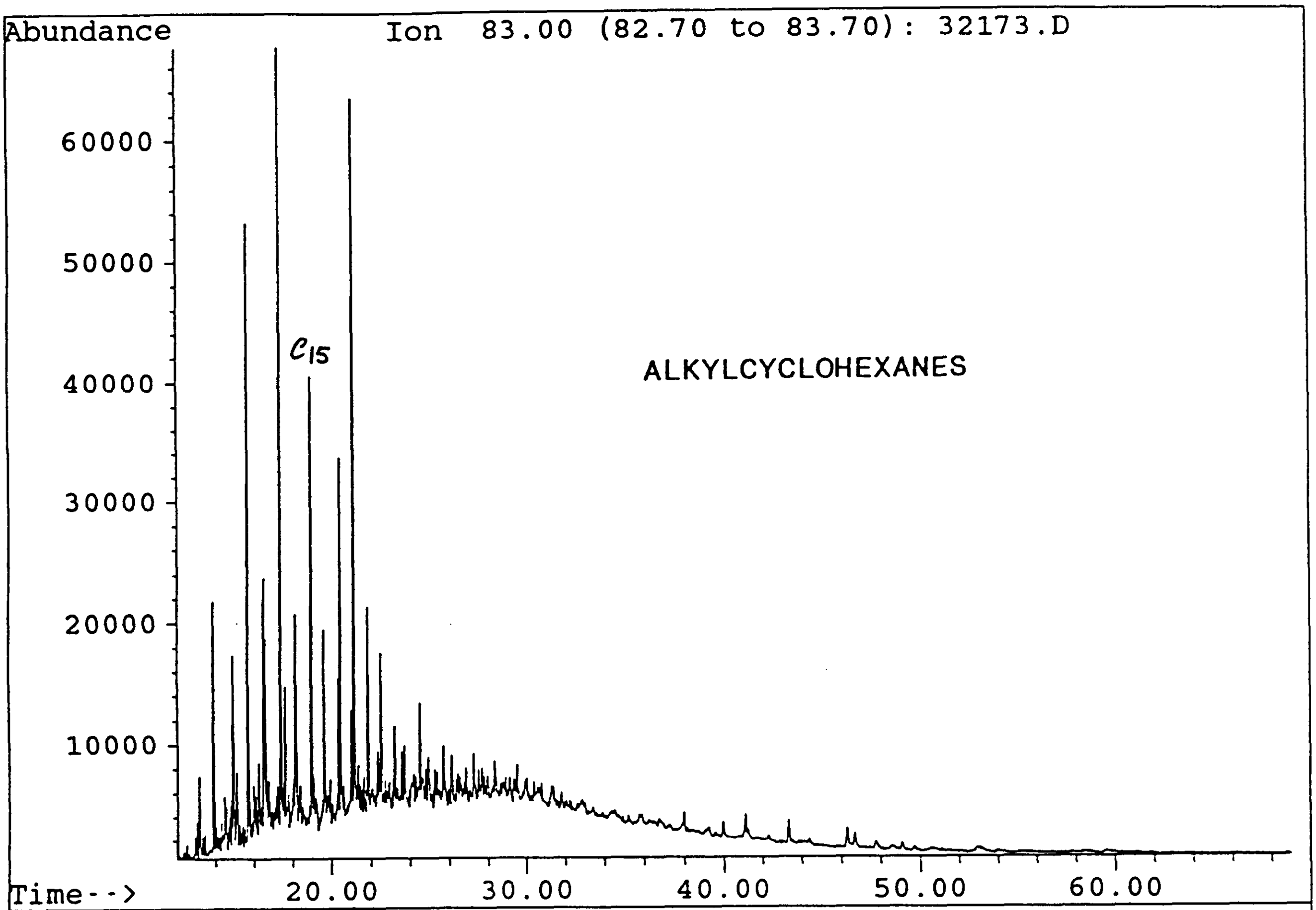
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC

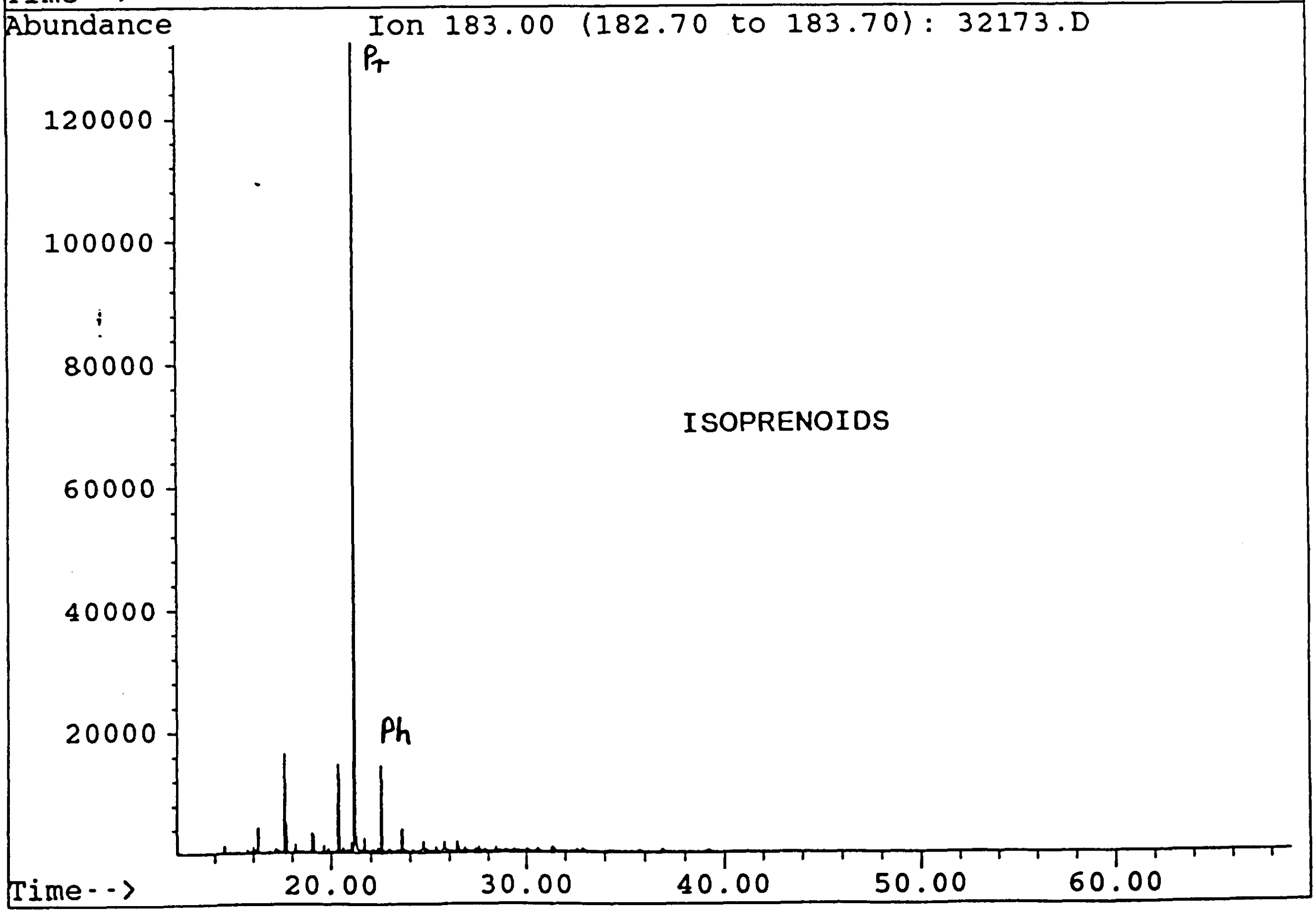


File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC

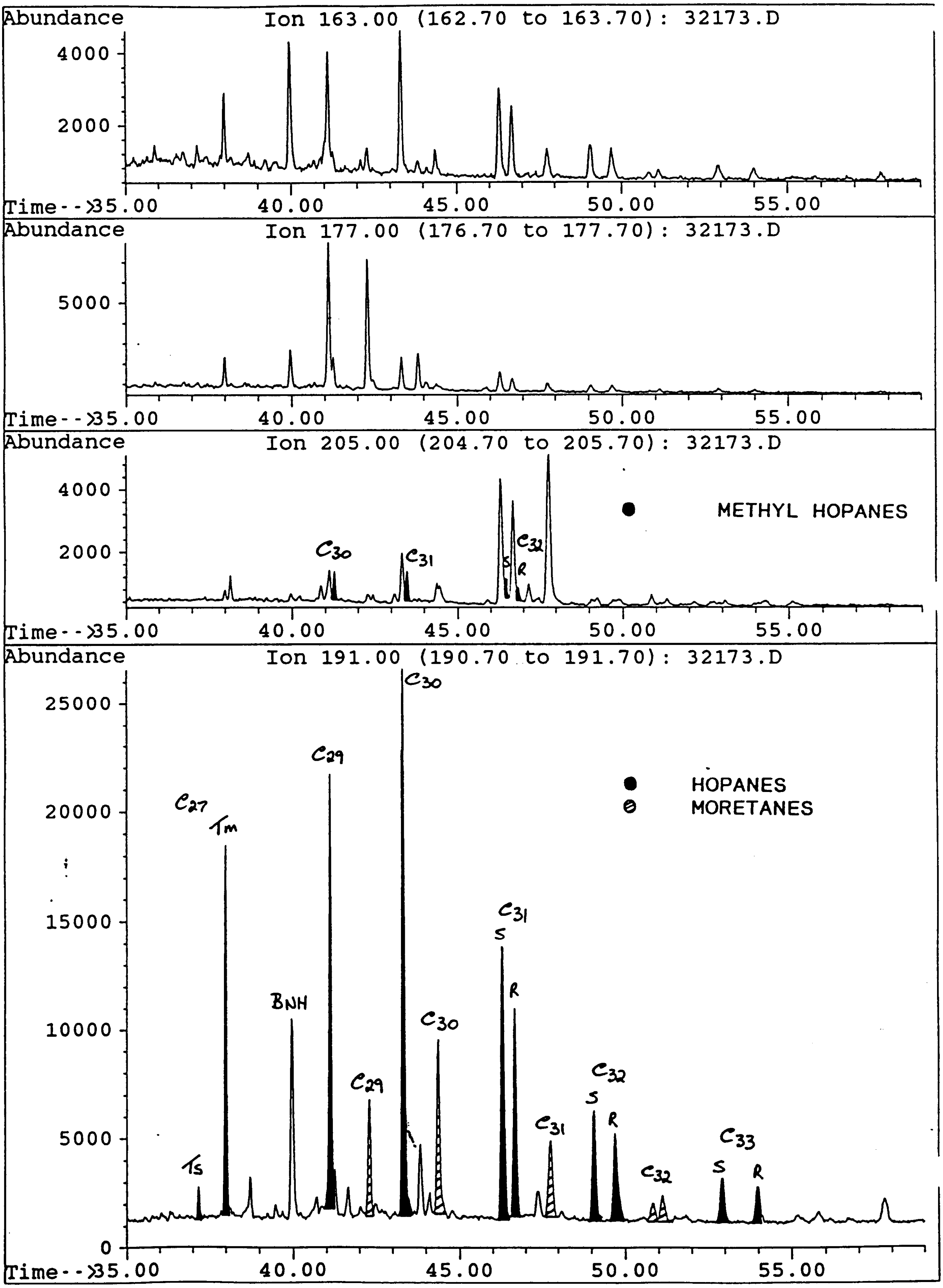


File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC

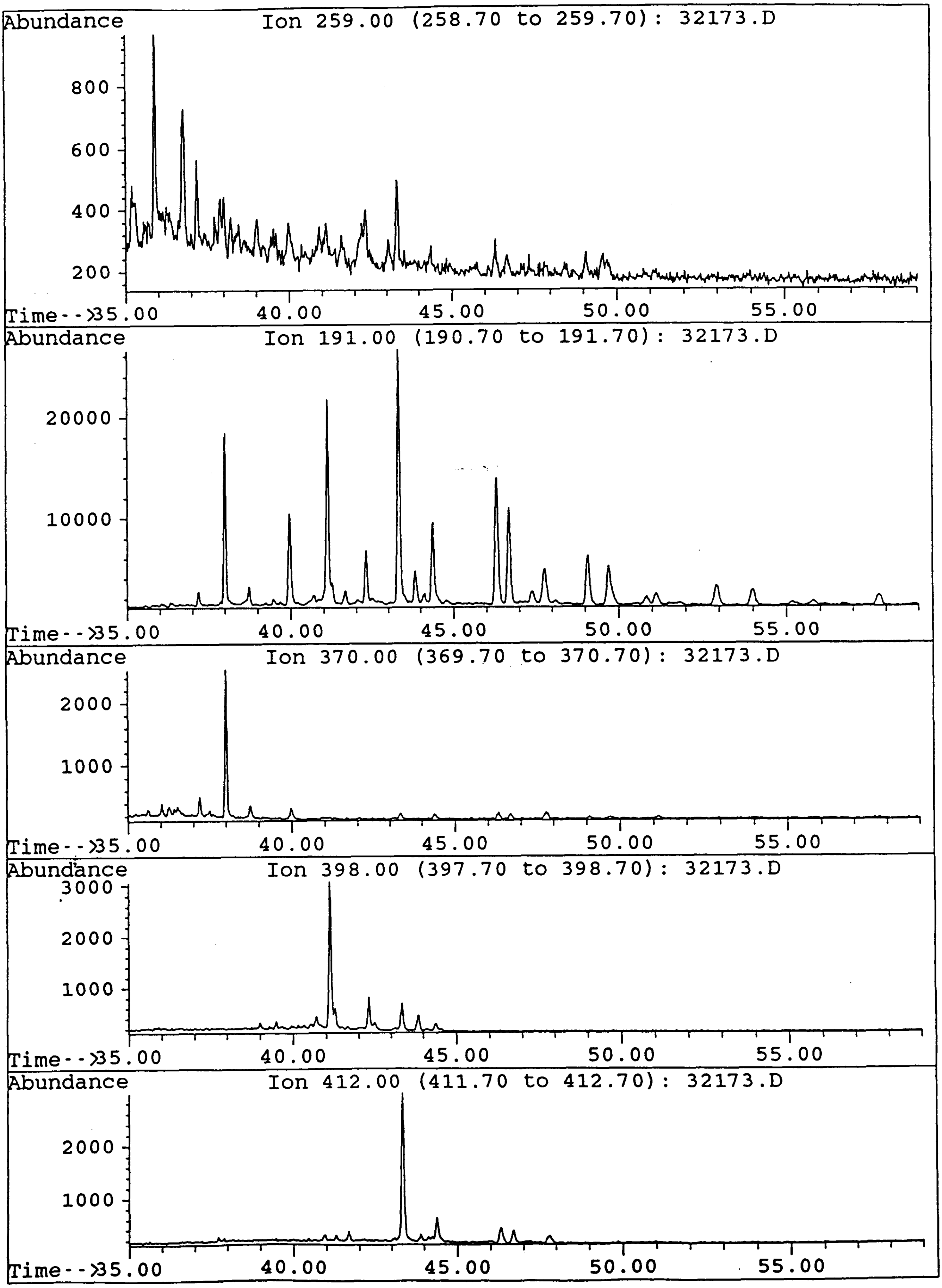




File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



Ion 259.00 (258.70 to 259.70): 32173.D

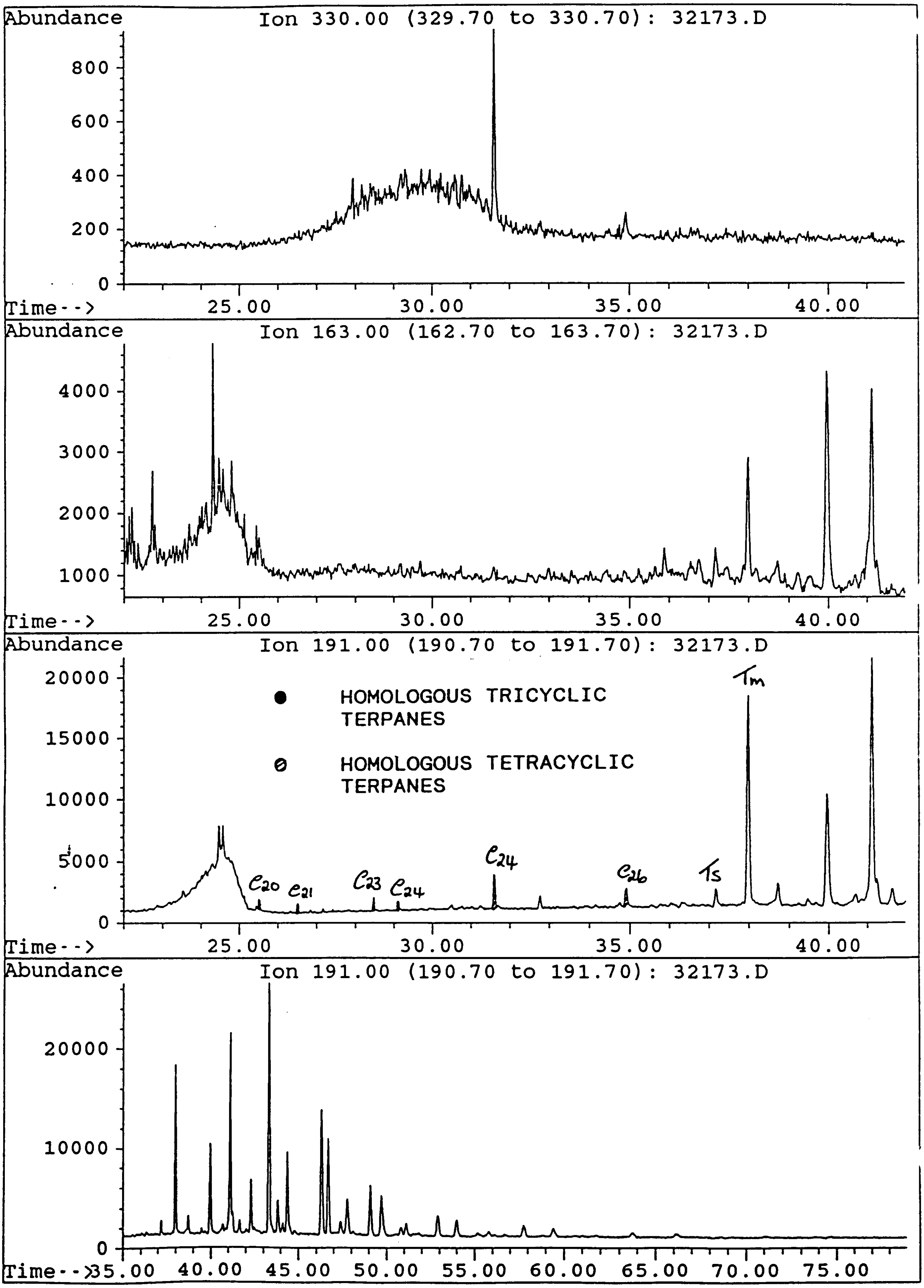
Ion 191.00 (190.70 to 191.70): 32173.D

Ion 370.00 (369.70 to 370.70): 32173.D

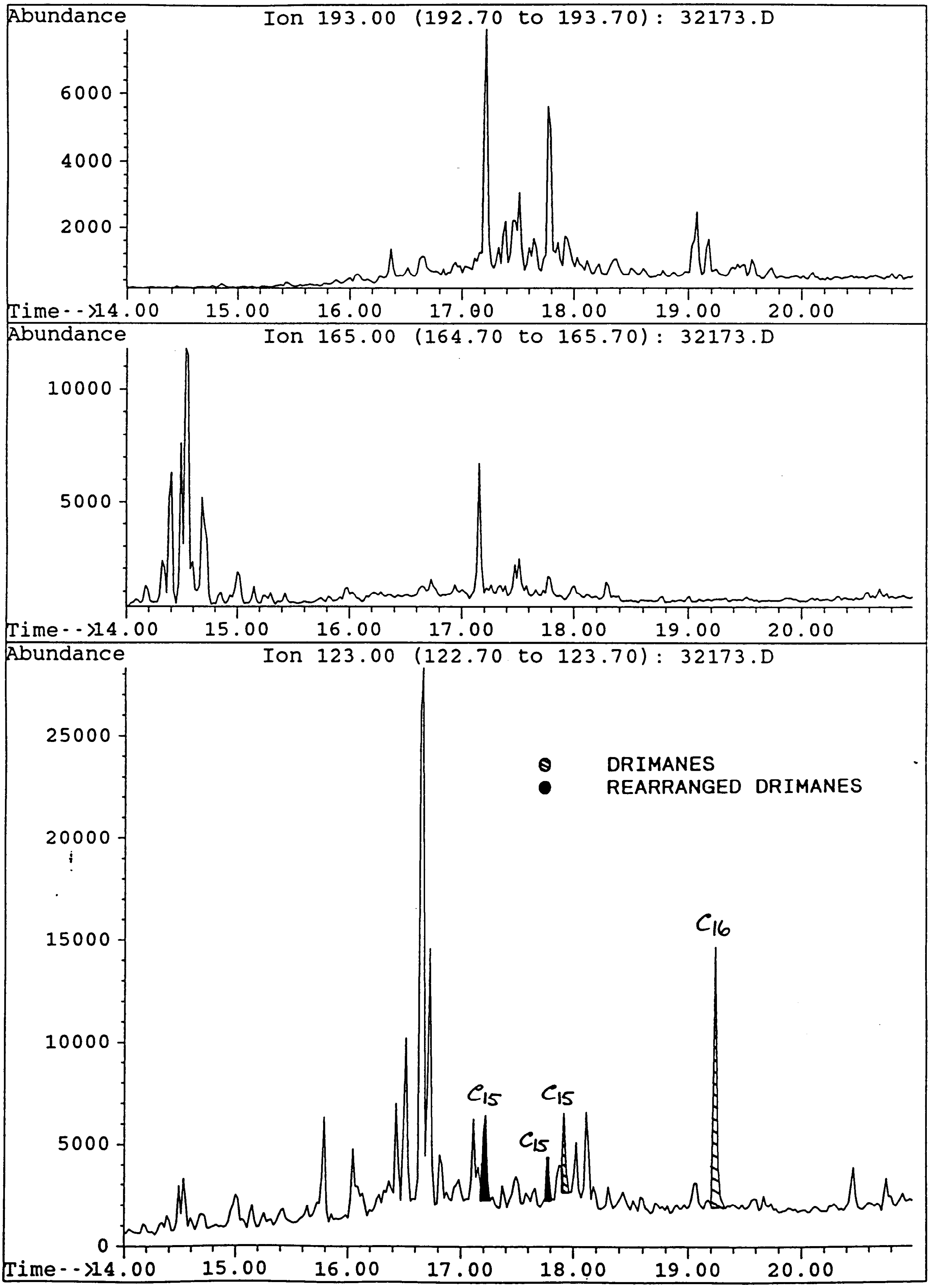
Ion 398.00 (397.70 to 398.70): 32173.D

Ion 412.00 (411.70 to 412.70): 32173.D

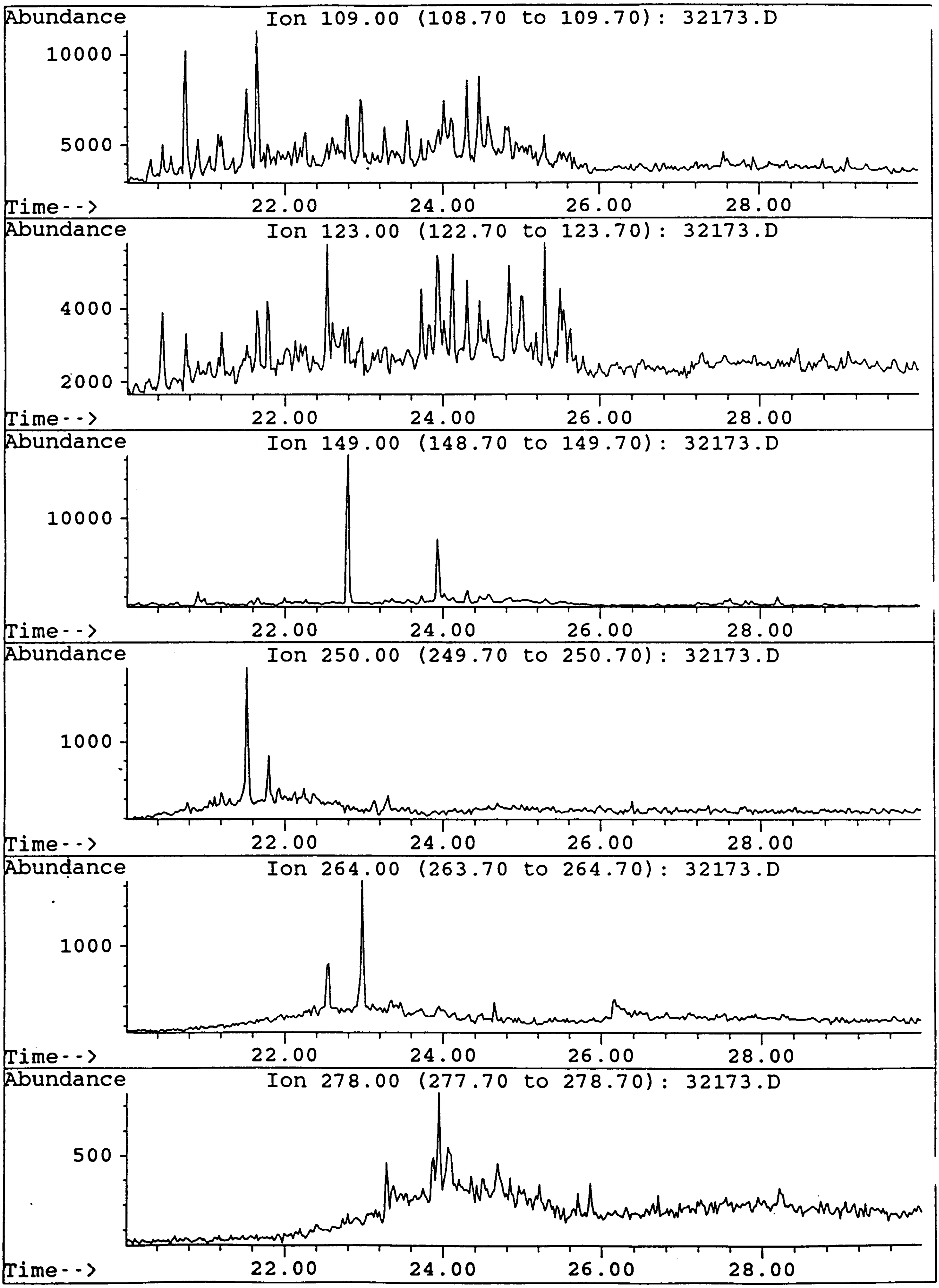
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



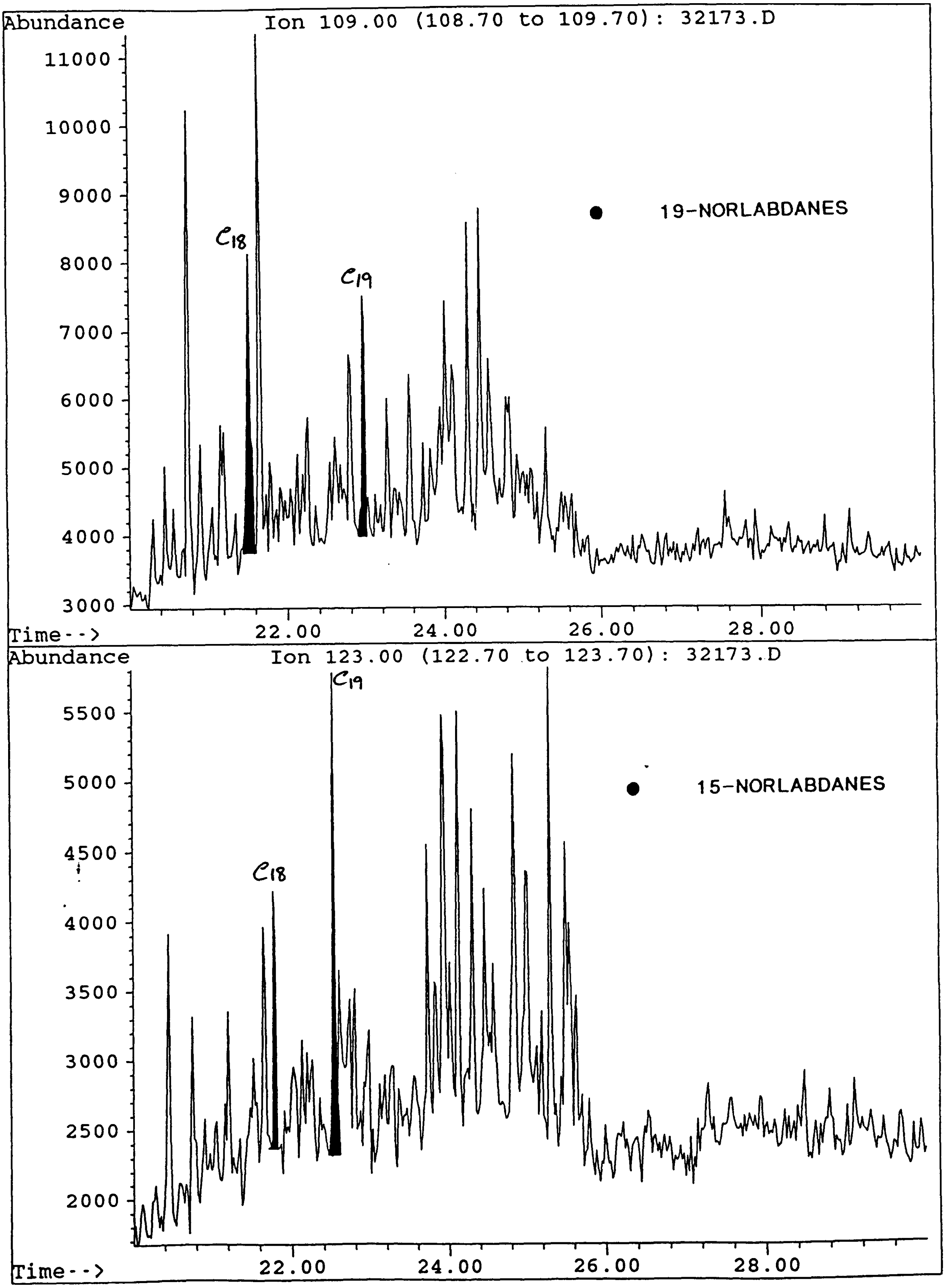
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



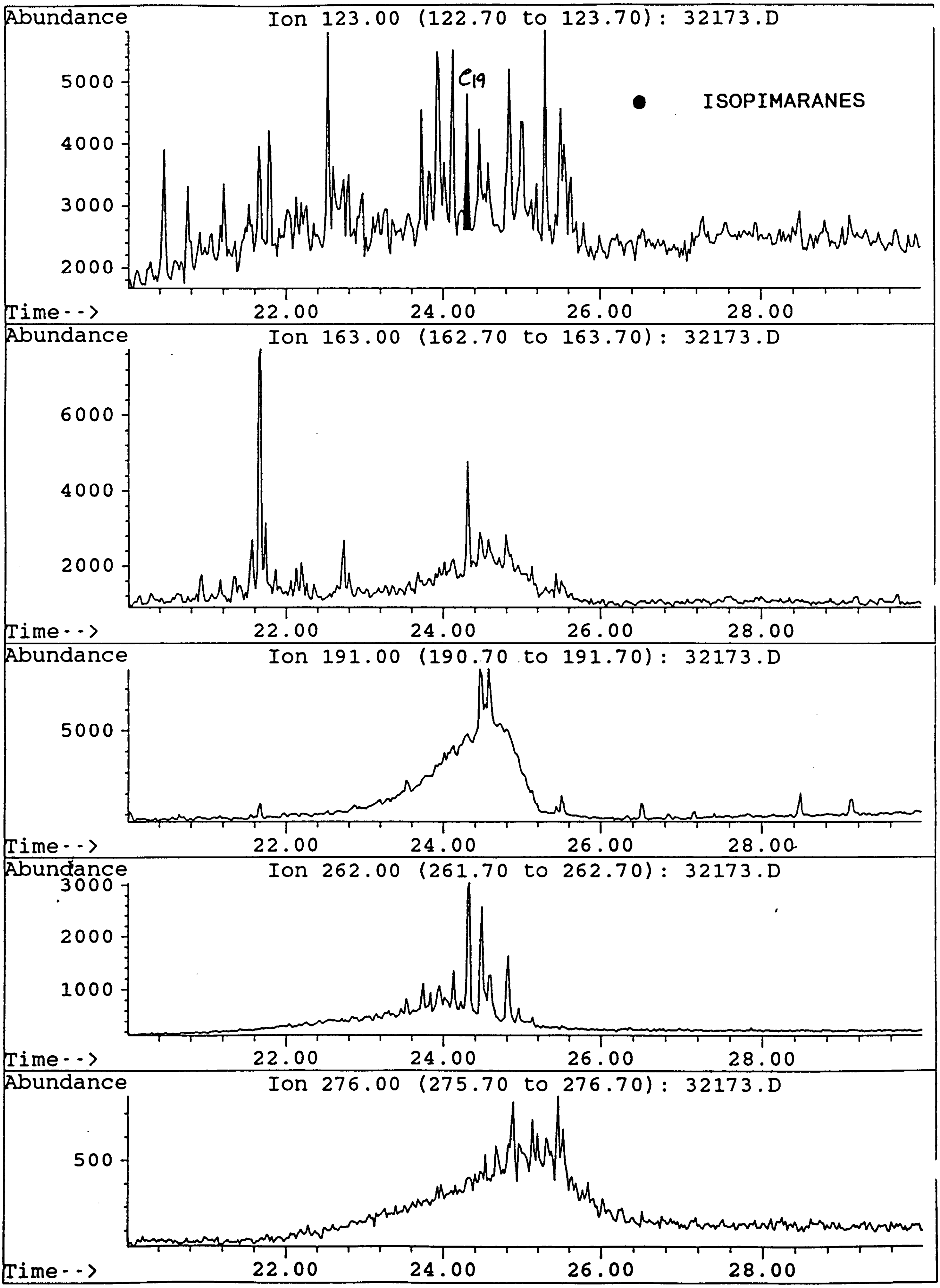
File :   32173.D
Sample :   LA BELLA#1, 2070.0m, B/C.
Misc. Info :   COL#143. 22-12-93. GEC



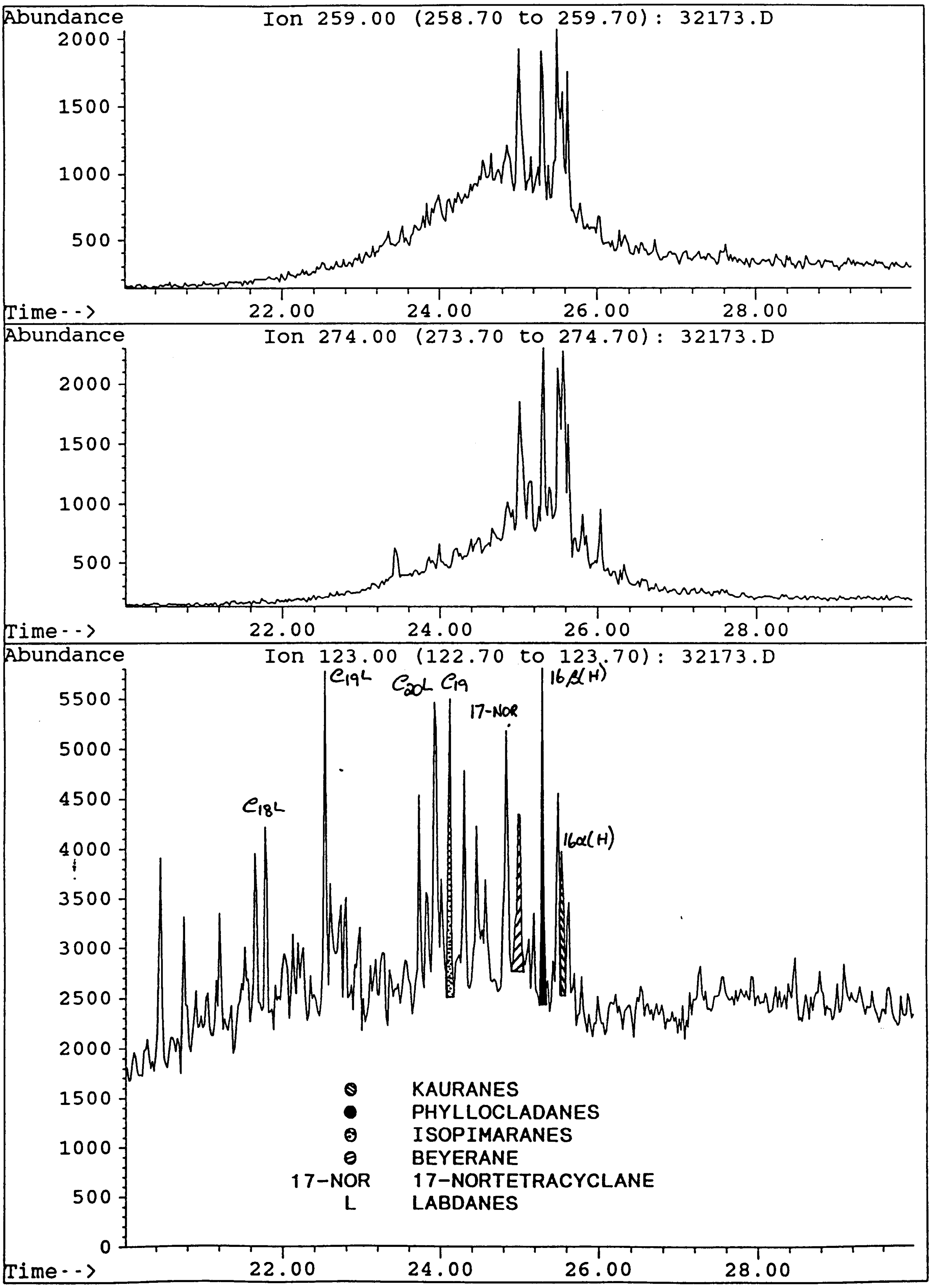
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



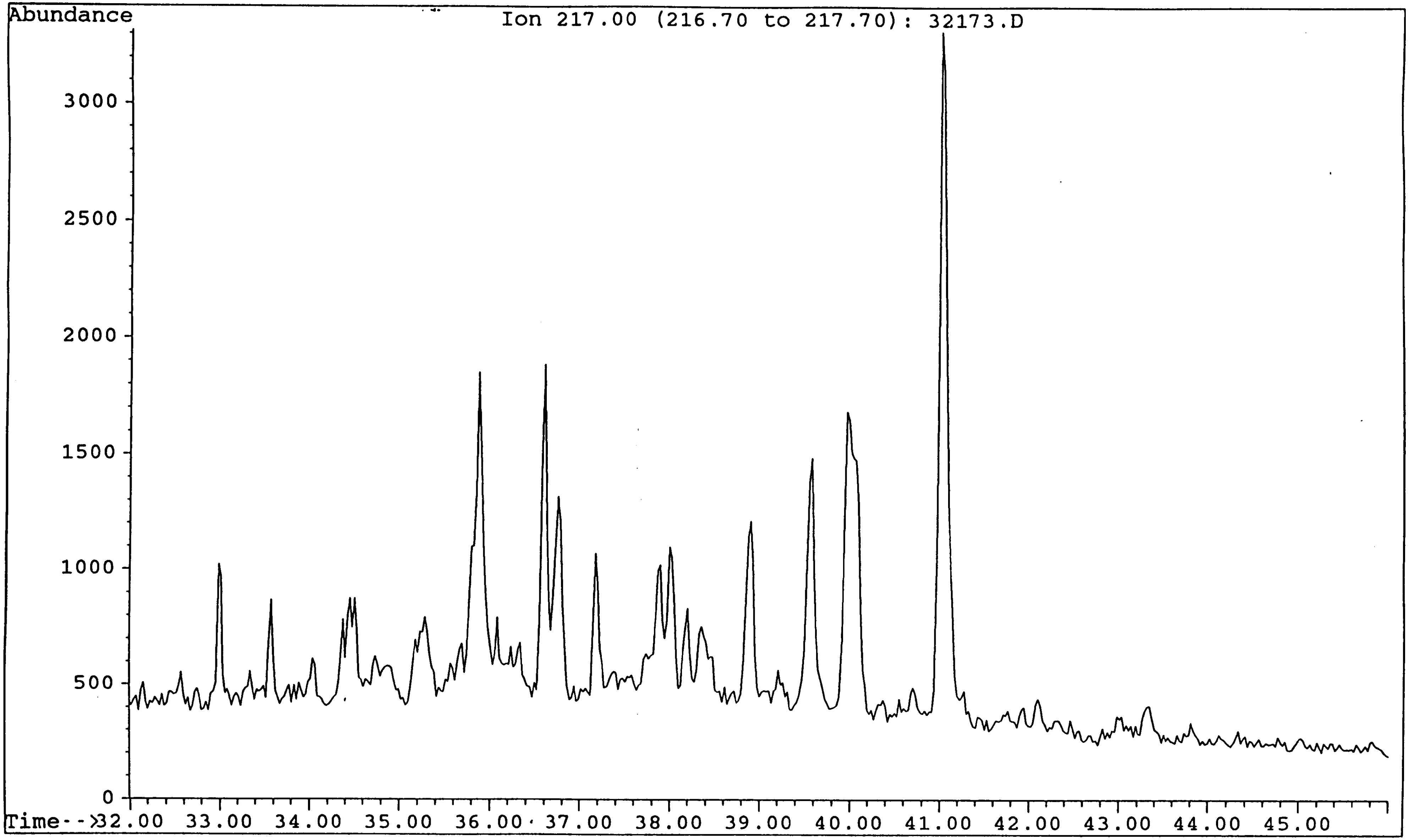
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



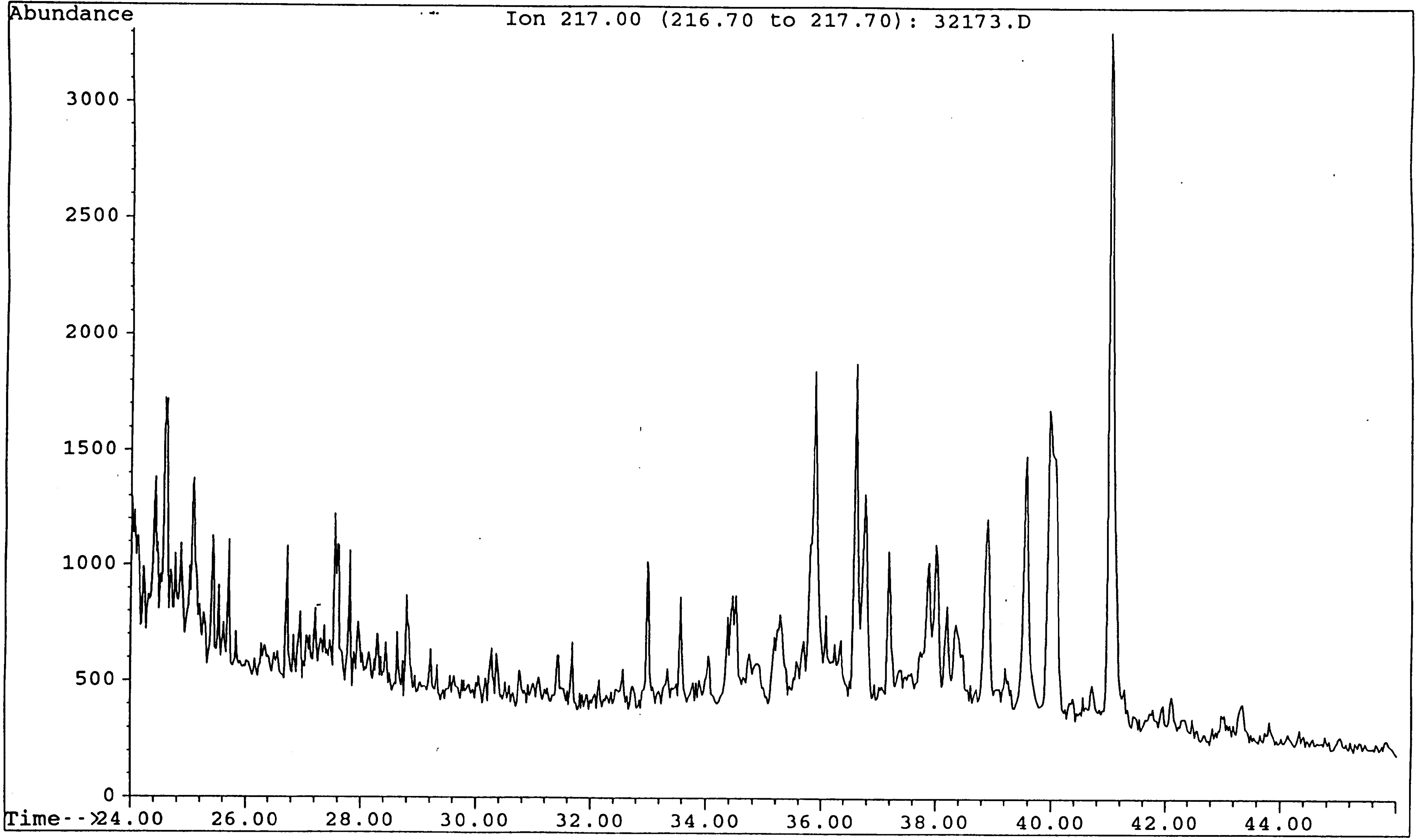
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



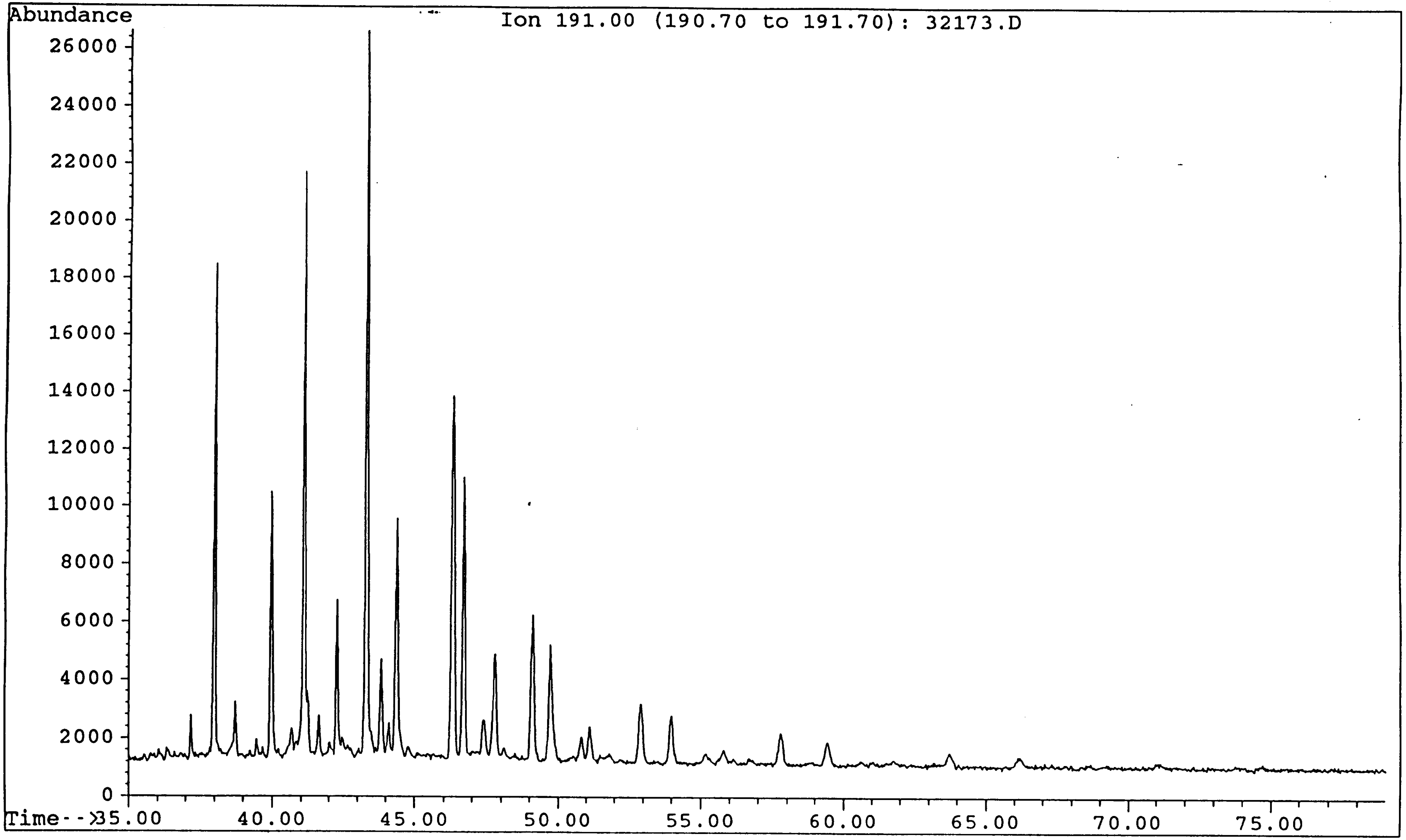
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



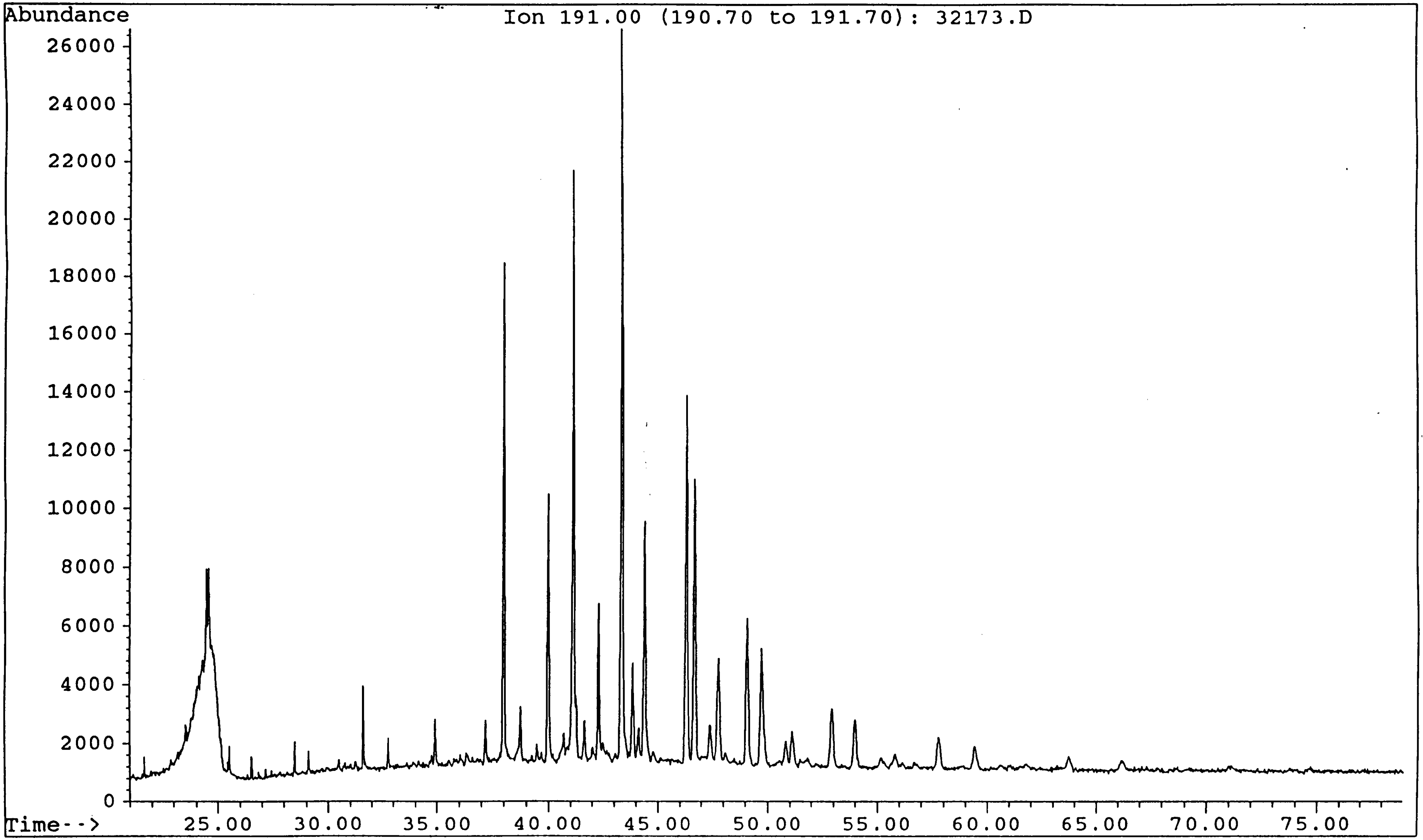
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



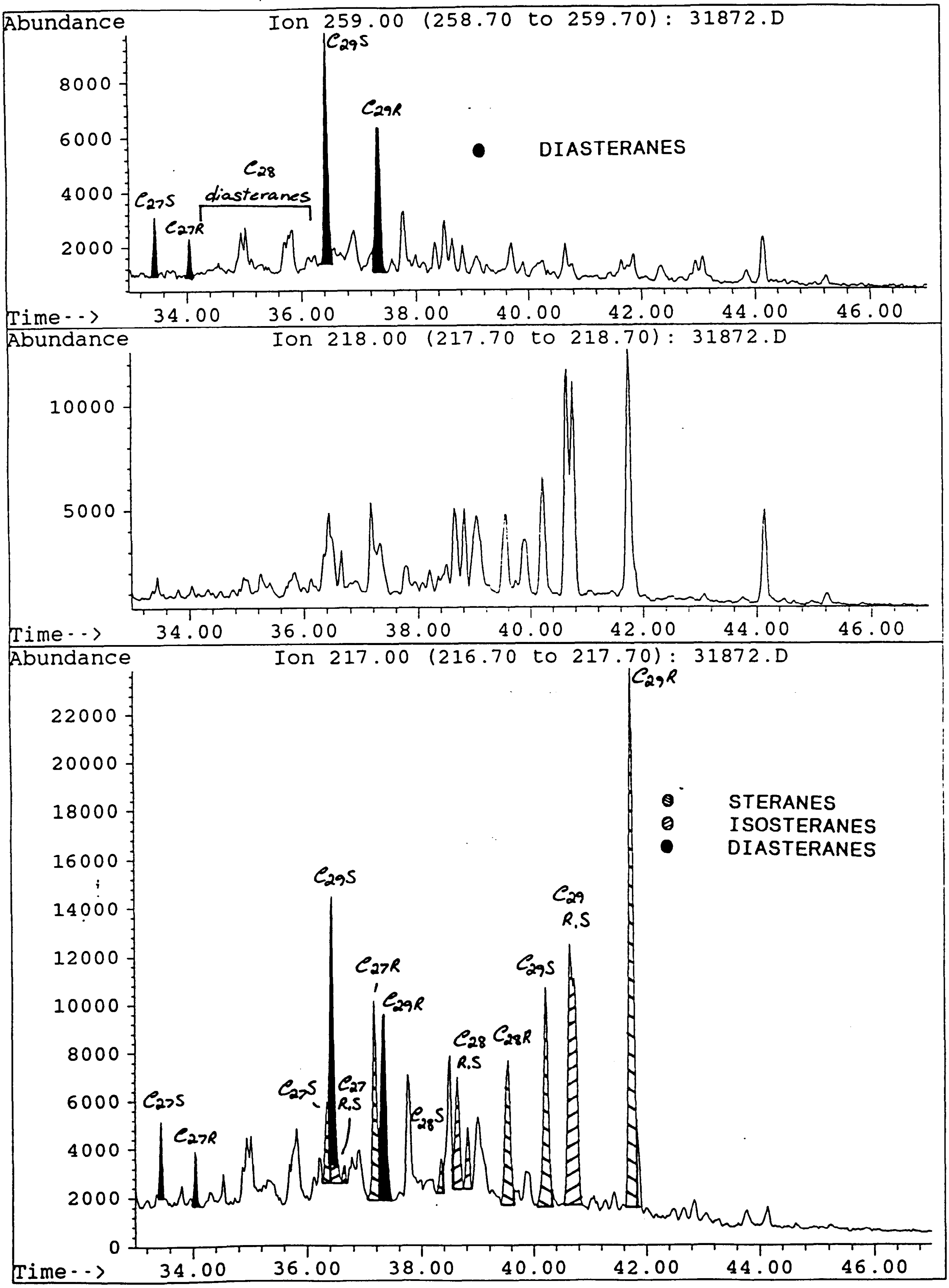
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



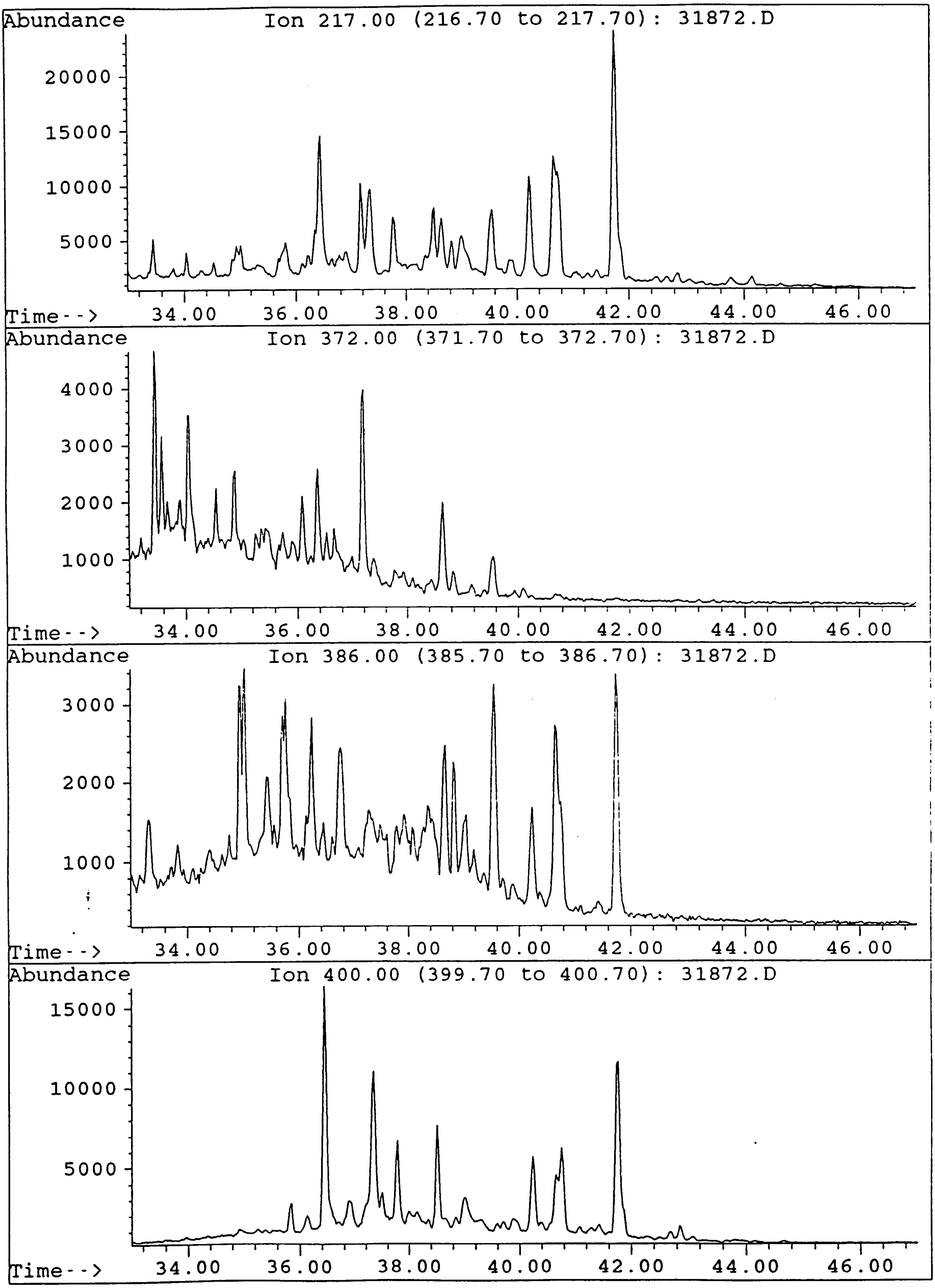
File : 32173.D
Sample : LA BELLA#1, 2070.0m, B/C.
Misc. Info : COL#143. 22-12-93. GEC



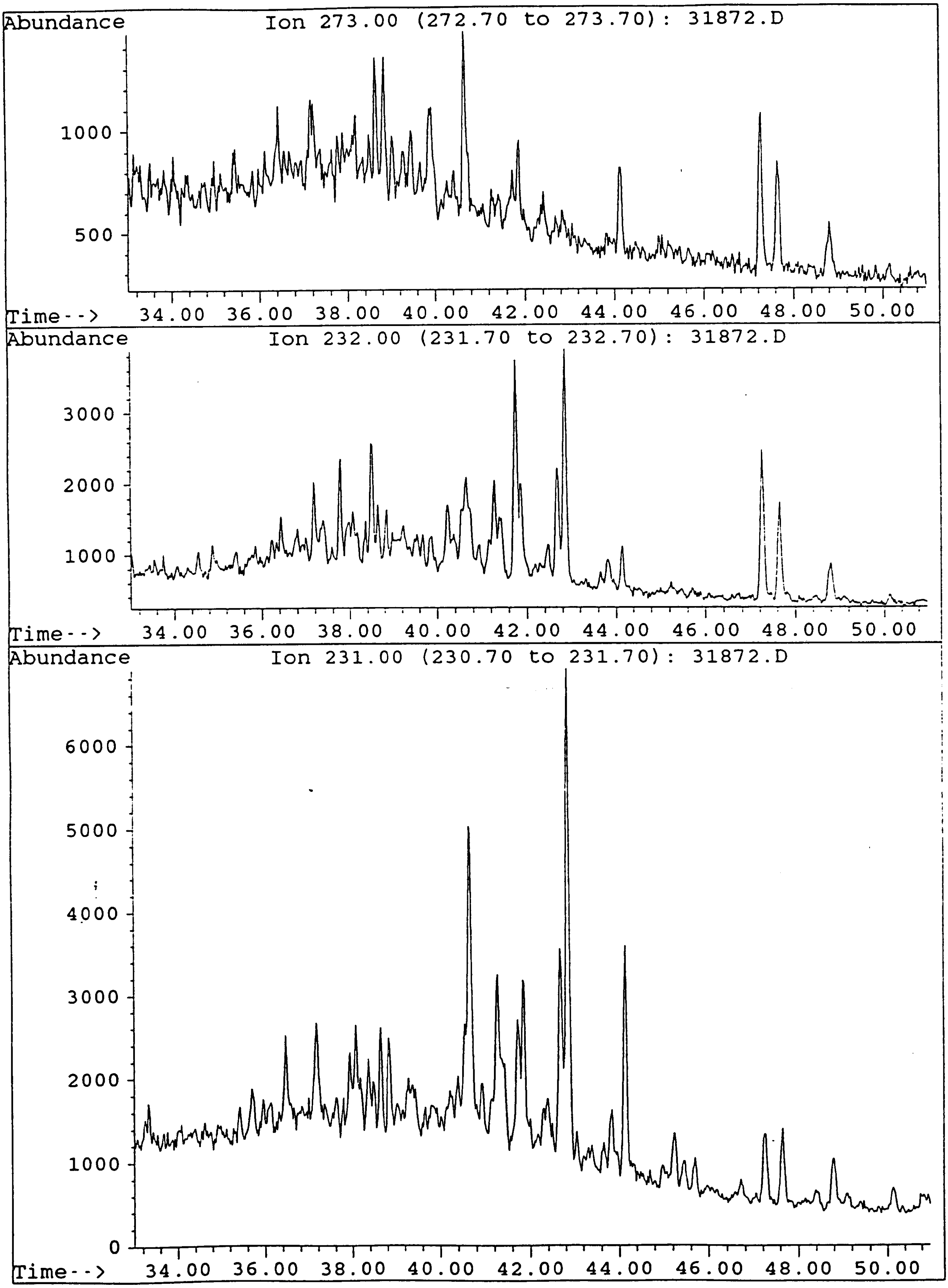
File : 31872.D
Sample : - -LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



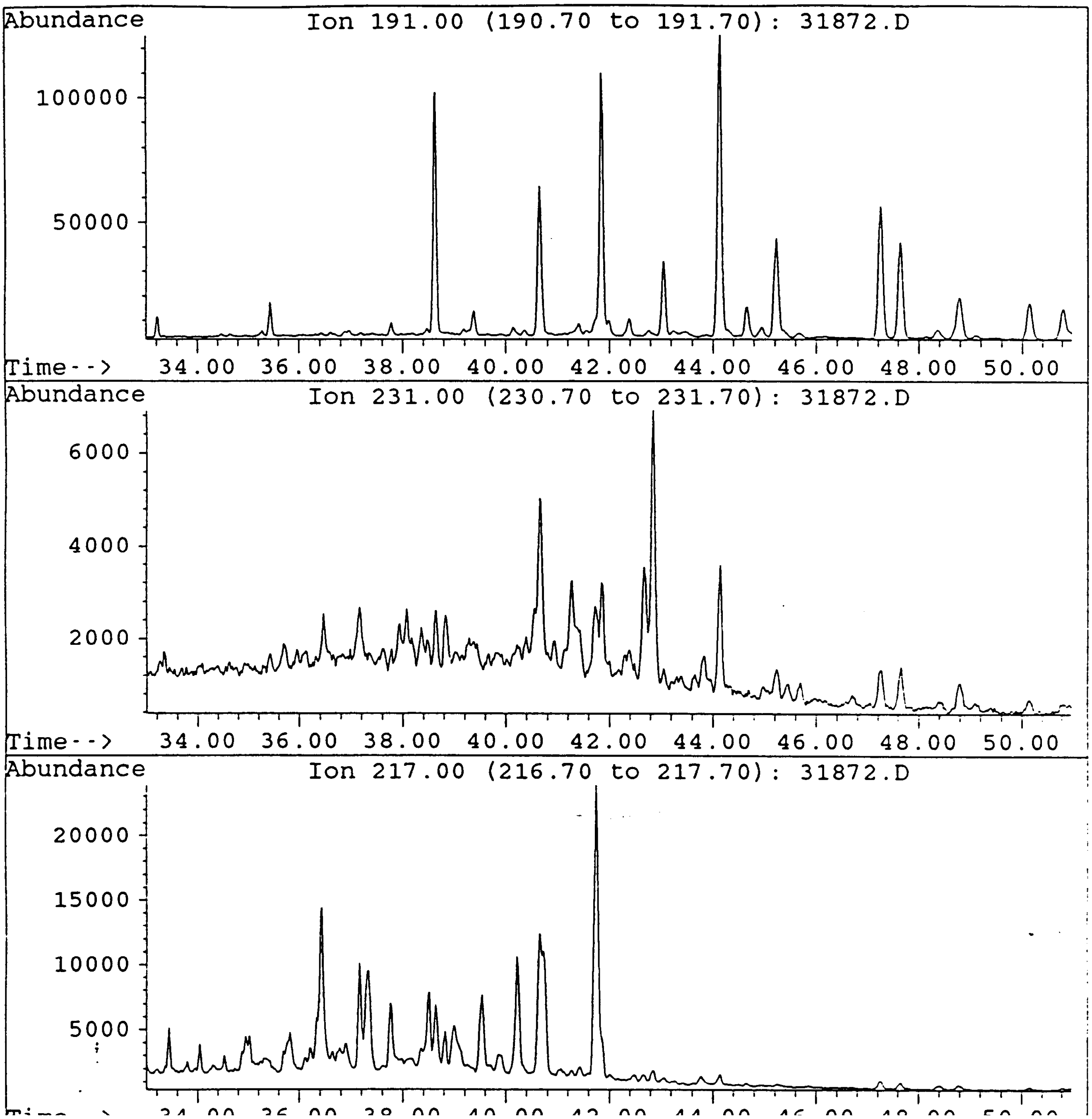
File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



File : 31872.D
Sample : - LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.

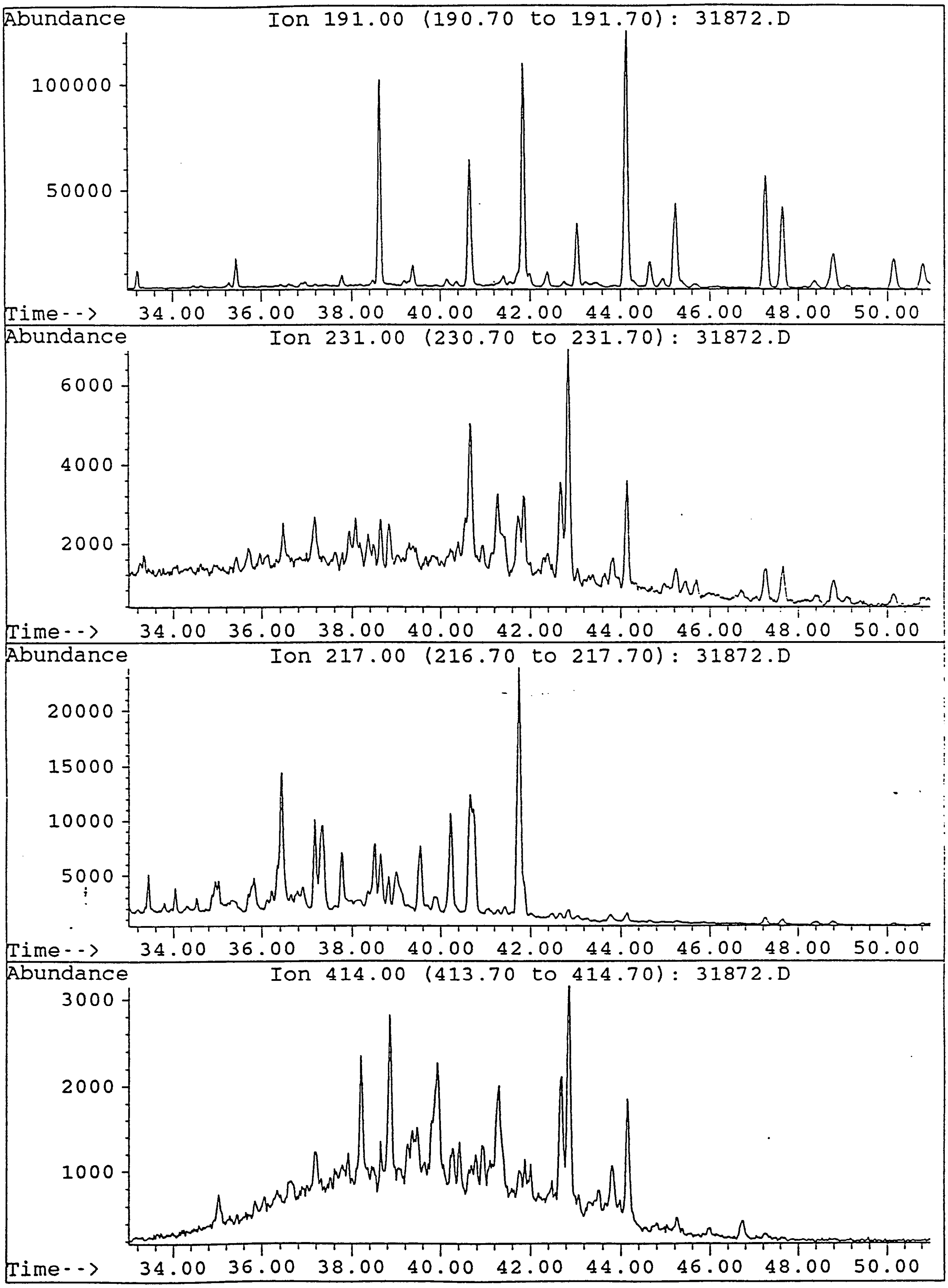


File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



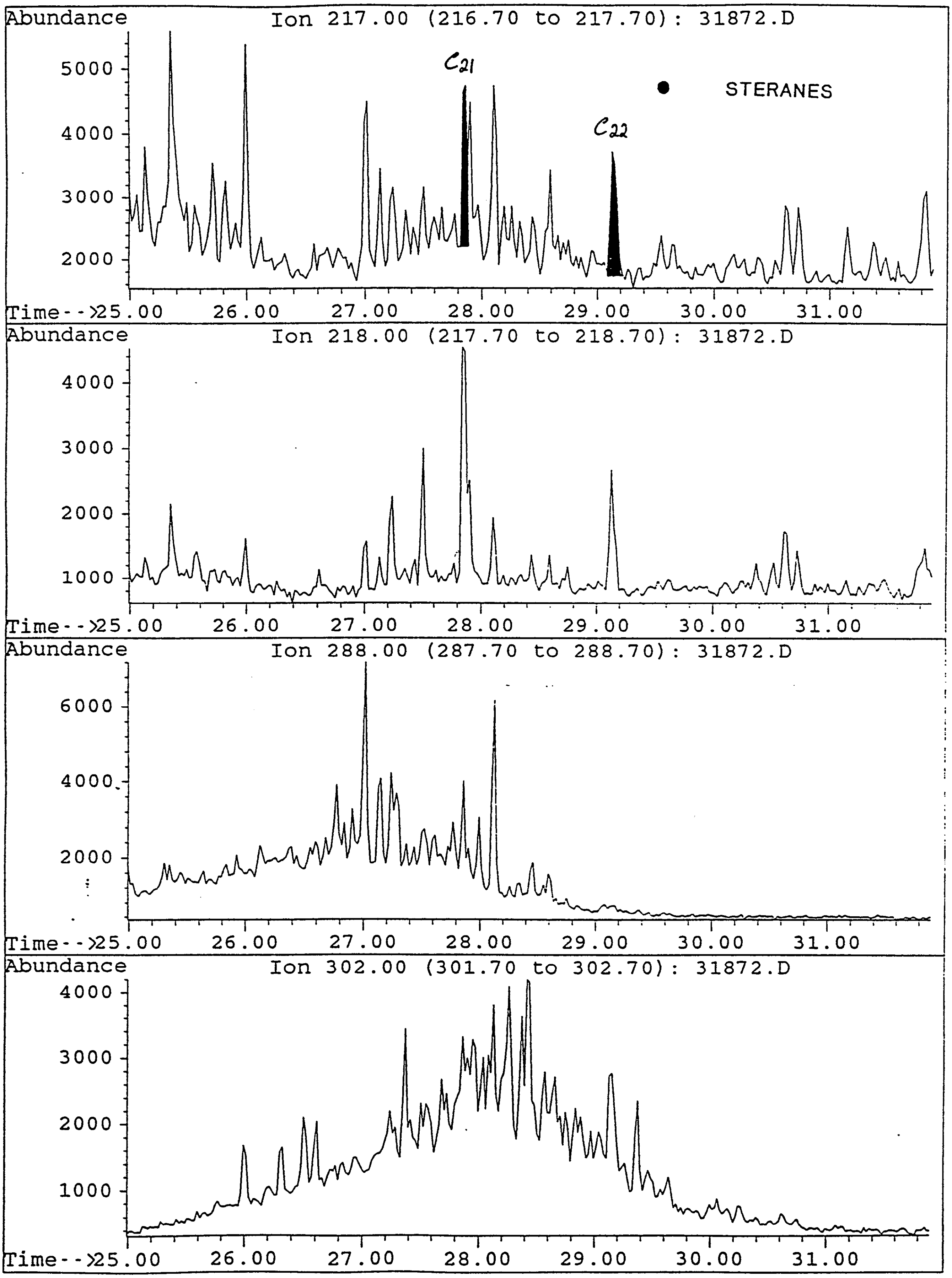
LABL1/PE900368/P316

File :   31872.D
Sample :   LA BELLA#1, 2097.70m, B/C.
Misc. Info :   COL#143. 1/600uL. 10-11-93. GEC.



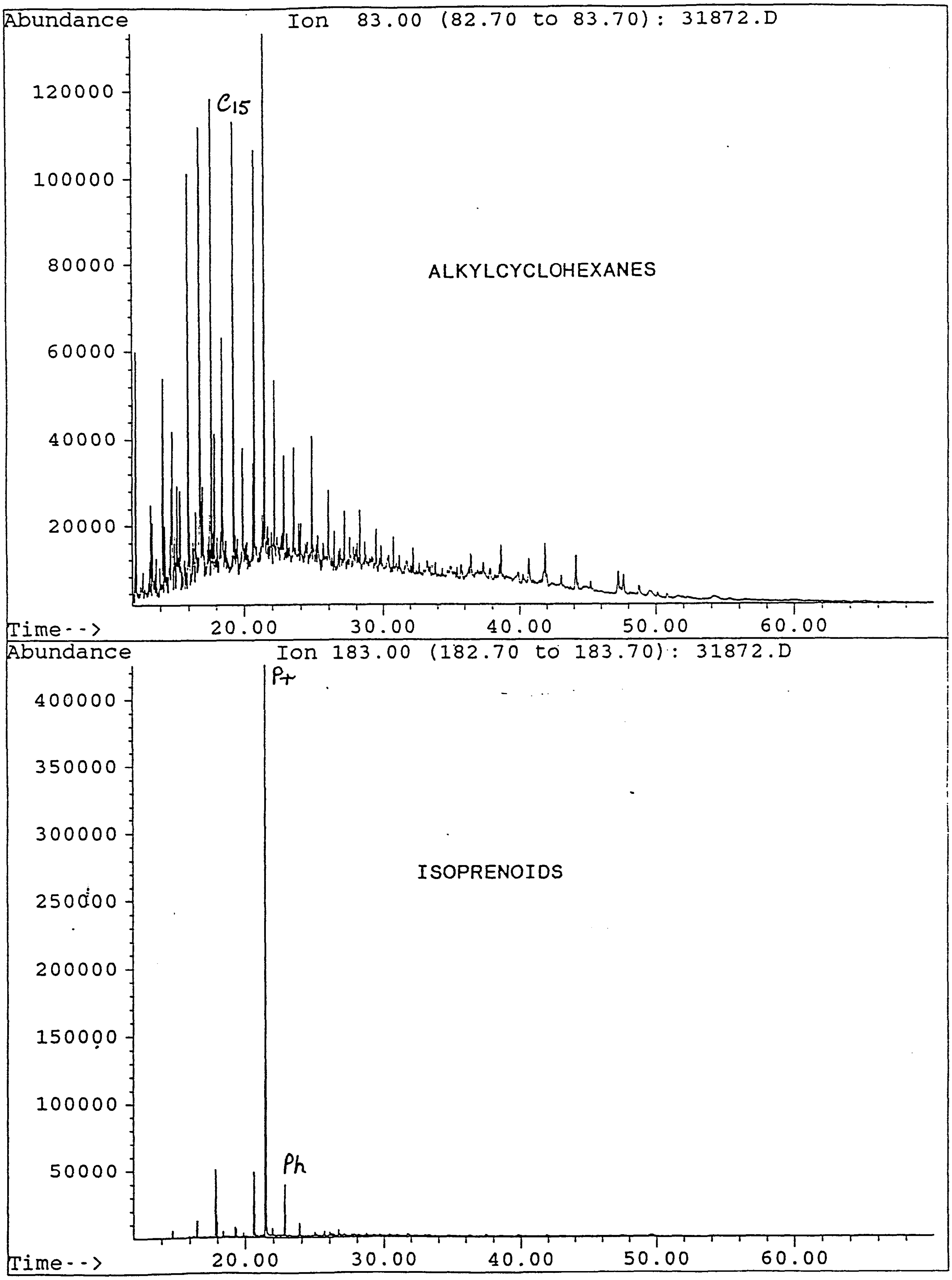
LABL1 / PE900368 / P17

File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



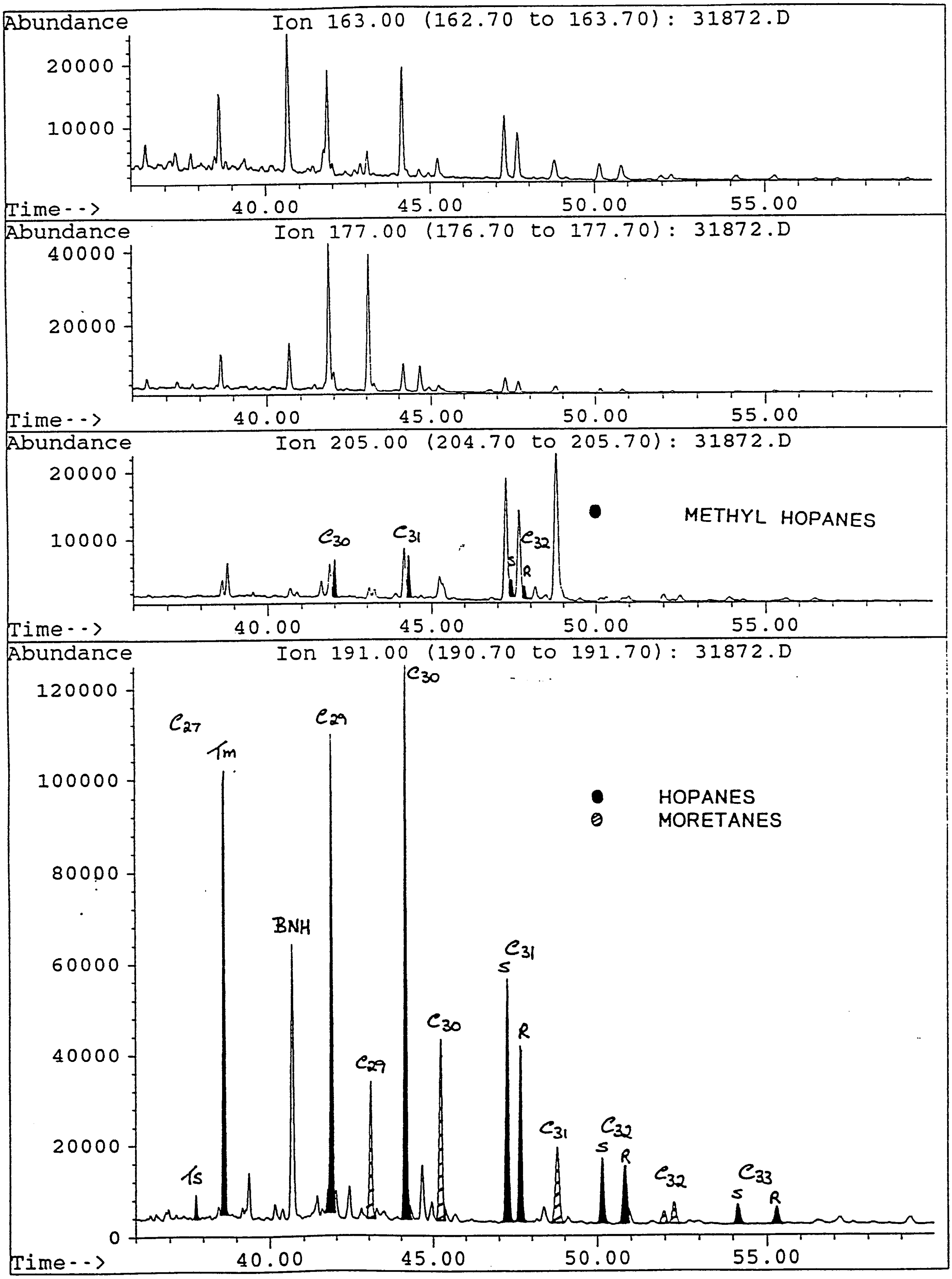
LABL1 /PE900368 /P18

File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.

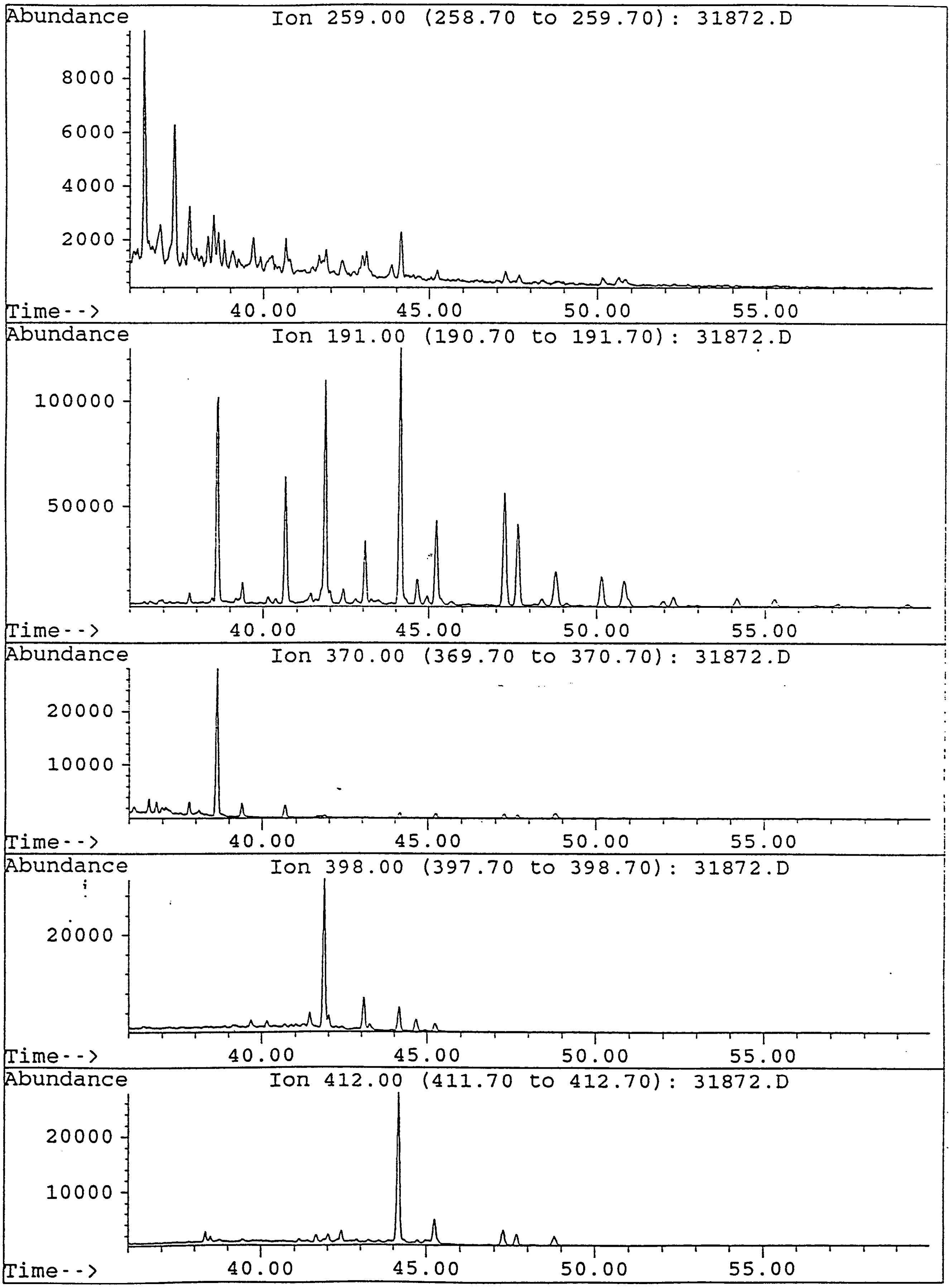


LABL 1/PE900368/P19

File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



Ion 259.00 (258.70 to 259.70): 31872.D

Ion 191.00 (190.70 to 191.70): 31872.D

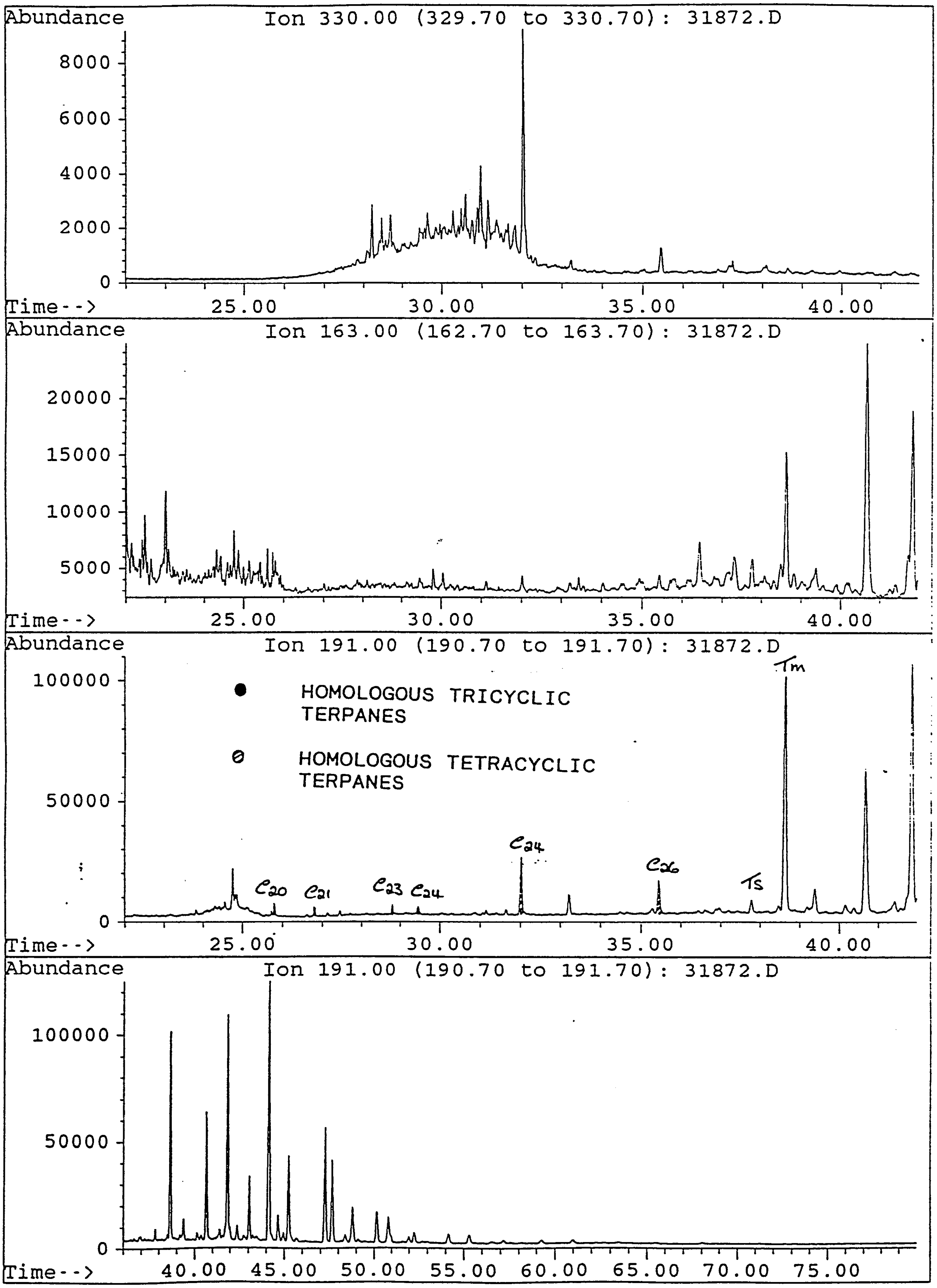
Ion 370.00 (369.70 to 370.70): 31872.D

Ion 398.00 (397.70 to 398.70): 31872.D

Ion 412.00 (411.70 to 412.70): 31872.D

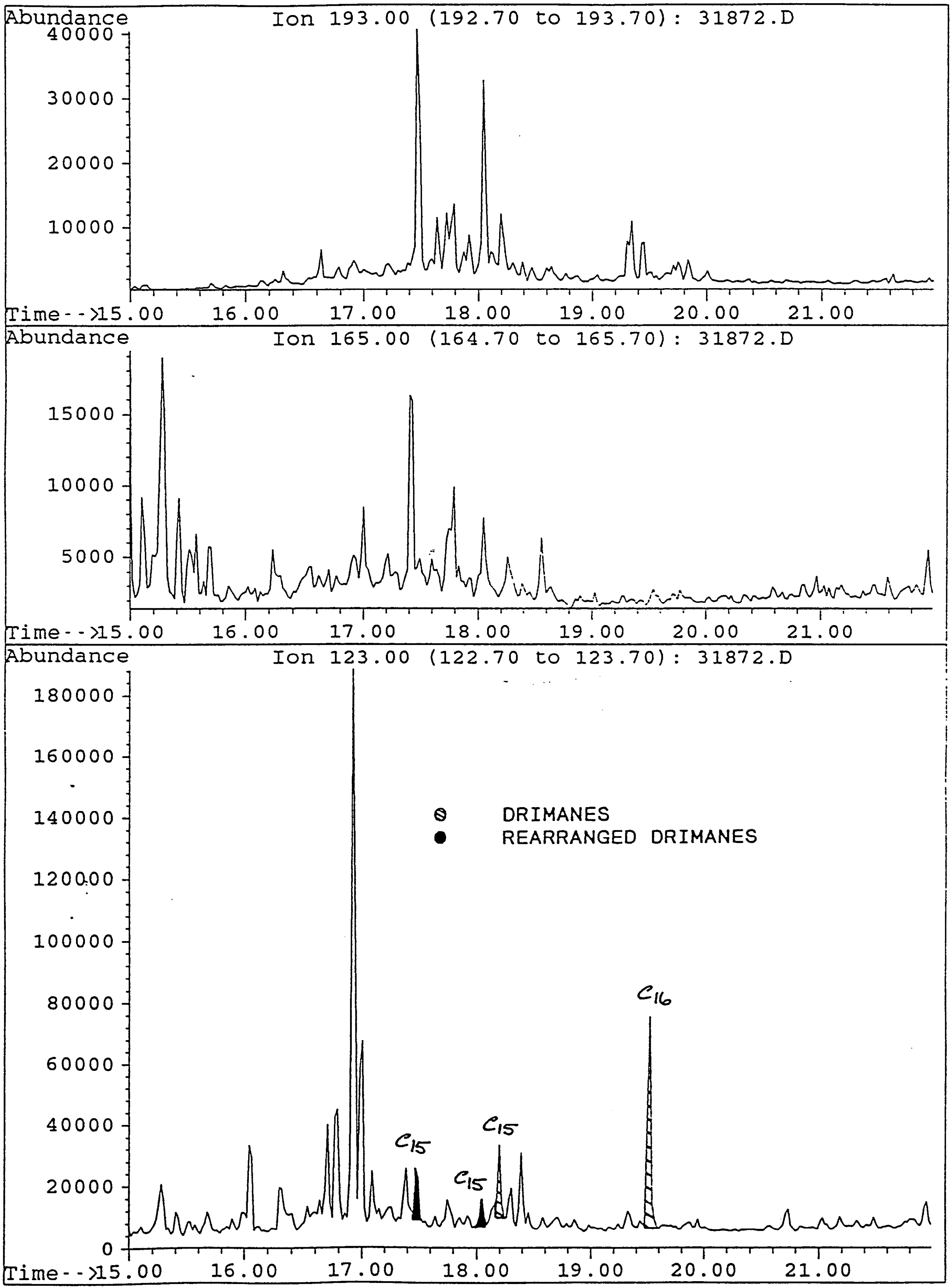
LABL1/PE900368/P21

File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



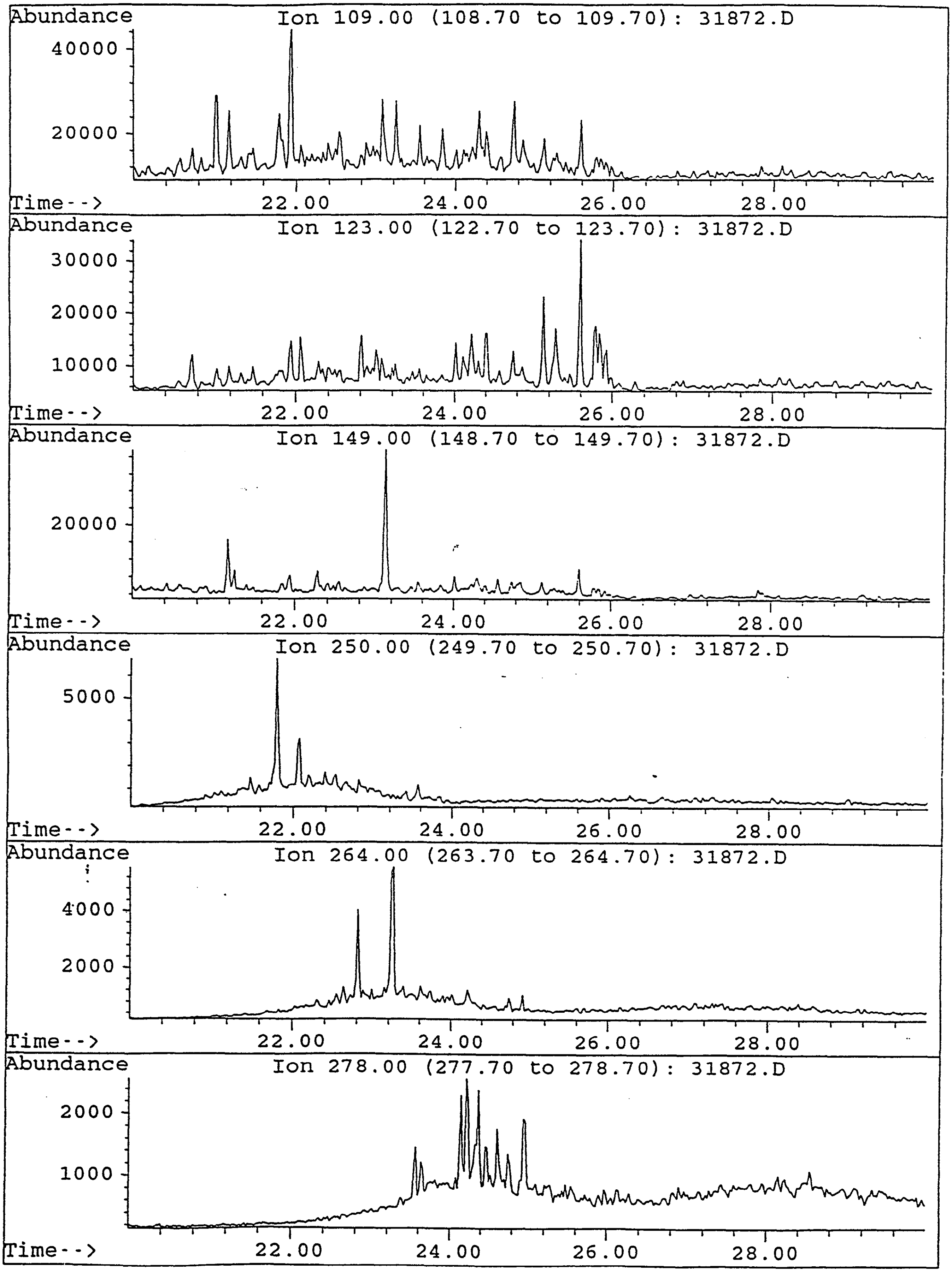
LABL 1/PE900368/P22

```
File :          31872.D
Sample :        LA BELLA#1, 2097.70m, B/C.
Misc. Info :    COL#143. 1/600uL. 10-11-93. GEC.
```



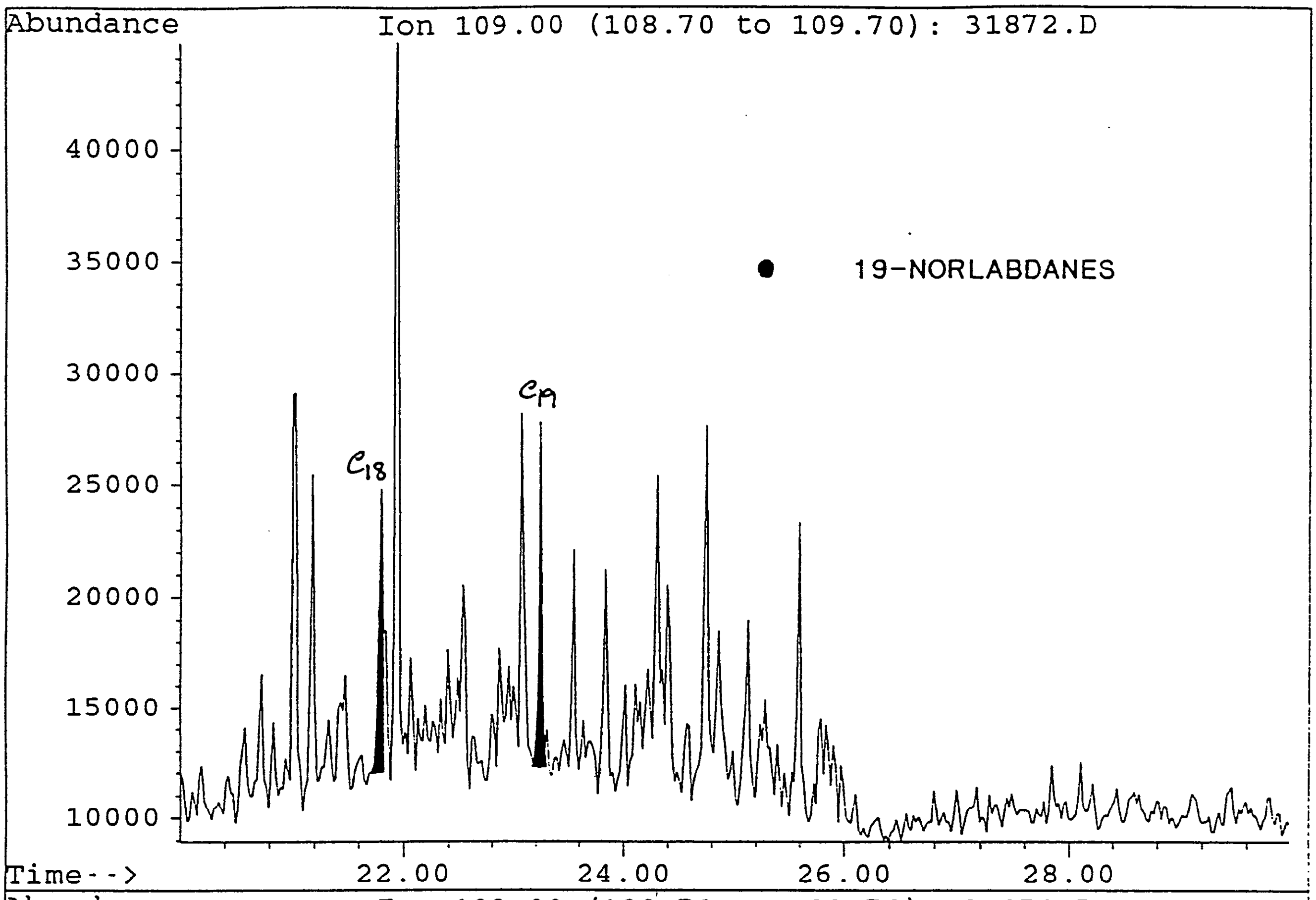
LABL 1/PE900368 /P23

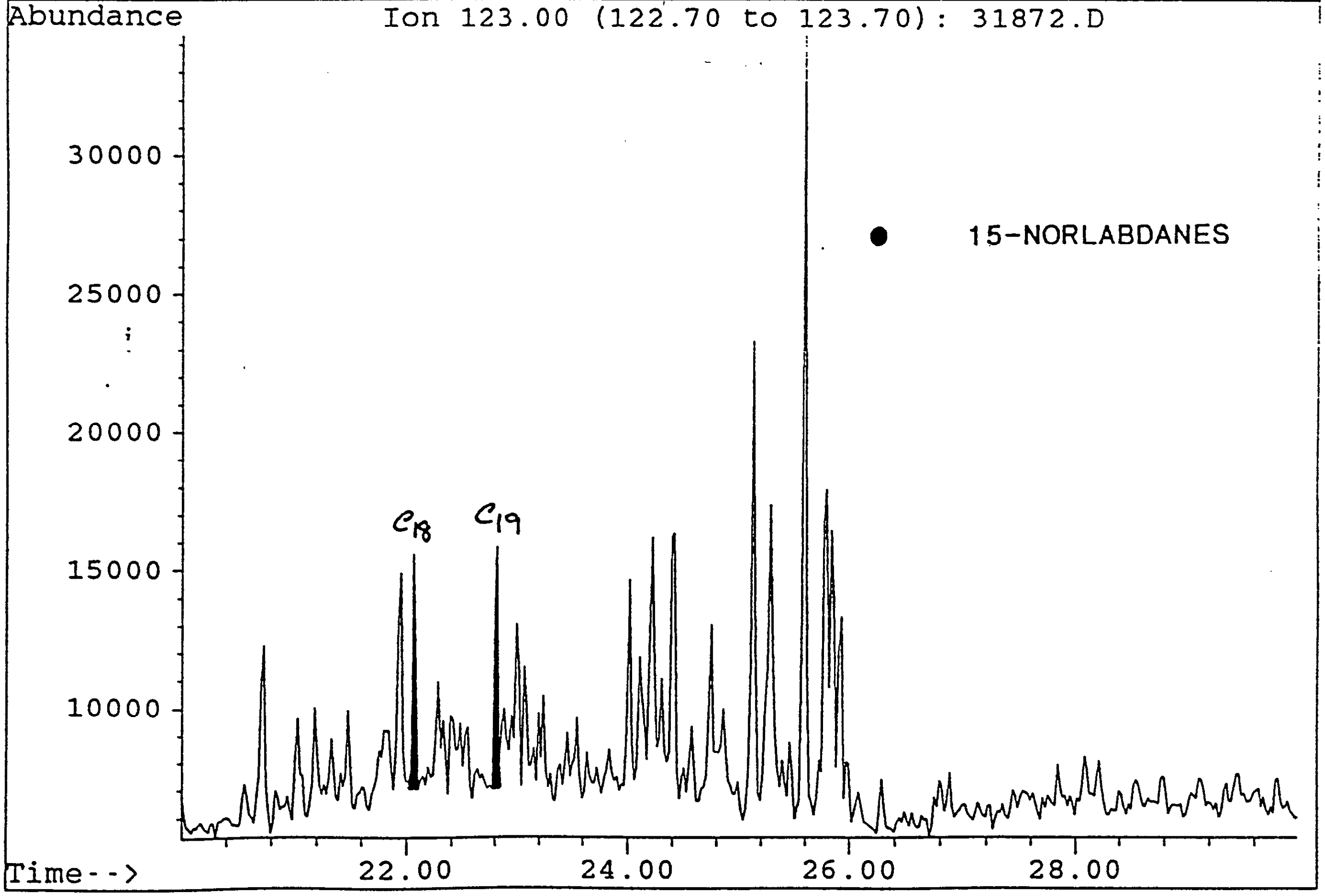
File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



LABL 1 / PE900368/ P24

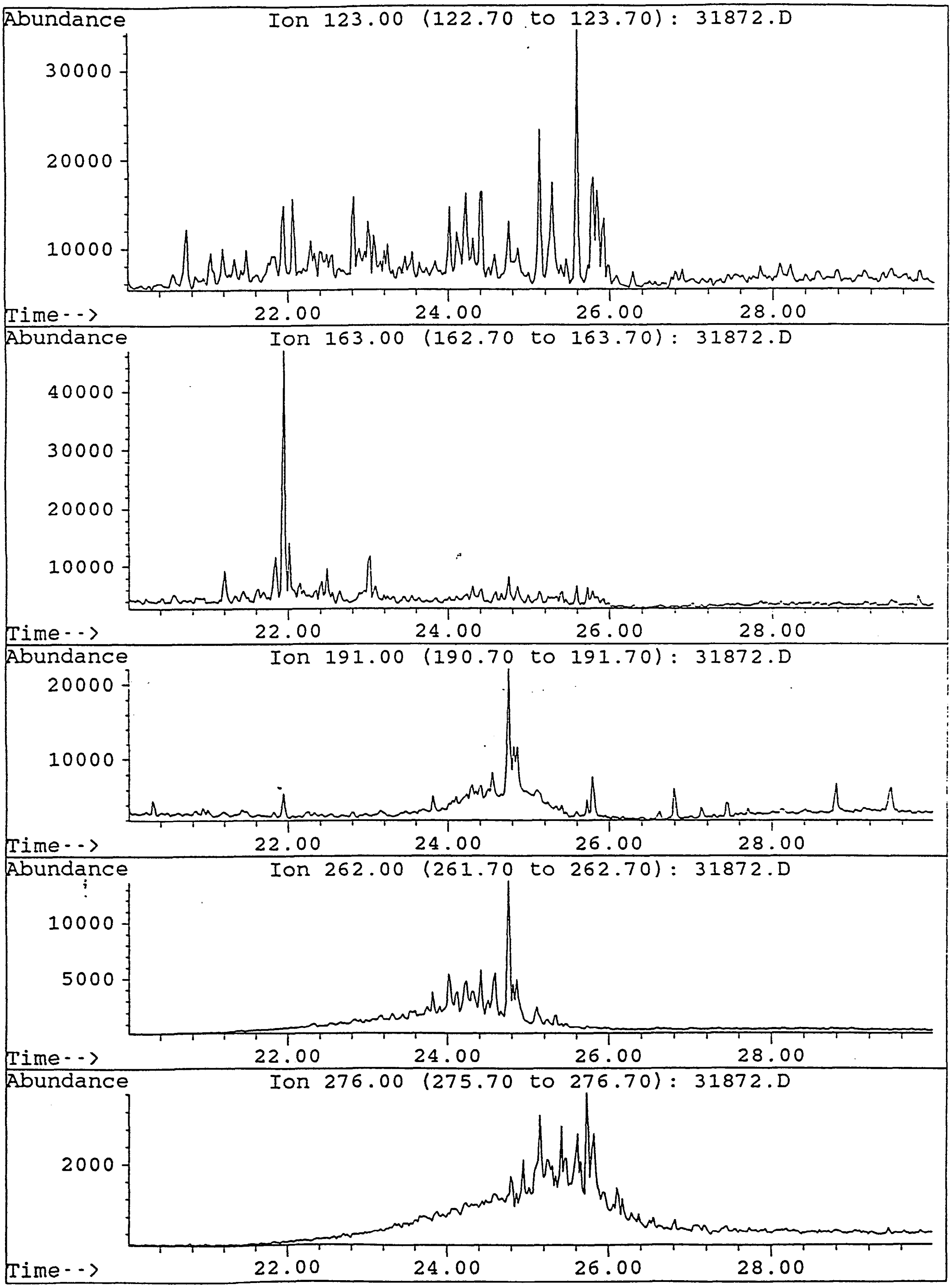
```
File :          31872.D
Sample :        LA BELLA#1, 2097.70m, B/C.
Misc. Info :    COL#143. 1/600uL. 10-11-93. GEC.
```



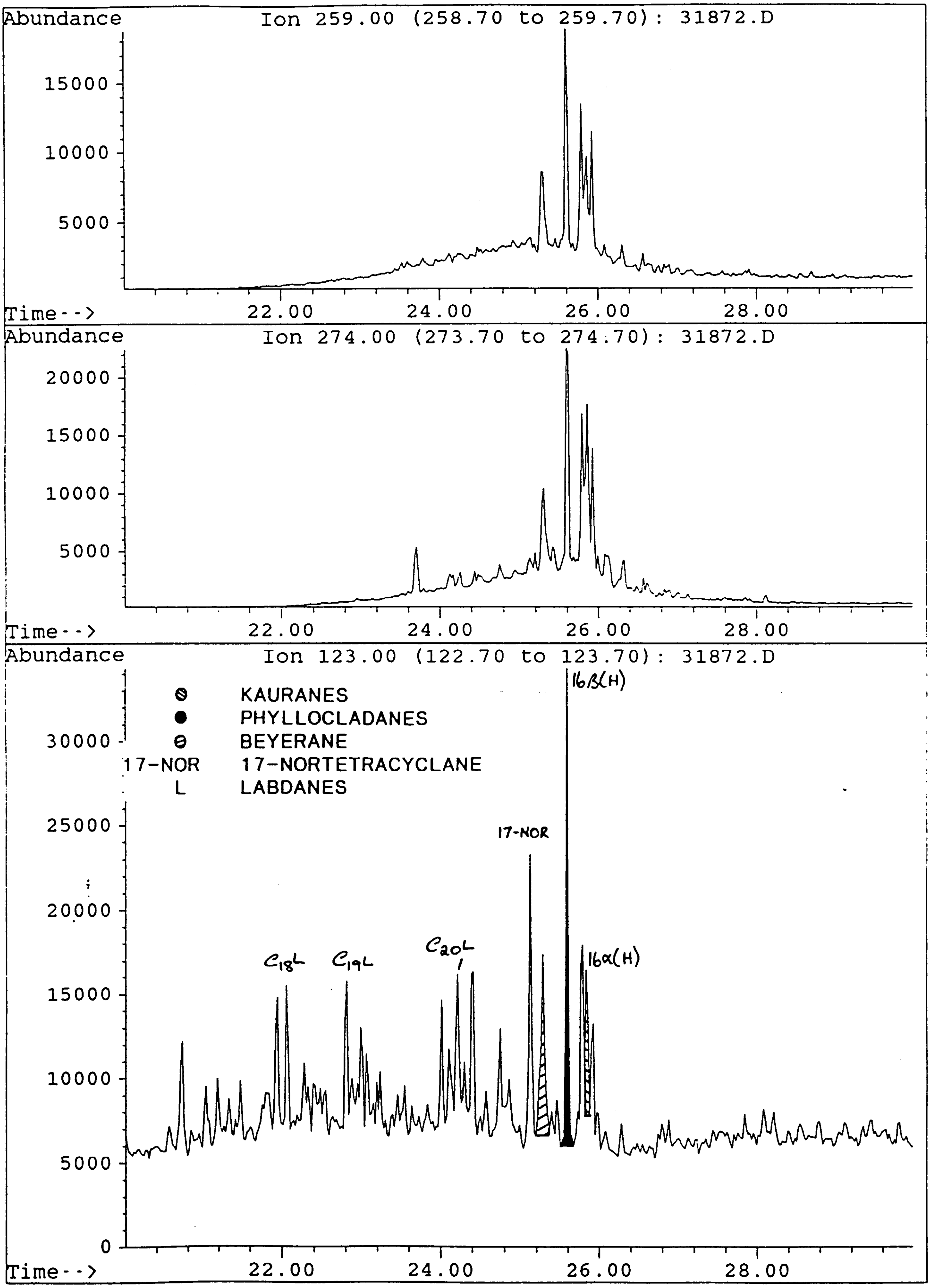


LABL 1 / PE900368 /P25

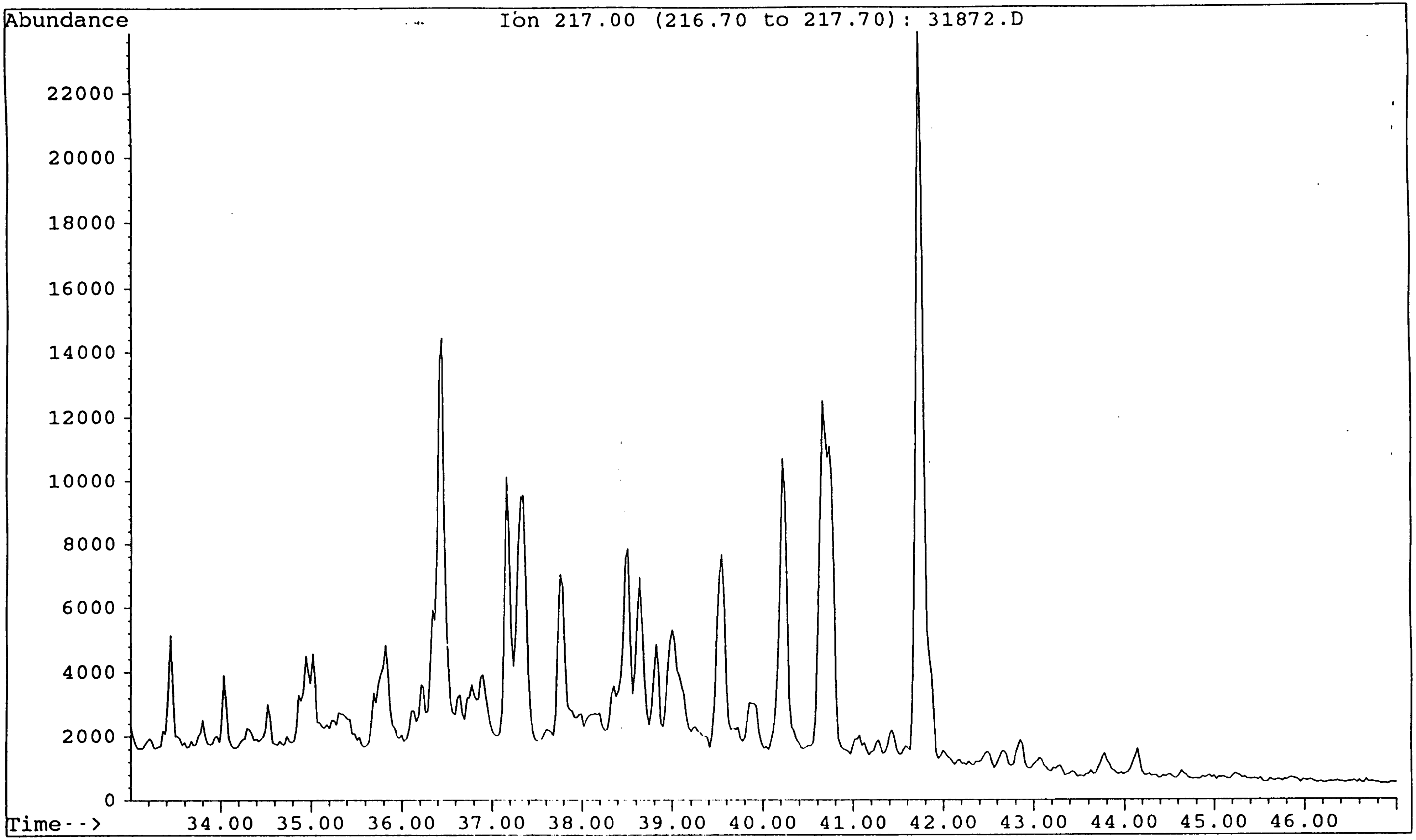
File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



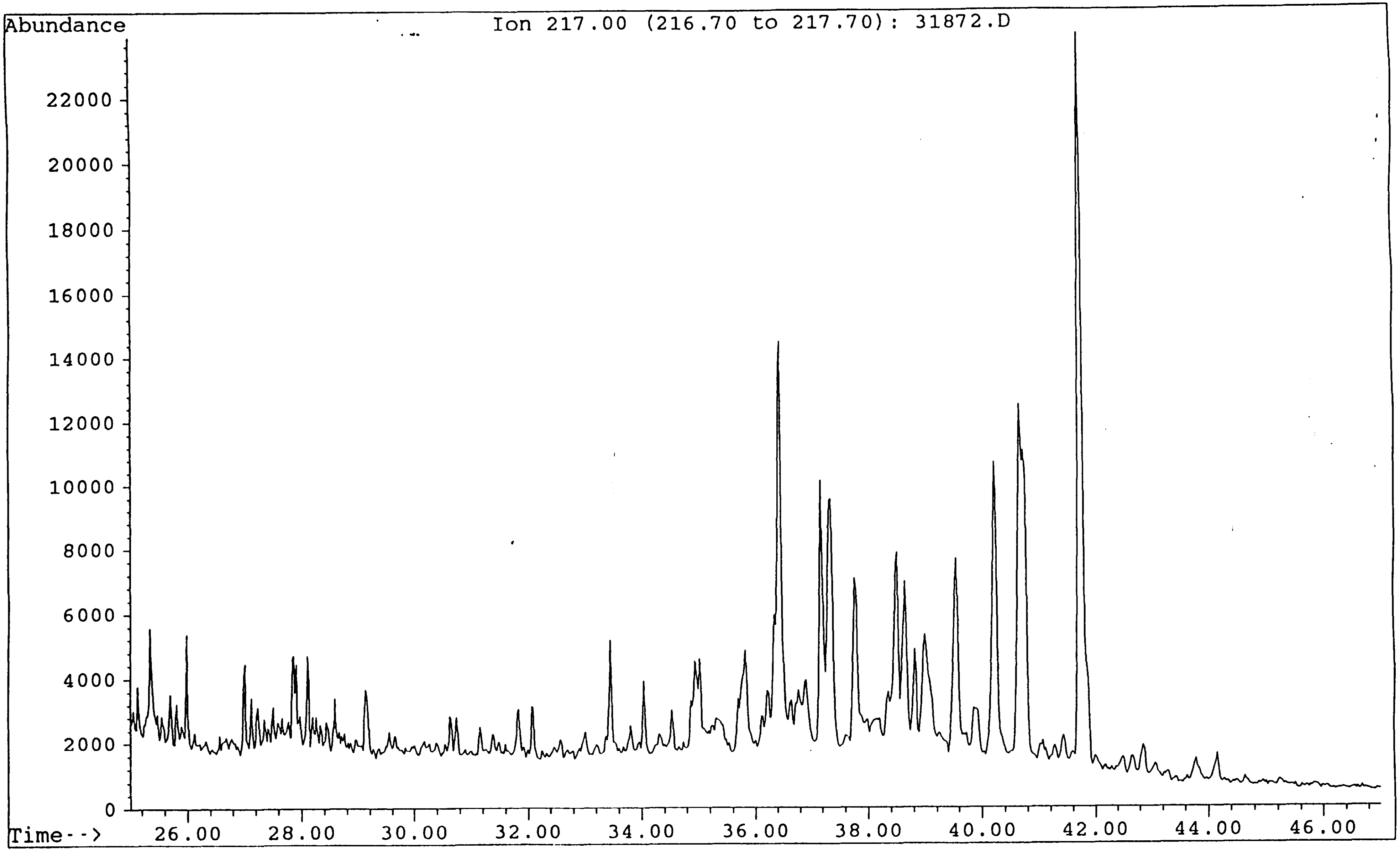
File :   31872.D
Sample :   LA BELLA#1, 2097.70m, B/C.
Misc. Info :   COL#143. 1/600uL. 10-11-93. GEC.



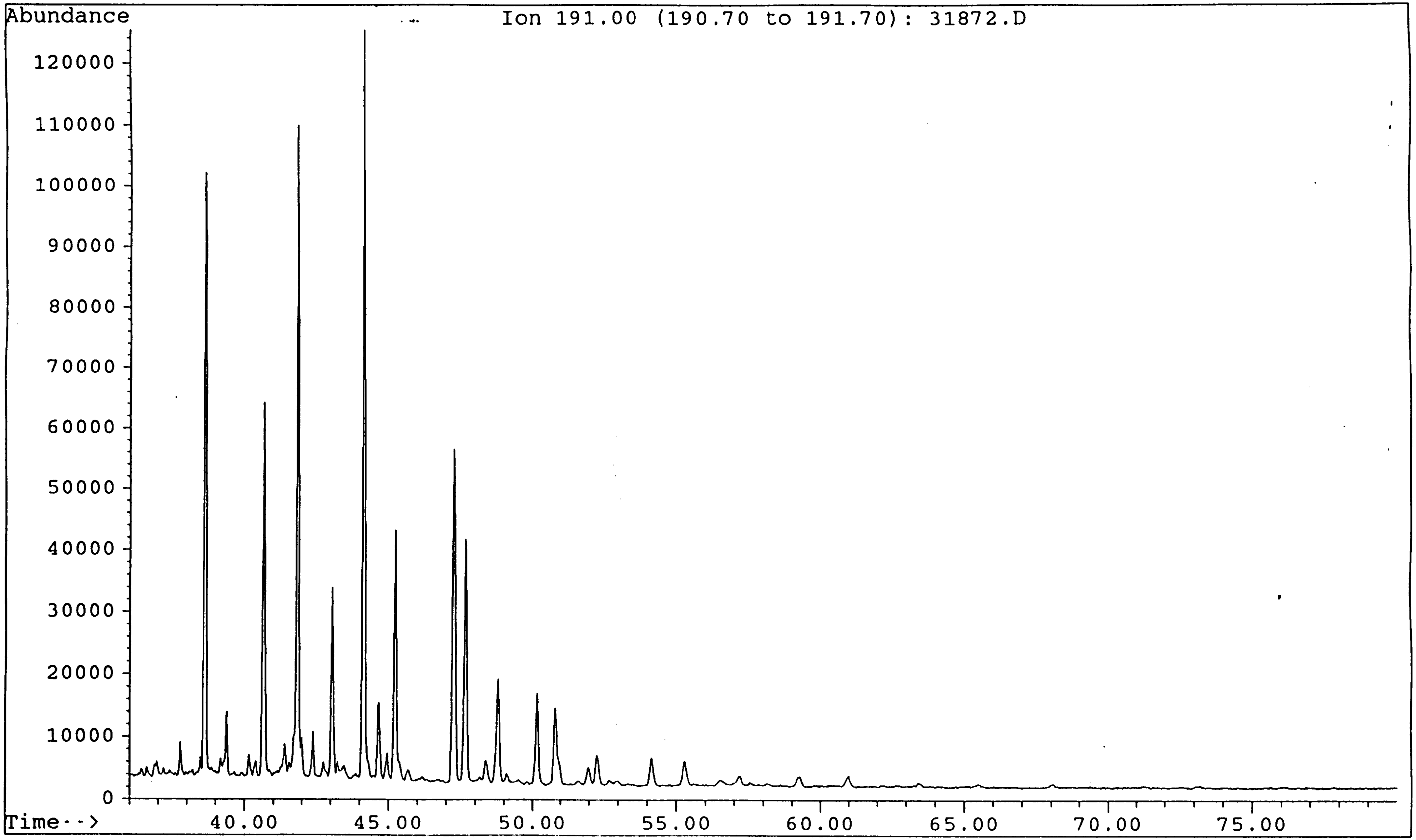
File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



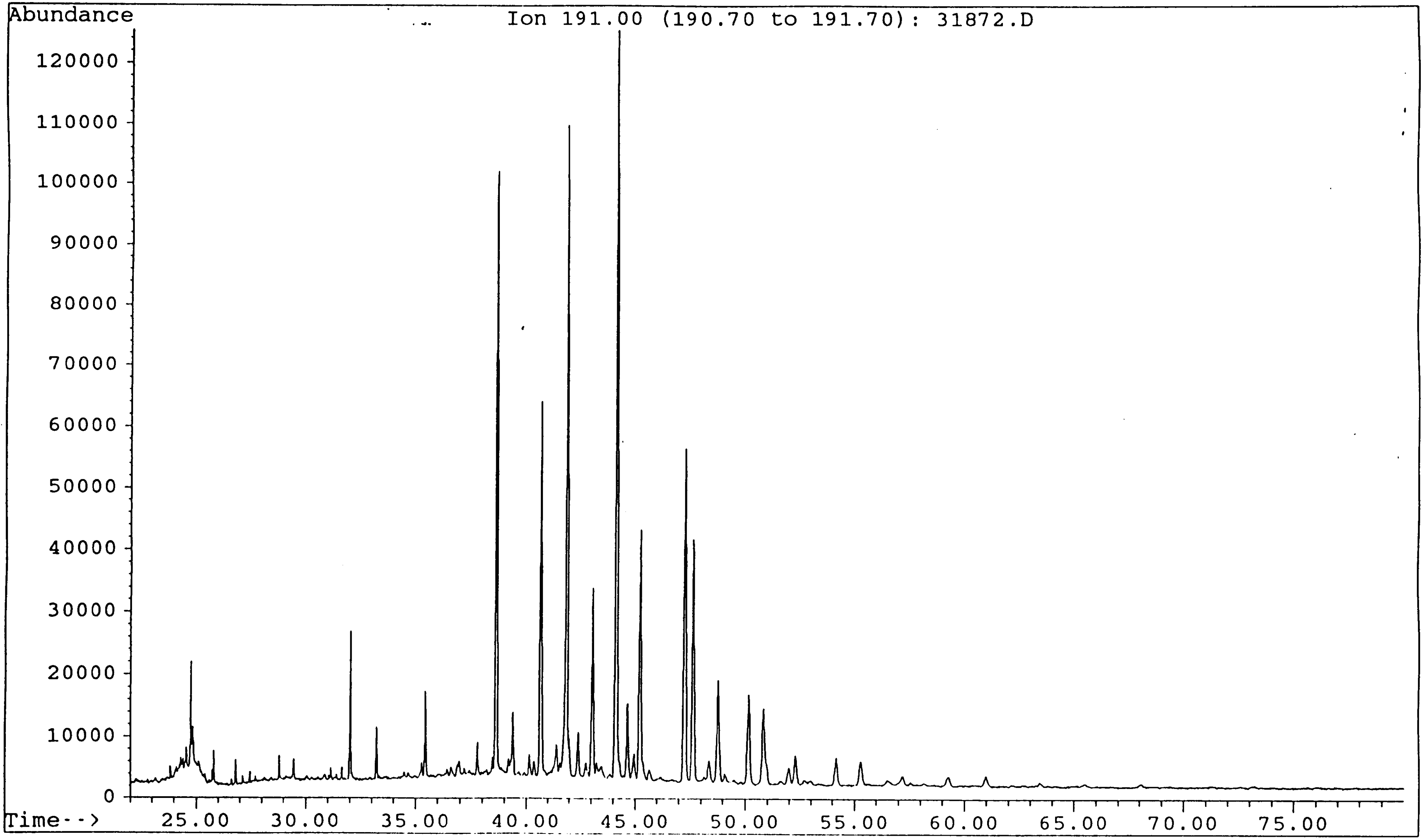
File 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



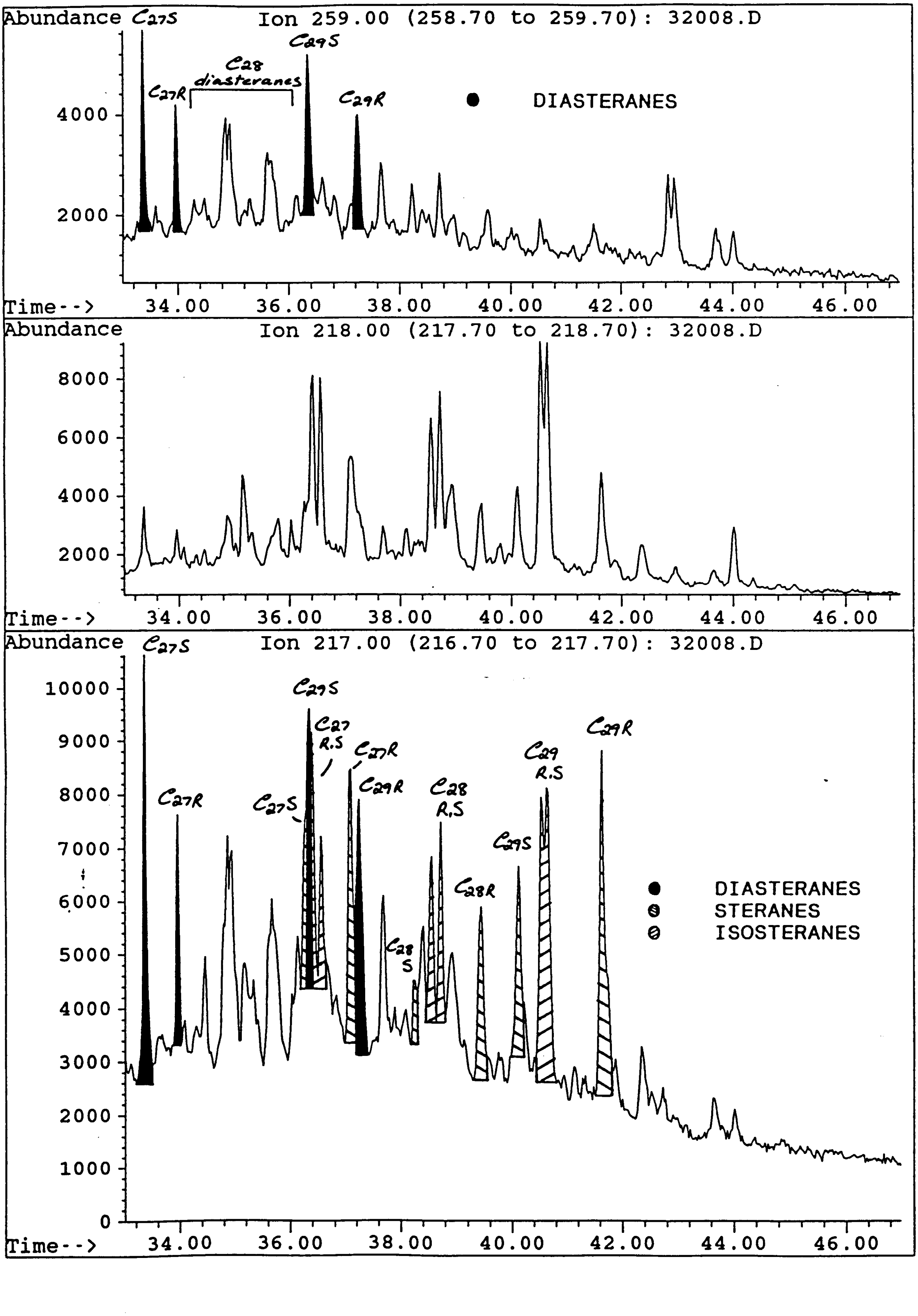
File : 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



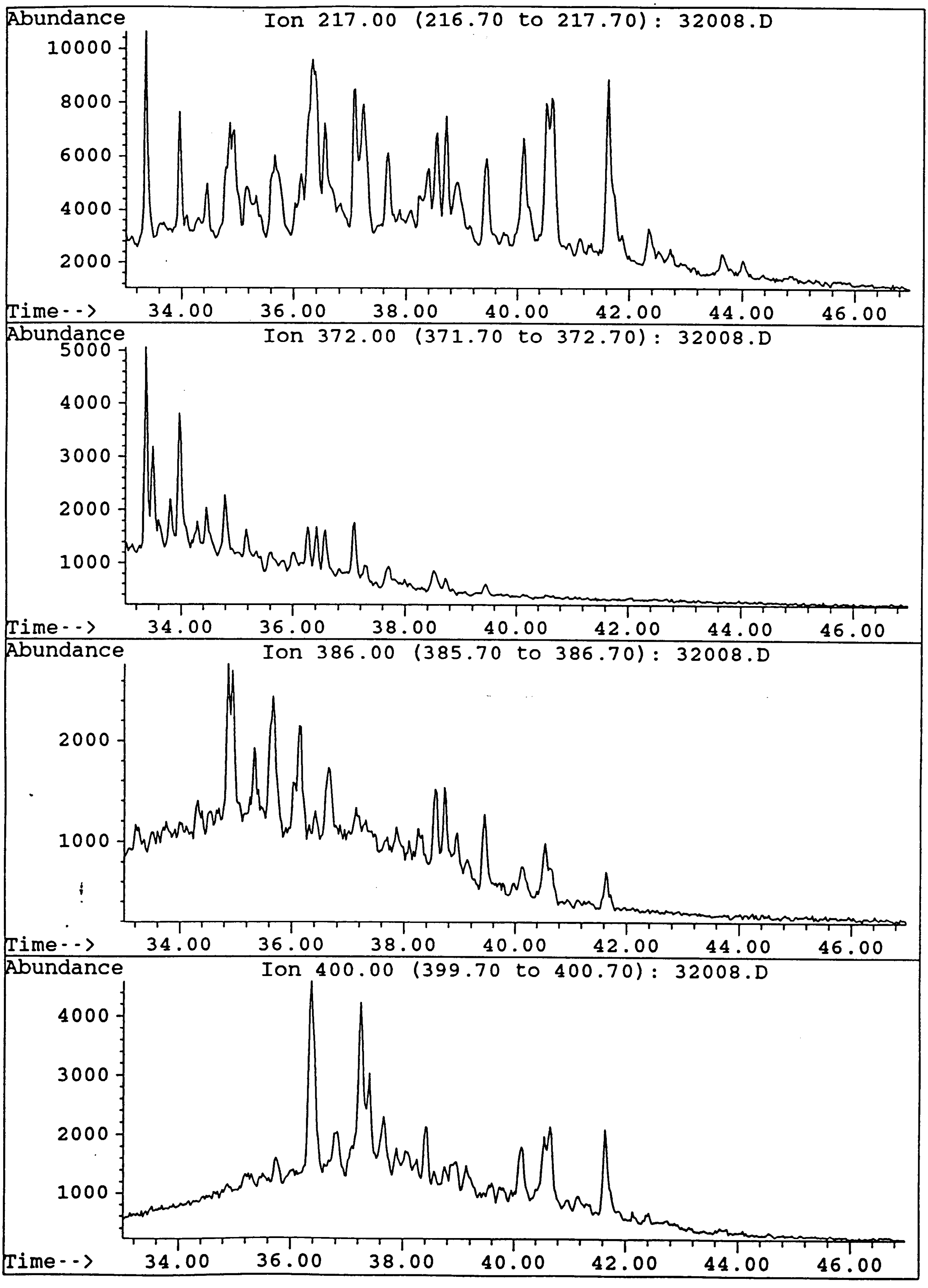
File 31872.D
Sample : LA BELLA#1, 2097.70m, B/C.
Misc. Info : COL#143. 1/600uL. 10-11-93. GEC.



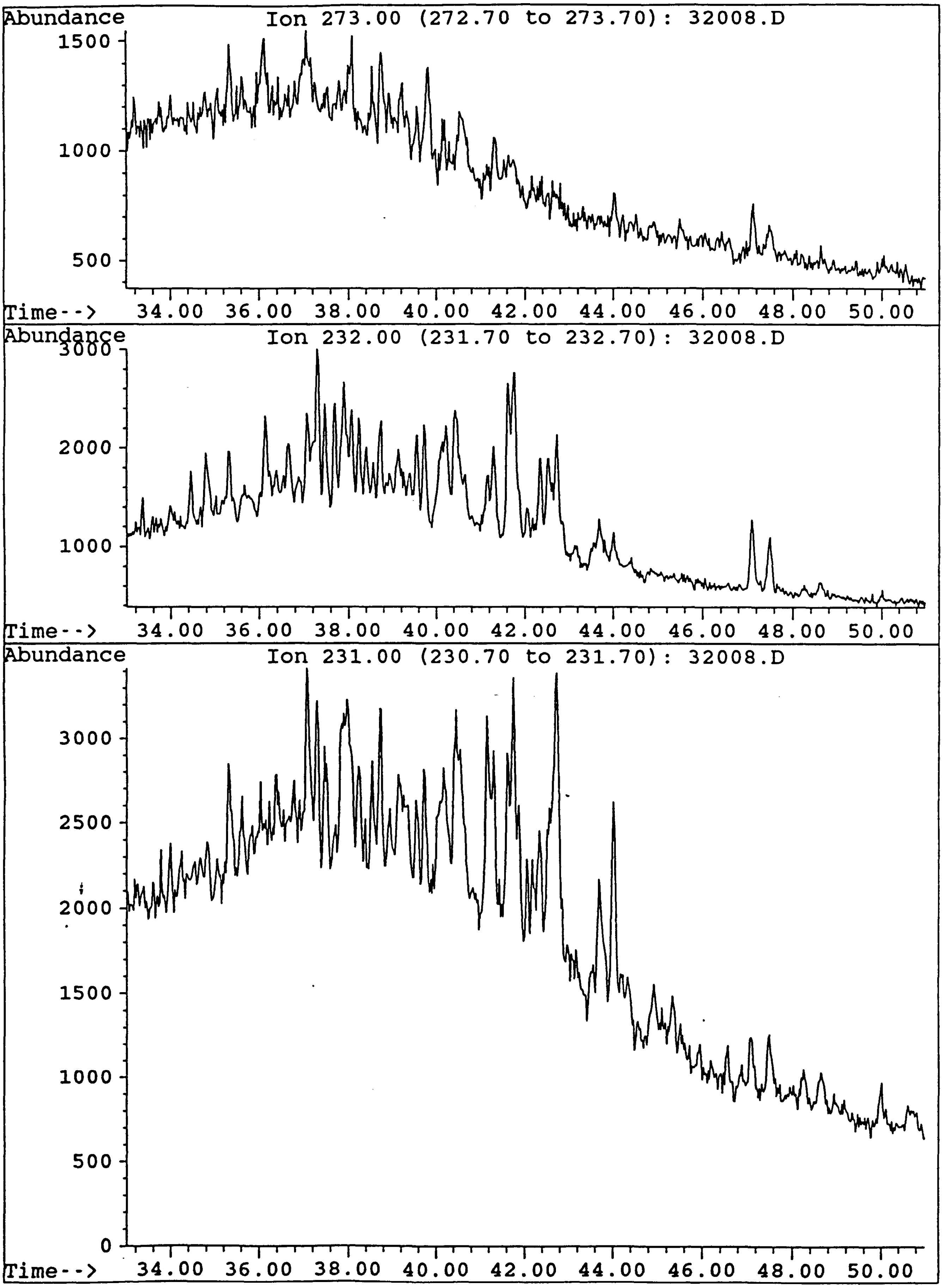
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



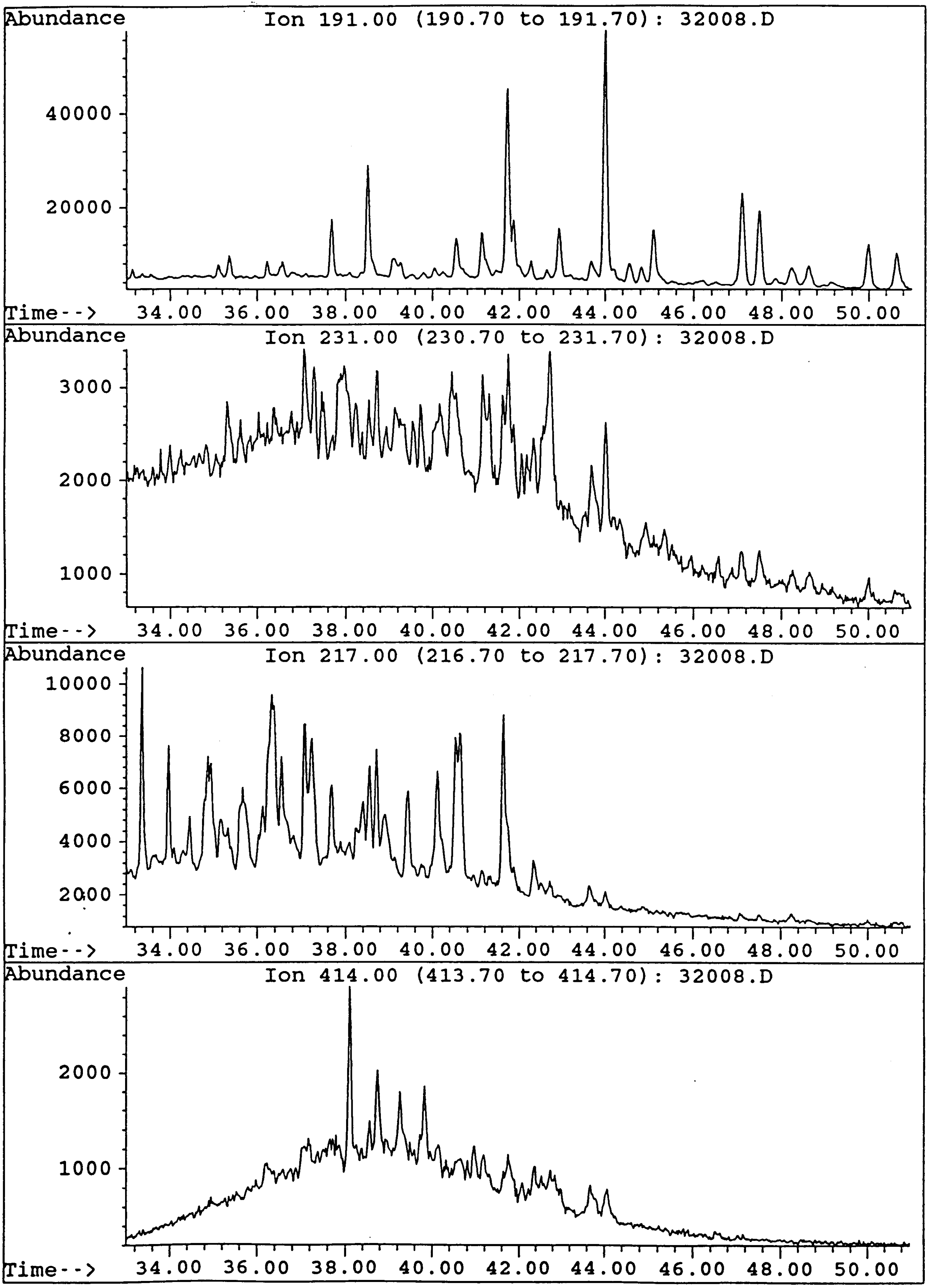
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



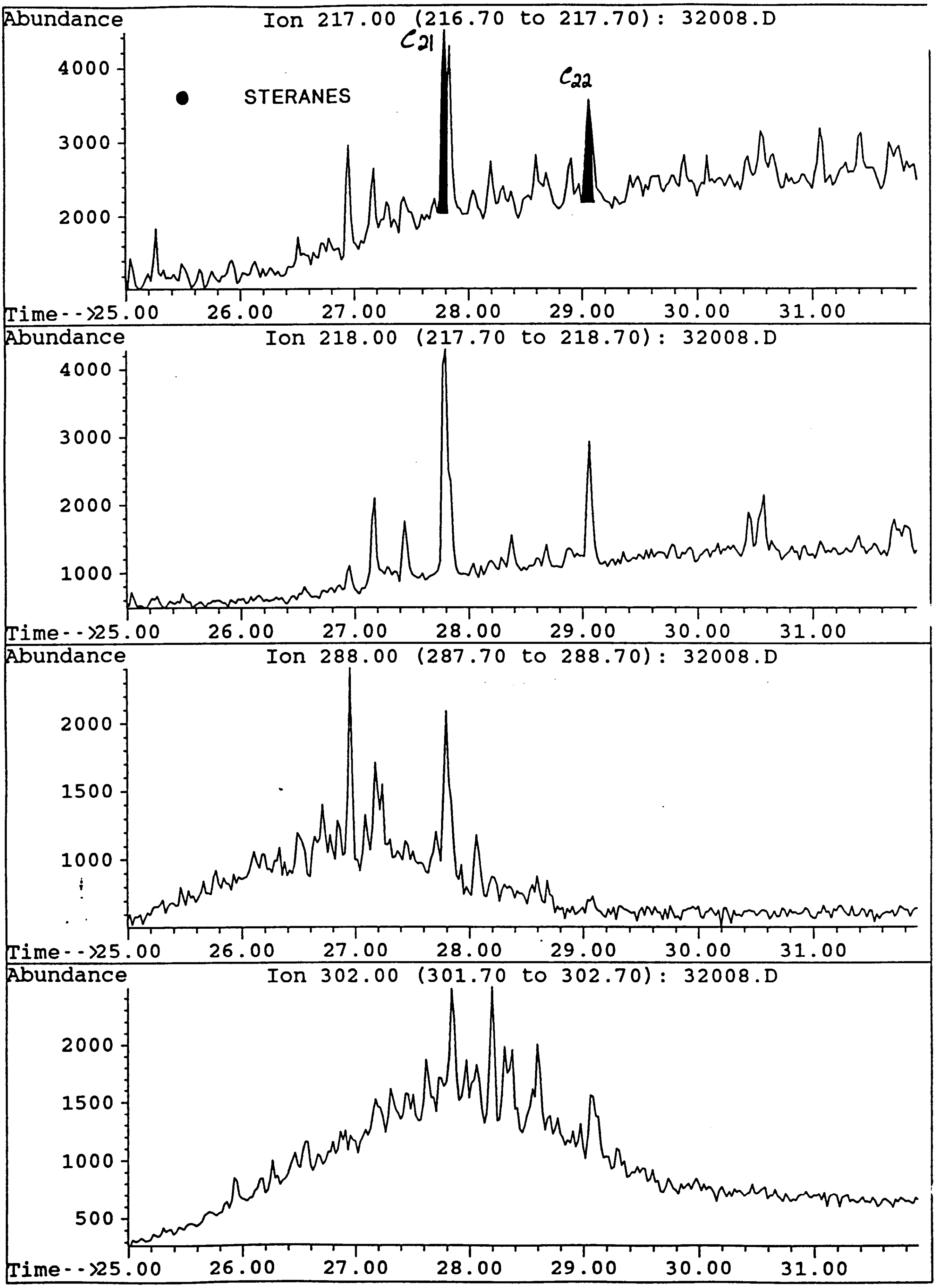
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



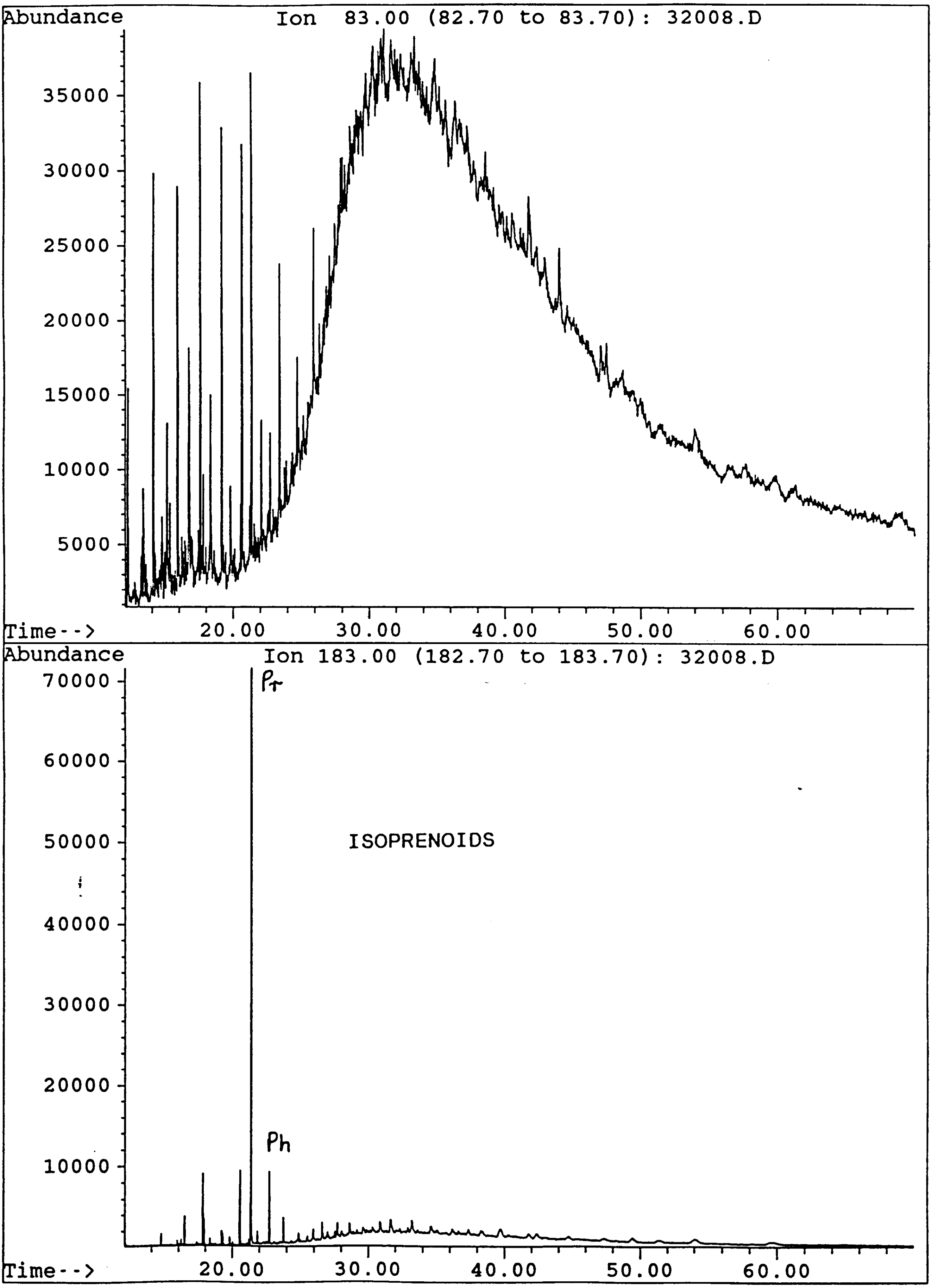
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



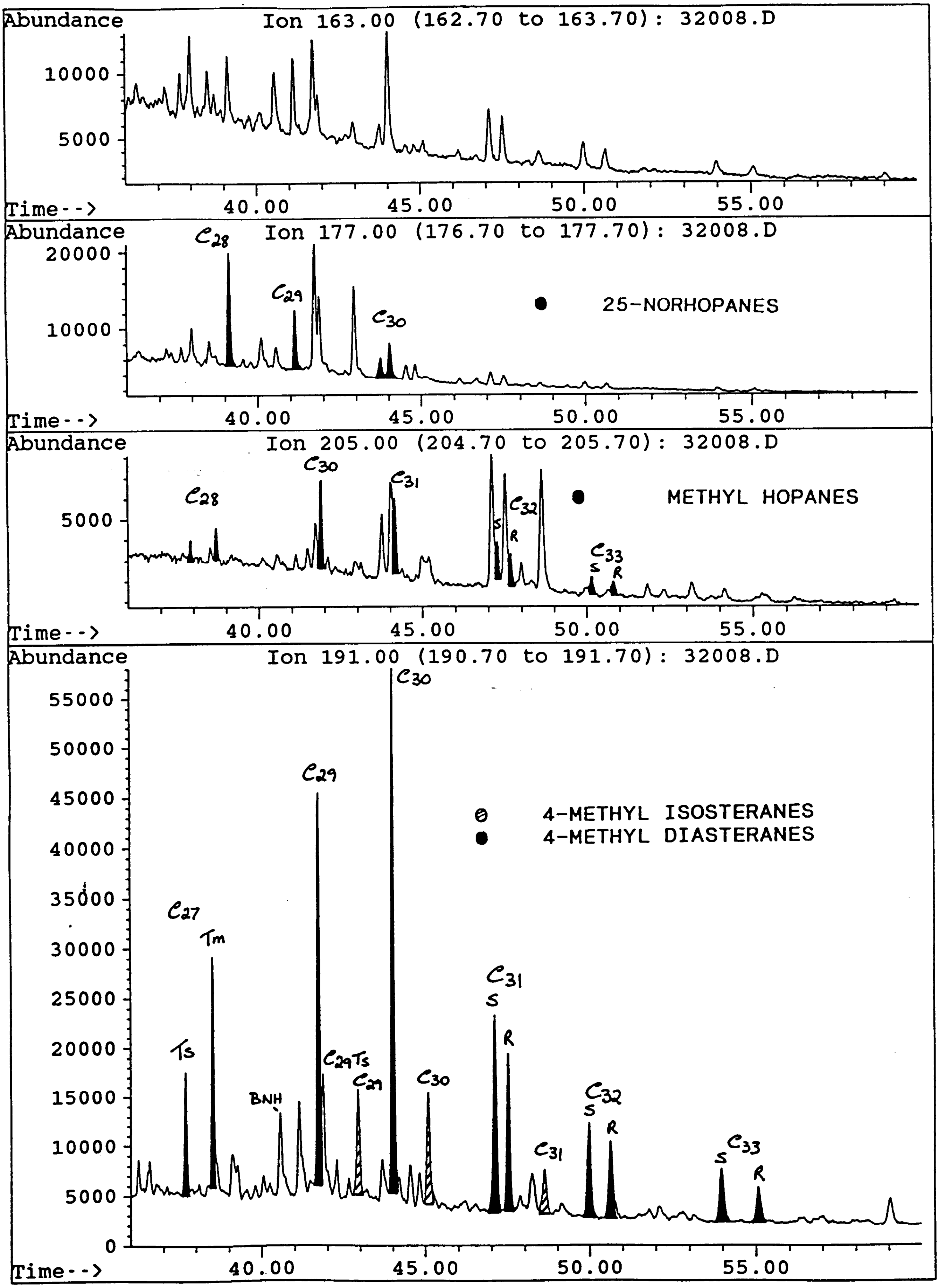
File :   32008.D
Sample :   LA BELLA #1, 2100-10m, B/Cs
Misc. Info :   1/1500uL, COL #143, 30-11-93, SF.



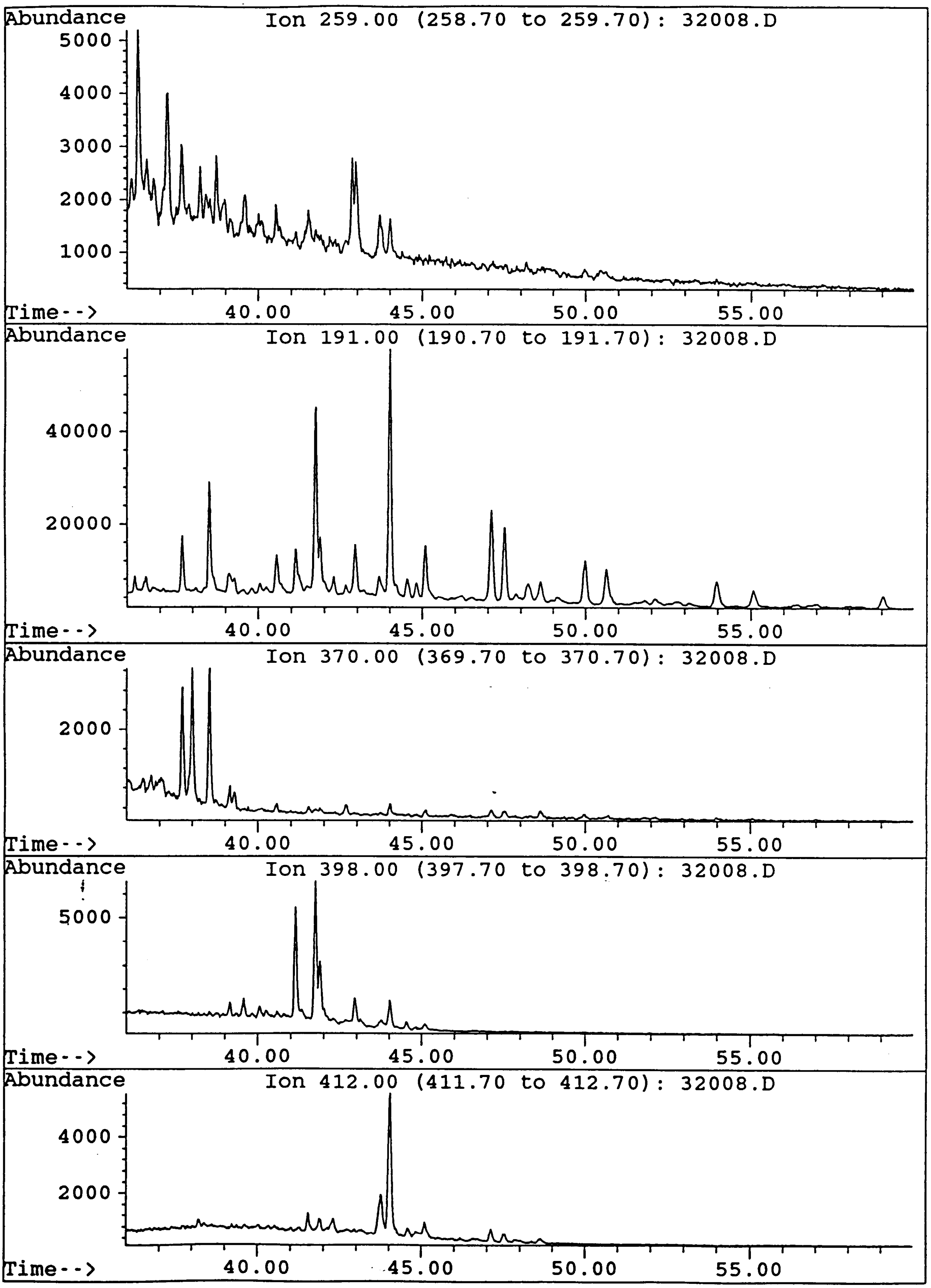
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



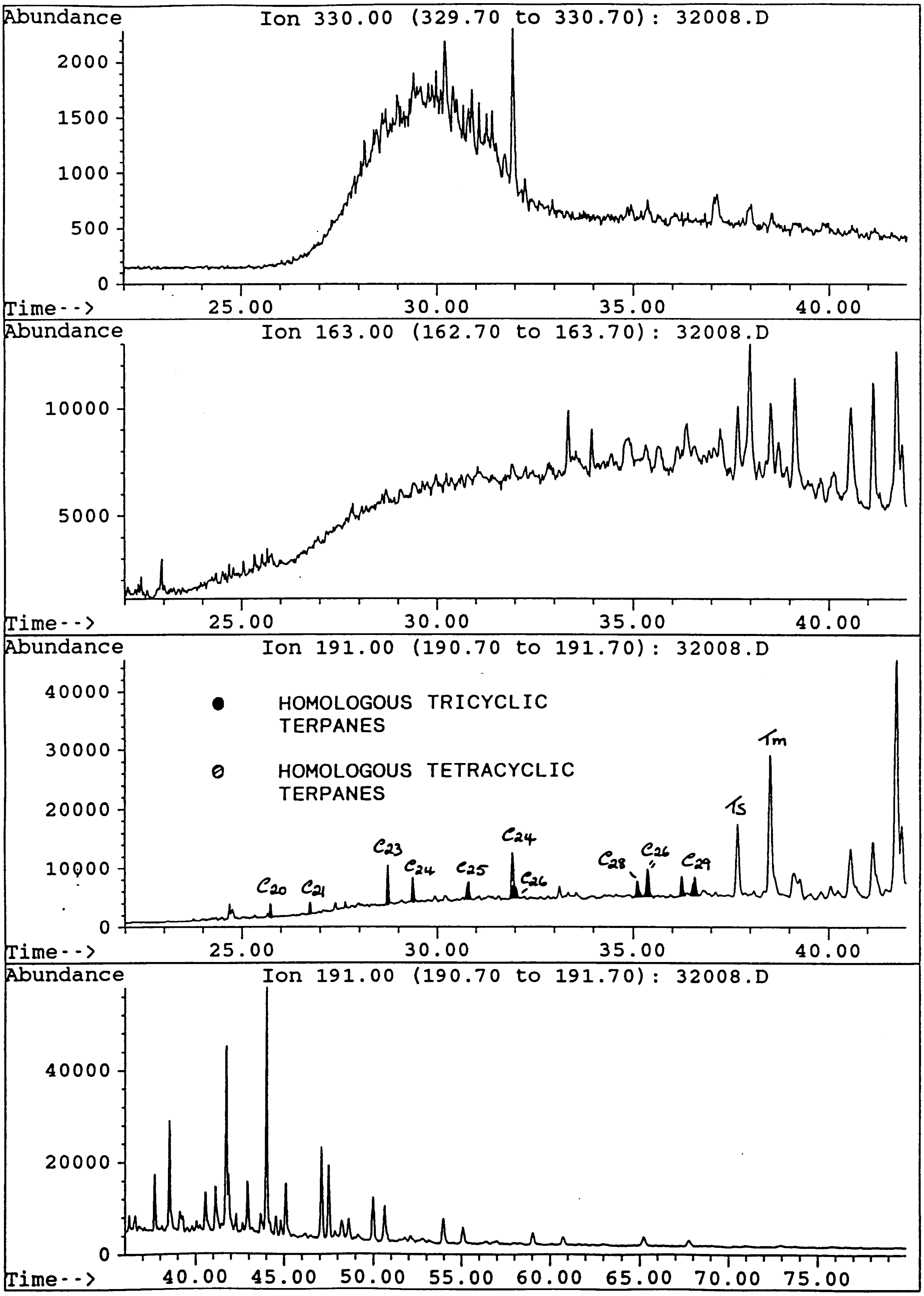
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



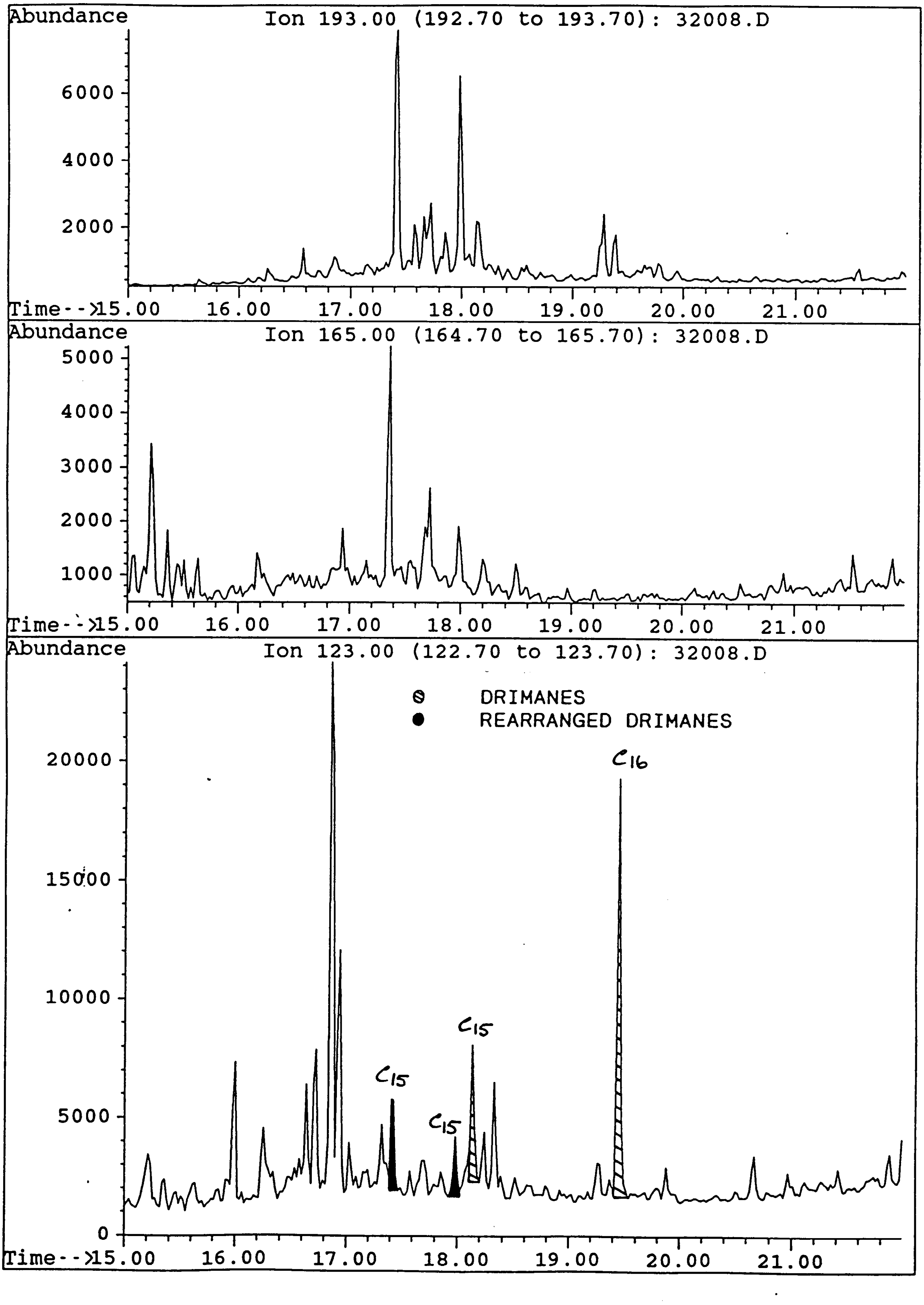
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



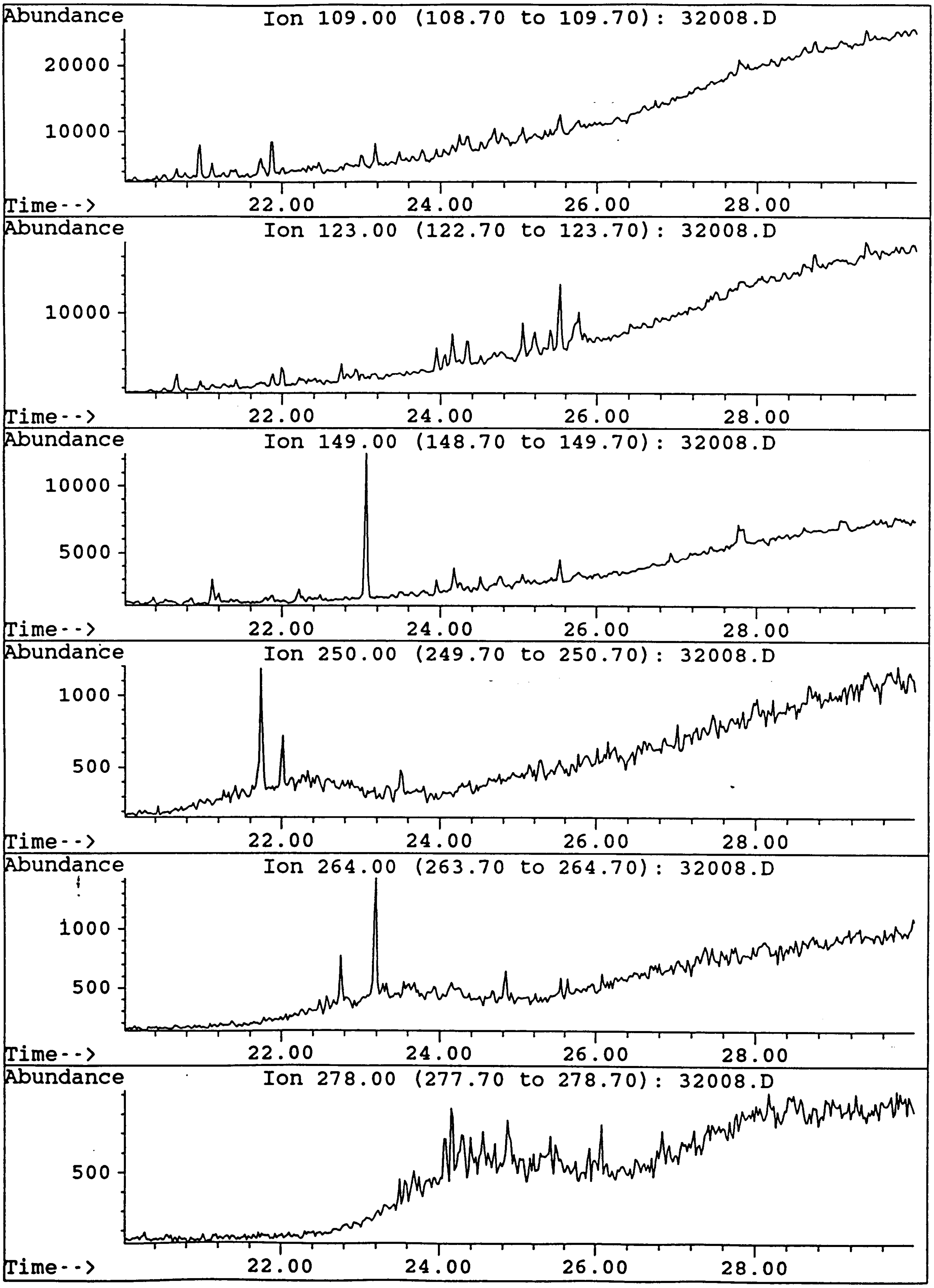
File :   32008.D
Sample :   LA BELLA #1, 2100-10m, B/Cs
Misc. Info :   1/1500uL, COL #143, 30-11-93, SF.



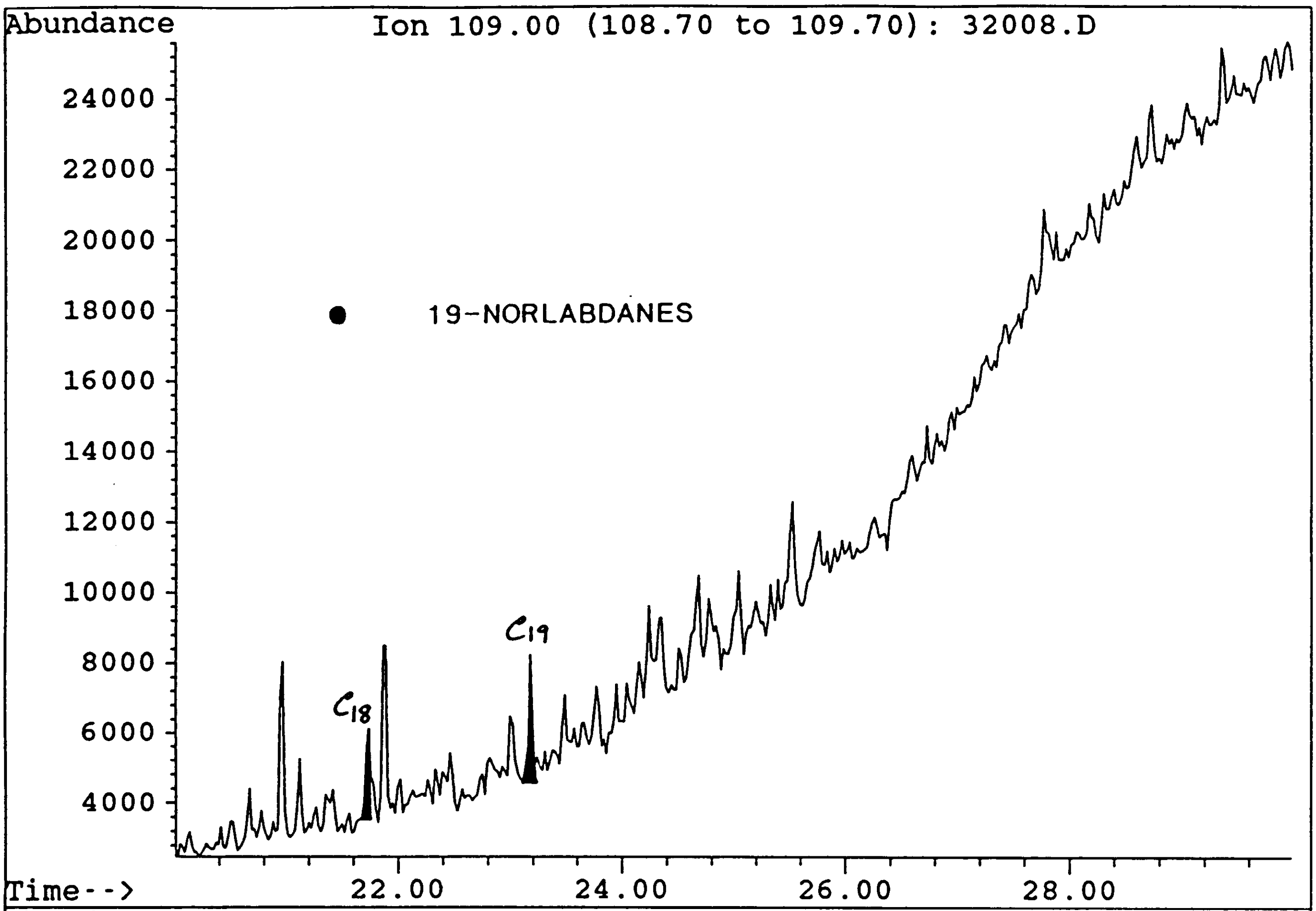
File :   32008.D
Sample :   LA BELLA #1, 2100-10m, B/Cs
Misc. Info :   1/1500uL, COL #143, 30-11-93, SF.

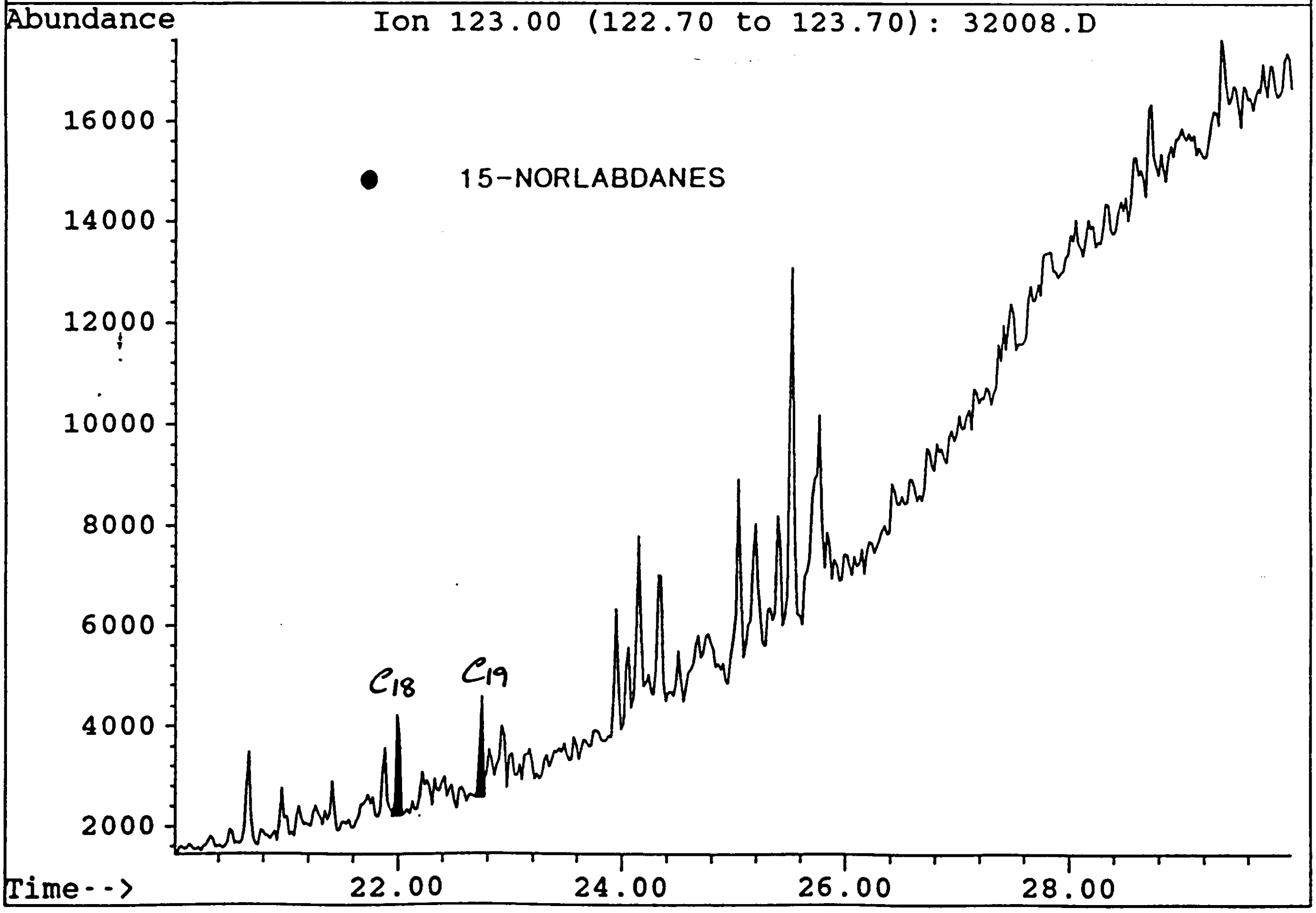


File :   32008.D
Sample :   LA BELLA #1, 2100-10m, B/Cs
Misc. Info :   1/1500uL, COL #143, 30-11-93, SF.

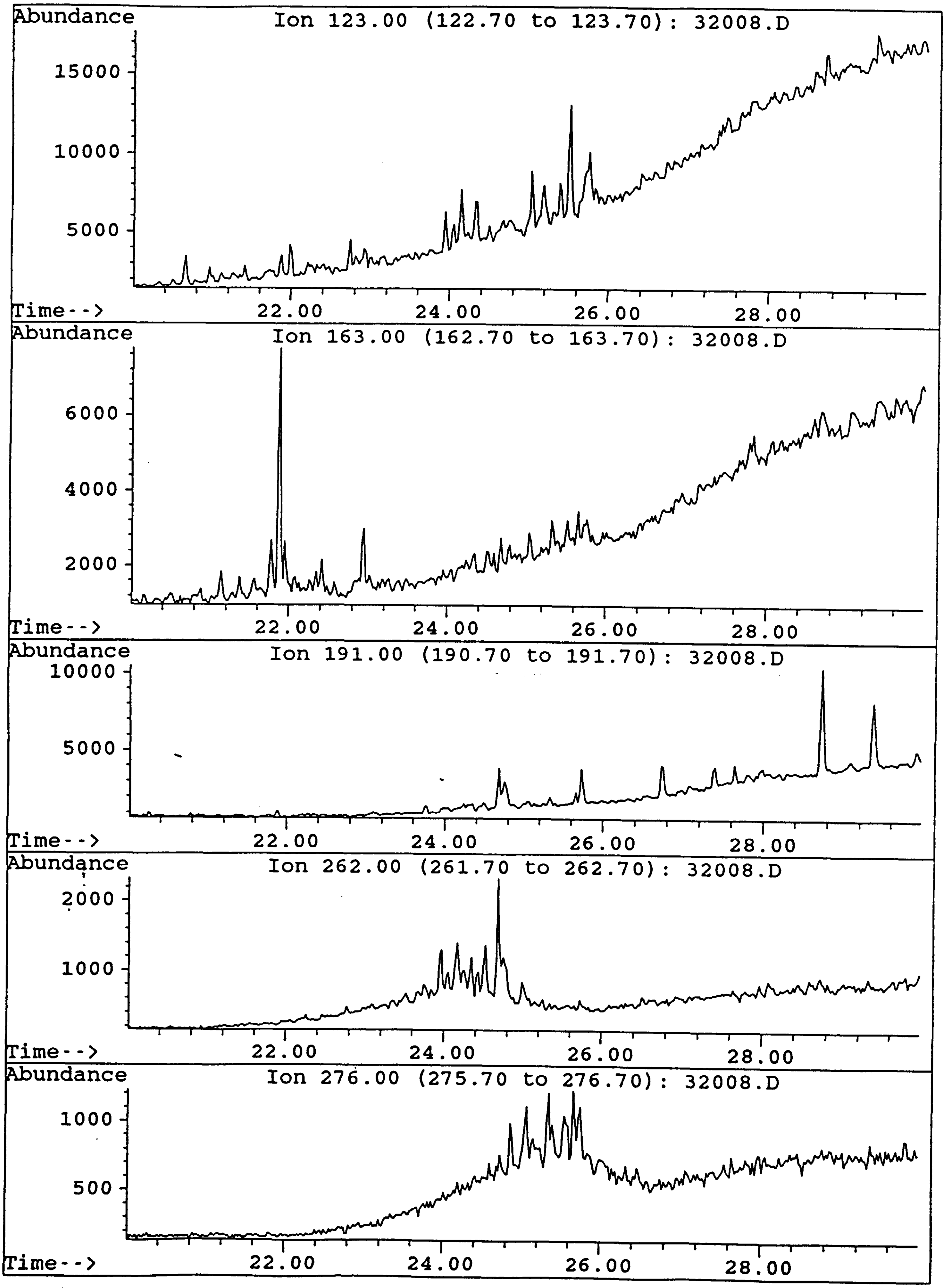


File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.

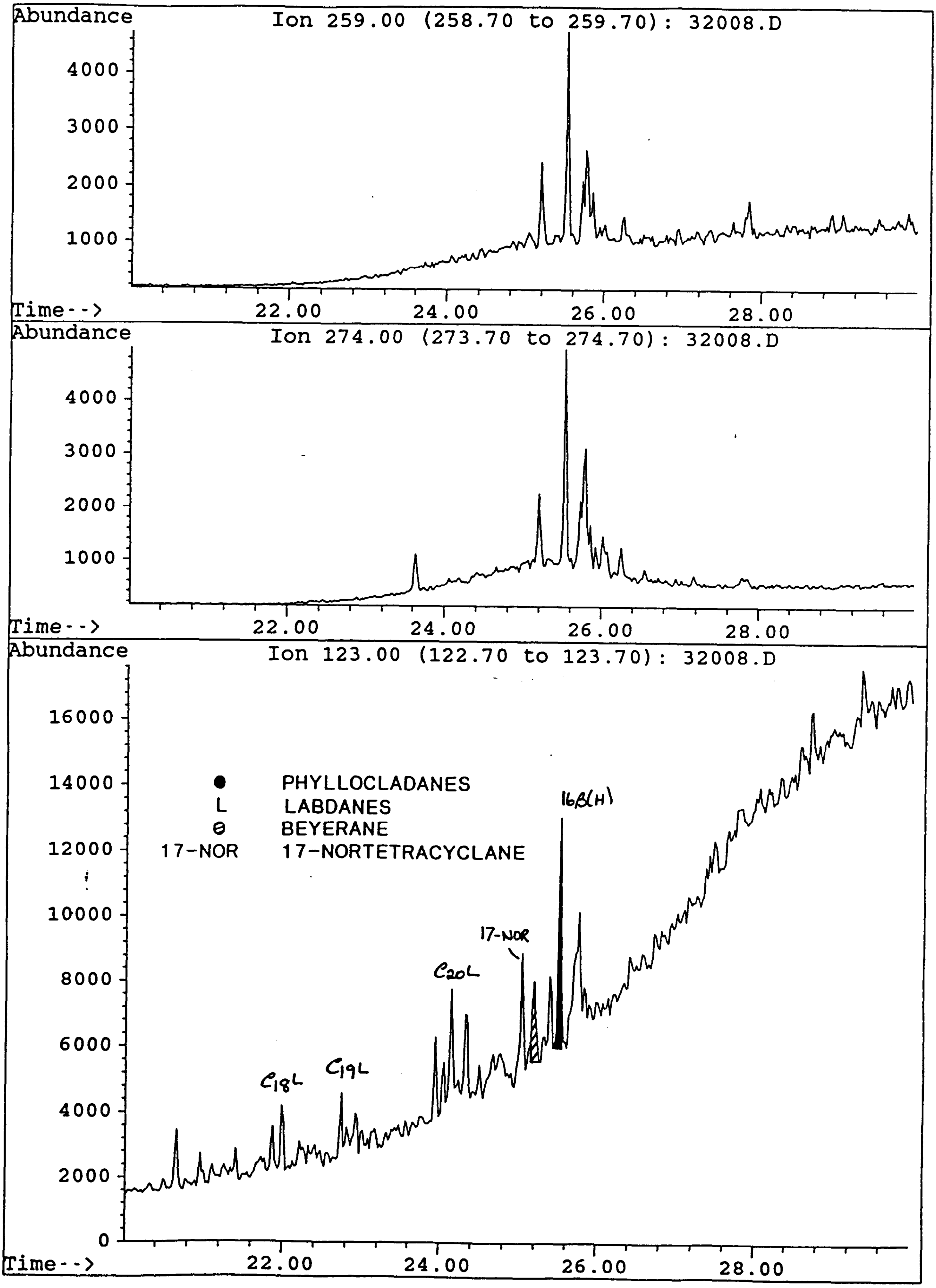




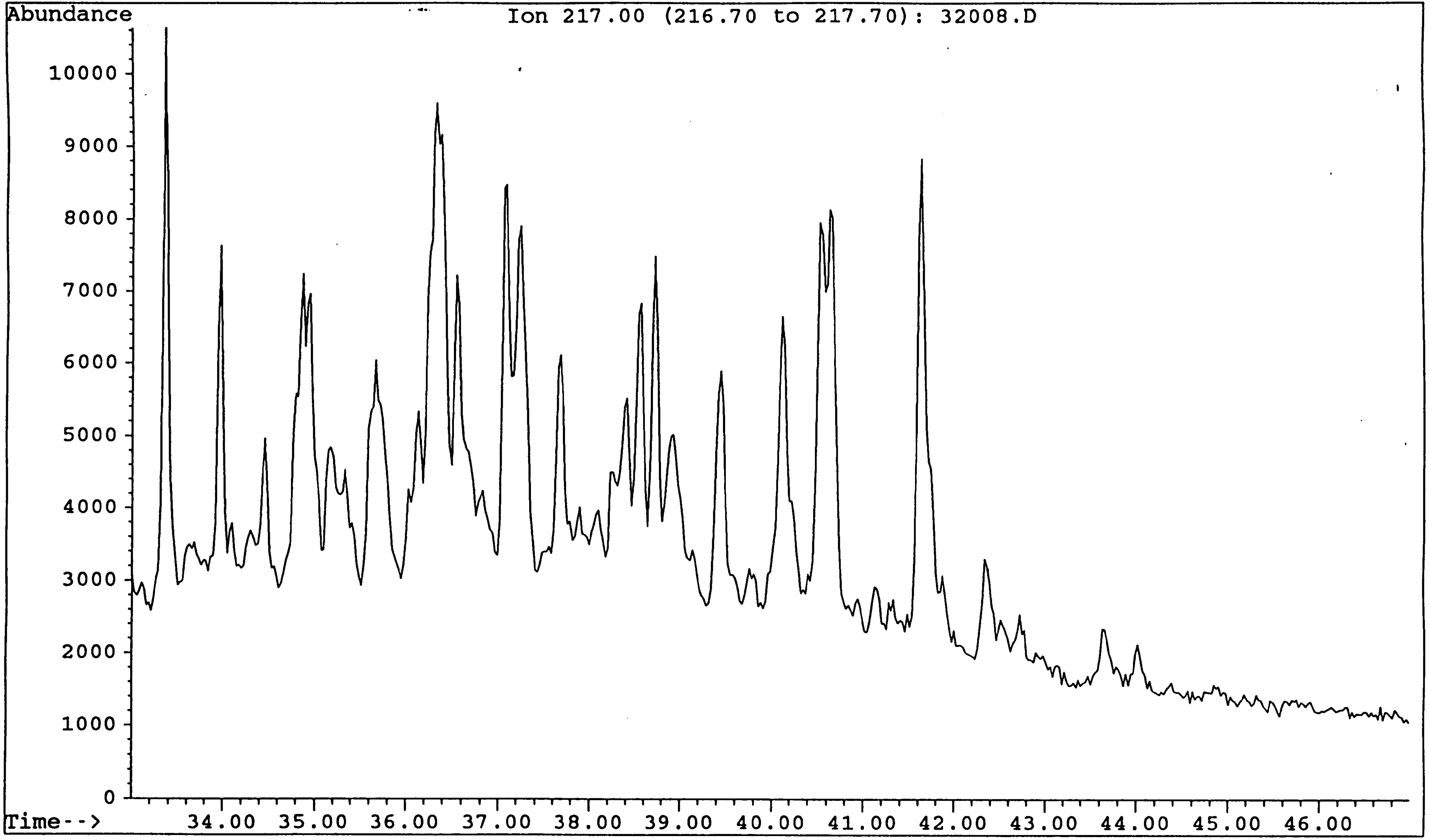
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



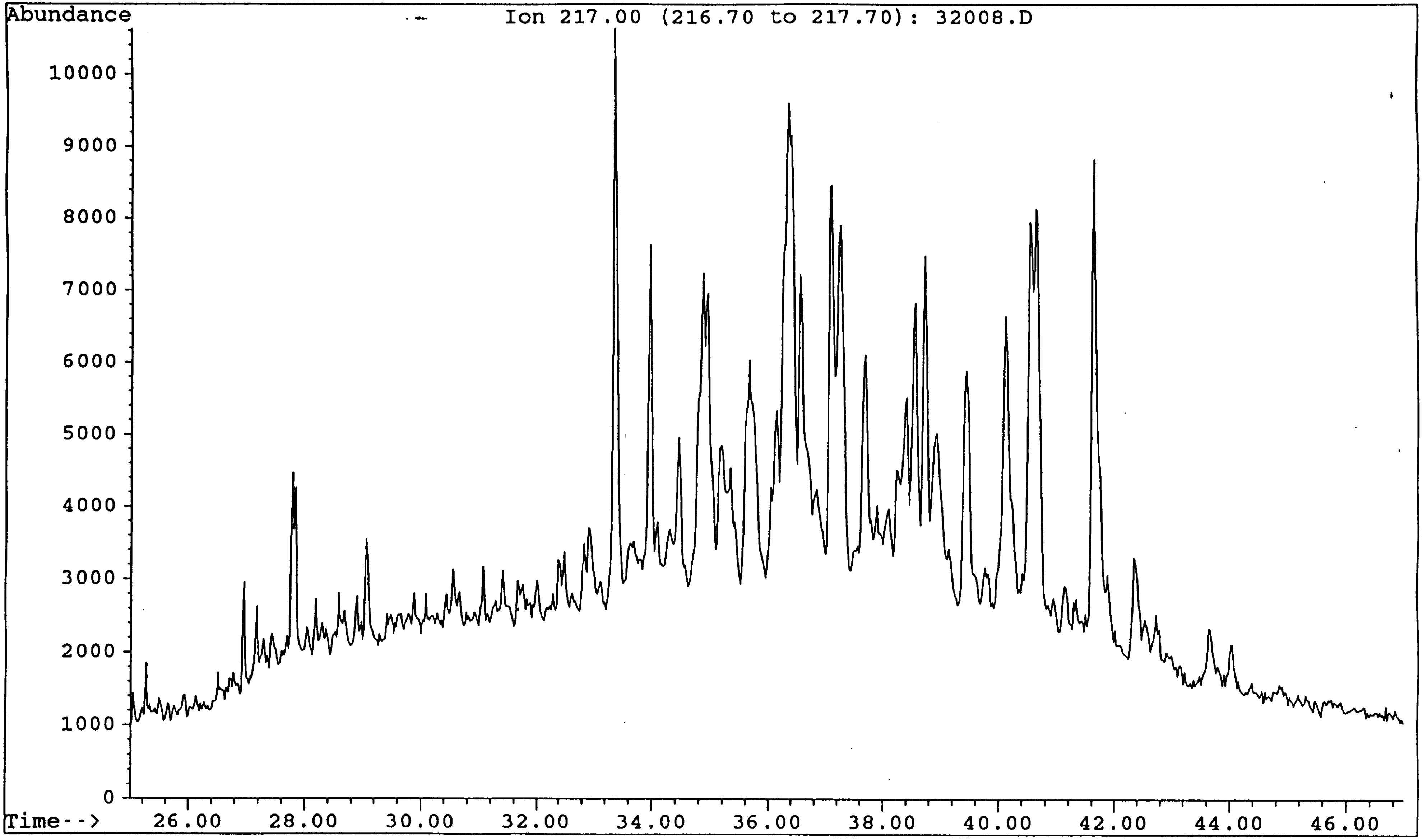
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



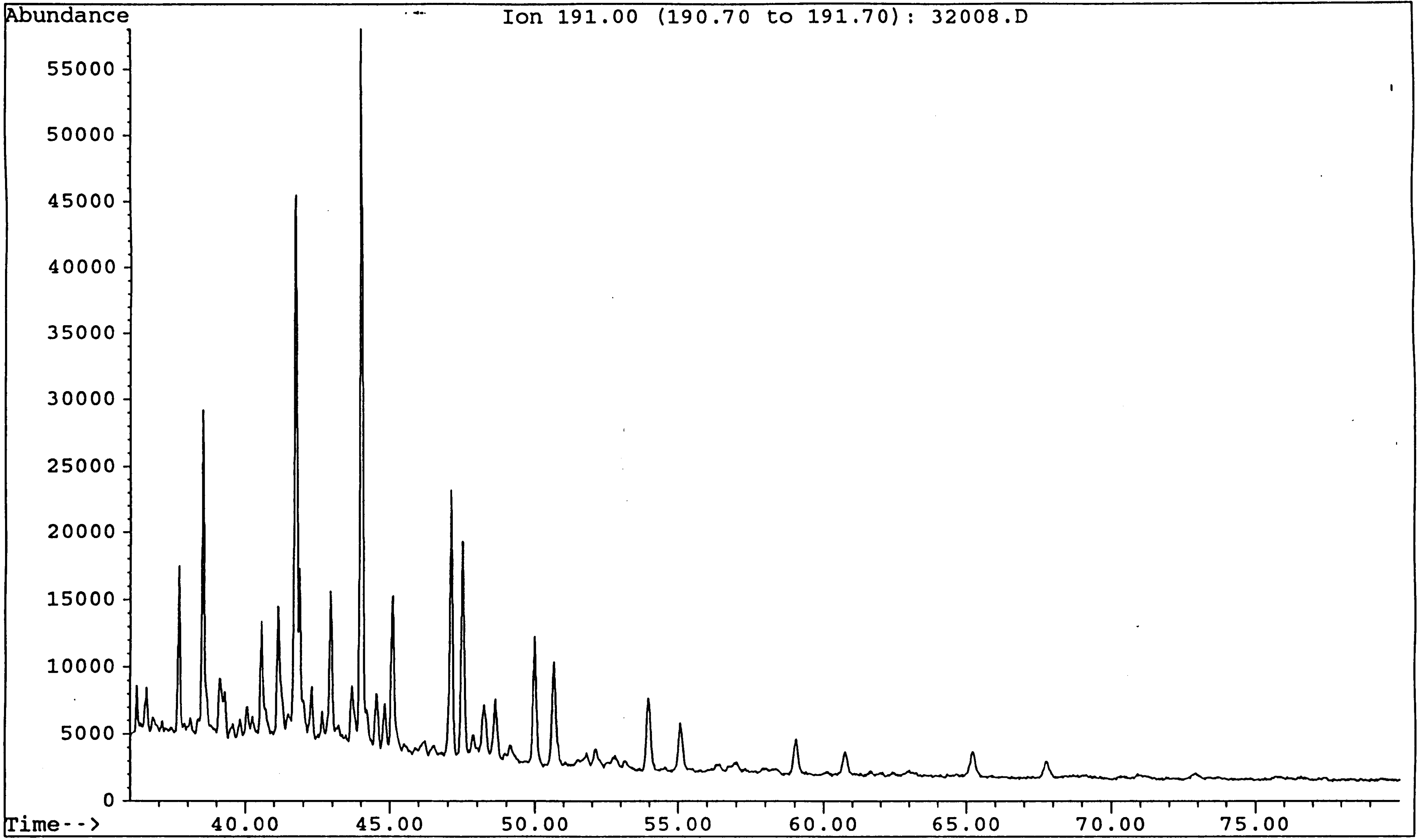
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



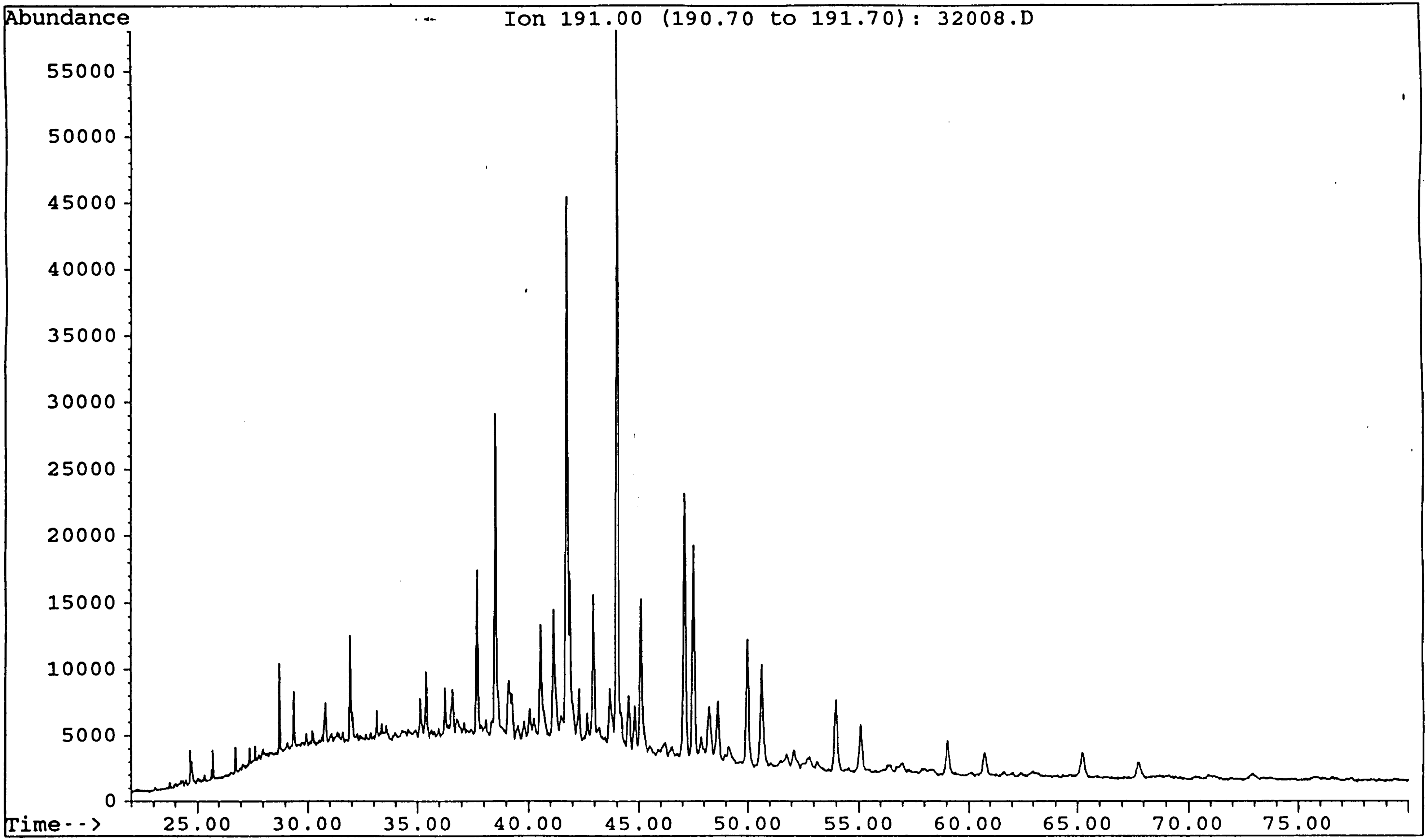
File 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



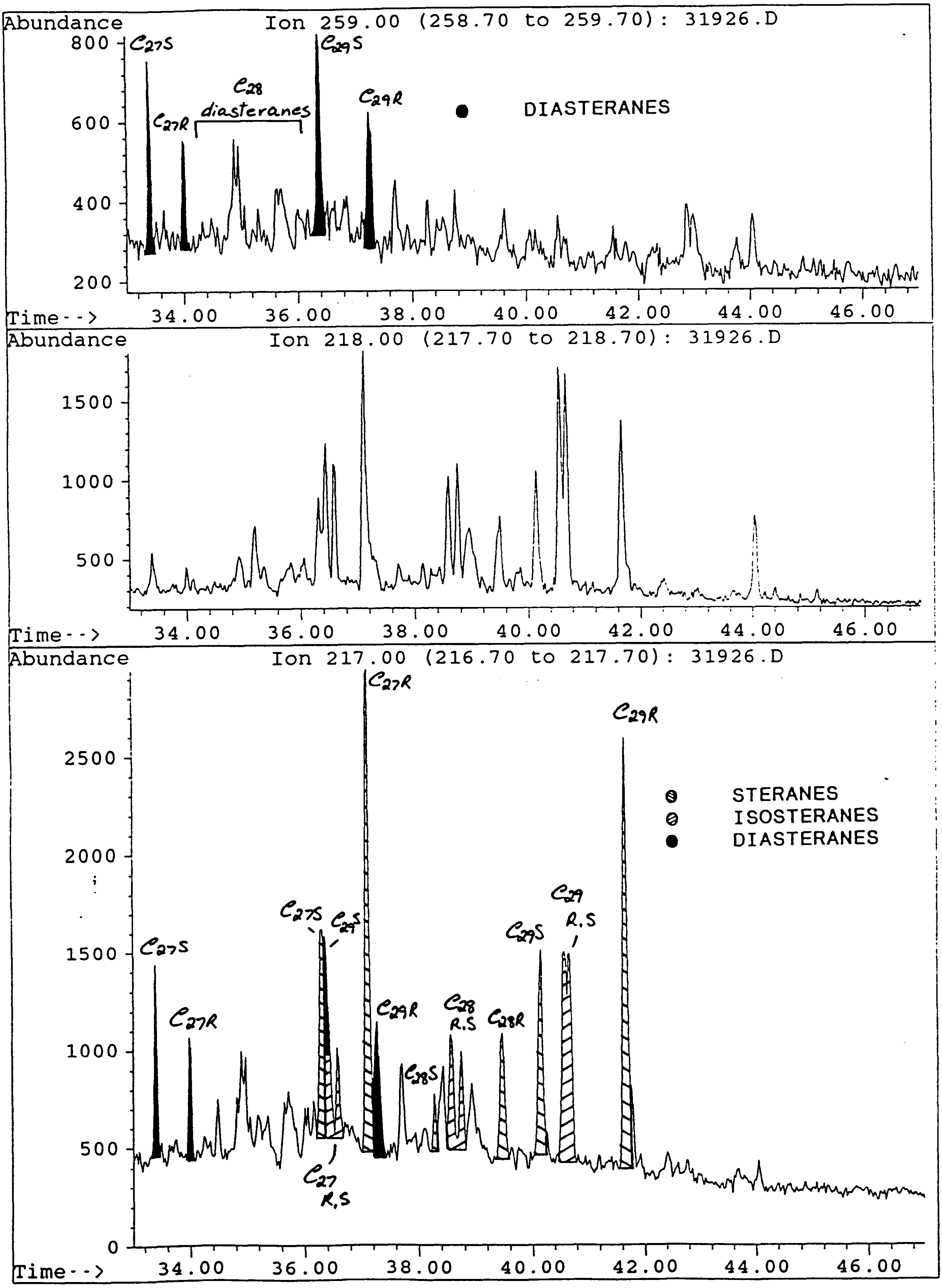
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



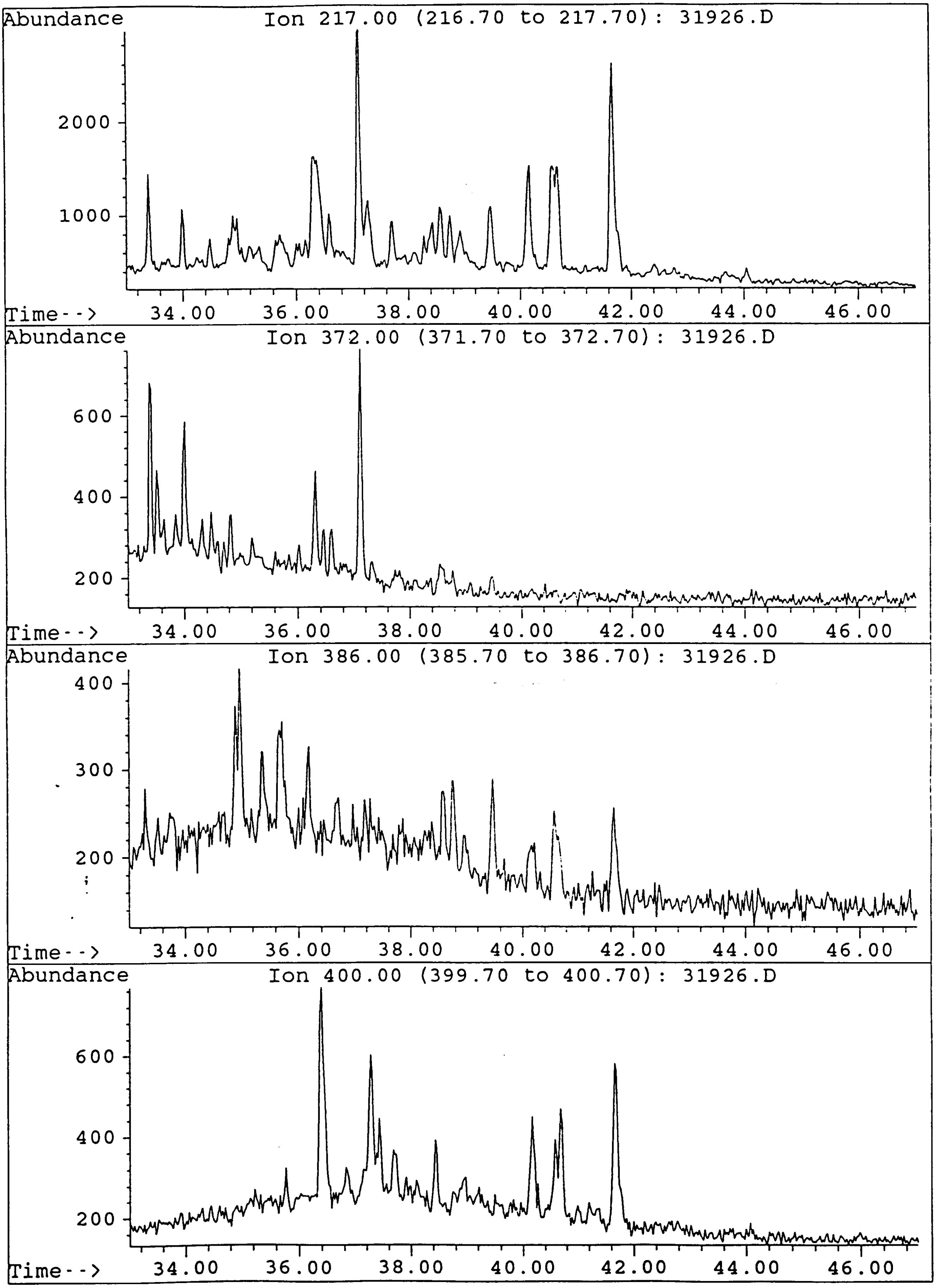
File : 32008.D
Sample : LA BELLA #1, 2100-10m, B/Cs
Misc. Info : 1/1500uL, COL #143, 30-11-93, SF.



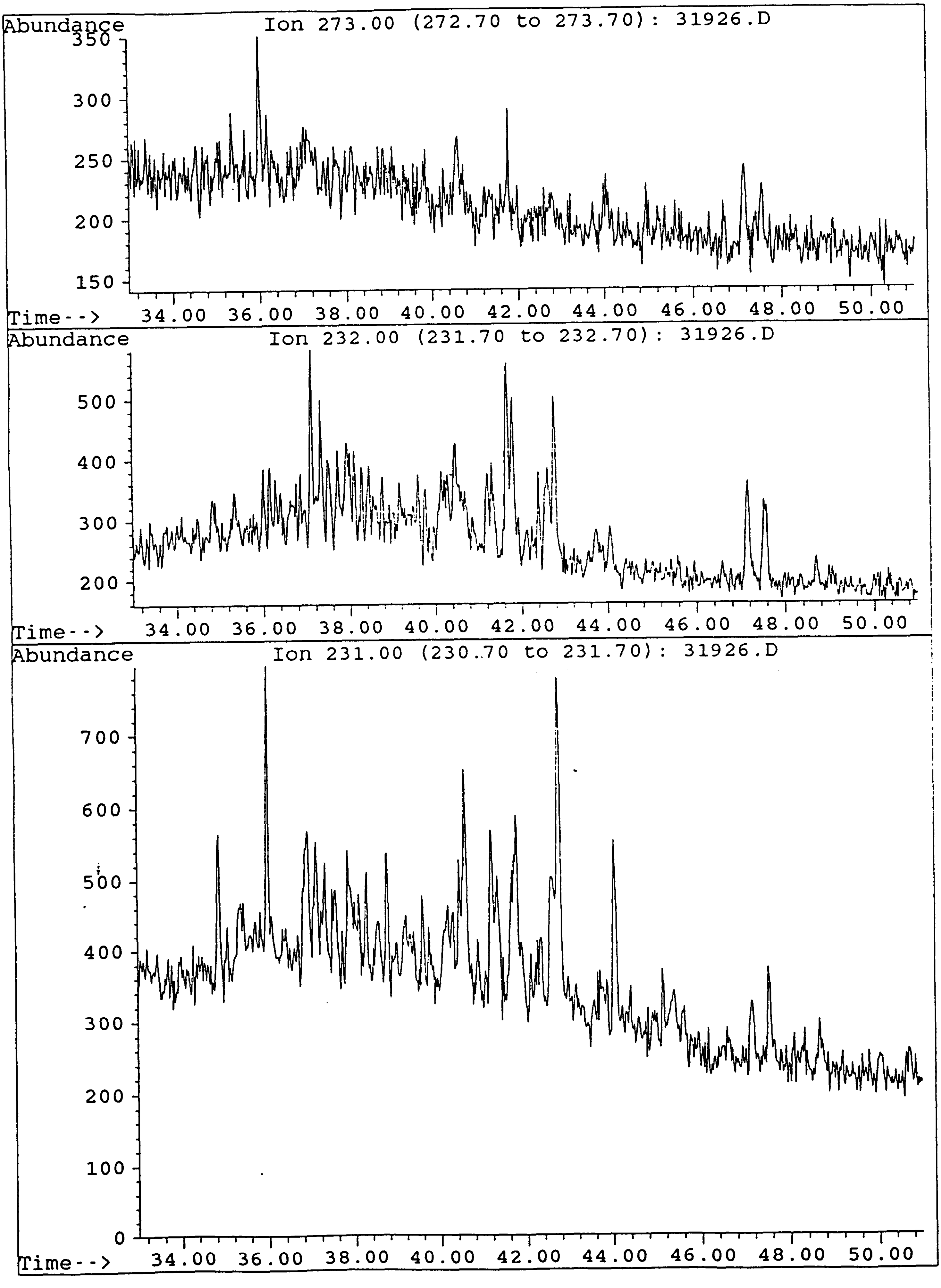
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



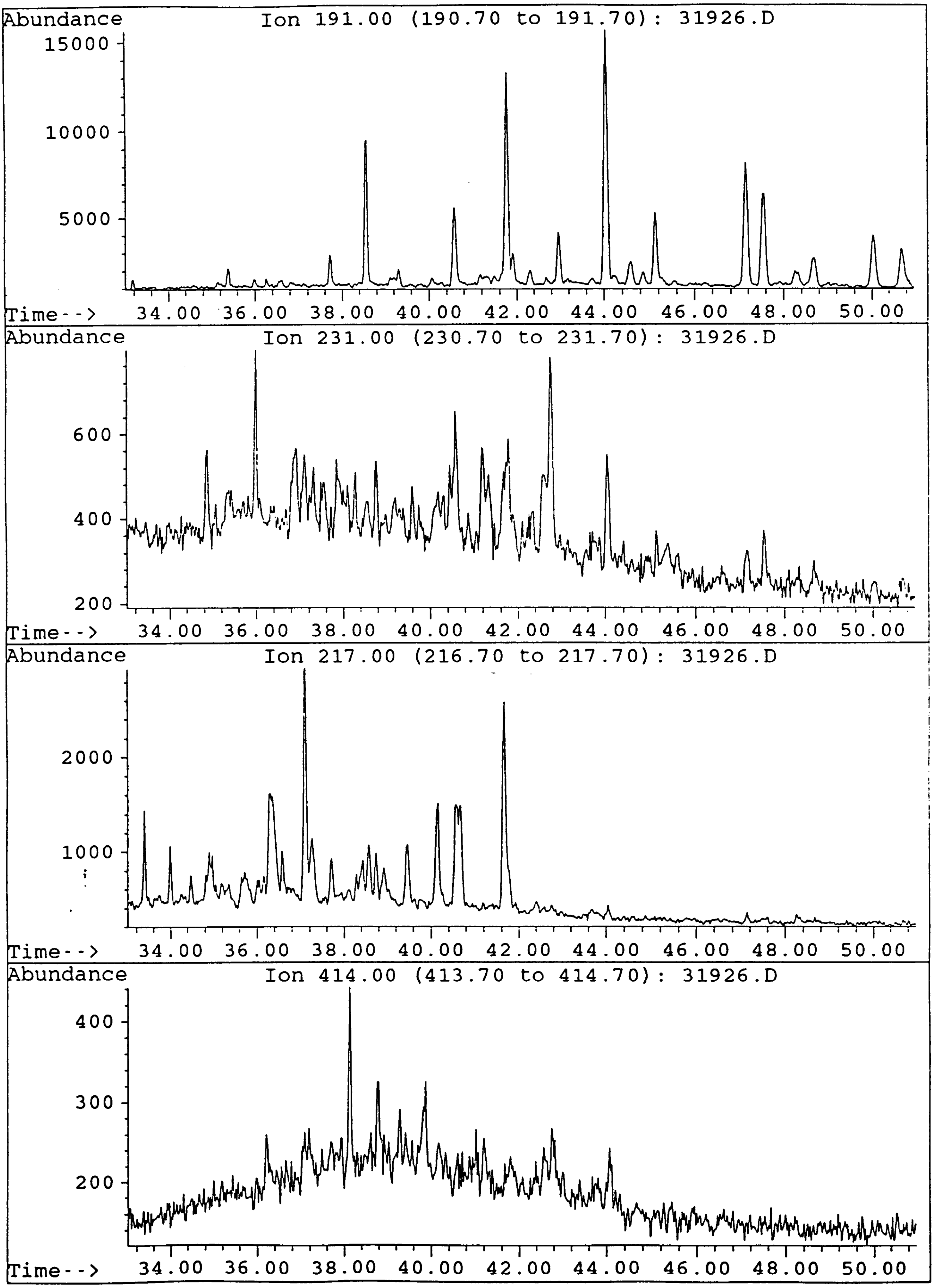
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.


Ion 273.00 (272.70 to 273.70): 31926.D

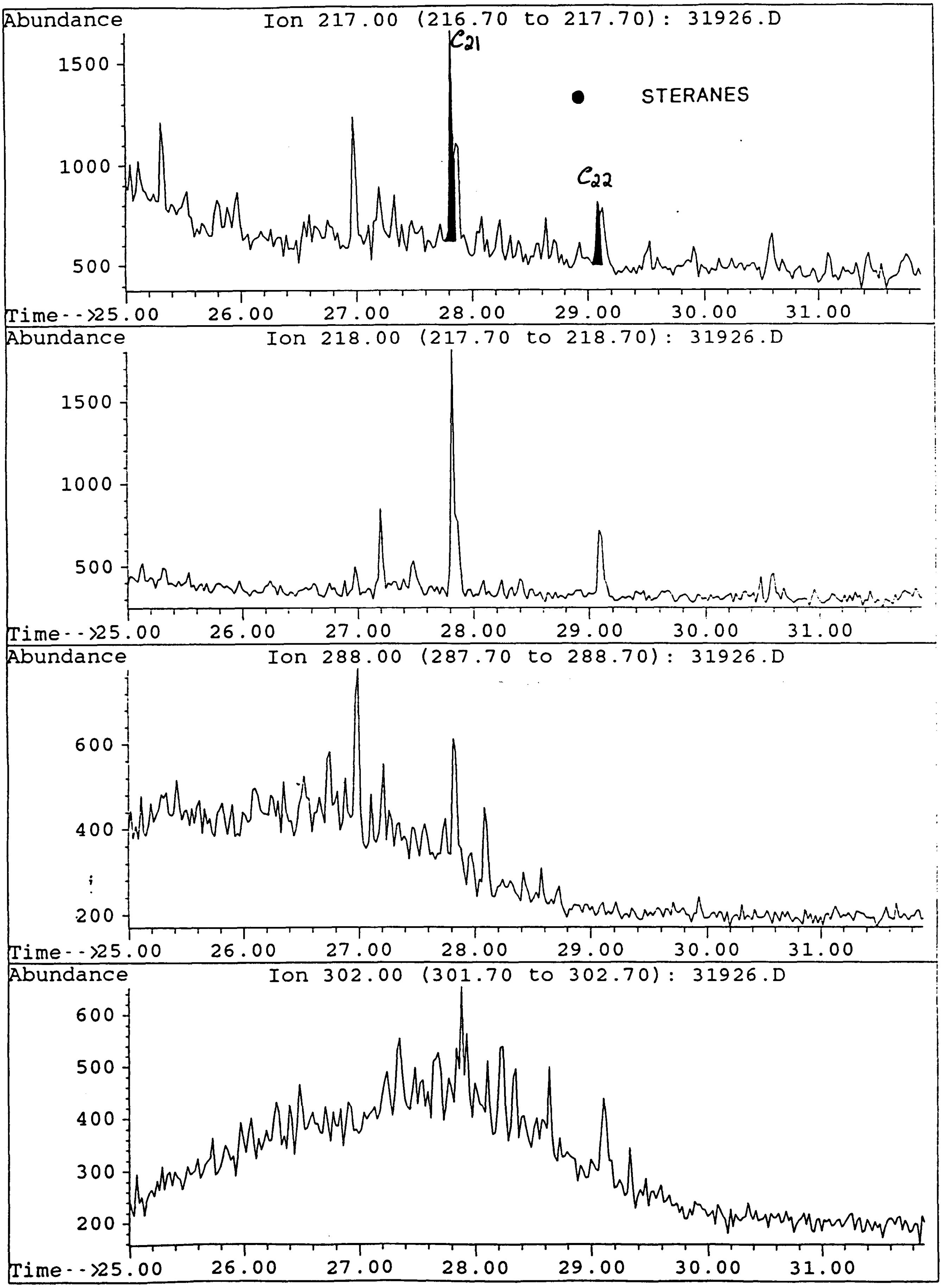
Ion 232.00 (231.70 to 232.70): 31926.D

Ion 231.00 (230.70 to 231.70): 31926.D

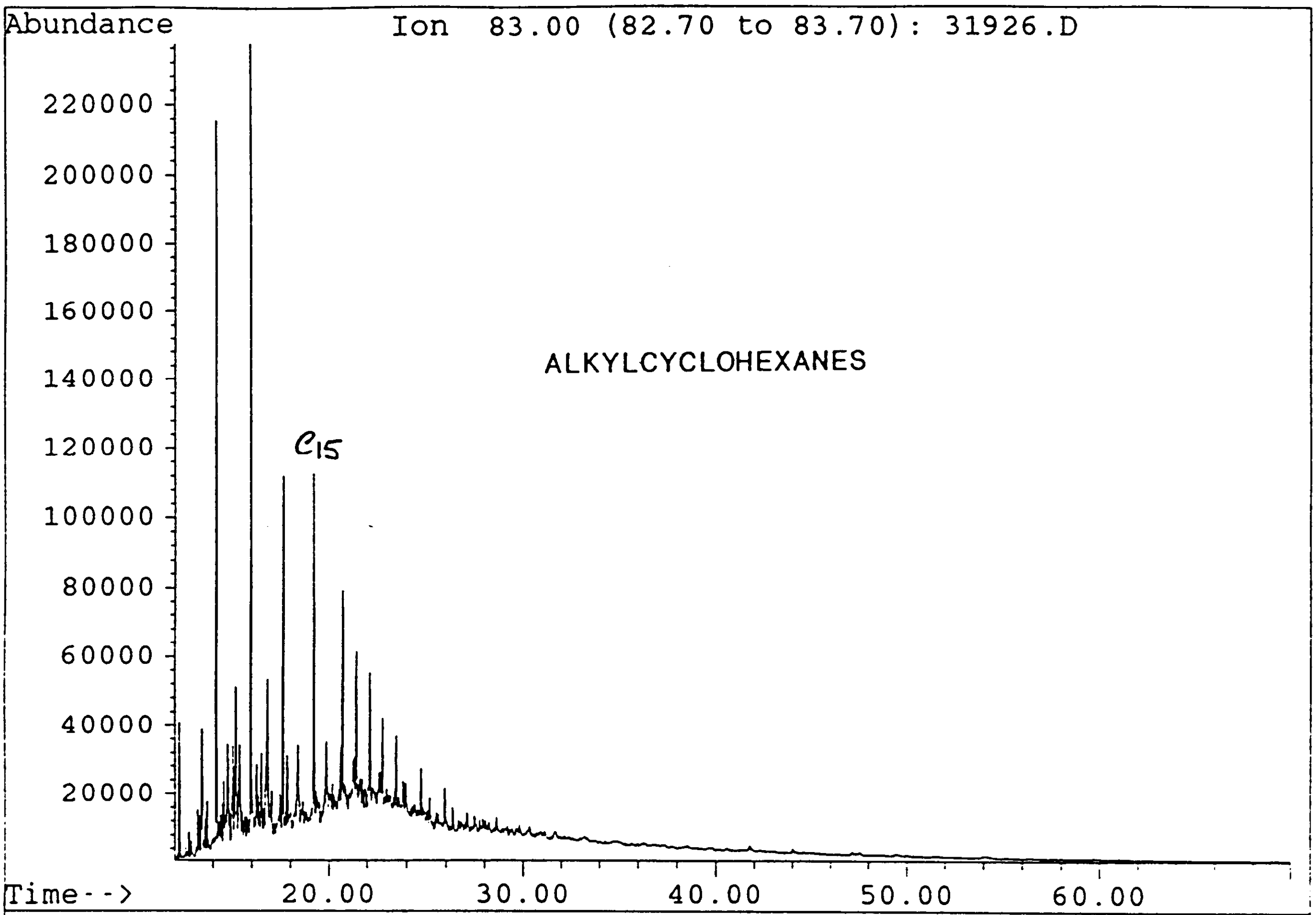
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

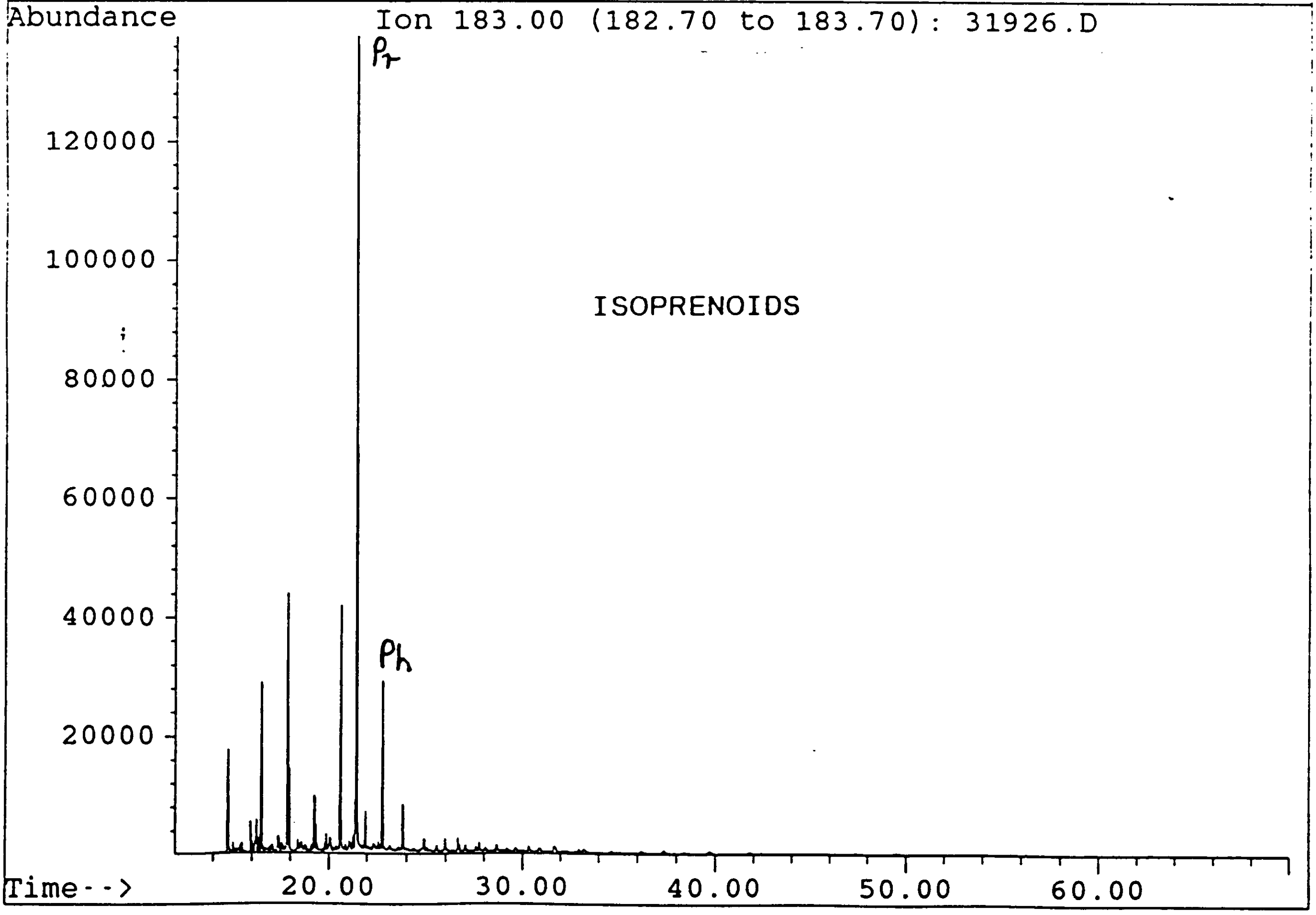


File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

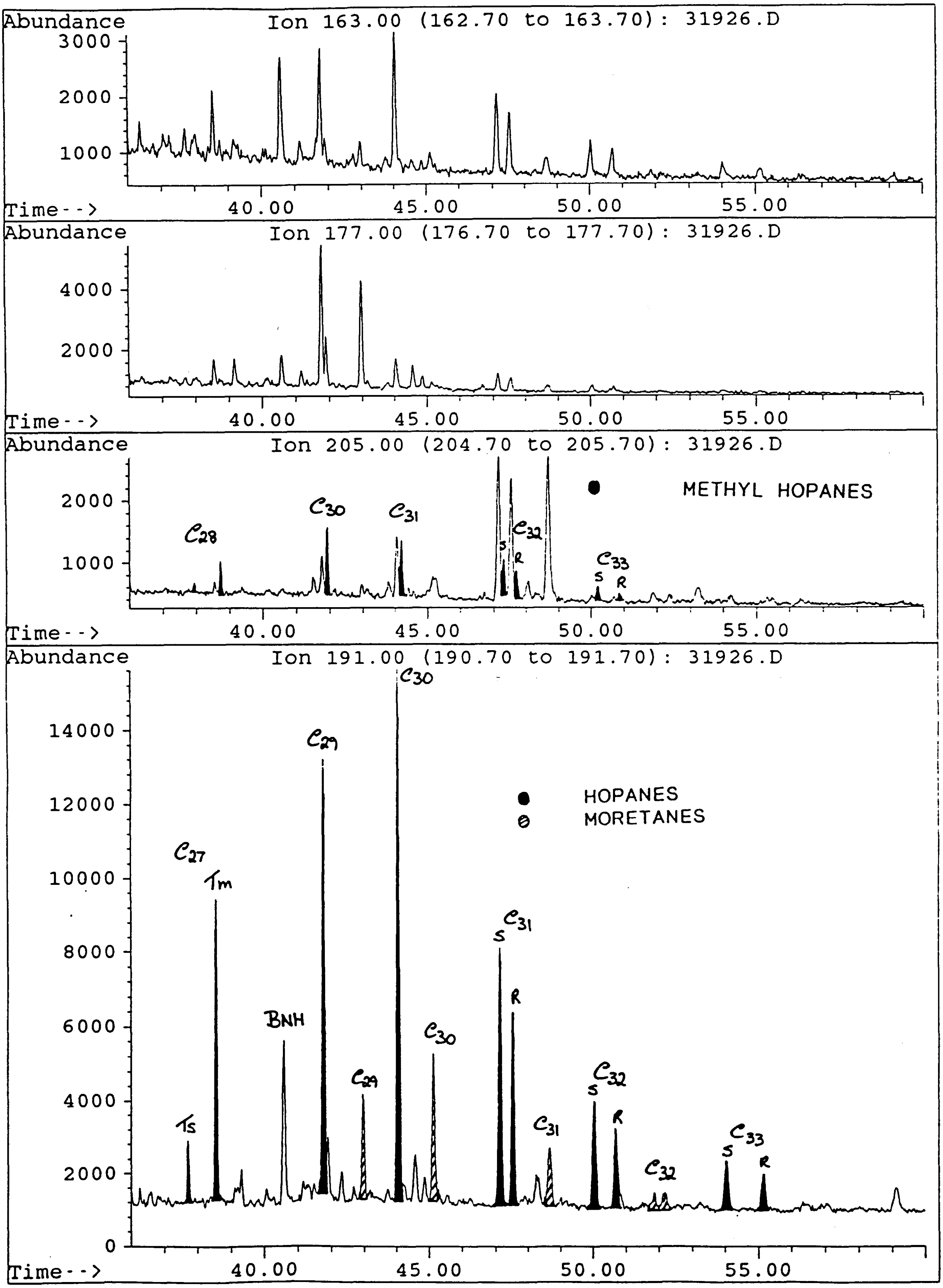


File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

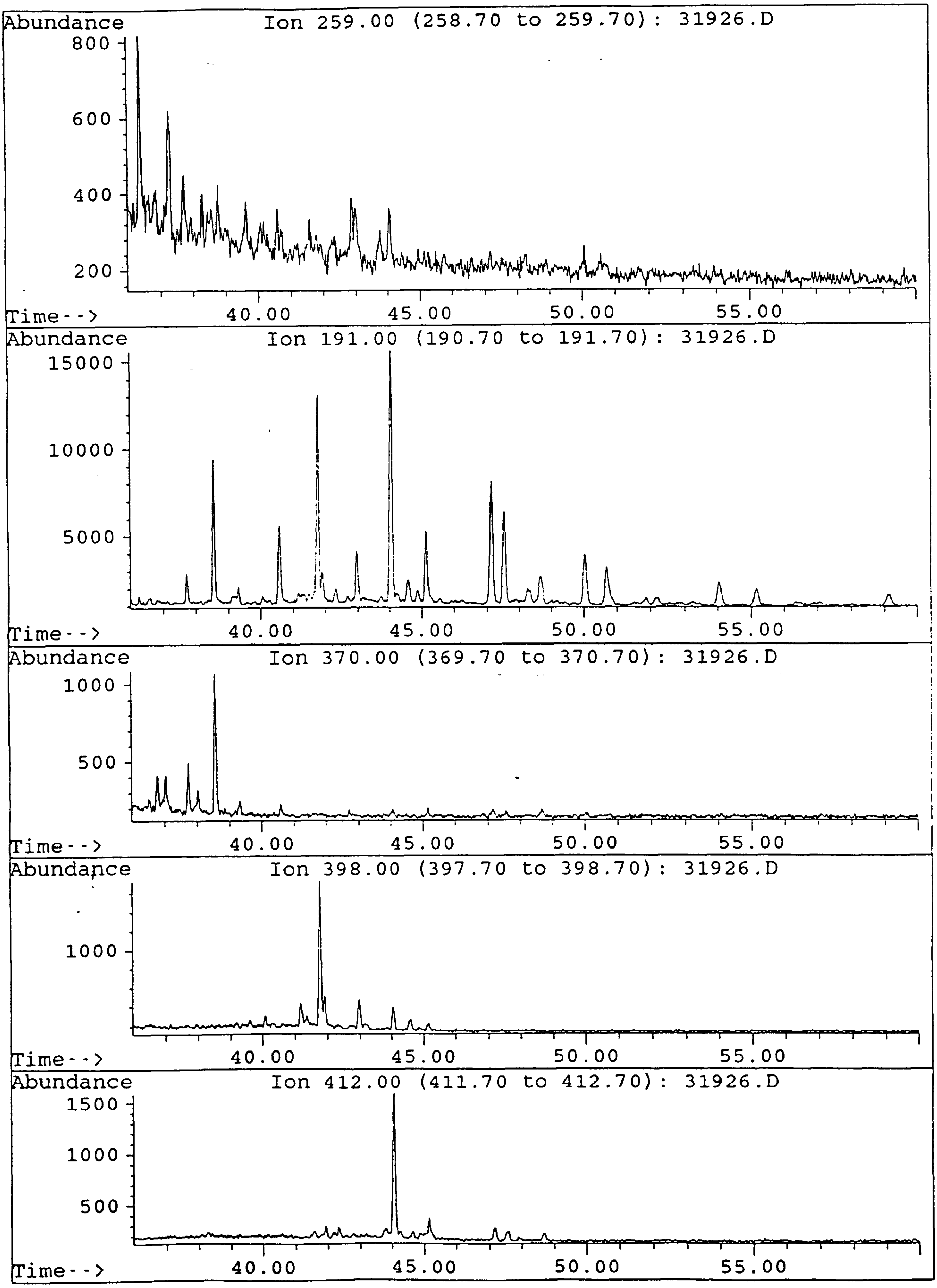




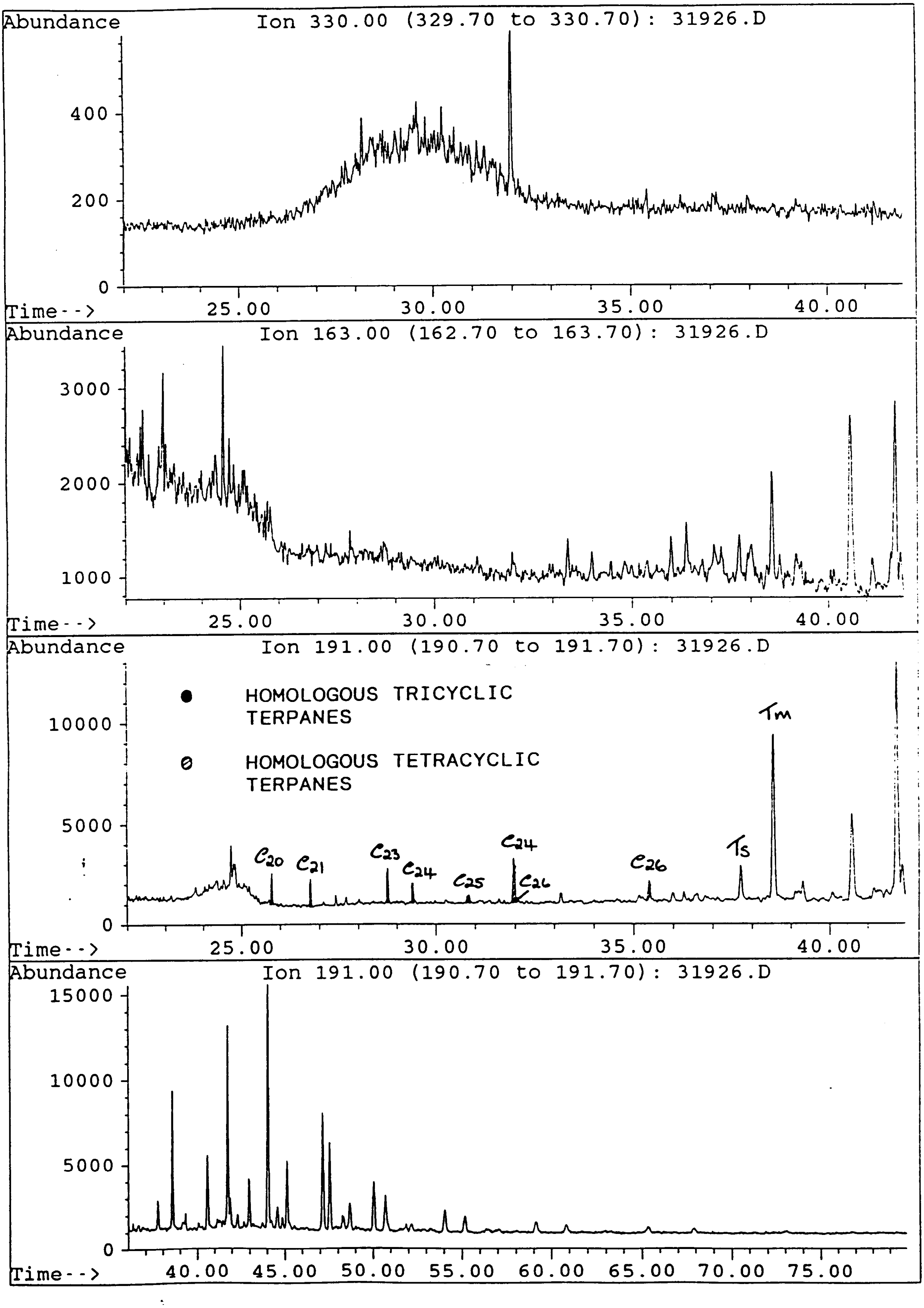
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



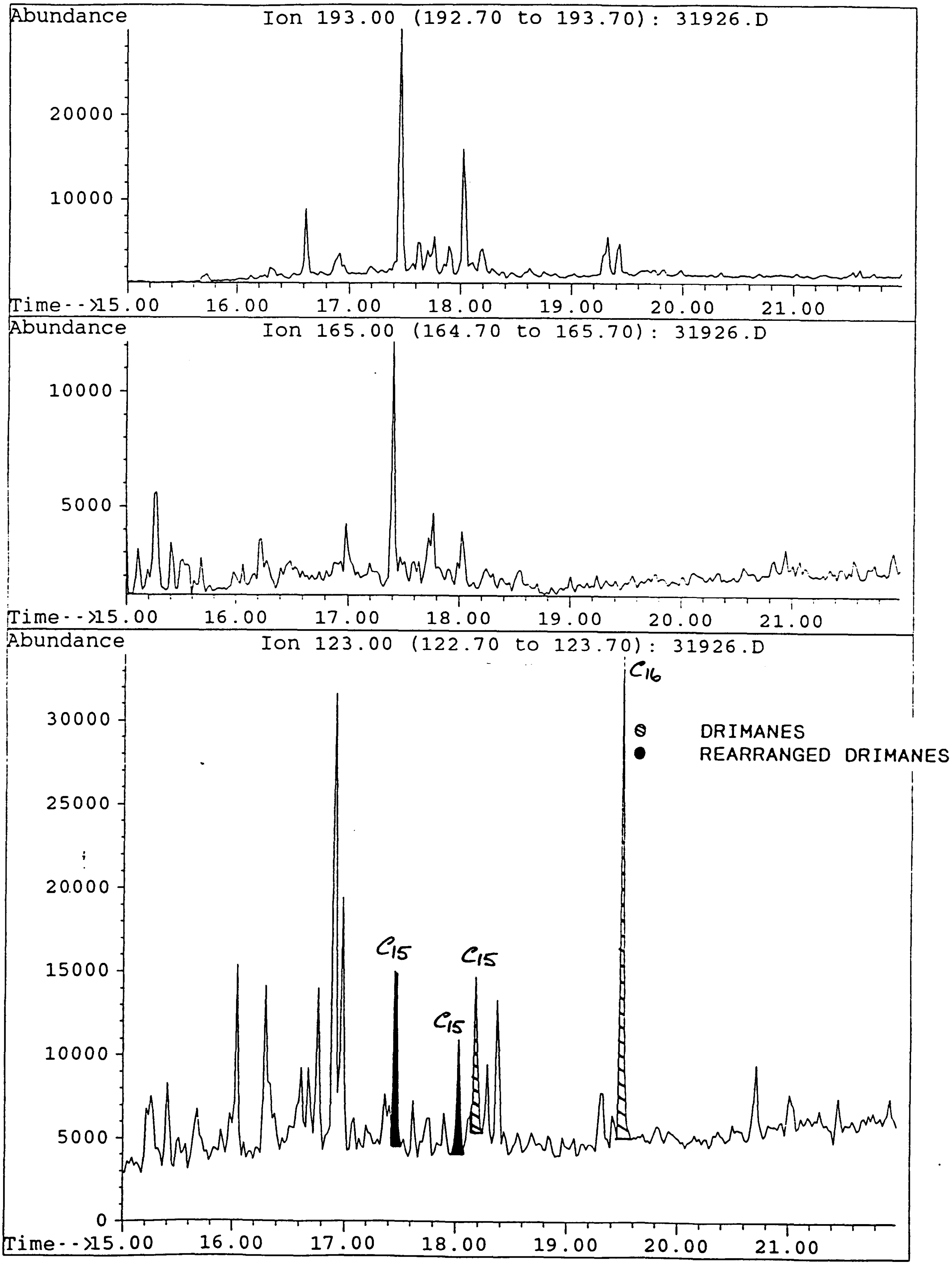
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



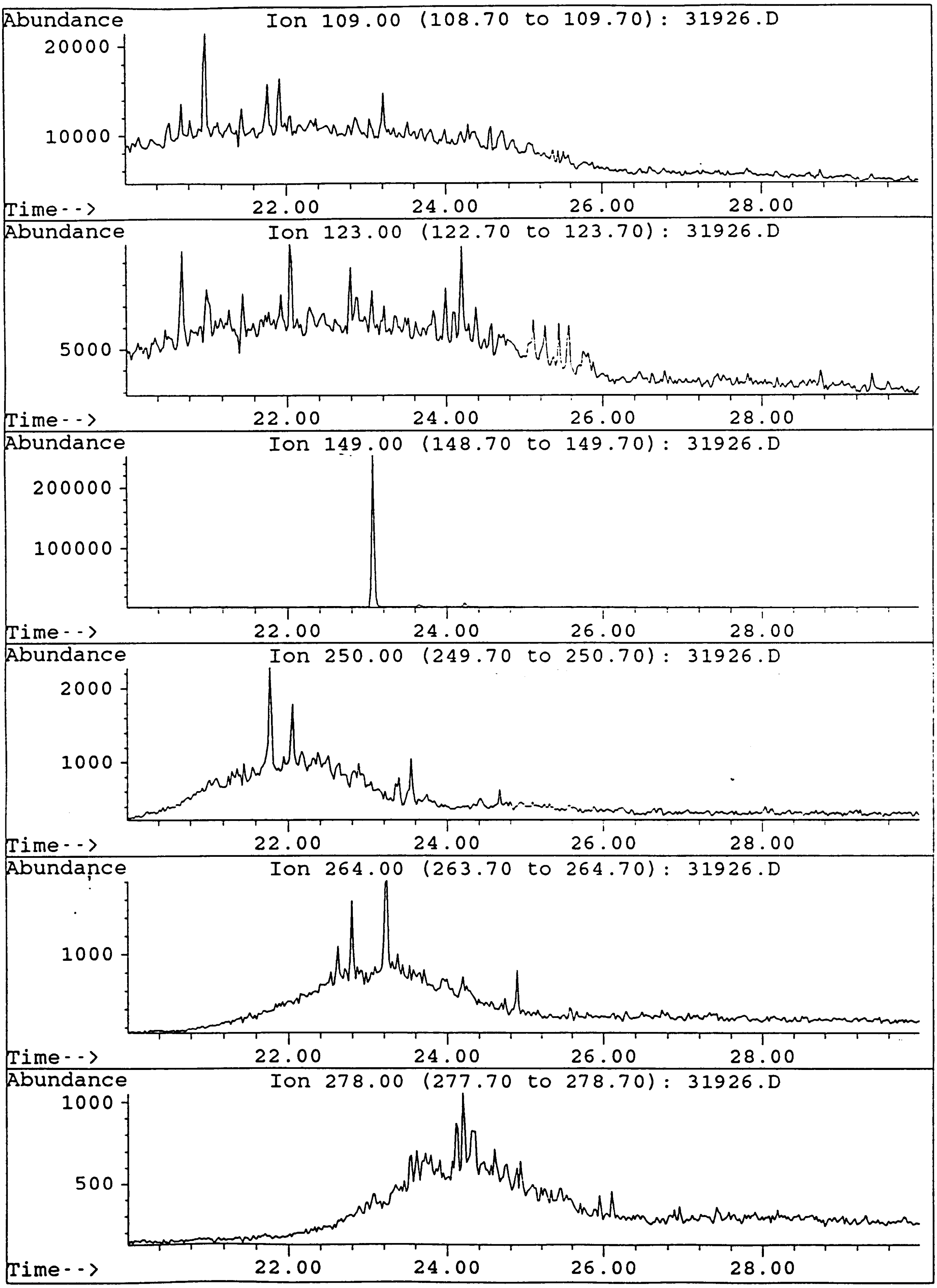
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



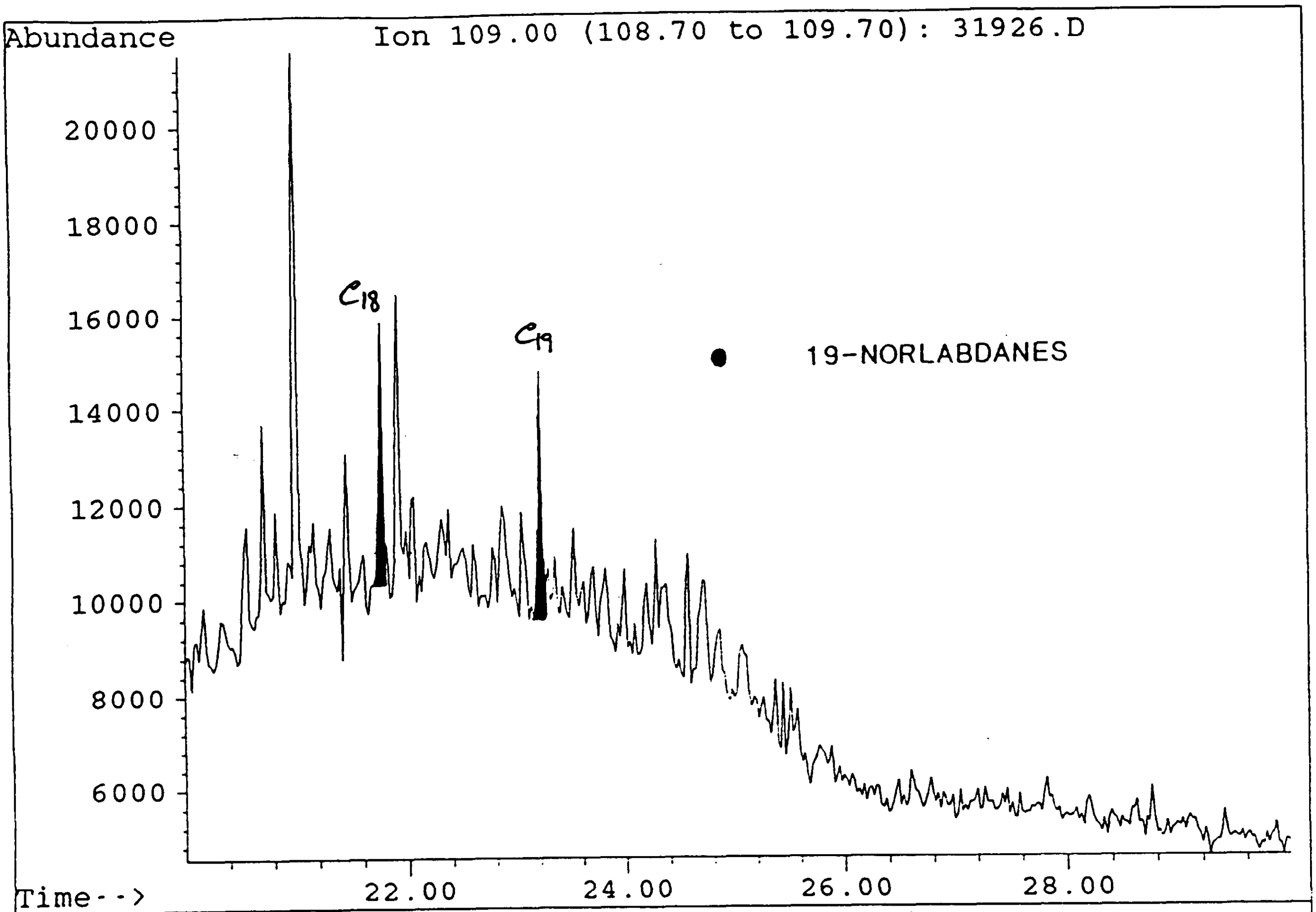
File :   31926.D
Sample :   LA BELLA #1, 2121.0m, B/C
Misc. Info :   1/60uL. 18-11-93. COL#143. SF.

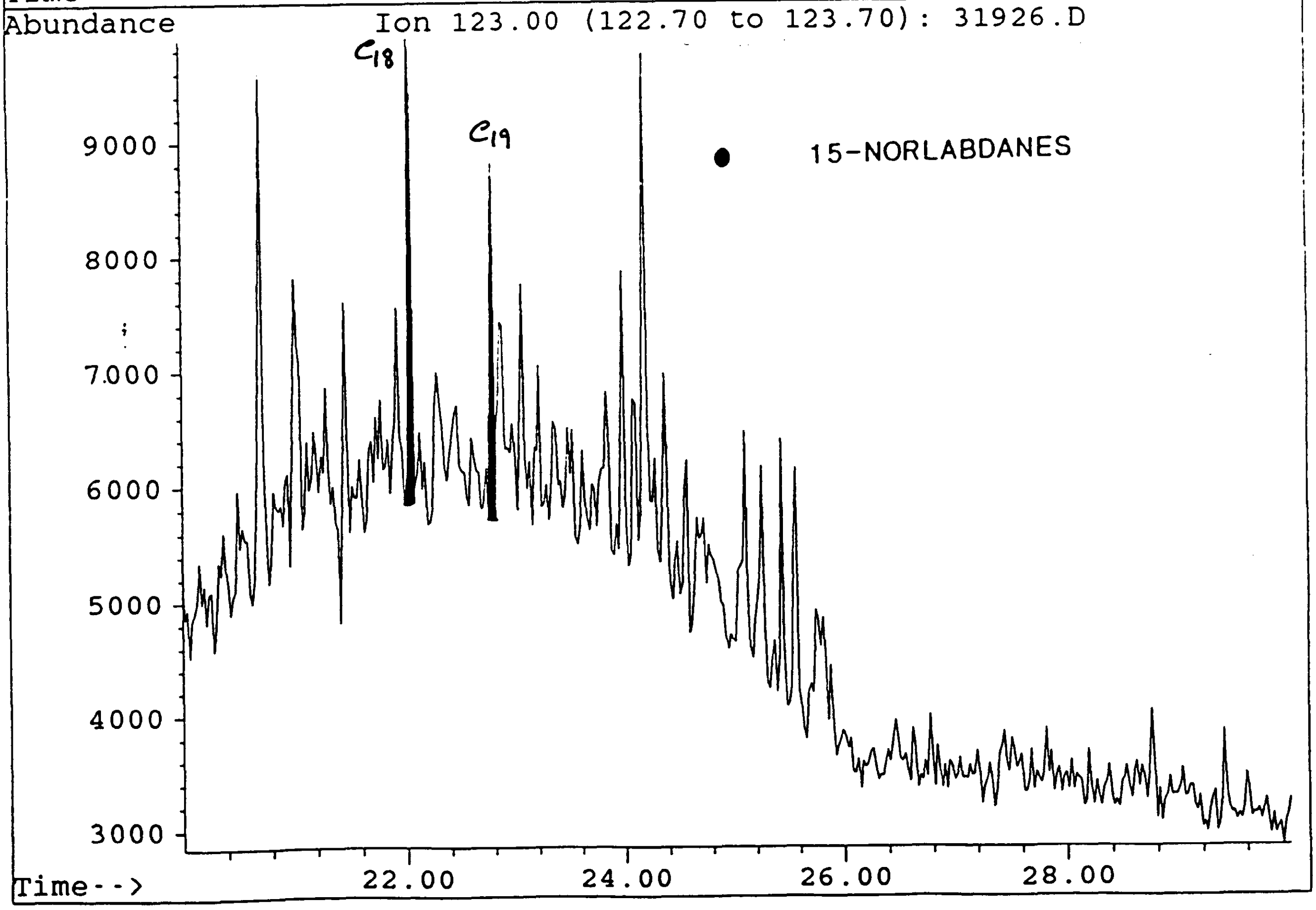


File :   31926.D
Sample :   LA BELLA #1, 2121.0m, B/C
Misc. Info :   1/60uL. 18-11-93. COL#143. SF.

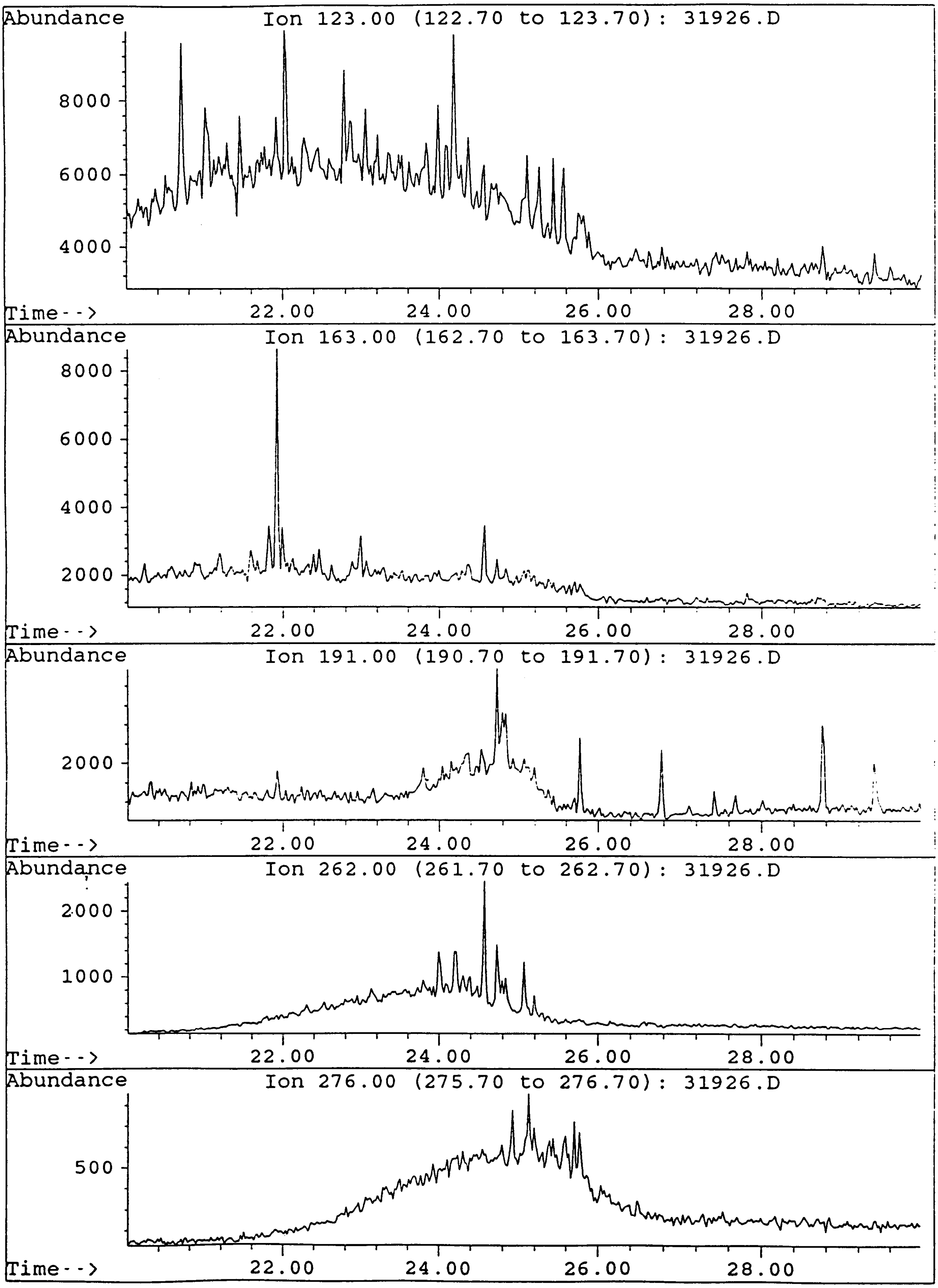


File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

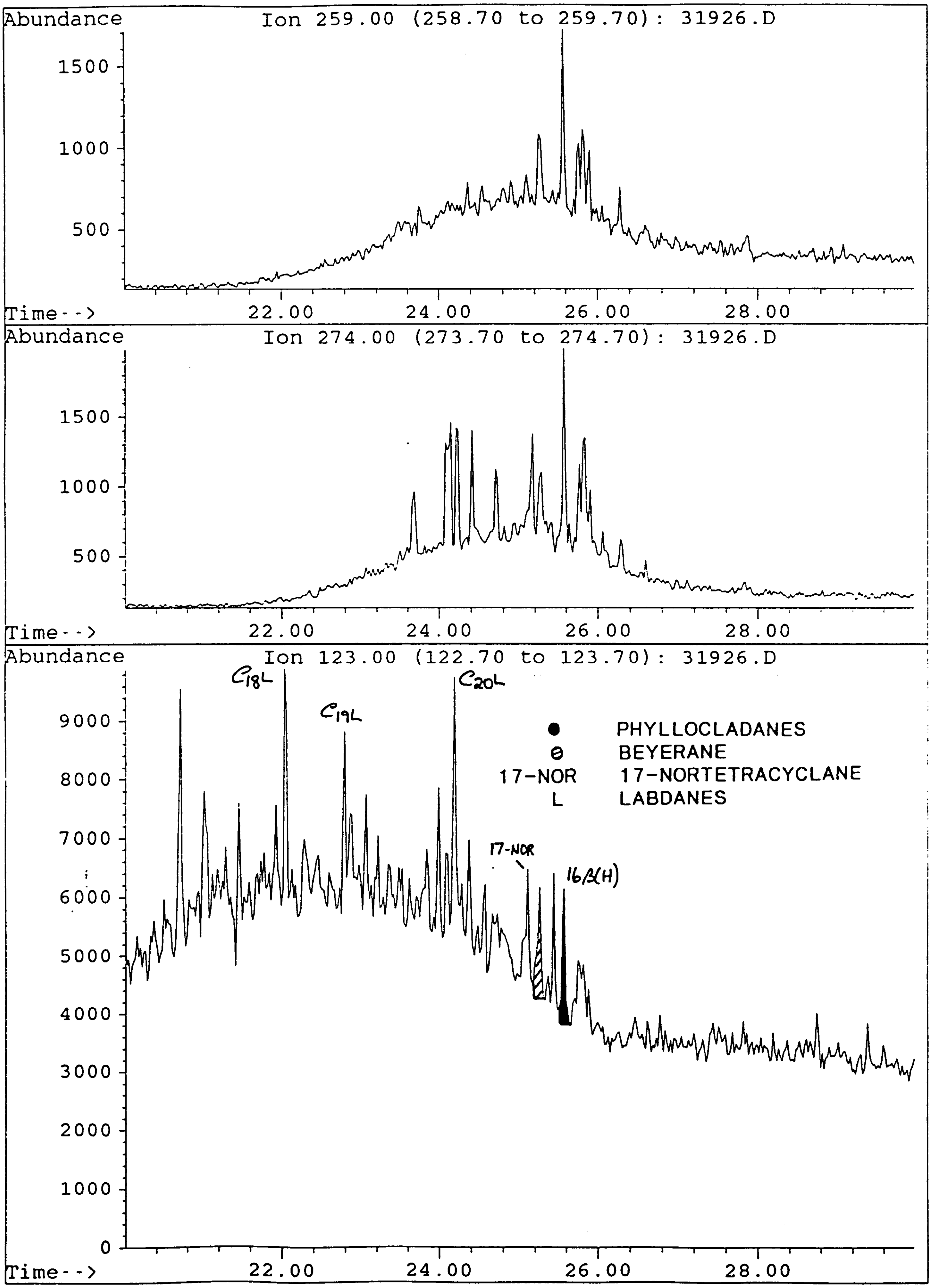

Ion 109.00 (108.70 to 109.70): 31926.D


Ion 123.00 (122.70 to 123.70): 31926.D

File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

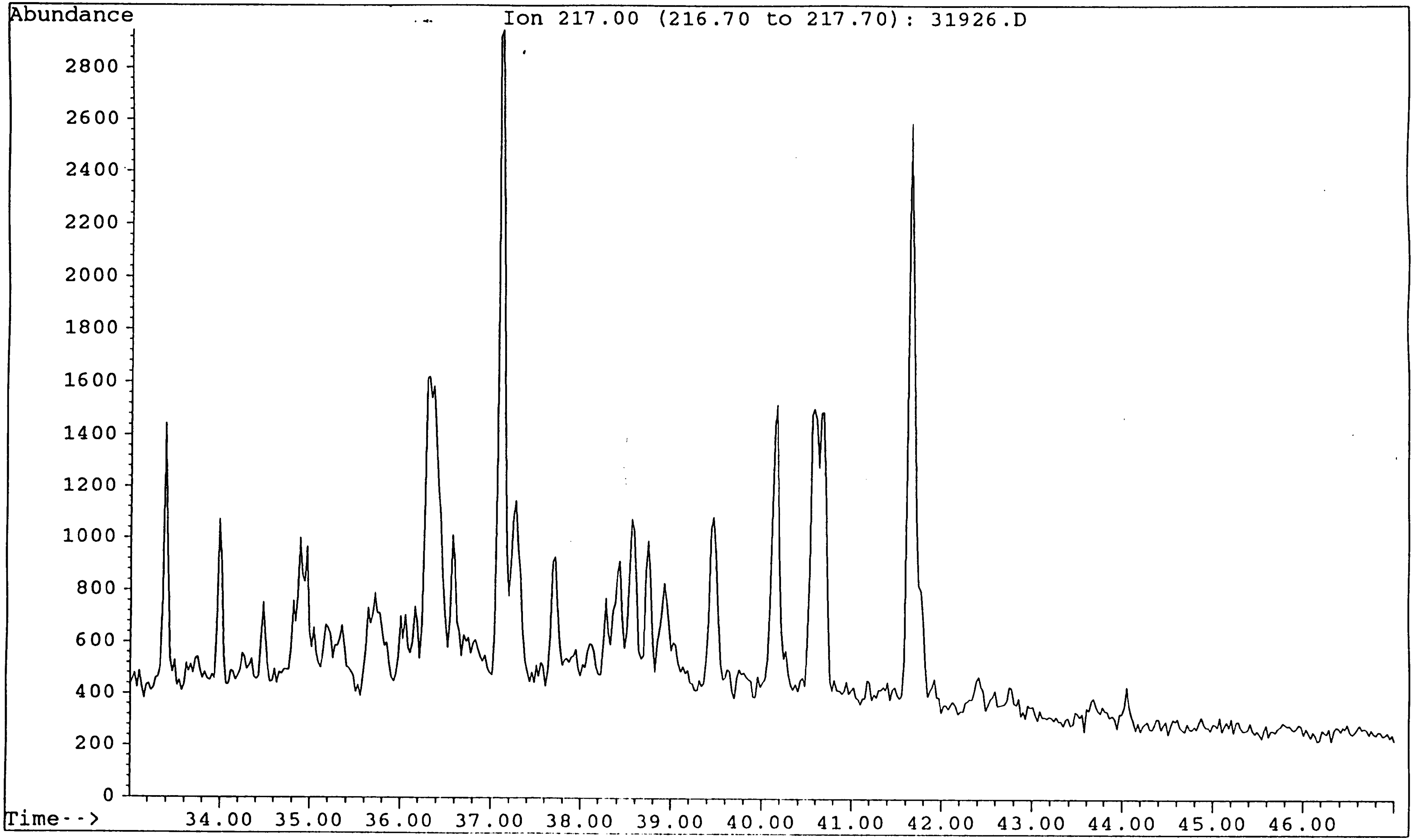


File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.

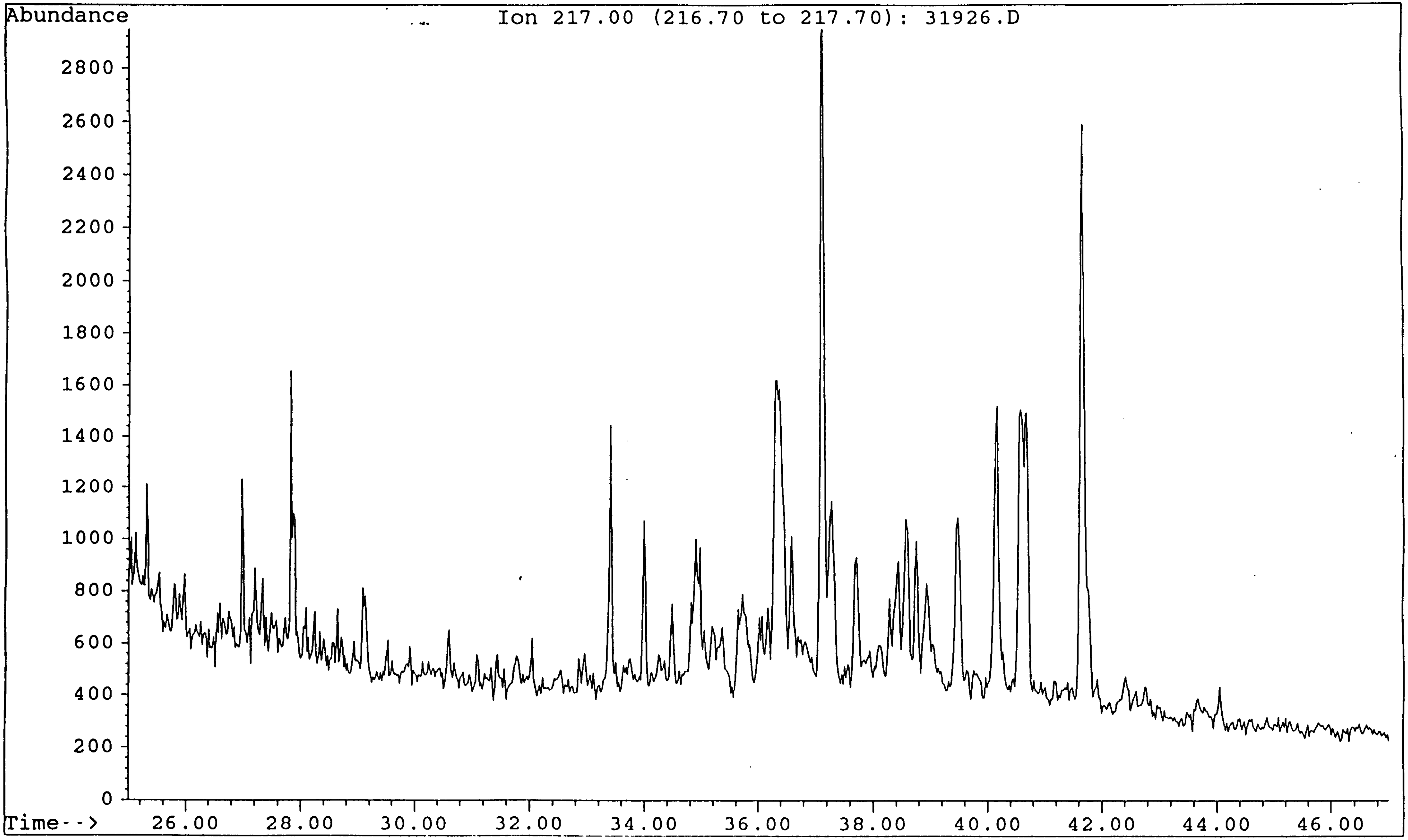


● PHYLLOCLADANES
θ BEYERANE
17-NOR 17-NORTETRACYCLANE
L LABDANES

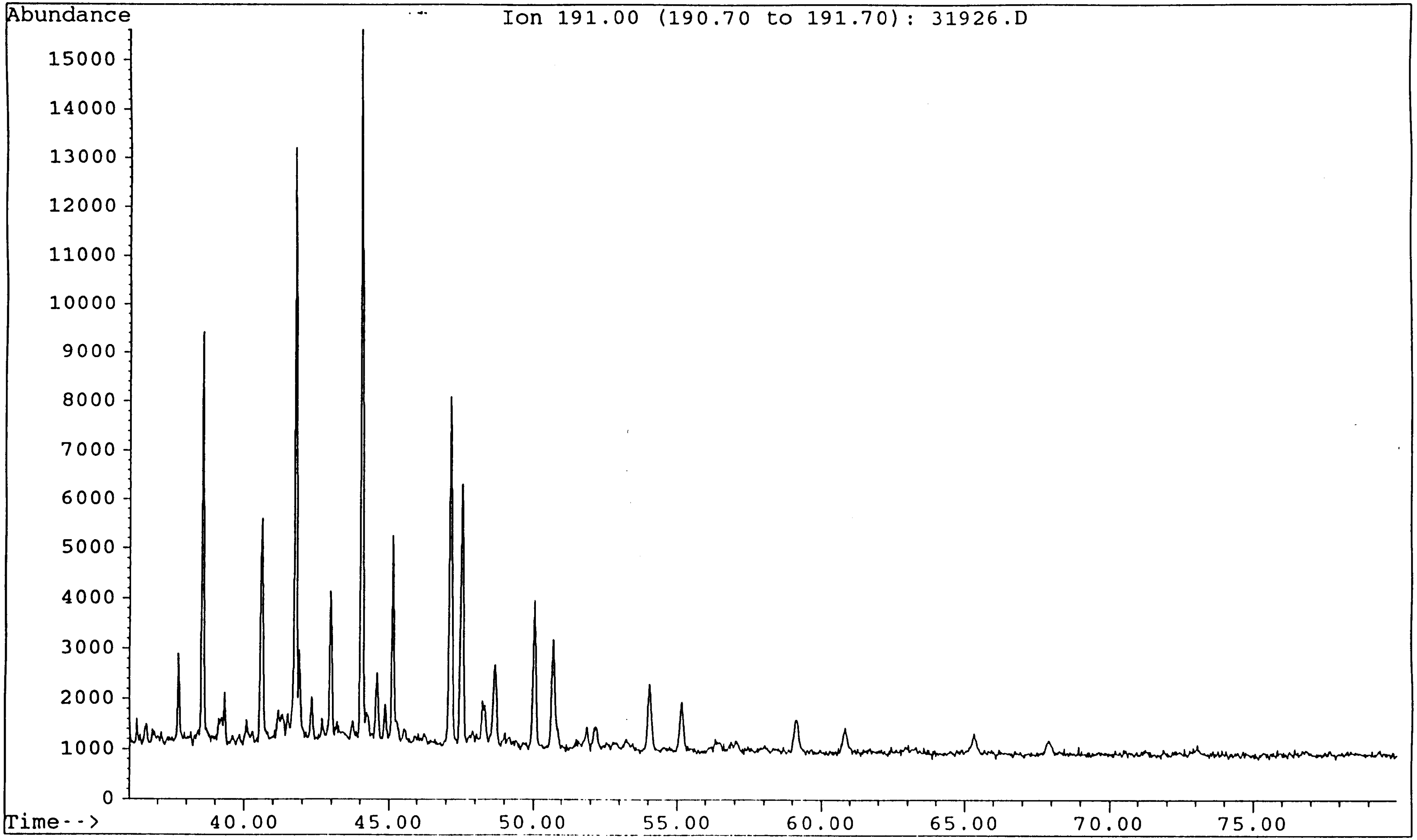
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



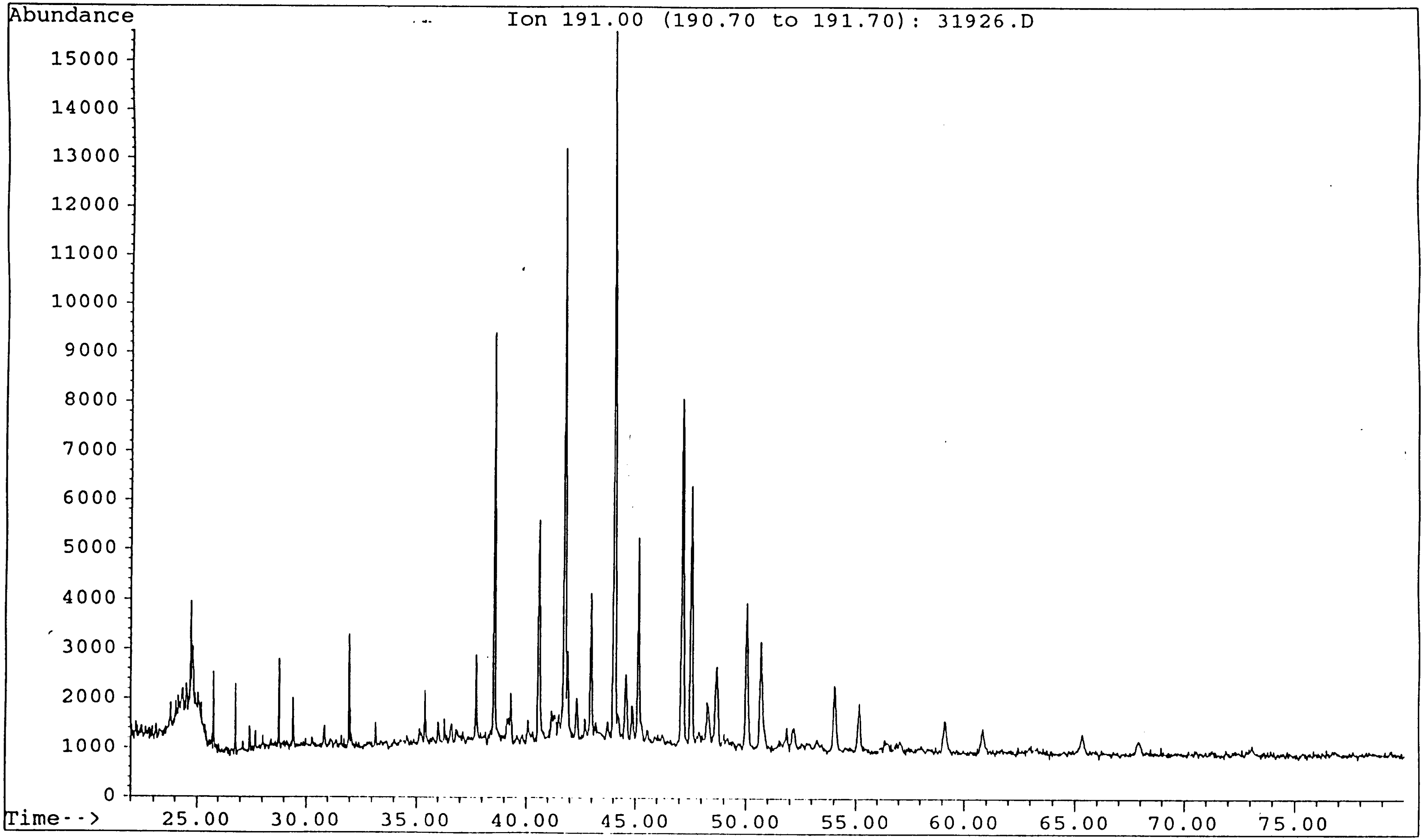
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



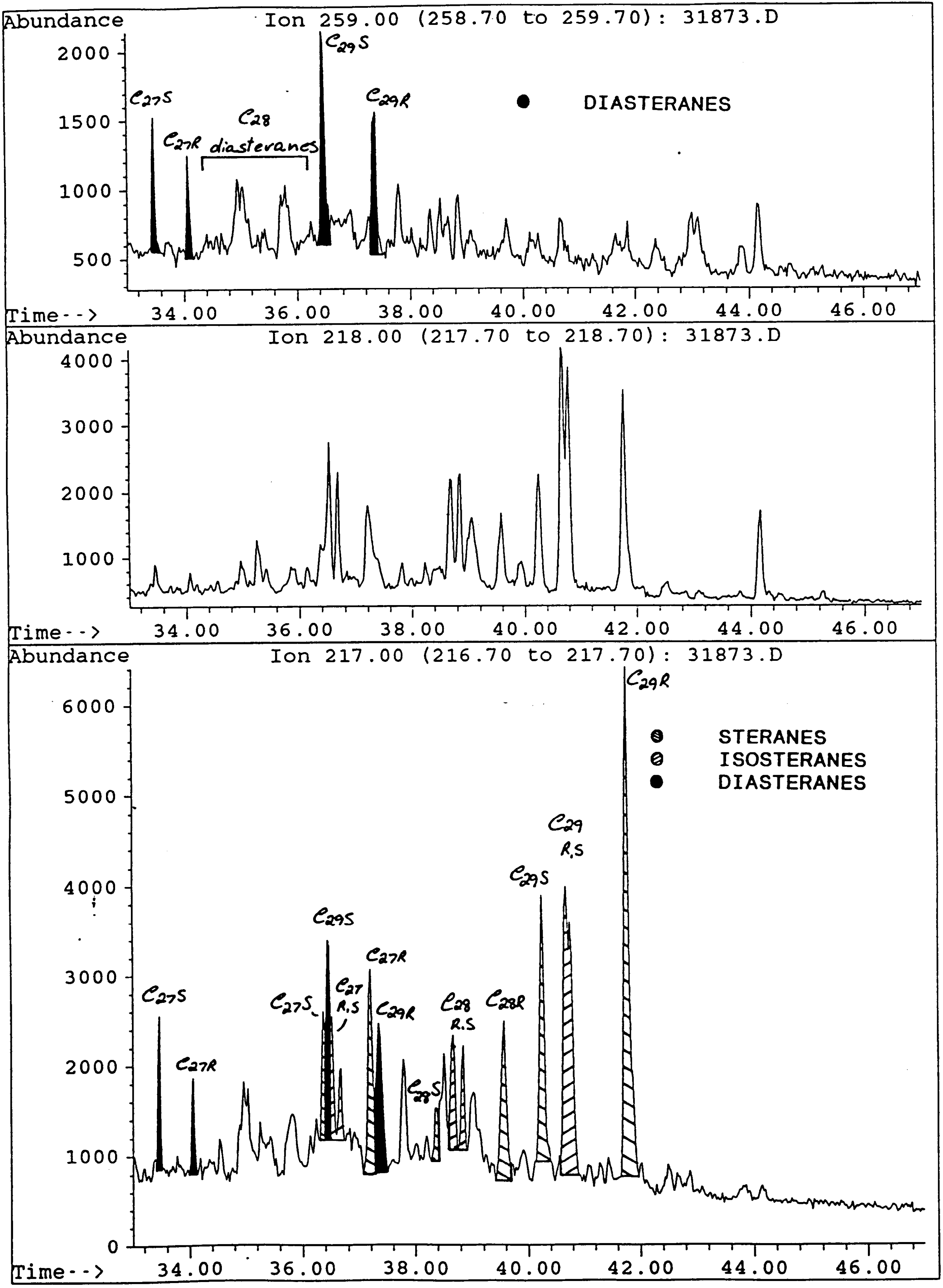
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



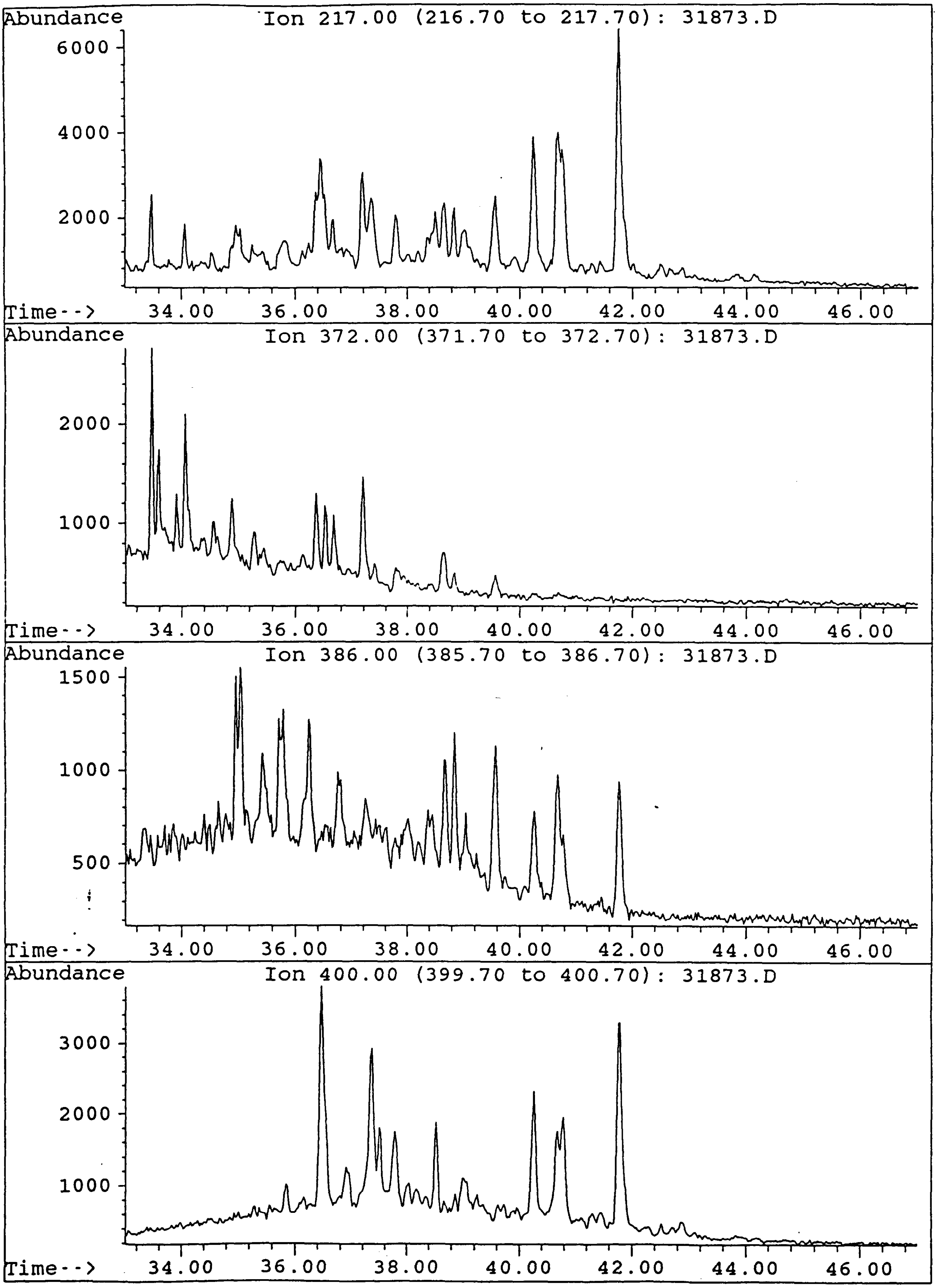
File : 31926.D
Sample : LA BELLA #1, 2121.0m, B/C
Misc. Info : 1/60uL. 18-11-93. COL#143. SF.



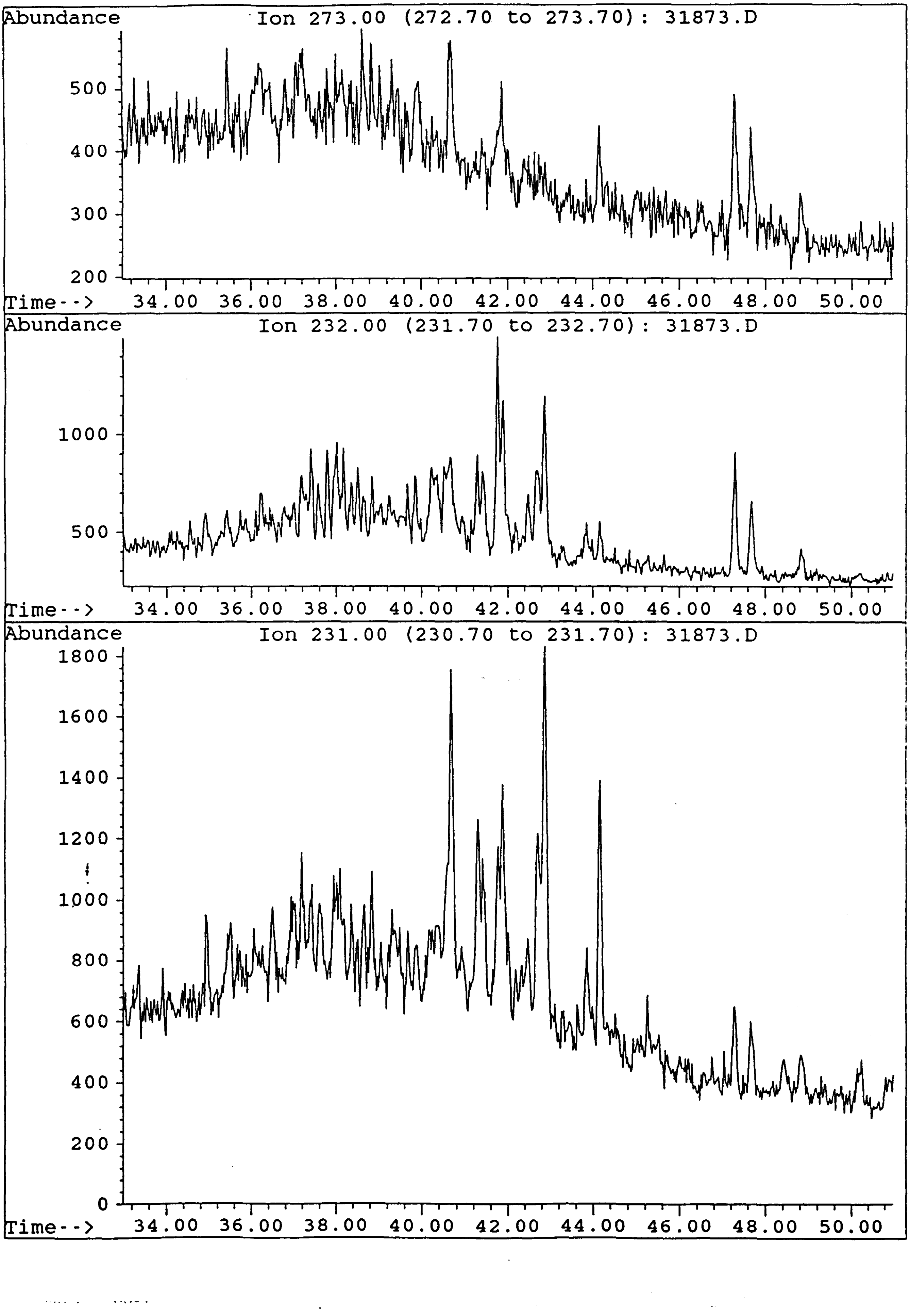
File :   31873.D
Sample :   LA BELLA#1, 2159.0m, B/C.
Misc. Info :   COL#143. 1/140uL. 10-11-93. GEC.



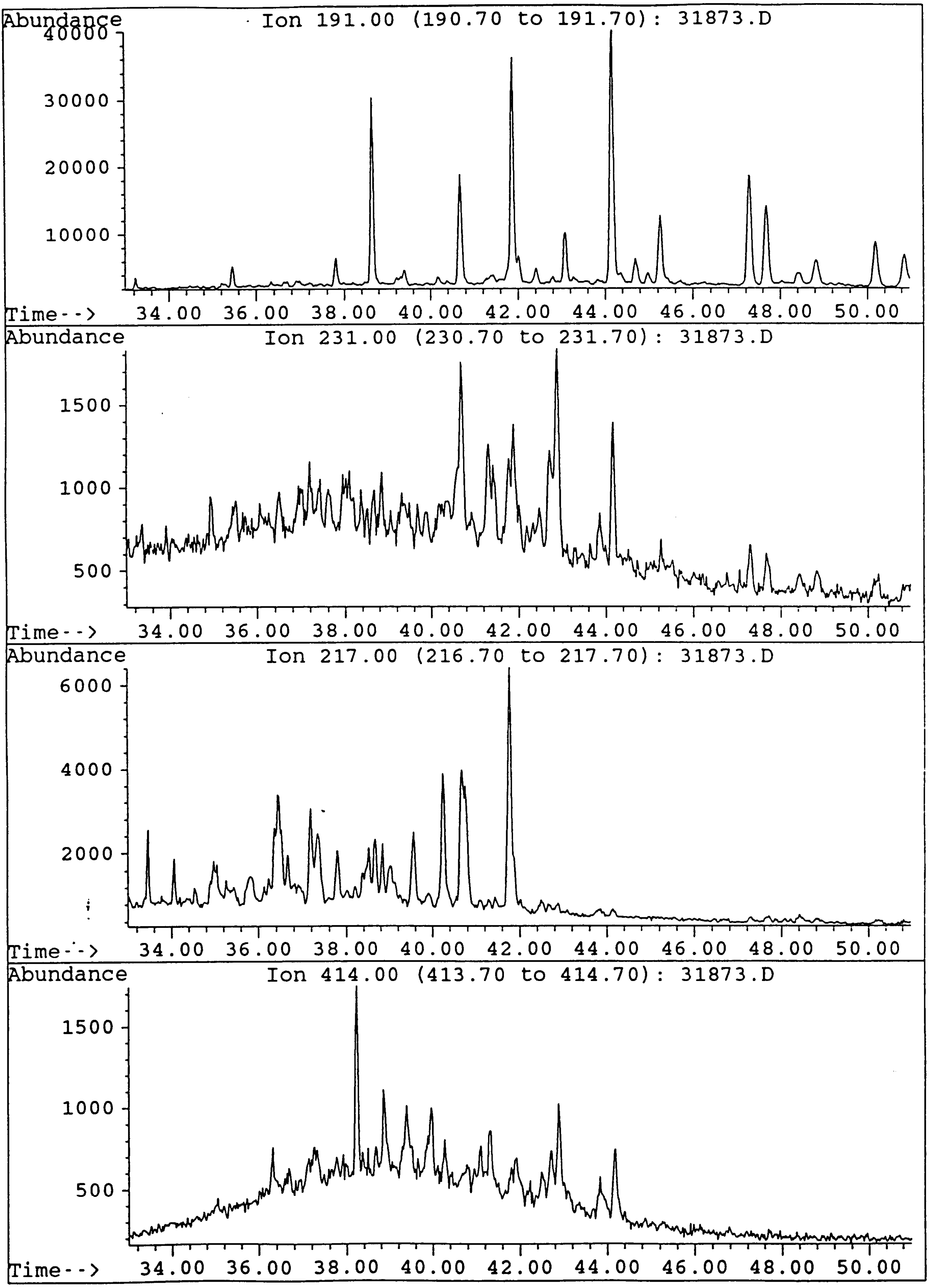
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



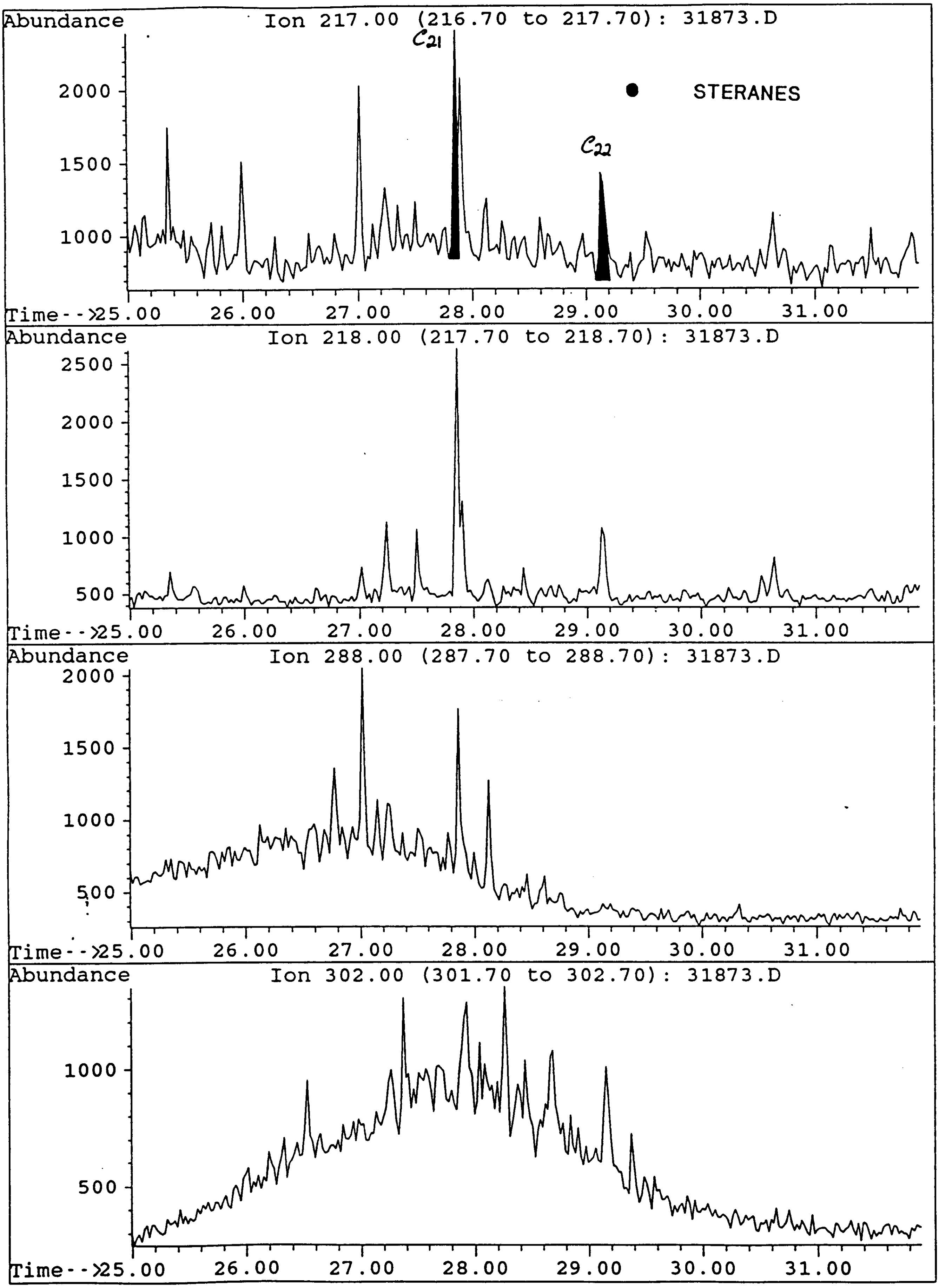
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



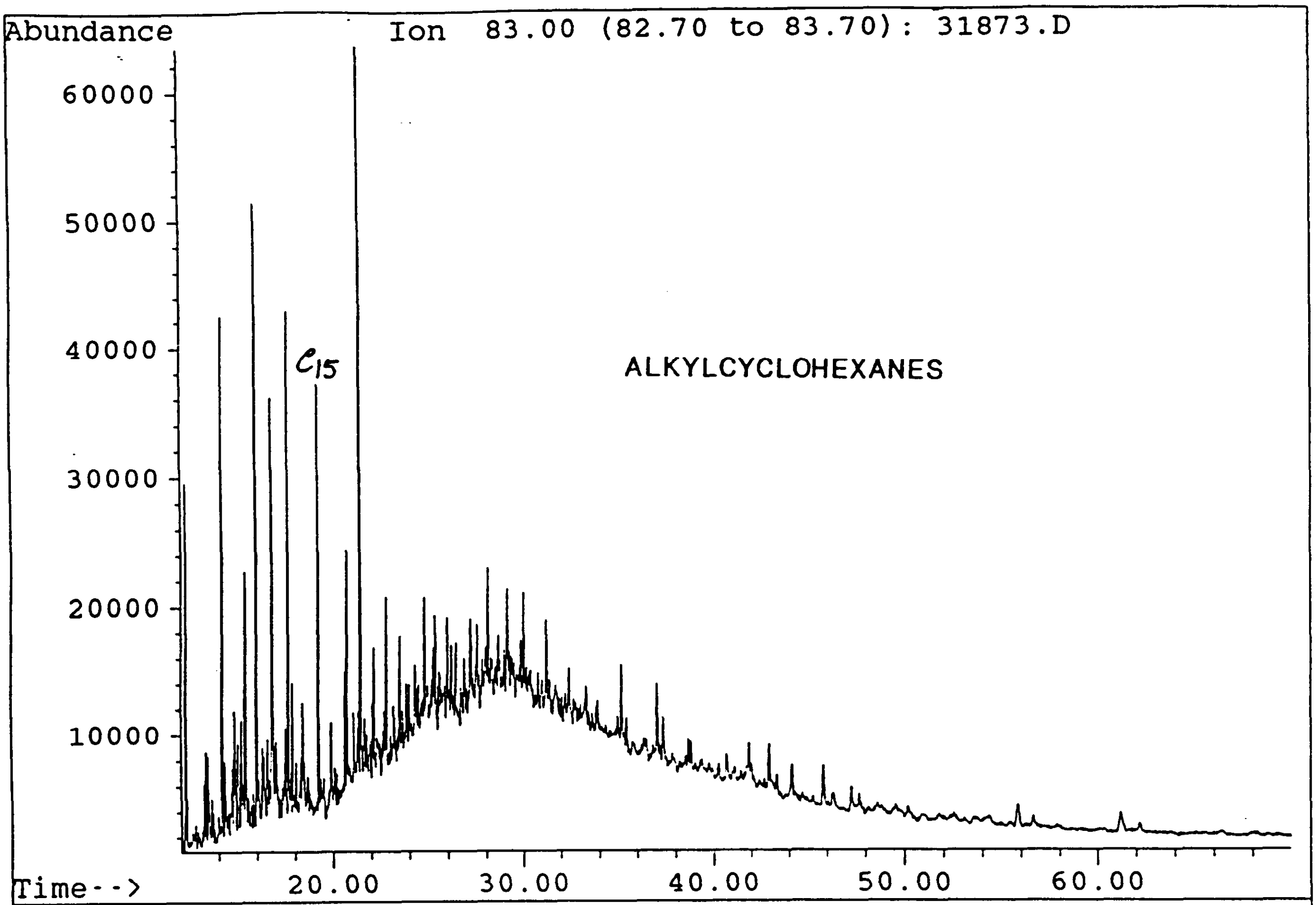
File :   31873.D
Sample :   LA BELLA#1, 2159.0m, B/C.
Misc. Info :   COL#143. 1/140uL. 10-11-93. GEC.

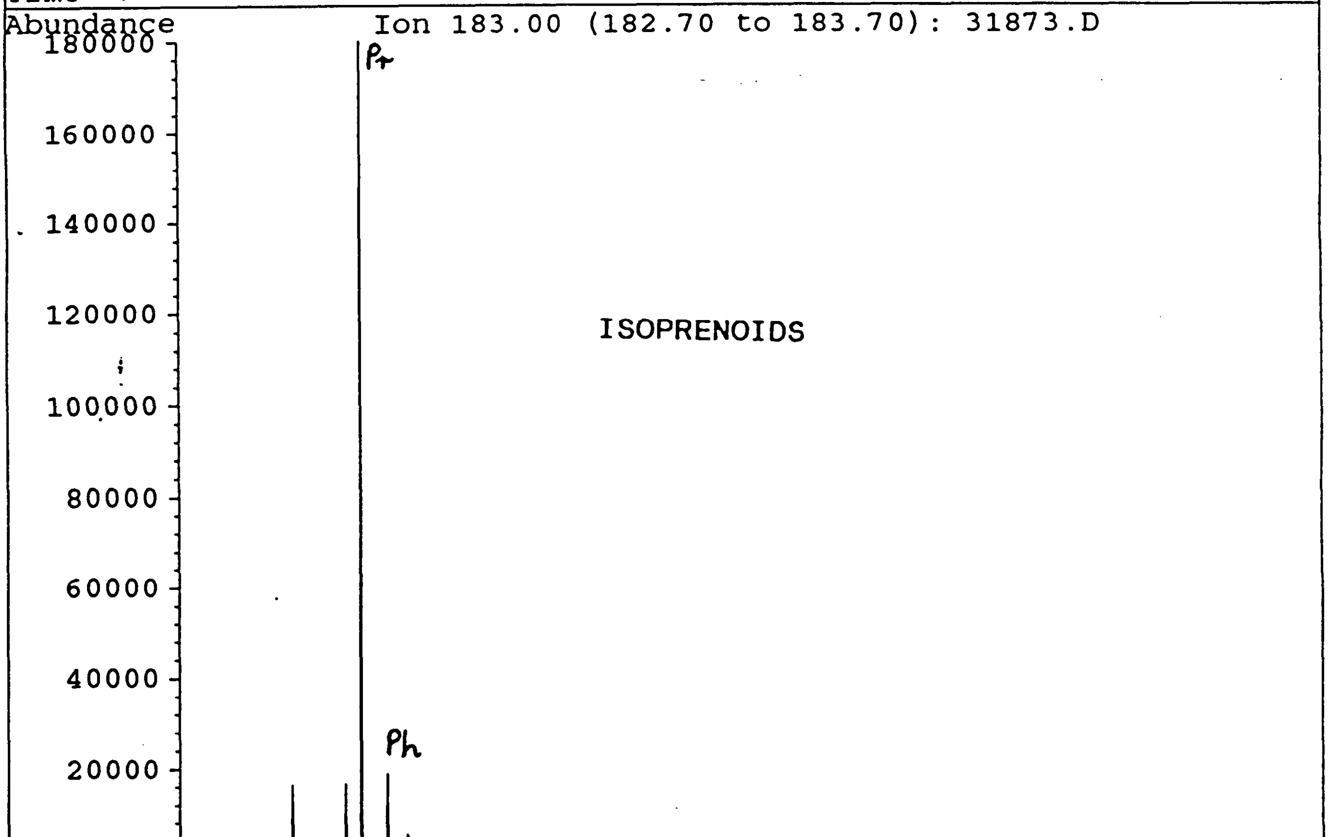


File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.

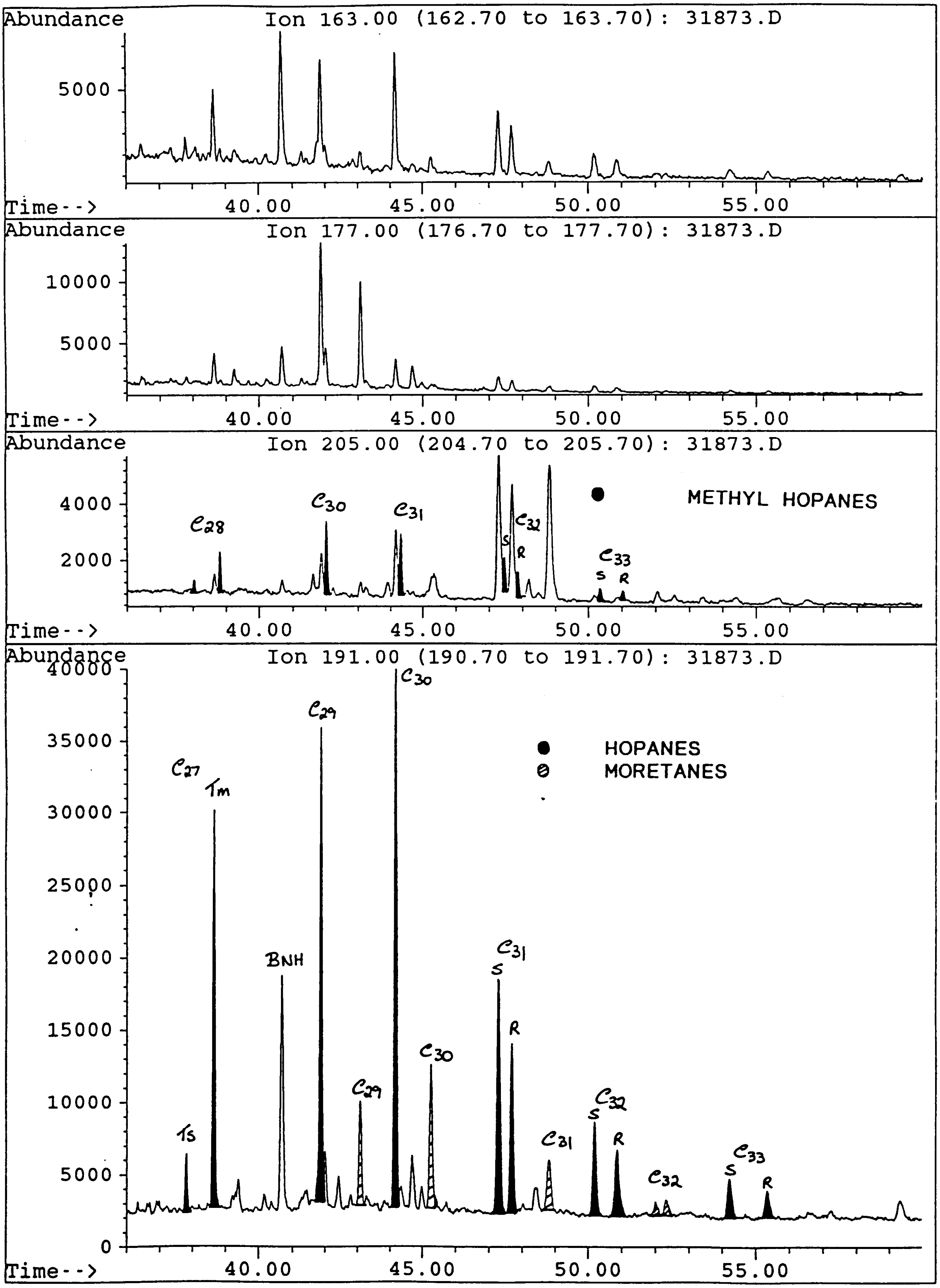


File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.

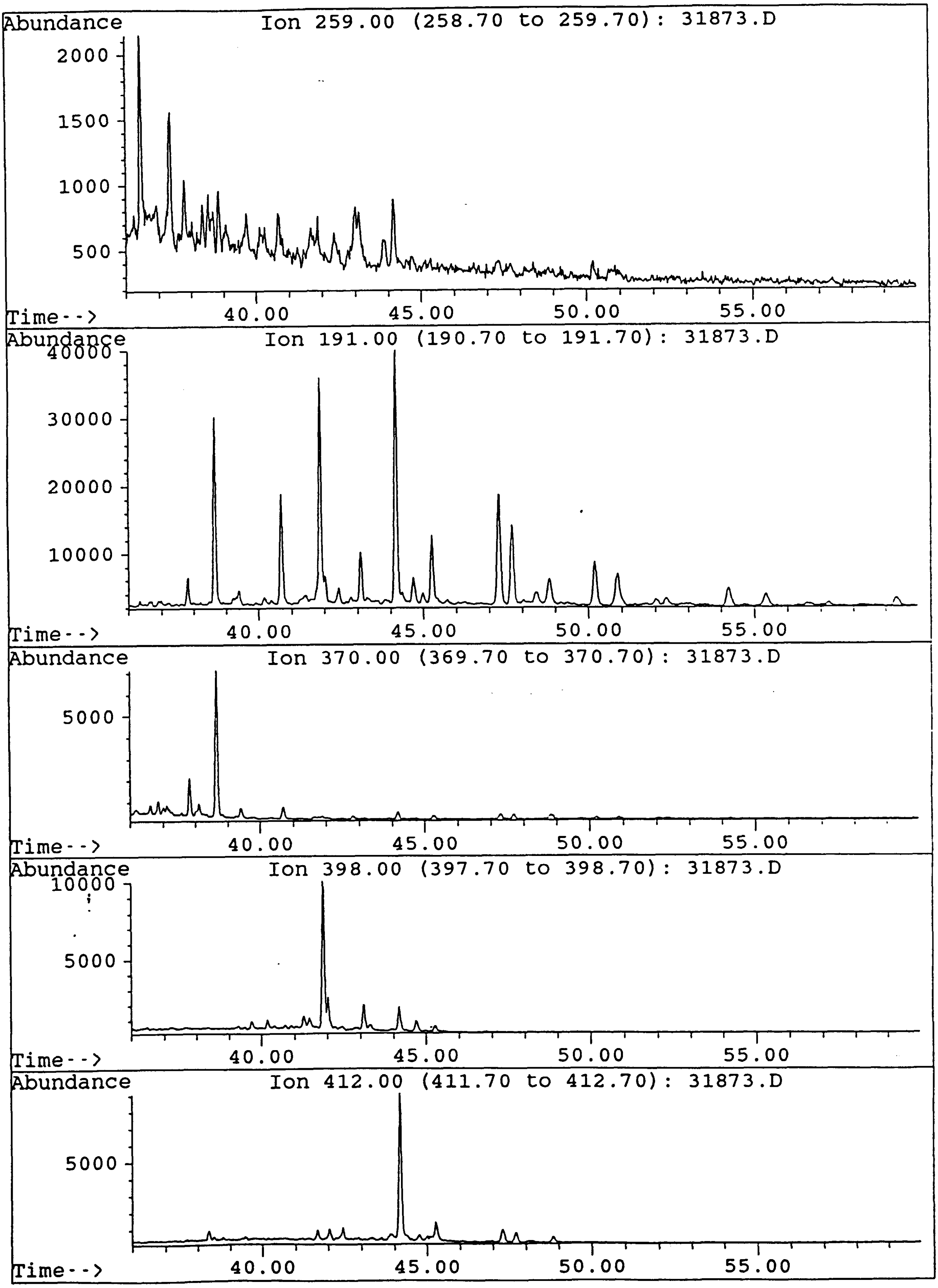




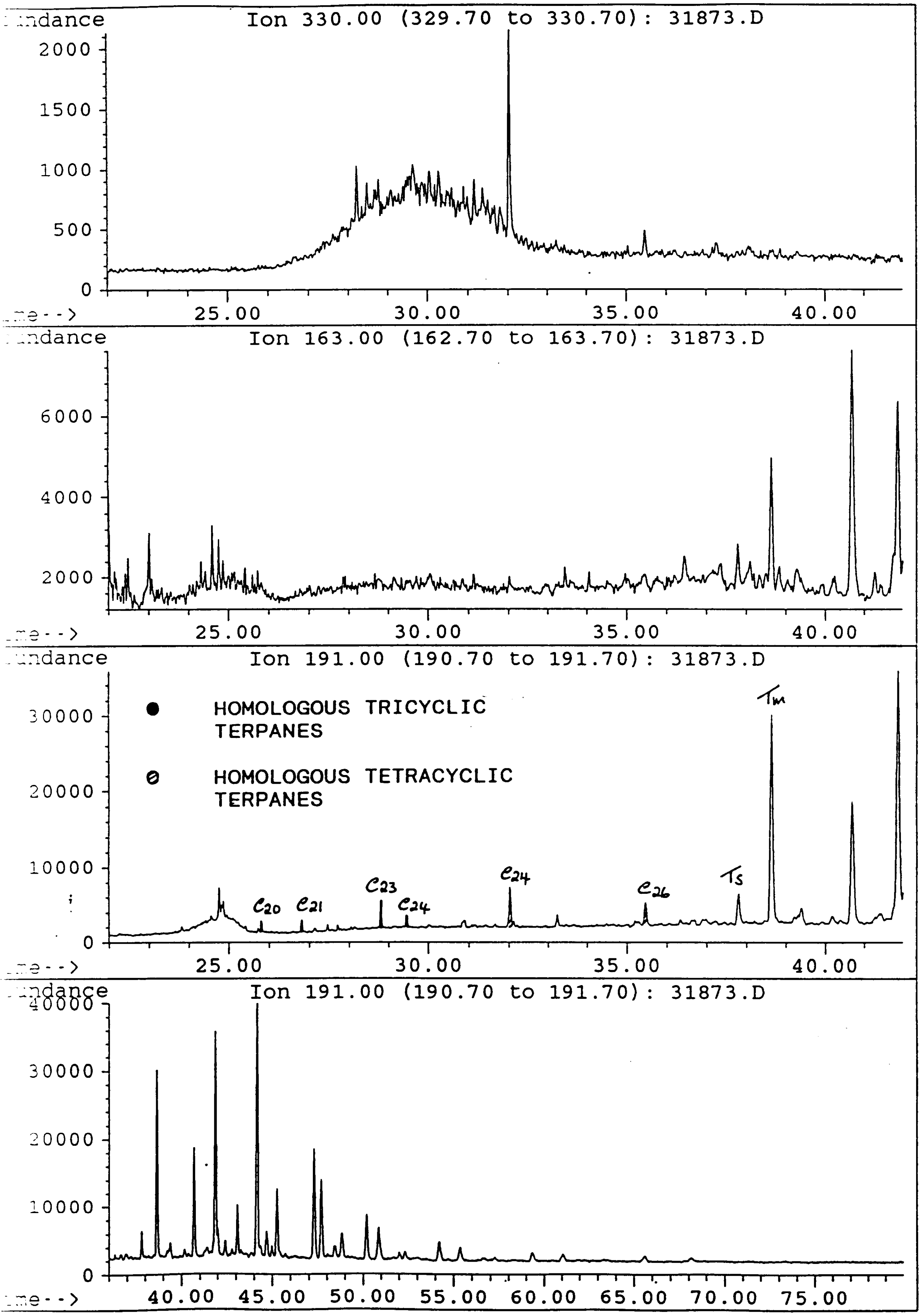
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



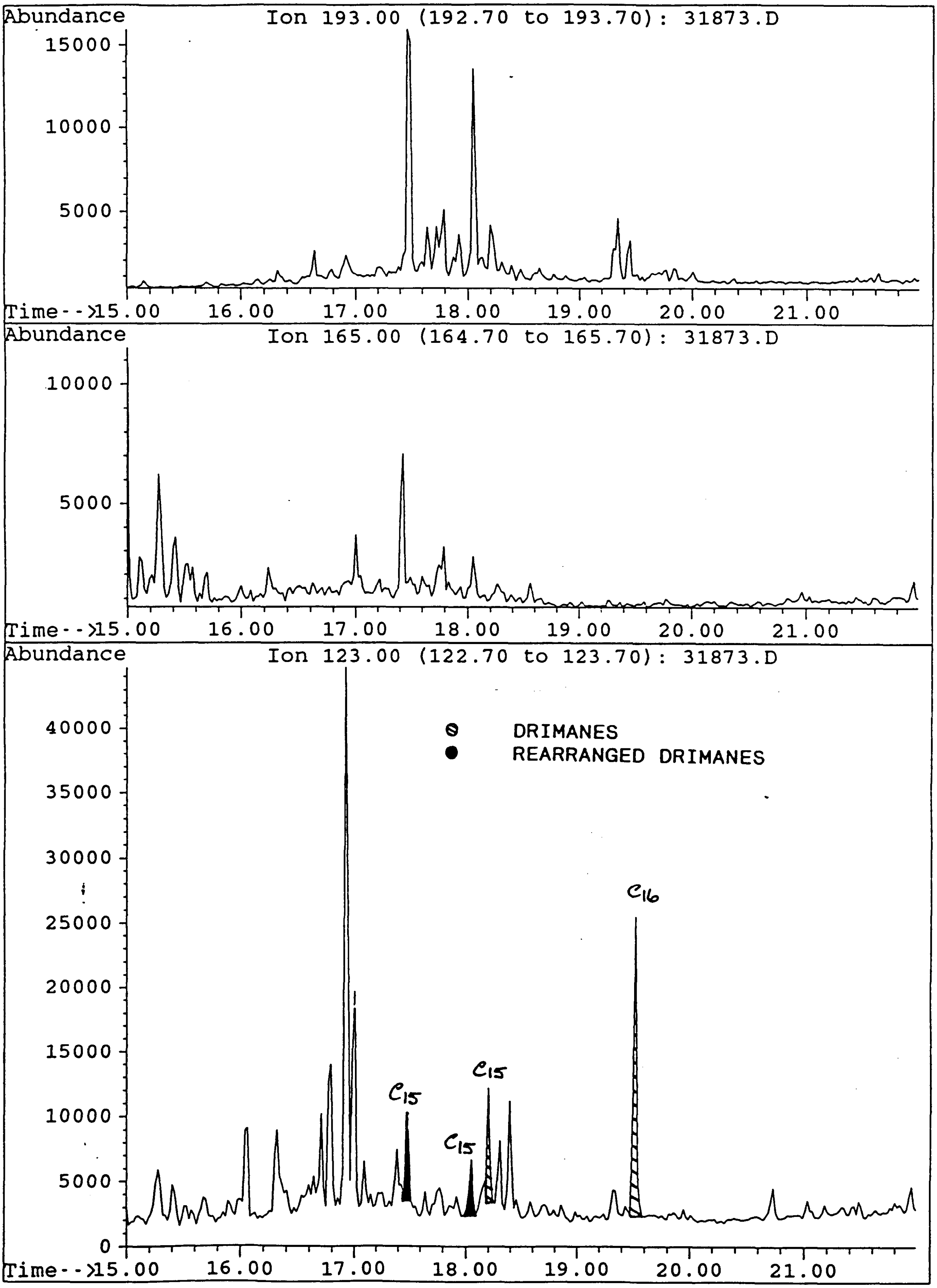
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



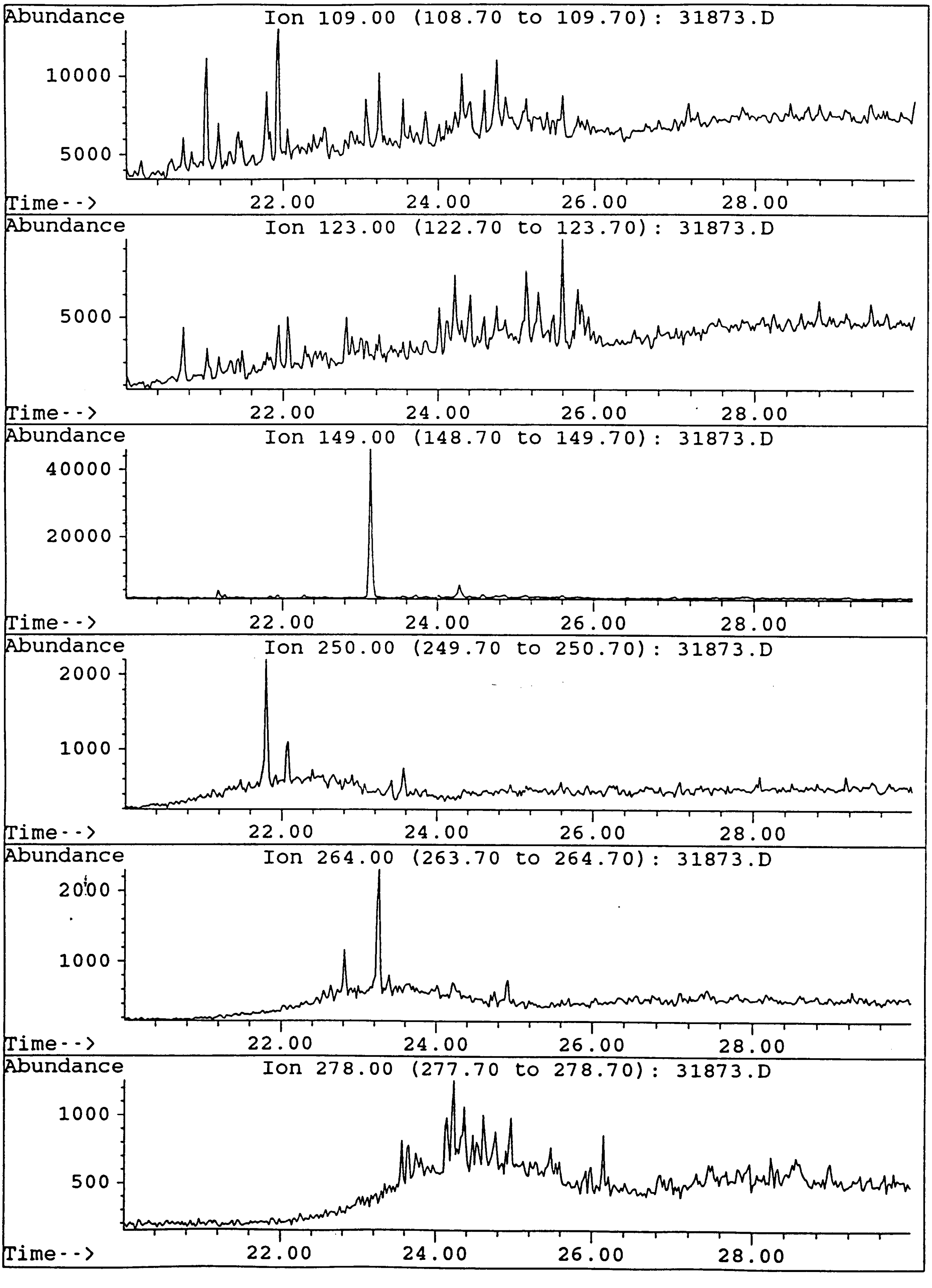
e : 31873.D
ple : LA BELLA#1, 2159.0m, B/C.
c. Info : COL#143. 1/140uL. 10-11-93. GEC.



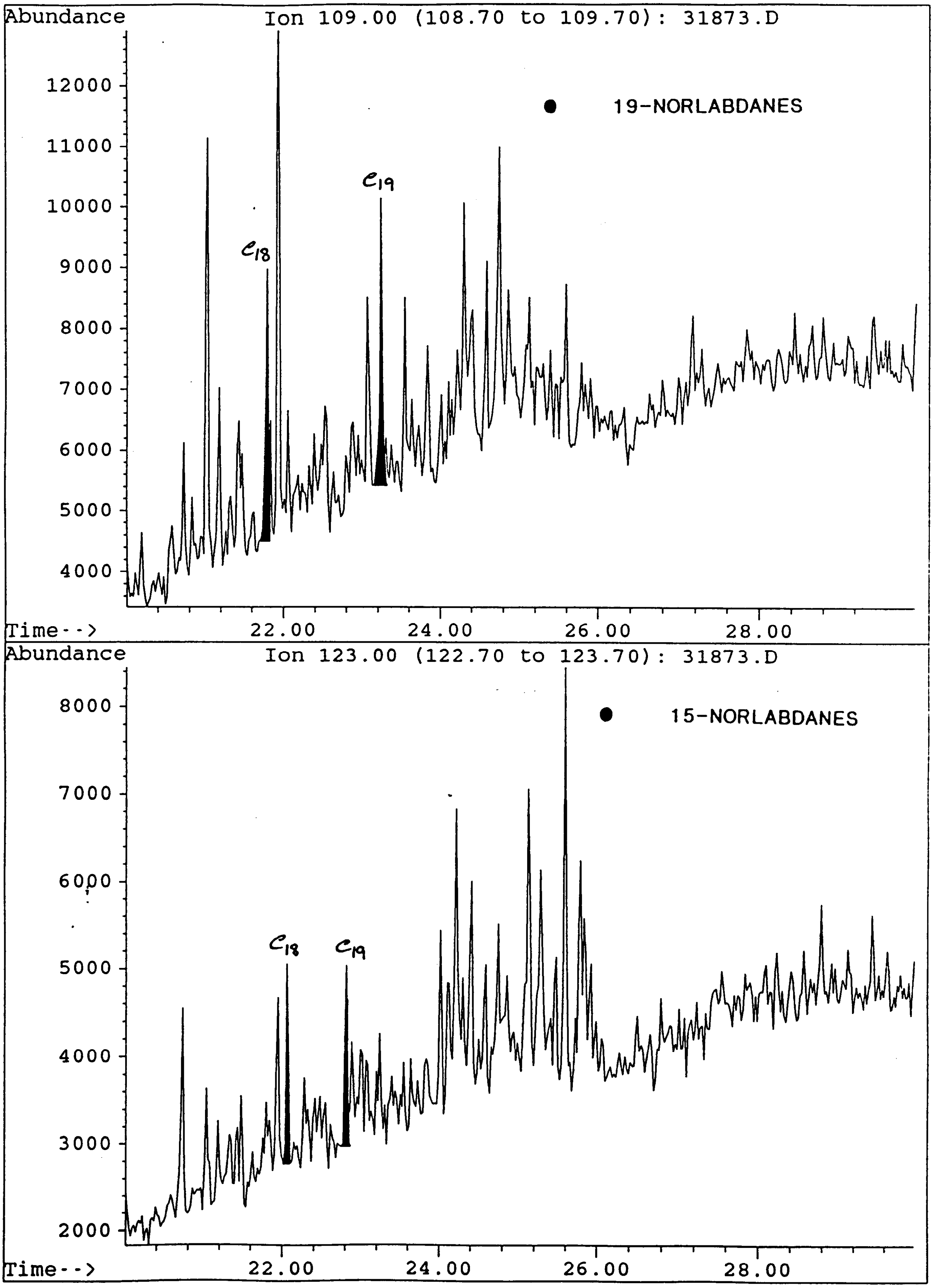
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



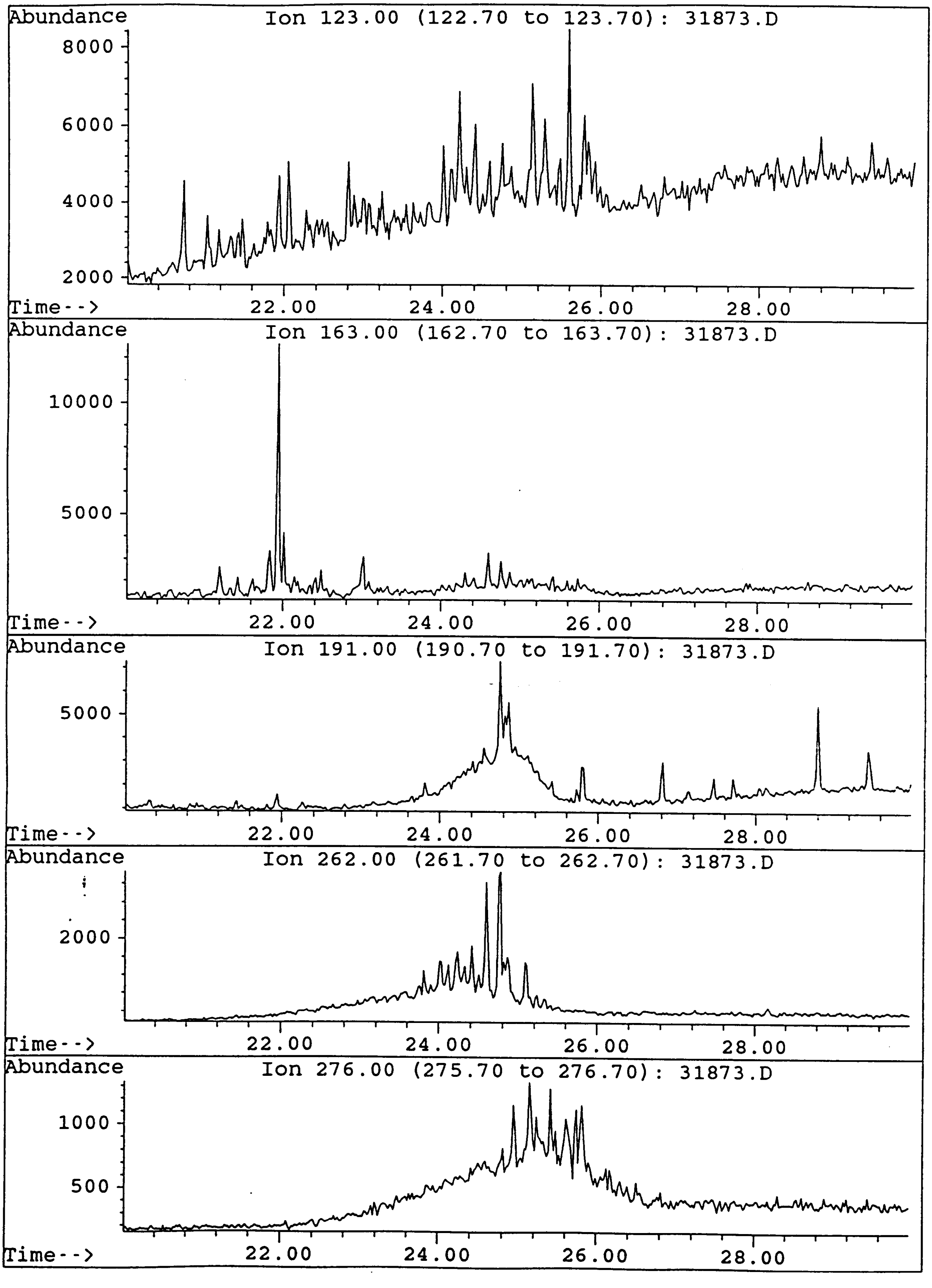
File :   31873.D
Sample :   LA BELLA#1, 2159.0m, B/C.
Misc. Info :   COL#143. 1/140uL. 10-11-93. GEC.



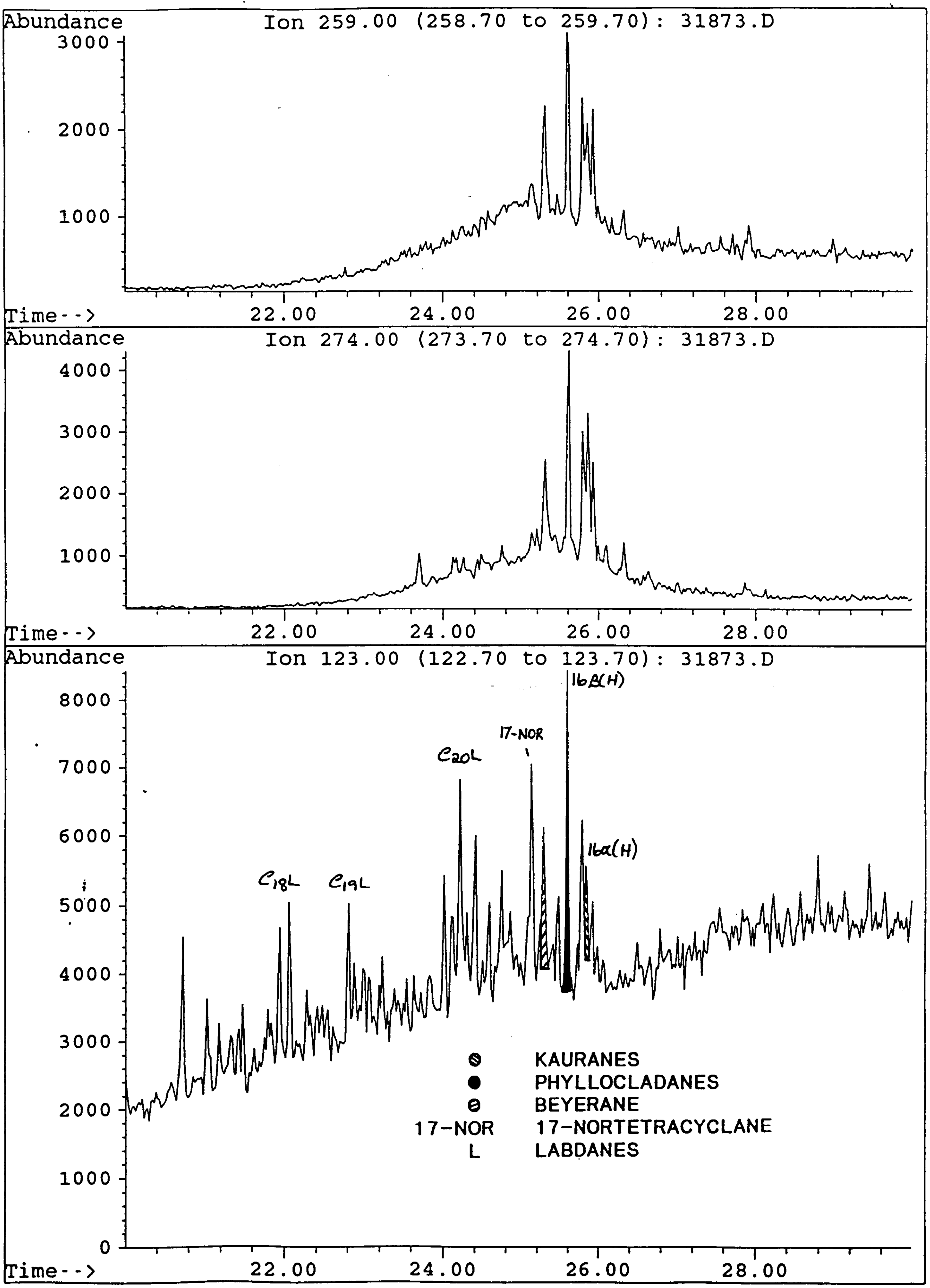
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



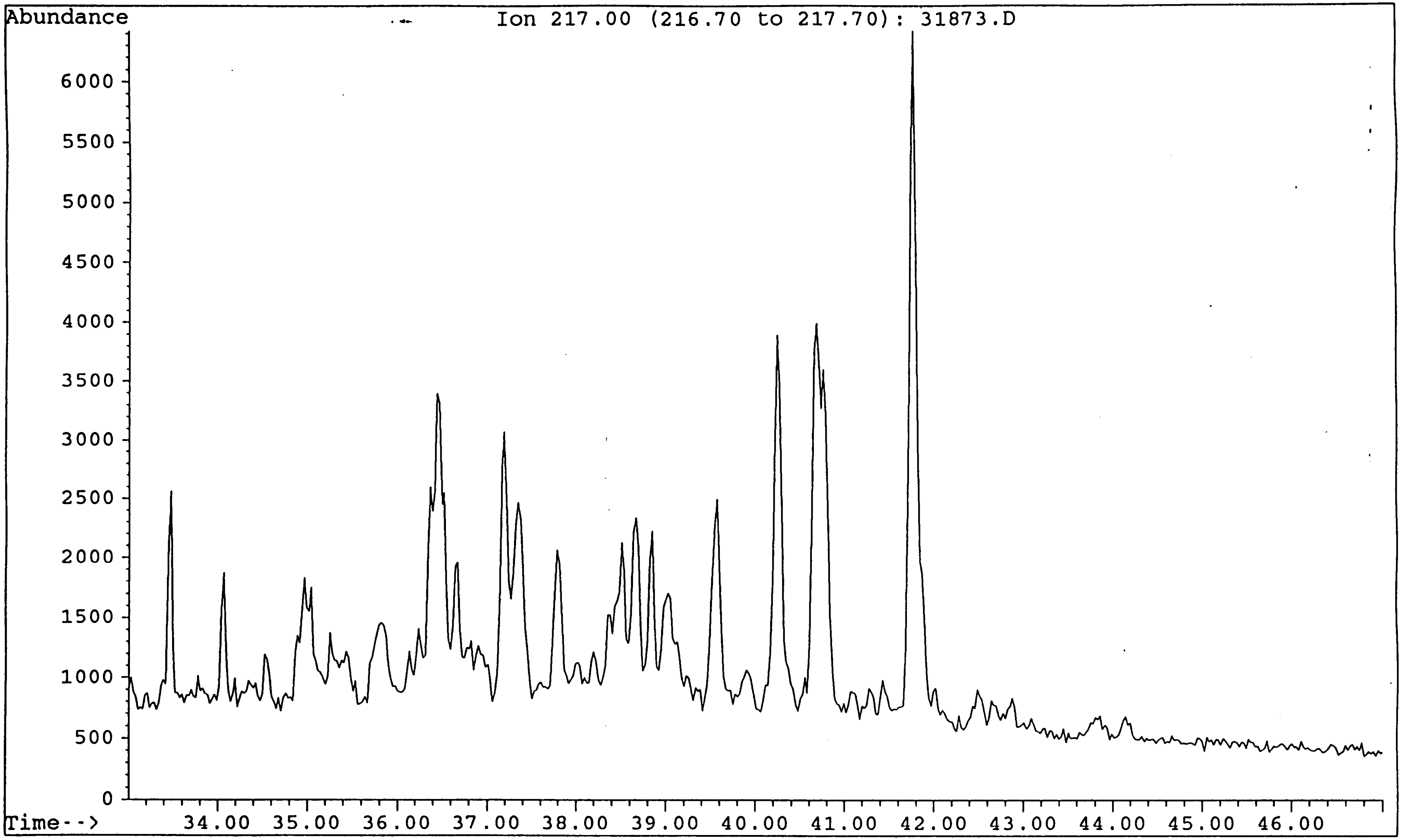
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



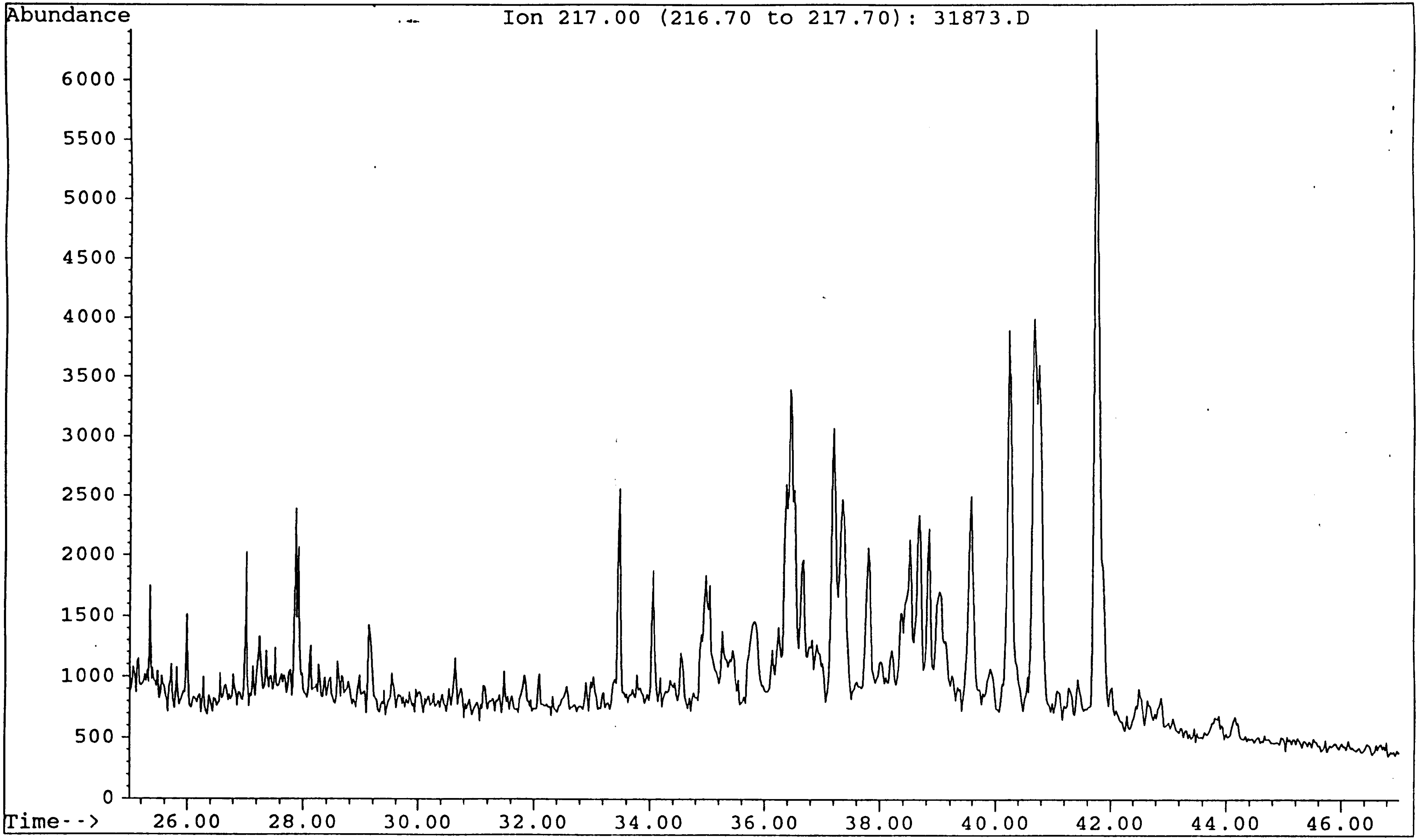
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



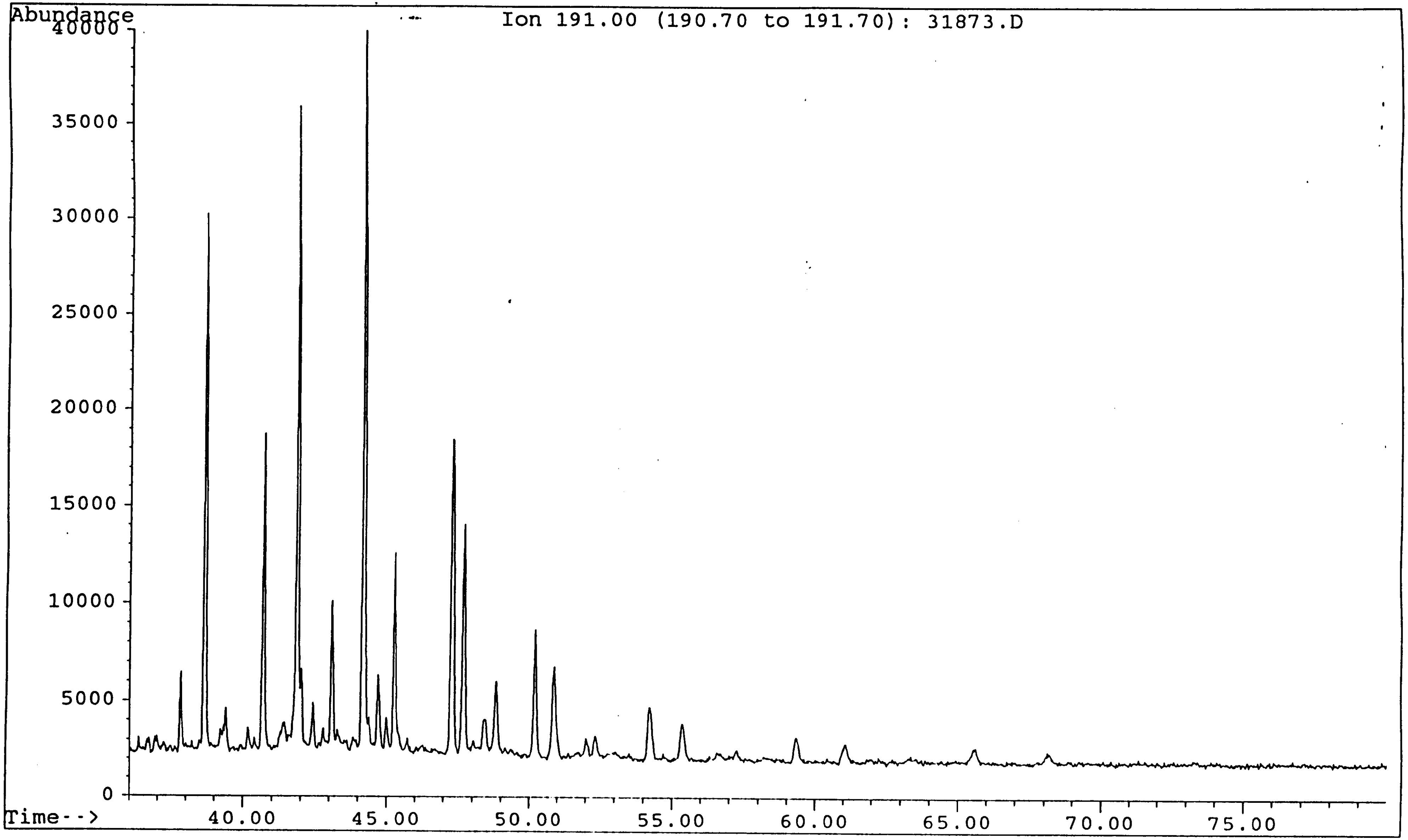
File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



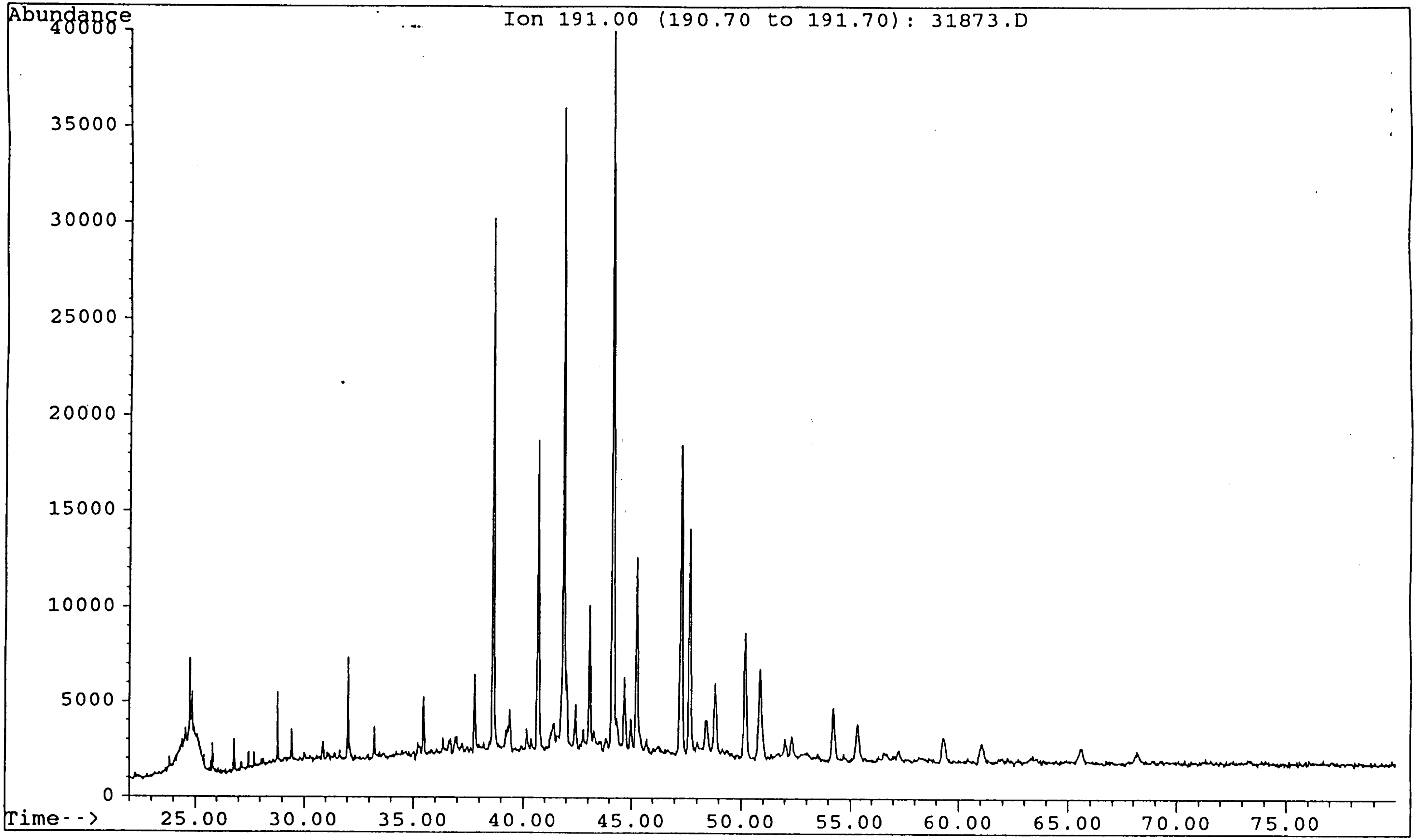
File 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



File : 31873.D
Sample : LA BELLA#1, 2159.0m, B/C.
Misc. Info : COL#143. 1/140uL. 10-11-93. GEC.



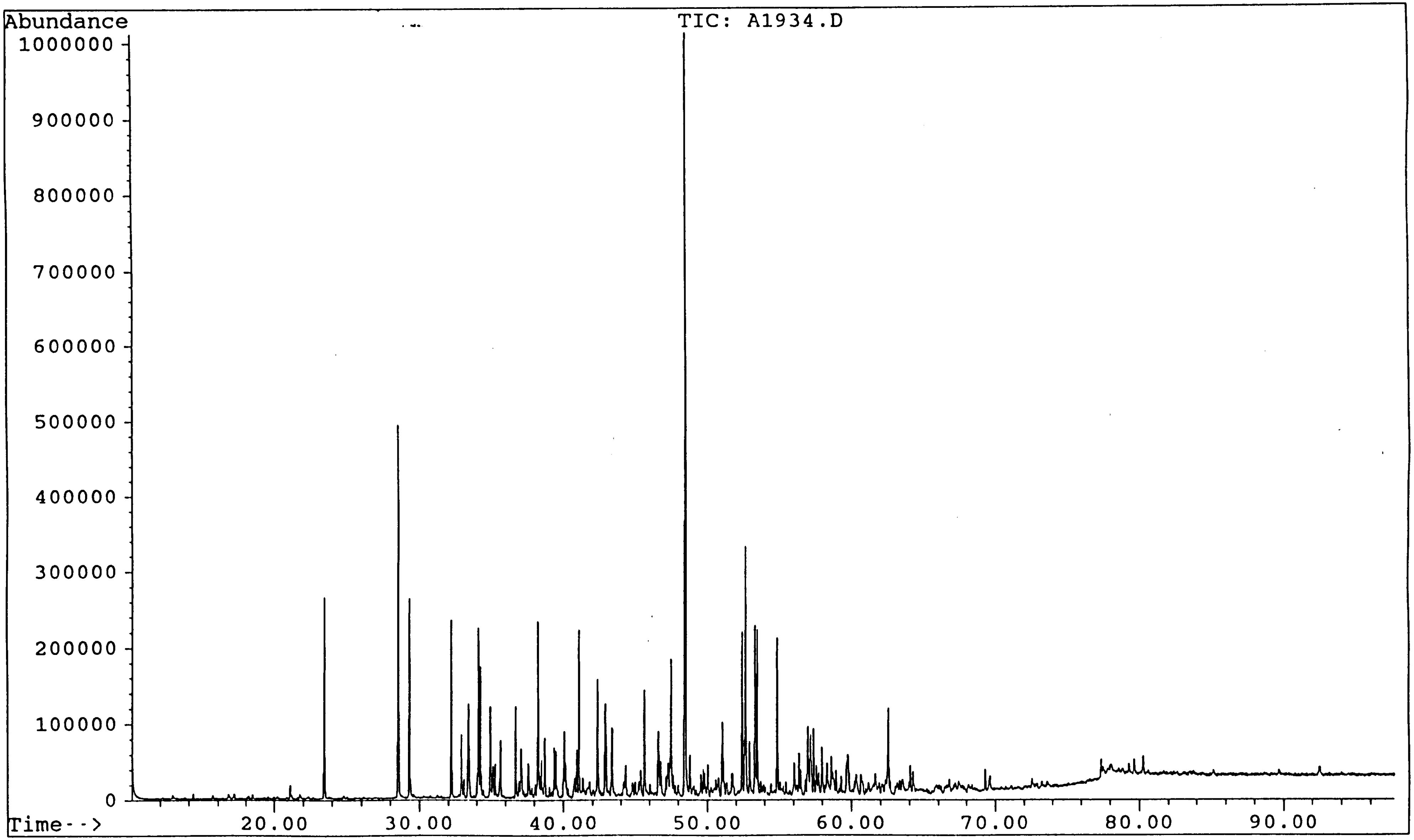
File .   31873.D
Sample :   LA BELLA#1, 2159.0m, B/C.
Misc. Info :   COL#143. 1/140uL. 10-11-93. GEC.



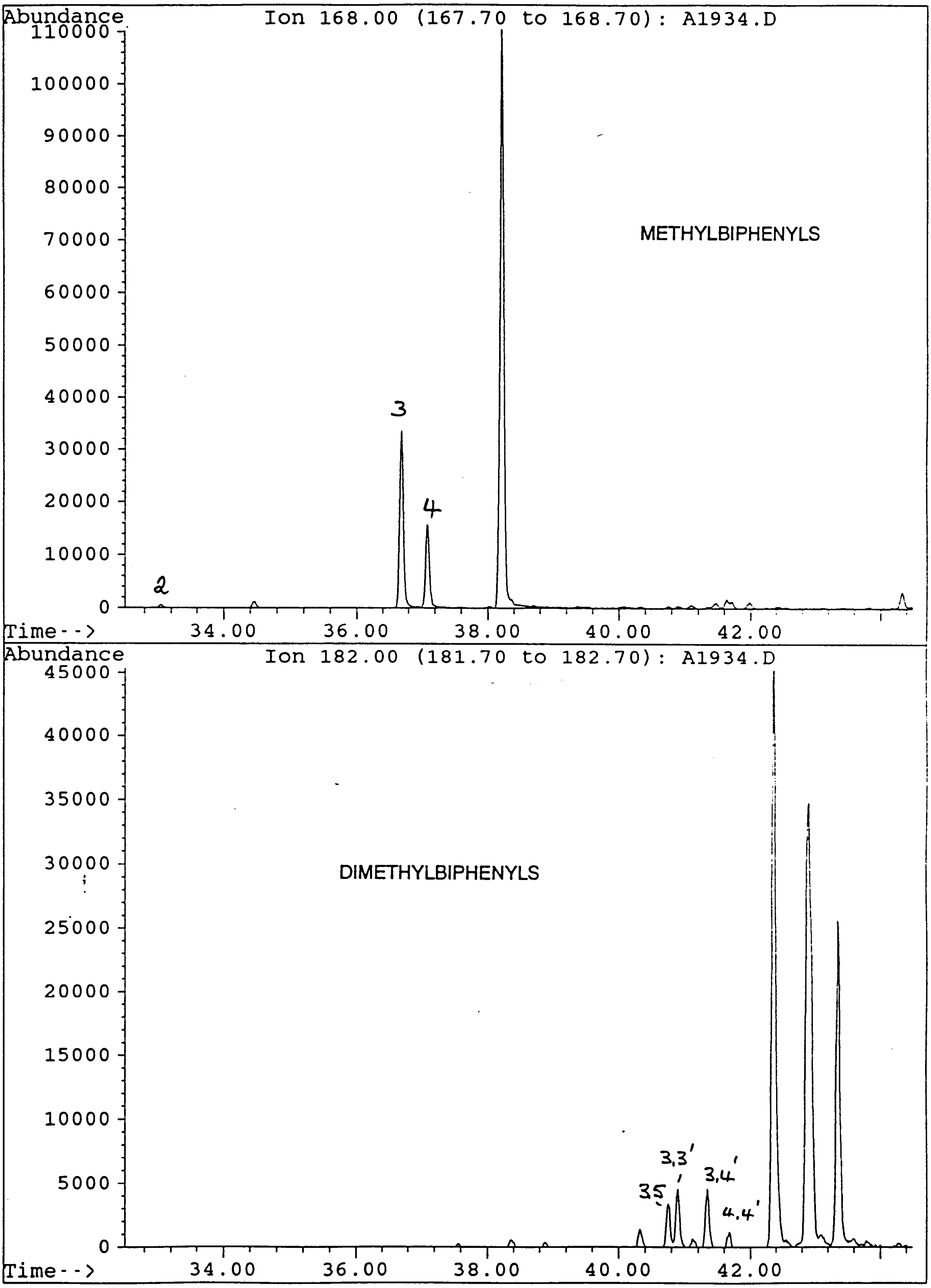
APPENDIX 4

SIR GC-MS (AROMS) MASS FRAGMENTOGRAMS : EXTRACTS

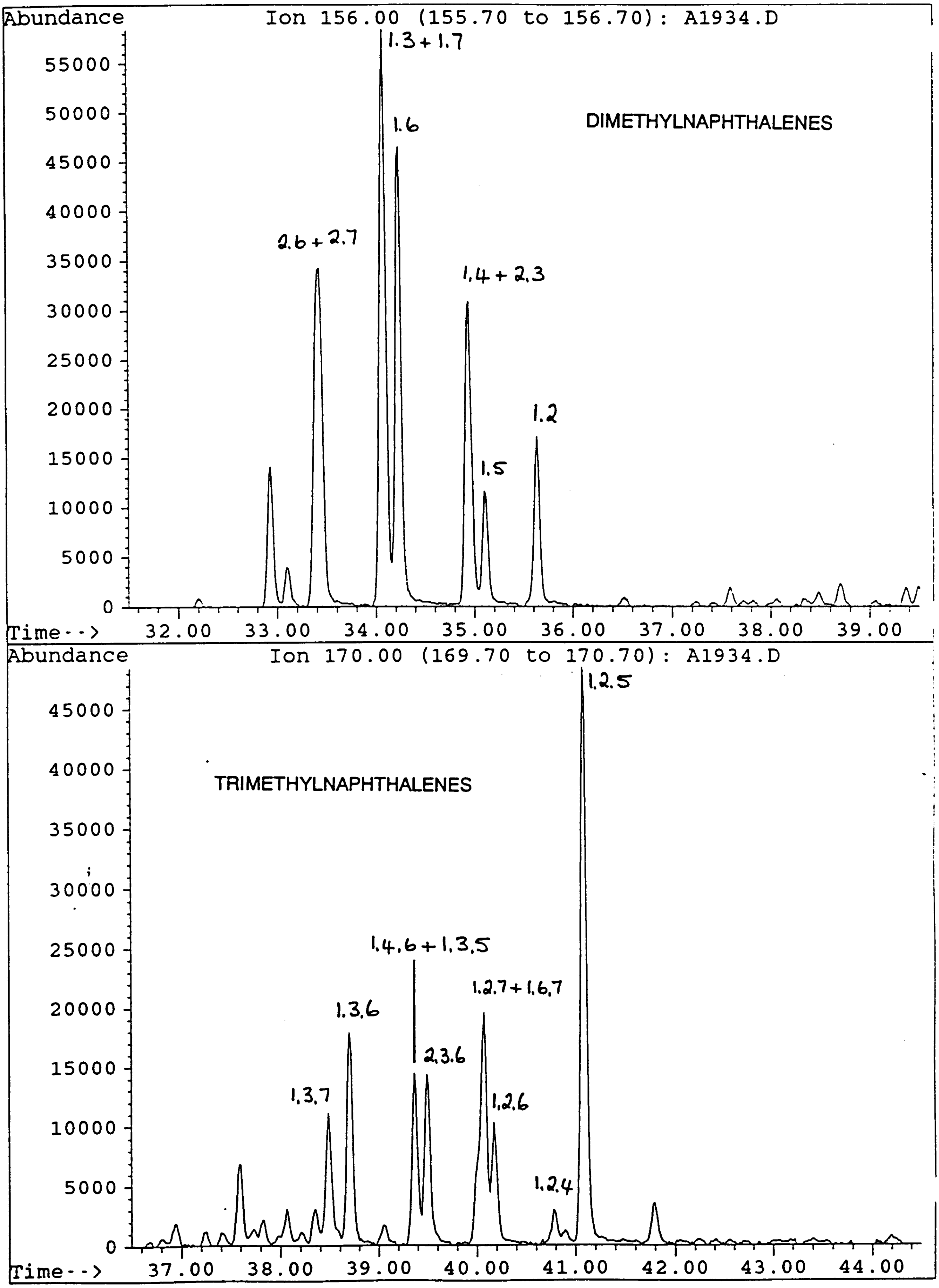
File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.



File :   A1934.D
Sample :   LA BELLA#1, 2070.0m. ARO.
Misc. Info :   COL#155. 1/200uL. 18-12-93. GEC.

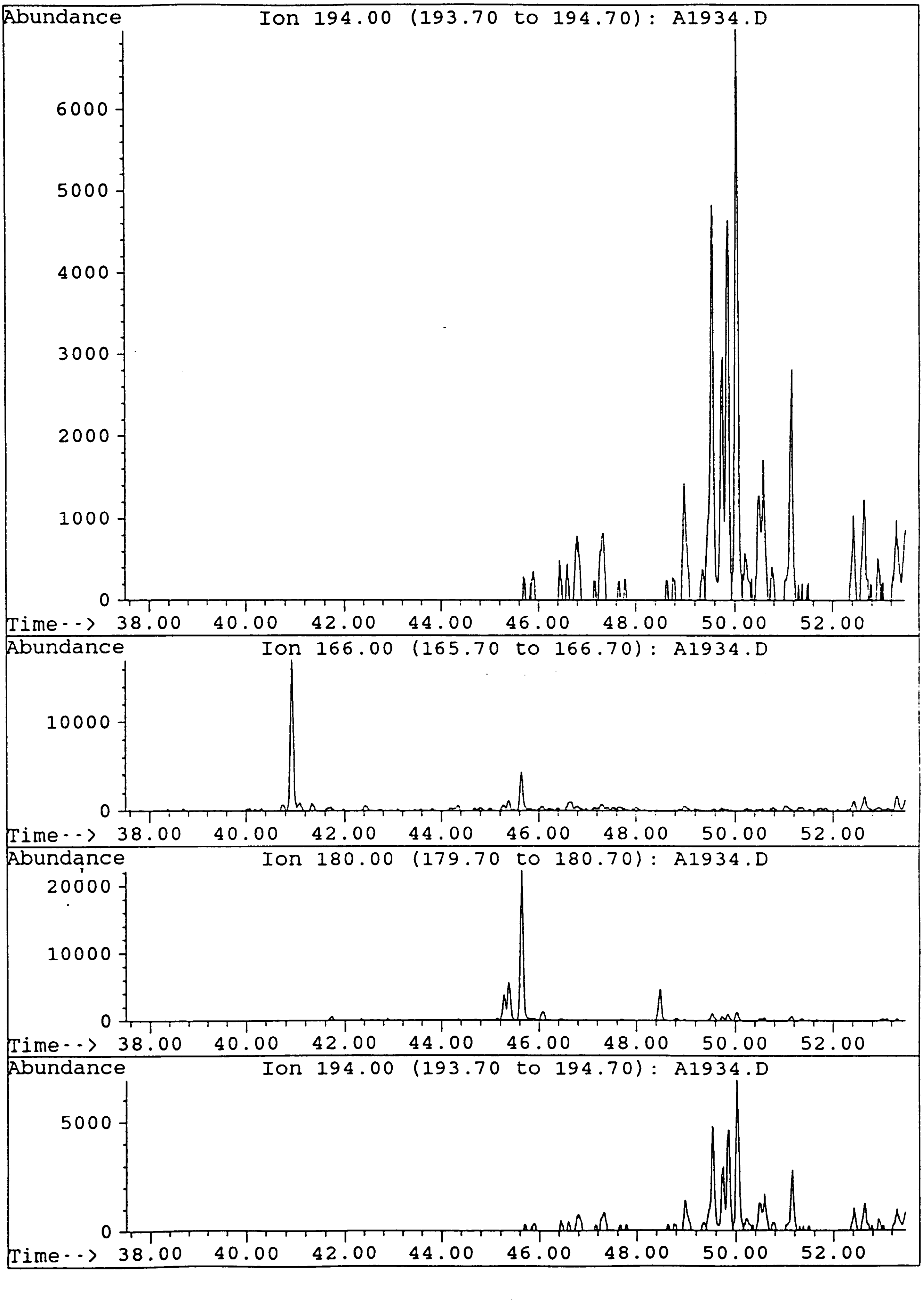


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

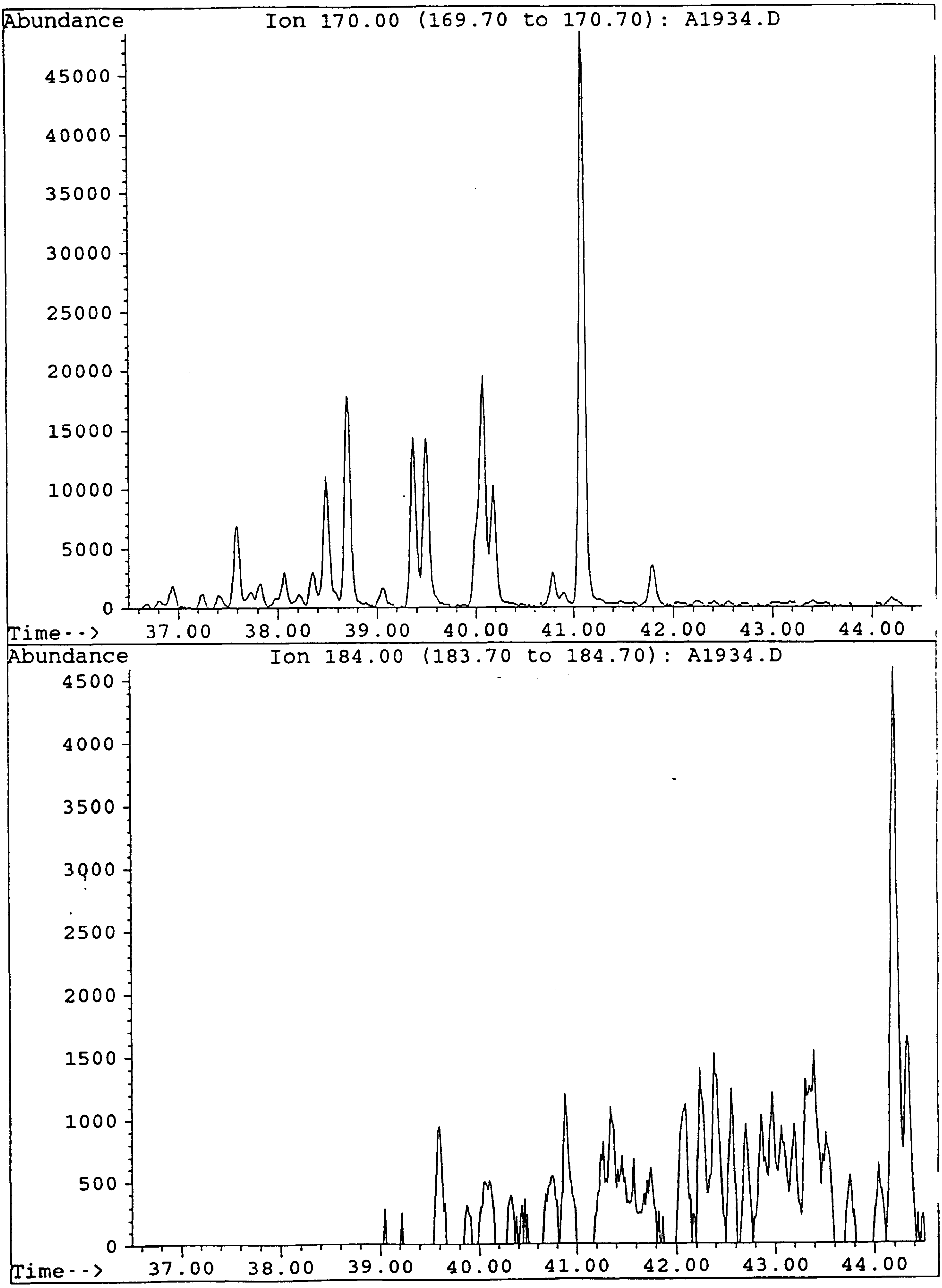


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

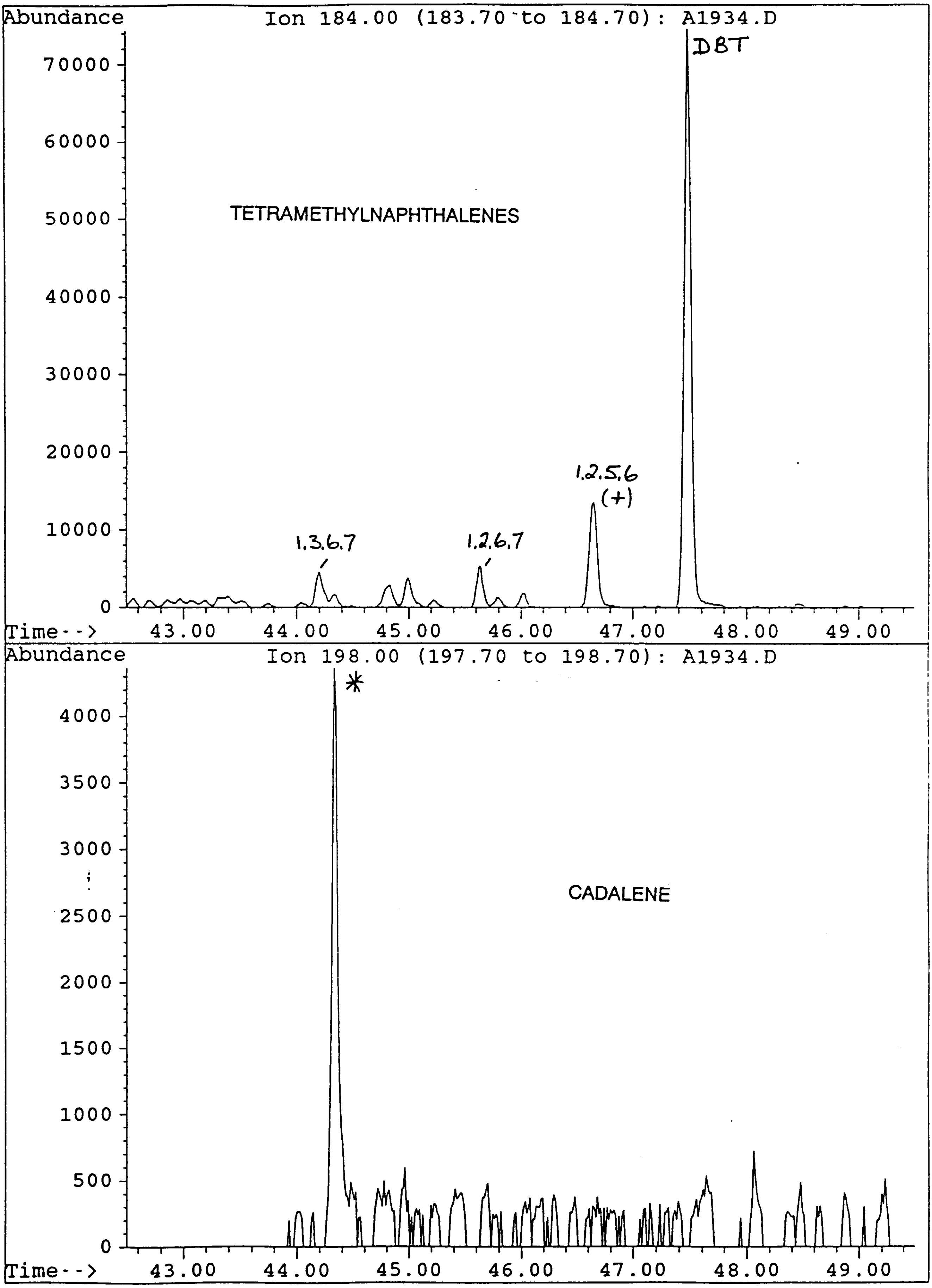
FLUORENES



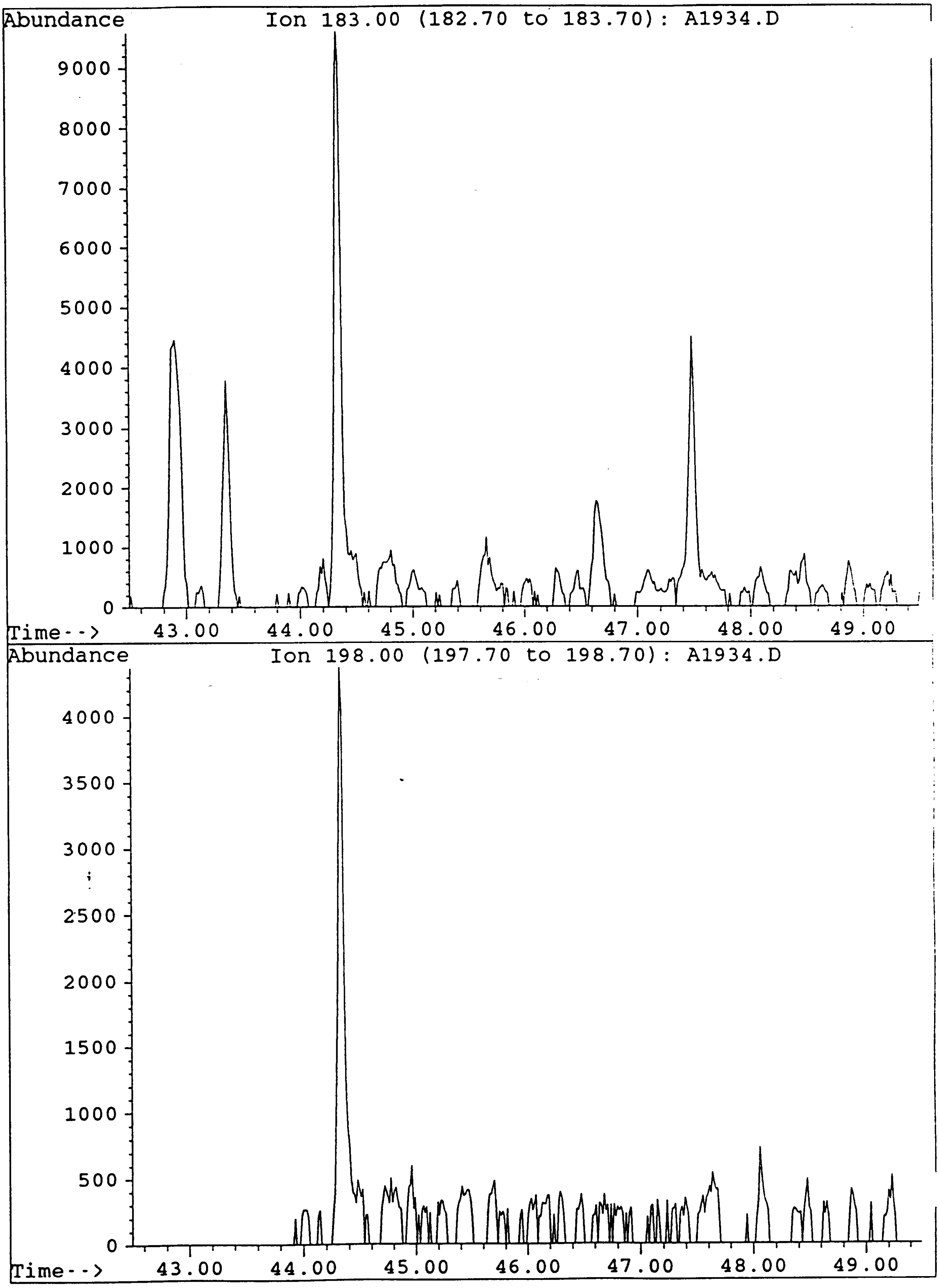
File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.



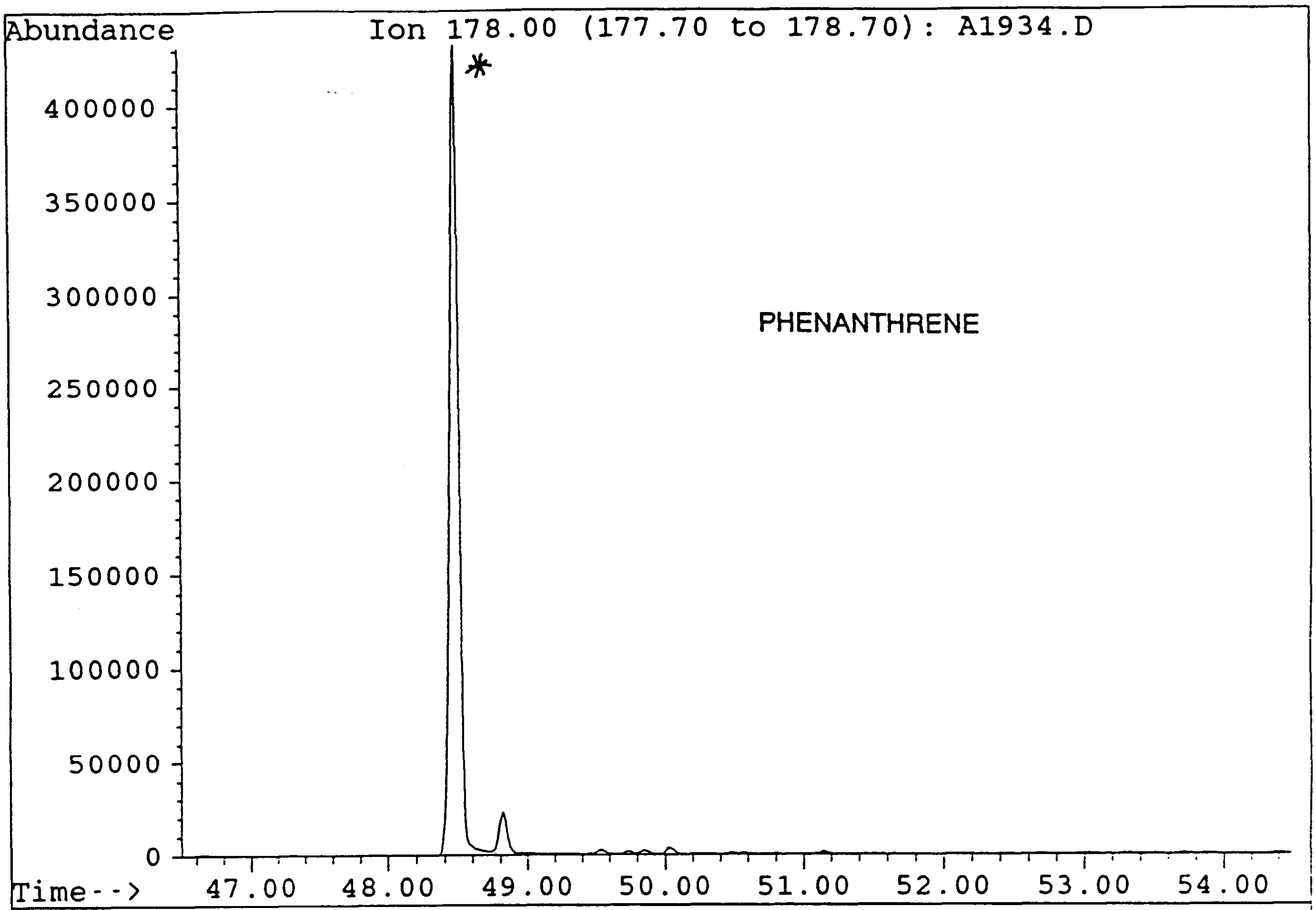
File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

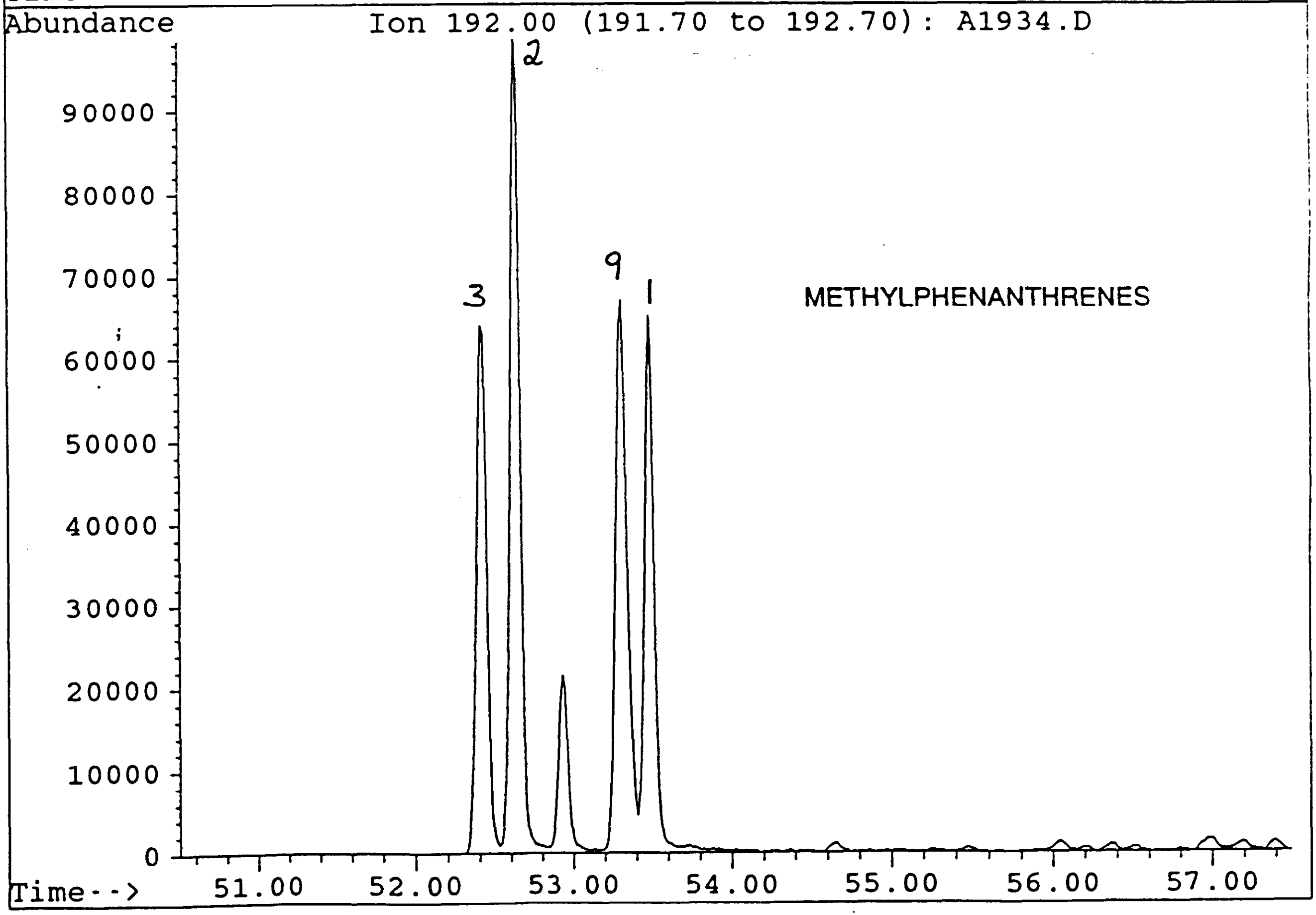


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

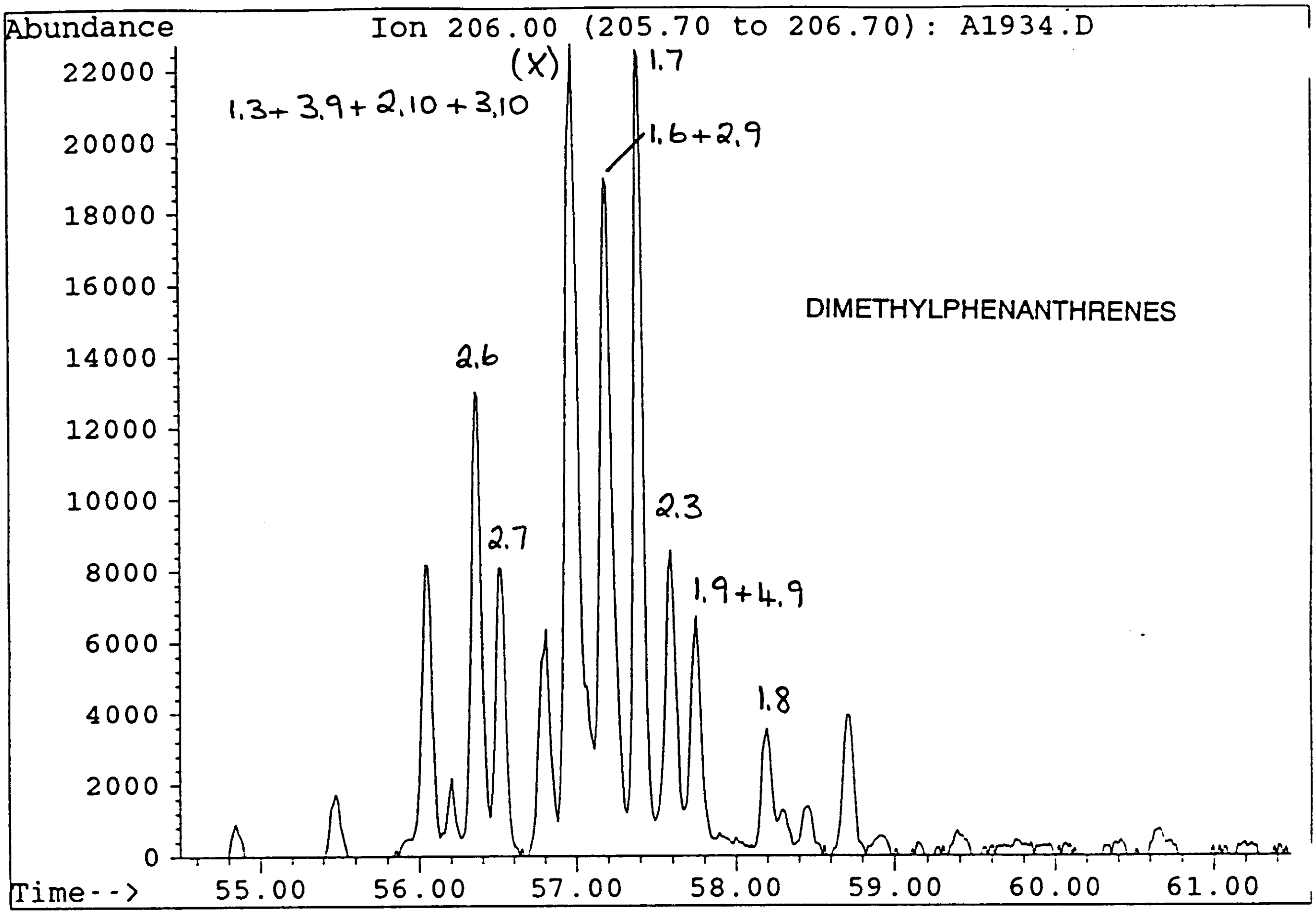


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

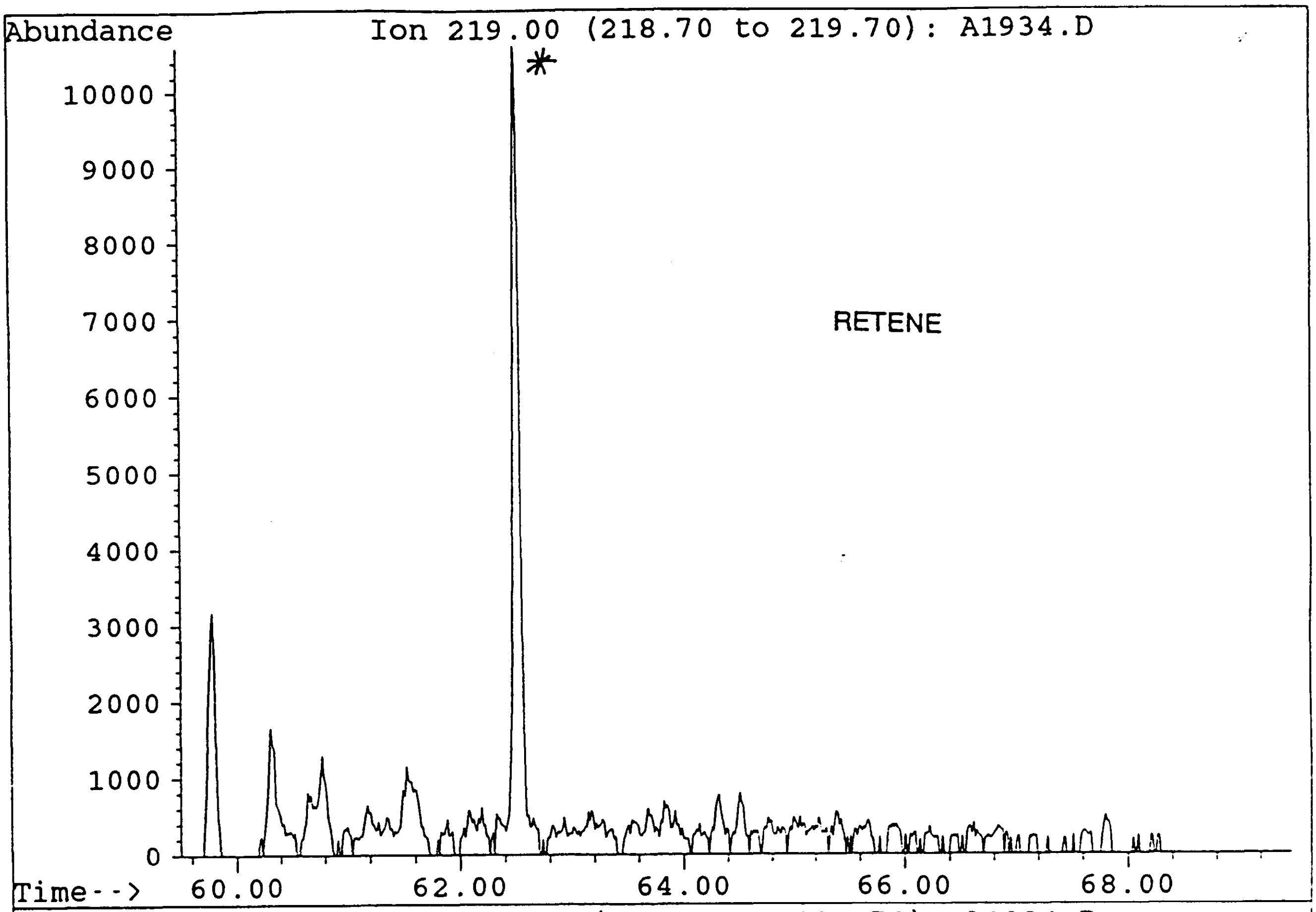


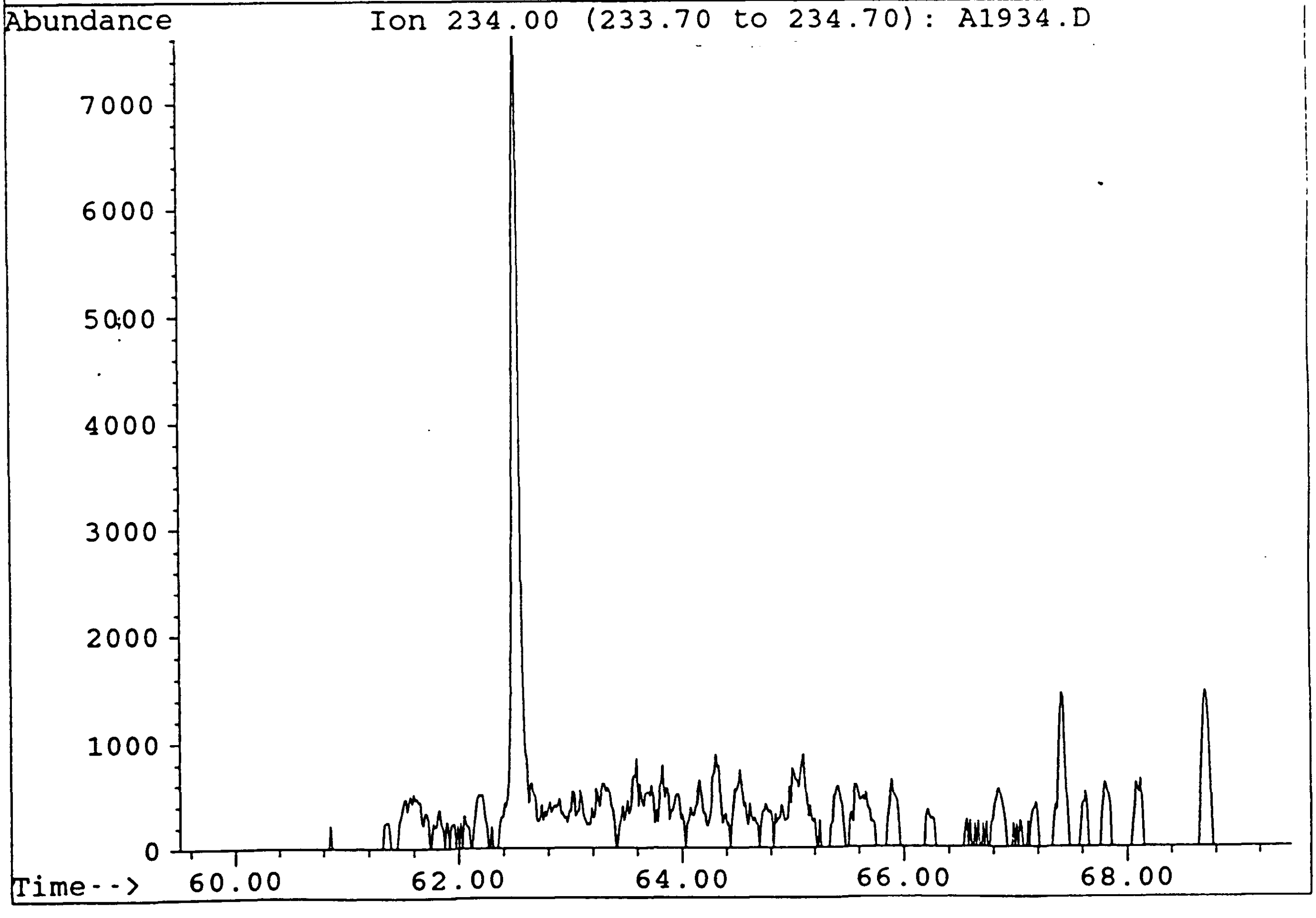


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

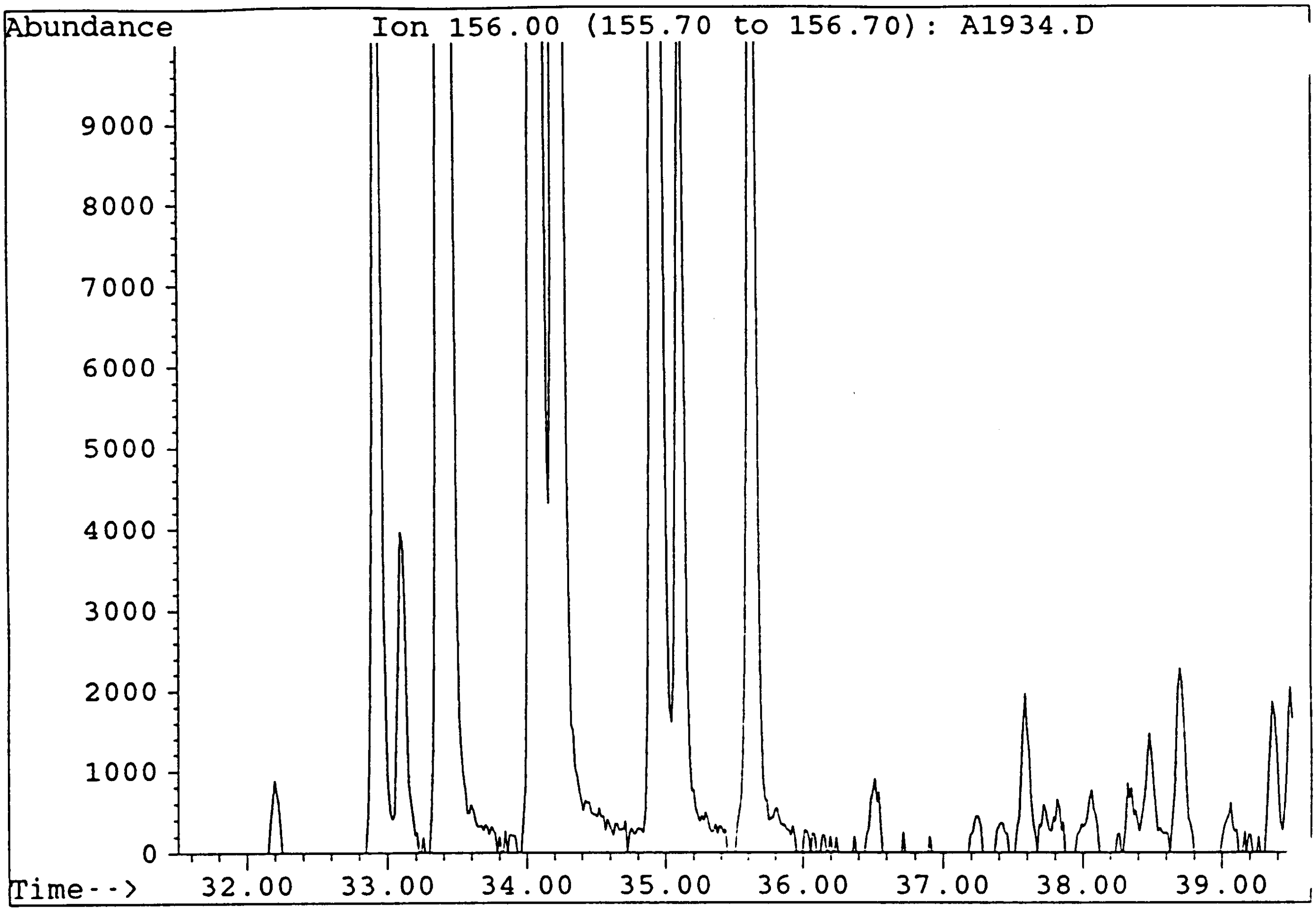


File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.

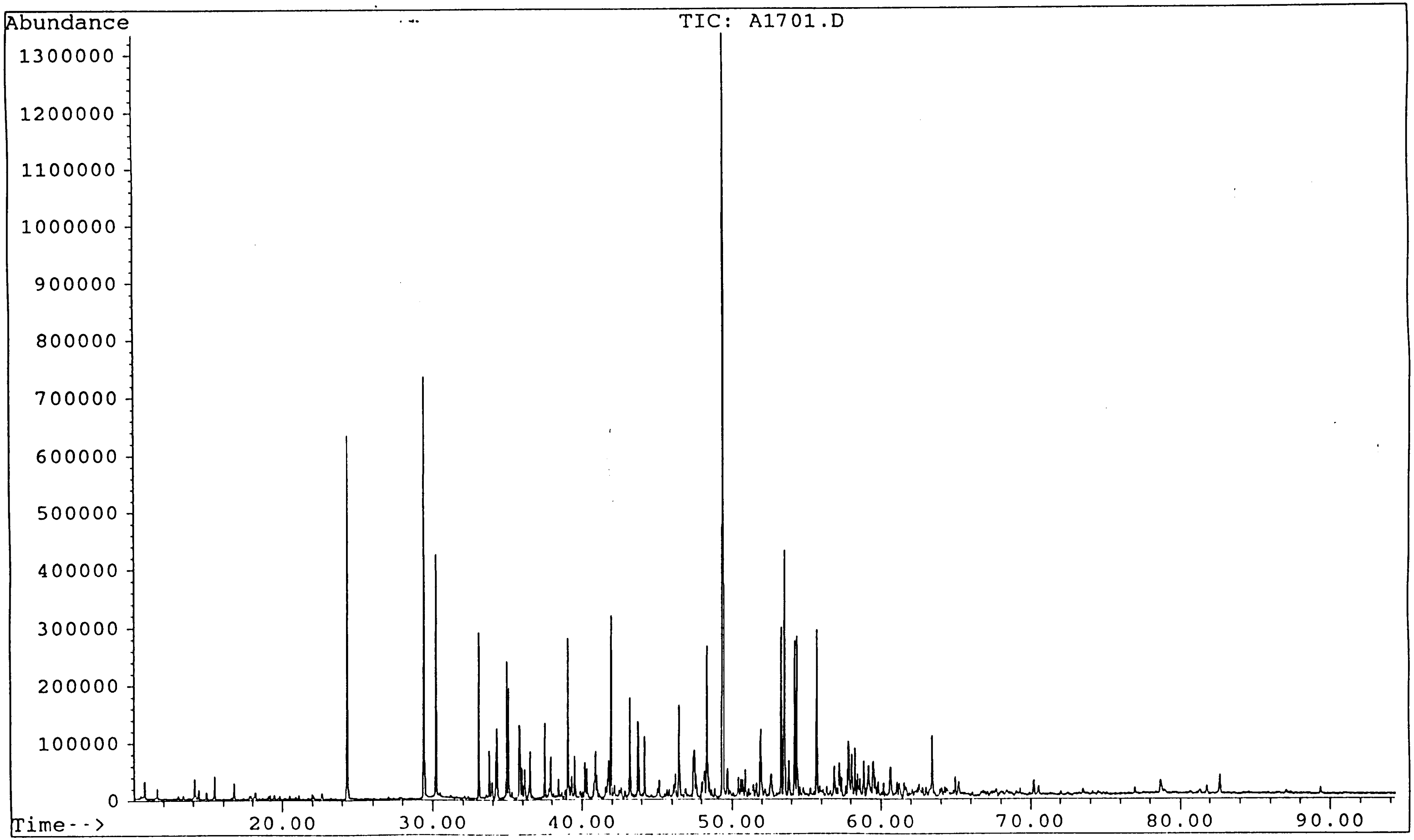




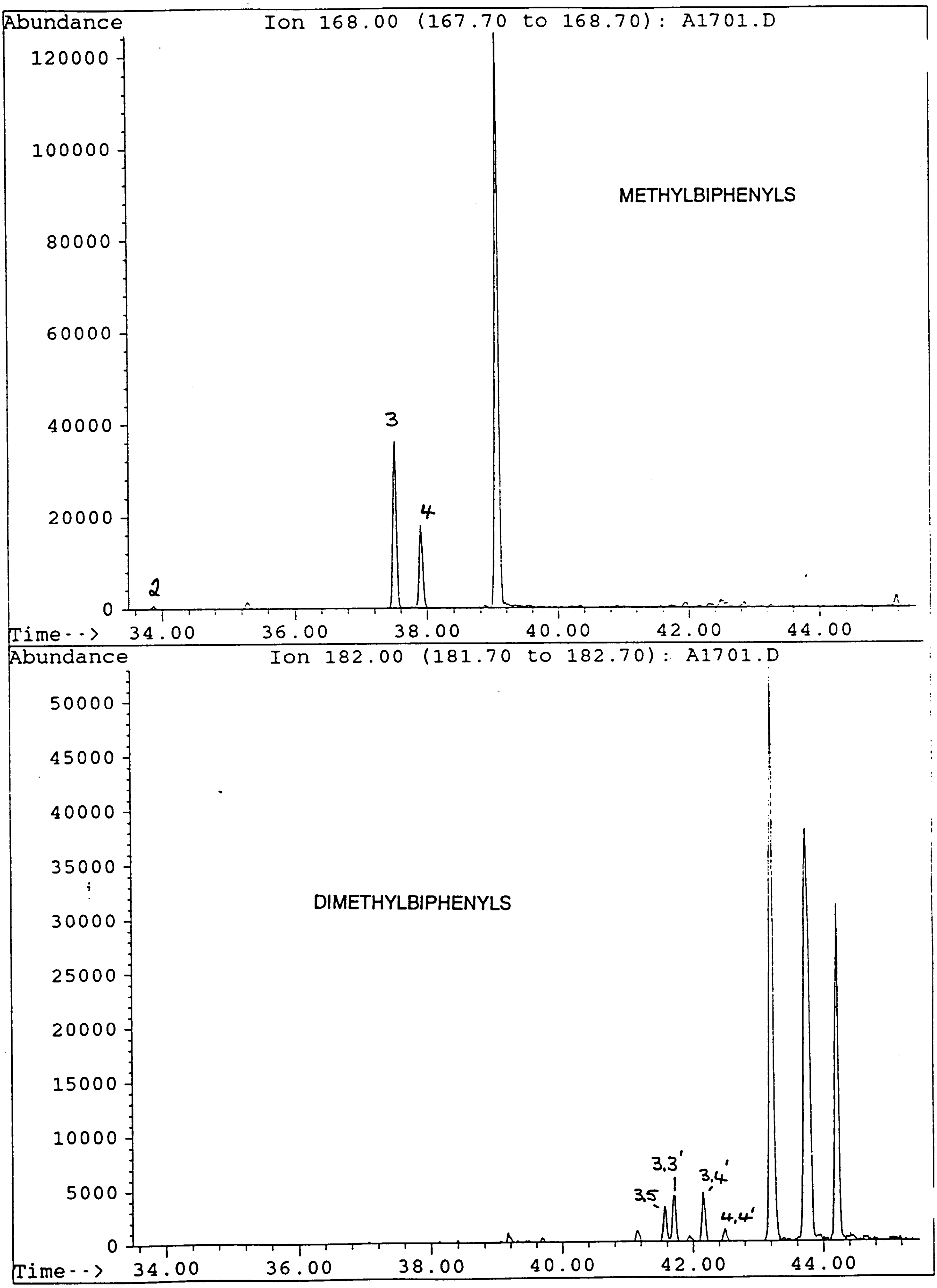
File : A1934.D
Sample : LA BELLA#1, 2070.0m. ARO.
Misc. Info : COL#155. 1/200uL. 18-12-93. GEC.



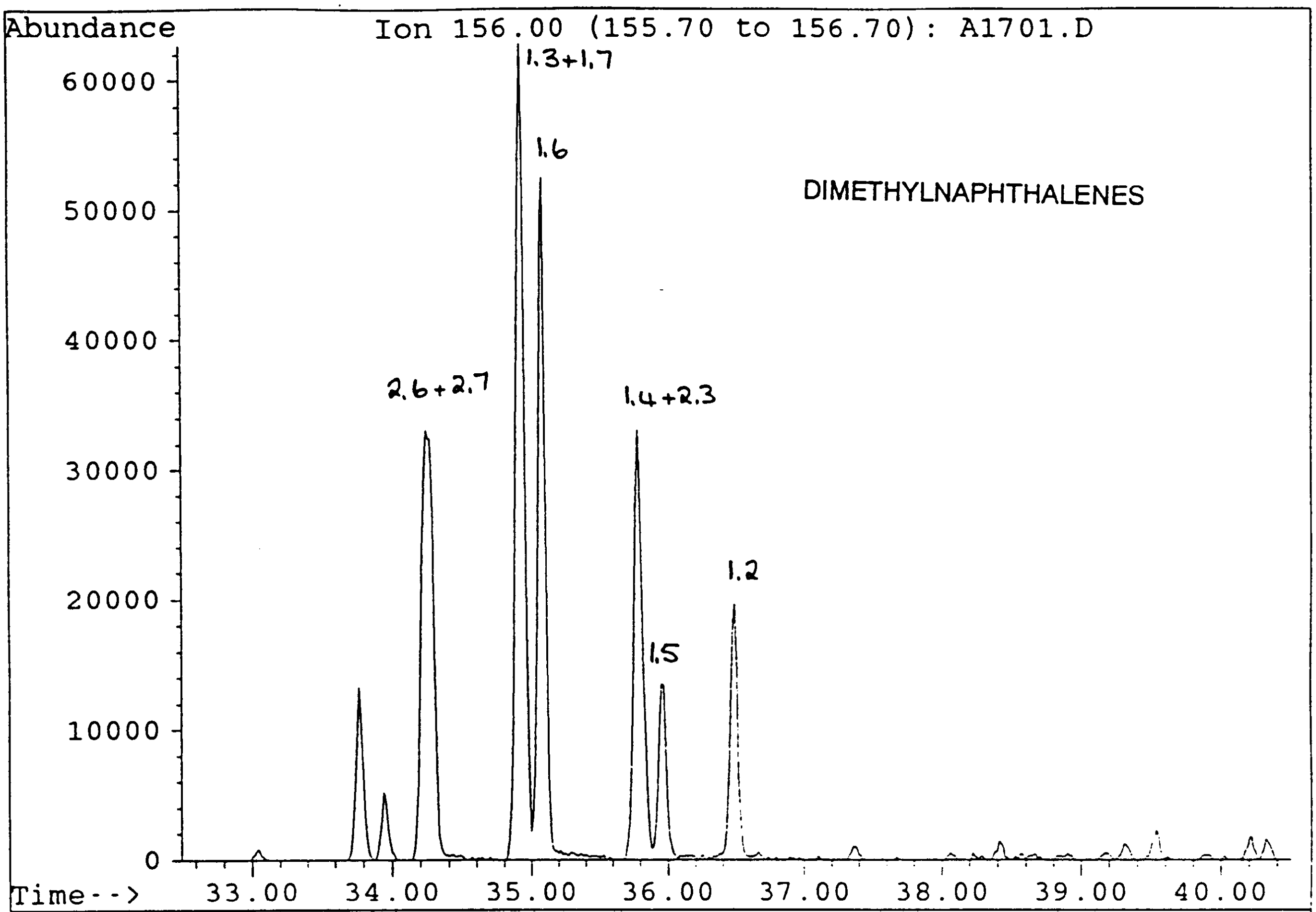
File A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.

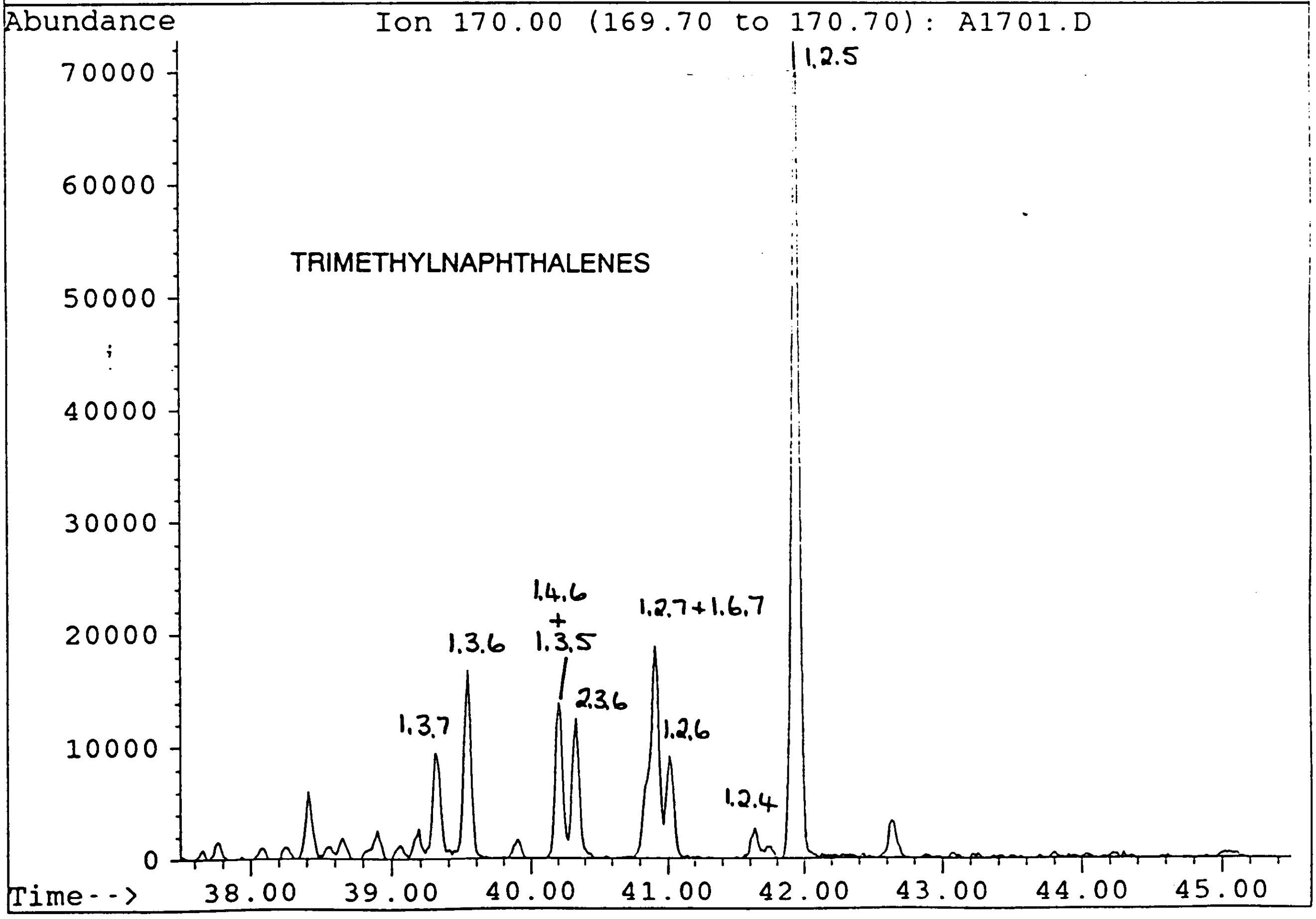


File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



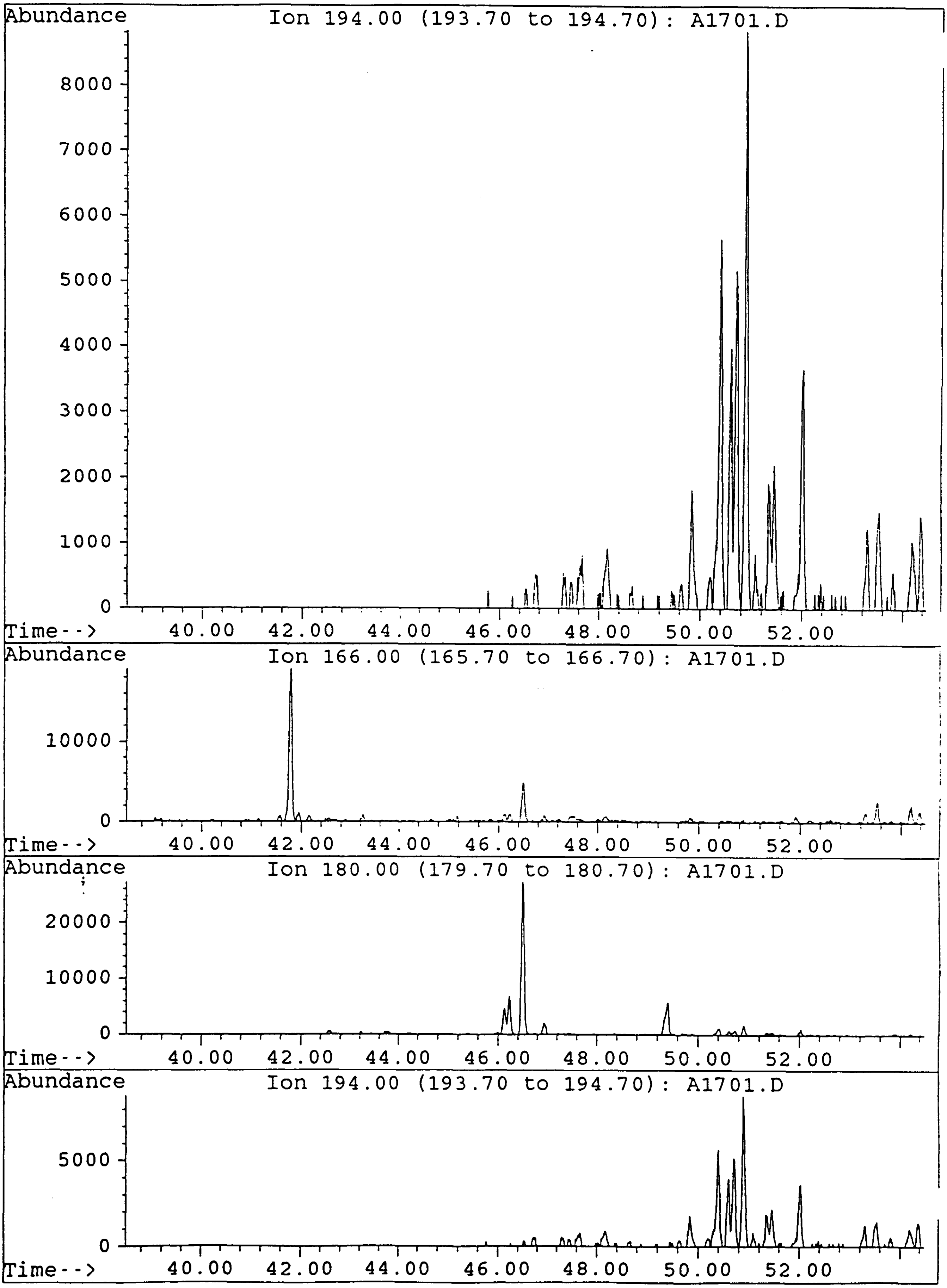
File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



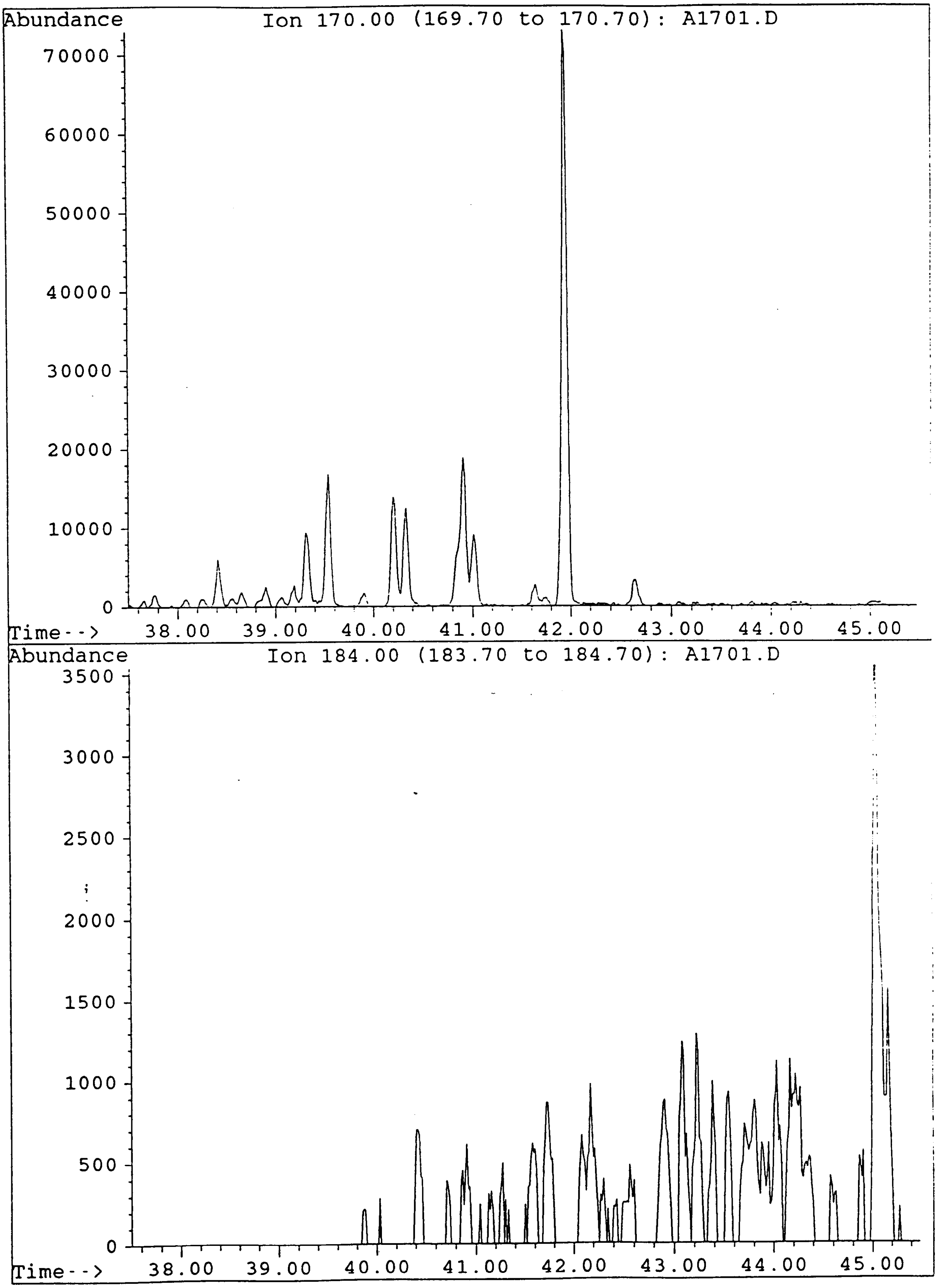


File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.

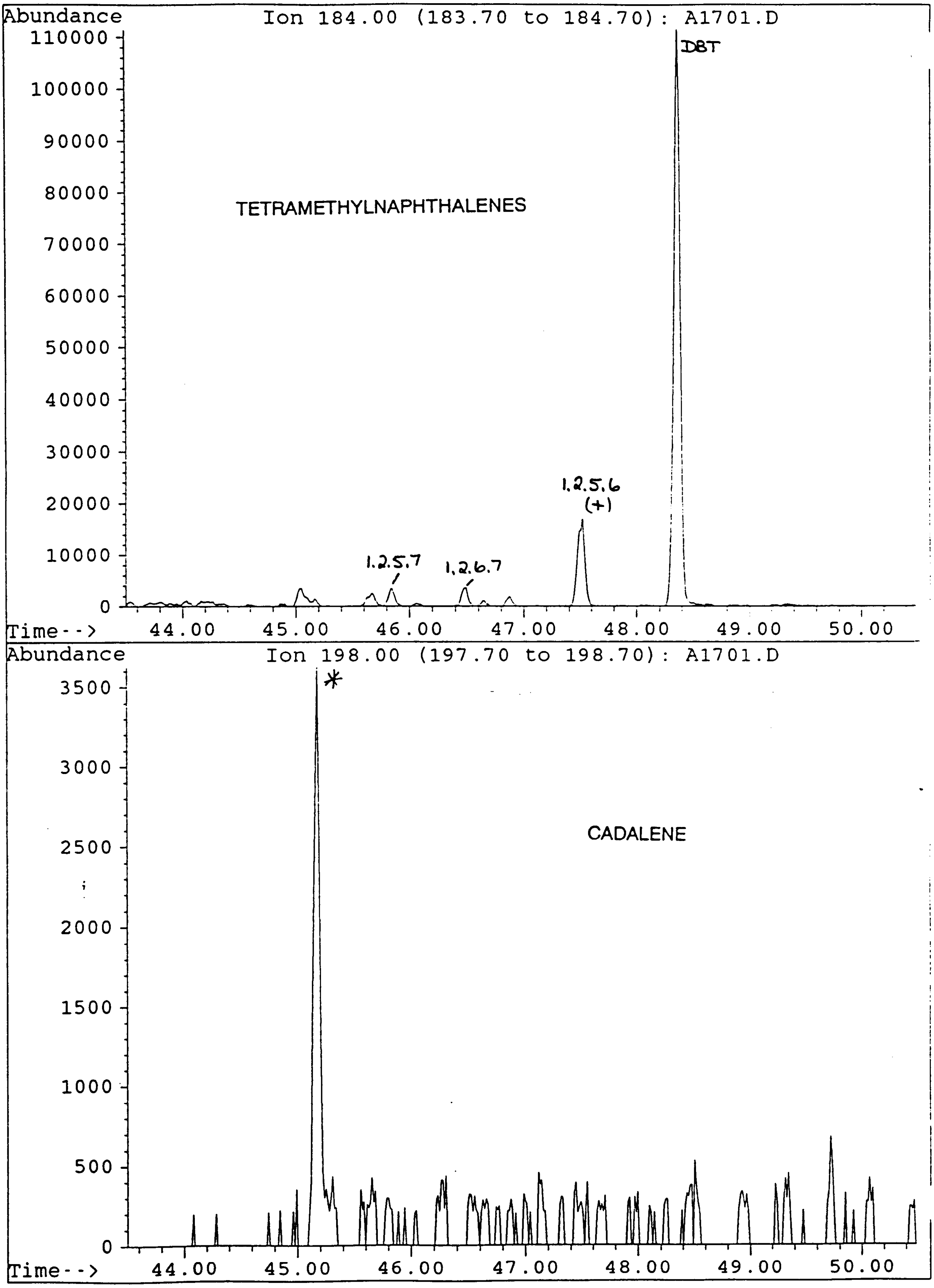
FLUORENES



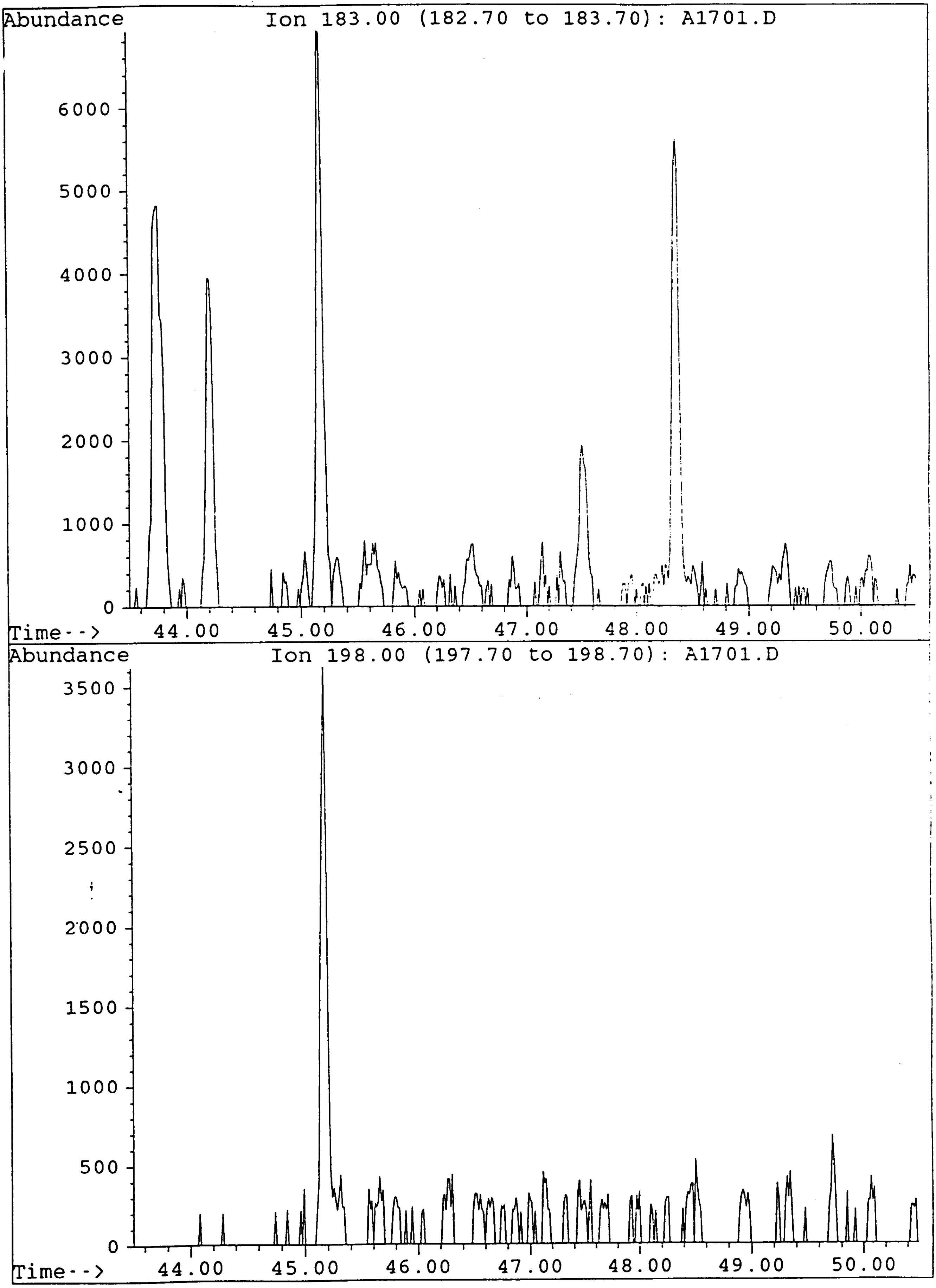
File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



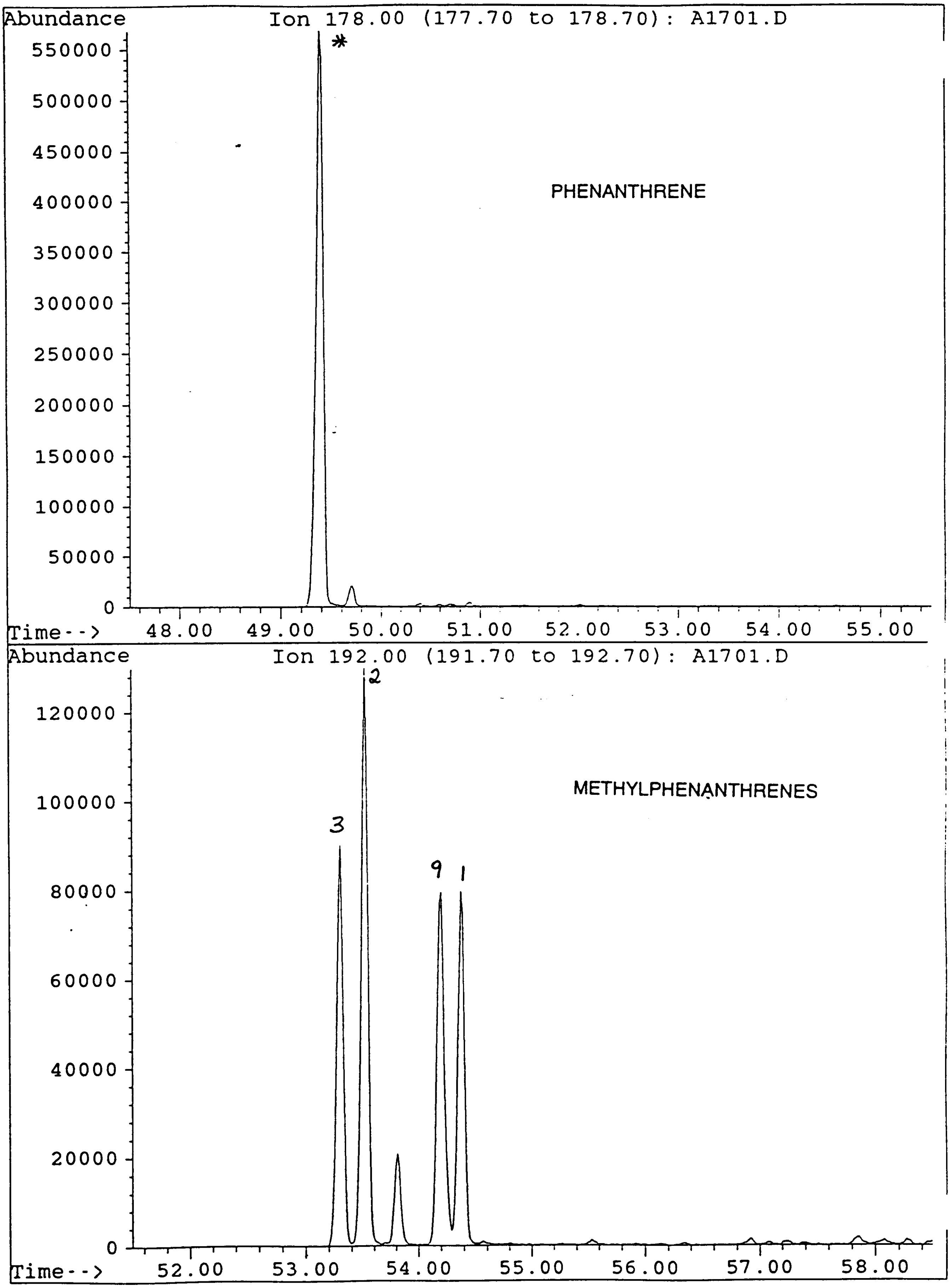
File :   A1701.D
Sample :   LA BELLA#1, 2097.70m, ARO.
Misc. Info :   COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



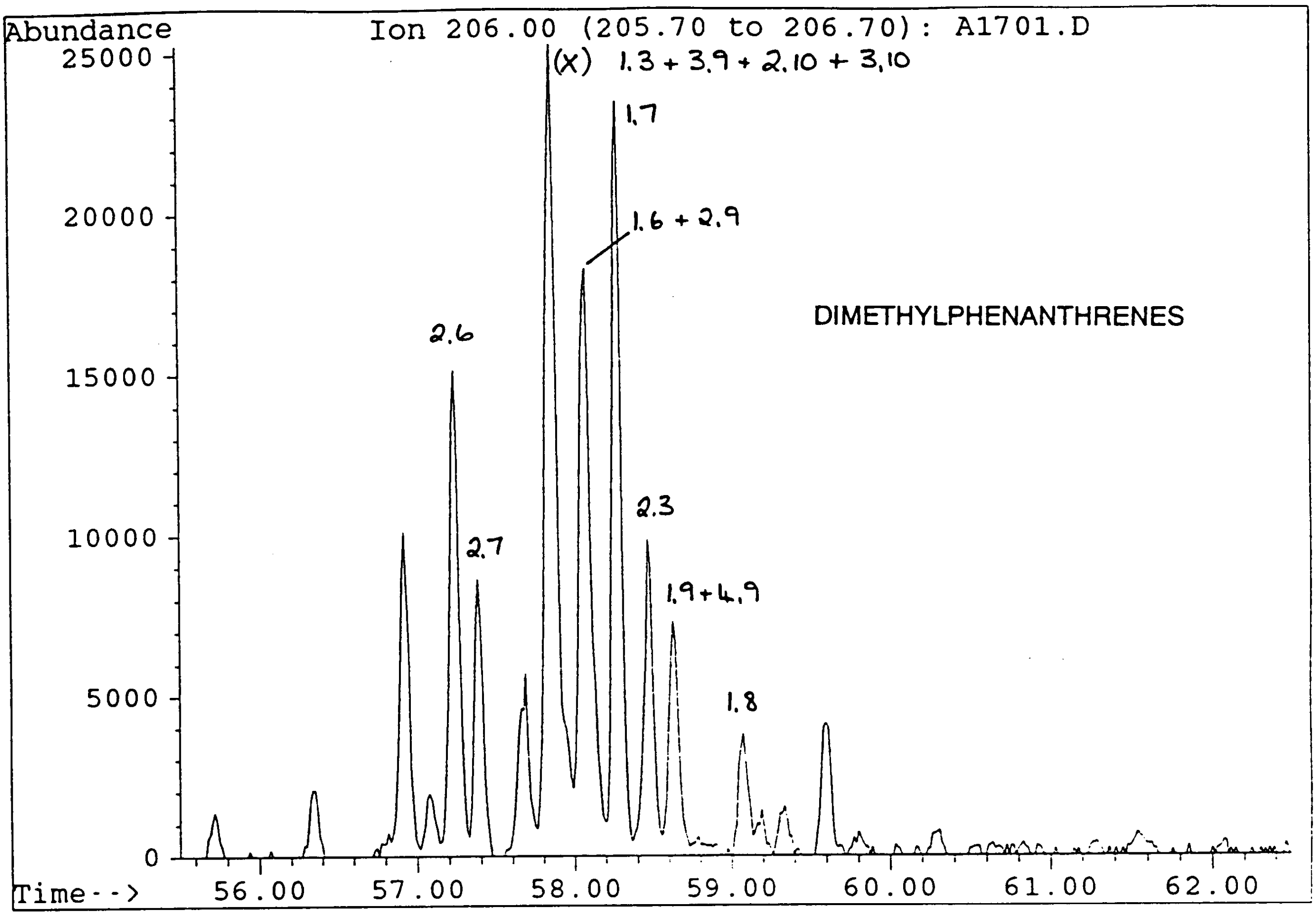
File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



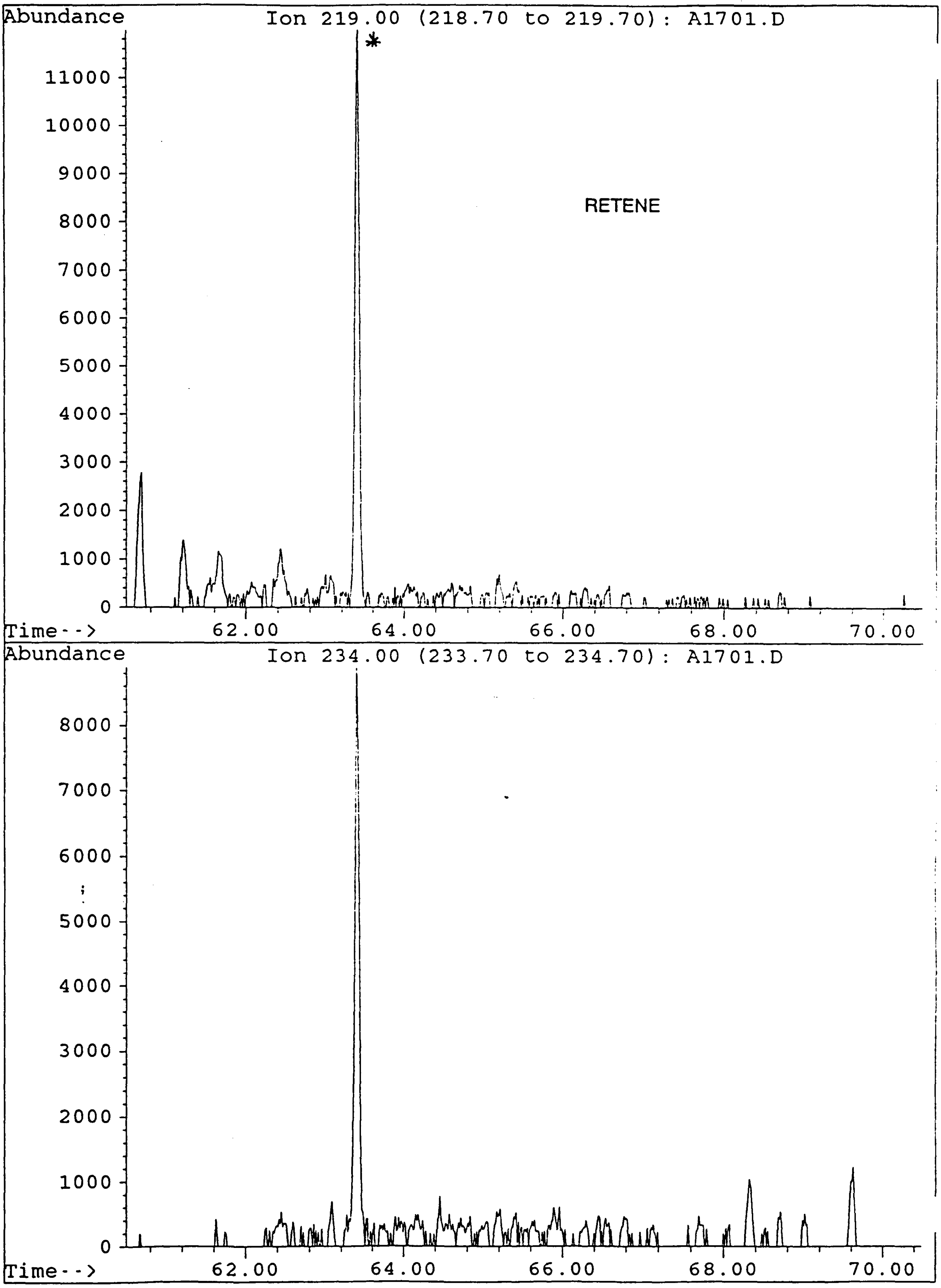
File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



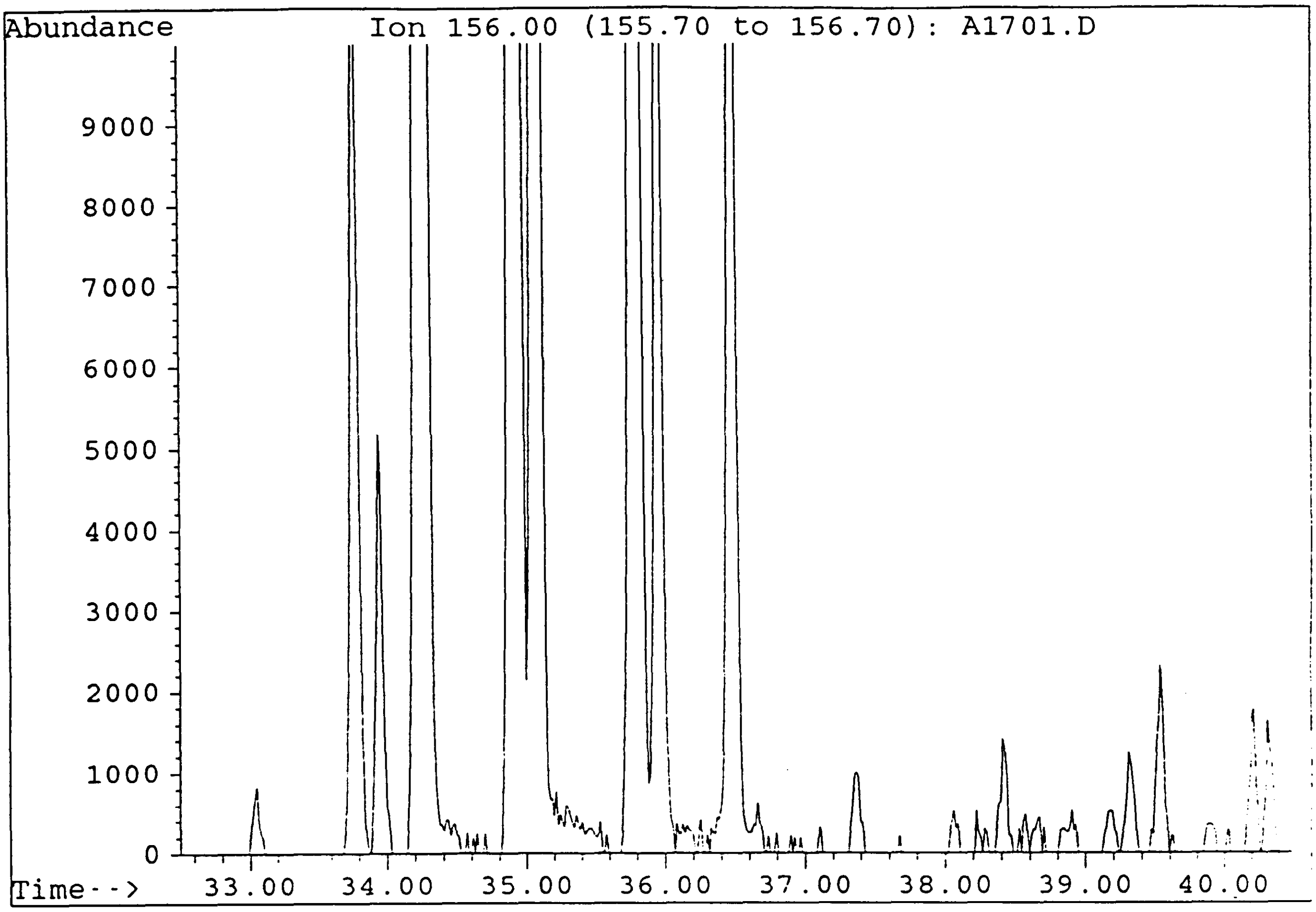
File :   A1701.D
Sample :   LA BELLA#1, 2097.70m, ARO.
Misc. Info :   COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



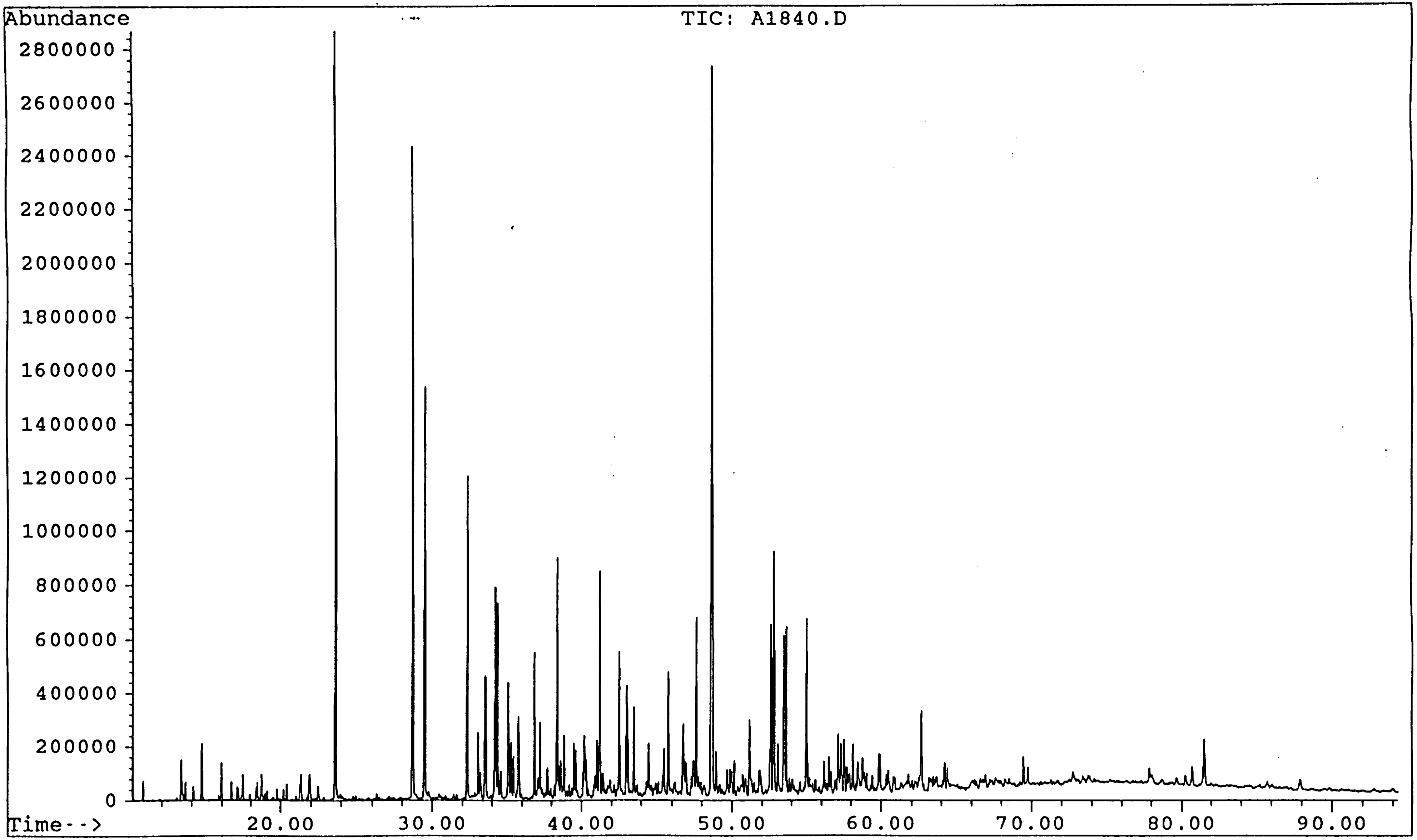
File : A1701.D
Sample : LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



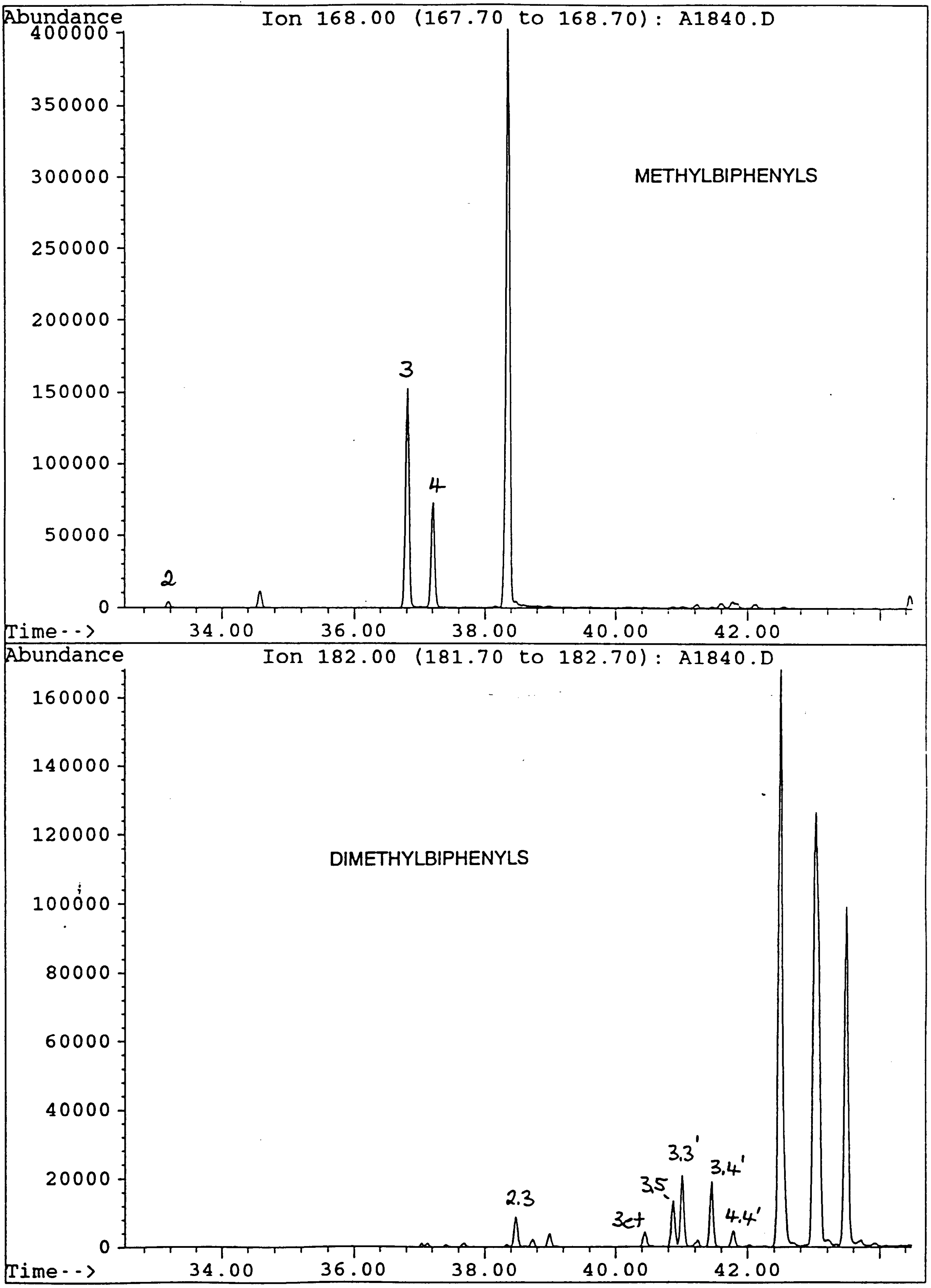
File :   A1701.D
Sample :   LA BELLA#1, 2097.70m, ARO.
Misc. Info : COL#155. [1000/20] 1/1600uL. 2-11-93. GEC.



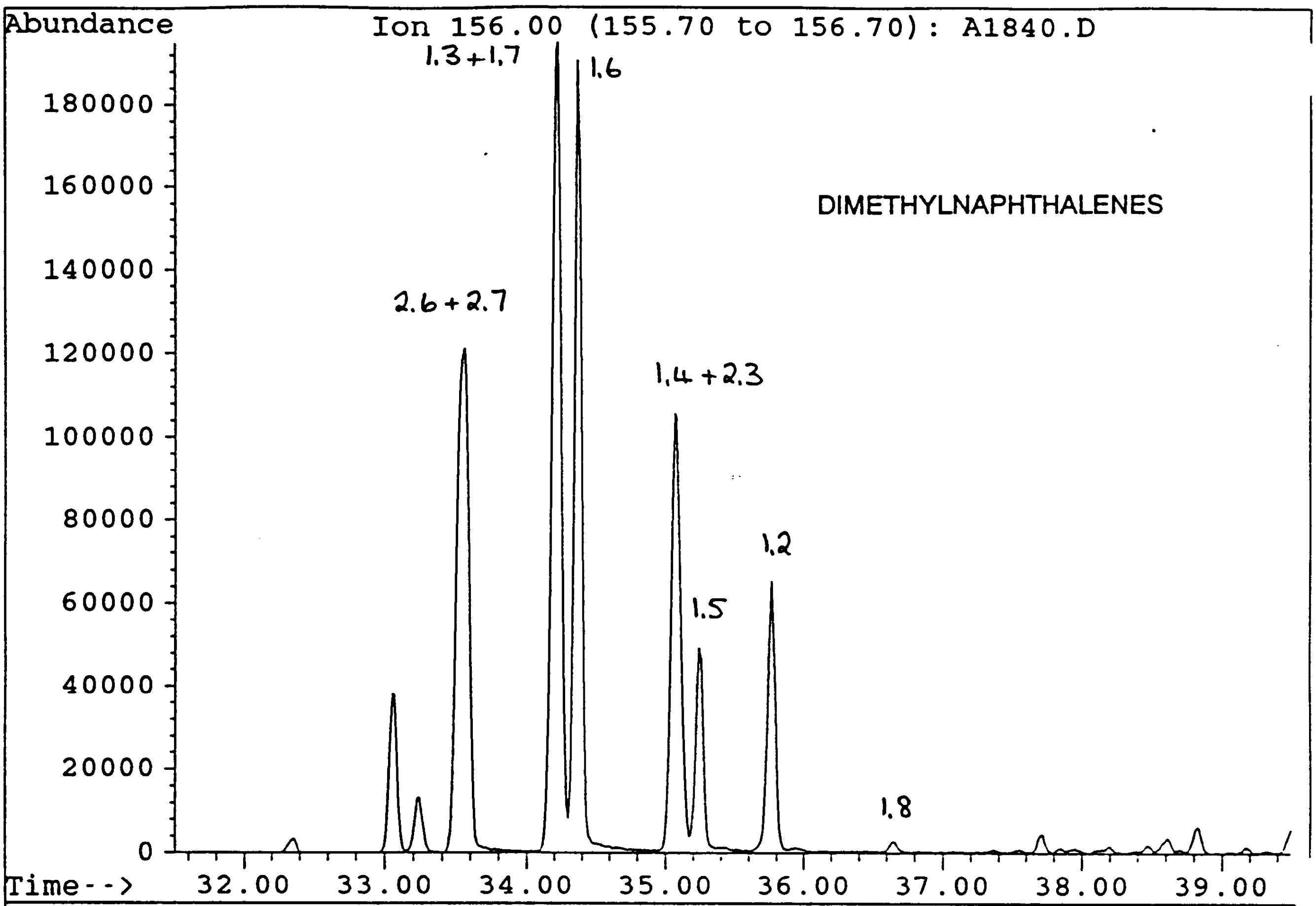
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.

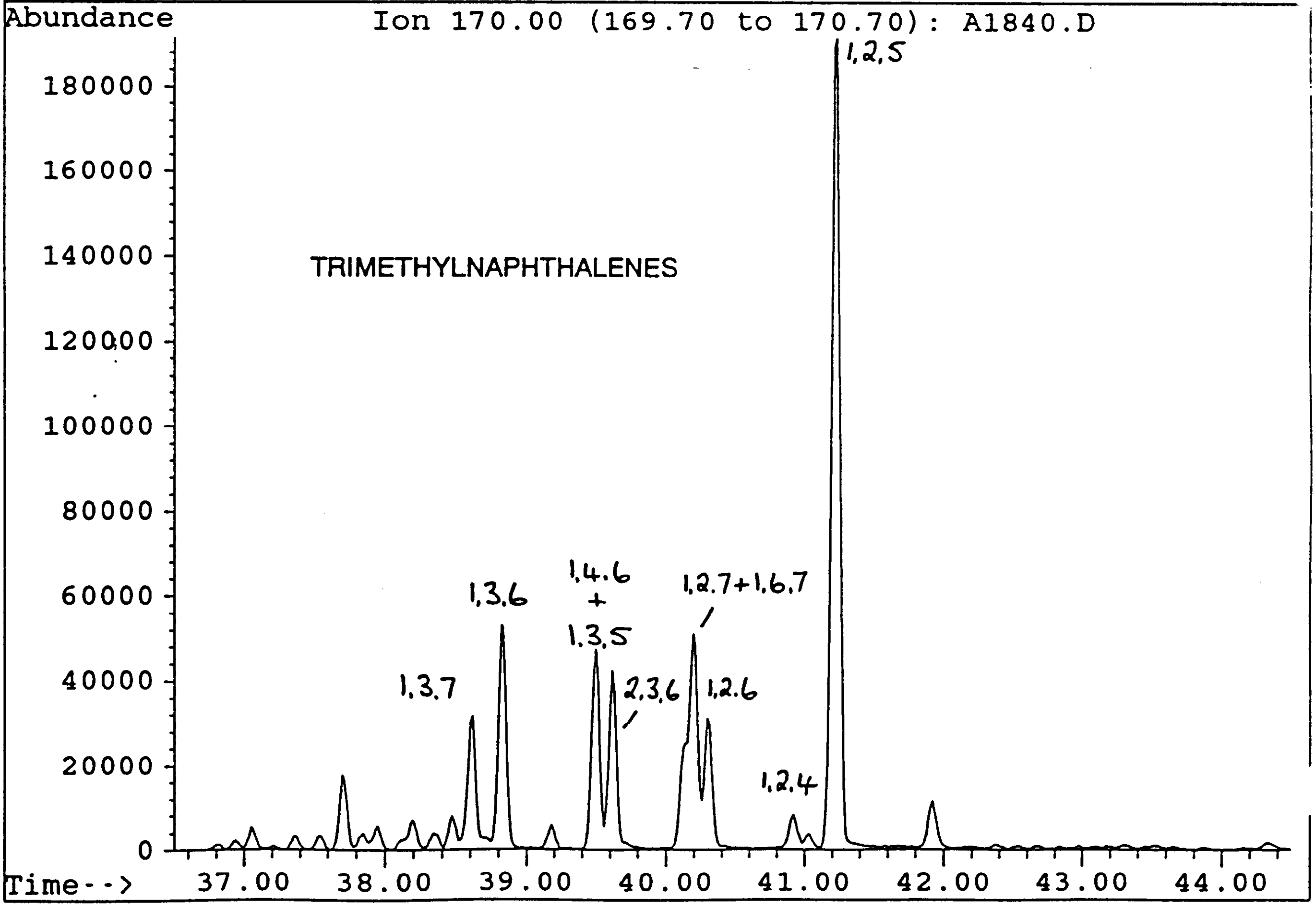


File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



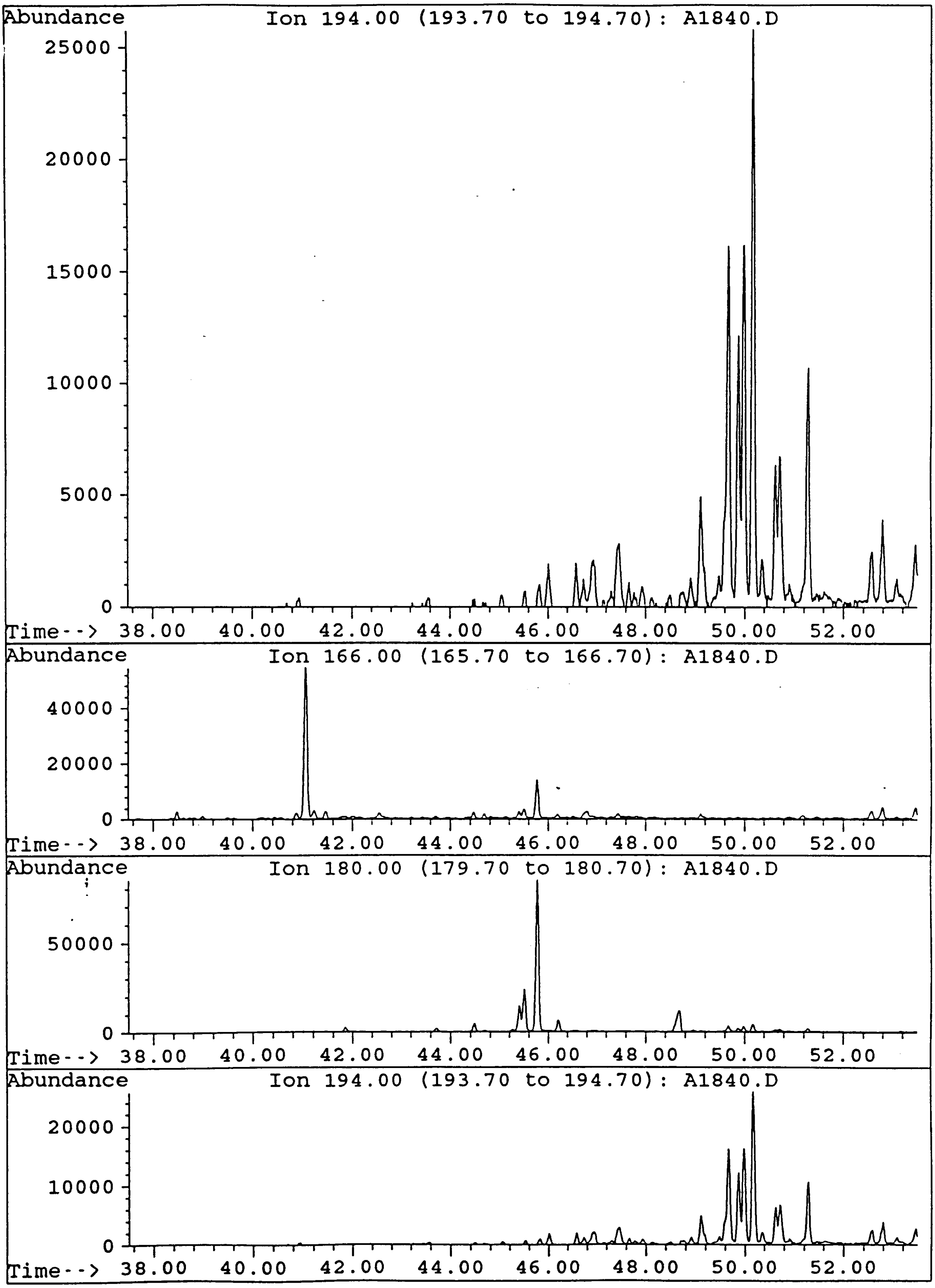
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



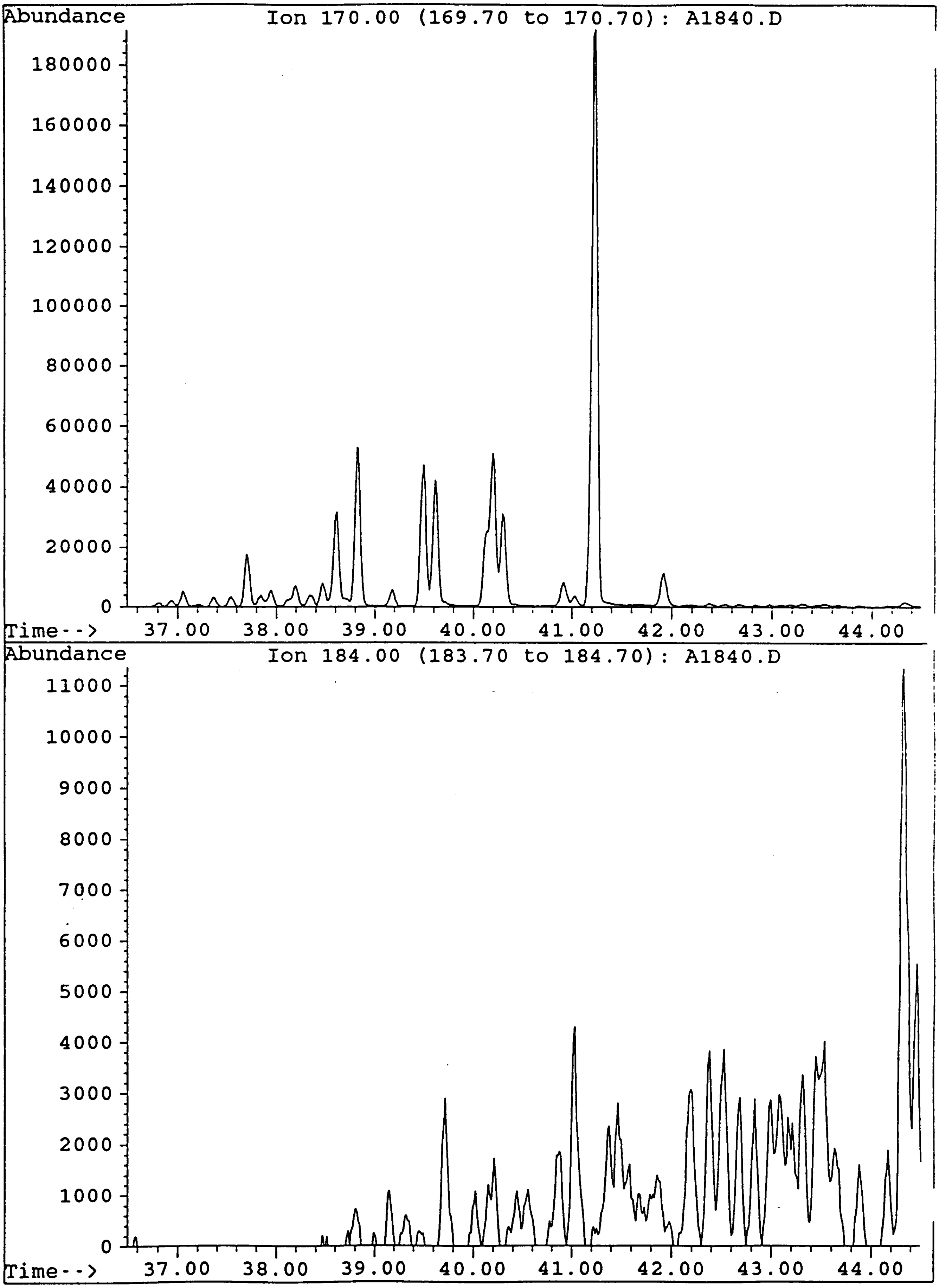


File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.

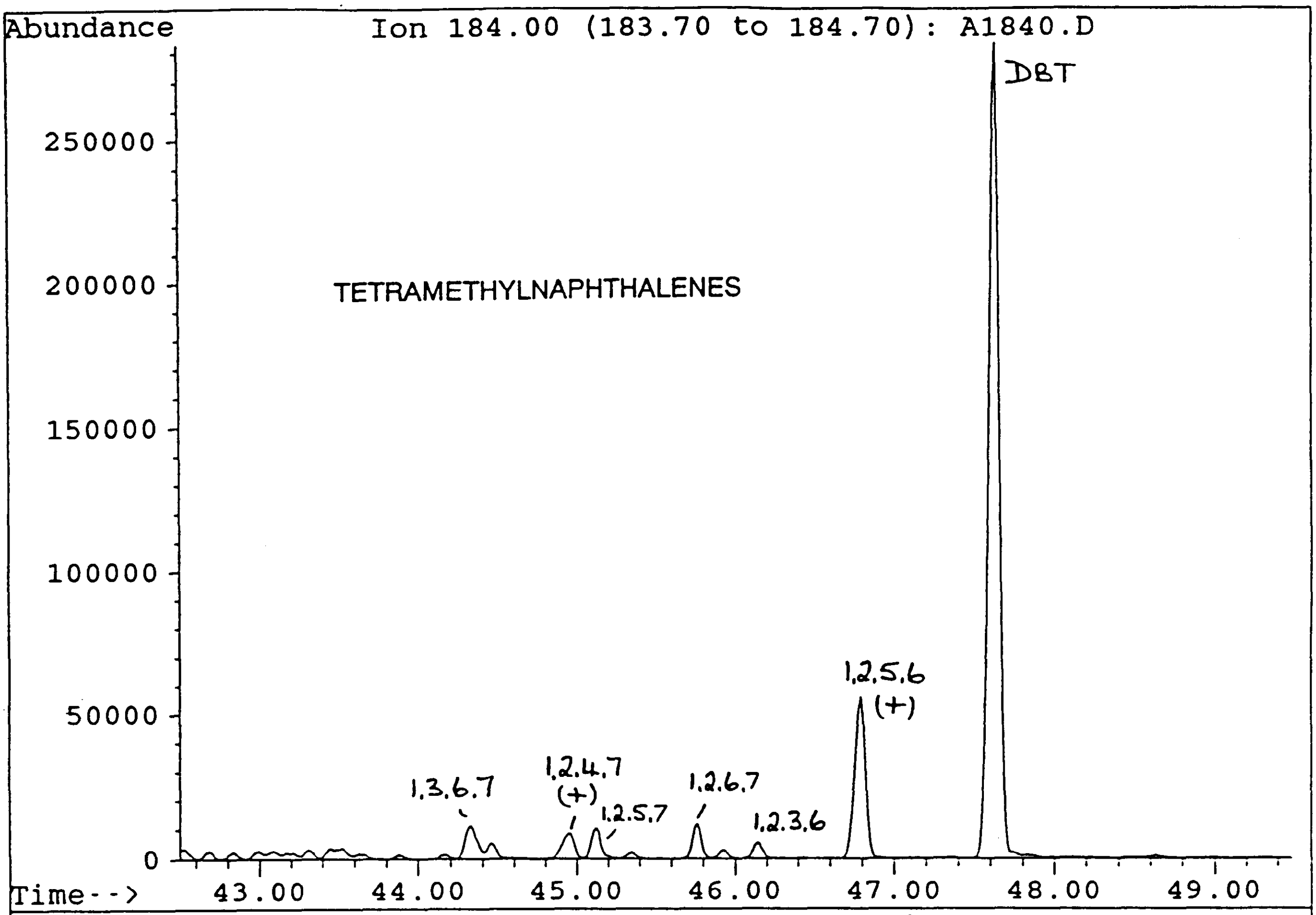
FLUORENES

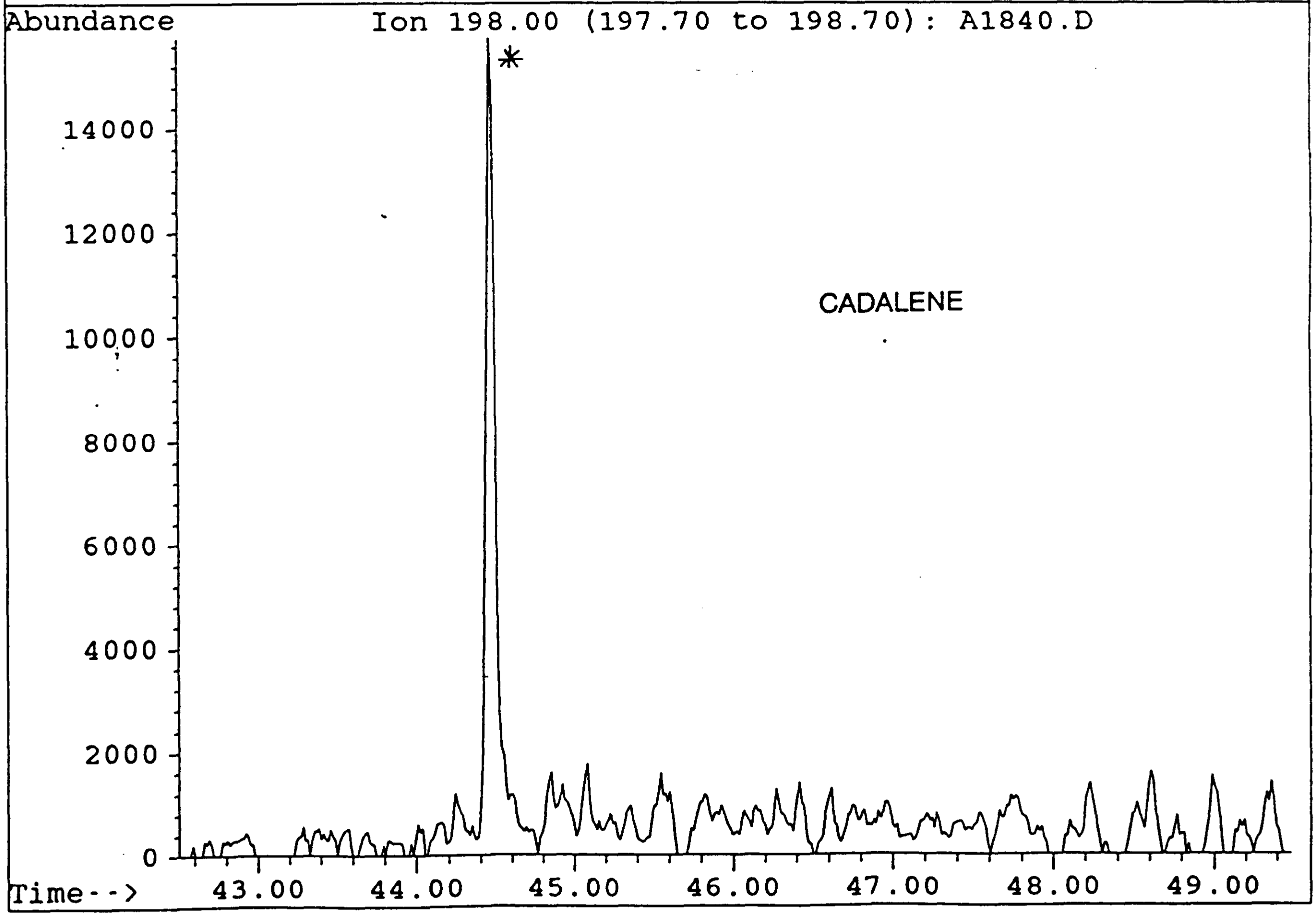


File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.

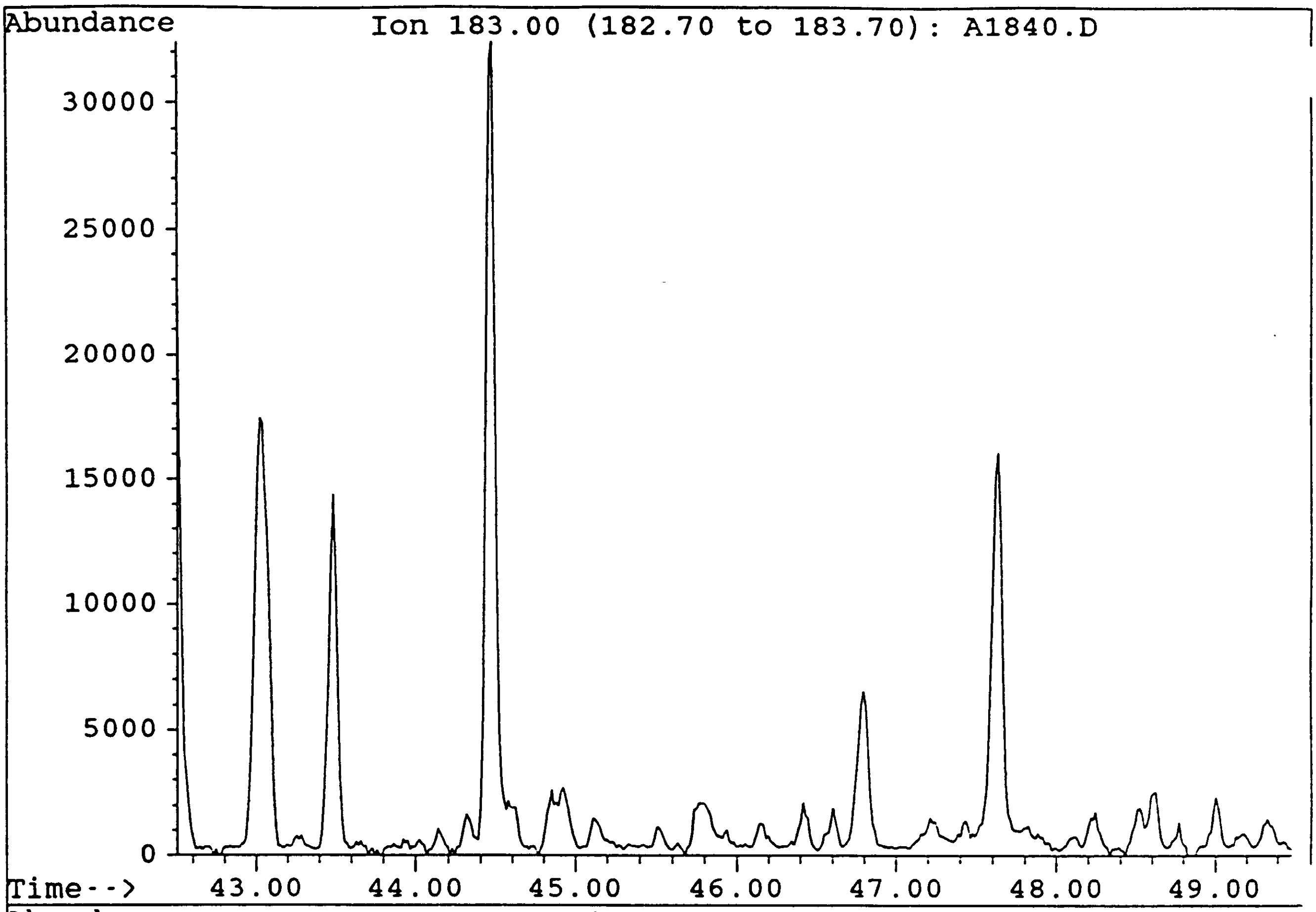


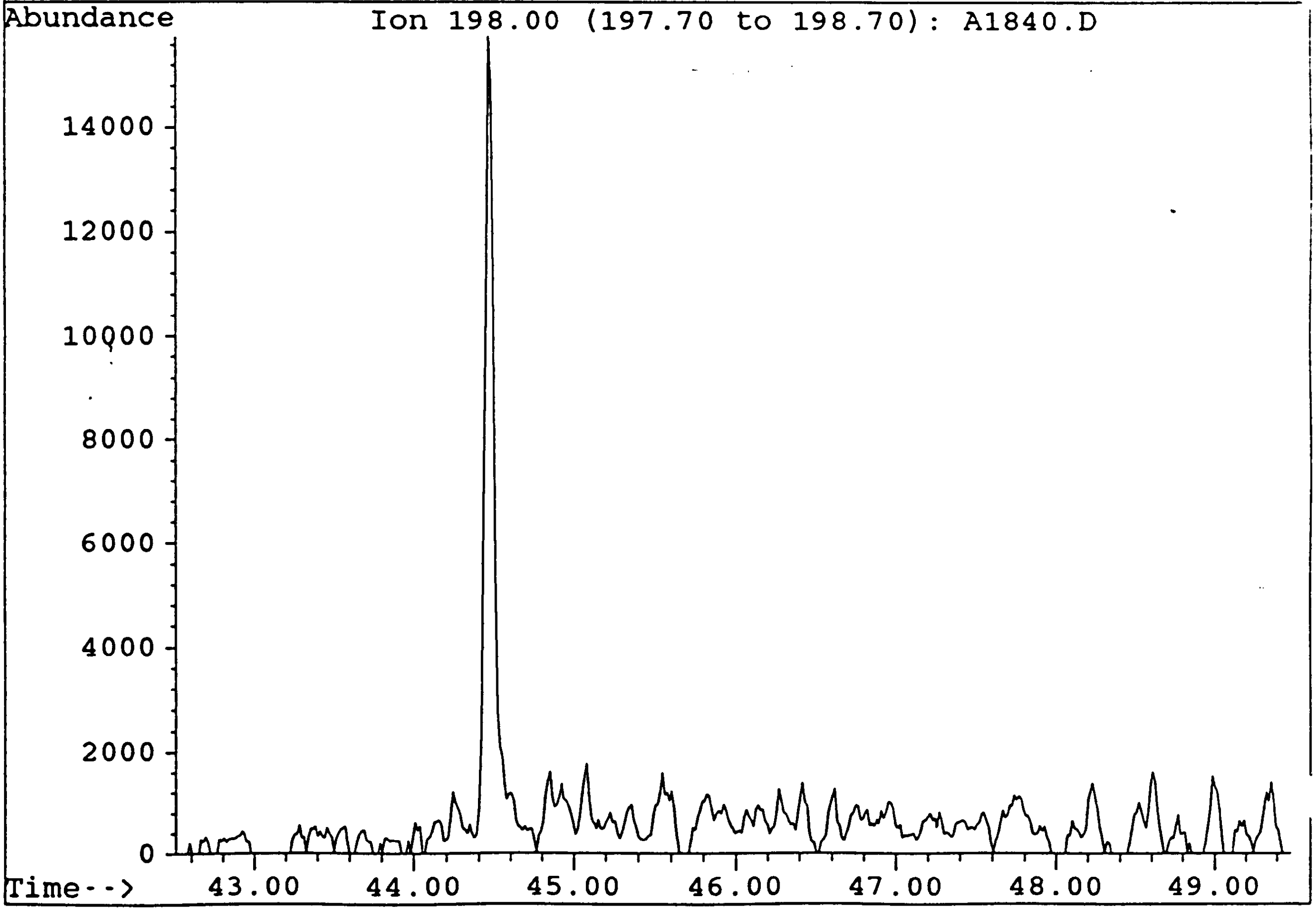
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



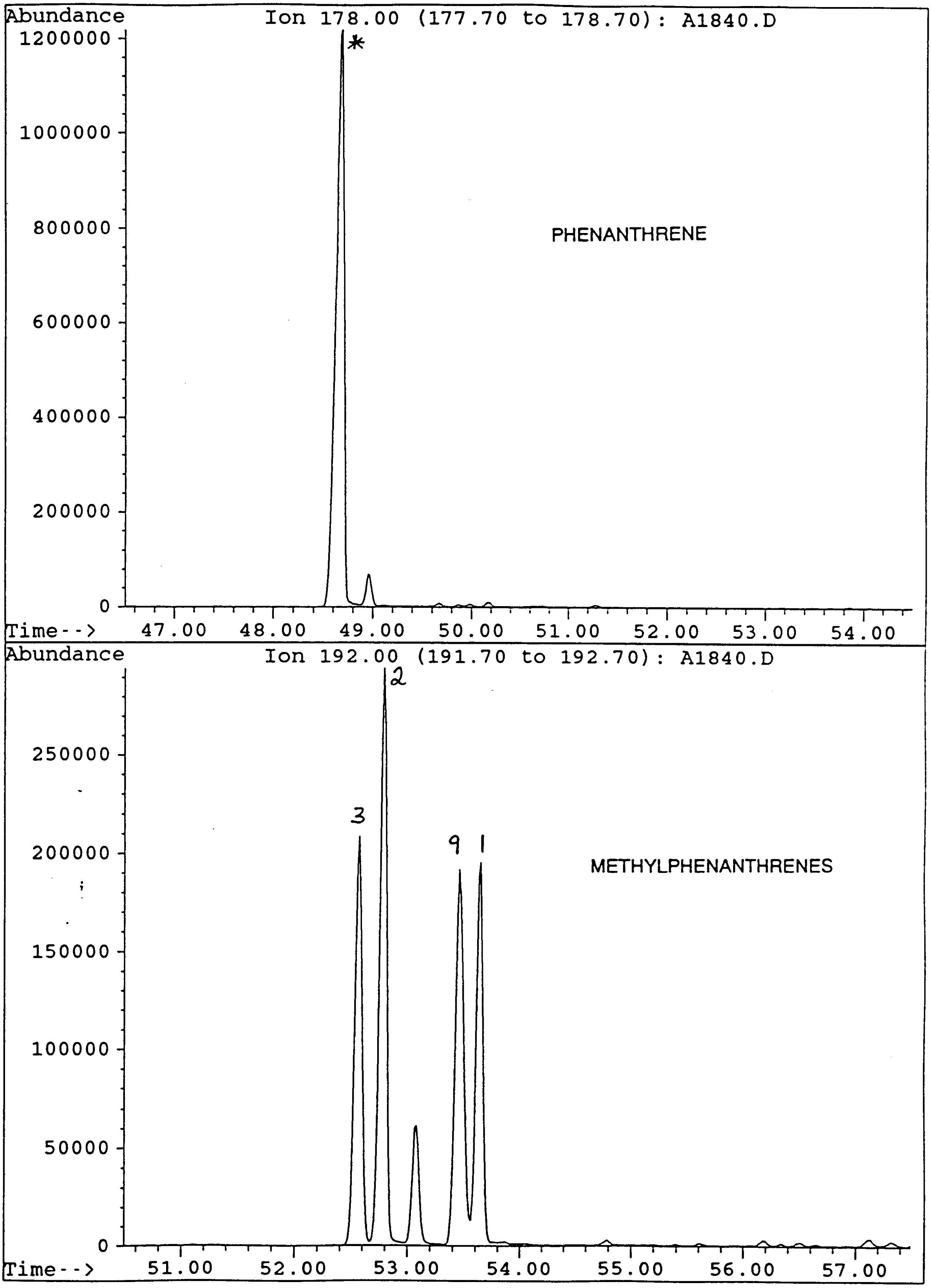


File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.

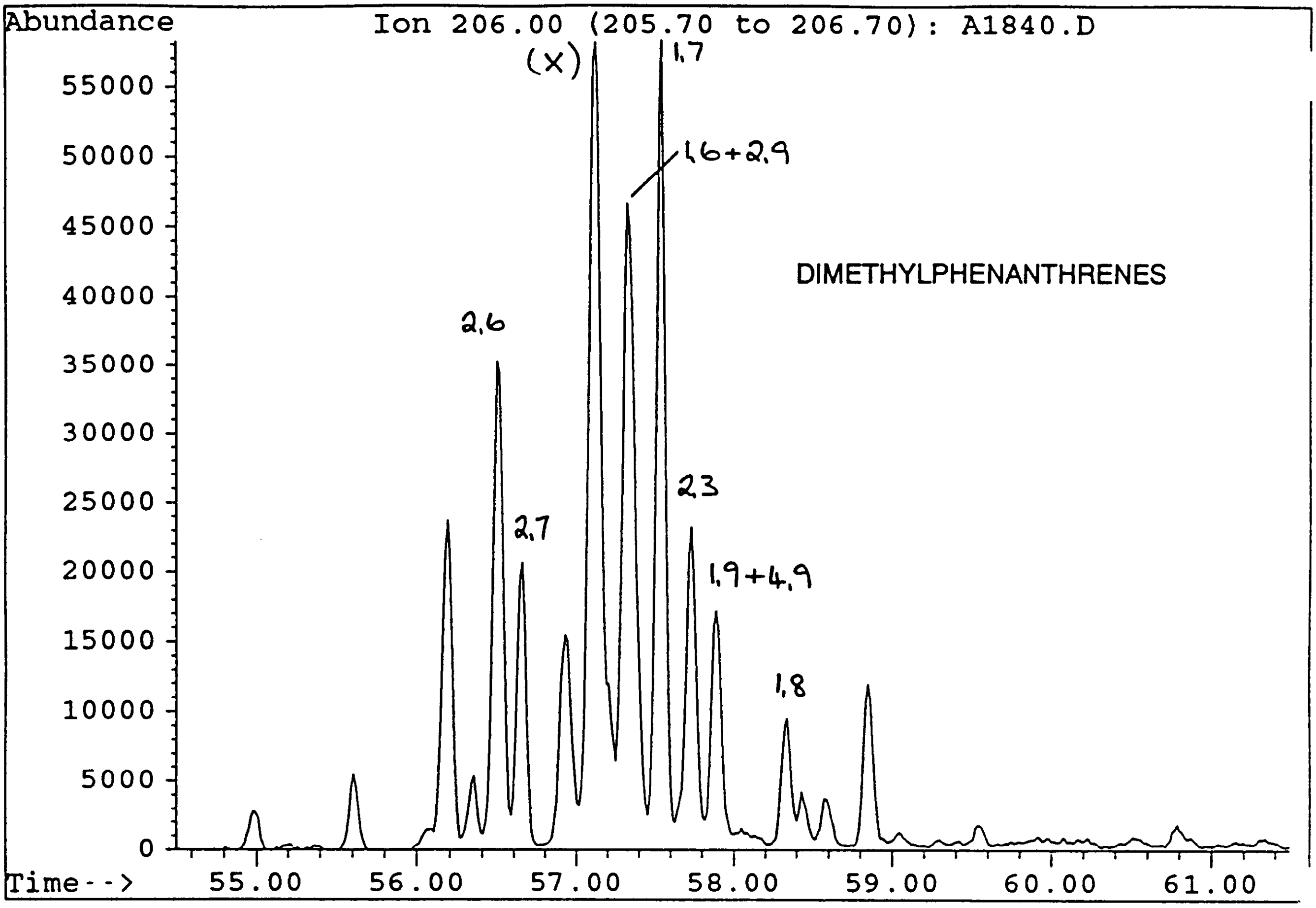




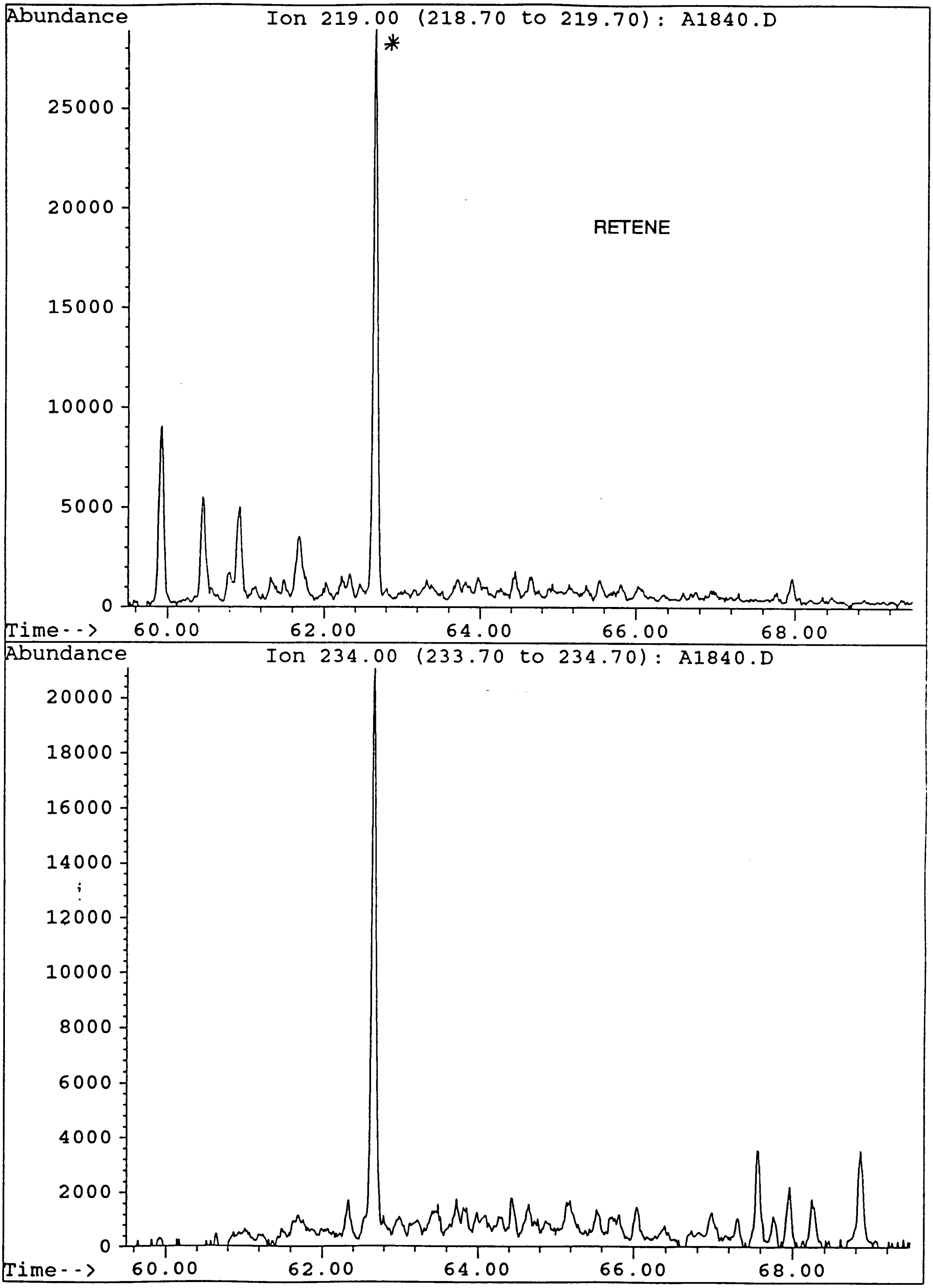
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



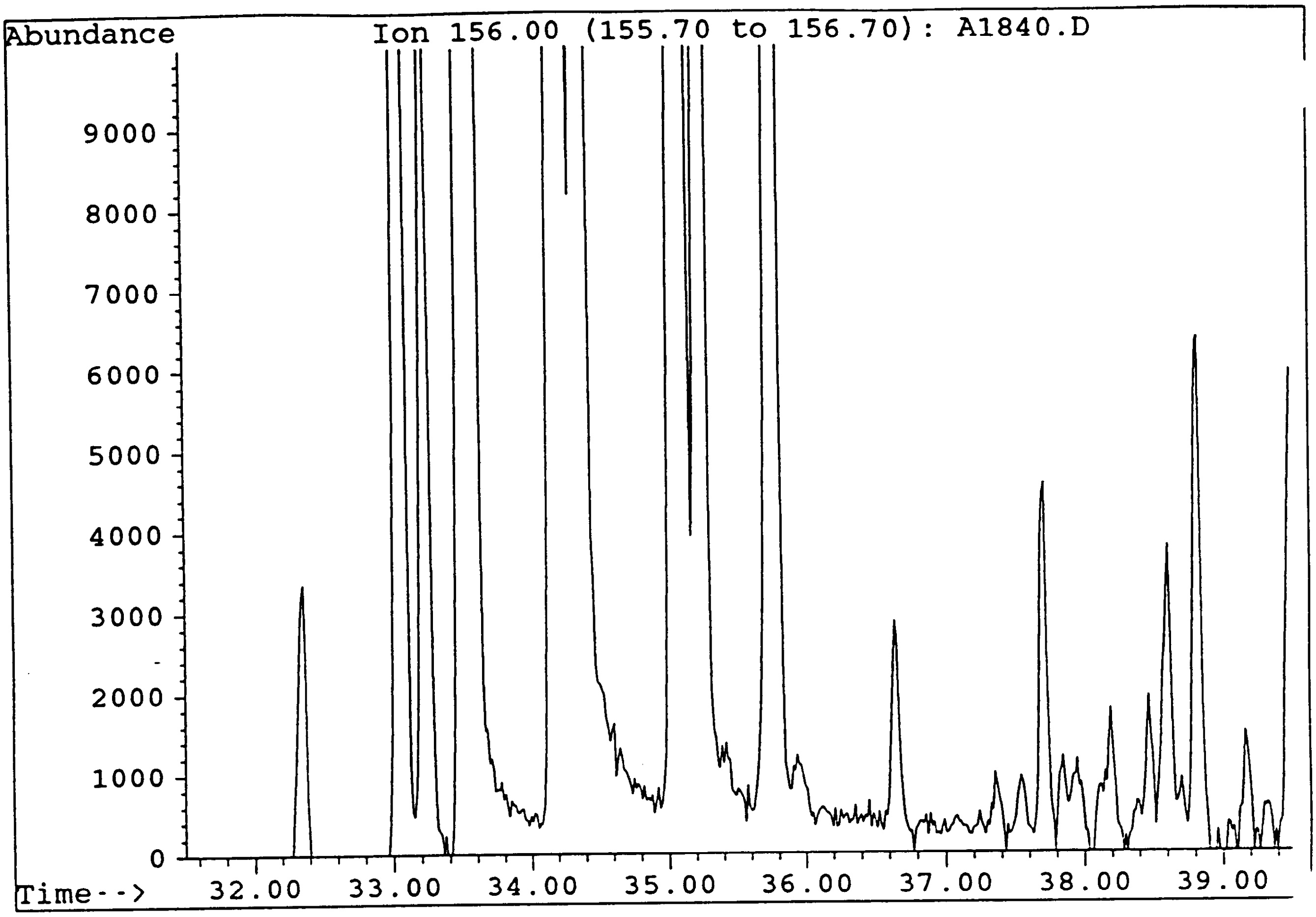
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



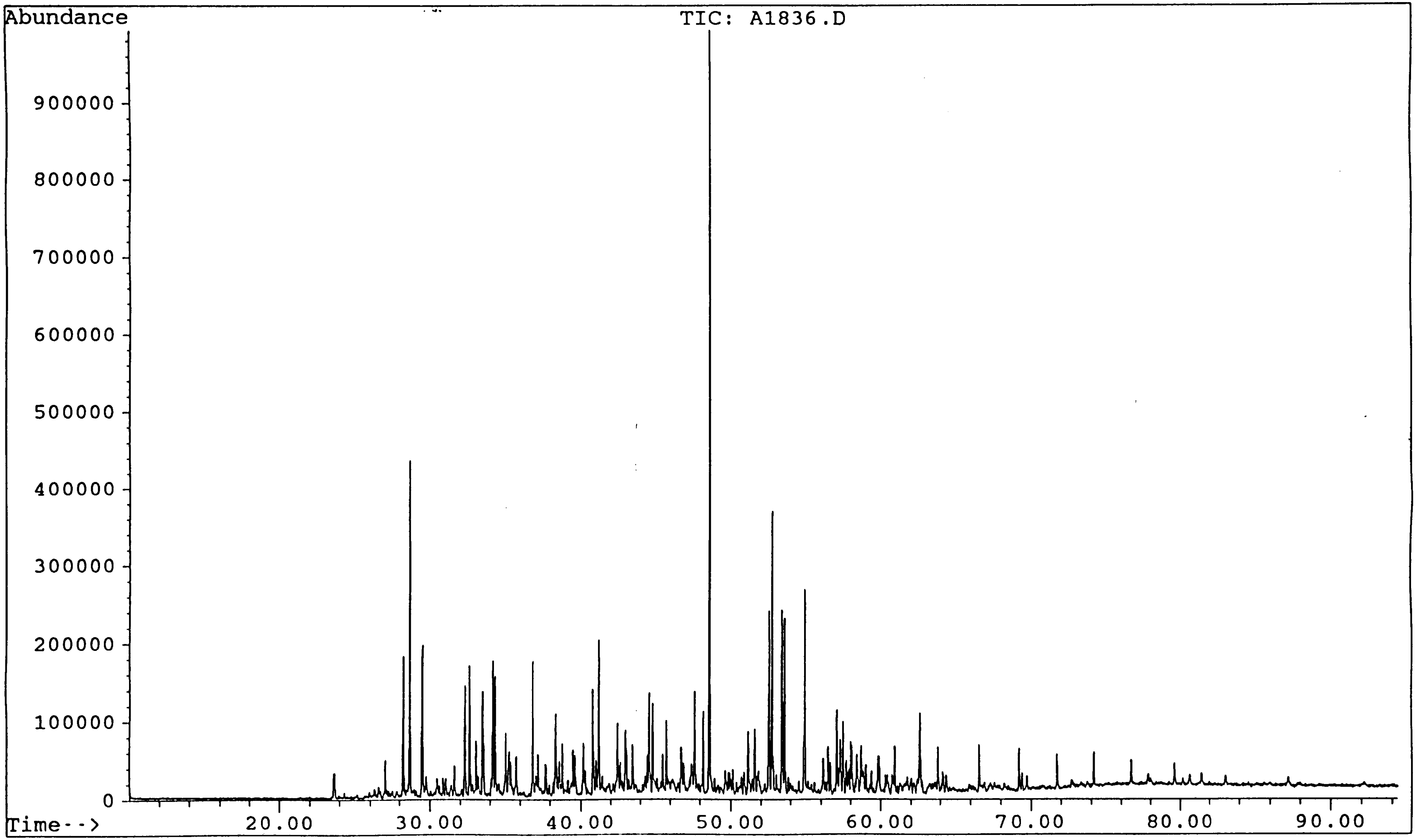
File :   A1840.D
Sample :   LA BELLA#1, 2100-2110m, AROS
Misc. Info :   COL #155, [1000/10] 1/400uL, 26-11-93. SF.



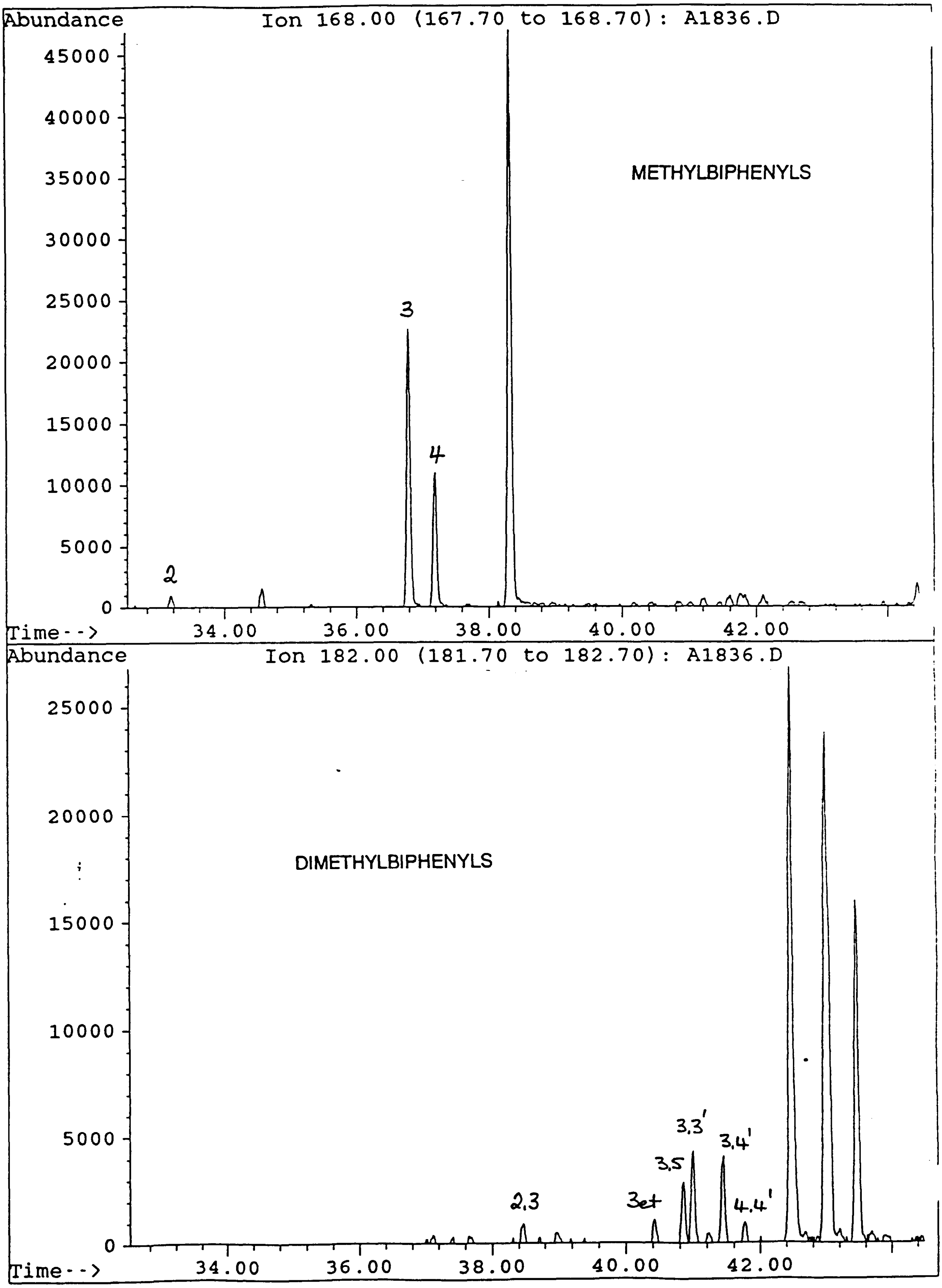
File : A1840.D
Sample : LA BELLA#1, 2100-2110m, AROS
Misc. Info : COL #155, [1000/10] 1/400uL, 26-11-93. SF.



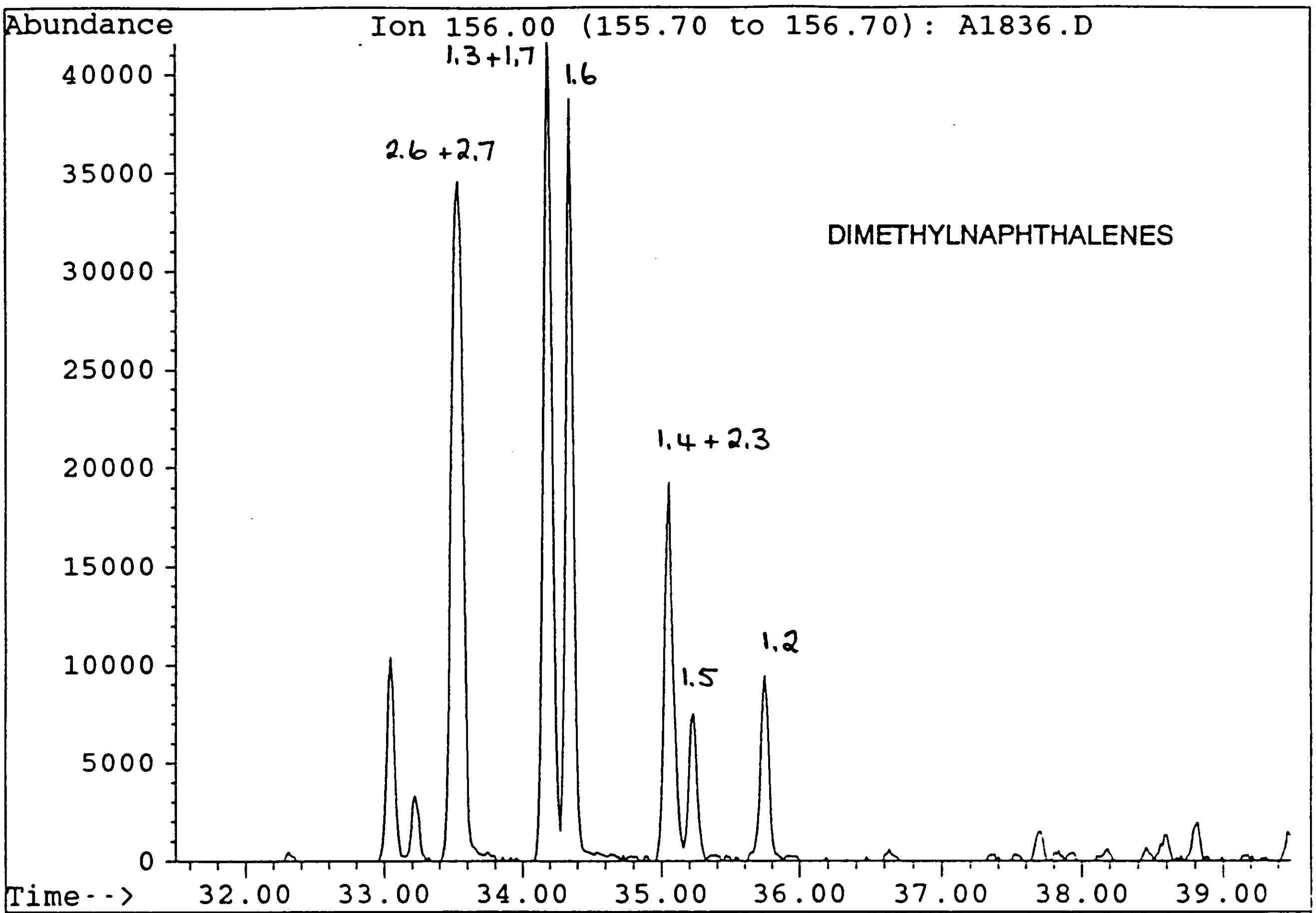
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.

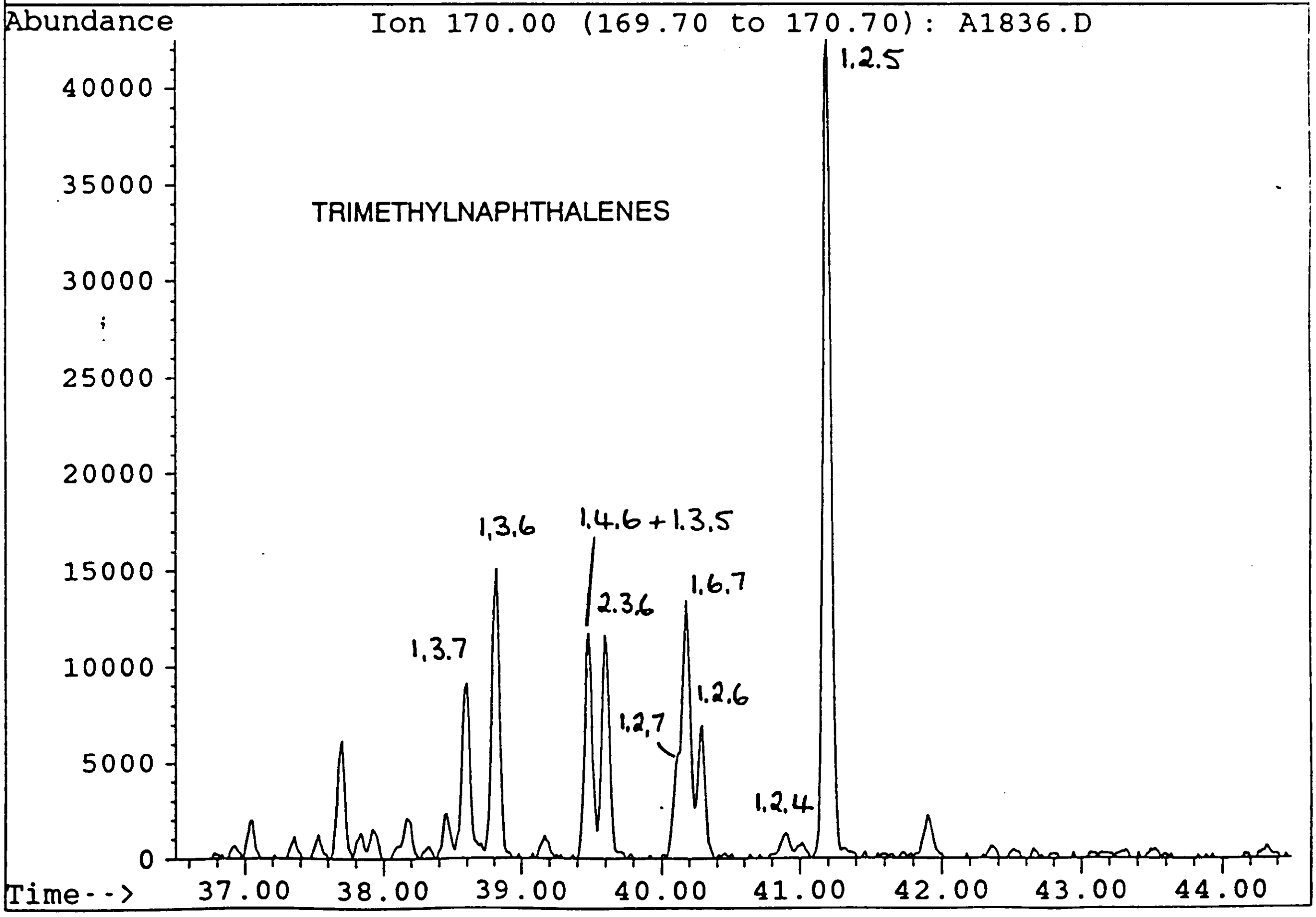


File :   A1836.D
Sample :   LA BELLA#1, 2121.0m, AROS
Misc. Info :   COL #155, 1/250uL, 26-11-93. SF.



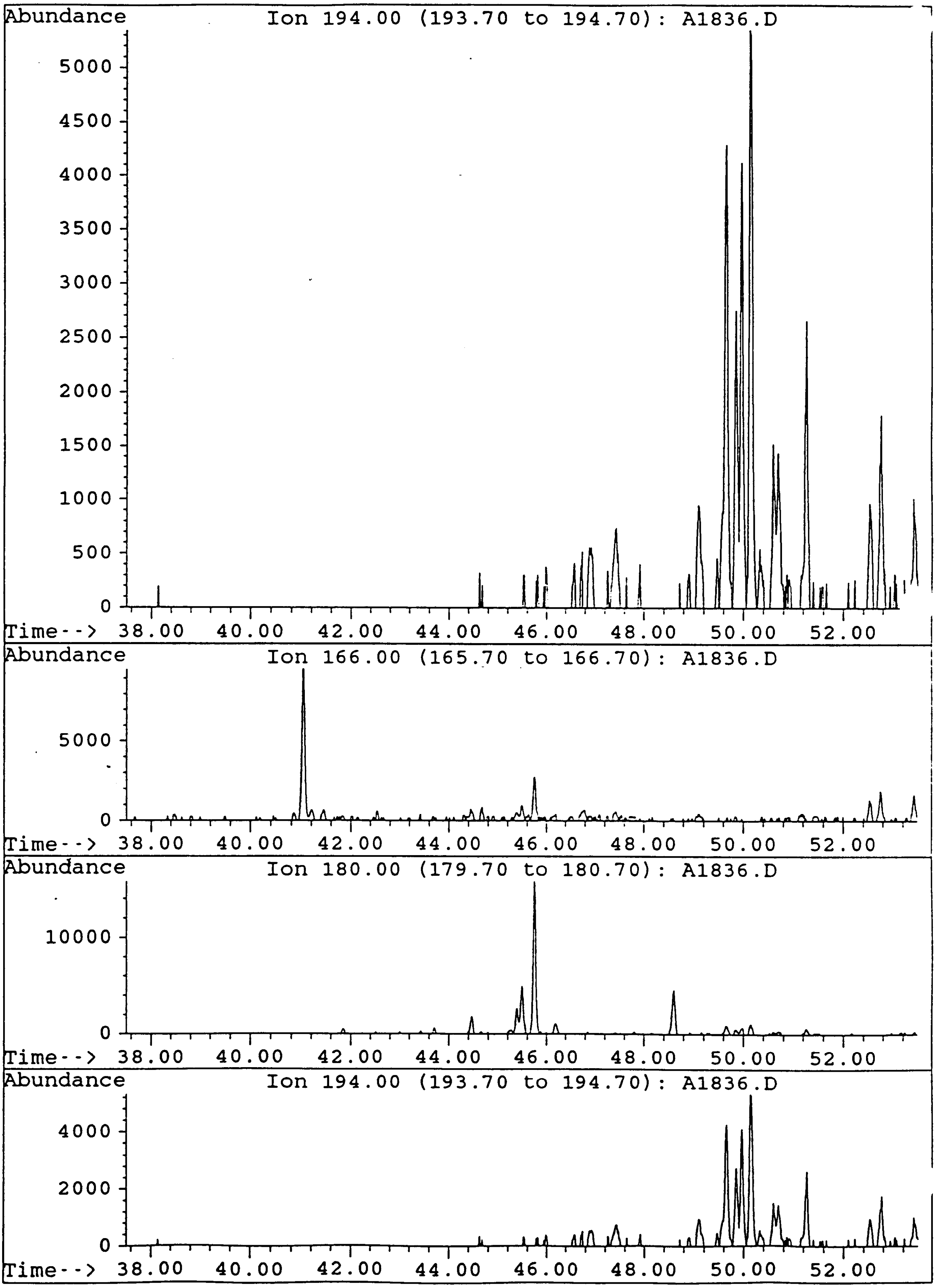
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.



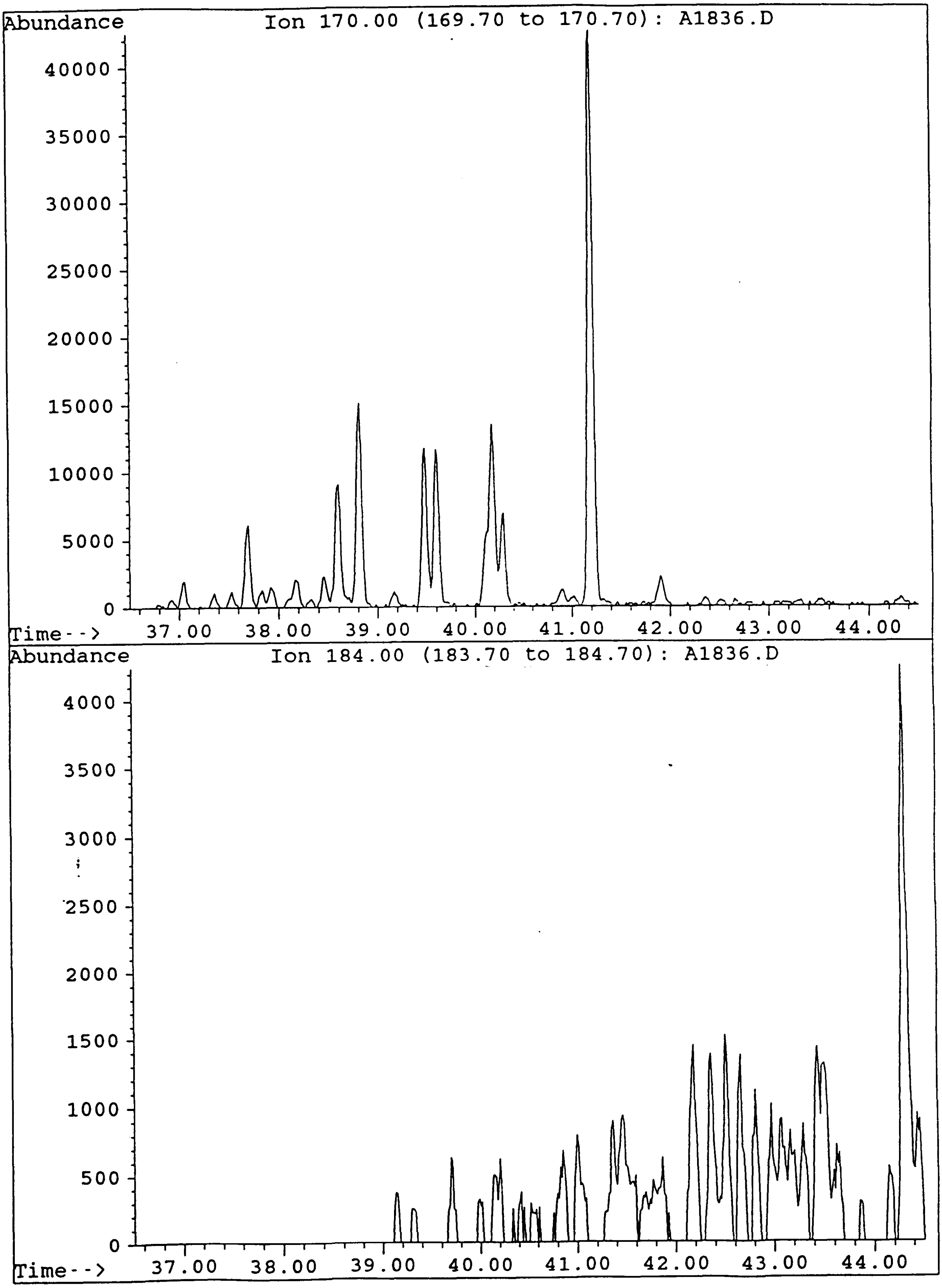


File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.

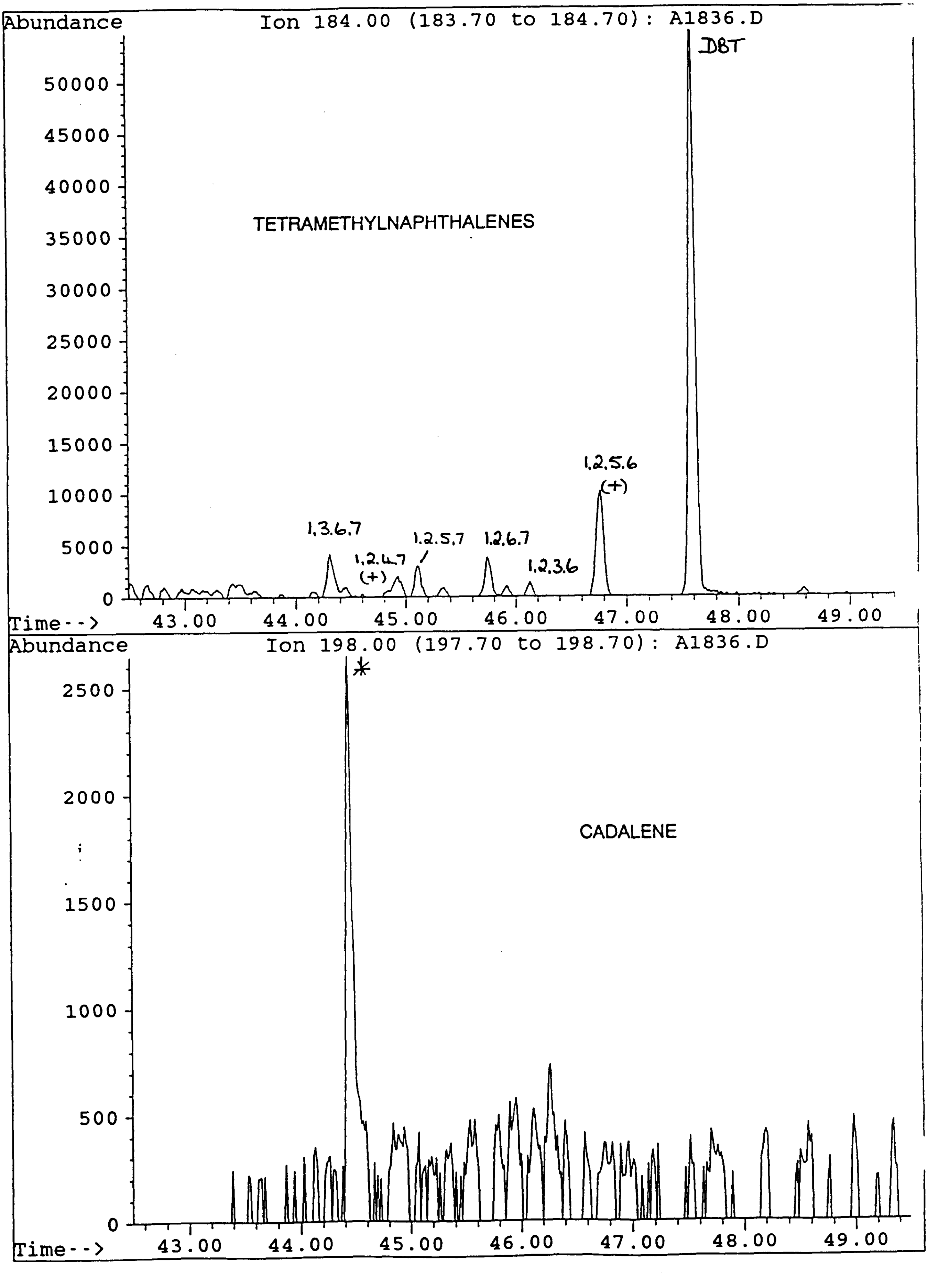
FLUORENES



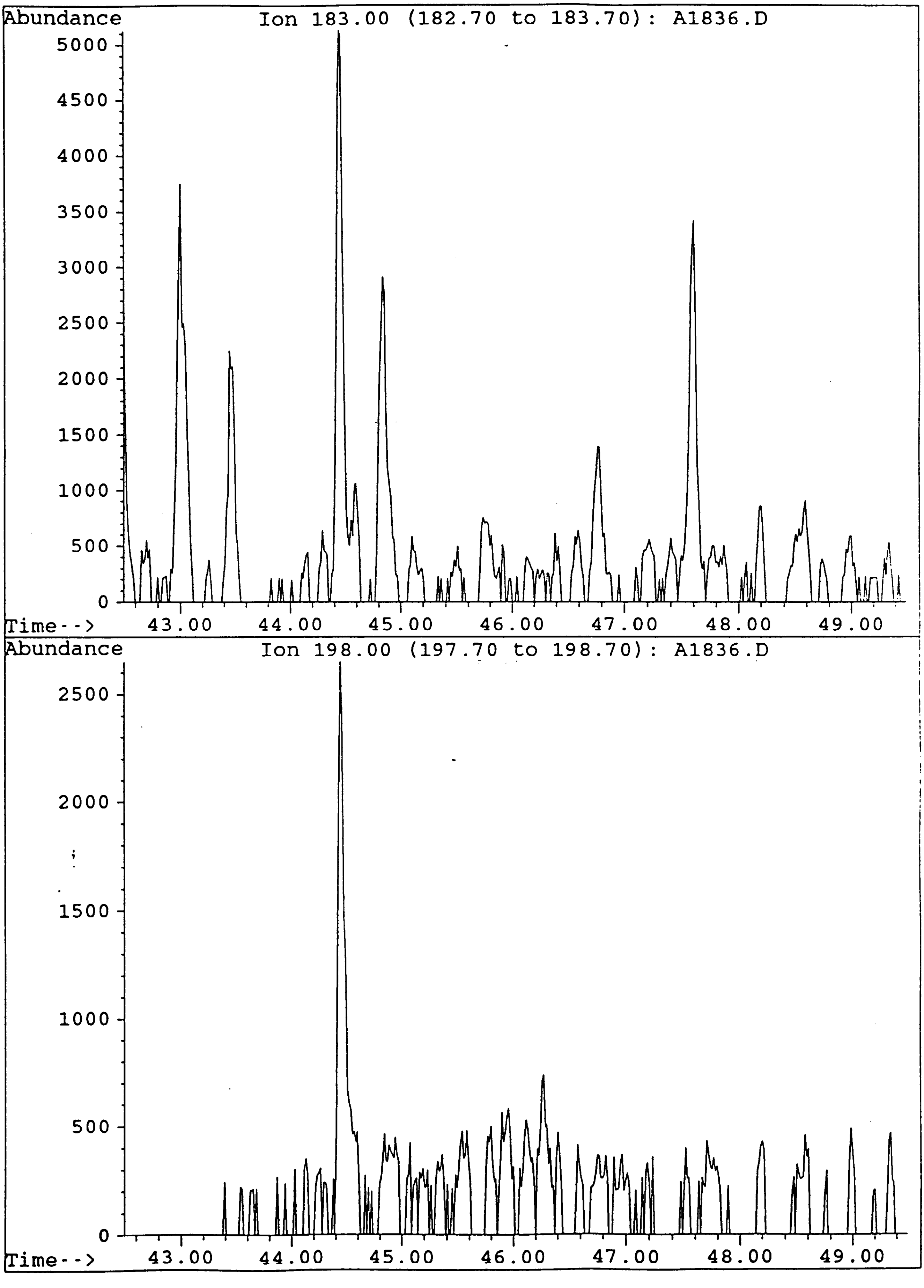
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.



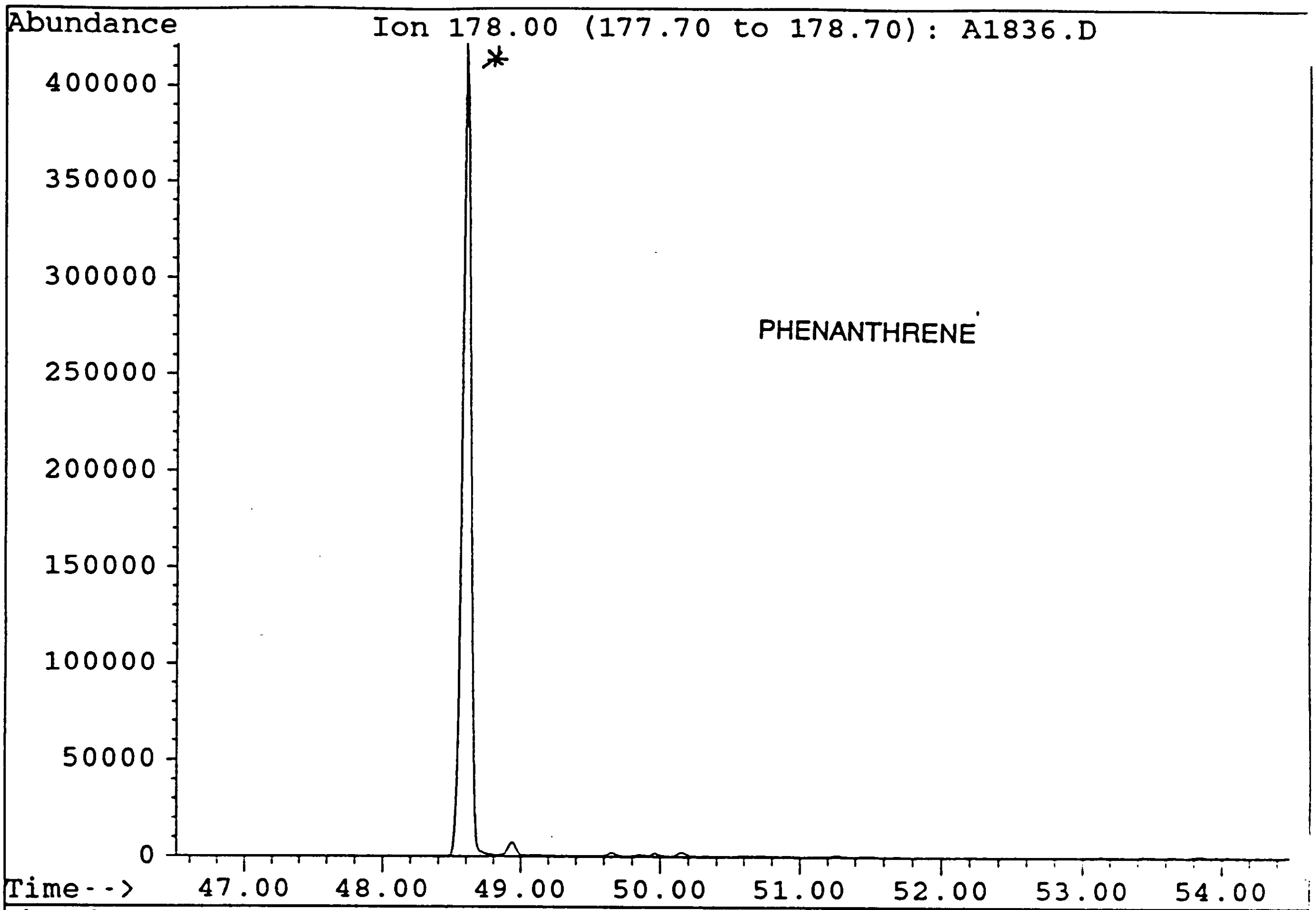
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.

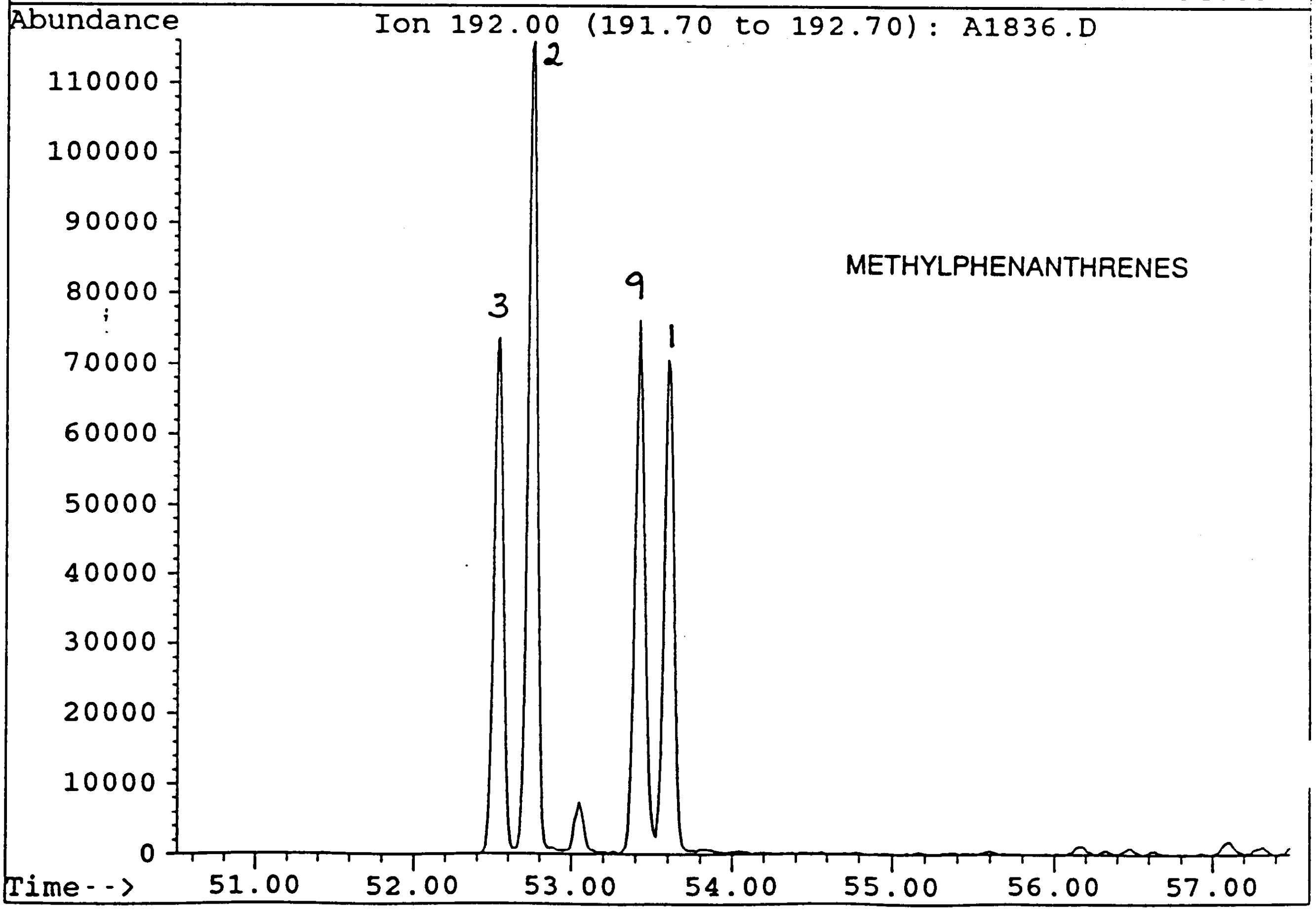


File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.

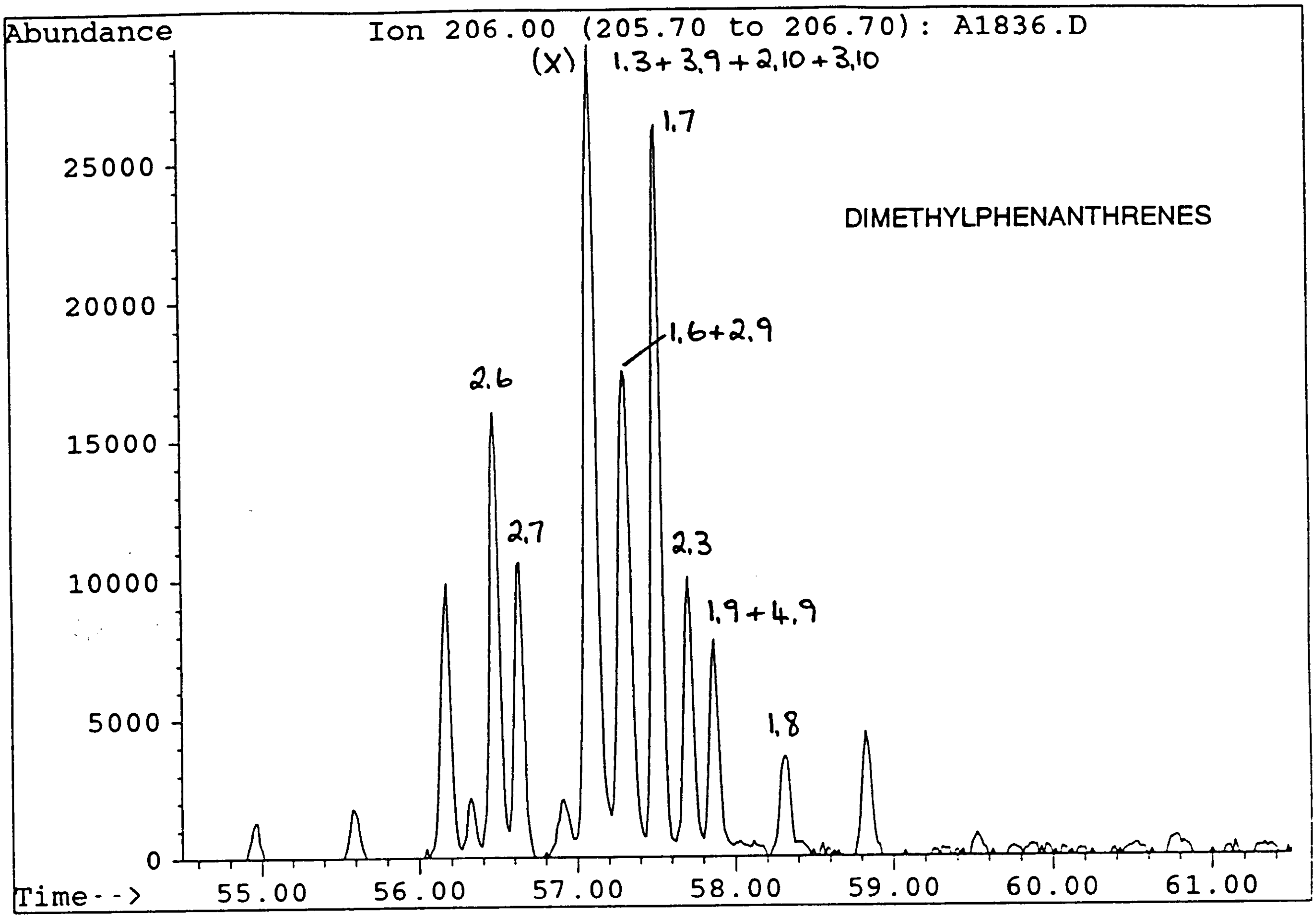


File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.

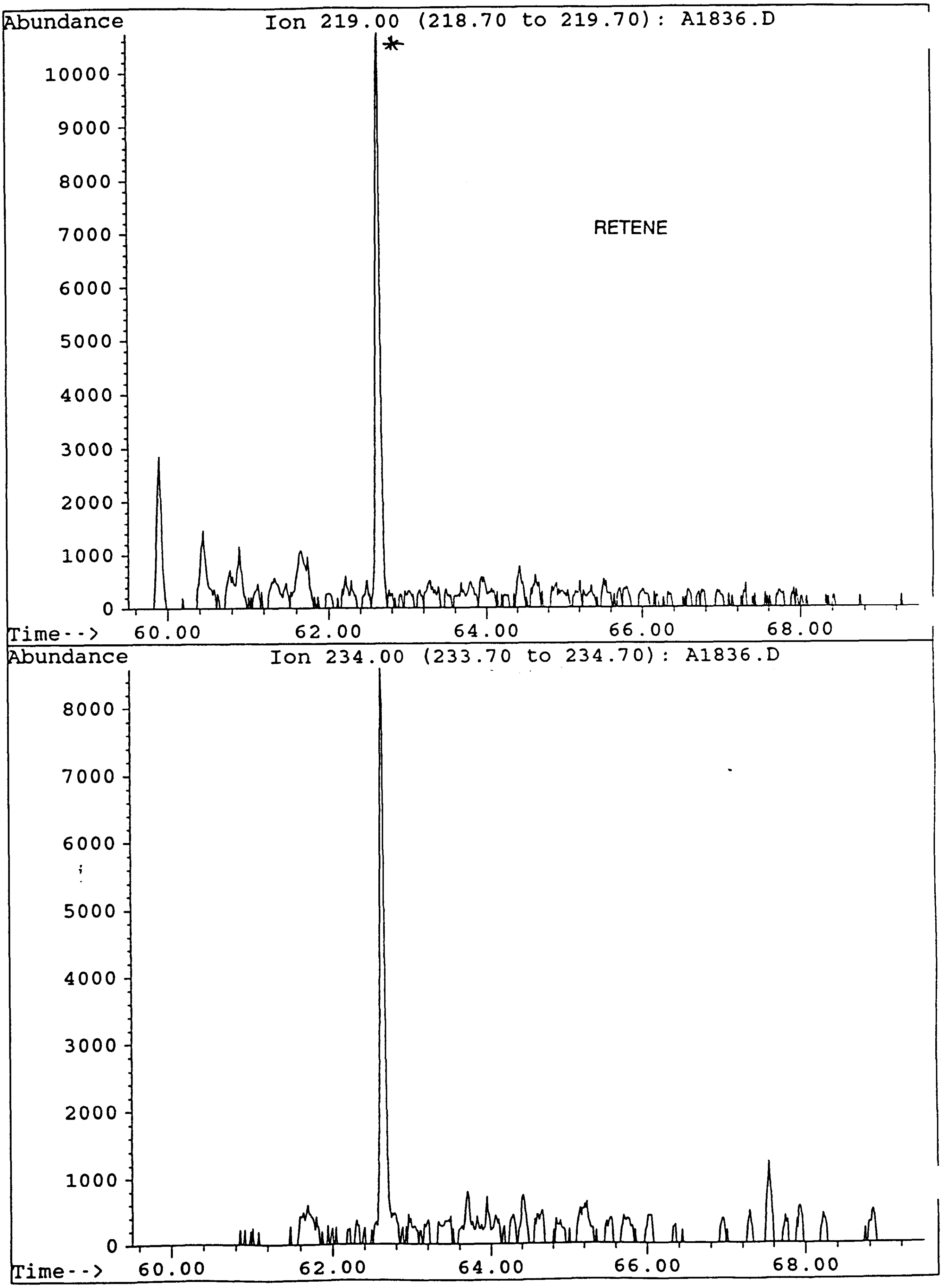




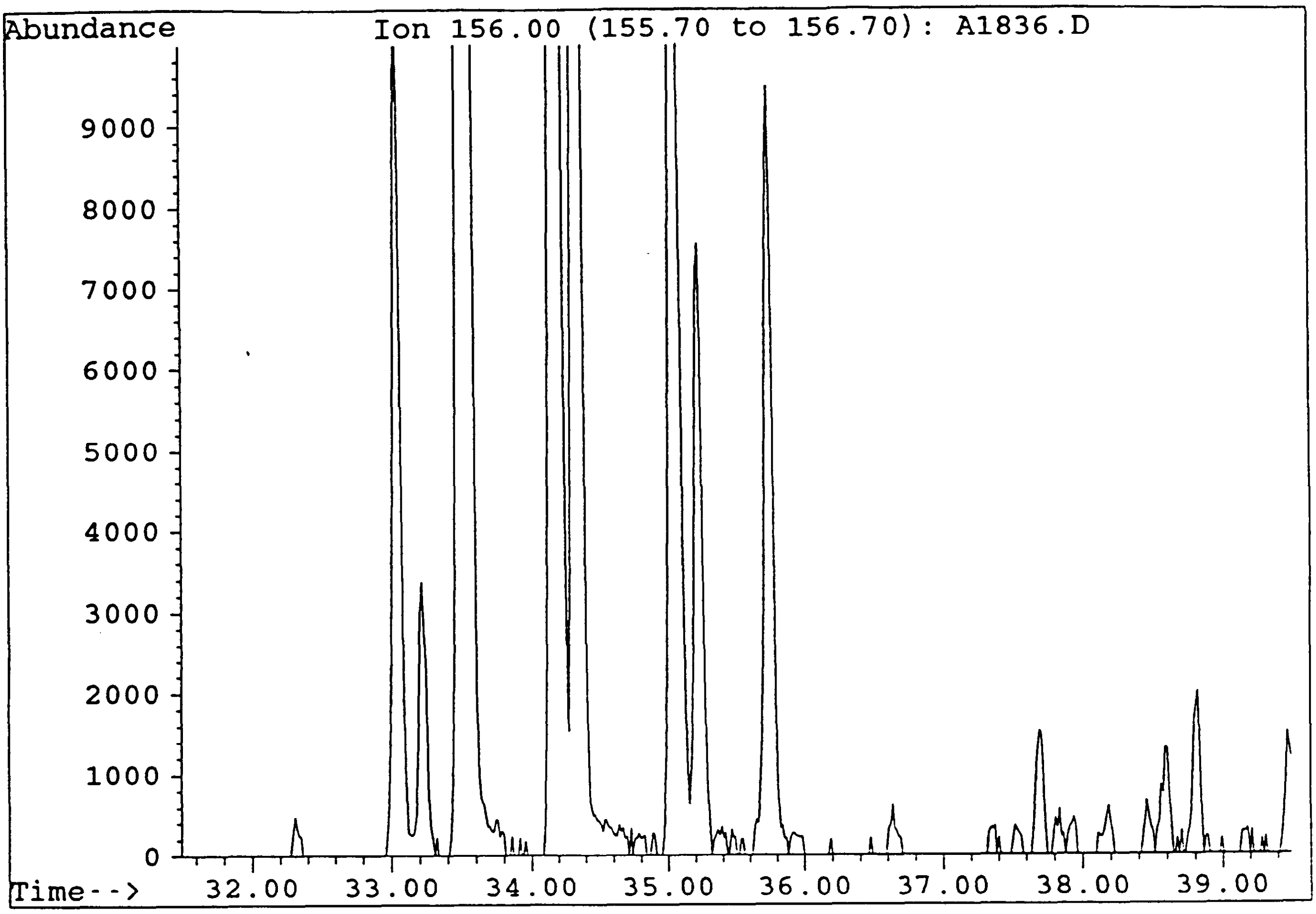
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.



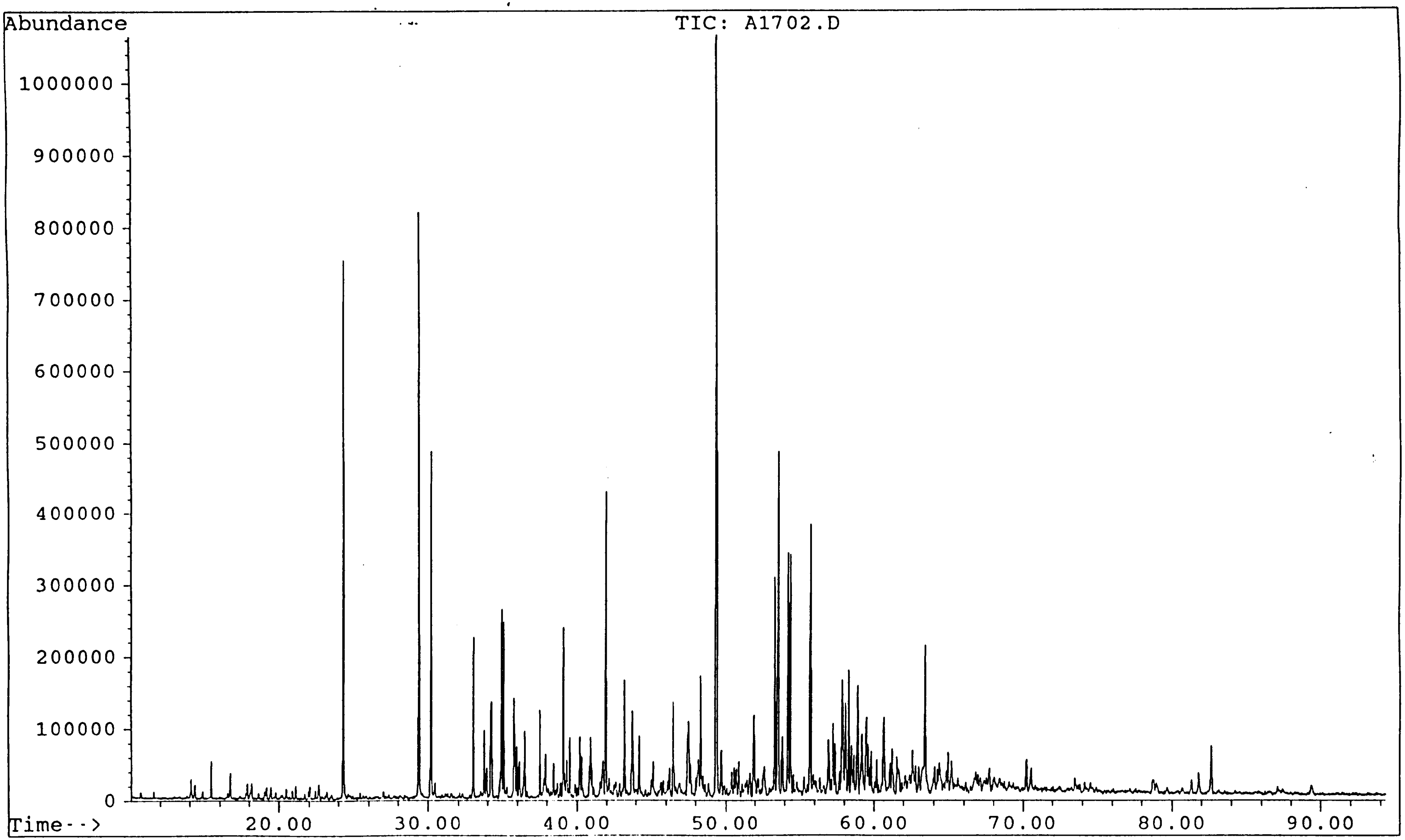
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.



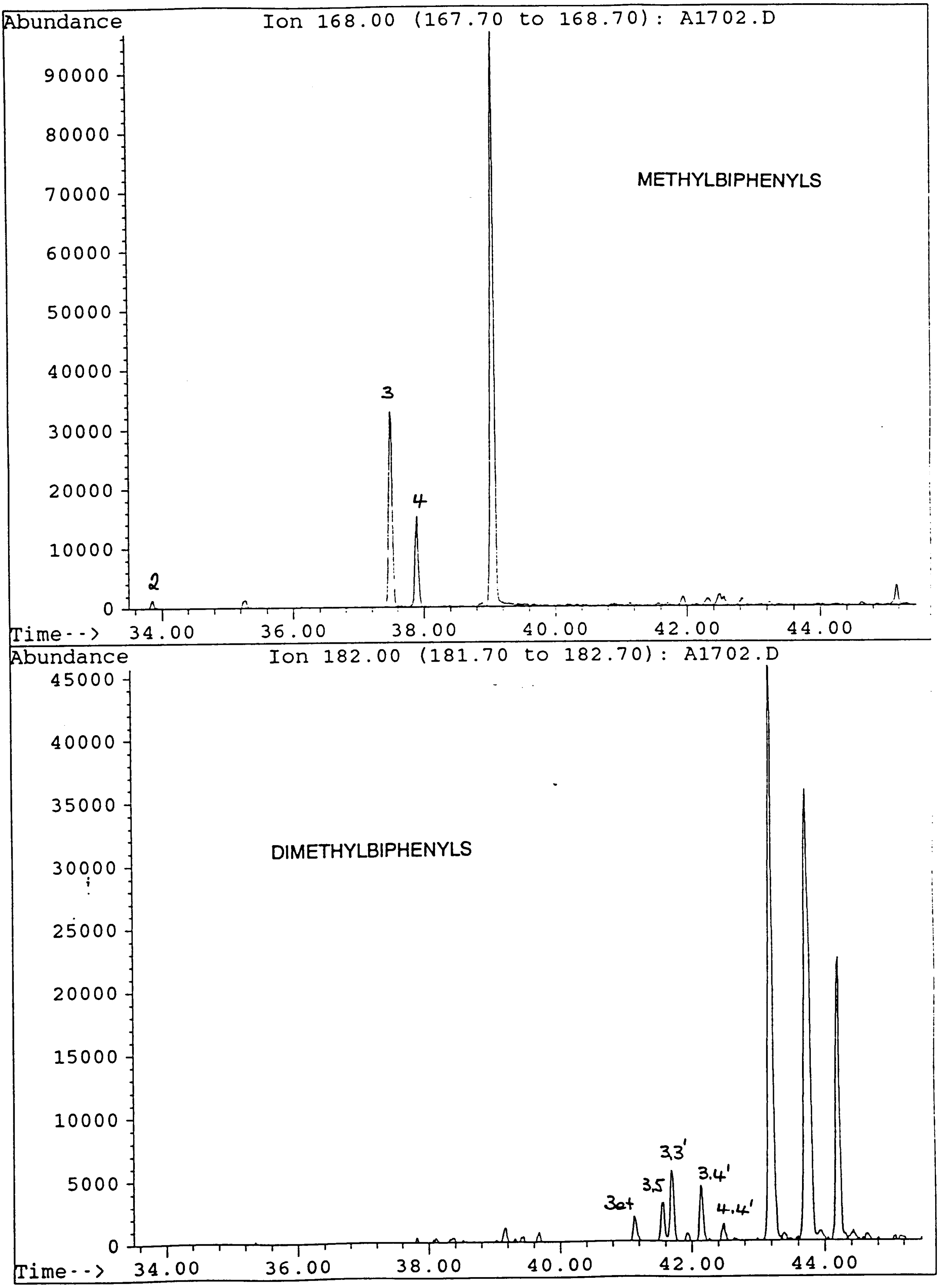
File : A1836.D
Sample : LA BELLA#1, 2121.0m, AROS
Misc. Info : COL #155, 1/250uL, 26-11-93. SF.



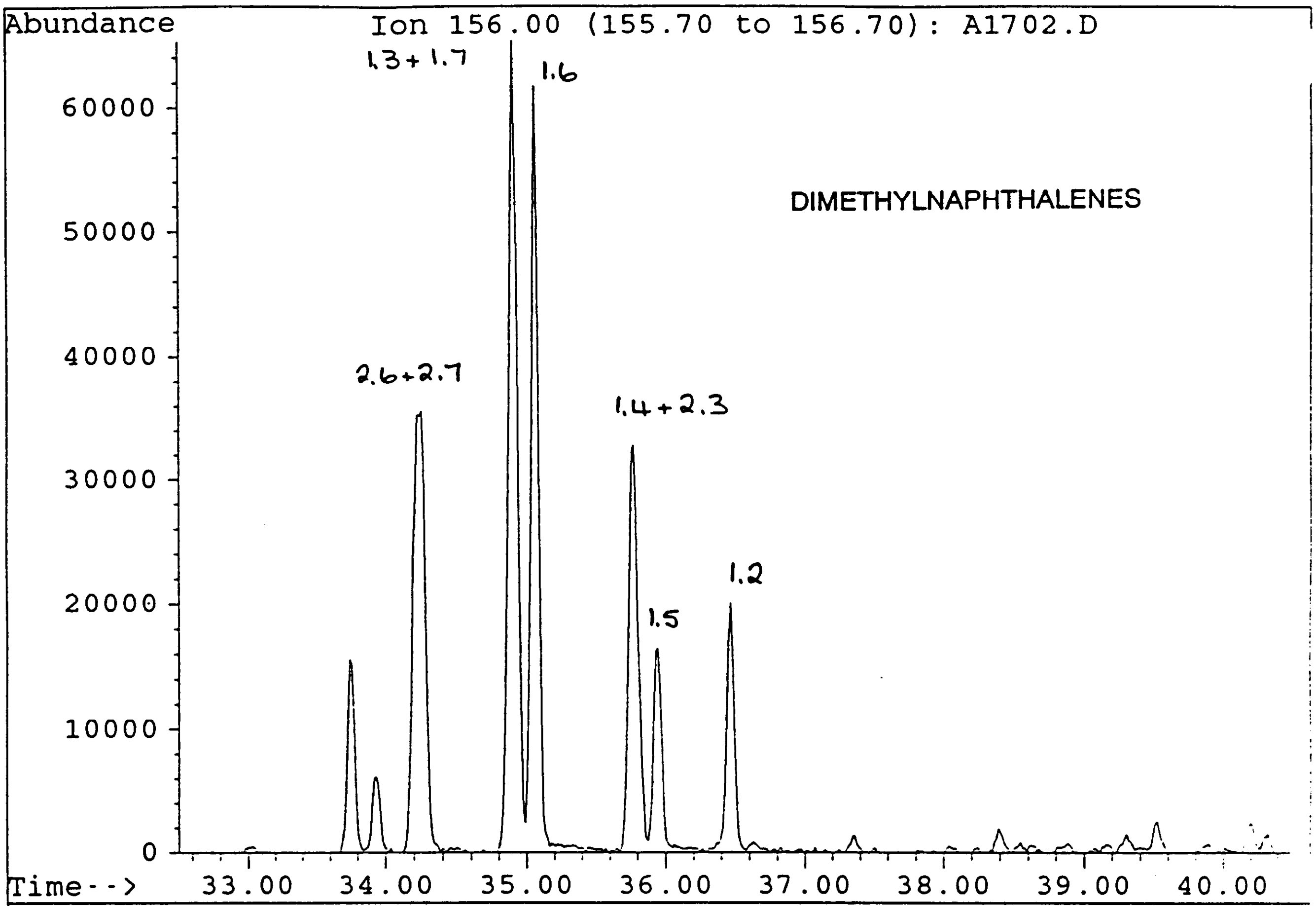
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.

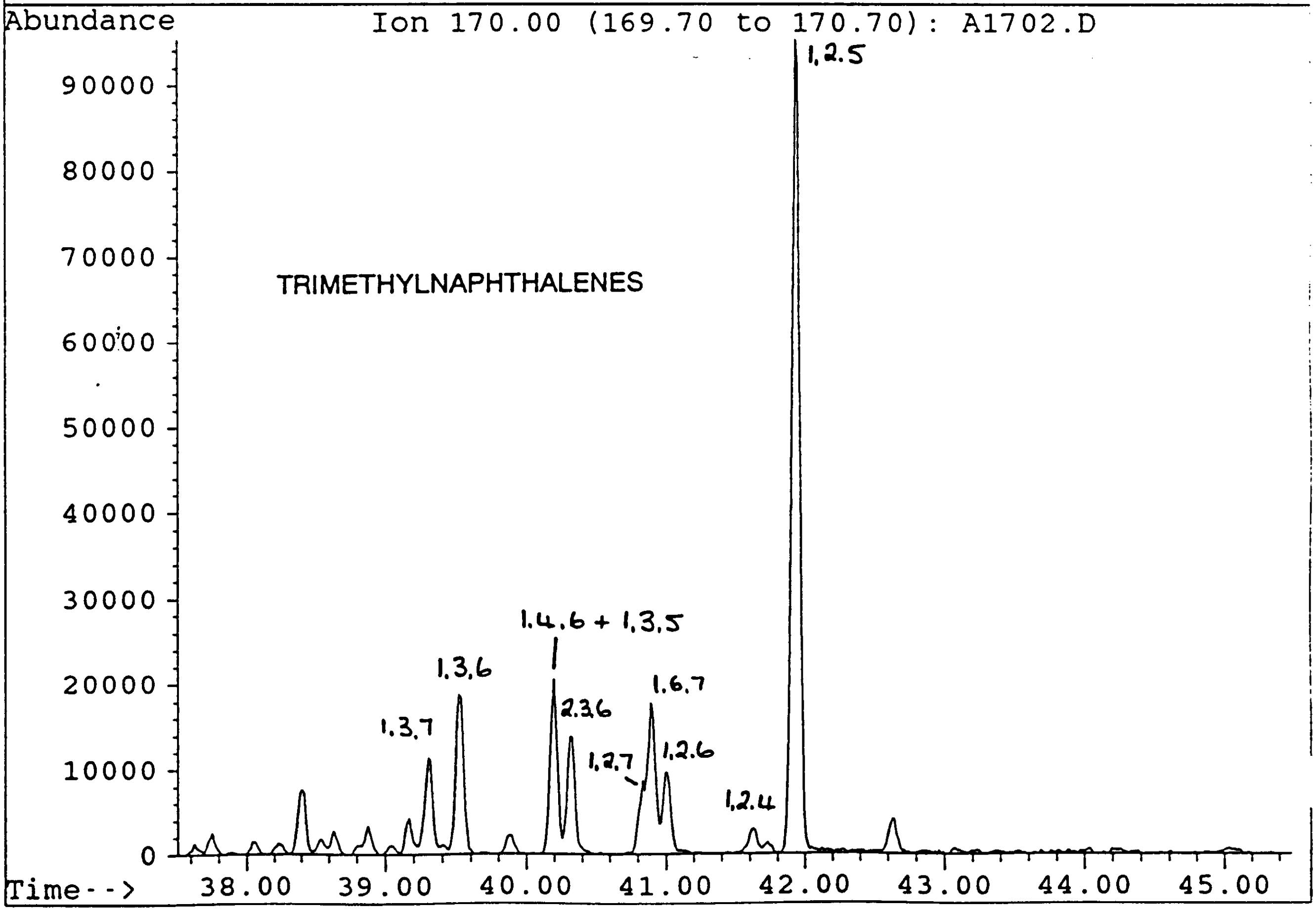


File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



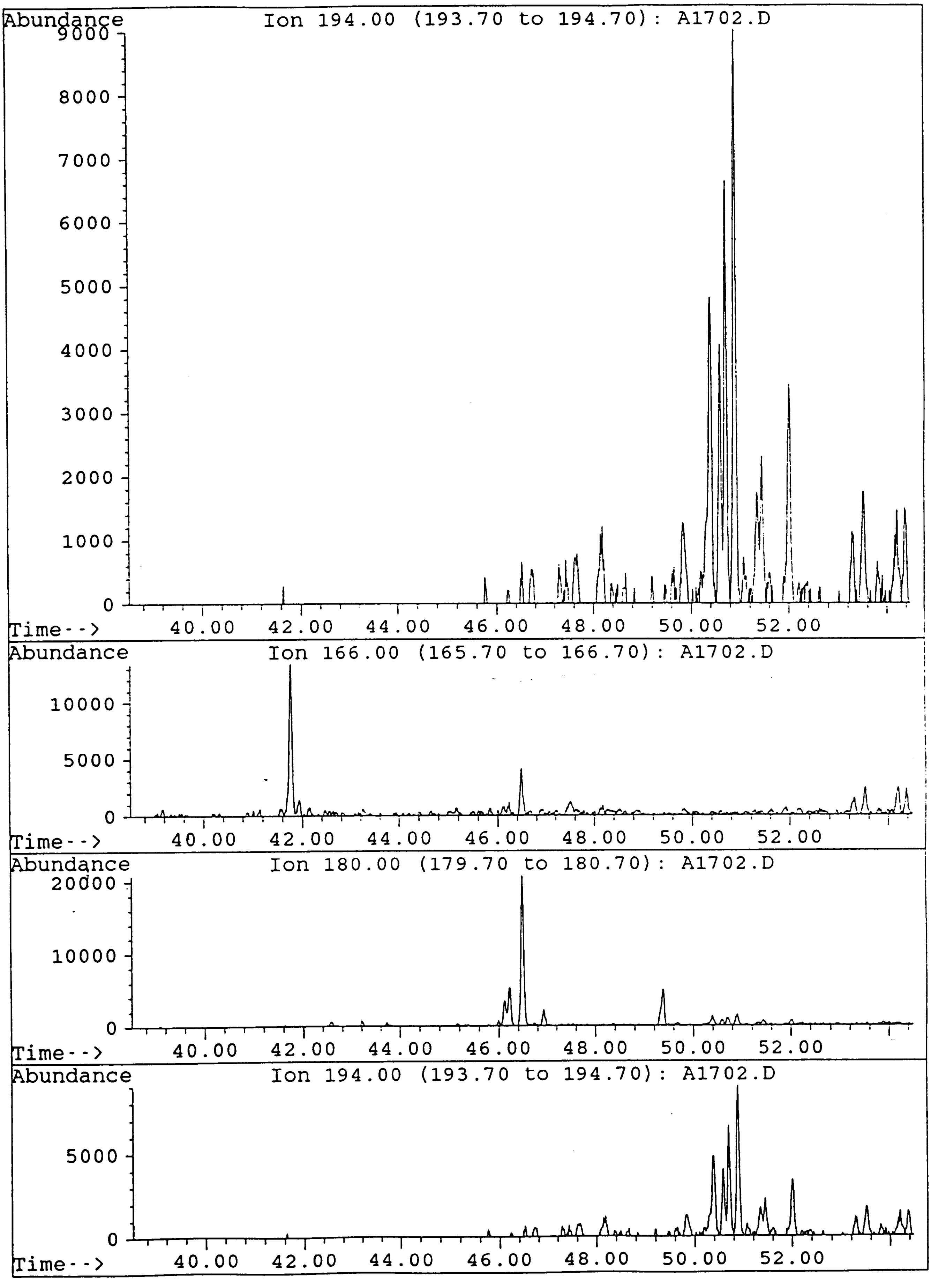
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



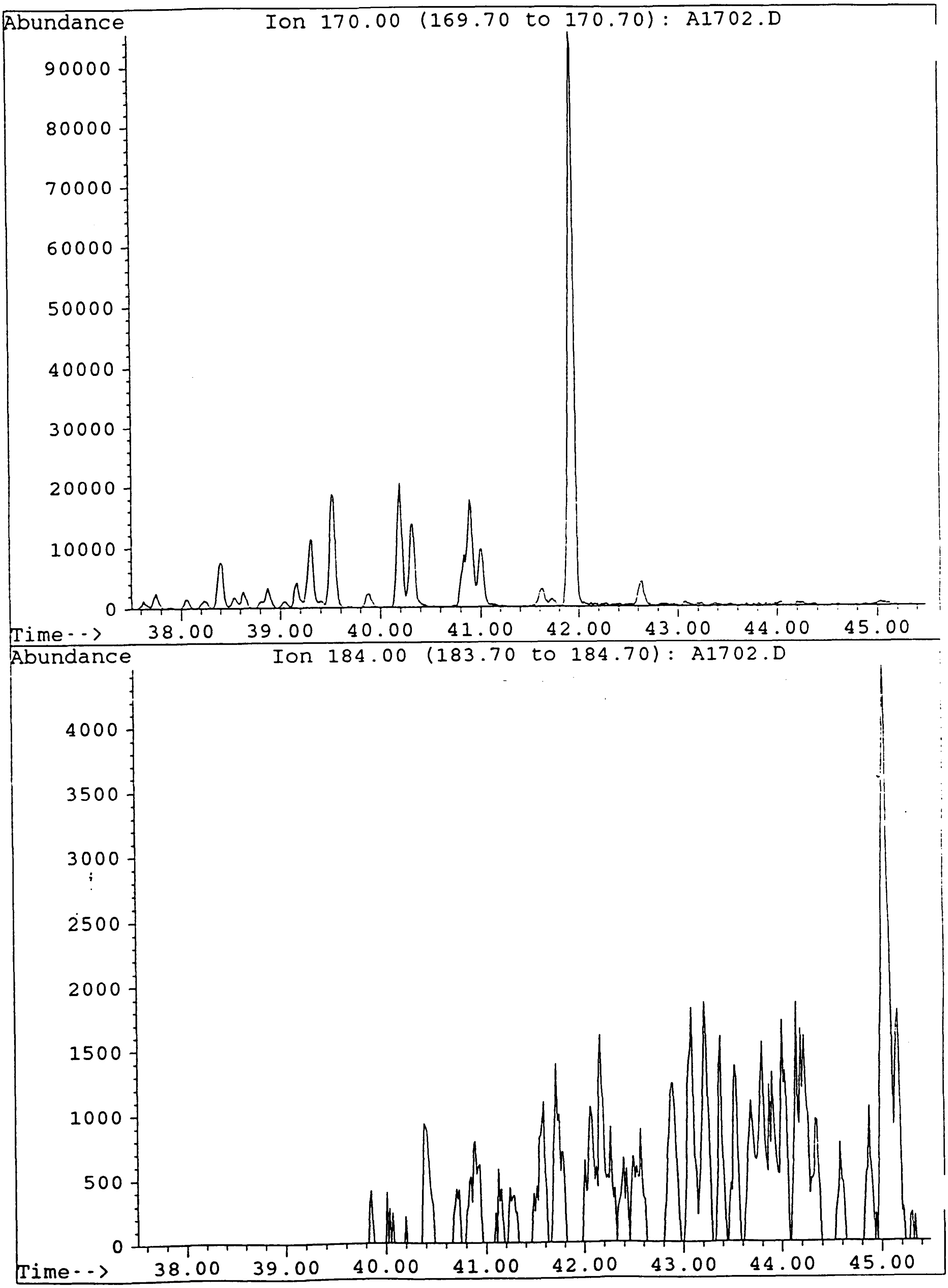


File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.

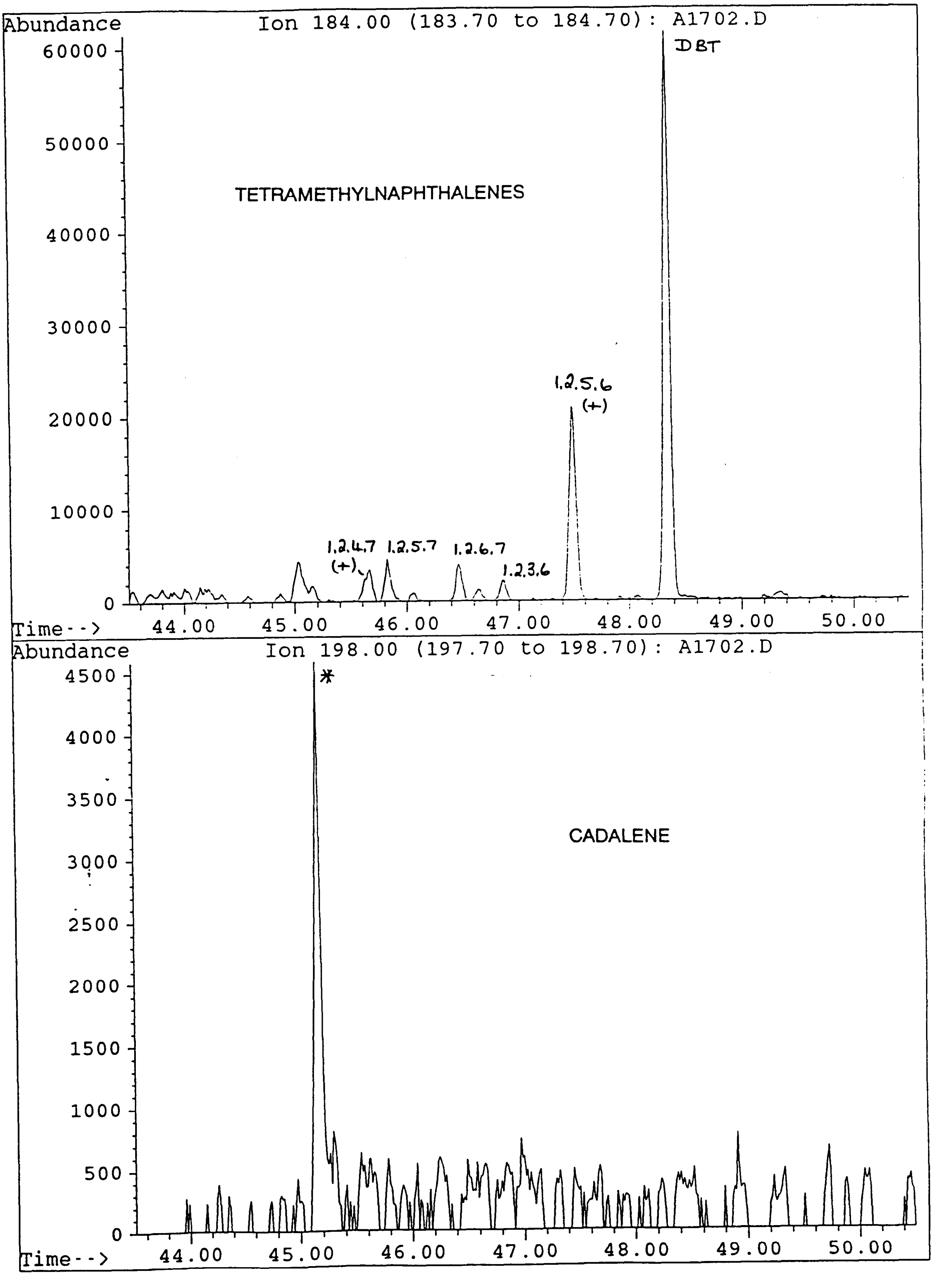
FLUORENES



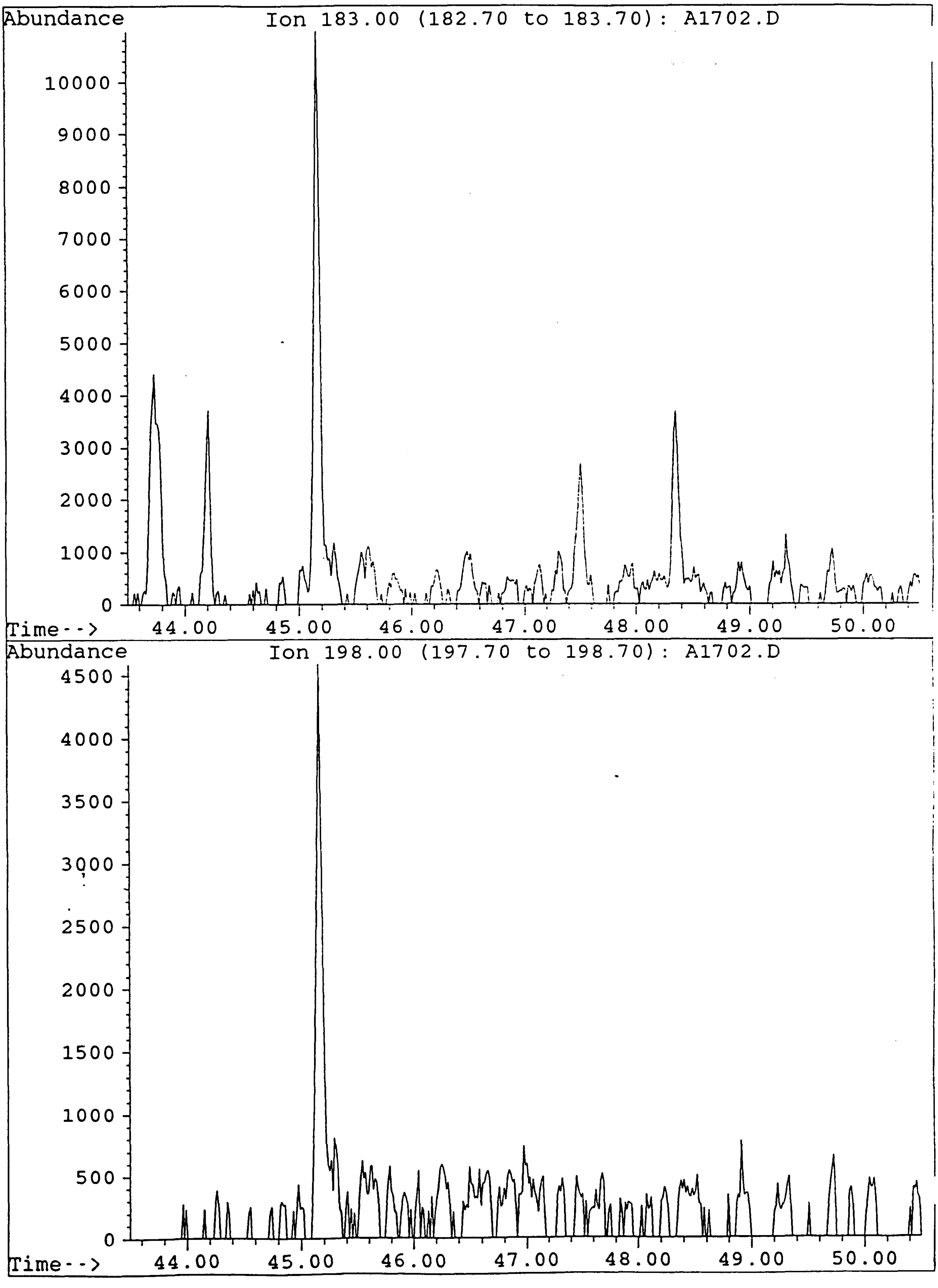
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



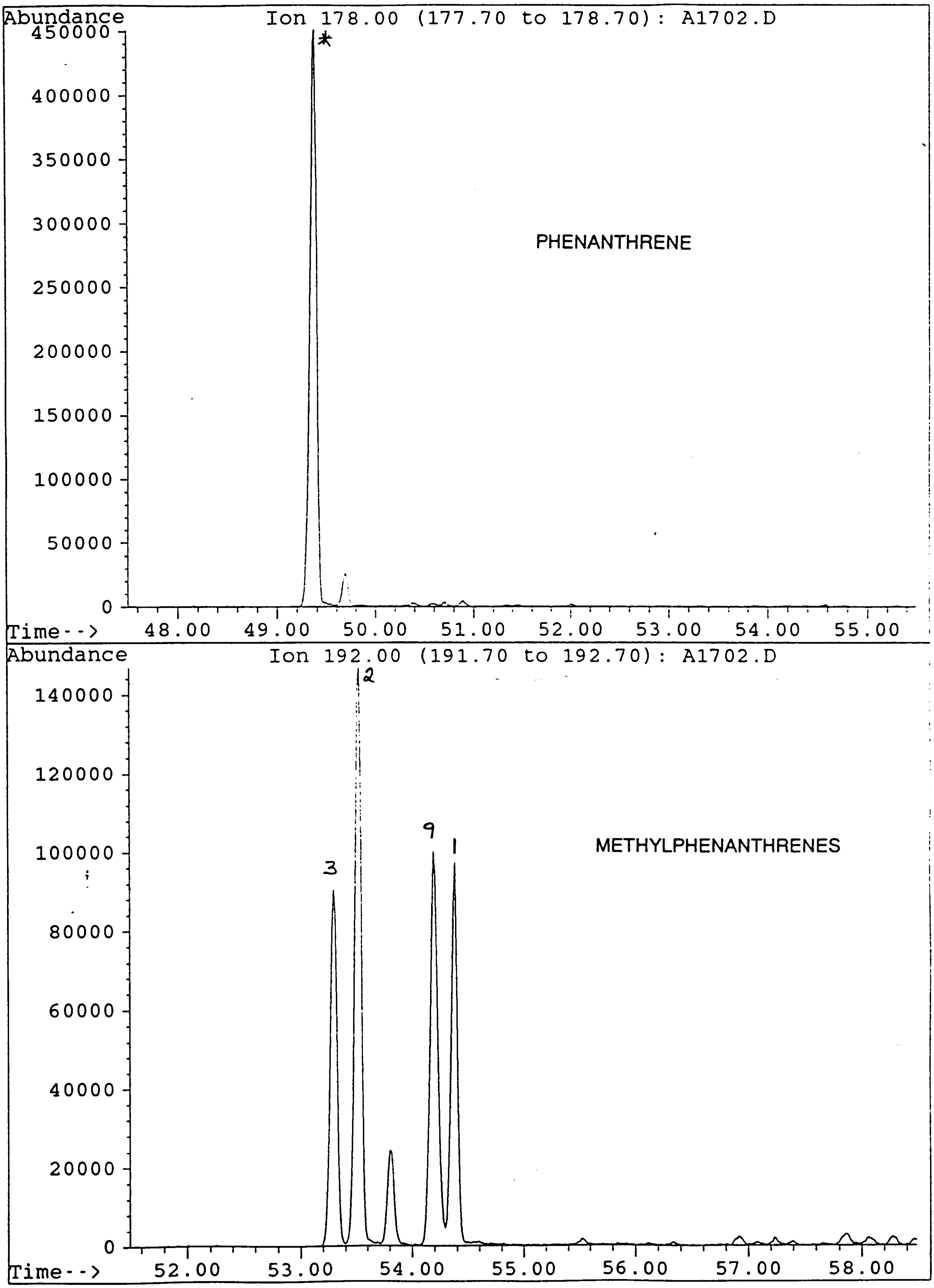
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



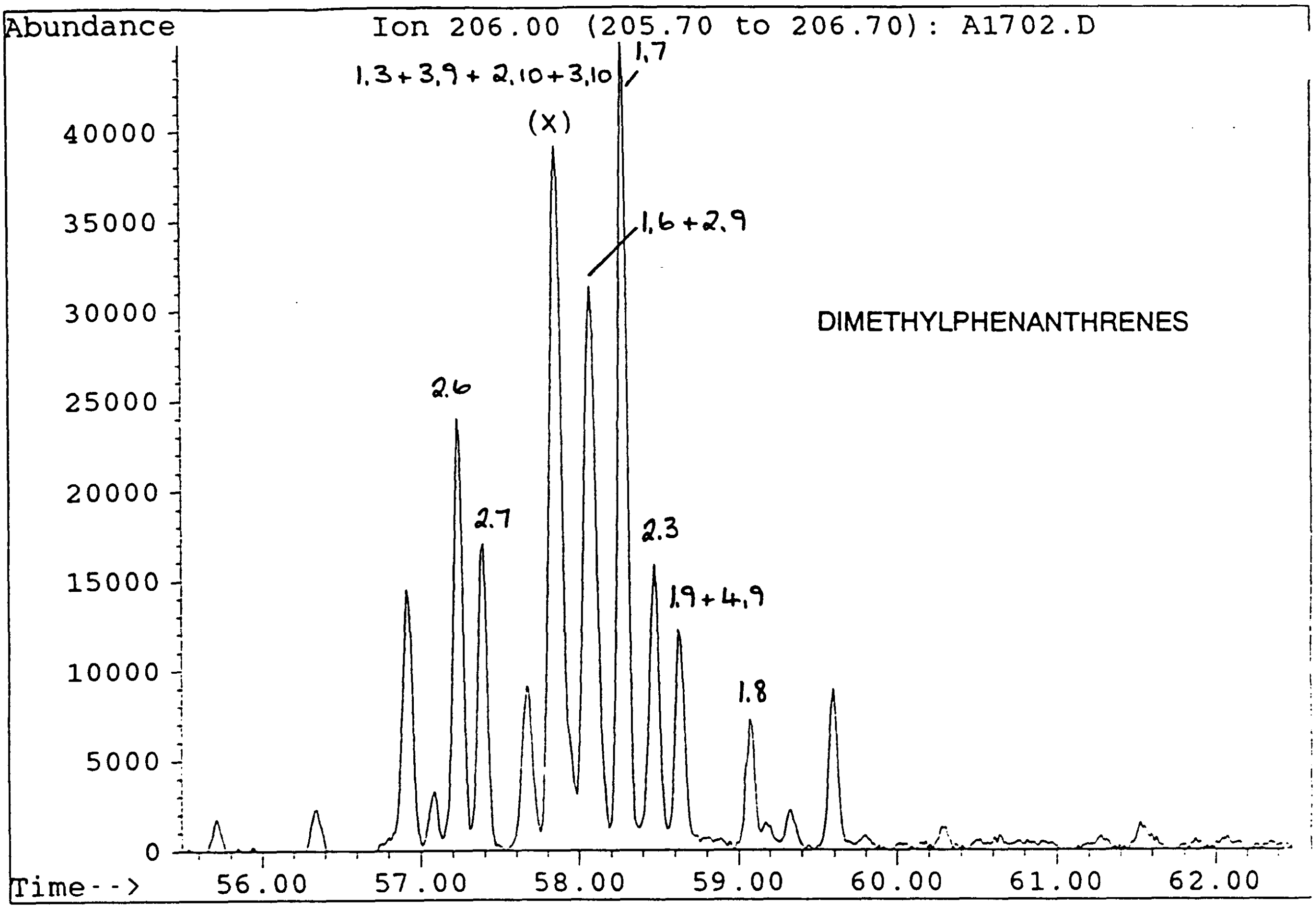
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



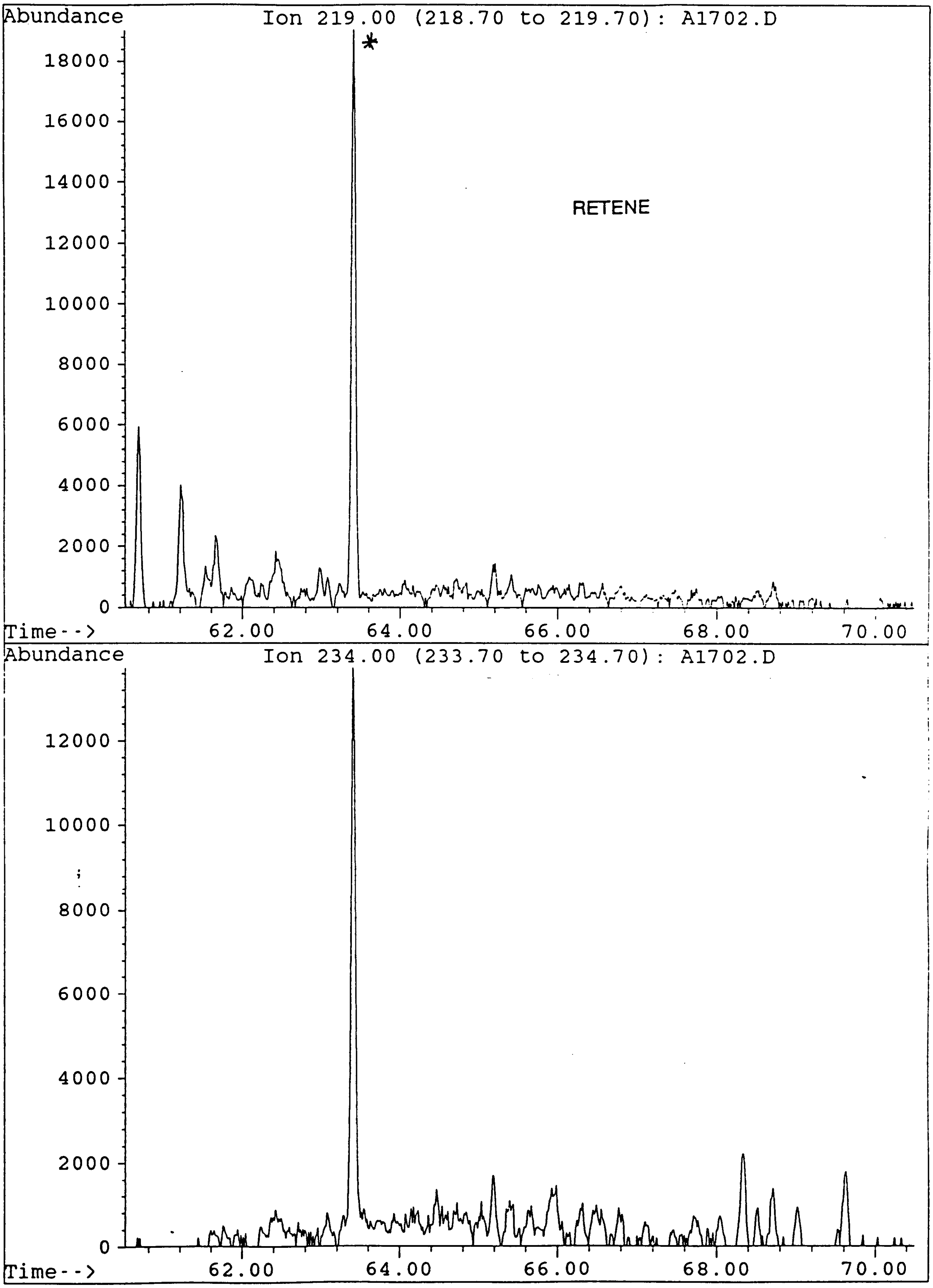
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



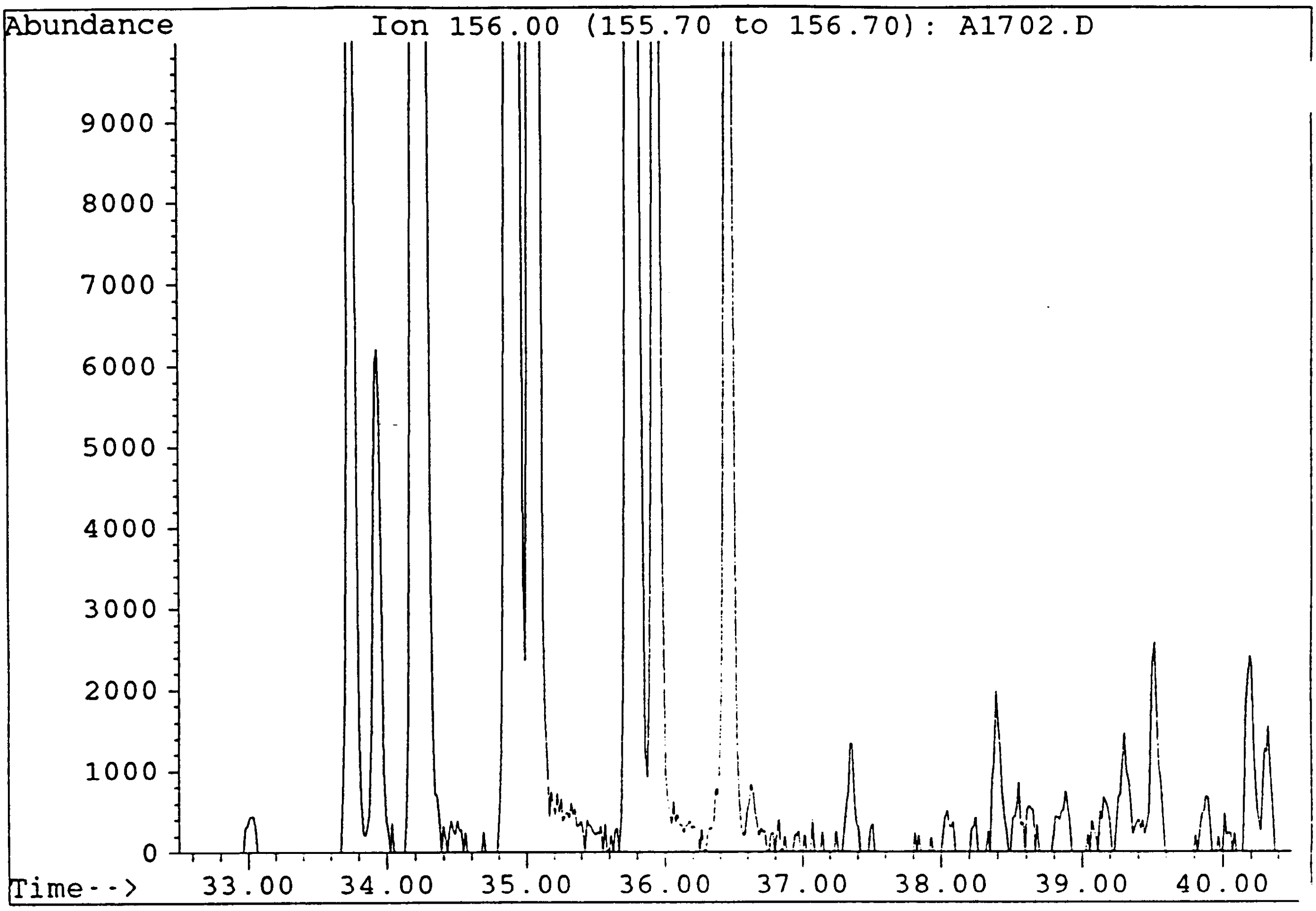
File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



```
File :          A1702.D
Sample :        LA BELLA#1, 2159.0m, ARO.
Misc. Info :    COL#155. 1/1200uL. 2-11-93. GEC.
```



File : A1702.D
Sample : LA BELLA#1, 2159.0m, ARO.
Misc. Info : COL#155. 1/1200uL. 2-11-93. GEC.



PE600265

This is an enclosure indicator page.
The enclosure PE600265 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600265 has the following characteristics:
ITEM-BARCODE = PE600265
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 Geochemistry Log (pyrolysis screening data)
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella 1 Geochemistry Log (pyrolysis screening data)
REMARKS =
DATE_CREATED = 29/03/94
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = *
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

5

BHP PETROLEUM PTY LTD.

LA BELLA-1

LOG INTERPRETATION REPORT

Prepared By:

ANDY CALCRAFT
Consultant Petrophysicist

Authorised By:

RICK ALDRED
Senior Petrophysicist

March 1993

Ref: ac0474.aga

File: LAB-1/PP/S01/r

Summary

The La Bella-1 exploration well was drilled to evaluate sandstones of the Shipwreck Group in VIC P30, some 130 kilometres South-East of Portland, Victoria, Australia.

The well was spudded on the 22nd January 1993 and reached a total depth of 2735 m.

The Shipwreck Group was encountered at 2051 m RT.

A gas bearing interval was encountered at 2067 m RT with a gross interval of 4.3 m of gas column (12% porosity and 60% gas saturation cutoff).

A second gas column was encountered at 2100 m RT from wireline logs with a Gas-Down-To at 2164 m. A Free Water Level of 2168 m RT was interpreted from RFT measurements. The gross gas column is 68 metres.

RFT pressure measurements show that the two gas bearing sandstones are in different pressure regimes. Log Analysis suggests that the water salinity may be the same in both sands.

An unusual, gas like, neutron log response was observed in the known water sand below 2170 m RT. The cause of this response is not understood and has complicated the petrophysical analysis. Log Analysis results should be treated with caution. Should a second well be drilled on the La Bella structure and a similar phenomenon be encountered then a rock and fluid sampling is recommended.

The resistivity response and associated water saturations were lower than expected for a moderately clean gas bearing sand up to 68 metres above a gas-water contact. The use of an inverted MWD data generated more reasonable results and these data were substituted for resistivity for the final water saturation calculation.

The well was considered non commercial and plugged and abandoned.

Summary Table:

Zone	Depths mRT	Gross m	Net m	N/G	Av Por %	Av Sw %
Up Ship Gas	2060-2075	15	4.1	27	14	46
Up Ship Gas	2100-2168	68	28.6	42	20	31

TABLE OF CONTENTS

TABLES:

FIGURES:

ENCLOSURES:

1. INTRODUCTION

La Bella-1 was drilled as an exploration well on the La Bella structure in VIC P30, approximately 130 kilometres South-East of Portland, Victoria, Australia. The well was designed to test the reservoir and hydrocarbon potential of sandstones within the Shipwreck Group

La Bella-1 spudded on 22nd January 1993 and reached a total depth of 2735 m. The Shipwreck Group was encountered at 2051 m RT.

The abbreviations used for depth measurements in this report are:

RT	Rotary table height (25 m) above Mean Seal Level (MSL).
m	Metres measured by driller below RT
m RT	Metres measured by logger below RT
m ss	Metres true vertical depth below MSL

2. AVAILABLE DATA

2.1 MWD data

Teleco Sonat MWD equipment recorded a gamma ray log and a short normal resistivity from 620 m to TD.

2.2 Conventional Cores

A conventional core was cut over the interval 2071.0 to 2098.65 m after encountering gas shows at the top of the Upper Shipwreck Group.

2.3 Sidewall Cores

Run	Shot	Recovered	Misfire	Lost	Empty
1	60	56	1	-	3
2	90	77	-	7	6

2.4 Wireline Formation Tests

An RFT, repeat formation tester, was run in La Bella-1 in suite 2 at TD. 28 of the 33 pre-tests attempted are considered valid. Four tests were interpreted to be supercharged or tight and one test was abandoned due to pressure instability in the Hewlett Packard pressure gauge. Two gas samples were recovered at 2072.8m RT and 2160m RT in the Upper Shipwreck Group.

2.5 Production and Drillstem Tests

None.

2.6 Logs Run

Suite	Logs Run	Top m RT	Bottom m RT
	29 January 1993		
1	DLL/MSFL/AS/GR/AMS/SP	120	1781
1	CSI (VSP)	200	1770
	08 February 1993		
2	DLL/MSFL/GR/AMS/SP	1785.5	2733
2	SDT/LDL/CNL/GR/AMS	1785.5	2728
2	FMS	1735.5	2735.5
2	CST	1735.5	2707.5
2	RFT-HP	2068.3	2624
2	CSI (VSP)	1520	2734

3. HOLE CONDITIONS

3.1 Caliper

The objective section was drilled with an 8.5" bit. Hole conditions were good with occasional minor caliper excursions. The caliper excursions were rarely sufficient to cause interpretation problems with the density-neutron logs.

3.2 Borehole Fluids

The objective section was drilled with a KCl polymer mud with the following properties:

Suite Number	**1**	**2**
Type	KCl PHPA	KCl PHPA
Weight	1.12	1.22
Viscosity	49	50
Rm	0.116 @ 21 °C	0.102 @ 19 °C
Rmf	0.094 @ 21 °C	0.083 @ 19 °C
Rmc	0.134 @ 21 °C	0.155 @ 17 °C
Rm (Arps)	-	0.0377 @ 88 °C
Rm (AMS)	-	0.039 @ 88 °C

3.3 Temperature

The following maximum temperatures were recorded:

Run	Tool	Depth (m)	Circ Time (hours)	Time since Circulation (days)	(Dt+T)/Dt)	BHT °C
1	DLL	1800	1.75	0.3125	6.6	67
1	VSP	1787	1.75	0.5625	4.1	76
2	DLL	2737	1.5	0.30694	5.9	96
2	SDT-CNL	2737	1.5	0.58542	3.56	104
2	FMS	2737	1.5	0.82639	2.83	109

Extrapolated bottom hole temperatures were 105 and 127 °C for Suites 1 and 2 respectively as illustrated by Figure 1.

4. DATA PREPARATION

4.1 Log Data

Wireline data was entered into WDS (Well Data System, Atlas Wireline) and Geolog (Mincom) for storage, display, manipulation and interpretation. All Suite 2 logs were depth matched to the Gamma Ray log recorded with the resistivity logs.

Environmental corrections were carried out using algorithms that emulate the appropriate correction charts (Schlumberger, 1989).

4.2 MWD data

MWD data were matched to the wireline logs by depth matching MWD gamma to the gamma ray log recorded with the resistivity wireline logs.

Teleco, as an experiment, generated inverted resistivity traces from the MWD resistivities and this was added to the data set. Inversion of MWD data is equivalent to deconvolving normal resistivity logs and results in increased vertical resolution. The process (Meyer 1992) first produces an approximate answer that then becomes the initial estimate of the more accurate second and final step. There are no parameters for the computer operator to adjust.

4.3 Core Data

Core data was depth matched to log data by matching core gamma data to the gamma ray log from the resistivity logs.

5 Interpretation Considerations

5.1 Optima

In view of petrophysical complexities found in the Otway Basin onshore in South Australia (Alexander E. 1992) a probabilistic interpretation model, Optima, was initially selected for the analysis. A non-linear weighted least squares method combines the actual log measurements with their associated theoretical values and uncertainties into an objective function. An iteration loop adjusts mineral and fluid volumes to minimise this objective function and thus to produce the set of results that best matches the original log data.

Optima permits the inclusion of minerals, possibly with unusual properties, into the petrophysical model.

5.2 Juhasz Equation

The water saturations computed by Optima were not considered likely because a reasonably clean fine grained sandstone some 60 metres above a gas water contact would have a water saturation in the 5-20% range rather than around 50%. One possible cause of the problem might be the use of the Indonesia Equation.

As an experiment the environmentally corrected data between 2050 and 2200m was imported into Geolog and a model based on the Juhasz Equation tried. In theory, one would expect the Juhasz Model to work well because this model, like its very close cousin the Dual Water Model, is firmly based on both theoretical considerations and experimental shaly sand data. This could be important in the relatively fresh formation waters encountered at La Bella-1.

The Juhasz Equation like all Dual Water type equations operate in the Total Porosity (Phit) system. Total porosity includes "clay porosity" which is normally full of immovable bound or clay water and effective porosity (Phie) which contains movable water and possibly hydrocarbons. Water Saturations are calculated for the Total Porosity (Sw, Sxo) system and should be converted to the Effective Porosity system (Swe).

A complication with this type of model occurs when the total porosity of shale is underestimated. Sw is calculated in the total porosity system and then converted to the Effective Porosity system. The effective water saturation becomes too low because the Effective Porosity is too small but the amount of hydrocarbon in the pore spaces does not change. In fact if the parameter mismatch is large enough then Swe can be negative - clearly a physical impossibility. Several software schemes exist to limit this effect to produce a cosmetic log but to do so disguises a shale-porosity-resistivity parameter mismatch. Proper selection of clay and fluid properties avoids this problem.

To determine what a reasonable wet clay point might be a density-neutron crossplot was constructed (Figure 2). The crossplot uses wireline data resampled to that of depth matched core. This approach helps minimise the risk of selecting a clay point that is, in reality, a silty or sandy shale because the "clay" point will still have significant amounts of measured porosity. In this case the approach is complicated by the presence of dense minerals such as siderite and probably gas. Nevertheless a clay neutron porosity of 27% and density of 2.67 g/cc are considered reasonable and consistent with more conventional density-neutron crossplots for the main Upper Shipwreck interval (Figure 4).

In retrospect there may be a case for moving the clay point further in the direction of higher neutron porosity since there is a tendency to compute high gas saturations in shaly formations.

To correctly pick clay and water resistivities a Cwa vs Qvn crossplot was constructed (Figure 3). This crossplot relates conductivity to normalised shalyness and is a one way to check that clay parameters are suitable for the sandstone reservoir rather than shaly non reservoir.

5.3 Inverted MWD

Water saturations computed using the Juhasz Equation in the manner described above were only slightly different from those obtained using Indonesia and Optima.

The inverted MWD data showed much higher resistivities in clean sands and an experimental run using inverted MWD data substituted for Rt and all parameters kept constant gave much more reasonable results. As Enclosure 2 illustrates the highest inverted resistivities correspond to the lowest gamma values. To a first approximation they may be regarded as porous sandstones that would be expected to have the highest gas saturations. The most marked effects are in the thinner sandstones where the boundary affects on the dual laterolog are greatest.

5.4 Neutron

The neutron, TNPH, and density, RHOB, traces show excessive, gas like, separation in a known water bearing sandstone between 2170 and 2185 m suggesting that there might be either unexpected gas saturations, unusual minerals or a miscalibrated log.

Density-Neutron crossplots of several known water bearing sand in La Bella-1 suggest that the phenomenon is confined to the sandstone immediately below the main gas column. (Figure 4.)

Density-Neutron, Neutron-Sonic and Density-Sonic crossplots were created and studied. The plots suggest that the density and sonic logs show a normal response but that the neutron log is about 5 pu too low. (Figure 5.)

Mudlog data suggests that there is a Gas-Water-Contact between 2164 and 2170 m and RFT interpretation places a Free Water level at 2168 m RT. This is consistent with resistivity logs that indicate a GDT at 2164 m RT.

Discussion with the wellsite geologist and inspection of sidewall core descriptions indicates that there are no unusual minerals present in the sort of quantities likely to cause the observed negative deflection on the neutron.

The tool calibrations were inspected and found to be within normal tolerances.

This phenomenon has also been observed in the Eromanga and Surat Basins where occasionally a neutron log shows excessive negative crossover in known water bearing sandstone (Hutton and Precipice Sandstones). Tool calibrations were double checked, tool and other serial numbers were traced between wells, sidewall cores were cut, XRD measurements carried out, mud and fluid properties checked but no satisfactory explanation was found.

The effect is not contractor specific since it has been observed on Schlumberger, Gearhart or Halliburton and BPB logs.

Eric The Red-1 was drilled immediately after La Bella-1 and the behaviour of the TNPH trace is normal.

Discussion, both internally and with Schlumberger, tended to confirm the view that the neutron tool was actually working correctly. If so, then a bulk shift over the entire section is quite inappropriate since the odd response is specific to the water sand interval below the lower gas column and possibly the gas column itself.

One possibility suggested by Schlumberger was that gas could be present in the mud filtrate and deep invasion of same. Based on the amount of gas that could be dissolved in water it is difficult to explain the amount of "gas effect" observed. The RFT conclusively shows that the continuous phase in this interval is water so the interval cannot be gas bearing.

An alternative explanation considered may be that the mudweight used to control higher pressures encountered deeper in the hole forced more KCl rich mud filtrate deeper into the formation than usual. Potassium, being a large ion will displace rather more hydrogen from water than would the relatively small sodium ion thus the neutron log would appear gas affected. According to S. Cheshire, Mincom Pty. Ltd., replacing NaCl with KCl would have an effect of less that 0.5 pu and that a more likely explanation was Boron in fluids or rare earths in the rock.

Reasonable results were obtained but the uncertainty of the results is larger than usual and they should be used with care. Should a second well be drilled on the La Bella structure then the Shipwreck Sandstone should be cored to a point well below the gas water contact so that if the neutron response be unusual again it can be properly tied back to core and mineral content in the main reservoir section. Analysis of drilling mud and formation fluid samples are recommended.

5.4 Pef

The Pef was affected by Baryte in the drilling mud and was considered unreliable and was not used for the analysis.

5.3 Core Data

Conventional core plugs were cut at 30 cm intervals along the core. Routine core measurements were made at atmospheric conditions. No measurements were made at reservoir conditions since the core does not cover the main reservoir zone.

6. UPPER SHIPWRECK GROUP (2050-2100M) (US1)

6.1 Mineralogy

This dominantly quartz sandstone and shale sequence contains minor amounts of siltstone. Traces to common amounts of glauconite, rare feldspar, lithics and carbonaceous matter and traces of calcite were described from sidewall cores

No shows were reported other than 10 units of ditch gas.

6.2 Interpretation Model

The model eventually adopted for this interval was a complex lithology model with shale, quartz, and a heavy mineral with a grain density of 3.89 g/cc to define the upper bound for acceptable grain density. Minimum grain density was forced to 2.65 g/cc and an iterative gas correction applied.

6.3 Input Parameters

Refer to Table 1. Input Parameters.

6.4 Water Saturation

The inverted MWD data resistivities exceed 30 ohmm within this unit, and clearly indicate hydrocarbon saturations whereas wireline logs exhibit resistivities of 10 ohmm. The effect is interpreted to be due to deep filtrate invasion caused by the mud weight increase required to counter higher pressures encountered in the Lower Shipwreck Group. Accordingly water saturation calculations used the Inverted MWD resistivity, RADI, as a substitute for RT. RADI exhibits spikes interpreted to be due to thin bed effects and the MWD resistivity is at least as reliable as the wireline RT[1].

Water Saturations were calculated using the Juhasz Equation. An initial estimate of water resistivity was derived from the SP and then Rw adjusted until a reasonable water saturation was obtained. Unfortunately, the SP derived Rw is both hydrocarbon and clay affected and is therefore not very accurate.

The Rw used was 0.292 ohmm at 25 °C or a salinity of 20,300 ppm

---

[1] Conversation with Teleco suggests that the Inverted Resistivity log interpretation is valid provided that there are no gaps in the data. Also refer to Myer W. H. 1992.

6.5 Results

The results of the log evaluation are illustrated in Enclosures 3 and 4, depth plots at a scale of 1:200 and 1:500 respectively. Table 2 provides a summary of the evaluation.

Log derived porosities do not match core porosities at the higher porosity range very well. This is probably not a thin bed problem because then log derived porosities would tend to be an average of the core derived porosities. The most likely explanation is that grain density is higher than interpreted by the model due to the presence of dense or heavy minerals like siderite and pyrite. The amount of filtrate invasion means that there may be insufficient gas correction from the MSFL based RXO log. It is possible to increase the gas correction by applying a multiplier (The code in the porosity model was adjusted to permit this.) but the amount of correction is not known since there are few high porosity points and their measured grain density ranges from 2.65 to 2.78 g/cc.

The water saturations are a guide only because of the uncertainty with water resistivity. Should further Rw data become available, from other wells, then the analysis should be revised.

7. UPPER SHIPWRECK GROUP (2100-2200M) (US2/3)

7.1 Mineralogy

This section consists of massive sandstone, shale and minor siltstone. This sandstone is mostly fine to medium quartz grained with common argillaceous matrix with rare partly altered feldspar, rare pyrite, traces mica and minor carbonaceous laminae and flecks.

7.2 Interpretation Model

Juhasz was selected for this interval using a complex lithology model with shale and the inverted MWD trace, RADI, substituted for Rt.

7.3 Input Parameters

Refer to Table 1, Input Parameters.

7.4 Water Saturation

An initial water resistivity was selected from a Pickett Plot, Figure 6. This was later modified by trial and error and by use of a Cwa vs Qvn crossplot (Figure 7) until water saturations averaged 100% were computed in the water bearing interval 2168 to 2180 m RT.

The Rw inferred for this interval is 0.659 ohmm at 25°C , equivalent to a water salinity of 8,500 ppm.

A gas-water contact is inferred from logs between 2164 m and 2167 m with a free water level at 2168 m from RFT analysis.

7.5 Results

The use of the inverted MWD log produces water saturations in the range expected for a shaly sand reservoir. These water saturations are considered realistic though should appropriate core data become available within this gas bearing sandstone on the La Bella structure then a, m and n measurements should be made since it is not uncommon for m and n to vary from the usual values of 2 used for this analysis.

Results of the analysis are tabulated by Table 2 and graphically illustrated by Enclosures 3 and 4.

8. THE UPPER SHIPWRECK GROUP (BETWEEN 2199 AND 2285 M) (US4/5)

8.1 Mineralogy

This section consists of silty claystone, argillaceous siltstone and clayey sandstone. Minor minerals include glauconite and rare carbonaceous laminae.

8.2 Interpretation Model

Optima was selected for this interval using quartz, clay and dolomite. Other minerals, including albite, orthoclase and carbonaceous matter (bituminous coal) were tested but equally good, if not better, results were achieved with a simpler model.

8.3 Input Parameters

Refer to Table 2, Input Parameters.

8.4 Water Saturation

Initial water resistivities were picked from a Pickett Plot, Figure 6, and then adjusted by trial and error until water saturations averaged 100% in the cleaner interval below 2199m.

The Rw inferred for this interval is 0.385 ohmm at 25 °C , equivalent to a water salinity of 15,000 ppm.

8.5 Results

Refer to Enclosure 3 and Table 2.

9. LOWER SHIPWRECK GROUP (2285-2597M) (LS)

9.1 Mineralogy

From sidewall description this is a clean, slightly clayey fine to medium grained quartz sandstone with a slightly calcareous cement and traces of glauconite.

9.2 Interpretation Model

A two mineral Optima model was used.

9.3 Input Parameters

Refer to Table 1.

9.4 Water Saturation

Initial resistivities were selected from a Pickett Plot and then refined by trial and error until water saturations averaged around 100%.

The Rw inferred for this interval is 0.385 ohmm at 25 °C , equivalent to a water salinity of 15,000 ppm.

9.5 Results

Refer to Enclosure 3 and Table 2.

10. OTWAY GROUP (2597M-TD) (OT)

10.1 Mineralogy

From sidewall description this is a clean, slightly clayey fine to medium grained quartz sandstone with a slightly calcareous cement and traces of glauconite.

10.2 Interpretation Model

A two mineral Optima model was used.

10.3 Input Parameters

Refer to Table 1.

10.4 Water Saturation

Initial resistivities were selected from a Pickett Plot and then refined by trial and error until water saturations averaged around 100%.

The Rw inferred for this interval is 0.385 ohmm at 25 °C , equivalent to a water salinity of 15,000 ppm.

10.5 Results

Refer to Enclosure 3 and Table 2.

11 BIBLIOGRAPHY

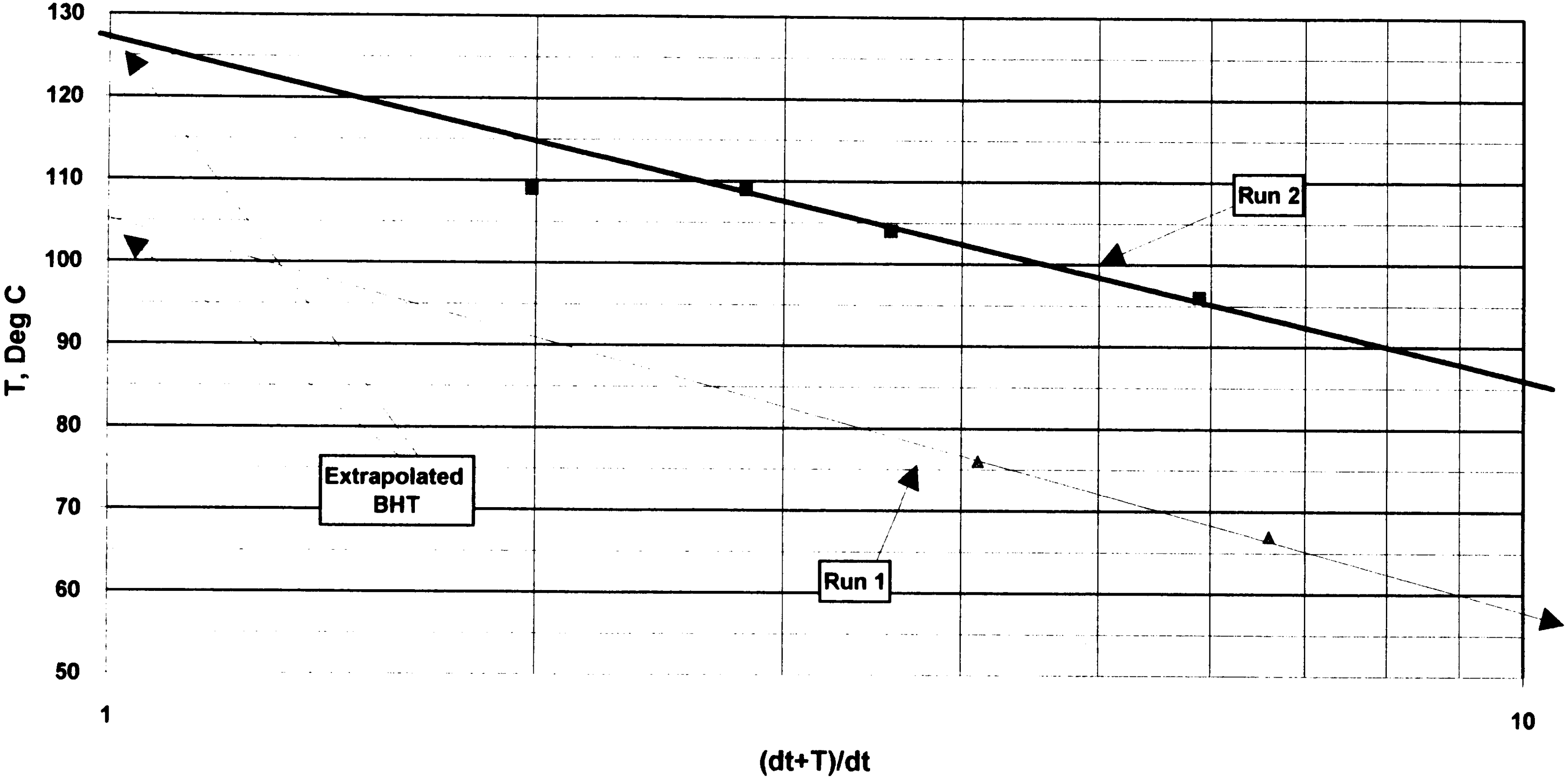
Alexander E.	Geology and Petrophysics of Petroleum Reservoirs from The Otway Group, Otway Basin. South Australian Department of Mines and Energy, ERDC Project 1424. 1992.
Juhasz I.	The Central Role of Qv and Formation-Water Salinity in the Evaluation of Shaly Formations. SPWLA 1980.
Juhasz I.,	Normalised Qv - the key to Shaly Sand Evaluation using the Waxman-Smits Equation in the absence of Core Data. SPWLA Symposium, 1981.
Meyer W.H.	Inversion of 2 MHz Propagation Resistivity Logs, SPWLA Symposium 1992.

Table 1
La Bella -1
Log Interpretation Input Parameters

Parameter	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**
Zone Name	US1 Upper Gas Up Shipwreck	US2/3 Main gas Up Shipwreck	US4/5 Up Shipwreck	LS Lr Shipwreck	OT Otway Grp
Top of zone	1050	2100	2199	2295	2591
Bottom of zone	2100	2199	2295	2591	2715
Rhob (sand)	2.64	2.64	2.64	2.64	2.64
Neutron (sand)	-0.02	-0.02	-0.02	-0.02	-0.02
Dt (sand)	55.6	55.6	55.6	55.6	55.6
Gamma (sand)	35	35	55	55	57
Rhob (clay)	2.67	2.67	2.67	2.67	2.67
Neutron (clay)	0.27	0.27	0.27	0.25	0.27
Dt (clay)	79	75	75	75	75
Gamma (clay)	140	140	150	150	150
Rt (clay)	9	40	60	60	61
Cw (clay)	4.40	1.3	1.3	2.2	2.2
Rw @ 25 °C	0.659	0.659	0.385	0.385	0.385
Salinity, ppm	8,500	8,500	15,000	15,000	15,000
Resistivity source	MWD	MWD	Wireline	Wireline	Wireline
a, m & n	1/2/2	1/2/2	1/2/2	1/2/2	1/2/2

* Cw (clay) defines electrical properties of clays in sandstone. Rt (clay) calculated from Cw (clay).

Bottom Hole Temperature
La Bella -1



BHP Petroleum
Production Geoscience

[BHT.XLW]LaBellaBHT XLC 4/08/93 10:44 AM

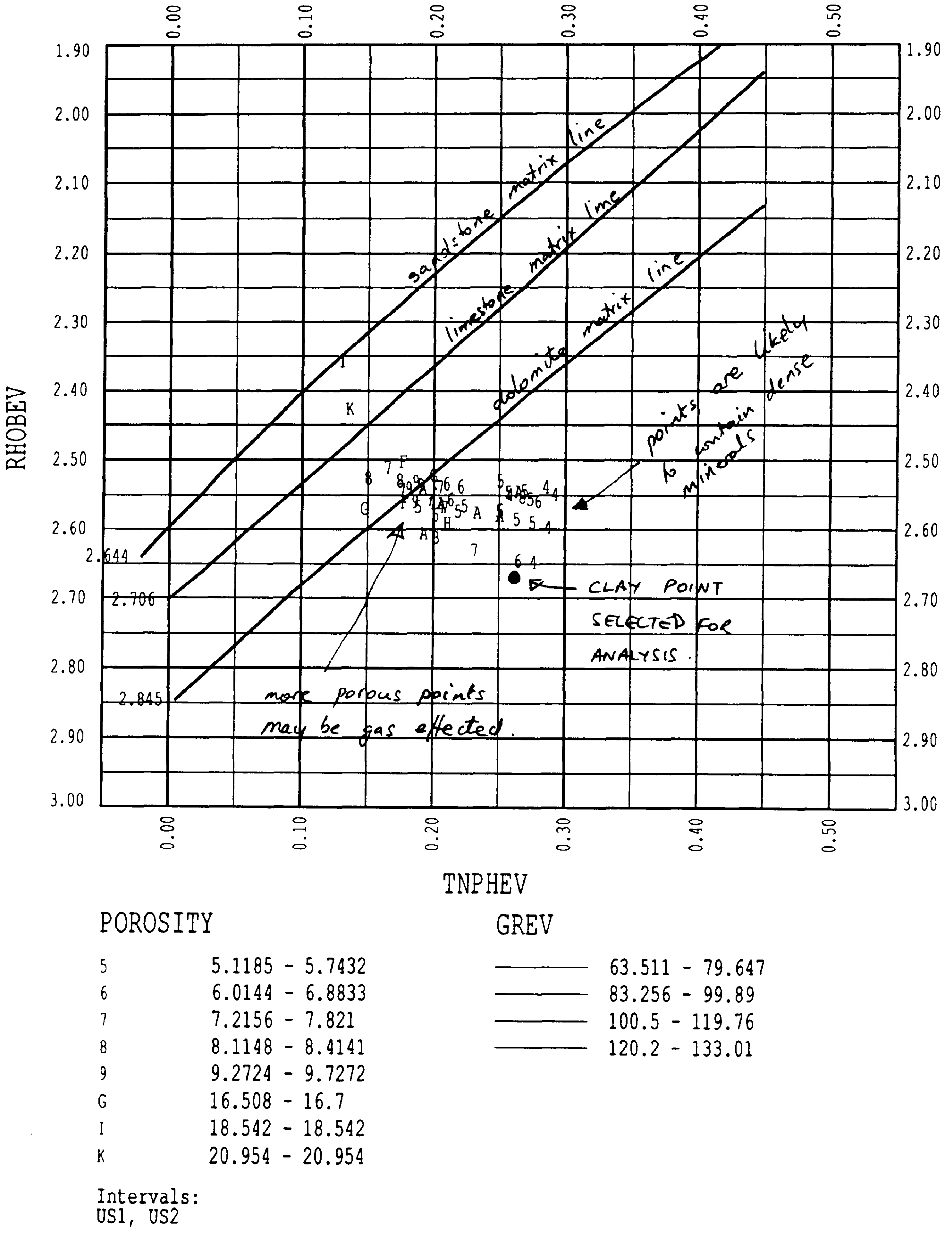
Figure 1

La Bella-1

Upper Shipwreck, Cored Interval

Neutron Porosity vs Bulk Density

Core Sample Points

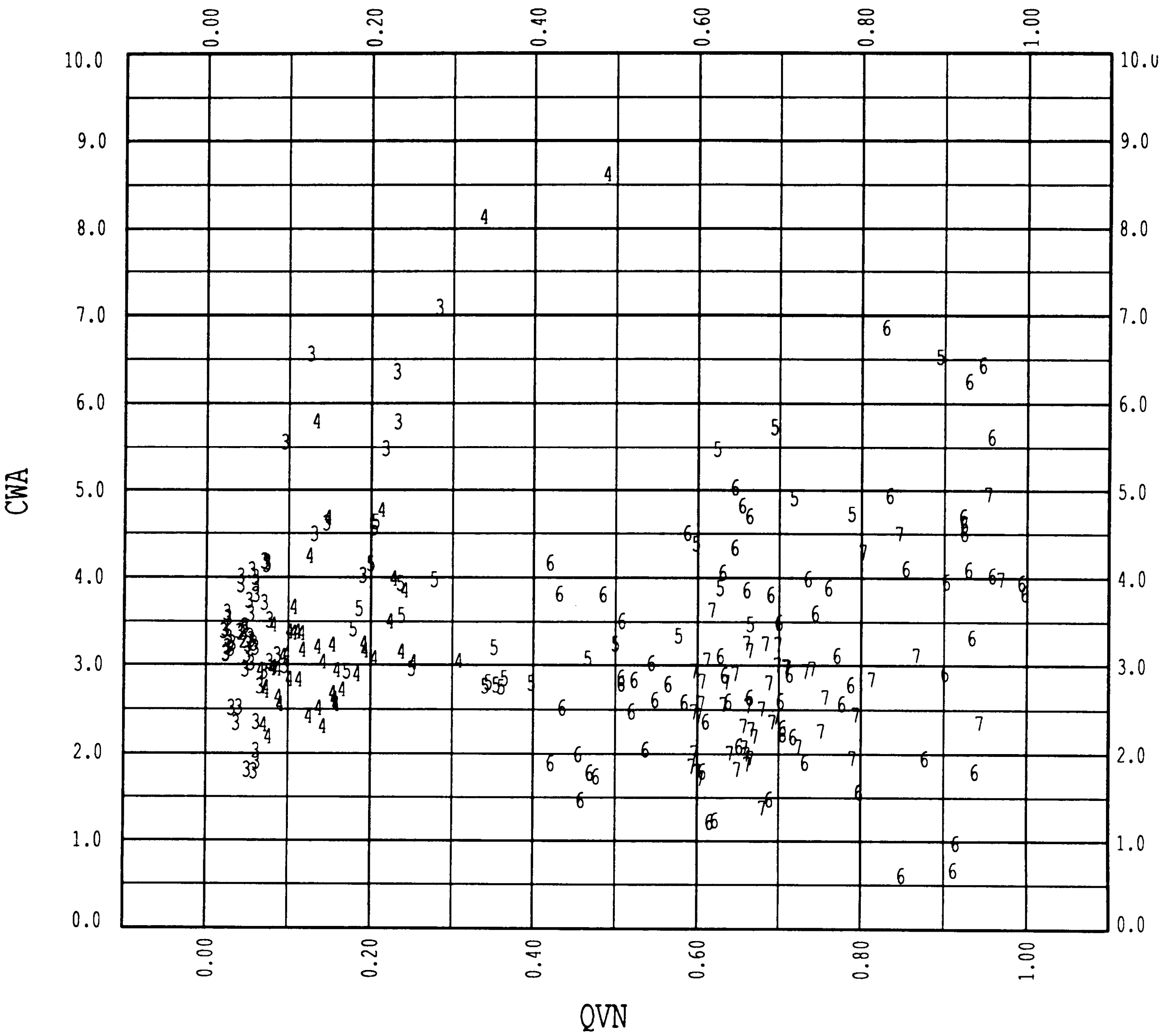


Andy Calcraft
18 May 1993

BHP Petroleum
Production Geoscience

Figure 2

CROSSPLOT OF QVN AGAINST CWA
LA-BELLA-1
Upper Shipwreck, water sand



GR_COR	
2	38.98 - 39.848
3	40.607 - 59.773
4	60.073 - 79.84
5	80.118 - 99.148
6	100.1 - 119.86
7	120.62 - 136.32

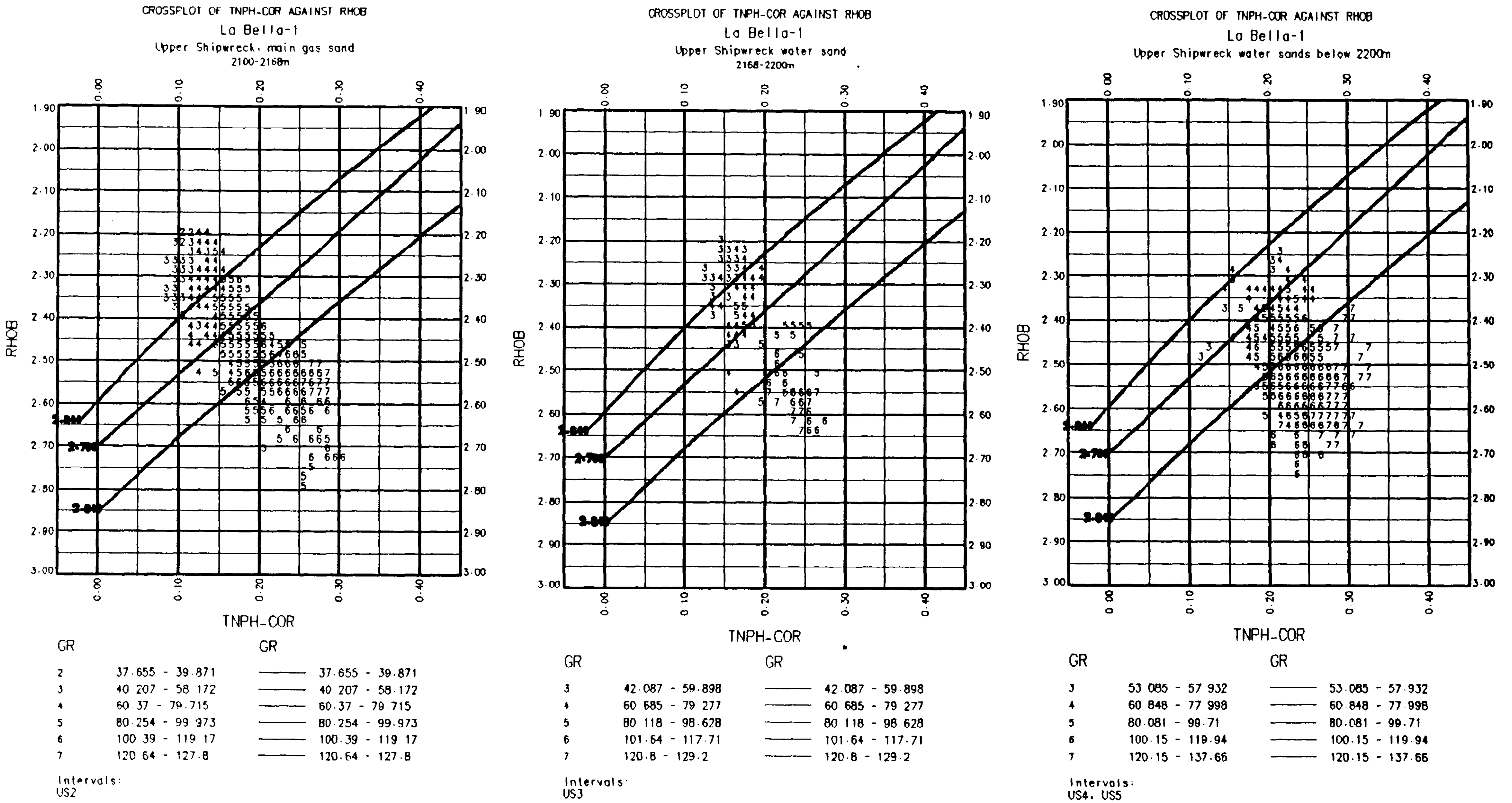
GR_COR	
————	38.98 - 39.848
————	40.607 - 59.773
————	60.073 - 79.84
————	80.118 - 99.148
————	100.1 - 119.86
————	120.62 - 136.32

Intervals:
US3

La Bella-1
Upper Shipwreck, Water Sand

BHP Petroleum
Production Geoscience
18 March 1993
Andy Calcraft

Figure 3

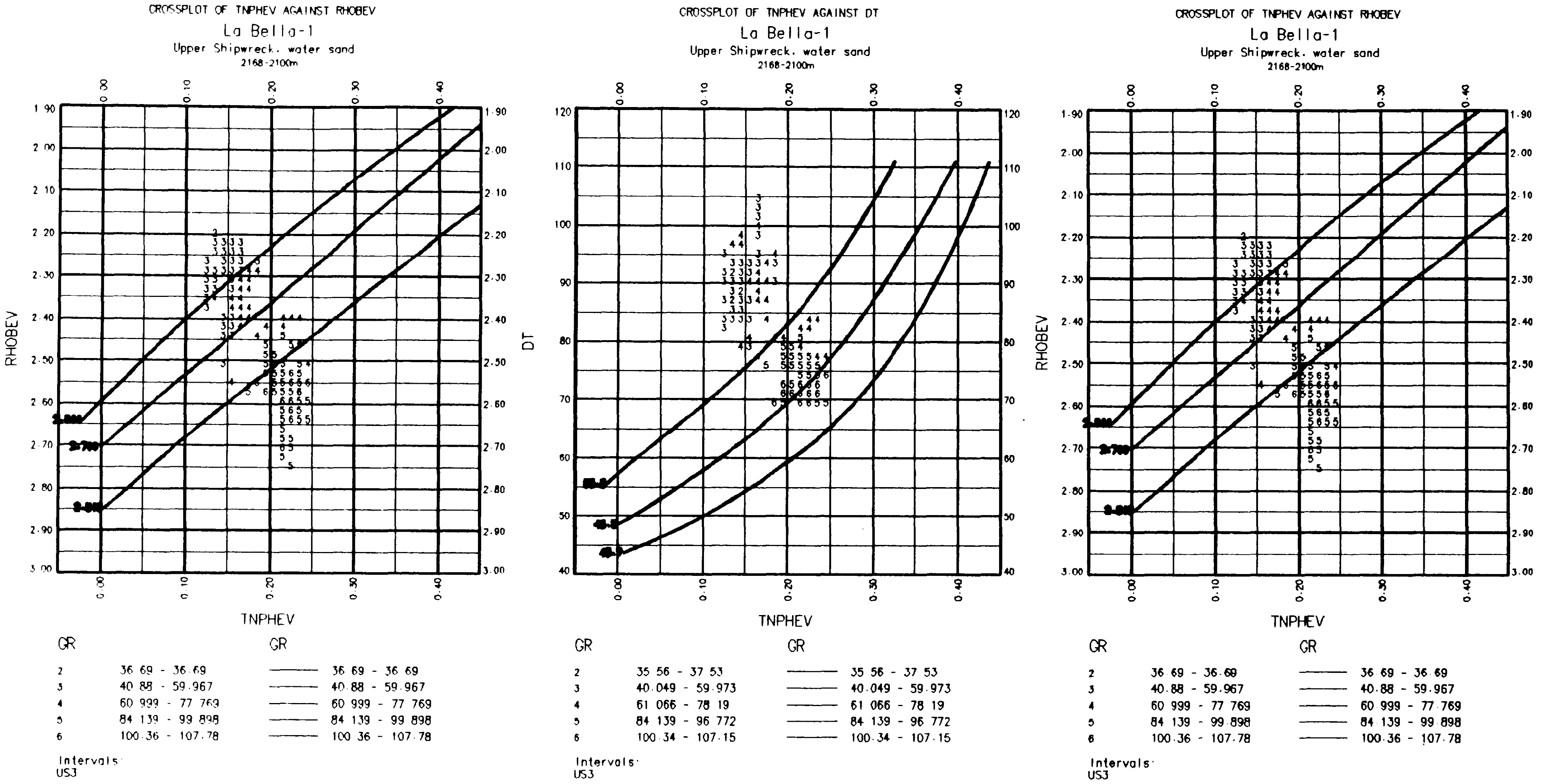


La Bella-1

Neutron-density Plots, Upper Shipwreck Group below 2100m

BHP Petroleum
18 March 1993
Andy Calcraft

Figure 4


CROSSPLOT OF TNPHEV AGAINST RHOBEV
La Bella-1
Upper Shipwreck. water sand
2168-2100m

CROSSPLOT OF TNPHEV AGAINST DT
La Bella-1
Upper Shipwreck. water sand
2168-2100m

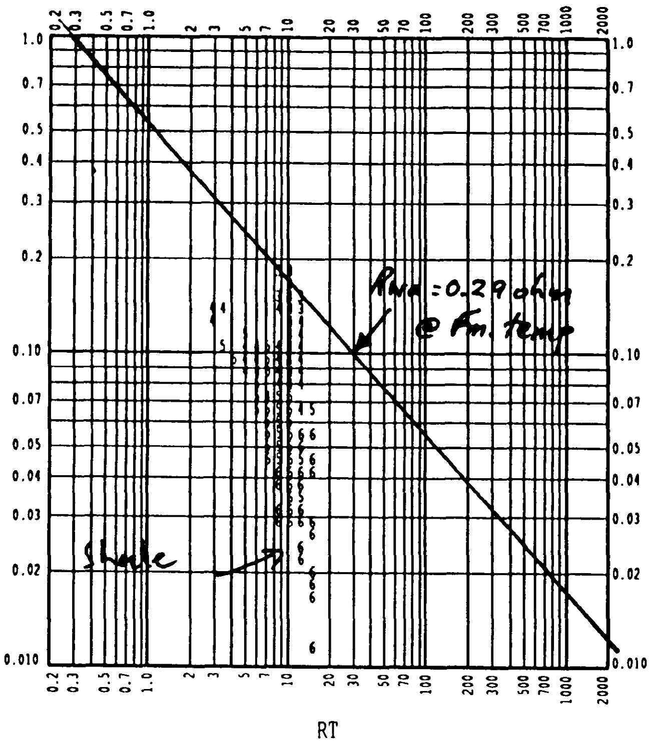
CROSSPLOT OF TNPHEV AGAINST RHOBEV
La Bella-1
Upper Shipwreck. water sand
2168-2100m

La Bella-1
Upper Shipwreck Water Sand, 2168-2200m

BHP Petroleum
Production Geoscience
18 March 1993
Andy Calcraft

Figure 5

Pickett Plot
La Bella-1
Upper Shipwreck sand 1
2050-2100 mRT



GR

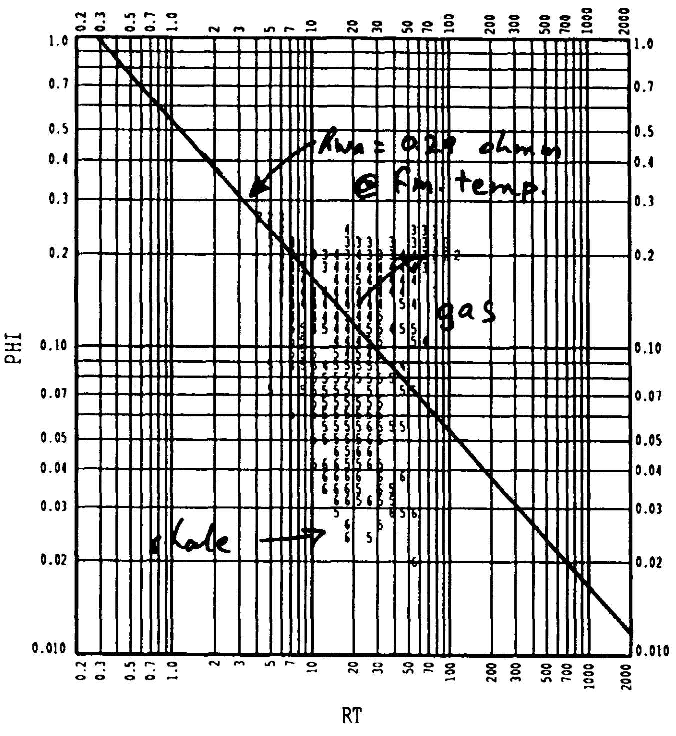
3 53.957 - 59.63
4 61.115 - 79.565
5 80.211 - 99.97
6 100.45 - 117.04

GR

53.957 - 59.63
61.115 - 79.565
80.211 - 99.97
100.45 - 117.04

Intervals:
US1

ickett Plot
La Bella-1
Upper Shipwreck, main gas sand
2100-2200 mRT



GR

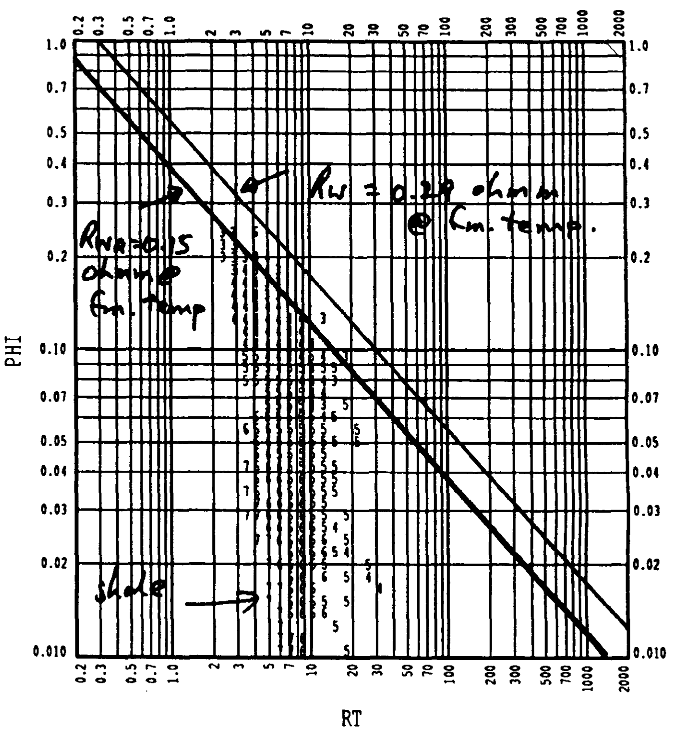
2 36.8 - 39.129
3 40.999 - 59.091
4 60.327 - 79.789
5 80.052 - 99.966
6 100.01 - 113.05

GR

36.8 - 39.129
40.999 - 59.091
60.327 - 79.789
80.052 - 99.966
100.01 - 113.05

Intervals:
US2, US3

Pickett Pl
La Bella-1
All sands deeper than 2200 mRT
>2200 mRT



GR

3 43.09 - 59.045
4 60.338 - 79.964
5 80.017 - 99.869
6 100.38 - 119.59
7 120.78 - 132.47

GR

43.09 - 59.045
60.338 - 79.964
80.017 - 99.869
100.38 - 119.59
120.78 - 132.47

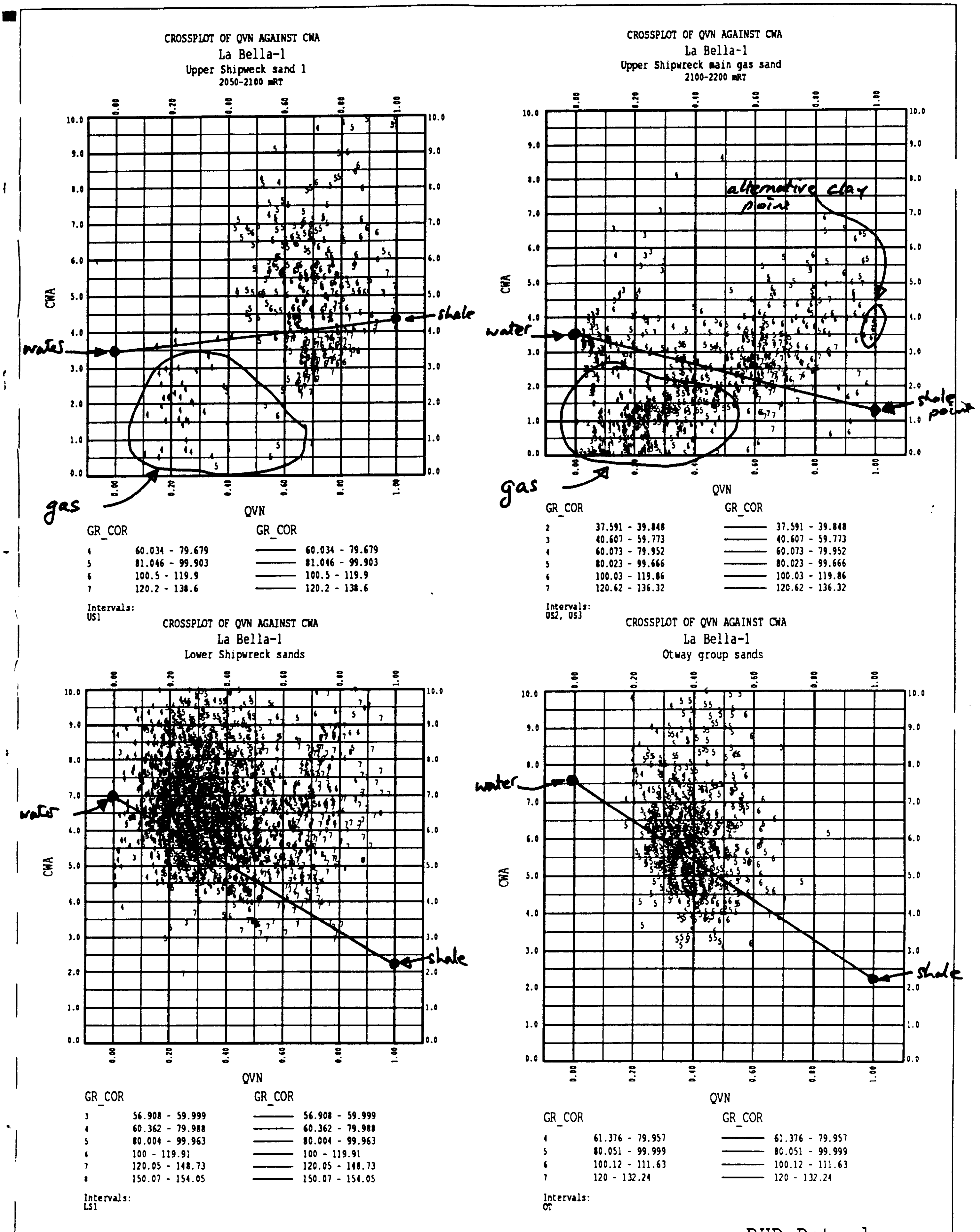
Intervals:
US4, US5, LS1, OT

La Bella-1

Selection of Pickett Plots for initial Rw estimation

BHP Petroleum
Production Geoscience
18 March 1993
Andy Calcraft

Figure 6



La Bella-1
Selected Qvn vs Cwa Crossplots

BHP Petroleum
Production Geoscience
18 March 1993
Andy Calcraft

Figure 7

PE600287

This is an enclosure indicator page.
The enclosure PE600287 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600287 has the following characteristics:

ITEM-BARCODE = PE600287
CONTAINER_BARCODE = PE900368
NAME = La Bella **1 Log Interpretation, Enclosure 4**
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella **1 Log Interpretation, Enclosure 4**
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic **Govt Mines Dept)**

PE600414

This is an enclosure indicator page.
The enclosure PE600414 is enclosed within the container PE900368 at this location in this document_

The enclosure PE600414 has the following characteristics:
ITEM-BARCODE = PE600414
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 Log Data Plot, Enclosure 1
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella 1 Log Data Plot, Enclosure 1
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = Wl075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE – Vic Govt Mines Dept)

PE600415

This is an enclosure indicator page.
The enclosure PE600415 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600415 has the following characteristics:

ITEM-BARCODE = PE600415
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 MWD and Wireline Comparison, Enclosure 2
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella 1 MWD and Wireline Comparison, Enclosure 2
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600416

This is an enclosure indicator page.
The enclosure PE600416 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600416 has the following characteristics:

ITEM-BARCODE = PE600416
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 Log Interpretation, Enclosure 3
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella 1 Log Interpretation, Enclosure 3
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE900392

This is an enclosure indicator page.
The enclosure PE900392 is enclosed within the container PE900368 at this location in this document.

The enclosure PE900392 has the following characteristics:

ITEM-BARCODE = PE900392
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 Paysummary Report Table 2, Vol 2 Appendix 5
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = NUM_LOG
DESCRIPTION = La Bella 1 Paysummary Report Table 2, Vol 2 Appendix 5
REMARKS =
DATE-CREATED = 30/06/93
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = *
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

6

La Bella-1

RFT REPORT

9th February 1993

Prepared by

Chris Taylor

Chris Taylor
Reservoir Operations Engineer

Approved by

Mark Shircore

Mark Shircore
Manager New Developments

LB1RFTRE.DOC

March 1993

MEMORANDUM

BHP Petroleum

TO: SEE DISTRIBUTION LIST

FROM: NEW DEVELOPMENTS MANAGER

DATE: 11th June, 1993

OUR REF: MS:CT:1301:MEM

FILE: LAB-1/WL/G02/R

LA BELLA-1 RFT REPORT

Please find attached the La Bella-1 RFT report.

Summary/Conclusions

The results of the La Bella-1 open hole RFT surveys indicated that the well intersected two isolated gas bearing sand packages in the Upper Shipwreck Group, with gas-water contacts at 2119.6 and 2142.9 mSS respectively. The shallower sand (Upper Shipwreck 1) was underpressured by 33psi with respect to the deeper sand package (Upper Shipwreck 2 and 3). The Lower Shipwreck Group consisted of a number of isolated, water bearing sands, overpressured by more than 400 psi from the Upper Shipwreck Group.

One sample of formation fluid was recovered from each of the gas bearing sands (2047.8 and 2135.5 mSS). Analysis of the sample recovered from 2047.8 mSS indicated dry gas with 12.5% carbon dioxide and 76.5% methane. Analysis of the sample recovered from 2135.5 mSS recovered both gas and condensate, with a condensate-gas ratio (pentanes plus) of 10 stb/MMscf.

Mark Shircore

MARK SHIRCORE
NEW DEVELOPMENTS MANAGER

Distribution List:

General Manager Exploration - J. Mitchell
Production Geoscience Manager - R. Hogarth
Area Exploration Manager (Otway Basin) - R. Marlow
Senior Petroleum Geologist (Otway Basin) - M. Durham
Senior Petroleum Engineer - Darwin - P. Moore

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ENCLOSURES

1. OPERATIONS SUMMARY

La Bella- was spudded on 23^{rd} January 1993 and reached a total depth of 2737.0 mRT (vertical well) on 9^{th} February 1993. Open hole logging commenced on the next day, with RFT procedures lasting 23.25 hours between 05:45 hrs, 9th February and 05:00 hours, 10th February 1993. Two RFT runs were made, during which 33 pretests were attempted. Of those, 28 were successful. Two segregated samples were taken.

2. CONCLUSIONS

Based upon the data and interpretations contained in this report, the following conclusions can be made:

1/. Two hydraulically isolated gas sands were intersected in the Upper Shipwreck Group.

2/. The shallower gas sand (Upper Shipwreck 1 sand) has a probable GWC at 2119.6 mSS. The deeper gas sand (Upper Shipwreck 2 and 3 sands) has a GWC at 2142.9 mSS.

3/. The Upper Shipwreck 1 sand unit is 33.1 psi underpressured with respect to the 2 and 3 sands.

4/. A water bearing sand was intersected below the gas in the Upper Shipwreck 3 sand. The aquifer had a pressure gradient of 1.42 psi/m and is overpressured with respect to a normally pressured 1.42 psi/m hydrostatic gradient by 200 psi.

5/. The Lower Shipwreck Group was overpressured with respect to the Upper Shipwreck Group by approximately 410 psi.

6/. Two fluid samples were recovered from the Upper Shipwreck Group. The sample from 2047.8 mSS recovered dry gas with approximately 13% CO_2, 3% N_2, 76% CH_4, and 5% C_2H_6. Gas and condensate were both recovered from the sample collected at 2135.5 mSS.

3. GEOLOGY

La Bella-1 was drilled in the southeastern part of Vic/P30 in the eastern Otway basin approximately 8 km southwest of Mussel-1 (Figure 1). The well was designed to test the fault dependant closure mapped at the Upper Shipwreck Group.

The La Bella structure is a northeast-southwest trending anticline comprising four fault blocks which are cut by northwest-southeast trending normal faults. These faults dip to the southwest, tilting the Shipwreck and Otway Group sediments back towards the northeast. The La Bella-1 well location was in the southwestern most fault block in a crestal location.

The primary reservoir is the Upper Shipwreck Group. This sequence contains fine to commonly coarse grained well sorted sandstone interbedded with siltstone and claystone.

A summary of well data is given in Table 1.

4. RFT PROGRAM

4.1. Objectives

The three main objectives of the La Bella-1 RFT program were as follows:

a. Determine the fluid gradients and contacts within the reservoir sections of the La Bella-1 well.

b. Recover representative hydrocarbon samples from the reservoir in order to determine PVT properties.

c. Evaluate the CGR of any gas encountered in order to determine the need to perform a DST.

On the basis of requiring 75 MMstb of condensate in place to warrant a test, the CGR needed to be greater than 50 stb/MMscf, (based upon a preliminary GIIP estimate of 1500 bcf)

4.2 RFT Tool Configuration

The formation sampling tool used on La Bella-1 was the Schlumberger RFT tool, incorporating a long nose probe with a standard packer and a HP quartz crystal gauge. The tool was run with an AMS and Gamma Ray sonde and three 1" stand-offs. A 1 gallon upper and a 6 gallon lower sample chamber were used, both with water cushions. Four x 20/1000" chokes were used in both the 1 and 6 gallon chambers.

4.3 Open-Hole Log Reference

All La Bella-1 RFT depths were correlated to the 8½ " open hole LDL-MSFL-GR hole log recorded on 8th Feburary 1993, (see Enclosure 1).

The hole was in good condition over the intervals programmed for the RFT survey. The hole diameter was between 8½" and 9¾" over the entire RFT survey section.

4.4 Tool Performance

Modular Formation Dynamics Tester (MDT)

During the drilling of La Bella, it became apparent that the Upper Shipwreck Group sandstone contained gas. Returns from the well showed traces of hydrocarbons up to C_5. Because of the possibility of the reservoir containing a highly saturated gas, it was planned to use the Schlumberger MDT (Modular Formation Dynamic Tester) tool. This tool would enable the drawdown to be controlled during formation fluid sampling.

Communication between BHPP operations personnel and Schlumberger confirmed the availability of the tool and it was transported from Darwin to the Byford Dolphin, arriving on Monday the 8th February.

During testing prior to the MDT job, the tool failed to hold hydraulic pressure. This occurred when the tool was connected on the MDT testing apparatus, and also when the tool was connected to the Maxis logging unit. It was later determined by the Schlumberger personnel that the tool was losing hydraulic pressure as a result of a failed O-ring. It was not possible to redress the tool on the rig. The program was continued using the RFT-B tool.

As a result of this occurrence, the following recommendations are made;

1/. Never mobilise the Schlumberger MDT tool to the wellsite unless adequate time and facilities are available to prepare the tool for use prior to running in the hole. Liason with Schlumberger will be required with specific questioning on this issue in order to establish what can and cannot be guaranteed by Schlumberger.

2/. Always ensure there is a functioning RFT-B tool available to use as a backup if the MDT fails.

3/. Try to allow as much time as possible between the request to mobilise the tool to the rig and when the tool will be required.

RFT-B

Following the failure of the MDT tool, the RFT-B tool was prepared for use. This was done quickly and efficiently. The RFT-B tool performed well throughout the logging program. Stabilisation times were relatively short for the HP pressure gauge.

The use of the four x 20/1000" chokes in both the 6 and 1 gallon sample chambers resulted in a drawdown during sampling of 50 and 90 psi respectively. This was well within the tolerances required to produce a representative formation fluid sample.

This result brings into question the need for a controlled drawdown as provided by an MDT tool in medium to high permeability gas reservoirs. It is felt that under these circumstances, the RFT-B tool will produce adequate samples for PVT and compositional analysis.

5. RFT PRETEST INTERPRETATION

5.1 Pressures

All pretest and sample pressures are given in Tables 2 and are shown plotted in Figure 2. Of the 33 pretests attempted; 28 pretests recorded good formation pressures, 4 were tight or supercharged, and one pretest was abandoned due to pressure instability in the HP gauge.

5.2 Temperature

Figure 3 shows the temperatures measured in the La Bella-1 well versus depth, and Figure 4 shows the temperature versus time form the start of the RFT survey.

The maximum temperature recorded during the RFT survey was 111 °C at 2599.0 mSS. This temperature was recorded 36.5 hours after circulation was stopped.

5.3 Quality Control

Initial and final HP gauge hydrostatic mud pressures recorded before and after each pretest were in close agreement (see Table 2 and Figure 5). Figure 6 shows a plot of the hydrostatic pressure gradient measured with the HP gauge. The hydrostatic gradient indicates a mud specific gravity (SG) of 1.20. This is in good agreement with the mud gravity measured on the rig (1.22 S.G).

Figure 7 shows the pressure difference between the HP and strain gauges for all of the pretests. As can be seen from the figure, the average difference is 14.6 ± 1.4 psi. As the HP gauge reads absolute pressure and the strain gauge reads gauge pressure, it would be expected that the pressure difference between the two gauges would be 14.7 psi. But, since the strain gauge is only absolutely accurate to within 0.1 % of full scale, (± 10 psi), the difference of 14.6 psi between the strain and HP gauges is an extremely good result.

5.4 Reservoir Fluid Gradients

Figure 8 shows the interpreted La Bella-1 RFT results. Figure 9 shows an expanded view covering the Upper Shipwreck Group sand units. Two main gas sands were intercepted by the well; the Upper Shipwreck 1 sand unit, (2068.0 to 2073.1 mRT) and the Upper Shipwreck 2 and 3 sand units, (2100.0 to 2190.0 mRT).

Three valid pretests were obtained in the Upper Shipwreck 1 sand unit, but no gradient could be fitted through the data as the pretest points were all within half a metre of each other. It has been assumed in the calculation of the GWC for this sand that the gas gradient is the same as that in the upper part of the Upper Shipwreck 2 and 3 units, (see below), i.e. 0.24 psi/m.

A gas gradient of 0.24 psi/m was interpreted over the main reservoir section from 2075 to 2143 mSS.

A water gradient of 1.42 psi/m was interpreted below 2143 mSS. Four good pretests were obtained over this section of the Upper Shipwreck Group defining this gradient well. Extrapolating this gradient back to sea level indicates that this unit is overpressured by approximately 200 psi.

Pretests obtained below 2250 mSS in the Lower Shipwreck Group exhibited considerable overpressuring with respect to the pretests discussed above. Five valid pretests were obtained over the interval 2250 to 2516 mSS. Two more pretests appeared to be supercharged. The gradient made by these Lower Shipwreck pressure points is far too high to be valid. It is therefore thought that the sands tested are hydraulically isolated with undetermined fluid gradients.

> Note: It has been suggested that the water below 2250 mSS may be saturated with carbon dioxide (CO_2). The mudman noticed a drop in the pH of the mud while drilling the Lower Shipwreck Group, possibly from acidic dissolved CO_2. Solubility of CO_2 in fresh water at 4000 psi and 100 °C is in the order of 6 w/w%. The log interpretation over this interval indicated a salinity of 14,800 ppm which translates into a fluid gradient of 1.38 psi/m with no CO_2 and 1.46 psi/m with 6 %w/w CO_2 dissolved in the water.

5.5 Fluid Contacts

Figure 9 shows the interpreted La Bella-1 RFT results over the primary objective sands. Shown in the figure are two gas water contacts (GWC) at 2119.6 and 2142.9 mSS. The upper contact is associated with the Upper Shipwreck 1 gas sand, and the lower contact with the Upper Shipwreck 2 and 3 gas sands. Note; the position of the Upper Shipwreck 1 GWC assumed a gas gradient of 0.24 psi/m.

From pretest data it has been determined that the Upper Shipwreck 1 sand unit is underpressured by 33.1 psi with respect to the Upper Shipwreck 2 and 3 sand units. Assuming a common aquifer, this results in a GWC 23.3 m shallower in the 1 sand than in the 2 and 3 sands.

The assumption of a common aquifer cannot be proven because the significant overpressuring seen throughout the well indicates that sands separated by significant shales may well be in different pressure regimes.

5.6 Permeabilities

Spherical mobility estimates from the pretests are given in Table 2. The assumptions made to correct the calculated spherical mobility to horizontal permeability are:

1. Mud filtrate viscosity[2] = 0.34 cP
   (Temp = 95°C, Pressure = 3200 psia,
   Equivalent NaCl salinity = 39,000 ppm)

2. $K_h/K_v = 10$

The correction used was:

$K_h = [K_D \times (K_h/K_D)]/K_{rw}$

Where,

K_D = Drawdown permeability
= (Mobility) x (Filtrate Viscosity)

K_h/K_D = 1.844
= ratio of horizontal to drawdown permeability. This is a function of K_h/K_v and flow geometry; which is spherical, (Table A1, Ref [2]).

K_{rw} = relative permeability to filtrate.
= 0.15 , Ref [2]

From the calculation results shown in Table 2, the Upper Shipwreck sands have permeabilities of between 20 and 1740 mD.

5.7 Comparison to Other Wells

The following discussion uses data obtained from Eric The Red-1 which was drilled after La Bella-1. All of the wells mentioned are shown in Figure 1.

The RFT program in Eric The Red-1 (ETR-1) was designed to provide data on the regional aquifer. Prior to the Eric The Red-1 RFT survey there were only two other pressure data points in the two permits VIC/P30 and VIC/P31, (La Bella-1 and Pecten-1A).

Pecten-1A was drilled in 1967 by Shell in what is now VIC/P30. The well drillstem tested a small gas sand in the Lower Shipwreck Group. The well completion report states the SIBHP measured during the DST to be 2420 psig at 1688 mSS.

Figure 10 shows all of the available pressure data from VIC/P30 and VIC/P31. As can be seen in this figure, the single pressure point obtained in Pecten-1A lies along the observed pressure gradient of Eric The Red-1. This would indicate that Eric The Red-1 and Pecten-1A are, or have at one stage, been in hydraulic communication. Extrapolation of the gradient obtained from these two wells to sea-level indicates the Lower Shipwreck to be normally pressured.

La Bella-1, on the other hand, has an overpressured Upper and Lower Shipwreck Group, (w.r.t Eric The Red-1). This indicates that both the Upper and Lower Shipwreck Groups are not in pressure communication with the Shipwreck Groups as seen in Pecten-1A and Eric The Red-1.

6. RFT SAMPLES

6.1 Sampling Summary

Fluid properties as determined at the wellsite are given in Tables 3 and 4.

One segregated sample was taken at 2160.5 mRT using a one and a six gallon sample chamber, both with a water cushion and four x 20/1000" chokes. The main objective of taking samples from La Bella-1 was to establish the condensate gas ratio, (CGR) of the reservoir fluid. The decision of whether or not to test would be strongly influenced by the CGR as determined at the wellsite.

The six gallon sample chamber on the rig floor and contained 134 ft^3 of gas, approximately 75 cc of condensate, and 575 cc of filtrate. It was apparent from this data that the CGR of the sample was well below the 50 stb/MMscf required to justify testing of the well. The CGR of the sample recovered from 2160.5 mRT was calculated to be 3.5±1 stb/MMscf.

A second sample from 2072.8 mRT was recovered on the second RFT run. The six gallon chamber recovered 124 ft^3 of gas and approximately 35 cc of condensate (a CGR of 1.8±1 stb/MMscf), and 315 cc of filtrate.

6.2 Hydrocarbon Properties

Tables 3a to 3b detail the data gathered on the wellsite regarding the recovered samples. The gas recovered from the 6 gallon chambers was passed through the mud-loggers gas chromatograph and the following gas compositions determined:

La Bella-1 Open Hole and RFT Data: Lower Chamber Gas Composition (%)

Component	2160.5	2072.8	mRT
C_1	79.2	81.55	
C_2	5.30	5.20	
C_3	2.04	1.89	
iC_4	0.31	0.31	
nC_4	0.30	0.25	
C_{5+}	0.066	0.002	
CO_2	12.3	10.8	
Total	**100**	**100**	

Listed below is a summary of the fluid properties, as determined by Petrolab, of the reservoir samples taken at 2160.5, and 2072.8 mRT . Appendix A contains a copy of the Petrolab report.

Summary of Results:

		2160.5	2072.8	mRT
Reservoir Temperature	T	237	194	°F
Reservoir Pressure	P	3229	3178	psig
Formation Volume Factor	B_g	0.00726	0.00502	rb/stb
Gas Expansion Factor	E	137.75	199.01	stb/rb
Gas Deviation Factor	Z	0.853	0.868	@ T & P
Specific Volume		0.1234	0.0873	ft^3/lb
Gas Viscosity		0.0184	0.0226	cP
Density		0.1298	0.1836	gm/cc
Density (From RFT Gradient)		0.17		gm/cc
Molecular Weight		22.34	21.86	
Gas Gravity		0.774	0.757	Air=1.0
Critical Pressure		713.0	709.3	psia
Critical Temperature		391.7	386.6	°R

Reservoir Fluid Compositional Analysis:

Component		Mole % 2160.5	2072.8	mRT
Carbon Dioxide	CO_2	13.30	12.46	
Nitrogen	N_2	2.90	3.43	
Methane	CH_4	75.43	76.46	
Ethane	C_2H_6	4.91	4.58	
Propane	C_3H_8	1.81	1.71	
Butane+	C_4+	1.65	1.36	
Total		**100.0**	**100.0**	

6.3 Formation Water Properties

The liquid obtained from the 6 gallon RFT chambers recovered from 2160.5 and 2072.8 mRT was verified as mud filtrate by measurement of its resistivity, (See Tables 3a, and 3b).

7. REFERENCES

[1] BHP Petroleum RFT Manual.
December 1988.

Well Data Sheet

Table 1.

Well:		**La Bella-1**
Permit:		VIC/P30
Location:	Lat:	39 ° 00 ' 14.20 " South
	Long:	142 ° 41 ' 42.90 " East
Rig:		Semi-Submersible Byford Dolphin
Seismic Reference Line:		OH 91-149
DF Elevation:		25.0 m above MSL
Water Depth		95.0 m
Well TD:		2737.0 mRT
Spud Date:		
Date Reached TD:		9th February 1993
Well Status:		Plugged & Abandoned
Casing Points:		9 5/8" @ 1786.5.0 mDF
Reservoir Tops:	Upper Shipwreck 1	2068.0 mRT
	Upper Shipwreck 2	2100.0 mRT
	Upper Shipwreck 3	2168.0 mRT
	Upper Shipwreck 4	2190.0 mRT
	Upper Shipwreck 5	2275.0 mRT
Datum Depth (GWC):		2124.9 mSS
Pressure at Datum:		3245.0 psia
Reservoir Temperature:		111 °C @ 2624 mRT
Tritium Used:		No
Fluids In Well:	Gas:	Yes
	Oil:	No
	Water:	Yes
Contacts:	GOC:	N/A
	OWC:	N/A
	GWC:	2119.6 mSS 2124.9 mSS

LA BELLA-1 OPEN HOLE RFT RESULTS

Test No.	Depth		Time	Initial Hydrostatic Pressure		Formation Pressure		Temperature	Final Hydrostatic Pressure		Mobility	Permeability*	Comments
				Strain Gauge	HP Gauge	Strain Gauge	HP Gauge		Strain Gauge	HP Gauge			
	mTVDDF	mTVDSS	hh:mm	psig	psia	psig	psia	DegC	psig	psia	mD/cp	mD	
1	2068.3	2043.3	07:15										Tight
2	2068.4	2043.4	08:20	3607.2	3622.2	3288.9	3304.63	91.4	3606.9	3623.3	0.4	<10	Low Perm
3	2070.0	2045.0	09:01	3609.6	3625.7	3203.1	3218.66	91.8	3609.9	3626.7	0.9	<10	Low Perm
4	2072.8	2047.8	09:30	3614.6	3631.2	3177.8	3193.05	91.7	3615.0	3631.2	6.7	30	Good
5	2082.7	2057.7	09:40	3631.8	3647.9			92.1	3631.6	3650.6			Tight
6	2100.4	2075.4	09:49	3662.1	3679.3	3213.5	3228.82	92.5	3662.2	3679.0	5.1	20	Good
7	2103.2	2078.2											Not Attempted
8	2109.8	2084.8	10:06	3678.3	3696.1	3216.6	3231.36	92.7	3678.9	3695.7	12.2	50	Good
9	2116.1	2091.1											Not Attempted
10	2120.5	2095.5	10:24	3697.3	3715.9	3218.9	3233.92	93.2	3697.3	3713.1	2.1	<10	Good
11	2125.8	2100.8	10:39	3600.2				93.9	3705.9				Supercharged
12	2133.9	2108.9	11:00	3720.8	3737.5	3222.3	3236.22	94.1	3720.7	3736.6	831.0	1740	Good
13	2141.5	2116.5	11:18	3733.4	3750.7	3240.3	3255.80	94.3	3733.7	3751.0	4.9	20	Low Perm
14	2149.5	2124.5	11:45	3747	3764.6	3235.6	3250.56	94.7	3747.5	3765.0	4.3	20	Good
15	2153.1	2128.1	12:03	3754.2	3770.0	3227.1	3240.91	94.8	3754.0	3770.1	113.0	470	Good
16	2156.0	2131.0	12:17	3759.9	3774.6	3227.6	3241.52	94.8	3759.1	3774.4	9.1	40	Good
17	2160.5	2135.5	12:28	3766.7	3783.4	3228.9	3243.26	94.9	3766.5	3783.2	65.0	270	Good
18	2162.0	2137.0	12:37	3769.6	3786.0	3229.0	3243.43	94.8	3769.4	3785.9	20.7	90	Good, HP Unstable
19	2165.5	2140.5	13:02	3775.9	3792.4			95.1					HP & Strain Unstable
20	2165.0	2140.0	13:16	3774.2	3791.5			95.1					Tight
21	2168.2	2143.2	13:23	3780.6	3797.6	3231.6	3245.42	95.4	3780.2	3796.5	48.2	200	Good, HP Unstable
22	2170.2	2145.2											Not Attempted
23	2173.3	2148.3	13:50	3788.6	3805.7	3238.7	3252.10			3805.0	89.8	375	Good
24	2179.0	2154.0	14:09	3798.5	3815.2	3247.0	3260.60	96.0	3798.8	3814.4	92.7	390	Good
25	2183.2	2158.2	14:30	3805.5	3820.5	3253.6	3267.80	96.0	3805.7	3821.8	38.9	165	Good
26	2205.0	2180.0	14:52	3842.5	3855.5								Poor Seat, Rerun
27	2205.0	2180.0	15:00	3842.3	3857.0	3278.9	3293.10	97.1	3842.1	3859.4	22.9	100	Good
28	2239.0	2214.0	15:15	3900.3	3919.7	3375.8	3391.30	98.0	3900.4	3916.9	1.4	<10	Good
29	2278.5	2253.5	15:40	3967.6	3987.3	3766.9	3781.94	99.6	3967.3	3983.0	3.1	15	Good
30	2378.0	2353.0	16:15	4136.2	4151.8	3952.0	3966.90	102.0	4136.1	4152.0	11.3	50	Good
31	2448.3	2423.3	16:45	4256.1	4271.6	4059.0	4074.20	105.0	4255.8	4271.4	3.2	15	Good
32	2497.0	2472.0	17:05	4338.1	4355.5	4133.2	4147.50	107.0	4339.2	4354.0			Good, Low Perm
33	2502.0	2477.0	17:30	4347.6	4363.9	4169.8	4184.80	107.0	4348.0	4363.1	1.3	<10	Good, Gauges Unstable
34	2541.0	2516.0	17:55	4414.4	4434.6	4203.2	4219.10	108.0	4414.3	4430.2	1.1	<10	Good, Gauges Unstable
35	2624.0	2599.0	18:22	4557.3	4576	4441.1	4456.36	111.0	4557.3	4574.0			Good
36	2160.5	2135.5	19:20	3764.6	3778.5	3230.1	3243.31	98.0					Good, Sample Taken
37	2072.8	2047.8	20:12	3612.5	3623.1	3178.2	3192.60	94.5			56.1	235	Good
37	2071.5	2046.5				3182.4	3196.90	94.1	3609.3	3626.4	2.2	<10	Good
39	2072.8	2047.8	01:00	3610	3625.2	3178.6	3192.20				2.2	<10	Good, Sample Taken

*N.B. Permeability rounded to nearest 10 mD
K(h)/k(v)=10
Filtrate Viscosity = 0.34 cP
k(rw)=0.15 for k<1000 mD
k(rw)=0.30 for k>1000 mD

Table 2.

RFT Sample Data Sheet

Table 3a.

Well: La Bella-1

Date: 10th January 1993

KB: 25.0 m
Sample No: 1 **Depth:** 2160.5 mAHKB

Formation Pressure: 3243.31 psia

	Lower	Upper	
Chamber No:	222	RFS-AD-MR-1116	
Chamber Size:	6	1	gal
Flowing Pressure:	3181.4	3141.5	psig
Time To Fill:	22.0	2.5	minutes
Opening Pressure:	1960	1900	psia
Gas Volume:	134	Preserved	ft^3
Total Liquids:	650	For PVT	cc
Oil/Condensate Volume:	Approx. 75	Analysis	cc
Filtrate/Water Volume:	575		cc
Gas Oil Ratio:	----		Scf/Stb
Condensate Gas Ratio:	3.5		Stb/MMscf

Oil/Condensate Analysis

Specific Gravity:	Sample Too Small		Air = 1, Temp =
Colour:	Green Tinge		
Flourescence:	Bt-Mod Direct Blue		

Gas Analysis:

	Average of 3 samples			
C1:	15.10	79.72		%
C2:	5.30	5.30		%
C3:	2.04	2.04		%
iC4:	0.31	0.31		%
nC4:	0.30	0.30		%
C5+:	0.066	0.066		%
CO2:	12.3	12.3		%
H2S:	0	0		ppm

See Note Below

Water/Filtrate Analysis:

	Lower	Upper	Filtrate		
			Drilled	Logged	
Rw:					
pH:			9.5		
Cl-:	39,000		49,000		mg/l
Total Hardness (Ca/Mg):	500 +		140		
KCl:			7		

Tritium Analysis:

Average Activity:	N/A	N/A	N/A	N/A	Bq/cc
Returns:					Bq/cc
% Filtrate:					

Note: GC was not performing analysis on sample accurately. The raw data results for the gas analysis are shown on the left, modified results are shown on the right. The modification to the GC results entailed making up the percentage difference with methane.

RFT Sample Data Sheet

Table 3b.

Well: La Bella-1

Date: 10th January 1993

KB: 25.0 m

Sample No: 2 **Depth:** 2072.8 mAHKB

Formation Pressure: 3192.20 psia

	Lower	Upper	
Chamber No:	222	RFS-AD-MR-1120	
Chamber Size:	6	1	gal
Flowing Pressure:	1754	2217	psig
Time To Fill:	60	6	minutes
Opening Pressure:	2000	1960	psia
Gas Volume:	124	Preserved	ft^3
Total Liquids:	350	For PVT	cc
Oil/Condensate Volume:	35	Analysis	cc
Filtrate/Water Volume:	315		cc
Gas Oil Ratio:	---		Scf/Stb
Condensate Gas Ratio:	1.8		Stb/MMscf

Oil/Condensate Analysis

Specific Gravity:	Sample Too Small		Air=1, Temp=
Colour:	---		
Flourescence:	Bright Blue		

Gas Analysis:

	Average of 2 samples			
C1:	14.60	81.55		%
C2:	5.20	5.20		%
C3:	1.89	1.89		%
iC4:	0.31	0.31		%
nC4:	0.25	0.25		%
C5+:	0.0024	0.0024		%
CO2:	10.8	10.8		%
H2S:	0	0		ppm

*See Note Below

Water/Filtrate Analysis:

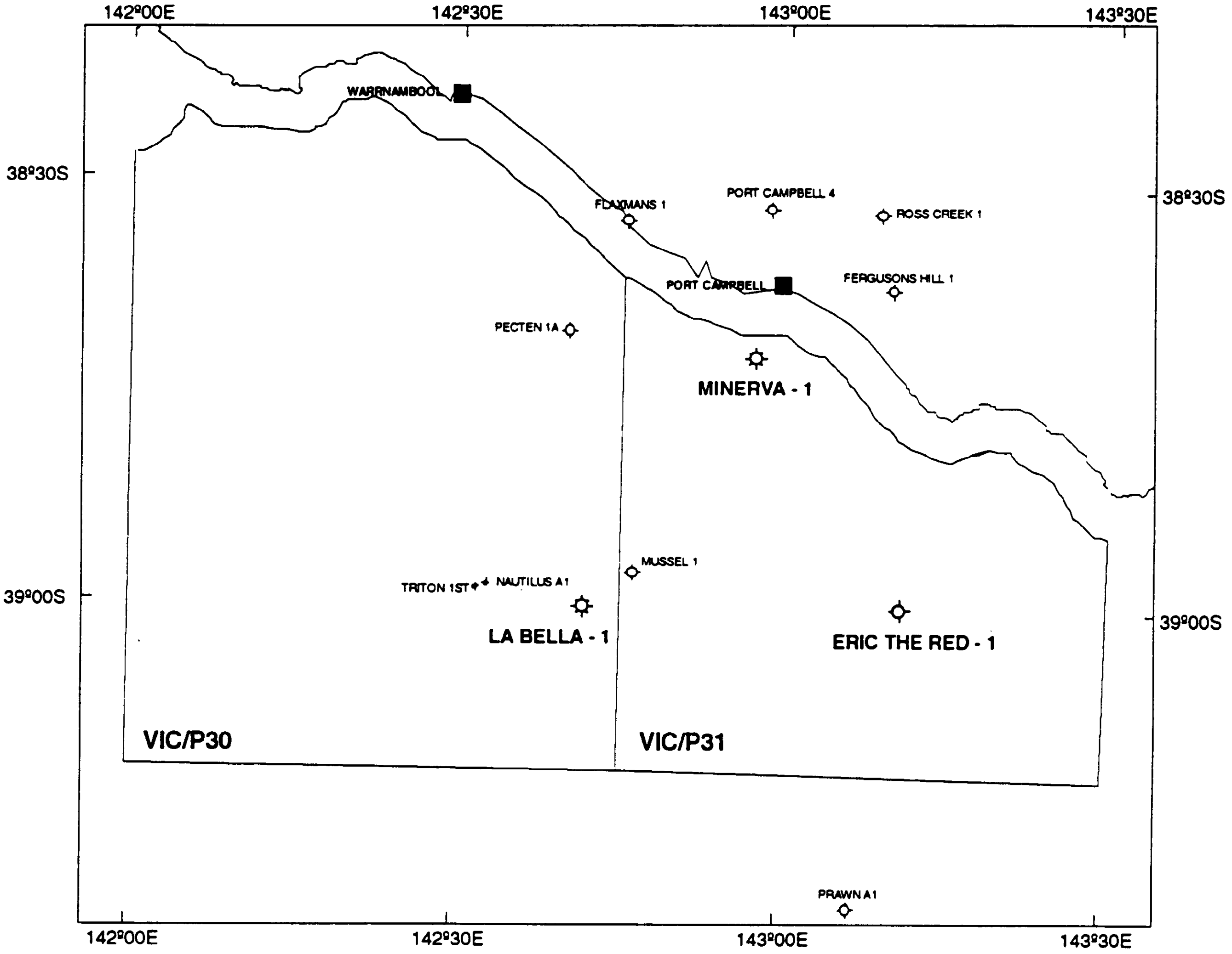
	Lower	Upper	Filtrate Drilled	Filtrate Logged	
Rw:					
pH:			9.5		
Cl-:	49,000		49,000		mg/l
Total Hardness (Ca/Mg):	600		140		
KCl:			7		

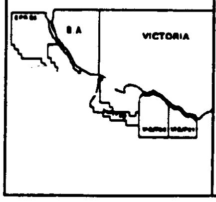
Tritium Analysis:

Average Activity:	N/A	N/A	N/A	N/A	Bq/cc
Returns:					Bq/cc
% Filtrate:					

Note: GC was not performing analysis on sample accurately. The raw data results for the gas analysis are shown on the left, modified results are shown on the right. The modification to the GC results entailed making up the percentage difference with methane.

Figure 1





VICP30/31
WELL LOCATIONS
LABELLA-1, ERIC THE RED-1 & MINERVA - 1

BHP Petroleum

OTWAY BASIN

VICP30/P31
LOCATION MAP

AUTHOR:	DATE: 05/04/23
DRAWN BY TDELPHIN	DWG NO: 005_TD

La Bella-1 RFT Results

Formation Pressure vs Depth (HP)

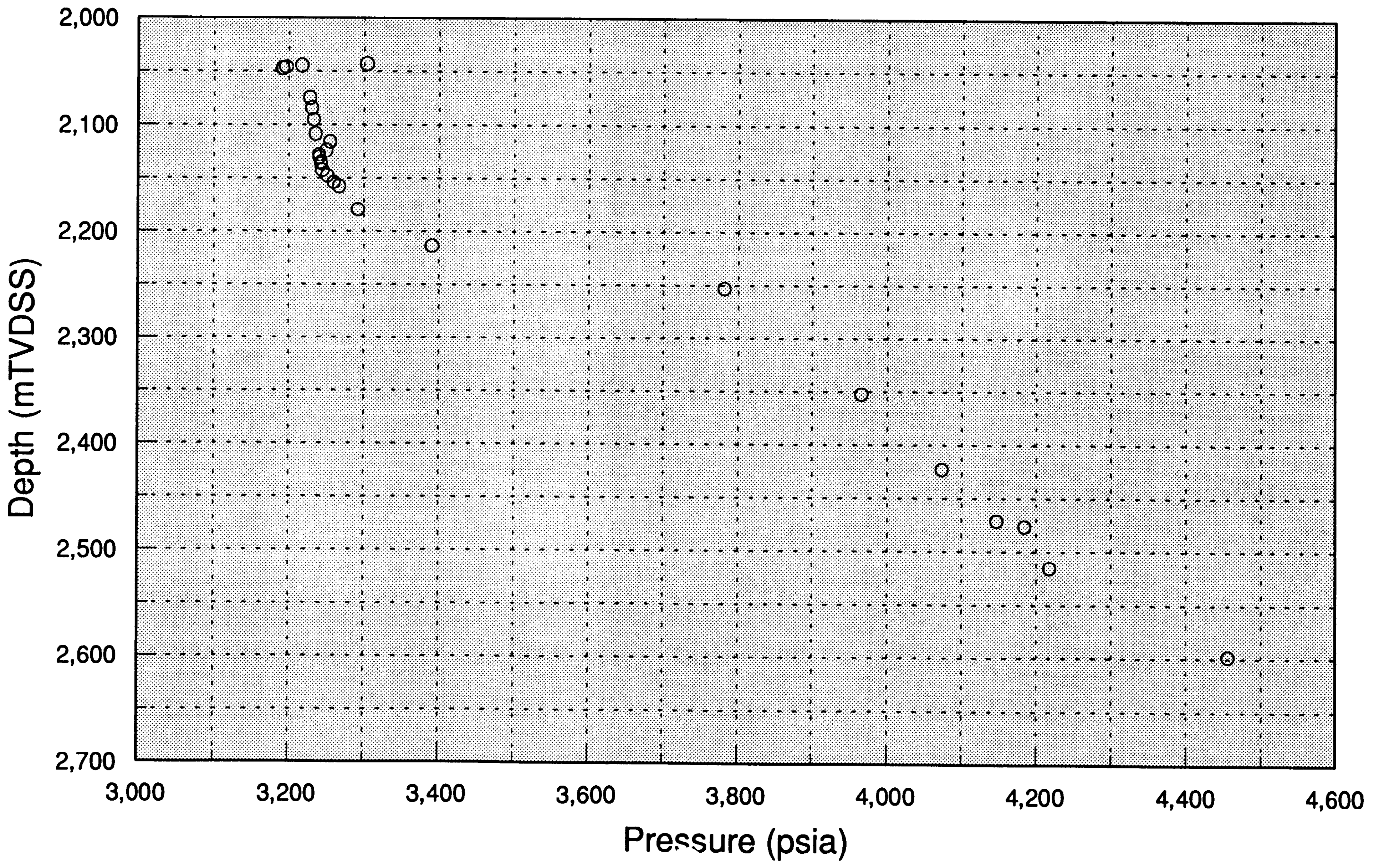
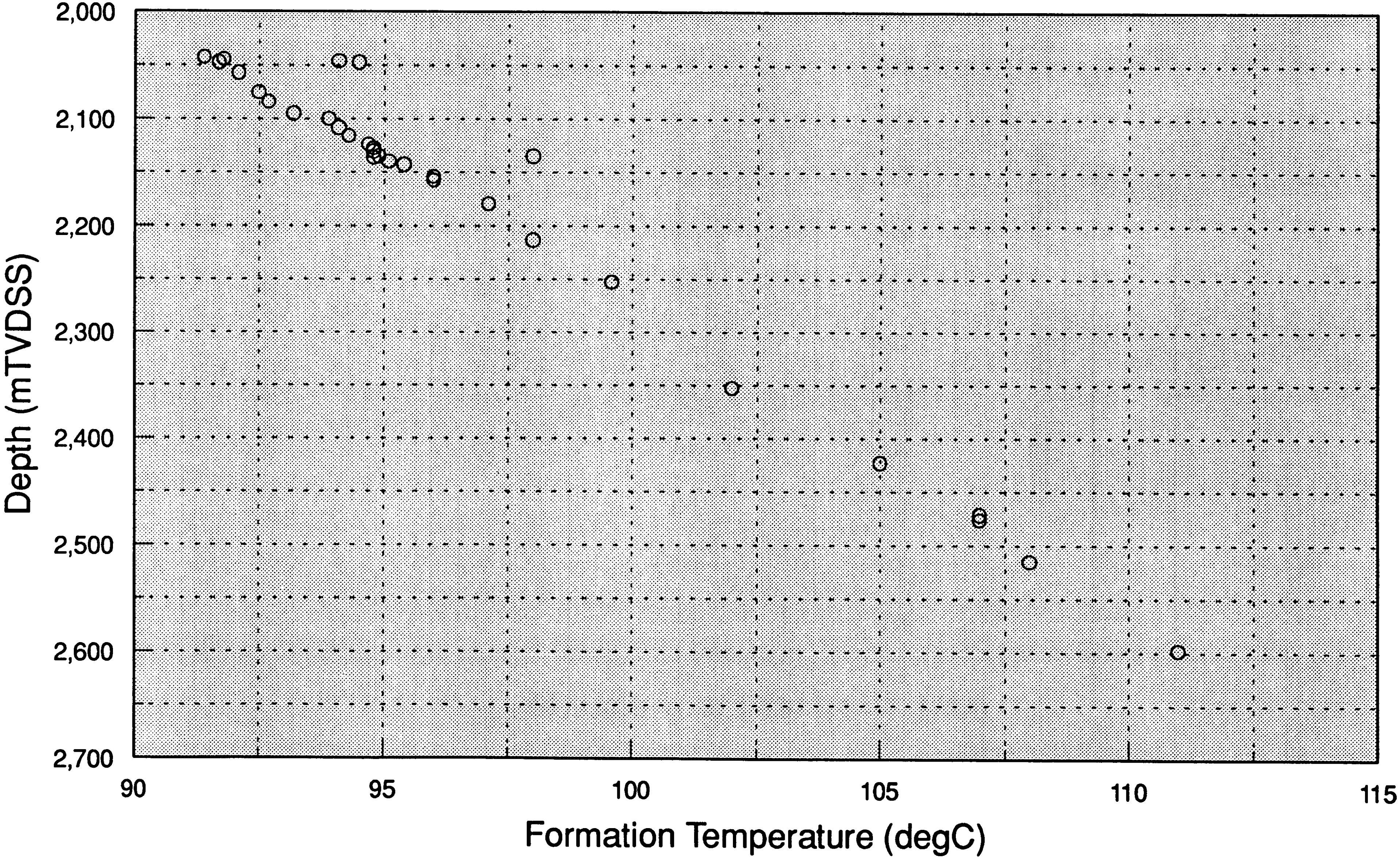


Figure 2.



La Bella-1 RFT Results

Formation Temperature vs Depth

Figure 3.

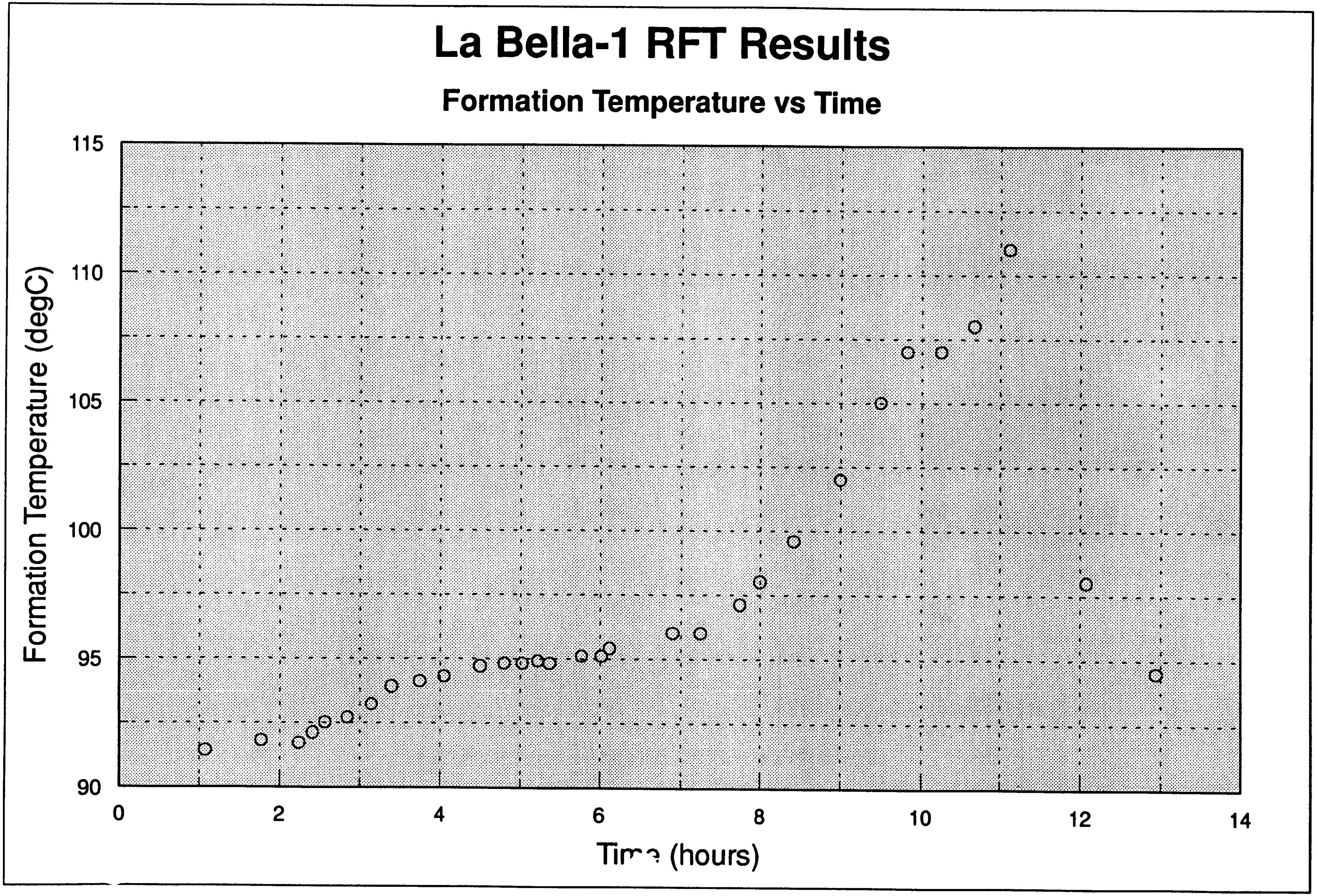

La Bella-1 RFT Results
Formation Temperature vs Time
Formation Temperature (degC)
115
110
105
100
95
90
0
2
4
6
8
10
12
14
Time (hours)

Figure 4.

La Bella-1 RFT Results

Final-Initial Hydrostatic Pressure (HP)

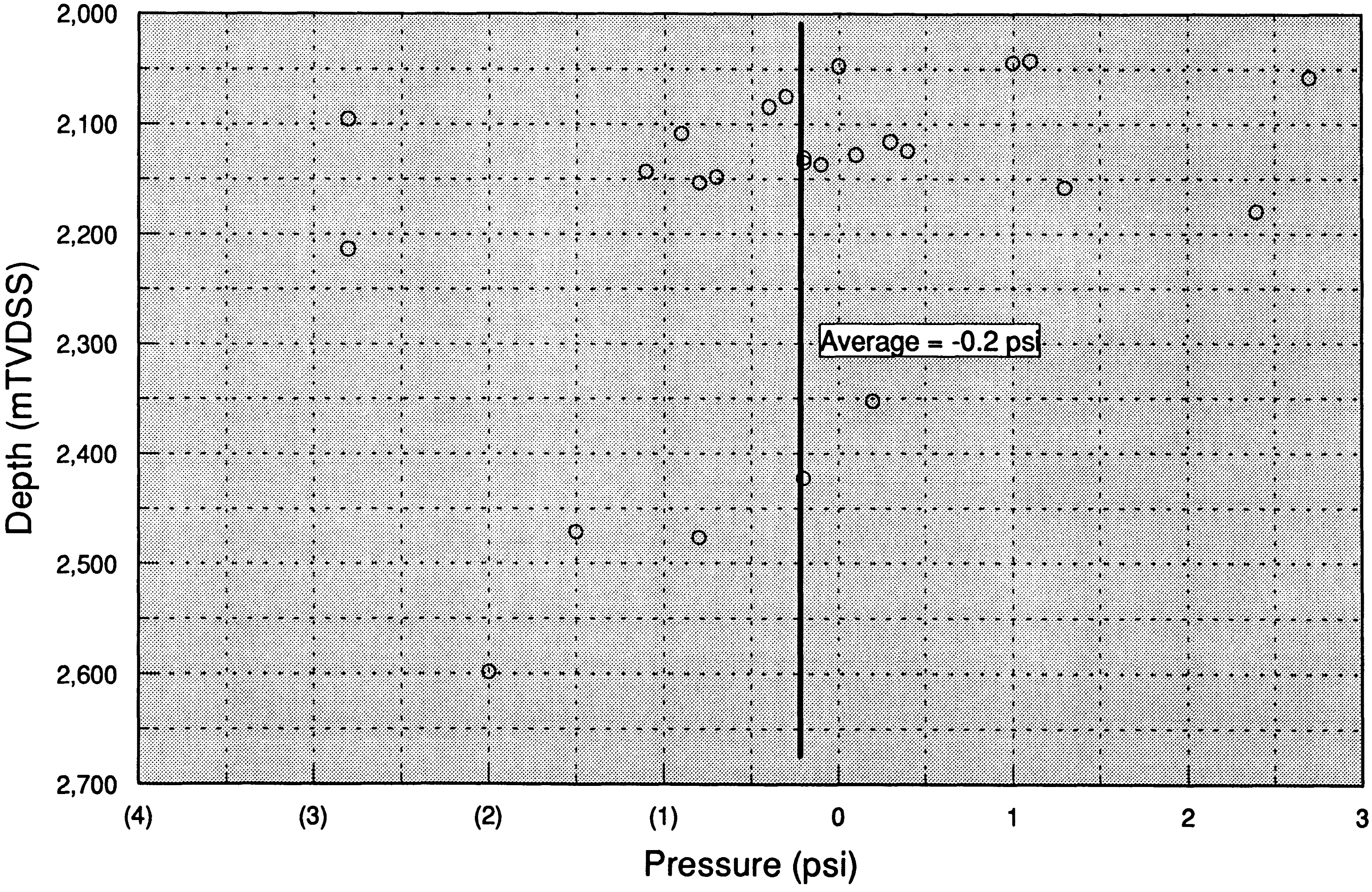


Figure 5.

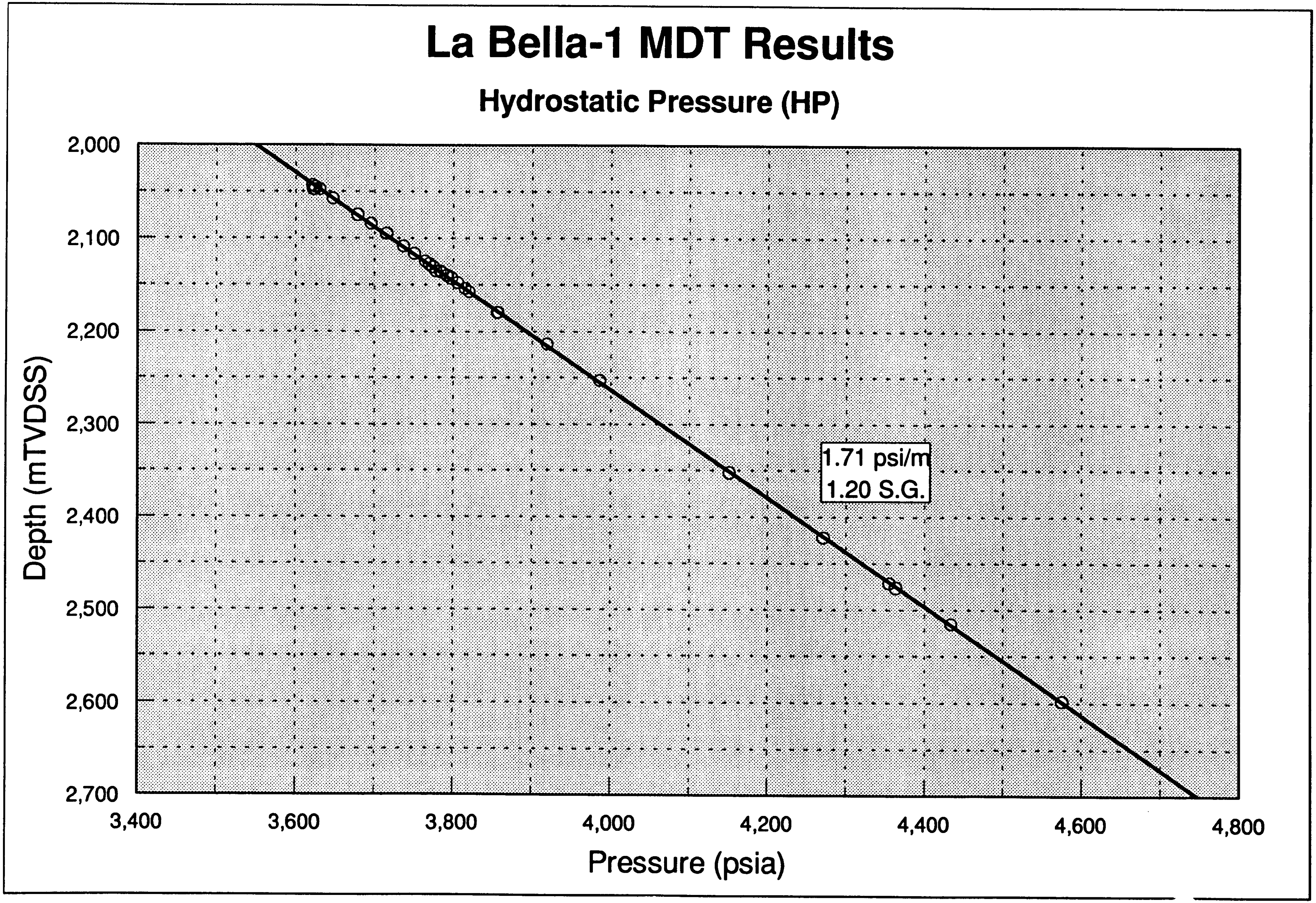

La Bella-1 MDT Results
Hydrostatic Pressure (HP)
Depth (mTVDSS)
2,000
2,100
2,200
2,300
2,400
2,500
2,600
2,700
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
Pressure (psia)
1.71 psi/m
1.20 S.G.

Figure 6.

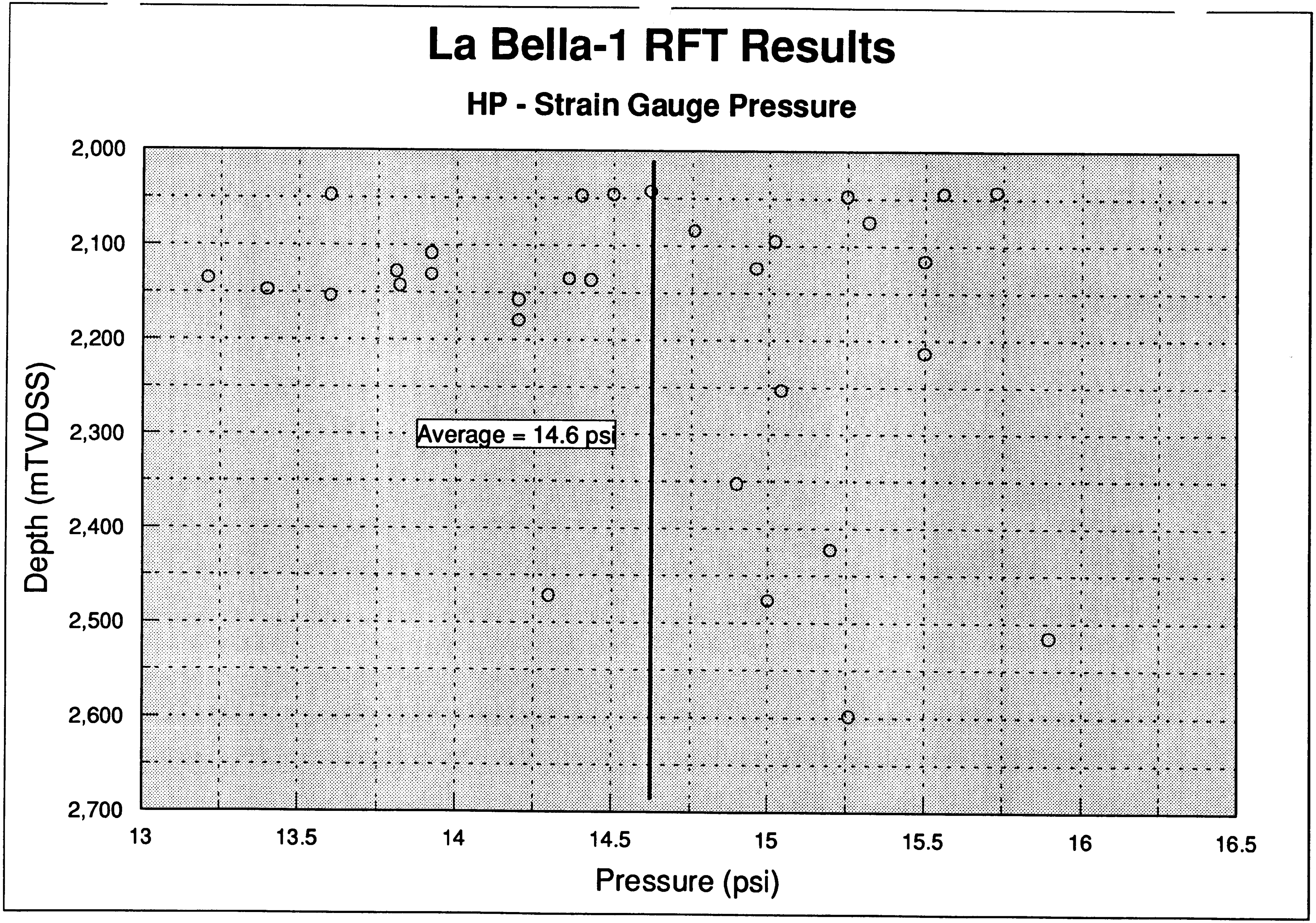
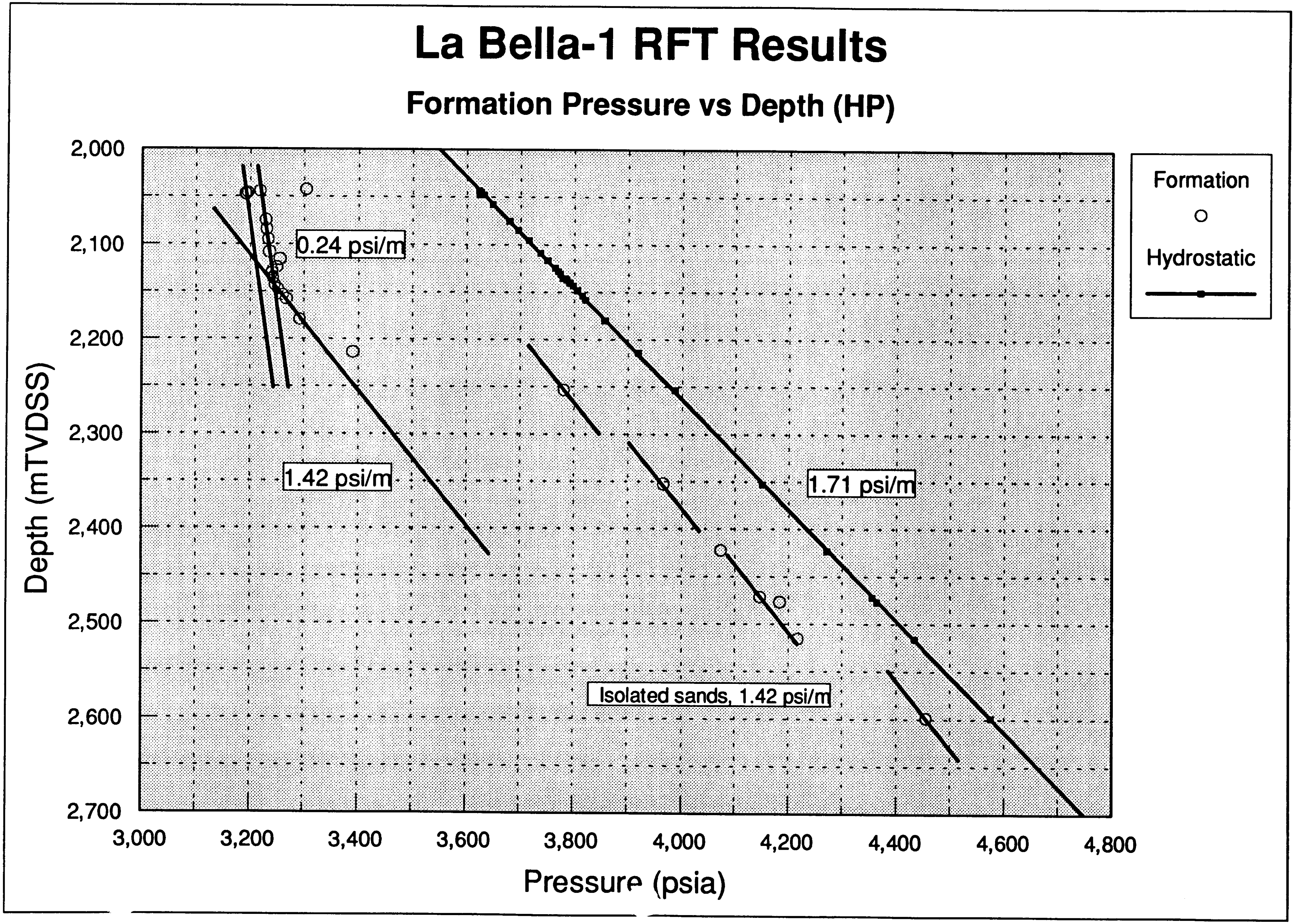

La Bella-1 RFT Results
HP - Strain Gauge Pressure
Depth (mTVDSS)
2,000
2,100
2,200
2,300
2,400
2,500
2,600
2,700
Average = 14.6 psi
13
13.5
14
14.5
15
15.5
16
16.5
Pressure (psi)

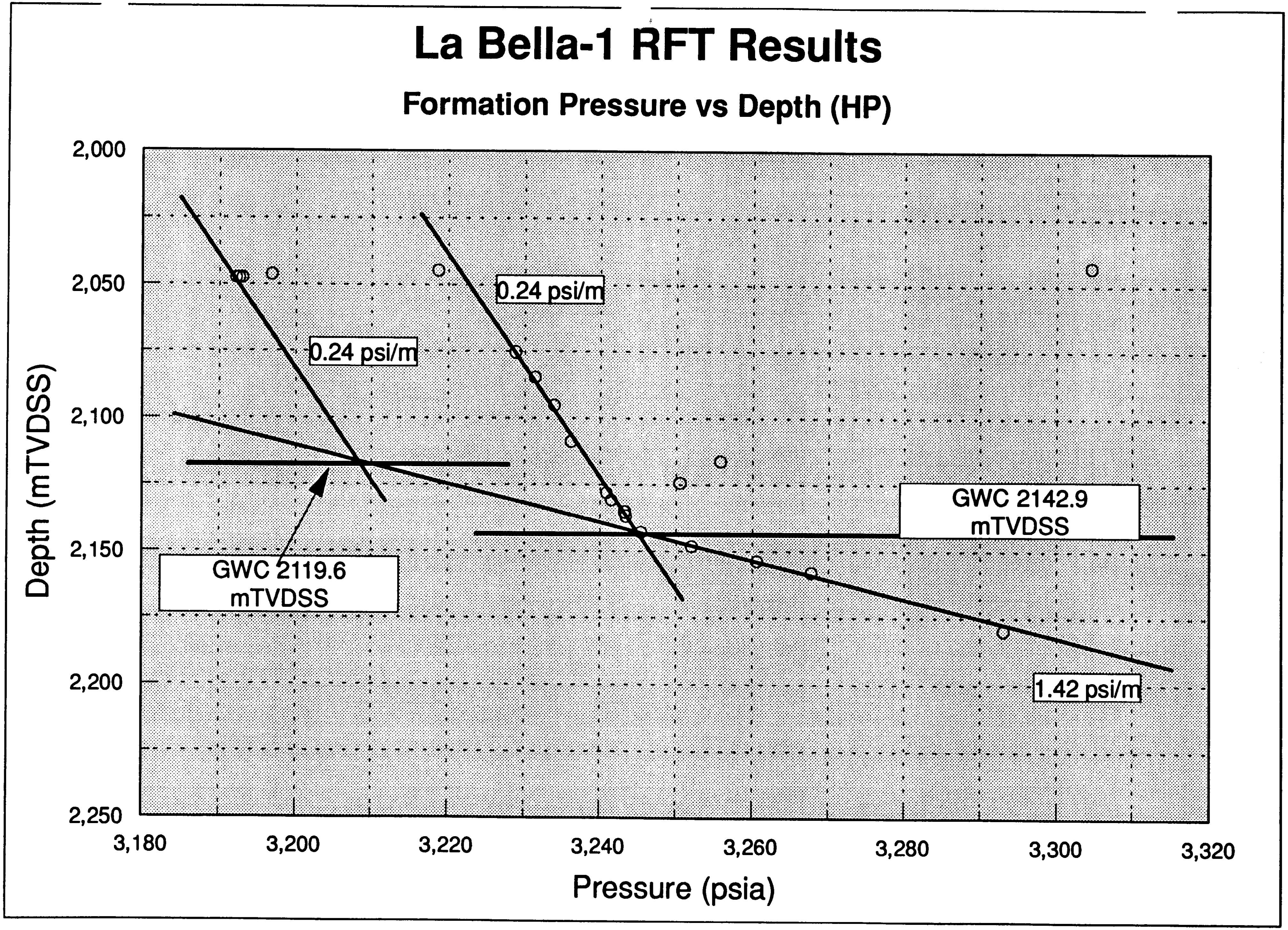
Figure 7.



La Bella-1 RFT Results

Formation Pressure vs Depth (HP)

Figure 8.



La Bella-1 RFT Results

Formation Pressure vs Depth (HP)

Figure 9.

VIC/P30 and VIC/P31 Formation Pressure Data

Formation Pressure vs Depth (Strain Gauge)

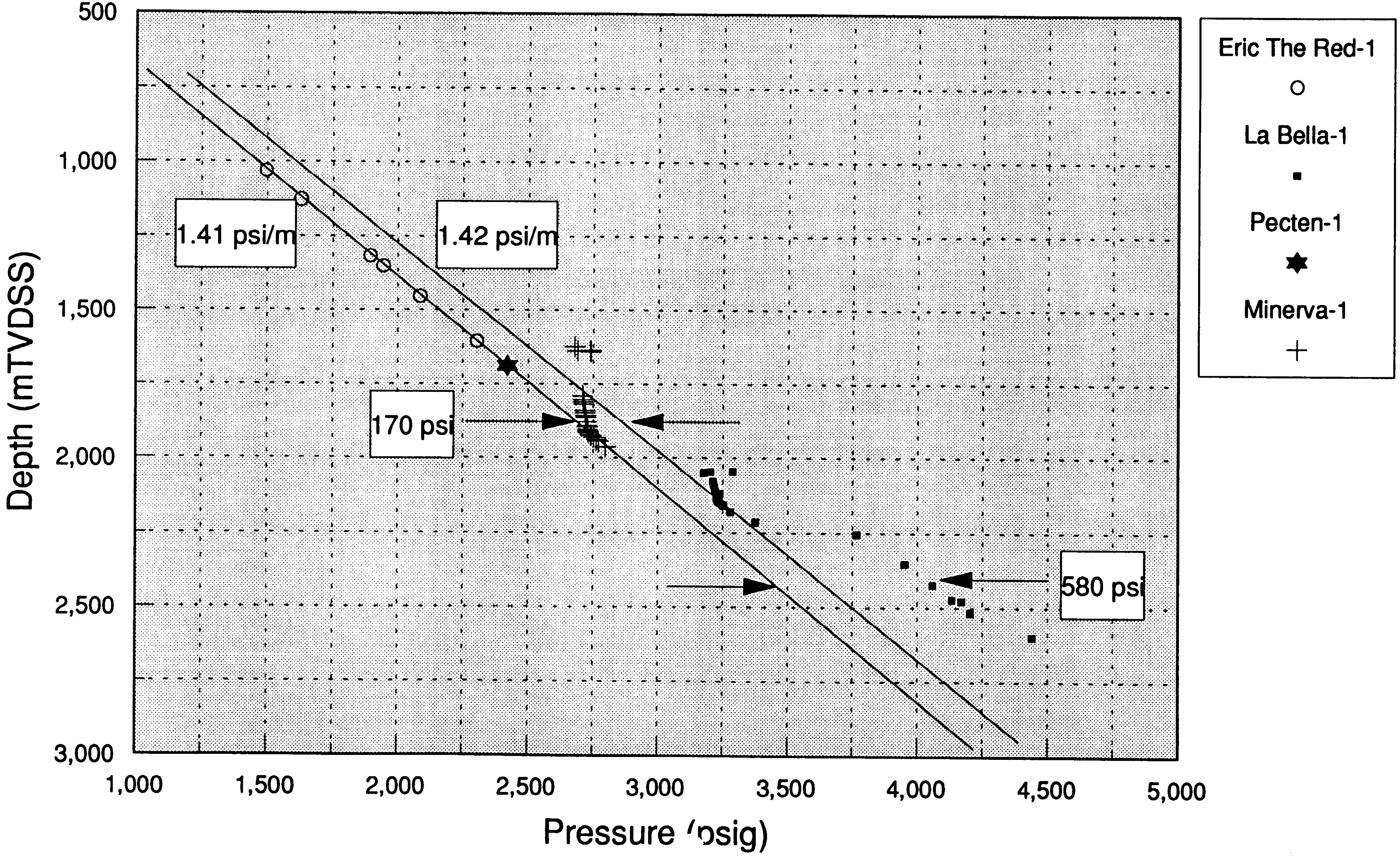


Figure 10.

APPENDIX A:

PETROLAB PVT ANALYSIS REPORT

47 Woodforde Road, Magill,
South Australia, 5072
P.C 410,
Ma South Australia, 5072

PETROLAB

Fax: 364 1500
Telex: AA88214
Tel: (08) 364 1500
(08) 333 0787

Reservoir Fluid and Core Services, Laboratory Consulting and Analysis

A. C. N. 008 130 667

Adelaide, March 12, 1993
P. O. Box 410
Magill
S. A. 5072

B H P Petroleum Pty. Ltd.
G. P. O. Box 1911-R
Melbourne
Vic. 3001

Subject: Reservoir Fluid Study
Well : La Bella # 1
File : B - 93009

Attention: Mr. Chris Taylor
Mr. Keith Edwards

Dear Sirs,

Please find enclosed our results of compositional analyses and constant mass studies performed on bottom hole samples transferred from RFT chambers # RFS AD-1120 and # RFS AD-1120 containing samples from subject well.

Representative low pressure samples from all RFT chambers were also transferred into gas cylinders for isotope and other geochemical analyses and forwarded to BHP in Melbourne.

During these constant composition expansions at the reservoir temperature, no dew point pressure was observed for the sample from RFT chamber # RFS AD-1120, but the sample from RFS AD-1116 exhibited a dew point at 2187 psig.

We thank BHP Petroleum Pty. Ltd. for the opportunity given to be of service. Please do not hesitate in contacting us should you require any further information or if we can assist you in any other way.

Yours Sincerely,

Jan G. Bon
Manager

REPORT INDEX

Page

RFS – AD – 1120

RFS – AD # 1116

TRANSFER DETAILS

RFT Chamber	:	RFS – AD # 1120
Depth	:	2072.8 M KB
Capacity	:	1 Gallon
Run Type	:	Open Hole RFT
Received	:	February 19, 1993
Opening Pressure	:	2220 Psig @ 39 oC

Injected 100 cc's of mercury in chamber to stir up sample. Chamber compressed to 5000 psig with approximately 1420 cc's of water behind piston. Transferred 1800 cc's into Petrolab cylinders # L–096, L–158 and # L–134 @ 5000 psig. Flashed rest of sample to atmosphere. Recovered an additional 50 cc's of water and all mercury. Tool dismantled and cleaned of all mercury and shipped back to Schlumberger on February 22, 1992.

SUMMARY OF RESULTS

RESERVOIR FLUID IS DRY GAS !! NO DEW POINT MEASURED !!

VAPOUR AT RESERVOIR CONDITIONS:

Reservoir Temperature (°F)	:	194
Dew Point Pressure (psig)	:	---
Gas Formation Volume Factor (Bg)	:	0.00502
Gas Expansion Factor (E)	:	199.01
Gas Deviation Factor (Z)	:	0.868
Specific Volume (CFT/LB)	:	0.08727
Density (gm/cc)	:	0.1836
Viscosity (centipoise)	:	0.0226
Molecular Weight	:	21.86
Gas Gravity (Air = 1.000)	:	0.757
Gross Heating Value (BTU/ft3)	:	958

Total Plant Products in Reservoir Fluid (GPMM):

Ethane	:	1226
Propane	:	472
Butanes	:	215
Pentanes Plus	:	285

FIELD CHARACTERISTICS:

Formation Name	:	--
Date first well completed	:	--
Original reservoir pressure (psia)	:	--
@ datum (ft KBMD)	:	--
Original Gas-Liquid Ratio SCF/STB)	:	--
Separator pressure (psig)	:	--
Separator temperature (°F)	:	--
Liquid gravity (°API @ 60 °F)	:	--

WELL CHARACTERISTICS:

Depth datum (m)	:	KB
Elevation above MSL (m)	:	25.0
Total depth (m MD)	:	--
Producing interval (m)	:	--
Perforated intervals (m)	:	--
Casing Shoe (m KB)	:	--
Casing Size (inch)	:	--
Reservoir temperature (°F)	:	194
Last reservoir pressure (psia)	:	3193
@ datum (m TVD ss)	:	--
date	:	--
Status of well	:	--

BOTTOM HOLE SAMPLING CONDITIONS:

Chamber #	:	RFS - AD # 1120
Run Type	:	Open hole RFT
Capacity	:	1 Gallon
Depth sampled (m KB)	:	2072.8
Sample type	:	Gas
Sampled by	:	Schlumberger

COMPOSITIONAL ANALYSIS OF Reservoir Fluid

RFS AD # 1120

Component		Mol %	GPM
Oxygen	O2	0.00	
Carbon Dioxide	CO2	12.46	
Nitrogen	N2	3.43	
Methane	C1	76.46	
Ethane	C2	4.58	1.226
Propane	C3	1.71	0.472
Iso-Butane	iC4	0.34	0.111
N-Butane	nC4	0.33	0.104
Iso-Pentane	iC5	0.12	0.044
N-Pentane	nC5	0.08	0.029
Hexanes	C6	0.15	0.058
Heptanes	C7	0.20	0.084
Octanes	C8	0.06	0.027
Nonanes	C9	0.03	0.015
Decanes	C10	0.03	0.016
Undecanes	C11	0.02	0.012
Dodecanes Plus	C12+	0.00	0.000
TOTAL		100.00	2.198

Pressure Base : 14.696
Zsc : 0.997

Mol Weight : 21.86
Gas Gravity : 0.757
Pc : 709.3
Tc : 386.6

Mol Weight C6+ : 99.6
Density C6+ : 0.6886

Mol Weight C7+ : 106.5
Density C7+ : 0.6974

Mol Weight C8+ : 121.5
Density C8+ : 0.7148

Mol Weight C11+ : 147.0
Density C11+ : 0.7400

Mol Weight C12+ : --
Density C12+ : --

Heating Value (BTU/ft3)
Gross : 958
Nett : 866

Wobbe Index : 1102

Zpt * : 0.893

(P)ressure : 3178 psig (T)emperature: 194 °F

CONSTANT MASS STUDY
@ 194 °F

Pressure (psig)	Relative Volume (V/Vsat) (1)	Formation Volume Factor (Bg) (2)	Gas Expansion Factor (E) (3)	Deviation Factor (Z)	Specific Volume (CFT/LB)	Gas Viscosity (Centipoise) (4)
5000	0.7203	0.00362	276.29	0.982	0.06286	0.0307
4500	0.7707	0.00387	258.20	0.946	0.06727	0.0285
4000	0.8356	0.00420	238.17	0.912	0.07292	0.0263
3500	0.9230	0.00464	215.60	0.882	0.08056	0.0240
3178 *	1.0000	0.00502	199.01	0.868	0.08727	0.0226
2802	1.1178	0.00562	178.03	0.856	0.09756	0.0209
2580	1.2078	0.00607	164.77	0.852	0.10541	0.0199
2277	1.3707	0.00689	145.19	0.854	0.11963	0.0186
1962	1.6003	0.00804	124.36	0.860	0.13966	0.0173
1657	1.9121	0.00961	104.08	0.869	0.16687	0.0163
1416	2.2573	0.01134	88.16	0.878	0.19700	0.0155
1114	2.9036	0.01459	68.54	0.891	0.25341	0.0146

* Reservoir Pressure

!! NO DEW POINT FOUND RESERVOIR FLUID IS ~~WET~~ DRY GAS !!

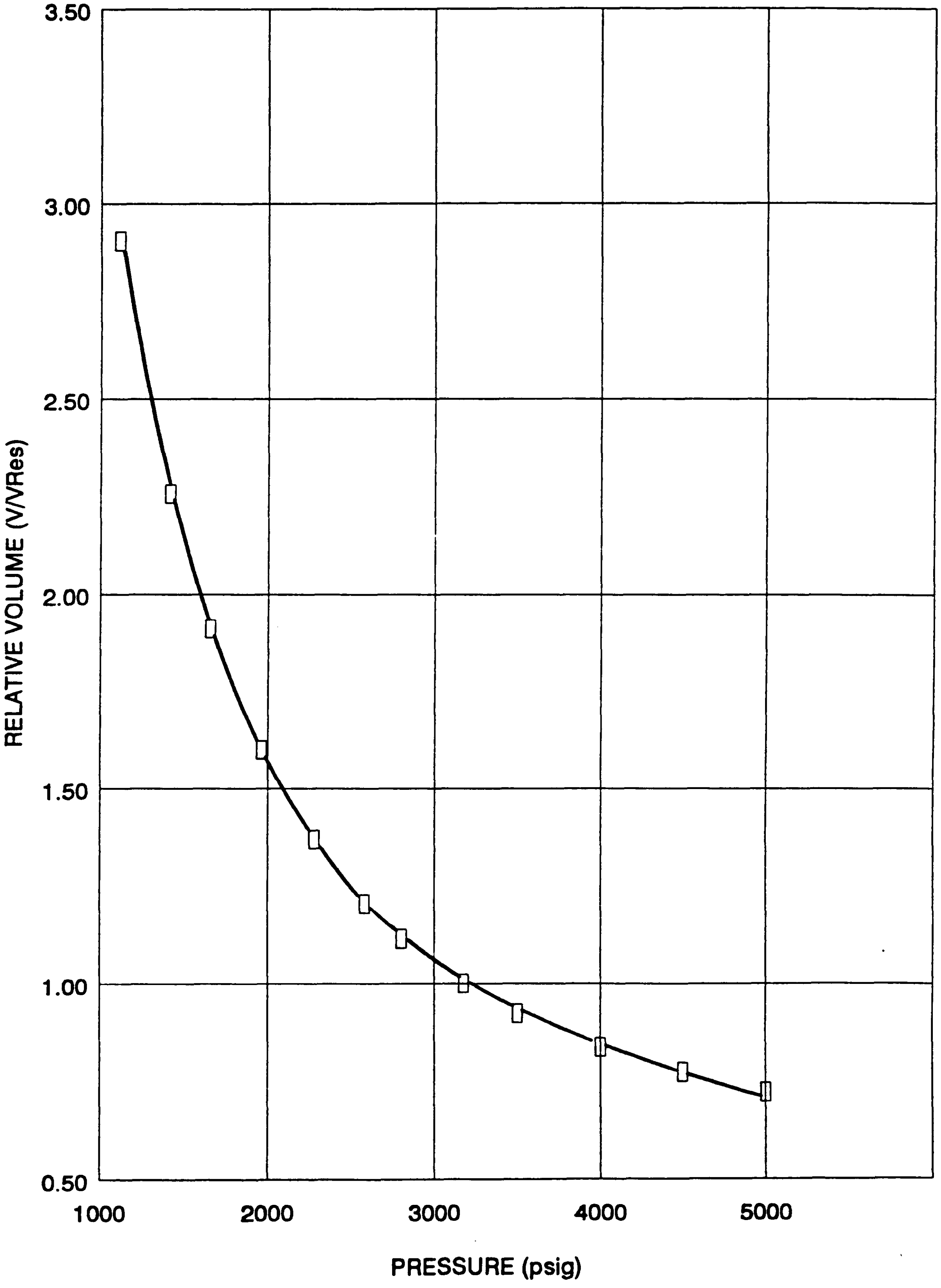
(1) Cubic feet of gas at indicated pressure and temperature per cubic foot at reservoir pressure

(2) Cubic feet of gas at indicated pressure and temperature per cubic foot at 14.696 psia and 60 °F

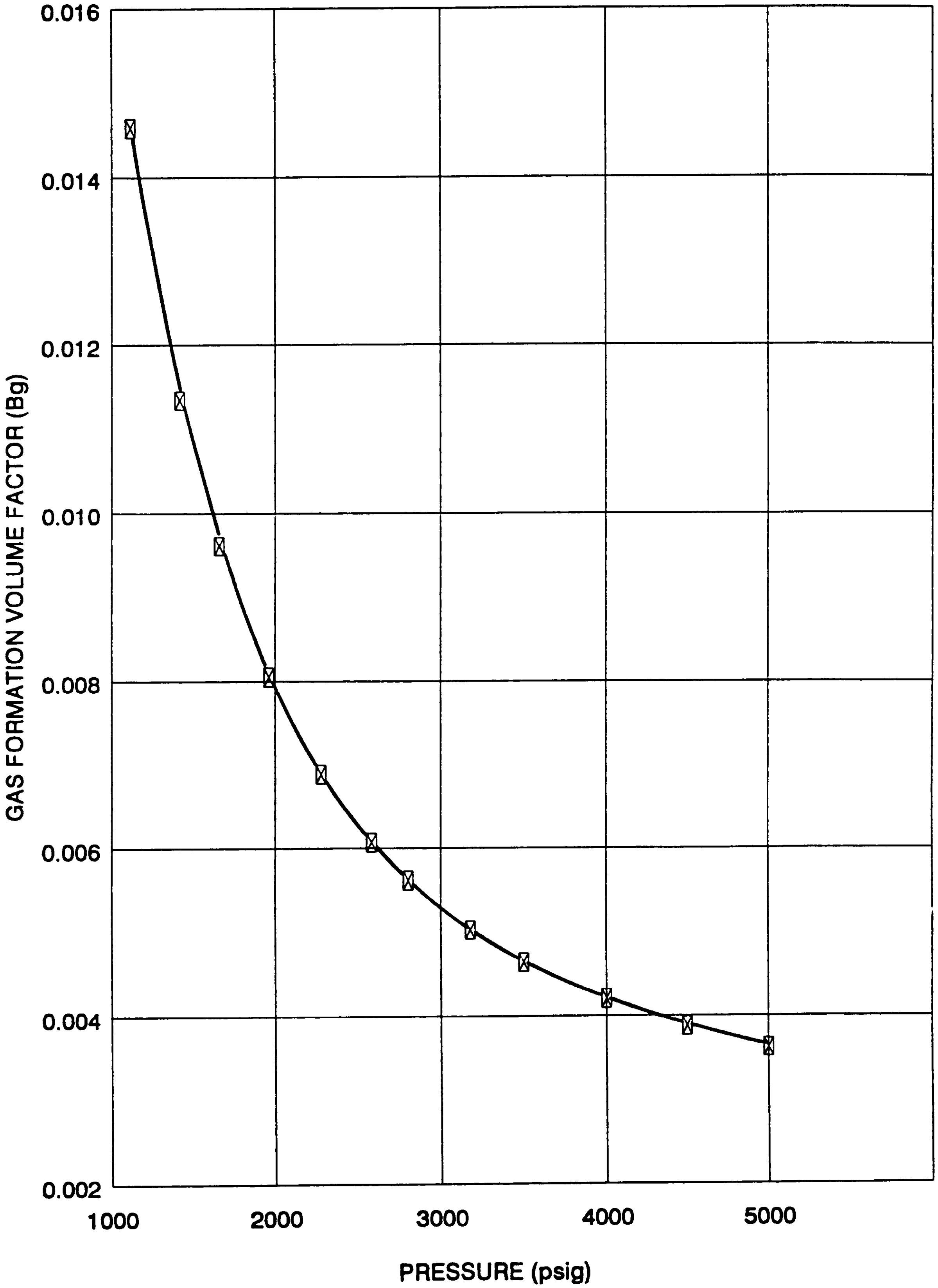
(3) Cubic feet of gas at 14.696 psia and 60 °F per cubic foot at indicated pressure and temperature

(4) Calculated from correlation of Lee, Gonzales and Eakin

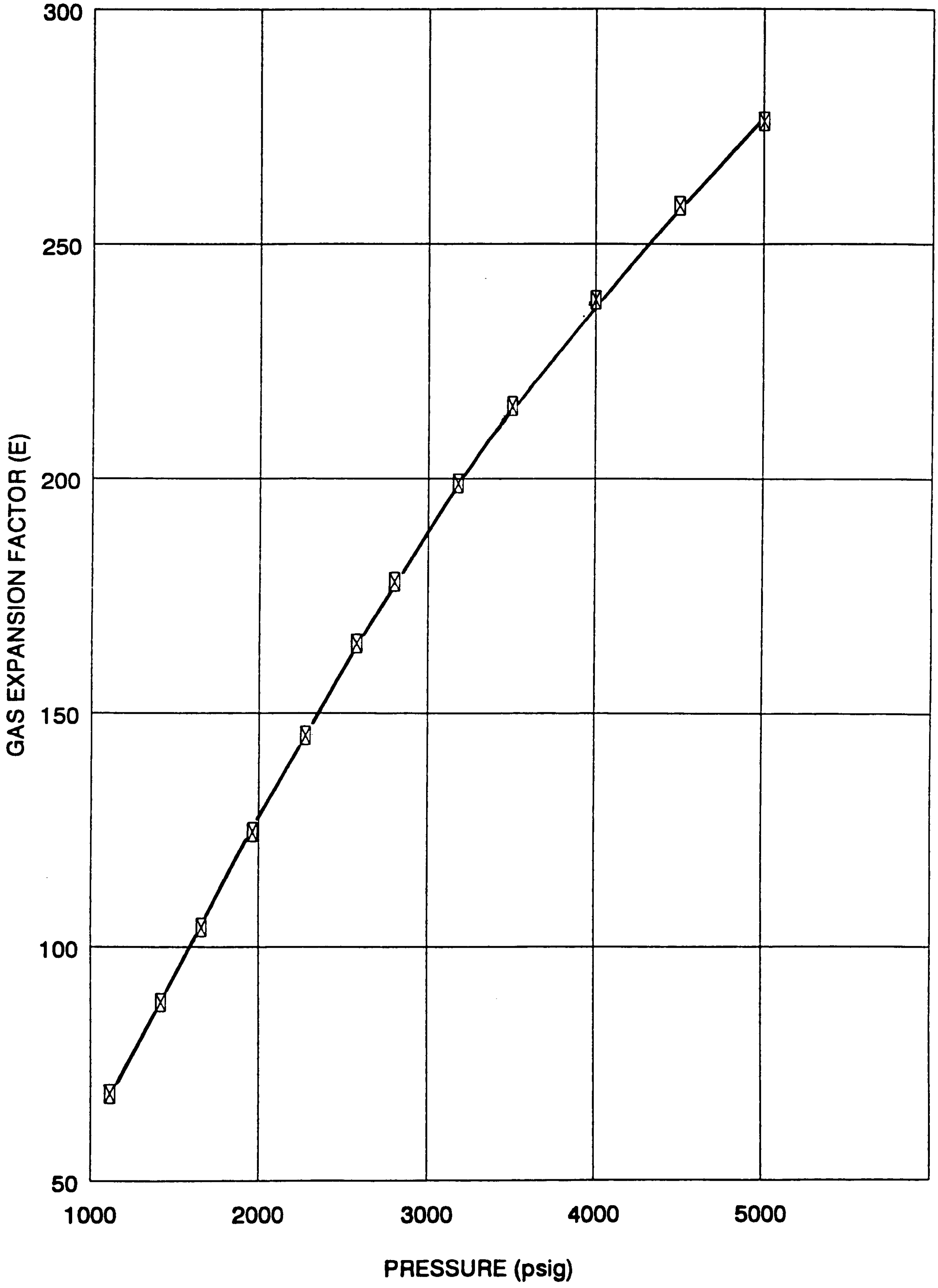
RELATIVE VOLUME



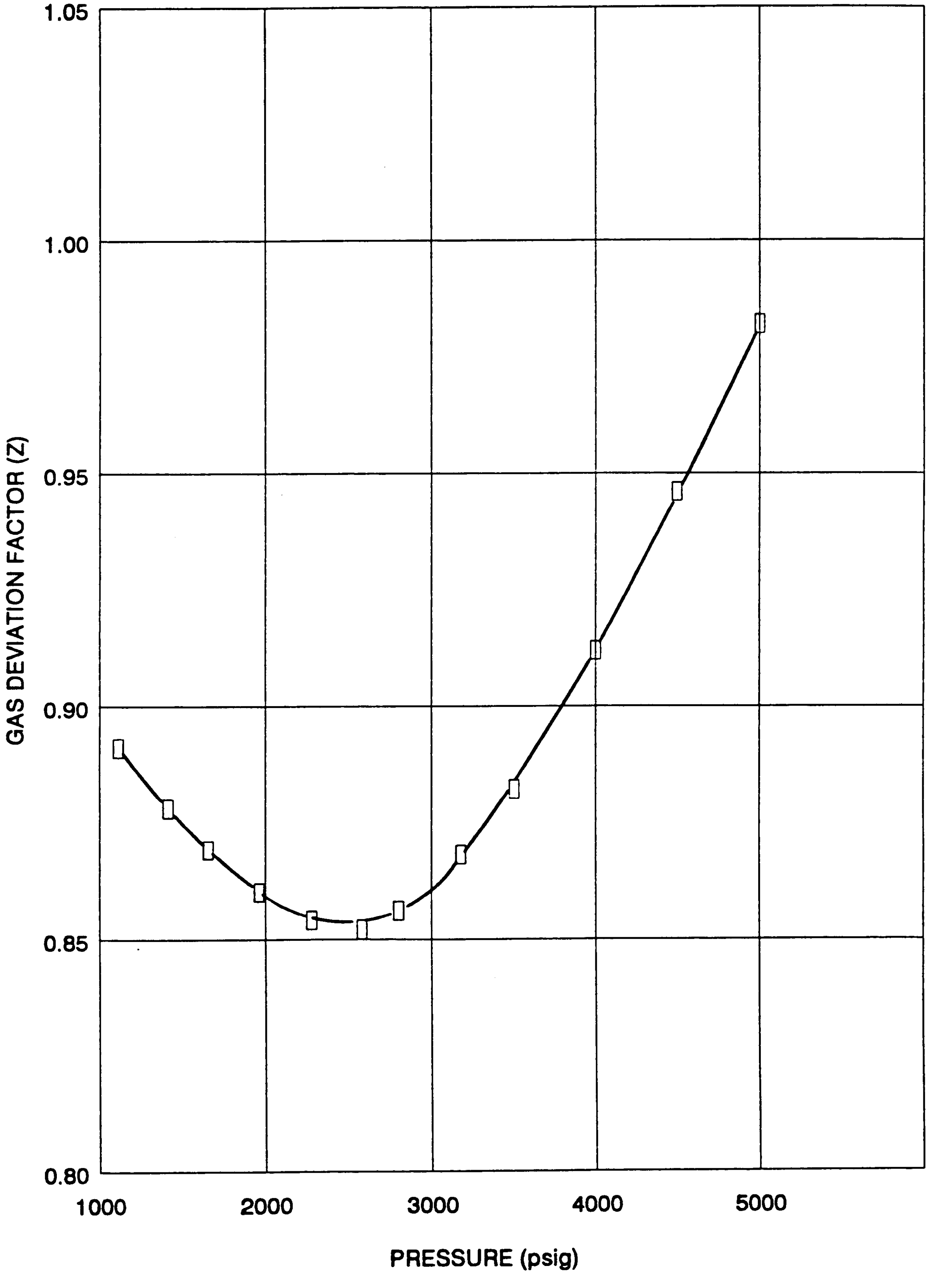
GAS FORMATION VOLUME FACTOR



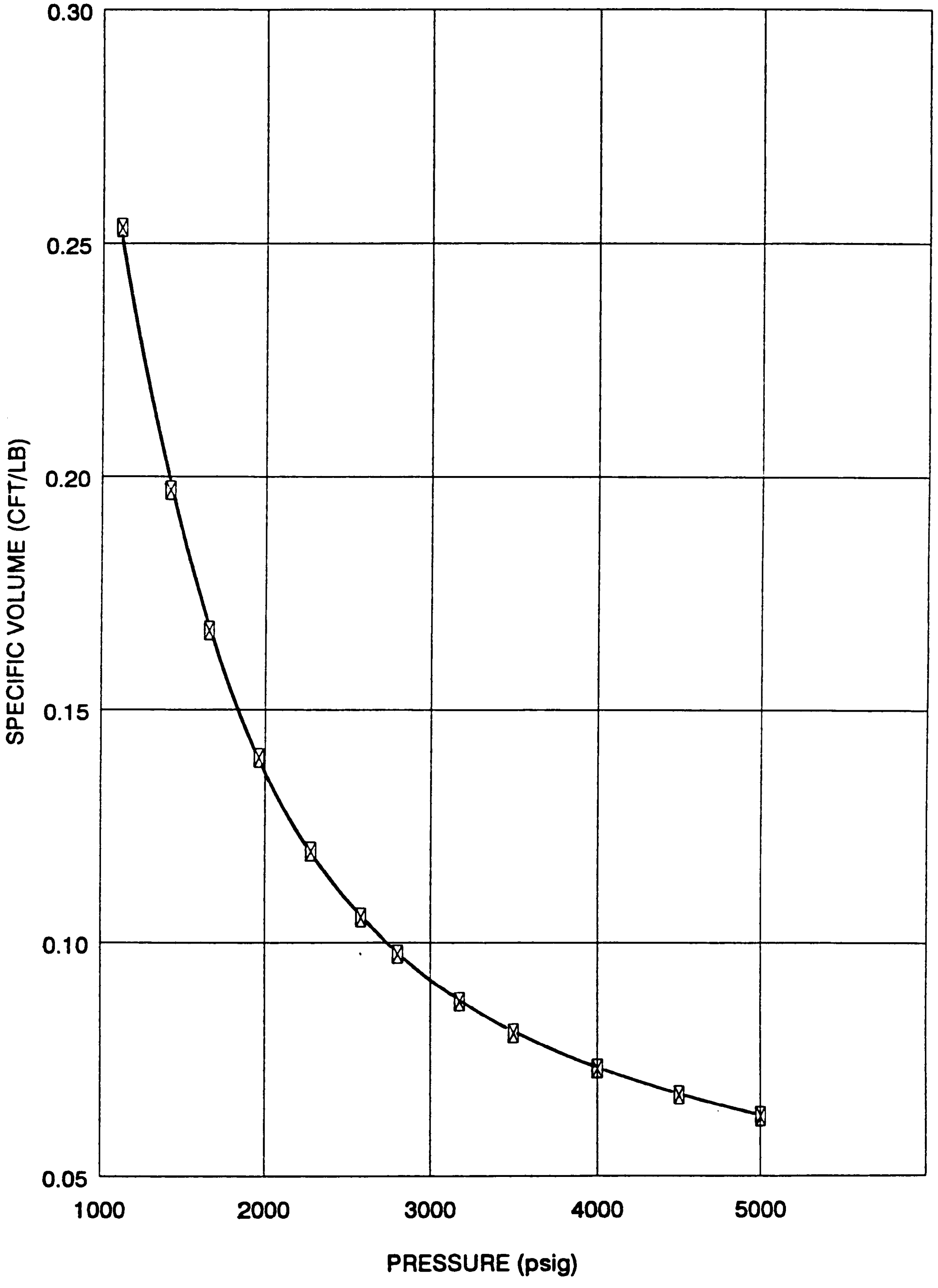
GAS EXPANSION FACTOR



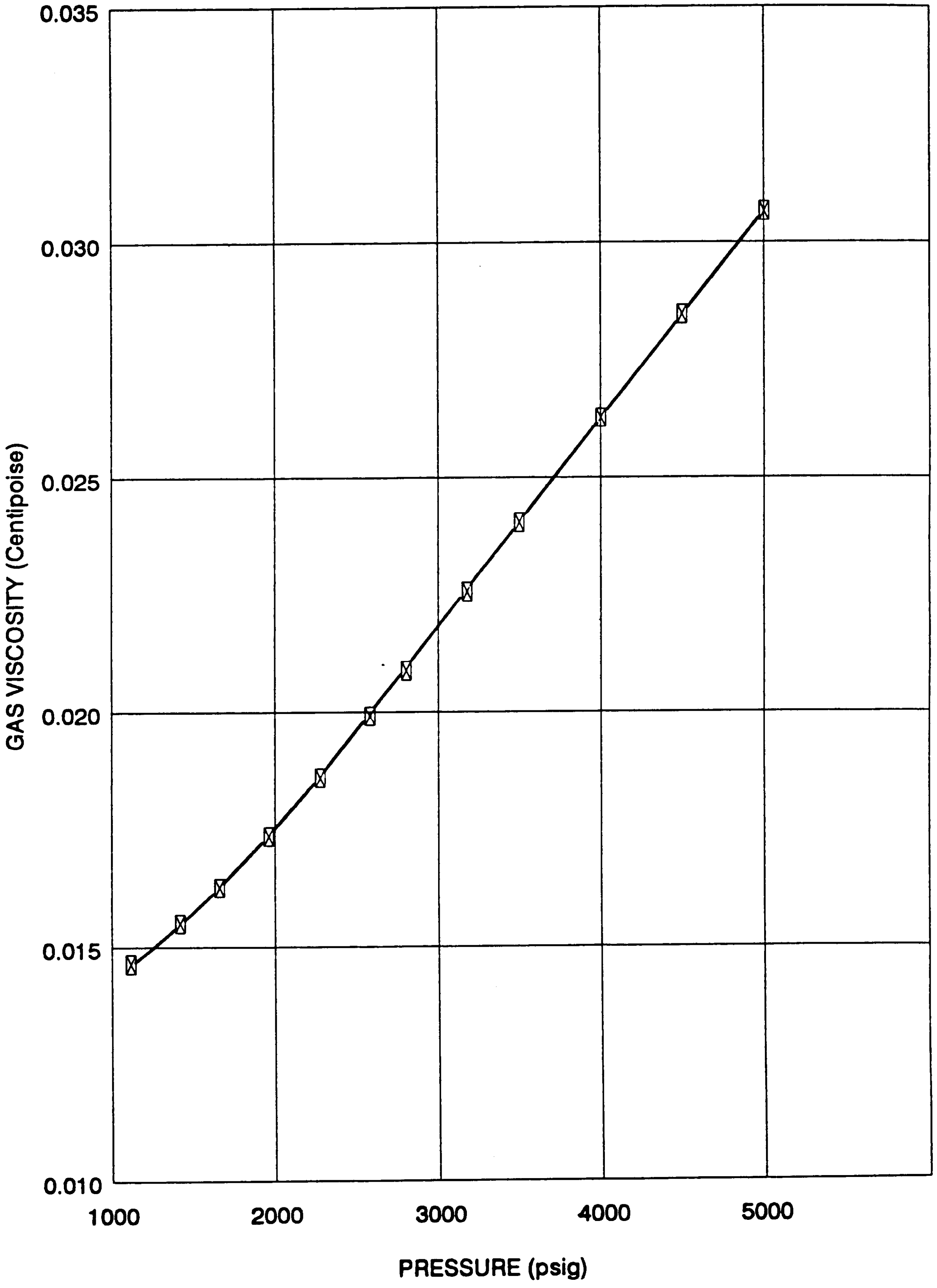
GAS DEVIATION FACTOR



RESERVOIR FLUID SPECIFIC VOLUME



VISCOSITY OF RESERVOIR FLUID



TRANSFER DETAILS

RFT Chamber	:	RFS – AD # 1116
Depth	:	2160.5 M KB
Capacity	:	1 Gallon
Run Type	:	Open Hole RFT
Received	:	February 19, 1993
Opening Pressure	:	2000 Psig @ 27 oC

Injected 150 cc's of mercury in chamber to stir up sample. Chamber compressed to 5000 psig with approximately 1550 cc's of water behind piston. Transferred 1800 cc's into Petrolab cylinders # L–062, L–183 and # L–076 @ 5000 psig. Flashed rest of sample to atmosphere. Recovered an additional 120 cc's of water and all mercury. Tool dismantled and cleaned of all mercury and shipped back to Schlumberger on February 22, 1992.

SUMMARY OF RESULTS

RESERVOIR FLUID IS GAS CONDENSATE

SATURATED VAPOUR:

Reservoir Temperature (°F)	:	203
Dew Point Pressure (psig)	:	2187
Gas Formation Volume Factor (Bg)	:	0.00726
Gas Expansion Factor (E)	:	137.75
Gas Deviation Factor (Z)	:	0.853
Specific Volume (CFT/LB)	:	0.12337
Density (gm/cc)	:	0.1298
Viscosity (centipoise)	:	0.0184
Molecular Weight	:	22.34
Gas Gravity (Air = 1.000)	:	0.774
Gross Heating Value (BTU/ft3)	:	972

Total Plant Products in Reservoir Fluid (GPMM):

Ethane	:	1314
Propane	:	499
Butanes	:	215
Pentanes Plus	:	409

FIELD CHARACTERISTICS:

Formation Name	:	--
Date first well completed	:	--
Original reservoir pressure (psia)	:	--
@ datum (ft KBMD)	:	--
Original Gas-Liquid Ratio SCF/STB)	:	--
Separator pressure (psig)	:	--
Separator temperature (°F)	:	--
Liquid gravity (°API @ 60 °F)	:	--

WELL CHARACTERISTICS:

Depth datum (m)	:	KB
Elevation above MSL (m)	:	25.0
Total depth (m MD)	:	--
Producing interval (m)	:	--
Perforated intervals (m)	:	--
Casing Shoe (m KB)	:	--
Casing Size (inch)	:	--
Reservoir temperature (°F)	:	203
Last reservoir pressure (psia)	:	3243
@ datum (m TVD ss)	:	--
date	:	--
Status of well	:	--

BOTTOM HOLE SAMPLING CONDITIONS:

Chamber #	:	RFS - AD # 1116
Run Type	:	Open hole RFT
Capacity	:	1 Gallon
Depth sampled (m KB)	:	2160.5
Sample type	:	Gas
Sampled by	:	Schlumberger

COMPOSITIONAL ANALYSIS OF
Reservoir Fluid

RFS AD # 1116

Component		Mol %	GPM
Oxygen	O2	0.00	
Carbon Dioxide	CO2	13.30	
Nitrogen	N2	2.90	
Methane	C1	75.43	
Ethane	C2	4.91	1.314
Propane	C3	1.81	0.499
Iso-Butane	iC4	0.32	0.105
N-Butane	nC4	0.35	0.110
Iso-Pentane	iC5	0.13	0.048
N-Pentane	nC5	0.10	0.036
Hexanes	C6	0.23	0.089
Heptanes	C7	0.29	0.122
Octanes	C8	0.10	0.045
Nonanes	C9	0.07	0.035
Decanes	C10	0.04	0.022
Undecanes	C11	0.02	0.012
Dodecanes Plus	C12+	0.00	0.000
TOTAL		100.00	2.437

Pressure Base	14.696
Zsc	0.997
Mol Weight	22.34
Gas Gravity	0.774
Pc	713.0
Tc	391.7
Mol Weight C6+	99.5
Density C6+	0.6884
Mol Weight C7+	106.4
Density C7+	0.6973
Mol Weight C8+	119.4
Density C8+	0.7126
Mol Weight C11+	147.0
Density C11+	0.7400
Mol Weight C12+	--
Density C12+	--
Heating Value (BTU/ft3)	
Gross	972
Nett	879
Wobbe Index	1105
Zpt *	0.895

(P)ressure : 3228 psig (T)emperature: 203 °F

CONSTANT MASS STUDY
@ 203 °F

Pressure (psig)	Relative Volume (V/Vsat) (1)	Formation Volume Factor (Bg) (2)	Gas Expansion Factor (E) (3)	Deviation Factor (Z)	Specific Volume (CFT/LB)	Gas Viscosity (Centipoise) (4)
5000	0.5029	0.00365	273.93	0.977	0.06204	0.0311
4500	0.5374	0.00390	256.33	0.940	0.06630	0.0289
4000	0.5844	0.00424	235.71	0.909	0.07210	0.0266
3500	0.6485	0.00471	212.43	0.883	0.08000	0.0242
3228 *	0.6941	0.00504	198.46	0.872	0.08563	0.0229
3000	0.7397	0.00537	186.22	0.864	0.09126	0.0219
2500	0.8766	0.00636	157.15	0.854	0.10814	0.0197
2187 **	1.0000	0.00726	137.75	0.853	0.12337	0.0184

* Reservoir Pressure
** Dew Point Pressure

(1) Cubic feet of gas at indicated pressure and temperature per cubic foot at reservoir pressure

(2) Cubic feet of gas at indicated pressure and temperature per cubic foot at 14.696 psia and 60 °F

(3) Cubic feet of gas at 14.696 psia and 60 °F per cubic foot at indicated pressure and temperature

(4) Calculated from correlation of Lee, Gonzales and Eakin

CONSTANT MASS STUDY
@ 203 °F

Pressure (psig)	Relative Volume (V/Vsat) (1)	Retrograde Liquid Deposit (Bbl/MMSCF) (2)	Retrograde Liquid Deposit (Volume%) (3)
2187 *	1.0000	0.00	0.00
1997	1.0996	1.68	0.13
1855	1.1886	3.10	0.24
1758	1.2580	3.52	0.27
1647	1.3483	4.20	0.32
1455	1.5349	5.45	0.42
1338	1.6772	6.29	0.49
1223	1.8414	7.55	0.58
1129	1.9995	8.90	0.69
1029	2.2010	9.96	0.77

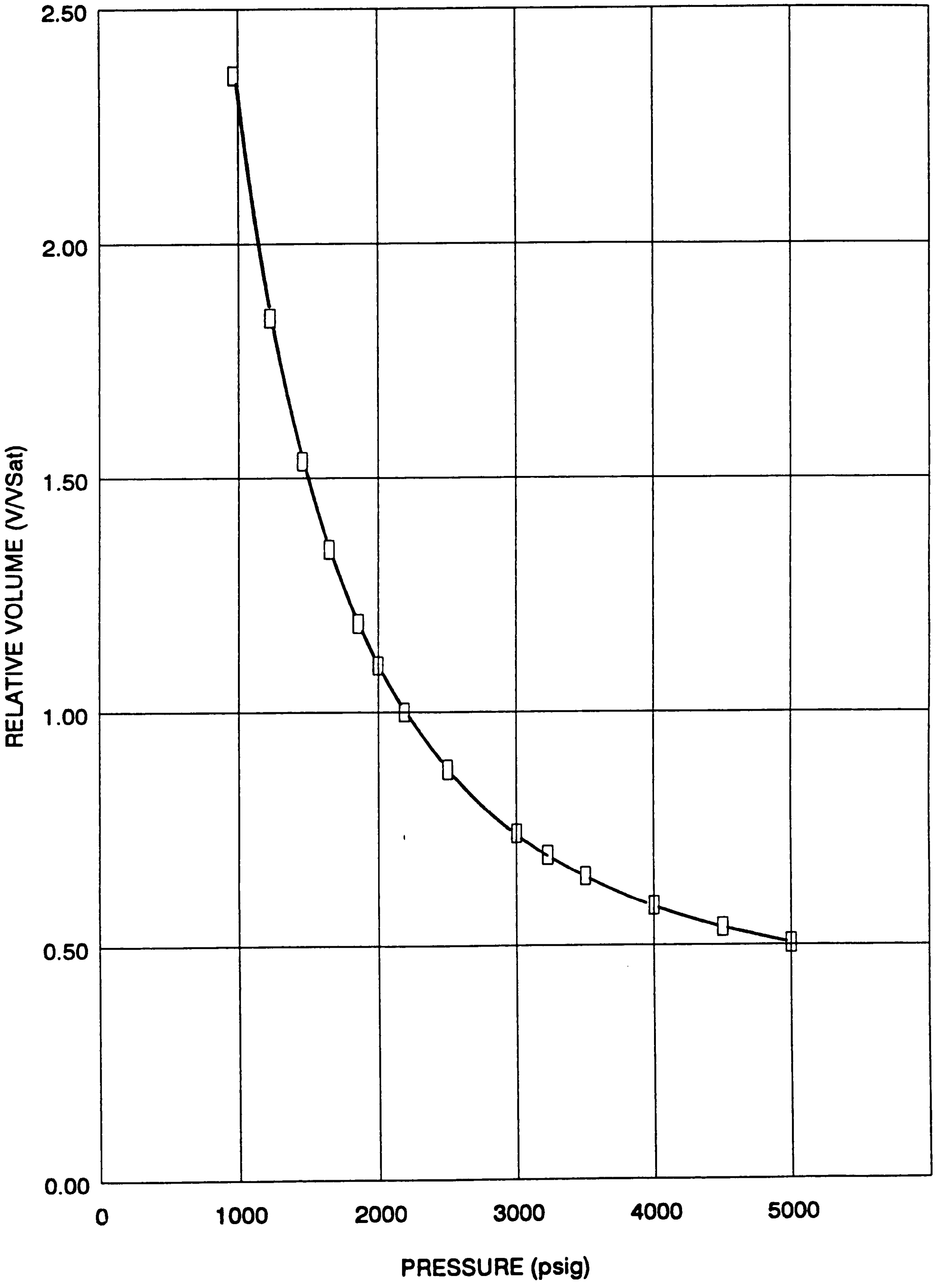
* Dew Point Pressure

(1) Cubic feet of gas at indicated pressure and temperature per cubic foot at saturation pressure

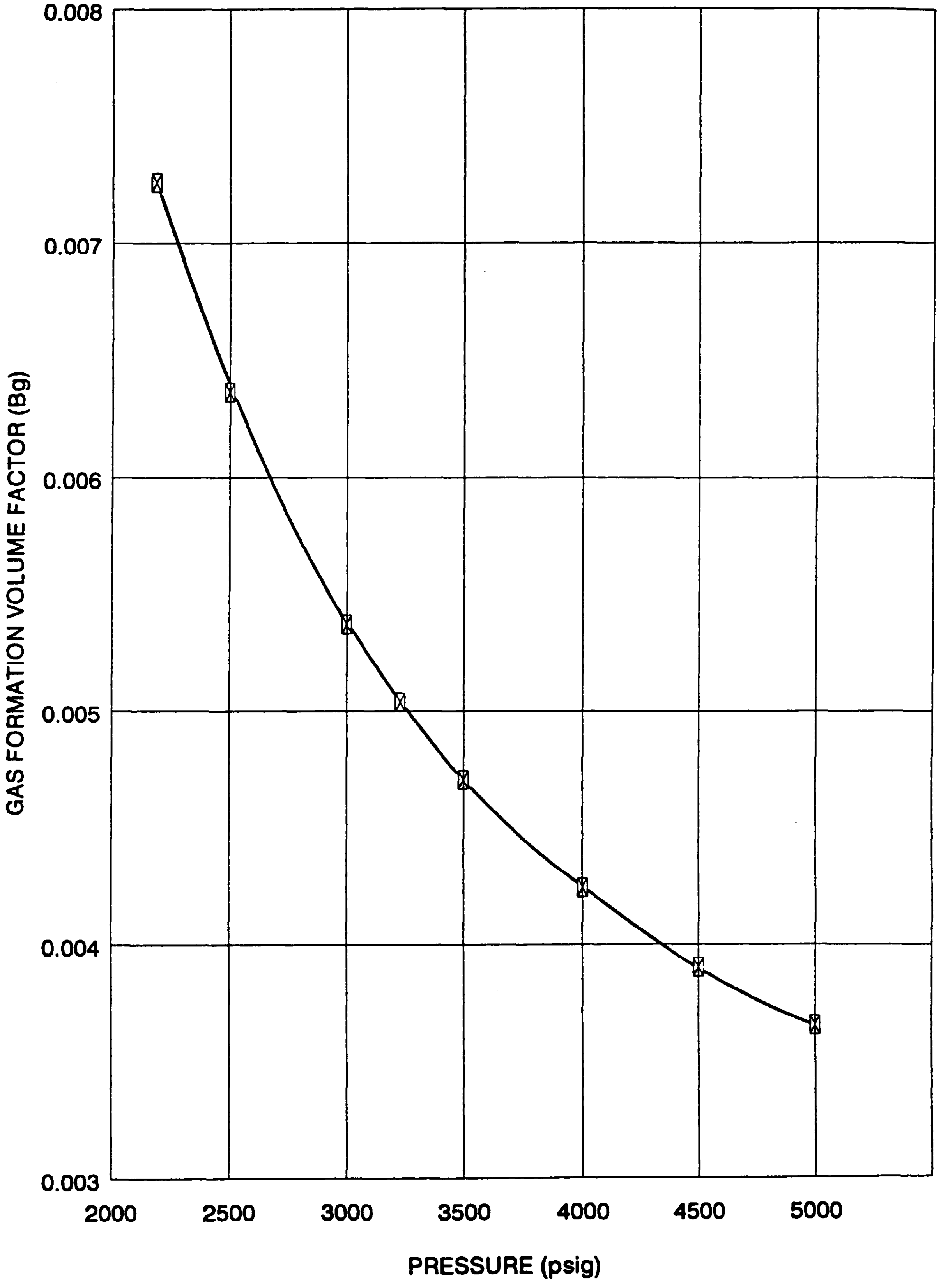
(2) Barrels of liquid at indicated pressure and temperature per MMSCF of original reservoir fluid

(3) Percent of reservoir hydrocarbon pore space at dew point

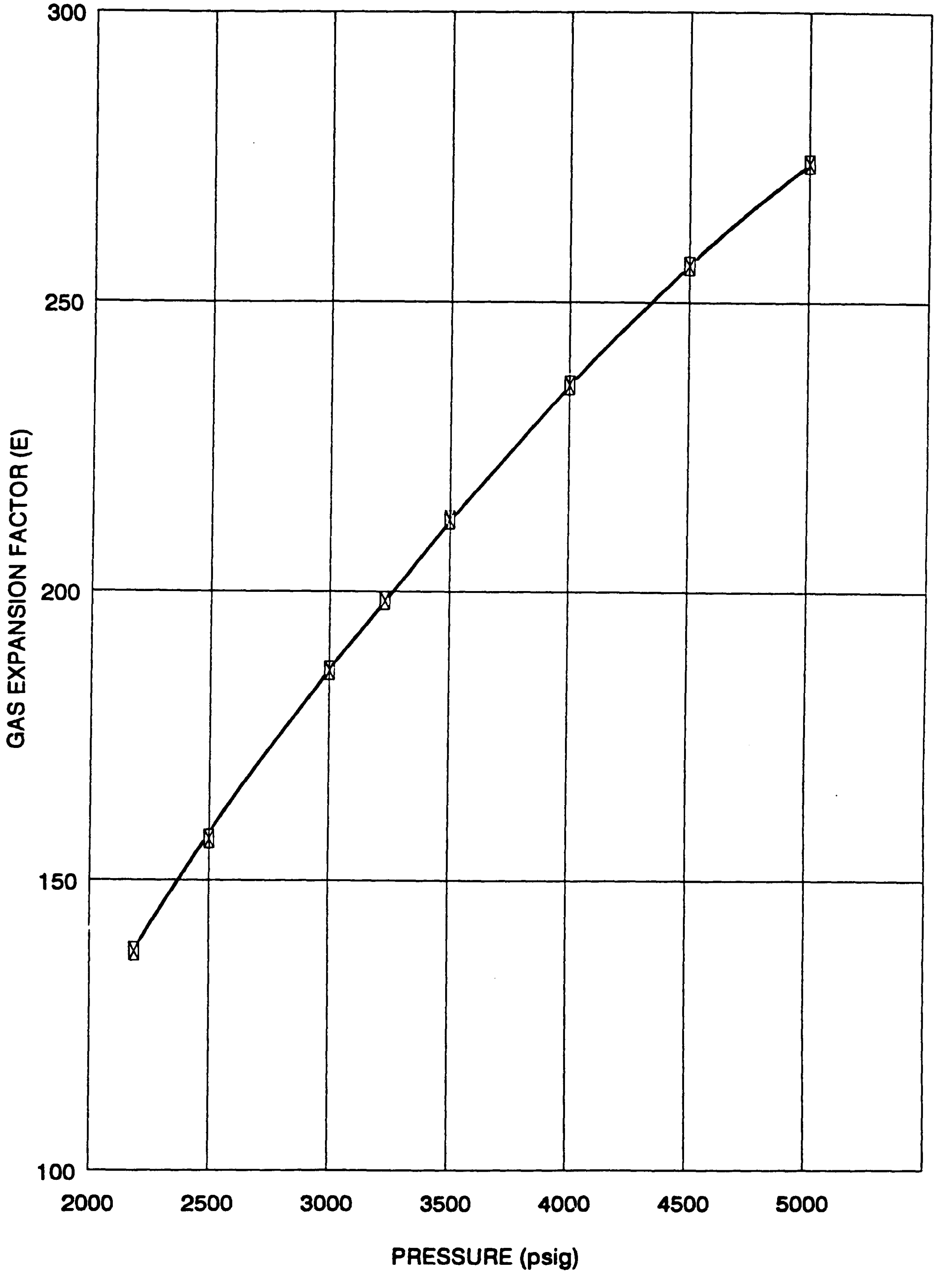
RELATIVE VOLUME



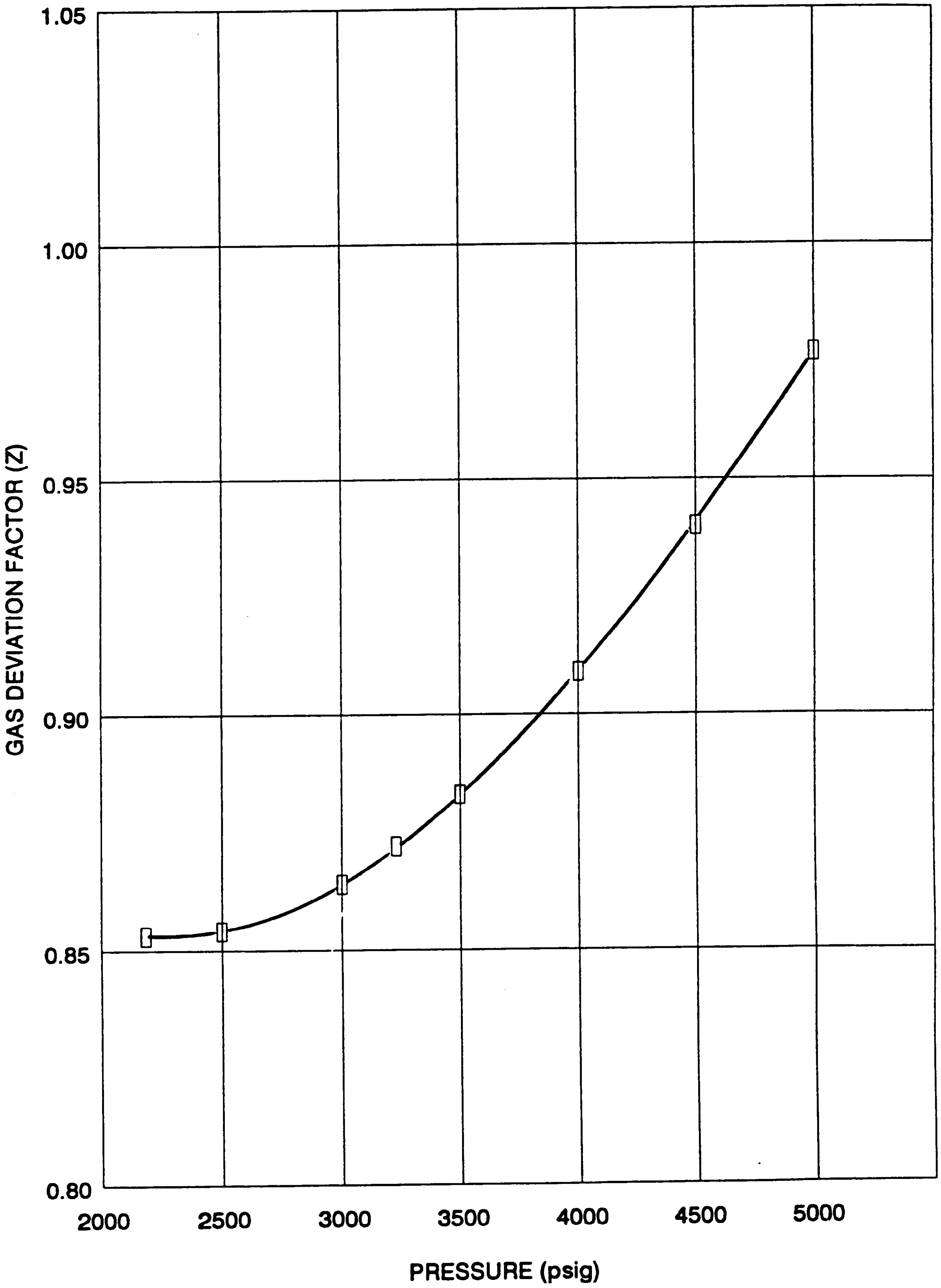
GAS FORMATION VOLUME FACTOR



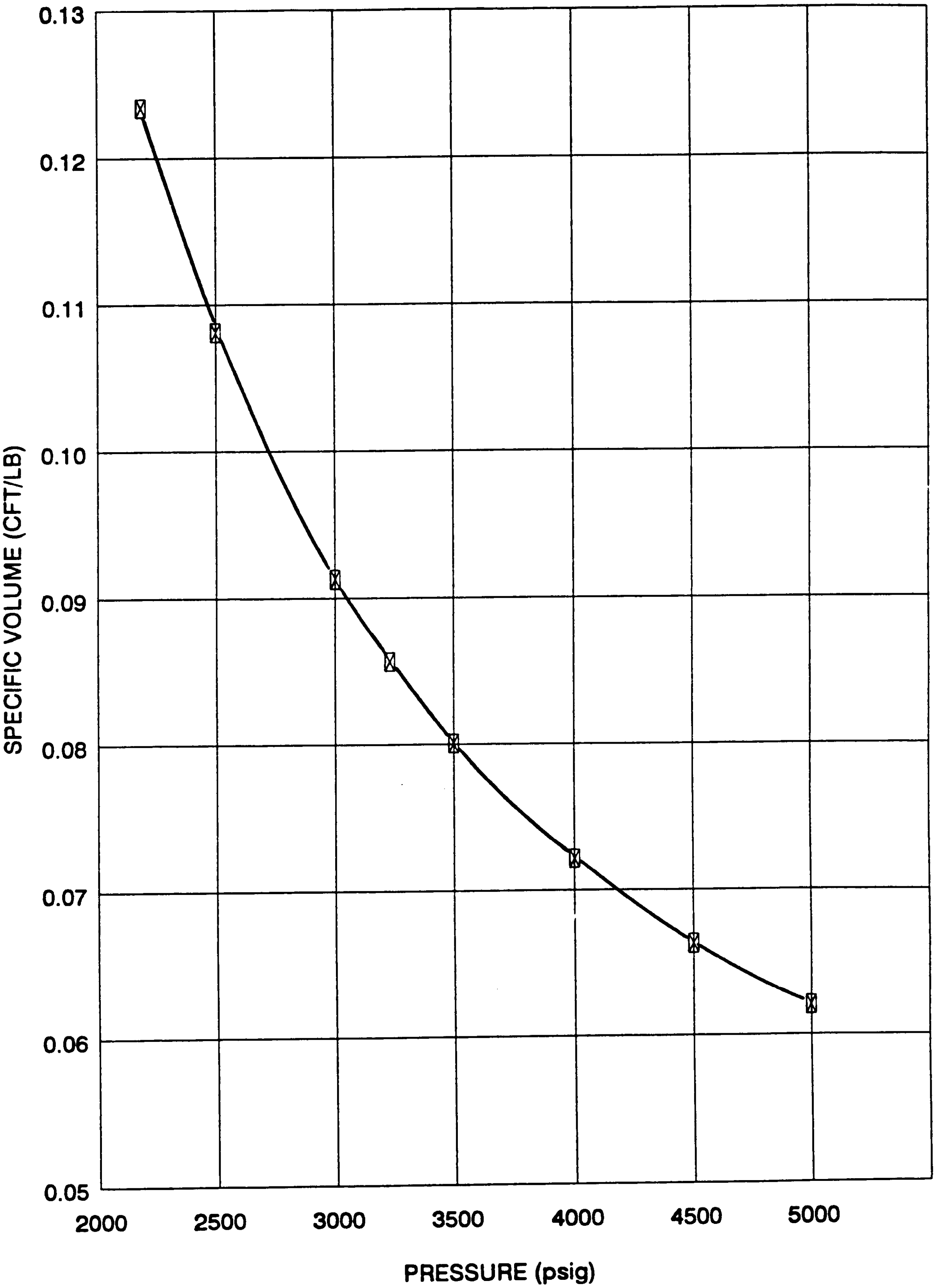
GAS EXPANSION FACTOR



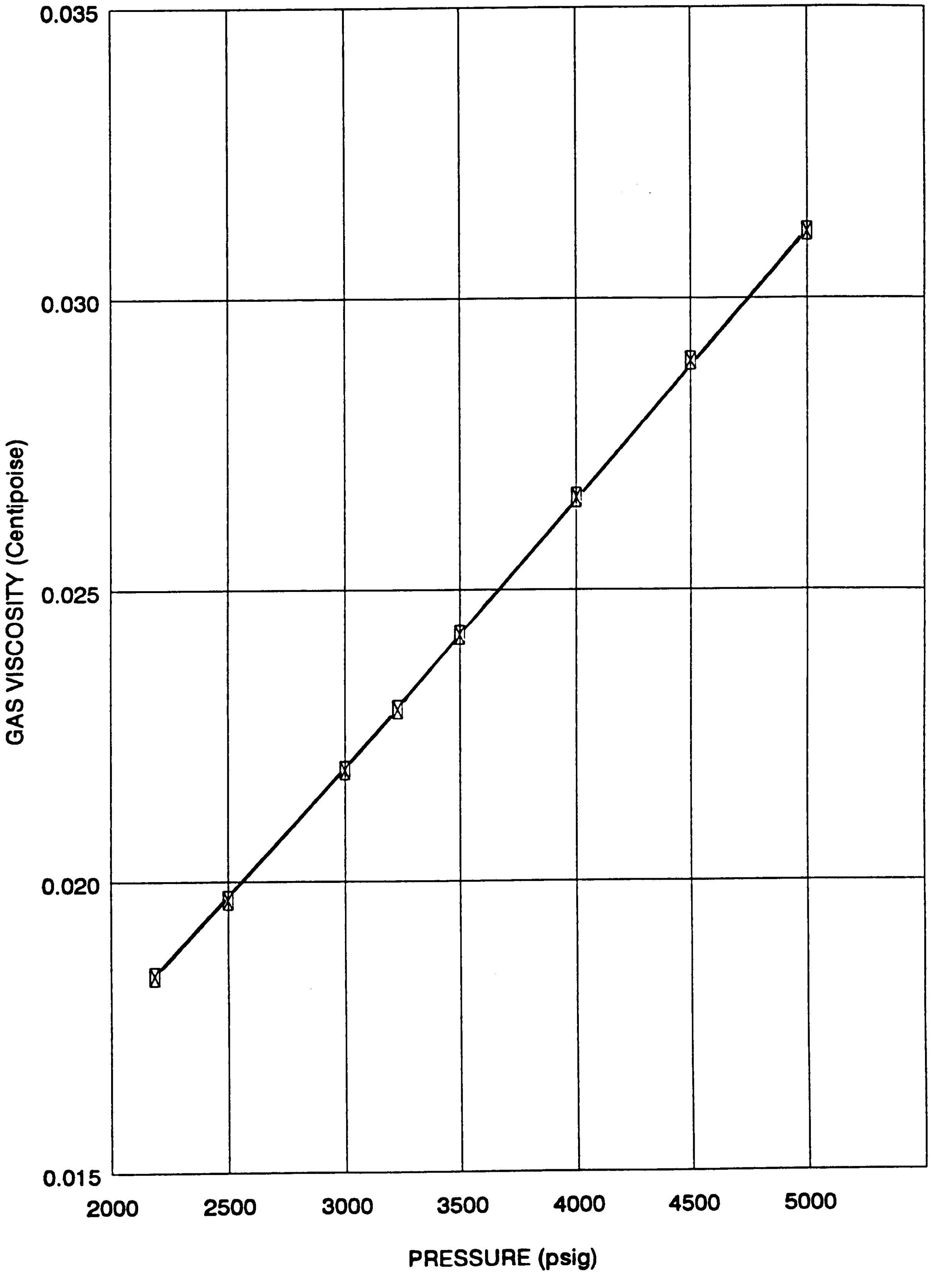
GAS DEVIATION FACTOR



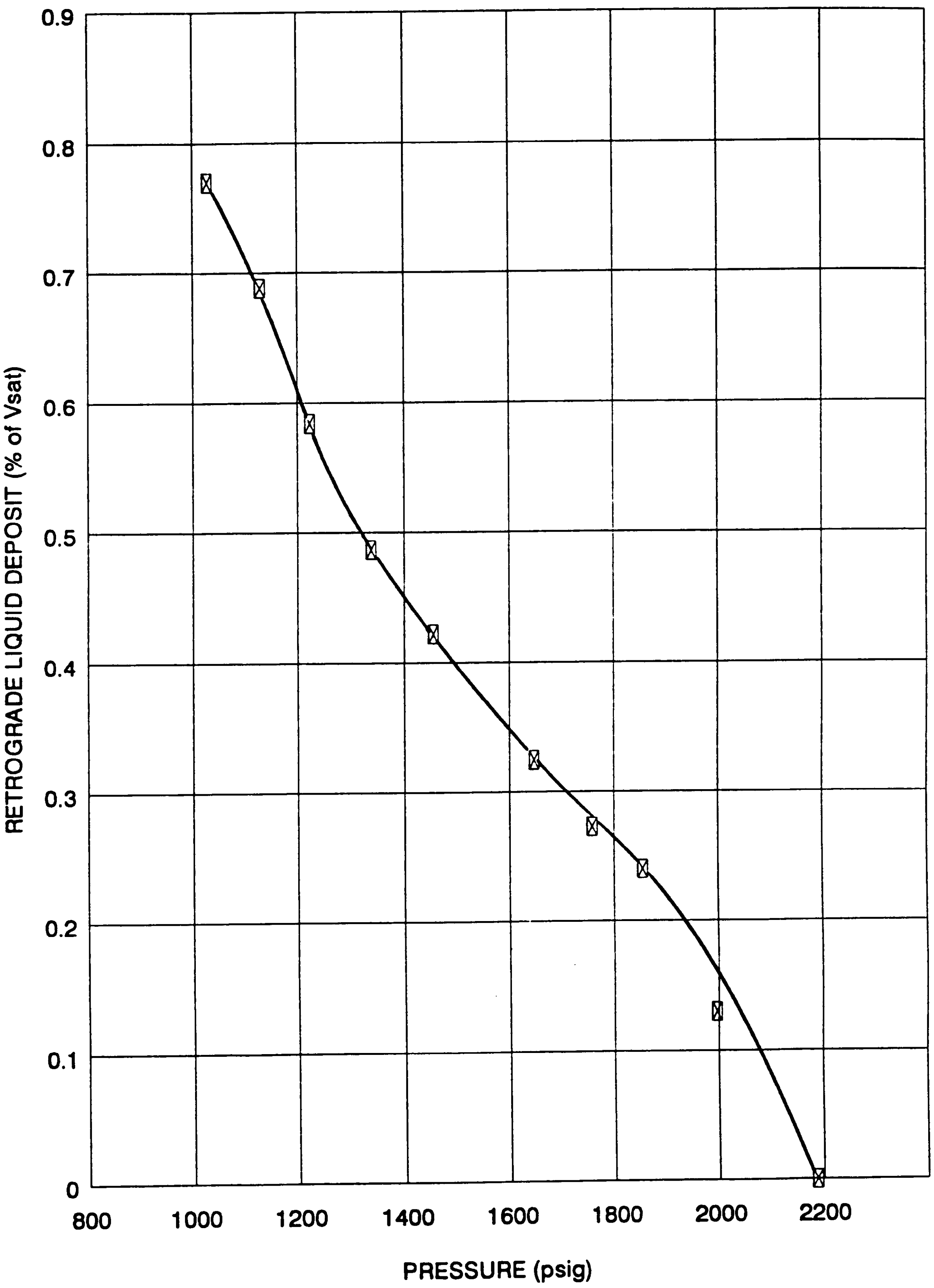
RESERVOIR FLUID SPECIFIC VOLUME



VISCOSITY OF RESERVOIR FLUID



RETROGRADE CONDENSATION



PE600298

This is an enclosure indicator page.
The enclosure PE600298 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600298 has the following characteristics:

ITEM-BARCODE = **PE600298**
CONTAINER_BARCODE = **PE900368**
NAME = **La** Bella **1 SDT-LDL-CNL-GR-AMS** (2728-1785.5m)
BASIN = **Otway**
PERMIT = **VIP/P30**
TYPE = **WELL**
SUBTYPE = **WELL-LOG**
DESCRIPTION = **La** Bella **1 SDT-LDL-CNL-GR-AMS** (2728-1785.5m), **Suite 2, Run 1.** 1:200
REMARKS =
DATE-CREATED = 8/02/93
DATE-RECEIVED = 16/04/93
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = **BHP**
CLIENT_OP_CO = **BHP**

(Inserted by DNRE - Vic **Govt Mines Dept)**

PE600302

This is an enclosure indicator page.
The enclosure PE600302 **is enclosed within the container PE900368 at this location in this document.**

The enclosure PE600302 has the following characteristics:

ITEM-BARCODE = PE600302
CONTAINER_BARCODE = PE900368
NAME = La Bella **1 Log DLL-MSFL-AS-GR-AMS-SP** (2733-1785.5m)
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = La Bella **1 Log DLL-MSFL-AS-GR-AMS-SP** (2733-1785.5m) **Suite 2, Run 2.** 1:200
REMARKS =
DATE-CREATED = 8/02/93
DATE-RECEIVED = 16/04/93
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic **Govt Mines Dept)**

7

PE600413

This is an enclosure indicator page.
The enclosure PE600413 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600413 has the following characteristics:

```
     ITEM_BARCODE = PE600413
CONTAINER_BARCODE = PE900368
             NAME = La Bella 1 Enclosure 1 Composite Plot
            BASIN = Otway
           PERMIT = VIP/P30
             TYPE = WELL
          SUBTYPE = COMPOSITE_LOG
      DESCRIPTION = La Bella 1 Enclosure 1 Composite Plot
          REMARKS =
     DATE_CREATED = *
    DATE_RECEIVED = *
             W_NO = W1075
        WELL_NAME = LABELLA-1
       CONTRACTOR = BHP
     CLIENT_OP_CO = BHP
```

(Inserted by DNRE - Vic Govt Mines Dept)

PE600286

This is an enclosure indicator page.
The enclosure PE600286 is enclosed within the container PE900368 at this location in this document.

The enclosure PE600286 has the following characteristics:

ITEM-BARCODE = PE600286
CONTAINER_BARCODE = PE900368
NAME = La Bella 1 Well Summary Log
BASIN = Otway
PERMIT = VIP/P30
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = La Bella 1 Well Summary Log
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W1075
WELL-NAME = LABELLA-1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE900369

This is an enclosure indicator page.
The enclosure PE900369 is enclosed within the container PE900368 at this location in this document.

The enclosure PE900369 has the following characteristics:

```
     ITEM_BARCODE = PE900369
CONTAINER_BARCODE = PE900368
             NAME = La Bella 1 Enclosure 5 Top Upper
                    Shipwreck Group Depth Structure Map
            BASIN = Otway
           PERMIT = VIP/P30
             TYPE = SEISMIC
          SUBTYPE = HRZN_CONTR_MAP
      DESCRIPTION = La Bella 1 Enclosure 5 Top Upper
                    Shipwreck Group Depth Structure Map
          REMARKS =
     DATE_CREATED = *
    DATE_RECEIVED = *
             W_NO = W1075
        WELL_NAME = LABELLA-1
       CONTRACTOR = BHP
     CLIENT_OP_CO = BHP
```

(Inserted by DNRE - Vic Govt Mines Dept)