HYDROCARBON CHARACTERISATION STUDY

WEST MOONFISH-1

PROFESSIONAL OPINION

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EXECUTIVE SUMMARY

A sample suite from West Moonfish-1, drilled by ESSO Australia Pty Ltd, was submitted for geochemical analyses. The suite comprised the following samples:

- West Moonfish-1 exL194, exMPSR 0113, 2106m gas
- West Moonfish-1 exL193, exMPSR 0122, 2121m gas
- West Moonfish-1 exL194, exMPSR 0113, 2106m oil
- West Moonfish-1 exL193, exMPSR 0122, 2121m oil

Three oil samples from Moonfish-1, previously analysed by Geotech in 1992, were re-submitted for analysis to enable correlation with the West Moonfish-1 samples:

- Moonfish-1 ST-1 1838.7m
- Moonfish-1 1914.5m
- Moonfish-1 2260m

A geochemical program was undertaken to evaluate the thermal maturity, source and depositional environment of the West Moonfish-1 samples and to correlate these with the Moonfish-1 fluids.

This report provides a compilation of geochemical data obtained from analysis of the hydrocarbons from the oils and gases together with an interpretation of these data.

West Moonfish-1 Gases

Compositional analysis and CSIA of the two West Moonfish-1 gases indicate the samples are genetically related. Compositional analysis indicates both samples derive from oil mature source rocks and have been generated from a very similar source. Neither sample has been altered by mixing or biodegradation. Isotopically heavy methane and wet gas is consistent with derivation of gas primarily from humic kerogen.

West Moonfish-1 Oils

Whole oil GC-MS analysis of the two West Moonfish-1 oils indicates that neither has been altered by secondary processes such as mixing, water washing or biodegradation. The two oils are genetically related and both are of high thermal maturity, based on their respective saturate GC-MS profiles and calculated parameters derived from aromatic and branched/cyclic data. The two samples are of thermal maturity equivalent to approximately 0.9% to 1% VR, based on MPI values of 0.85 and 1.04 for West Moonfish-1 2106m and West Moonfish-1 2121m, respectively. Pristane to phytane ratios are suggestive of oxic, nearshore depositional environments. Biomarker analysis attests to a significant contribution of higher plant derived organic matter to both samples, based on the high abundance of C_{29} steranes and the presence of aromatic land plant biomarkers. A C_{27}/C_{29} sterane ratio of almost one for West Moonfish-1 2121m however, is consistent with some contribution to this sample from marine derived organic material.

Correlation with Moonfish-1

The three Moonfish-1 samples derive from oxic, nearshore depositional environments and show strong terrestrial signatures based on biomarker analysis. West Moonfish-1 2106m, which similarly contains predominantly terrestrial derived organic matter, shows very strong correlation with the Moonfish-1 oils. Both West Moonfish-1 samples are of a comparable level of thermal maturity to the Moonfish-1 oils. All samples contain comparable hopane, tri- and tetracyclic biomarker profiles and similar distributions of higher plant biomarkers. The marine influence observed from West Moonfish-1 2121m, however, is not apparent in any of the Moonfish-1 oils, consistent with a slightly different source facies for this sample.

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TABLE OF CONTENTS

1 INTRODUCTION

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- Moonfish-1 ST-1 RFT 1838.7m
- Moonfish-1 RFT 1914.5m
- Moonfish-1 RFT 2260m

This report provides a compilation of geochemical data obtained from analysis of the hydrocarbons from the oils and gases together with an interpretation of these data.

One hardcopy and one electronic copy of this report have been sent to Jill Stevens at ESSO Australia Pty Ltd. Any queries related to it may be directed to Cindy Barber or Dr Birgitta Hartung-Kagi at Geotechnical Services Pty Ltd.

All data and information are proprietary to ESSO Australia and regarded as highly confidential by all Geotech personnel.

Geotechnical Services has endeavoured to use techniques and equipment to achieve results and information as accurately as it possibly can. However, such equipment and techniques are not necessarily perfect. Therefore, Geotechnical Services shall not be held responsible or liable for the results of any actions taken on the basis of the information contained in this document. Moreover, this report should not be the sole reference when considering issues that may have commercial implications.

2 ANALYTICAL PROCEDURES

2.1 GASES

Two West Moonfish-1 gas samples were submitted for compositional analysis and were also sampled for compound specific isotope analysis of C_1 to C_5 components.

2.2 OILS

Two associated West Moonfish-1 liquid samples were submitted for hydrocarbon characterisation. The samples were initially analysed by whole oil GC-MS and were subsequently subjected to liquid chromatography separation in order to isolate the saturate, aromatic and polar fractions. The saturate and aromatic fractions from both oisl were analysed by GC-MS. The branched/cyclic components were isolated from the saturate fraction by treatment with ZSM5 molecular sieves and these components were similarly analysed by GC-MS.

Three Moonfish-1 oils, previously analysed at Geotech, were resubmitted for liquid chromatography and subsequent GC-MS analysis of saturate, aromatic and branched/cyclic components to allow for correlation with the West Moonfish-1 samples.

3 RESULTS AND INTERPRETATION

3.1 WEST MOONFISH-1 GASES

Two gas samples from West Moonfish-1 (MPSR 0113, 2106m and MPSR 0122, 2121m) were submitted for compositional and isotopic analyses. Figure 1 presents a plot of the compositional data which indicates derivation of both gases from oil mature source rocks. Neither sample shows evidence for mixing or alteration. Both samples contain high methane concentrations (79.3mol% and 76.8mol%, respectively) and moderate carbon dioxide contents (12.8mol% and 13.8mol%, respectively). The compositional results are consistent with the two gases having been generated from a very similar source.

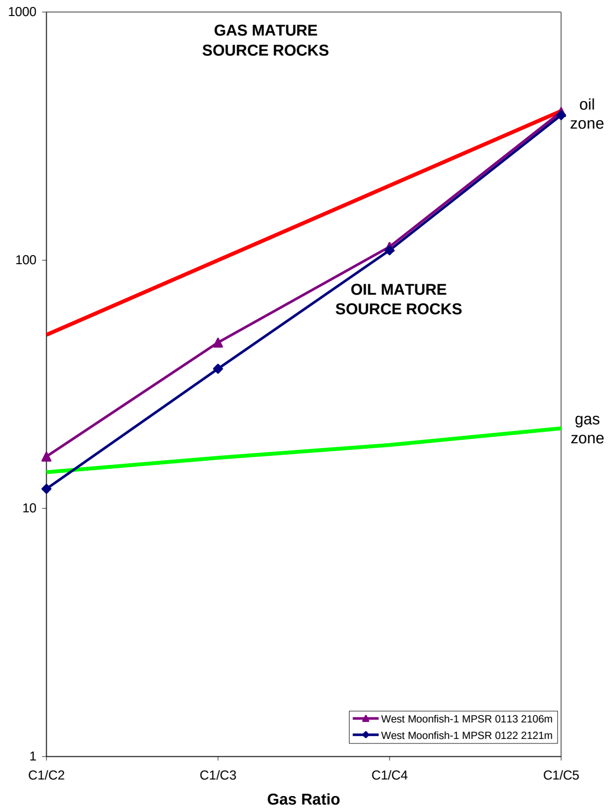


Figure 1. Compositional analysis of West Moonfish-1 gases

The results of compound specific isotope analysis (CSIA) of the two gas samples are presented in Figure 2. The gas components from both samples show little discernible isotopic difference, indicating similar levels of thermal maturity. The wet gas is isotopically heavy (between -27.3‰ and –25.8‰), suggesting high gas maturity. The methane from both samples is similarly isotopically heavy (-32.4‰ for West Moonfish-1 2106m and –32.4‰ for West moonfish-1 2121m) which, together with low wetness values, is consistent with derivation of gas primarily from humic kerogen with only very minor secondary amounts derived from sapropelic kerogen (cf. Schoell, 1983).

Figure 3 presents a Whiticar plot for the two gas samples (cf. Whiticar, 1984). Both samples plot along the empirical trend indicating generation from source rocks of similar maturity. There is no indication of either sample having been altered by biodegradation, which would be evident in the isotopic composition of propane. Furthermore, there is no indication of mixing, consistent with the compositional data.

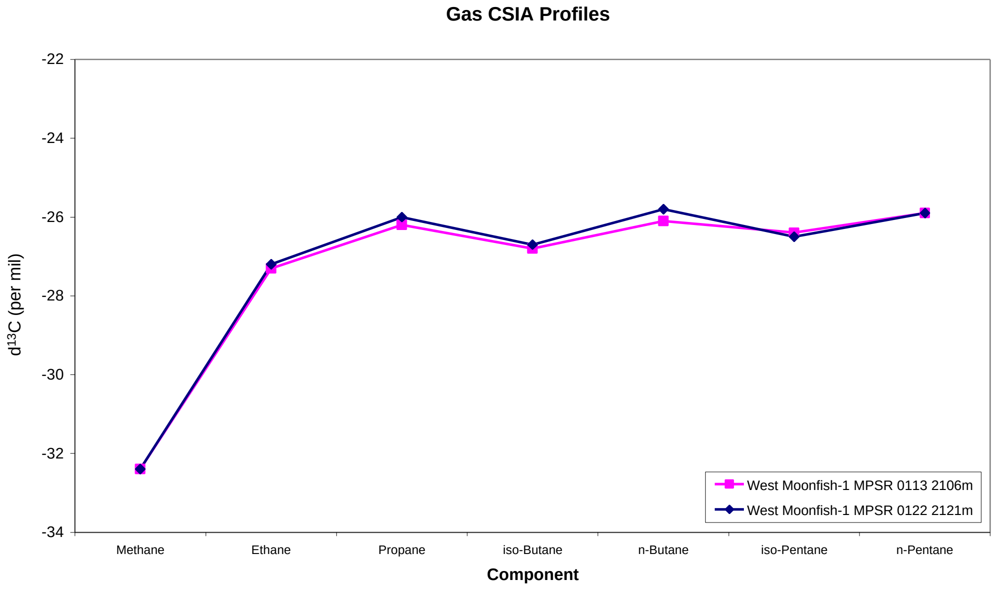


Figure 2. Stable carbon isotopic composition of West Moonfish-1 gases

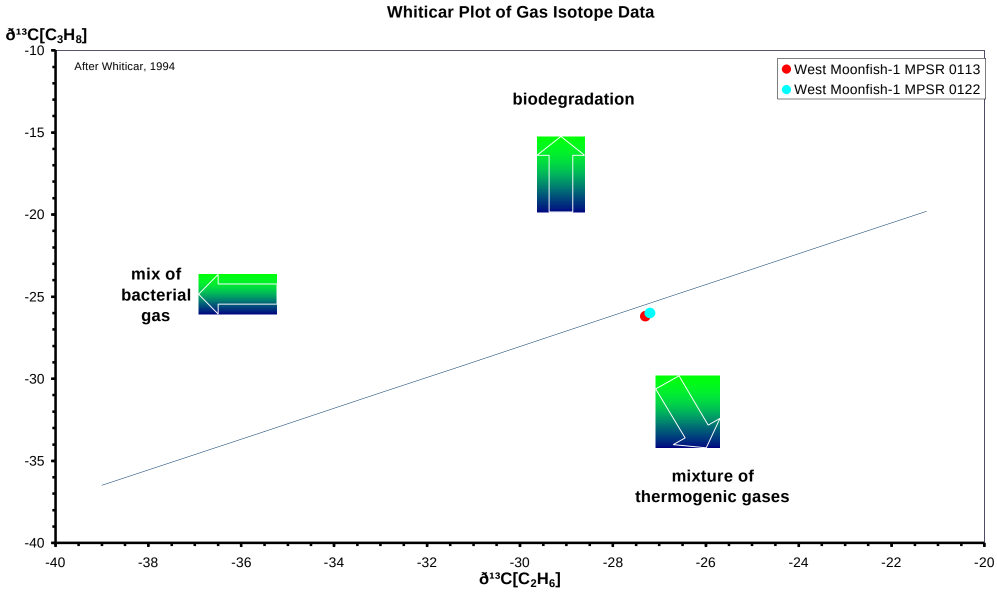


Figure 3. Whiticar plot for West Moonfish-1 gases

3.2 WEST MOONFISH-1 OILS

Whole Oil GC-MS

Two West Moonfish-1 samples (MPSR 0113, 2106m and MPSR 0122, 2121m) were submitted for whole oil GC-MS analysis. Whole oil GC-MS allows for analysis of the gasoline range hydrocarbons as well as providing an overall profile of components up to approximately C_{30}. The distribution and relative abundance of the gasoline range hydrocarbons are readily altered by the physical processes of biodegradation and water washing.

Figure 4 shows the whole oil chromatograms obtained from analysis of the two West Moonfish-1 samples. Whilst the two samples display very different whole oil profiles, both are characterised by a low relative abundance of low molecular weight components, which is likely to be a result of evaporation loss upon storage. West Moonfish-1 2106m shows a unimodal *n*-alkane profile maximising around C_{10} and a low relative abundance of high molecular weight components ($>C_{22}$), a distribution commonly observed in high maturity

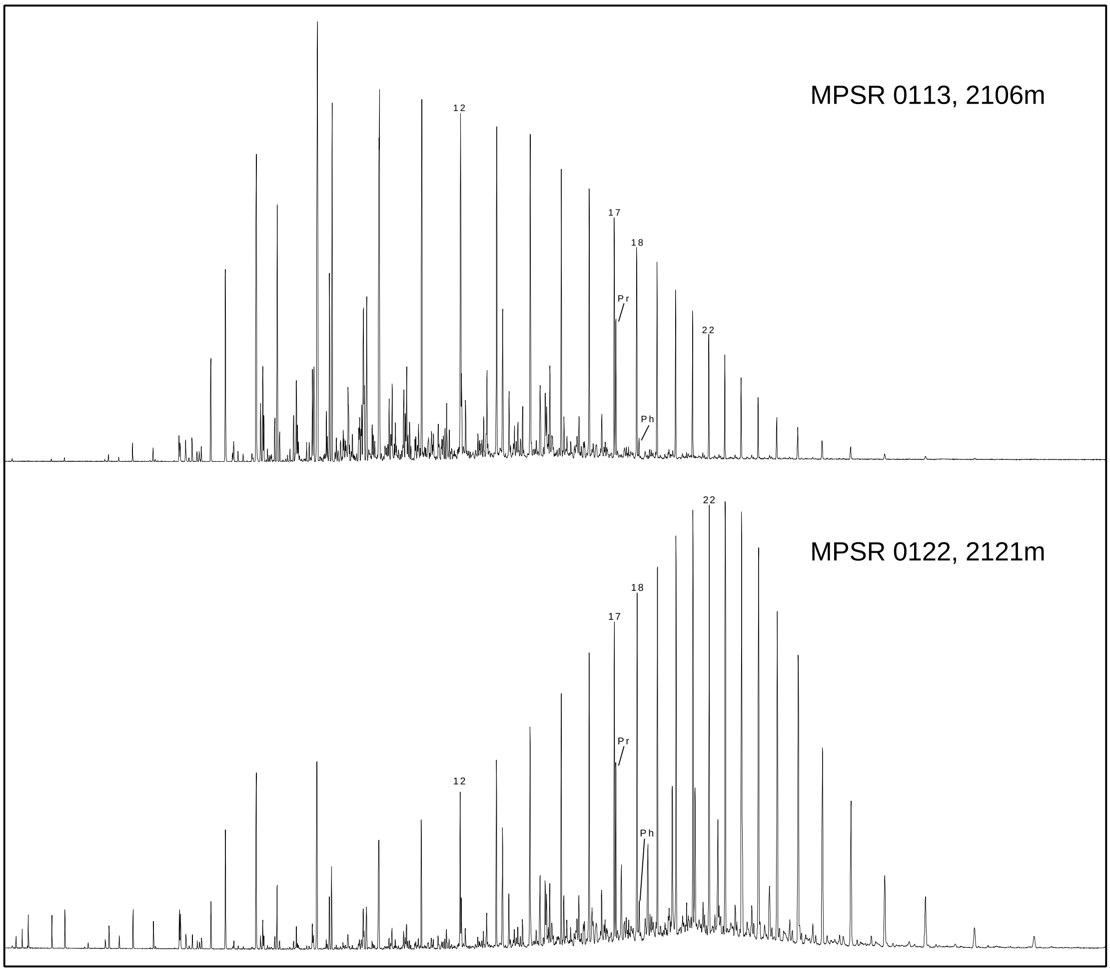


Figure 4. Whole oil mass chromatograms from West Moonfish-1 oils

condensates. West Moonfish-1 2121m on the other hand, whilst similarly displaying an unimodal *n*-alkane profile, shows a predominance of high molecular weight components maximising at C_{23}. Such a distribution is typical of derivation of organic matter primarily from higher plant/terrestrial sources.

The distributions of gasoline range hydrocarbons from both West Moonfish-1 2106m and 2121m (Figure 5) show no indication of biodegradation, both samples producing low I/J (0.2 and 0.3, respectively) and V/U (1.3 and 1.7, respectively) biodegradation ratios. Low I/M and V/X water washing ratios also suggest that water washing has not altered the composition of either sample.

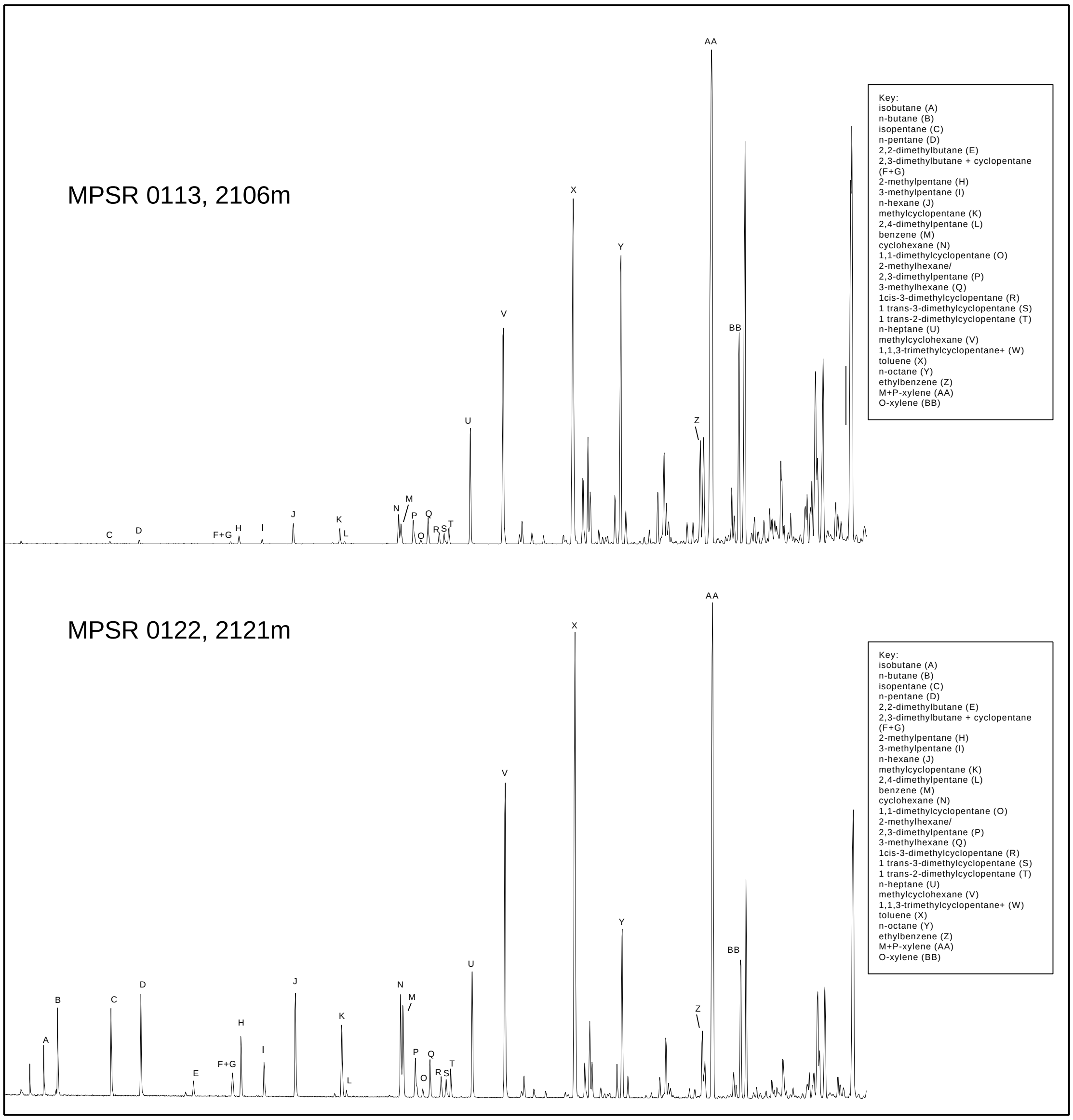


Figure 5. Distribution of gasoline range hydrocarbons in West Moonfish-1 oils

Saturate GC-MS

The two West Moonfish-1 samples were submitted for liquid chromatographic separation in order to obtain saturate, aromatic and polar fractions. The saturate fractions were subsequently analysed by GC-MS and the mass chromatograms are presented in Figure 6.

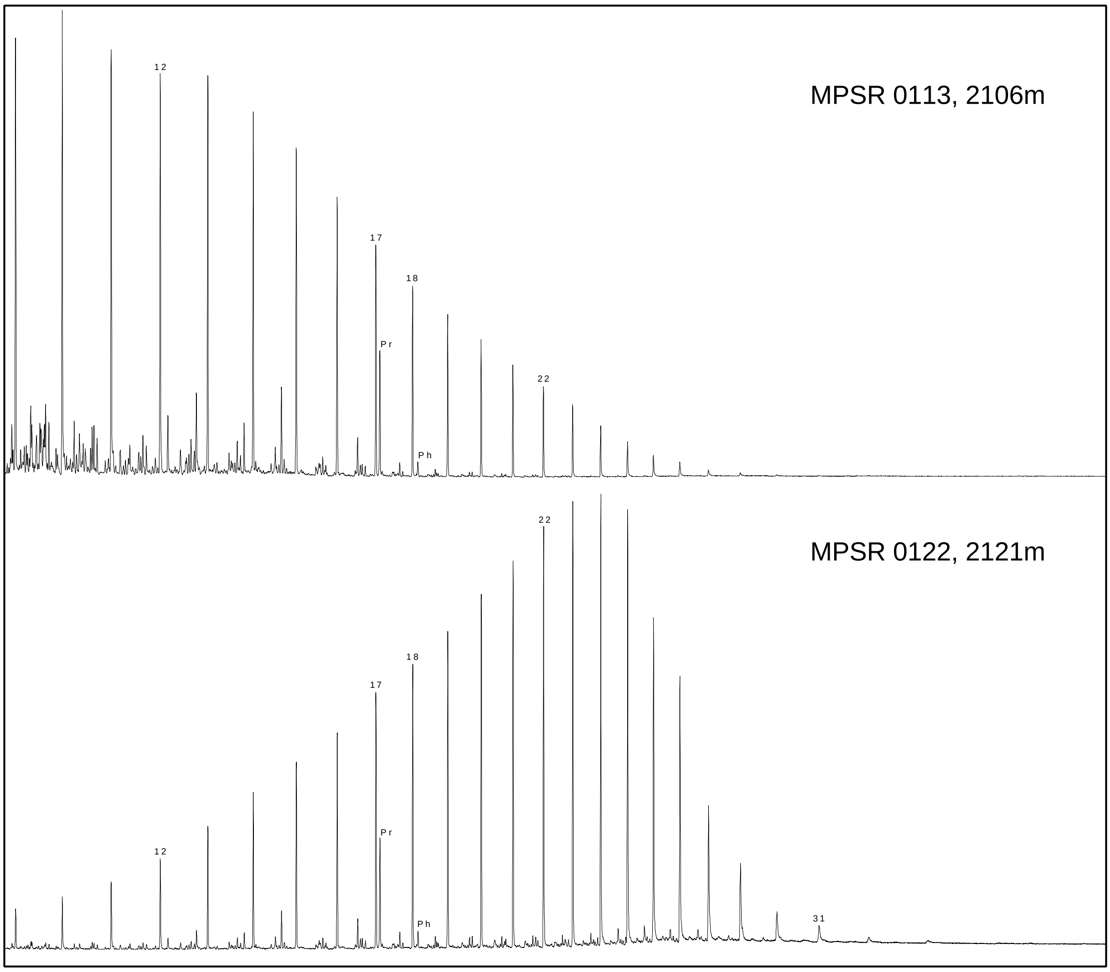
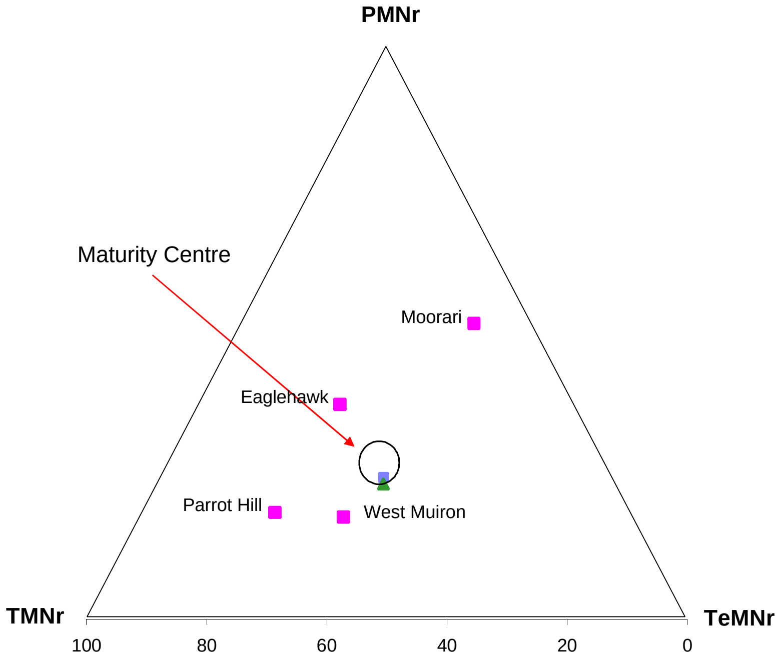


Figure 6. Saturate chromatograms from GC-MS analysis of West Moonfish-1 oils

The saturate profiles are consistent with the whole oil analyses, the two samples displaying very different *n*-alkane profiles. West Moonfish-1 2106m shows a high relative abundance of low molecular weight components, whilst the opposite is observed from West Moonfish-1 2121m which maximises at C_{24}. The difference in the abundance of low to high molecular weight n-alkanes for the two samples is reflected in the ratio of $(C_{16} + C_{17})/(C_{28} + C_{29})$ compounds, West Moonfish-1 2106m showing a value of 32 whilst 2121m shows a value of 1.4. Such a difference suggests that either the sample from 2106m is higher in level of maturity resulting in depletion of high molecular weight components, or that the two samples derive from slightly different source facies. CPI values for the two samples are, however, similar, as are the pristane/C_{17} values, both of which can be used to infer thermal maturation level. The similar values for these parameters for both West Moonfish-1 samples imply that the two oils are of similar maturity. The pristane to phytane ratios of 8.24 and 6.37 for West Moonfish-1 2106m and 2121m, respectively, suggest deposition of source rocks under similarly oxic environmental conditions.

Aromatic and Branched/Cyclic GC-MS

The two West Moonfish-1 samples were subsequently submitted for detailed molecular characterisation in order to gain information related to maturity, source and depositional environment. Studies by van Aarssen et al. (2000) suggest that processes such as mixing, extensive water washing and biodegradation of crude oils can be identified by plotting relative abundances of selected trimethylnaphthalenes, tetramethylnaphthalenes and pentamethylnaphthalenes. The relative abundances of these selected alkylnaphthalenes in the West Moonfish-1 oils are shown to plot within the 'maturity centre' on the ternary diagram (Figure 7). This suggests that neither oil has been significantly altered by any of these secondary processes.



After van Aarssen et al., 2000

Figure 7. Ternary diagram showing the distribution of methylated naphthalenes in West Moonfish-1 oils

Figure 8 presents total ion chromatograms showing the distribution of aromatic components observed from the two samples, both of which show a high relative abundance of low molecular weight compounds consistent with their high level of thermal maturity. MPI values of 0.85 and 1.04, for 2106m and 2121m, respectively (vitrinite reflectance equivalence of 0.91 and 1.02) further indicate high maturity, as do calculated maturity parameters based on branched/cyclic components. C_{29} 20S/20R sterane ratios of 1.13 (2106m) and 1.48 (2121m)

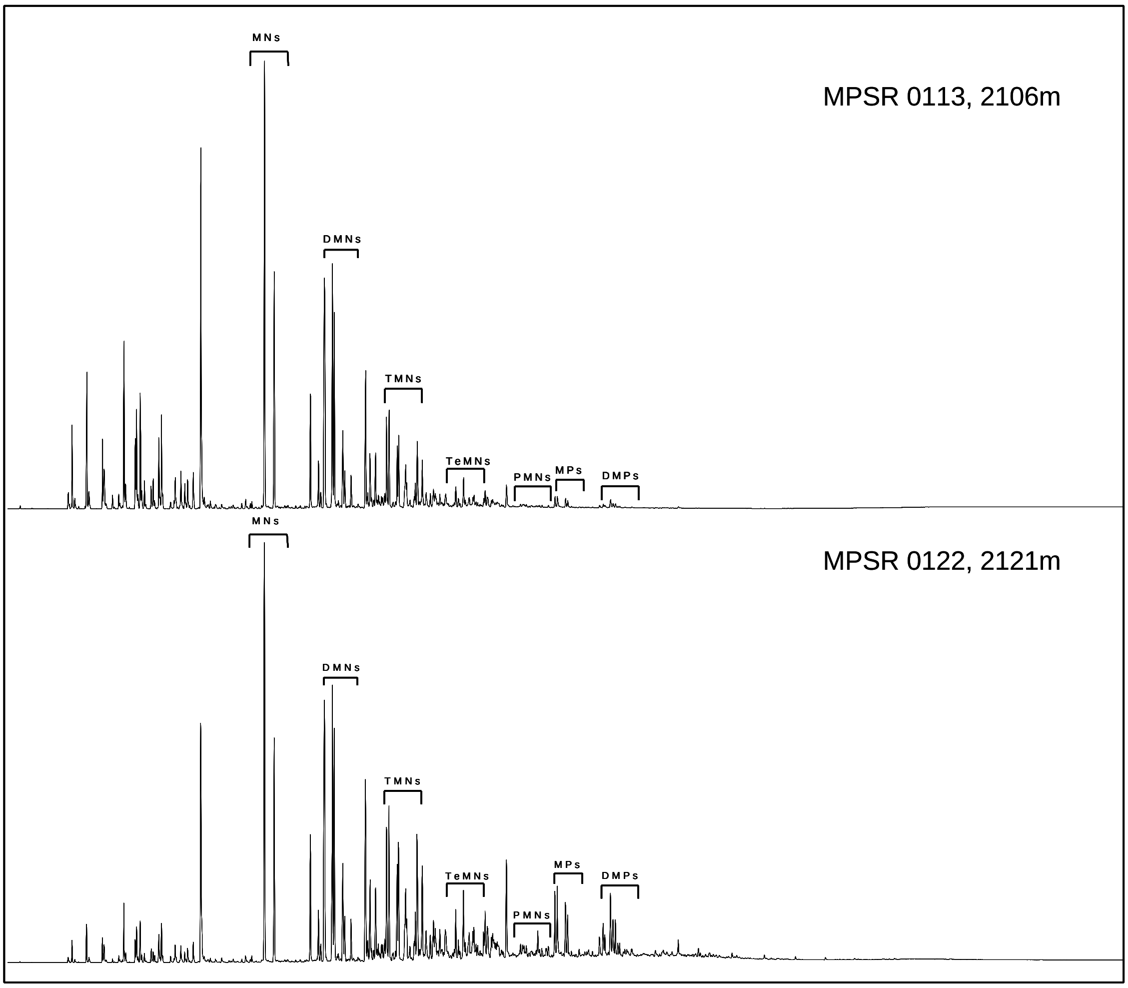
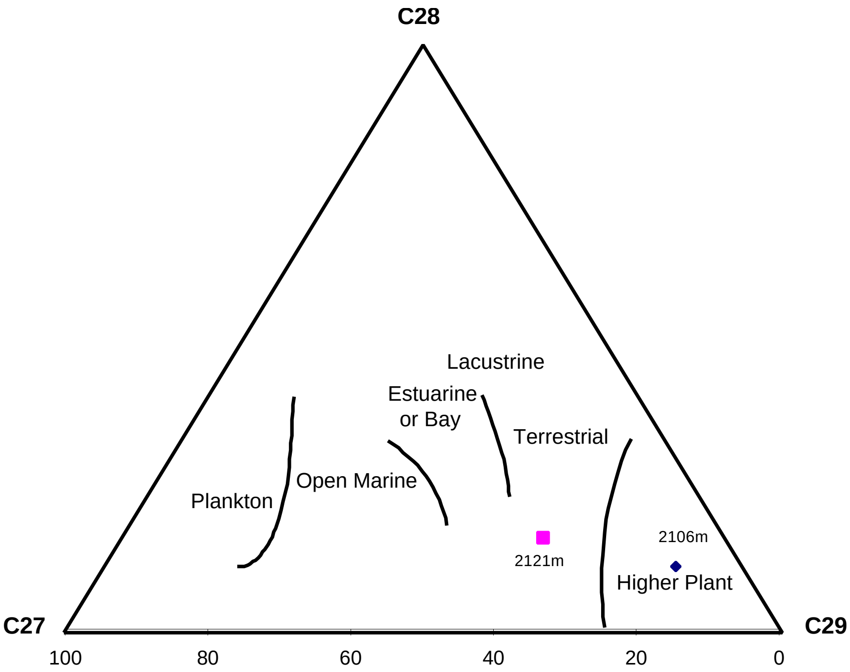


Figure 8. Total ion chromatograms of the aromatic fractions of West Moonfish-1 oils

are particularly high, characterising maturity levels equivalent to >1.1% VR which may be overestimating the true maturity of the oils somewhat.

Retene, cadalene and I-HMN-IV are all present in the aromatic fraction of the samples, albeit in low relative abundance, together producing higher plant index (HPI) values of 0.31 (2106m) and 0.52 (2121m). Since these components enter the geosphere through incorporation of plant detrital matter into sediments, the presence of these higher plant biomarkers is believed to be indicative of a contribution to the organic matter from terrigenous sources. Both West Moonfish-1 oils also contain diterpane components including kaurane and phyllocladane which are reported to derive from higher plant resin material.

Figure 9 shows a triplot of isosterane components which characterise the original depositional environment for the two samples as higher plant/terrestrial, although West Moonfish-1 2121m shows some marine contribution. Figure 10 presents partial m/z 217 mass chromatograms for



(After Huang and Meinschein, 1979)

Figure 9. Ternary diagram showing the distribution of sterane components in the West Moonfish-1 oils

the two West Moonfish-1 samples which show a prominence of land plant derived C_{29} steranes, particularly for West Monfish-1 2106m. Corresponding C_{27} steranes are in significantly lower relative abundance in this sample, resulting in a low C_{27}/C_{29} sterane ratio (0.37). West Moonfish-1 2121m shows a more significant contribution from marine derived organic matter based on sterane distributions (Figure 10) as indicated by a C_{27}/C_{29} sterane ratio of almost one.

Overall, the two West Moonfish-1 samples show comparable saturate and aromatic profiles. Results suggest that both oils were sourced from similarly mature, primarily terrestrial derived organic matter which was deposited under near shore, oxic environmental conditions. The enhanced abundance of marine derived C_{27} sterane components in West Moonfish 2121m relative to West Moonfish-1 2106m attests to deposition in a slightly more marine environment, resulting in an enhanced contribution of algal material to this sample.

Stable Carbon Isotope Analysis

The two West Moonfish-1 oils were submitted for compound specific isotope analysis (CSIA). Since biomarker data indicate the two oils are of similar maturity, CSIA can assist in oil-oil correlation. Results from CSIA of the oils support the above biomarker interpretation that the two West Moonfish-1 condensates derive from a similar source. Figure 11 presents a plot of the CSIA data for the West Moonfish-1 oils. The isotopic composition of n-alkanes in the two condensates are very comparable, with values ranging from -25.2‰ up to -28.8‰. In the absence of CSIA data from other wells in the region, little information concerning source and maturity can be gained from the West Moonfish-1 isotopic data although the data does confirm that the two oil samples are genetically related. There is, however, some enrichment in the stable carbon isotopic composition of the higher molecular weight components for West Moonfish-1 2121m relative to 2106m. This difference, whilst only approximately 1‰, may reflect the enhanced marine influence which was observed from West Moonfish-1 2121m.

CSIA of the two West Moonfish-1 gases has also enabled a positive correlation of the gases with the West Moonfish-1 oils to be established. Figure 11 indicates that there is no apparent disconnect between the isotopic composition of the oils and the West Monfish-1 gases suggesting a common provenance for all West Moonfish-1 fluids.

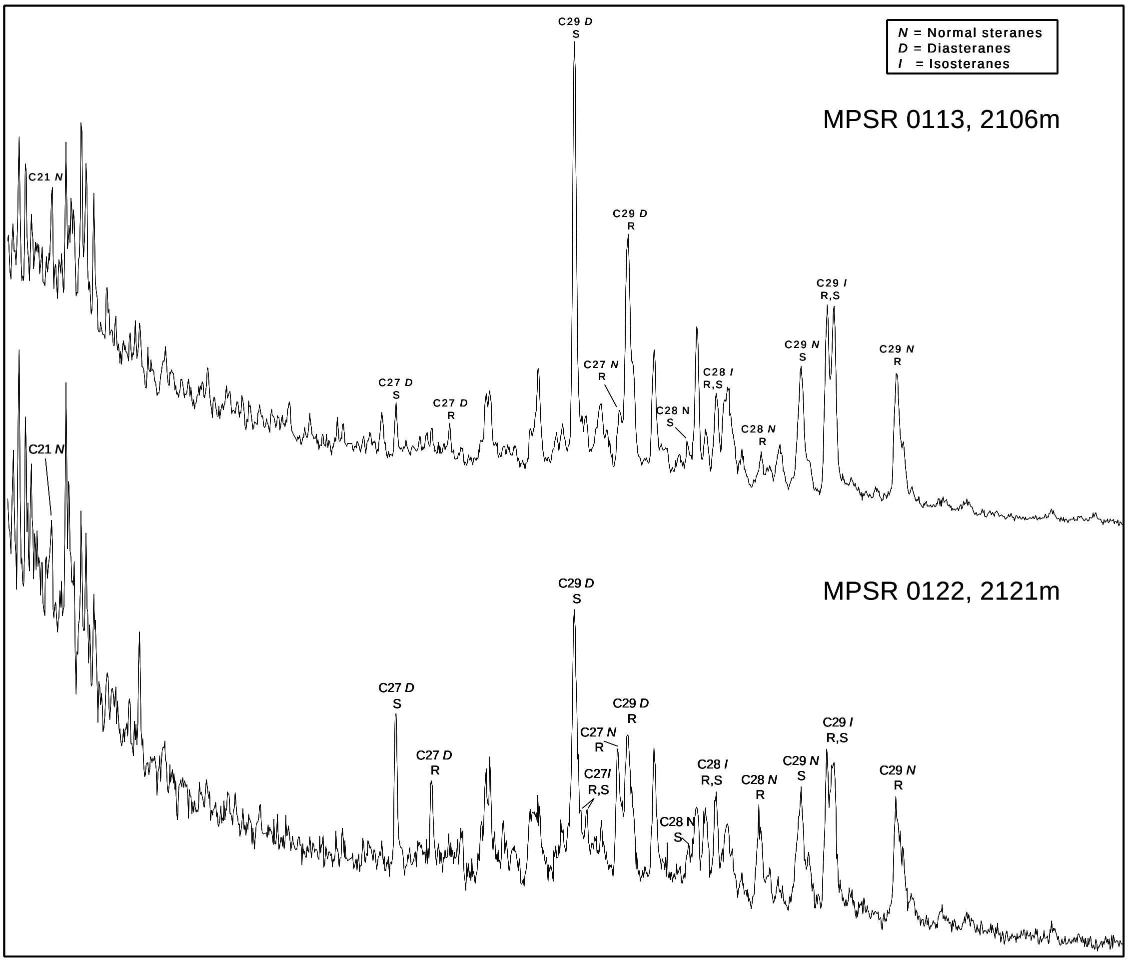


Figure 10. Partial m/z 217 mass chromatograms showing the distribution of steranes in the West Moonfish-1 oils

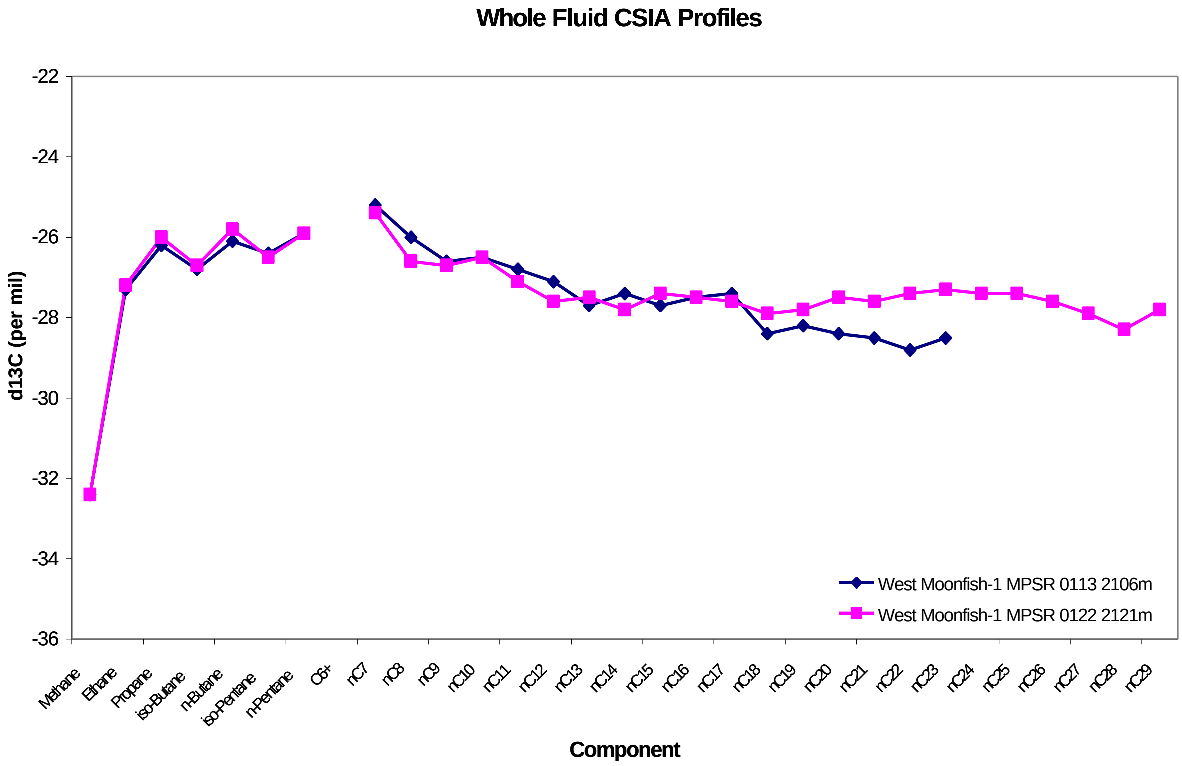


Figure 11. Whole fluid CSIA profiles for West Moonfish-1 samples

3.3. CORRELATION WITH MOONFISH-1 OILS

Summary of Moonfish-1 data

Three crude oils from Moonfish-1, previously analysed at Geotech, were re-submitted as part of the current job for correlation with the two West Moonfish-1 samples:

Moonfish-1/ST-1	RFT 1838.7m
Moonfish-1	RFT 1914.5m
Moonfish-1	RFT 2260.5m

The saturate chromatograms obtained from GC-MS analysis of the three samples are presented in Figure 12. All three Moonfish-1 samples are paraffinic crudes showing a high relative abundance of high molecular weight components (>n-C_{22}), reflecting strong input of higher plant derived organic material. Pristane to phytane ratios are similar for all three samples, varying between 6.55 and 6.90, consistent with deposition of associated source rocks under oxic environmental conditions.

Figure 13 presents a triplot of selected trimethylnaphthalenes, tetramethylnaphthalenes and pentamethylnaphthalenes for each of the three Moonfish-1 oils showing the samples have not been altered to any significant extent by secondary processes such as biodegradation or water washing. All three samples are of moderate to high maturity, with vitrinite reflectance equivalence values ranging from 0.89% up to 0.95%. Total ion chromatograms of the aromatic fractions (Figure 14) are consistent with this interpretation, all three samples showing a high relative abundance of low molecular weight components suggesting high thermal maturity. Calculated maturity parameters based on branched/cyclic components are in agreement with aromatic derived parameters, with C_{29} 20S/20R ratios of 0.75 and 0.72 (approximately equivalent to 0.85% to 0.90% VR) for West Moonfish-1 1838.7m and 1914.5m, respectively. The higher value (1.13) for West Moonfish-1 2260.5m, whilst suggestive of overmaturity, is unlikely to be a true indication of the level of thermal maturity of this sample.

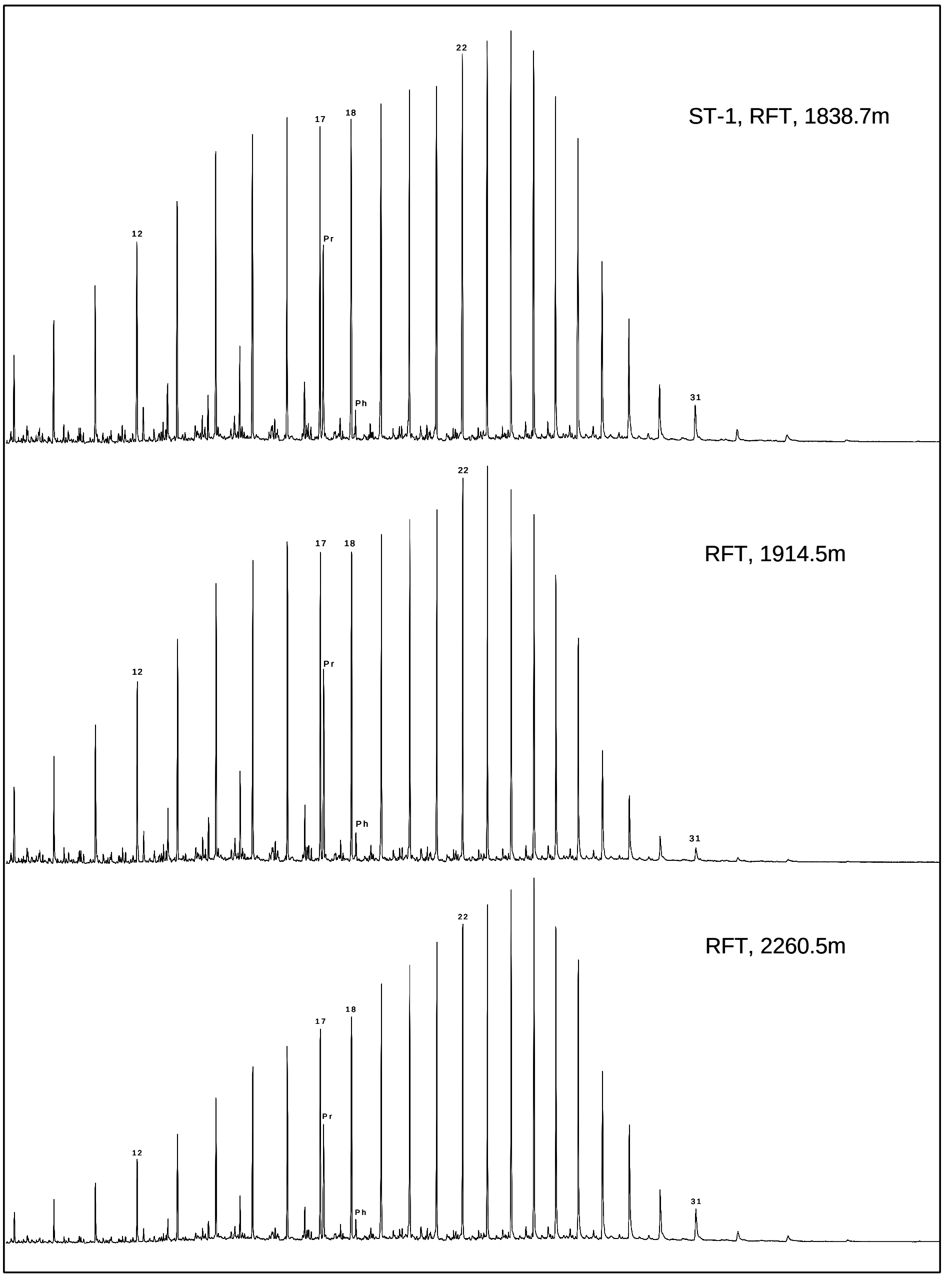
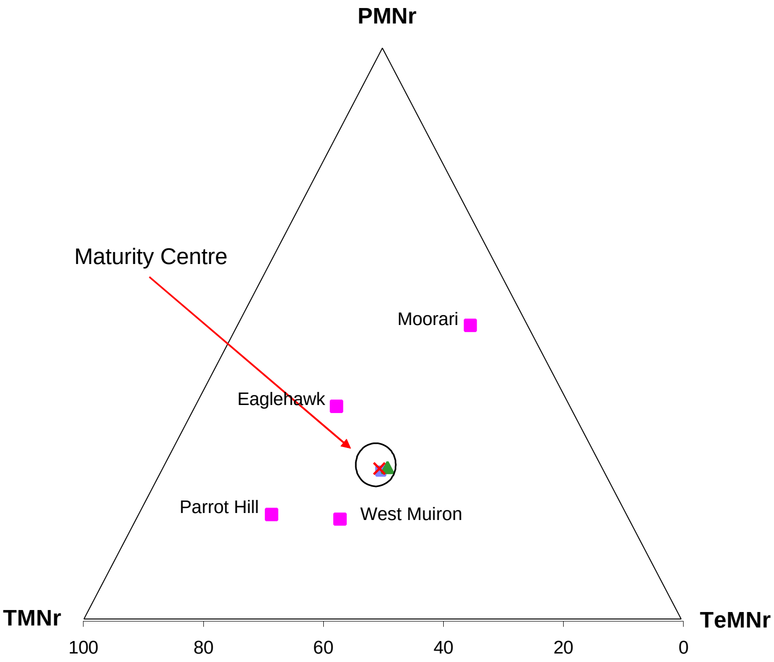


Figure 12. Saturate GC-MS profiles for the Moonfish-1 oils



After van Aarssen et al., 2000

Figure 13. Ternary diagram showing the distribution of methylated naphthalenes in the Moonfish-1 oils

Source related biomarker distributions indicate that the oils are genetically related and support a high contribution of terrestrial organic matter. Sterane distributions are dominated by C_{29} components with algal/marine derived C_{27} steranes and diasteranes almost below GC-MS detection limits. Hopane/sterane ratios, ranging from 1.08 to 1.26, are similarly consistent with deposition of source rocks in a terrestrial environment. The hopane/sterane ratio is generally assumed to reflect the relative contribution of prokaryotic and eukaryotic organic matter. High values are generally observed in terrestrial environments, suggesting increased levels of bacterial activity and an associated increase in the production of hopanoids components (cf. Peters and Moldowan, 1993). Figure 15 shows a triplot of isosterane components, which also characterise the original source rock depositional environment as fluvial/deltaic with a concomitant input of substantial land plant derived organic material.

The higher plant derived aromatic components, retene, cadalene and i-HMN-IV have all been identified in the Moonfish-1 samples, together producing HPI values ranging from 1.08 to 1.53. Analysis of the m/z 123 mass chromatograms from the branched/cyclic fractions also show the presence of higher plant derived diterpene components including kaurane and phyllocladane in high relative abundance. These diterpanes are reported to derive from higher plant resins, similarly indicating a significant contribution of terrestrial organic matter to the sediments.

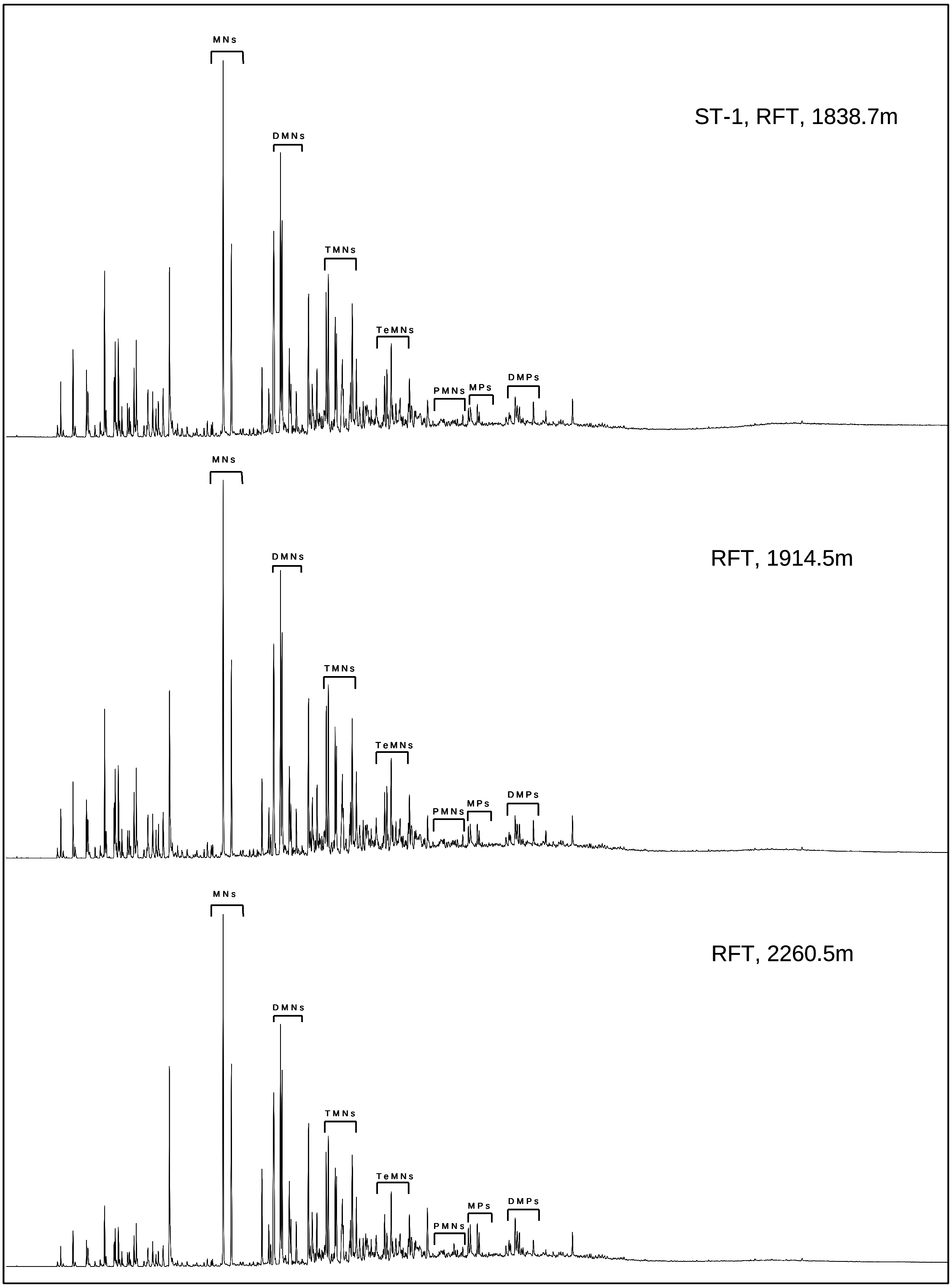
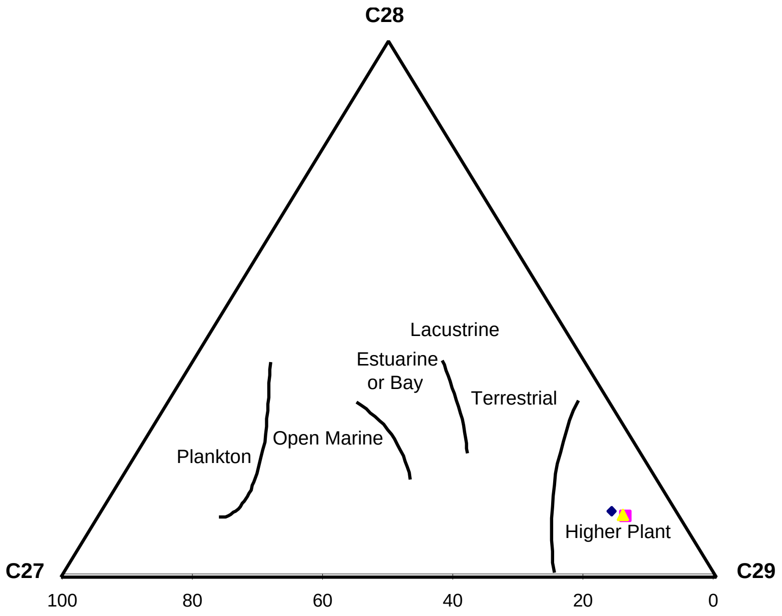


Figure 14. Total ion chromatograms of the aromatic fractions of the Moonfish-1 oils



(After Huang and Meinschein, 1979)

Figure 15. Ternary diagram showing the distribution of steranes in the Moonfish-1 oils

Correlation of West Moonfish-1 and Moonfish-1

GC-MS analysis indicates that the West Moonfish-1 and Moonfish-1 samples are all of comparable maturity and, since there is no indication that biodegradation or water washing has altered the composition of the oils, the two sets of samples can be correlated. Overall, all samples analysed are very comparable in their molecular composition with strong terrestrial signatures characterising both the West Moonfish-1 and Moonfish-1 oils. Whilst subtle differences are observed between samples, for example the HPI values which are somewhat higher in the Moonfish-1 oils, a positive correlation between the two wells is herein confirmed. West Moonfish-1 2106m in particular shows very strong correlation with the Moonfish-1 oils based on sterane distributions (Figure 16). The sterane profile of West Moonfish-1 2121m shows less correlation with Moonfish-1 samples due to the contribution of marine derived C_{27} sterane components to the sample.

Figure 17 presents partial m/z 191 mass chromatograms for both West Moonfish-1 and Moonfish-1 oils showing the distribution of hopanes in the oils. Whilst the profiles observed are not unique to these wells, nor to Gippsland Basin fluids in general, the similarity between hopane profiles does suggest derivation of organic matter from similar source facies. Furthermore, the low relative abundance of tri- and tetracyclic terpanes (Figure 18) is a feature common to all samples, with the C_{24} tetracyclic component being in higher relative abundance than the C_{23} tricyclic component. The C_{24} tetracyclic, although abundant in carbonate and evaporite environments, has been reported in high relative abundance in

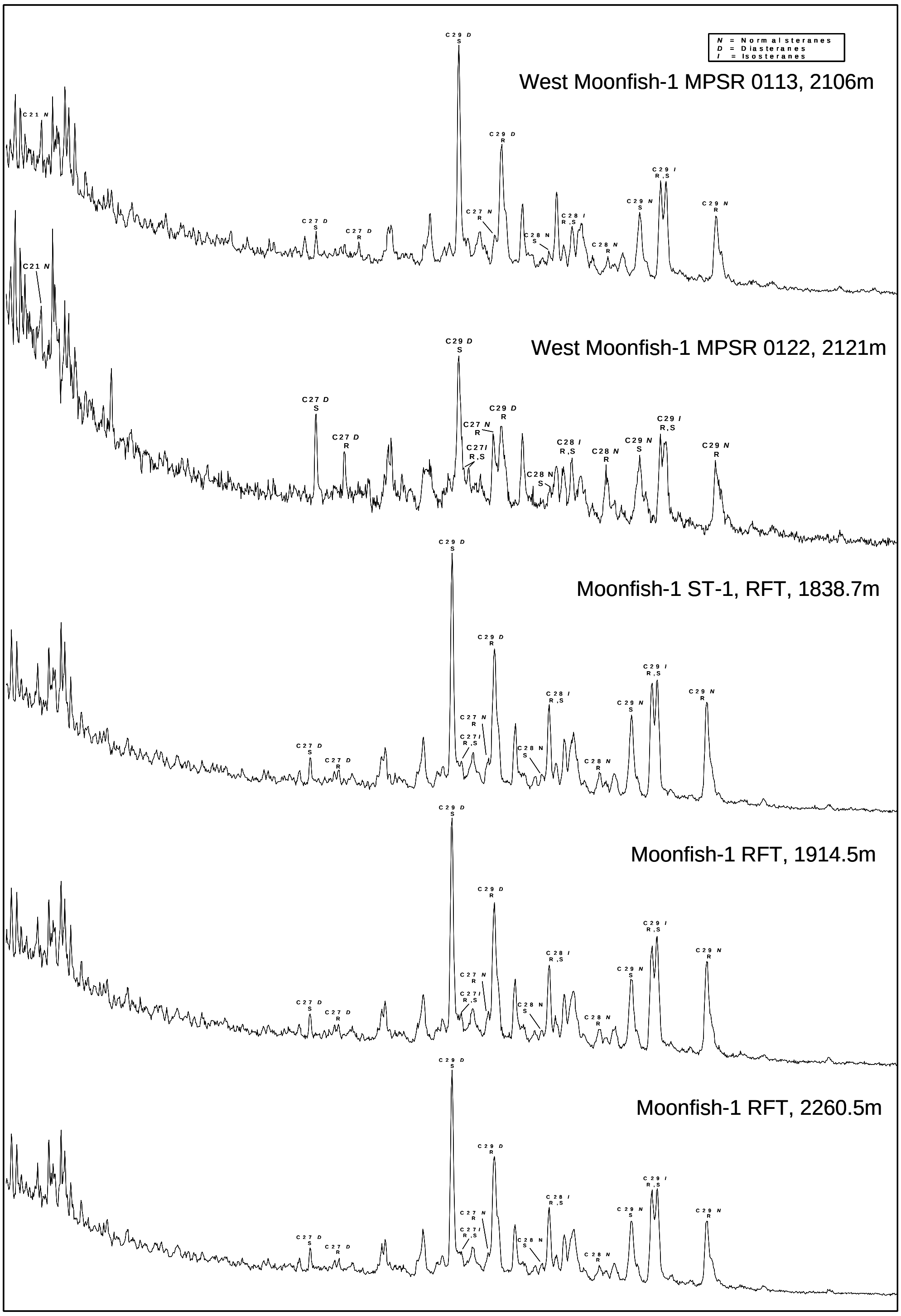


Figure 16. Partial m/z 217 mass chromatograms showing the correlation of steranes from West Moonfish-1 with Moonfish-1 samples

samples generated from terrigenous organic matter (Philp and Gilbert, 1986), further supporting derivation of all samples from a similar source facies.

Figure 19 presents partial m/z 123 mass chromatograms for the West Moonfish-1 and Moonfish-1 oils showing the distribution of land plant derived diterpenes. Whilst these components are often observed from samples containing abundant terrigenous organic matter, basic diterpane profiles can vary quite significantly. The comparability between the m/z 123 mass chromatograms for the West Moonfish-1 and Moonfish-1 oils attests to the samples all being genetically related, having derived from a similar source.

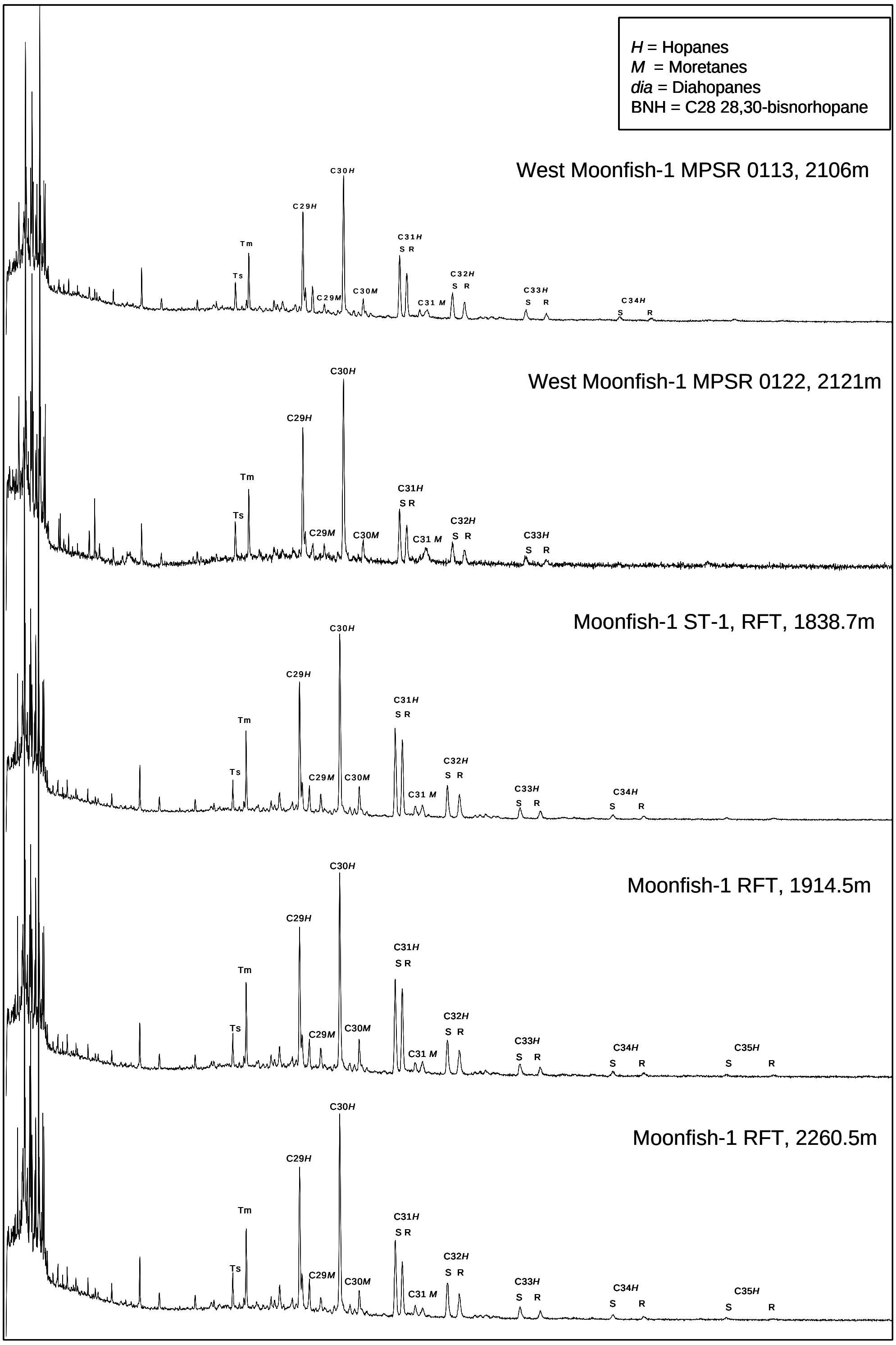


Figure 17. Partial m/z 191 mass chromatograms showing the correlation of hopanes from West Moonfish-1 with Moonfish-1 samples

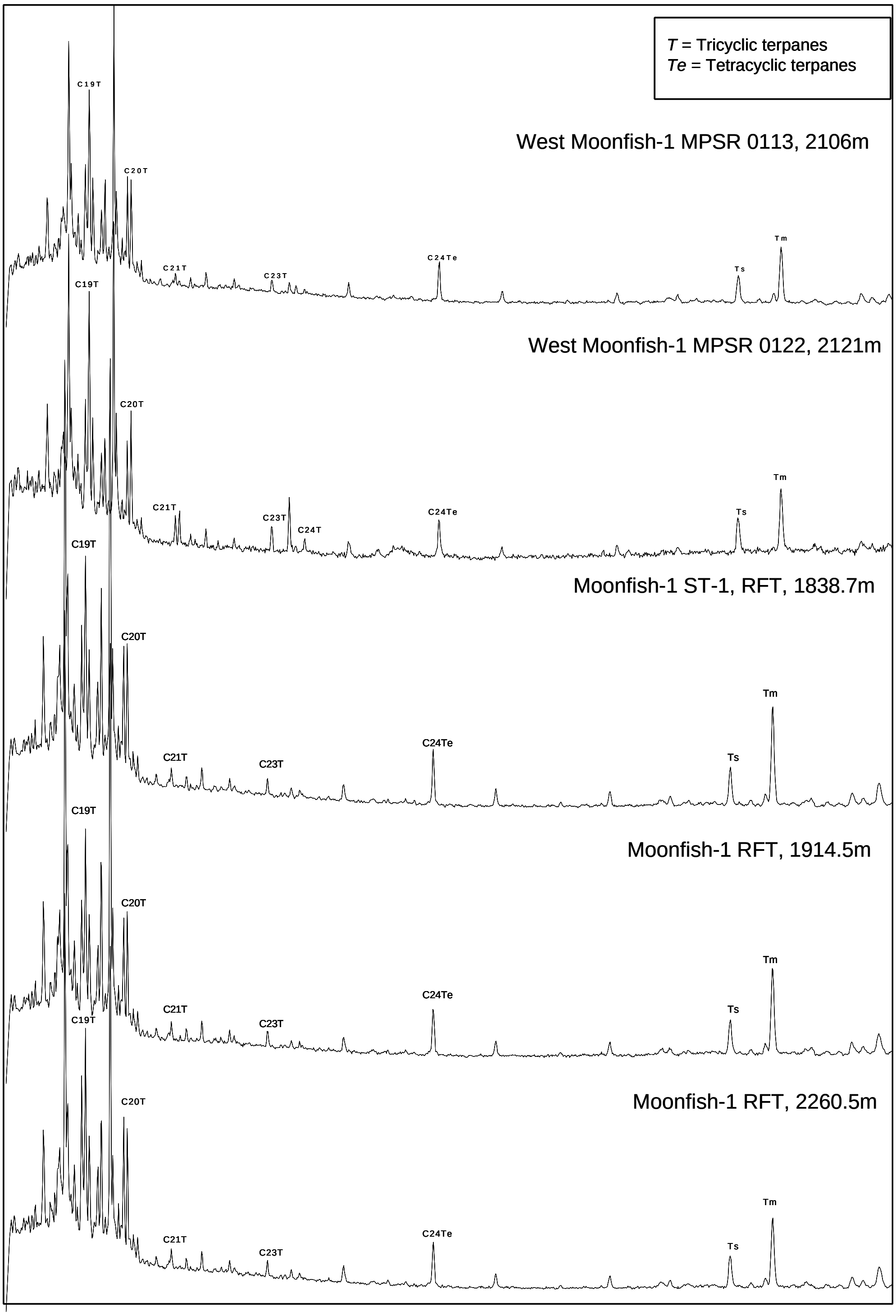


Figure 18. Partial m/z 191 mass chromatograms showing the correlation of tri- and tetracyclic components from West Moonfish-1 with Moonfish-1 samples

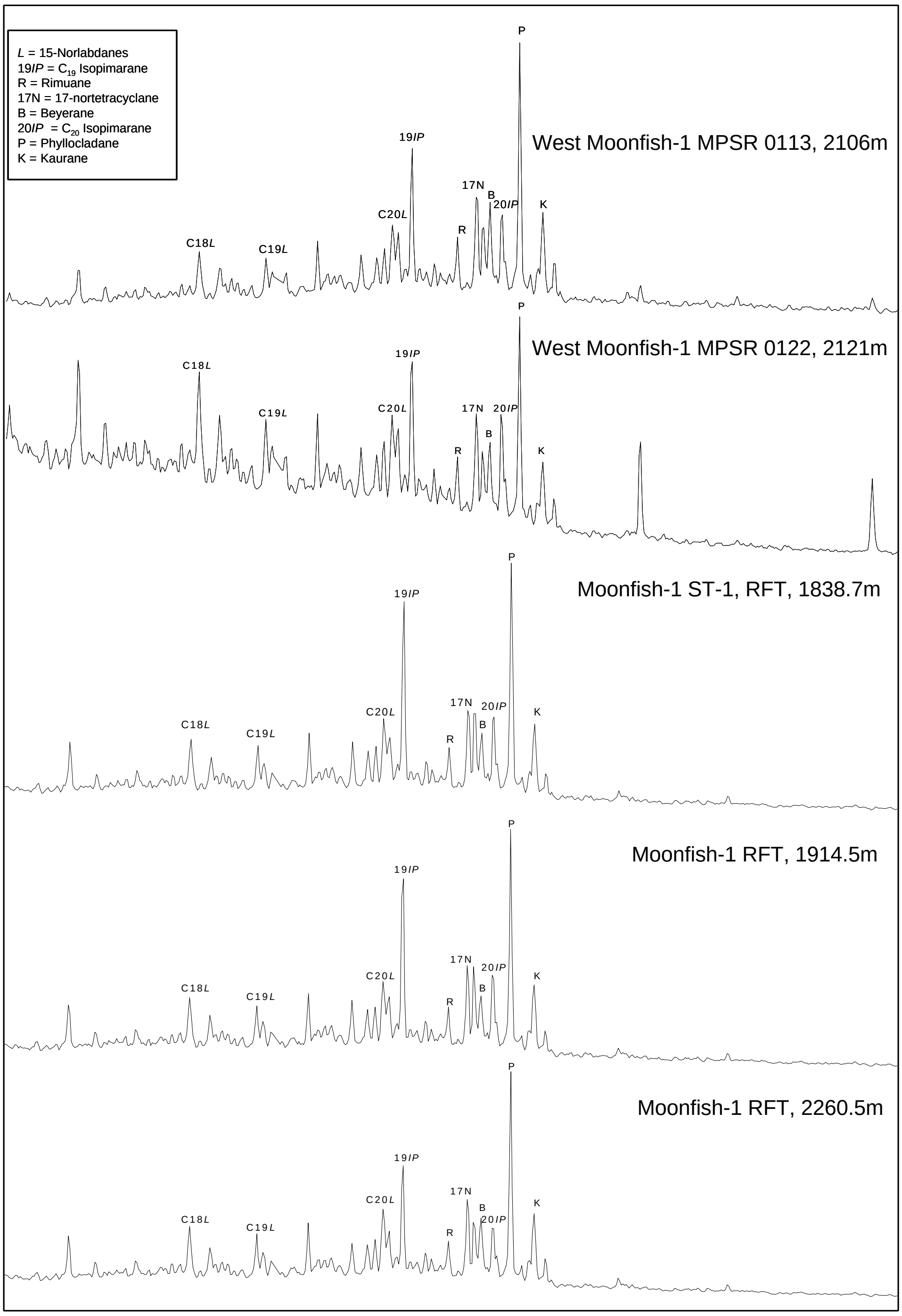


Figure 19. Partial m/z 123 mass chromatograms showing the correlation of diterpane components from West Moonfish-1 with Moonfish-1 samples

4 CONCLUSION

4.1 WEST MOONFISH-1 GASES

Compositional analysis and CSIA of the two West Moonfish-1 gases indicates the samples are genetically related. Compositional analysis indicates both samples derive from oil mature source rocks and have been generated from a very similar source. Neither sample has been altered by mixing or biodegradation. Isotopically heavy methane and wet gas is consistent with derivation of gas primarily from humic kerogen.

4.2 WEST MOONFISH-1 OILS

Whole oil GC-MS analysis of the two West Moonfish-1 oils indicates that neither has been altered by secondary processes such as mixing, water washing or biodegradation. The two oils are genetically related and both are of high thermal maturity based on their respective saturate GC-MS profiles and calculated aromatic and branched/cyclic data parameters. The two samples are of high thermal maturity, equivalent to approximately 0.9% to 1% VR, based on MPI values of 0.85 and 1.04 for West Moonfish-1 2106m and West Moonfish-1 2121m, respectively. Pristane to phytane ratios are suggestive of oxic, nearshore depositional environments. Biomarker analysis attests to a significant contribution of higher plant derived organic matter to both samples, based on the high abundance of C_{29} steranes and the presence of aromatic land plant biomarkers. A C_{27}/C_{29} sterane ratio of almost one for West Moonfish-1 2121m however, is consistent with some contribution to this sample from marine derived organic material.

4.3 CORRELATION WITH MOONFISH-1 OILS

The three Moonfish-1 samples derive from oxic, nearshore depositional environments and show strong terrestrial signatures based on biomarker analysis. West Moonfish-1 2106m, which similarly contains predominantly terrestrial derived organic matter, shows very strong correlation with the Moonfish-1 oils. Both West Moonfish-1 samples are of a comparable level of thermal maturity to the Moonfish-1 oils. All samples contain comparable hopane and tri- and tetracyclic biomarker profiles and similar distributions of higher plant biomarkers. The marine influence observed from West Moonfish-1 2121m, however, is not apparent in any of the Moonfish-1 oils, consistent with a slightly different source facies for this sample.

5 REFERENCES

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APPENDIX A

DATA AND TABLES

DATA AND TABLES

WEST MOONFISH-1

TABLE OF CONTENTS

ANALYSIS OF GAS COMPONENTS *

West Moonfish-1, ex MPSR 0113, 2106m

Compound	*Mol%*	*Mol Fraction*
methane	79.3	0.8
ethane	4.9	0.0
propane	1.7	0.0
i-butane	0.3	<0.01
n-butane	0.4	<0.01
i-pentane	0.1	<0.01
n-pentane	0.1	<0.01
C_6+	0.2	<0.01
CO_2	12.8	0.1
O_2+Ar	<0.1	<0.01
N_2	<0.1	<0.01

* H_2 and He content not determined

nd = not detected

TABLE 1-2

ANALYSIS OF GAS COMPONENTS *

West Moonfish-1, ex MPSR 0122, 2121m

GEOTECH

Compound	*Mol%*	*Mol Fraction*
methane	76.8	0.8
ethane	6.4	0.1
propane	2.1	0.0
i-butane	0.3	<0.01
n-butane	0.4	<0.01
i-pentane	<0.1	<0.01
n-pentane	<0.1	<0.01
C_6+	0.1	<0.01
CO_2	13.8	0.1
O_2+Ar	<0.1	<0.01
N_2	<0.1	<0.01

* H_2 and He content not determined

TABLE 2-1

COMPOUND SPECIFIC ISOTOPE ANALYSIS (GC-IRMS)

WEST MOONFISH-1, exL-194, ex MPSR 0113, 2106m

GEOTECH

Compound	*d ^{13}C*	*SD*	*Misc. Information*
methane	-32.4	0.28	
ethane	-27.3	0.11	
propane	-26.2	0.06	
i-butane	-26.8	0.19	
n-butane	-26.1	0.11	
i-pentane	-26.4	0.07	
n-pentane	-25.9	0.09	
CO_2	-4.9	0.19	

* Misc. Information : indicates if the abundance of the compound is low and therefore the value calculated less reliable

Units: $^{o}/_{oo}$ PDB

(per mil International Standard Peedee Belemnite)

29/11/2005

nd = not detected

TABLE 2-2

COMPOUND SPECIFIC ISOTOPE ANALYSIS (GC-IRMS)

WEST MOONFISH-1, exL-193, ex MPSR 0122, 2121m

GEOTECH

Compound	*$d^{13}C$*	*SD*	*Misc. Information*
methane	-32.4	0.11	
ethane	-27.2	0.23	
propane	-26.0	0.05	
i-butane	-26.7	0.02	
n-butane	-25.8	0.01	
i-pentane	-26.5	0.13	
n-pentane	-25.9	0.01	
CO_2	-4.6	0.32	

* Misc. Information : indicates if the abundance of the compound is low and therefore the value calculated less reliable

29/11/2005
nd = not detected

Units: $^{o}/_{oo}$ PDB
(per mil International Standard Peedee Belemnite)

TABLE 3-1

ANALYSIS OF CRUDE OIL BY GC-MS

WEST MOONFISH-1, ex-L194, ex MPSR-0113, 2106m, Crude Oil

GEOTECH

Composition of C4 to C8 Fraction

Compound	*Rel.Wt%*	*Compound*	*Rel.Wt%*
isobutane (A)	-	1,1-dimethylcyclopentane (O)	0.2
n-butane (B)	-	2-methylhexane/2,3-dimethylpentane (P)	1.5
isopentane (C)	0.1	3-methylhexane (Q)	1.3
n-pentane (D)	0.1	1 cis-3-dimethylcyclopentane (R)	0.4
2,2-dimethylbutane (E)	0.0	1 trans-3-dimethylcyclopentane (S)	0.4
(cyclopentane		1 trans-2-dimethylcyclopentane (T)	0.7
2,3-dimethylbutane (F+G)	0.1	n-heptane (U)	6.0
2-methylpentane (H)	0.3	methylcyclohexane (V)	8.1
3-methylpentane (I)	0.2	1 cis-2-dimethylcyclopentane (W) +	0.2
n-hexane (J)	0.7	toluene (X)	14.6
methylcyclopentane (K)	0.6	n-octane (Y)	17.0
2,4-dimethylpentane (L)	0.1	ethylbenzene (Z)	4.1
benzene (M)	0.8	M+P-xylene (AA)	33.1
cyclohexane (N)	0.9	O-xylene (BB)	8.5

Calculated Data from the C4 to C8 Fraction

Paraffin Index I	1.8	I/M (Water washing)	0.2
Paraffin Index II	30.8	V/X (Water washing)	0.6
J/K (Maturity)	1.2	I/J (Biodegradation)	0.2
		V/U (Biodegradation)	1.3

- = Below detection limit or not determined
29/11/2005

Paraffin Index I = (P+Q)/(R+S+T)
Paraffin Index II = %U in N to V

FIGURE 1A-1

Sample : **WEST MOONFISH-1, 2106m, Crude Oil**
File ID :   352501W

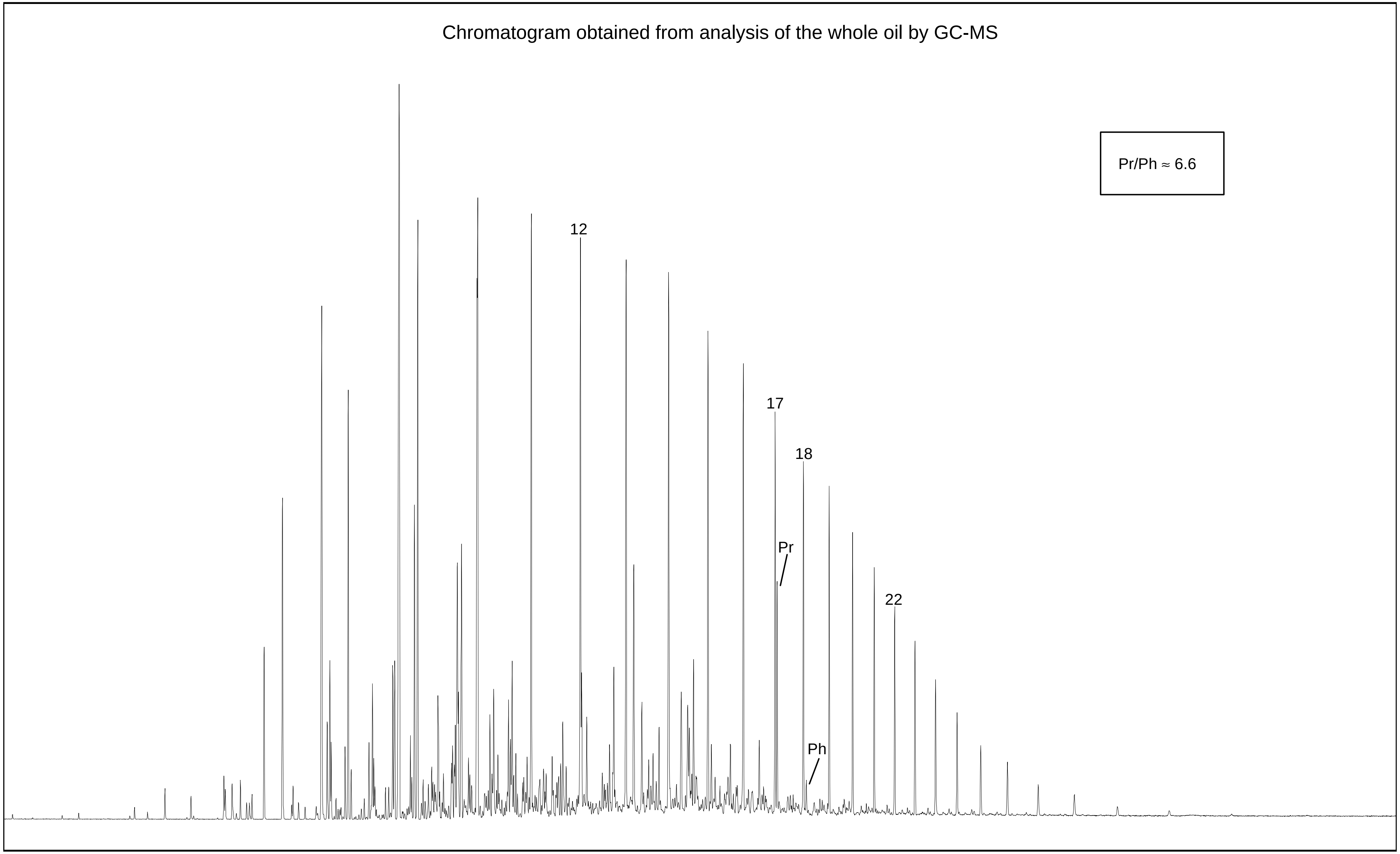

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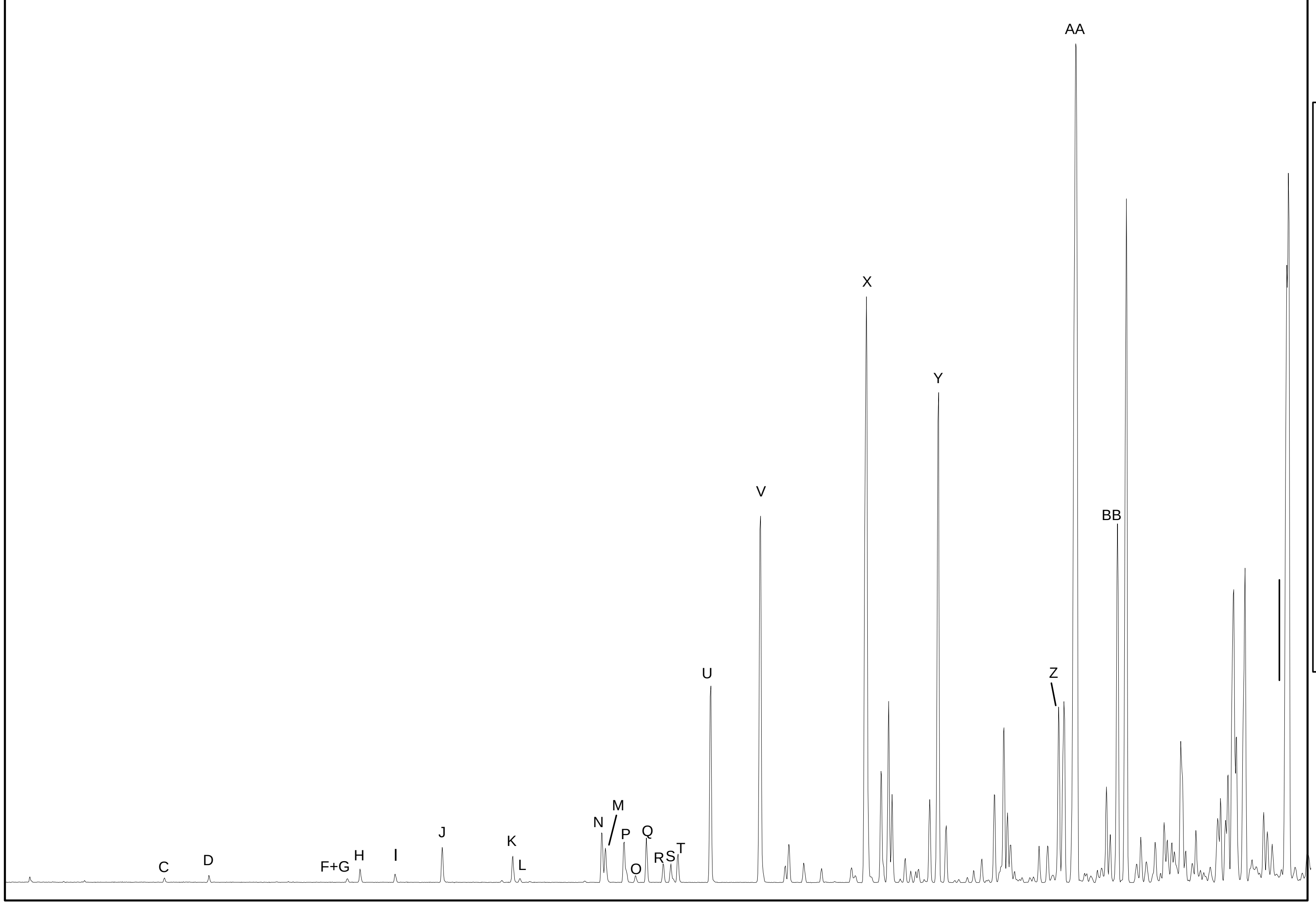
FIGURE 1B-1

Sample : **WEST MOONFISH-1, 2106m, Crude Oil**
File ID :   352501W



Partial chromatogram obtained from analysis of the whole oil by GC-MS

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

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TABLE 3-2

ANALYSIS OF CRUDE OIL BY GC-MS

WEST MOONFISH-1, ex-L193, ex MPSR-0122, 2121m, Crude Oil

GEOTECH

Composition of C4 to C8 Fraction

Compound	*Rel.Wt%*	*Compound*	*Rel.Wt%*
isobutane (A)	1.0	1,1-dimethylcyclopentane (O)	0.3
n-butane (B)	2.2	2-methylhexane/2,3-dimethylpentane (P)	2.0
isopentane (C)	2.7	3-methylhexane (Q)	1.6
n-pentane (D)	3.2	1 cis-3-dimethylcyclopentane (R)	0.7
2,2-dimethylbutane (E)	0.1	1 trans-3-dimethylcyclopentane (S)	0.7
(cyclopentane		1 trans-2-dimethylcyclopentane (T)	0.9
2,3-dimethylbutane (F+G)	1.0	n-heptane (U)	5.6
2-methylpentane (H)	2.1	methylcyclohexane (V)	9.3
3-methylpentane (I)	1.0	1 cis-2-dimethylcyclopentane (W) +	5.3
n-hexane (J)	3.0	toluene (X)	15.1
methylcyclopentane (K)	2.3	n-octane (Y)	7.2
2,4-dimethylpentane (L)	0.2	ethylbenzene (Z)	2.2
benzene (M)	2.9	M+P-xylene (AA)	20.4
cyclohexane (N)	2.7	O-xylene (BB)	4.5

Calculated Data from the C4 to C8 Fraction

Paraffin Index I	1.6	I/M (Water washing)	0.3
Paraffin Index II	23.5	V/X (Water washing)	0.6
J/K (Maturity)	1.3	I/J (Biodegradation)	0.3
		V/U (Biodegradation)	1.7

- = Below detection limit or not determined
29/11/2005

Paraffin Index I = (P+Q)/(R+S+T)
Paraffin Index II = %U in N to V

FIGURE 1A-2

Sample : **WEST MOONFISH-1, 2121m, Crude Oil**
File ID :   352502WB

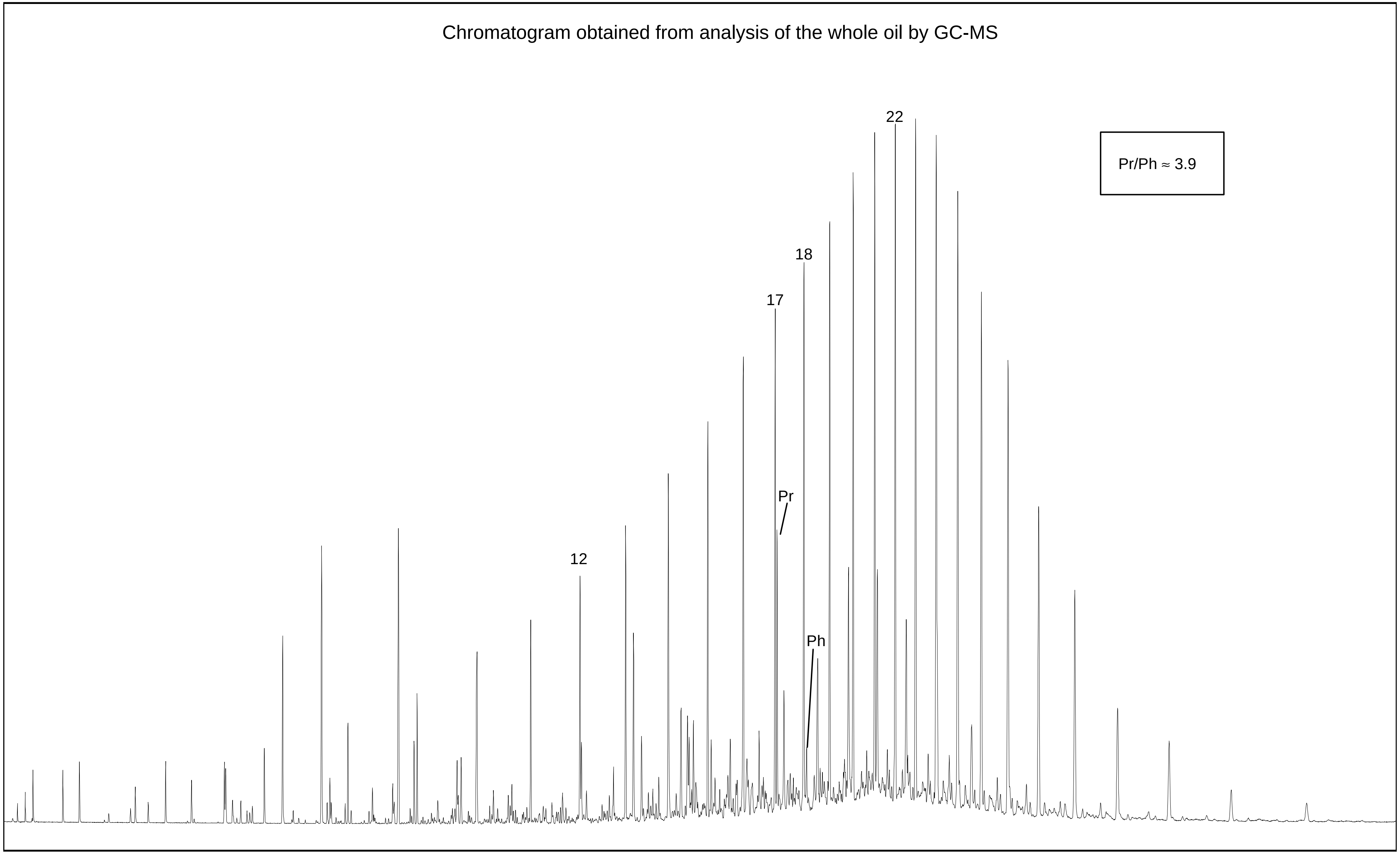

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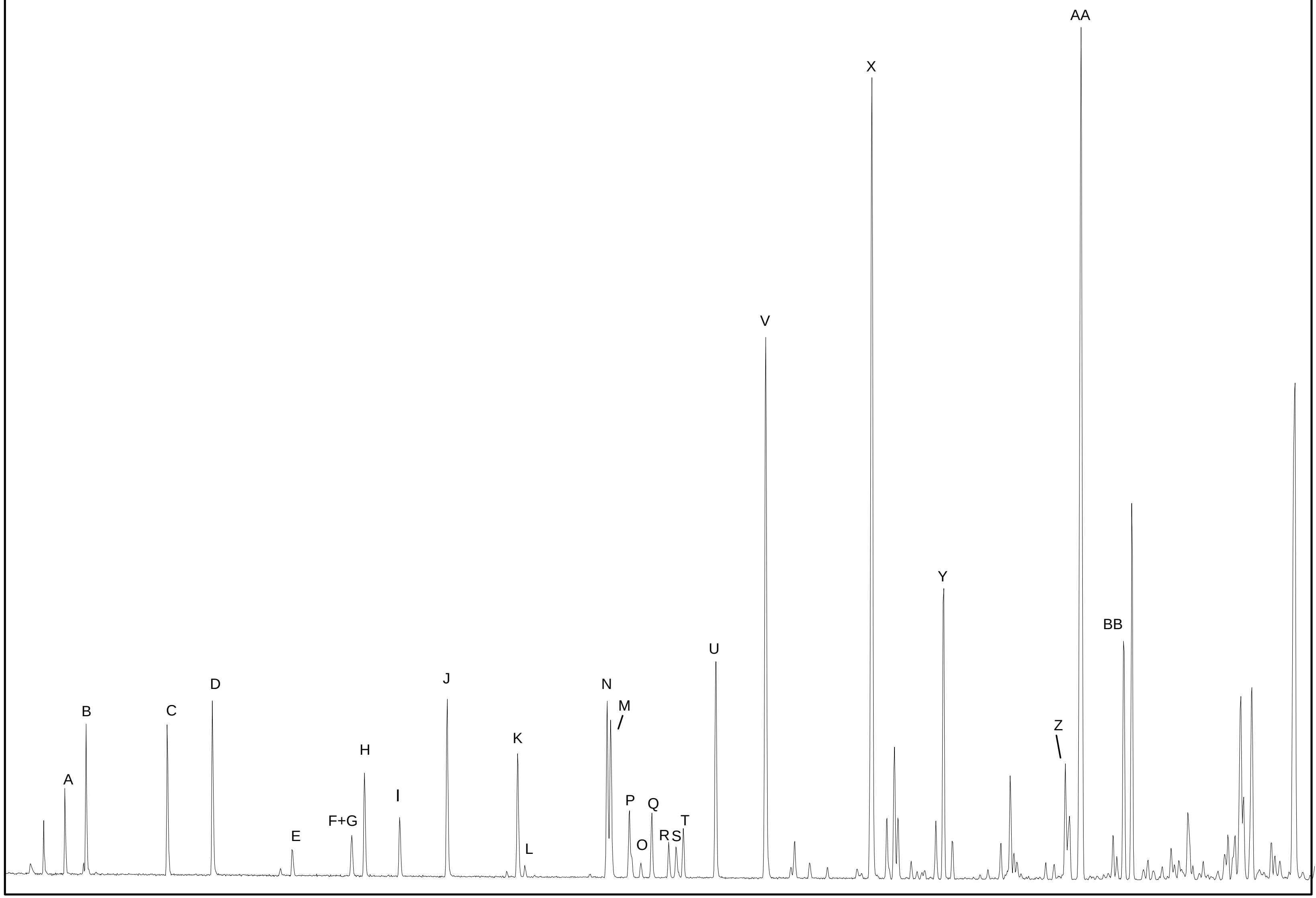
FIGURE 1B-2

Sample : **WEST MOONFISH-1, 2121m, Crude Oil**
File ID : 352502WB

GEOTECH

Partial chromatogram obtained from analysis of the whole oil by GC-MS



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

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TABLE 4

LIQUID CHROMATOGRAPHY DATA
OIL

WEST MOONFISH-1

Yields (%) and Selected Ratios

		------Hydrocarbons------			------Non-hydrocarbons------			Sats	Asph.	HC
DEPTH	Sample Type	Sats	Aros	HC's	NSOs	Asph.	Non HC's	Aros	NSO	Non HC
2106.0m, ex L-194	Condensate	75.2	23.3	98.5	1.5	nd	1.5	3.2	nd	64.0
2121.0m, ex L-193	Crude	77.4	19.1	96.5	3.5	nd	3.5	4.0	nd	27.8

29/11/2005
nd = no data

TABLE 5

ANALYSIS OF SATURATED HYDROCARBONS BY GC-MS

OIL

WEST MOONFISH-1

A. Selected Ratios

GEOTECH

DEPTH	Sample Type	Prist./Phyt.	Prist./n-C17	Phyt./n-C18	CPI(1)	CPI(2)	(C21+C22)/(C28+C29)
2106.0m, ex L-194	Condensate	8.24	0.62	0.09	1.12	1.11	12.49
2121.0m, ex L-193	Crude	6.37	0.52	0.07	1.07	1.04	2.42

WEST MOONFISH-1

B. n-Alkane Distributions

DEPTH	nC12	nC13	nC14	nC15	nC16	nC17	Pr	nC18	Ph	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31
2106.0m, ex L-194	13.6	13.3	11.9	10.7	8.7	7.3	4.5	6.0	0.5	5.1	4.3	3.6	3.0	2.4	1.7	1.3	0.8	0.7	0.3	0.2	0.1	0.1
2121.0m, ex L-193	1.8	2.3	2.9	3.5	4.0	4.6	2.4	5.1	0.4	5.9	6.5	7.1	7.8	8.4	8.4	8.2	6.8	6.1	3.7	2.5	1.1	0.7

$$\mathrm{CPI(1)} = \frac{(C23+C25+C27+C29)+(C25+C27+C29+C31)}{2x(C24+C26+C28+C30)}$$

$$\mathrm{CPI(2)} = \frac{(C23+C25+C27)+(C25+C27+C29)}{2x(C24+C26+C28)}$$

29/11/2005
nd = no data

FIGURE 2-1

Sample : **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**
File ID : 352501S

Chromatogram obtained from the analysis of saturated hydrocarbons by GC-MS

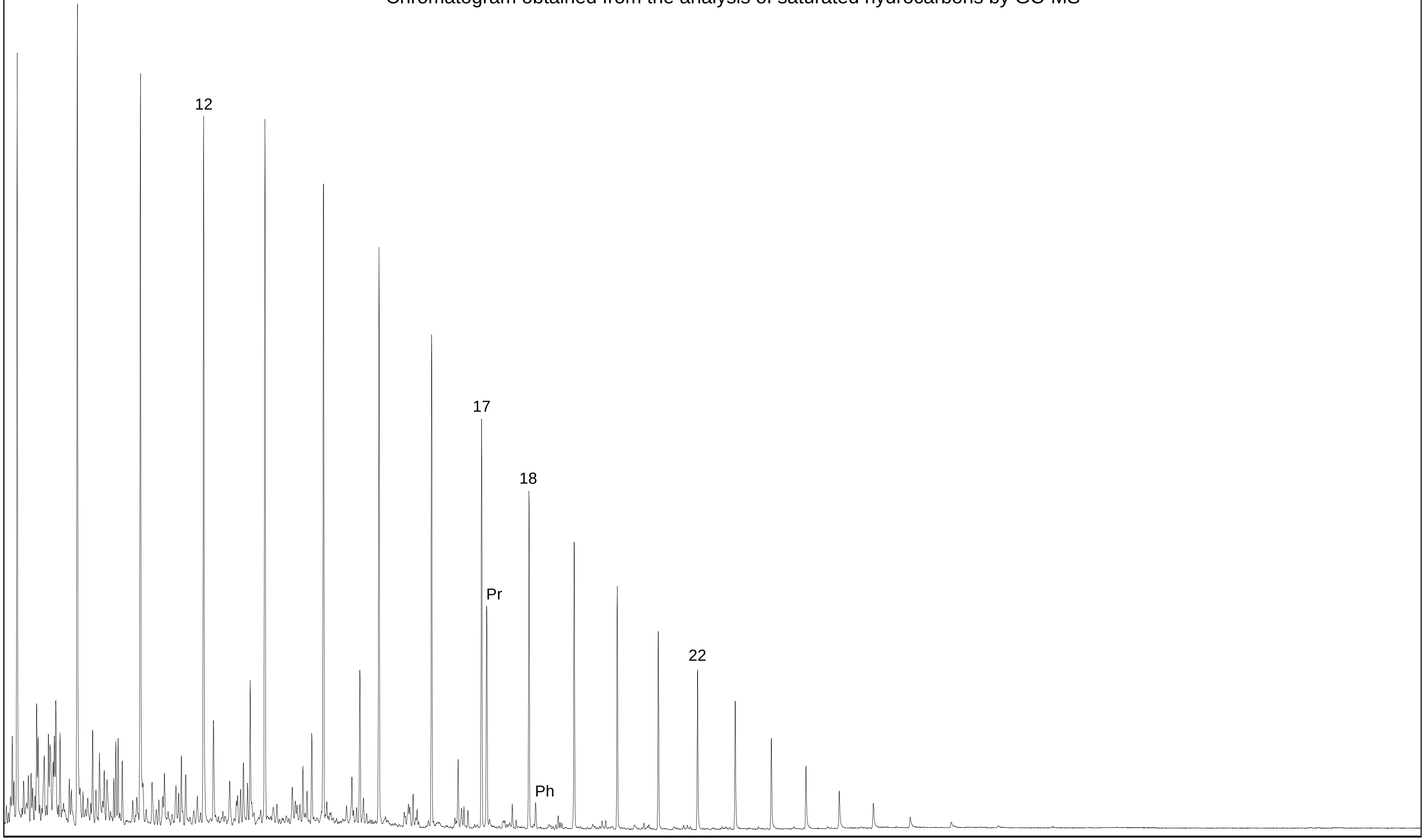

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FIGURE 2-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L-193, ex MPSR 0122, Crude Oil**
File ID : 352502SB

Chromatogram obtained from the analysis of saturated hydrocarbons by GC-MS

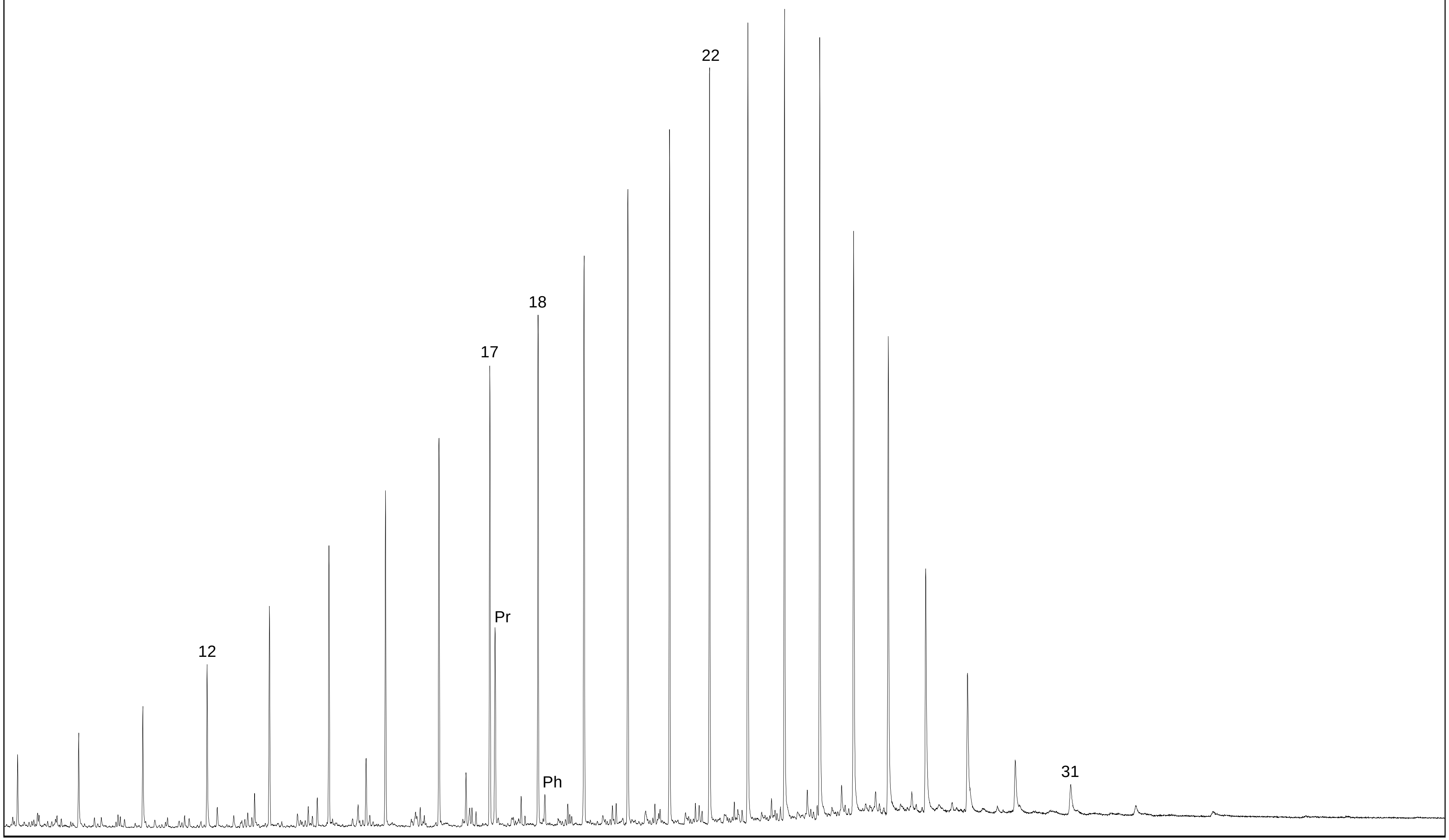

TABLE 6

ANALYSIS OF AROMATIC HYDROCARBONS BY GC-MS

WEST MOONFISH-1

DEPTH	TYPE	DNR-1	DNR-5	DNR-6	TNR-1	TNR-5	TNR-6	MPR-1	MPI-1	MPI-2	Rc(a)	Rc(b)
2106.0m, ex L-19	Condensate	11.53	nd	4.25	1.14	0.31	0.26	3.11	0.85	0.87	0.91	1.79
2121.0m, ex L-19	Crude Oil	10.36	nd	3.73	1.13	0.34	0.23	3.33	1.04	1.09	1.02	1.68

response factors have not been applied to these ratios

WEST MOONFISH-1

DEPTH	TYPE	1,7-DMP/X (m/z 206)	RETENE/9-MP (m/z 219,192)	1MP/9MP	HPI
2106.0m, ex L-19	Condensate	0.46	0.09	0.80	0.31
2121.0m, ex L-19	Crude Oil	0.47	0.16	0.73	0.52

HPI = Higher Plant Index (i.e (retene + cadalene + iHMN-IV)/1,3,6,7-TeMN))

29/11/2005

nd = no data

iHMN-IV = RODB

FIGURE 3A-1

Sample: **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID: **352501A**

GEOTECH

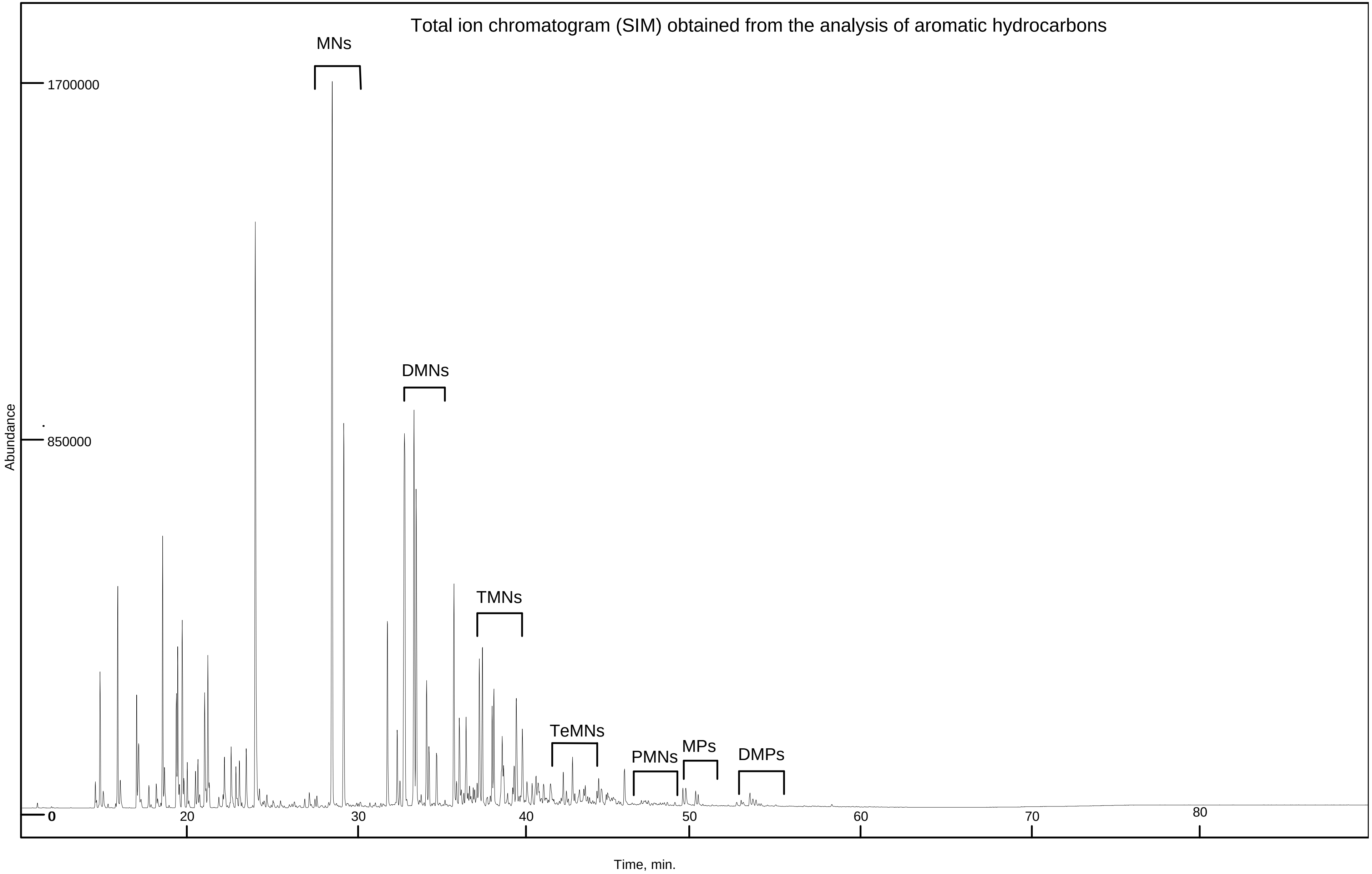

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FIGURE 3B-1

Sample: **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID: **352501A**

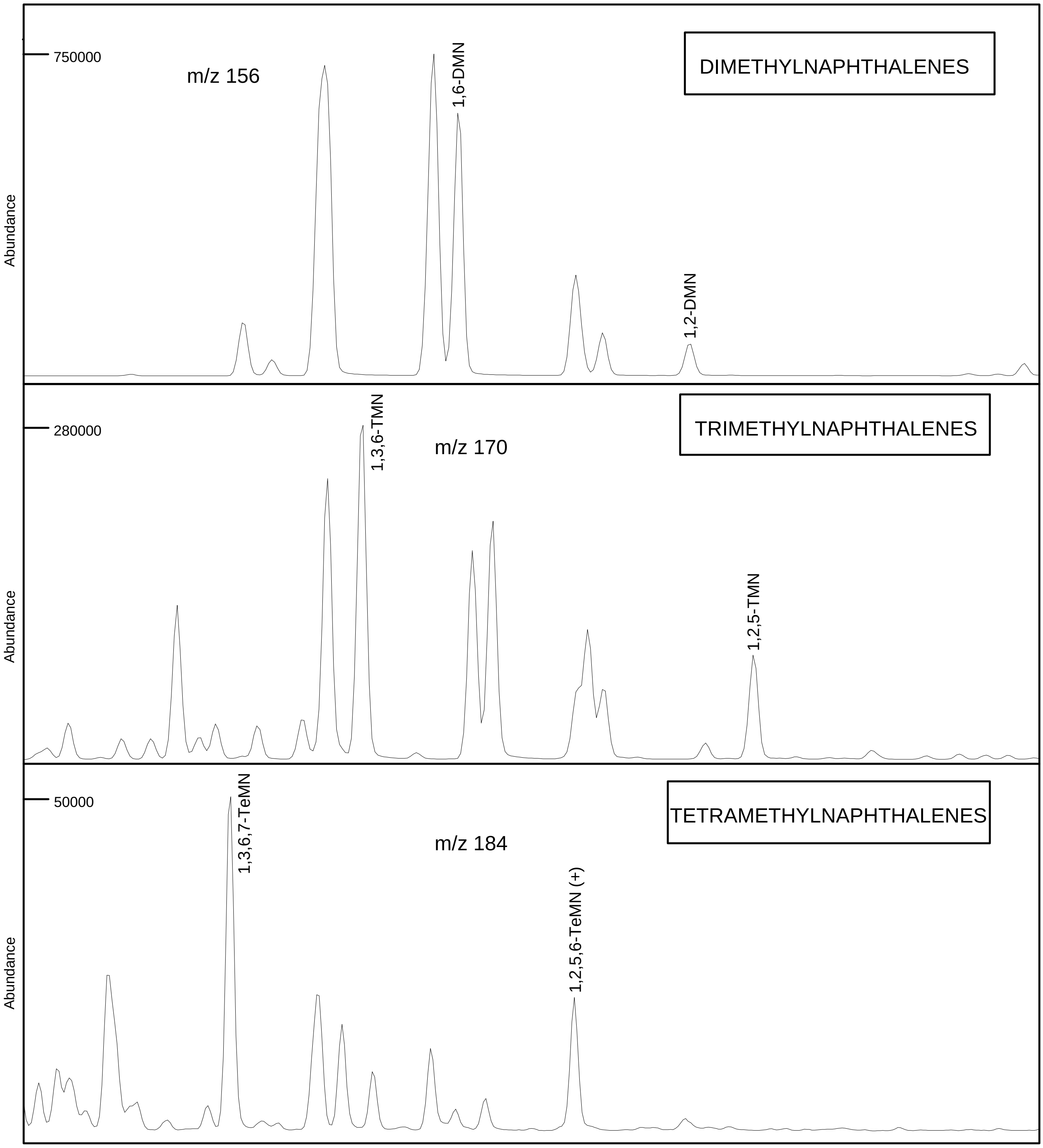


FIGURE 3C-1

Sample: **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID: **352501A**

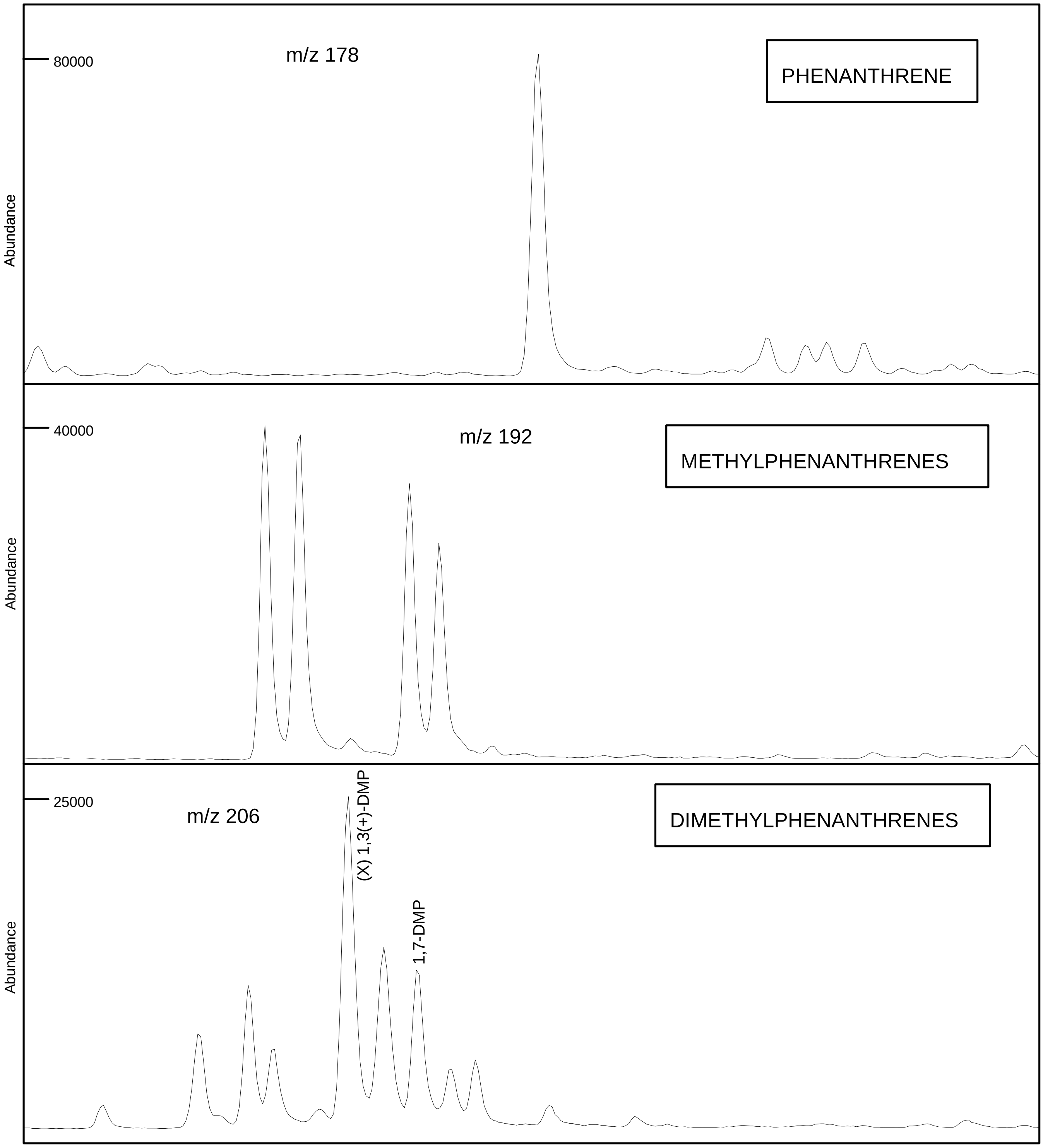


FIGURE 3D-1

Sample: **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID: **352501A**

GEOTECH

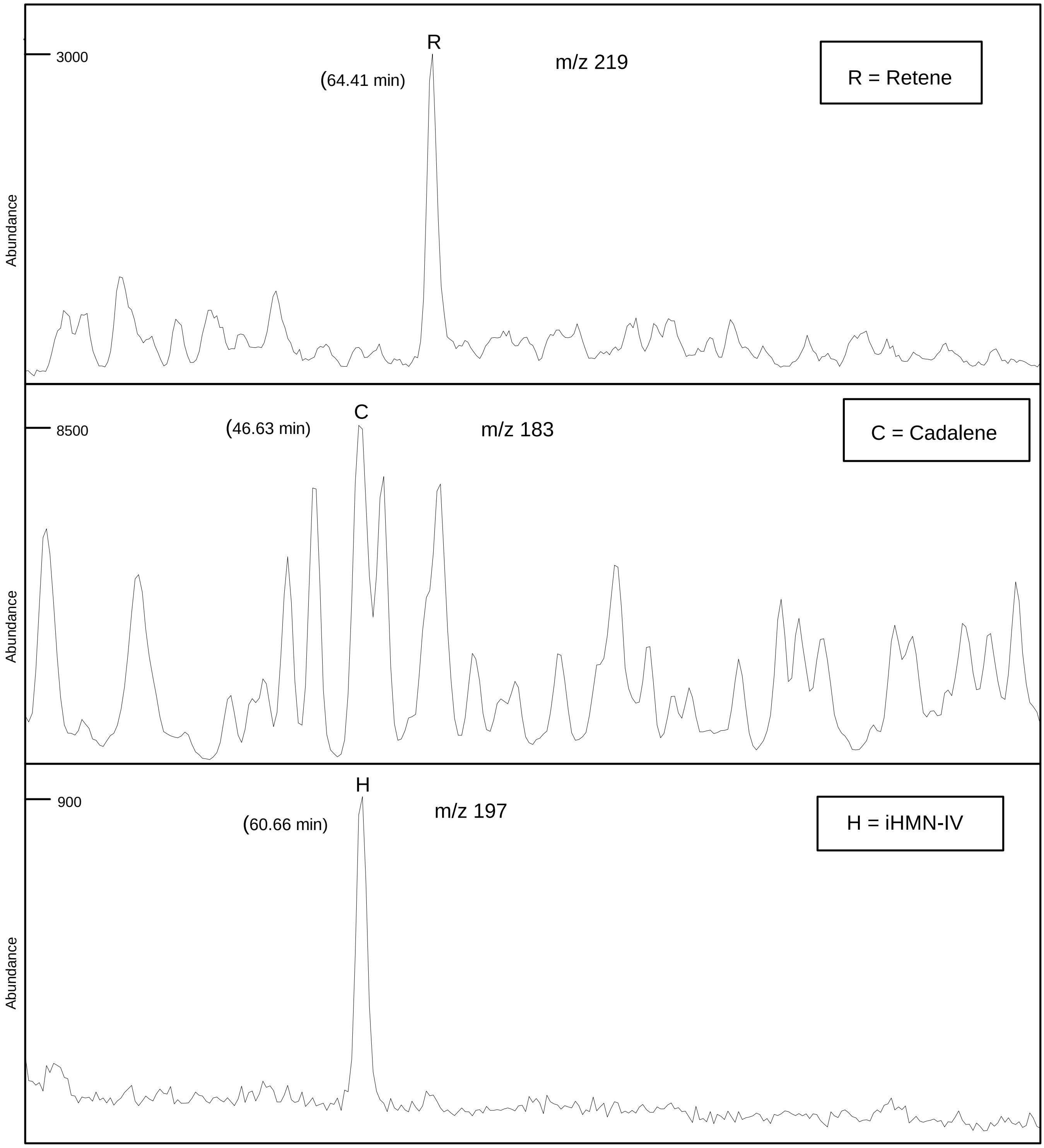


FIGURE 3E-1

Sample: **WEST MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID: **352501A**

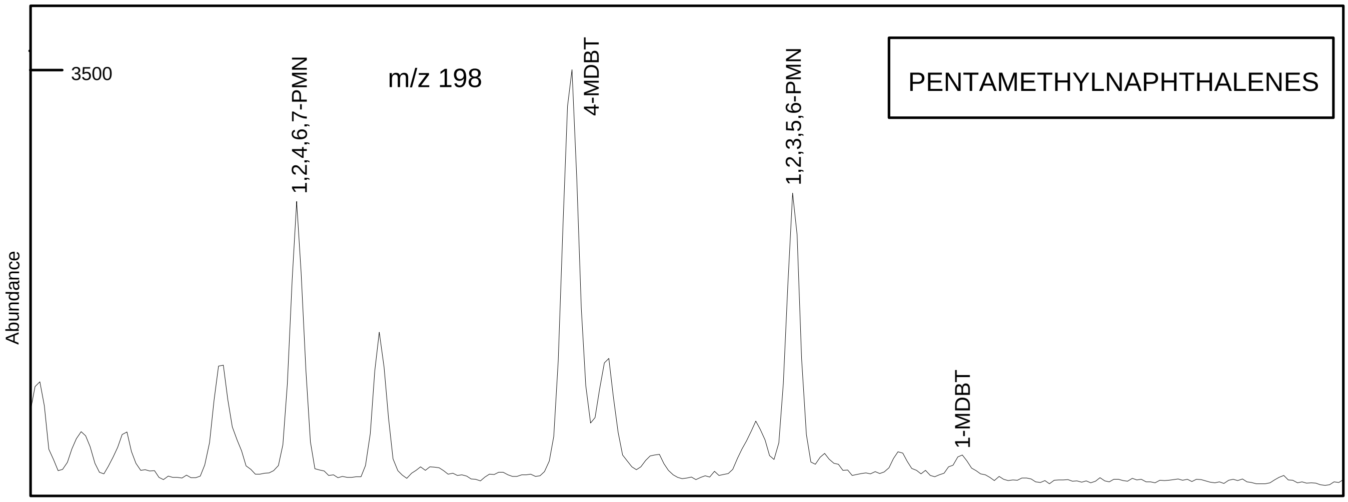
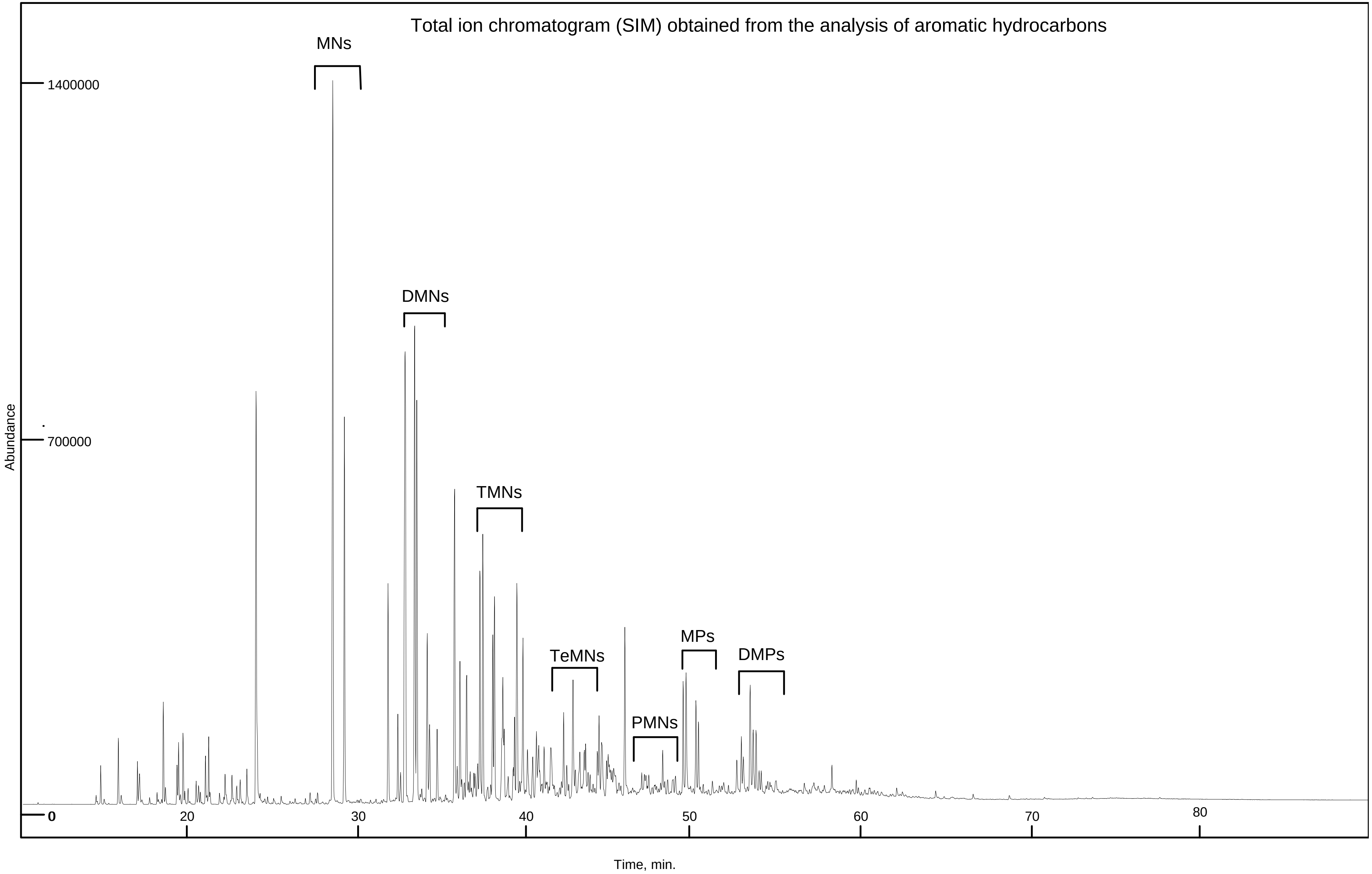


FIGURE 3A-2

Sample: **WEST MOONFISH-1, 2121.0m, ex L-193, MPSR 0122, Crude Oil**

File ID: **352502A**

GEOTECH



GEOTECHNICAL SERVICES PTY LTD

FIGURE 3B-2

Sample: **WEST MOONFISH-1, 2121.0m, ex L-193, MPSR 0122, Crude Oil**

File ID: **352502A**

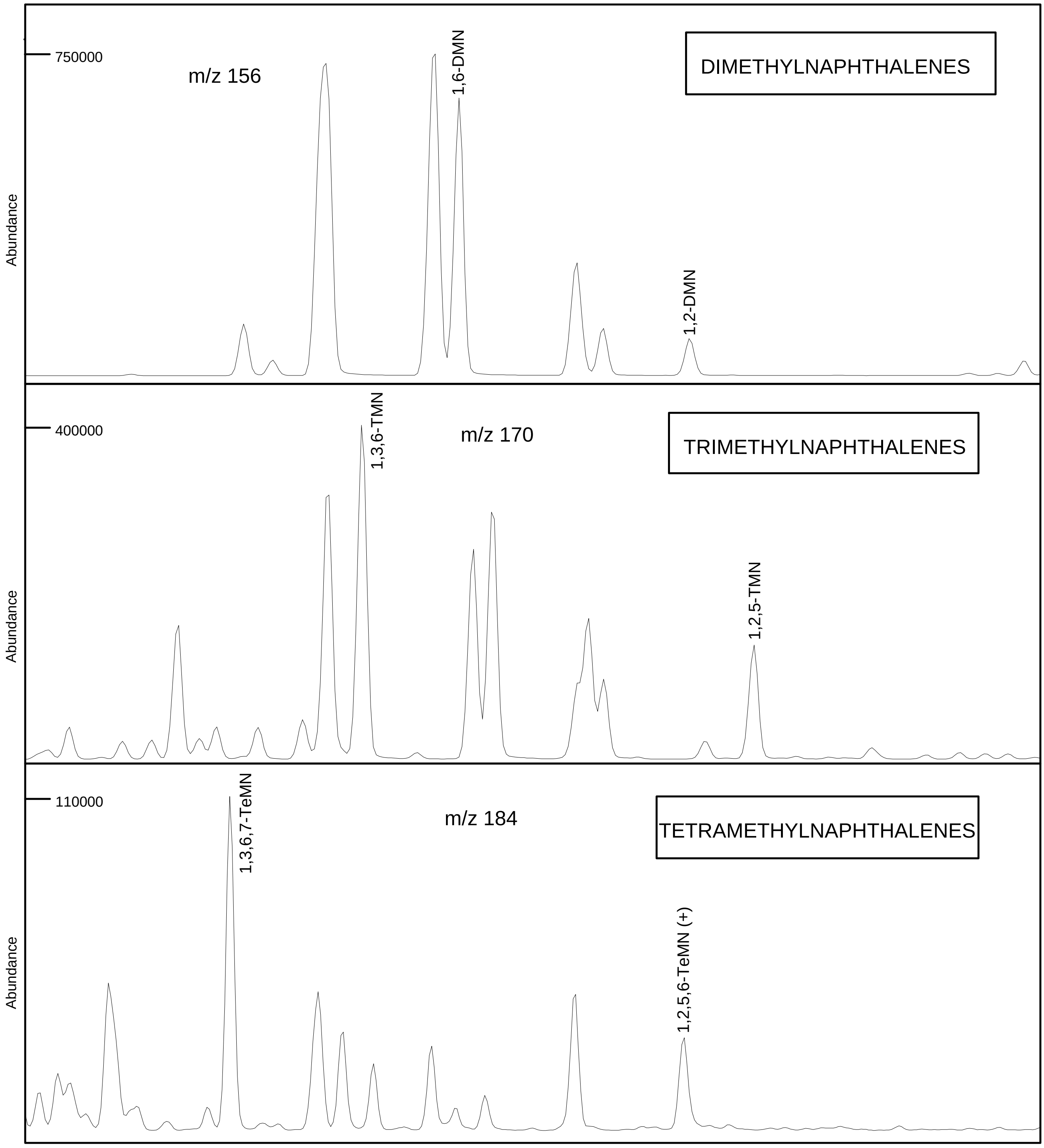


FIGURE 3C-2

Sample: **WEST MOONFISH-1, 2121.0m, ex L-193, MPSR 0122, Crude Oil**

File ID: **352502A**

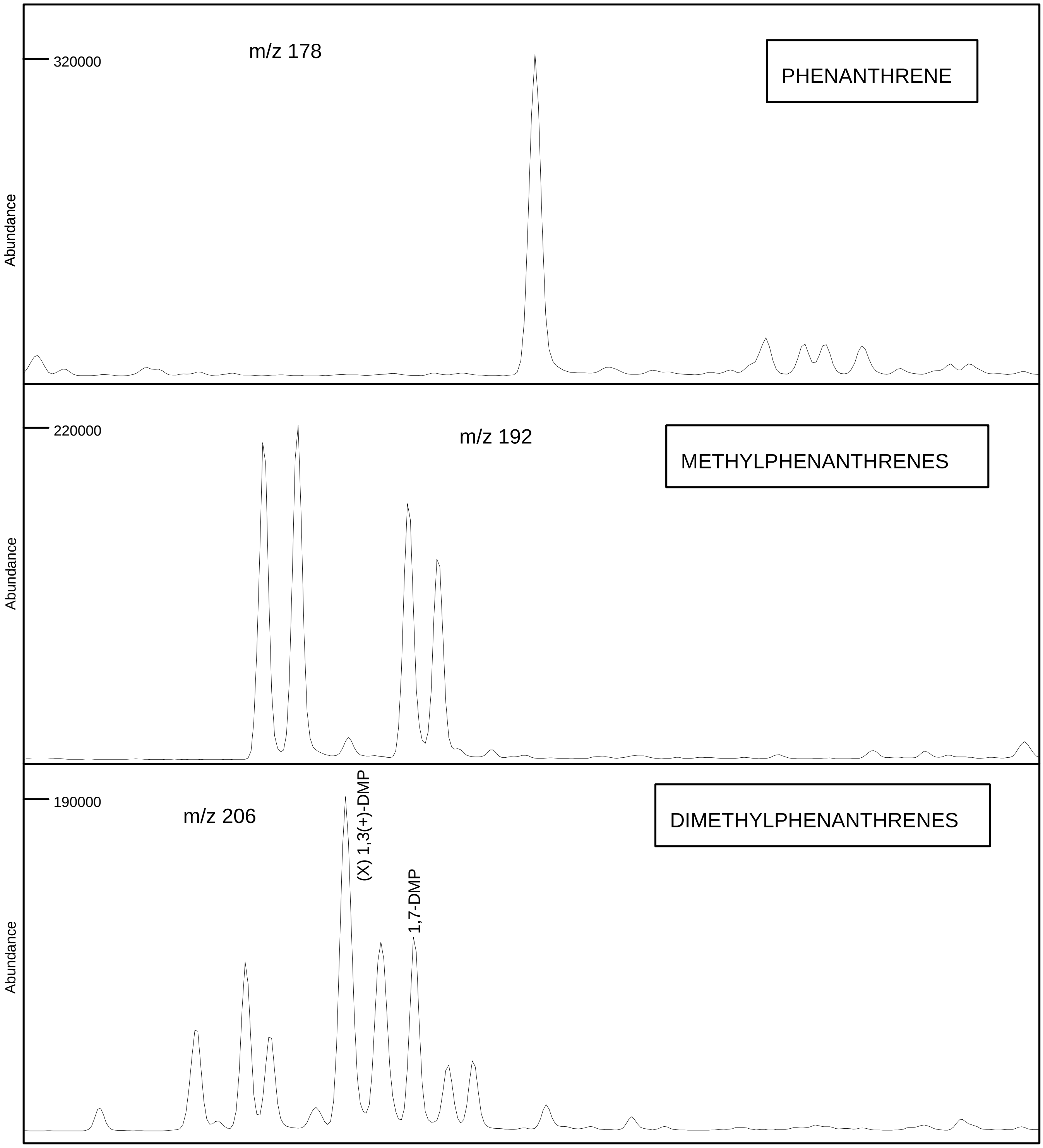


FIGURE 3D-2

Sample: **WEST MOONFISH-1, 2121.0m, ex L-193, MPSR 0122, Crude Oil**

File ID: **352502A**

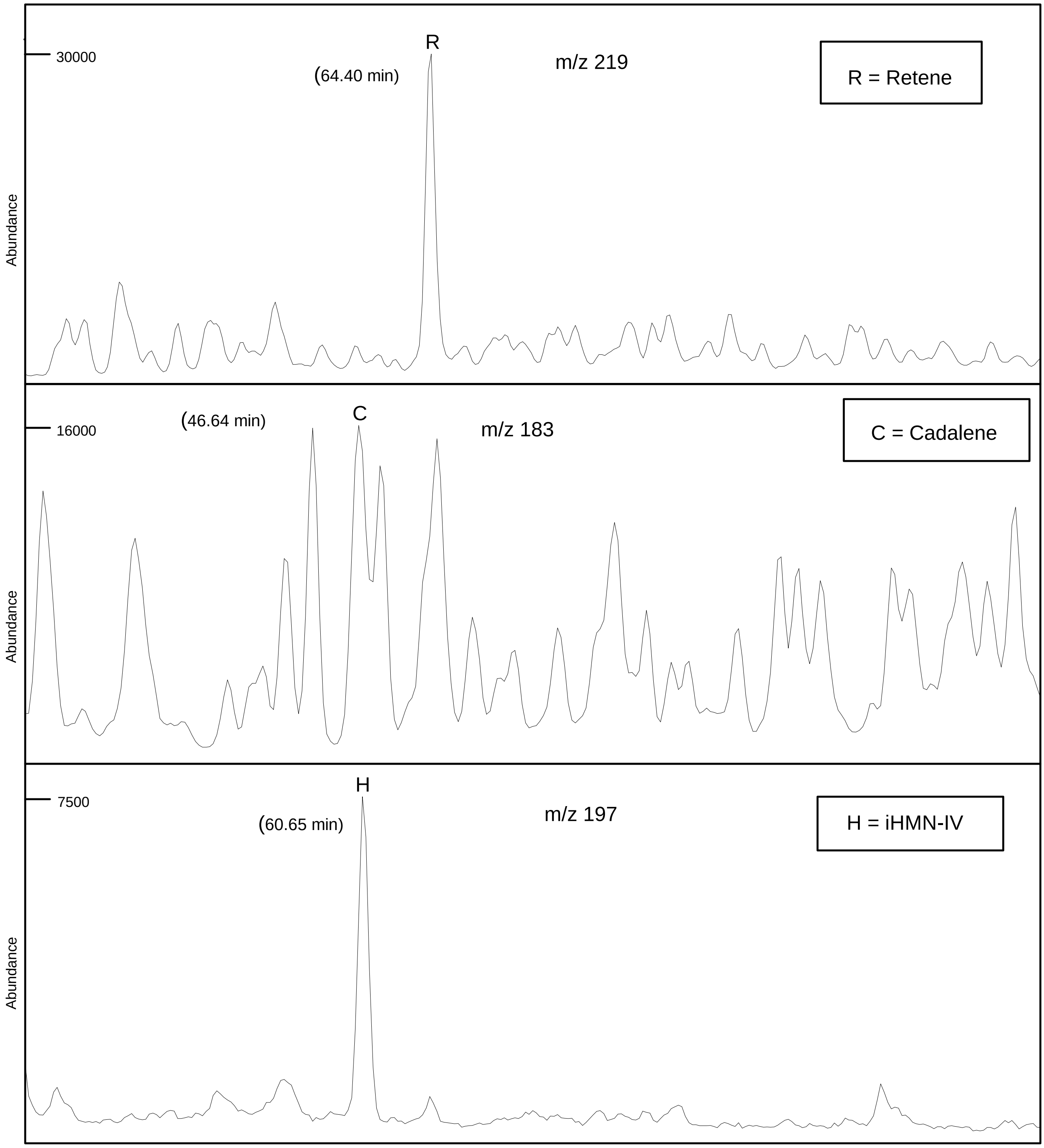


FIGURE 3E-2

Sample: **WEST MOONFISH-1, 2121.0m, ex L-193, MPSR 0122, Crude Oil**

File ID: **352502A**

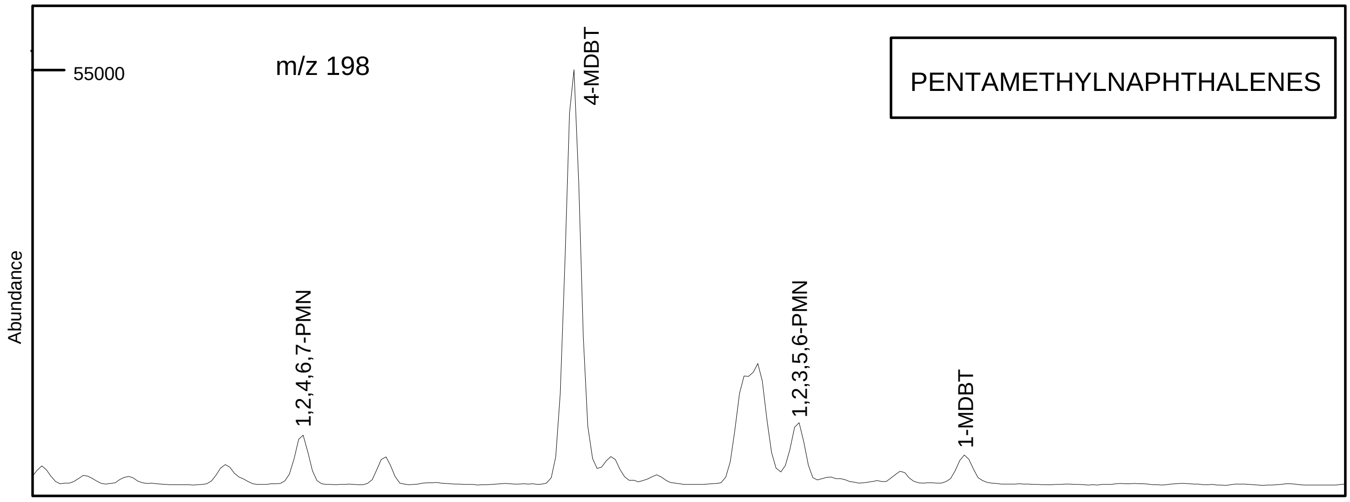


TABLE 7-1

ANALYSIS OF BRANCHED AND CYCLIC SATURATED HYDROCARBONS BY GC-MS

WEST MOONFISH-1, 2106.0m, exL194, ex MPSR 0113, Condensate

GEOTECH

	Selected Parameters	*Ion(s)*	*Value*
1.	18α(H)-hopane/17α(H)-hopane (Ts/Tm)	191	0.53
2.	C30 hopane/C30 moretane	191	7.67
3.	C31 22S hopane/C31 22R hopane	191	1.37
4.	C32 22S hopane/C32 22R hopane	191	1.49
5.	C29 20S ααα sterane/C29 20R ααα sterane	217	1.13
6.	C29 ααα steranes (20S / 20S+20R)	217	0.53
7.	$\frac{\text{C29 }\alpha\beta\beta\text{ steranes}}{\text{C29 }\alpha\alpha\alpha\text{ steranes + C29 }\alpha\beta\beta\text{ steranes}}$	217	0.53
8.	C27/C29 diasteranes	259	0.08
9.	C27/C29 steranes	217	0.37
10.	18α(H)-oleanane/C30 hopane	191	nd
11.	$\frac{\text{C29 diasteranes}}{\text{C29 }\alpha\alpha\alpha\text{ steranes + C29 }\alpha\beta\beta\text{ steranes}}$	217	0.86
12.	$\frac{\text{C30 (hopane + moretane)}}{\text{C29 (steranes + diasteranes)}}$	191/217	1.11
13.	C15 drimane/C16 homodrimane	123	0.66
14.	Rearranged drimanes/normal drimanes	123	0.86

nd = no data

FIGURE 4A-1

Sample : WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B

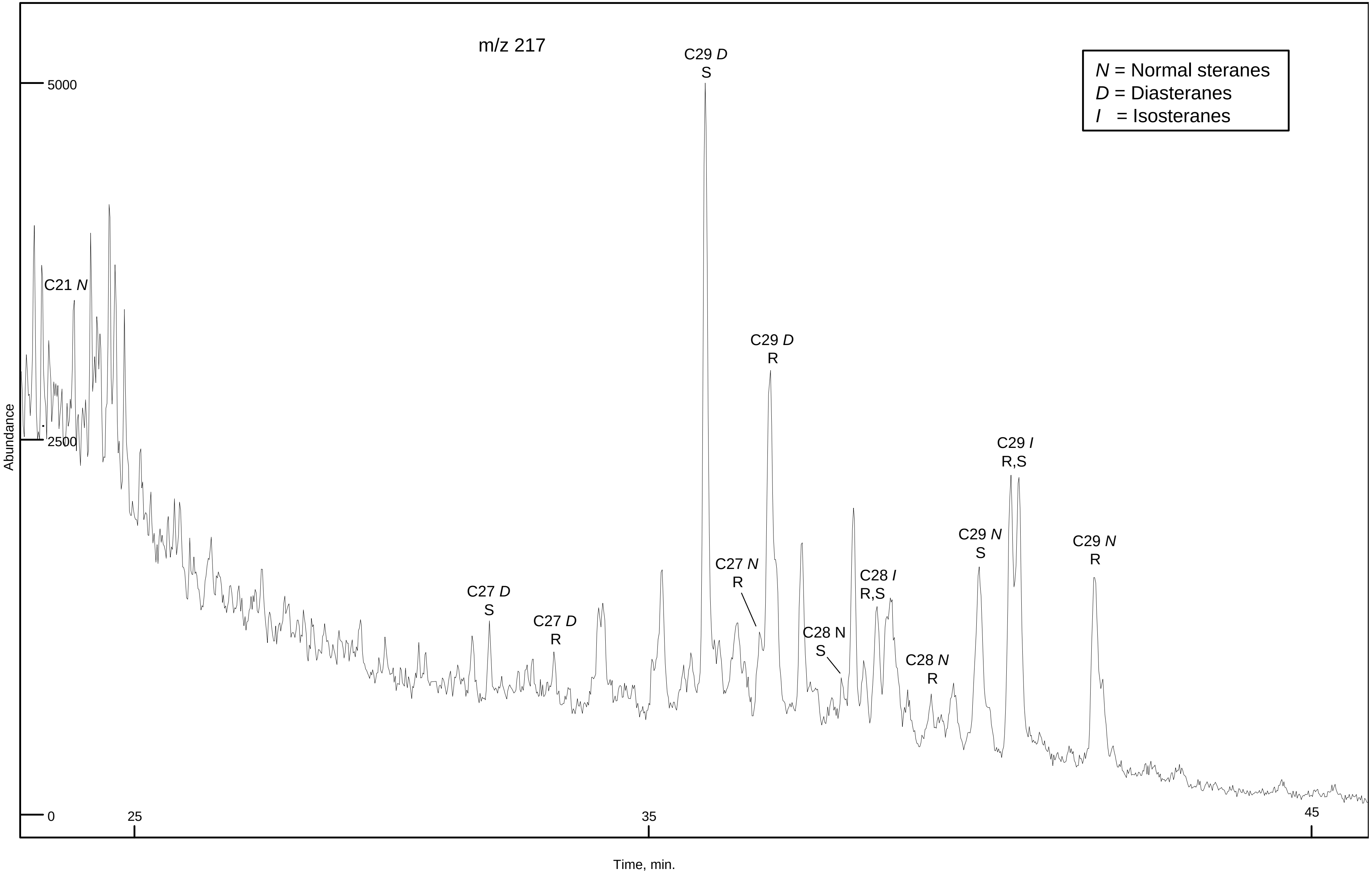


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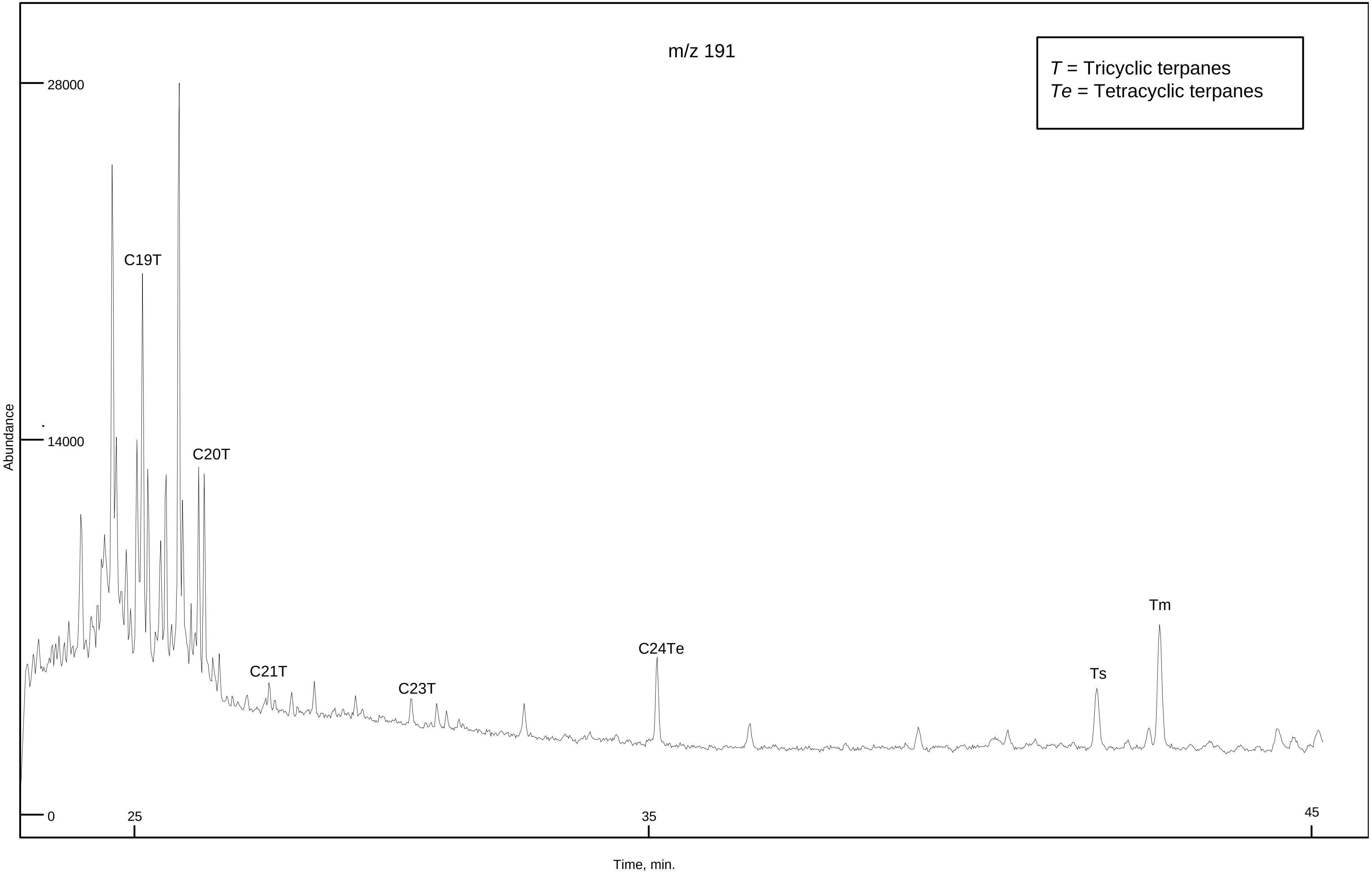
FIGURE 4B-1

Sample : WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B

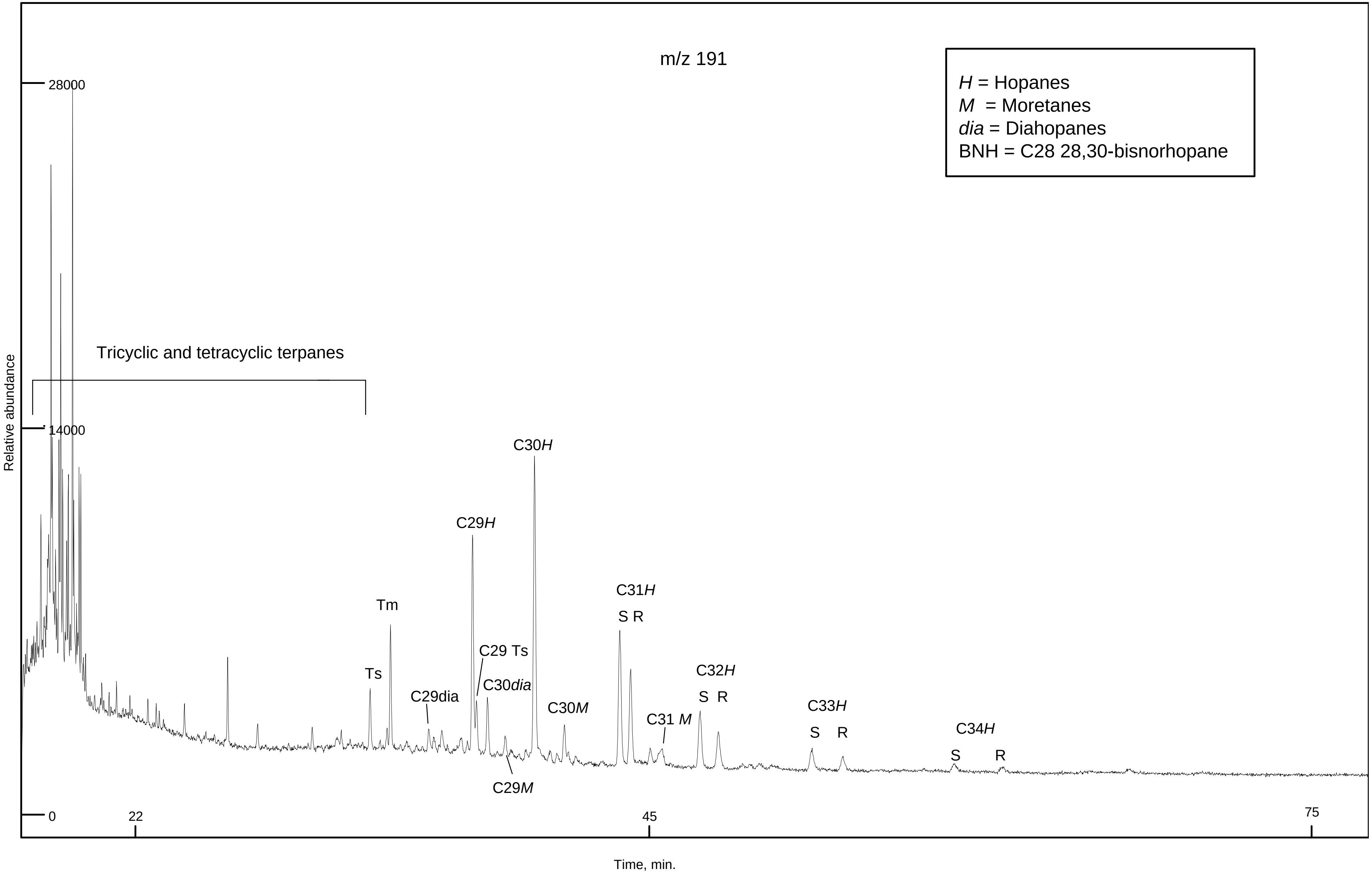


GEOTECHNICAL SERVICES PTY LTD

FIGURE 4C-1

Sample : WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B



Sample :WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B

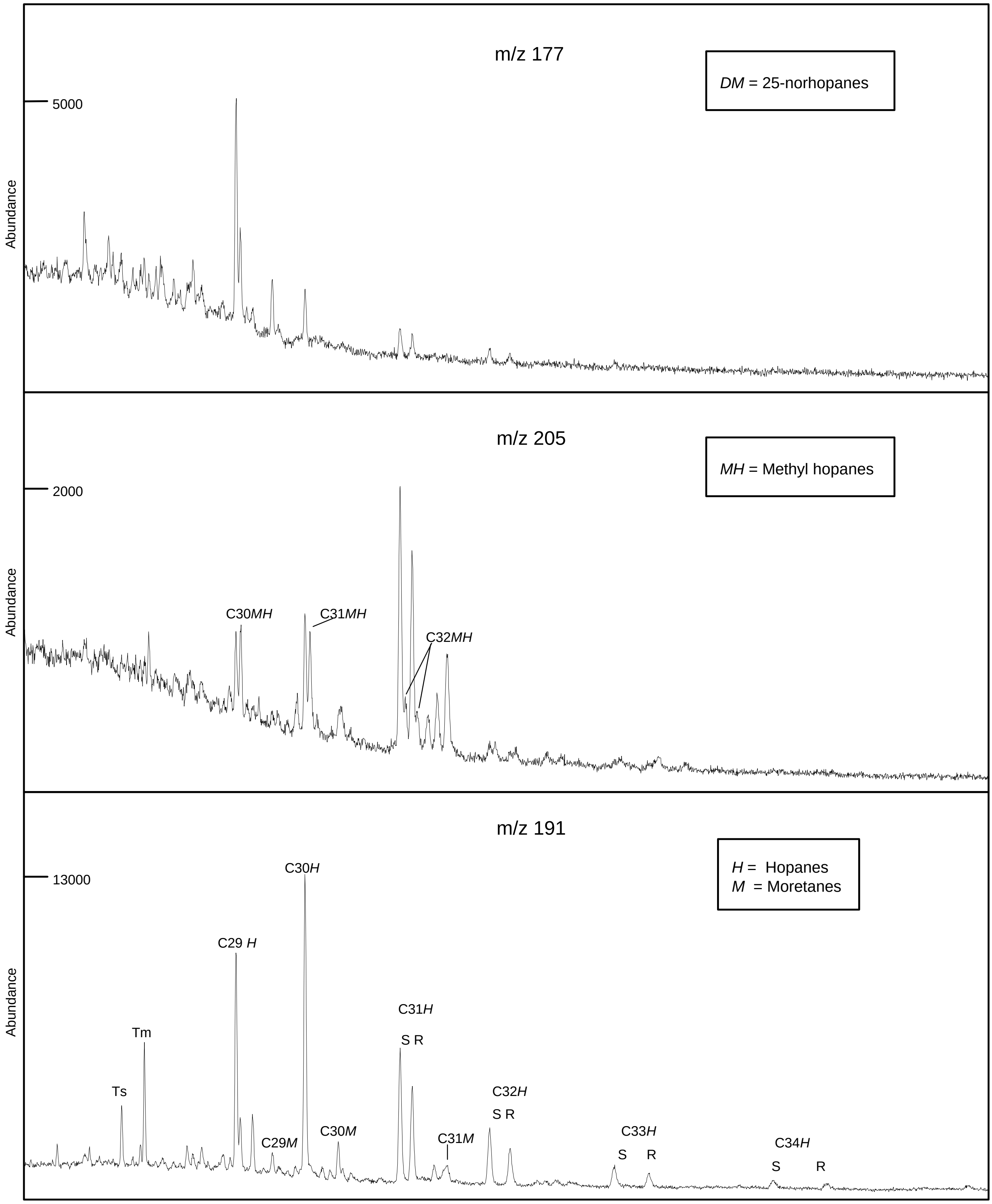


FIGURE 4E-1

Sample :WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B

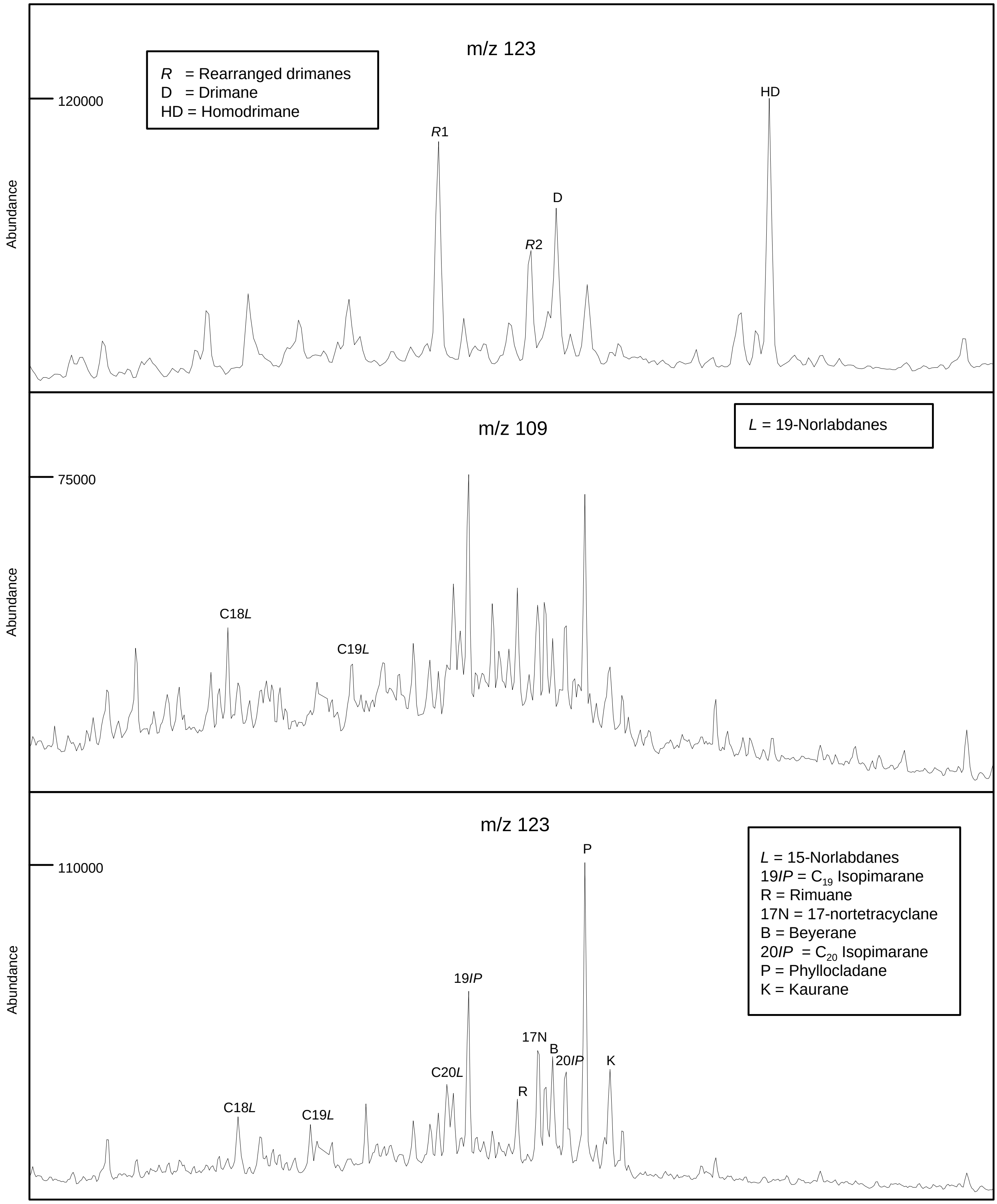


FIGURE 4F-1

Sample : WEST **MOONFISH-1, 2106.0m, ex L-194, ex MPSR 0113, Condensate**

File ID : 352501B

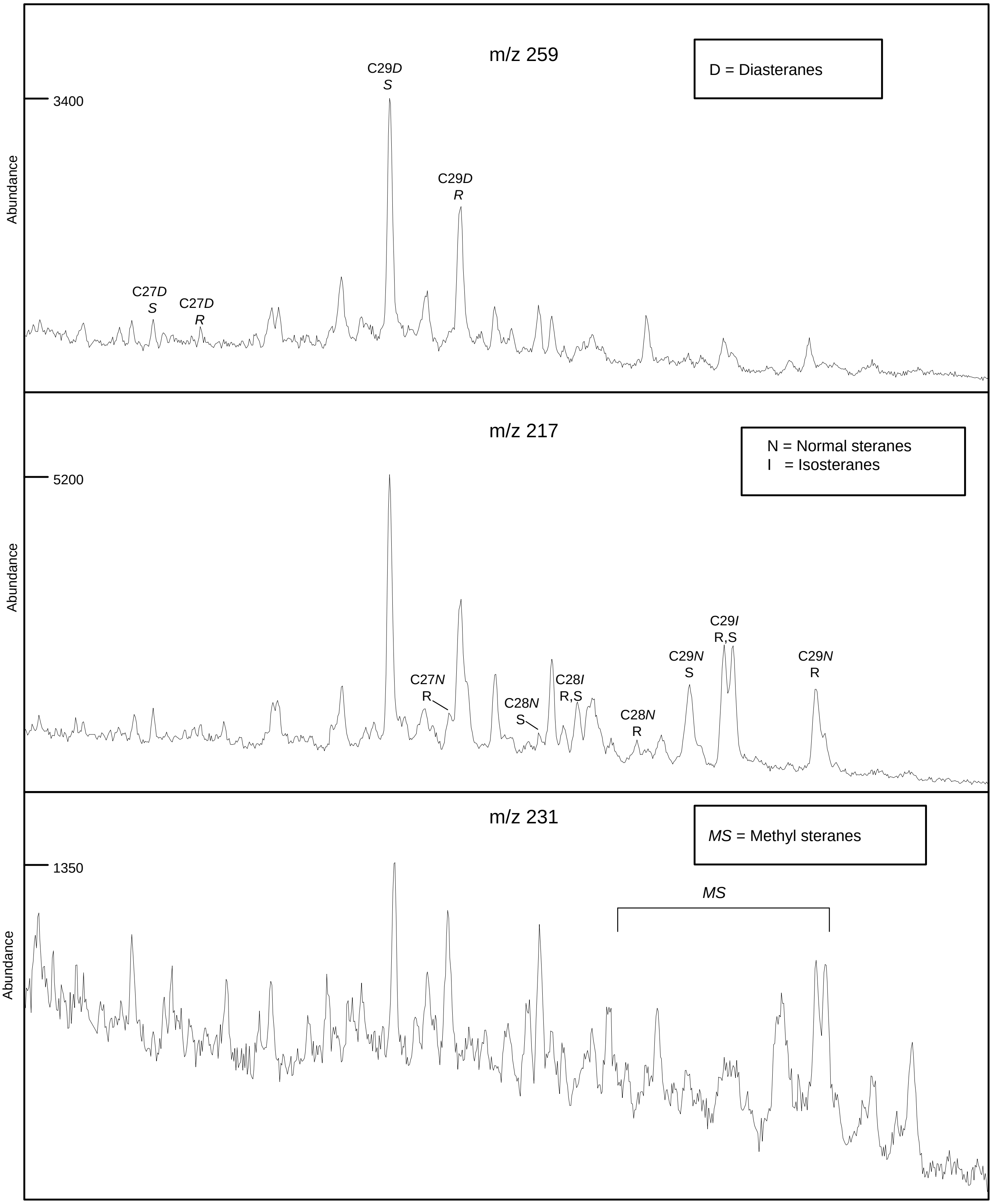


TABLE 7-2

ANALYSIS OF BRANCHED AND CYCLIC SATURATED HYDROCARBONS BY GC-MS

WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil

GEOTECH

	Selected Parameters	*Ion(s)*	*Value*
1.	18α(H)-hopane/17α(H)-hopane (Ts/Tm)	191	0.55
2.	C30 hopane/C30 moretane	191	7.39
3.	C31 22S hopane/C31 22R hopane	191	1.32
4.	C32 22S hopane/C32 22R hopane	191	1.13
5.	C29 20S ααα sterane/C29 20R ααα sterane	217	1.48
6.	C29 ααα steranes (20S / 20S+20R)	217	0.60
7.	$\frac{\text{C29 }\alpha\beta\beta\text{ steranes}}{\text{C29 }\alpha\alpha\alpha\text{ steranes + C29 }\alpha\beta\beta\text{ steranes}}$	217	0.49
8.	C27/C29 diasteranes	259	0.43
9.	C27/C29 steranes	217	0.94
10.	18α(H)-oleanane/C30 hopane	191	nd
11.	$\frac{\text{C29 diasteranes}}{\text{C29 }\alpha\alpha\alpha\text{ steranes + C29 }\alpha\beta\beta\text{ steranes}}$	217	0.62
12.	$\frac{\text{C30 (hopane + moretane)}}{\text{C29 (steranes + diasteranes)}}$	191/217	2.89
13.	C15 drimane/C16 homodrimane	123	0.88
14.	Rearranged drimanes/normal drimanes	123	1.13

nd = no data

FIGURE 4A-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

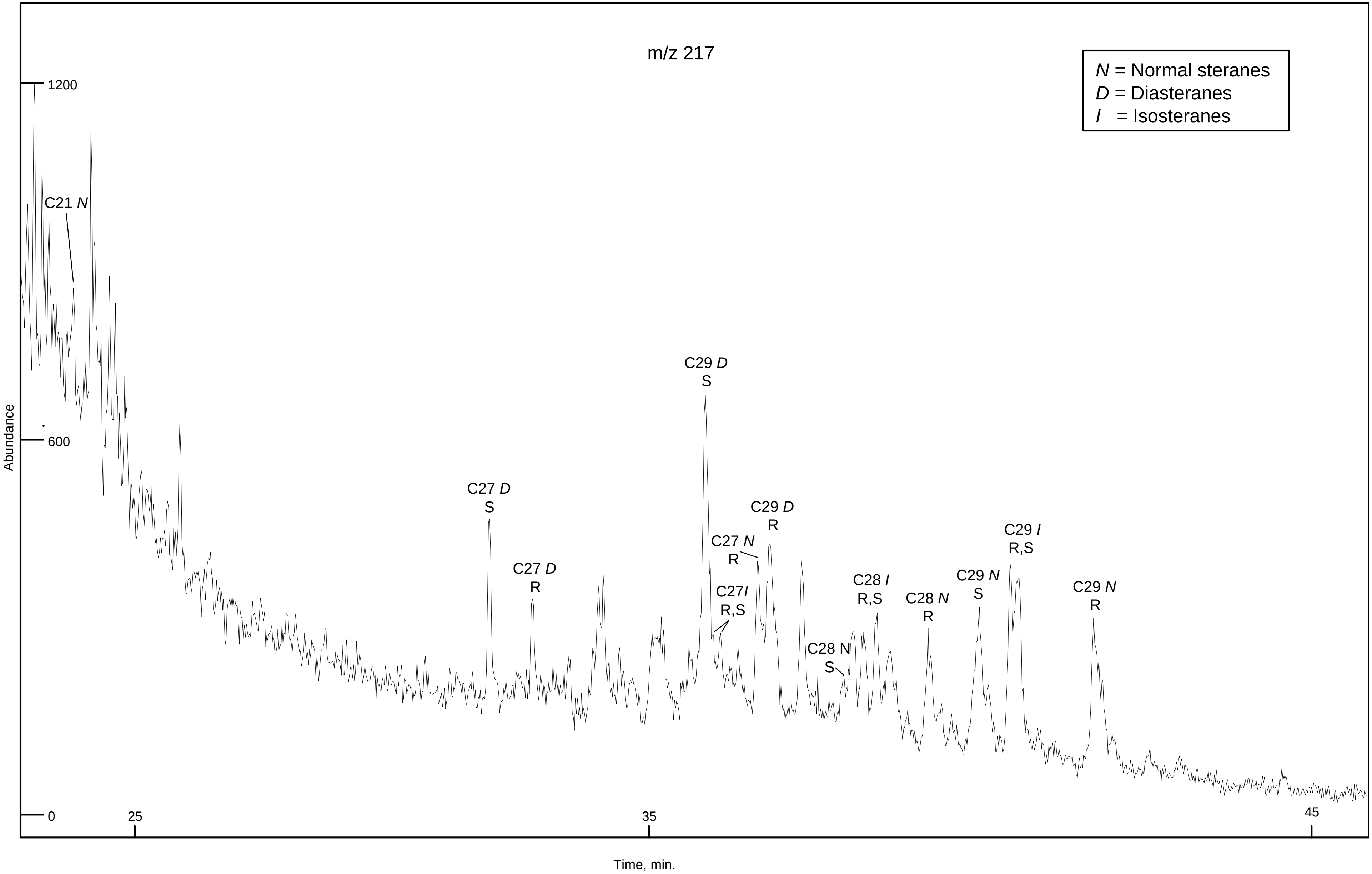


FIGURE 4B-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

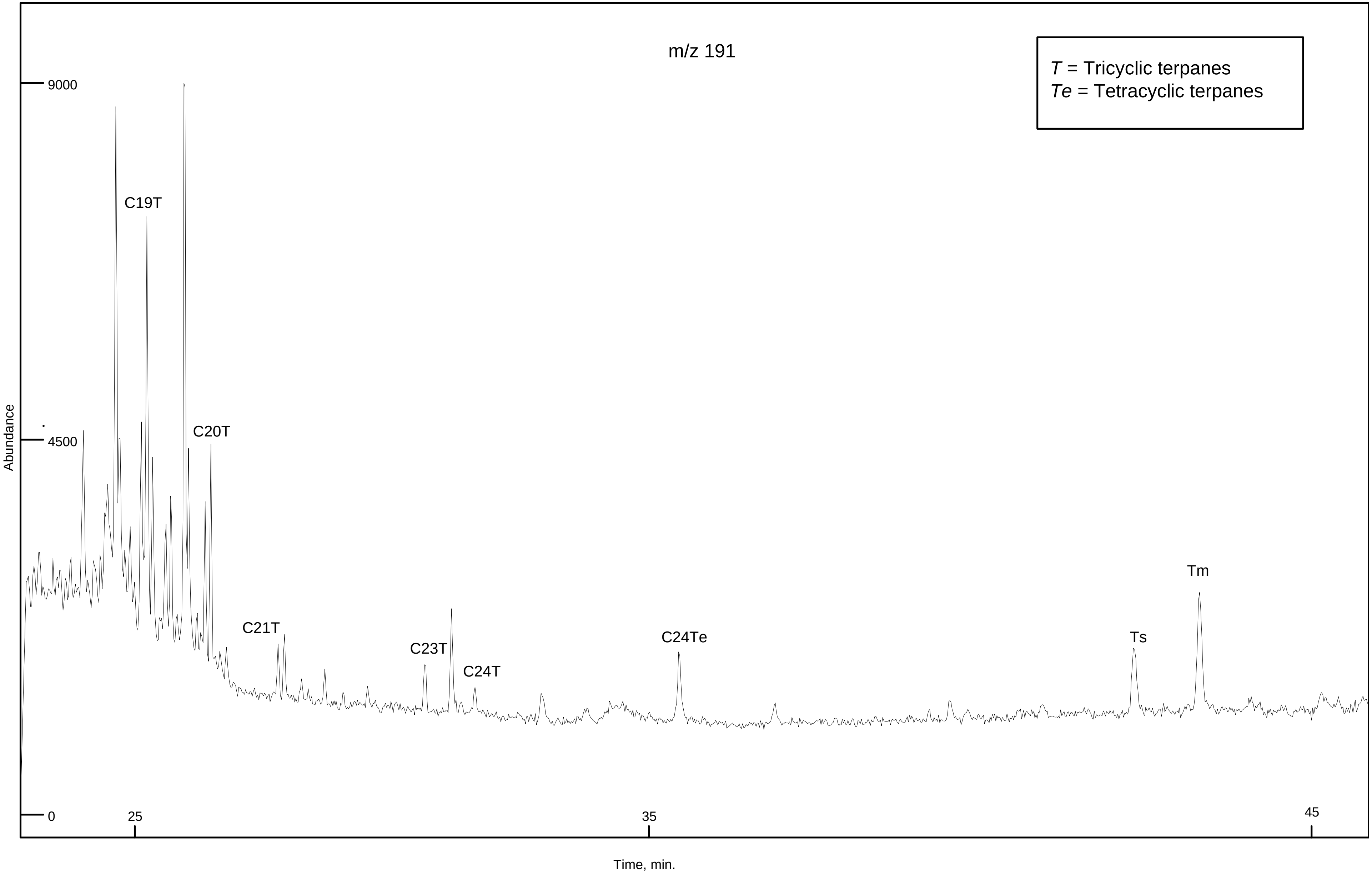


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FIGURE 4C-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

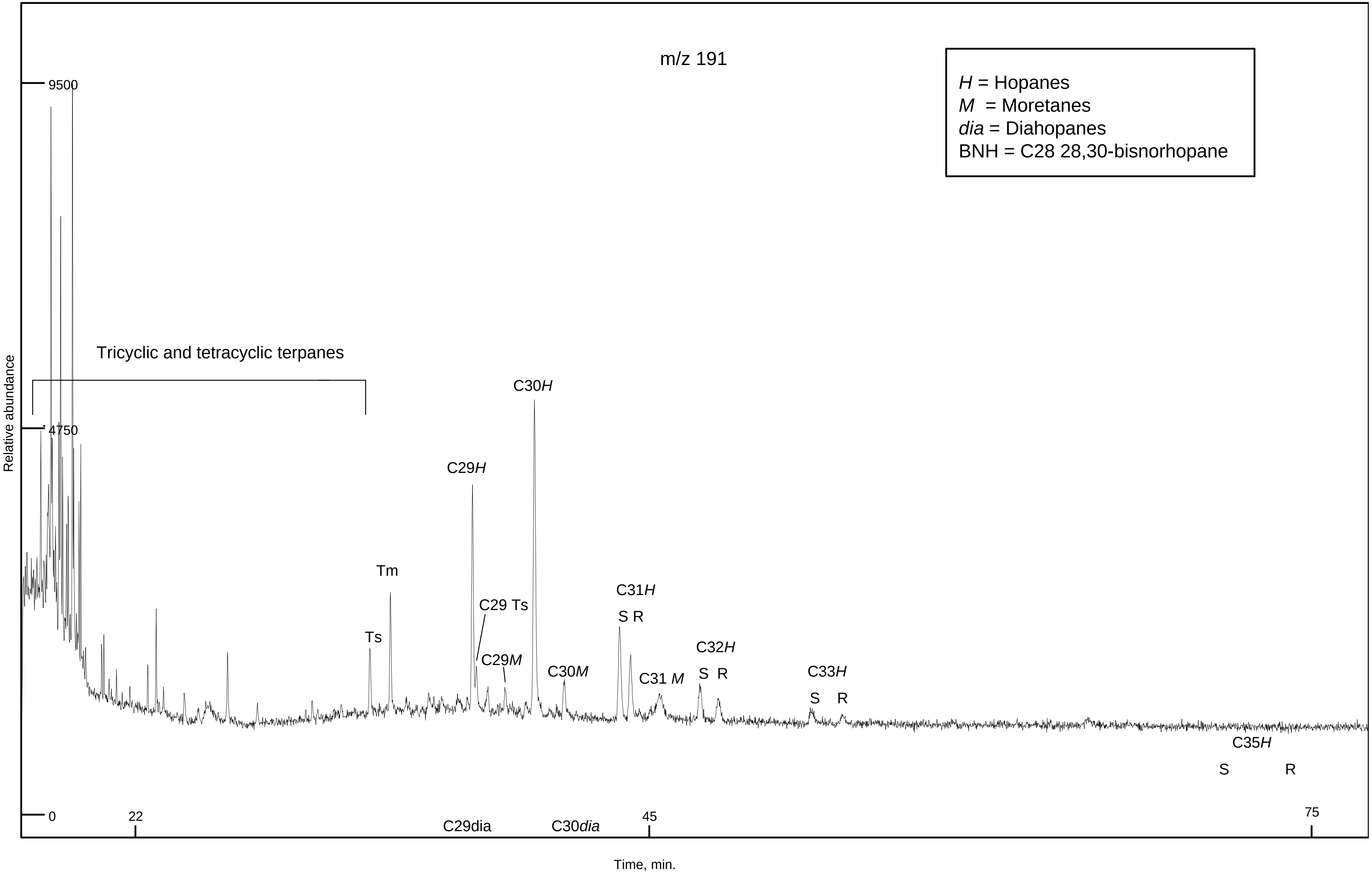

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FIGURE 4D-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

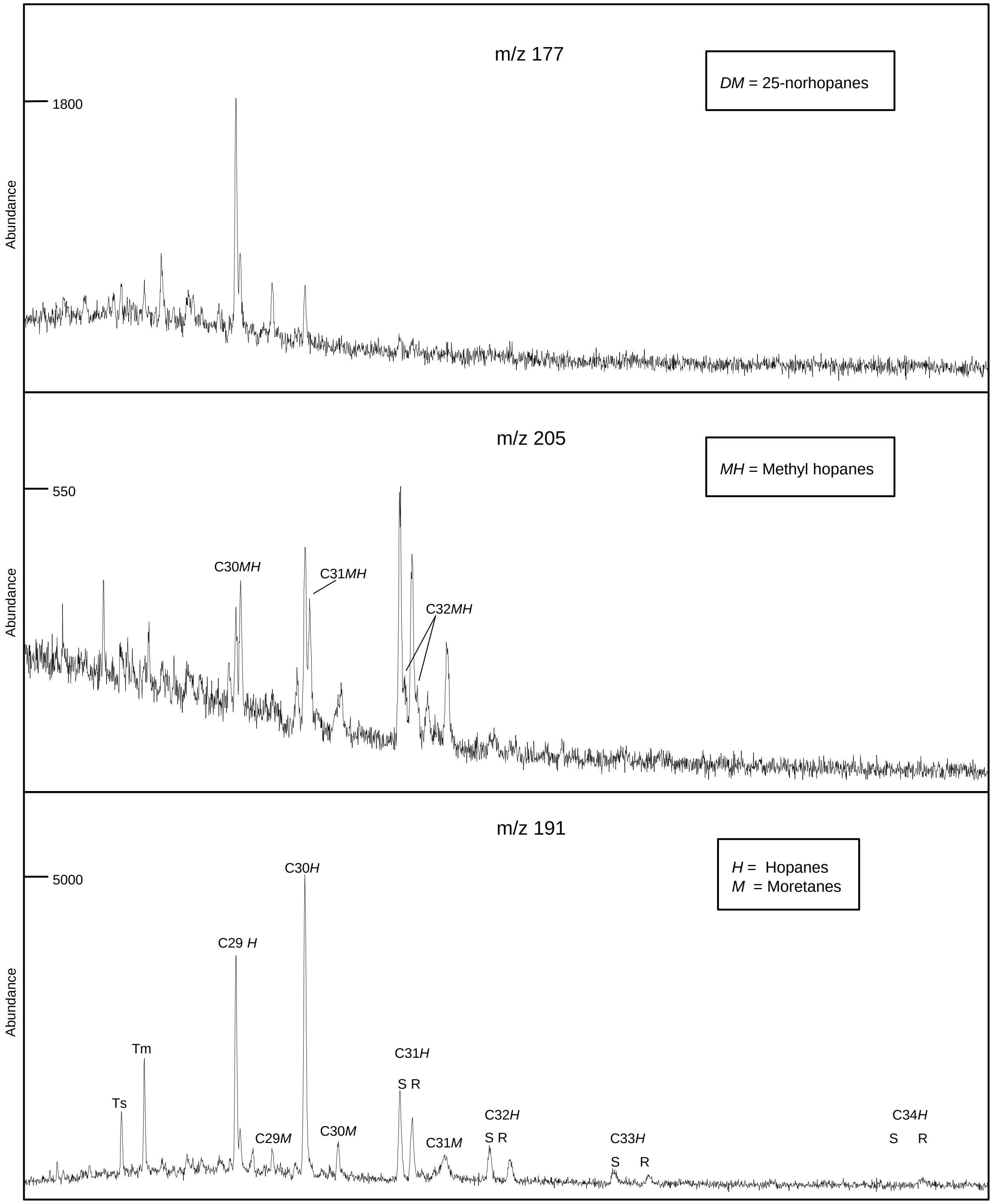


FIGURE 4E-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

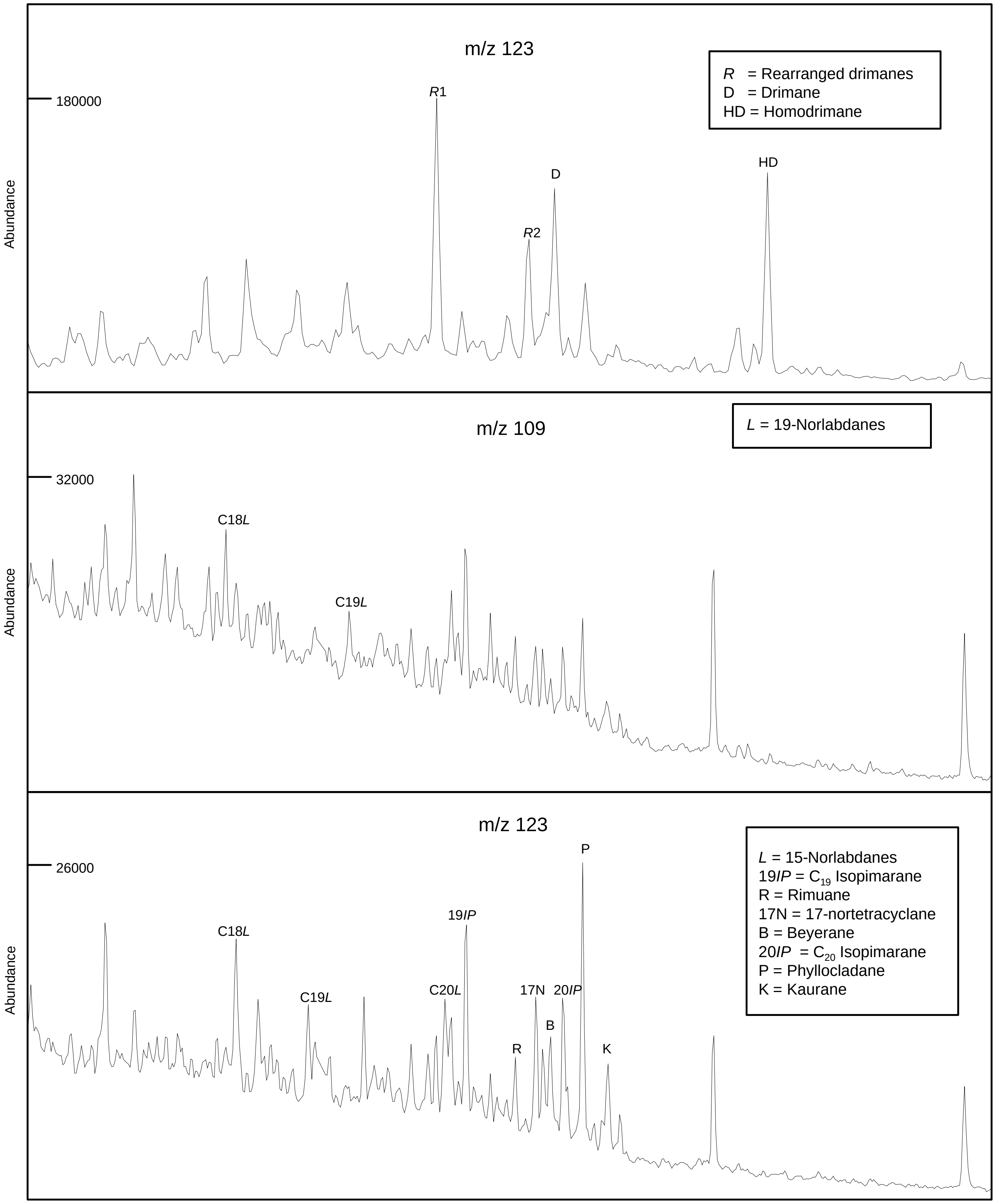


FIGURE 4F-2

Sample : **WEST MOONFISH-1, 2121.0m, ex L193, MPSR 0122, Crude Oil**

File ID : 352502BB

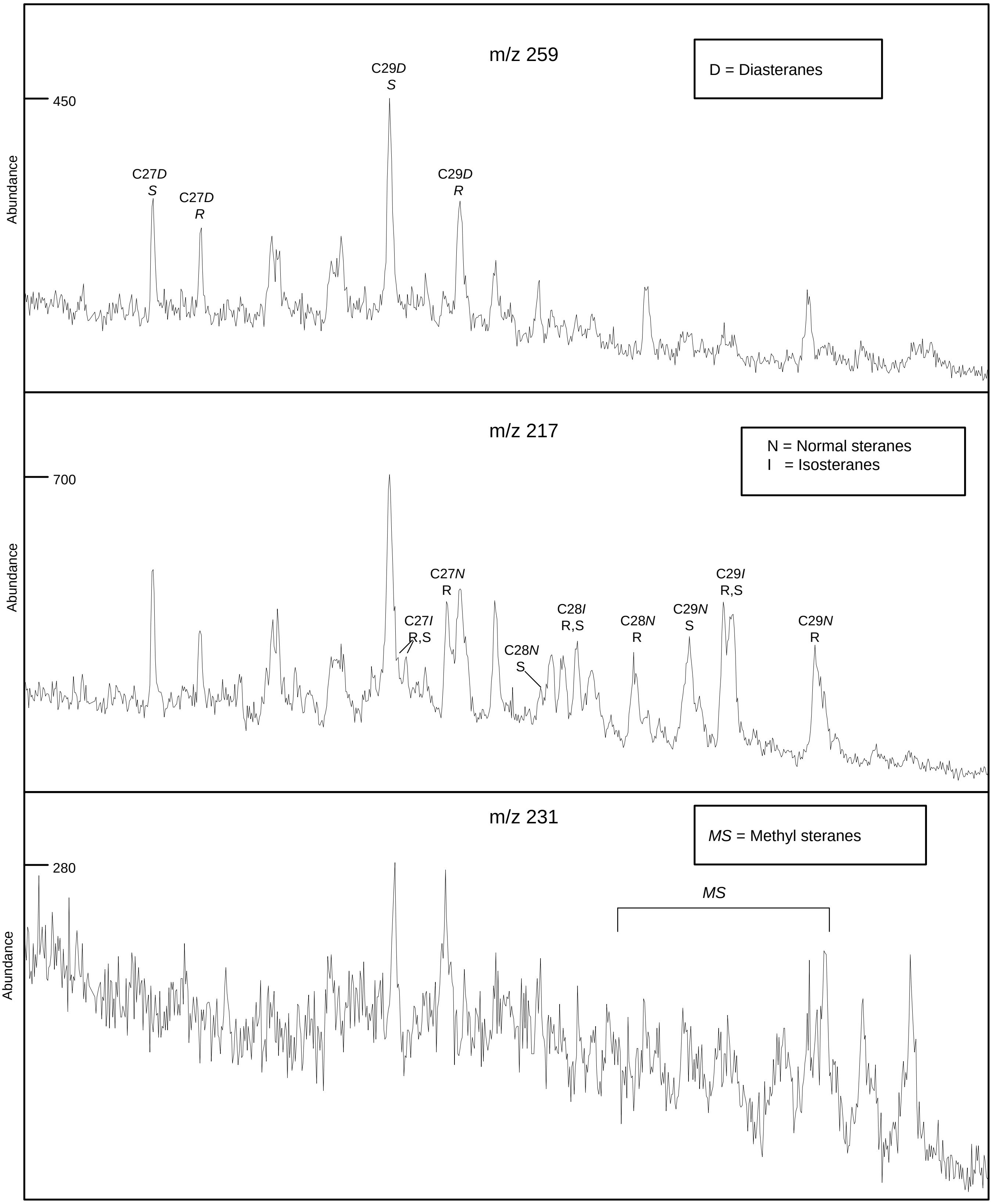


TABLE 8-1

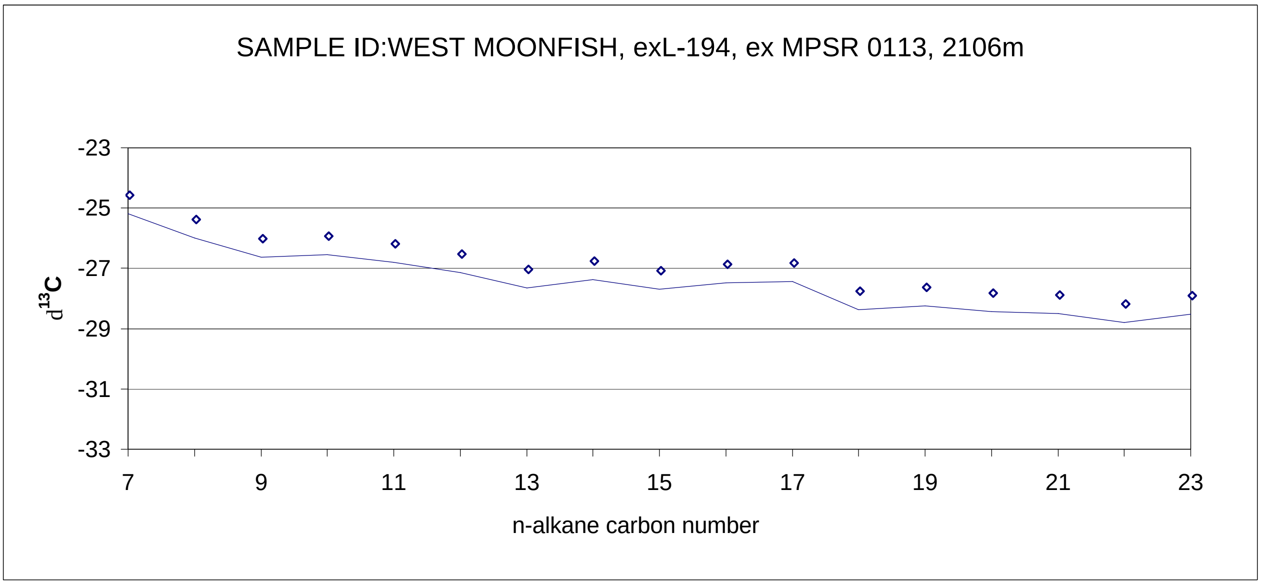
GEOTECH

COMPOUND SPECIFIC ISOTOPE ANALYSIS (GC-IRMS)

WEST MOONFISH, exL-194, ex MPSR 0113, 2106m

`

Carbon No.	δ^{13}C (per mil)	SD	Misc. Information
7	-25.2	0.12	
8	-26.0	0.13	
9	-26.6	0.08	
10	-26.5	0.27	
11	-26.8	0.04	
12	-27.1	0.21	
13	-27.7	0.23	
14	-27.4	0.23	
15	-27.7	0.13	
16	-27.5	0.21	
17	-27.4	0.19	
18	-28.4	0.09	
19	-28.2	0.05	
20	-28.4	0.22	
21	-28.5	0.13	
22	-28.8	0.01	
23	-28.5	0.34	low
24	nd	nd	
25	nd	nd	
26	nd	nd	
27	nd	nd	
28	nd	nd	
29	nd	nd	
30	nd	nd	
31	nd	nd	
32	nd	nd	
33	nd	nd	

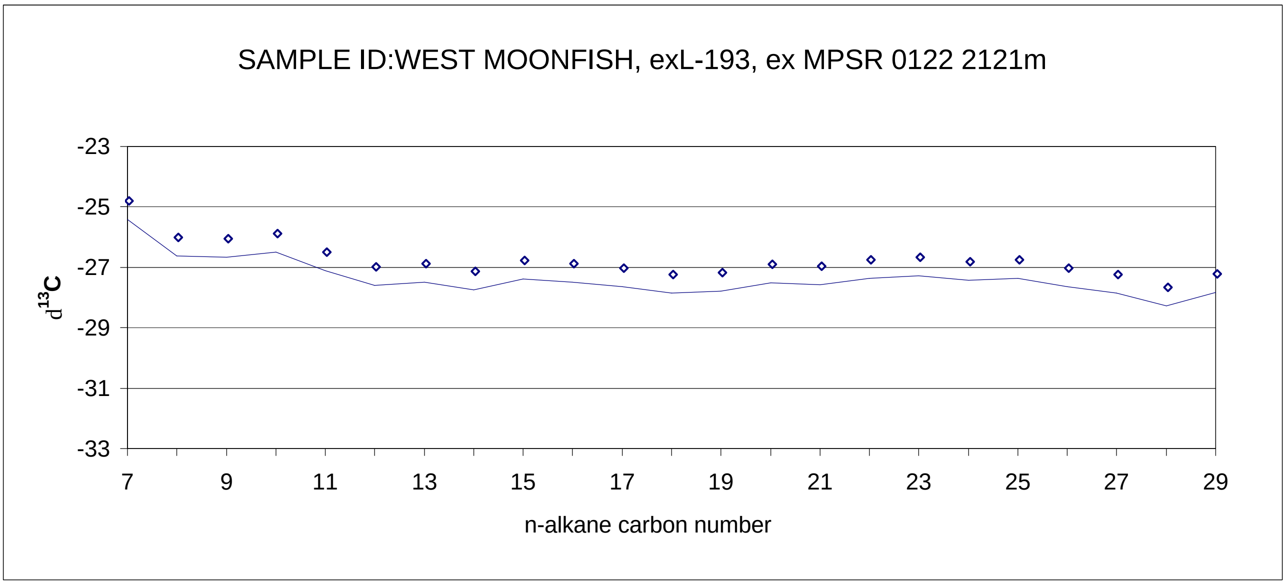


*Misc. Information: indicates if the abundance of the n-alkane is low and therefore the value calculated less reliable

COMPOUND SPECIFIC ISOTOPE ANALYSIS (GC-IRMS)

WEST MOONFISH, exL-193, ex MPSR 0122, 2121m

Carbon No.	δ^{13}C (per mil)	SD	Misc. Information
7	-25.4	0.20	
8	-26.6	0.01	
9	-26.7	0.25	
10	-26.5	0.06	
11	-27.1	0.07	
12	-27.6	0.03	
13	-27.5	0.05	
14	-27.8	0.22	
15	-27.4	0.22	
16	-27.5	0.05	
17	-27.6	0.05	
18	-27.9	0.14	
19	-27.8	0.34	
20	-27.5	0.27	
21	-27.6	0.18	
22	-27.4	0.12	
23	-27.3	0.11	
24	-27.4	0.06	
25	-27.4	0.11	
26	-27.6	0.38	
27	-27.9	0.14	
28	-28.3	0.04	
29	-27.8	0.20	
30	nd	nd	
31	nd	nd	
32	nd	nd	
33	nd	nd	



*Misc. Information: indicates if the abundance of the n-alkane
is low and therefore the value calculated less reliable

APPENDIX B

THEORY AND METHODS

INSTRUMENT CONDITIONS

SOURCE ROCK ANALYSES

A.1 Total Organic Carbon (TOC)

Samples were finely crushed and digested in acid (HCl) to remove the carbonate minerals. The remaining sample was heated to 1700°C using a Leco CS-444 system (CS-444 Determinator; HF-400 Induction Furnace) in an atmosphere of pure oxygen. The CO_2 produced was measured with an infra-red detector, and values calculated according to standard calibration.

TOC values generated for the products in this study have been categorised according to the following classification scheme, based on their perceived effect on geological data:

Classification	**%TOC**
Low	0.00 - 0.20
Moderate	0.20 - 0.50
High	0.50 - 1.00
Very High	> 1.00

A.2 Rock-Eval Pyrolysis

Samples were pyrolysed on a Rock-Eval II instrument under an inert atmosphere of helium. The samples were heated to 300°C (held for 3 mins) in order to thermally distill free or adsorbed hydrocarbons (S1) which were then measured by a flame ionisation detector (FID). The oven temperature was ramped from 300°C to 550°C at 25°C/min and held at 550°C for 1 minute, in order to crack the kerogen and generate hydrocarbons (S2). These hydrocarbons were measured by a FID. CO_2 released during the kerogen cracking process (S_3) is trapped and subsequently measured by a thermal conductivity detector (TCD). The temperature at which the maximum amount of S_2 hydrocarbons is generated is referred to as the T_{MAX}.

S1 and S2 values generated for the products in this study have been described according to the following classification schemes, based on their perceived effect on geological data.

Characterisation	**S_1 (mg/g)**
Low	0.00 - 0.20
Moderate	0.20 - 0.80
High	0.80 - 3.00
Very High	> 3.00

Characterisation	**S_2 (mg/g)**
Low	0.00 - 0.50
Moderate	0.50 - 2.00
High	2.00 - 4.00
Very High	> 4.00

A.3 Pyrolysis Gas Chromatography (Pyrolysis GC)

Pyrolysis GC was performed on solvent extracted samples. The samples were pyrolysed by a GHM pyrojector which was coupled directly to a Varian 3400 Series gas chromatograph. The operating conditions were:

Column:	ZB-1 (30 m x 0.25 mm i.d; 0.25 μm film thickness)
Pyrolysis programme:	*Thermal extract (S1): 155^{o}C to 330^{o}C @ 60^{o}C/min (3mins);
	*Pyrolysis GC (S2): 330^{o}C to 530^{o}C @ 25^{o}C/min (5.8mins)
Oven conditions:	40^{o} (22mins) to 300^{o}C @ 4^{o}/min (17.50mins)
	(A liquid nitrogen trap was used from 0-22mins)
Carrier gas:	Helium

HYDROCARBON CHARACTERISATION ANALYSES

A.4 Solvent Extraction of Solid Products

Solid products were finely crushed and extracted with dichloromethane using sonic vibration. After filtration, a small quantity of magnesium sulphate was added to the extract to remove any water. The extract was then filtrated and passed through activated copper powder to remove elemental sulphur. The extractable organic matter (EOM) was collected by evaporation of the solvent by fractional distillation.

A.5 Whole Extract or 'Hexane' Solubles GC-MS

Fluid samples and extracts (from solid products) were analysed by GC-MS in scan mode producing a chromatogram of the compounds present from C_9 to C_{36}. These analyses were performed under the following conditions:

Instrument: Hewlett-Packard 5890 Series II GC/5971 MSD
Column: ZB-1 (30 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode: Split
Oven conditions: 60^oC (1min) to 300^oC @ 5^oC/min (13mins)
Carrier Gas: Helium

A.6 Liquid Chromatographic Separation

Fluid products and extracts (from solid products) were separated into saturate, aromatic and NSO (polars) fractions.

This separation was achieved by liquid column chromatography using activated silica gel adsorbent and eluting solvents of varying polarity (pentane, pentane/dichloromethane and dichloromethane/methanol). The saturate, aromatic and NSO fractions were recovered by evaporation of the solvent by fractional distillation.

A.7 Saturate GC-MS

The saturate fraction obtained from liquid chromatographic separation was analysed by GC-MS in scan mode producing a chromatogram of the compounds present from C_9 to C_{34}. The analyses were performed under the following conditions:

Instrument: Hewlett Packard 6890 GC/5973 MSD
Column: ZB-1 (60 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode: Pulsed splitless
Oven conditions: 60^oC to 300^oC @ 6^o/min (22mins)
Carrier Gas: Helium

A.8 Aromatic GC-MS

The aromatic fraction obtained from liquid chromatographic separation was analysed by GC-MS in selected ion monitoring (SIM) mode under the following conditions:

Instrument:	Hewlett Packard 6890 GC/5973 MSD
Column:	ZB-5 (60 m x 0.25 mm i.d; 0.25 μm film thickness)
Mode:	Pulsed splitless
Oven conditions:	50^{o}C to 300^{o}C @ 3^{o}/min (17min)
Carrier Gas:	Helium

A.9 Branched/cyclic GC-MS

The saturate fractions were treated with ZSM-5 in order to isolate the branched/cyclic compounds, which were then analysed by GC-MS. In those cases where insufficient saturate material was obtained to perform the separation, the entire saturate fraction was analysed by the branched/cyclic GC-MS method.

Analysis was carried out in SIM mode under the following operating conditions:

Instrument:	Hewlett Packard 6890 GC/5973 MSD
Column:	ZB-1 (60 m x 0.25 mm i.d; 0.25 μm film thickness)
Mode:	Pulsed splitless
Oven conditions:	70^{o}C(1min) to 270^{o}C @ 8^{o}/min; 270^{o}C to 285^{o}C @ 1^{o}/min (49 mins)
Carrier Gas:	Helium