# Geochemical Evidence for Multiple Source Rocks on the Scotian Shelf

**Martin Fowler**

**Applied Petroleum (Canada) Ltd.**

**Applied Petroleum Technology AS**
**P.O. Box 173 Kalbakken**
**NO-0903 Oslo**
**Norway**

**Address:** **Applied Petroleum Technology AS**
**P.O. Box 173 Kalbakken**
**NO-0903 Oslo**
**Norway**
**Telephone:** **+47 453 96 000**

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## Authors

Martin Fowler

| | Name | Date | Signature |
|---|---|---|---|
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# 1 Executive Summary

This report reviews the evidence for there being multiple source rocks for hydrocarbons on the Scotian Shelf. It concentrates on the evidence from liquid hydrocarbons rather than source rock data. Most Scotian Shelf discoveries are gas associated with light oils/condensates. This is what would be expected from a deltaic source rock with Type III-II organic matter such as the Tithonian on the Scotian Shelf.

There are variations in the light hydrocarbon compositions between Scotian Shelf oils. Oils from Cohasset-Balmoral-Panuke areas, as well as Penobscot, have low concentrations of aromatics and low GORs, while oils along the Shelf edge such as Banquereau, Glenelg and North Triumph have high aromatic contents and GORs. Other oils, such as those in the Sable Island area, show intermediate geochemical characteristics (some are biodegraded) but generally high GORs. The high and low aromatic content oils occur in different parts of the Sable Basin which could suggest contributions from different source rocks or different organic facies of the same source rock. However, the range in compositions are also those expected from gas washing/evaporative fractionation, a process that commonly occurs in gas-rich deltaic basins. Other geochemical methods such as Compound Specific Isotope Analysis (CSIA) or diamondoid analysis do not provide convincing evidence of multiple source rocks for these oils. Based on their biomarker and diamondoid data, some other workers have suggested that hydrocarbons could have multiple source rocks in the Sable Basin. However, this data is far from being unequivocal and can be explained without invoking an additional source rock to the Tithonian.

The Primrose N-50 DST 1 oil that was reservoired in a Lower Jurassic Iroquois Cap Rock above a salt diapir is heavier than most other Scotian Shelf oils. Based on previous evidence, it appears to be partly sourced from the Tithonian with a contribution of terrestrial organic matter from another (lower maturity?) interval. The results of a new analysis of the Primrose N-50 DST-1 oil done for this study confirmed this, as well as indicating that it has a very different source rock to the Mic Mac area stains.

Extensive staining occurs in the Erie-Mic Mac-Wyandot wells, ~100 km north east of Sable Island. Geochemical data provided by Shell for an oil from a wireline test at Mic Mac J-77 in the Missisauga Formation indicates that it has a very different source to other Scotian Shelf oils. This data suggests that the J-77 oil has a marly, marine source rock deposited under more restricted conditions than the Tithonian source rock.

Based on this, it was decided to investigate further the oil stains reported at Mic Mac J-77 and other wells in this area to see if they have similar characteristics. Sampling and analysis of thirteen reportedly stained Lower Cretaceous – Upper Jurassic intervals in the Erie D-26, Mic Mac D-89, Mic Mac J-77, Missisauga H-54 and Wyandot E-53 wells was undertaken. Based principally on the occurrence of mature biomarker distributions in these intervals where organic matter should be immature, almost all of the samples are interpreted to contain some hydrocarbons that have migrated from deeper intervals. However, some samples are significantly more stained than others as the amount of extractable organic matter (EOM) varied significantly. Interpretation of the source of the staining hydrocarbons is complicated by the extent of biodegradation of some samples, a contribution of low maturity hydrocarbons from intervals close to where some samples were collected, evaporation of more volatile hydrocarbons, drilling contamination and possibly the effects of multiple hydrocarbon charges. Taking this into account, samples with better-quality data can be split into two types, called A and B here.

Type A samples show characteristics that suggest a marine source rock deposited under more restricted and more carbonate influenced conditions than type B. The source rock for type A is likely a marl while that for type B is a marine clastic source rock. While there are consistent differences between the two types, the differences are generally not great. Both types can be found in the same well, are not restricted to a particular formation and are around the same maturity. Type A show a closer similarity to the Mic Mac J-77 oil than type B but are not identical. Both types are very different from Scotian Shelf light oils/condensates that have a Tithonian source rock. The level of biodegradation and mixing of biodegraded and unbiodegraded hydrocarbons in these shallow samples imply that the reservoirs containing the stains were filled when close to present day depths.

Rock-Eval/TOC analysis of the Tithonian source rock at Mic Mac H-86 suggests that in this area of the basin, this interval is also dominated by Type III terrestrial derived organic matter.

Based on the discussion above, the maturity of the staining hydrocarbons compared to the regional maturity of potential source rocks, the predominantly marine nature of the source rocks of the stains and some age sensitive parameters, a Lower Jurassic age source is favored for the staining hydrocarbons in the Mic Mac area. Contributions from two intervals that are stratigraphically close together with different organic- and lithofacies could explain the variation in stain hydrocarbon characteristics.

# 2 Introduction

This report attempts to summarize what is known about the petroleum systems of the Scotian Basin. It does this by examining geochemical and other appropriate data on petroleum and source rocks from this area. The Scotian Basin covers a large area, extending for 1200 km from the Yarmouth Arch/United States border in the southwest to the Avalon Uplift on the Grand Banks of Newfoundland in the northeast with an average breadth of 250 km and an area of about 260,000 km$^2$. It is a classic, passive volcanic conjugate margin containing up to 18 km of Mesozoic-Cenozoic sediments. Over this area there have been 130 exploration wells drilled since 1967 as well as 80 development wells. This resulted in 25 discoveries, mostly in the shallow water (<200 m water depth) Sable Island area, but only discovery has been made since 1986. There was production of light oil from the Cohasset-Panuke fields and gas from the giant Venture and surrounding fields. Hence there is a considerable amount of data, although as discussed below, a lot of it is frustrating from a geochemist’s viewpoint.

This project was in two stages. The first part was to assess existing data for possible evidence of indications of a source rock other than that the Tithonian/Kimmeridgian Verrill Canyon and its equivalents for hydrocarbons on the Scotian Shelf. The time allocated to do this review was limited with an emphasis on oil rather than rock geochemistry. The data itself is of variable quality and vintage. The BASIN data base maintained by Natural Resources Canada is a principal source of information, but other resources have been examined. Comparing data from different labs and time periods is not easy and often misleading. A complicating factor from the Scotian Shelf is the use of drilling additives such as oil-based mud (OBM) and lignin and its derivatives. As far as can be determined, the use of drilling additives has not affected the quality of drill stem test (DST) and other fluid samples. However, as noted by the Play Fairway Analysis or PFA (2011), the use of drilling additives has seriously compromised the data obtained from cuttings in many Scotian Shelf wells. For example, Mukhopadhyay and co-workers (Mukhopadhyay and Birk, 1989; Mukhopadhyay et al., 1995) visually observed that most of their high TOC samples were contaminated by drilling mud additives such as lignite, plastic, asphalt, rubber and paint as well as cavings. Some of these contaminants remained even after hand-picking. This indicates the care that must be taken to interpret the Rock-Eval data. The failure to recognize that samples have been contaminated led to some older workers making erroneous interpretations. An example where contamination by OBM appears to compromise geochemical data leading to erroneous conclusions can be understood from the following example. Mukhopadhyay (1990, 1991) had the saturate and aromatic fractions of several oil and rock extract samples analysed for carbon isotopes. On Figure 4a in Mukhopadhyay (1991), many of the rock extract saturated hydrocarbon fractions appear to be anomalously depleted in $^{13}$C. All but two of these samples having $^{13}$C depleted saturate fractions are from wells identified as having been drilled with OBM.

After this initial survey of existing data had been completed, additional analyses of the Primrose N-50 DST 1 oil and intervals reported to be stained in the Mic Mac J-77 and nearby wells were recommended. This recommendation was accepted and was the second part of the study. Samples were obtained, and the analyses done at the APT laboratories. The new data (see Appendix) and its interpretation are included in the present report.

# 3 Source Rocks on the Scotian Shelf

Since Powell (1982), the principle source rock for the Scotian Shelf has been thought to be the Upper Jurassic (Kimmeridgian-Tithonian) Verrill Canyon Formation or its equivalents. However, other intervals have been considered. Five potential source rocks are identified in the 2011 PFA Atlas (Fig. 1). These were of Aptian, Valanginian, Tithonian-Kimmeridgian, Callovian and Early Jurassic age. Based on the data provided, only one of these, the Tithonian (Mic Mac/Verrill Canyon fms) shows good evidence of being a proven source rock for the oil and gas found on the Scotian Shelf. The three other Lower Cretaceous and Upper Jurassic intervals appear to have limited hydrocarbon potential and would be, at best, be minor contributors to the discovered hydrocarbons. This is because they have relatively low TOC contents for source rocks and Type III organic matter. Subsequent to the PFA (2011), the possibility of Cenomanian-Turonian source rocks occurring offshore Nova Scotia, equivalent to those of that age in Morocco, has been considered. There is no evidence at present to suggest a Cenomanian-Turonian source rock does occur offshore Nova Scotia, possibly because the intervals in Morocco are thought to be partially a result of upwelling which occurs predominantly on the western side of continents.

A potential Lower Jurassic oil-prone source rock was implied by the PFA (2011) to have contributed to Scotian Shelf hydrocarbon deposits but there was no strong supporting evidence that supported this assertion. This interval has only been penetrated at Uniacke G-72 (PFA, 2011) which did not encounter a source rock facies. Its presence was suggested based on indirect evidence from liquid hydrocarbons or stains although this was not convincing. As discussed later, other authors (e.g. Forkner et al. 2018) have subsequently proposed a Lower Jurassic contribution for oils in the Sable Island area based on newer data. A recent study of the offshore Morocco conjugate margin suggests that an interval of this age may be possible (Fowler, 2019). It is possible that the lack of evidence for a Lower Jurassic source rock may reflect the concentration of attention paid to the Sable Island area because of the discoveries and production there and/or inappropriate geochemical methodologies employed to date. A major objective of this study is to examine evidence for a second source rock contributing to hydrocarbons on the Scotian Shelf besides the Tithonian and in particular an older Jurassic interval.

The only interval for which there is generally considered to be good evidence for it being a source rock is the Tithonian-Kimmeridgian. This was deposited in a deltaic environment and contains Type III-II organic matter. It would thus be expected to generate mostly gas with minor amounts of liquids. This is what is observed for the Scotian Shelf. Biomarkers are generally in low concentrations in Scotian Shelf oils but where they have been detected they support a predominantly terrestrial contribution to the source rock; e.g. high pristane/phytane, $C_{29}$ steranes >> $C_{27}$ steranes and rearranged steranes >> regular steranes (Fowler et al., 2016).

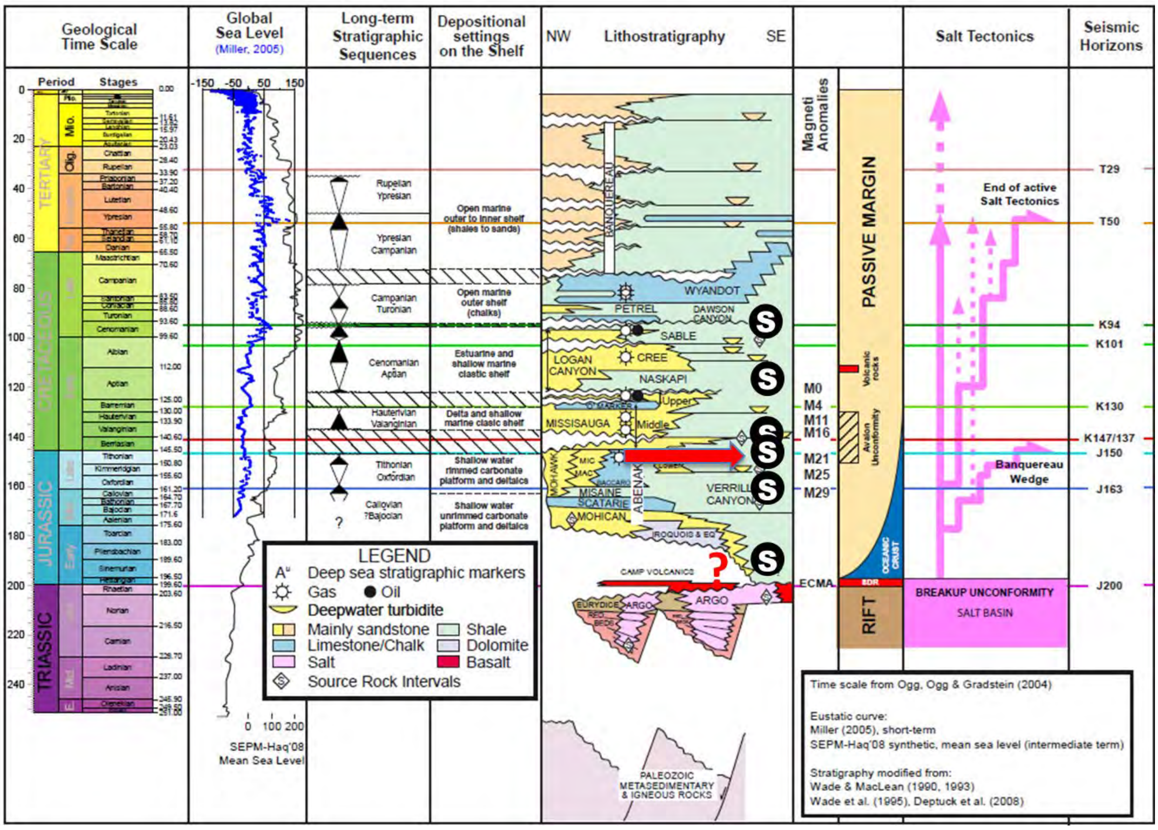

Figure 1. Potential source rocks identified on the Scotian Shelf in the PFA (2011), plus the Cenomanian-Turonian interval later proposed as an additional possibility. Figure adapted from figures in Chapter 4 of the PFA (2011).

Even for the Tithonian source rock, there are only a few wells that show unambiguous evidence for its occurrence. This is probably related to contamination, maturity and drilling location. This can be illustrated by examining the data for six wells suggested to have the Tithonian source rock in the PFA (2011).

*South Venture O-59* The Tithonian Maximum Flooding Surface (MFS) occurs towards the base of the well at around 5900-6000 m. There are some high TOC values in this part of the well, but they are associated with Tmax values that are much lower than what would be expected for the maturity of the organic matter, suggesting the possibility of contamination. There are samples with TOC contents of 1-2% with higher Tmax values that could be uncontaminated.

Mic Mac H-86 No TOC data for this well in BASIN data base and no indication in PFA (2011) where the data is from. Mic Mac D-89 does have TOC data but there are no high values in the Mic Mac Formation. As discussed later, the Tithonian source rock in this well was reanalysed by Rock-Eval/TOC for this study which showed it to contain an organic-rich section with marginally mature Type III organic matter.

*Louisbourg J-17* This well appears to show good evidence for a source rock in the vicinity of the Tithonian MFS over the 3840-4090 m interval. Many samples over this marginally mature interval have TOC contents greater than 2% and there are HI values up to 469 although most are 200-300. There are no obvious indications of contamination.

*South Griffin J-13* It is not obvious why this well was chosen to indicate the presence of the Tithonian source rock except that this interval is not contaminated. Only two samples within 400 m of the Tithonian MFS at ~4450-4500 m have TOC contents greater than 1%. These are at 4370 and 4380 m with TOC contents of 1.15 and 2.05 and HI values of 129 and 182 respectively suggesting very limited hydrocarbon potential for the Tithonian at this location.

*Alma F-67* As mentioned in the PFA (2011), samples in the interval around the Tithonian MFS are obviously very contaminated.

*Glenelg J-48* Samples from the vicinity of the Tithonian MFS are also contaminated in this well. PFA (2011) suggest that Tithonian samples with TOC contents of 1.79-2.10% from t.d. to the depth of DST 1 could be indicated an overmature source rock. These samples certainly have Tmax values that are closer to those expected for the maturity of the interval based on vitrinite reflectance measurements than more TOC-rich samples that are contaminated by lignite.

Hence only two of these six wells show good evidence for a Tithonian source rock. Nevertheless, this seems at present to be the most widespread source rock, at least in Sable Island area. Obviously, its occurrence and quality will depend on where conditions in the Tithonian deltaic system were appropriate for source rock development, which would not be expected over the entire Scotian Shelf.

# 4 Efforts to distinguish geochemically multiple oil families in the Sable Sub-Basin

## 4.1 Early Work

Powell and Snowdon (1979) and Powell (1982) attempted to divide several of the earlier oil and condensate discoveries into families using saturate fraction and gasoline range hydrocarbon gas chromatograms, $\delta^{13}C$ values of saturate and aromatic hydrocarbon fractions and ring distributions in aromatic fractions. Three families of oils were distinguished that were confined to stratigraphically discrete reservoirs; 1) Wyandot Formation (Primrose oils), 2) Mic Mac, Missisauga and Verrill Canyon formations (Sable and Cohasset oils) and 3) Logan Canyon Formation (Citnalta, Intrepid, Thebaud and Venture oils). Group 3 oils were further subdivided on the basis of whether they were biodegraded. Powell (1982) thought that, with the exception of his Group 1 samples, the general similarity of the oils and condensates suggested a generally uniform source rock dominated by terrestrial organic matter, which he thought was the Upper Jurassic Verrill Canyon Formation. He suggested that the Group 2 and 3 samples differed on the basis of their relative maturity. Examination of the data from the Primrose Wyandot oils suggests that these differed from other oils in Powell’s studies because they are biodegraded.

Mukhopadhyay (1990, 1991) also used carbon isotopes of saturate and aromatic fractions to split Scotian Shelf oils. One group contains only Mic Mac, Missisauga and Abenaki reservoired samples with the other groups containing oils and condensates from various reservoirs and from different parts of the basin. Mukhopadhyay et al. (1995) used aromatic hydrocarbon parameters for oil-oil correlations of Scotian Shelf samples. The oils were determined to be at “advanced levels of thermal maturation (middle to late oil window)”. These authors were still able to split their samples into two main groupings but did not relate these to stratigraphy. If this is done, then one of their groupings are from Mic Mac, Missisauga and Abernaki reservoirs while most of the oils in their other grouping came from Logan Canyon reservoirs. Mukhopadhyay et al. (1995) also demonstrated using pyrolysis-gas chromatography that the pyrolyzate of an asphaltene from Sable Island 3H-58 was significantly more aromatic than that from Cohasset A-52.

Reservoired petroleum on the Scotian Shelf is mostly gas, gas-condensate or light oil, and hence contains very low concentrations of or no biomarkers. Fowler and Obermajer (1997) reported on some biomarker analyses that they had done. These were standard analyses of saturate and aromatic fractions as well as some where they had removed n-alkanes using urea adduction prior to GC-MS or GC-MS-MS analysis. All samples showed sterane distributions dominated by $C_{29}$ members and triaromatic steranes dominated by $C_{28}$ members, consistent with a source rock dominated by an input from terrestrial organic matter. The oils also showed a large predominance of diasteranes over regular steranes indicative of high maturity and the clastic nature of the source rock. A number of samples showed evidence for possible contamination, either geological (i.e. biomarkers picked up during migration) or during production (Fowler and Obermajer, 1999) that can be related to the very low concentrations of biomarkers in Scotian Shelf oils that make these compounds easily affected by contamination.

## 4.2 Gasoline Range Hydrocarbon Studies

Fowler and Obermajer (1997, 1999) investigated if the gasoline range hydrocarbons could distinguish families of oils/condensates as this was the largest fraction available for analysis of most samples. These authors showed that gasoline range gas chromatograms showed a wide variation, especially in the relative abundance of the three principle $C_7$ compounds, n-heptane, methylcyclohexane and toluene (Fig. 2). They split Scotian Shelf condensates/oils into three groups. Their group 1 samples are oils from the Cohasset-Balmoral-Panuke area from Late Jurassic to Lower Cretaceous reservoirs. Oil stain samples from Penobscot L-30 have similar characteristics. They are characterized by very low amounts of toluene and moderate to high abundance of n-heptane relative to methylcyclohexane. Group 2 includes samples that are from mostly from wells along the shelf edge such as Banquereau, Glenelg, and North Triumph. These oils contain a relatively high abundance of toluene and low amounts of n-heptane. Group 3 was divided to two subgroups. Group 3a have a very high abundance of methylcyclohexane relative to n-heptane and toluene while Group 3b were similar but had higher amounts of n-heptane and toluene. All the Group 3 samples were from the Sable Island area except for those from Primrose wells. Group 3a oils tend to be those that show evidence of biodegradation with the low toluene suggesting water-washing may also have occurred. Other samples were hard to assign a group. Some of these also show evidence of biodegradation.

The groupings also correlate with other characteristics. Type 1 oils correspond to those Scotian Shelf oils having a very low GOR (<20) and high saturate to aromatic ratio. As the oils in each of these groups generally come from geographically restricted parts of the basin (Fig. 3), the differences in their light hydrocarbon distributions could be related to variations in source rock facies. For example, the high abundance of toluene relative to n-heptane in the Group 2 oils could indicate that they were sourced from an organic facies containing a higher proportion of higher land plant material than the other oils/condensates. However, it is possible that they are less mature or that a reservoir process such as evaporative fractionation could be responsible (see below).

It has been shown that some of the light hydrocarbon ratios devised by Mango (1987, 1990) have applications for oil-oil correlations (ten Haven, 1996, Obermajer et al, 2000). Mango (1987) noted that there was generally an invariance in the ratio (2-methylhexane + 2,3-dimethylpentane) versus 3-methylhexane + 2,4-dimethylpentane) which can vary between different sets of oils. These variations have been attributed to source (ten Haven, 1996, Obermajer et al, 2000). The Scotian Shelf oils analysed by Fowler and Obermajer (1997) mostly show a constant K1 ratio of 1.11-1.14 (Fig. 4a). Peters et al., (2005, p.183) also found an invariance for K1 for their set of Scotian Shelf oils with a similar average K1 of 1.11. This could suggest that all the Scotian Shelf oils in these two studies have the same source rock. However, Peters et al. (2005, p. 183) commented that the subtle variations that they observed in their Sable E-48 samples using CSIA gasoline data and Halpern plots were not shown by the K1 plot. Interestingly, samples from Sable 2H-58 and 3H-58 have anomalous K1 values of 2.01 and 2.12 compared to other Scotian Shelf samples but these are biodegraded. Hence it is not known if Peters et al. (2005) were observing biodegradation rather than source effects in their Sable Island samples.

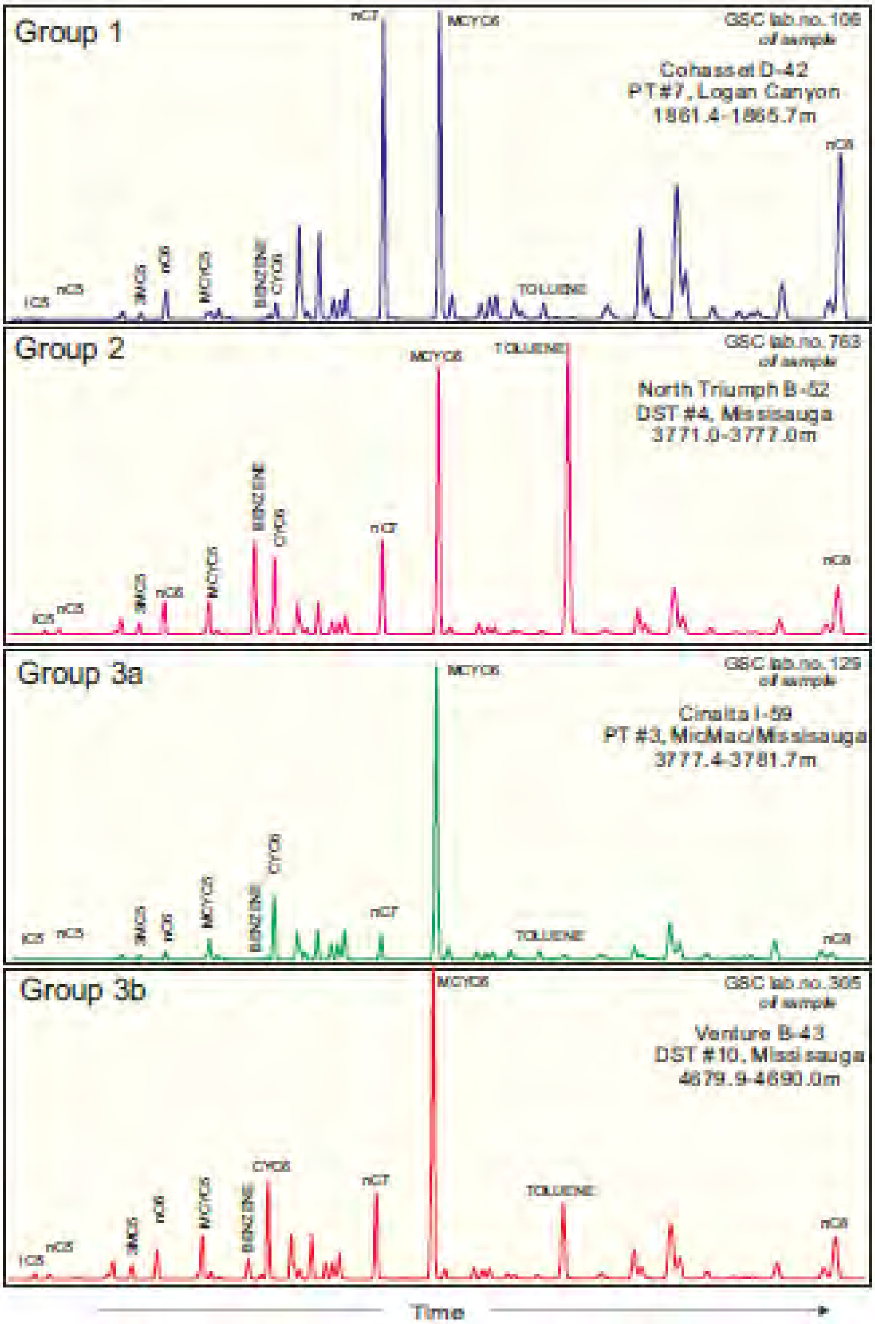

Figure 2. Figure 1 from Fowler and Obermajer (1997) showing representative gasoline range gas chromatograms of Scotian Shelf light oils/condensates. The chromatograms show the variable relative abundances of n-heptane (nC7), methylcyclohexane (MCYC6) and toluene that was used by the authors to split Scotian Shelf oils into groups 1, 2, 3a and 3b.

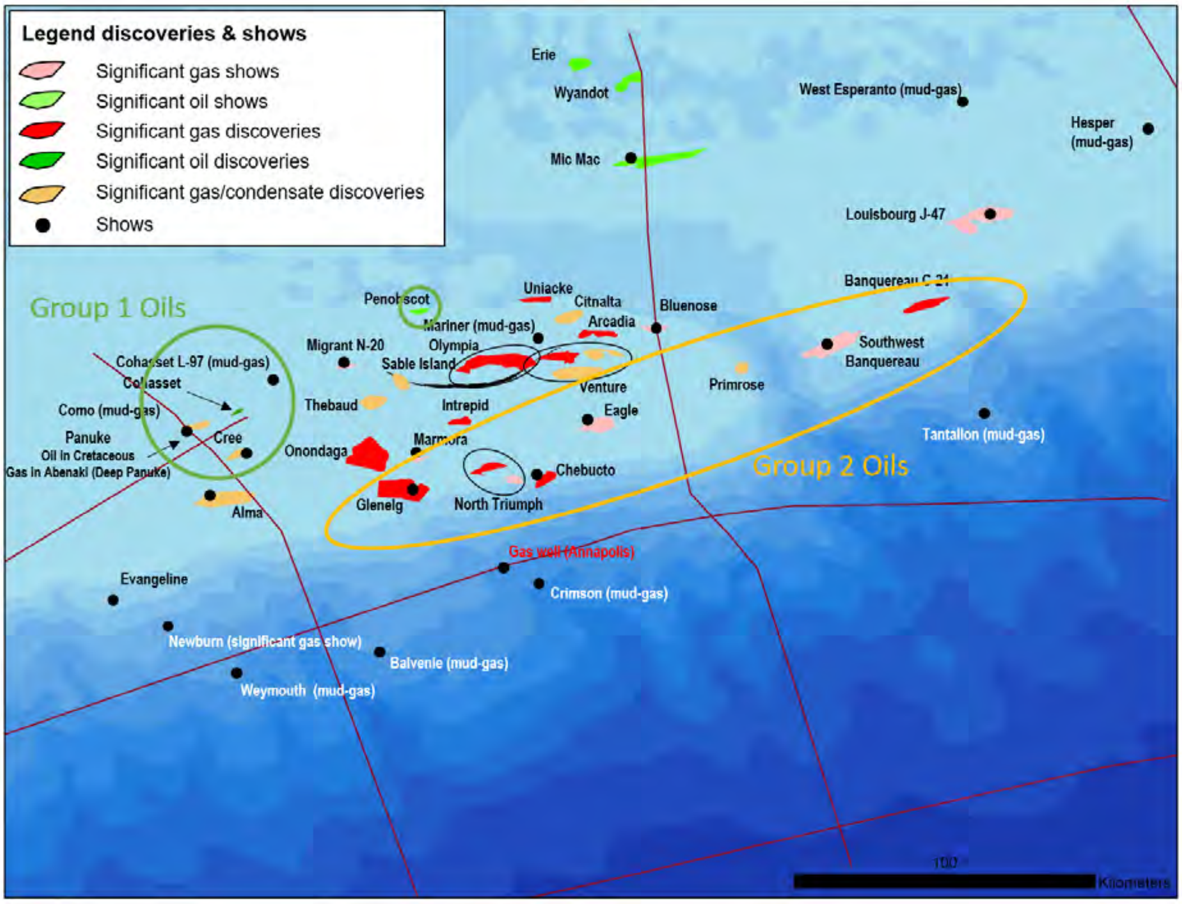

Figure 3. Map of part of the Scotian Shelf showing the areal distribution of Groups 1 and 2 oils.

If the Scotian Shelf samples defined by Fowler and Obermajer (1997) as Group 3 are removed, then the Group 1 and Group 2 samples form distinct clusters (Fig 4b). Cross-plots of other Mango parameters, that have been suggested to help divide oils into different families, give similar results. It was suggested that these cross-plots might provide further support for the concept of at least two different source rocks or source facies on the Scotian Shelf. Group 3 may be derived from a third source rock with characteristics intermediate between those responsible for Groups 1 and 2 or be a mixture from the two sources.

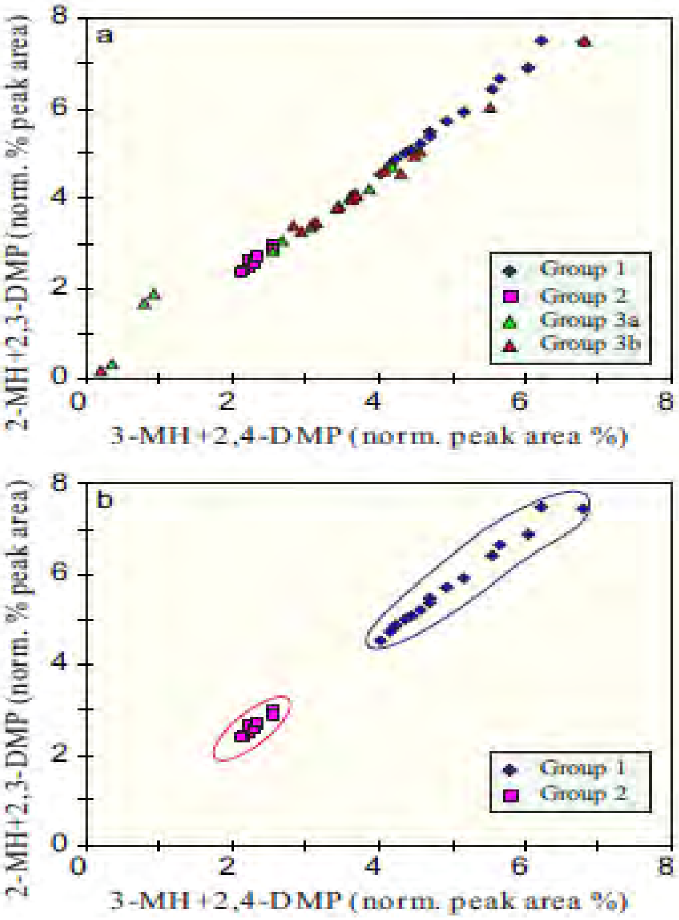

Figure 4. Fowler and Obermajer (1997) Figure 6. Cross-plots of the normalized % peak area of 3-methylhexane + 2,4-dimethylpentane versus 2-methylhexane + 2,3-dimethylpentane showing (a) the invariance of Mango's K1 parameter (a) and (b) the separation of Fowler and Obermajer's group 1 and 2 samples (i.e. removing the group 3 oils).

Evaporative fractionation (Thompson, 1987, 1988) is a reservoir process that is thought to commonly occur in deltaic basins such as that in the Sable Island area where large volumes of methane are generated and subsequent gas-washing can lead to light oils and condensates having very different compositions despite having the same source rock. It occurs when a gas carrying oil fractionates into a gas phase and a volatile depleted residual oil. The gas phase can migrate into shallower reservoirs where further fractionation may take place if there is additional gas charge. This can be repeated several times as long as there is continued recharging of the residual oil with methane. Because of different gas solubilities, light aromatic and cyclic hydrocarbons preferentially partition into the residual oil and the condensate has a higher concentration of normal and branched alkanes.

Thompson used a cross-plot of n-heptane/methylcyclohexane versus toluene/n-heptane (his F and B parameters) to show this. Scotian Shelf data taken from Fowler and Obermajer (1997) is plotted in Figure 5. This figure appears to suggest that evaporative fractionation could be occurring on the Scotian Shelf. Type 1 oils plot parallel to the n-heptane/methylcyclohexane axis and Type 2 and 3 oils progressively up the Toluene/nC7 axis, as expected if evaporative fractionation was occurring. However, it is oils from the Cohasset-Panuke-Balmoral fields that are distinguished from other Scotian Shelf oils by their low GOR (<20), that have a very low abundance of toluene (toluene/n-heptane < 0.05) while tests with high GORs have high toluene/n-heptane, the opposite of what is expected from evaporative fractionation. Additionally, the Fowler and Obermajer oil groups occur in distinct areas of the basin rather than show stratigraphic/depth trends (this is also illustrated by Fig. 7.25 in Peters et al. 2005). This suggests variation due to organic facies or different source rocks.

Additional processes that can affect toluene abundance are biodegradation, water-washing and maturity (Thompson, 1987). Some oils in the Sable Island area have certainly been affected by biodegradation and possibly water-washing which has removed much of the n-heptane and toluene in these samples.

The Sable Island basin depositional system is one where evaporative fractionation might be expected to occur and Figure 5 tends to support that. Moreover, more than one company has told the author privately that their modelling indicates that this is the case. However, possibly because there is either something missing from the author’s understanding of the process or in the data, it does not appear certain that evaporative fractionation has occurred.

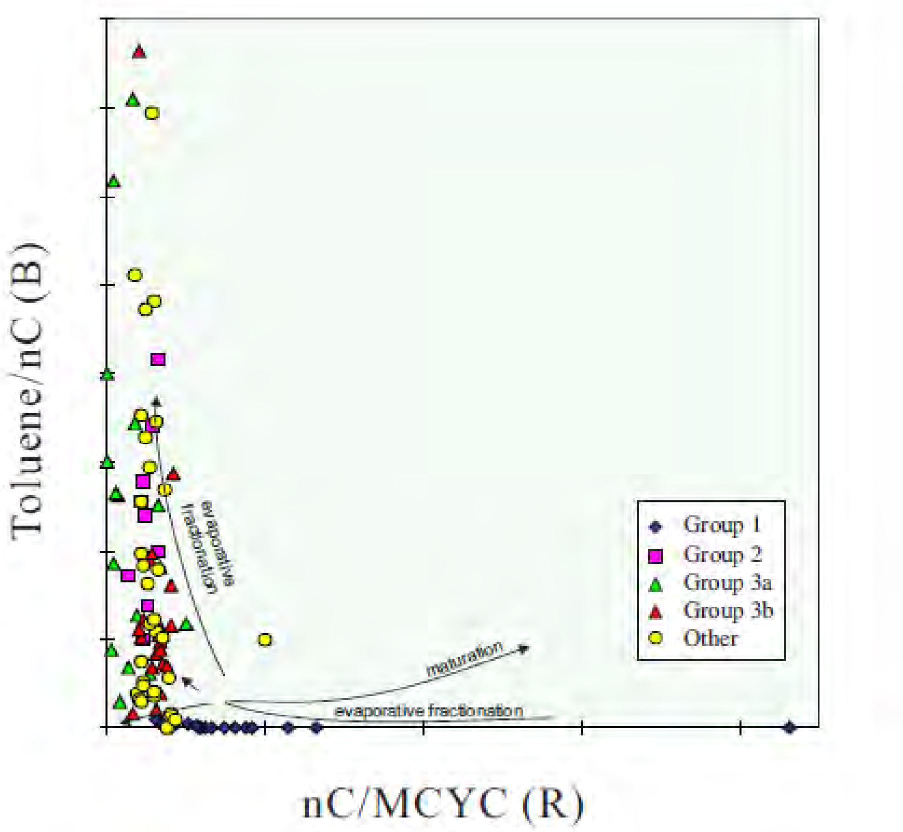

Figure 5. Fowler and Obermajer (1997) Figure 5. Cross-plot of n-heptane/methylcyclohexane (Thompson parameter R but now usually designated as F) versus toluene/n-heptane (Thompson parameter B). The alteration vectors (evaporative fractionation, maturation, biodegradation) after Thompson, (1987).

Ten Haven (1996) empirically defined ‘lacustrine’, ‘mixed’ and ‘terrigenous’ fields on a plot of N2/P3 versus P2. The Scotian Shelf samples plot mostly in the terrigenous field with some extending into the mixed field. This agrees with other data that suggest that the Scotian Shelf oils/condensates are derived from source rocks with mostly terrestrial derived organic matter.

Peters et al. (2005, p.173-191) used a combination of $C_7$ compositional and CSIA data to distinguish two oil families on the Scotian Shelf and suggest that most were sourced from prodelta (Verrill Canyon) shales and a few from a more marly facies.

## 4.3 PFA Work

Some analytical work was done in 2015-2016 under the Play Fairway Project to determine if using different analyses to those done earlier could provide evidence for the older, deeper Lower Jurassic source rock previously suggested in PFA (2011). To do this the following analytical work was done:

- i) Compound Specific Isotope Analysis (CSIA) of $C_{10}$-$C_{30}$ n-alkanes was done by APT.
- ii) CSIA of the gasoline fraction by Geochemical Analytic Services Corporation under the supervision of Dr Michael Whiticar at the University of Victoria. This method was used to determine if the results discussed by Peters et al. (2005) could be reproduced.
- iii) Diamondoid analysis done by APT.

The CSIA methodologies were selected to provide possible evidence of different oil families. Diamondoid analyses were selected to investigate a potential contribution from a deeper source rock to some Scotian Shelf light oils/condensates as these would be expected to contain higher concentrations of diamondoids than oils without such a contribution.

Fourteen oil samples from the Scotian Shelf were selected for n-alkane compound specific isotope analysis (CSIA) and diamondoid analysis. The oils were chosen based mainly on the variation that they or similar samples show in the gasoline range hydrocarbon distributions. This was done using the data of Fowler and Obermajer (1997) and their division of Scotian Shelf oils into three groups.

Group 1 is represented by oils from Cohasset A-52 and D-42, Panuke B-90 and Penobscot L-30; Group 2 by samples from Acadia J-16, Banqureau C-21, Glenelg N-49 and North Triumph B-52; Group 3a samples from Intrepid L-80 and Primrose N-50 and Group 3b from South Venture 0-59, Thebaud C-74 and Venture B-43. Two oils were selected from Thebaud C-74, both in Missisauga reservoirs but separated by about 900 m depth for comparison. Other analyses such as the saturate/aromatic hydrocarbon ratio and Paraffin Indices suggest the deeper sample is significantly more mature.

N-Alkane CSIA over the $C_{16}$-$C_{30}$ range was selected to see if the groupings based on the gasoline range hydrocarbons were apparrent in higher molecular weight range (in the absence of or very low concentration of biomarkers in these samples) and hence suggest that more than one source rock has been effective on the Scotian Shelf.

Diamondoid analysis was done on a deep Panuke sample in 2001 and discussed in a report by Sassen and Post (2007). These authors commented that “unlike nearly all condensates from offshore Nova Scotia about which data is published, the Deep Panuke condensate is characterized by an unusually high content of diamondoids”. It is not clear which other reports that Sassen and Post were referring to as there does not seem to be any other reports publicly available at that time, to this author’s knowledge. That is not to say that they do not exist but may be internal to oil companies. It was decided to analyze for diamondoids in a Scotian Shelf sample set to see if the deep Panuke sample was anomalous in its diamondoid content compared to other Scotian Shelf oils.

### 4.3.1 Compound Specific Isotope Analysis (CSIA) Data

N-alkane CSIA data is presented in Figures 6. All the oils show generally similar n-alkane $\delta^{13}C$ profiles, suggesting that they have the same or similar source rocks. The isotopic values for all n-alkanes in the oils are generally within 2‰ of each other.

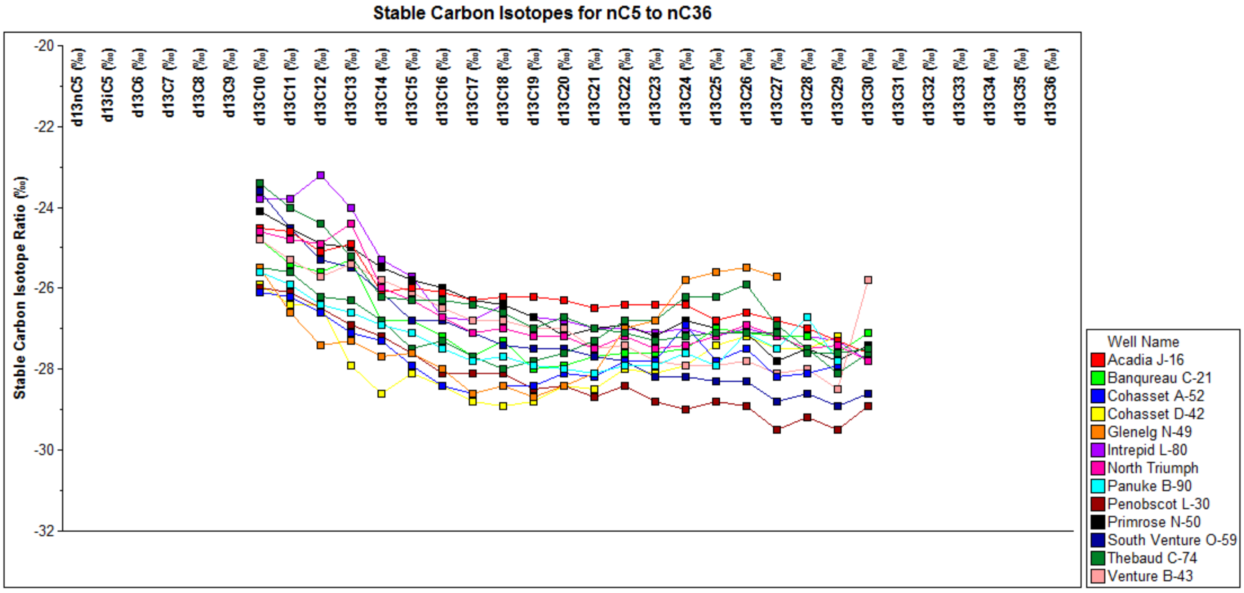

Figure 6. Variation in isotopic composition of $C_{10}$-$C_{30}$ n-alkanes in a suite of Scotian Shelf oils.

Depletion in $\delta^{13}C$ for $C_{18}$ and higher n-alkanes has been suggested as typical of a source containing deltaic/terrigenous organic matter (Murray et al., 1994) or as a result of increasing maturation (Bjorøy et al., 1994, Clayton and Bjorøy 1994). The Scotian Shelf oils show this from $nC_{13}$ which could further support other evidence for their source rocks being deposited in a deltaic environment. None of the Scotian Shelf samples, including the $nC_7$ rich Group 1 oils, show a slight anomaly at $nC_{17}$ that Murray et al, (1994) observed in some of their samples and which they suggested could be an indication of a greater algal contribution to some of their deltaic oils.

Clayton and Bjorøy (1994) noted that more mature oils will be isotopically heavier with maturity leading to an increase in $\delta^{13}C$ of 2-3‰. This appears to explain some of the variation in the Scotian Shelf sample set. The Arcadia J-16 DST 9 sample is the isotopically heaviest or one of the heaviest over the analyzed carbon range. This sample has a very mature looking Whole Oil Gas Chromatogram (WOGC) (Fig. 7) and was from a test with a GOR of 463,000, much the highest of those oils sampled for CSIA (the next highest is Primrose with a GOR of 53,200) suggesting that it is the most mature. In contrast, Penobscot L-30 RFT 5 sample shows a much less mature looking WOGC with a greater abundance of higher molecular weight n-alkanes (Fig. 7) and has the isotopically lightest n-alkanes over much of the analyzed carbon number range. Hence maturity could be a reason for some of the differences in the Scotian Shelf sample set.

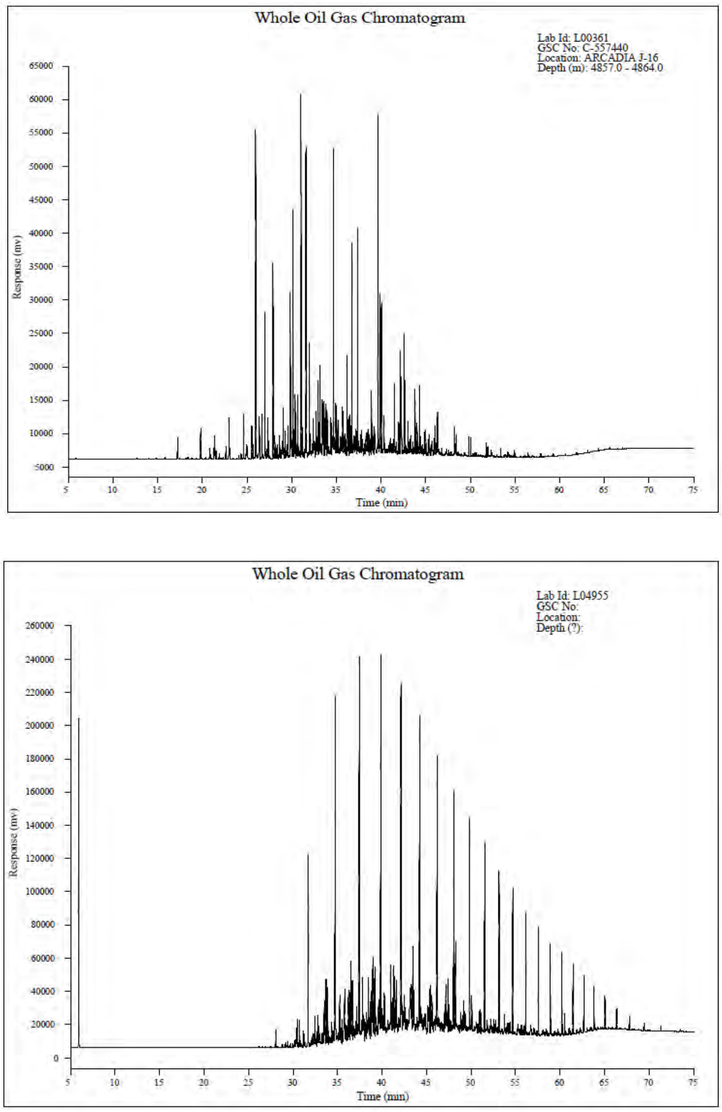

Figure 7. Whole oil gas chromatograms of the Arcadia J-16 DST 9 (upper) and Penobscot L-30 RFT 5 (lower) oils.

The Type 2 toluene rich oils are generally slightly isotopically heavier than the Type 1 toluene depleted oils. The type 3 oils that appeared to be intermediate in their gasoline range compositions, are also intermediate in their CSIA profiles. Hence, for most part, on a limited sample set, the CSIA data seems to be able to separate the oils in a similar way to the gasoline range data. Glenelg N-49 DST 1 is somewhat anomalous as between $C_{10}$-$C_{20}$ it has some of the lightest values for its n-alkanes and is more similar to Type 1 oils but after $nC_{20}$ shows a dramatic change in its profile so that by $nC_{23}$ it has the heaviest $\delta^{13}C$ values. This suggests the $C_{20+}$ n-alkanes have a different origin than their lower molecular weight homologues. It is not evident from the WOGC or SFGC of the Glenelg N-49 DST 1 sample of any change in the n-alkane abundance profile that would suggest an addition of n-alkanes from another source, unlike for example Glenelg J-48 DST 9 which shows a bimodal distribution of n-alkanes with a much lower secondary maximum at $C_{21}$-$C_{23}$ (this sample was not analyzed by CSIA). The WOGC of the Glenelg N-49 DST 1 sample is similar to Type 2 oils (e.g. Arcadia J-16 oil in Fig 7a) in having high abundances of compounds other than n-alkanes. No satisfactory reason can be suggested at this time for its n-alkane CSIA profile.

### 4.3.2 Compound Specific Isotopic Analysis (CSIA) of Light Hydrocarbons

CSIA of the gasoline range hydrocarbons of some Scotian Shelf light oils and condensates was considered as a method would be very appropriate for these samples which are dominated by lower molecular weight compounds. Additionally, Peters et al. (2005, p.191) used CSIA of light hydrocarbons as well as a ‘Halpern’ Star Diagram to suggest that two oil groups occurred at the Sable Island E-48 well.

Samples were originally selected based on the variation in gasoline range gas chromatograms observed by Fowler and Obermajer (1997). For example, samples with high n-heptane or high toluene were selected. A significant problem was that despite the oil samples being stored in tightly sealed bottles in a fridge at -20°C, based on their WOGCs, many of the older samples had lost most of their lighter hydrocarbons in the intervening twenty years. An example of the difference in WOGCs of oil samples stored over different time periods is shown in Fig 8 for the Cohasset A-52 DST 6 sample analyzed in 1997 and a Panuke B-90 DST 1 sample available in 2015 which are believed to originally have had very similar gas chromatograms. It is evident that that the Panuke sample has a greater amount of lighter hydrocarbons.

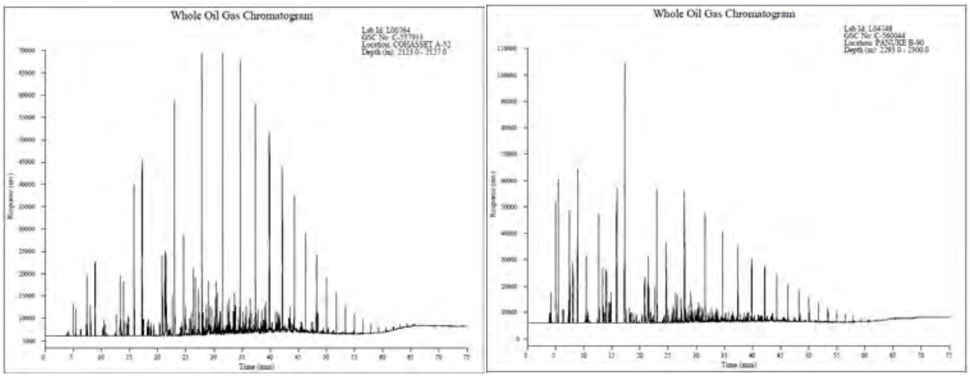

Figure 8. Whole oil gas chromatograms of a Cohasset A-52 DST 6 oil (left) and a Panuke B-90 DST 1 oil (right). The Panuke oil sample has retained more its lighter hydrocarbons than the Cohasset A-52 sample.

The effect of evaporation of CSIA light hydrocarbon data is uncertain. Bjorøy et al. (1994) and Carpentier et al. (1996) reported little or no isotopic fractionation due to evaporation. Whiticar and Snowdon (1999) mentioned that isotopic effects due to evaporation are not significant unless the sample quantity is small or has been stored open and warm for long periods of time, then there are shifts to $^{13}$C enriched values, especially for n-pentane and iso-pentane but less for $C_6$-$C_{12}$ compounds.. It was decided that newer samples in the GSC oil library which showed less evaporation of their light ends would be preferentially selected for analysis. Of the samples that were analyzed by GASCo, only

Cohasset A-52 DST 6 and Thebaud C-74 DST 9 and DST 2 samples were in the original report by Fowler and Obermajer (1997). Hence, mostly newer samples that had been sampled more recently or were a duplicate of older samples, but which had evidently been stored better were analyzed.

Figure 9 is an isotopogram of all the samples analyzed for this study with values for all the compounds measured isotopically. An isotopogram (Whiticar and Snowdon, 1999) is a plot with selected compounds measured for their $\delta^{13}$C versus on the x axis in the order that they would elute on the gas chromatographic column versus the measured $\delta^{13}$C value on the y axis. For certain compounds, all the oils are isotopically similar but for others there is a widespread range in values. Compounds which show the greatest range in isotopic values such as ethylcyclopentane and the dimethylhexanes are those in lowest concentrations. This might explain why some authors (e.g. Rooney et al.1998; Peters et al., 2005) report on a more restricted number of compounds than Whiticar and Snowdon (1999) and provided by GASCo here. These variations are most evident in samples that appeared to have suffered most from evaporation. Hence, there is a suspicion that despite earlier workers reporting that there is little isotopic fractionation due to evaporation, it might be a factor causing variation in this sample set. Whiticar and Snowdon (1999) noted that a large dynamic range in the relative amounts of gasoline range hydrocarbons present in a sample can cause analytical problems with the CSIA method. This might occur in this sample set as it would account for some of the variation in the isotopic values for methylcyclohexane. This is the compound in highest concentration in the gasoline fractions of many Scotian Shelf oils, being twice or more times more abundant than the next most abundant compound in many samples.

Another possible factor affecting variation is thermal maturity. The results of pyrolysis experiments undertaken by Rooney et al. (1998) suggested that n-alkanes became isotopically heavier with increasing maturity.  Scotian Shelf light oils and condensates show a range in maturity. Mukhopadyay (1991) and Fowler and Obermajer (1997) suggest that within the Scotian Shelf area, the Cohasset-Panuke oils are the least mature with Thebaud and Venture the most mature. Comparing n-alkane values for the samples, those with the heaviest values are from Thebaud, South Sable, Uniacke and Primrose reservoirs which are among the most mature samples while those with the lightest values are from Balmoral, Cohasset, Panuke. Hence maturity may be also factor in the variation observed between samples.

Three good quality oil samples from Alma (F-67 DSTs 5 and 7; K-85 DST 4) did show very similar isotopograms suggesting that the method does show promise with fresh samples. Restricting the data to just the highest quality samples (i.e. those with gasoline range distributions thought to be close to the original oils), suggests that there is only minor differences between samples.

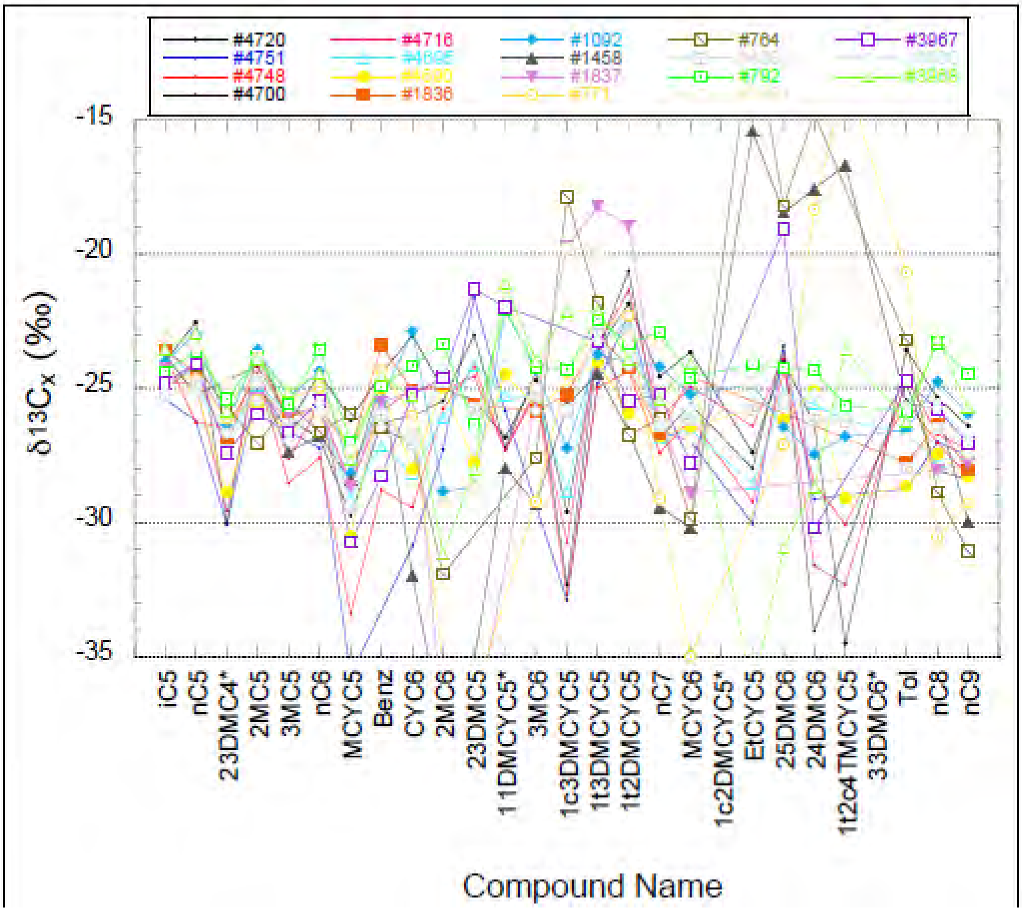

Figure 9. Isotopograms for all compounds in all Scotian Shelf oils analyzed by CSIA.

Overall, based on these observations, much of the variation in the gasoline range CSIA data obtained on the Scotian Shelf samples is related to analytical and sample quality and some possibly to maturity. There is nothing obvious in the data to indicate multiple families of oils on the Scotian Shelf, but the quality of the data means that it cannot be ruled out.

### 4.3.3 Diamondoids

Diamondoids are thermally stable $C_{10}$-$C_{18}$ compounds with carbon-carbon bonds arranged in a diamond shape. They increase in concentration in oils with increasing maturation due to their greater stability compared to other compounds.

The impetus for the analysis of diamondoids in Scotian Shelf oils in 2015 was a communication by Paul Post (US MMS) to Dave Brown (CNSOPB) on anomalously high concentrations of diamondoids in a Deep Panuke (M-79) oil. This data was from an analysis of diamondoids that was included as an Appendix in a Reservoir and Compositional Analysis Report done for Pan Canadian Resources in 2001 by Core Labs Calgary laboratory. The comment on the high concentration of the diamondoids was based on a comparison to the abundance of diamondoids in two Hudson Canyon condensates from the Baltimore Canyon Trough, offshore northeastern USA that Sassen and Post (2008) examined. For example, the Panuke M-79 had 7678 ppm adamantanes versus 4038-4266 ppm for the Hudson

Canyon samples. Post and Sassen suggested that the same, or a similar, source rock was responsible for both Hudson Canyon condensates that were from Late Jurassic Kimmeridgian and the Early Cretaceous Albian reservoirs.

Scotian Shelf light oils/condensate samples were selected for diamondoid analysis were the same as those for $C_{10}$-$C_{30}$ CSIA, based on their different gasoline range characteristics in Fowler and Obermajer (1997). As discussed previously, it was discovered subsequently that many of these oils had undergone extensive evaporation in the intervening years. The loss of the volatile components would likely have increased the concentration of diamondoids in the samples. Data from these analyses are summarized in Table 1.

| | | |
|---|---|---|
| Total diamondoids | 4385-16153 ppm | |
| Adamantanes | 4243-15659 ppm | (7678) |
| Diamantanes | 86-493 ppm | (1541) |
| 3+4 Me Diamantanes | 32-171 ppm | |
| MDI maturity parameter | 0.34-0.46 | (0.51) |
| MAI maturity parameter | 0.56-0.66 | (0.73) |
| Panuke M-79 data (2007) is in brackets (from P. Post) | | |

Table 1. Summary of Diamondoid data from 15 Scotian Shelf light oils/condensates obtained in 2015, compared to Sassen and Post (2007) data in brackets.
MDI (Methyldiamantane Index) = 4-MD/(1-MD + 3-MD + -4MD) MD are methyldiamantanes
MAI (Methyladamantane Index) = 1MA/(1MA + 2 MA) MA are methyladamantanes

As indicated in Table 1, the Panuke M-79 sample analyzed by Core Labs has an adamantane concentration towards the middle of the range of the Scotian Shelf samples. The diamantine concentration is higher for the Panuke M-79 sample than for the APT analyses. This is not what would be expected if the samples sent to APT had suffered extensive evaporation as the adamantanes are more volatile than the diamantanes. This maybe because Core Labs included the trimethyldiamantanes which are measured from the m/z 215 mass chromatogram in their diamantine abundance which are not included in the APT diamantine quantification. The diamondoid maturity parameters suggest that the Panuke M-79 sample is more mature than the other samples, although these should be used with caution (e.g. Peters et al., 2005, p.162). Despite the possible evaporation problems, the Scotian shelf samples analyzed by APT show a rough correlation with GOR which suggests that the diamondoid concentration in these oils could at least partly reflect maturity.

Hence GSC Group 1 oils from Cohasset, Panuke (Missisauga reservoir) and Penobscot generally have the lowest concentrations of diamondoids. The highest concentrations of diamondoids were in the Arcadia J-16 sample that had the highest GOR. Diamondoid concentrations do not distinguish between Fowler and Obermajer Type 2 and 3 oils. There was also no trend in the MDI and MAI ratios with the Fowler and Obermajer grouping of oils.

## 4.4 Paul Post Follow-Up Study on Panuke oils

Paul Post followed up the Sassen and Post (2008) work and the comparison with Panuke M-79 by conducting a more thorough study with GeoMark in 2010. This data was provided to the author by CNSOPB in December 2018. The GeoMark study (Zumberge,2010), compared the geochemistry of oils from deep Panuke oils (i.e. those in Abenaki reservoirs) to “Panuke” oils which were oils in Missisauga reservoirs, as well as referring to other data that GeoMark had for Scotian Shelf oils. The study noted the high abundance of light end aromatics in Deep Panuke oils and suggested that they had undergone “gas washing” (i.e. evaporative fractionation). Zumberge suggested based on a plot of $C_{19}/C_{23}$ tricyclic terpanes versus $C_{29}$ steranes that the Deep Panuke oils had a source rock with Type II/III organic matter while “Panuke and most other Scotian Shelf oils” are from a source rock dominated by Type III organic matter. Deep Panuke oils were thought to be much more mature than “Panuke and other Scotian Shelf oils” which is not surprising as the Abenaki reservoirs are about 1000 m deeper than the Missisauga reservoirs. Examining the data, it is possible that the lower amounts of $C_{29}$ steranes and $C_{23}$ tricyclic terpanes that are driving the conclusion that the Deep Paunke samples had a greater contribution Type II (algal) organic matter could be related to their higher maturity and the preferential cracking of the larger compounds. Regular $C_{27}$-$C_{29}$ steranes are very minor peaks in the m/z 217 chromatograms provided (m/z 218 chromatograms were not provided) which are dominated by rearranged steranes (rearranged steranes/regular steranes are 12.33-15.83 for deep Panuke samples and 4.48-7.75 for Missisauga samples). Maturity may also be the reason for the difference in pristane/phytane (pr/ph) ratios between the Panuke samples. Deep Panuke oils have pr/ph ratios of 2.19-2.33 while the Missisauga reservoired Panuke oils are 3.33-3.57. This could be taken to suggest a less oxidizing depositional environment for the deep Panuke oils but the pr/ph also decreases at higher maturity levels (e.g. Peters et al. 2005, p. 502). Stable isotopes show consistent differences of about 1‰ between deep Panuke (heavier) and shallower Panuke oils which Zumberge interpreted as consistent with a Type II organic matter contribution to the deep Panuke oils. However, oils become isotopically heavier with increasing maturity.

The only diamondoid data in the report is a plot of MAI versus MDI which shows again that the deep Panuke oils are more mature than the shallower Panuke samples. Both sets of samples are highly mature with maturity in the 2.0-2.2% vitrinite reflectance range using the correlation of Chen et al. (1996) although this is not particularly reliable (e.g. Peters et al., 2005, p.162).

In summary, the GeoMark study suggests there is a possibility that deep Panuke hydrocarbons may have a different source rock, or a contribution from a different source rock than for the shallower Panuke and other Scotian Shelf oils. The data suggests that the deep Panuke source rock would not be too different from that of the other Scotian Shelf oils and potentially could be just a slightly different organic facies with a greater algal contribution to the same source rock. The differences between the deep and shallow Panuke oils can also be related to the higher maturity of the former. Hence it is concluded that GeoMark (2010) data is not conclusive for the deep Panuke oil having a different source rock than other Scotian Shelf oils.

## 4.5 Forkner et al Study

Forkner et al (2017, 2018) investigated whether there are multiple Jurassic-aged source rocks, offshore Nova Scotia. Forkner et al. (2018) provides the most details on their study. They looked at eight oils from the Scotian Shelf for their biomarker and diamondoid content. Their results indicated the following:

*Maturity*: They suggested that a portion of the fluids are early to middle oil window and attribute this low maturity contribution to a Verrill Canyon or equivalents source. However, the low biomarker concentrations and high diamondoid concentrations were suggested to imply a predominate charge from a post-mature source.

*Source Rock Age*: The “most likely age” of the biomarkers in the oils was thought to be Upper Jurassic while the diamondoid fraction was interpreted to be older and probably Lower Jurassic. Forkner et al. said it was not possible to quantitatively determine the age of the older fraction.

*Environment of Deposition*: Biomarkers suggest a mostly terrestrial contribution to most samples. A sample from a Venture B-13 Missisauga reservoir was interpreted to have a greater marine contribution. This was based on a C27:28:29 regular sterane ternary plot that suggested the Venture B-13 sample had a slightly greater relative abundance of $C_{27}$ steranes. This was not shown on their ternary plot of the diasteranes which are in much higher concentrations than the regular steranes (hence easier to measure) where Venture B-13 plotted with other samples.

*Diamondoid Component*: Quantitative extended diamondoid component of four samples was undertaken (Fig. 10). Three of the samples were said to be uniform with the exception being sample 8 from Venture B-13. This was interpreted to have a distribution that had been observed previously in carbonate-dominated hypersaline systems in the Gulf of Mexico because Pentamantane-1 is higher than Tetramantane-3 and Pentamantane-4. From my perspective, it is not much different from sample 1, a Missisauga reservoired sample from Alma F-67 with both of these different from the two Logan Canyon reservoired samples (4 and 7) from Cohasset A-52 and Sable Island 2H-58.

Figure 10. This is Figure 6 from Forkner et al. (2018) showing the results from the Quantitative Extended Diamondoid Analysis of four Scotian Shelf oils; sample 1 is Alma F-67 DST 2, sample 4 is Cohasset A-52 DST 3, sample 7 is Sable Island 2H-58 and sample 8 is Venture B-13 DST 6.

Biomarkers are present in these light oil/condensate samples in extremely low concentrations and hence are easily altered by contamination during production or geological contamination. Geological contamination is apparent when biomarkers provide misleading correlation or maturity information for higher maturity oils (Curiale 2002). This occurs because the distributions of biomarkers in the original oil are affected by molecular components dissolved from organic matter along the migration route. This or contamination can often be detected from inconsistencies in maturity and source suggested by biomarkers compared to the bulk properties (e.g. API) or the molecular data from the lighter fractions of the oil. This appears to be the case with at least some of these Scotian Shelf samples. An example of contamination is shown in the PFA (2011, PL 4-3-5) of a m/z 191 mass chromatogram of a Deep Panuke oil that is taken from a Fowler and Obermajer (1999) presentation. This shows obvious contamination including the presence of oleanane, a biomarker derived from angiosperms that did not evolve until the Late Cretaceous and a low maturity hopane distribution. A problem with Forkner et al (2018) is that there is no acknowledgement that geological contamination or other processes may explain the presence of lower maturity biomarkers in light oils/condensates that otherwise show indications of higher maturity. The diamondoid distributions will not be affected in this way. However, presently there is very few publicly available studies on the distributions of extended diamondoids and is not known what causes the variations whether is source or other factors.

Forkner et al also provide a brief geological/seismic analysis for the possible presence of a Lower Jurassic source rock. It was suggested that these could be present in half graben basins just inboard of the Abenaki margin.

# 5 Primrose Oils

Primrose was a mostly gas/condensate discovery made in 1972. It is located 64.4 km east of Sable Island within the Sable Subbasin near the eastern edge of the Sable Delta Complex. Four wells were drilled on a salt structure play (Fig. 11). The A-41, F-41 and N-50 Primrose wells all reached a maximum depth in Early Jurassic Argo salt (Fig. 11). Gas reservoirs are the Early Cretaceous limestones of the Wyandot Formation (A-41, F-41, N-50 wells) and sandstones of the same age Logan Canyon Formation (N-50). The N-50 also recovered a small but significant amount of oil, with flow rates of 48-56 $m^3$/day and an API of 31-33.6°API, from Early Jurassic dolomites of the Iroquois Formation which form the cap rock of the salt diapir (Canada-Nova Scotia Petroleum Board, 2000). This is the oldest interval that was tested on the Scotian Shelf which is why it of interest to this study.

As part of a larger study looking at 36 Scotian Shelf oils, Powell and Snowdon (1979) examined five oils from Primrose, including the N-50 Iroquois Fm. oil. They noted that this differed from other Scotian Shelf samples in their study by showing a higher proportion of higher molecular weight components and being isotopically heavier, especially the aromatics. No explanation was given for the origin of this oil.

Fowler and Mort (unpublished results) looked at a ‘fresh’ N-50 DST-1 sample provided to the GSC in 2016 using whole oil gas chromatography (Fig. 12). This sample shows a higher abundance of higher molecular weight compounds (up to least $nC_{30}$) than any other Scotian Shelf liquid sample, confirming what Powell and Snowdon reported. The higher abundance of heavier compounds in the WOGC would explain why this sample has a lower API than other samples. The gasoline range is dominated by aromatics (benzene and toluene) and methylcyclohexane with n-heptane in much lower abundance than these compounds. There are peaks in the $C_{13}$-$C_{16}$ n-alkane elution range that are not normally observed in saturated gas chromatograms and hence may be mid-range aromatics.

The top of the salt is only about 1300 m (CNSOPB, 2000) and hence the reservoirs at Primrose are shallow enough for biodegradation to be taking place. This explains the obvious biodegradation in some of the Wyandot reservoired oils. The Primrose N-50 Iroquois Formation reservoired oil may also be slightly biodegraded which could explain the lack of lower molecular weight n-alkanes that in turn is the reason for the apparent increase amount of higher molecular weight n-alkane peaks and the small unresolved complex mixture hump in the later eluting part of the gas chromatogram. Several oils from the Sable Island area also show a predominance of aromatics in their Whole Oil Gas Chromatograms that were analyzed at the GSC at a similar time to the Primrose N-50 oil that correspond to the Type 2 or 3 oils of Fowler and Obermajer (1997) and hence gas washing/evaporative fractionation may be another explanation.

The Iroquois Formation oil has a high pr/ph (3.0 -3.6) similar to other Scotian Shelf oils and a low pr/C17 ratio (0.14-0.16) suggesting it is mature oil with a source rock that has a significant terrestrial contribution deposited in a relatively oxidizing environment. A clastic source rock is also suggested by the low S (0.09% S) for this sample. The N-50 Iroquois Fm oil was analyzed for its biomarker distributions by the GSC. Biomarkers were found to be in very low concentrations in this sample. Steranes were not detected and terpanes were in just high enough concentrations that aspects of their distributions could be observed. These were typical of an oil derived from a mature clastic source rock with 17α(H)- hopanes predominating, $C_{30}$ in higher abundance than the $C_{29}$ 17α(H)-hopane and no homohopane prominence. Tricyclic terpanes are in low concentration. Some earlier eluting peaks were tentatively identified as gymnosperm-derived diterpenoids such as retene and simonellite.

In summary, the N-50 Iroquois Cap Rock oil looks like a mixture of a biodegraded or gas washed condensate and a heavier unbiodegraded or partially biodegraded component. The diterpenoid compounds imply that the heavier component is a contribution from a source rock/coal with an input of conifer resins. Because of the quality of data, this is still conjecture at present.

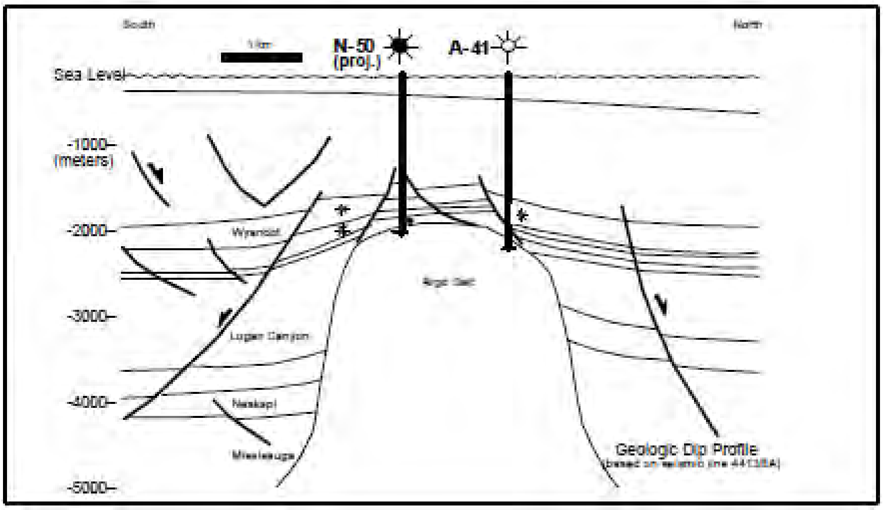

Figure 11. Cross section of the Primrose field showing the location of the N-50 well relative to the salt diapir. The thin (~136 m) Iroquois Formation 'cap rock' is not readily apparent in this diagram. Figure taken from CNSOPB (2000).

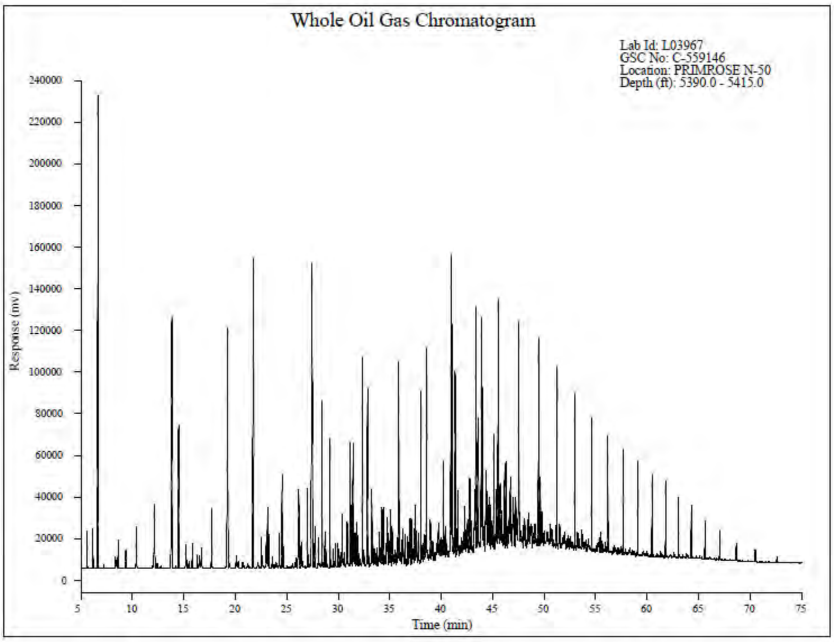

Figure 12. Whole Oil Gas Chromatogram of Primrose N-50 1642.8-1650.5 m PT1, ‘Iroquois Fm Cap Rock’ oil.

During the second stage of the study, a sample of the Primrose N-50 DST-1 oil was obtained from the CNSOPB Geoscience Center so that hopefully better quality data could be obtained than that previously supplied by the GSC from the analysis of their sample. The whole oil gas chromatogram (WOGC) of the sample obtained for the present study (Fig. 13a) indicates that it has lost more of its light ends than the GSC sample which was analyzed some years ago (Fig. 12). Like the GSC sample, the WOGC obtained for this study shows several peaks around the $C_{16}$-$C_{18}$ n-alkane elution time. These peaks are missing from the saturate fraction gas chromatogram (SFGC) suggesting that they are aromatic compounds (Fig. 13b). Both the WOGC and the SFGC show no odd over even preference for $C_{23}$-$C_{31}$ n-alkanes and hence no indication of a contribution from lower maturity terrestrial organic matter. The pr/ph ratio is 2.53 which is slightly lower than that obtained by the GSC but suggests a source rock deposited in a relatively oxic environment. The pr/C17 and ph/C18 ratios are low (0.21 and 0.10) implying a mature sample.

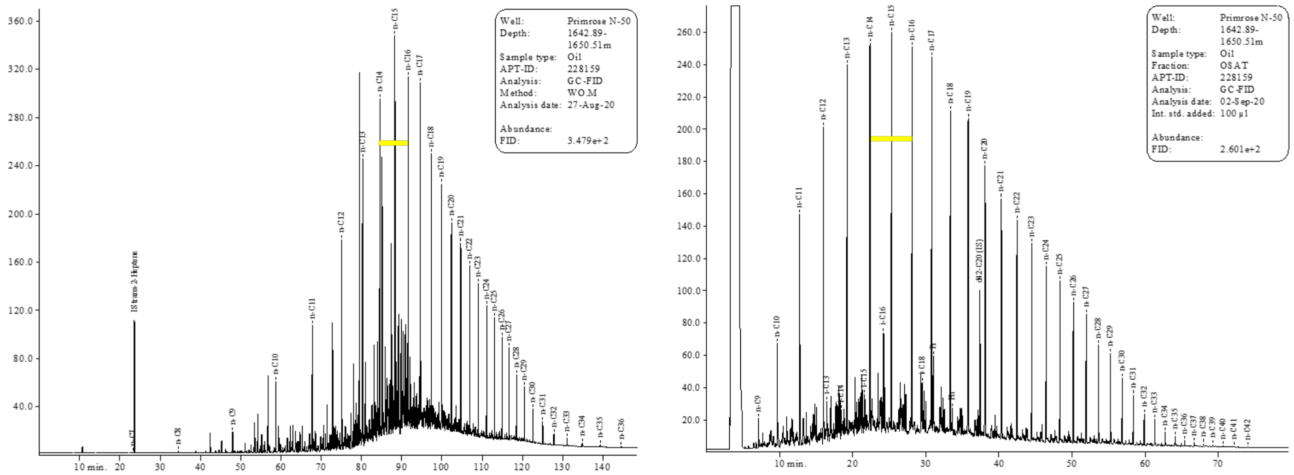

Figure 13. a) Whole Oil Gas Chromatogram (WOGC) and b) Saturate Fraction Gas Chromatogram (SFGC) for Primrose N-50 DST 1 analyzed for this study. The yellow bar is between the $C_{14}$ and $C_{16}$ n-alkanes in each chromatogram. Note that many significant peaks eluting under the yellow bar in the WOGC are missing in the SFGC, indicating that they are probably aromatic rather than saturate hydrocarbons.

Much better biomarker data was obtained from the analysis done for this study than that at the GSC, possibly because of the evaporation of lighter hydrocarbons in the new sample increased the concentration of biomarkers. For example, the distribution of steranes, compounds that were not discernible in the GSC analysis, are easily observed in the analysis done for this study (see Table A4 and mass chromatograms in Appendix). These compounds show a $C_{29}$ predominance, very low $C_{30}$ 4-desmethylsteranes with rearranged steranes dominating over regular steranes suggesting a clastic source rock with a significant terrestrial input. Sterane isomerization parameters are near their equilibrium values indicating that the oil was generated in the middle of the oil window. The hopanes show no homohopane prominence, very low gammacerane, and large peaks in the m/z 191 mass chromatogram around the elution times of the $C_{19}$ and $C_{20}$ tricyclic terpanes that could possibly be diterpanes. This sample also has a high $C_{19}/C_{23}$ tricyclic terpane ratio (4.46) which is usually associated with greater terrestrial influence These are all characteristics that would be expected from an oil with a terrestrially dominated source rock. Tricyclic terpane ratios such as 22/21, 26/25 suggest a clastic source rock (Table A4).

A peak eluting with a similar retention time to 28,30-bisnorhopane is present in the m/z 191 mass chromatogram. Bisnorhopane is associated with oils derived from clay-poor source rocks deposited under anoxic conditions. As discussed later, a similar peak is observed in some of the stained samples from the Mic Mac J-77 and Missisauga H-54 wells which have a component of low maturity higher land plant derived hydrocarbons. This suggests that the peak may not be bisnorhopane but a higher land plant triterpenoid. There are some indications that there could be a possible lower maturity contribution such as the relatively low abundance of rearranged hopanes to unrearranged hopanes for an oil of this maturity derived from a clastic source rock, and the higher than expected abundance of moretanes to hopanes for the level of maturity indicated by other maturity parameters (e.g. %27Ts and %29Ts, %βα, Table A4). However, this is not supported by other ratios that would be expected to show this such as the %31 22S and $C_{29}$ sterane isomerization ratios (Table A4).

The extended tricyclic terpane (ETR) ratio has been suggested as method of distinguishing between Jurassic and Triassic marine sourced oils (Holba et al., 2001). This ratio is much lower for the Primrose oil than any of the Mic Mac area stain samples discussed later and supports a Late Jurassic or younger source for these hydrocarbons. The Primrose oil has a very low $C_{28}/C_{29}$ sterane ratio (Table AX) for one with a Mesozoic marine source rock, supporting a non-marine contribution to the source organic matter.

Aromatic parameters indicate the Primrose oil was generated in the late oil window with methylphenanthrenes, methyldibenzothiophenes and trimethylnaphthalenes suggesting between 0.98 and 1.18% vitrinite reflectance equivalent using the correlations of Radke and co-workers (Radke, 1986; Radke et al., 1994). Aromatic sterane cracking ratios support this level of maturity (Table A5). If plotted on the cross-plots with the Mic Mac area stained samples that are discussed later, it is generally more mature than any of the staining hydrocarbons.

Carbon isotopes of saturate and aromatic fractions of a presumed Primrose N-50 DST-1 oil sample (sample is called N-90 DST 1) were reported by Mukhopadhyay (1991) and found to plot with other Scotian Shelf oils/condensates that he analyzed. Although somewhat lighter than the values reported by Mukopadhyay, the data collected from this study (Table A17) confirms this (Fig. 30).

The Primrose N-50 DST-1 oil shows mostly characteristics that suggest it was generated from a mature terrestrially influenced source rock such as the Tithonian that is the major source of Scotian Shelf oils/condensates. There is no evidence to suggest that it has an older source rock. It is difficult to provide an explanation of the lower API and black oil character of the Primrose N-50 oil. However, the presence of presumed diterpenoids and some biomarker maturity parameters suggest a contribution of less mature hydrocarbons from a second terrestrial source rock is one possible reason.

# 6 Staining in the Erie/Mic Mac/Wyandot Wells

Staining has been reported in the Erie, Mic Mac and Wyandot wells, especially Mic Mac J-77 (Fig. 14). These wells are in area that was modelled as immature for the Tithonian in the PFA (2011, Pl 7-3-2-6). If this is correct then the staining hydrocarbons are from long distance migration or they have a different, presumably older, more mature source. Hence there will be a more detailed discussion on this area.

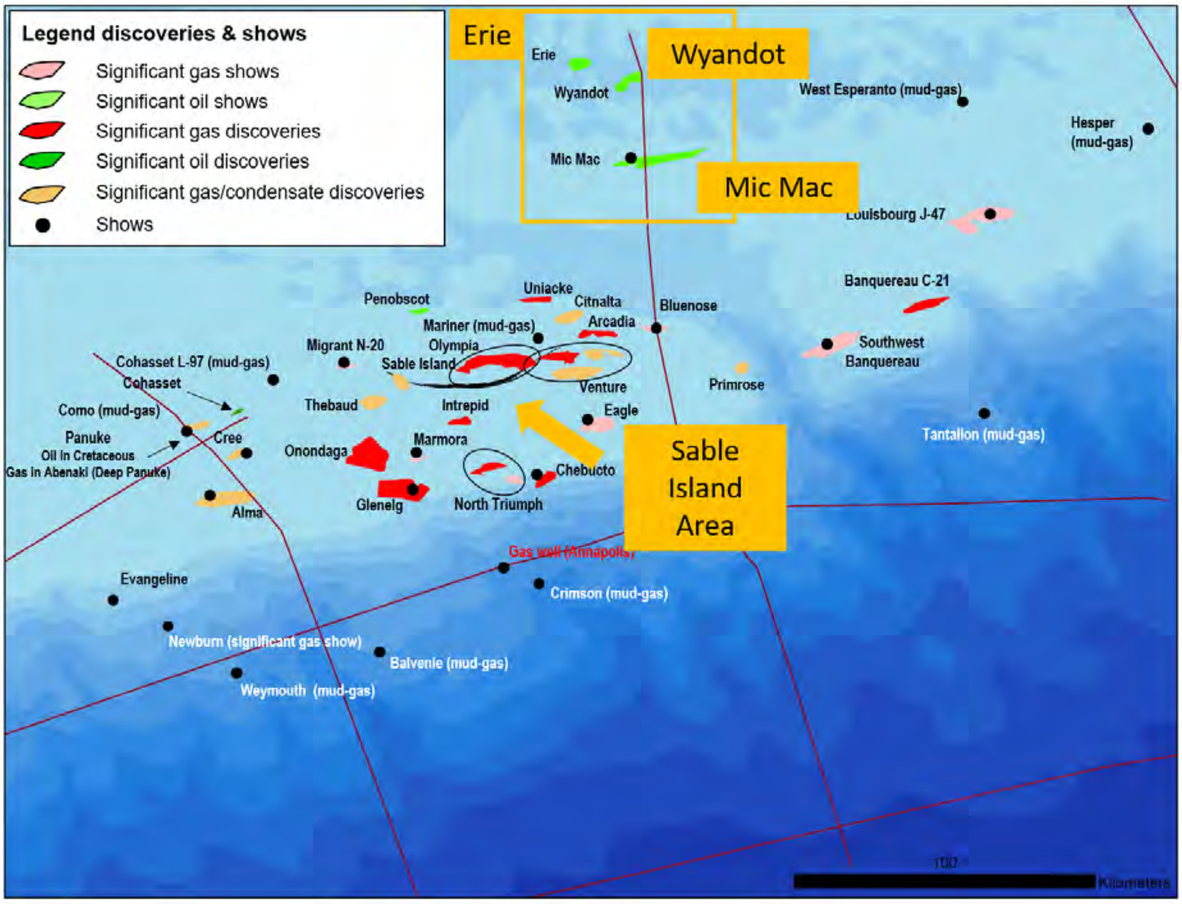

Figure 14. Map showing the location of the Erie-Mic Mac-Wyandot area (in yellow square) relative to the Sable Island area. Figure adapted from Figure 2 of Pl 4-2-1 of PFA (2011).

There is relatively little data on the wells in this area in the BASIN database despite the reported presence of staining in these wells. No tests are listed for any of the wells and there is very little geochemical or maturity data. Details of staining and other source rock information is given for the wells below. Much of the information on the staining in the wells was provided by David Brown (CNSOPB). This is supplemented by other information from the BASIN data base and other cited sources.

**Erie D-26:** Staining was reported over the 1809.9-2258.6 m (5938-7410 ft) interval comprising a lower Missisauga – top Abenaki section. Based on well log descriptions, the sections showing heaviest staining are over the 1845.6 to 1851.7 m (6055-6075 ft) lower Missisauga siltstone and fine-grained sandstone interval that has “uniform staining” and a 2253.1-2255.5 m (7392-7400 ft) upper Abenaki oolitic limestone interval with “good spotted staining”. Two wirelines tests at 1809.9 and 1895.2 m (5938 and 6218 ft) recovered oil-flecked water as well as a small amount of gas in the latter. There is no test or maturity data. The only source rock data is for just four Upper Cretaceous samples.

**Mic Mac D-89:** This well was drilled as a delineation well for Mic Mac J-77 but found staining in the Late Cretaceous Dawson and Logan Canyon formations over the 818.8 -918 m interval (Kendell et al.

2013). There is no test, source rock or maturity data for this well. TOC data was collected with the head-space gas analyses. There are no high TOC values throughout the Jurassic although there are some within the Early Cretaceous Logan Canyon Formation.

**Mic Mac H-86**: Minor oil staining was observed in this well at the top of the Missisauga sandstones (Kendall, 2013). No test or source rock data in Basin data base but there is a large amount of maturity data. The PFA (2011) identifies a Tithonian source rock in this well at around 2800-3000 m with TOC contents of 2-4% and a vitrinite reflectance of about 0.6%. The source of the TOC data is not provided.

**Mic Mac J-77**: Staining was observed over an extensive section in J-77, from 981.5 to 3589 m (981.5-11775 ft). According to Kendell et al. (2013), the main oil pay is two zones at the top of the Early Cretaceous Missisagua Formation at 1984.0-2045.7 m (62 m sand, 2.0 m oil play) and 2054-2095 m (41 m sand, 1.0 m oil play). In detail, good staining was reported at several depths in the upper-middle Logan Canyon Fm., especially the 981.5 to 1466 m (3220-4810 ft) section, and the 1984.2 to 2881.9 m (6510-9455 ft) Missisauga Fm. section. The 3586-3589 m (11765-11775 ft) lower Mic Mac Fm interval was reported to have spotted staining and pyrobitumen. A wireline test at 1985 m (6514 ft) recovered from a 10,000 cc (10 litre) container, 7.6 litres of 37.8°oil and 0.6 $ft^2$ charge gas, as well as 2.1 litres of filtrate and 200 cc of sand. No test, source rock or maturity data is in Basin except for some vitrinite reflectance measurements made by Hacquebard (1973) on shallow coals, with the deepest depth being 2724 m (6883 ft) in the Missisauga middle member which is 0.44% VRo. Assuming that the trend in vitrinite reflectance values is constant, the oil window could be reached in the Mic Mac Formation.

**Wyandot E-53:** Staining was observed sporadically over the 2366.8-2874.3 m (7765-9430 ft) lower Missisauga to top Mohawk interval. The less questionable staining appears restricted to the lower Missisauga (2366.8-2369.8 m) and lower Mic Mac (2785.9 m). No test, source rock or maturity data in BASIN except for some vitrinite reflectance measurements on Cretaceous coals by Hacquebard.

**Missisauga H-54:** staining was reported at the base of the Logan Canyon Formation in this well located to south of the Mic Mac wells.

## *6.1 Mic Mac J-77 oil data*

Prior to the second phase of the study, the only geochemical data available to this study for any of the stained intervals in these wells was from the Mic Mac J-77 oil. Some of this data was provided by Dave Brown (CNSOPB). There is a whole oil gas chromatogram (WOGC) and a GC-MS analysis of ~1 ml preserved oil sample that was provided to him by Alec Bray (Shell). The notes provided on this sample say that it was from Wireline Test #2 (1985.467 m) and was obtained from the top of a 61 m (200 ft) thick fluvial channel at the top of the Early Cretaceous (latest Barremian) Missisauga Formation. The GC-MS data are only m/z 191 and m/217 chromatograms with the former especially not of great quality, possibly because of the very low concentration of biomarkers in this sample. Quantitation on the GC-MS data was provided although certain peaks are missing (notably 17α(H)-norhopane), as well as some gross compositional data. Subsequently, Eric Tegelaar (Shell) was asked if any additional data that could be provided, and he provided some GC-MS-MS chromatograms. There are some significant differences between the GC-MS and GC-MS-MS data, especially for the hopanes that suggests that some caution should be taken with drawing conclusions from this data.

Some information on the J-77 oil has been tabulated below (Table 2).

| | |
|---|---|
| **Sulphur** | 0.45 wt.% (Shell 1970 analysis) versus 0.35 wt. % (Shell 2014 analysis) |
| **Gravity** | 38.7° API @ 15.6°C (Shell 1970 analysis) |
| **Viscosity** | 14.5 cp @ 23.6°C (Shell 1970 analysis) |
| **Asphaltenes** | 0.8 wt. % (Shell 1970 analysis) |

**Table 2** Mic Mac J-77 Wireline Test #2 Oil Gross Characteristics

The sulphur content is that most likely expected from a shale source rock (e.g. Tissot and Welte, 1984, p. 446). It could be somewhat lower because of the maturity of the oil and hence a marl source rock is also a possibility. The gravity is what would be expected based on the sulphur content (e.g. Hunt, 1995, Fig 3.10). Unfortunately, the only isotopic data provided is a $\delta^{13}C$ of -15.9‰ for the aromatic fraction which is clearly anomalous.

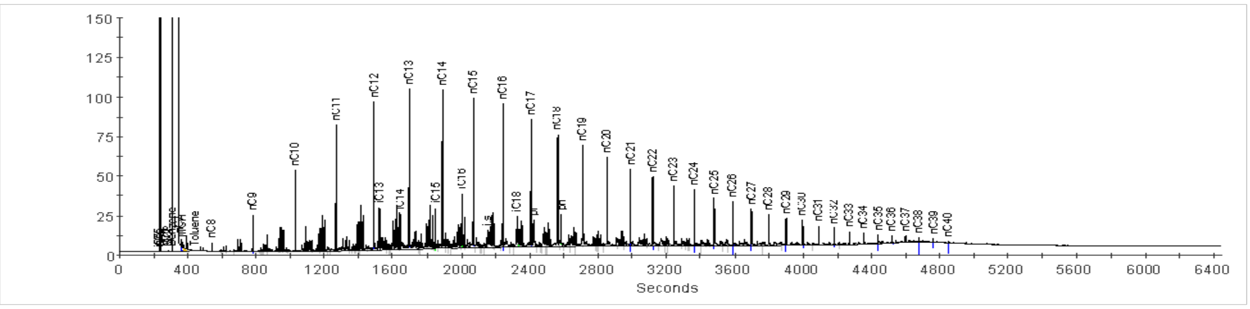

Figure 15. Whole Oil Gas Chromatogram of Mic Mac J-77 Wireline Test #2 oil. No quantification of peaks was provided for this analysis and GC parameters are based on measurement of peak heights.

The WOGC of the Mic Mac J-77 sample (Fig. 15) is dominated by n-alkanes indicating that it is not biodegraded as might be expected at this relatively shallow reservoir depth. Biomarkers including pristane and phytane are in low concentrations (pristane/nC17 = 0.22; phytane/nC18 = 0.28) suggesting this is a mature oil sample. The pristane/phytane ratio is less than one (0.89) suggesting an anoxic depositional environment and is significantly lower than the ratios recorded for most other Scotian Shelf oils that are believed to have a Tithonian source rock. Shell provided a comment that based on the pattern of peaks between the n-alkanes that the WOGC could have been impacted by the use of the Shell 'Saraline' drilling additive. There is no evidence of its use at J-77 based on the well history report and appendices (D. Brown pers comm.). Moreover, based on Shell brochures for Saraline, it does not appear to have been invented until 1993 and hence its use at J-77 seems very unlikely. If there had not been this comment by Shell, the WOGC would not have been suspected to have been impacted by the use of drilling fluids as the distribution of peaks between the n-alkanes looks normal.

The m/z 191 and 217 mass chromatograms provided by Shell are shown in Figures 16 and 17 respectively. The m/z 191 mass chromatogram shows a rise in the base line at higher elution times, suggesting the hopanes and terpanes are in low concentrations in this sample. However, this is not observed for the m/z 217 mass chromatogram which are in similar or lower concentrations to the hopanes based on the quantification supplied by Shell. The m/z 191 mass chromatogram also suggests there is a bias towards later eluting compounds caused by either the operating conditions or the condition of the GC-MS instrument used for the analysis. Several parameters calculated from the data supplied by Shell are provided in Table 3. This data is not optimal as some parameters had to be calculated by measuring peak heights as there were no quantitation provided for the relevant peaks or the GC-MS-MS data had to be used. As discussed below, despite the data shortcomings, there is some consistency with what it implies about the source of the hydrocarbons that suggests the J-77 oil has a different source rock from the majority of the Scotian Shelf hydrocarbons.

Biomarkers show mature distributions suggesting a mid-mature oil. For example, sterane isomerization ratios (e.g. $C_{29}$ S/S+R and $C_{29}$ bb/aa + bb) are close to their equilibrium values. The presence of $C_{30}$ 4-desmethylsteranes suggests a marine source rock. The much higher abundance of $C_{29}$ compared to $C_{27}$ steranes could indicate either a high contribution of higher land material to the source rock or a more restricted depositional environment. It should be noted that the Cap Juby oils from offshore Morocco show a $C_{29}$ sterane predominance. The $C_{28}/C_{29}$ sterane ratio is relatively low (0.54) and falls in the 0.4-0.7 range suggested by Grantham and Wakefield (1988) for Upper Paleozoic to Lower Jurassic oils, although as suggested by Peters et al. (2005) caution should be exercise in using this ratio for age without supporting data. The 24-nordiacholestane ratio (NDR) is low and suggests a source rock older than Cretaceous. The extended tricyclic terpane ratio is low and does not support a Lower Jurassic or older source rock.

Data from Mic Mac J-77 when plotted on different biomarker ratio cross-plots in Peters et al. (2005) tends to be in the area between carbonate and shale sourced oils and associated with those sourced from marls. This also occurs for crossplots of $C_{22}/C_{21}$ versus $C_{24}/C_{23}$ tricyclic terpanes, $C_{26}/C_{25}$ versus $C_{31}R/C_{30}$ hopane and $C_{29}/C_{30}$ hopane versus $C_{35}/C_{34}$ hopane ratios (Peters et al., 2005 Figs 13.76, 13.77 and 13.90 respectively). Short-chain $C_{20}$ and $C_{21}$ steranes (pregnanes) are in relatively high abundance compared to the $C_{27}$-$C_{29}$ regular steranes which is a characteristic usually associated with carbonate source rocks (e.g. Wang et al., 2015).

GC-MS-MS analysis (m/z 414 -> 259 transition) also indicated that $C_{30}$ tetracyclic polyprenoids are present in the J-77 oil in low abundance (TPP ratio very low, Table 3). These compounds have been suggested to be markers for lacustrine source rocks (Holba et al., 2000) but are present in lower concentrations in many marine oils, including for example, Jeanne d'Arc Basin oils.

Mort (2013), in work done for the PFA NS 13-1 project, extracted some samples from Erie E-53, Mic Mac J-77 and Wyandot E-53. However, he provides very little data except for saturate fraction gas chromatograms of Mic Mac J-77 4780 ft (1457 m), 6500 ft (1981 m) and Wyandot 9130-9140 ft

(2782.8-2785.9 m) samples. The Mic Mac 4780 ft gas chromatogram is dominated by lighter hydrocarbons but the 6500 ft and Wyandot E-53 chromatograms show higher amounts of higher molecular weight components and have low pristane/phytane ratios, suggesting their staining hydrocarbons are similar to the J-77 oil. Biomarker peaks can be observed in these chromatograms indicating that GC-MS analysis would be effective in giving biomarker information.

In summary, based on the data provided by Shell, the Mic Mac J-77 oil shows different geochemical characteristics to other Scotian Shelf oils, implying that it has a different source rock. These characteristics suggest that it is a mid-mature oil that has a marly marine source rock. There are some similarities to the offshore Morocco Cap Juby oils (Fowler, 2019) and to some oil stains from the Lower Jurassic (Iroquois and Argo formations) of the southern Grand Banks (APT proprietary data).

| **STERANES** | | | **TERPANES** | |
|---|---|---|---|---|
| | | | | |
| **Parameter** | **Value** | | **Parameter** | **Value** |
| | | | | |
| C29 S/S+R | 0.45 | | 29/30 | 0.62 |
| C29 bb/aa + bb | 0.60 | | M/M+H | 0.17 |
| C27 dia/reg | 0.83 | | 35/34 | 1.13 |
| 27:28:29 | 22:27:50 | | Ts/Ts+Tm | 0.49 |
| 28/29 | 0.54 | | 22/21 | 0.49 |
| NDR | 0.15 | | 24/23 | 0.57 |
| TPP | 0.05 | | 26/25 | 0.94 |
| | | | C31R/C30 | 0.53 |
| | | | C24 tet/C23tri | 0.43 |
| | | | Gammacerane Index | 2.83 |
| | | | Extended Tricyclic Ratio | 0.67 |

Table 3. Biomarker ratios for the Mic Mac J-77 Wireline Test# 2 oil provided by Shell. Parameters were calculated using concentration (?) data provided by Shell that appears to be based on the GC-MS analysis shown in figures 16 and 17 with three exceptions. The ratio of 27:28:29 steranes was made using αββ steranes from a m/z 218 mass chromatogram that was not provided. The 29/30 hopane was calculated using peak height measurements because the concentration data for 17α(H)-norhopane was not included in the data provided by Shell. NDR was calculated by measuring peak heights obtained from the GC-MS-MS data supplied by Shell, using the m/z 358->217 transition chromatogram. TPP ratio calculated using peak heights on m/z 414 -> 259 transition for the TPP a peak and the m/z 358 -> 217 transition for the 27-norcholestanes. Explanation for the ratio annotation given in Table 4.

| **Parameter** | **Explanation** |
|---|---|
| C29 S/S+R | $C_{29}$ 5α(H),14α(H),17α(H) 20S/20R steranes |
| C29 bb/aa + bb | $C_{29}$ 5α(H),14β(H),17β(H)/ 5α(H),14α(H),17α(H)+ 5α(H),14β(H),17β(H) steranes |
| C27 dia/reg | $C_{27}$ 13β(H),17α(H) 20R/5α(H),14α(H),17α(H) 20R steranes |
| 27:28:29 | ratio of $C_{27}$:$C_{28}$:$C_{29}$ 5α(H),14β(H),17β(H) steranes |
| 28/29 | ratio of $C_{28}$ and $C_{29}$ 5α(H),14β(H),17β(H) steranes |
| NDR | 24nor27dβ(S+R)/24nor27dβ(S+R) + 27nor27dβ(S+R) $C_{26}$ steranes |
| 29/30 | $C_{29}$/$C_{30}$ 17α(H) hopanes |
| M/M+H | 17β(H)-moretane/17β(H)-moretane + 17α(H)-hopane |
| 35/34 | $C_{35}$/$C_{34}$ 22S 17α(H)-hopanes |
| Ts/Ts+Tm | 18α(H)/18α(H) + 17α(H)-trisnorhopanes |
| 22/21 | $C_{22}$/$C_{21}$ tricyclic terpanes |
| 24/23 | $C_{24}$/$C_{23}$ tricyclic terpanes |
| 26/25 | $C_{26}$/$C_{25}$ tricyclic terpanes |
| C31R/C30 | $C_{31}$ 22R 17α(H)-homohopane/17α(H)-hopane |
| C24tet/C23tri | $C_{24}$ tetracyclic tetracyclic/$C_{23}$ tricyclic terpane |
| Gammacerane Index | 10 x Gammacerane/(Gammacerane + Hopane) |

Table 4. Explanation of parameters in Table 3.

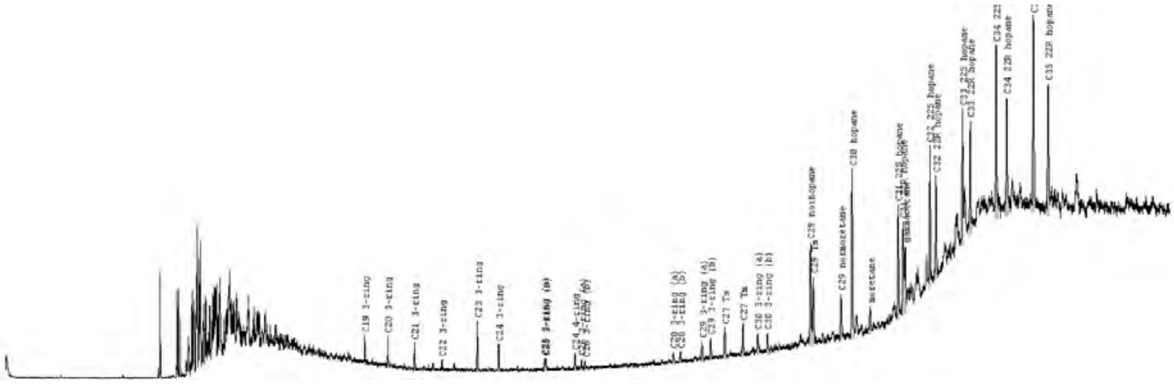

Figure 16. M/z 191 mass chromatogram of Mic Mac J-77 Wireline Test# 2 oil provided by Shell.

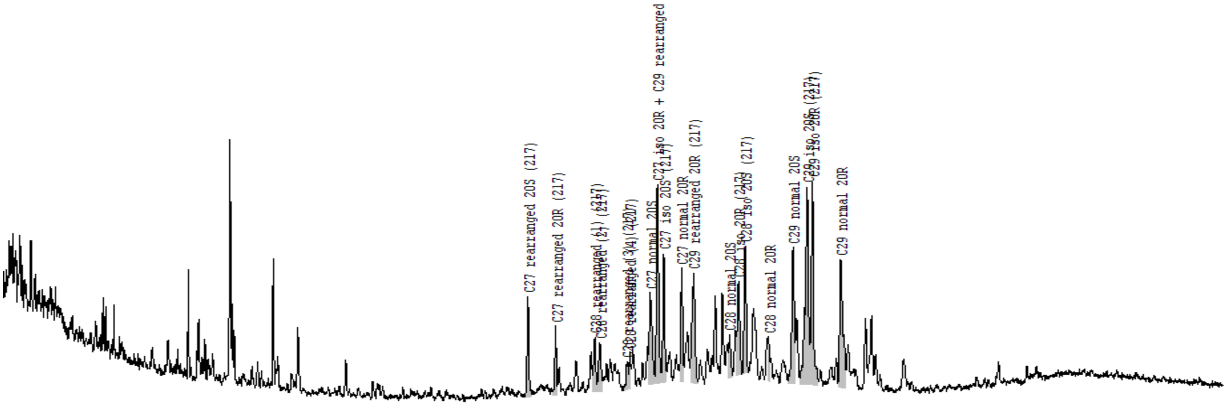

Figure 17. M/z 217 mass chromatogram of Mic Mac J-77 Wireline Test# 2 oil provided by Shell.

## 6.2 *Analysis of Staining in Erie/Mic Mac/Wyandot wells*

It was decided to follow-up on the Shell data from the small oil discovery made at Mic Mac J-77 and investigate if the J-77 oil characteristics were present in the staining described in this and other wells in the area. It was thought that this was the best chance of providing unequivocal evidence for a Lower Jurassic source being present on the Scotian Shelf. There was also an expectation that better quality data than the old analyses provided by Shell would provide more clarity on the type and age of the source rock responsible for the oil stains, as well as the maturity of the hydrocarbons.

Sampling was based on which intervals were reported to show the best evidence of staining. The samples collected and analyzed are listed in Table 5.

Background material and advice that enabled the prioritization of sampling intervals was provided by CNSOPB. As evident in Table 5, only cuttings were available for these intervals except for core #2 from Erie D-26. The samples were analyzed at the APT laboratory where they were extracted and analyzed by gas chromatography and gas chromatography-mass spectrometry (GC-MS), plus carbon isotopic analyses of the saturate and aromatic fractions. All the results of the analyses are provided in the Appendix. Some figures and tables have been extracted for the discussion below to aid in the reading of the report.

| Well | sample type | upper depth (ft) | lower depth (ft) | upper depth (m) | lower depth (m) | Stratigraphic Location | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Erie D-26 | core | 7381.12 | | 2249.77 | | upper Abenaki | |
| Erie D-26 | cuttings | 5940 | 5950 | 1810.51 | 1813.56 | lower Missisauga | |
| Erie D-26 | cuttings | 6060 | 6070 | 1847.09 | 1850.14 | lower Missisauga | |
| Erie D-26 | cuttings | 6220 | 6230 | 1895.86 | 1898.90 | lower Missisauga | |
| Mic Mac D-89 | cuttings | 2950 | 2980 | 899.16 | 908.30 | Logan Canyon | |
| Mic Mac J-77 | cuttings | 3210 | 3240 | 978.41 | 987.55 | top Logan Canyon | |
| Mic Mac J-77 | cuttings | 4245 | 4275 | 1293.88 | 1303.02 | upper Logan Canyon | |
| Mic Mac J-77 | cuttings | 6510 | 6520 | 1984.25 | 1987.30 | middle Logan Canyon | oil sample depth |
| Mic Mac J-77 | cuttings | 6740 | 6750 | 2054.35 | 2057.40 | upper Abenaki | |
| Mic Mac J-77 | cuttings | 11760 | 11770 | 3584.45 | 3587.50 | lower Mic Mac | pyrobitumen reported |
| Missisauga H-54 | cuttings | 7910 | 7920 | 2410.97 | 2414.02 | base of Logan Canyon | |
| Wyandot E-53 | cuttings | 7760 | 7770 | 2365.25 | 2368.30 | lower Missisauga | |
| Wyandot E-53 | cuttings | 9140 | 9150 | 2785.87 | 2788.92 | lower Mic Mac | |

Table 5. Oil stain samples collected and analyzed for this study from the Mic Mac area of the Scotian Shelf. The stratigraphic location of the samples is from Kendell et al (2013) and other information provided by CNSOPB. Note this differs from the most recent lithostratigraphy provided in the BASIN data base from Maclean and Wade (1993).

### 6.2.1 Presence of Migrated Hydrocarbons in samples

Before identifying the source of the staining hydrocarbons, it was first necessary to identify which of the analyzed samples actually contain migrated hydrocarbons.

Screening for the presence of migrated hydrocarbons was based on the following criteria:

- Amount of extractable organic matter (EOM) and its composition such as the percentage of hydrocarbons and the saturate/aromatic ratio.

- Appearance of saturate fraction gas chromatogram (SFGC). Do the SFGCs show obvious indications of contamination or low maturity higher land plant derived hydrocarbons as indicated by an odd carbon number preference for the $C_{25}$-$C_{31}$ n-alkanes?
- Do biomarkers indicate that hydrocarbons are of sufficient maturity to have migrated from a source rock and how do they compare to the maturity of organic matter over the intervals sampled? There is limited maturation data for these wells, just some data obtained on the vitrinite reflectance of coals in the J-77, H-54 and E-53 wells by Hacquebard (1973) that is included in the BASIN data base. This data suggests that any organic matter in the intervals analyzed in these wells are immature with respect to hydrocarbon generation. This is also supported by data from Mic Mac H-86, for which there is much more data than from the wells sampled for staining, from Avery (1986) and Robertson Research International Ltd. (1976). Although the data from these authors deviate from each other at greater depths, over the upper 2000 m Early Cretaceous and younger strata that was sampled for staining, they both indicate organic matter is immature. Hence any mature hydrocarbons present must have migrated from a deeper, more mature source rock.

Table 6 presents a summary of the screening assessment of the hydrocarbons in the analyzed samples. Details on this assessment is provided in the following section.

Table 6 (Below). Summary indicating if samples are stained by migrated hydrocarbons and processes that may have affect the interpretation of the geochemical data. CPI is measure of odd carbon number preference for $C_{24}$-$C_{32}$ n-alkanes (see Table A3). In GC comments, UCM indicates an Unresolved Complex Mixture hump in the SFGC, b/g means sample biodegraded, contam = contaminated.

| Well | Depth (ft) | Extract ppm | CPI | GC comments | GC-MS comments | Migrated Hydrocarbons present |
|---|---|---|---|---|---|---|
| Erie D-26 | 5940-5950 | 723 | 1.36 | poss diesel contam,large UCM | mature, 25-norhopanes | YES, in very low amounts |
| Erie D-26 | 6060-6070 | 2435 | 1.18 | no contam, large UCM | mature, 25-norhopanes | YES |
| Erie D-26 | 6210-6220 | 925 | 1.59 | significant UCM, CPI | mature, 25-norhopanes | YES, in low amounts |
| Erie D-26 | 7381.12 | 14458 | 0.87 | very significant UCM, low n-alkanes, b/g | mature | YES |
| Mic Mac D-89 | 2950-2960 | 878 | 1.94 | significant diesel contam, CPI | mature, poss lignite contam | YES in low amounts, plus in situ and contam HCs |
| Mic Mac J-77 | 3210-3241 | 19058 | 1.65 | very large UCM, b/g | mature, 25-norhopanes | YES |
| Mic Mac J-77 | 4245-4276 | 2789 | 1.09 | large UCM, contam? | mature | YES |
| Mic Mac J-77 | 6510-6520 | 1165 | 1.23 | significant UCM, CPI | mixed maturity biomarkers, 28,30-bisnorhopane | YES, plus in situ HCs |
| Mic Mac J-77 | 6740-6750 | 1033 | 1.08 | no significant UCM | mixed maturity biomarkers, 28,30-bisnorhopane | YES, plus in situ HCs |
| Mic Mac J-77 | 11760-11770 | 560 | 1.11 | no significant UCM, no obvious contam | mature | probably in situ HCs |
| Missisauga H-54 | 7910-7920 | 299 | 1.34 | significant UCM, CPI | mixed maturity biomarkers, 28,30-bisnorhopane | YES in minor amounts, plus in situ HCs |
| Wyandot E-53 | 7760-7770 | 757 | 1.57 | poss diesel contam,CPI | mixed maturity biomarkers | Mostly in situ HCs |
| Wyandot E-53 | 9140-9150 | 1662 | 1.00 | no significant UCM, minor diesel contam | mature | YES |

## Erie D-26

Four samples were collected from Erie D-26. Three were cuttings samples (5940, 6060 and 6210 ft) from the lower part of the Missisauga Formation and one was a core sample taken at 7381.12 ft from the upper part of the Abenaki Formation (Fig. 19).

The 5940-5950 ft sample gave a low amount of EOM of which only 4.2% were hydrocarbons with a high saturate/aromatic ratio (5.83). The SFGC shows n-alkanes and other compounds superimposed upon a large unresolved complex mixture (UCM) hump which is especially pronounced over the $C_{25}$-$C_{33}$ n-alkane range corresponding to where biomarkers would elute (Fig. 18a). This SFGC suggests that the hydrocarbons are a mixture of biodegraded and unbiodegraded hydrocarbons. The m/z 177 mass chromatogram shows the presence of 25-norhopanes indicating that the level of biodegradation has been severe enough to effect biomarker distributions. It should be noted that the peak at the elution time of oleanane in the m/z 191 mass chromatogram is not this compound but the $C_{30}$ 22S 17α(H)-25-norhopane derived from the 22S $C_{31}$ 17α(H)-homohopane through microbial alteration that has a similar retention time. Both saturate and aromatic biomarkers indicate that the hydrocarbons were generated in the oil window and hence could represent migrated hydrocarbons.

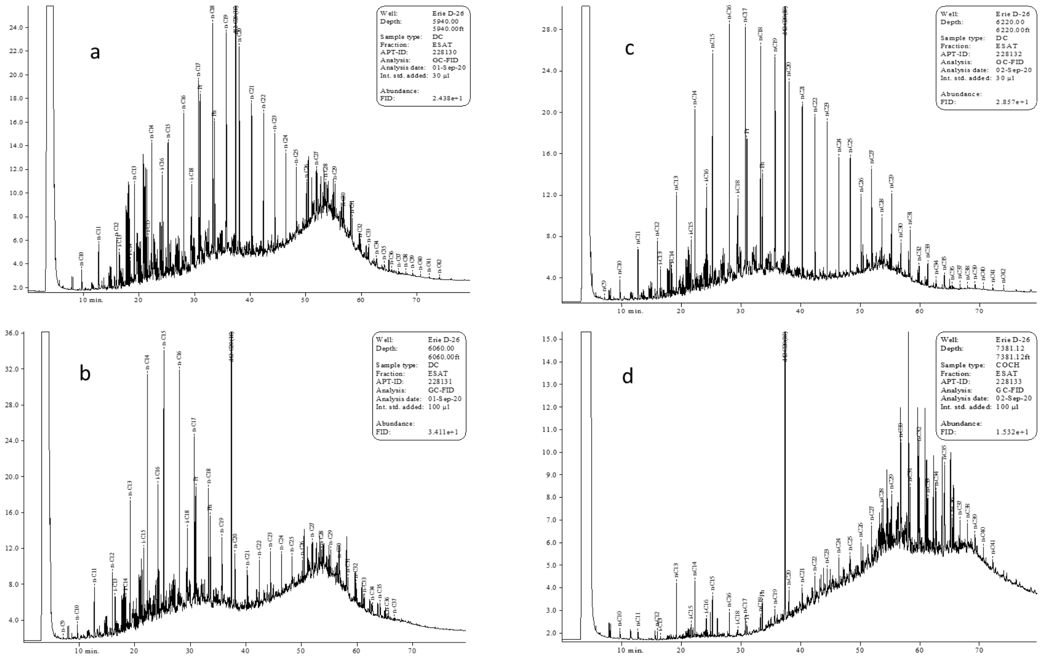

Figure 18. SFGCs of Erie D-26 samples; a) 5940-5950 ft, b) 6060-6070 ft, c) 6220-6230 ft and d) 7318.12 ft.

The 6060-6070 ft sample gave a much higher amount of EOM (2435 ppm) than the 5940-5950 ft sample, with a greater proportion of hydrocarbons (37.6%) and a lower saturate/aromatic ratio (2.62). The SFGC is dominated by a bimodal UCM hump with n-alkanes superimposed, especially $C_{14}$-$C_{18}$ (Fig 18b). This sample also appears to be a mixture of biodegraded and unbiodegraded hydrocarbons. Both saturate and aromatic biomarker maturity parameters indicate the hydrocarbons were generated in the oil window. The sample shows similarities in its biomarker distributions to that from 5940-5950 ft sample including the presence of 25-norhopanes.

The 6210-6220 ft sample gave a low amount of EOM (925 ppm) with a similar proportion of hydrocarbons and saturate/aromatic ratio to the 6060-6070 ft sample. The SFGC shows n-alkanes superimposed on a significant UCM hump (Fig. 18c). The UCM hump is smaller than for the shallower samples suggesting this sample is less biodegraded, which reflects its greater depth. There is a predominance of odd over even $C_{25}$-$C_{33}$ n-alkanes indicating a contribution of low maturity terrestrial organic matter. Biomarker characteristics indicate a proportion of the hydrocarbons were generated in the oil window. However, some biomarker maturity parameters suggest a lower maturity than the 6060 ft sample (e.g. $C_{29}$ sterane isomerization ratios, $C_{31}$ 22S/22R ratio). This could reflect the contribution of hydrocarbons derived from low maturity terrestrial organic matter to the more mature hydrocarbons that have migrated from deeper intervals.

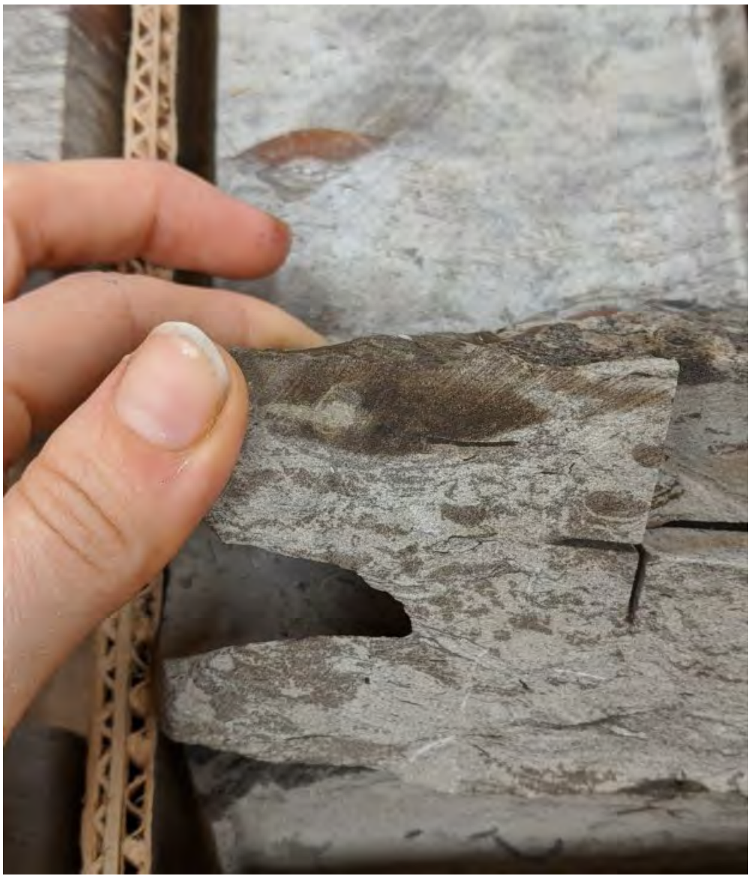

Figure 19. Erie D-26 Core #2, showing where sample was taken at 7381.12 ft (2449.77 m).

The Abenaki Formation core sample from 7381.12 ft (Fig. 19) shows different characteristics to the Erie D-26 Missisauga cuttings samples. It gave a very high amount of EOM (14458 ppm) indicating that this interval is heavily stained. The lack of major peaks or a UCM hump in the earlier eluting part of the SFGC suggests there has been loss of the more volatile hydrocarbons, possibly during storage (Fig. 18d). If this interval had been analyzed sooner after drilling, it would have given a substantially greater amount of EOM. The SFGC is dominated by a UCM hump over the $C_{27}$-$C_{40}$ n-alkane elution time which could indicate that this sample is also biodegraded. The presence of $C_{13}$-$C_{16}$ n-alkanes showing a small secondary maximum are probably later minor contamination. The level of biodegradation is less than for the Missisauga samples as the m/z 177 mass chromatogram indicates that 25-norhopanes are essentially absent and there is no $C_{30}$ 25-norhopane peak with the elution time of oleanane in the m/z 191 mass chromatogram. Biomarker ratios such as sterane isomerization ratios (e.g. %20S, %bb, Table A4) suggest hydrocarbons were generated in the middle oil window and hence have migrated into this interval. Aromatic sterane cracking parameters suggest a lower maturity for 7381.12 ft sample than the Missisauga Formation samples (Table A5). This is not related to biodegradation as both the triaromatic and monoaromatic cracking ratios show this and while the $C_{20}$ and $C_{21}$ triaromatic steranes are more biodegradable than their $C_{26}$-$C_{28}$ homologues, the reverse is true for the $C_{21}$ and $C_{22}$ monoaromatic steranes compared to their $C_{27}$-$C_{29}$ homologues. It is most likely increased evaporation of the lighter short-chain aromatics relative to their higher molecular weight homologues is the cause of this apparent low maturity. This may be because it is a core sample whose storage made it more amenable to loss of more volatile hydrocarbons during the 50 years of storage.

All the Erie D-26 samples show evidence for the presence of migrated hydrocarbons. The evidence is much more conclusive for the 6060-6070 and 7381.12 ft samples which gave higher amounts of EOM than the other two samples. Based on the low amount of extractable hydrocarbons in the 5940-5950 ft sample, this sample has very minor staining, some of which in the $C_{14}$-$C_{16}$ n-alkane elution range may be diesel. The 6210-6220 ft sample also has a low amount of EOM of which a proportion is derived from low maturity higher land material that is likely organic matter deposited with or close to the where the sample originates ("in situ" hydrocarbons). The Missisauga Formation samples have been biodegraded severe enough that biomarker distributions have been affected, and hence are above level 5 on the Peters and Moldowan (1993) scale. They also contain some unbiodegraded hydrocarbons indicating that there may have been multiple hydrocarbon charges into these intervals. Using the abundance of the $C_{30}$ 25-norhopane (Table A4), that elutes at the same time as oleanane in the m/z 191 mass chromatogram, relative to that of 17α(H)-hopane indicates not unexpectedly there is an increase in biodegradation with depth at Erie D-26 with the 5940 ft sample being the most degraded, the 6060 and 6210 ft showing lower levels of degradation and the 7381.12 ft showing no evidence of 25-norhopanes.

Later discussion on the origin of migrated hydrocarbons in these samples will concentrate on the lower Missisauga 6060 ft and upper Abernaki 7381.12 ft samples that show the greatest amount of staining and are less affected by contributions from contaminants or hydrocarbons associated with in situ organic matter. All the lower Missisauga samples show strong similarities indicating that they received the same migrated hydrocarbon charge.

## Mic Mac D-89

One sample was collected from Mic Mac D-89. This was a Logan Canyon sample from 2950-2960 ft. which gave a relatively low amount of extract (878 ppm). The SFGC shows a small UCM hump over the $C_{13}$-$C_{18}$ n-alkane elution time that has many peaks superimposed on it whose distribution suggests the sample is contaminated with drilling additives (Fig. 20). The $C_{25}$-$C_{33}$ n-alkanes are in low abundance but show a strong odd carbon predominance (CPI of 1.94) indicating a contribution from low maturity higher land plant derived alkanes. This is supported by the m/z 191 mass chromatogram showing several compounds eluting near the $C_{19}$ tricyclic terpane that could be diterpenoids, $C_{31}$ 22S and 22R hopanes having a lower isomerization ratio than their $C_{32}$-$C_{35}$ homologues (Table A4), as well as there being a peak that elutes just before the $C_{33}$ 22S ab homohopane that has an elution time similar to the $C_{31}$ bb hopane. This all supports a low maturity higher plant contribution which could be in situ organic matter but also may indicate a low amount of contamination from the lignosulphonate drilling mud used in this well. Other biomarker maturity ratios suggest that a significant proportion of the hydrocarbons were generated in the oil window and hence could have migrated into this interval. Despite the shallow depth, hydrocarbons in this sample are not significantly biodegraded.

In summary, this sample contains a small amount of hydrocarbons that have migrated from a deeper source rock, but there are also some derived from contamination and in situ organic matter.

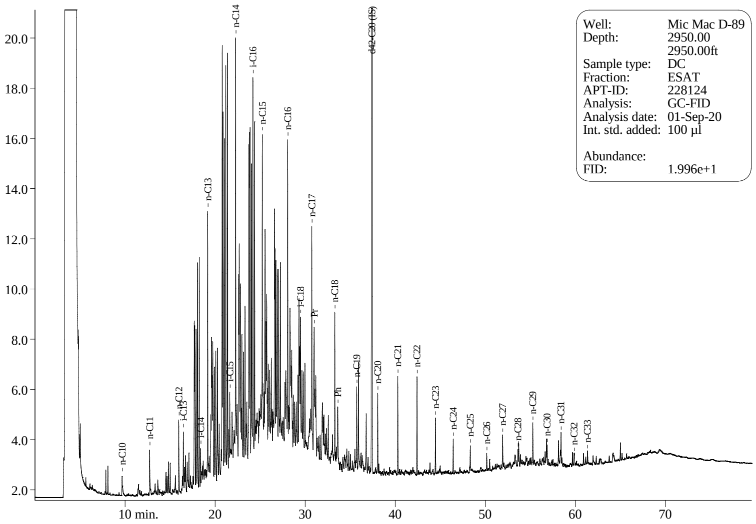

Figure 20. SFGC of Mic Mac D-89 2960-2980 ft sample.

## Mic Mac J-77

Five samples from the Logan Canyon, Abenaki and Mic Mac formations at Mic Mac J-77 were analyzed. Based on Hacquebard (1973) vitrinite reflectance data in the BASIN data base, organic matter in the Logan Canyon and Abenaki formations is immature with respect to hydrocarbon generation.

The sample from 3210-3241 ft from the top of the Logan Canyon Formation gave the highest amount of EOM (19058 ppm) of the samples analyzed for this project. The SFGC is dominated by a very large UCM hump with some peaks superimposed on it (Fig. 21a). These include n-alkanes in low abundance and biomarkers. There is possible evidence for minor OBM contamination in the $C_{14}$-$C_{16}$ n-alkane range. This sample appears to be heavily biodegraded which is not surprising considering its shallow depth. Biomarkers show mature distributions. The presence of 25-norhopanes indicate that there has been some biodegradation of the biomarkers.

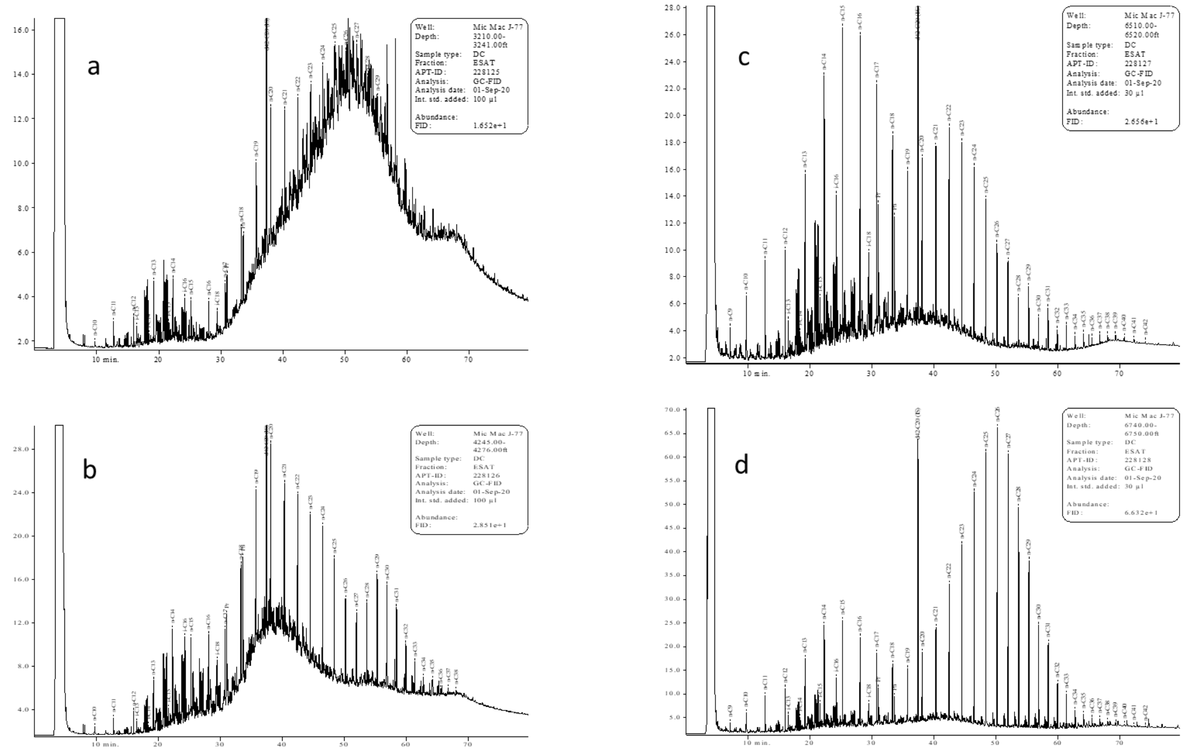

Figure 21. SFGCs of Mic Mac J-77 samples; a) 3210-3240 ft, b) 4245-4275 ft, c) 6510-6520 ft and d) 6740-6750 ft. The SFGC of the 11760-11770 ft sample is not shown but can be found in the Appendix.

The 4245-4275 ft sample from the upper Logan Canyon Formation gave a relatively high amount of EOM (2789 ppm). The SFGC has a very large UCM hump with large n-alkane peaks superimposed, implying a mixture of biodegraded and unbiodegraded hydrocarbons (Fig. 21b). The distribution of peaks in the $C_{14}$-$C_{16}$ n-alkane elution range suggests possible minor OBM contamination. Biomarkers show mature distributions indicating that they have migrated from a more mature source rock. 25-Norhopanes are absent or in very low concentrations in this sample indicating that it is not as severely biodegraded as the sample from 3210-3241 ft.

The 6510-6520 ft middle Logan Canyon Formation sample was obtained at the same depth interval as the Shell oil sample. It gave less EOM (1165 ppm) than the two shallower J-77 Logan Canyon samples. The SFGC shows a smaller UCM than these samples with a bimodal distribution of n-alkanes superimposed with maxima at $C_{15}$ and $C_{22}$ (Fig. 21c). There is a low abundance of $C_{27}$-$C_{33}$ n-alkanes with an odd carbon number preference indicating a contribution of hydrocarbons derived from low maturity higher land plant derived organic matter. Biomarkers show a mixture of low maturity and high maturity characteristics. $C_{29}$ sterane isomerization parameters, especially the %20S are low while the %20S for the $C_{27}$ steranes have a value indicating higher maturity (Table A4). This would be expected from a contribution of low maturity terrestrially dominated hydrocarbons which would supply higher amounts of $C_{29}$ steranes dominated by the biologically inherited 5α(H),14α(H),17α(H) 20R isomers relative to $C_{27}$ and $C_{28}$ steranes. In contrast, there are high amounts of tricyclic terpanes and short-chain steranes relative to regular steranes that suggest higher maturity. Aromatic parameters also indicate a maturity sufficient to indicate that some hydrocarbons have migrated into the sampled interval. As discussed later, an unusual feature of this sample is the presence of a peak with a similar elution time to 28,30-bisnorhopane (Table A4), a compound that is thought to be associated with anoxia (e.g. Peters et al., 2005). This peak may be another compound associated with the low maturity contribution.

The 6740-6770 ft sample was from the upper Abenaki Formation. Slightly less EOM was obtained from this sample (1033 ppm) than that from 6510-6540 ft. It also shows a bimodal distribution of n-alkanes in its SFGC but with the principle maxima at $nC_{26}$ and a much lower secondary maximum at $nC_{15}$ (Fig. 21d). There is not a significant UCM hump, suggesting that biodegradation has not occurred. The $C_{25}$-$C_{35}$ n-alkanes do not show an odd over even carbon number predominance. This sample has some similarities in its biomarker distributions to the 6510-6520 ft sample in showing a mixture of low and higher maturity characteristics, as well as the presence of a peak with a similar elution time to 28,30-bisnorhopane (Table A4).

The 11760-11770 ft sample from the lower part of the Mic Mac Formation gave much the lowest amount of extract of the Mic Mac J-77 samples (Table 6). The SFGC is dominated by n-alkanes showing a maximum at $C_{23}$, possibly because of evaporation of lighter compounds. The sample does not look biodegraded, as might be expected based on its much greater depth than the other J-77 samples. It shows mature saturated and aromatic biomarker distributions that suggest the possibility of migrated hydrocarbons. However, based on the trend in the vitrinite reflectance data of Hacqubard (1973) in the BASIN data base, the small amount of hydrocarbons in this sample need not be migrated but could have been generated from in situ organic matter close to where this sample was taken.

Of the Mic Mac J-77 samples, the Abenaki Formation samples from 3210-3241 and 4245-4275 ft show the best evidence for staining based on the amount of EOM and their mature biomarker distributions. They contain a mixture of biodegraded and unbiodegraded hydrocarbons with those in the 3210-3241 ft sample more microbially altered. Although from a similar depth to the Shell J-77 oil sample, the 6510-6520 ft sample gave a lower amount of EOM than the shallower samples with a mixture of partially biodegraded migrated and low maturity, terrestrially derived, hydrocarbons from nearby in situ organic matter. The latter may represent bitumen associated with organic matter in this part of the section. The 6740-6770 ft Abenaki Formation sample is similar to the 6510-6520 ft sample. Only a low amount of EOM was obtained from the 11760-11770 ft sample that may represent bitumen generated in place. However, a migrated component cannot be ruled out.

### Missisauga H-54

Just one sample from the base of the Logan Canyon at 7910-7920 ft was analyzed from Missisauga H-54. This gave the lowest amount of EOM (299 ppm) of all the samples analyzed in this study. The SFGC shows a moderate UCM hump under the $C_{17}$-$C_{22}$ n-alkanes which are also those in highest abundance (Fig. 22). There is an odd carbon number predominance of the $C_{27}$-$C_{35}$ n-alkanes. Saturated biomarkers show a mixture of low maturity and high maturity characteristics. Sterane isomerization ratios, %22S $C_{32}$ homohopane ratio, high abundance of βα hopanes (Table X) and presence of ββ hopanes suggest immature organic matter in agreement with what would be expected from vitrinite reflectance data from this well (Hacquebard, 1973). The high abundance of tricyclic terpanes, rearranged and short-chain steranes suggests there could be a contribution of more mature hydrocarbons. In common with the Mic Mac J-77 6510 and 6740 ft samples, a peak with the retention time of 28,30-bisnorhopane is in relatively high abundance in this sample.

In summary, only a small amount of EOM was obtained from this Missisauga H-54 sample that contains predominantly lower maturity hydrocarbons with a probable small contribution from a mature source. This sample will not be discussed further in detail.

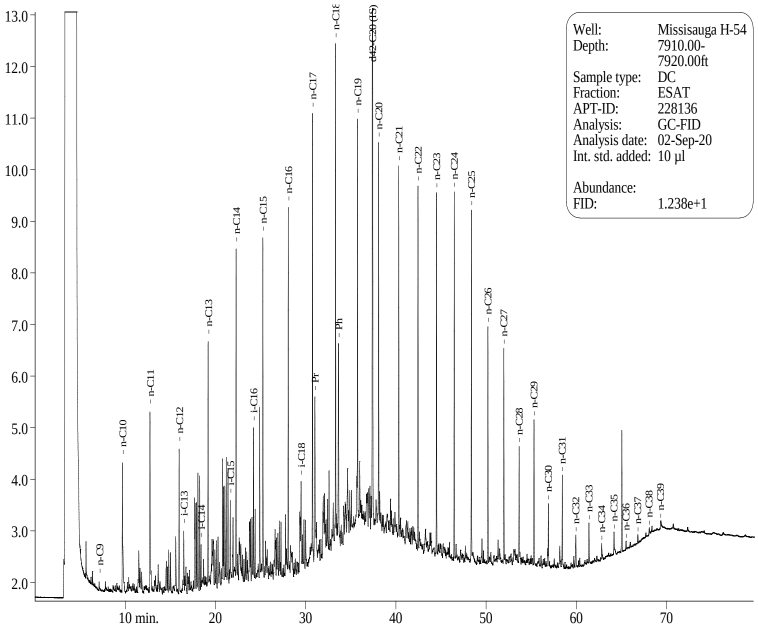

Figure 22. SFGC of Missisauga H-54 7910-7920 ft sample.

## Wyandot E-53

Two samples were analyzed from Wyandot E-53, one from the lower Missisauga Formation over the 7760-7770 ft interval and one from the lower Mic Mac Formation at 9140-9150 ft.

The 9140 ft sample gave over twice the amount of EOM as the Missisauga sample (Table 6) and had a SFGC with a smooth n-alkane distribution, no odd or even carbon number preference and a lack of lighter compounds that is almost certainly because of evaporation (Fig. 22b). Saturate and aromatic biomarkers indicate mature hydrocarbons. The SFGC 7760-7770 ft sample shows a greater amount of lighter alkanes in its SFGC which look like they could be from diesel or some other type of drilling contamination. These are also present in the 9140-9150 ft sample in much lower abundance. The later eluting part of the 7760-7770 ft SFGC suggests a low maturity hydrocarbon contribution with a small UCM hump under the $C_{27}$-$C_{31}$ n-alkanes corresponding to where biomarkers would be expected to elute, and an odd carbon number preference for the $C_{25}$-$C_{33}$ n-alkanes (Fig. 22a). Saturate and aromatic maturity parameters suggest hydrocarbons in this sample are significantly lower maturity than the 9140 ft sample (e.g. %27Ts, %29Ts, %20S, ba/ab+ba hopanes, aromatic cracking ratios, Tables A4). Extrapolating the vitrinite reflectance data of Hacquebard (1973) suggests that organic matter at this depth is most likely immature suggesting that there could be some migrated hydrocarbons contributing to the EOM of this sample. However, based on the low amount of EOM and the presence of lower maturity hydrocarbons and contamination, these are present in minor amounts.

Based on the preceding, it is thought that staining by more mature hydrocarbons has occurred at 9140-9150 ft. The hydrocarbons in the 7760-7770 ft sample are mostly contamination or from in situ organic matter with a possible minor migrated component. This latter sample will not be discussed further in any detail.

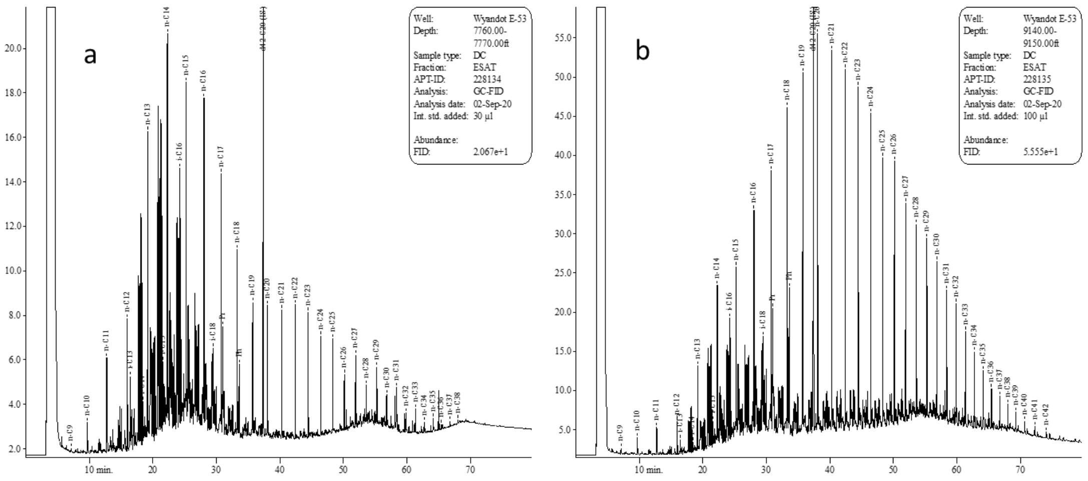

Figure 23. SFGCs of Wyandot E-53 samples; a) 7760-7770 ft, b) 9140-9150 ft.

## 6.3 *Discussion Of Results From Analysis Of Stains*

### 6.3.1 Maturity of Migrated Stain Hydrocarbons

The relative maturity of the samples is hard to determine with any accuracy because of the factors affecting the biomarker distributions that have previously been discussed. No cross-plot of maturity parameters shows a simple trend of increasing maturity between the samples and there are variations between different cross-plots depending how susceptible the compounds are to different processes.

An example is the commonly used cross-plot of $C_{29}$ sterane isomerization parameters, %20S versus %bb steranes (Fig. 24). This shows two groupings of samples. One group towards the top right hand side of the plot includes most of the samples. These show values for the maturity parameters that indicate that they were generated in the oil window. There are also three samples that have values that suggest they are immature. These are samples from Mic Mac J-77 6510-6520 ft and 6740-6750 ft, and Missisauga H-54 7910-7920 ft which show indications in their SFGCs of a contribution of hydrocarbons from lower maturity organic matter, probably close to where the sample was taken. These are also the three samples that show the possible presence of bisnorhopane suggesting that whatever this compound is, it is not associated with the migrated mature hydrocarbons. Two other samples that are suggested by their SFGCs to contain a contribution of lower maturity higher land plant hydrocarbons as well as significant contamination, Mic Mac D-89 2950-2960 ft and Wyandot E-53 7760-7770 ft, plot as the least mature of the other samples. There is no obvious effect of biodegradation on this cross-plot. Hence it confirms that most of the samples except those with the contribution of lower maturity organic matter and Mic Mac J-77 11760-11770 (because of its greater depth) contain mature hydrocarbons that likely migrated from deeper intervals.

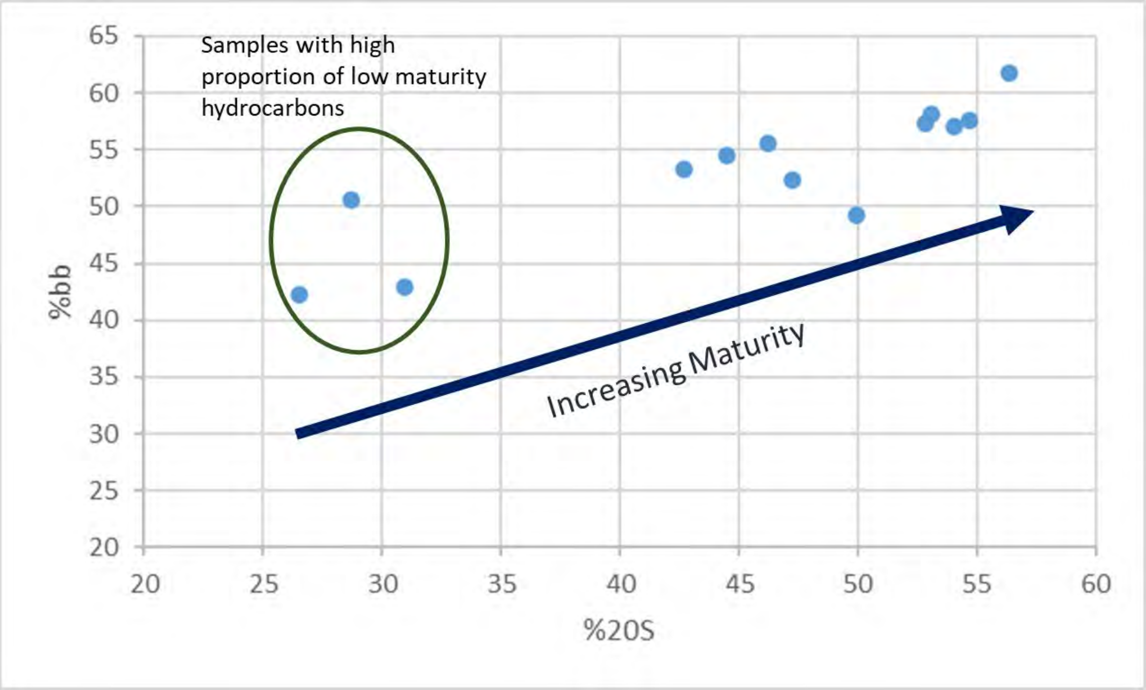

Figure 24. A cross-plot of sterane isomerization parameters, %20S (5α(H),14α(H),17α(H) 20S/(20S+20R) steranes) versus %bb (5α(H),14β(H),17β(H)/ 5α(H),14β(H),17β(H) + 5α(H),14α(H),17α(H) steranes) for Scotian Shelf stain samples. Values from Table A4 in Appendix. Ratios should increase with increasing maturity. The three points within the green oval are the Mic Mac J-77 6510-6520 ft and 6740-6750 ft, and Missisauga H-54 7910-7920 ft samples which are believed to have the greatest proportion of low maturity hydrocarbons.

A cross-plot of %27Ts versus %27dbS (i.e. ratios of rearranged hopanes and steranes versus unrearranged hopanes and steranes) does not show a clear maturity trend (Fig. 25). This is because these ratios are affected by lithology (clastic versus carbonate) as well as maturity. As for the sterane isomerization cross-plot, it separates out those samples with a significant contribution of lower maturity hydrocarbons derived from organic matter close to the sample location (Fig. 25). The remaining samples do not show an obvious maturity trend because samples that show more carbonate features have lower amounts of rearranged steranes. These are the Erie D-26 7381.12 ft, Mic Mac J-774245-4276 ft and Mic Mac D-89 2950-2960 ft samples (Fig. 25).

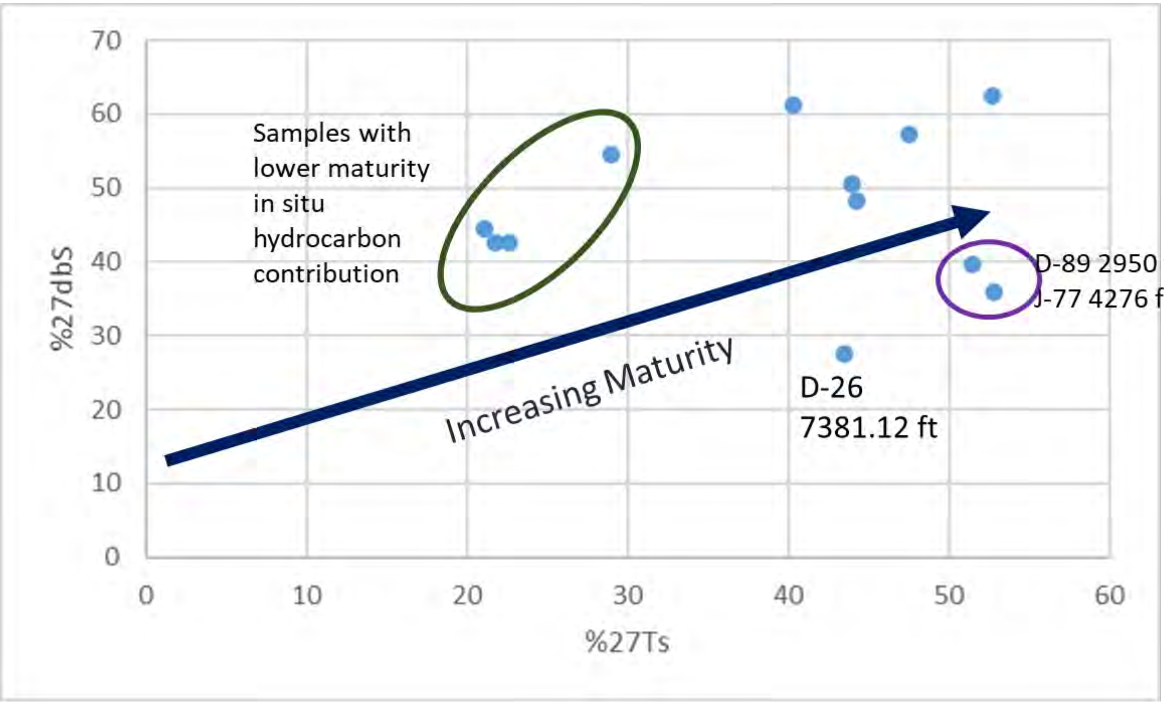

Figure 25. A cross-plot of %27Ts (Ts/(Ts+Tm) *100) versus %27dbS (27dβS/(27dβS+27αα(R+S))*100) for Scotian Shelf stain samples except Mic Mac J-77 11760-11770 ft. Values taken from Table A4. Samples with a contribution of lower maturity hydrocarbons within the green oval are those from Mic Mac J-77 6510-6520 ft and 6740-6750 ft, Missisauga H-54 7910-7920 ft and Wyandot E-53 7760-7770 ft.

Cross-plots of aromatic maturity parameters also do not show simple maturity trends. This is illustrated by cross-plot of the triaromatic versus monoaromatic sterane cracking ratios (Table A5 Crack 2 versus MSArom1) in Figure 26. The samples with a contribution of low maturity hydrocarbons tend to plot as lower maturity, especially for the monoaromatic sterane parameter. Most samples that contain 25-norhopanes do not show low cracking ratios for triaromatic relative to monoaromatic steranes which might be expected if the more biodegradable triaromatic steranes had been affected. The apparent low maturity of the Erie D-26 7381.12 ft core sample is probably because of the evaporation of the lower molecular weight short-chain aromatic steranes. The most mature sample on this plot is the J-77 11760-11770 ft sample which is most likely in situ hydrocarbons. The next two most mature samples are the other samples besides Erie D-26 7381.12 ft that show carbonate characteristics (Mic Mac J-77 4245-4276 ft and Mic Mac D-89 2950-2960 ft).

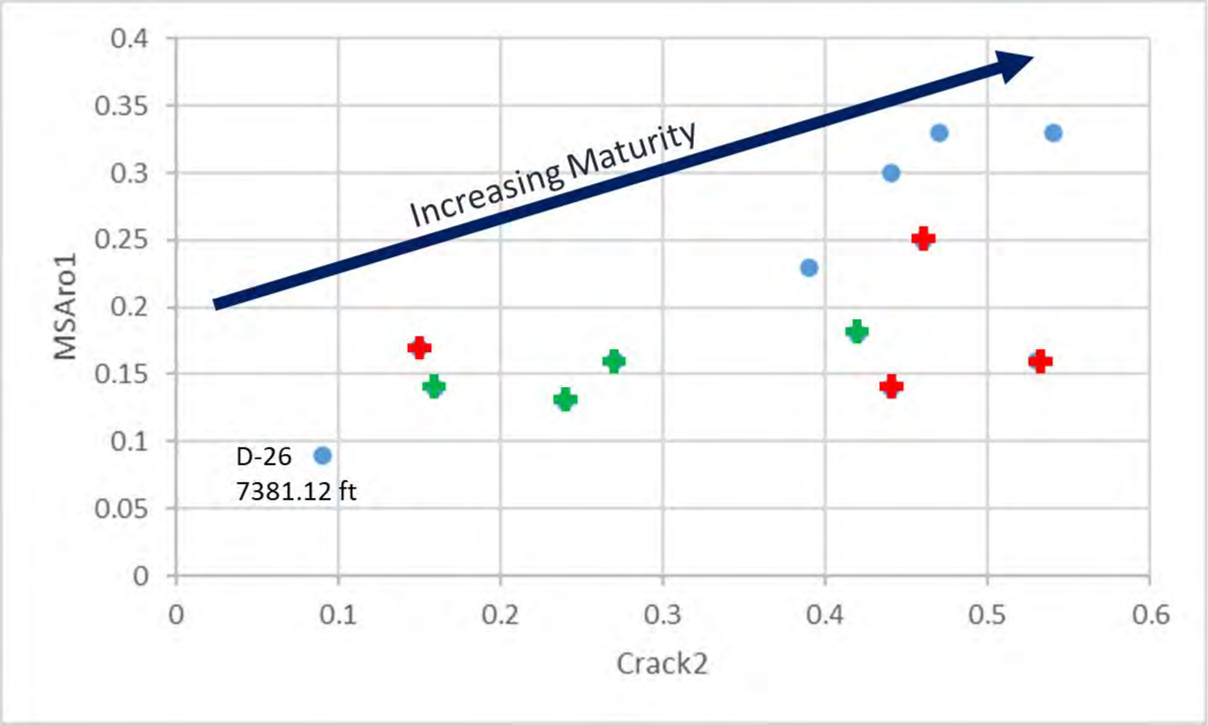

Figure 26. Cross plot of triaromatic cracking ratio (Crack2) versus monoaromatic cracking ratio (MSAro1). Data from Table A5. Points indicated by green crosses are those with a contribution of low maturity hydrocarbons (Mic Mac J-77 6510-6520 ft and 6740-6750 ft, Missisauga H-54 7910-7920 ft and Wyandot E-53 7760-7770 ft) and those by red crosses contain 25-norhopanes indicating they are severely biodegraded.

It was hoped that the plot of the sterane aromatization parameter (AROM in Table AX, triaromatic/monoaromatic +triaromatic steranes) versus the monoaromatic sterane cracking ratio would not be affected by biodegradation. However, most of the samples with 25-norhopanes plot as lower maturity with the samples containing low maturity organic matter in figure 27. The cross-plot shows that Erie D-26 7381.12 ft is one of the more mature samples as indicated by the AROM2 parameter. This agrees with the sterane isomerization parameters in figure 24. As previously mentioned, it has a low monoaromatic cracking ratio because of the preferential loss of the $C_{21}$ and $C_{22}$ compounds to evaporation. Samples with more carbonate features (Erie D-26 7381.12, Mic Mac J-77 4245-4276 and Mic Mac D-89 2950-2960 ft) are not consistently more mature using AROM 2 than those with more clastic features (e.g. Mic Mac J-77 3210-3241, Erie D-26 6060-6070 and Wyandot E-53 9140-9150 ft).

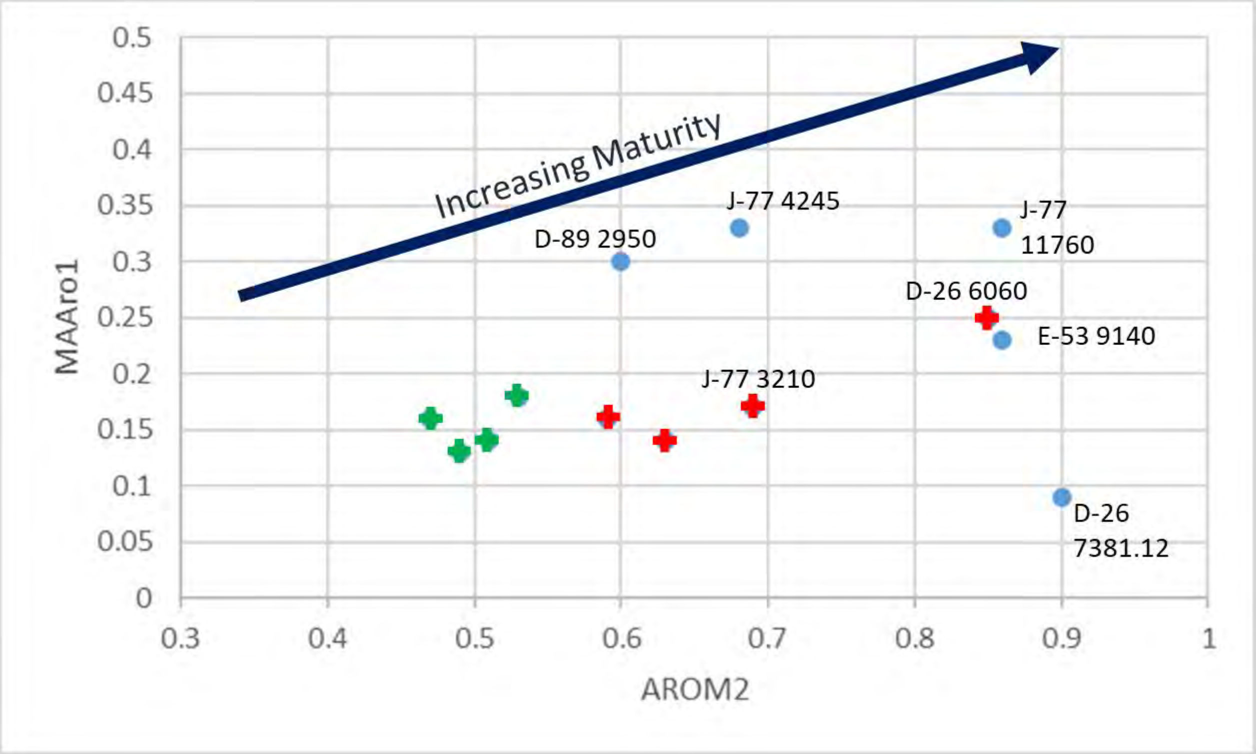

Figure 27. Cross plot of steroid aromatization cracking ratio (AROM 2) versus monoaromatic cracking ratio (MSAro1). Data from Table A5. Points indicated by green crosses are those with a contribution of low maturity hydrocarbons (Mic Mac J-77 6510-6520 ft and 6740-6750 ft, Missisauga H-54 7910-7920 ft and Wyandot E-53 7760-7770 ft) and those by red crosses contain 25-norhopanes indicating they are severely biodegraded.

Cross-plots of ratios of mid-range aromatic compounds such as methylphenanthrenes (e.g. MPI-1) and trimethylnaphthalenes (TNR-2) do not show much correlation with maturity, as they may be more affected by biodegradation, addition of low maturity terrestrial derived hydrocarbons, evaporation loss and other processes.

Overall, the data suggests that the heavier component of the staining hydrocarbons has a similar maturity for the all the samples. Looking at the two samples with the greatest amount of EOM from Mic Mac J-77, several ratios suggest that the 4245-4276 ft is more mature than the 3210-3241 ft sample. This may be significant as other evidence (discussed later) suggests they have different source rocks. This is more difficult for the 6060-6070 ft and 7381.12 ft. samples from Erie D-26 because of biodegradation and evaporation effects ratios. Parameters that are considered more reliable (e.g. %20S, %bb, %27Ts, AROM2) suggest they have similar maturity.

There may be more variation in maturity than indicated by the biomarkers within the lighter hydrocarbons but as these have been affected by various processes, there is no way of knowing. For example, it is not possible to say if the later pulse of hydrocarbons evident in some samples has a higher maturity than the original pulse. The latter will probably define the biomarker distributions because its biomarkers will have been concentrated by the effects of biodegradation. In fresher sediment samples, the impact of a different maturity second pulse would be shown by the mid-range aromatic compounds or in an oil by gasoline range parameters.

Maturity parameters based on biomarkers suggest that the staining hydrocarbons were generated from intervals substantially deeper than those from which they were extracted. It is difficult to give an approximate vitrinite reflectance equivalent for the hydrocarbons as different results are obtained from different parameters because of non-maturity effects. However, it is reasonable to assume based on the more reliable ratios and that these hydrocarbons have been generated and expelled, that their source rocks were at least in the middle oil window, i.e. at least 0.85% VRo. The lack of maturity data in the area makes it difficult to say what depth of burial that this would correspond to. If vitrinite reflectance data from Mic Mac H-86 is used, which suggests 0.6% VRo at the depth of the Tithonian source rock (2800-3000 m), then it should be significantly deeper than this. Unfortunately, the vitrinite reflectance data in the BASIN data base from Avery (1986) and Robertson Research International (1976) give very different profiles for the lower part of the well with the former suggesting 1.7% VRo and the latter 0.75% VRo at 4500 m, within the Early to Middle Jurassic Mohican Formation. The only biostratigraphy on the lower part of the Mic Mac H-86 well in BASIN is from Ascoli (1988) which says that from 4419-4782.37 m (t.d.) was undatable and non-marine. If the source rock is present in this area, it is presumably deeper than this as it certainly shows marine character. If the lithostratigraphy in the area of the Mic Mac wells is generally similar to that at H-86 then this would suggest that a Pleinsbachian source rock would be 2000 m or more deeper than the strata containing the stains.

### 6.3.2 Biodegradation

As discussed earlier, many of the stained samples are biodegraded. Biodegradation in subsurface reservoirs can be significant up to temperatures of around 60-80°C which under typical geothermal gradients corresponds to depths of 2000 m. This appears to be the approximate geothermal gradient for the northern part of the Scotian Shelf based on temperature data in PFA (2011). As all the samples that contain biodegraded hydrocarbons in the present study are about 2000 m or shallower, this suggests that the observed biodegradation could be presently occurring.

The SFGCs of all the Erie D-26 samples, which are from ~1810-2250 m, show a large UCM hump suggesting they are biodegraded. The size of the UCM hump decreases with depth for the Missisauga samples, suggesting decreasing biodegradation with increasing depth. The Erie D-26 Missisauga Formation samples, from 1810-1900 m, contain 25-norhopanes indicating a severe level of biodegradation that may have occurred when the reservoirs were shallower and at lower temperatures more conducive to this degree of microbial alteration. These compounds are not observed in the deeper 7381.12 ft Mic Mac Formation sample from this well suggesting it has never been at shallow enough depths for this level of biodegradation to occur. The Missisauga Formation samples show n-alkanes superimposed on the UCM hump. As these are the first compounds to be removed by microbial alteration, this indicates a later hydrocarbon charge into this formation. Only a low concentration of $C_{15}$-$C_{30}$ n-alkanes are present in the 7381.12 ft sample, possibly because of the extent of evaporation of these compounds from this sample. It is possible that the second charge mostly entered Missisauga Formation reservoirs, higher in the section. The presence of n-alkanes in the Missisauga samples implies that this second charge is recent, either when the depth of this formation became too great for biodegradation, or that there is biodegradation occurring today but hydrocarbons are presently charging these reservoirs faster than microbes metabolize them. It is not possible to say if this second charge has the same source rock as the original charge. The Missisauga samples do show different biomarker distributions to the Mic Mac sample but it is unlikely that this was caused by a different second charge to these samples as the differences in the biomarker distributions are so great.

The Mic Mac J-77 samples show a similar story. Based on the size of the UCM in the SFGCs, the amount of biodegradation decreases with increasing depth to the 6510-6520 ft sample. The 6740-6750 ft sample is not obviously biodegraded. The shallowest Mic Mac J-77 sample also contains a very large UCM hump in its SFGC as well as 25-norhopanes indicating it is severely biodegraded. For the 6510-6520 and 6740-6750 ft samples, biomarkers indicate a contribution of lower maturity hydrocarbons that might be largely responsible for the n-alkanes superimposed on the UCM hump. In summary, there is a trend of decreasing biodegradation with depth from severely biodegraded at ~980 m to little or no biodegradation at 2050 m.

The Mic Mac D-89 2950-2980 ft sample is the shallowest of the samples analyzed for this study. However, because of contamination and the presence of lower maturity hydrocarbons, its SFGC does not look obviously biodegraded. Biomarkers also show no indications of being affected. No explanation can be offered for this.

Wyandot E-53 samples do not appear to be biodegraded which is expected based on their current depth.

Overall, the level of biodegradation of the samples (with the exception of Mic Mac D-89) reflect their current reservoir depth. This and the presence of unbiodegraded n-alkanes in some otherwise severely biodegraded shallow samples supports the reservoirs being at least partially filled when close to their present-day depth. If derived from a Lower Jurassic source rock, this would seem to be in contradiction with the results of the basin modelling in PFA (2011) which suggests that a Pleinsbachian source rock would have generated most of its hydrocarbons by the Early-Middle Cretaceous.

### 6.3.3 Source Rock Characteristics

The pristane/phytane (pr/ph) ratio is commonly used as an indicator of the redox conditions of the source rock. This ratio was not useful for most of these samples because of biodegradation, contamination and evaporation. Moreover, samples where the pr/ph might be useful are those where these compounds could be derived from a second hydrocarbon charge that might not have the same source rock as the original hydrocarbon charge. These samples are from Mic Mac J-77 6510-6520 and 6740-6750 ft, Erie D-26 6060-6070 and 6210-6220 ft. They have pr/ph ratios of 1.12-1.32 (Table A3) which suggests dysoxic conditions for the source rock of these hydrocarbons.

The source rock(s) for the migrated hydrocarbons was certainly deposited in a marine environment. This is supported by the $C_{27}$-$C_{30}$ sterane relative abundance. $C_{30}$ 4-desmethylsteranes (24-n-propylcholestanes) are markers for an input of marine organic matter (e.g. Peters et al., 2005, p. 527). They usually constitute less than 10% of the total $C_{27}$-$C_{30}$ steranes because even in source rocks derived entirely from marine plankton, the plankton that synthesize 24-n-proplycholesterols are generally a minor part of the phytoplankton assemblage. These compounds are present in all of the samples analyzed for staining ranging from 3 to 6%. The highest abundance of 4-desmethylsteranes relative to $C_{27}$-$C_{30}$ steranes are found in the three samples that show the most carbonate features (Erie D-26 7381.12 ft, Mic Mac J-77 4245-4276 ft, Mic Mac D-89 2950-2960 ft) (Fig. 28).

$C_{27}$ steranes are generally thought to have a marine plankton origin and $C_{29}$ steranes to be derived from primarily terrestrial organic matter although age and other environmental factors can also influence the relative amount of $C_{27}$ and $C_{29}$ steranes. The samples with the highest $C_{27}$/$C_{29}$ sterane ratio are the three Erie D-26 Missisauga Formation cuttings samples that show the same distinct sterane distribution of $C_{27}>C_{28}>C_{29}$. The D-26 7381.12 ft sample shows the lowest $C_{27}/C_{29}$ ratio which could be the result of the extensive evaporation that this core sample has undergone that has led to a greater loss of $C_{27}$ relative to $C_{29}$ steranes, rather than a greater terrestrial input. Samples that show the presence of immature terrestrial organic matter do not show lower $C_{27}/C_{29}$ ratios than other samples. This is probably because this ratio is measured on 5α(H),14β(H),17β(H) steranes which are in lower abundance relative to the biologically inherited 5α(H),14α(H),17α(H) 20R steranes in samples of lower maturity.

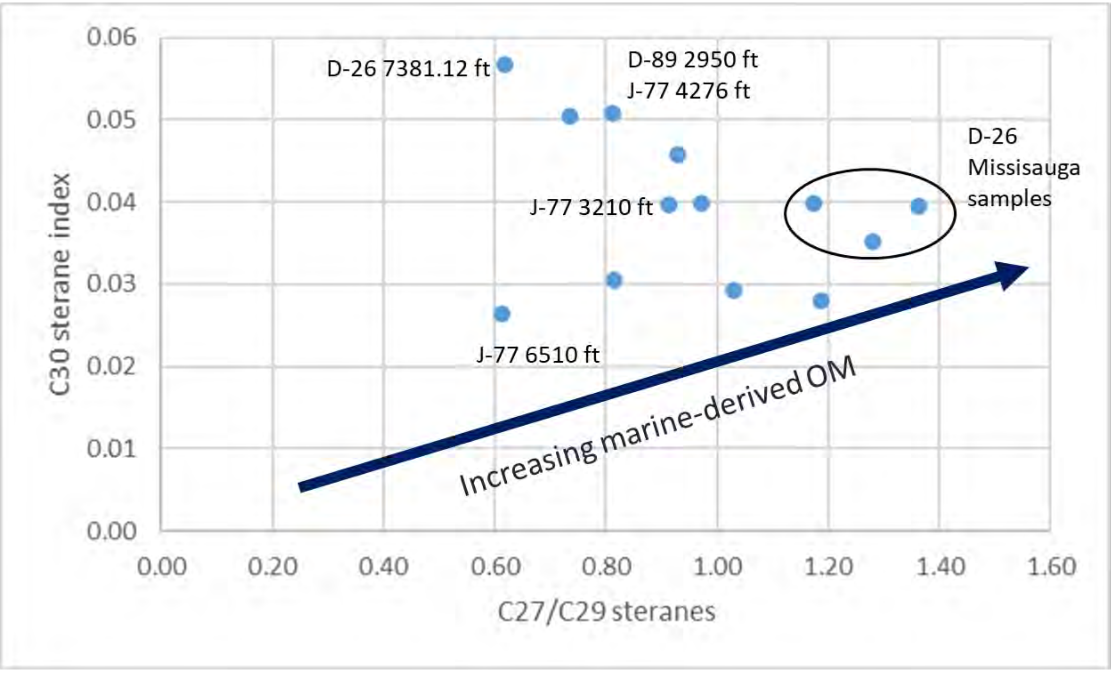

Figure 28. Cross-plot of $C_{27}/C_{29}$ 5α(H),14β(H),17β(H) steranes versus $C_{30}$ sterane index ($C_{30}/C_{27}$-$C_{30}$) steranes. The location of certain samples on the plot are shown.

As indicated by their m/z 245 aromatic mass chromatograms (see appendix), all the stain samples have high abundances of aromatic dinosteroids. This would be expected from Mesozoic marine source rocks (Moldowan et al., 1996). The aromatic dinosteroids are derived from 4,23,24-trimethylsteroids that are mostly but not exclusively derived from marine dinoflagellates (Moldowan et al., 1996). The Primrose N-50 oil, which is thought to be derived from mostly terrestrial organic matter shows much lower concentrations of dinosterols compared to regular or methyl aromatic steranes.

A cross-plot of the Gammacerane Index versus the C35/C34 homohopane ratio (Figure 29) shows a relatively good correlation with those samples having higher amounts of gammacerane also having a higher $C_{35}/C_{34}$ ratio. Higher amounts of gammacerane are usually associated with water stratification and higher C35/C34 homohopane ratio with anoxia. The samples with higher values of these parameters are Erie D-26 7381.12 ft, Mic Mac J-77 4245-4276 ft and Mic Mac D-89 2950-2960 ft. They would be expected to have source rocks that were deposited under more restricted and more possibly carbonate conditions than hydrocarbons in other samples including the Mic Mac 3210-3241 ft sample which gave the highest amount of EOM of the samples. For comparison, these samples have similar gammacerane abundance and higher $C_{35}/C_{34}$ ratios than Jeanne d'Arc Basin oils such as those from the Hibernia and Terra Nova fields that have a Egret Member source rock deposited under very restricted conditions (Fowler and McAlpine, 1995).

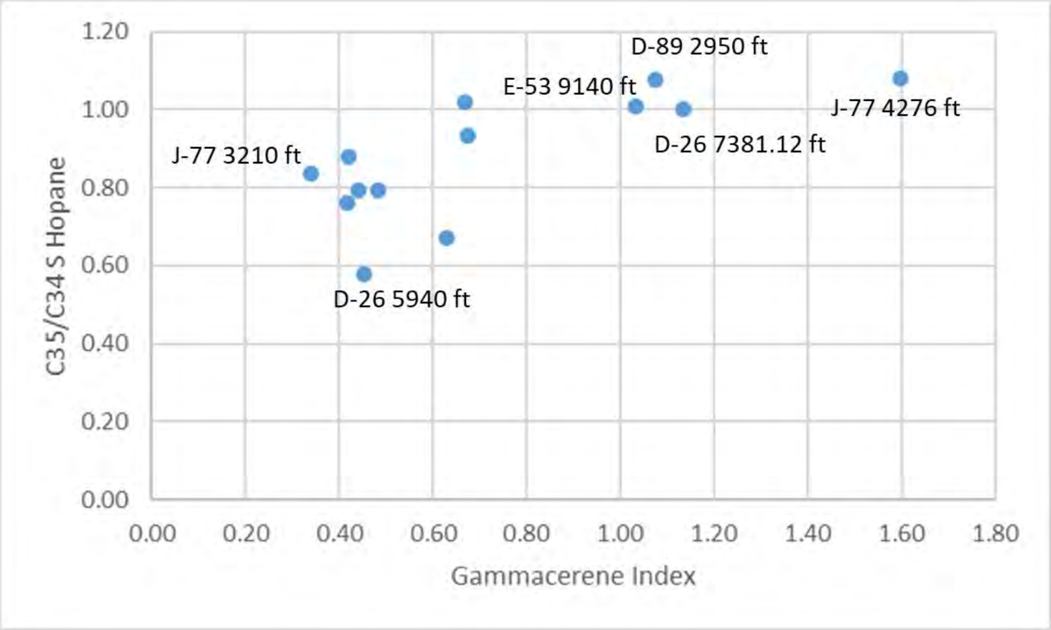

Figure 29. Cross plot of Gammacerane Index (10 x Gammacerane/Gammacerane+ Hopane) versus C35/C34 homohopanes. Location of certain samples on plot indicated.

As indicated by Figure 25, the Erie D-26 7381.12 ft, Mic Mac J-77 4245-4276 ft and Mic Mac D-89 2950-2960 ft samples also show lower amounts of diasteranes than other samples which also suggests they were deposited under less clastic conditions. These samples also have higher $C_{29}/C_{30}$ hopane ratios than other samples (Table A4), although still much lower than most carbonate source rocks (e.g. Peters et al., 2005, Fig 13.90).

On tricyclic terpane cross-plots such as $C_{22}/C_{21}$ versus $C_{24}/C_{23}$ (e.g. Peters et al., 2005 Fig. 13.76) or $C_{26}/C_{25}$ versus $C_{31}R/C_{30}$ hopane cross-plot (Peters et al., 2005, Fig 13.77), all the samples plot with oils that have marine shale source rocks.

### 6.3.4 Source Rock Age

The extended tricyclic terpane ratio (ETR) (Holba et al. 2001) is based on the abundance of the $C_{28}$ and $C_{29}$ tricyclic terpanes relative to the $C_{27}$ Ts hopane. The ratio is considered most useful for distinguishing Triassic and Jurassic marine sourced oils. It has been suggested that Triassic oils have mostly a ETR ≥0.67, Early Jurassic oils are mostly ≤0.67 and Mid-Late Jurassic oils mostly <0.55. These differences are thought to be related to the mass extinction at the end of the Triassic that had an impact on the biological sources of the tricyclic terpanes (possibly Tasmanities), and a subsequent lesser extinction in the Toarcian that may also have adversely impacted these organisms. Subsequent studies on ETR have suggested that high ETR values are related to marine upwelling (Holba et al., 2003) and that this ratio should be a guide only.

The samples in this study show a range of 0.54-0.75 (Table A4) suggesting that the oils were most likely sourced from Lower Jurassic or Triassic source rocks. The three highest values were obtained from Erie D-26 cuttings samples that contain 25-norhopanes suggesting that their ETR values could have been affected by preferential biodegradation of $C_{27}$ Ts. However, this seems unlikely as the Mic Mac J-77 3210 ft sample that also contains 25-norhopanes shares with the Mic Mac D-89 sample the lowest value, and Ts is thought to be one of the most resistant hopanes to microbial attack.

Another parameter that can be used to provide an indication on the age of the source rock of oils is the ratio of $C_{28}/C_{29}$ steranes. This ratio shows a general increase through time for oils derived from marine source rocks (Grantham and Wakefield, 1988). However, there are many exceptions to this including if there is a contribution from terrestrial organic matter which would lower the ratio (e.g. Peters et al., 2005, p. 526-527).The $C_{28}/C_{29}$ sterane ratio shows a large range for the Scotian Shelf stain samples. The three samples with the highest values are the Erie D-26 cuttings samples containing 25-norhopanes suggesting biodegradation could be a factor. However, this is not believed to be the case as Peters et al. (2005, p. 665) suggest that $C_{27}$ and $C_{28}$ steranes are preferentially biodegraded before $C_{29}$ steranes. Additionally, diasteranes which are more resistant to biodegradation than regular steranes also show a $C_{27}$ sterane predominance with higher $C_{28}/C_{29}$ ratio than other samples. If interpreted to reflect the age of the source rock, the $C_{28}/C_{29}$ sterane ratio of these Erie D-26 samples would suggest a Cretaceous/Tertiary source which seems unlikely based on the maturity of these strata in this area. The Wyandot E-53 samples show a similar relative abundance of $C_{27}$:$C_{28}$:$C_{29}$ steranes that also suggest a contribution from Cretaceous marine organic matter. The other samples have values for the $C_{28}/C_{29}$ ratio between 0.38 and 0.63, which according to Grantham and Wakefield (1988), would suggest an Upper Paleozoic to Lower Jurassic source. It is emphasized that this ratio should be used cautiously with these stained samples as an indicator of age of source rock.

In summary, age parameters suggest that the majority of samples could have a source from a Jurassic source rock and possibly a Lower Jurassic source rock. However, the data is not able to provide an age on its own because there are so many factors effecting the biomarker distributions.

### 6.3.5 Carbon Isotopes of Stained Samples

Despite all the differences in source, level of biodegradation, addition of low maturity organic matter and contamination, the Scotian Shelf stain samples plot fairly close together on a Sofer Plot (Sofer, 1984) of $\delta^{13}$C saturates versus $\delta^{13}$C aromatics (Fig. 30). All the extracts have isotopically lighter hydrocarbons than Scotian Shelf light oils/condensates from the Sable sub-basin that have a Tithonian source rock, as well as the Primrose N-50 oil that was analyzed for this study. There may some impact on the isotopic data from biodegradation as the three severely biodegraded Missisauga samples from Erie D-26 are slightly heavier than the other samples. Biodegradation can cause an increase in $\delta^{13}$C values of up to 1-2‰ (e.g. Sofer, 1984). However, the Mic Mac J-77 3210-3241 ft sample that also contains 25-norhopanes is the lightest of the stain samples.

Overall, isotopes do not distinguish different source rocks for the stain hydrocarbons but do suggest that they have a different source rock to Tithonian sourced Scotian Shelf oils. As there is a general trend of $^{13}$C enrichment with decreasing age of source rock (e.g. Andrusevich et al. 1998) the data could imply that the source of the stains was older than that of the oils. However, this inference should be treated with caution as isotopes can be affected by other reasons such as source organic matter type and depositional environment. As indicated on Figure 30, these staining hydrocarbons are slightly heavier than the "Area of Lias Oils" on a figure presented by Bishop (2020b). While this is based on a limited number of UK onshore and offshore oils, Lower Jurassic Gordondale sourced oils from Western Canada plot in the same area (Ejezie, 2007). However, within a specific time interval, $\delta^{13}$C values of oils can vary due to paleoenvironmental effects on the primary marine biomass such as paleolatitude (probably related to sea temperature) and salinity (Andrusevich et al., 2000) and the area of all Lias oils is probably greater than indicated by Bishop (2020b). This is supported by oil staining present in Lower Jurassic strata from the Southern Grand Banks (APT 2020) which are thought to have source rocks of the same age, that have hydrocarbon fraction $\delta^{13}$C values intermediate between the Lias Oils area of Bishop (2020b) and the Scotian Shelf samples but are closer to the latter.

It is noteworthy that the shallow core sediment samples collected in 2018 from the Scotian Slope at site 7, which contain the greatest amount of hydrocarbons that have seeped up to the surface, have similar isotopic compositions to the stains. The 2018 site 7 0.32-0.34 and 0.34-0.38 cm samples have $\delta^{13}$C sats of -28.6 and -28.2‰ and $\delta^{13}$C aromatics of -28.2 and -28.4‰ respectively and would plot close to the Mic Mac J-77 3210-3241 ft sample on Figure 30.

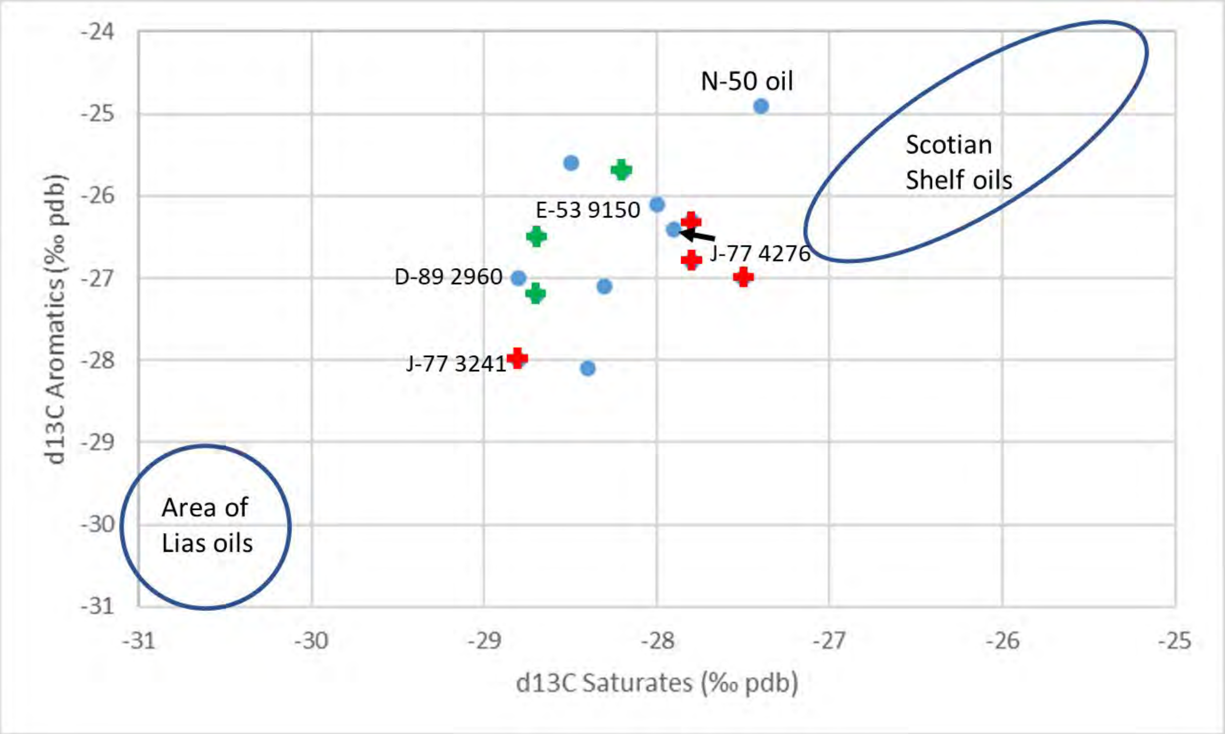

Figure 30. A Sofer plot of $\delta^{13}$Csaturates versus $\delta^{13}$C aromatics (Sofer, 1984) showing the samples analyzed in this study. Points indicated by green crosses are those with a contribution of low maturity hydrocarbons (Mic Mac J-77 6510-6520 ft and 6740-6750 ft, Missisauga H-54 7910-7920 ft and Wyandot E-53 7760-7770 ft) and those by red crosses contain 25-norhopanes indicating they are severely biodegraded. The blue oval shows the approximate location of Scotian Shelf oils based on Mukopadhyay (1991) and the blue circle shows the approximate area designated as Lias oils by Bishop (2020b).

## *6.4 Origin of Staining Hydrocarbons*

Based on the preceding discussion, most of the extracted sediment samples are thought to contain hydrocarbons that have migrated from a source rock deeper in the section. However, as discussed below, there is considerable variation in the biomarker distributions between different samples in the same well and between wells. There are a number of possible reasons for this:

- Migrated hydrocarbons may have more than one source rock
- EOM is a mixture of migrated and in situ hydrocarbons
- The effects of biodegradation
- Some intervals might have received multiple hydrocarbon charges
- The length of the time that the samples have been stored and the possible affect that this has had on hydrocarbon distributions
- Contamination

**Mic Mac J-77**

The effect of the above factors can be illustrated by closer examination of the results from Mic Mac J-77. The samples from 6510 and 6740 ft show a number of low maturity biomarker characteristics such as low $C_{29}$ sterane isomerization values (%20S and %bb) and lower %Ts and %C29Ts than the 2950 and 3210 ft samples (Table A4, Fig. 32). The 6510 ft sample also has $C_{27}$-$C_{33}$ n-alkanes with an odd carbon number preference indicating a contribution of low maturity terrestrial derived organic matter in this sample (Fig 21c). These samples have a major peak eluting with the retention time of the 28,30-bisnorhopane (Fig. 31) which is only found in one other sample (Missisauga H-54 7910 ft) that also contains a mixture of low and higher maturity biomarkers. The presence of this peak could indicate a source rock deposited under clay-poor anoxic conditions (Peters et al., 2005, p. 562). The identity of this peak as 28,30-bisnorhopane has been investigated based on the just the GC-MS-SIM data available for this study, and there is no obvious alternative compound with a similar elution time in the m/z 191 and m/z 177 mass chromatograms. The bisnorhopane was not present in the J-77 oil that was analyzed by Shell. Its presence in just these three cuttings samples that are not from the same formation, using either the CNSOPB or Maclean and Wade (1993) lithostratigraphy, and which are not the most heavily stained is not easily explained. The three samples all contain hydrocarbons derived from multiple sources, both mature hydrocarbons that have migrated from a deeper source rock and immature hydrocarbons derived from organic matter at a similar depth to the sample. If this compound is actually present, then it would suggest that there are multiple source rocks for the staining hydrocarbons at Mic Mac J-77. Bisnorhopane is not present in any of the other samples that contain higher amounts of migrated hydrocarbons suggesting its apparent presence in these samples is related to the occurrence of low maturity hydrocarbons. There is nothing to suggest that there is a Lower Cretaceous source rock present in the in this area that has an anoxic clay-poor depositional environment which might be the source of this compound. Hence it is probable that the peak in the m/z 191 mass chromatogram is actually a plant derived triterpenoid rather than 28,30-bisnorhopane, that is associated with the low maturity, higher land plant derived hydrocarbon component and not the migrated hydrocarbons.

Much more EOM was obtained from the two shallower J-77 samples, especially that from 3210-3241 ft. 25-Norhopanes are present in this sample indicating that biodegradation has been severe enough to have affected the hopanes. However, it is not obvious what other effects that biodegradation has had on its biomarker distributions. Steranes do not show obvious evidence that they have been affected by biodegradation (Fig. 32). While diasteranes are in higher abundance in this sample compared to the other J-77 samples, the short-chain steranes, that are equally resistant to microbially alteration, are in lower abundance (Fig.32). There is also no preferential removal of the 5α(H),14α(H),17α(H) 20R (αααR) steranes relative to the 20S isomers. Hence these and other biomarker differences are not because of biodegradation but suggest this sample has a contribution from a different source rock to the other J-77 hydrocarbons. This sample has a high saturate/aromatic ratio (5.06) which is not expected from a biodegraded sample as saturated hydrocarbons are more susceptible to microbial attack. It implies that large polycyclic alkanes make up a significant portion of the compounds under the very large UCM hump in the SFGC.

The 4245-4276 ft sample does not show the presence of 25-norhopanes but has higher concentrations of the tricyclic terpanes that are more resistant to microbial alteration than the hopanes, as do the 6510-6520 and 6740-6750 ft samples (Fig. 31). There are other differences between the 3210-3241 and 4245-4276 ft samples that indicate their hydrocarbons almost certainly have different source rocks. The 4245-4276 ft sample has a higher abundance of homohopanes relative to the 17α(H)-hopane with a $C_{35}/C_{34}$ ratio greater than 1, it shows a higher amount of gammacerane (Gammacerane index of 1.6 versus 0.34), higher $C_{29}/C_{30}$ hopane ratio, $C_{24}$ tetracyclic peak is greater than those for the $C_{26}$ tricyclic terpanes, lower abundance of rearranged steranes but higher amounts of short-chain steranes and a different relative abundance of $C_{27}$-$C_{29}$ steranes. It has significantly higher cracking ratios for both the sterane isomerization ratios and the triaromatic and monoaromatic steranes (Table A5), as well as %27Ts and %29Ts than the 3210-3241 ft sample indicating it is more mature. Other ratios such as AROM2 and MSAro3 ratio based on methylphenathrenes suggest they are of similar maturity. The carbon isotopes of the two samples are also different enough to suggest a different source rock. The differences are not related to the greater biodegradation of the 3210 ft sample as the $\delta^{13}C$ is 1‰ lighter and biodegradation usually causes hydrocarbon fractions to become isotopically heavier. Overall, the biomarker characteristics suggest that the 4245-4276 ft hydrocarbons were generated at higher maturity from a source rock that was deposited under more anoxic and carbonate-influenced conditions than the source rock for the 3210-3241 ft hydrocarbons.

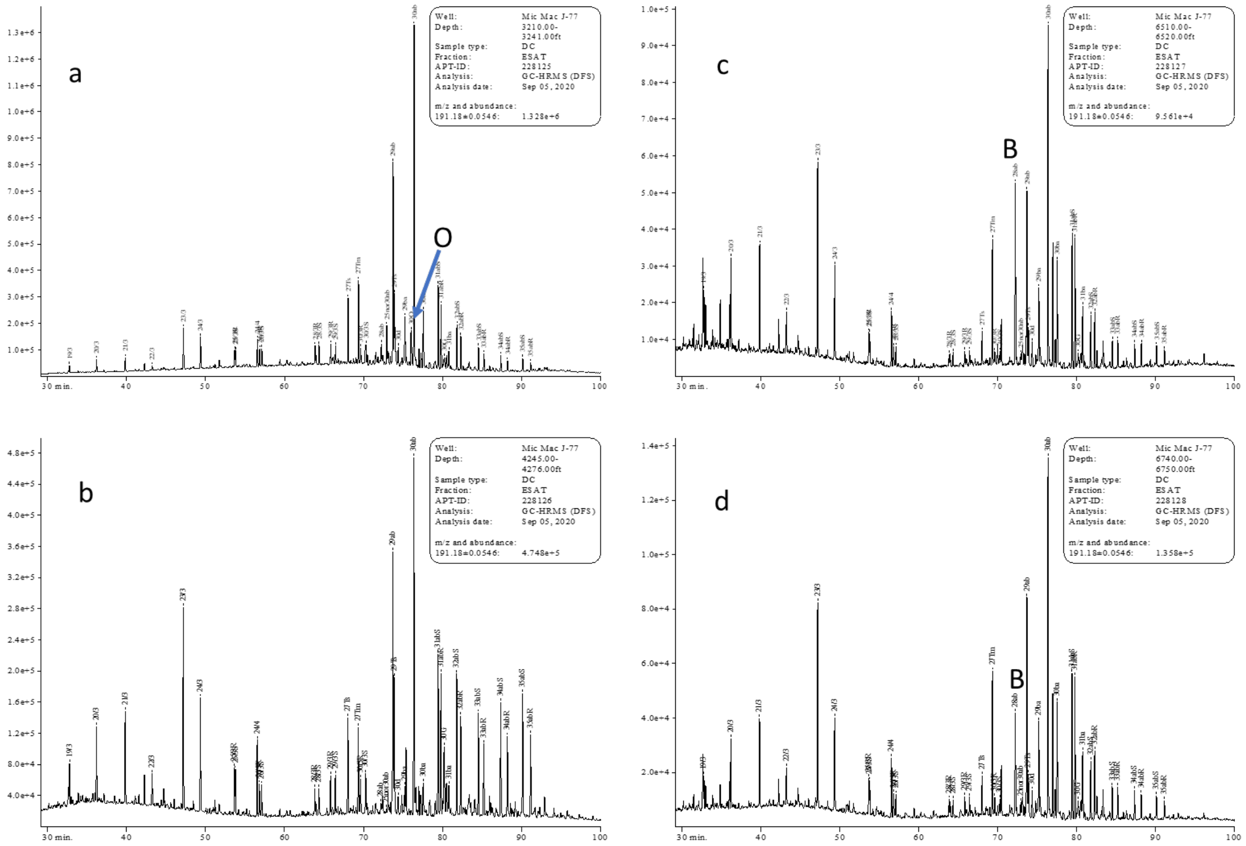

Figure 31. M/z 191 mass chromatograms of Mic Mac J-77 samples; a) 3210-3240 ft, b) 4245-4275 ft, c) 6510-6520 ft and d) 6740-6750 ft. B is 28,30-bisnorhopane, O is a peak eluting at the same time as oleanane that is believed to actually be a 25-norhopane. Larger images of the mass chromatograms are in the Appendix. The m/z 191 mass chromatogram of the 11760-11770 ft sample is not shown but can be found in the Appendix.
Note other differences between the samples besides the presence or absence of bisnorhopane and the 25-norhopanes, including the relative amounts of homohopanes and tricyclic terpanes.

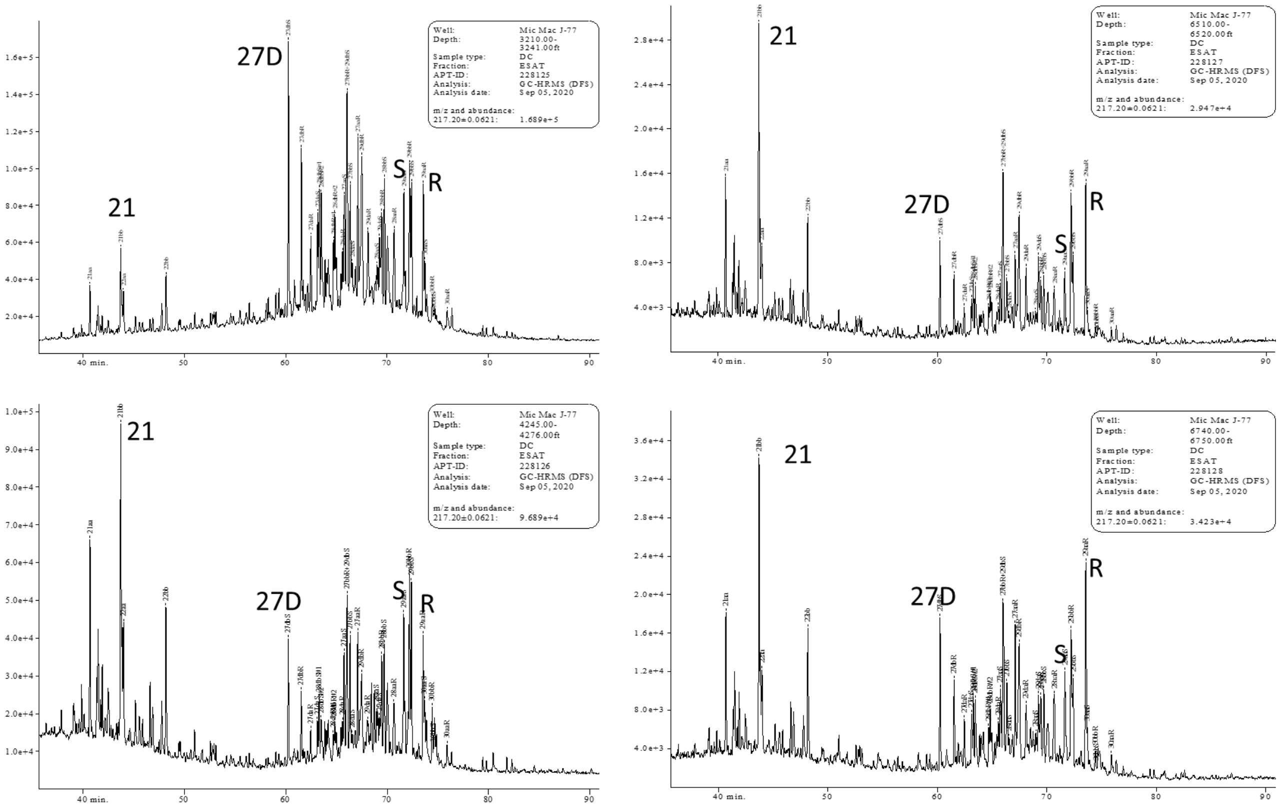

Figure 32. M/z 217 mass chromatograms of Mic Mac J-77 samples; a) 3210-3240 ft, b) 4245-4275 ft, c) 6510-6520 ft and d) 6740-6750 ft. 21 is C21 sterane, 27D is C27 13β(H), 17α(H), 20S diasterane, S and R are the C29 5α(H), 14α(H), 17α(H), 20S and 20R steranes. Larger images of the mass chromatograms are in the Appendix. The m/z 217 mass chromatogram of the 11760-11770 ft sample is not shown but can be found in the Appendix.
Note the variation in the relative amounts of 21 and 27D to the R peak, and the variation in the relative sizes of the S and R peaks. R is the biologically inherited isomer and, with increasing maturity, the relative amount of S increases until they are of similar abundance.

Of the samples extracted from Mic Mac J-77 for this study, it is the 4245-4276 ft sample that shows the closest similarity to the J-77 oil analyzed by Shell, rather than the 6510 ft sample collected over the same depth interval or the 3210-3241 ft sample that gave much the greatest amount of extract. Similarities between the 4245-4276 ft sample and the J-77 oil include the high abundance of homohopanes, a 35/34 hopane ratio > 1, relatively high abundance of tricyclic terpanes relative to 17α(H)-hopane, $C_{24}$ tetracyclic terpane > $C_{26}$ tricyclic terpanes, high abundance of short-chain steranes, lower amounts of rearranged steranes relative to regular steranes and a $C_{29}$ sterane predominance.

Age parameters such as ETR and the relative abundance of triaromatic dinosteroid ratios suggest the hydrocarbons for the both the 3210-3241 and 4245-4276 ft samples are sourced from similar age intervals. Although difficult to say unequivocally because of the lack of light hydrocarbons in the extracts which dominate almost all Scotian Shelf oils, none of the J-77 extracts show characteristics that would suggest they are derived from the Tithonian source rock. For example, biomarkers are present in higher concentrations than in Scotian Shelf oils, they do not have a very large $C_{29}$ sterane predominance (>60%) and rearranged steranes in much higher concentrations than regular steranes ($C_{27}$ diasterane/aaaR sterane >5). Based on a comparison with data in Mukhopadhyay (1991), the hydrocarbons are isotopically lighter than Scotian Shelf oils (Fig. 30). Hence, they could be sourced from an older interval or a very different facies of the Tithonian source rock than seen elsewhere. Based on the Rock-Eval/TOC results from the Tithonian section at Mic Mac H-86, the Tithonian in this area has Type III organic matter, as seen elsewhere.

### Erie D-26

All of the samples from Erie D-26 appear to contain some migrated hydrocarbons. However, the 5940-5950 and 6210-6220 ft samples gave a low amount of EOM that shows evidence of severe biodegradation and additionally contamination in the case of the 5940-5950 ft sample. The 6060-6070 ft sample also shows severe biodegradation but gave a much greater amount of EOM. Its SFGC indicates that this sample also has a mixture of biodegraded and unbiodegraded hydrocarbons that could suggest multiple hydrocarbon charges. The 7381.12 ft sample is also biodegraded based on the lack of n-alkanes in the SFGC but the absence of 25-norhopanes or any other indication that the biomarkers have been affected, suggests that it was not degraded as much as the shallower cuttings samples. A bigger problem with this sample are the effects of evaporation on the distribution of biomarkers. The discussion on samples from this well will concentrate on the 6060-6070 ft cuttings sample and the 7381.12 ft core sample as they gave the highest amount of EOM. The 5940-5950 and 6210-6220 ft samples show many similarities to the 6060-6070 ft sample indicating that they received a lesser amount of the same hydrocarbon charge.

A comparison of the biomarker distributions of the 6060-6070 and 7381.12 ft samples indicates some similarities but many significant differences. The 7381.12 ft sample has a higher abundance of homohopanes with a $C_{35}/C_{34}$ ratio of 1, higher gammacerane (Gammacerane Index of 1.13 versus 0.67), lower amounts of tricyclic terpanes, lower amounts of rearranged steranes relative to regular steranes and very different $C_{27}$-$C_{29}$ sterane distribution that is $C_{29}>C_{27}>C_{28}$ rather than $C_{27}>C_{28}>C_{29}$ shown by the other Erie D-26 samples (Figs 33-35). Saturate maturity parameters such as %Ts, %20S and %20bb (Table A4) suggest a similar maturity. The triaromatic and monoaromatic cracking ratios indicate a much lower maturity for the 7381.12 ft sample than for the other D-26 samples because of the low abundance of short-chain homologues (Table A5). The maturity indicated by methylated aromatic ratios (e.g. methylphenanthrenes, di- and tri-methylnaphthalenes, methyldibenzothiophenes) suggest marginal maturity for the 7381.12 and early mature for the 6060-6070 ft hydrocarbons. The maturity of the 7381.12 hydrocarbons using these parameters has been affected by evaporation of the lower molecular weight compounds in these maturity ratios such as the short-chain monoaromatic and triaromatic steranes and the tricyclic terpanes relative to hopanes.

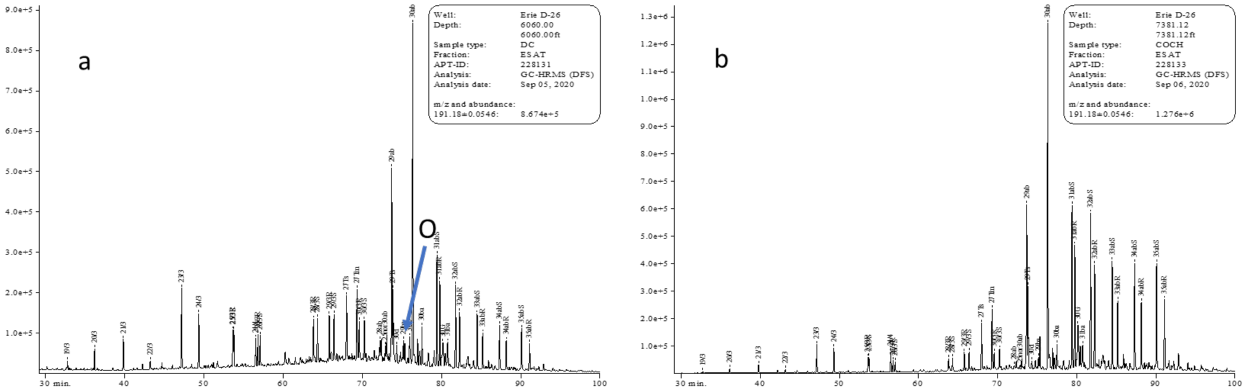

Figure 33. M/z 191 mass chromatograms of Erie D-26 samples; a) 6060-6070 ft and b) 7381.12 ft. O is a peak eluting at the same time as oleanane that is believed to actually be a 25-norhopane. Larger images of the mass chromatograms are in the Appendix.
Note other differences between the samples besides the presence or absence of the 25-norhopane, including the relative amounts of homohopanes and tricyclic terpanes which could be due to greater loss of the latter because of evaporation.

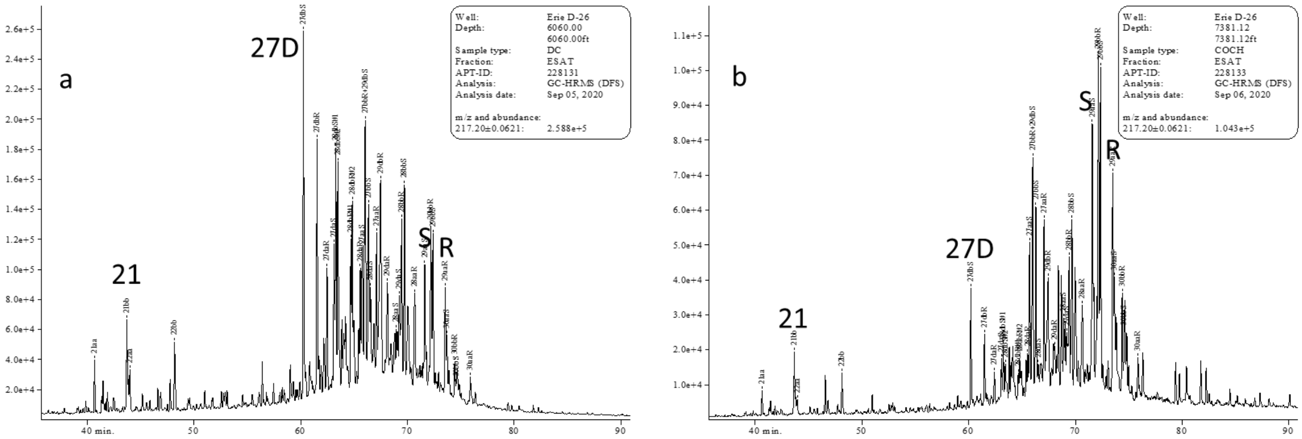

Figure 34. M/z 217 mass chromatograms of Erie D-26 samples; a) 6060-6070 ft and b) 7381.12 ft. 21 is $C_{21}$ sterane, 27D is $C_{27}$ 13β(H), 17α(H), 20S diasterane, S and R are the $C_{29}$ 5α(H), 14α(H), 17α(H), 20S and 20R steranes. Larger images of the mass chromatograms are in the Appendix.
Note the variation in the relative amounts of 27D to the R peak

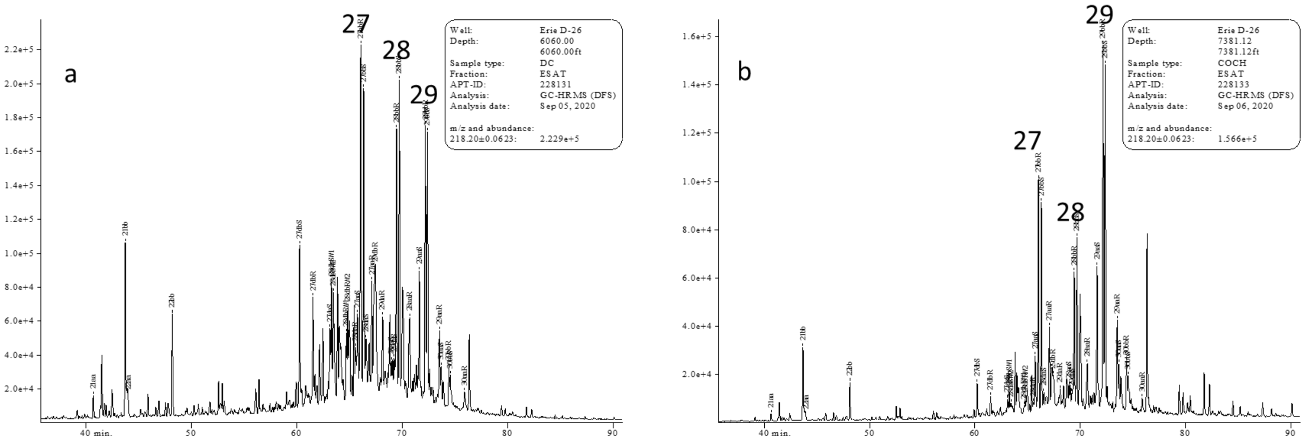

Figure 35. M/z 218 mass chromatograms of Erie D-26 samples; a) 6060-6070 ft and b) 7381.12 ft. 27, 28, 29 are the $C_{27}$-$C_{29}$ 5α(H), 14β(H), 17β(H), 20S and 20R steranes. Larger images of the mass chromatograms are in the Appendix.
Note the variation in the relative abundance of $C_{27}$-$C_{29}$ steranes. The 5940-5950 and 6210-6220 ft samples are very similar to the 6060-6070 ft sample.

The 4245-4276 ft sample from Mic Mac J-77 and the 7381.12 ft sample from Erie D-26 both show characteristics that suggest the source rock for their hydrocarbons has more carbonate character than the source of the hydrocarbons in the other samples. Their similarities include the homohopane distributions and the high $C_{35}/C_{34}$ homohopane ratio, the relatively high abundance of gammacerane, low diasteranes (as indicated by %27dbS). Both samples also show a $C_{29}$ sterane predominance that is more pronounced for the Erie D-26 sample. The samples also show some differences. These include the proportion of tricyclic terpanes to hopanes, $C_{20}$-$C_{21}$ to $C_{27}$-$C_{29}$ steranes and short-chain aromatic steranes to their higher molecular weight homologues all being lower in the Erie D-26 sample because it has lost lighter compounds due to a greater evaporation.

The Mic Mac D-89 sample gives a low amount of EOM that, based on the SFGC, is dominated by contamination and low maturity hydrocarbons. However, there are certain biomarker characteristics that suggest a contribution from a marine carbonate source rock similar to that at Mic Mac J-77 4245-4276 ft. These include the homohopane distribution with the ratio of $C_{35}/C_{34}$ homohopanes >1 (1.08), a relatively high abundance of gammacerane compared to 17α(H)-hopane (Table X) (gammacerane index of 1.08), the $C_{22}/C_{21}$, $C_{24}/C_{23}$, $C_{26}/C_{25}$ tricyclic terpane ratios, $C_{31}R/C_{30}$, and $C_{29}/C_{30}$ versus $C_{35}/C_{34}$ that are closest to carbonate fields in cross-plots of these ratios (Peter et al. 2005, Figs 13.76, 13.77 and 13.90) . Steranes show a somewhat similar distribution to the Erie D-26 core sample of $C_{29}>C_{27}>C_{28}$. Presence of $C_{30}$ 4-desmethylsteranes supports a marine source rock. The results from this sample indicate a mixing of hydrocarbons from different sources. However, it is probable that this sample contains a small amount of migrated hydrocarbons from a marine carbonate source rock similar to that for Mic Mac J-77 4245-4276 ft and Erie D-26 7381.12 ft.

The Wyandot E-53 9140-9150 ft EOM appears to be mostly migrated hydrocarbons with minor possible diesel contamination (Table X). It shows many similarities to other samples that show indications of having a clastic source rock such as the Mic Mac J-77 3210-3241 ft sample. Similarities include the $C_{27}$-$C_{29}$ sterane distribution, the high abundance of rearranged and low abundance of short-chain steranes relative to regular steranes, the low abundance of tricyclic terpanes, and similar %27Ts and %29Ts ratios. There are some differences such as the presence of 25-norhopanes and the low triaromatic sterane cracking ratios in the J-77 3210-3241 ft sample that are probably related to its greater level of biodegradation. This latter is supported by the Monoaromatic Sterane Cracking ratios being more similar between the samples. There are also many similarities to the Erie D-26 6050-6060 ft sample although this has a different sterane distribution.

## 6.5 Synthesis

After accounting for the effects on biomarker characteristics that are not related to source, it is possible to split the staining hydrocarbons into two groups.

Type A represented by Erie D-26 7381.12 ft, Mic Mac J-77 4245-4276 ft and Mic Mac D-89 2950-2960 ft.

Type B represented by Mic Mac J-77 3210-3241 ft, Erie D-26 6060-6070 ft (other Erie D-26 lower Missisauga Fm samples similar to 6060-6070 ft) Wyandot E-53 9140-9150 ft.

If the addition of low maturity hydrocarbons to the Mic Mac J-77 6510-6520 ft and 6740-6750 ft samples are taken into account, the migrated hydrocarbons in these samples are closer to Type B.

Type A show characteristics that suggest they have a marine source rock deposited under more restricted, possibly more carbonate influenced conditions than Type B which have a marine clastic source rock.

Type A and B stains can be found in the same well and are not restricted to a particular formation using either those provided by CNSOPB for the samples or the lithostratigraphy of Maclean and Wade (1993). There does not appear to be obvious differences in the maturity of the two stain types based on the data available except in Mic Mac J-77 between the 3210-3241 and 4245-4275 ft samples with the latter showing slightly higher maturity. This could suggest that in this area the more carbonate source interval is deeper than the clastic source rock.

While there are consistent differences between in Type A and Type B stains, they are generally not great for most parameters. The differences could be possibly explained by the hydrocarbons being derived from two distinct source rocks that are likely in the same part of the stratigraphic sequence, or different facies of the same source rock. This latter scenario is less favoured as source rock facies would be expected to change over a geographic area and hence a well would be expected to show just one stain type. Samples from wells in a different parts of the basin would show different stain types. The small differences between the two stain types could be because of mixing of hydrocarbons from the two different source rocks merging their characteristics.

Comparing the two stain types with the Mic Mac J-77 oil suggests that Type A show more similarity. This is not straight-forward because of the analytical problem within the Shell SIM/GC-MS data that caused later eluting peaks to appear in higher apparent abundance than they almost certainly are. Shell also provided GC-MS-MS data of more modern vintage than the SIM/GC-MS data, including chromatograms that are the sum of parent ion to m/z 191 and m/z 217 transitions. This provides comparable (but not identical because of different ionization methods in the mass spectrometers) chromatograms to that obtained by SIM-GC-MS monitoring of the m/z 191 and 217 ions. Figures 36 and 37 show the SIM-GC-MS data obtained for this study for the Mic Mac J-77 4245-4276 ft sample with that provided by Shell for terpanes and steranes for the Mic Mac J-77 oil. Although not identical, the J-77 4245-4276 ft shows the closest similarity to the J-77 oil within those samples extracted despite its extensive biodegradation. For example, the higher abundance of homohopanes, the high relative amount of gammacerane to the $C_{30}$ and $C_{31}$ hopanes, lower proportion of diasteranes relative to regular steranes, and the relative abundance of short chain steranes.

As discussed previously, the 6510-6520 ft sample taken over the same depth interval as the J-77 oil does not show a good resemblance to the oil. This is at least partially because of the contribution of low maturity terrestrial-derived hydrocarbons to the EOM of the 6510-6520 ft sample. Additionally, not a lot of EOM was obtained from the 6510-6520 ft cuttings compared to the more heavily stained samples. This implies that despite the cuttings being at a similar sample depth to the oil, the reservoir interval was not represented in these cuttings.

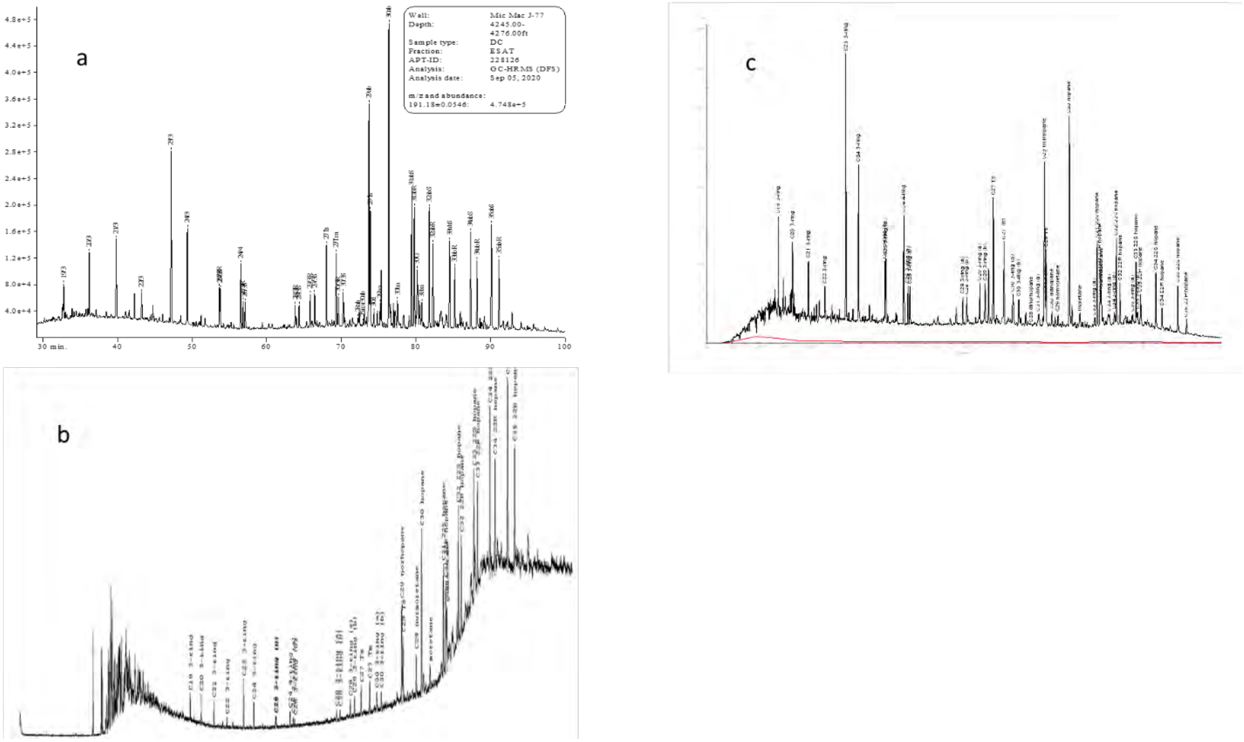

Figure 36. Comparison of terpane and hopane distributions between Mic Mac J-77 4245-4276 ft and Mic Mac J-77 oil (6514 ft); a) is m/z 191 mass chromatogram for 4245-4275 ft sample obtained for this study, b) is m/z 191 mass chromatogram of J-77 oil provided by Shell, c) is sum of parent to m/z 191 transitions for J-77 oil provided by Shell.

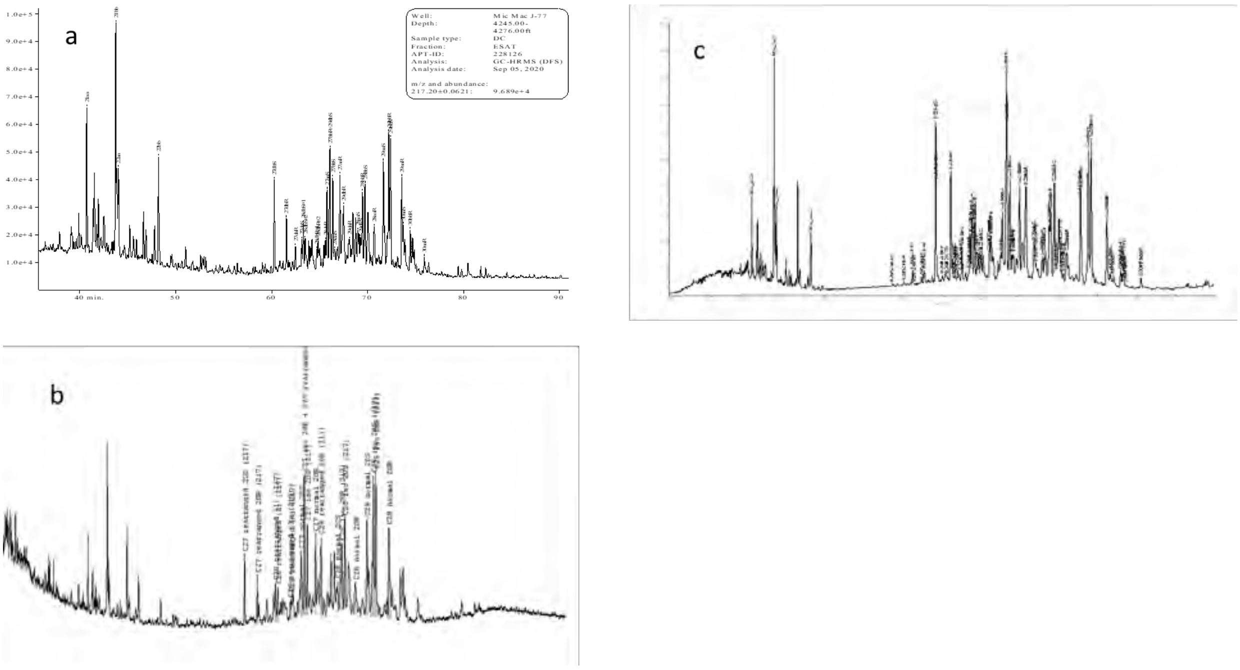

Figure 37. Comparison of sterane distributions between Mic Mac J-77 4245-4276 ft and Mic Mac J-77 oil (6514 ft); a) is m/z 217 mass chromatogram for 4245-4275 ft sample obtained for this study, b) is m/z 217 mass chromatogram of J-77 oil provided by Shell, c) is sum of parent to m/z 217 transitions for J-77 oil provided by Shell.

The age of the source rocks for the staining hydrocarbons could not be confidently established from geochemistry. Regional maturity suggests that the source rocks should be Middle to Early Jurassic (PFA, 2011). This is supported by ETR which suggests Lower Jurassic or Triassic source rocks. However, the oils appear to be isotopically heavier than the “Area of Lias oils” outlined by Bishop (2020a), although this was based on a limited set of oils. Different paleoenvironmental factors affecting Lower Jurassic source rock deposition could extend this “area of Lias oils” to possibly include the Scotian Shelf stains. The Scotian Shelf stains are closer isotopically to some from the Southern Grand Banks that are thought to have a Lower Jurassic source rock. The marine character of the stain hydrocarbons is very different to Scotian Shelf light oils/condensates from the Sable sub-basin which have a Tithonian source rock that is dominated by terrestrially derived organic matter. The Rock-Eval results for the Tithonian at Mic Mac H-86 suggest the Tithonian is dominated by Type III organic matter in the area of the wells analyzed for staining.

Based on the preceding lines of evidence, it seems that the source rocks for the Scotian Shelf stains in the Erie-Mic Mac-Wyandot area are most likely Lower Jurassic. Compared to many other North Atlantic presumed Lower Jurassic derived hydrocarbons such as from the southern Grand Banks, Morocco, or Portugal, they appear to have a more clastic character. However, there are Lower Jurassic organic black shale source rocks within carbonate dominated sequences that generate oils with clastic biomarker characteristics such as those present at Ait Moussa in the Middle Atlas of Morocco (Sachse et al., 2012, Fowler, 2019) and in the northern part of the Lusitanian Basin (Brito et al., 2017; the Coimbra Formation source of their 14A-1 oil).

In order to explain the results, it is conjectured that there may be multiple (thin?) Lower Jurassic source rock intervals deposited under slightly different depositional conditions on the Scotian Shelf, as observed for Pleinsbachian – Sinemurian intervals in the Lusitanian Basin (e.g. Duarte et al., 2010). This would offer an explanation for the relatively minor variation in biomarker characteristics between the different staining hydrocarbons, especially if there has been mixing between hydrocarbons from the different source rocks, and for their generally similar maturity.

# 7 Tithonian Source Rock at Mic Mac H-86

The Tithonian source rock was proposed to be present at Mic Mac H-86 by PFA (2011). This was based on TOC data that suggested TOC contents between 2-4% over the 2850-3000 m interval. It is unclear what the source of the TOC data was as it is not cited in PFA (2011) and there is no geochemical data for this well in the BASIN data base. The maturity of the Tithonian interval at H-86 based on measured vitrinite reflectance data (Robertson Research International Ltd., 1976; Avery, 1986) is around 0.6% VRo and hence marginally mature. It was decided to sample this interval to better understand what the characteristics of the Tithonian Source Rock are in this area. Twenty cuttings samples from 10 ft intervals over the 9330 ft (2843.8 m) to 9830 ft (2996 m) interval were collected and analyzed by a Leco instrument for TOC and a HAWK instrument for Rock-Eval type data. Samples were pre-extracted prior to analysis to remove the diesel that was reported to have been used during drilling. Dispersed Lignosulphonate was the main drilling additive used and would not all be removed by solvent extraction if present in the samples. Results are provided in Tables A6 and A7 in the Appendix.

All the samples had TOC contents greater than 1%. The range was 1.4-5.82% with the average being 3.21%. Hydrogen Index varied between 76-166 mg HC/g TOC with an average of 127. There is a good relationship of increasing HI with increasing TOC. Tmax shows a range of 435-447°C with an average of 442.1°C. The pyrograms (see Appendix) look good and do not suggest any Tmax problems due to contamination. There is no relationship between Tmax and TOC and HI. Using the empirical Tmax to vitrinite reflectance correlation of Jarvie et al. (2001) gives a VRo range of 0.65 to 0.89% with the average Tmax of 442°C corresponding to about 0.8% vitrinite reflectance and the early part of the main phase of oil generation. This is higher than the measured vitrinite reflectance values. It is possible that because of the length of time that the cuttings samples have been stored (50 years for this well) that TOC, HI and Tmax have all been affected by oxidation of the organic matter over the years. According to Jarvie (2015), TOC and S2 can be reduced as much as a factor of 2 depending how the cuttings are stored. Hence these H-86 samples may have had a higher TOC originally. Oxidation would also be expected to increase the Tmax. The vitrinite reflectance measurements made when the samples were fresher are likely more reliable than the Tmax values from the Rock-Eval measurements made for this study.

The Rock-Eval data does suggest that the Tithonian source rock in Mic Mac H-86 is similar to elsewhere in the Scotian Shelf in containing Type III organic matter that is most likely terrestrially derived. Even if the maturity was that suggested by the Tmax or if the organic matter has been heavily oxidized, the HI values would not have been Type II (As HI is S2/TOC, if S2 and TOC are both being reduced, then HI will be less affected than if just one of these measured parameters is being reduced). Hence this interval would expect to generate, if it has sufficient maturity, gas and condensate/light oil as found in most Scotian Shelf reservoirs.

The results from the analysis of the Tithonian source rock at H-86 suggest that it is unlikely to be the source of the Mic Mac J-77 oil, based on both organic matter type and maturity grounds. It was hoped that a couple of samples could be extracted for a more direct comparison but there was not enough of the H-86 samples provided to the lab to do this.

# 8 Conclusions

There has been considerable conjecture on the occurrence of second, older Jurassic, more oil-prone source rock contributing to hydrocarbons on the Scotian Shelf, in addition to the Tithonian source rock. Reviewing the available information on Scotian Shelf discoveries indicates that almost all are similar, being mostly gas that are associated with minor quantities of light oils and condensates with APIs greater than 40°. If there is a secondary contribution from a marine source rock, then it is subtle and not easily distinguished from the presumed dominant Tithonian contribution. Fluids generally show characteristics that suggest their source rock contained predominantly land plant derived organic matter. This is what would be expected from the Tithonian source rock that was deposited in a deltaic environment with Type III/II organic matter. There are some variations in the geochemistry of the Scotian Shelf condensates but all show characteristics of being derived from a terrestrially dominated source rock (e.g. high pristane/phytane ratios). It is possible that these could represent different facies of the Tithonian source rock as it is possible in a deltaic system to have a range of depositional environments with some having a greater algal contribution such as where ephemeral lakes occurred. However, the geochemical differences between the oils may also be caused by gas washing/evaporative fractionation.

Some workers have suggested possible evidence for the presence of a contribution from a deeper Jurassic source rock in the Sable Island area (Zumberge, 2010; Forkner et al., 2018). This data is far from being unequivocal and can be interpreted in a different way. The Primrose N-50 Iroquois ‘Cap Rock’ oil is from a Lower Jurassic reservoir but does not show geochemical characteristics indicating that it has a marine source rock. Geochemical data suggests it is probably sourced from the Tithonian with a contribution from another less mature source rock also dominate by terrestrial organic matter.

The best evidence for a source other than the Tithonian is provided by the data on the Mic Mac J-77 oil supplied by Shell and staining from this and other nearby wells that are ~100 km north east of the Sable Island. The Mic Mac J-77 oil shows very different characteristics to any other Scotian Shelf oils suggesting it was sourced from a marine marly source rock deposited under more restricted conditions than the Tithonian source rock.

Interpretation of the source of the staining hydrocarbons in the Erie D-26, Mic Mac D-89, Mic Mac J-77 Missisauga H-54 and Wyandot E-53 wells is complicated by the extent of biodegradation of some samples, a contribution of low maturity hydrocarbons from intervals close to where some samples were collected, evaporation of more volatile hydrocarbons, drilling contamination and possibly the effects of multiple hydrocarbon charges. Taking these complications into account, samples with better-quality data can be split into two types, designated A and B. Type A show characteristics that suggest a marine source rock deposited under more restricted and more carbonate influenced conditions than type B. The source rock for type A is likely a marl while that for type B is a marine clastic source rock. While there are consistent differences between the two types, the differences are generally not great. Type A show a closer similarity to the Mic Mac J-77 oil than type B but are not identical. Both types are very different from Scotian Shelf light oils/condensates that have a Tithonian source rock. Rock-Eval/TOC analysis of the Tithonian source rock at Mic Mac H-86 suggests that in this area of the basin this interval is also dominated by Type III terrestrial derived organic matter. Based on this, the maturity of the staining hydrocarbons compared to the regional maturity of potential source rocks, the predominantly marine nature of the source rocks of the stains, and some age sensitive parameters, a Lower Jurassic age source is favored for the staining hydrocarbons in the Mic Mac area. Contributions from two intervals that are stratigraphically close together with different organic- and lithofacies could explain the variation in stain hydrocarbon characteristics. A Lower Jurassic source rock on the Scotian Shelf would point to the possibility of a regional North Atlantic Lower Jurassic source rock although it does not seem to occur everywhere (Bishop 2020a). As the level of biodegradation reflects the current depth of samples and there is mixing of biodegraded and unbiodegraded hydrocarbons in shallow reservoirs, this would imply that the reservoirs containing the stains were filled when close to present day depths.

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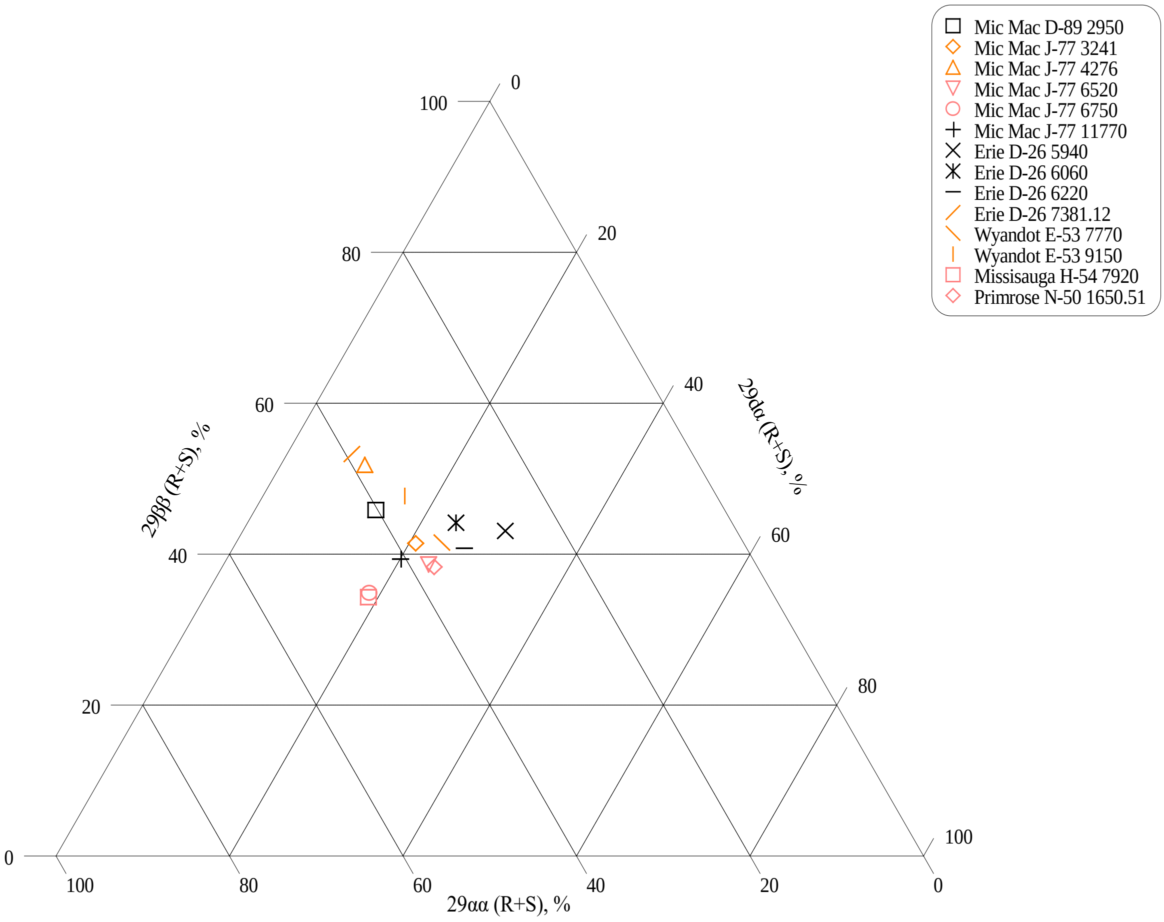
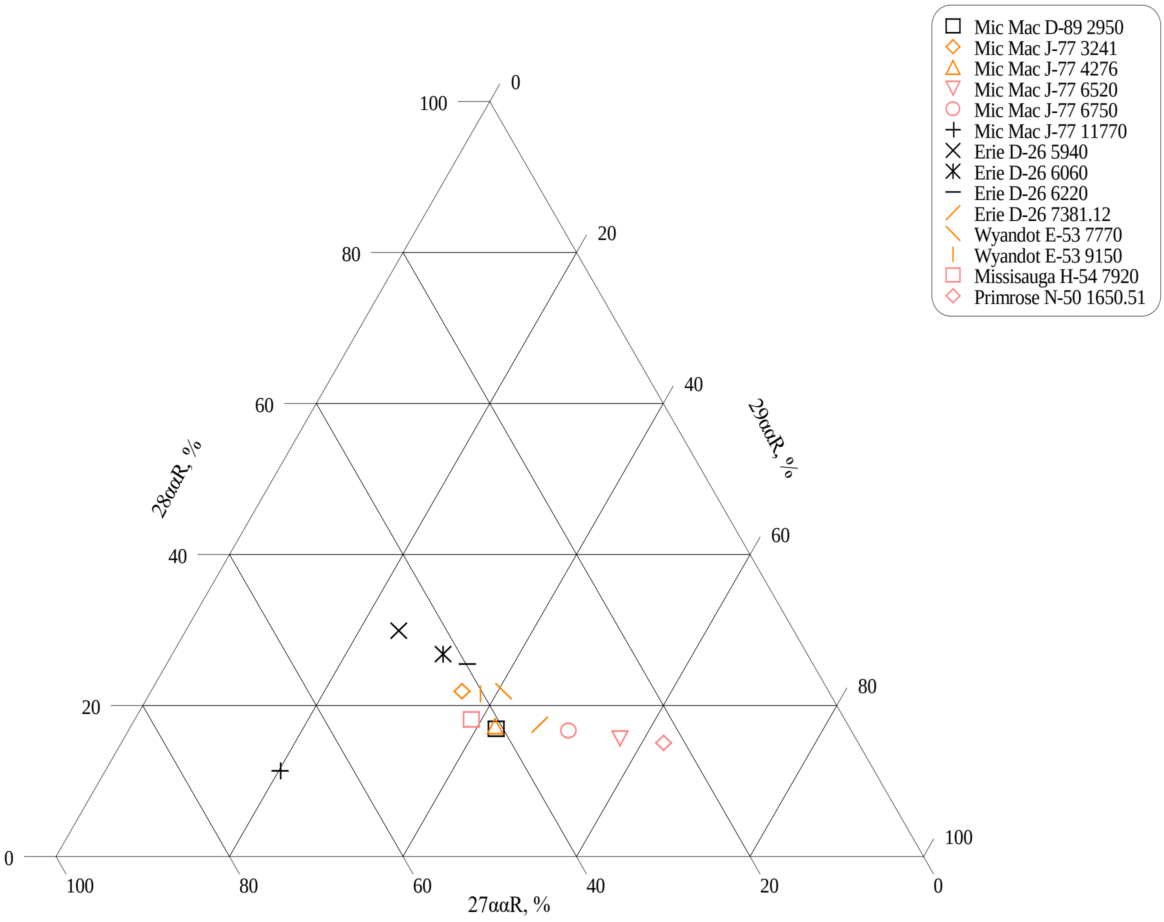
# 11 APPENDIX

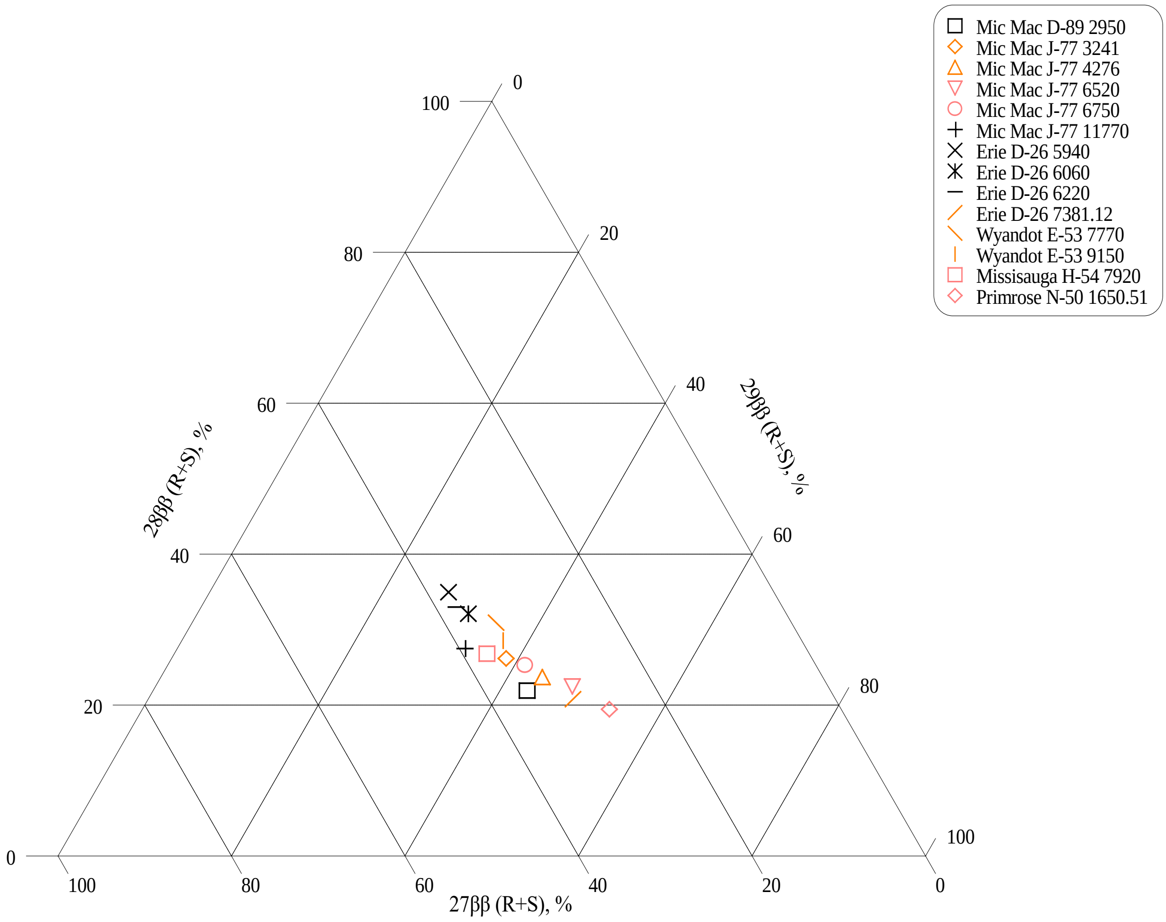
## *Table A1. Number of analyses performed*

| Analysis | Cuttings | Core | Fluid | Total |
|---|---|---|---|---|
| Leco TOC | 20 | | | 20 |
| TOC/Rock-Eval | 20 | | | 20 |
| Extraction | 12 | 1 | | 13 |
| Asphaltenes | 12 | 1 | 1 | 14 |
| MPLC | 12 | 1 | 1 | 14 |
| GC of Whole Oil | | | 1 | 1 |
| GC of Saturated hydrocarbons | 12 | 1 | 1 | 14 |
| GC-MS of Saturated hydrocarbons | 12 | 1 | 1 | 14 |
| GC-MS of Aromatic hydrocarbons | 12 | 1 | 1 | 14 |
| Stable isotopes of fractions | 12 | 1 | 1 | 14 |

## *Steranes Triangle Plots*


Mic Mac D-89 2950
Mic Mac J-77 3241
Mic Mac J-77 4276
Mic Mac J-77 6520
Mic Mac J-77 6750
Mic Mac J-77 11770
Erie D-26 5940
Erie D-26 6060
Erie D-26 6220
Erie D-26 7381.12
Wyandot E-53 7770
Wyandot E-53 9150
Missisauga H-54 7920
Primrose N-50 1650.51
29ββ (R+S), %
29αα (R+S), %
29αα (R+S), %
0
20
40
60
80
100


Mic Mac D-89 2950
Mic Mac J-77 3241
Mic Mac J-77 4276
Mic Mac J-77 6520
Mic Mac J-77 6750
Mic Mac J-77 11770
Erie D-26 5940
Erie D-26 6060
Erie D-26 6220
Erie D-26 7381.12
Wyandot E-53 7770
Wyandot E-53 9150
Missisauga H-54 7920
Primrose N-50 1650.51
28ααR, %
29ααR, %
27ααR, %
0
20
40
60
80
100


□ Mic Mac D-89 2950
◇ Mic Mac J-77 3241
△ Mic Mac J-77 4276
▽ Mic Mac J-77 6520
○ Mic Mac J-77 6750
+ Mic Mac J-77 11770
× Erie D-26 5940
✳ Erie D-26 6060
— Erie D-26 6220
/ Erie D-26 7381.12
\ Wyandot E-53 7770
| Wyandot E-53 9150
□ Missisauga H-54 7920
◇ Primrose N-50 1650.51
28ββ (R+S), %
29ββ (R+S), %
27ββ (R+S), %
0
20
40
60
80
100
100
80
60
40
20
0
0
20
40
60
80
100
100
80
60
40
20
0

## *Table A2. GC of Whole Oil (parameters)*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | A | B | X | W | C | I | F | H | U | R | S | CPI 1 | Pr/n-C17 | Ph/n-C18 | (Pr/n-C17)/(Ph/n- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 |  | 0.94 | 12.62 |  | 0.58 | 1.42 | 0.69 | 27.76 |  | 5.84 |  | 1.10 | 0.22 | 0.10 | 2.11 |

Table 2. continued, GC of Whole Oil (parameters)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Pr/Ph | n-C17/(n-C17+n-C27) | Tr1 | Tr2 | Tr3 | Tr4 | Tr5 | Tr7 | Tr8 | C1 | C2 | C3 | C4 | C5 | P1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.73 | 0.81 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 7.093 | 0.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 22.12 |

## Table 2. continued, GC of Whole Oil (parameters)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | P2 | P3 | 5N1 | N2 | 6N1 | K1 | K2 | 5N1/6N1 | P3/N2 | ln(24DMP/23 DMP) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 11.26 | 1.59 | 8.50 | 3.48 | 53.05 | 0.719 | 0.108 | 0.160 | 0.455 | -inf |

**A:** Benz/n-$C_6$
**B:** Tol/n-$C_7$
**X:** m+p-Xyl/n-$C_8$
**W:** Benz*10/Cy$C_6$
**C:** (n-$C_6$+n-$C_7$)/(Cy$C_6$+MCy$C_6$)
**I:** (2-M$C_6$+3-M$C_6$)/(c1,3-DMCy$C_5$+t1,3-DMCy$C_5$+t1,2-DMCy$C_5$)
**F:** n-$C_7$/MCy$C_6$
**H:** n-$C_7$*100/
(Cy$C_6$+2-M$C_6$+3-M$C_6$+c1,3-DMCy$C_5$+t1,3-DMCy$C_5$+t1,2-DMCy$C_5$+n-$C_7$+MCy$C_6$)
**U:** Cy$C_6$/MCy$C_5$
**R:** n-$C_7$/2-M$C_6$
**S:** n-$C_6$/2,2-DM$C_4$
**CPI1** 0.5*((n-$C_{25}$+n-$C_{27}$+n-$C_{29}$+n-$C_{31}$)/(n-$C_{24}$+n-$C_{26}$+n-$C_{28}$+n-$C_{30}$)+(n-$C_{25}$+n-$C_{27}$+n-$C_{29}$+n-$C_{31}$)/
(n-$C_{26}$+n-$C_{28}$+n-$C_{30}$+n-$C_{32}$))
**Tr1** Tol/1,1-DMCy$C_5$
**Tr2** n-$C_7$/1,1-DMCy$C_5$
**Tr3** 3-M$C_6$/1,1-DMCy$C_5$
**Tr4** 2-M$C_6$/1,1-DMCy$C_5$
**Tr5** (2-M$C_6$+3-M$C_6$)/1,1-DMCy$C_5$
**Tr7** t-1,3-DMCy$C_5$/1,1-DMCy$C_5$
**Tr8** (2-M$C_6$+3-M$C_6$)/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**C1** 2,2-DM$C_5$/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**C2** 2,3-DM$C_5$/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**C3** 2,4-DM$C_5$/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**C4** 3,3-DM$C_5$/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**C5** 3-E$C_5$/(2,2-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+3,3-DM$C_5$+3-E$C_5$)
**SumP** 2,2-DM$C_5$+2,4-DM$C_5$+2,2,3-TM$C_4$+3,3-DM$C_5$+2-M$C_6$+2,3-DM$C_5$+1,1-DMCy$C_5$+
3-M$C_6$+c-1,3-DMCy$C_5$+t-1,3-DMCy$C_5$+3-E$C_5$+t-1,2-DMCy$C_5$+n-$C_7$+MCy$C_6$+ECy$C_5$+Tol
**P1** 100*n-$C_7$/SumP
**P2** 100*(2-M$C_6$+3-M$C_6$)/SumP
**P3** 100*(3-E$C_5$+3,3-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+2,2-DM$C_5$+2,2,3-TM$C_4$)/SumP
**5N1** 100*(ECy$C_5$+t-1,2-DMCy$C_5$)/SumP
**N2** 100*(1,1-DMCy$C_5$+c-1,3-DMCy$C_5$+t-1,3-DMCy$C_5$)/SumP
**6N1** 100*(MCy$C_6$+Tol)/SumP
**dK1** (2-M$C_6$+2,3-DM$C_5$)/(3-M$C_6$+2,4-DM$C_5$)
**dK2** (3-E$C_5$+3,3-DM$C_5$+2,3-DM$C_5$+2,4-DM$C_5$+2,2-DM$C_5$+2,2,3-TM$C_4$)/
(2-M$C_6$+3-M$C_6$+1,1-DMCy$C_5$+c-1,3-DMCy$C_5$+t-1,3-DMCy$C_5$)
**5N16N1** (ECy$C_5$+t-1,2-DMCy$C_5$)/(MCy$C_6$+Tol)

## Table A3. GC of saturated compounds (parameters)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | CPI 1 | Pr/n-C17 | Ph/n-C18 | (Pr/n-C17)/ (Ph/n-C18) | Pr/Ph | n-C17/ (n-C17+n-C27) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.94 | 0.90 | 0.64 | 1.40 | 2.16 | 0.85 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.65 | 1.82 | 1.02 | 1.78 | 1.00 | 0.31 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.09 | 1.83 | 1.34 | 1.37 | 0.92 | 0.49 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.23 | 0.84 | 0.97 | 0.87 | 1.12 | 0.73 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.08 | 0.82 | 0.77 | 1.06 | 1.32 | 0.19 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.11 | 0.67 | 0.60 | 1.12 | 1.11 | 0.67 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.36 | 1.41 | 0.99 | 1.43 | 1.17 | 0.73 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.18 | 1.06 | 1.23 | 0.87 | 1.29 | 0.80 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 1.59 | 0.85 | 0.70 | 1.22 | 1.29 | 0.66 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 0.87 | 1.00 | 3.17 | 0.31 | 0.34 | 0.21 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.57 | 0.65 | 0.62 | 1.06 | 1.48 | 0.74 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.00 | 0.82 | 0.72 | 1.14 | 0.97 | 0.53 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.34 | 0.63 | 0.64 | 0.98 | 0.90 | 0.66 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.09 | 0.21 | 0.10 | 2.22 | 2.53 | 0.79 |

## *Table A4. GCMS SIR of saturated compounds (parameters)*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | %23:3 | %28ab | %30D | %27Ts | %22S | %29Ts | %20S | %bb | %27dbS | %C27 | %C29 | 28/29 | 24:4/23:3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 27.58 | 7.10 | 3.52 | 51.48 | 57.55 | 20.50 | 42.69 | 53.29 | 39.67 | 34.98 | 43.11 | 0.47 | 0.37 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 10.78 | 5.74 | 5.25 | 44.00 | 57.13 | 17.34 | 47.26 | 52.28 | 50.63 | 35.25 | 38.58 | 0.63 | 0.66 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 36.13 | 2.89 | 4.84 | 52.80 | 58.87 | 27.68 | 52.86 | 57.37 | 35.99 | 32.32 | 43.96 | 0.48 | 0.38 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 36.35 | 34.69 | 6.49 | 21.07 | 48.54 | 10.13 | 28.72 | 50.59 | 44.48 | 29.49 | 48.04 | 0.38 | 0.28 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 36.42 | 22.15 | 6.93 | 21.77 | 45.90 | 10.73 | 30.98 | 42.86 | 42.57 | 33.53 | 41.17 | 0.44 | 0.29 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 41.22 | 9.46 | 8.53 | 26.91 | 59.69 | 12.34 | 49.95 | 49.19 | 27.25 | 39.35 | 33.15 | 0.63 | 0.31 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 22.83 | 9.42 | 6.68 | 52.69 | 58.88 | 16.63 | 56.38 | 61.75 | 62.46 | 37.50 | 27.53 | 1.14 | 0.20 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 19.10 | 5.67 | 4.87 | 47.55 | 59.59 | 17.72 | 53.06 | 58.13 | 57.31 | 36.64 | 31.24 | 0.91 | 0.35 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 23.13 | 8.59 | 5.47 | 40.32 | 54.25 | 14.63 | 46.25 | 55.60 | 61.17 | 37.63 | 29.38 | 0.93 | 0.24 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 7.43 | 1.09 | 2.36 | 43.50 | 59.92 | 19.29 | 54.66 | 57.56 | 27.64 | 30.25 | 48.97 | 0.39 | 0.73 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 14.77 | 8.75 | 6.09 | 28.99 | 56.39 | 14.82 | 44.48 | 54.44 | 54.43 | 34.05 | 35.02 | 0.73 | 0.37 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 14.97 | 4.71 | 4.19 | 44.25 | 59.91 | 19.23 | 54.06 | 57.05 | 48.18 | 34.40 | 37.04 | 0.63 | 0.46 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 39.73 | 21.84 | 4.82 | 22.58 | 46.19 | 10.16 | 26.55 | 42.27 | 42.63 | 37.15 | 36.04 | 0.60 | 0.25 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 13.60 | 14.26 | 16.09 | 29.10 | 59.93 | 14.98 | 48.94 | 50.70 | 60.18 | 26.73 | 53.83 | 0.27 | 1.71 |

| | |
|---|---|
| **%23:3** | 23:3/(23:3+30αβ)*100 |
| **%28αβ** | 28αβ/(28αβ+30αβ)*100 |
| **%30D** | 30D/(30D+30αβ)*100 |
| **%27Ts** | 27Ts/(27Ts+27Tm)*100 |
| **%22S** | 32αβS/(32αβS+32αβR)*100 |
| **%29Ts** | 29Ts/(29Ts+30αβ)*100 |
| **%20S** | 29ααS/(29ααS+29ααR)*100 |
| **%ββ** | 29ββ(R+S)/(29ββ(R+S)+29αα(R+S))*100 |
| **%27dβS** | 27dβS/(27dβS+27αα(R+S))*100 |
| **%C27** | 27ββ(R+S)/(27ββ(R+S)+28ββ(R+S)+29ββ(R+S))*100 |
| **%C29** | 29ββ(R+S)/(27ββ(R+S)+28ββ(R+S)+29ββ(R+S))*100 |
| **28/29** | (28αα(R+S)+28ββ(R+S))/(29αα(R+S)+29ββ(R+S)) |
| **24:4/23:3** | 24:4/23:3 |

## Table A4 cont. GCMS SIR of saturated compounds (parameters)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 22/21 | 24/23 | 26/25 | 24/26 | 29/30 | %βa | %31 22S | 35/34 | %C30 25-nor | Gm Inex | ETR | 27/29 | 30/27-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 0.52 | 0.52 | 0.76 | 0.92 | 0.74 | 11.08 | 50.54 | 1.08 | 0.00 | 1.08 | 0.54 | 0.81 | 0.05 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.34 | 0.76 | 1.06 | 0.76 | 0.59 | 14.33 | 56.55 | 0.84 | 9.67 | 0.34 | 0.54 | 0.91 | 0.04 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 0.35 | 0.56 | 0.69 | 1.19 | 0.73 | 8.26 | 53.23 | 1.08 | 0.00 | 1.60 | 0.58 | 0.74 | 0.05 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 0.39 | 0.48 | 0.63 | 1.39 | 0.51 | 23.62 | 51.00 | 0.88 | 0.00 | 0.42 | 0.63 | 0.61 | 0.03 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 0.43 | 0.45 | 0.66 | 1.28 | 0.61 | 24.35 | 50.55 | 0.79 | 0.00 | 0.48 | 0.65 | 0.81 | 0.03 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 0.43 | 0.51 | 0.75 | 0.92 | 0.89 | 19.54 | 47.18 | 0.67 | 0.00 | 0.63 | 0.65 | 1.19 | 0.03 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 0.35 | 0.62 | 0.93 | 0.22 | 0.66 | 13.37 | 57.52 | 0.58 | 14.42 | 0.45 | 0.79 | 1.36 | 0.04 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 0.28 | 0.68 | 0.86 | 0.44 | 0.57 | 10.17 | 56.42 | 0.93 | 7.31 | 0.67 | 0.74 | 1.17 | 0.04 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 0.31 | 0.56 | 0.82 | 0.41 | 0.59 | 17.29 | 51.41 | 0.79 | 7.97 | 0.44 | 0.75 | 1.28 | 0.04 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 0.36 | 0.89 | 0.73 | 0.92 | 0.48 | 6.85 | 56.98 | 1.00 | 0.00 | 1.13 | 0.58 | 0.62 | 0.06 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 0.39 | 0.53 | 0.89 | 0.60 | 0.74 | 18.91 | 56.74 | 1.02 | 0.00 | 0.67 | 0.70 | 0.97 | 0.04 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 0.40 | 0.71 | 0.82 | 0.68 | 0.59 | 11.69 | 54.47 | 1.01 | 0.00 | 1.03 | 0.66 | 0.93 | 0.05 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 0.38 | 0.46 | 0.69 | 1.01 | 0.63 | 26.50 | 39.87 | 0.76 | 0.00 | 0.42 | 0.66 | 1.03 | 0.03 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.14 | 0.59 | 1.53 | 3.42 | 0.83 | 17.33 | 60.17 | 0.43 | 0.00 | 0.21 | 0.35 | 0.50 | 0.03 |

| | |
|---|---|
| **22/21** | 22:3/21:3 |
| **24/23** | 24:3/23:3 |
| **26/25** | 26:3/25:3 |
| **24/26** | 24:4/26:3 R+S |
| **29/30** | 29αβ/30αβ |
| **%βα** | 30βα/(30βα+30αβ)*100 |
| **%31 22S** | 29ααS/(29ααS+29ααR)*100 |
| **35/34** | 35αβS/34αβS |
| **%C30 25-nor** | 30O/(30O+30αβ))*100 (30O is actually $C_{30}$ 22S 17α(H)-25-norhopane that elutes at similar retention time to oleanane) |
| **Gm index** | (10*30G)/(30G+30αβ) |
| **ETR** | 28:3+29:3/28:3+29:3+27Ts |
| **27/29** | (27ββ(R+S)/(29ββ(R+S) |
| **30/27-30** | 30ββ(R+S)/(27+28+29+30ββ(R+S)) |

## Table A5. GCMS SIR of aromatic compounds (parameters)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | AROM2 | Crack1 | Crack2 | MSAro1 | MSAro2 | MSAro3 | MSAro4 | MSAro5 | MSAro6 | MSAro7 | MSAro8 | MSAro9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 0.60 | 0.67 | 0.44 | 0.30 | 3.76 | 0.52 | 2.24 | 7.16 | 2.35 | 0.07 | 1.66 | 0.41 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.69 | 0.33 | 0.15 | 0.17 | 6.22 | 0.56 | 1.93 | 7.28 | 1.82 | 0.08 | 1.29 | 0.69 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 0.68 | 0.70 | 0.47 | 0.33 | 4.35 | 0.55 | 1.96 | 6.64 | 2.20 | 0.08 | 2.55 | 0.62 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 0.53 | 0.63 | 0.42 | 0.18 | 3.73 | 0.42 | 1.82 | 3.87 | 3.13 | 0.02 | 0.89 | 0.30 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 0.47 | 0.50 | 0.27 | 0.16 | 2.91 | 0.43 | 1.77 | 3.77 | 2.09 | 0.02 | 0.58 | 0.32 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 0.86 | 0.74 | 0.54 | 0.33 | 2.82 | 0.43 | 1.70 | 4.44 | 1.05 | 0.07 | 3.84 | 0.78 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 0.59 | 0.76 | 0.53 | 0.16 | 3.63 | 0.52 | 1.83 | 6.18 | 2.61 | 0.04 | 13.30 | 0.49 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 0.85 | 0.66 | 0.46 | 0.25 | 1.75 | 0.41 | 1.59 | 4.32 | 2.77 | 0.01 | 1.73 | 0.75 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 0.63 | 0.56 | 0.44 | 0.14 | 3.42 | 0.48 | 1.83 | 5.63 | 1.61 | 0.02 | 1.29 | 0.41 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 0.90 | 0.16 | 0.09 | 0.09 | 1.15 | 0.32 | 1.29 | 2.26 | 3.43 | 0.08 | 3.69 | 0.89 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 0.49 | 0.34 | 0.24 | 0.13 | 2.12 | 0.42 | 1.75 | 4.39 | 1.31 | 0.03 | 0.61 | 0.31 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 0.86 | 0.64 | 0.39 | 0.23 | 2.26 | 0.44 | 1.44 | 3.30 | 1.53 | 0.05 | 8.79 | 0.77 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 0.51 | 0.41 | 0.16 | 0.14 | 3.81 | 0.43 | 1.70 | 3.37 | 1.46 | 0.03 | 1.62 | 0.40 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.61 | 0.77 | 0.53 | 0.47 | 9.14 | 0.58 | 2.36 | 9.12 | 1.52 | 0.04 | 6.14 | 0.50 |

AROM2: $(C_{20}TA+C_{21}TA+SC_{26}TA+RC_{26}TA+SC_{27}TA+SC_{28}TA+RC_{27}TA+RC_{28}TA/(C_{20}TA+C_{21}TA+SC_{26}TA+RC_{26}TA+SC_{27}TA+SC_{28}TA+RC_{27}TA+RC_{28}TA+C_{21}MA+C_{22}MA+\beta SC_{27}MA+\beta RC_{27}MA+\beta RC_{27}DMA+\alpha SC_{27}MA+\beta SC_{28}MA+\beta SC_{28}DMA+\alpha RC_{27}DMA+\alpha SC_{27}DMA+\alpha RC_{27}MA+\alpha SC_{28}MA+\alpha SC_{29}MA+\alpha RC_{29}MA)$
Crack1: $(C_{20}TA)/(C_{20}TA+RC_{28}TA)$
Crack2: $(C_{20}TA+C_{21}TA)/(C_{20}TA+C_{21}TA+SC_{26}TA+RC_{26}TA+SC_{27}TA+SC_{28}TA+RC_{27}TA+RC_{28}TA)$
MSAro1: $(C_{21}MA+C_{22}MA)/(C_{21}MA+C_{22}MA+\beta SC_{27}MA+\beta RC_{27}MA+\beta RC_{27}DMA+\alpha SC_{27}MA+\beta SC_{28}MA+\beta SC_{28}DMA+\alpha RC_{27}DMA+\alpha SC_{27}DMA+\alpha RC_{27}MA+\alpha SC_{28}MA+\alpha SC_{29}MA+\alpha RC_{29}MA)$
MSAro2: 4-MDBT/1-MDBT
MSAro3: (2-MP+3-MP)/(1-MP+2-MP+3-MP+9-MP)
MSAro4: 2-MN/1-MN
MSAro5: (2,6-DMN+2,7-DMN)/1,5-DMN
MSAro6: 4-MDBT/DBT
MSAro7: DBT/P
MSAro8: 3-MP/Retene
MSAro9: $RC_{28}TA/( RC_{28}TA+\alpha RC_{28}MA+\beta RC_{29}MA+\beta RC_{29}DMA)$

## *Table A6. Leco TOC data*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | TOC (%) |
|---|---|---|---|---|---|---|
| Mic Mac H-86 | DC | 9330 | 9340 | ft | 228137X | 5.08 |
| Mic Mac H-86 | DC | 9540 | 9550 | ft | 228138X | 2.07 |
| Mic Mac H-86 | DC | 9550 | 9560 | ft | 228139X | 4.95 |
| Mic Mac H-86 | DC | 9560 | 9570 | ft | 228140X | 2.86 |
| Mic Mac H-86 | DC | 9570 | 9580 | ft | 228141X | 2.27 |
| Mic Mac H-86 | DC | 9620 | 9630 | ft | 228142X | 5.02 |
| Mic Mac H-86 | DC | 9650 | 9660 | ft | 228143X | 1.69 |
| Mic Mac H-86 | DC | 9700 | 9710 | ft | 228144X | 1.40 |
| Mic Mac H-86 | DC | 9710 | 9720 | ft | 228145X | 3.61 |
| Mic Mac H-86 | DC | 9720 | 9730 | ft | 228146X | 2.50 |
| Mic Mac H-86 | DC | 9730 | 9740 | ft | 228147X | 2.24 |
| Mic Mac H-86 | DC | 9740 | 9750 | ft | 228148X | 5.82 |
| Mic Mac H-86 | DC | 9750 | 9760 | ft | 228149X | 3.73 |
| Mic Mac H-86 | DC | 9760 | 9770 | ft | 228150X | 5.54 |
| Mic Mac H-86 | DC | 9770 | 9780 | ft | 228151X | 4.17 |
| Mic Mac H-86 | DC | 9780 | 9790 | ft | 228152X | 3.24 |
| Mic Mac H-86 | DC | 9790 | 9800 | ft | 228153X | 2.34 |
| Mic Mac H-86 | DC | 9800 | 9810 | ft | 228154X | 2.27 |
| Mic Mac H-86 | DC | 9810 | 9820 | ft | 228155X | 1.57 |
| Mic Mac H-86 | DC | 9820 | 9830 | ft | 228156X | 1.88 |

# *Table A7. TOC and Rock-Eval data*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | S1 (mg/g) | S2 (mg/g) | S3 (mg/g) | Tmax (°C) | PP (mg/g) | PI (wt ratio) | HI (mg HC/ g TOC) | OI (mg CO2/ g TOC) | TOC (%)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac H-86 | DC | 9330 | 9340 | ft | 228137X | 0.24 | 8.02 | 0.22 | 437 | 8.26 | 0.03 | 158 | 4 | 5.08 |
| Mic Mac H-86 | DC | 9540 | 9550 | ft | 228138X | 0.16 | 2.99 | 0.12 | 447 | 3.15 | 0.05 | 144 | 6 | 2.07 |
| Mic Mac H-86 | DC | 9550 | 9560 | ft | 228139X | 0.20 | 7.91 | 0.19 | 437 | 8.11 | 0.02 | 160 | 4 | 4.95 |
| Mic Mac H-86 | DC | 9560 | 9570 | ft | 228140X | 0.12 | 3.43 | 0.20 | 443 | 3.55 | 0.03 | 120 | 7 | 2.86 |
| Mic Mac H-86 | DC | 9570 | 9580 | ft | 228141X | 0.12 | 2.77 | 0.17 | 447 | 2.89 | 0.04 | 122 | 7 | 2.27 |
| Mic Mac H-86 | DC | 9620 | 9630 | ft | 228142X | 0.24 | 8.74 | 0.22 | 443 | 8.98 | 0.03 | 174 | 4 | 5.02 |
| Mic Mac H-86 | DC | 9650 | 9660 | ft | 228143X | 0.14 | 1.44 | 0.17 | 446 | 1.58 | 0.09 | 85 | 10 | 1.69 |
| Mic Mac H-86 | DC | 9700 | 9710 | ft | 228144X | 0.15 | 1.07 | 0.18 | 445 | 1.22 | 0.12 | 76 | 13 | 1.40 |
| Mic Mac H-86 | DC | 9710 | 9720 | ft | 228145X | 0.14 | 4.62 | 0.19 | 442 | 4.76 | 0.03 | 128 | 5 | 3.61 |
| Mic Mac H-86 | DC | 9720 | 9730 | ft | 228146X | 0.11 | 2.56 | 0.19 | 441 | 2.67 | 0.04 | 102 | 8 | 2.50 |
| Mic Mac H-86 | DC | 9730 | 9740 | ft | 228147X | 0.13 | 2.65 | 0.18 | 438 | 2.78 | 0.05 | 118 | 8 | 2.24 |
| Mic Mac H-86 | DC | 9740 | 9750 | ft | 228148X | 0.16 | 8.19 | 0.22 | 442 | 8.35 | 0.02 | 141 | 4 | 5.82 |
| Mic Mac H-86 | DC | 9750 | 9760 | ft | 228149X | 0.17 | 5.72 | 0.18 | 437 | 5.89 | 0.03 | 153 | 5 | 3.73 |
| Mic Mac H-86 | DC | 9760 | 9770 | ft | 228150X | 0.19 | 9.21 | 0.23 | 435 | 9.40 | 0.02 | 166 | 4 | 5.54 |
| Mic Mac H-86 | DC | 9770 | 9780 | ft | 228151X | 0.15 | 5.53 | 0.24 | 442 | 5.68 | 0.03 | 133 | 6 | 4.17 |
| Mic Mac H-86 | DC | 9780 | 9790 | ft | 228152X | 0.15 | 4.39 | 0.21 | 441 | 4.54 | 0.03 | 135 | 6 | 3.24 |
| Mic Mac H-86 | DC | 9790 | 9800 | ft | 228153X | 0.13 | 2.82 | 0.16 | 446 | 2.95 | 0.04 | 121 | 7 | 2.34 |
| Mic Mac H-86 | DC | 9800 | 9810 | ft | 228154X | 0.10 | 2.34 | 0.14 | 444 | 2.44 | 0.04 | 103 | 6 | 2.27 |
| Mic Mac H-86 | DC | 9810 | 9820 | ft | 228155X | 0.09 | 1.64 | 0.19 | 443 | 1.73 | 0.05 | 104 | 12 | 1.57 |
| Mic Mac H-86 | DC | 9820 | 9830 | ft | 228156X | 0.10 | 1.87 | 0.16 | 446 | 1.97 | 0.05 | 99 | 9 | 1.88 |

*: Leco TOC

## Table A8. Extraction, Asphaltene precipitation and MPLC data

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Rock weight (g) | EOM (mg) | EOM (mg/kg Rock) | SAT (wt% of EOM/Oil) | ARO (wt% of EOM/Oil) | POL (wt% of EOM/Oil) | ASP (wt% of EOM/Oil) | HC (wt% of EOM/Oil) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 8.544 | 7.5 | 878 | 22.4 | 7.9 | 51.6 | 18.1 | 30.3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 10.683 | 203.6 | 19058 | 32.9 | 6.5 | 44.8 | 15.9 | 39.3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 7.028 | 19.6 | 2789 | 32.5 | 9.1 | 47.4 | 11.1 | 41.5 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 8.499 | 9.9 | 1165 | 19.6 | 8.3 | 42.7 | 29.3 | 28.0 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 8.517 | 8.8 | 1033 | 22.1 | 7.1 | 36.9 | 33.8 | 29.3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 9.639 | 5.4 | 560 | 22.9 | 13.8 | 37.6 | 25.7 | 36.7 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 8.995 | 6.5 | 723 | 3.5 | 0.6 | 86.8 | 9.1 | 4.2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 8.952 | 21.8 | 2435 | 27.2 | 10.4 | 42.9 | 19.5 | 37.6 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 8.974 | 8.3 | 925 | 26.5 | 8.7 | 43.0 | 21.7 | 35.3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 13.107 | 189.5 | 14458 | 16.1 | 12.8 | 36.6 | 34.5 | 28.9 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 8.584 | 6.5 | 757 | 25.1 | 12.1 | 41.5 | 21.4 | 37.1 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 10.231 | 17.0 | 1662 | 34.8 | 7.7 | 40.8 | 16.7 | 42.5 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 9.045 | 2.7 | 299 | 21.2 | 7.8 | 46.3 | 24.7 | 29.0 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 |  |  |  | 52.6 | 40.8 | 6.3 | 0.3 | 93.4 |

## *Table A9. GC of Whole Oil (peak area)*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | IS | n-C3 | i-C4 | n-C4 | i-C5 | n-C5 | 2,2-DMC4 | CyC5 | 2,3-DMC4 | 2-MC5 | 3-MC5 | n-C6 | 2,2-DMC5 | MCyC5 | 2,4-DMC5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.83e3 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 2.42e2 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2,2,3-TMC4 | Benz | 3,3-DMC5 | CyC6 | 2-MC6 | 2,3-DMC5 | 1,1-DMCyC5 | 3-MC6 | c-1,3-DMCyC5 | t-1,3-DMCyC5 | 3-EC5 | t-1,2-DMCyC5 | n-C7 | c-1,2-DMCyC5 | MCyC6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.00e0 | 0.00e0 | 0.00e0 | 2.33e0 | 1.40e0 | 5.88e-01 | 0.00e0 | 2.77e0 | 5.87e-01 | 7.29e-01 | 0.00e0 | 1.69e0 | 8.19e0 | 0.00e0 | 1.22e1 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,1,3-TMCyC5 | ECyC5 | 2,5-DMC6 | 2,2,3-TMC5+2,4-DMC6 | c,t-1,2,4-TMCyC5 | 3,3-DMC6 | t,c-1,2,3-TMCyC5 | 2,3,4-TMC5 | Tol | 2,3-DMC6 | 2-MC7 | 4-MC7 | 3-MC7 | c-1,3-DMCyC6 | t-1,4-DMCyC6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 4.77e-01 | 1.52e0 | 5.70e-01 | 8.68e-01 | 1.11e0 | 0.00e0 | 8.91e-01 | 0.00e0 | 8.39e0 | 6.65e-01 | 7.95e0 | 2.28e0 | 6.33e0 | 1.41e1 | 4.80e0 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,1-DMCyC6 | t-1,2-DMCyC6 | n-C8 | E-CyC6 | i-C9 | E-Benz | m-Xyl | p-Xyl | 4-MC8 | 2-MC8 | 3-MC8 | o-Xyl | n-C9 | i-C10 | n-C10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.37e0 | 9.51e0 | 5.03e1 | 7.20e1 | 1.45e1 | 5.32e1 | 5.45e2 | 1.38e2 | 4.48e1 | 6.42e1 | 7.74e1 | 3.35e2 | 4.79e2 | 8.40e1 | 1.47e3 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | i-C11 | n-C11 | n-C12 | i-C13 | i-C14 | n-C13 | i-C15 | n-C14 | i-C16 | n-C15 | n-C16 | i-C18 | n-C17 | Pristane | n-C18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.40e2 | 2.61e3 | 3.66e3 | 4.69e2 | 3.91e2 | 4.41e3 | 4.89e2 | 4.73e3 | 1.07e3 | 6.56e3 | 5.26e3 | 8.89e2 | 4.90e3 | 1.09e3 | 3.79e3 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Phytane | n-C19 | n-C20 | n-C21 | n-C22 | n-C23 | n-C24 | n-C25 | n-C26 | n-C27 | n-C28 | n-C29 | n-C30 | n-C31 | n-C32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 3.98e2 | 3.33e3 | 2.73e3 | 2.44e3 | 2.13e3 | 1.91e3 | 1.65e3 | 1.53e3 | 1.31e3 | 1.14e3 | 9.02e2 | 8.13e2 | 5.62e2 | 4.63e2 | 2.68e2 |

Table 9. continued, GC of Whole Oil (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C33 | n-C34 | n-C35 | n-C36 |
|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.17e2 | 1.21e2 | 8.81e1 | 5.23e1 |

## *Table A10. GC of Whole Oil (amounts in ng/g)*

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | IS | n-C3 | i-C4 | n-C4 | i-C5 | n-C5 | 2,2-DMC4 | CyC5 | 2,3-DMC4 | 2-MC5 | 3-MC5 | n-C6 | 2,2-DMC5 | MCyC5 | 2,4-DMC5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 6.68e6 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 5.74e5 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2,2,3-TMC4 | Benz | 3,3-DMC5 | CyC6 | 2-MC6 | 2,3-DMC5 | 1,1-DMCyC5 | 3-MC6 | c-1,3-DMCyC5 | t-1,3-DMCyC5 | 3-EC5 | t-1,2-DMCyC5 | n-C7 | c-1,2-DMCyC5 | MCyC6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.00e0 | 0.00e0 | 0.00e0 | 5.41e3 | 3.32e3 | 1.39e3 | 0.00e0 | 6.55e3 | 1.36e3 | 1.69e3 | 0.00e0 | 3.91e3 | 1.94e4 | 0.00e0 | 2.82e4 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,1,3-TMCyC5 | ECyC5 | 2,5-DMC6 | 2,2,3-TMC5+2,4-DMC6 | c,t-1,2,4-TMCyC5 | 3,3-DMC6 | t,c-1,2,3-TMCyC5 | 2,3,4-TMC5 | Tol | 2,3-DMC6 | 2-MC7 | 4-MC7 | 3-MC7 | c-1,3-DMCyC6 | t-1,4-DMCyC6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.11e3 | 3.54e3 | 1.35e3 | 2.05e3 | 2.57e3 | 0.00e0 | 2.07e3 | 0.00e0 | 1.83e4 | 1.57e3 | 1.88e4 | 5.39e3 | 1.49e4 | 3.27e4 | 1.11e4 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,1-DMCyC6 | t-1,2-DMCyC6 | n-C8 | E-CyC6 | i-C9 | E-Benz | m-Xyl | p-Xyl | 4-MC8 | 2-MC8 | 3-MC8 | o-Xyl | n-C9 | i-C10 | n-C10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 5.49e3 | 2.21e4 | 1.19e5 | 1.67e5 | 3.41e4 | 1.17e5 | 1.20e6 | 3.03e5 | 1.06e5 | 1.51e5 | 1.83e5 | 7.35e5 | 1.13e6 | 1.97e5 | 3.46e6 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | i-C11 | n-C11 | n-C12 | i-C13 | i-C14 | n-C13 | i-C15 | n-C14 | i-C16 | n-C15 | n-C16 | i-C18 | n-C17 | Pristane | n-C18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 3.29e5 | 6.12e6 | 8.60e6 | 1.10e6 | 9.16e5 | 1.03e7 | 1.15e6 | 1.11e7 | 2.50e6 | 1.54e7 | 1.23e7 | 2.08e6 | 1.15e7 | 2.54e6 | 8.86e6 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Phytane | n-C19 | n-C20 | n-C21 | n-C22 | n-C23 | n-C24 | n-C25 | n-C26 | n-C27 | n-C28 | n-C29 | n-C30 | n-C31 | n-C32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 9.30e5 | 7.79e6 | 6.37e6 | 5.69e6 | 4.97e6 | 4.45e6 | 3.84e6 | 3.58e6 | 3.06e6 | 2.66e6 | 2.10e6 | 1.89e6 | 1.31e6 | 1.08e6 | 6.24e5 |

Table 10. continued, GC of Whole Oil (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C33 | n-C34 | n-C35 | n-C36 |
|---|---|---|---|---|---|---|---|---|---|
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 5.04e5 | 2.83e5 | 2.05e5 | 1.22e5 |

## Table A11. GC of saturated compounds (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C8 | n-C9 | n-C10 | n-C11 | n-C12 | i-C13 | i-C14 | n-C13 | i-C15 | n-C14 | i-C16 | n-C15 | n-C16 | i-C18 | n-C17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 0.00e0 | 0.00e0 | 1.10e1 | 3.20e1 | 5.00e1 | 4.00e1 | 2.10e1 | 1.47e2 | 4.10e1 | 2.49e2 | 2.19e2 | 1.85e2 | 1.78e2 | 8.60e1 | 1.25e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.00e0 | 0.00e0 | 3.00e0 | 2.00e1 | 2.50e1 | 1.50e1 | 7.00e0 | 3.80e1 | 1.20e1 | 3.90e1 | 3.00e1 | 2.60e1 | 2.40e1 | 1.90e1 | 2.80e1 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 0.00e0 | 0.00e0 | 1.20e1 | 2.90e1 | 3.60e1 | 1.90e1 | 1.20e1 | 6.40e1 | 2.50e1 | 1.26e2 | 1.18e2 | 1.07e2 | 1.12e2 | 9.00e1 | 1.06e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 0.00e0 | 3.60e1 | 9.30e1 | 1.36e2 | 1.34e2 | 4.60e1 | 2.30e1 | 1.89e2 | 4.90e1 | 2.71e2 | 1.61e2 | 3.25e2 | 3.25e2 | 1.21e2 | 2.64e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 0.00e0 | 3.60e1 | 8.30e1 | 1.36e2 | 1.58e2 | 5.70e1 | 4.10e1 | 2.11e2 | 6.20e1 | 2.93e2 | 1.46e2 | 3.00e2 | 2.66e2 | 9.30e1 | 2.18e2 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 0.00e0 | 3.20e1 | 9.00e1 | 1.25e2 | 1.24e2 | 3.90e1 | 3.20e1 | 1.59e2 | 4.70e1 | 2.02e2 | 8.80e1 | 2.09e2 | 2.09e2 | 7.40e1 | 2.29e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 0.00e0 | 0.00e0 | 2.70e1 | 7.10e1 | 7.00e1 | 5.00e1 | 3.00e1 | 1.22e2 | 4.70e1 | 1.71e2 | 1.30e2 | 1.62e2 | 1.89e2 | 1.38e2 | 2.25e2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 0.00e0 | 3.00e0 | 3.40e1 | 1.01e2 | 1.27e2 | 8.20e1 | 6.20e1 | 2.05e2 | 1.26e2 | 3.82e2 | 2.37e2 | 4.20e2 | 3.70e2 | 1.82e2 | 2.83e2 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 0.00e0 | 4.00e0 | 4.20e1 | 8.80e1 | 9.70e1 | 4.90e1 | 3.40e1 | 1.35e2 | 7.00e1 | 2.45e2 | 1.42e2 | 3.12e2 | 3.36e2 | 1.54e2 | 3.34e2 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 0.00e0 | 0.00e0 | 5.00e0 | 6.00e0 | 7.00e0 | 4.00e0 | 0.00e0 | 3.40e1 | 9.00e0 | 3.40e1 | 1.40e1 | 2.60e1 | 1.60e1 | 5.00e0 | 1.00e1 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 0.00e0 | 3.00e0 | 2.40e1 | 7.80e1 | 1.00e2 | 5.40e1 | 2.70e1 | 1.89e2 | 4.00e1 | 2.70e2 | 1.77e2 | 1.99e2 | 2.08e2 | 6.30e1 | 1.63e2 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 0.00e0 | 1.20e1 | 4.30e1 | 6.10e1 | 7.30e1 | 3.20e1 | 1.90e1 | 1.53e2 | 4.20e1 | 2.83e2 | 2.35e2 | 3.02e2 | 3.92e2 | 2.23e2 | 5.01e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 0.00e0 | 3.00e0 | 5.10e1 | 6.20e1 | 4.60e1 | 1.90e1 | 1.30e1 | 6.70e1 | 2.20e1 | 9.00e1 | 4.60e1 | 9.30e1 | 9.80e1 | 3.60e1 | 1.23e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.00e0 | 2.72e2 | 1.22e3 | 2.67e3 | 3.48e3 | 5.05e2 | 2.61e2 | 4.22e3 | 3.73e2 | 4.82e3 | 1.10e3 | 5.18e3 | 5.12e3 | 6.16e2 | 4.92e3 |

Table 11. continued, GC of saturated compounds (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Pr | n-C18 | Ph | n-C19 | n-C20 | n-C21 | n-C22 | n-C23 | n-C24 | n-C25 | n-C26 | n-C27 | n-C28 | n-C29 | n-C30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.12e2 | 8.10e1 | 5.20e1 | 4.40e1 | 3.80e1 | 5.50e1 | 5.60e1 | 3.20e1 | 2.00e1 | 1.60e1 | 1.00e1 | 2.20e1 | 1.00e1 | 2.80e1 | 1.10e1 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 5.10e1 | 5.00e1 | 5.10e1 | 7.50e1 | 9.80e1 | 7.80e1 | 8.20e1 | 6.50e1 | 6.50e1 | 6.20e1 | 5.10e1 | 6.40e1 | 1.80e1 | 2.30e1 | 0.00e0 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.94e2 | 1.58e2 | 2.11e2 | 2.33e2 | 3.09e2 | 2.06e2 | 2.17e2 | 2.12e2 | 2.00e2 | 1.61e2 | 1.21e2 | 1.09e2 | 1.10e2 | 1.61e2 | 1.40e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.23e2 | 2.06e2 | 2.00e2 | 1.70e2 | 1.88e2 | 1.89e2 | 2.12e2 | 2.07e2 | 1.88e2 | 1.56e2 | 1.14e2 | 9.90e1 | 5.70e1 | 6.60e1 | 3.90e1 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.78e2 | 1.74e2 | 1.34e2 | 1.63e2 | 2.11e2 | 2.94e2 | 4.20e2 | 5.64e2 | 7.50e2 | 9.07e2 | 9.94e2 | 9.18e2 | 7.15e2 | 5.55e2 | 3.27e2 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.54e2 | 2.32e2 | 1.39e2 | 2.37e2 | 2.66e2 | 3.59e2 | 4.71e2 | 5.61e2 | 3.91e2 | 2.09e2 | 1.26e2 | 1.12e2 | 7.90e1 | 8.10e1 | 5.50e1 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.17e2 | 2.74e2 | 2.70e2 | 2.71e2 | 2.57e2 | 1.94e2 | 1.74e2 | 1.51e2 | 1.14e2 | 8.10e1 | 6.30e1 | 8.40e1 | 4.40e1 | 4.20e1 | 1.90e1 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 3.01e2 | 1.90e2 | 2.33e2 | 1.15e2 | 9.90e1 | 7.00e1 | 7.90e1 | 8.60e1 | 6.50e1 | 5.30e1 | 4.40e1 | 7.00e1 | 4.40e1 | 5.40e1 | 3.70e1 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.83e2 | 3.16e2 | 2.20e2 | 2.96e2 | 2.73e2 | 2.39e2 | 2.32e2 | 2.12e2 | 1.70e2 | 1.67e2 | 1.20e2 | 1.71e2 | 7.00e1 | 1.14e2 | 5.20e1 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.00e1 | 9.00e0 | 2.90e1 | 1.10e1 | 1.00e1 | 1.50e1 | 1.70e1 | 1.90e1 | 1.90e1 | 1.70e1 | 2.40e1 | 3.80e1 | 3.30e1 | 4.00e1 | 6.70e1 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.06e2 | 1.16e2 | 7.20e1 | 8.90e1 | 7.60e1 | 8.40e1 | 8.70e1 | 8.30e1 | 6.80e1 | 6.30e1 | 3.70e1 | 5.60e1 | 2.60e1 | 4.10e1 | 2.10e1 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 4.12e2 | 5.91e2 | 4.26e2 | 6.94e2 | 7.75e2 | 7.40e2 | 7.13e2 | 6.48e2 | 5.95e2 | 5.21e2 | 5.04e2 | 4.47e2 | 3.65e2 | 3.45e2 | 3.08e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 7.70e1 | 1.33e2 | 8.50e1 | 1.10e2 | 1.10e2 | 1.06e2 | 1.04e2 | 1.01e2 | 1.09e2 | 1.01e2 | 7.10e1 | 6.30e1 | 3.40e1 | 4.30e1 | 2.20e1 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.05e3 | 4.33e3 | 4.16e2 | 3.88e3 | 3.20e3 | 2.81e3 | 2.44e3 | 2.20e3 | 1.92e3 | 1.74e3 | 1.48e3 | 1.33e3 | 1.04e3 | 8.97e2 | 6.20e2 |

Table 11. continued, GC of saturated compounds (peak area)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C31 | n-C32 | n-C33 | n-C34 | n-C35 | n-C36 | n-C37 | n-C38 | n-C39 | n-C40 | n-C41 | n-C42 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.80e1 | 7.00e0 | 8.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.22e2 | 8.10e1 | 4.70e1 | 2.60e1 | 3.50e1 | 1.10e1 | 9.00e0 | 1.00e1 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 5.00e1 | 3.30e1 | 3.10e1 | 1.80e1 | 2.10e1 | 1.10e1 | 1.10e1 | 9.00e0 | 8.00e0 | 5.00e0 | 6.00e0 | 4.00e0 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.71e2 | 1.60e2 | 1.33e2 | 6.60e1 | 5.20e1 | 2.90e1 | 2.60e1 | 1.80e1 | 1.30e1 | 9.00e0 | 4.00e0 | 3.00e0 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 5.70e1 | 4.30e1 | 3.80e1 | 2.70e1 | 2.10e1 | 1.30e1 | 1.20e1 | 1.10e1 | 1.10e1 | 9.00e0 | 6.00e0 | 8.00e0 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.40e1 | 1.40e1 | 2.40e1 | 1.50e1 | 1.00e1 | 4.00e0 | 4.00e0 | 4.00e0 | 4.00e0 | 4.00e0 | 4.00e0 | 4.00e0 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 3.20e1 | 4.30e1 | 2.30e1 | 2.20e1 | 3.20e1 | 6.00e0 | 5.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 7.90e1 | 4.00e1 | 4.00e1 | 2.20e1 | 2.80e1 | 7.00e0 | 1.00e1 | 8.00e0 | 1.00e1 | 8.00e0 | 7.00e0 | 9.00e0 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 4.40e1 | 5.90e1 | 3.60e1 | 5.10e1 | 6.50e1 | 2.40e1 | 1.50e1 | 2.00e1 | 1.40e1 | 1.20e1 | 1.10e1 | 0.00e0 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 2.80e1 | 1.40e1 | 1.80e1 | 9.00e0 | 9.00e0 | 4.00e0 | 6.00e0 | 3.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.69e2 | 2.57e2 | 1.96e2 | 1.67e2 | 1.46e2 | 1.03e2 | 7.30e1 | 6.20e1 | 4.90e1 | 3.70e1 | 2.80e1 | 2.40e1 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 2.80e1 | 1.10e1 | 1.50e1 | 6.00e0 | 9.00e0 | 3.00e0 | 2.00e0 | 3.00e0 | 3.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 5.14e2 | 3.13e2 | 2.96e2 | 1.67e2 | 1.13e2 | 6.30e1 | 5.10e1 | 3.50e1 | 2.60e1 | 2.20e1 | 1.40e1 | 1.10e1 |

## Table A12. GC of saturated compounds (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C8 | n-C9 | n-C10 | n-C11 | n-C12 | i-C13 | i-C14 | n-C13 | i-C15 | n-C14 | i-C16 | n-C15 | n-C16 | i-C18 | n-C17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 0.00e0 | 0.00e0 | 1.31e5 | 3.93e5 | 6.14e5 | 4.89e5 | 2.59e5 | 1.81e6 | 5.06e5 | 3.06e6 | 2.69e6 | 2.28e6 | 2.18e6 | 1.06e6 | 1.54e6 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.00e0 | 0.00e0 | 1.03e4 | 5.87e4 | 7.33e4 | 4.43e4 | 2.03e4 | 1.13e5 | 3.51e4 | 1.15e5 | 8.90e4 | 7.63e4 | 7.21e4 | 5.56e4 | 8.30e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 0.00e0 | 0.00e0 | 4.76e4 | 1.14e5 | 1.41e5 | 7.50e4 | 4.50e4 | 2.48e5 | 9.57e4 | 4.86e5 | 4.57e5 | 4.14e5 | 4.32e5 | 3.49e5 | 4.09e5 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 0.00e0 | 2.02e5 | 5.23e5 | 7.60e5 | 7.54e5 | 2.60e5 | 1.28e5 | 1.06e6 | 2.72e5 | 1.52e6 | 9.05e5 | 1.82e6 | 1.82e6 | 6.76e5 | 1.48e6 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 0.00e0 | 1.83e5 | 4.23e5 | 6.90e5 | 8.01e5 | 2.87e5 | 2.09e5 | 1.07e6 | 3.15e5 | 1.49e6 | 7.41e5 | 1.52e6 | 1.35e6 | 4.70e5 | 1.10e6 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 0.00e0 | 2.30e5 | 6.49e5 | 9.05e5 | 8.97e5 | 2.84e5 | 2.29e5 | 1.15e6 | 3.39e5 | 1.46e6 | 6.35e5 | 1.50e6 | 1.50e6 | 5.33e5 | 1.65e6 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 0.00e0 | 0.00e0 | 1.80e5 | 4.73e5 | 4.66e5 | 3.37e5 | 2.02e5 | 8.12e5 | 3.13e5 | 1.14e6 | 8.71e5 | 1.08e6 | 1.26e6 | 9.20e5 | 1.50e6 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 0.00e0 | 9.50e3 | 1.09e5 | 3.21e5 | 4.04e5 | 2.61e5 | 1.97e5 | 6.51e5 | 4.00e5 | 1.21e6 | 7.52e5 | 1.33e6 | 1.18e6 | 5.79e5 | 8.98e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 0.00e0 | 2.63e4 | 2.73e5 | 5.74e5 | 6.31e5 | 3.21e5 | 2.22e5 | 8.82e5 | 4.57e5 | 1.60e6 | 9.23e5 | 2.03e6 | 2.19e6 | 1.00e6 | 2.17e6 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 0.00e0 | 0.00e0 | 1.25e4 | 1.76e4 | 1.81e4 | 1.02e4 | 0.00e0 | 9.31e4 | 2.61e4 | 9.42e4 | 3.97e4 | 7.18e4 | 4.31e4 | 1.35e4 | 2.73e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 0.00e0 | 3.19e4 | 2.60e5 | 8.35e5 | 1.07e6 | 5.74e5 | 2.92e5 | 2.02e6 | 4.32e5 | 2.89e6 | 1.90e6 | 2.13e6 | 2.23e6 | 6.78e5 | 1.74e6 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 0.00e0 | 4.33e4 | 1.58e5 | 2.24e5 | 2.70e5 | 1.19e5 | 6.89e4 | 5.62e5 | 1.54e5 | 1.04e6 | 8.65e5 | 1.11e6 | 1.44e6 | 8.18e5 | 1.84e6 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 0.00e0 | 4.39e4 | 7.69e5 | 9.31e5 | 6.92e5 | 2.85e5 | 1.88e5 | 1.00e6 | 3.33e5 | 1.35e6 | 6.93e5 | 1.39e6 | 1.47e6 | 5.37e5 | 1.84e6 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 0.00e0 | 5.90e5 | 2.64e6 | 5.80e6 | 7.55e6 | 1.10e6 | 5.66e5 | 9.15e6 | 8.10e5 | 1.05e7 | 2.38e6 | 1.12e7 | 1.11e7 | 1.34e6 | 1.07e7 |

Table 12. continued, GC of saturated compounds (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | Pr | n-C18 | Ph | n-C19 | n-C20 | n-C21 | n-C22 | n-C23 | n-C24 | n-C25 | n-C26 | n-C27 | n-C28 | n-C29 | n-C30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.38e6 | 9.98e5 | 6.40e5 | 5.45e5 | 4.66e5 | 6.81e5 | 6.87e5 | 3.95e5 | 2.44e5 | 1.96e5 | 1.23e5 | 2.73e5 | 1.21e5 | 3.39e5 | 1.33e5 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.51e5 | 1.48e5 | 1.51e5 | 2.22e5 | 2.90e5 | 2.29e5 | 2.42e5 | 1.92e5 | 1.92e5 | 1.85e5 | 1.49e5 | 1.89e5 | 5.39e4 | 6.85e4 | 0.00e0 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 7.50e5 | 6.11e5 | 8.18e5 | 9.03e5 | 1.20e6 | 7.97e5 | 8.39e5 | 8.23e5 | 7.76e5 | 6.22e5 | 4.68e5 | 4.24e5 | 4.27e5 | 6.22e5 | 5.43e5 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.25e6 | 1.15e6 | 1.12e6 | 9.51e5 | 1.06e6 | 1.06e6 | 1.19e6 | 1.16e6 | 1.05e6 | 8.73e5 | 6.41e5 | 5.55e5 | 3.17e5 | 3.72e5 | 2.17e5 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 9.00e5 | 8.82e5 | 6.80e5 | 8.28e5 | 1.07e6 | 1.49e6 | 2.13e6 | 2.86e6 | 3.80e6 | 4.60e6 | 5.04e6 | 4.65e6 | 3.62e6 | 2.81e6 | 1.66e6 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.11e6 | 1.68e6 | 1.00e6 | 1.71e6 | 1.92e6 | 2.59e6 | 3.40e6 | 4.05e6 | 2.82e6 | 1.51e6 | 9.10e5 | 8.07e5 | 5.72e5 | 5.84e5 | 3.95e5 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 2.12e6 | 1.83e6 | 1.80e6 | 1.81e6 | 1.72e6 | 1.29e6 | 1.16e6 | 1.00e6 | 7.62e5 | 5.40e5 | 4.21e5 | 5.61e5 | 2.95e5 | 2.79e5 | 1.30e5 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 9.55e5 | 6.03e5 | 7.39e5 | 3.65e5 | 3.15e5 | 2.22e5 | 2.50e5 | 2.75e5 | 2.05e5 | 1.69e5 | 1.40e5 | 2.22e5 | 1.39e5 | 1.72e5 | 1.18e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 1.84e6 | 2.06e6 | 1.43e6 | 1.93e6 | 1.78e6 | 1.56e6 | 1.51e6 | 1.38e6 | 1.11e6 | 1.09e6 | 7.80e5 | 1.11e6 | 4.56e5 | 7.41e5 | 3.39e5 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 2.73e4 | 2.53e4 | 8.02e4 | 3.09e4 | 2.85e4 | 4.04e4 | 4.81e4 | 5.33e4 | 5.14e4 | 4.71e4 | 6.56e4 | 1.04e5 | 9.03e4 | 1.11e5 | 1.85e5 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.14e6 | 1.24e6 | 7.66e5 | 9.54e5 | 8.17e5 | 8.96e5 | 9.34e5 | 8.85e5 | 7.32e5 | 6.78e5 | 3.98e5 | 6.01e5 | 2.78e5 | 4.34e5 | 2.28e5 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.51e6 | 2.17e6 | 1.57e6 | 2.55e6 | 2.85e6 | 2.72e6 | 2.62e6 | 2.38e6 | 2.19e6 | 1.92e6 | 1.85e6 | 1.64e6 | 1.34e6 | 1.27e6 | 1.13e6 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.15e6 | 2.00e6 | 1.28e6 | 1.65e6 | 1.65e6 | 1.59e6 | 1.56e6 | 1.51e6 | 1.63e6 | 1.51e6 | 1.06e6 | 9.38e5 | 5.08e5 | 6.41e5 | 3.25e5 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.28e6 | 9.38e6 | 9.03e5 | 8.42e6 | 6.94e6 | 6.10e6 | 5.29e6 | 4.76e6 | 4.16e6 | 3.78e6 | 3.20e6 | 2.88e6 | 2.25e6 | 1.95e6 | 1.35e6 |

Table 12. continued, GC of saturated compounds (amounts in ng/g)

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | n-C31 | n-C32 | n-C33 | n-C34 | n-C35 | n-C36 | n-C37 | n-C38 | n-C39 | n-C40 | n-C41 | n-C42 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.26e5 | 8.95e4 | 1.02e5 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 4.71e5 | 3.13e5 | 1.82e5 | 1.02e5 | 1.34e5 | 4.38e4 | 3.57e4 | 3.84e4 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.81e5 | 1.83e5 | 1.74e5 | 1.03e5 | 1.17e5 | 6.41e4 | 6.30e4 | 5.22e4 | 4.46e4 | 3.00e4 | 3.32e4 | 2.42e4 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.37e6 | 8.09e5 | 6.73e5 | 3.36e5 | 2.63e5 | 1.48e5 | 1.32e5 | 9.01e4 | 6.61e4 | 4.74e4 | 1.93e4 | 1.66e4 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 4.08e5 | 3.11e5 | 2.74e5 | 1.93e5 | 1.55e5 | 9.26e4 | 9.01e4 | 7.68e4 | 7.95e4 | 6.65e4 | 4.44e4 | 5.82e4 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 2.29e5 | 9.17e4 | 1.57e5 | 1.03e5 | 6.36e4 | 2.92e4 | 2.49e4 | 2.58e4 | 2.94e4 | 2.58e4 | 2.69e4 | 2.70e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.03e5 | 1.37e5 | 7.26e4 | 6.83e4 | 1.01e5 | 1.88e4 | 1.60e4 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 5.14e5 | 2.58e5 | 2.61e5 | 1.41e5 | 1.83e5 | 4.81e4 | 6.75e4 | 5.00e4 | 6.30e4 | 4.95e4 | 4.34e4 | 5.77e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.21e5 | 1.62e5 | 9.96e4 | 1.42e5 | 1.80e5 | 6.55e4 | 4.21e4 | 5.39e4 | 3.75e4 | 3.22e4 | 2.98e4 | 0.00e0 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.01e5 | 1.45e5 | 1.89e5 | 1.00e5 | 9.85e4 | 4.39e4 | 6.15e4 | 2.85e4 | 0.00e0 | 0.00e0 | 0.00e0 | 0.00e0 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 9.87e5 | 9.44e5 | 7.22e5 | 6.14e5 | 5.36e5 | 3.79e5 | 2.69e5 | 2.28e5 | 1.79e5 | 1.36e5 | 1.01e5 | 8.65e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 4.12e5 | 1.72e5 | 2.27e5 | 9.41e4 | 1.36e5 | 3.77e4 | 3.30e4 | 4.17e4 | 4.77e4 | 0.00e0 | 0.00e0 | 0.00e0 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.11e6 | 6.79e5 | 6.43e5 | 3.63e5 | 2.44e5 | 1.36e5 | 1.11e5 | 7.66e4 | 5.62e4 | 4.68e4 | 3.06e4 | 2.30e4 |

## Table A13. GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 177 | | | | 191 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 25nor28αβ | 25nor29αβ | 25nor30αβ | 25nor31αβR | 19/3 | 20/3 | 21/3 | 22/3 | 23/3 | 24/3 | 25/3R | 25/3S | 24/4 | 26/3R | 26/3S |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.21e3 | 3.09e3 | 2.30e3 | 1.09e4 | 5.01e3 | 1.25e4 | 1.61e4 | 8.37e3 | 5.27e4 | 2.76e4 | 1.44e4 | 1.39e4 | 1.97e4 | 1.09e4 | 1.06e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.62e4 | 2.05e5 | 1.05e5 | 1.09e5 | 2.88e4 | 4.79e4 | 5.29e4 | 1.80e4 | 1.57e5 | 1.19e5 | 6.58e4 | 6.24e4 | 1.04e5 | 6.75e4 | 6.83e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 3.30e3 | 1.17e4 | 4.55e3 | 3.64e4 | 5.47e4 | 9.77e4 | 1.19e5 | 4.19e4 | 2.60e5 | 1.46e5 | 6.11e4 | 5.86e4 | 9.86e4 | 4.20e4 | 4.08e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.06e3 | 3.64e3 | 2.06e3 | 7.60e3 | 1.63e4 | 2.52e4 | 2.95e4 | 1.13e4 | 5.31e4 | 2.55e4 | 8.70e3 | 8.46e3 | 1.50e4 | 5.34e3 | 5.46e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.46e3 | 5.49e3 | 3.45e3 | 1.03e4 | 1.26e4 | 2.57e4 | 3.28e4 | 1.42e4 | 7.58e4 | 3.43e4 | 1.34e4 | 1.25e4 | 2.19e4 | 8.67e3 | 8.44e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.96e3 | 5.10e3 | 3.04e3 | 6.57e3 | 1.11e4 | 1.68e4 | 2.06e4 | 8.87e3 | 6.00e4 | 3.05e4 | 1.34e4 | 1.33e4 | 1.85e4 | 1.04e4 | 9.72e3 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.43e4 | 7.85e4 | 4.38e4 | 5.54e4 | 7.49e3 | 2.54e4 | 5.09e4 | 1.76e4 | 1.76e5 | 1.09e5 | 8.46e4 | 8.72e4 | 3.49e4 | 7.91e4 | 8.04e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.11e4 | 5.58e4 | 2.88e4 | 6.85e4 | 2.23e4 | 5.37e4 | 7.67e4 | 2.11e4 | 1.99e5 | 1.35e5 | 9.09e4 | 9.12e4 | 6.89e4 | 7.98e4 | 7.67e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 4.53e3 | 2.39e4 | 1.37e4 | 2.82e4 | 1.22e4 | 2.88e4 | 4.01e4 | 1.25e4 | 1.02e5 | 5.70e4 | 3.64e4 | 3.71e4 | 2.46e4 | 2.98e4 | 3.06e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.02e4 | 1.02e4 | 1.48e3 | 9.29e4 | 5.42e3 | 1.68e4 | 3.11e4 | 1.10e4 | 1.01e5 | 8.99e4 | 5.35e4 | 5.60e4 | 7.37e4 | 4.12e4 | 3.85e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.33e3 | 6.80e3 | 3.84e3 | 1.29e4 | 4.62e3 | 8.09e3 | 9.44e3 | 3.67e3 | 2.69e4 | 1.43e4 | 9.20e3 | 9.42e3 | 1.00e4 | 8.54e3 | 8.12e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 4.38e3 | 1.44e4 | 7.90e3 | 4.05e4 | 9.39e3 | 2.13e4 | 2.93e4 | 1.16e4 | 9.37e4 | 6.62e4 | 3.97e4 | 3.78e4 | 4.35e4 | 3.39e4 | 2.98e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.62e2 | 1.55e3 | 9.12e2 | 2.48e3 | 8.39e3 | 1.09e4 | 1.14e4 | 4.36e3 | 2.02e4 | 9.27e3 | 3.57e3 | 3.62e3 | 5.04e3 | 2.46e3 | 2.53e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.36e2 | 8.00e2 | 1.87e3 | 9.22e3 | 8.83e4 | 7.00e4 | 2.92e4 | 3.95e3 | 1.98e4 | 1.18e4 | 3.39e3 | 3.07e3 | 3.38e4 | 5.03e3 | 4.85e3 |

## Table 13. continued, GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 191 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 28/3R | 28/3S | 29/3R | 29/3S | 27Ts | 27Tm | 30/3R | 30/3S | 28αβ | 25nor30αβ | 29αβ | 29Ts | 30d | 29βα | 30O |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 8.83e3 | 9.77e3 | 1.17e4 | 1.09e4 | 3.45e4 | 3.25e4 | 9.88e3 | 1.47e4 | 1.06e4 | 3.13e3 | 1.03e5 | 3.57e4 | 5.05e3 | 1.76e4 | 0.00e0 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 7.35e4 | 7.57e4 | 7.70e4 | 7.00e4 | 2.50e5 | 3.18e5 | 6.28e4 | 7.83e4 | 7.88e4 | 1.47e5 | 7.68e5 | 2.72e5 | 7.18e4 | 1.88e5 | 1.39e5 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 3.47e4 | 3.49e4 | 5.07e4 | 5.14e4 | 1.24e5 | 1.11e5 | 4.49e4 | 5.22e4 | 1.37e4 | 6.92e3 | 3.37e5 | 1.76e5 | 2.34e4 | 3.61e4 | 0.00e0 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.33e3 | 3.73e3 | 4.10e3 | 4.08e3 | 9.12e3 | 3.42e4 | 3.59e3 | 3.63e3 | 4.93e4 | 2.92e3 | 4.75e4 | 1.05e4 | 6.44e3 | 2.13e4 | 0.00e0 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 6.54e3 | 6.28e3 | 7.41e3 | 7.10e3 | 1.48e4 | 5.32e4 | 6.95e3 | 6.40e3 | 3.76e4 | 5.00e3 | 8.08e4 | 1.59e4 | 9.85e3 | 3.51e4 | 0.00e0 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 6.34e3 | 6.76e3 | 6.67e3 | 6.86e3 | 1.45e4 | 3.95e4 | 5.21e3 | 5.31e3 | 8.93e3 | 4.15e3 | 7.58e4 | 1.20e4 | 7.98e3 | 1.38e4 | 0.00e0 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.30e5 | 1.31e5 | 1.27e5 | 1.27e5 | 1.35e5 | 1.22e5 | 1.07e5 | 1.07e5 | 6.18e4 | 5.85e4 | 3.92e5 | 1.19e5 | 4.26e4 | 5.42e4 | 1.00e5 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.09e5 | 1.10e5 | 1.17e5 | 1.16e5 | 1.60e5 | 1.76e5 | 9.78e4 | 1.01e5 | 5.08e4 | 3.83e4 | 4.81e5 | 1.82e5 | 4.32e4 | 5.75e4 | 6.66e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 4.26e4 | 4.42e4 | 4.25e4 | 4.33e4 | 5.65e4 | 8.36e4 | 3.48e4 | 3.49e4 | 3.19e4 | 1.71e4 | 2.02e5 | 5.82e4 | 1.97e4 | 4.64e4 | 2.94e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 4.61e4 | 4.77e4 | 6.82e4 | 6.85e4 | 1.70e5 | 2.21e5 | 6.37e4 | 7.55e4 | 1.39e4 | 1.80e3 | 6.01e5 | 3.01e5 | 3.04e4 | 4.39e4 | 0.00e0 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.14e4 | 1.16e4 | 1.20e4 | 1.20e4 | 1.99e4 | 4.88e4 | 1.20e4 | 1.28e4 | 1.49e4 | 4.38e3 | 1.14e5 | 2.70e4 | 1.01e4 | 3.41e4 | 0.00e0 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 3.90e4 | 4.01e4 | 4.98e4 | 5.25e4 | 9.25e4 | 1.17e5 | 4.69e4 | 4.91e4 | 2.63e4 | 1.05e4 | 3.15e5 | 1.27e5 | 2.32e4 | 4.40e4 | 0.00e0 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.73e3 | 1.96e3 | 1.73e3 | 1.59e3 | 3.62e3 | 1.24e4 | 1.44e3 | 1.64e3 | 8.57e3 | 1.10e3 | 1.92e4 | 3.47e3 | 1.55e3 | 8.87e3 | 0.00e0 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.60e3 | 3.25e3 | 4.56e3 | 2.04e3 | 2.12e4 | 5.16e4 | 3.44e3 | 3.02e3 | 2.09e4 | 3.87e3 | 1.05e5 | 2.21e4 | 2.41e4 | 1.59e4 | 0.00e0 |

## Table 13. continued, GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 191 | | | | | | | | | | | | | | 217 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 30αβ | 30βα | 31αβS | 31αβR | 30G | 31βα | 32αβS | 32αβR | 33αβS | 33αβR | 34αβS | 34αβR | 35αβS | 35αβR | 21αα |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.38e5 | 1.72e4 | 5.20e4 | 5.09e4 | 1.67e4 | 1.11e4 | 4.13e4 | 3.04e4 | 2.96e4 | 2.01e4 | 2.57e4 | 1.57e4 | 2.77e4 | 1.75e4 | 5.12e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.30e6 | 2.17e5 | 3.18e5 | 2.45e5 | 4.54e4 | 7.15e4 | 1.73e5 | 1.30e5 | 9.23e4 | 6.52e4 | 5.98e4 | 4.10e4 | 5.00e4 | 3.32e4 | 2.76e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 4.59e5 | 4.13e4 | 2.06e5 | 1.81e5 | 8.73e4 | 3.85e4 | 1.81e5 | 1.27e5 | 1.32e5 | 9.24e4 | 1.46e5 | 1.03e5 | 1.58e5 | 1.06e5 | 5.24e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 9.29e4 | 2.87e4 | 3.69e4 | 3.54e4 | 4.08e3 | 1.68e4 | 1.43e4 | 1.52e4 | 7.51e3 | 7.59e3 | 6.39e3 | 6.36e3 | 5.61e3 | 4.45e3 | 1.25e4 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.32e5 | 4.26e4 | 5.36e4 | 5.25e4 | 6.70e3 | 2.51e4 | 2.15e4 | 2.53e4 | 1.21e4 | 1.19e4 | 1.09e4 | 9.35e3 | 8.65e3 | 6.74e3 | 1.48e4 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 8.55e4 | 2.08e4 | 3.62e4 | 4.05e4 | 5.75e3 | 1.07e4 | 1.97e4 | 1.33e4 | 9.91e3 | 6.62e3 | 7.10e3 | 4.79e3 | 4.78e3 | 3.20e3 | 7.67e3 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 5.94e5 | 9.17e4 | 1.48e5 | 1.09e5 | 2.82e4 | 5.18e4 | 7.77e4 | 5.42e4 | 4.81e4 | 3.09e4 | 2.43e4 | 1.54e4 | 1.41e4 | 9.15e3 | 3.09e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 8.44e5 | 9.56e4 | 2.77e5 | 2.14e5 | 6.11e4 | 6.36e4 | 2.06e5 | 1.39e5 | 1.37e5 | 9.01e4 | 1.11e5 | 7.26e4 | 1.03e5 | 6.59e4 | 3.50e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.40e5 | 7.10e4 | 9.91e4 | 9.37e4 | 1.57e4 | 3.61e4 | 5.39e4 | 4.54e4 | 3.40e4 | 2.48e4 | 2.54e4 | 1.74e4 | 2.01e4 | 1.31e4 | 2.18e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.26e6 | 9.27e4 | 5.99e5 | 4.52e5 | 1.61e5 | 9.03e4 | 5.68e5 | 3.80e5 | 3.94e5 | 2.51e5 | 3.87e5 | 2.46e5 | 3.88e5 | 2.56e5 | 7.17e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.55e5 | 3.62e4 | 5.75e4 | 4.38e4 | 1.11e4 | 1.79e4 | 3.23e4 | 2.50e4 | 2.03e4 | 1.43e4 | 1.73e4 | 1.26e4 | 1.76e4 | 1.09e4 | 4.26e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 5.32e5 | 7.04e4 | 2.24e5 | 1.87e5 | 6.12e4 | 5.06e4 | 1.87e5 | 1.25e5 | 1.30e5 | 8.66e4 | 1.16e5 | 7.58e4 | 1.17e5 | 7.07e4 | 1.04e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.07e4 | 1.11e4 | 1.10e4 | 1.66e4 | 1.34e3 | 5.77e3 | 3.74e3 | 4.35e3 | 1.61e3 | 2.14e3 | 1.16e3 | 1.40e3 | 8.80e2 | 8.14e2 | 4.69e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.26e5 | 2.64e4 | 4.96e4 | 3.28e4 | 2.71e3 | 1.06e4 | 2.66e4 | 1.78e4 | 1.13e4 | 6.79e3 | 5.60e3 | 3.63e3 | 2.39e3 | 2.13e3 | 6.09e3 |

## Table 13. continued, GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 217 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 21ββ | 22αα | 22ββ | 27dβS | 27dβR | 27daR | 27daS | 28dβS#1 | 28dβS#2 | 28dβR#1 | 28dβR#2 | 28daR | 27ααS | 27ββR+29dβS | 27ββS |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.17e4 | 3.63e3 | 7.83e3 | 1.58e4 | 8.13e3 | 4.11e3 | 5.77e3 | 6.39e3 | 5.17e3 | 3.11e3 | 4.27e3 | 2.63e3 | 1.01e4 | 1.58e4 | 9.97e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 4.63e4 | 2.30e4 | 3.01e4 | 1.49e5 | 8.97e4 | 4.10e4 | 5.33e4 | 6.61e4 | 6.38e4 | 3.77e4 | 5.15e4 | 2.93e4 | 5.88e4 | 1.14e5 | 6.24e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 8.44e4 | 3.20e4 | 3.94e4 | 3.36e4 | 1.92e4 | 8.68e3 | 1.07e4 | 1.66e4 | 1.08e4 | 6.95e3 | 9.88e3 | 9.41e3 | 2.75e4 | 4.25e4 | 3.17e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.65e4 | 6.58e3 | 9.83e3 | 8.70e3 | 5.53e3 | 2.57e3 | 3.24e3 | 4.56e3 | 4.32e3 | 2.45e3 | 3.57e3 | 2.23e3 | 4.30e3 | 1.42e4 | 4.63e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 3.07e4 | 8.70e3 | 1.37e4 | 1.58e4 | 9.17e3 | 5.02e3 | 5.53e3 | 7.25e3 | 6.97e3 | 4.02e3 | 5.82e3 | 4.22e3 | 7.52e3 | 1.64e4 | 7.90e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.64e4 | 4.89e3 | 8.07e3 | 1.15e4 | 7.39e3 | 3.44e3 | 4.27e3 | 6.21e3 | 5.38e3 | 2.93e3 | 4.29e3 | 2.48e3 | 9.64e3 | 9.48e3 | 6.16e3 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 5.33e4 | 2.88e4 | 4.30e4 | 3.39e5 | 2.25e5 | 1.12e5 | 1.32e5 | 2.17e5 | 2.27e5 | 1.37e5 | 1.70e5 | 1.01e5 | 9.60e4 | 2.14e5 | 1.29e5 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.09e4 | 2.78e4 | 4.59e4 | 2.44e5 | 1.69e5 | 8.15e4 | 9.53e4 | 1.59e5 | 1.49e5 | 9.82e4 | 1.23e5 | 7.59e4 | 8.69e4 | 1.73e5 | 1.16e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.50e4 | 1.53e4 | 2.13e4 | 1.11e5 | 7.09e4 | 3.52e4 | 4.09e4 | 6.98e4 | 6.80e4 | 4.39e4 | 5.65e4 | 3.40e4 | 3.27e4 | 7.07e4 | 4.40e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.80e4 | 4.36e3 | 1.18e4 | 3.42e4 | 2.04e4 | 9.16e3 | 1.25e4 | 1.62e4 | 1.07e4 | 7.21e3 | 1.14e4 | 1.12e4 | 4.23e4 | 6.53e4 | 5.07e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 8.21e3 | 2.49e3 | 4.65e3 | 2.64e4 | 1.92e4 | 8.85e3 | 1.04e4 | 1.88e4 | 1.83e4 | 1.11e4 | 1.35e4 | 8.75e3 | 9.48e3 | 2.27e4 | 1.29e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.23e4 | 6.54e3 | 1.19e4 | 5.94e4 | 3.90e4 | 1.92e4 | 2.56e4 | 3.88e4 | 3.48e4 | 2.05e4 | 2.90e4 | 1.96e4 | 2.89e4 | 5.39e4 | 3.78e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 9.31e3 | 2.40e3 | 3.66e3 | 5.05e3 | 3.12e3 | 1.52e3 | 1.75e3 | 2.50e3 | 2.11e3 | 1.22e3 | 1.76e3 | 1.07e3 | 1.91e3 | 3.40e3 | 2.02e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 4.90e3 | 5.90e3 | 1.30e4 | 6.12e3 | 3.03e3 | 2.11e3 | 2.28e3 | 3.60e3 | 4.64e3 | 1.94e3 | 2.97e3 | 1.87e3 | 1.35e3 | 1.76e4 | 2.35e3 |

## Table 13. continued, GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 217 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 28daS | 27ααR | 29dβR | 29daR | 28ααS | 29daS | 28ββR | 28ββS | 28ααR | 29ααS | 29ββR | 29ββS | 29ααR | 30ααS | 30ββR |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.64e3 | 1.39e4 | 7.99e3 | 3.91e3 | 2.96e3 | 4.82e3 | 7.86e3 | 8.65e3 | 5.77e3 | 1.07e4 | 1.49e4 | 1.38e4 | 1.44e4 | 4.83e3 | 2.93e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.99e4 | 8.65e4 | 7.84e4 | 3.99e4 | 2.15e4 | 3.64e4 | 4.99e4 | 6.81e4 | 4.48e4 | 6.58e4 | 8.13e4 | 7.12e4 | 7.34e4 | 3.23e4 | 1.39e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 5.49e3 | 3.22e4 | 2.09e4 | 8.29e3 | 1.15e4 | 9.38e3 | 2.58e4 | 2.89e4 | 1.36e4 | 3.72e4 | 4.83e4 | 4.63e4 | 3.31e4 | 1.60e4 | 1.48e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.28e3 | 6.56e3 | 1.02e4 | 5.57e3 | 1.65e3 | 6.54e3 | 4.44e3 | 4.83e3 | 3.77e3 | 5.56e3 | 1.27e4 | 7.12e3 | 1.38e4 | 2.37e3 | 1.03e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.12e3 | 1.38e4 | 1.19e4 | 5.65e3 | 2.84e3 | 6.85e3 | 6.70e3 | 7.41e3 | 7.05e3 | 9.63e3 | 1.41e4 | 9.17e3 | 2.15e4 | 4.32e3 | 2.04e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.82e3 | 2.10e4 | 5.83e3 | 3.16e3 | 2.04e3 | 2.91e3 | 4.38e3 | 5.37e3 | 3.48e3 | 6.15e3 | 6.73e3 | 5.20e3 | 6.17e3 | 3.04e3 | 9.91e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 7.88e4 | 1.08e5 | 1.65e5 | 8.29e4 | 3.75e4 | 6.76e4 | 1.30e5 | 1.57e5 | 7.06e4 | 7.49e4 | 1.09e5 | 1.06e5 | 5.79e4 | 3.89e4 | 2.43e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.04e4 | 9.50e4 | 1.29e5 | 5.98e4 | 3.04e4 | 5.39e4 | 1.06e5 | 1.30e5 | 6.06e4 | 7.98e4 | 1.07e5 | 1.02e5 | 7.06e4 | 3.94e4 | 2.43e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.45e4 | 3.79e4 | 5.21e4 | 2.60e4 | 1.36e4 | 2.42e4 | 4.08e4 | 5.02e4 | 2.43e4 | 2.84e4 | 4.02e4 | 3.66e4 | 3.30e4 | 1.46e4 | 8.32e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 5.62e3 | 4.73e4 | 3.08e4 | 1.11e4 | 1.93e4 | 1.51e4 | 3.68e4 | 4.74e4 | 2.32e4 | 7.55e4 | 9.53e4 | 9.21e4 | 6.26e4 | 3.31e4 | 2.93e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 6.82e3 | 1.26e4 | 1.68e4 | 8.53e3 | 4.13e3 | 8.29e3 | 1.31e4 | 1.48e4 | 7.37e3 | 1.10e4 | 1.62e4 | 1.33e4 | 1.37e4 | 5.94e3 | 3.13e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.29e4 | 3.50e4 | 3.68e4 | 1.68e4 | 1.15e4 | 1.60e4 | 3.33e4 | 4.17e4 | 1.87e4 | 3.90e4 | 5.00e4 | 4.58e4 | 3.32e4 | 1.88e4 | 1.38e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 7.03e2 | 4.88e3 | 2.59e3 | 1.20e3 | 5.84e2 | 1.21e3 | 1.77e3 | 1.81e3 | 2.06e3 | 1.59e3 | 2.70e3 | 1.69e3 | 4.40e3 | 9.96e2 | 4.58e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 7.06e2 | 2.70e3 | 9.73e3 | 4.00e3 | 8.68e2 | 5.66e3 | 1.91e3 | 3.58e3 | 1.81e3 | 7.21e3 | 9.28e3 | 5.87e3 | 7.52e3 | 3.26e3 | 2.20e2 |

## Table 13. continued, GCMS SIR of saturated compounds (peak height)

| | | | | | m/z | 217 | | 218 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 30ββS | 30ααR | 27ββR | 27ββS | 28ββR | 28ββS | 29ββR | 29ββS | 30ββR | 30ββS |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.30e3 | 2.73e3 | 2.06e4 | 1.68e4 | 1.07e4 | 1.27e4 | 2.35e4 | 2.26e4 | 2.85e3 | 2.87e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 5.91e3 | 1.09e4 | 1.19e5 | 9.69e4 | 7.05e4 | 9.02e4 | 1.24e5 | 1.13e5 | 1.43e4 | 1.11e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 4.22e3 | 6.11e3 | 6.02e4 | 5.09e4 | 3.78e4 | 4.37e4 | 7.74e4 | 7.36e4 | 1.07e4 | 7.56e3 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.40e2 | 1.04e3 | 9.09e3 | 6.96e3 | 5.58e3 | 6.65e3 | 1.47e4 | 1.15e4 | 7.88e2 | 6.82e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 5.06e2 | 2.14e3 | 1.43e4 | 1.22e4 | 9.39e3 | 1.06e4 | 1.79e4 | 1.46e4 | 1.36e3 | 1.12e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 3.95e2 | 6.47e2 | 1.15e4 | 9.56e3 | 6.80e3 | 7.89e3 | 8.97e3 | 8.74e3 | 8.91e2 | 6.47e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.20e4 | 2.12e4 | 2.43e5 | 1.98e5 | 1.94e5 | 2.17e5 | 1.63e5 | 1.61e5 | 2.67e4 | 2.15e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.05e4 | 1.86e4 | 2.02e5 | 1.75e5 | 1.50e5 | 1.80e5 | 1.62e5 | 1.59e5 | 2.35e4 | 1.90e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.53e3 | 6.44e3 | 8.10e4 | 6.86e4 | 5.95e4 | 7.16e4 | 6.03e4 | 5.65e4 | 8.25e3 | 6.27e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.33e4 | 1.23e4 | 9.59e4 | 8.62e4 | 5.55e4 | 6.95e4 | 1.51e5 | 1.43e5 | 2.11e4 | 1.51e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.29e3 | 2.29e3 | 2.38e4 | 1.89e4 | 1.85e4 | 2.02e4 | 2.38e4 | 2.01e4 | 2.92e3 | 2.27e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 4.73e3 | 7.70e3 | 7.19e4 | 6.44e4 | 5.11e4 | 6.20e4 | 7.59e4 | 7.08e4 | 1.12e4 | 7.79e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 2.17e2 | 6.12e2 | 3.63e3 | 2.83e3 | 2.21e3 | 2.45e3 | 3.40e3 | 2.87e3 | 2.74e2 | 2.50e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.44e2 | 2.96e2 | 6.95e3 | 2.68e3 | 2.29e3 | 4.71e3 | 1.10e4 | 8.37e3 | 9.78e2 | 0.00e0 |

# Abbreviations of saturated biomarkers

| | |
|---|---|
| 17α(H), 21β(H)-25,28,30-trisnorhopane | 25nor28αβ |
| 17α, 21β-25,30-bisnorhopane | 25nor29αβ |
| 17α(H), 21β(H)-25-norhopane | 25nor30αβ |
| 17α, 21β, 22(R/S)-25-norhomohopane | 25nor31αβ |
| $C_{19}H_{34}$ tricyclic terpane | 19/3 |
| $C_{20}H_{36}$ tricyclic terpane | 20/3 |
| $C_{21}H_{38}$ tricyclic terpane | 21/3 |
| $C_{23}H_{42}$ tricyclic terpane | 23/3 |
| $C_{24}H_{44}$ tricyclic terpane | 24/3 |
| $C_{25}H_{46}$ tricyclic terpane | 25/3R |
| $C_{25}H_{46}$ tricyclic terpane | 25/3S |
| $C_{24}H_{42}$ tetracyclic terpane | 24/4 |
| $C_{26}H_{48}$ tricyclic terpane | 26/3R |
| $C_{26}H_{48}$ tricyclic terpane | 26/3S |
| $C_{28}H_{52}$ tricyclic terpane | 28/3R |
| $C_{28}H_{52}$ tricyclic terpane | 28/3S |
| $C_{29}H_{54}$ tricyclic terpane | 29/3R |
| $C_{29}H_{54}$ tricyclic terpane | 29/3S |
| 18α(H)-22,29,30-trisnorneohopane | 27Ts |
| 17α(H)-22,29,30-trisnorhopane | 27Tm |
| $C_{30}H_{56}$ tricyclic terpane | 30/3R |
| $C_{30}H_{56}$ tricyclic terpane | 30/3S |
| 17α(H), 21β(H)-28,30-bisnorhopane | 28αβ |
| 17α(H), 21β(H)-30-norhopane | 29αβ |
| 18α(H)-30-norneohopane | 29Ts |
| 15α-methyl-17α(H)-27-norhopane (diahopane) | 30d |
| 17β(H), 21α(H)-30-norhopane (normoretane) | 29βα |
| 18α(H)-oleanane | 30O |
| 17α(H), 21β(H)-hopane | 30αβ |
| 17β(H), 21α(H)-hopane (moretane) | 30βα |
| 17α(H), 21β(H), 22(S)-homohopane | 31αβS |
| 17α(H), 21β(H), 22(R)-homohopane | 31αβR |
| Gammacerane | 30G |
| 17β(H), 21α(H)-homohopane | 31βα |
| 17α(H), 21β(H), 22(S)-bishomohopane | 32αβS |
| 17α(H), 21β(H), 22(R)-bishomohopane | 32αβR |
| 17α(H), 21β(H), 22(S)-trishomohopane | 33αβS |

| | |
|---|---|
| 17α(H), 21β(H), 22(R)-trishomohopane | 33αβR |
| 17α(H), 21β(H), 22(S)-tetrakishomohopane | 34αβS |
| 17α(H), 21β(H), 22(R)-tetrakishomohopane | 34αβR |
| 17α(H), 21β(H), 22(S)-pentakishomohopane | 35αβS |
| 17α(H), 21β(H), 22(R)-pentakishomohopane | 35αβR |
| C21-5α(H), 14α(H), 17α(H)-pregnane | 21αα |
| C21-5α(H), 14β(H), 17β(H)-pregnane | 21ββ |
| C22-5α(H), 14α(H), 17α(H)-pregnane | 22αα |
| C22-5α(H), 14β(H), 17β(H)-pregnane | 22ββ |
| 13β(H), 17α(H), 20(S)-cholestane (diasterane) | 27dβS |
| 13β(H), 17α(H), 20(R)-cholestane (diasterane) | 27dβR |
| 13α(H), 17β(H), 20(R)-cholestane (diasterane) | 27dαR |
| 13α(H), 17β(H), 20(S)-cholestane (diasterane) | 27dαS |
| 24-methyl-13β(H), 17α(H), 20(S)-cholestane (diasterane) | 28dβS |
| 24-methyl-13β(H), 17α(H), 20(R)-cholestane (diasterane) | 28dβR |
| 24-methyl-13α(H), 17β(H), 20(R)-cholestane (diasterane) | 28dαR |
| 5α(H), 14α(H), 17α(H), 20(S)-cholestane | 27ααS |
| 5α(H), 14β(H), 17β(H), 20(R)-cholestane | 27ββR |
| 24-ethyl-13β(H), 17α(H), 20(S)-cholestane (diasterane) | 29dβS |
| 5α(H), 14β(H), 17β(H), 20(S)-cholestane | 27ββS |
| 24-methyl-13α(H), 17β(H), 20(S)-cholestane (diasterane) | 28dαS |
| 5α(H), 14α(H), 17α(H), 20(R)-cholestane | 27ααR |
| 24-ethyl-13β(H), 17α(H), 20(R)-cholestane (diasterane) | 29dβR |
| 24-ethyl-13α(H), 17β(H), 20(R)-cholestane (diasterane) | 29dαR |
| 24-methyl-5α(H), 14α(H), 17α(H), 20(S)-cholestane | 28ααS |
| 24-ethyl-13α(H), 17β(H), 20(S)-cholestane (diasterane) | 29dαS |
| 24-methyl-5α(H), 14β(H), 17β(H), 20(R)-cholestane | 28ββR |
| 24-methyl-5α(H), 14β(H), 17β(H), 20(S)-cholestane | 28ββS |
| 24-methyl-5α(H), 14α(H), 17α(H), 20(R)-cholestane | 28ααR |
| 24-ethyl-5α(H), 14α(H), 17α(H), 20(S)-cholestane | 29ααS |
| 24-ethyl-5α(H), 14β(H), 17β(H), 20(R)-cholestane | 29ββR |
| 24-ethyl-5α(H), 14β(H), 17β(H), 20(S)-cholestane | 29ββS |
| 24-ethyl-5α(H), 14α(H), 17α(H), 20(R)-cholestane | 29ααR |
| 24-propyl-5α(H), 14α(H), 17α(H), 20(S)-cholestane | 30ααS |
| 24-propyl-5α(H), 14β(H), 17β(H), 20(R)-cholestane | 30ββR |
| 24-propyl-5α(H), 14β(H), 17β(H), 20(S)-cholestane | 30ββS |
| 24-propyl-5α(H), 14α(H), 17α(H), 20(R)-cholestane | 30ααR |

## Table A14. GCMS SIR of saturated compounds (amounts in ng/g)

| | | | | | m/z | 177 | | | | 191 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 25nor28αβ | 25nor29αβ | 25nor30αβ | 25nor31αβR | 19/3 | 20/3 | 21/3 | 22/3 | 23/3 | 24/3 | 25/3R | 25/3S | 24/4 | 26/3R | 26/3S |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.37e3 | 6.03e3 | 4.50e3 | 2.14e4 | 9.79e3 | 2.44e4 | 3.14e4 | 1.63e4 | 1.03e5 | 5.38e4 | 2.81e4 | 2.73e4 | 3.84e4 | 2.12e4 | 2.07e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 5.54e3 | 7.04e4 | 3.60e4 | 3.73e4 | 9.88e3 | 1.64e4 | 1.81e4 | 6.15e3 | 5.37e4 | 4.09e4 | 2.25e4 | 2.14e4 | 3.55e4 | 2.31e4 | 2.34e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.78e3 | 6.34e3 | 2.46e3 | 1.97e4 | 2.95e4 | 5.28e4 | 6.46e4 | 2.26e4 | 1.40e5 | 7.91e4 | 3.30e4 | 3.16e4 | 5.33e4 | 2.27e4 | 2.20e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.37e3 | 4.70e3 | 2.67e3 | 9.82e3 | 2.11e4 | 3.25e4 | 3.81e4 | 1.47e4 | 6.86e4 | 3.30e4 | 1.13e4 | 1.09e4 | 1.94e4 | 6.90e3 | 7.06e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.34e3 | 5.05e3 | 3.17e3 | 9.49e3 | 1.16e4 | 2.36e4 | 3.01e4 | 1.31e4 | 6.96e4 | 3.15e4 | 1.23e4 | 1.15e4 | 2.01e4 | 7.96e3 | 7.75e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 2.61e3 | 6.78e3 | 4.05e3 | 8.74e3 | 1.47e4 | 2.23e4 | 2.74e4 | 1.18e4 | 7.98e4 | 4.05e4 | 1.79e4 | 1.77e4 | 2.46e4 | 1.38e4 | 1.29e4 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.15e4 | 6.30e4 | 3.51e4 | 4.44e4 | 6.02e3 | 2.04e4 | 4.09e4 | 1.41e4 | 1.41e5 | 8.78e4 | 6.79e4 | 7.00e4 | 2.80e4 | 6.35e4 | 6.45e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 5.88e3 | 2.94e4 | 1.52e4 | 3.61e4 | 1.17e4 | 2.83e4 | 4.05e4 | 1.11e4 | 1.05e5 | 7.11e4 | 4.80e4 | 4.81e4 | 3.64e4 | 4.21e4 | 4.05e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 5.02e3 | 2.65e4 | 1.51e4 | 3.12e4 | 1.35e4 | 3.19e4 | 4.44e4 | 1.38e4 | 1.13e5 | 6.32e4 | 4.03e4 | 4.11e4 | 2.72e4 | 3.31e4 | 3.40e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 5.19e3 | 5.19e3 | 7.55e2 | 4.74e4 | 2.77e3 | 8.55e3 | 1.59e4 | 5.63e3 | 5.17e4 | 4.59e4 | 2.73e4 | 2.86e4 | 3.76e4 | 2.10e4 | 1.96e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.08e3 | 1.57e4 | 8.87e3 | 2.97e4 | 1.07e4 | 1.87e4 | 2.18e4 | 8.46e3 | 6.21e4 | 3.29e4 | 2.12e4 | 2.18e4 | 2.31e4 | 1.97e4 | 1.87e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.59e3 | 8.54e3 | 4.67e3 | 2.40e4 | 5.56e3 | 1.26e4 | 1.73e4 | 6.87e3 | 5.54e4 | 3.92e4 | 2.35e4 | 2.23e4 | 2.57e4 | 2.01e4 | 1.76e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.65e3 | 7.05e3 | 4.15e3 | 1.13e4 | 3.82e4 | 4.96e4 | 5.21e4 | 1.98e4 | 9.20e4 | 4.22e4 | 1.62e4 | 1.65e4 | 2.29e4 | 1.12e4 | 1.15e4 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 9.20e1 | 3.11e2 | 7.26e2 | 3.59e3 | 3.43e4 | 2.72e4 | 1.14e4 | 1.54e3 | 7.70e3 | 4.58e3 | 1.32e3 | 1.19e3 | 1.31e4 | 1.96e3 | 1.89e3 |

Table 14. continued, GCMS SIR of saturated compounds (amounts in ng/g)

| | | | | | m/z | 191 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 28/3R | 28/3S | 29/3R | 29/3S | 27Ts | 27Tm | 30/3R | 30/3S | 28αβ | 25nor30αβ | 29αβ | 29Ts | 30d | 29βα | 30O |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.73e4 | 1.91e4 | 2.29e4 | 2.13e4 | 6.73e4 | 6.35e4 | 1.93e4 | 2.88e4 | 2.07e4 | 6.11e3 | 2.01e5 | 6.97e4 | 9.87e3 | 3.44e4 | 0.00e0 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 2.52e4 | 2.60e4 | 2.64e4 | 2.40e4 | 8.57e4 | 1.09e5 | 2.15e4 | 2.68e4 | 2.70e4 | 5.05e4 | 2.63e5 | 9.31e4 | 2.46e4 | 6.45e4 | 4.75e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.87e4 | 1.89e4 | 2.74e4 | 2.78e4 | 6.70e4 | 5.99e4 | 2.43e4 | 2.82e4 | 7.40e3 | 3.74e3 | 1.82e5 | 9.50e4 | 1.26e4 | 1.95e4 | 0.00e0 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 4.31e3 | 4.83e3 | 5.31e3 | 5.28e3 | 1.18e4 | 4.42e4 | 4.64e3 | 4.69e3 | 6.38e4 | 3.78e3 | 6.14e4 | 1.35e4 | 8.33e3 | 2.76e4 | 0.00e0 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 6.01e3 | 5.77e3 | 6.81e3 | 6.53e3 | 1.36e4 | 4.89e4 | 6.38e3 | 5.88e3 | 3.46e4 | 4.60e3 | 7.42e4 | 1.46e4 | 9.05e3 | 3.23e4 | 0.00e0 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 8.43e3 | 9.00e3 | 8.87e3 | 9.12e3 | 1.93e4 | 5.25e4 | 6.92e3 | 7.06e3 | 1.19e4 | 5.52e3 | 1.01e5 | 1.60e4 | 1.06e4 | 1.83e4 | 0.00e0 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.04e5 | 1.06e5 | 1.02e5 | 1.02e5 | 1.09e5 | 9.76e4 | 8.57e4 | 8.59e4 | 4.96e4 | 4.70e4 | 3.15e5 | 9.52e4 | 3.42e4 | 4.35e4 | 8.04e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 5.73e4 | 5.81e4 | 6.16e4 | 6.14e4 | 8.42e4 | 9.29e4 | 5.16e4 | 5.34e4 | 2.68e4 | 2.02e4 | 2.54e5 | 9.60e4 | 2.28e4 | 3.04e4 | 3.52e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 4.72e4 | 4.90e4 | 4.71e4 | 4.79e4 | 6.26e4 | 9.26e4 | 3.85e4 | 3.86e4 | 3.54e4 | 1.90e4 | 2.24e5 | 6.45e4 | 2.18e4 | 5.14e4 | 3.26e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 2.35e4 | 2.43e4 | 3.48e4 | 3.49e4 | 8.69e4 | 1.13e5 | 3.25e4 | 3.85e4 | 7.12e3 | 9.16e2 | 3.07e5 | 1.54e5 | 1.55e4 | 2.24e4 | 0.00e0 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 2.63e4 | 2.67e4 | 2.78e4 | 2.76e4 | 4.60e4 | 1.13e5 | 2.77e4 | 2.95e4 | 3.44e4 | 1.01e4 | 2.64e5 | 6.24e4 | 2.33e4 | 7.87e4 | 0.00e0 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.30e4 | 2.37e4 | 2.95e4 | 3.11e4 | 5.47e4 | 6.90e4 | 2.77e4 | 2.91e4 | 1.55e4 | 6.23e3 | 1.86e5 | 7.49e4 | 1.38e4 | 2.60e4 | 0.00e0 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 7.87e3 | 8.90e3 | 7.85e3 | 7.25e3 | 1.65e4 | 5.64e4 | 6.56e3 | 7.44e3 | 3.90e4 | 5.01e3 | 8.75e4 | 1.58e4 | 7.06e3 | 4.04e4 | 0.00e0 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 6.23e2 | 1.27e3 | 1.77e3 | 7.93e2 | 8.24e3 | 2.01e4 | 1.34e3 | 1.18e3 | 8.14e3 | 1.51e3 | 4.08e4 | 8.62e3 | 9.38e3 | 6.19e3 | 0.00e0 |

Table 14. continued, GCMS SIR of saturated compounds (amounts in ng/g)

| | | | | | m/z | 191 | | | | | | | | | | | | | | 217 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 30αβ | 30βα | 31αβS | 31αβR | 30G | 31βα | 32αβS | 32αβR | 33αβS | 33αβR | 34αβS | 34αβR | 35αβS | 35αβR | 21αα |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.70e5 | 3.37e4 | 1.02e5 | 9.95e4 | 3.26e4 | 2.16e4 | 8.06e4 | 5.95e4 | 5.79e4 | 3.92e4 | 5.03e4 | 3.08e4 | 5.41e4 | 3.42e4 | 1.00e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 4.44e5 | 7.42e4 | 1.09e5 | 8.38e4 | 1.56e4 | 2.45e4 | 5.92e4 | 4.44e4 | 3.16e4 | 2.24e4 | 2.05e4 | 1.40e4 | 1.71e4 | 1.14e4 | 9.46e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.48e5 | 2.23e4 | 1.11e5 | 9.77e4 | 4.72e4 | 2.08e4 | 9.79e4 | 6.84e4 | 7.11e4 | 4.99e4 | 7.90e4 | 5.56e4 | 8.55e4 | 5.73e4 | 2.83e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.20e5 | 3.71e4 | 4.77e4 | 4.58e4 | 5.27e3 | 2.18e4 | 1.85e4 | 1.96e4 | 9.71e3 | 9.81e3 | 8.26e3 | 8.22e3 | 7.25e3 | 5.76e3 | 1.62e4 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.22e5 | 3.91e4 | 4.93e4 | 4.82e4 | 6.16e3 | 2.30e4 | 1.97e4 | 2.33e4 | 1.11e4 | 1.09e4 | 1.00e4 | 8.59e3 | 7.95e3 | 6.19e3 | 1.36e4 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.14e5 | 2.76e4 | 4.81e4 | 5.39e4 | 7.65e3 | 1.42e4 | 2.62e4 | 1.77e4 | 1.32e4 | 8.80e3 | 9.45e3 | 6.37e3 | 6.35e3 | 4.26e3 | 1.02e4 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 4.77e5 | 7.36e4 | 1.19e5 | 8.77e4 | 2.26e4 | 4.16e4 | 6.23e4 | 4.35e4 | 3.86e4 | 2.48e4 | 1.95e4 | 1.23e4 | 1.13e4 | 7.34e3 | 2.48e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 4.46e5 | 5.04e4 | 1.46e5 | 1.13e5 | 3.22e4 | 3.36e4 | 1.08e5 | 7.36e4 | 7.21e4 | 4.75e4 | 5.85e4 | 3.83e4 | 5.45e4 | 3.48e4 | 1.85e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.76e5 | 7.87e4 | 1.10e5 | 1.04e5 | 1.74e4 | 4.00e4 | 5.97e4 | 5.04e4 | 3.76e4 | 2.75e4 | 2.81e4 | 1.92e4 | 2.23e4 | 1.46e4 | 2.41e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 6.43e5 | 4.73e4 | 3.06e5 | 2.31e5 | 8.23e4 | 4.61e4 | 2.90e5 | 1.94e5 | 2.01e5 | 1.28e5 | 1.98e5 | 1.25e5 | 1.98e5 | 1.31e5 | 3.66e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.59e5 | 8.36e4 | 1.33e5 | 1.01e5 | 2.57e4 | 4.13e4 | 7.47e4 | 5.77e4 | 4.68e4 | 3.31e4 | 4.00e4 | 2.91e4 | 4.07e4 | 2.52e4 | 9.83e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 3.15e5 | 4.16e4 | 1.33e5 | 1.11e5 | 3.62e4 | 2.99e4 | 1.10e5 | 7.39e4 | 7.72e4 | 5.12e4 | 6.86e4 | 4.49e4 | 6.92e4 | 4.18e4 | 6.13e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.40e5 | 5.03e4 | 5.01e4 | 7.56e4 | 6.09e3 | 2.63e4 | 1.70e4 | 1.98e4 | 7.32e3 | 9.75e3 | 5.26e3 | 6.37e3 | 4.00e3 | 3.71e3 | 2.13e4 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 4.89e4 | 1.03e4 | 1.93e4 | 1.28e4 | 1.06e3 | 4.13e3 | 1.04e4 | 6.93e3 | 4.41e3 | 2.64e3 | 2.18e3 | 1.41e3 | 9.30e2 | 8.28e2 | 2.37e3 |

Table 14. continued, GCMS SIR of saturated compounds (amounts in ng/g)

| m/z | | | | | | 217 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 21ββ | 22αα | 22ββ | 27dβS | 27dβR | 27daR | 27daS | 28dβS#1 | 28dβS#2 | 28dβR#1 | 28dβR#2 | 28daR | 27ααS | 27ββR+29dβS | 27ββS |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.29e4 | 7.09e3 | 1.53e4 | 3.09e4 | 1.59e4 | 8.03e3 | 1.13e4 | 1.25e4 | 1.01e4 | 6.09e3 | 8.34e3 | 5.15e3 | 1.98e4 | 3.09e4 | 1.95e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.59e4 | 7.87e3 | 1.03e4 | 5.11e4 | 3.07e4 | 1.41e4 | 1.83e4 | 2.27e4 | 2.19e4 | 1.29e4 | 1.77e4 | 1.00e4 | 2.02e4 | 3.91e4 | 2.14e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 4.56e4 | 1.73e4 | 2.13e4 | 1.81e4 | 1.04e4 | 4.69e3 | 5.78e3 | 8.94e3 | 5.85e3 | 3.75e3 | 5.34e3 | 5.08e3 | 1.49e4 | 2.30e4 | 1.71e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.43e4 | 8.51e3 | 1.27e4 | 1.12e4 | 7.15e3 | 3.33e3 | 4.19e3 | 5.89e3 | 5.59e3 | 3.17e3 | 4.62e3 | 2.89e3 | 5.55e3 | 1.83e4 | 5.98e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.82e4 | 7.99e3 | 1.26e4 | 1.45e4 | 8.42e3 | 4.61e3 | 5.08e3 | 6.67e3 | 6.40e3 | 3.70e3 | 5.35e3 | 3.88e3 | 6.91e3 | 1.51e4 | 7.26e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 2.18e4 | 6.51e3 | 1.07e4 | 1.53e4 | 9.83e3 | 4.57e3 | 5.68e3 | 8.26e3 | 7.16e3 | 3.90e3 | 5.70e3 | 3.30e3 | 1.28e4 | 1.26e4 | 8.20e3 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 4.28e4 | 2.31e4 | 3.45e4 | 2.72e5 | 1.80e5 | 8.96e4 | 1.06e5 | 1.74e5 | 1.83e5 | 1.10e5 | 1.36e5 | 8.09e4 | 7.71e4 | 1.72e5 | 1.03e5 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 3.21e4 | 1.47e4 | 2.42e4 | 1.29e5 | 8.93e4 | 4.30e4 | 5.03e4 | 8.40e4 | 7.87e4 | 5.18e4 | 6.49e4 | 4.00e4 | 4.59e4 | 9.14e4 | 6.12e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.88e4 | 1.69e4 | 2.36e4 | 1.23e5 | 7.85e4 | 3.90e4 | 4.53e4 | 7.73e4 | 7.54e4 | 4.87e4 | 6.26e4 | 3.76e4 | 3.62e4 | 7.83e4 | 4.88e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 9.18e3 | 2.23e3 | 6.02e3 | 1.75e4 | 1.04e4 | 4.68e3 | 6.37e3 | 8.25e3 | 5.44e3 | 3.68e3 | 5.83e3 | 5.73e3 | 2.16e4 | 3.33e4 | 2.59e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.90e4 | 5.74e3 | 1.07e4 | 6.09e4 | 4.43e4 | 2.04e4 | 2.39e4 | 4.35e4 | 4.22e4 | 2.56e4 | 3.12e4 | 2.02e4 | 2.19e4 | 5.24e4 | 2.98e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.32e4 | 3.87e3 | 7.06e3 | 3.52e4 | 2.31e4 | 1.14e4 | 1.52e4 | 2.30e4 | 2.06e4 | 1.22e4 | 1.72e4 | 1.16e4 | 1.71e4 | 3.19e4 | 2.24e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 4.24e4 | 1.09e4 | 1.66e4 | 2.29e4 | 1.42e4 | 6.92e3 | 7.95e3 | 1.14e4 | 9.59e3 | 5.54e3 | 8.00e3 | 4.88e3 | 8.67e3 | 1.55e4 | 9.21e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.91e3 | 2.30e3 | 5.06e3 | 2.38e3 | 1.18e3 | 8.20e2 | 8.87e2 | 1.40e3 | 1.81e3 | 7.53e2 | 1.16e3 | 7.28e2 | 5.24e2 | 6.84e3 | 9.13e2 |

Table 14. continued, GCMS SIR of saturated compounds (amounts in ng/g)

| | | | | | m/z | 217 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 28daS | 27ααR | 29dβR | 29daR | 28ααS | 29daS | 28ββR | 28ββS | 28ααR | 29ααS | 29ββR | 29ββS | 29ααR | 30ααS | 30ββR |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 3.20e3 | 2.72e4 | 1.56e4 | 7.63e3 | 5.79e3 | 9.41e3 | 1.54e4 | 1.69e4 | 1.13e4 | 2.10e4 | 2.91e4 | 2.70e4 | 2.81e4 | 9.44e3 | 5.72e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 6.81e3 | 2.96e4 | 2.69e4 | 1.37e4 | 7.36e3 | 1.25e4 | 1.71e4 | 2.34e4 | 1.54e4 | 2.25e4 | 2.79e4 | 2.44e4 | 2.52e4 | 1.11e4 | 4.78e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.97e3 | 1.74e4 | 1.13e4 | 4.48e3 | 6.21e3 | 5.07e3 | 1.39e4 | 1.56e4 | 7.36e3 | 2.01e4 | 2.61e4 | 2.50e4 | 1.79e4 | 8.63e3 | 8.00e3 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.65e3 | 8.48e3 | 1.32e4 | 7.20e3 | 2.13e3 | 8.46e3 | 5.74e3 | 6.24e3 | 4.87e3 | 7.19e3 | 1.64e4 | 9.21e3 | 1.78e4 | 3.06e3 | 1.33e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.94e3 | 1.26e4 | 1.10e4 | 5.19e3 | 2.61e3 | 6.29e3 | 6.15e3 | 6.81e3 | 6.47e3 | 8.85e3 | 1.30e4 | 8.42e3 | 1.97e4 | 3.97e3 | 1.87e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 2.42e3 | 2.79e4 | 7.76e3 | 4.21e3 | 2.72e3 | 3.87e3 | 5.83e3 | 7.15e3 | 4.62e3 | 8.18e3 | 8.95e3 | 6.92e3 | 8.20e3 | 4.05e3 | 1.32e3 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 6.32e4 | 8.63e4 | 1.32e5 | 6.66e4 | 3.01e4 | 5.43e4 | 1.04e5 | 1.26e5 | 5.67e4 | 6.01e4 | 8.74e4 | 8.47e4 | 4.65e4 | 3.12e4 | 1.95e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 3.19e4 | 5.01e4 | 6.83e4 | 3.15e4 | 1.60e4 | 2.85e4 | 5.59e4 | 6.85e4 | 3.20e4 | 4.21e4 | 5.62e4 | 5.40e4 | 3.73e4 | 2.08e4 | 1.28e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.71e4 | 4.20e4 | 5.77e4 | 2.88e4 | 1.51e4 | 2.69e4 | 4.52e4 | 5.56e4 | 2.69e4 | 3.14e4 | 4.45e4 | 4.06e4 | 3.65e4 | 1.62e4 | 9.21e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 2.87e3 | 2.41e4 | 1.57e4 | 5.67e3 | 9.83e3 | 7.72e3 | 1.88e4 | 2.42e4 | 1.19e4 | 3.85e4 | 4.86e4 | 4.70e4 | 3.20e4 | 1.69e4 | 1.50e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.57e4 | 2.91e4 | 3.87e4 | 1.97e4 | 9.53e3 | 1.91e4 | 3.02e4 | 3.43e4 | 1.70e4 | 2.53e4 | 3.73e4 | 3.07e4 | 3.16e4 | 1.37e4 | 7.23e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 7.63e3 | 2.07e4 | 2.18e4 | 9.96e3 | 6.83e3 | 9.46e3 | 1.97e4 | 2.47e4 | 1.11e4 | 2.31e4 | 2.96e4 | 2.71e4 | 1.96e4 | 1.11e4 | 8.16e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.20e3 | 2.22e4 | 1.18e4 | 5.46e3 | 2.66e3 | 5.51e3 | 8.05e3 | 8.24e3 | 9.38e3 | 7.23e3 | 1.23e4 | 7.69e3 | 2.00e4 | 4.53e3 | 2.08e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.75e2 | 1.05e3 | 3.79e3 | 1.56e3 | 3.38e2 | 2.20e3 | 7.44e2 | 1.40e3 | 7.05e2 | 2.81e3 | 3.61e3 | 2.29e3 | 2.93e3 | 1.27e3 | 8.60e1 |

Table 14. continued, GCMS SIR of saturated compounds (amounts in ng/g)

| | | | | | m/z | 217 | | 218 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 30ββS | 30ααR | 27ββR | 27ββS | 28ββR | 28ββS | 29ββR | 29ββS | 30ββR | 30ββS |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.54e3 | 5.33e3 | 4.02e4 | 3.28e4 | 2.09e4 | 2.48e4 | 4.59e4 | 4.41e4 | 5.57e3 | 5.60e3 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 2.02e3 | 3.72e3 | 4.10e4 | 3.32e4 | 2.42e4 | 3.09e4 | 4.24e4 | 3.87e4 | 4.89e3 | 3.80e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.28e3 | 3.30e3 | 3.25e4 | 2.75e4 | 2.04e4 | 2.36e4 | 4.18e4 | 3.98e4 | 5.76e3 | 4.08e3 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.10e2 | 1.35e3 | 1.18e4 | 9.00e3 | 7.22e3 | 8.59e3 | 1.90e4 | 1.48e4 | 1.02e3 | 8.82e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 4.65e2 | 1.97e3 | 1.31e4 | 1.12e4 | 8.63e3 | 9.72e3 | 1.64e4 | 1.34e4 | 1.25e3 | 1.03e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 5.26e2 | 8.61e2 | 1.52e4 | 1.27e4 | 9.04e3 | 1.05e4 | 1.19e4 | 1.16e4 | 1.18e3 | 8.60e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 9.63e3 | 1.70e4 | 1.95e5 | 1.59e5 | 1.55e5 | 1.75e5 | 1.30e5 | 1.29e5 | 2.14e4 | 1.73e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 5.53e3 | 9.80e3 | 1.07e5 | 9.22e4 | 7.92e4 | 9.49e4 | 8.56e4 | 8.38e4 | 1.24e4 | 1.00e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.91e3 | 7.14e3 | 8.98e4 | 7.60e4 | 6.59e4 | 7.94e4 | 6.68e4 | 6.26e4 | 9.14e3 | 6.95e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 6.78e3 | 6.26e3 | 4.89e4 | 4.40e4 | 2.83e4 | 3.55e4 | 7.73e4 | 7.31e4 | 1.08e4 | 7.69e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 2.97e3 | 5.28e3 | 5.49e4 | 4.36e4 | 4.28e4 | 4.66e4 | 5.49e4 | 4.63e4 | 6.75e3 | 5.25e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.80e3 | 4.55e3 | 4.25e4 | 3.81e4 | 3.02e4 | 3.67e4 | 4.49e4 | 4.19e4 | 6.63e3 | 4.61e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 9.85e2 | 2.78e3 | 1.65e4 | 1.29e4 | 1.01e4 | 1.12e4 | 1.55e4 | 1.31e4 | 1.25e3 | 1.14e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 9.50e1 | 1.15e2 | 2.70e3 | 1.04e3 | 8.92e2 | 1.83e3 | 4.29e3 | 3.26e3 | 3.80e2 | 0.00e0 |

## Table A15. GCMS SIR of aromatic compounds (peak height)

| | | | | | m/z | 142 | | 156 | | | | | | | | | | 170 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2-MN | 1-MN | 2-EN | 1-EN | 2,6-DMN | 2,7-DMN | 1,3- + 1,7-DMN | 1,6-DMN | 2,3- + 1,4-DMN | 1,5-DMN | 1,2-DMN | 1,8-DMN | 1,3,7-TMN | 1,3,6-TMN | 1,3,5- + 1,4,6-TMN |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.78e5 | 1.24e5 | 1.51e4 | 6.06e3 | 7.31e4 | 7.13e4 | 1.05e5 | 1.01e5 | 4.20e4 | 2.02e4 | 1.68e4 | 4.40e2 | 2.75e4 | 4.36e4 | 2.96e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.28e5 | 6.63e4 | 9.32e3 | 2.94e3 | 3.36e4 | 3.46e4 | 5.14e4 | 4.80e4 | 1.99e4 | 9.36e3 | 8.41e3 | 1.06e2 | 1.16e4 | 1.78e4 | 1.20e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.83e5 | 1.44e5 | 1.96e4 | 1.03e4 | 1.01e5 | 1.08e5 | 1.60e5 | 1.47e5 | 6.10e4 | 3.16e4 | 2.46e4 | 6.75e2 | 5.04e4 | 7.61e4 | 5.39e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.06e6 | 1.13e6 | 1.09e5 | 7.04e4 | 4.33e5 | 4.79e5 | 1.02e6 | 9.83e5 | 4.69e5 | 2.36e5 | 1.98e5 | 1.18e4 | 2.21e5 | 4.28e5 | 3.93e5 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.21e6 | 1.25e6 | 9.34e4 | 6.06e4 | 3.73e5 | 4.19e5 | 8.94e5 | 8.33e5 | 4.00e5 | 2.10e5 | 1.50e5 | 8.96e3 | 1.68e5 | 2.99e5 | 2.52e5 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 3.37e6 | 1.98e6 | 1.52e5 | 7.63e4 | 5.12e5 | 5.27e5 | 1.13e6 | 1.14e6 | 4.88e5 | 2.34e5 | 2.02e5 | 7.76e2 | 2.32e5 | 3.93e5 | 2.67e5 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.01e5 | 1.64e5 | 1.18e4 | 6.71e3 | 8.46e4 | 9.29e4 | 1.49e5 | 1.41e5 | 5.99e4 | 2.87e4 | 1.99e4 | 7.98e2 | 4.33e4 | 7.91e4 | 5.00e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 2.45e6 | 1.54e6 | 1.01e5 | 7.60e4 | 5.87e5 | 6.61e5 | 1.27e6 | 1.23e6 | 5.76e5 | 2.89e5 | 2.16e5 | 1.22e4 | 2.58e5 | 4.54e5 | 4.30e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.13e6 | 1.16e6 | 7.96e4 | 5.50e4 | 5.21e5 | 5.96e5 | 9.71e5 | 9.77e5 | 4.26e5 | 1.99e5 | 1.50e5 | 5.45e3 | 1.84e5 | 3.64e5 | 2.35e5 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 7.83e4 | 6.09e4 | 4.06e3 | 2.81e3 | 1.43e4 | 1.54e4 | 3.86e4 | 3.02e4 | 1.54e4 | 1.31e4 | 1.04e4 | 3.21e2 | 9.39e3 | 1.76e4 | 1.73e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.18e5 | 1.82e5 | 1.66e4 | 9.79e3 | 5.90e4 | 6.45e4 | 1.30e5 | 1.39e5 | 5.99e4 | 2.82e4 | 2.67e4 | 1.14e3 | 2.89e4 | 5.17e4 | 3.93e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 7.88e5 | 5.48e5 | 4.58e4 | 3.12e4 | 1.64e5 | 1.78e5 | 4.31e5 | 4.01e5 | 1.88e5 | 1.04e5 | 8.17e4 | 1.37e3 | 9.39e4 | 1.69e5 | 1.25e5 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.47e5 | 8.66e4 | 5.46e3 | 3.25e3 | 2.19e4 | 2.40e4 | 5.58e4 | 4.72e4 | 2.35e4 | 1.36e4 | 8.39e3 | 6.31e2 | 9.87e3 | 1.92e4 | 1.54e4 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.11e8 | 4.72e7 | 5.72e6 | 2.24e6 | 2.68e7 | 2.49e7 | 3.62e7 | 3.48e7 | 1.32e7 | 5.67e6 | 4.60e6 | 2.00e4 | 1.31e7 | 1.62e7 | 9.99e6 |

Table 15. continued, GCMS SIR of aromatic compounds (peak height)

| | | | | | m/z | 170 | | | | | 178 | 192 | | | | 206 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2,3,6-TMN | 1,2,7-TMN | 1,6,7 + 1,2,6-TMN | 1,2,4-TMN | 1,2,5-TMN | P | 3-MP | 2-MP | 9-MP | 1-MP | 2-EP+9-EP+ 3,6-DMP | 1-EP | 2,6- + 2,7- + 3,5-DMP | 1,3- + 2,10- + 3,9- + 3,10-DMP | 1,6- + 2,5- + 2,9-DMP |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 3.84e4 | 8.99e3 | 2.66e4 | 3.74e3 | 2.39e4 | 1.54e5 | 3.76e4 | 4.71e4 | 4.63e4 | 3.27e4 | 6.48e3 | 1.41e4 | 1.05e4 | 4.07e4 | 2.20e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.38e4 | 3.75e3 | 9.89e3 | 1.41e3 | 7.01e3 | 1.81e5 | 6.94e4 | 8.44e4 | 6.82e4 | 5.25e4 | 1.29e4 | 2.53e4 | 1.69e4 | 6.75e4 | 3.22e4 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 6.44e4 | 1.62e4 | 4.59e4 | 7.16e3 | 4.25e4 | 6.55e5 | 2.17e5 | 2.84e5 | 2.38e5 | 1.66e5 | 3.73e4 | 7.29e4 | 5.73e4 | 2.14e5 | 1.08e5 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.05e5 | 8.36e4 | 3.27e5 | 4.02e4 | 4.41e5 | 3.00e6 | 5.03e5 | 7.98e5 | 9.52e5 | 8.14e5 | 7.34e4 | 1.59e5 | 1.20e5 | 5.27e5 | 2.63e5 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.98e5 | 5.60e4 | 2.28e5 | 2.78e4 | 3.00e5 | 2.61e6 | 3.42e5 | 5.16e5 | 6.22e5 | 5.27e5 | 4.32e4 | 8.97e4 | 6.25e4 | 2.69e5 | 1.52e5 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 3.35e5 | 8.22e4 | 3.06e5 | 3.42e4 | 3.34e5 | 4.12e6 | 7.24e5 | 1.09e6 | 1.26e6 | 1.14e6 | 7.57e4 | 1.40e5 | 8.84e4 | 4.63e5 | 2.56e5 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 5.85e4 | 1.15e4 | 3.84e4 | 5.38e3 | 2.58e4 | 5.38e5 | 1.05e5 | 1.68e5 | 1.46e5 | 1.11e5 | 1.20e4 | 2.71e4 | 2.20e4 | 8.01e4 | 4.70e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 2.99e5 | 8.15e4 | 3.22e5 | 4.36e4 | 2.41e5 | 4.18e6 | 6.66e5 | 1.23e6 | 1.66e6 | 1.09e6 | 1.23e5 | 2.24e5 | 1.58e5 | 1.01e6 | 5.22e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.60e5 | 5.92e4 | 2.12e5 | 2.47e4 | 2.18e5 | 3.18e6 | 4.22e5 | 8.01e5 | 7.47e5 | 5.96e5 | 4.16e4 | 8.54e4 | 6.18e4 | 2.53e5 | 1.42e5 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 9.16e3 | 4.40e3 | 9.46e3 | 2.46e3 | 1.51e4 | 7.69e4 | 2.66e4 | 3.19e4 | 7.67e4 | 4.54e4 | 7.01e3 | 1.11e4 | 6.79e3 | 6.07e4 | 3.13e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.27e4 | 1.25e4 | 3.49e4 | 6.01e3 | 4.67e4 | 5.91e5 | 6.55e4 | 1.04e5 | 1.15e5 | 1.21e5 | 6.63e3 | 1.25e4 | 9.18e3 | 3.44e4 | 2.00e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.09e5 | 3.21e4 | 1.05e5 | 1.45e4 | 1.19e5 | 1.54e6 | 2.51e5 | 4.01e5 | 4.73e5 | 3.48e5 | 3.18e4 | 5.64e4 | 3.51e4 | 1.93e5 | 1.06e5 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.17e4 | 3.23e3 | 1.40e4 | 1.58e3 | 1.61e4 | 2.43e5 | 3.41e4 | 4.86e4 | 5.77e4 | 5.13e4 | 3.05e3 | 6.28e3 | 4.39e3 | 1.66e4 | 9.58e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.22e7 | 2.35e6 | 8.78e6 | 1.09e6 | 4.81e6 | 5.96e6 | 3.87e6 | 3.80e6 | 3.24e6 | 2.22e6 | 9.31e5 | 1.42e6 | 7.90e5 | 3.03e6 | 1.39e6 |

Table 15. continued, GCMS SIR of aromatic compounds (peak height)

| | | | | | m/z | 206 | | | | | 219 | 184 | 198 | | | 253 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,7-DMP | 2,3-DMP | 1,9- + 4,9- + 4,10-DMP | 1,8-DMP | 1,2-DMP | Retene | DBT | 4-MDBT | (3+2)-MDBT | 1-MDBT | C21MA | C22MA | βSC27MA | βSC27DMA | βRC27MA+ βRC27DMA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.36e4 | 6.42e3 | 1.02e4 | 5.80e3 | 3.77e3 | 2.27e4 | 1.06e4 | 2.48e4 | 9.36e3 | 6.61e3 | 1.22e3 | 7.96e2 | 2.40e2 | 5.33e2 | 4.32e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 3.77e4 | 1.22e4 | 1.58e4 | 8.57e3 | 4.13e3 | 5.38e4 | 1.46e4 | 2.65e4 | 7.42e3 | 4.27e3 | 1.26e3 | 8.58e2 | 9.70e2 | 1.47e3 | 1.73e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.10e5 | 2.96e4 | 5.10e4 | 2.55e4 | 1.61e4 | 8.50e4 | 5.18e4 | 1.14e5 | 4.64e4 | 2.62e4 | 1.82e3 | 1.19e3 | 2.12e2 | 6.52e2 | 6.03e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.33e5 | 8.58e4 | 1.80e5 | 9.93e4 | 6.12e4 | 5.66e5 | 5.84e4 | 1.83e5 | 8.34e4 | 4.90e4 | 2.70e3 | 1.27e3 | 2.69e2 | 1.55e3 | 1.32e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.86e5 | 5.07e4 | 1.07e5 | 5.04e4 | 4.72e4 | 5.89e5 | 5.38e4 | 1.13e5 | 5.11e4 | 3.88e4 | 2.52e3 | 1.40e3 | 5.59e2 | 3.01e3 | 2.75e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 3.37e5 | 1.22e5 | 1.80e5 | 8.46e4 | 1.13e5 | 1.89e5 | 2.68e5 | 2.82e5 | 1.30e5 | 1.00e5 | 4.08e2 | 3.63e2 | 1.19e2 | 2.48e2 | 2.28e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 6.29e4 | 1.25e4 | 2.25e4 | 1.55e4 | 1.11e4 | 7.92e3 | 2.29e4 | 5.98e4 | 2.22e4 | 1.65e4 | 1.94e2 | 1.19e2 | 1.16e2 | 2.16e2 | 2.40e2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.56e5 | 1.29e5 | 3.29e5 | 2.04e5 | 1.27e5 | 3.85e5 | 5.48e4 | 1.52e5 | 4.95e4 | 8.64e4 | 4.81e3 | 3.07e3 | 6.54e2 | 1.72e3 | 1.67e3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.01e5 | 4.35e4 | 8.51e4 | 5.15e4 | 4.22e4 | 3.28e5 | 7.72e4 | 1.24e5 | 5.17e4 | 3.64e4 | 1.62e3 | 9.96e2 | 2.85e2 | 1.38e3 | 1.37e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 3.96e4 | 7.97e3 | 2.30e4 | 1.55e4 | 8.38e3 | 7.21e3 | 6.50e3 | 2.23e4 | 7.90e3 | 1.93e4 | 1.73e3 | 1.62e3 | 1.86e3 | 8.90e3 | 7.76e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.28e4 | 8.20e3 | 1.33e4 | 8.12e3 | 1.78e4 | 1.08e5 | 1.91e4 | 2.51e4 | 1.37e4 | 1.18e4 | 8.59e2 | 3.68e2 | 2.13e2 | 7.21e2 | 7.05e2 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.24e5 | 3.82e4 | 6.29e4 | 3.98e4 | 2.62e4 | 2.85e4 | 7.39e4 | 1.13e5 | 5.49e4 | 4.99e4 | 5.18e2 | 5.17e2 | 2.03e2 | 5.99e2 | 4.21e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 1.40e4 | 3.76e3 | 6.32e3 | 4.21e3 | 3.14e3 | 2.10e4 | 7.04e3 | 1.03e4 | 4.01e3 | 2.70e3 | 1.76e2 | 1.44e2 | 8.40e1 | 2.88e2 | 2.34e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.28e6 | 6.60e5 | 6.20e5 | 2.37e5 | 1.90e5 | 6.30e5 | 2.54e5 | 3.86e5 | 2.90e5 | 4.23e4 | 5.41e3 | 6.20e3 | 5.42e2 | 1.83e3 | 1.59e3 |

Table 15. continued, GCMS SIR of aromatic compounds (peak height)

| | | | | | m/z | 253 | | | | | | | | | | 231 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | αSC27MA | βSC28MA+ βSC28DMA+ αRC27DMA | αSC27DMA | αRC27MA | αSC28MA | βRC28MA+ βRC28DMA | βSC29MA+ βSC29DMA | αSC29MA | αRC28MA+ βRC29MA+ βRC29DMA | αRC29MA | C20TA | C21TA | SC26TA | RC26TA+ SC27TA | M1 |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 2.17e2 | 1.37e3 | 1.04e2 | 2.99e2 | 7.05e2 | 1.20e3 | 1.56e3 | 5.03e2 | 1.51e3 | 7.31e2 | 2.19e3 | 2.11e3 | 6.49e2 | 2.12e3 | 6.30e1 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 5.96e2 | 3.59e3 | 5.68e2 | 6.55e2 | 1.25e3 | 3.58e3 | 2.41e3 | 5.36e2 | 1.98e3 | 7.00e2 | 2.27e3 | 2.05e3 | 3.09e3 | 8.79e3 | 2.27e2 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.43e2 | 1.63e3 | 2.21e2 | 2.85e2 | 1.02e3 | 1.32e3 | 1.53e3 | 8.67e2 | 1.41e3 | 9.00e2 | 5.17e3 | 3.83e3 | 8.28e2 | 3.46e3 | 1.41e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 3.07e2 | 5.66e3 | 2.18e3 | 3.35e2 | 1.54e3 | 3.96e3 | 1.17e4 | 3.63e3 | 8.89e3 | 2.46e3 | 6.42e3 | 3.75e3 | 9.98e2 | 4.17e3 | 1.40e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 6.63e2 | 7.20e3 | 2.36e3 | 6.34e2 | 2.09e3 | 4.91e3 | 9.57e3 | 2.76e3 | 7.91e3 | 2.03e3 | 3.67e3 | 2.52e3 | 1.86e3 | 5.58e3 | 1.61e2 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 7.50e1 | 4.62e2 | 1.03e2 | 6.10e1 | 1.98e2 | 2.36e2 | 7.22e2 | 1.86e2 | 4.83e2 | 1.03e2 | 4.80e3 | 3.09e3 | 7.50e2 | 2.05e3 | 1.13e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.10e2 | 3.59e2 | 1.09e2 | 9.50e1 | 1.89e2 | 2.44e2 | 3.57e2 | 2.43e2 | 3.12e2 | 2.06e2 | 9.62e2 | 5.52e2 | 1.50e2 | 4.52e2 | 0.00e0 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.56e2 | 5.83e3 | 1.56e3 | 7.99e2 | 2.50e3 | 3.96e3 | 1.07e4 | 5.72e3 | 7.23e3 | 4.25e3 | 4.17e4 | 4.39e4 | 7.66e3 | 3.63e4 | 1.09e3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 3.43e2 | 3.90e3 | 1.22e3 | 4.83e2 | 1.41e3 | 2.66e3 | 9.70e3 | 3.65e3 | 7.36e3 | 3.00e3 | 6.73e3 | 6.92e3 | 1.45e3 | 4.92e3 | 6.30e1 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.14e3 | 1.58e4 | 2.68e3 | 1.65e3 | 2.08e3 | 1.07e4 | 1.45e4 | 1.23e3 | 9.89e3 | 9.64e2 | 1.41e4 | 1.71e4 | 2.34e4 | 1.06e5 | 2.97e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 1.84e2 | 2.27e3 | 7.98e2 | 2.42e2 | 6.87e2 | 1.30e3 | 5.10e3 | 1.82e3 | 4.09e3 | 1.19e3 | 9.50e2 | 1.23e3 | 5.48e2 | 1.91e3 | 4.00e1 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.56e2 | 1.18e3 | 5.39e2 | 1.54e2 | 2.43e2 | 6.97e2 | 1.37e3 | 2.79e2 | 1.01e3 | 2.60e2 | 5.99e3 | 4.52e3 | 2.20e3 | 5.69e3 | 1.93e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 8.90e1 | 6.42e2 | 1.70e2 | 1.16e2 | 1.98e2 | 4.30e2 | 7.75e2 | 2.88e2 | 5.33e2 | 1.75e2 | 2.50e2 | 1.39e2 | 2.53e2 | 7.45e2 | 3.00e1 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 6.09e2 | 4.17e3 | 1.42e3 | 5.58e2 | 1.50e3 | 2.32e3 | 6.93e3 | 1.76e3 | 4.01e3 | 9.60e2 | 1.30e4 | 7.42e3 | 1.91e3 | 5.38e3 | 2.08e2 |

## Table 15. continued, GCMS SIR of aromatic compounds (peak height)

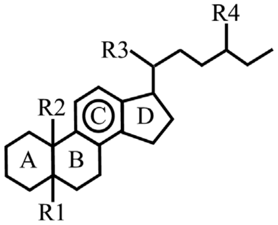
| | | | | | m/z | 231 | | | | | | 245 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | M2 | SC28TA | RC27TA | M3 | M4 | RC28TA | 3MS-TA | 4MS-TA | 2,24DMS-TA | 3,24DMS+3MR-TA | 4,24DMS+4MR-TA | D1-TA | 3M24ES-TA | D2-TA | 4M24ES-TA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.20e2 | 9.12e2 | 7.87e2 | 1.16e2 | 1.70e2 | 1.06e3 | 1.00e2 | 5.17e2 | 6.60e1 | 2.98e2 | 6.23e2 | 1.14e2 | 2.17e2 | 3.31e2 | 6.51e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 4.50e2 | 4.40e3 | 3.25e3 | 5.32e2 | 7.46e2 | 4.51e3 | 6.01e2 | 1.16e3 | 2.75e2 | 1.43e3 | 1.88e3 | 5.04e2 | 1.05e3 | 1.32e3 | 1.17e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 3.02e2 | 2.04e3 | 1.57e3 | 2.72e2 | 4.41e2 | 2.26e3 | 2.54e2 | 9.31e2 | 1.67e2 | 5.96e2 | 1.54e3 | 3.75e2 | 5.01e2 | 1.06e3 | 1.11e3 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.18e2 | 3.08e3 | 2.01e3 | 2.89e2 | 2.06e2 | 3.78e3 | 3.31e2 | 6.47e2 | 1.80e2 | 1.47e3 | 1.40e3 | 2.28e2 | 1.62e3 | 5.82e2 | 1.39e3 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 3.62e2 | 3.12e3 | 2.15e3 | 3.73e2 | 4.12e2 | 3.65e3 | 3.70e2 | 1.04e3 | 2.74e2 | 1.44e3 | 2.35e3 | 6.58e2 | 1.23e3 | 1.71e3 | 1.11e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.54e2 | 1.46e3 | 8.52e2 | 1.31e2 | 1.66e2 | 1.67e3 | 1.59e2 | 2.86e2 | 5.50e1 | 4.95e2 | 5.98e2 | 1.93e2 | 4.58e2 | 4.32e2 | 3.98e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 4.00e1 | 2.20e2 | 1.92e2 | 4.60e1 | 5.50e1 | 3.05e2 | 3.00e1 | 6.60e1 | 2.60e1 | 8.40e1 | 1.43e2 | 4.70e1 | 5.90e1 | 1.20e2 | 9.80e1 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 2.75e3 | 1.78e4 | 1.63e4 | 2.57e3 | 3.89e3 | 2.12e4 | 9.76e2 | 8.61e3 | 1.45e3 | 5.86e3 | 1.42e4 | 4.70e3 | 4.07e3 | 1.23e4 | 8.68e3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.90e2 | 4.14e3 | 1.89e3 | 2.35e2 | 3.01e2 | 5.21e3 | 2.63e2 | 1.12e3 | 1.75e2 | 1.49e3 | 3.15e3 | 3.50e2 | 1.63e3 | 1.26e3 | 1.63e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.01e4 | 6.05e4 | 5.00e4 | 1.02e4 | 1.42e4 | 7.66e4 | 4.01e3 | 3.15e4 | 5.32e3 | 1.78e4 | 4.93e4 | 1.79e4 | 1.38e4 | 5.04e4 | 3.28e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 2.07e2 | 1.73e3 | 8.18e2 | 1.13e2 | 1.23e2 | 1.85e3 | 6.90e1 | 4.58e2 | 1.45e2 | 4.09e2 | 1.83e3 | 4.28e2 | 6.27e2 | 1.01e3 | 9.01e2 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 3.68e2 | 2.91e3 | 2.44e3 | 3.82e2 | 4.61e2 | 3.34e3 | 3.02e2 | 1.24e3 | 1.93e2 | 1.11e3 | 2.97e3 | 5.50e2 | 6.36e2 | 1.32e3 | 1.03e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 7.10e1 | 3.63e2 | 2.66e2 | 5.00e1 | 8.70e1 | 3.62e2 | 5.30e1 | 1.42e2 | 2.20e1 | 1.35e2 | 2.49e2 | 9.40e1 | 1.31e2 | 2.43e2 | 1.46e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.64e2 | 4.88e3 | 1.69e3 | 2.79e2 | 4.01e2 | 3.96e3 | 5.93e2 | 1.13e3 | 2.78e2 | 1.14e3 | 1.37e3 | 2.31e2 | 1.11e3 | 3.29e2 | 7.50e2 |

Table 15. continued, GCMS SIR of aromatic compounds (peak height)

| m/z | | | | | | 245 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 3,24DMR-TA | 4,24DMR-TA | D3-TA | D4-TA | 2M24ER-TA | 3M24ER-TA | D5-TA | 4M24ER-TA | D6-TA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.32e2 | 3.81e2 | 4.39e2 | 4.26e2 | 6.60e1 | 1.54e2 | 2.82e2 | 4.33e2 | 5.49e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 5.92e2 | 9.39e2 | 1.27e3 | 1.38e3 | 3.57e2 | 8.60e2 | 8.47e2 | 1.11e3 | 1.65e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 3.32e2 | 9.59e2 | 1.31e3 | 1.45e3 | 1.41e2 | 4.05e2 | 1.03e3 | 1.14e3 | 1.76e3 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 6.26e2 | 7.99e2 | 6.84e2 | 1.17e3 | 1.80e2 | 1.05e3 | 5.50e2 | 1.52e3 | 8.10e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 5.28e2 | 1.17e3 | 2.21e3 | 3.04e3 | 1.51e2 | 6.56e2 | 1.81e3 | 1.26e3 | 2.37e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 2.06e2 | 3.98e2 | 4.33e2 | 5.23e2 | 1.79e2 | 3.16e2 | 3.05e2 | 2.70e2 | 6.94e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 4.70e1 | 5.50e1 | 1.34e2 | 1.20e2 | 2.30e1 | 6.50e1 | 1.08e2 | 8.90e1 | 1.52e2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 3.35e3 | 7.71e3 | 1.38e4 | 1.62e4 | 1.12e3 | 3.36e3 | 1.03e4 | 9.02e3 | 1.92e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 5.40e2 | 1.63e3 | 6.67e2 | 1.00e3 | 3.45e2 | 1.15e3 | 5.49e2 | 1.87e3 | 1.42e3 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.16e4 | 2.63e4 | 5.04e4 | 5.82e4 | 5.03e3 | 1.43e4 | 4.17e4 | 3.94e4 | 8.33e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 2.92e2 | 1.02e3 | 1.23e3 | 1.60e3 | 1.32e2 | 4.96e2 | 8.68e2 | 9.81e2 | 1.55e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 4.37e2 | 1.57e3 | 1.52e3 | 1.84e3 | 2.40e2 | 4.82e2 | 1.18e3 | 9.90e2 | 1.85e3 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 6.20e1 | 1.38e2 | 2.62e2 | 3.23e2 | 0.00e0 | 1.11e2 | 1.97e2 | 1.54e2 | 2.95e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 3.97e2 | 4.39e2 | 3.64e2 | 2.70e2 | 3.07e2 | 5.87e2 | 1.69e2 | 3.56e2 | 2.33e2 |

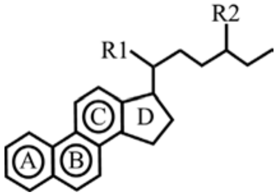
# Abbreviation of aromatic biomarkers

## C-ring monoaromatic steroid



| Substituents | | | | Label |
|---|---|---|---|---|
| $R_1$ | $R_2$ | $R_3$ | $R_4$ | |
| | | | | $C_{21}MA$ |
| | | | | $C_{22}MA$ |
| $\beta(H)$ | $CH_3$ | $S(CH_3)$ | H | $\beta SC_{27}MA$ |
| $\beta(CH_3)$ | H | $S(CH_3)$ | H | $\beta SC_{27}DMA$ |
| $\beta(CH_3)$ | H | $RCH_3)$ | H | $\beta RC_{27}DMA+$ |
| $\beta(H)$ | $CH_3$ | $R(CH_3)$ | H | $\beta RC_{27}MA$ |
| $\alpha(H)$ | $CH_3$ | $S(CH_3)$ | H | $\alpha SC_{27}MA$ |
| $\beta(H)$ | $CH_3$ | $S(CH_3)$ | $CH_3$ | $\beta SC_{28}MA+$ |
| $\alpha(CH_3)$ | H | $R(CH_3)$ | H | $\alpha RC_{27}DMA+$ |
| $\beta(CH_3)$ | H | $S(CH_3)$ | $CH_3$ | $\beta SC_{28}DMA$ |
| $\alpha(CH_3)$ | H | $S(CH_3)$ | $CH_3$ | $\alpha SC_{27}DMA$ |
| $\alpha(H)$ | $CH_3$ | $R(CH_3)$ | H | $\alpha RC_{27}MA$ |
| $\alpha(H)$ | $CH_3$ | $S(CH_3)$ | $CH_3$ | $\alpha SC_{28}MA$ |
| $\beta(H)$ | $CH_3$ | $R(CH_3)$ | $CH_3$ | $\beta RC_{28}MA+$ |
| $\beta(CH_3)$ | H | $R(CH_3)$ | $CH_3$ | $\beta RC_{28}DMA$ |
| $\beta(H)$ | $CH_3$ | $S(CH_3)$ | $C_2H_5$ | $\beta SC_{29}MA+$ |
| $\beta(CH_3)$ | H | $S(CH_3)$ | $C_2H_5$ | $\beta SC_{29}DMA$ |
| $\alpha(H)$ | $CH_3$ | $S(CH_3)$ | $C_2H_5$ | $\alpha SC_{29}MA$ |
| $\alpha(H)$ | $CH_3$ | $R(CH_3)$ | $CH_3$ | $\alpha RC_{28}MA+$ |
| $\beta(H)$ | $CH_3$ | $R(CH_3)$ | $C_2H_5$ | $\beta RC_{29}MA+$ |
| $\beta(CH_3)$ | H | $R(CH_3)$ | $C_2H_5$ | $\beta RC_{29}DMA$ |
| $\alpha(H)$ | $CH_3$ | $R(CH_3)$ | $C_2H_5$ | $\alpha RC_{29}MA$ |

## ABC-ring triaromatic steroids



| Substituents | | |
|---|---|---|
| $R_1$ | $R_2$ | Label |
| $CH_3$ | H | $C_{20}TA$ |
| $CH_3$ | $CH_3$ | $C_{21}TA$ |
| $S(CH_3)$ | $C_6H_{13}$ | $SC_{26}TA$ |
| $R(CH_3)$ | $C_6H_{13}$ | $RC_{26}TA+$ |
| S(CH3) | $C_7H_{15}$ | $SC_{27}TA$ |
| $S(CH_3)$ | $C_8H_{17}$ | $SC_{28}TA$ |
| $R(CH_3)$ | $C_7H_{15}$ | $RC_{27}TA$ |
| $R(CH_3)$ | $C_8H_{17}$ | $RC_{28}TA$ |

## Polycyclic aromatic hydrocarbons and sulphur compounds

| | |
|---|---|
| MN | Methylnaphthalene |
| EN | Ethylnaphthalene |
| DMN | Dimethylnaphthalene |
| TMN | Trimethylnaphthalene |
| TeMN | Tetramethylnaphthalene |
| P | Phenanthrene |
| MP | Methylphenanthrene |
| EP | Ethylphenanthrene |
| DMP | Dimethylphenanthrene |
| DBT | Dibenzothiophene |
| MDBT | Methyldibenzothiophene |
| DMDBT | Dimethyldibenzothiophene |

## Tri-aromatic steroids (TA)

| | |
|---|---|
| 3MS-TA | (20S) 3-methyl TA |
| 4MS-TA | (20S) 4-methyl TA |
| 2,24DMS-TA | (20S) 2,24-dimethyl TA |
| 3,24DMS-TA | (20S) 3,24-dimethyl TA |
| 3MR-TA | (20R) 3-methyl TA |
| 4,24DMS-TA | (20S) 4,24-dimethyl TA |
| 4MR-TA | (20R) 4-methyl TA |
| 3M24ES-TA | (20S) 3-methyl-24-ethyl TA |
| 4M24ES-TA | (20S) 4-methyl-24-ethyl TA |
| 3,24DMR-TA | (20R) 3,24-dimethyl TA |
| 4,24DMR-TA | (20R) 4,24-dimethyl TA |
| 2M24ER-TA | (20R) 2-methyl-24-ethyl TA |
| 3M24ER-TA | (20R) 3-methyl-24-ethyl TA |
| 4M24ER-TA | (20R) 4-methyl-24-ethyl TA |

## Tri-aromatic dinosteroids

| | |
|---|---|
| D1-TA | TA-dinosteroid #1 |
| D2-TA | TA-dinosteroid #2 |
| D3-TA | TA-dinosteroid #3 |
| D4-TA | TA-dinosteroid #4 |
| D5-TA | TA-dinosteroid #5 |
| D6-TA | TA-dinosteroid #6 |
| M1 | 23,24-dimethyl-triaromatic steroid #1 |
| M2 | 23,24-dimethyl-triaromatic steroid #2 |
| M3 | 23,24-dimethyl-triaromatic steroid #3 |
| M4 | 23,24-dimethyl-triaromatic steroid #4 |

## *Table A16. GCMS SIR of aromatic compounds (amounts in ng/g)*

| | | | | | m/z | 142 | | 156 | | | | | | | | | | 170 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2-MN | 1-MN | 2-EN | 1-EN | 2,6-DMN | 2,7-DMN | 1,3- + 1,7-DMN | 1,6-DMN | 2,3- + 1,4-DMN | 1,5-DMN | 1,2-DMN | 1,8-DMN | 1,3,7-TMN | 1,3,6-TMN | 1,3,5- + 1,4,6-TMN |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.42e5 | 6.35e4 | 7.72e3 | 3.09e3 | 3.74e4 | 3.64e4 | 5.38e4 | 5.17e4 | 2.15e4 | 1.03e4 | 8.57e3 | 2.25e2 | 1.41e4 | 2.23e4 | 1.51e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.30e4 | 6.71e3 | 9.44e2 | 2.98e2 | 3.41e3 | 3.51e3 | 5.20e3 | 4.87e3 | 2.01e3 | 9.49e2 | 8.52e2 | 1.10e1 | 1.18e3 | 1.80e3 | 1.21e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 7.37e4 | 3.76e4 | 5.11e3 | 2.69e3 | 2.64e4 | 2.83e4 | 4.17e4 | 3.84e4 | 1.59e4 | 8.24e3 | 6.40e3 | 1.76e2 | 1.31e4 | 1.98e4 | 1.41e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 9.36e5 | 5.14e5 | 4.95e4 | 3.20e4 | 1.97e5 | 2.18e5 | 4.64e5 | 4.47e5 | 2.13e5 | 1.07e5 | 8.99e4 | 5.36e3 | 1.00e5 | 1.95e5 | 1.79e5 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 8.07e5 | 4.57e5 | 3.41e4 | 2.21e4 | 1.36e5 | 1.53e5 | 3.27e5 | 3.04e5 | 1.46e5 | 7.67e4 | 5.49e4 | 3.27e3 | 6.12e4 | 1.09e5 | 9.21e4 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 2.00e6 | 1.17e6 | 9.03e4 | 4.53e4 | 3.04e5 | 3.13e5 | 6.68e5 | 6.80e5 | 2.90e5 | 1.39e5 | 1.20e5 | 4.61e2 | 1.38e5 | 2.33e5 | 1.58e5 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 1.30e5 | 7.12e4 | 5.13e3 | 2.91e3 | 3.67e4 | 4.03e4 | 6.48e4 | 6.10e4 | 2.60e4 | 1.25e4 | 8.64e3 | 3.46e2 | 1.88e4 | 3.43e4 | 2.17e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.03e5 | 3.79e5 | 2.48e4 | 1.87e4 | 1.45e5 | 1.63e5 | 3.12e5 | 3.02e5 | 1.42e5 | 7.11e4 | 5.30e4 | 3.01e3 | 6.34e4 | 1.12e5 | 1.06e5 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 8.45e5 | 4.61e5 | 3.16e4 | 2.19e4 | 2.07e5 | 2.37e5 | 3.86e5 | 3.88e5 | 1.69e5 | 7.89e4 | 5.95e4 | 2.17e3 | 7.32e4 | 1.45e5 | 9.35e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 7.99e3 | 6.21e3 | 4.14e2 | 2.87e2 | 1.45e3 | 1.57e3 | 3.93e3 | 3.08e3 | 1.58e3 | 1.34e3 | 1.06e3 | 3.30e1 | 9.57e2 | 1.80e3 | 1.76e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.94e5 | 2.25e5 | 2.05e4 | 1.21e4 | 7.30e4 | 7.99e4 | 1.61e5 | 1.73e5 | 7.42e4 | 3.49e4 | 3.30e4 | 1.41e3 | 3.58e4 | 6.40e4 | 4.87e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 4.30e5 | 2.99e5 | 2.50e4 | 1.70e4 | 8.93e4 | 9.73e4 | 2.35e5 | 2.19e5 | 1.02e5 | 5.65e4 | 4.46e4 | 7.48e2 | 5.12e4 | 9.24e4 | 6.83e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.37e5 | 1.98e5 | 1.25e4 | 7.44e3 | 5.01e4 | 5.50e4 | 1.28e5 | 1.08e5 | 5.38e4 | 3.12e4 | 1.92e4 | 1.44e3 | 2.26e4 | 4.40e4 | 3.53e4 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.20e7 | 5.06e6 | 6.14e5 | 2.40e5 | 2.87e6 | 2.67e6 | 3.89e6 | 3.73e6 | 1.42e6 | 6.08e5 | 4.93e5 | 2.14e3 | 1.41e6 | 1.74e6 | 1.07e6 |

Table 16. continued, GCMS SIR of aromatic compounds (amounts in ng/g)

| | | | | | m/z | 170 | | | | | 178 | 192 | | | | 206 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 2,3,6-TMN | 1,2,7-TMN | 1,6,7 + 1,2,6-TMN | 1,2,4-TMN | 1,2,5-TMN | P | 3-MP | 2-MP | 9-MP | 1-MP | 2-EP+9-EP+3,6-DMP | 1-EP | 2,6- + 2,7- + 3,5-DMP | 1,3- + 2,10- + 3,9- + 3,10-DMP | 1,6- + 2,5- + 2,9-DMP |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.96e4 | 4.59e3 | 1.36e4 | 1.91e3 | 1.22e4 | 8.05e4 | 1.96e4 | 2.46e4 | 2.42e4 | 1.71e4 | 3.38e3 | 7.36e3 | 5.48e3 | 2.13e4 | 1.15e4 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.40e3 | 3.80e2 | 1.00e3 | 1.43e2 | 7.10e2 | 3.30e4 | 1.27e4 | 1.54e4 | 1.25e4 | 9.60e3 | 2.36e3 | 4.63e3 | 3.10e3 | 1.23e4 | 5.88e3 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.68e4 | 4.22e3 | 1.20e4 | 1.87e3 | 1.11e4 | 1.66e5 | 5.49e4 | 7.18e4 | 6.01e4 | 4.21e4 | 9.45e3 | 1.84e4 | 1.45e4 | 5.41e4 | 2.73e4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.39e5 | 3.80e4 | 1.49e5 | 1.83e4 | 2.01e5 | 8.97e5 | 1.51e5 | 2.39e5 | 2.85e5 | 2.44e5 | 2.20e4 | 4.77e4 | 3.60e4 | 1.58e5 | 7.86e4 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 7.24e4 | 2.04e4 | 8.31e4 | 1.02e4 | 1.10e5 | 8.43e5 | 1.11e5 | 1.67e5 | 2.01e5 | 1.71e5 | 1.40e4 | 2.90e4 | 2.02e4 | 8.71e4 | 4.93e4 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.99e5 | 4.88e4 | 1.81e5 | 2.03e4 | 1.99e5 | 2.10e6 | 3.68e5 | 5.53e5 | 6.42e5 | 5.82e5 | 3.85e4 | 7.12e4 | 4.50e4 | 2.36e5 | 1.30e5 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 2.54e4 | 5.01e3 | 1.67e4 | 2.33e3 | 1.12e4 | 2.74e5 | 5.36e4 | 8.55e4 | 7.41e4 | 5.67e4 | 6.09e3 | 1.38e4 | 1.12e4 | 4.08e4 | 2.40e4 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 7.37e4 | 2.01e4 | 7.93e4 | 1.07e4 | 5.92e4 | 7.75e5 | 1.23e5 | 2.29e5 | 3.08e5 | 2.03e5 | 2.28e4 | 4.15e4 | 2.93e4 | 1.88e5 | 9.68e4 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 1.04e5 | 2.35e4 | 8.41e4 | 9.82e3 | 8.67e4 | 9.64e5 | 1.28e5 | 2.43e5 | 2.27e5 | 1.81e5 | 1.26e4 | 2.59e4 | 1.88e4 | 7.68e4 | 4.31e4 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 9.34e2 | 4.49e2 | 9.65e2 | 2.51e2 | 1.54e3 | 1.43e4 | 4.95e3 | 5.93e3 | 1.43e4 | 8.45e3 | 1.30e3 | 2.07e3 | 1.26e3 | 1.13e4 | 5.83e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 4.05e4 | 1.54e4 | 4.32e4 | 7.45e3 | 5.78e4 | 7.66e5 | 8.49e4 | 1.35e5 | 1.49e5 | 1.57e5 | 8.59e3 | 1.62e4 | 1.19e4 | 4.45e4 | 2.59e4 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 5.97e4 | 1.75e4 | 5.75e4 | 7.90e3 | 6.50e4 | 6.21e5 | 1.01e5 | 1.62e5 | 1.91e5 | 1.40e5 | 1.29e4 | 2.28e4 | 1.42e4 | 7.79e4 | 4.29e4 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 2.68e4 | 7.40e3 | 3.20e4 | 3.62e3 | 3.68e4 | 6.80e5 | 9.55e4 | 1.36e5 | 1.62e5 | 1.43e5 | 8.53e3 | 1.76e4 | 1.23e4 | 4.65e4 | 2.68e4 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.31e6 | 2.52e5 | 9.43e5 | 1.17e5 | 5.16e5 | 8.20e5 | 5.32e5 | 5.23e5 | 4.45e5 | 3.06e5 | 1.28e5 | 1.95e5 | 1.09e5 | 4.17e5 | 1.91e5 |

Table 16. continued, GCMS SIR of aromatic compounds (amounts in ng/g)

| | | | | | m/z | 206 | | | | | 219 | 184 | 198 | | | 253 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 1,7-DMP | 2,3-DMP | 1,9- + 4,9- + 4,10-DMP | 1,8-DMP | 1,2-DMP | Retene | DBT | 4-MDBT | (3+2)-MDBT | 1-MDBT | C21MA | C22MA | βSC27MA | βSC27DMA | βRC27MA+ βRC27DMA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.23e4 | 3.35e3 | 5.34e3 | 3.03e3 | 1.97e3 | 1.18e4 | 5.52e3 | 1.30e4 | 4.89e3 | 3.45e3 | 8.13e2 | 5.31e2 | 1.60e2 | 3.55e2 | 2.89e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 6.90e3 | 2.24e3 | 2.90e3 | 1.57e3 | 7.54e2 | 9.84e3 | 2.67e3 | 4.85e3 | 1.36e3 | 7.80e2 | 2.63e2 | 1.79e2 | 2.02e2 | 3.06e2 | 3.59e2 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 2.79e4 | 7.49e3 | 1.29e4 | 6.45e3 | 4.07e3 | 2.15e4 | 1.31e4 | 2.89e4 | 1.17e4 | 6.63e3 | 5.78e2 | 3.78e2 | 6.70e1 | 2.07e2 | 1.91e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 9.96e4 | 2.57e4 | 5.40e4 | 2.97e4 | 1.83e4 | 1.69e5 | 1.75e4 | 5.47e4 | 2.50e4 | 1.47e4 | 1.01e3 | 4.72e2 | 1.00e2 | 5.77e2 | 4.92e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 6.02e4 | 1.64e4 | 3.47e4 | 1.63e4 | 1.53e4 | 1.91e5 | 1.74e4 | 3.65e4 | 1.65e4 | 1.25e4 | 1.06e3 | 5.87e2 | 2.35e2 | 1.26e3 | 1.15e3 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.71e5 | 6.22e4 | 9.15e4 | 4.31e4 | 5.74e4 | 9.59e4 | 1.36e5 | 1.44e5 | 6.60e4 | 5.10e4 | 2.46e2 | 2.19e2 | 7.20e1 | 1.50e2 | 1.38e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.20e4 | 6.38e3 | 1.15e4 | 7.88e3 | 5.65e3 | 4.03e3 | 1.17e4 | 3.05e4 | 1.13e4 | 8.39e3 | 1.48e2 | 9.00e1 | 8.80e1 | 1.64e2 | 1.83e2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.22e5 | 2.39e4 | 6.10e4 | 3.78e4 | 2.35e4 | 7.14e4 | 1.02e4 | 2.81e4 | 9.18e3 | 1.60e4 | 1.00e3 | 6.38e2 | 1.36e2 | 3.57e2 | 3.47e2 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 6.10e4 | 1.32e4 | 2.58e4 | 1.57e4 | 1.28e4 | 9.95e4 | 2.34e4 | 3.78e4 | 1.57e4 | 1.10e4 | 7.15e2 | 4.39e2 | 1.25e2 | 6.08e2 | 6.05e2 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 7.37e3 | 1.48e3 | 4.28e3 | 2.88e3 | 1.56e3 | 1.34e3 | 1.21e3 | 4.15e3 | 1.47e3 | 3.60e3 | 3.41e2 | 3.20e2 | 3.66e2 | 1.76e3 | 1.53e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 4.25e4 | 1.06e4 | 1.73e4 | 1.05e4 | 2.31e4 | 1.40e5 | 2.48e4 | 3.25e4 | 1.78e4 | 1.54e4 | 1.44e3 | 6.16e2 | 3.56e2 | 1.21e3 | 1.18e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 5.01e4 | 1.54e4 | 2.54e4 | 1.61e4 | 1.06e4 | 1.15e4 | 2.99e4 | 4.56e4 | 2.22e4 | 2.02e4 | 2.43e2 | 2.43e2 | 9.60e1 | 2.81e2 | 1.98e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.90e4 | 1.05e4 | 1.77e4 | 1.18e4 | 8.78e3 | 5.89e4 | 1.97e4 | 2.88e4 | 1.12e4 | 7.55e3 | 7.52e2 | 6.15e2 | 3.60e2 | 1.23e3 | 1.00e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 1.76e5 | 9.07e4 | 8.53e4 | 3.26e4 | 2.62e4 | 8.66e4 | 3.49e4 | 5.31e4 | 3.99e4 | 5.81e3 | 8.01e2 | 9.18e2 | 8.00e1 | 2.71e2 | 2.35e2 |

Table 16. continued, GCMS SIR of aromatic compounds (amounts in ng/g)

| | | | | | m/z | 253 | | | | | | | | | | 231 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | αSC27MA | βSC28MA+<br>βSC28DMA+<br>αRC27DMA | αSC27DMA | αRC27MA | αSC28MA | βRC28MA+<br>βRC28DMA | βSC29MA+<br>βSC29DMA | αSC29MA | αRC28MA+<br>βRC29MA+<br>βRC29DMA | αRC29MA | C20TA | C21TA | SC26TA | RC26TA+<br>SC27TA | M1 |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 1.45e2 | 9.13e2 | 6.90e1 | 1.99e2 | 4.71e2 | 8.02e2 | 1.04e3 | 3.36e2 | 1.01e3 | 4.88e2 | 1.46e3 | 1.41e3 | 4.33e2 | 1.41e3 | 4.20e1 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.24e2 | 7.47e2 | 1.18e2 | 1.36e2 | 2.60e2 | 7.45e2 | 5.01e2 | 1.11e2 | 4.12e2 | 1.46e2 | 4.71e2 | 4.27e2 | 6.43e2 | 1.83e3 | 4.70e1 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 7.70e1 | 5.18e2 | 7.00e1 | 9.00e1 | 3.22e2 | 4.19e2 | 4.87e2 | 2.75e2 | 4.48e2 | 2.86e2 | 1.64e3 | 1.22e3 | 2.63e2 | 1.10e3 | 4.50e1 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 1.14e2 | 2.11e3 | 8.10e2 | 1.25e2 | 5.72e2 | 1.48e3 | 4.37e3 | 1.35e3 | 3.31e3 | 9.15e2 | 2.39e3 | 1.40e3 | 3.72e2 | 1.55e3 | 5.20e1 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.78e2 | 3.02e3 | 9.91e2 | 2.66e2 | 8.78e2 | 2.06e3 | 4.02e3 | 1.16e3 | 3.32e3 | 8.54e2 | 1.54e3 | 1.06e3 | 7.81e2 | 2.34e3 | 6.80e1 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 4.50e1 | 2.79e2 | 6.20e1 | 3.70e1 | 1.19e2 | 1.42e2 | 4.36e2 | 1.13e2 | 2.92e2 | 6.20e1 | 2.90e3 | 1.87e3 | 4.53e2 | 1.24e3 | 6.90e1 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 8.40e1 | 2.73e2 | 8.30e1 | 7.20e1 | 1.44e2 | 1.85e2 | 2.72e2 | 1.85e2 | 2.37e2 | 1.57e2 | 7.31e2 | 4.20e2 | 1.14e2 | 3.44e2 | 0.00e0 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 1.37e2 | 1.21e3 | 3.25e2 | 1.66e2 | 5.21e2 | 8.25e2 | 2.24e3 | 1.19e3 | 1.51e3 | 8.85e2 | 8.68e3 | 9.15e3 | 1.59e3 | 7.56e3 | 2.27e2 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 1.51e2 | 1.72e3 | 5.38e2 | 2.13e2 | 6.20e2 | 1.17e3 | 4.27e3 | 1.61e3 | 3.24e3 | 1.32e3 | 2.96e3 | 3.05e3 | 6.36e2 | 2.17e3 | 2.80e1 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 2.25e2 | 3.13e3 | 5.29e2 | 3.25e2 | 4.10e2 | 2.11e3 | 2.87e3 | 2.44e2 | 1.95e3 | 1.90e2 | 2.78e3 | 3.37e3 | 4.62e3 | 2.10e4 | 5.86e2 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.07e2 | 3.80e3 | 1.34e3 | 4.05e2 | 1.15e3 | 2.18e3 | 8.54e3 | 3.04e3 | 6.85e3 | 1.99e3 | 1.59e3 | 2.06e3 | 9.18e2 | 3.20e3 | 6.70e1 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 7.30e1 | 5.52e2 | 2.53e2 | 7.20e1 | 1.14e2 | 3.28e2 | 6.45e2 | 1.31e2 | 4.76e2 | 1.22e2 | 2.82e3 | 2.13e3 | 1.04e3 | 2.68e3 | 9.10e1 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.79e2 | 2.75e3 | 7.28e2 | 4.97e2 | 8.46e2 | 1.84e3 | 3.32e3 | 1.23e3 | 2.28e3 | 7.48e2 | 1.07e3 | 5.93e2 | 1.08e3 | 3.19e3 | 1.30e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 9.00e1 | 6.17e2 | 2.10e2 | 8.30e1 | 2.21e2 | 3.43e2 | 1.03e3 | 2.61e2 | 5.93e2 | 1.42e2 | 1.92e3 | 1.10e3 | 2.82e2 | 7.96e2 | 3.10e1 |

Table 16. continued, GCMS SIR of aromatic compounds (amounts in ng/g)

| | | | | | m/z | 231 | | | | | | 245 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | M2 | SC28TA | RC27TA | M3 | M4 | RC28TA | 3MS-TA | 4MS-TA | 2,24DMS-TA | 3,24DMS+3MR-TA | 4,24DMS+4MR-TA | D1-TA | 3M24ES-TA | D2-TA | 4M24ES-TA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 8.00e1 | 6.08e2 | 5.25e2 | 7.70e1 | 1.13e2 | 7.05e2 | 6.70e1 | 3.45e2 | 4.40e1 | 1.99e2 | 4.16e2 | 7.60e1 | 1.45e2 | 2.21e2 | 4.34e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 9.40e1 | 9.15e2 | 6.76e2 | 1.11e2 | 1.55e2 | 9.37e2 | 1.25e2 | 2.42e2 | 5.70e1 | 2.97e2 | 3.91e2 | 1.05e2 | 2.19e2 | 2.75e2 | 2.44e2 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 9.60e1 | 6.47e2 | 4.97e2 | 8.60e1 | 1.40e2 | 7.18e2 | 8.10e1 | 2.95e2 | 5.30e1 | 1.89e2 | 4.87e2 | 1.19e2 | 1.59e2 | 3.38e2 | 3.53e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 8.10e1 | 1.15e3 | 7.49e2 | 1.08e2 | 7.70e1 | 1.41e3 | 1.23e2 | 2.41e2 | 6.70e1 | 5.46e2 | 5.23e2 | 8.50e1 | 6.04e2 | 2.16e2 | 5.17e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 1.52e2 | 1.31e3 | 9.02e2 | 1.56e2 | 1.73e2 | 1.53e3 | 1.55e2 | 4.38e2 | 1.15e2 | 6.06e2 | 9.85e2 | 2.76e2 | 5.17e2 | 7.16e2 | 4.66e2 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 9.30e1 | 8.82e2 | 5.15e2 | 7.90e1 | 1.00e2 | 1.01e3 | 9.60e1 | 1.73e2 | 3.30e1 | 2.99e2 | 3.61e2 | 1.17e2 | 2.77e2 | 2.61e2 | 2.40e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.00e1 | 1.67e2 | 1.46e2 | 3.50e1 | 4.10e1 | 2.32e2 | 2.30e1 | 5.00e1 | 2.00e1 | 6.40e1 | 1.09e2 | 3.60e1 | 4.50e1 | 9.10e1 | 7.50e1 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 5.73e2 | 3.72e3 | 3.39e3 | 5.36e2 | 8.11e2 | 4.40e3 | 2.03e2 | 1.79e3 | 3.02e2 | 1.22e3 | 2.95e3 | 9.78e2 | 8.48e2 | 2.56e3 | 1.81e3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 1.28e2 | 1.82e3 | 8.34e2 | 1.03e2 | 1.32e2 | 2.29e3 | 1.16e2 | 4.94e2 | 7.70e1 | 6.57e2 | 1.39e3 | 1.54e2 | 7.19e2 | 5.56e2 | 7.19e2 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 1.99e3 | 1.20e4 | 9.88e3 | 2.02e3 | 2.81e3 | 1.51e4 | 7.92e2 | 6.23e3 | 1.05e3 | 3.51e3 | 9.74e3 | 3.54e3 | 2.73e3 | 9.96e3 | 6.48e3 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 3.47e2 | 2.91e3 | 1.37e3 | 1.88e2 | 2.06e2 | 3.10e3 | 1.16e2 | 7.67e2 | 2.43e2 | 6.84e2 | 3.06e3 | 7.16e2 | 1.05e3 | 1.70e3 | 1.51e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 1.73e2 | 1.37e3 | 1.15e3 | 1.79e2 | 2.17e2 | 1.57e3 | 1.42e2 | 5.85e2 | 9.10e1 | 5.19e2 | 1.39e3 | 2.59e2 | 2.99e2 | 6.18e2 | 4.83e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 3.02e2 | 1.55e3 | 1.14e3 | 2.12e2 | 3.72e2 | 1.55e3 | 2.27e2 | 6.07e2 | 9.50e1 | 5.77e2 | 1.07e3 | 4.01e2 | 5.59e2 | 1.04e3 | 6.26e2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 2.40e1 | 7.21e2 | 2.51e2 | 4.10e1 | 5.90e1 | 5.86e2 | 8.80e1 | 1.67e2 | 4.10e1 | 1.68e2 | 2.02e2 | 3.40e1 | 1.64e2 | 4.90e1 | 1.11e2 |

Table 16. continued, GCMS SIR of aromatic compounds (amounts in ng/g)

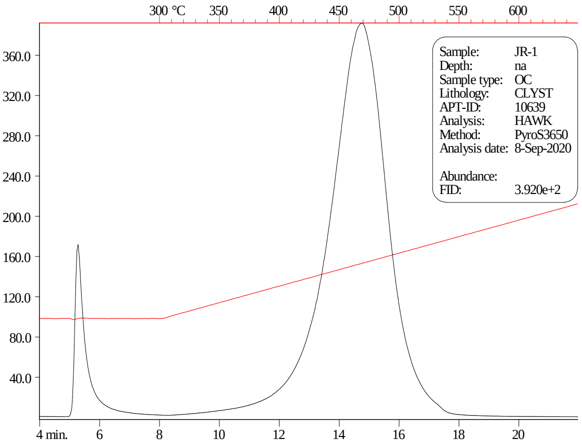
| | | | | | m/z | 245 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | 3,24DMR-TA | 4,24DMR-TA | D3-TA | D4-TA | 2M24ER-TA | 3M24ER-TA | D5-TA | 4M24ER-TA | D6-TA |
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | 8.80e1 | 2.55e2 | 2.93e2 | 2.84e2 | 4.40e1 | 1.03e2 | 1.88e2 | 2.89e2 | 3.66e2 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | 1.23e2 | 1.95e2 | 2.64e2 | 2.87e2 | 7.40e1 | 1.79e2 | 1.76e2 | 2.30e2 | 3.43e2 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | 1.05e2 | 3.04e2 | 4.15e2 | 4.59e2 | 4.50e1 | 1.28e2 | 3.26e2 | 3.63e2 | 5.58e2 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | 2.33e2 | 2.97e2 | 2.55e2 | 4.36e2 | 6.70e1 | 3.91e2 | 2.05e2 | 5.65e2 | 3.01e2 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | 2.22e2 | 4.90e2 | 9.26e2 | 1.28e3 | 6.30e1 | 2.75e2 | 7.58e2 | 5.29e2 | 9.96e2 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | 1.24e2 | 2.40e2 | 2.62e2 | 3.16e2 | 1.08e2 | 1.91e2 | 1.84e2 | 1.63e2 | 4.20e2 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | 3.60e1 | 4.20e1 | 1.02e2 | 9.10e1 | 1.80e1 | 5.00e1 | 8.20e1 | 6.80e1 | 1.16e2 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | 6.97e2 | 1.60e3 | 2.87e3 | 3.37e3 | 2.32e2 | 6.99e2 | 2.15e3 | 1.88e3 | 3.99e3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | 2.38e2 | 7.17e2 | 2.94e2 | 4.40e2 | 1.52e2 | 5.05e2 | 2.42e2 | 8.24e2 | 6.27e2 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | 2.29e3 | 5.20e3 | 9.96e3 | 1.15e4 | 9.94e2 | 2.82e3 | 8.24e3 | 7.78e3 | 1.65e4 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | 4.90e2 | 1.71e3 | 2.06e3 | 2.68e3 | 2.21e2 | 8.31e2 | 1.45e3 | 1.64e3 | 2.60e3 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | 2.05e2 | 7.40e2 | 7.16e2 | 8.64e2 | 1.13e2 | 2.27e2 | 5.56e2 | 4.65e2 | 8.69e2 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | 2.66e2 | 5.90e2 | 1.12e3 | 1.38e3 | 0.00e0 | 4.75e2 | 8.41e2 | 6.57e2 | 1.26e3 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | 5.90e1 | 6.50e1 | 5.40e1 | 4.00e1 | 4.50e1 | 8.70e1 | 2.50e1 | 5.30e1 | 3.40e1 |

# Table A17. Isotopes of fractions (δ¹³C (‰ VPDB))

| Well | Sample type | Upper Depth | Lower Depth | Depth units | APT ID | δ¹³C-Sat | δ¹³C-Aro |
|---|---|---|---|---|---|---|---|
| Mic Mac D-89 | DC | 2950 | 2950 | ft | 228124 | -28.8 | -27.0 |
| Mic Mac J-77 | DC | 3210 | 3241 | ft | 228125 | -28.8 | -28.0 |
| Mic Mac J-77 | DC | 4245 | 4276 | ft | 228126 | -27.9 | -26.4 |
| Mic Mac J-77 | DC | 6510 | 6520 | ft | 228127 | -28.2 | -25.7 |
| Mic Mac J-77 | DC | 6740 | 6750 | ft | 228128 | -28.7 | -26.5 |
| Mic Mac J-77 | DC | 11760 | 11770 | ft | 228129 | -28.5 | -25.6 |
| Erie D-26 | DC | 5940 | 5940 | ft | 228130 | -27.5 | -27.0 |
| Erie D-26 | DC | 6060 | 6060 | ft | 228131 | -27.8 | -26.3 |
| Erie D-26 | DC | 6220 | 6220 | ft | 228132 | -27.8 | -26.8 |
| Erie D-26 | COCH | 7381.12 | 7381.12 | ft | 228133 | -28.3 | -27.1 |
| Wyandot E-53 | DC | 7760 | 7770 | ft | 228134 | -28.4 | -28.1 |
| Wyandot E-53 | DC | 9140 | 9150 | ft | 228135 | -28.0 | -26.1 |
| Missisauga H-54 | DC | 7910 | 7920 | ft | 228136 | -28.7 | -27.2 |
| Primrose N-50 | Oil | 1642.89 | 1650.51 | m | 228159 | -27.4 | -24.9 |

# Rock-Eval pyrograms

The temperature scale for the pyrograms is uncalibrated. The TMax temperature is lower than on the graphs.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Sample type: OC
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Analysis: HAWK
Method: PyroS3650
Analysis date: 8-Sep-2020

Abundance:
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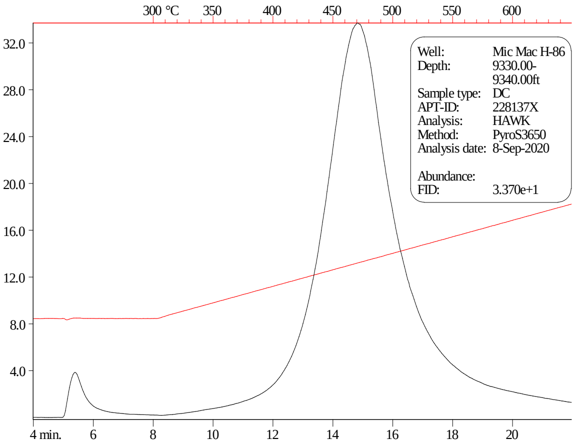
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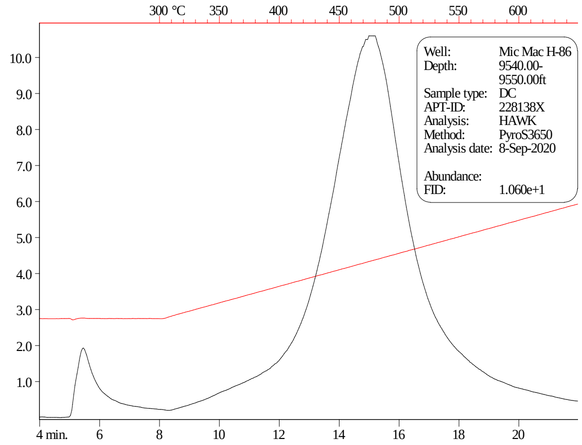
Depth: 9330.00-9340.00ft
Sample type: DC
APT-ID: 228137X
Analysis: HAWK
Method: PyroS3650
Analysis date: 8-Sep-2020

Abundance:
FID: 3.370e+1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Depth: 9540.00-9550.00ft
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APT-ID: 228138X
Analysis: HAWK
Method: PyroS3650
Analysis date: 8-Sep-2020

Abundance:
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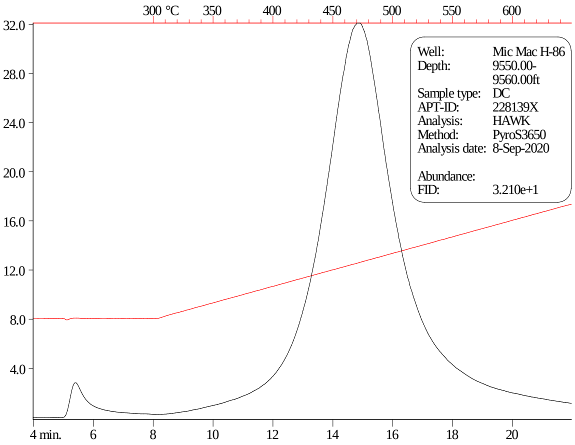
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Analysis: HAWK
Method: PyroS3650
Analysis date: 8-Sep-2020

Abundance:
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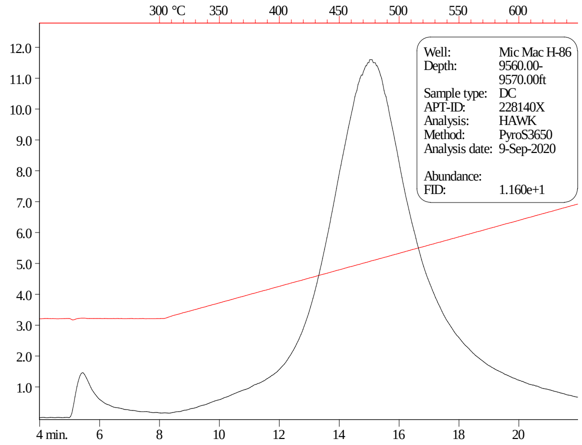
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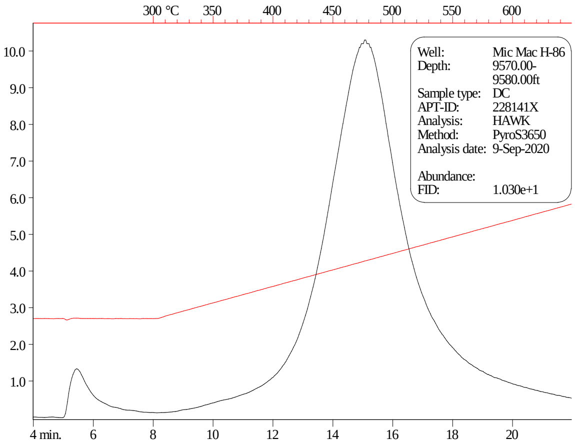
Depth: 9560.00-9570.00ft
Sample type: DC
APT-ID: 228140X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020

Abundance:
FID: 1.160e+1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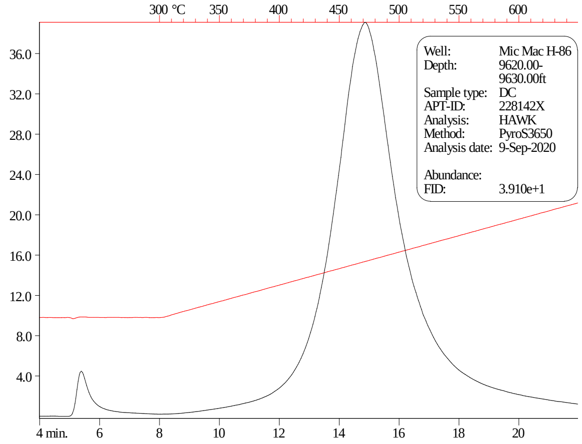
Depth: 9570.00-9580.00ft
Sample type: DC
APT-ID: 228141X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020

Abundance:
FID: 1.030e+1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400
450
500
550
600
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9620.00-9630.00ft
Sample type: DC
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Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
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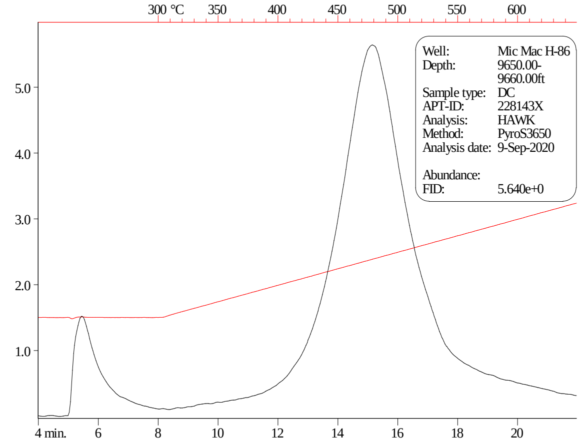
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400
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600
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9650.00-9660.00ft
Sample type: DC
APT-ID: 228143X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
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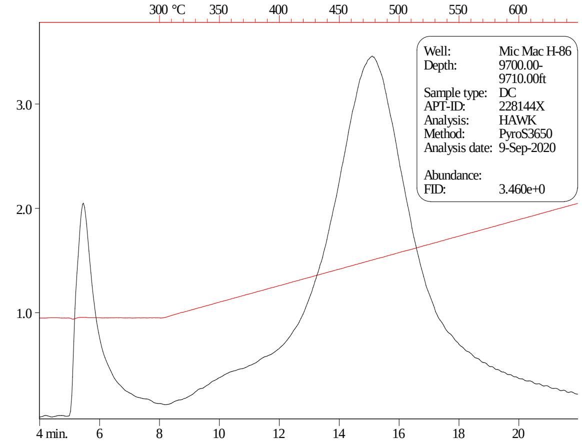
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4 min.
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8
10
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16
18
20
Well: Mic Mac H-86
Depth: 9700.00-9710.00ft
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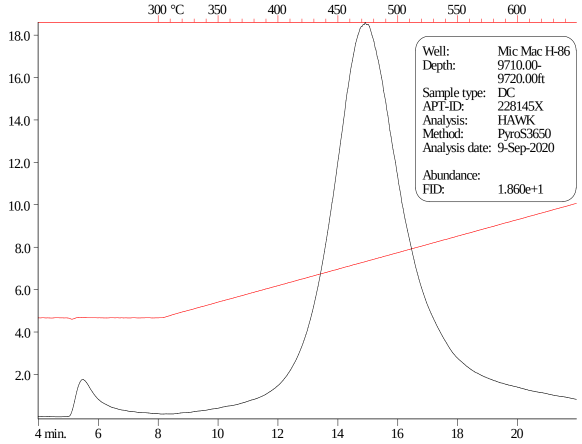
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 3.460e+0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400
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500
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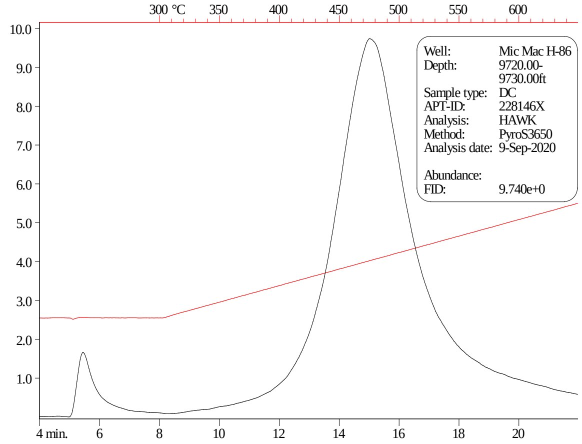
14.0
12.0
10.0
8.0
6.0
4.0
2.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9710.00-9720.00ft
Sample type: DC
APT-ID: 228145X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 1.860e+1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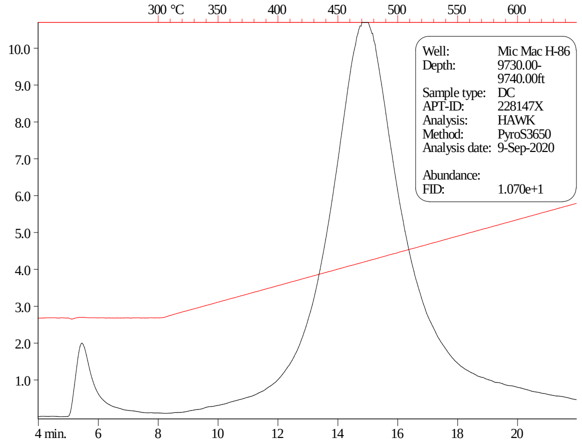
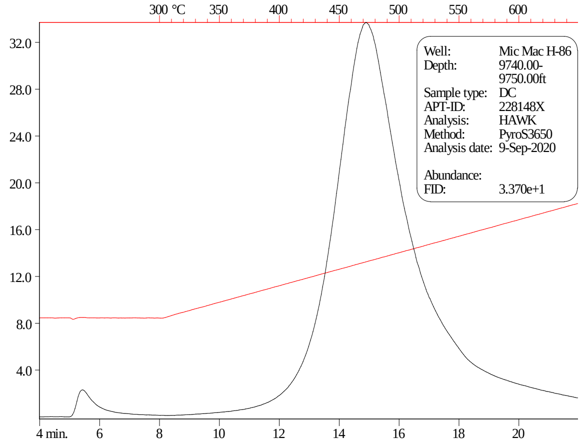
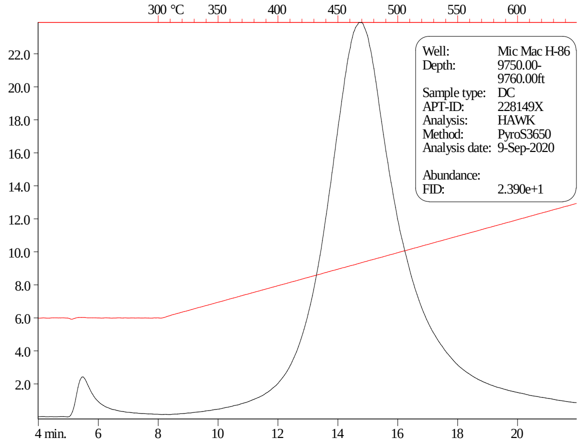
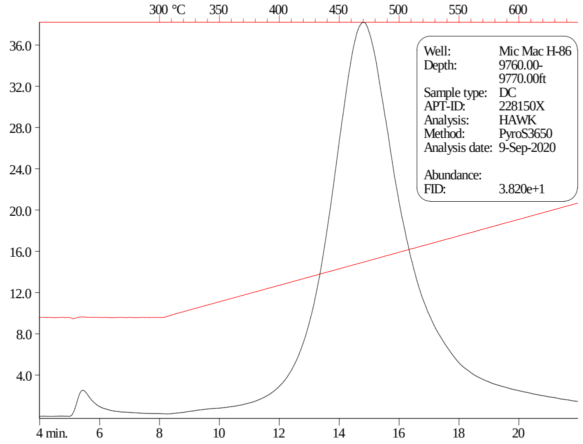
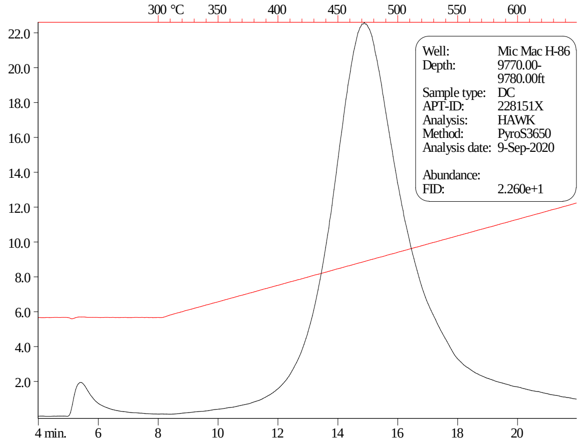
400
450
500
550
600
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9720.00-9730.00ft
Sample type: DC
APT-ID: 228146X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 9.740e+0

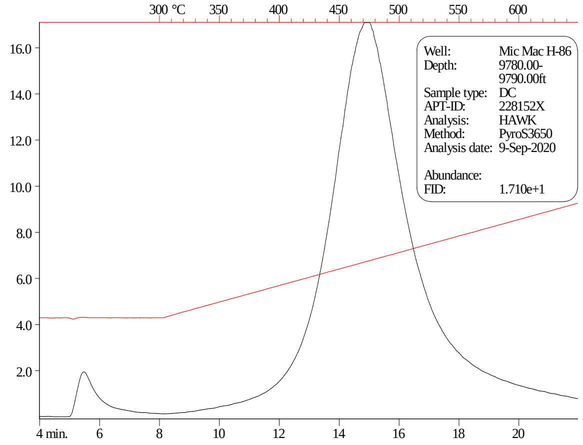

300 °C
350
400
450
500
550
600
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9730.00-9740.00ft
Sample type: DC
APT-ID: 228147X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 1.070e+1

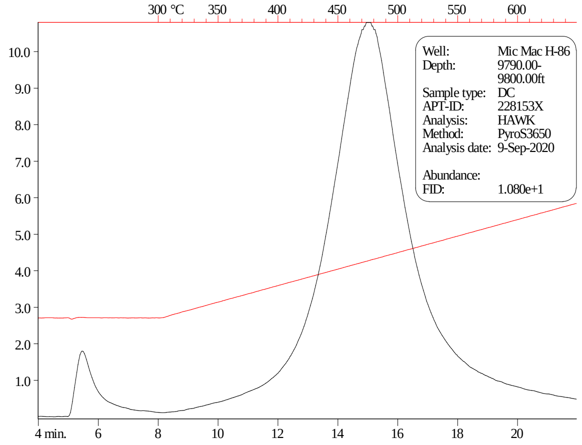

300 °C
350
400
450
500
550
600
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9740.00-9750.00ft
Sample type: DC
APT-ID: 228148X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 3.370e+1

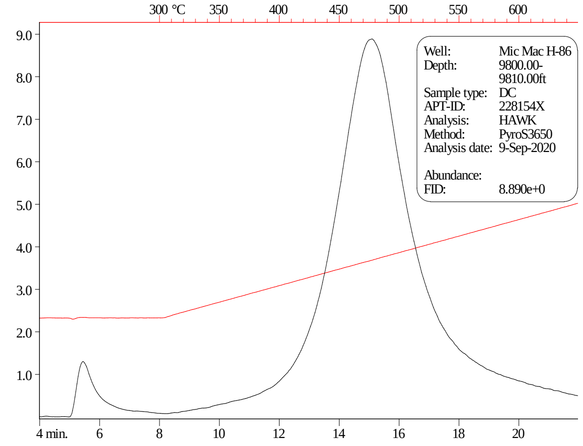

300 °C
350
400
450
500
550
600
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9750.00-9760.00ft
Sample type: DC
APT-ID: 228149X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 2.390e+1

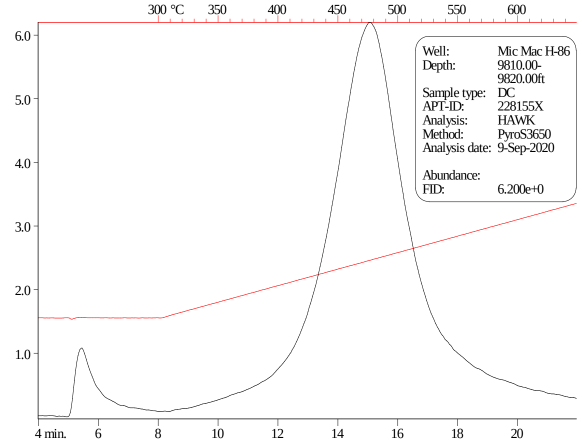

300 °C
350
400
450
500
550
600
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9760.00-9770.00ft
Sample type: DC
APT-ID: 228150X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 3.820e+1

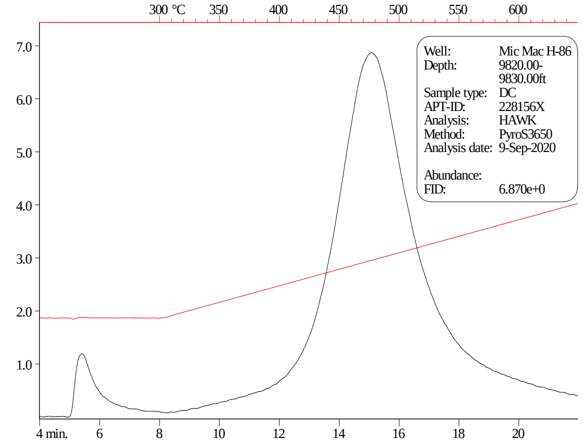

300 °C
350
400
450
500
550
600
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9770.00-9780.00ft
Sample type: DC
APT-ID: 228151X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 2.260e+1


300 °C
350
400
450
500
550
600
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9780.00-9790.00ft
Sample type: DC
APT-ID: 228152X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 1.710e+1

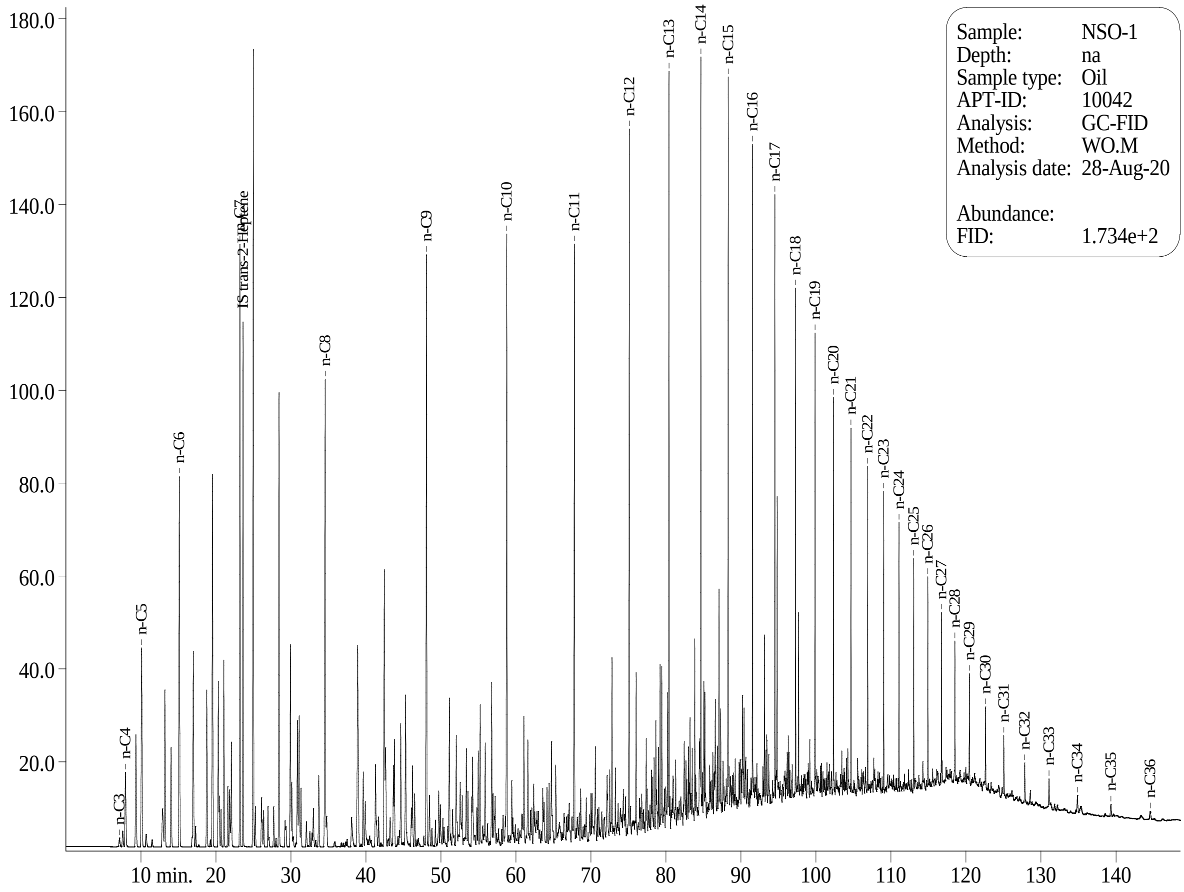

300 °C
350
400
450
500
550
600
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9790.00-9800.00ft
Sample type: DC
APT-ID: 228153X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 1.080e+1


300 °C
350
400
450
500
550
600
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9800.00-9810.00ft
Sample type: DC
APT-ID: 228154X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 8.890e+0


300 °C
350
400
450
500
550
600
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9810.00-9820.00ft
Sample type: DC
APT-ID: 228155X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 6.200e+0

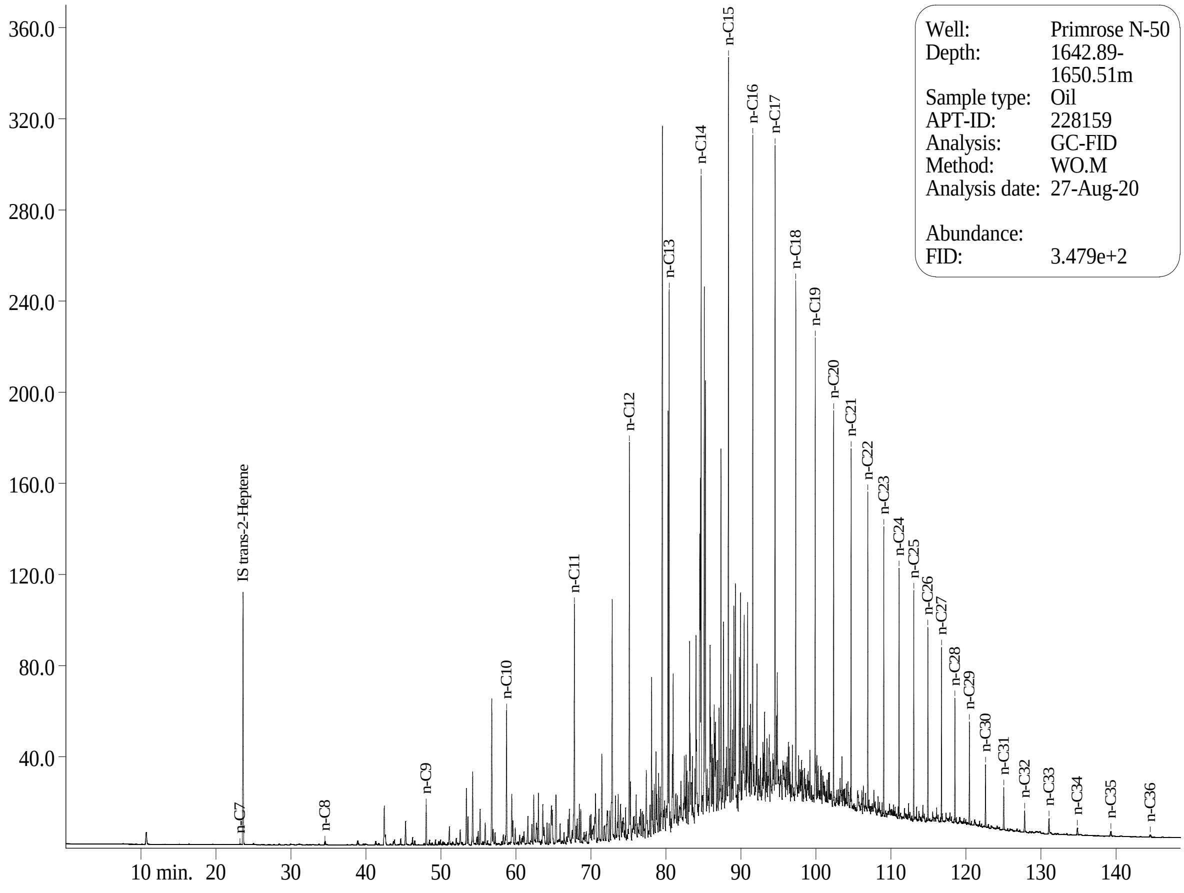

300 °C
350
400
450
500
550
600
7.0
6.0
5.0
4.0
3.0
2.0
1.0
4 min.
6
8
10
12
14
16
18
20
Well: Mic Mac H-86
Depth: 9820.00-9830.00ft
Sample type: DC
APT-ID: 228156X
Analysis: HAWK
Method: PyroS3650
Analysis date: 9-Sep-2020
Abundance:
FID: 6.870e+0

## *GC Chromatograms of Whole Oil*



Sample: NSO-1
Depth: na
Sample type: Oil
APT-ID: 10042
Analysis: GC-FID
Method: WO.M
Analysis date: 28-Aug-20

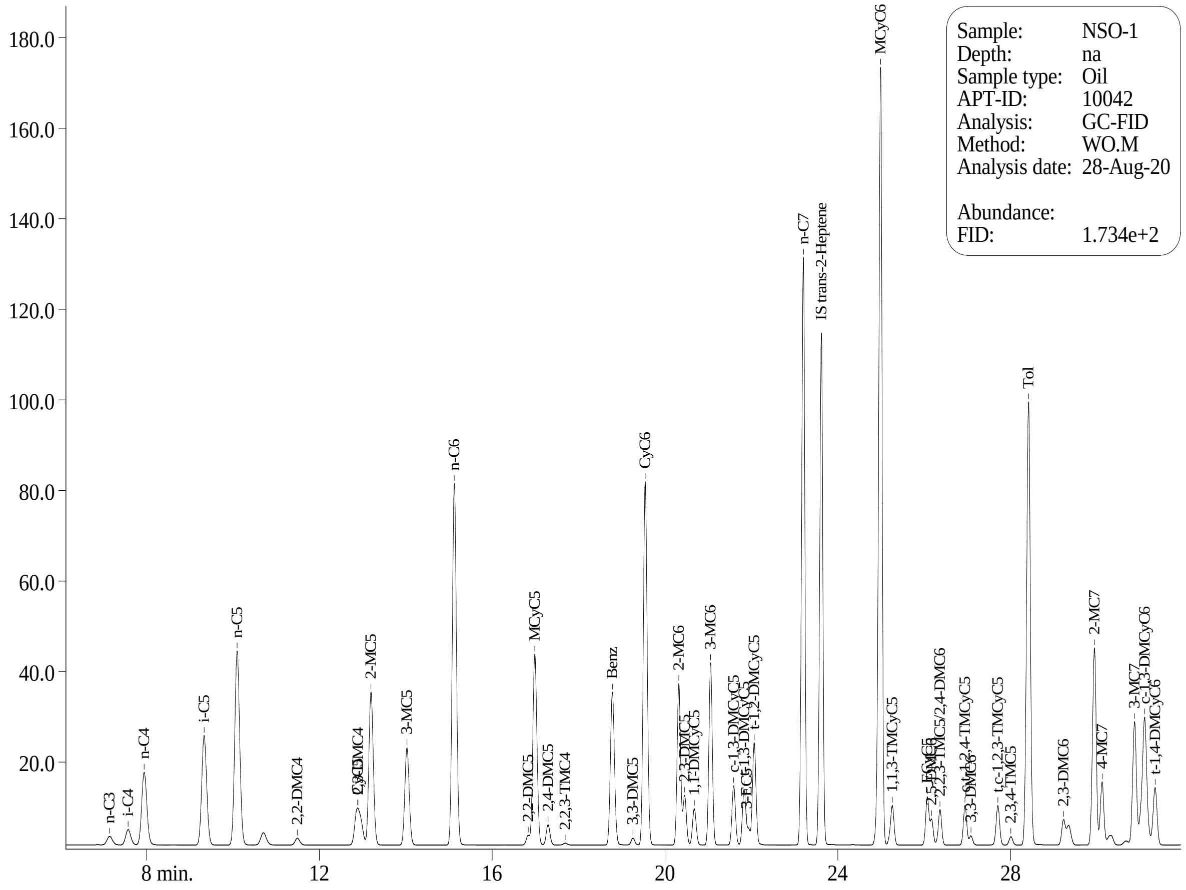
Abundance:
FID: 1.734e+2

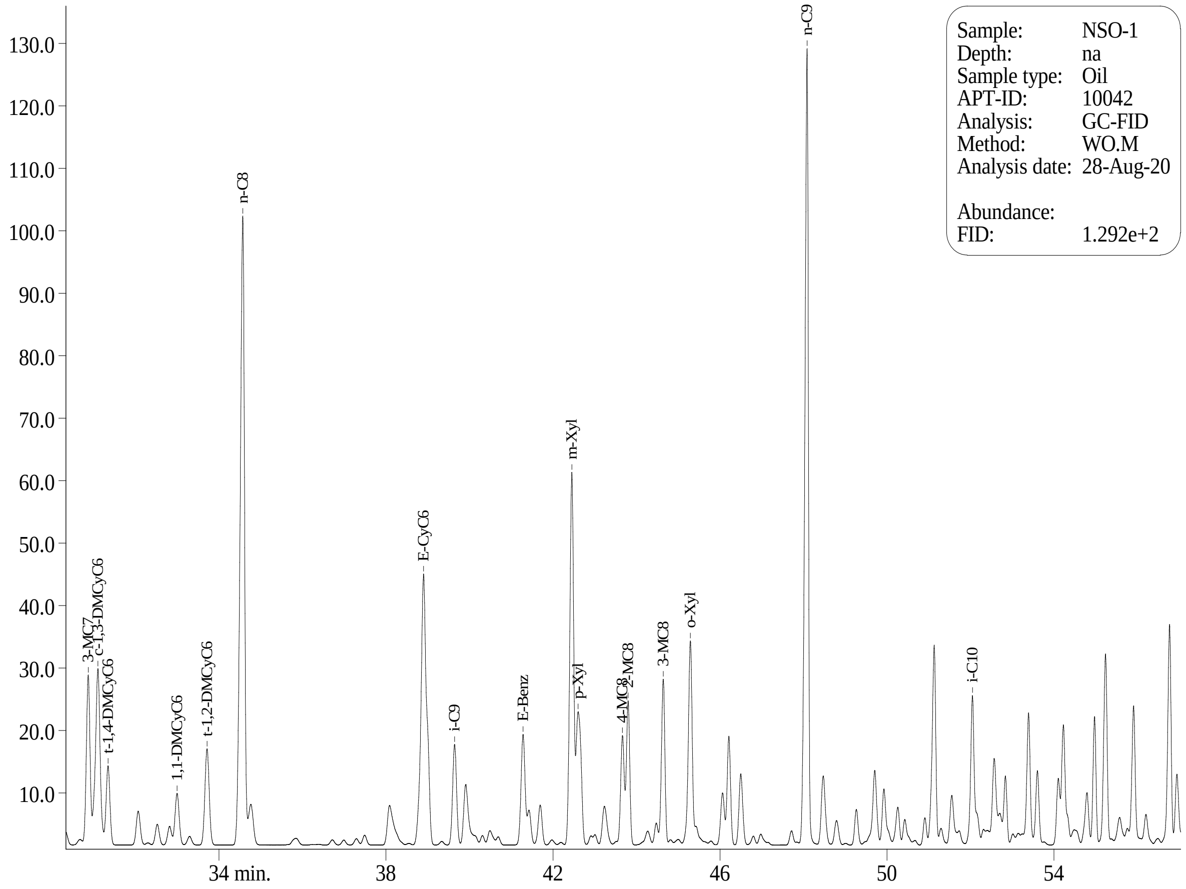


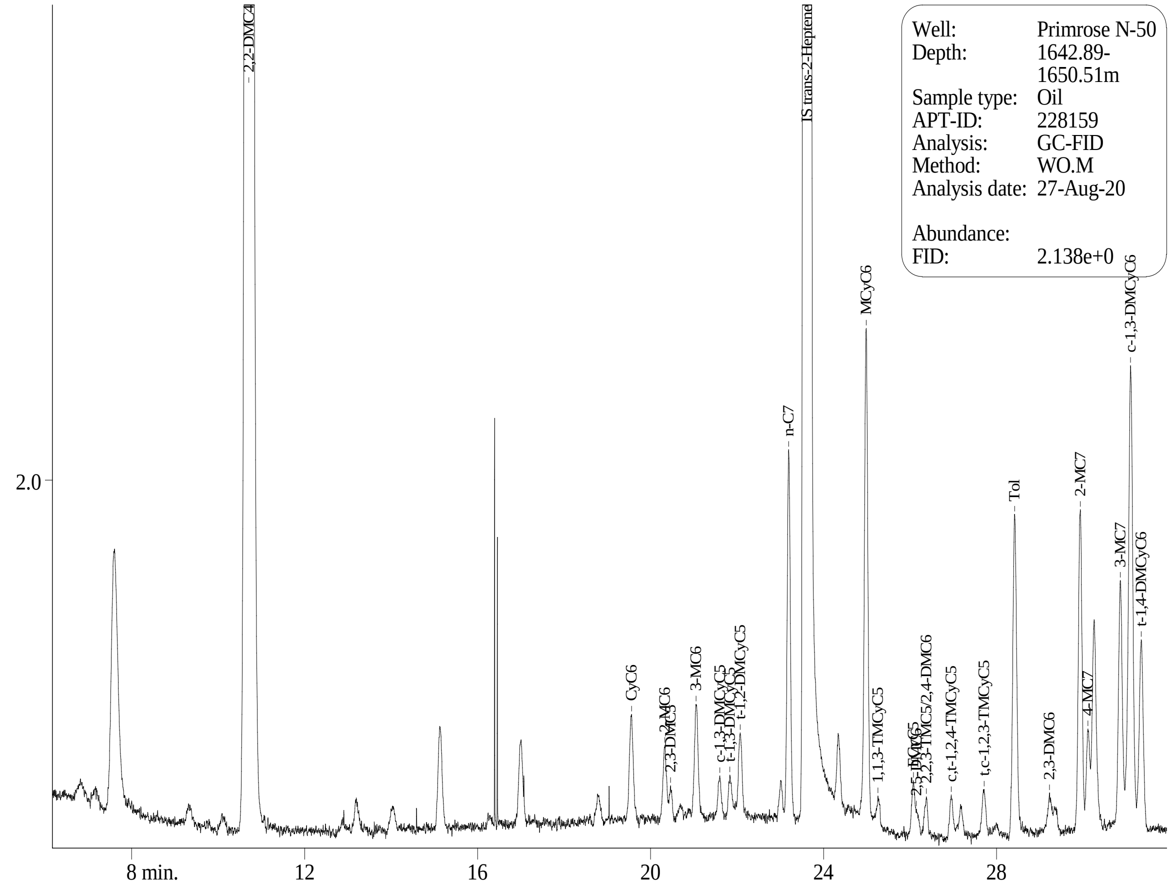
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
APT-ID: 228159
Analysis: GC-FID
Method: WO.M
Analysis date: 27-Aug-20

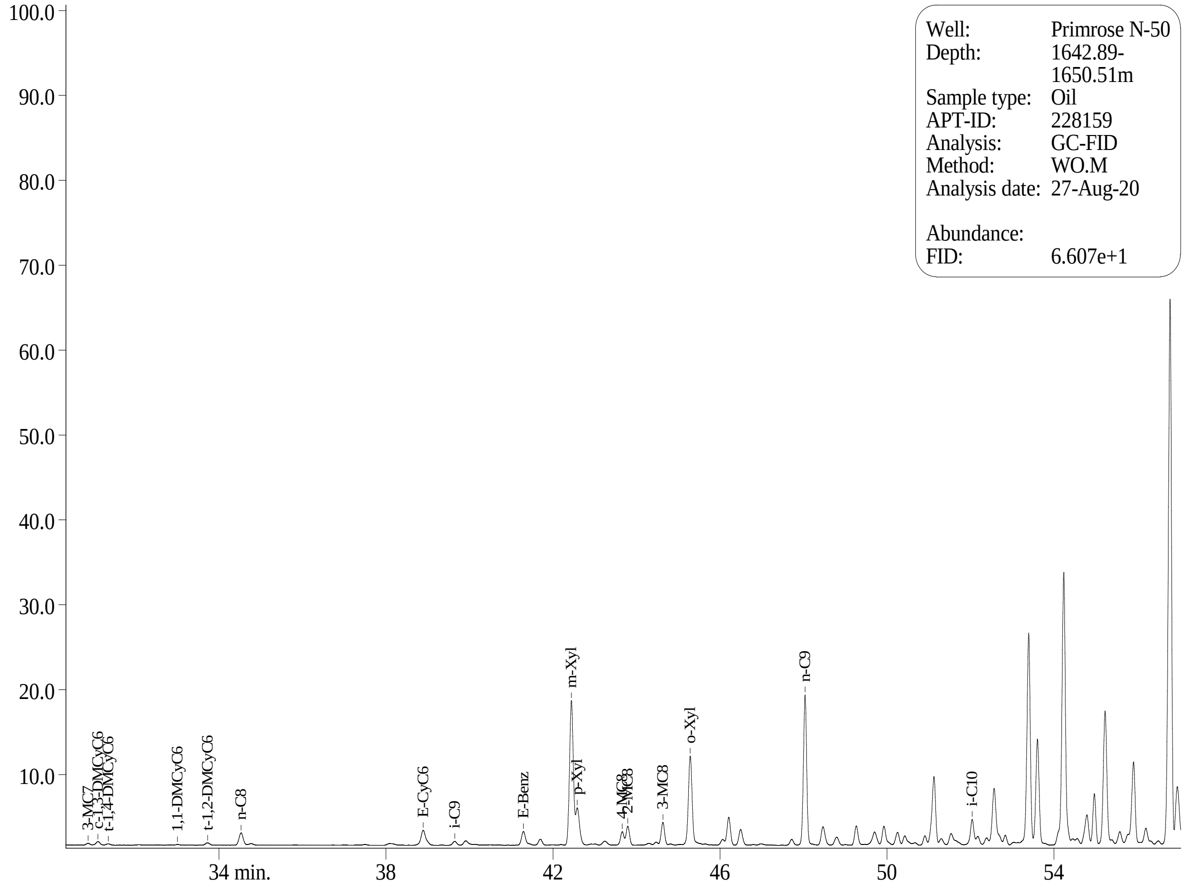
Abundance:
FID: 3.479e+2

## *GC Chromatograms of Whole Oil - detailed*

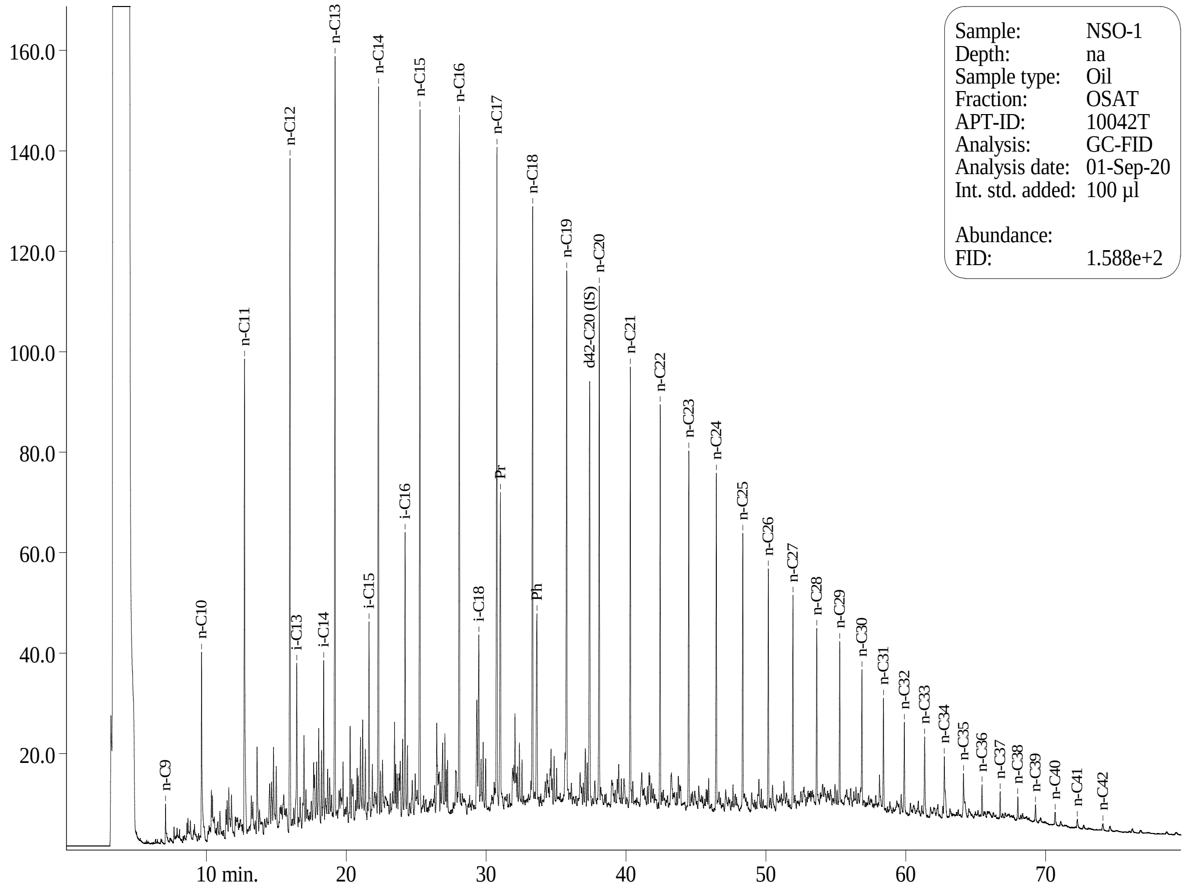

Sample: NSO-1
Depth: na
Sample type: Oil
APT-ID: 10042
Analysis: GC-FID
Method: WO.M
Analysis date: 28-Aug-20
Abundance:
FID: 1.734e+2
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
8 min.
12
16
20
24
28
n-C3
i-C4
n-C4
i-C5
n-C5
2,2-DMC4
CyC5
2,3-DMC4
2-MC5
3-MC5
n-C6
2,2-DMC5
MCyC5
2,4-DMC5
2,2,3-TMC4
Benz
3,3-DMC5
CyC6
2-MC6
2,3-DMC5
1,1-DMCyC5
3-MC6
c-1,3-DMCyC5
3-EC5
t-1,3-DMCyC5
t-1,2-DMCyC5
n-C7
IS trans-2-Heptene
MCyC6
1,1,3-TMCyC5
ECyC5
2,5-DMC6
2,2,3-TMC5/2,4-DMC6
c,t-1,2,4-TMCyC5
3,3-DMC6
t,c-1,2,3-TMCyC5
2,3,4-TMC5
Tol
2,3-DMC6
2-MC7
4-MC7
3-MC7
c-1,3-DMCyC6
t-1,4-DMCyC6


Sample: NSO-1
Depth: na
Sample type: Oil
APT-ID: 10042
Analysis: GC-FID
Method: WO.M
Analysis date: 28-Aug-20
Abundance:
FID: 1.292e+2
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
34 min.
38
42
46
50
54
3-MC7
c-1,3-DMCyC6
t-1,4-DMCyC6
1,1-DMCyC6
t-1,2-DMCyC6
n-C8
E-CyC6
i-C9
E-Benz
m-Xyl
p-Xyl
4-MC8
2-MC8
3-MC8
o-Xyl
n-C9
i-C10


2,2-DMC4
IS trans-2-Heptene
MCyC6
c-1,3-DMCyC6
n-C7
2-MC7
Tol
3-MC7
t-1,4-DMCyC6
CyC6
2-MC6
2,3-DMC5
3-MC6
c-1,3-DMCyC5
t-1,3-DMCyC5
t-1,2-DMCyC5
1,1,3-TMCyC5
2,5-DMC6
ECyC5
2,2,3-TMC5/2,4-DMC6
c,t-1,2,4-TMCyC5
t,c-1,2,3-TMCyC5
2,3-DMC6
4-MC7
2.0
8 min.
12
16
20
24
28
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
APT-ID: 228159
Analysis: GC-FID
Method: WO.M
Analysis date: 27-Aug-20
Abundance:
FID: 2.138e+0

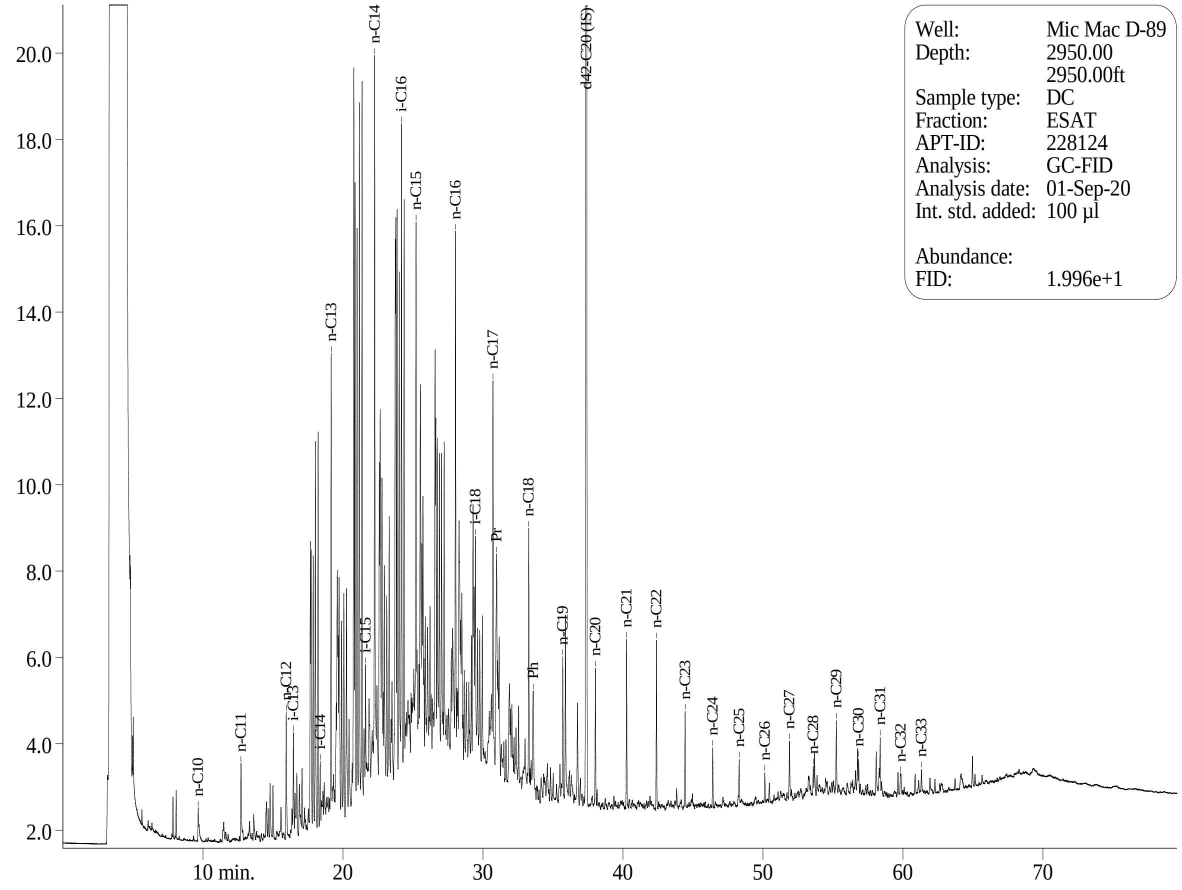

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
3-MC7
c-1,3-DMCyC6
t-1,4-DMCyC6
1,1-DMCyC6
t-1,2-DMCyC6
n-C8
E-CyC6
i-C9
E-Benz
m-Xyl
p-Xyl
4-MC8
2-MC8
3-MC8
o-Xyl
n-C9
i-C10
34 min.
38
42
46
50
54
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
APT-ID: 228159
Analysis: GC-FID
Method: WO.M
Analysis date: 27-Aug-20
Abundance:
FID: 6.607e+1

## *GC Chromatograms of Saturated Hydrocarbons*



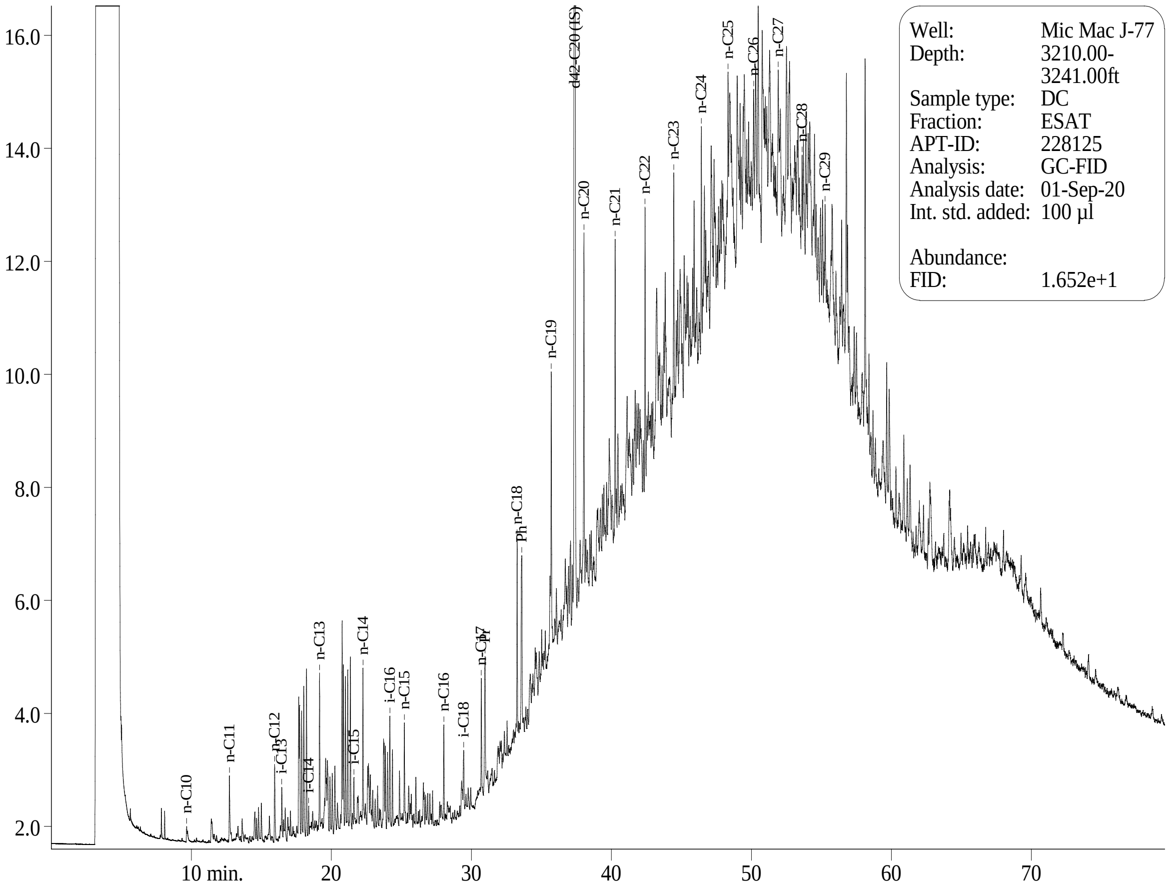
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 100 µl

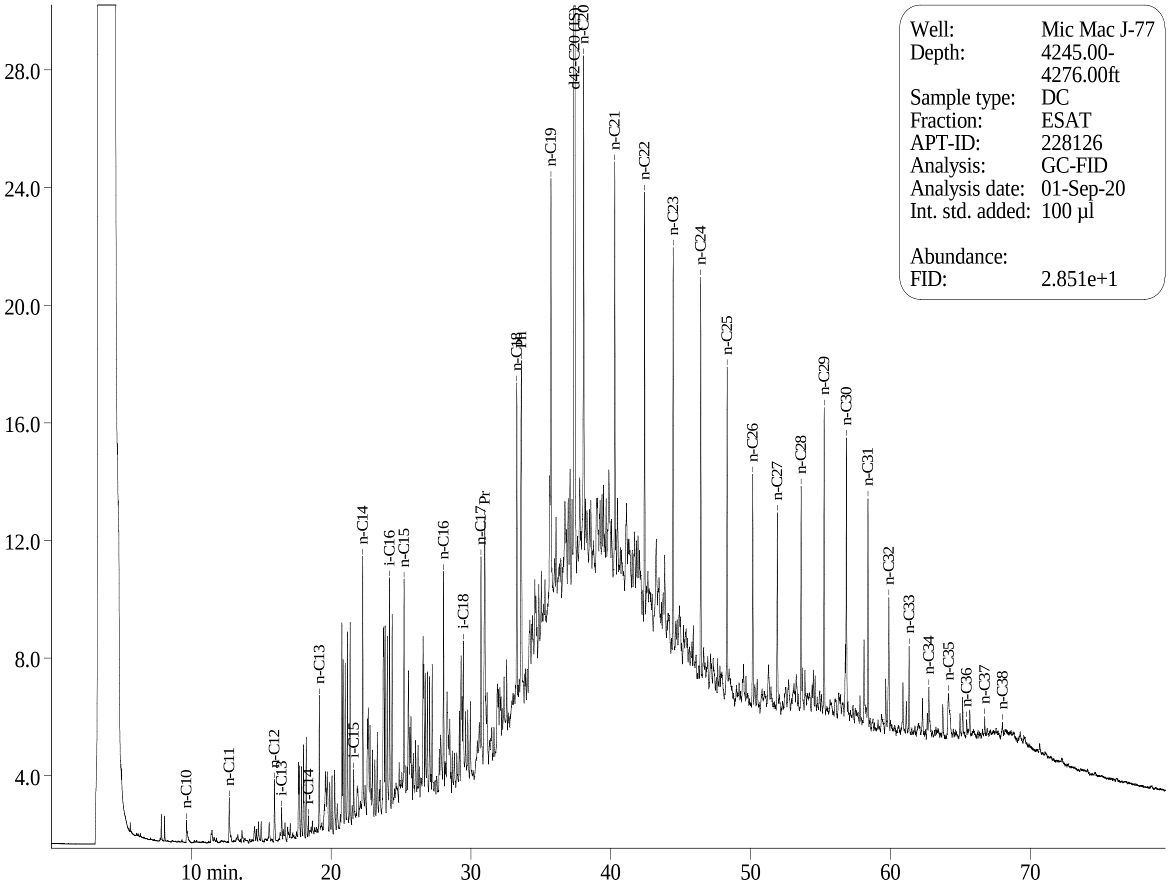
Abundance:
FID: 1.588e+2

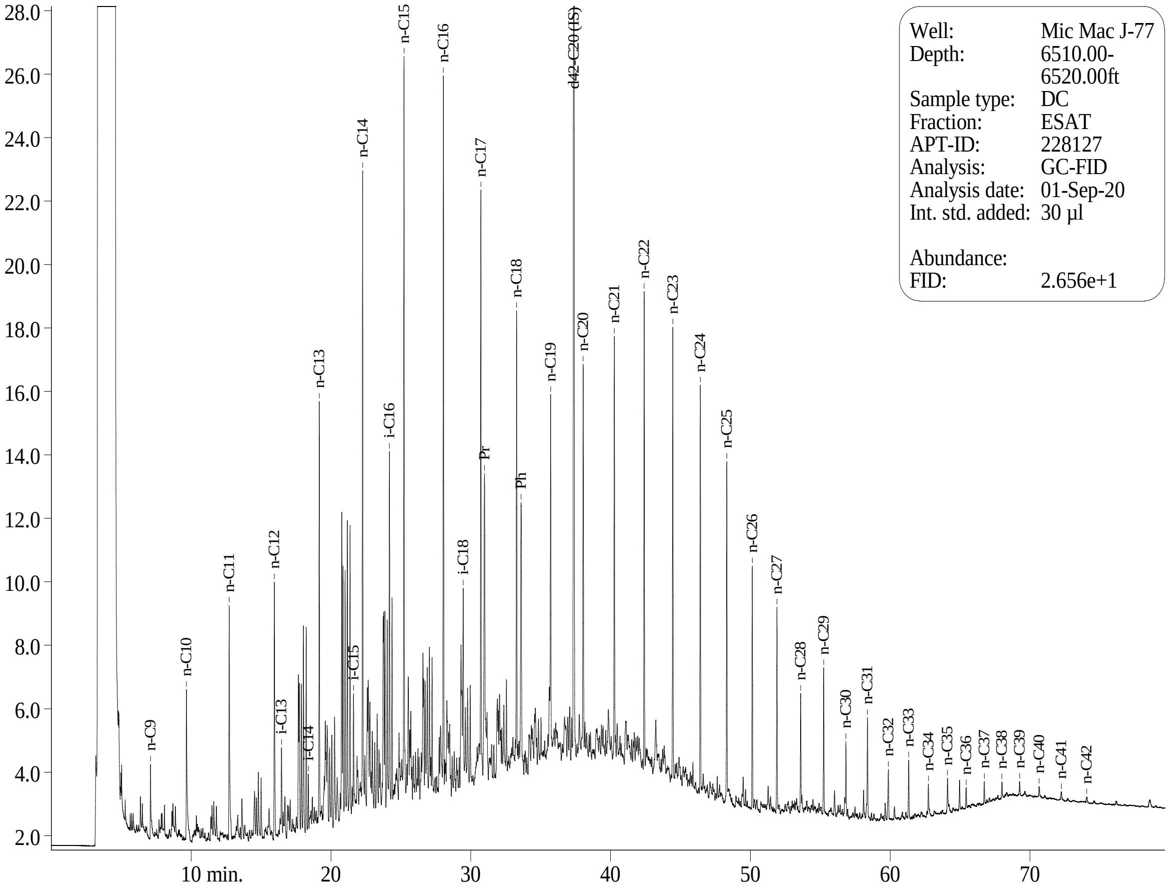


Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 100 µl

Abundance:
FID: 1.996e+1

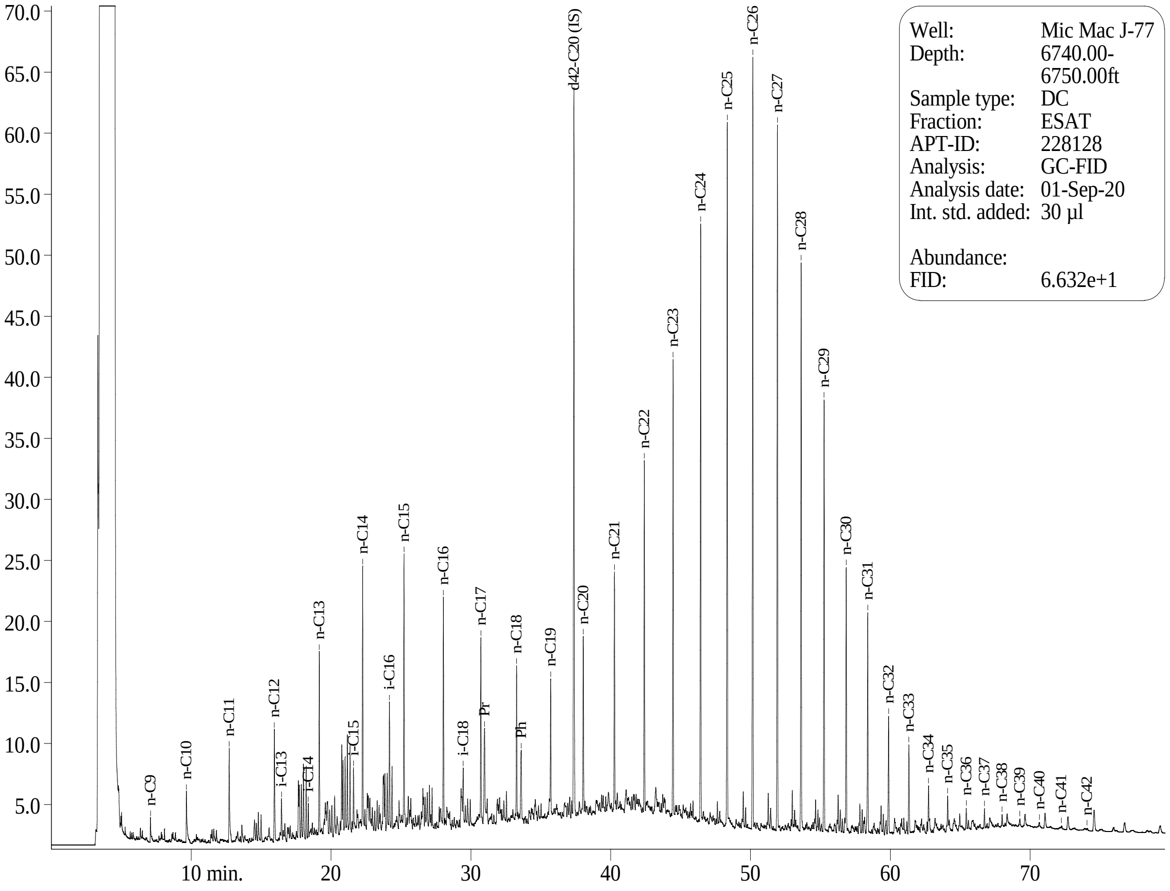

Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 100 µl
Abundance:
FID: 1.652e+1
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
10 min.
20
30
40
50
60
70
n-C10
n-C11
n-C12
i-C13
i-C14
n-C13
i-C15
n-C14
i-C16
n-C15
n-C16
i-C18
n-C17
Pr
Ph
n-C18
n-C19
d42-C20 (IS)
n-C20
n-C21
n-C22
n-C23
n-C24
n-C25
n-C26
n-C27
n-C28
n-C29


Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 100 µl
Abundance:
FID: 2.851e+1
28.0
24.0
20.0
16.0
12.0
8.0
4.0
10 min.
20
30
40
50
60
70
n-C10
n-C11
n-C12
i-C13
i-C14
n-C13
i-C15
n-C14
i-C16
n-C15
n-C16
i-C18
n-C17
Pr
n-C18
Ph
n-C19
d42-C20 (IS)
n-C20
n-C21
n-C22
n-C23
n-C24
n-C25
n-C26
n-C27
n-C28
n-C29
n-C30
n-C31
n-C32
n-C33
n-C34
n-C35
n-C36
n-C37
n-C38



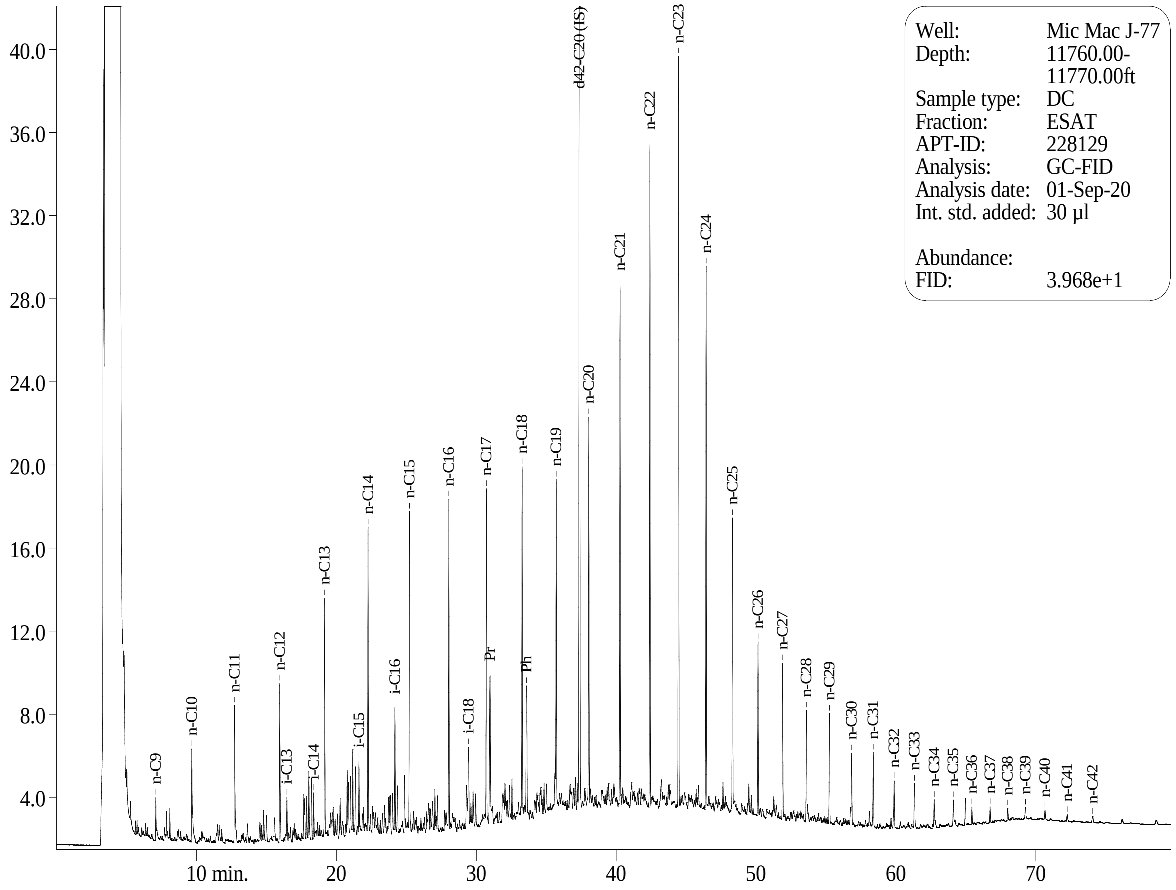
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228127
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 30 µl

Abundance:
FID: 2.656e+1



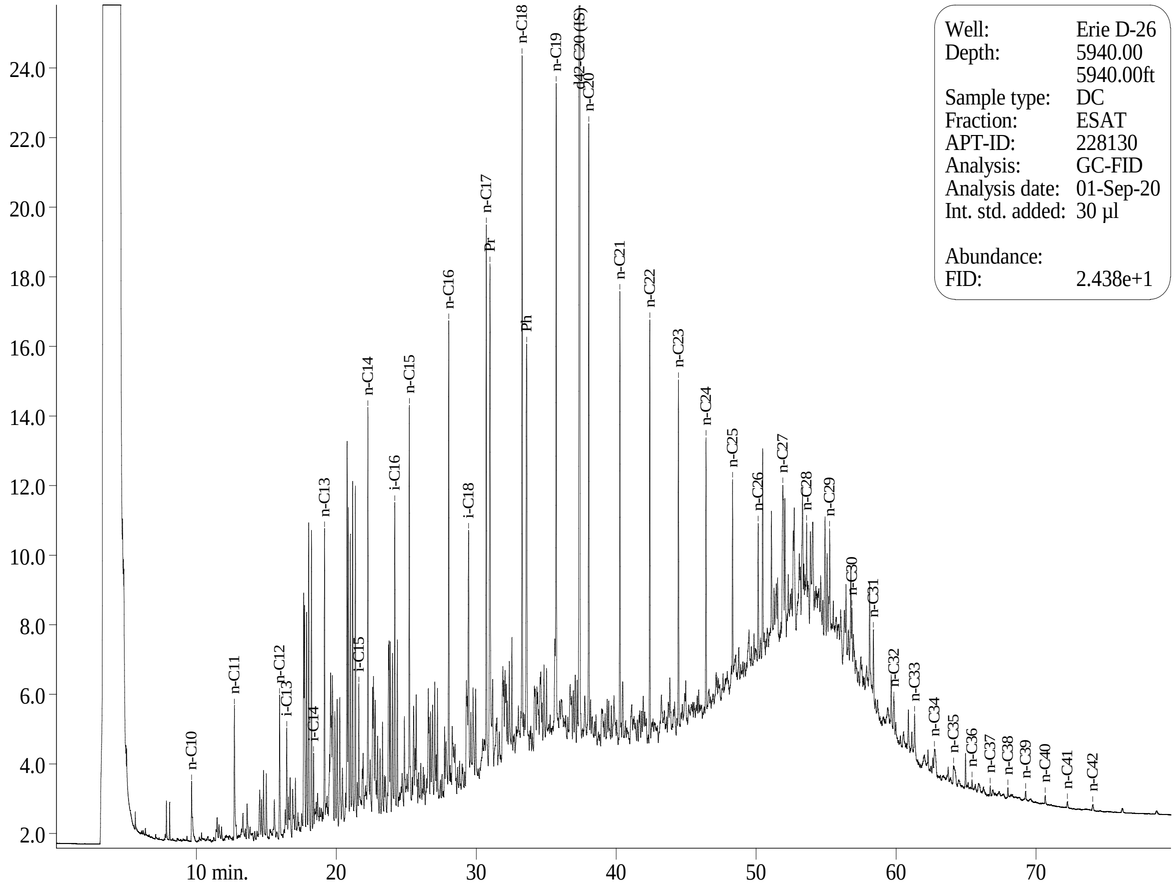
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228128
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 30 µl

Abundance:
FID: 6.632e+1



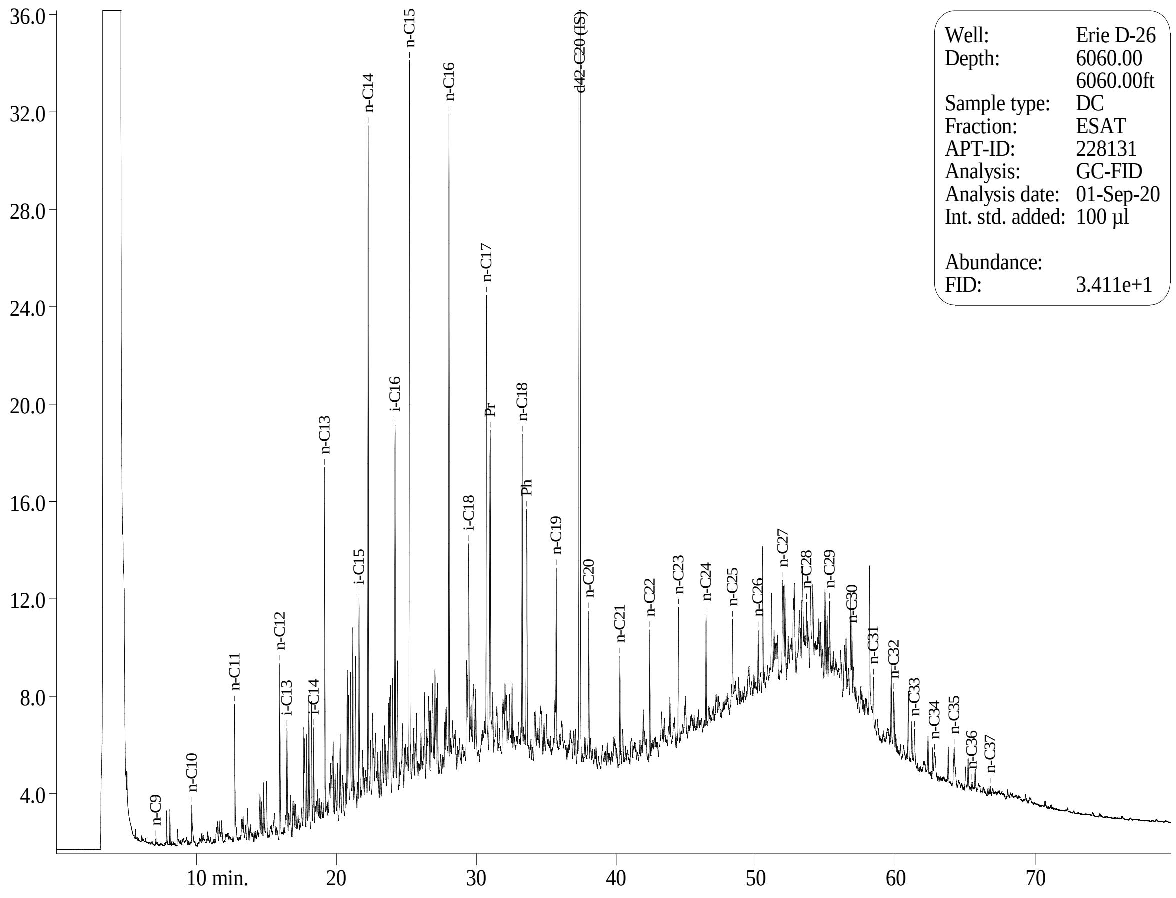
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 30 µl

Abundance:
FID: 3.968e+1



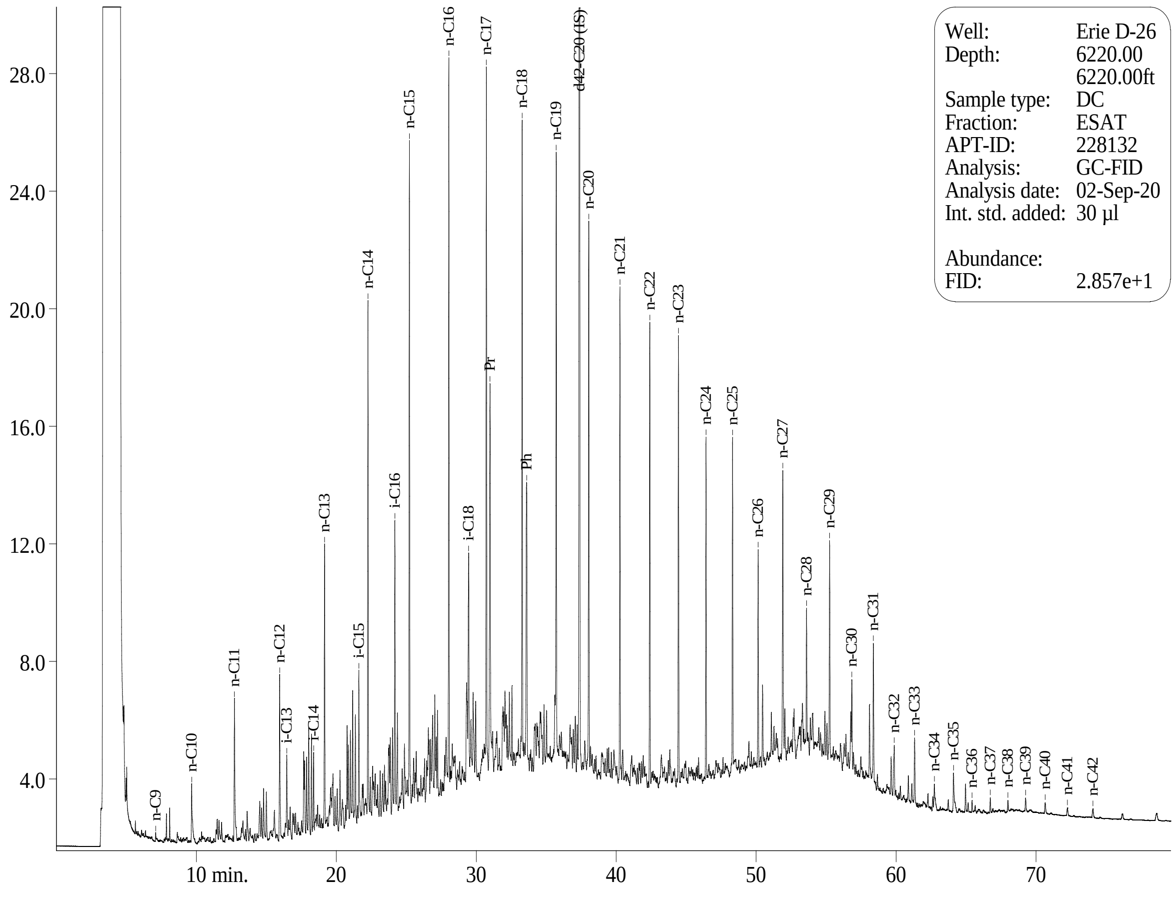
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 30 µl

Abundance:
FID: 2.438e+1



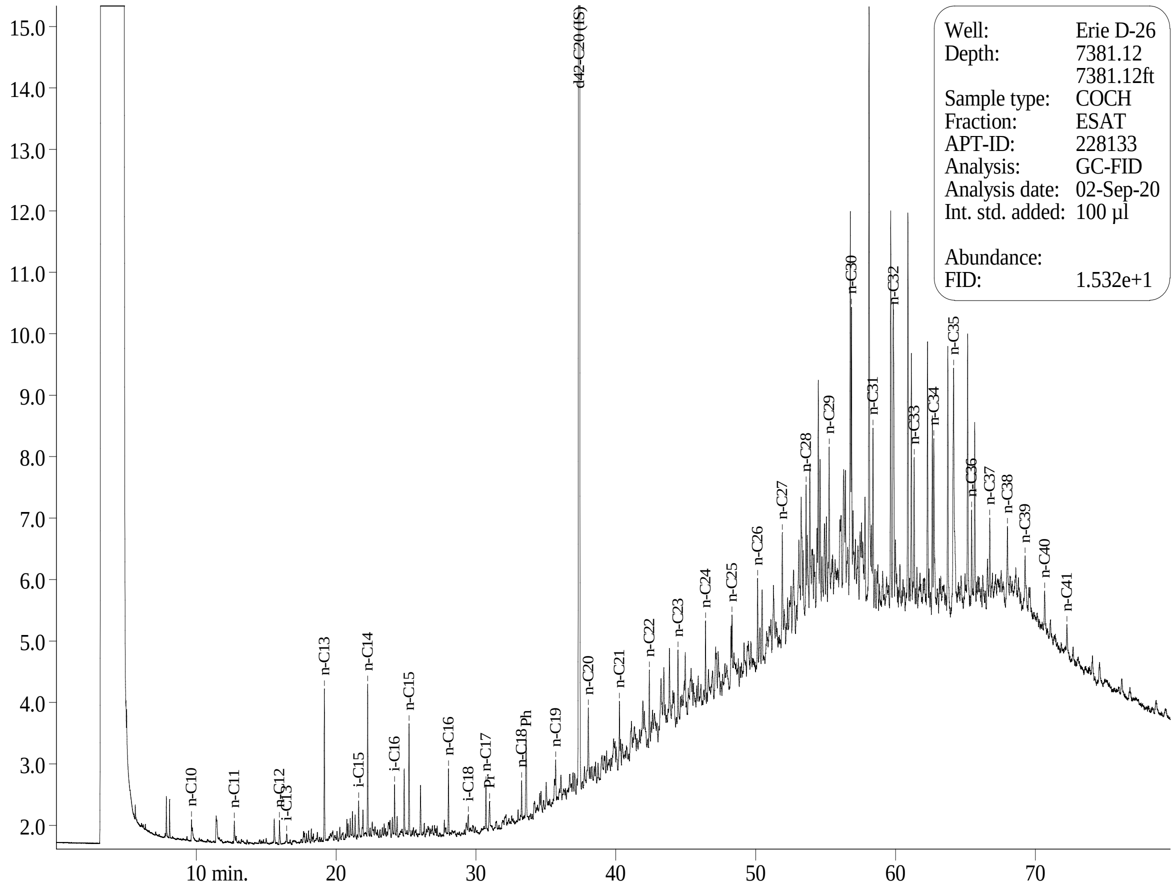
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-FID
Analysis date: 01-Sep-20
Int. std. added: 100 µl

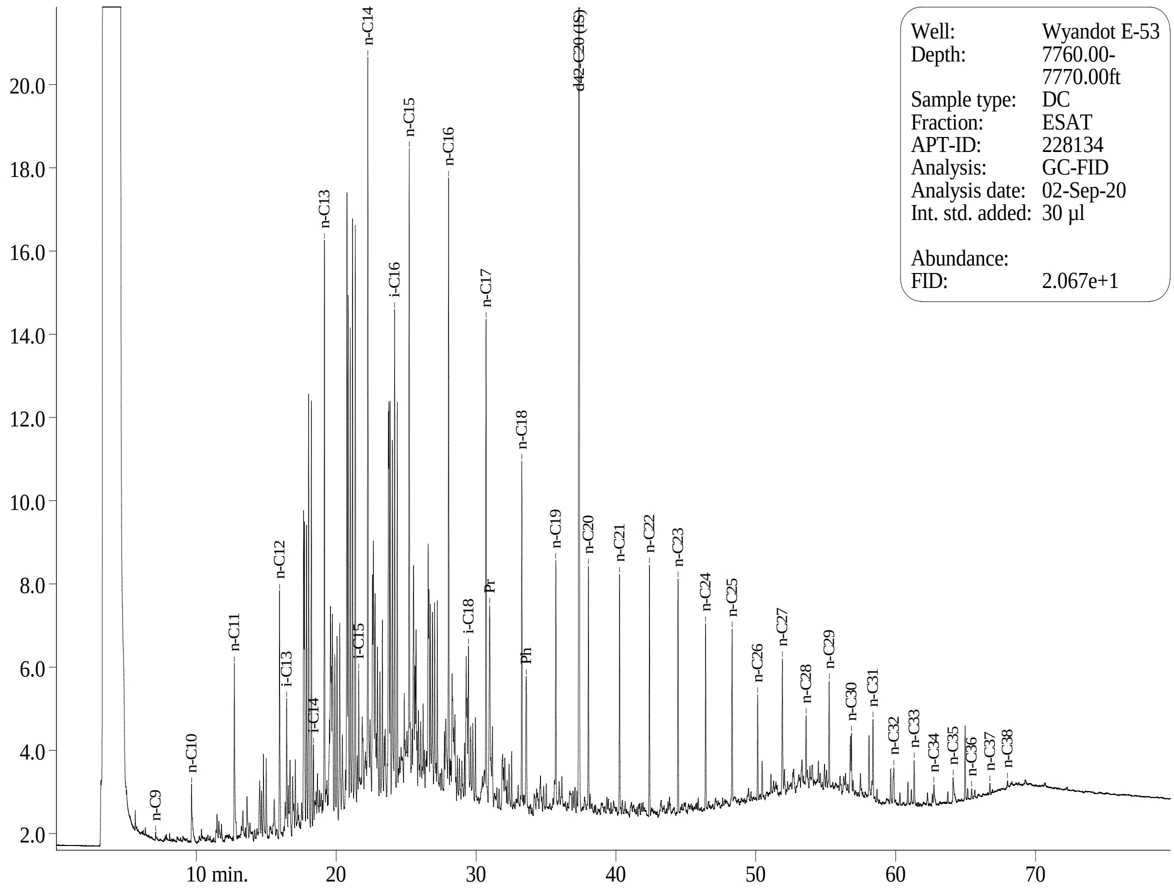
Abundance:
FID: 3.411e+1

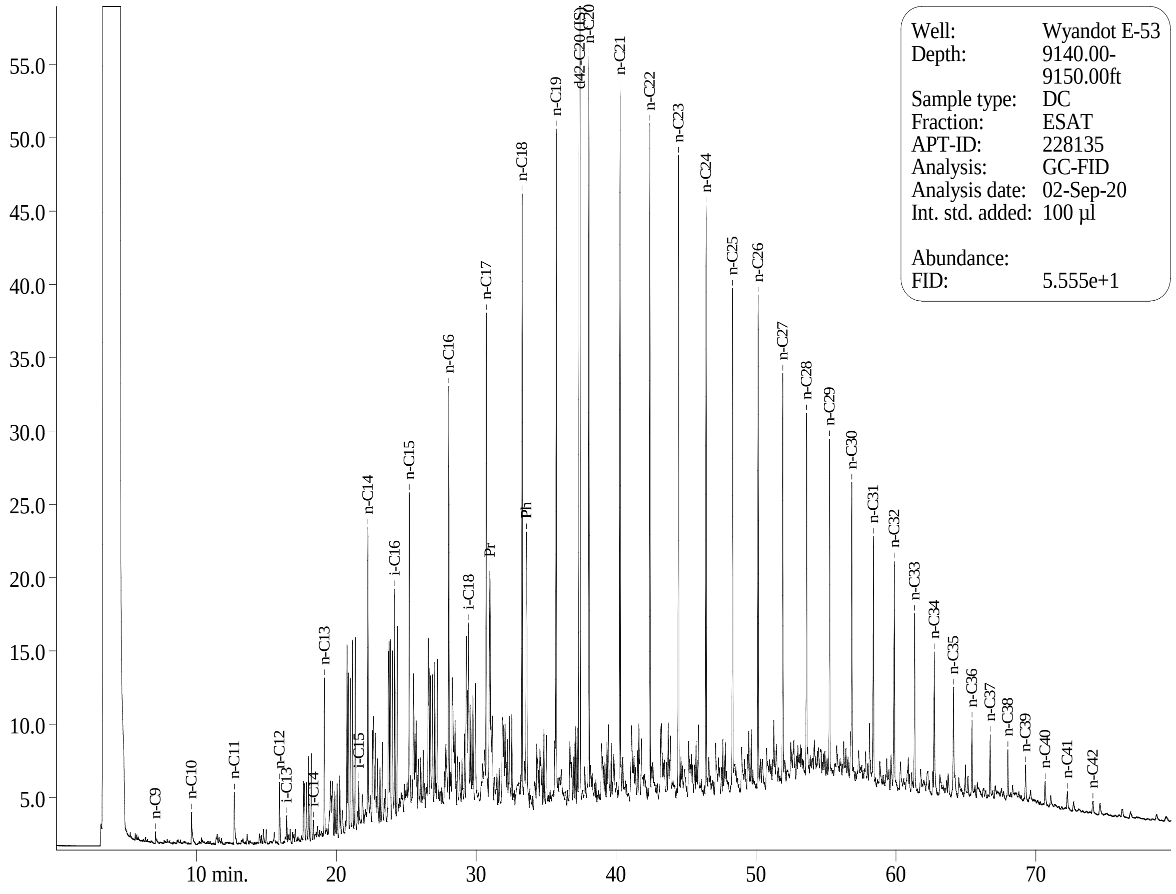


Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-FID
Analysis date: 02-Sep-20
Int. std. added: 30 µl

Abundance:
FID: 2.857e+1

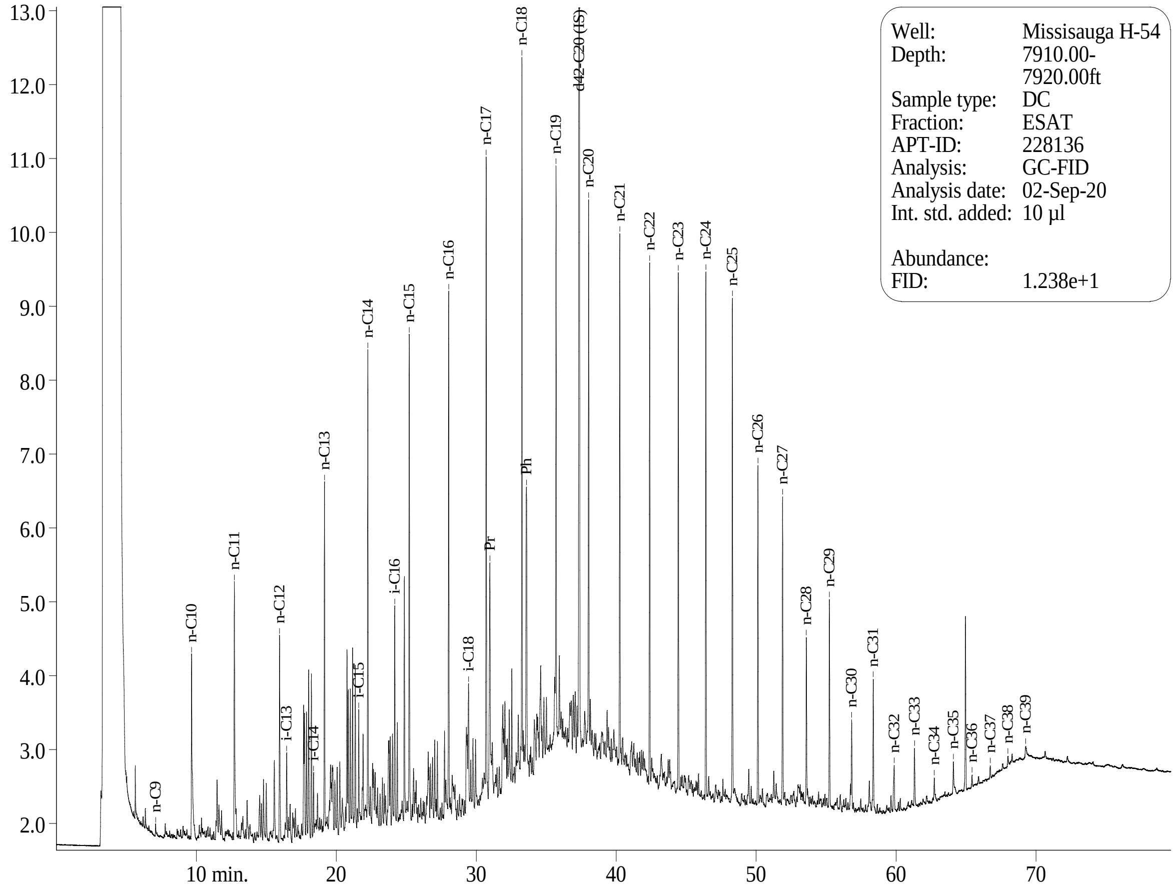

15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
10 min.
20
30
40
50
60
70
n-C10
n-C11
n-C12
Pr
i-C13
n-C13
i-C15
n-C14
i-C16
n-C15
n-C16
i-C18
Pr
n-C17
n-C18
Ph
n-C19
d42-C20 (IS)
n-C20
n-C21
n-C22
n-C23
n-C24
n-C25
n-C26
n-C27
n-C28
n-C29
n-C30
n-C31
n-C32
n-C33
n-C34
n-C35
n-C36
n-C37
n-C38
n-C39
n-C40
n-C41
Well: Erie D-26
Depth: 7381.12 7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-FID
Analysis date: 02-Sep-20
Int. std. added: 100 µl
Abundance:
FID: 1.532e+1


20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
10 min.
20
30
40
50
60
70
n-C9
n-C10
n-C11
n-C12
i-C13
i-C14
n-C13
i-C15
n-C14
i-C16
n-C15
n-C16
i-C18
n-C17
Pr
n-C18
Ph
n-C19
d42-C20 (IS)
n-C20
n-C21
n-C22
n-C23
n-C24
n-C25
n-C26
n-C27
n-C28
n-C29
n-C30
n-C31
n-C32
n-C33
n-C34
n-C35
n-C36
n-C37
n-C38
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-FID
Analysis date: 02-Sep-20
Int. std. added: 30 µl
Abundance:
FID: 2.067e+1



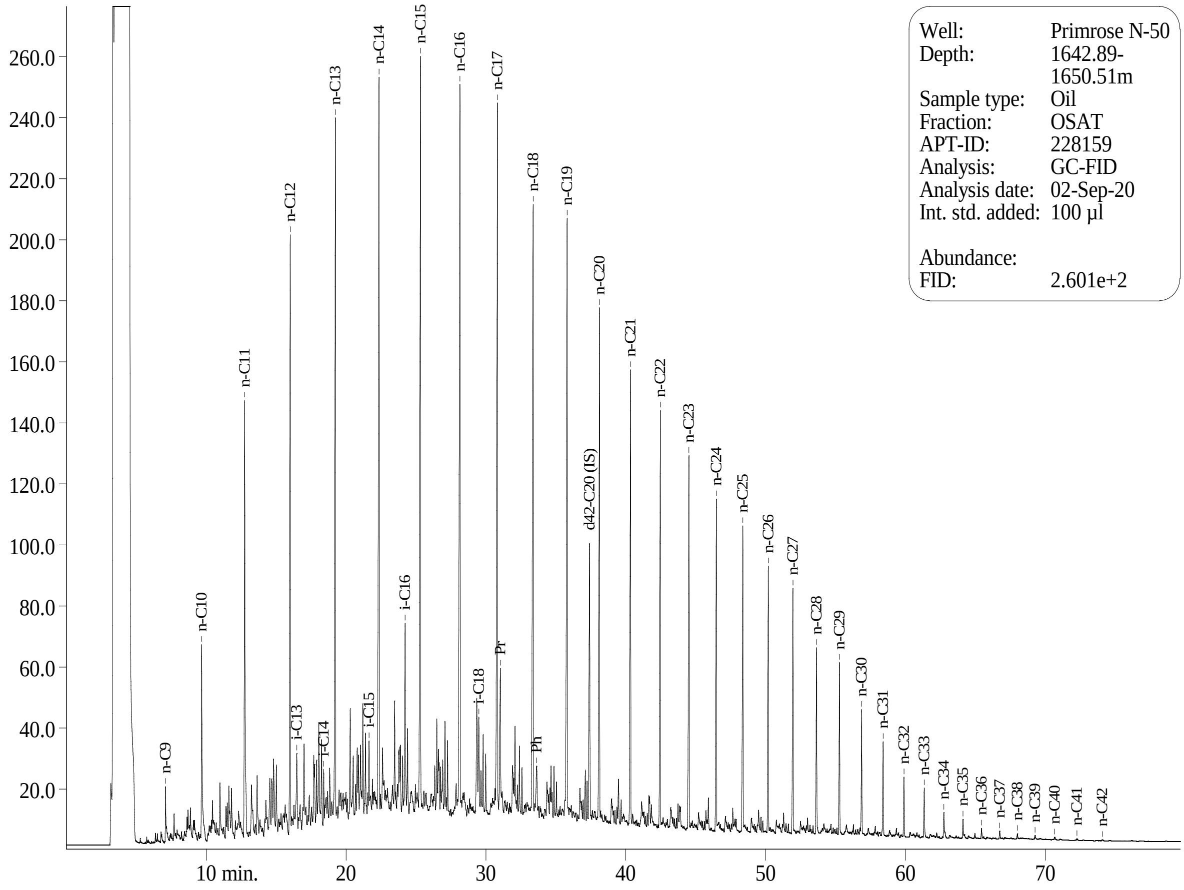
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-FID
Analysis date: 02-Sep-20
Int. std. added: 100 µl

Abundance:
FID: 5.555e+1



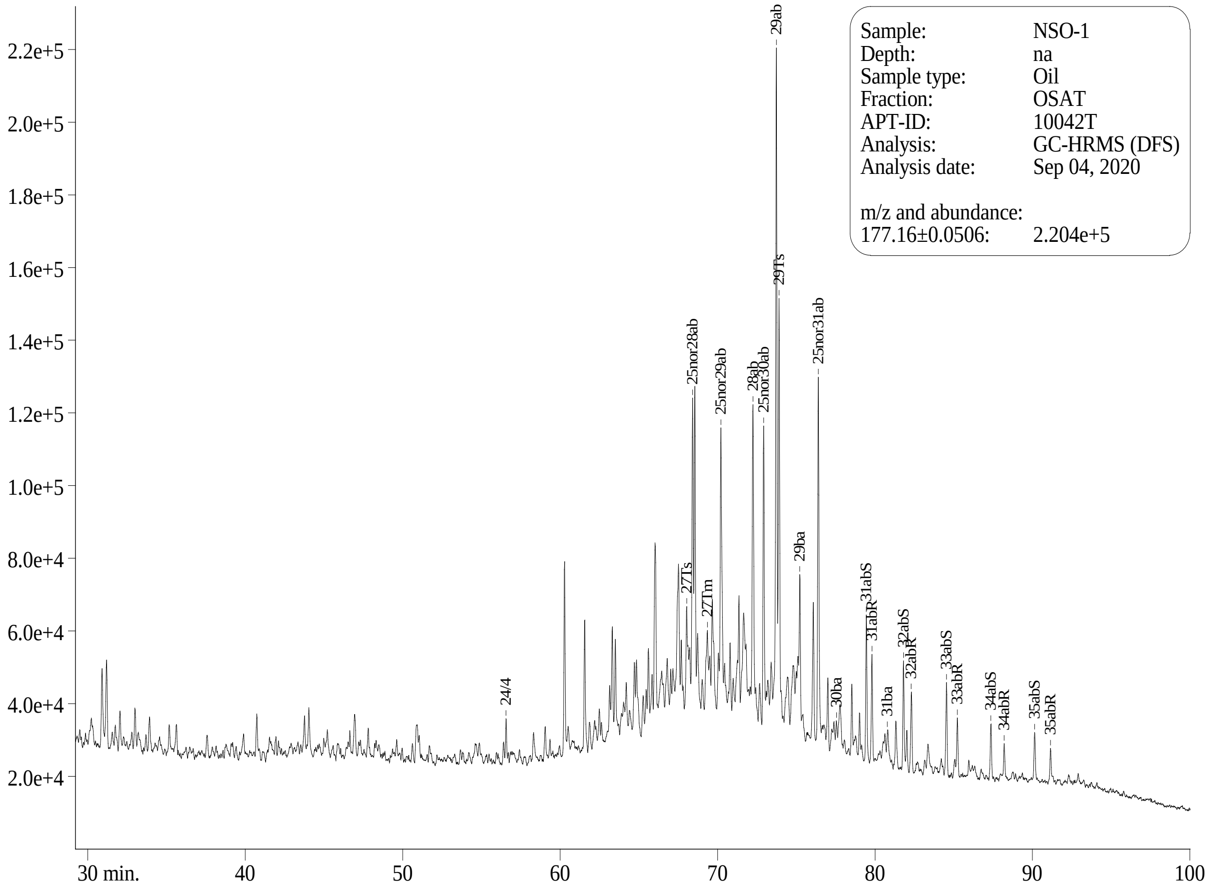
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-FID
Analysis date: 02-Sep-20
Int. std. added: 10 µl

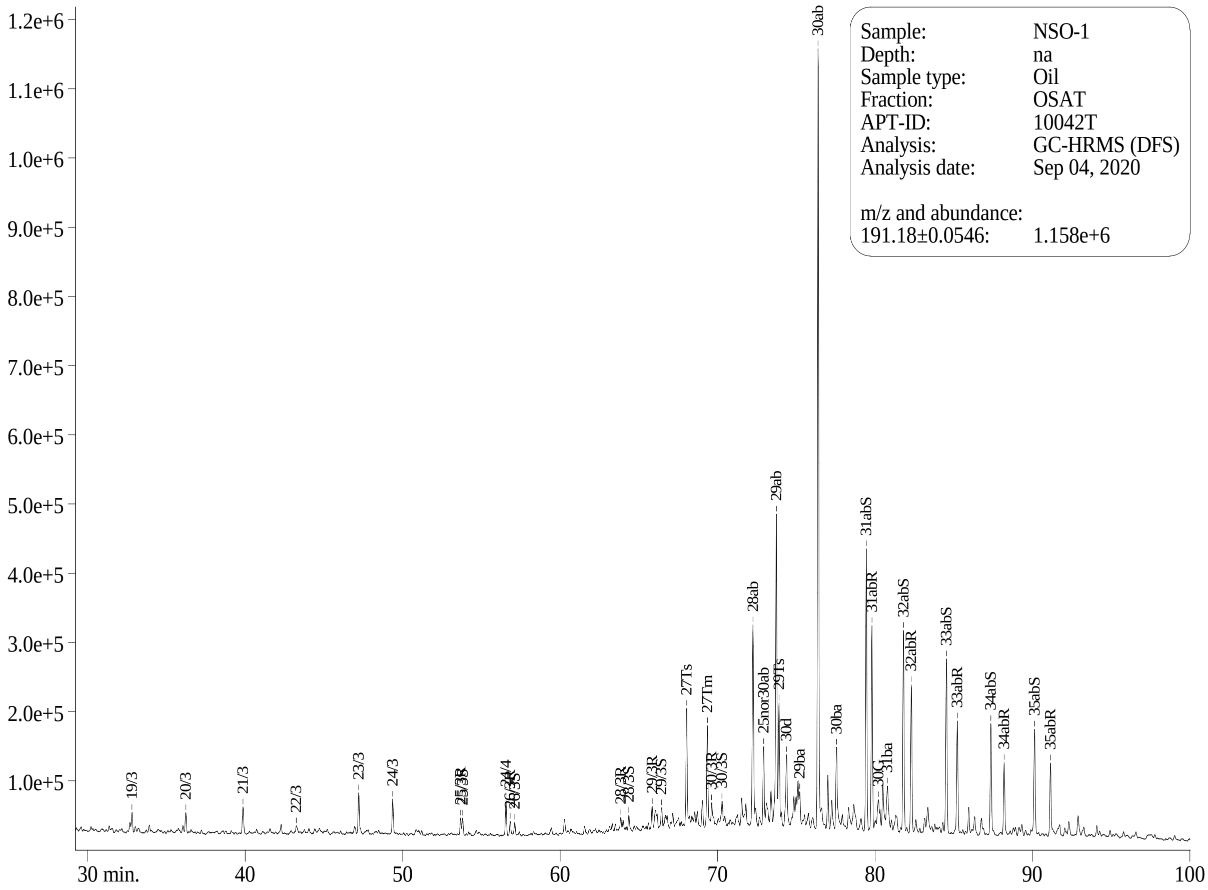
Abundance:
FID: 1.238e+1

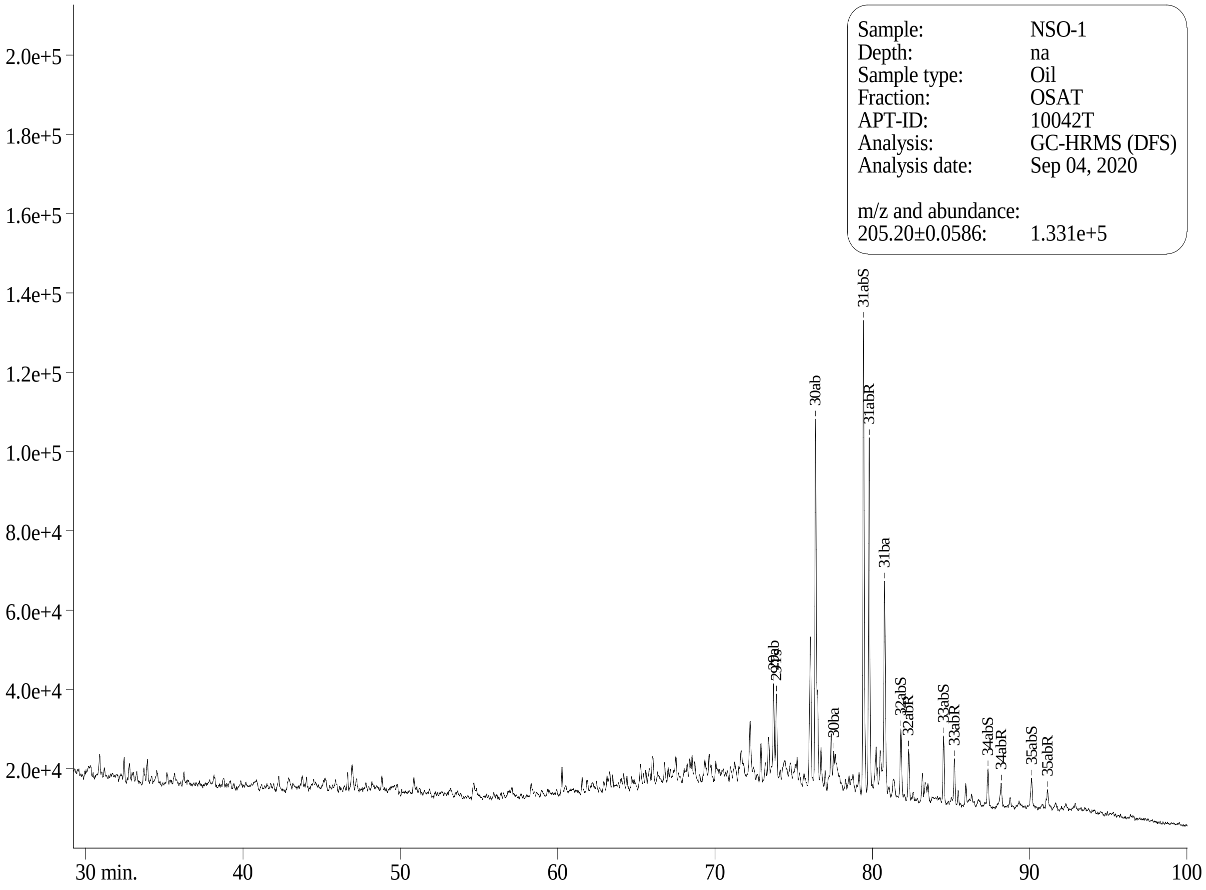


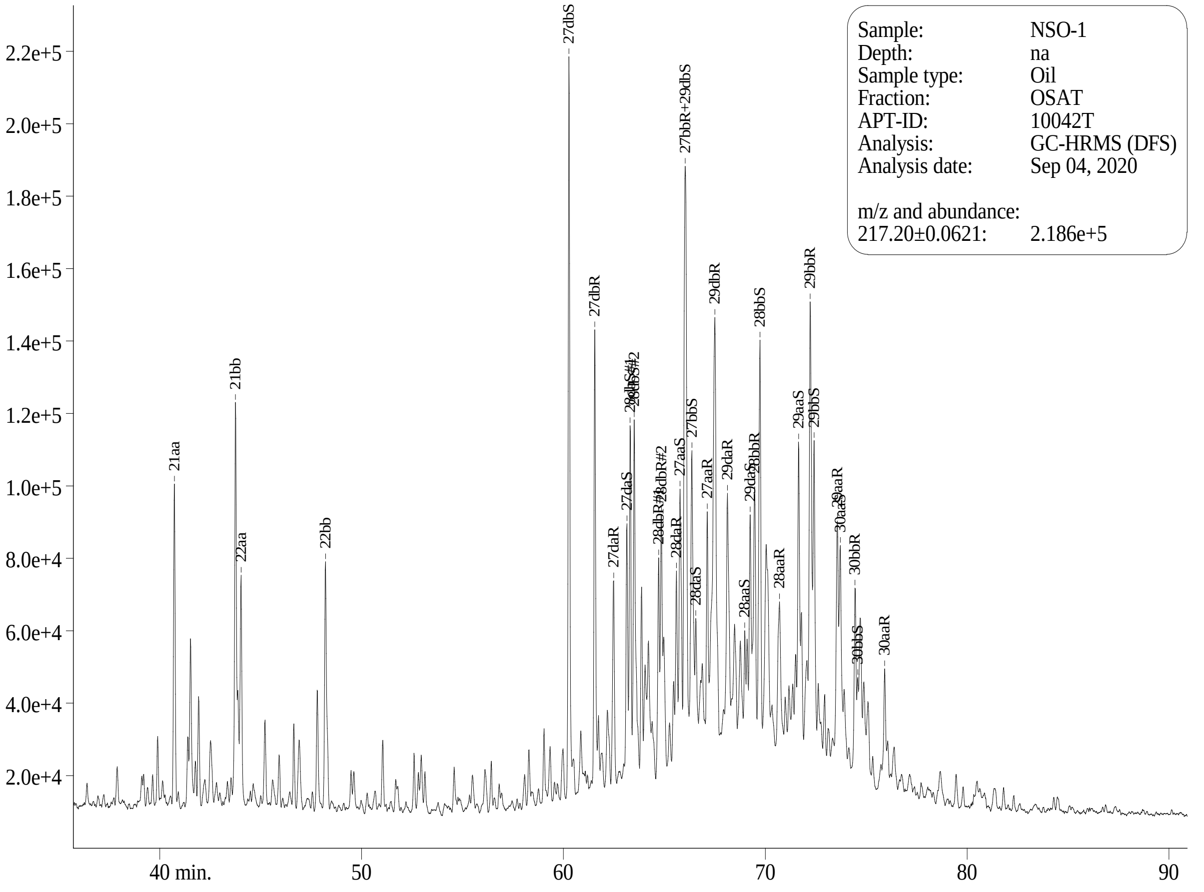
| | |
|---|---|
| Well: | Primrose N-50 |
| Depth: | 1642.89-1650.51m |
| Sample type: | Oil |
| Fraction: | OSAT |
| APT-ID: | 228159 |
| Analysis: | GC-FID |
| Analysis date: | 02-Sep-20 |
| Int. std. added: | 100 µl |
| | |
| Abundance: | |
| FID: | 2.601e+2 |

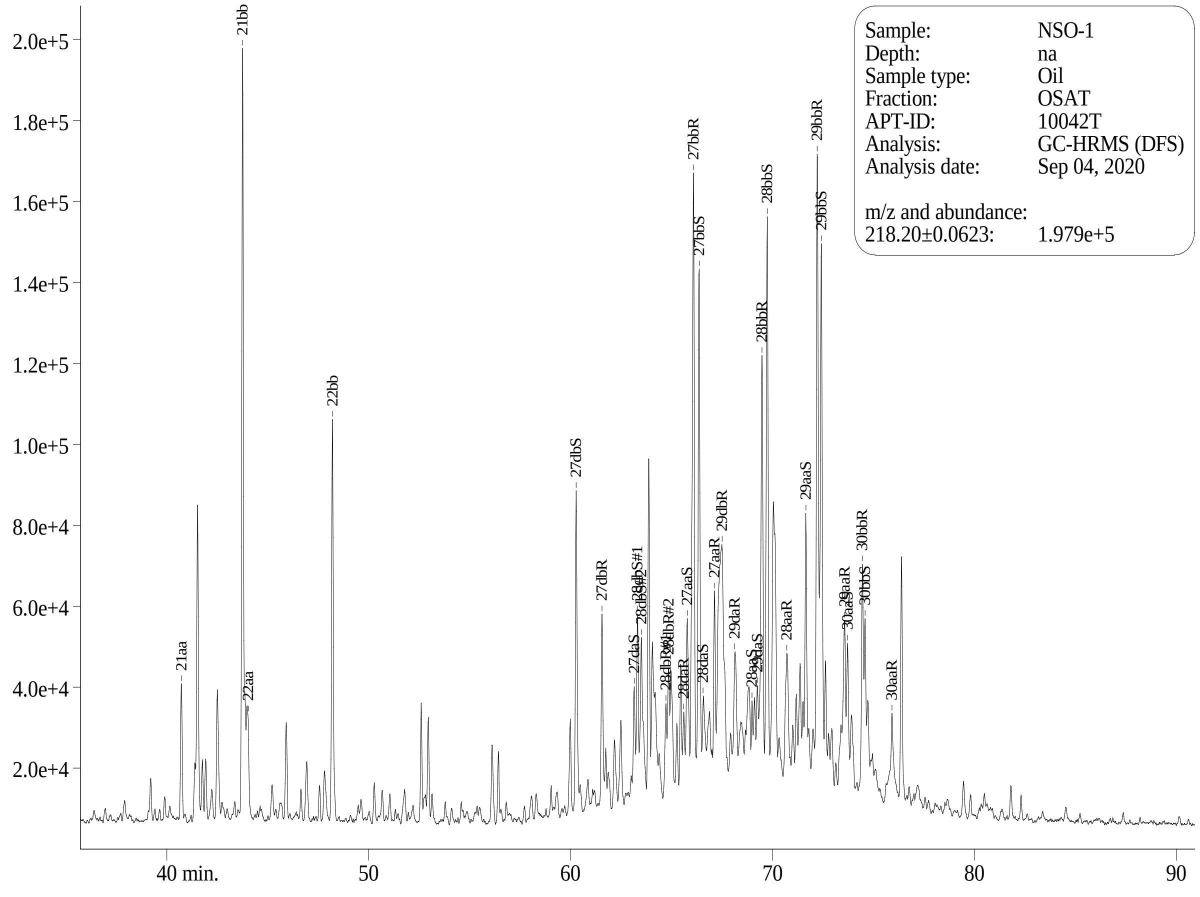
## *GC-MS Chromatograms of Saturated Hydrocarbons*


Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020
m/z and abundance:
177.16±0.0506: 2.204e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
24/4
27Ts
27Tm
25nor28ab
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020
m/z and abundance:
191.18±0.0546: 1.158e+6
1.2e+6
1.1e+6
1.0e+6
9.0e+5
8.0e+5
7.0e+5
6.0e+5
5.0e+5
4.0e+5
3.0e+5
2.0e+5
1.0e+5
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29ab
29Ts
30d
29ba
30ab
30ba
31abS
31abR
30G
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR

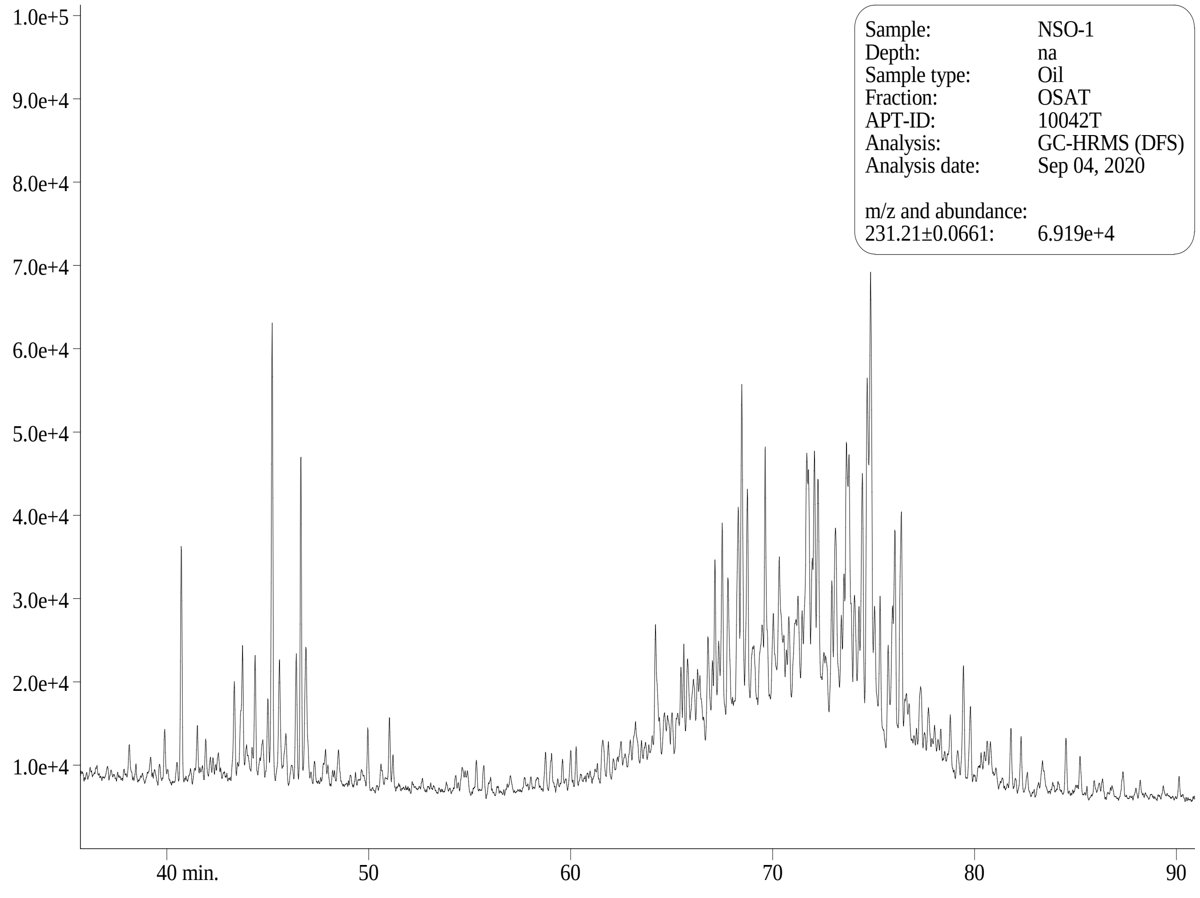

Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020
m/z and abundance:
205.20±0.0586: 1.331e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
29ab
29Ts
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020
m/z and abundance:
217.20±0.0621: 2.186e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR+29dbS
27bbS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR



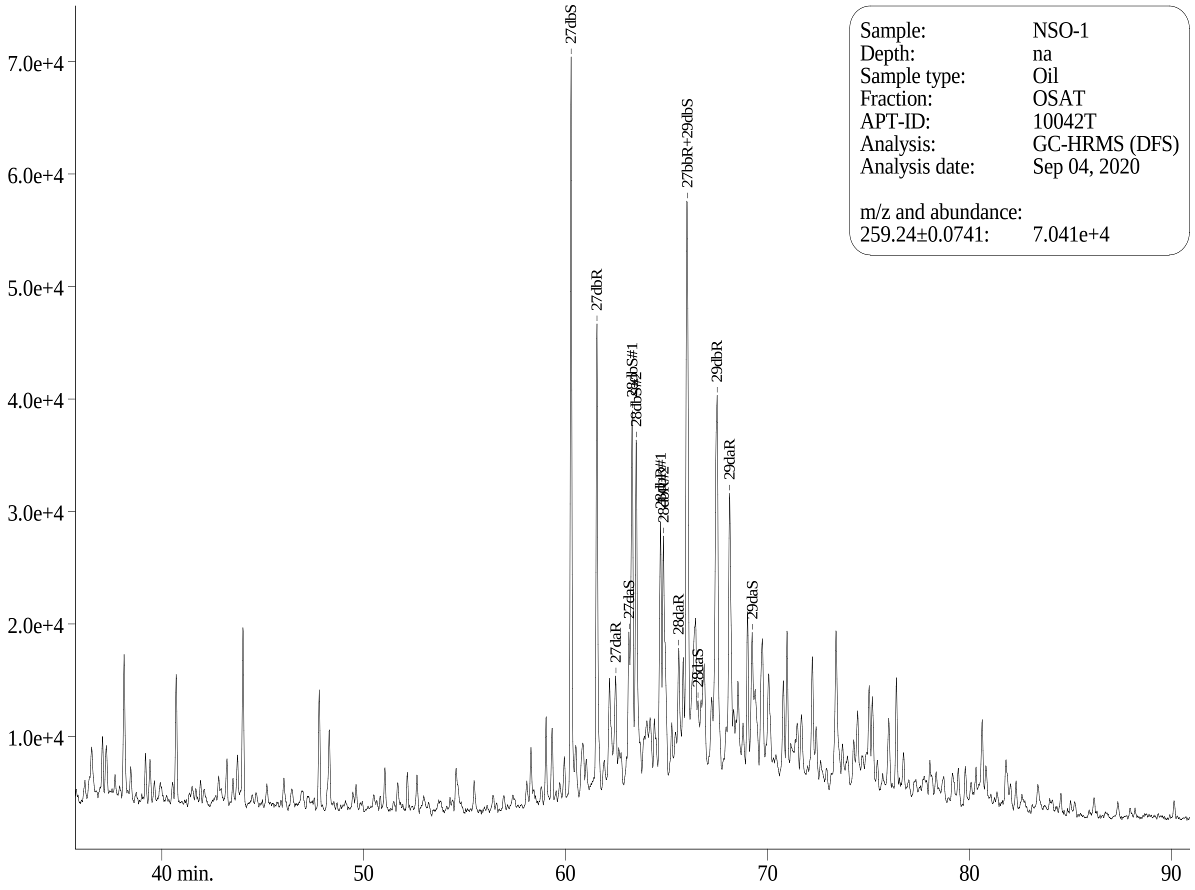
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020

m/z and abundance:
218.20±0.0623: 1.979e+5

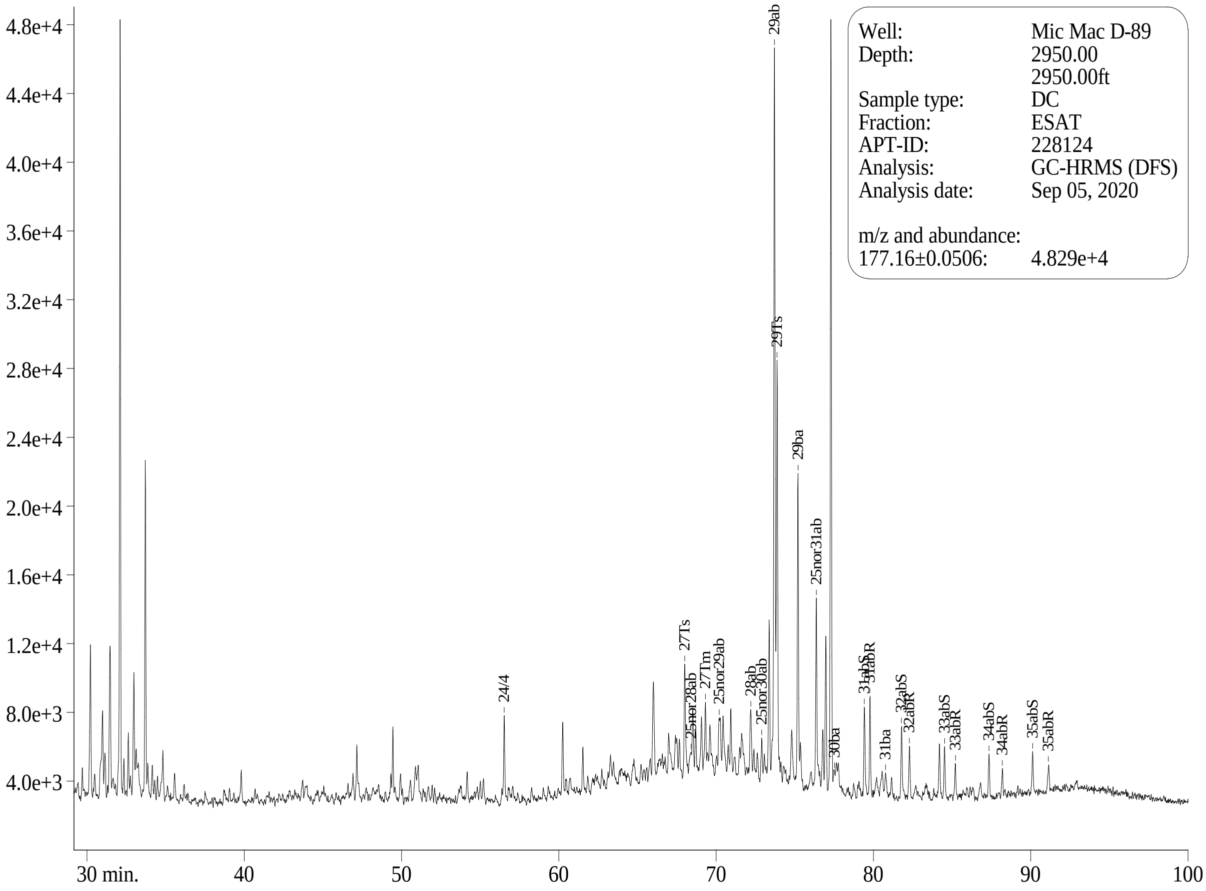


Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OSAT
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 04, 2020

m/z and abundance:
231.21±0.0661: 6.919e+4

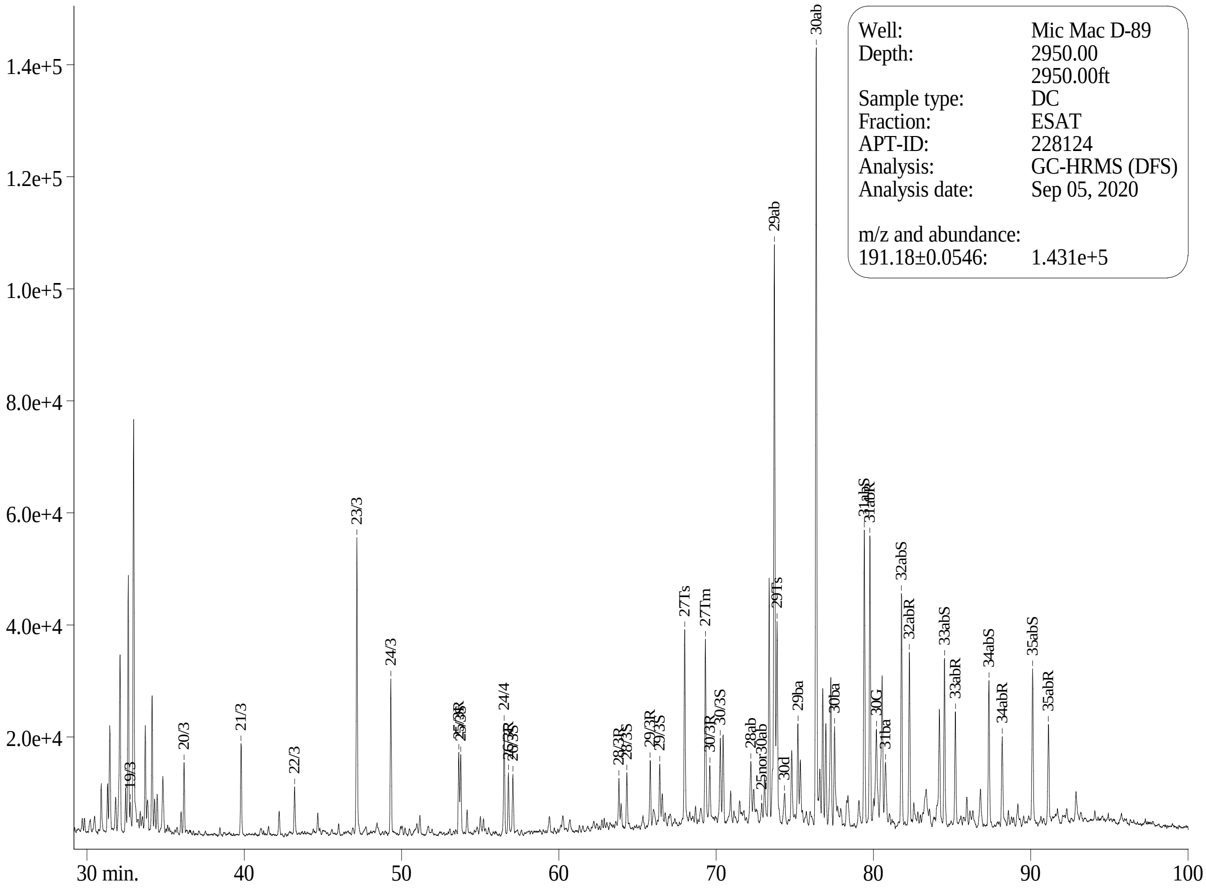


| | |
|---|---|
| Sample: | NSO-1 |
| Depth: | na |
| Sample type: | Oil |
| Fraction: | OSAT |
| APT-ID: | 10042T |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 04, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 7.041e+4 |



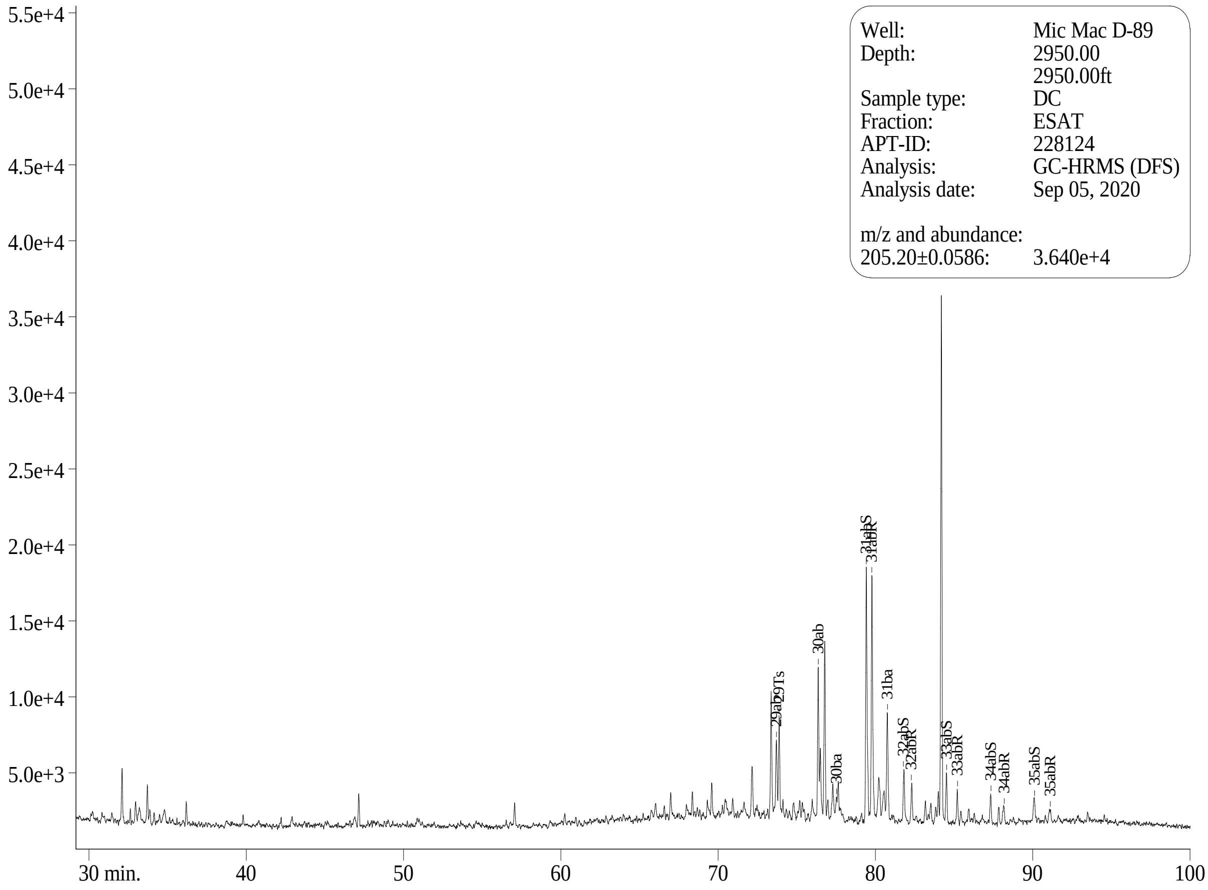
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

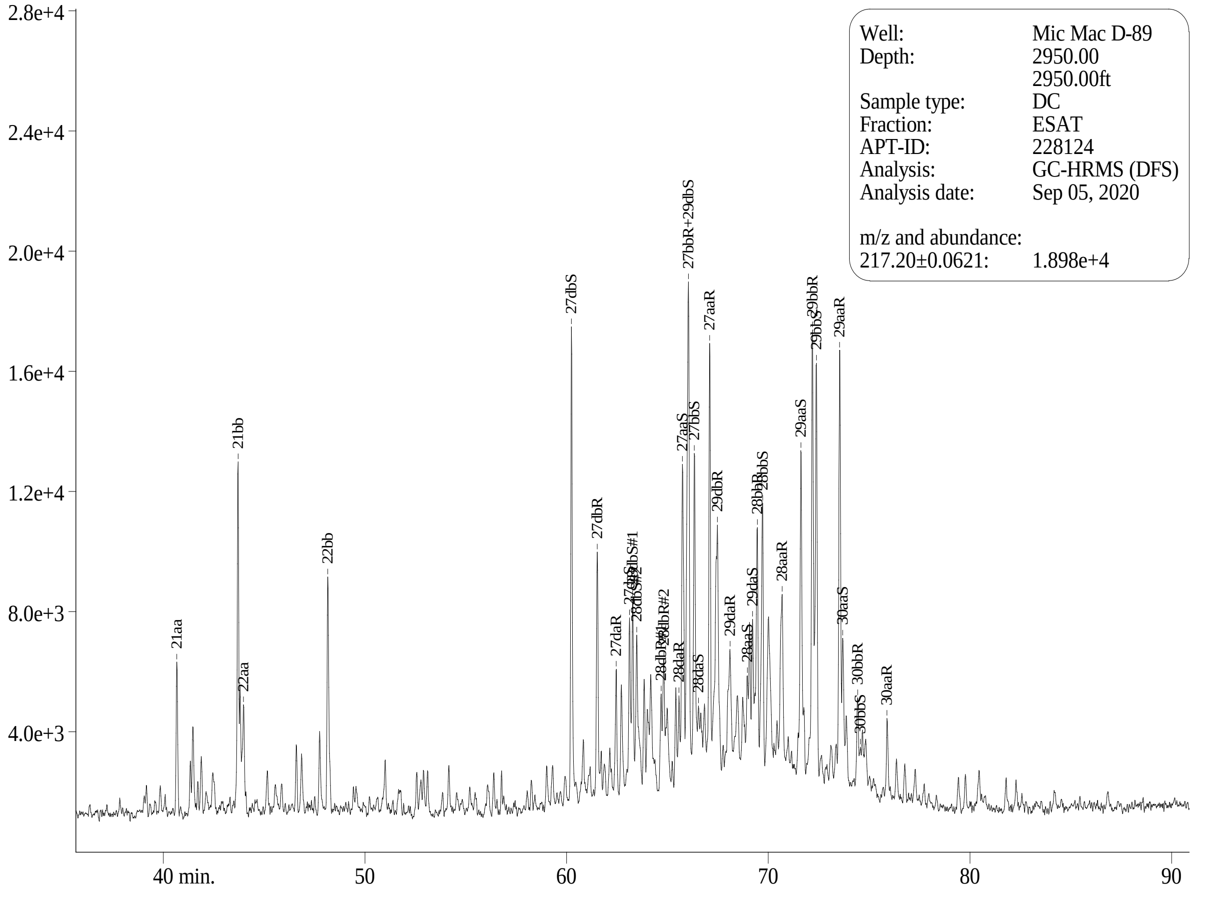
m/z and abundance:
177.16±0.0506: 4.829e+4

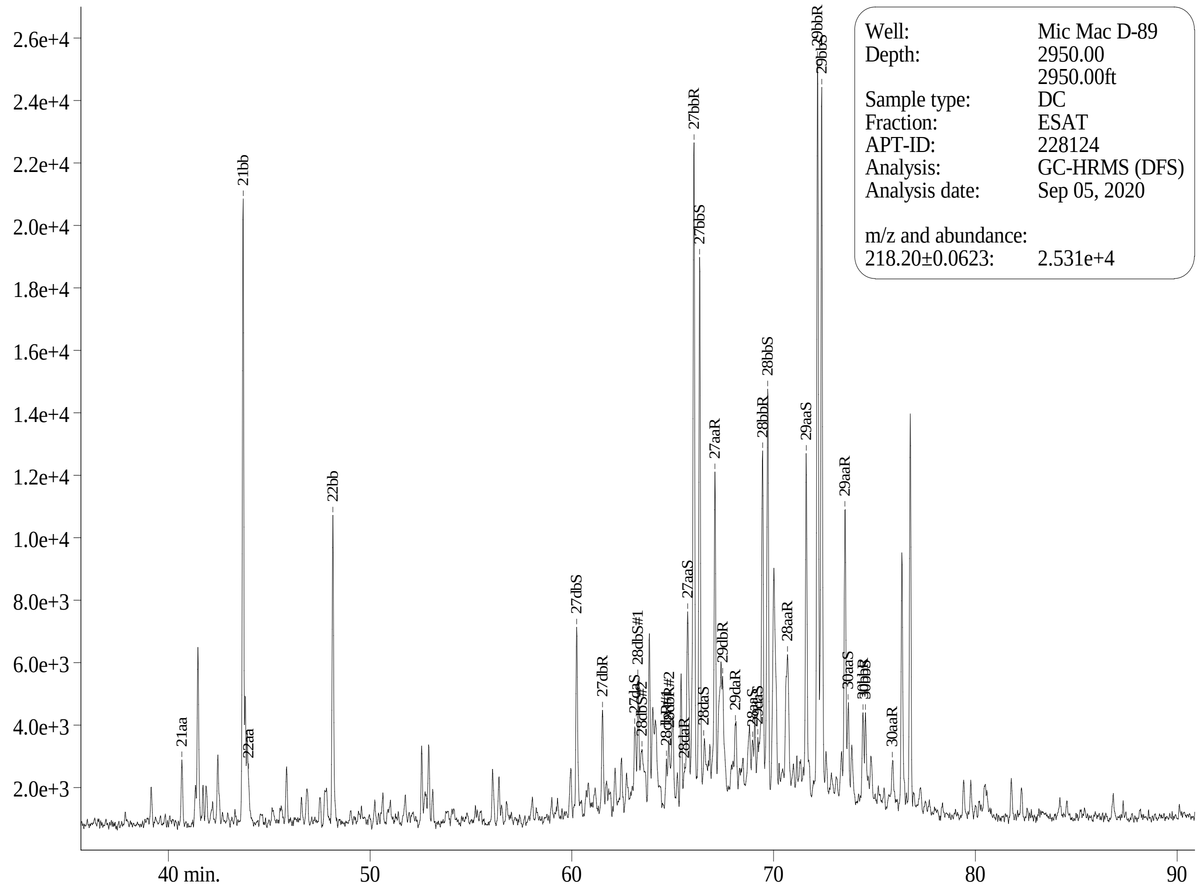


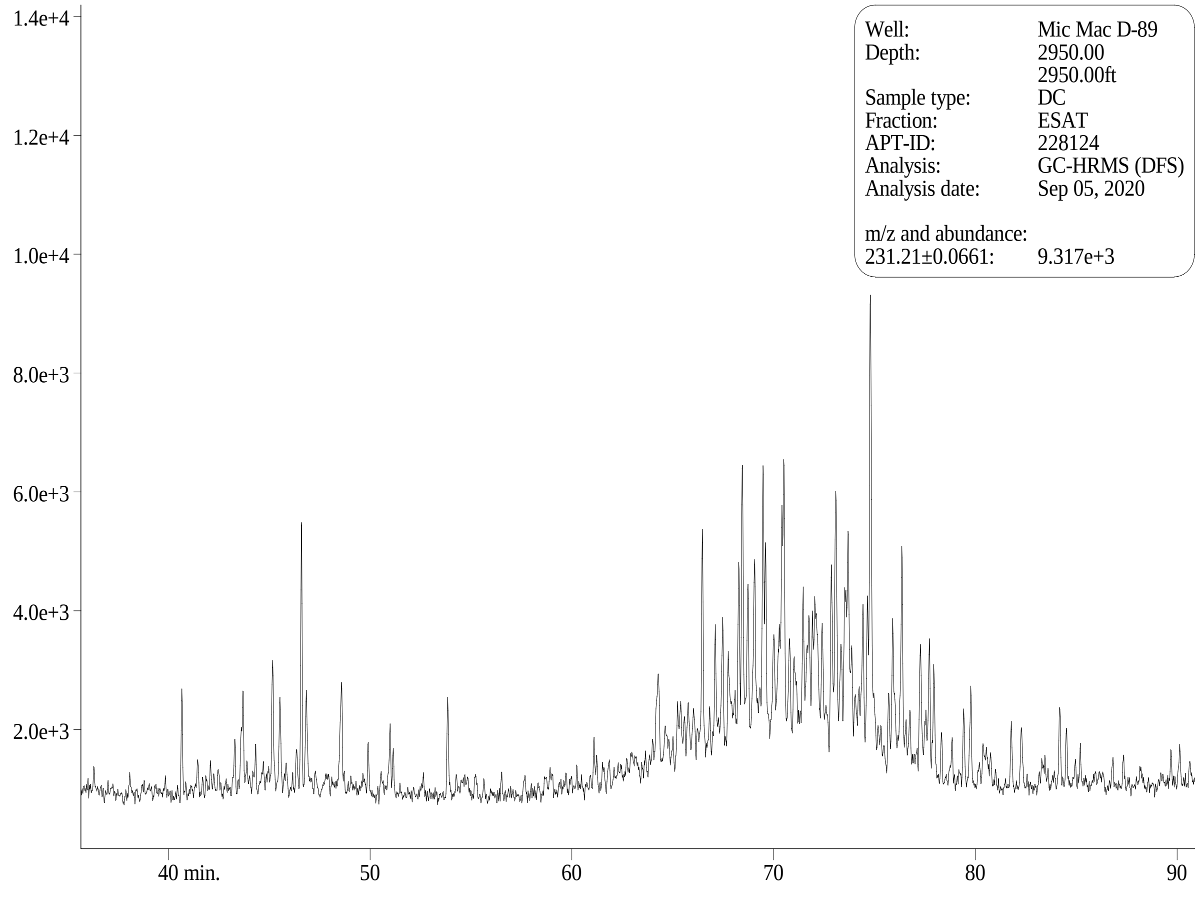
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

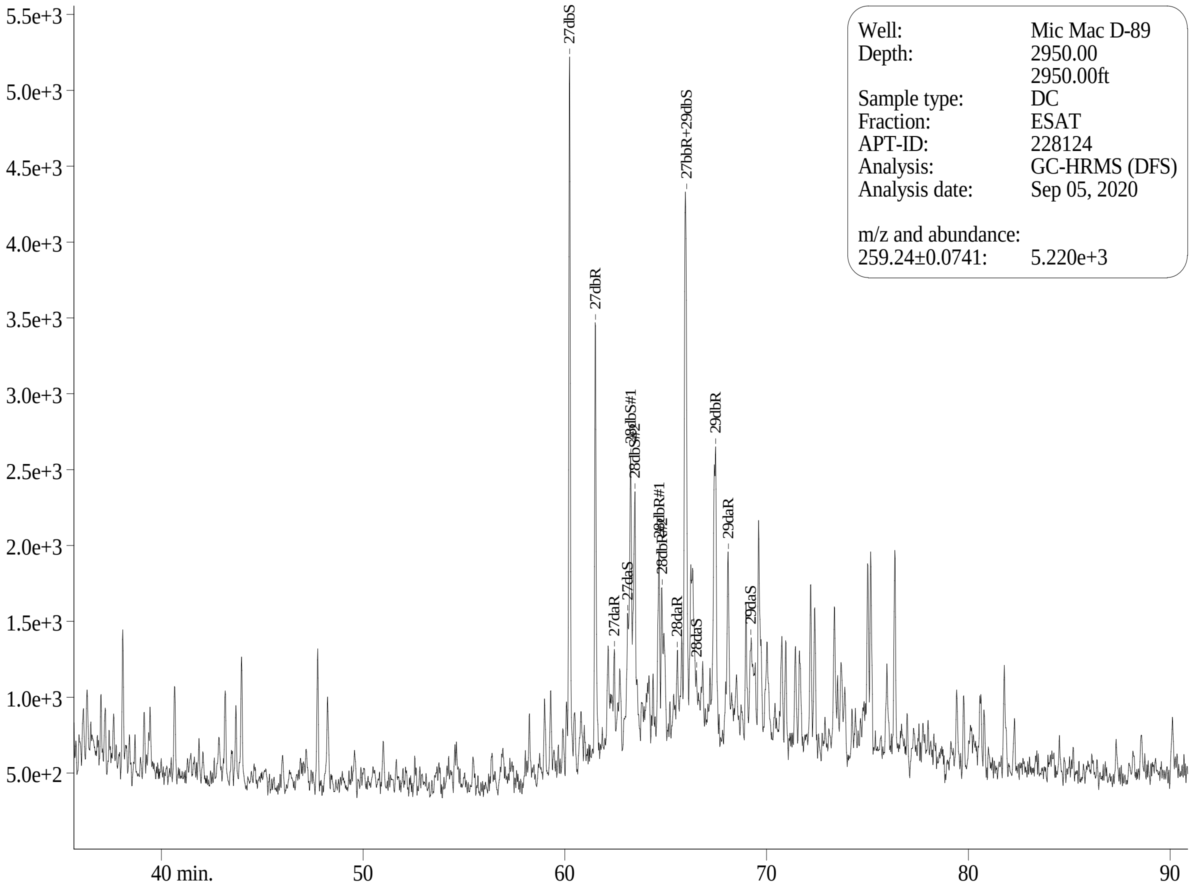
m/z and abundance:
191.18±0.0546: 1.431e+5


5.5e+4
5.0e+4
4.5e+4
4.0e+4
3.5e+4
3.0e+4
2.5e+4
2.0e+4
1.5e+4
1.0e+4
5.0e+3
30 min.
40
50
60
70
80
90
100
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
205.20±0.0586: 3.640e+4
29ab
29Ts
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR

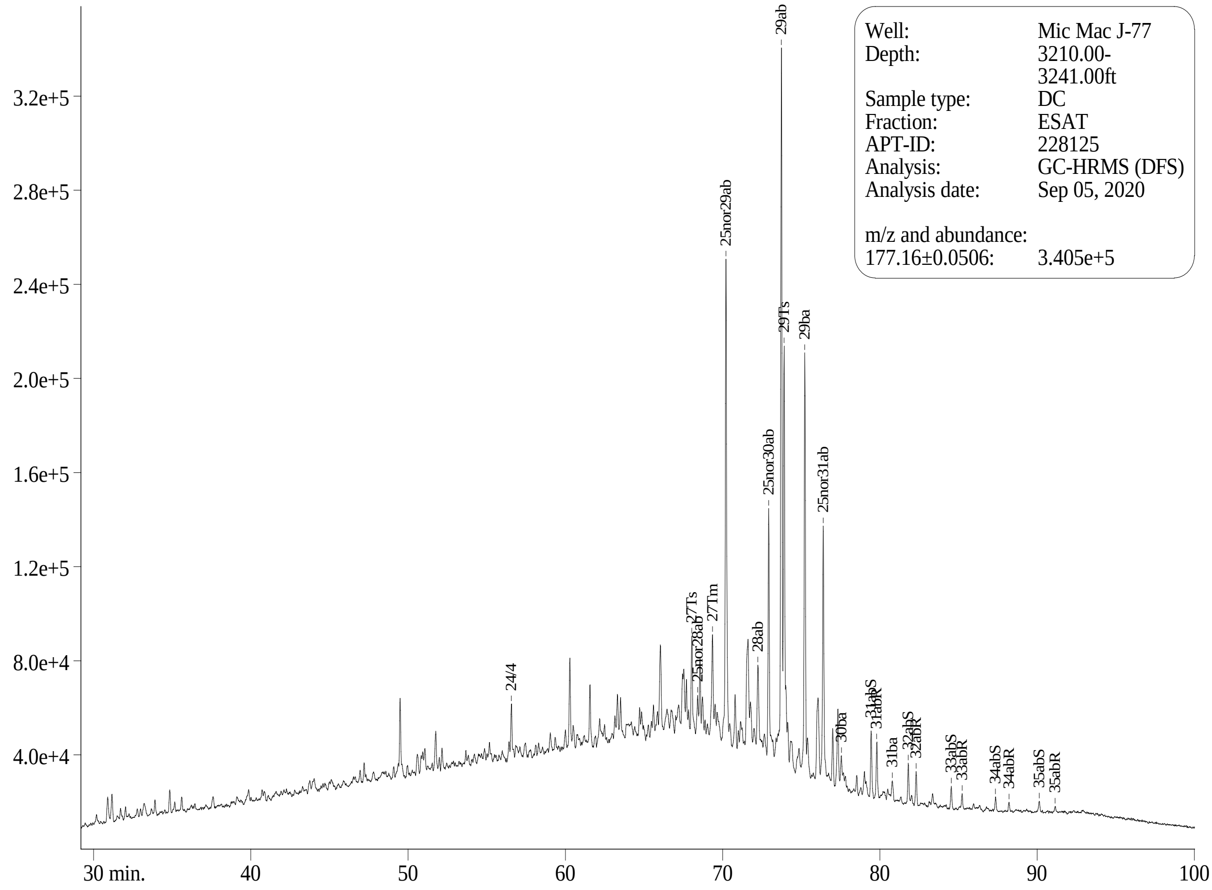

2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
217.20±0.0621: 1.898e+4
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
27bbR+29dbS
27bbS
28daS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbS
29bbR
29aaR
30aaS
30bbR
30bbS
30aaR

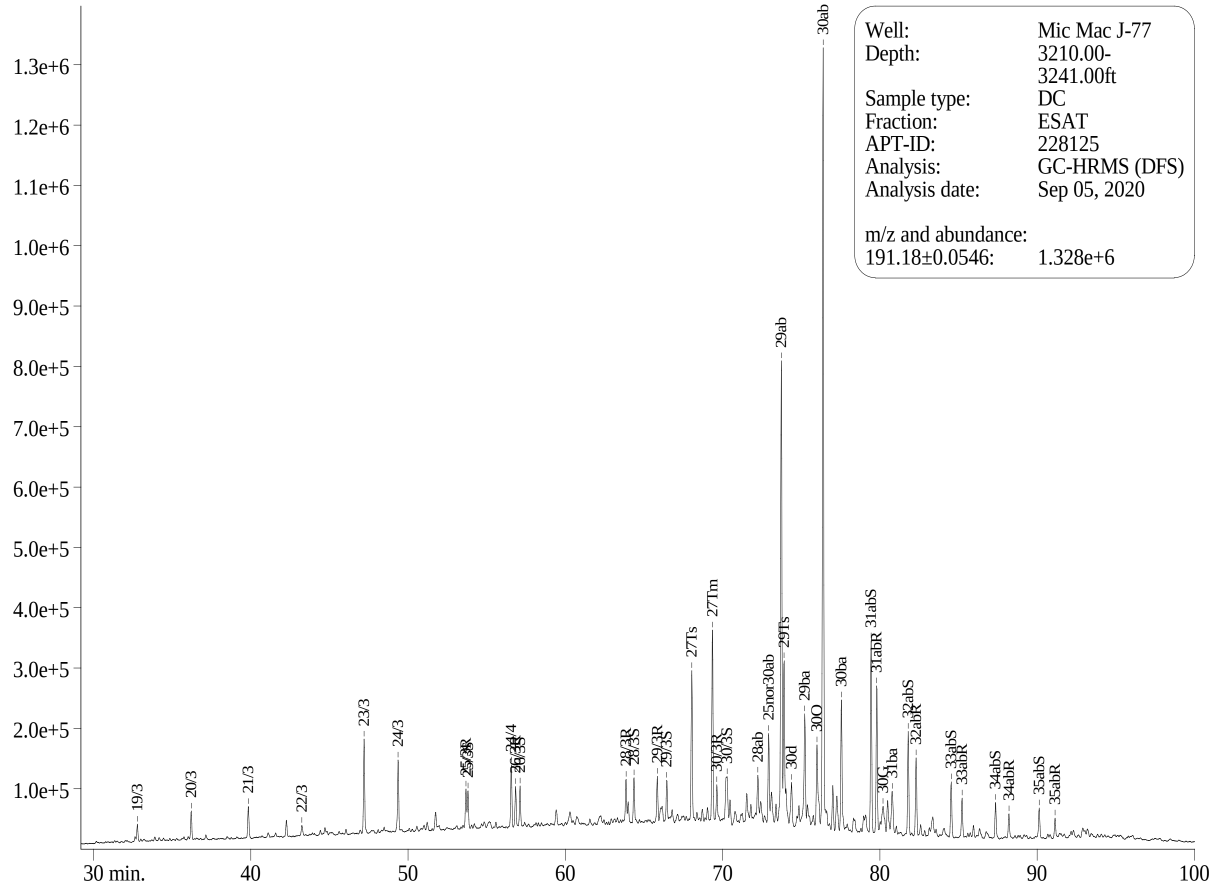

Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
218.20±0.0623: 2.531e+4
2.6e+4
2.4e+4
2.2e+4
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28daR
27bbR
27bbS
27aaS
27aaR
28daS
29dbR
29daR
28aaS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR

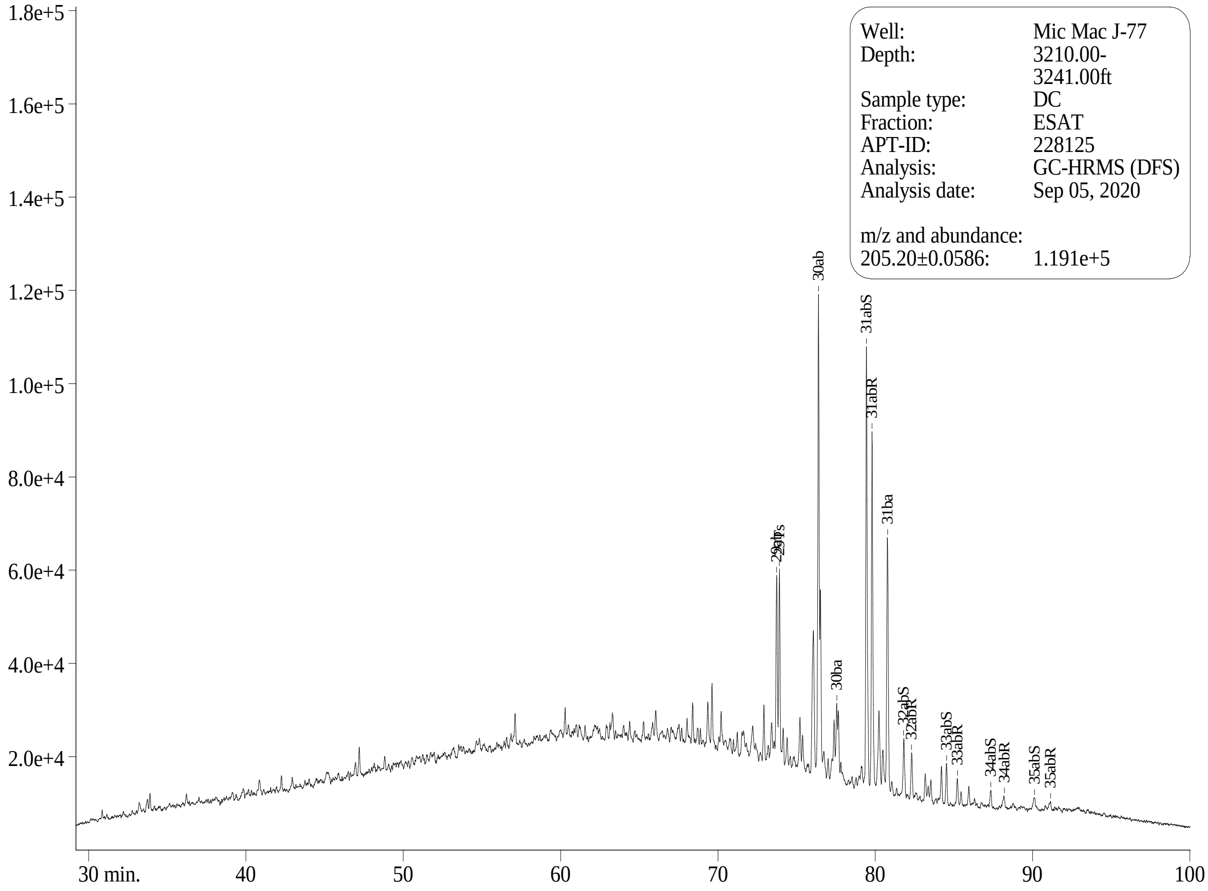

Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
231.21±0.0661: 9.317e+3
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90



|  |  |
|---|---|
| Well: | Mic Mac D-89 |
| Depth: | 2950.00<br>2950.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228124 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: |  |
| 259.24±0.0741: | 5.220e+3 |

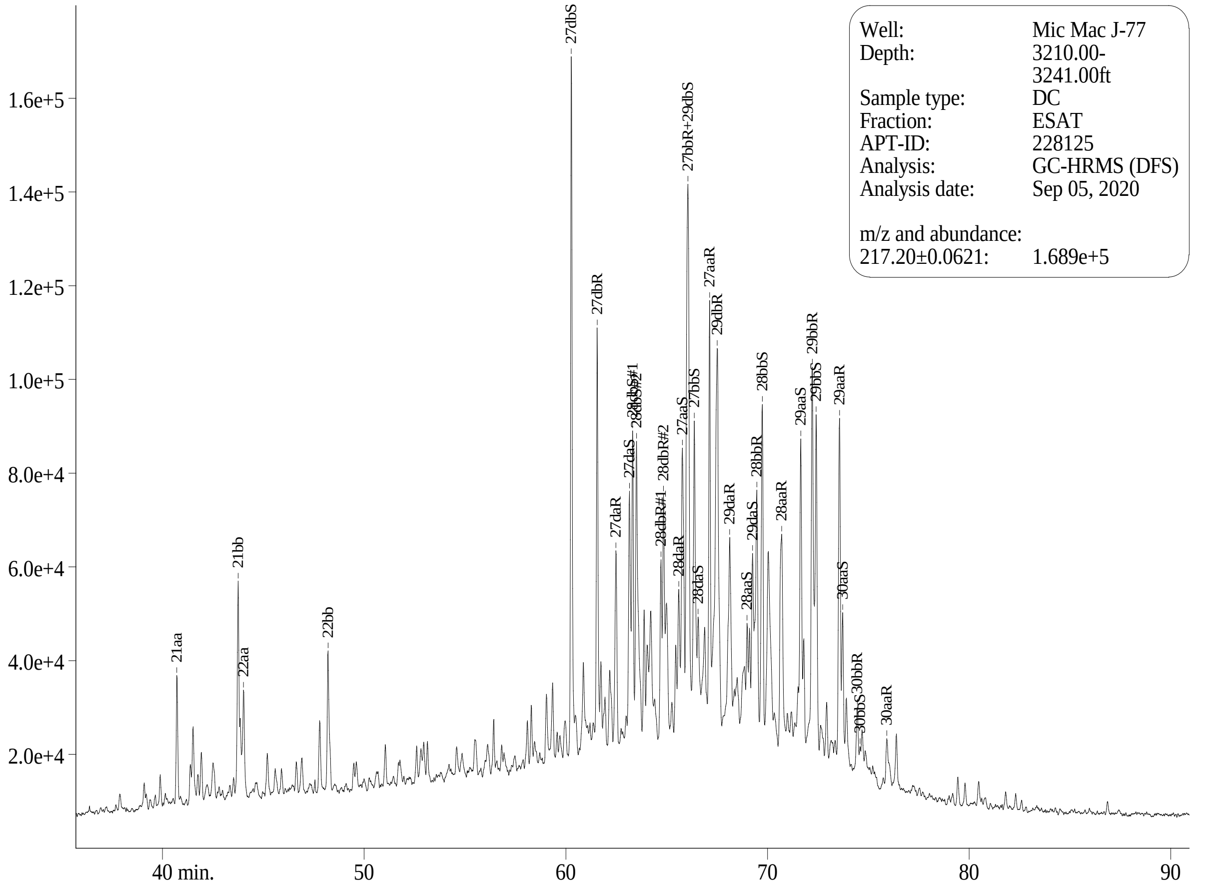

Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 3.405e+5
3.2e+5
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 1.328e+6
1.3e+6
1.2e+6
1.1e+6
1.0e+6
9.0e+5
8.0e+5
7.0e+5
6.0e+5
5.0e+5
4.0e+5
3.0e+5
2.0e+5
1.0e+5
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
26/3R
24/4
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
30d
29ab
29Ts
29ba
30O
30ab
30ba
31abS
31abR
30G
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



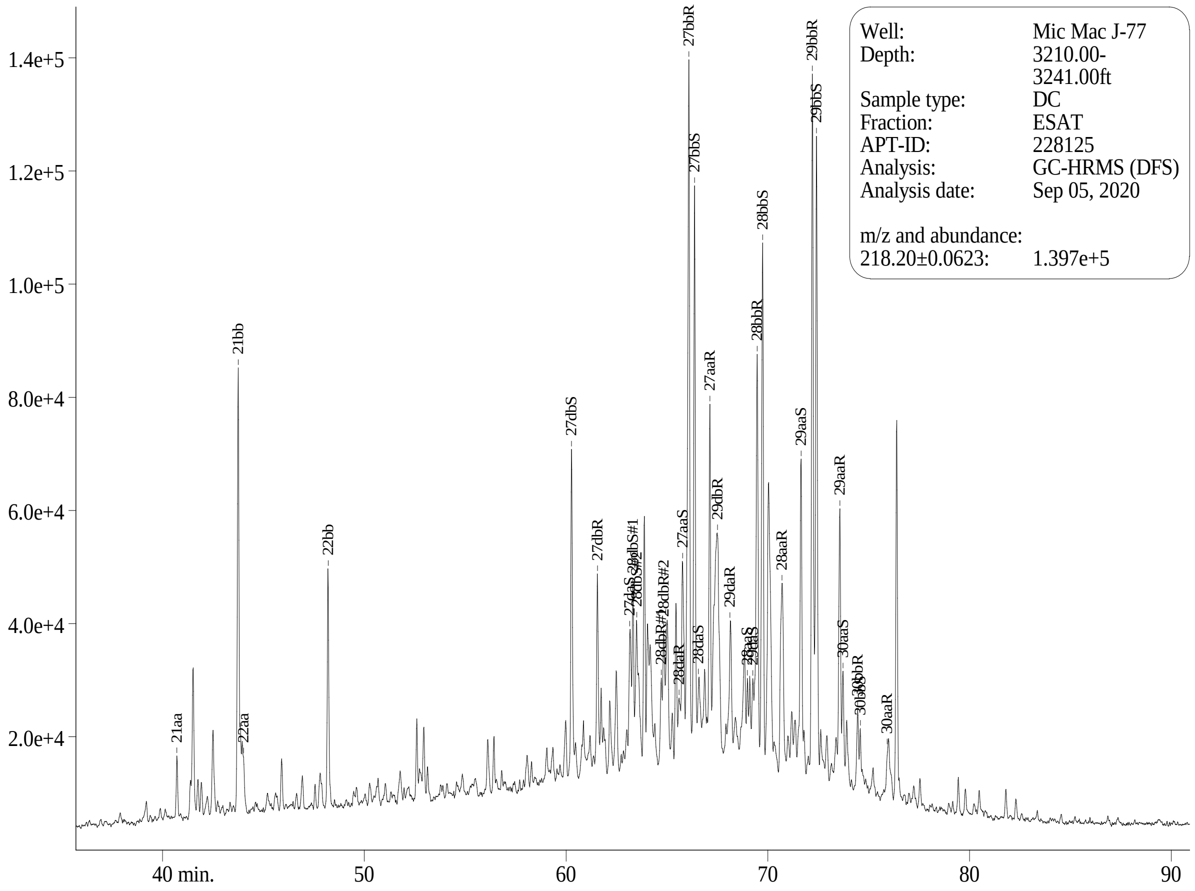
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
205.20±0.0586: 1.191e+5



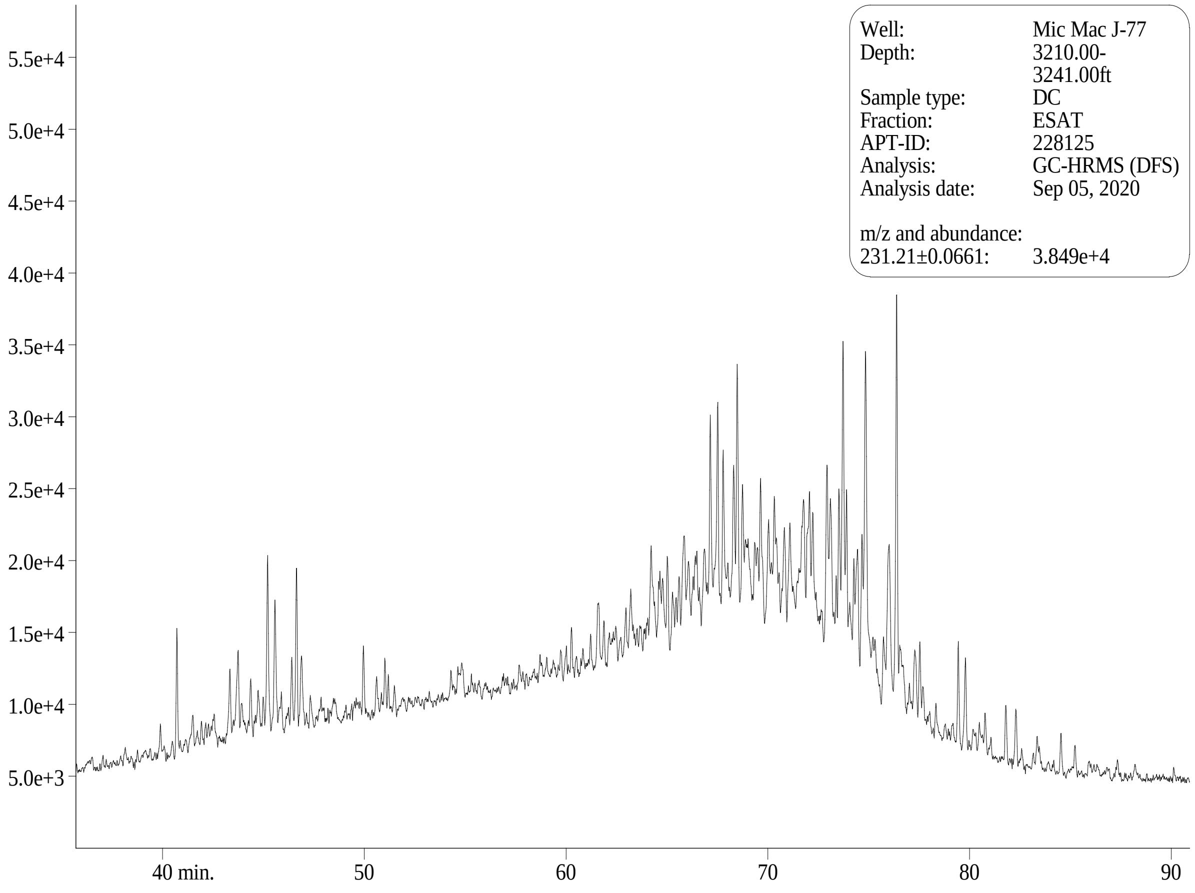
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
217.20±0.0621: 1.689e+5



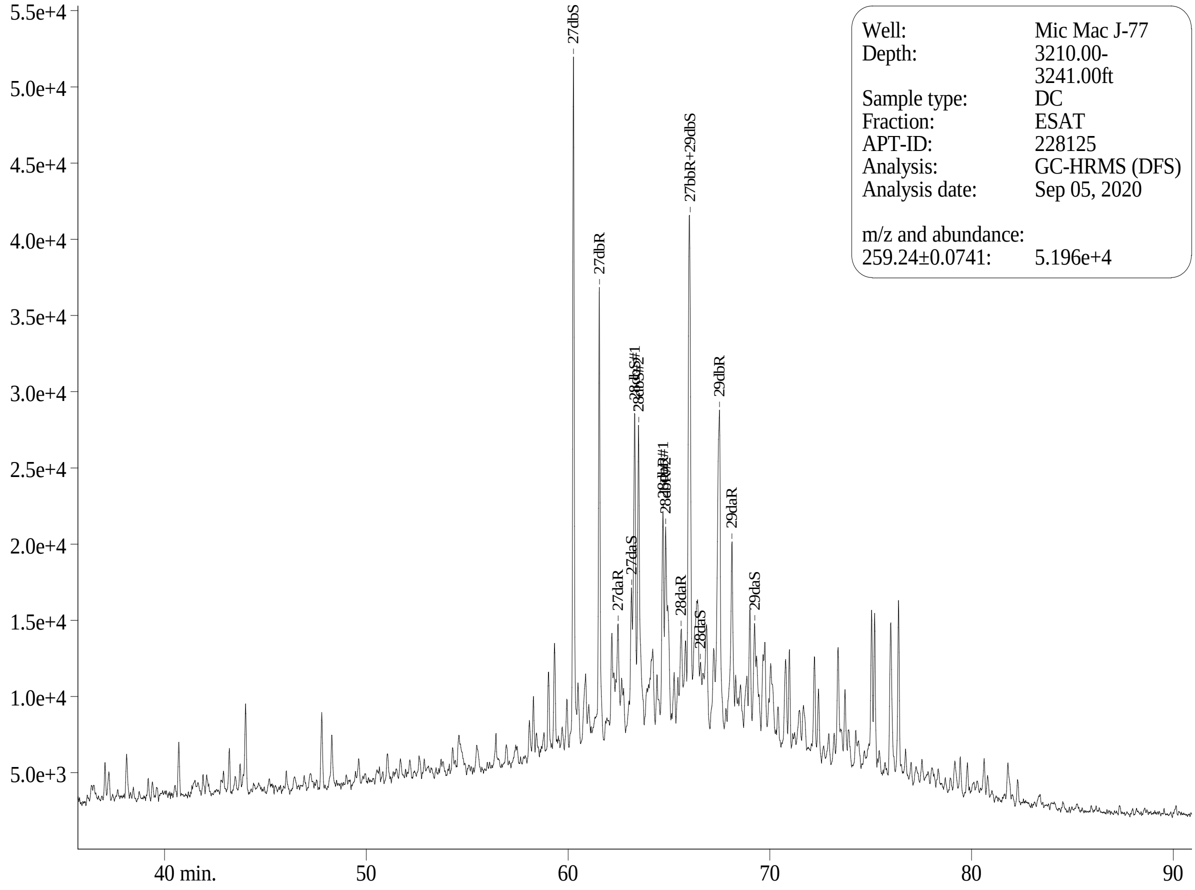
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
218.20±0.0623: 1.397e+5

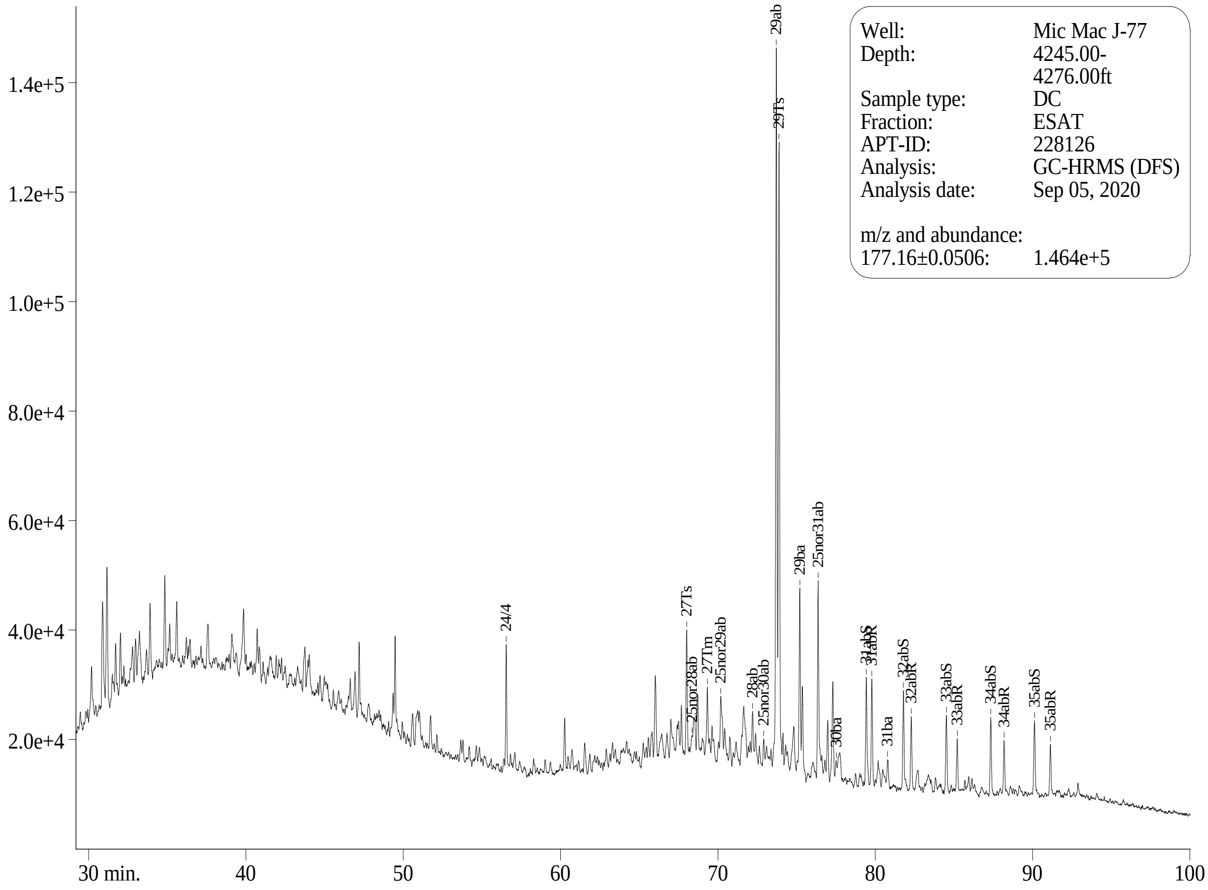


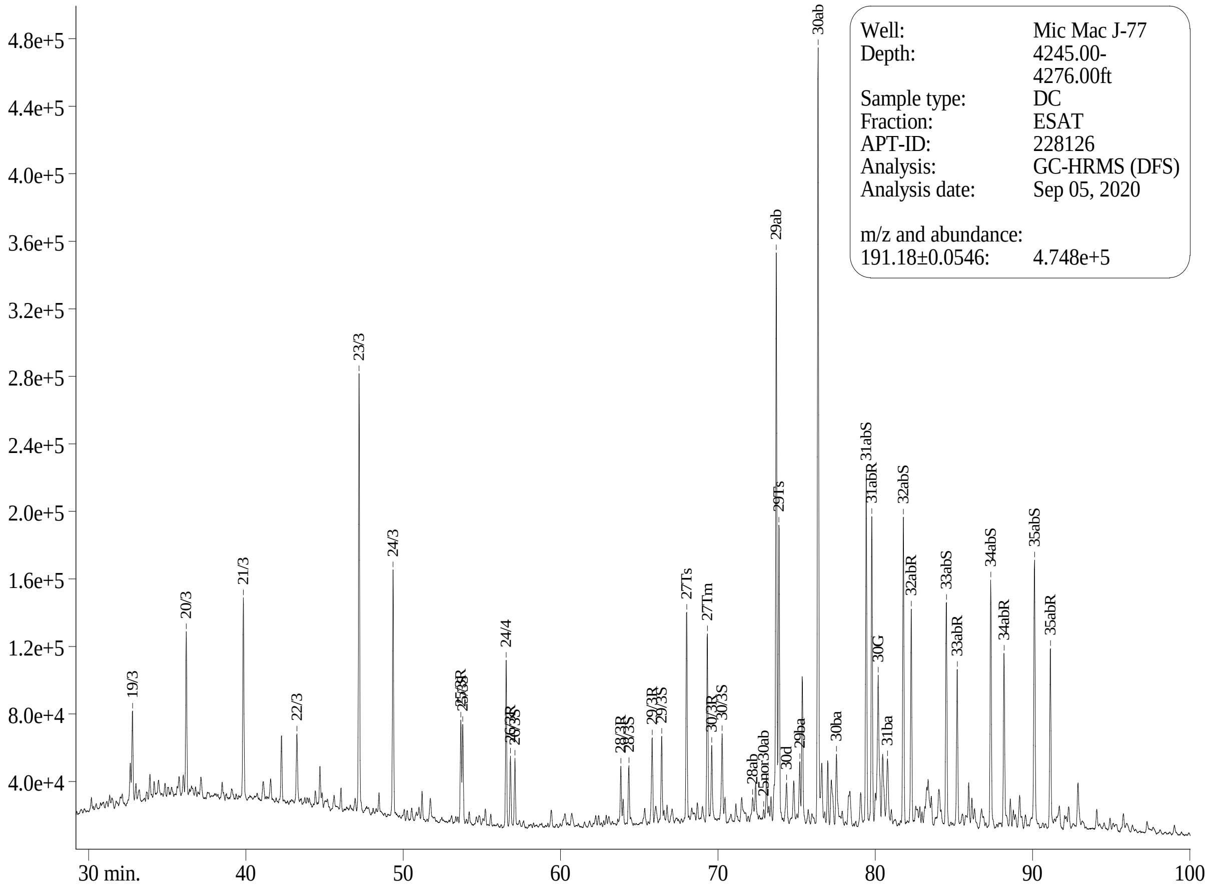
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

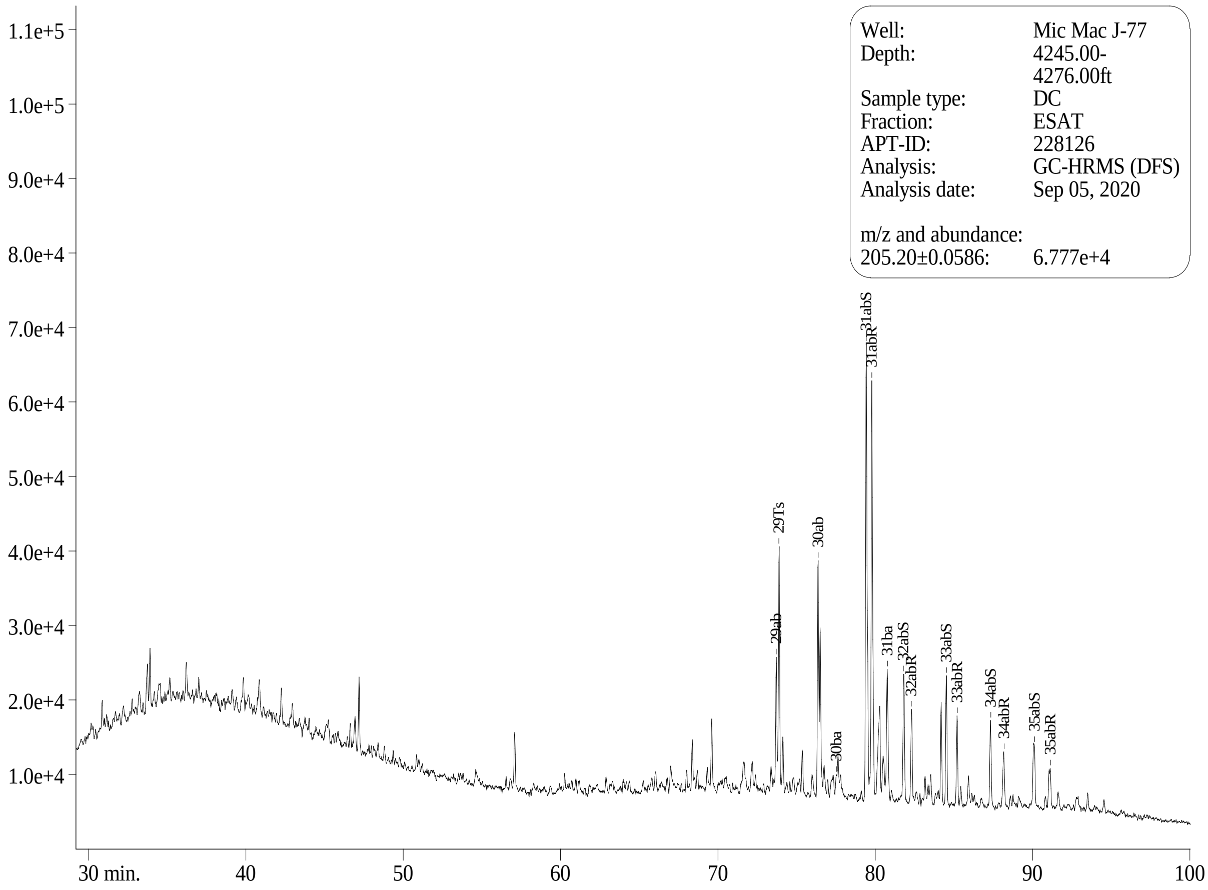
m/z and abundance:
231.21±0.0661: 3.849e+4



| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 3210.00-<br>3241.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228125 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 5.196e+4 |

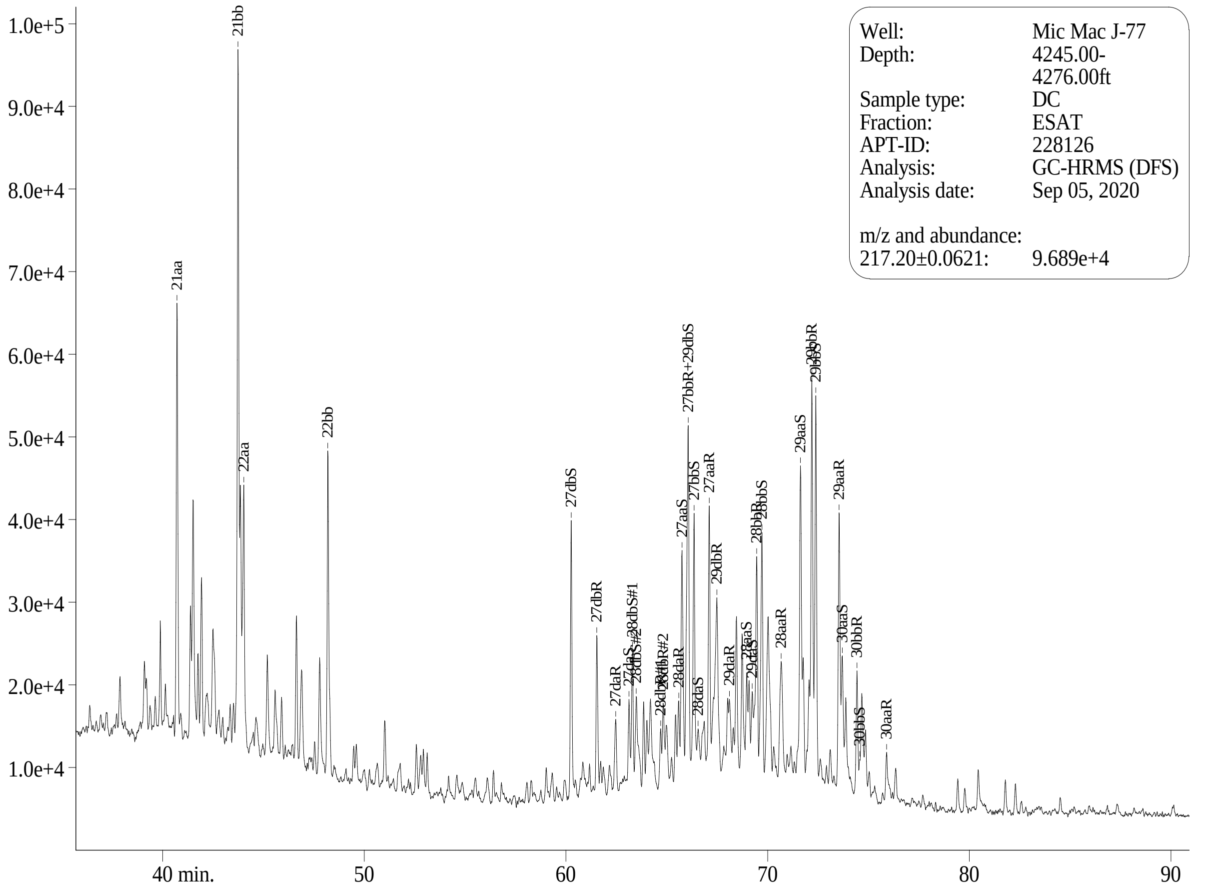

Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 1.464e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
24/4
25nor28ab
27Ts
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 4.748e+5
4.8e+5
4.4e+5
4.0e+5
3.6e+5
3.2e+5
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29ab
29Ts
30d
29ba
30ab
30ba
31abS
31abR
30G
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



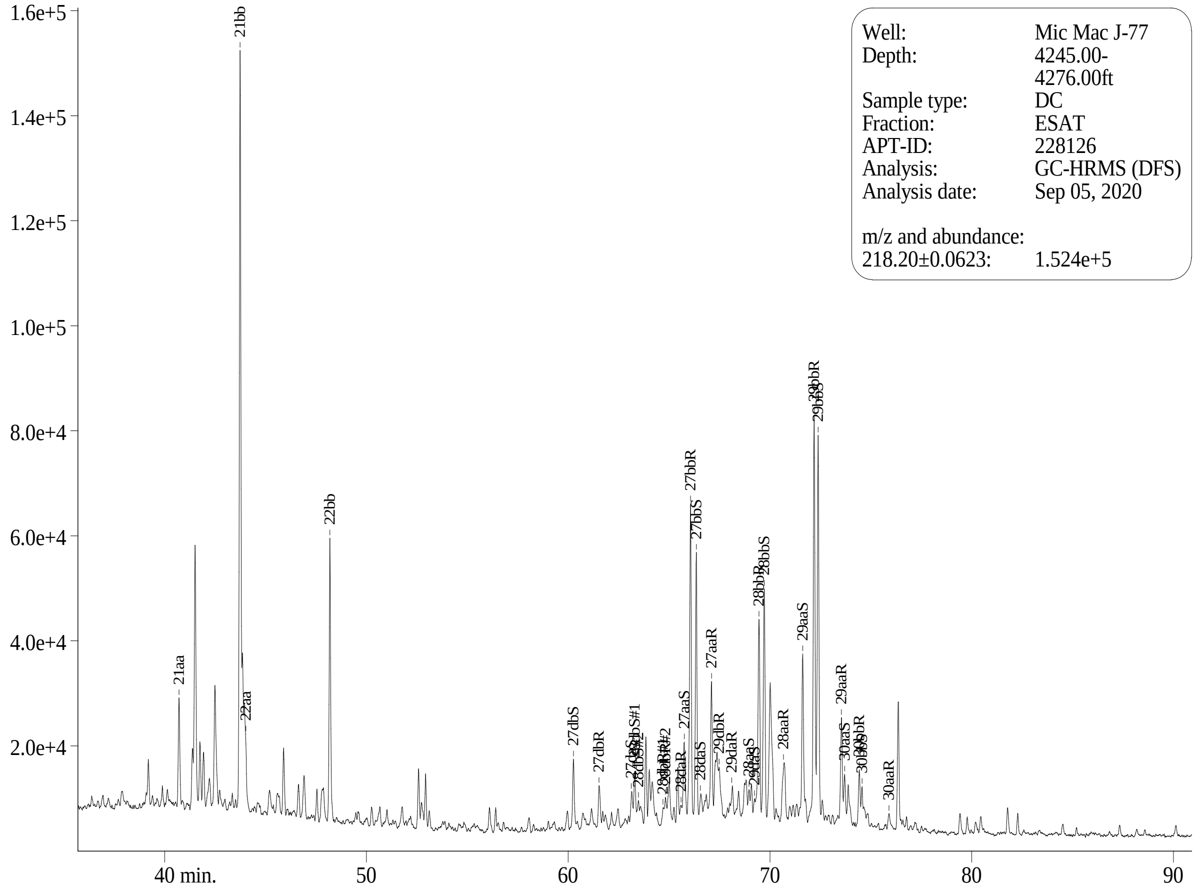
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
205.20±0.0586: 6.777e+4



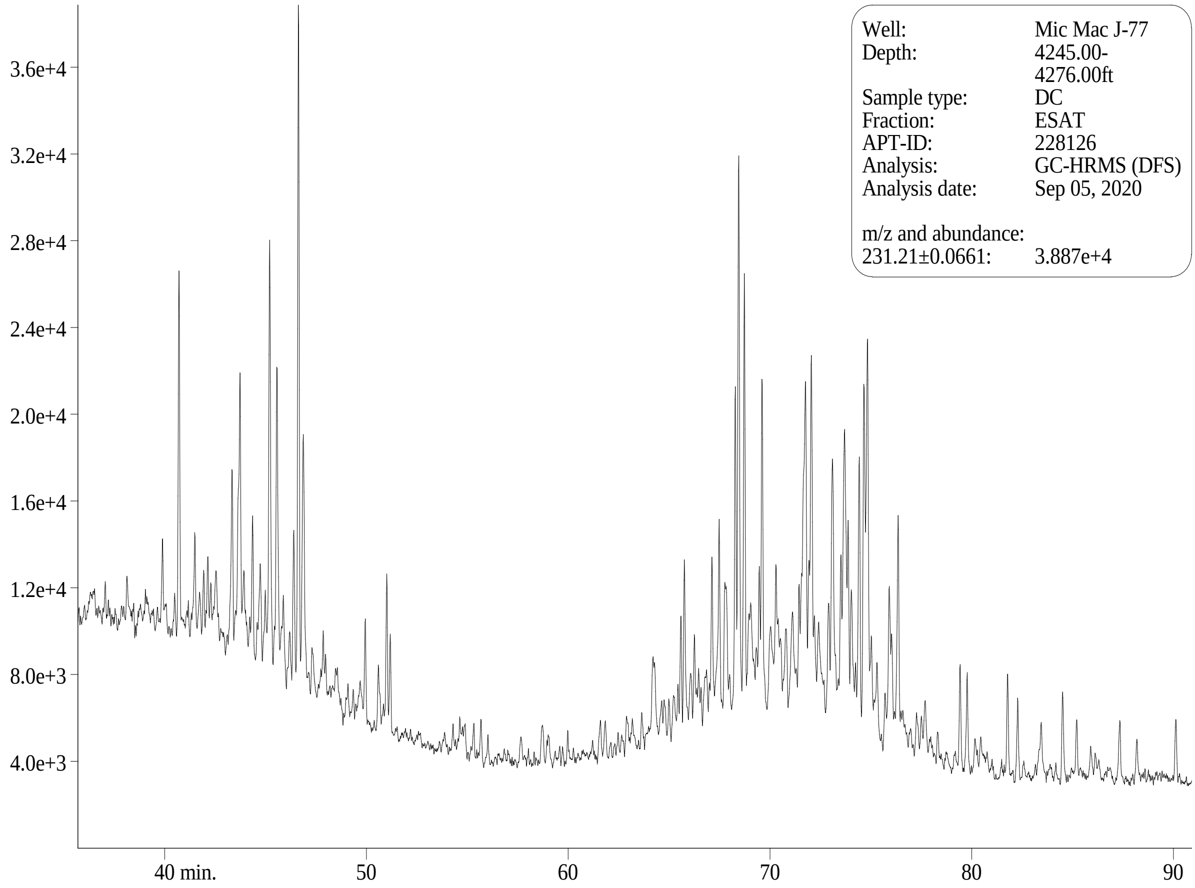
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
217.20±0.0621: 9.689e+4



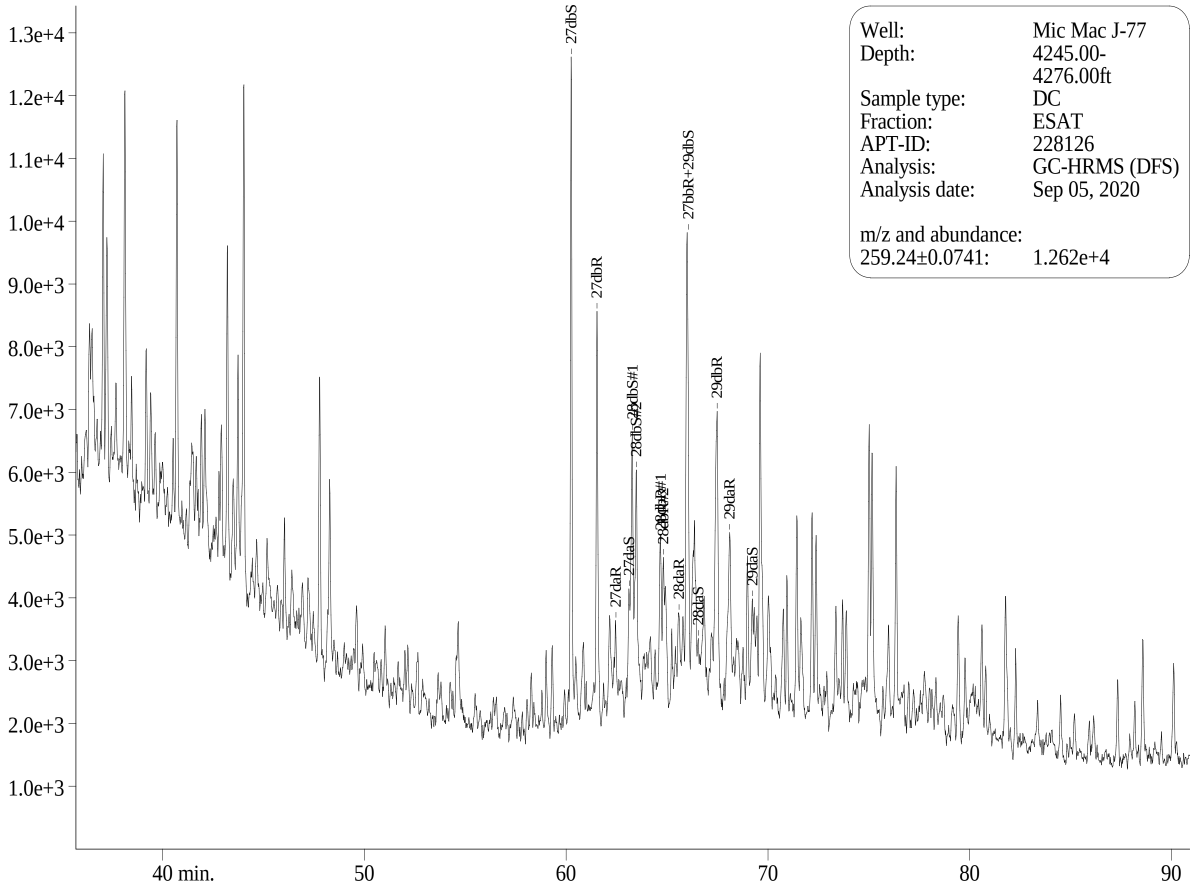
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
218.20±0.0623: 1.524e+5



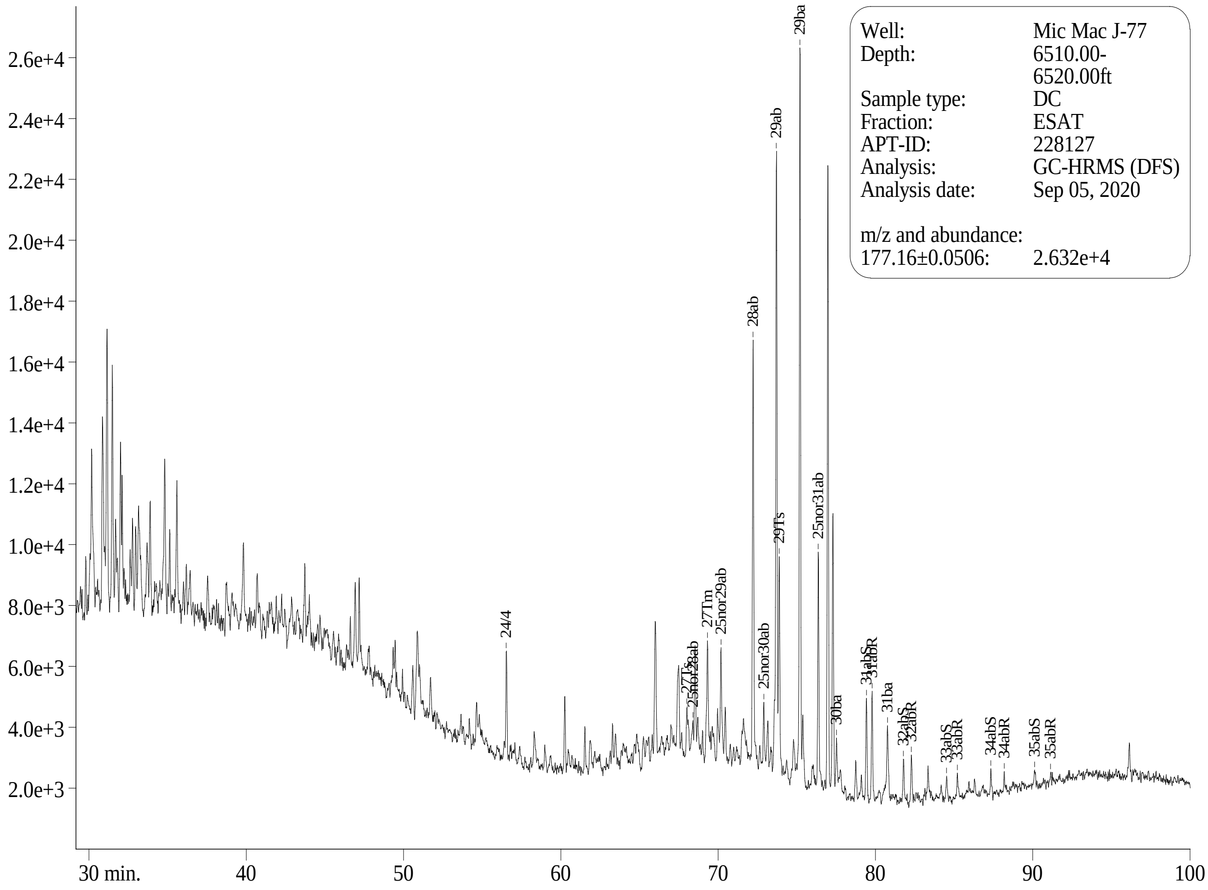
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
231.21±0.0661: 3.887e+4



Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
259.24±0.0741: 1.262e+4


Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 2.632e+4
2.6e+4
2.4e+4
2.2e+4
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
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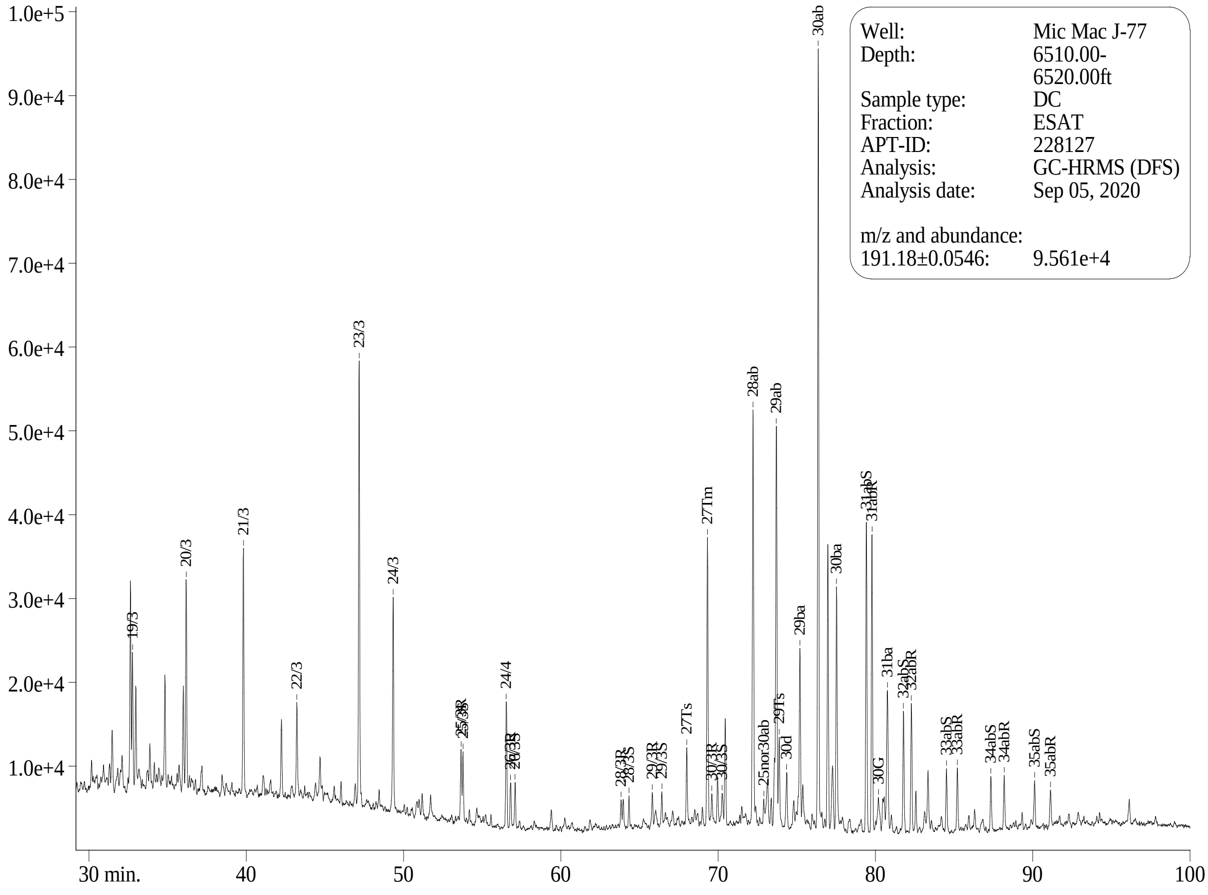
34abS
34abR
35abS
35abR


Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 9.561e+4
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29ab
29Ts
30d
29ba
30ab
30ba
30G
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31abR
31ba
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32abR
33abS
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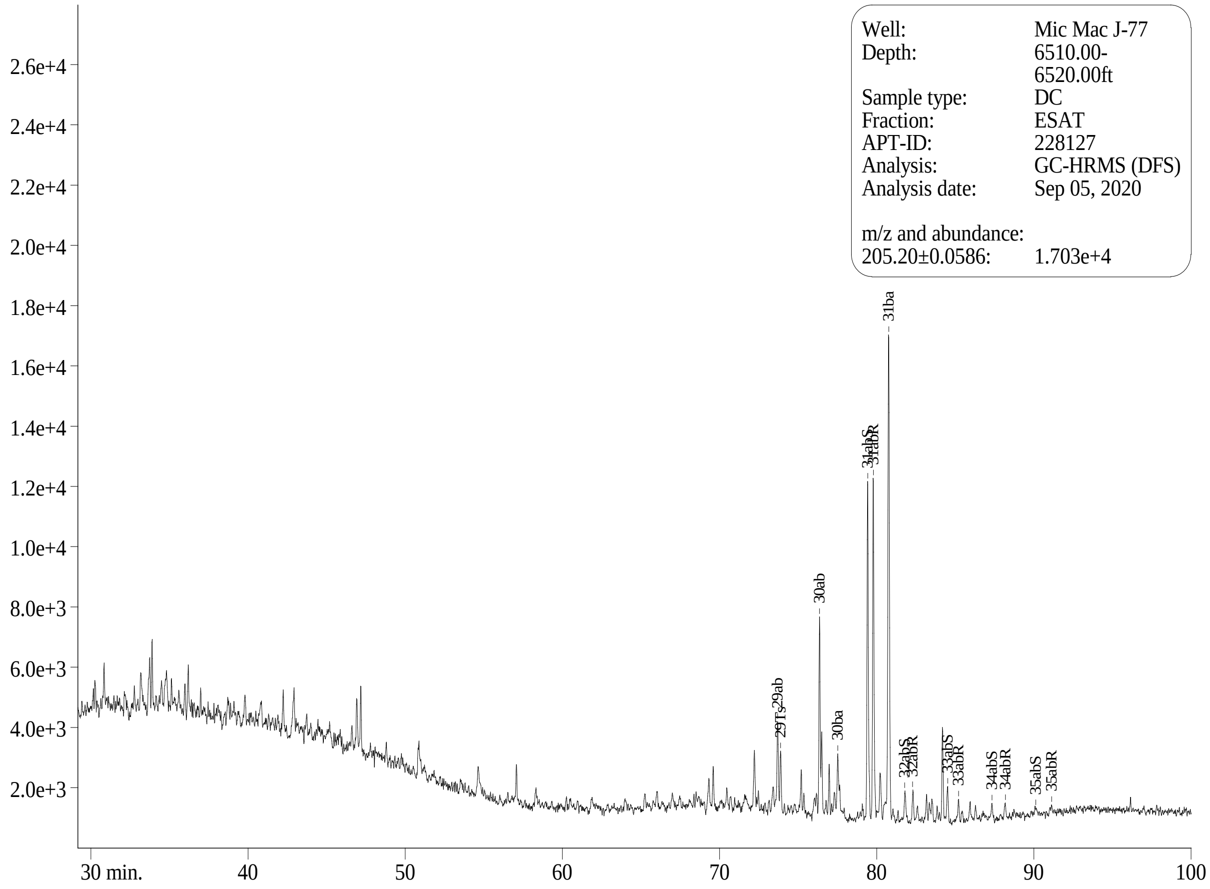
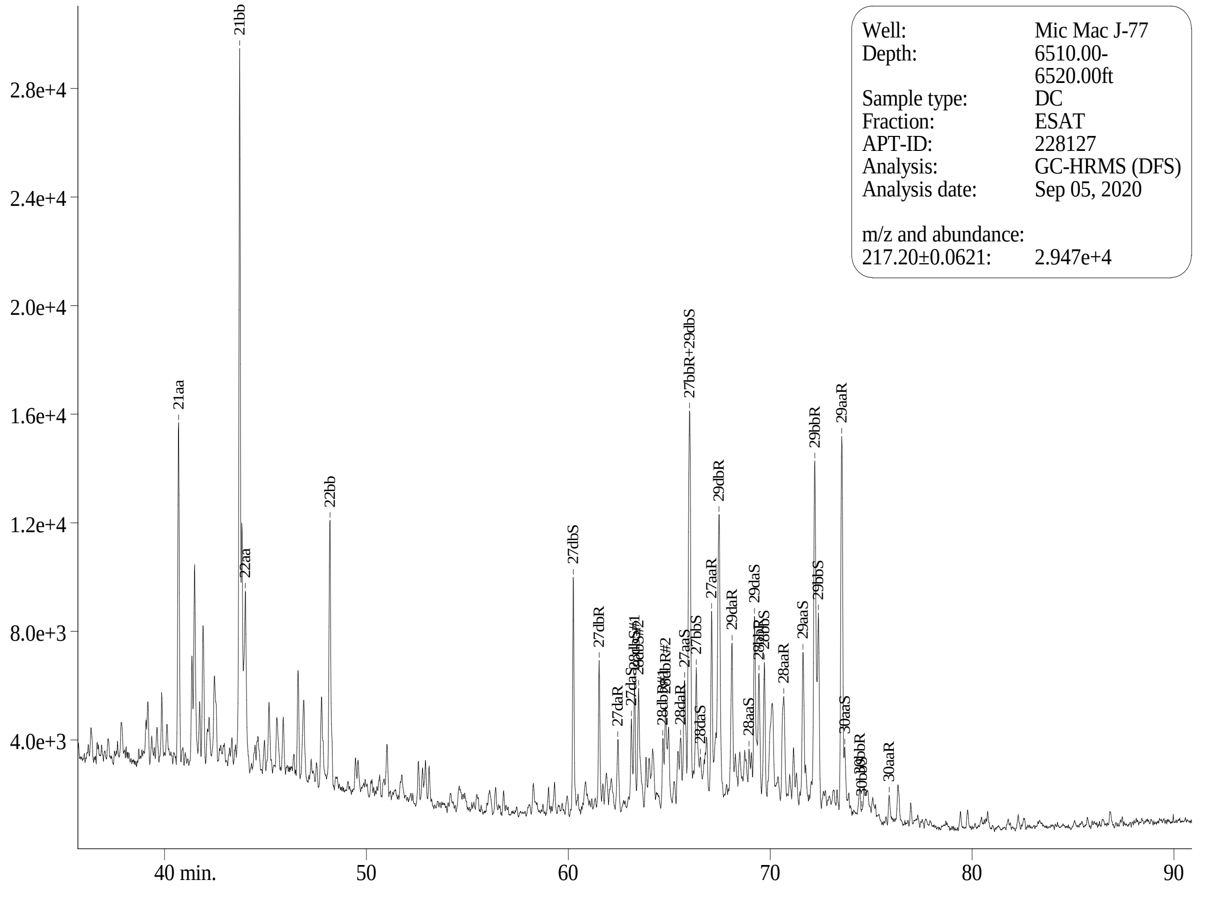
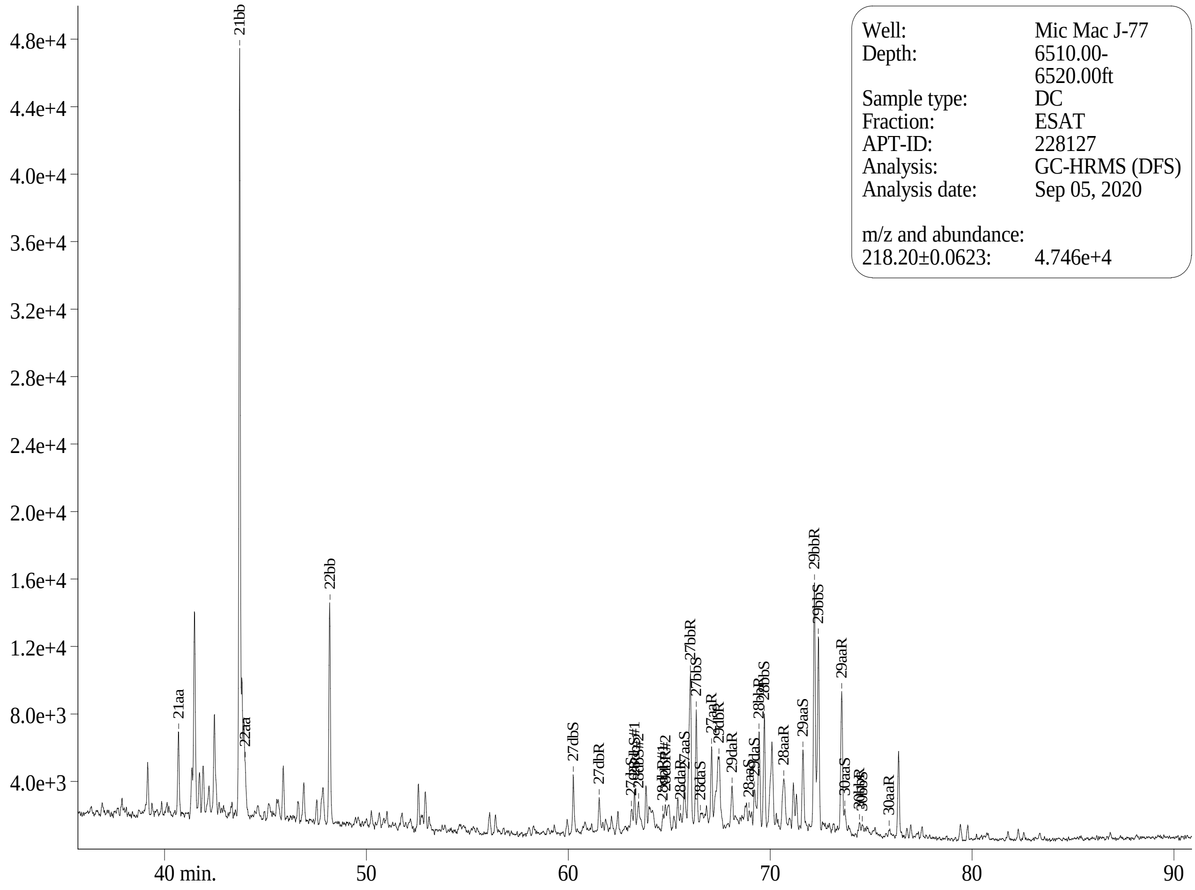
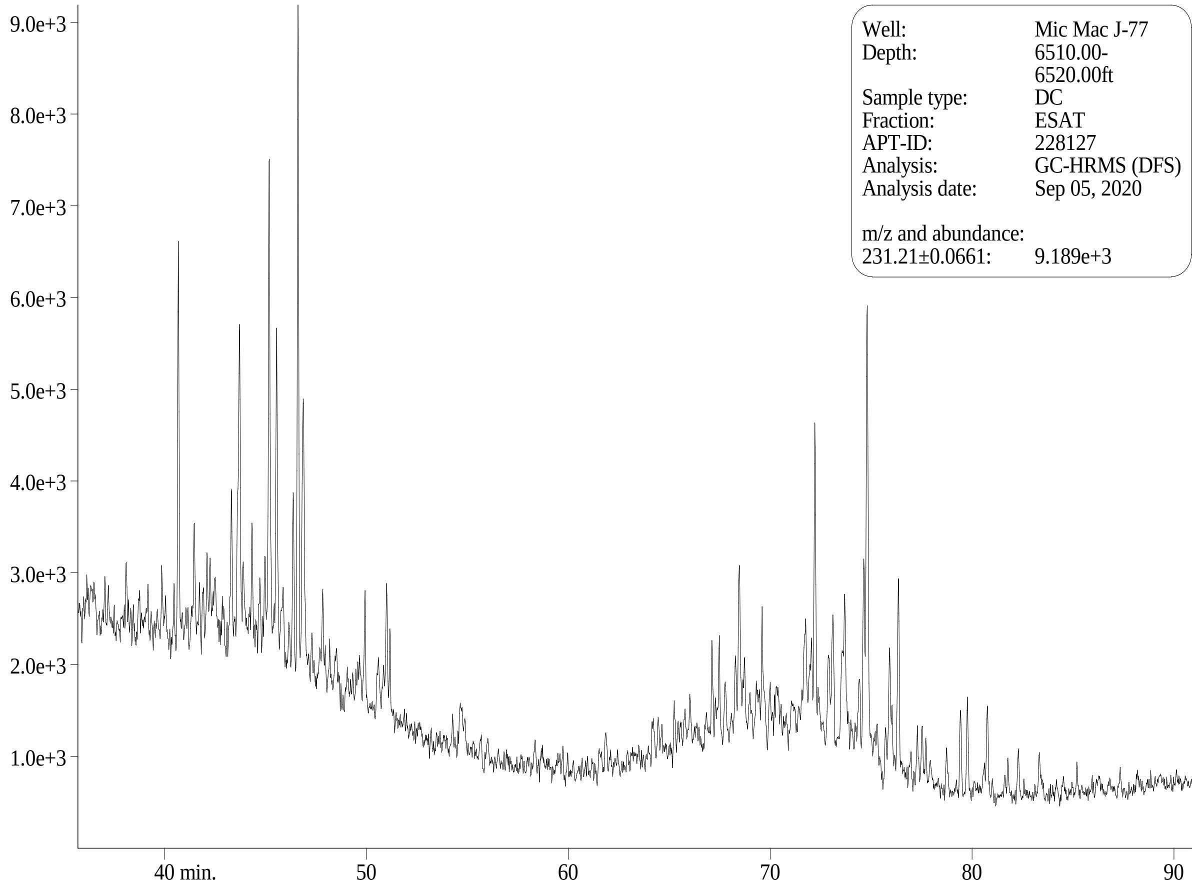
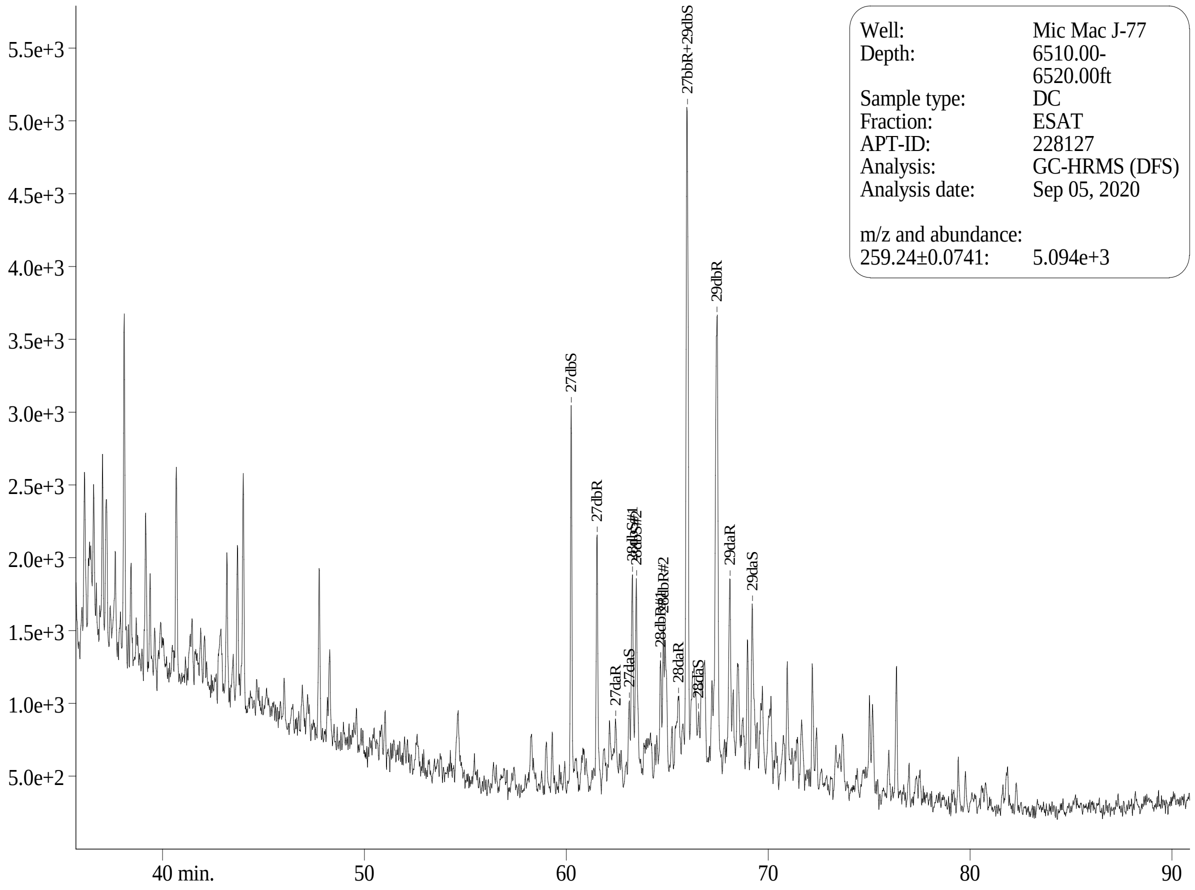
34abS
34abR
35abS
35abR


Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
205.20±0.0586: 1.703e+4
2.6e+4
2.4e+4
2.2e+4
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
30 min.
40
50
60
70
80
90
100
29Ts
29ab
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR

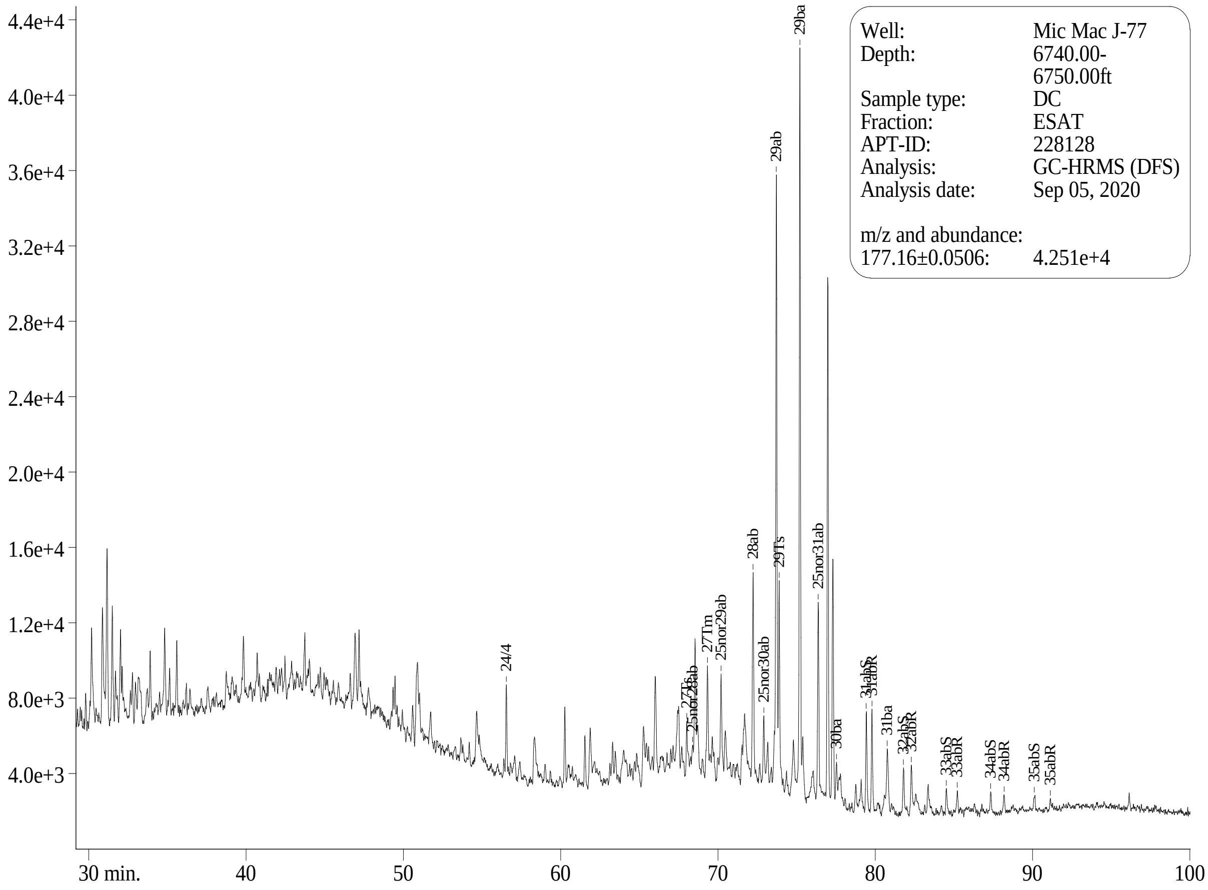

Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
217.20±0.0621: 2.947e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
27bbS
27bbR+29dbS
28daS
27aaR
29dbR
29daR
28aaS
29daS
29bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbS
30bbR
30aaR


4.8e+4
4.4e+4
4.0e+4
3.6e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27bbR
27bbS
27aaS
27aaR
28daS
28daR
29daR
29daS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30aaR
Well:
Mic Mac J-77
Depth:
6510.00-6520.00ft
Sample type:
DC
Fraction:
ESAT
APT-ID:
228127
Analysis:
GC-HRMS (DFS)
Analysis date:
Sep 05, 2020
m/z and abundance:
218.20±0.0623:
4.746e+4


9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
40 min.
50
60
70
80
90
Well:
Mic Mac J-77
Depth:
6510.00-6520.00ft
Sample type:
DC
Fraction:
ESAT
APT-ID:
228127
Analysis:
GC-HRMS (DFS)
Analysis date:
Sep 05, 2020
m/z and abundance:
231.21±0.0661:
9.189e+3



| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 6510.00-<br>6520.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228127 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 5.094e+3 |


Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 4.251e+4
4.4e+4
4.0e+4
3.6e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
25nor30ab
28ab
29ab
29Ts
29ba
25nor31ab
30ba
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31abR
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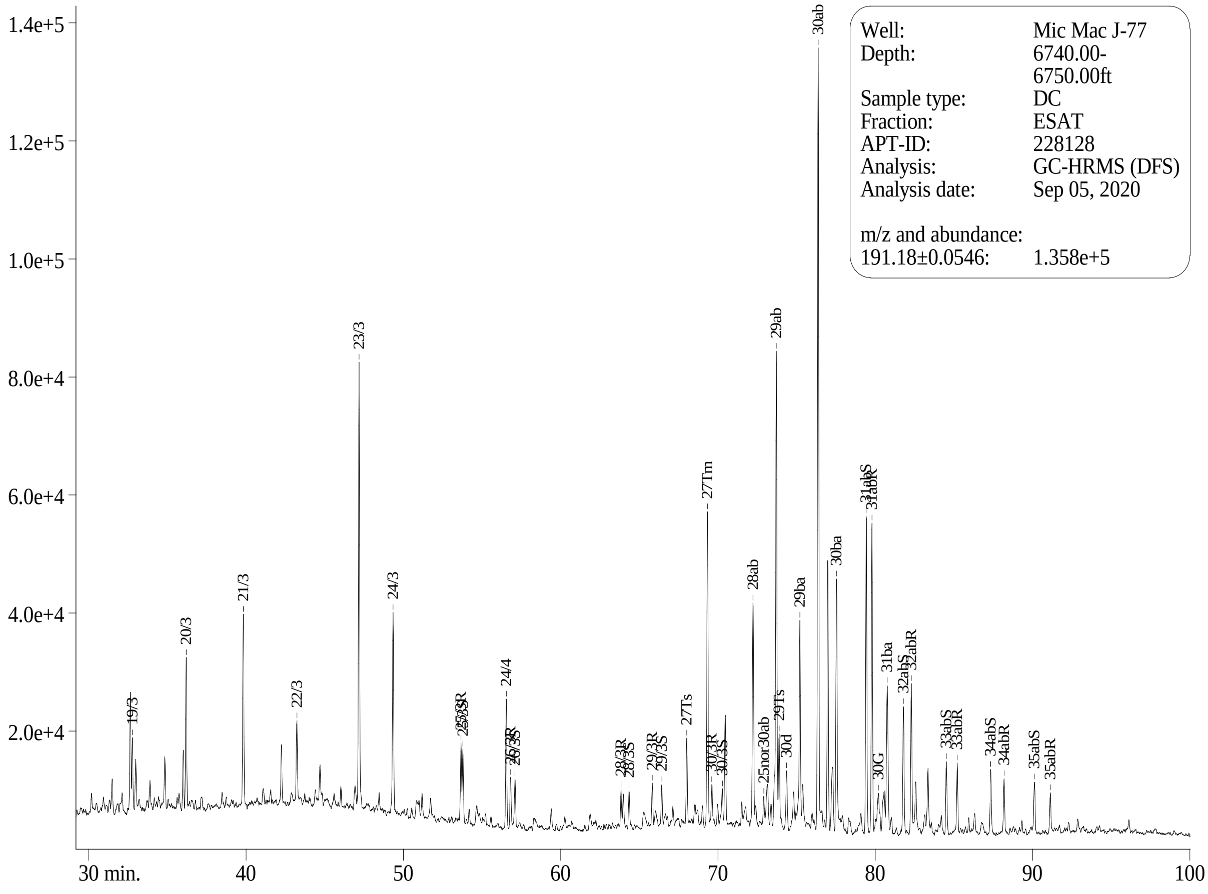
34abS
34abR
35abS
35abR


Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 1.358e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3S
25/3R
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29Ts
30d
29ab
29ba
30ab
30ba
30G
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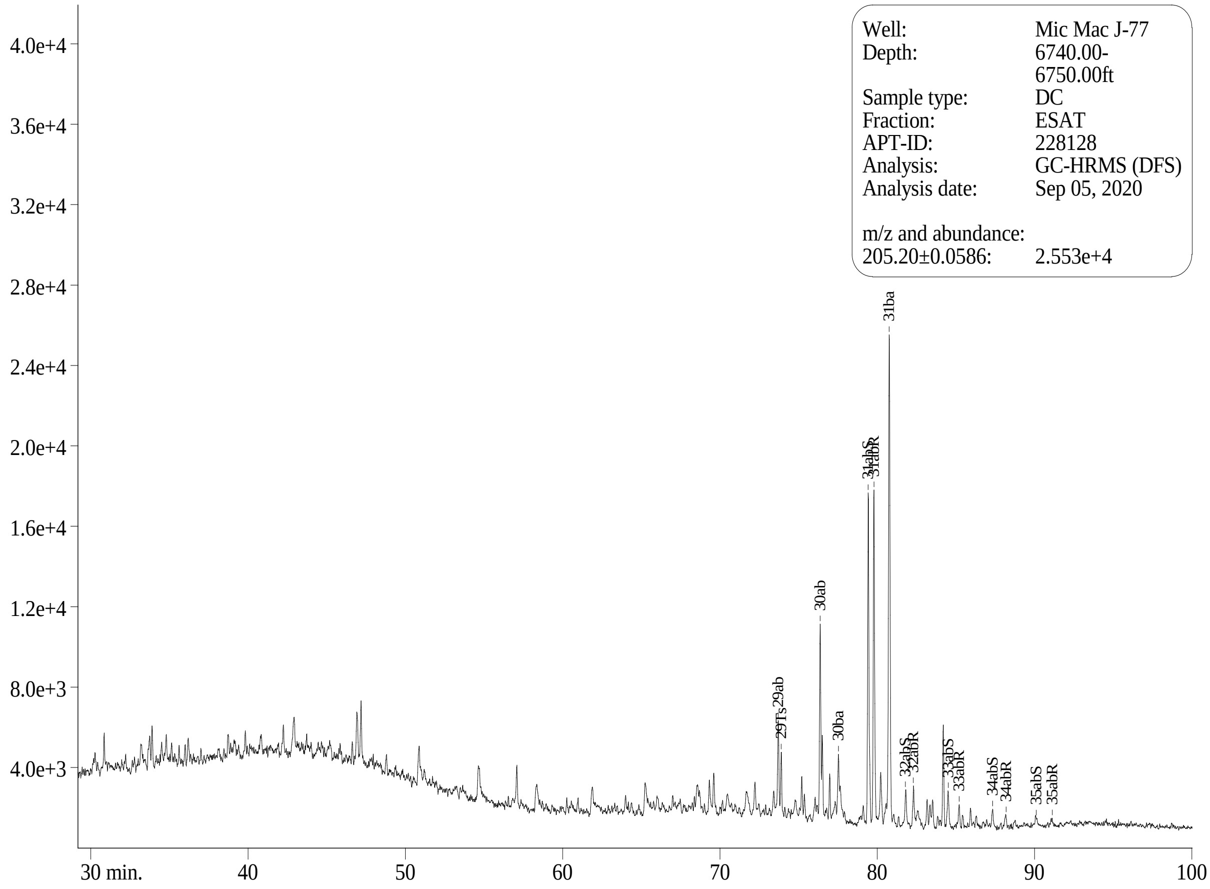
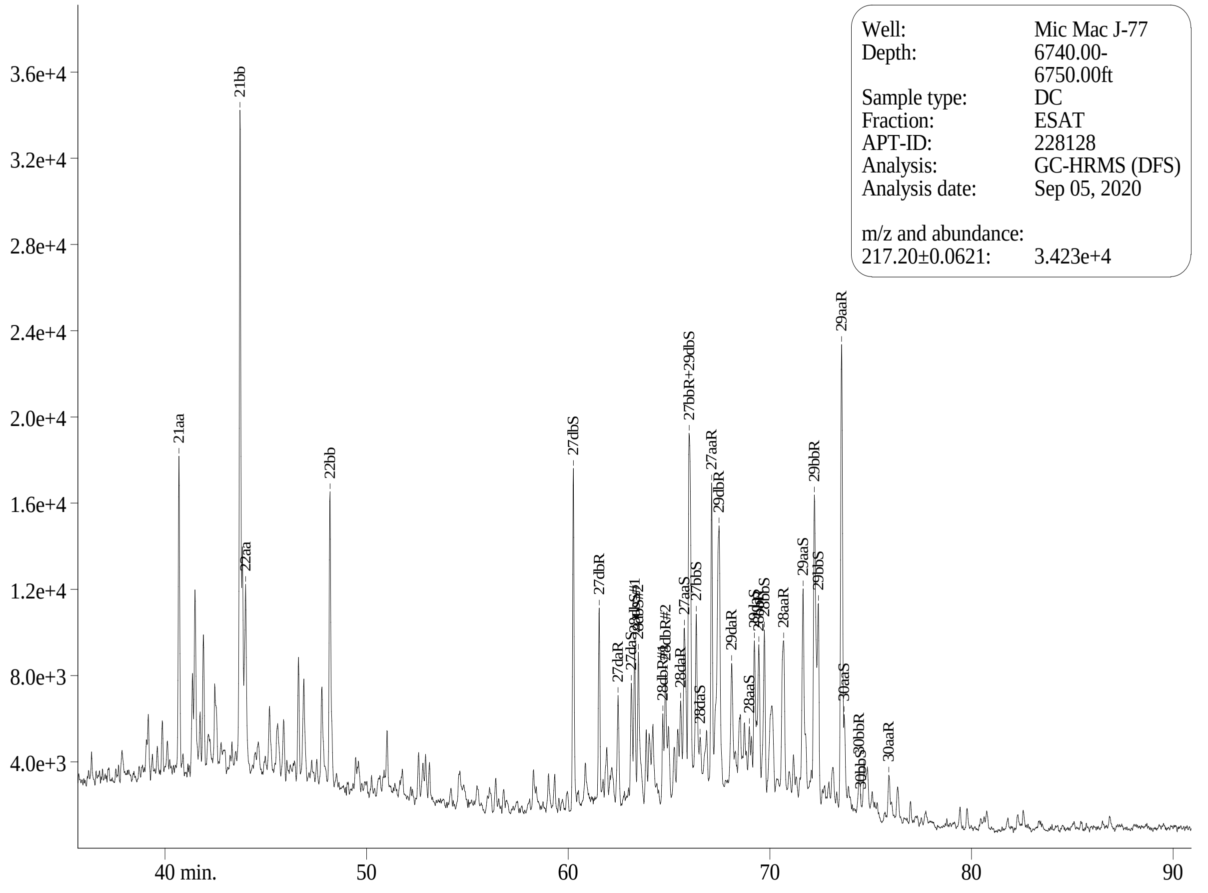
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



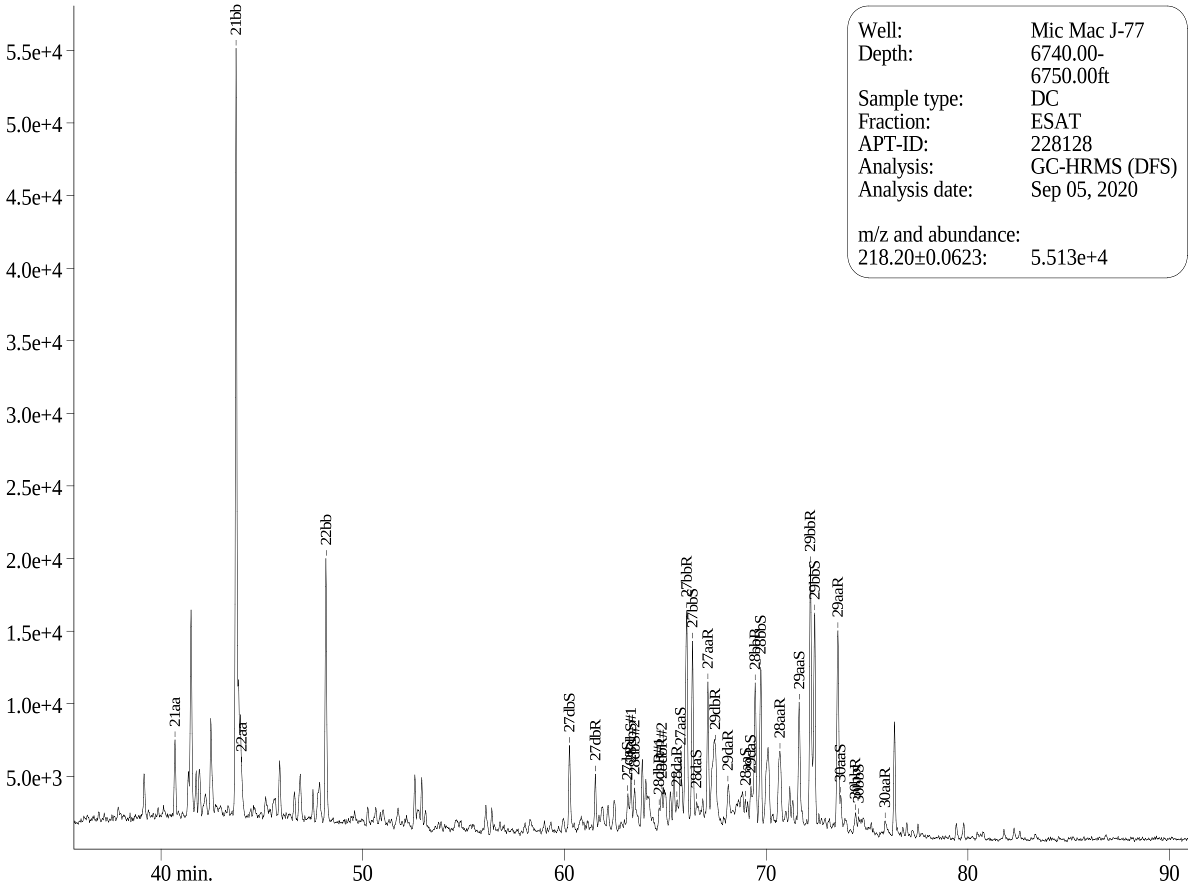
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
205.20±0.0586: 2.553e+4

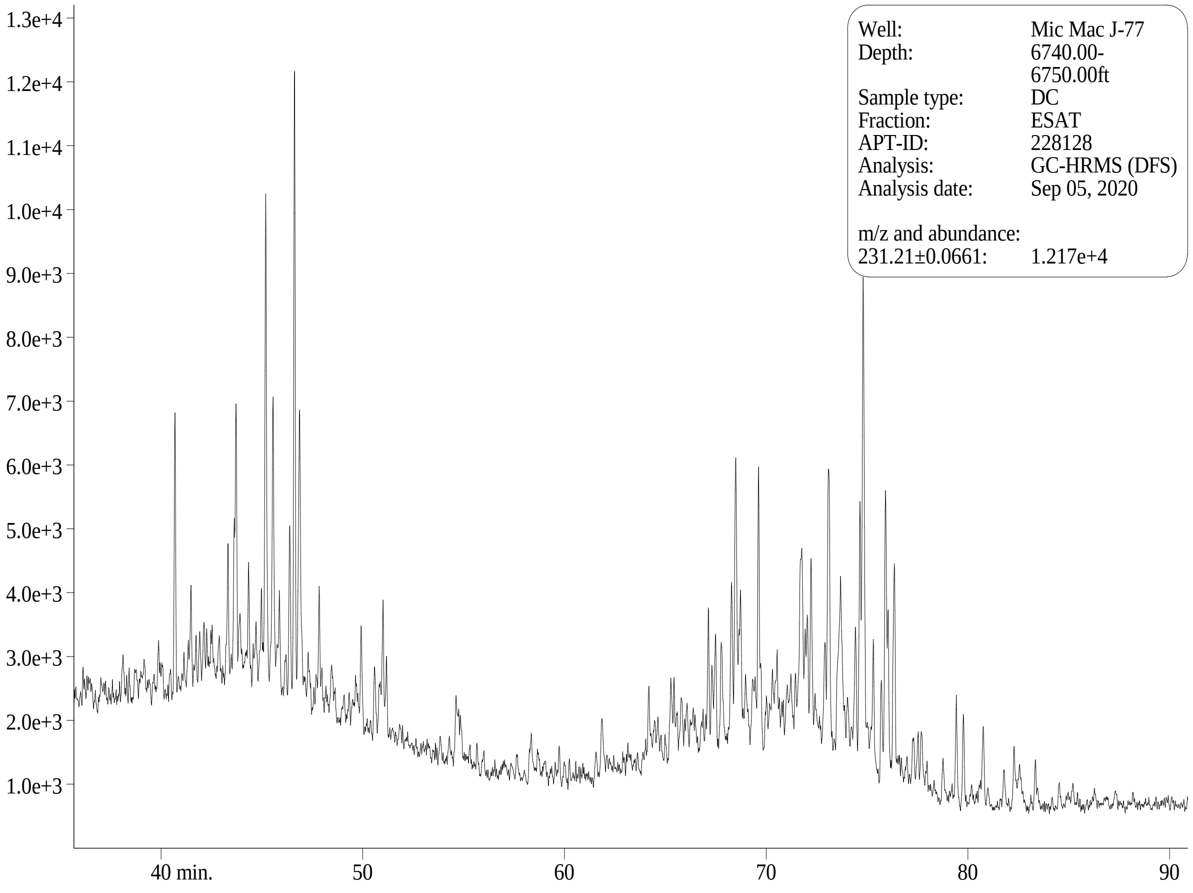


Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

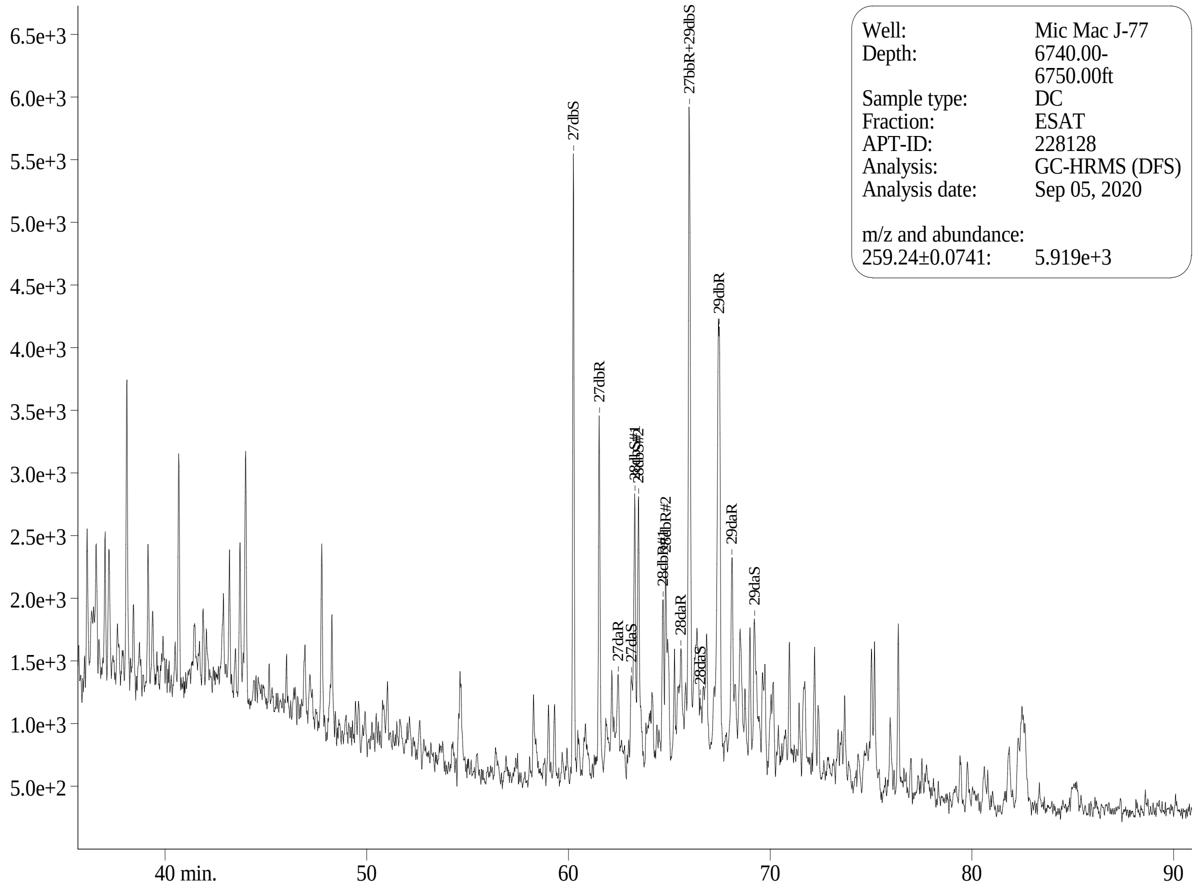
m/z and abundance:
217.20±0.0621: 3.423e+4



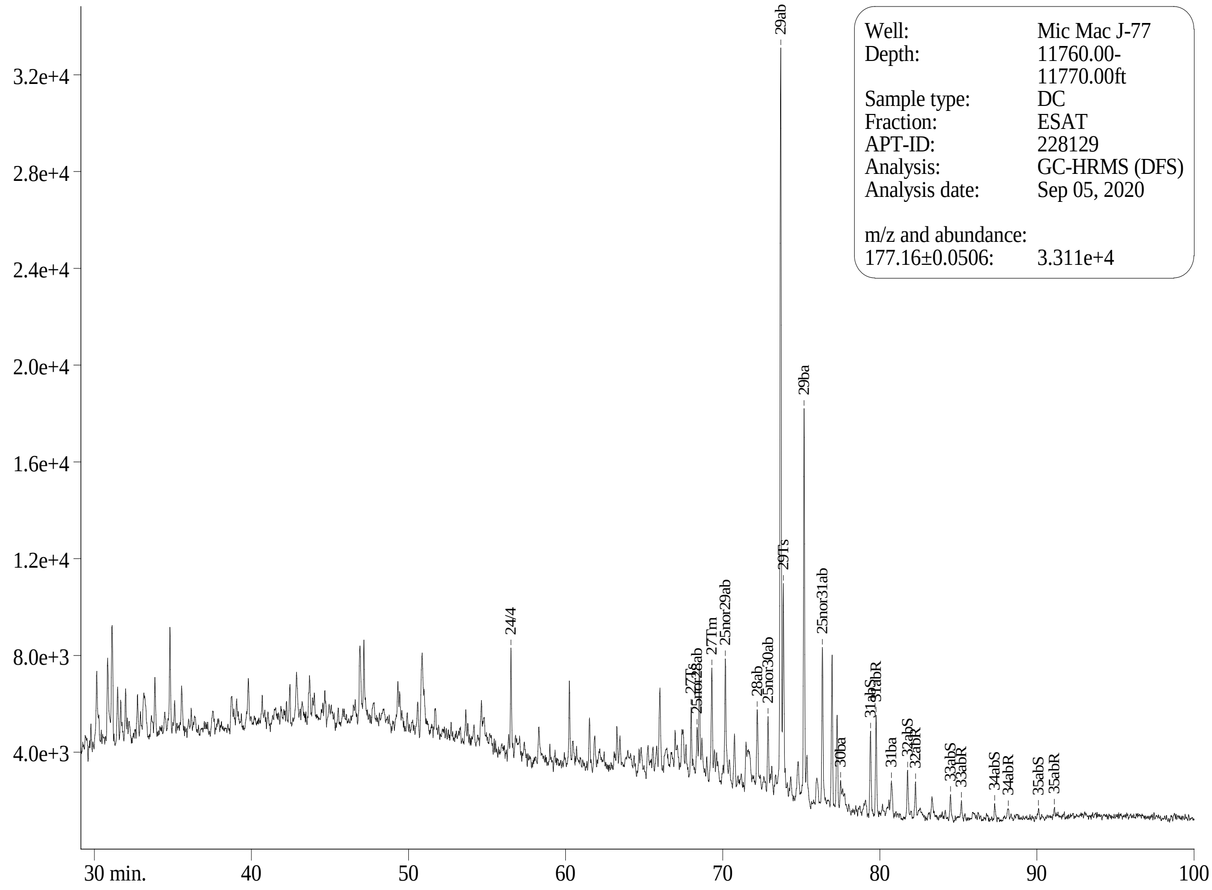
| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 6740.00-<br>6750.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228128 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 218.20±0.0623: | 5.513e+4 |

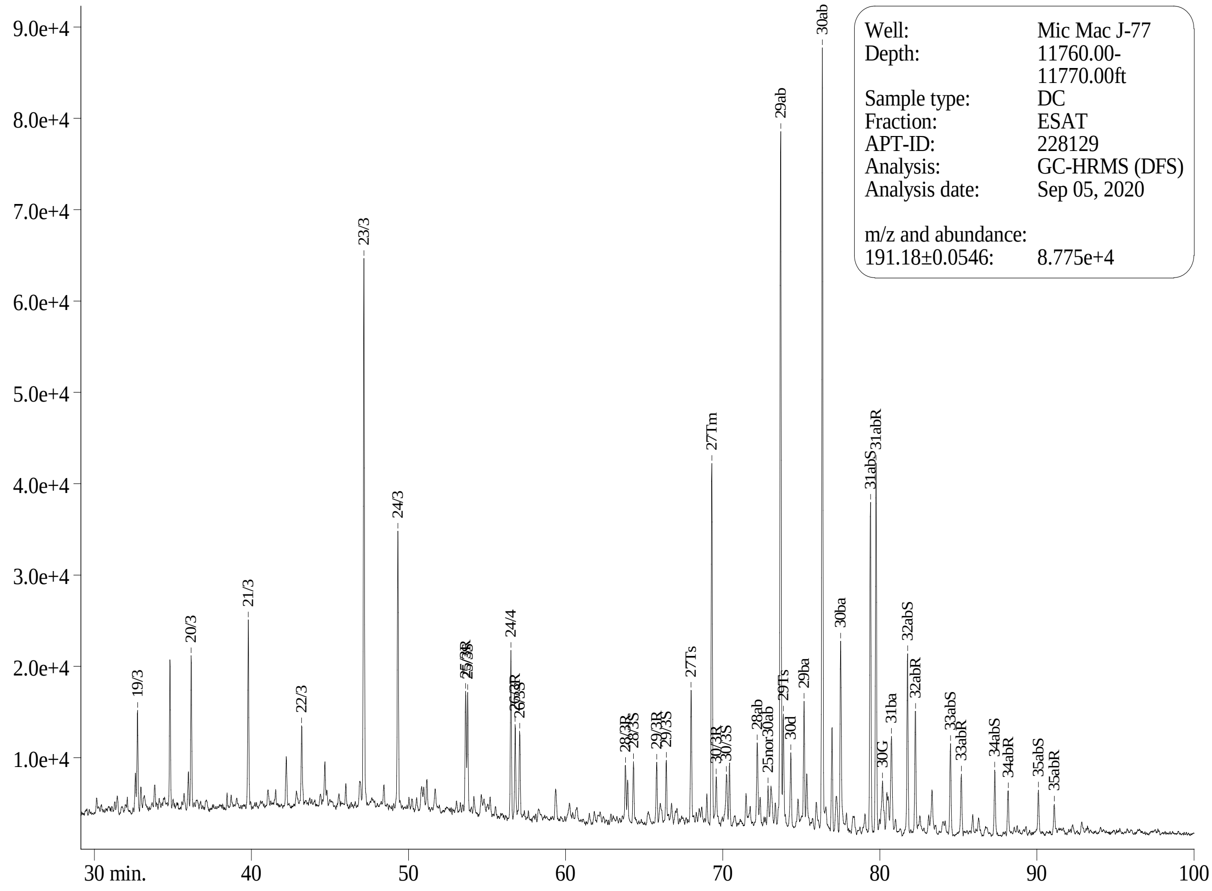


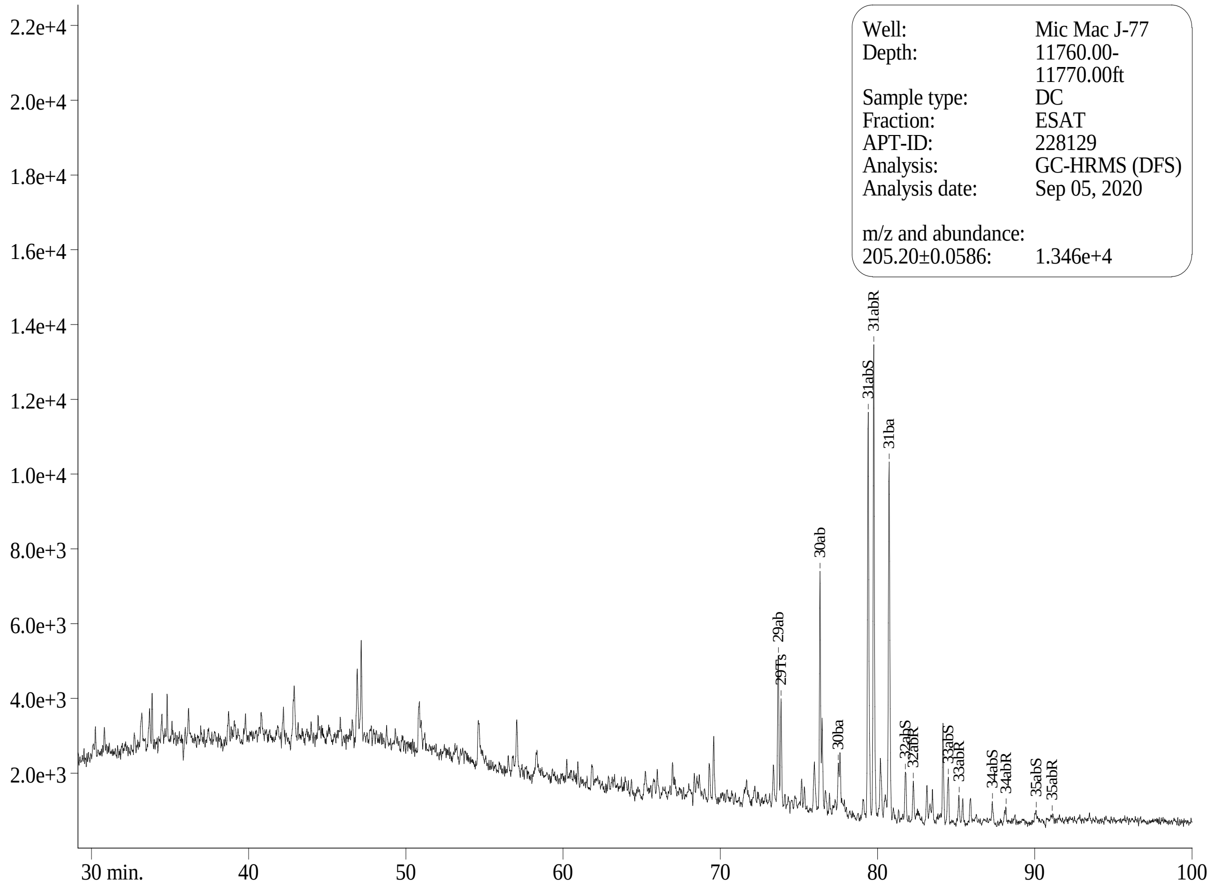
| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 6740.00-<br>6750.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228128 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 231.21±0.0661: | 1.217e+4 |



| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 6740.00-<br>6750.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228128 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 5.919e+3 |

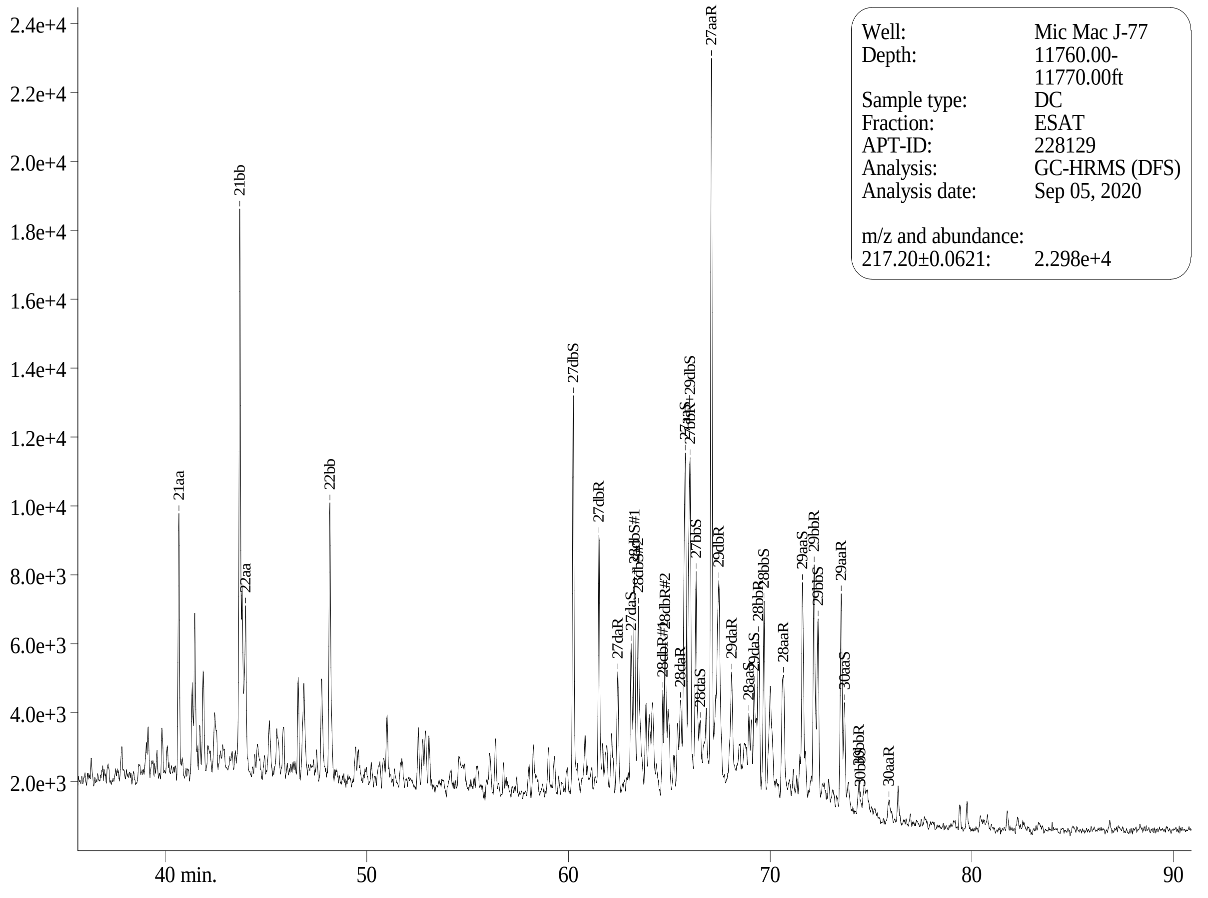

3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
29Ts
29ab
28ab
25nor30ab
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 3.311e+4


9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29Ts
30d
29ab
29ba
30ab
30ba
31abS
31abR
30G
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 8.775e+4



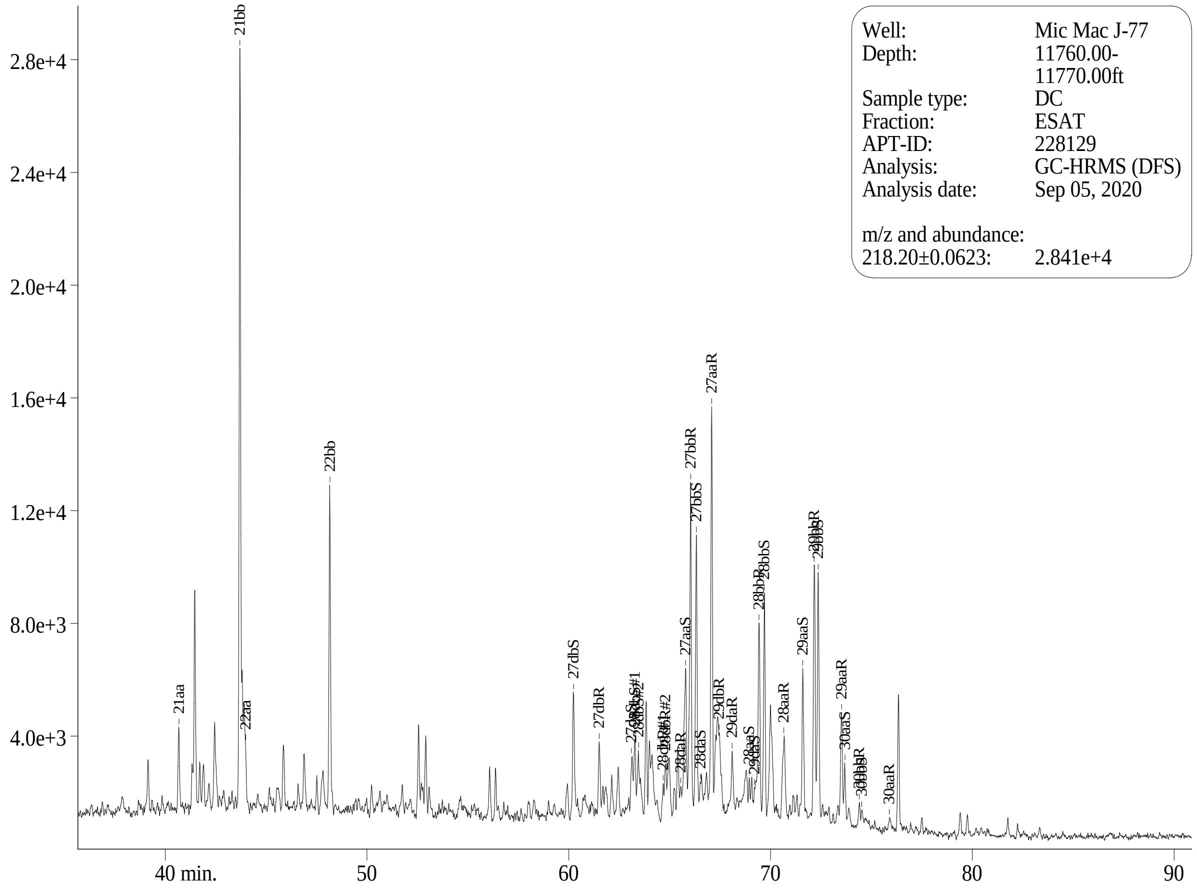
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
205.20±0.0586: 1.346e+4



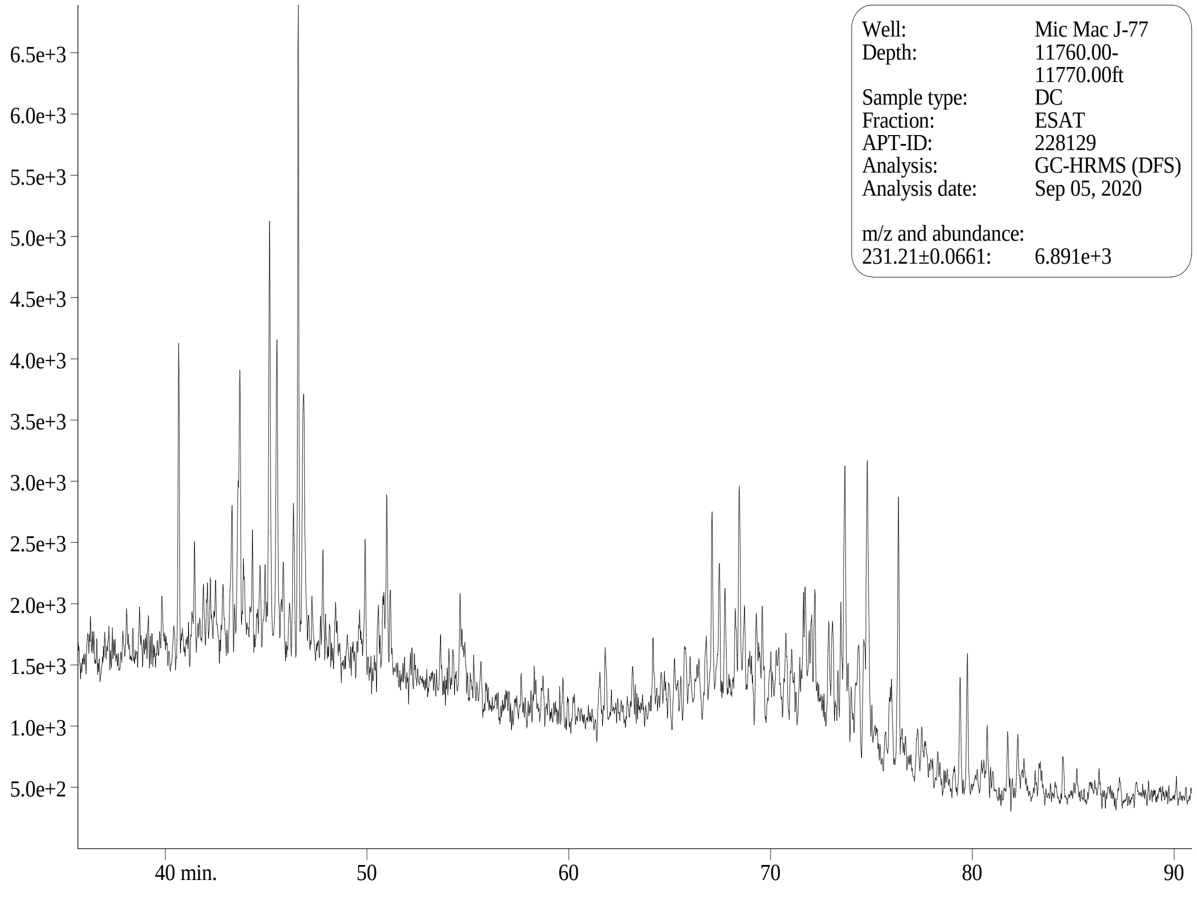
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
217.20±0.0621: 2.298e+4



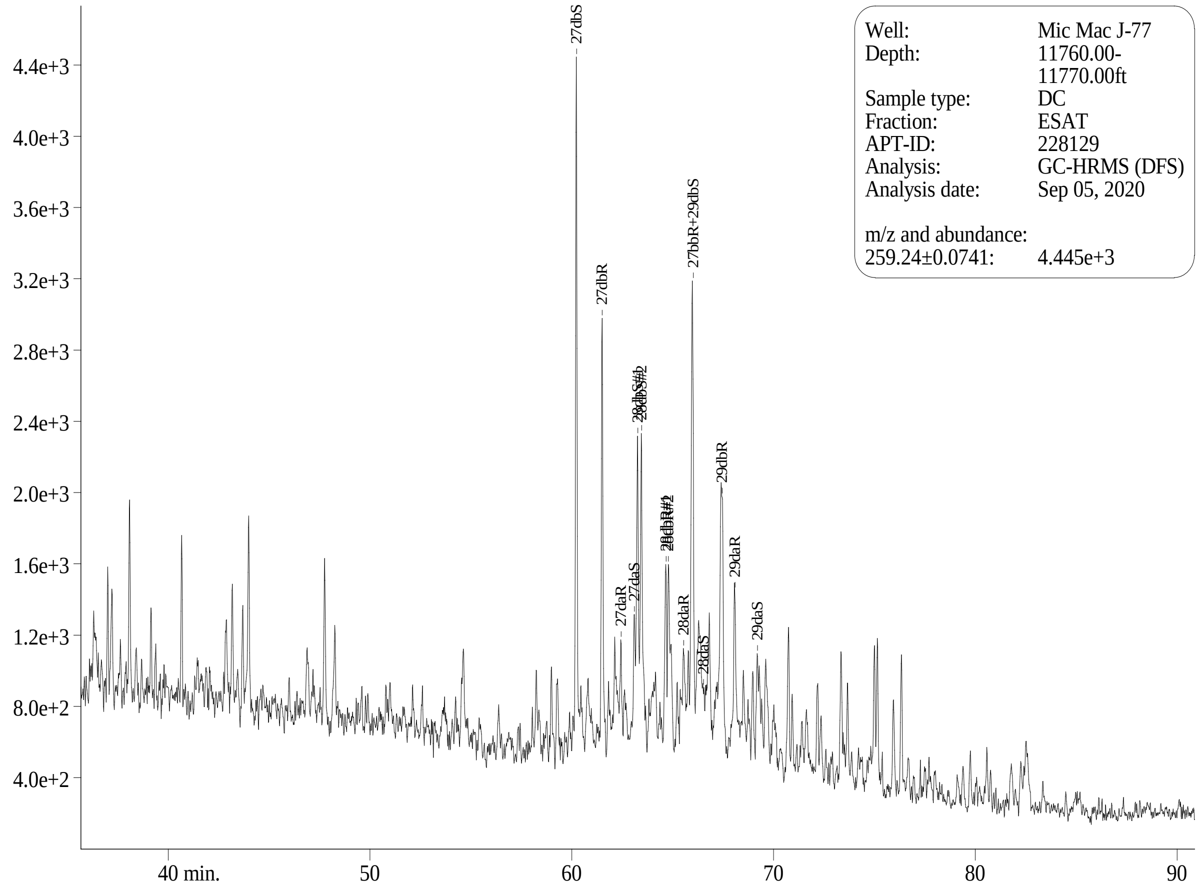
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
218.20±0.0623: 2.841e+4



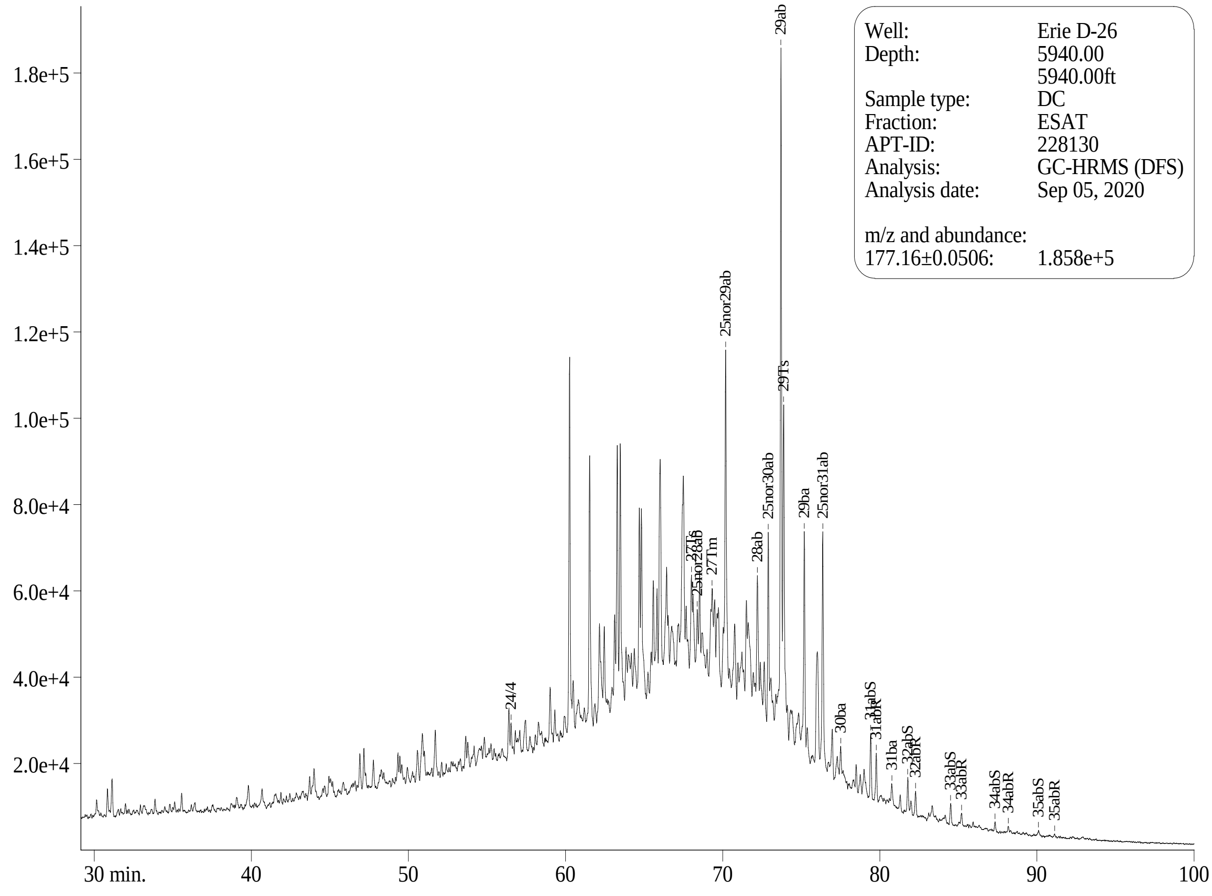
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
231.21±0.0661: 6.891e+3



Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
259.24±0.0741: 4.445e+3


Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 1.858e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
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31abR
31ba
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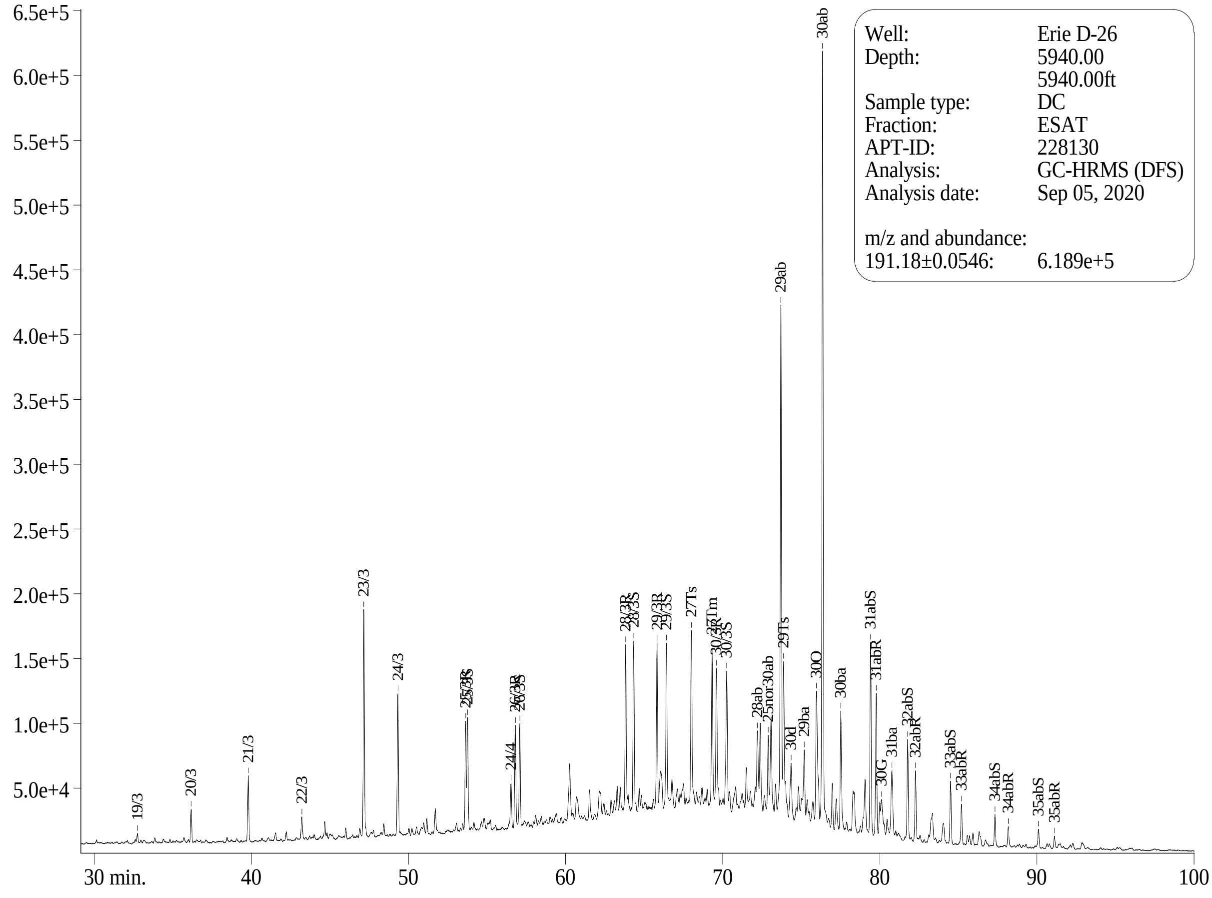
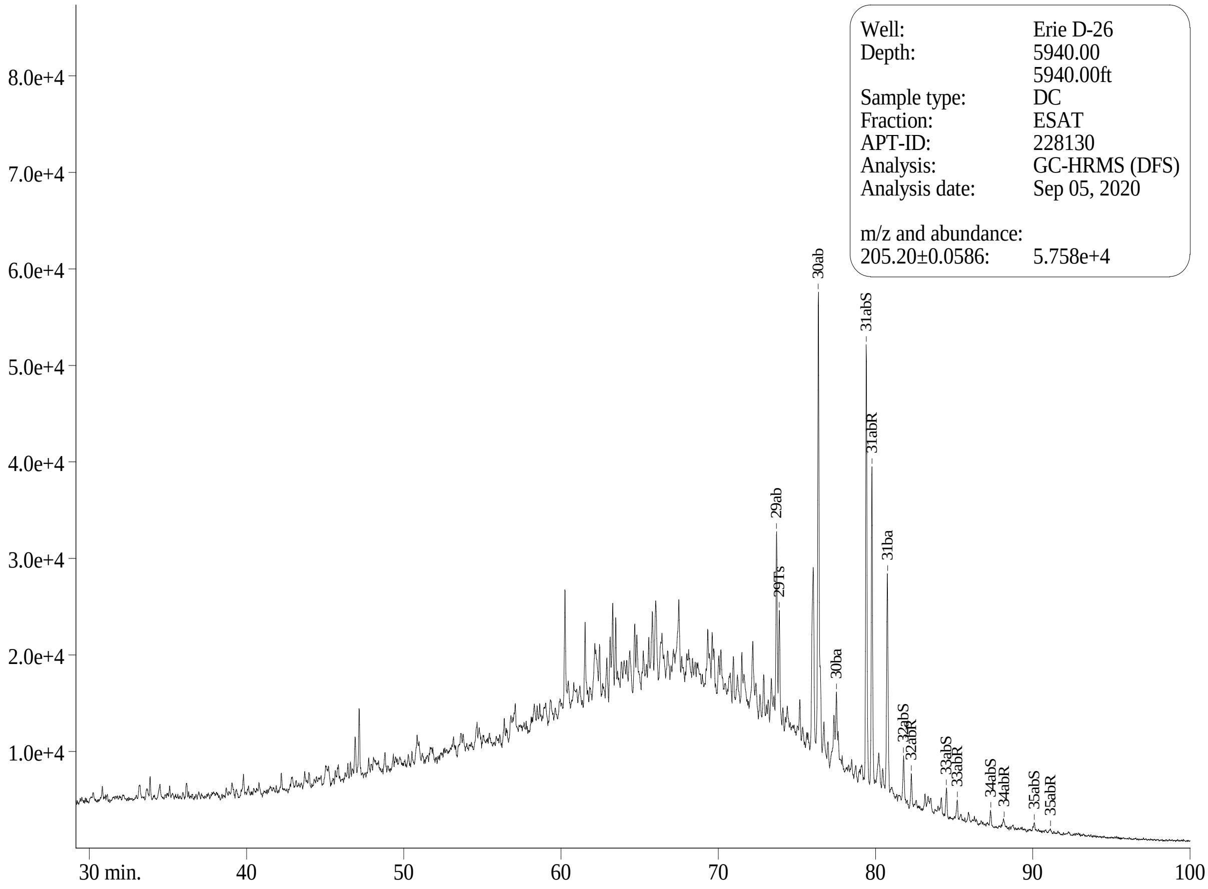
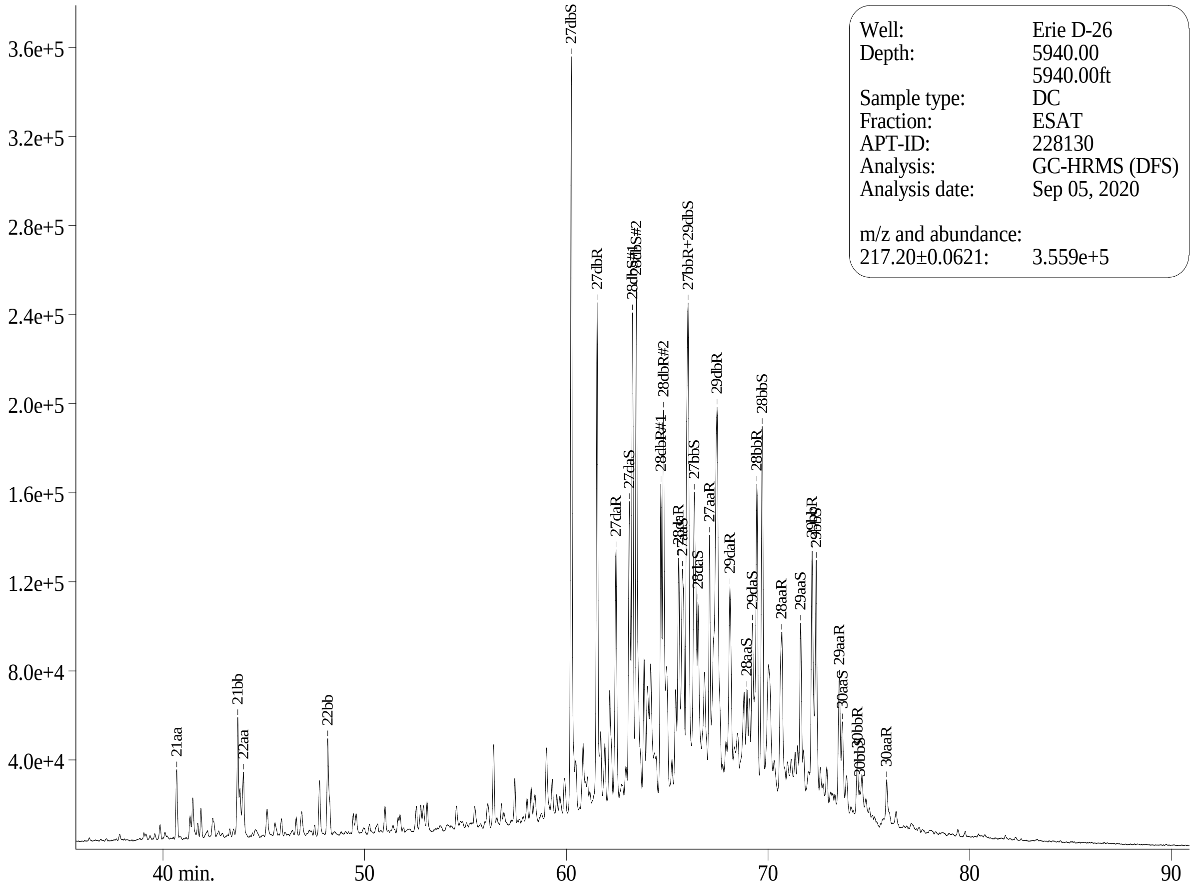
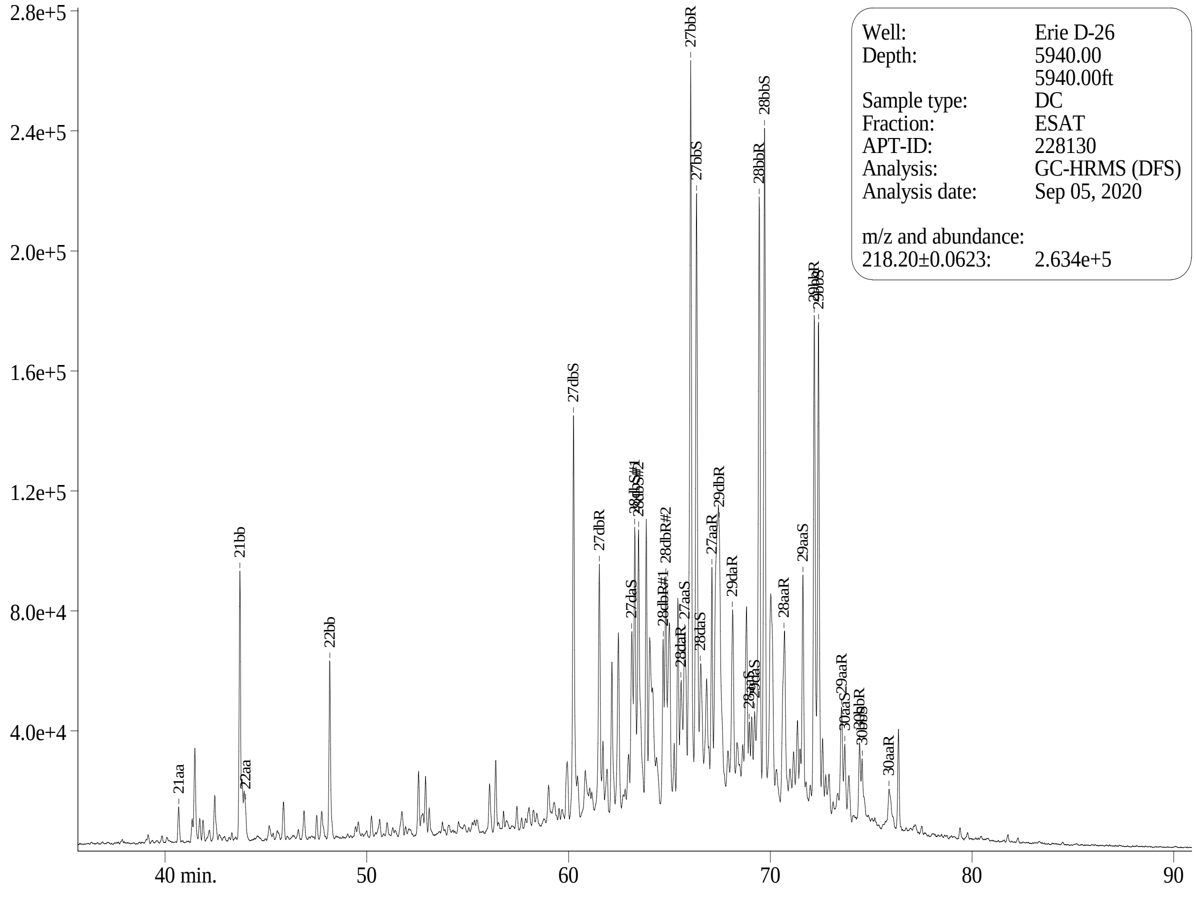
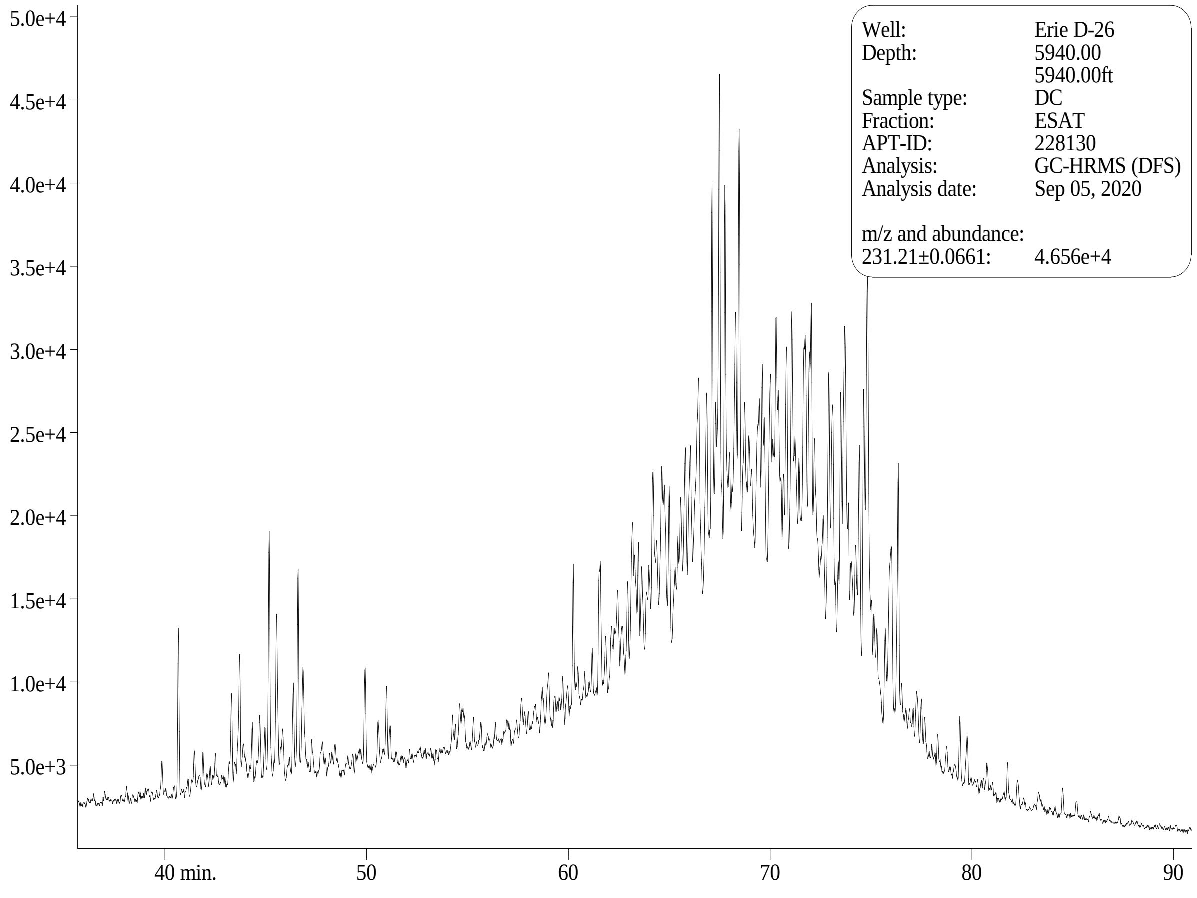
33abR
34abS
34abR
35abS
35abR

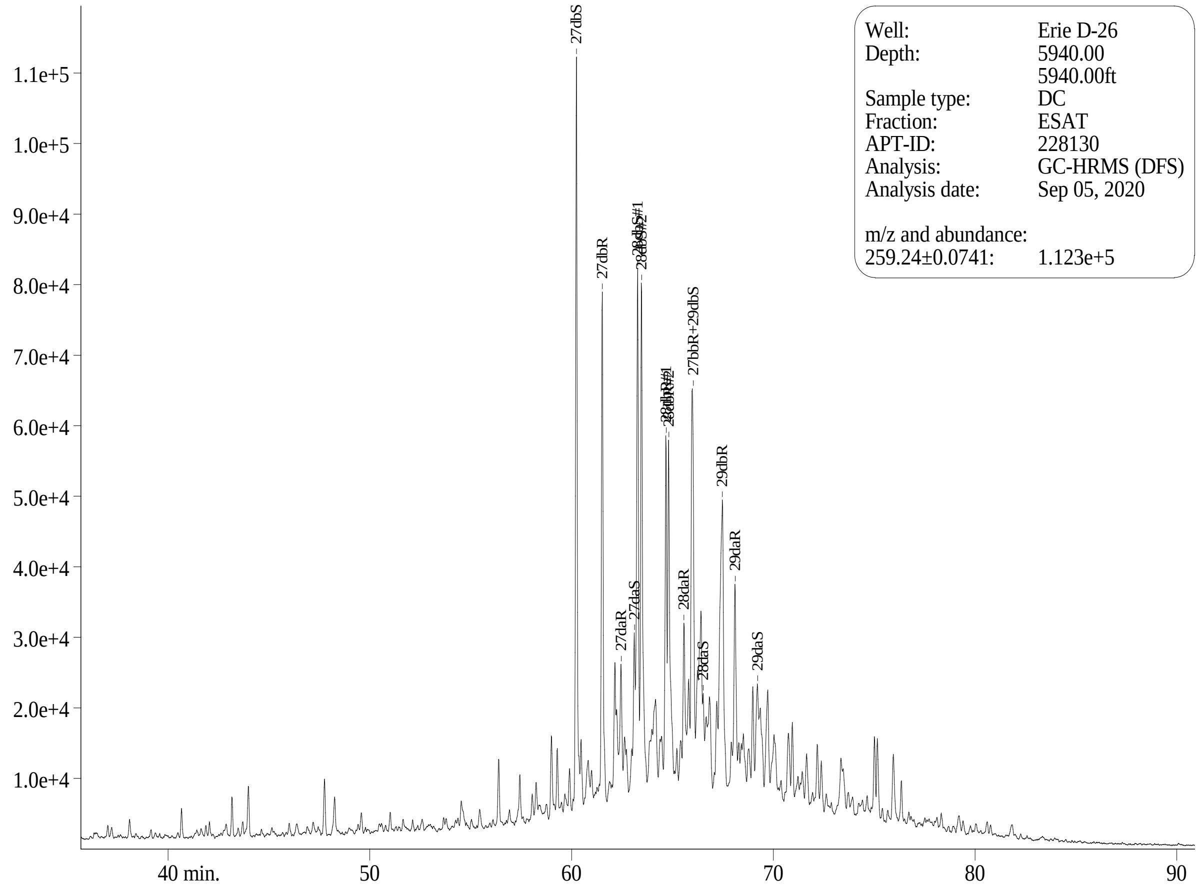

Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 6.189e+5
6.5e+5
6.0e+5
5.5e+5
5.0e+5
4.5e+5
4.0e+5
3.5e+5
3.0e+5
2.5e+5
2.0e+5
1.5e+5
1.0e+5
5.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29ab
29Ts
30d
29ba
30O
30ab
30ba
31abS
31abR
30G
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
205.20±0.0586: 5.758e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
30ab
31abS
31abR
29ab
29Ts
31ba
30ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR
30 min.
40
50
60
70
80
90
100

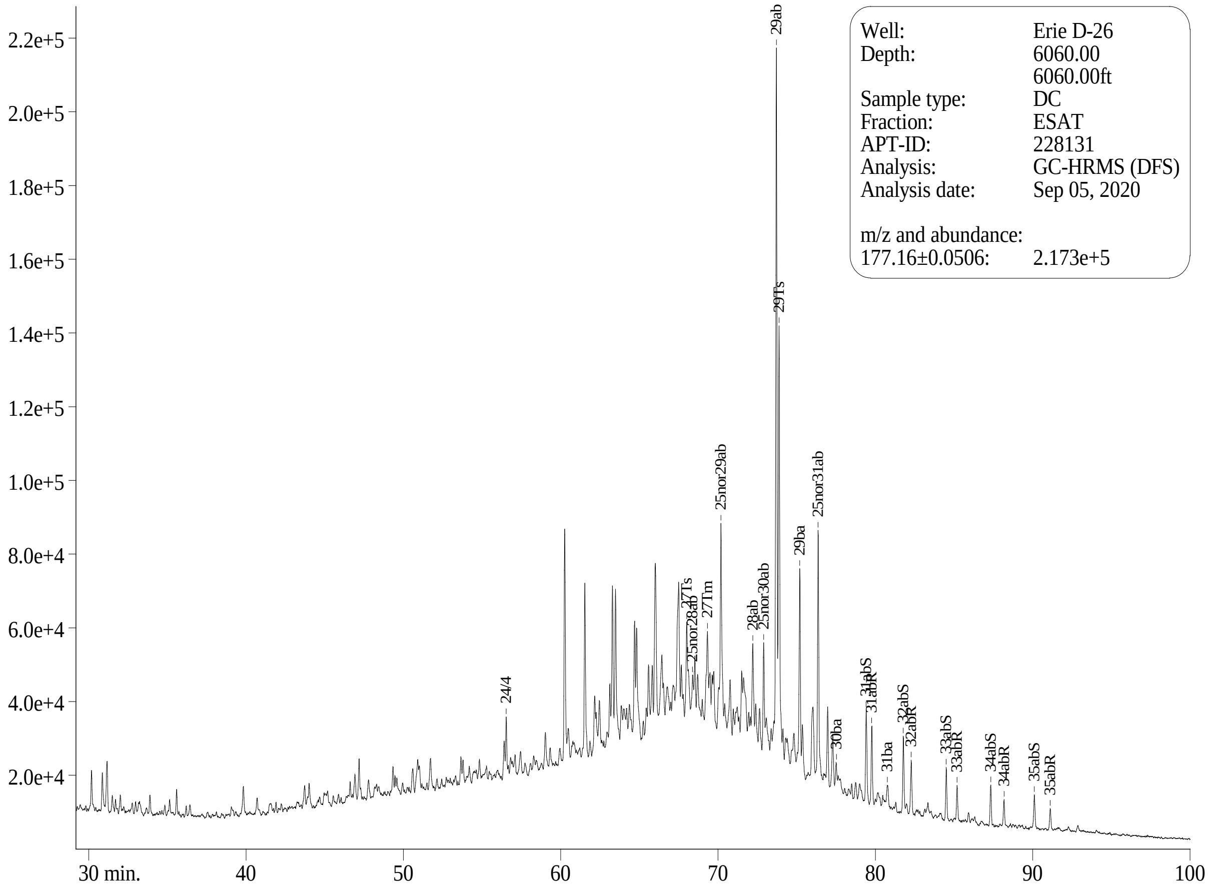

Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
217.20±0.0621: 3.559e+5
3.6e+5
3.2e+5
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
27dbS
27dbR
28dbS#1
28dbS#2
27bbR+29dbS
28dbR#2
28dbR#1
29dbR
28bbS
28bbR
27daS
27bbS
27daR
27aaR
28daR
27aaS
28daS
29daR
29daS
28aaR
29aaS
28aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR
21aa
21bb
22aa
22bb
40 min.
50
60
70
80
90

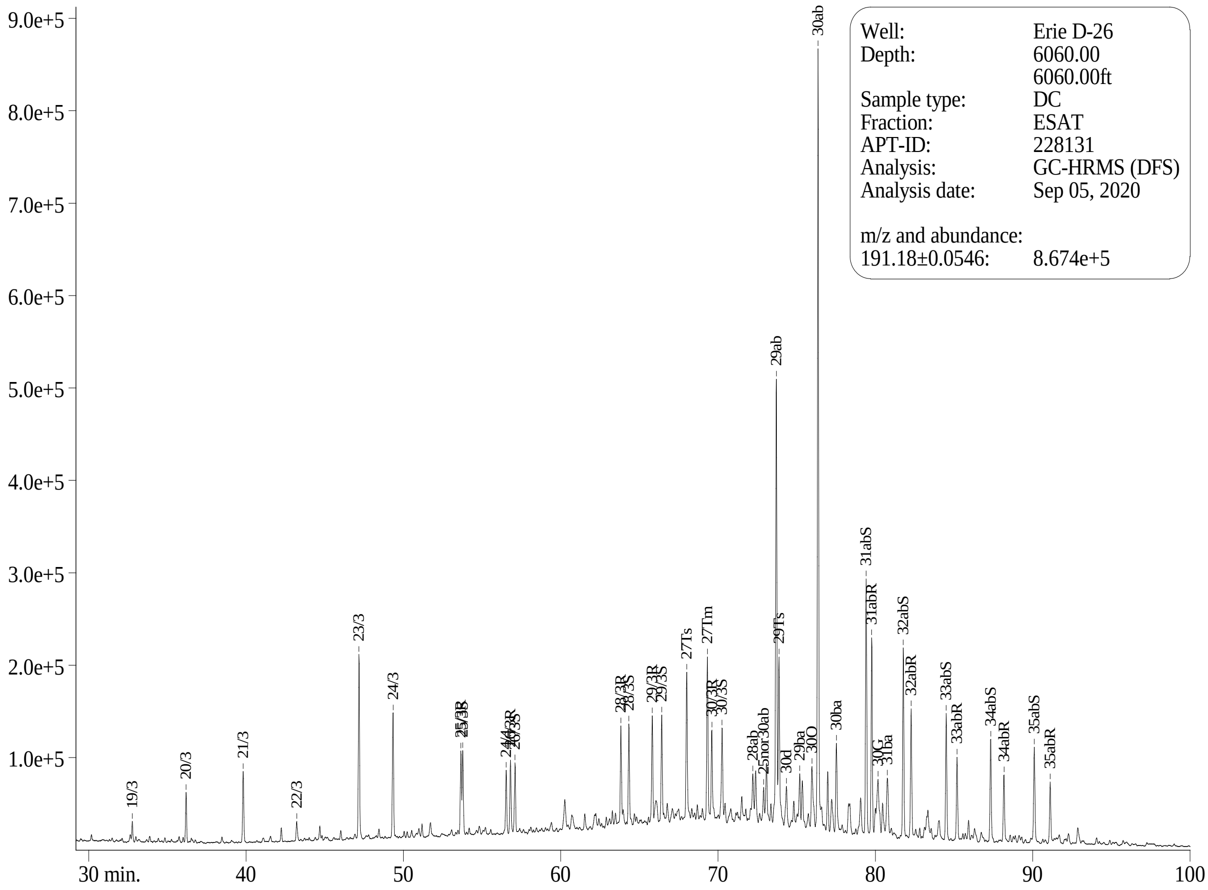

2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR
27bbS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30dbR
30dbS
30aaR
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
218.20±0.0623: 2.634e+5

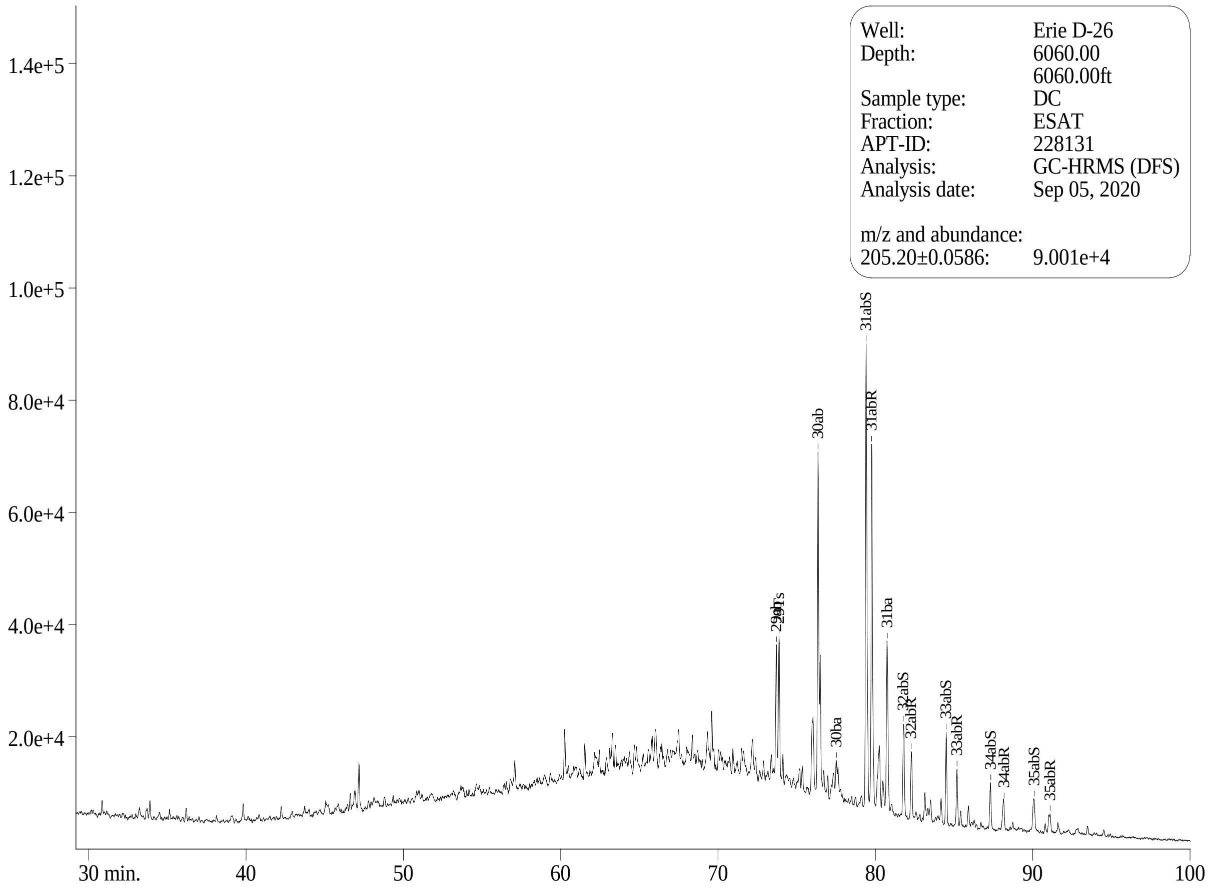

5.0e+4
4.5e+4
4.0e+4
3.5e+4
3.0e+4
2.5e+4
2.0e+4
1.5e+4
1.0e+4
5.0e+3
40 min.
50
60
70
80
90
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
231.21±0.0661: 4.656e+4



| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 5940.00 |
| | 5940.00ft |
| Sample type: | DC |
| Fraction: | ESAT |
| APT-ID: | 228130 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 05, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 1.123e+5 |

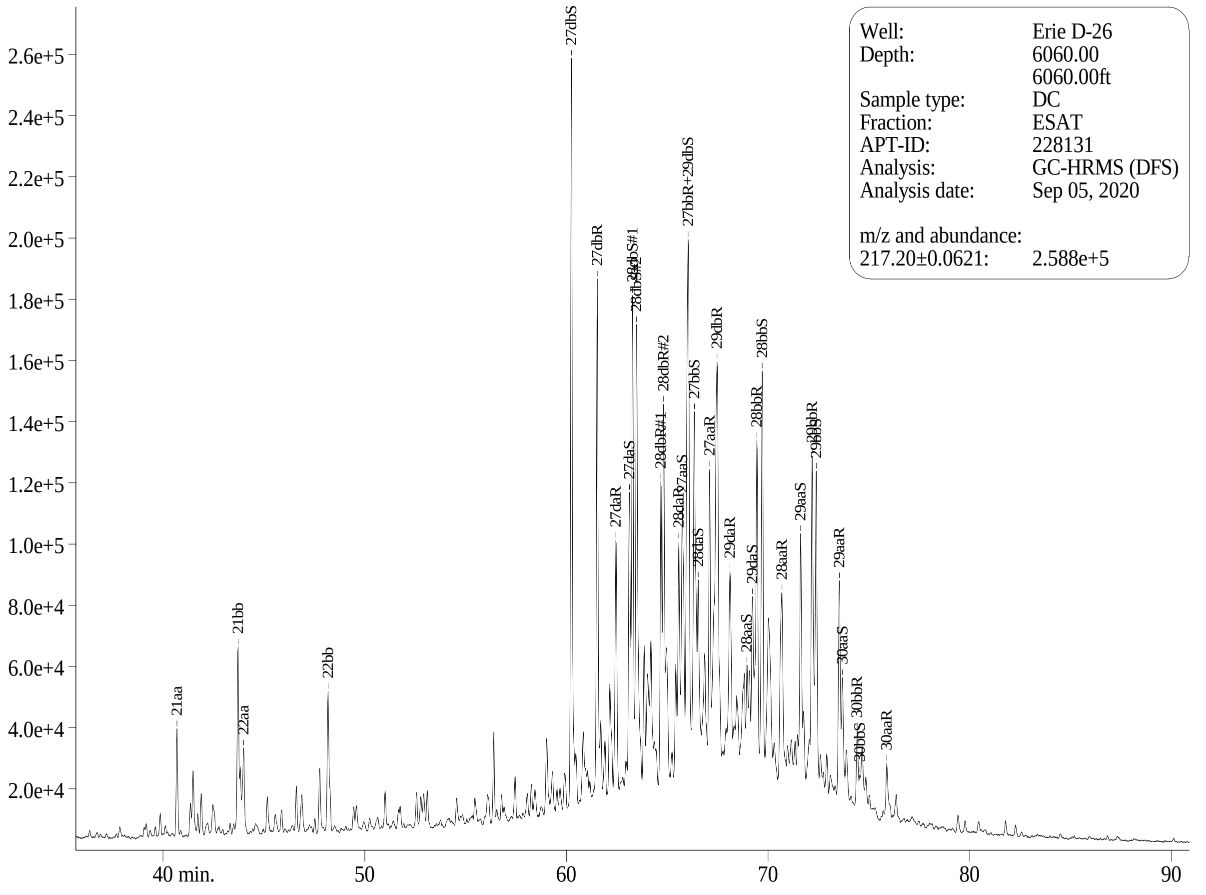

Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
177.16±0.0506: 2.173e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
24/4
25nor28ab
27Ts
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
191.18±0.0546: 8.674e+5
9.0e+5
8.0e+5
7.0e+5
6.0e+5
5.0e+5
4.0e+5
3.0e+5
2.0e+5
1.0e+5
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29ab
29Ts
30d
29ba
30O
30ab
30ba
30G
31ba
31abS
31abR
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



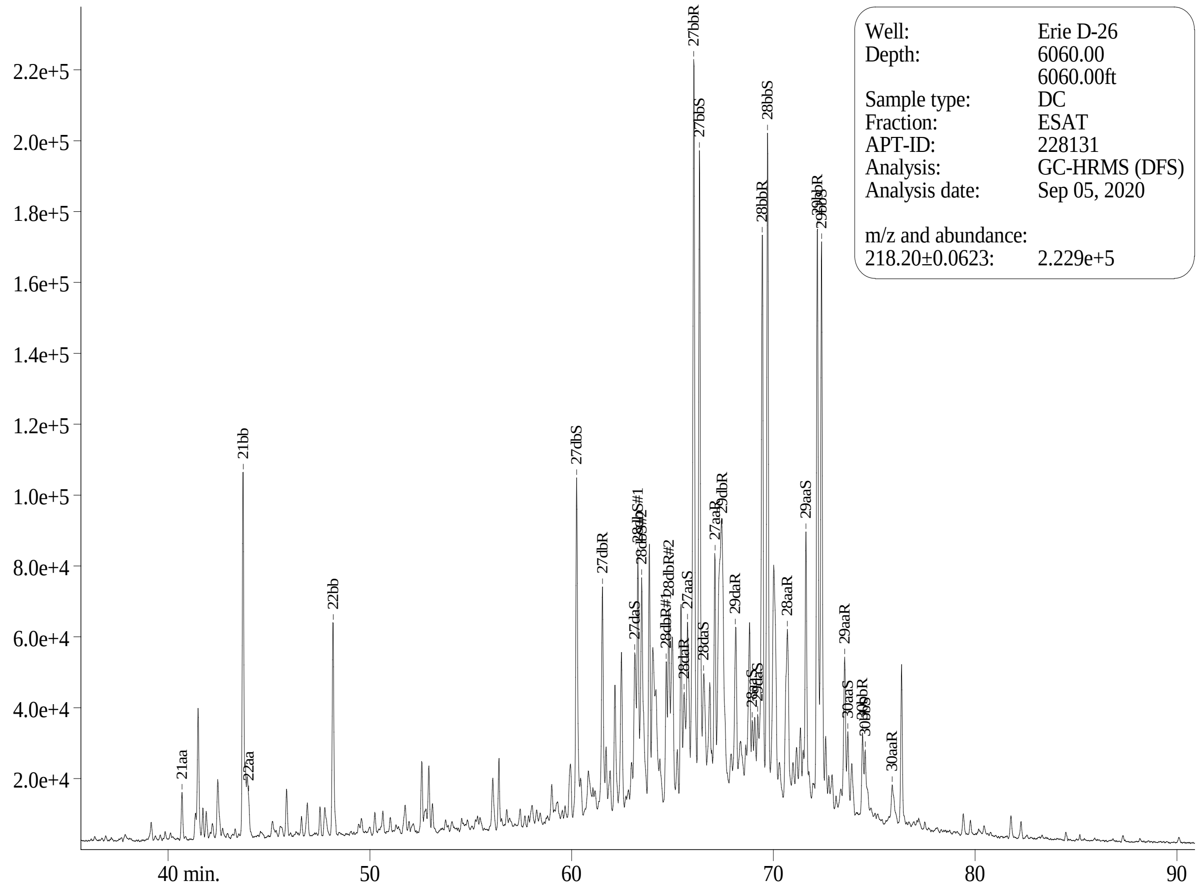
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

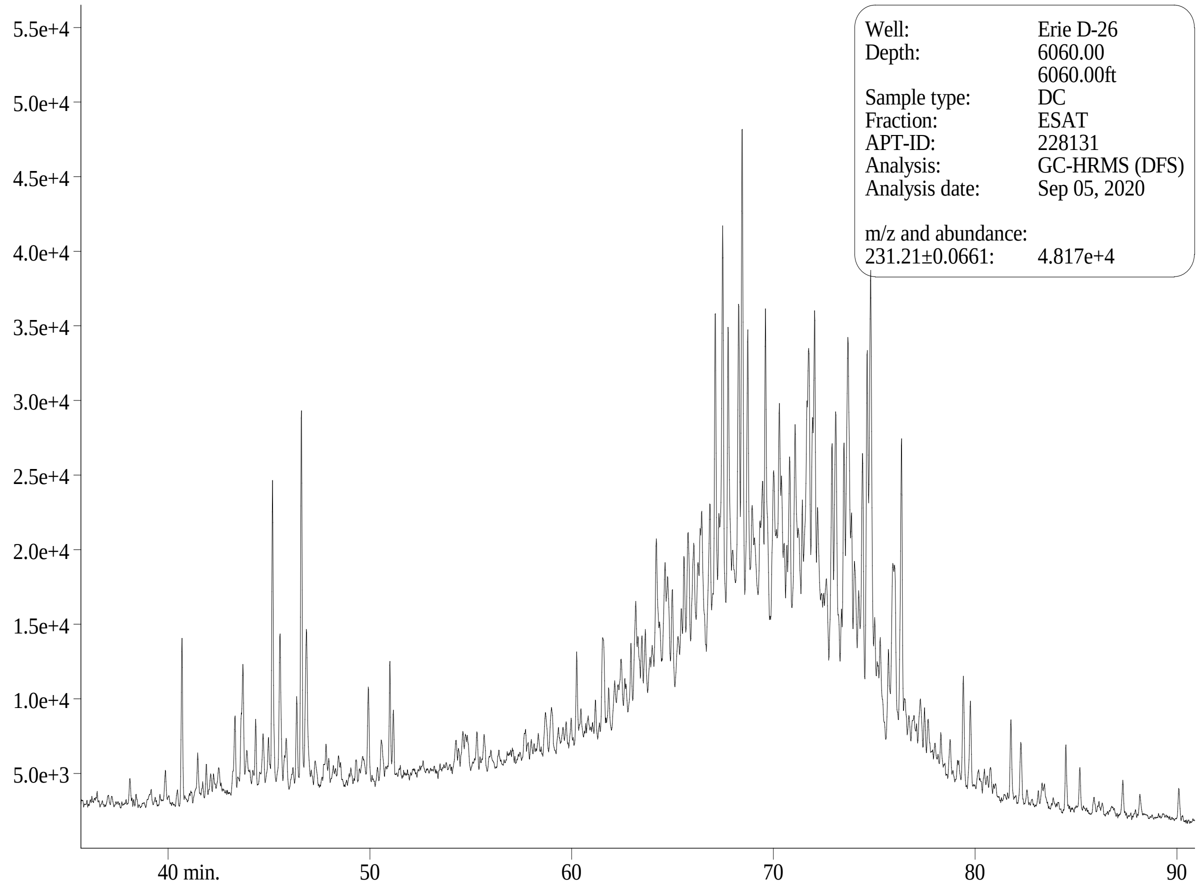
m/z and abundance:
205.20±0.0586: 9.001e+4

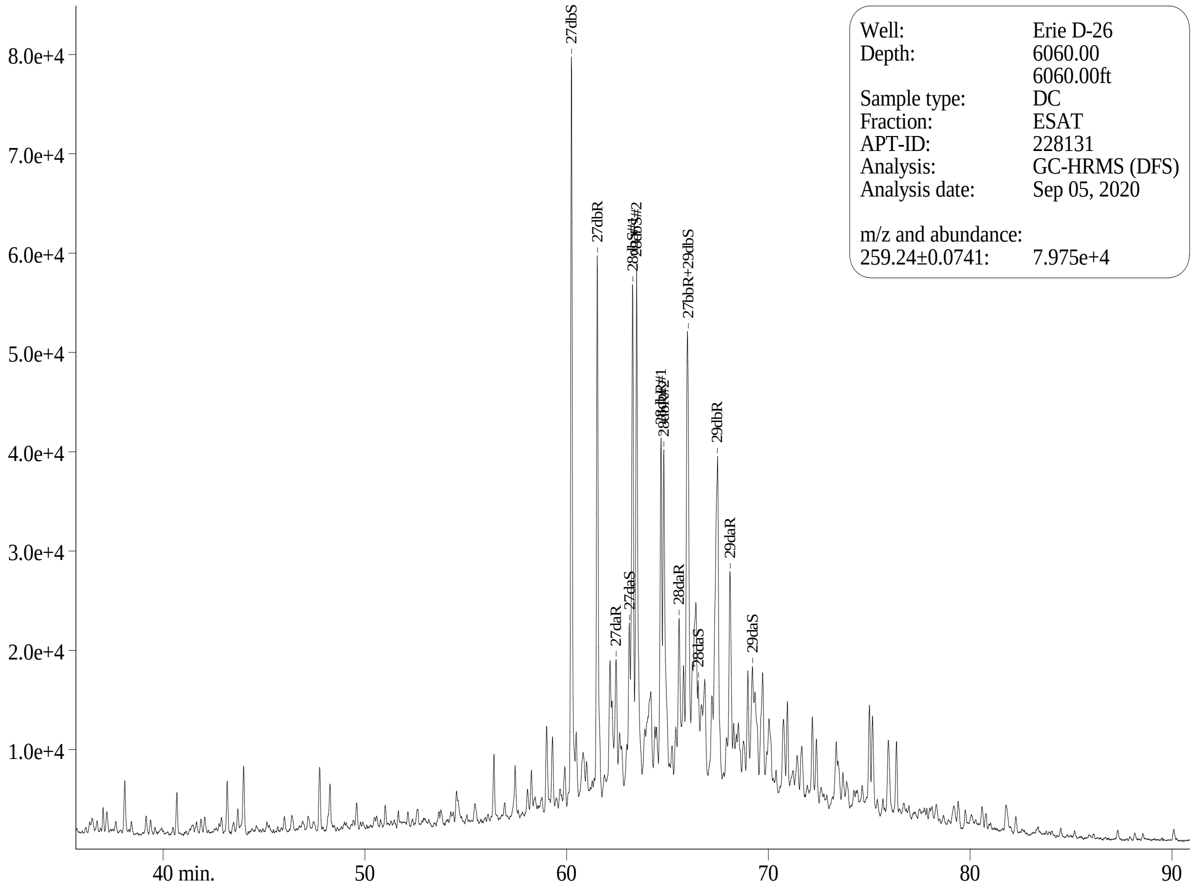


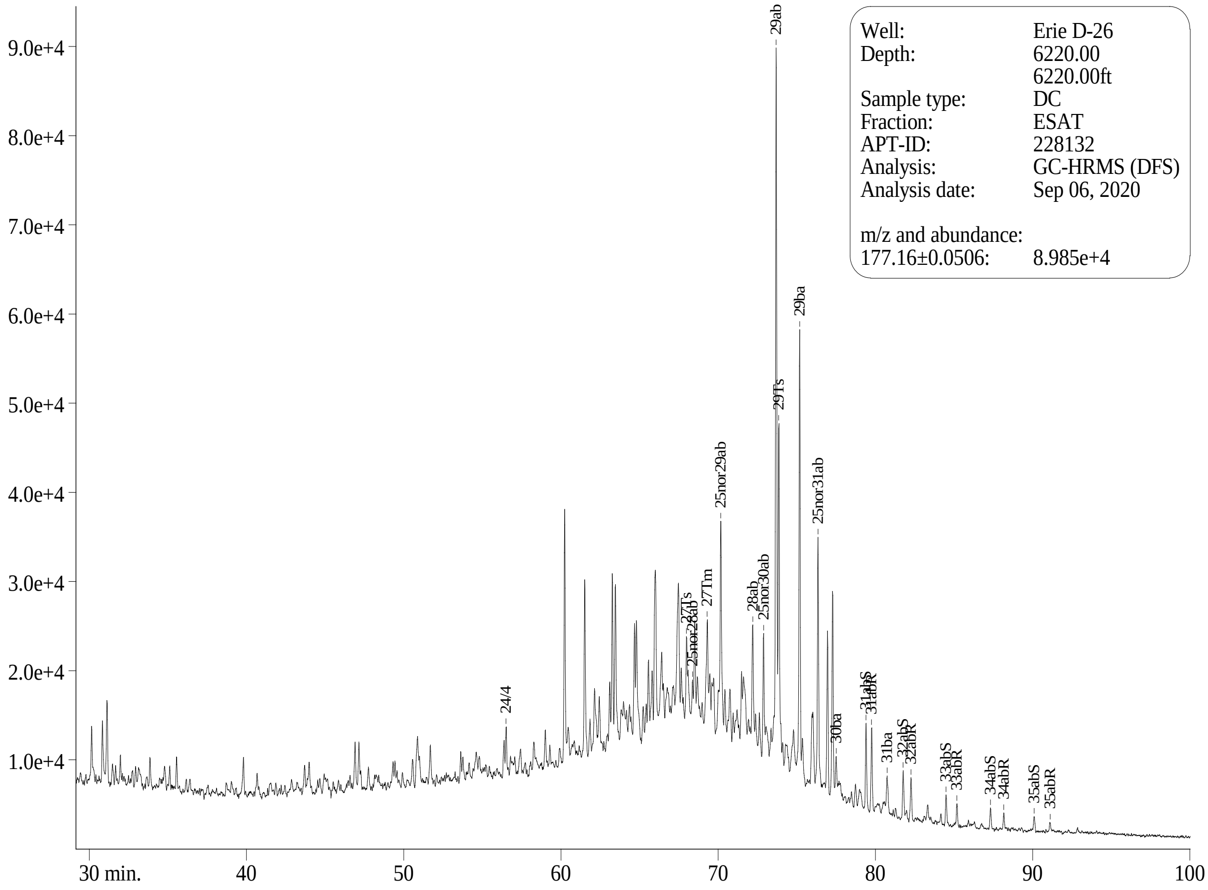
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020

m/z and abundance:
217.20±0.0621: 2.588e+5


Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
218.20±0.0623: 2.229e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR
27bbS
27aaR
29dbR
29daR
28bbR
28bbS
28aaS
29daS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR

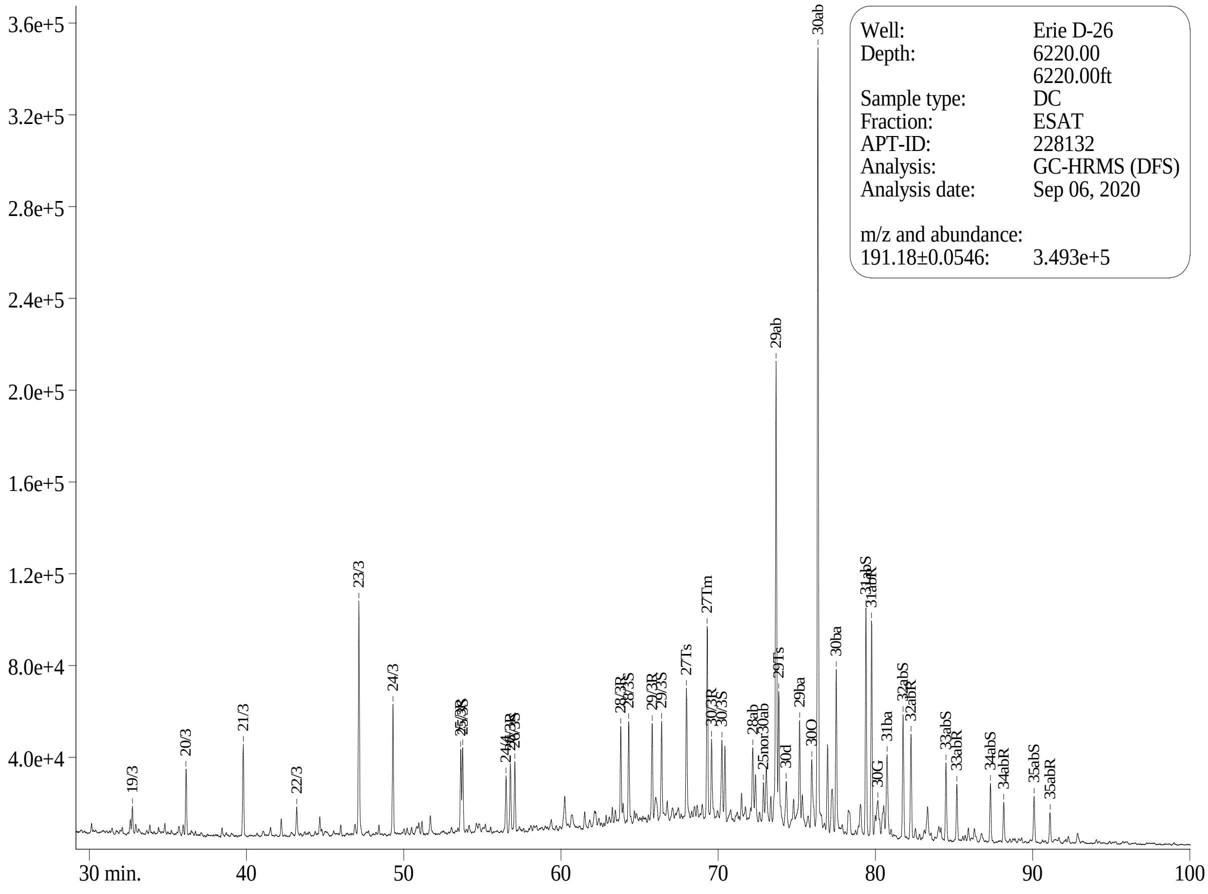

Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
231.21±0.0661: 4.817e+4
5.5e+4
5.0e+4
4.5e+4
4.0e+4
3.5e+4
3.0e+4
2.5e+4
2.0e+4
1.5e+4
1.0e+4
5.0e+3
40 min.
50
60
70
80
90


8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
40 min.
50
60
70
80
90
27dbS
27dbR
28dbS#1
28dbS#2
27daR
27daS
28dbR#1
28dbR#2
27bbR+29dbS
28daR
28daS
29dbR
29daR
29daS
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 05, 2020
m/z and abundance:
259.24±0.0741: 7.975e+4



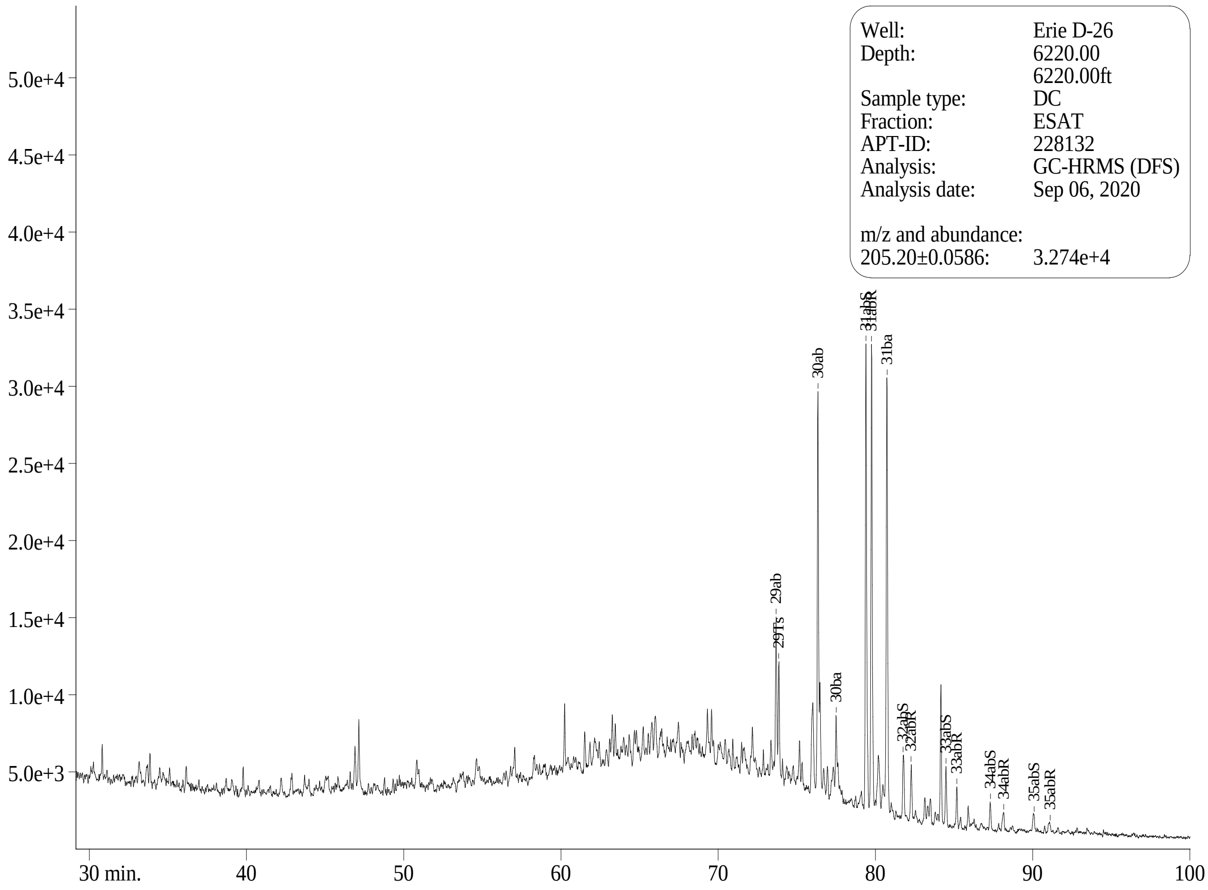
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
177.16±0.0506: 8.985e+4



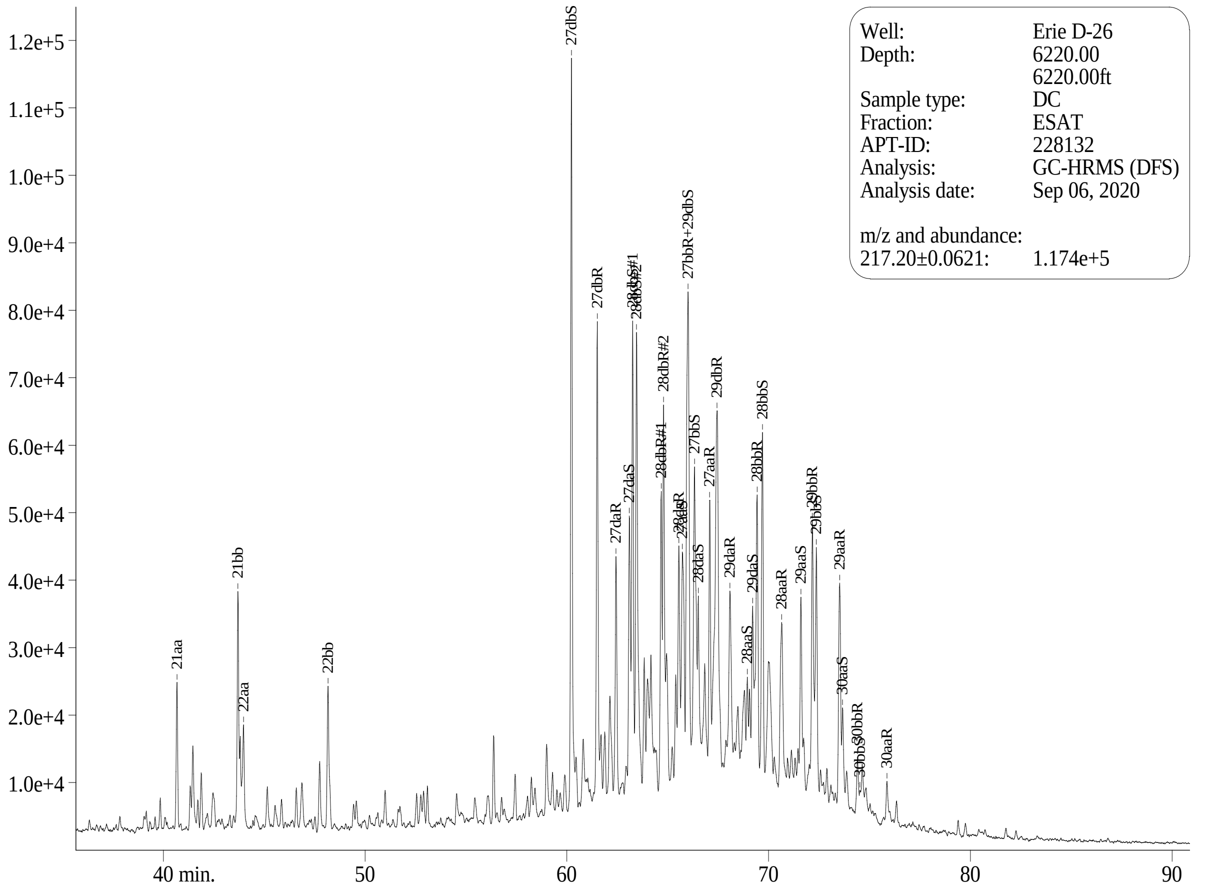
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
191.18±0.0546: 3.493e+5



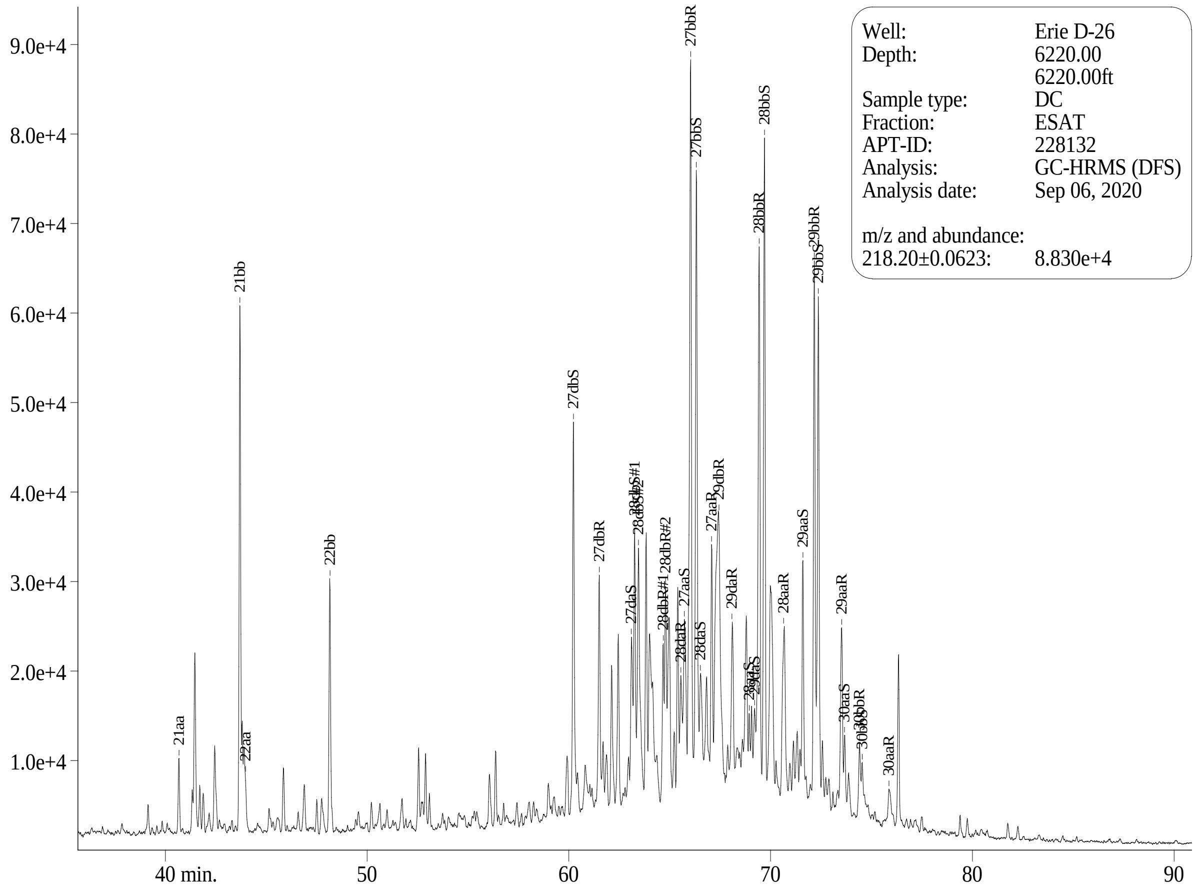
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
205.20±0.0586: 3.274e+4



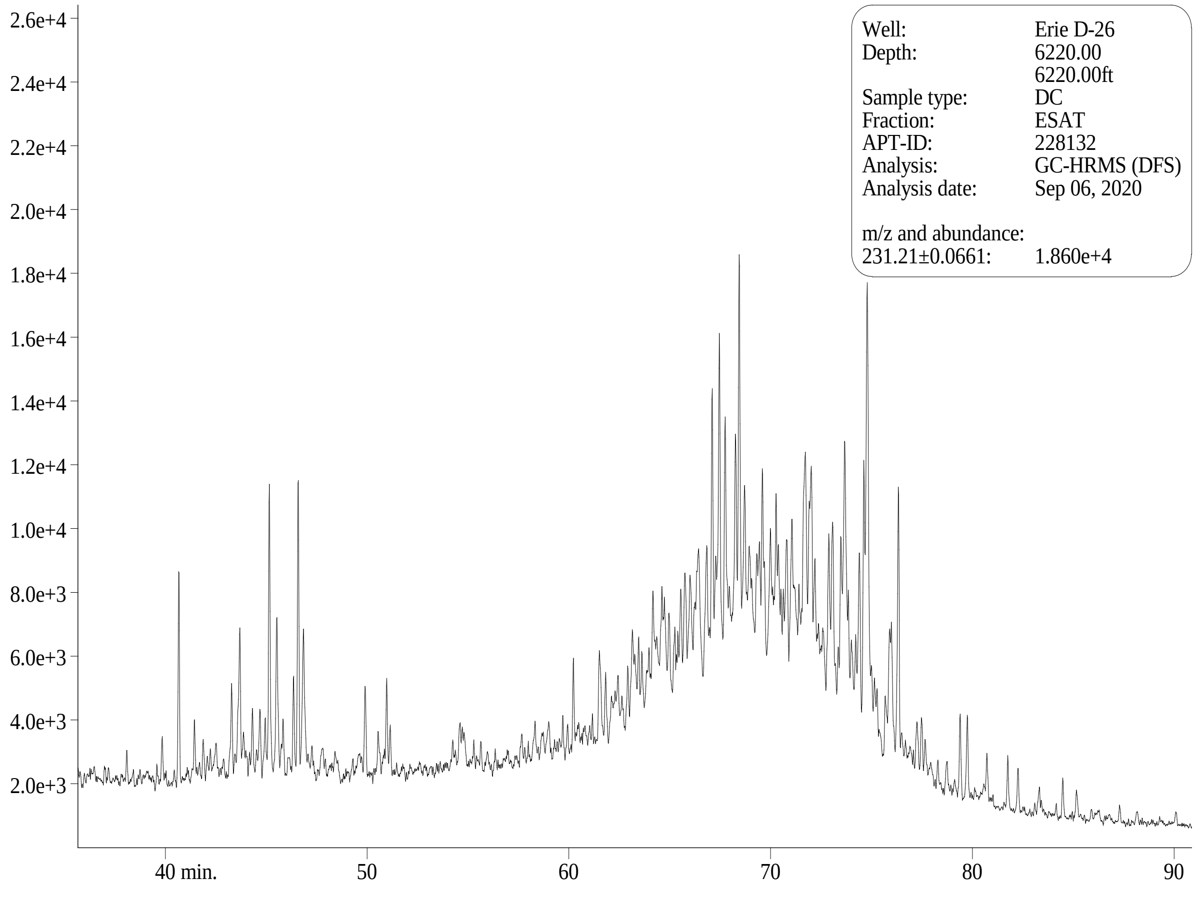
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
217.20±0.0621: 1.174e+5



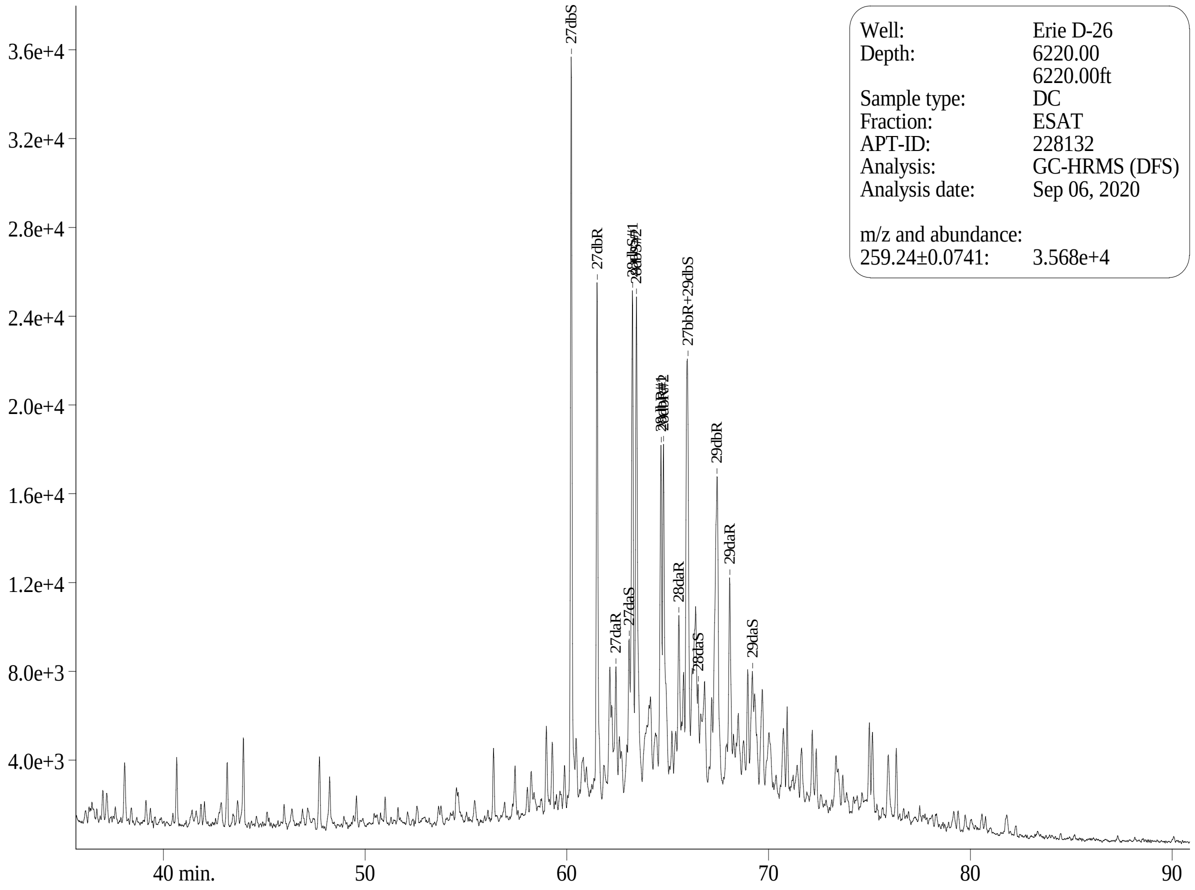
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

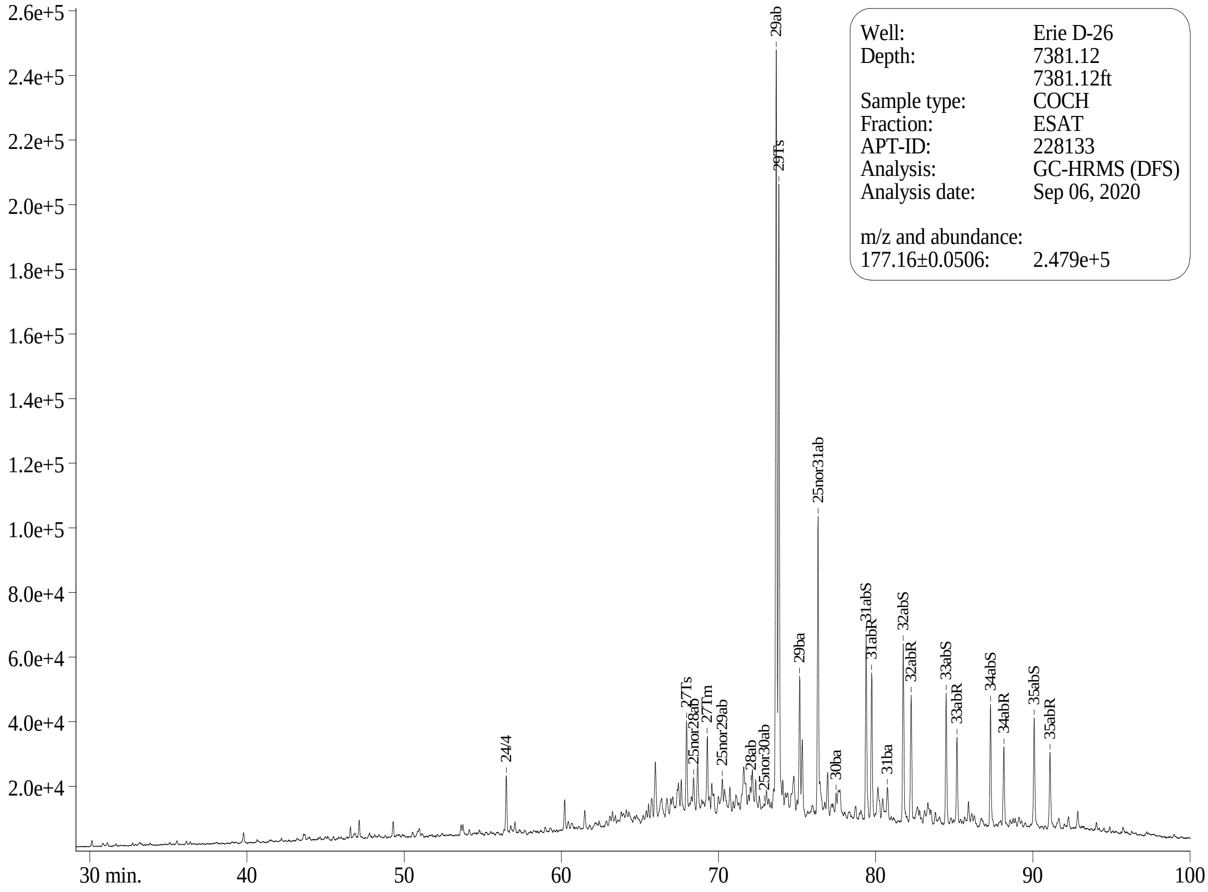
m/z and abundance:
218.20±0.0623: 8.830e+4



Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

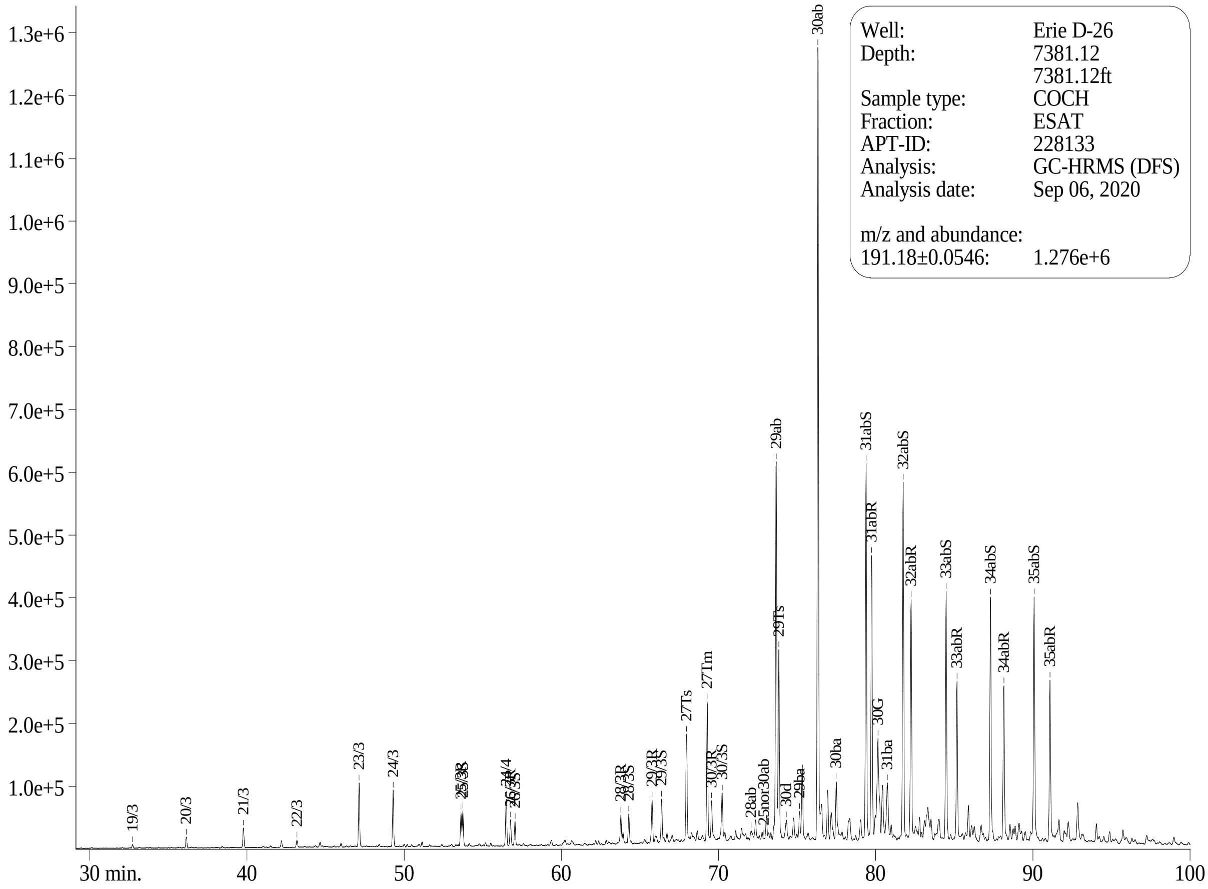
m/z and abundance:
231.21±0.0661: 1.860e+4


3.6e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90
27dbS
27dbR
28dbS#1
28dbS#2
27daR
27daS
28dbR#1
28dbR#2
27bbR+29dbS
28daR
28daS
29dbR
29daR
29daS
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
259.24±0.0741: 3.568e+4



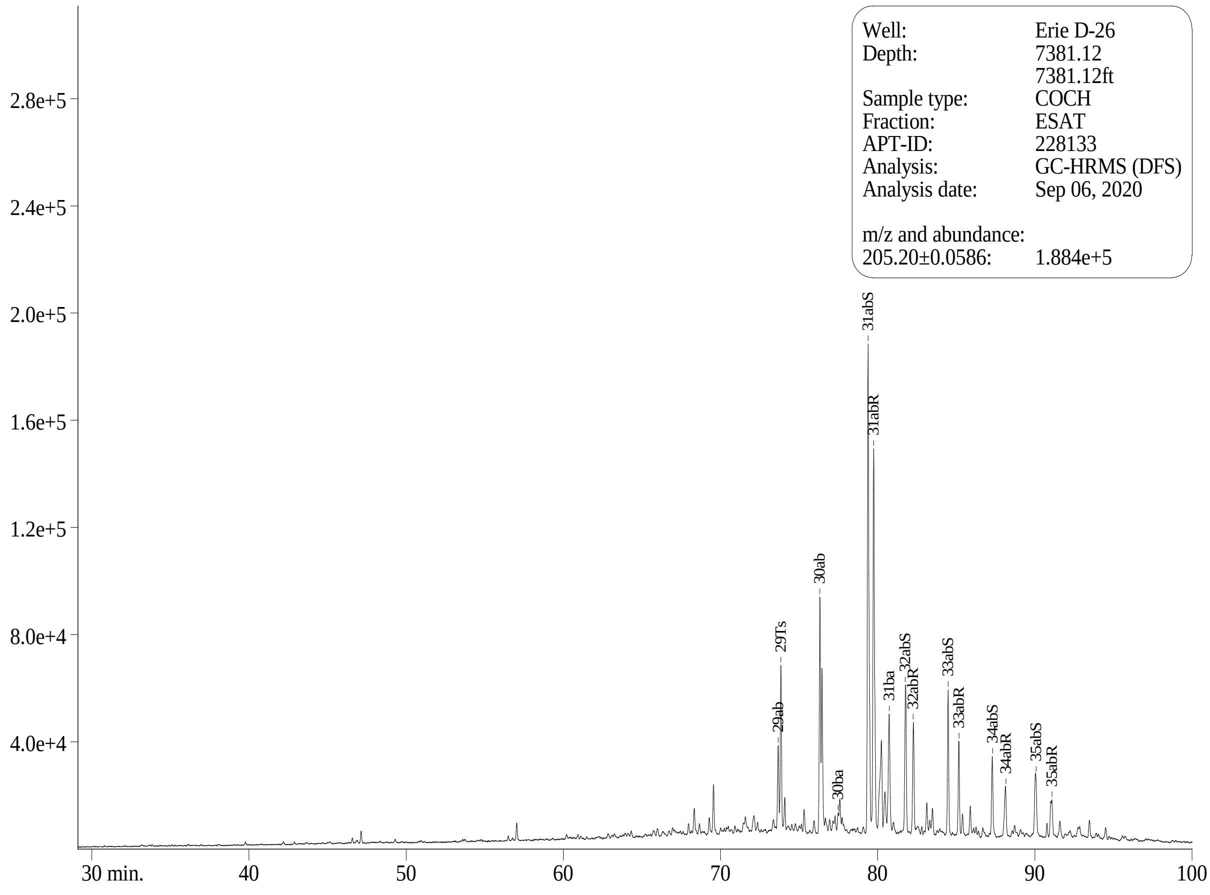
Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

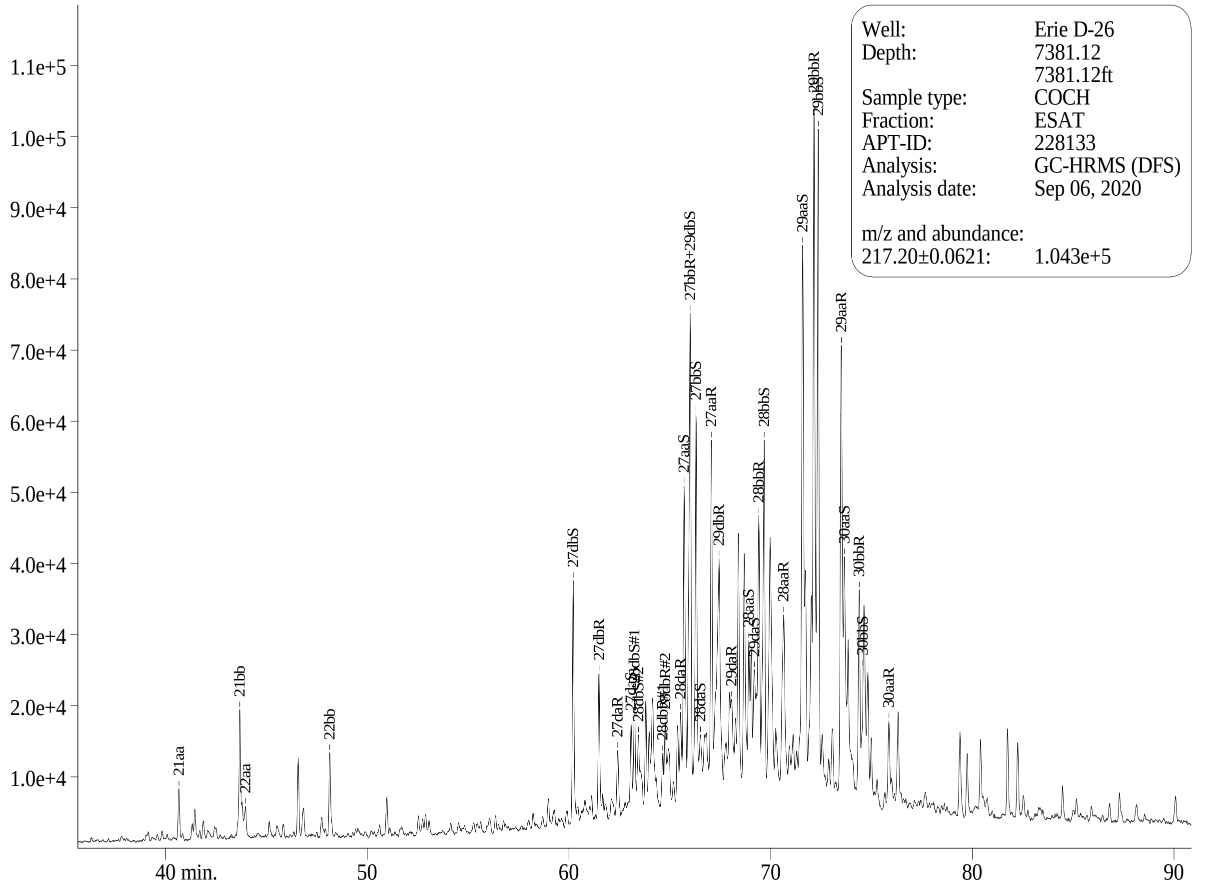
m/z and abundance:
177.16±0.0506: 2.479e+5



Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
191.18±0.0546: 1.276e+6


Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
205.20±0.0586: 1.884e+5
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
30 min.
40
50
60
70
80
90
100
29ab
29Ts
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
217.20±0.0621: 1.043e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
28daS
27aaS
27bbR+29dbS
27bbS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
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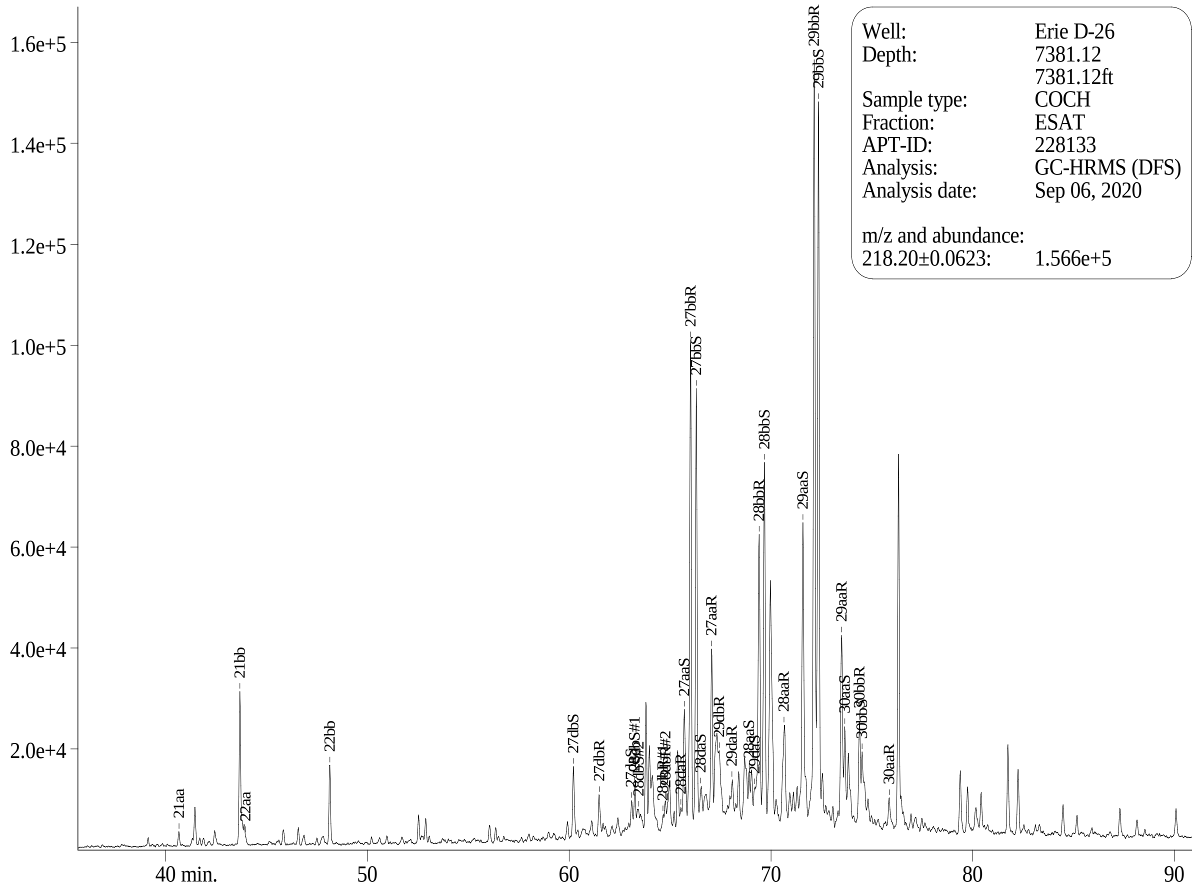
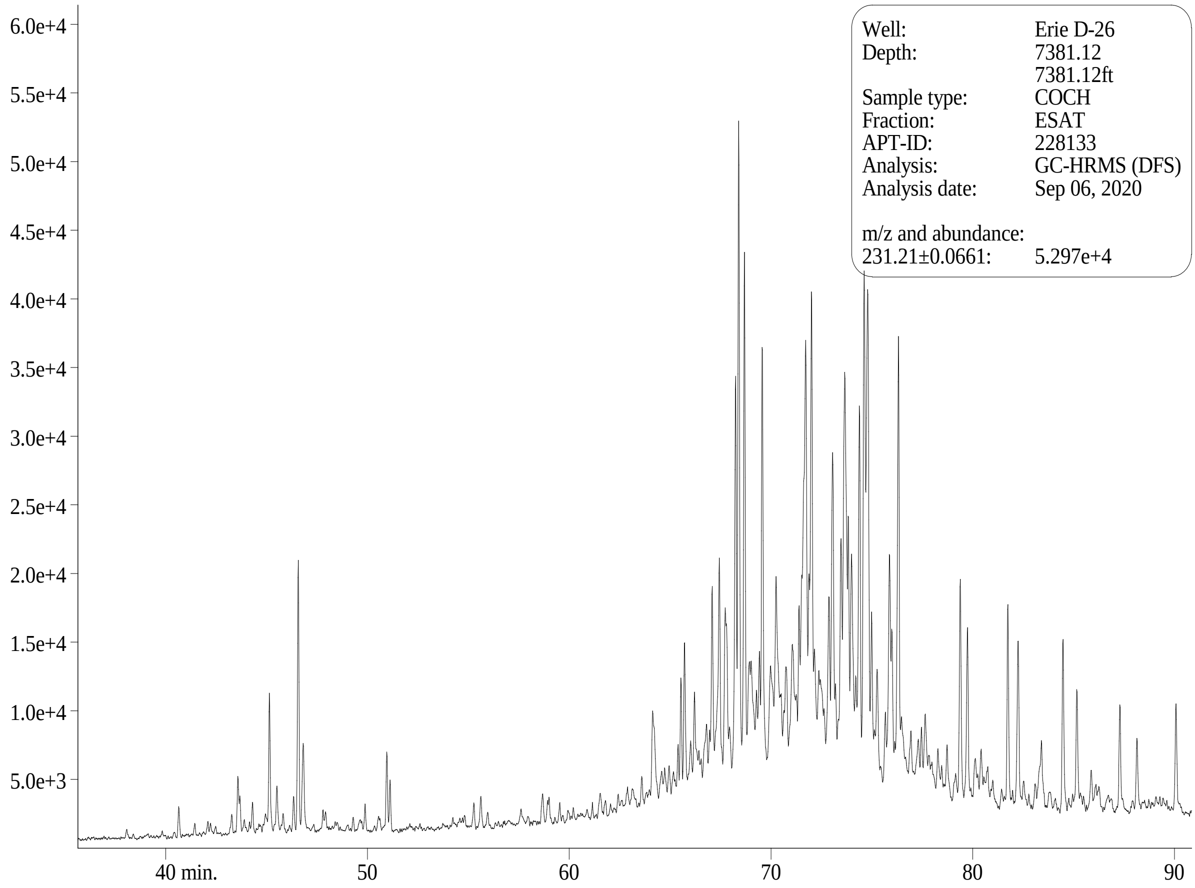
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR



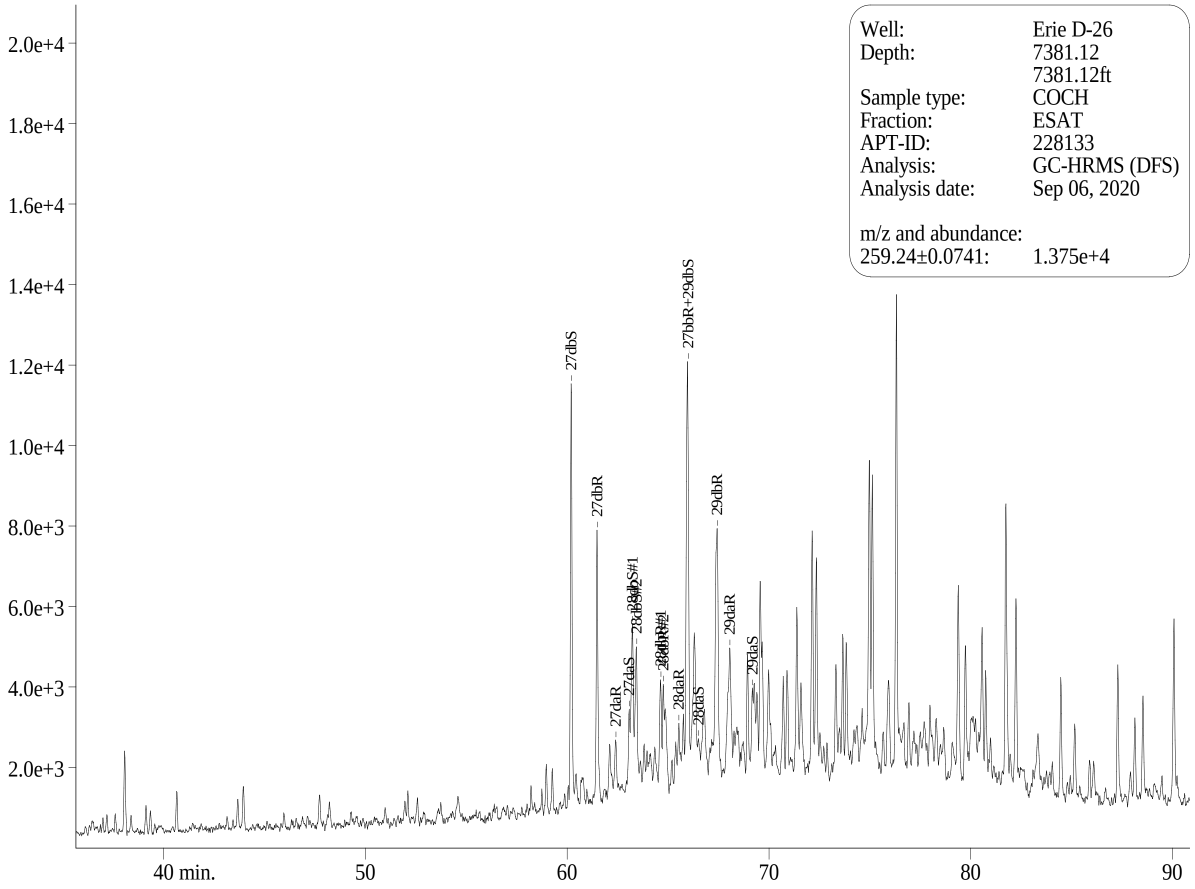
Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
218.20±0.0623: 1.566e+5

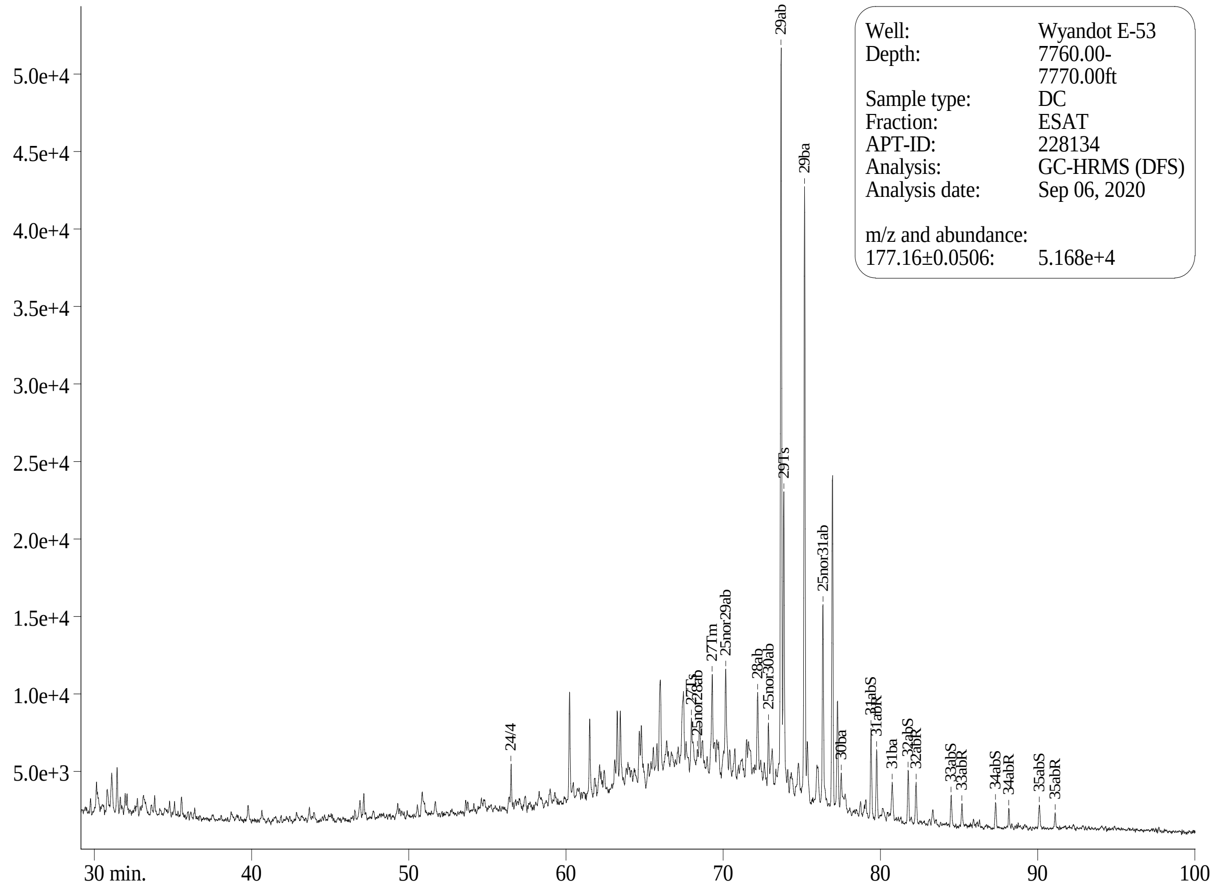


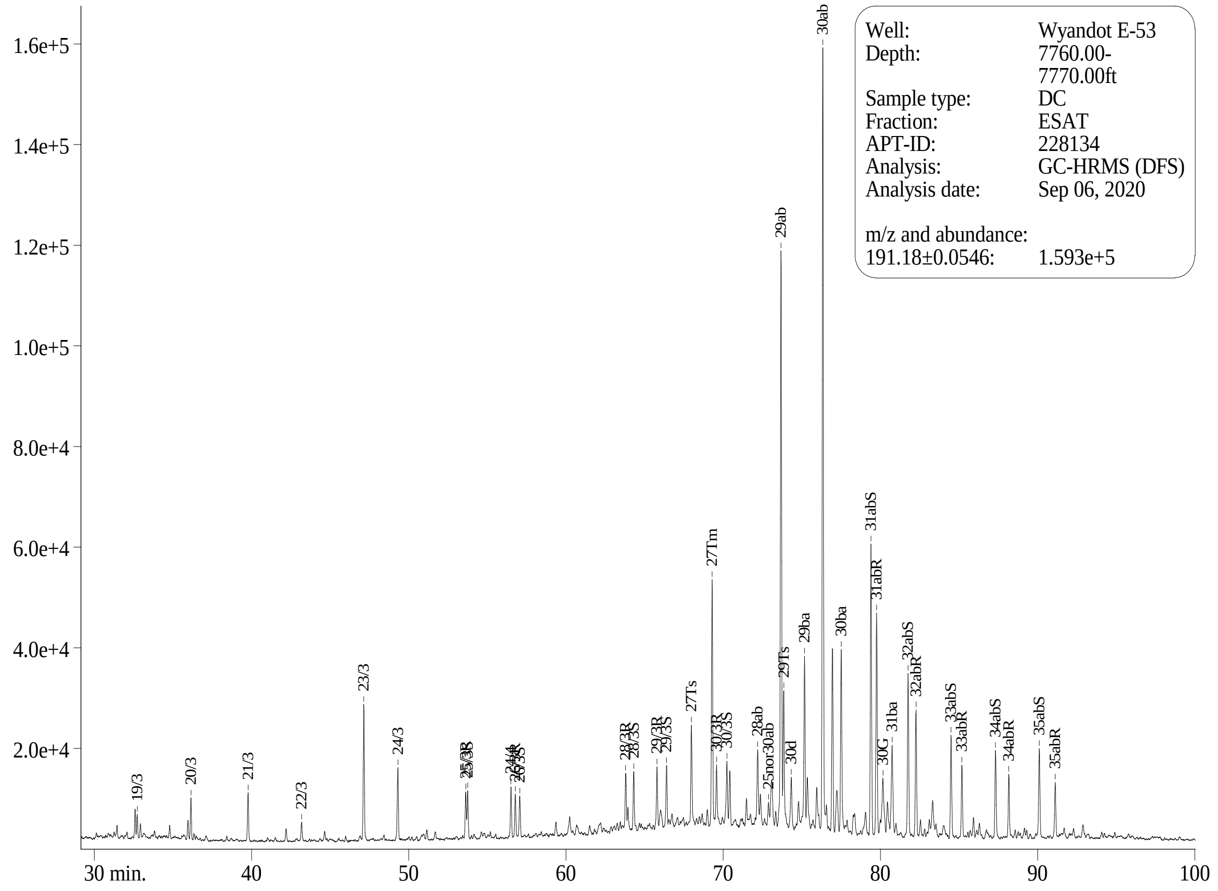
Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: ESAT
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

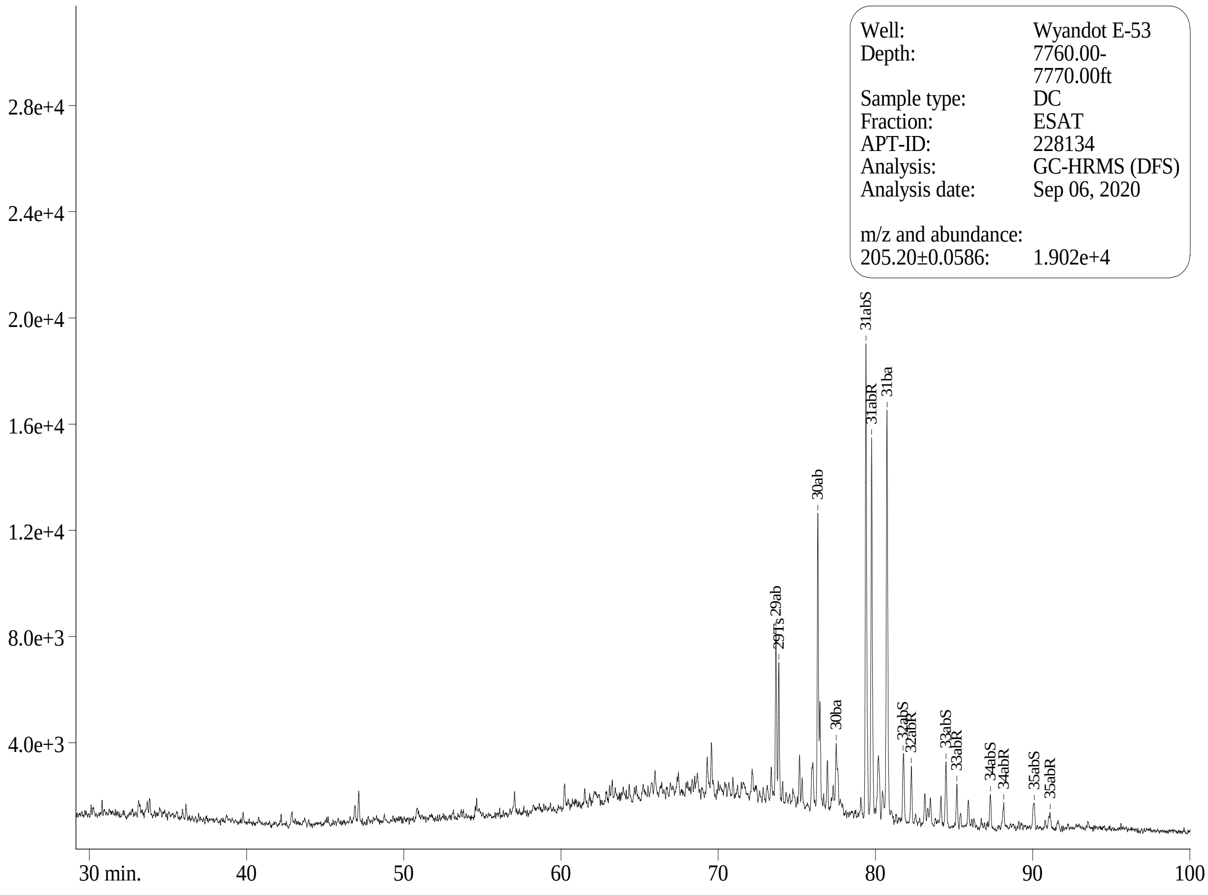
m/z and abundance:
231.21±0.0661: 5.297e+4



| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 7381.12<br>7381.12ft |
| Sample type: | COCH |
| Fraction: | ESAT |
| APT-ID: | 228133 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 06, 2020 |
| m/z and abundance: | |
| 259.24±0.0741: | 1.375e+4 |

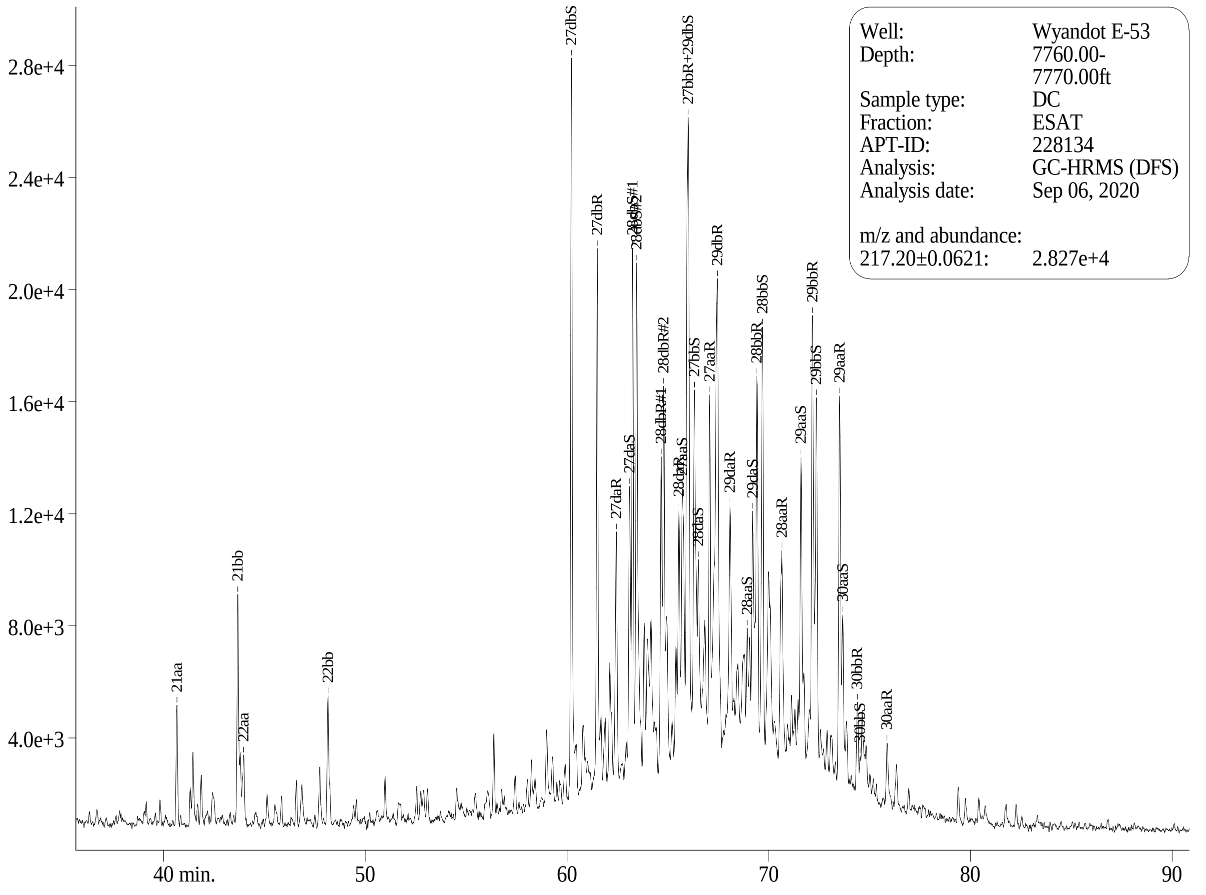

Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
177.16±0.0506: 5.168e+4
5.0e+4
4.5e+4
4.0e+4
3.5e+4
3.0e+4
2.5e+4
2.0e+4
1.5e+4
1.0e+4
5.0e+3
30 min.
40
50
60
70
80
90
100
24/4
27Ts
25nor28ab
27Tm
25nor29ab
28ab
25nor30ab
29ab
29Ts
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
191.18±0.0546: 1.593e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
100
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29Ts
29ab
30d
29ba
30ab
30G
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



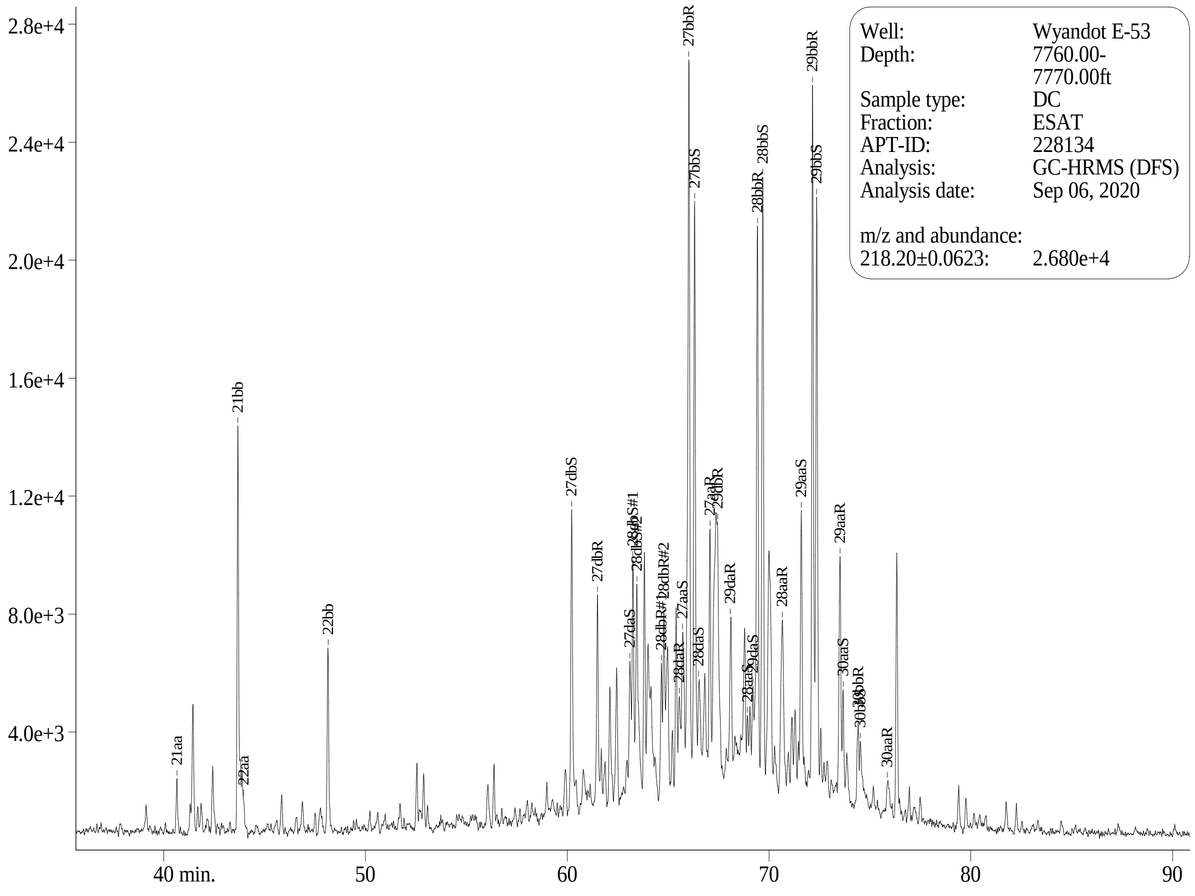
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

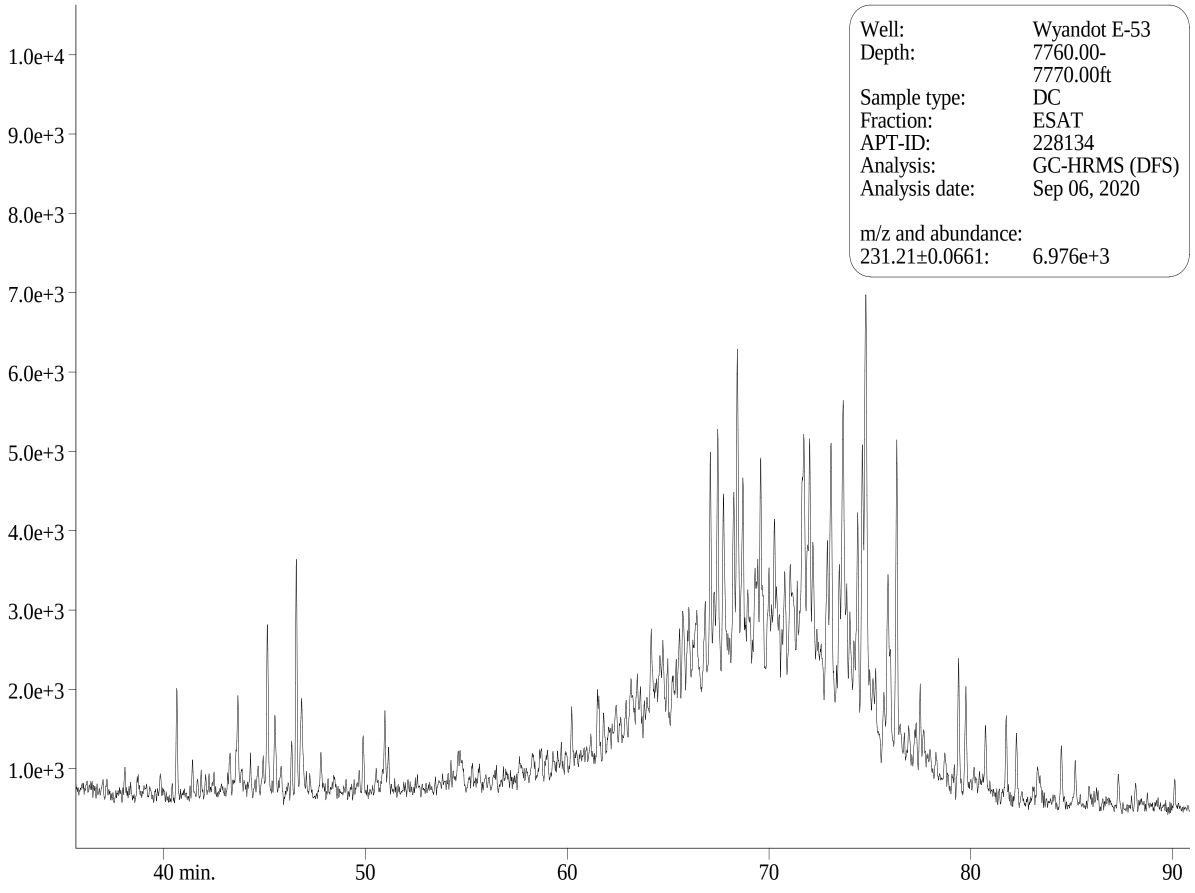
m/z and abundance:
205.20±0.0586: 1.902e+4

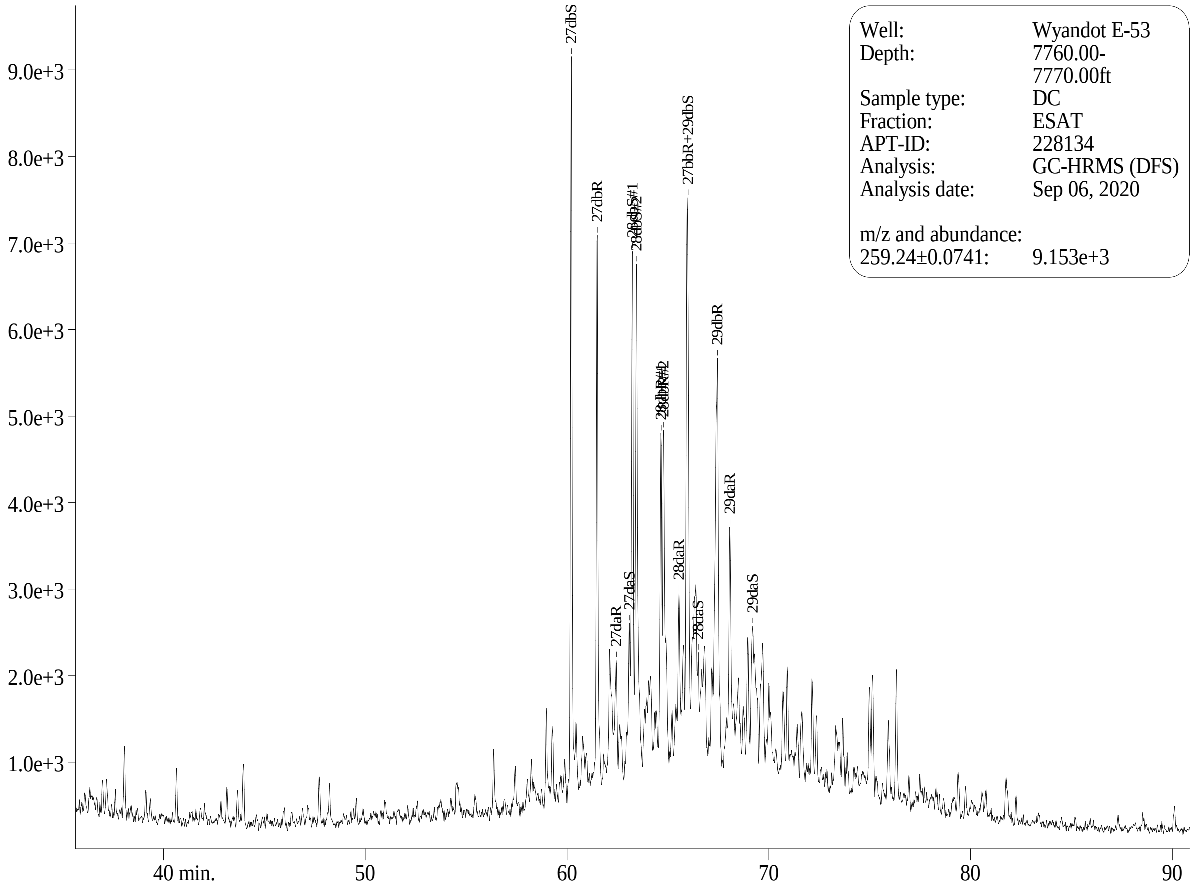


Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

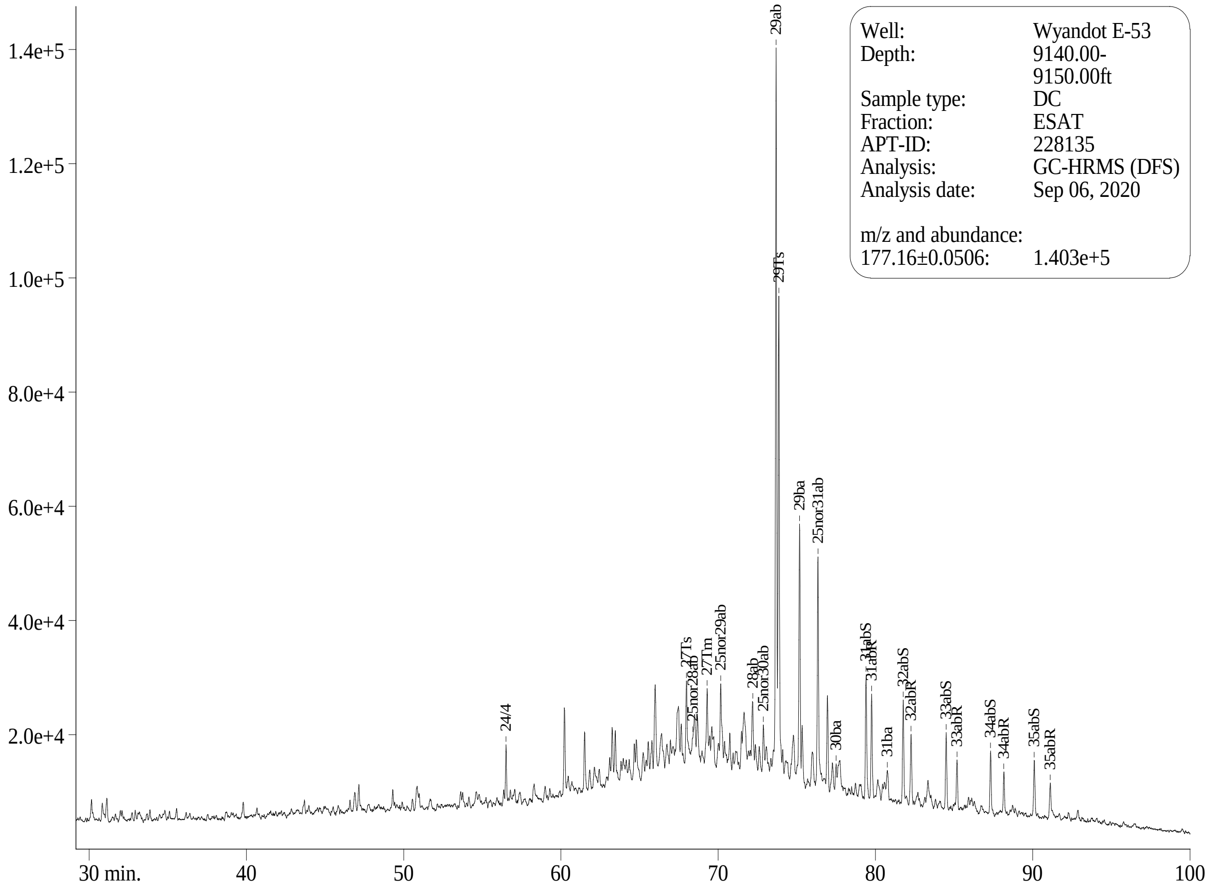
m/z and abundance:
217.20±0.0621: 2.827e+4


2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR
27bbS
27aaR
29dbR
29daR
28bbR
28bbS
28aaS
29daS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
218.20±0.0623: 2.680e+4


1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
40 min.
50
60
70
80
90
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
231.21±0.0661: 6.976e+3

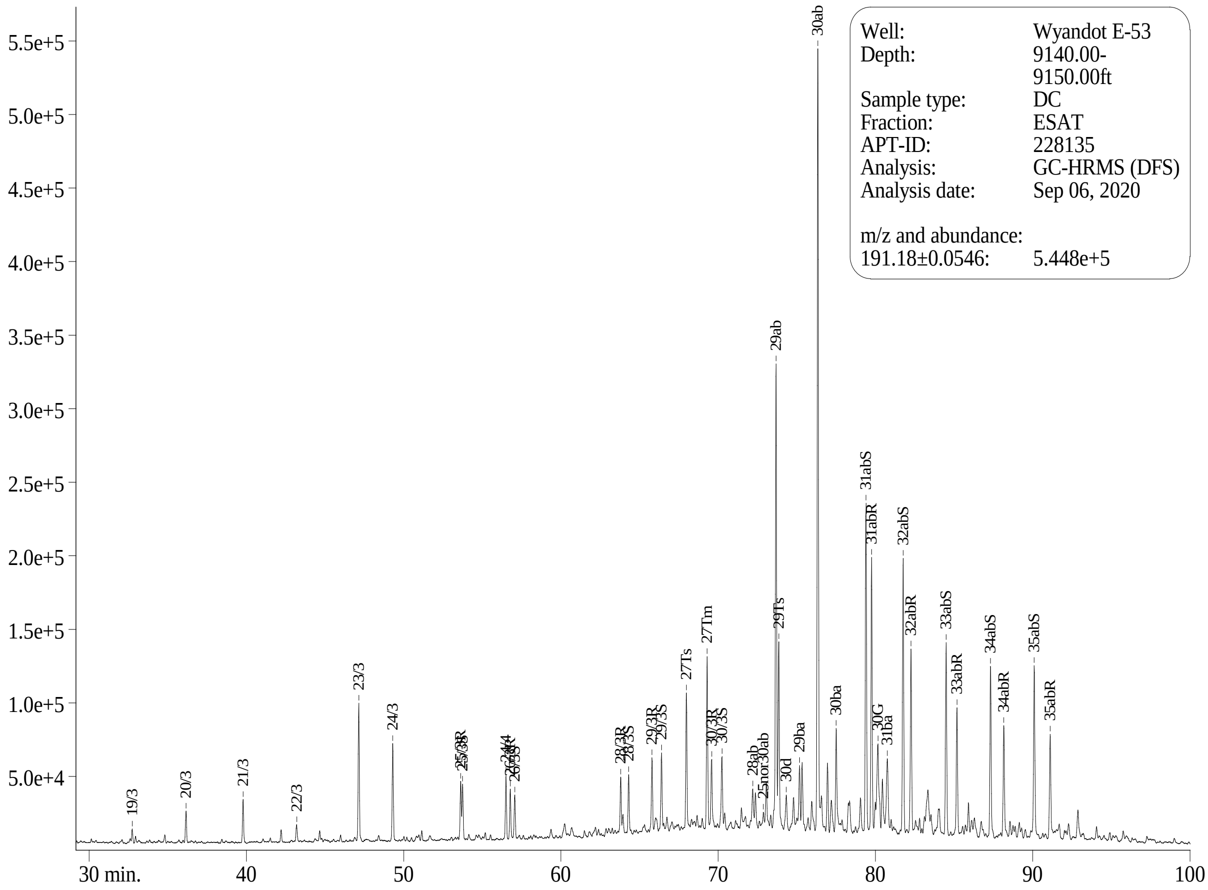

Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

m/z and abundance:
259.24±0.0741: 9.153e+3



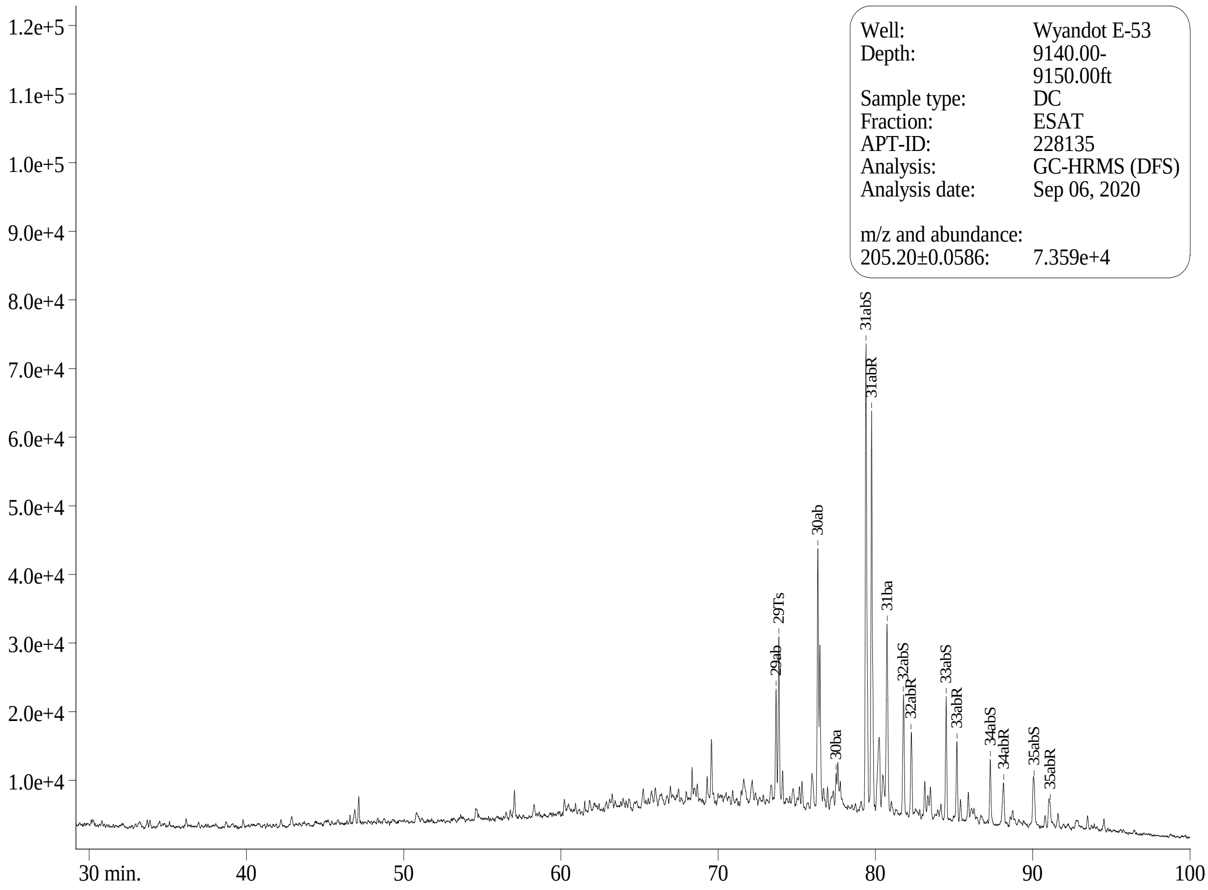
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

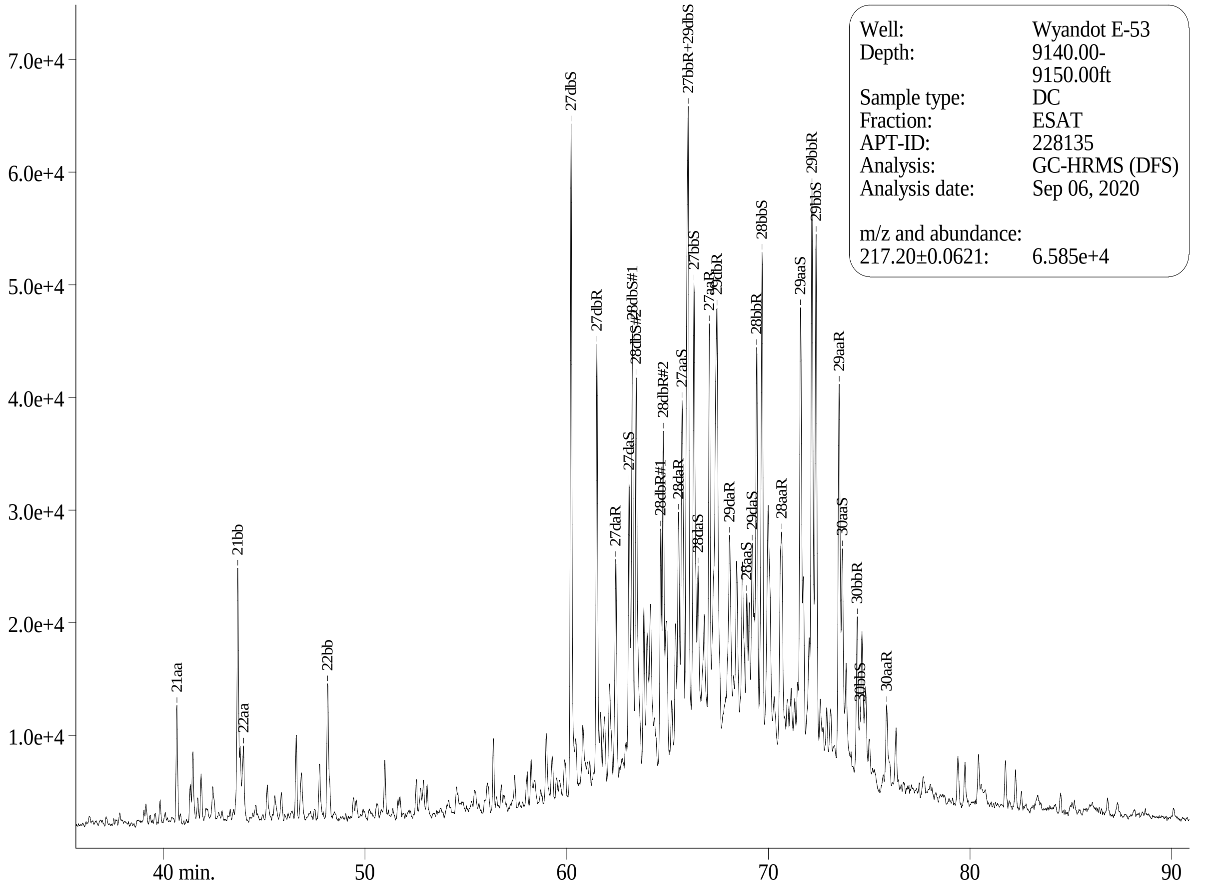
m/z and abundance:
177.16±0.0506: 1.403e+5

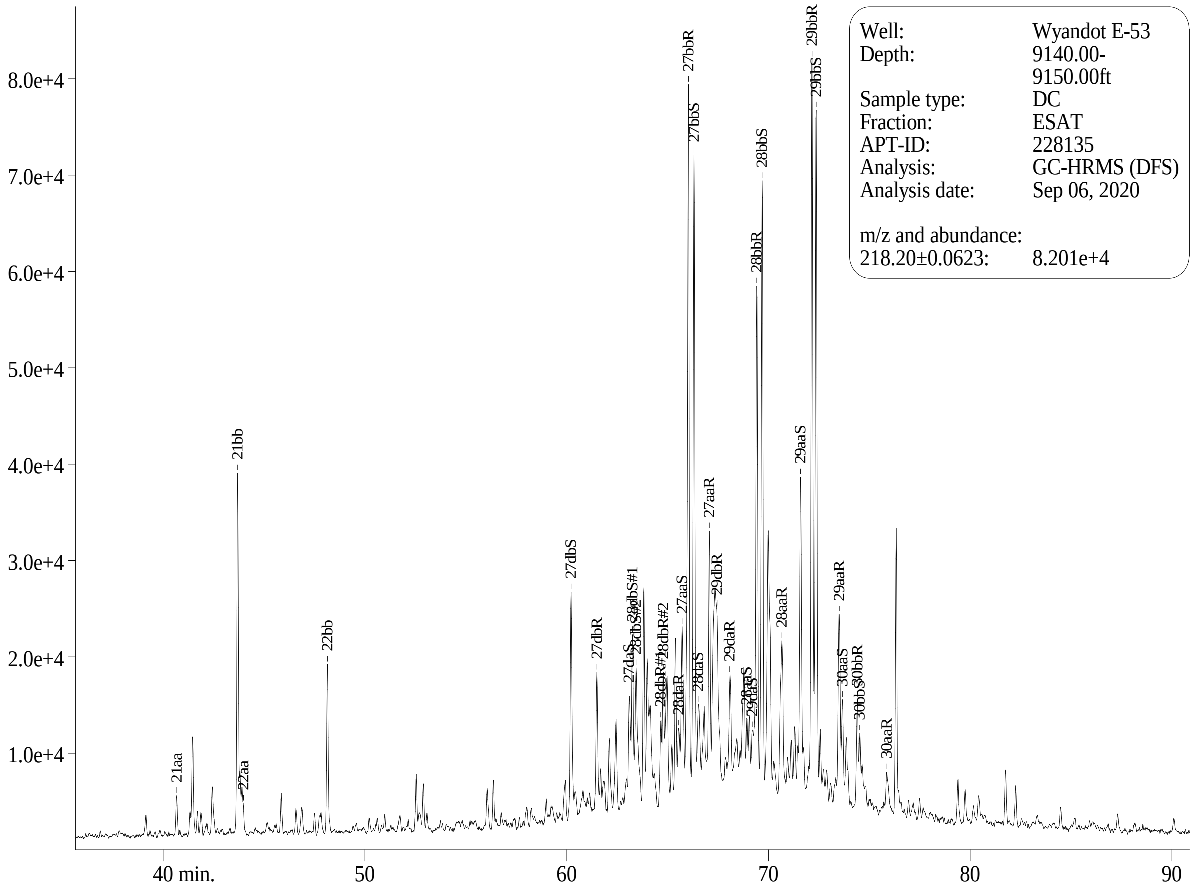


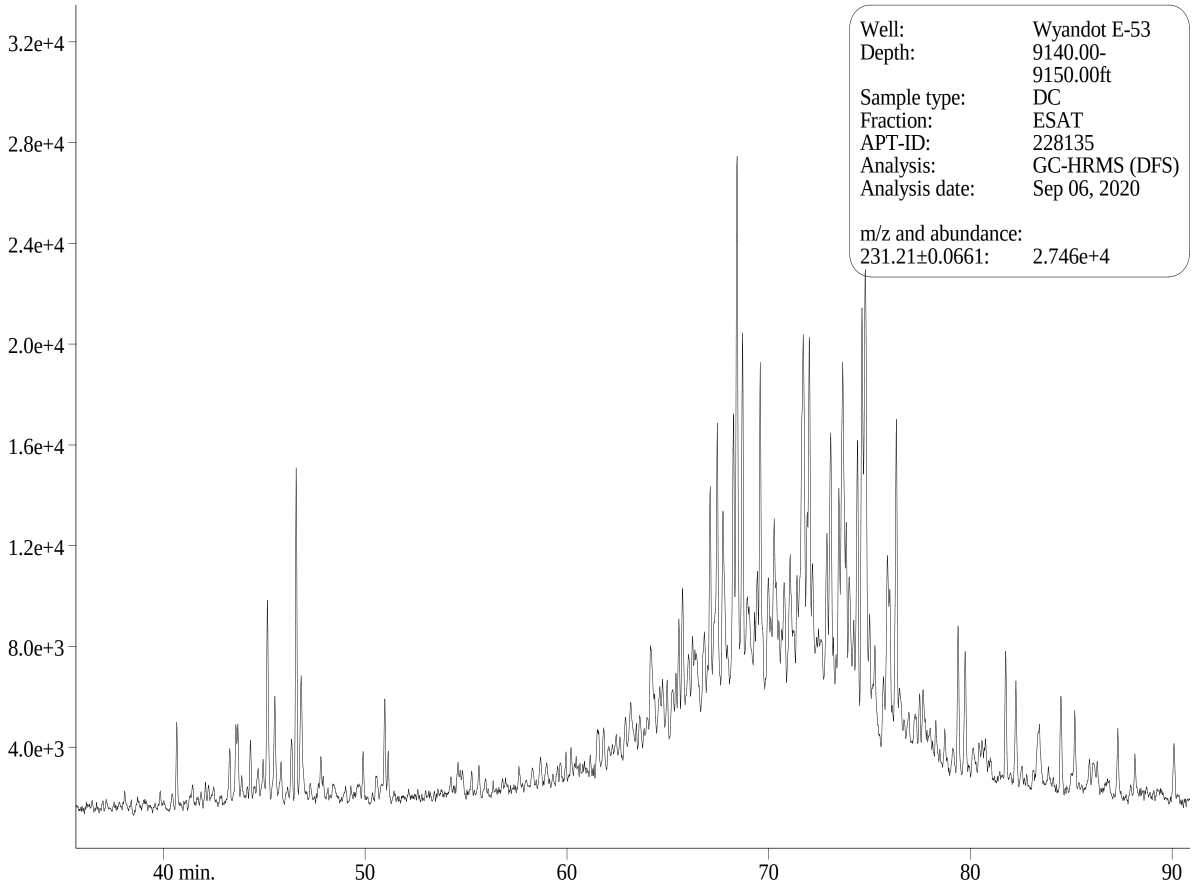
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

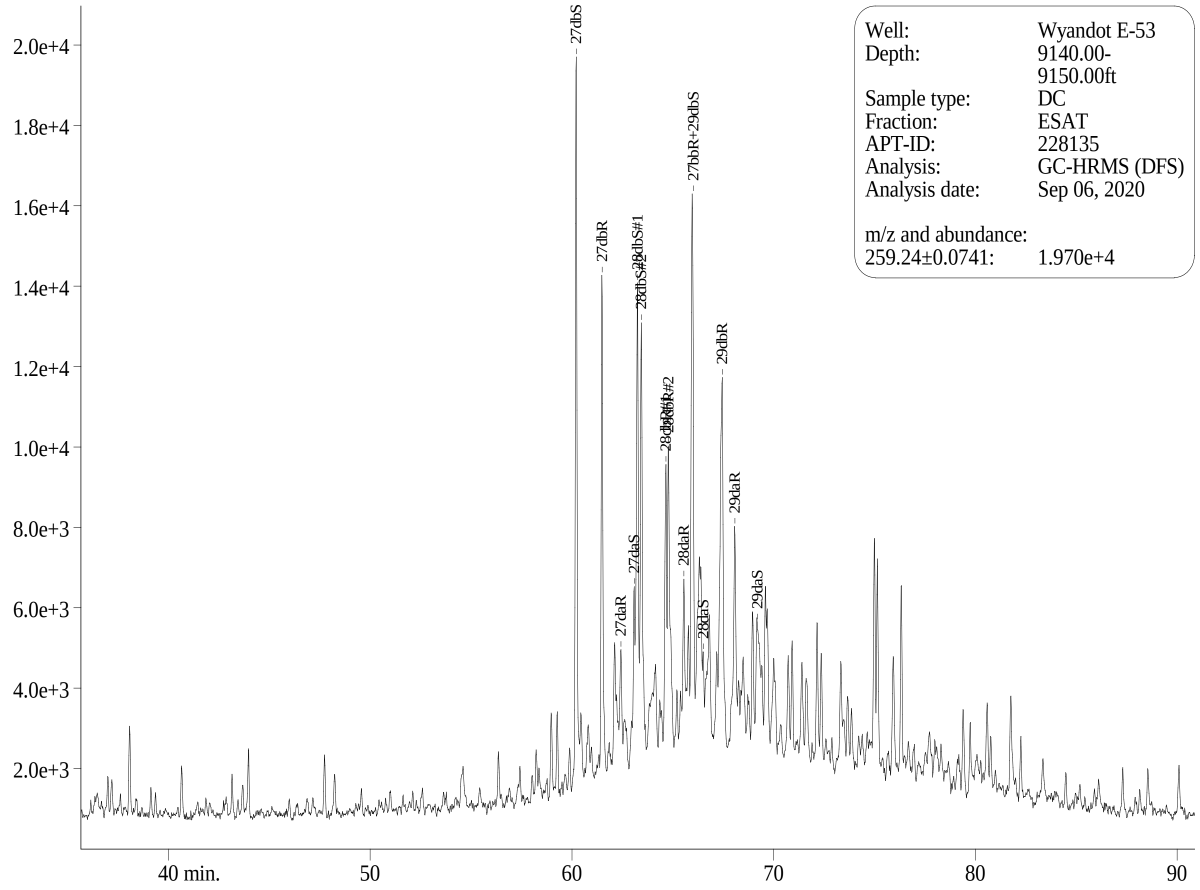
m/z and abundance:
191.18±0.0546: 5.448e+5

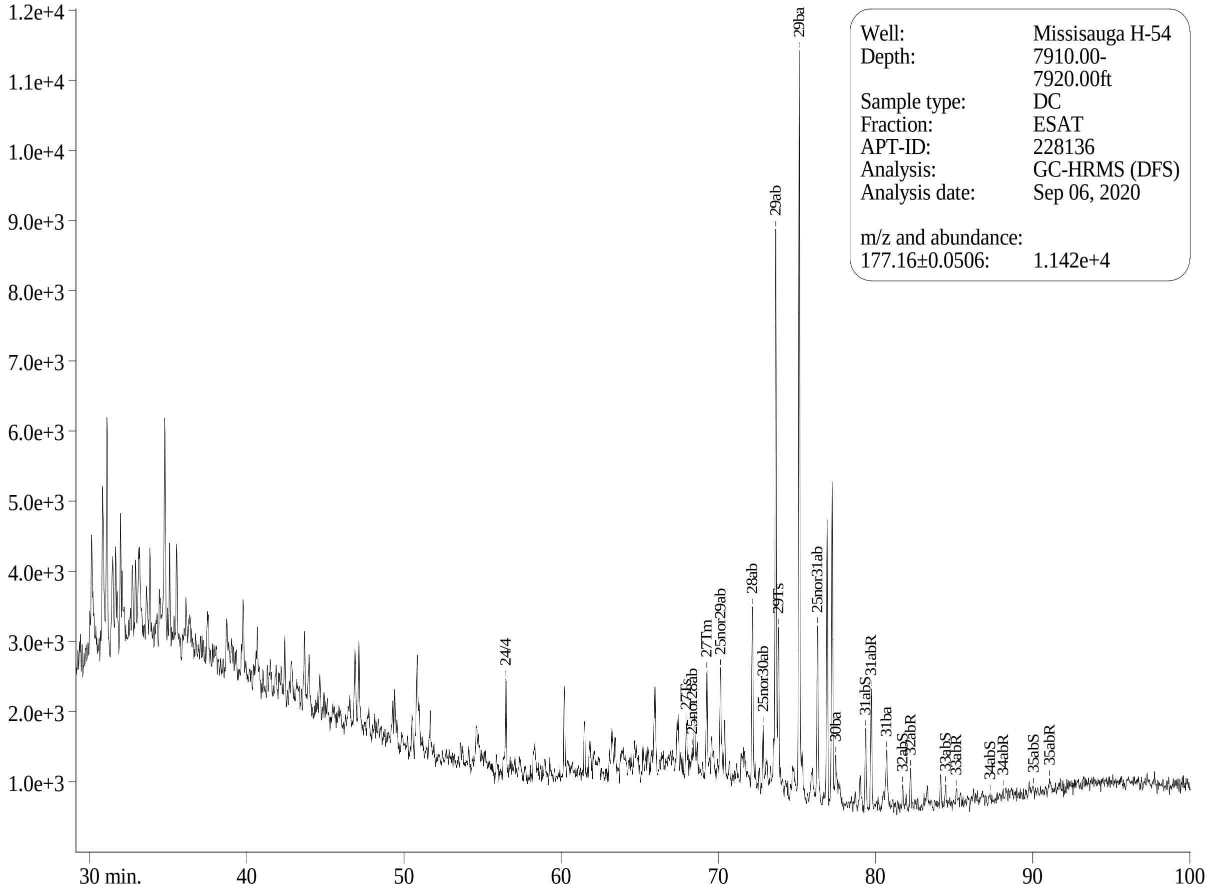

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
205.20±0.0586: 7.359e+4
1.2e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
30 min.
40
50
60
70
80
90
100
29ab
29Ts
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
217.20±0.0621: 6.585e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#2
28dbS#1
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR+29dbS
27bbS
27aaR
29dbR
29daR
29daS
28aaS
28bbR
28bbS
28aaR
29aaS
29bbS
29bbR
29aaR
30aaS
30bbR
30bbS
30aaR


Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
218.20±0.0623: 8.201e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbR
27bbS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR

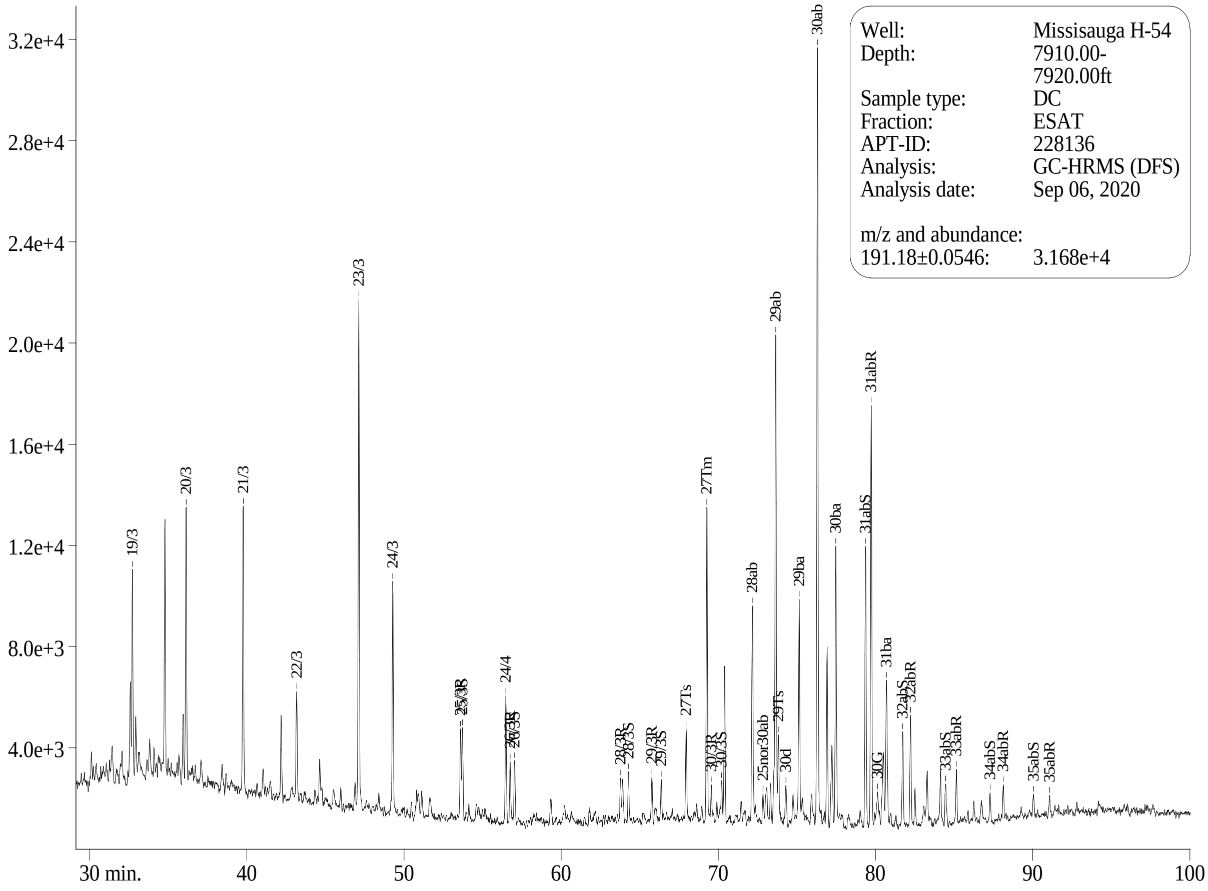

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
231.21±0.0661: 2.746e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
40 min.
50
60
70
80
90


27dbS
27dbR
28dbS#1
28dbS#2
27daS
27daR
28dbR#1
28dbR#2
28daR
27bbR+29dbS
28daS
29dbR
29daR
29daS
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
259.24±0.0741: 1.970e+4



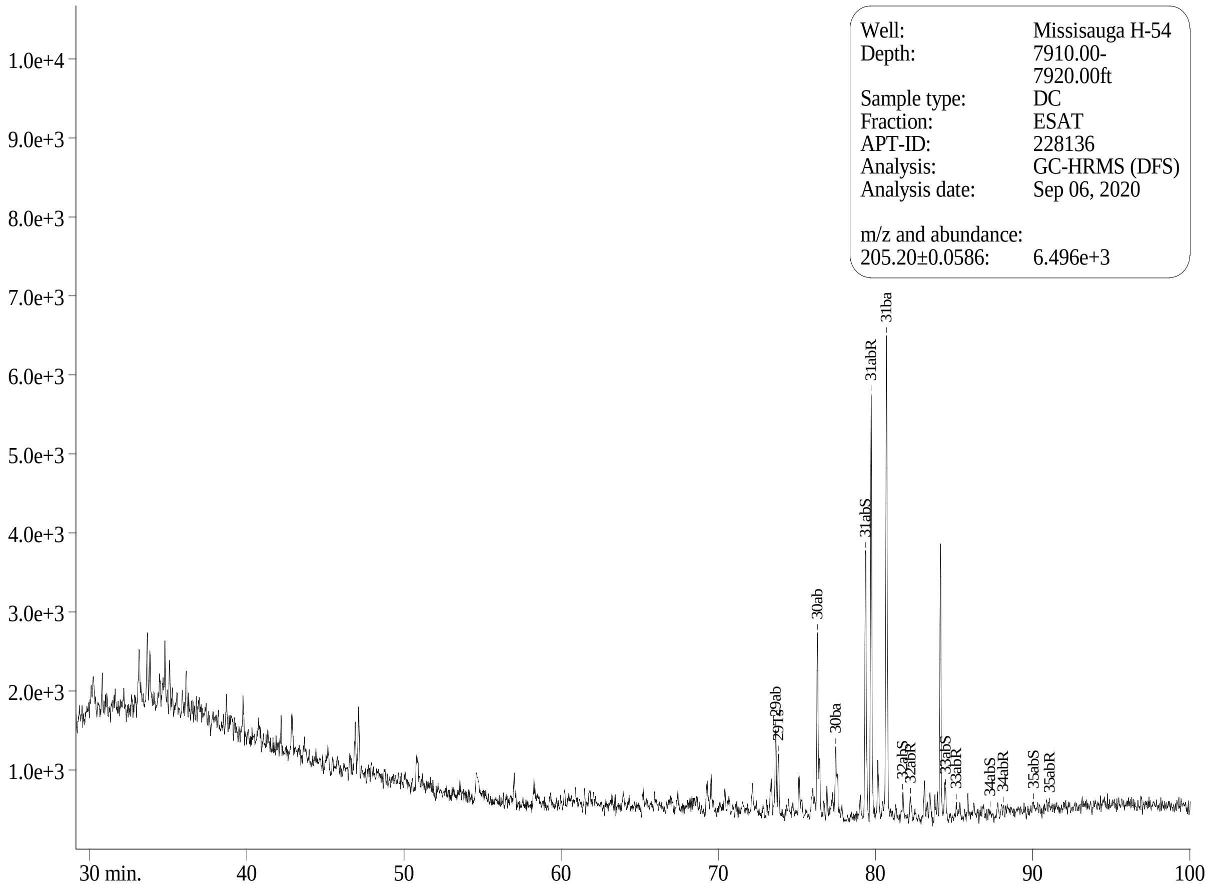
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

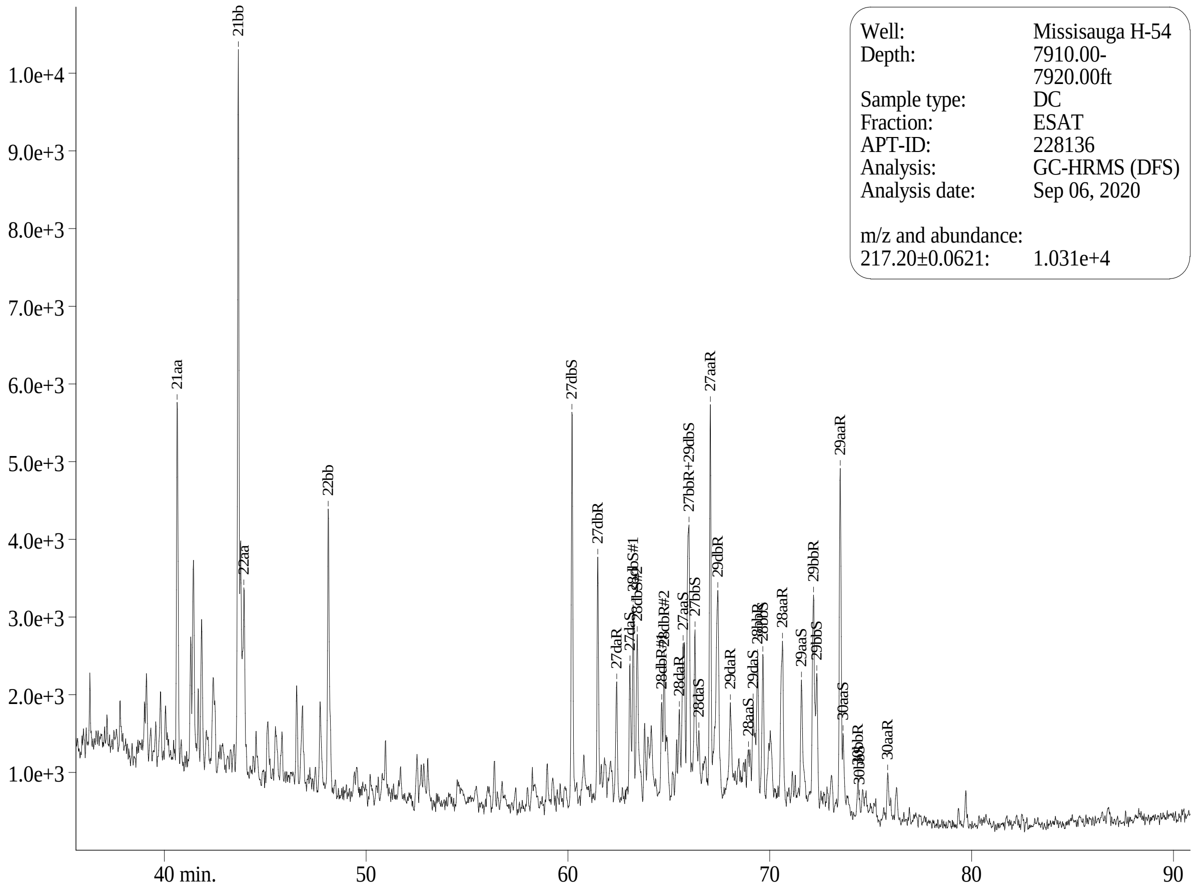
m/z and abundance:
177.16±0.0506: 1.142e+4

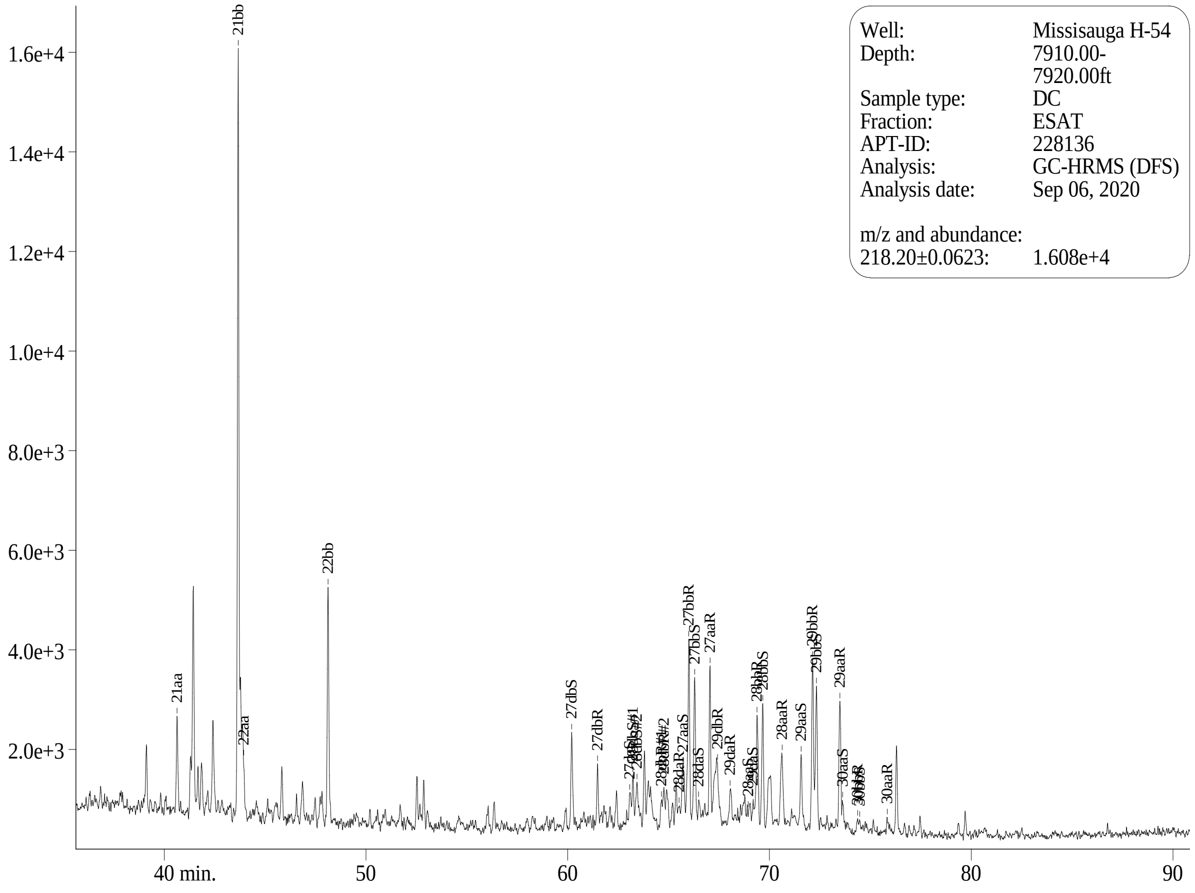


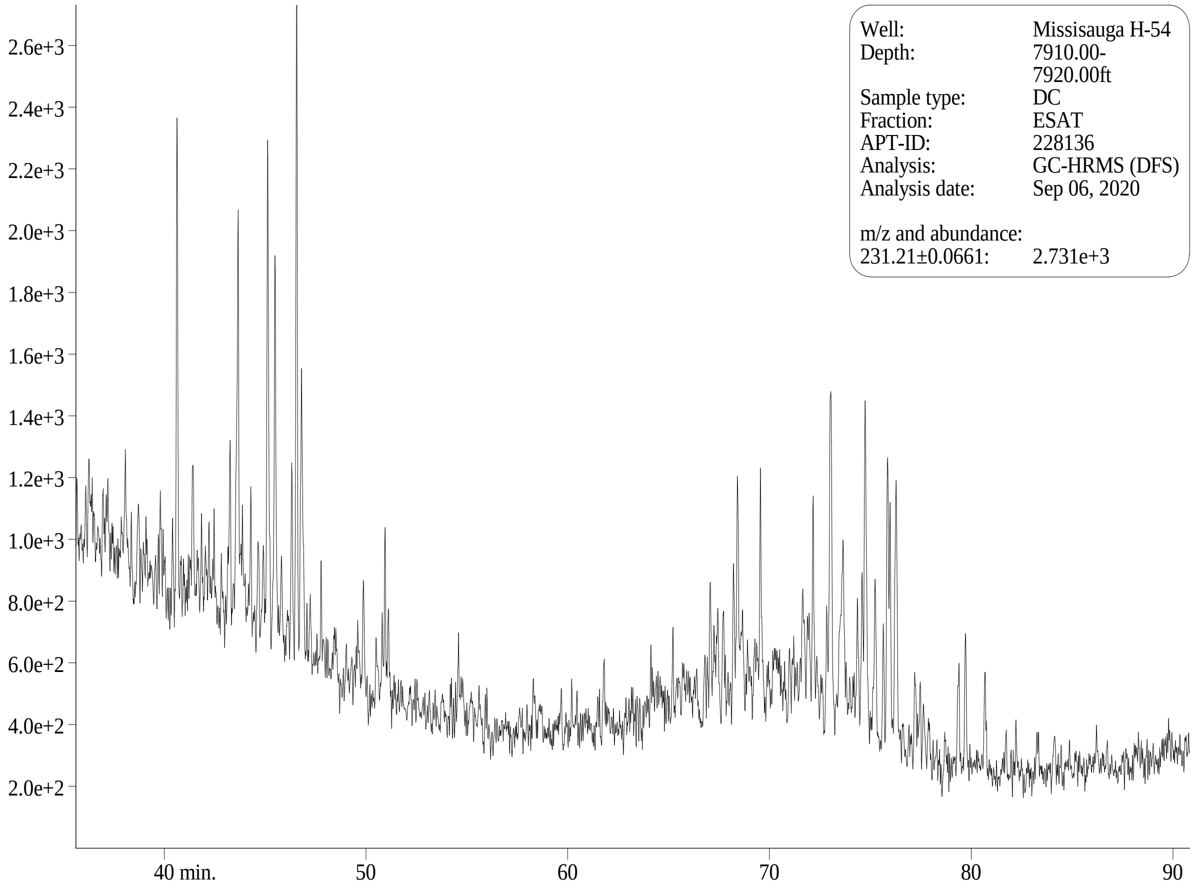
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

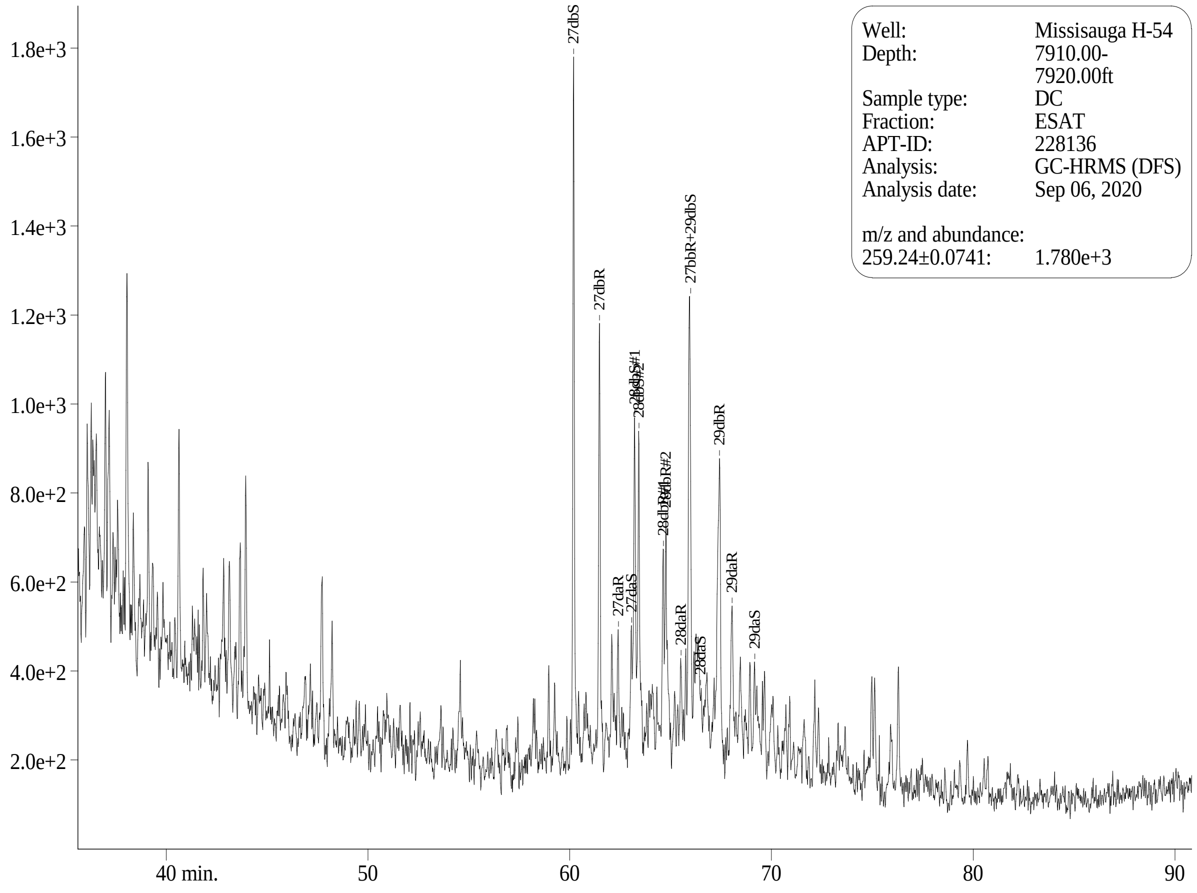
m/z and abundance:
191.18±0.0546: 3.168e+4

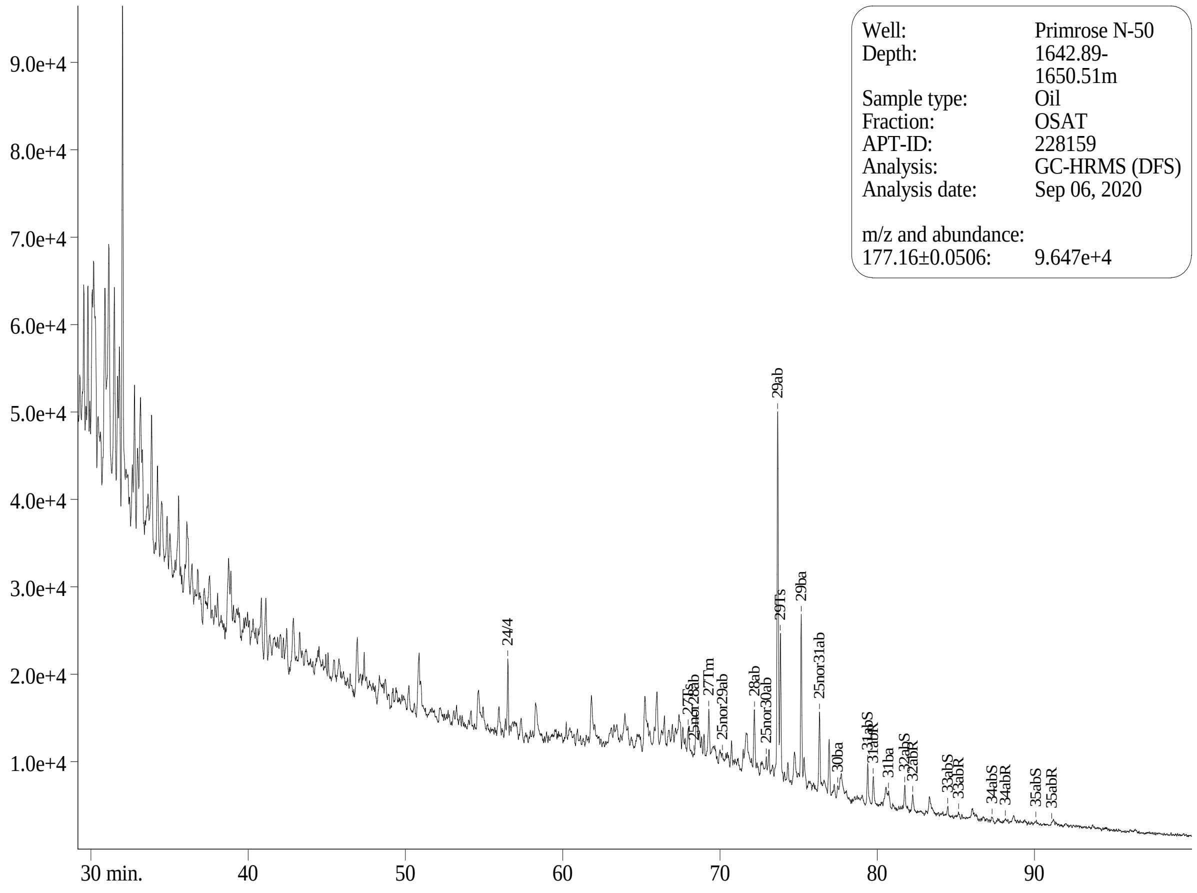

Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
205.20±0.0586: 6.496e+3
1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
30 min.
40
50
60
70
80
90
100
29Ts
29ab
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR

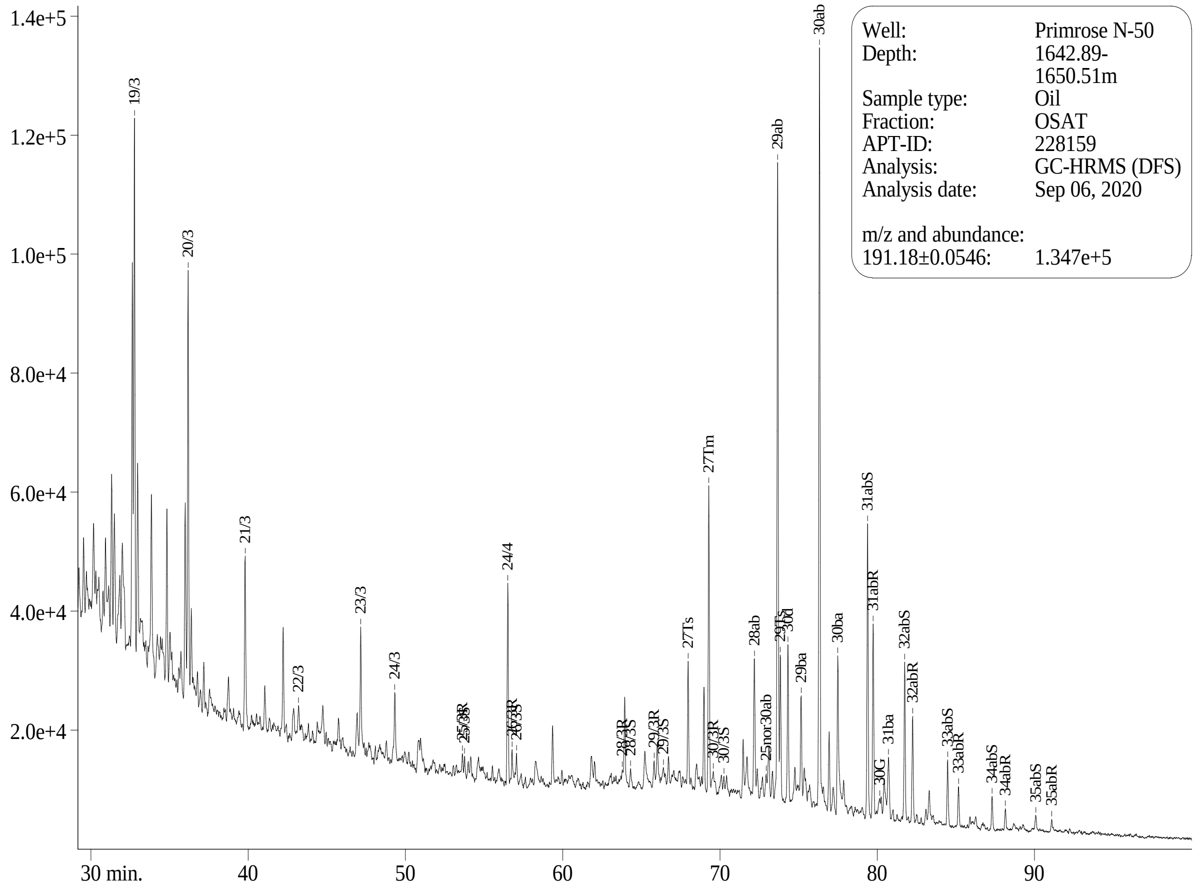

Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
217.20±0.0621: 1.031e+4
1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
27bbR+29dbS
27bbS
28daS
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbS
29bbR
29aaR
30aaS
30bbR
30bbS
30aaR


1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
21bb
21aa
22aa
22bb
27dbS
27dbR
27bbR
27bbS
27aaR
27aaS
28daS
28daR
29dbR
29daR
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30aaR
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
218.20±0.0623: 1.608e+4


2.6e+3
2.4e+3
2.2e+3
2.0e+3
1.8e+3
1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
40 min.
50
60
70
80
90
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
231.21±0.0661: 2.731e+3


Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: ESAT
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
259.24±0.0741: 1.780e+3
1.8e+3
1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
40 min.
50
60
70
80
90
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
28daS
27bbR+29dbS
29dbR
29daR
29daS


Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
177.16±0.0506: 9.647e+4
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
30 min.
40
50
60
70
80
90
24/4
27Ts
25nor28ab
27Tm
25nor29ab
28ab
25nor30ab
29Ts
29ab
29ba
25nor31ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR


Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
191.18±0.0546: 1.347e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
30 min.
40
50
60
70
80
90
19/3
20/3
21/3
22/3
23/3
24/3
25/3R
25/3S
24/4
26/3R
26/3S
28/3R
28/3S
29/3R
29/3S
27Ts
27Tm
30/3R
30/3S
28ab
25nor30ab
29Ts
29ab
30d
29ba
30ab
30ba
31abS
31abR
30G
31ba
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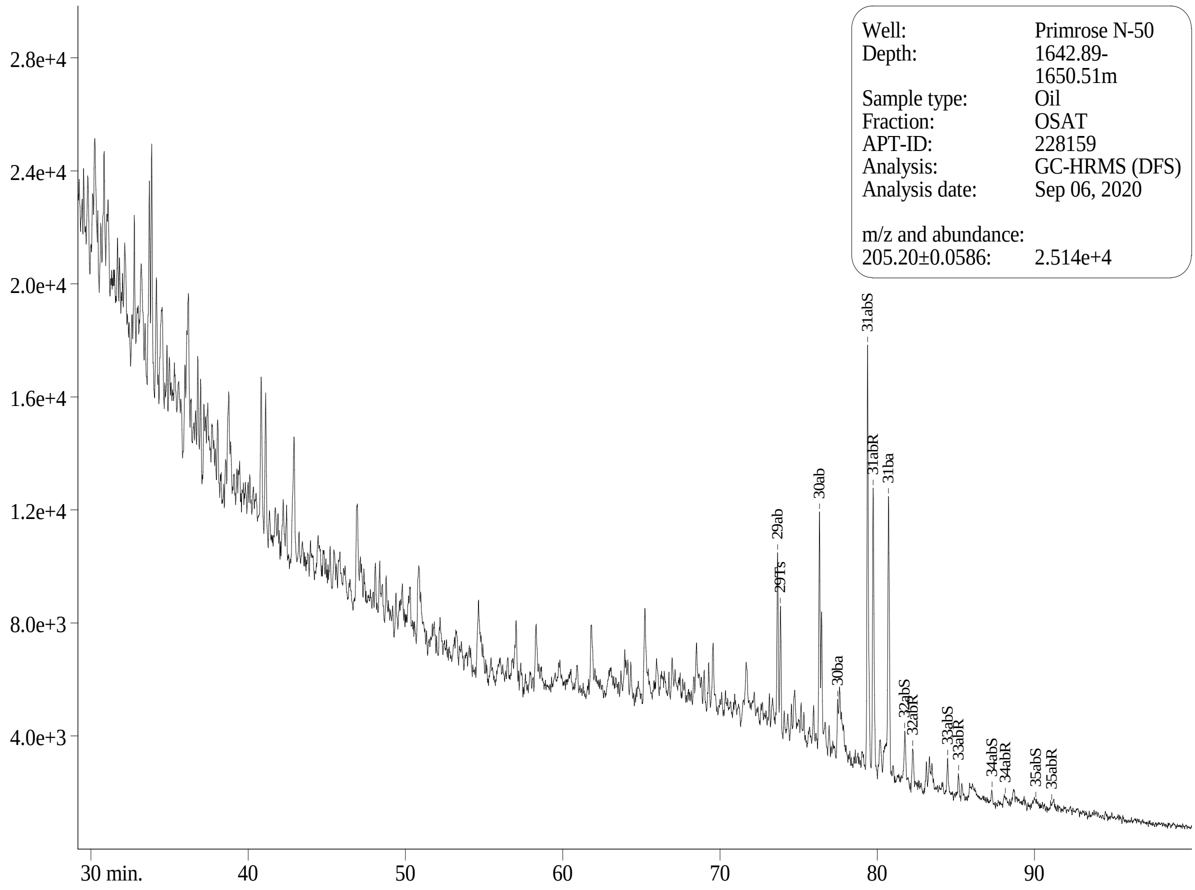
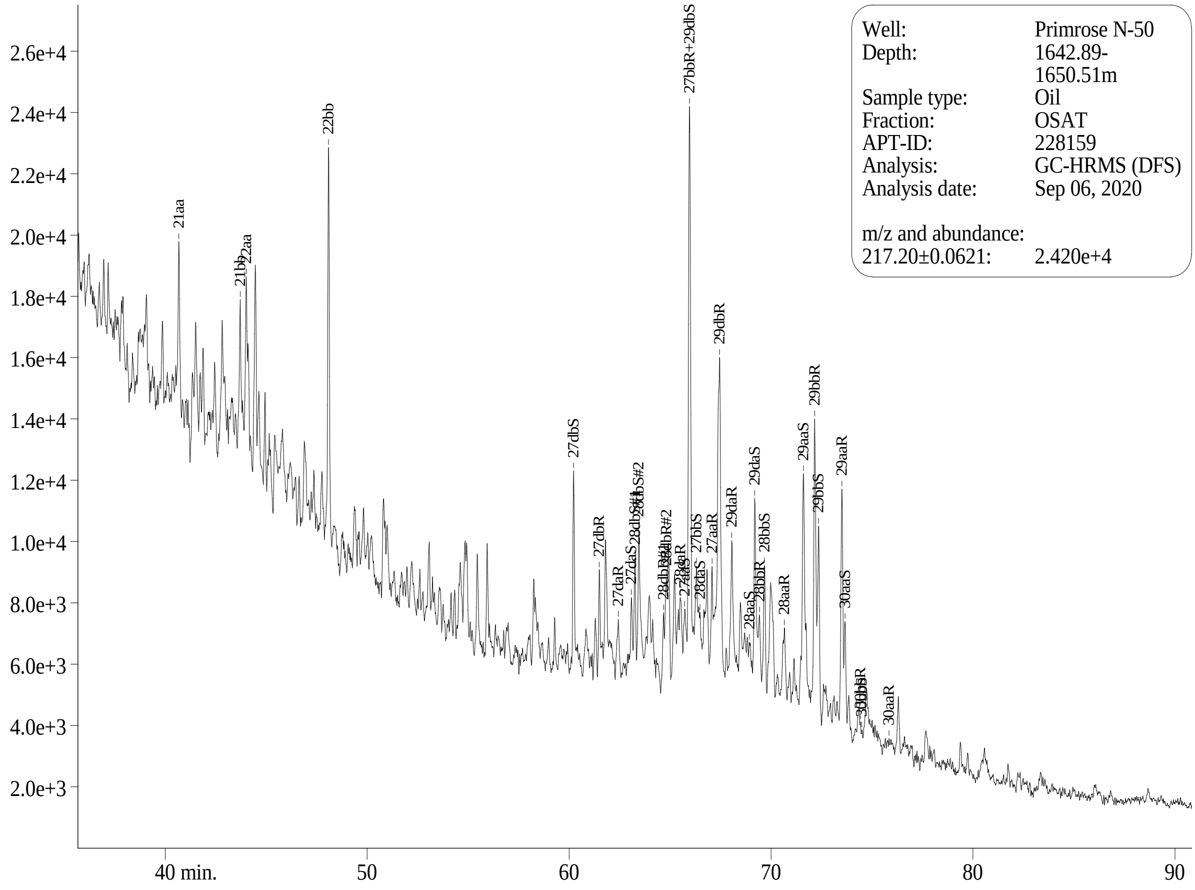
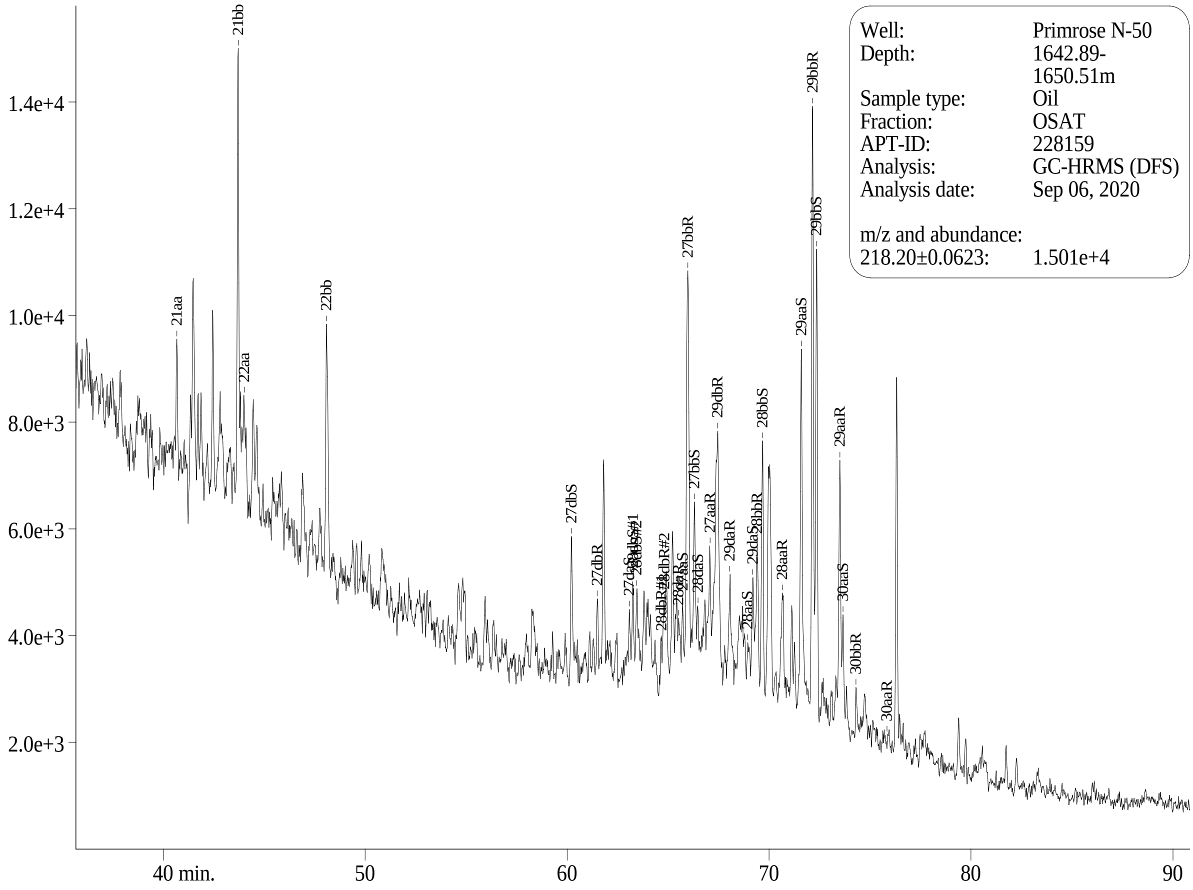
32abR
33abS
33abR
34abS
34abR
35abS
35abR

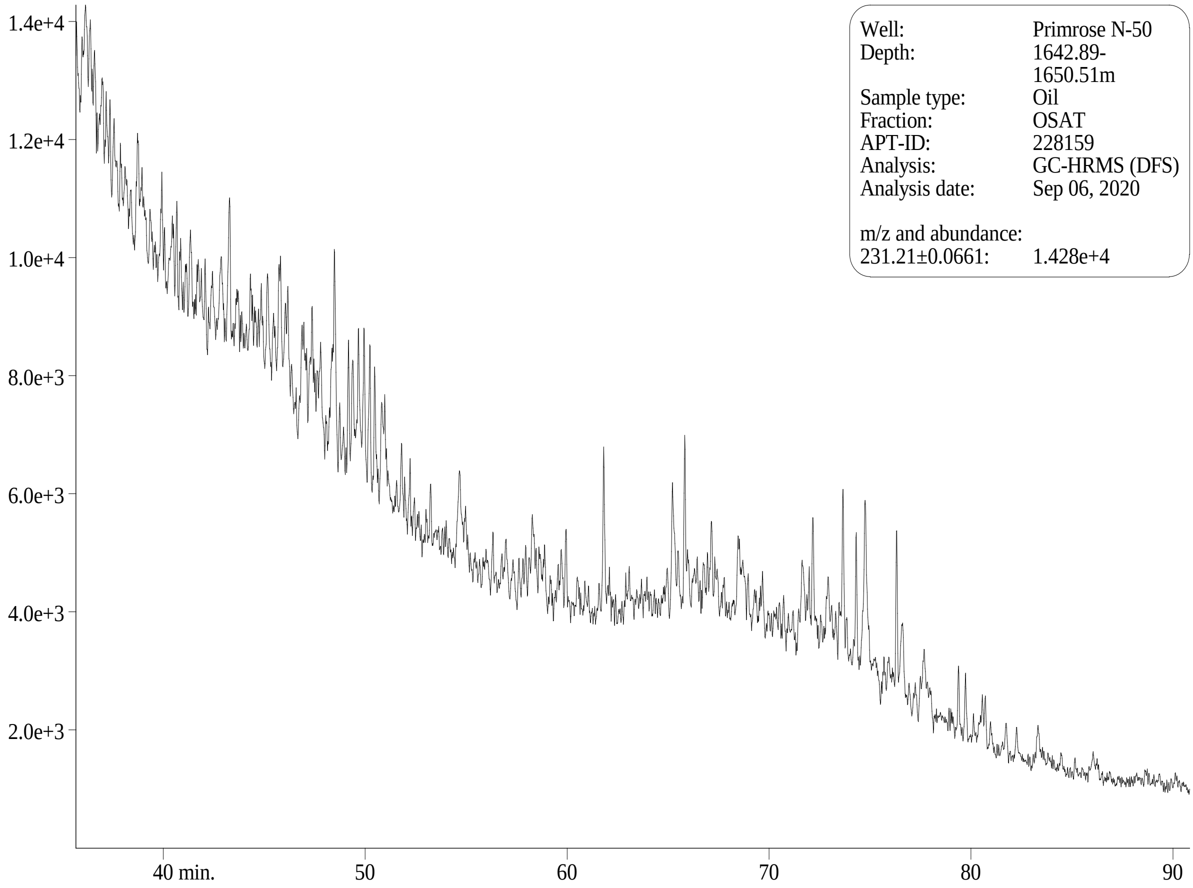


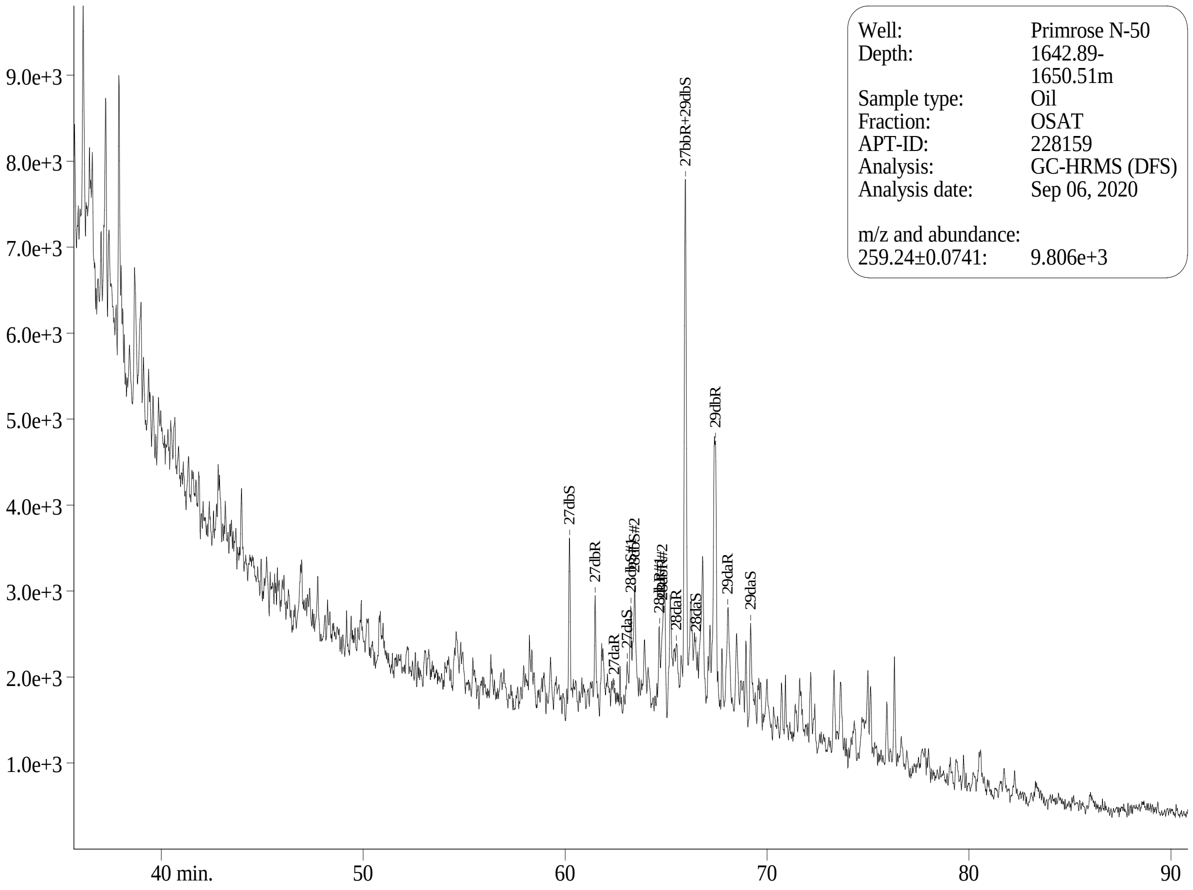
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
205.20±0.0586: 2.514e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
30 min.
40
50
60
70
80
90
29Ts
29ab
30ab
30ba
31abS
31abR
31ba
32abS
32abR
33abS
33abR
34abS
34abR
35abS
35abR



Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
217.20±0.0621: 2.420e+4
2.6e+4
2.4e+4
2.2e+4
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
21aa
21bb
22aa
22bb
27dbS
27dbR
27daR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
27bbR+29dbS
28daS
27bbS
27aaR
29dbR
29daR
29daS
28aaS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30bbS
30aaR


21bb
21aa
22aa
22bb
27dbS
27dbR
27daS
28dbS#1
28dbS#2
28dbR#1
28dbR#2
28daR
27aaS
28daS
27bbS
27bbR
27aaR
29dbR
29daR
28aaS
29daS
28bbR
28bbS
28aaR
29aaS
29bbR
29bbS
29aaR
30aaS
30bbR
30aaR
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
218.20±0.0623: 1.501e+4

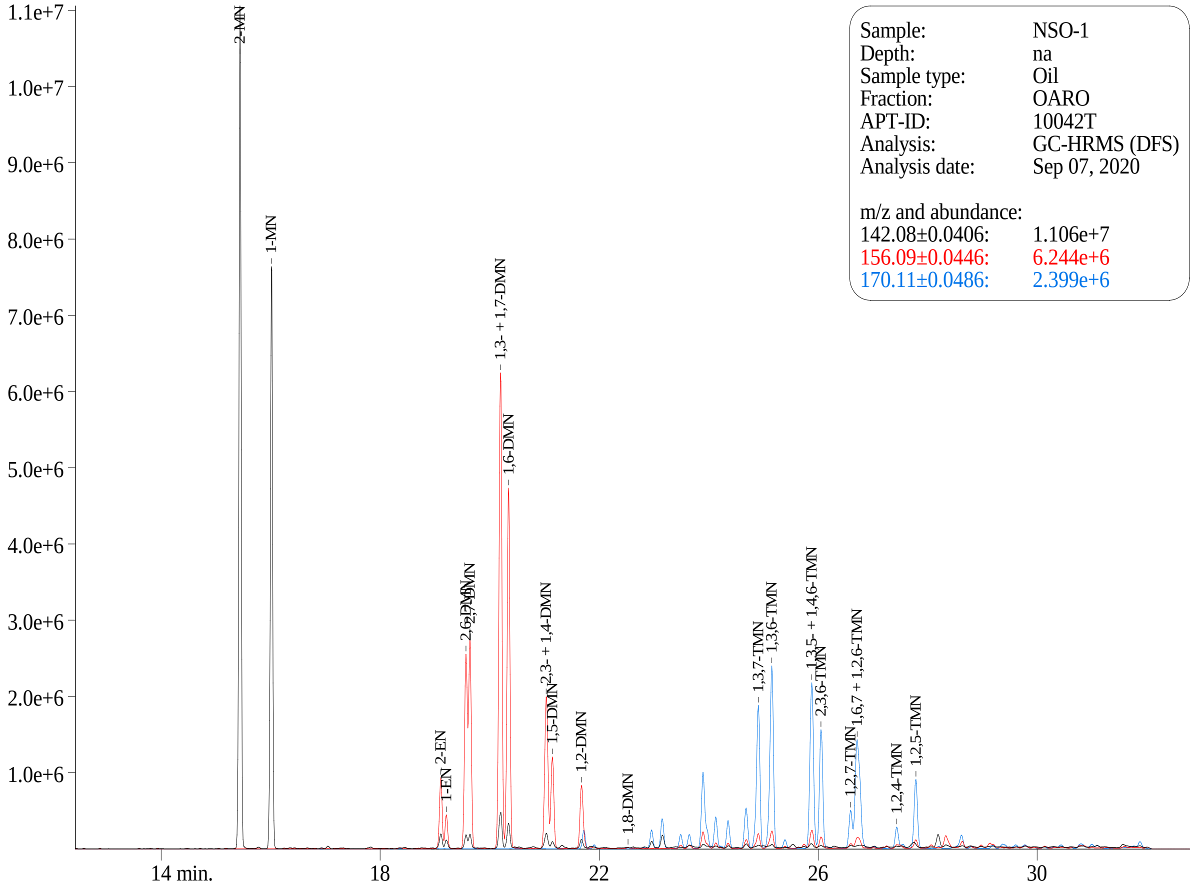

1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
40 min.
50
60
70
80
90
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020
m/z and abundance:
231.21±0.0661: 1.428e+4

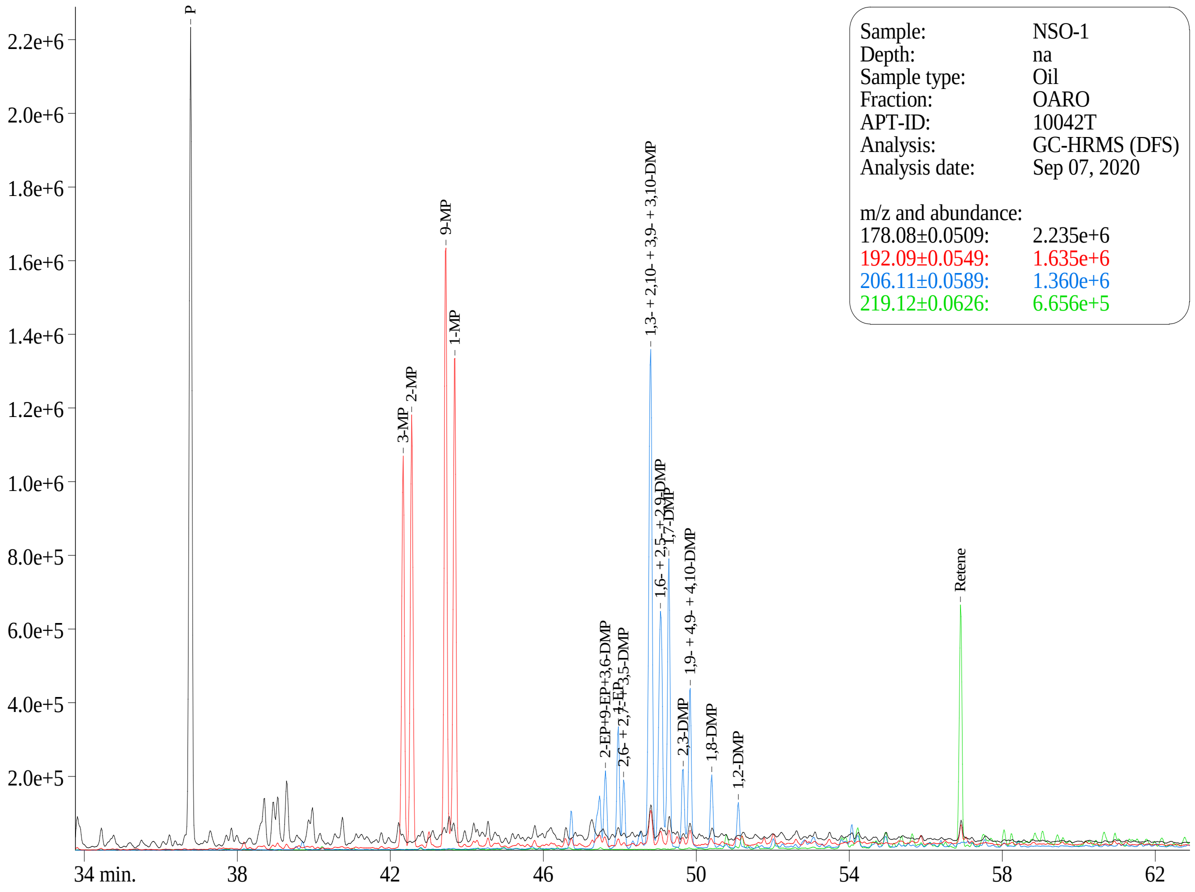


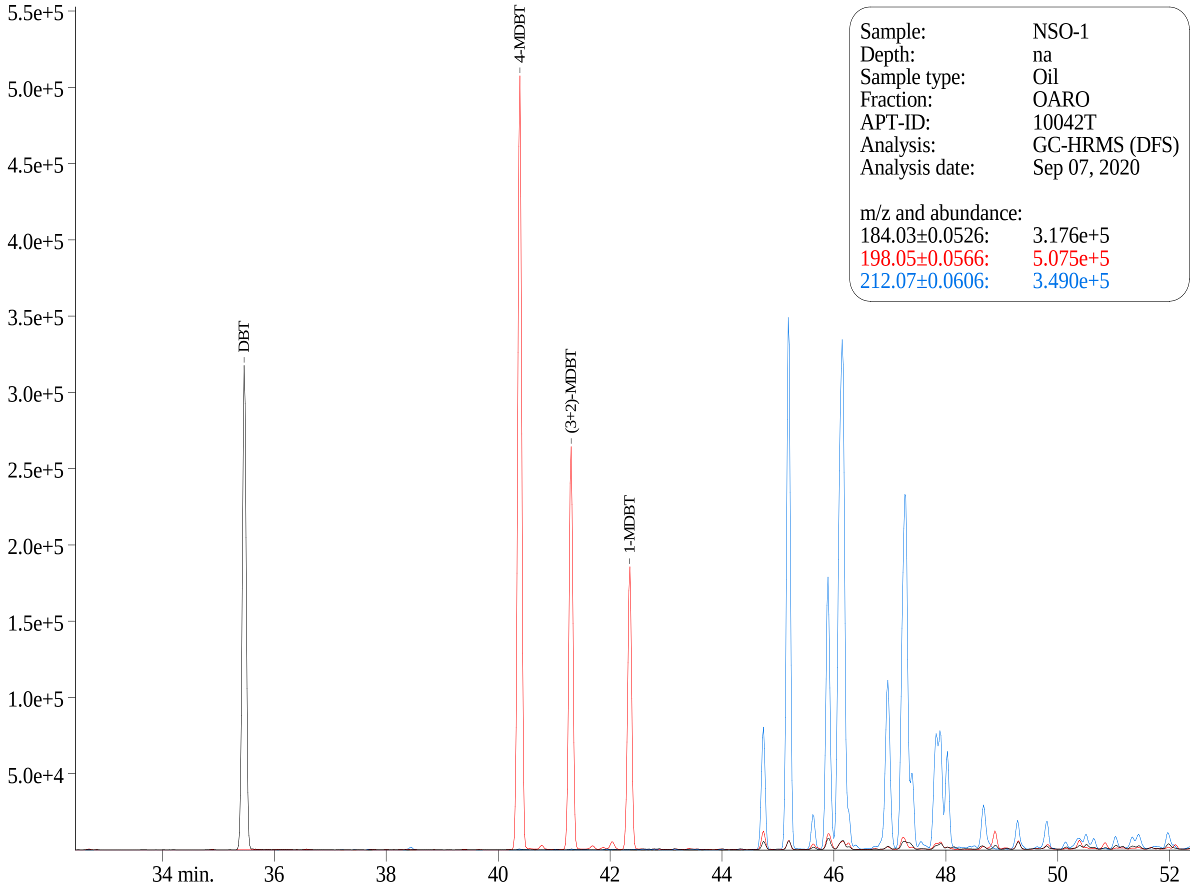
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OSAT
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 06, 2020

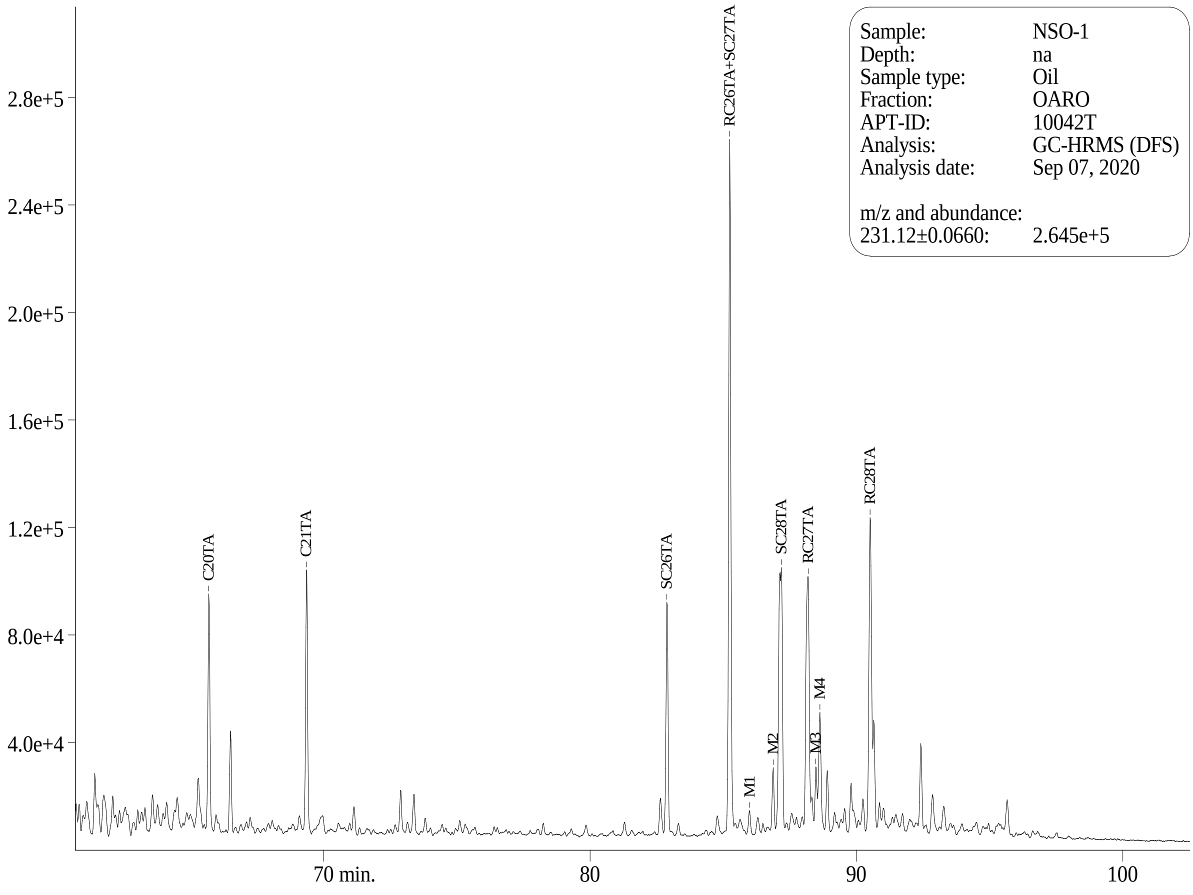
m/z and abundance:
259.24±0.0741: 9.806e+3

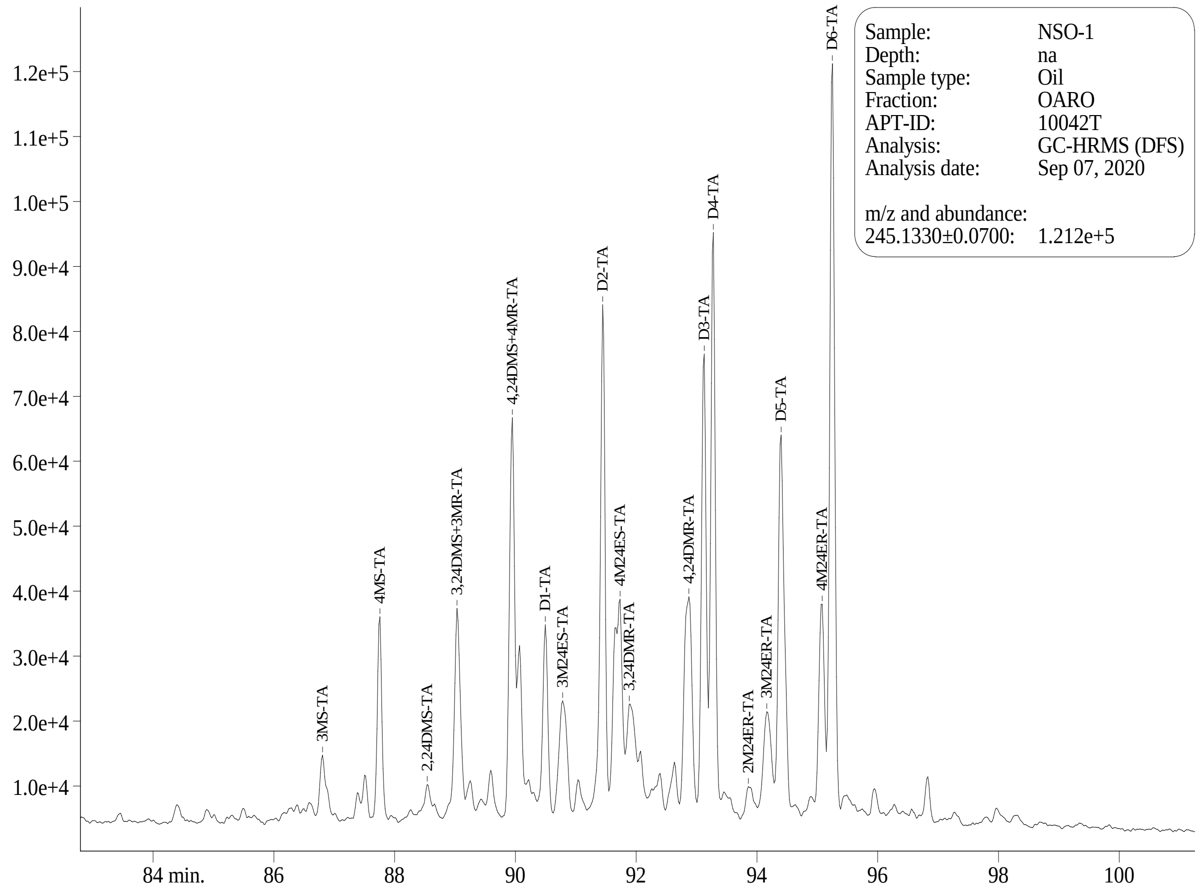
## *GC-MS Chromatograms of Aromatic Hydrocarbons*

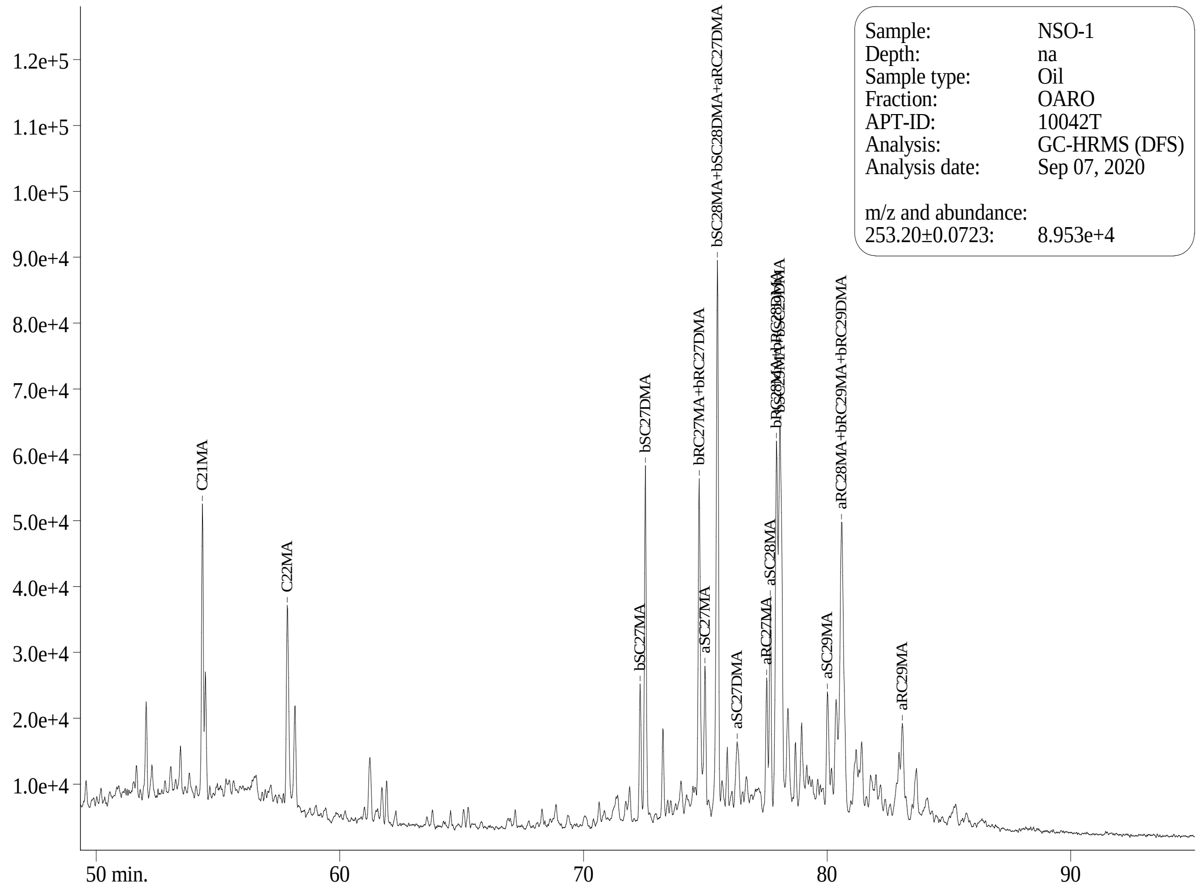

Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
142.08±0.0406: 1.106e+7
156.09±0.0446: 6.244e+6
170.11±0.0486: 2.399e+6
1.1e+7
1.0e+7
9.0e+6
8.0e+6
7.0e+6
6.0e+6
5.0e+6
4.0e+6
3.0e+6
2.0e+6
1.0e+6
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN

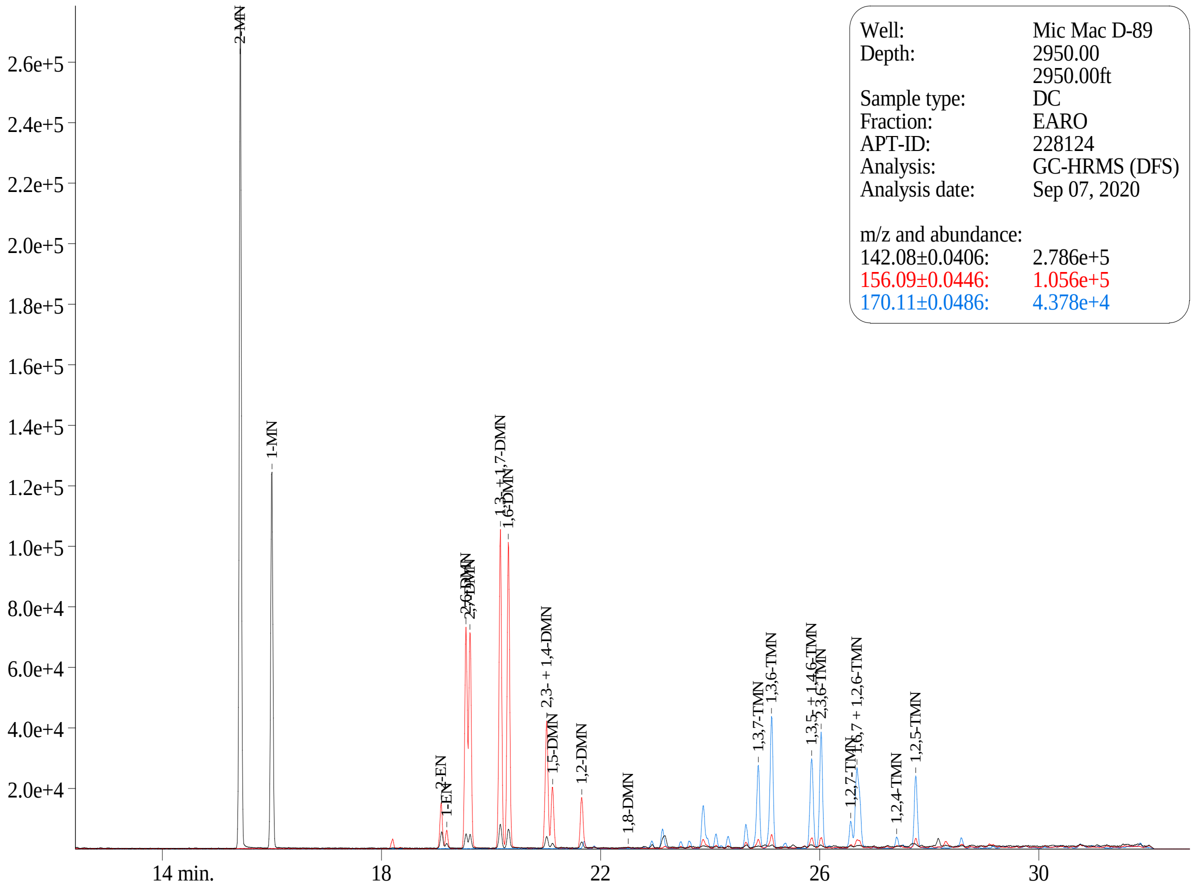

Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
178.08±0.0509: 2.235e+6
192.09±0.0549: 1.635e+6
206.11±0.0589: 1.360e+6
219.12±0.0626: 6.656e+5
2.2e+6
2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene

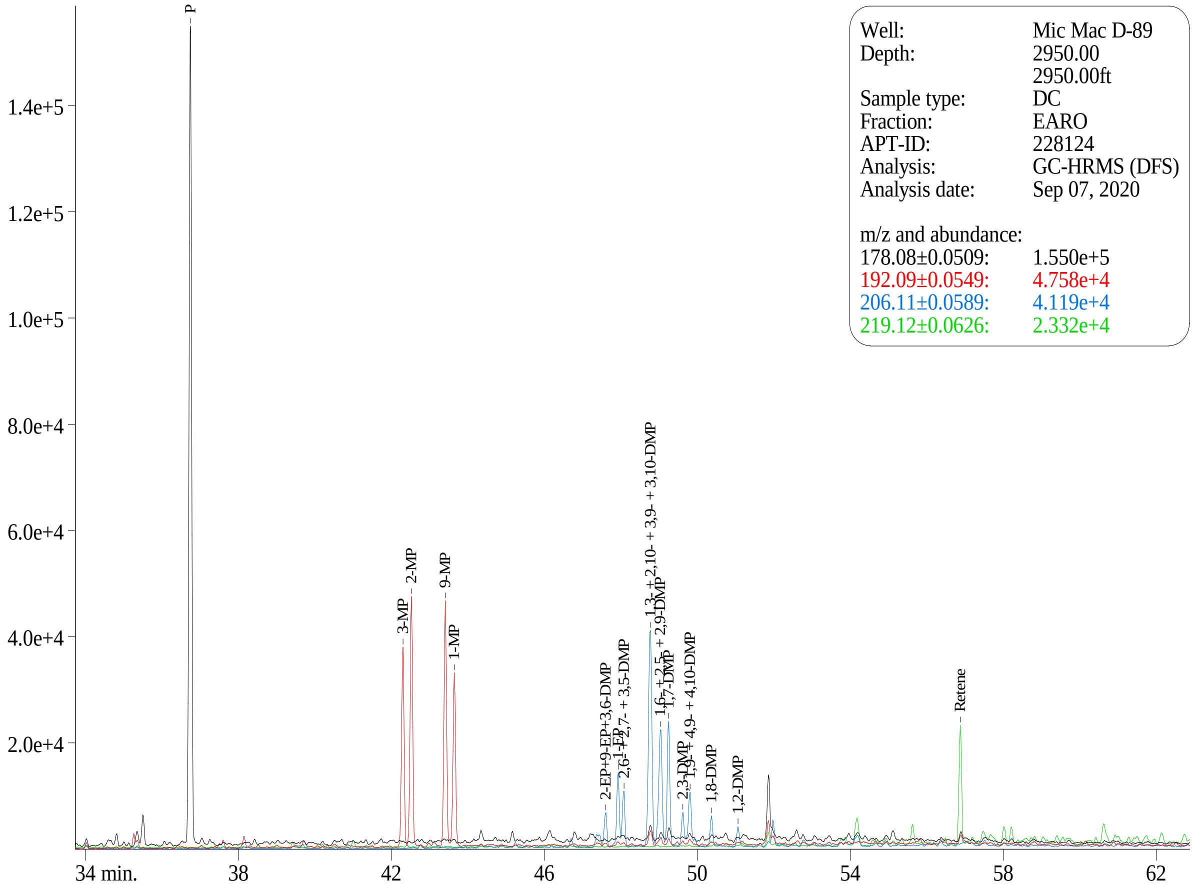

5.5e+5
5.0e+5
4.5e+5
4.0e+5
3.5e+5
3.0e+5
2.5e+5
2.0e+5
1.5e+5
1.0e+5
5.0e+4
34 min.
36
38
40
42
44
46
48
50
52
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
184.03±0.0526: 3.176e+5
198.05±0.0566: 5.075e+5
212.07±0.0606: 3.490e+5

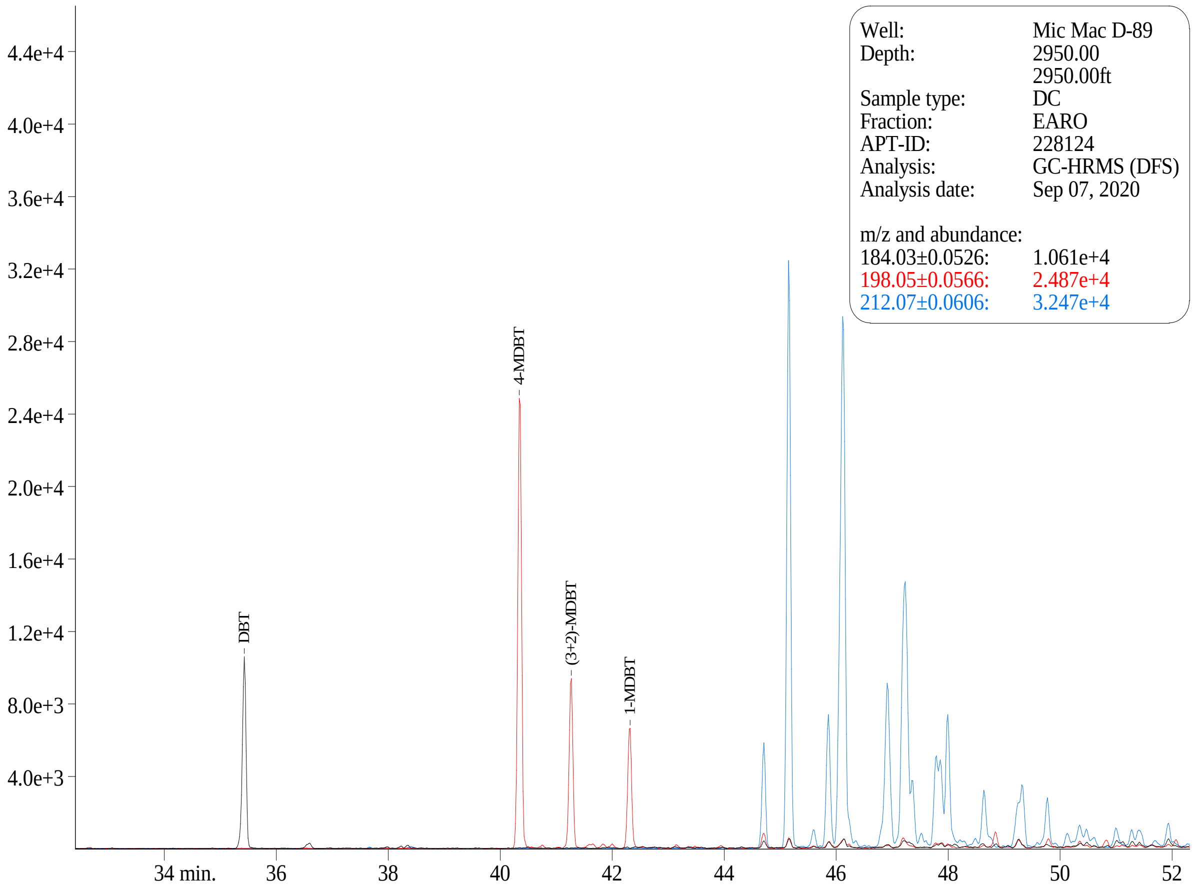

2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
70 min.
80
90
100
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
231.12±0.0660: 2.645e+5

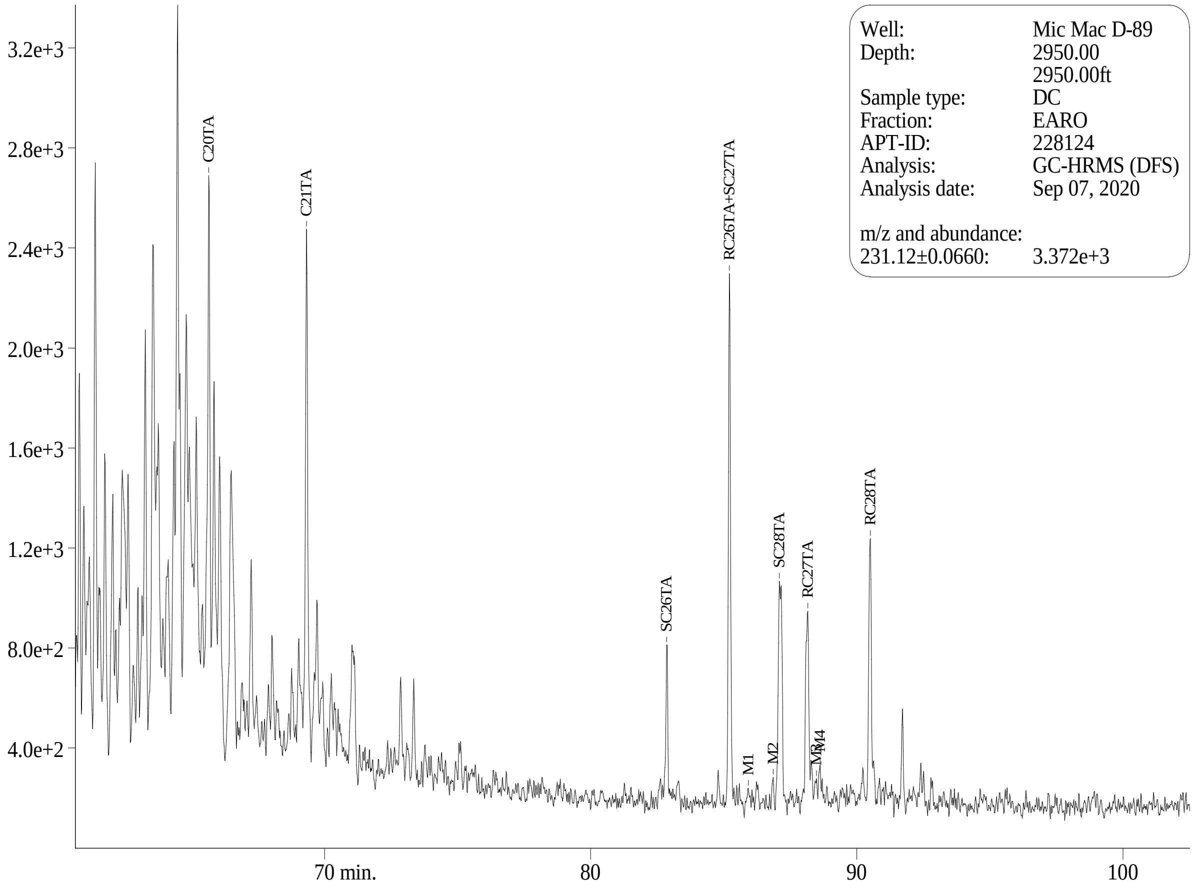

1.2e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
245.1330±0.0700: 1.212e+5

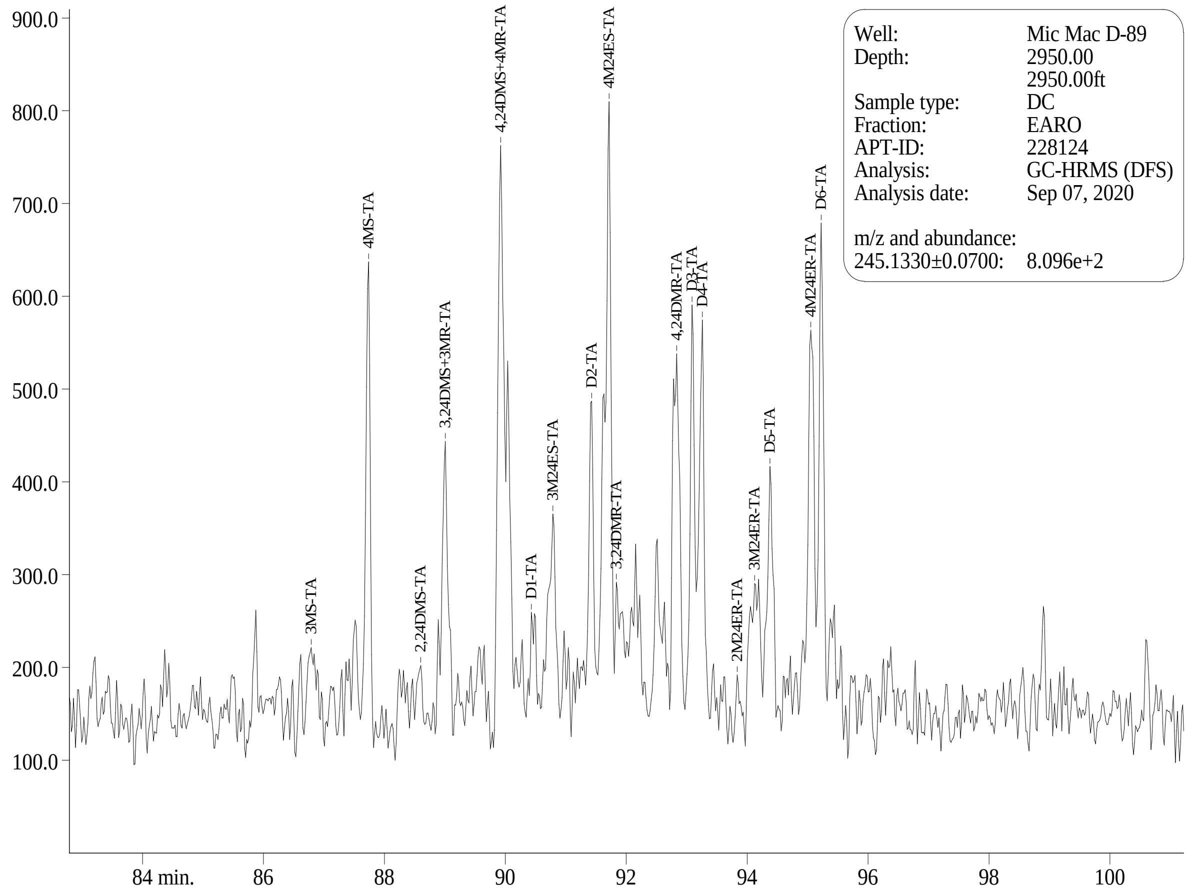

1.2e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Sample: NSO-1
Depth: na
Sample type: Oil
Fraction: OARO
APT-ID: 10042T
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
253.20±0.0723: 8.953e+4

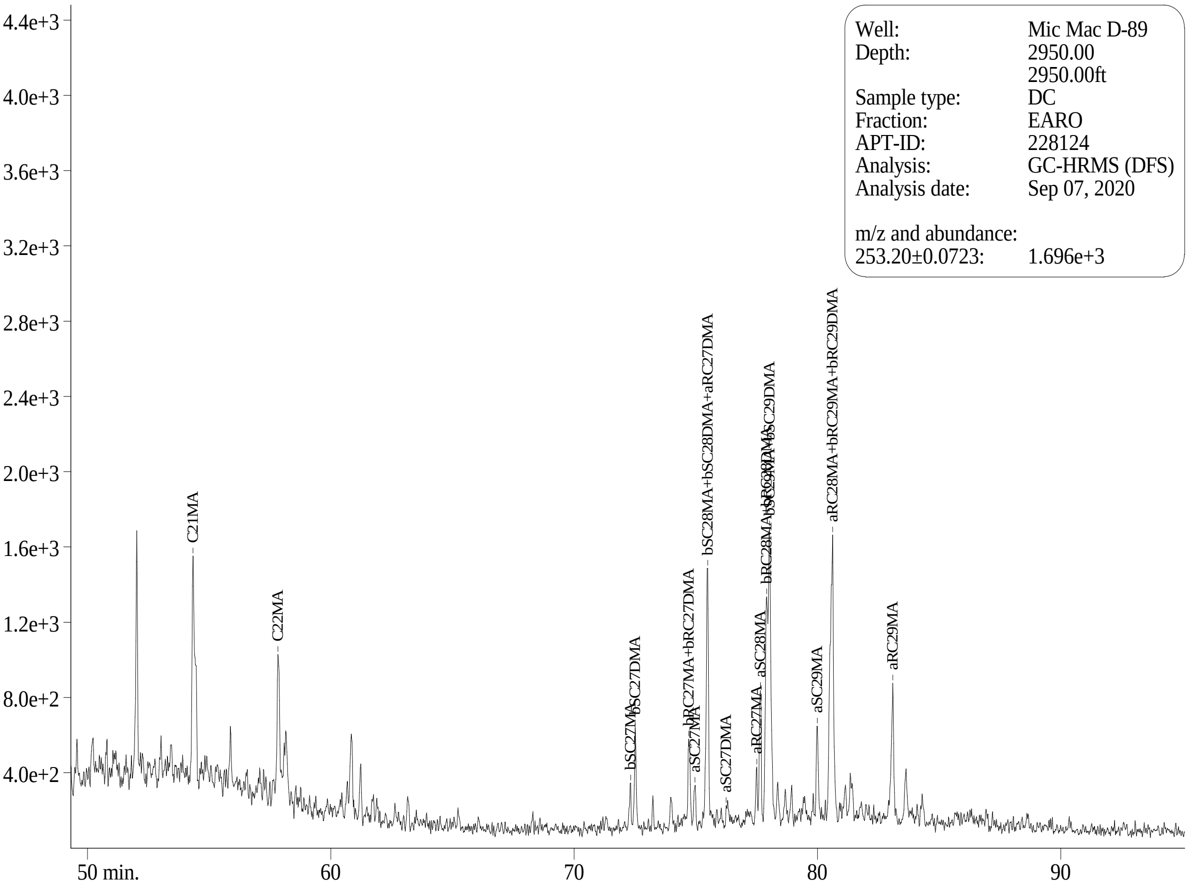

2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
2.6e+5
2.4e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
14 min.
18
22
26
30
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
142.08±0.0406: 2.786e+5
156.09±0.0446: 1.056e+5
170.11±0.0486: 4.378e+4

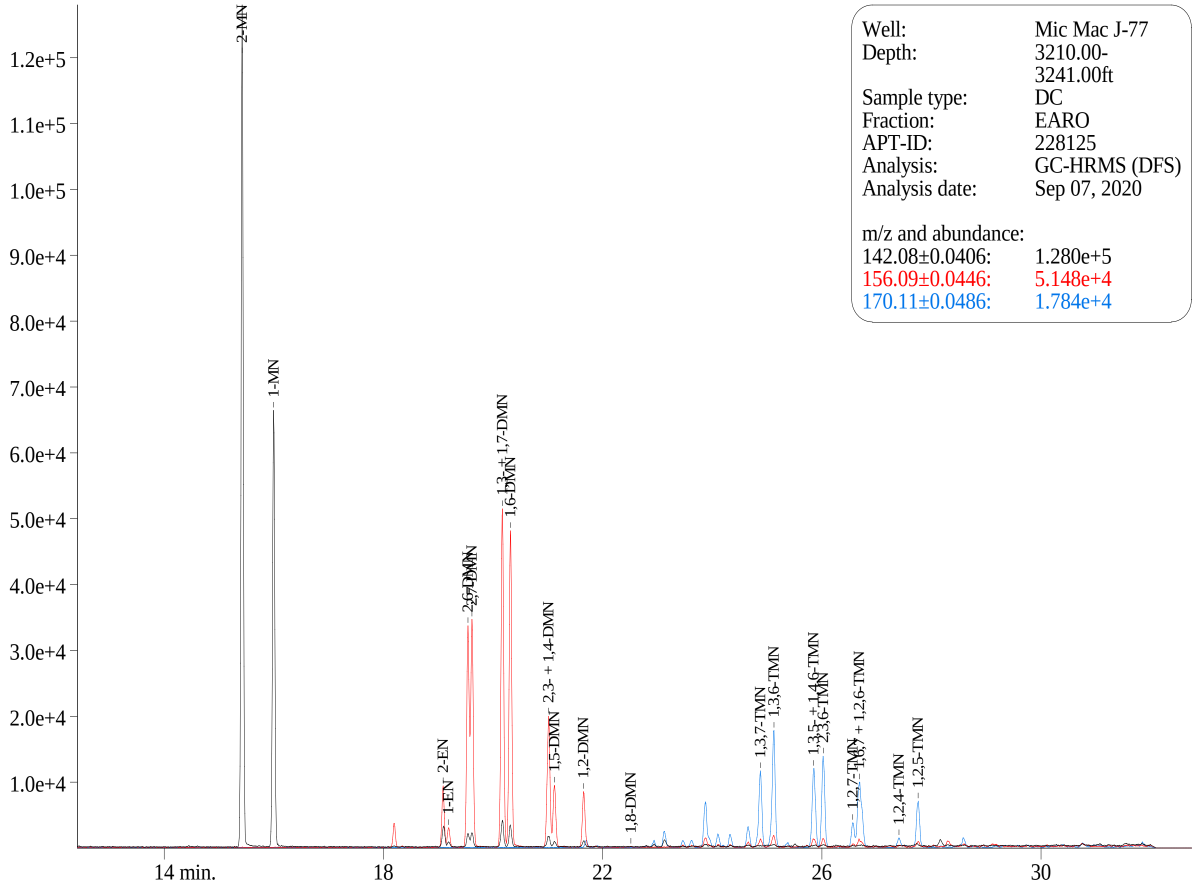

P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
3-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
34 min.
38
42
46
50
54
58
62
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
178.08±0.0509: 1.550e+5
192.09±0.0549: 4.758e+4
206.11±0.0589: 4.119e+4
219.12±0.0626: 2.332e+4

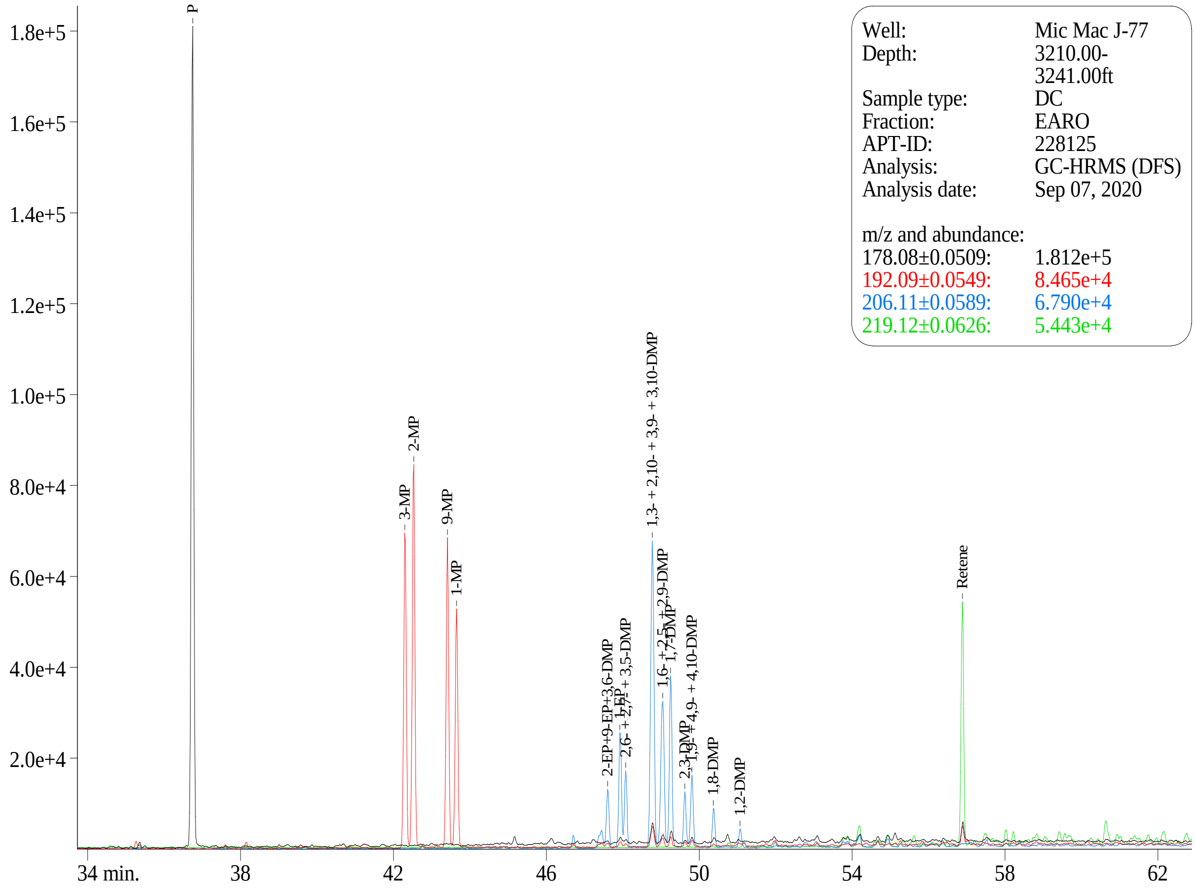

Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
184.03±0.0526: 1.061e+4
198.05±0.0566: 2.487e+4
212.07±0.0606: 3.247e+4
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
4.4e+4
4.0e+4
3.6e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
34 min.
36
38
40
42
44
46
48
50
52

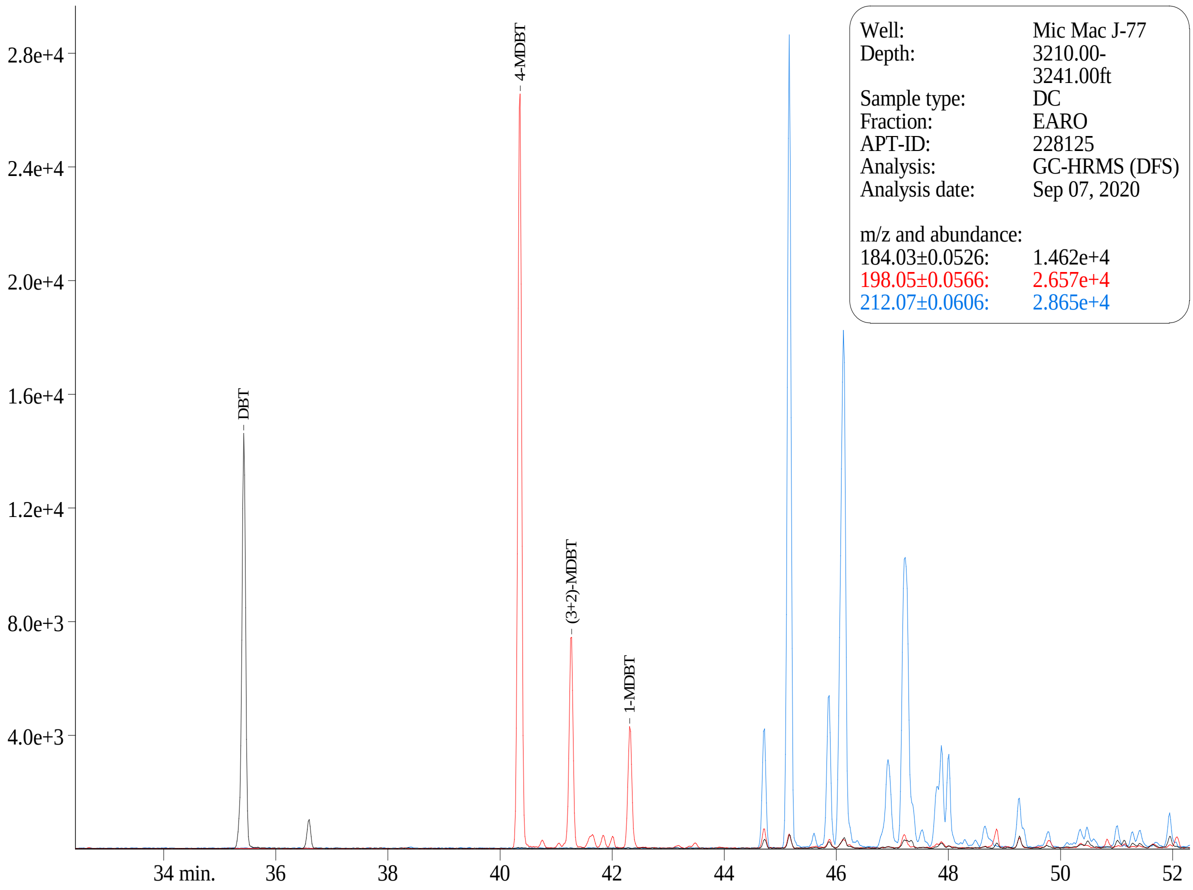

Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
231.12±0.0660: 3.372e+3
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
70 min.
80
90
100


900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
245.1330±0.0700: 8.096e+2


4.4e+3
4.0e+3
3.6e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC29DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Mic Mac D-89
Depth: 2950.00
2950.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228124
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
253.20±0.0723: 1.696e+3

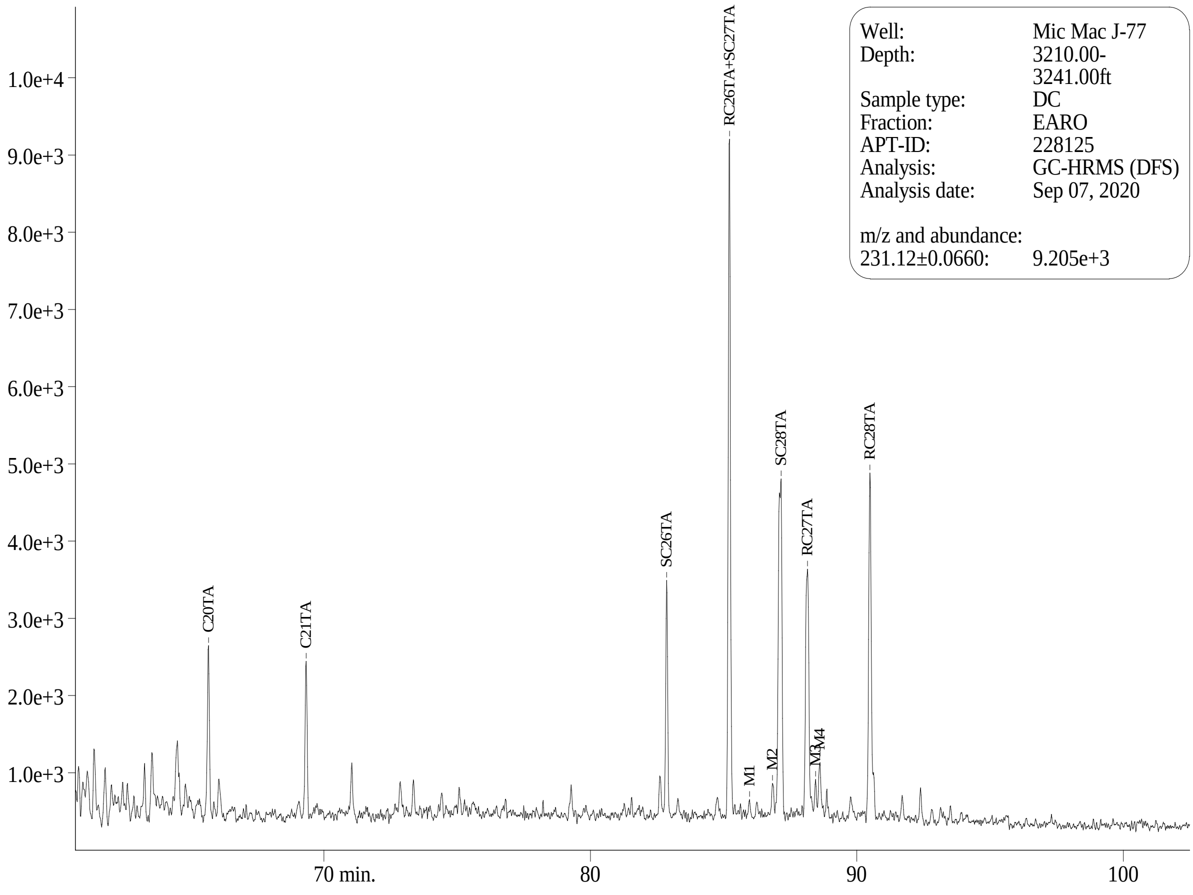

1.2e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
142.08±0.0406: 1.280e+5
156.09±0.0446: 5.148e+4
170.11±0.0486: 1.784e+4


1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
178.08±0.0509: 1.812e+5
192.09±0.0549: 8.465e+4
206.11±0.0589: 6.790e+4
219.12±0.0626: 5.443e+4



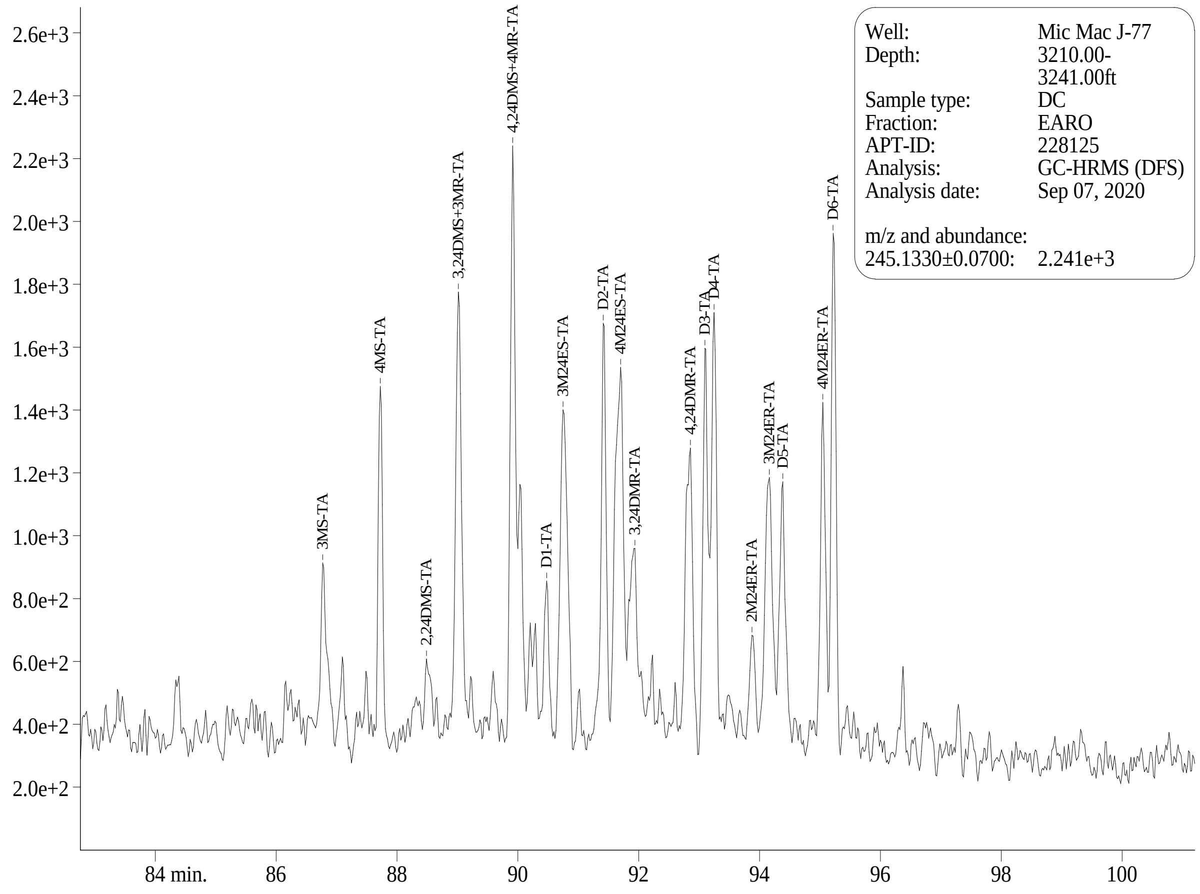
Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020

m/z and abundance:
184.03±0.0526: 1.462e+4
198.05±0.0566: 2.657e+4
212.07±0.0606: 2.865e+4

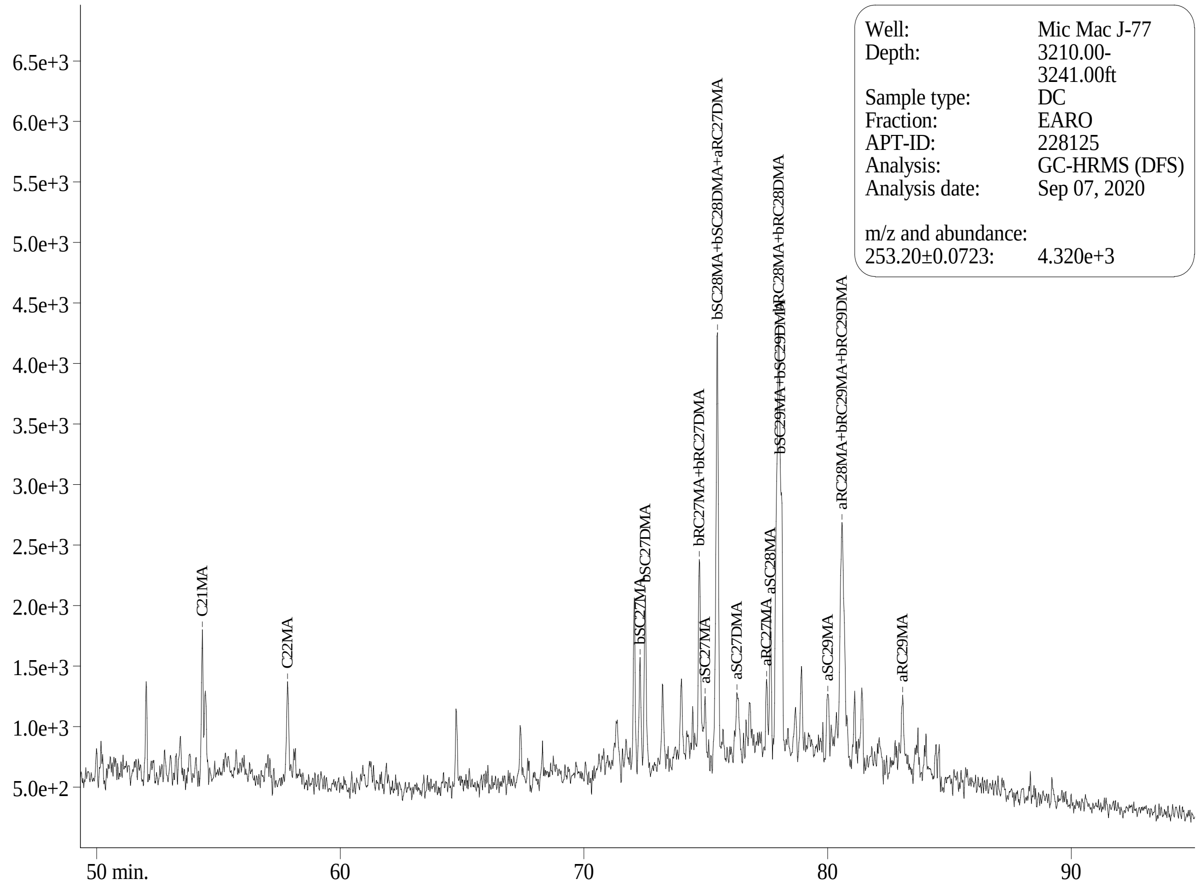


Well: Mic Mac J-77
Depth: 3210.00-3241.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228125
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020

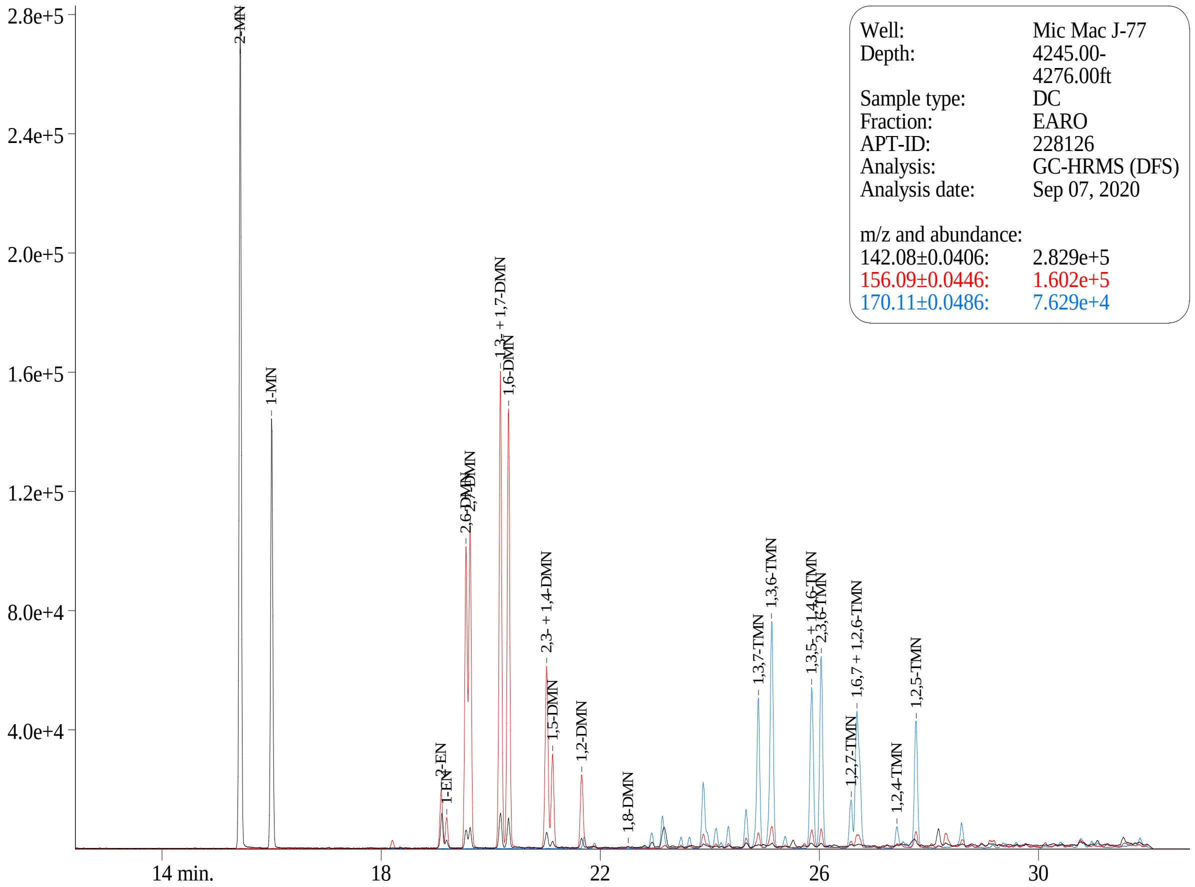
m/z and abundance:
231.12±0.0660: 9.205e+3

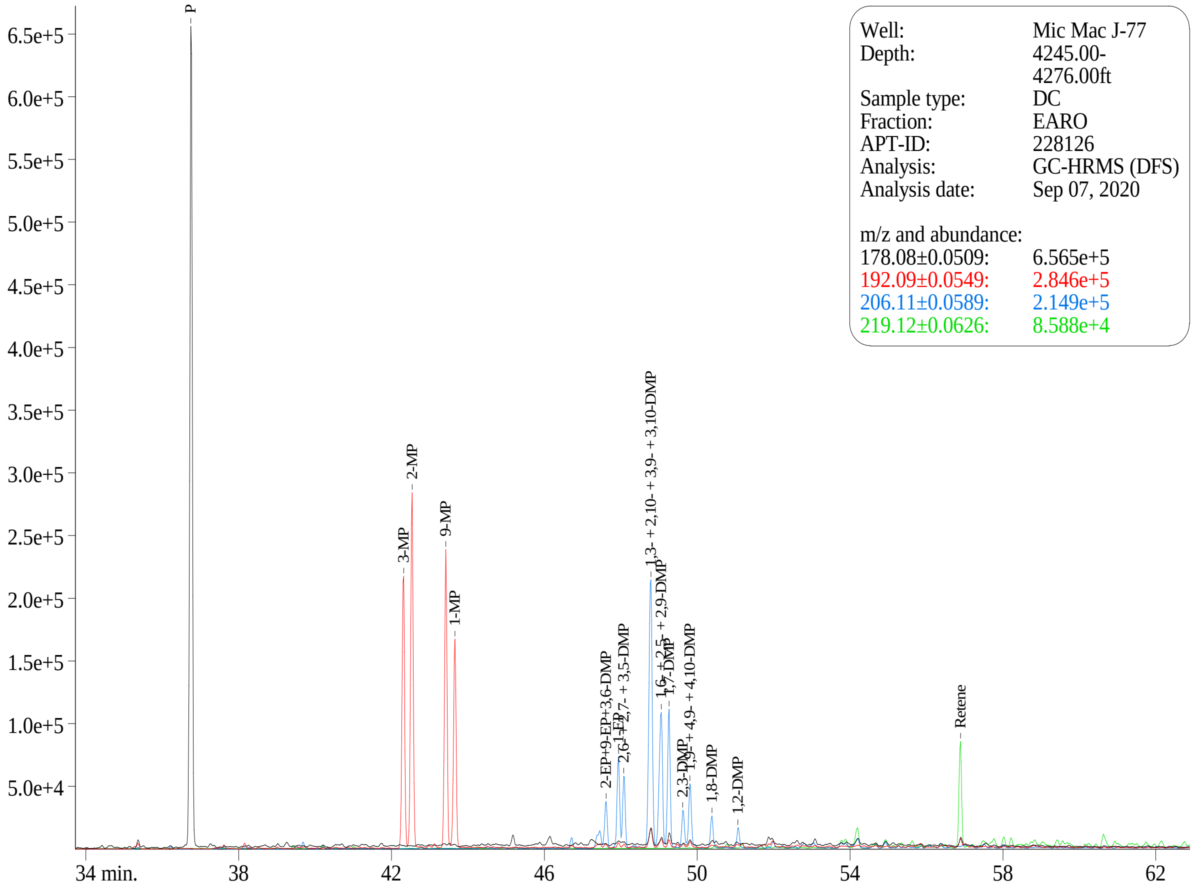


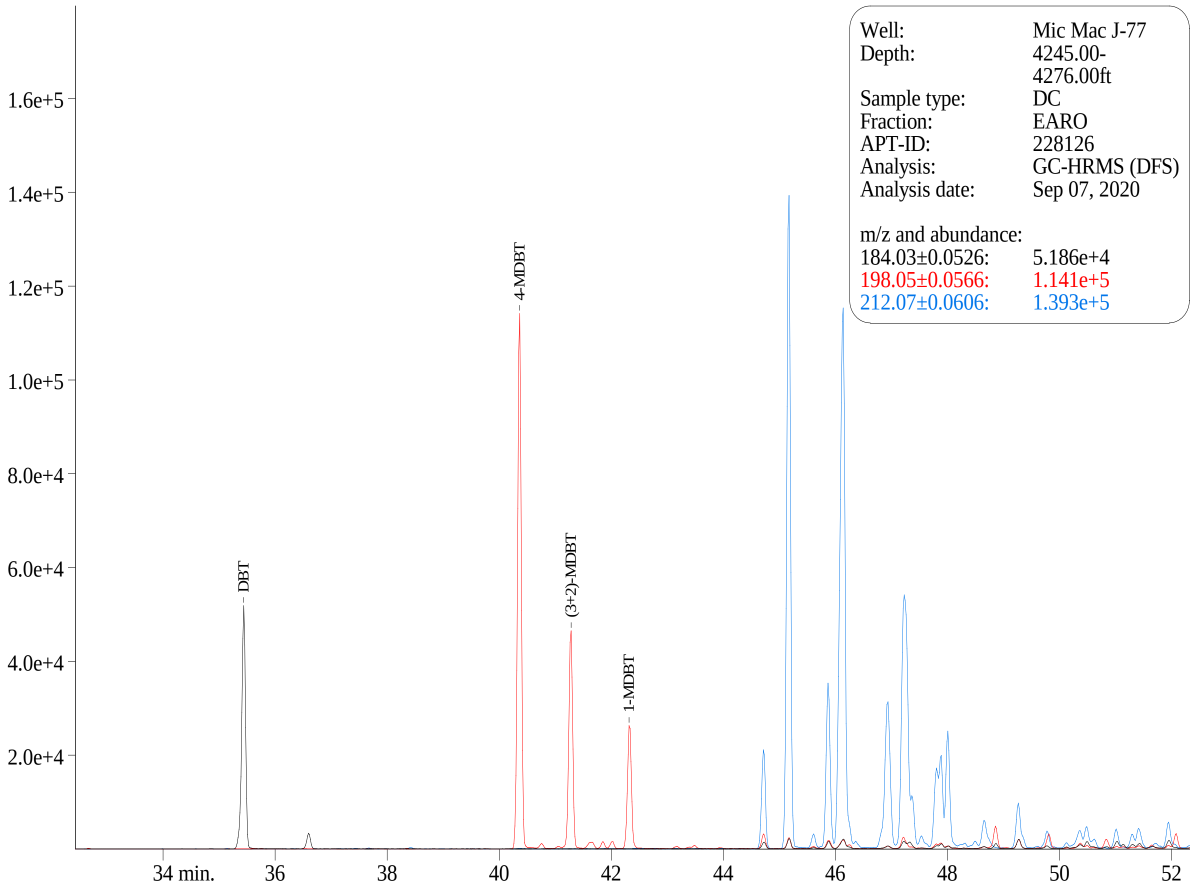
| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 3210.00-<br>3241.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228125 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 07, 2020 |
| m/z and abundance: | |
| 245.1330±0.0700: | 2.241e+3 |



| | |
|---|---|
| Well: | Mic Mac J-77 |
| Depth: | 3210.00-<br>3241.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228125 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 07, 2020 |
| m/z and abundance: | |
| 253.20±0.0723: | 4.320e+3 |

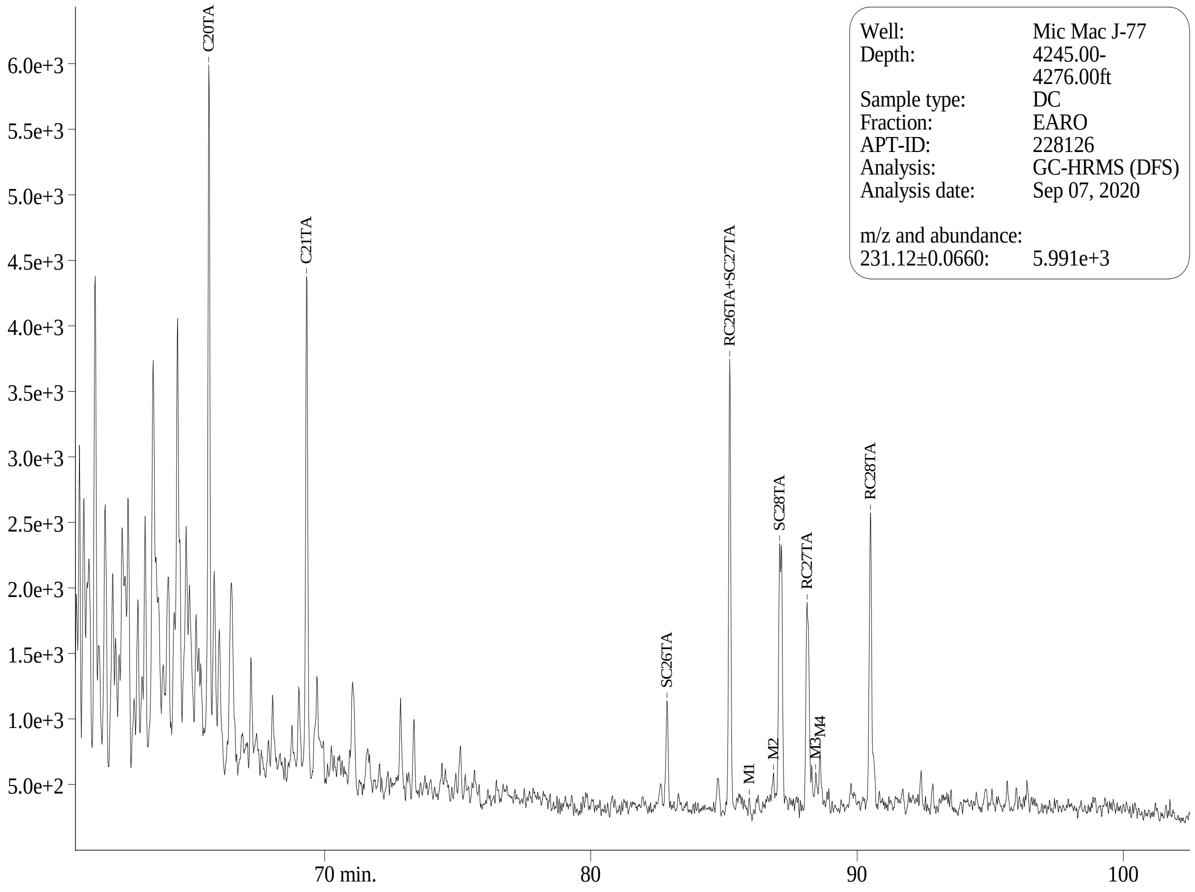

2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
142.08±0.0406: 2.829e+5
156.09±0.0446: 1.602e+5
170.11±0.0486: 7.629e+4


6.5e+5
6.0e+5
5.5e+5
5.0e+5
4.5e+5
4.0e+5
3.5e+5
3.0e+5
2.5e+5
2.0e+5
1.5e+5
1.0e+5
5.0e+4
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
178.08±0.0509: 6.565e+5
192.09±0.0549: 2.846e+5
206.11±0.0589: 2.149e+5
219.12±0.0626: 8.588e+4



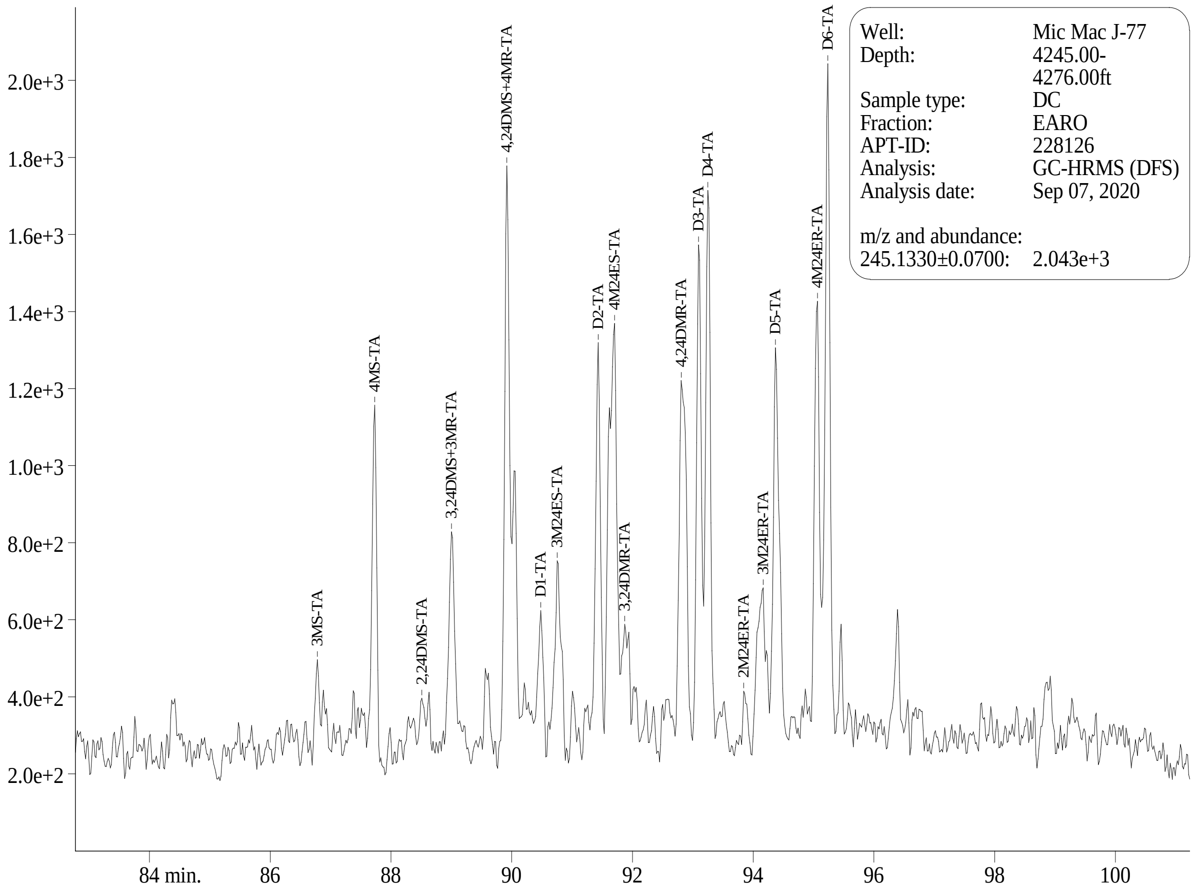
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020

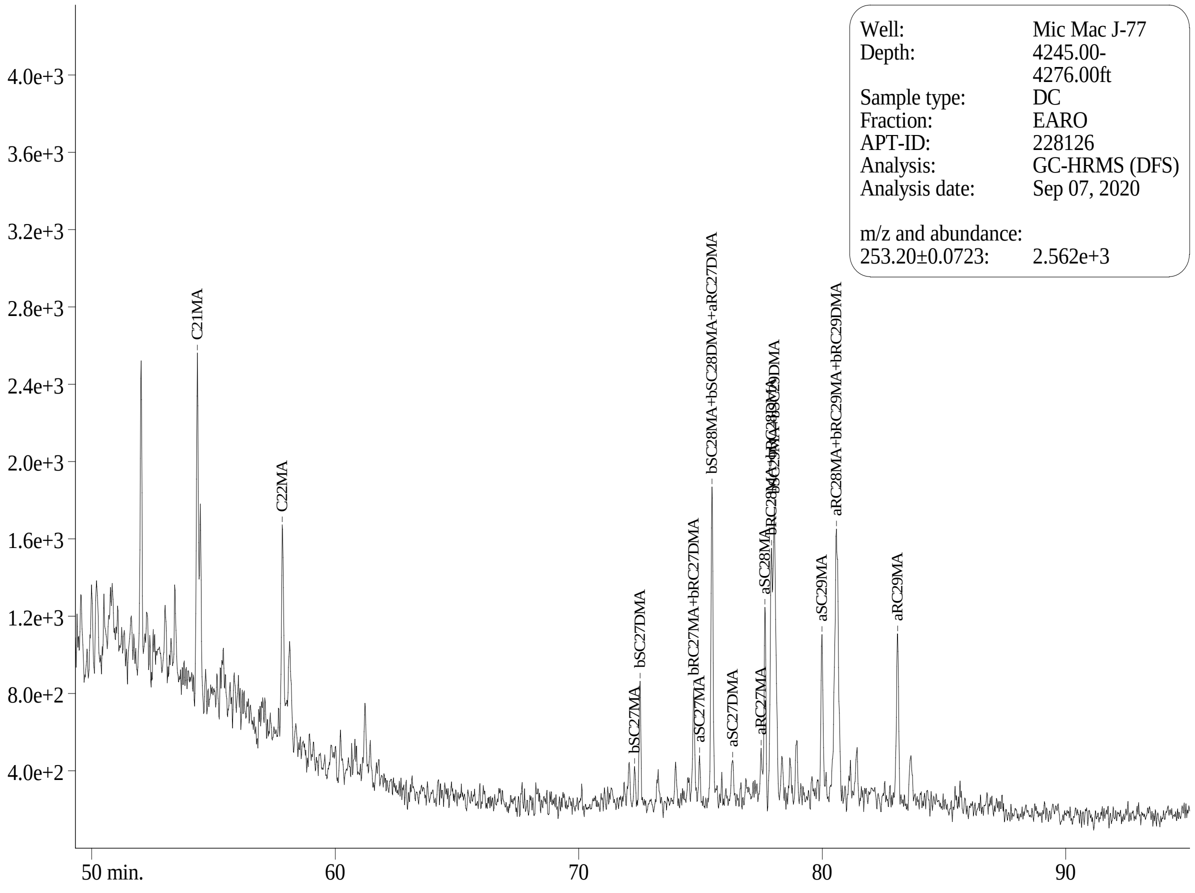
m/z and abundance:
184.03±0.0526: 5.186e+4
198.05±0.0566: 1.141e+5
212.07±0.0606: 1.393e+5

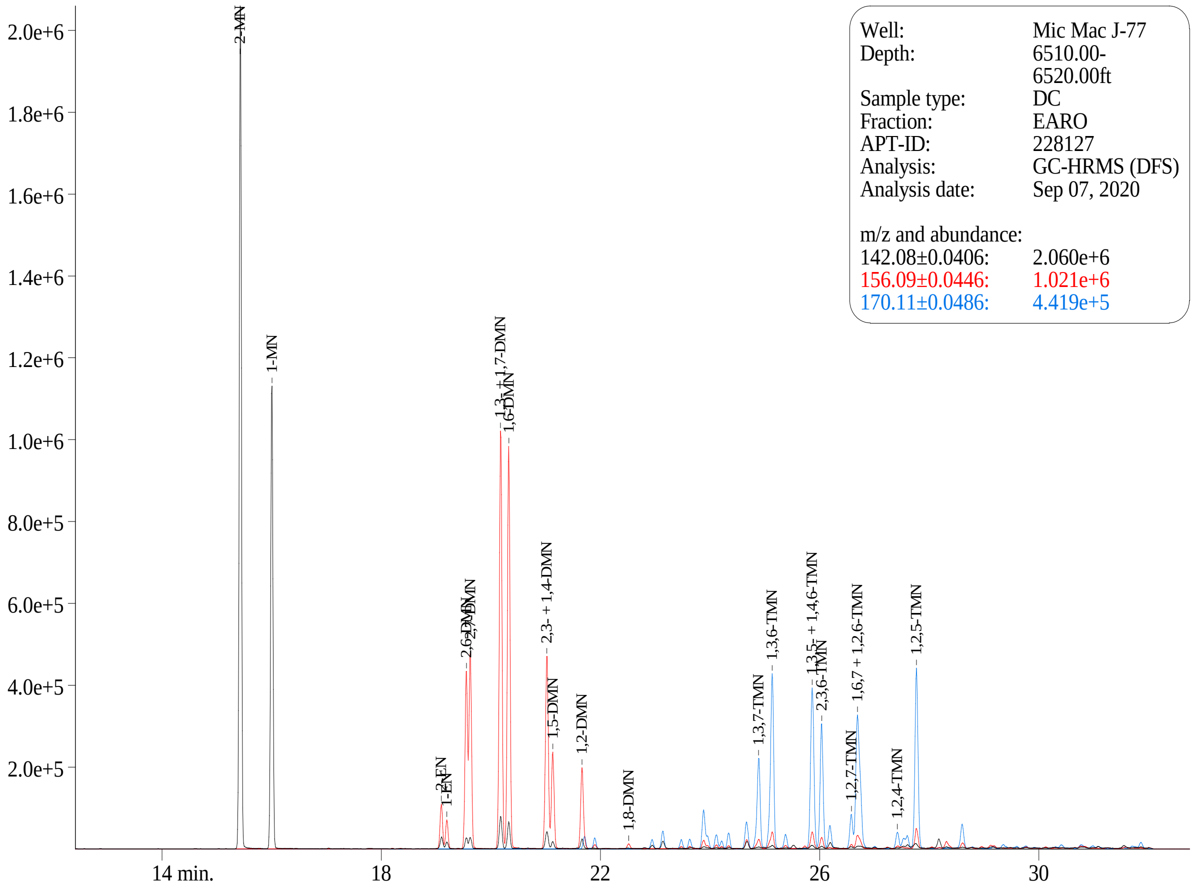


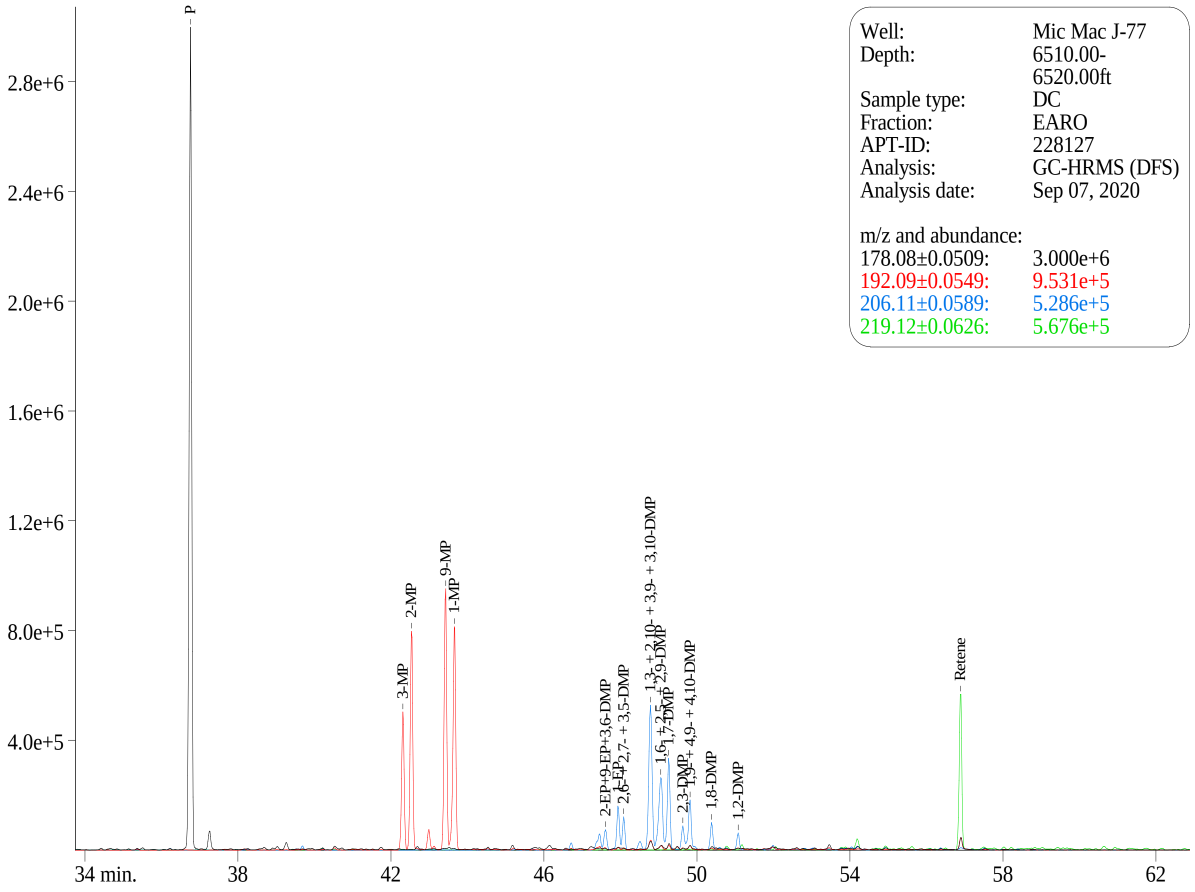
Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020

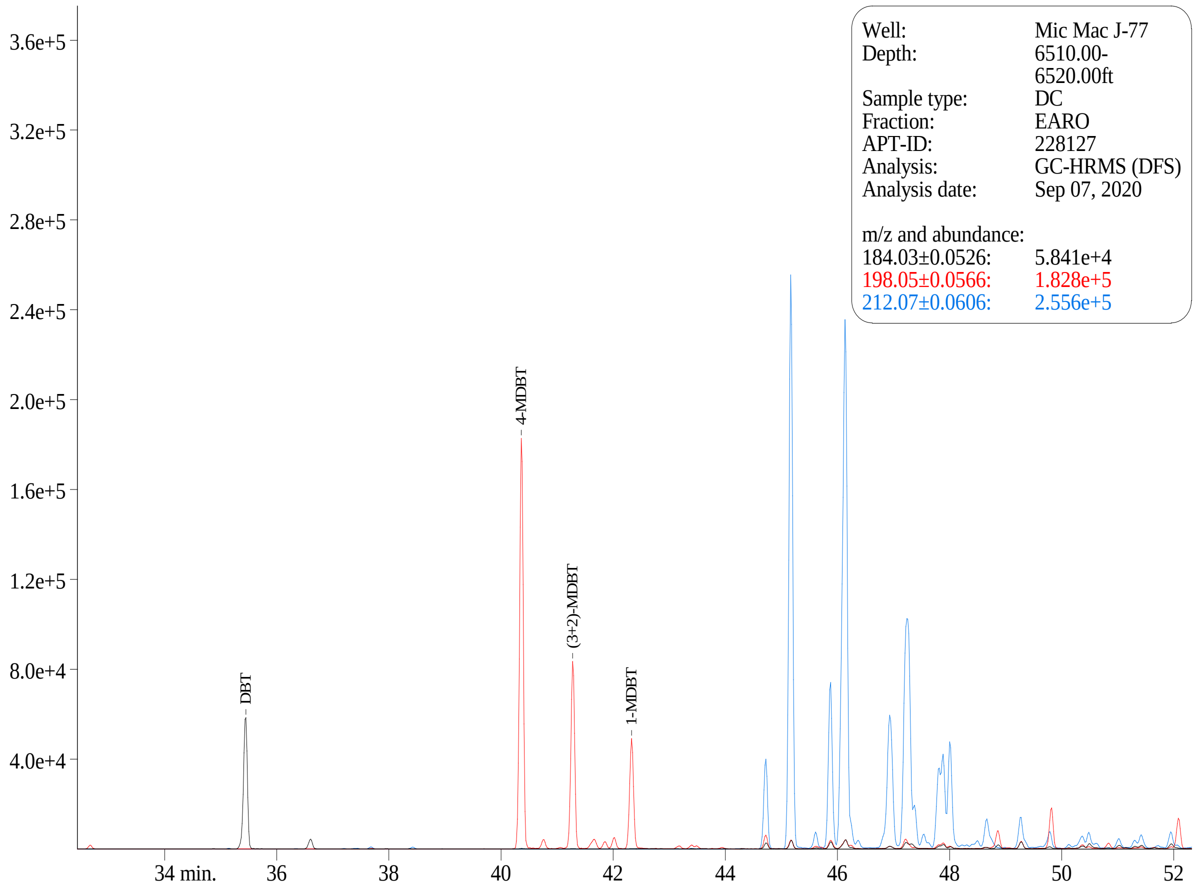
m/z and abundance:
231.12±0.0660: 5.991e+3

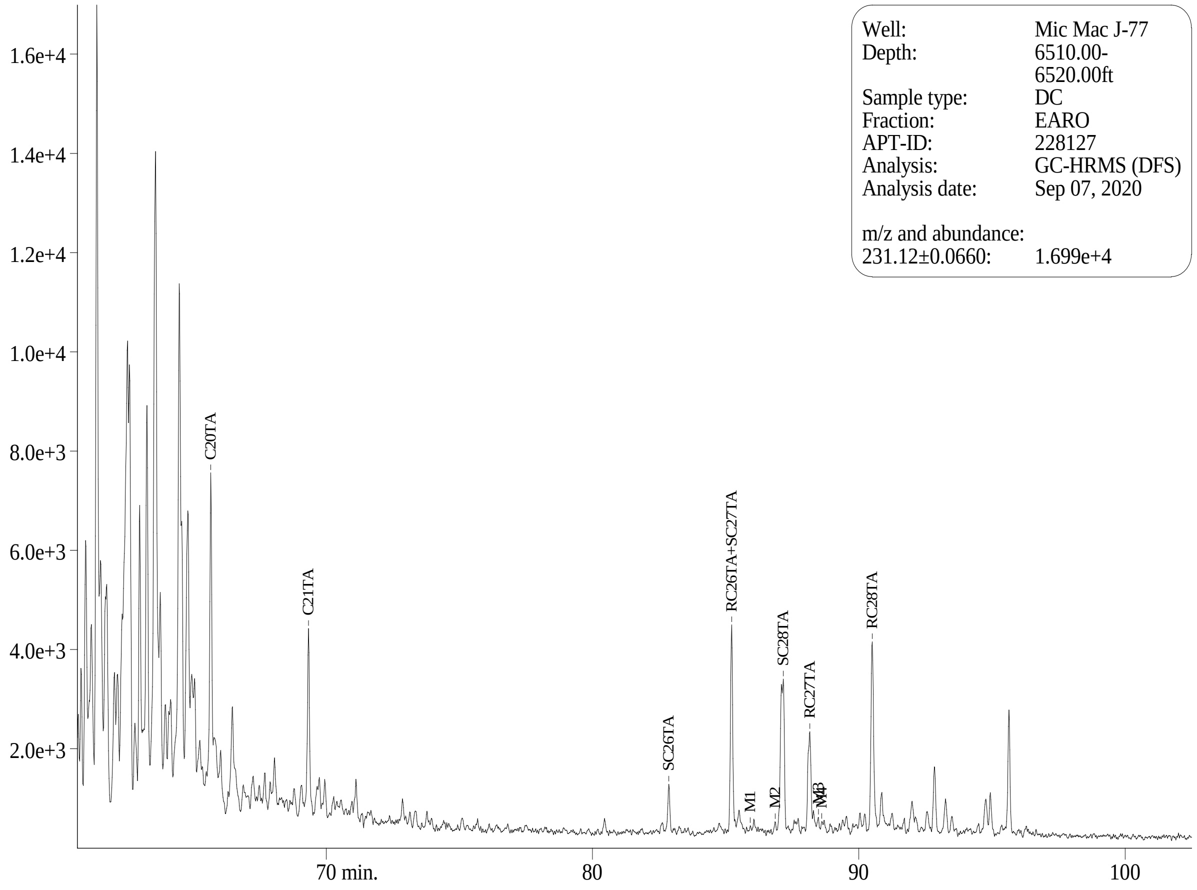

Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
245.1330±0.0700: 2.043e+3
2.0e+3
1.8e+3
1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA

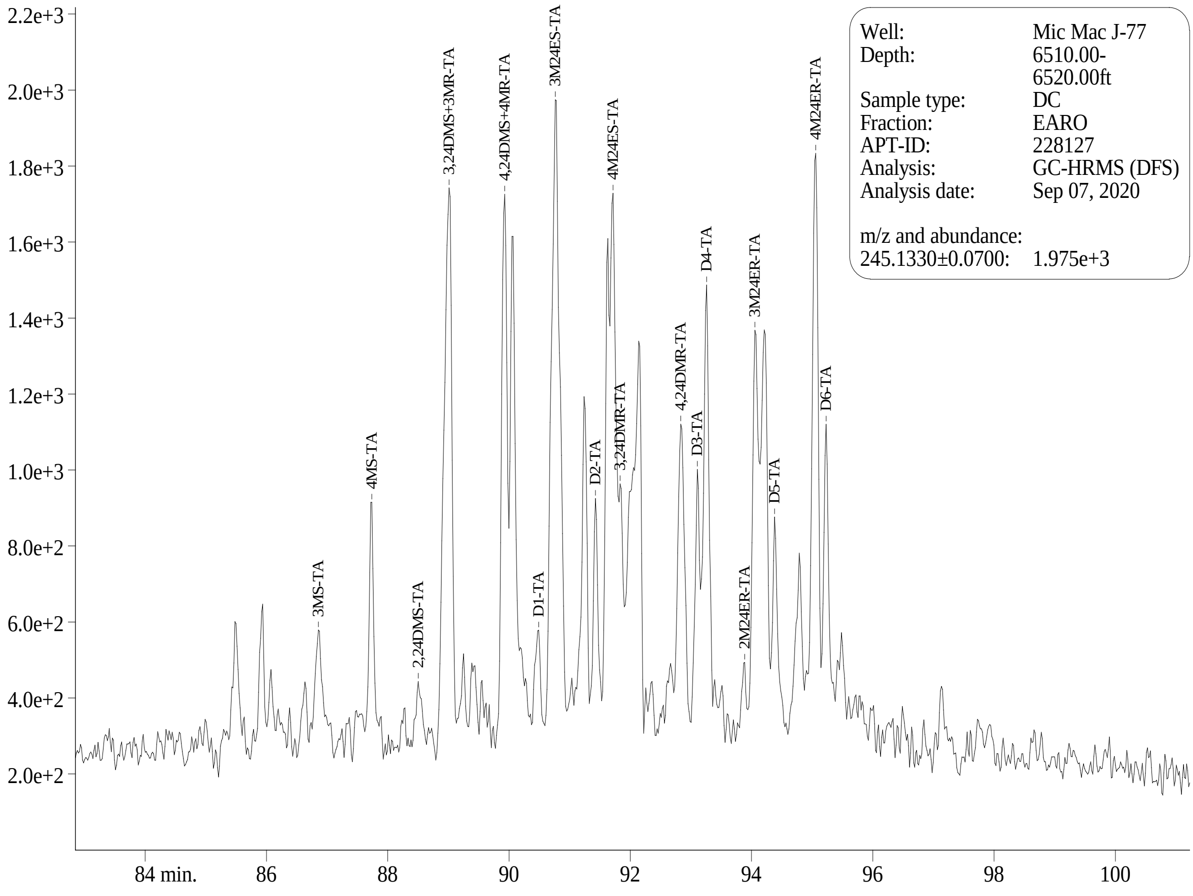

Well: Mic Mac J-77
Depth: 4245.00-4276.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228126
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
253.20±0.0723: 2.562e+3
4.0e+3
3.6e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
aSC27MA
bRC27MA+bRC27DMA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA

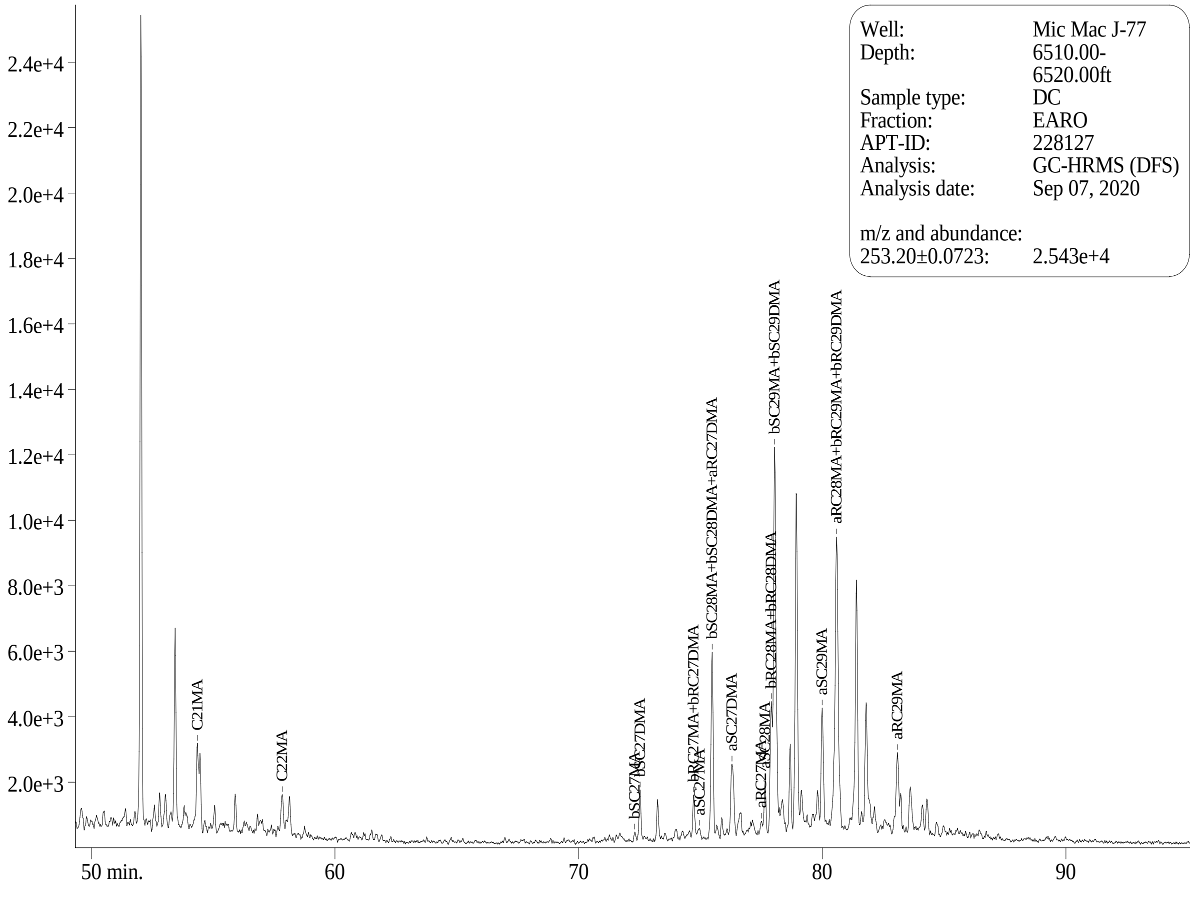

2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
142.08±0.0406: 2.060e+6
156.09±0.0446: 1.021e+6
170.11±0.0486: 4.419e+5

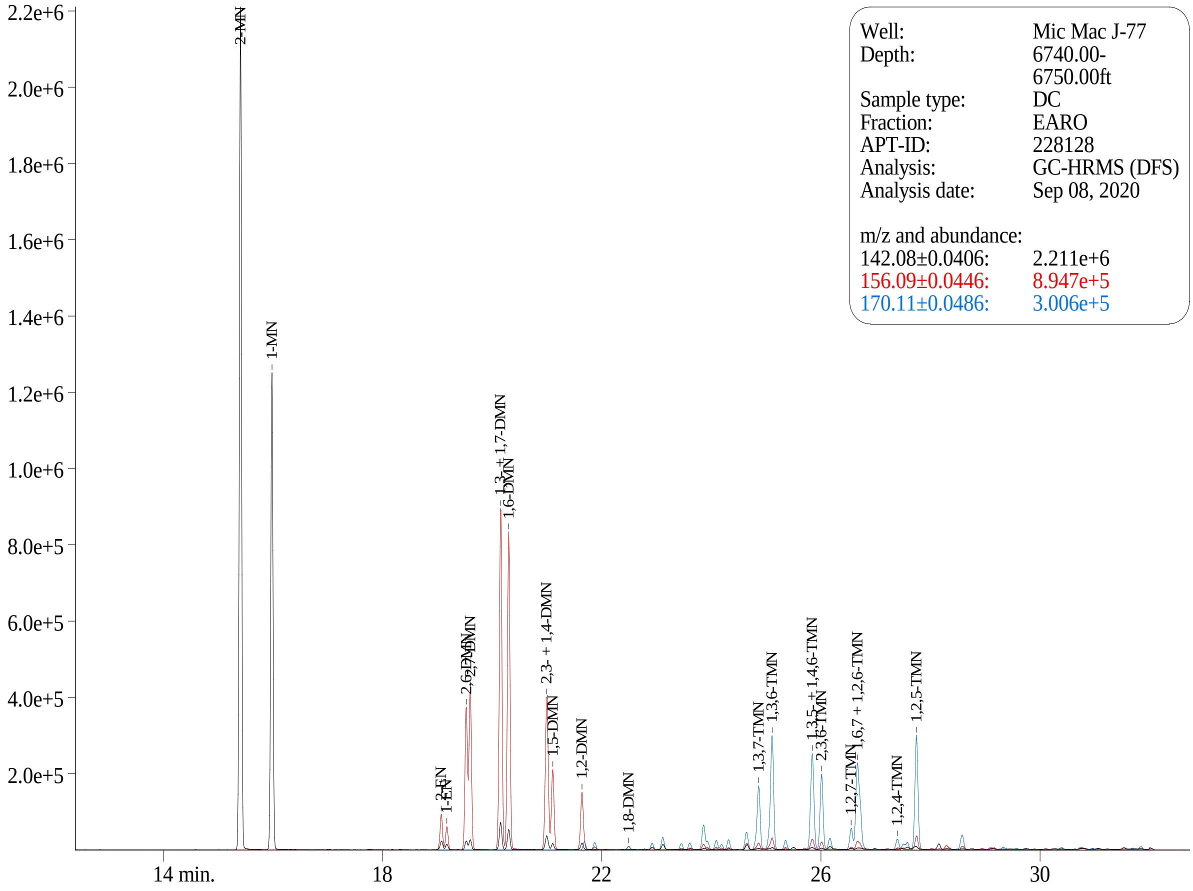

2.8e+6
2.4e+6
2.0e+6
1.6e+6
1.2e+6
8.0e+5
4.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
178.08±0.0509: 3.000e+6
192.09±0.0549: 9.531e+5
206.11±0.0589: 5.286e+5
219.12±0.0626: 5.676e+5

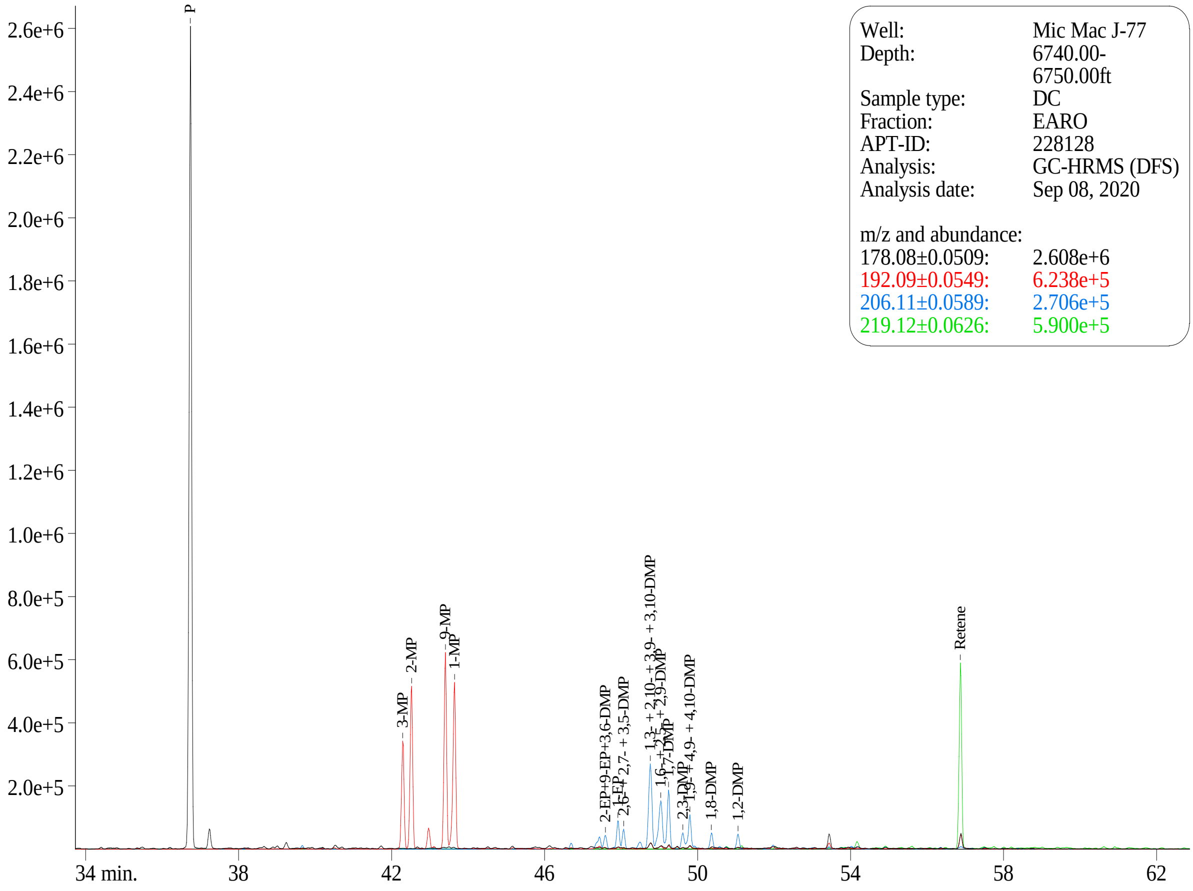

3.6e+5
3.2e+5
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
34 min.
36
38
40
42
44
46
48
50
52
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
184.03±0.0526: 5.841e+4
198.05±0.0566: 1.828e+5
212.07±0.0606: 2.556e+5

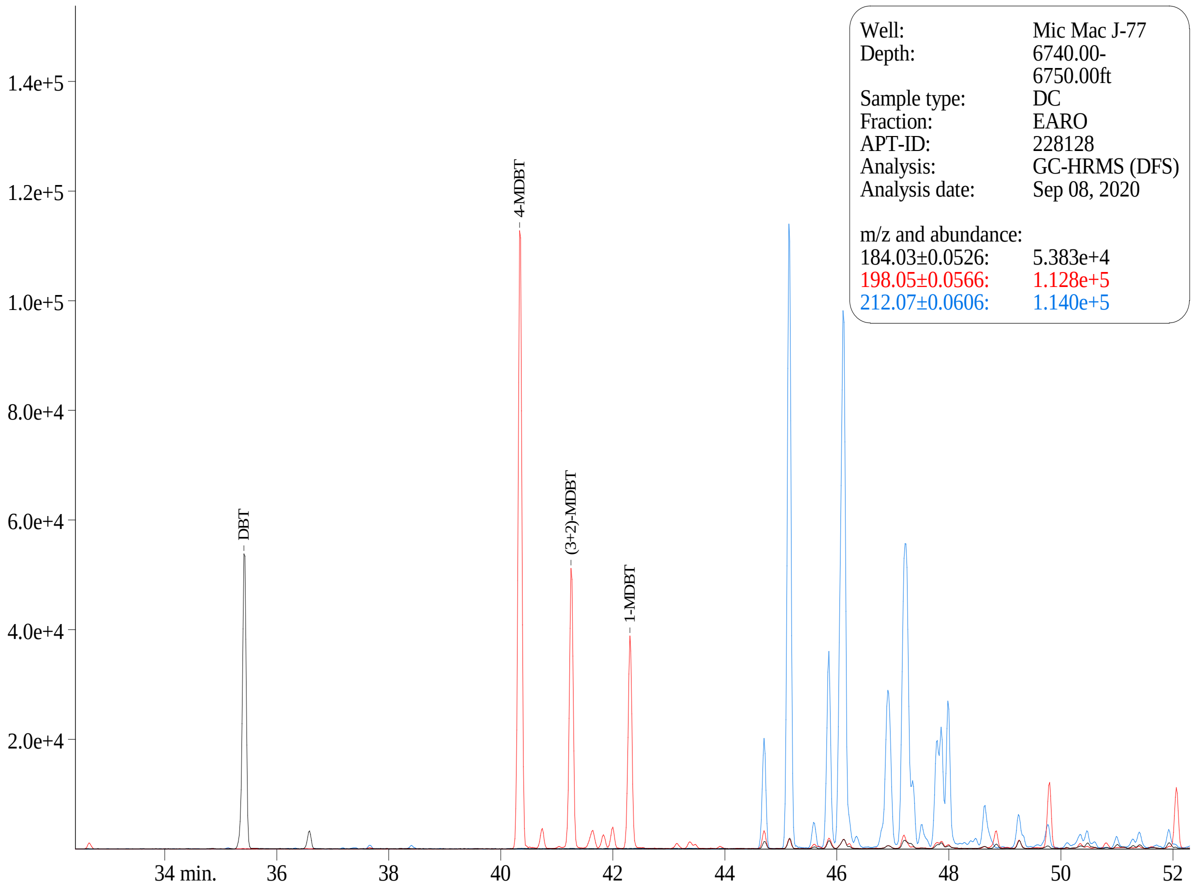

1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
70 min.
80
90
100
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
231.12±0.0660: 1.699e+4

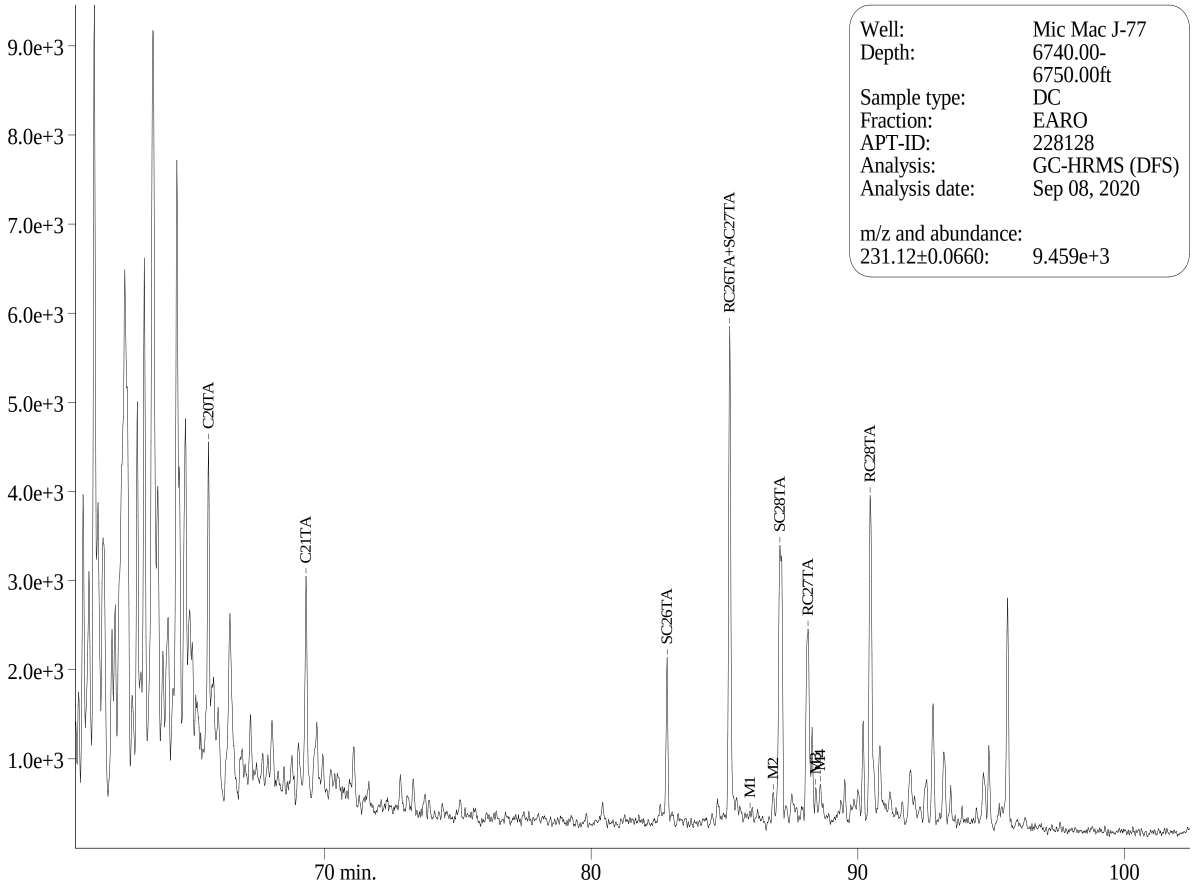

2.2e+3
2.0e+3
1.8e+3
1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
245.1330±0.0700: 1.975e+3

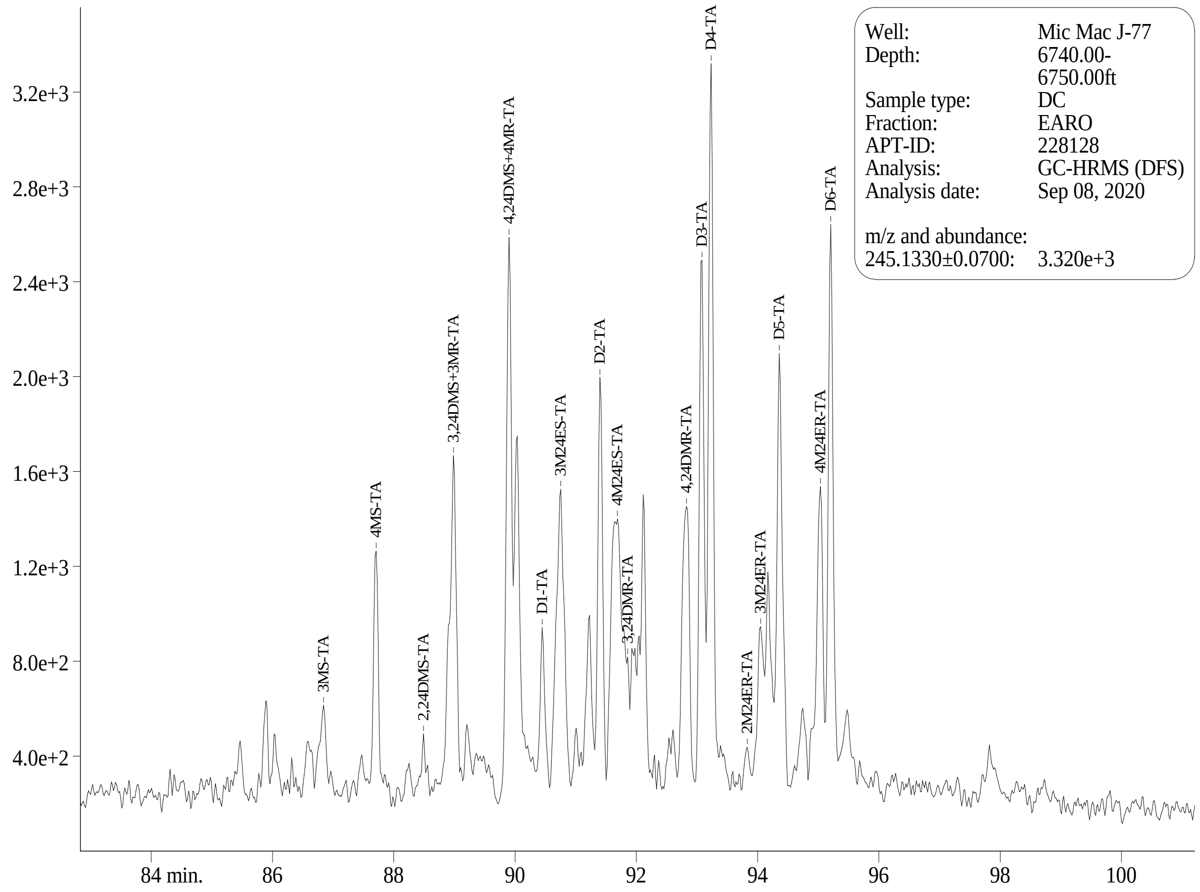

2.4e+4
2.2e+4
2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Mic Mac J-77
Depth: 6510.00-6520.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228127
Analysis: GC-HRMS (DFS)
Analysis date: Sep 07, 2020
m/z and abundance:
253.20±0.0723: 2.543e+4


2.2e+6
2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
142.08±0.0406: 2.211e+6
156.09±0.0446: 8.947e+5
170.11±0.0486: 3.006e+5


2.6e+6
2.4e+6
2.2e+6
2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
178.08±0.0509: 2.608e+6
192.09±0.0549: 6.238e+5
206.11±0.0589: 2.706e+5
219.12±0.0626: 5.900e+5

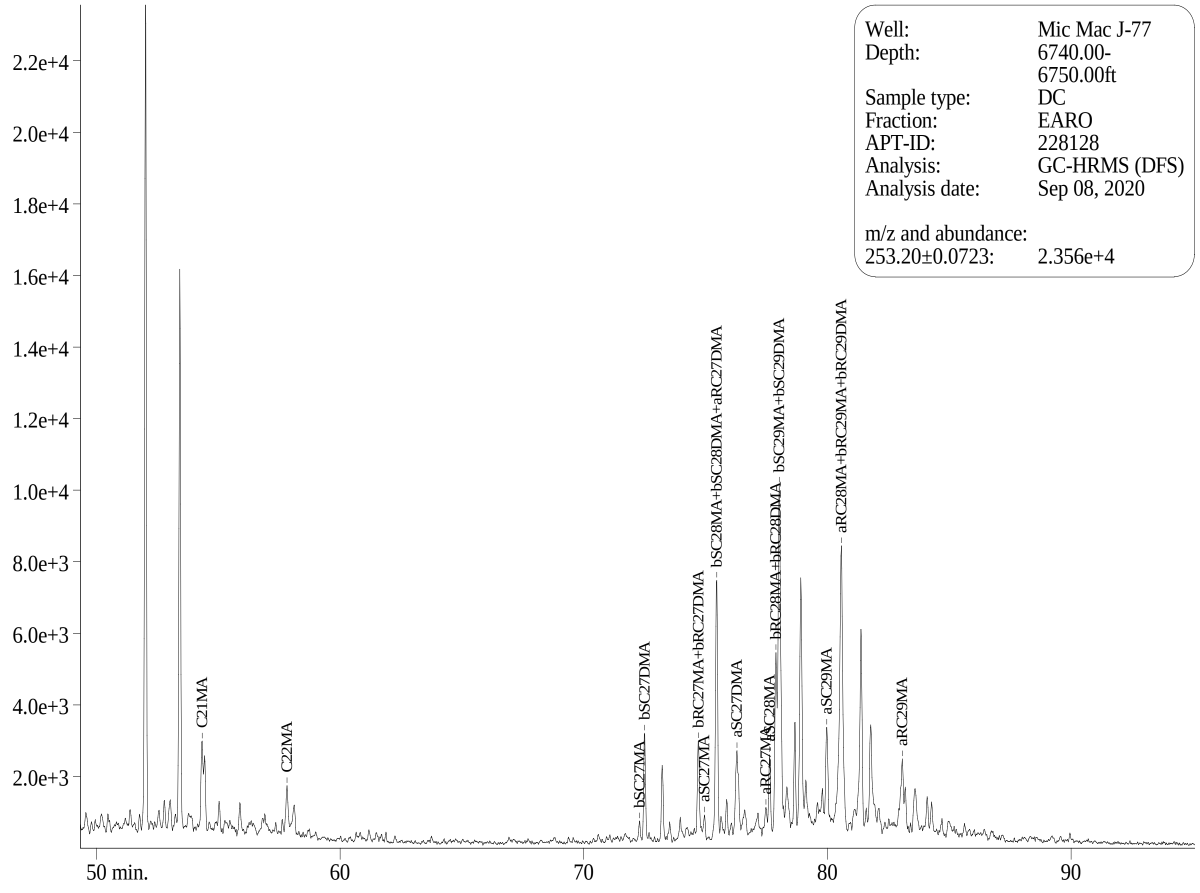

1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
34 min.
36
38
40
42
44
46
48
50
52
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
184.03±0.0526: 5.383e+4
198.05±0.0566: 1.128e+5
212.07±0.0606: 1.140e+5


9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
70 min.
80
90
100
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
231.12±0.0660: 9.459e+3



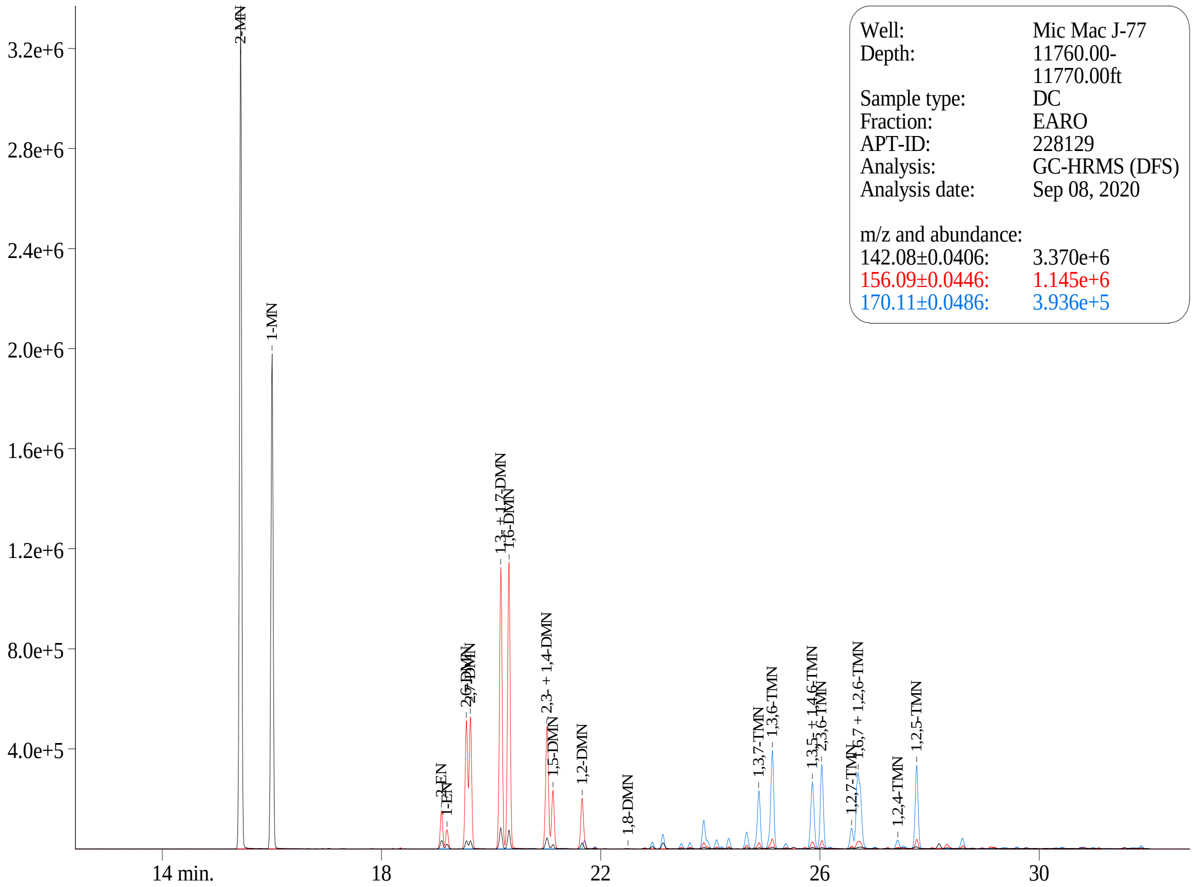
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

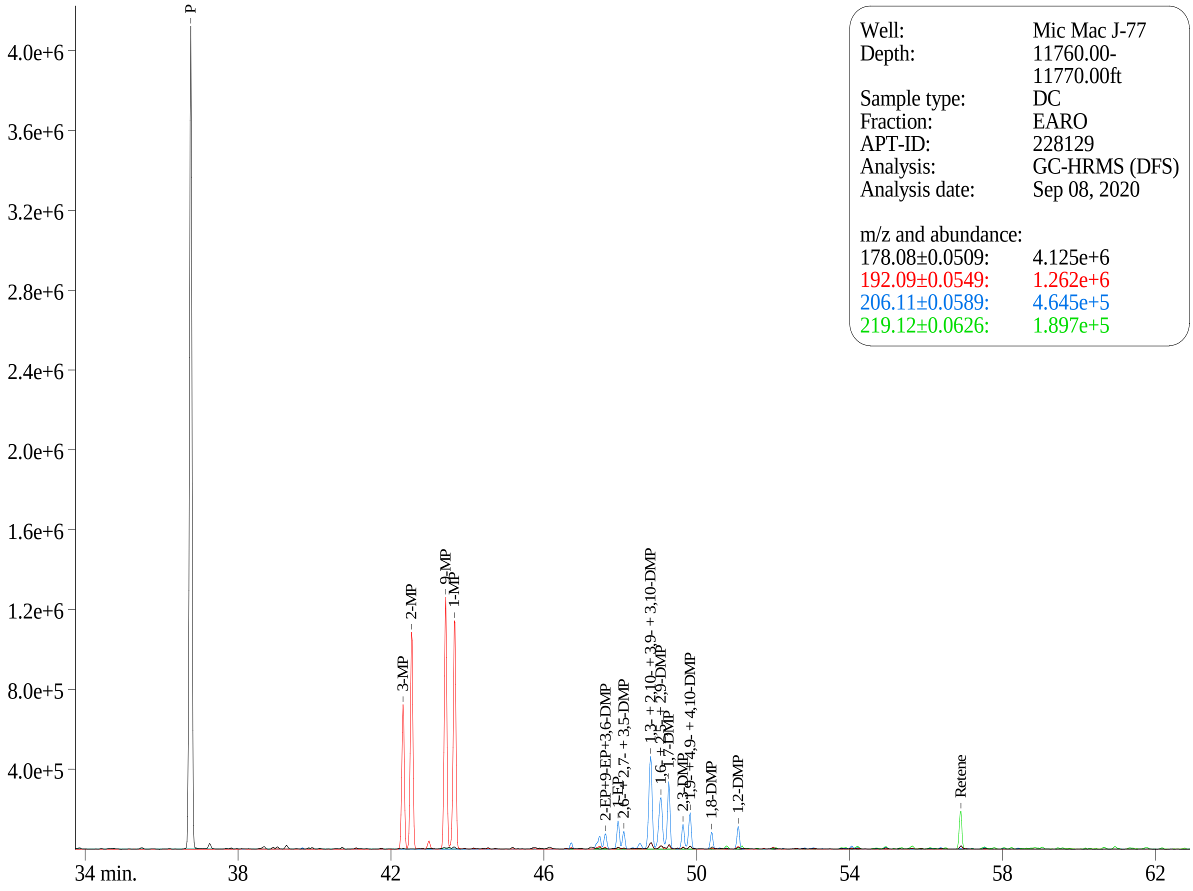
m/z and abundance:
245.1330±0.0700: 3.320e+3

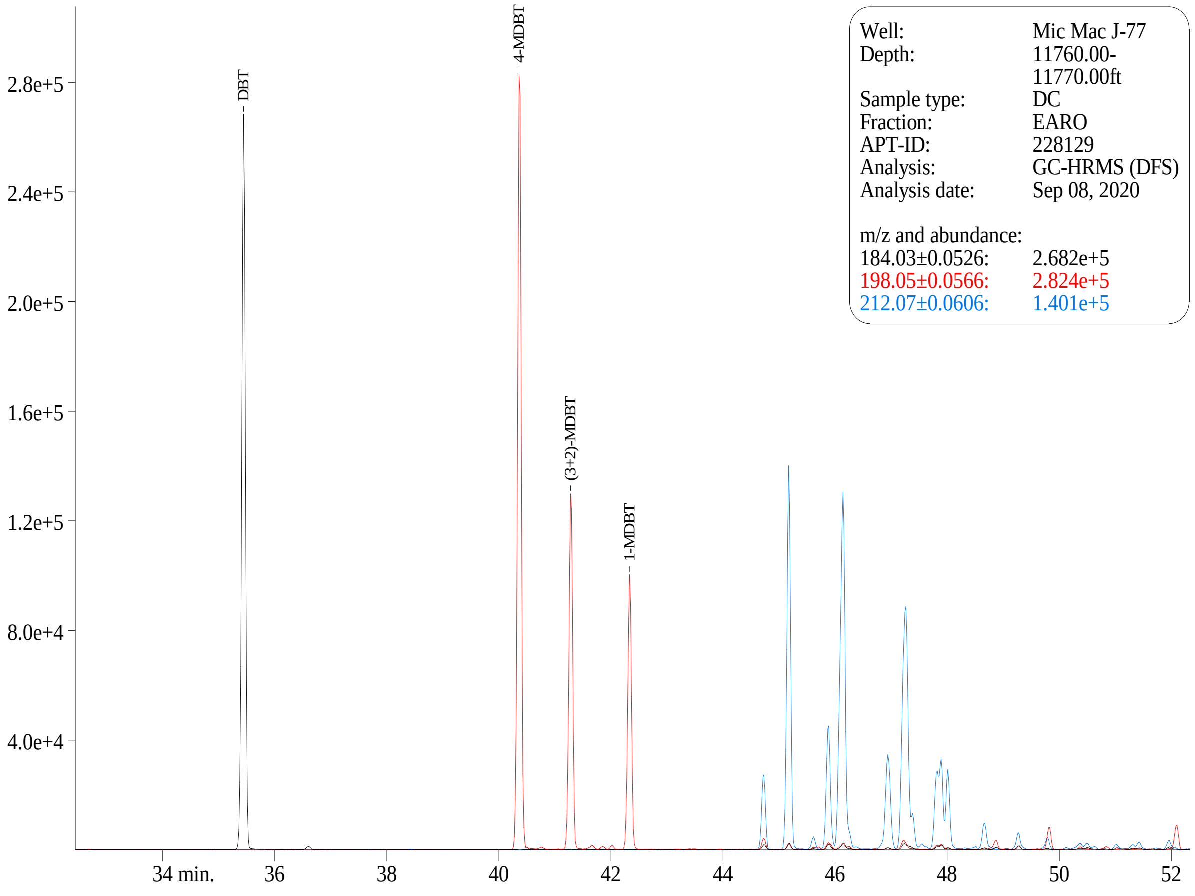


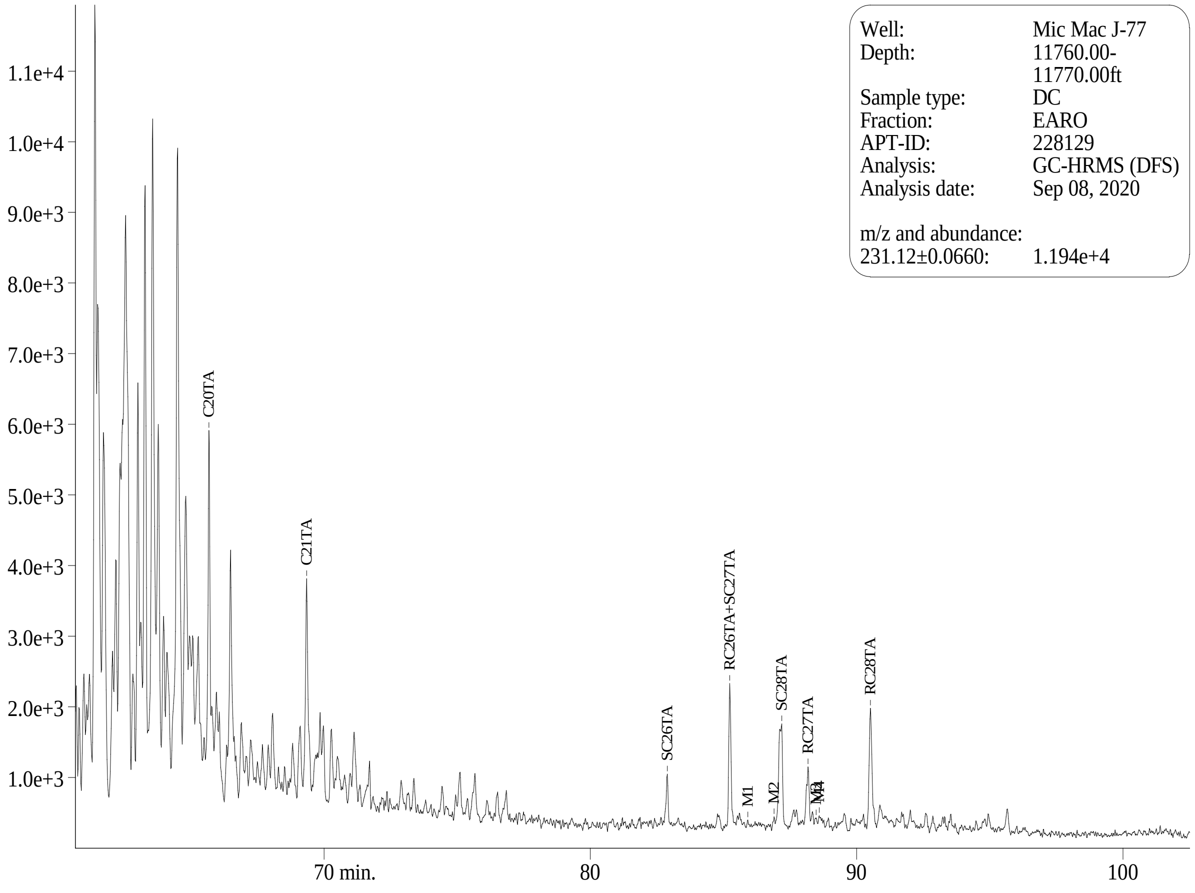
Well: Mic Mac J-77
Depth: 6740.00-6750.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228128
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

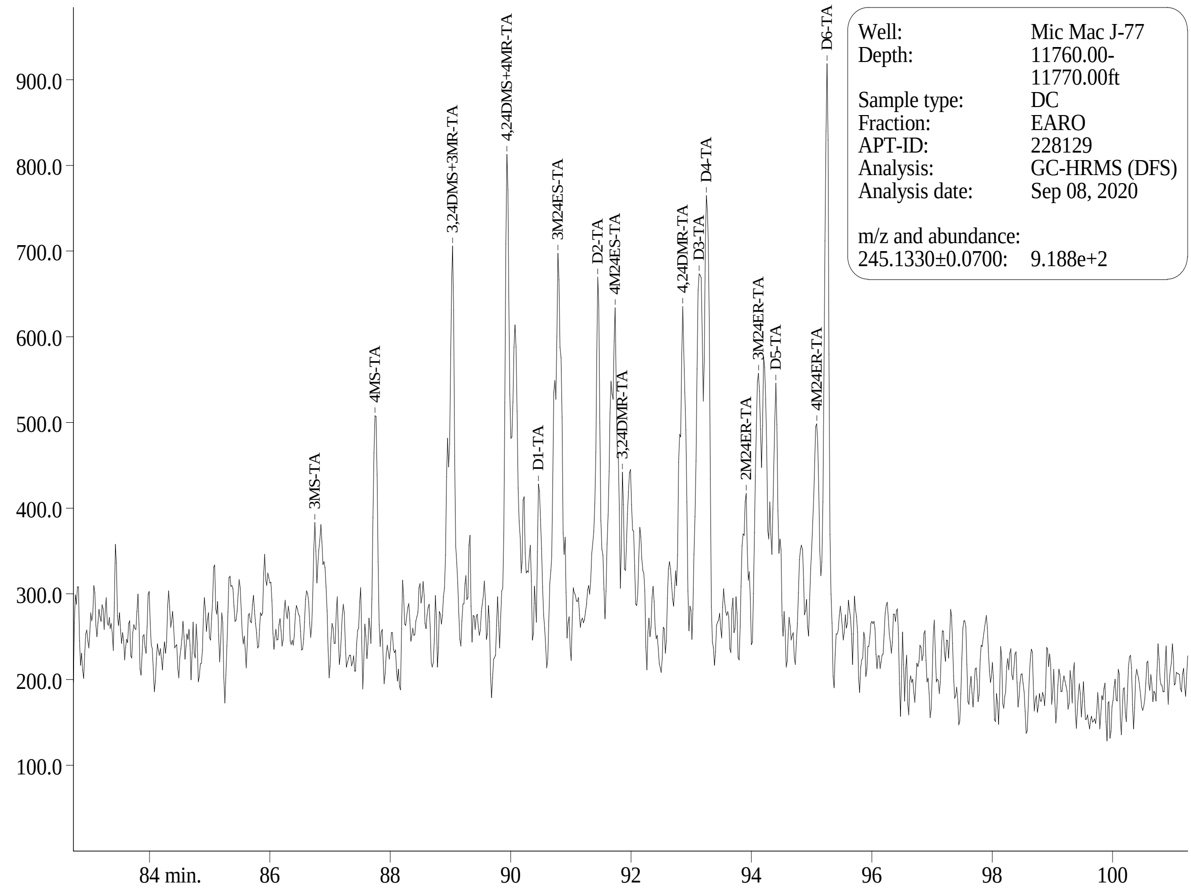
m/z and abundance:
253.20±0.0723: 2.356e+4

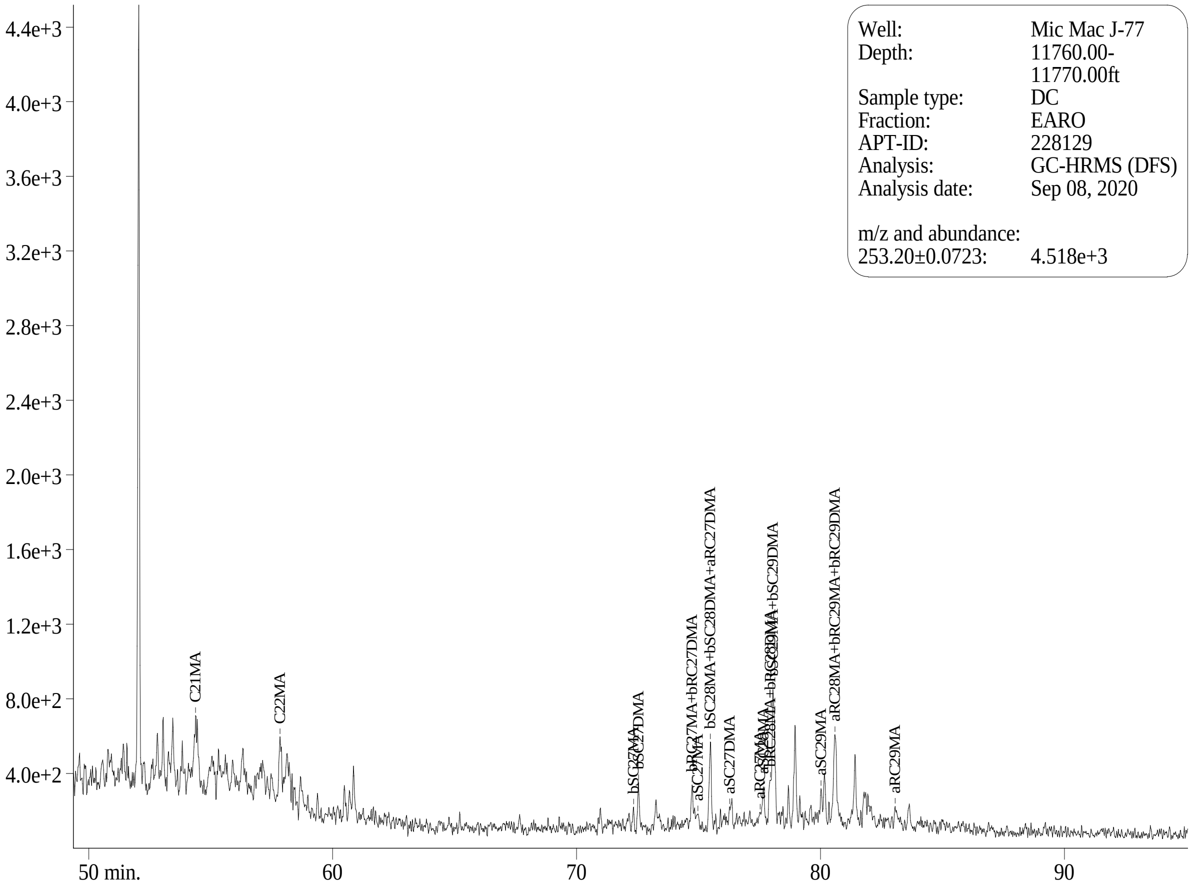

3.2e+6
2.8e+6
2.4e+6
2.0e+6
1.6e+6
1.2e+6
8.0e+5
4.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
142.08±0.0406: 3.370e+6
156.09±0.0446: 1.145e+6
170.11±0.0486: 3.936e+5

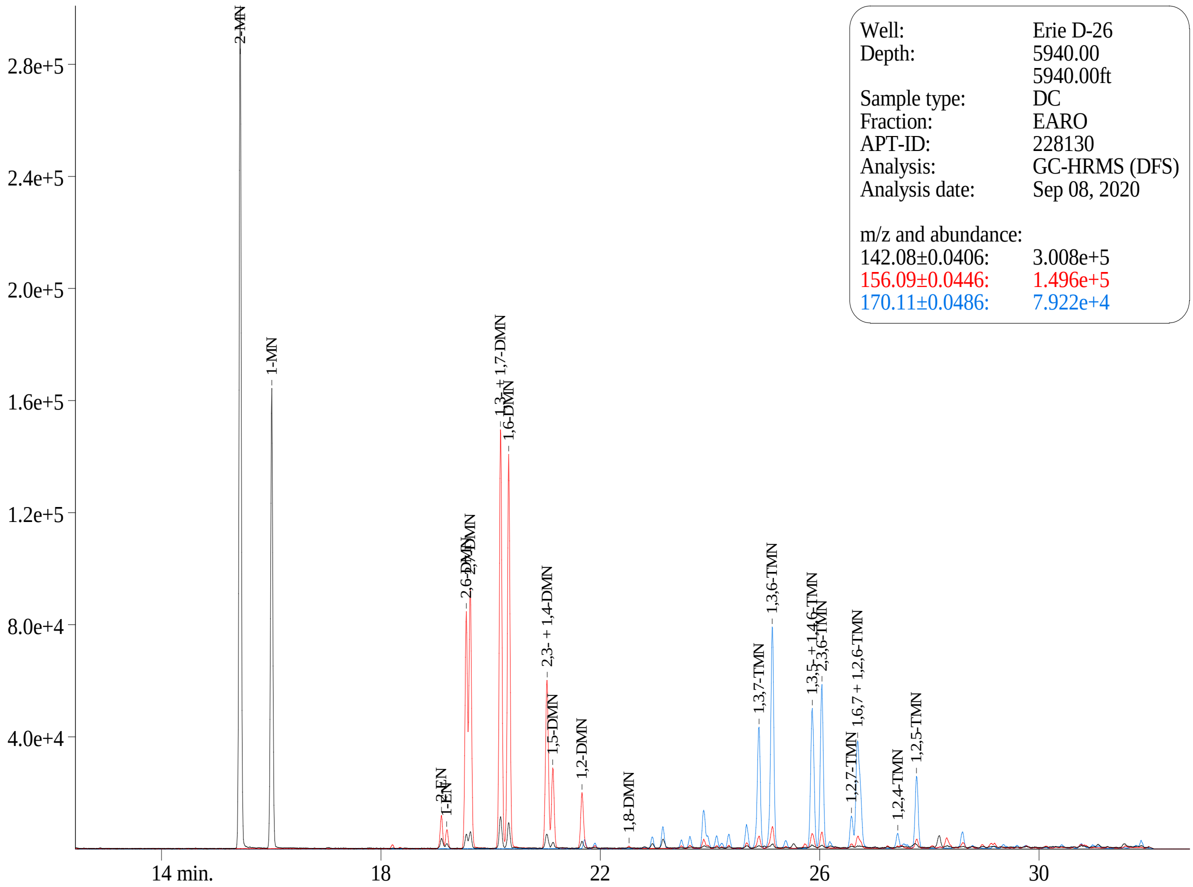

4.0e+6
3.6e+6
3.2e+6
2.8e+6
2.4e+6
2.0e+6
1.6e+6
1.2e+6
8.0e+5
4.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
178.08±0.0509: 4.125e+6
192.09±0.0549: 1.262e+6
206.11±0.0589: 4.645e+5
219.12±0.0626: 1.897e+5


Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
184.03±0.0526: 2.682e+5
198.05±0.0566: 2.824e+5
212.07±0.0606: 1.401e+5
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
2.8e+5
2.4e+5
2.0e+5
1.6e+5
1.2e+5
8.0e+4
4.0e+4
34 min.
36
38
40
42
44
46
48
50
52


Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
231.12±0.0660: 1.194e+4
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
1.1e+4
1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
70 min.
80
90
100

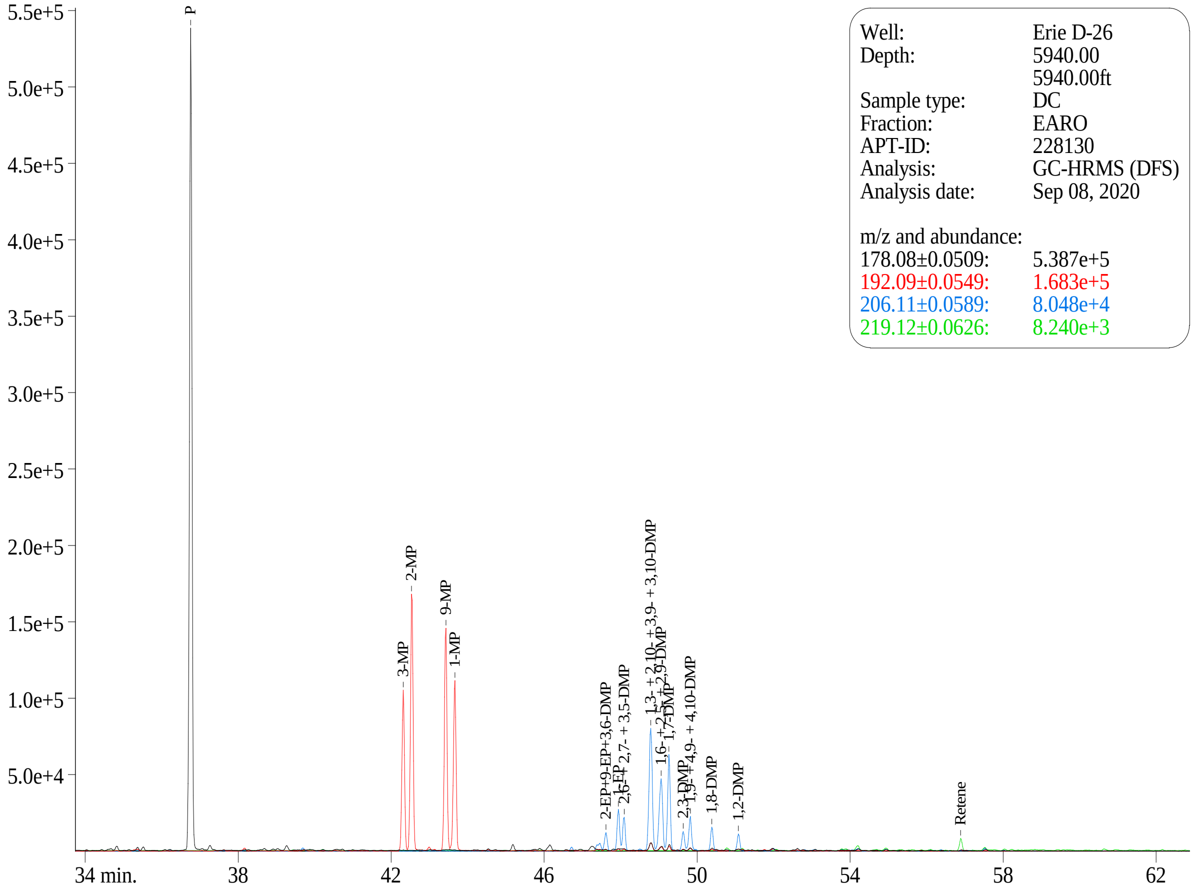

Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
245.1330±0.0700: 9.188e+2
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA


Well: Mic Mac J-77
Depth: 11760.00-11770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228129
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
253.20±0.0723: 4.518e+3
4.4e+3
4.0e+3
3.6e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA



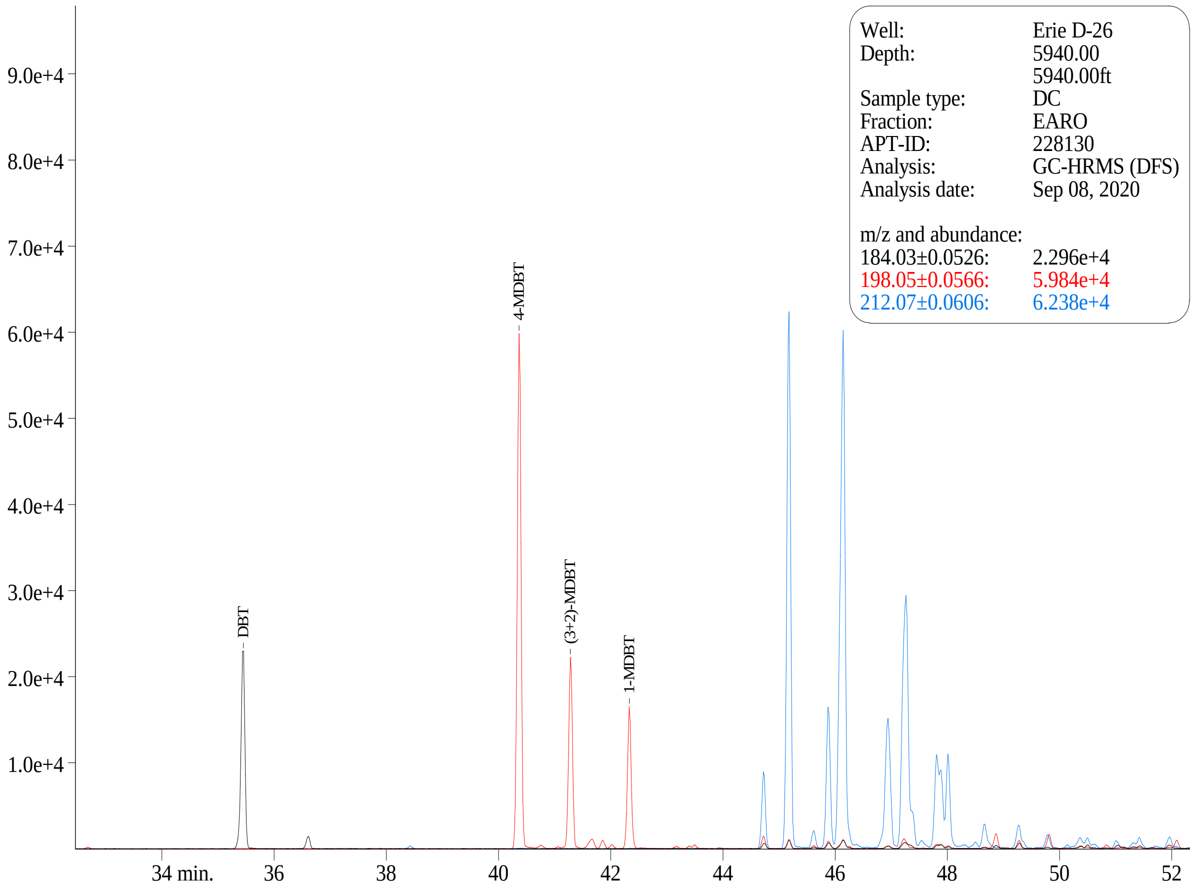
| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 5940.00<br>5940.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228130 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |

| m/z and abundance: | |
|---|---|
| 142.08±0.0406: | 3.008e+5 |
| 156.09±0.0446: | 1.496e+5 |
| 170.11±0.0486: | 7.922e+4 |



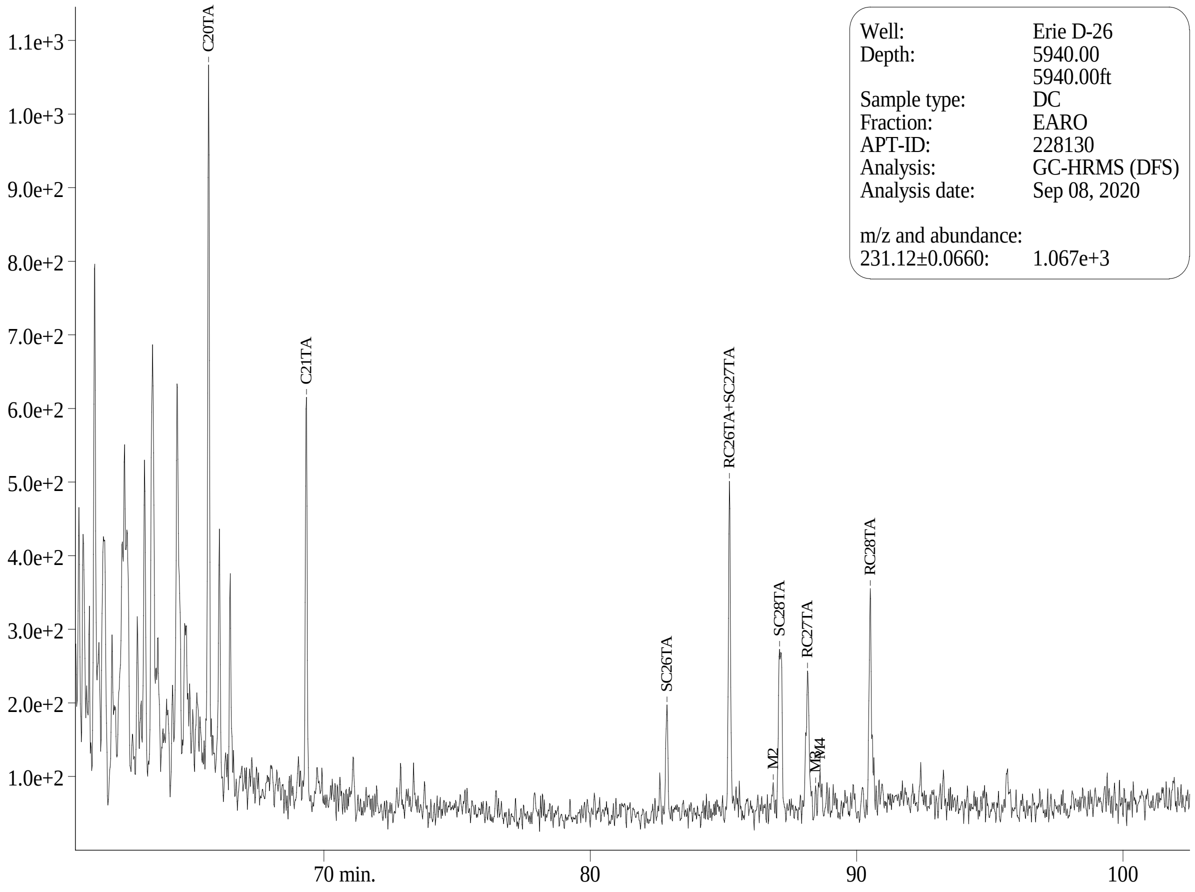
| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 5940.00<br>5940.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228130 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |

| m/z and abundance: | |
|---|---|
| 178.08±0.0509: | 5.387e+5 |
| 192.09±0.0549: | 1.683e+5 |
| 206.11±0.0589: | 8.048e+4 |
| 219.12±0.0626: | 8.240e+3 |



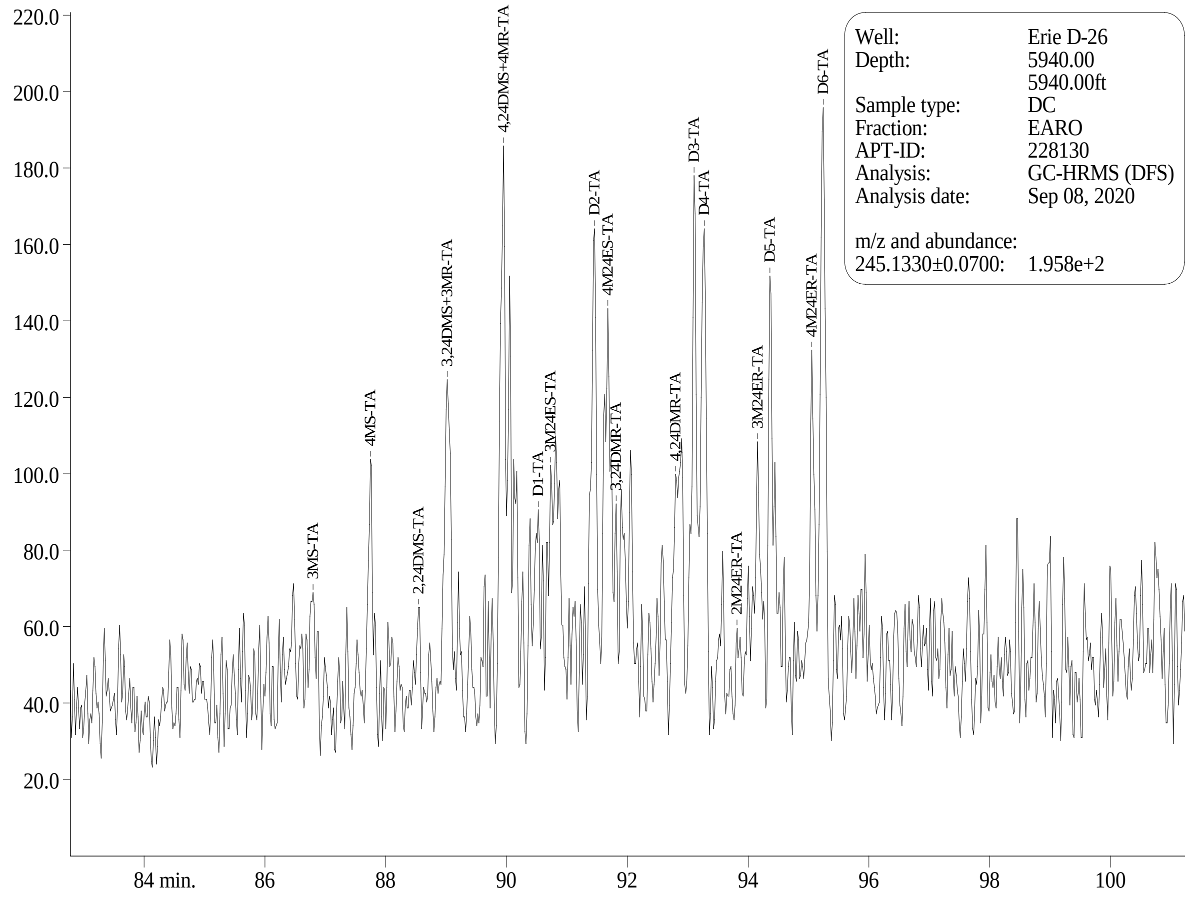
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

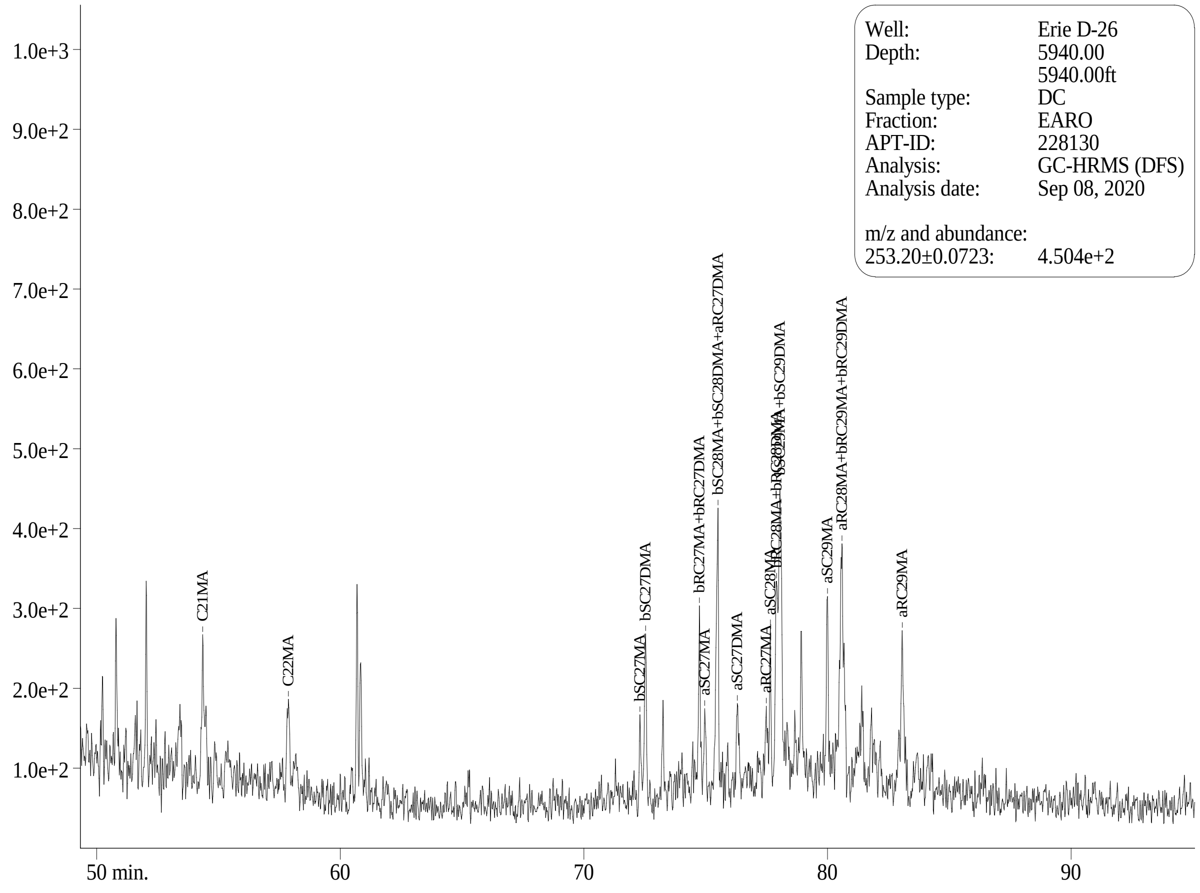
m/z and abundance:
184.03±0.0526: 2.296e+4
198.05±0.0566: 5.984e+4
212.07±0.0606: 6.238e+4

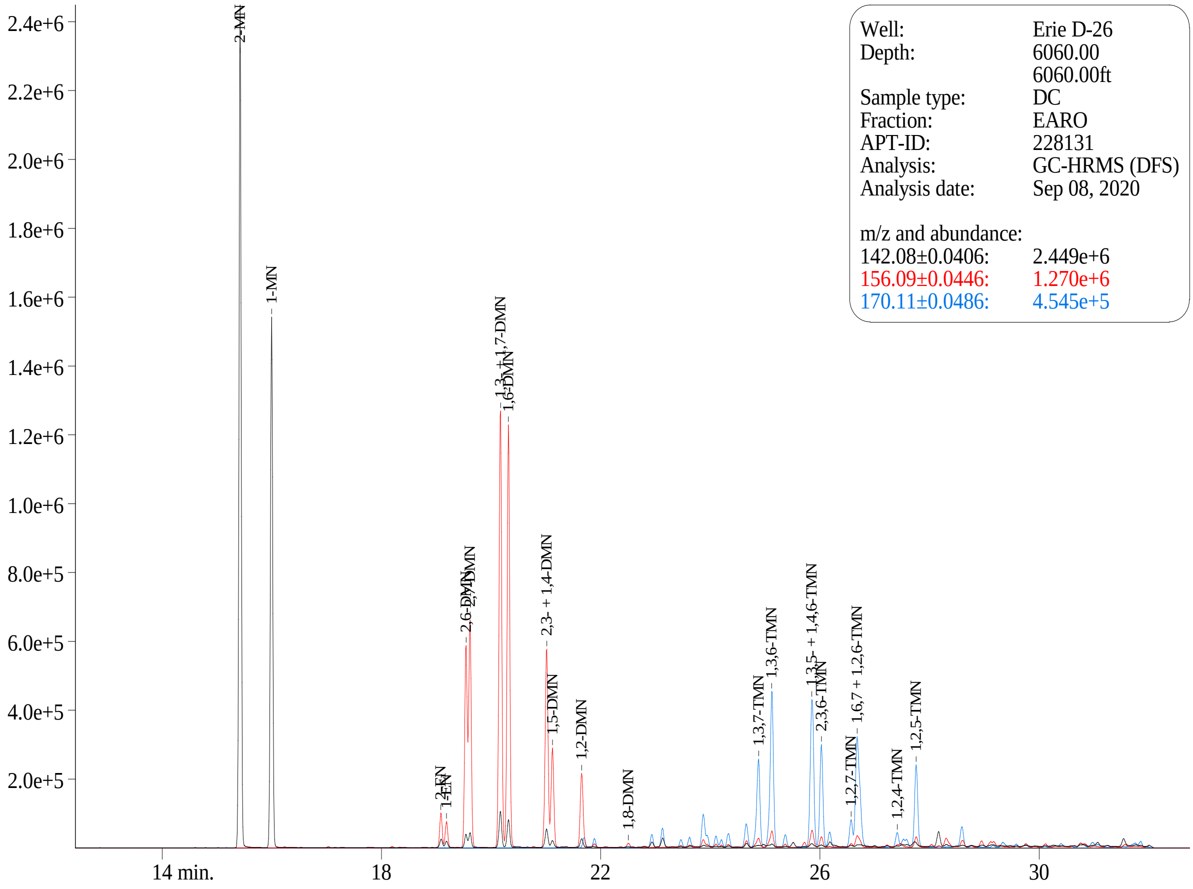


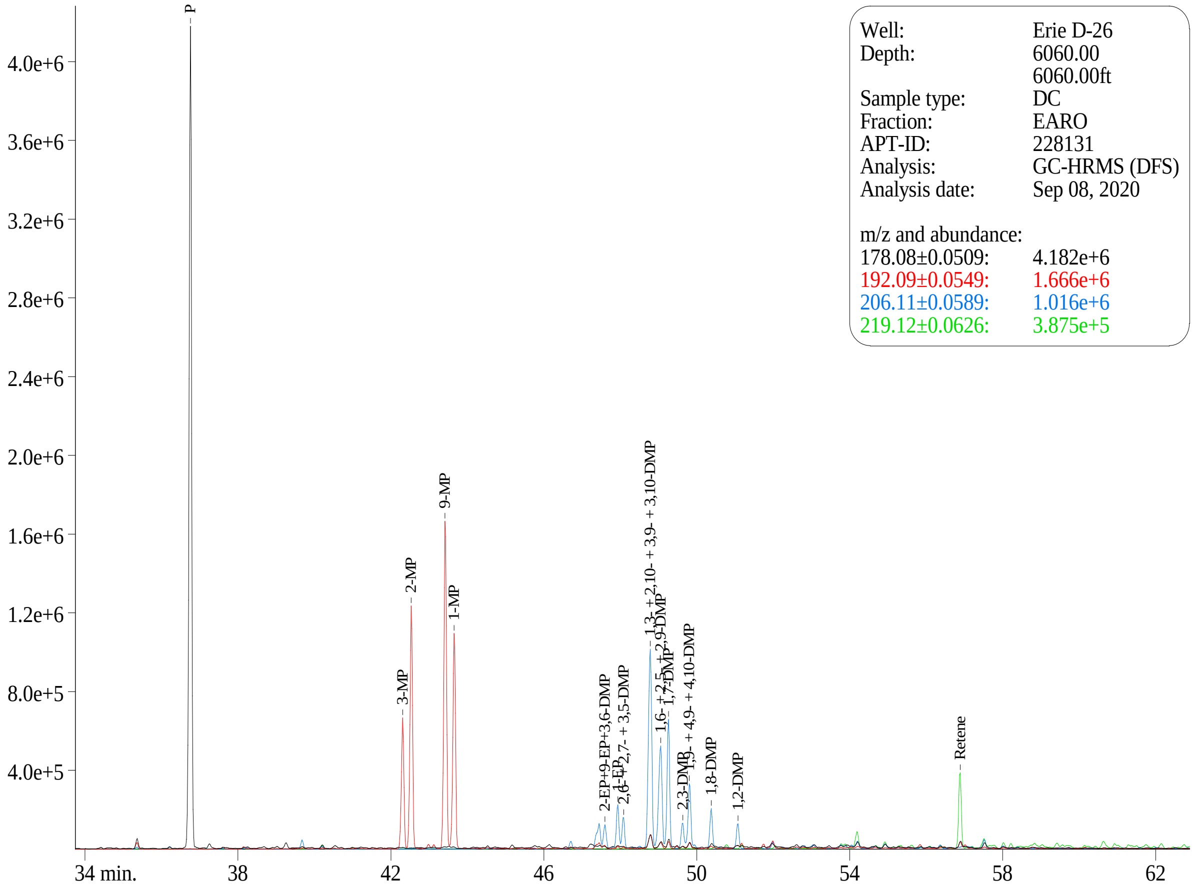
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

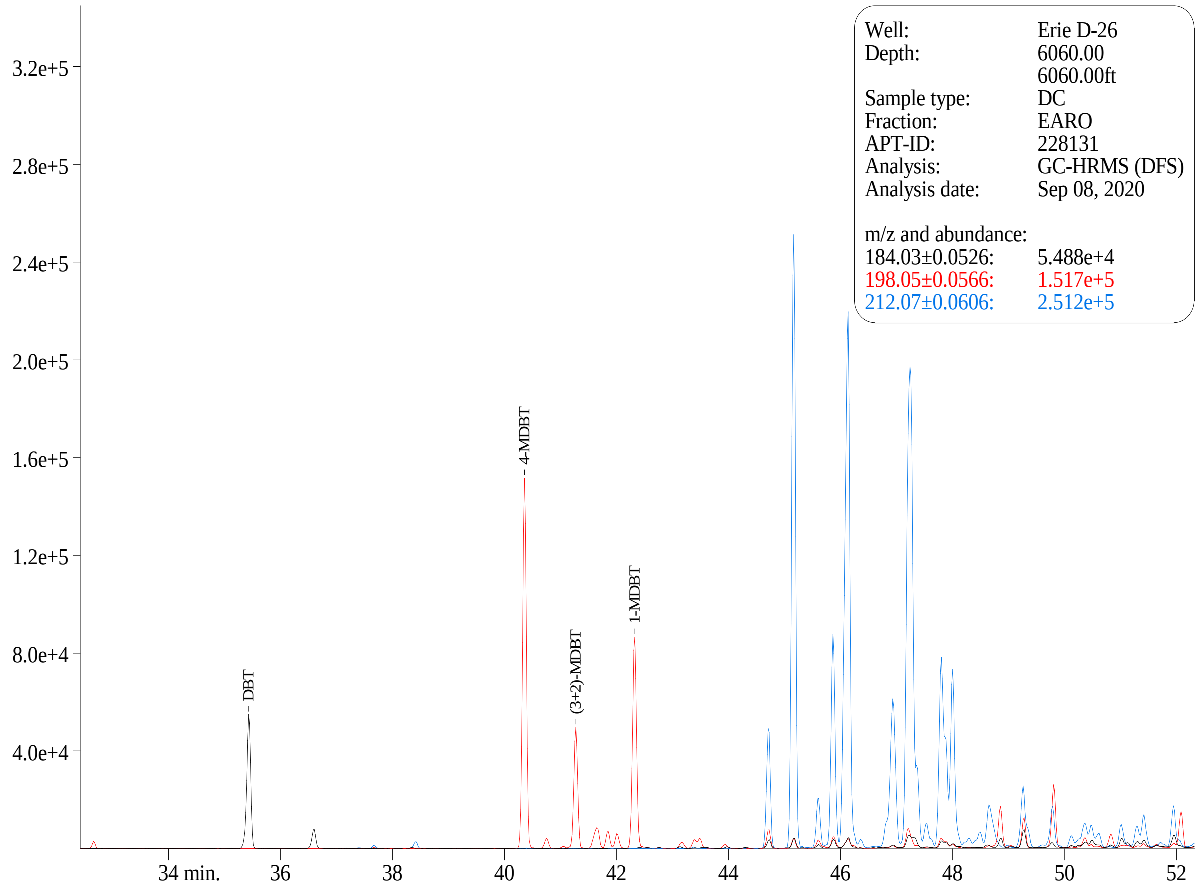
m/z and abundance:
231.12±0.0660: 1.067e+3


220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
245.1330±0.0700: 1.958e+2


1.0e+3
9.0e+2
8.0e+2
7.0e+2
6.0e+2
5.0e+2
4.0e+2
3.0e+2
2.0e+2
1.0e+2
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Erie D-26
Depth: 5940.00
5940.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228130
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
253.20±0.0723: 4.504e+2

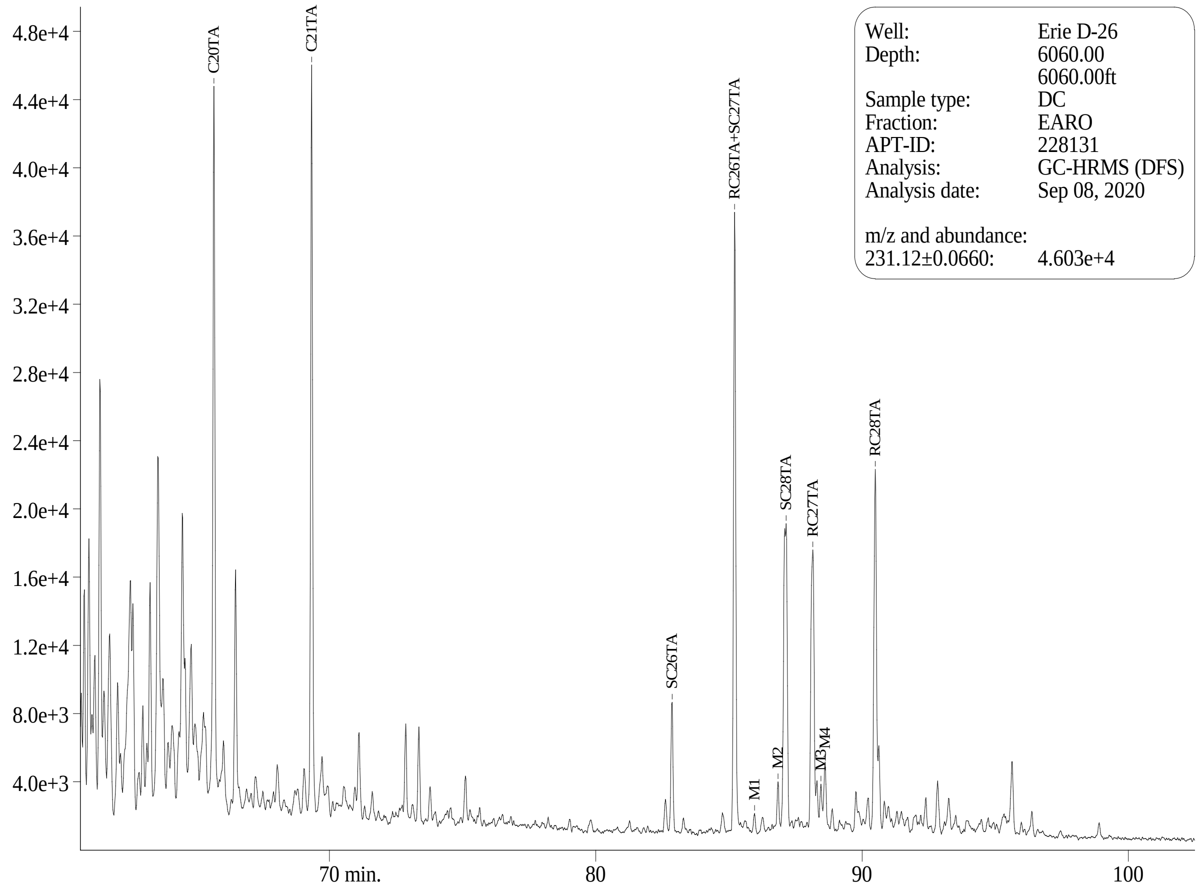

2.4e+6
2.2e+6
2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
142.08±0.0406: 2.449e+6
156.09±0.0446: 1.270e+6
170.11±0.0486: 4.545e+5


4.0e+6
3.6e+6
3.2e+6
2.8e+6
2.4e+6
2.0e+6
1.6e+6
1.2e+6
8.0e+5
4.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Erie D-26
Depth: 6060.00
6060.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228131
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
178.08±0.0509: 4.182e+6
192.09±0.0549: 1.666e+6
206.11±0.0589: 1.016e+6
219.12±0.0626: 3.875e+5



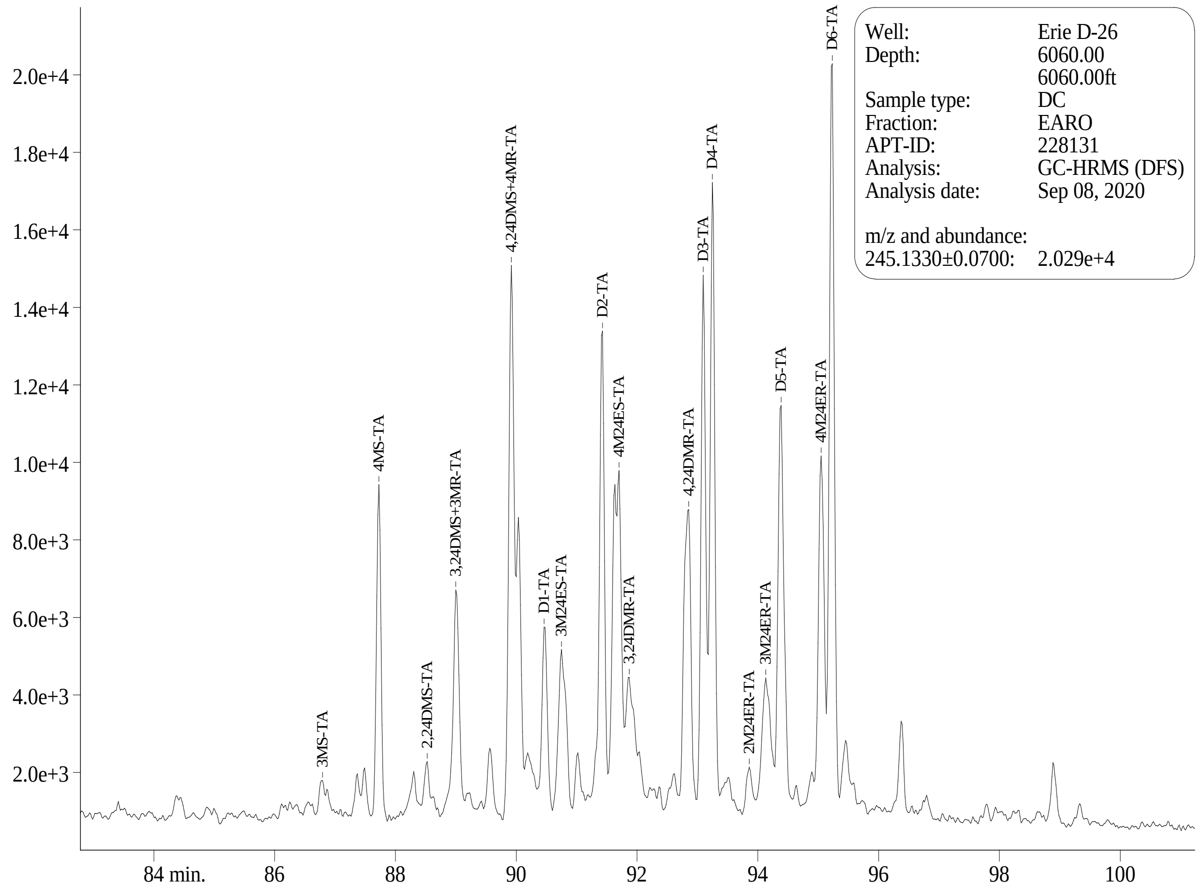
| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 6060.00<br>6060.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228131 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |

| m/z and abundance: | |
|---|---|
| 184.03±0.0526: | 5.488e+4 |
| 198.05±0.0566: | 1.517e+5 |
| 212.07±0.0606: | 2.512e+5 |

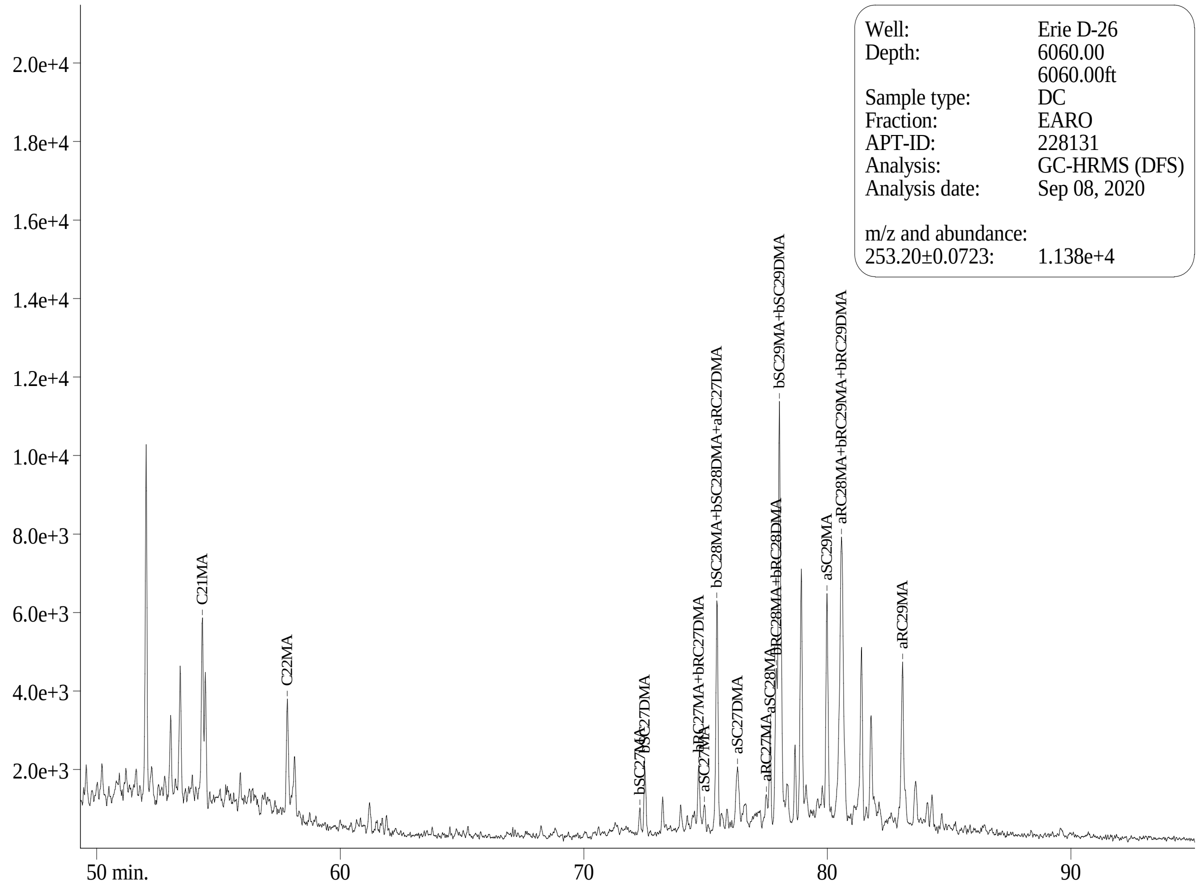


| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 6060.00<br>6060.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228131 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |

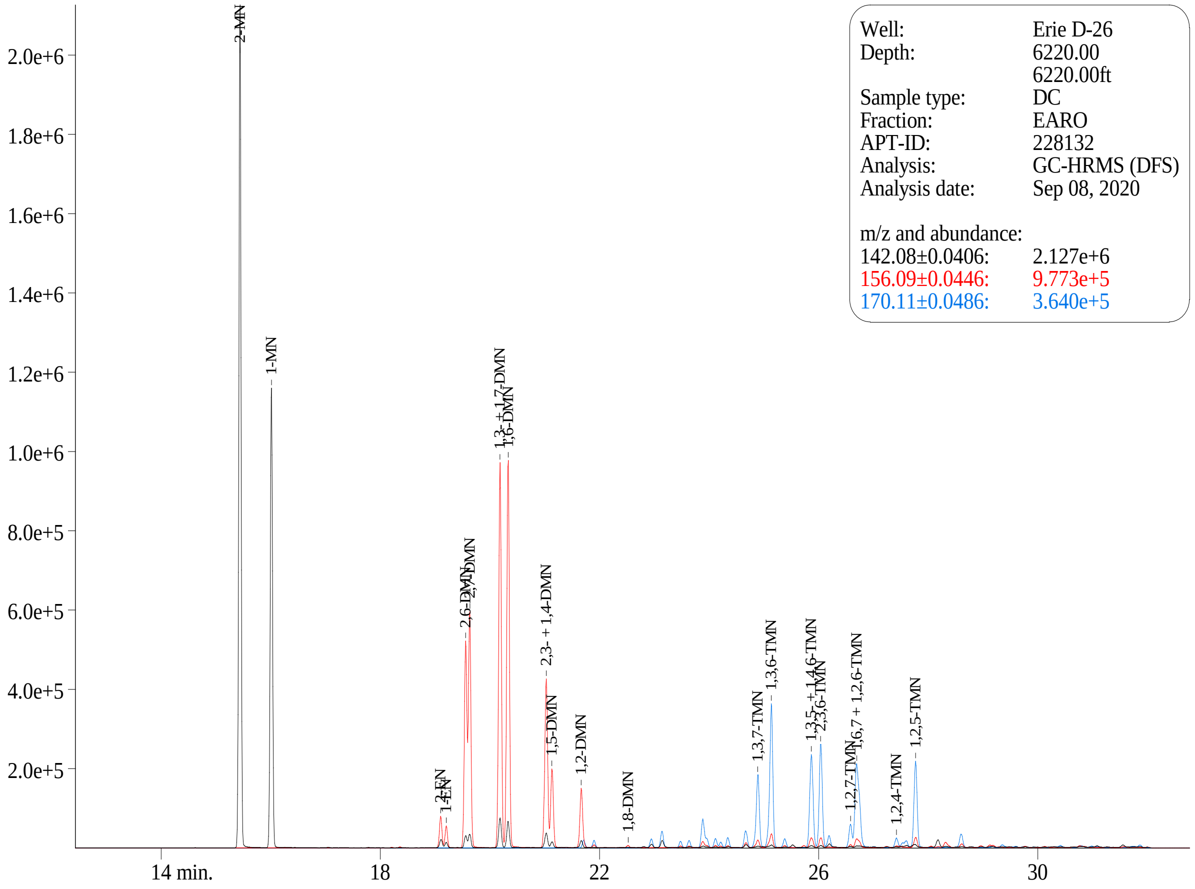
| m/z and abundance: | |
|---|---|
| 231.12±0.0660: | 4.603e+4 |

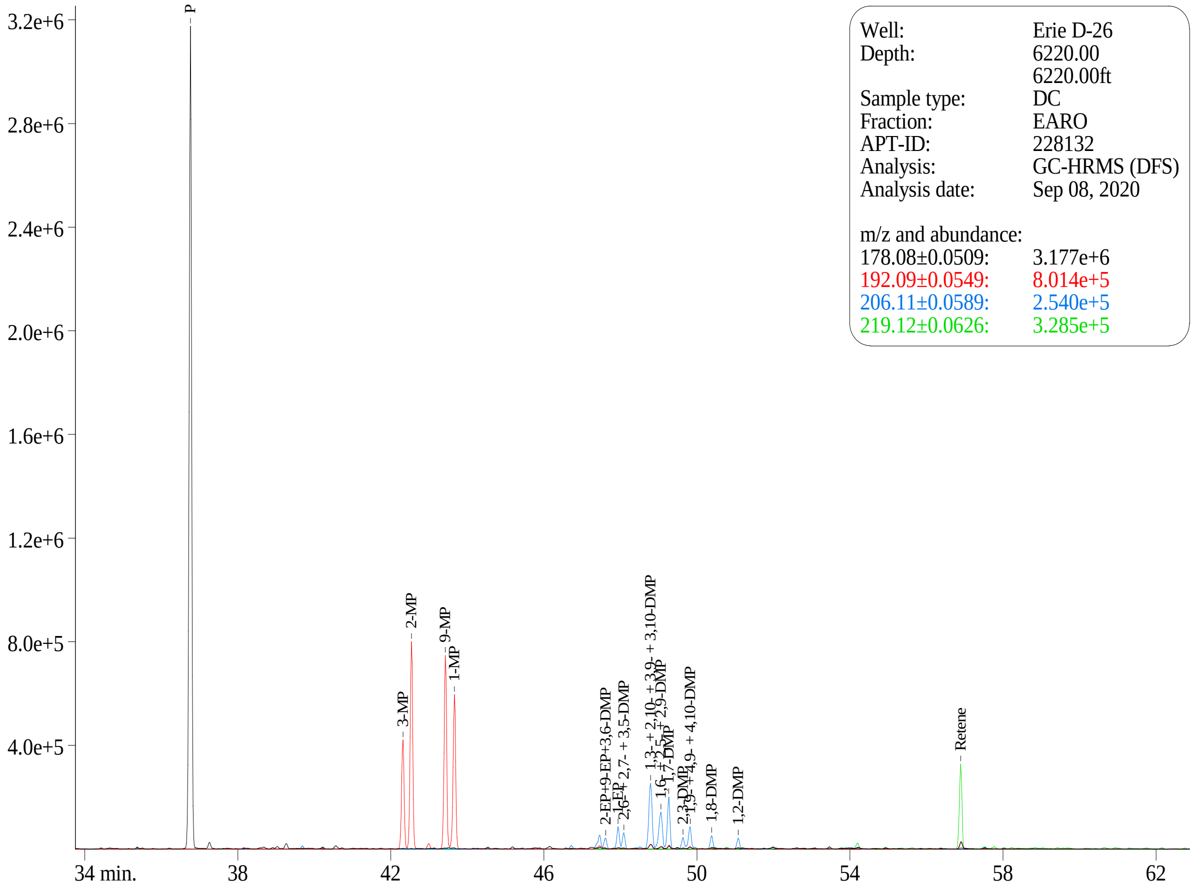


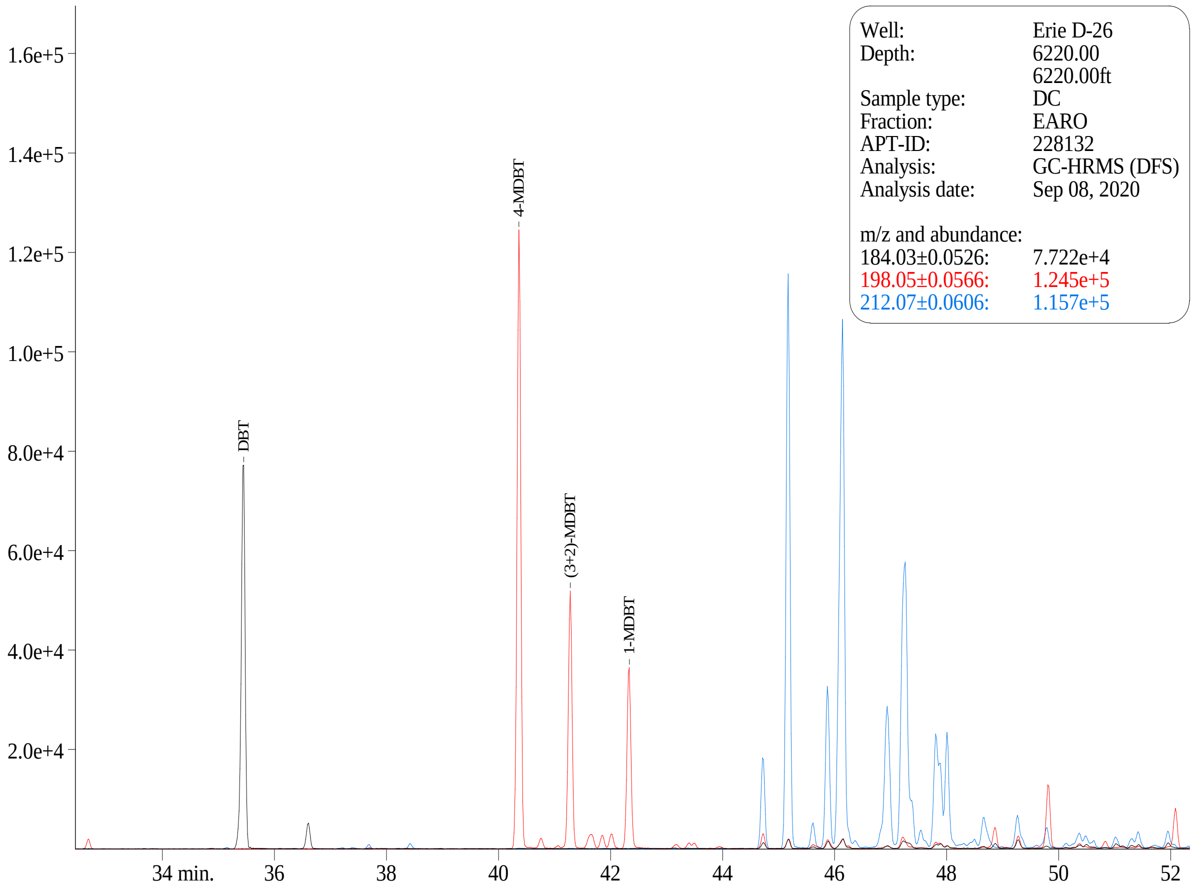
| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 6060.00<br>6060.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228131 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |
| m/z and abundance: | |
| 245.1330±0.0700: | 2.029e+4 |

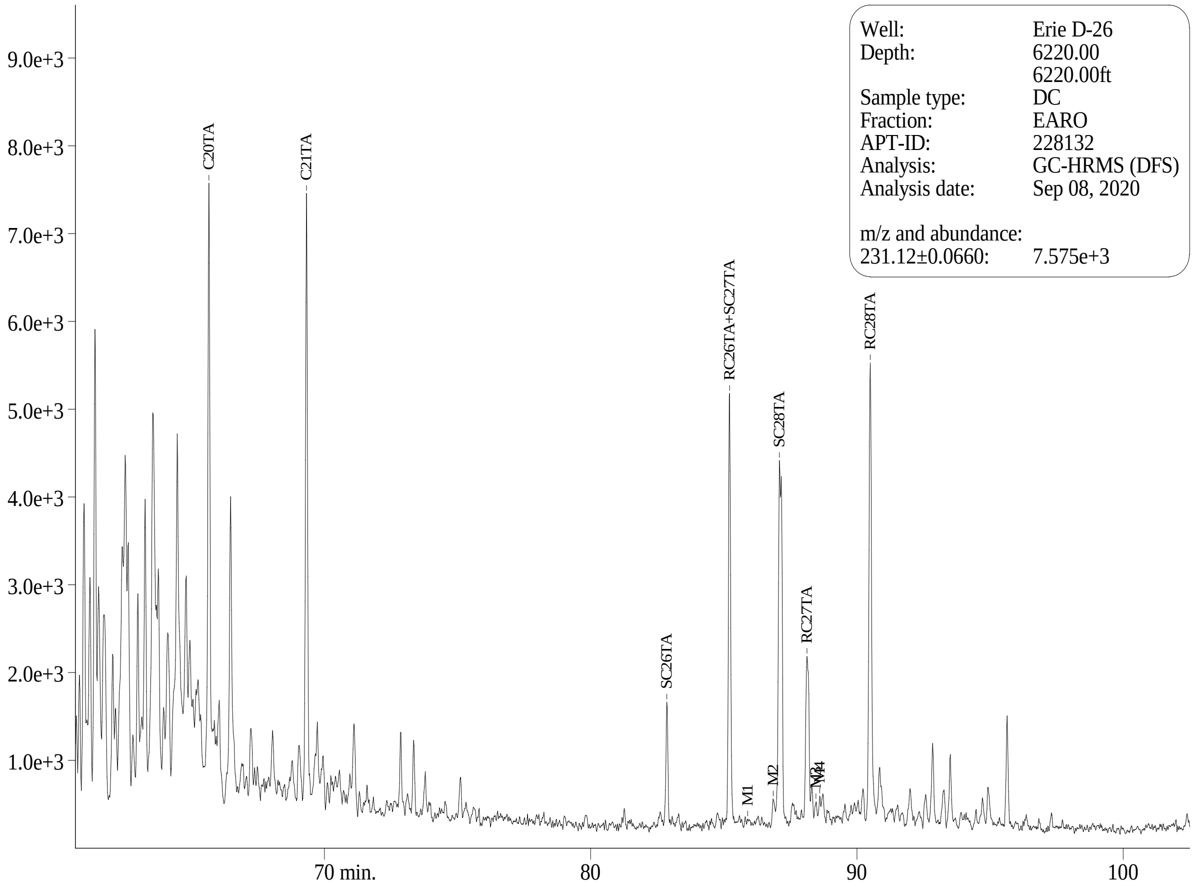


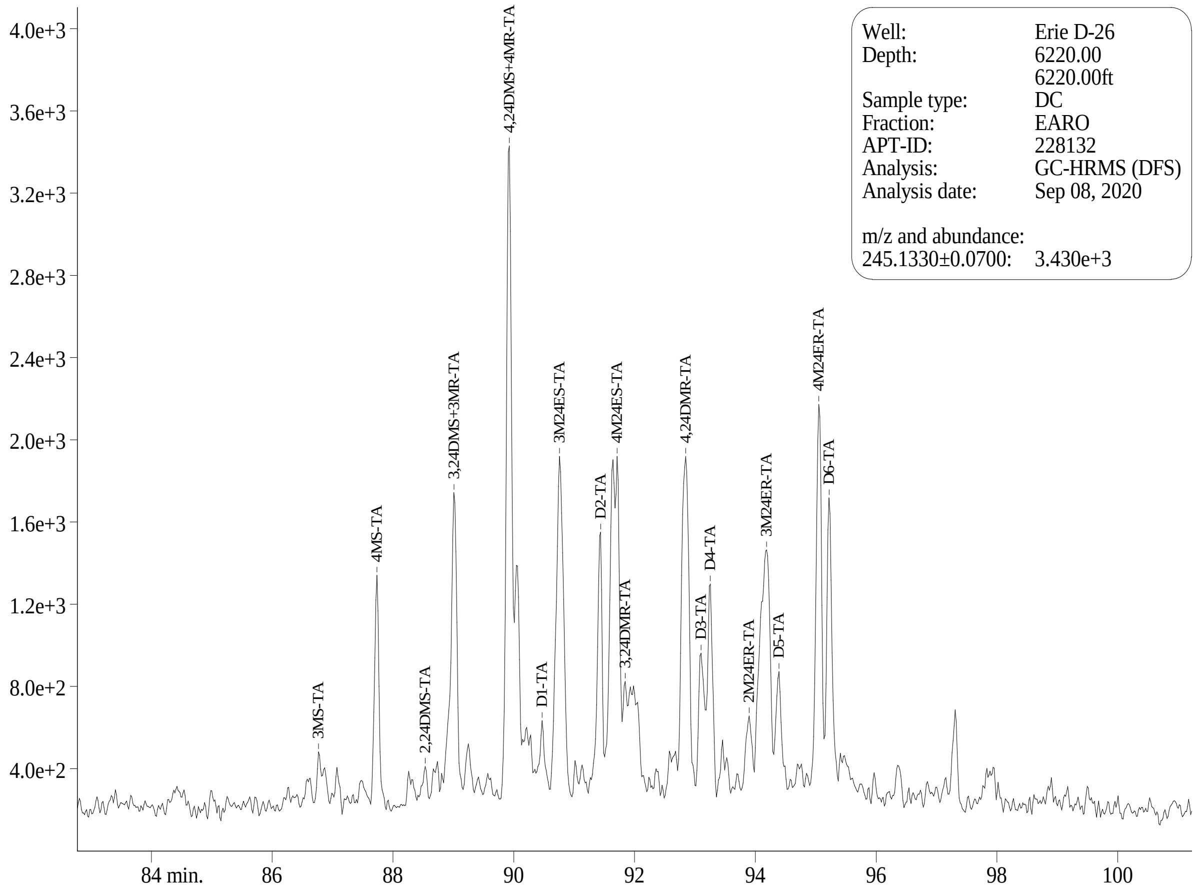
| | |
|---|---|
| Well: | Erie D-26 |
| Depth: | 6060.00<br>6060.00ft |
| Sample type: | DC |
| Fraction: | EARO |
| APT-ID: | 228131 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 08, 2020 |
| m/z and abundance: | |
| 253.20±0.0723: | 1.138e+4 |

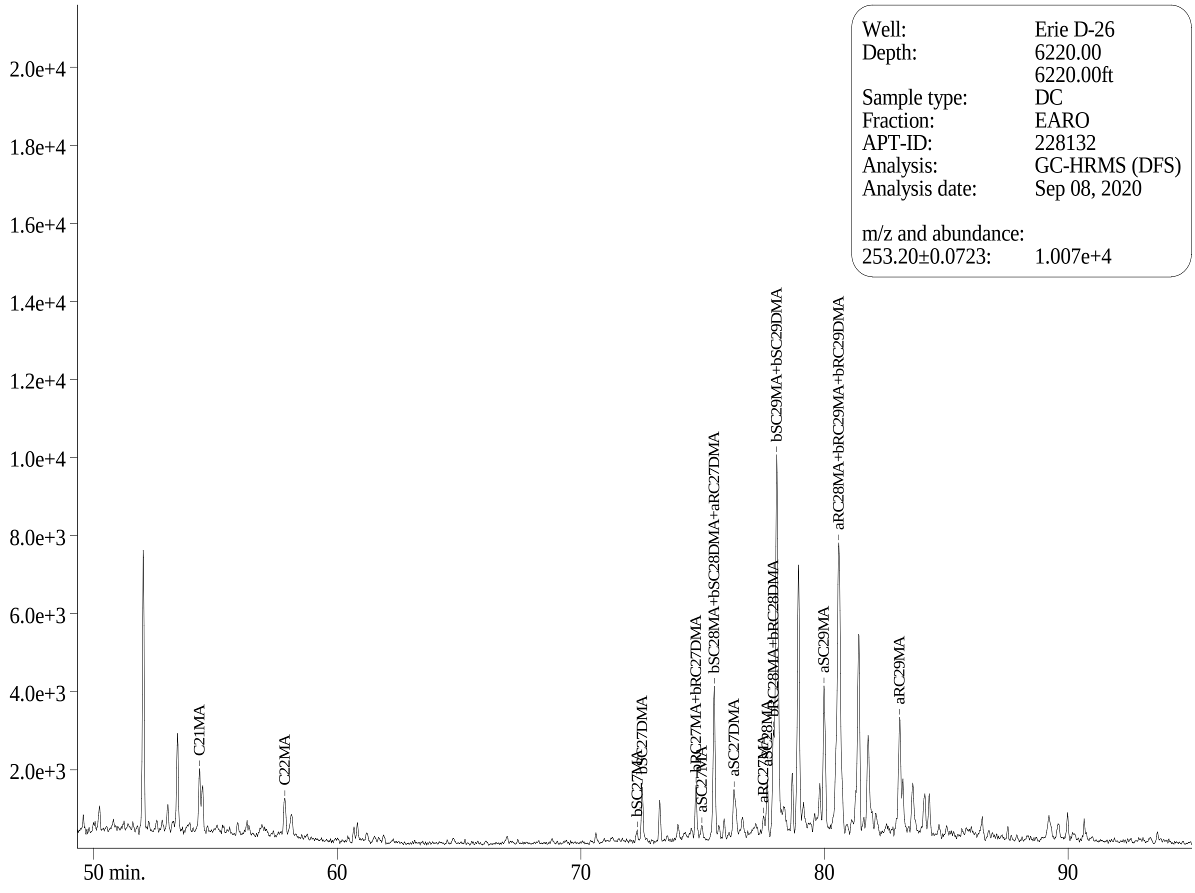

2.0e+6
1.8e+6
1.6e+6
1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
142.08±0.0406: 2.127e+6
156.09±0.0446: 9.773e+5
170.11±0.0486: 3.640e+5

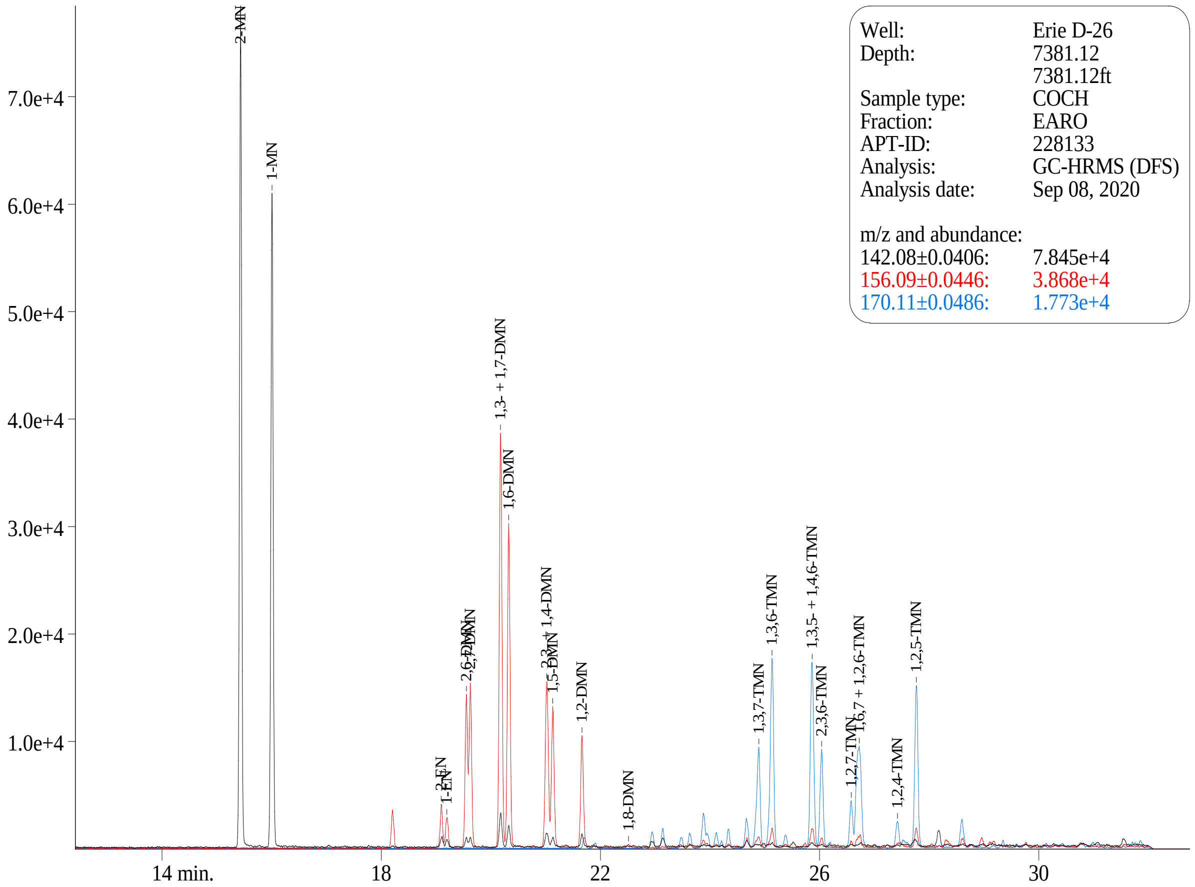

3.2e+6
2.8e+6
2.4e+6
2.0e+6
1.6e+6
1.2e+6
8.0e+5
4.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
178.08±0.0509: 3.177e+6
192.09±0.0549: 8.014e+5
206.11±0.0589: 2.540e+5
219.12±0.0626: 3.285e+5

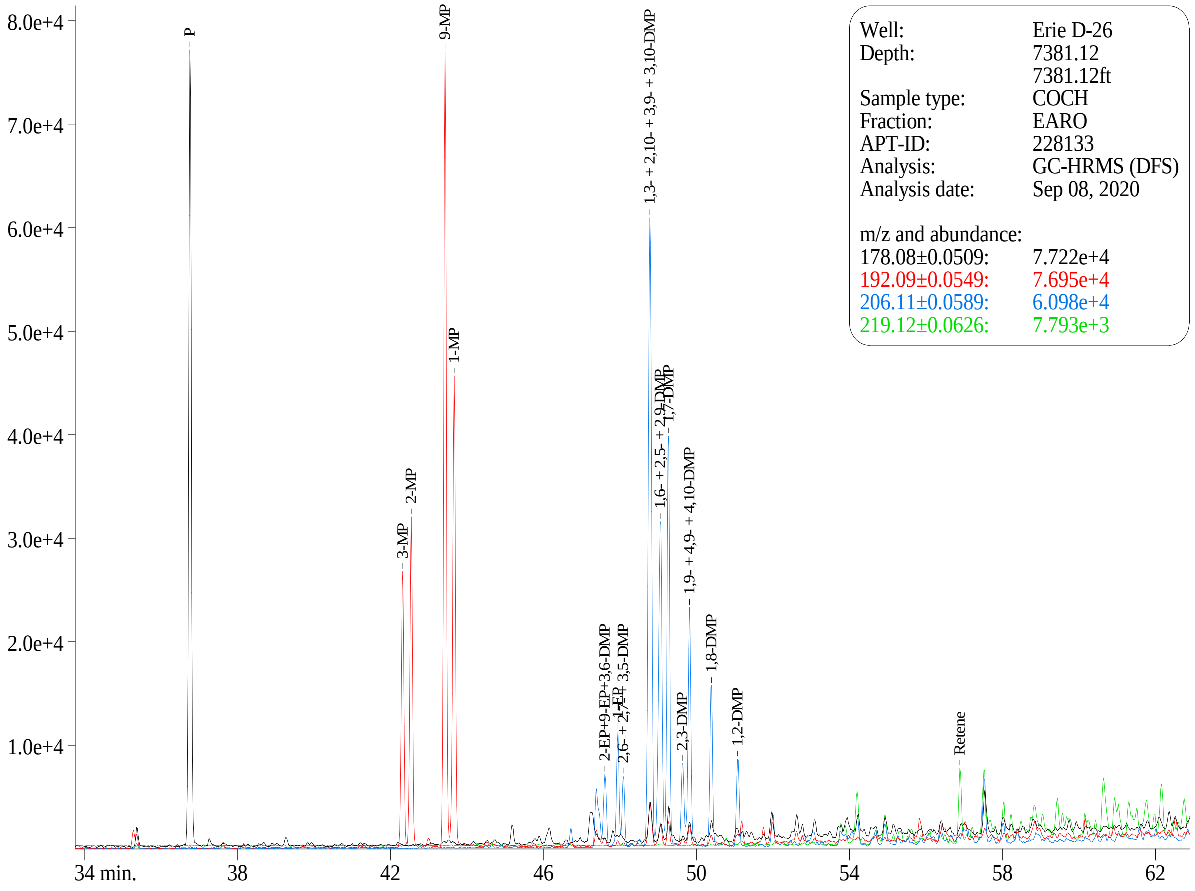

1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
34 min.
36
38
40
42
44
46
48
50
52
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
184.03±0.0526: 7.722e+4
198.05±0.0566: 1.245e+5
212.07±0.0606: 1.157e+5

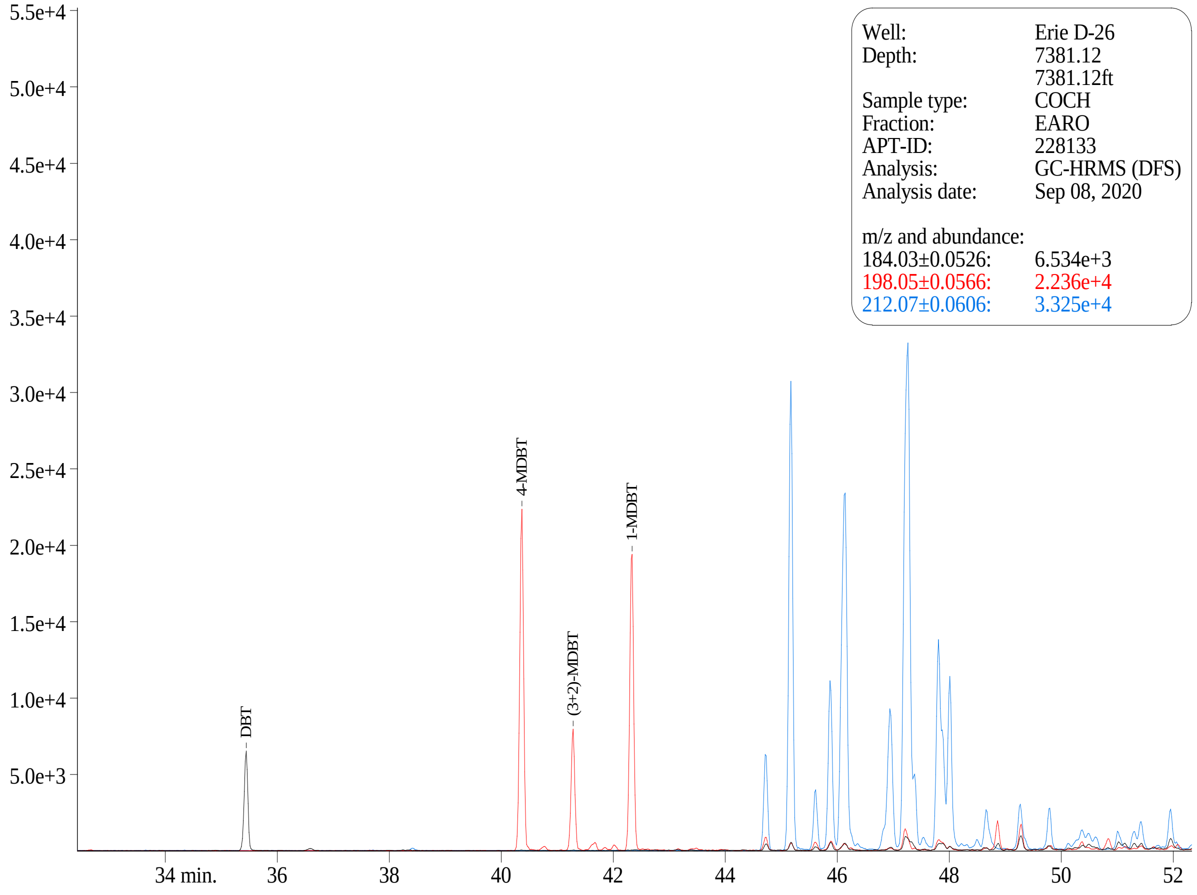

9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
70 min.
80
90
100
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
231.12±0.0660: 7.575e+3


4.0e+3
3.6e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
245.1330±0.0700: 3.430e+3

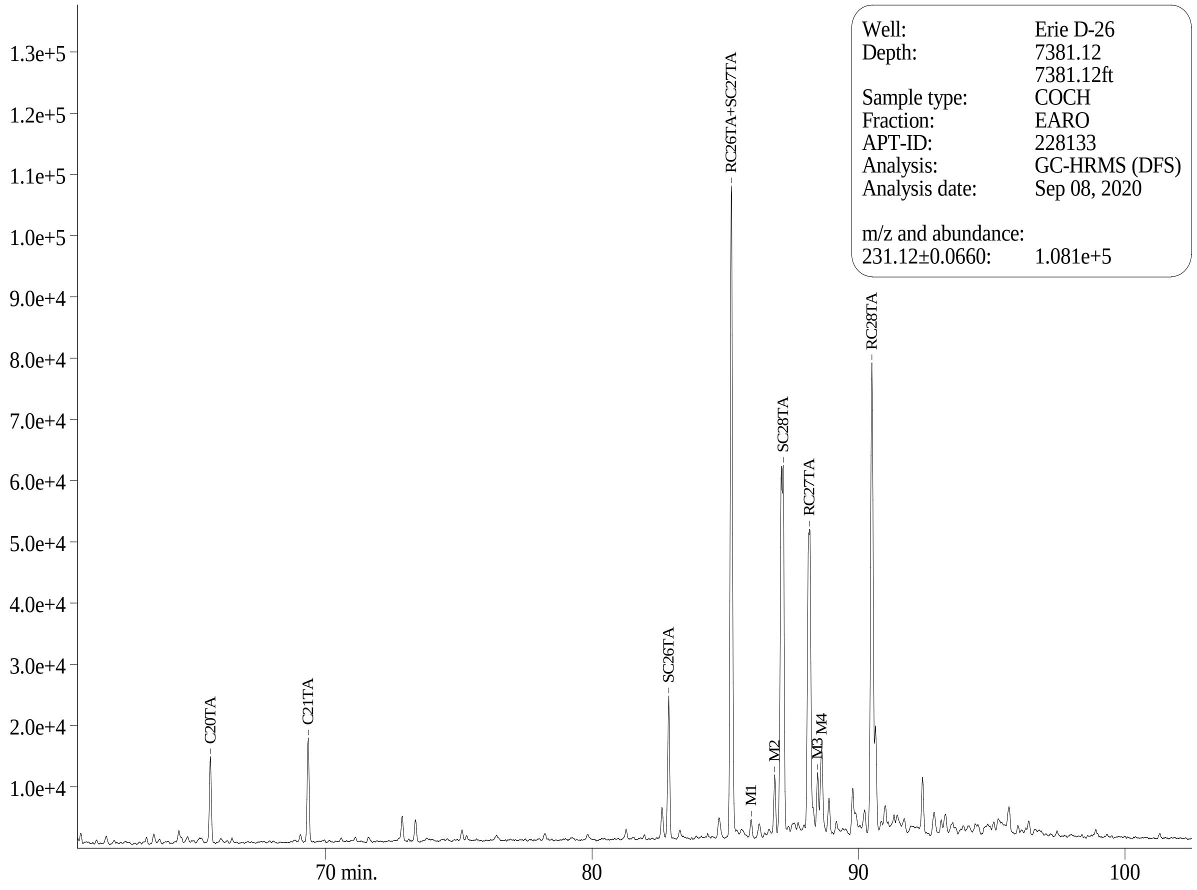

2.0e+4
1.8e+4
1.6e+4
1.4e+4
1.2e+4
1.0e+4
8.0e+3
6.0e+3
4.0e+3
2.0e+3
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Erie D-26
Depth: 6220.00
6220.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228132
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
253.20±0.0723: 1.007e+4


Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
142.08±0.0406: 7.845e+4
156.09±0.0446: 3.868e+4
170.11±0.0486: 1.773e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6- + 2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN

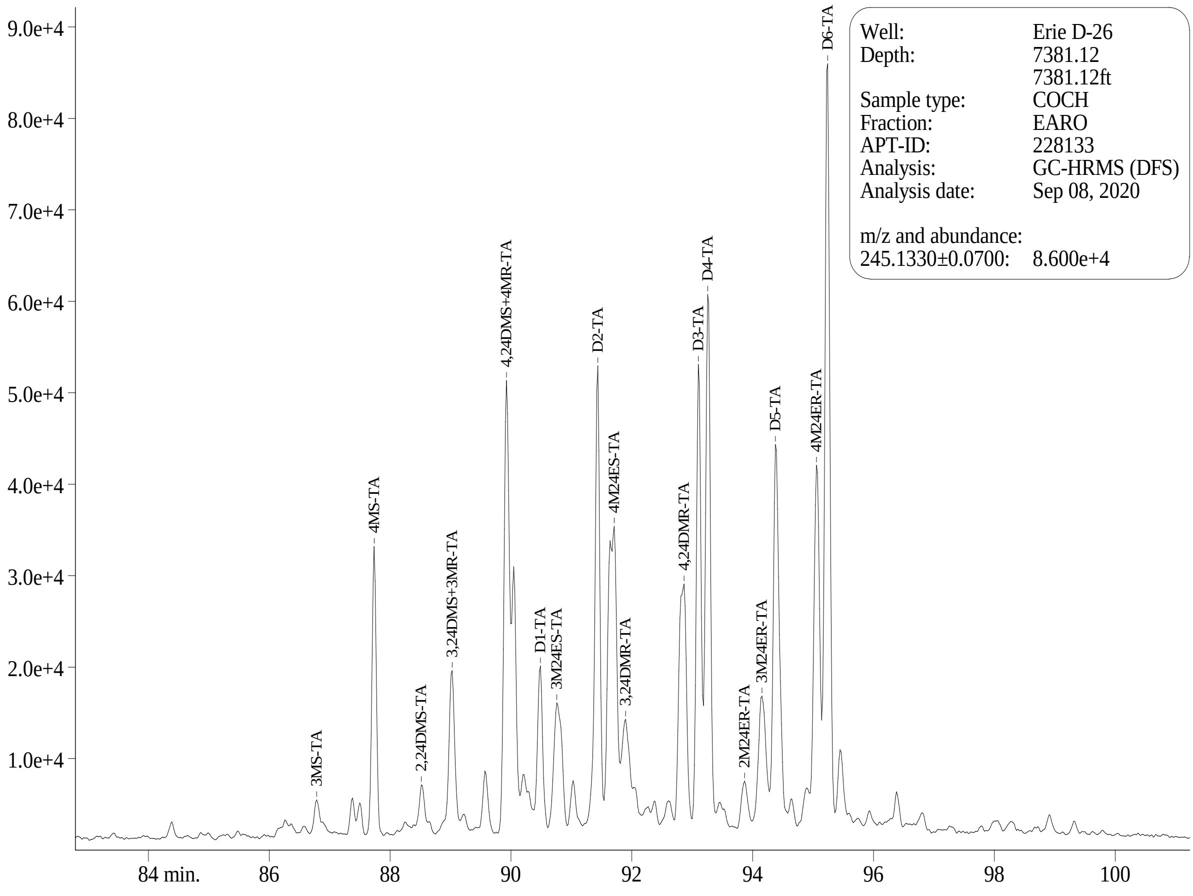

Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
178.08±0.0509: 7.722e+4
192.09±0.0549: 7.695e+4
206.11±0.0589: 6.098e+4
219.12±0.0626: 7.793e+3
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene



Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
184.03±0.0526: 6.534e+3
198.05±0.0566: 2.236e+4
212.07±0.0606: 3.325e+4
5.5e+4
5.0e+4
4.5e+4
4.0e+4
3.5e+4
3.0e+4
2.5e+4
2.0e+4
1.5e+4
1.0e+4
5.0e+3
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
34 min.
36
38
40
42
44
46
48
50
52

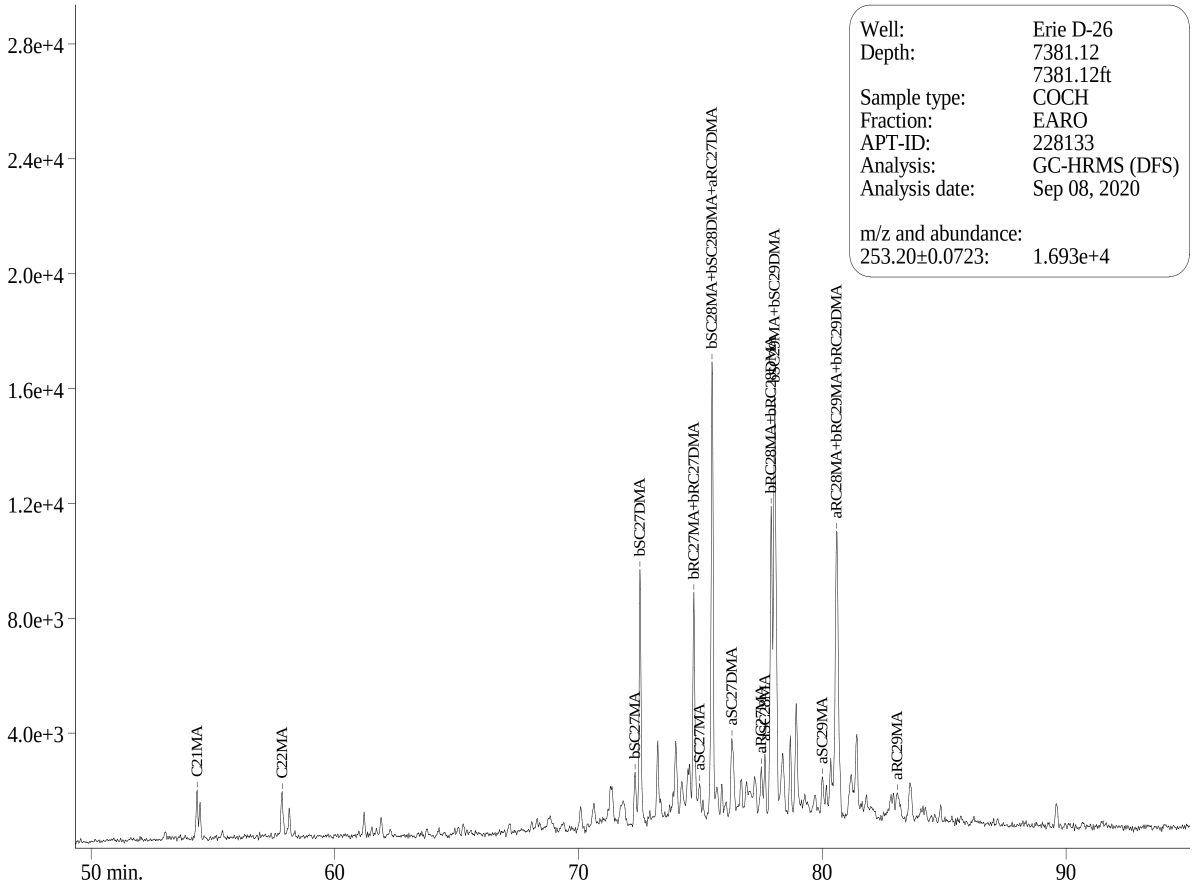


Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
231.12±0.0660: 1.081e+5
1.3e+5
1.2e+5
1.1e+5
1.0e+5
9.0e+4
8.0e+4
7.0e+4
6.0e+4
5.0e+4
4.0e+4
3.0e+4
2.0e+4
1.0e+4
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
70 min.
80
90
100



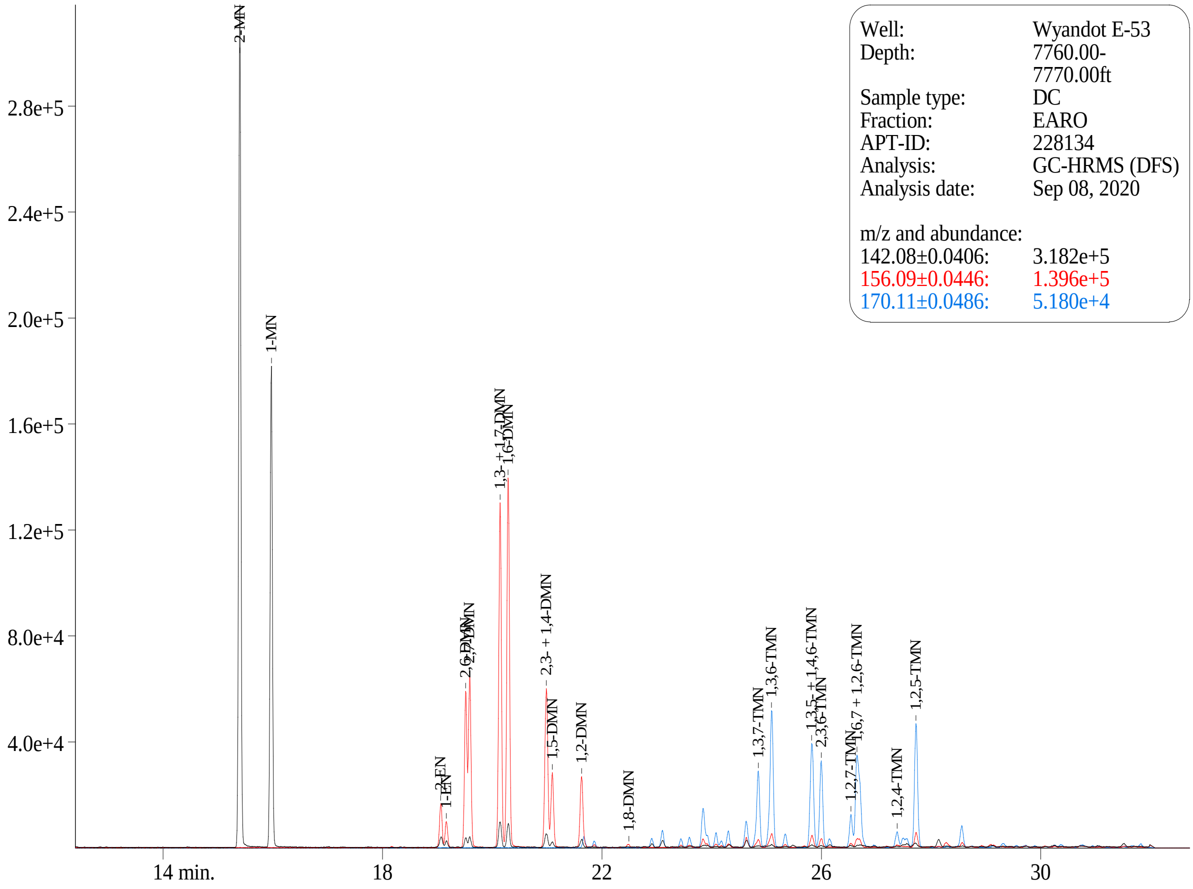
Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

m/z and abundance:
245.1330±0.0700: 8.600e+4



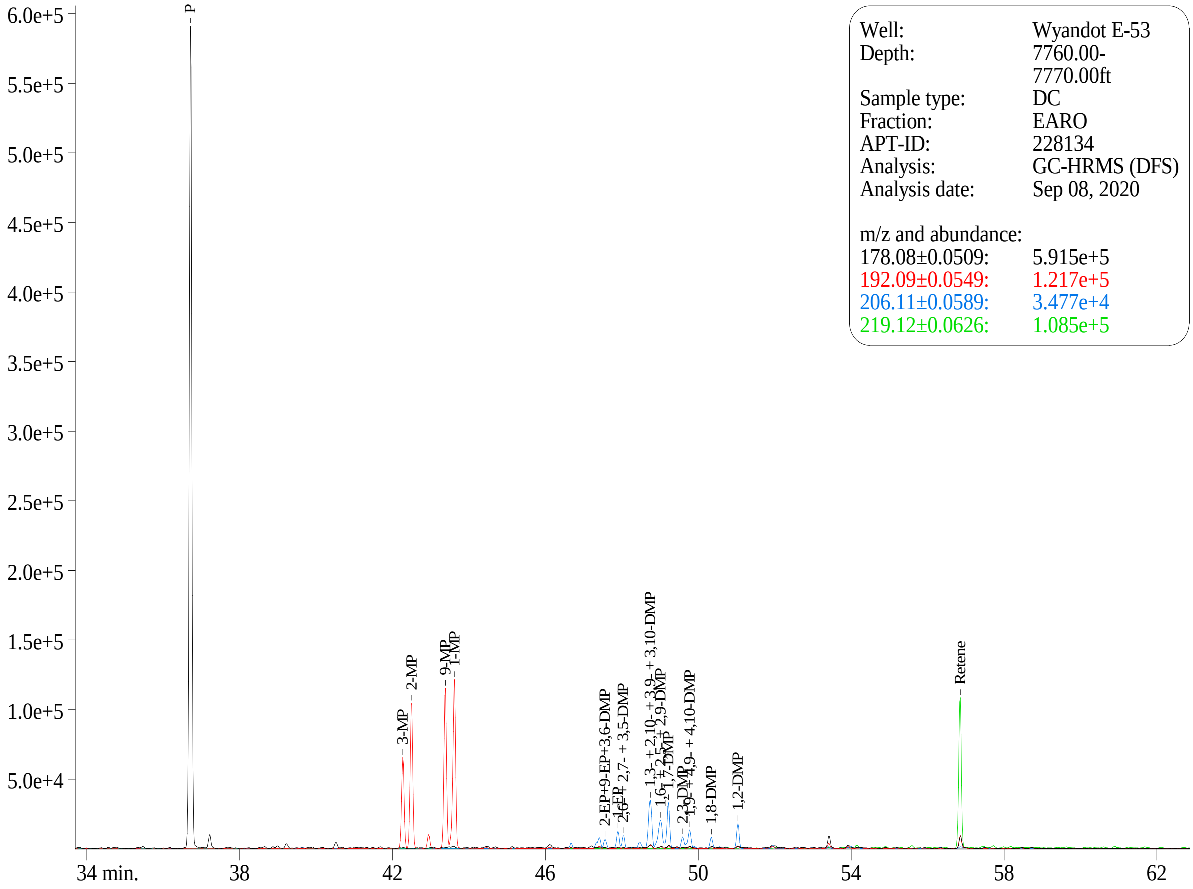
Well: Erie D-26
Depth: 7381.12
7381.12ft
Sample type: COCH
Fraction: EARO
APT-ID: 228133
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

m/z and abundance:
253.20±0.0723: 1.693e+4



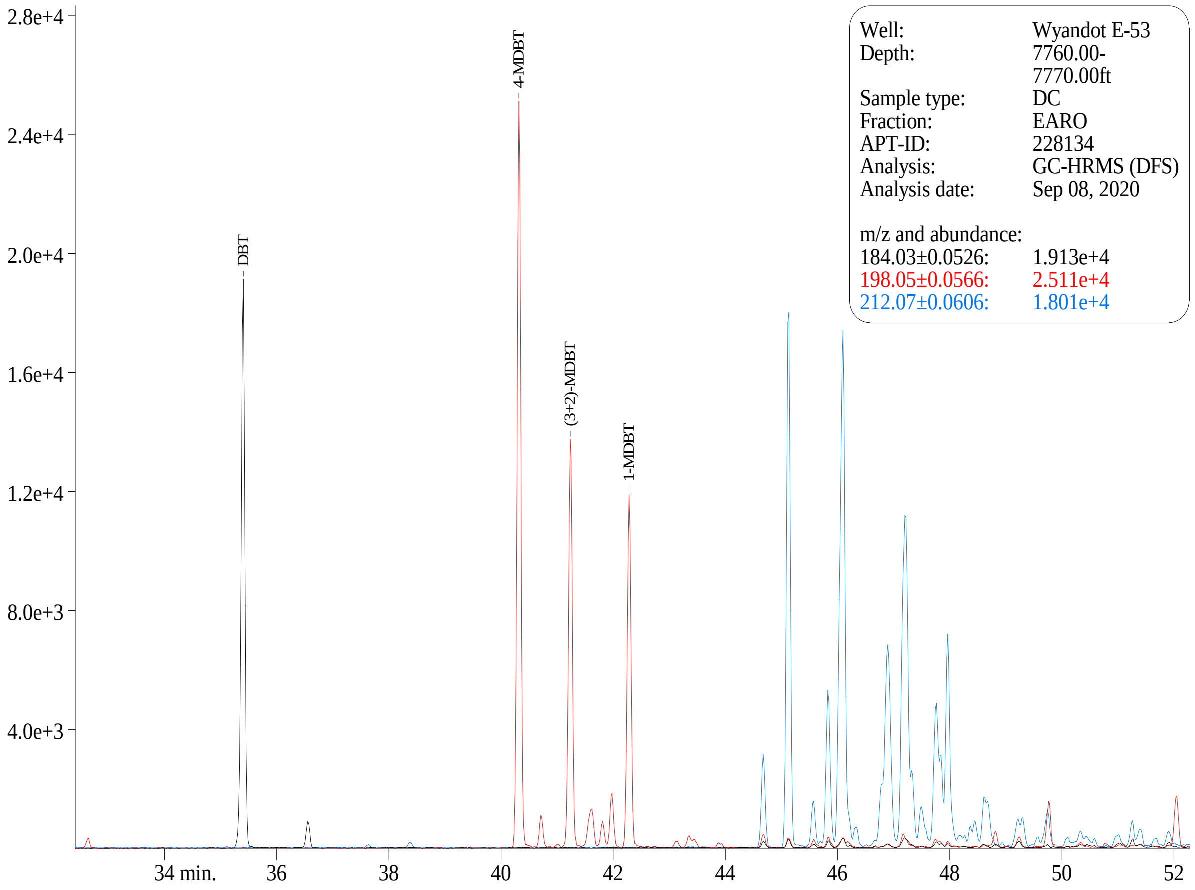
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

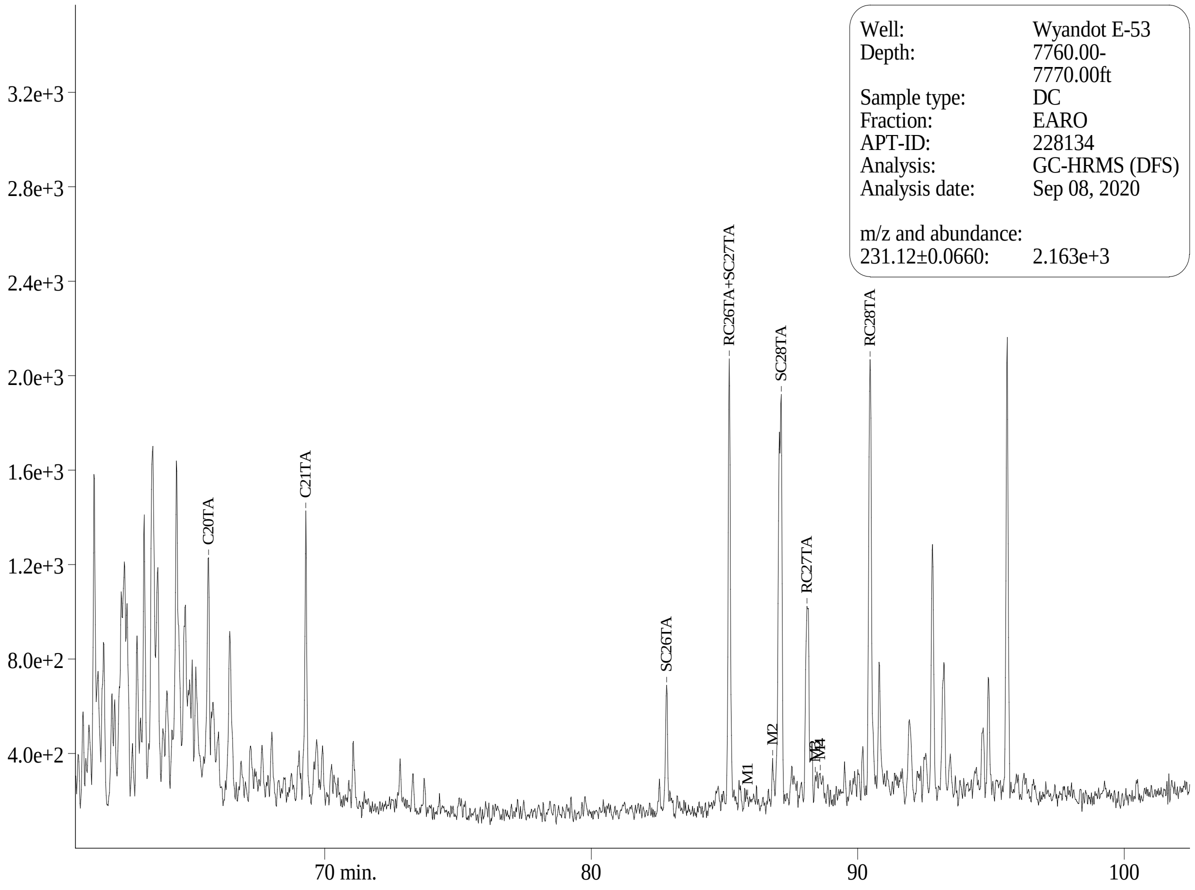
m/z and abundance:
142.08±0.0406: 3.182e+5
156.09±0.0446: 1.396e+5
170.11±0.0486: 5.180e+4

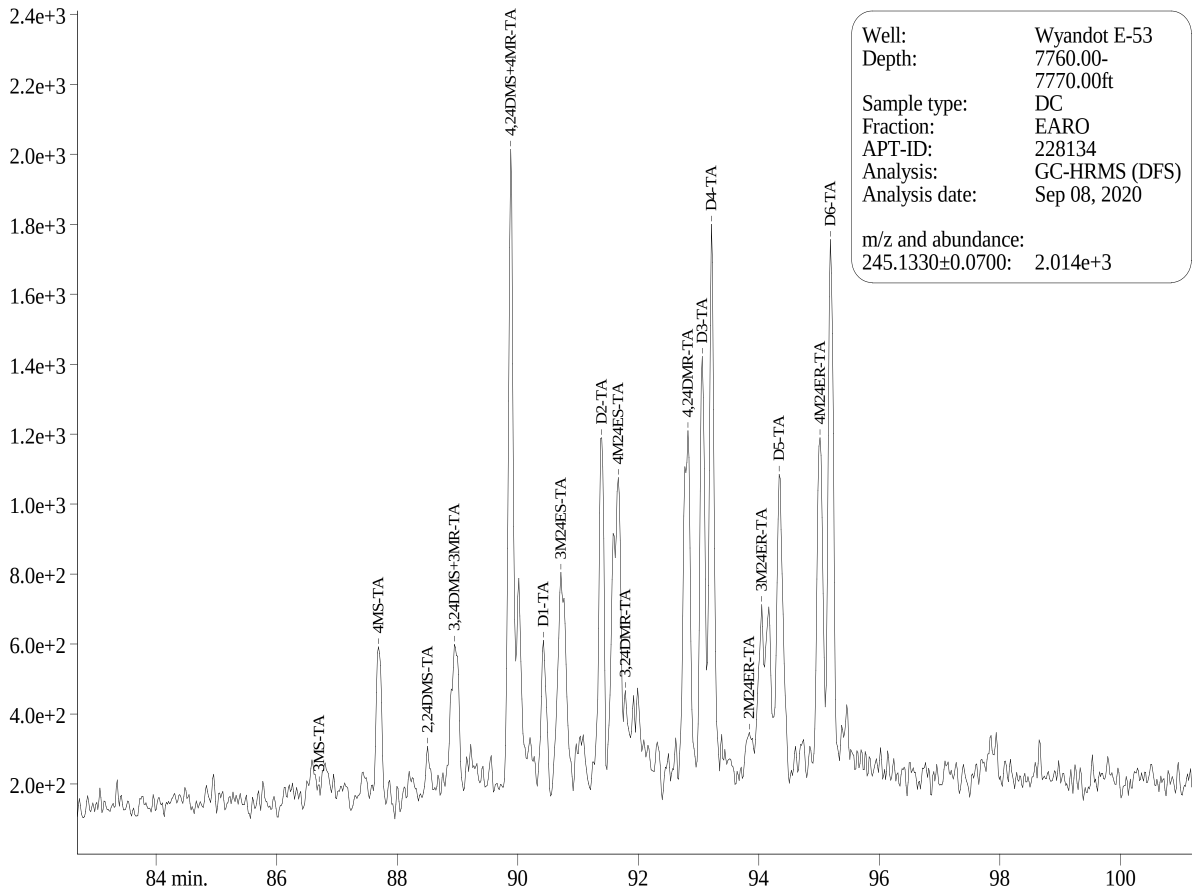


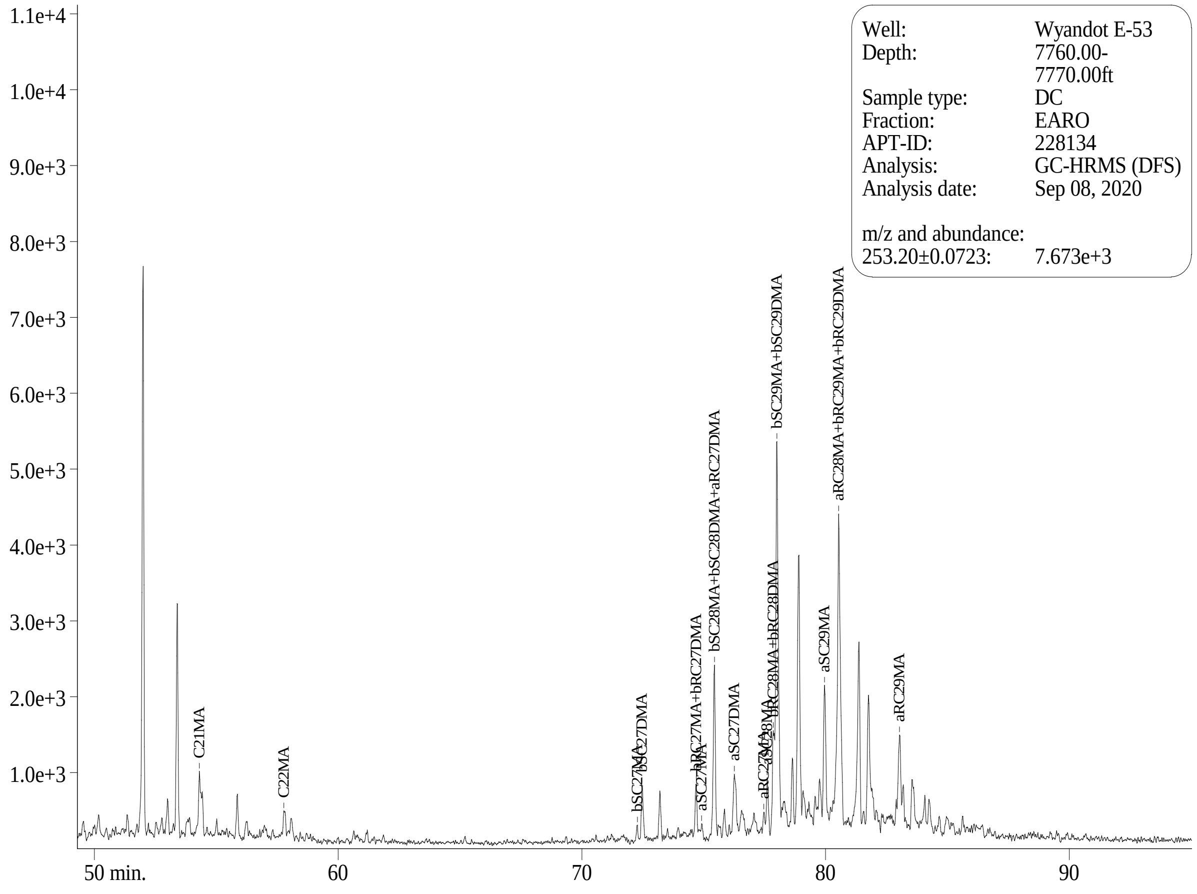
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020

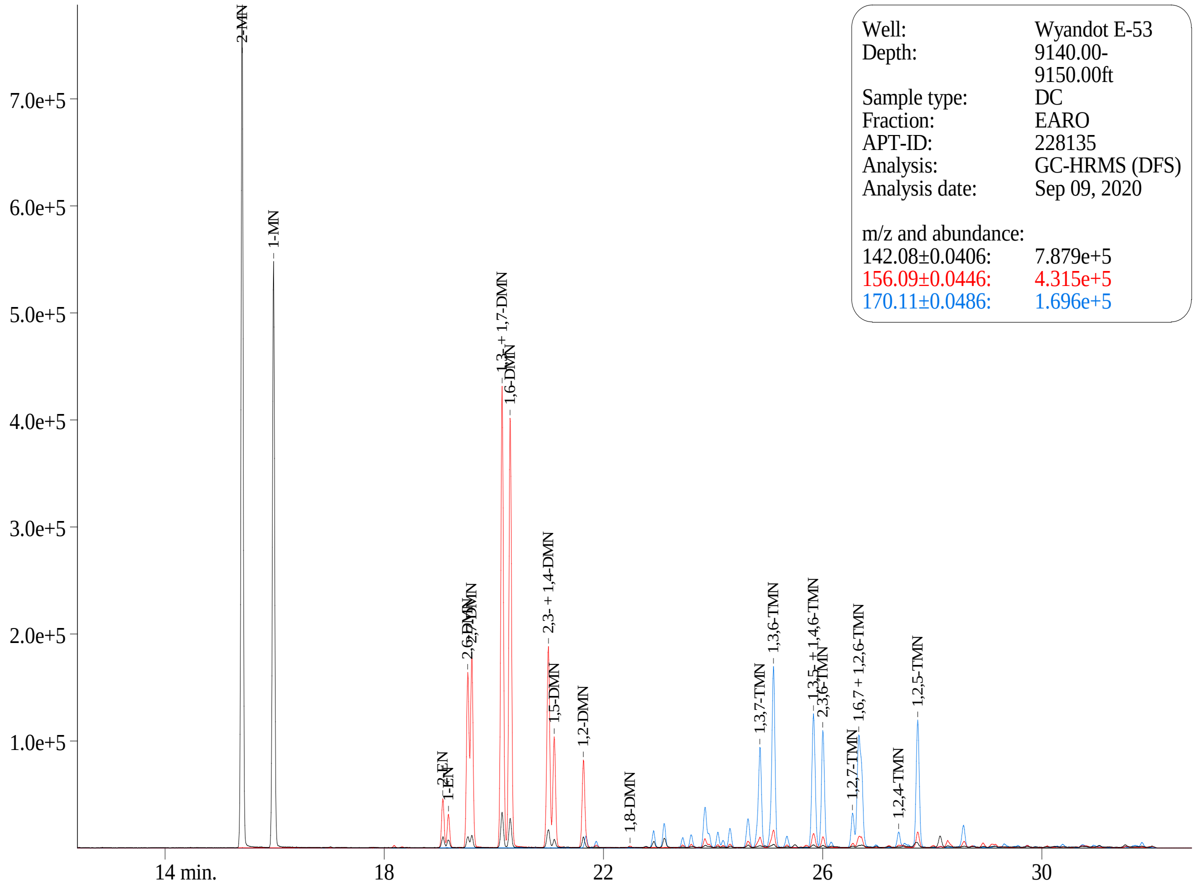
m/z and abundance:
178.08±0.0509: 5.915e+5
192.09±0.0549: 1.217e+5
206.11±0.0589: 3.477e+4
219.12±0.0626: 1.085e+5

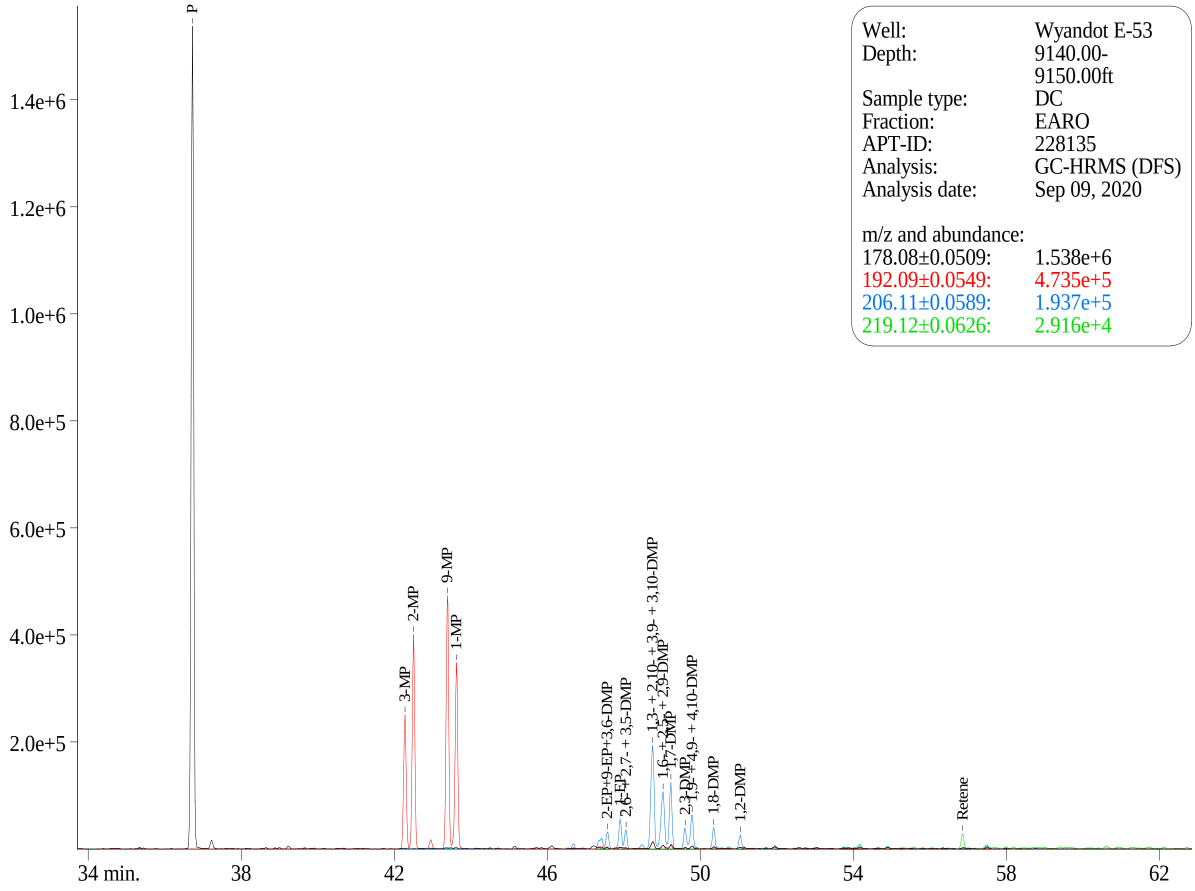

2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
34 min.
36
38
40
42
44
46
48
50
52
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
184.03±0.0526: 1.913e+4
198.05±0.0566: 2.511e+4
212.07±0.0606: 1.801e+4

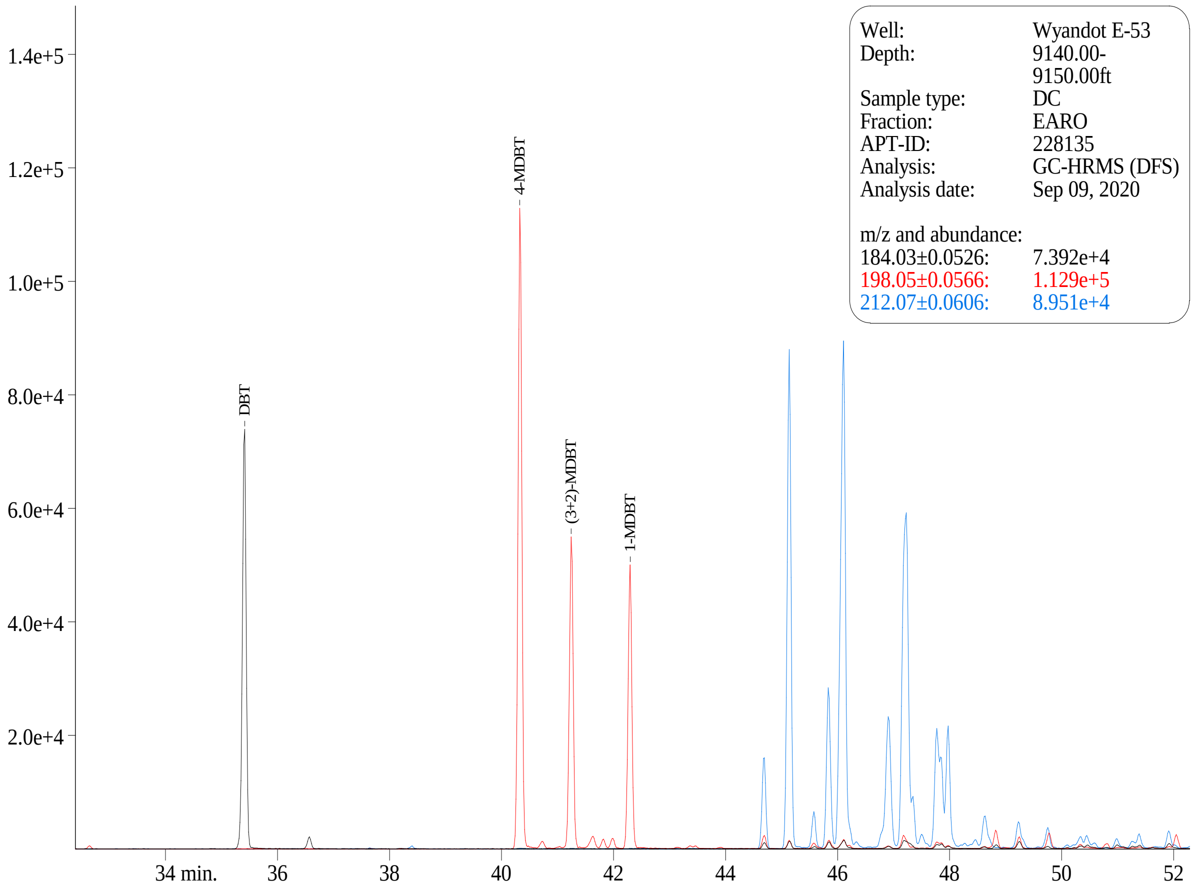

3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
70 min.
80
90
100
Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
231.12±0.0660: 2.163e+3

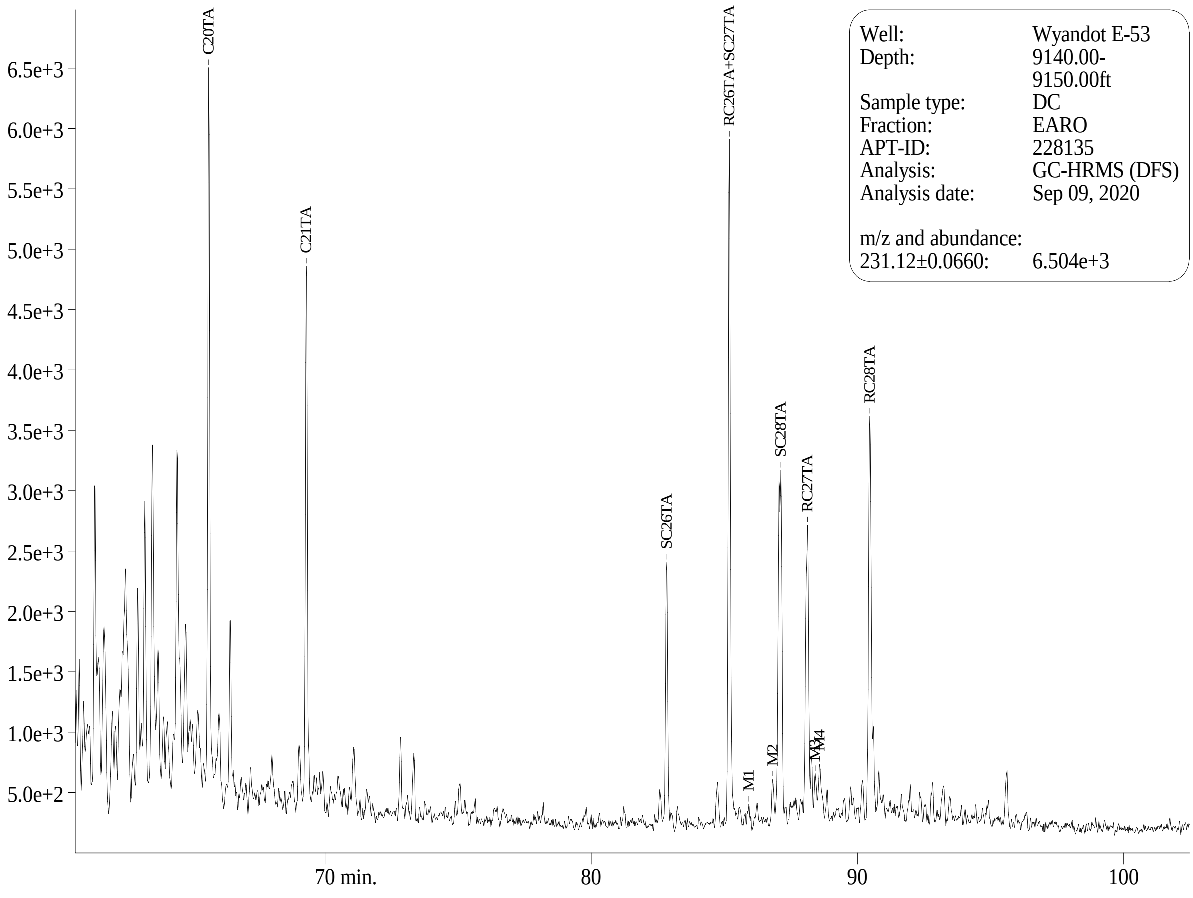

Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
245.1330±0.0700: 2.014e+3
2.4e+3
2.2e+3
2.0e+3
1.8e+3
1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA

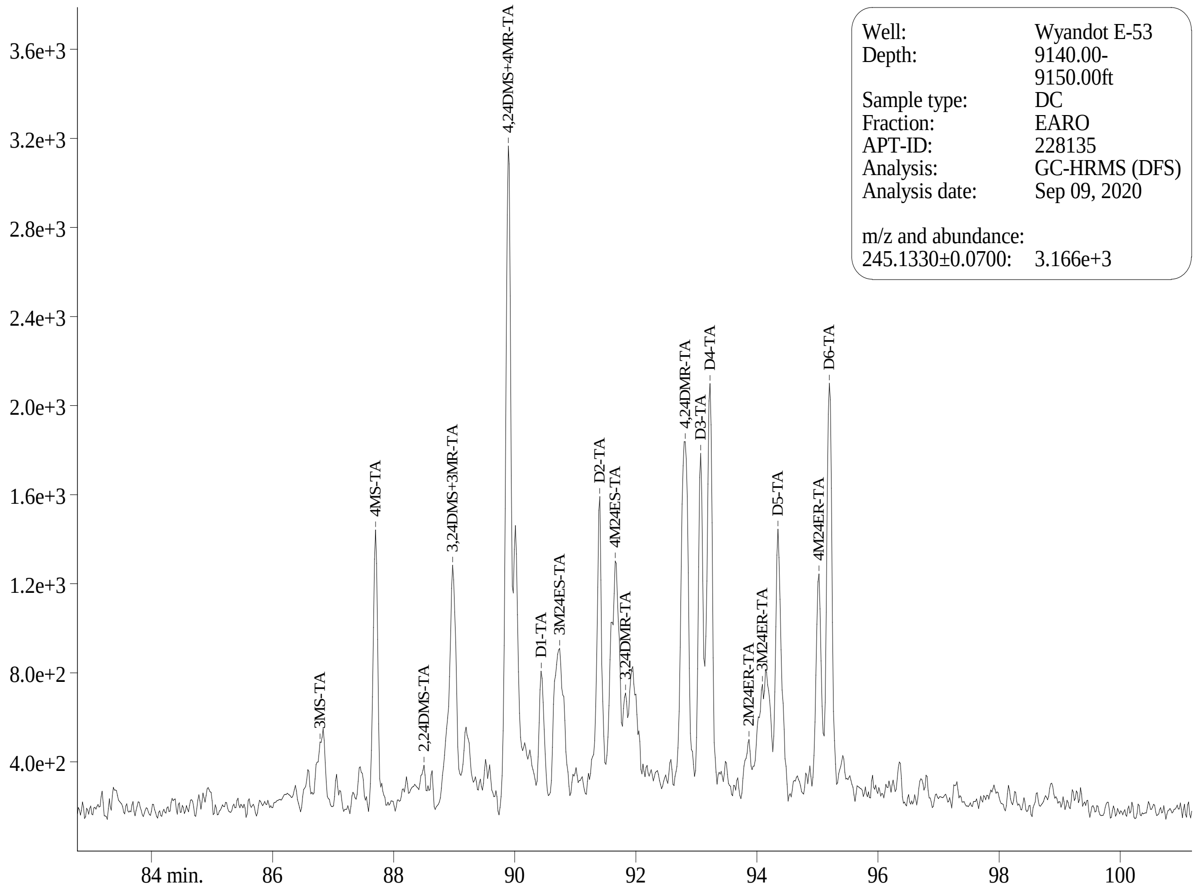

Well: Wyandot E-53
Depth: 7760.00-7770.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228134
Analysis: GC-HRMS (DFS)
Analysis date: Sep 08, 2020
m/z and abundance:
253.20±0.0723: 7.673e+3
1.1e+4
1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA

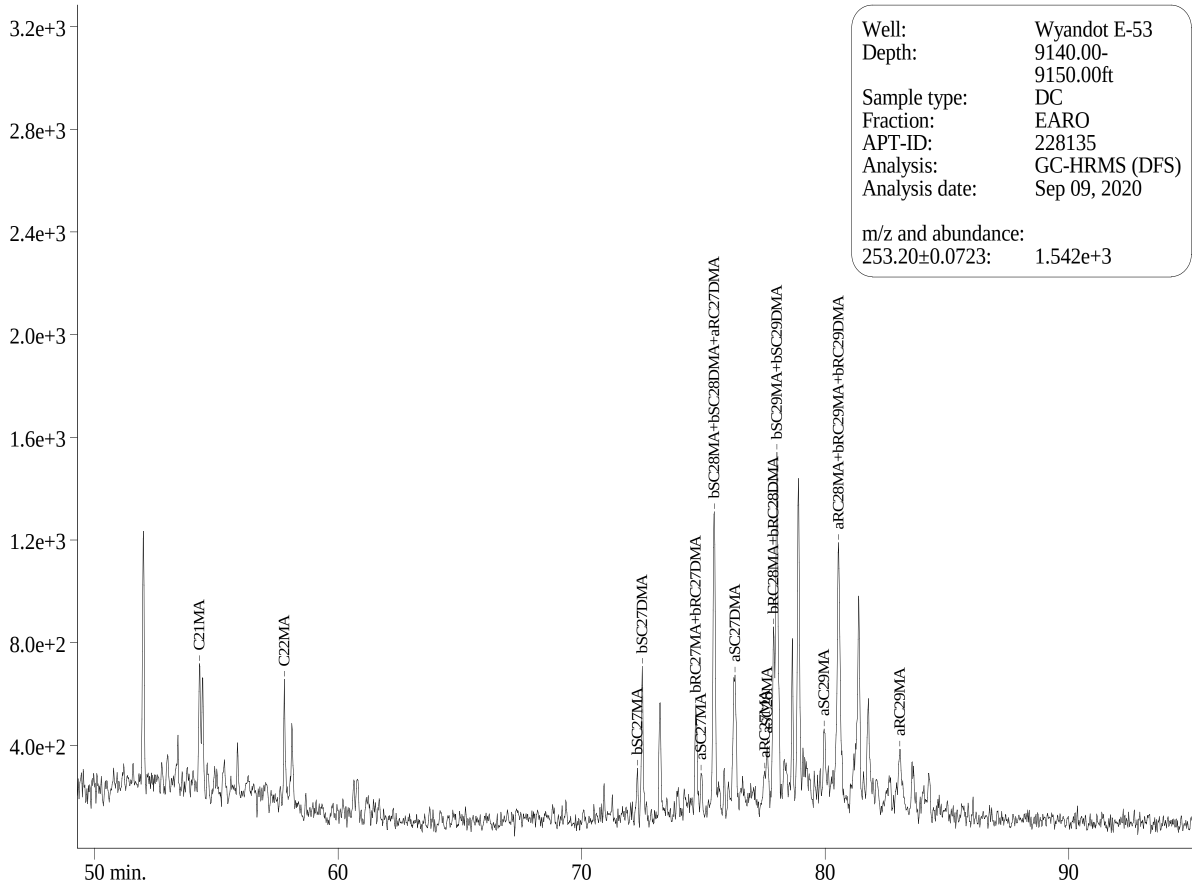

7.0e+5
6.0e+5
5.0e+5
4.0e+5
3.0e+5
2.0e+5
1.0e+5
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
142.08±0.0406: 7.879e+5
156.09±0.0446: 4.315e+5
170.11±0.0486: 1.696e+5

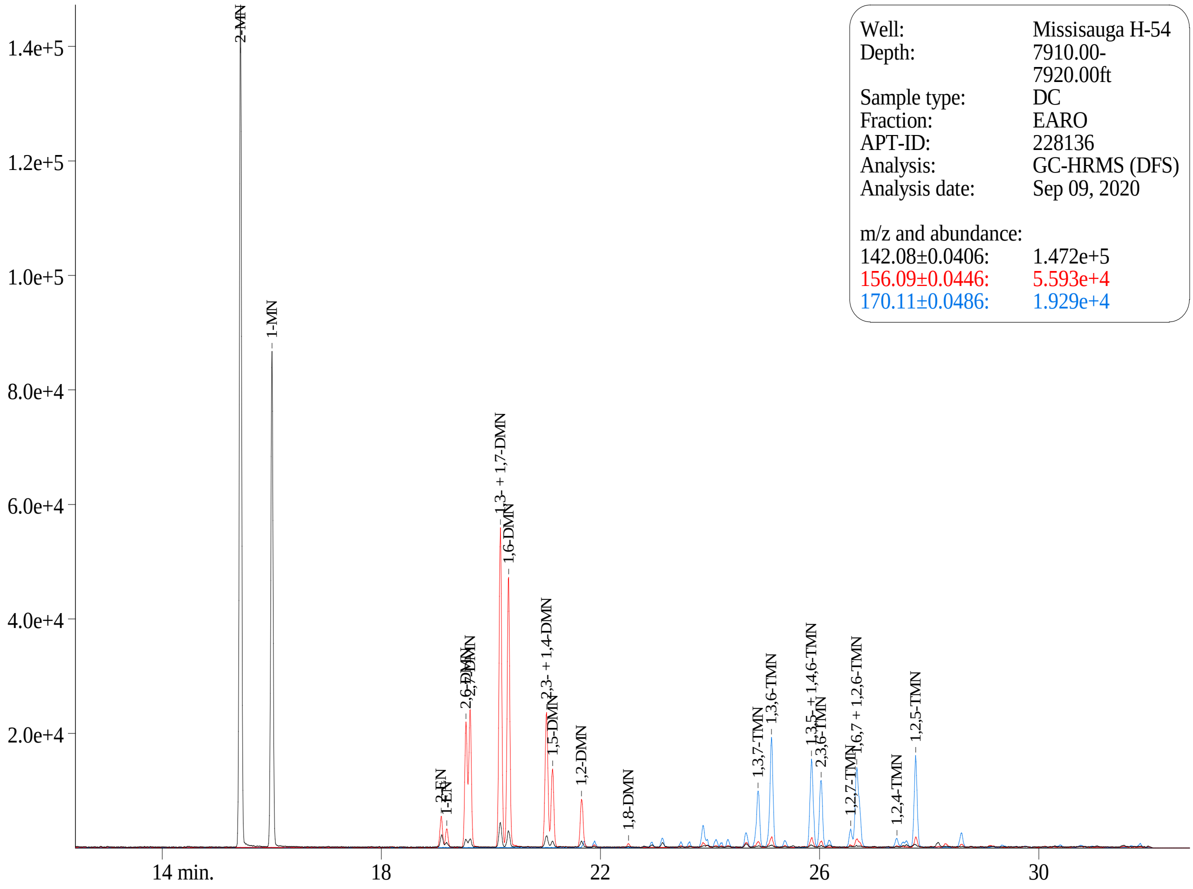

1.4e+6
1.2e+6
1.0e+6
8.0e+5
6.0e+5
4.0e+5
2.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
178.08±0.0509: 1.538e+6
192.09±0.0549: 4.735e+5
206.11±0.0589: 1.937e+5
219.12±0.0626: 2.916e+4

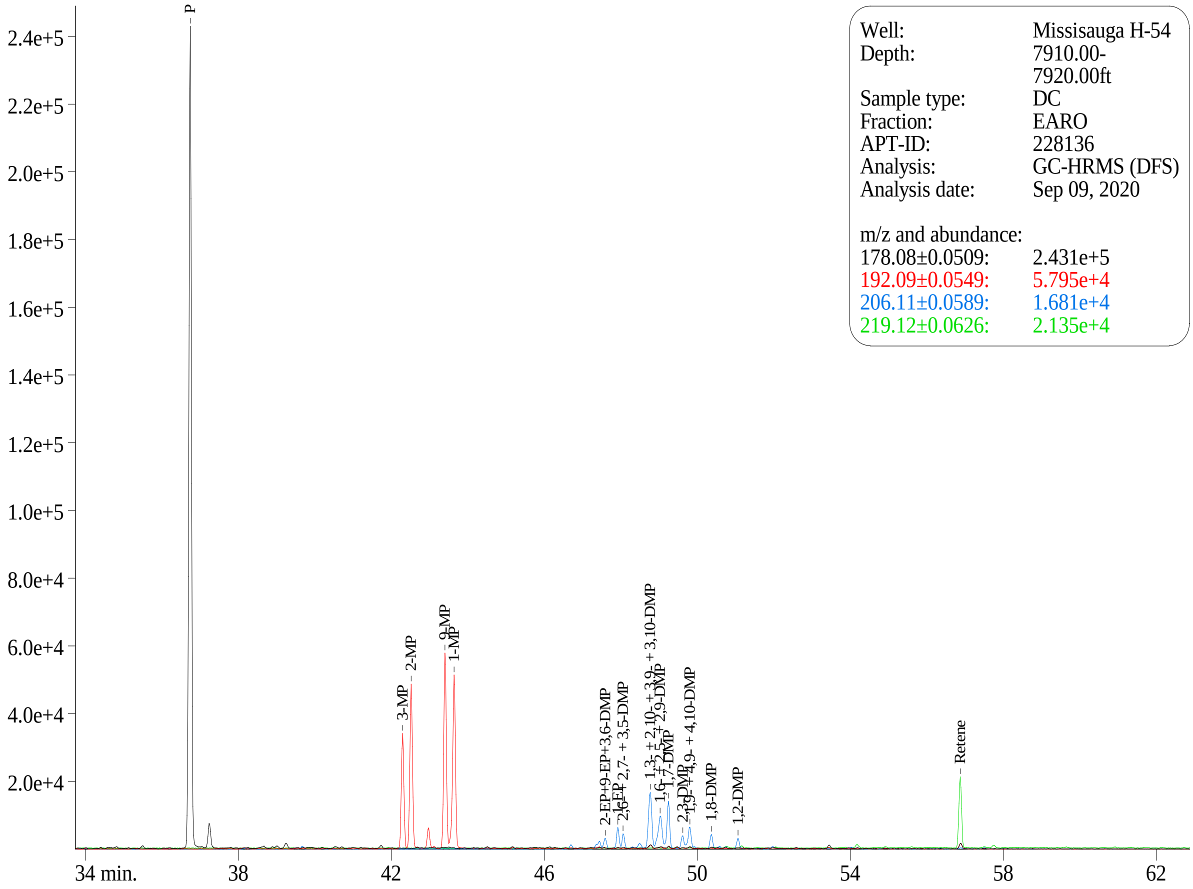

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
184.03±0.0526: 7.392e+4
198.05±0.0566: 1.129e+5
212.07±0.0606: 8.951e+4
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
34 min.
36
38
40
42
44
46
48
50
52

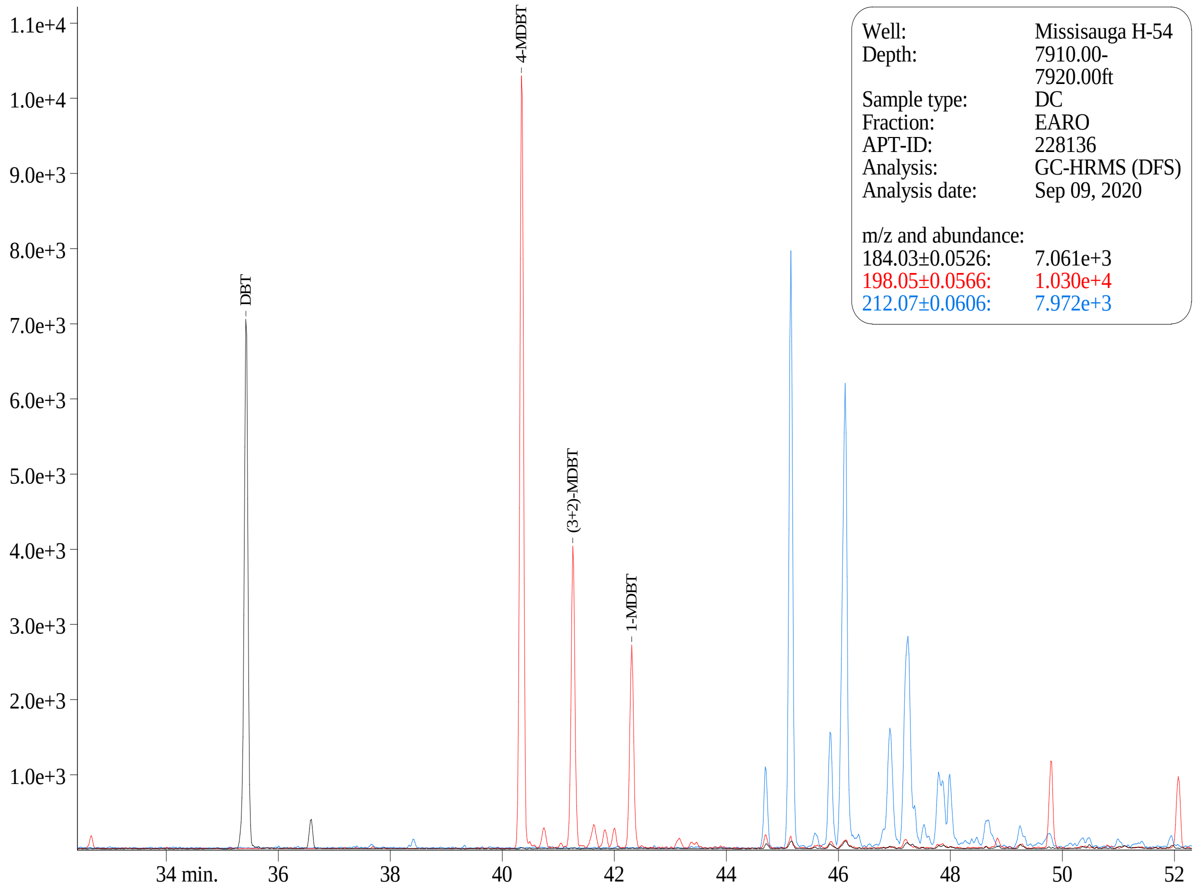

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
231.12±0.0660: 6.504e+3
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
6.5e+3
6.0e+3
5.5e+3
5.0e+3
4.5e+3
4.0e+3
3.5e+3
3.0e+3
2.5e+3
2.0e+3
1.5e+3
1.0e+3
5.0e+2
70 min.
80
90
100

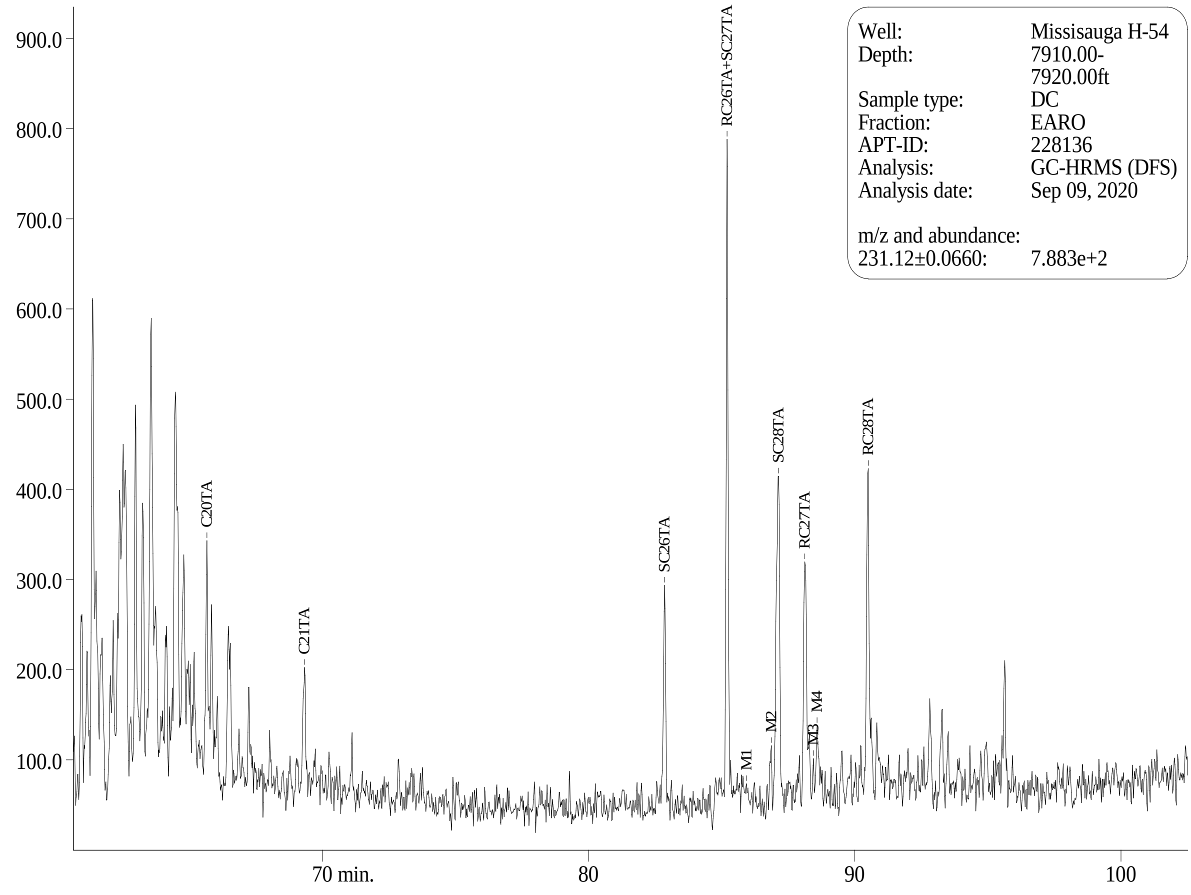

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
245.1330±0.0700: 3.166e+3
3.6e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
84 min.
86
88
90
92
94
96
98
100

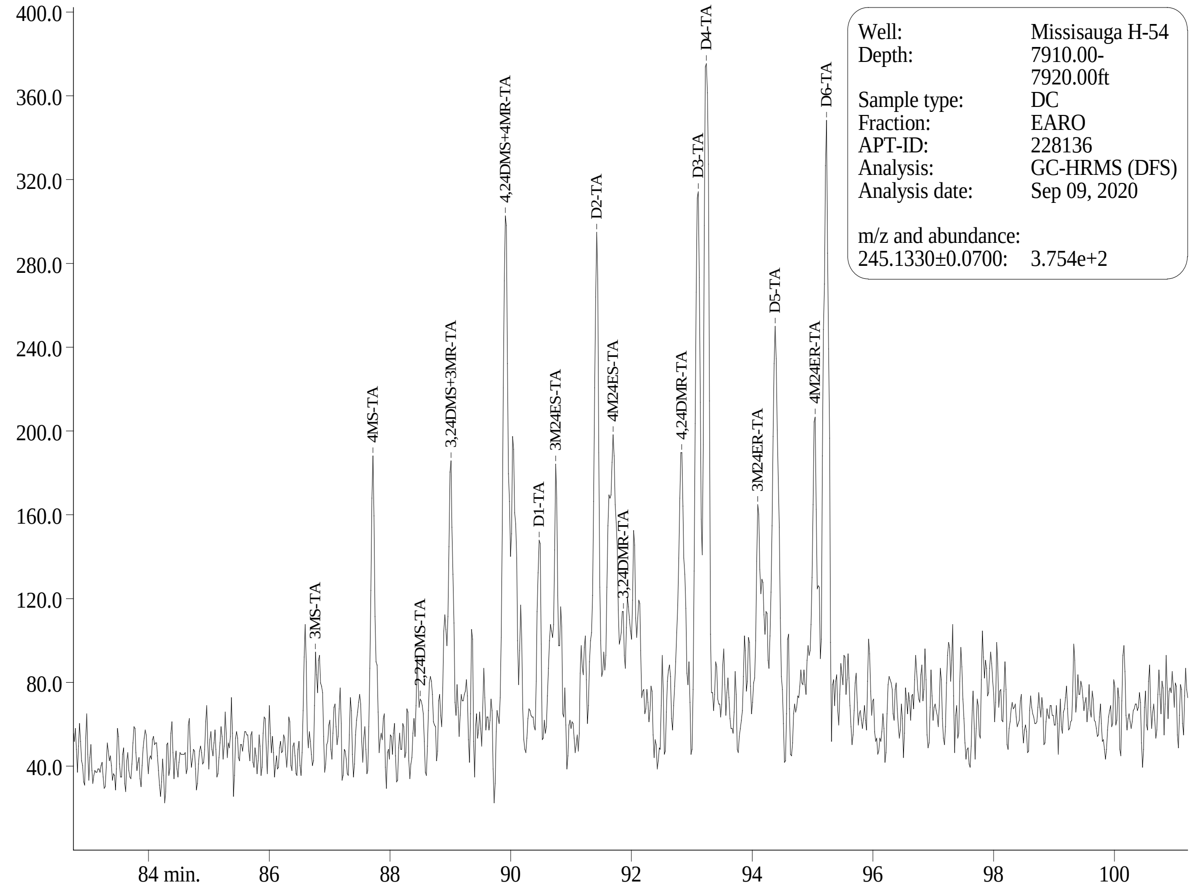

Well: Wyandot E-53
Depth: 9140.00-9150.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228135
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
253.20±0.0723: 1.542e+3
3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
C21MA
C22MA
bSC27MA
bSC27DMA
aSC27MA
bRC27MA+bRC27DMA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
50 min.
60
70
80
90

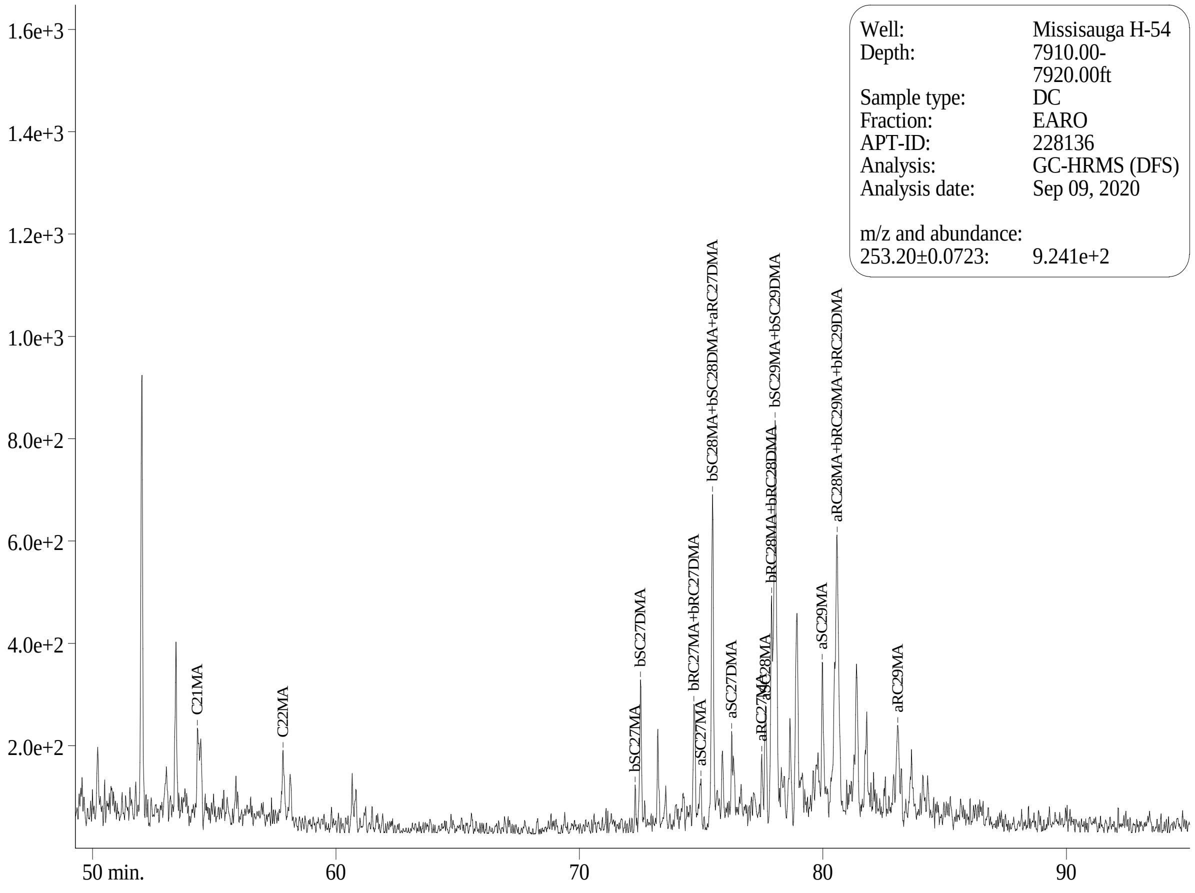

1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
142.08±0.0406: 1.472e+5
156.09±0.0446: 5.593e+4
170.11±0.0486: 1.929e+4

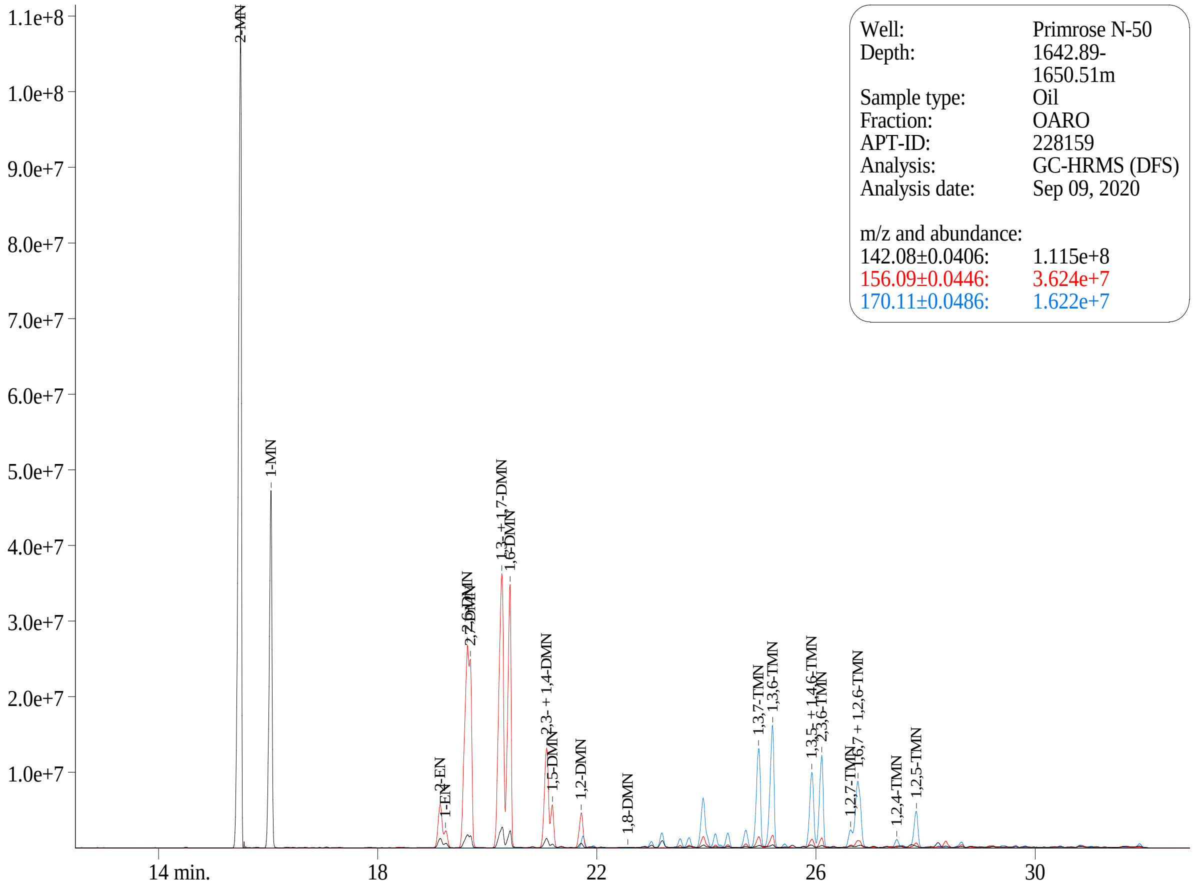

2.4e+5
2.2e+5
2.0e+5
1.8e+5
1.6e+5
1.4e+5
1.2e+5
1.0e+5
8.0e+4
6.0e+4
4.0e+4
2.0e+4
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
178.08±0.0509: 2.431e+5
192.09±0.0549: 5.795e+4
206.11±0.0589: 1.681e+4
219.12±0.0626: 2.135e+4

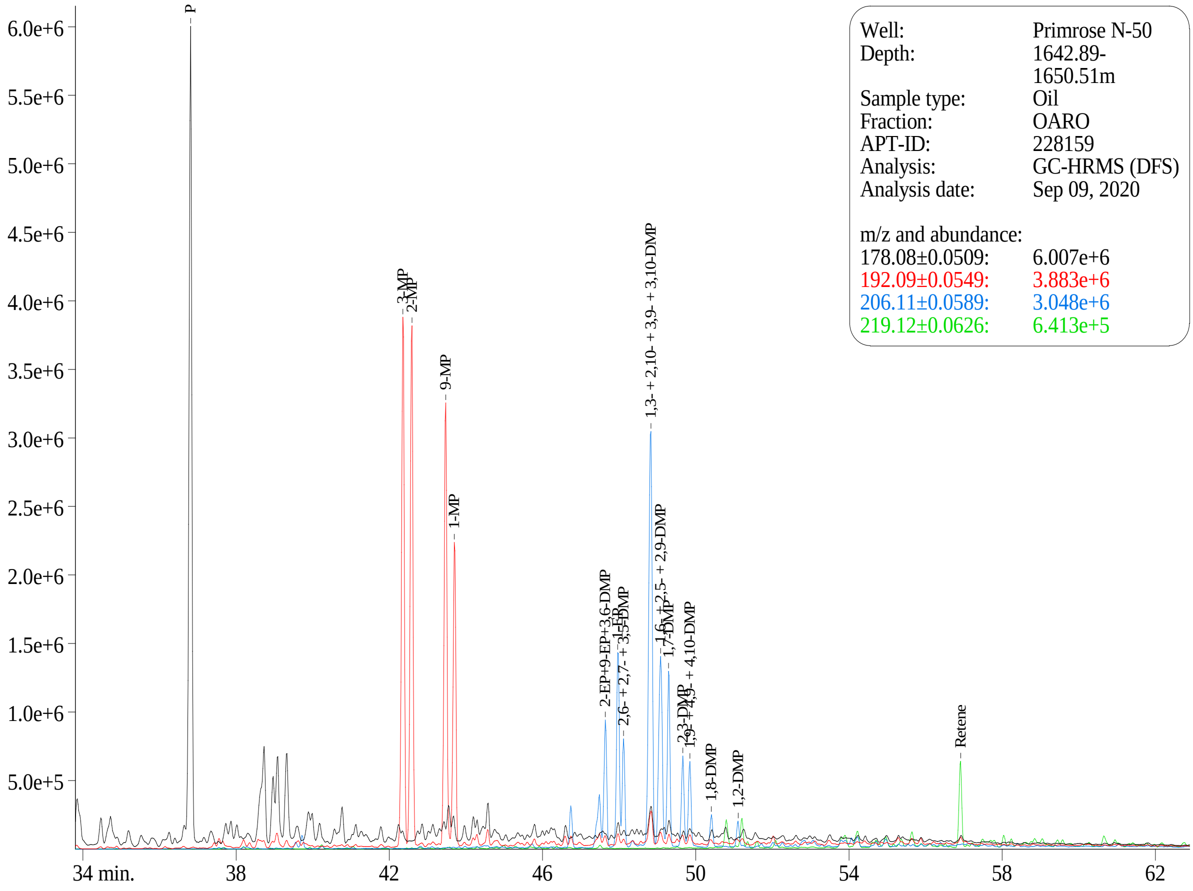

1.1e+4
1.0e+4
9.0e+3
8.0e+3
7.0e+3
6.0e+3
5.0e+3
4.0e+3
3.0e+3
2.0e+3
1.0e+3
DBT
4-MDBT
(3+2)-MDBT
1-MDBT
34 min.
36
38
40
42
44
46
48
50
52
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
184.03±0.0526: 7.061e+3
198.05±0.0566: 1.030e+4
212.07±0.0606: 7.972e+3

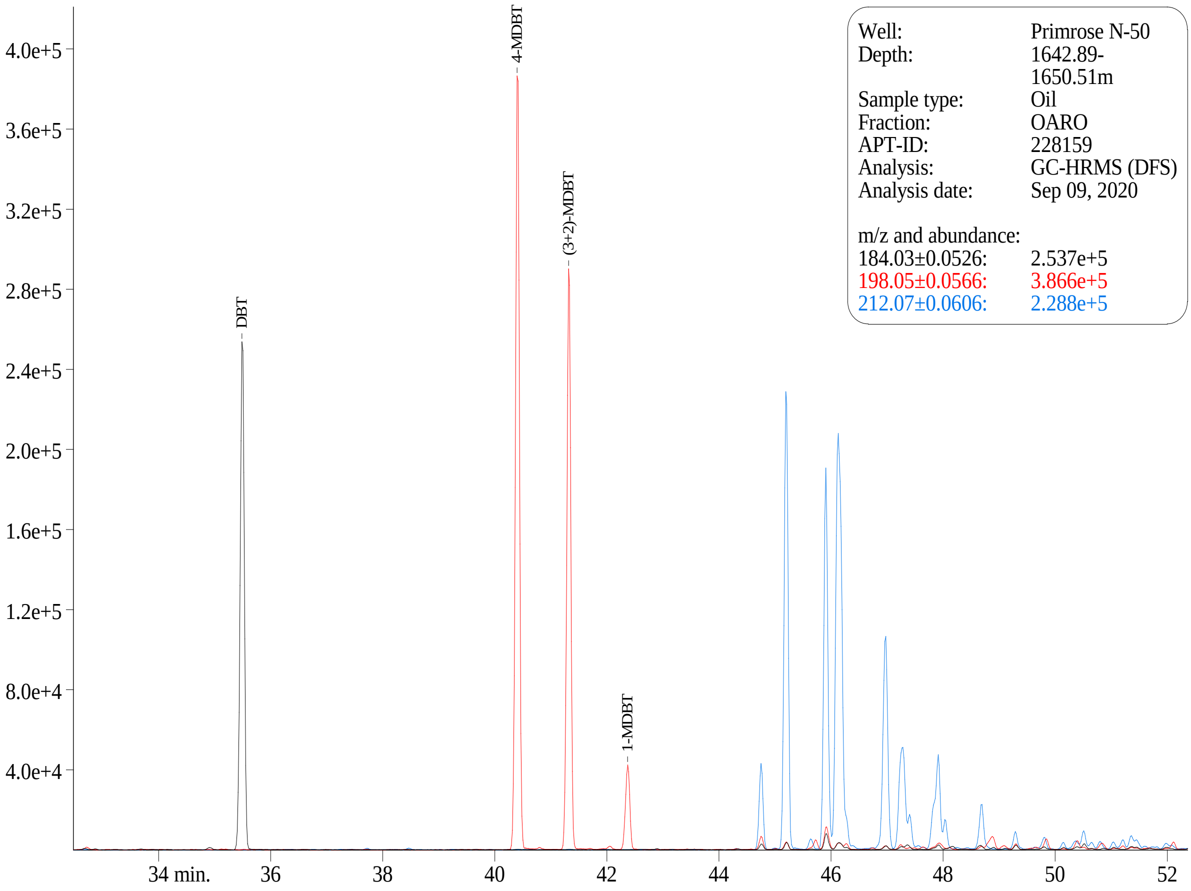

900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
C20TA
C21TA
SC26TA
RC26TA+SC27TA
M1
M2
SC28TA
RC27TA
M3
M4
RC28TA
70 min.
80
90
100
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
231.12±0.0660: 7.883e+2


400.0
360.0
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
245.1330±0.0700: 3.754e+2


1.6e+3
1.4e+3
1.2e+3
1.0e+3
8.0e+2
6.0e+2
4.0e+2
2.0e+2
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Missisauga H-54
Depth: 7910.00-7920.00ft
Sample type: DC
Fraction: EARO
APT-ID: 228136
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
253.20±0.0723: 9.241e+2


1.1e+8
1.0e+8
9.0e+7
8.0e+7
7.0e+7
6.0e+7
5.0e+7
4.0e+7
3.0e+7
2.0e+7
1.0e+7
14 min.
18
22
26
30
2-MN
1-MN
2-EN
1-EN
2,6-DMN
2,7-DMN
1,3- + 1,7-DMN
1,6-DMN
2,3- + 1,4-DMN
1,5-DMN
1,2-DMN
1,8-DMN
1,3,7-TMN
1,3,6-TMN
1,3,5- + 1,4,6-TMN
2,3,6-TMN
1,2,7-TMN
1,6,7 + 1,2,6-TMN
1,2,4-TMN
1,2,5-TMN
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OARO
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
142.08±0.0406: 1.115e+8
156.09±0.0446: 3.624e+7
170.11±0.0486: 1.622e+7

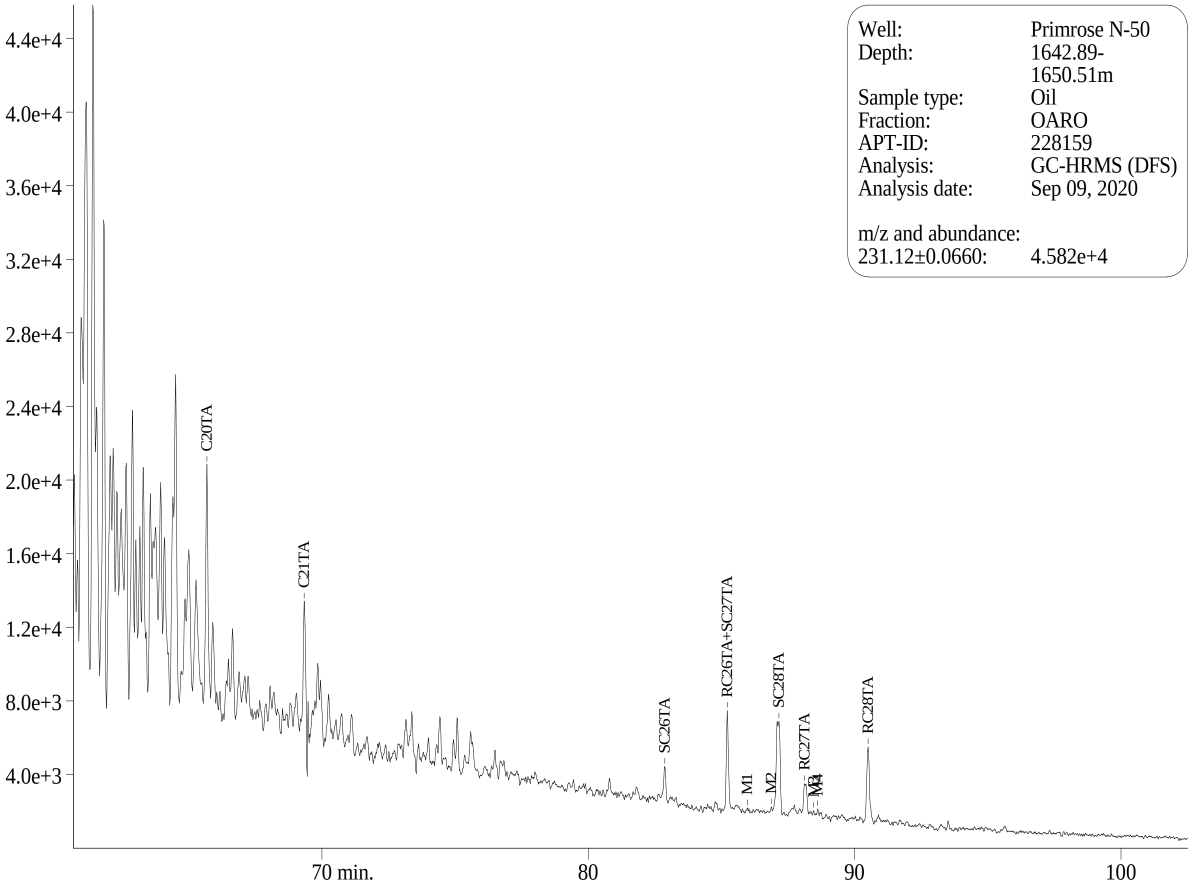

6.0e+6
5.5e+6
5.0e+6
4.5e+6
4.0e+6
3.5e+6
3.0e+6
2.5e+6
2.0e+6
1.5e+6
1.0e+6
5.0e+5
34 min.
38
42
46
50
54
58
62
P
3-MP
2-MP
9-MP
1-MP
2-EP+9-EP+3,6-DMP
1-EP
2,6- + 2,7- + 3,5-DMP
1,3- + 2,10- + 3,9- + 3,10-DMP
1,6- + 2,5- + 2,9-DMP
1,7-DMP
2,3-DMP
1,9- + 4,10-DMP
1,8-DMP
1,2-DMP
Retene
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OARO
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
178.08±0.0509: 6.007e+6
192.09±0.0549: 3.883e+6
206.11±0.0589: 3.048e+6
219.12±0.0626: 6.413e+5



| | |
|---|---|
| Well: | Primrose N-50 |
| Depth: | 1642.89-1650.51m |
| Sample type: | Oil |
| Fraction: | OARO |
| APT-ID: | 228159 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 09, 2020 |

m/z and abundance:

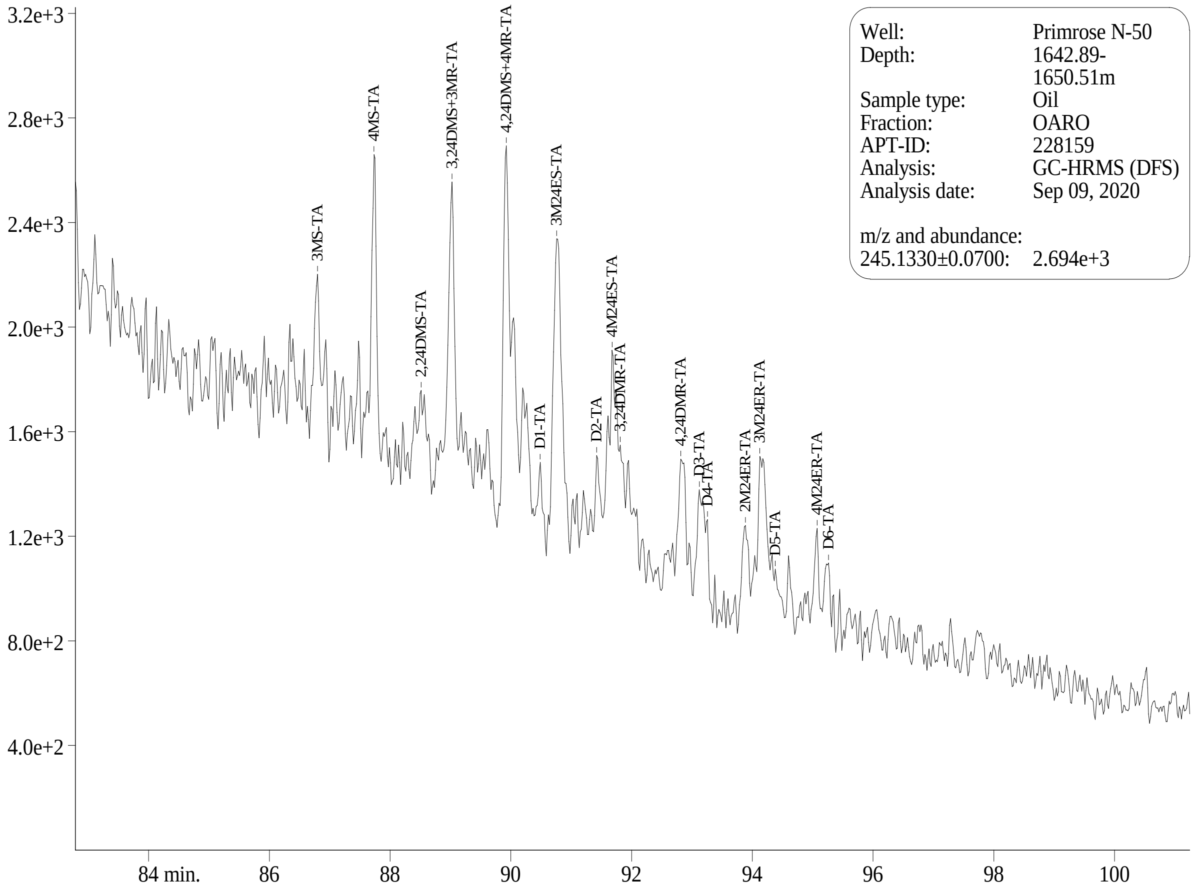
| | |
|---|---|
| 184.03±0.0526: | 2.537e+5 |
| 198.05±0.0566: | 3.866e+5 |
| 212.07±0.0606: | 2.288e+5 |

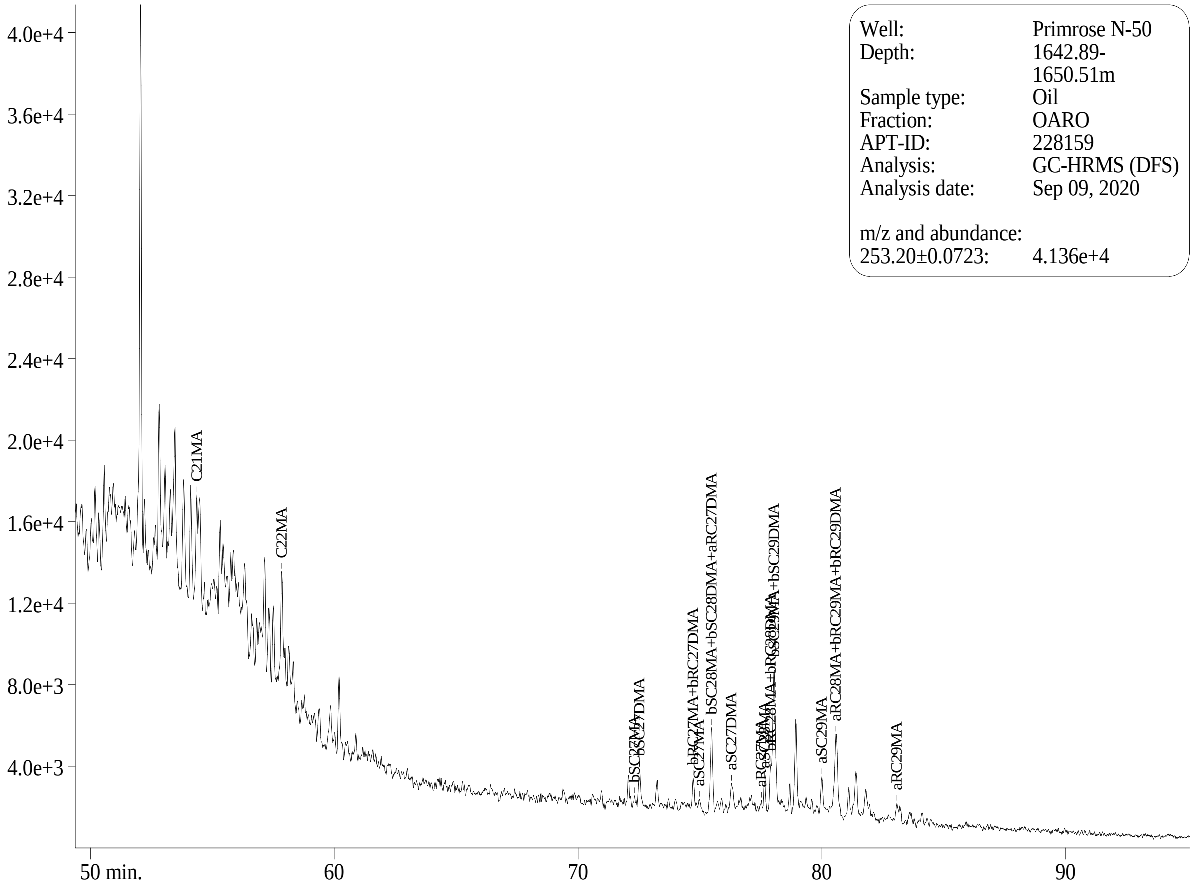


| | |
|---|---|
| Well: | Primrose N-50 |
| Depth: | 1642.89-1650.51m |
| Sample type: | Oil |
| Fraction: | OARO |
| APT-ID: | 228159 |
| Analysis: | GC-HRMS (DFS) |
| Analysis date: | Sep 09, 2020 |

m/z and abundance:

| | |
|---|---|
| 231.12±0.0660: | 4.582e+4 |


3.2e+3
2.8e+3
2.4e+3
2.0e+3
1.6e+3
1.2e+3
8.0e+2
4.0e+2
84 min.
86
88
90
92
94
96
98
100
3MS-TA
4MS-TA
2,24DMS-TA
3,24DMS+3MR-TA
4,24DMS+4MR-TA
D1-TA
3M24ES-TA
D2-TA
4M24ES-TA
3,24DMR-TA
4,24DMR-TA
D3-TA
D4-TA
2M24ER-TA
3M24ER-TA
D5-TA
4M24ER-TA
D6-TA
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OARO
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
245.1330±0.0700: 2.694e+3


4.0e+4
3.6e+4
3.2e+4
2.8e+4
2.4e+4
2.0e+4
1.6e+4
1.2e+4
8.0e+3
4.0e+3
50 min.
60
70
80
90
C21MA
C22MA
bSC27MA
bSC27DMA
bRC27MA+bRC27DMA
aSC27MA
bSC28MA+bSC28DMA+aRC27DMA
aSC27DMA
aRC27MA
aSC28MA
bRC28MA+bRC28DMA
bSC29MA+bSC29DMA
aSC29MA
aRC28MA+bRC29MA+bRC29DMA
aRC29MA
Well: Primrose N-50
Depth: 1642.89-1650.51m
Sample type: Oil
Fraction: OARO
APT-ID: 228159
Analysis: GC-HRMS (DFS)
Analysis date: Sep 09, 2020
m/z and abundance:
253.20±0.0723: 4.136e+4

## Table 18. Reference data for GC Whole Oil measured on NSO-1

| Variable | Permissible range | Most likely value | 26.08.2020 |
|---|---|---|---|
| Pristane/n-C17 | 0.55-0.64 | 0.60 | 0.61 |
| Benzene/Hexane | 0.38-0.42 | 0.41 | 0.41 |

## Table 19. Reference data for GC of Saturated Compounds measured on NSO-1

| Variable | Permissible range | Most likely value | 31.08.2020 | 01.09.2020 | 02.09.2020 | 02.09.2020 |
|---|---|---|---|---|---|---|
| Pr/n-C17 | 0.55-0.66 | 0.60 | 0.60 | 0.58 | 0.60 | 0.60 |
| n-C15/n-C20 | 1.4-2.0 | 1.8 | 1.5 | 1.5 | 1.5 | 1.5 |
| n-C30/n-C20 | 0.20-0.32 | 0.29 | 0.25 | 0.25 | 0.25 | 0.25 |
| n-C17/(n-C17+n-C27) | 0.75-0.82 | 0.79 | 0.78 | 0.77 | 0.77 | 0.77 |

## Table 20. Reference data for GC-MS of Saturated Compounds measured on NSO-1

| Variable | Permissible range | Most likely value | 04.09.2020 | 05.09.2020 | 06.09.2020 |
|---|---|---|---|---|---|
| [23/3]/30αβ | 0.04-0.09 | 0.07 | 0.05 | 0.05 | 0.05 |
| 35αβR/30αβ | 0.06-0.13 | 0.08 | 0.09 | 0.09 | 0.09 |
| 25nor30αβ/25nor28αβ | 0.3-0.8 | 0.5 | 0.96 | 0.97 | 1.02 |
| 29ααR/27dβS | 0.2-0.6 | 0.3 | 0.32 | 0.31 | 0.32 |
| 29ββS/27ββR | 0.7-1.2 | 0.9 | 0.90 | 0.84 | 0.87 |

Our column resolves the 25nor28αβ doublet, thus giving a value in the high-end region of the acceptable range specified by NIGOGA.

# *Table 21. Reference data for GC-MS of Aromatic Compounds measured on NSO-1*

| Variable | Permissible range | Most likely value | 07.09.2020 | 09.09.2020 | 09.09.2020 |
|---|---|---|---|---|---|
| 1-MP/P | 0.53-0.70 | 0.59 | 0.60 | 0.65 | 0.66 |
| A1/E1 | 0.3-0.7 | 0.5 | 0.53 | 0.49 | 0.51 |
| a1/d1 | 0.2-0.4 | 0.31 | 0.34 | 0.34 | 0.35 |

## Experimental Procedures

All procedures follow NIGOGA, 4th Edition. Below are brief descriptions of procedures/analytical conditions.

### Sample preparation

Cuttings samples are washed in water to remove mud. When oil based mud is used, soap (Zalo) is added to the sample and the sample is washed thoroughly in warm water to remove mud and soap.

### Extraction

A Soxtec Tecator instrument is used. Thimbles are pre extracted in dichloromethane with 7% (vol/vol) methanol, 10 min boiling and 20 min rinsing. The crushed sample is weighed accurately in the pre extracted thimbles and boiled for 1 hour and rinsed for 2 hours in approximately 80 cc of dichloromethane with 7% (vol/vol) methanol. Copper blades activated in concentrated hydrochloric acid are added to the extraction cups to cause free sulphur to react with the copper. An aliquot of 10% of the extract is transferred to a pre weighed bottle and evaporated to dryness. The amount of extractable organic matter is calculated from the weight of this 10% aliquot.

### Deasphaltening

Extracts are evaporated almost to dryness before a small amount of dichloromethane (3 times the amount of EOM) is added. Pentane is added in excess (40 times the volume of EOM/oil and dichloromethane). The solution is stored for at least 12 hours in a dark place before the solution is filtered or centrifuged and the weight of the asphaltenes measured.

### TOC

A Leco SC-632 instrument is used. Diluted HCl is added to the crushed rock sample to remove carbonate. The sample is then introduced into the Leco combustion oven, and the amount of carbon in the sample is measured as carbon dioxide by an IR-detector.

### Rock-Eval Pyrolysis

A HAWK instrument is used. Jet-Rock 1 was run as every tenth sample and checked against the acceptable range given in NIGOGA.

*Temperature programme*

5 minutes purge before: Pyrolysis: 300 °C (3 min.) - 25 °C/min. - 650 °C (0 min.)

### Quantitative MPLC 3 fractions

The MPLC is constructed as described by Radke et al. (1980). The system includes two HPLC pumps, sample injector, sample collector and two packed columns. The pre column is filled with Kieselgel 100, which is heated at 600 °C for 2 hours to deactivate it. The main column, a LiChroprep Si60 column, is heated at 120 °C for 2 hours with a helium flow to make it water free.

Approximately 30 mg of deasphaltened oil or EOM diluted in 1 ml hexane is injected into a sample loop. The solvents used are hexane and dichloromethane.

Fraction 1 - Saturates

Hexane through the sample loop, the pre column and the main column is collected until all saturates are collected.

Fraction 2 – Aromatics A
Hexane that back flushes the main column is collected.

Fraction 3 – Polars (NSO-fraction)
Dichloromethane that back flushes the pre column is collected.

Solvents from all fractions are removed until the total volume is 1 ml by using a Turbovap unit. The fractions are transferred to small pre weight vials and dried carefully. Then the weights are measured.

**Stable carbon isotope analysis of fractions**
The samples were dissolved in a known amount of dichloromethane and 20ul was transferred to a 5X8mm tin capsule. The solvent was evaporated in an oven at 50 °C. The samples were then loaded into an automatic sampler which then placed them into a combustion reactor (Thermo Fisher Scientific Elemental Analyzer) held at 1020 °C. The excess supply of oxygen helps to flash combust the tin capsules which results in a temperature rise to 1700 °C. The produced water is trapped on Magnesium Perchlorate. CO2 is separated by column and flashed into Delta V Plus Isotope Ratio Mass Spectrometer (IRMS) (Thermo Fisher Scientific) via Conflo IV. A standard (NGS NSO-1, topped oil) is analyzed for each 12th sample. The δ13C value obtained for this standard is –28.6‰ vPDB. The variation in the isotopic values for NSO-1 by repeated analysis over a period of one year is ± 0.09‰.

**GC of whole oil**
An Agilent 7890 A instrument is used. The column is a HP PONA, length 50 m, i.d. 0.2 mm, film thickness 0.5 μm. 2-heptene is used as an internal standard.

*Temperature programme*
30 °C (10 min.) - 2 °C/min. - 60 °C (10 min.)- 2 °C/min - 130 °C (0 min.)-4 °C/min. - 320 °C (25 min.)

**GC of saturated fraction**
A HP7890 A instrument is used. The column is a CP-Sil-5 CB-MS, length 30 m, i.d. 0.25 mm, film thickness 0.25 μm. C20D42 is used as an internal standards.

*Temperature programme*
50 °C (1 min.) - 4 °C/min. - 320 °C (25 min.)

**GC-MS of saturated and aromatic fractions**
A Thermo Scientific DFS high resolution instrument is used. The instrument is tuned to a resolution of 3000 and data is acquired in Selected Ion Recording (SIR) mode. The column used is a 60 m CP-Sil-5 CB-MS with an i.d. of 0.25 mm and a film thickness 0.25 μm. $D_4$-27ααR is used as internal standard when quantitative results are requested for the saturated compounds. $D_8$-Naphthalene, $D_{10}$-Biphenyl , $D_{10}$-Phenanthrene and $D_{12}$- Chrysene are used as internal standards when quantitative results are required for the aromatic compounds. The aromatic and aliphatic fractions may be analysed together or separately.

*Temperature programme*
50 °C (1 min.) - 20 °C/min. - 120 °C - 2 °C/min - 320 °C (20 min.)