No. 10 Tank Investigation
Work Plan Addendum
Expansion: Groundwater Investigation

Area B: Parcel B18
Tradepoint Atlantic
Sparrows Point, Maryland

Prepared for:
EnviroAnalytics Group
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Revision 0
February 16, 2018

ARM Project 150300M-14

Respectfully Submitted,

Taylor R. Smith
Project Engineer

Eric S. Magdar
Vice President

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1.0 INTRODUCTION

1.1. BACKGROUND

ARM Group Inc. (ARM), on behalf of EnviroAnalytics Group (EAG), has prepared this Work Plan Addendum to characterize the dissolved phase petroleum hydrocarbons associated with previously identified non-aqueous phase liquid (NAPL) in the groundwater on a portion of the Tradepoint Atlantic property located in the vicinity of the No. 10 Fuel Oil Tank within Area B: Parcel B18 (the Site). This supplemental groundwater investigation was specifically requested by the MDE due to the confirmed presence of NAPL in groundwater at the Site in close proximity to the surface water at the coal dock slip. Parcel B18 is comprised of approximately 36.8 acres of the approximately 3,100-acre former steel plant property located as shown on *Figure 1* of the Parcel B18 Phase II Investigation Work Plan (Revision 0) dated September 22, 2016. This Work Plan and an associated comment response letter were approved by the agencies on March 30, 2017.

The No. 10 Fuel Oil Tank was an aboveground storage tank with a capacity of 2.3-million gallons (containing No. 6 fuel oil) according to the Description of Current Conditions (DCC) Report prepared by Rust Environment & Infrastructure dated January 1998, and the Phase I Environmental Site Assessment (ESA) prepared by Weaver Boos Consultants dated May 19, 2014. The tank was located at the intersection of Ship Yard Road and Blast Furnace Road and was taken out of service in 1977. The following information was provided in the DCC Report:

> Visible oil which surfaced in the nearby coal dock slip in April 1987 led to the involvement of the Marine Safety Office of the U.S. Coast Guard through cleanup actions and investigations. It was found that 161,000 gallons of rainwater laden with fuel oil had accumulated in the tank in the 10 years since it was taken out of service in 1977. In August 1987, following clean-up activities inside the tank and in the surrounding soils, the tank was demolished. Demolition of the tank foundation revealed oil-saturated soils. Six monitoring wells were installed in the vicinity of the tank in March 1988, and an effort was made to inoculate the surrounding soil with bacteria to accelerate biodegradation of residual oil materials. However, this remediation plan was unsuccessful due to high salinity in the soil from tidal influence. An additional remediation plan was proposed to contain the fuel oil contamination by installing a flexible membrane cap and providing hydraulic containment; however, it is unclear if this remediation plan was implemented as originally proposed.

Based on recent field investigations completed in the vicinity of the former tank area, some form of a containment remedy was implemented (c. 1989) to the west of the former No. 10 Fuel Oil Tank foundation, as indicated by the presence of an existing cut-off wall (discussed in greater detail below). The DCC Report recommended that further action was needed for the No. 10 Fuel

Oil Tank. Weaver Boos considered the No. 10 Fuel Oil Tank and surrounding tanks to be a Recognized Environmental Condition (REC) and recommended that the No. 10 Fuel Oil Tank area be assessed for residual contamination associated with the past release of fuel oil.

1.1.1. Parcel B18 Phase II Investigation

During the Phase II Investigation of Parcel B18, six existing historical monitoring wells were found in the vicinity of the No. 10 Fuel Oil Tank. The locations of these existing historical wells are indicated in **Figure 1**. These wells were subsequently inspected and gauged using an oil-water interface probe, and NAPL was observed in four of the six historical wells. The completed well inspection forms for the six permanent monitoring wells are provided as **Appendix A.**

Three of the soil borings completed during the Phase II Investigation of Parcel B18 were associated with the No. 10 Fuel Oil Tank area (B18-044-SB, B18-045-SB, and B18-046-SB). Two of the soil borings (B18-044-SB and B18-045-SB) were located within the footprint of the former No. 10 Fuel Oil Tank. The third boring (B18-046-SB) was located to the southeast within the footprint of the No. 11 Fuel Oil Tank. The locations of these three soil borings are indicated on **Figure 2**, which incorporates the 5500 Set of historical steel plant drawings. Based on a review of historical drawings, including the 5500 Set shown on the figure, the tanks appear to have been historically surrounded by a single containment berm. Hand-drawn annotations on the 5500 Set indicate that the berm surrounding the No. 10 and No. 11 Fuel Oil Tanks may have been reconstructed in the past to enclose only the No. 11 Fuel Oil Tank. It is likely that the relocation of this containment berm coincided with the demolition of the No. 10 Fuel Oil Tank foundation and associated remedial actions completed from 1987 through 1989.

In accordance with the Parcel B18 Phase II Investigation Work Plan, seven additional soil borings were completed to the east of the No. 10 and No. 11 Fuel Oil Tank area, and two additional soil borings were completed to the north of this area. The borings located to the east of the No. 10 and No. 11 Fuel Oil Tank area (B18-037-SB, B18-038-SB, B18-049-SB, B18-050-SB, B18-057-SB, B18-058-SB, and B18-077-SB) targeted several aboveground storage tanks (ASTs) and associated structures. The borings located to the north (B18-042-SB and B18-043-SB) targeted the Shipyard Impoundment near the property boundary.

During field screening of the Phase II Investigation soil borings completed in the vicinity of the No. 10 and No. 11 Fuel Oil Tanks, NAPL was observed in four of the 12 soil cores (B18-044-SB, B18-045-SB, B18-046-SB, and B18-077-SB). Piezometers were installed at locations B18-046-SB and B18-077-SB to collect groundwater samples in accordance with the Parcel B18 Work Plan. In addition, piezometers were installed for NAPL screening purposes at B18-044-SB and B18-045-SB. Evidence of NAPL was not observed in the other eight Phase II Investigation soil borings completed outside of the area contained by the berm(s) (B18-037-SB, B18-038-SB, B18-042-SB, B18-043-SB, B18-049-SB, B18-050-SB, B18-057-SB, and B18-058-SB). However, the final depth of several soil borings completed to the east of the No. 10 and

No. 11 Fuel Oil Tanks (B18-037-SB, B18-038-SB, B18-049-SB, B18-050-SB, and B18-058-SB) may not have been sufficient to characterize the presence of NAPL. These five boring locations were terminated at depths ranging from 2 to 5 feet below ground surface (bgs) due to equipment refusal, and groundwater was not encountered in the soil cores. Thus, these eastern borings provided only limited information as to the potential presence of NAPL in the groundwater near the additional ASTs to the east of the No. 10 and No. 11 Fuel Oil Tanks. These additional ASTs could be potential sources of groundwater impacts (including NAPL) in the upgradient direction of the No. 10 and No. 11 Fuel Oil Tanks.

1.1.2. Supplemental Investigation Activities Completed to Date

This groundwater investigation is intended to supplement the soil investigation activities outlined in the No. 10 Tank Investigation Work Plan Addendum dated November 29, 2016, which were completed in December 2016. Under the previous Work Plan Addendum, 78 soil borings were distributed around the No. 10 Fuel Oil Tank area. The targeted depth of each supplemental boring was 20 feet bgs, although some borings were terminated following equipment refusal prior to reaching the target depth. NAPL was observed at various depths in many of the soil borings, prompting the MDE to request the completion of the supplemental groundwater investigation described herein. The location of each soil boring completed in the No. 10 Fuel Oil Tank area is indicated on **Figure 3**. The specific results of the soil delineation will be presented to the agencies (along with proposed response actions) in supplemental documents to be completed in the future.

1.1.3. NAPL Sample Activities – Fingerprint Analysis

On December 22, 2016, NAPL samples were extracted from historical wells BA-81-7941, BA-81-7942, and BA-81-7944, as well as from piezometer B18-045-PZ. A photograph log of the collected NAPL samples is included as **Appendix B**. The photographs and field observations indicate that both light (LNAPL) and dense (DNAPL) fractions appear to be present at the Site. The NAPL samples were submitted to Pace Analytical Services, Inc. (PACE) for Whole Oil (ASTM D3328) and Full Scan (ASTM D5739) analytical testing to determine the "fingerprint" of the hydrocarbons and determine the type(s) of petroleum. All four samples were determined to be 100% aromatic hydrocarbons and were comprised mostly of naphthalene, 1-methyl-naphthalene, and 2-methyl-naphthalene. **Appendix C** presents the fingerprint laboratory reports received from PACE for the four samples.

1.1.4. Existing Cut-Off Wall

Following the supplemental soil investigation activities completed under the No. 10 Tank Investigation Work Plan Addendum dated November 29, 2016, Tradepoint Atlantic provided an historical drawing which indicated that a cut-off wall may have been previously installed in 1989 in the vicinity of the NAPL-impacted area. The drawing of the cut-off wall is included in

Appendix D. At the time of receipt of the plan drawing (October 30, 2017), it was unknown whether containment via a cut-off wall had been implemented. According to the plan drawing, the cut-off wall was proposed to be completed with steel sheet piling, a polyethylene geomembrane, geotextile fabric, and slag and clay backfill to mitigate the potential for NAPL to discharge into the surface water to the west of the impacted area.

To verify the existence of the cut-off wall, the approximate location indicated on the plan drawing was investigated using excavation equipment. Portions of the cut-off wall were successfully located in the field, and soil was removed from the area to expose the top of the sheet piling across the entire length of the cut-off wall. The cut-off wall was determined to be approximately 125 feet in length. A photograph log of the uncovered sheet piling is included in **Appendix E**. The sheet piling alignment was recorded by ARM personnel using a hand-held GPS unit, and the extent of the cut-off wall is indicated on relevant figures included with this Work Plan Addendum. The location of the cut-off wall was taken into account while developing the groundwater sampling plan.

1.2. OBJECTIVE

The primary objective of the supplemental groundwater investigation is to characterize the dissolved phase petroleum hydrocarbons associated with previously identified NAPL in the groundwater in the vicinity of the No. 10 Fuel Oil Tank area. The groundwater investigation is intended to supplement the (completed) soil investigation activities outlined in the No. 10 Tank Investigation Work Plan Addendum dated November 29, 2016. The groundwater investigation activities in the No. 10 Fuel Oil Tank area will be performed in compliance with requirements pursuant to the following:

- Administrative Consent Order (ACO) between Tradepoint Atlantic (formerly Sparrows Point Terminal, LLC) and the Maryland Department of the Environment (MDE), effective September 12, 2014; and
- Settlement Agreement and Covenant Not to Sue (SA) between Tradepoint Atlantic (formerly Sparrows Point Terminal, LLC) and the United States Environmental Protection Agency (USEPA), effective November 25, 2014.

1.3. SAMPLING DESIGN AND RATIONALE

Four temporary groundwater sample collection points and three permanent groundwater monitoring wells will be installed and sampled in the vicinity of the No. 10 and No. 11 Fuel Oil Tank area to better characterize the impacts of NAPL on the shallow groundwater aquifer. In addition, three existing piezometers installed during the Phase II Investigation of Parcel B18, and two of the existing historical groundwater monitoring wells (installed in March 1988) will be sampled to provide additional groundwater data to evaluate current conditions in the No. 10 Fuel

Oil Tank area. The location of each proposed sampling point is shown in relation to the historical tank locations in **Figure 4**.

Three 2-inch diameter permanent groundwater monitoring wells (SW-082-MWS, SW-083-MWS, and SW-084-MWS) will be installed to the west of the former location of the No. 10 Fuel Oil Tank and adjacent to the surface water. Two of these permanent groundwater monitoring wells, SW-083-MWS and SW-084-MWS, will be placed on the downgradient side of the cut-off wall. The two groundwater sample points downgradient of the cut-off wall will provide insight regarding the efficacy of the cut-off wall to contain NAPL and associated dissolved constituents. Based on the historical drawing provided in **Appendix D**, the depth of the sheet piling is believed to extend into a clay unit located at approximately 20 feet bgs. Field observations will be used to ensure that none of the temporary groundwater sample collection points interfere with the integrity of the sheet piling or geotextile/geomembrane.

Additional piezometers B18-078-PZ, B18-079-PZ, B18-080-PZ, and B18-081-PZ will be distributed east of the cut-off wall, throughout the impacted tank area. Groundwater samples will also be collected from the existing Phase II investigation piezometers B18-044-PZ, B18-046-PZ, and B18-077-PZ as well as the historical wells BA-81-7945 and BA-81-7946. The network of groundwater sample collection points (12 locations in total) will provide a wide spatial distribution to characterize the existing impacts.

The area's remaining permanent groundwater monitoring wells (BA-81-7941, BA-81-7942, BA-81-7943, and BA-81-7944) will not be utilized for the collection of groundwater samples during this supplemental investigation. As shown in **Figure 1**, the permanent wells (with the exception of BA-81-7945 and BA-81-7946) have indicated a significant accumulation of NAPL when they were gauged during recent events, and likely may be fouled due to the long-term presence of free-phase product. The 12 proposed sampling points will provide adequate groundwater data without the need for additional samples from the historical wells with documented NAPL impacts. Instead of additional groundwater samples, a pure NAPL sample will be collected from one of the existing historical monitoring wells (BA-81-7941). The collected free-phase product will be analyzed for PCB contamination, as requested by the MDE.

Permanent wells SW13-PZM003 and SW-029-MWS (installed for the Area B Groundwater Investigation) and temporary groundwater sample collection point B18-061-PZ (installed for the Parcel B18 Phase II Investigation) will not be included as additional sampling points for this investigation, but they may be gauged in order to better understand the potentiometric surface in the investigation area. These points are located further to the east of the historical tank locations, by several hundred feet.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1. PROJECT PERSONNEL

The groundwater investigation activities in Parcel B18 will be conducted by ARM under a contract with EAG. ARM will provide project planning, field screening, and reporting support. Any required drilling will be contracted directly by EAG. The management and field responsibilities of key project personnel are defined in this section.

The ARM Project Manager, Mr. Eric Magdar, is responsible for ensuring that all activities are conducted in accordance with this Work Plan Addendum and the contract requirements. Mr. Magdar will provide technical coordination with the MDE, USEPA, and EAG. The ARM Project Manager is responsible for managing all operations conducted for this project including:

- Ensure all personnel assigned to this project review the technical project plans before initiation of all tasks associated with the project.
- Review of project plans in a timely manner.
- Ensure proper methods and procedures are implemented to collect representative samples.
- Monitor the project budget and schedule and ensure the availability of necessary personnel, equipment, subcontractors, and other necessary services.

The lead ARM Project Scientist, Mr. Nicholas Kurtz, will be responsible for coordinating field activities including the collection, preservation, documentation, and shipment of samples. Mr. Kurtz will directly communicate with the ARM Project Manager and Laboratory Project Manager on issues pertaining to sample shipments, schedules, container requirements, and other necessary issues. Mr. Kurtz is also responsible for ensuring the accuracy of sample documentation including the completion of the Chain of Custody forms.

Pace Analytical Services, Inc. (PACE) of Greensburg, Pennsylvania will provide the analytical services for this project. The address for the laboratory is as follows:

Pace Analytical
1638 Roseytown Road
Greensburg, PA 15601

During the field activities, the Laboratory Project Manager will coordinate directly with the ARM Project Manager on issues regarding sample shipments, schedules, container requirements, and other field-laboratory logistics. The Laboratory Project Manager will monitor the daily activities of the laboratory, coordinate all production activities, and ensure that work is being

conducted as specified in this document. Ms. Samantha Bayura will be the Laboratory Project Manager for PACE on this project.

2.2. HEALTH AND SAFETY ISSUES

Because of the potential presence of hazardous constituents in the soil and groundwater at the Site, the investigation will be conducted under a Health and Safety Plan (HASP) to protect investigation workers from possible exposure to contaminated materials. This investigation will be conducted under to the property-wide HASP developed by EAG.

Based on information provided to ARM, the planned site activities will be conducted under modified Level D personal protection. The requirements of the modified Level D protection are defined in the property-wide HASP. All field personnel assigned for work at the Site have been trained in accordance with the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response standard (29 CFR 1910.120) and other applicable OSHA training standards. All field staff will be experienced in hazardous waste site work, use of personal protective equipment (PPE), and emergency response procedures.

3.0 FIELD ACTIVITIES AND PROCEDURES

3.1. UTILITY CLEARANCE

ARM will take appropriate precautions to avoid subsurface utilities and structures during the site investigation. Prior to initiating any subsurface investigations, ARM will attempt to determine the location of utilities in the project area using the Miss Utility system. Additionally, any required state or local permits will be acquired prior to the commencement of site activities.

In addition to the Miss Utility system, EAG will clear each proposed boring with utility personnel currently working on the property. To facilitate this, ARM will locate with a GPS and mark all proposed boring locations in the field, unless the investigation area has been previously cleared of active utilities. ARM will coordinate the completion of borings in the field with Tradepoint Atlantic utility personnel to avoid conflicts. Historical utility drawings which may be relevant include the 5500 Set (Plant Sewer Lines), 5600 Set (Plant Water Lines), and 5800 Set (Plant Gas Lines).

3.2. GROUNDWATER INVESTIGATION

This Work Plan Addendum presents the methods and protocols to be used to complete the proposed groundwater and NAPL sampling activities. These methods and procedures follow the applicable MDE and USEPA guidelines. Information regarding the project organization, field activities and sampling methods, sampling equipment, sample handling and management procedures, the laboratory analytical methods and selected laboratory, quality control and quality assurance procedures, investigation-derived waste (IDW) management methods, and reporting requirements are described in detail in the QAPP that has been developed to support the investigation and remediation of the Tradepoint Atlantic Site (Quality Assurance Project Plan, ARM Group Inc., April 5, 2016).

The area that will be investigated, along with the proposed groundwater sample collection locations, have been provided in **Figure 4**. There are three existing shallow temporary piezometers which will be used as temporary groundwater sample collection points and thus are included in the sampling plan (B18-044-PZ, B18-046-PZ, and B18-077-PZ). Two of the permanent monitoring wells installed in March 1988 (BA-81-7945 and BA-81-7946) will also be included in the sampling plan based on a lack of NAPL accumulation (and possible fouling) observed to date at these locations. Because it has been years since these existing wells have been sampled, each well will be redeveloped according to procedures referenced in QAPP Worksheet 21 – Field SOPs, SOP No. 018 – Well Development. After redevelopment, ARM will record the depth to bottom again in each well to compare to other recent measurements.

To supplement the five existing sample locations, four temporary groundwater sample collection points and three permanent groundwater monitoring wells will be installed and sampled at the locations identified on **Figure 4** in accordance with the procedures referenced in the QAPP

Worksheet 21 – Field SOPs, SOP No. 028 – Direct Push Installation and Construction of Temporary Groundwater Sample Collection Points and SOP No. 014 – Monitoring Well Construction. The groundwater sample collection points are proposed to be installed with 15 feet of screen which will span the vertical interval of approximately 5 to 20 feet bgs. Piezometer and well screen intervals may also be adjusted in the field if warranted based on field observations during installation.

If the Geoprobe® and/or Hollow Stem Auger is unable to access any of the proposed installation locations due to physical/topographic obstructions, or if equipment refusal is encountered prior to reaching a viable target depth, alternate installation locations or methods may need to be selected on a case-by-case basis. Geologic logging will be completed for each soil core, and the presence and depth of any observed NAPL contamination will be documented. After the installation is completed at each location, down-hole equipment will be decontaminated in accordance with QAPP Worksheet 21 – Field SOPs, SOP No. 016 – Equipment Decontamination (Section 3.8) using a mobile decontamination platform and steam cleaner to remove any soil and residual NAPL from the Geoprobe® and/or Hollow Stem Auger tooling.

Groundwater samples will be collected from the seven temporary groundwater sample collection points (B18-044-PZ, B18-046-PZ, B18-077-PZ, B18-078-PZ, B18-079-PZ, B18-080-PZ, and B18-081-PZ), three permanent groundwater monitoring wells (SW-082-MWS, SW-083-MWS, and SW-084-MWS), and two existing permanent wells (BA-81-7945 and BA-81-7946) using hand bailing techniques or a peristaltic pump. Before purging, each groundwater sample collection point will be checked for the presence of NAPL using an oil-water interface probe, in accordance with methods referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 019 – Depth to Groundwater and NAPL Measurements. A minimum of three wetted well volumes will be removed from each location, and the groundwater point will be checked again using the oil-water interface probe prior to sampling. If NAPL accumulates in the casing of any groundwater sample collection point, additional groundwater will be purged to remove the bulk of the localized NAPL mass, and a grab sample will not be collected until any measureable NAPL at the water surface has been removed. Low-flow sampling techniques will not be required for this investigation because significant NAPL and/or dissolved phase contamination is anticipated to exist in the investigation area, and the use of a flow-through cell and multiparameter meter could damage or foul this equipment. All groundwater samples will be submitted for analysis of VOCs and SVOCs.

An additional sample of free-phase product (i.e., NAPL) will be collected from one of the existing historical monitoring wells (BA-81-7941). Samples of NAPL were previously collected from several locations for the fingerprinting analysis described in the introduction of this document; however, the MDE has requested that an additional sample of NAPL be collected to determine whether PCBs are present in the free-phase product. The NAPL sample will be collected using hand bailing techniques or a peristaltic pump, and will be analyzed for PCBs.

All samples of groundwater and NAPL will be collected using dedicated sampling equipment. Analytical methods, sample containers, preservatives, and holding times for the sample analyses are listed in the QAPP Worksheet 19 & 30 – Sample Containers, Preservation, and Holding Times. Samples will be labeled and recorded on the Chain of Custody form in accordance with methods referenced in the QAPP Worksheet 26 & 27 – Sample Handling, Custody and Disposal. The samples will be submitted to PACE for analysis with a standard turnaround time (approximately 5 work days). The specific lists of analytes that the groundwater and NAPL samples will be analyzed for, as well as the quantitation limits and Project Action Limits (PALs), are provided in QAPP Worksheet 15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits.

The groundwater sample collection points (both temporary and permanent) will also be surveyed to obtain groundwater elevation data. The elevation data from these groundwater sample locations will be used to create a groundwater contour map indicating localized groundwater flow directions. Other distal groundwater locations SW13-PZM003, SW-029-MWS, and B18-061-PZ (from the Parcel B18 Phase II Investigation or Area B Groundwater Investigation completed under separate approved Phase II Investigation Work Plans) may also be utilized to provide additional groundwater elevation data to define the potentiometric surface. Once each temporary groundwater sample collection point has been sampled, surveyed, and/or checked for NAPL, it will remain in place until the MDE approves its abandonment. Ultimately, the boreholes will be abandoned in accordance with Maryland abandonment standards as stated in COMAR 26.04.04.34 through 36.

4.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

All investigation derived waste (IDW) procedures will be carried out in accordance with methods referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 005 – Investigation-Derived Wastes Management.

5.0 REPORTING

A letter report summarizing the findings of this investigation will be prepared following the completion of all groundwater and NAPL sampling activities in the vicinity of the No. 10 Fuel Oil Tank area. The results will be presented in tabular and graphical formats as appropriate to best summarize the data for future use. The letter report will indicate whether any additional site investigation activities are warranted to characterize the nature and extent of the dissolved phase petroleum hydrocarbons associated with NAPL in the No. 10 Fuel Oil Tank area.

Based on sequencing needs for development or remediation, the groundwater investigation report may be combined into a comprehensive report which will also present the findings of the completed soil investigation activities outlined in the No. 10 Tank Investigation Work Plan Addendum dated November 29, 2016.

6.0 SCHEDULE

The schedule of completion for the proposed field activities and laboratory analysis is shown below. In addition, a letter report will be submitted to the appropriate regulatory authorities within 1 month of completion of the field activities (including sampling analysis) in accordance with these approximate timeframes:

- the temporary groundwater sample collection point and permanent groundwater monitoring well installation activities, permanent well development activities, and groundwater/NAPL sample collection activities are expected to require approximately 3 weeks to complete (including mobilization activities) once approval of the Work Plan Addendum is received;
- the groundwater/NAPL sample analysis (PACE) is expected to require an additional 2 weeks to complete; and
- the preparation of the letter report, including an internal Quality Assurance review cycle, is expected to require another 4 weeks.

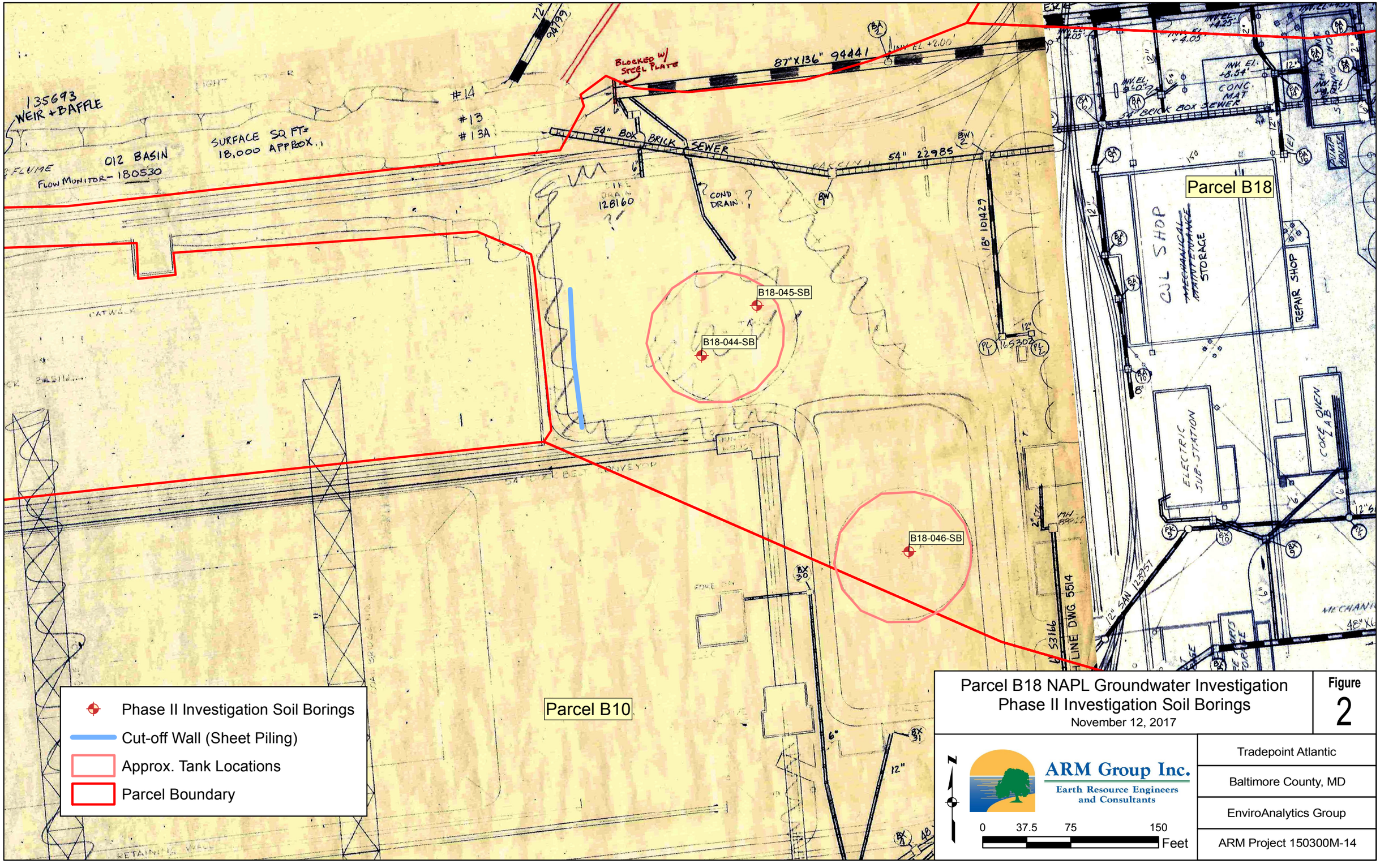
FIGURES

Parcel B18 NAPL Groundwater Investigation
Historical Monitoring Wells
November 12, 2017

Figure 1

ARM Group Inc.
Earth Resource Engineers and Consultants

Tradepoint Atlantic
Baltimore County, MD
EnviroAnalytics Group
ARM Project 150300M-14



Parcel B18 NAPL Groundwater Investigation
Phase II Investigation Soil Borings
November 12, 2017

Figure 2

ARM Group Inc.
Earth Resource Engineers and Consultants

0 37.5 75 150 Feet

Tradepoint Atlantic
Baltimore County, MD
EnviroAnalytics Group
ARM Project 150300M-14

Parcel B18 NAPL Groundwater Investigation
Completed Soil Boring Investigation
January 23, 2018

Figure
3

ARM Group Inc.
Earth Resource Engineers and Consultants

Tradepoint Atlantic

Baltimore County, MD

EnviroAnalytics Group

ARM Project 150300M-14

Parcel B18 NAPL Groundwater Investigation
Proposed Groundwater Sampling Plan
February 16, 2018

Figure
4

ARM Group Inc.
Earth Resource Engineers and Consultants

Tradepoint Atlantic

Baltimore County, MD

EnviroAnalytics Group

ARM Project 150300M-14

APPENDIX A

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP/LG Date: 10/20/16 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-81-7941 Well Permit No.: BA-81-7941

Coordinates:

Latitude/Northing 563475.43 Longitude/Easting 1455886.02

Condition of pad and/or cover: casing in good condition/no pad Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	7.31’ TOC	
Depth to Bottom (feet BGS/TOC)	20.00’ TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: Depth to Product = 10.29’ TOC
S/U = 2.00’

PICTURE OF WELL DURING INSPECTION

ARM Group Inc.

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP/LG Date: 10/21/16 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-84-7942 Well Permit No.: BA-84-7942

Coordinates:

Latitude/Northing 563508.85 Longitude/Easting 1455832.72

Condition of pad and/or cover: casing good/no pad Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	9.39’ TOC	
Depth to Bottom (feet BGS/TOC)	22.40’ TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: Depth to product = 13.10’ TOC
S/U = 2’ 5’’

PICTURE OF WELL DURING INSPECTION

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP Date: 6/21/2017 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-81-7943 Well Permit No.: BA-81-7943

Coordinates:

Latitude/Northing 563544.61 Longitude/Easting 1455750.97

Condition of pad and/or cover: No Pad/Heavy Vegetation Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good, except PVC cap cut for access.

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	9.93’ TOC	
Depth to Bottom (feet BGS/TOC)	21.86’ TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: Depth to Product: 20.35’ TOC
S/U = 2.0’

PICTURE OF WELL DURING INSPECTION

ARM Group Inc.

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP/LG Date: 10/21/16 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-81-7944 Well Permit No.: BA-81-7944

Coordinates:

Latitude/Northing 563417.81 Longitude/Easting 1455877.50

Condition of pad and/or cover: casing in good condition Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	7.70’ TOC	
Depth to Bottom (feet BGS/TOC)	18.50’TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: Depth to product = 10.73’ TOC
S/U = 2.1’

PICTURE OF WELL DURING INSPECTION

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP Date: 6/21/2017 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-81-7945 Well Permit No.: BA-81-7945

Coordinates:

Latitude/Northing 563563.88 Longitude/Easting 1455904.83

Condition of pad and/or cover: No Pad/Heavy Vegetation Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	7.93’ TOC	
Depth to Bottom (feet BGS/TOC)	19.63’ TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: No NAPL/DNAPL
S/U = 0.95’

PICTURE OF WELL DURING INSPECTION

WELL INSPECTION FORM

Site: Sparrows Point Location of Well: B18

ARM Representative: LP/LG Date: 10/21/16 Project Number: 150300M-14-3

WELL INFORMATION

Well ID: BA-81-7946 Well Permit No.: BA-81-7946

Coordinates:

Latitude/Northing 563442.72 Longitude/Easting 1455979.55

Condition of pad and/or cover: casing good Flush Mount or Stick-Up? S/U

Well ID Marked? Yes If yes, where? Permit Tag

Locking cap? Yes Lock? No Diameter of Well: 4”

Structural integrity of well: Good

WELL MEASUREMENTS

	Measured (Current)	Historic Reported
Depth to Water (feet BGS/TOC)	9.31’ TOC	
Depth to Bottom (feet BGS/TOC)	10.25’ TOC	

Notes: BGS = below ground surface, TOC = top of casing

Additional Comments: No DNAPL or LNAPL
S/U = 1.93’

PICTURE OF WELL DURING INSPECTION

APPENDIX B

Parcel B18 NAPL Sampling
Photograph Log
Sparrows Point, Maryland

Photo 1: View of NAPL collected from a B18 well. Take note of the NAPL observed as LNAPL and DNAPL.

Photo 2: Another view of the NAPL collected in Photo 1.

Photo 3: View from the top of the same NAPL jar from Photo 1.

APPENDIX C

January 11, 2017

James Calenda
EnviroAnalytics Group
1430 Sparrows Point Blvd
Sparrows Point, MD 21219

RE: Parcel B18 NAPL
Project Number: 150300M-14-3

Pace Analytical received 4 samples on December 23, 2016 for analysis labeled B18-045-PZ, BA-81-7941, BA-81-7944, and BA-81-7942. Per client request, the following analyses were performed:

1. Whole Oil (ASTM D3328)
2. Full Scan (ASTM D5739)

The sample was performed in house under laboratory number **21410**.

Please call the lab at 412-826-5245, or you may email any questions or concerns to ruth.welsh@pacelabs.com regarding any analytical data reports.

Respectfully submitted,

Ruth Welsh

Ruth Welsh
Project Manager

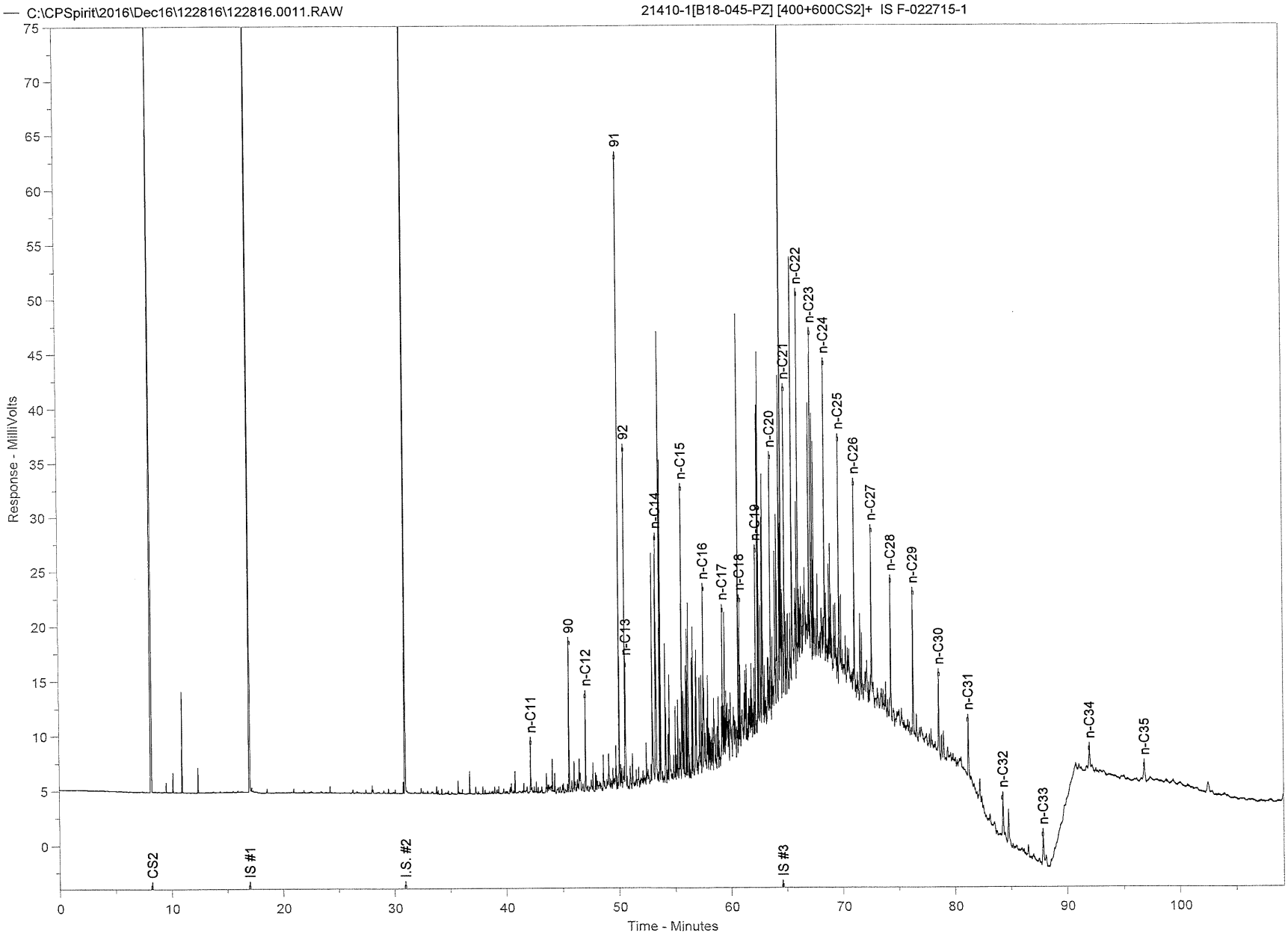
Whole Oil Analyses

ZymaX ID	21410-1
Sample ID	B18-045-PZ
Evaporation	
n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00
Waterwashing	
Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	0.00
Aromatics / Naphthenes	0.00
Biodegradation	
(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00
Octane rating	
2,2,4,-Trimethylpentane / Methylcyclohexane	0.00
Relative percentages - Bulk hydrocarbon composition as PIANO	
% Paraffinic	0.00
% Isoparaffinic	0.00
% Aromatic	100.00
% Naphthenic	0.00
% Olefinic	0.00

ZymaX ID		21410-1
Sample ID		B18-045-PZ
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

ZymaX ID		21410-1
Sample ID		B18-045-PZ
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	0.00
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	0.00
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	0.00
70	3,3,4-Trimethylheptane	0.00

ZymaX ID		21410-1
Sample ID		B18-045-PZ
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	0.00
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	0.00
77	1,2,3-Trimethylbenzene	0.00
78	Indan	0.00
79	1,3-Diethylbenzene	0.00
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	0.00
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	0.00
90	Naphthalene	16.69
91	2-Methyl-naphthalene	55.19
92	1-Methyl-naphthalene	28.12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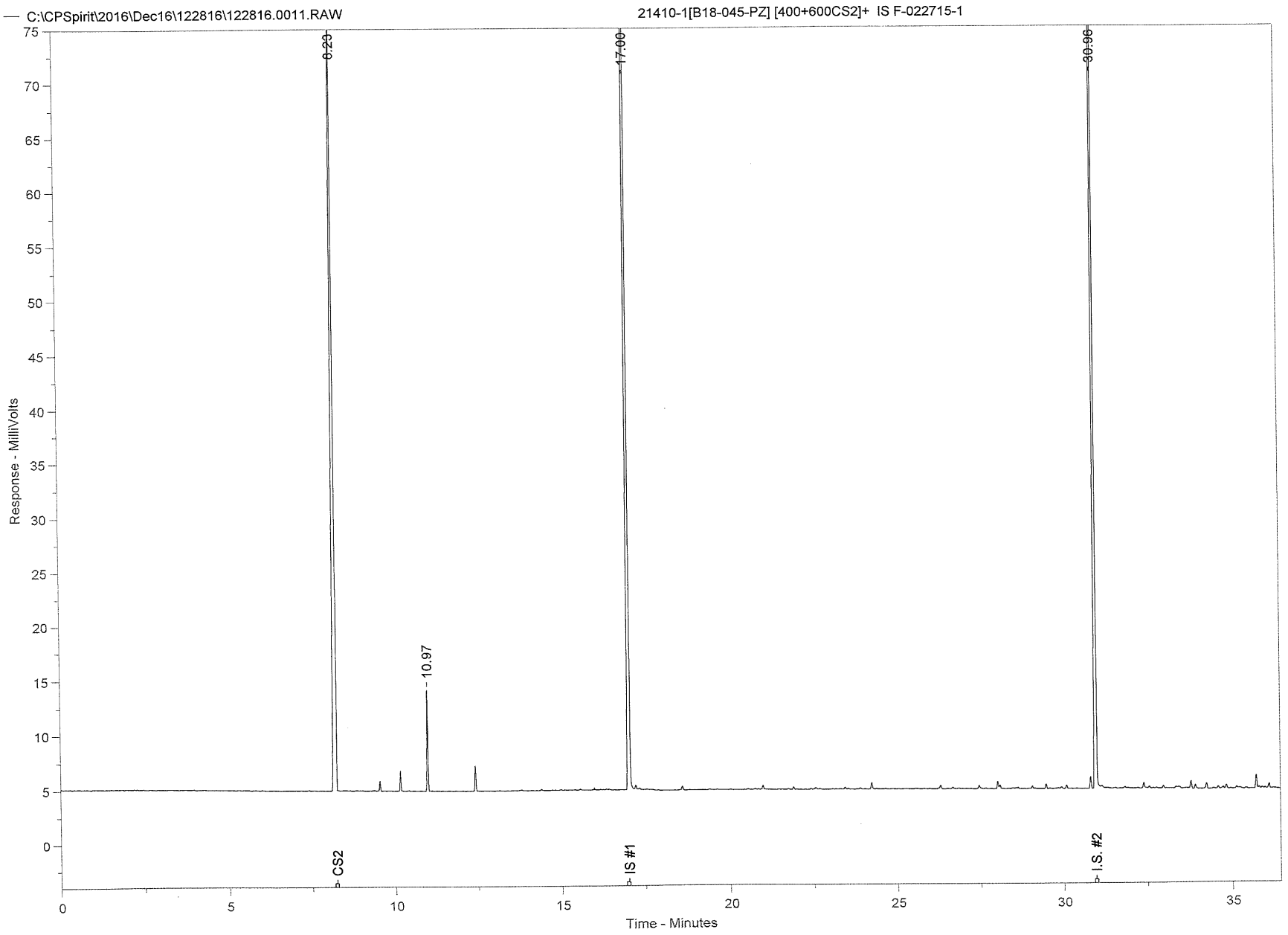
21410-1[B18-045-PZ] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
CS2
IS #1
I.S. #2
IS #3
n-C11
n-C12
n-C13
n-C14
n-C15
n-C16
n-C17
n-C18
n-C19
n-C20
n-C21
n-C22
n-C23
n-C24
n-C25
n-C26
n-C27
n-C28
n-C29
n-C30
n-C31
n-C32
n-C33
n-C34
n-C35
90
91
92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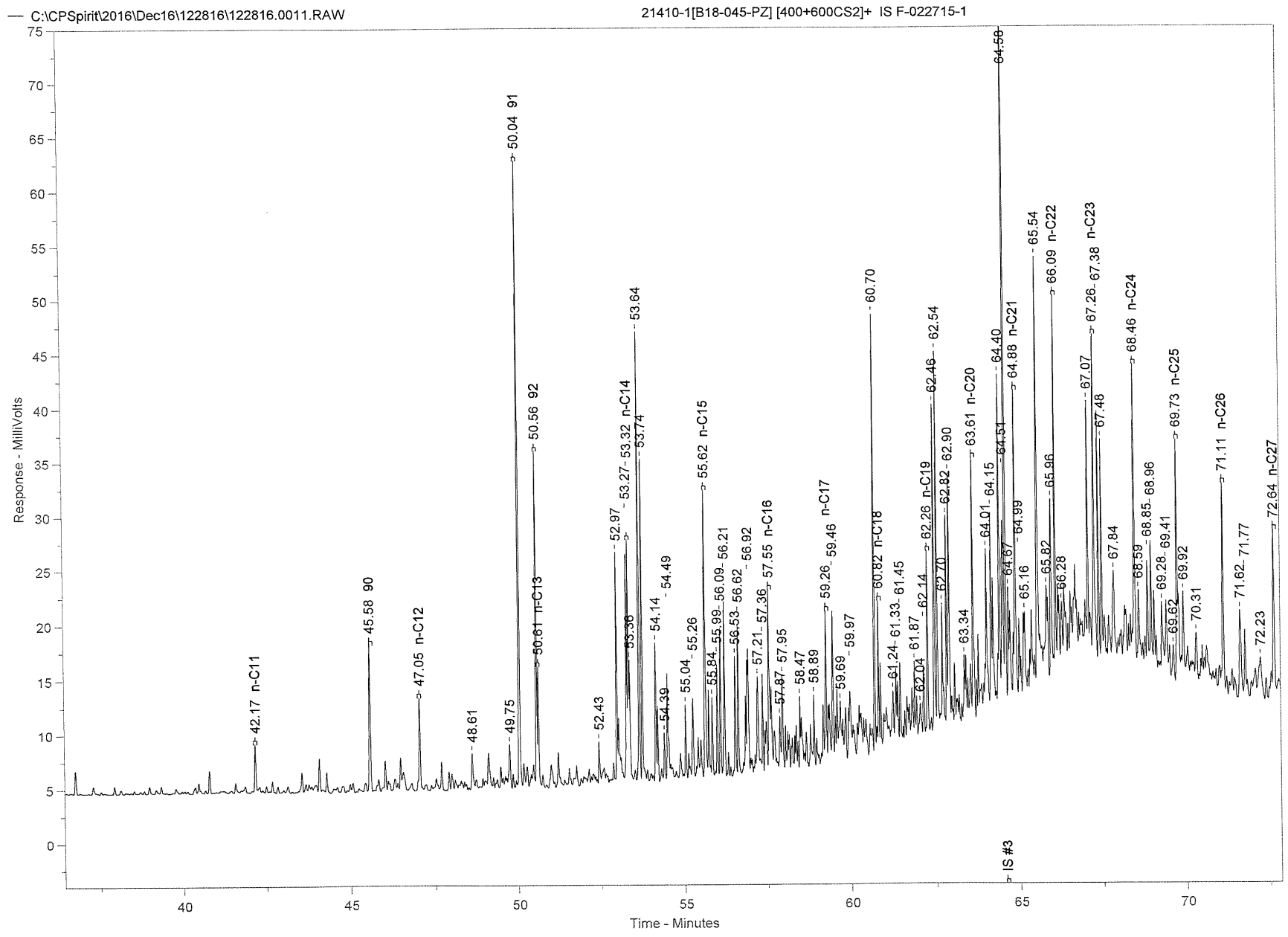
21410-1[B18-045-PZ] [400+600CS2]+ IS F-022715-1
6.29
10.97
17.00
30.90
CS2
IS #1
I.S. #2
Response - MilliVolts
Time - Minutes
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75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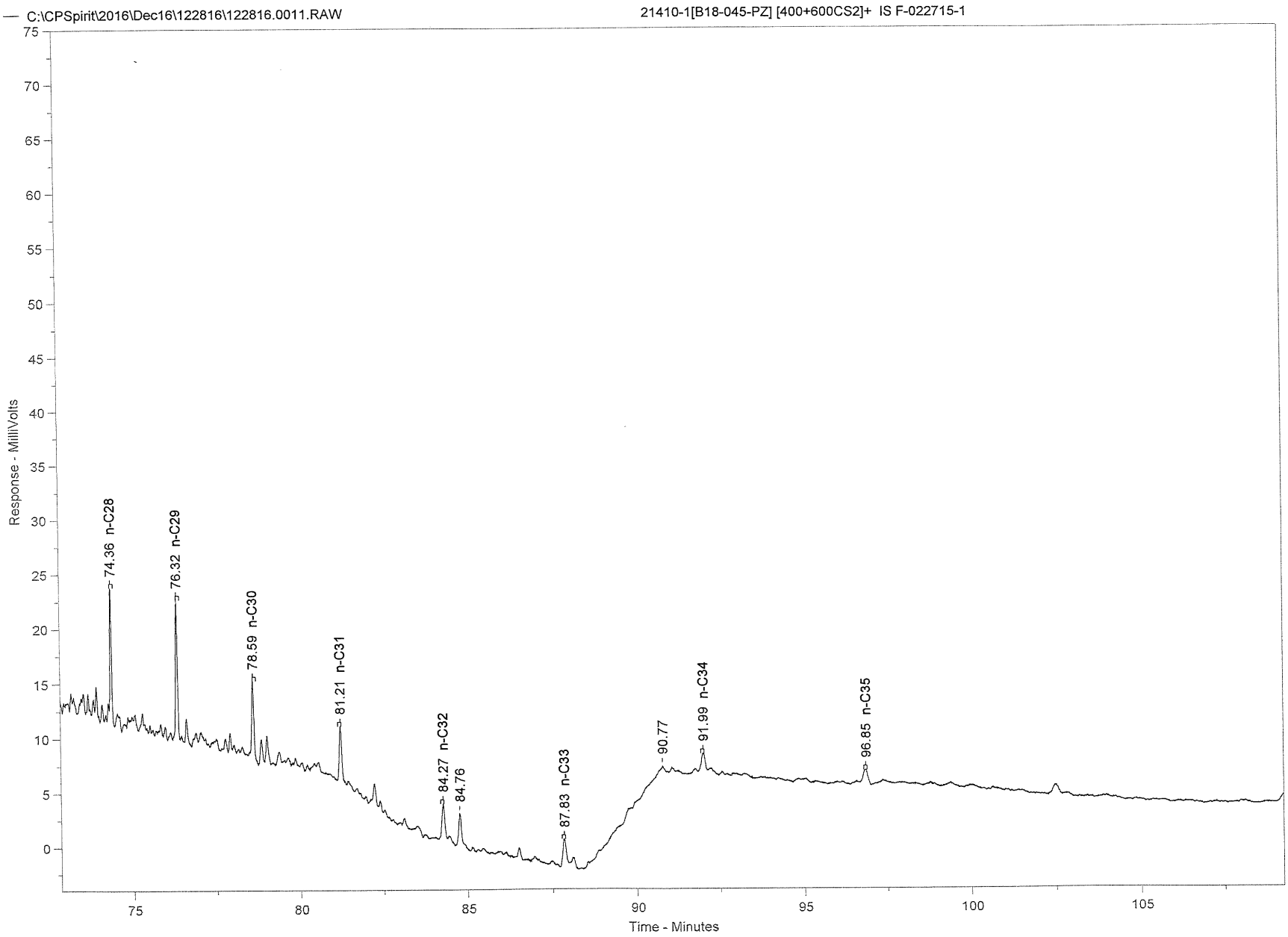
21410-1[B18-045-PZ] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
42.17 n-C11
45.58 90
47.05 n-C12
48.61
49.75
50.04 91
50.56 92
50.81 n-C13
52.43
52.97
53.27
53.32 n-C14
53.64
53.74
54.14
54.39
54.49
55.04
55.26
55.62 n-C15
55.84
55.99
56.09
56.21
56.53
56.62
56.92
57.21
57.36
57.55 n-C16
57.87
57.95
58.47
58.89
59.26
59.46 n-C17
59.69
59.97
60.70
60.82 n-C18
61.24
61.33
61.45
61.87
62.04
62.14
62.26 n-C19
62.46
62.54
62.70
62.82
62.90
63.34
63.61 n-C20
64.01
64.15
64.40
64.51
64.56
64.67
64.88 n-C21
64.99
65.16
65.54
65.82
65.96
66.09 n-C22
66.28
67.07
67.26
67.38 n-C23
67.48
67.84
68.46 n-C24
68.59
68.85
68.96
69.28
69.41
69.62
69.73 n-C25
69.92
70.31
71.11 n-C26
71.62
71.77
72.23
72.64 n-C27
IS #3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21410-1[B18-045-PZ] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
74.36 n-C28
76.32 n-C29
78.59 n-C30
81.21 n-C31
84.27 n-C32
84.76
87.83 n-C33
90.77
91.99 n-C34
96.85 n-C35

Sample Name = **21410-1[B18-045-PZ] [400+600CS2]+ IS F-022715-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2016\Dec16\122816\122816.0011.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\121616.cal

Date Taken (end) = 12/31/2016 4:28:16 AM
Method Version = 44
Calibration Version = 2

Peak Name	Ret. Time	Area %	Area
CS2	8.23	6.6748	329289.30
	10.97	0.3864	19064.72
IS #1	17.00	10.8405	534797.60
I.S. #2	30.96	9.0750	447702.70
n-C11	42.17	0.2264	11170.05
90	45.58	0.7334	36182.48
n-C12	47.05	0.4759	23478.14
	48.61	0.1842	9086.60
	49.75	0.2145	10584.27
91	50.04	2.4245	119609.00
92	50.56	1.2354	60946.01
n-C13	50.61	0.4412	21766.60
	52.43	0.1689	8331.31
	52.97	1.2089	59637.53
	53.27	0.8575	42305.62
n-C14	53.32	0.8820	43510.96
	53.36	0.4046	19958.62
	53.64	1.6268	80254.15
	53.74	1.1528	56870.16
	54.14	0.5068	24999.98
	54.39	0.1754	8655.02
	54.49	0.6225	30707.95
	55.04	0.2639	13019.58
	55.26	0.3852	19004.16
n-C15	55.62	1.3905	68599.29
	55.84	0.3109	15339.52
	55.99	0.4202	20731.43
	56.09	0.5431	26791.78
	56.21	0.7218	35606.43
	56.53	0.4920	24270.53
	56.62	0.5162	25463.54
	56.92	1.0095	49800.73
	57.21	0.5212	25714.88
	57.36	0.3039	14991.97
n-C16	57.55	1.0744	53004.92
	57.87	0.2223	10967.30
	57.95	0.4115	20300.14
	58.47	0.4661	22992.36
	58.89	0.2141	10561.41
n-C17	59.26	0.5938	29295.67
	59.46	0.5422	26749.70
	59.69	0.2893	14270.04
	59.97	0.4290	21163.83
	60.70	1.3725	67707.88
n-C18	60.82	0.4263	21033.26
	61.24	0.2321	11449.72
	61.33	0.5148	25394.95
	61.45	0.2831	13966.04
	61.87	0.5582	27540.27
	62.04	0.2031	10020.85
	62.14	0.2796	13796.00
n-C19	62.26	0.6601	32567.46
	62.46	1.2117	59778.88
	62.54	1.2996	64114.46
	62.70	0.5750	28369.05

Peak Name	Ret. Time	Area %	Area
	62.82	0.7038	34719.81
	62.90	1.1948	58941.25
	63.34	0.6240	30784.37
n-C20	63.61	1.0990	54217.71
	64.01	0.6223	30698.12
	64.15	0.5553	27396.73
	64.40	1.3814	68146.78
	64.51	1.0602	52304.53
IS #3	64.58	3.6463	179886.00
	64.67	0.7872	38835.51
n-C21	64.88	1.3724	67704.76
	64.99	0.3653	18023.97
	65.16	0.6004	29620.64
	65.54	2.2952	113229.50
	65.82	0.9230	45532.63
	65.96	0.9118	44981.56
n-C22	66.09	1.1759	58013.49
	66.28	0.2294	11315.82
	67.07	0.8921	44011.02
n-C23	67.26	1.5104	74512.46
	67.38	0.8776	43294.43
	67.48	0.7196	35501.04
	67.84	0.5931	29257.30
n-C24	68.46	1.2499	61662.11
	68.59	0.3236	15966.30
	68.85	0.3926	19370.63
	68.96	0.4455	21975.67
	69.28	0.3855	19018.09
	69.41	0.4446	21935.68
	69.62	0.2042	10074.39
n-C25	69.73	1.4308	70587.34
	69.92	0.3901	19247.00
	70.31	0.2459	12128.94
n-C26	71.11	0.9439	46566.09
	71.62	0.5849	28853.05
	71.77	0.2568	12667.18
	72.23	0.3993	19697.06
n-C27	72.64	0.7748	38224.89
n-C28	74.36	0.7169	35366.90
n-C29	76.32	0.9704	47874.86
n-C30	78.59	0.6351	31333.63
n-C31	81.21	0.6758	33337.45
n-C32	84.27	0.5533	27297.59
	84.76	0.4410	21756.19
n-C33	87.83	0.3424	16889.80
	90.77	3.1978	157760.10
n-C34	91.99	0.3402	16782.28
n-C35	96.85	0.2586	12757.66

Total Area = 4933347 Total Height = 1882010 Total Amount = 0

ZymaX ID	21410-2
Sample ID	BA-81-7941

Evaporation

n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00

Waterwashing

Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	0.00
Aromatics / Naphthenes	0.00

Biodegradation

(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00

Octane rating

2,2,4,-Trimethylpentane / Methylcyclohexane	0.00

Relative percentages - Bulk hydrocarbon composition as PIANO

% Paraffinic	0.00
% Isoparaffinic	0.00
% Aromatic	100.00
% Naphthenic	0.00
% Olefinic	0.00

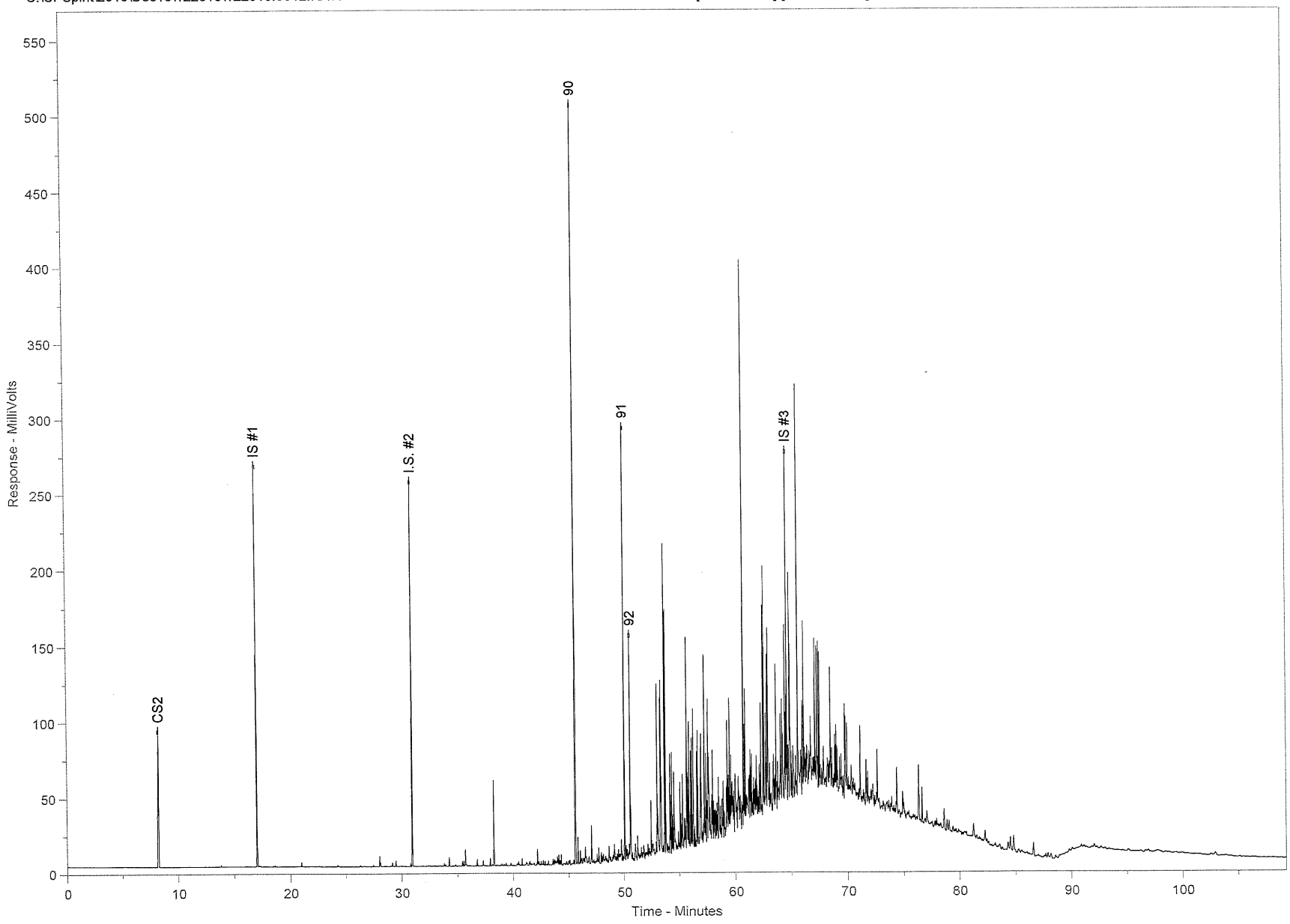
ZymaX ID		21410-2
Sample ID		BA-81-7941
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

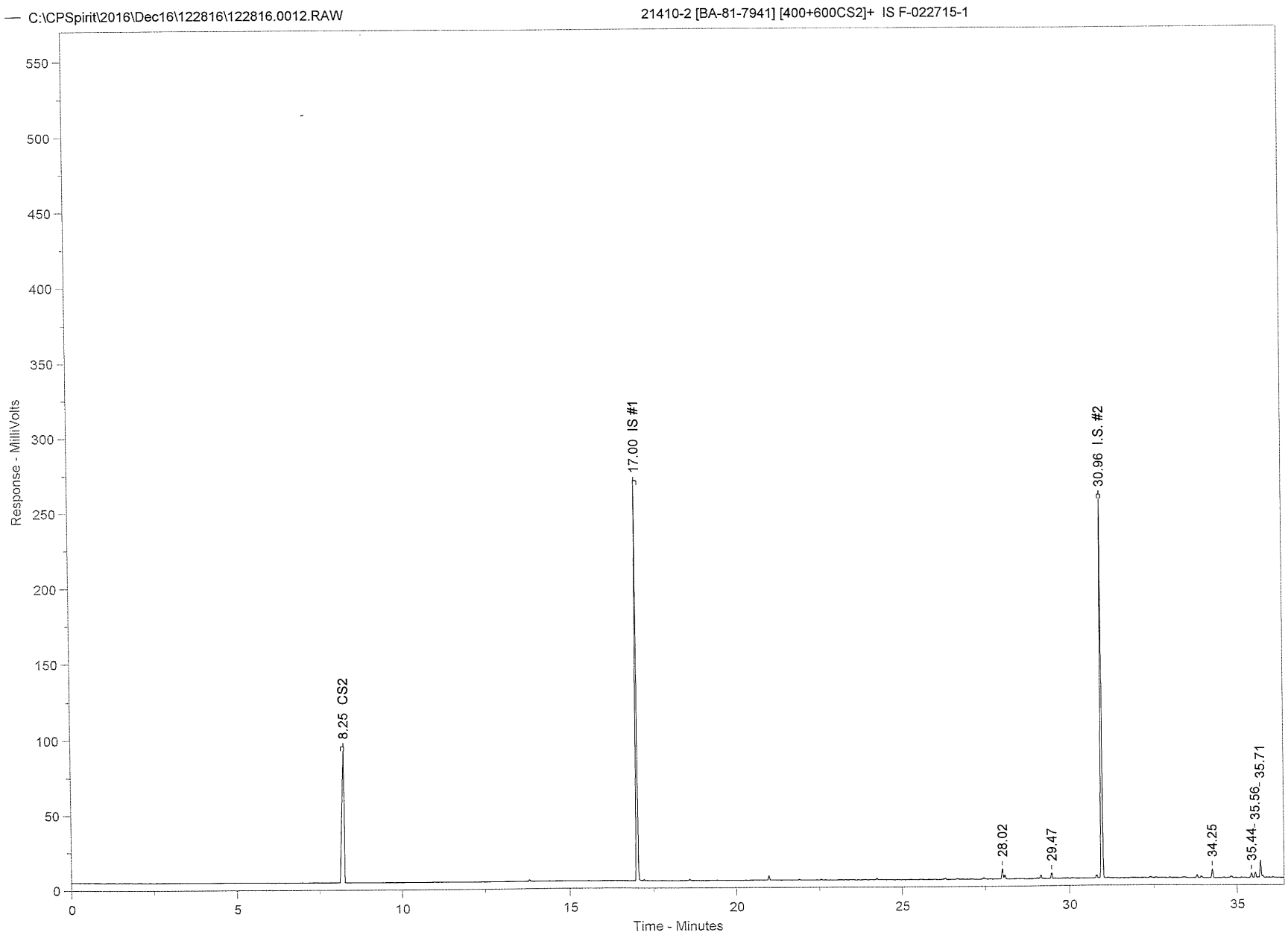
ZymaX ID		21410-2
Sample ID		BA-81-7941
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	0.00
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	0.00
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	0.00
70	3,3,4-Trimethylheptane	0.00

ZymaX ID		21410-2
Sample ID		BA-81-7941
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	0.00
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	0.00
77	1,2,3-Trimethylbenzene	0.00
78	Indan	0.00
79	1,3-Diethylbenzene	0.00
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	0.00
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	0.00
90	Naphthalene	59.61
91	2-Methyl-naphthalene	25.00
92	1-Methyl-naphthalene	15.40

C:\CPSpirit\2016\Dec16\122816\122816.0012.RAW

21410-2 [BA-81-7941] [400+600CS2]+ IS F-022715-1

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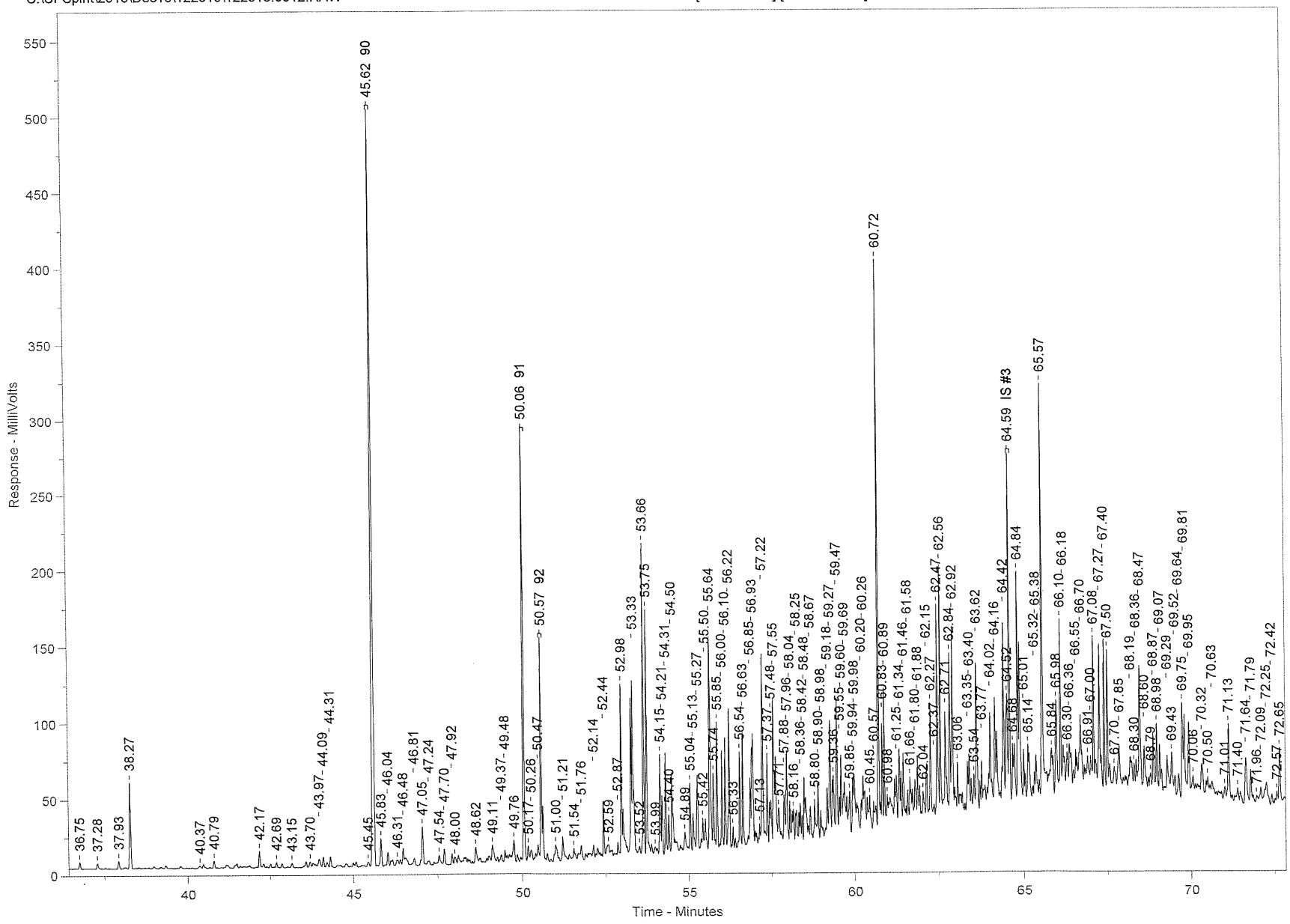
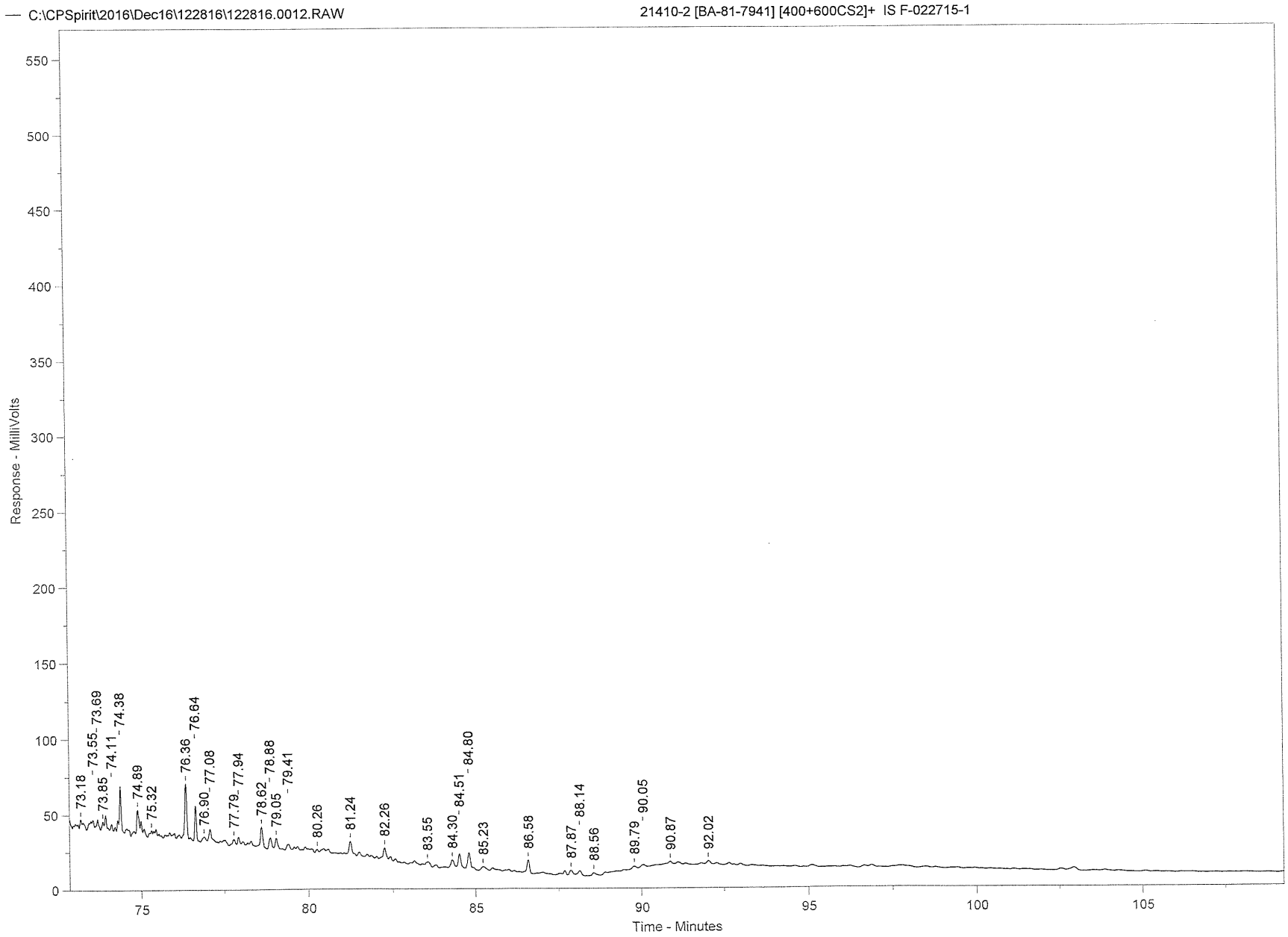
21410-2 [BA-81-7941] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
8.25 CS2
17.00 IS #1
28.02
29.47
30.96 I.S. #2
34.25
35.44
35.56
35.71

C:\CPSpirit\2016\Dec16\122816\122816.0012.RAW

21410-2 [BA-81-7941] [400+600CS2]+ IS F-022715-1

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21410-2 [BA-81-7941] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
0
50
100
150
200
250
300
350
400
450
500
550
75
80
85
90
95
100
105
73.18
73.55
73.69
73.85
74.11
74.38
74.89
75.32
76.36
76.64
76.90
77.08
77.79
77.94
78.62
78.88
79.05
79.41
80.26
81.24
82.26
83.55
84.30
84.51
84.80
85.23
86.58
87.87
88.14
88.56
89.79
90.05
90.87
92.02

Sample Name = **21410-2 [BA-81-7941] [400+600CS2]+ IS F-022715-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2016\Dec16\122816\122816.0012.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\21410.cal

Date Taken (end) = 12/31/2016 6:31:22 AM
Method Version = 44
Calibration Version = 1

Peak Name	Ret. Time	Area %	Area
CS2	8.25	1.4991	409624.80
IS #1	17.00	2.3671	646817.30
	28.02	0.0534	14593.31
	29.47	0.0349	9545.34
I.S. #2	30.96	2.3492	641913.40
	34.25	0.0576	15725.95
	35.44	0.0322	8786.19
	35.56	0.0347	9480.32
	35.71	0.1240	33882.46
	36.75	0.0437	11952.12
	37.28	0.0404	11042.27
	37.93	0.0482	13159.98
	38.27	0.5345	146046.20
	40.37	0.0235	6412.04
	40.79	0.0479	13100.57
	42.17	0.1005	27475.02
	42.69	0.0353	9655.77
	43.15	0.0377	10301.09
	43.70	0.0359	9806.37
	43.97	0.0681	18621.84
	44.09	0.0601	16415.44
	44.31	0.0726	19836.61
	45.45	0.0408	11135.34
90	45.62	5.3073	1450219.00
	45.83	0.1890	51633.48
	46.04	0.0818	22345.51
	46.31	0.0430	11743.61
	46.48	0.0694	18966.94
	46.81	0.0650	17756.74
	47.05	0.2839	77588.69
	47.24	0.0615	16798.11
	47.54	0.1078	29463.97
	47.70	0.1169	31931.53
	47.92	0.0628	17164.89
	48.00	0.0531	14498.19
	48.62	0.1209	33029.73
	49.11	0.1462	39958.84
	49.37	0.0602	16459.46
	49.48	0.1163	31777.69
	49.76	0.1936	52892.41
91	50.06	2.2258	608203.10
	50.17	0.1005	27467.90
	50.26	0.1064	29084.36
	50.47	0.1303	35593.50
92	50.57	1.3708	374556.50
	51.00	0.2299	62817.01
	51.21	0.2374	64870.90
	51.54	0.1307	35711.43
	51.76	0.1084	29610.36
	52.14	0.0726	19826.71
	52.44	0.2758	75356.01
	52.59	0.1045	28562.75
	52.87	0.0743	20299.68
	52.98	1.2006	328072.10
	53.33	1.9465	531887.90

Peak Name	Ret. Time	Area %	Area
	53.52	0.0683	18657.84
	53.66	1.5180	414794.60
	53.75	1.1841	323543.10
	53.99	0.0969	26482.79
	54.15	0.5775	157789.40
	54.21	0.2625	71726.80
	54.31	0.4897	133798.80
	54.40	0.2237	61123.82
	54.50	0.7456	203735.50
	54.89	0.2178	59516.69
	55.04	0.3418	93407.58
	55.13	0.2436	66556.18
	55.27	0.5091	139107.30
	55.42	0.2432	66462.62
	55.50	0.2300	62853.60
	55.64	1.4169	387157.00
	55.74	0.4303	117580.60
	55.85	0.6814	186194.80
	56.00	0.5161	141014.70
	56.10	0.5426	148263.60
	56.22	0.7593	207465.10
	56.33	0.0953	26047.75
	56.54	0.5686	155356.90
	56.63	0.5641	154144.80
	56.85	0.4377	119598.20
	56.93	1.0860	296737.60
	57.13	0.1219	33298.87
	57.22	1.2474	340836.70
	57.37	0.3867	105671.10
	57.48	0.4625	126389.20
	57.55	1.4148	386583.50
	57.71	0.3707	101303.60
	57.88	0.3110	84968.23
	57.96	0.5387	147196.20
	58.04	0.1856	50716.89
	58.16	0.3166	86499.30
	58.25	0.2571	70251.98
	58.36	0.2808	76736.59
	58.42	0.1055	28832.61
	58.48	0.6755	184577.50
	58.67	0.1933	52808.16
	58.80	0.2742	74932.48
	58.90	0.3019	82480.16
	58.98	0.2027	55395.07
	59.18	0.3111	85000.25
	59.27	0.7182	196251.80
	59.36	0.5563	151998.70
	59.47	0.7809	213387.90
	59.55	0.2278	62238.04
	59.60	0.3969	108440.90
	59.69	0.5658	154598.90
	59.85	0.3215	87836.85
	59.94	0.2661	72702.30
	59.98	0.7165	195768.60
	60.20	0.0817	22311.62
	60.26	0.1200	32799.07
	60.45	0.3188	87103.90
	60.57	0.0718	19627.97
	60.72	2.5629	700314.50
	60.83	0.4342	118651.30
	60.89	0.6104	166778.60
	60.98	0.5935	162167.80
	61.25	0.4858	132753.90
	61.34	0.6683	182619.50
	61.46	0.4141	113156.40
	61.58	0.1672	45685.33
	61.66	0.4508	123172.00

Peak Name	Ret. Time	Area %	Area
	61.80	0.3021	82542.67
	61.88	0.4845	132384.50
	62.04	0.2139	58451.50
	62.15	0.3508	95862.80
	62.27	0.5775	157799.30
	62.37	0.0792	21649.70
	62.47	1.1244	307247.90
	62.56	1.1113	303665.40
	62.71	0.7595	207532.70
	62.84	0.7393	202016.50
	62.92	1.2543	342745.40
	63.06	0.5163	141084.50
	63.35	0.2933	80156.34
	63.40	0.4087	111685.10
	63.54	0.2243	61296.01
	63.62	0.8567	234084.50
	63.77	0.4032	110183.10
	64.02	0.8538	233305.30
	64.16	1.1088	302978.50
	64.42	1.0865	296872.00
	64.52	0.8724	238389.80
IS #3	64.59	1.5744	430212.80
	64.68	0.1239	33841.75
	64.84	1.9260	526282.00
	65.01	0.3095	84559.52
	65.14	0.5012	136958.50
	65.32	0.0971	26519.25
	65.38	0.3188	87107.80
	65.57	2.3312	636984.60
	65.84	0.6845	187051.30
	65.98	0.7585	207255.70
	66.10	0.7816	213583.00
	66.18	0.4677	127805.70
	66.30	0.3341	91294.08
	66.36	0.5513	150654.20
	66.55	0.3939	107622.60
	66.70	0.8597	234919.80
	66.91	0.3265	89207.76
	67.00	0.2377	64949.69
	67.08	0.9288	253802.00
	67.27	1.0341	282574.20
	67.40	0.6742	184215.50
	67.50	0.5819	159006.60
	67.70	0.1416	38702.43
	67.85	0.3705	101247.80
	68.19	0.3544	96837.80
	68.30	0.1145	31277.96
	68.36	0.1896	51812.92
	68.47	0.8301	226824.40
	68.60	0.3162	86397.67
	68.79	0.0830	22684.69
	68.87	0.3122	85313.78
	68.98	0.3194	87284.12
	69.07	0.1609	43963.94
	69.29	0.2674	73065.16
	69.43	0.3114	85095.80
	69.52	0.1132	30931.01
	69.64	0.1725	47144.58
	69.75	0.5647	154295.10
	69.81	0.5501	150311.60
	69.95	0.4765	130214.50
	70.06	0.1152	31485.42
	70.32	0.2403	65671.31
	70.50	0.1640	44806.53
	70.63	0.1202	32855.48
	71.01	0.0920	25145.61
	71.13	0.5086	138984.40

Peak Name	Ret. Time	Area %	Area
	71.40	0.0712	19445.44
	71.64	0.4480	122415.80
	71.79	0.2376	64927.70
	71.96	0.0908	24815.89
	72.09	0.1800	49196.21
	72.25	0.3786	103459.60
	72.42	0.0710	19402.78
	72.57	0.0700	19138.08
	72.65	0.3651	99757.26
	73.18	0.0451	12335.92
	73.55	0.2229	60898.23
	73.69	0.1276	34860.74
	73.85	0.0432	11793.75
	74.11	0.0513	14022.07
	74.38	0.4423	120845.40
	74.89	0.2022	55261.19
	75.32	0.0682	18647.87
	76.36	0.5823	159104.00
	76.64	0.3002	82021.16
	76.90	0.0909	24847.64
	77.08	0.1871	51119.92
	77.79	0.0802	21908.74
	77.94	0.0647	17684.30
	78.62	0.2196	60003.62
	78.88	0.1599	43690.72
	79.05	0.1593	43540.43
	79.41	0.0828	22629.79
	80.26	0.0311	8485.56
	81.24	0.2060	56300.39
	82.26	0.1289	35216.89
	83.55	0.0763	20840.70
	84.30	0.1489	40676.73
	84.51	0.2210	60382.73
	84.80	0.2808	76734.05
	85.23	0.0907	24793.79
	86.58	0.1662	45413.99
	87.87	0.0911	24883.74
	88.14	0.0942	25735.94
	88.56	0.0586	16025.44
	89.79	0.2287	62481.78
	90.05	0.0639	17452.53
	90.87	0.0364	9948.91
	92.02	0.0568	15509.95

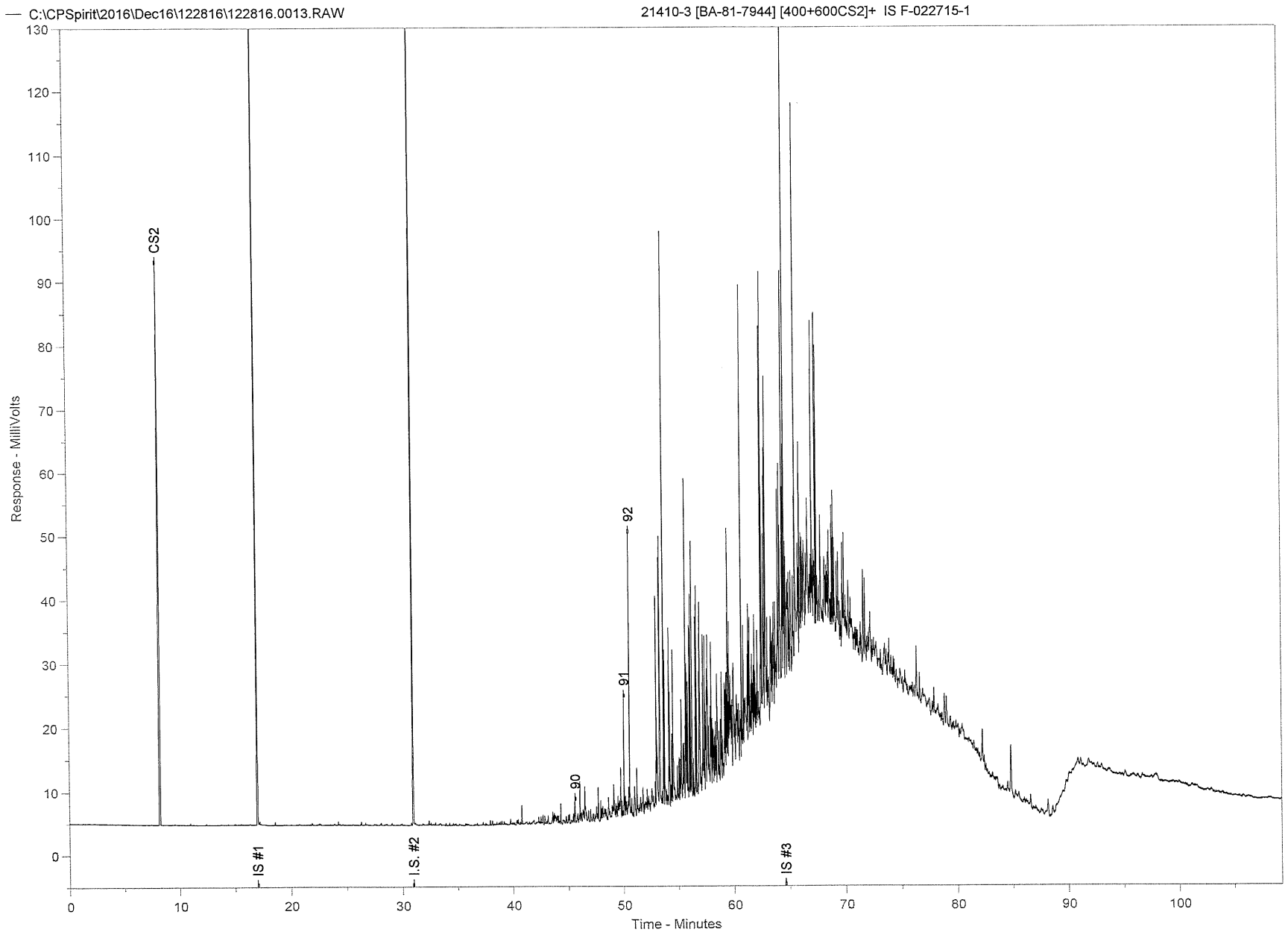
Total Area = 2.73248E+07 Total Height = 9693096 Total Amount = 0

ZymaX ID	21410-3
Sample ID	BA-81-7944
Evaporation	
n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00
Waterwashing	
Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	0.00
Aromatics / Naphthenes	0.00
Biodegradation	
(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00
Octane rating	
2,2,4,-Trimethylpentane / Methylcyclohexane	0.00
Relative percentages - Bulk hydrocarbon composition as PIANO	
% Paraffinic	0.00
% Isoparaffinic	0.00
% Aromatic	100.00
% Naphthenic	0.00
% Olefinic	0.00

ZymaX ID		21410-3
Sample ID		BA-81-7944
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

ZymaX ID		21410-3
Sample ID		BA-81-7944
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	0.00
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	0.00
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	0.00
70	3,3,4-Trimethylheptane	0.00

ZymaX ID		21410-3
Sample ID		BA-81-7944
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	0.00
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	0.00
77	1,2,3-Trimethylbenzene	0.00
78	Indan	0.00
79	1,3-Diethylbenzene	0.00
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	0.00
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	0.00
90	Naphthalene	9.19
91	2-Methyl-naphthalene	30.65
92	1-Methyl-naphthalene	60.15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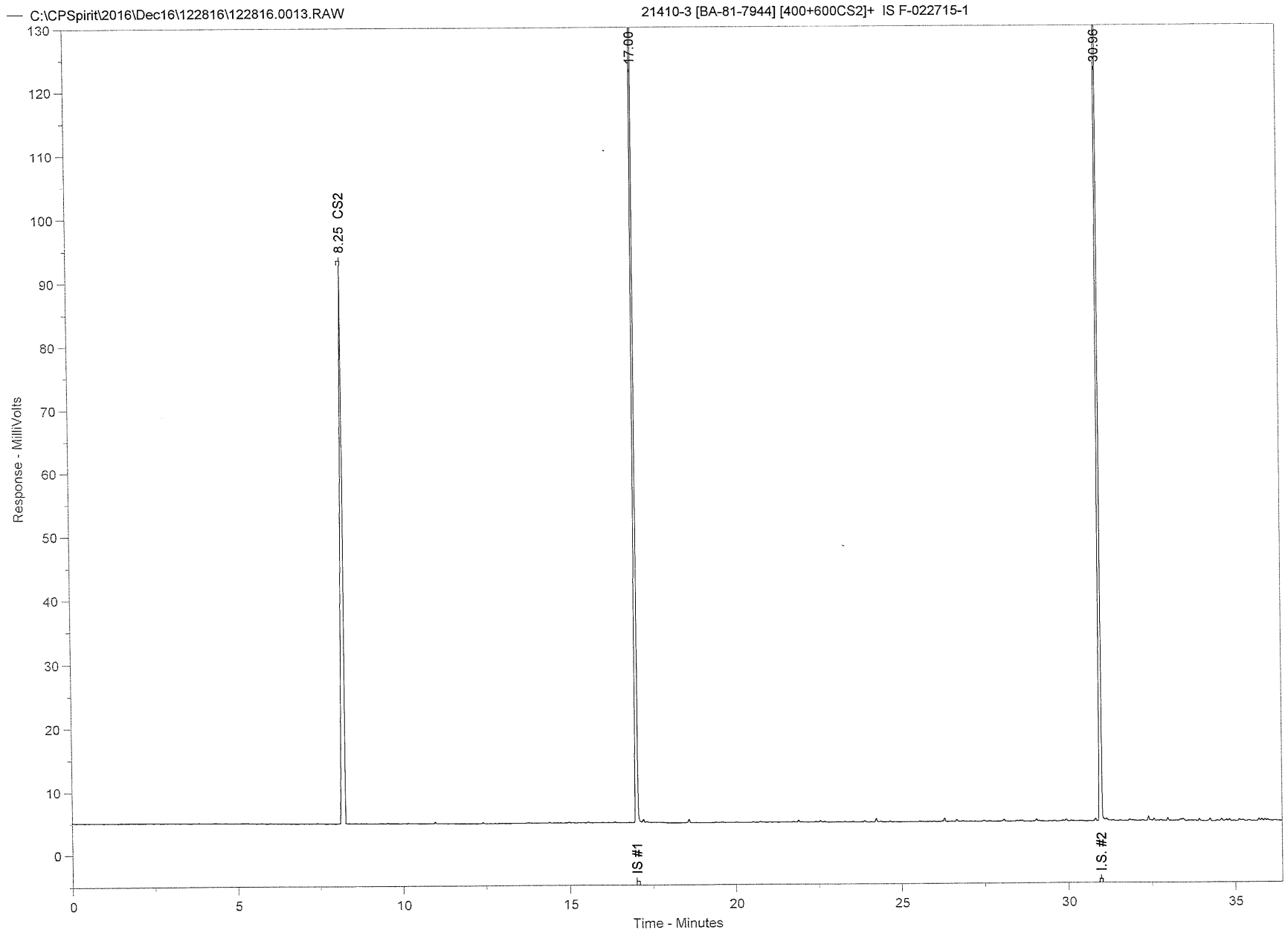
21410-3 [BA-81-7944] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
CS2
IS #1
I.S. #2
90
91
92
IS #3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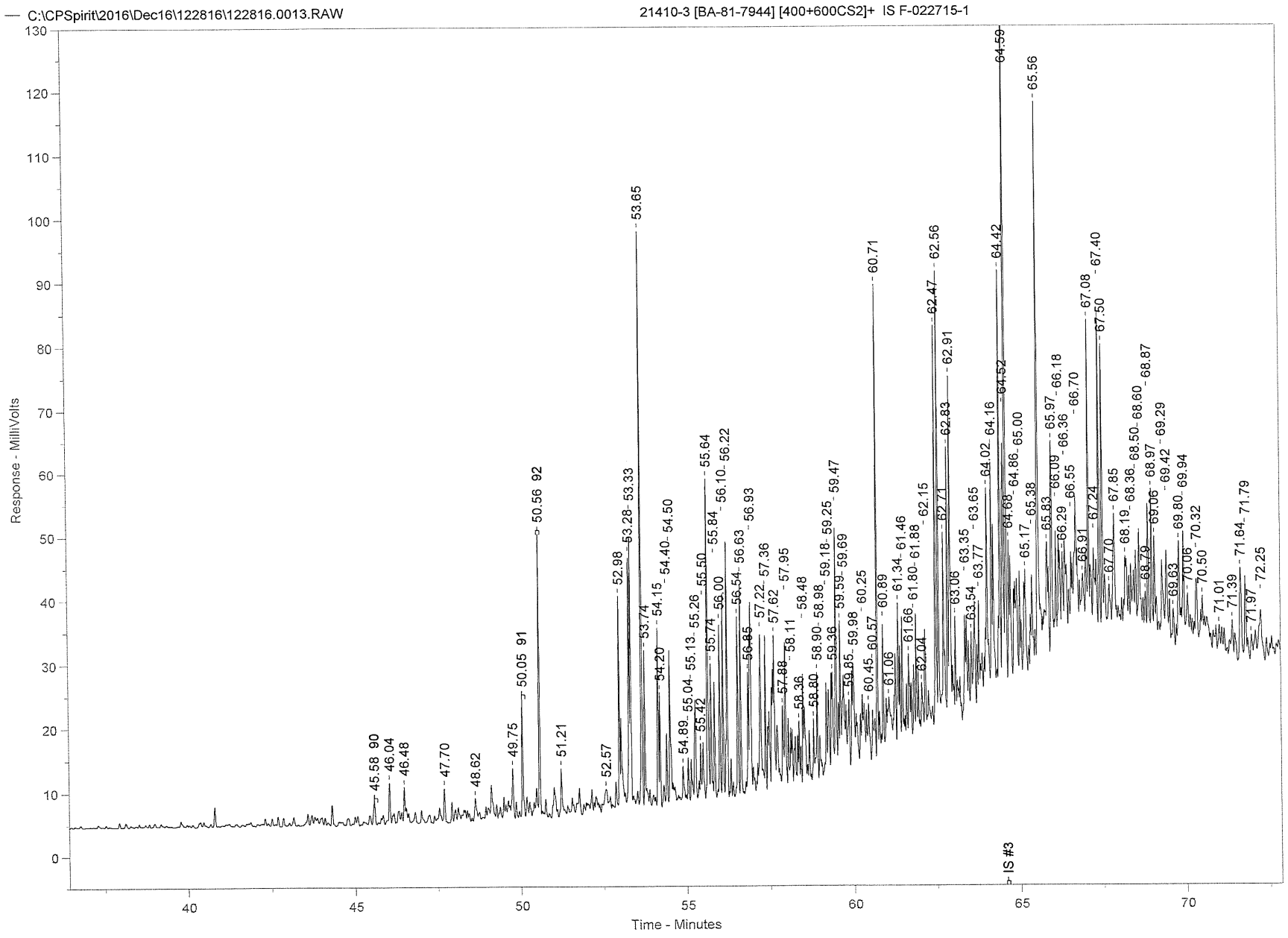
21410-3 [BA-81-7944] [400+600CS2]+ IS F-022715-1
8.25 CS2
17.00
30.96
IS #1
I.S. #2
Response - MilliVolts
Time - Minutes
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
5
10
15
20
25
30
35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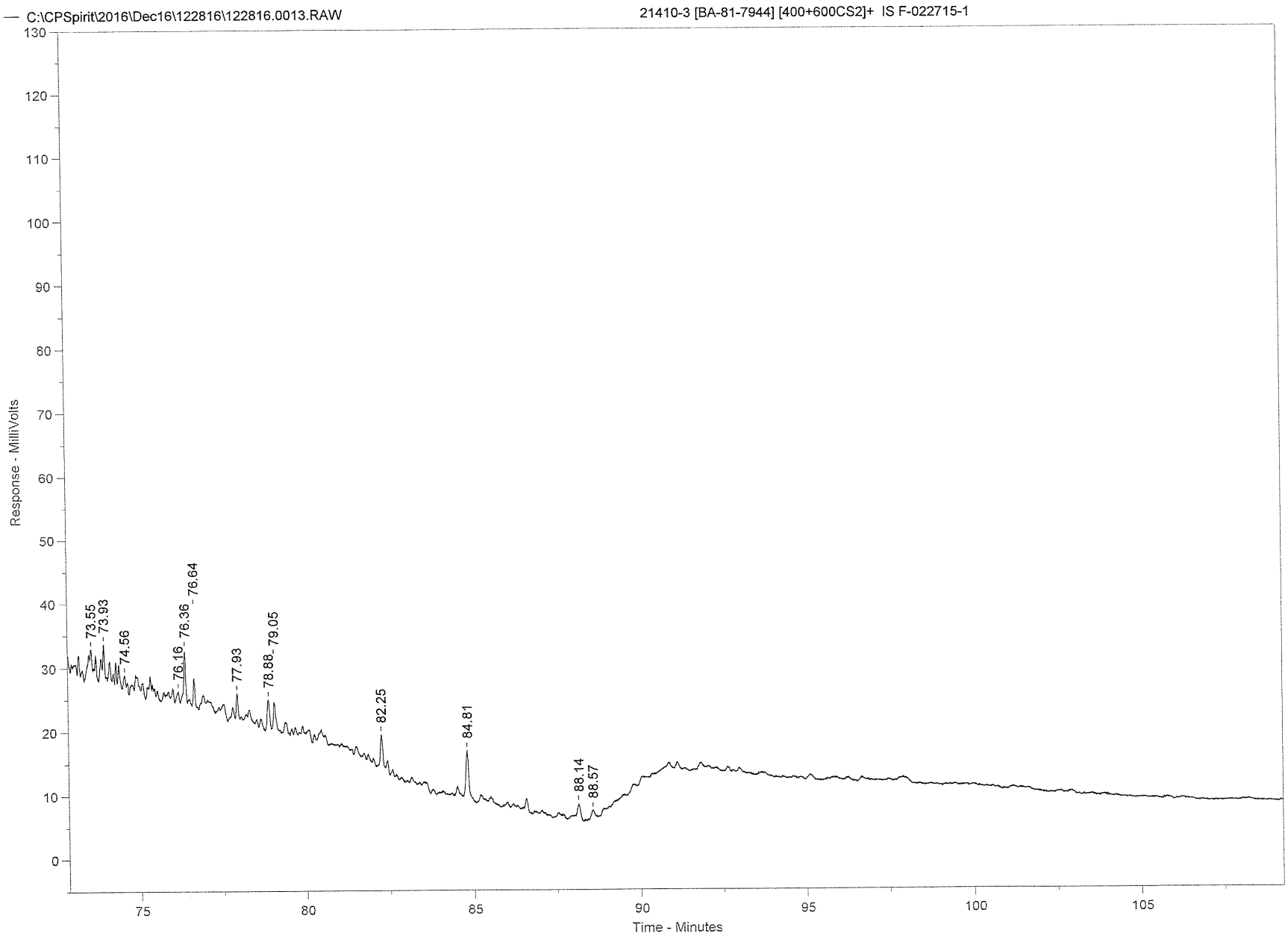
21410-3 [BA-81-7944] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
IS #3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21410-3 [BA-81-7944] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
73.55
73.93
74.56
76.16
76.36
76.64
77.93
78.88
79.05
82.25
84.81
88.14
88.57

Sample Name = **21410-3 [BA-81-7944] [400+600CS2]+ IS F-022715-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2016\Dec16\122816\122816.0013.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\21410.cal

Date Taken (end) = 12/31/2016 8:34:20 AM
Method Version = 44
Calibration Version = 1

Peak Name	Ret. Time	Area %	Area
CS2	8.25	4.2371	409560.50
IS #1	17.00	7.3181	707378.40
I.S. #2	30.96	6.3844	617126.30
90	45.58	0.1343	12979.48
	46.04	0.1582	15290.56
	46.48	0.2310	22328.49
	47.70	0.1436	13884.25
	48.62	0.1224	11834.19
	49.75	0.2128	20567.74
91	50.05	0.4477	43273.16
92	50.56	0.8786	84922.02
	51.21	0.2560	24745.56
	52.57	0.1112	10749.16
	52.98	1.0891	105273.60
	53.28	0.8393	81125.52
	53.33	0.7785	75254.13
	53.65	1.8088	174838.70
	53.74	0.5292	51152.43
	54.15	0.6789	65621.13
	54.20	0.3410	32963.82
	54.40	0.2273	21969.15
	54.50	0.7717	74597.18
	54.89	0.1869	18062.78
	55.04	0.1473	14237.99
	55.13	0.1862	18000.82
	55.26	0.4817	46556.99
	55.42	0.1827	17664.58
	55.50	0.2589	25030.25
	55.64	1.2182	117750.60
	55.74	0.5049	48800.98
	55.84	0.3784	36573.51
	56.00	0.5480	52973.41
	56.10	0.6448	62328.00
	56.22	0.9018	87166.49
	56.54	0.6324	61127.95
	56.63	0.6282	60718.39
	56.85	0.3606	34858.06
	56.93	1.1189	108157.10
	57.22	0.6848	66197.06
	57.36	0.4169	40296.61
	57.62	1.1039	106707.30
	57.88	0.3095	29916.41
	57.95	0.5471	52887.96
	58.11	0.2714	26233.54
	58.36	0.1026	9912.89
	58.48	0.6850	66214.77
	58.80	0.2645	25569.82
	58.90	0.3606	34854.95
	58.98	0.2021	19533.17
	59.18	0.3417	33032.70
	59.25	0.3807	36802.42
	59.36	0.6396	61824.61
	59.47	0.9194	88873.41
	59.59	0.7522	72708.40
	59.69	0.6625	64038.62

Peak Name	Ret. Time	Area %	Area
	59.85	0.3577	34572.33
	59.98	0.6475	62587.54
	60.25	0.1914	18504.45
	60.45	0.1718	16606.65
	60.57	0.2338	22596.95
	60.71	1.5506	149878.30
	60.89	0.4152	40135.56
	61.06	0.7647	73919.30
	61.34	0.8437	81550.63
	61.46	0.4932	47671.63
	61.66	0.5311	51341.54
	61.80	0.2492	24086.84
	61.88	0.2719	26283.27
	62.04	0.2086	20161.58
	62.15	0.3401	32872.09
	62.47	1.3981	135146.90
	62.56	1.4283	138059.20
	62.71	0.9286	89757.44
	62.83	0.8534	82487.69
	62.91	1.3889	134251.50
	63.06	0.7616	73617.32
	63.35	1.0758	103988.90
	63.54	0.3538	34200.43
	63.65	0.6428	62130.78
	63.77	0.4799	46388.71
	64.02	1.4110	136392.80
	64.16	1.7531	169459.00
	64.42	1.7089	165188.10
	64.52	1.3690	132329.60
IS #3	64.59	3.1312	302662.70
	64.68	1.0976	106091.70
	64.86	0.6640	64183.54
	65.00	0.5433	52515.81
	65.17	0.7420	71726.25
	65.38	0.6553	63340.45
	65.56	2.8135	271952.60
	65.83	0.8118	78472.84
	65.97	1.2273	118630.90
	66.09	0.4220	40788.85
	66.18	0.8122	78509.80
	66.29	0.5552	53669.08
	66.36	0.8295	80185.30
	66.55	0.6211	60032.60
	66.70	1.5014	145131.90
	66.91	0.5597	54104.56
	67.08	1.3315	128705.10
	67.24	0.7186	69461.62
	67.40	0.9887	95565.51
	67.50	0.8137	78653.18
	67.70	0.2044	19760.11
	67.85	0.6563	63434.21
	68.19	0.3231	31234.17
	68.36	0.1134	10963.99
	68.50	0.1972	19064.32
	68.60	0.4540	43884.32
	68.79	0.1358	13129.04
	68.87	0.4570	44172.27
	68.97	0.5017	48499.63
	69.06	0.4362	42163.04
	69.29	0.4942	47769.77
	69.42	0.5245	50699.63
	69.63	0.1869	18065.12
	69.80	0.5382	52021.29
	69.94	0.4665	45091.86
	70.06	0.1892	18289.31
	70.32	0.2975	28754.80
	70.50	0.1786	17262.49

Peak Name	Ret. Time	Area %	Area
	71.01	0.1658	16024.70
	71.39	0.1265	12223.32
	71.64	0.6130	59249.01
	71.79	0.3937	38056.63
	71.97	0.1528	14766.69
	72.25	0.5591	54047.03
	73.55	0.3273	31641.31
	73.93	0.3544	34256.45
	74.56	0.1561	15090.32
	76.16	0.0998	9645.83
	76.36	0.4730	45718.07
	76.64	0.1835	17736.64
	77.93	0.1673	16171.87
	78.88	0.2630	25425.72
	79.05	0.2475	23927.22
	82.25	0.2417	23367.19
	84.81	0.4842	46802.63
	88.14	0.1416	13687.09
	88.57	0.1080	10435.07

Total Area = 9666131 Total Height = 3395682 Total Amount = 0

ZymaX ID	21410-4
Sample ID	BA-81-7942

Evaporation

n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00

Waterwashing

Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	0.00
Aromatics / Naphthenes	0.00

Biodegradation

(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00

Octane rating

2,2,4,-Trimethylpentane / Methylcyclohexane	0.00

Relative percentages - Bulk hydrocarbon composition as PIANO

% Paraffinic	0.00
% Isoparaffinic	0.00
% Aromatic	100.00
% Naphthenic	0.00
% Olefinic	0.00

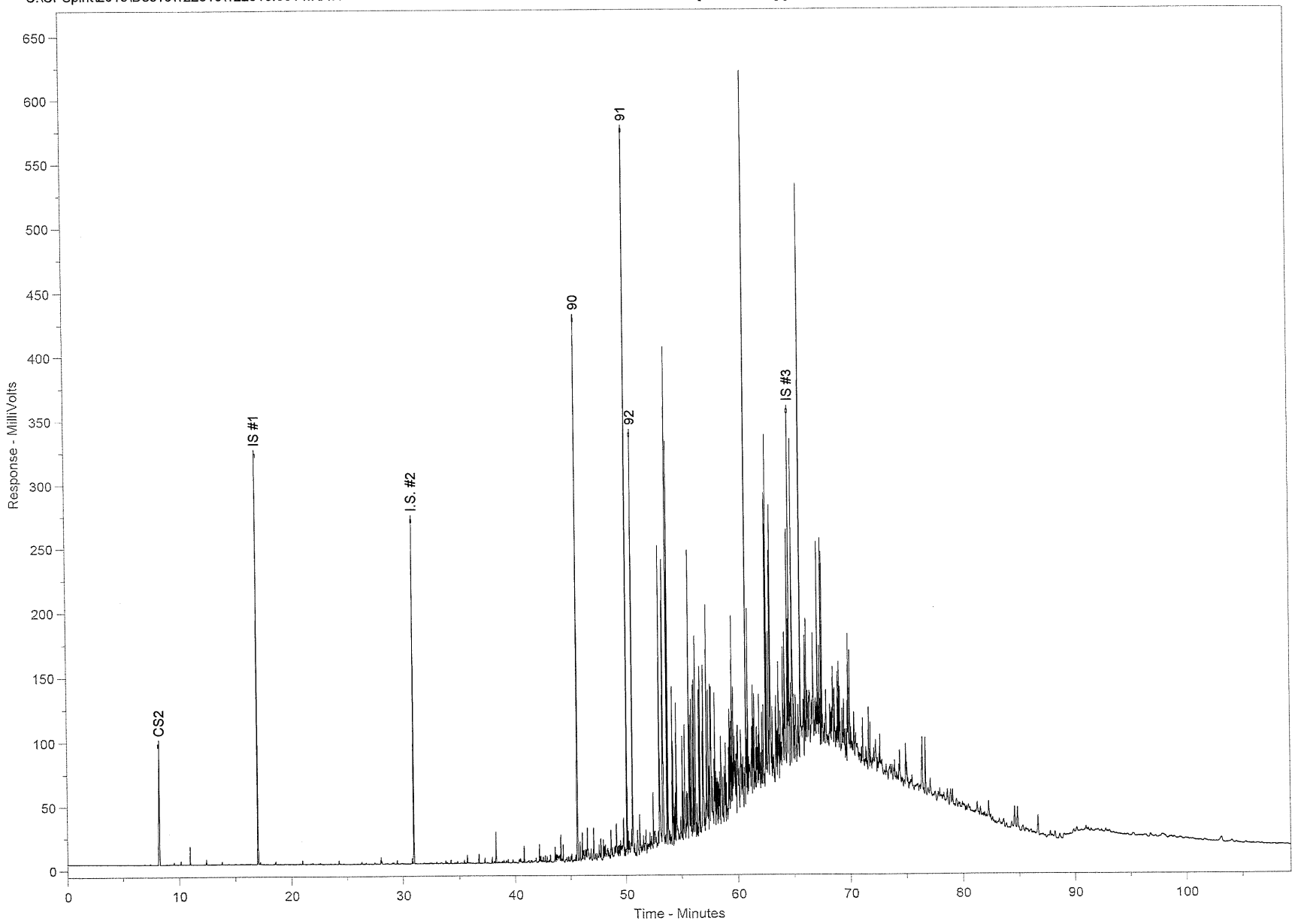
ZymaX ID		21410-4
Sample ID		BA-81-7942
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

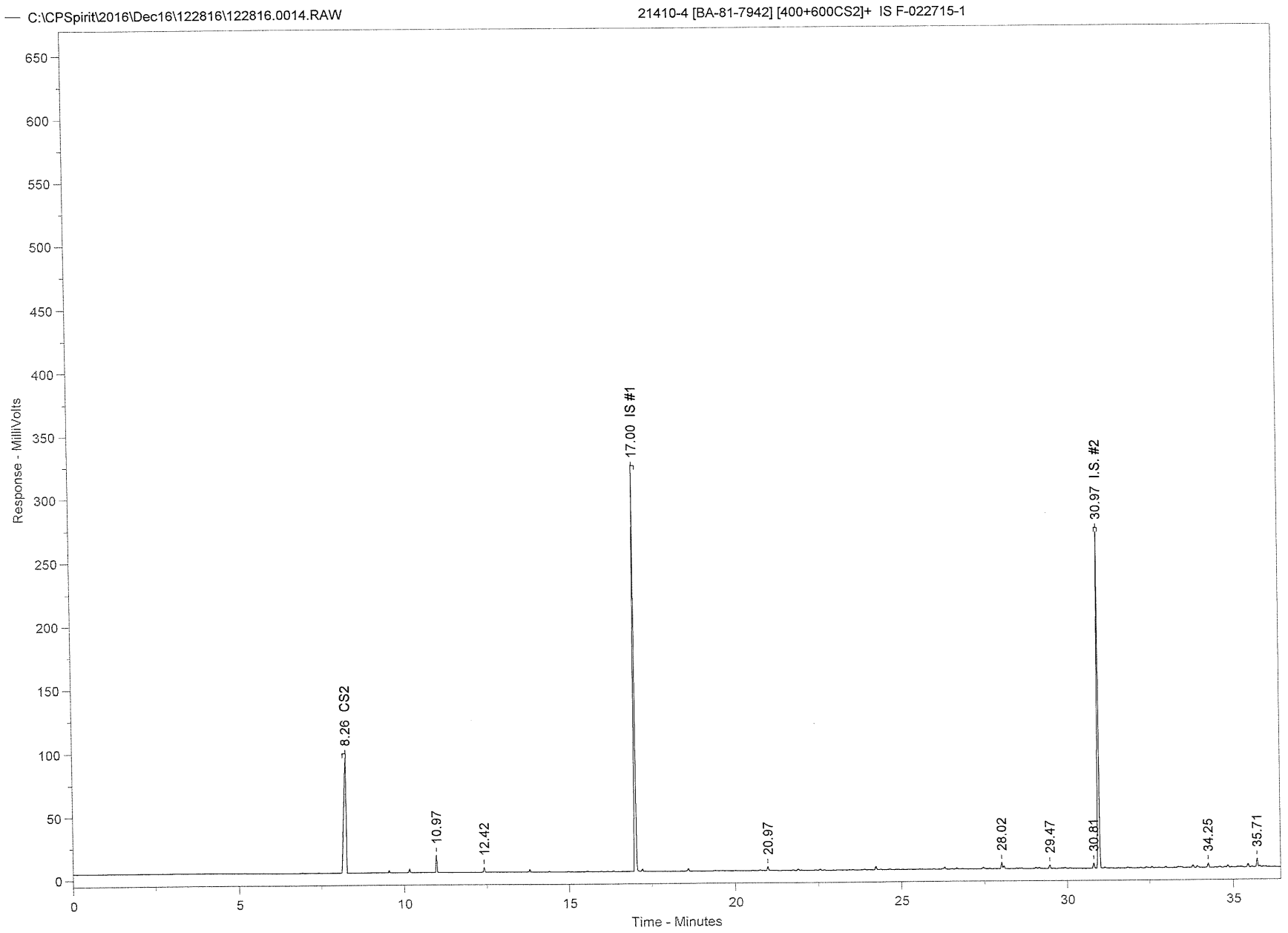
ZymaX ID		21410-4
Sample ID		BA-81-7942
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	0.00
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	0.00
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	0.00
70	3,3,4-Trimethylheptane	0.00

ZymaX ID		21410-4
Sample ID		BA-81-7942
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	0.00
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	0.00
77	1,2,3-Trimethylbenzene	0.00
78	Indan	0.00
79	1,3-Diethylbenzene	0.00
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	0.00
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	0.00
90	Naphthalene	36.62
91	2-Methyl-naphthalene	39.96
92	1-Methyl-naphthalene	23.42

C:\CPSpirit\2016\Dec16\122816\122816.0014.RAW

21410-4 [BA-81-7942] [400+600CS2]+ IS F-022715-1

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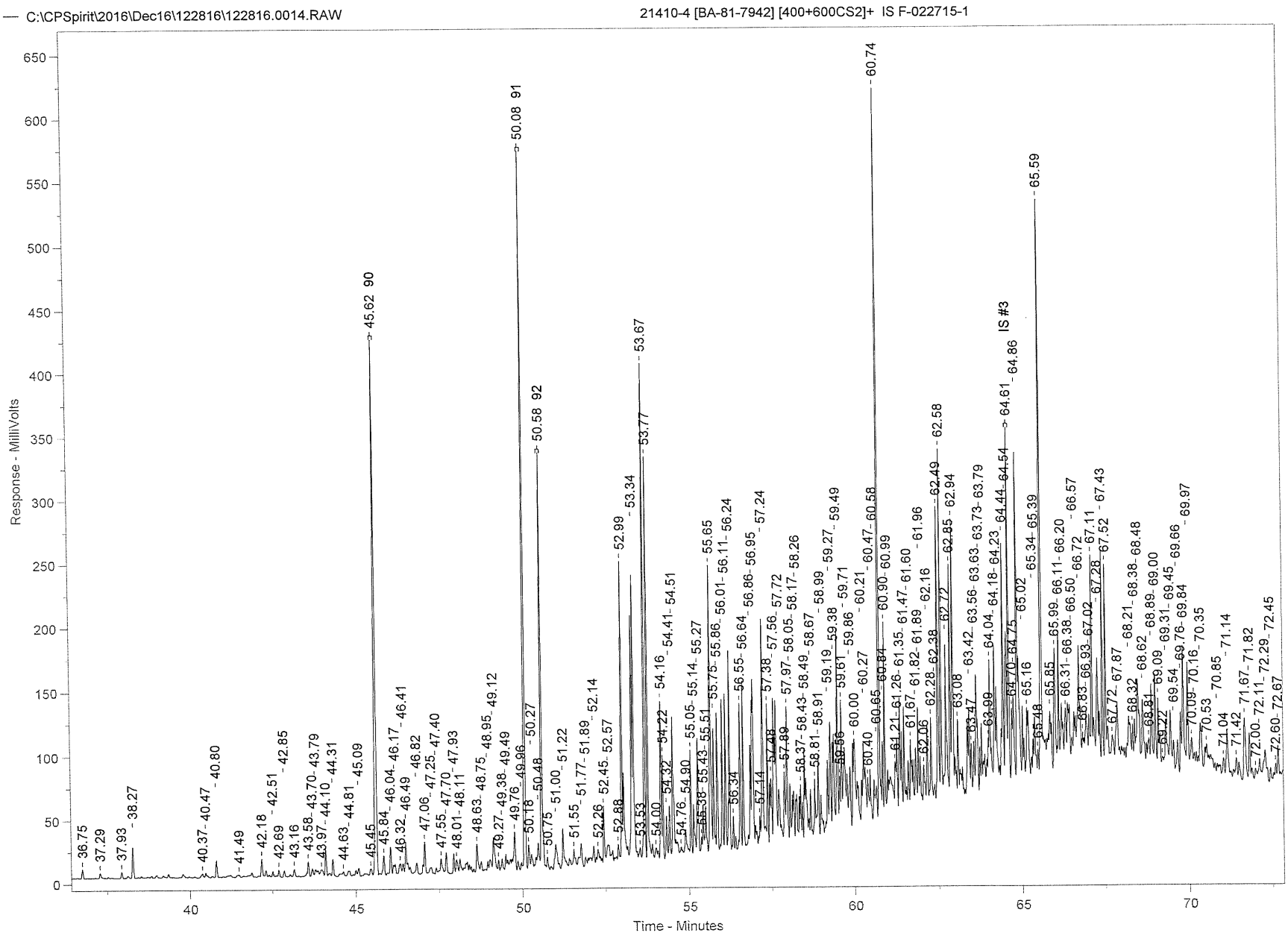
21410-4 [BA-81-7942] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
8.26 CS2
10.97
12.42
17.00 IS #1
20.97
28.02
29.47
30.81
30.97 I.S. #2
34.25
35.71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21410-4 [BA-81-7942] [400+600CS2]+ IS F-022715-1
Response - MilliVolts
Time - Minutes
IS #3

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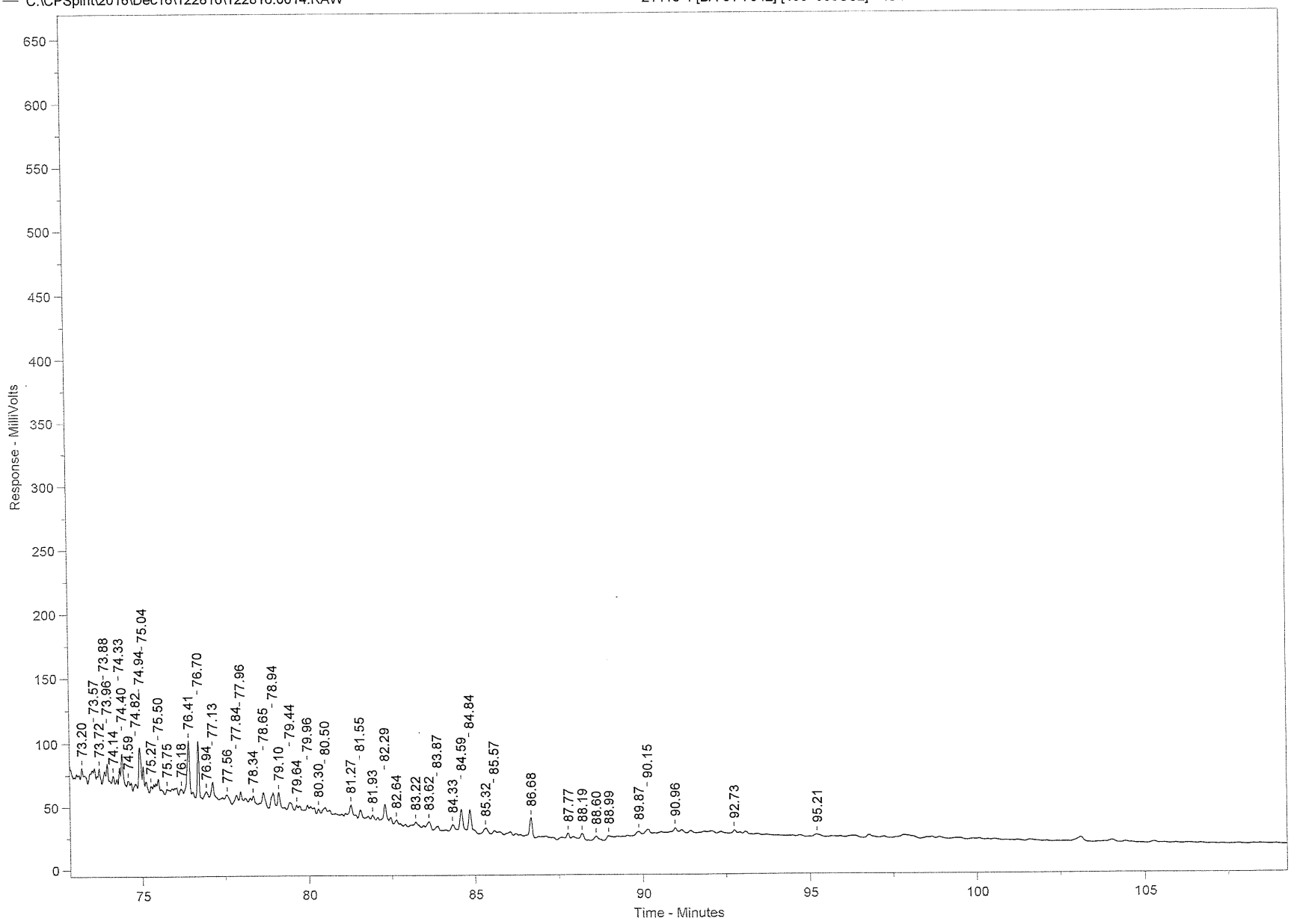
21410-4 [BA-81-7942] [400+600CS2]+ IS F-022715-1



Sample Name = **21410-4 [BA-81-7942] [400+600CS2]+ IS F-022715-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2016\Dec16\122816\122816.0014.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\121616.cal

Date Taken (end) = 12/31/2016 10:37:27 AM
Method Version = 44
Calibration Version = 2

Peak Name	Ret. Time	Area %	Area
CS2	8.26	0.9650	445624.70
	10.97	0.0617	28507.60
	12.42	0.0191	8823.06
IS #1	17.00	1.6782	774985.80
	20.97	0.0171	7893.47
	28.02	0.0230	10603.55
	29.47	0.0166	7673.49
	30.81	0.0245	11321.15
I.S. #2	30.97	1.4694	678560.70
	34.25	0.0203	9365.96
	35.71	0.0330	15250.12
	36.75	0.0423	19540.65
	37.29	0.0262	12096.07
	37.93	0.0280	12919.93
	38.27	0.1368	63183.51
	40.37	0.0299	13827.47
	40.47	0.0338	15588.26
	40.80	0.0782	36118.18
	41.49	0.0248	11438.57
	42.18	0.0783	36167.81
	42.51	0.0247	11421.41
	42.69	0.0330	15254.54
	42.85	0.0353	16313.15
	43.16	0.0448	20701.03
	43.58	0.0772	35627.35
	43.70	0.0420	19403.40
	43.79	0.0715	32999.38
	43.97	0.0588	27162.45
	44.10	0.1151	53137.49
	44.31	0.0791	36539.85
	44.63	0.0602	27821.45
	44.81	0.0503	23217.82
	45.09	0.0738	34079.01
	45.45	0.0407	18817.86
90	45.62	2.5919	1196906.00
	45.84	0.1015	46863.13
	46.04	0.1209	55817.81
	46.17	0.0772	35628.82
	46.32	0.0748	34519.39
	46.41	0.0489	22601.56
	46.49	0.1995	92127.41
	46.82	0.0737	34031.39
	47.06	0.1824	84233.21
	47.25	0.0692	31973.58
	47.40	0.0317	14634.75
	47.55	0.1027	47407.31
	47.70	0.1122	51808.85
	47.93	0.0761	35148.61
	48.01	0.0698	32229.42
	48.11	0.0609	28115.77
	48.63	0.1557	71899.90
	48.75	0.0508	23438.22
	48.95	0.0242	11161.43
	49.12	0.1785	82451.91
	49.27	0.0359	16557.62

Peak Name	Ret. Time	Area %	Area
	49.38	0.0618	28525.63
	49.49	0.0668	30853.55
	49.76	0.3317	153178.00
	49.96	0.0343	15857.64
91	50.08	2.8279	1305895.00
	50.18	0.1260	58165.23
	50.27	0.0986	45523.34
	50.48	0.2432	112311.90
92	50.58	1.6579	765616.40
	50.75	0.0569	26255.60
	51.00	0.2346	108327.40
	51.22	0.2595	119854.30
	51.55	0.1354	62538.48
	51.77	0.1942	89669.09
	51.89	0.0347	16044.24
	52.14	0.0711	32831.53
	52.26	0.0796	36748.15
	52.45	0.2102	97055.43
	52.57	0.1994	92101.37
	52.88	0.0891	41123.64
	52.99	1.5159	700025.90
	53.34	2.0417	942814.50
	53.53	0.0775	35797.65
	53.67	1.7897	826477.20
	53.77	1.4006	646801.60
	54.00	0.1043	48181.42
	54.16	0.6575	303623.40
	54.22	0.3185	147077.60
	54.32	0.1702	78593.05
	54.41	0.2113	97558.27
	54.51	0.7258	335168.70
	54.76	0.0716	33046.38
	54.90	0.2009	92760.97
	55.05	0.3553	164052.50
	55.14	0.2395	110583.80
	55.27	0.5264	243073.70
	55.38	0.0626	28912.12
	55.43	0.1760	81270.80
	55.51	0.2269	104785.60
	55.65	1.2967	598785.40
	55.75	0.4758	219740.50
	55.86	0.5488	253413.20
	56.01	0.5556	256586.80
	56.11	0.5530	255380.40
	56.24	0.7684	354832.90
	56.34	0.1035	47783.89
	56.55	0.5965	275446.20
	56.64	0.5493	253638.90
	56.86	0.4377	202110.40
	56.95	1.1013	508564.10
	57.14	0.1162	53665.06
	57.24	1.0094	466140.50
	57.38	0.4146	191447.30
	57.48	0.4777	220616.90
	57.56	1.3133	606458.20
	57.72	0.3862	178326.70
	57.89	0.3153	145582.30
	57.97	0.5534	255535.50
	58.05	0.1755	81058.13
	58.17	0.3261	150575.70
	58.26	0.2652	122450.40
	58.37	0.2773	128040.20
	58.43	0.1023	47247.88
	58.49	0.6552	302559.00
	58.67	0.1763	81422.42
	58.81	0.2598	119970.40
	58.91	0.3046	140677.50

Peak Name	Ret. Time	Area %	Area
	58.99	0.1989	91854.21
	59.19	0.3098	143053.30
	59.27	0.5199	240063.70
	59.38	0.6152	284078.00
	59.49	0.8036	371103.30
	59.56	0.2280	105297.40
	59.61	0.4298	198496.90
	59.71	0.8092	373662.80
	59.86	0.3300	152400.60
	60.00	1.0811	499241.00
	60.21	0.1516	70015.13
	60.27	0.6290	290452.80
	60.40	0.2172	100283.70
	60.47	0.2122	97993.20
	60.58	0.1459	67375.29
	60.65	0.1780	82195.66
	60.74	2.5100	1159110.00
	60.84	0.2491	115051.40
	60.90	0.6134	283242.30
	60.99	0.6948	320872.60
	61.21	0.2684	123939.20
	61.26	0.2402	110916.90
	61.35	0.7601	351017.20
	61.47	0.4764	219988.20
	61.60	0.2002	92438.63
	61.67	0.5386	248729.80
	61.82	0.2943	135923.60
	61.89	0.3317	153192.20
	61.96	0.2143	98958.03
	62.06	0.2453	113295.30
	62.16	0.3588	165713.30
	62.28	0.4113	189942.20
	62.38	0.0962	44446.65
	62.49	1.1745	542357.40
	62.58	1.1315	522500.40
	62.72	0.8622	398165.20
	62.85	0.7815	360891.60
	62.94	1.3408	619148.50
	63.08	0.5358	247431.10
	63.42	0.6029	278431.90
	63.47	0.1600	73881.23
	63.56	0.2266	104659.30
	63.63	0.6402	295650.80
	63.73	0.1314	60673.33
	63.79	0.3251	150121.50
	63.99	0.2731	126099.80
	64.04	0.6383	294781.20
	64.18	0.6232	287800.80
	64.23	0.4376	202060.00
	64.44	1.0919	504211.60
	64.54	0.9316	430196.90
IS #3	64.61	1.1463	529337.80
	64.70	0.2879	132955.70
	64.75	0.4106	189596.30
	64.86	1.7990	830769.30
	65.02	0.3813	176080.40
	65.16	0.5404	249549.20
	65.34	0.1987	91758.55
	65.39	0.3039	140344.80
	65.48	0.0896	41376.13
	65.59	2.8468	1314609.00
	65.85	0.4217	194747.30
	65.99	0.7470	344968.60
	66.11	0.4467	206259.30
	66.20	0.4726	218231.50
	66.31	0.3584	165510.40
	66.38	0.5717	264016.00

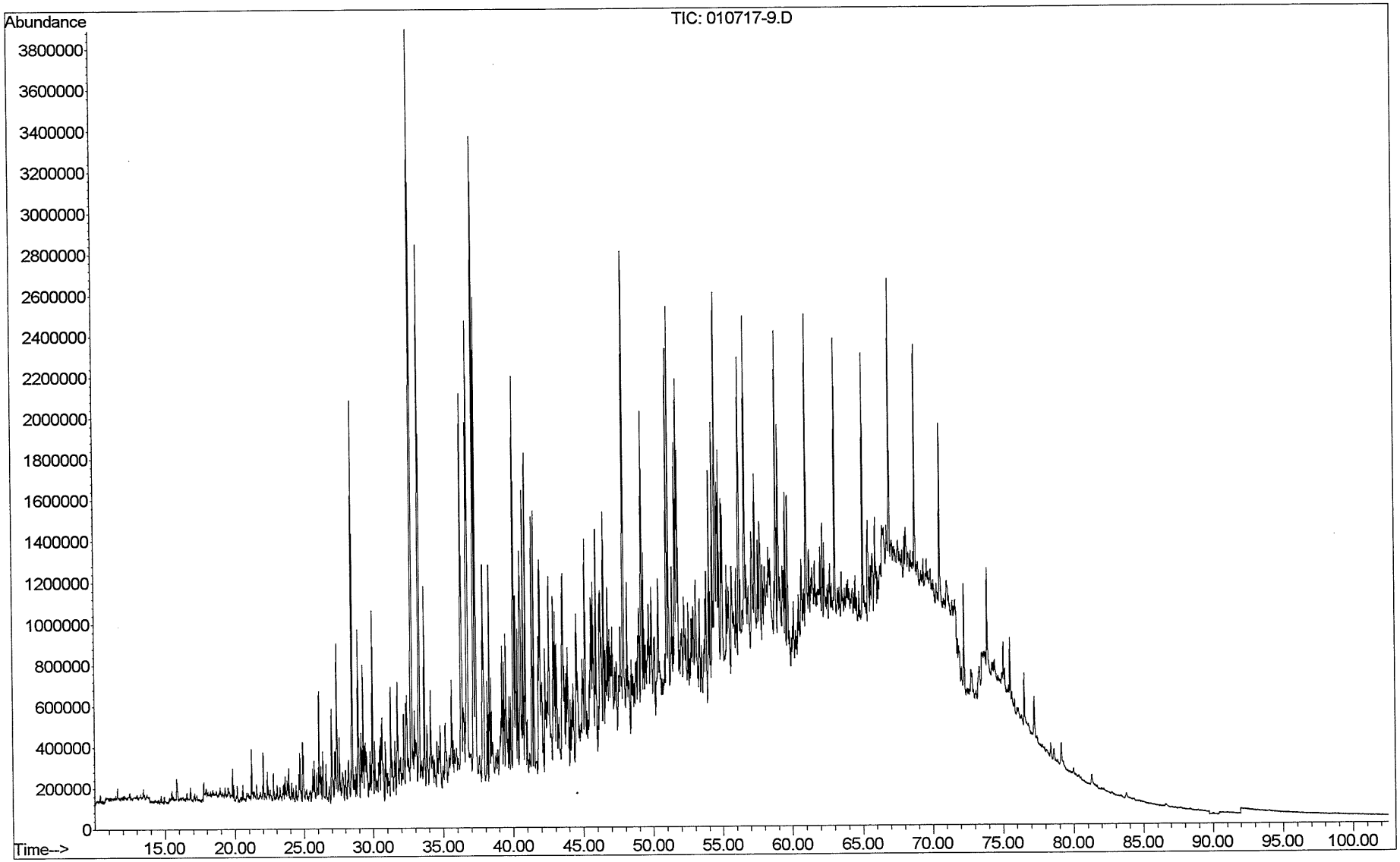
Peak Name	Ret. Time	Area %	Area
	66.50	0.1430	66015.73
	66.57	0.3887	179516.00
	66.72	0.9039	417416.50
	66.83	0.1842	85071.55
	66.93	0.3638	167978.00
	67.02	0.2341	108110.50
	67.11	0.8866	409433.60
	67.28	0.7184	331733.70
	67.43	0.6758	312096.10
	67.52	0.5765	266208.20
	67.72	0.1260	58183.64
	67.87	0.3712	171395.50
	68.21	0.3881	179222.80
	68.32	0.1247	57587.01
	68.38	0.2150	99264.55
	68.48	0.5887	271846.30
	68.62	0.4070	187936.90
	68.81	0.1551	71623.27
	68.89	0.3906	180359.00
	69.00	0.3856	178064.80
	69.09	0.2674	123480.70
	69.22	0.0749	34596.44
	69.31	0.3619	167117.20
	69.45	0.3530	163005.90
	69.54	0.1377	63585.19
	69.66	0.1702	78593.19
	69.76	0.2461	113660.40
	69.84	0.6374	294359.20
	69.97	0.5212	240674.20
	70.09	0.1585	73172.82
	70.16	0.0362	16718.68
	70.35	0.2565	118469.10
	70.53	0.1209	55847.28
	70.85	0.0880	40644.89
	71.04	0.0873	40299.45
	71.14	0.3189	147261.70
	71.42	0.0738	34100.66
	71.67	0.4235	195552.90
	71.82	0.2333	107757.80
	72.00	0.0828	38226.29
	72.11	0.1905	87976.40
	72.29	0.3466	160048.20
	72.45	0.0630	29109.94
	72.60	0.0609	28140.61
	72.67	0.1428	65933.15
	73.20	0.0455	21024.49
	73.57	0.2513	116059.10
	73.72	0.1268	58558.31
	73.88	0.1000	46176.22
	73.96	0.1470	67867.37
	74.14	0.0645	29763.05
	74.33	0.0860	39734.18
	74.40	0.2188	101041.90
	74.59	0.0293	13551.81
	74.82	0.0529	24442.07
	74.94	0.3135	144753.50
	75.04	0.0874	40358.92
	75.27	0.0238	11011.90
	75.50	0.0428	19774.46
	75.75	0.0335	15474.61
	76.18	0.0684	31565.54
	76.41	0.5199	240093.60
	76.70	0.3441	158883.20
	76.94	0.1070	49420.21
	77.13	0.2290	105772.00
	77.56	0.1272	58739.80
	77.84	0.0821	37893.63

Peak Name	Ret. Time	Area %	Area
	77.96	0.0676	31223.31
	78.34	0.0377	17428.75
	78.65	0.1251	57766.43
	78.94	0.1929	89094.70
	79.10	0.1579	72938.83
	79.44	0.0907	41865.11
	79.64	0.0186	8582.41
	79.96	0.0240	11083.01
	80.30	0.0306	14124.42
	80.50	0.0519	23966.92
	81.27	0.0928	42867.29
	81.55	0.0906	41826.81
	81.93	0.0377	17407.26
	82.29	0.1439	66461.01
	82.64	0.0357	16475.94
	83.22	0.0475	21948.39
	83.62	0.0862	39803.21
	83.87	0.0440	20318.63
	84.33	0.0972	44872.59
	84.59	0.2680	123779.30
	84.84	0.2802	129382.80
	85.32	0.0798	36872.90
	85.57	0.0856	39551.93
	86.68	0.1727	79767.02
	87.77	0.0436	20120.35
	88.19	0.0692	31956.87
	88.60	0.0672	31043.63
	88.99	0.0605	27959.71
	89.87	0.0600	27710.02
	90.15	0.0706	32592.79
	90.96	0.0376	17357.91
	92.73	0.0489	22565.90
	95.21	0.0580	26761.86

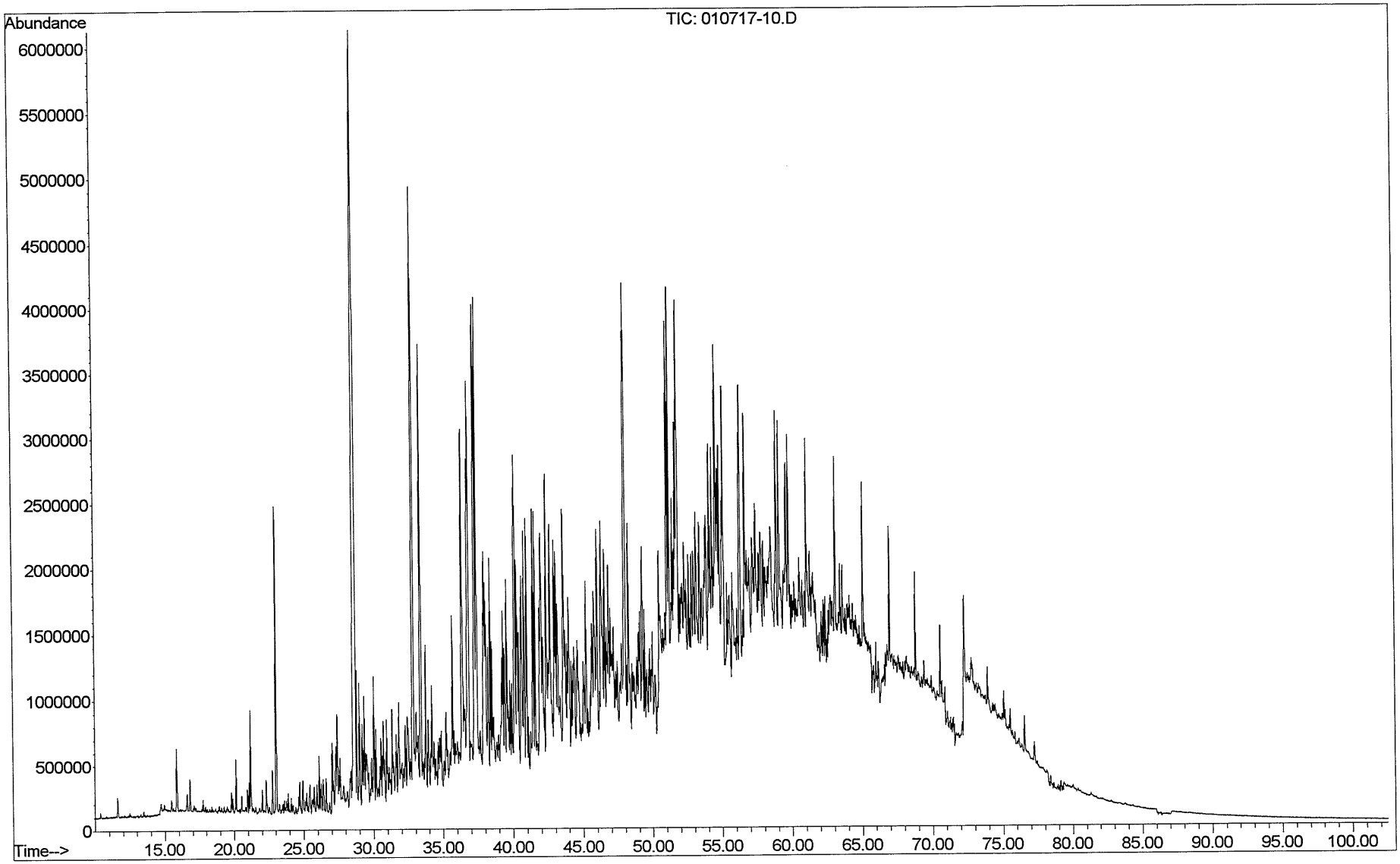
Total Area = 4.617903E+07 Total Height = 1.57965E+07 Total Amount = 0

Full Scan Analyses

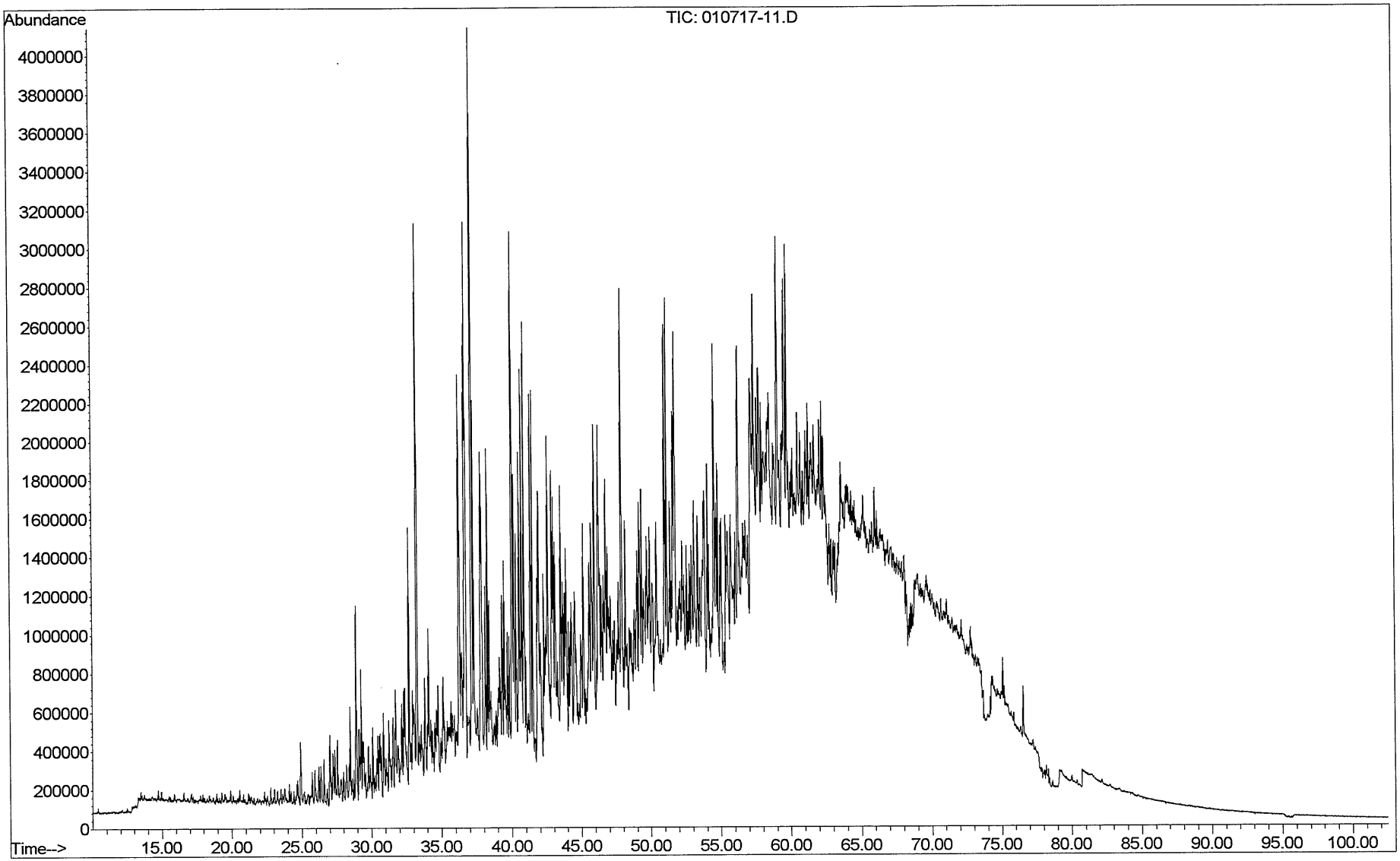
Sample Name: B18-045-PZ (21410-1)
Misc Info :



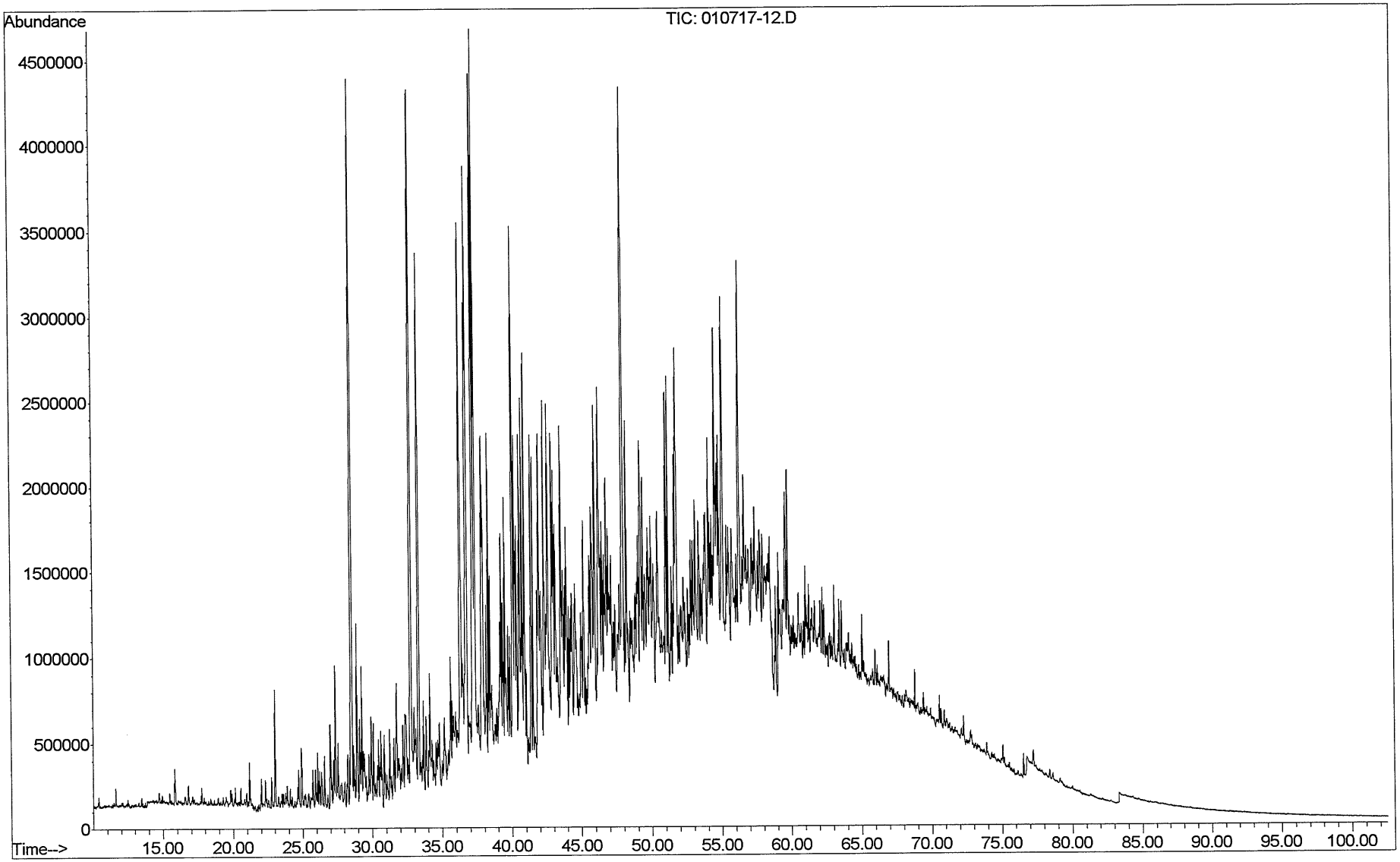
Sample Name: BA-81-7941 (21410-2)
Misc Info :



Sample Name: BA-81-7944 (21410-3)
Misc Info :



Sample Name: BA-81-7942 (21410-4)
Misc Info :

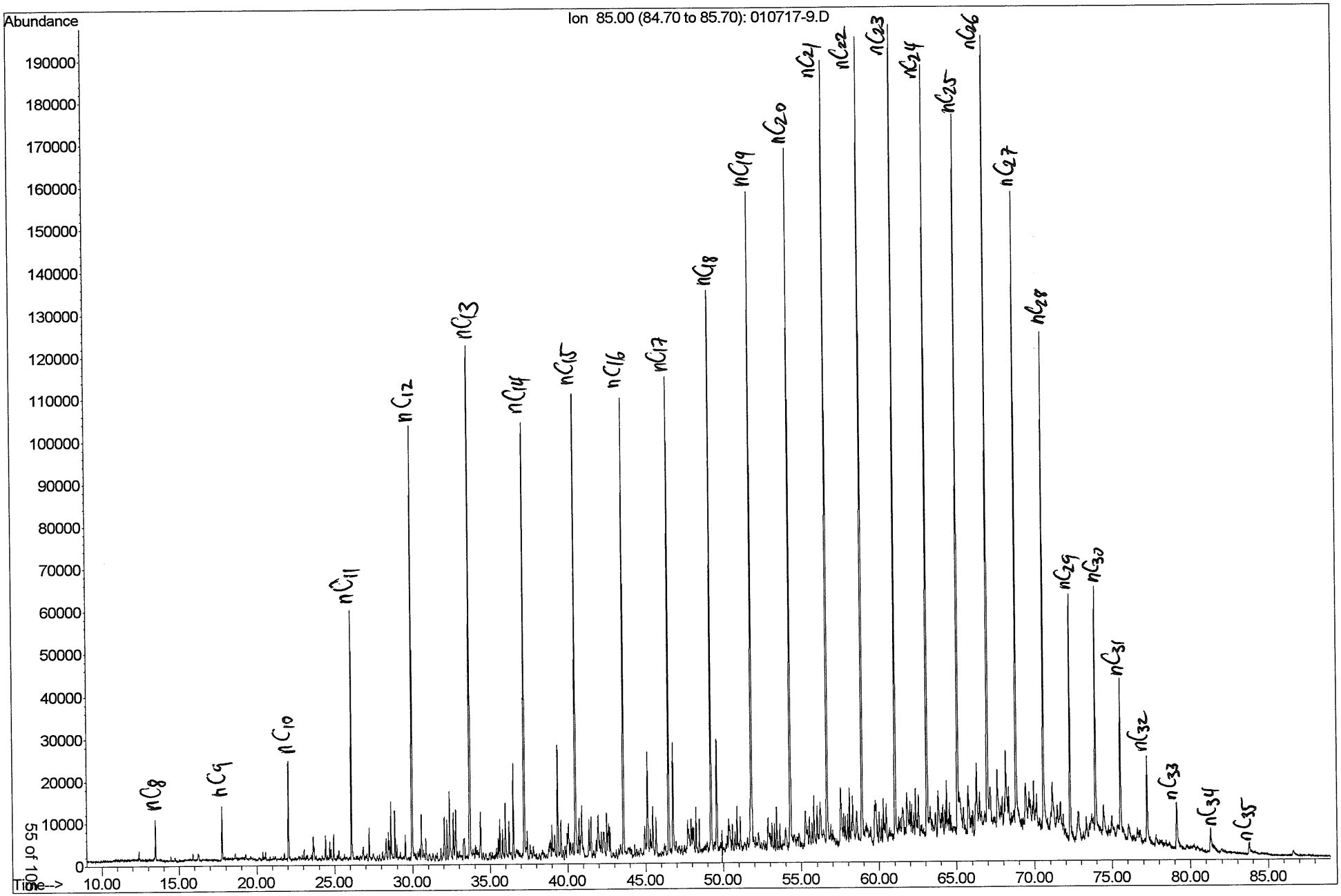


Table

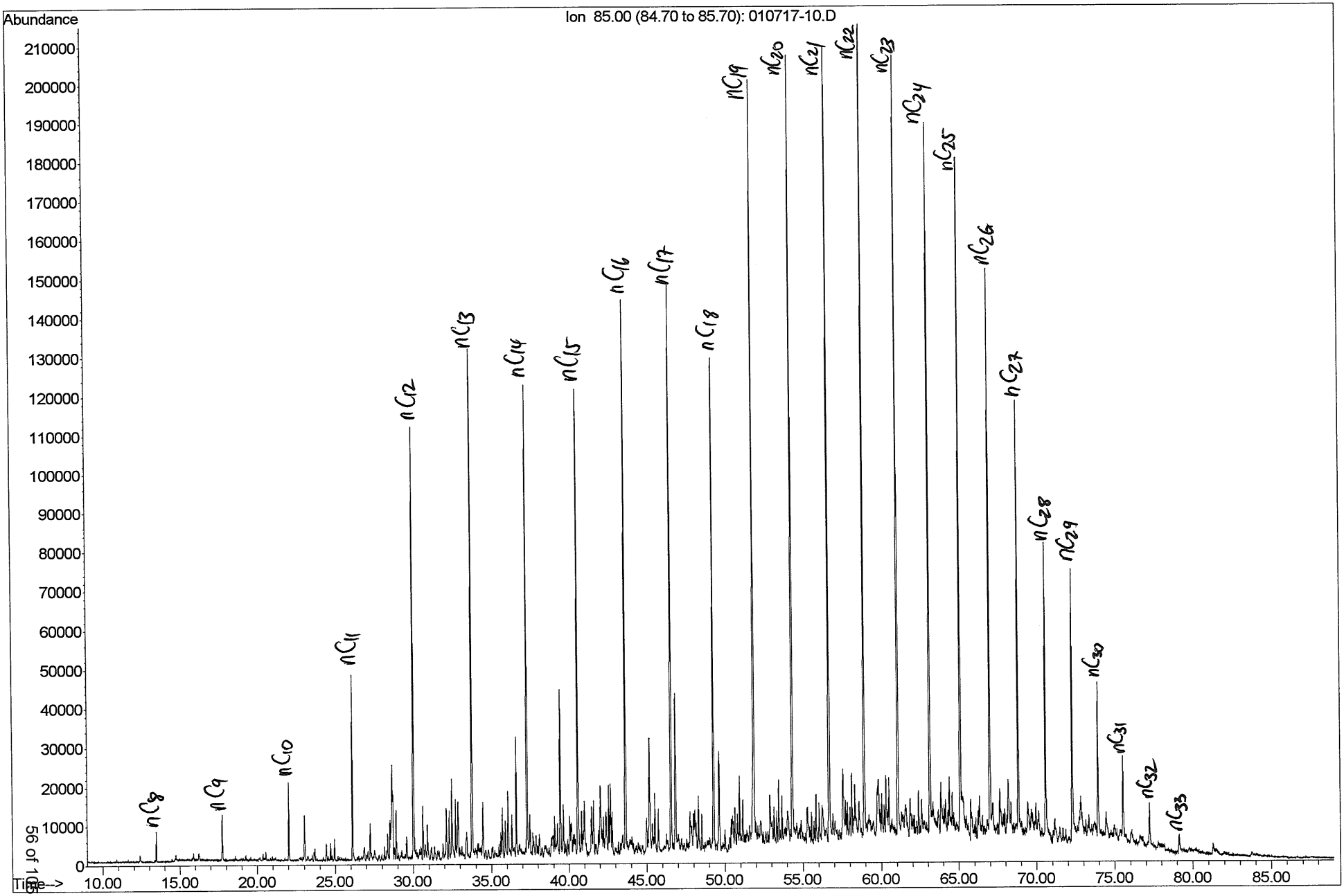
Key to Chromatogram Symbol Identification for m/z 85 and m/z 113 Paraffins and Isoparaffins

Symbol	Detail
i-10	Iso-alkane with 10 carbon atoms
i-15	Farnesane (isoprenoid with 15 carbon atoms)
i-16	Isoprenoid with 16 carbon atoms
Pr	Pristane (isoprenoid with 19 carbon atoms)
Ph	Phytane (isoprenoid with 20 carbon atoms)
nC_8	n-C_8 normal alkane
nC_{15}	n-C_{15} normal alkane
i-8	2,5-(2,4)-Dimethylhexane
i-8'	2,3,4-Trimethylpentane
i-8"	2,3-Dimethylhexane
CH-*n*	Alkylcyclohexane (where *n* indicates number of carbon atoms in the side chain)

B18-045-PZ (21410-1)



BA-81-7941 (21410-2)



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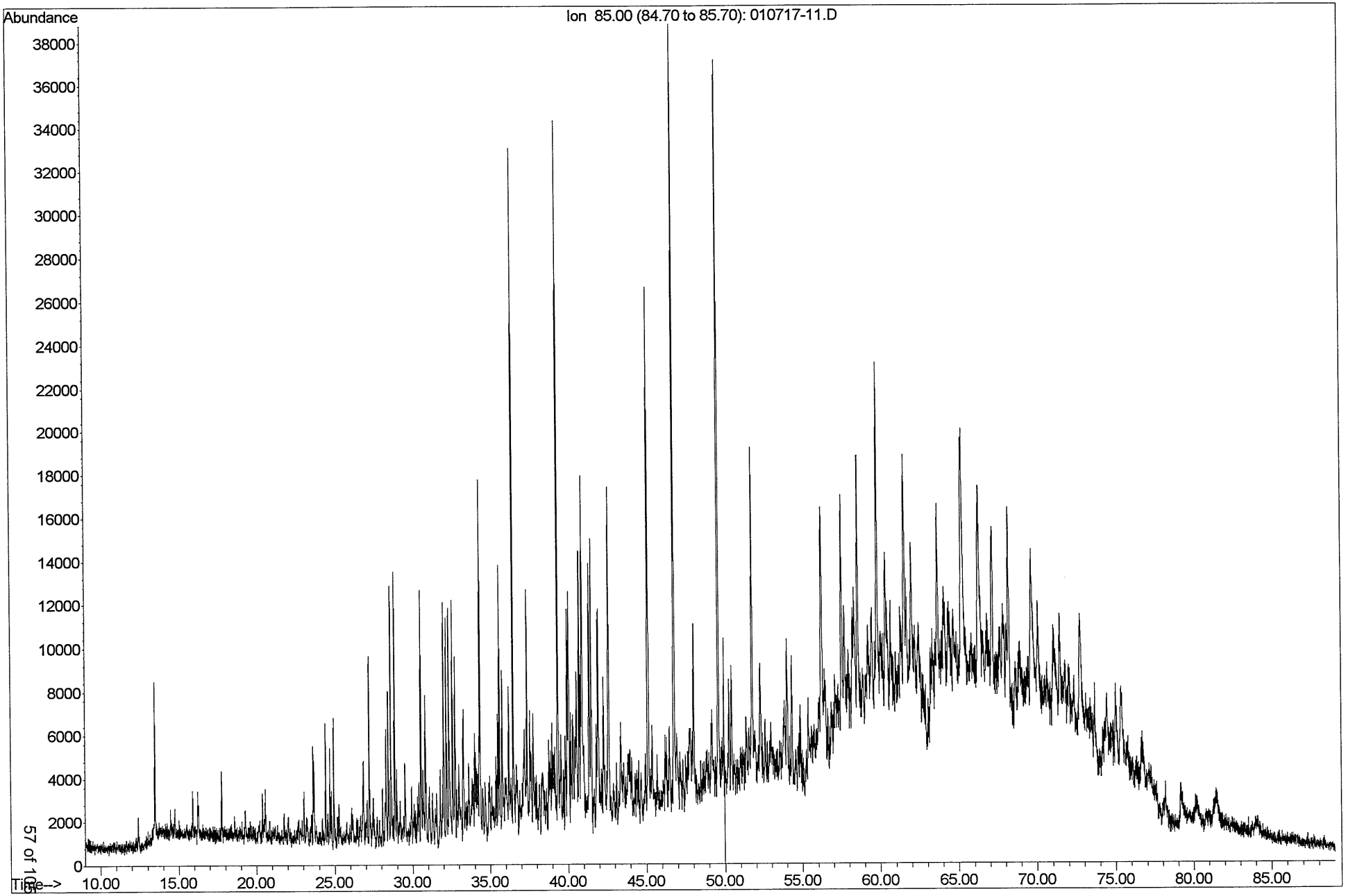

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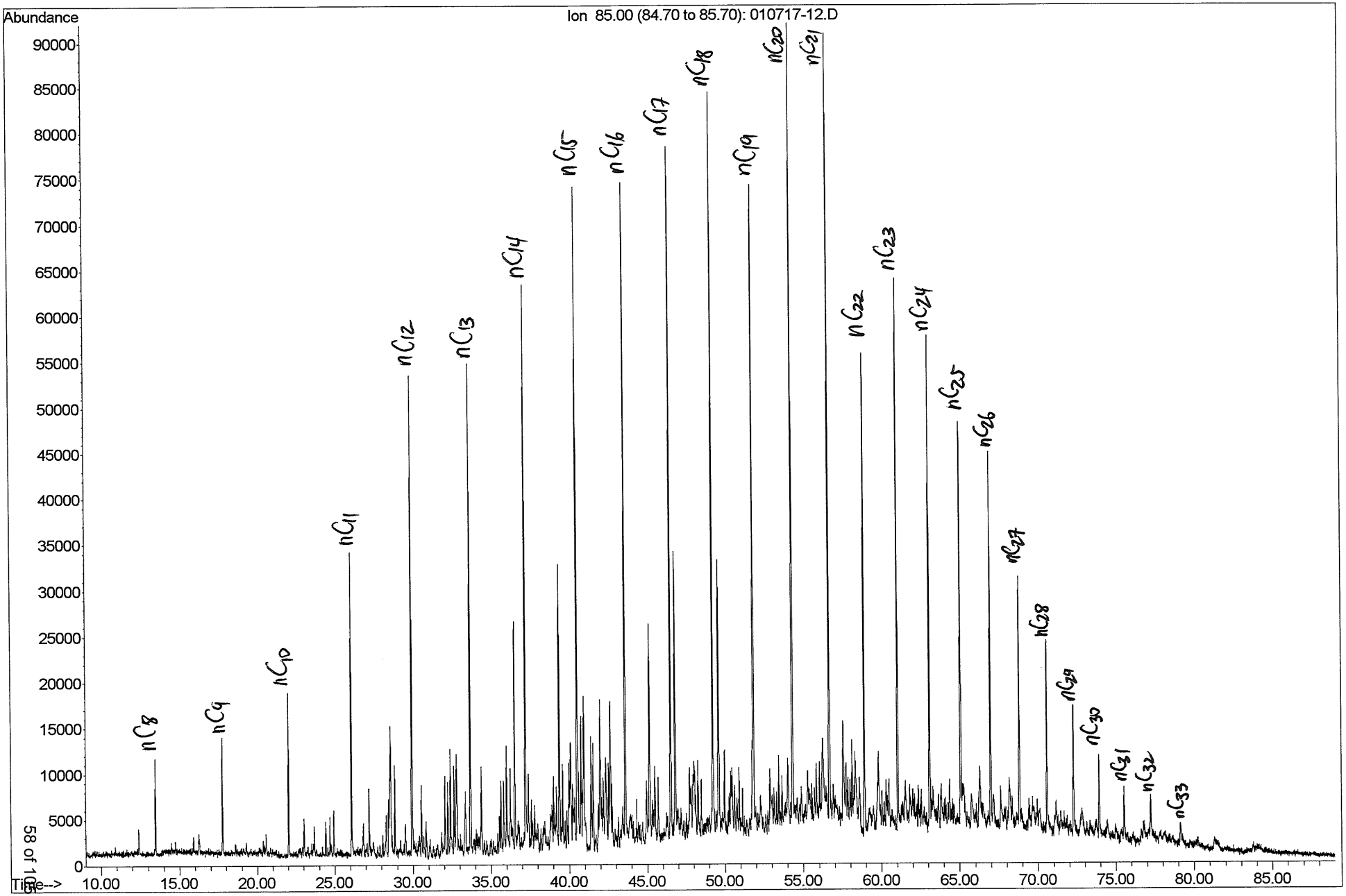

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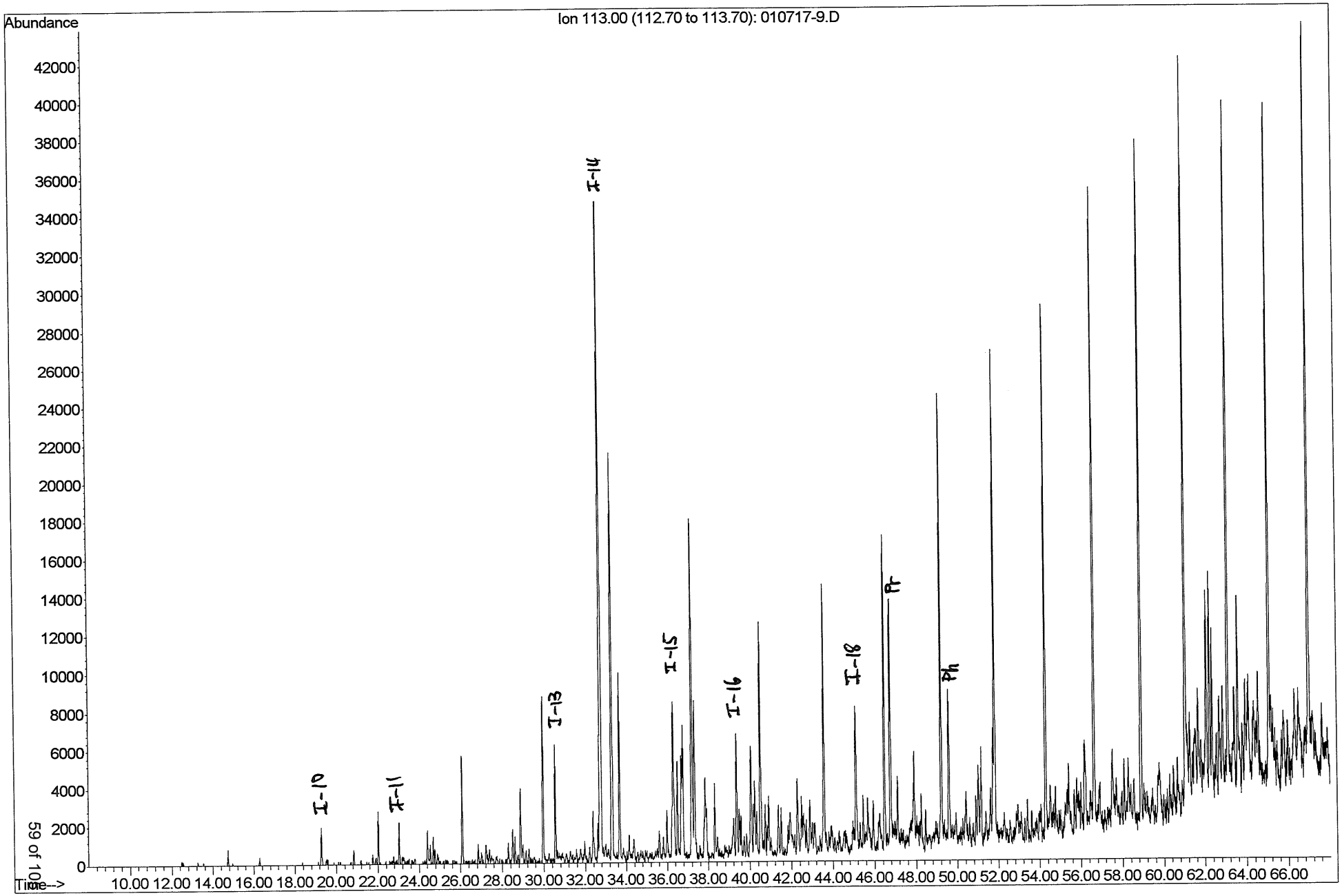

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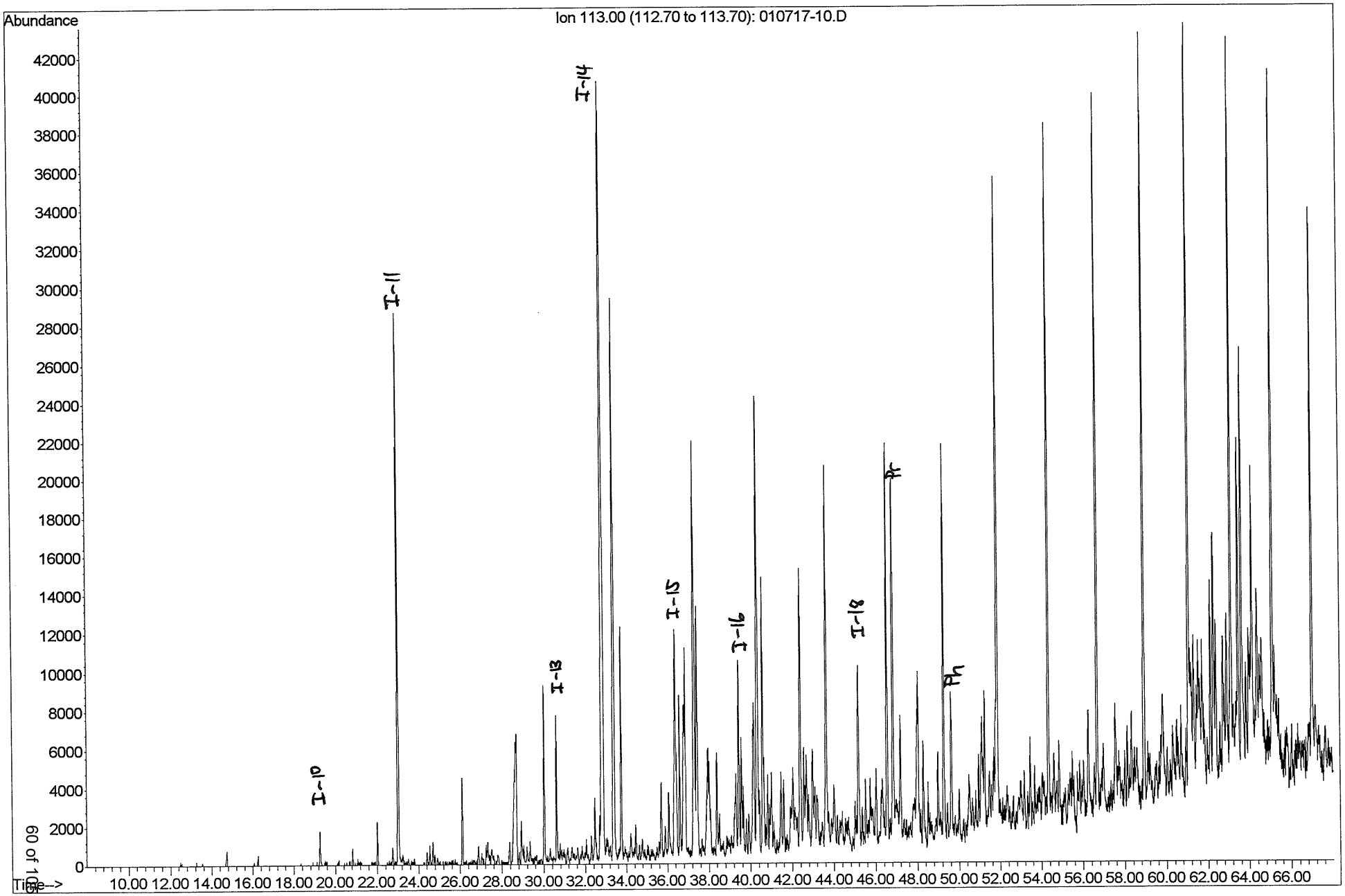

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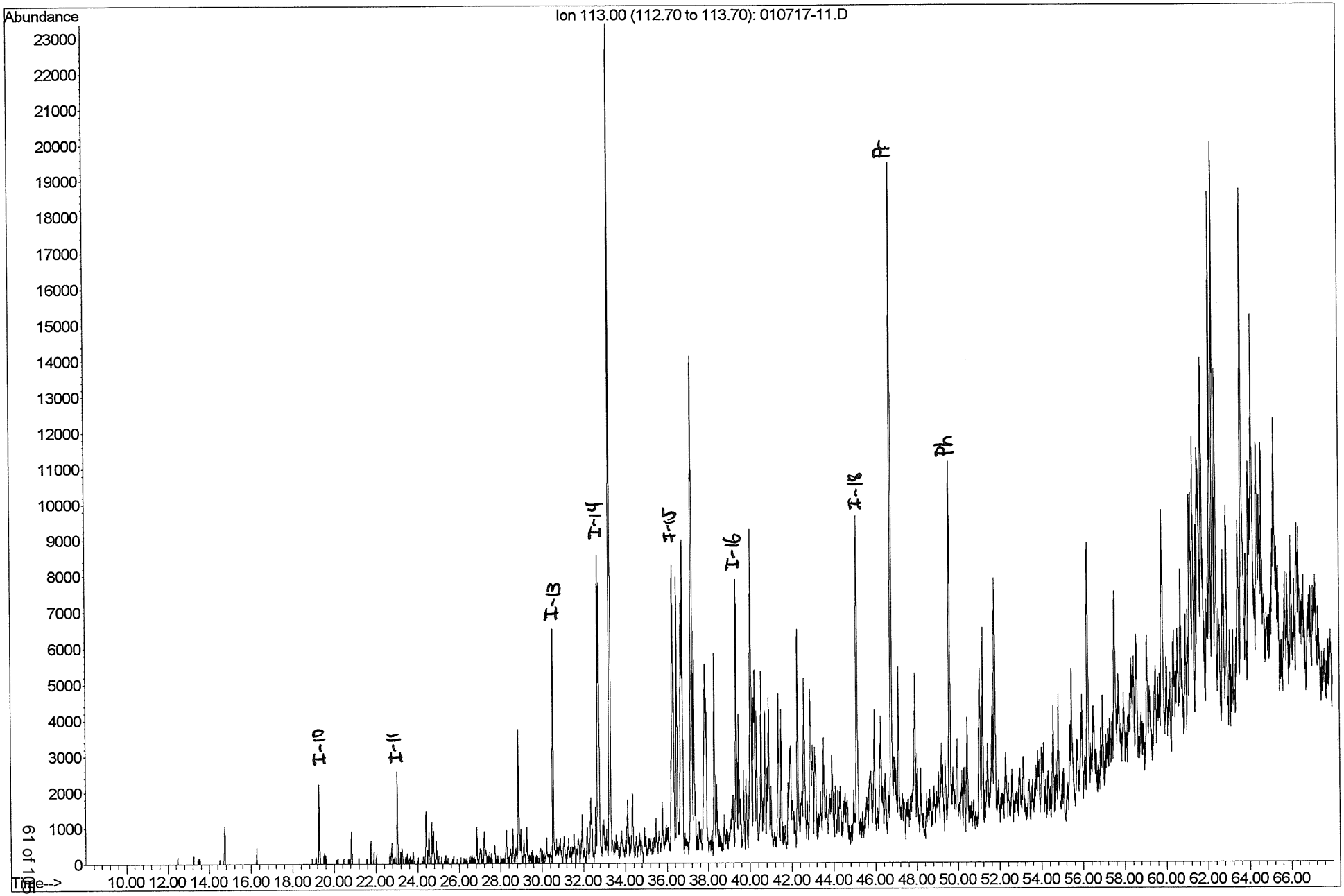

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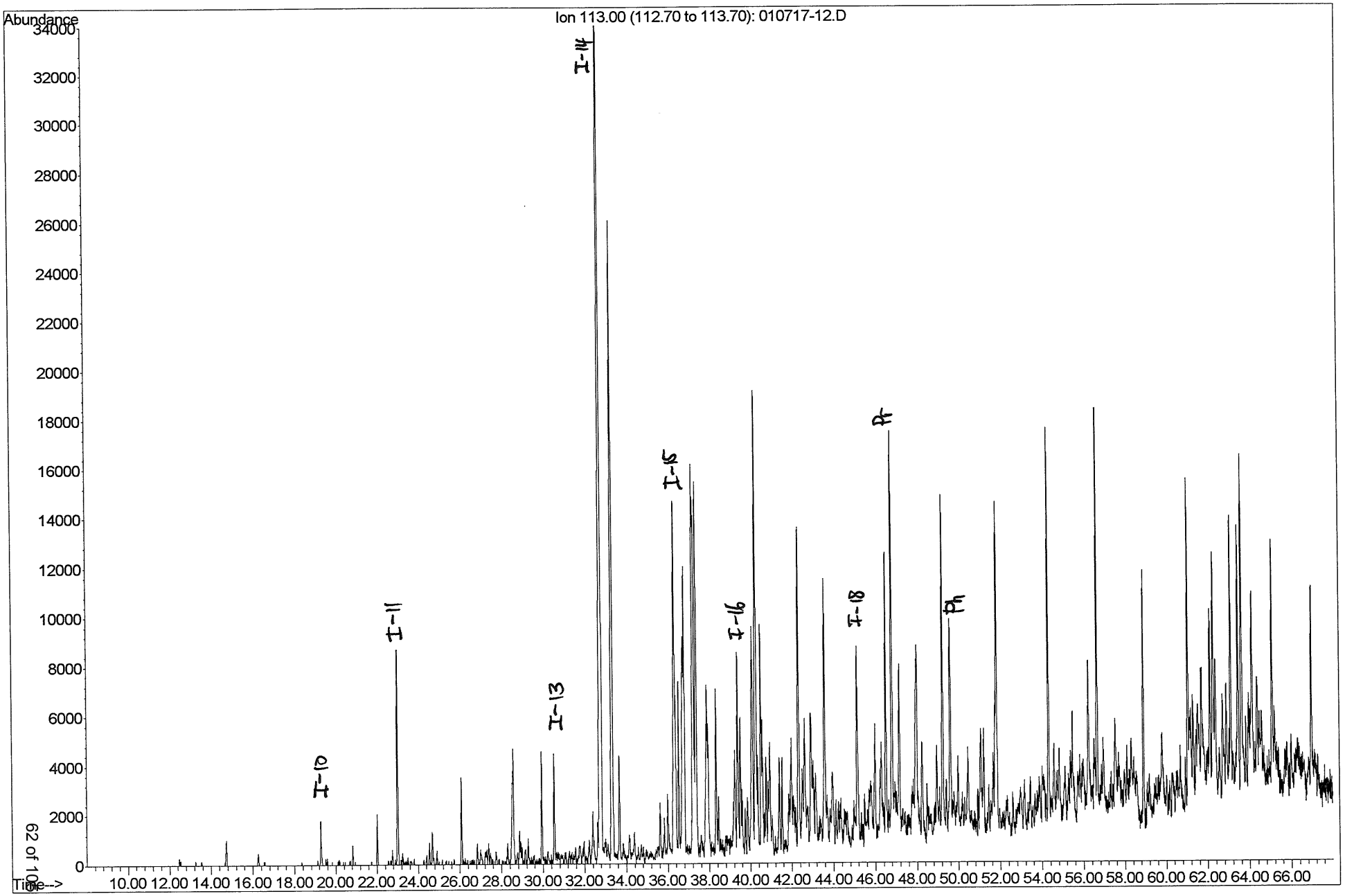
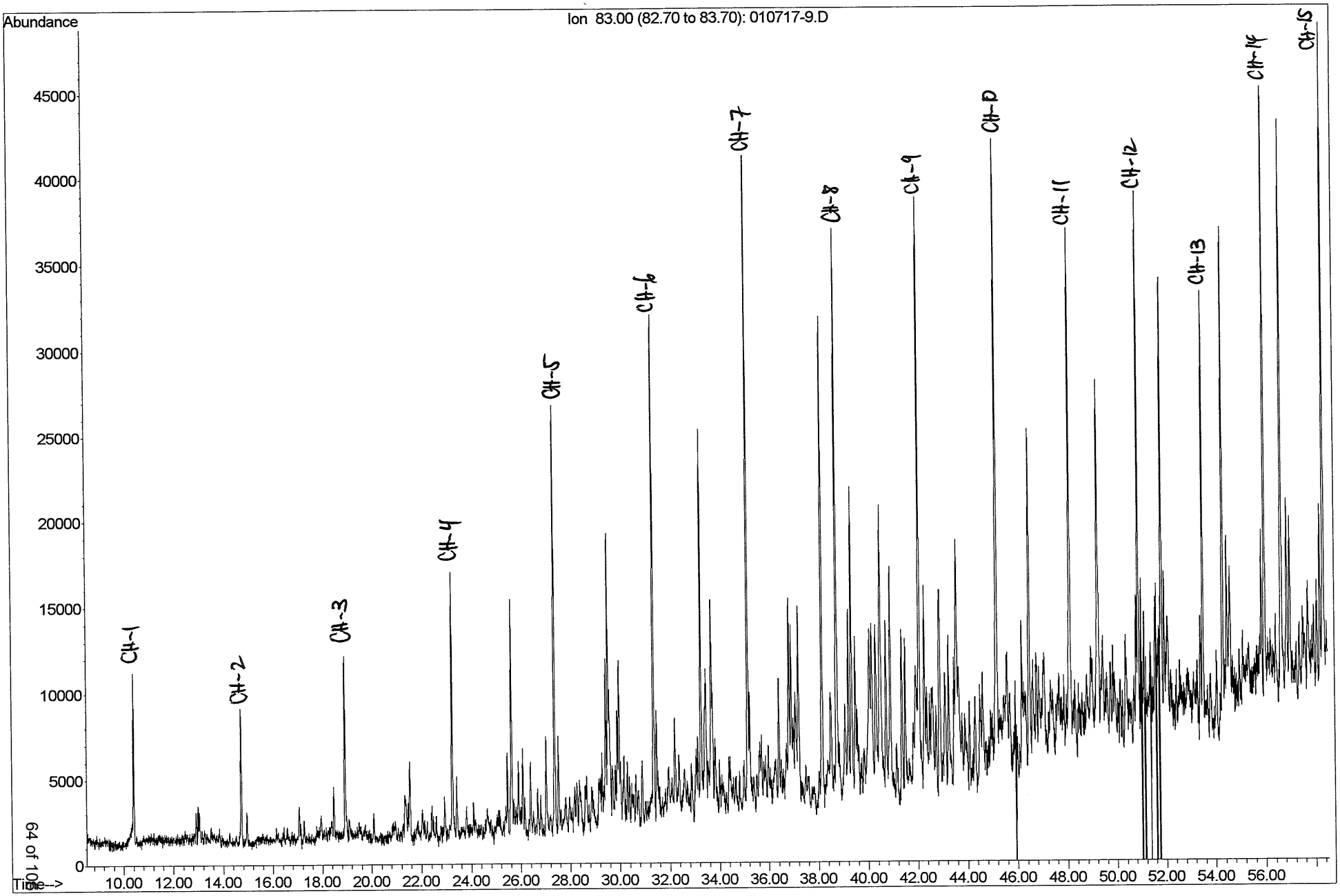


Table

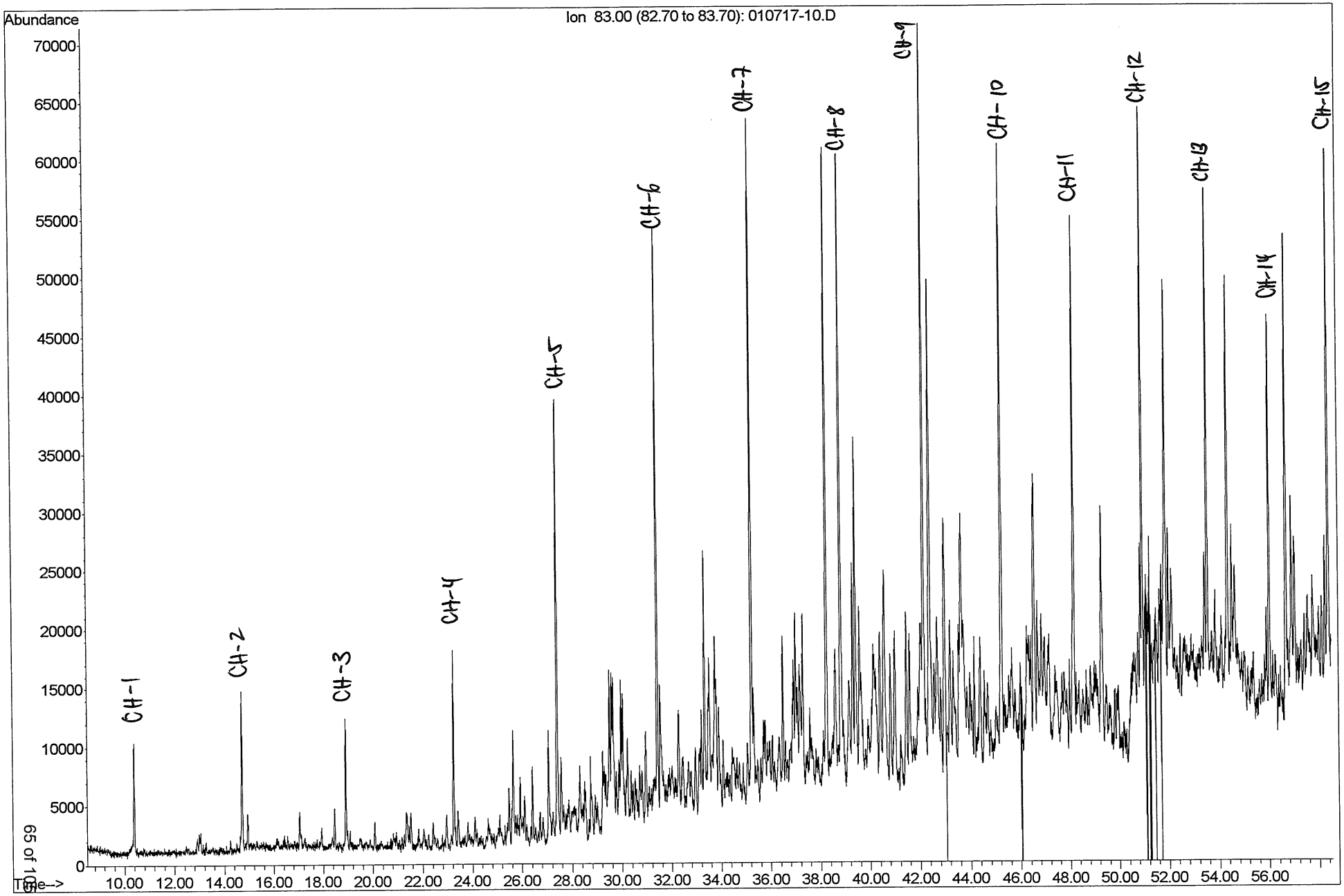
Key for Alkylcyclohexanes at m/z 83

Symbol	Detail
CH-1:	Methylcyclohexane
CH-2:	Ethylcyclohexane
CH-3:	Propylcylohexane
CH-4:	Butylcyclohexane
CH-5:	Pentylcyclohexane
CH-6:	Hexylcyclohexane
CH-7:	Heptylcyclohexane
CH-8:	Octylcyclohexane
CH-9:	Nonylcyclohexane
CH-10:	Decylcyclohexane
CH-11:	Undecylcyclohexane
CH-12:	Dodecylcyclohexane
CH-13:	Tridecylcyclohexane
CH-14:	Tetradecylcyclohexane

B18-045-PZ (21410-1)



BA-81-7941 (21410-2)



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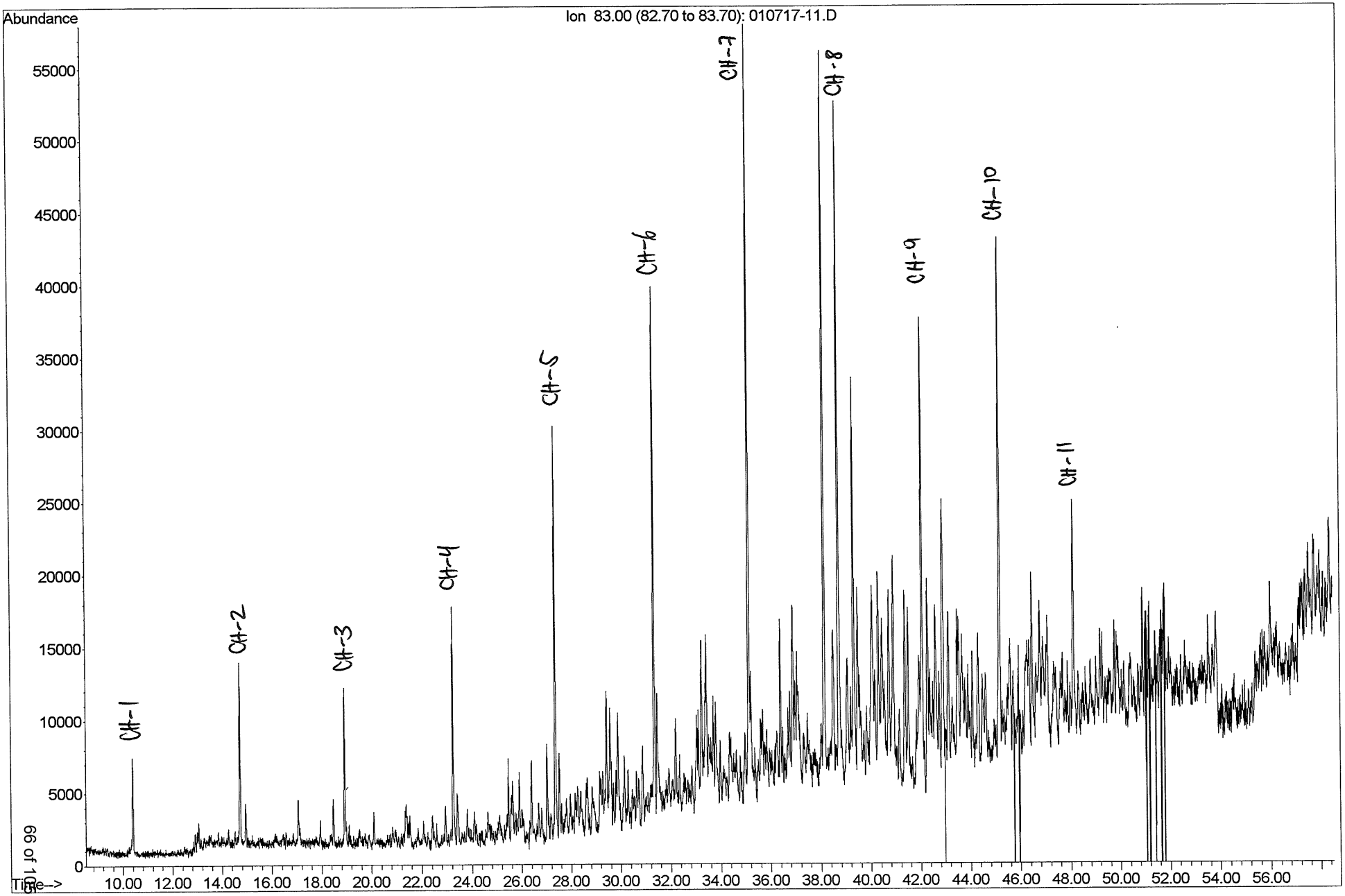
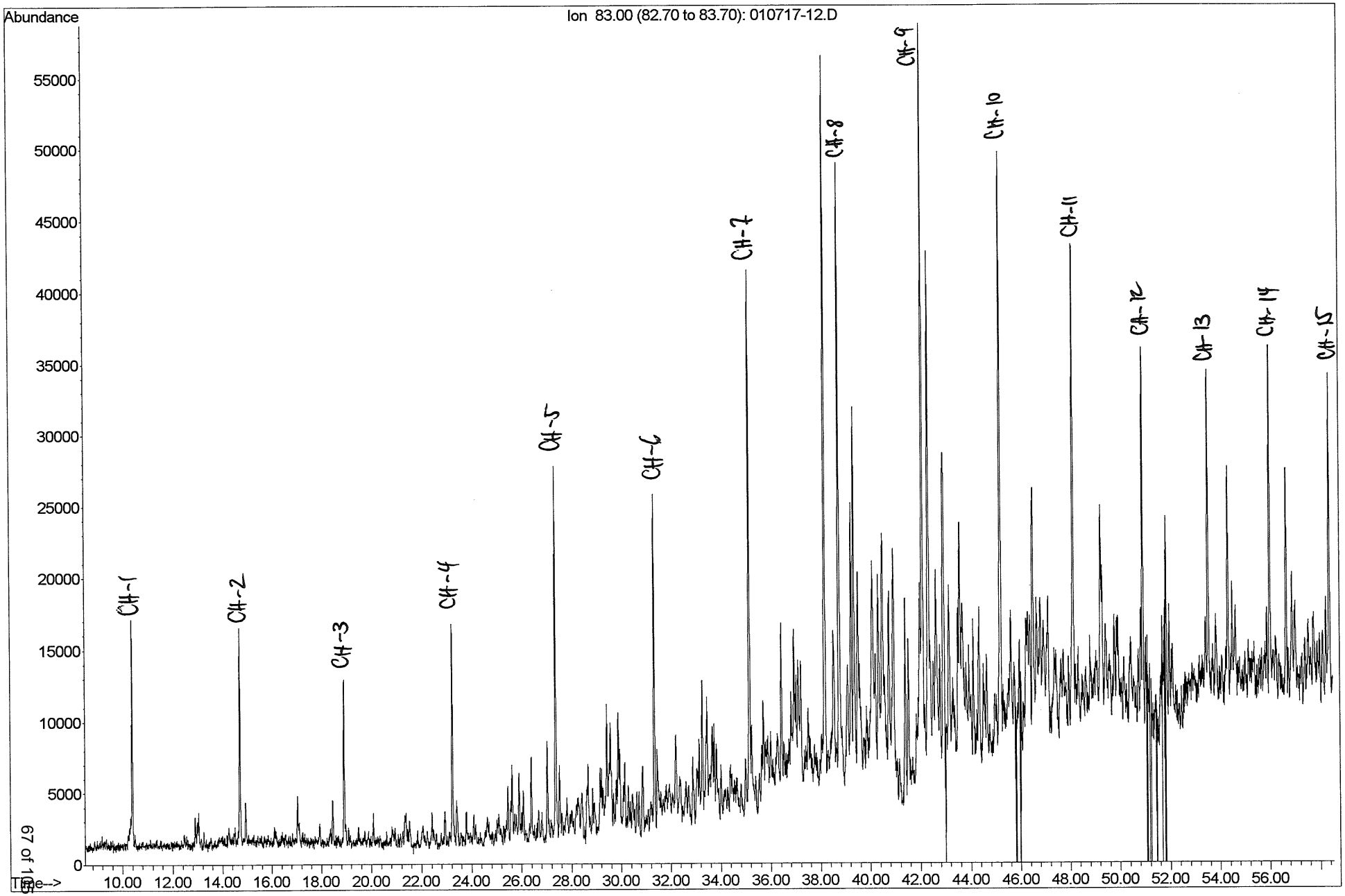


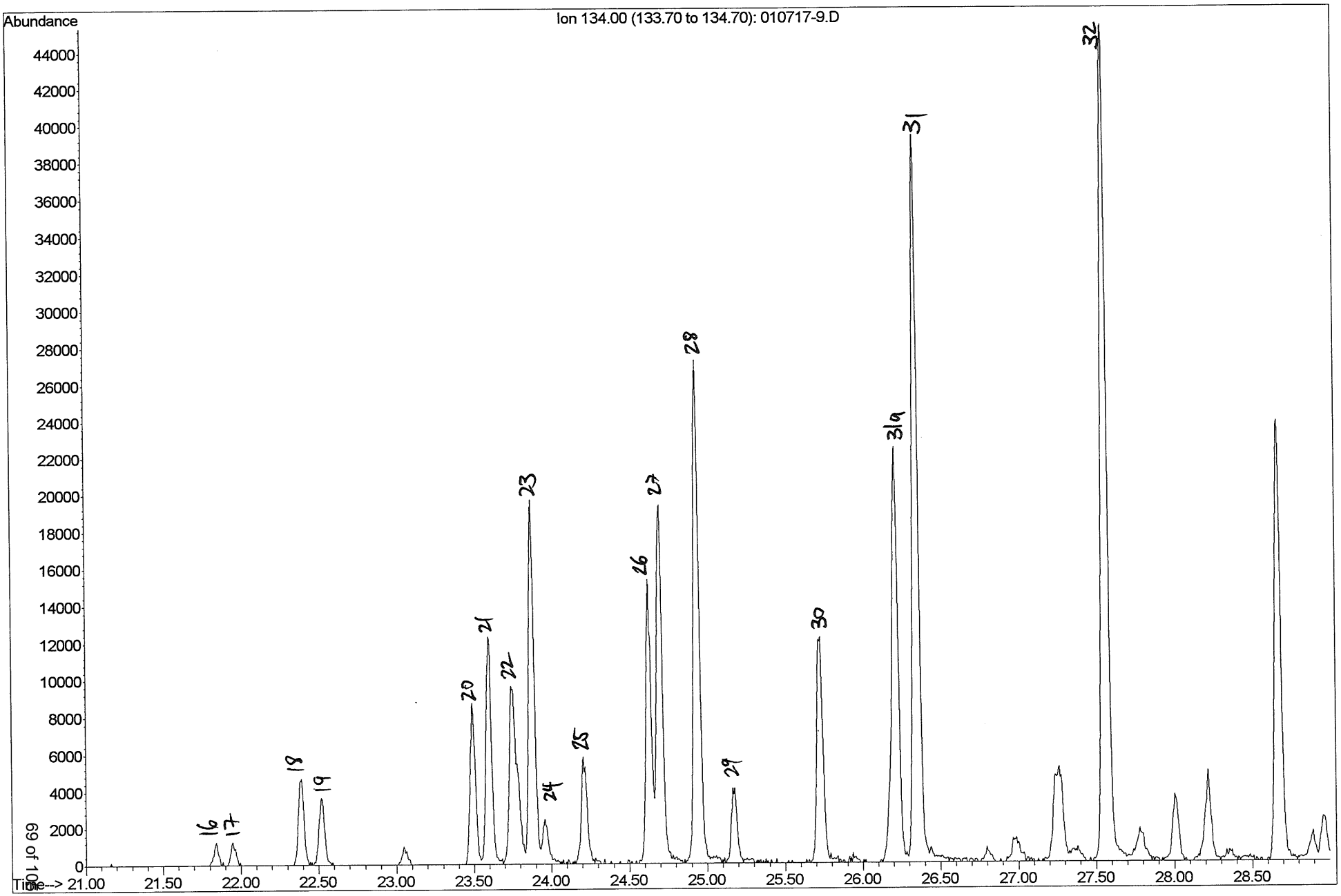
BA-81-7942 (21410-4)



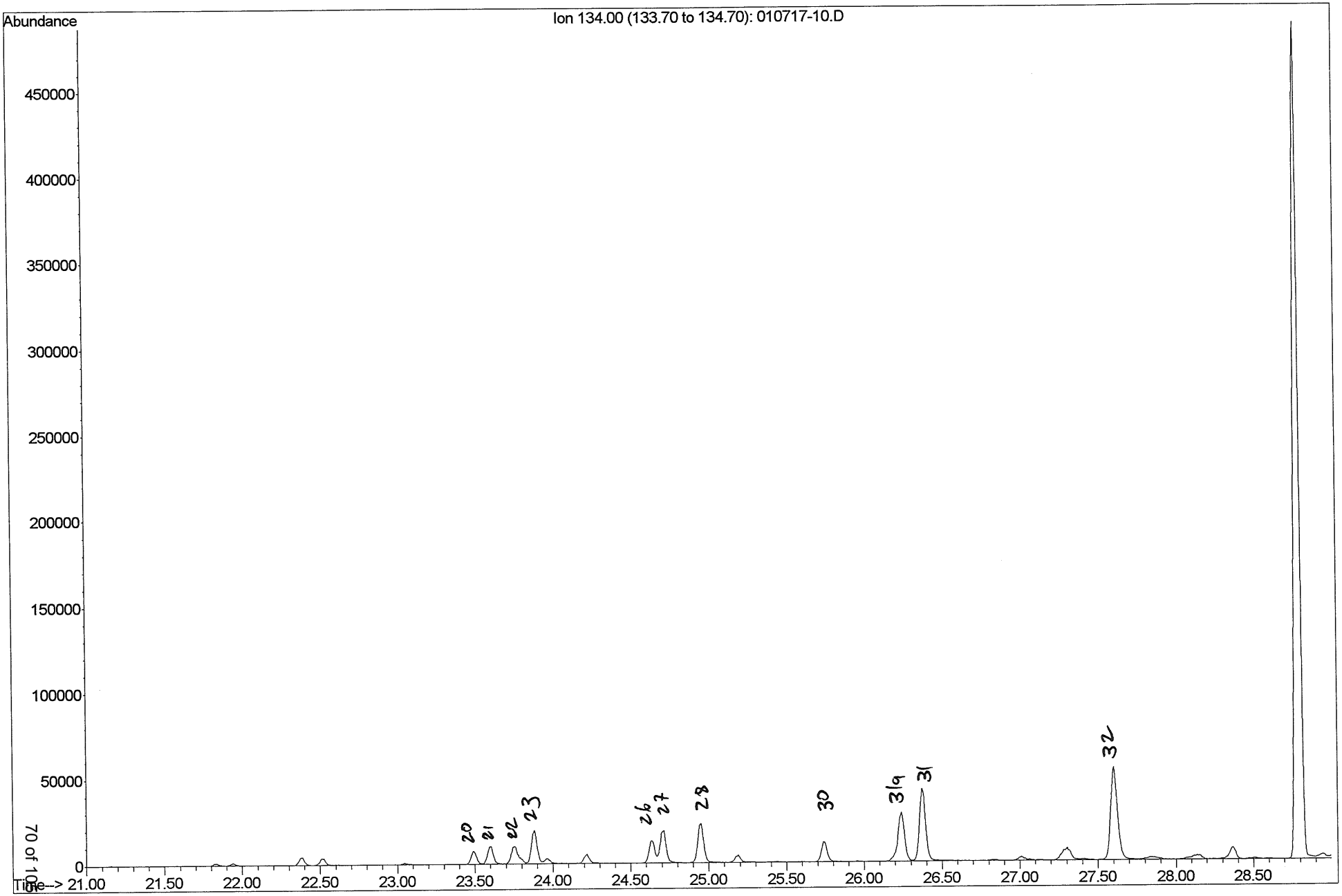
Key for C_4-Alkylbenzenes (m/z 134 mass chromatograms)

#	Compound
16	Sec-Butylbenzene
17	1-Methyl-3-Isopropylbenzene
18	1-Methyl-4-Isopropylbenzene
19	1-Methyl-2-Isopropylbenzene
20	1,3-Diethylbenzene
21	1-Methyl-3-Propylbenzene
22	Butylbenzene
23	1,3-Dimethyl-5-Ethylbenzene
24	1,2-Diethylbenzene
25	1-Methyl-2-Propylbenzene
26	1,4-Dimethyl-2-Ethylbenzene
27	1,3-Dimethyl-4-Ethylbenzene
28	1,2-Dimethyl-4-Ethylbenzene
29	1,3-Dimethyl-2-Ethylbenzene
30	1,2-Dimethyl-3-Ethylbenzene
31a	1,2,4,5-Tetramethylbenzene
31	1,2,3,5-Tetramethylbenzene
32	1,2,3,4-Tetramethylbenzene

B18-045-PZ (21410-1)



BA-81-7941 (21410-2)



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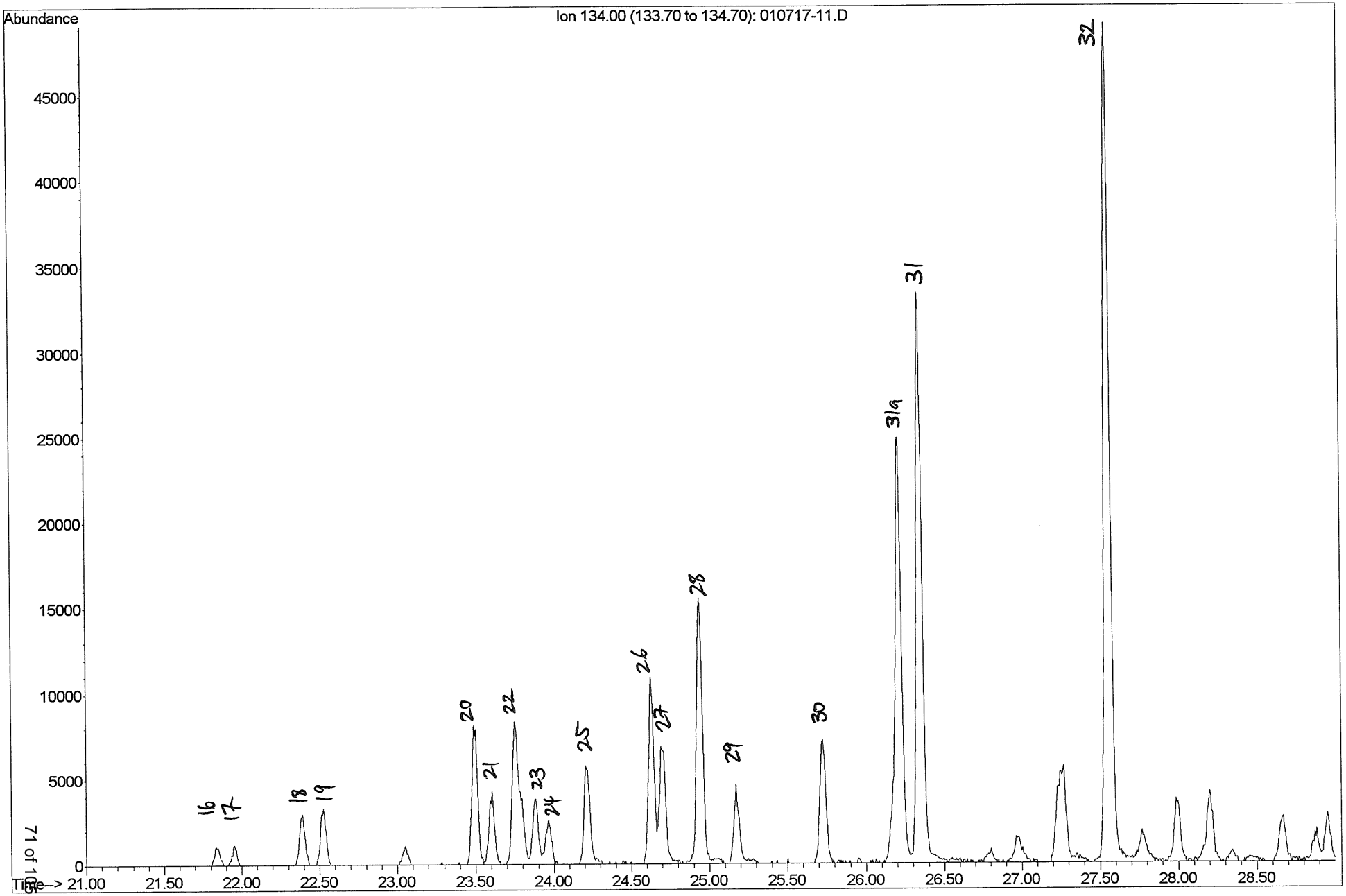
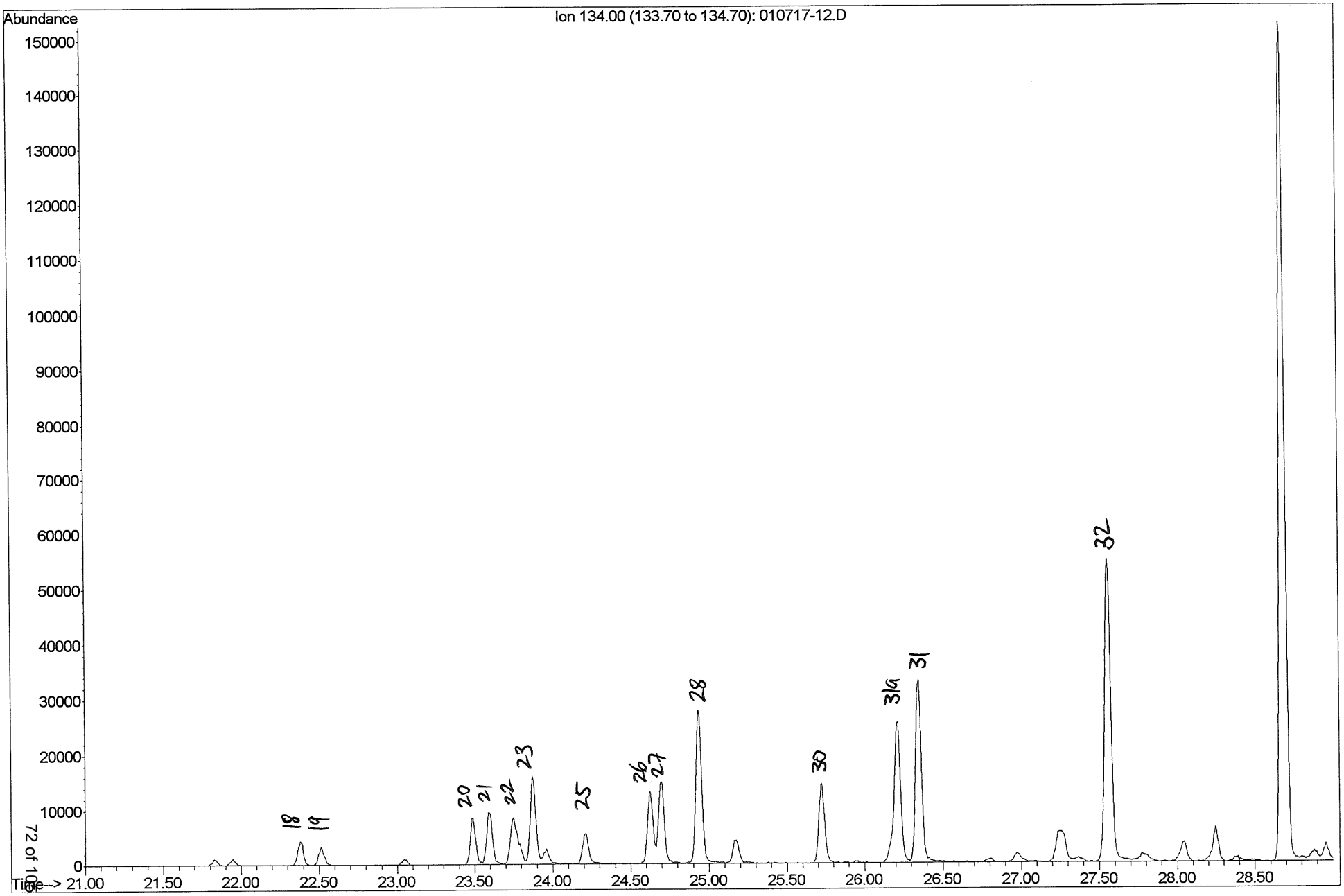


BA-81-7942 (21410-4)

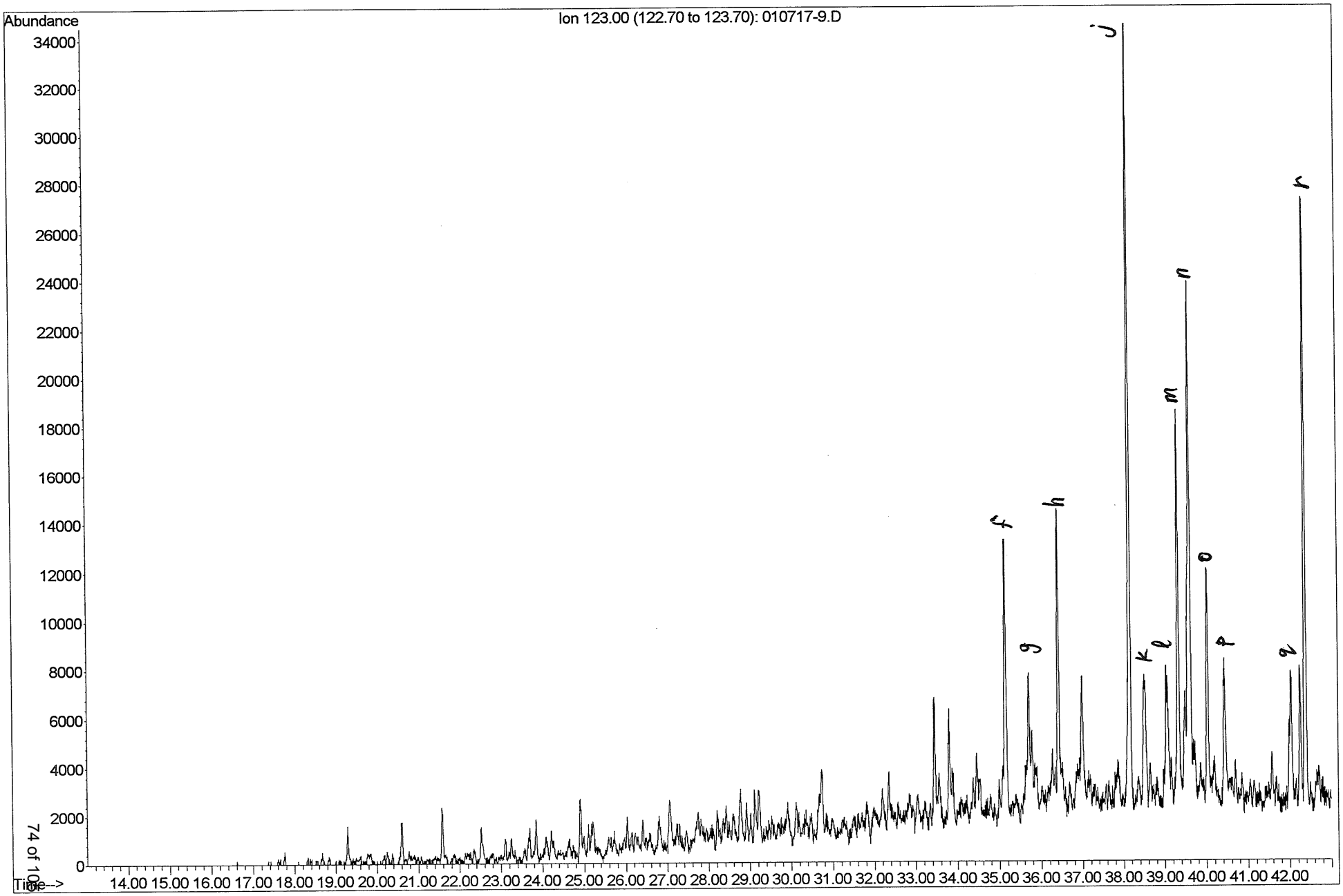


Table

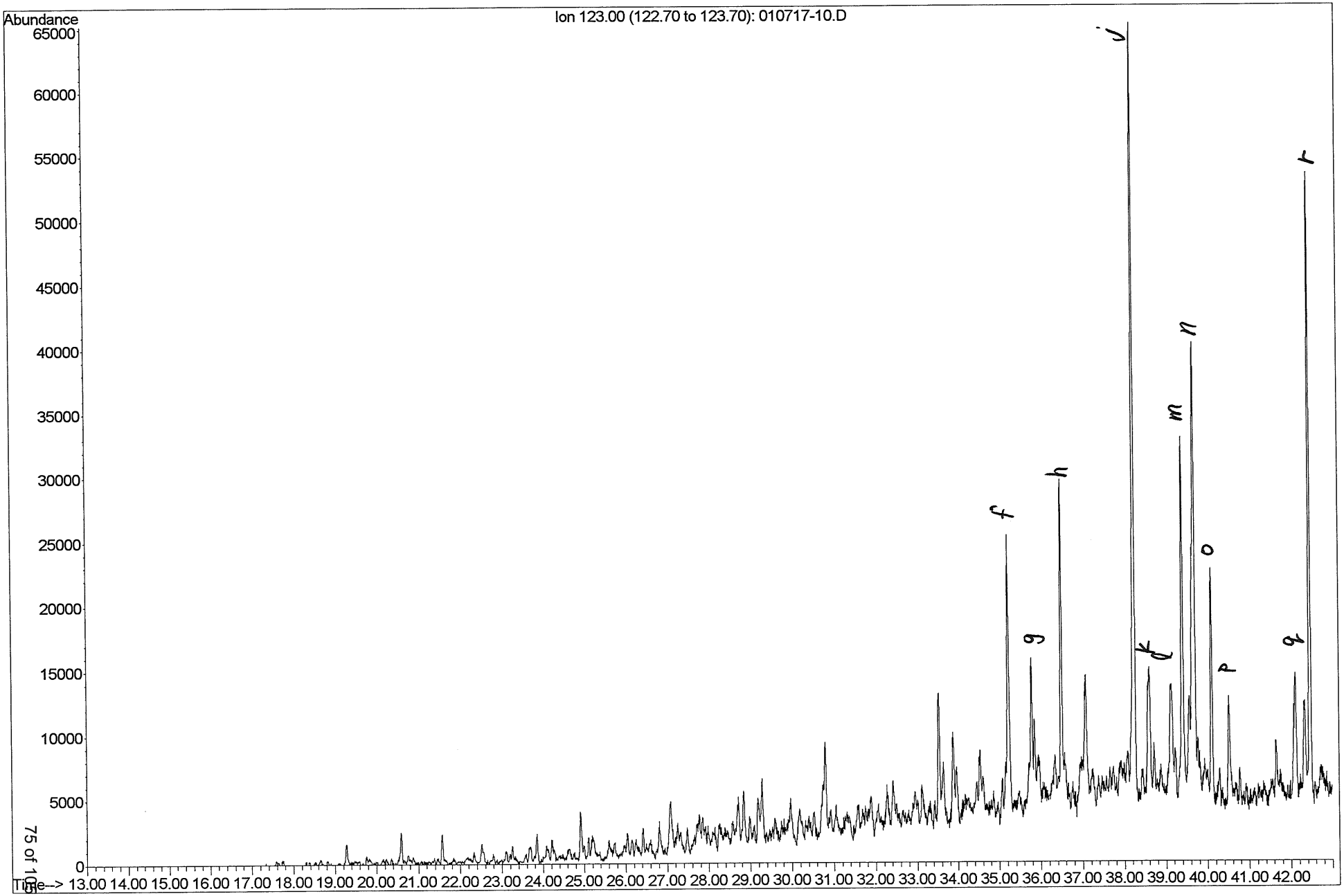
Key for identification of the Bicyclanes (m/z 123 mass chromatograms)

Peak No.	Identity	Formula	M.W.
a	2,2,3-Trimethylbicyloheptane	$C_{10}H_{18}$	138
b	C_{10} bicycloalkane	$C_{10}H_{18}$	138
c	3,3,7-Trimethylbicycloheptane	$C_{10}H_{18}$	138
d	C_{11} decalin	$C_{11}H_{20}$	152
f	Nordrimane	$C_{14}H_{26}$	194
g	Nordrimane	$C_{14}H_{26}$	194
h	Rearranged drimane	$C_{15}H_{28}$	208
j	Rearranged drimane	$C_{15}H_{28}$	208
k	Isomer of eudesmane	$C_{15}H_{28}$	208
l	4β(H) Eudesmane	$C_{15}H_{28}$	208
m	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
n	8β(H) Drimane	$C_{15}H_{28}$	208
o	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
p	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
q	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
r	8β(H) Homodrimane	$C_{16}H_{30}$	222

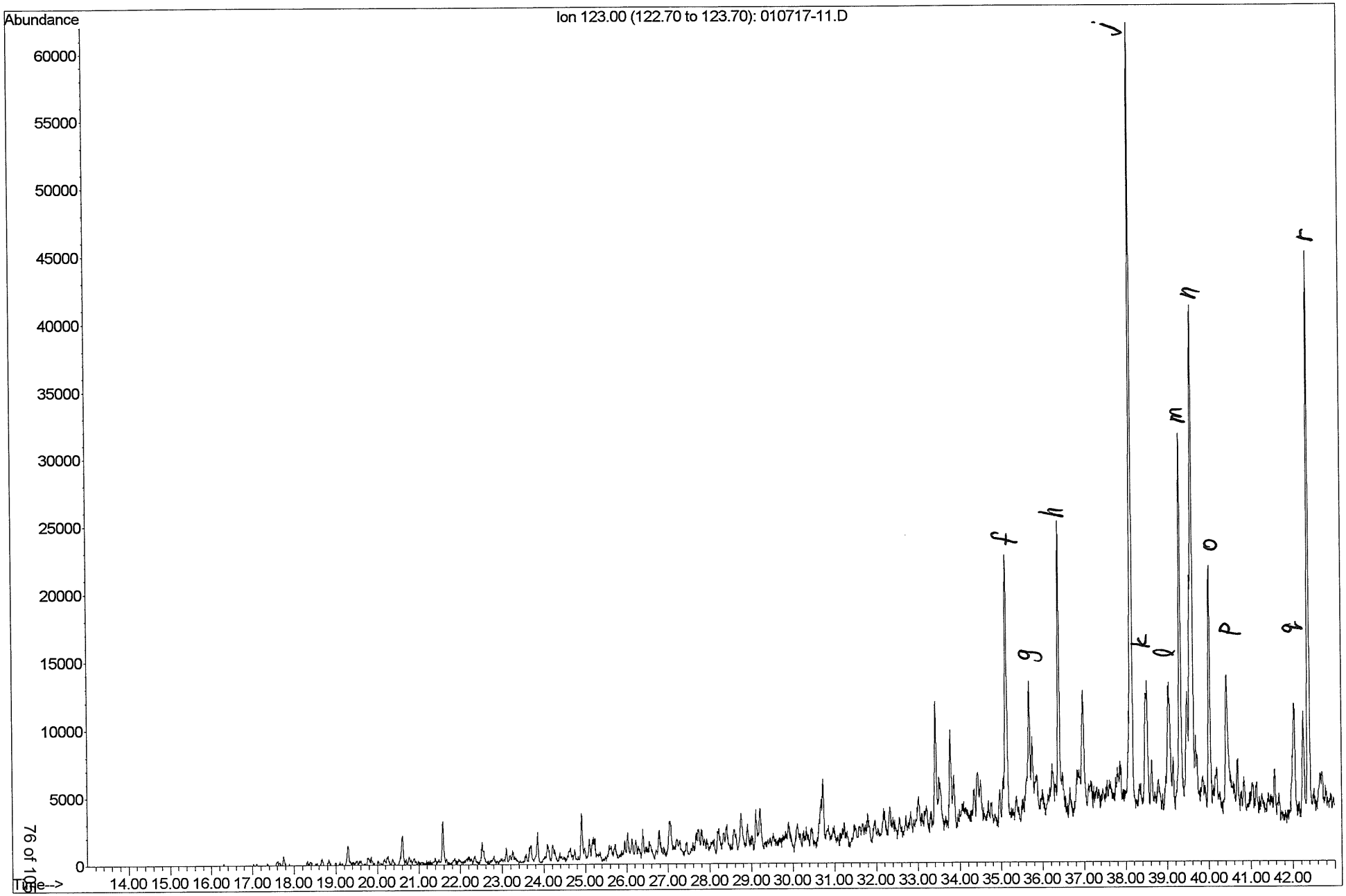
B18-045-PZ (21410-1)



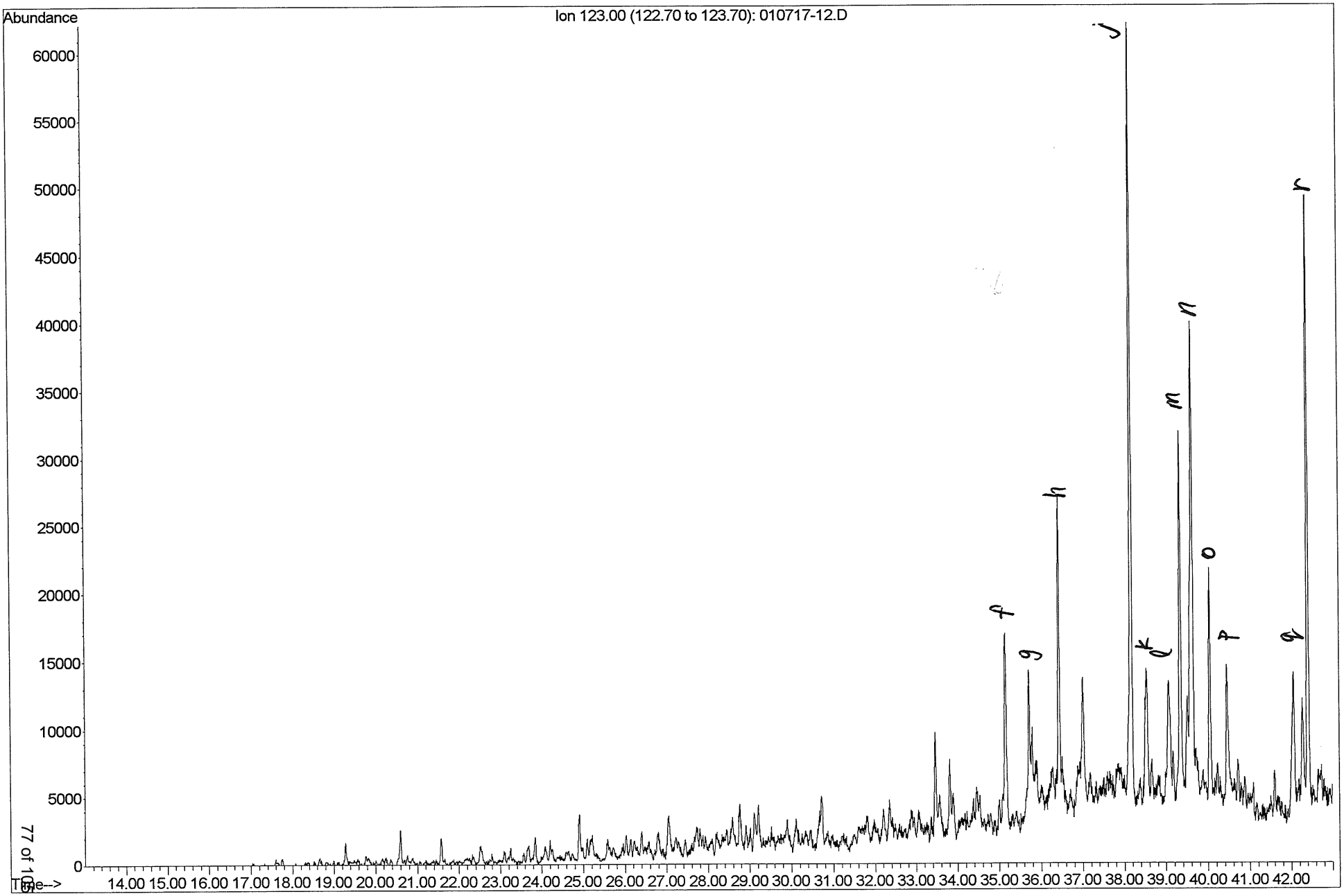
BA-81-7941 (21410-2)

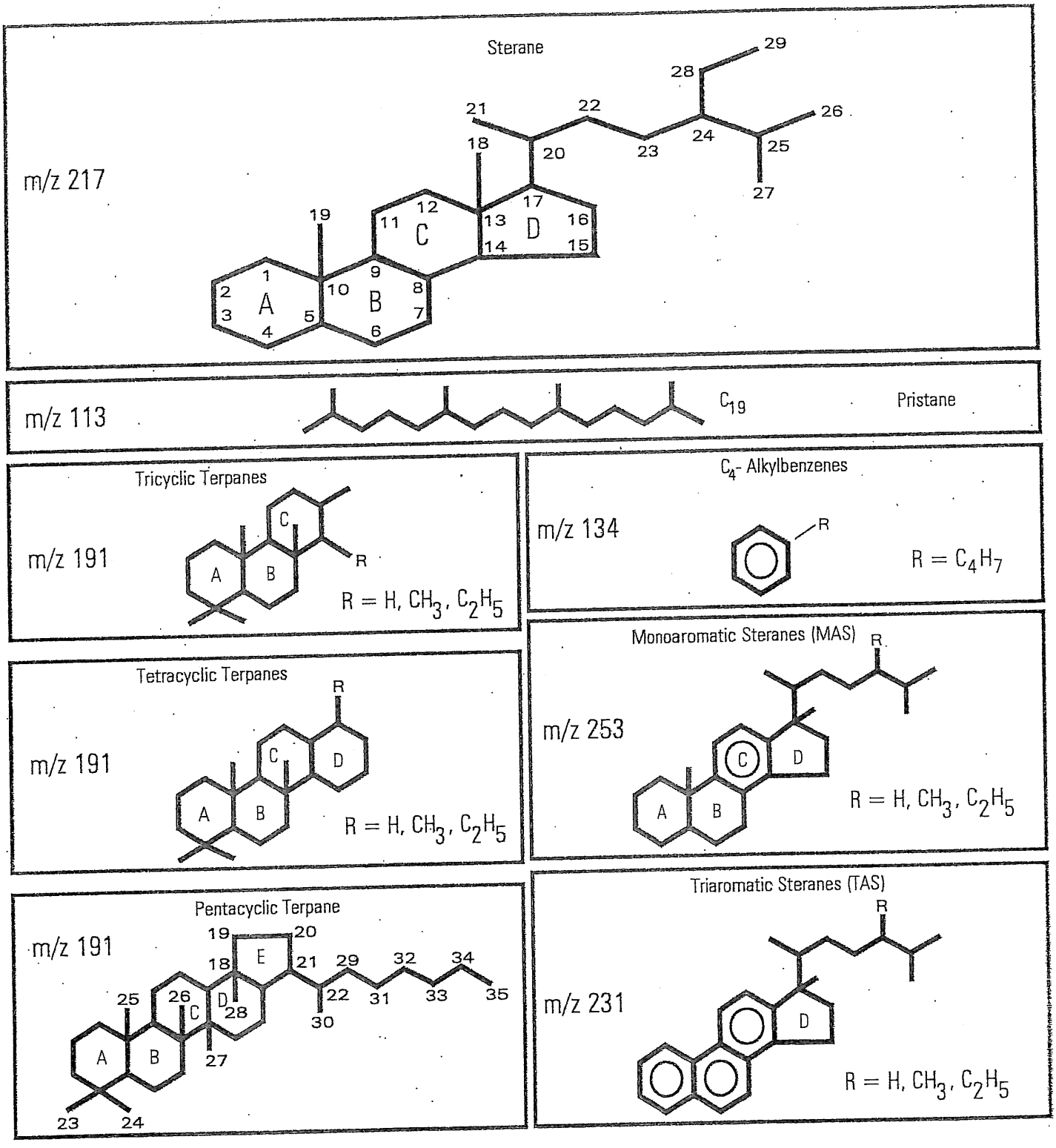


BA-81-7944 (21410-3)



BA-81-7942 (21410-4)





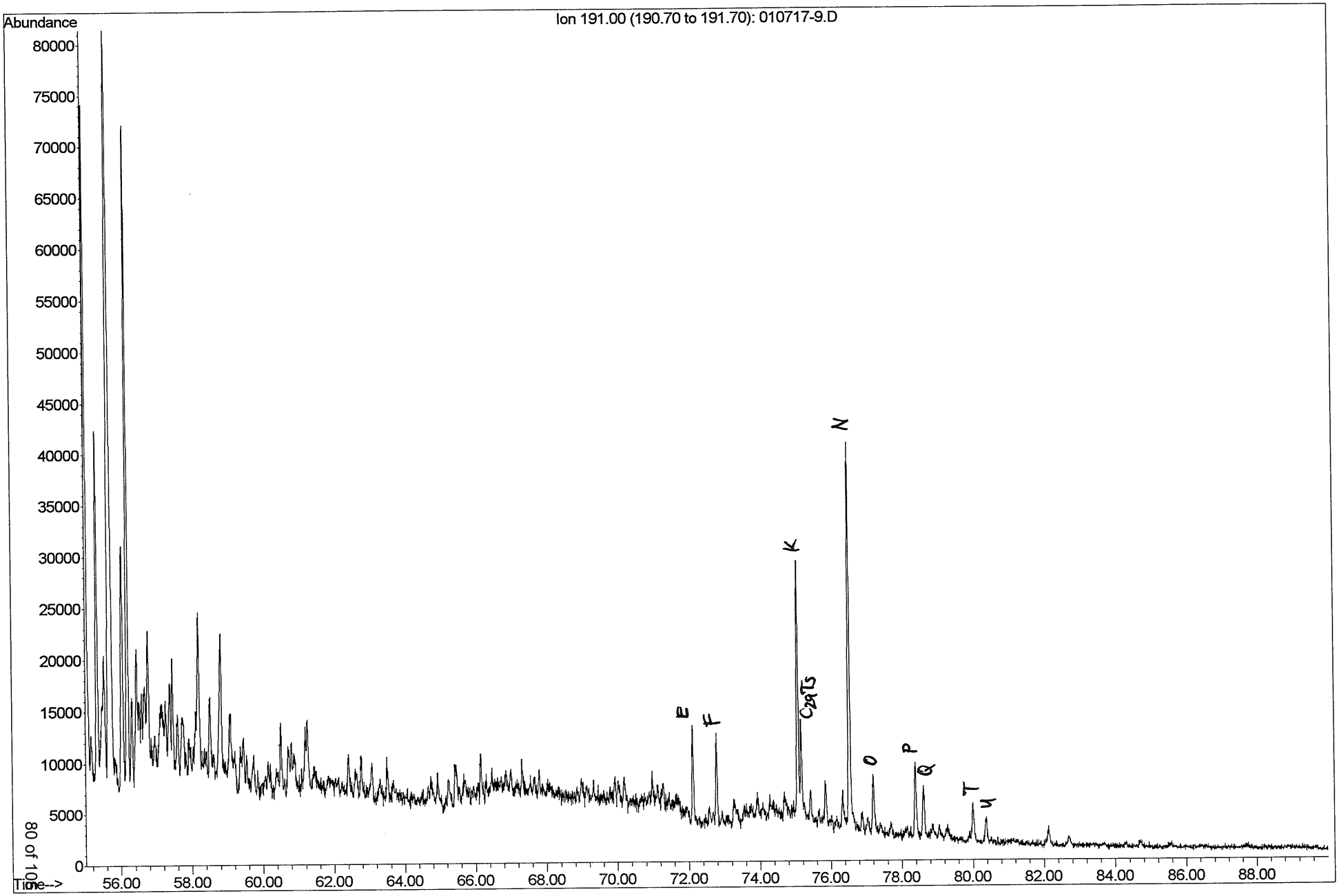
The compound structures of pristane, C_4-alkylbenzenes, sterane; terpanes; monoaromatic and triaromatic steranes

ZymaX FORENSICS

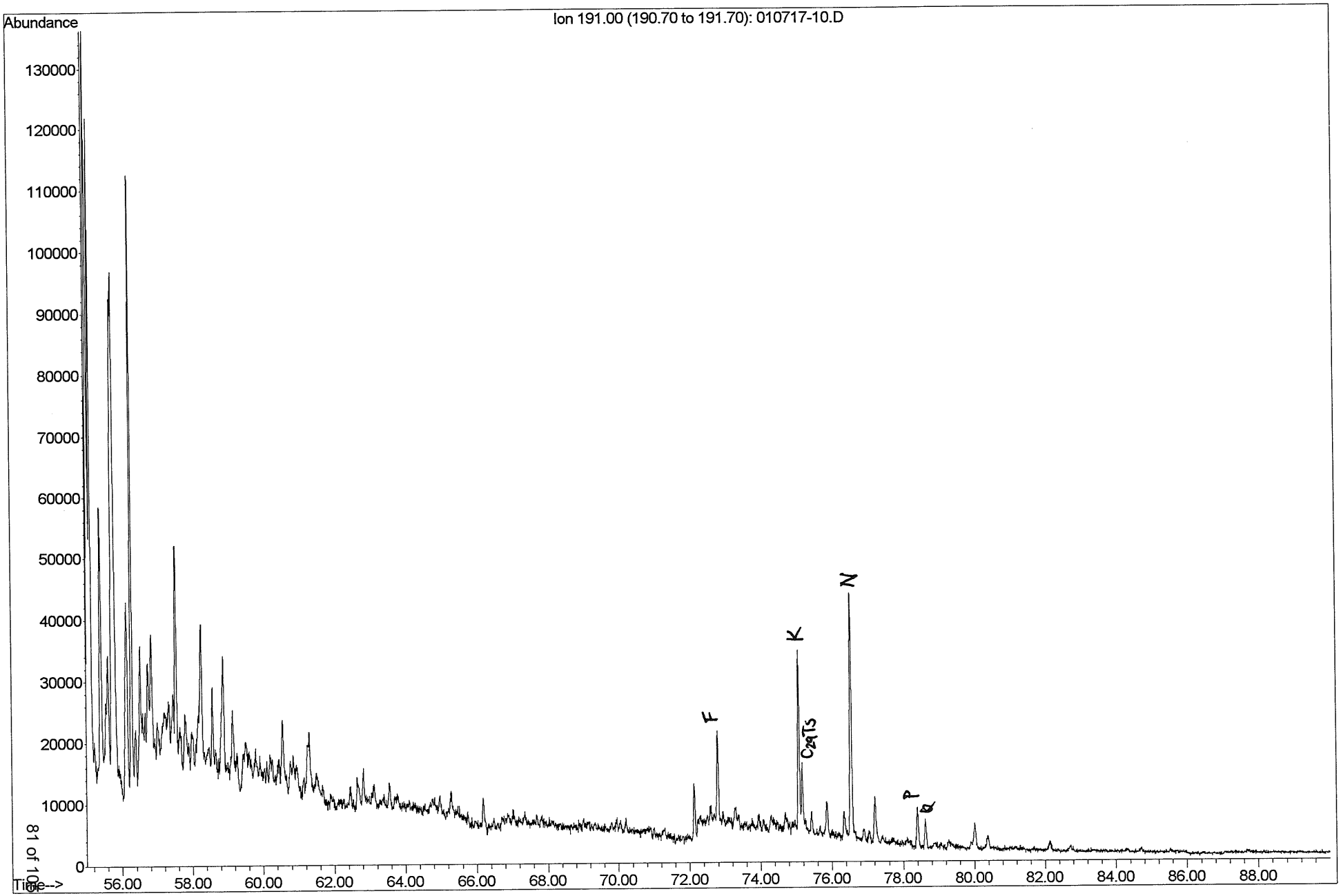
Key for Tricyclic, Tetracyclic, and Pentacyclic Terpanes Identification (m/z 191 mass chromatograms)

Code	Identity	Carbon #
0	C_{20}-Tricyclic Terpane	20
1	C_{21}-Tricyclic Terpane	21
2	C_{22}-Tricyclic Terpane	22
3	C_{23}-Tricyclic Terpane	23
4	C_{24}-Tricyclic Terpane	24
5	C_{25}-Tricyclic Terpane	25
Z4	C_{24}-Tetracyclic Terpane	24
6a	C_{26}-Tricyclic Terpane	26
6b	C_{26}-Tricyclic Terpane	26
7	C_{27}-Tricyclic Terpane	27
A	C_{28}-Tricyclic Terpane #1	28
B	C_{28}-Tricyclic Terpane #2	28
C	C_{29}-Tricyclic Terpane #1	29
D	C_{29}-Tricyclic Terpane #2	29
E	18α-22,29,30-Trisnorneohopane (Ts)	27
F	17α-22,29,30-Trisnorhopane (Tm)	27
G	17ß-22,29-30-Trisnorhopane	27
H	17α-23,28-Bisnorlupane	28
10a	C_{30}-Tricyclic Terpane #1	30
10b	C_{30}-Tricyclic Terpane #2	30
I	17α-28,30-Bisnorhopane	28
11a	C_{31}-Tricyclic Terpane #1	31
J	17α-25-Norhopane	29
11b	C_{31}-Tricyclic Terpane #2	31
K	17α,21ß-30-Norhopane	29
C_{29}Ts	18α-30-Norneohopane	29
C_{30}*	17α-Diahopane	30
L	17ß-21α-30-Normoretane	29
Ma	18α-Oleanane	30
Mb	18ß-Oleanane	30
N	17α,21ß-Hopane	30
O	17ß,21α-Moretane	30
13a	C_{33}-Tricyclic Terpane #1	33
13b	C_{33}-Tricyclic Terpane #2	33
P	22S-17α,21ß-30-Homohopane	31
Q	22R-17α,21ß-30-Homohopane	31
R	Gammacerane	30
14a	C_{34}-Tricyclic Terpane #1	34
S	17ß,21α-Homomoretane	31
14b	C_{34}-Tricyclic Terpane #2	34
T	22S-17α,21ß-30-Bishomohopane	32
U	22R-17α,21ß-30-Bishomohopane	32
15a	C_{35}-Tricyclic Terpane #1	35
15b	C_{35}-Tricyclic Terpane #2	35
V	17ß,21α-C_{32}-Bishomomoretane	32
WS	22S-17α,21ß-30,31,32-Trishomohopane	33
WR	22R-17α,21ß-30,31,32-Trishomohopane	33
16a	C_{36}-Tricyclic Terpane #1	36
16b	C_{36}-Tricyclic Terpane #2	36
XS	22S-17α,21ß-30,31,32,33-Tetrahomohopane	34
XR	22R-17α,21ß-30,31,32,33-Tetrahomohopane	34
YS	22S-17α,21ß-30,31,32,33,34-Pentahomohopane	35
YR	22R-17α,21ß-30,31,32,33,34-Pentahomohopane	35

B18-045-PZ (21410-1)



BA-81-7941 (21410-2)



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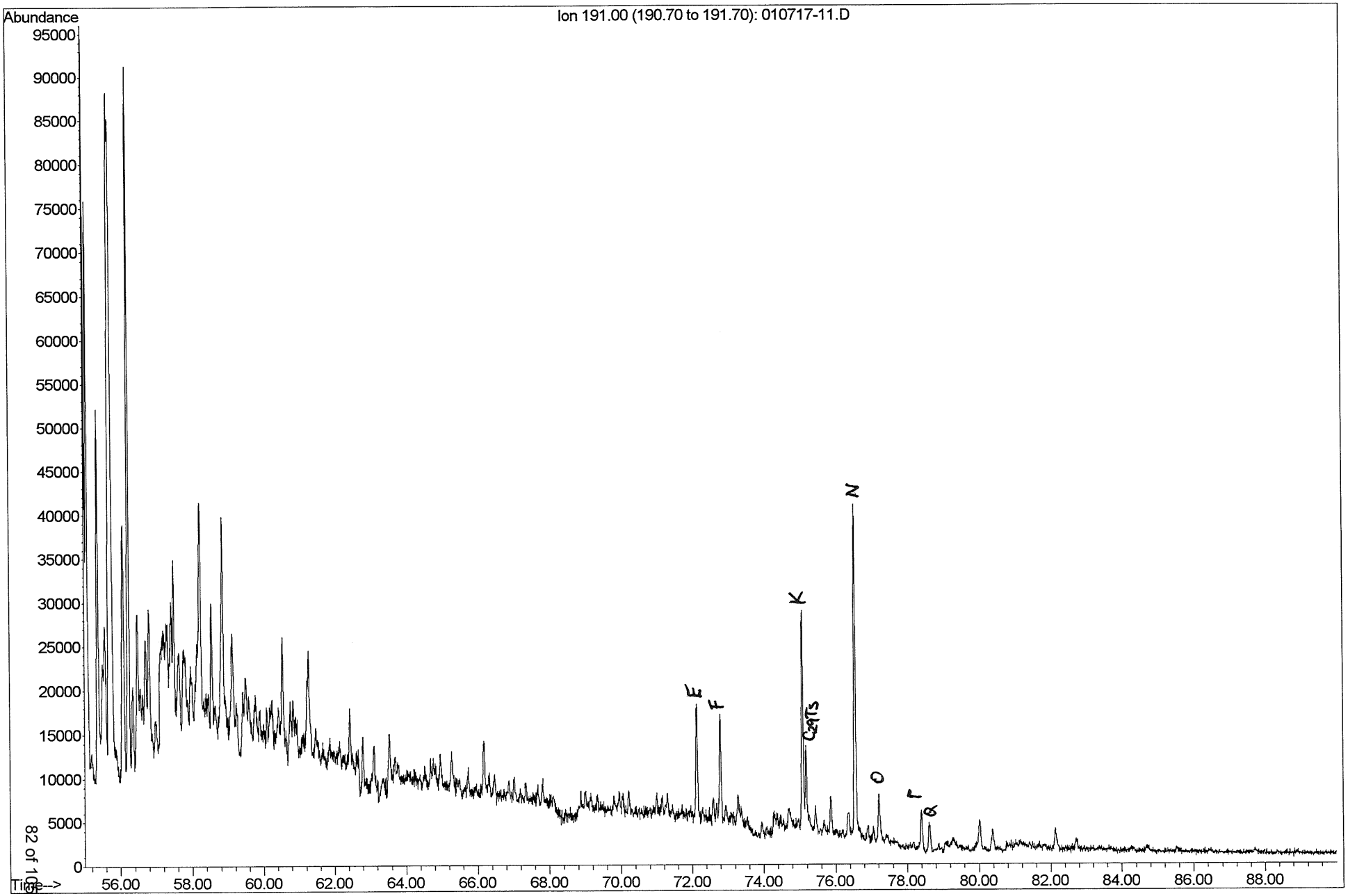

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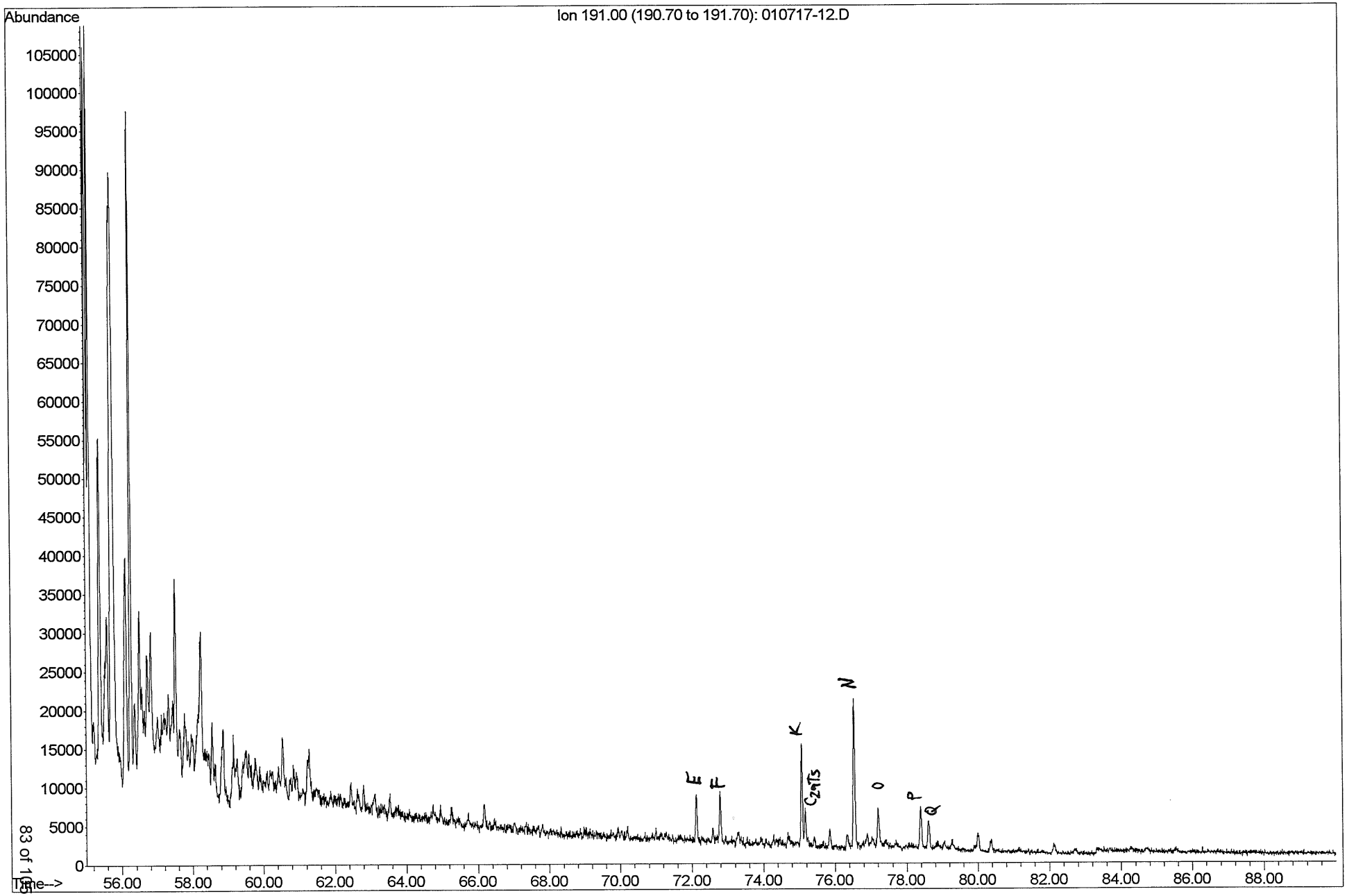
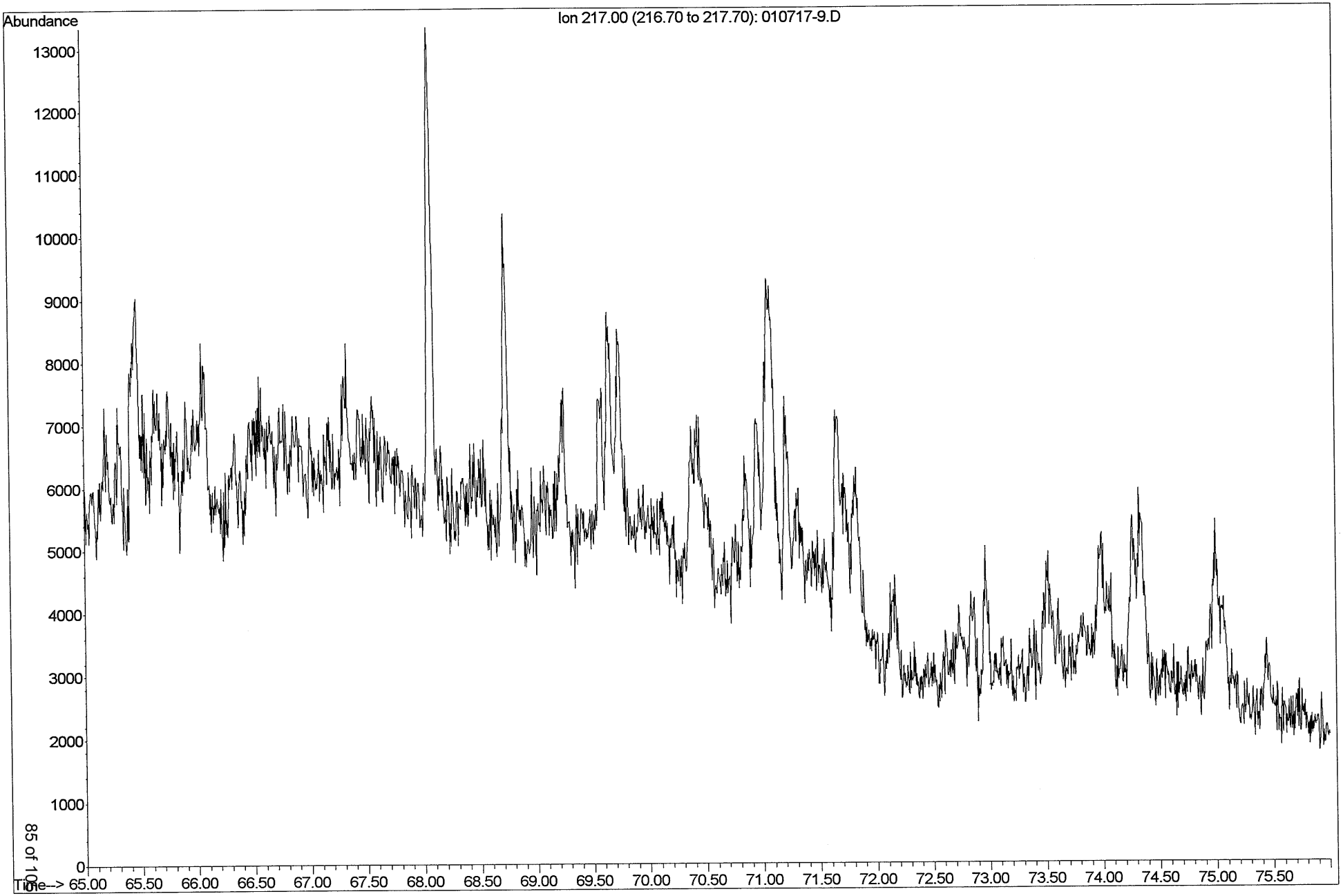


Table

Key for Steranes Identification (m/z 217 Mass Chromatogram)

Code	Identity	Carbon #
1	13ß,17α-diacholestane (20S)	27
2	13ß,17α-diacholestane (20R)	27
3	13α,17ß-diacholestane (20S)	27
4	13α,17ß-diacholestane (20R)	27
5	24-methyl-13ß,17α-diacholestane (20S)	28
6	24-methyl-13ß,17α-diacholestane (20R)	28
7D	24-methyl-13α,17ß-diacholestane (20S)	28
7	14α,17α-cholestane (20S)	27
8D	24-ethyl-13ß,17α-diacholestane (20S)	29
8	14ß,17ß-cholestane (20R)	27
9	14ß,17ß-cholestane (20S)	27
9D	24-methyl-13α,17ß-diacholestane (20R)	28
10	14α,17α-cholestane (20R)	27
11	24-ethyl-13ß,17α-diacholestane (20R)	29
12	24-ethyl-13α,17ß-diacholestane (20S)	29
13	24-methyl-14α,17α-cholestane (20S)	28
14D	24-ethyl-13α,17ß-diacholestane (20R)	29
14	24-methyl-14ß,17ß-cholestane (20R)	28
15	24-methyl-14ß,17ß-cholestane (20S)	28
16	24-methyl-14α,17α-cholestane (20R)	28
17	24-ethyl-14α-cholestane (20S)	29
18	24-ethyl-14ß,17ß-cholestane (20R)	29
19	24-ethyl-14ß,17ß-cholestane (20S)	29
20	24-ethyl-14α,17α-cholestane (20R)	29
21A	24-n-Propylcholestane (20S)	30
21B	4-methyl-24-ethylcholestane (20S)	30
22A	4α-methyl-24-ethyl-14β,17β-cholestane(20S)	30
22B	24-n-propyl-14β,17β-cholestane (20S)	30
23A	4α-methyl-24-ethyl-14β,17β-cholestane(20R)	30
23B	24-n-propyl-14β,17β-cholestane (20R)	30
24A	4α-methyl-24-ethylcholestane(20R)	30
24B	24-n-propylcholestane (20R)	30

B18-045-PZ (21410-1)



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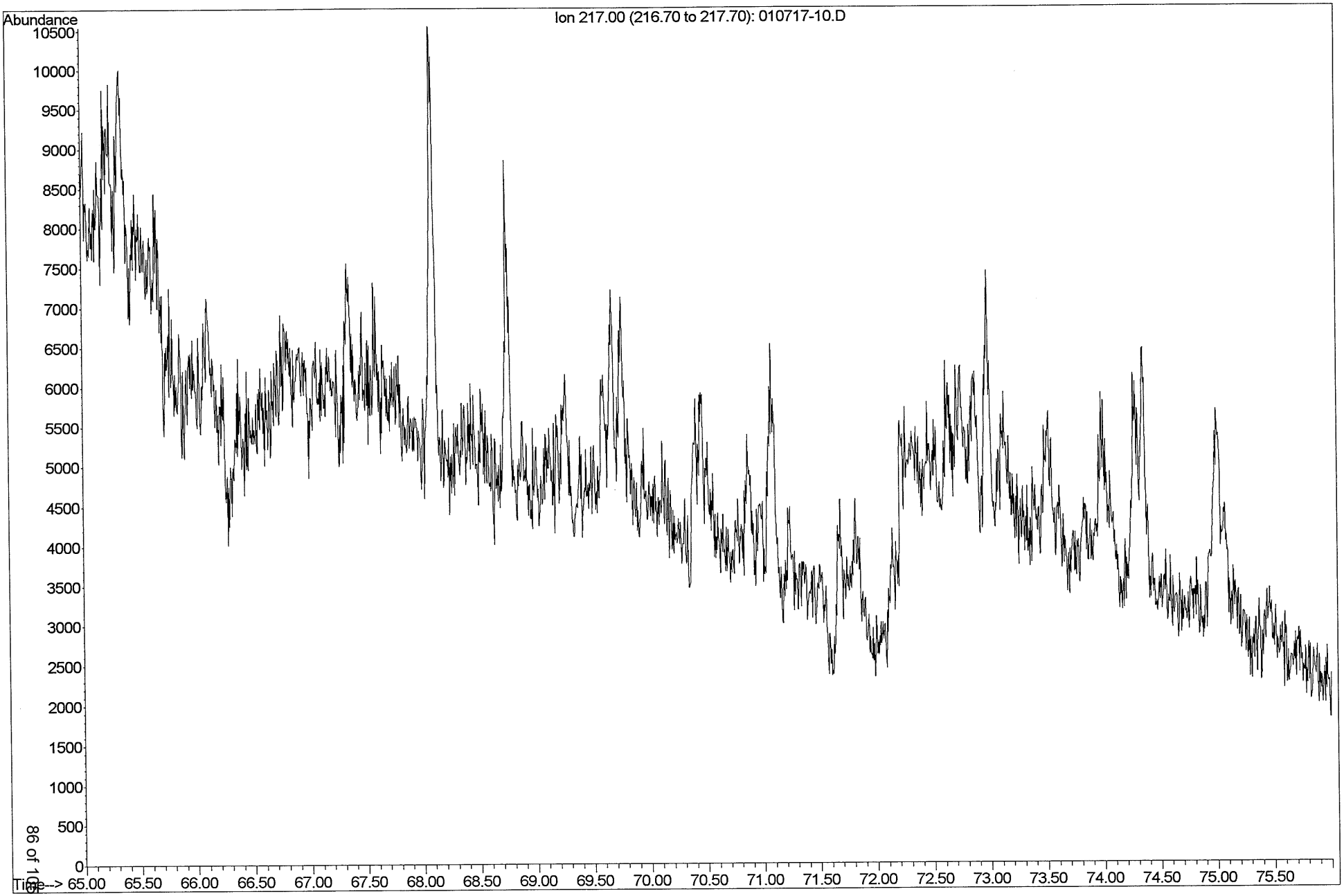

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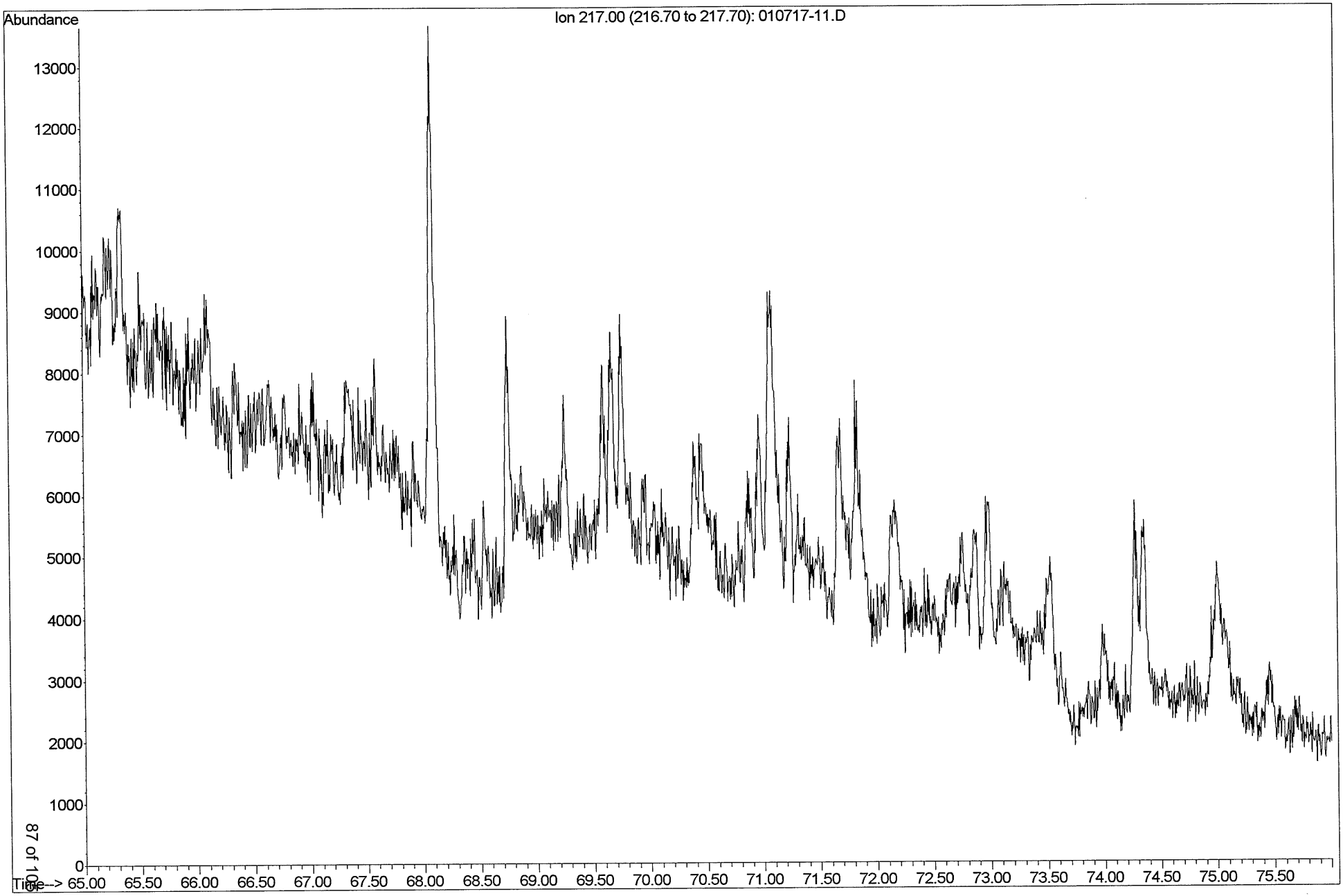

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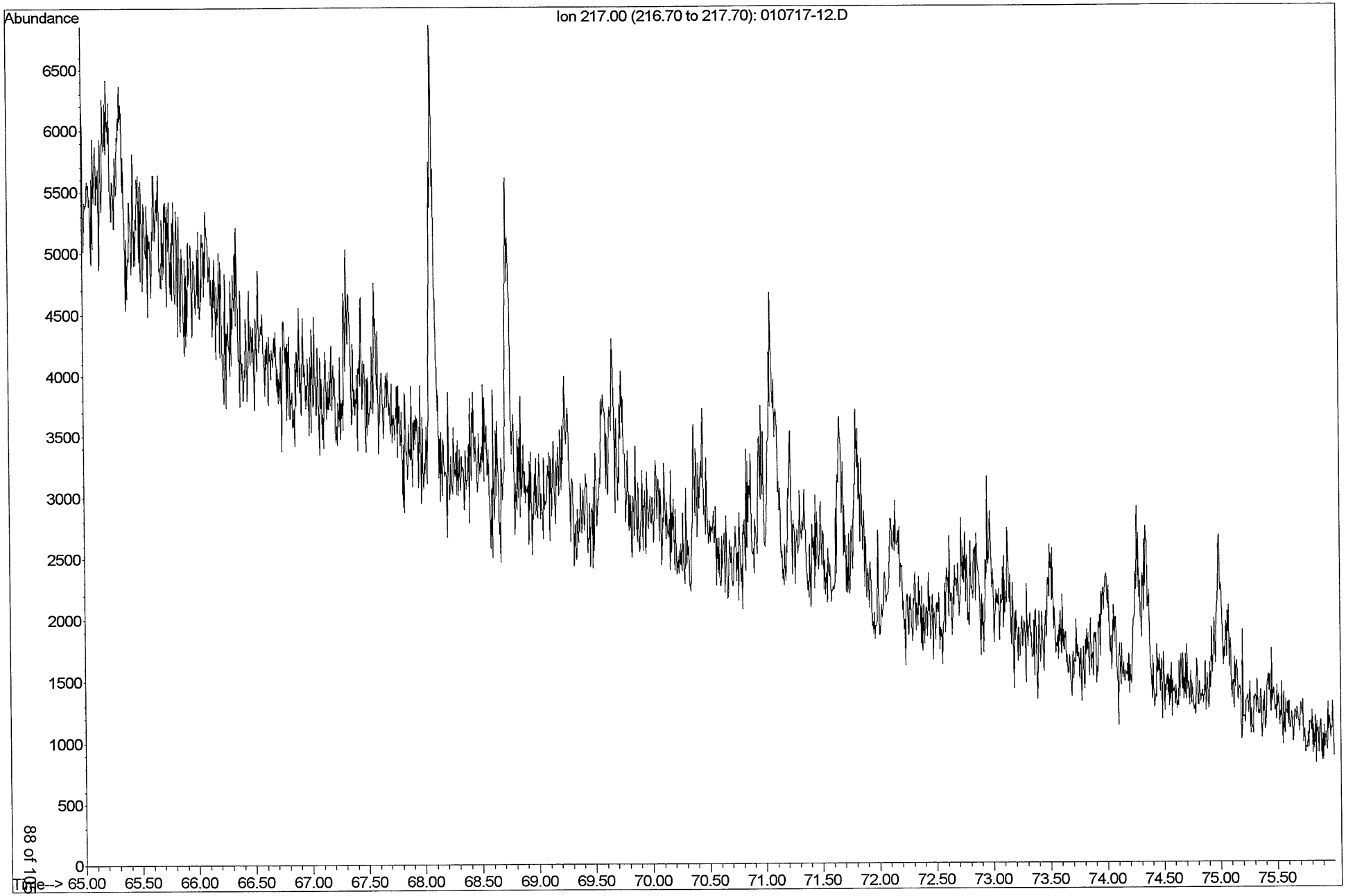
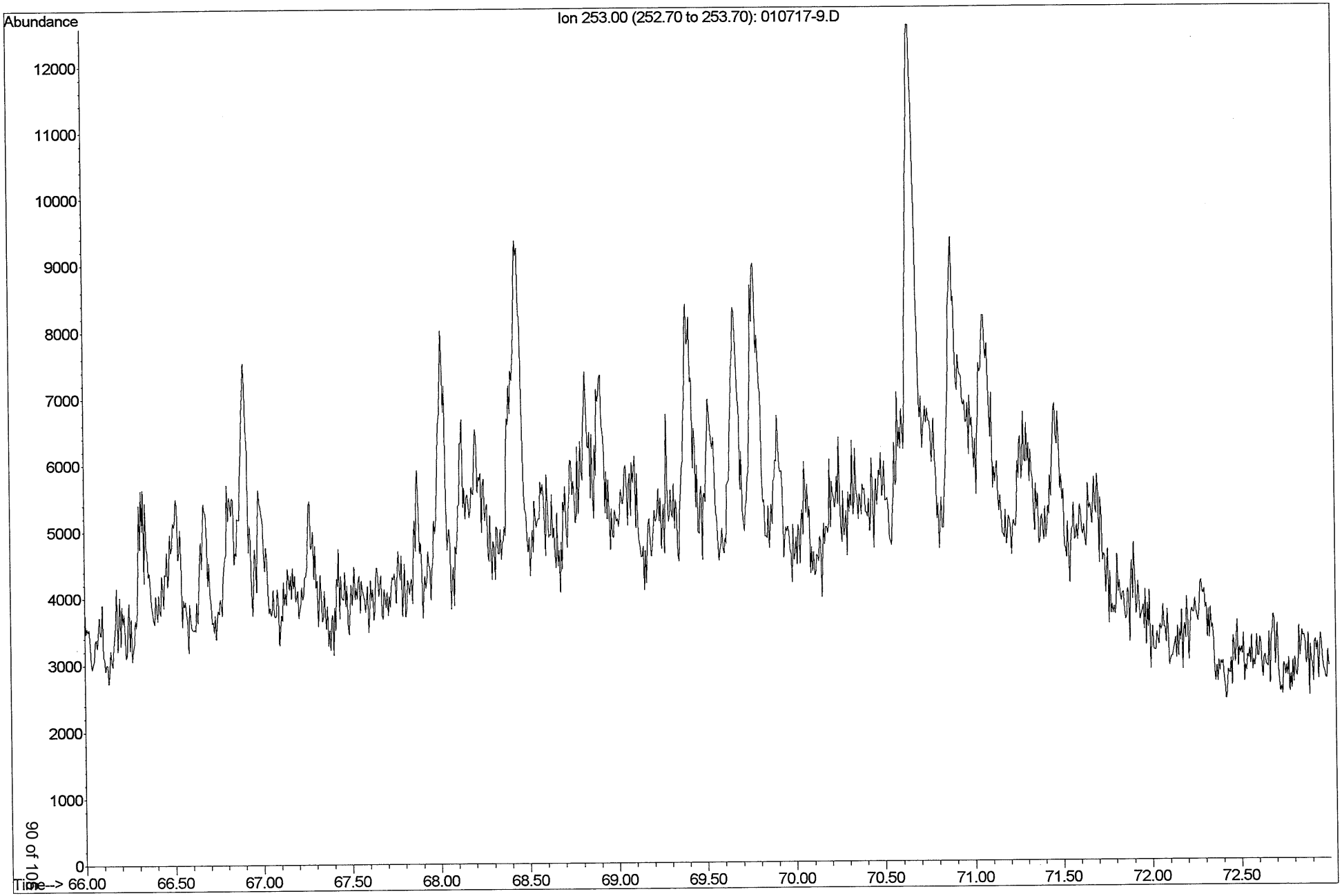


Table

Key for Monoaromatic Steranes Identification (m/z 253 mass chromatogram)

Code	Identity	Elemental Composition
a	20S, 5ß C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
b	20S, dia C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
c	20R, 5ß C_{27}-Monoaromatic sterane + 20R C_{27} dia MAS	$C_{27}H_{42}$
d	20S, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
e	20S, 5ß C_{28}-Monoaromatic sterane + 20S C_{28} dia MAS	$C_{28}H_{44}$
f	20R, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
g	20S, 5α C_{28}-Monoaromatic sterane	$C_{28}H4_4$
h	20R, 5ß C_{28}-Monoaromatic sterane + 20R C_{28} dia MAS	$C_{28}H_{44}$
i	20S, 5ß C_{29}-Monoaromatic sterane + 20S C_{29} dia MAS	$C_{29}H_{46}$
j	20S, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$
k	20R, 5α C_{28}-Monoaromatic sterane	$C_{28}H_{44}$
l	20R, 5ß C_{29}-Monoaromatic sterane + 20R C_{29} dia MAS	$C_{29}H_{46}$
m	20R, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$

B18-045-PZ (21410-1)



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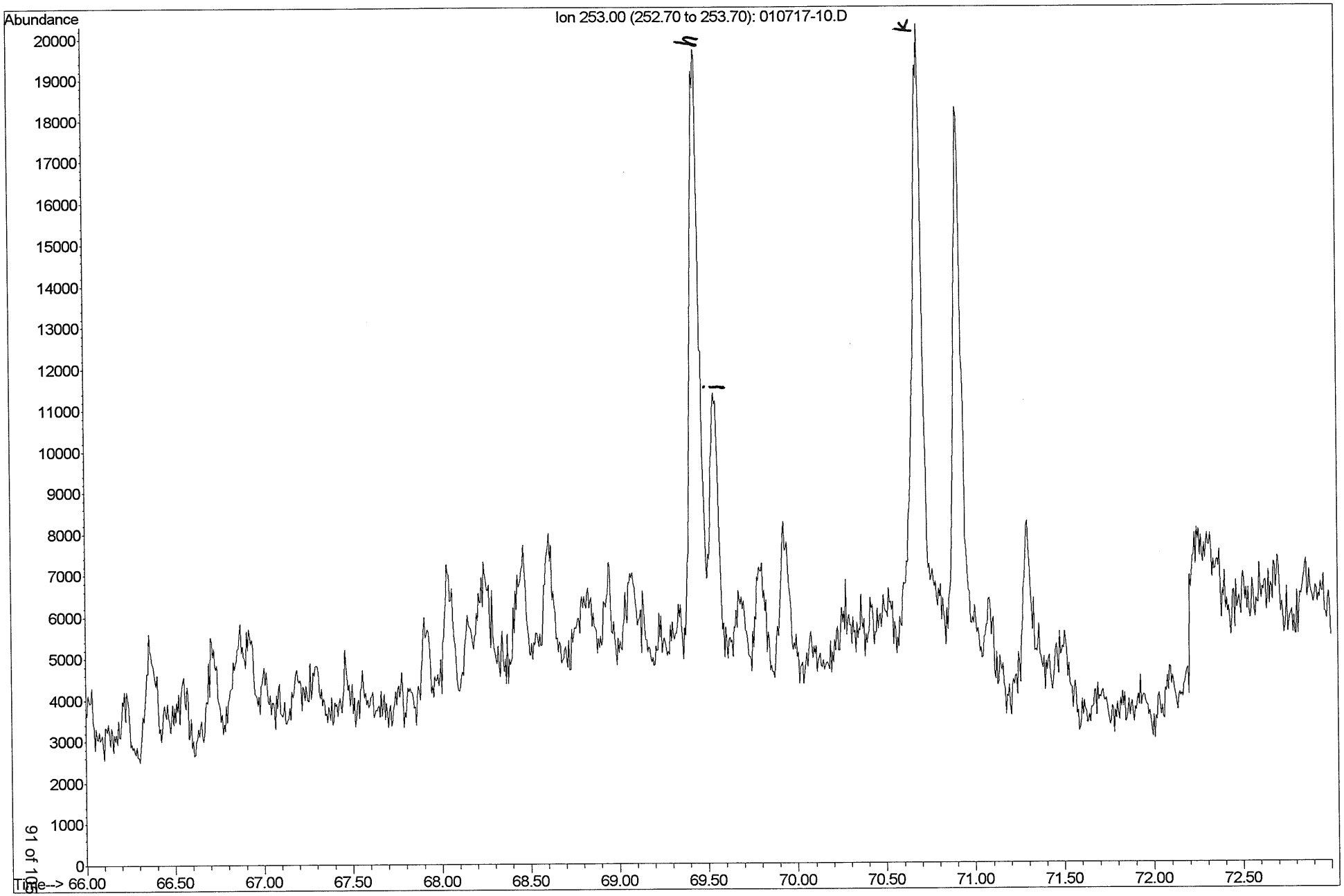

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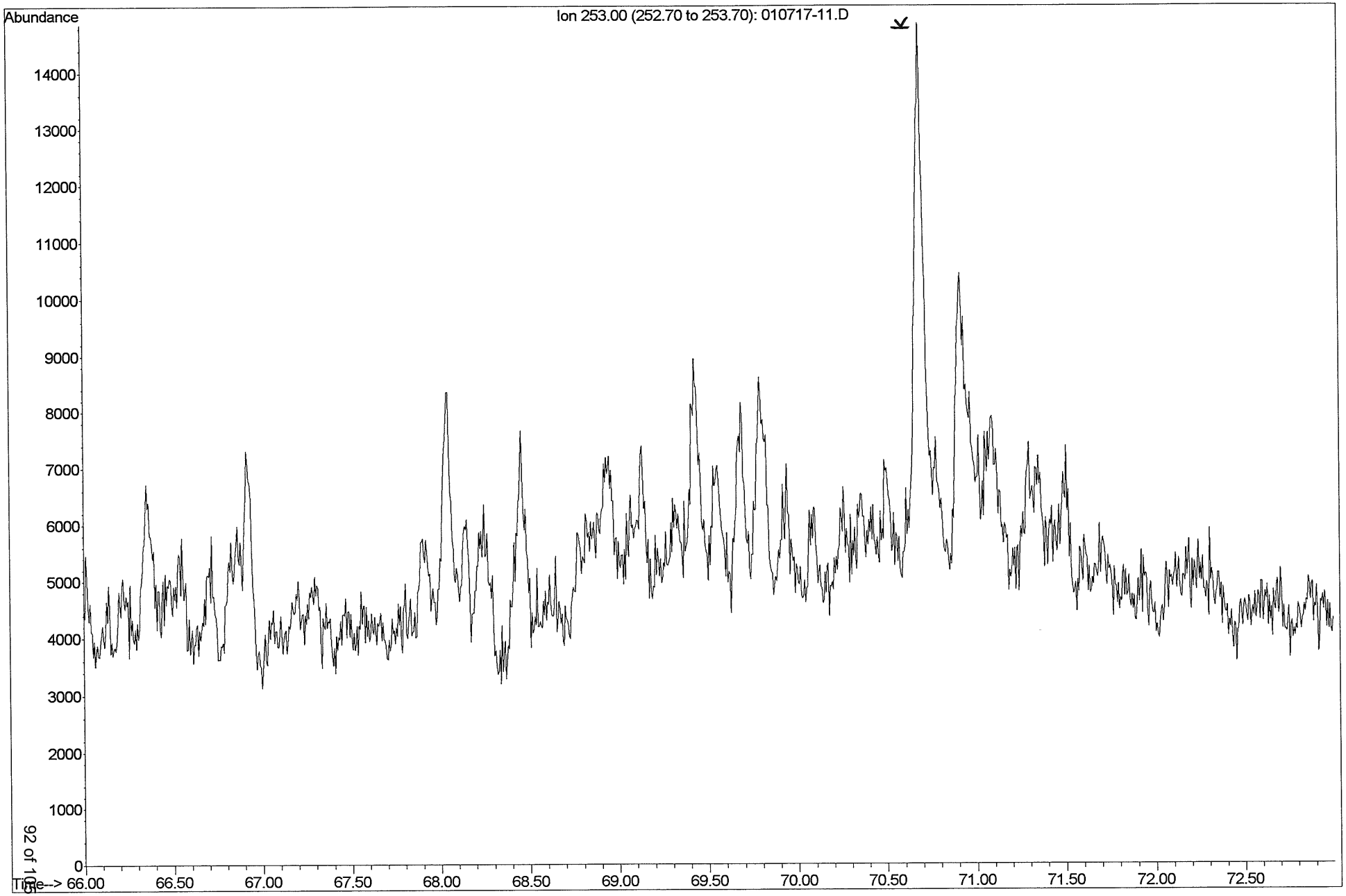

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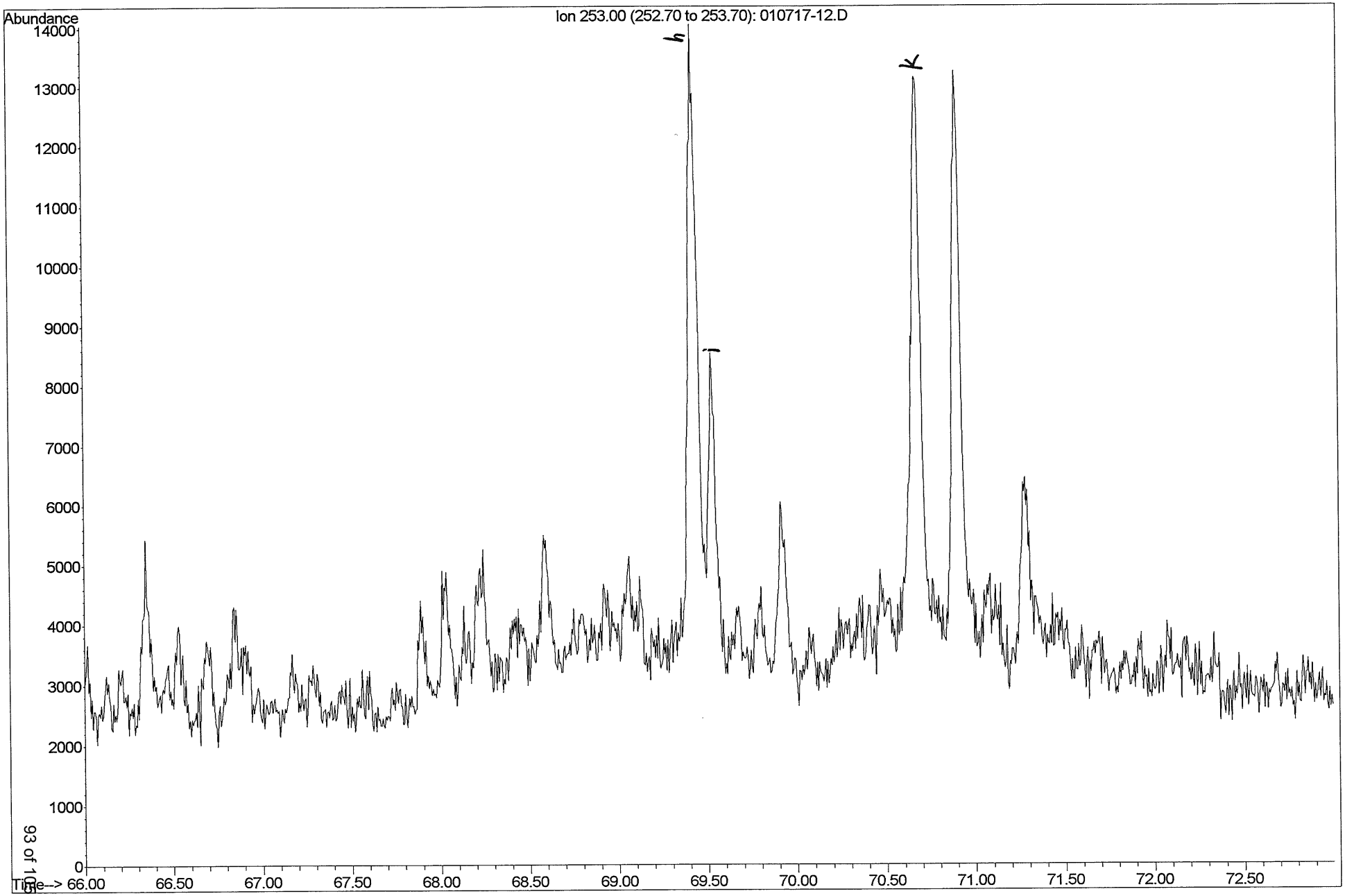
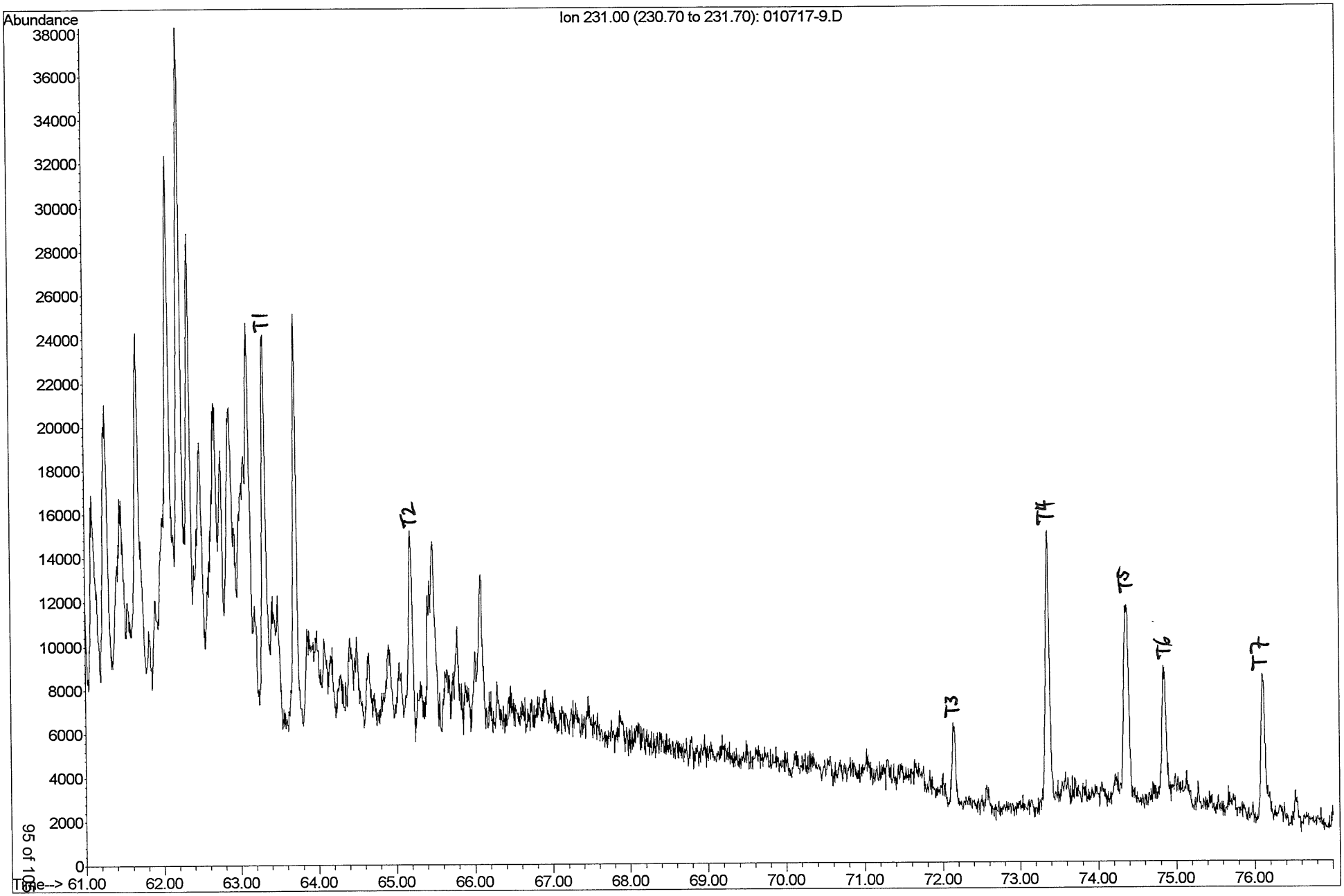


Table

Key for Triaromatic Steranes Identification (m/z 231 chromatogram)

Code	Identity	Elemental Composition
T1	C_{20} Triaromatic sterane	$C_{20}H_{20}$
T2	C_{21} Triaromatic sterane	$C_{21}H_{22}$
T3	20S C_{26} Triaromatic sterane	$C_{26}H_{32}$
T4	20R C_{26} + 20S C_{27}-Triaromatic steranes	$C_{26}H_{32}$ + $C_{27}H_{34}$
T5	20S C_{28}-Triaromatic sterane	$C_{28}H_{36}$
T6	20R C_{27}-Triaromatic sterane	$C_{27}H_{34}$
T7	20R C_{28}-Triaromatic sterane	$C_{28}H_{36}$

B18-045-PZ (21410-1)



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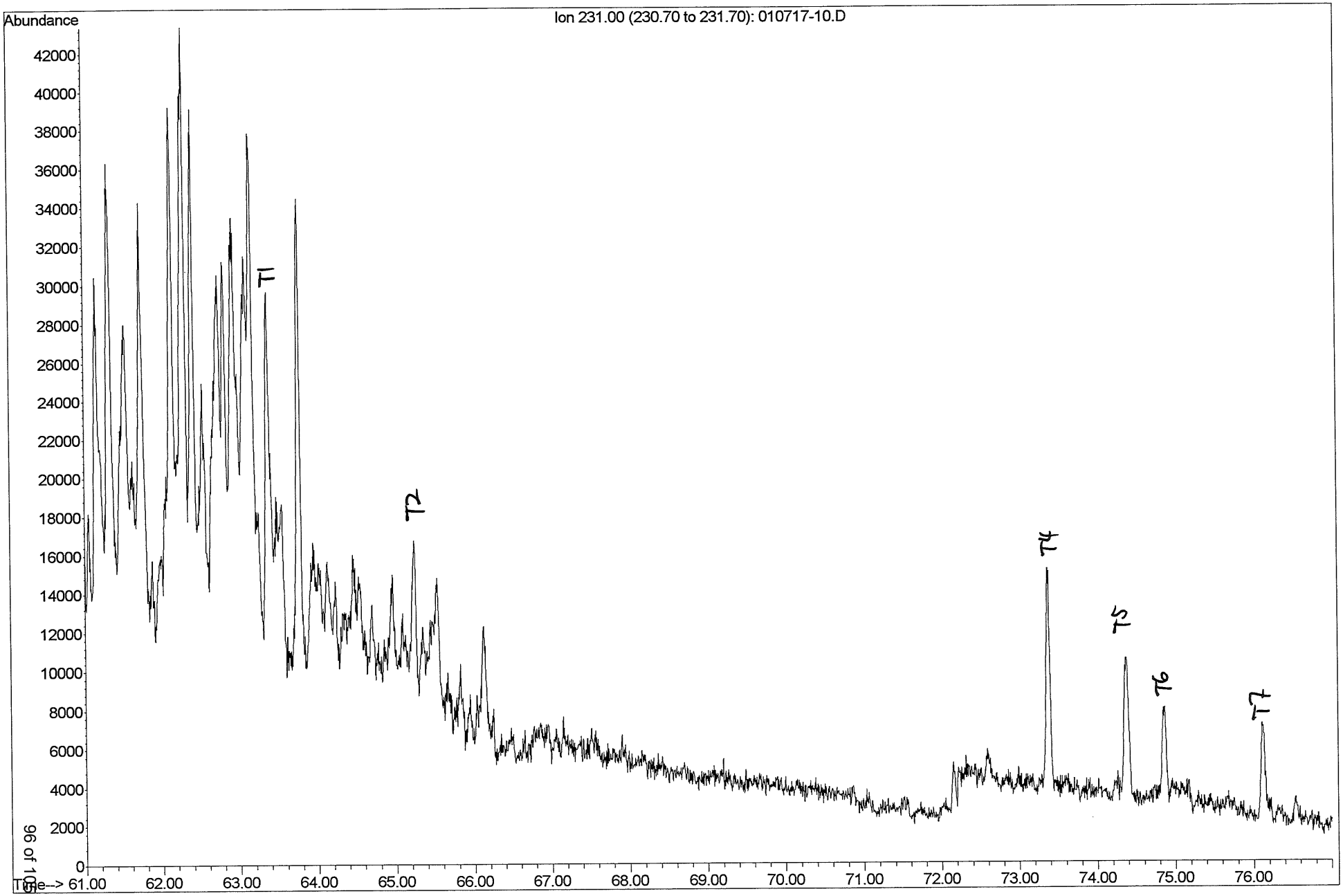

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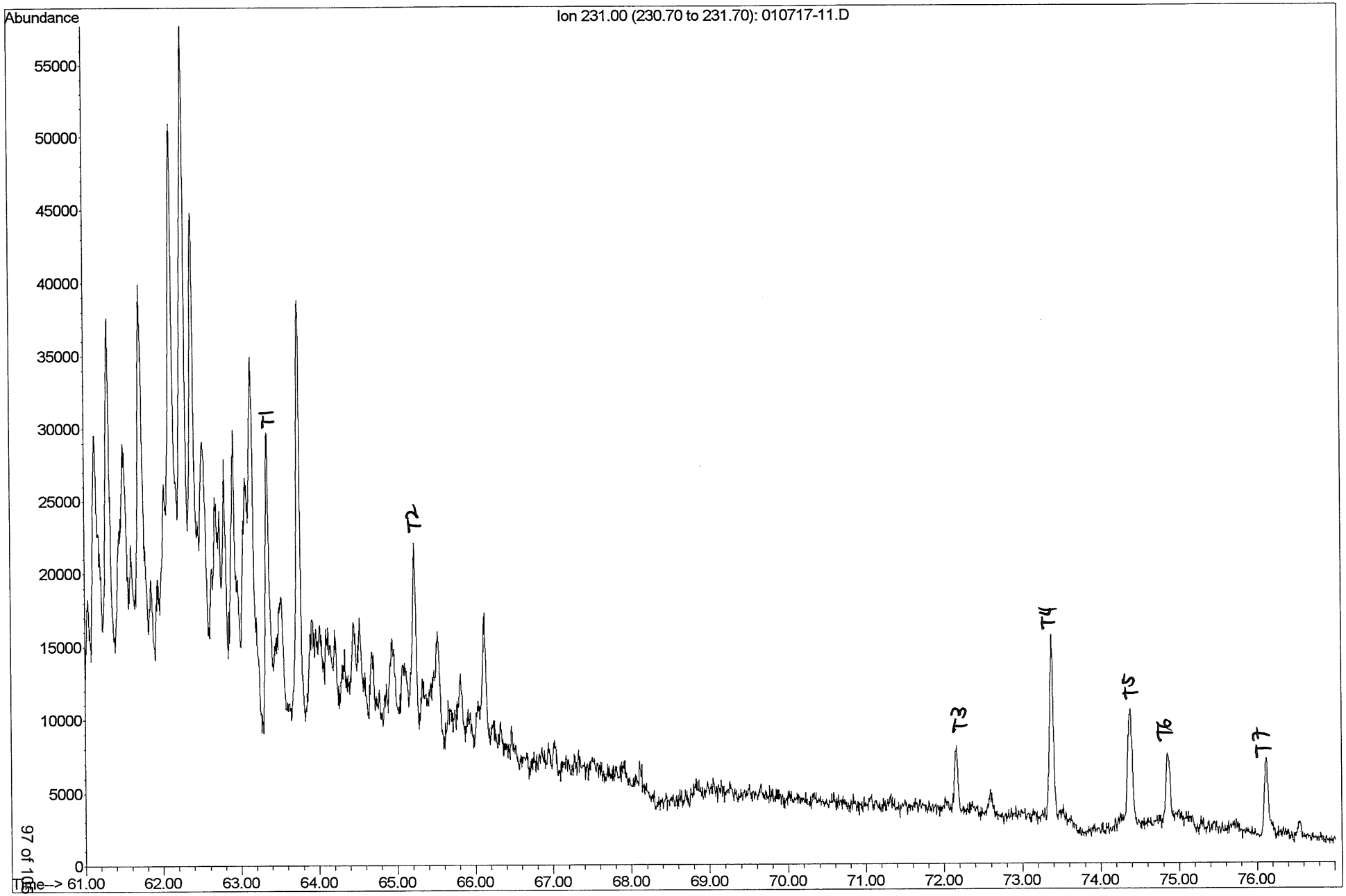

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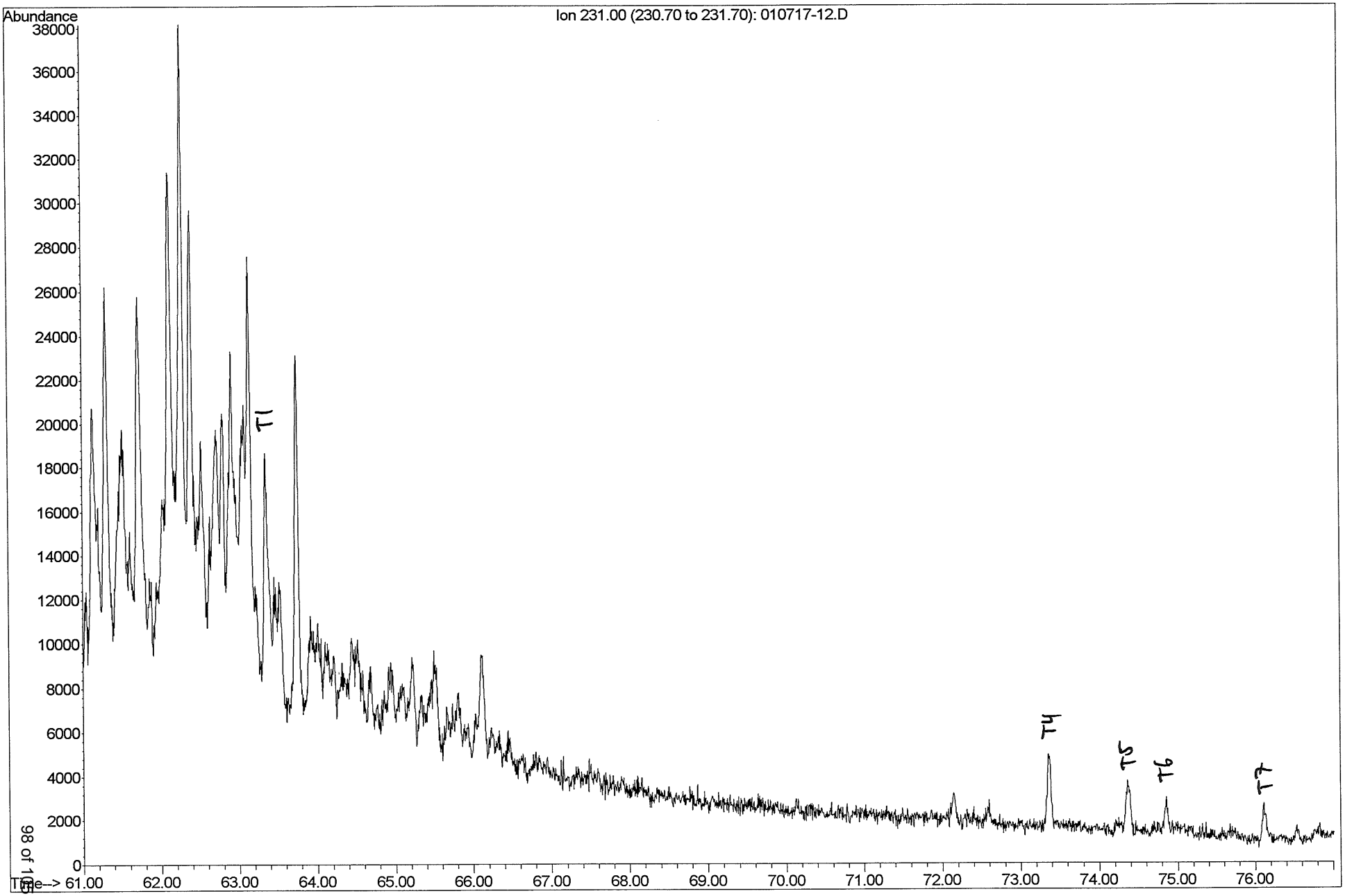


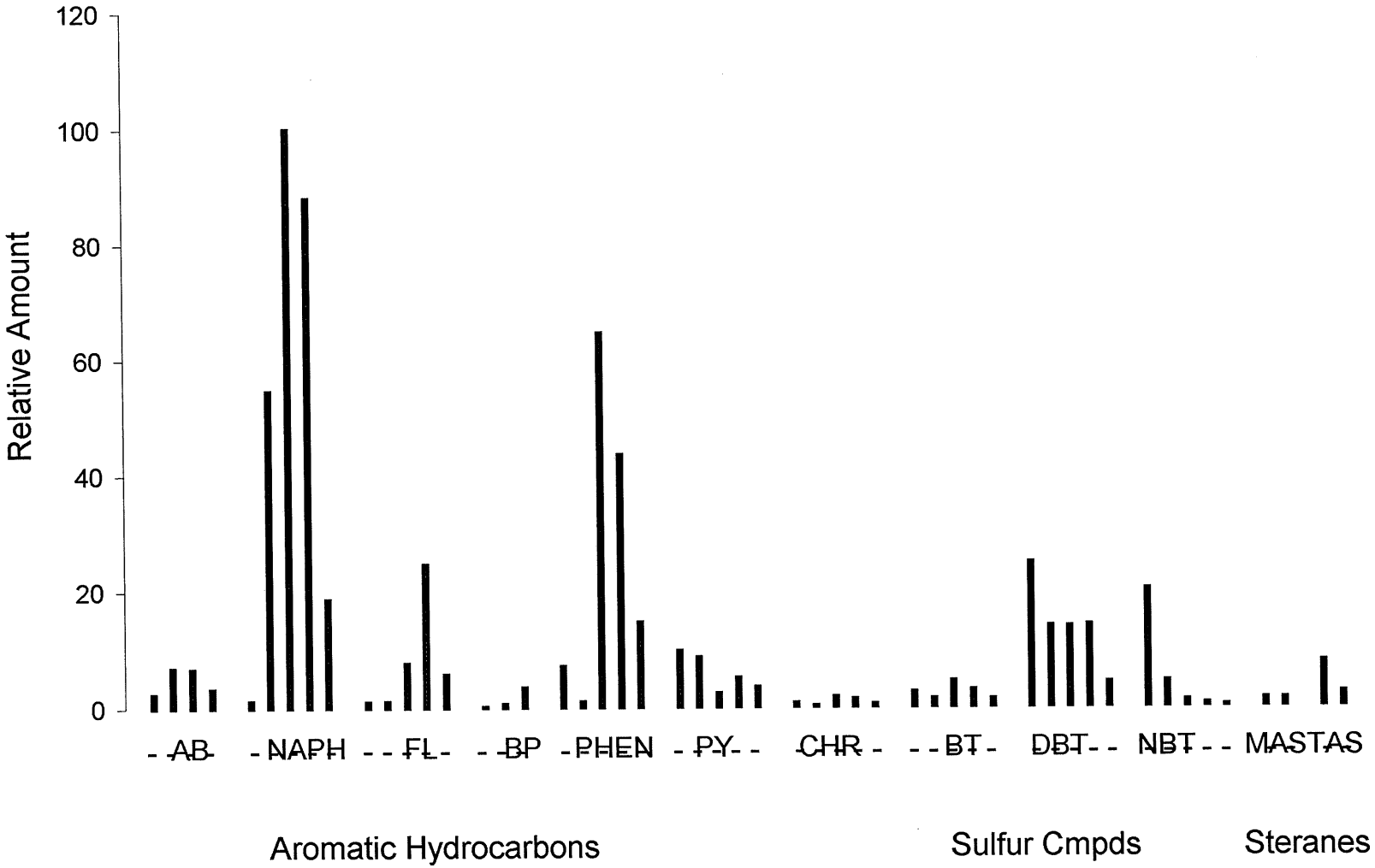
Table

Key for Identifying Aromatic Hydrocarbons

No.	m/z	Abbreviation	Compound
1	120	AB	C_3-alkylbenzenes
2	134		C_4-alkylbenzenes
3	148		C_5-alkylbenzenes
4	162		C_6-alkylbenzenes
5	128	NAPH	C_0-naphthalene
6	142		C_1-naphthalenes
7	156		C_2-naphthalenes
8	170		C_3-naphthalenes
9	184		C_4-naphthalenes
10	166	FL	C_0-fluorene
11	180		C_1-fluorenes
12	194		C_2-fluorenes
13	208		C_3-fluorenes
14	222		C_4-fluorenes
15	154	BP	C_0-biphenyl
16	168		C_1-biphenyls + dibenzofuran
17	182		C_2-biphenyls + C_1-dibenzofuran
18	178	PHEN	C_0-phenanthrene
19	192		C_1-phenanthrenes
20	206		C_2-phenanthrenes
21	220		C_3-phenanthrenes
22	234		C_4-phenanthrenes
23	202	PY	C_0-pyrene/fluoranthene
24	216		C_1-pyrenes/fluoranthenes
25	230		C_2-pyrenes/fluoranthenes
26	244		C_3-pyrenes/fluoranthenes
27	258		C_4-pyrenes/fluoranthenes
28	228	CHR	C_0-chrysene
29	242		C_1-chrysenes
30	256		C_2-chrysenes
31	270		C_3-chrysenes
32	284		C_4-chrysenes
33	148	BT	C_1-benzothiophenes
34	162		C_2-benzothiophenes
35	176		C_3-benzothiophenes
36	190		C_4-benzothiophenes
37	204		C_5-benzothiophenes
28	184	DBT	C_0-dibenzothiophene
39	198		C_1-dibenzothiophenes
40	212		C_2-dibenzothiophenes
41	226		C_3-dibenzothiophenes
42	240		C_4-dibenzothiophenes
43	234	NBT	C_0-naphthobenzothiophene
44	248		C_1-naphthobenzothiophenes
45	262		C_2-naphthobenzothiophenes
46	276		C_3-naphthobenzothiophenes
47	290		C_4-naphthobenzothiophenes
48	253	MAS	Monoaromatic steranes
49	267		Monoaromatic steranes
50	239		Monoaromatic steranes
51	231	TAS	Triaromatic steranes
52	245		Triaromatic steranes

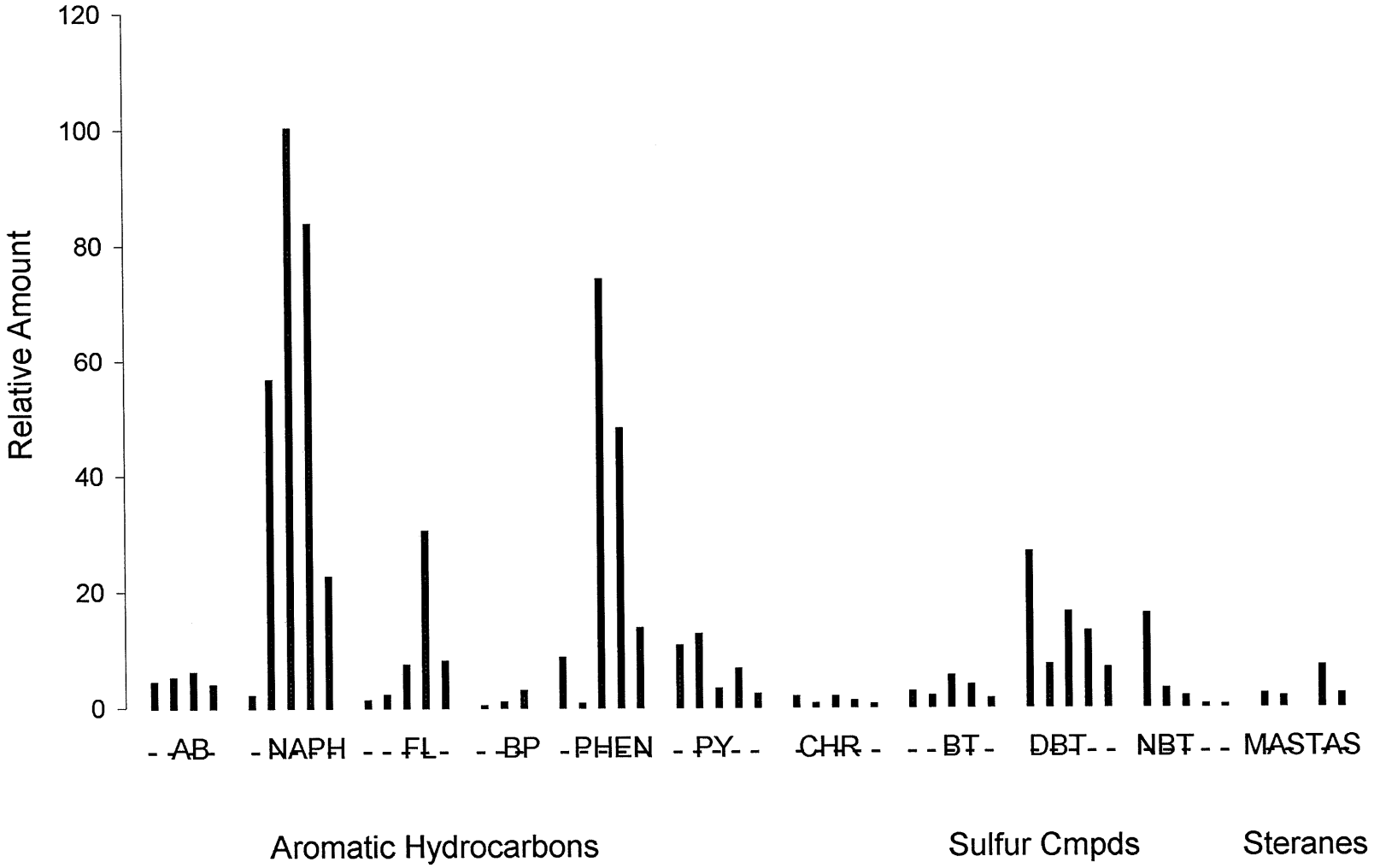
Aromatic Hydrocarbon Distribution

B18-045-PZ (21410-1)



Aromatic Hydrocarbon Distribution

BA-81-7941 (21410-2)



Aromatic Hydrocarbon Distribution

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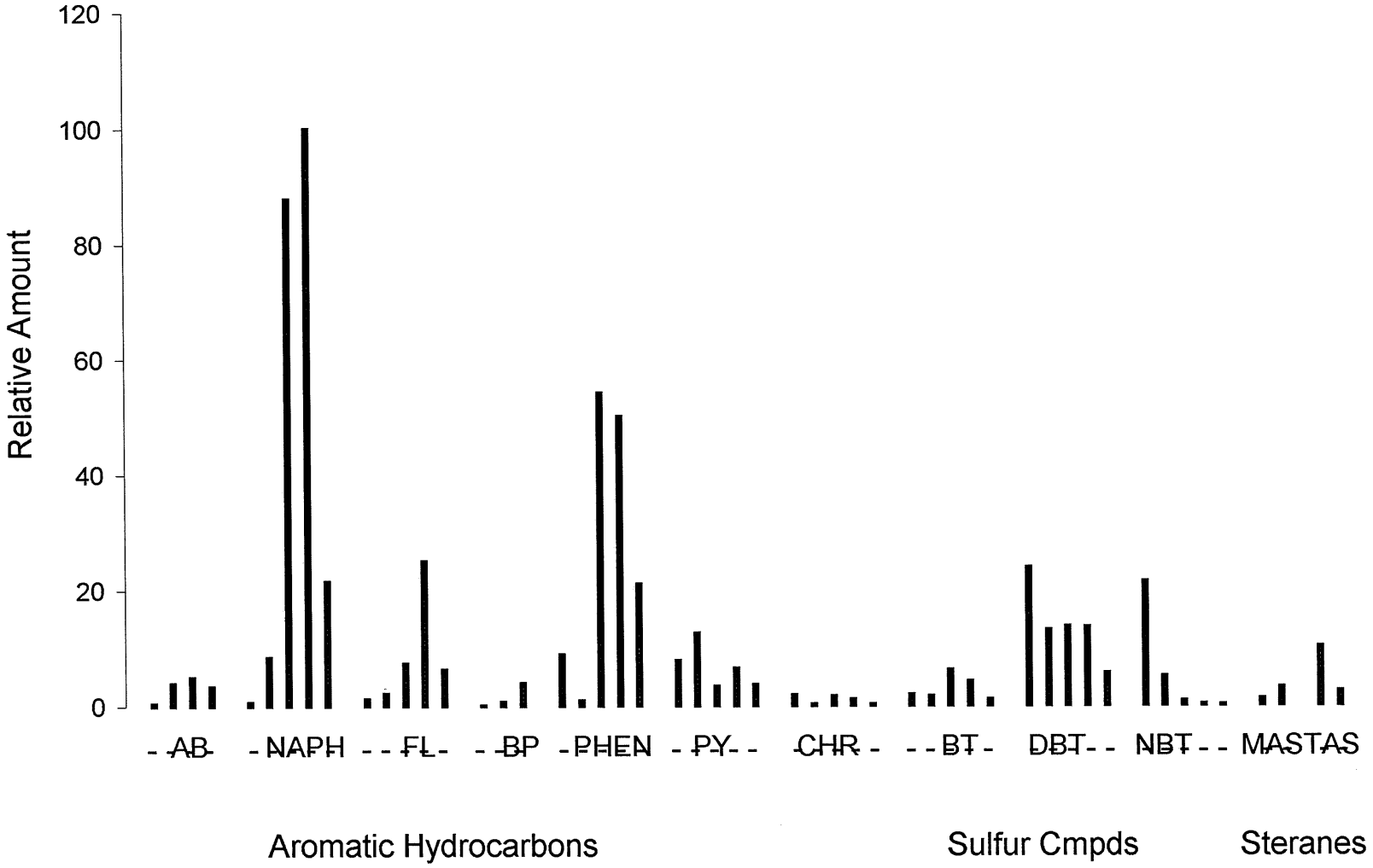
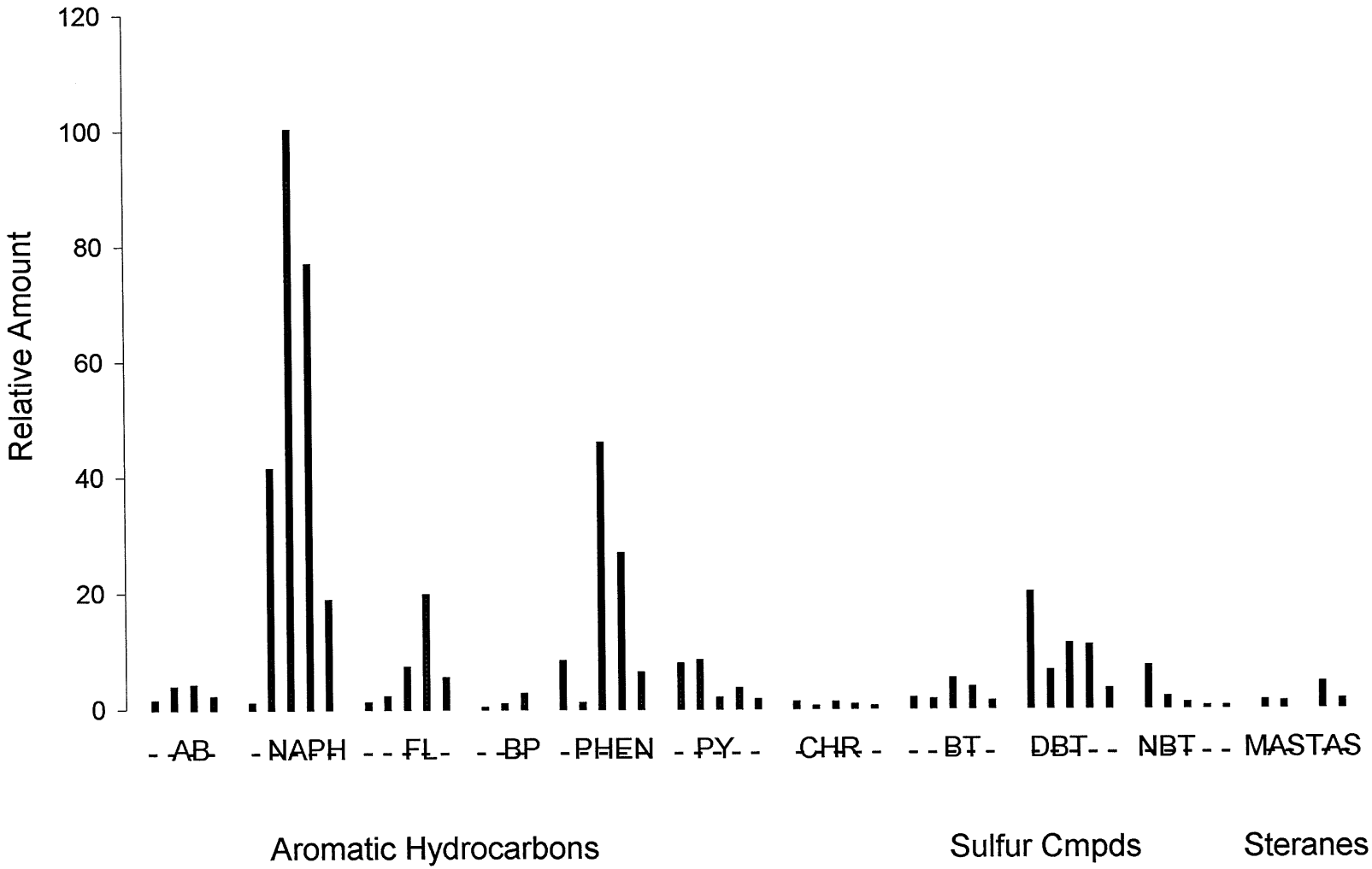


Aromatic Hydrocarbon Distribution

BA-81-7942 (21410-4)



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21410

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

104 of 105

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	EnviroAnalytics Group	Report To:	James Calenda	Attention:	Laura Sargent
Address:	1430 Sparrows Point Blvd	Copy To:		Company Name:	EnviroAnalytics Group
	Sparrows Point, MD 21219			Address:	1650 Des Peres Road, Suite 303 St. Louis, MO 63131
Email To:	jcalenda@enviroanalyticsgroup.com	PO Number:	EAG-SPT-5530	Pace Quote Reference:	
Phone:	314-620-3056 Fax:	Project Name:	Parcel B18 NAPL	Pace Project Manager:	
Requested Due Date/TAT:	Standard	Project Number:	150300M-14-3	Pace Profile #:	

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: MD

Requested Analysis Filtered (Y/N)

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW WT
WATER	WW
WASTE WATER	P
PRODUCT	SL
SOIL/SOLID	OL
OIL	WP
WIPE	AR
AIR	OT
OTHER	TS
TISSUE	

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N: (CB-C40 Full Scan)	(ASTM-5739 (GC/MS))	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	B18-045-PZ	OL	G			12/22/16	850		1	1								Y	Y		
2	BA-81-7941	"	"			"	950		2	2								Y	Y		
3	BA-81-7944	"	"			"	1030		2	2								Y	Y		
4	BA-81-7942	"	"			"	1100		2	2								Y	Y		
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
Data Package Required? (Y/N):	[signature]	12/22/16	1208	[signature] Pace	12/23/16	1250				
Data Validation Required? (Y/N):	[signature] Pace	12/22/16	1545	[signature] Pace	12/22/16	1515				
If data package is required, attach data package checklist.	[signature]	12/22/16	2200	[signature]	12/22/16	2200	3.7	Y	N	Y
	[signature] Pace	12/23/16	1135	[signature] Pace	12/23/16	1135				

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Nick Kurtz

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 12/22/16

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

[signature] Pace 12/23/16 1235

KDZ PACE 12.23.16 1240 1°C

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Cooler Receipt Form

Client Name: EnviroAnalytics Project: Parcel B18 NAPL Lab Work Order: 21410

A. Shipping/Container Information (circle appropriate response)

Courier: FedEx UPS USPS Client (Other: PaceG) Air bill Present: Yes No

Tracking Number: _____

Custody Seal on Cooler/Box Present: Yes (No) Seals Intact: Yes No

Cooler/Box Packing Material: Bubble Wrap Absorbent Foam (Other: _____)

Type of Ice: (Wet) Blue None Ice Intact: (Yes) Melted

Cooler Temperature: 1°C Radiation Screened: Yes (No) Chain of Custody Present: (Yes) No

Comments: _____

B. Laboratory Assignment/Log-in (check appropriate response)

	YES	NO	N/A	Comment Reference non-Conformance
Chain of Custody properly filled out	✓			
Chain of Custody relinquished	✓			
Sampler Name & Signature on COC	✓			
Containers intact	✓			
Were samples in separate bags	✓			
Sample container labels match COC Sample name/date and time collected	✓			
Sufficient volume provided	✓			
PAES containers used			✓	
Are containers properly preserved for the requested testing? (as labeled)			✓	
If an unknown preservation state, were containers checked? Exception: VOA's coliform			✓	If yes, see pH form.
Was volume for dissolved testing field filtered, as noted on the COC? Was volume received in a preserved container?			✓	

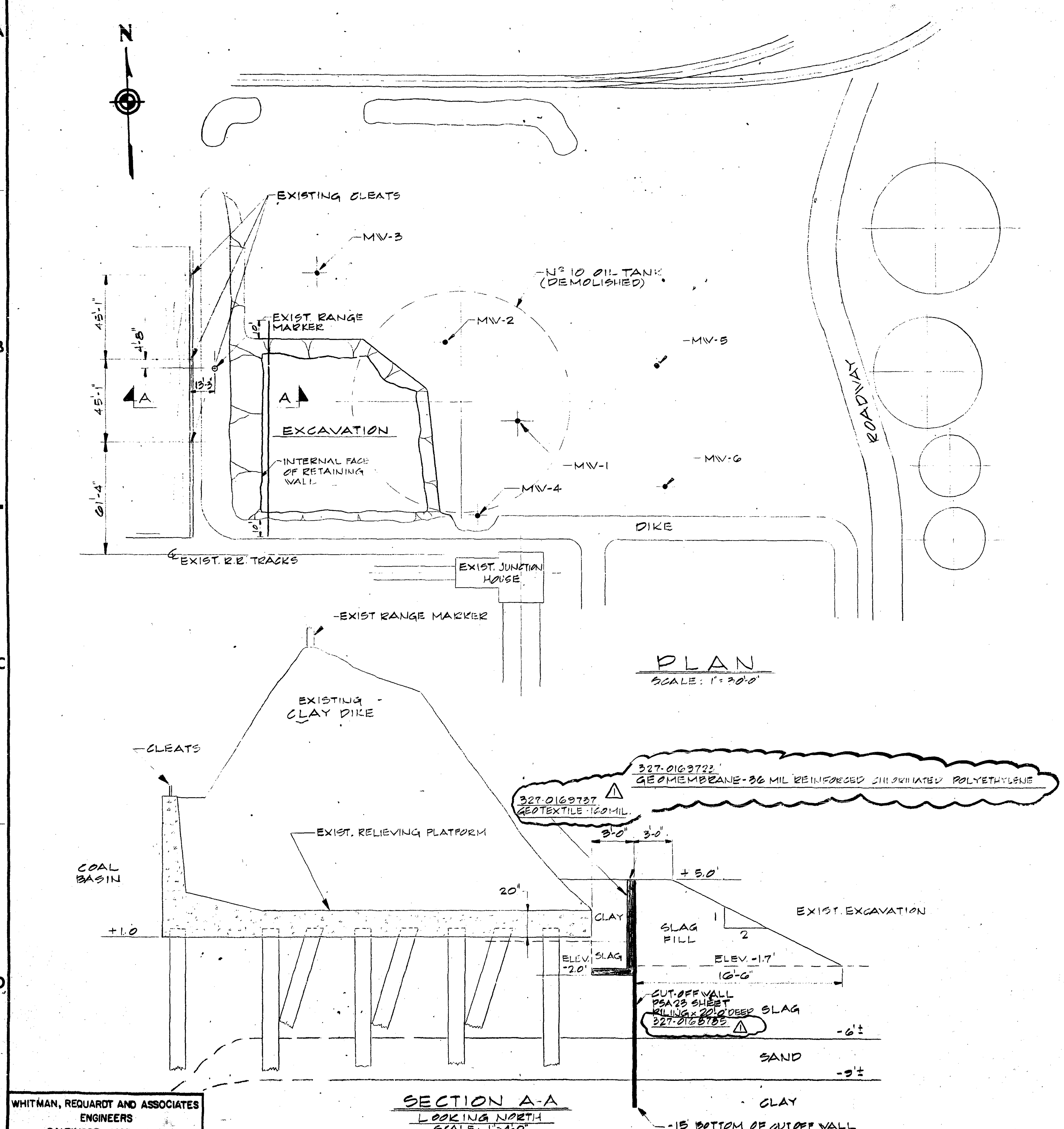
Comments: _____

Cooler contents examined/received by: LY Date: 12.23.16

Project Manager Review: RW Date: 12-23-14

APPENDIX D

192463



GENERAL NOTES

1) SITE PREPARATION WILL BE REQUIRED ALONG THE SHEET PILE LINE AT THE NORTH AND SOUTH ENDS OF THE EXISTING EXCAVATION AND TO LOWER THE GRADE BETWEEN THE SHEET PILING AND THE RELIEVING PLATFORM FOR INSTALLATION OF THE GEOMEMBRANE.
2) THE CUTOFF WALL WILL CONSIST OF APPROXIMATELY 115 FEET OF PSA 23, ASTM A328 SHEET PILING, 20 FEET IN LENGTH.
3) A FLEXIBLE GEOMEMBRANE, SUCH AS 36 MIL POLYETHYLENE SHALL BE PLACED IN CONTACT WITH THE FACE OF THE SHEET PILES. A PROTECTIVE LAYER OF 160 MIL NON-WOVEN GEOTEXTILE SHALL BE PLACED OVER THE GEOMEMBRANE. GEOMEMBRANE AND GEOTEXTILE ARE TO COVER APPROXIMATELY 95 FEET OF THE CUT OFF WALL LENGTH (TOP OF BANK TO TOP OF BANK OF EXISTING EXCAVATION) 20 FOOT WIDTHS ARE PREFERRED AND WIDTHS ARE TO BE OVERLAPPED TO REDUCE SEEPAGE.
4) SLAG FILL WILL BE REQUIRED TO CONSTRUCT A WORKING PLATFORM FOR CONSTRUCTION EQUIPMENT. THIS WORKING PLATFORM SLAG FILL IS TO BECOME PART OF THE FILL EAST OF THE SHEET PILING AS SHOWN ON SECTION A-A.
5) PORTIONS OF THE EXISTING CLAY DIKE ON THE RELIEVING PLATFORM ARE TO BE USED (IN LIEU OF SLAG). IN THE UPPER AREA BETWEEN THE RELIEVING PLATFORM AND THE SHEET PILES. CARE MUST BE TAKEN SO AS NOT TO DISTURB THE EXISTING RANGE MARKER.

WHITMAN, REQUARDT AND ASSOCIATES
ENGINEERS
BALTIMORE, MARYLAND

W.O. 11781

DRAWING NO.	REFERENCE
42762	COAL DOCK BULKHEAD

REVISION

Number	Date	DESCRIPTION	Coordinate	Initial
	5/31/89	FIRST ISSUE		JJP
1	6/15/89	ADDED REQUISITION NOS. & REV. NOTE 3		JJP
2				
3				
4				
5				
6				
7				
8				
9				
0				

FINISHES ON THIS DRAWING CONFORM TO A. I. S. E. STANDARDS

DEPT: COKE OVENS
SECTION OR AREA: COAL DOCK BASIN
JOB: Nº 10 TANK REMEDIATION
PART: PLAN & SECTION
CHECKED BY: H.J.B. — 5113 — 5-31-89
DRAWN BY: P.L.L. — SCALE: AS SHOWN=1 ft.
APPROVED: [signature]
BETHLEHEM STEEL
PLANT: SPARROWS POINT
DRAWING NO. 192463

Acctg. Charge/E. W. O.: 9P11-001-3100

01
91
MA
TS
SM
MS
PA
BR
LU

39778 (Rev E 2-88)

APPENDIX E

Parcel B18 Cut-Off Wall Field Verification
Photograph Log
Sparrows Point, Maryland

Photo 1: View of a section of the sheet piling (uncovered) located at the southern extent.

Photo 2: Northern extent of the sheet piling.

Photo 3: View of the sheet piling's southern extent and its alignment in the north direction.

Photo 4: View of the sheet piling's northern extent and its alignment in the south direction.